Fish Habitat Characterization-Genesis Project

Iron Ore Company of Canada

Labrador City, NL

Final

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EXECUTIVE SUMMARY

The watersheds of Leg Lake, Throne Lake and Tup Lake underwent a complete habitat assessment during August 2011. In order to complete the assessment, surface water, sediment, physical habitat quality and quantity and biota were all sampled.

Leg Lake Watershed

In total three streams, and three ponds were sampled/surveyed, making up the entire watershed. Habitat types were analyzed and classified according to both the Beak (1980) and New Classifications systems (McCarthy et al. 2007).

Within Tributary T2A there are a total of 72.83, 55.51, 73.35 and 69.84 HEU for brook trout, burbot, lake chub and sculpin, respectively. The habitat is comprised primarily of Riffle, contains smaller proportions of Pool and Steady and has limited Rapid and Cascade habitat types.

Tributary T2B has a total of 2.09, 5.21, 4.83 and 7.08 HEU for brook trout, burbot, lake chub and sculpin, respectively. The habitat is comprised primarily of Pool with limited Riffle habitat types.

Tributary T2-4 has a total of 8.12,10.26, 11.68 and 12.62 HEU for brook trout, burbot, lake chub and sculpin, respectively. The habitat is comprised primarily of Pool with limited Riffle habitat types.

Within the Leg Lake watershed, Leg Lake was the largest waterbody present, and the only one with substantial profundal habitat. Leg Lake has a surface area of approximately 62.6 ha, of which 12.8 ha was littoral habitat and 49.8 ha was profundal. Pumphouse Pond comprised of 7.5 ha, of which 7.4 ha was littoral habitat and profundal habitat made up 0.1 ha. Drum Lake comprised of 5.6 ha, which was entirely comprised of littoral habitat.

During the surveys, brook trout were the only species found to be utilizing the lacustrine habitats within the Leg Lake watershed. Each of the three ponds sampled were determined to be fish habitat, with varying degrees of productivity. CPUE within the ponds ranged from 1.17-2.67 fish/net-night.

Burbot, brook trout, lake chub, and sculpin were found to be utilizing the riverine habitats present. All four species were captured in electrofishing Station #1, while only brook trout were captured in Station #2. Biomass estimates per unit (100 m2) of habitat were 418.7 g, 177.35 g, 28.7 g for brook trout, burbot and sculpin, respectively for Station #1. Due to the small catch of lake chub it was not possible to provide a biomass estimate. For Station #2 brook trout biomass was estimated to be 371 g per unit. Standardized CPUE (# captured/300 seconds) within electrofishing Station #1 resulted in catches of 1.1 burbot, 5.2 brook trout, 0.2 lake chub and 1.59 sculpin caught per 300 seconds of electrofishing. Within Station #2 brook trout were the only species caught and had a standardized CPUE of 3.6 fish/300 seconds.

Water samples were also collected, analyzed and compared to CCME FWAL guidelines. It was found that Pumphouse Pond showed no exceedances in tested parameters. Drum Lake and Leg Lake both showed exceedances in cadmium, and Tributary 2 showed exceedances in aluminum and iron.

Of the three watersheds sampled, the average invertebrate Shannon-Weiner index was greatest for Leg Lake watershed lakes/ponds. Similarly, Shannon-Weiner index was also highest for stream habitat (Tributary T4) in the Leg lake watershed. Average evenness was also highest in the Leg Lake watershed lakes/ponds but was lowest of all streams sampled.

Throne Lake Watershed

In total three streams, and two ponds were sampled/surveyed, making up the entire watershed.

Habitat types were analyzed and classified according to both the Beak (1980) and New Classification systems (McCarthy et al. 2007).

Within Tributary T9 there is a total of 44.69 HEU for brook trout . The habitat is comprised primarily of Steady, contains smaller proportions of Run and Riffle Pool and has limited Pool, Rapid and Cascade habitat types.

Tributary T9-2 has a total of 11.61HEU for brook trout. The habitat is comprised primarily of a mixture of Pool and Riffle with smaller proportions of Rapid, Steady and Cascade habitat.

Tributary T9-3 has a total of 10.10 HEU for brook trout. The habitat is comprised primarily of a mixture of Riffle and Steady with smaller proportions of Pool, Run and Rapid habitat.

The new classification system (McCarthy et al. 2007) identifies a total of 81.95 units of Riffle, 11.47 units of Pool/small pond, 3.17 units of Steady, 1.60 units of Rapid, and 0.38 units of Cascade habitat types (95.7 total habitat units) within Tributary T2A. Within Tributary T2B 6.91 units of Pool habitat, 1.54 units of Run habitat and 0.07 units of Falls are identified for a total of 8.52 habitat units. Tributary T2-4 contains 0.73 units of Run, 3.22 units of Cascade, 1.83 units of Riffle and 10.03 units of Pool habitat for a total of 15.81 habitat units.

Within the Throne Lake watershed, Throne Lake was the largest water body present, and the only one with substantial profundal habitat. Throne Lake has a surface area of approximately 50.2 ha, of which 18.4 ha was littoral habitat and 31.8 ha was profundal. Highway Pond comprises 2.14 ha, of which 2.1 ha is littoral habitat and 0.04 ha is profundal.

During the surveys, brook trout were the only species found to be utilizing all lacustrine habitats within the Throne Lake watershed. Lake chub were found to utilize Highway Pond. Each of the ponds sampled were determined to be fish habitat, with varying degrees of productivity. CPUE for brook trout within the ponds were 15.8 fish/net night for Highway Pond and 2.0 fish/net night for Throne Lake, whereas CPUE for Lake Chub in Highway Pond was 6.7 fish/net night.

Only brook trout were found to be utilizing the riverine habitats present in the watershed. Standardized CPUE (# fish/300 seconds) resulted in capture rates of 4.5 and 5 fish/300 seconds from index electrofishing Stations #1 and #2, respectively. Standardized CPUE for Throne Lake electrofishing stations was similar to the CPUE for Leg Lake electrofishing stations (5.2 and 3.6 fish/300 seconds for Stations #1 and #2, respectively).

Water samples were also collected, analyzed and compared to CCME FWAL guidelines. It was found that Throne Lake showed no exceedances of tested parameters, whereas Highway Pond showed exceedances for aluminum and iron. Tributary T9 no showed exceedances.
Analysis of sediment collected from each pond/lake and from Tributary T9 resulted in no exceedances of the interim sediment quality guidelines for any parameter tested.

Of the three watersheds sampled the Throne Lake watershed had the second highest average invertebrate Shannon-Weiner index for lakes/ponds and for streams. Average evenness was also second highest in the Throne Lake watershed lakes/ponds but was highest of the streams sampled.

Tup Lake Watershed

In total one streams, and one pond was sampled/surveyed, making up the entire watershed.

Habitat types were analyzed and classified according to both the Beak (1980) and New Classifications systems (McCarthy et al. 2007).

Tributary T14-3 has a total of 20.21 HEU for brook trout. The habitat is comprised primarily of a mixture of Riffle and Pool with smaller proportions of Steady and Rapid with minimal Cascade habitat.

Within the Tup Lake watershed, Tup Lake was the only waterbody present. Tup Lake has a surface area of approximately 7.2 ha, of which 3.8 ha is littoral habitat and 3.4 ha is profundal.

During the surveys, brook trout were the only species found to be utilizing lacustrine and riverine habitats within the watershed. Tup Lake was determined to be fish habitat with a CPUE of 11.3 fish/net-night for brook trout. Standardized CPUE (# fish/300 seconds) at the index electrofishing station resulted in catches of 3.4 fish/300 seconds. Standardized CPUE from Leg Lake quantitative elctrofishing stations was similar (5.2 and 3.6 fish/300 seconds for Stations #1 and #2, respectively).

Water samples were also collected, analyzed and compared to CCME FWAL guidelines. It was found that Tup Lake showed exceedances for acid extractable chromium whereas Trbutary T14-3 showed an exceedance for cadmium and lead.

The Tup Lake watershed had the lowest Shannon-Weiner invertebrate index for lakes/ponds and for streams. Evenness was also lowest in Tup Lake but was second highest of the streams sampled.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

The Iron Ore Company of Canada (IOC) is planning to expand their mining operations within the western Labrador area, Newfoundland and Labrador. Part of the expansion includes potential development of additional ore bodies and infrastructure upgrades. As a result of the locations of the ore bodies and planned infrastructure upgrades it may be necessary to alter portions of nearby watersheds (Figure 1.1).

The alteration of watersheds has the potential to result in the harmful alteration, disruption or destruction of fish habitat (HADD) as per Section 35 of the Fisheries Act, and would require authorization by the Minister of Fisheries and Oceans Canada (DFO). Furthermore, this activity may be subject to approval under Transport Canada’s Navigable Waters Protection Act if watercourses are determined to be navigable.

The proposed site and process may also require additional process water sources. Extraction of water from surrounding watersheds may also result in HADD; however, the overall degree would depend on many factors such as the habitat quality potentially affected and the volume and rate of water extraction required.

In addition to providing the information required as part of the HADD determination process, the freshwater resources of the Project Area may be included within an environmental assessment of the project. In particular, baseline information can be required to assist the proponent in predicting potential effects to Valued Ecosystem Components (VECs), to assist regulators in determining significance of impacts and to describe baseline conditions for any required Environmental Effects Monitoring (EEM) programs.

This report provides the results of the 2011 freshwater baseline data collection program conducted in support of future planning.

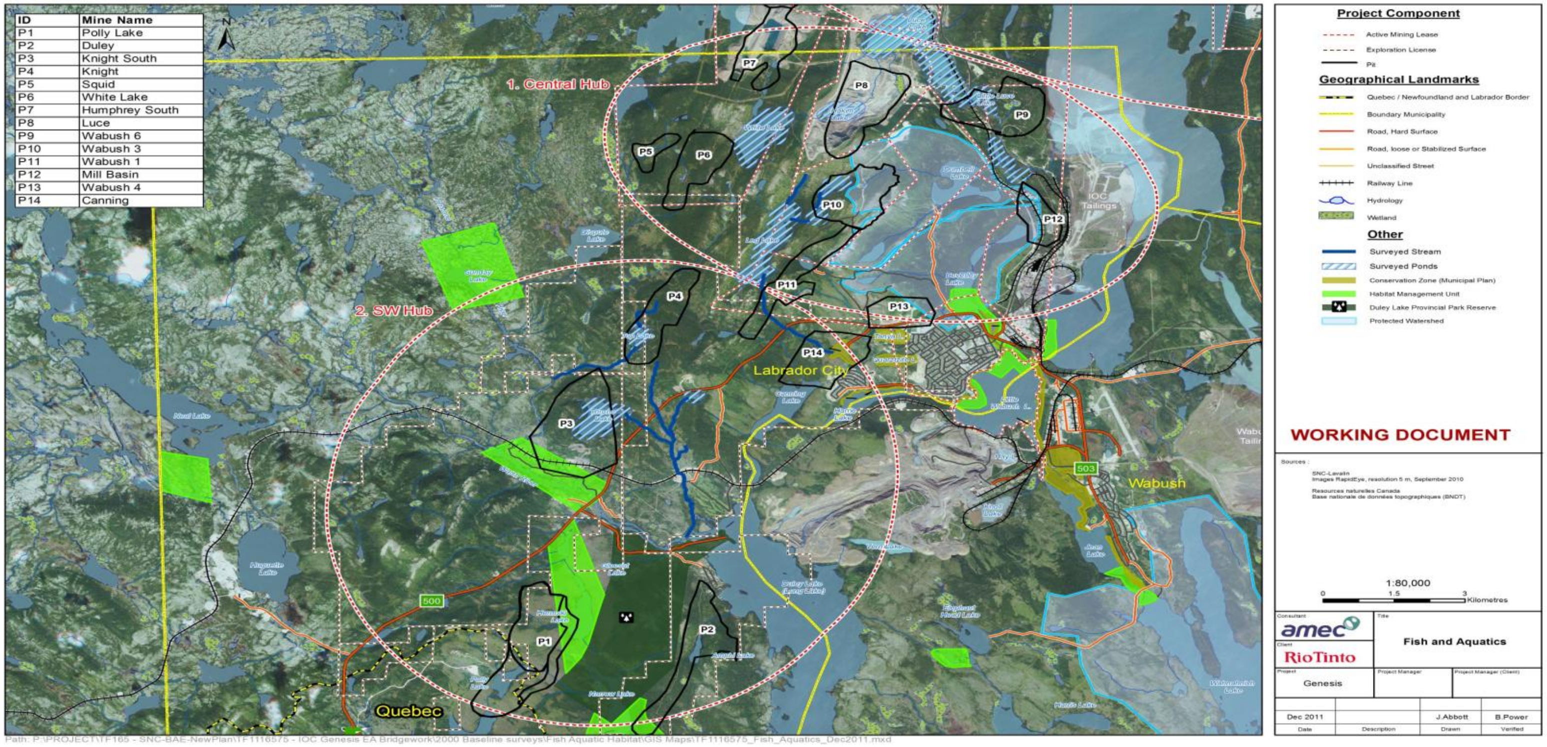


Figure 1.1: Overview of the project area and potential expansion considerations.

2.0 OBJECTIVES

The freshwater resources habitat characterization adds data to IOC's regional baseline information on the freshwater environment and addresses information requirements related to habitat characterization suitable for quantification in the context of potential DFO HADD requirements, as well as general aquatic habitat characterization. The specific 2011 work scope was to determine fish baseline habitat characterization and quantification of lacustrine (ponds and lakes) and streams in areas potentially within or around the Project footprint of any future expansion.

Fish habitat characterization includes measurements of physical parameters as well as surface water and sediment quality as well as benthic invertebrates. Sampling for fish species presence and habitat utilization has also been included.

2.1 Study Team

Core study team members for this project have been conducting freshwater and groundwater surveys and habitat classification for many years in Newfoundland and Labrador. Key team members are outlined below.

James H. McCarthy, M.Sc. is a Senior Biologist and Project Manager with AMEC St. John's and a Certified Fisheries Professional with the American Fisheries Society with over nineteen years experience in fisheries research and environmental assessment. He has been involved in a wide range of projects in Newfoundland and Labrador, Nova Scotia, British Columbia and Alaska working for private organizations and government agencies.

In addition to assisting the DFO in numerous policy and guideline developments over the past seven years, he has also participated in most of the larger fish habitat characterizations in the province including the Lower Churchill Hydroelectric Generation Project, the Labrador-Island Link Transmission Line, The Long Harbour Processing Plant, the Granite Canal Hydroelectric Development, the Rambler Mines Development, the Rose Blanche Hydroelectric Development, the Menihek Hydroelectric Development, the Sandy Lake reservoir expansion, the Rattling Brook Hydroelectric Development tailrace assessment, the proposed Southern Head Oil Refinery and the LabMag Iron Ore Project (including slurry pipeline).

Mr. McCarthy acted as Project Manager and senior biologist. Jim also led QA/QC on reporting.

Matthew Gosse, B.Sc. is an AMEC Biologist with seven years experience in the environmental field involving monitoring and baseline data collection. He has been involved in numerous fish habitat programs and over the past three years, has been an aquatic field crew lead for such projects as the Lower Churchill Hydroelectric Generation Project, the Duck Pond Gold Mine, the proposed Voisey's Bay Mine/Mill Expansion, the proposed IOC Mine Expansion, and the Rambler Mines Development. Mr. Gosse has also been involved in aquatic surveys associated with the Southern Head Oil Refinery, the

Labrador-Island Link Transmission Line, the Rattling Brook Hydroelectric Development tailrace assessment, and the Long Harbour Processing Plant.

Mr. Gosse acted as Lead field crew member for the required lacustrine fieldwork.

Kyle Reid Fairhurst is a fish and wildlife technologist with six years experience in field data collection and record keeping related to wildlife and fish habitat. Mr. Fairhurst has recently joined AMEC and has been involved in fish habitat surveys for various projects including the 2011 Long Harbour Processing Plant Fish Habitat Compensation Construction, IOC's fish habitat surveys associated with proposed expansion, Lower Churchill Hydroelectric Generation Project's ongoing baseline fish habitat data collection, and Vale NL's Fish Habitat Compensation works associated with the Mine/Mill. Mr. Fairhurst has also participated in field identification of water fowl and nesting habitat, wetland and upland vegetation identification, identifying riparian zones, fish habitat surveys as it applies to forest harvesting and tree removal. He has also assessed culvert placement as it relates to fish movement and stream bank erosion.

Mr. Fairhurst acted as lead field crew member for required stream fieldwork.

