Appendix V5-3D

Hope Bay Belt Project: 2000 Supplemental Environmental Baseline Data Report

TMAC RESOURCES

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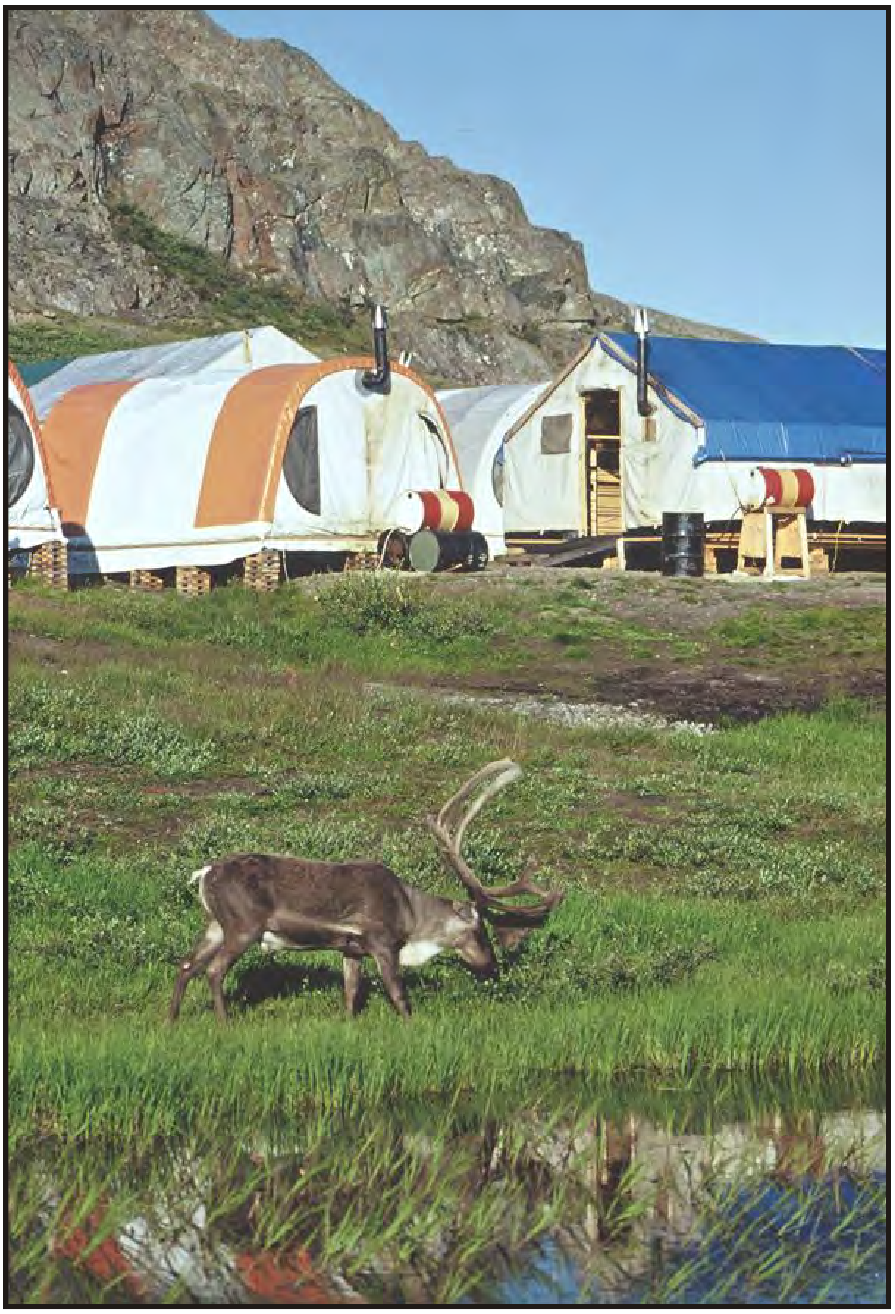
Hope Bay Joint Venture

Hope Bay Belt Project

Nunavut, Canada

2000 Supplemental Environmental Baseline Data Report Hope Bay Belt Project



March 2001

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EXECUTIVE SUMMARY

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Supplemental environmental baseline studies were carried out within the Hope Bay Belt project area in 2000. Environmental work conducted in 2000 was designed to fill in any gaps in biophysical baseline data, especially for the Doris Property. Supplemental baseline data were acquired for the future purposes of generating an Environmental Impact Assessment, and for forming the basis of future monitoring programs.

The 2000 scope of work was designed around the understanding of the proposed mine plan in the spring of 2000. Supplemental baseline studies covered the following major disciplines: meteorology, hydrology, lake and stream water quality, marine sediment/benthos, lake and stream aquatic communities, lake and stream fish communities and habitat, shoreline habitat in Roberts Bay, archeology, and acid rock drainage (ARD). Bathymetric surveys of Tail and Ogama lakes were also completed. Results of the 2000 archeology survey and the long-term ARD kinetic testwork are provided as separate companion reports.

The following sections provide brief summaries of the major results from each discipline included in the 2000 supplemental baseline studies.

Meteorology

Two automated meteorology stations and a Class A evaporation pan were monitored as part of the supplemental baseline work. Data collected from 1998 and 1999 were also included in the analysis, as they were not previously reported.

Results from the Boston camp and Roberts Bay meteorological stations indicated representative values for temperatures and rainfall for an arid arctic location. Air temperatures in the Mackenzie District were above average during the summer of 2000 and have been above normal for the past 13 seasons. Mean monthly air temperatures were below freezing for eight months of each year. The 1998 and 1999 mean air temperatures at the Boston meteorological station were –9.0 and –10.4 ºC, respectively. Rainfall contributed 45% to the annual total precipitation (201 mm) at the Boston site from October 1998 to September 1999. The predominant wind directions were from the south, northwest and southeast. Calm conditions were infrequent with the maximum instantaneous wind speed for the period of record being 30.1 m/s (108 km/hr) at Boston. The total evaporation rate for the Boston Class A evaporation pan was estimated to be 335 mm for the entire open water season. Global solar radiation was monitored for the first time in 2000, with values peaking during mid-July. Values were considered representative for a northern (67ºN) location.

Hydrology

A total of four sites within the study area were monitored for continuous water levels with automated hydrometric stations. During the open-water season, discharge

measurements were conducted at each site using a Swoffer Model 2100 flowmeter. Stage-discharge relationships were developed and applied to derive continuous discharge data from the water levels.

The hydrographs generated from the four monitoring locations were similar to each other and typical for the area. Peak flows occurred in early summer followed by declining flows thereafter as the active storage was released. All monitoring locations showed responses to rainfall events through the summer and in particular in September as rainfall increased. All monitoring locations sustained flow through the open-water season.

Physical Limnology and Bathymetry

Secchi depths were measured at five lakes within the Hope Bay Belt area during the 2000 open-water season. Calculated euphotic zone depths indicated that adequate light was available for photosynthesis to occur throughout the majority of the water column for some lakes. Dissolved oxygen and temperature profiles were measured once during the 2000 open-water season. All lakes sampled were relatively shallow and had unstratified water columns as a result of summer wind mixing.

Bathymetric surveys of Tail and Ogama lakes were conducted in 2000. A differentential global positioning system along with echosounder and manual measurements were used to chart the bathymetric features of the lakes. Tail Lake was calculated to have a volume of 2,380,000 m^3, and Ogama Lake was calculated to have a volume of 4,209,800 m^3.

Surface Water Quality

Surface water quality was sampled in four lakes and four streams (including the Koignuk River) during the open-water season of 2000. Surface waters were in general slightly basic, soft, and clear, with low concentrations of total metals and nutrients. Total metal concentrations were in general at or well below federal guidelines for the protection of freshwater aquatic life. Total aluminum concentrations are elevated in streams and the Koignuk River and are indicative of natural variability. There were seasonal differences in surface water quality for both lakes and streams.

Primary Producers

Phytoplankton and periphyton assemblages were sampled in three lakes and streams during the 2000 open-water season. Phytoplankton biomass and abundance concentrations were high in Doris and Pelvic lakes relative to typical Arctic lakes. Cyanobacteria dominated the phytoplankton assemblages in late July. Periphyton biomass and density concentrations were similar among the three streams sampled. Periphyton assemblages were very diverse and healthy, being composed of diatoms and cyanobacteria.

Secondary Producers

Zooplankton assemblages and lake benthos communities were sampled in three lakes, and drift organisms assemblages and stream benthos communities were sampled in three streams during the 2000 open-water season. Zooplankton assemblage composition and diversity were similar for the three lakes sampled (Tail, Doris and Pelvic), while abundance was different among all three lakes. Lake benthos communities had similar densities among the three lakes sampled. Lake benthos density and dipteran diversity decreased with increasing depth, a typical trend observed in lakes from other regions. Drift organism abundance was variable among the three streams sampled, and was lower in Tail Outflow as compared to Doris and Pelvic outflows. Drift organism assemblage composition varied among the three streams, but dipteran diversity indices were similar. Stream benthos density values were high in Doris Outflow relative to Tail and Pelvic outflows, primarily due to high densities of Coelenterata, Arachnida and Diptera. Diptera were major representatives in all three streams with similar dipteran diversity indices among all three locations.

Fish Communities

Fish communities were surveyed in two lakes and seven streams during the 2000 open-water season. Only lake trout were captured in Tail Lake, while five species were captured in Little Roberts Lake; Arctic char, lake trout, lake whitefish, cisco, and broad whitefish. Lakes that are connected to the ocean, such as Little Roberts Lake, generally have greater diversity than inland lakes. Few fish were captured in the streams, most of which were ninespine sticklebacks. Other species included Arctic char, lake trout, Arctic grayling, and slimy sculpins.

Fish habitat assessments were conducted in several stream crossings along the proposed all-weather road route. For each stream, habitat quality with respect to spawning, rearing, adult feeding, overwintering, and migration was rated as one of five categories from non-existent to excellent. Little Roberts and Roberts outflows were assessed as being very important to local fish populations. Spawning, rearing, adult feeding areas, and migration habitats, were rated as either good or excellent. The NE Inflow of Aimaoktak Lake, first surveyed in 2000, also had excellent suitability for spawning, rearing, adult feeding, and migration. A fourth stream, Glenn Outflow, was rated good for migrating and rearing. All of these streams consisted of high quality habitat, and will need considerable attention if the proposed all-weather road is constructed.

A reconnaissance level lake habitat assessment was conducted in Tail, Doris, and Little Roberts lakes. Substrate composition of the littoral zone of each lake was classified as one of five types (silt, sand, cobble, boulder, and bedrock), and habitat quality was also rated. A large portion of the littoral zone in Tail Lake consisted primarily of sand with 25% or less cobble and boulders. These sections were rated as fair quality for lake trout habitat. Approximately half the shore of Doris Lake consisted of sections of bedrock and were ranked as poor quality, whereas half the east shore of Doris Lake was ranked as good or excellent habitat for fish. The entire shoreline of Little Roberts Lake was rated as fair habitat quality due to the lack of cobble and boulders, and abundance of silt.

Roberts Bay Habitat Assessment

A general habitat assessment was conducted along the shoreline of Roberts Bay in August of 2000. Substrate along the shoreline of Roberts Bay consisted primarily of large boulders, cobblestone and bedrock in the northern portions of the bay and fine grained sediments, such as sand and silt, in the southern area. None of the areas surveyed were vegetated. Habitat quality was rated fair to good in the northern areas and good to excellent in the southern region on the basis of cover provided for fish and invertebrates and potential for supporting communities of invertebrates, a food source for marine fish. Sea-run fish, including Arctic char, were found during 2000 in Glenn Outflow and Little Roberts Lake, which drains directly into Roberts Bay. Both outflows are therefore considered especially important fish habitat.

Acid Generation Testwork

Rock samples were obtained from Boston and Doris drill core, the proposed port site at Roberts Bay, and at quarry sites along the proposed all-weather road for acid rock drainage (ARD) characterization. Overall, the results of static testwork in the form of acid-base accounting indicated that the majority of Hope Bay samples collected in 2000 have a low acid-generating potential. However, a number of samples with quartz mineralization (15 samples out of 36 quartz samples) and some mafic volcanic and gabbro samples (6 out of 32 mafic volcanic samples and 1 out of 7 gabbro samples) have the potential to generate acid. These samples contain a combination of limited amounts of neutralizing minerals and relatively high amounts of sulphur. The remaining samples, comprised entirely of mafic volcanics and quartz mineralization, have an uncertain acid-generating potential. Kinetic testwork in the form of humidity cells has been initiated and is expected to last for at least six months. The results from kinetic testing will be used to calculate acid production and metal leaching rates.

ACKNOWLEDGEMENTS

ACKNOWLEDGEMENTS

This report was produced by Rescan™ Environmental Services Ltd. (Rescan), with Deborah Muggli managing the project. The following Rescan scientists conducted field work and/or were major authors of the report: Paul Dagenais (M.A.Sc.), Dan Jarratt (P.Eng.), François Landry (M.Sc., R.P.Bio.), Deborah Muggli (Ph.D., M.Sc., R.P.Bio.), Jonathan Olsen (B.Sc. Hons.), Christopher Teichreb (M.Sc., R.P.Bio.) and Shane Uren (M.A.Sc.). Jackie van der Eerden was responsible for production coordination.

Several people of the Hope Bay Joint Venture assisted in the 2000 environmental program. Darren Lindsay (P.Geo.) assisted in identifying representative rock types at the potential quarry sites which were sampled for the ARD characterization program. Gina Almeada, Val Weaver, and Megan O'Donnell assisted with the evaporation pan readings. Ted Mahoney (P.Geo.) and Adrian Fleming (P.Geo.) provided logistical and on-site support. Hugh Wilson was the Hope Bay Joint Venture manager for the project.

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GLOSSARY

GLOSSARY

Abiotic Factors	Environmental influences that arise from non-living entities, *e.g.*, climate.
Alluvial	Clay, silt, sand and gravel material deposited by running water.
Anoxic	Without oxygen. Term commonly used to refer to water with extremely low dissolved oxygen concentrations, and sediment with no oxygen present.
Anthropogenic	Related to human activity.
Benthic	Pertaining to the bottom region of a water body, on or near bottom sediments or rocks.
Biodiversity	The variety of organisms that exist on the planet or within an ecosystem.
Biomass	The amount of living matter as measured on a weight or concentration basis. Biomass is an indication of the amount of food available for higher trophic levels. Phytoplankton and periphyton biomass can be measured as chlorophyll *a* (or carbon or nitrogen), zooplankton biomass can be measured as milligrams of dry weight per cubic metre, and benthos biomass can be measured as grams of wet or dry weight per square metre.
Catch Per Unit Effort (CPUE)	The number of fish caught per 24-h soak time per 100 m of gillnet; or per 24-h soak time for trapnets.
Chlorophyll	Chlorophyll is a molecule contained in photosynthetic organisms which is required to carry out photosynthesis. It is an easily detected molecule, and is used as an indicator of phytoplankton biomass in this report.
Detritus	Unconsolidated material composed of both inorganic and dead and decaying organic material.
DFO	Department of Fisheries and Oceans.
Diagenesis	The sum of all chemical, physical and biological influences on sediment composition.
Diatom	Diatoms are primary producers, and can be found in both phytoplankton and periphyton assemblages. They are single-celled algae which photosynthesize and live either free-floating in water or attached to substrates. Diatoms contain a silica shell (called a frustule) outside of their cell membrane.
Diptera	Refers to an insect order. Dipterans are the true flies, and are a major component of lake and stream benthos communities. Dipterans are characterized by a single pair of functional wings and include a wide diversity of species. The Diptera include the familiar mosquito and black-fly, and are an important food source for fish as larvae. Their abundance and diversity can be used as an indicator of lake or stream water and sediment quality.
Diurnal	Having a daily cycle.
Diversity Indices	A measure of how varied a community or assemblage of organisms is. In general, a healthy ecosystem will support a variety of species and have a high diversity index.
Dorsal	Pertaining to the back.
Dorsal Fin	A fin on the back of a fish, usually central in position and supported by rays or spines.

GLOSSARY

Ecology	The study of the interactions between organisms and their environment.
Ecosystem	A community of interacting organisms considered together with the chemical and physical factors that make up their environment.
Ephemeral Stream	Ephemeral streams are streams where surface water flow is not always measurable. These streams could become dry seasonally (*e.g.* every summer), or only occasionally (once every 10 years).
Ephemeroptera-Plecoptera-Trichoptera (EPT)	Refers to three insect orders which are all important constituents of stream benthos communities. Common names for the organisms are mayflies, stoneflies and caddisflies. Many of these insects are very susceptible to changes in water and sediment quality, so their abundance and diversity can be used as an indicator of stream health.
Esker	Sinuous ridge of weakly stratified gravel and sand deposited by a stream flowing in (or beneath) the ice of a retreating glacier, and left behind when the ice melted.
Euphotic Zone	The euphotic zone refers to the upper portion of the water column in which adequate light is present for photosynthesis to occur.
Fork Length	Distance from the proximal tip of the head to the tip of the middle ray of the caudal fin.
Freshet	Freshet refers to a high water flow event within a stream. The term is commonly used to refer to spring hydrology conditions in which the majority of annual water volume passes through streams in a short period of time (due to snowmelt).
Geology	The science concerned with the study of the rocks that compose the Earth.
Geomorphology	The study of the classification, description, nature, origin and development of landforms and their relationships to underlying structures, and the history of geologic changes as recorded by these surface features.
Herbivore	An animal that feeds on plants.
Hydrology	The study of the properties of water and its movement in relation to land.
Index Gill Netting	Standard sampling design where small-mesh gillnets are set perpendicular to the shore beginning at depths of 2 m to 3 m.
Invertebrates	Collective term for all animals without a backbone or spinal column.
Lake Benthos	Lake benthos communities are a group of organisms that live associated with the bottom of lakes. These communities contain a diverse assortment of organisms, which have different mechanisms of feeding. The term lake benthos is used interchangeably with lake benthic macro-invertebrates in this report. Common lake benthos organisms include larval caddisflys, mayflies, and stoneflies. Lake benthos are an important food source for fish.
Larva	The immature stage, between egg and pupa, of an insect with complete metamorphosis.
Limnology	The study of lakes, including their physical, chemical, and biological processes.
Littoral	Region of a lake in which enough sunlight penetrates to the bottom to support photosynthesis (*e.g.* the shallow areas of a lake from the high water level).
Lotic	Flowing freshwater environments (*e.g.*, streams and rivers).
Macro-invertebrate	Invertebrates which are visible to the naked eye. The term macro-invertebrate is

	generally used in this report to refer to stream and lake benthos.
Macrophyte	Macrophytes are non-microscopic primary producers which live submerged in lakes and rivers. They are multi-cellular algae that can photosynthesize.
Otolith	Inner ear bone found in bony fishes (flat and oval in structure).
Pectoral Fins	The most anterior or uppermost of the paired fins of a fish.
Pelagic	Inhabiting the open water of a lake, in contrast to the lake bottom (benthic region).
Periphyton	Periphyton are aquatic primary producers found living attached to substrates (such as rocks, debris, or plants) in lakes and streams. They are single-celled organisms that can photosynthesize. Other non-photosynthetic organisms can be associated with periphyton (*e.g.* bacteria, fungi). The term periphyton is used to refer to the photosynthetic organisms only in this report.
Photosynthesis	The metabolic process by which carbon dioxide and sunlight are converted to simple sugars and oxygen. Organisms which photosynthesize contain the molecule chlorophyll.
Phytoplankton	Phytoplankton are microscopic primary producers which live free-floating in water. These organisms are single-celled algae and photosynthesize. Some common types of phytoplankton include diatoms and cyanobacteria.
Piscivorous	Fish eating.
Planktivorous	Plankton eating.
Primary Producers	In this report, primary producers refer to organisms which convert sunlight into food through the process of photosynthesis. Aquatic primary producers include phytoplankton, periphyton, macrophytes, and submerged vegetation.
Pupa	The stage between larva and adult in insects with complete metamorphosis.
Redox Conditions	A measure of electron activity of an environment (*i.e.*, sediments); high redox conditions mean oxygen-rich environments, low redox conditions mean oxygen-poor environments.
Riffle	Shallow areas in a stream or river section characterized by increased habitat heterogeneity, sediment size, stream velocity and slope, and sometimes oxygen content.
Runoff Coefficient	A ratio expressed in decimal form. The precipitation contributing to overland flow as compared to the total precipitation occurring over a given area.
Salmonid	Family of freshwater or anadromous fishes; dominant family in northern waters of North America (includes lake trout, round whitefish, Arctic grayling).
Secchi Depth	Secchi depth is the depth at which a Secchi disc (standardized white and black disc) can no longer be seen when it is lowered into a lake. Secchi depth can be used to calculate the depth of the euphotic zone.
Secondary Producers	Secondary producers derive their food from eating primary producers. Aquatic secondary producers include zooplankton, and some lake and stream benthic invertebrates.
Stream Benthos	Stream benthos communities are a group of organisms that live associated with the bottom of streams. These communities contain a diverse assortment of organisms, which have different mechanisms of feeding. The term stream benthos is used interchangeably with stream benthic macro-invertebrates in this report. Common

GLOSSARY

	stream benthos organisms include larval caddisflys, mayflies, and stoneflies. Stream benthos are an important food source for fish.
Submerged Vegetation	Submerged vegetation refers to plants living submerged in water within lakes and streams. These organisms are primary producers (and hence photosynthesize), and are vascular plants rather than non-vascular algae.
Tailings	Ground waste material and water (slurry) rejected from a mill or process plant after most of the valuable minerals have been extracted.
Thermocline	Layer in a thermally stratified body of water in which temperature changes rapidly relative to the remainder of the water column.
Till	Unstratified rock material deposited directly by glaciers, consisting of a mixture of clay, silt, sand, gravel and boulders ranging widely in size and shape.
Trophic Levels	Functional classification of organisms in an ecosystem according to feeding relationships. Primary producers constitute the first trophic level, and convert energy from the sun into food. All other trophic levels depend upon primary producers for their food. Secondary producers (or primary consumers) constitute the second trophic level, and tertiary producers (or secondary consumers) constitute the third trophic level. In a lake, phytoplankton constitute the first trophic level, zooplankton and some benthic organisms the second, and fish the third.
Turbidity	A condition of reduced transparency in water caused by suspended colloidal or particulate material.
Waste Rock	Barren rock or rock too low in grade to be mined or processed economically.
YOY (young of the year)	Juvenile fish during the period from the last larval stage to adulthood, or one year of age, whichever comes sooner.
Zooplankton	Small invertebrates which live free-floating in the water. They are secondary producers and feed mainly on phytoplankton.

1. INTRODUCTION

1. INTRODUCTION

1.1 General

The Hope Bay Belt Project area is located in the Canadian Arctic to the east of Bathurst Inlet, near the community of Umingmaktok, Nunavut (Figure 1.1-1). The project area consists of three main properties: the Doris Property, the Madrid Property, and the Boston Property. The Doris Property is the northern-most area, and includes the coastal areas of Roberts Bay and Hope Bay.

Environmental baseline studies were carried out within the Boston Property from 1993 to 1997, and within the Doris Property from 1995 to 1998. Compliance monitoring and site assessment work was conducted within both properties in 1999 (Rescan 1999b).

Miramar Hope Bay Ltd., on behalf of the Hope Bay Joint Venture, contracted Rescan™ Environmental Services (Rescan) to conduct supplemental environmental baseline work during the year 2000.

Environmental work conducted in 2000 was designed to fill in any gaps in biophysical baseline data for the Doris Property, for the future purposes of generating an Environmental Impact Assessment and forming the basis for future monitoring programs. The scope of work for the 2000 program was a result of a meeting held at Rescan on March 29, 2000 with Mr. Hugh Wilson, in which a previous version of the scope was evaluated and edited. The proposed scope of work was designed around the understanding of the mine plan in the spring of 2000. The mine plan identified Tail Lake as the priority location for tailings placement, with Doris Lake serving as a possible second location. The mine plan also included a potential all-weather road connecting the two main properties (Doris and Boston), and a potential port/mill site on Roberts Bay.

Supplemental baseline studies conducted in 2000 covered the following major disciplines: meteorology, hydrology, lake and stream water quality, marine sediment/ benthos, lake and stream aquatic communities, lake and stream fish communities and habitat, shoreline habitat in Roberts Bay, archeology, and acid rock drainage (ARD). Bathymetric surveys of Tail and Ogama lakes were also completed. This report includes results from all major disciplines, with the exceptions of archeology and long-term ARD kinetic testwork. Short-term ARD testwork results are included in this report. Results of the 2000 archeology survey and the long-term ARD kinetic testwork will be provided as separate companion reports.

1.2 2000 Sampling Program

Figure 1.2-1 provides an overview of the Hope Bay Belt Project area. Areas that were monitored (any discipline) as part of the 2000 program included the following: Roberts Bay, Tail Lake and outflow, Doris Lake and outflow, Little Roberts Lake and outflow,

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FIGURE 1.1-1

Hope Bay Belt Project Location

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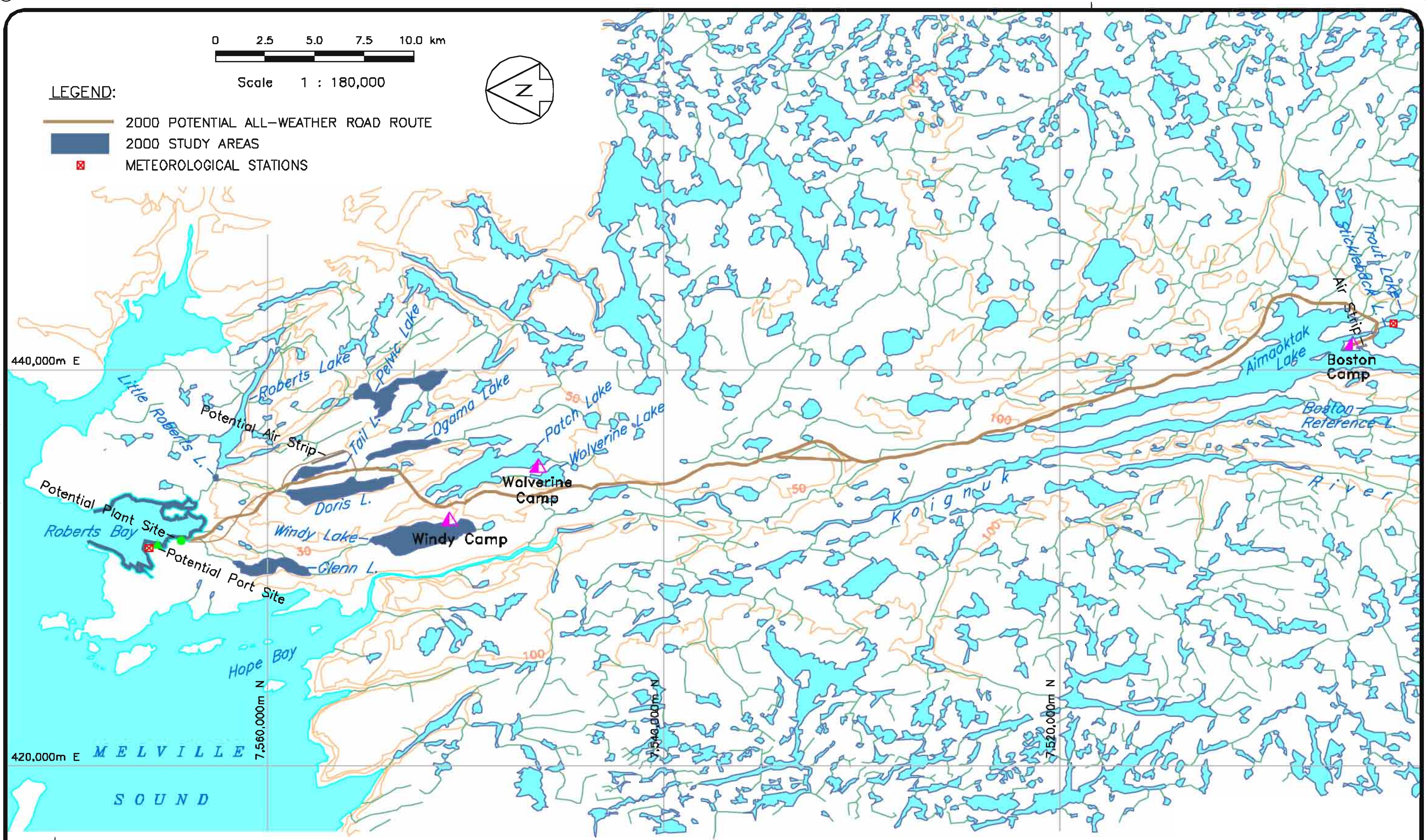

Figure 1.2-1

Locations of 2000 Study Areas, Hope Bay Belt Project

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Pelvic Lake and outflow (Reference Area), Ogama Lake and outflow, Roberts Outflow, Glenn Outflow, Koignuk River, and the proposed all-weather road route. Figure 1.2-2 provides a more detailed map of environmental sampling locations for the Doris Property area.

Pelvic Lake and outflow are designated reference areas. Monitoring at these locations provides a foundation for future aquatic effects monitoring programs, future assessments, and adds to the environmental baseline knowledge of the area.

Roberts Bay is the proposed location for a port and/or mill site. As such, a habitat assessment was conducted in the area, with emphasis on substrate type and habitat quality. Rock samples were also collected in the area to determine ARD potential. Tail and Doris lakes and Tail, Doris and Ogama outflows were monitored in order to provide more baseline data in the event of future regulatory requirements regarding fish-related issues. Tail, Doris, and Pelvic lakes and outflows were monitored to fill in historical gaps in order to provide adequate data for future monitoring programs and environmental assessment. Little Roberts Lake and outflow, and Roberts Outflow were assessed for the possibility of use by Arctic Char. Glenn Outflow was monitored as it represents a major drainage area for the property (Windy Lake area). The proposed all-weather road was preliminarily surveyed for stream crossings (fish community/habitat), archeological sites (separate report), and ARD potential. ARD potential was also determined for samples of drill core collected from the Boston and Doris properties.

Table 1.2-2 presents the overall sampling program that was carried out in 2000. Sampling details and methodology are provided for each discipline in subsequent chapters.

1.3 Overview of Report

This report is organized by major disciplines. Environmental disciplines are presented as separate chapters in the following order: meteorology, hydrology, surface water quality, marine sediment quality, physical limnology and bathymetry, primary producers, secondary producers, marine benthic invertebrates, fish communities, Roberts Bay habitat assessment, and acid generation testwork. All original data and analytical results are provided as appendices at the end of the report. Results presented in this report focus exclusively on information obtained during the 2000 sampling program, with the exception of meteorology, for which data from 1998, 1999, and 2000 are presented. Meteorology data were acquired in late 1998/1999 but were never included in an environmental report; these data are provided here so that the information is readily available for future efforts.

Table 1.2-2
2000 Hope Bay Belt Sampling Program

Location	Meteorology	Hydrology	Water Quality	Sediment Quality	Bathymetry	Primary and Secondary Producers	Fish Community	Habitat Assessment	ARD Assessment/ Testwork[2]
Roberts Bay	X			X		X[1]		X	X (port site)
Tail Lake			X	X	X	X	X	X	
Doris Lake			X	X		X	X	X	
Pelvic Lake			X	X		X			
Ogama Lake					X				
Little Roberts Lake							X	X	
Windy Lake			X						
Tail Outflow		X	X			X	X	X	
Doris Outflow		X	X			X	X	X	
Pelvic Outflow		X	X			X			
Ogama Outflow								X	
Little Roberts Outflow								X	
Roberts Outflow								X	
Glenn Outflow		X					X[3]	X[3]	
Koignuk River			X						
All-Weather Road							X	X	X
Potential Quarry Sites									X
Boston Camp	X								

1: Secondary producers only.
2: Samples were also collected from Boston and Doris drill core.
3: This site was assessed as part of the all-weather road stream crossings survey.

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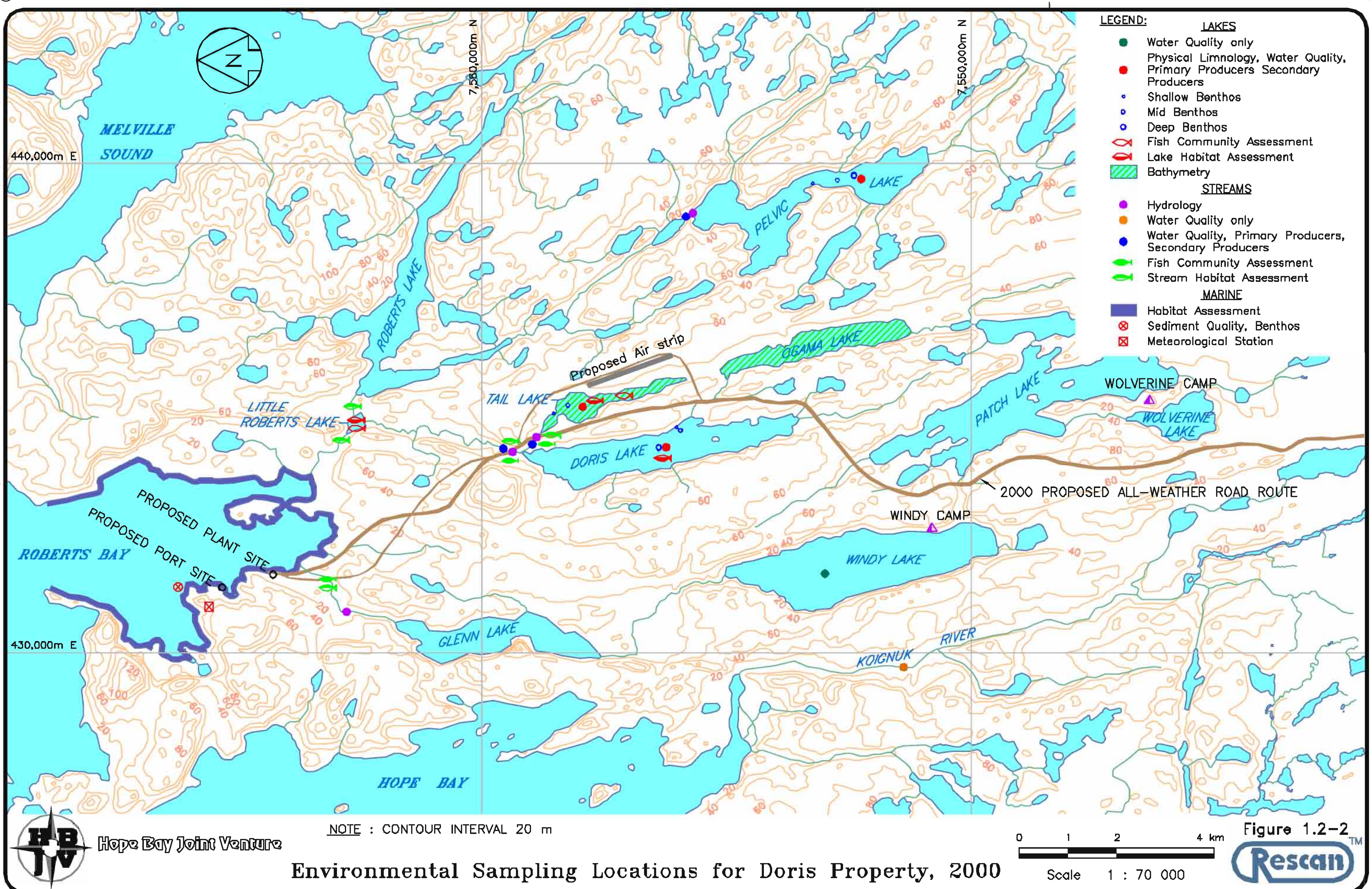

Figure 1.2-2

Environmental Sampling Locations for Doris Property, 2000

2. METEOROLOGY

2. METEOROLOGY

The 1999/2000 climatological component of the Hope Bay Belt area supplemental baseline studies consisted of the operation of automated weather stations at the Boston Property and Roberts Bay, and a Class A evaporation pan at the Boston Property (summer 2000 only). A description of the monitoring methods, setting, results and discussion follows.

2.1 Methods

The locations of all meteorology equipment along with the dates of operation are provided in Table 2.1-1.

An automated weather station has been in continuous operation at the Boston Property since July 1993. Data for the period July 1993 to August 1998 has been included in the previous data reports. The weather station utilizes a Campbell Scientific CR10 datalogger and includes a tipping bucket rain gauge, temperature and relative humidity sensor, ultrasonic snow depth gauge, and wind monitor (direction and speed). The station is powered by two 12 V deep cycle marine batteries that are recharged with a 30 W solar panel. The sensors are read at five-second intervals. Hourly and daily averages are saved to the final storage area of the datalogger and transferred to a storage module at the top of each hour. The location of the station is shown in the previous chapter in Figure 1.2-1.

Table 2.1-1
Meteorology Sampling Locations and Dates,
Hope Bay Belt, 1998 to 2000

Sampling Locations	Parameters	Dates
Boston Camp Meteorological Station	wind, snow depth, temperature, relative humidity, rain, solar radiation	August 1998 - September 2000[1]
Boston Camp	Class A evaporation	June 20 - September 21, 2000
Roberts Bay Meteorological Station	wind	June 20 - September 12, 2000

1: No wind or snow depth data available from October 1999 to June 2000. Solar radiation data begins June 2000.

Data collection continued in 1999/2000 at the Boston automated weather station and the storage module was downloaded on several occasions and checked to ensure that all of the sensors were working properly. The 10-meter tower supporting the instruments fell over on October 1, 1999 and remained on its side until repairs were completed on June 18, 2000 (261 days). Hence, the wind monitor and ultrasonic snow depth gauge were not recording reliable data for this period of time. A new Texas Instruments Model TE 525 tipping bucket rain gauge and a LI-COR Model LI200SZ pyronometer were added to the

Boston meteorological station on June 18, 2000. In addition a new cable was installed for the ultrasonic snow depth gauge. Duckbill anchors were driven into permafrost and attached to the guy wires that support the 10-meter tower.

During the mid-June site visit, a manual rain gauge and maximum-minimum thermometer were re-installed near the Boston camp. Data collected daily from these instruments were used to verify the data collected by the automated station. Due to the consistency of the regional topography, data collected at the Boston weather station are considered representative of the climatological conditions for the Doris Lake Project, the road corridor and the Roberts Bay areas.

An automated weather station was also installed at Roberts Bay, the potential port site, to obtain wind loading data for port design. The weather station was equipped with a wind speed and direction sensor mounted on a 3 m tripod tower. This station used the same logging interval (5 seconds) and power supply equipment (12 V lead acid battery) as the Boston weather station. Unfortunately, the solar panel used to charge the 12 V battery could not be located prior to the commissioning of the station on June 20, 2000. The Roberts Bay station was decommissioned on September 12, 2000. The Roberts Bay meteorological station was installed to provide wind data for a potential future port installation.

A Class A evaporation pan was installed at the beginning of the ice-free period of Year 2000 (June 19th) at the Boston camp. The pan was moved to Boston from Windy Lake in 1997 under the assumption that a tailings facility would eventually be established near the Boston site. The evaporation pan was not monitored during the 1999 open-water season. The hook gauge for the evaporation pan was designed to be monitored daily along with precipitation from a manual rain gauge. An on-site technician was trained in mid-June 2000 to collect data from the evaporation pan and other manual climate monitoring instruments.

The manually operated Nipher shielded snow gauge that was located near the Windy Lake Camp during 1997 was moved to Boston Camp in June 1998. The snow gauge has been used in the past to measure snowfall once a day. The snow collected in the copper cylinder is melted and the resulting volume of water is measured in units of millimetres of snow-water-equivalent. The Nipher snow gauge is limited in its capacity to accurately monitor snow accumulation due to frequent persistent winds. Therefore, snow-water-equivalent data for the winter of 1998/1999 were calculated using data from the ultrasonic snow depth gauge at the Boston meteorological station.

Wind speed and direction data were collected at the Boston camp automated weather station and the semi-automatic station at Windy Lake during 1999 and 2000. The automated station monitored wind speed and direction at a height of 10 m with a RM Young Model 05103 sensor that was scanned at five-second intervals. Ten-minute and hourly average wind speeds and directions were saved to final storage in the Campbell Scientific CR10 datalogger. Standard deviation for wind direction was also logged for the last ten minutes of each hour and for the entire hour. This standard deviation for wind direction helps to identify how frequently wind directions are changing. Daily maximum instantaneous wind speeds were recorded at the end of the day along with the corresponding wind direction and time of day.

To obtain the requisite verification of the on-site data for a potential future environmental impact assessment, the climatological databases for the Boston and Doris Lake projects have been augmented with data collected by Environment Canada Atmospheric Environment Service (AES). The location of the regional AES weather stations (primarily Lupin and Kugluktuk) are indicated on Figure 2.1-1.

2.2 Results and Discussion

Results of the 1998-2000 baseline study for air temperature, precipitation, wind speed and direction and evaporation are presented and general comparisons to previous years and regional data have been made.

2.2.1 Air Temperature

The nearest regional AES climatological stations are located at Lupin Mine (Echo Bay Mines) and Kugluktuk (Coppermine). The Boston automated weather station had similar monthly mean temperatures for the period of record (August 1998 to September 2000) to the two regional AES stations (Table 2.2-1 and Figure 2.2-1).

Monthly average temperatures for 1998 to 2000 at the Boston Property were slightly cooler than Lupin and Kugluktuk. The differences in mean monthly air temperatures for the three stations were greater during winter than summer. The daily mean air temperatures from the Boston automated weather station are summarized in Appendix 2.2-1.

The mean annual temperature calculated for the Boston weather station (September 1998 to August 1999 and September 1999 to August 2000) were –9.3 and –10.3°C, respectively. The mean annual temperatures calculated for Lupin were –8.2 and –9.3°C for a similar period of record. For the last three years the mean annual air temperature at Lupin was slightly warmer than at Boston. A similar difference exists for the mean annual air temperatures at Kugluktuk. The mean annual air temperatures for Coppermine were –7.7 and –9.4°C for a similar period of record.

The extreme 1-minute average minimum air temperatures recorded at the Boston weather station for 1999 and 2000 were –43.2 and –45.6°C (February 3rd and February 19th), respectively. The extreme 1-minute average maximum air temperatures recorded at the Boston station for 1999 and 2000 were 23.8 and 29.8°C (June 16th and July 27th), respectively.

Overall the trend for air temperatures in Nunavut, Northwest Territories and Canada has been a gradual increase. Environment Canada reported that the summer of 1998 was the warmest on record. Air temperatures in the Mackenzie District were above average during the summer of 2000 and have been above normal for the past 13 seasons.

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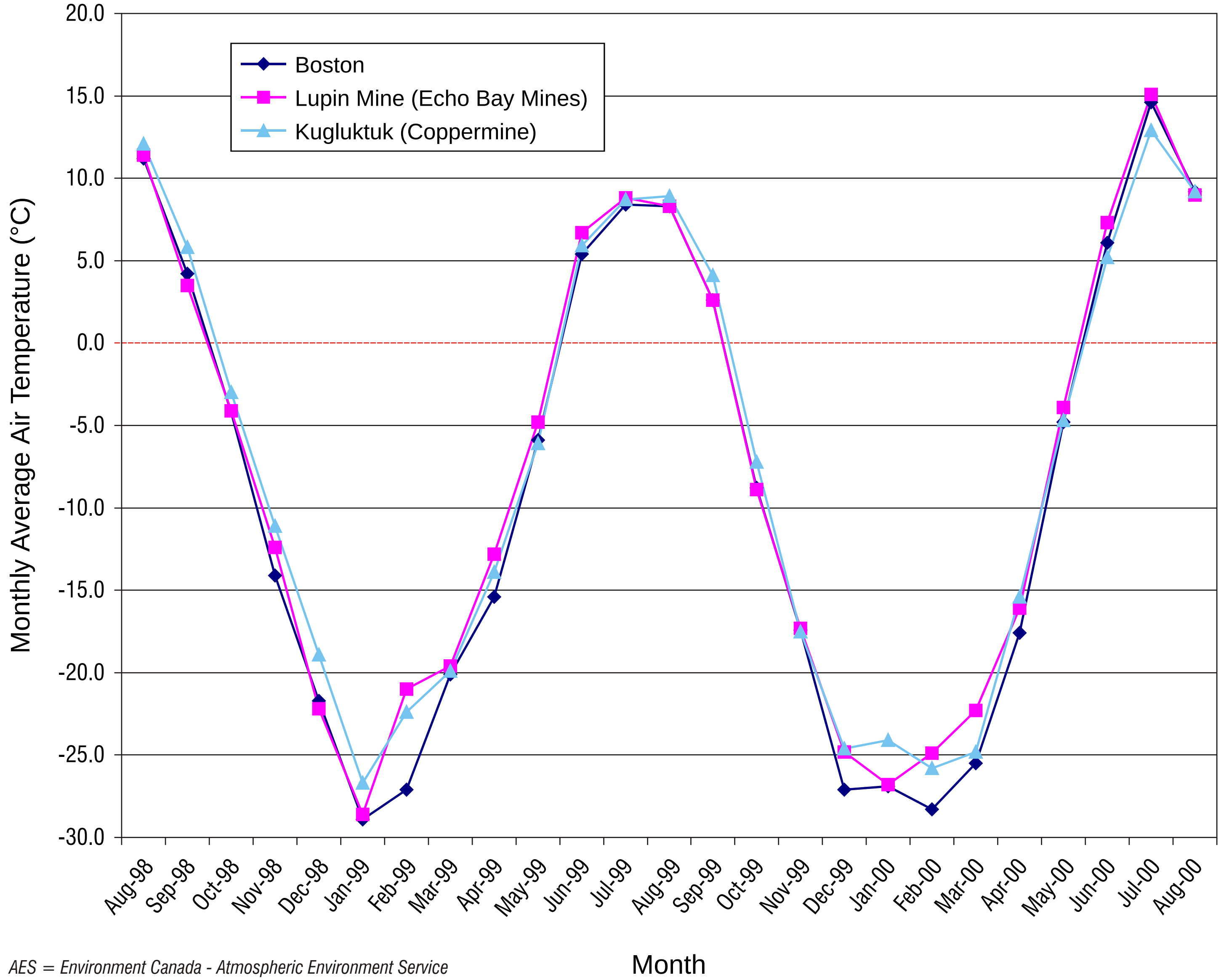
FIGURE 2.1-1

Location of Regional Climate Stations

◎ **Table of Contents**



AES = Environment Canada - Atmospheric Environment Service

FIGURE 2.2-1

Monthly Average Air Temperatures for Boston Property and Regional AES Stations

Table 2.2-1
Average Monthly Temperature (°C) at Boston Camp and Regional AES Stations

Month	Boston Camp	Lupin Mine (Echo Bay Mines)	Kugluktuk (Coppermine)[2]
August 1998	11.2	11.4	12.1
September	4.2	3.5	5.8
October	-4.2	-4.1	-3.0
November	-14.1	-12.4	-11.1
December	-21.7	-22.2	-18.9
January 1999	-28.9	-28.6	-26.7
February	-27.1	-21.0	-22.4
March	-20.1	-19.6	-19.9
April	-15.4	-12.8	-13.9
May	-5.9	-4.8	-6.1
June	5.4	6.7	5.9
July	8.4	8.8	8.7
August	8.3	8.3	8.9
September	2.6	2.6	4.1
October	-8.8	-8.9	-7.2
November	-17.4	-17.3	-17.5
December	-27.1	-24.8	-24.6
January 2000	-26.9	-26.8	-24.1
February	-28.3	-24.9	-25.8
March	-25.5	-22.3	-24.8
April	-17.6	-16.1	-15.4
May	-4.8	-3.9	-4.7
June	6.1	7.3	5.2
July	14.6	15.1	12.9
August	9.2	9.0	9.2
September	5.2[1]	1.1	2.7
12 Month Mean (Sept. 1998 to Aug. 1999)	**-9.3**	**-8.2**	**-7.7**
12 Month Mean (Sept. 1999 to Aug. 2000)	**-10.3**	**-9.3**	**-9.4**

Note: 1: September 1 to 14, 2000 only.
2: Source = Environment Canada – Atmospheric Environment Service (AES) 2000.

Temperature statistics for Canada indicated that the greatest trend towards warmer air temperatures over a 53 year period of record has occurred in the Mackenzie District (+1.1°C).

2.2.2 Precipitation

Precipitation occurs every month of the year although it is often higher during the late summer to early winter period. Precipitation can be monitored at three different sites in the Hope Bay Belt area. The Nipher shielded snow gauge at Boston is capable of monitoring snow-water-equivalent precipitation, however no Nipher data are available for 1998, 1999 and 2000. A manual rain gauge was installed at the Boston camp beside the Class A evaporation pan in mid-June 2000 and monitored until mid-September 2000. This manual rain gauge served two purposes. Firstly, it provided data for calculation of daily evaporation rates. Secondly, it can provide validation of the data collected by the tipping bucket rain gauge at the Boston automated weather station. The tipping bucket rain gauge at the Boston station was out of service between early October 1999 and mid-June 2000 due to the tower blowing over and damaging the instrumentation. A new gauge was installed on June 18, 2000.

The manual rain gauge near the evaporation pan at Boston camp was monitored to support the evaporation calculations, however, it was not monitored on a daily basis.

The results of the 1998, 1999 and 2000 precipitation data are summarized in Table 2.2-2 and Figure 2.2-2. July 1999 recorded the highest monthly precipitation rate at Boston (53.6 mm) and the two regional AES stations (Lupin = 62.4 mm, Coppermine = 64.0 mm).

Historical data, compiled from the Canadian Climate Normals (Environment Canada, 1992) for periods before 1990, indicated that the mean annual precipitation for the Boston project site is approximately 200 mm. This estimate is based on interpolation of data from the nearest regional AES stations. The annual precipitation (October 1998 to September 1999) calculated for Boston was 201.0 mm and this value appears to be reasonable since it is close to the interpolated value discussed above and includes snow-water-equivalent data from the ultrasonic snow depth sensor at the Boston weather station. The snow-water-equivalent data reported in Table 2.2-2 were estimated from the snow depth readings recorded by the ultrasonic sensor at the Boston automated weather station. The sensor determines the distance to a target by sending out ultrasonic sound pulses and listening for the echoes returning off the target. The time from transmit to return of the echo is the basis for obtaining the distance measurement. All depth measurements were corrected by subtracting an average distance recorded during a snow-free period, August 1 to 31, 1998. Average snow depth measurements are shown in Figure 2.2-3. Because of tower problems the ultrasonic sensor was out of service from October 1, 1999 to June 18, 2000.

Continuous precipitation data have not been collected at the Boston site in the past (*i.e.* especially from the Nipher snow gauge) therefore, no direct comparisons of annual precipitation are possible. However, general trends in the data may be delineated for the past several years. For the past several years (1996, 1997, 1998), August yielded the highest precipitation. However, during 1999 July recorded the highest monthly precipitation. Approximately 27% (53.6 mm) of the total annual precipitation (201.0 mm) occurred in July 1999. At the two regional stations, the precipitation from October through April (*i.e.* winter months) contributed less than 37% to the total annual precipitation, as shown in Figure 2.2-2. At the Boston site the winter contribution was slightly higher at 47%.

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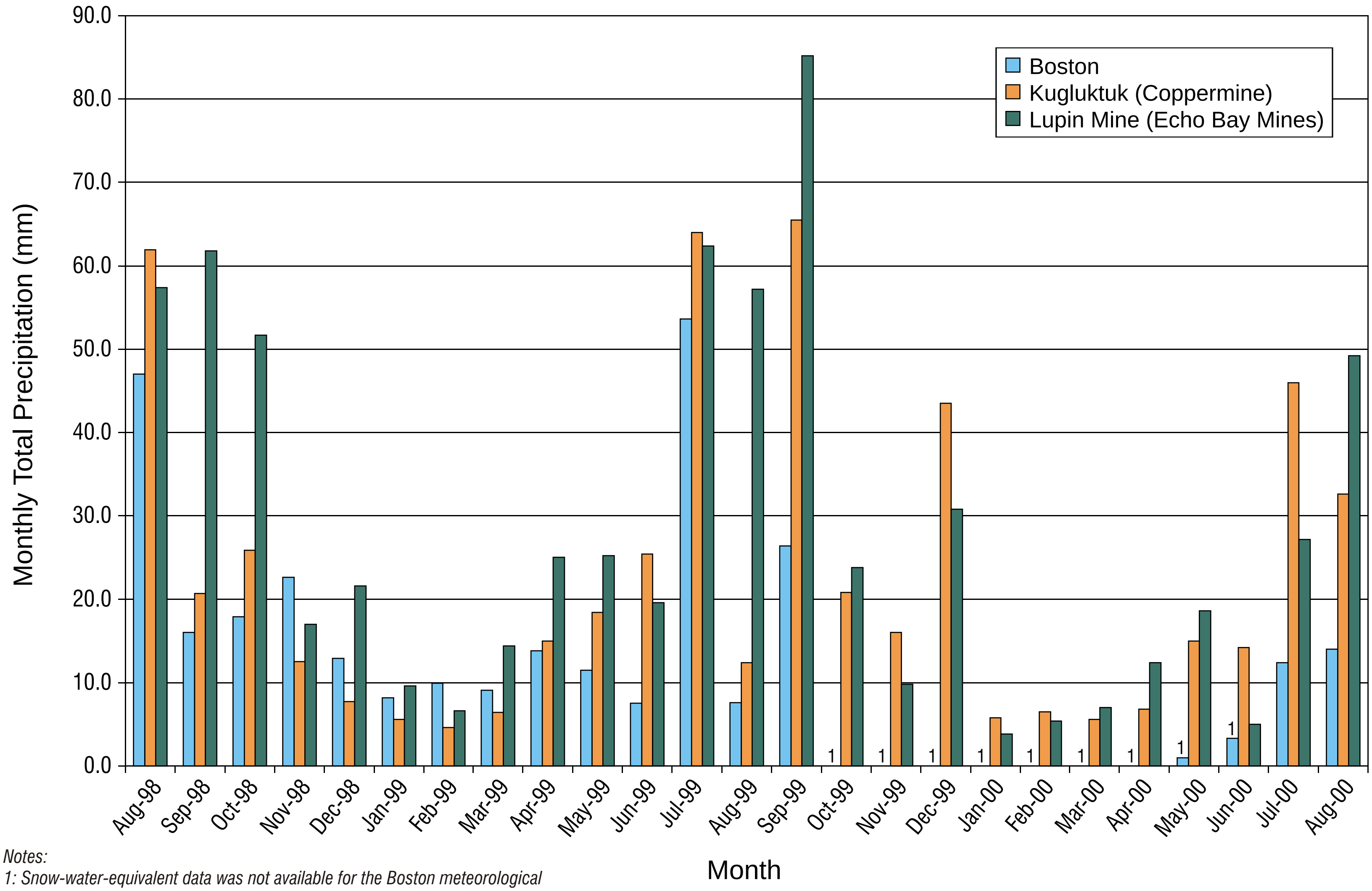

Notes:
1: Snow-water-equivalent data was not available for the Boston meteorological station from October 1999 to mid-June 2000 due to damaged equipment.
AES = Environment Canada - Atmospheric Environment Service

FIGURE 2.2-2

Monthly Total Precipitation for Boston Property and Regional AES Stations

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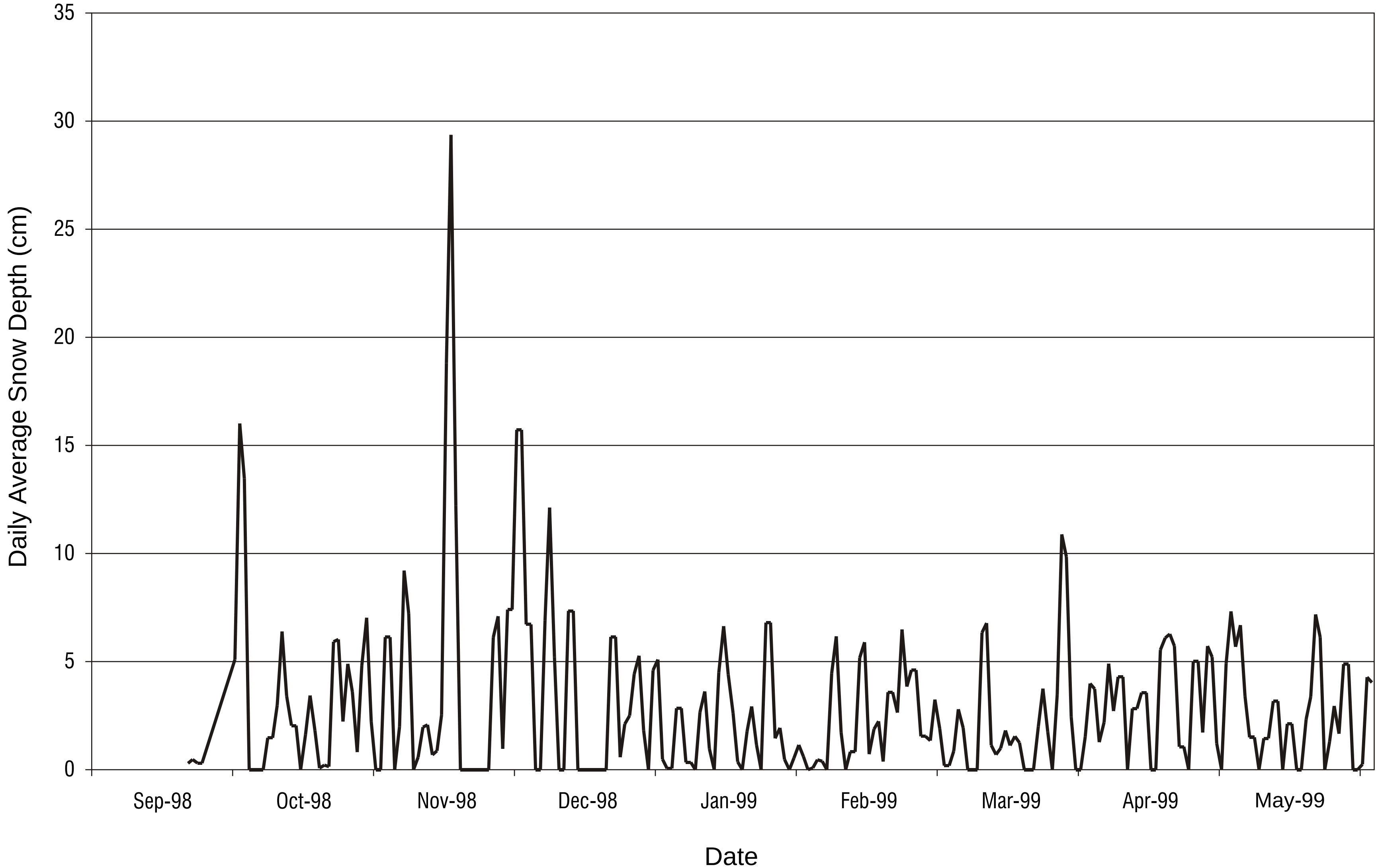


FIGURE 2.2-3

Corrected Daily Average Snow Depths at Boston Weather Station 1998-99 (2 Day Moving Average)

Table 2.2-2
Total Precipitation (mm) at Boston Camp and Regional AES Stations

Month	Boston Camp (Rain)	Boston Camp (SWE)	Boston Camp Total	Lupin Mine (Echo Bay Mines)	Kugluktuk (Coppermine) Total
August 1998	47.0	0.0	47.0	57.4	61.9
September	16.0	0.0	16.0	61.8	20.7
October	4.3	13.6	17.9	51.7	25.9
November	0.0	22.6	22.6	17.0	12.5
December	0.0	12.9	12.9	21.6	7.7
January 1999	0.0	8.2	8.2	9.6	5.6
February	0.0	9.9	9.9	6.6	4.6
March	0.0	9.1	9.1	14.4	6.4
April	0.0	13.8	13.8	25.0	15.0
May	0.5	11.0	11.5	25.2	18.4
June	0.3	7.2	7.5	19.6	25.4
July	53.6	0.0	53.6	62.4	64.0
August	7.6	0.0	7.6	57.2	12.4
September	24.1	2.3	26.4	85.2	65.5
October	0.0	n/a	n/a	23.8	20.8
November	0.0	n/a	n/a	9.8	16.0
December	0.0	n/a	n/a	30.8	43.5
January 2000	0.0	n/a	n/a	3.8	5.8
February	0.0	n/a	n/a	5.4	6.5
March	0.0	n/a	n/a	7.0	5.6
April	0.0	n/a	n/a	12.4	6.8
May	1.0	n/a	1.0	18.6	15.0
June	3.3[1]	n/a	3.3[1]	5.0	14.2
July	12.4	0.0	12.4	27.2	46.0
August	14.0	0.0	14.0	49.2	32.6
September	15.5[2]	0.0[2]	15.5[2]	58.6	72.3
Total Annual Precipitation (Oct. 1998 to Sept. 1999)	**90.4**	**110.6**	**201.0**	**395.5**	**263.4**

Notes: **SWE = snow-water-equivalent.**
n/a: not available because the ultrasonic snow depth gauge was out of service.
1: Only June 18 to 30, 2000 was available due to a damaged tipping bucket rain gauge.
2: Only September 1 to 13, 2000 was available. September 13, 2000 was the last time the Boston meteorological station was visited.

Metcalfe and Ishida (1994) indicated that measuring snow is much more difficult than rainfall because snow cover has a highly variable temporal and spatial structure related to land cover and terrain and redistribution by wind. In addition, snowfall is difficult to measure because of varying density, significant errors in gauge measurements due to wind, wetting and evaporation losses. Metcalfe *et al.* (1994) determined that the mean snowfall density for the NWT barrens (east and west of longitude 110°) was approximately 141 kg/m^3. For the Boston automated weather station the distance measurements from the ultrasonic sensor were converted to accumulated snow depths and then based on the typical snow density for the region, 14%, snow-water-equivalents were calculated. The resulting snow-water-equivalents are presented in Table 2.2-3 along with similar data from regional AES stations.

Table 2.2-3
Snow-Water-Equivalent Precipitation (mm) at Boston Camp and Regional AES Stations

Month	Boston Camp	Lupin Mine (Echo Bay Mines)	Kugluktuk (Coppermine)
October 1998	13.6	47.4	22.5
November	22.6	17.0	30.1
December	12.9	21.6	16.7[1]
January 1999	8.2	9.6	14.8[2]
February	9.9	6.6	13.8[3]
March	9.1	14.4	15.1
April	13.8	22.8	28.8[2]
May	11.0	19.6	24.0[4]
June	7.2	0.4	0.0
July	0.0	2.2	0.0
August	0.0	3.2	0.0[4]
September	2.3	17.8	2.2
12 Month Total	**110.6**	**182.6**	**168.0**
% of Annual	**55**	**46**	**63**

Notes: **1: Seven days of record were missing.**
2: Two days of record were missing.
3: Six days of record were missing.
4: One day of record was missing.

During October 1998 through May 1999, the snow-water-equivalent precipitation at the Boston Property was 110.6 mm and the total annual precipitation was 201.0 mm. Hence snow contributed 55% of the total annual precipitation. This value is considered a good approximation because for a similar period of record the snow-water-equivalent precipitation was 46% of the annual total precipitation at Lupin (182.6/395.5) and 63% of the annual total precipitation at Kugluktuk (168.0/263.4). The snow-water-equivalent data calculated for Boston appear to be reasonable when compared with Lupin and Kugluktuk.

2.2.3 Wind Speed and Direction

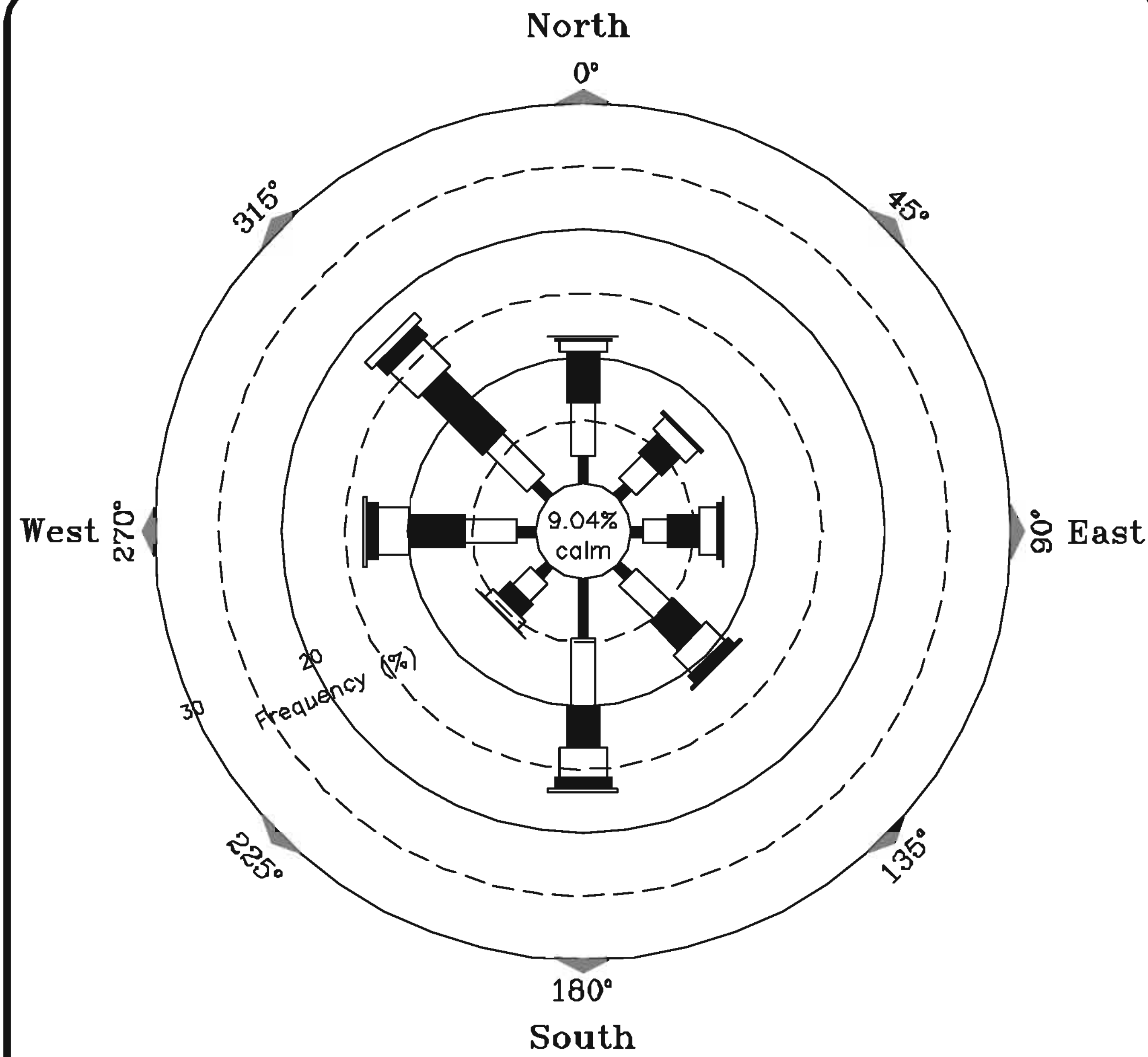
Continuous wind data were not available for the Boston station for October 1, 1999 to June 18, 2000 due to problems with the 10-meter tower. The predominant wind direction during the August 1998 to September 1999 period (Figure 2.2-4) was from the northwest (17.7% of the time). The wind speeds were predominantly between 5.0 to 7.5 m/s when the wind was from the northwest. Calm conditions (*i.e.* wind speeds below one metre per second) occurred 9.0% of the time. These winds are very similar to the patterns established in previous years. In 1995 and 1996, the predominant wind directions were from the northeast (28% of the time) and northwest (26.1% of the time), respectively, and calm winds prevailed for 8.7% and 9.8%, respectively (Rescan, 1996). In 1997, the predominant wind direction was from the north (18.7% of the time) with calm winds 5.8% of the time.

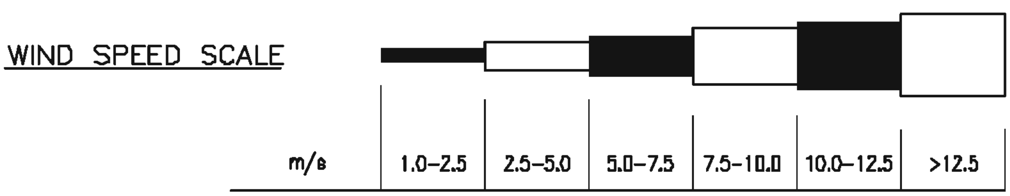
A partial Year 2000 data set for wind is available from the Boston station (June 18 to September 14) as summarized in Figure 2.2-5. This data represents "summer" conditions and the predominant wind directions were from the southeast (15.1%) and northwest (15.0%). Calm conditions were less frequent during the summer (3.6%).

The portable automated weather station at Roberts Bay was installed during Year 2000 to collect wind data needed for potential future port design. The wind speed and direction sensor, datalogger, power supply and data collection parameters for the Roberts Bay weather station were similar to the Boston station. One major difference was the height of the wind sensor. The wind sensor at Boston is mounted 10 m above the ground and the Roberts Bay wind sensor is mounted 3 m above ground. Continuous wind data have been collected at Roberts Bay for 1997, 1998 and 2000 during the summer. During these three years the station operated for 86, 181 and 84 days, respectively. In 1997 the predominant winds were from the north (20.9% of the time). Calm conditions occurred 3.0% of the time. In 1998 the most frequent wind direction was from the northwest (19.7% of the time). Calm winds occurred approximately 3.1% of the time. In Year 2000, the predominant wind direction was from the north (16.8%) and calm conditions occurred 3.0% of the time. Hence, there is a good agreement between the three years for predominant wind directions and the frequency of calms. The Year 2000 wind rose for the Roberts Bay weather station is shown in Figure 2.2-6.

2.2.4 Evaporation

Evaporation data were collected from a Class A evaporation pan located at Boston camp during the Year 2000 open-water season. Daily evaporation was measured with a graduated hook gauge set on a stilling well to determine the water level in the pan. The hook gauge was adjusted until the point just breaks the water surface and a reading is taken from the attached scale. On-site staff was trained to collect the hook gauge reading on a daily basis. The evaporation pan was installed June 19, 2000 and monitored intermittently until September 21, 2000. The station was visited a total of 42 days out of a possible 96 days (44% data collection efficiency). The daily Class A evaporation pan records for the 2000 open-water season are summarized in Appendix 2.2-2.





Period of record is August 21st, 1998 to September 30th, 1999. (The 10 m tower for the Boston meteorolgical station was damaged and the wind data is biased after September 30th, 1999.)

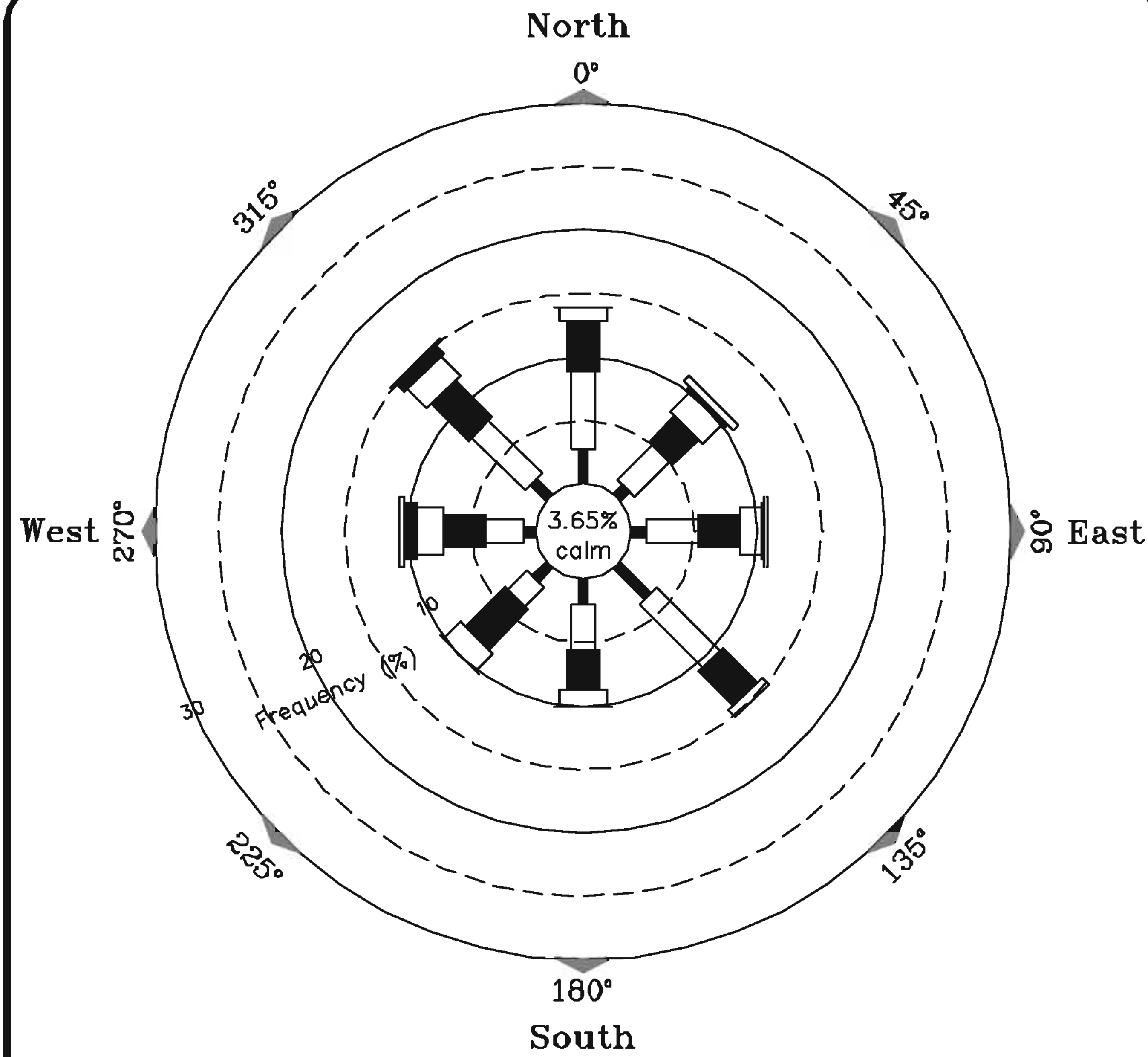
1998–1999 Wind Rose for Boston Weather Station

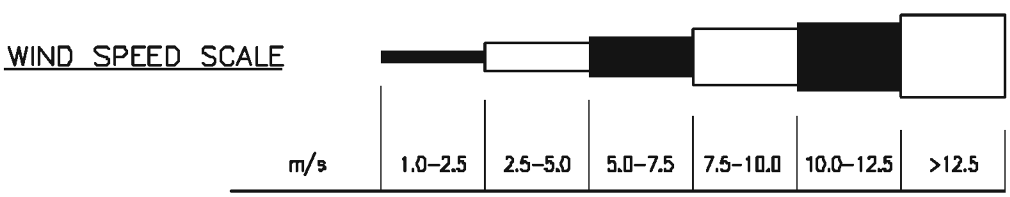
Hope Bay Joint Venture

Figure 2.2–4

Rescan™

Cad No. C1044 Sht. 11 View C10 Scale 2 : 1 Job No. 583-1 Hope Bay Belt Gold Project 01/15/2001 – 9:24am RES_AP





Period of record is June 18th to September 14th, 2000. (Prior to June 18th the tower for the meteorological station was damaged.)

2000 Wind Rose for Boston Weather Station

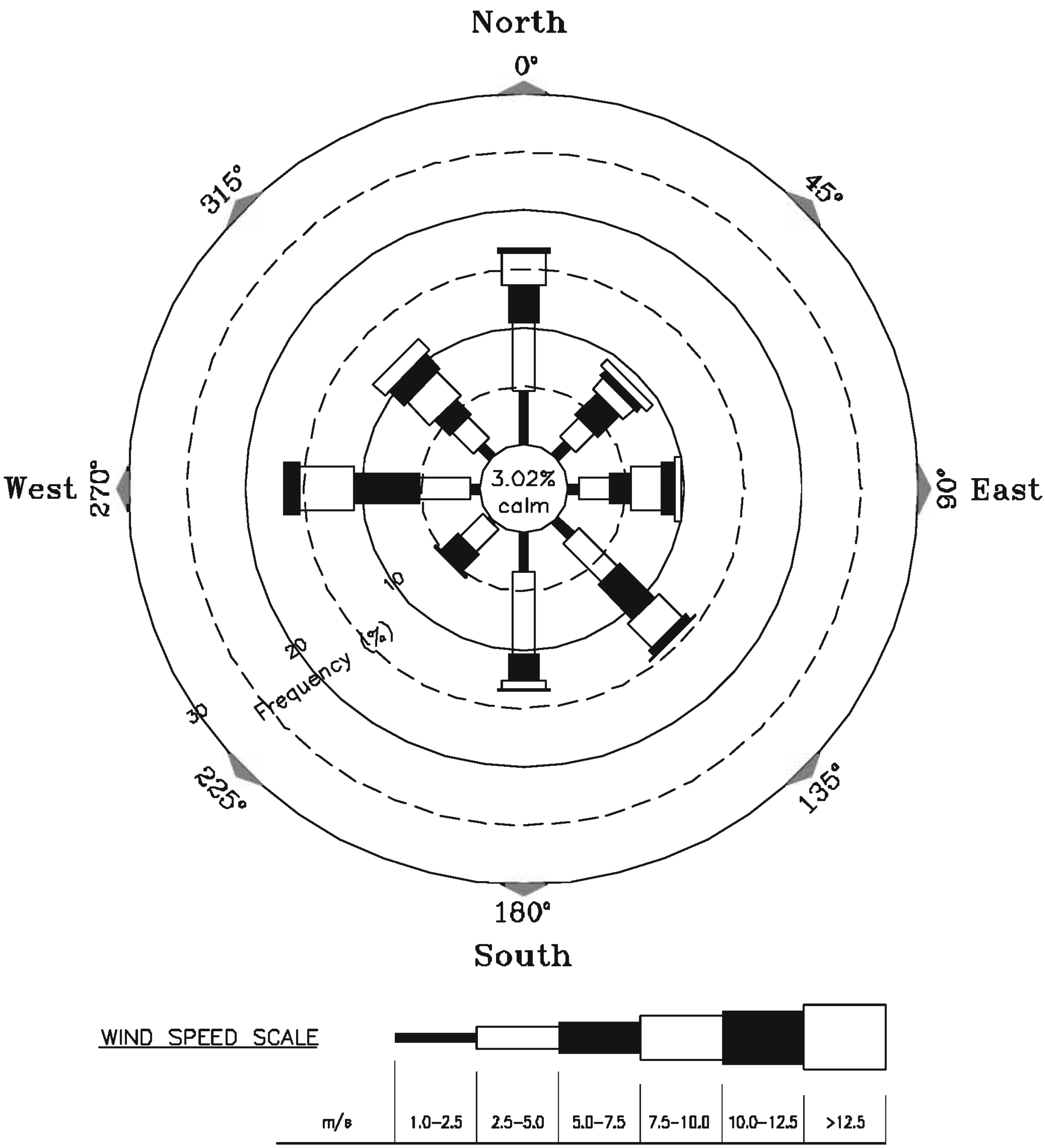
Hope Bay Joint Venture

Figure 2.2–5

Rescan™

Cad No. C1044 Sht. 12 View C6 Scale 2 : 1 Job No. 583-1 Hope Bay Belt Gold Project 01/15/2001 – 7:55am RES_AP

Cad No. C1044 Sht. 13 View C5 Scale 2 : 1 Job No. 583-1 Hope Bay Belt Gold Project 01/15/2001 - 7:39am RES_AP



Period of record is June 20th to September 12th, 2000 (84 days)

2000 Wind Rose for Roberts Bay Meteorological Station

Figure 2.2-6

Hope Bay Joint Venture

Rescan™

The 2000 Class A evaporation pan data collected at Boston camp are summarized in Table 2.2-4. The total Class A evaporation for 42 days of monitoring was 149.8 mm. The average Class A evaporation rate was 3.6 mm/day. The comparison of mean daily evaporation rates between Windy Lake during the open-water season of 1996 (2.4 mm/day) and Boston Property during the open-water seasons of 1997 (2.7 mm/day) and 1998 (4.1 mm/day) suggests that the pan was not being monitored consistently enough during Year 2000 with 56% of the data missing.

Table 2.2-4
Year 2000 Class A Evaporation Pan at Boston Camp

Month	Daily Evaporation Rate (mm/day)	
	Boston Camp 2000	Days of Available Record
June	3.7	6
July	5.9	9
August	3.9	16
September	1.1	11
Total	**--**	**42**
Mean	**3.6**	**--**

The Year 2000 Class A evaporation pan data for Boston Property is questionable because of the high number of missing days and the presence of animals drinking from the pan which would result in an over-estimate of the mean daily evaporation rate.

Lake evaporation may be estimated by applying a coefficient to the Class A pan evaporation. Pan evaporation is almost always higher than lake evaporation because of radiation and boundary effects. In the past years a coefficient of 0.75 has been used for the Hope Bay Belt Project Class A pan evaporation data. This value agrees closely with the range of pan coefficients of 0.69 to 0.72 reported by Reid (1996) for Yellowknife airport for 1992 to 1994 and the mean pan coefficient of 0.77 reported by Linacre (1994) for the U.S. Pan coefficients vary seasonally, with relative humidity, lake size, and consequently with geographic location (Linarcre, 1994).

If the pan coefficient of 0.75 is applied to the Year 2000 data for an assumed open-water season at the Boston site (124 days), an estimated lake evaporation of 335 mm is obtained. This value is to be interpreted with caution because of the number of days with no available data.

2.2.5 Solar Radiation

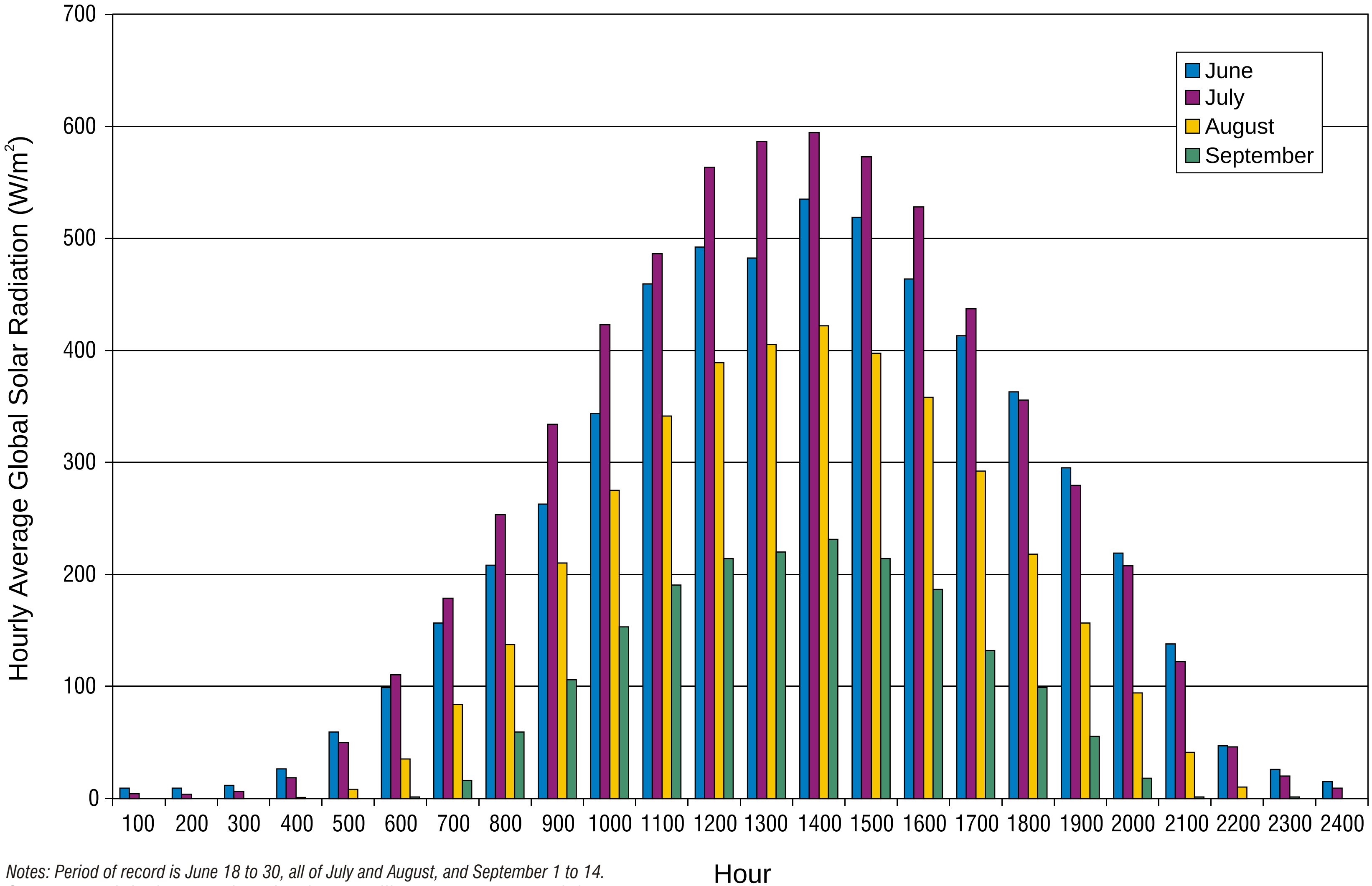
A silicon pyranometer was added to the Boston automated meteorological station on June 18, 2000. The pyranometer is read every 5 seconds by the CR10 datalogger and hourly averages are saved to final storage. The pyranometer measures global solar radiation which is the total incoming direct and diffuse short-wave solar radiation received from the whole dome of the sky on a horizontal surface measured in Watts per square metre (W/m^2). Table 2.2-5 and Figure 2.2-7 summarize the data collected thus far.

Table 2.2-5
Summary of Year 2000 Solar Radiation at Boston Meteorological Station (W/m^2)

Hour of Day	June[1]	July	August	September[2]
100	9	4	0	0
200	9	4	0	0
300	12	6	0	0
400	26	19	1	0
500	59	50	8	0
600	99	111	35	1
700	157	179	84	16
800	208	253	138	60
900	263	334	210	106
1000	344	423	275	153
1100	459	486	341	190
1200	492	564	389	214
1300	485	587	405	220
1400	535	594	422	231
1500	519	573	397	214
1600	464	528	358	187
1700	413	437	292	132
1800	363	356	218	99
1900	295	279	157	55
2000	219	208	94	18
2100	138	122	41	2
2200	47	46	10	0
2300	26	20	2	0
2400	15	9	0	0

Notes: 1: June 18 to 30, 2000.
2: September 1 to 14, 2000.

The most intense solar radiation occurs during July and gradually declines during August and September. The peak values during mid-day in July are 590 W/m^2. A similar instrument located near the equator would record values near 1,000 W/m^2. The latitude of the Boston site (67° North) causes the solar radiation to be less intense. Solar radiation data could be used as a tool to calculate the length of growing seasons and assist in the selection of vegetation for reclamation programs for mineral exploration sites and mine sites that have been decommissioned.



Notes: Period of record is June 18 to 30, all of July and August, and September 1 to 14. Global solar radiation is the total incoming direct and diffuse short-wave solar radiation received from the whole dome of the sky on a horizontal surface.

FIGURE 2.2-7

Boston Meteorological Station
Global Solar Radiation - June to September, 2000

3. HYDROLOGY

3. HYDROLOGY

This chapter presents a brief description of Arctic hydrology, followed by the methods and results of data collected from hydrometric monitoring stations within the Hope Bay Belt Project area. Hydrological data collected in 2000 for the Hope Bay Belt Project represented supplemental baseline hydrology information.

In the continental Canadian Arctic, the extreme climate and the unique ground conditions influence the hydrological cycle. The climate is characterized by long, very cold winters and short summers. Snow and ice affect the temporal redistribution of liquid water on the earth's surface, thereby affecting the timing and character of flood runoff (Pomeroy *et al.*, 1997). Additionally, the extremely cold environment causes the ground to be perennially frozen, thus influencing the runoff regime by drastically altering infiltration properties of soils and changing runoff pathways (Quinton and Marsh, 1999). The principal hydrological processes in the region are snow accumulation and redistribution, snowmelt, surface runoff, streamflow, evaporation, and lake hydrology.

3.1 The Northern Hydrologic Cycle

The duration of the hydrologic cycle in the continental Canadian Arctic is defined by above freezing temperatures in the spring and below freezing temperatures in the fall. Initial temperatures above freezing in June mark the onset of the open-water season. During the weeks that follow, water levels vary greatly as diurnal temperature fluctuations influence melt and re-freezing of the snow and ice. Peak flows occur once the air temperature remains above freezing. The active storage is discharged through the summer months; flows typically reach minimum levels in September. Flows increase and decline in response to rain events until the air temperature drops below freezing to mark the end of one hydrological cycle and the beginning of another (Winter and Woo, 1990). Fall freeze-up typically occurs in September/October, although the exact timing varies with yearly temperature. All active storage present in the watershed at the time of freeze-up and all precipitation recorded after fall freeze-up are available for discharge the following hydrologic year. Observing the exact time of winter freeze-up is critical for computing hydrologic parameters such as runoff depths and coefficients.

Peak flows in the area are influenced by a number of factors. Climatic conditions play the dominant role. The amount of accumulated precipitation also influences the peak flow. However, melting conditions determine the nature of the release of the accumulated precipitation. A quick thaw will result in a higher peak flow as compared to a slow thaw. Thus, peak flow prediction methodologies must incorporate a number of thaw scenarios. Predicting the influence of a given thaw scenario is made difficult by the unpredictable nature of ice and snow blockages. A given thaw scenario coupled with a major blockage will likely yield a different peak flow than a similar thaw scenario with no significant blockage. All of these factors make it difficult to predict the magnitude of peak flows during freshet, as well as interpret results once the peaks are recorded.

Large fluctuations in flow can also occur before the occurrence of the peak flow. Fluctuations in flow prior to the peak flow are caused by temperature fluctuations. Above freezing temperatures begin to mobilize the freshet volume. The stage and the flow then increase as the mobilized volume exceeds the conveyance of the channel. If the temperature drops below freezing no additional water is mobilized, resulting in a quick drop in stage and flow as the upstream volume dissipates. As temperatures begin to rise above freezing, more freshet volume is mobilized and the stage and flow again rise. If temperatures again drop below freezing before the entire freshet volume is mobilized, the pattern will repeat itself. However, if the temperature remains above freezing long enough to mobilize the entire freshet volume then the flow will recede until the minimum is reached in late summer. This pattern of flow fluctuations in response to temperature changes is further complicated by the occurrence of ice and snow blockages.

The magnitude and timing of the minimum flow is dependent on two factors: freshet volume and the timing of summer rain events. A smaller than average freshet volume coupled with unusually late summer rain events could result in a brief period of no-flow conditions. Accurate estimates of freshet volume, together with local hydraulic variables, could be used to predict the time required to have no-flow conditions. However, unpredictable rain events during the course of the summer months make it difficult to predict the timing and magnitude of the minimum flow before it actually occurs.

In the absence of summer rain events, flows in smaller drainage areas could run dry before fall freeze-up. This can occur because the area is characterized by vast permafrost and there is no sustained recharge from groundwater (Winter and Woo, 1990). Seepage from the active layer does occur, although the active layer only extends approximately 2 m below the surface. Thus, groundwater recharge to streams and lakes is not a dominant variable affecting flows. There is no active aquifer that contributes to a base flow.

3.2 Methods

A total of four sites within the study area were monitored for continuous water levels with automated hydrometric stations (Figure 1.2-2). Each automated hydrometric station consisted of a staff gauge for manual water levels readings, and a pressure transducer and datalogger for automated water level readings. Readings were taken at 30-minute intervals by Instrumentation Northwest Inc. PS9000 pressure transducers and the data were subsequently stored in Terrascience Elf dataloggers. During the open-water season, discharge measurements were conducted at each site using a Swoffer Model 2100 flowmeter (Appendix 3.2-1). Stage-discharge relationships were developed and applied to derive continuous discharge data from the water level readings (Appendix 3.2-2). Table 3.2-1 presents a summary of the hydrometric monitoring stations utilized in 2000 along with the active monitoring period.

Table 3.2-1
Automated Hydrology Station Locations and Dates, Hope Bay Belt, 2000

Location	Coordinates[1]	Drainage Area (km^2)	Monitored Period	Staff Gauge	Data Logger
Tail Outflow	68° 08' 17'' N 106° 34' 54'' W	4.4	June 16 – September 12	Yes	Yes
Doris Outflow	68° 08' 31'' N 106° 35' 16'' W	93.1	June 16 – September 11	Yes	Yes
Pelvic Outflow	68° 06' 38'' N 106° 28' 6'' W	49.2	June 17 – September 12	Yes	Yes
Glenn Outflow	68° 10' 22'' N 106° 39' 55'' W	31.6	June 15 – September 11	Yes	Yes

1: Datum = NAD83.

The hydrometric station at the outlet of Doris Lake encompasses the largest drainage area of all the monitoring locations. The major lakes that contribute to streamflow at Doris Outflow include Doris, Tail, Ogama, Patch, and Wolverine. A number of small unnamed lakes also contribute flow. There are two main lakes that contribute flow at the Glenn Outflow hydrometric station; Glenn and Windy lakes. The removal of water from Windy Lake for domestic use does not likely result in a measurable change in flow at the outlet of Doris Lake. Tail Lake is a headwater lake that drains into Doris Outflow. The hydrometric station on Pelvic Outflow is the sole reference site. Pelvic Lake is a mid-sized lake with five significant inflows.

3.3 Results and Discussion

3.3.1 Streamflow Hydrograph

The average daily flow computed for the four monitoring locations is summarized in Appendix 3.3-1. The continuous stream flow records of the streams monitored and precipitation data collected during the 2000 open-water season are presented in Figure 3.3-1. Hydrographs from all monitoring locations were similar through the open-water season. Peak flows occurred during the freshet period as the accumulated snow and ice melted. The decline of the hydrographs during the early summer was caused by two phenomena. Firstly, the depletion of snow patches reduced the main source of water available for streamflows. Secondly, the percentage of surface runoff reaching the streams decreased as thawing of the active layer provided a thicker zone in which suprapermafrost groundwater could be stored. Once the snow and ice were completely depleted, summer rainfall was the major source of water supply.

The general shape of the unit yield hydrograph at Tail Outflow deviated from those at the other monitoring locations. During freshet, the unit yield at Tail Outflow maintained a high unit yield over a period of about 20 days. As a result, the peak unit yield was not

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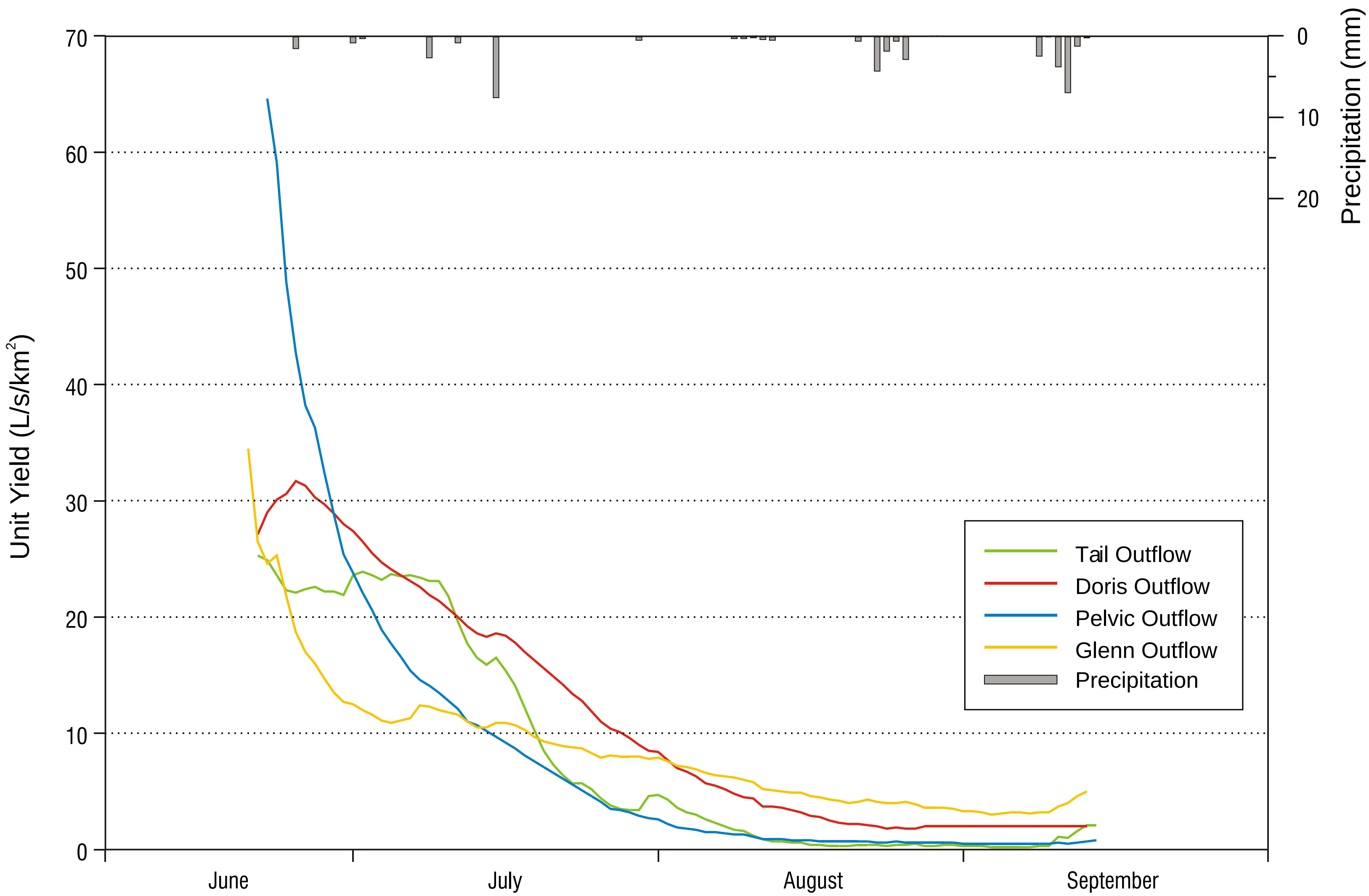

FIGURE 3.3-1

Unit Yield for Site Specific Monitoring Locations, Hope Bay Belt, 2000

significantly greater than the average unit yield during this time period. The low gradient, wide and densely vegetated channel significantly dampened flows through the area. These conditions result in a slower, steadier release of the active storage. In contrast, the other monitoring locations have higher gradient and incised channels that respond quickly to upstream increases in active storage.

Short increases in unit yield after peaks were attained resulted from rainfall events. A significant rainfall event in July resulted in a short duration increase in unit yield at Tail, Doris, and Glenn outflows. The unit yield hydrograph produced from flow monitoring at Pelvic Outflow did not show any response to this rainfall event. Highly localized rainfall is typical for this region. The drainage area upstream of the Pelvic Outflow monitoring station is situated approximately 10 kilometers to the southeast. This distance is great enough to miss a localized rainfall event situated over the other monitoring locations.

All monitoring locations had elevated unit yields in September as rain continued for six consecutive days. Unit yields typically remain high until temperatures fall below freezing and the unit yield drops to zero as streams freeze completely, marking the end of the hydrologic cycle.

3.3.2 Peak Flows

The magnitude of the peak daily discharges generally reflected the size of the drainage basin, with the exception of the peak recorded at Pelvic Outflow (Table 3.3-1). The monitoring stations at Doris and Pelvic outflows recorded the two largest one-day average flows.

Table 3.3-1
Summary of Maximum Daily Flows (m^3/s) and Unit Yields (L/s/km^2), Hope Bay Belt Streams, 2000

Monitoring Location	Date	Maximum Daily Discharge (m^3/s)	Maximum Unit Yield (L/s/km^2)
Tail Outflow	June 16	0.111	25.0
Doris Outflow	June 20	2.949	32.0
Pelvic Outflow	June 17	3.180	64.0
Glenn Outflow	June 15	1.091	35.0

The comparable peak unit yields from Doris and Glenn outflows reflect the similar conditions within the outflow channels and upstream drainage areas. Both outlets are single, well-defined channels that concentrate the flow. In contrast, the outlet at Tail Outflow is a low gradient channel with thick vegetation along its flat streambanks. These conditions increase the likelihood that a portion of the flow will go undetected as water slowly flows through the thick vegetation.

The peak values in Table 3.3-1 for Tail, Pelvic, and Glenn outflows can be considered close approximations of the actual peaks since their hydrographs do not show a distinct peak. Peak flows in Arctic streams are often difficult to record as they occur quickly as the temperature rises above the freezing mark. Peaks often occur while snow and ice remain in the channel making it difficult to install monitoring equipment.

The peak unit yield recorded at Pelvic Outflow was significantly greater than all other sites. The advantage of plotting unit yield as opposed to the actual recorded flow is that the flow is normalized by drainage area. Similar peak unit yields were expected from the four monitoring locations. The extremely high peak unit yield at Pelvic Outflow, as compared to the other stations, was possibly influenced by snow and ice blockages that held back the release of the active storage.

3.3.3 Low Flows

The timing of the minimum stream flow in Arctic regions generally depends on two factors; the rate at which the active storage is released and the onset of late summer rain events. The monitoring stations at Tail, Pelvic, and Glenn outflows all recorded the minimum one-day flow in early September (Table 3.3-2). The minimum at Doris Outflow occurred about 10 days earlier.

Table 3.3-2
Summary of Minimum Daily Flows (m^3/s)
and Unit Yields ($L/s/km^2$), Hope Bay Belt Streams, 2000

Monitoring Location	Date	Minimum Daily Discharge (m^3/s)	Minimum Unit Yield ($L/s/km^2$)
Tail Outflow	September 2	0.001	0.2
Doris Outflow	August 21	0.168	2.0
Pelvic Outflow	September 6	0.020	0.4
Glenn Outflow	September 1	0.095	3.0

Comparing unit yield among monitoring locations removes the drainage area as a factor that contributes to the magnitude and timing of the minimum recorded flow. Differences among sites on a unit yield basis result from localized differences in the drainage area conditions and the nature of the outlet. At Tail Outflow, the flow is spread out over a wide area that is densely populated with vegetation. These conditions make it hard to accurately monitor flow, thus the reported minimum flow at Tail Outflow is likely an underestimate of the actual value.

3.3.4 Runoff Depths

The runoff depth is computed by dividing the total discharged volume by the upstream drainage area. That is, it is the depth of water spread over the entire drainage area. Table 3.3-3 presents the runoff depth for the 2000 monitoring period. Ideally for Arctic watersheds, the runoff depth is computed for the entire open-water season. This is done so that comparisons can be made between the total precipitation in the watershed and the runoff depth. The 2000 monitoring period did not encompass the entire open-water season. Therefore, the runoff depths reported in Table 3.3-3 should not be used for comparison with the total precipitation in the watershed.

Table 3.3-3
Runoff Depth (mm) Recorded During the Monitoring Period
June 15 to September 12, Hope Bay Belt Streams, 2000

Monitoring Location	Runoff Depth (mm)
Tail Outflow	64
Doris Outflow	87
Pelvic Outflow	65
Glenn Outflow	66

However, since the monitoring periods at the four stations were similar, general comparisons can be made among monitoring locations. Tail, Pelvic, and Glenn outflows all had very similar runoff depths. The higher runoff depth at Doris Outflow indicates that only a small portion of the active storage, as compared to the other locations, was released prior to the monitoring period. This was likely due to slow melting of snow and ice at the outlet of Doris Lake. The hydrograph from Doris Outflow presented in Figure 3.3-1 shows that the actual peak flow was recorded, as well as pre-peak flows. This indicates that the reported runoff depth in Table 3.3-3 closely approximates the runoff depth from the entire open-water season.

3.4 Summary

The hydrographs from the four monitoring locations were similar to each other and typical for the area. Stream flow in areas of continuous permafrost typically have peak flows in early summer followed by declining flow thereafter as the active storage is released. Flows at Tail Outflow did deviate somewhat from the other locations. This was likely due to the unique conditions in the channel at the monitoring location. All monitoring locations showed responses to rainfall events through the summer and in particular in September as rainfall increased. All monitoring locations sustained flow through the open-water season. A runoff depth for the entire open-water season was not computed since the monitoring program ended before the end of the hydrologic cycle.

4. SURFACE WATER QUALITY

4. SURFACE WATER QUALITY

This section presents details of the surface water quality sampling component of the supplemental baseline studies conducted within the Hope Bay Belt property in 2000. The sampling methodology that was followed is outlined and pertinent results are presented and discussed.

4.1 Freshwater - Lakes

4.1.1 Methods

Water quality samples were collected from Tail, Doris, Pelvic and Windy lakes during the open-water season of 2000. All sampling locations are indicated on the map in Figure 1.2-2. Table 4.1-1 presents sampling locations and dates for all lake water quality samples collected.

Samples were obtained from the deepest part of the lake at mid-depth and at 1 m below the surface. Water samples were collected in duplicate using a metered line and a 5 L Teflon-lined Go-Flo sampling bottle that was triggered shut at the appropriate depth using a Teflon-coated messenger. Samples were stored in the dark and taken back to Windy Camp where they were preserved, if necessary. Once at camp, the samples were kept cool and in the dark until shipment to the analytical laboratory.

Analysis for various parameters (physical parameters, dissolved anions, nutrients, and total metals) was conducted by Analytical Service Laboratories in Vancouver, British Columbia.

Quality assurance/quality control (QA/QC) measures were taken in the form of field blanks and travel blanks. Field blanks were taken into the field and left open while a sample was being collected and then taken back to the camp and preserved if necessary. Travel blanks were included with the shipment of samples to and from the analytical laboratory.

Table 4.1-1
Lake Water Quality Sampling Locations and Dates, Hope Bay Belt, 2000

Lake	Date	Depth(s) Sampled	Number of Samples
Tail	July 19,2000	1 m, 3 m	n=2/depth
	August 19, 2000	3 m	n=2
Doris	July 24, 2000	1 m, 8 m	n=2/depth
	August 22, 2000	8 m	n=2
Pelvic	July 24, 2000	1 m, 9 m	n=2/depth
Windy	July 25, 2000	1 m, 7 m	n=2/depth

4.1.2 Results and Discussion

Complete results from the analysis of the water quality samples are provided in Appendix 4.1-1. Results for select water quality parameters are presented in Table 4.1-2. The parameters included in this table were selected because of their significance to aquatic life and/or the presence of federal water quality guidelines (CCREM). While it is understood that the CCREM values are only guidelines and not legislated criteria, they do provide an internationally recognized set of water quality standards that are useful when making comparative analyses among sites.

Lake waters were in general characterized by slightly basic, soft waters, with very low total suspended solid and total metal concentrations. Nutrient concentrations were also generally low, with Tail Lake having slightly higher ammonia concentrations compared to the other lakes (mean of 0.016 mg/L compared to 0.005 mg/L). The reason for the higher ammonia concentrations in Tail is unclear.

None of the parameters exceeded any of the Canadian guidelines for the protection of freshwater aquatic life (CCREM 1987). Selenium concentrations in Windy Lake in July (0.0009 ± 0.0001 mg/L) and Doris Lake in August (0.001 mg/L) were close to or at the criterion value of 0.001 mg/L. Aluminum concentrations in Pelvic Lake in July (0.091 ± 0.001 mg/L) were close to the federal guideline of 0.100 mg/L. Aside from these three instances, all other parameter values were well below the federal criteria for the protection of freshwater aquatic life, usually orders-of-magnitude lower than the criterion value.

Based on the results of the analysis of the QA/QC samples (Appendix 4.1-2), the only possible contamination may have been for total organic carbon (the field blank had a TOC concentration of 1.4 mg/L). The TOC contamination was approximately three times greater than the analytical detection limit, and the source of the contamination is unknown. Possible explanations are gasoline residues in the boat or insect/plant contamination. TOC concentrations measured were within the range of expected values for lakes in the area.

4.2 Freshwater - Streams

4.2.1 Methods

Water quality samples were collected from Tail Outflow, Doris Outflow, Pelvic Outflow, and the Koignuk River (see Figure 1.2-2) during the open-water season of 2000. Table 4.2-1 presents sampling locations and dates for all stream water quality samples collected. Samples were collected from the Koignuk River in 2000 to extend the period of record for this site (1998 was the only other year of sample collection).

Table 4.1-2
Average Values[1] for Select Lake Water Quality Parameters, Hope Bay Belt, 2000

Parameter	Tail Lake July 19, 2000	Tail Lake Aug. 19, 2000	Doris Lake July 24, 2000	Doris Lake Aug. 22, 2000	Pelvic Lake July 24, 2000	Windy Lake July 25, 2000	CCREM[2] Guidelines
Hardness	30.2 ± 0.6	33.5 ± 0.6	36.2 ± 0.5	42.0 ± 0.7	30.3 ± 0.1	63.3 ± 0.7	-
pH	7.6	7.7	7.4 ± 0.1	7.8	7.6	7.9	6.5 - 9.0
TSS	2.4 ± 0.9	2.0	3.0 ± 1.0	5.0	6.0 ± 1.0	2.3 + 0.4	10.0[3]
Turbidity	0.6 ± 0.1	1.0 ± 0.1	2.7 ± 0.3	4.8 ± 0.1	6.1 ± 0.4	0.9 ± 0.1	-
Ammonia	0.017 ± 0.0010	0.015 ± 0.0020	<0.005	0.006 ± 0.0005	<0.005	<0.005	0.93 - 2.5[4]
Nitrate	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Nitrite	0.002 ± 0.0001	<0.001	<0.001	0.002 ± 0.0005	<0.001	<0.001	0.06
Total P	0.010 ± 0.001	0.016 ± 0.003	0.015 ± 0.001	0.017 ± 0.001	0.023 ± 0.002	0.006	-
TOC	6.7 ± 0.1	6.9 ± 0.3	7.0 ± 0.1	7.0 ± 0.3	6.5 ± 0.1	3.1 ± 0.2	-
Aluminum	0.0198 ± 0.0003	0.0290 ± 0.0020	0.0200 ± 0.0010	0.0190	0.0913 ± 0.0012	0.0410 ± 0.0010	0.005/0.10[5]
Arsenic	0.0002	0.0003	0.0003	0.0005	0.0003	0.0004	0.05
Cadmium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0002/0.0008[6]
Chromium	<0.0005	<0.0005	<0.0005	0.0007	<0.0005	<0.0005	0.002
Copper	0.00103 ± 0.00003	0.00115 ± 0.00005	0.00125 ± 0.00003	0.00140	0.00133 ± 0.00003	0.00085 ± 0.00003	0.002/0.002[6]
Iron	0.053 ± 0.003	0.060	0.083 ± 0.005	0.045 ± 0.005	0.175 ± 0.003	0.040	0.3
Lead	0.00005	0.00010 ± 0.00001	0.00007 ± 0.00002	0.00010 ±0.00005	0.00010 ± 0.00001	0.00007	0.001/0.002[6]
Mercury	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0001
Nickel	0.00050	0.00060	0.00033 ± 0.00003	0.00040	0.00030	0.00023 ± 0.00003	0.025/0.065[6]
Selenium	<0.001	<0.001	<0.001	0.001	<0.001	0.001 ± 0.0001	0.001
Silver	0.00002 ± 0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00001 ± 0.000001	0.0001
Zinc	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.03

Note: Units are mg/L, except pH (pH units) and turbidity (NTU).
1: Values are averages for all samples collected (n=4 in July; n=2 in Aug.) along with the standard error. If a value was below detection limit, one-half of the detection limit was used to calculate the average. If no standard error is provided, all values were the same.
2: Canadian Council of Resource and Environment Ministers (CCREM), 1987 – guidelines for the protection of freshwater aquatic life.
3: CCREM criterion is for suspended solids not to be more than 10.0 mg/L above background concentrations when background concentrations are below 100.0 mg/L.
4: CCREM criterion for ammonia concentration is pH- and temperature-dependent. The range provided is for pH 6.5 - 8.0 and temperatures from 0 - 20°C.
5: CCREM criterion for aluminum is pH-dependent. At pH less than or equal to 6.5, the aluminum criterion is 0.005 mg/L; at pH greater than 6.5, the aluminum criterion is 0.10 mg/L.
6: CCREM criteria for cadmium, copper, lead and nickel are hardness-dependent. The two values provided are the criterion at hardness 0-60 mg/L $CaCO_3$ and 60-120 mg/L $CaCO_3$, respectively.

Table 4.2-1
Stream Water Quality Sampling Locations and Dates, Hope Bay Belt, 2000

Stream	Date	Depth Sampled	Number of Samples[1]
Tail Outflow	June 20, Sept 14, 2000	depth-integrated	n=2
Doris Outflow	June 20, Sept 14, 2000	depth-integrated	n=2
Pelvic Outflow	June 20, Sept 14, 2000	depth-integrated	n=2
Koignuk River	June 20, Sept 15, 2000	depth-integrated	n=2

1: Number of samples collected on each sampling date.

Depth-integrated water samples were collected from the stream by lowering the sample bottle from just below the water surface to the stream bottom, taking care not to disturb stream sediments. Samples were stored in the dark and handled similarly to the lake water quality samples. All samples were sent to Analytical Service Laboratories for analysis.

Quality assurance/quality control (QA/QC) measures were taken in the form of travel blanks. Travel blanks were included with the shipment of samples to and from the analytical laboratory.

4.2.2 Results and Discussion

Complete results from the analysis of the water quality samples are provided in Appendix 4.2-1. Results for select water quality parameters are presented in Table 4.2-2.

In general, streams and rivers were characterized by soft, neutral to slightly basic waters. Total suspended solids and turbidity levels were slightly greater than lake values, as would be expected. The Koignuk River is a large river which tended to have slightly higher concentrations of total metals than the much smaller streams. There were seasonal differences in most parameters for all streams/rivers sampled.

The majority of the parameters at most of the sites were well below federal guidelines for the protection of freshwater aquatic life. However, there were a number of exceptions. Aluminum concentrations were at or above the federal criterion (0.100 mg/L) in both the Koignuk River and Pelvic Outflow in June and September. In the case of the Koignuk River, aluminum concentrations in June (0.427 mg/L) were more than four times the federal criterion. The fact that Pelvic Outflow also had elevated aluminum concentrations suggests that background levels within the Hope Bay region are naturally high. The copper criterion of 0.002 mg/L was slightly exceeded in September at Doris

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Table 4.2-2
Average Values[1] for Select Stream Water Quality Parameters, Hope Bay Belt, 2000

Parameter	Tail Outflow June 20, 2000	Tail Outflow Sept. 14, 2000	Doris Outflow June 20, 2000	Doris Outflow Sept. 14, 2000	Pelvic Outflow June 20, 2000	Pelvic Outflow Sept. 14, 2000	Koignuk June 20, 2000	Koignuk Sept. 14, 2000	CCREM[2] Guidelines
Hardness	14.2 ± 0.3	43.3 ± 0.3	48.9 ± 0.1	56.4 ± 9.5	14.5 ± 0.1	35.0 ± 0.3	21.3 ± 5.1	36.5 ± 0.1	-
pH	7.3	7.6 ± 0.1	7.7 ± 0.1	7.6	7.0	7.6	7.2	7.4	6.5 - 9.0
TSS	<3.0	3.3 ± 1.8	<3.0	7.0	3.3 ± 1.8	12.0 ± 1.0	12.0 ± 2.0	5.5 ± 0.5	10.0[3]
Turbidity	0.8	4.9 ± 0.4	4.9 ± 0.4	6.2 ± 0.4	5.3 ± 0.2	15.6 ± 0.4	11.0 ± 0.6	9.2 ± 0.7	-
Ammonia	0.030	<0.005	<0.005	<0.005	0.149 ± 0.001	0.008 ± 0.001	0.031	0.010 ± 0.001	0.93 - 2.5[4]
Nitrate	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.009 ± 0.0005	<0.005	-
Nitrite	<0.001	<0.001	<0.001	<0.001	0.001 ± 0.0003	0.001 ± 0.0003	0.001 ± 0.0003	<0.001	0.06
Total P	-	0.006	-	0.016 ± 0.001	-	0.035 ± 0.004	-	0.014	-
TOC	5.3 ± 0.1	6.1 ± 0.1	6.2 ± 0.3	6.4 ± 0.1	6.1	6.4 ± 0.1	6.5	5.5 ± 0.2	-
Aluminum	0.0305 ± 0.0005	0.0140	0.0310 ± 0.003	0.0580 ± 0.034	0.0995 ± 0.0005	0.1795 ± 0.0045	0.4265 ± 0.0025	0.2825 ± 0.0005	0.005/0.10[5]
Arsenic	0.0001	0.0002	0.0003	0.0004 ± 0.00005	0.0002	0.0005 ± 0.00005	0.0007 ± 0.0005	0.0003	0.05
Cadmium	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00005 ± 0.00002	<0.00005	0.0002[6]
Chromium	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0009	0.0007 ± 0.00005	0.002
Copper	0.00075 ± 0.00005	0.00075 ± 0.00005	0.00155 ± 0.00005	0.00195 ± 0.00035	0.00090	0.00165 ± 0.00005	0.00165 ± 0.00015	0.00155 ± 0.00005	0.002[6]
Iron	0.080	0.580 ± 0.010	0.065 ± 0.005	0.110 ± 0.010	0.160	0.140	0.565 ± 0.005	0.360	0.30
Lead	0.00006 ± 0.00001	0.00008 ± 0.00001	0.00009	0.00021 ± 0.00006	0.00010	0.00016 ± 0.00001	0.00044 ± 0.00020	0.00023 ± 0.00001	0.001[6]
Mercury	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0001
Nickel	0.0040	0.0005	0.0004	0.0005 ± 0.0001	0.0006	0.0003	0.0012 ± 0.0001	0.0009 ± 0.00005	0.025[6]
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Silver	0.00004 ± 0.00002	<0.00001	0.00001 ± 0.00001	<0.00001	<0.00001	<0.00001	0.00005 ± 0.00003	<0.00001	0.0001
Zinc	<0.001	<0.001	<0.001	0.001 ± 0.0008	<0.001	<0.001	0.004 ± 0.0015	0.002 ± 0.0005	0.03

Note: Units are mg/L, except pH (pH units) and turbidity (NTU).
1: values are averages for all samples collected (n=2 in June; n=2 in Sept.) along with the standard error. If a value was below detection limit, one-half of the detection limit was used to calculate the average. If no standard error is provided, all values were the same.
2: Canadian Council of Resource and Environment Ministers (CCREM), 1987 – guidelines for the protection of freshwater aquatic life.
3: CCREM criterion is for suspended solids not to exceed 10.0 mg/L of background concentrations when background concentrations are below 100.0 mg/L.
4: CCREM criterion for ammonia concentration is pH- and temperature-dependent. The range provided is for pH 6.5 - 8.0 and temperatures from 0 - 20°C.
5: CCREM criterion for aluminum is pH-dependent. At pH less than or equal to 6.5, the aluminum criterion is 0.005 mg/L; at pH greater than 6.5, the aluminum criterion is 0.10 mg/L.
6: CCREM criteria for cadmium, copper, lead and nickel are hardness-dependent. The value provided is the criterion at hardness 0-60 mg/L $CaCO_3$.

Outflow. Iron concentrations in the Koignuk River in both June and September and in Tail Outflow in September exceeded the federal criterion of 0.30 mg/L. As with aluminum, the iron concentrations measured in the Koignuk River and Tail Outflow indicate that background concentrations in the region are naturally elevated. The elevated metals concentrations correlated with elevated TSS and turbidity levels, suggesting that the metals may be associated with particulate matter.

Results of the QA/QC analysis indicated that there was little or no contamination of the stream water quality samples.

5. MARINE SEDIMENT QUALITY

5. MARINE SEDIMENT QUALITY

As a result of changes in the overall mine plan over the last few years, data on marine sediments in the location of the potential port site do not exist. Marine sediment sampling in the vicinity of the potential port site was carried out in the summer of 2000.

5.1 Methods

The location of the area sampled for marine sediments is indicated on Figure 1.2-2. On July 25, 2000, a small boat along with a depth sounder were used to conduct the sampling. Marine sediments were to be collected using an Ekman grab sampler (the same apparatus that was used for lake benthos collection). Samples were to be collected in triplicate within the footprint of the potential port facility.

Sediment samples were to be sent to Analytical Service Laboratories in Vancouver, B.C. for analysis of physical and chemical parameters.

5.2 Results and Discussion

Results of the sediment survey indicated that the ocean bottom of the area surveyed consisted of hardpan, large boulders and/or large gravel. No soft sediments were present, and no sediment quality samples were obtained. Attempts at various locations within the same general area indicated that the ocean bottom was similar for at least an area of 50 m wide by 100 m long (parallel to shore).

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6. PHYSICAL LIMNOLOGY AND BATHYMETRY

6. PHYSICAL LIMNOLOGY AND BATHYMETRY

This chapter presents methods and results for the physical limnology and bathmetry components of the supplemental environmental work conducted within the Hope Bay Belt area in 2000.

6.1 Physical Limnology

Dissolved oxygen/temperature profiles and Secchi depths were measured in Tail, Doris, Pelvic, Windy, and Little Roberts lakes during the open-water season of 2000 in order to assess the physical properties and structure of the water column in each lake.

6.1.1 Methods

All physical limnology sampling locations and dates are provided in Table 6.1-1. A Secchi depth and a dissolved oxygen/temperature profile were measured at the deepest spot of each lake. Sampling stations corresponded to the water quality and aquatic biology stations and are indicated in Figure 1.2-2. The Secchi depth was obtained by lowering a Secchi depth over the shaded side of the boat until it was no longer visible. This depth was recorded and used to calculate the extinction coefficient. The extinction coefficient was then used to determine the base of the euphotic zone (defined as the depth at which 0.1% of the surface irradiance penetrates; Parsons *et al.* 1984a).

Dissolved oxygen/temperature profiles were obtained using a YSI Model 52 DO/T meter equipped with 50 m of cable and an *in situ* probe. The probe membrane was inspected prior to use and replaced if necessary. The meter was air-calibrated in the field before deployment. To obtain a profile, the probe was lowered close to the sediment/water interface and allowed to stabilize. Depth, temperature and dissolved oxygen were recorded every half metre as the probe was raised, after allowing the probe to stabilize at each depth.

Table 6.1-1
Physical Limnology Sampling Locations and Dates, Hope Bay Belt, 2000

Location	Date	DO/T Profile[1]	Secchi Depth
Tail Lake	July 19, 2000		yes
Tail Lake	August 22, 2000	yes	yes
Doris Lake	July 24, 2000		yes
Doris Lake	August 22, 2000	yes	yes
Pelvic Lake	July 24, 2000		yes
Pelvic Lake	August 23, 2000	yes	yes
Little Roberts Lake	August 26, 2000		yes
Windy Lake	July 25, 2000		yes

1: Dissolved Oxygen/Temperature Profile.

Weather observations, including percent cloud cover, wind speed, and wind direction were also recorded on all sampling days.

6.1.2 Results and Discussion

Secchi depths, along with the resulting euphotic zone depths, are provided in Table 6.1-2. The euphotic zone (the zone in which phytoplankton are able to photosynthesize) is calculated using the extinction coefficient (a value that represents the degree to which light is attenuated). In late July, Secchi depths varied from 1.6 m (Pelvic Lake) to 5.4 m (Tail Lake). In late August, Secchi depths varied from 0.5 m (Pelvic Lake) to 4.2 m (Tail Lake). For both months, Tail Lake had the deepest euphotic zone depth (21.9 m and 17.0 m) and Pelvic Lake had the shallowest euphotic zone depth (6.5 m and 2.0 m). Calculated euphotic zone depths indicated that adequate light was available for photosynthesis to occur throughout the majority of the water column for Tail, Windy and Little Roberts lakes.

Dissolved oxygen and temperature data are provided in Appendix 6.1-1, and are presented graphically in Figure 6.1-1. The water columns of all lakes were well mixed, without any evidence of stratification. All waters were relatively well oxygenated with the lowest value (8.2 mg/L) occurring at 14.5 m depth in Doris Lake. All lakes sampled were relatively shallow and had unstratified water columns as a result of summer wind mixing.

Table 6.1-2
Secchi Depth (D_S), Extinction Coefficient (k'), and Depth of Euphotic Zone for Hope Bay Belt Lakes, July/August 2000

Lake	Date	Estimated Lake Depth (m)	D_s	k'	Euphotic Zone Depth[1]
July					
Tail Lake	July 19, 2000	5.5	5.4 m (bottom)	0.31 m	21.9 m
Doris Lake	July 24, 2000	15.0	2.2 m	0.77 m	8.9 m
Pelvic Lake	July 24, 2000	18.0	1.6 m	1.06 m	6.5 m
Windy Lake	July 25, 2000	13.0	2.9 m	0.59 m	11.8 m
August					
Tail Lake	August 22, 2000	5.5	4.2 m	0.40 m	17.0 m
Doris Lake	August 22, 2000	15.0	1.5 m	1.13 m	6.1 m
Pelvic Lake	August 23, 2000	18.0	0.5 m	3.40 m	2.0 m
Little Roberts Lake	August 26, 2000	2.7	1.6 m	1.06 m	6.5 m

1: defined as 0.1% of surface irradiance.

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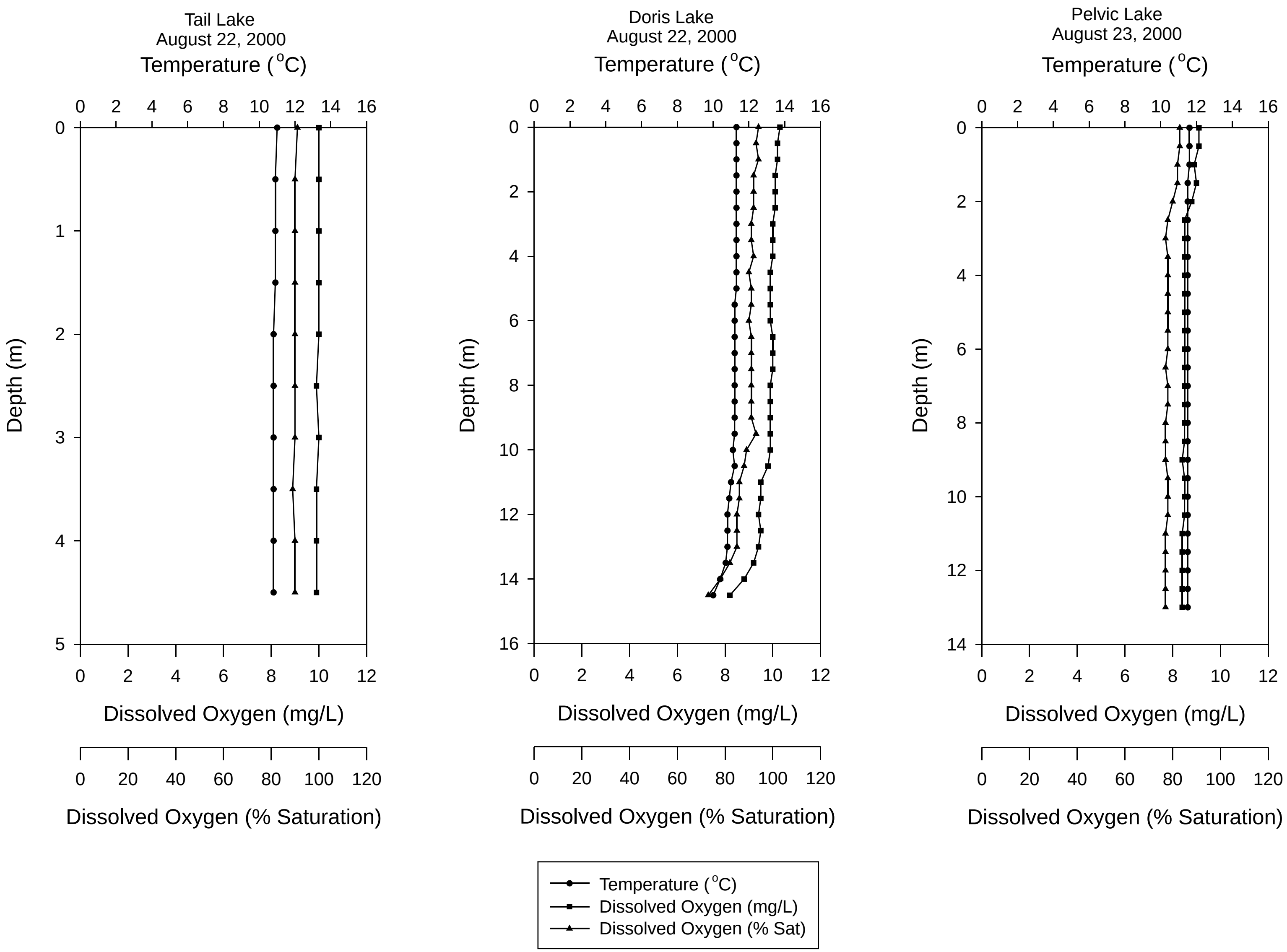

FIGURE 6.1-1

Dissolved Oxygen/Temperature Profiles for Tail, Doris and Pelvic Lakes, 2000

6.2 Lake Bathymetry

Bathymetric surveys of Tail and Ogama lakes were undertaken between July 20 and 26, 2000. The work included echosounder measurements, manual depth measurements and position measurements of the lakes. These detailed bathymetric surveys were undertaken in order to provide detailed volume and topographical information in the event that either lake is considered for tailings placement.

6.2.1 Methods

Bathymetric work on the lakes was performed from a 2.5 m aluminum boat between July 20 and 26, 2000. Positioning throughout the two surveys was determined with a Trimble ProXRS differential global positioning system (DGPS) in 3D-overdetermined mode. Differential corrections were made using data from a portable base station (Trimble 4600LS Surveyor) situated at a point with known coordinates. The base stations used were within 100 m of the lakes. Differential correction of position data is believed to be accurate to within 1 m. A Seamax echosounder was used to measure water depth greater than 1.0 m. The echosounder transducer was positioned at the back of the boat, approximately 10 cm below the surface. DGPS position and sounder data streams were merged onto a Trimble TSC1 data logger. The perimeters of both lakes were surveyed with the DGPS on foot. Data were transferred nightly to a laptop computer, and a Zip disk was used as a data backup.

The horizontal datum used to determine positioning was WGS-84, Zone 13 North, while the vertical reference for depth was determined from the portable base station. All measurements were recorded in metres.

6.2.2 Results

6.2.2.1 Tail Lake

A total of 9,246 point positionings and soundings were processed to generate the bathymetric chart. Figure 6.2-1 shows the route navigated on the lake. The length of the lake along its center axis is 2,914 m, and the total perimeter length is 6,923 m. The maximum measured width of the lake is 608 m, while the maximum depth is 6.2 m. Tail Lake has a surface area of 766,433 m^2 and a volume of 2,380,000 m^3. Figure 6.2-2 presents the resultant bathymetric map of Tail Lake.

6.2.2.2 Ogama Lake

A total of 7,754 point positionings and soundings were processed to generate the bathymetric chart. Figure 6.2-3 shows the route navigated on the lake. The length of the lake along its center axis is 4,005 m, and the total perimeter length is 9,803 m. The maximum measured width of the lake is 578 m, while the maximum depth is 7.1 m. The surface area of the lake is 1,618,667 m^2, while the volume is 4,209,800 m^3. Figure 6.2-4 presents the resultant bathymetric map of Ogama Lake.

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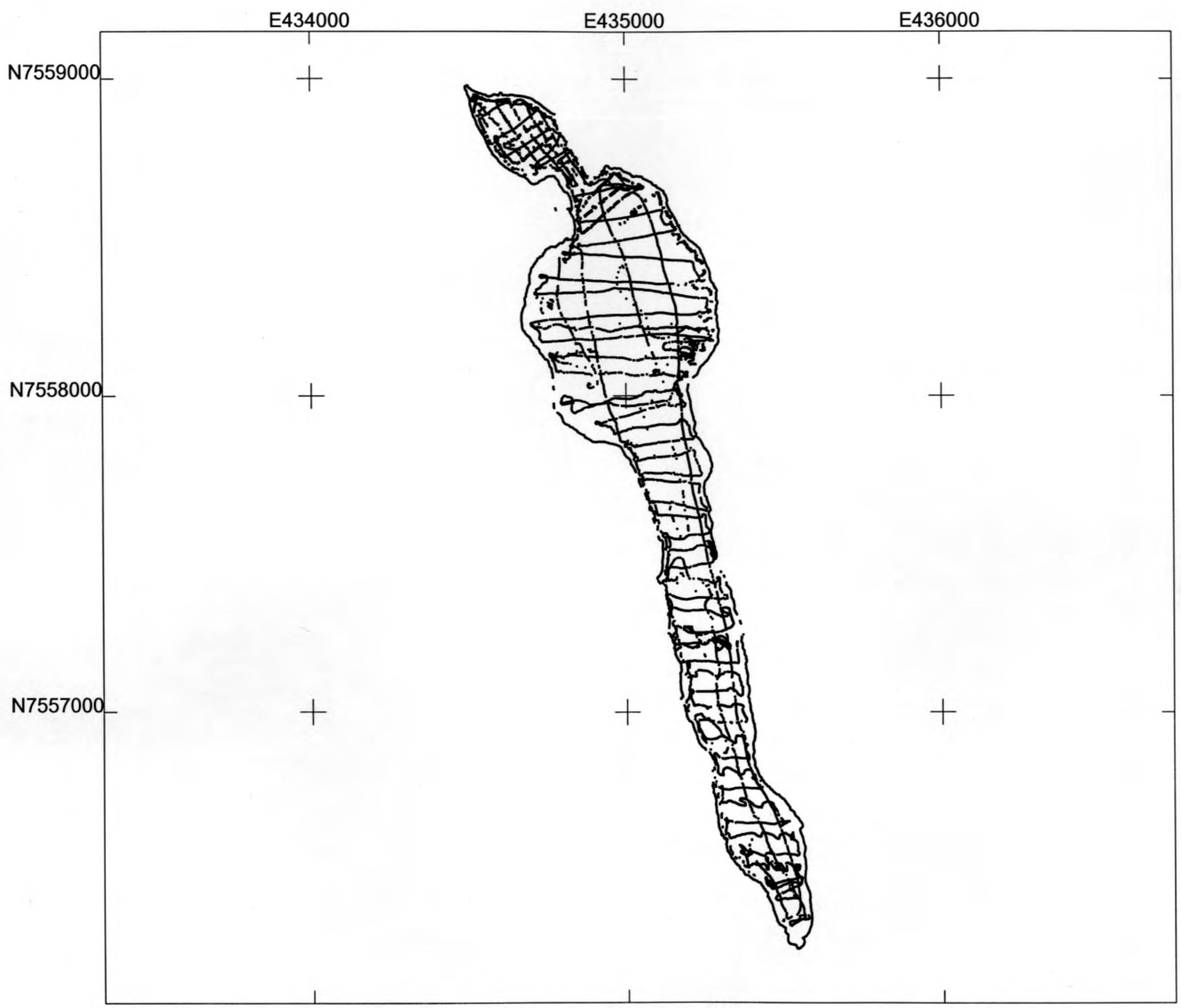

Navigational Route During Bathymetric Survey of Tail Lake, Hope Bay Belt, 2000

FIGURE 6.2-1

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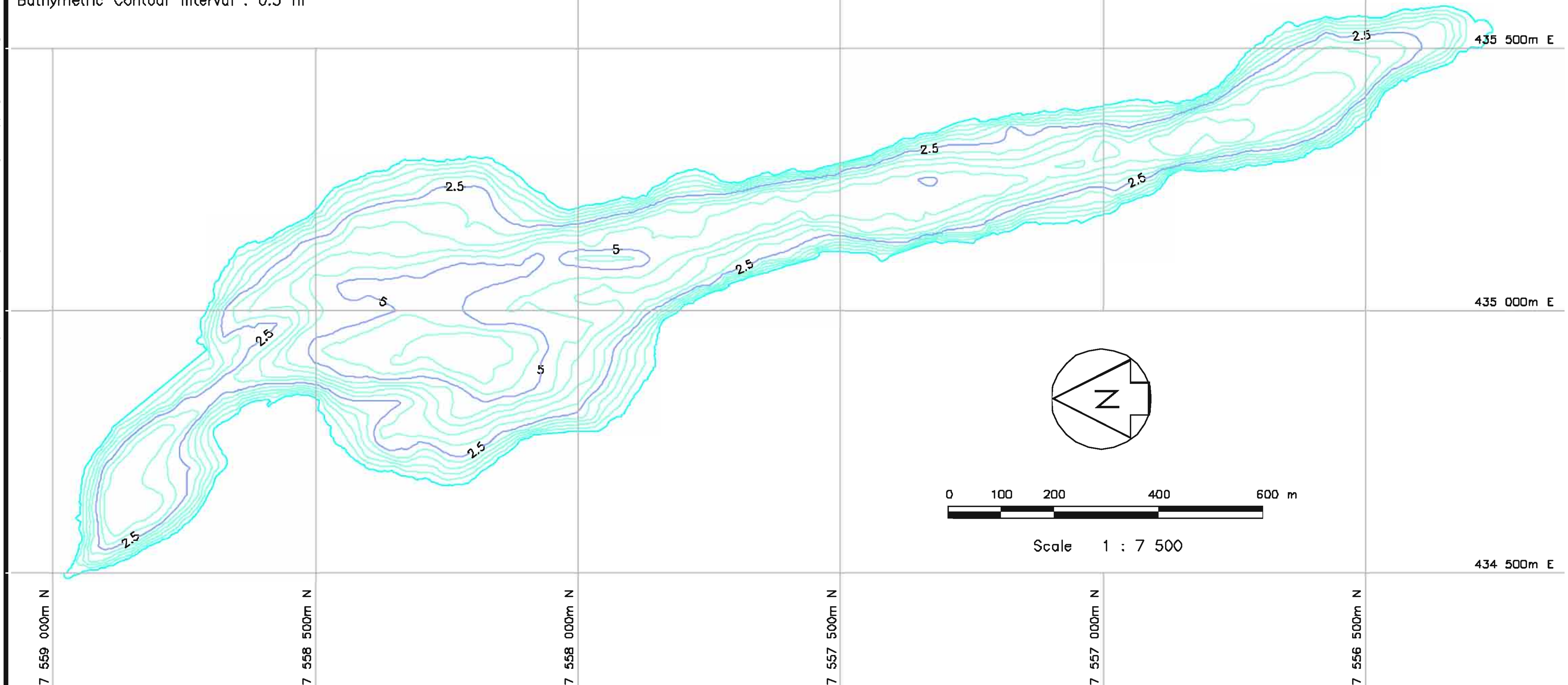
Lake Morphometry	
Max. Width	608.0 m
Length	2 914.0 m
Maximum depth	6.5 m
Area	766 300.0 m²
Volume	2 380 000.0 m³
Shoreline	6 923.0 m

Bathymetric Contour Interval : 0.5 m



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Hope Bay Joint Venture

Figure 6.2-2

Bathymetry of Tail Lake

Rescan™

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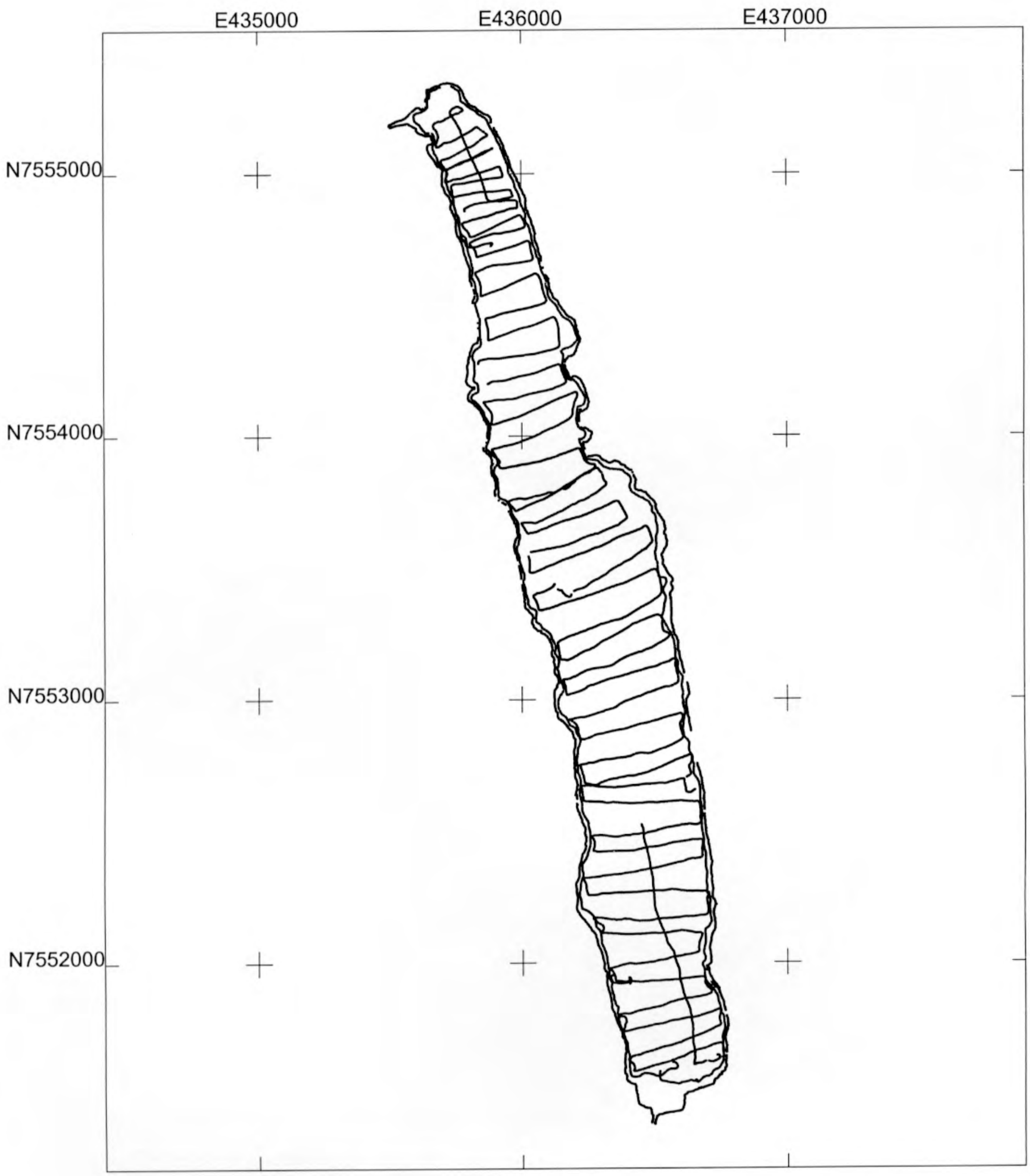

FIGURE 6.2-3

Navigational Route During Bathymetric Survey of Ogama Lake, Hope Bay Belt, 2000

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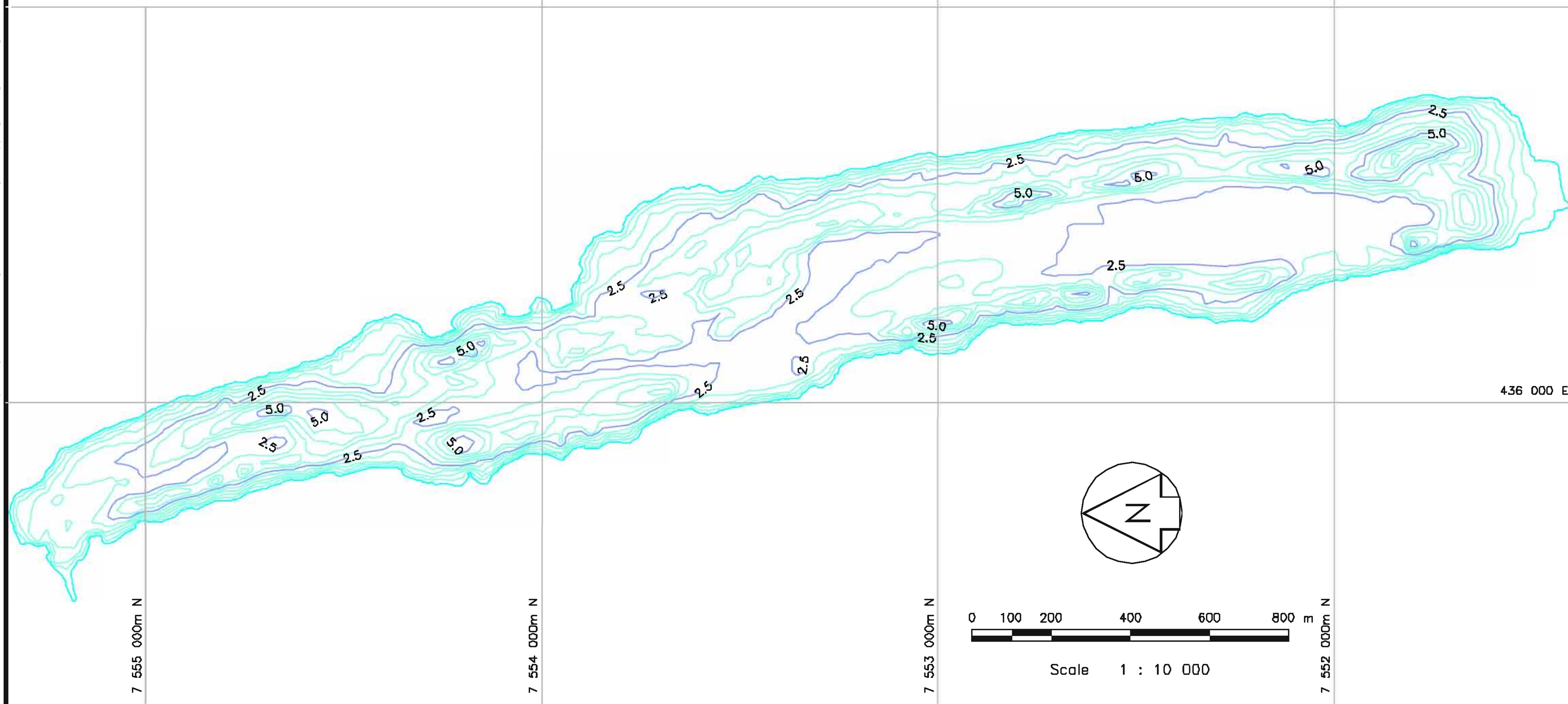
Lake Morphometry	
Max. Width	578.0 m
Length (l)	4 005.0 m
Maximum depth	7.4 m
Area	1 618 667.0 m²
Volume	4 209 800.0 m³
Shoreline	9 803.0 m

Bathymetric Contour Interval : 0.5 m



Cad No. C1234 Sht. 15 View C2 Job No. 583-1 Hope Bay Belt Gold Project Ref : Eagle Mapping – ogama.dwg 01/18/2001– 10:59am RES_BL

Hope Bay Joint Venture

Figure 6.2-4

Bathymetry of Ogama Lake

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7. PRIMARY PRODUCERS

7. PRIMARY PRODUCERS

This chapter presents the methods and results for the primary producer component of the supplemental environmental studies that were conducted in 2000.

Primary producers are organisms which can convert energy from sunlight into food. All other organisms within an aquatic ecosystem depend upon primary producers, directly or indirectly, for their energy. Primary producers are often monitored in aquatic ecosystems as changes often signal changing conditions within the ecosystem, especially changing water quality conditions. Primary producers in lakes that live free-floating within the water column are referred to as phytoplankton. The term periphyton refers to single-celled primary producers that live attached to substrates within streams. Secondary producers such as zooplankton and benthic invertebrates are the major consumers of phytoplankton and periphyton, respectively.

7.1 Lake Primary Producers-Phytoplankton

7.1.1 Methods

Phytoplankton samples were collected from Tail, Doris and Pelvic lakes during the 2000 open-water season (late July). All sampling locations are indicated on the map in Figure 1.2-2. Table 7.1-1 presents sampling locations and dates for all phytoplankton samples collected within the Hope Bay Belt property in 2000.

Table 7.1-1
Phytoplankton Sampling Locations and Dates, Hope Bay Belt, 2000

Lake	Date	Phytoplankton Biomass[1]	Phytoplankton Taxonomy[1]
Tail Lake	July 19, 2000	n=3	n=3
Doris Lake	July 24, 2000	n=3	n=3
Pelvic Lake	July 24, 2000	n=3	n=3

1: Triplicate samples were collected at 1 m depth.

Samples for phytoplankton biomass and taxonomic composition/enumeration were collected in triplicate in Tail, Pelvic, and Doris lakes. Samples were obtained using a 5 L Teflon-lined Go-Flo bottle, which was lowered and triggered closed at one metre depth after enough time for equilibration.

For phytoplankton biomass measurements as chlorophyll *a*, triplicate samples were collected at 1 m depth. Clean 1 L plastic bottles were filled from the Go-Flo bottle and kept cold and in the dark until returned to camp. Once in camp, samples were gently shaken and filtered onto 0.45 µm 47 mm diameter membrane filters. Filters were carefully folded in half, wrapped in aluminum foil, and frozen until analysis by the fluorometric method of Parsons *et al.* (1984b).

For taxonomic composition and enumeration samples, water from the Go-Flo bottle was transferred into clean 1 L plastic bottles and preserved with Lugol's iodine solution. Taxonomic samples were sent to Fraser Environmental Services for identification and enumeration. All phytoplankton samples collected in previous years were sent to Fraser Environmental Services.

Phytoplankton diversity indices were calculated as described in Appendix 7.1-1. The taxonomic level of genus was used in all calculations.

7.1.2 Results and Discussion

Average phytoplankton biomass values for the three lakes sampled are presented in Figure 7.1-1. Average phytoplankton biomass values ranged from 0.32 µg chl *a*/L (Tail Lake, July 19) to 4.67 µg chl *a*/L (Pelvic Lake, July 24). Doris Lake (July 24) had an average biomass value of 2.71 µg chl *a*/L.

Results from the identification and enumeration of phytoplankton samples are provided in Appendix 7.1-2. Figure 7.1-2 presents the average phytoplankton abundance measured for the three lakes sampled. Average phytoplankton abundances ranged from 175 (Tail Lake, July 19) to 63,973 cells/mL (Pelvic Lake, July 24). Doris Lake had an average abundance of 35,108 cells/mL.

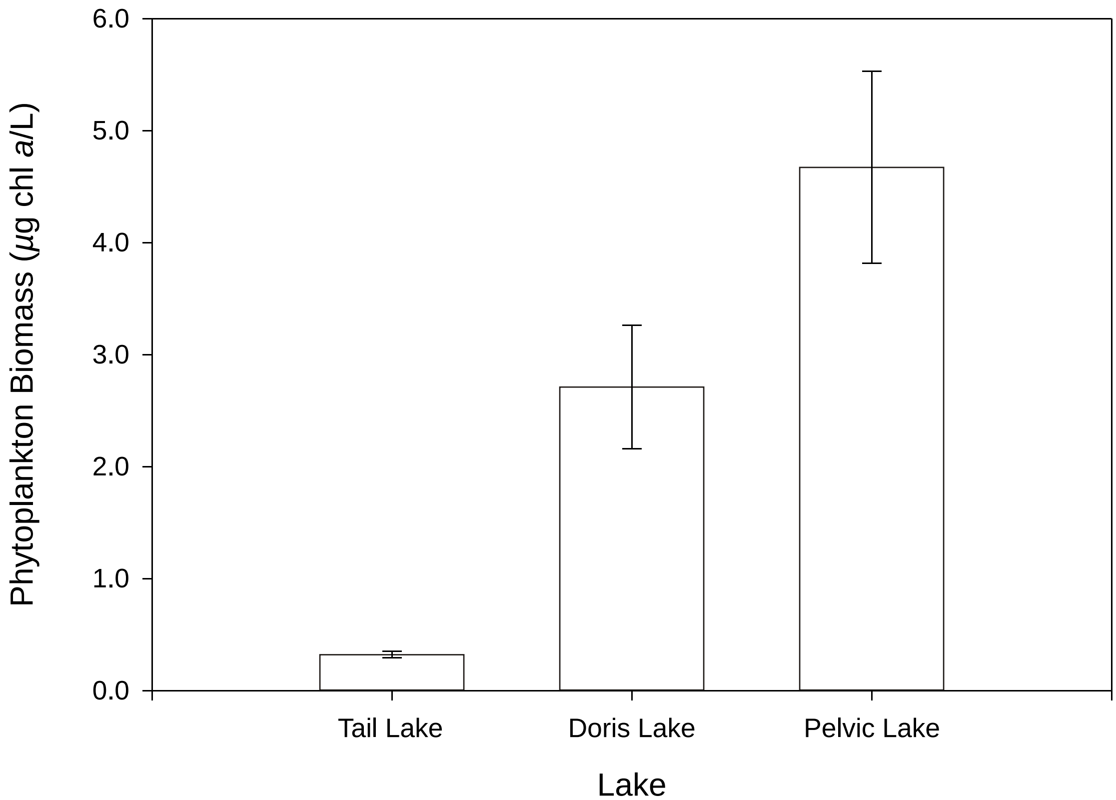
Figure 7.1-3 presents the average taxonomic composition by abundance of the assemblages sampled. The phytoplankton assemblages of both Doris and Pelvic lakes were dominated by Cyanophyta, with 99 and 98% of their respective assemblages being accounted for by this taxonomic group. The phytoplankton assemblage in Tail Lake was dominated by diatoms (Bacillariophyceae; 50 %) followed by chrysophytes (42%).

The general characteristics of the phytoplankton assemblages, including Shannon and Simpson diversity indices, are presented in Table 7.1-2. The average number of genera identified ranged from 7 (Tail and Doris lakes) to 8 (Pelvic Lake) genera. The average number of genera comprising 90% of the assemblage varied from 2 (Doris and Pelvic lakes) to 4 (Tail Lake). Shannon diversity indices ranged from 0.54 (Pelvic Lake) to 1.42 (Tail Lake). Simpson diversity indices ranged from 0.23 (Pelvic Lake) to 0.67 (Tail Lake).

Table 7.1-2
Average Diversity Indices for Phytoplankton Assemblages, Hope Bay Belt Lakes, July 2000

Lake	Date	G	G (90%)	Max. Dom (%)	Shannon Diversity Index	Simpson Diversity Index
Tail Lake	July 19, 2000	7	4	45.7	1.42	0.67
Doris Lake	July 24, 2000	7	2	75.2	0.77	0.40
Pelvic Lake	July 24, 2000	8	2	87.5	0.54	0.23

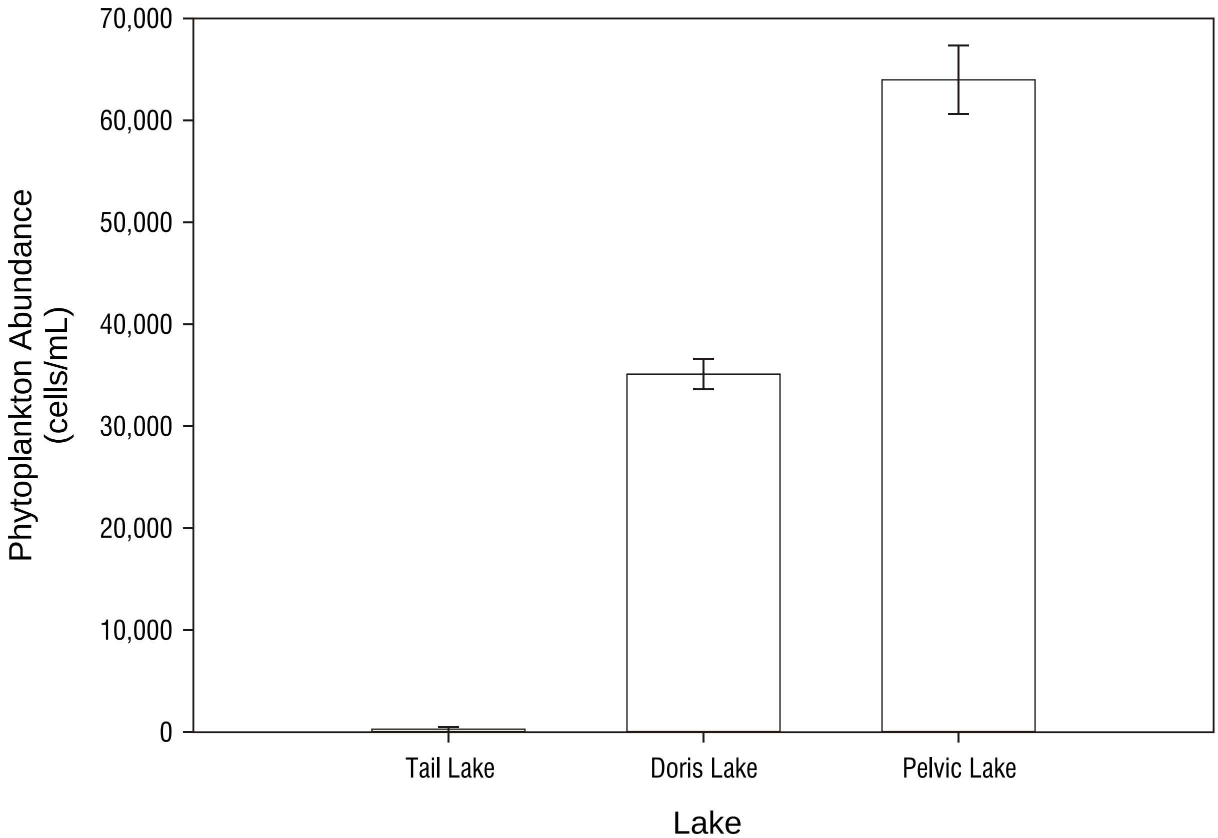
G: The number of genera per site
G (90%): The number of genera contributing to 90% of the abundance
Max. Dom.(%): The maximum dominance by abundance accounted for by a single genus



Note: Error bars represent standard error of the mean.

FIGURE 7.1-1

Average Phytoplankton Biomass, Hope Bay Belt Lakes, July 2000



Note: Error bars represent standard error of the mean.

FIGURE 7.1-2

Average Phytoplankton Abundance, Hope Bay Belt Lakes, July 2000

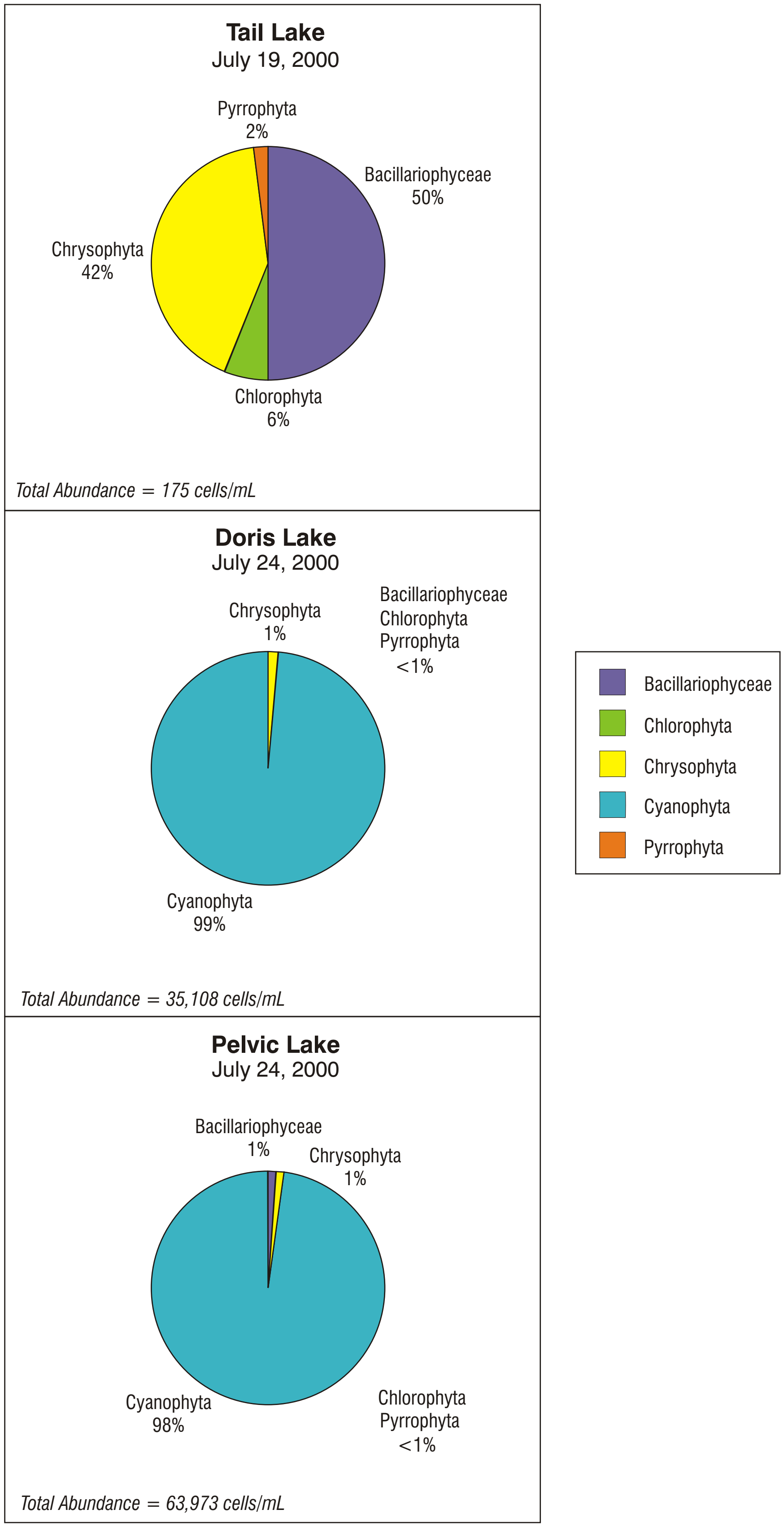


FIGURE 7.1-3

Average Taxonomic Composition of Phytoplankton Assemblages, Hope Bay Belt Lakes, July 2000

In general, phytoplankton biomass and abundance were high in Doris and Pelvic lakes relative to Tail Lake. These values were generally higher than values observed from similar Arctic lakes. The high abundance and biomass in Doris and Pelvic lakes was primarily due to high numbers of *Oscillatoria* sp. (Cyanophyta). While the total number of species observed in the lakes sampled was similar, diversity indices were much lower in Doris and Pelvic lakes as a result of dominance by this cyanobacteria. This cyanobacteria bloom suggests that nitrogen concentrations may have been the limiting nutrient in the lake, as many photosynthetic bacteria are capable of utilizing atmospheric nitrogen.

7.2 Stream Primary Producers-Periphyton

7.2.1 Methods

Stream periphyton samples were collected from Tail, Doris, and Pelvic outflows in 2000. All sampling locations are indicated on the map in Figure 1.2-2. Table 7.2-1 presents sampling locations and dates for all periphyton samples collected within the Hope Bay Belt property in 2000.

Periphyton biomass and taxonomic samples were obtained using Plexiglas plate artificial substrate samplers (100 cm^2). These samplers provide a uniform substrate for periphyton organisms to colonize, making it possible to compare periphyton assemblages between different stream sites.

Five samplers were placed at each stream site on the dates given in Table 7.2-1. To anchor the samplers, the Plexiglas plates were tied to rocks with fishing line. The samplers were then placed in as similar conditions as possible between sites (*i.e.* similar water flows, similar depth for light penetration, *etc.*). Flagging tape was attached to the fishing line on the downstream side to ensure efficient retrieval of the samplers approximately one month later. Three samplers were retrieved from each site.

Table 7.2-1
Periphyton Sampling Locations and Dates, Hope Bay Belt, 2000

Stream	Date of Plate Installation	Date of Plate Retrieval	Replication
Tail Outflow	July 19, 2000	August 16, 2000	n=3
Doris Outflow	July 22, 2000	August 16, 2000	n=3
Pelvic Outflow	July 22, 2000	August 16, 2000	n=3

Samples for biomass (as chlorophyll *a*) and taxonomic analysis were obtained from the same sampler. A known surface area was gently scraped into a plastic wide-mouth jar using distilled, deionized water (DDW) and a brush. DDW was added to keep the sample moist and in suspension. While still in the field, samples were gently shaken and filtered onto 0.45 µm 47 mm diameter membrane filters. Filters were carefully folded in half, wrapped in aluminum foil, and frozen until analysis by the fluorometric method of

Parsons *et al*. (1984b) by Analytical Service Laboratories. Values of chlorophyll *a* were normalized to surface area.

For taxonomy samples, single samples were collected from three samplers. A known surface area was gently scraped into a 500 ml plastic wide-mouth jar using DDW and a brush. Approximately 100 ml of DDW was added to keep the sample in suspension. Samples were preserved in Lugol's iodine solution and sent to Fraser Environmental Services for identification and enumeration.

Periphyton diversity indices were determined as described in Appendix 7.1-1. The taxonomic level of genus was used in the diversity calculations.

7.2.2 Results and Discussion

Average periphyton biomass values for the three streams sampled are presented in Figure 7.2-1. Average biomass values ranged from 0.31 (Tail Outflow) to 0.60 µg chl a/cm^2 (Pelvic Outflow). The average biomass value for Doris Outflow was 0.53 µg chl a/cm^2.

Results from the identification and enumeration of periphyton samples are provided in Appendix 7.2-1. Figure 7.2-2 presents the average periphyton density for the three streams sampled. Average periphyton densities ranged from 182,998 (Doris Outflow) to 493,492 cells/cm^2 (Tail Outflow). The average periphyton density at Pelvic Outflow was 252,467 cells/ cm^2.

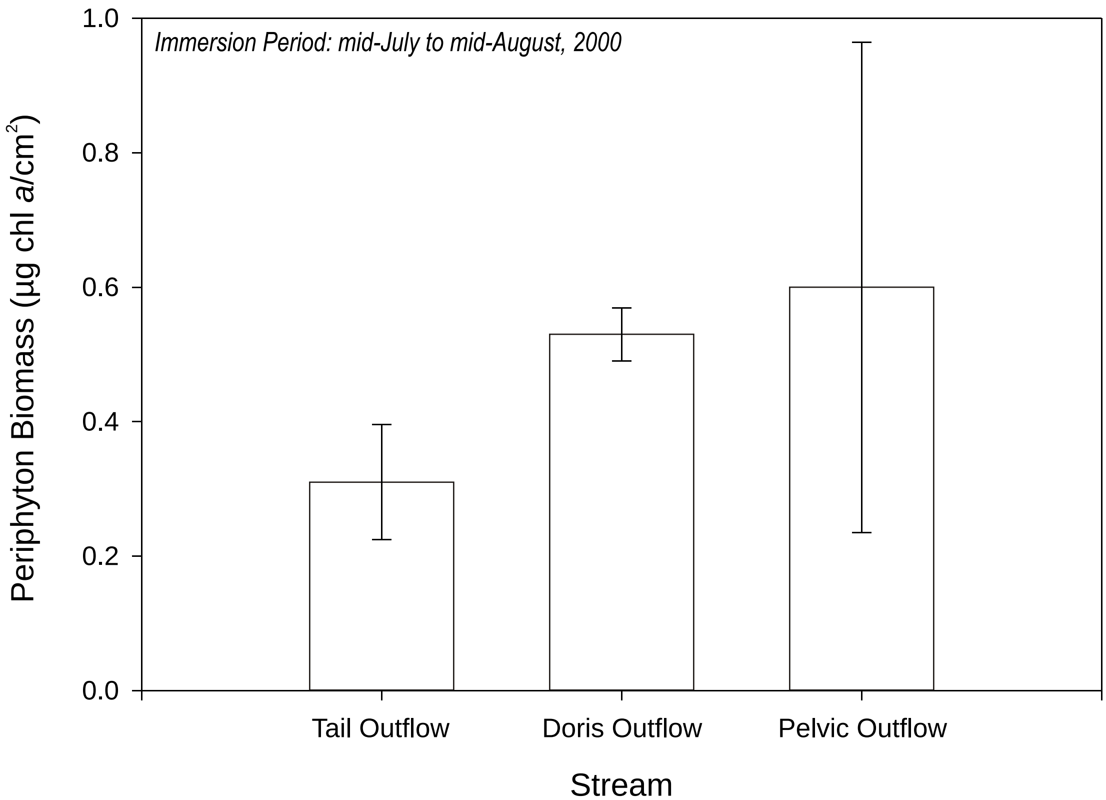
Figure 7.2-3 presents the average taxonomic composition by density of the periphyton assemblages samples. The assemblages at all three outflows were dominated by Bacillariophyceae (50 to 56%) and Cyanophyta (32 to 43%). Chlorophytes, chrysophytes, and dinoflagellates (Pyrrophyta) were also present in the assemblages.

The general characteristics of the periphyton assemblages, including Shannon and Simpson diversity indices, are presented in Table 7.2-2. The average number of genera identified ranged from 24 (Tail Outflow) to 31 (Doris Outflow). The average number of genera comprising 90% of the assemblage varied from 10 (Tail Outflow) to 11 (Doris and Pelvic outflows). Shannon diversity indices ranged from 2.17 (Pelvic Outflow) to 2.40 (Tail Outflow). Simpson diversity indices ranged from 0.79 (Pelvic Outflow) to 0.88 (Tail Outflow).