Justin So, M.Sc., Grad.Dip.Sci.Comm., B.Sc. is a biologist with AMEC with over three years of experience in marine and freshwater biology research. His diverse experience and education provides him with strong skills in research and analysis. He is familiar with local freshwater ecology and has completed a research project on diving beetles in Newfoundland. Justin has also completed a M.Sc. in biology where he was responsible for data collection, analyzing results and reporting results to a variety of stakeholders. Prior to joining AMEC, Justin was an Aquaculture Technician with AquaBounty Canada where worked extensively on research and sampling of salmonids.

Mr. So acted as field crew member for required stream fieldwork and was the Field Data Manager.

Andrea Patterson, B. Eng. is a recent civil engineering graduate. She has experience in a variety of fields, including Environmental Site Assessment and Monitoring, Remediation, Underground Tank Removal and Assessment, Potable Water Quality Assessment, Hazardous Materials Assessment, and Mould Assessment. As an Environmental Engineer she is responsible for cost estimation, contaminant assessment, technical reporting and remediation planning. She has knowledge of both provincial and federal occupational and environmental legislation and guidelines.

Ms. Patterson acted as field crew member for required stream fieldwork.

Eva Mooers, B. Eng. is a recent environmental engineering graduate. Her experience includes data management, analytical data interpretation and report writing on a multitude of projects that include the Goose Bay Remediation Project at 5 Wing Goose Bay (NL) and various private clients. Her field work experience includes groundwater and surface water sample collection, water level and free product measurements that include Basewide groundwater monitoring and sampling for both 14 Wing

Greenwood (NS), 9 Wing Gander (NL) and various residential, commercial and industrial sites. She is a member of AMEC's sustainability committee and promotes these values throughout her work. Ms. Mooers is extremely conscious of health and safety protocols as part of any project.

Ms. Moores acted as field crew member for required stream fieldwork.

Cassidy Pottle, is a Field Technician with over five years of seasonal experience in collecting soil, water, sediment and fish samples for a variety of projects including environmental effects monitoring and environmental site investigations. Mr. Pottle has been involved in many projects in Labrador including the 5-Wing Goose Bay Aquatic Environmental Effects Monitoring program, the assessment of fish movement at the Black Rock Bridge causeway on the lower Churchill River, the Lab Mag baseline aquatic surveys and the lower Churchill Hydroelectric Development Project.

Mr. Pottle acted as field crew member for required lacustrine fieldwork.

3.0 METHODS

Regardless of field measurement or analysis technique, all tasks incorporated the following in their completion.

3.1 Quality Assurance

Work Instructions (WIs) developed by AMEC Environment & Infrastructure for conducting studies were implemented during the current program. These included:

- Water, Sediment, Fish and Macro-invertebrate Sampling
- Electrofishing
- Bathymetry
- Fyke net and minnow trap use
- Riverine and lacustrine habitat assessment
- Field Data Management and transfer

WIs serve as established procedures for conducting a task ensuring that the work is completed to an acceptable standard and in a prescribed manner. The WIs used by AMEC are maintained on our electronic Quality Management file system. WIs were reviewed by all team members to ensure consistency of sample collection. In addition, as part of each team's Job-Safety Assessment (JSA) was a list of contact numbers for senior biologists and a call-in procedure to ensure that each day's data collection was consistent and accurate. In addition to WIs, Quality Assurance/Quality Control (QA/QC) forms were completed and tracked for all data transfer from field (hard copy) to digital form and any aspect of the project where data validation was deemed necessary. These forms are an integral part of AMEC's QA/QC for data entry.

3.2 Health and Safety

Safety, health and environment (SHE) is an important part of every participant's overall job performance. Although AMEC has made great efforts in reducing the accident and injury rate, the goal is to have zero accidents and injuries. Obtaining this goal requires developing and maintaining an effective safety, health and environment (SHE) management system and a safety culture among all employees. Managers continue to make safety their number one priority by promoting programs that are effective in identifying and reducing hazards in the workplace, providing ongoing training and making safety the primary consideration in all operations. As part of this program, a project-specific H&S Plan was developed and implemented. In addition, site-specific risks and challenges during field operations require job health and safety assessments (JSA) to be completed prior to remote or changes in activities. JSA documents are working documents that are brought to the work site and reviewed by all participants. Any outstanding issues are identified, documented and addressed as they arise. JSA reports are kept on file upon completion of the program. Daily toolbox meetings area also conducted each morning prior to start of work to highlight risks and review procedures.

3.3 Data Collection

The field data manager was responsible for ensuring that WIs were followed during the collection of data and also for the daily transcription of field data to data forms for subsequent computer entry. For samples requiring laboratory analysis, chain of custody forms were completed including documentation of preservation and storage methods. At least weekly, all transcribed data was reviewed by the data manager and cross referenced with field note books. Any discrepancies were noted on field data forms and a review of procedure was conducted.

3.4 Technical Reporting

Technical quality assurance extending from field data collection to data review and reporting was provided by field supervisors and senior scientists. Their role included reviewing the data entered for analysis and all subsequent reports for accuracy.

3.5 Technical Reporting

The naming of streams, ponds and landmarks was standardized for field teams and reporting. Each pond and stream was labeled by a unique identification number. For example, all ponds have been numbered and are represented by the code P##. Similarly, any stream sample locations have been identified using the codes T##. However, in order to provide context for readers and reviewers, names of streams or ponds as found on 1:50,000 topographic maps or previous reports were also used, such Leg Lake. All streams surveyed for habitat classification (i.e. not a point sample location) were named using the standard tributary structure outlined in Scruton et al. (1992). All names are provided in the appropriate sections of the report.

3.6 Geo-referencing

All sample locations were geo-referenced using handheld Global Positioning Systems (GPS) (Garmin GPSMap78 models). Each position was recorded on an internal SD chip and also recorded in field notebooks. All field positions were gathered using North American Datum dating from 1983 (NAD83), datum unless sample locations from previous reports were used. In these circumstances, the original datum was used and is clearly indicated. Where greater accuracy was required (i.e. during bathymetric surveys), Differential Global Positioning Systems (DGPS) were used. These systems used one of two methods to correct for position accuracy; integration of Canadian Coast Guard differential correction data or by integration of OMNIstar differential correction data. Tests on both systems prior to deployment indicated accuracies of less than one meter.

3.7 Schedule

All sampling was conducted between August 9-29, 2011. Table 3.1 presents the sampling collection summary for the study ponds and streams respectively.

Table 3.1: Sampling summary for ponds and streams, 2011.

Site ID	Site Name	August 2011			
		Water	Sediment	Macro-invertebrates	Fish[1]
P01	Drum Lake	●	●	●	●
P02	Leg Lake	●	●	●	●
P03	Pumphouse Pond	●	●	●	●
T02	Tributary T2	●	●	●	●
T9	Tributary T9	●	●	●	●
T13	Tributary T13	●	●	●	●
P04	Throne Lake	●	●	●	●
P05	Highway Pond	●	●	●	●
P06	Tup Lake	●	●	●	●

[1] Fyke netting was used for the capture of fish within Lakes/Ponds and electrofishing was used for the capture of fish within tributaries

4.0 HABITAT CHARACTERIZATION / QUANTIFICATION

To ensure consistent and comparable results for future work, sampling was conducted using standard methods compliant with known DFO requirements. Additional details or modifications for specific tasks are outlined in the appropriate sections below.

The work comprised a set of clearly defined tasks which were carried out in accordance with the scope of work. In total, three watersheds were included for habitat characterization (Figure 4.1) identified generally as Leg Lake, Throne Lake and Tup Lake watersheds.

4.1 Lacustrine Habitat Characterization / Quantification

All identified waterbodies within the study area were surveyed for lacustrine habitat classification/quantification during August 2011. The approach used for the quantification of lacustrine habitat was conducted as per the DFO Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador (Bradbury et al. 2001). The approach involved the completion of both littoral and profundal habitat/substrate mapping and sampling for species presence and habitat utilization. The data collected is used to describe the habitat within each waterbody and to quantify it in terms of Habitat Equivalent Units to assist Fisheries and Oceans Canada (DFO) in HADD determination.

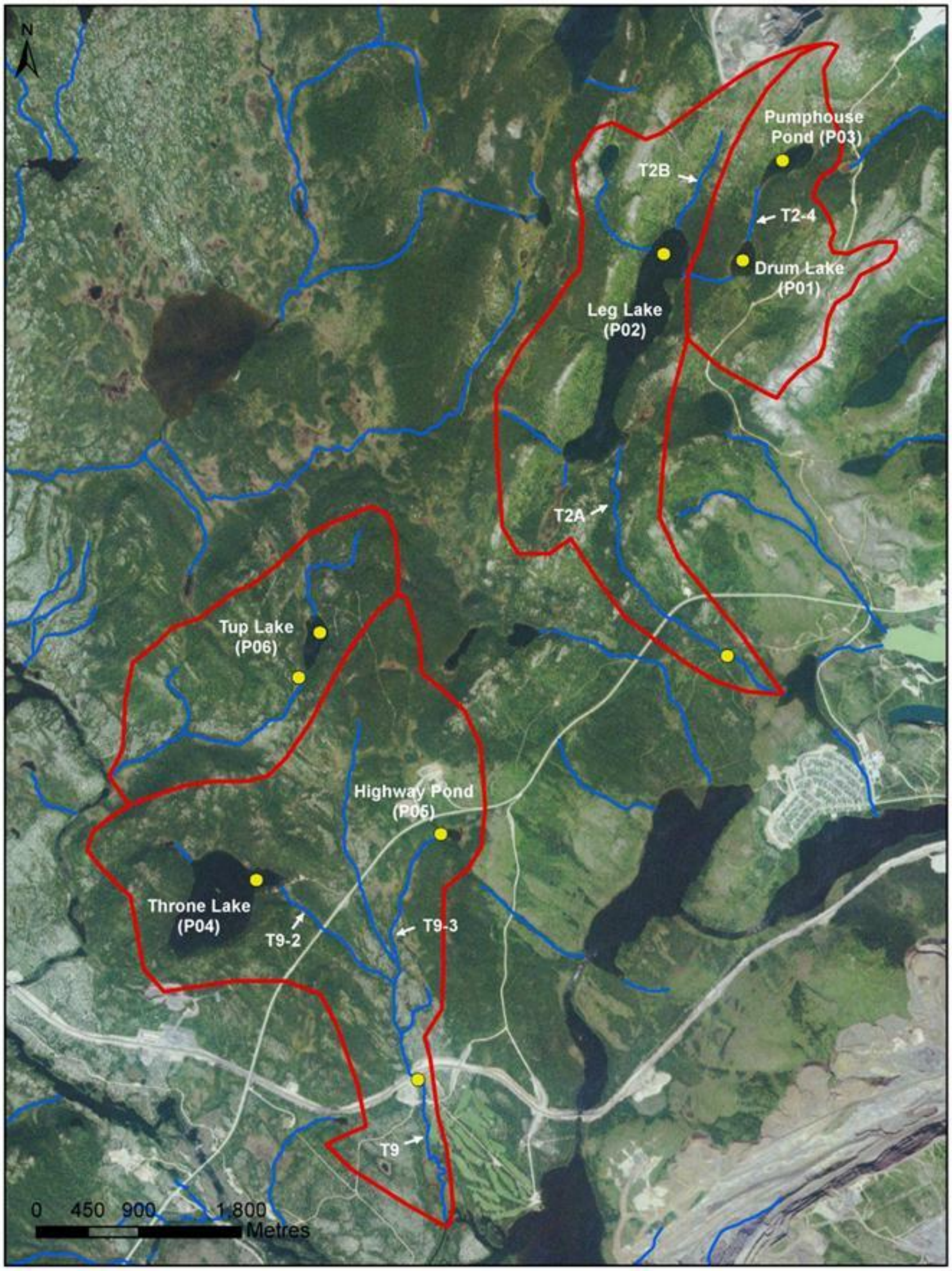


Figure 4.1: Sampling locations (yellow dots), Labrador West Study Area.

The methods used to collect the required information are briefly described below. Additional details can be obtained from Bradbury et al. (2001).

4.1.1 Bathymetry

Bathymetry (i.e. depth contours) of each pond was conducted using digital sonar with DGPS (differential GPS) attached to a Zodiac™ boat. The sonar was calibrated to collect a position and water depth every second. The data was digitally collected and mapped upon completion of the surveys using existing mapping of the study area and contour mapping software. The pond boundary was extracted from existing provincial 1:50,000 digital base maps of the area and was used as the boundary for all contour modelling. Bathymetric plots were generated using 3DField™ software, gridding the data using simple linear equations with grid intervals of 1 m. All completed bathymetric contours were then exported to ARCGIS™ for analysis.

4.1.2 Littoral / Profundal Habitat Delineation

The areal extent of both littoral and profundal habitat is used in habitat characterization and quantification. The delineation between nearshore (littoral) and deeper offshore (profundal) habitats is determined using Secchi disc measurements as an indication of the depth of light penetration within the water column. A Secchi disc is lowered in the water column on the shaded side of the boat using a calibrated line. The water depth when the disc disappeared from sight as it descended is recorded as well as the distance when the disc re-appeared as it ascends. The mean of these values represents Secchi Disc depth and therefore the water depth of light penetration and the extent of the littoral zone.

4.1.3 Lacustrine Substrate Mapping

The substrate composition of the waterbody is an important parameter in determining its habitat suitability for the various fish species that reside there. Typically, species can utilize different substrate types for different life-cycle stages. For example, salmonids such as brook trout can use gravels for spawning and larger substrates for cover during juvenile and adult stages. The substrate composition is recorded for the entire littoral zone of each pond visually and by confirmatory Ponar grabs in deeper sections of the littoral zone. The percent composition of each substrate class is determined for various littoral zone sections to ultimately determine the overall substrate percentage. Typically, the profundal zone is depositional in nature and substrates are comprised of smaller particles such as silt and detritus. However, the deeper, less-visable profundal zone substrate composition is confirmed using Ponar grabs of the bottom substrate. Subsets of samples are collected throughout the pond and composition is determined.

4.1.4 Surface Water Quality

Water and sediment samples were collected at select locations within each watershed as shown in Table 4.1. Within lakes and ponds, samples are collected over the deepest location. Samples were analyzed for parameters identified in Table 4.2. Each sample consisted of water collected at the near-surface.

Samples were collected and decanted into appropriately labelled bottles for shipment to the lab. All samples were stored in coolers and sent to the lab for analysis as soon as possible.

All samples were analyzed by a CALA certified lab. Standard field duplicates of 10% of all samples were collected and sent to the lab for QA/QC. In addition, lab results also identify all in-lab QA/QC measures (blanks and calibrations) as part of standard reporting.

All water parameter results have been compared to applicable Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Freshwater Aquatic Life (FWAL), (CCME 2011).

Table 4.1: Sample locations for 2011 Freshwater Study, Labrador City

Ponds		Streams	
Location	**Coordinates (UTM NAD 83, Zone 19)**	**Location**	**Coordinates (UTM NAD 83, Zone 19)**
Drum Lake (Pond P01)	N 5871615 E 637111	Tributary 2	N5868136 E636976
Leg Lake (Pond P02)	N5871670 E636417	Tribtary 9	N5864409 E634256
Pumphouse Pond (Pond P03)	N5872491 E637463	Tributary 14	N5867946 E633205
Throne Lake (Pond P04)	N5866166 E632834		
Highway Pond (Pond P05)	N5866571 E634457		
Tup Lake (Pond P06)	N5868341 E633393		

4.1.5 Sediment Sampling

Sediment sampling was also conducted at the deepest known point of each pond, similar to the locations identified above for water sample collection, using a Ponar grab (model 1725-F10). The grab was laid on the bottom, activated to collect an undisturbed sample, and brought to the surface. Once retrieved, the appropriate depth horizons were extracted from the sampler using stainless steel instruments. Parameters analyzed are outlined in Table 4.3 below.

All water parameter results have been compared to applicable Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Freshwater Aquatic Life (FWAL), (CCME 2011).

Table 4.2: Analytical requirements for freshwater water quality, 2011.