Table 7.2-2
Average Diversity Indices for Periphyton Assemblages, Hope Bay Belt Streams, August 2000

Stream	Date	G	G (90%)	Max. Dom (%)	Shannon Diversity Index	Simpson Diversity Index
Tail Outflow	August 16, 2000	24	10	20.2	2.40	0.88
Doris Outflow	August 16, 2000	31	11	24.5	2.38	0.86
Pelvic Outflow	August 16, 2000	27	11	38.5	2.17	0.79

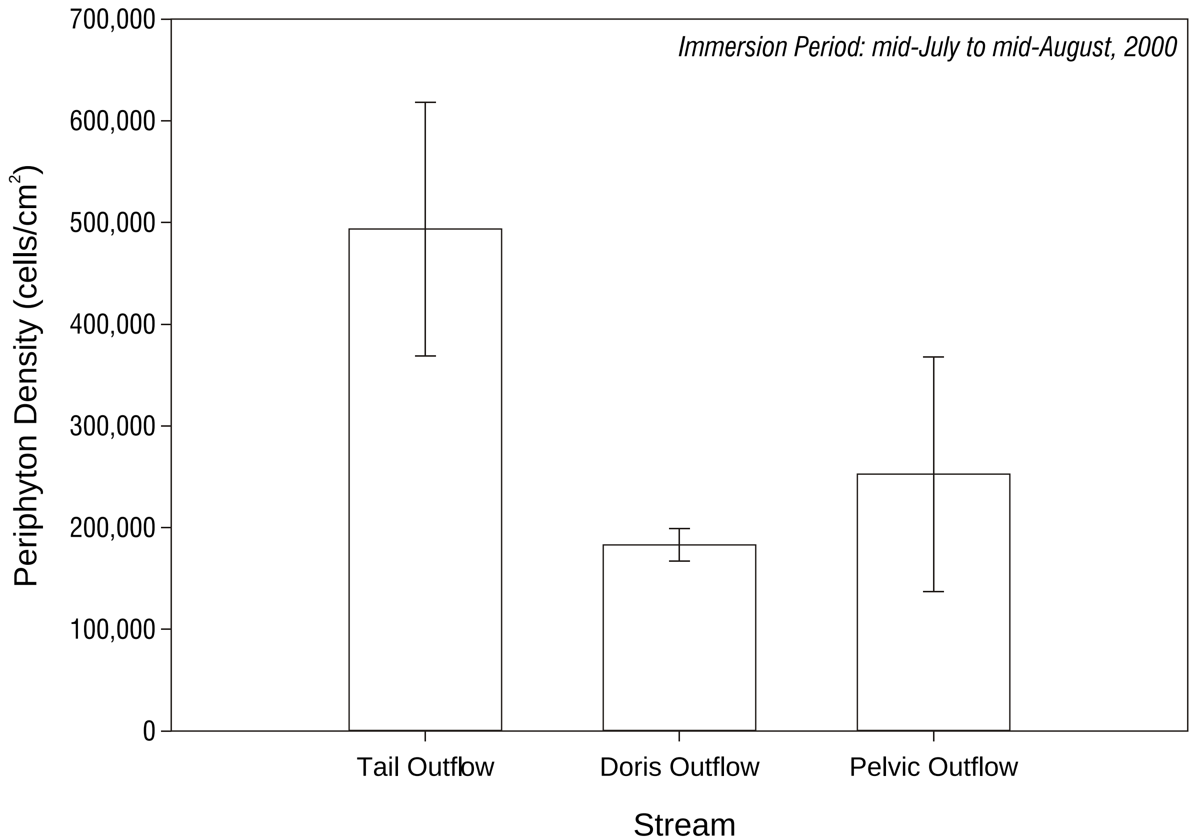
G: The number of genera per site. Date provided indicates date of retrieval.
G (90%): The number of genera contributing to 90% of the abundance
Max. Dom. (%): The maximum dominance by abundance accounted for by a single genus



Note: Error bar represents standard error of the mean.

FIGURE 7.2-1

Average Periphyton Biomass, Hope Bay Belt Streams, August 2000



Note: Error bars represent standard error of the mean.

FIGURE 7.2-2

Average Periphyton Density, Hope Bay Belt Streams, July 2000

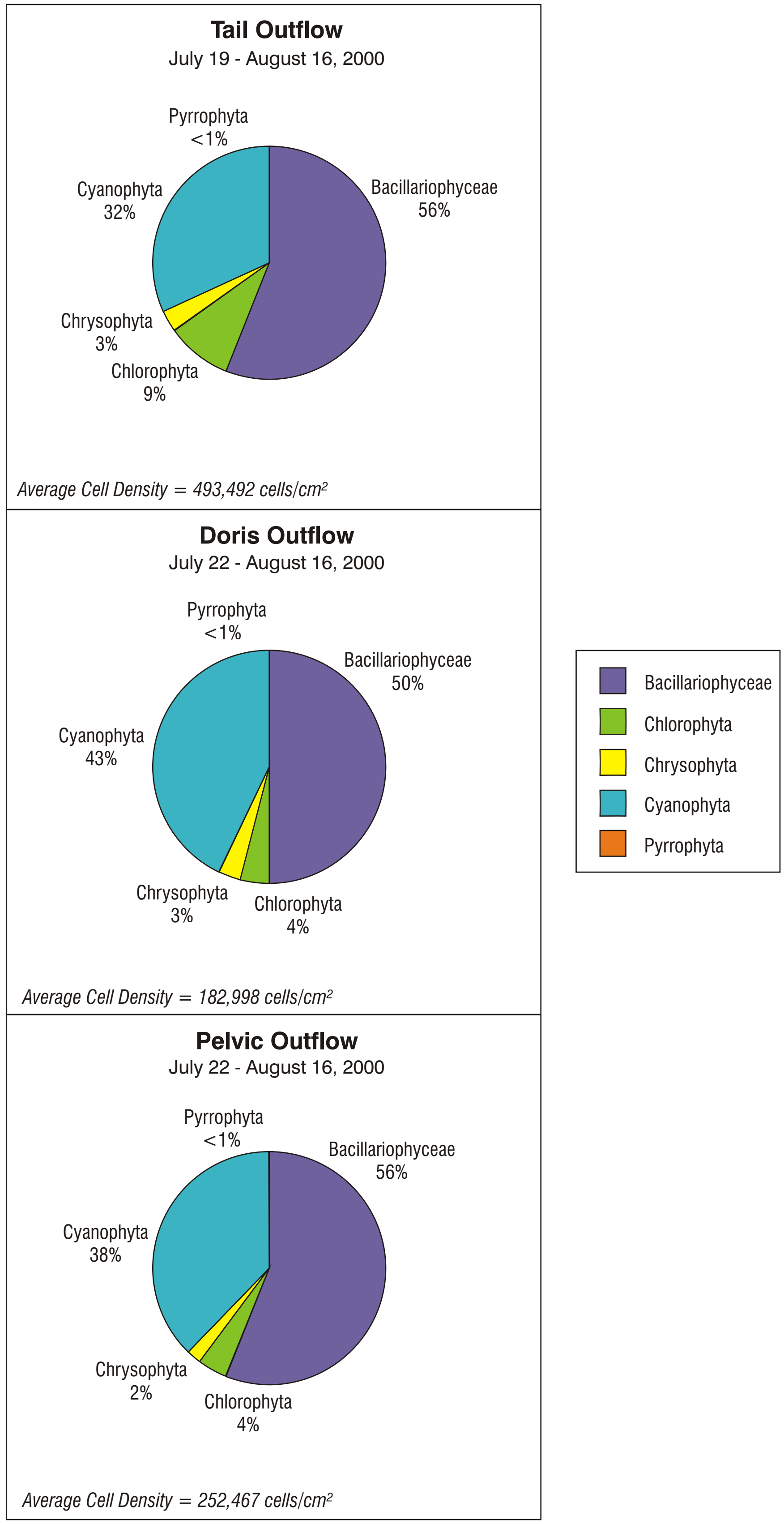


FIGURE 7.2-3

Average Taxonomic Composition of Periphyton Assemblages, Hope Bay Belt Streams, August 2000

Overall, periphyton biomass and density were similar among the outflows sampled during 2000, with similar taxonomic compositions. As is common with other Arctic streams, diatoms (Bacillariophyceae) and cyanobacteria (Cyanophyta) were the predominant taxa in periphyton assemblages. All of the sites sampled had a large number of genera resulting in very high diversity indices. These diverse periphyton assemblages likely support healthy, diverse secondary producer communities which, in turn, support fish communities.

8. SECONDARY PRODUCERS – FRESHWATER

8. SECONDARY PRODUCERS – FRESHWATER

This chapter presents the methods and results for the secondary producer component of the supplemental baseline studies carried out in 2000.

Secondary producers are organisms which feed on primary producers. For arctic aquatic ecosystems, there are two main groups of lake secondary producers (zooplankton, benthic invertebrates), and two main groups of stream secondary producers (drift organisms, benthic invertebrates). Zooplankton and drift organisms are microscopic animals which live free-floating in lakes and streams, and benthic invertebrates (benthos) are animals which live associated with sediments and other substrates.

8.1 Lake Secondary Producers – Zooplankton

Zooplankton are an important link between phytoplankton and fish in lake ecosystems. Zooplankton are the primary consumers of phytoplankton and, along with lake benthos, are the primary food source for many fish species.

8.1.1 Methods

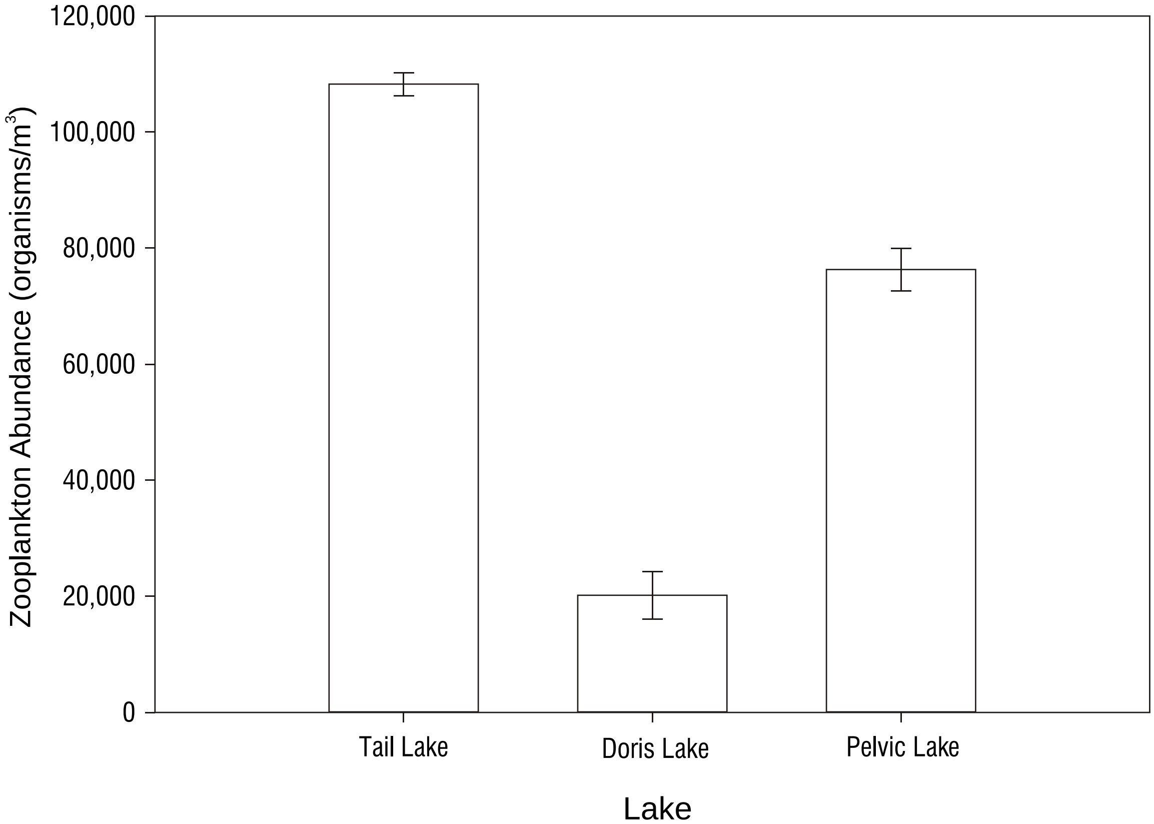
Samples for zooplankton were collected in triplicate from Tail, Doris and Pelvic lakes on the dates indicated in Table 8.1-1. All sampling locations are indicated on Figure 1.2-2. Samples were collected vertically over the deepest spot of the lake using a 0.3 m diameter 180 μm mesh net with a removable cod-end, equipped with an internally mounted flowmeter. For each haul, an initial flowmeter reading was recorded and the net lowered cod-end first to 1 m above the lake bottom. The net was then raised at a constant speed of 0.5 m/s until the net mouth was at the surface of the water. The flowmeter was immediately read and the value recorded on the field data sheet. Flowmeter readings were used to calculate the volume of water that passed through the net on each tow.

Table 8.1-1
Zooplankton Sampling Locations and Dates, Hope Bay Belt, 2000

Lake	Sampling Date	Zooplankton Taxonomy[1]
Tail Lake	July 19, 2000	n=3
Doris Lake	July 19, 2000	n=3
Pelvic Lake	July 19, 2000	n=3

1: Triplicate vertical hauls were collected.

The contents of the cod-end were transferred into a clean, 500 ml wide mouth plastic jar. Buffered formalin was then added to a final concentration of 5% by volume. Sample jars were closed and agitated gently. Preserved zooplankton samples were sent to Applied Technical Services for identification and enumeration. Shannon and Simpson diversity indices were calculated using the methods outlined in Appendix 7.1-1.



Note: Error bars represent standard error of the mean.

FIGURE 8.1-1

Average Zooplankton Abundance, Hope Bay Belt Lakes, July 2000

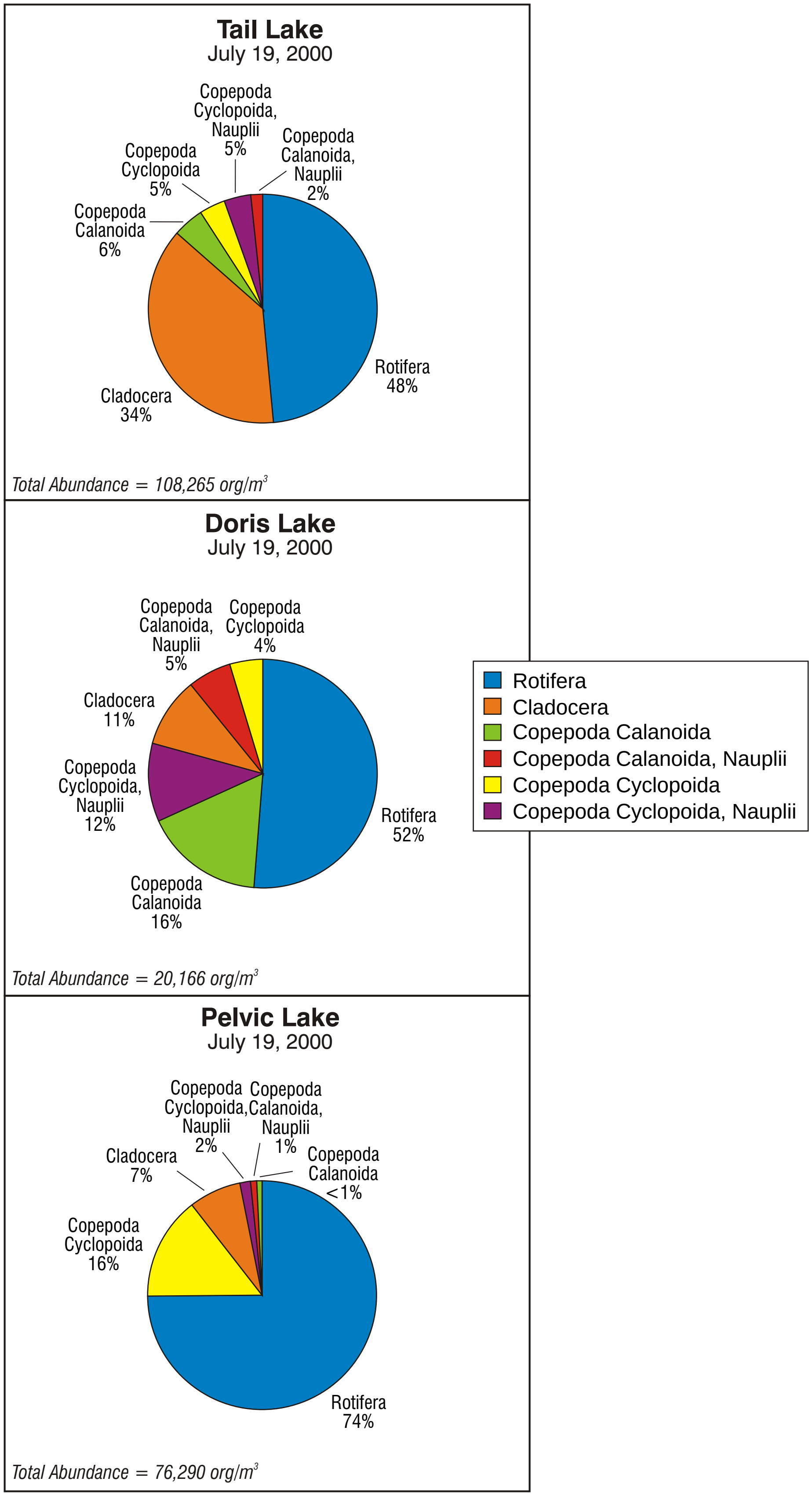


FIGURE 8.1-2

Average Taxonomic Composition of Zooplankton Assemblages, Hope Bay Belt Lakes, July 2000

8.1.2 Results and Discussion

Taxonomic results of zooplankton assemblages in the three lakes surveyed are presented in Appendix 8.1-1. Total average zooplankton abundance is presented in Figure 8.1-1.

Average zooplankton abundance ranged from 20,166 (Doris Lake) to 108,265 organisms/m^3 (Tail Lake). Tail Lake had a higher average zooplankton abundance as compared to Doris and Pelvic lakes, and Doris Lake had a lower average zooplankton biomass as compared to Tail and Pelvic lakes.

The taxonomic composition of the three assemblages sampled are presented in Figure 8.1-2. In general, rotifers dominated zooplankton assemblages in all three lakes on July 19, 2000, ranging from 48% (Tail Lake) to 74% (Pelvic Lake). This was due primarily to the presence of large numbers of *Kellicottia longispina*. Other groups present in significant numbers included Cladocera (7% in Pelvic Lake to 34% in Tail Lake), Copepoda Cyclopoida (nauplii and adults; 10% in Tail Lake to 18% in Pelvic Lake), and Copepoda Calanoida (nauplii and adults; 1% in Pelvic Lake to 20% in Doris Lake).

Shannon and Simpson diversity indices were calculated for each of the replicate zooplankton samples collected. Average diversity indices are presented in Table 8.1-2.

Table 8.1-2
Average Diversity Indices for Zooplankton Samples, Hope Bay Belt Lakes, July 2000

Lake	Date	G	G (90%)	Max. Dom. (%)	Shannon Diversity Index	Simpson Diversity Index
Tail Lake	July 19, 2000	9	4	54.6	1.31	0.62
Doris Lake	July 19, 2000	7	3	54.8	1.22	0.61
Pelvic Lake	July 19, 2000	8	3	66.9	1.05	0.52

G: The number of genera per site
G (90%): The number of genera contributing to 90% of the abundance
Max. Dom. (%): The maximum dominance by abundance accounted for by a single genus

Zooplankton assemblages were comprised of between seven and nine genera (Doris and Tail lakes, respectively) with three to four genera contributing to 90% of the abundance. Diversity indices were similar among the three lakes sampled. The average Shannon diversity index ranged from 1.05 (Pelvic Lake) to 1.31 (Tail Lake) while the average Simpson diversity index ranged from 0.52 (Pelvic Lake) to 0.62 (Tail Lake).

In general, while the taxonomic composition and diversity of the three lakes sampled in July were similar, total zooplankton abundances were different among all three lakes. This may potentially be the result of differing food sources (phytoplankton) or predation pressure (fish) among the lakes sampled.

8.2 Lake Secondary Producers – Lake Benthos

Lake benthos, along with zooplankton, represent the secondary producers in lake ecosystems. Lake benthos consume phytoplankton and detritus and, along with zooplankton, are a primary food source for many fish.

8.2.1 Methods

Lake benthos samples were collected from Tail, Doris and Pelvic lakes during July, 2000 (Table 8.2-1) at three depth strata; shallow (0.0-5.0 m), mid (5.1-10.0 m) and deep (>10.1 m; Doris and Pelvic lakes only). Sampling locations can be found in Figure 1.2-2. Samples were collected in triplicate using a 0.0225 m^2 Ekman grab sampler. At each depth, the Ekman grab sampler was opened and lowered gently into the lake sediment using a metered line. A messenger was then used to close the Ekman's spring-loaded jaws. The Ekman sampler was raised to the surface, and a sieve net placed underneath the Ekman. The sample was checked for acceptability and then sieved through a 500 µm sieve net by gentle agitation. The remaining material and organisms were transferred to a clean 500 ml plastic wide mouth jar. Buffered formalin was added to a final concentration of 10% by volume for fixation and preservation of the sample. Sample jars were closed and agitated gently. All lake benthos samples were sent to Applied Technical Services for identification and enumeration. Shannon and Simpson diversity indices were calculated for the dipteran community (generally the taxonomically dominant grouping in lake benthos) using the methods outlined in Appendix 7.1-1.

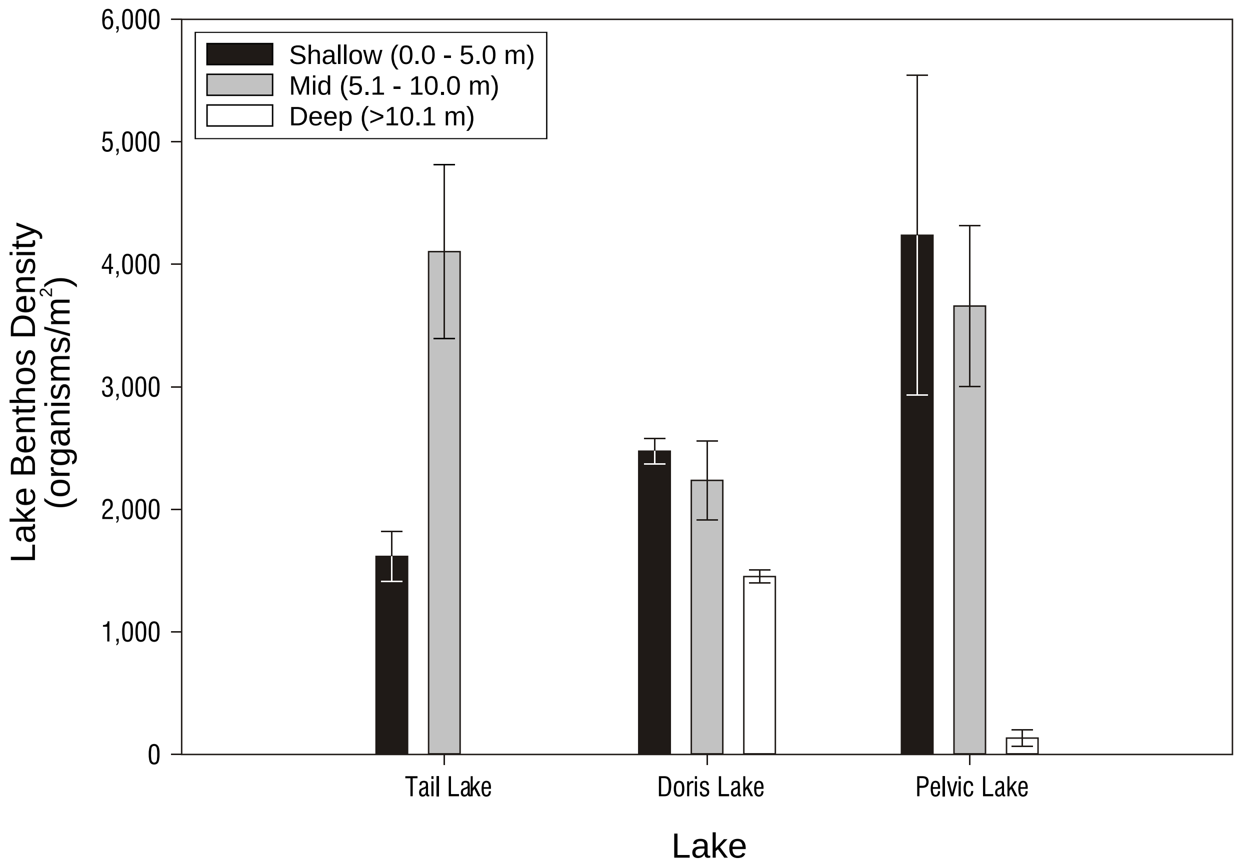
Table 8.2-1
Lake Benthos Sampling Locations and Dates, Hope Bay Belt, 2000

Lake	Sampling Date	Shallow (0.0 – 5.0 m)	Mid (5.1 – 10.0 m)	Deep (>10.1 m)
Tail Lake	July 19, 2000	n=3	n=3	
Doris Lake	July 24, 2000	n=3	n=3	n=3
Pelvic Lake	July 24, 2000	n=3	n=3	n=3

8.2.2 Results and Discussion

Taxonomic results for lake benthos are presented in Appendix 8.2-1. Average lake benthos densities are presented graphically in Figure 8.2-1.

In general, lake benthos density in the three lakes sampled was greatest in the shallow depth stratum (0.0 to 5.0 m) and lowest at the deep depth stratum (>10.1 m). At shallow depths, average lake benthos densities ranged from 1,615 (Tail Lake) to 4,237



Notes: Error bars represent standard error of the mean.

FIGURE 8.2-1

Average Lake Benthos Density, Hope Bay Belt Lakes, July 2000

organisms/m^2 (Pelvic Lake). Mid depth lake benthos densities ranged from 2,237 (Doris Lake) to 4,104 organisms/m^2 (Tail Lake). Finally, deep depth lake benthos densities ranged from 133 (Pelvic Lake) to 1,452 organisms/m^2 (Doris Lake). There was no deep depth stratum in Tail Lake.

The average taxonomic composition of the lake benthos communities for the three lakes sampled in July are presented graphically in Figure 8.2-2. By far, the most dominant group at all depths was the Diptera, ranging from 42% (Tail Lake – Shallow) to 95% (Doris Lake – Deep and Pelvic Lake – Shallow). There was no predominance of one genera or species of Diptera. The next most prevalent taxon was Mollusca (0% in Pelvic Lake – Deep to 36% in Doris Lake – Shallow). Overall, Pelvic Lake had the least number of taxa, ranging from three (deep and mid depth) to four (mid depth) taxonomic groupings, while Tail Lake had the greatest number of taxa, ranging from seven (mid depth) to ten (shallow depth) taxonomic groupings.

Results for average dipteran Shannon and Simpson diversity indices are presented in Table 8.2-2. The average number of dipteran genera in the lakes sampled ranged from one (Doris – deep) to six (Tail – mid and Doris – shallow). The number of genera contributing to 90% of the abundance ranged from one (Doris – deep) to five (Doris – shallow). Maximum dominance of a single genus ranged from 39.1% (Doris – shallow) to 98.8% (Doris – deep).

Table 8.2-2
Average Dipteran Diversity Indices for Lake Benthos Communities, Hope Bay Belt Lakes, July 2000

Lake	Date	G	G (90%)	Max. Dom. (%)	Shannon Diversity Index	Simpson Diversity Index
Tail – Shallow	July 19, 2000	5	4	53.2	1.25	0.64
Tail – Mid	July 19, 2000	6	4	59.9	1.17	0.58
Doris – Shallow	July 24, 2000	6	5	39.1	1.54	0.74
Doris – Mid	July 24, 2000	5	3	48.6	1.16	0.61
Doris – Deep	July 24, 2000	1	1	98.8	0.05	0.02
Pelvic – Shallow	July 24, 2000	5	3	55.5	1.10	0.58
Pelvic – Mid	July 24, 2000	6	4	48.4	1.29	0.65
Pelvic – Deep	July 24, 2000	2	2	41.7	0.46	0.25

G: The number of genera per site
G (90%): The number of genera contributing to 90% of the density
Max. Dom. (%): The maximum dominance by density accounted for by a single genus
Shallow = 0.0 - 5.0 m; Mid = 5.1 - 10.0 m; Deep >10.1 m

Shannon and Simpson diversity indices were similar among all lakes sampled at the shallow and mid depth strata, but appeared to be much lower at the deep depth stratum. Average Shannon diversity indices ranged from 0.05 (Doris – deep) to 1.54 (Doris – shallow). Average Simpson diversity indices ranged from 0.02 (Doris – deep) to 0.74 (Doris – shallow).

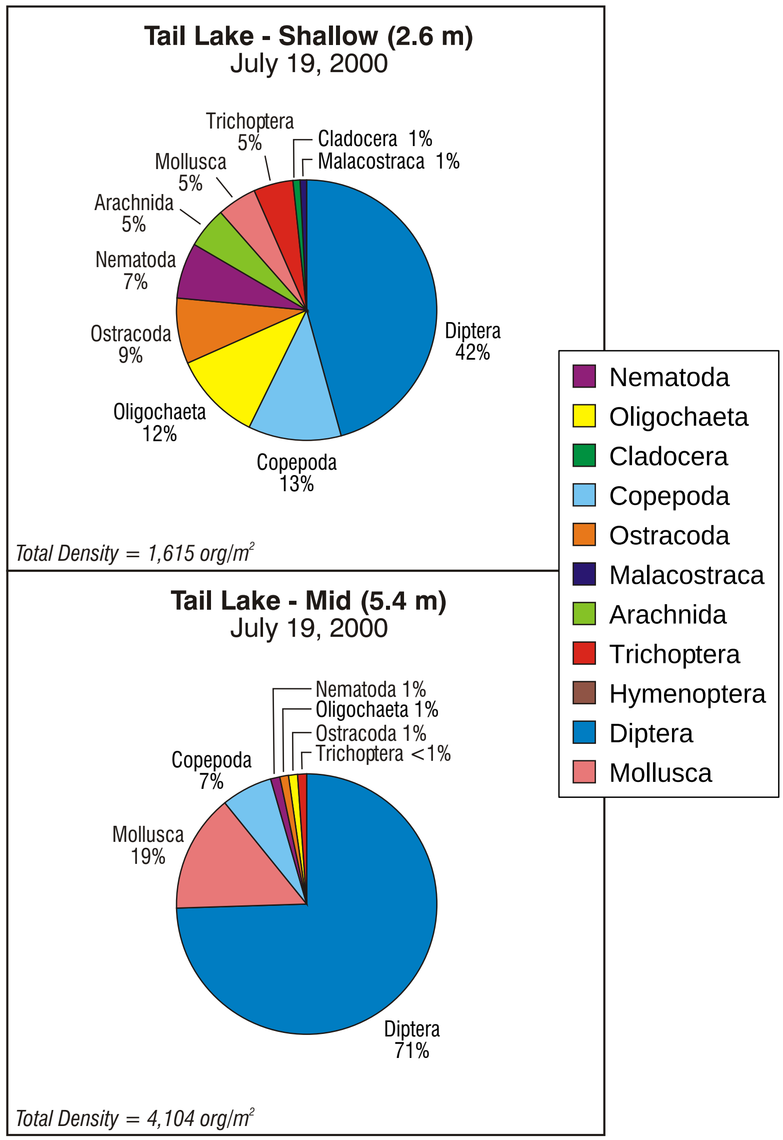


FIGURE 8.2-2a

Average Taxonomic Composition of Lake Benthos Communities, Hope Bay Belt Lakes, July 2000

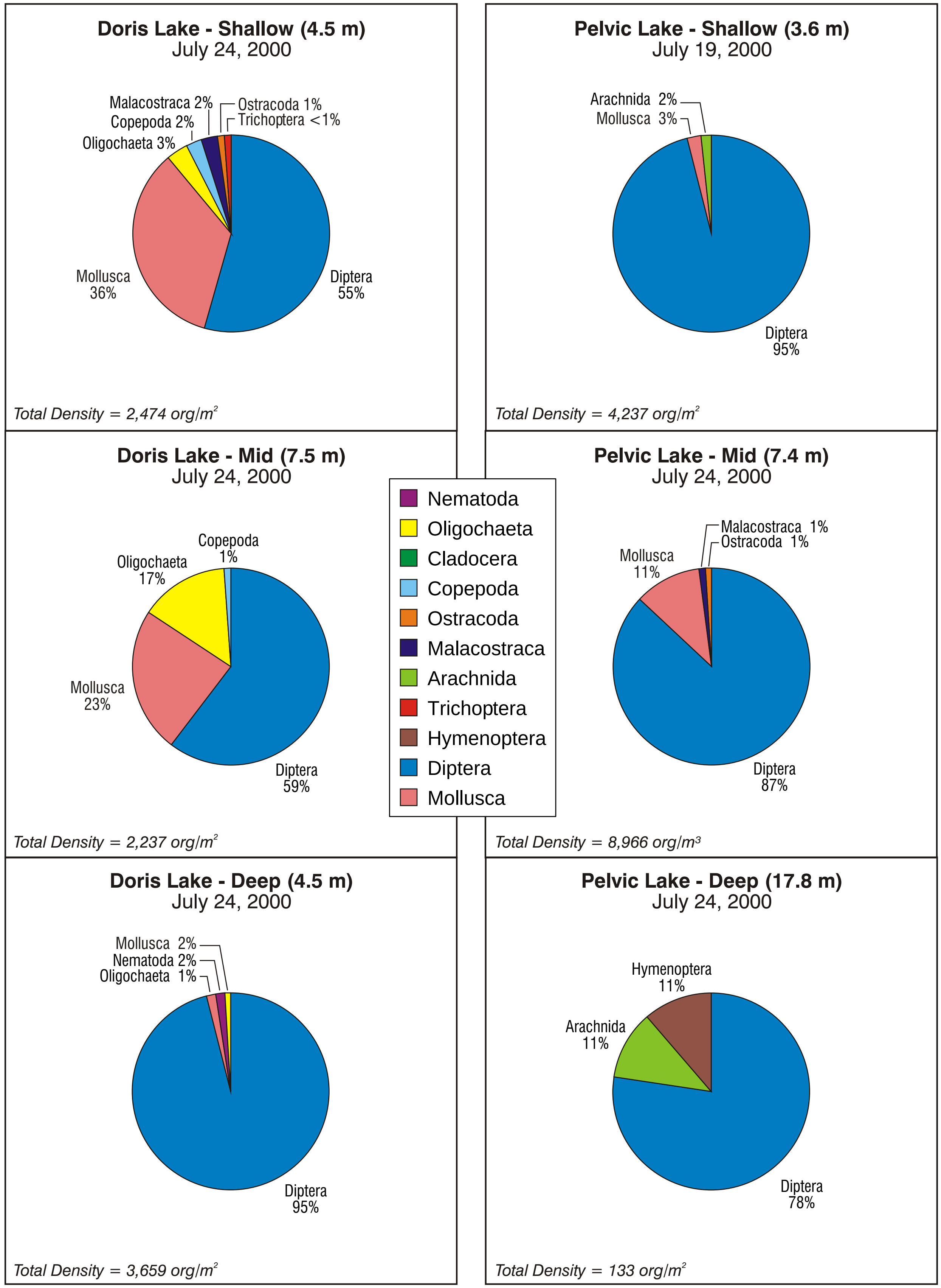


FIGURE 8.2-2b

Average Taxonomic Composition of Lake Benthos Communities, Hope Bay Belt Lakes, July 2000

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Overall, lake benthos densities were similar for all lakes sampled, with significantly higher densities at shallow and mid depths as compared to deep depths. As with density, dipteran diversity was lowest at deep depths and higher at shallow and mid depths. The lake benthos communities in the lakes sampled were composed primarily of Diptera with the greatest number of taxonomic groupings in Tail Lake followed by Doris Lake and finally Pelvic Lake.

8.3 Stream Secondary Producers – Drift Organisms

Drift organisms in combination with stream benthos, comprise the secondary producers in stream ecosystems. Drift organisms are one of the major consumers of periphyton and are a major food source for many fish. Drift organisms include all organisms which do not secure themselves to the stream substrate, or purposely allow themselves to drift in search of food and shelter. For this report, drift organisms included not only invertebrates, but small fish such as the nine-spine stickleback (*Pungitius pungitius*).

8.3.1 Methods

Samples for drift organisms were collected in triplicate from Tail, Doris and Pelvic outflows during July, 2000 (Table 8.3-1). The locations of all stream samples are indicated in Figure 1.2-2. Samples were collected using 500 µm mesh nets with removable cod-ends attached to 0.135 m^2 frames. The drift samplers were secured to the stream bed with the open ends facing upstream. Nets were completely submerged for a known period (24 hours). At both the start and end of the net submersion, four flow measurements were taken across the width of the net. These flow measurements were averaged to estimate the volume of water that passed through the nets.

Table 8.3-1
Drift Organism Sampling Locations and Dates, Hope Bay Belt, 2000

Stream	Immersion Dates	Number of Replicates
Tail Outflow	July 19 to July 20, 2000	3
Doris Outflow	July 22 to July 23, 2000	3
Pelvic Outflow	July 22 to July 23, 2000	3

After 24 hours, cod-ends were removed and samples transferred into labeled 500 mL plastic wide mouth jars. Buffered formalin was added as a preservative and fixative to a final concentration of 5%. Samples were sent to Applied Technical Services for identification and enumeration. Shannon and Simpson diversity indices were calculated using the methods described in Appendix 7.1-1.

8.3.2 Results and Discussion

Taxonomic results for drift organisms collected from the three streams are presented in Appendix 8.3-1. Average drift organism abundance for the three outflows is presented in Figure 8.3-1.

Average drift organism abundance ranged from 5,392 organisms/10,000 m^3 in Tail Outflow to 53,889 organisms/10,000 m^3 in Doris Outflow. Abundance was similar in Pelvic Outflow (45,847 organisms/10,000 m^3) as compared to Doris Outflow. The higher abundance in Doris and Pelvic outflows was due primarily to the presence of large numbers of zooplankton Cladocera and Copepoda. However, the relatively shallow depths and low flow in Tail Outflow are likely not conducive to the support of large drift organism populations.

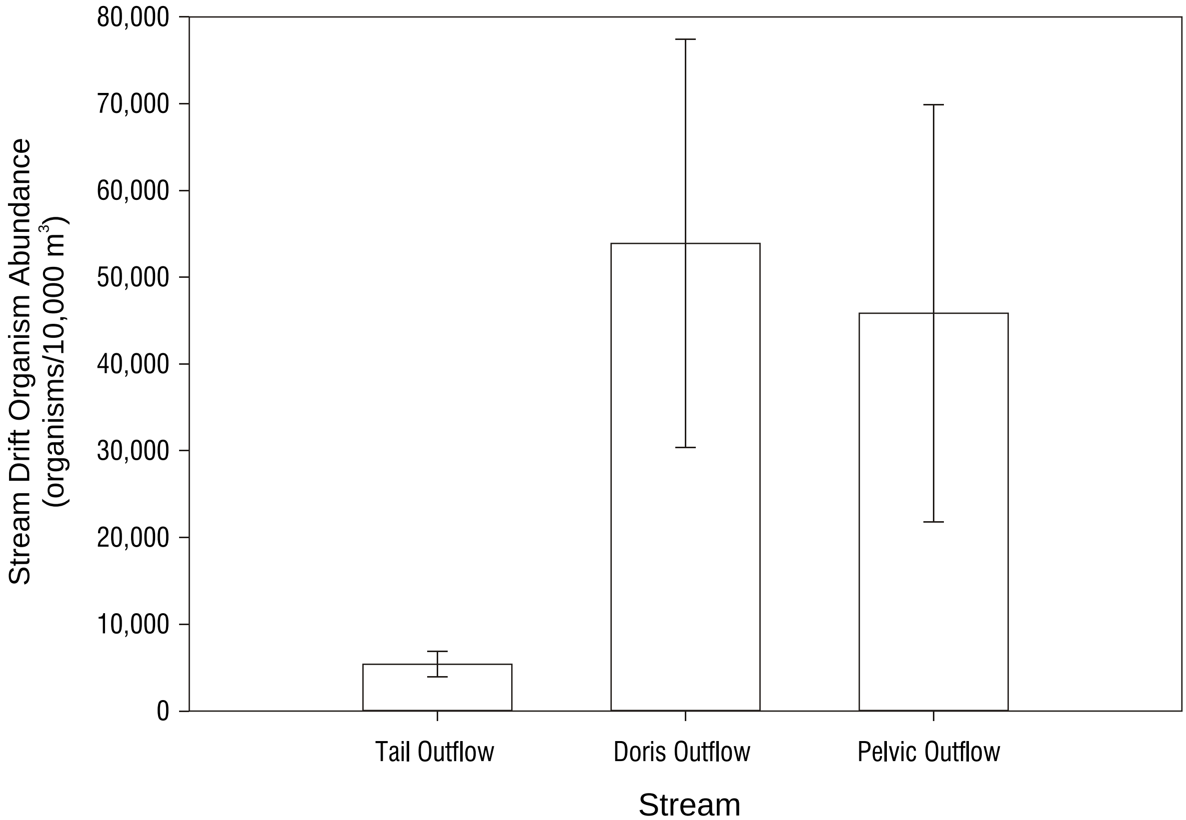
Taxonomic composition of the drift organism assemblages for the three streams sampled are presented in Figure 8.3-2. The taxonomic composition of the three streams varied greatly. Tail Outflow was dominated by Diptera (84%) followed by Ostracoda (7%). Doris Outflow was comprised almost entirely of zooplankton Cladocera (51%) and zooplankton Copepoda (46%), with only a small percentage of Diptera (2%). Finally, Pelvic Outflow was comprised primarily of zooplankton Cladocera (74%), Diptera (19%) and Arachnida (7%).

The differences in taxonomic composition likely reflected differences in stream morphology. Tail Outflow is very shallow with minimal water flow while Doris and Pelvic outflows are wider, deeper and relatively fast flowing. The stream bottom at Pelvic Outflow was composed primarily of large boulders and cobble while Doris Outflow was more sandy and silty.

Average dipteran diversity indices for the three streams sampled are presented in Table 8.3-2. The average number of genera per site ranged from nine (Tail and Doris outflows) to ten (Pelvic Outflow) while the number of genera that comprised 90% of the abundance ranged from three (Doris Outflow) to four (Tail and Pelvic Outflow). No one genera dominated the dipteran community, as is reflected in the maximum dominance values which ranged from 33.0% in Pelvic Outflow to 67.6% in Doris Outflow.

The Shannon diversity index ranged from 0.98 (Doris Outflow) to 1.59 (Pelvic Outflow) while the Simpson diversity index ranged from 0.49 (Doris Outflow) to 0.76 (Pelvic Outflow). In general, diversity indices were similar among all sites sampled with relatively little variability around the mean. This low variability indicated that the same genera were found in similar numbers in each of the three replicates per site sampled.

Overall, drift organism abundance was similar in Doris and Pelvic outflows while being much lower in Tail Outflow. At all three sites, there was a great deal of variability in drift organism abundance, potentially a result of relatively low, patchy abundance. The taxonomic composition of drift organism assemblages was very different for the three



Note: Error bars represent standard error of the mean.

FIGURE 8.3-1

Average Drift Organism Abundance, Hope Bay Belt Streams, July 2000

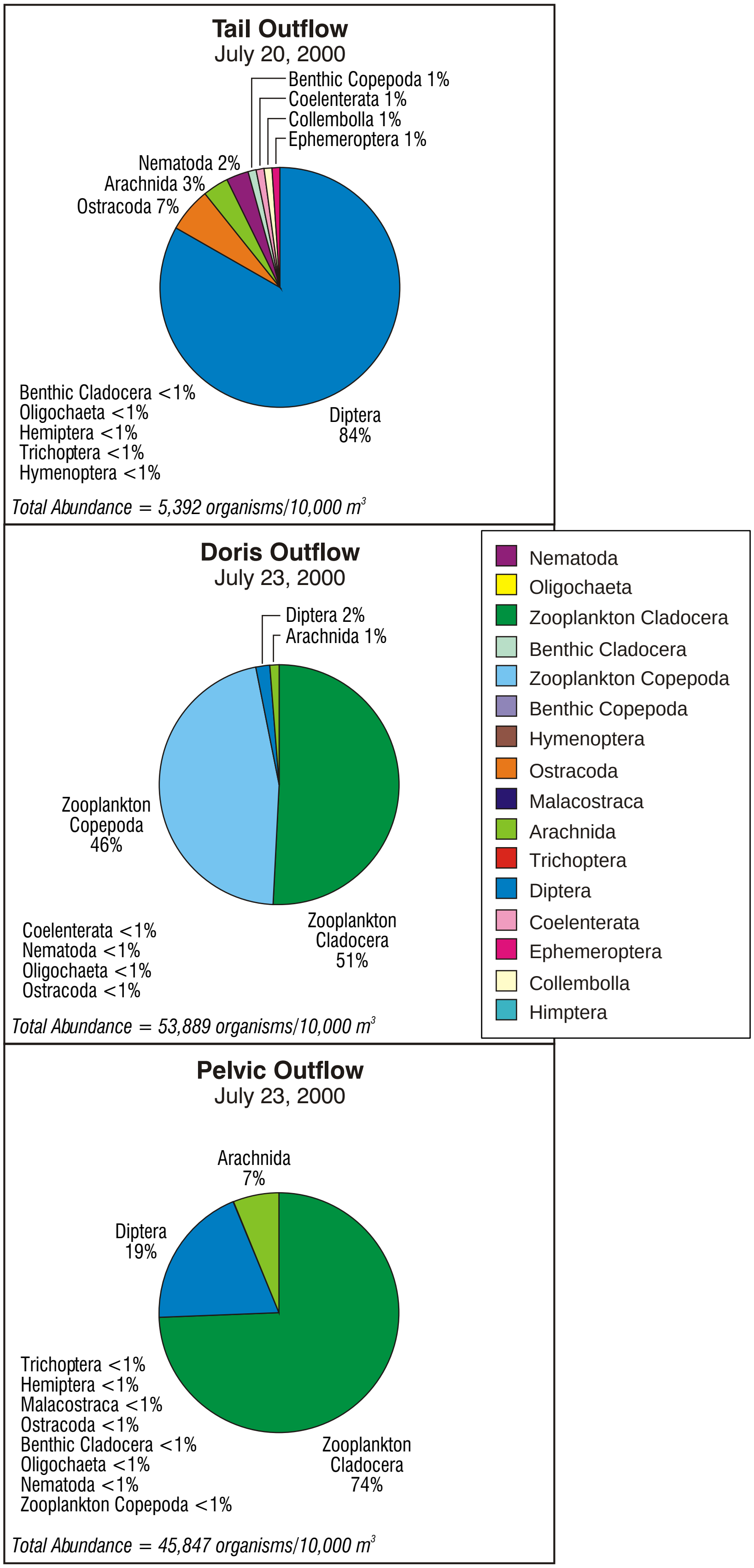


FIGURE 8.3-2

Taxonomic Composition of Drift Organism Assemblages, Hope Bay Belt Streams, July 2000

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Table 8.3-2
Average Dipteran Diversity Indices for Drift Organism Assemblages, Hope Bay Belt Streams, July 2000

Stream	Date	G	G (90%)	Max. Dom. (%)	Shannon Diversity Index	Simpson Diversity Index
Tail Outflow	July 20, 2000	9	4	49.1	1.41	0.66
Doris Outflow	July 23, 2000	9	3	67.6	0.98	0.49
Pelvic Outflow	July 23, 2000	10	4	33.0	1.59	0.76

G: The number of genera per site
G (90%): The number of genera contributing to 90% of the abundance
Max. Dom. (%): The maximum dominance by abundance accounted for by a single genus

sites, likely a reflection of varied habitat. Finally, dipteran diversity indices were quite similar for all three sites. Both abundance and diversity indices were somewhat lower as compared to drift organism assemblages from other northern streams.

8.4 Stream Secondary Producers – Stream Benthos

Along with drift organisms, stream benthos comprise the major consumers of primary producers in streams. Similar to drift organisms, stream benthos are a major food source for many fish. Stream benthos differ from drift organisms as they are associated with the stream sediments, clinging to rocks, twigs and other debris. Many stream benthos actively search out food, grazing on periphyton as they move about the bottom of the stream.

8.4.1 Methods

The locations of all streams sampled are indicated in Figure 1.2-2. Stream benthos samples were collected in triplicate from Doris and Pelvic outflows on the dates indicated in Table 8.4-1. Only two samples were collected from Tail Outflow, as the other samplers were above the water-line (due to dropping water levels) or could not be located in August. Samples were collected from artificial substrates (Hester-Dendy samplers) that were submerged in the streams for a one-month period to allow colonization of the samplers by benthic invertebrates. Samplers consisted of nine 7.5 cm x 7.5 cm (56.25 cm^2) plates attached to a large eyebolt with 3 mm spacings in between each plate. The bottom of the eyebolt was used to secure the Hester-Dendy sampler to the stream bottom. Five samplers were submerged in each stream, and three samples were retrieved for sampling.

Upon retrieval, Hester-Dendy samplers were placed in a 500 µm sieve, and organisms gently removed using a brush and 500 µm filtered water. Both sides of each of the nine plates were sampled for organisms with the exception of the outer top and bottom surfaces. The outer bottom plate rested on the streambed and could not be colonized by organisms, while the outer top plate was exposed to scouring effects of water flow. The total area considered suitable for colonization was 0.09 m^2.

Table 8.4-1
Stream Benthos Sampling Locations and Dates, Hope Bay Belt, 2000

Stream	Submersion Period	Number of Replicates
Tail Outflow	July 19 to August 16, 2000	2
Doris Outflow	July 22 to August 16, 2000	3
Pelvic Outflow	July 22 to August 16, 2000	3

Organisms were transferred to 500 mL labeled wide-mouth plastic jars and preserved with buffered formalin to a final concentration of 10%. Samples were sent to Applied Technical Services for identification and enumeration.

8.4.2 Results and Discussion

Results of the taxonomic analysis of stream benthos collected from the three streams sampled are presented in Appendix 8.4-1. Average stream benthos density is presented graphically in Figure 8.4-1. The average taxonomic composition of the stream benthos communities sampled is presented in Figure 8.4-2.

Stream benthos densities were relatively low in Tail (6,233 organisms/m^2) and Pelvic (10,507 organisms/m^2) outflows as compared to Doris Outflow (207,867 organisms/m^2). The high density in Doris Outflow was due primarily to the presence of *Hydra* (Coelenterata), Hydracarina (Arachnida), and Chironomidae larva (Diptera). *Hydra* are voracious, highly motile invertebrate predators that are commonly found in high densities when suitable food sources are present. Food sources for *Hydra* can range from invertebrates to small fish (Slobodkin and Bossert, 1991). The Hydracarina or water mites depend on suitable invertebrate or vertebrate hosts for their parasitic larval stage, and are often predatory during the short-lived adult stage as well (Smith and Cook, 1991). Chironomidae (non-biting midges) are ubiquitous in northern lakes and streams and comprise a major food source for many larger organisms (Hilsenhoff, 1991). They are commonly found in very high densities, especially during larval stages.

Diversity indices were calculated for all stream benthos samples for both the Ephemeroptera-Plecoptera-Trichoptera (EPT) and Diptera communities. Results for the EPT diversity calculations are presented in Table 8.4-2.

Both the average number of genera per stream and number of genera contributing to 90% of the density ranged from zero at Pelvic Outflow to two at Tail Outflow. Maximum dominance by a single genus ranged on average from 33.3% in Pelvic Outflow to 94.7% in Tail Outflow. The reason that Pelvic Outflow had a maximum dominance value while Table 8.4-2 indicates that there were no EPT genera present at this site is because a single genera was found in one replicate. Since the average number of genera over three replicates equaled one-third, G and G (90%) were rounded down to zero.

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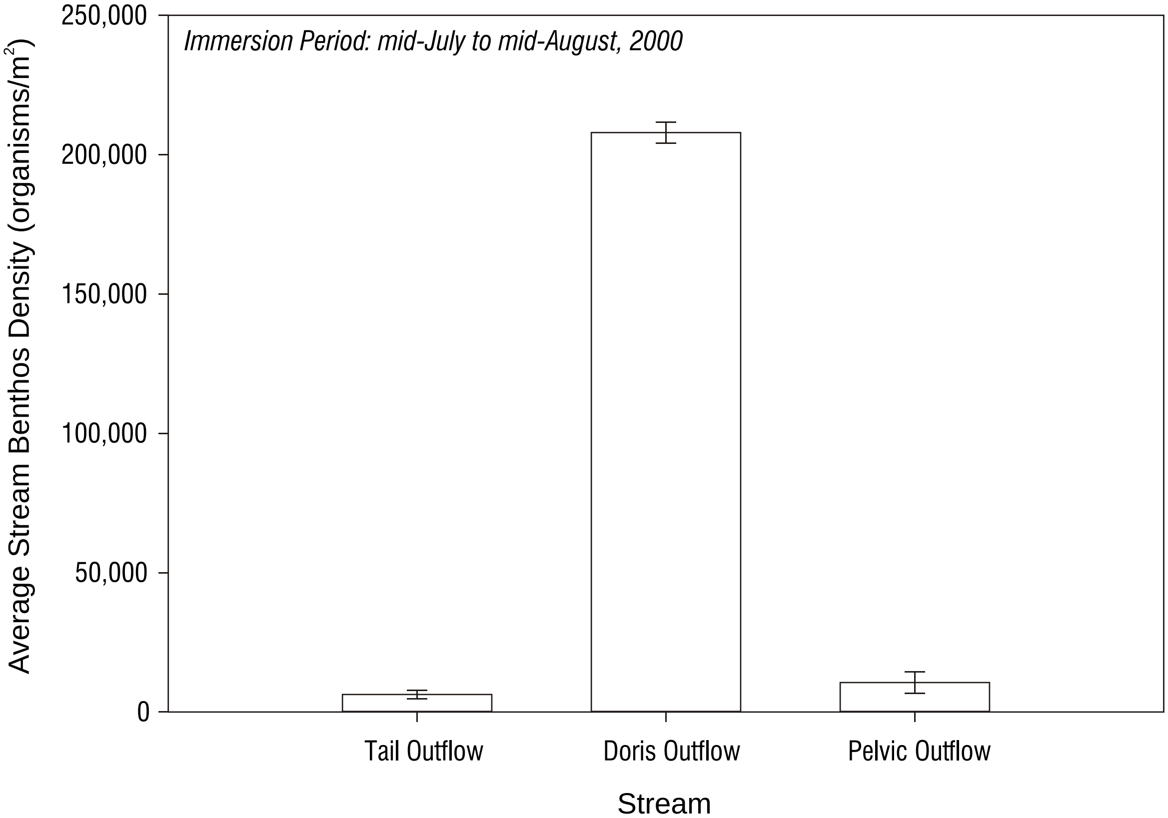

Notes: Error bars represent standard error of the mean.

FIGURE 8.4-1

Average Stream Benthos Density, Hope Bay Belt Streams, August 2000

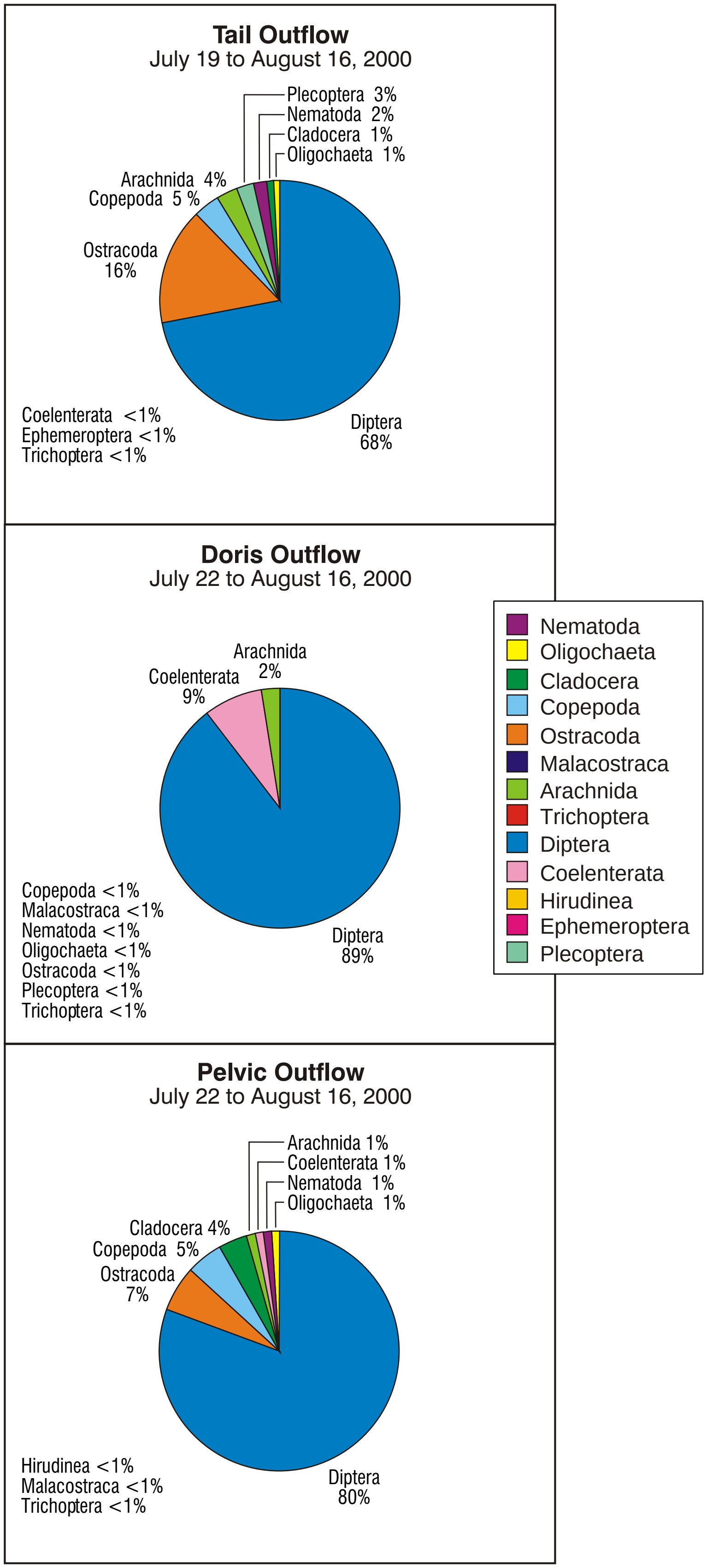

FIGURE 8.4-2

Average Taxonomic Composition of Stream Benthos Communities, Hope Bay Belt Streams, 2000

Table 8.4-2
Average EPT[1] Diversity Indices for Stream Benthos Communities, Hope Bay Belt Streams, July 2000

Stream	Date	G	G (90%)	Max. Dom. (%)	Shannon Diversity Index	Simpson Diversity Index
Tail Outflow	August 16, 2000	2	2	94.7	0.20	0.10
Doris Outflow	August 16, 2000	1	1	50.0	0.23	0.17
Pelvic Outflow	August 16, 2000	0	0	33.3	0.00	0.00

1: EPT = Ephemeroptera-Plecoptera-Trichoptera
G: The number of genera per site
G (90%): The number of genera contributing to 90% of the density
Max. Dom. (%): The maximum dominance by density accounted for by a single genus
Date provided indicates date of retrieval

The average Shannon diversity index ranged from 0.00 in Pelvic Outflow to 0.23 in Doris Outflow, while the average Simpson diversity index ranged from 0.00 in Pelvic Outflow to 0.17 in Doris Outflow. These values indicate that the EPT community was poorly represented in the streams sampled during the August sampling period. The EPT community represented less than 1% (Doris and Pelvic Outflows) to 3% (Tail Outflow) and did not comprise a large percentage of the density either.

Average Dipteran diversity indices for the streams sampled are presented in Table 8.4-3. The average number of dipteran genera in the stream benthos samples ranged from four in Doris Outflow to nine in Pelvic Outflow, with G (90%) ranging from three in Tail and Doris outflows to five in Pelvic Outflow. The maximum dominance by a single genus ranged from 50.6% in Doris Outflow to 59.3% in Tail Outflow. Shannon and Simpson diversity indices were very similar among the streams sampled. The average Shannon diversity index ranged from 1.00 in Doris Outflow to 1.40 in Pelvic Outflow while the average Simpson diversity index ranged from 0.58 in Tail Outflow to 0.62 in Pelvic Outflow. Both diversity indices indicate a relatively diverse dipteran stream benthos community in the streams sampled.

Table 8.4-3
Average Dipteran Diversity Indices for Stream Benthos Samples, Hope Bay Belt Streams, July 2000

Stream	Date	G	G (90%)	Max. Dom. (%)	Shannon Diversity Index	Simpson Diversity Index
Tail Outflow	August 16, 2000	6	3	59.3	1.10	0.58
Doris Outflow	August 16, 2000	4	3	50.6	1.00	0.60
Pelvic Outflow	August 16, 2000	9	5	57.5	1.40	0.62

G: The number of genera per site
G (90%): The number of genera contributing to 90% of the density
Max. Dom. (%): The maximum dominance by density accounted for by a single genus
Date provided indicates date of retrieval

Overall, stream benthos density in Doris Outflow was very high compared to values in Tail and Pelvic outflows. This high density was due primarily to the abundance of Coelenterata (*Hydra*), Arachnida (water mites) and Diptera (Chironomidae larva). The presence of the predators (*Hydra* and water mites) indicates that there were favourable food sources in Doris Outflow, most likely the chironomid larva. The chironomid larva in turn likely had a suitable food source available in Doris Outflow.

The Diptera comprised the majority of the stream benthos community by density, but many other taxa were represented. While EPT diversity indices were relatively low at all sites, dipteran diversity indices were indicative of a diverse community. Despite higher dipteran density at Doris Outflow, diversity indices were not higher relative to Tail and Pelvic outflows.

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9. MARINE BENTHIC INVERTEBRATES

9. MARINE BENTHIC INVERTEBRATES

Benthic invertebrates (benthos) are important organisms in marine food webs. They play an important role as scavengers and detritivores in marine systems and are consumed by numerous other organisms such as fish. In arctic systems, marine benthos must cope with limited food sources and decreased temperatures, making them very susceptible to impacts that may affect their environment.

9.1 Methods

A single composite sample was collected from Roberts Bay on July 25, 2000. Several attempts were made to collect discrete samples using an Ekman grab sampler. However, the marine sediments were too densely packed for the Ekman to penetrate to sufficient depths to collect an appropriate sample. The single sample discussed here represents a collection of surface organisms only, and is not believed to be representative of the true marine benthic community.

Organisms collected were pooled in a 500 mL wide mouth plastic container. Buffered formalin was added as a preservative and fixative to a final concentration of 10%. The sample was sent to Applied Technical Services for identification and enumeration.

9.2 Results and Discussion

As was found from the marine sediment quality sampling, the area sampled was primarily composed of hard substrate. Taxonomic results from the single pooled sample are summarized in Appendix 9.2-1. As this sample does not represent a discrete sample, no statistical or graphical analysis of the data are possible. The sample does give an indication of some of the surface benthos present in Roberts Bay. Green urchins (*Strongylocentrotus droebachiensis*), clams (*Hiatella arctica*), nematodes, polychaetes and amphipods (Gammaridea) were all present and it is likely that there are a number of other species that live in Roberts Bay. The species present are commonly found in cool non-polluted marine waters and are typical of arctic marine ecosystems.

10. FISH COMMUNITIES

10. FISH COMMUNITIES

This chapter presents methods and results for the fish community component of the supplemental baseline studies that were carried out in 2000. Lake fish communities, stream fish communities, and lake and stream habitats were examined in several lakes and streams within the Hope Bay Belt Project area.

The main objectives of the fisheries component of the 2000 supplemental baseline work were as follows:

1. Conduct fish community surveys in Tail and Little Roberts lakes in the fall;
2. Conduct spring and fall fish community surveys and habitat assessments in streams that will be crossed by the proposed all-weather road;
3. Conduct fish community and habitat assessments in Tail and Doris outflows to assess their use for any migratory fish populations;
4. Conduct a fish community survey and habitat assessment in Little Roberts Outflow in the fall and assess its use as migratory habitat for Arctic char (*Salvelinus alpinus*); and
5. Conduct lake habitat assessments in Tail, Doris, and Little Roberts lakes in the fall.

Any potential fish community and habitat that could be altered or destroyed by development activities needs to be assessed prior to development. In addition to providing supplemental baseline data, the fisheries work conducted in 2000 assessed specific areas that may be potentially affected by project activities as understood by the mine plan in the spring of 2000.

10.1 Lake Communities

10.1.1 Methods

Fish communities were surveyed in Tail Lake on the 17th, 18th, and 19th of August 2000 and in Little Roberts Lake on the 26th and 27th of August (Figure 1.2-2 and Table 10.1-1). Each lake was fished with gillnets, which consisted of gangs of three panels with 38 mm (1.5") stretched mesh. Each panel measured 15.2 m long with a height of 2.44 m. The surface area covered by each gang was 110 m^2. These nets are referred as index gillnets, and their mesh size and short set duration minimizes fish mortality (McCarthy, 1997). The same nets and methodology were used in 1997 and 1998 for surveys in surrounding lakes (Rescan, 1998; Rescan 1999a). Nets were set perpendicular to shore in shallow water and in no specific orientation in deeper water (Figure 10.1-1 and 10.1-2). Sampling was conducted throughout the entire lake for both lakes in order to sample all habitat types.

Nets were only set during the day in order to minimize mortalities. The catchability of fish by gillnets is related to their activity (Rudstam *et al.*, 1984). Fish are less active and less likely to struggle against a net during the day compared to dawn and dusk. Nets were set throughout the day between 8:00 a.m. and 4:30 p.m. for approximately one hour.

Table 10.1-1
Lake Fish Community Sampling Locations and Dates, Hope Bay Belt, 2000

Lake	Date Sampled	# of Gillnet Sets
Tail	August 17, 18 and 19	25
Little Roberts	August 26 and 27	20

Once the nets were retrieved, fish were removed and identified to species, measured (fork length in mm), sampled for aging structure (left pelvic fin clip), and weighed (± 25 g). Live fish were then released. All living fishes over 300 mm were marked with a uniquely numbered Floy anchor tag. Fish that died in the nets were dissected to identify the following parameters: sex, maturity, reproductive status, stomach contents, and age using otoliths. Stomach contents of dissected fish were examined in the field to determine the diet of individual fish. The fullness of the stomachs was recorded as well as the identification of prey items.

Pelvic fin rays were used to age each fish. Aging of fins (and otoliths when available) was performed by John Tost of North Shore Environmental Services, Thunder Bay, Ontario. Fin rays were air dried and then mounted in 50:50 epoxy medium. Microsections were cut using a Beuller Isomet diamond saw. Sections were then mounted on slides and the annuli were read using a compound microscope. Otoliths were air dried, cracked, and passed over a flame to make growth rings more visible. They were subsequently mounted in Plasticine and immersed in oil. Growth rings were read under a dissecting microscope.

The analysis of fish community data was conducted in a similar fashion to previous years (Rescan, 1998; Rescan, 1999a) for consistency, and for potential future comparisons among years. Fish communities were characterized using different measurements such as mean length, mean weight, and mean age. Abundance of different species in each lake were reported in numbers and calculated as catch-per-unit-effort (CPUE) and biomass-per-unit-effort (BPUE). CPUE is calculated as the number of fish captured per gang (per area), per unit time (standardized to 24 hours). Mean CPUE was calculated for both lakes. CPUE was reported as the number of fish per 100 m^2 of net set for 24 hours.

CPUE = # fish caught per gang X (100/total gang area) X (24/set time)

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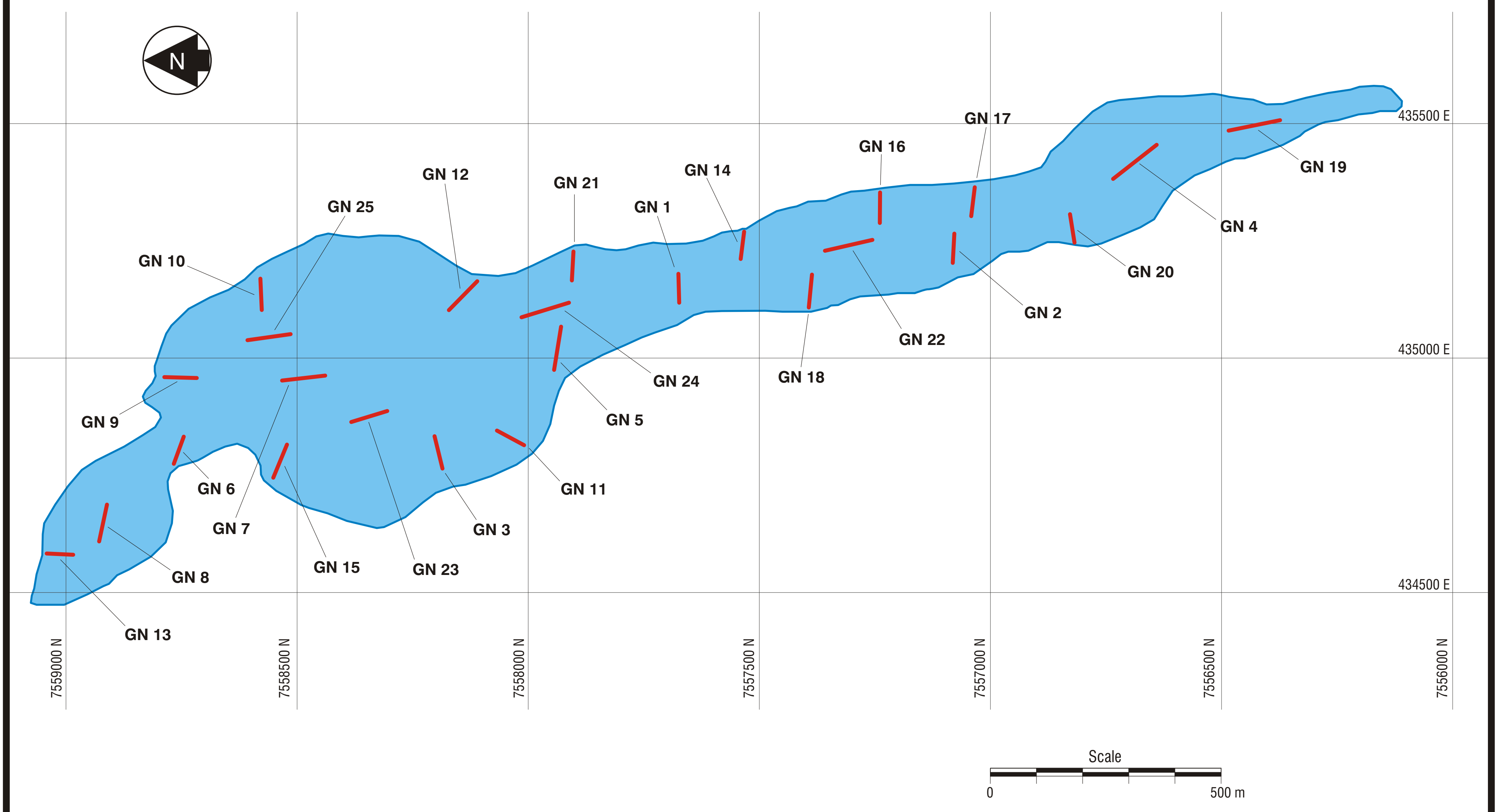

FIGURE 10.1-1

Gillnet Set Locations in Tail Lake, Hope Bay Belt, August 17 to 19, 2000

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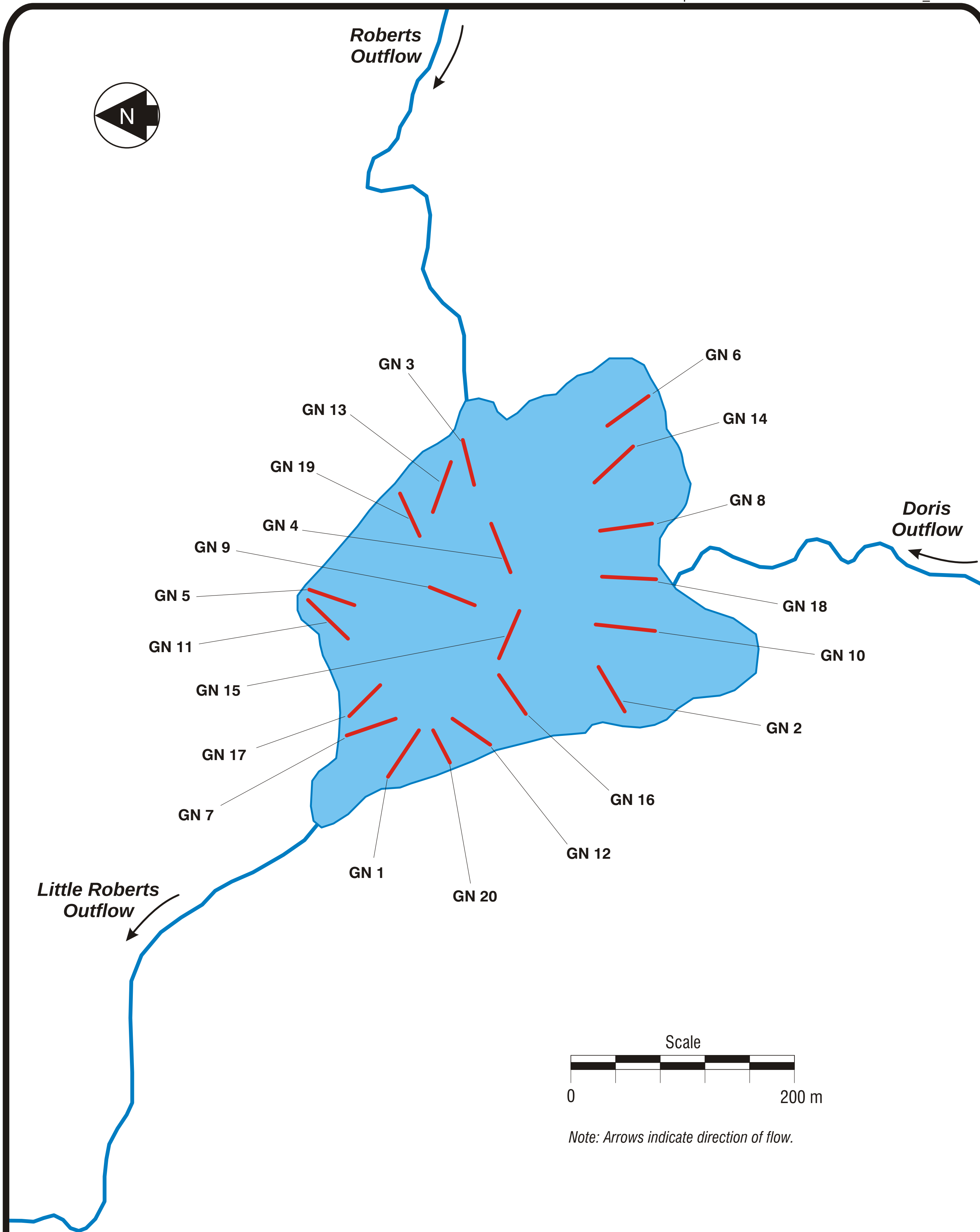

FIGURE 10.1-2

Gillnet Set Locations in Little Roberts Lake, Hope Bay Belt, August 26 and 27, 2000

The true abundance of fish within lakes is difficult to determine without tremendous effort. However, CPUE statistics are good indicators to compare relative abundance of fish among lakes and years. Variability in fish behaviour and environmental factors can cause fluctuations in CPUE and interfere with interpretation of data. Interfering factors can include water temperature, time of day (day or night), season, and turbidity. Consequently, standardization of nets and methods reduces this variability. Index gillnets were utilized in 2000 as in previous years and sampling was conducted during the same time period.

The other index used to characterize fish communities is the BPUE. Similar to the CPUE, BPUE also standardizes catch data, so that direct comparisons can be made between lakes or between sampling periods. It provides information on fish biomass within each lake and is reported as the fish biomass per 100 m^2 of net set for 24 hours. BPUE is calculated as follows:

BPUE = kilograms of fish per gang X (100/total gang area) X (24 hours/set time)

Relative condition factors (CF) and weight-length relationships are indicators of the relative health of fish within a lake. The relative CF was calculated for all fish for which both individual length and weight data were obtained based on the following formula from Ricker (1975):

$$\mathbf{CF = weight\ (g) \times 10^5 / length^3\ (mm)}$$

Weight-length relationships were calculated for fish with sufficient numbers caught, which were lake trout (*Salvelinus namaycush*) and Arctic char. Regression analysis on logarithmic transformations of individual fork lengths and weights was performed. The slopes of the regressions can be used to monitor changes in the growth rate of the population. Length frequency distributions were presented for all fish caught and age data were plotted against fork length.

10.1.2 Results and Discussion

10.1.2.1 Community Composition and Abundance

A list of all fish species found during the 2000 surveys is provided in Appendix 10.1-1 along with associated codes, common names, and species names. Gillnet gangs were set on 25 occasions in Tail Lake over a period of three days. Fishing effort was spread throughout the whole lake to sample all possible habitats (Figure 10.1-1). Habitat partitioning in Arctic lakes is much simpler than in temperate lakes given the lack of lake stratification, absence of macrophytes, and uniform littoral zones. On average, gillnets were set for 82 minutes (Appendix 10.1-2). All fish data collected during sampling are presented in Appendix 10.1-3. A total of 134 lake trout were caught in Tail Lake (Table 10.1-2). No other species of fish were captured. Low species diversity and dominance of lake trout is typical of Arctic lakes (Kalff, 1970; Johnson, 1976). Ninespine sticklebacks

(*Pungitius pungitius*) were observed in stomachs of lake trout and in the shallow water, but could not be caught in the nets because of their small body.

Of the 134 lake trout captured, 128 were tagged with a Yellow Floy tag (Appendix 10.1-3). If an individual fish is recaptured in future monitoring years, these tags help provide information on individual fish movement and growth.

Fishing effort was similar in Little Roberts Lake with 20 gillnet sets averaging 86 minutes (Appendix 10.1-4). The effort was conducted over two days and covered most of the area of the lake (Figure 10.1-2). A total of 63 fish were caught, mostly represented by Arctic char (46%) and lake trout (32%) (Table 10.1-2). Other species captured were lake whitefish (*Coregonus clupeaformis*), least cisco (*Coregonus sardinella*), and broad whitefish (*Coregonus nasus*). The fish community of Little Roberts Lake was more diverse than Tail Lake. Lakes connected to the ocean usually have a greater diversity of fish than inland lakes because of the presence of anadromous species such as Arctic char, and some whitefish and cisco species, that in some instances can not reach inland lakes due to barriers. Of the fish captured, 20 lake trout, 9 Arctic char, and 1 broad whitefish were tagged with blue Floy tags (Appendix 10.1-5).

Table 10.1-2
Summary of Fish Community Parameters for
Tail Lake and Little Roberts Lake, Hope Bay Belt, 2000

	Tail Lake	Little Roberts Lake				
	Lake Trout	**Arctic Char**	**Broad Whitefish**	**Least Cisco**	**Lake Whitefish**	**Lake Trout**
Number of fish caught	134	29	1	6	7	20
Relative abundance (%)	100	46	2	10	11	32
Fork Length (mm)						
Mean	556	332	533	191	187	382
Range	284 – 665	149 – 869	533	169 – 221	118 - 213	288 - 523
Weight (g)						
Mean	1,615	1,026	2,000	87	101	751
Range	280 – 2,550	67 – 7,250	2,000	61 – 115	70 - 130	140 – 1,750
Age (yr.)						
Mean	20	4	12	3	5	12
Range	4 – 33	2 - 9	12	2 – 6	4 - 6	7 - 25
Condition Factor						
Mean	0.9	1.4	1.3	1.2	1.9	1.3
Range	0.7 - 1.8	1.1 - 3.0	1.3	1.1 - 1.3	1.2 - 5.2	0.4 - 1.5

10.1.2.2 Length, Weight, and Condition Factor

Table 10.1-2 presents means and ranges of length (mm), weight (g), and condition factors for lake trout, Arctic char, broad whitefish, least cisco, and lake whitefish for both Tail and Little Roberts lakes. The mean length of lake trout in Tail Lake was 556 mm, and the mean weight was 1,615 g. The mean condition factor was 0.9, which is lower than what has been documented in other lakes from the area (Rescan, 1998; Rescan, 1999a). Mean condition factors from the summers of 1997 and 1998 from Pelvic, Aimaoktoak, and Windy lakes were 1.1 and for Doris Lake, 1.0. The lower condition of trout in Tail Lake is probably due to the absence of forage fish for lake trout to feed upon such as lake whitefish and least cisco. A length-frequency distribution for lake trout caught with index gillnets is presented in Figure 10.1-3. Fish length ranged from 284 mm to 665 mm, with the majority of fish having lengths between 551 and 575 mm.

Lake trout caught in Little Roberts Lake were much smaller than in Tail Lake (Table 10.1-2). Fork lengths ranged from 288 to 523 mm and averaged 382 mm. The majority of fish caught were between 351 mm and 375 mm (Figure 10.1-4). Little Roberts lake trout weighed approximately half the weight (751 g) of Tail lake trout. When forage species are present, the mean size of lake trout is usually greater than when there are no forage fish present (Welch and Kling, 1996). However, this was not the case in Little Roberts Lake. The smaller size may be due to competition for food with Arctic char. Condition factors were higher than in Tail Lake.

Arctic char were the most abundant fish caught in Little Roberts Lake. The mean length was 332 mm (Table 10.1-2) and lengths ranged from 149 mm to 869 mm (Figure 10.1-5). The majority were small, between 150 mm and 300 mm, with only five fish over 550 mm. These big fish were mature migrating adults (Plate 10.1-1). Mean weight was 1,026 g and ranged between 67 and 7,250 g (Table 10.1-2). Mean condition factor was high (1.4).

Plate 10.1-1: Male Arctic char captured in Little Roberts Lake, August 26, 2000.