Parameter	MDL	Parameter	MDL
Anion Sum	N/A	Aluminum	5 µg/L
Calcium Biocarb. Alkalinity (calc. as $CaCO_3$)	1 mg/L	Antimony	1 µg/L
Calculated TDS	1 mg/L	Arsenic	1 µg/L
Carb. Alkalinity ($CaCO_3$)	1 mg/L	Barium	1 µg/L
Cation Sum	N/A	Beryllium	1 µg/L
Hardness ($CaCO_3$)	1 mg/L	Bismuth	2 µg/L
Ion Balance (% difference)	%	Boron	50 µg/L
Langelier Index (@20C)	N/A	Cadmium	0.017 µg/L
Langelier Index (@4C)	N/A	Calcium	100 µg/L
Nitrite (N)	0.05 mg/L	Chromium	1 µg/L
Saturation pH (@20C)	N/A	Cobalt	0.4 µg/L
Saturation pH (@4C)	N/A	Copper	2 µg/L
Total Alkalinity (Total as $CaCO_3$)	5 mg/L	Iron	50 µg/L
Dissolved Chloride (Cl)	1 mg/L	Lead	0.50 µg/L
Colour	5 TCU	Magnesium	100 µg/L
Nitrate+Nitrite	0.05 mg/L	Manganese	2 µg/L
Nitrite (N)	0.01 mg/L	Molybdenum	2 µg/L
Nitrogen (Ammonia Nitrogen)	0.05 mg/L	Nickel	2 µg/L
Total Organic Carbon (C)	1 mg/L	Phosphorous	100 µg/L
Orthophosphate (P)	0.01 mg/L	Potassium	100 µg/L
pH	N/A	Selenium	1 µg/L
Reactive Silica (SiO2)	0.5 mg/L	Silver	0.1µg/L
Dissolved Sulfate	2 mg/L	Sodium	100 µg/L
Turbidity	0.1 NTU	Strontium	2 µg/L
Conductivity	1 µS/cm	Thallium	0.1 µg/L
		Tin	2 µg/L
		Titanium	2 µg/L
		Uranium	0.1 µg/L
		Vanadium	2 µg/L
		Zinc	5 µg/L

Table 4.3: Analytical requirements for freshwater sediment, 2011.

Parameter	MDL	Parameter	MDL
Acid Extractable Aluminum	50 µg/g	Available Cadmium	0.3 mg/kg
Acid Extractable Barium	2 µg/g	Available Chromium	2 mg/kg
Acid Extractable Beryllium	0.5 µg/g	Available Cobalt	1 mg/kg
Acid Extractable Cadmium	0.5 µg/g	Available Copper	2 mg/kg
Acid Extractable Calcium	50 µg/g	Available Iron	500 mg/kg
Acid Extractable Chromium	1 µg/g	Available Lead	0.5 mg/kg
Acid Extractable Cobalt	2 µg/g	Available Lithium	2 mg/kg
Acid Extractable Copper	2 µg/g	Available Manganese	2 mg/kg
Acid Extractable Iron	500 µg/g	Available Mercury	0.1 mg/kg
Acid Extractable Lead	5 µg/g	Available Molybdenum	2 mg/kg
Acid Extractable Magnesium	50 µg/g	Available Nickel	2 mg/kg
Acid Extractable Manganese	1 µg/g	Available Rubidium	2 mg/kg
Acid Extractable Molybdenum	2 µg/g	Available Selenium	2 mg/kg
Acid Extractable Nickel	5 µg/g	Available Silver	0.5 mg/kg
Acid Extractable Phosphorous	20 µg/g	Available Strontium	5 mg/kg
Acid Extractable Potassium	200 µg/g	Available Thallium	0.1 mg/kg
Acid Extractable Silver	1 µg/g	Available Tin	2 mg/kg
Acid Extractable Sodium	100 µg/g	Available Uranium	0.1 mg/kg
Acid Extractable Strontium	1 µg/g	Available Vanadium	2 mg/kg
Acid Extractable Sulphur	50 µg/g	Available Zinc	5 mg/kg
Acid Extractable Tin	20 µg/g	Ammonia-N	0.3 mg/kg
Acid Extractable Vanadium	5 µg/g	Chloride (Cl)	5 mg/kg
Acid Extractable Zinc	5 µg/g	Conductivity	1 µS/cm
Available Aluminum	10 mg/kg	Moisture	%
Available Antimony	2 mg/kg	Nitrate+Nitrite	0.25 mg/kg
Available Arsenic	2 mg/kg	Nitrite (N)	0.05 mg/kg
Available Barium	5 mg/kg	Organic carbon (TOC)	0.2 g/kg
Available Beryillium	2 mg/kg	Orthophosphate (P)	0.05 mg/kg
Available Bismuth	2 mg/kg	Soluble (5:1) pH	N/A
Available Boron	5 mg/kg	Sulphate (SO4)	10 mg/kg

4.1.6 Benthic Invertebrates

Benthic macroinvertebrates have been shown to be good indicators of habitat health (Reice and Wohlenberg 1993) and are typically involved in long-term Environmental Effects Monitoring (EEM) Programs. Each sample was collected at moderate depth along the shoreline at random locations using a Ponar grab (model 1725-F10) with a total collection volume of 2.4 litres. The Ponar was equipped with 500 µm top screens which assisted in reducing the loss of macroinvertebrates residing on the surface substrates prior to recovery of the grab. Each sample was stored in bottles with preservative (90% ethanol). Samples were taken to the lab and cleaned with all invertebrates placed in a clean vial in 70% ethanol.

Organisms in each sample were identified to the lowest possible level (typically to Family) and enumerated. Baseline diversity analyses were completed using standard methods with calculations of richness (total number of families), Shannon-Weiner Diversity Indices (H) and an estimation of Species Evenness (D).

Richness refers to the total number of families identified in the sample. The Shannon-Weiner Diversity Index is a measure of richness and evenness and is calculated as follows:

$$H = \sum_{n=1}^{n} \mathrm{p_i} \, \mathrm{Log}_2 \, \mathrm{p_i}$$

The term pi refers to the abundance of each family, calculated as the number of individuals of a family divided by the total number of individuals in the sample. The index generally ranges between 1.5 (indicating low richness and evenness) to 3.5 (indicating high richness and evenness).

Evenness refers to how numerically equal species found in the sample are. It is calculated as the Shannon-Weiner Diversity Index (H) divided by Hmax, which is the maximum possible index number if all species are present in equal numbers.

4.1.7 Lacustrine Habitat Utilization

Fish presence was determined within each waterbody using fyke nets, minnow traps and angling (DFO permit number NL-731-11). All fish species captured were considered indicative of that species utilizing the habitat for its various life-cycle stages identified by DFO. This information was used in habitat quantification.

Each fish captured was anaesthetized with clove oil (2 ml of 10:1 ethanol:clove oil in 8L of water), identified by species, measured (fork length for most species; total length for burbot) and weighed (grams). Each fish was live-captured and upon completion of measurements, were allowed to recover in buckets of clean water and then released back into the waterbody where they were captured.

4.2 Riverine Habitat Classification

All identified streams within the study area were surveyed and characterized. The methods used to classify and quantify the aquatic habitat was based on standardized DFO methodologies such as Scruton et al. (1992), Sooley et al. (1998), Bradbury et al. (2001) and McCarthy et al. (2007). Each stream was sub-divided into habitat reaches based on visible and measured changes in habitat characteristics (eg. streambed slope, water velocity, stream width and/or water depth). Each stream reach was surveyed for numerous parameters such as channel width, wetted perimeter, mean water column velocity, mean water depth, streambed slope and substrate composition. Based on these measurements, each reach was classified into various habitat types.

Two habitat classification systems were used; the Beak (1980) and a new classification system soon to be implemented by DFO (McCarthy et al. 2007). The Beak habitat classification system uses a total of four habitat types based on salmonid life-cycle stages and habitat suitabilities (Table 4.4).

The proposed newer classification system outlined in McCarthy et al. (2007) takes into account the suitability of the habitat for each species using the habitat by life-cycle stage (spawning, young-of-year, juvenile and adult). Table 4.5 provides a description of each habitat type along with the range of parameter values associated with each.

Table 4.4: Habitat classifications of Beak (1980).

Habitat Classification	Habitat Description
Type I	Good salmonid spawning and rearing habitat: often with some feeding pools for larger age classes: **flows:** moderate riffles; **current:** 0.1-0.3 m/s; **depth:** relatively shallow, 0.3-1.0 m; **substrate:** gravel to small cobble, some large rocks, boulders; **general habitat types:** primarily riffle, pool.
Type II	Good salmonid rearing habitat with limited spawning usually only in isolated gravel pockets, good feeding and holding areas for larger fish in deeper pools, pockets or backwater eddies: **flows:** heavier riffles to light rapids; **current:** 0.3-1.0 m/s; **depth:** variable from 0.3-1.5 m; **substrate:** Larger cobble/rubble size rock to boulders, bedrock, some gravel pockets between larger rocks; **general habitat types:** run, riffle, pocketwater, pool.
Type III	Poor rearing habitat with no spawning capabilities, used for migratory purposes: **flows:** very fast, turbulent, heavy rapids, chutes, small falls; **current:** 1.0 m/s or greater; **depth:** variable, 0.3-1.5 m; **substrate:** Large rock and boulders, bedrock; **general habitat types:** run, pocketwater, cascades.
Type IV	Poor juvenile salmonid rearing habitat with no spawning capability, provides shelter and feeding habitat for larger, older salmonid (especially brook trout): **flows:** sluggish; **current:** 0.15 m/s; **depth:** variable but often 1 m; **substrate:** Soft sediment or sand, occasionally large boulders or bedrock, aquatic macrophytes present in many locations; **general habitat types:** flat, pool, glide.

Each habitat type has a discrete range of water velocities, substrate types, depths and gradients as possible which have been determined using the described biological ‘preferences’ outlined in Grant and Lee (2004). While not a defined habitat requirement, gradient is listed as a parameter which can be used in various levels of the system to distinguish between habitat types. It should be noted that not all habitat parameter descriptions are exclusive of all others (e.g., water depth); however, the combined parameters should offer a reasonable designation of most habitat types encountered.

Table 4.5: Descriptions of riverine habitat classifications in McCarthy et al. (2007).

Habitat Type	Habitat Parameter	Description
Fast Water	**Mean Water Velocity**	**> 0.5m/s**
	Stream Gradient	**Generally > 4%.**
Rapid	General Description	Considerable white water[1] present.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	< 0.6 m
	Substrate	Usually dominated by boulder (Coarse[2]) and rubble (Medium[2]) with finer substrates (Medium and Fine[2]) possibly present in smaller amounts. Larger boulders typically break the surface.
	Stream Gradient	Generally 4-7%
Falls/Chute/Cascade	General Description	Mainly white water present. The dominating feature is a rapid change in stream gradient with most water free-falling over a vertical drop or series of drops.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	Variable and will depend on degree of constriction of stream banks.
	Substrate	Dominated by bedrock and/or large boulders (Coarse).
	Stream Gradient	> 7% and can be as high as 100%.
Run	General Description	Relatively swift flowing, laminar[3] and non-turbulent.
	Mean Water Velocity	> 0.5 m/s
	Mean Water Depth	> 0.3 m
	Substrate	Predominantly gravel, cobble and rubble (Medium) with some boulder (Coarse) and sand (Fine) in smaller amounts.
	Stream Gradient	Typically < 4% (exception to gradient rule of thumb)
Moderate Water	**Mean Water Velocity**	**0.2-0.5m/s**
	Stream Gradient	**>1 and < 4%**
Riffle	General Description	Relatively shallow and characterized by a turbulent surface[4] with little or no white water.
	Mean Water Velocity	0.2 – 0.5 m/s
	Mean Water Depth	< 0.3 m
	Substrate	Typically dominated by gravel and cobble (Medium) with some finer substrates present, such as sand (Fine). A small amount of larger substrates (Coarse) may be present, which may break the surface.[5]
	Stream Gradient	Generally >1 and < 4%
Steady/Flat	General Description	Relatively slow-flowing, width is usually wider than stream average and generally has a flat bottom.
	Mean Water Velocity	0.2 - 0.5 m/s
	Mean Water Depth	>0.2 m
	Substrate	Predominantly sand and finer substrates (Fine) with some gravel and cobble (Medium).

Habitat Type	Habitat Parameter	Description
	Stream Gradient	> 1 and < 4%
Slow Water	**Mean Water Velocity** **Stream Gradient**	**Generally < 0.2m/s (some eddies can be up to 0.4m/s).** **< 1%.**
Plunge / Trench / Debris Pools	General Description	Generally caused by increased erosion near or around a larger, embedded object in the stream such as a rock or log or created by upstream water impoundment resulting from a complete, or near complete, channel blockage. These pool types may be classified as an entire reach (e.g., pools greater than 60% of the stream width) or as sub-divisions of a fast water habitat.
	Mean Water Velocity	< 0.2 m/s
	Mean Water Depth	> 0.5 m depending on stream size (e.g., may be shallower in smaller systems).
	Substrate	Highly variable (i.e., coarse, medium or fine substrates)
	Stream Gradient	Generally < 1%
Eddy	General Description	Relatively small pools caused by a combination of damming and scour: however scour is the dominant forming action. Formation is due to a partial obstruction to stream flow from boulders, roots and/or logs. Partial blockage of flow creates erosion near obstruction. It is typically < 60% of the stream width and hence will be a sub-division of a faster-water habitat type (e.g., Run with 20% eddies).
	Mean Water Velocity	Typically < 0.4 m/s, but can be variable.
	Mean Water Depth	> 0.3 m. May vary depending on obstruction type, orientation, streambed and bank material and flows experienced.
	Substrate	Predominantly sand, silt and organics (Fine) with some gravels (Medium) in smaller amounts.
	Stream Gradient	Variable

[1] White water is present when hydraulic jumps are sufficient to entrain air bubbles which disturb the water surface and reduces visibility of objects in the water.

[2] Coarse, Medium and Fine substrate types are classified according to the Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador (Bradbury *et al.* 2001).

[3] Laminar describes the surface of the water as smooth and glass-like with no reduced visibility of objects in the water.

[4] Turbulence is present if there are local patches of white water or if water movement disturbs a portion of the surface.

[5] Pocket water often constitutes an important component of riffles in Newfoundland and Labrador and is characterized by a predominance of larger substrates (e.g., boulders) breaking the surface. The result is a riffle with many eddies around the boulders.

4.2.1 Surface Water Quality

Similar to pond sampling, water samples were conducted at identified stream locations for parameters identified in Table 4.2. Each sample consisted of water collection near the surface. Samples were collected and decanted into appropriately labelled bottles for shipment to the lab. All samples were stored in coolers and sent to the lab for analysis as soon as possible.

4.2.2 Sediment Sampling

Sediment sampling was conducted, similar to lacustrine sampling, at suitable locations within stream habitat of each watershed; for example, stream sediment was collected in depositional areas using a Ponar grab (model 1725-F10). The grab was brought to the surface and the appropriate depth horizons extracted from the sampler using stainless steel instruments. Parameters analyzed are outlined in Table 4.3.

4.2.3 Benthic Invertebrates

Benthic sampling was conducted at select stream locations within each watershed using standard methodologies. Each sample was collected at moderate depths along a stream transect representative of the watershed using a surber sampler. The sampler was set on the bottom and the substrate within the grid boundary cleaned. Invertebrates cleaned from the substrate were washed into the mesh downstream of the grid. Once the larger substrate was cleaned and removed, the smaller material was disturbed for at least 30 seconds to dislodge any remaining invertebrates. The sampler was then removed from the stream and cleaned into collection jars with preservative (90% ethanol). Samples were taken to the lab and cleaned with all invertebrates placed in a clean vial in 70% ethanol.

Organisms in each sample were identified to the lowest possible level (typically to Family) and enumerated. Baseline diversity analyses were completed using standard methods with calculations of richness (total number of families), Shannon-Weiner Diversity Indices (H) and an estimation of Species Evenness (D). Additional detail is provided in Section 4.1.1 above.

4.2.4 Riverine Habitat Utilization

Riverine habitat utilization by fish species was completed using electrofishing techniques; index and quantitative stations (see Scruton and Gibson 1995). The method employed within each watershed was dependant on several factors including access, logistics and size of the stream. The fish species captured are used to determine the species habitat utilization and are brought forward for final habitat quantification.

Quantitative electrofishing includes the use of barrier nets to isolate a section of stream habitat for electrofishing. Barrier nets are established at the downstream and upstream end of the station prior to electrofishing which was then sampled using a Smith-Root electrofisher (model 15-D). Any captured fish are retained in aerated buckets for processing at the end of each pass (i.e. a pass is a complete electrofishing effort through the station). Each fish captured is anaesthetized, identified by species, measured, weighed, and scales collected for age determination, if required. They are then allowed to recover in clean water and released downstream of the station. A minimum of four passes are completed such that population estimates can be generated using the capture data (i.e. depletion method). Population estimates are established (with confidence limits) using Microfish 3.0 (Van Deventer and Platts 1989).

Index electrofishing is similar to quantitative except that barrier nets are not established. Instead, a minimum effort of 300 seconds of electrofishing was completed. The effort can be standardized and compared to quantitative efforts.

4.2.5 Riverine Habitat Quantification

The quantification of potentially affected riverine habitat within the identified streams was completed using the data collected and both classification systems. The quantification of habitat using the Beak classification is simply the total area of each habitat type. Under the proposed newer system, the typical species habitat preference ranges contained within Grant and Lee (2004) and the measured habitat parameter ranges are used to derive a more detailed habitat suitability estimate of each habitat type present.

To calculate final suitability values under the newer system, both substrate and velocity ratings are taken into consideration. The preferred range of water velocity listed in Grant and Lee (2004) and the ranges measured within each habitat are compared to determine the proportion available to each species life-cycle stage. A similar exercise is also conducted using the preferred substrate ranges and the proportions estimated from each habitat type. In order to keep final suitability calculations similar to the Lacustrine Quantification Methodology (Bradbury et al. 1999), the mean of both values is used to derive a final suitability value unless an unsuitable rating (i.e., 0.00) is present for either. In this case, the habitat suitability would be 0.00. These calculations were completed for all species and life stages present. As a precautionary approach, the highest suitability value of the four life stages is used as the species-specific utilization value for that habitat type in an attempt to ensure that any ‘critical’ habitat requirements that a species/life stage might have would be incorporated to the highest extent possible. Using the final habitat suitability values and the overall area of each habitat type, the total Habitat Equivalent Units (HEU) of each habitat type can be calculated for each species. The total HEU is the quantity of suitable habitat for each species within a watershed or specific stream reach.

4.2.6 Watershed Hydrology

In addition to the direct measurement of habitat parameters, the hydrology of each watershed was calculated in order to determine whether a direct impact, such as the removal of a sub-watershed from the hydraulic regime (e.g., removal of the pond due to a mine pit), could have the potential to effect further downstream (i.e., indirect effects). The analysis included the development of typical hydrographs (normal, wet and dry), as well as flow duration curves for each watershed identified. Since there is no hydrometric station data available within each specific watershed, an estimate of inflows is required. To derive this information, a representative inflow sequence from a nearby gauged watershed is required.

There are three basic approaches that are typically used in developing a hydrological inflow sequence for a location that does not have a continuous record of flow data available for a long period of record. The choice depends on the type and quality of data available. The three basic approaches are as follows:

1. Use back-calculated inflows from recorded water level and flow data.
2. Use precipitation and temperature data, assuming that a relationship has been or can be developed between precipitation and runoff. The hydrological inflow sequence is then produced by simulating runoff for the required period from climate data.
3. Select a basin with suitable characteristics from the Environment Canada network of hydrometric stations and adjust the daily flows from that basin to represent inflows to the basin of interest. Adjustment of flow data can be achieved from relationship of basin characteristics or correlation of flow data for a given period of overlapping flow data with the location of interest.

To develop a realistic hydrological inflow sequence, using either of the approaches described above, it is general practice to ensure that the sequence selected is sufficiently long in record to include typical dry and wet periods in the basin. Based on the three approaches noted above for developing inflow sequences, it was decided that, due to the lack of recorded flows and the variation of temperature and precipitation in Lab West, Approach 3 should be used. The benefit of using Approach 3 over the other approaches is that if a basin can be located that is easily adjusted to the location of interest, the quality and accuracy of the flow data is improved.

Flow records were obtained from Water Survey Canada (a division of Environment Canada). These flow data are adjusted under quality management controls by Environment Canada. Note that for this assessment some years of available flow data is preliminary (ie. subject to change as they have not been posted publicly online).

There are five watersheds of interest within the IOC mining area in Labrador West (see Figure 4.1.). The five drainage basins consist of the following areas: Leg Lake Sub-Drainage Outflow (9 km2), Leg Lake Sub-Drainage Inflow to Leg Lake (2.9 km2), Leg lake drainage total (11.9 km2), Throne Lake drainage (8.5 km2) and Tup Lake drainage (3.4 km2). There are no active hydrometric stations at these drainage outlets, therefore these areas are referred to as ungauged basins.

These five watersheds of interest are located in the drainage division 030A, as delineated by Water Survey Canada. Four hydrometric stations available to the public are within this drainage division; however there were two additional hydrometric stations, available through Environment Canada for private IOC use.

Of the four public gauges, only one was suitable to conduct hydrological assessment. The remaining three gauges were located either on streams where the flow was regulated, or the flow was only measured seasonally. The additional two private gauges were not used in this hydrologic assessment either, as the two watersheds were understood to be affected by mining operations (ie. Flora Creek affected by flows from slurried tailings deposition and Luce Brook affected flows from developed land for mining and possibility of unaccounted water displacement). Wabush Lake provided the most complete and applicable flows, however it should be noted that the available flow data are only available for four years.

A summary of the four public hydrometric stations and additional two private hydrometric stations in drainage division 030A is provided in Table 4.6, information provided by Water Survey Canada.

Table 4.6: Summary of Hydrometric Stations within Drainage Division 030A

Station Name	Station ID	Drainage Area (km^2)	Flow Records
Wabush Lake at Lake Outlet	030A005 (active)	1596.7	2007-2010[1] (4 years)
Ashuanipi River below Wightman Lake	030A004 (active)	8,310	1972-1983 Seasonal/Continuous (0 complete years)
McPhadyen River near the mouth	030A003 (discontinued)	3,610	1972-1985 Seasonal/Continuous (3 full years)
Ashuanipi River at Menihek Rapids	030A001 (active)	19,000	1952-2003 (52 years; regulated flow)
Luce Brook Below Tinto Pond	030A012 (active)	43.4	2002-2003 & 2007-2010[2] (6 years)
Flora Creek Below Flora Lake	030A010 (active)	137.32	2002-2003 & 2007-2010[3] (6 years)

Notes:
[1]: Flow records for 030A005 years 2009 and 2010 are preliminary
[2]: Flow records for 030A012 year 2010 are preliminary
[3]: Flow records for 030A010 year 2010 are preliminary

Note that the available data in this tertiary drainage division is the best available data, however, it is not considered adequate to provide substantial and or accurate flow data for the watersheds of interest. It is suggested that these flows be used with caution, and to update the prorated flows when more information is available. The length of record is very short and typically would not be used for these analyses. It should also be noted that the drainage area of Wabush Lake (030A005) is quite large compared to the drainage basins of interest.

5.0 RESULTS

A total of three watersheds were surveyed in 2011 (see Figure 1.1). The results and analyses provided below have been separated by watershed. While it is unknown at this time the potential extent of interaction between any expansion and existing aquatic habitat, all habitat surveyed has been included below for completeness.

5.1 Leg Lake Watershed

The Leg Lake watershed is the most northerly of those surveyed and may be affected by the footprint of the proposed Wabush 3 mine site (see Figure 1.1). The watershed is a total of 11.92 km2 in size and drains to the south. Baseline field surveys within the Leg Lake watershed entailed surveying three lakes, Drum Lake, Leg Lake and Pumphouse Pond and three streams, T2-4 (outflow of Pond Pumphouse Pond and inflow into Drum Lake), T2B (inflow of Leg Lake), and T2A (outflow of Leg Lake). Figure 5.1 presents the Leg Lake watershed and its lacustrine and stream habitat. Photos of each pond are provided in Appendix A.

5.1.1 Lacustrine Habitat Characterization / Quantification

The results of the lacustrine habitat characterization and quantification for Drum Lake, Leg Lake and Pumphouse Pond are presented below.

5.1.1.1 Drum Lake (Pond P01)

Drum Lake (Pond 01) is the first pond located within the T2-4 tributary of the Leg Lake watershed (Figure 5.1). Drum Lake is 5.6 ha in size with a maximum depth measured at 2.8 m. Figure 5.2 presents the bathymetric contours. As shown, the entire pond consists of littoral habitat as modeled from the data.

The majority of the substrate present throughout the pond was mud (comprising an estimated 85% of total substrate coverage), with isolated small rocky outcrops consisting of 5.8% boulder, 2.5% rubble, 5% cobble and 1.7% sand. Table 5.1 presents the overall composition of each substrate type.

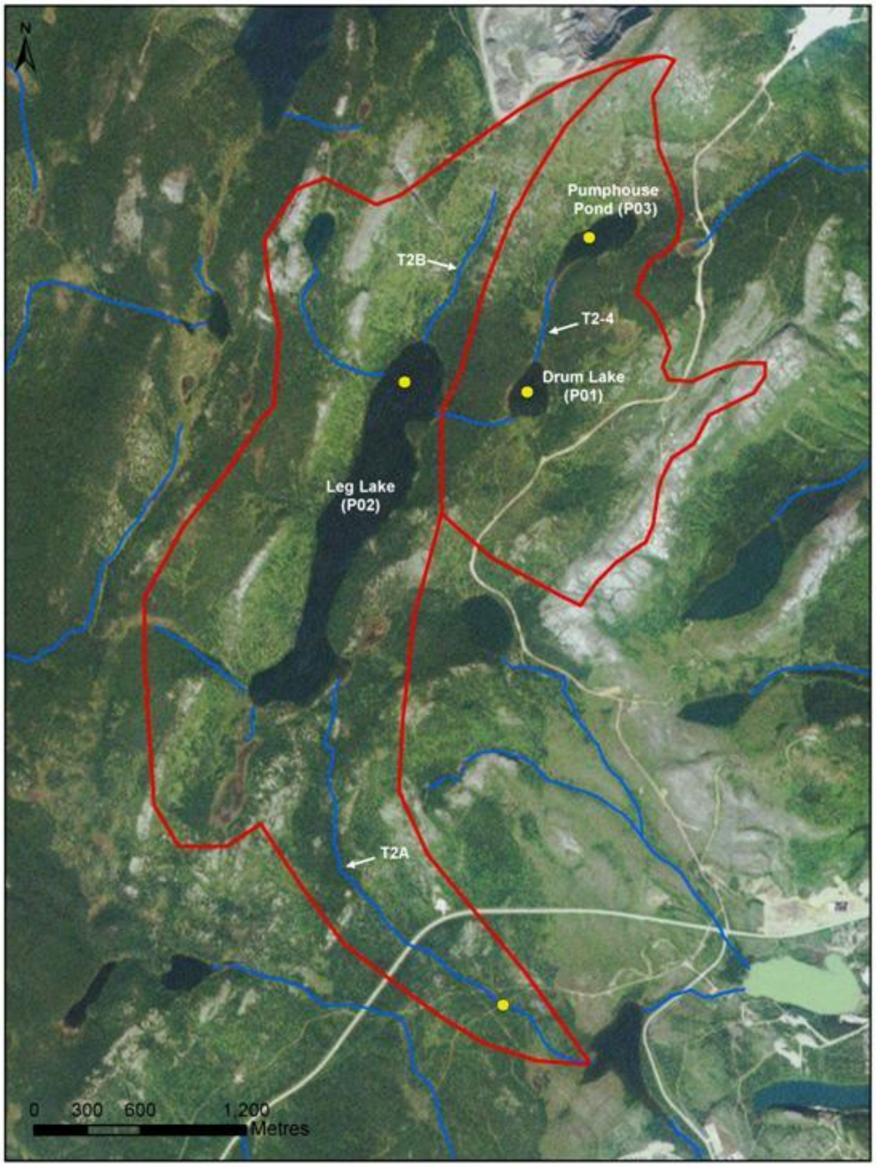


Figure 5.1: Lacustrine and riverine sampling locations (yellow dots), Leg Lake watershed.

Figure 5.2: Drum Lake Bathymetric contours with littoral and profundal zones indicated, August 2011.

Table 5.1: Substrate composition across habitat zones for Drum Lake.

Substrate Type	Depth Zone Area (m^2)	
	Littoral	Profundal
Bedrock	0.00	
Boulder	3,266.67	
Rubble	1,400.00	
Cobble	2,800.00	
Gravel	0.00	
Sand	933.33	
Muck/Detritus (organic)	47,600.00	
Total	**56,000.00**	**0.00**

5.1.1.2 Water Quality

Water quality results are provided in Appendix C. In general, the only parameter which exceeded the CCME guidelines (0.010 µg/L) in Drum Lake was Cadmium (0.067 µg/L). All others were either below Method Detection Limits of the lab analysis or below CCME guideline values.

5.1.1.3 Sediment Quality

Sediment quality results are provided in Appendix C. In general, There were no parameters which exceeded the CCME guidelines in Drum Lake.

5.1.1.4 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified 31 individuals, belonging to four groups (family, order or class) within Drum Lake. Shannon-Weiner index and species evenness was calculated to be 1.58 and 0.789, respectively. Complete tabulated results for all samples are provided in Appendix D.

5.1.1.5 Fish Species within Drum Lake

A total of three fyke nets (6 net-nights total effort) were deployed throughout the pond over a period of two days. Brook trout (Salvelinus fontinalis) was the only species captured. A brief general life history of each species is provided below as well as a general description of those captured in Drum Lake.

Brook Trout

Brook trout are widely distributed throughout Newfoundland and Labrador. Spawning in Labrador normally occurs between late September and early November in streams and occasionally in lakes. In lakes, spawning typically occurs at depths less than two metres (Bradbury et al. 1999 and Grant and Lee 2004).

Optimal brook trout habitat can be characterized as clean, cold spring-fed water; silt free rocky substrate in riffle-run areas; well vegetated stream banks; approximate 1:1 pool-riffle ratio with areas of slow, deep water; abundant instream cover; and relatively stable water flow, temperature regimes and stream banks. Brook trout often seek refuge among rocks, aquatic vegetation, woody debris, overhanging logs and undercut banks (Bradbury et al. 1999 and Grant and Lee 2004).

A total of 12 brook trout were captured and ranged from 109-223 mm in length and 17.3-130.5 g in weight. The length-weight relationship for those captured is presented in Figure 5.3.

5.1.1.6 Habitat Quantification

The determined Secchi depth of Drum Lake was 2.2 m. As a result, Drum Lake is comprised entirely of littoral habitat. Table 5.2 presents the overall areal extent of the delineation between habitat types.

Habitat Suitabilities

The field habitat and species presence data collected was used within the DFO spreadsheet for calculating lacustrine habitat suitabilities and habitat equivalent units. Table 5.3 presents an overview of the habitat information used to determine habitat areas. Table 5.4 shows the habitat suitabilities of each habitat type for brook trout.

Habitat Equivalent Units

DFO spreadsheet calculations were used to determine final HEUs for Drum Lake. Table 5.5 presents the results for brook trout. Total HEU is calculated at 3.90 ha.