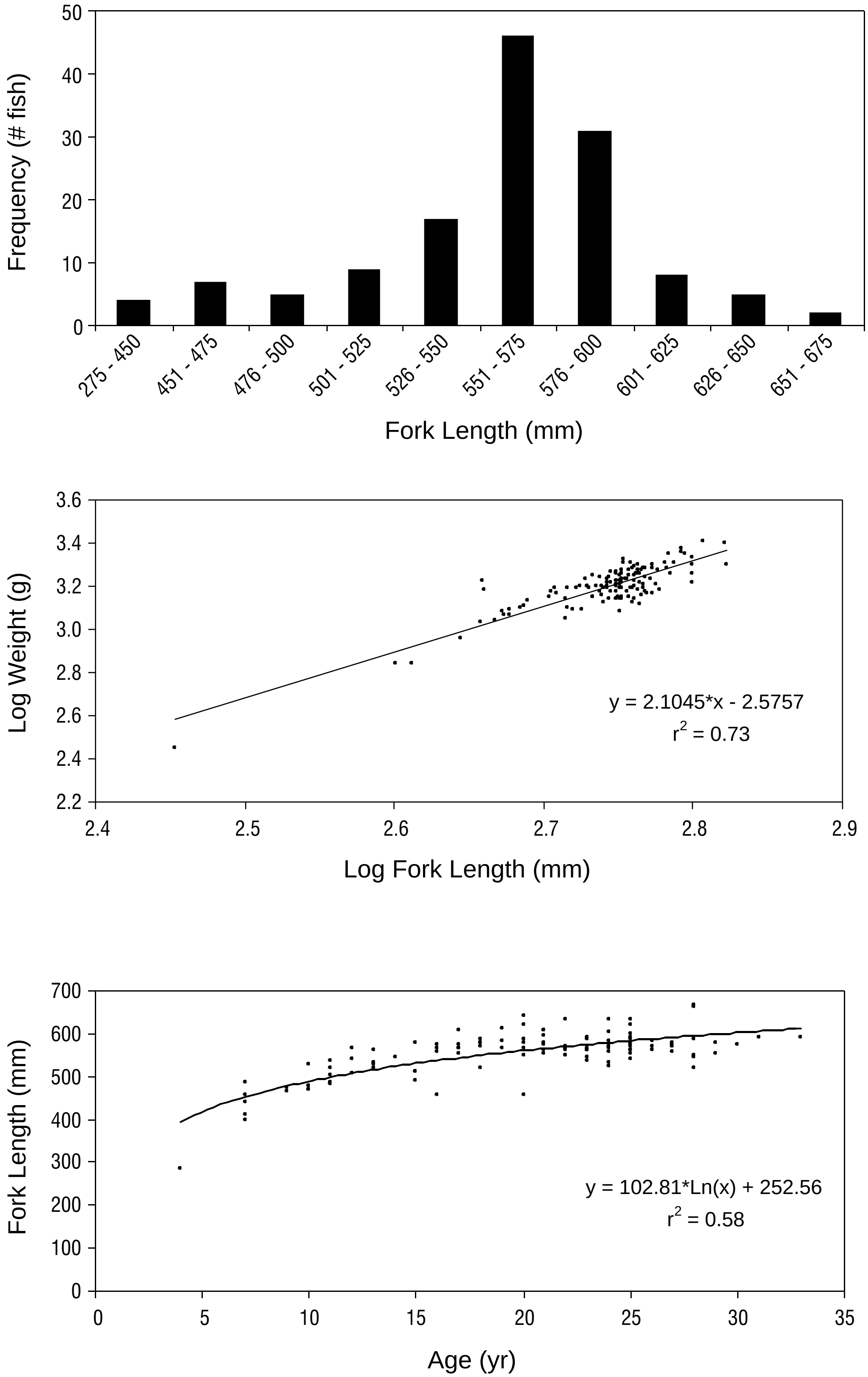

FIGURE 10.1-3

Population Characteristics of Lake Trout in Tail Lake, Hope Bay Belt, 2000

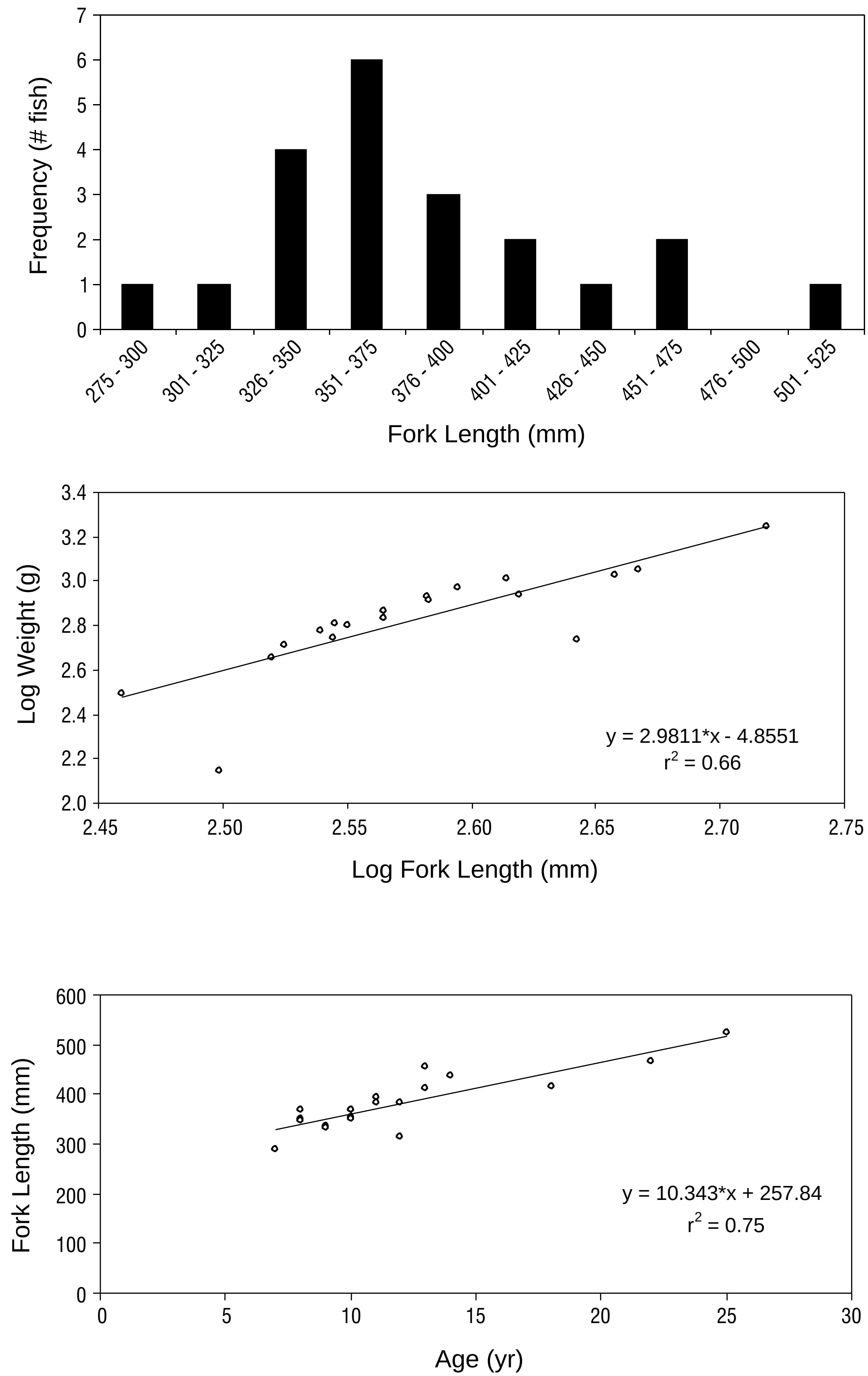

FIGURE 10.1-4

Population Characteristics of Lake Trout in Little Roberts Lake, Hope Bay Belt, 2000

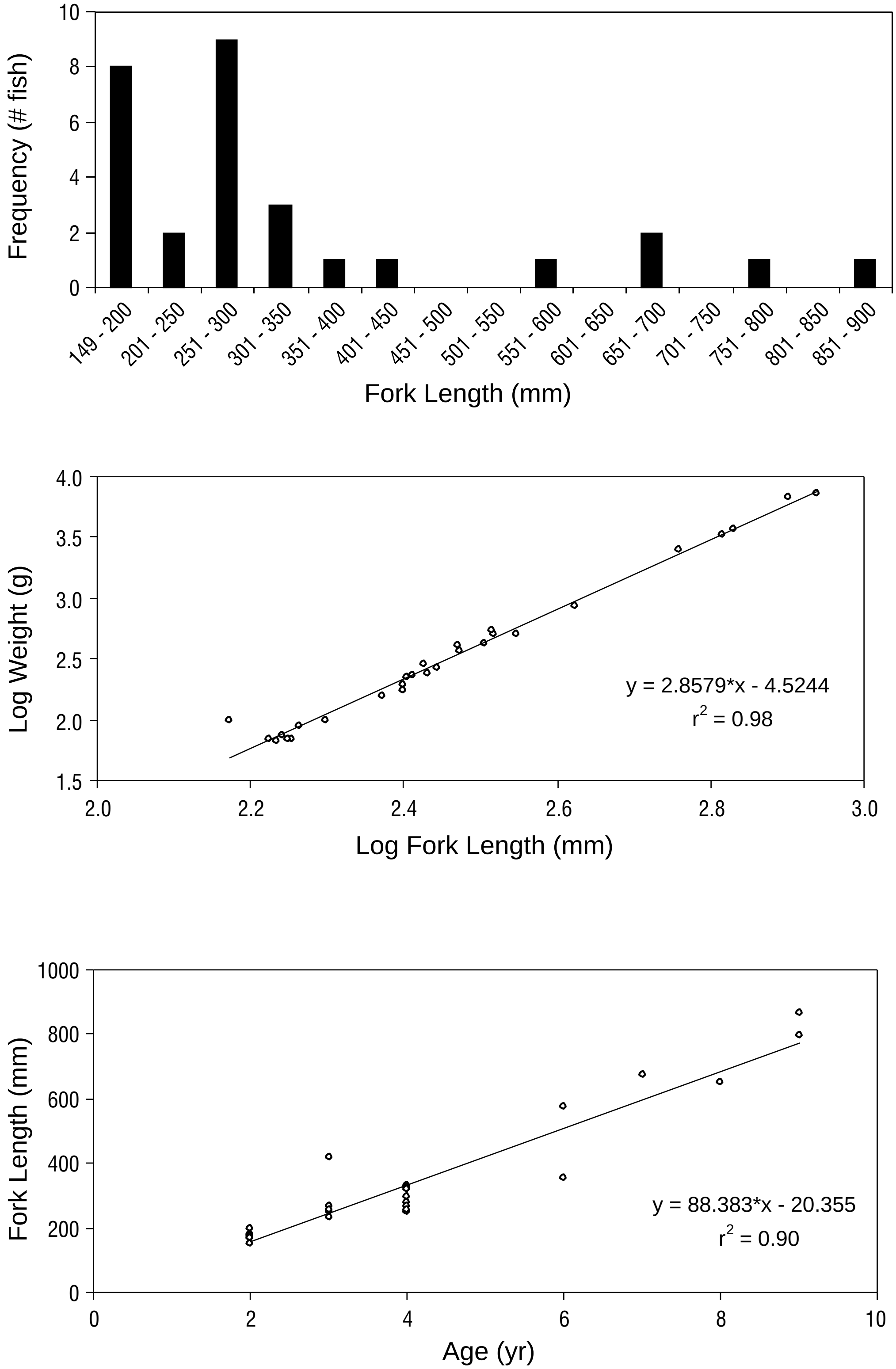

FIGURE 10.1-5

Population Characteristics of Arctic Char in Little Roberts Lake, Hope Bay Belt, 2000

Other species captured in lower numbers within Little Roberts Lake included broad whitefish, least cisco, and lake whitefish. The only broad whitefish captured measured 533 mm and weighed 2,000 g (Plate 10.1-2). The six least ciscos caught had a mean fork length of 191 mm, and ranged from 169 to 221 mm. The average length of Little Roberts lake whitefish (187 mm) was lower compared to whitefish from surrounding lakes (Rescan, 1998; Rescan, 1999a). However, the mean was based on a small sample size (Table 10.1-2).

Plate 10.1-2: Broad whitefish captured in Little Roberts Lake, August 27, 2000.

10.1.2.3 Growth and Age

Age of fish were determined from pelvic fin rays. The mean age of lake trout in Tail Lake was 20 years, while the mean age for trout in Little Roberts Lake was 12 years (Table 10.1-2). The presence of younger fish in Little Roberts Lake may be due to the fact that the lake is inhabited by only young transient fish because of its small size and shallow depth and there are no old resident fish. Tail Lake trout ranged in age from 4 to 33 years old, while Little Roberts trout ranged from 7 to 25 years old. Lake trout populations from Patch, Doris, Windy, and Pelvic lakes averaged over 20 years of age and ranging between 8 and 54 years (Rescan, 1998; Rescan, 1999a). Populations of lake trout in the Arctic typically display older populations than in temperate lakes due to slower growth rates.

All lake whitefish sampled in Little Roberts Lake were 4 or 6 years old. This is much younger than the mean age found in surrounding lakes (*e.g.*, over 20 years in Aimaoktak, Doris, and Patch lakes; Rescan, 1998). The absence of older fish may be due to the small sample size or due to the shortage of habitat, which may yield lower survival. Ages of Arctic char in Little Roberts Lake ranged from 2 to 9 years old. This char population is fairly young relative to other Arctic lakes, as other populations support fish over 15 and up to 24 years (Scott and Crossman, 1973). The single broad whitefish captured was 12 years old and the least ciscos ranged in age from 2 to 6 years old.

Growth rates of Arctic fish are very slow compared to growth rates found in fish from temperate lakes, resulting in fish that live longer. Lakes in the north are usually oligotrophic (poor in nutrients), have short growing seasons, and cold temperatures. Arctic fish of the same age tend to have large differences in size. This was observed for lake trout, where at a given age, size varied by over 150 mm (Figure 10.1-3). Fin rays showed fairly rapid growth up to ages 9 –12 and then growth would often shut down, probably coinciding with maturity (J. Tost, pers. comm., North Shore Environmental Services, Thunder Bay, Ontario). Lake trout from Great Bear Lake, NT, attain maturity at approximately 13 years (Scott and Crossman, 1973). The regression of fork length and age for Tail Lake trout do show that growth is more rapid at a small size and slows down at about 15 years (Figure 10.1-3). The regression of log weight against fork length for lake trout was significant.

The age-length regression for lake trout in Little Roberts Lake does not show clearly the higher growth at younger age due to the small sample size (Figure 10.1-4). The length-weight regression had a similar r^2 as the Tail Lake population. Growth rates of Arctic char did not slow down (Figure 10.1-5) as observed with lake trout from Tail Lake. The age range was smaller than for lake trout. These char have the potential to grow more, as the population was noticeably younger than other northern populations. A high r^2 (0.98) was obtained in the length-weight regression of Arctic char.

10.1.2.4 Catch-per-Unit-Effort and Biomass-per-Unit-Effort

Index gillnets were set on 20 occasions in Little Roberts Lake and 25 times in Tail Lake. Numbers of fish captured per set in Little Roberts Lake were between zero and eight, except for one set where 20 fish were caught (Appendix 10.1-4). Numbers of fish caught in Tail Lake varied between zero and 15 (Appendix 10.1-2). The mean CPUE in Tail Lake was 87 fish per 100 m^2 of net per 24 hours, all of which were lake trout, whereas the mean CPUE for lake trout in Little Roberts Lake was much lower (15.3; Table 10.1-3). CPUE values for lake trout from various lakes in the area sampled in 1997 and 1998 ranged between 19 and 34 (Rescan, 1998; Rescan, 1999a). The high value for Tail Lake is likely due to the absence of other species and therefore less competition for limited food resources. The total CPUE effort for Little Roberts Lake was 48.1, much lower than Tail Lake. It is also lower than most of the surrounding lakes, which vary between 21 and 394 fish per 100 m^2 of net per 24 hours (Rescan, 1998; Rescan, 1999a). The species with the highest CPUE in Little Roberts Lake was the Arctic char with 23.2 fish/100 m^2 of nets/24 hrs and the lowest was broad whitefish with 1.4.

BPUE provides information on fish biomass and can also be used as an index to compare fish communities between lakes and between sampling periods. Total BPUE values for both lakes sampled in 2000 differed by more than three-fold. The BPUE value for Tail Lake and Little Roberts Lake was 140.5 and 42.9 kg of fish per 100 m^2 of net per 24 hours (Table 10.1-3). The difference may be due to the absence of interspecific competition for limited food resources in Tail Lake, which would yield higher growth rates and survival rates. Arctic char represented the biggest proportion (70%) of the total BPUE in Little Roberts Lake due to the presence of large adults. The only BPUE data available from previous monitoring years is for Pelvic Lake (1998) with 160 kg of fish per 100 m^2 of net per 24 hours (Rescan, 1999a).

Table 10.1-3
Catch-per-unit-effort and Biomass-per-unit-effort Results for Tail Lake and Little Roberts Lake, Hope Bay Belt, 2000

	Tail Lake	Little Roberts Lake					
	Lake Trout	Arctic Char	Broad Whitefish	Least Cisco	Lake Whitefish	Lake Trout	Total
CPUE	87.0	23.2	1.4	3.6	4.6	15.3	48.1
SD	(60.5)	(26.9)	(6.2)	(9.1)	(20.5)	(17.8)	(56.7)
BPUE	140.5	30.0	1.4	0.3	0.5	10.8	42.9
SD	(100.8)	(54.6)	(6.2)	(0.8)	(2.1)	(13.9)	(59.1)

Notes: Values in parentheses are standard deviations. Data based on 25 sets for Tail Lake and 20 sets for Little Roberts Lake.

10.1.2.5 Sex and Maturity

Minimal number of fish died during the study; only 18 fish out of 197. In Tail Lake, six lake trout died and in Little Roberts Lake, six Arctic char and six lake whitefish died. All these fish were dissected to determine their sex and maturity (Table 10.1-4). In Tail Lake, the four female and two male lake trout caught were all mature except for one female. Three of the trout captured were imminent spawners. This was expected as lake trout generally spawn in the fall, usually during September in the north (Scott and Crossman, 1973). Sexual maturity in lake trout from Great Bear Lake, NT, has been observed to commence at age 13 (Scott and Crossman, 1973). All the mature trout caught in Tail Lake were 13 years and older except for one (age 10).

All of the lake whitefish mortalities from Little Roberts Lake were immature (Table 10.1-4). Of the six mortalities, five were female and one was male. All of the fish were very young (4 and 6 years old). Much older fish (over 20 years) have been previously captured in lakes within the Doris Property (Rescan, 1998).

Similar to lake whitefish, all Arctic char dissected were immature; half of which were females. Five of the fish measured were approximately 260 mm long and were either 3 or 4 years old. It is likely that these fish have not made their first migration to sea, as it has been shown to usually occur at ages 5-7 (Grainger, 1953). One male and one female Arctic char were captured and released alive; both were mature. These were much larger fish (869 mm and 799 mm, respectively).

Table 10.1-4
Maturity and Reproductive Status of Fish from Tail Lake and Little Roberts Lake, Hope Bay Belt, 2000

	Tail Lake	Little Roberts Lake	
	Lake Trout	Arctic Char	Lake Whitefish
Number sampled	6	6	6
Male	2	3 (1)*	5
Female	4	3 (1)*	1
Immature	1	6	6
Mature	5	(2)*	0
Reproductive status			
Undeveloped	1	6	6
Green (maturing)	2	0	0
Ripe (imminent spawner)	3	0	0

* Numbers in parentheses represent live fish where sex and maturity were identified while alive.

10.1.2.6 Diet

A total of 18 stomachs were dissected. The composition of the dietary items was examined in the field to determine the diets of each species. Stomach fullness ranged from empty to 100% full (Appendix 10.1-3 and 10.1-5). The most common prey were tadpole shrimps, also referred as Notostraca (Table 10.1-5). Notostracans are crustaceans that have a broad carapace and a narrow trunk giving the animal a tadpole like appearance. These were the only food items found in Arctic char and they were also present in two lake trout from Tail Lake (Table 10.1-5). Out of the three species dissected, lake trout had the most diverse diet. Four different group of organisms were found in lake trout stomachs from Tail Lake; trichopterans, isopods, tadpole shrimps, and ninespine stickleback. Lake trout usually feed on a broad range of organisms such as crustaceans, aquatic and terrestrial insects, many species of fish, and even small mammals (Scott and Crossman, 1973). Three lake whitefish from Little Roberts Lake had ingested vegetation.

Table 10.1-5
Stomach Content of Fish from Tail Lake and Little Roberts Lake, Hope Bay Belt, 2000

	Tail Lake	Little Roberts Lake	
	Lake Trout	Arctic Char	Lake Whitefish
Number sampled	6	6	6
Mean stomach fullness (%)	48	53	27
# fish with these diet items:			
Vegetation	0	0	3
Trichoptera	2	0	0
Isopods	1	0	0
Tadpole shrimps	2	4	0
Ninespine stickleback	3	0	0

10.2 Stream Communities

10.2.1 Methods

The proposed route for the all-weather road within the Hope Bay Belt area traverses 30 streams (Figure 10.2-1). Stream crossings along the route were initially identified from 1:50,000 topographic maps. An aerial assessment survey was conducted by helicopter to assess whether these crossings would provide habitat to local fish populations. Following the assessments, streams that would potentially contain habitat were then surveyed for fish communities and fish habitat. The smaller streams not surveyed were found to be ephemeral draws draining wetlands or snowmelt, with no water flowing during most of the open-water season and therefore containing no potential fish habitat.

A large portion the crossings were surveyed during the 1997 baseline studies (Figure 10.2-1; Rescan, 1998), therefore, only a few sites required assessment in 2000 and some were surveyed a second time. A total of seven crossings identified as containing potential fish habitat were selected for the 2000 survey, three of which had been assessed in 1997. The seven crossings were Glenn Outflow (#1), Doris Outflow (#4), Tail Outflow (#5), Proposed road crossing (PRC) 13, 14 and 15, as well as the NE Inflow of Aimaoktak Lake (Figure 10.2-1). Fish communities were assessed at all crossings except for the NE Inflow due to its physical condition (presence of rapids and high water level). In addition, the community was assessed in Little Roberts Outflow (Table 10.2-1).

Table 10.2-1
Stream Fish Community Sampling Locations and Dates, Hope Bay Belt, 2000

Stream	June Survey Date	Length of Section Electrofished (m)	August Survey Date	Length of Section Electrofished (m)
Little Roberts Outflow	-	-	August 25	1,250
Glenn Outflow	June 25	300	August 20	200
Doris Outflow	June 25	150	August 25	150
Tail Outflow	June 25	100	-	-
PRC-13	-	-	August 29	100
PRC-14	June 25	300	-	-
PRC-15	-	-	August 29	175

A Smith-Root model 15C POW electrofisher was used to assess the fish populations. Once the crossings were identified, an accessible portion of the stream was selected, and beginning at the downstream end of the section, a single pass with the electrofisher was conducted while walking upstream. Fish stunned with the electrofisher were captured with a dipnet. They were then identified to species, measured, and released. Stream sections surveyed varied in length between 100 and 1,250 m. After the electrofishing survey, a habitat inventory of the section was conducted.

10.2.2 Results and Discussion

Electrofishing was conducted in seven streams. No fish were caught in Little Roberts Outflow or Tail Outflow. Few fish were captured in all other streams with total numbers ranging from 3 fish in PRC-13 to 19 fish in the Doris Outflow (Table 10.2-2). The majority of fish caught were ninespine sticklebacks ranging in numbers between 3 (in PRC-13 and PRC-14) to 19 in Doris Outflow. The total length of these sticklebacks ranged from 24 to 81 mm (Appendix 10.2-1 and 10.2-2).

Table 10.2-2
Number of Fish Caught in Streams to be Crossed by the All-Weather Road Route, Hope Bay Belt, 2000

Stream Crossing	Ninespine Stickleback	Slimy Sculpin	Arctic Char	Lake Trout	Arctic Grayling
Little Roberts Outflow[1] (August)					
Glenn Outflow[1] (June)					
Glenn Outflow (August)		3	1	1	
Doris Outflow (June)					
Doris Outflow (August)	19				
Tail Outflow[1] (June)					
PRC-13 (August)	3				
PRC-14 (June)	16				
PRC-15 (August)	3				1

1: No fish were caught at these locations.

The most diverse fish community was found in Glenn Outflow in August, where slimy sculpins (*Cottus cognatus*), Arctic char, and lake trout were caught (Table 10.2-2). The Arctic char caught was a mature large female. It measured 820 mm and weighed 5,150 g (Table 10.2-3 and Appendix 10.2-2). The lake trout was a juvenile that measured 142 mm and weighed 43 g. A juvenile Arctic grayling (*Thymallus arcticus*) measuring 55 mm was captured in the PRC-15 crossing (Table 10.2-3), suggesting that the stream is utilized by Arctic grayling.

Table 10.2-3
Mean Length of Fish Caught at Five Crossings of the All-Weather Road Route, Hope Bay Belt, 2000

Stream Crossing	Ninespine Stickleback TL (mm)	Slimy Sculpin TL (mm)	Arctic Char FL (mm)	Lake Trout FL (mm)	Arctic Grayling TL (mm)
Glenn Outflow (June)		-	820 (-)	142 (-)	
Doris Outflow (August)	38.4 (14.4)				
PRC-13 (August)	29.3 (4.7)				
PRC-14 (June)	37.7 (11.4)				
PRC-15 (August)	31.0 (2.6)				55 (-)

Note: Standard deviations are provided in parentheses.

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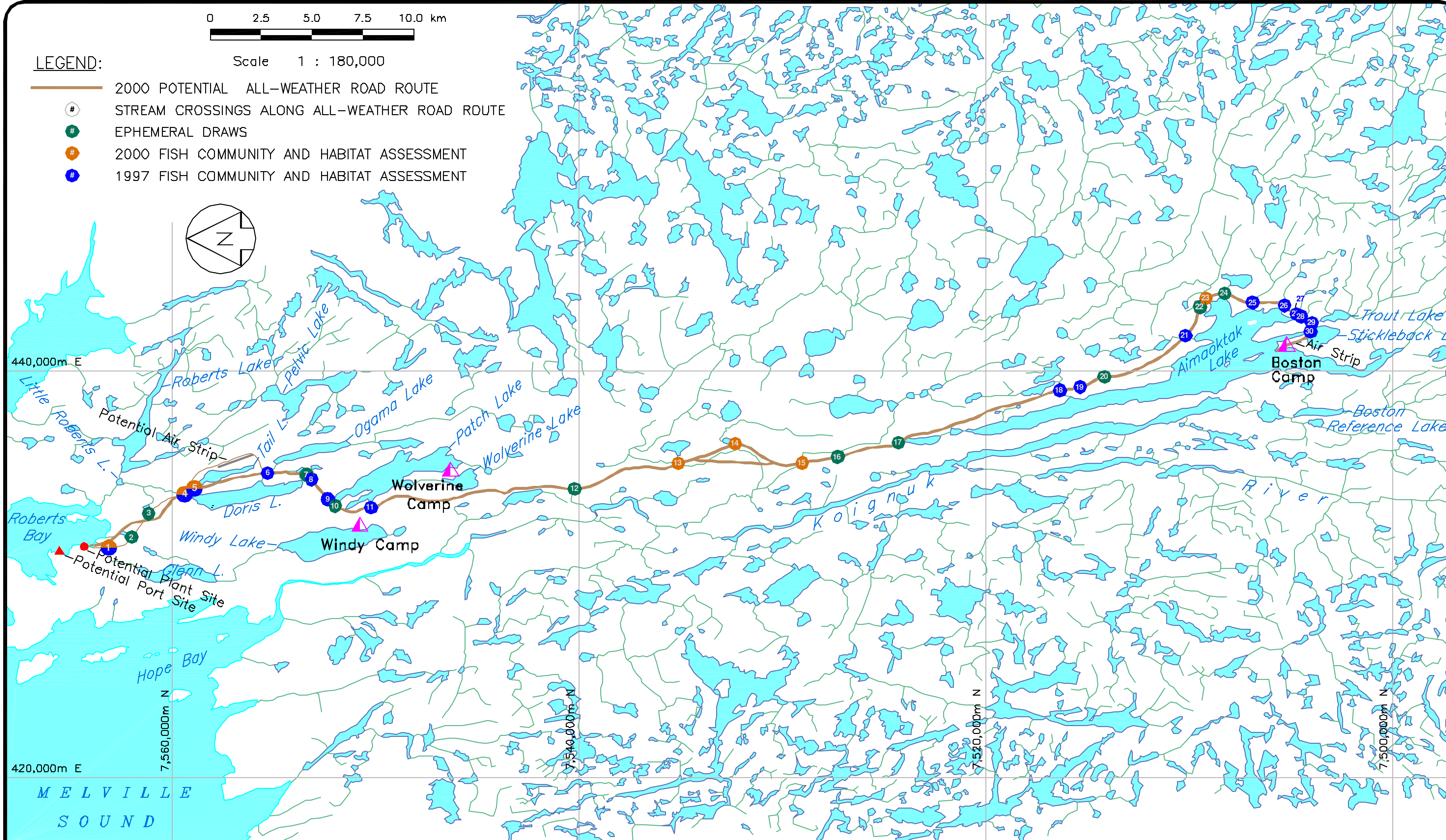

Figure 10.2-1

Stream Crossings and Fish Community and Habitat Assessment Locations Along the All-Weather Road Route, Hope Bay Belt, 2000

Hope Bay Joint Venture

Rescan

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10.3 Habitat Assessment

10.3.1 Methods

10.3.1.1 Lakes

A reconnaissance level lake habitat assessment was conducted in Tail, Doris, and Little Roberts lakes in August 2000 (Table 10.3-1). Any alteration or destruction of habitat due to project development activities could possibly affect fish populations that utilize these lakes. Therefore, the objective of the assessment was to classify substrate composition along the littoral zone, as it is important for local fish populations, such as lake trout that need certain size substrate for spawning and for cover. Classification of the substrate was conducted by helicopter surveys on August 25 and 28. A topographic map delineating the lake perimeter was used to identify transition areas of different substrate composition. These zones were marked on the map during low altitude flights. Once the zones were identified, the composition of each area was recorded as a percent coverage (*e.g.*, 25% cobble, 75% boulder). The substrate type was classified into five categories: silt, sand, cobble, boulder, and bedrock. A map depicting the composition of each zone along the perimeter of the lakes was produced.

Table 10.3-1
Lake Fish Habitat Assessment Locations and Dates, Hope Bay Belt, 2000

Lake	Date
Tail	August 28
Doris	August 28
Little Roberts	August 25

Ratings of the habitat quality were based on the habitat classification system presented in Table 10.3-2. Most of the lakes in the Arctic are composed mainly of lake trout and coregonid species (whitefish and ciscos). Important habitats in lakes include spawning, rearing, and feeding areas. All five substrate types were classified as poor, fair, good, or excellent for each habitat and each group of species. Lake trout spawn over cobble and boulders; therefore both substrate types were rated as good for trout spawning. Coregonids spawn over cobble and sometimes over sand (lake whitefish); these substrate types were rated good and fair for coregonid spawning, respectively. Rearing habitat provides cover and is important for survival of younger fish. Boulders and cobble provide cover for all species, and were therefore classified as good, while all other substrate types were rated as poor for rearing habitat. Ratings of feeding areas vary between these group of species. Sand and silt bottom provide good habitat for benthic invertebrates, and hence good forage habitat for coregonids. Lake trout are piscivorous fish and feed on coregonids and smaller lake trout; consequently, areas where coregonids and younger lake trout are present are classified as good habitat. Overall, based on an average of all rankings, lake habitat quality for silt and sand is classified as fair, cobble as excellent, boulders as good, and bedrock as poor (Table 10.3-2). Using the map depicting the substrate composition of each zone, a subsequent map was produced with habitat quality ratings. The most abundant substrate was used for rating habitat quality when only one or two types of substrate were present. When three or more substrates were present an average was calculated.

Table 10.3-2
Lake Substrate Type Habitat Classification System for Lake Trout and Coregonids, Hope Bay Belt, 2000

Substrate Type	Potential Habitat Uses						Overall Habitat Quality
	Spawning		Rearing (cover)		Feeding		
	Lake Trout	Coregonids	Lake Trout	Coregonids	Lake Trout	Coregonids	
Silt	Poor	Poor	Poor	Poor	Good	Good	Fair[1]
Sand	Poor	Fair	Poor	Poor	Good	Good	Fair
Cobble	Excellent	Good	Good	Good	Good	Fair	Excellent[2]
Boulder	Good	Poor	Good	Good	Good	Poor	Good
Bedrock	Poor	Poor	Poor	Poor	Poor	Poor	Poor

Note: Coregonids include all whitefishes and ciscos.
1: Rated as fair (instead of poor) to reflect the fact that silt can be a good substrate type for feeding.
2: Rated as excellent (instead of good) to reflect the fact that cobble can be an excellent substrate for spawning.

10.3.1.2 Streams

Fish habitat assessments were conducted in all six crossings where fish community surveys were carried out. In addition to these, the NE Inflow of Aimaoktak Lake and the Little Roberts and Roberts outflows were assessed (Table 10.3-3). The Little Roberts Lake system was assessed during 2000 as it is suspected to be used as a migration corridor for an anadromous Arctic char population that overwinters in Roberts Lake. The system is located downstream of Tail and Doris lakes, therefore, it could be affected by alteration of stream flow, turbidity, and chemistry, if Tail Lake is used as an impoundment area. All streams were surveyed twice (June and August), except for Doris and Tail outflows and the NE Inflow, which were assessed once, because they had been previously surveyed in 1997.

An extensive habitat survey was conducted at all crossings over distances that varied between 100 m and 1,250 m. The methods employed for the assessments were the same as used in 1997 (Rescan, 1998). Within each segment surveyed, habitat units (*e.g.*, pools, runs, flats, rapids, cascades, and riffles) were first quantified as a percentage of the entire reach. Brief descriptions of the different habitat types are given in Appendix 10.3-1. For each habitat unit, a series of habitat features were determined and averaged over the entire section. These features included:

- Length and gradient;
- Mean channel width, mean depth, mean maximum pool depth, and mean maximum riffle depth;

Table 10.3-3
Stream Fish Habitat Assessment Locations and Dates, Hope Bay Belt, 2000

Stream	June Survey Date	Length of Section Surveyed (m)	August Survey Date	Length of Section Surveyed (m)
Roberts Outflow	June 26	600	August 25	600
Little Roberts Outflow	June 26	1250	August 25	1250
Glenn Outflow	June 25	300	August 20	200
Doris Outflow	-	-	August 25	150
Tail Outflow	June 25	100	-	-
PRC-13	June 25	500	August 29	100
PRC-14	June 25	300	August 29	350
PRC-15	June 26	-	August 29	175
NE Inflow of Aimaoktak	June 26	750	-	-

- Composition of streambed material (percent organic matter, silt, sand, small gravel, large gravel, cobble, boulder, and bedrock);
- Total cover for fish (percent from pools, boulders, cutbanks, macrophytes, and overhanging vegetation);
- Streambed compaction and embeddedness;
- Water level, water temperature, and water colour; and
- Bank height, bank stability, substrate composition of banks, and bank area covered by vegetation.

In addition, the suitability of the stream's habitat with respect to spawning, rearing, adult feeding, overwintering, and migration was classified using a numerical scale from 0 to 4. Under this scheme, 0 = no habitat present, 1 = poor, 2 = fair, 3 = good, and 4 = excellent habitat. Particular attention was given to Tail and Doris outflows, to assess their use as migratory habitats.

10.3.2 Results and Discussion

10.3.2.1 Lakes

The substrate composition of the littoral zones of Tail, Doris, and Little Roberts lakes were diverse. In Tail Lake, the majority of the delineated zones were comprised of sections of bedrock alternating with sections dominated by sand (Figure 10.3-1). Presence of silt was practically non-existent in Tail Lake. Bedrock does not provide cover for fish nor does it provide habitat for colonization of benthic invertebrates. These areas were subsequently categorized as poor quality (Figure 10.3-2). Sand, however, is good habitat for burrowing invertebrates that are part of fish diets.

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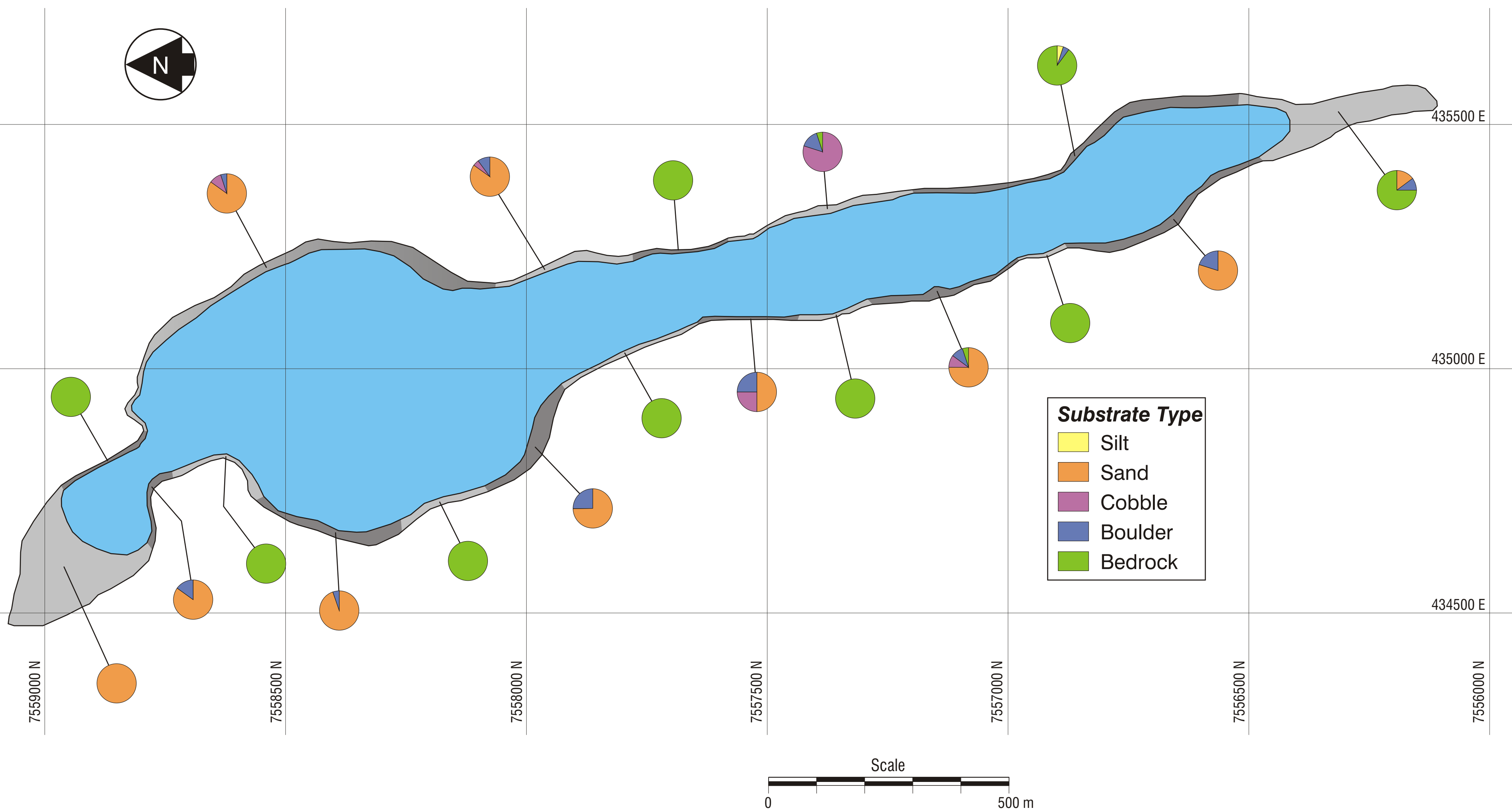

FIGURE 10.3-1

Tail Lake Habitat Assessment (Substrate Type), Hope Bay Belt, 2000

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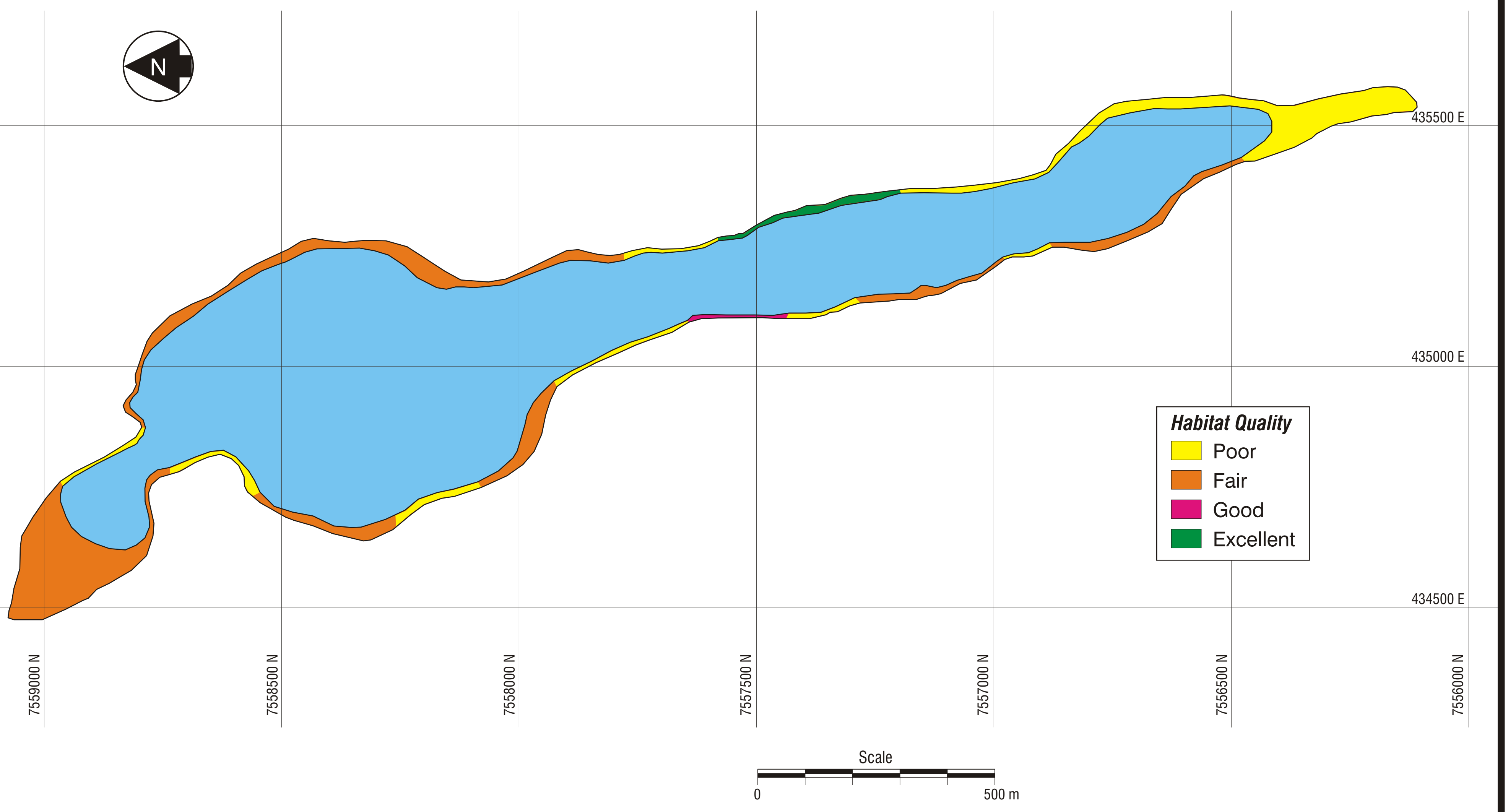

Tail Lake Habitat Assessment (Habitat Quality), Hope Bay Belt, 2000

FIGURE 10.3-2

Rescan™

Lake trout was the only species captured in Tail Lake. Two essential physical attributes for the survival success of lake trout populations are the availability of spawning substrate and nursery refugia (Marshall, 1996). Lake trout commonly choose cobble, boulders, and rubble, free of sediment for spawning (Fitzsimons, 1996; Gunn *et al.*, 1996). Cobbles and boulders also provide cover for young fish. Cobble was dominant in one zone only on the east side of Tail Lake (Figure 10.3-1). Cobble represented 80% of this section, with the remainder comprised of boulders (15%) and bedrock (5%). This area would potentially provide good spawning habitat and cover for lake trout, and therefore ranked as excellent habitat (Figure 10.3-2). Across the lake, on the west side, is a small section that was classified as good habitat quality as it was composed mainly of boulders and cobble (50%). A large portion of the littoral zone consisted of mostly sand with 25% or less cobble and boulders. These sections were rated as fair quality.

Approximately 50% of the shore of Doris Lake consisted of sections of bedrock (Figure 10.3-3), while the remainder was well diversified. The southern end of the lake was dominated by sand over roughly 500 m on each side of the lake. The accumulation of sand may have originated from the small stream located at the south end of the lake. Least cisco, lake whitefish, and lake trout inhabit Doris Lake (Rescan, 1998). As explained in the previous paragraph, cobble and boulders provide good habitat for lake trout. Least cisco and lake whitefish also utilize cobble for spawning and use boulders and cobble for cover. Therefore, high coverage by these substrates would be classified as excellent fish habitat. Abundance of these substrates was greater in this lake than in Tail Lake. Approximately half of the east shore of Doris Lake was ranked as good or excellent habitat (Figure 10.3-4). A small island at the south end provided excellent habitat. A section across the island on the west shore was also ranked excellent.

Little Roberts Lake is much smaller than Tail and Doris lakes. There are two inflows discharging into the lake; one from Roberts Lake and one from Doris Lake (Plate 10.3-1). Most of the shoreline was vegetated flat areas. The littoral zone was dominated by silt and some boulders (Figure 10.3-5). Sand was abundant near the mouth of Doris Outflow. The entire lake shore was ranked as fair habitat quality due to the lack of cobble and boulders (Figure 10.3-6). Fish living in Little Roberts Lake may be transient, as there were no good or excellent habitats. Fish may only use the lake in the summer as most of the lake is probably frozen during the rest of the year due to its shallow depth.

10.3.2.2 Streams

A comprehensive description of the fish habitat at each site is summarized below. All data obtained during the assessments are presented in Appendix 10.3-2. A schematic colour coded habitat assessment of Little Roberts Outflow and Roberts Outflow is presented in Figure 10.3-5.

10.3.2.2.1 Roberts Outflow

Roberts Outflow discharges into Little Roberts Lake (Figure 10.3-5). The outflow was surveyed because it is the access route for a known population of Arctic char that

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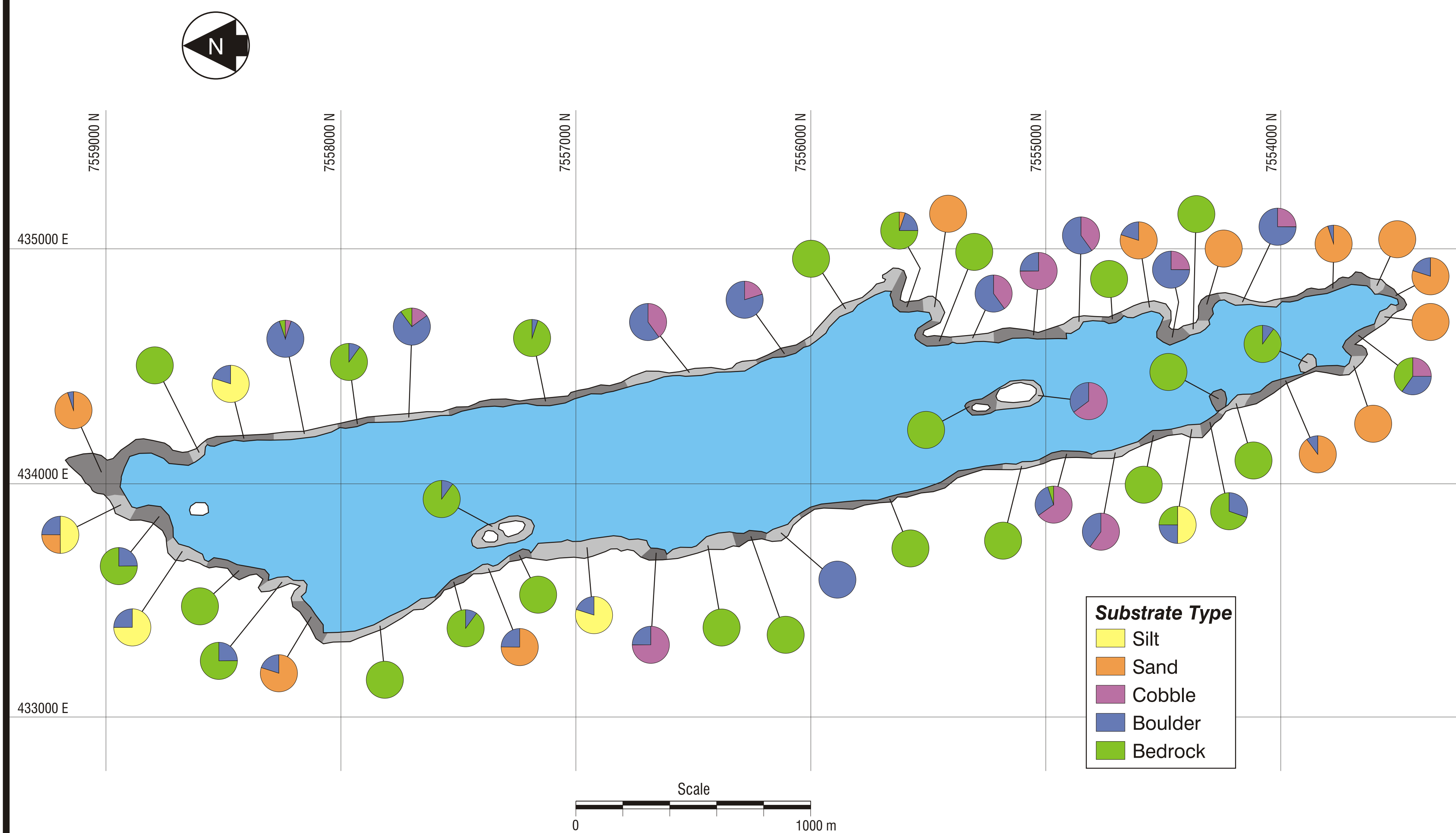

FIGURE 10.3-3

Doris Lake Habitat Assessment (Substrate Type), Hope Bay Belt, 2000

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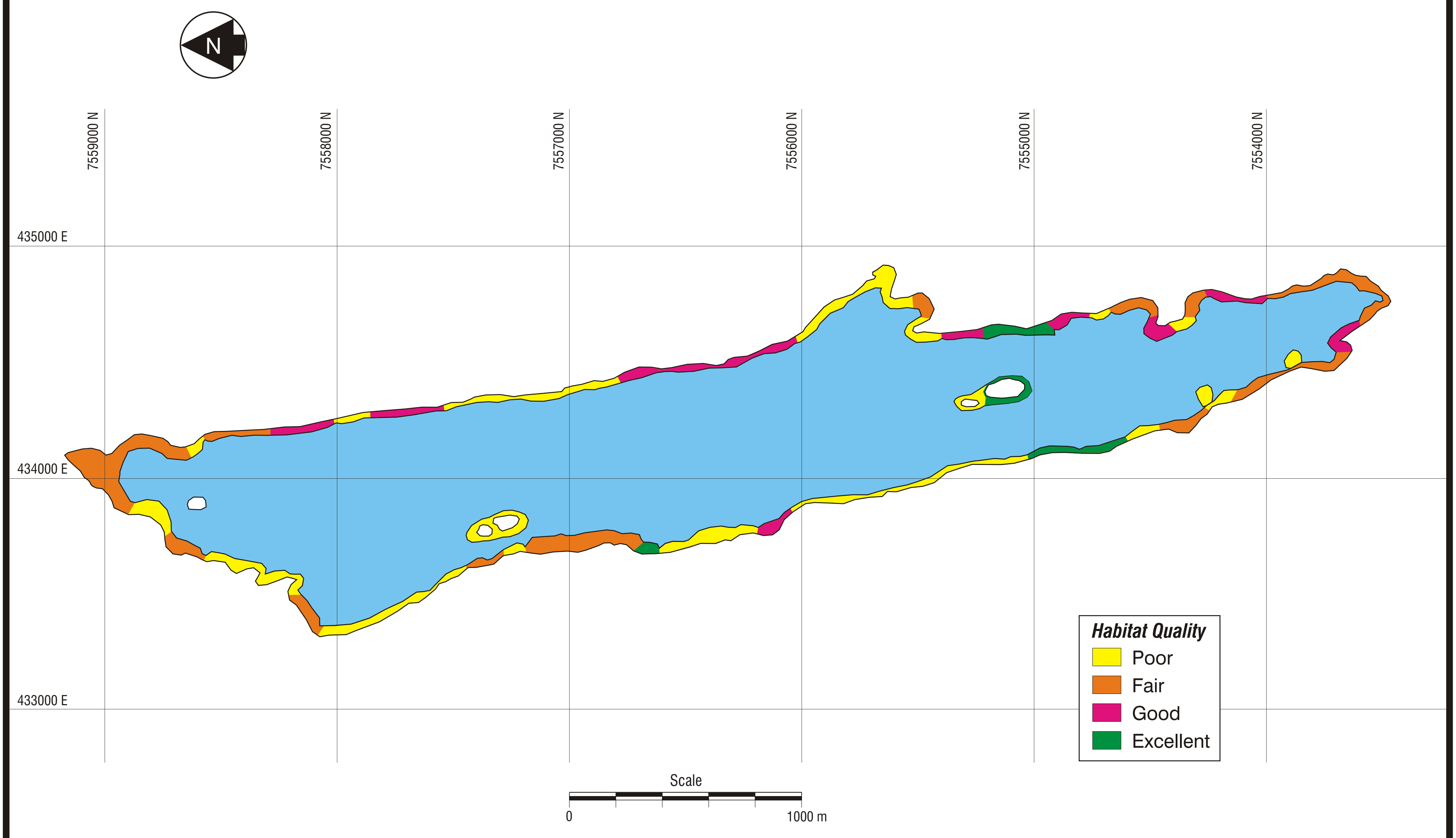

FIGURE 10.3-4

Doris Lake Habitat Assessment (Habitat Quality), Hope Bay Belt, 2000

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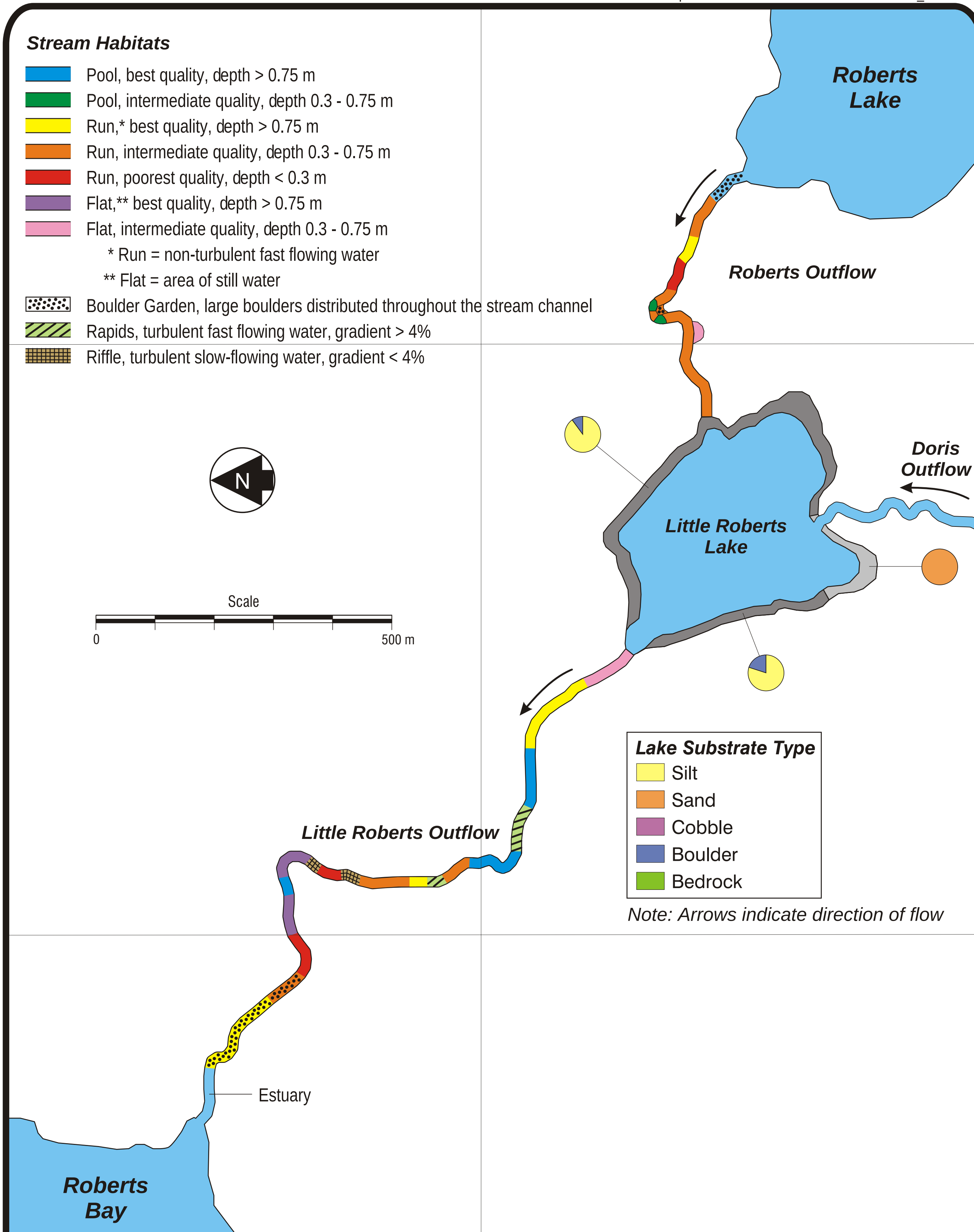

Habitat Assessment of Little Roberts Lake, Roberts Outflow, and Little Roberts Outflow, Hope Bay Belt, August 25, 2000

FIGURE 10.3-5

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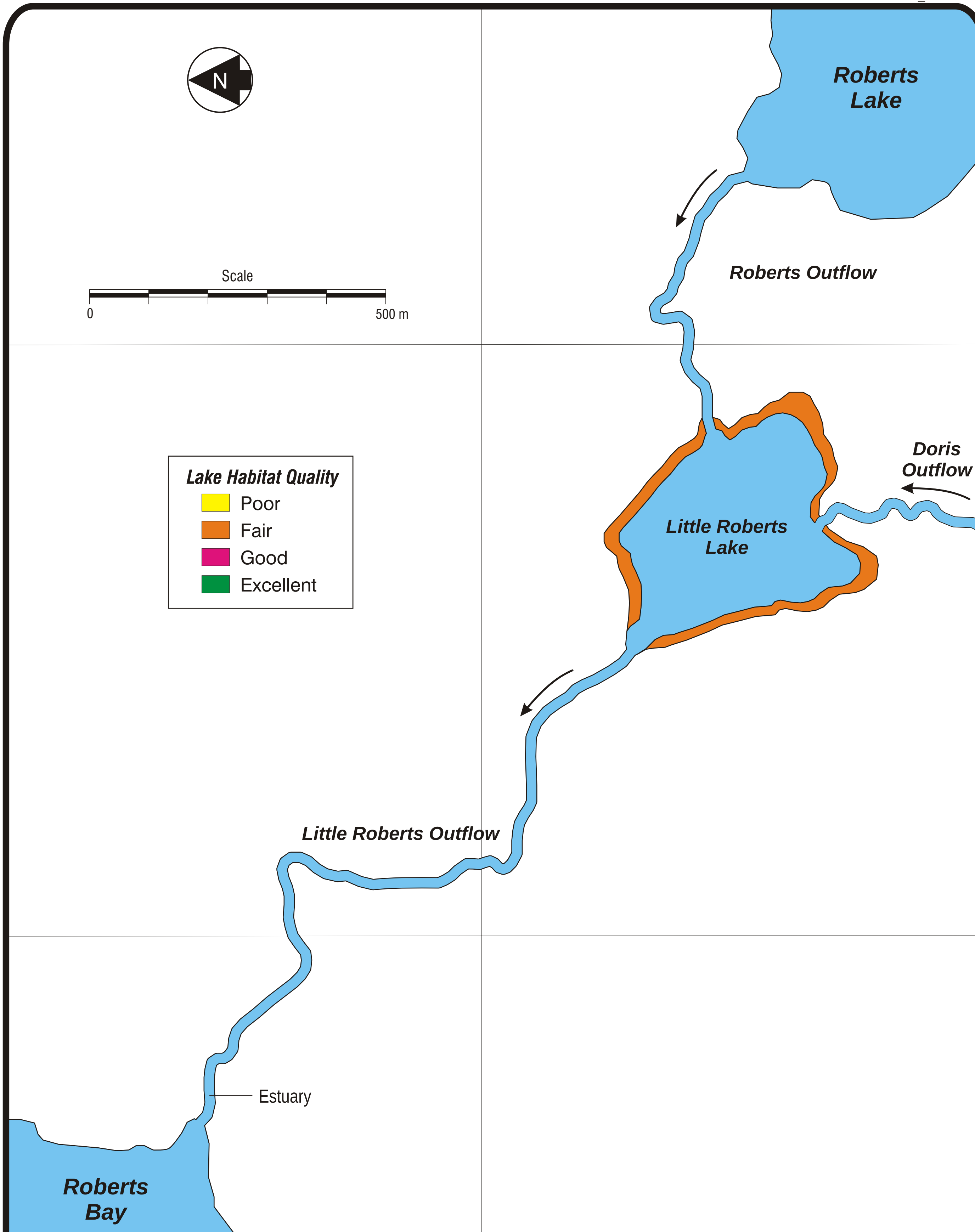

Habitat Assessment of
Little Roberts Lake (Habitat Quality),
Hope Bay Belt, 2000

FIGURE 10.3-6

Plate 10.3-1: Aerial view of Little Roberts Lake. The Doris Outflow is located on the left, the Roberts Outflow at the bottom right, and Little Roberts Outflow at the top.

overwinters in Roberts Lake (C. Hanks, pers. comm.). The length of the channel surveyed on June 26 was approximately 600 m, with a mean width of 13 m and a gradient of less than 1% (Appendix 10.3-2a). The majority of the section was composed of high quality run habitat (50%) and high quality flat (still water) habitat (30%). The rest was made up of rapids and good quality pools (>0.75 m), which provide cover for fish. The substrate was composed mainly of silt (50%), with a mixture of organic matter, sand, cobble, and boulders. The boulders provided cover for fish to some extent. The banks were approximately 2 m high, composed primarily of sand and silt, and were fairly stable. Over 85% of the banks were covered by vegetation. Overall, this stream provided good fish habitat for spawning, rearing and adult feeding, but poor habitat for overwintering. In addition, it was classified as an excellent passage to Roberts Lake for migrating Arctic char.

The channel was also surveyed at lower flow in August (Figure 10.3-5). As observed in June, the majority of the reach consisted of run habitat. This was classified as intermediate quality on August 25, as opposed to high in June, due to lower water levels. There was still a small section ranked as high, as well as one ranked poor quality. At approximately half the distance along the stream, there were pools and flat areas with depths ranging from 0.30 m to 0.75 m. The first 75 m of the reach were lined by a boulder garden (Plate 10.3-2).

Plate 10.3-2: Aerial view of Roberts Lake and Roberts Outflow. Boulder gardens cover the first habitat unit at the upstream section of Roberts Outflow.

10.3.2.2.2 Little Roberts Outflow

Little Roberts Outflow was surveyed on June 26 and August 25, 2000. It flows into Roberts Bay (Figure 10.3-6), and therefore can be used by migrating Arctic char. Little Roberts Outflow has been previously reported to be used as a traditional Arctic char fishing stream by the people of Umingmaktok (C. Hanks, pers. comm.). The stream has a low gradient (<1%) and measures approximately 1,250 m with a mean width of 18 m (Appendix 10.3-2b). Both banks were stable and measured 3.5 m in height. They were composed mainly of silt and boulders with extensive vegetation cover (95%). This outflow consisted of mixed habitat types such as good quality flats, pools, and runs, in addition to rapids, riffles, and chutes. The most predominant substrate was cobble (45%) followed by boulder, silt, sand, and bedrock, in order of abundance. Due to the heterogeneity of the habitat and substrates, the section provided excellent rearing habitat and good spawning and adult feeding habitat. The presence of deep runs provided a good migrating corridor for Arctic char. Overwintering habitat was classified as poor.

The outflow was assessed again in August at low flow (Figure 10.3-5). The variety of habitat types was evident, as it was in June. Good quality pools and runs were abundant, however, there were some portions of lower quality runs. Boulders were plentiful near the mouth of the stream. At the furthest upstream section, there was approximately 100 m of calm water. Rapids and riffles were present at various locations throughout the reach.

10.3.2.2.3 Glenn Outflow

Glenn Outflow is the first stream crossing along the proposed all-weather road route near Roberts Bay (Figures 1.2-2 and 10.2-1). The section was surveyed on two occasions; June 25 and August 20, 2000. Glenn Outflow originates from Glenn Lake and discharges into Roberts Bay. The section surveyed in June had a low gradient (1%) and measured 300 m (Appendix 10.3-2c). It was located between two sets of cascades. Flow was high at the time with a mean depth of 0.60 m and a mean channel width of 3.5 m. The habitat was comprised of runs, totaling 75% of the surveyed section. Two thirds of those runs were classified as poor quality, being very shallow and one third intermediate quality, with depths ranging between 0.30 m and 0.75 m. The remainder of the habitat types were riffles (15%), cascades (5%), and rapids (5%).

The streambed material was dominated by silt (45%), while sand, small gravel, cobble, and boulder were present in smaller quantities. Due to the large amount of silt, embeddedness was 70%. The limited abundance of boulders provided a minimum amount of cover (10%) for small fish. The banks were very high, between 8 and 10 m, and were composed primarily of silt and sand. The left bank was unstable due to low abundance of vegetation. Stream flow was high and water was very turbid and grey in colour. Fish habitat suitability varied from non-existent (for overwintering) to excellent (for rearing) for the different types of habitat. Potential for spawning was classified as poor, adult feeding as fair, and migrating as good. Glenn Outflow could be used by Arctic char as it provides a migrating corridor to Glenn Lake.

The section surveyed in August was 200 m in length and 3.5 m wide. Water level was lower, averaging 0.30 m. Poor quality runs represented 40% of the reach due to low flows. Shallow riffles and rapids comprised another 50% of the area, while the remaining 10% were pools less than 0.75 m deep. The substrate was again dominated by silt (70%) as it was in June, with the remainder being very heterogeneous and composed of organic matter, sand, small and large gravel, cobble, and boulders. Cover for fish was limited (20%), but diverse, being represented by pools, boulders, cutbanks, and macrophytes. Fish habitat suitability was similar to the June sampling, with no overwintering habitat, excellent migration and good rearing habitat. Both spawning grounds and adult feeding areas were negligible.

10.3.2.2.4 Doris Outflow

Doris Outflow was surveyed once in August over a 150 m reach from the mouth of Doris Lake (Figures 1.2-2 and 10.2-1). Waterfalls further downstream make Doris Lake inaccessible for migrating fish originating from Little Roberts Lake. The primary habitats were runs (Plate 10.3-3). Sixty percent were intermediate quality, and 20% were poor quality (less than 0.30 m deep). Riffles and pools represented the balance of the habitats. Sand was the predominant substrate (50%) followed by small gravel (25%) and limited amounts of organic matter, silt, large gravel, cobble, and boulder (Appendix 10.3-2d). Macrophytes and/or submerged vegetation were present and provided approximately 25% of available cover for small fish. The stream had a low gradient and

Plate 10.3-3: Photograph of Doris Outflow taken near the mouth of Doris Lake representing run habitat.

an average width of 2.5 m. There was no overwintering habitat due to the shallowness of the reach; however, rearing habitat was present to some extent. Spawning habitat was classified as fair due to the abundance of gravel but lack of adult feeding areas.

10.3.2.2.5 Tail Outflow

Tail Outflow is the stream that flows into Doris Outflow (Figures 1.2-2 and 10.2-1) near the mouth of Doris Lake. It was assessed on June 25. This stream is approximately 600 m in length and has a gradient of <1% (Appendix 10.3-2e). It flows through a flooded terrace with sedges and willows providing some cover for fish. However, macrophytes and/or submerged vegetation were more abundant within the channel providing 80% cover for small fish (Plate 10.3-4). The main channel of the outflow was very narrow (0.45 m) and shallow (0.25 m). The majority of the stream consisted of riffle habitat (75%) with the rest comprised of poor quality runs (20%) and pools (5%). The streambed material was composed predominantly of organic matter (90%) with sand and cobble. The banks were low and very stable due to coverage by vegetation. This section does not provide any spawning habitat due to the abundance of organic matter, nor does it provide overwintering habitat due to the relatively shallow depths. Rearing and migration habitat was considered to be minimal and there was no observable adult feeding areas.

10.3.2.2.6 Proposed Road Crossing 13

Stream crossings 13, 14, and 15 are all located approximately halfway between Aimaoktak Lake and Roberts Bay (Figure 10.2-1). They were surveyed twice, once in June and once in August. A 500 m section of Crossing 13 was assessed on June 25, 2000. Water level was high (mean depth of 1.2 m), channel width was 8 m, and gradient was low (<1%). Good and intermediate quality run habitat represented 65% and 20% of the area, respectively (Appendix 10.3-2f). The remainder was composed of a few pools and riffles. The channel bottom was dominated by silt (75%), organic matter and sand, explaining why the field crew were not able to electrofish (substrate was too soft). Cover was not abundant, only providing 20% of the area for fish use. It was comprised of pools, boulders, and overhanging vegetation. The banks were entirely covered with vegetation and very stable. They measured 1.5 m in height and were composed of silt and organic matter.

Plate 10.3-4: Tail Outflow channel flowing through a flooded terrace filled with sedges and macrophytes. The stream channel was very narrow (0.45 m on average).

Spawning habitat was classified as poor due to the scarcity of spawning substrate and 100% embeddedness (due to large amount of silt). However, given the width and depth of the channel, this section could be excellent for migration. There was no overwintering habitat, fair rearing habitat, and poor adult feeding areas.

On August 29, the section was assessed a second time, which corresponded to the low flow period. The section of the channel surveyed (100 m) was significantly narrower (2 m) and shallower (0.5 m). Pools and runs were equally abundant, representing 45% each of the total area (Appendix 10.3-2f). Quality of runs decreased significantly from June, with the majority being poor, but 40% of the total area was high quality pool habitat. Substrate was still predominantly silt (65%). The cover for small fish increased from 20 to 75% from the June sampling period due to the abundance of pools and new growth of macrophytes and/or submerged vegetation. Periphyton was very abundant. Both banks were in the same condition as they were in June.

Due to the low water level, the section was classified as poor habitat for migration. No spawning, overwintering, or adult feeding habitats were present. The section was again classified as fair for rearing.

10.3.2.2.7 Proposed Road Crossing 14

On June 25, 2000, Crossing 14 was surveyed over a continuous length of 300 m. This channel section has a low gradient (2%) and was 2.2 m wide on average with a mean depth of 0.35 m. A series of riffles and poor quality runs represented 70% of the section (Appendix 10.3-2g). Other habitats included fair quality runs (10%) and fair and poor quality pools (5 and 15%, respectively). Organic matter covered approximately 80% of the stream bottom. The rest was silt. Very little cover (20%) existed for fish in this section. Cover consisted primarily of pools. The presence of vegetation in the channel suggested that it dries up later in the season. Banks were composed mainly of organic matter with some silt and were unstable. They ranged between 25 and 50 cm in height and were moderately covered by vegetation (60%).

There was very little fish habitat present. As observed at Crossing 13, migration habitat was classified the highest, ranked good at this crossing. Rearing habitat was the only other type of habitat present, but ranked poor.

The section was surveyed a second time in August at low flow. The width and depth were very similar to the June sampling period, 2.5 m and 0.45 m, respectively (Appendix 10.3-2g). The length assessed was 350 m. The whole section was dominated by pools (90%). Forty percent were poor quality (< 0.3 m), 30% intermediate quality (0.3 - 0.75 m), and 20% were good quality (> 0.75 m). The average maximum pool depth was 1.3 m. The rest of the reach consisted of riffles. Boulders covered 10% of the channel; the rest was silt and organic matter, in equal amounts. Cover for fish was more abundant (40%) than in June, due to the high quantity of pools. Despite the abundance of pools, there was no fish habitat present except for some rearing habitat, classified as poor.

10.3.2.2.8 Proposed Road Crossing 15

Stream crossing 15 along the road route was sampled on June 26 and August 29, 2000 (Figure 10.2-1). The length of the section surveyed was not recorded in June; a 175 m section was surveyed in August. In June, the width of the channel was 3 m with a gradient of less than 1%. Instream habitat consisted of a series of pools connected by runs and deep riffles (Appendix 10.3-2h). The runs comprised of 55% of the habitat (15% good quality and 40% intermediate quality), riffles 25%, with pool habitat classified as good, making the remainder of the habitat. As observed in Crossing 13 and 14, there were practically no boulders, gravel or cobble in the streams. The majority of the substrate (85%) was composed of organic matter, with some silt, sand, and a few boulders. The banks were entirely lined with sedges and willows and measured 0.50 m in height. Approximately half of the area within the stream channel provided cover for fish. Cover was comprised mainly of pools and some cutbanks. The channel was deeply cut into the permafrost and thus provided an excellent migrating channel for adult fish. There were no observable overwintering habitat and spawning and adult feeding habitat was classified as poor. Rearing habitat was classified as fair.

In August, the water level was significantly lower, the width was 1 m and the mean depth was 0.8 m. The reach surveyed was very heterogeneous with a series of different habitat types; pools, runs, riffles, and flats (Appendix 10.3-2h). Very deep pools (~ 2 m) were connected by deep narrow channels cut in the tundra. The flow was barely perceptible and periphyton was abundant. Organic matter was again the most abundant substrate (65%) with a good portion (25%) of silt. Macrophytes and/or submerged vegetation had grown tremendously over the summer, therefore providing extensive cover for fish. A total of 70% of the stream channel area was available for cover, of which 50% was due to macrophytes and/or submerged vegetation, 35% to pools and the remainder cutbanks and overhanging vegetation. This vegetation covered 100% of the banks, making them fairly stable. The banks were 0.75 m high and composed of organic matter and sand. Migration habitat was still abundant due to the depth of the section. The only other potential habitat for fish was rearing, ranked as poor.

10.3.2.2.9 Proposed Road Crossing Aimaoktak NE Inflow

The NE Inflow, located at Crossing 23, is the largest stream flowing into Aimaoktak Lake (Figure 10.2-1) and the widest stream crossing along the road route. A 750 m continuous section was surveyed on June 26, 2000 at high flow. The channel was very wide (20 m) with a mean gradient of 2% (Appendix 10.3-2i). More than half of the reach consisted of a high gradient series of rapids. There were also shallow rapids or riffles with lower gradients. There was a pair of chutes along the rapids, which could potentially be used as a location for a bridge. The remainder of the habitat was deeper than 0.75 m and consisted of high quality runs, pools, and flat areas. The streambed was free of silt and had minimal sand (5%). It primarily consisted of boulders (65%), cobble (15%), and bedrock (15%). The large quantity of boulders provided good cover for fish. The banks were also composed of boulders with vegetation and were approximately 1 m in height. The section should be given significant consideration due to its excellent suitability for spawning, rearing, adult feeding, and migration. The stream is especially good for Arctic grayling, but has poor overwintering habitat. Due to its size and discharge, it likely provides a large portion of the stream fish habitat utilized by Aimaoktak Lake fishes.

10.3.2.2.10 Summary of Stream Habitat Assessments

Potential fisheries habitat within streams that could potentially be impacted by project development were assessed during the open-water season 2000. As expected, due to the known population of Arctic char that overwinters in Roberts Lake, Roberts and Little Roberts outflows provide excellent habitat for migrating Arctic char. These streams are very important to local fish populations as their habitat provide excellent spawning, rearing, and adult feeding areas, in addition to a migrating corridor. Future monitoring should be conducted in this system, due to its importance to fish communities.

The other habitat assessments were conducted along the proposed road route. Habitat values varied along those crossings, with the highest found at the NE Inflow. The NE Inflow of Aimaoktak Lake had excellent suitability for spawning, rearing, adult feeding, and migration. If development of the road is initiated, special consideration will need to be taken when traversing this stream. Another crossing that will need considerable attention is Glenn Outflow. Its habitat value was rated good, as both migrating and rearing habitats were classified as either good or excellent during both surveys. It is located near Roberts Bay, and therefore can be accessed by anadromous Arctic char. One Arctic char was captured in August within this stream and a group of 12 adults were observed below some rapids.

Two of the three crossings midway along the road route (PRC-13 and 14) were classified as poor value, except at high flow (June) when migration was rated as high. Organic matter and silt dominated both channel streambeds, with no spawning substrate available. Channel crossing 15 was similar to the first 2 crossings, but with more pools present, and was therefore rated as fair. Doris and Tail outflows were very shallow. Their fish habitat values were classified as poor with minimal or no habitat. Waterfalls located just downstream of the reach surveyed in Doris Outflow inhibits fish access to the lake.

11. ROBERTS BAY HABITAT ASSESSMENT

11. ROBERTS BAY HABITAT ASSESSMENT

A habitat assessment was conducted along the shoreline of Roberts Bay in 2000, in order to provide baseline environmental data for potential project activities such as a port or plant site. The shoreline assessment focussed on potentially available habitat for marine intertidal organisms as well as fish.

11.1 Methods

The shoreline of Roberts Bay was surveyed on August 29, 2000, in which a habitat assessment was conducted by surveying the entire perimeter of Roberts Bay by helicopter. Notes were made on the general composition of the marine substrate/sediments in the area as well as suitability of habitat for fish and aquatic organisms. Substrate types were categorized as silt, sand, gravel, cobble, boulders, and bedrock. Ratings of the habitat quality were based upon available cover for fish and invertebrates, suitability of substrate for feeding/foraging, and suitability of the substrate for habitation by marine benthic invertebrates. Benthic invertebrates are generally more common in areas with greater proportions of sand or silt as compared to areas dominated by large boulders or bedrock. However, boulders and bedrock do provide habitat for sessile organisms (permanently attached to substrate). Boulder and cobble areas can also provide cover for fish. General habitat quality was categorized into four types; poor, fair, good and excellent.

11.2 Results and Discussion

The marine shoreline environment of Roberts Bay is subject to a very small tidal range, likely on the order of 30 cm or less (Canadian Hydrographic Service). Tidal information is available for Cambridge Bay (approximately 150 km NNE of the bay) and Kugluktuk (Coppermine; approximately 300 km west of the bay). The two areas have quite different tidal patterns (Cambridge Bay exhibits mainly semi-diurnal tides, while Kugluktuk exhibits mainly diurnal tides), and the tidal cycle at Roberts Bay is likely somewhere in between. Regardless of the number of tidal cycles per day, water height varies only slightly in Roberts Bay, with steep rock areas showing minimal tidal variation, and flatter sand beach areas showing more variation. Given the small magnitude of tidal fluctuations in Roberts Bay, other physical forces such as waves, storms, and ice-scouring likely influence the physical habitat of shoreline organisms in Roberts Bay more than tides.

Fish species that may use Roberts Bay include marine species such as Arctic cod and sand lance, and other species such as Arctic char, Arctic cisco, least cisco, broad whitefish, slimy sculpins, and ninespine sticklebacks that live in both freshwater and marine environments. Some of these fish will spend most of their life in the sea, whereas others will spend most of it in freshwater. The Arctic char, Arctic cisco, and least cisco are anadromous species (they will spawn in freshwater and return to sea). The larvae of the migratory forms of the least cisco move downstream toward the sea upon hatching (Scott and Crossman, 1973), whereas young Arctic char may not return to sea until they are 5 – 7 years old (Grainger, 1953). Broad whitefish mainly live in freshwater but in brackish waters on occasion. The majority of these fish spawn in freshwater, and therefore, do not utilize the marine environment as spawning habitat. The major potential for habitat use in Roberts Bay by most fish species is for rearing and feeding. Therefore, habitats that provide cover and food items are high quality habitats.

Results from the Roberts Bay shoreline substrate survey are presented in Figure 11.2-1. Figure 11.2-2 presents the results of the general habitat assessment. These ratings are semi-qualitative as a fairly large area was surveyed with no detailed ground work.

Roberts Bay is dominated by cliffs up to 50 m in height at the northern and western areas of the bay (Plate 11.2-1). The eastern and southern areas of Roberts Bay are more gradually sloped and contain numerous lake drainages. While the cliff areas were generally devoid of terrestrial vegetation, the gently sloped valleys had lush growths of reeds, grasses and other vegetation (see terrestrial vegetation indicated on Figure 11.2-2). However, none of this vegetation was observed to grow in or hang over the water, thus it did not provide habitat or cover for aquatic organisms.

Plate 11.2-1: View of western side of Roberts Bay looking north. While southern portions were vegetated and gently sloping, northern areas consisted primarily of bedrock cliffs over 50 m in height.

Starting from the northwest peninsula, shoreline substrate consisted primarily of bedrock, boulders and cobblestone with several areas consisting solely of bedrock (Plate 11.2-2). This habitat was considered poor to fair for fish and aquatic organisms, as it provides little or no potential cover but a suitable substrate for colonization by some benthic organisms such as small benthic invertebrates, anemones and barnacles.

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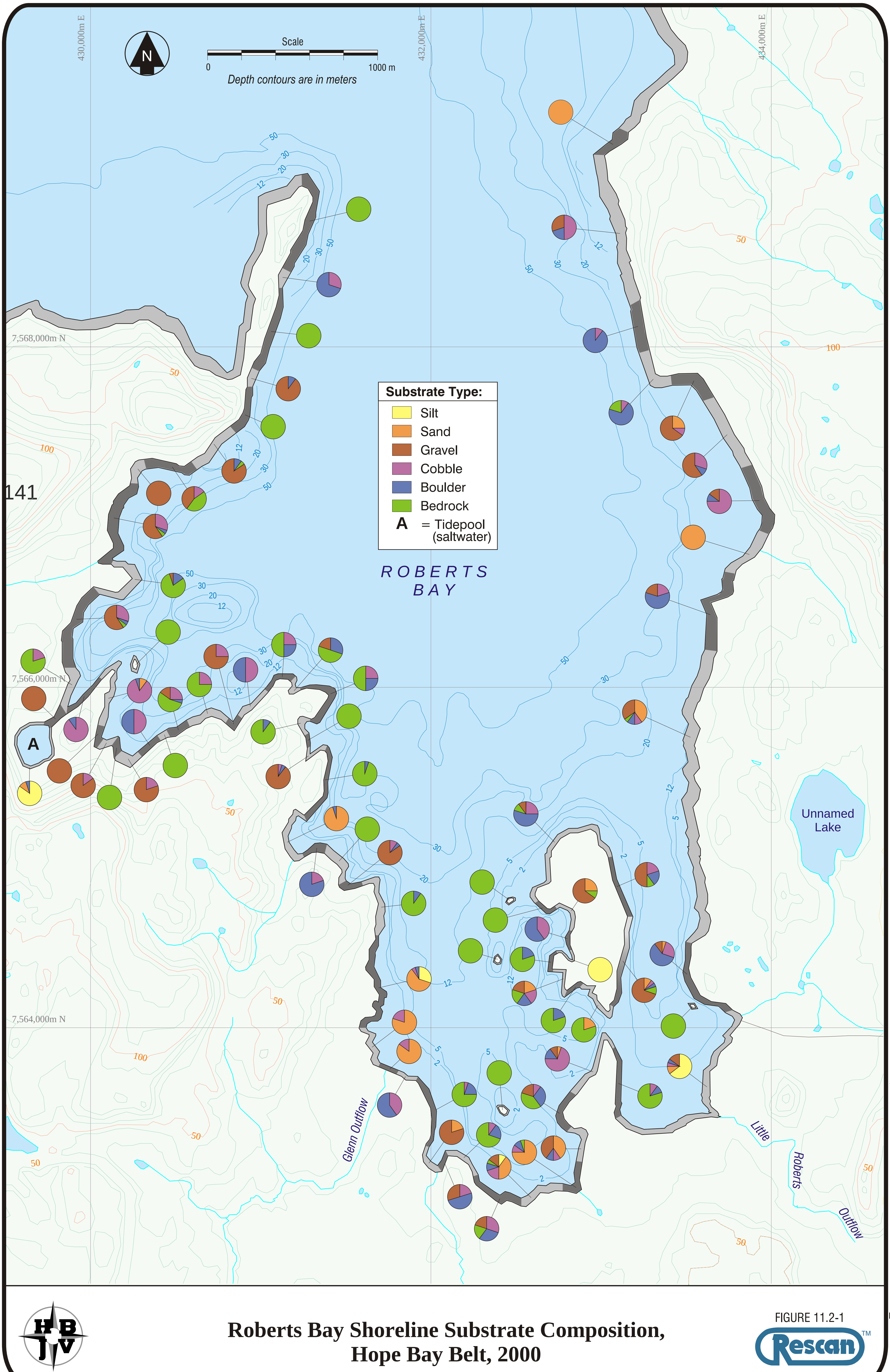

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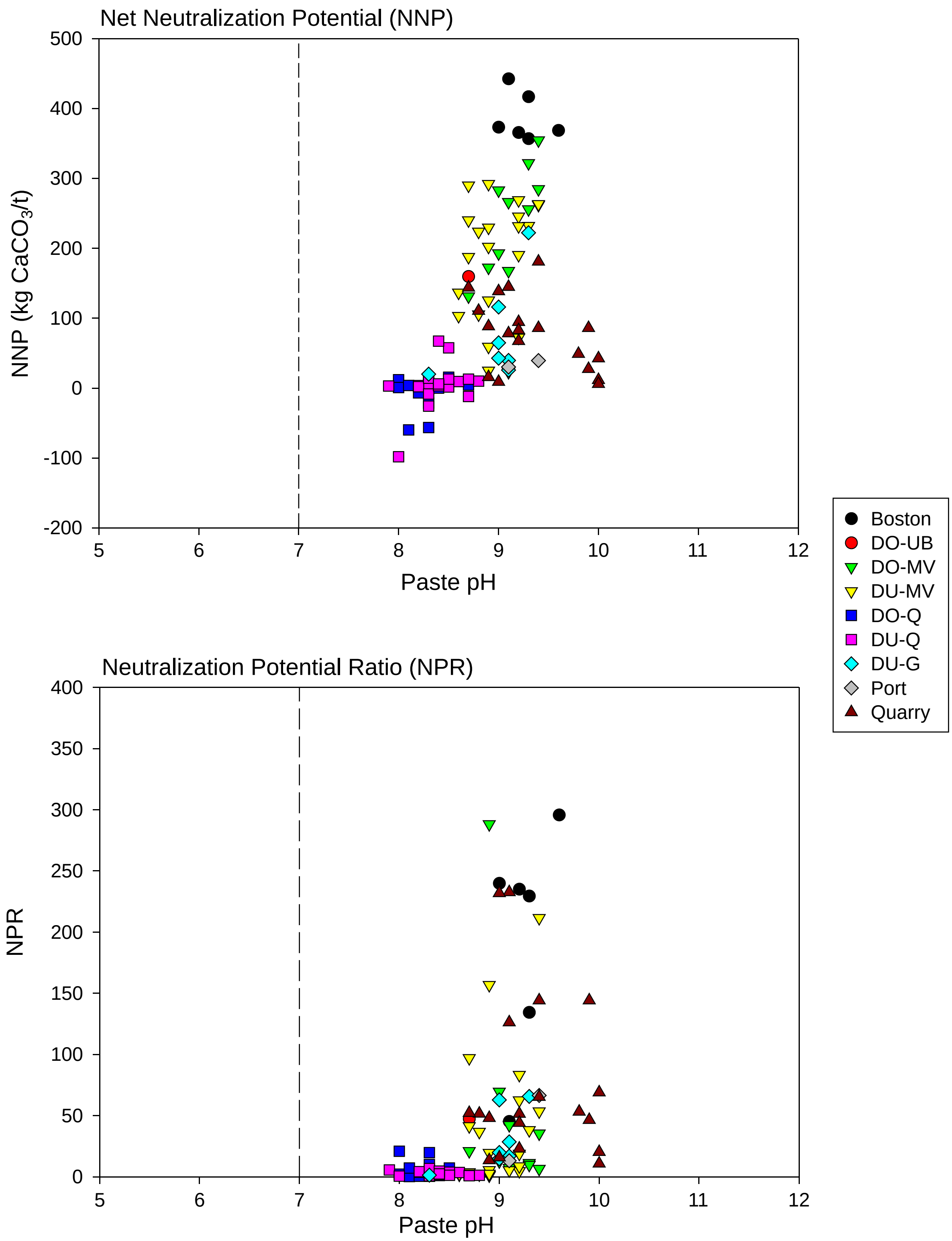
Roberts Bay Shoreline Substrate Composition, Hope Bay Belt, 2000

Source: Canadian Hydrographic Services

DO-MV = Doris open pit-mafic volcanics; DU-MV = Doris underground-mafic volcanics; DO-Q = Doris open pit-quartz;
DU-Q = Doris underground-quartz; DU-G = Doris underground-gabbro; DO-UB = Doris open pit-unaltered basalt



Net Neutralization Potential (NNP) and Neutralization Potential Ratio (NPR) vs Paste pH, Hope Bay Belt Static Test Results, 2000

FIGURE 12.2-2

Plate 11.2-2: Close-up view of bedrock area characteristic of the northern portions of Roberts Bay.

Moving south, the proportion of gravel increased, becoming dominant at several sites. Sand was found at relatively few sites, but its presence allowed for potential colonization by smaller, burrowing organisms. This may subsequently provide a food source for fish. Boulders provided potential cover for fish. These areas were rated as good habitat for fish and marine benthic invertebrates.

Along the western portion of Roberts Bay, a small tide pool connected to the bay was observed (marked A on Figures 11.2-1 and 11.2-2). This tide pool consisted primarily of silt and sand and represented potentially important habitat for marine benthic invertebrates. This area was rated as good habitat for fish and invertebrates. Colonization by smaller bodied, burrowing invertebrates would have been greater here as compared to northern areas, and could potentially provide a food source for fish.