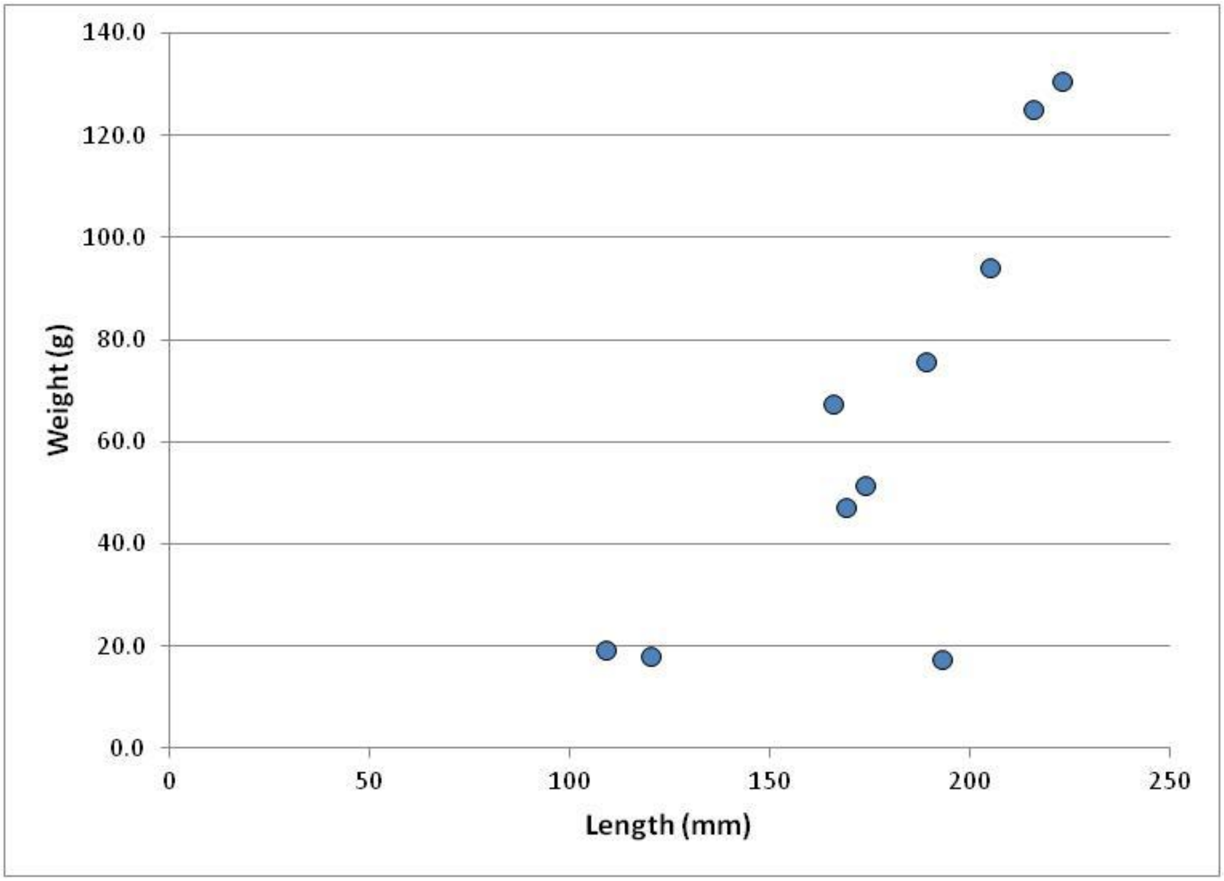


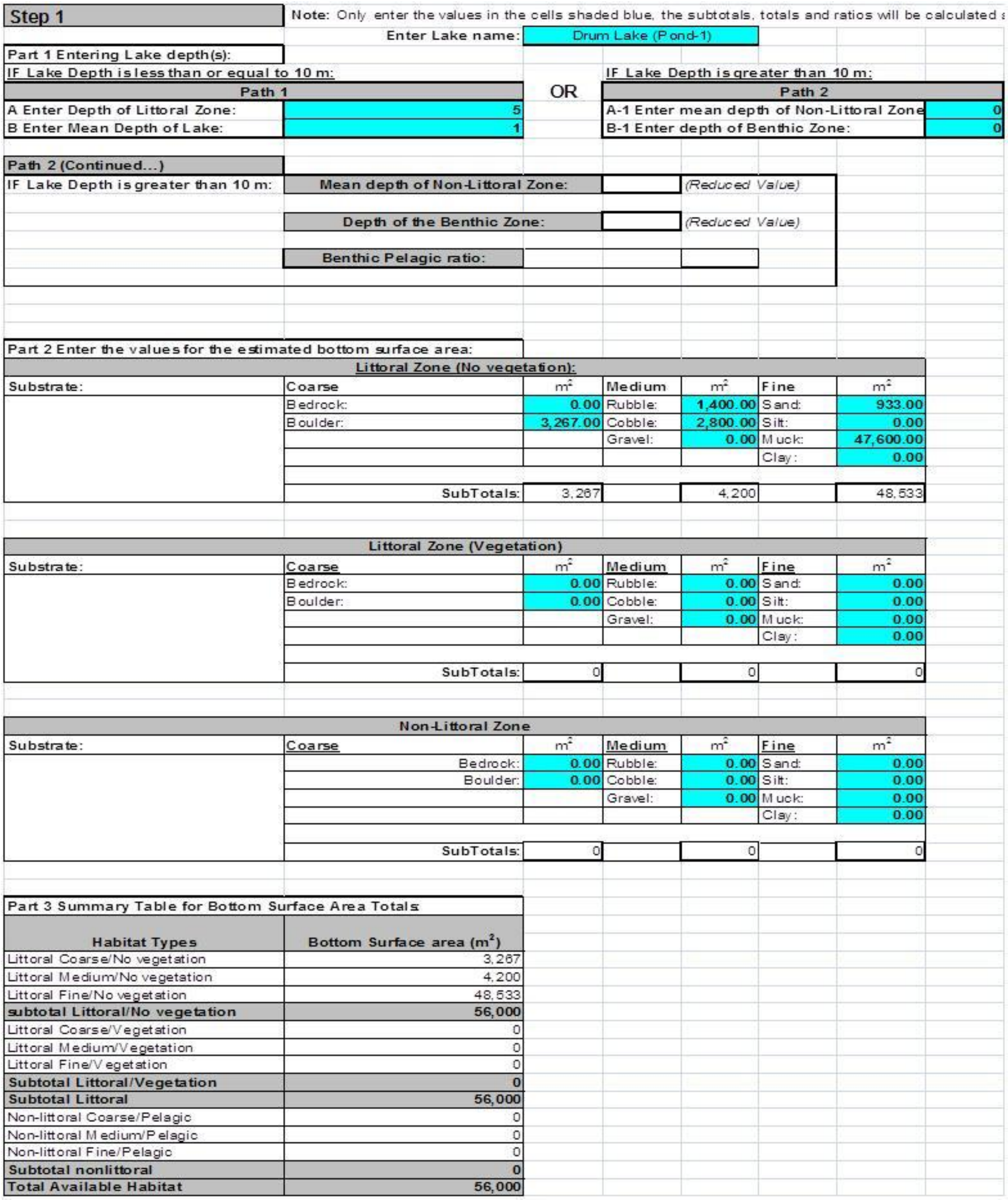
Figure 5.3: Length-weight relationship for brook trout captured in Drum Lake, 2011.

Table 5.2: The calculated total area of each habitat type within Drum Lake.

Habitat Type	Area (ha)
P - Profundal Zone	**0.00**
Lc - Littoral Zone - Coarse	0.3
Lm - Littoral Zone - Medium	0.4
Lf - Littoral Zone – Fine, no aquatic vegetation	4.9
Sub Total, Littoral Zone	**5.6**
Total Habitat	**5.6**

Littoral Coarse (comprising a majority of bedrock, boulder);
Littoral Medium (comprising a majority of rubble, cobble and gravel);
Littoral Fine (comprising a majority of sand and organics/detritus); and
Profundal (comprising a majority of organics/detritus).

Table 5.3: Summary of Drum Lake habitat values used to calculate aerial extents.



Step 1

Note: Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated

Enter Lake name: Drum Lake (Pond-1)

Part 1 Entering Lake depth(s):

IF Lake Depth is less than or equal to 10 m:			IF Lake Depth is greater than 10 m:	
Path 1		OR	Path 2	
A Enter Depth of Littoral Zone:	5		A-1 Enter mean depth of Non-Littoral Zone	0
B Enter Mean Depth of Lake:	1		B-1 Enter depth of Benthic Zone:	0

Path 2 (Continued...)

IF Lake Depth is greater than 10 m:	Mean depth of Non-Littoral Zone:		*(Reduced Value)*
	Depth of the Benthic Zone:		*(Reduced Value)*
	Benthic Pelagic ratio:		

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):

Substrate:	Coarse	m^2	Medium	m^2	Fine	m^2
	Bedrock:	0.00	Rubble:	1,400.00	Sand:	933.00
	Boulder:	3,267.00	Cobble:	2,800.00	Silt:	0.00
			Gravel:	0.00	Muck:	47,600.00
					Clay:	0.00
	SubTotals:	3,267		4,200		48,533

Littoral Zone (Vegetation)

Substrate:	Coarse	m^2	Medium	m^2	Fine	m^2
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	0.00
					Clay:	0.00
	SubTotals:	0		0		0

Non-Littoral Zone

Substrate:	Coarse	m^2	Medium	m^2	Fine	m^2
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	0.00
					Clay:	0.00
	SubTotals:	0		0		0

Part 3 Summary Table for Bottom Surface Area Totals

Habitat Types	Bottom Surface area (m^2)
Littoral Coarse/No vegetation	3,267
Littoral Medium/No vegetation	4,200
Littoral Fine/No vegetation	48,533
subtotal Littoral/No vegetation	**56,000**
Littoral Coarse/Vegetation	0
Littoral Medium/Vegetation	0
Littoral Fine/Vegetation	0
Subtotal Littoral/Vegetation	**0**
Subtotal Littoral	**56,000**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	0
Subtotal nonlittoral	**0**
Total Available Habitat	**56,000**

Table 5.4: Habitat suitabilities for all species, Drum Lake.

			Littoral Zone						Non-Littoral Zone		
	Species	Life Stage	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic
1	Brook Trout (freshwater resident)	Spawning	0.00	0.64	0.64	0.00	0.64	0.64	0.00	0.42	0.14
		YOY	1.00	1.00	0.00	1.00	1.00	0.00	0.67	0.67	0.00
		Juvenile	1.00	1.00	0.00	1.00	1.00	0.00	0.84	0.84	0.00
		Adult	0.00	0.50	0.34	0.00	0.50	0.39	0.00	0.42	0.17

Table 5.5: Habitat equivalent units for all species, Drum Lake.

		Littoral Zone						Non-Littoral Zone			
	Species	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic	Total Available Habitat
☐ 1	Brook Trout (freshwater resident)	3267	4200	31546	0	0	0	0	0	0	39013.0

5.1.1.7 Leg Lake (Pond P02)

Leg Lake (Pond P02) is the largest pond within the Leg Lake watershed (Figure 5.1) being 62.6 ha in size with a maximum depth measured at 28 m. Figure 5.4 presents the bathymetric contours and outlines the littoral and profundal areas of Leg Lake as modeled from the data.

The pond has a shoreline comprising a majority of sand, cobble, and rubble with the deeper zones comprised of muck (organics and detritus). There was very little emergent vegetation noted within Leg Lake. Table 5.6 presents the overall composition of each substrate type (m^2).

Figure 5.4: Leg Lake Bathymetric contours with littoral and profundal zones indicated, August 2011.

Table 5.6: Substrate composition across habitat zones for Leg Lake.

Substrate Type	Depth Zone Area (m^2)	
	Littoral	Profundal
Bedrock	3,459.46	
Boulder	29,059.46	
Rubble	22,832.43	
Cobble	33,210.81	
Gravel	1,210.81	
Sand	34,594.59	
Muck/Detritus (organic)	3,632.43	498,000
Total	**128,000**	**498,000**

5.1.1.8 Water Quality

Water quality results are provided in Appendix C. In general, the only parameter which exceeded the CCME guideline in Leg Lake was Cadmium at 0.018 µg/L (CCME guideline is 0.012 µg/L). All others were either below Method Detection Limits of the lab analysis or below CCME guideline values.

5.1.1.9 Sediment Quality

Sediment quality results are provided in Appendix C. Cadmium (1.4 mg/kg), chromium (48 mg/kg), mercury (0.2 mg/kg) and zinc (180 mg/kg) exceeded the CCME interim sediment quality guidelines (0.6 mg/kg, 37.3 mg/kg, 0.17 mg/kg, 123 mg/kg, respectively) in Leg Lake but no parameter exceeded the Probable Effects Level. All other parameters were either below Method Detection Limits of the lab analysis (i.e. non-detectable) or below CCME guideline values.

5.1.1.10 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified five individuals, belonging to four groups (family or class) within Leg Lake. Shannon-Weiner index and species evenness was calculated to be 1.92 and 0.961, respectively. Complete results are provided in Appendix D.

5.1.1.11 Fish Species within Leg Lake

A total of three fyke nets were deployed throughout the pond over a period of three days (nine net-nights effort). Brook trout were the only species captured (Section 5.1.1.1 provides brief life history of the species). A total of 24 brook trout were captured and ranged from 78-230 mm in length and 3.8-129.0 g in weight. The length-weight relationship is presented in Figure 5.5.

5.1.1.12 Habitat Quantification

Secchi depth was averaged over two samples and determined to be 3.6 m. Leg Lake is comprised of 62.6 ha; of which 12.8 ha is littoral and 49.8 ha is profundal habitat. Table 5.7 presents the overall areal extent of the delineation between the littoral as well as profundal habitat types.

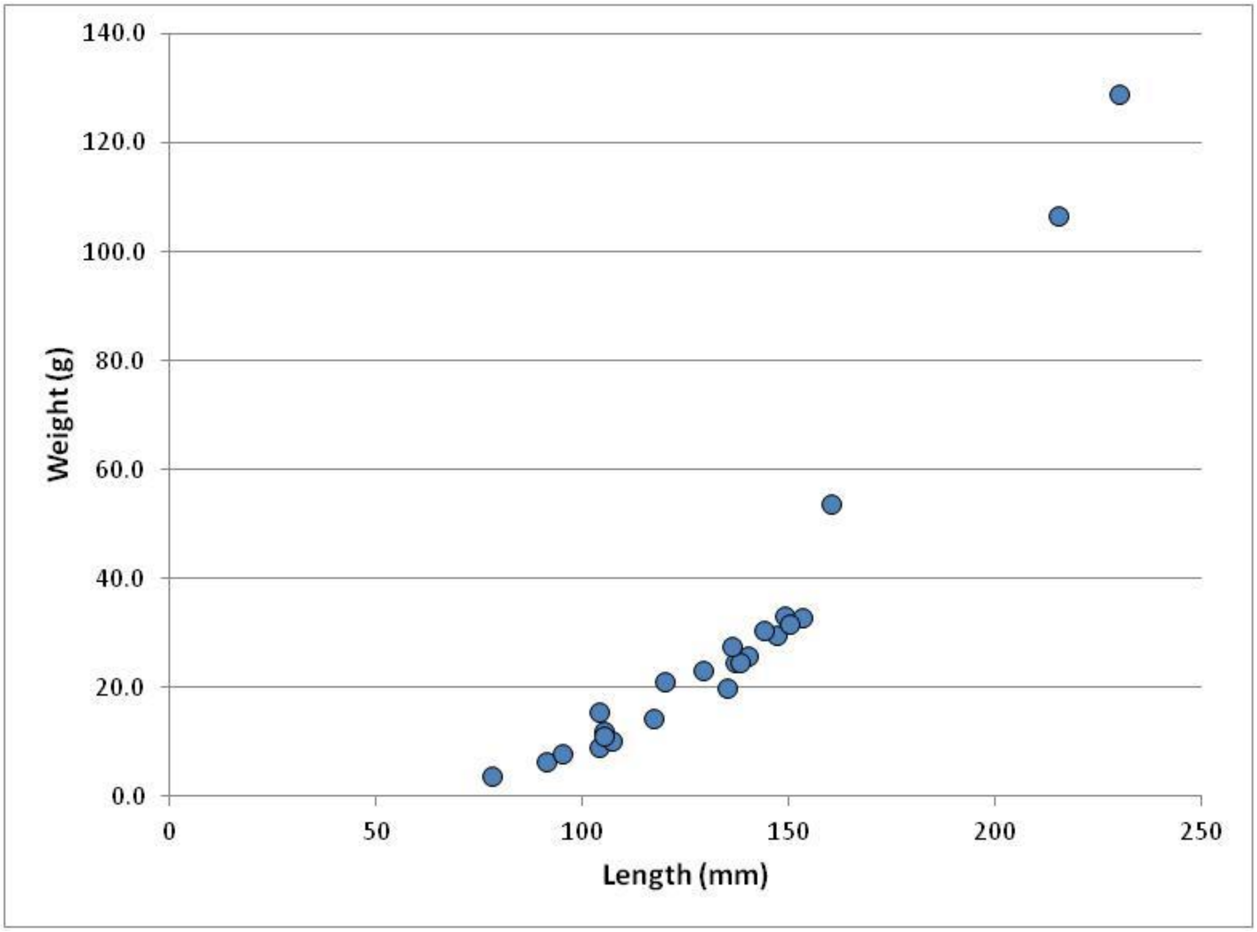


Figure 5.5: Length-weight relationship for brook trout captured in Leg Lake, 2011.

Table 5.7: The calculated total area of each habitat type within Leg Lake.

Habitat Type	Area (ha)
P - Profundal Zone	**49.8**
Lc - Littoral Zone - Coarse	3.3
Lm - Littoral Zone - Medium	5.7
Lf - Littoral Zone – Fine, no aquatic vegetation	3.7
Sub Total, Littoral Zone	**12.7**
Total Habitat	**62.6**

Littoral Coarse (comprising a majority of bedrock, boulder);
Littoral Medium (comprising a majority of rubble, cobble and gravel);
Littoral Fine (comprising a majority of sand and organics/detritus); and
Profundal (comprising a majority of organics/detritus).