Further south, towards the more gently sloped areas, the proportion of gravel, sand and silt increased (Plate 11.2-3). The increase in sand and silt were likely the result of the multiple outflows draining into Roberts Bay. Outflow areas are heavily utilized by fish inhabiting both fresh and marine environments such as the species identified earlier. Areas of silt and sand usually provide good habitat for benthic invertebrates, and they are preyed upon by fish. These outflow areas were given a rating of excellent as they provided habitat for known anadromous fish and the composition of the sediments provided adequate cover for fish and marine organisms. Overland run-off and outflowing waters may provide nutrients beneficial to marine algae, which ultimately benefits invertebrates and fish.

Plate 11.2-3: View from southern area of Roberts Bay looking eastward. Sediments in this area were dominated by sands and silts. Silt (light brown area) is clearly visible towards the shoreline.

The eastern shoreline of Roberts Bay consisted primarily of gravel and sand at the southern portion, and was dominated by cobble and boulders towards the northern portion. A decrease in shoreline vegetation and increase in surrounding slope accompanied this shift to larger grained sediments (Plate 11.2-4). The southern portion was rated as good habitat as it provided some cover and suitable habitat for fish and marine organisms. The northern portion of the western shoreline was rated as poor to fair as it did not provide much cover for fish or suitable substrate for marine benthic organisms.

The island at the south end of Roberts Bay was also surveyed. The island's shoreline consisted primarily of gravel with boulders and bedrock at the northern end and sand at the southern end (Plate 11.2-4). Habitat quality ranged from fair at the northern end to good at the southern end.

Areas of specific concern in Roberts Bay include Glenn and Little Roberts outflows, and the existing archaeological sites. Glenn and Little Roberts outflows are located along the southern portion of Roberts Bay. These outflows are of potential interest as both are utilized by anadromous Arctic char. In addition, broad whitefish and least cisco, both of which live in marine and freshwater environments, were found in Little Roberts Lake during the August 2000 survey.

The outflow leading from the unnamed lake located on the eastern side of Roberts Bay was disconnected from the lake during the August survey (Plate 11.2-5). An examination of the outflow did not reveal the presence of any arctic char.

Plate 11.2-4: View from the southern island in Roberts Bay looking towards the eastern side. This view shows the shift from gently sloped, vegetated areas dominated by fine grained sediments in the southern areas, to more steeply sloped, non-vegetated areas dominated primarily by bedrock in the north.

Plate 11.2-5: View of the disconnected outflow from the unnamed lake (Figure 11.2-1) located on the eastern rim of Roberts Bay.

The shoreline habitat of Roberts Bay ranged from fair (bedrock dominated northern areas) to excellent (Glenn and Little Roberts outflows in the southern area). Project development activities should take into account issues related to shoreline habitat near the Glenn and Little Roberts outflows.

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12. ACID GENERATION TESTWORK

12. ACID GENERATION TESTWORK

This section presents a brief discussion of the static ARD characterization testwork performed on samples from the Boston and Doris properties. The analytical methods used for static testing are described below and pertinent results are presented and discussed.

12.1 Methods

Static prediction testwork is carried out to determine the balance between the acid-generating components and the acid-consuming components of a sample. The work is performed prior to kinetic testwork and provides important information for the interpretation of kinetic test results. Details of the sampling regime and the analytical testwork are presented below.

12.1.1 Sample Collection

Samples were obtained from both the Boston and Doris properties. Samples were collected from the Boston Property to address possible discrepancies arising from previous testwork. It is believed that samples collected previously from bulk samples and drill core were not necessarily representative of geologic material that could be expected to be extracted during development of the Boston Property. Under the direction of Hope Bay Joint Venture geologists, six additional drill core samples were collected in July of 2000 and submitted for analysis. Information on the Boston samples that were collected in 2000 is provided in Appendix 12.1-1. Sampling details are provided in Table 12.1-1.

Table 12.1-1
ARD Sampling Locations and Dates,
Hope Bay Belt, 2000

Sample Location	Date Collected
Boston - Drill Core	July 17, 2000
Doris - Drill Core	July 21 and 23, 2000
Proposed Port Site	July 18, 2000
Potential Quarry Sites	July 18, 2000

Previous work on the Doris Property consisted of static testwork on 76 drill core samples. These samples were collected near the mineralized zone of the Central Vein to represent rock types that might be disturbed if bulk sampling at Doris Lake were to proceed. Based on the results of the previous analytical testwork, additional samples were selected in consultation with a Hope Bay Joint Venture geologist to fill in data gaps and obtain information on rock types that could be encountered if development of the Lakeshore

Vein were to proceed. With assistance from a Hope Bay geologist, a total of 52 drill core samples and 24 assay pulp samples were obtained from Doris material in July of 2000. The pulp samples were used when it was found during the selection of drill core that the interval of interest had already been sampled. Sample information is provided in Appendix 12.1-1. Sufficient sample was collected from a particular interval to ensure there was enough material for analysis. At the analytical laboratory, the sample was prepared (crushed to less than 60 mesh in the case of drill core) and a sub-sample was taken for acid-base accounting (ABA) analysis.

Development of the Hope Bay property may involve the construction of an all-weather road and a port site. Chip samples were collected under the direction of a Hope Bay geologist from potential quarry sites along the potential road route and in the area of the potential port site (Figure 12.1-1). A total of 19 chip samples were collected from six separate locations along the road route and two chip samples were taken from the area of the potential port site. Information on the road and port samples is provided in Appendix 12.1-1.

Samples that were collected represent the rock types listed in Table 12.1-2. A total of 58 drill core samples (6 from Boston, 52 from Doris), 24 pulp samples (all from Doris) and 21 grab samples (19 from road route, 2 from port site) were collected in 2000 and submitted for ABA analysis.

Table 12.1-2
Rock Types at Boston and Doris Properties

Rock Type	Sample Label(s)	Description
Mafic Volcanics	DO-MV, DU-MV	• hematite staining; trace-1% magnetite
	"	• dolomite/sericite alteration; <1% pyrite
	"	• dolomite/sericite alteration; >1-2% pyrite
	Port	• see Appendix 12.1-1 for detailed descriptions
Quartz	DO-Q, DU-Q	• rare-1% pyrite; Lakeshore Vein
	"	• > 1% pyrite; Lakeshore Vein
Gabbro	DU-G	• coarse-grained massive
Basalt	Boston	• altered basalt
	DO-UB	• unaltered basalt
	Quarry	• see Appendix 12.1-1 for detailed descriptions

1: DO-MV: Doris open pit – mafic volcanics; DU-MV: Doris underground – mafic volcanics; DO-Q: Doris open pit – quartz; DU-Q: Doris underground – quartz; DU-G: Doris underground-gabbro; DO-UB: Doris open pit – unaltered basalt.

12.1.2 Analytical Methods

Analytical work was performed by B.C. Research Inc. (BCRI) in Vancouver, British Columbia. BCRI was used for both the static prediction testwork and the kinetic prediction testwork that was conducted during the 2000 ARD characterization program.

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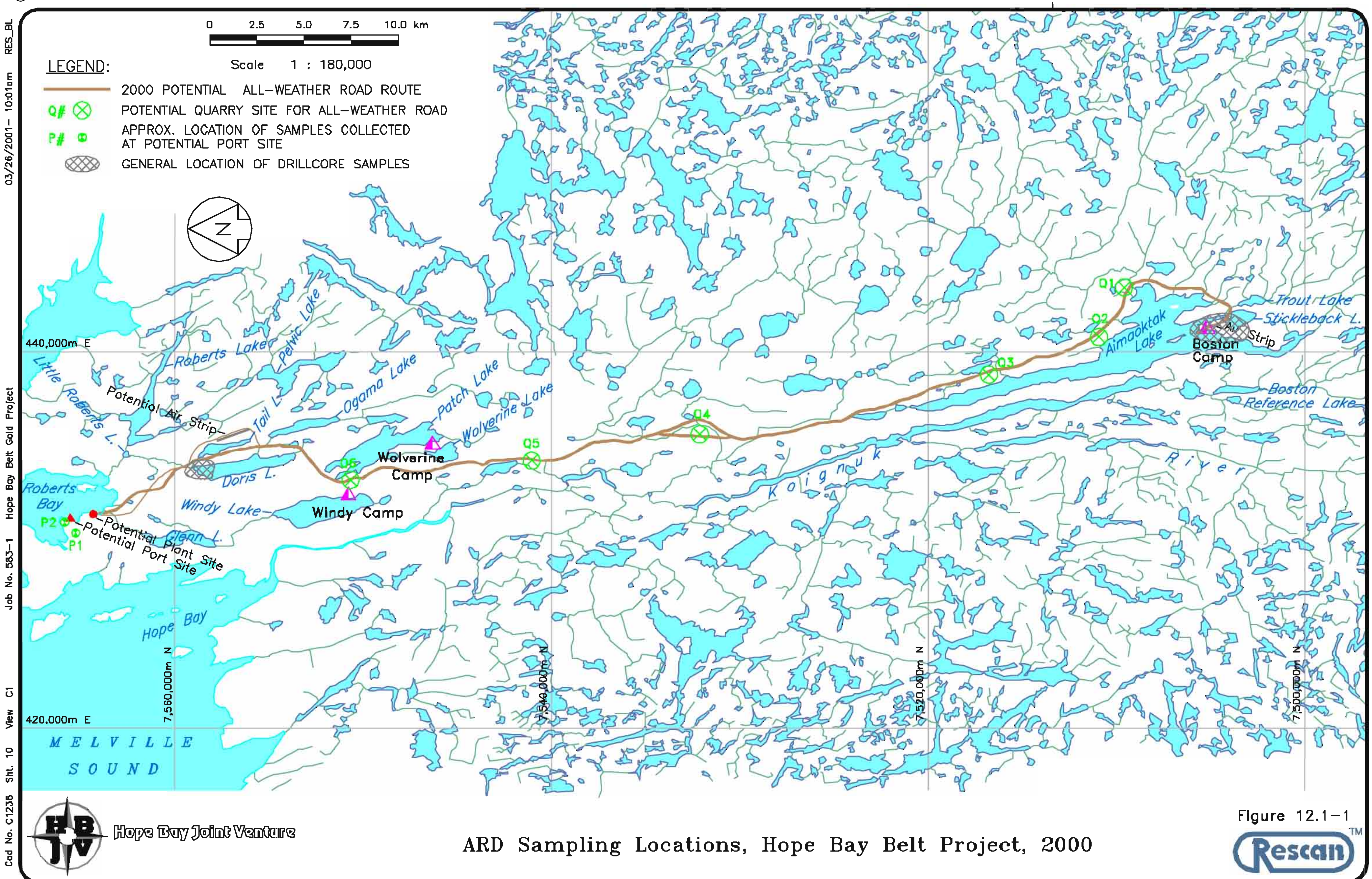


Figure 12.1-1

ARD Sampling Locations, Hope Bay Belt Project, 2000

Static prediction testing is used to determine the balance between the acid-consuming potential and acid-generating potential of a sample. The accepted method of static prediction testing is acid-base accounting (ABA). The ABA methods outlined below are based on standard methods developed by the U.S. EPA (Sobek *et al.*, 1978). The ABA methods used for the analysis of the Hope Bay Belt samples are described in greater detail in the Department of Indian Affairs and Northern Development (DIAND) Guidelines for Acid Rock Drainage Prediction in the North (DIAND, 1993) and the more recent Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia (Price and Errington, 1998). The following parameters were determined during the static prediction testwork: fizz test, paste pH, total sulphur, sulphide sulphur, sulphate sulphur, inorganic carbon and neutralization potential. The analytical procedure that was followed to determine each of these parameters is described below.

12.1.2.1 Fizz Test

A fizz test is performed to determine the volume and normality of hydrochloric acid that is to be used in the neutralization potential (NP) analysis (see Table 12.1-3). The test is conducted by adding one or two drops of 25% HCl to approximately 0.5 g of crushed sample and rating the amount of effervescence produced, from none (1) to strong (4).

Table 12.1-3
Volumes and Normalities of Acid Used in NP Determination[1]

Fizz Rating	Volume of HCl (mL)	Normality of HCl (N)
None (1)	20	0.1
Slight (2)	40	0.1
Moderate (3)	40	0.5
Strong (4)	80	0.5

1: adapted from Sobek *et al*., 1978.

12.1.2.2 Paste pH

Paste pH is a measure of the amount of readily available neutralizing mineral associated with a sample. Paste pH is determined by adding approximately 5 mL of deionized water to 10 g of crushed sample and allowing the sample to become saturated. More water can be added if necessary to produce the desired consistency. The sample is stirred and the pH of the paste is measured using a pH meter.

12.1.2.3 Sulphur Analysis

Total sulphur is analyzed using a Leco sulphur analyzer. The sample (0.5 g of crushed material) is heated to approximately 1350ºC in an induction furnace while a stream of oxygen is passed through the sample. Sulphur dioxide released by the sample is measured using an infrared detection system and the total sulphur result is provided.

Acid-leachable sulphate is measured by placing a 05 g sample of less than 60 mesh material in a filter. Dilute (2:3) hydrochloric acid is added to the sample. The sample is then leached with distilled/deionized water until chlorides can no longer be detected in the leachate. The sample is air dried overnight and then transferred to a ceramic crucible for residual total sulphur analysis.

Sulphide sulphur is measured by placing a 0.5 g sample of less than 60 mesh material into a flask. Dilute (1:7) nitric acid is added to the sample and allowed to stand overnight at room temperature. The material in the flask is then poured into a funnel lined with filter paper. Distilled/deionized water is used to rinse all material out of the flask into the funnel. Sample is leached with distilled/deionized water until nitrates can no longer be detected in the leachate. The sample is air dried overnight and then transferred to a ceramic crucible for residual total sulphur analysis.

12.1.2.4 Inorganic Carbon

Inorganic carbon is determined by leaching a prepared sample with dilute hydrochloric acid. Carbon dioxide is released and carried into a measuring buret by a stream of oxygen. The volume of the two gases is measured and the gases are then passed through a potassium hydroxide solution that dissolves the carbon dioxide. The oxygen is returned to the buret and the volume is again measured. The difference in volume, corrected for temperature and pressure, is proportional to the percentage of inorganic carbon in the sample.

12.1.2.5 Neutralization Potential

Neutralization potential is measured following the standard Sobek method, also known as the EPA-600 method. A 2.0 g sample of crushed material is treated with the volume and normality of HCl determined from Table 12.1-3. The sample is heated gently until the reaction is complete and then carbon dioxide-free deionized water is added. The solution is allowed to boil for one minute and then covered tightly to cool. Once the solution has cooled to room temperature, it is titrated with the appropriate volume and normality of sodium hydroxide until the pH reading remains at 7.0 for at least 30 seconds. The neutralization potential is calculated from this information, using the following formula:

$$\textbf{Neutralization Potential}\ (NP) = \frac{50a\,[x-(b/a)y]}{c}$$

where a = normality of HCl
b = normality of NaOH
c = sample weight in grams
x = volume of HCl added (mL)
y = volume of NaOH added (mL) to pH 7.0

The NP is expressed as kilograms of calcium carbonate equivalent per tonne of material (kg $CaCO_3$/t).

12.1.2.6 Calculated Parameters

From these values, a number of other parameters can be calculated, including: maximum potential acidity (MPA), carbonate neutralization potential (CaNP), net neutralization potential (NNP) and the neutralization potential ratio (NPR). Maximum potential acidity is calculated by multiplying the percent total sulphur (as measured by the Leco furnace) by 31.25. This is a molar conversion based on the assumptions that the sulphur is present as pyrite, sulphur is converted to sulphate and 4 moles of H^+ are produced for each mole of pyrite oxidized. The molar conversion is based on one gram of sulphur in 100 g of material (1% S) is equivalent to 0.03125 moles of sulphur, which would be neutralized by 0.03125 moles of $CaCO_3$ (3.125 % $CaCO_3$). To express this value as kg $CaCO_3$/t, the conversion factor is 31.25. The calculation for MPA generates a value expressed in the same terms as NP (*i.e.*, kg $CaCO_3$/t). The carbonate NP is calculated by multiplying the percent CO_2 by 22.743. This is also a molar conversion that converts the value into kilograms of $CaCO_3$ equivalent per tonne of material. The atomic weight of one mole of $CaCO_3$ (100.09) is divided by the atomic weight of one mole of CO_2 (44.01) and to express the resulting value as kg $CaCO_3$/t, the value is multiplied by 10 (=22.743). The NNP is calculated by subtracting the MPA from the NP and the NPR is calculated by dividing the NP by the MPA.

12.2 Results and Discussion

The results of the 2000 ARD characterization testwork completed on samples collected from the Boston and Doris properties indicate that the majority of samples are likely to be non-acid generating. The complete analytical results are presented in Appendix 12.2-1. Selected results are discussed below.

12.2.1 General Interpretation

To properly interpret the static test results, a basic understanding of the different parameters being examined is required. Brief interpretations of the main parameters discussed in the following sections are provided below.

12.2.1.1 Paste pH

Paste pH is a measure of the amount of readily available neutralizing minerals associated with a sample. A paste pH of 5 or higher indicates that the sample contains sufficient neutralizing minerals to provide some degree of buffering capacity. A pH of less than 5, however, indicates that the sample has potentially generated acidity.

12.2.1.2 Net Neutralization Potential

The net neutralization potential (NNP) is the mathematical difference between the neutralization potential (NP) and the acid-generating potential (MPA). Theoretically, a sample with an NNP greater than zero would be considered net acid-consuming. In practice, however, it has been observed that samples with an NNP of up to 20 kg $CaCO_3$/t may still generate net acidity. Therefore, it is generally accepted that a sample must have an NNP of 20 kg $CaCO_3$/t or higher to be considered net acid-consuming (DIAND, 1993).

12.2.1.3 Neutralization Potential Ratio

While the NNP can provide useful information, it can also be somewhat misleading. The problem with the NNP can be best illustrated with an example. A sample with an NP of 40 and an MPA of 10 and a sample with an NP of 230 and an MPA of 200 both have an NNP of +30 kg $CaCO_3$/t. Relatively speaking, however, the first sample has four times as much acid-consuming potential as acid-generating potential while the second sample has approximately the same amount of acid-consuming and acid-generating potential. Assuming that both samples have the same mineralogy, the first sample is less likely to go acid than the second sample.

Therefore, a more useful predictor of a sample's acid-generating potential is the neutralization potential ratio (NPR). This value is the ratio of neutralization potential (NP) to acid-generating potential (MPA) in a sample. In the Northwest Territories, an NPR of greater than 3 indicates the sample has a low potential for generating acid; an NPR between 1 and 3 indicates an uncertain potential for generating acid; and an NPR of less than 1 indicates that the sample has a high potential for generating acid (DIAND, 1993). In most cases, samples with an NPR between 1 and 3 require further characterization, typically in the form of kinetic prediction testing.

12.2.2 Static Testwork

Presented below are selected results from the 2000 ARD characterization program. Where possible, these results are compared to those from the 1996 characterization program. Sulphur analyses indicated that sulphate was detectable in only five of the 103 samples submitted. The complete results are presented in Appendix 12.2-1.

Sulphide sulphur is calculated as the difference between total sulphur and sulphate sulphur. Therefore, the difference between total sulphur and sulphide sulphur for the 2000 Hope Bay samples was negligible. Depending on the analysis, total sulphur or sulphide sulphur can be used to interpret the results. For the analysis used in the 2000 testwork, total sulphur is used for interpretation. This is a slightly conservative method as total sulphur values were higher than sulphid sulphur values in five of the samples (2.98% vs. 2.97%, 6.57% vs 6.54%, 4.54% vs. 4.53%, 2.20 vs. 2.19% and 6.02% vs. 5.99%, respectively). The minor differences among these samples did not affect the conclusions discussed in the following sections.

12.2.2.1 Paste pH

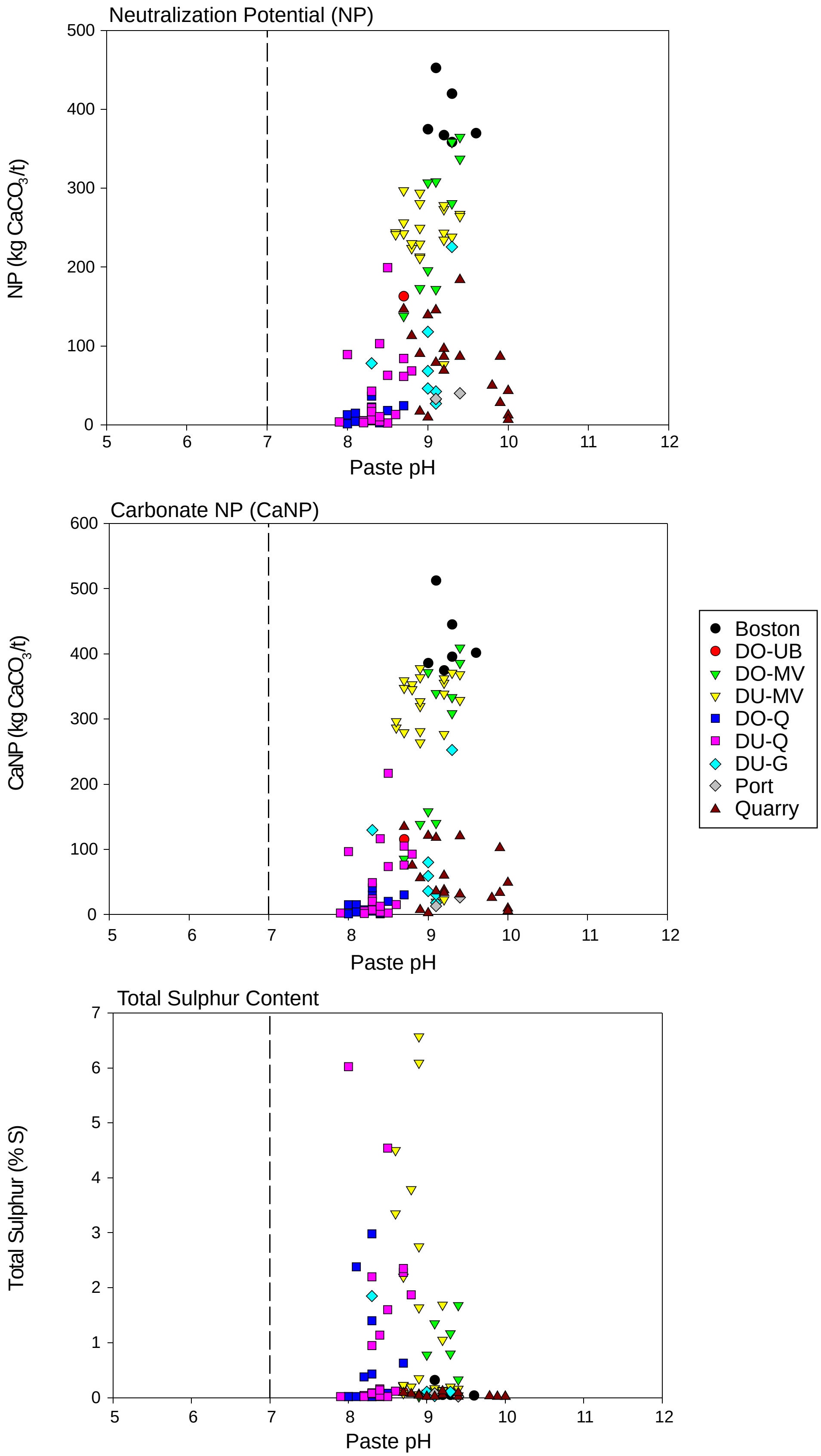
Figures 12.2-1 and 12.2-2 present various parameters (NP, CaNP, sulphur, NNP, NPR) plotted against paste pH. The Hope Bay samples had paste pH values that ranged from 7.9 to 10.0. The quarry samples produced the highest paste pH values (up to 10.0) of all the samples collected in 2000. These high paste pH values indicate that the samples contained significant amounts of neutralizing minerals. Results from the previous testwork conducted in 1996 indicated that Doris Lake samples had paste pH values that were slightly lower than the 2000 values, varying between 7.4 and 9.8.

Figures 12.2-1 and 12.2-2 indicate that the Hope Bay samples analyzed in 2000 had NP values that ranged from 1 to 452 kg $CaCO_3$/t. The Boston samples had high neutralization potential (390 ± 15 kg $CaCO_3$/t) and low total sulphur contents (<0.35% S). On the other hand, the Doris Lake samples with quartz mineralization (DO-Q and DU-Q) had fairly low neutralization potential (11.7 ± 2.4 kg $CaCO_3$/t and 40 ± 11 kg CaCO3/t, respectively) and contained highly variable total sulphur (<0.02 to 6.02% S). Mafic volcanic samples (DO-MV and DU-MV) had relatively high, but variable, NP (263 ± 27 kg $CaCO_3$/t and 233 ± 14 kg $CaCO_3$/t, respectively). The mafic volcanic samples also had the most variable total sulphur contents, ranging from <0.02 to 6.57% S. The samples collected from the proposed port site (Port) and the potential quarry sites (Quarry) typically had low to moderate NP (36.3 ± 3.6 kg $CaCO_3$/t and 78 ± 12 kg $CaCO_3$/t, respectively) and very low total sulphur contents (<0.02 to 0.12% S). Doris Lake samples analyzed in 1996 had NP values that ranged from 1 to 347 kg $CaCO_3$/t.

12.2.2.2 Neutralization Potential

The NNP of the Hope Bay samples ranged from -98 to 442 kg $CaCO_3$/t, but the majority (62%) of samples had NNP values that were greater than the DIAND guideline of 20 kg $CaCO_3$/t. The NPR of the Hope Bay samples varied from 0.2 to as high as 296, but over 70% of the samples had NPR values greater than the DIAND guideline of 3. These values indicate that the majority of samples have low acid-generating potential and that they contain some relatively fast-reacting neutralizing minerals, most likely dolomite or possibly calcite. The NNP values for Doris Lake samples from 1996 varied between -36 and 343 kg $CaCO_3$/t, a somewhat narrower range than that of the 2000 samples.

DO-MV = Doris open pit-mafic volcanics; DU-MV = Doris underground-mafic volcanics; DO-Q = Doris open pit-quartz;
DU-Q = Doris underground-quartz; DU-G = Doris underground-gabbro; DO-UB = Doris open pit-unaltered basalt



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Neutralization Potential (NP), Carbonate NP (CaNP) and Total Sulphur Content vs Paste pH, Hope Bay Belt Static Test Results, 2000

FIGURE 12.2-1

Rescan™

DO-MV = Doris open pit-mafic volcanics; DU-MV = Doris underground-mafic volcanics; DO-Q = Doris open pit-quartz;
DU-Q = Doris underground-quartz; DU-G = Doris underground-gabbro; DO-UB = Doris open pit-unaltered basalt

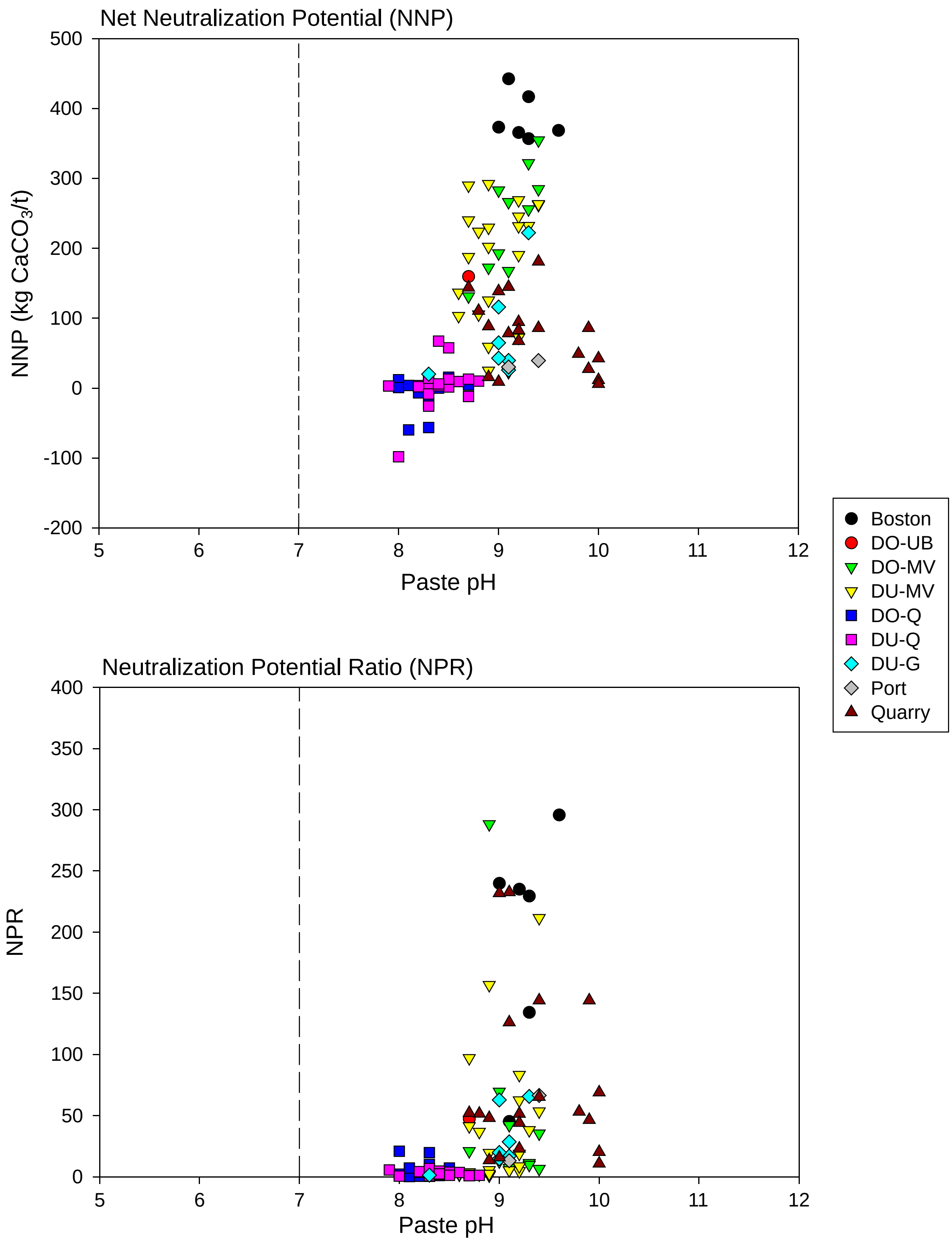


FIGURE 12.2-2

Net Neutralization Potential (NNP) and Neutralization Potential Ratio (NPR) vs Paste pH, Hope Bay Belt Static Test Results, 2000

DO-MV = Doris open pit-mafic volcanics; DU-MV = Doris underground-mafic volcanics; DO-Q = Doris open pit-quartz;
DU-Q = Doris underground-quartz; DU-G = Doris underground-gabbro; DO-UB = Doris open pit-unaltered basalt

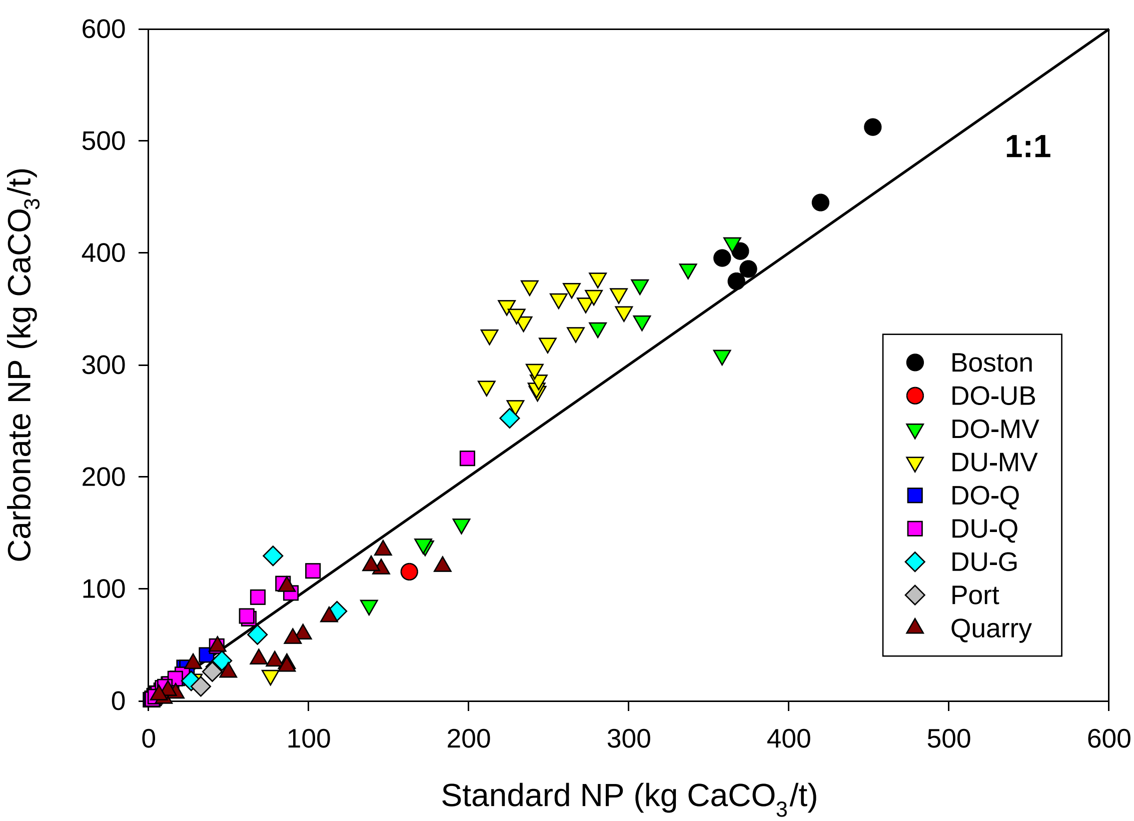


FIGURE 12.2-3

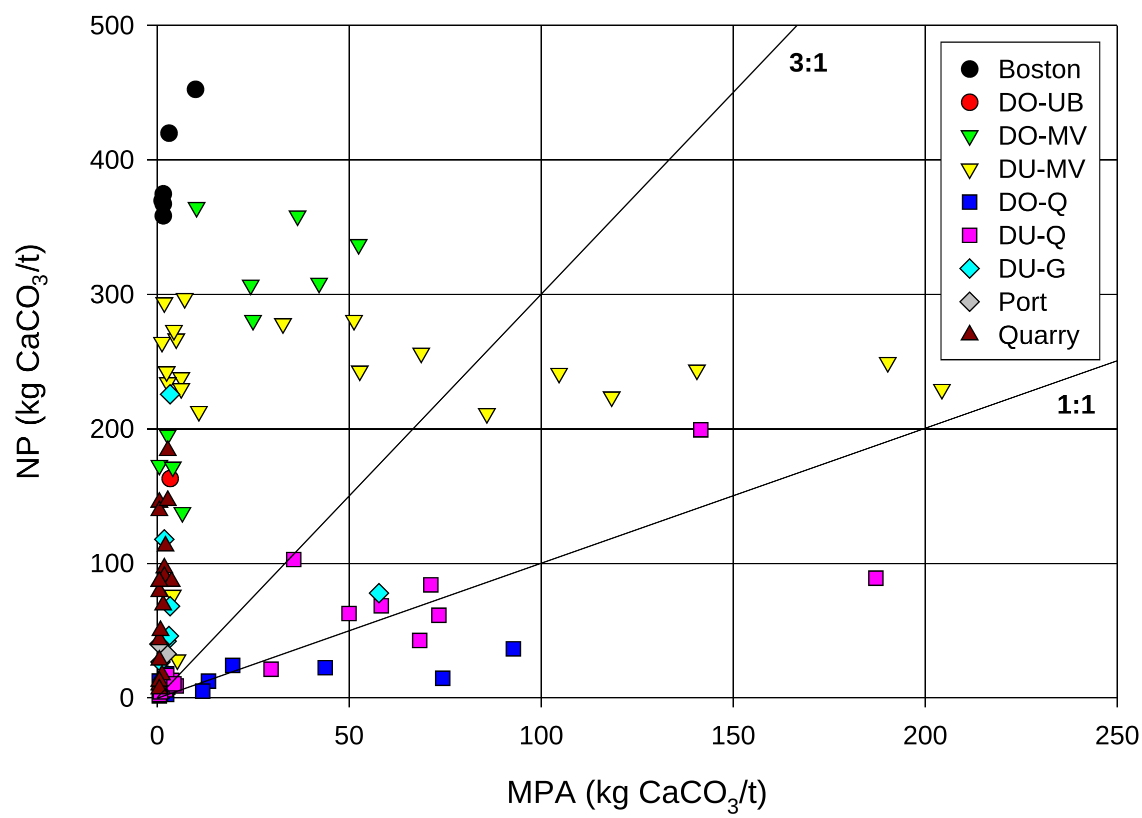
Carbonate NP vs Standard NP
Hope Bay Belt Static Test Results, 2000

Figure 12.2-3 plots carbonate NP against standard NP. The line indicates where carbonate NP equals standard NP (i.e. all of the measured NP is coming from carbonate dissolution). If a sample plots above the line, this indicates that there are carbonates in the sample that are not contributing net neutralization. Typical examples of these types of carbonates are siderite and rhodochrosite. If a sample plots below the line, this indicates that the NP is being contributed by both carbonates and other neutralizing minerals, such as fast-weathering silicates. From Figure 12.2-3 it appears that the Boston samples and the majority of the mafic volcanic samples (DO-MV and DU-MV) contain carbonates that do not contribute net neutralization. The majority of DO-Q and DU-Q samples had NP that was being contributed by net neutralizing carbonates, most likely dolomite. The gabbro samples (DU-G), port samples and quarry samples had NP that was being contributed by both carbonates and other neutralizing minerals.

Figure 12.2-4 plots neutralization potential (NP) against maximum potential acidity (MPA). By dividing the NP by the MPA, one gets the neutralization potential ratio (NPR). The lines plotted on Figure 12.2-4 represent NPR values of 3:1 and 1:1, the criteria used to assess ARD potential (DIAND, 1993). Those samples that plot above the 3:1 line are classified as having a low acid-generating potential; those that plot below the 1:1 line are classified as having a high acid-generating potential; and those that plot between the 3:1 and 1:1 lines are classified as having an uncertain acid-generating potential. From Figure 12.2-4 it is evident that the Hope Bay samples analyzed in 2000 had NPR values that varied from 0.2 to 296. Most (>70%) of the samples plot above the 3:1 line, indicating that the majority of samples can be classified as having a low acid-generating potential. Less than 10% of the samples plot below the 1:1 line, indicating only a few of the samples can be classified as having a high acid-generating potential. The samples that plot between the 3:1 and 1:1 lines are a mixture of mafic volcanic (DU-MV), gabbro (DU-G) and quartz samples (DO-Q, DU-Q). Of the samples that plot below the 1:1 line, all of them contain quartz mineralization (DO-Q and DU-Q). Doris Lake samples analyzed in 1996 had NPR values that ranged from 0.1 to 144. Again, the 1996 values are similar to, but lower than, the 2000 values.

An NPR-S diagram is plotted in Figure 12.2-5. This figure is divided into four quadrants, which are delineated by the DIAND criterion for NPR (3:1) and the total sulphur content below which acid generation is typically expected to be minimal (0.3% S). Samples located in Quadrant I are considered to have low acid-generating potential because the NPR is high (> 3) and the total sulphur content is low (< 0.3%). Samples located in Quadrant II or III have uncertain acid-generating potential. In Quadrant II, the NPR (> 3) is balanced by the total sulphur content (> 0.3%) while in Quadrant III, the total sulphur content (< 0.3%) is balanced by the NPR (< 3). Samples located in Quadrant IV are considered to have high acid-generating potential because of the combination of low NPR (< 3) and total sulphur content (> 0.3%). The majority of samples (60%) fall within Quadrant I, indicating a low acid-generating potential for most Hope Bay samples. All of the DO-UB, port and quarry samples and more than 80% of the Boston and DU-G samples fall within Quadrant I. However, less than half of the mafic volcanic and quartz mineralized samples (DO-MV, DU-MV, DO-Q, DU-Q) fall within Quadrant I. Approximately 20% of the samples fall within Quadrants II and III (12% and 7%,

DO-MV = Doris open pit-mafic volcanics; DU-MV = Doris underground-mafic volcanics; DO-Q = Doris open pit-quartz;
DU-Q = Doris underground-quartz; DU-G = Doris underground-gabbro; DO-UB = Doris open pit-unaltered basalt



Neutralization Potential (NP) vs Maximum Potential Acidity (MPA) Hope Bay Belt Static Test Results, 2000

Hope Bay Joint Venture

FIGURE 12.2-4

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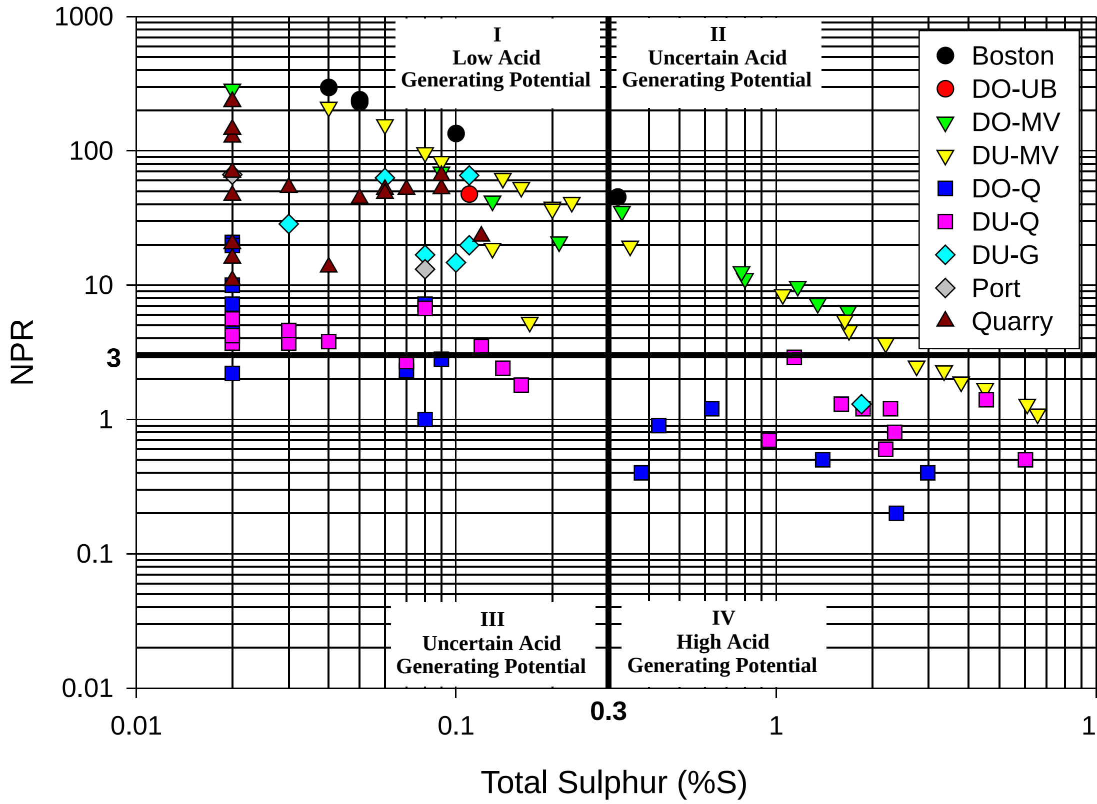
DO-MV = Doris open pit-mafic volcanics; DU-MV = Doris underground-mafic volcanics; DO-Q = Doris open pit-quartz; DU-Q = Doris underground-quartz; DU-G = Doris underground-gabbro; DO-UB = Doris open pit-unaltered basalt



Neutralization Potential Ratio (NPR)
vs Total Sulphur Content
Hope Bay Belt Static Test Results, 2000

FIGURE 12.2-5

respectively) and in Quadrant IV (21%). The samples in Quadrant II consist primarily of the mafic volcanic samples (DO-MV and DU-MV), while the Quadrant III samples are comprised entirely of the DO-Q and DU-Q samples. Quadrant IV represents a mixture of DO-Q, DU-G, DU-MV and DU-Q samples. Of the Hope Bay samples collected in 2000, approximately 20% have high acid-generating potential, 20% have uncertain acid-generating potential and 60% have low acid-generating potential.

12.2.3 Kinetic Testwork

Kinetic testwork in the form of humidity cells was initiated in December, 2000 on five samples that were selected based on the results of the static testwork. One of the samples was selected from the Boston material (Boston) and four of the samples were selected from the Doris material (DO-MV, DU-MV, DU-Q, DU-G). Specific sample details are provided in Appendix 12.3-1.

Results from the humidity cells are inconclusive at this time. The cells are likely still reaching a state of equilibrium, thus preventing a preliminary calculation of acid production and metal leaching rates. A complete analysis of the kinetic testwork will be included in an addendum to this report once the humidity cell testing has concluded.

12.3 Conclusions

Overall, the results of static testwork in the form of acid-base accounting indicate that the majority of Hope Bay samples collected in 2000 have a low acid-generating potential. However, a number of samples with quartz mineralization (DO-Q and DU-Q) and some mafic volcanic and gabbro samples (DU-MV, DU-G) have some high acid-generating potential. These samples contain a combination of limited amounts of neutralizing minerals and relatively high amounts of sulphur. The remaining samples, comprised entirely of mafic volcanics and quartz mineralization, have an uncertain acid-generating potential. Kinetic testwork in the form of humidity cells has been initiated and is expected to last for at least 6 months. The results from kinetic testing will be used to calculate acid production and metal leaching rates.

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APPENDIX 2.2-1
DAILY MEAN AIR TEMPERATURE FOR BOSTON WEATHER STATION, AUGUST 1998 TO SEPTEMBER 2000

Appendix 2.2-1
Daily Mean Air Temperatures for Boston Weather Station, August 1998 to September 2000

Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)
01-Aug-98	14.8	01-Sep-98	8.1	01-Oct-98	-1.6	01-Nov-98	-11.5	01-Dec-98	-12.0	01-Jan-99	-27.6
02-Aug-98	13.0	02-Sep-98	8.7	02-Oct-98	-2.3	02-Nov-98	-13.7	02-Dec-98	-15.2	02-Jan-99	-25.2
03-Aug-98	19.4	03-Sep-98	10.2	03-Oct-98	-3.1	03-Nov-98	-7.6	03-Dec-98	-19.5	03-Jan-99	-28.1
04-Aug-98	16.4	04-Sep-98	8.5	04-Oct-98	1.3	04-Nov-98	-7.0	04-Dec-98	-16.3	04-Jan-99	-28.2
05-Aug-98	10.0	05-Sep-98	5.9	05-Oct-98	3.4	05-Nov-98	-9.9	05-Dec-98	-14.9	05-Jan-99	-27.0
06-Aug-98	13.9	06-Sep-98	2.9	06-Oct-98	-2.6	06-Nov-98	-16.8	06-Dec-98	-14.4	06-Jan-99	-27.9
07-Aug-98	10.7	07-Sep-98	3.8	07-Oct-98	-5.5	07-Nov-98	-7.4	07-Dec-98	-18.9	07-Jan-99	-28.4
08-Aug-98	10.1	08-Sep-98	9.2	08-Oct-98	-6.1	08-Nov-98	-4.6	08-Dec-98	-26.5	08-Jan-99	-29.5
09-Aug-98	10.9	09-Sep-98	6.5	09-Oct-98	-2.5	09-Nov-98	-10.4	09-Dec-98	-14.7	09-Jan-99	-32.5
10-Aug-98	15.9	10-Sep-98	7.5	10-Oct-98	-1.5	10-Nov-98	-12.7	10-Dec-98	-11.8	10-Jan-99	-32.8
11-Aug-98	14.6	11-Sep-98	5.7	11-Oct-98	-4.5	11-Nov-98	-18.6	11-Dec-98	-14.9	11-Jan-99	-33.0
12-Aug-98	11.2	12-Sep-98	5.1	12-Oct-98	-1.6	12-Nov-98	-23.8	12-Dec-98	-16.4	12-Jan-99	-29.4
13-Aug-98	11.1	13-Sep-98	3.4	13-Oct-98	-2.1	13-Nov-98	-15.7	13-Dec-98	-20.9	13-Jan-99	-31.0
14-Aug-98	10.4	14-Sep-98	2.8	14-Oct-98	-2.8	14-Nov-98	-11.5	14-Dec-98	-21.8	14-Jan-99	-27.0
15-Aug-98	12.2	15-Sep-98	2.7	15-Oct-98	-9.0	15-Nov-98	-14.7	15-Dec-98	-28.8	15-Jan-99	-23.9
16-Aug-98	15.6	16-Sep-98	2.3	16-Oct-98	-5.8	16-Nov-98	-22.1	16-Dec-98	-24.8	16-Jan-99	-28.4
17-Aug-98	12.6	17-Sep-98	1.1	17-Oct-98	0.9	17-Nov-98	-18.7	17-Dec-98	-23.3	17-Jan-99	-27.0
18-Aug-98	9.1	18-Sep-98	2.2	18-Oct-98	0.6	18-Nov-98	-21.5	18-Dec-98	-24.8	18-Jan-99	-22.3
19-Aug-98	5.6	19-Sep-98	1.9	19-Oct-98	-3.5	19-Nov-98	-25.2	19-Dec-98	-27.1	19-Jan-99	-22.8
20-Aug-98	8.4	20-Sep-98	2.9	20-Oct-98	-0.8	20-Nov-98	-30.0	20-Dec-98	-24.1	20-Jan-99	-24.7
21-Aug-98	12.2	21-Sep-98	5.4	21-Oct-98	-4.5	21-Nov-98	-17.5	21-Dec-98	-21.8	21-Jan-99	-23.9
22-Aug-98	12.8	22-Sep-98	4.8	22-Oct-98	-7.3	22-Nov-98	-8.7	22-Dec-98	-23.2	22-Jan-99	-27.0
23-Aug-98	9.9	23-Sep-98	3.6	23-Oct-98	-9.8	23-Nov-98	-12.0	23-Dec-98	-28.9	23-Jan-99	-34.6
24-Aug-98	7.1	24-Sep-98	2.0	24-Oct-98	-11.3	24-Nov-98	-16.1	24-Dec-98	-20.2	24-Jan-99	-35.3
25-Aug-98	7.0	25-Sep-98	1.6	25-Oct-98	-5.8	25-Nov-98	-12.3	25-Dec-98	-19.0	25-Jan-99	-31.6
26-Aug-98	8.6	26-Sep-98	2.4	26-Oct-98	-3.7	26-Nov-98	-6.9	26-Dec-98	-27.9	26-Jan-99	-24.9
27-Aug-98	9.1	27-Sep-98	3.2	27-Oct-98	-3.7	27-Nov-98	-8.9	27-Dec-98	-33.8	27-Jan-99	-27.3
28-Aug-98	7.0	28-Sep-98	2.3	28-Oct-98	-7.9	28-Nov-98	-12.7	28-Dec-98	-29.2	28-Jan-99	-26.5
29-Aug-98	8.0	29-Sep-98	1.6	29-Oct-98	-5.6	29-Nov-98	-12.3	29-Dec-98	-28.5	29-Jan-99	-31.0
30-Aug-98	11.4	30-Sep-98	-1.2	30-Oct-98	-11.2	30-Nov-98	-13.1	30-Dec-98	-27.3	30-Jan-99	-38.7
31-Aug-98	8.4			31-Oct-98	-10.5			31-Dec-98	-22.2	31-Jan-99	-39.5
Mean	**11.2**		**4.2**		**-4.2**		**-14.1**		**-21.7**		**-28.9**

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Appendix 2.2-1
Daily Mean Air Temperatures for Boston Weather Station, August 1998 to September 2000 (continued)

Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)
01-Feb-99	-39.1	01-Mar-99	-29.3	01-Apr-99	-20.9	01-May-99	-14.0	01-Jun-99	2.3	01-Jul-99	5.2
02-Feb-99	-40.5	02-Mar-99	-32.4	02-Apr-99	-14.2	02-May-99	-10.0	02-Jun-99	2.6	02-Jul-99	4.7
03-Feb-99	-40.4	03-Mar-99	-33.6	03-Apr-99	-13.0	03-May-99	-6.5	03-Jun-99	1.3	03-Jul-99	7.3
04-Feb-99	-35.2	04-Mar-99	-30.9	04-Apr-99	-16.1	04-May-99	-15.6	04-Jun-99	1.3	04-Jul-99	8.8
05-Feb-99	-30.4	05-Mar-99	-25.8	05-Apr-99	-18.3	05-May-99	-17.7	05-Jun-99	0.0	05-Jul-99	11.0
06-Feb-99	-27.8	06-Mar-99	-27.1	06-Apr-99	-15.1	06-May-99	-17.1	06-Jun-99	-0.2	06-Jul-99	12.3
07-Feb-99	-28.2	07-Mar-99	-31.1	07-Apr-99	-15.7	07-May-99	-13.3	07-Jun-99	3.3	07-Jul-99	14.4
08-Feb-99	-34.9	08-Mar-99	-29.1	08-Apr-99	-19.2	08-May-99	-7.6	08-Jun-99	3.2	08-Jul-99	13.4
09-Feb-99	-32.0	09-Mar-99	-18.9	09-Apr-99	-17.8	09-May-99	-9.2	09-Jun-99	0.1	09-Jul-99	8.7
10-Feb-99	-28.4	10-Mar-99	-14.5	10-Apr-99	-18.0	10-May-99	-4.9	10-Jun-99	-0.6	10-Jul-99	8.7
11-Feb-99	-24.1	11-Mar-99	-9.7	11-Apr-99	-19.6	11-May-99	3.3	11-Jun-99	-0.8	11-Jul-99	11.7
12-Feb-99	-23.5	12-Mar-99	-11.9	12-Apr-99	-17.0	12-May-99	3.2	12-Jun-99	2.6	12-Jul-99	6.8
13-Feb-99	-28.6	13-Mar-99	-16.8	13-Apr-99	-14.2	13-May-99	-7.3	13-Jun-99	6.6	13-Jul-99	4.8
14-Feb-99	-22.9	14-Mar-99	-18.0	14-Apr-99	-15.8	14-May-99	-8.4	14-Jun-99	12.2	14-Jul-99	5.9
15-Feb-99	-21.4	15-Mar-99	-13.2	15-Apr-99	-15.8	15-May-99	-5.6	15-Jun-99	14.6	15-Jul-99	5.5
16-Feb-99	-31.6	16-Mar-99	-14.2	16-Apr-99	-14.2	16-May-99	-4.6	16-Jun-99	16.7	16-Jul-99	5.6
17-Feb-99	-23.6	17-Mar-99	-19.6	17-Apr-99	-11.6	17-May-99	-5.0	17-Jun-99	10.5	17-Jul-99	7.0
18-Feb-99	-23.4	18-Mar-99	-17.1	18-Apr-99	-12.5	18-May-99	-5.9	18-Jun-99	3.8	18-Jul-99	11.5
19-Feb-99	-24.0	19-Mar-99	-17.5	19-Apr-99	-17.2	19-May-99	-4.4	19-Jun-99	4.4	19-Jul-99	10.5
20-Feb-99	-18.7	20-Mar-99	-12.7	20-Apr-00	-9.9	20-May-99	-1.9	20-Jun-99	9.8	20-Jul-99	5.6
21-Feb-99	-17.4	21-Mar-99	-19.2	21-Apr-99	-15.6	21-May-99	-7.0	21-Jun-99	5.3	21-Jul-99	7.6
22-Feb-99	-17.0	22-Mar-99	-15.1	22-Apr-99	-8.2	22-May-99	-5.2	22-Jun-99	4.8	22-Jul-99	7.9
23-Feb-99	-18.7	23-Mar-99	-7.3	23-Apr-99	-7.1	23-May-99	-3.2	23-Jun-99	4.9	23-Jul-99	5.7
24-Feb-99	-21.1	24-Mar-99	-13.1	24-Apr-99	-15.9	24-May-99	0.9	24-Jun-99	5.8	24-Jul-99	6.5
25-Feb-99	-23.9	25-Mar-99	-9.5	25-Apr-99	-18.2	25-May-99	1.2	25-Jun-99	6.6	25-Jul-99	10.9
26-Feb-99	-23.4	26-Mar-99	-11.2	26-Apr-99	-16.7	26-May-99	-3.6	26-Jun-99	7.7	26-Jul-99	8.8
27-Feb-99	-26.5	27-Mar-99	-19.4	27-Apr-99	-19.2	27-May-99	-6.7	27-Jun-99	11.4	27-Jul-99	8.0
28-Feb-99	-31.6	28-Mar-99	-24.7	28-Apr-99	-17.3	29-May-99	-5.8	28-Jun-99	10.4	28-Jul-99	7.2
		29-Mar-99	-27.8	29-Apr-99	-14.1	30-May-99	-5.2	29-Jun-99	4.8	29-Jul-99	7.4
		30-Mar-99	-28.5	30-Apr-99	-12.7	31-May-99	-2.1	30-Jun-99	5.4	30-Jul-99	11.3
		31-Mar-99	-25.0							31-Jul-99	11.2
Mean	**-27.1**		**-20.1**		**-15.4**		**-6.3**		**5.4**		**8.4**

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Appendix 2.2-1
Daily Mean Air Temperatures for Boston Weather Station, August 1998 to September 2000 (continued)

Date	Daily Mean Temperature (°C)	Date	Daily Mean Temperature (°C)	Date	Daily Mean Temperature (°C)	Date	Daily Mean Temperature (°C)	Date	Daily Mean Temperature (°C)	Date	Daily Mean Temperature (°C)
01-Aug-99	11.8	01-Sep-99	4.3	01-Oct-99	-4.8	01-Nov-99	-11.4	01-Dec-99	-24.5	01-Jan-00	-21.9
02-Aug-99	11.6	02-Sep-99	4.7	02-Oct-99	-8.0	02-Nov-99	-8.1	02-Dec-99	-26.1	02-Jan-00	-20.5
03-Aug-99	11.9	03-Sep-99	5.1	03-Oct-99	-7.5	03-Nov-99	-14.6	03-Dec-99	-29.4	03-Jan-00	-18.8
04-Aug-99	10.4	04-Sep-99	7.9	04-Oct-99	-6.6	04-Nov-99	-20.1	04-Dec-99	-22.7	04-Jan-00	-19.7
05-Aug-99	7.9	05-Sep-99	11.9	05-Oct-99	-9.8	05-Nov-99	-24.9	05-Dec-99	-26.3	05-Jan-00	-22.9
06-Aug-99	6.0	06-Sep-99	9.2	06-Oct-99	-11.7	06-Nov-99	-20.5	06-Dec-99	-23.0	06-Jan-00	-26.6
07-Aug-99	8.0	07-Sep-99	4.9	07-Oct-99	-7.0	07-Nov-99	-24.6	07-Dec-99	-25.5	07-Jan-00	-23.7
08-Aug-99	10.6	08-Sep-99	5.4	08-Oct-99	-3.5	08-Nov-99	-23.1	08-Dec-99	-21.9	08-Jan-00	-26.4
09-Aug-99	10.2	09-Sep-99	6.4	09-Oct-99	-3.8	09-Nov-99	-11.0	09-Dec-99	-21.7	09-Jan-00	-38.0
10-Aug-99	10.5	10-Sep-99	2.2	10-Oct-99	-8.4	10-Nov-99	-3.8	10-Dec-99	-18.4	10-Jan-00	-33.6
11-Aug-99	10.2	11-Sep-99	0.1	11-Oct-99	-9.8	11-Nov-99	-14.0	11-Dec-99	-22.9	11-Jan-00	-29.0
12-Aug-99	10.4	12-Sep-99	0.0	12-Oct-99	-6.5	12-Nov-99	-12.1	12-Dec-99	-26.5	12-Jan-00	-32.2
13-Aug-99	10.1	13-Sep-99	3.1	13-Oct-99	-6.8	13-Nov-99	-15.3	13-Dec-99	-32.1	13-Jan-00	-29.6
14-Aug-99	11.2	14-Sep-99	1.5	14-Oct-99	-10.2	14-Nov-99	-17.8	14-Dec-99	-32.1	14-Jan-00	-31.0
15-Aug-99	12.8	15-Sep-99	-0.5	15-Oct-99	-10.5	15-Nov-99	-25.1	15-Dec-99	-33.1	15-Jan-00	-26.9
16-Aug-99	10.9	16-Sep-99	-0.2	16-Oct-99	-16.3	16-Nov-99	-24.0	16-Dec-99	-28.3	16-Jan-00	-26.2
17-Aug-99	9.4	17-Sep-99	-0.6	17-Oct-99	-18.2	17-Nov-99	-21.9	17-Dec-99	-25.1	17-Jan-00	-30.0
18-Aug-99	8.6	18-Sep-99	1.5	18-Oct-99	-15.9	18-Nov-99	-18.6	18-Dec-99	-30.1	18-Jan-00	-32.3
19-Aug-99	8.8	19-Sep-99	4.9	19-Oct-99	-13.6	19-Nov-99	-20.4	19-Dec-99	-33.1	19-Jan-00	-39.1
20-Aug-99	6.4	20-Sep-99	5.7	20-Oct-99	-12.7	20-Nov-99	-21.6	20-Dec-99	-33.6	20-Jan-00	-39.0
21-Aug-99	5.6	21-Sep-99	1.4	21-Oct-99	-15.8	21-Nov-99	-25.7	21-Dec-99	-34.1	21-Jan-00	-34.7
22-Aug-99	6.6	22-Sep-99	0.0	22-Oct-99	-12.3	22-Nov-99	-15.1	22-Dec-99	-27.8	22-Jan-00	-30.4
23-Aug-99	7.4	23-Sep-99	0.2	23-Oct-99	-5.6	23-Nov-99	-15.0	23-Dec-99	-14.8	23-Jan-00	-27.4
24-Aug-99	6.9	24-Sep-99	5.2	24-Oct-99	-8.9	24-Nov-99	-14.5	24-Dec-99	-13.3	24-Jan-00	-34.5
25-Aug-99	7.2	25-Sep-99	2.9	25-Oct-99	-11.0	25-Nov-99	-13.5	25-Dec-99	-23.7	25-Jan-00	-28.3
26-Aug-99	6.1	26-Sep-99	0.7	26-Oct-99	-3.8	26-Nov-99	-14.3	26-Dec-99	-26.9	26-Jan-00	-16.9
27-Aug-99	6.8	27-Sep-99	-0.3	27-Oct-99	-3.1	27-Nov-99	-13.8	27-Dec-99	-32.7	27-Jan-00	-16.1
28-Aug-99	6.1	28-Sep-99	-1.1	28-Oct-99	-7.1	28-Nov-99	-15.9	28-Dec-99	-33.0	28-Jan-00	-18.2
29-Aug-99	2.4	29-Sep-99	-4.3	29-Oct-99	-5.3	29-Nov-99	-17.4	29-Dec-99	-30.2	29-Jan-00	-20.6
30-Aug-99	2.6	30-Sep-99	-4.7	30-Oct-99	-2.6	30-Nov-99	-23.5	30-Dec-99	-31.7	30-Jan-00	-24.6
31-Aug-99	2.8			31-Oct-99	-5.5			31-Dec-99	-35.0	31-Jan-00	-15.3
Mean	**8.3**		**2.6**		**-8.8**		**-17.4**		**-27.1**		**-26.9**

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Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)
01-Feb-00	-12.0	01-Mar-00	-34.7	01-Apr-00	-15.9	01-May-00	-0.5	01-Jun-00	-7.8	01-Jul-00	13.8
02-Feb-00	-19.3	02-Mar-00	-30.2	02-Apr-00	-17.5	02-May-00	-2.2	02-Jun-00	-1.5	02-Jul-00	16.3
03-Feb-00	-18.5	03-Mar-00	-31.5	03-Apr-00	-21.4	03-May-00	-3.7	03-Jun-00	-1.8	03-Jul-00	17.9
04-Feb-00	-22.8	04-Mar-00	-35.0	04-Apr-00	-22.9	04-May-00	-3.9	04-Jun-00	-4.5	04-Jul-00	11.1
05-Feb-00	-29.4	05-Mar-00	-33.1	05-Apr-00	-25.6	05-May-00	-6.6	05-Jun-00	-2.9	05-Jul-00	14.3
06-Feb-00	-26.9	06-Mar-00	-33.5	06-Apr-00	-26.4	06-May-00	-2.2	06-Jun-00	0.6	06-Jul-00	21.0
07-Feb-00	-26.0	07-Mar-00	-32.0	07-Apr-00	-25.6	07-May-00	-0.9	07-Jun-00	4.6	07-Jul-00	18.7
08-Feb-00	-31.4	08-Mar-00	-29.8	08-Apr-00	-24.7	08-May-00	-1.0	08-Jun-00	5.0	08-Jul-00	12.3
09-Feb-00	-28.4	09-Mar-00	-33.9	09-Apr-00	-23.7	09-May-00	-4.2	09-Jun-00	6.6	09-Jul-00	14.2
10-Feb-00	-23.4	10-Mar-00	-31.8	10-Apr-00	-22.6	10-May-00	-1.9	10-Jun-00	8.1	10-Jul-00	14.8
11-Feb-00	-32.2	11-Mar-00	-26.2	11-Apr-00	-26.1	11-May-00	-1.1	11-Jun-00	8.2	11-Jul-00	5.6
12-Feb-00	-27.7	12-Mar-00	-30.7	12-Apr-00	-23.8	12-May-00	-1.1	12-Jun-00	10.2	12-Jul-00	6.2
13-Feb-00	-26.2	13-Mar-00	-32.3	13-Apr-00	-21.9	13-May-00	-5.8	13-Jun-00	9.8	13-Jul-00	9.2
14-Feb-00	-33.3	14-Mar-00	-31.9	14-Apr-00	-22.9	14-May-00	-8.5	14-Jun-00	11.4	14-Jul-00	8.5
15-Feb-00	-34.4	15-Mar-00	-32.1	15-Apr-00	-20.3	15-May-00	-11.4	15-Jun-00	8.7	15-Jul-00	6.4
16-Feb-00	-33.5	16-Mar-00	-27.6	16-Apr-00	-22.4	16-May-00	-10.4	16-Jun-00	11.4	16-Jul-00	9.3
17-Feb-00	-40.9	17-Mar-00	-28.9	17-Apr-00	-23.0	17-May-00	-5.0	17-Jun-00	9.3	17-Jul-00	14.9
18-Feb-00	-42.2	18-Mar-00	-28.3	18-Apr-00	-20.2	18-May-00	-6.9	18-Jun-00	8.2	18-Jul-00	17.3
19-Feb-00	-38.7	19-Mar-00	-28.3	19-Apr-00	-16.9	19-May-00	-5.3	19-Jun-00	9.0	19-Jul-00	18.6
20-Feb-00	-36.9	20-Mar-00	-20.4	20-Apr-00	-15.4	20-May-00	-5.5	20-Jun-00	10.0	20-Jul-00	19.6
21-Feb-00	-24.5	21-Mar-00	-19.5	21-Apr-00	-17.1	21-May-00	-1.4	21-Jun-00	6.7	21-Jul-00	14.2
22-Feb-00	-29.6	22-Mar-00	-23.1	22-Apr-00	-5.3	22-May-00	0.3	22-Jun-00	4.6	22-Jul-00	9.1
23-Feb-00	-33.2	23-Mar-00	-21.8	23-Apr-00	-4.9	23-May-00	-4.1	23-Jun-00	7.8	23-Jul-00	10.9
24-Feb-00	-20.3	24-Mar-00	-13.8	24-Apr-00	-6.9	24-May-00	-8.0	24-Jun-00	7.7	24-Jul-00	15.3
25-Feb-00	-18.7	25-Mar-00	-18.0	25-Apr-00	-7.5	25-May-00	-6.0	25-Jun-00	10.0	25-Jul-00	21.3
26-Feb-00	-21.3	26-Mar-00	-16.6	26-Apr-00	-6.1	26-May-00	-6.4	26-Jun-00	6.7	26-Jul-00	21.9
27-Feb-00	-27.6	27-Mar-00	-15.2	27-Apr-00	-11.0	27-May-00	-3.5	27-Jun-00	9.8	27-Jul-00	22.7
28-Feb-00	-31.4	28-Mar-00	-7.1	28-Apr-00	-13.5	29-May-00	-6.4	28-Jun-00	7.2	28-Jul-00	20.6
29-Feb-00	-30.6	29-Mar-00	-9.8	29-Apr-00	-12.6	30-May-00	-9.4	29-Jun-00	10.0	29-Jul-00	18.2
		30-Mar-00	-14.1	30-Apr-00	-4.5	31-May-00	-8.1	30-Jun-00	9.5	30-Jul-00	13.5
		31-Mar-00	-19.0							31-Jul-00	15.4
Mean	**-28.3**		**-25.5**		**-17.6**		**-4.7**		**6.1**		**14.6**

Appendix 2.2-1
Daily Mean Air Temperatures for Boston Weather Station, August 1998 to September 2000 (completed)

Date	Daily Mean Temperature (ºC)	Date	Daily Mean Temperature (ºC)
01-Aug-00	19.5	01-Sep-00	6.2
02-Aug-00	16.1	02-Sep-00	8.3
03-Aug-00	15.2	03-Sep-00	10.4
04-Aug-00	18.0	04-Sep-00	11.0
05-Aug-00	19.3	05-Sep-00	9.9
06-Aug-00	14.8	06-Sep-00	3.7
07-Aug-00	12.4	07-Sep-00	3.8
08-Aug-00	7.0	08-Sep-00	5.1
09-Aug-00	7.9	09-Sep-00	2.7
10-Aug-00	10.8	10-Sep-00	2.0
11-Aug-00	12.3	11-Sep-00	1.4
12-Aug-00	12.2	12-Sep-00	2.7
13-Aug-00	8.8	13-Sep-00	1.5
14-Aug-00	11.4	14-Sep-00	n/a
15-Aug-00	9.8	15-Sep-00	n/a
16-Aug-00	5.5	16-Sep-00	n/a
17-Aug-00	8.3	17-Sep-00	n/a
18-Aug-00	11.6	18-Sep-00	n/a
19-Aug-00	13.4	19-Sep-00	n/a
20-Aug-00	6.9	20-Sep-00	n/a
21-Aug-00	6.3	21-Sep-00	n/a
22-Aug-00	9.3	22-Sep-00	n/a
23-Aug-00	9.1	23-Sep-00	n/a
24-Aug-00	4.9	24-Sep-00	n/a
25-Aug-00	2.3	25-Sep-00	n/a
26-Aug-00	2.2	26-Sep-00	n/a
27-Aug-00	2.4	27-Sep-00	n/a
28-Aug-00	1.6	28-Sep-00	n/a
29-Aug-00	1.6	29-Sep-00	n/a
30-Aug-00	1.2	30-Sep-00	n/a
31-Aug-00	3.2		
Mean	**9.2**		**5.3**

n/a = not available

APPENDIX 2.2-2
CALCULATION OF CLASS A EVAPORATION RATES FOR YEAR 2000 AT BOSTON CAMP

Appendix 2.2-2
Calculation of Class A Evaporation Rates for Year 2000 at Boston Camp

Date	Time (24 hours)	Hook-gauge reading (before) (cm)	Hook-gauge reading (after) (cm)	Precipitation (mm)	Temperature Min.	Max. (ºCelsius)	Current	Evaporation (mm)	Comments
19-Jun-00	9:02	7.262		0.0	-	-	10		Initial setup, 90% cloud cover
20-Jun-00	9:40	7.055		1.8	-	-	8	3.87	95% cloud cover
21-Jun-00	9:05	6.954		0.0	-	-	8	1.01	70% cloud cover
22-Jun-00	9:00	6.235		0.0	-	-	2	7.19	cool, low cloud
23-Jun-00	9:08	6.065	7.189	0.0	-	-	8	1.70	50% cloud cover, water was added
24-Jun-00	8:30	6.610		0.0	-	-	7	5.79	75% cloud cover
25-Jun-00	10:25	6.338		0.0	-	-	-	2.72	20% cloud cover
24-Jun-00									no data available
25-Jun-00									no data available
26-Jun-00									no data available
27-Jun-00									no data available
28-Jun-00									no data available
29-Jun-00									no data available
30-Jun-00									no data available
01-Jul-00									no data available
02-Jul-00									no data available
03-Jul-00									no data available
04-Jul-00									no data available
05-Jul-00									no data available
06-Jul-00									no data available
07-Jul-00									no data available
08-Jul-00									no data available
09-Jul-00									no data available
10-Jul-00									no data available
11-Jul-00									no data available
12-Jul-00									no data available
13-Jul-00									no data available
14-Jul-00									no data available
15-Jul-00									no data available
16-Jul-00									no data available
17-Jul-00									no data available
18-Jul-00									no data available
19-Jul-00									no data available
20-Jul-00	19:00	6.768							water changed in evaporation pan
21-Jul-00	11:00	6.654		0.0	17	26	22	1.14	
22-Jul-00	14:00	6.172		0.0	10	-	24	4.82	
23-Jul-00	14:00	5.894		0.0	-	-	26	2.78	rain, sun, then showers
24-Jul-00									no data available
25-Jul-00	10:00	5.206		0.0	20	37	20	6.88	two day evaporation
26-Jul-00	10:40	4.483	7.281	0.0	25	39	28	7.23	water added to the evaporation pan
27-Jul-00	9:40	6.741		0.7	16	35	28	6.10	late night rain
28-Jul-00	11:30	6.044		0.0	18	-	27	6.97	
29-Jul-00	6:00	5.178		0.0	16	29	27	8.66	windy

Appendix 2.2-2

Calculation of Class A Evaporation Rates for Year 2000 at Boston Camp (continued)

Date	Time (24 hours)	Hook-gauge reading (before) (cm)	Hook-gauge reading (after) (cm)	Precipitation (mm)	Temperature Min. (°Celsius)	Temperature Max. (°Celsius)	Temperature Current (°Celsius)	Evaporation (mm)	Comments
30-Jul-00									no data available
31-Jul-00	15:00	4.287		0.0	20	34	27	8.91	windy, two day evaporation
01-Aug-00	8:30	n/a	7.686	0.0	19	33	23	n/a	water was added to the evaporation pan, missing the initial
02-Aug-00	5:30	7.242		0.0	19	33	23	4.44	smokey
03-Aug-00	5:00	6.410		0.0	23	29	23	8.32	calm
04-Aug-00	6:00	5.893		0.0	24	29	28	5.17	calm
05-Aug-00									no data available
06-Aug-00	10:00	5.403		1.1	25	31	30	6.00	windy with rain
07-Aug-00	18:00	4.641		0.3	20	24	22	7.92	windy with rain
08-Aug-00									no data available
09-Aug-00	17:00	4.531		0.4	10	15	10	1.50	windy with rain
10-Aug-00	18:00	n/a	7.575	0.0	15	23	20	n/a	calm, pan re-filled, missing initial hook gauge reading
11-Aug-00									no data available
12-Aug-00									no data available
13-Aug-00									no data available
14-Aug-00	12:00	6.428		0.0	20	20	20	11.47	four day evaporation
15-Aug-00									no data available
16-Aug-00									no data available
17-Aug-00									no data available
18-Aug-00									no data available
19-Aug-00	5:30	4.995		2.0	7	14	13	16.33	five day evaporation, overcast, warm
20-Aug-00									very high winds - could not read hook gauge
21-Aug-00									very high winds - could not read hook gauge
22-Aug-00									very high winds - could not read hook gauge
23-Aug-00									very high winds - could not read hook gauge
24-Aug-00									very high winds - could not read hook gauge
25-Aug-00									very high winds - could not read hook gauge
26-Aug-00									very high winds - could not read hook gauge
27-Aug-00	10:00	9.188	10.882	8.8	-	-	-	<0	no data available, high winds sloshed water out
28-Aug-00	8:30	10.882	10.631	0.4	-	-	-	<0	of the evaporation pan, 2 mm of ice in pan
29-Aug-00	6:00								frozen
30-Aug-00	n/a	10.763		0.0	-	-	-	1.23	precipitation fell as snow and melted
31-Aug-00									very high winds - could not read hook gauge
01-Sep-00									very high winds - could not read hook gauge
02-Sep-00									no data available
03-Sep-00									no data available
04-Sep-00									no data available
05-Sep-00									no data available
06-Sep-00									no data available
07-Sep-00	7:00						-1		frozen
08-Sep-00	7:00			4.0	-	-	1		very high winds - could not read hook gauge
09-Sep-00	7:00			5.0	-	-	4		very high winds - could not read hook gauge
10-Sep-00	7:00	11.501		10.0	-	-	2	11.62	windy with ice pellets, 11 day evaporation

Appendix 2.2-2
Calculation of Class A Evaporation Rates for Year 2000 at Boston Camp (completed)

Date	Time (24 hours)	Hook-gauge reading (before) (cm)	Hook-gauge reading (after) (cm)	Precipitation (mm)	Temperature Min.	Max. (°Celsius)	Current	Evaporation (mm)	Comments
11-Sep-00									no data available
12-Sep-00									no data available
13-Sep-00									no data available
14-Sep-00									no data available
15-Sep-00	7:00	7.254		4.1	-	-	8	??46.57??	rain, 25 knot east wind, 5 day evaporation
16-Sep-00									ice and slush in the evaporation pan
17-Sep-00	7:00	out of range	6.859	16.2	-	-	1	n/a	rain and snow, water removed from the pan
18-Sep-00					-	-	-3		ice in the evaporation pan
19-Sep-00					-	-	-3		ice in the evaporation pan
20-Sep-00					-	-	-3		ice in the evaporation pan
21-Sep-00	12:00	7.169		1.4	-	-	1	n/a	melted snow
22-Sep-00	12:00	frozen					-1		high winds, water in pan was frozen
23-Sep-00		frozen					-2		high winds (35 knots) and snow storm
24-Sep-00		frozen					-7		high winds gusting to 55 knots

sum	149.77
average	5.99
max	16.33
min	1.01

	days measured	*sum [mm]*	*average [mm/day]*
June	6.0	22.3	3.7
July	9.0	53.5	5.9
August	16.0	62.4	3.9
September	11.0	11.6	1.1
Total	**42.0**	**149.8**	**3.6**

APPENDIX 3.2-1
STREAM FLOW MONITORING, HOPE BAY BELT, 2000

Rescan™

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 19-Jun-00
Time (24 hr): 16:45
Location: Doris OF
Flows monitored by: Shane/Dan

Gauge Ht. = 0.680 m
Discharge= 3.547 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	3.90					
	4.00	13	0	10	0.000	0.00
	4.50	23	27	50	0.016	0.44
	5.00	33	78	50	0.080	2.25
	5.50	44	88	50	0.161	4.54
	6.00	56	80	50	0.209	5.89
	6.50	65	80	50	0.242	6.82
	7.00	66	87	50	0.274	7.71
	7.50	63	83	50	0.274	7.73
	8.00	66	80	50	0.263	7.41
	8.50	70	78	50	0.269	7.57
	9.00	70	79	50	0.275	7.75
	9.50	70	83	50	0.284	7.99
	10.00	68	73	50	0.269	7.59
	10.50	62	30	50	0.171	4.81
	11.00	54	51	50	0.115	3.25
	11.50	50	52	50	0.134	3.77
	12.00	46	45	50	0.117	3.29
	12.50	46	38	50	0.095	2.69
	13.00	45	34	50	0.082	2.31
	13.50	41	38	50	0.077	2.18
	14.00	43	26	50	0.067	1.89
	14.50	31	4	50	0.031	0.88
	15.00	26	9	50	0.009	0.25
	15.50	30	10	50	0.013	0.38
	16.00	21	13	50	0.014	0.40
	16.50	17	0	50	0.007	0.19
	17.00	9	0	50	0.000	0.00
L. Bank	17.10	0	0	10	0.000	0.00
					3.547	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 24-Jun-00
Time (24 hr): 16:05
Location: Doris OF
Flows monitored by: DT and SM

Gauge Ht. = 0.630 m
Discharge= 2.779 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	17.30					
	16.80	9	0	50	0.000	0.00
	16.30	16	4	50	0.002	0.06
	15.80	24	5	50	0.005	0.17
	15.30	22	10	50	0.009	0.31
	14.80	26	6	50	0.009	0.34
	14.30	36	23	50	0.025	0.89
	13.80	34	28	50	0.045	1.60
	13.30	35	23	50	0.044	1.58
	12.80	41	31	50	0.052	1.87
	12.30	46	32	50	0.069	2.47
	11.80	46	39	50	0.082	2.94
	11.30	45	34	50	0.083	2.99
	10.80	57	37	50	0.091	3.27
	10.30	63	65	50	0.155	5.58
	9.80	65	66	50	0.210	7.54
	9.30	61	68	50	0.211	7.59
	8.80	65	68	50	0.214	7.71
	8.30	62	68	50	0.216	7.77
	7.80	58	70	50	0.207	7.45
	7.30	62	69	50	0.208	7.50
	6.80	69	76	50	0.238	8.57
	6.30	48	70	50	0.215	7.74
	5.80	57	75	50	0.191	6.87
	5.30	24	79	50	0.154	5.55
	4.80	16	0	50	0.047	1.71
	4.50	12	-4	30	-0.001	-0.03
L. Bank	4.20	0	0	30	-0.001	-0.03
					2.779	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 22-Jul-00
Time (24 hr): 15:35
Location: Doris OF
Flows monitored by: Shane

Gauge Ht. = 0.232 m
Discharge= 0.730 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	6.00					
	6.25	12	0	25	0.000	0.00
	9.30	16	0	305	0.000	0.00
	9.50	20	1	20	0.000	0.03
	10.00	27	3	50	0.003	0.35
	10.15	33	6	15	0.002	0.29
	10.40	35	35	25	0.018	2.44
	10.65	34	43	25	0.034	4.60
	10.90	37	46	25	0.040	5.42
	11.15	40	51	25	0.047	6.41
	11.40	41	49	25	0.051	6.94
	11.65	41	49	25	0.050	6.88
	11.90	39	49	25	0.049	6.71
	12.15	38	50	25	0.048	6.53
	12.40	36	53	25	0.048	6.52
	12.65	34	55	25	0.047	6.47
	12.90	31	57	25	0.045	6.23
	13.15	33	57	25	0.046	6.25
	13.40	33	56	25	0.047	6.39
	13.65	33	48	25	0.043	5.88
	13.90	32	31	25	0.032	4.41
	14.15	30	64	25	0.036	4.99
	14.40	29	15	25	0.029	4.03
	14.65	16	19	25	0.009	1.27
	14.90	12	11	25	0.005	0.75
	15.15	4	0	25	0.002	0.23
L. Bank	15.45	0	0	30	0.000	0.00
					0.730	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 16-Aug-00
Time (24 hr): 13:35
Location: Doris OF
Flows monitored by: Chris T

Gauge Ht. = -0.105 m
Discharge= 0.244 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	9.92					
	10.12	17	4	20	0.001	0.28
	10.32	18	11	20	0.003	1.09
	10.52	18	26	20	0.007	2.73
	10.72	21	36	20	0.012	5.01
	10.92	21	30	20	0.014	5.67
	11.12	22	31	20	0.013	5.37
	11.32	22	36	20	0.015	6.03
	11.52	22	39	20	0.016	6.75
	11.72	21	37	20	0.016	6.69
	11.92	20	40	20	0.016	6.45
	12.12	19	43	20	0.016	6.62
	12.32	18	37	20	0.015	6.07
	12.52	16	40	20	0.013	5.34
	12.72	16	49	20	0.014	5.83
	12.92	16	46	20	0.015	6.22
	13.12	16	39	20	0.014	5.56
	13.32	15	31	20	0.011	4.46
	13.52	15	22	20	0.008	3.25
	13.72	15	26	20	0.007	2.95
	13.92	11	43	20	0.009	3.53
	14.02	13	38	10	0.005	1.98
	14.12	13	21	10	0.004	1.57
	14.22	10	0	10	0.001	0.56
L. Bank	14.35	0	0	13	0.000	0.00
					0.244	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 11-Sep-00
Time (24 hr): 17:35
Location: Doris OF
Flows monitored by: SLU/DJ

Gauge Ht. = -0.130 m
Discharge= 0.196 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	9.25					
	10.05	15	0	80	0.000	0.00
	10.10	15	3	5	0.000	0.06
	10.30	16	20	20	0.004	1.86
	10.50	17	30	20	0.008	4.23
	10.70	20	37	20	0.013	6.37
	10.90	20	32	20	0.014	7.04
	11.10	21	34	20	0.014	6.90
	11.30	21	31	20	0.014	6.96
	11.50	21	32	20	0.013	6.75
	11.70	20	36	20	0.014	7.10
	11.90	19	35	20	0.014	7.06
	12.10	17	31	20	0.012	6.08
	12.30	17	30	20	0.010	5.29
	12.50	15	30	20	0.010	4.89
	12.70	14	37	20	0.010	4.94
	12.90	12	34	20	0.009	4.72
	13.10	12	34	20	0.008	4.16
	13.30	12	31	20	0.008	3.98
	13.50	13	18	20	0.006	3.09
	13.70	12	22	20	0.005	2.54
	13.90	10	34	20	0.006	3.08
	14.10	11	14	20	0.005	2.52
	14.20	8	0	10	0.001	0.39
L. Bank	14.50	0	0	30	0.000	0.00
					0.196	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 15-Jun-00
Time (24 hr): 16:00
Location: Glenn OF
Flows monitored by: Shane/Dan