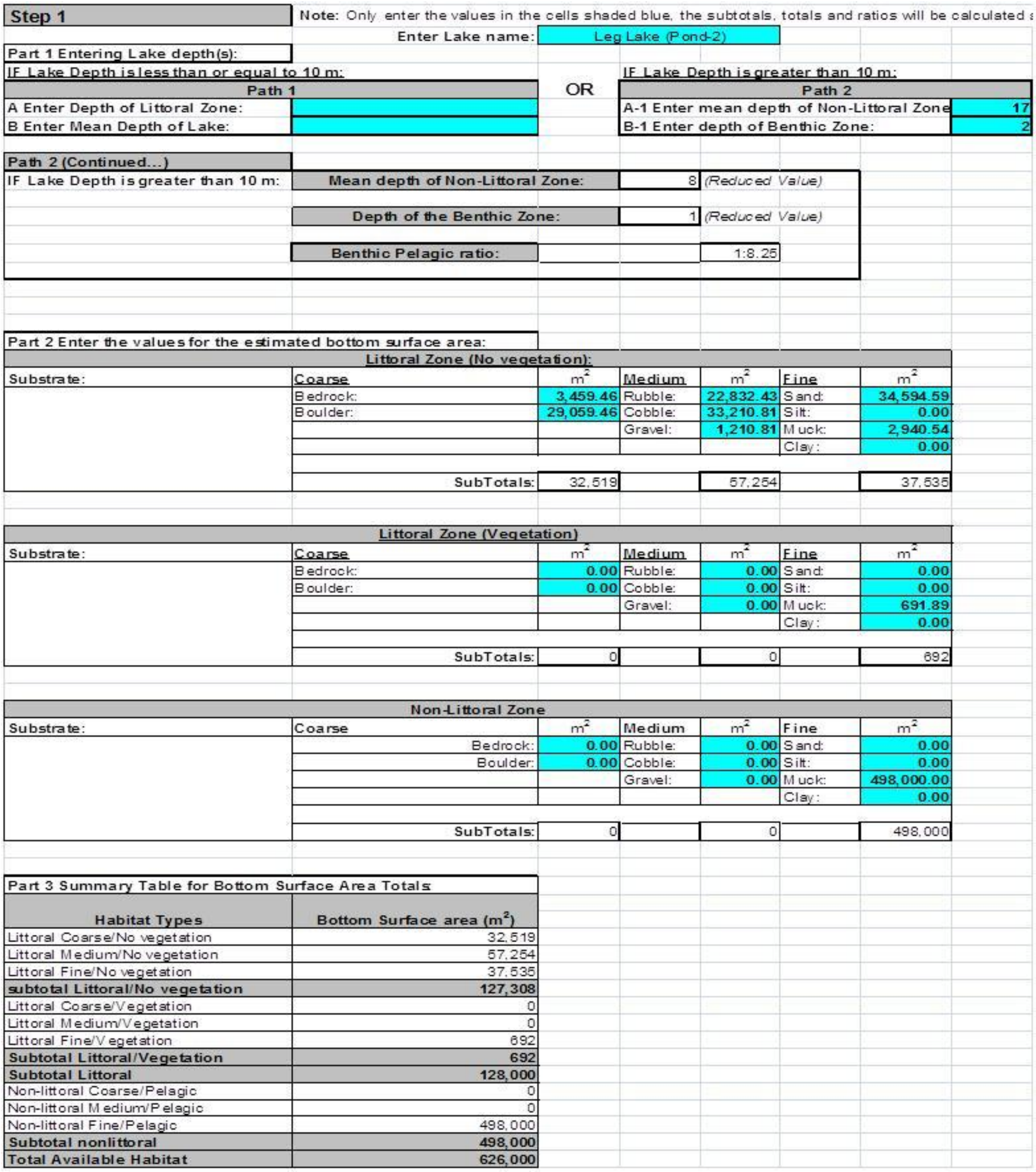
Habitat Suitabilities

The field habitat and species presence data collected was used within DFO spreadsheet for calculating lacustrine habitat suitabilities and habitat equivalent units. Table 5.8 presents an overview of the habitat information used to determine habitat areas. Table 5.9 shows the habitat suitabilities of each habitat type for brook trout.

Habitat Equivalent Units

DFO spreadsheet calculations were used to determine final HEUs for Leg Lake. Table 5.10 presents the results for brook trout. Total HEU is calculated at 21.3 ha.

Table 5.8: Summary of Leg Lake habitat values used to calculate aerial extents.



Step 1

Note: Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated

Enter Lake name: Leg Lake (Pond-2)

Part 1 Entering Lake depth(s):

IF Lake Depth is less than or equal to 10 m:			IF Lake Depth is greater than 10 m:	
Path 1		OR	Path 2	
A Enter Depth of Littoral Zone:			A-1 Enter mean depth of Non-Littoral Zone	17
B Enter Mean Depth of Lake:			B-1 Enter depth of Benthic Zone:	2

Path 2 (Continued...)

IF Lake Depth is greater than 10 m:	Mean depth of Non-Littoral Zone:	8	*(Reduced Value)*
	Depth of the Benthic Zone:	1	*(Reduced Value)*
	Benthic Pelagic ratio:	1:8.25	

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):

Substrate:	Coarse	m^2	Medium	m^2	Fine	m^2
	Bedrock:	3,459.46	Rubble:	22,832.43	Sand:	34,594.59
	Boulder:	29,059.46	Cobble:	33,210.81	Silt:	0.00
			Gravel:	1,210.81	Muck:	2,940.54
					Clay:	0.00
	SubTotals:	32,519		57,254		37,535

Littoral Zone (Vegetation)

Substrate:	Coarse	m^2	Medium	m^2	Fine	m^2
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	691.89
					Clay:	0.00
	SubTotals:	0		0		692

Non-Littoral Zone

Substrate:	Coarse	m^2	Medium	m^2	Fine	m^2
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	498,000.00
					Clay:	0.00
	SubTotals:	0		0		498,000

Part 3 Summary Table for Bottom Surface Area Totals

Habitat Types	Bottom Surface area (m^2)
Littoral Coarse/No vegetation	32,519
Littoral Medium/No vegetation	57,254
Littoral Fine/No vegetation	37,535
subtotal Littoral/No vegetation	**127,308**
Littoral Coarse/Vegetation	0
Littoral Medium/Vegetation	0
Littoral Fine/Vegetation	692
Subtotal Littoral/Vegetation	**692**
Subtotal Littoral	**128,000**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	498,000
Subtotal nonlittoral	**498,000**
Total Available Habitat	**626,000**

Table 5.9: Habitat suitabilities for all species, Leg Lake.

			Littoral Zone						Non-Littoral Zone		
	Species	Life Stage	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic
1	Brook Trout (freshwater resident)	Spawning	0.00	0.84	0.76	0.00	0.84	0.76	0.00	0.42	0.28
		YOY	0.50	1.00	0.00	0.50	1.00	0.00	0.50	1.00	0.00
		Juvenile	0.50	1.00	0.00	0.50	1.00	0.00	0.50	1.00	0.00
		Adult	0.00	0.67	0.34	0.00	0.67	0.39	0.00	0.50	0.22

Table 5.10: Habitat equivalent units for all species, Leg Lake.

		Littoral Zone						Non-Littoral Zone			
	Species	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic	Total Available Habitat
☑ 1	Brook Trout (freshwater resident)	16259	57254	0	0	0	526	0	0	139440	213479.5

5.1.1.13 Pumphouse Pond (Pond P03)

Pumphouse Pond (Pond P03) is the most northerly pond within the Leg Lake watershed (Figure 5.1). Pumphouse Pond is 7.5 ha in size with a maximum depth measured at 5.3 m. Figure 5.6 presents the bathymetric contours and outlines the littoral and profundal areas as modeled from the data.

The pond has a shoreline comprising a majority of mud, rubble and cobble with the deeper zones comprised of muck (organics and detritus). Table 5.11 presents the overall composition of each substrate type for Pumphouse Pond.

Table 5.11: Substrate composition across habitat zones for Pumphouse Pond.

Substrate Type	Depth Zone Area (m^2)	
	Littoral	Profundal
Bedrock	2,018.18	
Boulder	10,393.64	
Rubble	16,818.18	
Cobble	15,809.09	
Gravel	3,027.27	
Sand	6,054.55	
Muck/Detritus (organic)	20,518.18	1,300
Total	**74,639**	**1,300**

5.1.1.14 Water Quality

Water quality results are provided in Appendix C. In general, no parameter values exceeded the CCME guidelines in Pumphouse Pond.

5.1.1.15 Sediment Quality

Sediment quality results are provided in Appendix C. Cadmium (0.6 mg/kg; guideline 0.6 mg/kg) was equal to the interim sediment quality guideline whereas, chromium (38 mg/kg; guideline 37.3 mg/kg) and lead (62 mg/kg; guideline 35mg/kg) exceeded the CCME interim sediment quality guidelines in Pumphouse Pond but no parameter exceeded the Probable Effects Level. All other parameters were either non-detectable or below CCME guideline values.

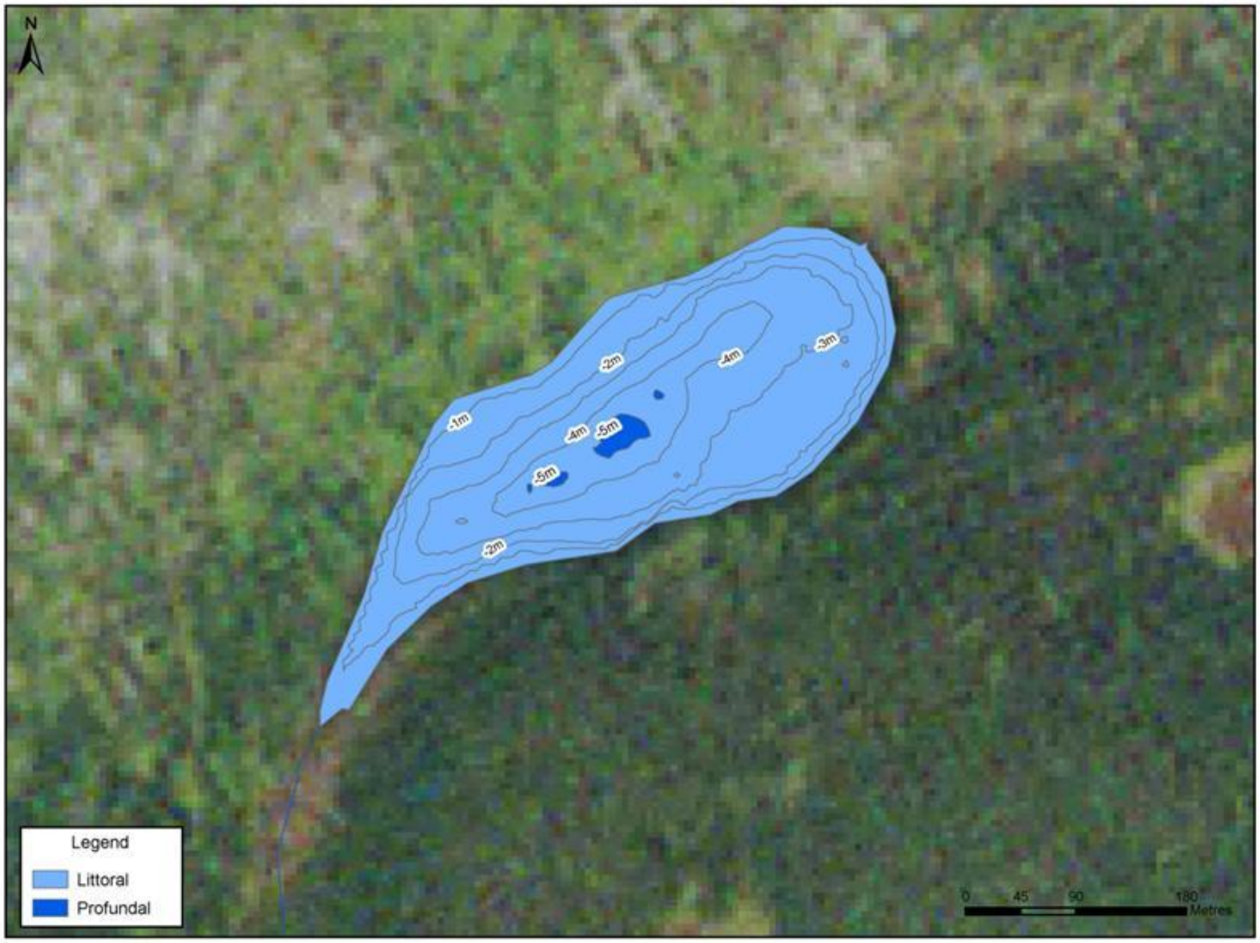


Figure 5.6: Pumphouse Pond Bathymetric contours with littoral and profundal zones indicated, August 2011.

5.1.1.16 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified 23 individuals, belonging to six groups (family, order or class) within Pumphouse Pond. Shannon-Weiner index and species evenness was calculated to be 1.83 and 0.706, respectively. Complete tabulated results are provided in Appendix D for all sample locations

5.1.1.17 Fish Species within Pumphouse Pond

A total of three fyke nets (six net-nights effort) were deployed throughout the pond over a period of two days. Brook trout were the only species captured (Section 5.1.1.1 provides brief life history of the species). A total of seven brook trout were captured and ranged from 175-278 mm in length and 57.4-204.7 g in weight. The length-weight relationship is presented in Figure 5.7.

5.1.1.18 Habitat Quantification

Secchi depth was averaged over two samples and determined to be 2.2 m. Pumphouse Pond is comprised of 7.4 ha of littoral and 0.1 ha of profundal habitat. Table 5.12 presents the overall areal extent of the delineation between the littoral as well as profundal habitat types.

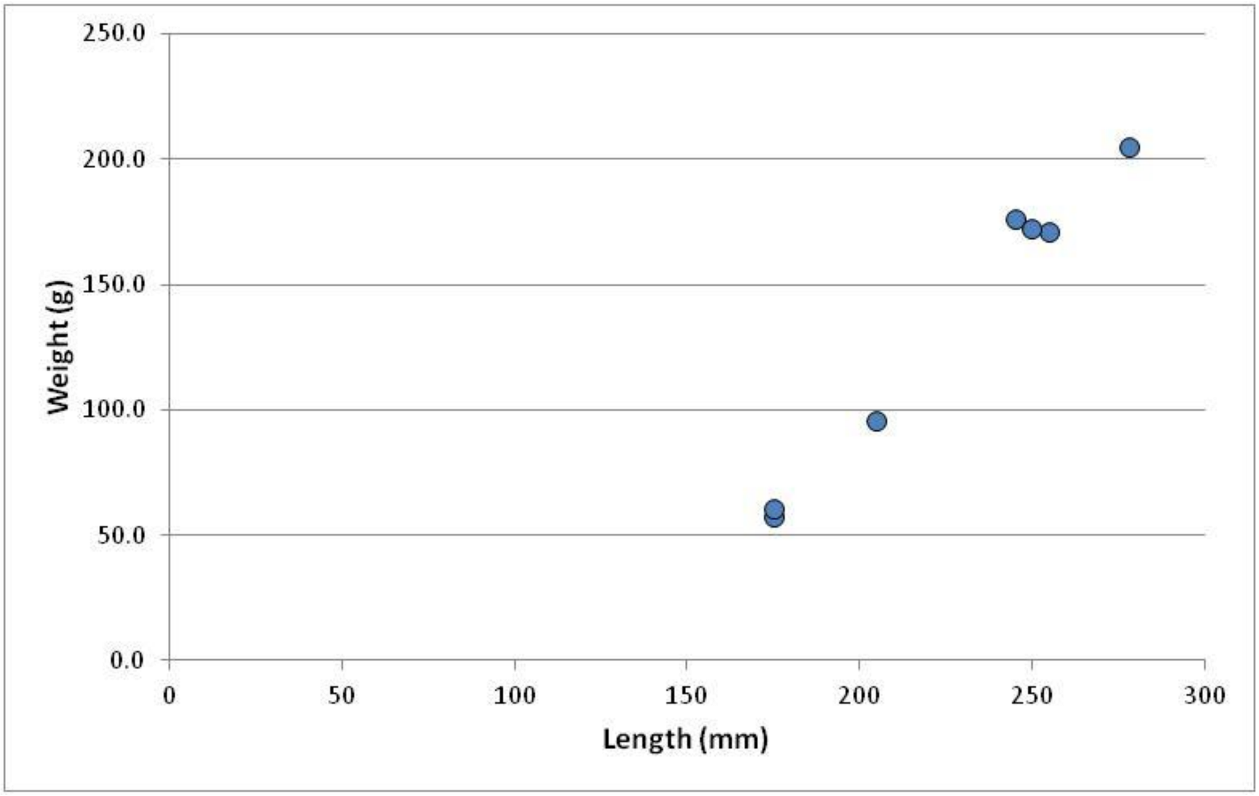


Figure 5.7: Length-weight relationship of brook trout captured within Pumphouse Pond, 2011.