Gauge Ht. = 0.510 m
Discharge= 1.221 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	4.1					
	4.4	13	0	30	0.000	0.00
	4.7	35	9	30	0.005	0.39
	5	40	45	30	0.032	2.60
	5.3	42	53	30	0.060	4.94
	5.6	45	55	30	0.071	5.77
	5.9	45	69	30	0.084	6.85
	6.2	44	66	30	0.090	7.38
	6.5	40	42	30	0.069	5.63
	6.8	46	73	30	0.076	6.19
	7.1	46	46	30	0.082	6.72
	7.4	48	64	30	0.078	6.37
	7.7	48	47	30	0.080	6.54
	8	47	51	30	0.070	5.71
	8.3	46	55	30	0.074	6.05
	8.6	46	57	30	0.077	6.33
	8.9	48	35	30	0.065	5.28
	9.2	49	49	30	0.061	5.01
	9.5	47	44	30	0.067	5.49
	9.8	33	11	30	0.036	2.99
	10.1	48	28	30	0.026	2.10
L. Bank	10.4	0	0	30	0.020	1.65
					1.221	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 24-Jun-00
Time (24 hr): 14:47
Location: Glenn OF
Flows monitored by: DT and SM

Gauge Ht. = 0.440 m
Discharge= 0.616 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	15.1					
	14.8	22	25	30	0.008	1.34
	14.5	23	41	30	0.022	3.63
	14.2	26	56	30	0.036	5.84
	13.9	27	52	30	0.043	6.96
	13.6	28	60	30	0.046	7.51
	13.3	28	55	30	0.048	7.84
	13	28	43	30	0.041	6.68
	12.7	25	50	30	0.037	5.97
	12.4	31	14	30	0.025	4.10
	12.1	33	57	30	0.035	5.64
	11.8	34	31	30	0.044	7.14
	11.5	31	58	30	0.043	6.94
	11.2	33	35	30	0.044	7.19
	10.9	31	52	30	0.042	6.74
	10.6	34	28	30	0.038	6.24
	10.3	32	29	30	0.028	4.58
	10	20	34	30	0.024	3.91
	9.7	22	1	30	0.011	1.71
L. Bank	9.5	0	0	20	0.000	0.04
					0.616	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 22-Jul-00
Time (24 hr): 14:25
Location: Glenn OF
Flows monitored by: Shane and Paul

Gauge Ht. = 0.297 m
Discharge= 0.222 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	10					
	10.1	11	40	10	0.002	0.99
	10.35	21	9	25	0.008	3.54
	10.6	20	11	25	0.005	2.30
	10.85	22	13	25	0.006	2.84
	11.1	23	32	25	0.013	5.74
	11.35	19	29	25	0.016	7.23
	11.6	17	46	25	0.017	7.49
	11.85	20	42	25	0.020	9.12
	12.1	20	18	25	0.015	6.74
	12.35	22	32	25	0.013	5.98
	12.6	17	12	25	0.011	5.10
	12.85	17	16	25	0.006	2.68
	13.1	15	24	25	0.008	3.55
	13.35	11	32	25	0.009	4.00
	13.6	15	24	25	0.009	4.00
	13.85	16	35	25	0.012	5.17
	14.1	16	38	25	0.015	6.57
	14.35	15	36	25	0.014	6.45
	14.6	15	26	25	0.012	5.23
	14.85	12	19	25	0.008	3.47
L. Bank	15.2	0	0	35	0.004	1.79
					0.222	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 11-Sep-00
Time (24 hr): 13:30
Location: Glenn OF
Flows monitored by: Shane/Dan

Gauge Ht. = 0.254 m
Discharge= 0.099 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	10.2					
	10.3	15	3	10	0.000	0.23
	10.55	19	5	25	0.002	1.77
	10.8	18	9	25	0.003	3.25
	11.05	16	4	25	0.003	2.86
	11.3	15	20	25	0.005	4.60
	11.55	15	22	25	0.008	7.97
	11.8	15	26	25	0.009	9.11
	12.05	17	5	25	0.006	6.01
	12.3	18	26	25	0.007	6.99
	12.55	17	11	25	0.008	8.28
	12.8	15	3	25	0.003	2.93
	13.05	15	9	25	0.002	2.28
	13.3	12	18	25	0.004	4.44
	13.55	12	18	25	0.005	5.46
	13.8	13	17	25	0.005	5.53
	14.05	11	26	25	0.006	6.41
	14.3	10	29	25	0.007	7.28
	14.55	10	25	25	0.007	6.83
	14.8	10	14	25	0.005	4.93
	15.05	6	7	25	0.002	2.30
L. Bank	15.3	0	0	25	0.001	0.53
					0.099	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 16-Jun-00
Time (24 hr): 17:00
Location: Tail OF
Flows monitored by: Shane/Dan

Gauge Ht. = 0.295 m
Discharge= 0.156 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	2.50					
	2.60	11	7	10	0.000	0.25
	2.70	13	14	10	0.001	0.83
	2.80	17	28	10	0.003	2.11
	2.90	18	44	10	0.006	4.06
	3.00	19	50	10	0.009	5.58
	3.10	23	93	10	0.015	9.89
	3.20	24	81	10	0.020	13.07
	3.30	24	76	10	0.019	12.06
	3.40	26	60	10	0.017	10.84
	3.50	24	51	10	0.014	8.91
	3.60	24	55	10	0.013	8.15
	3.70	16	3	10	0.007	4.38
	3.80	10	0	10	0.000	0.15
	5.50	8	5	170	0.003	2.18
	6.60	10	9	110	0.007	4.58
	6.70	10	9	10	0.001	0.58
	6.80	10	9	10	0.001	0.58
	6.90	10	9	10	0.001	0.58
	7.00	10	9	10	0.001	0.58
	7.10	10	9	10	0.001	0.58
	7.20	8	8	10	0.001	0.49
	7.60	8	13	40	0.003	2.15
	7.80	2	0	20	0.001	0.67
	7.90	0	0	10	0.000	0.00
	17.10	7	2	920	0.006	4.12
	17.20	10	2	10	0.000	0.11
	17.30	10	2	10	0.000	0.13
	17.40	5	1	10	0.000	0.08
	17.50	0	0	10	0.000	0.02
	21.10	0	0	360	0.000	0.00
	21.20	9	4	10	0.000	0.12
	21.50	10	8	30	0.002	1.11
	21.70	6	6	20	0.001	0.74
L. Bank	22.00	0	0	30	0.001	0.35
					0.156	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 25-Jun-00
Time (24 hr): 10:35
Location: Tail OF
Flows monitored by: Steve M

Gauge Ht. = 0.280 m
Discharge= 0.096 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	26.20					
	26.10	4	0	10	0.000	0.00
	26.00	11	16	10	0.001	0.92
	25.90	15	20	10	0.002	2.49
	25.80	19	39	10	0.005	5.45
	25.70	29	55	10	0.012	12.22
	25.60	31	62	10	0.018	18.40
	25.50	24	77	10	0.019	19.72
	25.40	20	48	10	0.014	14.69
	25.30	19	21	10	0.007	7.11
	25.20	21	13	10	0.003	3.52
	25.10	16	6	10	0.002	1.93
	25.00	12	0	10	0.000	0.50
	24.90	10	0	10	0.000	0.00
	24.80	8	0	10	0.000	0.00
	24.70	7	0	10	0.000	0.00
	24.60	6	11	10	0.000	0.35
	24.50	4	0	10	0.000	0.35
	24.40	3	0	10	0.000	0.00
	24.30	5	6	10	0.000	0.16
	24.20	6	6	10	0.000	0.35
	24.10	6	6	10	0.000	0.38
	24.00	6	6	10	0.000	0.38
	23.90	6	6	10	0.000	0.38
	23.80	6	6	10	0.000	0.38
	23.70	6	6	10	0.000	0.38
	23.60	6	6	10	0.000	0.38
	23.50	6	6	10	0.000	0.38
	23.40	6	6	10	0.000	0.38
	23.30	6	6	10	0.000	0.38
	23.20	6	6	10	0.000	0.38
	23.10	6	6	10	0.000	0.38
	23.00	6	6	10	0.000	0.38
	22.90	6	6	10	0.000	0.38
	22.80	6	6	10	0.000	0.38
	22.70	6	6	10	0.000	0.38
	22.60	6	6	10	0.000	0.38
	22.50	6	6	10	0.000	0.38
	22.40	6	6	10	0.000	0.38
	22.30	6	6	10	0.000	0.38
	22.20	6	6	10	0.000	0.38
	22.10	6	6	10	0.000	0.38
	22.00	6	6	10	0.000	0.38
	21.90	6	6	10	0.000	0.38
	21.80	6	6	10	0.000	0.38
	21.70	6	6	10	0.000	0.38
	21.60	6	6	10	0.000	0.38
	21.50	6	6	10	0.000	0.38
	21.40	6	6	10	0.000	0.38
	21.30	6	6	10	0.000	0.38
	21.20	6	6	10	0.000	0.38
	21.10	6	6	10	0.000	0.38
	21.00	0	0	10	0.000	0.19
	3.00	0	0	1800	0.000	0.00
	1.20	0	0	180	0.000	0.00
L. Bank	1.15	0	0	5	0.000	0.00
					0.096	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 19-Jul-00
Time (24 hr): 16:15
Location: Tail OF
Flows monitored by: Shane and Paul

Gauge Ht. = 0.235 m
Discharge= 0.012 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	1.10					
	1.15	7	30	5	0.001	4.21
	1.20	8	25	5	0.001	8.23
	1.25	10	41	5	0.002	12.24
	1.30	12	25	5	0.002	14.25
	1.35	13	22	5	0.001	11.76
	1.40	12	40	5	0.002	15.37
	1.45	12	28	5	0.002	16.37
	1.50	2	0	5	0.001	6.74
	1.55	3	0	5	0.000	0.00
	1.60	3	0	5	0.000	0.00
	1.65	7	0	5	0.000	0.00
	1.70	6	18	5	0.000	2.17
	1.75	9	18	5	0.001	5.42
L. Bank	1.80	0	0	5	0.000	3.25
					0.012	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 16-Aug-00
Time (24 hr): 12:00
Location: Tail OF
Flows monitored by: Chris T

Gauge Ht. = 0.150 m
Discharge= 0.003 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	5.70					
	5.84	10	20	14	0.001	42.42
L. Bank	6.03	0	0	19	0.002	57.58
					0.003	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 12-Sep-00
Time (24 hr): 12:00
Location: Tail OF
Flows monitored by: SU/DJ

Gauge Ht. = 0.190 m
Discharge= 0.008 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	0.50					
	0.55	10	0	5	0.000	0.00
	0.60	15	0	5	0.000	0.00
	0.65	13	28	5	0.001	10.96
	0.70	13	52	5	0.003	31.33
	0.75	10	38	5	0.003	31.81
	0.80	6	25	5	0.001	15.96
	0.85	5	18	5	0.001	7.23
	0.90	2	0	5	0.000	2.71
L. Bank	0.95	0	0	5	0.000	0.00
					0.008	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 17-Jun-00
Time (24 hr): 13:00
Location: Pelvic OF
Flows monitored by: Shane/Dan

Gauge Ht. = 0.550 m
Discharge= 2.664 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	0.70					
	1.00	22	0	30	0.000	0.00
	1.50	23	2	50	0.001	0.04
	2.00	31	8	50	0.007	0.28
	2.50	29	14	50	0.016	0.61
	3.00	37	34	50	0.042	1.56
	3.50	38	26	50	0.056	2.11
	4.00	43	40	50	0.068	2.54
	4.50	42	39	50	0.084	3.15
	5.00	57	33	50	0.088	3.30
	5.50	55	44	50	0.108	4.04
	6.00	37	52	50	0.109	4.08
	6.50	73	23	50	0.090	3.38
	7.00	45	26	50	0.071	2.67
	7.50	68	50	50	0.114	4.29
	8.00	62	19	50	0.114	4.30
	8.50	70	16	50	0.057	2.16
	9.00	78	36	50	0.098	3.69
	9.50	71	20	50	0.106	3.97
	10.00	57	35	50	0.085	3.20
	10.50	61	44	50	0.117	4.39
	11.00	70	55	50	0.163	6.13
	11.50	65	45	50	0.169	6.36
	12.00	71	51	50	0.164	6.14
	12.50	48	62	50	0.165	6.19
	13.00	66	40	50	0.140	5.27
	13.50	65	26	50	0.108	4.06
	14.00	56	23	50	0.074	2.79
	14.50	48	27	50	0.065	2.42
	15.00	43	27	50	0.061	2.31
	15.50	37	16	50	0.044	1.64
	16.00	39	19	50	0.033	1.25
	16.50	25	0	50	0.019	0.70
	17.00	39	6	50	0.006	0.22
	17.50	23	3	50	0.008	0.28
	18.00	14	10	50	0.005	0.20
	18.50	7	5	50	0.004	0.16
	19.00	8	2	50	0.001	0.05
	19.50	15	2	50	0.001	0.04
	20.00	12	0	50	0.001	0.03
L. Bank	20.50	0	0	50	0.000	0.00
					2.664	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 24-Jun-00
Time (24 hr): 17:00
Location: Pelvic OF
Flows monitored by: JD and SM

Gauge Ht. = 0.450 m
Discharge= 1.392 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	28.10					
	27.60	11	0	50	0.000	0.00
	27.10	19	0	50	0.000	0.00
	26.60	18	0	50	0.000	0.00
	26.10	25	8	50	0.005	0.36
	25.60	26	18	50	0.017	1.20
	25.10	30	24	50	0.030	2.13
	24.60	26	36	50	0.041	2.97
	24.10	36	35	50	0.055	3.94
	23.60	50	26	50	0.064	4.60
	23.10	26	47	50	0.063	4.53
	22.60	70	5	50	0.039	2.82
	22.10	37	40	50	0.046	3.29
	21.60	62	13	50	0.057	4.11
	21.10	57	8	50	0.032	2.27
	20.60	53	1	50	0.013	0.91
	20.10	73	16	50	0.031	2.19
	19.60	61	28	50	0.072	5.17
	19.10	54	21	50	0.071	5.10
	18.60	45	10	50	0.040	2.85
	18.10	54	62	50	0.095	6.82
	17.60	55	62	50	0.169	12.14
	17.10	41	50	50	0.137	9.81
	16.60	36	46	50	0.093	6.66
	16.10	36	36	50	0.074	5.30
	15.60	58	26	50	0.070	5.04
	15.10	26	9	50	0.044	3.13
	14.60	31	14	50	0.017	1.20
	14.10	33	5	50	0.015	1.08
	13.60	25	1	50	0.005	0.34
	13.10	26	0	50	0.001	0.04
	12.60	12	0	50	0.000	0.00
	12.10	20	0	50	0.000	0.00
	11.60	9	0	50	0.000	0.00
	11.10	5	0	50	0.000	0.00
L. Bank	10.80	0	0	30	0.000	0.00
					1.392	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 23-Jul-00
Time (24 hr): 14:00
Location: Pelvic OF
Flows monitored by: shane

Gauge Ht. = 0.240 m
Discharge= 0.241 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	3.50					
	3.60	5	0	10	0.000	0.00
	3.75	6	1	15	0.000	0.02
	4.00	7	3	25	0.000	0.14
	4.50	24	11	50	0.007	2.96
	5.00	18	20	50	0.016	6.48
	5.50	14	9	50	0.012	5.05
	6.00	54	2	50	0.006	2.43
	6.50	25	0	50	0.003	1.12
	7.00	42	1	50	0.001	0.44
	7.50	26	5	50	0.004	1.79
	8.00	30	11	50	0.012	4.78
	8.50	47	0	50	0.008	3.43
	9.00	38	8	50	0.008	3.16
	9.50	38	3	50	0.010	4.34
	10.00	38	-2	50	0.001	0.39
	10.50	33	18	50	0.013	5.38
	11.00	33	26	50	0.036	15.08
	11.50	40	26	50	0.047	19.72
	12.00	15	25	50	0.035	14.70
	12.50	41	2	50	0.011	4.75
	13.00	36	4	50	0.006	2.35
	13.50	2	0	50	0.004	1.50
L. Bank	15.70	0	0	220	0.000	0.00
					0.241	**100.00**

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Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 16-Aug-00
Time (24 hr): 16:00
Location: Pelvic OF
Flows monitored by: Chris T

Gauge Ht. = 0.110 m
Discharge= 0.043 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	3.90					
	5.50	18	0	160	0.000	0.00
	6.00	12	25	50	0.008	17.43
	6.50	35	0	50	0.008	17.43
	7.00	21	0	50	0.000	0.00
	7.50	22	12	50	0.007	15.34
	7.75	30	0	25	0.003	7.67
	8.00	21	0	25	0.000	0.00
	8.25	29	0	25	0.000	0.00
	8.50	34	0	25	0.000	0.00
	8.75	33	0	25	0.000	0.00
	9.00	15	14	25	0.003	6.10
	9.25	30	0	25	0.003	6.10
	9.50	36	0	25	0.000	0.00
	9.75	50	10	25	0.006	14.53
	10.00	30	0	25	0.006	14.53
	10.25	48	0	25	0.000	0.00
	10.50	0	0	25	0.000	0.00
	11.25	0	0	75	0.000	0.00
	11.50	34	0	25	0.000	0.00
	11.75	15	1	25	0.000	0.44
	12.00	21	0	25	0.000	0.44
	12.25	30	0	25	0.000	0.00
	12.50	31	0	25	0.000	0.00
	12.75	20	0	25	0.000	0.00
	13.00	28	0	25	0.000	0.00
	13.25	38	0	25	0.000	0.00
L. Bank	16.50	0	0	325	0.000	0.00
					0.043	**100.00**

Appendix 3.2-1
Stream Flow Monitoring, Hope Bay Belt, 2000

Date Monitored: 12-Sep-00
Time (24 hr): 10:00
Location: Pelvic OF
Flows monitored by: SLU/DJ

Gauge Ht. = 0.130 m
Discharge= 0.025 m^3/s

Notes	Station (m)	Depth (cm)	Average Velocity (cm/s)	Width (cm)	Flow (m^3/s)	%of total flow
R. Bank	14.25					
	16.70	0	0	245	0.000	0.00
	16.95	12	25	25	0.004	15.08
	17.30	0	0	35	0.005	21.11
	17.85	0	0	55	0.000	0.00
	18.04	22	12	19	0.003	10.09
	18.20	0	0	16	0.002	8.49
	19.30	0	0	110	0.000	0.00
	19.39	21	0	9	0.000	0.00
	19.52	0	0	13	0.000	0.00
	20.68	0	0	116	0.000	0.00
	20.83	40	14	15	0.004	16.89
	20.98	0	0	15	0.004	16.89
	21.40	0	0	42	0.000	0.00
	21.58	27	10	18	0.002	9.77
	21.60	0	0	2	0.000	1.09
	21.85	0	0	25	0.000	0.00
	22.12	21	0	27	0.000	0.00
	22.25	0	0	13	0.000	0.00
	22.83	0	0	58	0.000	0.00
	22.87	17	1	4	0.000	0.14
	23.00	0	0	13	0.000	0.44
	23.30	0	0	30	0.000	0.00
	23.69	10	0	39	0.000	0.00
	23.70	0	0	1	0.000	0.00
	23.93	0	0	23	0.000	0.00
L. Bank	22.55	8	0	138	0.000	0.00
					0.025	**100.00**

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APPENDIX 3.2-2
STAGE DISCHARGE CURVES, HOPE BAY BELT, 2000

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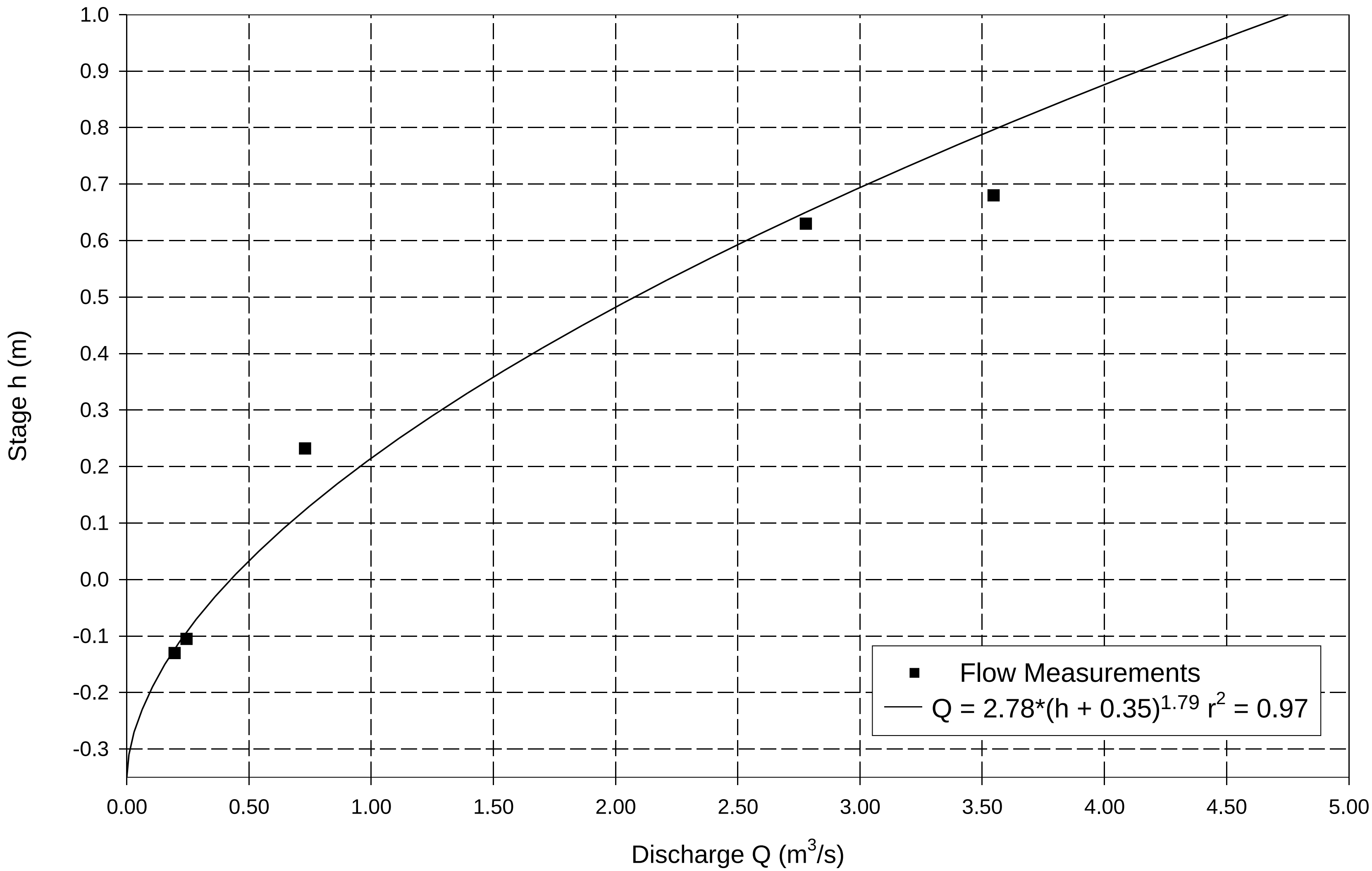
APPENDIX 3.2-2a
DORIS OUTFLOW STAGE DISCHARGE CURVE, HOPE BAY BELT, 2000

Rescan™



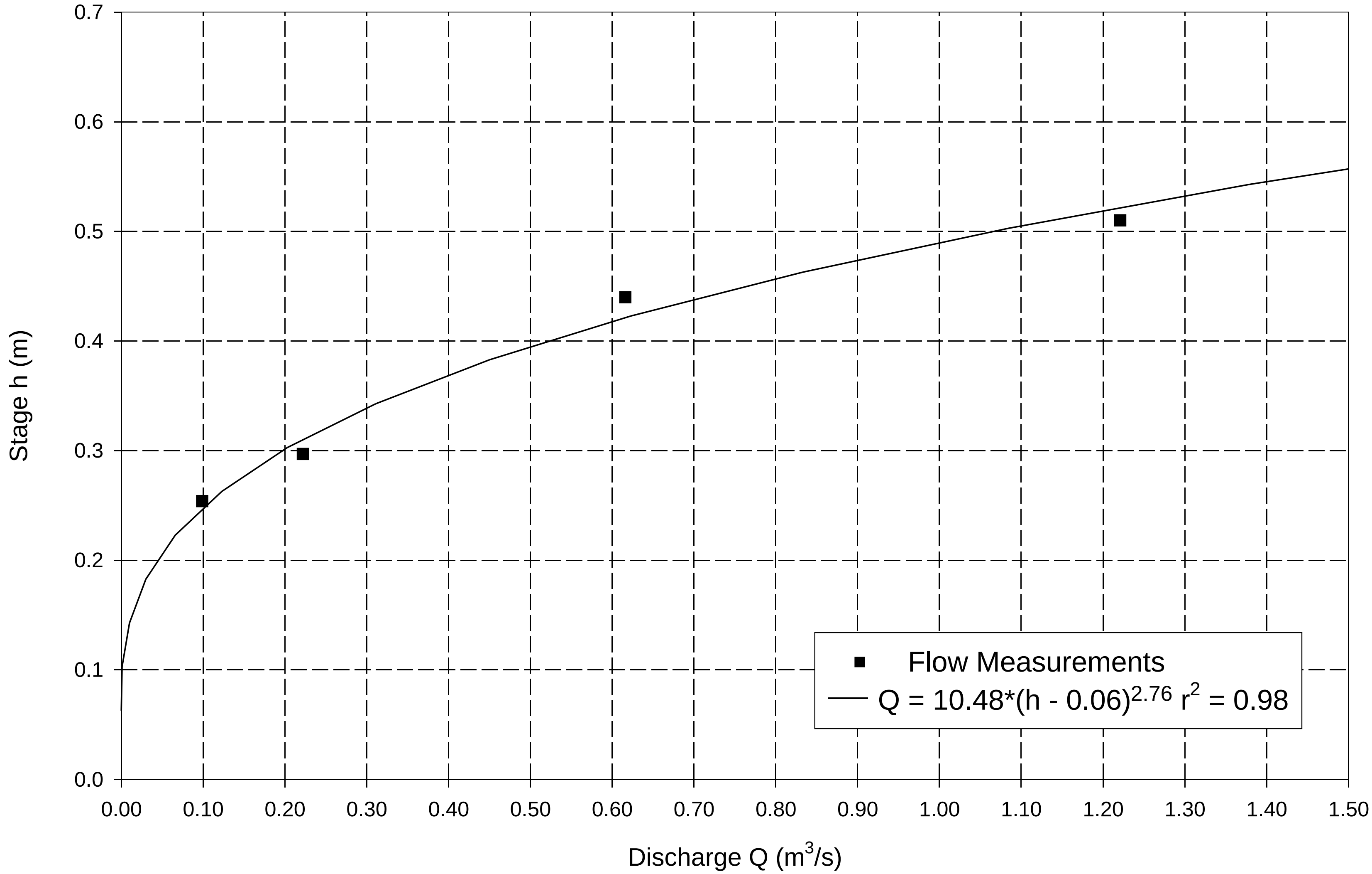
Note: Discharge rating curve is based on 5 flow measurements taken from 2000.

APPENDIX 3.2-2a

Doris Outflow Stage Discharge Curve, Hope Bay Belt, 2000

APPENDIX 3.2-2b
GLENN OUTFLOW STAGE DISCHARGE CURVE, HOPE BAY BELT, 2000

Rescan™



Note: Discharge rating curve is based on 4 flow measurements taken from 2000.

APPENDIX 3.2-2b

Glenn Outflow Stage Discharge Curve, Hope Bay Belt, 2000

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APPENDIX 3.2-2c
PELVIC OUTFLOW STAGE DISCHARGE CURVE, HOPE BAY BELT, 2000

Rescan™

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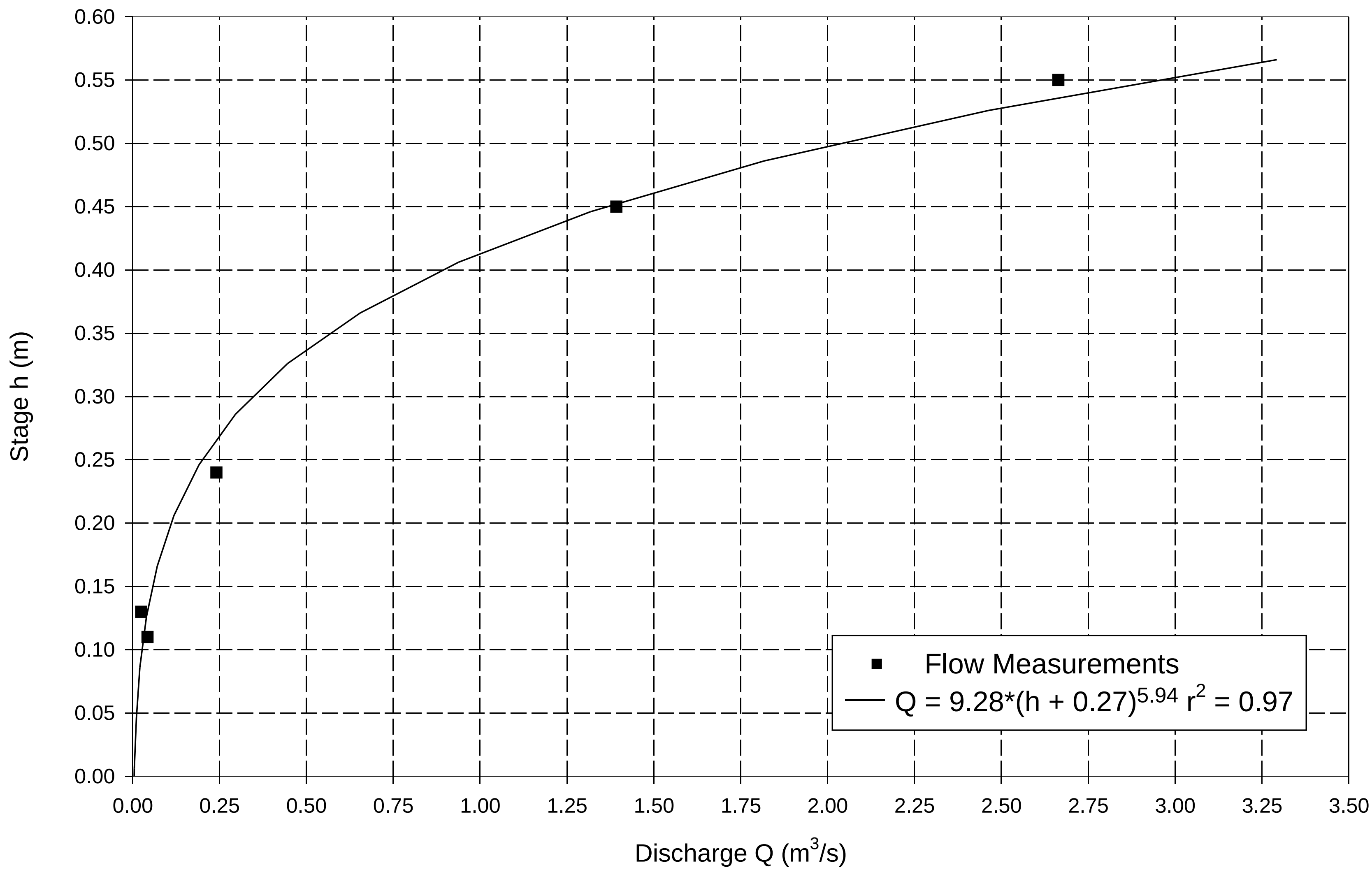

Note: Discharge rating curve is based on 5 flow measurements taken from 2000.

APPENDIX 3.2-2c

Pelvic Outflow Stage Discharge Curve, Hope Bay Belt, 2000

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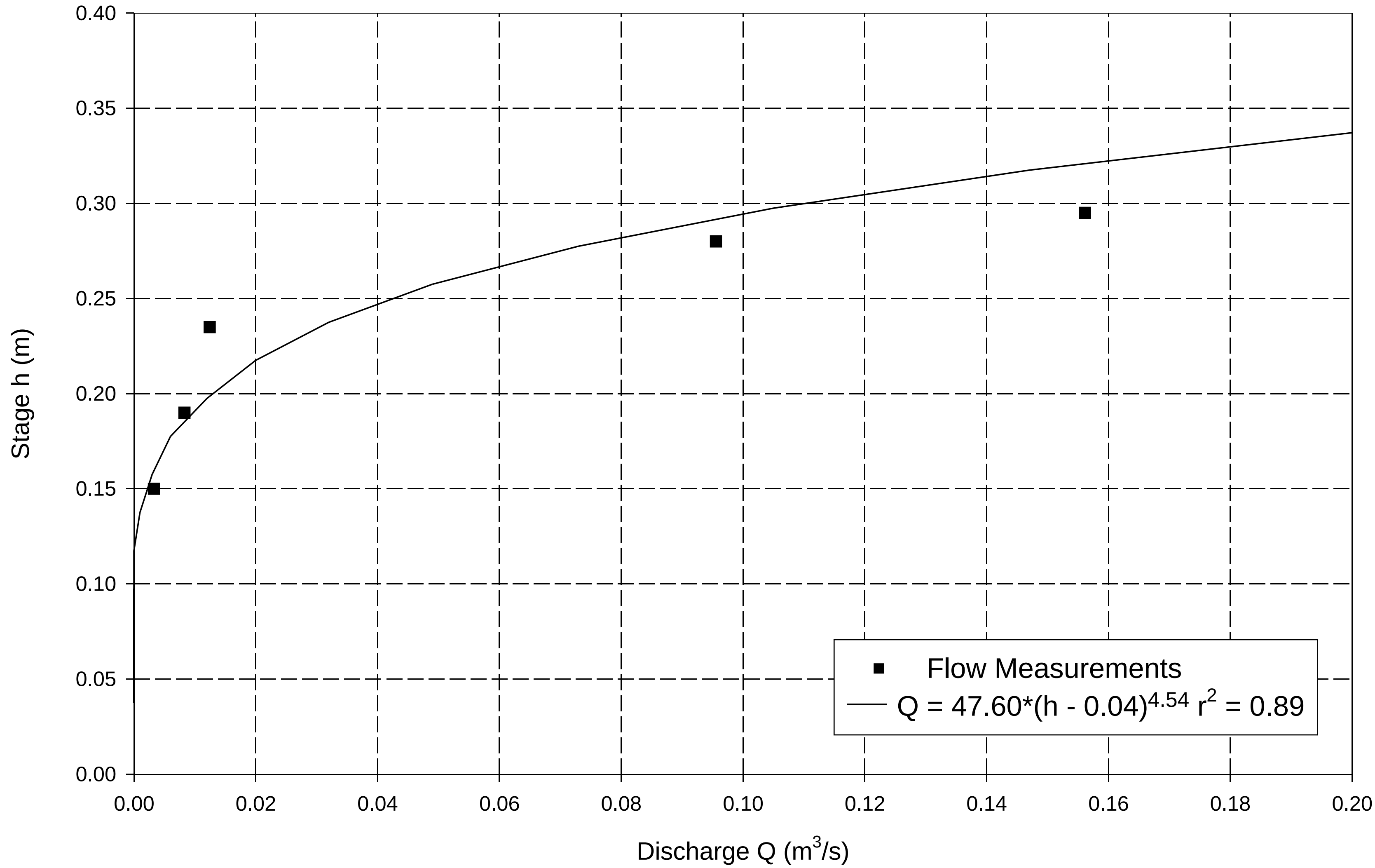
APPENDIX 3.2-2d
TAIL OUTFLOW STAGE DISCHARGE CURVE, HOPE BAY BELT, 2000



Note: Discharge rating curve is based on 5 flow measurements taken from 2000.

APPENDIX 3.2-2d

Tail Outflow Stage Discharge Curve, Hope Bay Belt, 2000

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APPENDIX 3.3-1
SUMMARIES OF MEAN DAILY DISCHARGE, HOPE BAY BELT, 2000

APPENDIX 3.3-1a
SUMMARY OF MEAN DAILY DISCHARGE (m^3/s) AT DORIS OUTFLOW, HOPE BAY BELT, 2000

Rescan™

Appendix 3.3-1a
Summary of Mean Daily Discharge (m^3/s) at Doris Outflow, Hope Bay Belt, 2000

Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)
01-Jun-00		01-Jul-00	2.194	01-Aug-00	0.584	01-Sep-00	0.185
02-Jun-00		02-Jul-00	2.148	02-Aug-00	0.532	02-Sep-00	0.185
03-Jun-00		03-Jul-00	2.100	03-Aug-00	0.508	03-Sep-00	0.185
04-Jun-00		04-Jul-00	2.039	04-Aug-00	0.488	04-Sep-00	0.185
05-Jun-00		05-Jul-00	1.989	05-Aug-00	0.448	05-Sep-00	0.186
06-Jun-00		06-Jul-00	1.924	06-Aug-00	0.419	06-Sep-00	0.187
07-Jun-00		07-Jul-00	1.863	07-Aug-00	0.405	07-Sep-00	0.187
08-Jun-00		08-Jul-00	1.788	08-Aug-00	0.349	08-Sep-00	0.186
09-Jun-00		09-Jul-00	1.730	09-Aug-00	0.346	09-Sep-00	0.185
10-Jun-00		10-Jul-00	1.705	10-Aug-00	0.331	10-Sep-00	0.186
11-Jun-00		11-Jul-00	1.727	11-Aug-00	0.316	11-Sep-00	0.187
12-Jun-00		12-Jul-00	1.710	12-Aug-00	0.297	12-Sep-00	
13-Jun-00		13-Jul-00	1.656	13-Aug-00	0.271	13-Sep-00	
14-Jun-00		14-Jul-00	1.581	14-Aug-00	0.256	14-Sep-00	
15-Jun-00		15-Jul-00	1.518	15-Aug-00	0.234	15-Sep-00	
16-Jun-00	2.527	16-Jul-00	1.450	16-Aug-00	0.215	16-Sep-00	
17-Jun-00	2.696	17-Jul-00	1.385	17-Aug-00	0.200	17-Sep-00	
18-Jun-00	2.798	18-Jul-00	1.318	18-Aug-00	0.200	18-Sep-00	
19-Jun-00	2.847	19-Jul-00	1.247	19-Aug-00	0.200	19-Sep-00	
20-Jun-00	2.949	20-Jul-00	1.189	20-Aug-00	0.182	20-Sep-00	
21-Jun-00	2.915	21-Jul-00	1.105	21-Aug-00	0.168	21-Sep-00	
22-Jun-00	2.822	22-Jul-00	1.023	22-Aug-00	0.175	22-Sep-00	
23-Jun-00	2.767	23-Jul-00	0.970	23-Aug-00	0.168	23-Sep-00	
24-Jun-00	2.695	24-Jul-00	0.944	24-Aug-00	0.169	24-Sep-00	
25-Jun-00	2.605	25-Jul-00	0.892	25-Aug-00	0.182	25-Sep-00	
26-Jun-00	2.554	26-Jul-00	0.835	26-Aug-00	0.187	26-Sep-00	
27-Jun-00	2.469	27-Jul-00	0.795	27-Aug-00	0.188	27-Sep-00	
28-Jun-00	2.372	28-Jul-00	0.778	28-Aug-00	0.187	28-Sep-00	
29-Jun-00	2.297	29-Jul-00	0.713	29-Aug-00	0.187	29-Sep-00	
30-Jun-00	2.246	30-Jul-00	0.655	30-Aug-00	0.187	30-Sep-00	
		31-Jul-00	0.620	31-Aug-00	0.186		

APPENDIX 3.3-1b
SUMMARY OF MEAN DAILY DISCHARGE (m^3/s) AT GLENN OUTFLOW, HOPE BAY BELT, 2000

Appendix 3.3-1b
Summary of Mean Daily Discharge (m^3/s) at Glenn Outflow, Hope Bay Belt, 2000

Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)
01-Jun-00		01-Jul-00	0.351	01-Aug-00	0.218	01-Sep-00	0.095
02-Jun-00		02-Jul-00	0.356	02-Aug-00	0.208	02-Sep-00	0.098
03-Jun-00		03-Jul-00	0.391	03-Aug-00	0.203	03-Sep-00	0.101
04-Jun-00		04-Jul-00	0.390	04-Aug-00	0.200	04-Sep-00	0.100
05-Jun-00		05-Jul-00	0.380	05-Aug-00	0.197	05-Sep-00	0.099
06-Jun-00		06-Jul-00	0.372	06-Aug-00	0.188	06-Sep-00	0.101
07-Jun-00		07-Jul-00	0.365	07-Aug-00	0.182	07-Sep-00	0.101
08-Jun-00		08-Jul-00	0.347	08-Aug-00	0.165	08-Sep-00	0.116
09-Jun-00		09-Jul-00	0.331	09-Aug-00	0.162	09-Sep-00	0.126
10-Jun-00		10-Jul-00	0.331	10-Aug-00	0.158	10-Sep-00	0.145
11-Jun-00		11-Jul-00	0.346	11-Aug-00	0.155	11-Sep-00	0.159
12-Jun-00		12-Jul-00	0.346	12-Aug-00	0.154	12-Sep-00	
13-Jun-00		13-Jul-00	0.337	13-Aug-00	0.147	13-Sep-00	
14-Jun-00		14-Jul-00	0.326	14-Aug-00	0.141	14-Sep-00	
15-Jun-00	1.091	15-Jul-00	0.306	15-Aug-00	0.135	15-Sep-00	
16-Jun-00	0.839	16-Jul-00	0.295	16-Aug-00	0.132	16-Sep-00	
17-Jun-00	0.777	17-Jul-00	0.288	17-Aug-00	0.128	17-Sep-00	
18-Jun-00	0.798	18-Jul-00	0.283	18-Aug-00	0.129	18-Sep-00	
19-Jun-00	0.690	19-Jul-00	0.277	19-Aug-00	0.136	19-Sep-00	
20-Jun-00	0.592	20-Jul-00	0.275	20-Aug-00	0.131	20-Sep-00	
21-Jun-00	0.537	21-Jul-00	0.263	21-Aug-00	0.127	21-Sep-00	
22-Jun-00	0.506	22-Jul-00	0.251	22-Aug-00	0.127	22-Sep-00	
23-Jun-00	0.463	23-Jul-00	0.255	23-Aug-00	0.130	23-Sep-00	
24-Jun-00	0.427	24-Jul-00	0.254	24-Aug-00	0.124	24-Sep-00	
25-Jun-00	0.403	25-Jul-00	0.252	25-Aug-00	0.114	25-Sep-00	
26-Jun-00	0.394	26-Jul-00	0.253	26-Aug-00	0.115	26-Sep-00	
27-Jun-00	0.380	27-Jul-00	0.246	27-Aug-00	0.114	27-Sep-00	
28-Jun-00	0.367	28-Jul-00	0.250	28-Aug-00	0.112	28-Sep-00	
29-Jun-00	0.351	29-Jul-00	0.239	29-Aug-00	0.105	29-Sep-00	
30-Jun-00	0.345	30-Jul-00	0.229	30-Aug-00	0.104	30-Sep-00	
		31-Jul-00	0.225	31-Aug-00	0.100		

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APPENDIX 3.3-1c
SUMMARY OF MEAN DAILY DISCHARGE (m^3/s) AT PELVIC OUTFLOW, HOPE BAY BELT, 2000

Appendix 3.3-1c
Summary of Mean Daily Discharge (m^3/s) at Pelvic Outflow, Hope Bay Belt, 2000

Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)
01-Jun-00		01-Jul-00	0.816	01-Aug-00	0.084	01-Sep-00	0.025
02-Jun-00		02-Jul-00	0.759	02-Aug-00	0.076	02-Sep-00	0.027
03-Jun-00		03-Jul-00	0.716	03-Aug-00	0.072	03-Sep-00	0.026
04-Jun-00		04-Jul-00	0.693	04-Aug-00	0.070	04-Sep-00	0.026
05-Jun-00		05-Jul-00	0.665	05-Aug-00	0.064	05-Sep-00	0.025
06-Jun-00		06-Jul-00	0.632	06-Aug-00	0.062	06-Sep-00	0.025
07-Jun-00		07-Jul-00	0.597	07-Aug-00	0.054	07-Sep-00	0.026
08-Jun-00		08-Jul-00	0.543	08-Aug-00	0.043	08-Sep-00	0.028
09-Jun-00		***09-Jul-00***	***0.526***	09-Aug-00	0.044	09-Sep-00	0.027
10-Jun-00		***10-Jul-00***	***0.501***	10-Aug-00	0.042	10-Sep-00	0.032
11-Jun-00		***11-Jul-00***	***0.476***	11-Aug-00	0.041	11-Sep-00	0.036
12-Jun-00		***12-Jul-00***	***0.451***	12-Aug-00	0.039	12-Sep-00	0.039
13-Jun-00		***13-Jul-00***	***0.426***	13-Aug-00	0.037	13-Sep-00	
14-Jun-00		***14-Jul-00***	***0.401***	14-Aug-00	0.036	14-Sep-00	
15-Jun-00		***15-Jul-00***	***0.376***	15-Aug-00	0.034	15-Sep-00	
16-Jun-00		***16-Jul-00***	***0.351***	16-Aug-00	0.033	16-Sep-00	
17-Jun-00	3.181	***17-Jul-00***	***0.326***	17-Aug-00	0.032	17-Sep-00	
18-Jun-00	2.909	***18-Jul-00***	***0.301***	18-Aug-00	0.033	18-Sep-00	
19-Jun-00	2.401	***19-Jul-00***	***0.276***	19-Aug-00	0.034	19-Sep-00	
20-Jun-00	2.099	***20-Jul-00***	***0.251***	20-Aug-00	0.032	20-Sep-00	
21-Jun-00	1.880	***21-Jul-00***	***0.226***	21-Aug-00	0.031	21-Sep-00	
22-Jun-00	1.787	***22-Jul-00***	***0.201***	22-Aug-00	0.034	22-Sep-00	
23-Jun-00	1.595	23-Jul-00	0.171	23-Aug-00	0.032	23-Sep-00	
24-Jun-00	1.418	24-Jul-00	0.169	24-Aug-00	0.029	24-Sep-00	
25-Jun-00	1.251	25-Jul-00	0.156	25-Aug-00	0.028	25-Sep-00	
26-Jun-00	1.171	26-Jul-00	0.144	26-Aug-00	0.029	26-Sep-00	
27-Jun-00	1.088	27-Jul-00	0.133	27-Aug-00	0.029	27-Sep-00	
28-Jun-00	1.012	28-Jul-00	0.128	28-Aug-00	0.028	28-Sep-00	
29-Jun-00	0.931	29-Jul-00	0.111	29-Aug-00	0.027	29-Sep-00	
30-Jun-00	0.868	30-Jul-00	0.095	30-Aug-00	0.027	30-Sep-00	
		31-Jul-00	0.089	31-Aug-00	0.025		

Note: Daily flows in bold-italics were interpolated from hydrologic data.

APPENDIX 3.3-1d
SUMMARY OF MEAN DAILY DISCHARGE (m^3/s) AT TAIL OUTFLOW, HOPE BAY BELT, 2000

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Appendix 3.3-1d
Summary of Mean Daily Discharge (m^3/s) at Tail Outflow, Hope Bay Belt, 2000

Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)	Date	Mean Daily Discharge (m^3/s)
01-Jun-00		01-Jul-00	0.103	01-Aug-00	0.013	01-Sep-00	0.001
02-Jun-00		02-Jul-00	0.104	02-Aug-00	0.012	02-Sep-00	0.001
03-Jun-00		03-Jul-00	0.103	03-Aug-00	0.010	03-Sep-00	0.001
04-Jun-00		04-Jul-00	0.102	04-Aug-00	0.009	04-Sep-00	0.001
05-Jun-00		05-Jul-00	0.102	05-Aug-00	0.007	05-Sep-00	0.001
06-Jun-00		06-Jul-00	0.096	06-Aug-00	0.007	06-Sep-00	0.001
07-Jun-00		07-Jul-00	0.086	07-Aug-00	0.005	07-Sep-00	0.001
08-Jun-00		08-Jul-00	0.078	08-Aug-00	0.004	08-Sep-00	0.005
09-Jun-00		09-Jul-00	0.073	09-Aug-00	0.003	09-Sep-00	0.005
10-Jun-00		10-Jul-00	0.070	10-Aug-00	0.003	10-Sep-00	0.007
11-Jun-00		11-Jul-00	0.073	11-Aug-00	0.003	11-Sep-00	0.009
12-Jun-00		12-Jul-00	0.068	12-Aug-00	0.002	12-Sep-00	0.009
13-Jun-00		13-Jul-00	0.062	13-Aug-00	0.002	13-Sep-00	
14-Jun-00		14-Jul-00	0.054	14-Aug-00	0.002	14-Sep-00	
15-Jun-00		15-Jul-00	0.045	15-Aug-00	0.001	15-Sep-00	
16-Jun-00	0.111	16-Jul-00	0.037	16-Aug-00	0.001	16-Sep-00	
17-Jun-00	0.109	17-Jul-00	0.032	17-Aug-00	0.001	17-Sep-00	
18-Jun-00	0.104	18-Jul-00	0.028	18-Aug-00	0.002	18-Sep-00	
19-Jun-00	0.098	19-Jul-00	0.025	19-Aug-00	0.002	19-Sep-00	
20-Jun-00	0.097	20-Jul-00	0.025	20-Aug-00	0.002	20-Sep-00	
21-Jun-00	0.099	21-Jul-00	0.023	21-Aug-00	0.002	21-Sep-00	
22-Jun-00	0.099	22-Jul-00	0.019	22-Aug-00	0.002	22-Sep-00	
23-Jun-00	0.098	23-Jul-00	0.017	23-Aug-00	0.002	23-Sep-00	
24-Jun-00	0.098	24-Jul-00	0.015	24-Aug-00	0.002	24-Sep-00	
25-Jun-00	0.097	25-Jul-00	0.015	25-Aug-00	0.001	25-Sep-00	
26-Jun-00	0.104	26-Jul-00	0.015	26-Aug-00	0.002	26-Sep-00	
27-Jun-00	0.105	27-Jul-00	0.020	27-Aug-00	0.002	27-Sep-00	
28-Jun-00	0.104	28-Jul-00	0.021	28-Aug-00	0.002	28-Sep-00	
29-Jun-00	0.102	29-Jul-00	0.019	29-Aug-00	0.001	29-Sep-00	
30-Jun-00	0.104	30-Jul-00	0.016	30-Aug-00	0.001	30-Sep-00	
		31-Jul-00	0.014	31-Aug-00	0.001		

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APPENDIX 4.1-1
ANALYTICAL RESULTS FOR LAKE WATER QUALITY SAMPLES, HOPE BAY BELT, 2000

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Appendix 4.1-1
Analytical Results for Lake Water Quality Samples, Hope Bay Belt, 2000

		Windy Lake 1m 25-Jul-00			Windy Lake 7m 25-Jul-00			Tail Lake 1m 19-Jul-00			Tail Lake 3m 19-Jul-00			Doris Lake 1m 24-Jul-00		
		Rep #1	Rep #2	Average[1]	Rep #1	Rep #2	Average	Rep #1	Rep #2	Average	Rep #1	Rep #2	Average	Rep #1	Rep #2	Average
Parameter	**Units**															
Physical Tests																
Conductivity	umhos/cm	416	418	417	419	421	420	143	143	143	143	144	144	231	235	233
Total Dissolved Solids	mg/L	228	229	229	229	231	230	78	78	78	77	79	78	126	128	127
Hardness (as $CaCO_3$)	mg/L	63.10	62.50	62.80	65.40	62.30	63.85	29.30	31.80	30.55	30.60	29.20	29.90	37.40	35.00	36.20
pH	pH units	7.9	7.9	7.9	7.9	7.9	7.9	7.5	7.7	7.6	7.7	7.6	7.7	7.1	7.5	7.3
Total Suspended Solids	mg/L	<3	3	2	<3	3	2	<3	5	3	<3	<3	<3	4	<3	3
Turbidity	NTU	1.0	1.0	1.0	0.8	0.6	0.7	0.6	0.8	0.7	0.3	0.8	0.6	2.1	2.2	2.2
Dissolved Anions																
Acidity (to pH 8.3) $CaCO_3$	mg/L	1	1	1	1	1	1	1	2	2	1	1	1	3	2	3
Alkalinity (Total $CaCO_3$)	mg/L	44	44	44	45	45	45	20	21	21	21	21	21	23	23	23
Bromide	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chloride	mg/L	94.9	94.7	94.8	95.9	95.8	95.9	26.9	26.9	26.9	26.8	26.9	26.9	53.4	52.9	53.2
Fluoride	mg/L	0.11	0.14	0.13	0.12	0.13	0.13	0.09	0.07	0.08	0.09	0.10	0.10	0.14	0.08	0.11
Sulphate	mg/L	7	7	7	7	7	7	2	2	2	2	2	2	2	2	2
Nutrients																
Ammonia Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.017	0.016	0.017	0.016	0.020	0.018	<0.005	<0.005	<0.005
Nitrate Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite Nitrogen	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved ortho-Phosphate	mg/L	0.004	0.003	0.004	0.002	0.002	0.002	0.003	0.005	0.004	0.003	0.004	0.004	0.007	0.007	0.007
Total Phosphate	mg/L	0.006	0.006	0.006	0.006	0.006	0.006	0.012	0.009	0.011	0.009	0.010	0.010	0.013	0.014	0.014
Total Organic Carbon	mg/L	2.6	3.2	2.9	3.1	3.3	3.2	6.5	6.9	6.7	6.6	6.8	6.7	6.8	6.9	6.9
Total Metals																
Aluminum	mg/L	0.043	0.043	0.043	0.038	0.038	0.038	0.019	0.020	0.020	0.020	0.020	0.020	0.020	0.022	0.021
Antimony	mg/L	0.00005	0.00006	0.00006	0.00005	0.00005	0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Arsenic	mg/L	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003
Barium	mg/L	0.00225	0.00229	0.00227	0.00234	0.00226	0.00230	0.00164	0.00167	0.00166	0.00169	0.00164	0.00167	0.00256	0.00259	0.00258
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron	mg/L	0.044	0.044	0.044	0.045	0.046	0.046	0.012	0.013	0.013	0.013	0.012	0.013	0.018	0.018	0.018
Cadmium	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium	mg/L	10.7	10.5	10.6	11.0	10.6	10.8	5.1	5.5	5.3	5.3	5.1	5.2	6.3	6.0	6.2
Chromium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.0009	0.0008	0.0009	0.0008	0.0009	0.0009	0.0011	0.0010	0.0011	0.0010	0.0010	0.0010	0.0013	0.0013	0.0013
Iron	mg/L	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.06	0.06	0.05	0.05	0.05	0.08	0.07	0.08
Lead	mg/L	0.00007	0.00007	0.00007	0.00007	0.00007	0.00007	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00010	0.00006	0.00008
Lithium	mg/L	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Magnesium	mg/L	8.8	8.8	8.8	9.2	8.7	9.0	4.0	4.4	4.2	4.2	4.0	4.1	5.2	4.9	5.1
Manganese	mg/L	0.00172	0.00170	0.00171	0.00187	0.00181	0.00184	0.00512	0.00522	0.00517	0.00526	0.00525	0.00526	0.00771	0.00796	0.00784
Mercury	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.00061	0.00060	0.00061	0.00061	0.00064	0.00063	0.00009	0.00009	0.00009	0.00009	0.00009	0.00009	0.00014	0.00015	0.00015
Nickel	mg/L	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0003	0.0003	0.0003
Potassium	mg/L	4	4	4	4	4	4	<2	<2	<2	<2	<2	<2	2	2	2
Selenium	mg/L	<0.001	0.001	0.001	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silicon	mg/L	0.29	0.27	0.28	0.29	0.28	0.29	0.34	0.38	0.36	0.37	0.36	0.37	0.99	0.96	0.98
Silver	mg/L	0.00001	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00005	0.00003	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Sodium	mg/L	53.0	52.0	52.5	53.0	50.0	51.5	15.0	16.0	15.5	15.0	14.0	14.5	28.0	26.0	27.0
Uranium	mg/L	0.00018	0.00018	0.00018	0.00018	0.00018	0.00018	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00003	0.00003	0.00003
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

1. A value of one-half the detection limit was used to calculate the average concentration of a parameter when one replicate had a value below the stated detection limit.

Appendix 4.1-1
Analytical Results for Lake Water Quality Samples, Hope Bay Belt, 2000

			Doris Lake			Pelvic Lake			Pelvic Lake			Tail Lake			Doris Lake	
			8m			1m			9m			3m			8m	
			24-Jul-00			24-Jul-00			24-Jul-00			19-Aug-00			22-Aug-00	
		Rep #1	Rep #2	Average	Rep #1	Rep #2	Average[1]	Rep #1	Rep #2	Average	Rep #1	Rep #2	Average	Rep #1	Rep #2	Average
Parameter	**Units**															
Physical Tests																
Conductivity	umhos/cm	239	241	240	207	206	207	205	208	207	153	153	153	244	244	244
Total Dissolved Solids	mg/L	131	133	132	115	113	114	114	116	115	89	89	89	140	140	140
Hardness (as $CaCO_3$)	mg/L	35.70	36.50	36.10	30.20	30.20	30.20	30.30	30.50	30.40	34.00	32.90	33.45	41.30	42.60	41.95
pH	pH units	7.3	7.6	7.4	7.5	7.6	7.6	7.5	7.7	7.6	7.7	7.7	7.7	7.8	7.8	7.8
Total Suspended Solids	mg/L	<3	3	2	8	4	6	6	6	6	<3	<3	<3	5	5	5
Turbidity	NTU	3.1	3.4	3.3	5.8	5.3	5.6	7.3	5.9	6.6	0.9	1.0	1.0	4.7	4.9	4.8
Dissolved Anions																
Acidity (to pH 8.3) $CaCO_3$	mg/L	2	1	2	1	1	1	2	1	2	<1	<1	<1	<1	<1	<1
Alkalinity (Total $CaCO_3$)	mg/L	23	23	23	16	16	16	16	16	16	24	24	24	24	24	24
Bromide	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5						
Chloride	mg/L	53.4	53.9	53.7	47.3	47.4	47.4	46.9	46.2	46.6	29.4	29.1	29.3	53.1	53.4	53.3
Fluoride	mg/L	0.11	0.09	0.10	0.08	0.07	0.08	0.05	0.05	0.05	0.14	0.09	0.12	0.07	0.08	0.08
Sulphate	mg/L	2	2	2	3	3	3	3	3	3	2	2	2	3	3	3
Nutrients																
Ammonia Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.013	0.016	0.015	0.006	0.005	0.006
Nitrate Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite Nitrogen	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	0.002
Dissolved ortho-Phosphate	mg/L	0.010	0.009	0.010	0.013	0.013	0.013	0.016	0.017	0.017	0.001	0.002	0.002	0.001	0.001	0.001
Total Phosphate	mg/L	0.016	0.017	0.017	0.020	0.020	0.020	0.026	0.024	0.025	0.013	0.018	0.016	0.018	0.016	0.017
Total Organic Carbon	mg/L	6.9	7.2	7.1	6.3	6.4	6.4	6.5	6.9	6.7	6.6	7.1	6.9	7.2	6.7	7.0
Total Metals																
Aluminum	mg/L	0.018	0.020	0.019	0.093	0.091	0.092	0.093	0.088	0.091	0.031	0.027	0.029	0.019	0.019	0.019
Antimony	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Arsenic	mg/L	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0005	0.0005	0.0005
Barium	mg/L	0.00256	0.00253	0.00255	0.00261	0.00265	0.00263	0.00271	0.00263	0.00267	0.00143	0.00143	0.00143	0.00255	0.00256	0.00256
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron	mg/L	0.018	0.018	0.018	0.018	0.018	0.018	0.017	0.019	0.018	0.015	0.015	0.015	0.021	0.021	0.021
Cadmium	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium	mg/L	6.1	6.1	6.1	3.9	3.9	3.9	3.9	3.9	3.9	5.6	5.4	5.5	6.8	7.0	6.9
Chromium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0007	0.0007	0.0007
Cobalt	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.0012	0.0012	0.0012	0.0014	0.0013	0.0014	0.0013	0.0013	0.0013	0.0012	0.0011	0.0012	0.0014	0.0014	0.0014
Iron	mg/L	0.09	0.09	0.09	0.17	0.17	0.17	0.18	0.18	0.18	0.06	0.06	0.06	0.04	0.05	0.05
Lead	mg/L	0.00010	<0.00005	0.00006	0.00008	0.00008	0.00008	0.00012	0.00010	0.00011	0.00011	0.00009	0.00010	0.00014	0.00005	0.00010
Lithium	mg/L	0.003	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003
Magnesium	mg/L	5.0	5.1	5.1	5.0	5.0	5.0	5.0	5.0	5.0	4.9	4.7	4.8	5.9	6.1	6.0
Manganese	mg/L	0.01200	0.01030	0.01115	0.01610	0.01600	0.01605	0.01910	0.02050	0.01980	0.00500	0.00499	0.00500	0.00810	0.00833	0.00822
Mercury	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.00014	0.00015	0.00015	0.00011	0.00012	0.00012	0.00011	0.00011	0.00011	0.00144	0.00089	0.00117	0.00063	0.00051	0.00057
Nickel	mg/L	0.0004	0.0003	0.0004	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0006	0.0006	0.0006	0.0004	0.0004	0.0004
Potassium	mg/L	2	2	2	<2	<2	<2	<2	<2	<2	2	2	2	2	2	2
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.001
Silicon	mg/L	0.99	1.00	1.00	1.20	1.22	1.21	1.20	1.21	1.21						
Silver	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Sodium	mg/L	25.0	26.0	25.5	25.0	25.0	25.0	25.0	25.0	25.0	14.4	14.9	14.7	27.3	28.9	28.1
Uranium	mg/L	0.00003	0.00003	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

1. A value of one-half the detection limit was used to calculate the average concentration of a parameter when one replicate had a value below the stated detection limit.

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APPENDIX 4.1-2
ANALYTICAL RESULTS FOR LAKE QA/QC SAMPLES, HOPE BAY BELT, 2000

Appendix 4.1-2
Analytical Results for Lake QA/QC Samples, Hope Bay Belt, 2000

Parameter	Units	Field Blank 25-Jul-00	Travel Blank 25-Jul-00
Physical Tests			
Conductivity	umhos/cm	<2	<2
Total Dissolved Solids	mg/L	<1	<1
Hardness (as $CaCO_3$)	mg/L	<0.5	<0.5
pH	pH units	6.0	5.6
Total Suspended Solids	mg/L	<3	<3
Turbidity	NTU	0.1	0.1
Dissolved Anions			
Acidity (to pH 8.3) $CaCO_3$	mg/L	<1	2
Alkalinity (Total $CaCO_3$)	mg/L	<1	<1
Bromide	mg/L	<0.5	<0.5
Chloride	mg/L	<0.5	<0.5
Fluoride	mg/L	<0.02	<0.02
Sulphate	mg/L	<1	<1
Nutrients			
Ammonia Nitrogen	mg/L	<0.005	<0.005
Nitrate Nitrogen	mg/L	<0.005	<0.005
Nitrite Nitrogen	mg/L	<0.001	<0.001
Dissolved ortho-Phosphate	mg/L	0.001	0.002
Total Phosphate	mg/L	<0.002	0.002
Total Organic Carbon	mg/L	1.4	<0.5
Total Metals			
Aluminum	mg/L	<0.001	<0.001
Antimony	mg/L	<0.00005	<0.00005
Arsenic	mg/L	<0.0001	<0.0001
Barium	mg/L	<0.00005	<0.00005
Beryllium	mg/L	<0.0005	<0.0005
Bismuth	mg/L	<0.0005	<0.0005
Boron	mg/L	<0.001	<0.001
Cadmium	mg/L	<0.00005	<0.00005
Calcium	mg/L	<0.05	<0.05
Chromium	mg/L	<0.0005	<0.0005
Cobalt	mg/L	<0.0001	<0.0001
Copper	mg/L	<0.0001	<0.0001
Iron	mg/L	<0.03	<0.03
Lead	mg/L	<0.00005	<0.00005
Lithium	mg/L	<0.001	<0.001
Magnesium	mg/L	<0.1	<0.1
Manganese	mg/L	<0.00005	<0.00005
Mercury	mg/L	<0.00005	<0.00005
Molybdenum	mg/L	<0.00005	<0.00005
Nickel	mg/L	<0.0001	<0.0001
Potassium	mg/L	<2	<2
Selenium	mg/L	<0.001	<0.001
Silicon	mg/L	<0.05	<0.05
Silver	mg/L	<0.00001	<0.00001
Sodium	mg/L	<2	<2
Uranium	mg/L	<0.00001	<0.00001
Vanadium	mg/L	<0.001	<0.001
Zinc	mg/L	<0.001	<0.001

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APPENDIX 4.2-1
ANALYTICAL RESULTS FOR STREAM WATER QUALITY SAMPLES, HOPE BAY BELT, 2000

Rescan™

Appendix 4.2-1
Analytical Results for Stream Water Quality Samples, Hope Bay Belt, 2000

		Tail Outflow 20-Jun-00			Tail Outflow 14-Sep-00			Doris Outflow 20-Jun-00			Doris Outflow 14-Sep-00		
Parameter	**Units**	**Rep #1**	**Rep #2**	**Average[1]**	**Rep #1**	**Rep #2**	**Average**	**Rep #1**	**Rep #2**	**Average**	**Rep #1**	**Rep #2**	**Average**
Physical Tests													
Conductivity	umhos/cm	58	57	58	209	209	209	269	268	269	261	262	262
Total Dissolved Solids	mg/L	38	32	35	125	125	125	136	161	149	157	157	157
Hardness (as $CaCO_3$)	mg/L	14.40	13.90	14.15	43.00	43.60	43.30	49.00	48.80	48.90	46.90	65.90	56.40
pH	pH units	7.3	7.3	7.3	7.6	7.5	7.6	7.6	7.7	7.7	7.6	7.6	7.6
Total Suspended Solids	mg/L	<3	<3	<3	<3	5	3	<3	<3	<3	7	7	7
Turbidity	NTU	0.8	0.8	0.8	5.3	4.5	4.9	4.5	5.3	4.9	5.8	6.5	6.2
Dissolved Anions													
Acidity (to pH 8.3) $CaCO_3$	mg/L	<1	1	1	2	2	2	2	1	2	2	3	3
Alkalinity-Total $CaCO_3$	mg/L	9	9	9	23	23	23	26	26	26	25	25	25
Chloride	mg/L	8.1	8.1	8.1	43.4	44.0	43.7	59.3	59.0	59.2	58.7	58.3	58.5
Fluoride	mg/L	0.04	0.04	0.04	0.08	0.08	0.08	0.07	0.07	0.07	0.08	0.08	0.08
Sulphate	mg/L	<1	<1	<1	5	6	6	3	3	3	4	4	4
Nutrients													
Ammonia Nitrogen	mg/L	0.031	0.029	0.030	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrate Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nitrite Nitrogen	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dissolved ortho-Phosphate	mg/L	0.006	0.006	0.006	0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001
Total Phosphorus	mg/L				0.006	0.006	0.006				0.015	0.017	0.016
Total Organic Carbon	mg/L	5.3	5.2	5.3	6.0	6.2	6.1	5.9	6.4	6.2	6.3	6.4	6.4
Total Metals													
Aluminum	mg/L	0.031	0.030	0.031	0.014	0.014	0.014	0.028	0.034	0.031	0.024	0.091	0.058
Antimony	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Arsenic	mg/L	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002	0.0003	0.0003	0.0003	0.0003	0.0004	0.0004
Barium	mg/L	0.00126	0.00122	0.00124	0.00288	0.00289	0.00289	0.00298	0.00305	0.00302	0.00301	0.00358	0.00330
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron	mg/L	0.005	0.005	0.005	0.013	0.012	0.013	0.022	0.021	0.022	0.020	0.022	0.021
Cadmium	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Calcium	mg/L	2.76	2.55	2.66	7.68	7.81	7.75	8.41	8.48	8.45	8.22	15.70	11.96
Chromium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Cobalt	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper	mg/L	0.0007	0.0008	0.0008	0.0008	0.0007	0.0008	0.0016	0.0015	0.0016	0.0016	0.0023	0.0020
Iron	mg/L	0.08	0.08	0.08	0.59	0.57	0.58	0.06	0.07	0.07	0.10	0.12	0.11
Lead	mg/L	0.00006	0.00005	0.00006	0.00007	0.00009	0.00008	0.00009	0.00009	0.00009	0.00015	0.00027	0.00021
Lithium	mg/L	0.001	0.001	0.001	0.003	0.003	0.003	0.004	0.004	0.004	0.004	0.004	0.004
Magnesium	mg/L	1.8	1.8	1.8	5.8	5.9	5.9	6.8	6.7	6.8	6.4	6.5	6.5
Manganese	mg/L	0.00152	0.00143	0.00148	0.01350	0.01340	0.01345	0.00793	0.00817	0.00805	0.01350	0.01490	0.01420
Mercury	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.00007	0.00006	0.00007	0.00006	0.00006	0.00006	0.00017	0.00017	0.00017	0.00014	0.00018	0.00016
Nickel	mg/L	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0006	0.0005
Potassium	mg/L	<2	<2	<2	2	2	2	3	3	3	9	4	6
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver	mg/L	0.00005	0.00002	0.00004	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	0.00002	<0.00001	<0.00001	<0.00001
Sodium	mg/L	5	5	5	19	18	18	37	36	37	26	28	27
Uranium	mg/L	0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	0.00003	0.00003	0.00003	0.00003	0.00004	0.00004
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.001

1: a value of one-half the detection limit was used to calculate the average concentration of a parameter when one replicate had a value below the stated detection limit.

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Appendix 4.2-1
Analytical Results for Stream Water Quality Samples, Hope Bay Belt, 2000

		Pelvic Outflow 20-Jun-00			Pelvic Outflow 14-Sep-00			Koignuk River 20-Jun-00			Koignuk River 15-Sep-00		
Parameter	**Units**	**Rep #1**	**Rep #2**	**Average**	**Rep #1**	**Rep #2**	**Average**	**Rep #1**	**Rep #2**	**Average**	**Rep #1**	**Rep #2**	**Average**
Physical Tests													
Conductivity	umhos/cm	88	87	88	231	231	231	61	61	61	168	169	169
Total Dissolved Solids	mg/L	51	51	51	139	139	139	46	47	47	101	101	101
Hardness (as $CaCO_3$)	mg/L	14.40	14.60	14.50	35.30	34.70	35.00	26.40	16.20	21.30	36.60	36.40	36.50
pH	pH units	7.0	7.0	7.0	7.6	7.6	7.6	7.2	7.2	7.2	7.5	7.4	7.4
Total Suspended Solids	mg/L	<3	5	3	13	11	12	14	10	12	5	6	6
Turbidity	NTU	5.1	5.5	5.3	15.2	15.9	15.6	11.5	10.4	11.0	9.8	8.5	9.2
Dissolved Anions													
Acidity (to pH 8.3) $CaCO_3$	mg/L	2	2	2	<1	1	1	1	1	1	<1	2	1
Alkalinity-Total $CaCO_3$	mg/L	7	7	7	18	17	18	9	9	9	13	14	14
Chloride	mg/L	18.7	18.5	18.6	53.4	53.2	53.3	9.1	9.1	9.1	33.9	35.0	34.5
Fluoride	mg/L	0.04	0.04	0.04	0.08	0.07	0.08	0.03	0.04	0.04	0.03	0.06	0.05
Sulphate	mg/L	2	2	2	4	4	4	2	2	2	9	9	9
Nutrients													
Ammonia Nitrogen	mg/L	0.150	0.148	0.149	0.009	0.007	0.008	0.031	0.031	0.031	0.009	0.011	0.010
Nitrate Nitrogen	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.008	0.009	0.009	<0.005	<0.005	<0.005
Nitrite Nitrogen	mg/L	<0.001	0.001	0.001	<0.001	0.001	0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001
Dissolved ortho-Phosphate	mg/L	0.005	0.012	0.009	<0.001	0.002	0.001	0.002	0.002	0.002	<0.001	<0.001	<0.001
Total Phosphorus	mg/L				0.031	0.038	0.035				0.014	0.014	0.014
Total Organic Carbon	mg/L	6.1	6.1	6.1	6.5	6.3	6.4	6.5	6.5	6.5	5.3	5.7	5.5
Total Metals													
Aluminum	mg/L	0.099	0.100	0.100	0.184	0.175	0.180	0.424	0.429	0.427	0.283	0.282	0.283
Antimony	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Arsenic	mg/L	0.0002	0.0002	0.0002	0.0004	0.0005	0.0005	0.0012	0.0002	0.0007	0.0003	0.0003	0.0003
Barium	mg/L	0.00241	0.00248	0.00245	0.00399	0.00407	0.00403	0.00628	0.00640	0.00634	0.00607	0.00623	0.00615
Beryllium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bismuth	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron	mg/L	0.008	0.008	0.008	0.023	0.022	0.023	0.005	0.005	0.005	0.009	0.008	0.009
Cadmium	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.00006	<0.00005	0.00004	<0.00005	<0.00005	<0.00005
Calcium	mg/L	1.89	1.93	1.91	4.44	4.33	4.39	7.41	3.45	5.43	6.64	6.63	6.64
Chromium	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0009	0.0009	0.0009	0.0006	0.0007	0.0007
Cobalt	mg/L	0.0002	0.0002	0.0002	<0.0001	<0.0001	<0.0001	0.0004	0.0003	0.0004	0.0002	0.0002	0.0002
Copper	mg/L	0.0009	0.0009	0.0009	0.0017	0.0016	0.0017	0.0018	0.0015	0.0017	0.0015	0.0016	0.0016
Iron	mg/L	0.16	0.16	0.16	0.14	0.14	0.14	0.57	0.56	0.57	0.36	0.36	0.36
Lead	mg/L	0.00010	0.00010	0.00010	0.00016	0.00015	0.00016	0.00064	0.00024	0.00044	0.00022	0.00023	0.00023
Lithium	mg/L	0.001	0.001	0.001	0.003	0.002	0.003	0.001	0.001	0.001	0.002	0.002	0.002
Magnesium	mg/L	2.4	2.4	2.4	5.9	5.8	5.9	1.9	1.9	1.9	4.9	4.8	4.9
Manganese	mg/L	0.04570	0.04640	0.04605	0.00904	0.00875	0.00890	0.02510	0.02370	0.02440	0.01110	0.01150	0.01130
Mercury	mg/L	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.00006	0.00007	0.00007	0.00019	0.00019	0.00019	0.00009	0.00006	0.00008	0.00011	0.00009	0.00010
Nickel	mg/L	0.0006	0.0006	0.0006	0.0003	0.0003	0.0003	0.0013	0.0011	0.0012	0.0008	0.0009	0.0009
Potassium	mg/L	<2	<2	<2	3	3	3	<2	<2	<2	1	1	1
Selenium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Silver	mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00007	0.00002	0.00005	<0.00001	<0.00001	<0.00001
Sodium	mg/L	10	11	11	27	27	27	6	5	6	15	15	15
Uranium	mg/L	0.00002	0.00002	0.00002	0.00005	0.00005	0.00005	0.00006	0.00005	0.00006	0.00005	0.00005	0.00005
Vanadium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	0.002	0.004	0.001	0.002	0.002

1: a value of one-half the detection limit was used to calculate the average concentration of a parameter when one replicate had a value below the stated detection limit.

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APPENDIX 4.2-2
ANALYTICAL RESULTS FOR STREAM QA/QC WATER QUALITY SAMPLES, HOPE BAY BELT, 2000

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Appendix 4.2-2
Analytical Results for Stream QA/QC Water Quality Samples, Hope Bay Belt, 2000

Parameter	Units	Travel Blank June	Travel Blank September
Physical Tests			
Conductivity	umhos/cm	<2	<2
Total Dissolved Solids	mg/L	<10	<10
Hardness (as $CaCO_3$)	mg/L	<0.5	<0.5
pH	pH units	5.4	5.6
Total Suspended Solids	mg/L	<3	<3
Turbidity	NTU	0.2	<0.1
Dissolved Anions			
Acidity (to pH 8.3) $CaCO_3$	mg/L	<1	<1
Alkalinity-Total $CaCO_3$	mg/L	<1	<1
Chloride	mg/L	<0.5	<0.5
Fluoride	mg/L	<0.02	<0.02
Sulphate	mg/L	<1	<1
Nutrients			
Ammonia Nitrogen	mg/L	<0.005	<0.005
Nitrate Nitrogen	mg/L	<0.005	<0.005
Nitrite Nitrogen	mg/L	<0.001	0.001
Dissolved ortho-Phosphate	mg/L	<0.001	<0.001
Total Phosphorus	mg/L	-	<0.002
Total Organic Carbon	mg/L	<0.5	<0.5
Total Metals			
Aluminum	mg/L	<0.001	<0.001
Antimony	mg/L	<0.00005	<0.00005
Arsenic	mg/L	<0.0001	<0.0001
Barium	mg/L	<0.00005	<0.00005
Beryllium	mg/L	<0.0005	<0.0005
Bismuth	mg/L	<0.0005	<0.0005
Boron	mg/L	<0.001	<0.001
Cadmium	mg/L	<0.00005	<0.00005
Calcium	mg/L	<0.05	<0.05
Chromium	mg/L	<0.0005	<0.0005
Cobalt	mg/L	<0.0001	<0.0001
Copper	mg/L	<0.0001	<0.0001
Iron	mg/L	<0.03	<0.03
Lead	mg/L	<0.00005	<0.00005
Lithium	mg/L	<0.001	<0.001
Magnesium	mg/L	<0.1	<0.1
Manganese	mg/L	0.00009	<0.00005
Mercury	mg/L	<0.00005	<0.00005
Molybdenum	mg/L	<0.00005	<0.00005
Nickel	mg/L	<0.0001	<0.0001
Potassium	mg/L	<2	<0.01
Selenium	mg/L	<0.001	<0.001
Silver	mg/L	<0.00001	<0.00001
Sodium	mg/L	<2	<0.01
Uranium	mg/L	<0.00001	<0.00001
Vanadium	mg/L	<0.001	<0.001
Zinc	mg/L	<0.001	<0.001

1. A value of one-half the detection limit was used to calculate the average concentration of a parameter when one replicate had a value below the stated detection limit.

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APPENDIX 6.1-1
DISSOLVED OXYGEN/TEMPERATURE DATA FOR HOPE BAY BELT LAKES, 2000

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Appendix 6.1-1
Dissolved Oxygen/Temperature Data for Hope Bay Belt Lakes, 2000

Tail Lake	Max Depth:	5.5 m	
22-Aug-00	Secchi Depth:	4.2 m	
Depth (m)	Temperature°C	DO (mg/L)	DO (% Sat)
0.0	11.0	10.0	91.0
0.5	10.9	10.0	90.0
1.0	10.9	10.0	90.0
1.5	10.9	10.0	90.0
2.0	10.8	10.0	90.0
2.5	10.8	9.9	90.0
3.0	10.8	10.0	90.0
3.5	10.8	9.9	89.0
4.0	10.8	9.9	90.0
4.5	10.8	9.9	90.0

Doris Lake	Max Depth:	15.0 m	
22-Aug-00	Secchi Depth:	4.2 m	
Depth (m)	Temperature°C	DO (mg/L)	DO (% Sat)
0.0	11.3	10.3	94.0
0.5	11.3	10.2	93.0
1.0	11.3	10.2	94.0
1.5	11.3	10.1	92.0
2.0	11.3	10.1	92.0
2.5	11.3	10.1	92.0
3.0	11.3	10.0	91.0
3.5	11.3	10.0	91.0
4.0	11.3	10.0	92.0
4.5	11.3	9.9	90.0
5.0	11.3	9.9	91.0
5.5	11.2	9.9	91.0
6.0	11.2	9.9	90.0
6.5	11.2	10.0	91.0
7.0	11.2	10.0	91.0
7.5	11.2	10.0	91.0
8.0	11.2	9.9	91.0
8.5	11.2	9.9	91.0
9.0	11.2	9.9	91.0
9.5	11.2	9.9	93.0
10.0	11.1	9.9	89.0
10.5	11.2	9.8	88.0
11.0	11.0	9.5	86.0
11.5	10.9	9.5	86.0
12.0	10.8	9.4	85.0
12.5	10.8	9.5	85.0
13.0	10.8	9.4	85.0
13.5	10.7	9.2	82.0
14.0	10.4	8.8	78.0
14.5	10.0	8.2	73.0

Pelvic Lake	Max Depth:	18.0 m	
22-Aug-00	Secchi Depth:	0.5 m	
Depth (m)	Temperature°C	DO (mg/L)	DO (% Sat)
0.0	11.6	9.1	83.0
0.5	11.6	9.1	83.0
1.0	11.6	8.9	82.0
1.5	11.5	9.0	82.0
2.0	11.5	8.8	80.0
2.5	11.5	8.5	78.0
3.0	11.5	8.5	77.0
3.5	11.5	8.5	78.0
4.0	11.5	8.5	78.0
4.5	11.5	8.5	78.0
5.0	11.5	8.5	78.0
5.5	11.5	8.5	78.0
6.0	11.5	8.5	78.0
6.5	11.5	8.5	77.0
7.0	11.5	8.5	78.0
7.5	11.5	8.5	78.0
8.0	11.5	8.5	77.0
8.5	11.5	8.5	77.0
9.0	11.5	8.4	77.0
9.5	11.5	8.5	78.0
10.0	11.5	8.5	78.0
10.5	11.5	8.5	78.0
11.0	11.5	8.4	77.0
11.5	11.5	8.4	77.0
12.0	11.5	8.4	77.0
12.5	11.5	8.4	77.0
13.0	11.5	8.4	77.0

Little Roberts	Max Depth:	2.7 m	
26-Aug-00	Secchi Depth:	1.6 m	
Depth (m)	Temperature°C	DO (mg/L)	DO (% Sat)
0.0	6.8	11.2	92.0
0.5	6.8	10.8	88.0
1.0	6.7	10.7	87.0
1.5	6.7	10.4	85.0
2.0	6.6	10.5	85.0
2.5	6.6	10.4	85.0

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APPENDIX 7.1-1
DIVERSITY INDEX CALCULATIONS

APPENDIX 7.1-1
DIVERSITY INDEX CALCULATIONS

Diversity indices are derived variable designed to simplify biological data sets and to help describe biological assemblages or communities. The analyses were carried out using the COMM program developed by Piepenburg and Piatkowski (1993). For each analysis, the COMM program generated the following parameters that were presented in this report:

- G: Genera richness or the total number of genera in a sample
- G (90%): Number of genera that account for 90% of the total numerical abundance or density.
- Maximum Dominance (%): Percentage of total abundance or density accounted for by the single-most abundant genera.

Diversity indices are designed to determine the diversity of a community or assemblage identified to the species or genus level, as long as the taxonomic level used is consistent. In this report, two diversity indices were derived from numerical abundance estimates obtained from various lake and stream samples: the Shannon-Weiner Index and the Simpson Index.

The Shannon-Weiner Index (H') is an information-based index defined as:

$$H' = -\sum_i p_i \cdot \ln(p_i)$$

where p_i is the proportion of the population that belongs to the i^{th} species/genera, and is defined as the numerical abundance of the i^{th} species/genera divided by the total number of organisms.

The Simpson Index (D) is defined as:

$$D = 1 - \sum_i (p_i)^2$$

where p_i is defined as in the Shannon-Weiner Index. The Simpson Index represents the probability that two individuals selected at random from the population are different species/genera.

Caution must be used in the interpretation of diversity indices, because diversity indices calculated from samples cannot be assumed to represent the diversity of the entire community or assemblage. As Green (1979) notes, this “may or may not be a serious problem when used for comparative purposes”. Indices calculated from counts obtained from identically made artificial substrate samplers (*e.g.* stream benthos or periphyton samplers used at Hope Bay) are less likely to be biased than are indices calculated from grab sample counts (*e.g.* lake benthos). Historically, there has not been a general connection between environmental quality and high diversity. It is therefore best to focus on site to site differences, and not make inferences as to the quality of the environment. Interpretation of diversity indices should be made with caution, with the life histories of the organisms and the timing of sample programs being kept in mind.