Table 5.12: The calculated total area of each habitat type within Pumphouse Pond.

Habitat Type	Area (ha)
P - Profundal Zone	**0.13**
Lc - Littoral Zone - Coarse	1.24
Lm - Littoral Zone - Medium	3.57
Lf - Littoral Zone – Fine, no aquatic vegetation	2.66
Sub Total, Littoral Zone	**7.46**
Total Habitat	**7.59**

Littoral Coarse (comprising a majority of bedrock, boulder);
Littoral Medium (comprising a majority of rubble, cobble and gravel);
Littoral Fine (comprising a majority of sand and organics/detritus); and
Profundal (comprising a majority of organics/detritus).

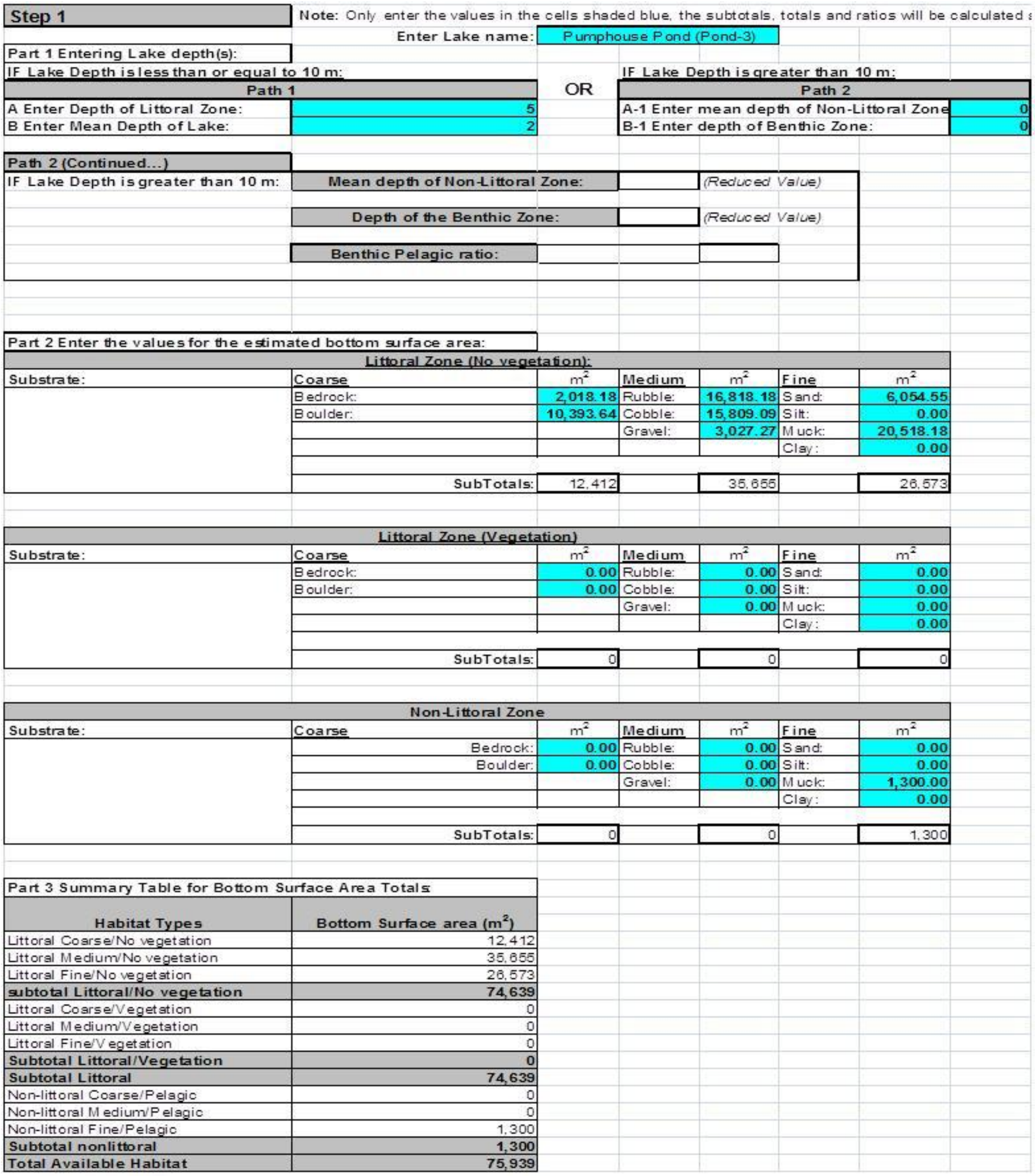
Habitat Suitabilities

The field habitat and species presence data collected was used within the DFO spreadsheet for calculating lacustrine habitat suitabilities and habitat equivalent units. Table 5.13 presents an overview of the habitat information used to determine habitat areas. Table 5.14 shows the habitat suitabilities of each habitat type for brook trout.

Habitat Equivalent Units

DFO spreadsheet calculations were used to determine final HEUs for Pumphouse Pond. Table 5.15 presents the results for brook trout. Total HEU is calculated at 5.94 ha.

Table 5.13: Summary of Pumphouse Pond habitat values used to calculate aerial extents.



Step 1

Note: Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated

Enter Lake name: Pumphouse Pond (Pond-3)

Part 1 Entering Lake depth(s):

IF Lake Depth is less than or equal to 10 m:			IF Lake Depth is greater than 10 m:	
Path 1		OR	Path 2	
A Enter Depth of Littoral Zone:	5		A-1 Enter mean depth of Non-Littoral Zone	0
B Enter Mean Depth of Lake:	2		B-1 Enter depth of Benthic Zone:	0

Path 2 (Continued...)

IF Lake Depth is greater than 10 m:			
	Mean depth of Non-Littoral Zone:		*(Reduced Value)*
	Depth of the Benthic Zone:		*(Reduced Value)*
	Benthic Pelagic ratio:		

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	2,018.18	Rubble:	16,818.18	Sand:	6,054.55
	Boulder:	10,393.64	Cobble:	15,809.09	Silt:	0.00
			Gravel:	3,027.27	Muck:	20,518.18
					Clay:	0.00
	SubTotals:	12,412		35,655		26,573

Littoral Zone (Vegetation)

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	0.00
					Clay:	0.00
	SubTotals:	0		0		0

Non-Littoral Zone

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	1,300.00
					Clay:	0.00
	SubTotals:	0		0		1,300

Part 3 Summary Table for Bottom Surface Area Totals

Habitat Types	Bottom Surface area (m^2)
Littoral Coarse/No vegetation	12,412
Littoral Medium/No vegetation	35,655
Littoral Fine/No vegetation	26,573
subtotal Littoral/No vegetation	**74,639**
Littoral Coarse/Vegetation	0
Littoral Medium/Vegetation	0
Littoral Fine/Vegetation	0
Subtotal Littoral/Vegetation	**0**
Subtotal Littoral	**74,639**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	1,300
Subtotal nonlittoral	**1,300**
Total Available Habitat	**75,939**

Table 5.14: Habitat suitabilities for all species, Pumphouse Pond.

			Littoral Zone						Non-Littoral Zone		
	Species	Life Stage	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic
1	Brook Trout (freshwater resident)	Spawning	0.00	0.72	0.64	0.00	0.72	0.64	0.00	0.42	0.14
		YOY	0.50	1.00	0.00	0.50	1.00	0.00	0.34	0.67	0.00
		Juvenile	0.50	1.00	0.00	0.50	1.00	0.00	0.42	0.84	0.00
		Adult	0.00	0.67	0.34	0.00	0.67	0.39	0.00	0.42	0.17

Table 5.15: Habitat equivalent units for all species, Pumphouse Pond.

		Littoral Zone						Non-Littoral Zone			
	Species	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic	Total Available Habitat
☐ 1	Brook Trout (freshwater resident)	6206	35655	17272	0	0	0	0	0	221	59353.5

5.1.1.19 Catch-per-unit-effort Comparison Between Ponds

Figure 5.8 presents a comparison of catch-per-unit-effort (CPUE) between the ponds surveyed within the Leg Lake watershed. As shown in the graph, Leg Lake has the highest CPUE (2.67 fish/net-night) while Pumphouse Pond had the lowest (1.17 fish/net-night). It should be noted that during the surveys of Pumphouse Pond large schools of brook trout (20+ fish) were noted travelling along the north shoreline. Nets were moved to this location, but catch was not increased.

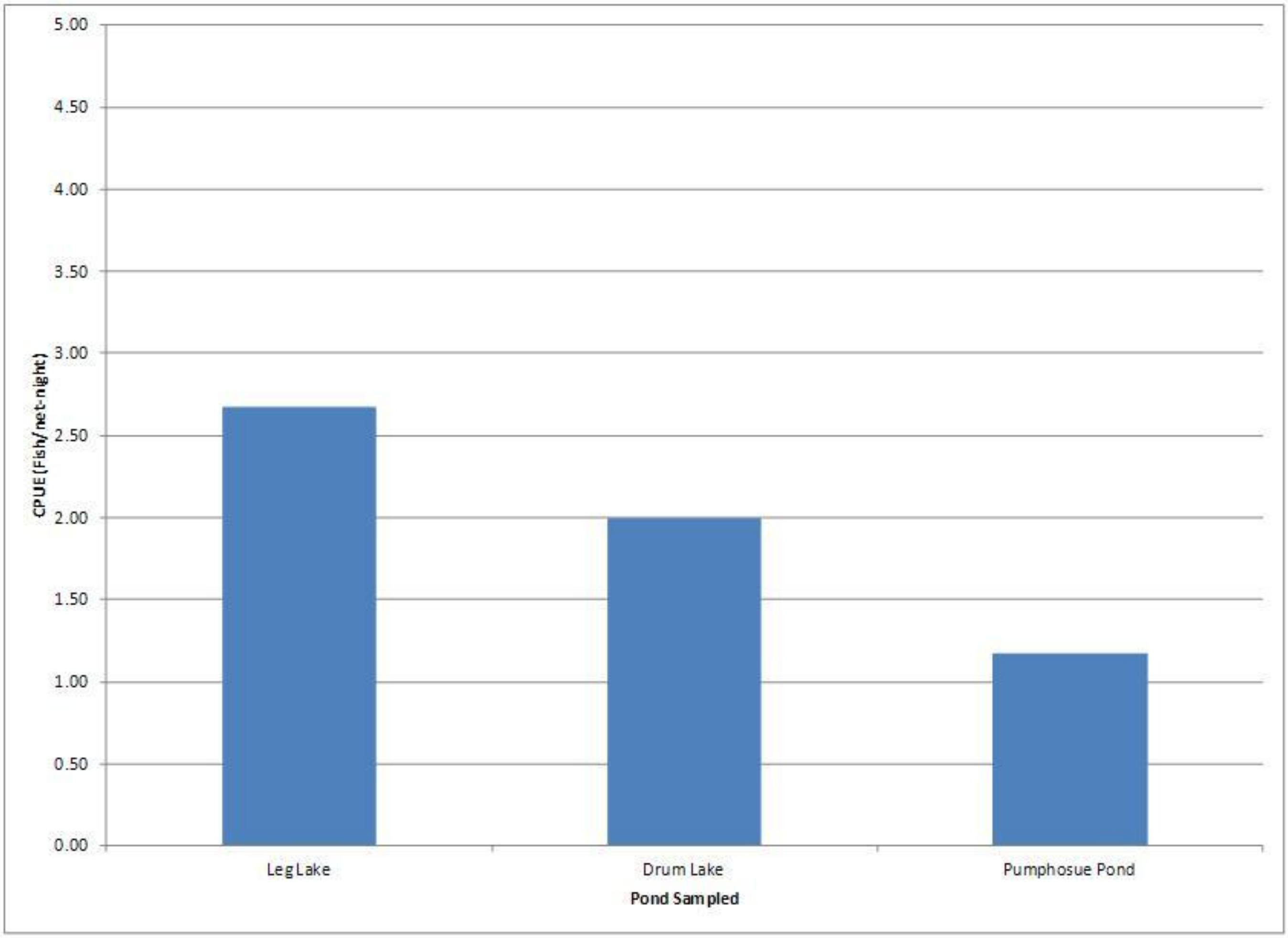


Figure 5.8: Summary of CPUE from Leg Lake Watershed's Lacustrine Habitats

5.1.2 Riverine Habitat Characterization

Survey data collected from riverine sites within the Leg Lake watershed were analyzed to determine the habitat classification of each site. In total, three tributaries are located within the Leg Lake watershed; T2A, T2B, and T2-4.

5.1.2.1 Surface Water Quality

Surface water quality results are provided in Appendix C. In general, aluminum (367 µg/L; CCME guideline 100 µg/L) and iron (800 µg/L; CCME guideline 300 µg/L) were in excess of CCME guidelines in Leg Lake stream (Tributary T2A).

5.1.2.2 Sediment Sampling

Sediment quality results are provided in Appendix C. There were no exceedances of CCME guidelines in Leg Lake stream sediment samples analyzed.

5.1.2.3 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified 19 individuals, belonging to nine families within Tributary T2. Shannon-Weiner index and species evenness was calculated to be 2.87 and 0.904, respectively. Complete tabulated results are provided in Appendix D for all samples collected.

5.1.2.4 Fish Species within the Leg Lake Watershed Streams

During the survey four species were identified within the Leg Lake watershed including brook trout, lake chub (Couesius plumbeus), burbot (Lota lota) and sculpin species (mottled - Cottus bairdii and slimy - Cottus cognatus). Recent DFO documents summarize the general biology of each species for use in habitat quantification (see Bradbury et al. 1999 and Grant and Lee 2004). Each is listed below with a brief life history description from the above documents. Note, brook trout life history summary was presented in Section 5.1.1.1.

Burbot

Burbot are the only member of the Gadidae family that resides in freshwater (Scott and Crossman 1998). They occur in continental Eurasia and North America, southward to about 40° North (Scott and Crossman 1998), where they frequent cool waters of large rivers, lower reaches of tributaries, and large lakes (Becker 1983).

Burbot either spawn in lakes (Boag 1989; Ghan and Sprules 1991; Scott and Crossman 1998; Bradbury et al. 1999) or rivers (Cahn 1936; Robbins and Deubler 1955; Chen 1969; McPhail and Lindsey 1970; Sorokin 1971; Johnson 1981; Breeser et al. 1988; Evenson 1993; Scott and Crossman 1998; Arndt and Hutchinson 2000). Spawning usually takes place in mid-winter (January-March) under the ice. The semi-buoyant eggs are broadcast into the water column well above the substrate (Fabricius 1954), then become demersal and settle into interstices in the substrate (Sorokin 1971; Morrow 1980; Ford et al. 1995). Eggs typically hatch from late February to June (AGRA 1999). Those that spawn in rivers reside in lakes but migrate into rivers to spawn (McPhail and Lindsey 1970). Throughout its geographical range in Canada, burbot generally reach sexual maturity between 2- 8 years of age (McCrimmon and Devitt 1954; Scott and Crossman 1973; Ryan 1980; Ford et al. 1995).

Burbot feed on benthic invertebrates initially, moving to an exclusively fish diet once they reach a size greater than 500 mm (AGRA 1999).

Lake Chub

The lake chub occurs widely throughout Canada and in scattered localities throughout the northern United States (Scott and Crossman 1998). In eastern Canada, the species is found in streams, rivers, and lakes of Nova Scotia, New Brunswick, Quebec, and Labrador (Scott and Crossman 1998). It has been reported in Labrador streams and lake-like expansions of the Churchill River system, Hamilton Inlet basin, and the Grand Lake system (Backus 1951; Ryan 1980; Black et al. 1986), but is not present on the island of Newfoundland (Black et al. 1986). The lake chub is known to tolerate a wide variety of conditions, ranging from clear to turbid waters and cool northern waters to the outlets of hot springs (McPhail and Lindsey 1970; Becker 1983; Scott and Crossman 1998).

Lake chub usually undergo spawning migrations from lakes to tributary streams in May or June, shortly after ice-out (Brown et al. 1970; McPhail and Lindsey 1970; Scott and Crossman 1973; Bruce and Parsons 1976; Burgess 1978; Morrow 1980).

Sculpin (Cottus sp.)