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APPENDIX 7.1-2
TAXONOMIC RESULTS FOR PHYTOPLANKTON SAMPLES, HOPE BAY BELT, 2000

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Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

Date:	18-Jul-96							
Site Name				Tail Lake				
Replicate Number			1	2	3	Mean	SE	%
FES Sample Number			257	258	259			
Units				Abundance (cells/mL)				
Phylum	**Order**	**Genera and Species**						
Bacillariophyceae	Centrales	*Cyclotella glomerata*						
		Cyclotella	2.8	<2.8	<2.8			
		Melosira italica						
		Melosira						
		Melosira ?						
		Rhizosolenia cf longiseta						
		Rhizosolenia						
	Pennales	*Achnanthes minutissima*	2.8	<2.8	<2.8			
		Achanathes						
		Amphora						
		Asterionella formosa	8.4	28.0	39.2			
		Ceratoneis						
		Cocconeis						
		Cymatopleura						
		Cymbella minuta						
		Cymbella						
		Diatoma	5.6	<2.8	<2.8			
		Eunotia cf pectinalis						
		Eunotia						
		Fragilaria crotonensis	<2.8	<2.8	56.0			
		Fragilaria		<2.8	<2.8			
		Frustulia						
		Gomphonema olivaceum						
		Gomphonema						
		Meridion						
		Navicula	<2.8	<2.8	<2.8			
		Nitzschia						
		Pinnularia						
		Pleurosigma / Gyrosigma	<2.8	<2.8	<2.8			
		Rhoicosphenia curvata						
		Stauroneis						
		Surirella						
		Synedra ulna						
		Synedra						
		Tabellaria fenestrata	<2.8	<2.8	<2.8			
		Tabellaria floculosa	11.2	53.2	50.4			
		UID						
		Sum:	**30.8**	**81.2**	**145.6**	**86**	**33**	**49**
Chlorophyta	Chlorococcales	*Ankistrodesmus*	5.6	2.8	<2.8			
		Botryococcus braunii						
		Crucigenia cf crucifera						
		Crucigenia quadrata						
		Crucigenia rectangularis						
		Crucigenia tetrapedia						
		Crucigenia						
		Dactylococcopsis						
		Dictyosphaerium						
		Dictyosphaerium ?						
		Elakatothrix gelatinosa	5.6	5.6	11.2			
		Kirchneriella ?						
		Nephrocytium						
		Nephrocytium ?						
		Oocystis						
		Pediastrum	<2.8	<2.8	<2.8			
		Quadrigula closteriodes						
		Quadrigula						

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Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

Date:	**18-Jul-96**							
Site Name				**Tail Lake**				
Replicate Number			**1**	**2**	**3**	**Mean**	**SE**	**%**
FES Sample Number			**257**	**258**	**259**			
Units				**Abundance (cells/mL)**				
Phylum	**Order**	**Genera and Species**						
		Scenedesmus						
		Schroederia ?	<2.8					
		Selenastrum						
		Sphaerocystis schroeteri						
		Tetraderon cf minimum						
		Tetraedron						
		Treubaria						
	Oedogoniales	Bulbochaete ?						
		Oedogonium						
		Oedogonium ?						
	Tetrasporales	Gloeocystis ampla						
	Ulothricales	Geminella						
		Geminella ?						
		Ulothrix						
		Ulothrix ?						
	Volvocales	Chlamydomonas						
		Eudorina						
		Eudorina ?						
		UID						
	Zygnematales	Arthrodesmus	<2.8	2.8	<2.8			
		Bambusina						
		Closteriopsis						
		Closterium						
		Cosmarium						
		Cylindrocystis						
		Euastrum	<2.8	<2.8	<2.8			
		Gonatozygon						
		Hyalotheca ?						
		Mougeotia						
		Mougeotia ?						
		Netrium						
		Spondylosium planum	<2.8	<2.8	<2.8			
		Staurastrum paradoxum						
		Staurastrum	<2.8	<2.8	<2.8			
		Xanthidium	<2.8					
		Zygnema ?						
		UID						
		Sum:	**11.2**	**11.2**	**11.2**	**11**	**0**	**6**
Chrysophyta	Ochromonadales	Chrysosphaerella cf longispina						
		Chrysosphaerella?						
		Dinobryon cf bavaricum	39.2	50.4	53.2			
		Dinobryon divergens	42.0	36.4	<2.8			
		Dinobryon elegantissimum						
		Dinobryon cf sertularia	<2.8	<2.8				
		Dinobryon	<2.8	<2.8	<2.8			
		Mallomonas						
		Uroglenopsis americana						
	Rhizochrysidales	Diceras phaseolus						
		Sum:	**81.2**	**86.8**	**53.2**	**74**	**10**	**42**
Cyanophyta	Chroococcales	Agmenellum tenuissima						
		Agmenellum						
		Anacystis cf elachista						
		Anacystis limneticus						
		Anacytsis						
		Dactylococcopsis						
		Gomphosphaeria cf pallidum						
		Gomphosphaeria						
	Nostocales	Anabaena flos-aquae						
		Anabaena						
		Anabaena ?						
		Anabaena ***						
		Aphanizomenon ?						
		Pseudanabaena ?	<2.8		<2.8			
		UID		<2.8				
	Oscillatoriales	Lyngbya cf limnetica	<2.8					
		Lyngbya		<2.8	<2.8			
		Oscillatoria cf tenuis						
		Oscillatoria						

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Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

Date:	**18-Jul-96**							
Site Name				**Tail Lake**				
Replicate Number			**1**	**2**	**3**	**Mean**	**SE**	**%**
FES Sample Number			**257**	**258**	**259**			
Units				**Abundance (cells/mL)**				
Phylum	**Order**	**Genera and Species**						
		Sum:	**0**	**0**	**0**	**0**	**0**	**0**
Euglenophyta	Euglenales	*Euglena*	<2.8	<2.8	<2.8			
		Phacus ?						
		Trachelomonas						
		UID						
		Sum:	**0**	**0**	**0**	**0**	**0**	**0**
Pyrrophyta	Cryptomonadales	*Chroomonas acuta*	5.6	2.8	2.8			
		Cryptomonas ovata / erosa	<2.8	<2.8	<2.8			
		Cryptomonas sp	<2.8	<2.8	<2.8			
	Dinokontae	*Ceratium hirundinella*						
		Gymnodinium ?						
		Peridinium cf inconspicuum						
		Peridinium sp.						
		Peridinium / Glenodinium	<2.8	<2.8	<2.8			
		UID						
		Sum:	**5.6**	**2.8**	**2.8**	**4**	**1**	**2**
		Total:	**128.8**	**182.0**	**212.8**	**175**	**25**	**100**
				Sum of averages:		175		

UID branched algae ***
UID filament ***
** Dinobryon cf bavaricum / sertularia
*** In poor condition.

UID = unidentified due to lack of size and/or missing morphological characters.

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Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

Date:	**23-Jul-96**								**Date:**
Site Name				**Doris Lake**					**Site Name**
Replicate Number			**1**	**2**	**3**	**Mean**	**SE**	**%**	**Replicate Numbe**
FES Sample Number			**260**	**261**	**262**				**FES Sample Nu**
Units				**Abundance (cells/mL)**					**Units**
Phylum	**Order**	**Genera and Species**							**Phylum**
Bacillariophyceae	Centrales	*Cyclotella glomerata*							Bacillariophyceae
		Cyclotella	<17.8	<17.8	<17.8				
		Melosira italica							
		Melosira	<17.8	<17.8	<17.8				
		Melosira ?							
		Rhizosolenia cf longiseta							
		Rhizosolenia							
	Pennales	*Achnanthes minutissima*	<17.8		<17.8				
		Achanathes							
		Amphora							
		Asterionella formosa	71.2	<17.8	124.6				
		Ceratoneis	<17.8		<17.8				
		Cocconeis	<17.8	<17.8	<17.8				
		Cymatopleura							
		Cymbella minuta							
		Cymbella							
		Diatoma	<17.8	<17.8	<17.8				
		Eunotia cf pectinalis							
		Eunotia		<17.8					
		Fragilaria crotonensis							
		Fragilaria	<17.8	35.6	<17.8				
		Frustulia							
		Gomphonema olivaceum							
		Gomphonema		<17.8					
		Meridion							
		Navicula	<17.8	<17.8	17.8				
		Nitzschia							
		Pinnularia							
		Pleurosigma / Gyrosigma		<17.8	<17.8				
		Rhoicosphenia curvata							
		Stauroneis							
		Surirella							
		Synedra ulna							
		Synedra	<17.8	<17.8	<17.8				
		Tabellaria fenestrata							
		Tabellaria floculosa							
		UID	<17.8		<17.8				
		Sum:	**71.2**	**35.6**	**142.4**	**83**	**31**	**0**	
Chlorophyta	Chlorococcales	*Ankistrodesmus*	35.6		35.6				Chlorophyta
		Botryococcus braunii	<17.8	<17.8	<17.8				
		Crucigenia cf crucifera							
		Crucigenia quadrata							
		Crucigenia rectangularis							
		Crucigenia tetrapedia							
		Crucigenia							
		Dactylococcopsis							
		Dictyosphaerium							
		Dictyosphaerium ?							
		Elakatothrix gelatinosa							
		Kirchneriella ?							
		Nephrocytium							
		Nephrocytium ?							
		Oocystis	<17.8		<17.8				
		Pediastrum							
		Quadrigula closteriodes							
		Quadrigula							

Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

Date:	23-Jul-96								Date:
Site Name				Doris Lake					Site Name
Replicate Number			1	2	3	Mean	SE	%	Replicate Numb
FES Sample Number			260	261	262				FES Sample Nu
Units			Abundance (cells/mL)						Units
Phylum	Order	Genera and Species							Phylum
		Scenedesmus	<17.8	<17.8	<17.8				
		Schroederia ?							
		Selenastrum							
		Sphaerocystis schroeteri							
		Tetraderon cf minimum	<17.8	<17.8	<17.8				
		Tetraedron	<17.8						
		Treubaria	<17.8		<17.8				
	Oedogoniales	Bulbochaete ?							
		Oedogonium							
		Oedogonium ?							
	Tetrasporales	Gloeocystis ampla							
	Ulothricales	Geminella							
		Geminella ?							
		Ulothrix							
		Ulothrix ?							
	Volvocales	Chlamydomonas	<17.8		<17.8				
		Eudorina							
		Eudorina ?							
		UID							
	Zygnematales	Arthrodesmus							
		Bambusina							
		Closteriopsis							
		Closterium							
		Cosmarium							
		Cylindrocystis							
		Euastrum							
		Gonatozygon							
		Hyalotheca ?							
		Mougeotia							
		Mougeotia ?							
		Netrium							
		Spondylosium planum	17.8		<17.8				
		Staurastrum paradoxum							
		Staurastrum							
		Xanthidium		<17.8					
		Zygnema ?							
		UID							
		Sum:	**53.4**	**0**	**35.6**	**30**	**16**	**0**	
Chrysophyta	Ochromonadales	Chrysosphaerella cf longispina							Chrysophyta
		Chrysosphaerella?							
		Dinobryon cf bavaricum	124.6	178.0	106.8				
		Dinobryon divergens		<17.8					
		Dinobryon elegantissimum		<17.8					
		Dinobryon cf sertularia	<17.8		17.8				
		Dinobryon	89.0	160.2	106.8				
		Mallomonas							
		Uroglenopsis americana							
	Rhizochrysidales	Diceras phaseolus							
		Sum:	**213.6**	**338.2**	**231.4**	**261**	**39**	**1**	
Cyanophyta	Chroococcales	Agmenellum tenuissima							Cyanophyta
		Agmenellum							
		Anacystis cf elachista							
		Anacystis limneticus							
		Anacytsis	<17.8		<17.8				
		Dactylococcopsis							
		Gomphosphaeria cf pallidum							
		Gomphosphaeria							
	Nostocales	Anabaena flos-aquae							
		Anabaena	<17.8		<17.8				
		Anabaena ?							
		Anabaena ***							
		Aphanizomenon ?	4,610.2	1,869.0	2,848.0				
		Pseudanabaena ?							
		UID		<17.8	<17.8				
	Oscillatoriales	Lyngbya cf limnetica	3,471.0	7,280.2	4,539.0				
		Lyngbya							
		Oscillatoria cf tenuis	29,459.0	24,386.0	25,454.0				
		Oscillatoria	<17.8	<17.8	<17.8				

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Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

Date:	**23-Jul-96**								**Date:**
Site Name				**Doris Lake**					**Site Name**
Replicate Number			**1**	**2**	**3**	**Mean**	**SE**	**%**	**Replicate Numb**
FES Sample Number			**260**	**261**	**262**				**FES Sample Nu**
Units				**Abundance (cells/mL)**					**Units**
Phylum	**Order**	**Genera and Species**							**Phylum**
		Sum:	**37540.2**	**33535.2**	**32841**	**34639**	**1464**	**99**	
Euglenophyta	Euglenales	*Euglena*	<17.8	<17.8	<17.8				Euglenophyta
		Phacus ?	<17.8						
		Trachelomonas							
		UID							
		Sum:	**0**	**0**	**0**	**0**	**0**		
Pyrrophyta	Cryptomonadales	*Chroomonas acuta*	53.4	53.4	17.8				Pyrrophyta
		Cryptomonas ovata / erosa	89.0	<17.8	53.4				
		Cryptomonas sp	17.8	<17.8	<17.8				
	Dinokontae	*Ceratium hirundinella*							
		Gymnodinium ?							
		Peridinium cf inconspicuum	<17.8	<17.8	<17.8				
		Peridinium sp.							
		Peridinium / Glenodinium	<17.8		<17.8				
		UID							
		Sum:	**160.2**	**53.4**	**71.2**	**95**	**33**	**0**	
		Total:	**38038.6**	**33962.4**	**33321.6**	**35108**	**1477**	**100**	
				Sum of averages:		35108			

UID branched algae ***
UID filament ***
** Dinobryon cf bavaricum / sertularia
*** In poor condition.

UID = unidentified due to lack of size and/or missing morphological characters.

UID branched alg
UID filament ***
** Dinobryon cf l
*** In poor condi

UID = unidentifie

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Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

23-Jul-96								
		Pelvic Lake						
er		1	2	3	Mean	SE	%
mber		263	264	265			
		Abundance (cells/mL)					
Order	**Genera and Species**						
Centrales	*Cyclotella glomerata*						
	Cyclotella						
	Melosira italica						
	Melosira	142.4	71.2	<35.6			
	Melosira ?						
	Rhizosolenia cf longiseta						
	Rhizosolenia						
Pennales	*Achnanthes minutissima*						
	Achanathes						
	Amphora	<35.6					
	Asterionella formosa	<35.6	<35.6	249.2			
	Ceratoneis						
	Cocconeis						
	Cymatopleura	<35.6	<35.6				
	Cymbella minuta						
	Cymbella						
	Diatoma	462.8	391.6	<35.6			
	Eunotia cf pectinalis						
	Eunotia						
	Fragilaria crotonensis	71.2	35.6	35.6			
	Fragilaria		<35.6	<35.6			
	Frustulia						
	Gomphonema olivaceum						
	Gomphonema						
	Meridion						
	Navicula	<35.6	<35.6	<35.6			
	Nitzschia	<35.6		<35.6			
	Pinnularia						
	Pleurosigma / Gyrosigma	<35.6	<35.6	<35.6			
	Rhoicosphenia curvata						
	Stauroneis						
	Surirella	<35.6	<35.6				
	Synedra ulna						
	Synedra						
	Tabellaria fenestrata						
	Tabellaria floculosa						
	UID	<35.6		<35.6			
	Sum:	**676.4**	**498.4**	**284.8**	**487**	**113**	**1**
Chlorococcales	*Ankistrodesmus*	35.6	<35.6	35.6			
	Botryococcus braunii	<35.6	<35.6	<35.6			
	Crucigenia cf crucifera						
	Crucigenia quadrata						
	Crucigenia rectangularis						
	Crucigenia tetrapedia						
	Crucigenia						
	Dactylococcopsis						
	Dictyosphaerium						
	Dictyosphaerium ?						
	Elakatothrix gelatinosa						
	Kirchneriella ?						
	Nephrocytium						
	Nephrocytium ?						
	Oocystis						
	Pediastrum						
	Quadrigula closteriodes						
	Quadrigula						

Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

23-Jul-96							
			Pelvic Lake				
er		**1**	**2**	**3**	**Mean**	**SE**	**%**
mber		**263**	**264**	**265**			
			Abundance (cells/mL)				
Order	**Genera and Species**						
	Scenedesmus	<35.6	<35.6	<35.6			
	Schroederia ?						
	Selenastrum						
	Sphaerocystis schroeteri						
	Tetraderon cf minimum						
	Tetraedron						
	Treubaria						
Oedogoniales	*Bulbochaete ?*						
	Oedogonium						
	Oedogonium ?						
Tetrasporales	*Gloeocystis ampla*						
Ulothricales	*Geminella*						
	Geminella ?						
	Ulothrix						
	Ulothrix ?						
Volvocales	*Chlamydomonas*						
	Eudorina						
	Eudorina ?						
	UID						
Zygnematales	*Arthrodesmus*						
	Bambusina						
	Closteriopsis						
	Closterium						
	Cosmarium						
	Cylindrocystis						
	Euastrum						
	Gonatozygon						
	Hyalotheca ?						
	Mougeotia						
	Mougeotia ?						
	Netrium						
	Spondylosium planum						
	Staurastrum paradoxum						
	Staurastrum						
	Xanthidium						
	Zygnema ?						
	UID						
	Sum:	**35.6**	**0**	**35.6**	**24**	**12**	**0**
Ochromonadales	*Chrysosphaerella cf longispina*						
	Chrysosphaerella?						
	Dinobryon cf bavaricum	356.0	320.4	284.8			
	Dinobryon divergens						
	Dinobryon elegantissimum						
	Dinobryon cf sertularia	71.2	35.6	106.8			
	Dinobryon	249.2	391.6	427.2			
	Mallomonas						
	Uroglenopsis americana						
Rhizochrysidales	*Diceras phaseolus*						
	Sum:	**676.4**	**747.6**	**818.8**	**748**	**41**	**1**
Chroococcales	*Agmenellum tenuissima*						
	Agmenellum						
	Anacystis cf elachista						
	Anacystis limneticus						
	Anacytsis						
	Dactylococcopsis						
	Gomphosphaeria cf pallidum						
	Gomphosphaeria						
Nostocales	*Anabaena flos-aquae*						
	Anabaena	<35.6	<35.6				
	Anabaena ?						
	Anabaena ***						
	Aphanizomenon ?	3,275.2	2,812.4	2,705.6			
	Pseudanabaena ?						
	UID			<35.6			
Oscillatoriales	*Lyngbya cf limnetica*	3,560.0	3,204.0	3,916.0			
	Lyngbya						
	Oscillatoria cf tenuis	57,316.0	61,232.0	49,484.0			
	Oscillatoria						

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Appendix 7.1-2
Taxonomic Results for Phytoplankton Samples, Hope Bay Belt, 2000

23-Jul-96							
		Pelvic Lake					
er		1	2	3	Mean	SE	%
mber		263	264	265			
		Abundance (cells/mL)					
Order	**Genera and Species**						
	Sum:	**64151.2**	**67248.4**	**56105.6**	**62502**	**3321**	**98**
Euglenales	*Euglena*	<35.6	<35.6	<35.6			
	Phacus ?						
	Trachelomonas						
	UID						
	Sum:	**0**	**0**	**0**	**0**	**0**	**0**
Cryptomonadales	*Chroomonas acuta*	106.8	35.6	106.8			
	Cryptomonas ovata / erosa	142.4	71.2	71.2			
	Cryptomonas sp	71.2		35.6			
Dinokontae	*Ceratium hirundinella*						
	Gymnodinium ?						
	Peridinium cf inconspicuum						
	Peridinium sp.						
	Peridinium / Glenodinium	<35.6	<35.6	<35.6			
	UID						
	Sum:	**320.4**	**106.8**	**213.6**	**214**	**62**	**0**
	Total:	**65860.0**	**68601.2**	**57458.4**	**63973**	**3352**	**100**
			Sum of averages:		63973		

ae ***

bavaricum / sertularia
tion.

ed due to lack of size and/or missing morphological characters.

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APPENDIX 7.2-1
TAXONOMIC RESULTS FOR PERIPHYTON SAMPLES, HOPE BAY BELT, 2000

Appendix 7.2-1
Taxonomic Results for Periphyton Samples, Hope Bay Belt, 2000

			Cell Density cells / cm ^{2}					
FES Sample Number			**000466**	**000467**	**000468**			
Sample Site				**Tail Outflow**				
Replicate Number			**1**	**2**	**3**			
Sampling Date			**08/16/00**	**08/16/00**	**08/16/00**			
Area Sampled (cm^2)			**16.65**	**19.36**	**21.32**			
Phylum	**Order**	**Genera and Species**				**Mean**	**SE**	**%**
Bacillariophyceae	Centrales	*Cyclotella spp.*						
		Melosira sp.						
		Rhizosolenia sp.						
		Stephanodiscus sp. ?						
	Pennales	*Achnanthes minutissima*	66,526.2	45,157.5	14,348.4			
		Achnanthes spp.	32,410.2	63,220.5	23,479.2			
		Amphiprora sp.						
		Amphora spp.						
		Asterionella formosa						
		Caloneis sp.						
		Cocconeis sp.						
		Cymatopleura solea						
		Cymbella spp.	9,097.6	12,042.0	3,478.4			
		Denticula sp. ?						
		Diatoma elongatum	27,292.8	36,126.0	6,087.2			
		Diatoma sp.						
		Diatomella sp.						
		Diploneis spp.						
		Epithemia sorex						
		Epithemia turgida						
		Epithemia sp.						
		Eunotia spp.	3,411.6	6,021.0	869.6			
		Fragilaria crotonensis						
		Fragilaria spp.	3,411.6	4,014.0	1,739.2			
		Frustulia sp.						
		Gomphonema spp.	32,410.2	93,325.5	33,914.4			
		Navicula radiosa	457.6	807.6	350.0			
		Navicula spp.	5,686.0	6,021.0	1,739.2			
		Nedium spp.						
		Nitzschia acicularis						
		Nitzschia spp.	2,274.4	4,014.0	869.6			
		Pinnularia spp.	457.6	807.6				
		Pleurosigma / Gyrosigma sp.						
		Rhopalodia gibba						
		Stauroneis sp.						
		Surirella spp.						
		Synedra ulna	40,939.2	60,210.0	6,956.8			
		Synedra spp.	35,821.8	57,199.5	45,654.0			
		Tabellaria fenestrata	457.6	<807.6				
		Tabellaria flocculosa	14,783.6	10,035.0	1,739.2			
		UID	2,274.4	4,014.0	2,608.8			
		Sum:	**277,712.4**	**403,015.2**	**143,834.0**	**274,853.9**	**74,832.8**	**55.7**
Chlorophyta	Chaetophorales	*Stigeoclonium ? **	3,203.2	10,035.0	<350.0			
		UID						
	Chlorococcales	*Ankistrodesmus falcatus*	12,509.2	10,035.0	3,478.4			
		Ankistrodemus spiralis	<457.6	3,230.4				
		Elakatothrix sp. ?	<457.6					
		Oocystis						
		Pediastrum spp.						
		Quadrigula sp.?	<457.6		<350.0			
		Scenedesmus spp.						
		Tetraedron spp.	<457.6					
	Euglenales	*Trachelomonas spp.*	<457.6					
		UID						
	Oedogoniales	*Bulbochaete sp.*						
		Oedogonium sp.	<457.6	<807.6	700.0			
	Tetrasporales	*Tetraspora sp.?*			<350.0			
	Ulothricales	*Microspora sp.*		<807.6				
	Volvocales	*Chlamydomonas spp.*						

Appendix 7.2-1
Taxonomic Results for Periphyton Samples, Hope Bay Belt, 2000

				Cell Density cells / cm^2				
FES Sample Number			**000466**	**000467**	**000468**			
Sample Site				**Tail Outflow**				
Replicate Number			**1**	**2**	**3**			
Sampling Date			**08/16/00**	**08/16/00**	**08/16/00**			
Area Sampled (cm^2)			**16.65**	**19.36**	**21.32**			
Phylum	**Order**	**Genera and Species**				**Mean**	**SE**	**%**
	Zygnematales	*Arthrodesmus sp.*						
		Closterium spp.	2,274.4	2,422.8	700.0			
		Cosmarium spp.	4,548.8	12,042.0	1,400.0			
		Euastrum sp.	915.2	807.6	350.0			
		Mougeotia spp.	3,411.6	4,845.6				
		Pleurotaenium sp.						
		Spirogyra sp						
		Staurastrum spp.	1,137.2	807.6	350.0			
		Teilingia granulata	<457.6	807.6	350.0			
		Zygnema sp.						
Chlorophyta		UID filamentous	15,920.8	22,077.0	9,565.6			
		UID flagellate		<807.6	<350.0			
		UID colonial	4,548.8	<807.6	1,400.0			
		UID unicellular	<457.6	3,010.5	2,608.8			
		Sum:	**48,469.2**	**70,121.1**	**20,902.8**	**46,497.7**	**14,242.3**	**9.4**
Chrysophyta		*Dinobryon bavaricum*						
		Dinobryon cf. cylindricum						
		Dinobryon divergens						
		Dinobryon sertularia						
		Dinobryon sp.	<457.6					
		Epixys ramosa	<457.6					
		Hyalobryon sp.	915.2	<807.6				
		Kephyrion/Pseudokephyrion s	457.6	2,007.0				
Chrysophyta		UID cyst	2,274.4	2,007.0	869.6			
		UID flagellate	3,411.6	6,021.0	869.6			
		UID unicellular	6,823.2	12,042.0	1,739.2			
		Sum:	**13,882.0**	**22,077.0**	**3,478.4**	**13,145.8**	**5,381.6**	**2.7**
Cyanophyta	Chamaesiphonale	*Chamaesiphon sp.*	36,390.4	12,042.0	10,435.2			
		Clastidium setigerum	27,292.8	22,077.0	3,478.4			
	Chroococcales	*Aphanocapsa spp.*						
		Aphanothece spp	18,195.2	12,921.6	869.6			
		Chroococcus spp.		<807.6				
		Merismopedia sp.						
		Gomphosphaeria sp.		<807.6				
		UID						
	Nostocales	*Anabaena spp. ? **						
		Anabaena /Pseudoanabaena s	5,948.8	<807.6	<350.5			
		Aphanizomenon sp.						
		UID						
	Oscillatoriales	*Lyngbya spp.*	34,320.0	24,084.0	16,522.4			
		Oscillatoria cf. tenuis						
		Oscillatoria spp.	13,646.4	<807.6	13,913.6			
		Pseudanabaena catenata	61,408.8	117,409.5	45,219.2			
		Sum:	**197,202.4**	**188,534.1**	**90,438.4**	**158,725.0**	**34,234.9**	**32.2**
Pyrrophyta	Cryptomonadales	*Cryptomonas sp.*		807.6				
	Dinokontae	*Peridinium / Glenodinium spp.*						
		Sum:	**0.0**	**807.6**	**0.0**	**269.2**	**269.2**	**0.1**
		Total:	**537,266.0**	**684,555.0**	**258,653.6**	**493,491.5**	**124,880.1**	**100.0**
				sum of averages:		**493,491.5**		
UID	UID	UID flagellate	1,705.8	6,021.0	3,478.4			
		UID unicellular	15,352.2	45,157.5	9,130.8			

cf. = similar to
? = possibly
UID = unidentified
* = small pieces

Synonyms:
Amphiprora = Entomoneis
Aphanotheca = Anacystis
Aphanocapsa = Anacystis
Chroococcus = Anacystis
Merismopedia = Agmenellum
Sphaerozosma = Teilingia

Appendix 7.2-1
Taxonomic Results for Periphyton Samples, Hope Bay Belt, 2000

			Cell Density cells / cm ^{2}					
FES Sample Number			**000469**	**000470**	**000471**			
Sample Site				**Doris Outflow**				
Replicate Number			**1**	**2**	**3**			
Sampling Date			**08/16/00**	**08/16/00**	**08/16/00**			
Area Sampled (cm^2)			**23.03**	**24.00**	**21.00**			
Phylum	**Order**	**Genera and Species**				**Mean**	**SE**	**%**
Bacillariophyceae	Centrales	*Cyclotella spp.*	376.8	764.4	1,338.3			
		Melosira sp.	376.8	1,528.8	446.1			
		Rhizosolenia sp.	376.8					
		Stephanodiscus sp. ?	<151.6	<153.8				
	Pennales	*Achnanthes minutissima*	9,608.4	14,905.8	3,122.7			
		Achnanthes spp.	13,564.8	32,104.8	13,384.0			
		Amphiprora sp.	<151.6					
		Amphora spp.	2,260.8	3,057.6	2,676.6			
		Asterionella formosa	<151.6	461.4	<179.5			
		Caloneis sp.		<153.8	<179.5			
		Cocconeis sp.	753.6	1,528.8	1,338.3			
		Cymatopleura solea	<151.6	<153.8				
		Cymbella spp.	1,507.2	3,822.0	3,122.7			
		Denticula sp. ?	303.2	<153.8				
		Diatoma elongatum	6,405.6	4,968.6	5,353.2			
		Diatoma sp.		153.8	2,230.5			
		Diatomella sp.						
		Diploneis spp.		764.4				
		Epithemia sorex		1,146.6	359.0			
		Epithemia turgida	151.6	153.8	<179.5			
		Epithemia sp.	<151.6	<153.8	179.5			
		Eunotia spp.		153.8	<179.5			
		Fragilaria crotonensis	<151.6	1,911.0	1,338.3			
		Fragilaria spp.	9,043.2	29,806.4	23,643.3			
		Frustulia sp.	<151.6		<179.5			
		Gomphonema spp.	376.8	1,528.8	446.1			
		Navicula radiosa	151.6	382.2	179.5			
		Navicula spp.	2,260.8	3,822.0	3,122.7			
		Nedium spp.	<151.6	<153.8	<179.5			
		Nitzschia acicularis	753.6	1,146.6	359.0			
		Nitzschia spp.	1,884.0	4,968.6	3,568.8			
		Pinnularia spp.		764.4	179.5			
		Pleurosigma / Gyrosigma sp.		153.8	<179.5			
		Rhopalodia gibba		<153.8	179.5			
		Stauroneis sp.	151.6	153.8	<179.5			
		Surirella spp.	<151.6	<153.8	179.5			
		Synedra ulna	9,043.2	7,644.0	18,068.4			
		Synedra spp.	1,884.0	3,057.6	1,784.4			
		Tabellaria fenestrata	<151.6	<153.8				
		Tabellaria flocculosa	1,212.8	382.2	1,784.4			
		UID	1,130.4	1,146.6	1,338.3			
		Sum:	**63,577.6**	**122,382.6**	**89,722.6**	**91,894.3**	**17,010.2**	**50.2**
Chlorophyta	Chaetophorales	*Stigeoclonium ? **						
		UID						
	Chlorococcales	*Ankistrodesmus falcatus*	1,507.2	615.2	892.2			
		Ankistrodemus spiralis	<151.6		179.5			
		Elakatothrix sp. ?						
		Oocystis						
		Pediastrum spp.		<153.8	<179.5			
		Quadrigula sp.?						
		Scenedesmus spp.	606.4	307.6	<179.5			
		Tetraedron spp.	376.8		446.1			
	Euglenales	*Trachelomonas spp.*						
		UID		<153.8				
	Oedogoniales	*Bulbochaete sp.*						
		Oedogonium sp.	454.8	153.8				
	Tetrasporales	*Tetraspora sp.?*						
	Ulothricales	*Microspora sp.*			179.5			
	Volvocales	*Chlamydomonas spp.*	<151.6	<153.8				

Appendix 7.2-1
Taxonomic Results for Periphyton Samples, Hope Bay Belt, 2000

			Cell Density cells / cm ^{2}					
FES Sample Number			**000469**	**000470**	**000471**			
Sample Site				**Doris Outflow**				
Replicate Number			**1**	**2**	**3**			
Sampling Date			**08/16/00**	**08/16/00**	**08/16/00**			
Area Sampled (cm^2)			**23.03**	**24.00**	**21.00**			
Phylum	**Order**	**Genera and Species**				**Mean**	**SE**	**%**
	Zygnematales	*Arthrodesmus sp.*						
		Closterium spp.	<151.6	<153.8	179.5			
		Cosmarium spp.	376.8	307.6	1,338.3			
		Euastrum sp.						
		Mougeotia spp.		<153.8	<179.5			
		Pleurotaenium sp.						
		Spirogyra sp			179.5			
		Staurastrum spp.		<153.8				
		Teilingia granulata						
		Zygnema sp.		2,614.6	1,795.0			
Chlorophyta		UID filamentous						
		UID flagellate			<179.5			
		UID colonial	1,819.2	1,146.6	1,784.4			
		UID unicellular	753.6	3,439.2	2,230.5			
		Sum:	**5,894.8**	**8,584.6**	**9,204.5**	**7,894.6**	**1,015.8**	**4.3**
Chrysophyta		*Dinobryon bavaricum*	<151.6	<153.8	179.5			
		Dinobryon cf. cylindricum	<151.6	<153.8				
		Dinobryon divergens						
		Dinobryon sertularia						
		Dinobryon sp.		764.4	<179.5			
		Epixys ramosa						
		Hyalobryon sp.						
		Kephyrion/Pseudokephyrion sp.						
Chrysophyta		UID cyst	1,695.6	2,675.4	2,676.8			
		UID flagellate		1,146.6	2,007.6			
		UID unicellular	753.6	1,719.6	446.1			
		Sum:	**2,449.2**	**6,306.0**	**5,310.0**	**4,688.4**	**1,155.9**	**2.6**
Cyanophyta	Chamaesiphonale	*Chamaesiphon sp.*	3,014.4	2,293.2	7,137.6			
		Clastidium setigerum	2,637.6	153.8	2,230.5			
	Chroococcales	*Aphanocapsa spp.*	<151.6	<153.8	2,676.6			
		Aphanothece spp	<151.6					
		Chroococcus spp.			<179.5			
		Merismopedia sp.						
		Gomphosphaeria sp.						
		UID			1,784.4			
	Nostocales	*Anabaena spp. ? **						
		Anabaena /Pseudoanabaena s	7,428.4	790.0	3,568.8			
		Aphanizomenon sp.	7,276.8	1,845.6	5,026.0			
		UID						
	Oscillatoriales	*Lyngbya spp.*	2,637.6					
		Oscillatoria cf. tenuis	2,122.4	7,261.8	13,383.0			
		Oscillatoria spp.	44,085.6	25,607.4	16,505.7			
		Pseudanabaena catenata	20,347.2	38,977.6	15,613.5			
		Sum:	**89,550.0**	**76,929.4**	**67,926.1**	**78,135.2**	**6,271.3**	**42.7**
Pyrrophyta	Cryptomonadales	*Cryptomonas sp.*		<153.8	179.5			
	Dinokontae	*Peridinium / Glenodinium spp*	376.8	153.8	446.1			
		Sum:	**376.8**	**153.8**	**625.6**	**385.4**	**136.3**	**0.2**
		Total:	**161,848.4**	**214,356.4**	**172,788.8**	**182,997.9**	**15,994.2**	**100.0**
				sum of averages:		**182,997.9**		
UID	UID	UID flagellate	376.8	2,292.8	2,007.6			
		UID unicellular	3,956.4	4,012.4	5,353.6			

cf. = similar to
? = possibly
UID = unidentified
* = small pieces

Synonyms:
Amphiprora = Entomoneis
Aphanotheca = Anacystis
Aphanocapsa = Anacystis
Chroococcus = Anacystis
Merismopedia = Agmenellum
Sphaerozosma = Teilingia

Appendix 7.2-1
Taxonomic Results for Periphyton Samples, Hope Bay Belt, 2000

			Cell Density cells / cm ^{2}					
FES Sample Number			**000472**	**000473**	**000474**			
Sample Site				**Pelvic Outflow**				
Replicate Number			**1**	**2**	**3**			
Sampling Date			**08/16/00**	**08/16/00**	**08/16/00**			
Area Sampled (cm^2)			**24.44**	**23.03**	**20.24**			
Phylum	**Order**	**Genera and Species**				**Mean**	**SE**	**%**
Bacillariophyceae	Centrales	*Cyclotella spp.*	949.8					
		Melosira sp.	21,243.6	315.2	15,358.4			
		Rhizosolenia sp.	786.8		<386.2			
		Stephanodiscus sp. ?			<386.2			
	Pennales	*Achnanthes minutissima*	10,621.8	315.2	4,799.5			
		Achnanthes spp.	25,964.4	788.0	38,874.6			
		Amphiprora sp.	<316.6	<31.7				
		Amphora spp.	2,360.4	157.6	2,879.7			
		Asterionella formosa	6,294.4	472.8	4,799.5			
		Caloneis sp.		<31.7	<386.2			
		Cocconeis sp.	<316.6	<31.7	<386.2			
		Cymatopleura solea						
		Cymbella spp.	7,081.2	630.4	9,599.0			
		Denticula sp. ?	316.6	<31.7	<386.2			
		Diatoma elongatum	7,868.0	157.6	10,558.9			
		Diatoma sp.	1,573.6	63.4	2,879.9			
		Diatomella sp.	<316.6					
		Diploneis spp.	316.6		<386.2			
		Epithemia sorex	1,583.0	<31.7	1,544.8			
		Epithemia turgida	316.6	<31.7	1,919.8			
		Epithemia sp.	1,899.6	63.4	5,793.0			
		Eunotia spp.	633.2	31.7	1,544.8			
		Fragilaria crotonensis	2,360.4	<31.7	2,879.7			
		Fragilaria spp.	62,550.6	1,733.6	23,997.5			
		Frustulia sp.	<316.6					
		Gomphonema spp.	633.2	31.7	386.2			
		Navicula radiosa	5,507.6	<31.7	1,158.6			
		Navicula spp.	28,324.8	630.4	12,478.7			
		Nedium spp.	<316.6		<386.2			
		Nitzschia acicularis	1,573.6		959.9			
		Nitzschia spp.	31,865.4	945.6	19,198.0			
		Pinnularia spp.	<316.6	<31.7	<386.2			
		Pleurosigma / Gyrosigma sp.		<31.7	<386.8			
		Rhopalodia gibba	316.6	<31.7	386.2			
		Stauroneis sp.	<316.6					
		Surirella spp.	949.8	<31.7	772.4			
		Synedra ulna	1,583.0	31.7	959.9			
		Synedra spp.	3,147.2	63.4	3,839.6			
		Tabellaria fenestrata	<316.6		<386.2			
		Tabellaria flocculosa	3,147.2	157.6	5,759.4			
		UID	2,360.4	157.6	2,879.7			
		Sum:	**234,129.4**	**6,746.9**	**176,207.7**	**139,028.0**	**68,221.3**	**55.1**
Chlorophyta	Chaetophorales	*Stigeoclonium ? **						
		UID		<31.7				
	Chlorococcales	*Ankistrodesmus falcatus*	1,899.6	31.7	959.9			
		Ankistrodemus spiralis	<316.6	<31.7	1,544.8			
		Elakatothrix sp. ?						
		Oocystis						
		Pediastrum spp.	316.6		<386.2			
		Quadrigula sp.?						
		Scenedesmus spp.	949.8		<386.2			
		Tetraedron spp.						
	Euglenales	*Trachelomonas spp.*						
		UID						
	Oedogoniales	*Bulbochaete sp.*	<316.6		<386.2			
		Oedogonium sp.	2,532.8	126.8	12,744.6			
	Tetrasporales	*Tetraspora sp.?*						
	Ulothricales	*Microspora sp.*						
	Volvocales	*Chlamydomonas spp.*	786.8					

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Appendix 7.2-1
Taxonomic Results for Periphyton Samples, Hope Bay Belt, 2000

				Cell Density cells / cm ^{2}				
FES Sample Number			**000472**	**000473**	**000474**			
Sample Site				**Pelvic Outflow**				
Replicate Number			**1**	**2**	**3**			
Sampling Date			**08/16/00**	**08/16/00**	**08/16/00**			
Area Sampled (cm^2)			**24.44**	**23.03**	**20.24**			
Phylum	**Order**	**Genera and Species**				**Mean**	**SE**	**%**
	Zygnematales	*Arthrodesmus sp.*	<316.6					
		Closterium spp.	<316.6					
		Cosmarium spp.	949.8	63.4	727.4			
		Euastrum sp.						
		Mougeotia spp.		<31.7				
		Pleurotaenium sp.			<386.2			
		Spirogyra sp						
		Staurastrum spp.	316.6	<31.7	772.4			
		Teilingia granulata						
		Zygnema sp.						
Chlorophyta		UID filamentous						
		UID flagellate	<316.6		2,879.7			
		UID colonial	1,266.4	<31.7	1,544.8			
		UID unicellular			959.9			
		Sum:	**9,018.4**	**221.9**	**22,133.5**	**10,457.9**	**6,366.2**	**4.1**
Chrysophyta		*Dinobryon bavaricum*						
		Dinobryon cf. cylindricum						
		Dinobryon divergens						
		Dinobryon sertularia						
		Dinobryon sp.						
		Epixys ramosa						
		Hyalobryon sp.						
		Kephyrion/Pseudokephyrion sp.						
Chrysophyta		UID cyst	6,294.4	315.2	8,639.1			
		UID flagellate						
		UID unicellular		157.6	1,919.8			
		Sum:	**6,294.4**	**472.8**	**10,558.9**	**5,775.4**	**2,923.1**	**2.3**
Cyanophyta	Chamaesiphonale	*Chamaesiphon sp.*						
		Clastidium setigerum		380.4	3,839.6			
	Chroococcales	*Aphanocapsa spp.*	7,868.0		1,544.8			
		Aphanothece spp						
		Chroococcus spp.						
		Merismopedia sp.	<316.6		<386.2			
		Gomphosphaeria sp.	5,065.6					
		UID			<386.2			
	Nostocales	*Anabaena spp. ? **	949.8		386.2			
		Anabaena /Pseudoanabaena s	1,899.6	221.9	<386.2			
		Aphanizomenon sp.	4,432.4	570.6	6,565.4			
		UID			<386.2			
	Oscillatoriales	*Lyngbya spp.*	7,081.2	760.8	4,248.2			
		Oscillatoria cf. tenuis	21,243.6	10,461.0	145,904.8			
		Oscillatoria spp.	28,324.8	792.5	12,478.7			
		Pseudanabaena catenata	5,507.6	4,255.2	15,358.4			
		Sum:	**82,372.6**	**17,442.4**	**190,326.1**	**96,713.7**	**50,419.7**	**38.3**
Pyrrophyta	Cryptomonadales	*Cryptomonas sp.*		<31.7	772.4			
	Dinokontae	*Peridinium / Glenodinium spp*	316.6	<31.7	386.2			
		Sum:	**316.6**	**0.0**	**1,158.6**	**491.7**	**345.7**	**0.2**
		Total:	**332,131.4**	**24,884.0**	**400,384.8**	**252,466.7**	**115,484.6**	**100.0**
				sum of averages:		**252,466.7**		
UID	UID	UID flagellate	1,573.6	63.4	959.9			
		UID unicellular	7,081.2	315.2	15,837.8			

cf. = similar to
? = possibly
UID = unidentified
* = small pieces

Synonyms:
Amphiprora = Entomoneis
Aphanotheca = Anacystis
Aphanocapsa = Anacystis
Chroococcus = Anacystis
Merismopedia = Agmenellum
Sphaerozosma = Teilingia

APPENDIX 8.1-1
TAXONOMIC RESULTS FOR ZOOPLANKTON SAMPLES, HOPE BAY BELT, 2000

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Appendix 8.1-1
Taxonomic Results for Zooplankton Samples, Hope Bay Belt, 2000

Location				**Tail Lake**						**Doris Lake**						**Pelvic Lake**			
Date				**19-Jul-00**						**19-Jul-00**						**19-Jul-00**			
Volume (m^3)		**0.16**	**0.18**	**0.18**				**0.43**	**0.5**	**0.51**				**0.49**	**0.4**	**0.5**			
Sample No.		**676**	**677**	**678**				**679**	**680**	**681**				**682**	**683**	**684**			
Units				**Abundance (org/m^3)**						**Abundance (org/m^3)**						**Abundance (org/m^3)**			
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
ROTIFERA																			
Kellicottia longispina		23,125.00	48,888.89	58,888.89				16,976.74	5,200.00	7,254.90				8,571.43	12,000.00	10,000.00			
Keratella cochlearis		625.00	555.56	1,666.67				697.67	200.00	196.08				5,918.37	5,250.00	3,800.00			
Keratella quadrata		625.00						232.56		19.61				41,224.49	43,500.00	35,600.00			
Conochilus	colony	3,125.00	1,111.11	555.56				232.56	200.00	196.08									
Asplanchna		6,875.00	3,333.33	5,555.56				232.56											
Filinia		625.00	1,111.11	1,666.67					200.00					1,224.49	1,000.00	200.00			
Polyarthra														408.16					
<u>SUM (org/m^3):</u>		35,000.00	55,000.00	68,333.33	52,777.78	9,686.44	48.75	18,372.09	5,800.00	7,666.67	10,612.92	3,916.83	52.63	57,346.94	61,750.00	49,600.00	56,232.31	3,551.40	73.71
CLADOCERA																			
Holopedium gibberum								1,697.67	1,800.00	3,333.33									
Daphnia longiremis		56,875.00	30,000.00	22,777.78										6,326.53	5,250.00	4,000.00			
Daphnia middendorffiana		268.75	155.56	44.44															
Bosmina longirostris		375.00	666.67	500.00										61.22	275.00	1,000.00			
<u>SUM (org/m^3):</u>		57,518.75	30,822.22	23,322.22	37,221.06	10,377.21	34.38	1,697.67	1,800.00	3,333.33	2,277.00	528.99	11.29	6,387.76	5,525.00	5,000.00	5,637.59	404.55	7.39
COPEPODA																			
Calanoida																			
Leptodiaptomus	V	18.75	27.78	27.78										40.82		20.00			
Leptodiaptomus	IV	31.25	55.56	27.78										20.41		40.00			
Leptodiaptomus	III	125.00	166.67	111.11										61.22					
Leptodiaptomus	II	562.50	444.44	722.22															
Leptodiaptomus	I	7,500.00	3,222.22	5,555.56				23.26											
Limnocalanus macrurus	M							767.44	680.00	725.49				4.08					
Limnocalanus macrurus	F							906.98	740.00	901.96				8.16					
Limnocalanus macrurus	V							1,395.35	1,600.00	1,058.82				2.04					
Limnocalanus macrurus	IV							116.28	80.00	156.86									
Limnocalanus macrurus	III							46.51	20.00	78.43					25.00				
Limnocalanus macrurus	II							46.51	20.00	58.82									
Limnocalanus macrurus	I							23.26	400.00										
Epischura nevadensis	V													40.82		20.00			
<u>SUM (org/m^3):</u>		8,237.50	3,916.67	6,444.44	6,199.54	1,253.31	5.73	3,325.58	3,540.00	2,980.39	3,281.99	163.01	16.28	177.55	25.00	80.00	94.18	44.61	0.12
Unidentified Calanoida	nauplius	250.00	2,777.78	2,388.89				1,395.35	600.00	196.08				204.08	1,250.00	1,000.00			
<u>SUM (org/m^3):</u>		250.00	2,777.78	2,388.89	1,805.56	785.84	1.67	1,395.35	600.00	196.08	730.48	352.29	3.62	204.08	1,250.00	1,000.00	818.03	315.34	1.07
Cyclopoida																			
Cyclops bicuspidatus thomasi	M							162.79	20.00	117.65				408.16	1,000.00	800.00			
Cyclops bicuspidatus thomasi	F							23.26	40.00	19.61				2,448.98	500.00	1,400.00			
Cyclops scutifer	M	312.50	2,777.78	1,777.78				139.53	220.00	39.22				1,020.41	3,000.00	1,800.00			
Cyclops scutifer	F	312.50	4,444.44	3,222.22				372.09	420.00	313.73				1,632.65	1,500.00	800.00			
Cyclops capillatus	M																		
Cyclops capillatus	F		5.56																
Cyclops																			
Cyclopoid	copepodite	1,250.00	722.22	1,166.67				697.67	60.00	98.04				6,938.78	5,750.00	7,400.00			
<u>SUM (org/m^3):</u>		1,875.00	7,950.00	6,166.67	5,330.56	1,802.84	4.92	1,395.35	760.00	588.24	914.53	245.47	4.54	12,448.98	11,750.00	12,200.00	12,132.99	204.54	15.90
Unidentified Cyclopoida	nauplius	3,125.00	6,111.11	5,555.56				2,093.02	2,600.00	2,352.94				1,224.49	1,500.00	1,400.00			
<u>SUM (org/m^3):</u>		3,125.00	6,111.11	5,555.56	4,930.56	916.91	4.55	2,093.02	2,600.00	2,352.94	2,348.65	146.37	11.65	1,224.49	1,500.00	1,400.00	1,374.83	80.52	1.80
				sum of averages:	108,265.05					sum of averages:	20,165.57					sum of averages:	76,289.93		
TOTAL		**106,006.25**	**106,577.78**	**112,211.11**	**108,265.05**	**1,979.92**	**100.00**	**28,279.07**	**15,100.00**	**17,117.65**	**20,165.57**	**4,098.35**	**100.00**	**77,789.80**	**81,800.00**	**69,280.00**	**76,289.93**	**3,691.20**	**100.00**

M = male
F = female
I, II, III, IV or V = instar stage

APPENDIX 8.2-1
TAXONOMIC RESULTS FOR LAKE BENTHOS SAMPLES, HOPE BAY BELT, 2000

Appendix 8.2-1
Taxonomic Results for Lake Benthos Samples, Hope Bay Belt, 2000

Location		Tail Lake - Shallow						Tail Lake - Mid						Doris Lake - Shallow					
Date		**19-Jul-00**						**19-Jul-00**						**24-Jul-00**					
Depth		**2.6 m**	**2.5 m**	**2.6 m**				**5.4 m**	**5.4 m**	**5.4 m**				**4.6 m**	**4.4 m**	**4.5 m**			
Sample No.		**685**	**686**	**687**				**688**	**689**	**690**				**691**	**692**	**693**			
Units		**Density (org./m^2)**						**Density (org./m^2)**						**Density (org./m^2)**					
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
NEMATODA		44	89	222				89	44										
SUM (org/m^2)		44	89	222	119	53	7	89	44	0	44	26	1	0	0	0	0	0	0
OLIGOCHAETA																			
Lumbriculidae																			
Lumbriculus		267	267	44					133										
Tubificidae	juv							44						44	89	89			
SUM (org/m^2)		267	267	44	193	74	12	44	133	0	59	39	1	44	89	89	74	15	3
CLADOCERA																			
Macrothricidae				44															
Chydorus sphaericus															44				
SUM (org/m^2)		0	0	44	15	15	1	0	0	0	0	0	0	0	44	0	15	15	1
COPEPODA																			
Calanoida																			
Limnocalanus macrurus																			
Cyclopoida		44		44						89				89					
Cyclops scutifer	M/F	89	178	267				178	178	400						44			
SUM (org/m^2)		133	178	311	207	53	13	178	178	489	281	104	7	89	0	44	44	26	2
OSTRACODA																			
Cypria		89	44	89				89											
Limnocythere		44	44	133												44			
SUM (org/m^2)		133	89	222	148	39	9	89	0	0	30	30	1	0	0	44	15	15	1
MALACOSTRACA																			
Gammaracanthus loricatus															44				
Gammarus lacustris				44															
Mysis relicta															44				
Saduria entomon																44			
SUM (org/m^2)		0	0	44	15	15	1	0	0	0	0	0	0	0	89	44	44	26	2
ARACHNIDA																			
Hydracarina	A	44	133	44															
Forelli	A																		
SUM (org/m^2)		44	133	44	74	30	5	0	0	0	0	0	0	0	0	0	0	0	0
TRICHOPTERA																			
Limnephilidae	L*																		
Grensia praeterita	L	44	44	133						44									
SUM (org/m^2)		44	44	133	74	30	5	0	0	44	15	15	0	0	0	0	0	0	0
HYMENOPTERA																			
Braconidae	A																		
SUM (org/m^2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Appendix 8.2-1
Taxonomic Results for Lake Benthos Samples, Hope Bay Belt, 2000

Location				**Tail Lake - Shallow**						**Tail Lake - Mid**						**Doris Lake - Shallow**			
Date				**19-Jul-00**						**19-Jul-00**						**24-Jul-00**			
Depth		**2.6 m**	**2.5 m**	**2.6 m**				**5.4 m**	**5.4 m**	**5.4 m**				**4.6 m**	**4.4 m**	**4.5 m**			
Sample No.		**685**	**686**	**687**				**688**	**689**	**690**				**691**	**692**	**693**			
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
DIPTERA																			
Culicidae	L																		
Anopheles	A																		
Chironomidae	L*		44																
Chironomidae	P		44																
Tanypodinae																			
Procladius	L	267	267	400				133	178	178				356	533	444			
Procladius	P																		
Tanytarsini																			
Paratanytarsus	L		44					178		44				44	89				
Stempellina	L			133					44										
Stempellina	P																		
Stempellinella	L																		
Stempellinella	P																		
Tanytarsus	L							533	133	178				133	133	89			
Tanytarsus	P																		
Chironomini																			
Chironomus	L							1778	1378	1778									
Chironomus	P																		
Phaenopsectra	L													667	356	444			
Phaenopsectra	P																		
Orthocladiinae	L*		133	44															
Orthocladiinae	P		44					178											
Cricotopus	L		44	44															
Heterotrissocladius	L	89						222	89	400				89	133	133			
Heterotrissocladius	P			89				622	222	178									
Orthocladius	L		44																
Paracricotopus	L														44				
Parakiefferiella	L													89					
Parakiefferiella	P													44					
Psectrocladius	L							44		133									
Diamesinae																			
Monodiamesa	L	133	44	133										133	44	178			
Protanypus	L		44																
SUM (org/m^2)		489	756	844	696	107	43	3689	2044	2889	2874	475	70	1556	1333	1289	1393	82	56
MOLLUSCA																			
Bivalvia																			
Sphaeriidae	juv			44				267	44	311				222	311	444			
Pisidium		133		44				667	267	844				533	800	356			
SUM (org/m^2)		133	0	89	74	39	5	933	311	1156	800	253	19	756	1111	800	889	112	36
				sum of averages:	1615					sum of averages:	4104					sum of averages:	2474		
TOTAL		**1289**	**1556**	**2000**	**1615**	**207**	**100**	**5022**	**2711**	**4578**	**4104**	**708**	**100**	**2444**	**2667**	**2311**	**2474**	**104**	**100**

M/F = male/female
juv = juvenile
L = larva
L* = larva too small to be identified, or damaged
P = pupa
A = adult

Appendix 8.2-1
Taxonomic Results for Lake Benthos Samples, Hope Bay Belt, 2000

Location				**Doris Lake - Mid**						**Doris Lake - Deep**						**Pelvic Lake - Shallow**			
Date				**24-Jul-00**						**24-Jul-00**						**19-Jul-00**			
Depth		**7.5 m**	**7.4 m**	**7.6 m**				**14.9 m**	**14.8 m**	**14.9 m**				**3.6 m**	**3.6 m**	**3.7 m**			
Sample No.		**694**	**695**	**696**				**697**	**698**	**699**				**700**	**701**	**702**			
Units				**Density (org./m²)**						**Density (org./m²)**						**Density (org./m²)**			
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
NEMATODA									89										
SUM (org/m²)		0	0	0	0	0	0	0	89	0	30	30	2	0	0	0	0	0	0
OLIGOCHAETA																			
Lumbriculidae																			
Lumbriculus																			
Tubificidae	juv	267	444	444						44									
SUM (org/m²)		267	444	444	385	59	17	0	0	44	15	15	1	0	0	0	0	0	0
CLADOCERA																			
Macrothricidae																			
Chydorus sphaericus																			
SUM (org/m²)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COPEPODA																			
Calanoida																			
Limnocalanus macrurus			44																
Cyclopoida																			
Cyclops scutifer	M/F		44																
SUM (org/m²)		0	89	0	30	30	1	0	0	0	0	0	0	0	0	0	0	0	0
OSTRACODA																			
Cypria																			
Limnocythere																			
SUM (org/m²)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MALACOSTRACA																			
Gammaracanthus loricatus																			
Gammarus lacustris																			
Mysis relicta																			
Saduria entomon																			
SUM (org/m²)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARACHNIDA																			
Hydracarina	A																		
Forelli	A													44	133	89			
SUM (org/m²)		0	0	0	0	0	0	0	0	0	0	0	0	44	133	89	89	26	2
TRICHOPTERA																			
Limnephilidae	L*																		
Grensia praeterita	L																		
SUM (org/m²)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HYMENOPTERA																			
Braconidae	A																		
SUM (org/m²)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Appendix 8.2-1
Taxonomic Results for Lake Benthos Samples, Hope Bay Belt, 2000

Location		**Doris Lake - Mid**						**Doris Lake - Deep**						**Pelvic Lake - Shallow**					
Date		**24-Jul-00**						**24-Jul-00**						**19-Jul-00**					
Depth		**7.5 m**	**7.4 m**	**7.6 m**				**14.9 m**	**14.8 m**	**14.9 m**				**3.6 m**	**3.6 m**	**3.7 m**			
Sample No.		**694**	**695**	**696**				**697**	**698**	**699**				**700**	**701**	**702**			
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
DIPTERA																			
Culicidae	L																		
Anopheles	A		44																
Chironomidae	L*																		
Chironomidae	P																		
Tanypodinae																			
Procladius	L	311	533	311					44					222	89	178			
Procladius	P																		
Tanytarsini																			
Paratanytarsus	L																		
Stempellina	L															44			
Stempellina	P													89		133			
Stempellinella	L													44		89			
Stempellinella	P													44		89			
Tanytarsus	L		89											3956	1111	1556			
Tanytarsus	P															44			
Chironomini																			
Chironomus	L							1378	1200	1244									
Chironomus	P							44		222									
Phaenopsectra	L	1111	489	311										2089	1289	533			
Phaenopsectra	P														44				
Orthocladiinae	L*																		
Orthocladiinae	P																		
Cricotopus	L																		
Heterotrissocladius	L	44		44															
Heterotrissocladius	P																		
Orthocladius	L																		
Paracricotopus	L																		
Parakiefferiella	L		89																
Parakiefferiella	P																		
Psectrocladius	L																		
Diamesinae																			
Monodiamesa	L	178	311	44										133	222	89			
Protanypus	L																		
SUM (org/m^2)		1644	1556	711	1304	297	58	1422	1244	1467	1378	68	95	6578	2756	2756	4030	1274	95
MOLLUSCA																			
Bivalvia																			
Sphaeriidae	juv	44	178	178					44					178		89			
Pisidium		533	356	267						44				44		44			
SUM (org/m^2)		578	533	444	519	39	23	0	44	44	30	15	2	222	0	133	119	65	3
				sum of averages:	2237					sum of averages:	1452					sum of averages:	4237		
TOTAL		**2489**	**2622**	**1600**	**2237**	**321**	**100**	**1422**	**1378**	**1556**	**1452**	**53**	**100**	**6844**	**2889**	**2978**	**4237**	**1304**	**100**

M/F = male/female
juv = juvenile
L = larva
L* = larva too small to be identified, or damaged
P = pupa
A = adult

Appendix 8.2-1
Taxonomic Results for Lake Benthos Samples, Hope Bay Belt, 2000

Location		**Pelvic Lake - Mid**						**Pelvic Lake - Deep**					
Date		**24-Jul-00**						**24-Jul-00**					
Depth		**7.3 m**	**7.4 m**	**7.4 m**				**17.6 m**	**17.8 m**	**18.0 m**			
Sample No.		**703**	**704**	**705**				**706**	**707**	**708**			
Units		**Density (org./m^2)**						**Density (org./m^2)**					
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**												
NEMATODA													
SUM (org/m^2)		0	0	0	0	0	0	0	0	0	0	0	0
OLIGOCHAETA													
Lumbriculidae													
Lumbriculus													
Tubificidae	juv												
SUM (org/m^2)		0	0	0	0	0	0	0	0	0	0	0	0
CLADOCERA													
Macrothricidae													
Chydorus sphaericus													
SUM (org/m^2)		0	0	0	0	0	0	0	0	0	0	0	0
COPEPODA													
Calanoida													
Limnocalanus macrurus													
Cyclopoida													
Cyclops scutifer	M/F												
SUM (org/m^2)		0	0	0	0	0	0	0	0	0	0	0	0
OSTRACODA													
Cypria													
Limnocythere		44		44									
SUM (org/m^2)		44	0	44	30	15	1	0	0	0	0	0	0
MALACOSTRACA													
Gammaracanthus loricatus													
Gammarus lacustris													
Mysis relicta		89											
Saduria entomon													
SUM (org/m^2)		89	0	0	30	30	1	0	0	0	0	0	0
ARACHNIDA													
Hydracarina	A												
Forelli	A									44			
SUM (org/m^2)		0	0	0	0	0	0	0	0	44	15	15	11
TRICHOPTERA													
Limnephilidae	L*												
Grensia praeterita	L												
SUM (org/m^2)		0	0	0	0	0	0	0	0	0	0	0	0
HYMENOPTERA													
Braconidae	A							44					
SUM (org/m^2)		0	0	0	0	0	0	44	0	0	15	15	11

Appendix 8.2-1
Taxonomic Results for Lake Benthos Samples, Hope Bay Belt, 2000

Location				**Pelvic Lake - Mid**						**Pelvic Lake - Deep**			
Date				**24-Jul-00**						**24-Jul-00**			
Depth		**7.3 m**	**7.4 m**	**7.4 m**				**17.6 m**	**17.8 m**	**18.0 m**			
Sample No.		**703**	**704**	**705**				**706**	**707**	**708**			
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**												
DIPTERA													
Culicidae	L												
Anopheles	A												
Chironomidae	L*												
Chironomidae	P		89										
Tanypodinae													
Procladius	L	356	133	178									
Procladius	P	44											
Tanytarsini													
Paratanytarsus	L												
Stempellina	L		44	44									
Stempellina	P	44	89										
Stempellinella	L	89	89	44									
Stempellinella	P	311	1111	44									
Tanytarsus	L	1467	44	1467				44					
Tanytarsus	P	133		44									
Chironomini													
Chironomus	L							44		133			
Chironomus	P												
Phaenopsectra	L	1644	844	533				44					
Phaenopsectra	P	44		44									
Orthocladiinae	L*												
Orthocladiinae	P												
Cricotopus	L												
Heteroctrissocladius	L			44									
Heteroctrissocladius	P												
Orthocladius	L												
Paracricotopus	L												
Parakiefferiella	L							44					
Parakiefferiella	P												
Psectrocladius	L												
Diamesinae													
Monodiamesa	L	356	89	133									
Protanypus	L												
SUM (org/m^2)		4489	2533	2578	3200	645	87	178	0	133	104	53	78
MOLLUSCA													
Bivalvia													
Sphaeriidae	juv	44	89	133									
Pisidium		311	400	222									
SUM (org/m^2)		356	489	356	400	44	11	0	0	0	0	0	0
				sum of averages:	3659					sum of averages:	133		
TOTAL		**4978**	**3022**	**2978**	**3659**	**659**	**100**	**222**	**0**	**178**	**133**	**68**	**100**

M/F = male/female
juv = juvenile
L = larva
L* = larva too small to be identified, or damaged
P = pupa
A = adult

APPENDIX 8.3-1
TAXONOMIC RESULTS FOR DRIFT ORGANISM SAMPLES, HOPE BAY BELT, 2000

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Appendix 8.3-1
Taxonomic Results for Drift Organism Samples, Hope Bay Belt, 2000

Location		**Tail Outflow**						**Doris Outflow**						**Pelvic Outflow**					
Date		**20-Jul-00**						**23-Jul-00**						**23-Jul-00**					
Volume		**1,047 m^3**	**2,002 m^3**	**1,045 m^3**				**4,571 m^3**	**4,602 m^3**	**2,962 m^3**				**1,682 m^3**	**1,602 m^3**	**1,473 m^3**			
Sample Number		**667**	**668**	**669**				**670**	**671**	**672**				**673**	**674**	**675**			
Units		**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**					
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
Zooplankton																			
CLADOCERA																			
Holopedium gibberum								52174	5870	24333				5294	125	133			
Daphnia longiremis														82353	2000	10667			
Bosmina longirostris															125	133			
SUM (org./10,000 m^3)		0	0	0	0	0	0.0	52174	5870	24333	27459	13458	51.0	87647	2250	10933	33610	27134	73.3
COPEPODA																			
Calanoida																			
Leptodiaptomus sp.																67			
Limnocalanus macrurus								45652	13261	9667									
Epischura nevadensis														6		67			
Cyclopoida																			
Cyclops scutifer								1739	2609	1000				12	63	67			
Cyclops capillatus															6				
SUM (org./10,000 m^3)		0	0	0	0	0	0.0	47391	15870	10667	24643	11473	45.7	18	69	200	95	54	0.2
Benthos																			
COELENTERATA																			
Hydra			5	100				22	22	100									
SUM (org./10,000 m^3)		0	5	100	35	33	0.6	22	22	100	48	26	0.1	0	0	0	0	0	0.0
NEMATODA		40	10	200				2						6		67			
SUM (org./10,000 m^3)		40	10	200	83	59	1.5	2	0	0	1	1	0.0	6	0	67	24	21	0.1
OLIGOCHAETA																			
Naididae	juv	10	10																
Nais										33									
Tubificidae	juv	20	10																
Enchytraeidae		20														67			
Hirudinea																			
Piscicola salmositica														6					
SUM (org./10,000 m^3)		50	20	0	23	15	0.4	0	0	33	11	11	0.0	6	0	67	24	21	0.1
CLADOCERA																			
Chydorus sphaericus			5												63				
SUM (org./10,000 m^3)		0	5	0	2	2	0.0	0	0	0	0	0	0.0	0	63	0	21	21	0.0

Appendix 8.3-1
Taxonomic Results for Drift Organism Samples, Hope Bay Belt, 2000

Location		**Tail Outflow**						**Doris Outflow**						**Pelvic Outflow**					
Date		**20-Jul-00**						**23-Jul-00**						**23-Jul-00**					
Volume		**1,047 m^3**	**2,002 m^3**	**1,045 m^3**				**4,571 m^3**	**4,602 m^3**	**2,962 m^3**				**1,682 m^3**	**1,602 m^3**	**1,473 m^3**			
Sample Number		**667**	**668**	**669**				**670**	**671**	**672**				**673**	**674**	**675**			
Units		**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**					
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
COPEPODA																			
Harpacticoida																			
Canthocamptidae		200																	
SUM (org./10,000 m^3)		200	0	0	67	67	1.2	0	0	0	0	0	0.0	0	0	0	0	0	0.0
OSTRACODA																			
Cypria		60	15	20				11	11					59	6	13			
Candona		20	125	900				11	35	33				29	88	307			
SUM (org./10,000 m^3)		80	140	920	380	271	7.0	22	46	33	34	7	0.1	88	94	320	167	76	0.4
MALACOSTRACA																			
Mysis relicta														6	6				
SUM (org./10,000 m^3)		0	0	0	0	0	0.0	0	0	0	0	0	0.0	6	6	0	4	2	0.0
ARACHNIDA																			
Oribatidae	A	10	10																
Hydracarina	A	220	60	150				28	370	733				471	750	400			
Forelli	A	30	5	10										2941	1125	3933			
SUM (org./10,000 m^3)		260	75	160	165	53	3.1	28	370	733	377	204	0.7	3412	1875	4333	3207	717	7.0
COLLEMBOLA																			
Anurida			5																
Entomobryidae		30		30															
Isotomidae		40	10																
Sminthuridae																			
Sminthurus	A		5	10															
SUM (org./10,000 m^3)		70	20	40	43	15	0.8	0	0	0	0	0	0.0	0	0	0	0	0	0.0
EPHEMEROPTERA																			
Baetidae																			
Baetis tricaudatus	N	20	145	40															
SUM (org./10,000 m^3)		20	145	40	68	39	1.3	0	0	0	0	0	0.0	0	0	0	0	0	0.0
HEMIPTERA																			
Aphididae	A	10												6					
Coccoidea				10															
Jassidae	A													6					
SUM (org./10,000 m^3)		10	0	10	7	3	0.1	0	0	0	0	0	0.0	12	0	0	4	4	0.0

Appendix 8.3-1
Taxonomic Results for Drift Organism Samples, Hope Bay Belt, 2000

Location		**Tail Outflow**						**Doris Outflow**						**Pelvic Outflow**					
Date		**20-Jul-00**						**23-Jul-00**						**23-Jul-00**					
Volume		**1,047 m^3**	**2,002 m^3**	**1,045 m^3**				**4,571 m^3**	**4,602 m^3**	**2,962 m^3**				**1,682 m^3**	**1,602 m^3**	**1,473 m^3**			
Sample Number		**667**	**668**	**669**				**670**	**671**	**672**				**673**	**674**	**675**			
Units		**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**					
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
TRICHOPTERA																			
Limnephilidae	L*																		
Grensia praeterita	L															7			
Onocosmoecus	L	20		10															
SUM (org./10,000 m^3)		20	0	10	10	6	0.2	0	0	0	0	0	0.0	0	0	7	2	2	0.0
HYMENOPTERA																			
Braconidae	A	10																	
Chalcoidea	A	10	5																
SUM (org./10,000 m^3)		20	5	0	8	6	0.2	0	0	0	0	0	0.0	0	0	0	0	0	0.0
DIPTERA																			
Unidentified	A														13				
Culicidae	L																		
Anopheles	A														13				
Empididae	P							2											
Ephydridae	A														6				
Clinocera	L		5																
Simulidae	L*																		
Prosimulium	L			10				74	39	60									
Simulium	L	50	300	100				67	43	30				29	2438	2267			
Simulium	P	10		10					4						88	33			
Simulium	A													6					
Tipulidae																			
Tipula	L		5																
Chironomidae	L*			10				43		100				294	1250	533			
Chironomidae	P													12	1813	867			
Tanypodinae	L*			1300										18	125	67			
Tanypodinae	P								4										
Thiennemannimyia	L		5						9	7					6				
Thiennemannimyia	P		5												31	93			
Tanytarsini	L	10																	
Tanytarsini	P													18	313				
Tanytarsini	A		5																
Micropsectra	L	10																	
Micropsectra	P								4	10				6	13				
Paratanytarsus	L	10								3				6					
Paratanytarsus	P							2		7				6	6	67			
Rheotanytarsus	L		5	10				2						12	31	400			
Rheotanytarsus	P		10	60										12	875	1267			
Stempellina	L			10															
Stempellina	P		5	0															
Stempellinella	L													6	6				
Stempellinella	P													6					
Tanytarsus	L		10	30															
Tanytarsus	P									7						7			

Appendix 8.3-1
Taxonomic Results for Drift Organism Samples, Hope Bay Belt, 2000

Location		**Tail Outflow**						**Doris Outflow**						**Pelvic Outflow**					
Date		**20-Jul-00**						**23-Jul-00**						**23-Jul-00**					
Volume		**1,047 m^3**	**2,002 m^3**	**1,045 m^3**				**4,571 m^3**	**4,602 m^3**	**2,962 m^3**				**1,682 m^3**	**1,602 m^3**	**1,473 m^3**			
Sample Number		**667**	**668**	**669**				**670**	**671**	**672**				**673**	**674**	**675**			
Units		**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**						**Abundance (org./10,000 m^3)**					
Replicate		**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																		
Chironomini	P								4						13	133			
Dicrotendipes	L		5																
Dicrotendipes	P									3									
Phaenopsectra	L			10															
Orthocladiinae	L*	200	90	100				87	326	200				241	313	1133			
Orthocladiinae	P								174					94	375	200			
Orthocladiinae	A	5900	1250	2400															
Corynoneura	P			20											13				
Cricotopus	P								2										
Eukiefferiella	L	460	165	20				2	891	600				229	875	1733			
Eukiefferiella	P		5	10					2	167				147	500	467			
Heterotanytarsus	L			20															
Orthocladius	L	150	240	30				239	239	267				224	688	933			
Orthocladius	P		75	240				130	65					176	250	200			
Paracladius	L									7									
Psectrocladius	L	10	40					20	4					553	813	2133			
Psectrocladius	P									3				6	25	13			
Diamesinae																			
Pseudokiefferiella	L	10												12	113	400			
Pseudokiefferiella	P														6				
SUM (org./10,000 m^3)		6820	2225	4390	4478	1327	83.1	670	1813	1470	1318	339	2.4	2112	11006	12947	8688	3336	19.0
Fish																			
Pungitius pungitius			5	60															
SUM (org./10,000 m^3)		0	5	60	22	19	0.4	0	0	0	0	0	0.0	0	0	0	0	0	0.0
				sum of averages:	5392					sum of averages:	53889					sum of averages:	45847		
TOTAL		**7590**	**2655**	**5930**	**5392**	**1450**	**100**	**100309**	**23989**	**37370**	**53889**	**23529**	**100**	**93306**	**15363**	**28873**	**45847**	**24048**	**100**

A = adult
juv = juvenile
L = larva
L* = larva too small to be identified or damaged
N = nymph
P = pupa

APPENDIX 8.4-1
TAXONOMIC RESULTS FOR STREAM BENTHOS SAMPLES, HOPE BAY BELT, 2000

Appendix 8.4-1
Taxonomic Results for Stream Benthos Samples, Hope Bay Belt, 2000

Location		**Tail Outflow**					**Doris Outflow**						**Pelvic Outflow**					
Date		**16-Aug-00**					**16-Aug-00**						**16-Aug-00**					
Sample No.		**1192**	**1193**				**1194**	**1195**	**1196**				**1197**	**1198**	**1199**			
Units		**Density (org./m^2)**					**Density (org./m2)**						**Density (org./m2)**					
Replicate		**1**	**2**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																	
COELENTERATA																		
Hydra			11				25778	7833	22344				56	89	56			
SUM (org./m^2)		0	11	6	6	0	25778	7833	22344	18652	5499	9	56	89	56	67	11	1
NEMATODA		44	156						11				133	111				
SUM (org./m^2)		44	156	100	56	2	0	0	11	4	4	0	133	111	0	81	41	1
OLIGOCHAETA																		
Naididae	juv	22	11															
Chaetogaster			22				111	111					111					
Nais							100	144	89				11		11			
Lumbriculidae	juv																	
Lumbriculus													11					
Tubificidae	juv													33				
Enchytraeidae		11							11									
SUM (org./m^2)		33	33	33	0	1	211	256	100	189	46	0	133	33	11	59	38	1
HIRUDINEA																		
Piscicola salmositica													11					
SUM (org./m^2)		0	0	0	0	0	0	0	0	0	0	0	11	0	0	4	4	0
CLADOCERA																		
Chydoridae	juv																	
Alonella excisa		67	89										556	444				
Chydorus sphaericus													333					
SUM (org./m^2)		67	89	78	11	1	0	0	0	0	0	0	889	444	0	444	257	4
COPEPODA																		
Cyclopoida																		
Cyclopidae													222	667	33			
Cyclops scutifer	M/F							11										
Eucyclops agilis	M/F												22	100	22			
Harpacticoida																		
Canthocamptidae		178	433										111	333				
SUM (org./m^2)		178	433	306	128	5	0	11	0	4	4	0	356	1100	56	504	310	5

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Appendix 8.4-1
Taxonomic Results for Stream Benthos Samples, Hope Bay Belt, 2000

Location			**Tail Outflow**						**Doris Outflow**						**Pelvic Outflow**			
Date			**16-Aug-00**						**16-Aug-00**						**16-Aug-00**			
Sample No.		**1192**	**1193**				**1194**	**1195**	**1196**				**1197**	**1198**	**1199**			
Units			**Density (org./m^2)**						**Density (org./m2)**						**Density (org./m2)**			
Replicate		**1**	**2**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																	
OSTRACODA																		
Cypris													33					
Candona		1133	911				167	556					1000	1333	11			
SUM (org./m^2)		1133	911	1022	111	16	167	556	0	241	165	0	1033	1333	11	793	400	8
MALACOSTRACA																		
Gammaracanthus loricatus								11							11			
SUM (org./m^2)		0	0	0	0	0	0	11	0	4	4	0	0	0	11	4	4	0
ARACHNIDA																		
Hydracarina	A	256	233				2811	4011	8689				178	22	22			
SUM (org./m^2)		256	233	244	11	4	2811	4011	8689	5170	1793	2	178	22	22	74	52	1
EPHEMEROPTERA																		
Baetidae																		
Baetis tricaudatus	N		22															
SUM (org./m^2)		0	22	11	11	0	0	0	0	0	0	0	0	0	0	0	0	0
PLECOPTERA																		
Nemouridae	N*																	
Nemoura	N	122	278				11		11									
SUM (org./m^2)		122	278	200	78	3	11	0	11	7	4	0	0	0	0	0	0	0
TRICHOPTERA																		
Limnephilidae	L*																	
Grensia praeterita	L		11						11					11				
Grensia praeterita	P													22				
SUM (org./m^2)		0	11	6	6	0	0	0	11	4	4	0	0	33	0	11	11	0
DIPTERA																		
Simulium	L		44												11			
Simulium	P	89	56												11			
Tipulidae																		
Tipula	L		11										33	67				
Chironomidae	L*	1311	3800				164556	187778	162222				2556	4889	2022			
Tanypodinae	L*	89	311				1667	5556	8889				667	2078	78			
Thiennemannimyia	L	33	22				156	411	256				156	189	22			

Appendix 8.4-1
Taxonomic Results for Stream Benthos Samples, Hope Bay Belt, 2000

Location				**Tail Outflow**						**Doris Outflow**						**Pelvic Outflow**		
Date				**16-Aug-00**						**16-Aug-00**						**16-Aug-00**		
Sample No.		**1192**	**1193**				**1194**	**1195**	**1196**				**1197**	**1198**	**1199**			
Units				**Density (org./m^2)**						**Density (org./m2)**						**Density (org./m2)**		
Replicate		**1**	**2**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**	**1**	**2**	**3**	**AVE**	**Std. Error**	**%**
Genus/Group	**Stage**																	
Tanytarsini	L	556	511				2222	5556	2222				1778	4778	311			
Tanytarsini	P													11				
Micropsectra	L							11					44	56				
Micropsectra	P												22	100				
Paratanytarsus	L													22				
Rheotanytarsus	L													78	467			
Stempellinella	L												1333	1222				
Tanytarsus	L		11										222	567	11			
Chironomini	L*						111											
Dicrotendipes	L													67				
Orthocladiinae	L*	111	122				2000	1556	1333				56	111	678			
Corynoneura	L	478	478										111	122	33			
Corynoneura	P	11											11					
Eukiefferiella	L	78	156				456	267	433				56	11	56			
Eukiefferiella	P	100	56				256	356	178				22		11			
Heterotanytarsus	L		11															
Orthocladius	L						878	322	1122				33	33	156			
Diamesinae																		
Potthastia	L													11				
Pseudokiefferiella	L						11								11			
SUM (org./m^2)		2856	5589	4222	1367	68	172311	201811	176656	183593	9195	88	7100	14411	3878	8463	3116	81
FISH																		
Pungitius pungitius			11										11					
SUM (org./m^2)		0	11	6	6	0	0	0	0	0	0	0	11	0	0	4	4	0
			sum of averages:	6233					sum of averages:	207867					sum of averages:	10507		
TOTAL:		**4689**	**7778**	**6233**	**1544**	**100**	**201289**	**214489**	**207822**	**207867**	**3811**	**100**	**9900**	**17578**	**4044**	**10507**	**3919**	**100**

A = adult
juv = juvenile
M/F = male/female
L = larva
L* = larva too small to be identified, or damaged
N = nymph
N* = nymph too small to be identified, or damaged
P = pupa

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APPENDIX 9.2-1
TAXONOMIC RESULTS FOR MARINE BENTHOS SAMPLES, HOPE BAY BELT, 2000

Appendix 9.2-1
Taxonomic Results for Marine Benthos Samples, Hope Bay Belt, 2000

Location	**Roberts Bay**
Date	**25-Jul-00**
Sample Number	**00684**
Replicate	**1**
Genus/Group	
Nematoda	3
Polychaeta	
Nephthys cornuta	5
Spionidae, unid juv and dam	2
Gammaridea Unid dam	1
Monoculodes (spinipes?)	1
Bivalvia	
Hiatella arctica	8
Echinodermata	
Strongylocentrotus droebachiensis	6
TOTAL	**26**

Note: Discrete samples were not possible with the Ekman grab. Data represents total benthos numbers from numerous scrapes of the sediment surface.

APPENDIX 10.1-1
KEY TO FISH NAMES, HOPE BAY BELT, 2000

Appendix 10.1-1
Key to Fish Names, Hope Bay Belt, 2000

Code	Common Name	Species Name
ARCH	Arctic char	*Salvelinus alpinus*
ARGR	Arctic grayling	*Thymallus arcticus*
BRWH	Broad whitefish	*Coregonus nasus*
CISCO	Cisco	*Coregonus artedii*
LKTR	Lake trout	*Salvelinus namaycush*
LKWH	Lake whitefish	*Coregonus clupeaformis*
NNST	Ninespine stickleback	*Pungitius pungitius*
SLSC	Slimy sculpin	*Cottus cognatus*

APPENDIX 10.1-2
DATA FROM GILLNET SETS FOR TAIL LAKE, HOPE BAY BELT, 2000

Appendix 10.1-2
Data from Gillnet Sets for Tail Lake, Hope Bay Belt, 2000

Site ID	Mesh	Set		Pulled		Effort	CPUE	BPUE	#	Total	Comments
	Size	Date	Time	Date	Time	(min)			LKTR		
GN1	1.5"	17-Aug	10:05	17-Aug	11:00	55	71.4	125	2	2	2 panels for this set
GN2	1.5"	17-Aug	10:15	17-Aug	11:30	75	69.8	108.7	4	4	
GN3	1.5"	17-Aug	11:30	17-Aug	12:50	80	65.5	110.5	4	4	
GN4	1.5"	17-Aug	11:55	17-Aug	13:20	85	0.0	0.0	0	0	
GN5	1.5"	17-Aug	13:10	17-Aug	14:30	80	32.7	54.82	2	2	
GN6	1.5"	17-Aug	13:30	17-Aug	15:00	90	29.1	34.91	2	2	
GN7	1.5"	17-Aug	14:55	17-Aug	16:30	95	41.3	49.61	3	3	includes 1 ecaped LKTR
GN8	1.5"	17-Aug	15:10	17-Aug	17:00	110	47.6	63.37	4	4	air temp 12.5 ^{o}C, water 12.0 ^{o}C
GN9	1.5"	18-Aug	9:00	18-Aug	10:15	75	69.8	105.2	4	4	
GN10	1.5"	18-Aug	9:10	18-Aug	10:45	95	179.1	298	13	13	
GN11	1.5"	18-Aug	10:40	18-Aug	12:15	95	96.5	157.1	7	7	
GN12	1.5"	18-Aug	11:25	18-Aug	12:45	80	229.1	384.1	14	14	
GN13	1.5"	18-Aug	12:20	18-Aug	14:00	100	39.3	59.24	3	3	
GN14	1.5"	18-Aug	13:30	18-Aug	14:50	80	114.5	167.4	7	7	
GN15	1.5"	18-Aug	14:10	18-Aug	15:20	70	168.3	250.1	9	9	
GN16	1.5"	18-Aug	15:15	18-Aug	16:20	65	80.6	132.4	4	4	
GN17	1.5"	18-Aug	15:55	18-Aug	16:35	40	163.6	278.2	5	5	
GN18	1.5"	19-Aug	9:15	19-Aug	11:00	105	74.8	106.3	6	6	
GN19	1.5"	19-Aug	9:25	19-Aug	11:30	125	83.8	146.1	8	8	
GN20	1.5"	19-Aug	11:20	19-Aug	12:50	90	116.4	218.5	8	8	
GN21	1.5"	19-Aug	12:00	19-Aug	13:35	95	206.7	321.4	15	15	
GN22	1.5"	19-Aug	13:25	19-Aug	15:10	105	49.9	73.25	4	4	
GN23	1.5"	19-Aug	14:15	19-Aug	15:35	80	65.5	112.5	4	4	
GN24	1.5"	19-Aug	15:30	19-Aug	16:20	50	78.5	155.8	3	3	
GN25	1.5"	19-Aug	15:45	19-Aug	16:25	40	0.0	0.0	0	0	
Total									**135**	**135**	

APPENDIX 10.1-3
RAW DATA FOR FISH CAPTURED WITH GILLNETS IN TAIL LAKE, HOPE BAY BELT, 2000

Appendix 10.1-3
Raw Data for Fish Captured with Gillnets in Tail Lake, Hope Bay Belt, 2000

Date	Site #	Sampling Method	Sampling Crew	Sample #	Species Code	FL (mm)	WT (g)	Age	Sex	Mat.	Repro. Status	Aging Struc.	Tag #	Fin Clips	Recap. (Y/N)	Comments	Stomach Fullness (%)	Diet
17-Aug-00	GN1	GN	JDT, CT	1	LKTR	548	1575	20					Yellow 945	LPV	N			
17-Aug-00	GN1	GN	JDT, CT	2	LKTR	606	1925	21					Yellow 946	LPV	N			
17-Aug-00	GN2	GN	JDT, CT	3	LKTR	575	1550	27					Yellow 947	LPV	N			
17-Aug-00	GN2	GN	JDT, CT	4	LKTR	578	1825	21					Yellow 948	LPV	N			
17-Aug-00	GN2	GN	JDT, CT	5	LKTR	487	1275	7					Yellow 949	LPV	N			
17-Aug-00	GN2	GN	JDT, CT	6	LKTR	560	1575	26					Yellow 950	LPV	N			
17-Aug-00	GN3	GN	JDT, CT	7	LKTR	579	1900	29					Yellow 951	LPV	N			
17-Aug-00	GN3	GN	JDT, CT	8	LKTR	575	1925	17					Yellow 952	LPV	N			
17-Aug-00	GN3	GN	JDT, CT	9	LKTR	571	1425	26					Yellow 953	LPV	N			
17-Aug-00	GN3	GN	JDT, CT	10	LKTR	556	1500	27	2	2	2	1		LPV	N	mortality	50	isopods
17-Aug-00	GN5	GN	JDT, CT	11	LKTR	609	1800	21					Yellow 954	LPV	N			
17-Aug-00	GN5	GN	JDT, CT	12	LKTR	585	1550	28					Yellow 955	LPV	N			
17-Aug-00	GN6	GN	JDT, CT	13	LKTR	475	1175	9					Yellow 956	LPV	N			
17-Aug-00	GN6	GN	JDT, CT	14	LKTR	476	1225	10					Yellow 957	LPV	N			
17-Aug-00	GN7	GN	JDT, CT	15	LKTR	584	1925						Yellow 958	LPV	N			
17-Aug-00	GN7	GN	JDT, CT	16	LKTR	561	1675	23					Yellow 959	LPV	N			
17-Aug-00	GN8	GN	JDT, CT	17	LKTR	582	1300						Yellow 960	LPV	N	Aaniak (skinny)		
17-Aug-00	GN8	GN	JDT, CT	18	LKTR	564	1775	12					Yellow 961	LPV	N			
17-Aug-00	GN8	GN	JDT, CT	19	LKTR	528	1550	13					Yellow 962	LPV	N			
17-Aug-00	GN8	GN	JDT, CT	20	LKTR	409	700	7					Yellow 963	LPV	N			
18-Aug-00	GN9	GN	JDT, CT	21	LKTR	399	700	7					Yellow 964	LPV	N			
18-Aug-00	GN9	GN	JDT, CT	22	LKTR	620	2350	25					Yellow 965	LPV	N			
18-Aug-00	GN9	GN	JDT, CT	23	LKTR	591	1700	25					Yellow 966	LPV	N			
18-Aug-00	GN9	GN	JDT, CT	24	LKTR	486	1275	11					Yellow 967	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	25	LKTR	565	1800	17					Yellow 968	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	26	LKTR	583	1900	24					Yellow 969	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	27	LKTR	544	1575	28					Yellow 970	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	28	LKTR	530	1575	10					Yellow 971	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	29	LKTR	555	1375	21					Yellow 972	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	30	LKTR	560	1825	25					Yellow 973	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	31	LKTR	546	1750	14					Yellow 974	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	32	LKTR	507	1500	12					Yellow 975	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	33	LKTR	578	1825	18					Yellow 976	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	34	LKTR	550	1550	28					Yellow 977	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	35	LKTR	560	1500	13					Yellow 978	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	36	LKTR	556	1650	24					Yellow 979	LPV	N			
18-Aug-00	GN10	GN	JDT, CT	37	LKTR	580	1800	25					Yellow 980	LPV	N			
18-Aug-00	GN11	GN	JDT, CT	38	LKTR	593	1925	33					Yellow 981	LPV	N			
18-Aug-00	GN11	GN	JDT, CT	39	LKTR	575	1325	21					Yellow 982	LPV	N			
18-Aug-00	GN11	GN	JDT, CT	40	LKTR	572	1775	18					Yellow 983	LPV	N	walleye (left side)		
18-Aug-00	GN11	GN	JDT, CT	41	LKTR	641	2550	20					Yellow 984	LPV	N			
18-Aug-00	GN11	GN	JDT, CT	42	LKTR	576	1375						Yellow 985	LPV	N			
18-Aug-00	GN11	GN	JDT, CT	43	LKTR	455	1075	7					Yellow 986	LPV	N			
18-Aug-00	GN11	GN	JDT, CT	44	LKTR	560	1375	25					Yellow 987	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	45	LKTR	531	1225	24					Yellow 988	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	46	LKTR	588	1475	18					Yellow 989	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	47	LKTR	598	1875						Yellow 990	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	48	LKTR	519	1125	18					Yellow 991	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	49	LKTR	631	1650	22					Yellow 992	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	50	LKTR	631	1800	25					Yellow 993	LPV	N			

Appendix 10.1-3
Raw Data for Fish Captured with Gillnets in Tail Lake, Hope Bay Belt, 2000

Date	Site #	Sampling Method	Sampling Crew	Sample #	Species Code	FL (mm)	WT (g)	Age	Sex	Mat.	Repro. Status	Aging Struc.	Tag #	Fin Clips	Recap. (Y/N)	Comments	Stomach Fullness (%)	Diet
18-Aug-00	GN12	GN	JDT, CT	51	LKTR	596	1625	21					Yellow 994	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	52	LKTR	585	1625						Yellow 995	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	53	LKTR	619	2275	20					Yellow 996	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	54	LKTR	577	1950	18					Yellow 997	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	55	LKTR	540	1425	25					Yellow 998	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	56	LKTR	605	2025	24					Yellow 999	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	57	LKTR	587	1750	25					Yellow 1000	LPV	N			
18-Aug-00	GN12	GN	JDT, CT	58	LKTR	565	1650	22					Yellow 751	LPV	N			
18-Aug-00	GN13	GN	JDT, CT	59	LKTR	565	1425	24					Yellow 752	LPV	N	walleye (right side, some in left)		
18-Aug-00	GN13	GN	JDT, CT	60	LKTR	536	1600	11					Yellow 753	LPV	N			
18-Aug-00	GN13	GN	JDT, CT	61	LKTR	587	1500	23					Yellow 754	LPV	N			
18-Aug-00	GN14	GN	JDT, CT	62	LKTR	568	1700	27					Yellow 755	LPV	N			
18-Aug-00	GN14	GN	JDT, CT	63	LKTR	567	2125	16					Yellow 756	LPV	N			
18-Aug-00	GN14	GN	JDT, CT	64	LKTR	549	1450	22					Yellow 757	LPV	N			
18-Aug-00	GN14	GN	JDT, CT	65	LKTR	489	1350	15					Yellow 758	LPV	N			
18-Aug-00	GN14	GN	JDT, CT	66	LKTR	572	1900	27					Yellow 759	LPV	N			
18-Aug-00	GN14	GN	JDT, CT	67	LKTR	572	1425	25					Yellow 760	LPV	N			
18-Aug-00	GN14	GN	JDT, CT	68	LKTR	284	280	4	2	1	1	1		LPV	N	mortality	100	25 NNST
18-Aug-00	GN15	GN	JDT, CT	69	LKTR	580	1525	27					Yellow 761	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	70	LKTR	520	1250	28					Yellow 762	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	71	LKTR	470	1200	10					Yellow 763	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	72	LKTR	563	1200	23					Yellow 764	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	73	LKTR	510	1550	15					Yellow 765	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	74	LKTR	592	1475	31					Yellow 766	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	75	LKTR	580	2000	20					Yellow 767	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	76	LKTR	538	1550	23					Yellow 768	LPV	N			
18-Aug-00	GN15	GN	JDT, CT	77	LKTR	564	1625	22					Yellow 769	LPV	N			
18-Aug-00	GN16	GN	JDT, CT	78	LKTR	520	1550	11					Yellow 770	LPV	N			
18-Aug-00	GN16	GN	JDT, CT	79	LKTR	505	1400	11					Yellow 771	LPV	N			
18-Aug-00	GN16	GN	JDT, CT	80	LKTR	592	2000	23					Yellow 772	LPV	N			
18-Aug-00	GN16	GN	JDT, CT	81	LKTR	560	1625	21					Yellow 773	LPV	N			
18-Aug-00	GN17	GN	JDT, CT	82	LKTR	577	1775						Yellow 774	LPV	N			
18-Aug-00	GN17	GN	JDT, CT	83	LKTR	562	1425	23					Yellow 775	LPV	N			
18-Aug-00	GN17	GN	JDT, CT	84	LKTR	573	1550	25					Yellow 776	LPV	N			
18-Aug-00	GN17	GN	JDT, CT	85	LKTR	608	2225	17					Yellow 777	LPV	N			
18-Aug-00	GN17	GN	JDT, CT	86	LKTR	457	1525	20					Yellow 778	LPV	N			
19-Aug-00	GN18	GN	JDT, CT	87	LKTR	525	1225	24					Yellow 779	LPV	N			
19-Aug-00	GN18	GN	JDT, CT	88	LKTR	550	1325	22					Yellow 780	LPV	N			
19-Aug-00	GN18	GN	JDT, CT	89	LKTR	540	1775	12					Yellow 781	LPV	N			
19-Aug-00	GN18	GN	JDT, CT	90	LKTR	553	1700	29					Yellow 782	LPV	N			
19-Aug-00	GN18	GN	JDT, CT	91	LKTR	441	900	7					Yellow 783	LPV	N			
19-Aug-00	GN18	GN	JDT, CT	92	LKTR	553	1600						Yellow 784	LPV	N	possibly mort		
19-Aug-00	GN19	GN	JDT, CT	93	LKTR	581	1650						Yellow 785	LPV	N			
19-Aug-00	GN19	GN	JDT, CT	94	LKTR	613	2025	19					Yellow 786	LPV	N			
19-Aug-00	GN19	GN	JDT, CT	95	LKTR	583	1450	19					Yellow 787	LPV	N			
19-Aug-00	GN19	GN	JDT, CT	96	LKTR	553	1550						Yellow 788	LPV	N			
19-Aug-00	GN19	GN	JDT, CT	97	LKTR	556	1850	16					Yellow 789	LPV	N			
19-Aug-00	GN19	GN	JDT, CT	98	LKTR	631	2150						Yellow 790	LPV	N			
19-Aug-00	GN19	GN	JDT, CT	99	LKTR	519	1375	13	1	2	3	1		LPV	N	mortality	5	1 NNST
19-Aug-00	GN19	GN	JDT, CT	100	LKTR	565	1900	17	2	2	3	1		LPV	N	mortality	30	1/2 tadpole shrimps, 1/2 trichoptera
19-Aug-00	GN20	GN	JDT, CT	101	LKTR	456	1675	16					Yellow 791	LPV	N			

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Appendix 10.1-3
Raw Data for Fish Captured with Gillnets in Tail Lake, Hope Bay Belt, 2000

Date	Site #	Sampling Method	Sampling Crew	Sample #	Species Code	FL (mm)	WT (g)	Age	Sex	Mat.	Repro. Status	Aging Struc.	Tag #	Fin Clips	Recap. (Y/N)	Comments	Stomach Fullness (%)	Diet
19-Aug-00	GN20	GN	JDT, CT	102	LKTR	534	1700	13					Yellow 792	LPV	N			
19-Aug-00	GN20	GN	JDT, CT	103	LKTR	624	2250						Yellow 793	LPV	N			
19-Aug-00	GN20	GN	JDT, CT	104	LKTR	573	2050	16					Yellow 794	LPV	N			
19-Aug-00	GN20	GN	JDT, CT	105	LKTR	665	2000	28					Yellow 795	LPV	N			
19-Aug-00	GN20	GN	JDT, CT	106	LKTR	584	1925	26					Yellow 796	LPV	N			
19-Aug-00	GN20	GN	JDT, CT	107	LKTR	565	1825						Yellow 797	LPV	N			
19-Aug-00	GN20	GN	JDT, CT	108	LKTR	577	1600	15					Yellow 798	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	109	LKTR	600	1525	25					Yellow 799	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	110	LKTR	563	1675						Yellow 800	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	111	LKTR	631	2000	24					Yellow 750	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	112	LKTR	483	1250	11					Yellow 749	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	113	LKTR	566	1700	23					Yellow 748	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	114	LKTR	570	1700	22					Yellow 747	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	115	LKTR	540	1400						Yellow 746	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	116	LKTR	546	1500	23					Yellow 745	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	117	LKTR	563	1375	23					Yellow 744	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	118	LKTR	581	1825						Yellow 743	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	119	LKTR	561	1850						Yellow 742	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	120	LKTR	570	1500	24					Yellow 741	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	121	LKTR	512	1475	15					Yellow 740	LPV	N			
19-Aug-00	GN21	GN	JDT, CT	122	LKTR	471	1175	10	1	2	3	1		LPV	N	mortality	100	23 NNST, 5 tadpole shrimps, 1 trichoptera
19-Aug-00	GN21	GN	JDT, CT	123	LKTR	566	1375	20	2	2	2	1		LPV	N	mortality	0	
19-Aug-00	GN22	GN	JDT, CT	124	LKTR	563	1550	22					Yellow 739	LPV	N			
19-Aug-00	GN22	GN	JDT, CT	125	LKTR	536	1575						Yellow 738	LPV	N			
19-Aug-00	GN22	GN	JDT, CT	126	LKTR	553	1650	25					Yellow 737	LPV	N			
19-Aug-00	GN22	GN	JDT, CT	127	LKTR	465	1100	9					Yellow 736	LPV	N			
19-Aug-00	GN23	GN	JDT, CT	128	LKTR	566	1550	19					Yellow 735	LPV	N			
19-Aug-00	GN23	GN	JDT, CT	129	LKTR	560	1375						Yellow 734	LPV	N			
19-Aug-00	GN23	GN	JDT, CT	130	LKTR	567	2025	17					Yellow 733	LPV	N			
19-Aug-00	GN23	GN	JDT, CT	131	LKTR	586	1925	20					Yellow 732	LPV	N			
19-Aug-00	GN24	GN	JDT, CT	132	LKTR	555	1750	17					Yellow 731	LPV	N			
19-Aug-00	GN24	GN	JDT, CT	133	LKTR	576	1675	30					Yellow 730	LPV	N			
19-Aug-00	GN24	GN	JDT, CT	134	LKTR	663	2525	28					Yellow 729	LPV	N			

Legend

Sampling Method — **GN** Gillnetting; **EF** Electrofishing

Sampling Crew — **JDT** Dave Tyson; **CT** Chris Teichreb; **SM** Steve Moore

FL Fork Length
WT Weight

Sex — 1 Male; 2 Female

Mat. Maturity — 1 Immature; 2 Mature

Repro. Status — Reproductive Status — 1 Undeveloped; 2 Green; 3 Ripe

Aging Struc. — Aging Structure — 1 Otolith; 2 Scale; 3 Fin Ray

Fin Clips — LPV Left pelvic

Recap. — Recapture

APPENDIX 10.1-4
DATA FROM GILLNET SETS FOR LITTLE ROBERTS LAKE, HOPE BAY BELT, 2000

Rescan™

Appendix 10.1- 4
Data from Gillnet Sets for Little Roberts Lake, Hope Bay Belt, 2000

Site ID	Mesh Size	Set Date	Set Time	Pulled Date	Pulled Time	Effort (min)	Species Caught BRWH	CISCO	LKTR	LKWH	ARCH	Total	Comments
GN1	1.5"	26-Aug	8:10	26-Aug	8:55	45			1		1	2	
GN2	1.5"	26-Aug	8:15	26-Aug	9:15	60			1		2	3	
GN3	1.5"	26-Aug	9:10	26-Aug	10:50	100		2	4	7	7	20	
GN4	1.5"	26-Aug	9:25	26-Aug	12:00	155		2	2		4	8	
GN5	1.5"	26-Aug	11:50	26-Aug	13:30	100			1		3	4	
GN6	1.5"	26-Aug	12:25	26-Aug	14:00	95			3		2	5	
GN7	1.5"	26-Aug	13:55	26-Aug	15:25	90			4			4	
GN8	1.5"	26-Aug	14:20	26-Aug	15:50	90		2	1		1	4	Incl. 1 escaped ARCH
GN9	1.5"	26-Aug	15:40	26-Aug	16:30	50					1	1	ARCH recaptured (#19)
GN10	1.5"	26-Aug	16:00	26-Aug	16:35	35						0	
GN11	1.5"	27-Aug	8:15	26-Aug	9:30	75					5	5	
GN12	1.5"	27-Aug	8:20	26-Aug	10:00	100					2	2	
GN13	1.5"	27-Aug	9:50	27-Aug	11:25	95					1	1	
GN14	1.5"	27-Aug	10:05	27-Aug	11:35	90			1			1	LKTR recaptured (#38)
GN15	1.5"	27-Aug	11:30	27-Aug	13:05	95						0	
GN16	1.5"	27-Aug	11:45	27-Aug	13:20	95	2					2	Incl. 1 escaped BRWH
GN17	1.5"	27-Aug	13:15	27-Aug	15:00	105			1			1	
GN18	1.5"	27-Aug	13:30	27-Aug	15:10	100			1		1	2	
GN19	1.5"	27-Aug	15:05	27-Aug	16:15	70			1		1	2	
GN20	1.5"	27-Aug	15:20	27-Aug	16:25	65						0	
Total							**2**	**6**	**21**	**7**	**31**	**67**	

Site ID	CPUE BRWH	CPUE CISCO	CPUE LKTR	CPUE LKWH	CPUE ARCH	CPUE TOTAL	BPUE BRWH	BPUE CISCO	BPUE LKTR	BPUE LKWH	BPUE ARCH	BPUE TOTAL
GN1	0	0	29.1	0	29.1	58.2	0	0	16.3	0	2.6	18.9
GN2	0	0	21.8	0	43.6	65.5	0	0	6.8	0	14.9	21.7
GN3	0	26.2	52.4	91.6	91.6	261.8	0	1.8	35.7	9.3	144.1	190.8
GN4	0	16.9	16.9	0	33.8	67.6	0	1.5	22.7	0	13.0	37.3
GN5	0	0	13.1	0	39.3	52.4	0	0	6.0	0	103.9	109.8
GN6	0	0	41.3	0	27.6	68.9	0	0	41.8	0	57.7	99.5
GN7	0	0	58.2	0	0	58.2	0	0	39.9	0	0	39.9
GN8	0	29.1	14.5	0	14.5	58.2	0	3.0	15.6	0	0	18.6
GN9	0	0	0	0	26.2	26.2	0	0	0	0	189.8	189.8
GN10	0	0	0	0	0	0	0	0	0	0	0	0
GN11	0	0	0	0	87.3	87.3	0	0	0	0	56.0	56.0
GN12	0	0	0	0	26.2	26.2	0	0	0	0	5.0	5.0
GN13	0	0	0	0	13.8	13.8	0	0	0	0	0.9	0.9
GN14	0	0	14.5	0	0	14.5	0	0	9.9	0	0	9.9
GN15	0	0	0	0	0	0	0	0	0	0	0	0
GN16	27.6	0	0	0	0	27.6	27.6	0	0	0	0	27.6
GN17	0	0	12.5	0	0	12.5	0	0	1.7	0	0	1.7
GN18	0	0	13.1	0	13.1	26.2	0	0	7.2	0	3.0	10.2
GN19	0	0	18.7	0	18.7	37.4	0	0	12.9	0	8.0	20.9
GN20	0	0	0	0	0	0	0	0	0	0	0	0

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APPENDIX 10.1-5
RAW DATA FOR FISH CAPTURED WITH GILLNETS IN LITTLE ROBERTS LAKE, HOPE BAY BELT, 2000

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Appendix 10.1-5
Raw Data for Fish Captured with Gillnets in Little Roberts Lake, Hope Bay Belt, 2000

Date	Site #	Sampling Method	Sampling Crew	Sample #	Species Code	FL (mm)	WT (g)	Age	Sex	Mat.	Repro. Status	Aging Struc.	Tag #	Fin Clips	Recap. (Y/N)	Comments	Stomach Fullness (%)	Diet
26-Aug-00	GN1	GN	JDT, CT	1	LKTR	350	560	8					Blue 16	LPV	N			
26-Aug-00	GN1	GN	JDT, CT	2	ARCH	183	89	2						LPV	N			
26-Aug-00	GN2	GN	JDT, CT	3	ARCH	352	510	6					Blue 17	LPV	N			
26-Aug-00	GN2	GN	JDT, CT	4	LKTR	288	310	7					Blue 18	LPV	N			
26-Aug-00	GN2	GN	JDT, CT	5	ARCH	251	175	4						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	6	ARCH	869	7250	9	1	2			Blue 19	LPV	N			
26-Aug-00	GN3	GN	JDT, CT	7	LKTR	335	515	9					Blue 20	LPV	N			
26-Aug-00	GN3	GN	JDT, CT	8	LKTR	367	730	10					Blue 21	LPV	N			
26-Aug-00	GN3	GN	JDT, CT	9	LKTR	382	850	11					Blue 22	LPV	N			
26-Aug-00	GN3	GN	JDT, CT	10	ARCH	179	70	2						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	11	LKWH	208	115	6						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	12	ARCH	177	70	2						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	13	LKTR	355	635	10					Blue 23	LPV	N			
26-Aug-00	GN3	GN	JDT, CT	14	ARCH	174	75	2						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	15	ARCH	168	68	2						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	16	LKWH	174	70	4	1	1	1	1		LPV	N	mortality	20	vegetation
26-Aug-00	GN3	GN	JDT, CT	17	LKWH	200	105	4	2	1	1	1		LPV	N	mortality	100	plant matter
26-Aug-00	GN3	GN	JDT, CT	18	LKWH	190	97	4	1	1	1	1		LPV	N	mortality	0	
26-Aug-00	GN3	GN	JDT, CT	19	LKWH	213	130	6	1	1	1	1		LPV	N	mortality	0	
26-Aug-00	GN3	GN	JDT, CT	20	LKWH	203	104	4	1	1	1	1		LPV	N	mortality	40	vegetation
26-Aug-00	GN3	GN	JDT, CT	21	LKWH	118	86	4	1	1	1	1		LPV	N	mortality	0	
26-Aug-00	GN3	GN	JDT, CT	22	CISCO	169	61	2						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	23	CISCO	180	73	3						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	24	ARCH	654	3375	8						LPV	N			
26-Aug-00	GN3	GN	JDT, CT	25	ARCH	199	99	2						LPV	N			
26-Aug-00	GN4	GN	JDT, CT	26	ARCH	297	370	4				3	Blue 25	LPV	N			
26-Aug-00	GN4	GN	JDT, CT	27	ARCH	295	405					3	Blue 26	none	N			
26-Aug-00	GN4	GN	JDT, CT	28	ARCH	329	505	4				3	Blue 27	LPV	N			
26-Aug-00	GN4	GN	JDT, CT	29	LKTR	393	940	11				3	Blue 28	LPV	N			
26-Aug-00	GN4	GN	JDT, CT	30	LKTR	523	1750	25				3	Blue 29	LPV	N			
26-Aug-00	GN4	GN	JDT, CT	31	CISCO	190	92	2				3		LPV	N			
26-Aug-00	GN4	GN	JDT, CT	32	CISCO	200	91	6				3		LPV	N			
26-Aug-00	GN4	GN	JDT, CT	33	ARCH	277	265	4	1	1	1	1, 3		LPV	N	mortality	100	tadpole shrimp

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Appendix 10.1-5
Raw Data for Fish Captured with Gillnets in Little Roberts Lake, Hope Bay Belt, 2000

Date	Site #	Sampling Method	Sampling Crew	Sample #	Species Code	FL (mm)	WT (g)	Age	Sex	Mat.	Repro. Status	Aging Struc.	Tag #	Fin Clips	Recap. (Y/N)	Comments	Stomach Fullness (%)	Diet
26-Aug-00	GN5	GN	JDT, CT	34	ARCH	420	850	3				3	Blue 30	LPV	N			
26-Aug-00	GN5	GN	JDT, CT	35	LKTR	331	455	9				3	Blue 31	LPV	N			
26-Aug-00	GN5	GN	JDT, CT	36	ARCH	799	6800	9	2	2		3	Blue 32, 33	LPV	N			
26-Aug-00	GN5	GN	JDT, CT	37	ARCH	267	285	3	1	1	1	1, 3			N	mortality	100	tadpole shrimp
26-Aug-00	GN6	GN	JDT, CT	38	LKTR	411	1030	13				3	Blue 34	LPV	N			
26-Aug-00	GN6	GN	JDT, CT	39	LKTR	465	1125	22				3	Blue 35	LPV	N			
26-Aug-00	GN6	GN	JDT, CT	40	LKTR	416	875	18				3	Blue 36	LPV	N			
26-Aug-00	GN6	GN	JDT, CT	41	ARCH	327	540	4				3	Blue 37	LPV	N			
26-Aug-00	GN6	GN	JDT, CT	42	ARCH	675	3650	7	1	1	1	3		LPV	N	mortality	0	
26-Aug-00	GN7	GN	JDT, CT	43	LKTR	367	680	8					Blue 38	LPV	N			
26-Aug-00	GN7	GN	JDT, CT	44	LKTR	383	825	12					Blue 39	LPV	N			
26-Aug-00	GN7	GN	JDT, CT	45	LKTR	351	645	10					Blue 40	LPV	N			
26-Aug-00	GN7	GN	JDT, CT	46	LKTR	346	595	8					Blue 41	LPV	N			
26-Aug-00	GN8	GN	JDT, CT	47	LKTR	455	1075	13					Blue 42	LPV	N			
26-Aug-00	GN8	GN	JDT, CT	48	CISCO	221	115	5						LPV	N			
26-Aug-00	GN8	GN	JDT, CT	49	CISCO	188	89	2						LPV	N			
27-Aug-00	GN11	GN	JDT, CT	50	ARCH	574	2500	6					Blue 43	LPV	N			
27-Aug-00	GN11	GN	JDT, CT	51	ARCH	149	100	2						LPV	N			
27-Aug-00	GN11	GN	JDT, CT	52	ARCH	270	240	4	2	1	1	1		LPV	N	mortality	20	tadpole shrimp
27-Aug-00	GN11	GN	JDT, CT	53	ARCH	250	195	4	2	1	1	1		LPV	N	mortality	100	tadpole shrimp
27-Aug-00	GN11	GN	JDT, CT	54	ARCH	251	175	3						LPV	N			
27-Aug-00	GN12	GN	JDT, CT	55	ARCH	235	155	3						LPV	N			
27-Aug-00	GN12	GN	JDT, CT	56	ARCH	254	225	3						LPV	N			
27-Aug-00	GN13	GN	JDT, CT	57	ARCH	171	67	2						LPV	N			
27-Aug-00	GN14	GN	JDT, CT	58	LKTR								Blue 38		Y			
27-Aug-00	GN16	GN	JDT, CT	59	BRWH	533	2000	12					Blue 44	LPV	N			
27-Aug-00	GN17	GN	JDT, CT	60	LKTR	315	140	12							N			
27-Aug-00	GN18	GN	JDT, CT	61	LKTR	439	550	14					Blue 45		N			
27-Aug-00	GN18	GN	JDT, CT	62	ARCH	258	230	4	2	1	1	1			N	mortality	0	
27-Aug-00	GN19	GN	JDT, CT	63	LKTR	367	730	10					Blue 46		N			
27-Aug-00	GN19	GN	JDT, CT	64	ARCH	320	430	4							N			

APPENDIX 10.2-1
RAW DATA FOR FISH CAUGHT WITH ELECTROFISHER AT PRC-13, PRC-14, AND PRC-15 CROSSINGS OF THE ALL WEATHER ROAD, HOPE BAY BELT, 2000

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Appendix 10.2-1
Raw Data for Fish Caught with Electrofisher at PRC-13, PRC-14, and PRC-15 Crossings of the All Weather Road, Hope Bay Belt, 2000

Date	Site #	Sample Method	Sampling Crew	Sample #	Species Code	TL (mm)
25-Jun-00	PRC-14	EF	JDT, SM	1	NNST	33
25-Jun-00	PRC-14	EF	JDT, SM	2	NNST	33
25-Jun-00	PRC-14	EF	JDT, SM	3	NNST	69
25-Jun-00	PRC-14	EF	JDT, SM	4	NNST	56
25-Jun-00	PRC-14	EF	JDT, SM	5	NNST	37
25-Jun-00	PRC-14	EF	JDT, SM	6	NNST	48
25-Jun-00	PRC-14	EF	JDT, SM	7	NNST	32
25-Jun-00	PRC-14	EF	JDT, SM	8	NNST	32
25-Jun-00	PRC-14	EF	JDT, SM	9	NNST	37
25-Jun-00	PRC-14	EF	JDT, SM	10	NNST	26
25-Jun-00	PRC-14	EF	JDT, SM	11	NNST	41
25-Jun-00	PRC-14	EF	JDT, SM	12	NNST	26
25-Jun-00	PRC-14	EF	JDT, SM	13	NNST	31
25-Jun-00	PRC-14	EF	JDT, SM	14	NNST	28
25-Jun-00	PRC-14	EF	JDT, SM	15	NNST	36
25-Jun-00	PRC-14	EF	JDT, SM	16	NNST	38
29-Aug-00	PRC-13	EF	JDT, CT	1	NNST	33
29-Aug-00	PRC-13	EF	JDT, CT	2	NNST	31
29-Aug-00	PRC-13	EF	JDT, CT	3	NNST	24
29-Aug-00	PRC-15	EF	JDT, CT	1	NNST	33
29-Aug-00	PRC-15	EF	JDT, CT	2	NNST	32
29-Aug-00	PRC-15	EF	JDT, CT	3	NNST	28
29-Aug-00	PRC-15	EF	JDT, CT	4	ARGR	55

Notes: PRC = permanent road crossing
See Appendix 10.1-1 for species codes and last page of Appendix 10.1-2 for sample method and sampling crew

APPENDIX 10.2-2
RAW DATA FOR FISH CAUGHT WITH ELECTROFISHER AT DORIS OUTFLOW AND GLENN OUTFLOW, HOPE BAY BELT, 2000

Appendix 10.2-2
Raw Data for Fish Caught with Electrofisher at Doris Outflow and Glenn Outflow, Hope Bay Belt, 2000

Date	Site #	Sampling Method	Sampling Crew	Sample #	Species Code	FL (mm)	TL (mm)	WT (g)	Sex	Mat.	Repro. Status	Aging Struc.	Fin Clips	Comments	Stomach Fullness (%)
20-Aug-00	Glenn Outflow	EF	JDT, CT	1	ARCH	820		5150	2	2	1	1	LPV	back broken; mortality	0
20-Aug-00	Glenn Outflow	EF	JDT, CT	2	LKTR	142		43				2	LPV		
20-Aug-00	Glenn Outflow	EF	JDT, CT	3	SLSC									juvenile; preserved	
20-Aug-00	Glenn Outflow	EF	JDT, CT	4	SLSC									juvenile; preserved	
20-Aug-00	Glenn Outflow	EF	JDT, CT	5	SLSC									juvenile; preserved	
25-Aug-00	Doris Outflow	EF	JDT, CT	1	NNST		45								
25-Aug-00	Doris Outflow	EF	JDT, CT	2	NNST		35								
25-Aug-00	Doris Outflow	EF	JDT, CT	3	NNST		34								
25-Aug-00	Doris Outflow	EF	JDT, CT	4	NNST		39								
25-Aug-00	Doris Outflow	EF	JDT, CT	5	NNST		81								
25-Aug-00	Doris Outflow	EF	JDT, CT	6	NNST		34								
25-Aug-00	Doris Outflow	EF	JDT, CT	7	NNST		28								
25-Aug-00	Doris Outflow	EF	JDT, CT	8	NNST		36								
25-Aug-00	Doris Outflow	EF	JDT, CT	9	NNST		37								
25-Aug-00	Doris Outflow	EF	JDT, CT	10	NNST		28								
25-Aug-00	Doris Outflow	EF	JDT, CT	11	NNST		32								
25-Aug-00	Doris Outflow	EF	JDT, CT	12	NNST		37								
25-Aug-00	Doris Outflow	EF	JDT, CT	13	NNST		71								
25-Aug-00	Doris Outflow	EF	JDT, CT	14	NNST		24								
25-Aug-00	Doris Outflow	EF	JDT, CT	15	NNST		43								
25-Aug-00	Doris Outflow	EF	JDT, CT	16	NNST		31								
25-Aug-00	Doris Outflow	EF	JDT, CT	17	NNST		37								
25-Aug-00	Doris Outflow	EF	JDT, CT	18	NNST		26								
25-Aug-00	Doris Outflow	EF	JDT, CT	19	NNST		32								

Notes: See Appendix 10.1-1 for species codes and last page of Appendix 10.1-2 for sample method and sampling crew

APPENDIX 10.3-1
HABITAT CLASSIFICATION SYSTEM FOR ARCTIC STREAMS

APPENDIX 10.3-1 HABITAT CLASSIFICATION SYSTEM FOR ARCTIC STREAMS

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 R3 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.

Chute (Ch) A steep section of the stream channel.

Falls (Fa) Water flows over a channel obstruction and into a downstream plunge pool. Obstruction height greater than 0.75 m and forms an obvious barrier to fish passage.

Flat (F) 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** – best quality flat habitat; depth greater than 0.75 m.
- **F2** – intermediate quality flat habitat; depth 0.3 to 0.75 m.
- **F3** – poorest quality flat habitat; depth less than 0.3 m.

Pools (P) Portions of the stream with reduced current velocity at low flow and deeper water than surrounding areas. Often associated with Run habitat types.

- **P1** – best quality pool habitat; depth greater than 0.75 m.
- **P2** – intermediate quality pool habitat; depth 0.3 to 0.75 m.
- **P3** – poorest quality pool habitat; depth less than 0.3 m.

Rapids (Ra) Water flows swiftly over completely or partially submerged materials to produce intense surface agitation. Usually greater than 0.2 m in depth, with a gradient of greater than 4%.

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%.

Run (R) 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.

- **R1** – best quality run habitat; depth greater than 0.75 m.
- **R2** – intermediate quality run habitat; depth 0.3 to 0.75 m.
- **R3** – poorest quality run habitat; depth less than 0.3 m.

Stream Habitat Suitability Classification

The suitability of a stream's habitat with respect to spawning, rearing, adult feeding, overwintering, and migration is expressed using a qualitative numerical scale from 0 to 4. Under this scheme, 0 = no habitat present, 1 = poor, 2 = fair, 3 = good, and 4 = excellent.

APPENDIX 10.3-2
STREAM HABITAT ASSESSMENT RESULTS, HOPE BAY BELT, 2000

APPENDIX 10.3-2a
HABITAT ASSESSMENT RESULTS FOR ROBERTS OUTFLOW, HOPE BAY BELT, 2000

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Appendix 10.3-2a
Habitat Assessment Results for Roberts Outflow, Hope Bay Belt, 2000

Date	26-Jun	**Survey Length**	600 m
Stream Name	Roberts Outflow	**Gradient**	<1%
Site	-	**Mean Channel Width**	13 m
Crew	JDT, SM	**Mean Depth**	-
		Mean Max. Pool Depth	-
		Mean Max. Riffle Depth	-

Instream Habitat[1]		**Substrate**		**Total Cover**	**45%**	
F1	30%	Organic matter	15%	Pool	80%	
Ra	7.5%	Silt	50%	Boulder	20%	
R1	50%	Sand	10%			
P1	12.5%	Cobble	10%			
		Boulder	15%			
Habitat Suitability[1]		**Compaction**	-	**Bank**	LUB	RUB
Spawning	3	**Embededdness**	-	Height	2 m	2.5 m
Rearing	3			Stability	80%	70%
Adult feeding	3	**Stage**	H	Texture A	Sa	Sa
Overwintering	1	**Water Temperature**	-	Texture B	Si	Si
Migration	4	**Water Colour**	turbid	Cover	90%	85%

Comments - none

Notes: [1] See Appendix 10.3-1 for key

Site PRC: Permanent Road Crossing

Banks LUB: Left Upstream Bank Texture A: Most dominant substrate on bank
RUB: Right Upstream Bank Texture B: Second most dominant substrate on bank
Texture: Sa = sand, Si = silt, OM = organic matter, Bo = boulder

Stage Depth of flow: L = low, M = medium, H = high

Compaction: The extent to which substrate is packed and refers to the density of the material
Embeddedness: The extent to which gravel, cobble, or boulders are covered or sunken in silt or sand

APPENDIX 10.3-2b
HABITAT ASSESSMENT RESULTS FOR LITTLE ROBERTS OUTFLOW, HOPE BAY BELT, 2000

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Appendix 10.3-2b
Habitat Assessment Results for Little Roberts Outflow, Hope Bay Belt, 2000

Date	26-Jun	**Survey Length**	1250 m
Stream Name	Little Roberts Outflow	**Gradient**	<1%
Site	-	**Mean Channel Width**	18 m
Crew	JDT, SM	**Mean Depth**	-
		Mean Max. Pool Depth	-
		Mean Max. Riffle Depth	0.9 m

Instream Habitat[1]		**Substrate**		**Total Cover**	**70%**
F1	20%	Silt	15%	Pool	20%
P1	15%	Sand	15%	Boulder	80%
R1	50%	Cobble	45%		
Ra	10%	Boulder	22.5%		
Rf	2.5%	Bedrock	2.5%		
Ch	2.5%				

Habitat Suitability[1]				**Bank**	LUB	RUB
Spawning	3	**Compaction**	-	Height	3.5 m	3.5 m
Rearing	4	**Embededdness**	-	Stability	90%	90%
Adult feeding	3	**Stage**	H	Texture A	Si	Si
Overwintering	1	**Water Temperature**	-	Texture B	Bo	Bo
Migration	4	**Water Colour**	turbid	Cover	95%	95%

Comments - none

Note: See Appendix 10.3-2a for legend

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APPENDIX 10.3-2c
HABITAT ASSESSMENT RESULTS FOR GLENN OUTFLOW, HOPE BAY BELT, 2000

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Appendix 10.3-2c
Habitat Assessment Results for Glenn Outflow, Hope Bay Belt, 2000

Date	25-Jun			**Survey Length**	300 m		
Stream Name	Glenn Outflow			**Gradient**	1%		
Site	-			**Mean Channel Width**	3.5 m		
Crew	JDT, SM			**Mean Depth**	0.6 m		
				Mean Max. Pool Depth	1.3 m		
				Mean Max. Riffle Depth	0.35 m		
Instream Habitat[1]		**Substrate**		**Total Cover**	**10%**		
Ca	5%	Silt	45%	Boulder	100%		
Ra	5%	Sand	25%				
Rf	15%	Small Gravel	10%				
R2	25%	Cobble	10%				
R3	50%	Boulder	10%				
Habitat Suitability[1]		**Compaction**	10%	**Bank**	LUB	RUB	
Spawning	1	**Embededdness**	70%	Height	10 m	8 m	
Rearing	4			Stability	10%	65%	
Adult feeding	2	**Stage**	H	Texture A	Si	Si	
Overwintering	0	**Water Temperature**	8°C	Texture B	Sa	Sa	
Migration	3	**Water Colour**	grey, very dirty	Cover	20%	100%	

Comments - very turbid - bottom is silt and sand, very muddy
- no fishes - conductivity higher

Date	20-Aug			**Survey Length**	200 m	
Stream Name	Glenn Outflow			**Gradient**	<1%	
Site	PRC-1			**Mean Channel Width**	3.5 m	
Crew	JDT, CT			**Mean Depth**	0.3 m	
				Mean Max. Pool Depth	1.5 m	
				Mean Max. Riffle Depth	0.2 m	
Instream Habitat[1]		**Substrate**		**Total Cover**	**20%**	
Rf	30%	Organic matter	5%	Pool	25%	
Ra	20%	Silt	70%	Boulder	55%	
P2	5%	Sand	5%	Cutbank	5%	
P3	5%	Small Gravel	5%	Macrophytes/Vegetation	15%	
R3	40%	Large Gravel	5%			
		Cobble	5%			
		Boulder	5%			
Habitat Suitability[1]		**Compaction**	-	**Bank**	LUB	RUB
Spawning	1	**Embededdness**	-	Height	see June	
Rearing	3			Stability	sampling	
Adult feeding	1	**Stage**	L	Texture A		
Overwintering	0	**Water Temperature**	-	Texture B		
Migration	4	**Water Colour**	-	Cover		

Comments - caught slimy sculpin, ninespine stickleback, arctic char - 12 arctic char pool below Ra - All adult sea-run

Note: See Appendix 10.3-2a for legend

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APPENDIX 10.3-2d
HABITAT ASSESSMENT RESULTS FOR DORIS OUTFLOW, HOPE BAY BELT, 2000

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Appendix 10.3-2d
Habitat Assessment Results for Doris Outflow, Hope Bay Belt, 2000

Date	25-Aug	**Survey Length**	150 m
Stream Name	Doris Outflow	**Gradient**	1%
Site	Crossing 4	**Mean Channel Width**	2.5 m
Crew	JDT, CT	**Mean Depth**	0.35 m
		Mean Max. Pool Depth	1.2 m
		Mean Max. Riffle Depth	0.15 m

Instream Habitat[1]		**Substrate**		**Total Cover**	**25%**	
R2	60%	Organic matter	5%	Pool	5%	
R3	20%	Silt	5%	Boulder	5%	
Rf	10%	Sand	50%	Cutbank	5%	
P2	5%	Small Gravel	25%	Macrophytes/Vegetation	85%	
P3	5%	Large Gravel	7.5%			
		Cobble	2.5%			
		Boulder	5%			
Habitat Suitability[1]		**Compaction**	-	**Bank**	LUB	RUB
Spawning	2	**Embededdness**	-	Height	-	-
Rearing	2			Stability	-	-
Adult feeding	1	**Stage**	M	Texture A	-	-
Overwintering	0	**Water Temperature**	9^{o}C	Texture B	-	-
Migration	0 (wf)	**Water Colour**	clear	Cover	-	-

Comments - none

Note: See Appendix 10.3-2a for legend
wf = waterfall

APPENDIX 10.3-2e
HABITAT ASSESSMENT RESULTS FOR TAIL OUTFLOW, HOPE BAY BELT, 2000

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Appendix 10.3-2e
Habitat Assessment Results for Tail Outflow, Hope Bay Belt, 2000

Date	25-Jun	**Survey Length**	100 m
Stream Name	Tail Outflow	**Gradient**	<1%
Site	-	**Mean Channel Width**	0.45 m
Crew	JDT, SM	**Mean Depth**	0.25 m
		Mean Max. Pool Depth	0.9 m
		Mean Max. Riffle Depth	0.35 m

Instream Habitat[1]		**Substrate**		**Total Cover**	**80%**	
Rf	75%	Organic matter	90%	Macrophytes/Vegetation	95%	
R3	20%	Sand	5%	Overhanging vegetation	5%	
P3	5%	Cobble	5%			
Habitat Suitability[1]		**Compaction**	-	**Bank**	LUB	RUB
Spawning	0	**Embededdness**	-	Height	0.5 m	0.5 m
Rearing	1			Stability	100%	100%
Adult feeding	0	**Stage**	M	Texture A	Sa	Sa
Overwintering	0	**Water Temperature**	7°C	Texture B	OM	OM
Migration	1	**Water Colour**	-	Cover	100%	100%

Comments
- stream flows through flooded terr. vegetated - sedges and willows
- very shallow ~ 4-8 cm
- no fish caught, electrofisher settings K6 V700 - time fished: 151 sec.

Note: See Appendix 10.3-2a for legend

APPENDIX 10.3-2f
HABITAT ASSESSMENT RESULTS FOR PERMANENT ROAD CROSSING 13, HOPE BAY BELT, 2000

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Appendix 10.3-2f
Habitat Assessment Results for Permanent Road Crossing 13, Hope Bay Belt, 2000

Date	25-Jun	**Survey Length**	500 m
Stream Name	Unnamed	**Gradient**	<1%
Site	PRC-13	**Mean Channel Width**	8 m
Crew	JDT, SM	**Mean Depth**	1.2 m
		Mean Max. Pool Depth	-
		Mean Max. Riffle Depth	0.35 m

Instream Habitat[1]		**Substrate**		**Total Cover**	**20%**	
Rf	5%	Organic matter	10%	Pool	30%	
R1	65%	Silt	75%	Boulder	10%	
R2	20%	Sand	12.5%	Overhanging vegetation	60%	
P2	5%	Boulder	2.5%			
P1	5%					
Habitat Suitability[1]		**Compaction**	50%	**Bank**	LUB	RUB
Spawning	1	**Embededdness**	100%	Height	1.5 m	1.5 m
Rearing	2			Stability	85%	90%
Adult feeding	1	**Stage**	H	Texture A	Si	Si
Overwintering	0	**Water Temperature**	12°C	Texture B	OM	OM
Migration	4	**Water Colour**	turbid	Cover	100%	100%

Comments
- low gradient
- potential for fish migration
- unable to electrofish because sinking in mud
- wide deep channel
- very muddy bottom

Date	29-Aug	**Survey Length**	100 m
Stream Name	Unnamed	**Gradient**	<1%
Site	PRC-13	**Mean Channel Width**	2 m
Crew	JDT, CT	**Mean Depth**	0.5 m
		Mean Max. Pool Depth	1.6 m
		Mean Max. Riffle Depth	0.35 m

Instream Habitat[1]		**Substrate**		**Total Cover**	**75%**	
P1	40%	Organic matter	10%	Pool	40%	
R2	15%	Silt	65%	Boulder	10%	
R3	30%	Small Gravel	10%	Cutbank	5%	
Rf	10%	Cobble	5%	Macrophytes/Vegetation	40%	
P2	5%	Boulder	10%	Overhanging vegetation	5%	
Habitat Suitability[1]		**Compaction**	30%	**Bank**	LUB	RUB
Spawning	0	**Embededdness**	40%	Height	1.2 m	1.8 m
Rearing	2			Stability	90%	90%
Adult feeding	0	**Stage**	L	Texture A	Si	Si
Overwintering	0	**Water Temperature**	6.5°C	Texture B	OM	OM
Migration	1	**Water Colour**	turbid	Cover	100%	100%

Comments
- series of pools connected by runs and riffles
- caught 3 young-of-the-year ninespine stickleback
- lots of macrophytes/submerged vegetation and periphyton

Note: See Appendix 10.3-2a for legend

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APPENDIX 10.3-2g
HABITAT ASSESSMENT RESULTS FOR PERMANENT ROAD CROSSING 14, HOPE BAY BELT, 2000

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Appendix 10.3-2g
Habitat Assessment Results for Permanent Road Crossing 14, Hope Bay Belt, 2000

Date	25-Jun			**Survey Length**	300 m	
Stream Name	Unnamed			**Gradient**	2%	
Site	PRC-14			**Mean Channel Width**	2.2 m	
Crew	JDT, SM			**Mean Depth**	0.35 m	
				Mean Max. Pool Depth	1.5 m	
				Mean Max. Riffle Depth	-	
Instream Habitat[1]		**Substrate**		**Total Cover**	**20%**	
Rf	35%	Organic matter	80%	Pool	85%	
R3	35%	Silt	20%	Cutbank	10%	
R2	10%			Overhanging vegetation	5%	
P3	15%					
P2	5%					
Habitat Suitability[1]		**Compaction**	10%	**Bank**	LUB	RUB
Spawning	0	**Embededdness**	60%	Height	0.25 m	0.5 m
Rearing	1			Stability	50%	50%
Adult feeding	0	**Stage**	H	Texture A	OM	OM
Overwintering	0	**Water Temperature**	7°C	Texture B	Si	Si
Migration	3	**Water Colour**	turbid	Cover	65%	60%

Comments
- series of Rf, R3, P2
- little habitat, short term or persistent
- water appears to have been much higher
- vegetation in channel suggests it dries up

Date	29-Aug			**Survey Length**	350 m	
Stream Name	Unnamed			**Gradient**	-	
Site	PRC-14			**Mean Channel Width**	2.5 m	
Crew	JDT, CT			**Mean Depth**	0.45 m	
				Mean Max. Pool Depth	1.3 m	
				Mean Max. Riffle Depth	0.05 m	
Instream Habitat[1]		**Substrate**		**Total Cover**	**40%**	
P1	20%	Organic matter	45%	Pool	80%	
P2	30%	Silt	45%	Cutbank	5%	
P3	40%	Boulder	10%	Macrophytes/Vegetation	10%	
Rf	10%			Overhanging vegetation	5%	
Habitat Suitability[1]		**Compaction**	-	**Bank**	LUB	RUB
Spawning	0	**Embededdness**	-	Height	-	-
Rearing	1			Stability	-	-
Adult feeding	0	**Stage**	L	Texture A	-	-
Overwintering	0	**Water Temperature**	-	Texture B	-	-
Migration	0	**Water Colour**	-	Cover	-	-

Comments
- series of pools
- channel width < 2 l/s
- very shallow riffles connecting pools
- did not electrofish
- aerial survey

Note: See Appendix 10.3-2a for legend

APPENDIX 10.3-2h
HABITAT ASSESSMENT RESULTS FOR PERMANENT ROAD CROSSING 15, HOPE BAY BELT, 2000

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Appendix 10.3-2h
Habitat Assessment Results for the Permanent Road Crossing 15, Hope Bay Belt, 2000

Date	26-Jun	**Survey Length**	-
Stream Name	Unnamed	**Gradient**	<1%
Site	PRC-15	**Mean Channel Width**	3 m
Crew	JDT, SM	**Mean Depth**	-
		Mean Max. Pool Depth	1.5 m
		Mean Max. Riffle Depth	0.65 m

Instream Habitat[1]		**Substrate**		**Total Cover**	**45%**	
R1	15%	Organic matter	85%	Pool	80%	
R2	40%	Silt	5%	Cutbank	20%	
P1	20%	Sand	5%			
Rf	25%	Boulder	5%			
Habitat Suitability[1]		**Compaction**	-	**Bank**	LUB	RUB
Spawning	1	**Embededdness**	-	Height	0.5 m	0.5 m
Rearing	2			Stability	100%	100%
Adult feeding	1	**Stage**	H	Texture A	OM	OM
Overwintering	0	**Water Temperature**	-	Texture B	Si	Si
Migration	4	**Water Colour**	clear tea	Cover	100%	100%

Comments
- series of pools connected by runs or deep riffles
- channel deeply cut into permafrost - narrow
- sedges and willows lining banks

Date	29-Aug	**Survey Length**	175 m
Stream Name	Unnamed	**Gradient**	<1%
Site	PRC-15	**Mean Channel Width**	1 m
Crew	JDT, CT	**Mean Depth**	0.8 m
		Mean Max. Pool Depth	2 m
		Mean Max. Riffle Depth	0.45 m

Instream Habitat[1]		**Substrate**				
P1	20%	Org. matt.	65%	**Total Cover**	**70%**	
P2	15%	Silt	25%	Pool	35%	
R2	10%	Sand	5%	Cutbank	10%	
R3	5%	Large Gravel	5%	Macrophytes/Vegetation	50%	
Rf	5%			Overhanging vegetation	5%	
F1	25%					
F2	20%					
Habitat Suitability[1]		**Compaction**	-	**Bank**	LUB	RUB
Spawning	0	**Embededdness**	-	Height	0.75 m	0.75 m
Rearing	1			Stability	80%	80%
Adult feeding	0	**Stage**	L	Texture A	OM	OM
Overwintering	0	**Water Temperature**	6^{o}C	Texture B	Sa	Sa
Migration	3	**Water Colour**	-	Cover	100%	100%

Comments
- very deep pools connected by deep narrow channels cut in tundra
- lots of macrophytes/submerged vegetation and periphyton
- flow barely perceptable

Note: See Appendix 10.3-2a for legend

APPENDIX 10.3-2i
HABITAT ASSESSMENT RESULTS FOR NE INFLOW OF AIMAOKTAK LAKE, HOPE BAY BELT, 2000

Appendix 10.3-2i
Habitat Assessment Results for the NE Inflow of Aimaoktak Lake, Hope Bay Belt, 2000

Date	26-Jun	**Survey Length**	750 m
Stream Name	NE Inflow	**Gradient**	2%
Site	PRC	**Mean Channel Width**	20 m
Crew	JDT, SM	**Mean Depth**	-
		Mean Max. Pool Depth	-
		Mean Max. Riffle Depth	-

Instream Habitat[1]		**Substrate**		**Total Cover**	**70%**
Ch	5%	Sand	5%	Pool	15%
P1	5%	Cobble	15%	Boulder	85%
R1	15%	Boulder	65%		
Rf	15%	Bedrock	15%		
Ra	55%				
F1	5%				

Habitat Suitability[1]				**Bank**	LUB	RUB
Spawning	4	**Compaction**	-	Height	1 m	1 m
Rearing	4	**Embededdness**	-	Stability	100%	100%
Adult feeding	4	**Stage**	H	Texture A	Bo	Bo
Overwintering	1	**Water Temperature**	-	Texture B	Sa	Sa
Migration	4	**Water Colour**	clear tea	Cover	100%	100%

Comments
- higher gradient series of rapids beginning a large pool
- pair of chutes
- stream is good, especially for Arctic grayling
- road should bridge at chutes

Note: See Appendix 10.3-2a for legend

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APPENDIX 12.1-1
SAMPLE DESCRIPTIONS FOR ARD CHARACTERIZATION, HOPE BAY BELT, 2000

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Appendix 12.1-1
Sample Descriptions for ARD Characterization, Hope Bay Belt, 2000

Drill Hole (UTM)	Interval (m)	Unit[1]	Sample ID	Label
Boston Property				
BUG330 (12290N)	22.80-23.30	Altered basalt	Boston #1	Boston
	8.60-9.40	Altered basalt	Boston #2	Boston
BUG316 (12340N)	14.75-15.25	Altered basalt	Boston #3	Boston
	22.80-23.45	Altered basalt	Boston #4	Boston
BUG293 (12520N)	29.90-30.55	Altered basalt	Boston #5	Boston
BUG371 (12560N)	24.70-25.45	Altered basalt	Boston #6	Boston
Doris Lake Property				
TDD 259 (15250 N)	133.35-134.41	Q2 (may need pulp)	DOP #1	DO-Q
TDD 210 (15325 N)	47.00-48.00	Q1 (pulp from 7692)	DOP #2	DO-Q
TDD 260 (15250 N)	99.75-100.71	Q2 (pulp from 5085)	DOP #3	DO-Q
TDD 260 (15250 N)	95.42-96.04	Q1	DOP #4	DO-Q
TDD 213 (15350 N)	49.42-49.82	H	DOP #5	DO-MV
TDD 223	104.93-105.23	H	DOP #6	DO-MV
TDD 258 (15250 N)	11.28-11.77	Q2	DOP #7	DO-Q
TDD 258 (15250 N)	20.42-20.94	D2	DOP #8	DO-MV
TDD 203 (15275 N)	103.76-104.45	Q1 (pulp from 5820)	DOP #9	DO-Q
TDD 203 (15275 N)	108.81-109.40	Q2	DOP #10	DO-Q
TDD 203 (15275 N)	118.29-118.67	D2 (with veining)	DOP #11	DO-MV
TDD 275 (15175 N)	54.60-54.88	D2	DOP #12	DO-MV
TDD 275 (15175 N)	64.81-65.13	H	DOP #13	DO-MV
TDD 212 (15350 N)	79.08-79.85	Q2 (pulp from 6007)	DOP #14	DO-Q
TDD 212 (15350 N)	108.81-109.25	D2 (with veining)	DOP #15	DO-MV
TDD 229	102.20-102.70	D2	DOP #16	DO-MV
TDD 209 (15300 N)	31.62-33.00	Q2 (pulp from 7445)	DOP #17	DO-Q
TDD 233 (15250 N)	124.97-126.06	D2 (pulp from 8620)	DOP #18	DO-MV
TDD 236 (15250 N)	37.00-37.47	D2	DOP #19	DO-MV
TDD 236 (15250 N)	86.00-86.85	Q1 (pulp from 8486)	DOP #20	DO-Q
TDD 236 (15250 N)	82.00-83.00	Q2 (pulp from 8482)	DOP #21	DO-Q
TDD 277 (15150 N)	61.58-61.90	H	DOP #22	DO-MV
TDD 277 (15150 N)	78.84-79.65	Q2 (pulp from 7901)	DOP #23	DO-Q
TDD 277 (15150 N)	79.65-81.04	Q1 (pulp from 7902 and 7903)	DOP #24	DO-Q
TDD 222 (15325 N)	53.00-54.00	Q1 (pulp from 7627)	DOP #25	DO-Q
TDD 222 (15325 N)	55.00-55.82	Q2 (pulp from 7629)	DOP #26	DO-Q
TDD 230	33.44-33.84	UB	DOUB #1	DO-UB
TDD 367 (13775N)	180.25-181.10	G (pulp from 6244)	DUG #1	DU-G
TDD 390A (13775 N)	241.33-241.70	G	DUG #2	DU-G
TDD 380 (13775 N)	282.86-283.05	G	DUG #3	DU-G
TDD 384 (13675 N)	222.48-222.82	G	DUG #4	DU-G
TDD 375A (13650 N)	255.56-255.84	G	DUG #5	DU-G
TDD 383 (13875 N)	199.32-199.69	G	DUG #6	DU-G
TDD 387 (13725 N)	224.79-225.06	G	DUG #7	DU-G
TDD 363 (13850 N)	213.42-213.67	G	DUG #8	DU-G

Appendix 12.1-1
Sample Descriptions for ARD Characterization, Hope Bay Belt, 2000 (continued)

Drill Hole (UTM)	Interval (m)	Unit[1]	Sample ID	Label
Doris Lake Property (cont'd)				
TDD 393 (13900 N)	172.00-173.00	D1	DUMV #1	DU-MV
TDD 367 (13775 N)	151.49-152.03	D2	DUMV #2	DU-MV
TDD 367 (13775 N)	?-166.73	D1 (pulp from 6231)	DUMV #3	DU-MV
TDD 390A (13775 N)	235.00-236.00	D1 (pulp from 9785)	DUMV #4	DU-MV
TDD 390A (13775 N)	169.88-170.66	D2 (with possible veining)	DUMV #5	DU-MV
TDD 380 (13775 N)	279.49-279.81	H	DUMV #6	DU-MV
TDD 384 (13675 N)	204.12-204.45	D1	DUMV #7	DU-MV
TDD 384 (13675 N)	198.22-198.61	D2	DUMV #8	DU-MV
TDD 370 (13700 N)	216.37-216.93	D1	DUMV #9	DU-MV
TDD 375A (13650 N)	231.90-232.21	D1	DUMV #10	DU-MV
TDD 375A (13650 N)	226.37-226.81	D2 (with veining)	DUMV #11	DU-MV
TDD 392 (13825 N)	216.68-217.36	D1	DUMV #12	DU-MV
TDD 385 (13800 N)	211.48-211.95	D1	DUMV #13	DU-MV
TDD 385 (13800 N)	247.75-248.15	D2	DUMV #14	DU-MV
TDD 382 (13800 N)	235.86-236.47	D1	DUMV #15	DU-MV
TDD 383 (13875 N)	180.82-181.05	D1	DUMV #16	DU-MV
TDD 383 (13875 N)	151.71-151.98	D2	DUMV #17	DU-MV
TDD 387 (13725 N)	64.86-65.26	H	DUMV #18	DU-MV
TDD 387 (13725 N)	205.92-206.35	D1	DUMV #19	DU-MV
TDD 387 (13725 N)	207.21-207.62	D2 (with veining)	DUMV #20	DU-MV
TDD 373 (13600 N)	182.82-183.17	D2	DUMV #21	DU-MV
TDD 373 (13600 N)	180.90-181.91	D1 (pulp from 6776)	DUMV #22	DU-MV
TDD 372 (13675 N)	170.17-170.62	D2	DUMV #23	DU-MV
TDD 372 (13675 N)	173.31-173.57	D1	DUMV #24	DU-MV
TDD 389 (13775 N)	174.00-175.00	D2 (pulp from 9700)	DUMV #25	DU-MV
TDD 388A (13725 N)	257.17-257.72	D2	DUMV #26	DU-MV
TDD 375 (13625 N)	202.00-203.00	Q1	DUQ #1	DU-Q
TDD 399 (13650 N)	243.78-244.55	Q2	DUQ #2	DU-Q
TDD 393 (13900 N)	165.17-166.00	Q1 (pulp from 8372)	DUQ #3	DU-Q
TDD 380 (13775 N)	258.84-259.47	Q2	DUQ #4	DU-Q
TDD 380 (13775 N)	254.48-255.33	Q1 (pulp from 7070)	DUQ #5	DU-Q
TDD 392 (13825 N)	212.45-212.70	Q2	DUQ #6	DU-Q
TDD 392 (13825 N)	215.98-216.68	Q1 (pulp from 9359)	DUQ #7	DU-Q
TDD 385 (13800 N)	237.87-238.48	Q1	DUQ #8	DU-Q
TDD 385 (13800 N)	238.88-239.88	Q2 (pulp from 7503)	DUQ #9	DU-Q
TDD 382 (13800 N)	255.12-255.72	Q2	DUQ #10	DU-Q
TDD 370 (13700 N)	239.88-240.79	Q1 (pulp from 5885)	DUQ #11	DU-Q
TDD 368 (13775 N)	167.00-168.08	Q2 (pulp from 6624)	DUQ #12	DU-Q
TDD 368 (13775 N)	173.00-174.03	Q1 (pulp from 6633)	DUQ #13	DU-Q
TDD 383 (13875 N)	162.80-163.19	Q1	DUQ #14	DU-Q
TDD 383 (13875 N)	153.20-153.72	Q2	DUQ #15	DU-Q
TDD 387 (13725 N)	198.48-199.23	Q1 (pulp from 9634)	DUQ #16	DU-Q

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Appendix 12.1-1
Sample Descriptions for ARD Characterization, Hope Bay Belt, 2000 (completed)

Drill Hole (UTM)	Interval (m)	Unit[1]	Sample ID	Label
Doris Lake Property (cont'd)				
TDD 387 (13725 N)	196.65-197.00	Q2 (pulp from 9630)	DUQ #17	DU-Q
TDD 388A (13725 N)	290.25-291.02	Q1 (pulp from 9737)	DUQ #18	DU-Q
TDD 388A (13725 N)	273.01-273.66	Q2 (pulp from 9713)	DUQ #19	DU-Q
TDD 363 (13850 N)	178.92-179.20	Q2 (pulp from 6197)	DUQ #20	DU-Q
Proposed Port Site				
431275 E 7565375 N	coarse grained up to amphibolite; locally up to 1% pyrite as sub-centimetre clots with trace calcite and quartz veinlets		P1-1	Port
	Massive mafic volcanic; hematite+calcite on fractures and up to 1% quartz+calcite locally		P1-2	Port
Potential Quarry Sites				
443549 E 7510049 N	Basalt flow to pillowed with local gabbro bodies. Trace calcite with no visible sulphides		Q1-1	Quarry
	As above with very trace sulphides in weak calcite veinlets		Q1-2	Quarry
	Dark green pillow basalt with calcite flooding/ veining at selvedges. Approx. 0.5% sulphides in calcite veinlets		Q1-3	Quarry
441013 E 7510771 N	Unaltered basalt with trace quartz+calcite on fracture surfaces		Q2-1	Quarry
	Moderately sheared basalt with chlorite/calcite alteration		Q2-2	Quarry
	Unaltered Mg-gabbro, marginally representative of m-scale (metre-scale ??) gabbro pods in basalt		Q2-3	Quarry
438902 E	Mg-basalt flow with trace calcite and no visible sulphides		Q3-1	Quarry
7516891 N	Pale green pillow basalt. 2x10m shear at base of outcrop on west side with trace calcite		Q3-2	Quarry
	pale green pillow basalt with weak pervasive calcite and calcite around selvedges		Q3-3	Quarry
435577 E 7532568 N	Lapilli tuff rhyolite, strong to moderate sericite alteration between fragments		Q4-1	Quarry
	As for Q4-1 above		Q4-2	Quarry
	Across from site marked "road" next to creek. Very small volume. As for Q4-1 above, but felsic with quartz veinlets		Q4-3	Quarry
	Felsic volcanics as above with rare quartz veinlets, local iron oxidation on fracture planes and rare visible sulphides		Q4-4	Quarry
434315 E 7541218 N	Moderately shear felsic volcanic with possible dacite, trace calcite and trace sulphides		Q5-1	Quarry
	Basalt flow/pillow calcite-filled fractures and selvedges near felsic contact		Q5-2	Quarry
	Basalt away from felsic contact, trace calcite on fracture surfaces		Q5-3	Quarry
433613 E 7550930 N	Madrid cliffs; dark green basalt to gabbro with weak chlorite+calcite		Q6-1	Quarry
	As above, but 25 m east and halfway down cliff. Trace to 1% sulphides with calcite in fractures and selvedges		Q6-2	Quarry
	Base of cliff; dark green basalt with 1 to 3% pyrite in calcite flooding		Q6-3	Quarry

1: D1: mafic volcanic; strong dolomite/sericite alteration, <1% disseminated pyrite
D2: mafic volcanic; strong dolomite/sericite alteration, 1-2% disseminated pyrite
G: gabbro
H: mafic volcanic; hematite staining, trace -1% magnetite
Q1: quartz; >1% pyrite
Q2: quartz; rare -1% pyrite
UB: unaltered basalt

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APPENDIX 12.2-1
ANALYTICAL RESULTS OF STATIC TESTWORK, HOPE BAY BELT, 2000

Appendix 12.2-1
Analytical Results of Static Testwork, Hope Bay Belt, 2000

Sample No.	Paste pH	CO2 Inorg. (Wt.%)	Carbonate NP (Kg CaCO3/Tonne)	Total Sulphur (Wt.%)	Sulphate Sulphur[1] (Wt.%)	Sulphide Sulphur[2] (Wt.%)	Maximum Potential Acidity[3] (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	Neutralization Potential Ratio (NP/AP)
Boston	9.3	19.60	444.9	0.10	***0.01***	0.10	3.1	419.8	416.7	134.3
Boston	9.3	17.42	395.4	0.05	***0.01***	0.05	1.6	358.4	356.8	229.4
Boston	9.0	16.99	385.7	0.05	***0.01***	0.05	1.6	374.7	373.1	239.8
Boston	9.6	17.69	401.6	0.04	***0.01***	0.04	1.3	369.7	368.5	295.8
Boston	9.1	22.57	512.3	0.32	***0.01***	0.32	10.0	452.4	442.4	45.2
Boston	9.2	16.50	374.6	0.05	***0.01***	0.05	1.6	367.2	365.6	235.0
Maximum	**9.60**	**22.57**	**512.34**	**0.32**	**0.01**	**0.32**	**10.0**	**452.4**	**442.4**	**295.8**
Minimum	**9.00**	**16.50**	**374.55**	**0.04**	**0.01**	**0.04**	**1.3**	**358.4**	**356.8**	**45.2**
Average	**9.25**	**18.46**	**419.08**	**0.10**	**0.01**	**0.10**	**3.2**	**390.4**	**387.2**	**196.6**
Std Dev	**0.21**	**2.27**	**51.63**	**0.11**	**0.00**	**0.11**	**3.4**	**37.3**	**34.2**	**90.6**
Std Error	**0.08**	**0.93**	**21.08**	**0.04**	**0.00**	**0.04**	**1.4**	**15.2**	**14.0**	**37.0**
DOP-MV	8.7	3.76	85.4	0.21	***0.01***	0.21	6.6	137.8	131.2	21.0
DOP-MV	8.9	6.1	138.5	***0.02***	***0.01***	***0.02***	0.6	172.9	172.3	288.2
DOP-MV	9.3	14.68	333.2	0.80	***0.01***	0.80	25.0	280.7	255.7	11.2
DOP-MV	9.1	14.95	339.4	1.35	***0.01***	1.35	42.2	308.3	266.1	7.3
DOP-MV	9.4	16.99	385.7	1.68	***0.01***	1.68	52.5	337.1	284.6	6.4
DOP-MV	9.0	6.96	158.0	0.09	***0.01***	0.09	2.8	195.5	192.7	69.5
DOP-MV	9.0	16.37	371.6	0.78	***0.01***	0.78	24.4	307.0	282.6	12.6
DOP-MV	9.3	13.60	308.7	1.17	***0.01***	1.17	36.6	358.4	321.8	9.8
DOP-MV	9.4	18.02	409.1	0.33	***0.01***	0.33	10.3	364.7	354.4	35.4
DOP-MV	9.1	6.17	140.1	0.13	***0.01***	0.13	4.1	171.7	167.6	42.3
Maximum	**9.40**	**18.02**	**409.05**	**1.68**	**0.01**	**1.68**	**52.50**	**364.70**	**354.39**	**288.17**
Minimum	**8.70**	**3.76**	**85.35**	**0.02**	**0.01**	**0.02**	**0.60**	**137.80**	**131.24**	**6.42**
Average	**9.12**	**11.76**	**266.95**	**0.66**	**0.01**	**0.66**	**20.50**	**263.41**	**242.91**	**50.37**
Std Dev	**0.23**	**5.38**	**122.06**	**0.59**	**0.00**	**0.59**	**18.45**	**85.58**	**73.27**	**85.93**
Std Error	**0.07**	**1.70**	**38.60**	**0.19**	**0.00**	**0.19**	**5.84**	**27.06**	**23.17**	**27.17**

1: Numbers in bold italics represent values that were below the analytical detection limit. For the purposes of calculating statistics, the detection limit was used as the value.

2: Sulphide sulphur is calculated as the difference between total sulphur and sulphate sulphur.

3: MPA = suphide sulphur x 31.25.

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Appendix 12.2-1
Analytical Results of Static Testwork, Hope Bay Belt, 2000

Sample No.	Paste pH	CO2 Inorg. (Wt.%)	Carbonate NP (Kg CaCO3/Tonne)	Total Sulphur (Wt.%)	Sulphate Sulphur[1] (Wt.%)	Sulphide Sulphur[2] (Wt.%)	Maximum Potential Acidity[3] (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	Neutralization Potential Ratio (NP/AP)
DOP-Q	8.3	0.23	5.2	***0.02***	***0.01***	***0.02***	0.6	6.0	5.4	10.0
DOP-Q	8.3	1.32	30.0	1.40	***0.01***	1.40	43.8	22.3	-21.5	0.5
DOP-Q	8.3	0.42	9.5	0.09	***0.01***	0.09	2.8	8.0	5.2	2.8
DOP-Q	8.0	0.66	15.0	***0.02***	***0.01***	***0.02***	0.6	12.5	11.9	20.8
DOP-Q	8.4	***0.05***	***1.1***	***0.02***	***0.01***	***0.02***	0.6	2.7	2.1	4.5
DOP-Q	8.3	0.42	9.5	0.43	***0.01***	0.43	13.4	12.3	-1.1	0.9
DOP-Q	8.5	0.89	20.2	0.08	***0.01***	0.08	2.5	18.0	15.5	7.2
DOP-Q	8.4	0.24	5.4	0.07	***0.01***	0.07	2.2	5.0	2.8	2.3
DOP-Q	8.0	***0.05***	***1.1***	***0.02***	***0.01***	***0.02***	0.6	1.3	0.7	2.2
DOP-Q	8.7	1.32	30.0	0.63	***0.01***	0.63	19.7	24.1	4.4	1.2
DOP-Q	8.4	0.1	2.3	0.08	***0.01***	0.08	2.5	2.5	0.0	1.0
DOP-Q	8.3	0.52	11.8	0.02	***0.01***	0.02	0.6	12.3	11.7	19.7
DOP-Q	8.1	0.66	15.0	2.38	***0.01***	2.38	74.4	14.5	-59.9	0.2
DOP-Q	8.3	1.81	41.1	2.98	0.01	2.97	92.8	36.3	-56.5	0.4
DOP-Q	8.2	0.31	7.0	0.38	***0.01***	0.38	11.9	5.0	-6.9	0.4
DOP-Q	8.10	0.17	3.9	***0.02***	***0.01***	***0.02***	0.6	4.3	3.7	7.2
Maximum	**8.70**	**1.81**	**41.09**	**2.98**	**0.01**	**2.97**	**92.81**	**36.30**	**15.50**	**20.83**
Minimum	**8.00**	**0.05**	**1.10**	**0.02**	**0.01**	**0.02**	**0.60**	**1.30**	**-59.88**	**0.19**
Average	**8.29**	**0.57**	**13.80**	**0.54**	**0.01**	**0.54**	**16.85**	**11.69**	**-5.15**	**5.08**
Std Dev	**0.18**	**0.52**	**11.75**	**0.92**	**0.00**	**0.91**	**28.58**	**9.61**	**22.33**	**6.60**
Std Error	**0.05**	**0.13**	**3.03**	**0.23**	**0.00**	**0.23**	**7.15**	**2.40**	**5.58**	**1.65**
DOUB	8.7	5.08	115.3	0.11	***0.01***	0.11	3.4	162.9	159.5	47.4
DUG	9.0	3.53	80.1	0.06	***0.01***	0.06	1.9	117.8	115.9	62.8
DUG	9.3	11.12	252.4	0.11	***0.01***	0.11	3.4	225.6	222.2	65.6
DUG	9.1	0.79	17.9	0.03	***0.01***	0.03	0.9	26.7	25.8	28.5
DUG	9.1	1.35	30.6	0.08	***0.01***	0.08	2.5	42.1	39.6	16.8
DUG	8.3	5.71	129.6	1.85	***0.01***	1.85	57.8	77.8	20.0	1.3
DUG	9.0	1.58	35.9	0.10	***0.01***	0.10	3.1	45.9	42.8	14.7
DUG	9.0	2.61	59.2	0.11	***0.01***	0.11	3.4	68.1	64.7	19.8
Maximum	**9.30**	**11.12**	**252.42**	**1.85**	**0.01**	**1.85**	**57.8**	**225.6**	**222.2**	**65.6**
Minimum	**8.30**	**0.79**	**17.93**	**0.03**	**0.01**	**0.03**	**0.9**	**26.7**	**20.0**	**1.3**
Average	**8.97**	**3.81**	**86.55**	**0.33**	**0.01**	**0.33**	**10.4**	**86.3**	**75.8**	**29.9**
Std Dev	**0.31**	**3.62**	**82.22**	**0.67**	**0.00**	**0.67**	**20.9**	**68.2**	**72.1**	**24.8**
Std Error	**0.12**	**1.37**	**31.08**	**0.25**	**0.00**	**0.25**	**7.9**	**25.8**	**27.2**	**9.4**

1: Numbers in bold italics represent values that were below the analytical detection limit. For the purposes of calculating statistics, the detection limit was used as the value.

2: Sulphide sulphur is calculated as the difference between total sulphur and sulphate sulphur.

3: MPA = suphide sulphur x 31.25.

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Appendix 12.2-1
Analytical Results of Static Testwork, Hope Bay Belt, 2000

Sample No.	Paste pH	CO2 Inorg. (Wt.%)	Carbonate NP (Kg CaCO3/Tonne)	Total Sulphur (Wt.%)	Sulphate Sulphur[1] (Wt.%)	Sulphide Sulphur[2] (Wt.%)	Maximum Potential Acidity[3] (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	Neutralization Potential Ratio (NP/AP)
DUMV	9.4	14.49	328.9	0.16	***0.01***	0.16	5.0	266.9	261.9	53.4
DUMV	9.2	12.18	276.5	1.69	***0.01***	1.69	52.8	243.1	190.3	4.6
DUMV	8.9	11.62	263.8	6.57	0.03	6.54	204.4	229.3	24.9	1.1
DUMV	9.1	0.86	19.5	0.17	***0.01***	0.17	5.3	28.2	22.9	5.3
DUMV	8.7	15.31	347.5	0.23	***0.01***	0.23	7.2	297.0	289.8	41.3
DUMV	8.9	14.07	319.4	6.09	***0.01***	6.09	190.3	249.4	59.1	1.3
DUMV	9.2	15.65	355.3	0.14	***0.01***	0.14	4.4	273.2	268.8	62.4
DUMV	9.4	16.23	368.4	0.04	***0.01***	0.04	1.3	264.4	263.2	211.5
DUMV	9.2	15.95	362.1	1.05	***0.01***	1.05	32.8	278.2	245.4	8.5
DUMV	9.3	16.33	370.7	0.20	***0.01***	0.20	6.3	238.1	231.9	38.1
DUMV	9.2	14.91	338.5	0.09	***0.01***	0.09	2.8	234.3	231.5	83.3
DUMV	8.9	16.63	377.5	1.64	***0.01***	1.64	51.3	280.7	229.5	5.5
DUMV	8.9	14.40	326.9	0.35	***0.01***	0.35	10.9	213.0	202.1	19.5
DUMV	8.7	12.31	279.4	0.08	***0.01***	0.08	2.5	242.5	240.0	97.0
DUMV	8.6	12.62	286.5	4.50	***0.01***	4.50	140.6	243.8	103.2	1.7
DUMV	9.2	1.01	22.9	0.13	***0.01***	0.13	4.1	76.3	72.2	18.8
DUMV	8.9	16.02	363.7	0.06	***0.01***	0.06	1.9	293.8	291.9	156.7
DUMV	8.7	15.82	359.1	2.20	***0.01***	2.20	68.8	256.3	187.6	3.7
DUMV	8.8	15.55	353.0	3.79	***0.01***	3.79	118.4	223.8	105.4	1.9
DUMV	8.6	13.05	296.2	3.35	***0.01***	3.35	104.7	241.3	136.6	2.3
DUMV	8.8	15.21	345.3	0.20	***0.01***	0.20	6.3	230.0	223.8	36.8
DUMV	8.9	12.38	281.0	2.75	***0.01***	2.75	85.9	211.3	125.4	2.5
Maximum	**9.40**	**16.63**	**377.50**	**6.57**	**0.03**	**6.54**	**204.4**	**297.0**	**291.9**	**211.5**
Minimum	**8.60**	**0.86**	**19.52**	**0.04**	**0.01**	**0.04**	**1.3**	**28.2**	**22.9**	**1.1**
Average	**8.98**	**13.30**	**301.91**	**1.61**	**0.01**	**1.61**	**50.4**	**232.5**	**182.1**	**39.0**
Std Dev	**0.25**	**4.29**	**97.31**	**2.05**	**0.00**	**2.05**	**64.0**	**63.5**	**86.1**	**55.4**
Std Error	**0.05**	**0.91**	**20.75**	**0.44**	**0.00**	**0.44**	**13.6**	**13.5**	**18.3**	**11.8**

1: Numbers in bold italics represent values that were below the analytical detection limit. For the purposes of calculating statistics, the detection limit was used as the value.

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Appendix 12.2-1
Analytical Results of Static Testwork, Hope Bay Belt, 2000

Sample No.	Paste pH	CO2 Inorg. (Wt.%)	Carbonate NP (Kg CaCO3/Tonne)	Total Sulphur (Wt.%)	Sulphate Sulphur[1] (Wt.%)	Sulphide Sulphur[2] (Wt.%)	Maximum Potential Acidity[3] (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	Neutralization Potential Ratio (NP/AP)
DUQ	8.8	4.08	92.6	1.87	***0.01***	1.87	58.4	68.3	9.9	1.2
DUQ	8.6	0.67	15.2	0.12	***0.01***	0.12	3.8	13.0	9.3	3.5
DUQ	8.2	0.21	362.1	0.03	***0.01***	0.03	0.9	3.5	2.6	3.7
DUQ	7.9	0.10	2.3	0.02	***0.01***	0.02	0.6	3.5	2.9	5.6
DUQ	8.5	9.54	338.5	4.54	0.01	4.53	141.6	199.2	57.6	1.4
DUQ	8.5	0.10	2.3	***0.02***	***0.01***	***0.02***	***0.6***	2.2	1.6	3.7
DUQ	8.5	3.24	326.9	1.60	***0.01***	1.60	50.0	62.7	12.7	1.3
DUQ	8.7	4.62	104.9	2.28	***0.01***	2.28	71.3	84.0	12.8	1.2
DUQ	8.2	0.24	286.5	0.04	***0.01***	0.04	1.3	4.8	3.6	3.8
DUQ	8.3	0.30	6.8	0.07	***0.01***	0.07	2.2	6.0	3.8	2.7
DUQ	8.3	2.16	363.7	2.20	0.01	2.19	68.4	42.6	-25.8	0.6
DUQ	8.2	0.07	359.1	***0.02***	***0.01***	***0.02***	***0.6***	2.5	1.9	4.2
DUQ	8.4	5.12	353.0	1.14	***0.01***	1.14	35.6	102.8	67.2	2.9
DUQ	8.3	1.05	23.8	0.95	***0.01***	0.95	29.7	21.2	-8.5	0.7
DUQ	8.3	0.88	20.0	0.08	***0.01***	0.08	2.5	16.7	14.2	6.7
DUQ	8.7	3.34	281.0	2.35	***0.01***	2.35	73.4	61.4	-12.0	0.8
DUQ	8.4	0.52	377.5	0.16	***0.01***	0.16	5.0	8.8	3.8	1.8
DUQ	8.0	4.25	19.5	6.02	0.03	5.99	187.2	89.0	-98.2	0.5
DUQ	8.4	0.17	301.9	0.03	***0.01***	0.03	0.9	4.3	3.4	4.6
DUQ	8.4	0.56	97.3	0.14	***0.01***	0.14	4.4	10.3	5.9	2.4
Maximum	**8.80**	**9.54**	**377.50**	**6.02**	**0.03**	**5.99**	**187.2**	**199.2**	**67.2**	**6.7**
Minimum	**7.90**	**0.07**	**2.27**	**0.02**	**0.01**	**0.02**	**0.6**	**2.2**	**-98.2**	**0.5**
Average	**8.38**	**2.06**	**186.74**	**1.18**	**0.01**	**1.18**	**36.9**	**40.3**	**3.4**	**2.7**
Std Dev	**0.23**	**2.49**	**156.65**	**1.67**	**0.00**	**1.66**	**51.9**	**50.3**	**31.6**	**1.8**
Std Error	**0.05**	**0.56**	**35.03**	**0.37**	**0.00**	**0.37**	**11.6**	**11.2**	**7.1**	**0.4**
Port	9.1	0.57	12.9	0.08	***0.01***	0.08	2.5	32.7	30.2	13.1
Port	9.4	1.15	26.1	***0.02***	***0.01***	***0.02***	***0.6***	39.9	39.3	66.5
Maximum	**9.40**	**1.15**	**26.11**	**0.08**	**0.01**	**0.08**	**2.5**	**39.9**	**39.3**	**66.5**
Minimum	**9.10**	**0.57**	**12.94**	**0.02**	**0.01**	**0.02**	**0.6**	**32.7**	**30.2**	**13.1**
Average	**9.25**	**0.86**	**19.52**	**0.05**	**0.01**	**0.05**	**1.6**	**36.3**	**34.8**	**39.8**
Std Dev	**0.21**	**0.41**	**9.31**	**0.04**	**0.00**	**0.04**	**1.3**	**5.1**	**6.4**	**37.8**
Std Error	**0.15**	**0.29**	**6.58**	**0.03**	**0.00**	**0.03**	**1.0**	**3.6**	**4.5**	**26.7**

1: Numbers in bold italics represent values that were below the analytical detection limit. For the purposes of calculating statistics, the detection limit was used as the value.

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3: MPA = suphide sulphur x 31.25.

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Sample No.	Paste pH	CO2 Inorg. (Wt.%)	Carbonate NP (Kg CaCO3/Tonne)	Total Sulphur (Wt.%)	Sulphate Sulphur[1] (Wt.%)	Sulphide Sulphur[2] (Wt.%)	Maximum Potential Acidity[3] (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	Neutralization Potential Ratio (NP/AP)
Quarry	9.2	2.63	59.7	0.06	***0.01***	0.06	1.9	96.5	94.6	51.5
Quarry	8.9	2.46	55.8	0.06	***0.01***	0.06	1.9	90.2	88.3	48.1
Quarry	9.2	1.65	37.5	0.05	***0.01***	0.05	1.6	68.9	67.3	44.1
Quarry	9.1	5.19	117.8	0.02	***0.01***	0.02	0.6	145.4	144.8	232.6
Quarry	9.2	1.47	33.4	0.12	***0.01***	0.12	3.8	86.5	82.8	23.1
Quarry	9.0	0.10	2.3	***0.02***	***0.01***	***0.02***	***0.6***	9.5	8.9	15.8
Quarry	8.9	0.31	7.0	0.04	***0.01***	0.04	1.3	17.0	15.8	13.6
Quarry	9.0	5.32	120.8	***0.02***	***0.01***	***0.02***	***0.6***	139.1	138.5	231.8
Quarry	8.8	3.31	75.1	0.07	***0.01***	0.07	2.2	112.8	110.6	51.6
Quarry	10.0	0.41	9.3	***0.02***	***0.01***	***0.02***	***0.6***	12.2	11.6	20.3
Quarry	10.0	0.24	5.4	***0.02***	***0.01***	***0.02***	***0.6***	6.5	5.9	10.8
Quarry	10.0	2.15	48.8	0.02	***0.01***	0.02	0.6	43.1	42.5	69.0
Quarry	9.9	1.47	33.4	***0.02***	***0.01***	***0.02***	***0.6***	27.9	27.3	46.5
Quarry	9.9	4.50	102.2	***0.02***	***0.01***	***0.02***	***0.6***	86.5	85.9	144.2
Quarry	8.7	5.93	134.6	0.09	***0.01***	0.09	2.8	146.6	143.8	52.1
Quarry	9.1	1.57	35.6	0.02	***0.01***	0.02	0.6	78.9	78.3	126.2
Quarry	9.4	1.36	30.9	***0.02***	***0.01***	***0.02***	***0.6***	86.5	85.9	144.2
Quarry	9.8	1.13	25.7	0.03	***0.01***	0.03	0.9	49.9	49.0	53.2
Quarry	9.4	5.29	120.1	0.09	***0.01***	0.09	2.8	183.8	181.0	65.4
Maximum	**10.00**	**5.93**	**134.61**	**0.12**	**0.01**	**0.12**	**3.8**	**183.8**	**181.0**	**232.6**
Minimum	**8.70**	**0.10**	**2.27**	**0.02**	**0.01**	**0.02**	**0.6**	**6.5**	**5.9**	**10.8**
Average	**9.34**	**2.45**	**55.54**	**0.04**	**0.01**	**0.04**	**1.3**	**78.3**	**77.0**	**76.0**
Std Dev	**0.45**	**1.92**	**43.60**	**0.03**	**0.00**	**0.03**	**1.0**	**51.9**	**51.5**	**68.1**
Std Error	**0.10**	**0.44**	**10.00**	**0.01**	**0.00**	**0.01**	**0.2**	**11.9**	**11.8**	**15.6**

1: Numbers in bold italics represent values that were below the analytical detection limit. For the purposes of calculating statistics, the detection limit was used as the value.

2: Sulphide sulphur is calculated as the difference between total sulphur and sulphate sulphur.

3: MPA = suphide sulphur x 31.25.

APPENDIX 12.3-1
SAMPLE DESCRIPTIONS FOR KINETIC TESTWORK, HOPE BAY BELT, 2000

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Appendix 12.3-1
Sample Descriptions for Kinetic Testwork, Hope Bay Belt, 2000

Sample ID	Unit	Approx. Mass (kg)	Paste pH	CO2 Inorg. (Wt.%)	Carbonate NP (Kg CaCO3/Tonne)	Total Sulphur (Wt.%)	Sulphate Sulphur (Wt.%)	Sulphide Sulphur* (Wt.%)	Maximum Potential Acidity** (Kg CaCO3/Tonne)	Neutralization Potential (Kg CaCO3/Tonne)	Net Neutralization Potential (Kg CaCO3/Tonne)	Neutralization Potential Ratio (NP/AP)	Fizz Rating
Boston #5	altered basalt	3.5	9.1	22.57	512.3	0.32	<0.01	0.32	10.0	452.4	442.4	45.2	moderate
DOP #12	mafic volcanic	1.7	9.4	16.99	385.7	1.68	<0.01	1.68	52.5	337.1	284.6	6.4	moderate
DUG #6	gabbro	2.0	8.3	5.71	129.6	1.85	<0.01	1.85	57.8	77.8	20.0	1.3	slight
DUMV #5	mafic volcanic	1.8	8.9	11.62	263.8	6.57	0.03	6.54	204.4	229.3	24.9	1.1	moderate
DUQ #1	quartz	2.8	8.8	4.08	92.6	1.87	<0.01	1.87	58.4	68.3	9.9	1.2	slight