<u>Mottled sculpin (Cottus bairdii)</u>

In eastern Canada, the mottled sculpin is confined to northern areas, occurring throughout the Churchill (AGRA 1999; Black et al. 1986) and Atikonak river systems (LGL Limited 1999) of Labrador, north through Ungava Bay, Quebec (Scott and Crossman 1998). Anderson (1985) reported that DFO surveys have identified sculpin from stomach contents of several species of fish (burbot, brook trout, lake whitefish, northern pike, lake trout) taken in the lower Churchill River main stem, as well as in the upper main stem of the river.

Mottled sculpin occur in cool, headwaters and, although typically a stream-dwelling species, they also inhabit large lakes (Becker 1983). Mottled sculpin are intolerant of high water temperatures and tend to occur in the coldest streams during the summer, usually with water temperatures between 11 and 16°C (Petrosky and Waters 1975). Spawning typically takes place in the spring, around April or mid-May (Scott and Crossman 1973), in the littoral zone (less than 1 m) of lakes under rocks and logs (Downhomer and Brown 1979; Lyons 1987; Ryan 1980; Savage 1963). Nesting is peculiar, with females depositing adhesive eggs on the ceilings of rocks, ledges or burrowed nesting sites (usually consists of small gravel) while in an inverted position (Downhomer and Brown 1979; Keenleyside 1979; Savage 1963; Scott and Crossman 1973), with the male subsequently guarding and aerating the eggs (Grant and Lee 2004).

Slimy sculpin (Cottus cognatus)

In eastern Canada, the slimy sculpin occurs in the Churchill and Fraser River systems of Labrador (Black et al. 1986; Scott and Crossman 1973) through most of Quebec and Ungava Bay (Scott and Crossman 1973). The species typically inhabits deep oligotrophic lakes, swift rocky bottomed streams, areas of groundwater upwelling and headwater pools and riffles (Scott and Crossman 1998). In eastern Canada, the slimy sculpin frequents rocky or gravel streams and lake bottoms, and have been captured at depths ranging from 0.5 to 150 m (Brandt 1986; Mohr 1984, 1985; Scott and Crossman 1973; Wells 1980). However, the habitat utilized varies greatly depending upon on substrate and temperature (Scott and Crossman 1998). The slimy sculpin has been shown to have a very small home range and they do not migrate great distances (Morrow 1980).

Spawning occurs in May, shortly after ice-out over sand and gravel substrate in shallow sections of streams and lakes (Burgess 1978; McPhail and Lindsey 1970; Mohr 1984; Morrow 1980; Scott and Crossman 1973). The male selects the spawning site, which can be found under rocks, submerged logs, tree roots, or amongst large gravel or other foreign debris and is most common at depths less than 30 cm (Mohr 1985; Morrow 1980; Ryan 1980; Scott and Crossman 1973). In rivers, juveniles and adults are generally found in areas with cobble/rubble bottoms t velocities of less than 0.3 m/s (Van Snik-Gray and Stauffer 1999). Generally, as young slimy sculpin grow and mature, they shift from a shallow water habitat and nocturnal feeding to continuous activity in deeper water (Brandt 1986; Mohr 1985; Wells 1968). Diet mainly consists of benthic organisms (Mohr 1984; Wells 1980).

5.1.2.5 Productivity Estimates

A total of two quantitative electrofishing stations were completed in the Lag Lake watershed (Figure 5.1). Table 5.16 presents the mean standing stock estimates of all fish species from the representative electrofishing stations in the Leg Lake watershed. For riverine habitat quantification, all fish were measured for length and weight. A length-weight relationship was established for each station for those species with many captures (i.e. >10) to determine total biomass within each habitat. Figures 5.9 and 5.10 present the length-weight relationships for brook trout recorded in the electrofishing stations completed within the Leg Lake watershed.

Table 5.16: Summary of standing stock and biomass estimates for electrofishing stations, August 2011.

Station	Area (m^2)	Species	Total Catch	Pop. Est./Unit (N/unit)	Confidence Limits (N/unit)		Estimated Biomass (gm/unit)
					LCL[1]	UCL[2]	
Quantitative Stations : Leg Lake Watershed							
Leg Lake Station 1	274	Brook trout Burbot	52 5	28 5	26 5	32 8	418.7 177.35

		Lake chub Sculpin	1 7	1[3] 7	- 7	- 8	- 28.7
Leg Lake Station 2	280	Brook Trout	53	30	27	34	371.0

[1] Lower Confidence Limit (LCL). If statistical CI is lower than number of fish actually captured, actual number captured is presented.

[2] Upper Confidence Limit (UCL).

[3] Number based on those captured (sample too small to calculate estimate or was an Index site).

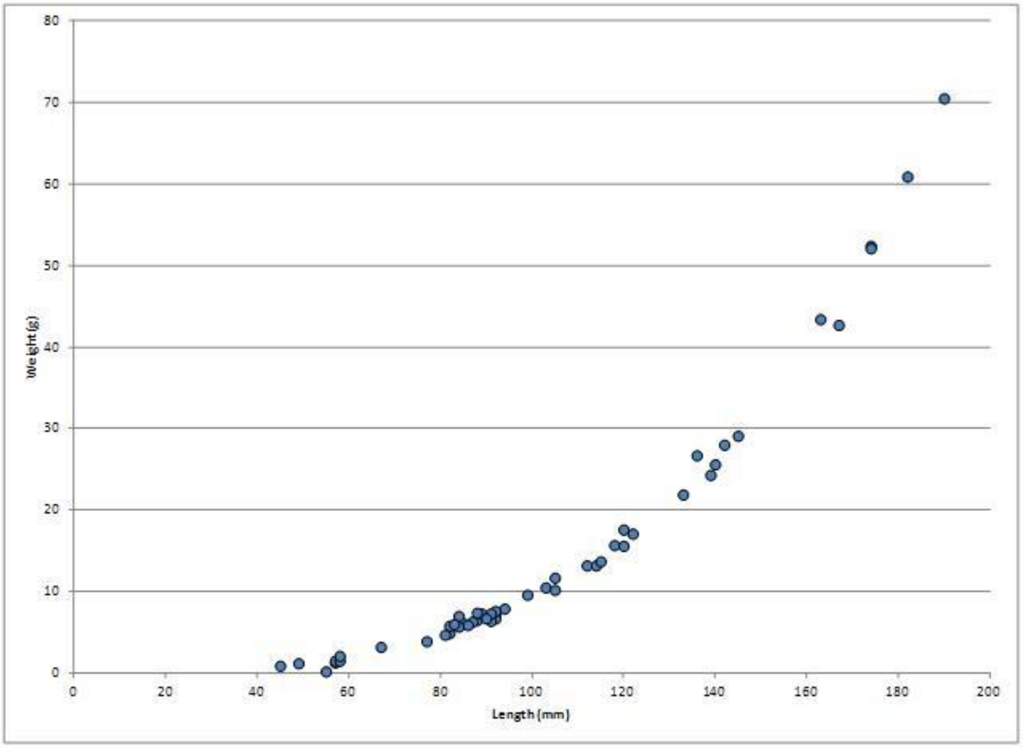


Figure 5.9: Length-weight relationship, brook trout, Electrofishing Station #1 (Tributary T2A), 2011.

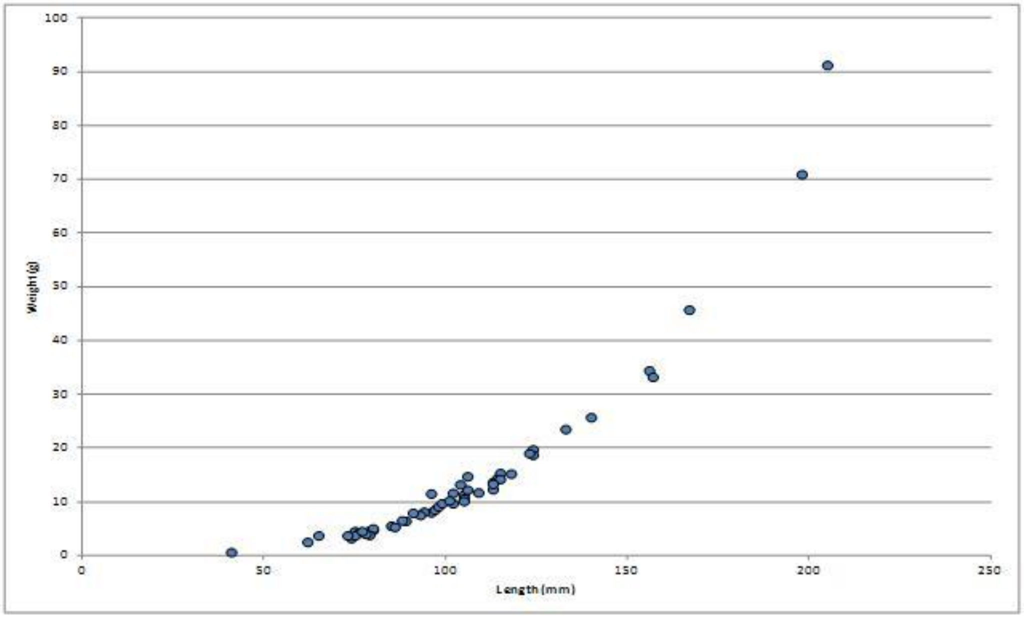


Figure 5.10: Length-weight relationship, brook trout, Electrofishing Station #2 (Tributary T2A), 2011

5.1.3 Riverine Habitat Quantification

5.1.3.1 Tributary T2

The Leg Lake drainage is classified as a second order tributary that drains into Harrie Lake. It has been given the tributary label T2. All subsequent sub-divisions of the tributary are T2A, T2B and T2-4. Each is described below. Photos of each stream survey reach are provided in Appendix B.

Tributary T2A

Tributary T2A is the lower portion of the drainage and consists of stream habitat downstream of Leg Lake. It is approximately 3,220 m in length and contains 95.7 units of riverine fish habitat. Channel widths ranged from 1.3-14.1 m and depths ranged from 0.04-0.39 m. Water velocities ranged from 0.01-2.25 m/s.

Table 5.17 presents a summary of habitat characteristics as well as the habitat classification in both the Beak and proposed new riverine classifications for each stream reach. The Beak habitat classification quantifies the river as a total of 50.11 units of Type I (Spawning and Rearing), 30.62 units of Type II (Rearing, Limited Spawning), 0.38 units of Type III (Migration) and 14.64 units of Type IV (Sheltering and Feeding) habitat. The new classification system (McCarthy et al. 2007) identifies a total of 81.95 units of Riffle, 11.47 units of Pool/small pond, 3.17 units of Steady, 1.60 units of Rapid, and 0.38 units of Cascade habitat types.

Table 5.18 summarizes the species suitability for each reach of Tributary T2A (i.e. highest life-cycle stage value) for all species found in the tributary, as well as the calculations of the HEUs. For Tributary T2A, Brook trout give an overall HEU value of 72.83 units, burbot give an overall HEU value of 55.51 units, lake chub give an overall HEU value of 73.35 units and sculpin give an overall HEU value of 69.84 units.

Table 5.17: Summary of habitat measurements and classifications for Tributary T2A south of Leg Lake.

Transect #	Section Length (m)	Wet Width (m)	Channel Width (m)	Area (units)	Bank Height (m)		Average Depth (m)	Average Velocity (m/s)	Slope (%)	Substrate (%)[1]												Classification	
					L	R				B	LgB	SmB	R	C	G	S	St	Cl	D	M	AqV	Beak	New
1	100	3.5	3.8	3.47	0.37	0.25	0.13	0.15	0.15							10				90		IV	Pool
2	100	3.1	4.0	3.08	0.52	0.45	0.35	0.09	0.2							10				90		IV	Pool
3	100	2.2	3.5	2.20	0.53	0.53	0.23	0.12	0.0							10			15	75		IV	Pool
4	100	1.3	1.9	1.34	0.41	0.52	0.17	0.25	0.3							80			10	10		I	Riffle
5	112	3.1	3.3	3.50	0.36	0.37	0.09	0.36	0.3						5	85			10			II	Riffle
6	5	11.1	12.0	0.54	-	-	0.12	0.07	-							15			5	80		IV	Pool
7	90	2.4	3.5	2.12	0.44	0.50	0.14	0.23	0.3						80	20						I	Riffle
8	6	4.7	4.7	0.27	0.30	0.39	0.39	0.02	-					15	60	20	5					IV	Pool
9	87	2.7	3.2	2.33	0.24	0.35	0.18	0.17	0.7			10		20	30	40						I	Riffle
10	100	1.7	2.2	1.70	0.29	0.31	0.15	0.52	1.0		5	20	30	25	15	5						II	Riffle
11	5	7.6	7.6	0.40	-	-	-	-	-					5	50	30	5		10			IV	Pool
12	105	2.1	3.0	2.23	0.32	0.41	0.08	0.56	2.4		5	35	30	15	15							II	Riffle
13	11	14.1	18.3	1.51	0.19	0.10	0.12	0.01	-		5	10	40	25	15	5						IV	Pool
14	100	3.2	5.2	3.17	0.18	0.21	0.16	0.09	0.5			10	15	45	15	10			5			IV	Steady
15	100	2.7	3.1	2.73	0.36	0.35	0.16	0.23	2.7		10	25	30	15	15	5						I	Riffle
16	100	2.5	2.9	2.49	0.43	0.30	0.14	0.16	2.0		5	15	35	20	15	10						I	Riffle
17	100	2.1	3.0	2.10	0.43	0.36	0.17	0.18	3.5			10	30	35	20	5						I	Riffle
18	100	2.7	3.8	2.70	0.32	0.26	0.08	0.40	2.6		15	20	20	15	25	5						II	Riffle
19	94	4.2	7.5	3.97	0.34	0.45	0.16	0.30	4.1		10	20	40	20	10							I	Riffle
20	100	1.6	2.7	1.60	0.56	0.55	0.14	0.71	7.3		25	40	15	10	10							II	Rapids
21	100	3.1	4.1	3.10	0.44	0.44	0.14	0.40	2.6		5	40	35	15	5							II	Riffle
22	100	3.7	3.9	3.70	0.32	0.44	0.24	0.26	9.0		5	50	30	10	5							I	Riffle
23	100	2.4	4.2	2.40	0.33	0.53	0.10	0.30	12.0		20	40	25	10	5							I	Riffle
24	100	2.9	3.9	2.90	0.38	0.42	0.18	0.36	6.9		20	35	30	10	5							II	Riffle
25	120	2.5	3.3	0.01	0.31	0.15	0.13	0.45	2.9			10	60	15	10	5						II	Riffle
26	87	3.3	3.4	2.84	0.35	0.32	0.10	0.36	0.6			15	30	25	20	10						II	Riffle
27	100	5.1	5.3	5.08	0.37	0.33	0.14	0.30	9.1		30	30	10	10	10	10						I	Riffle
28	40	2.8	3.6	1.10	0.24	0.40	0.09	0.55	6.9	50	25	15	5		5							II	Riffle
29	16	2.4	2.9	0.38	0.47	0.42	0.04	2.25	24.4	50	20	20		5	5							III	Cascade
30	100	2.9	3.3	2.90	0.33	0.26	0.18	0.19	0.5	10	10	5	30	25	10	10						I	Riffle
31	100	4.0	4.5	4.02	0.38	0.26	0.08	0.49	6.0		60	5	15	5	10	5						II	Riffle
32	60	3.9	4.5	2.36	0.44	0.41	0.16	0.29	1.4	30	5	20	25	15	5							I	Riffle
33	100	2.5	3.0	2.54	0.37	0.45	0.17	0.39	1.6	15	5	30	25	15	10							II	Riffle
34	100	2.4	2.6	2.38	0.32	0.04	0.12	0.50	1.1	15	5	40	20	10	10							II	Riffle
35	100	5.7	7.0	5.70	0.29	0.31	0.13	0.34	2.0	5	10	25	35		25							I	Riffle
36	120	3.9	5.2	4.68	0.34	0.37	0.14	0.21	0.1		5	10	15	25	30	15						I	Riffle
37	106	4.1	4.6	4.35	0.21	0.26	0.13	0.28	1.4		35	20	15	10	15	5						I	Riffle
38	25	3.6	3.7	0.89	0.27	0.20	0.05	0.17	2.5			25	40	15	15	5						I	Riffle
39	32	3.0	3.2	0.97	0.18	0.21	0.13	0.34	1.5			10	60	20	10							I	Riffle
Total	**3220**			**95.74**																			

[1] Be-Bedrock, LgB-Large Boulder, SmB–Small Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, St-Silt, D-Detritus, M-Mud, AqV-Aquatic Vegetation.

Table 5.18: Summary habitat suitability information and HEUs for Tributary T2A south of Leg Lake.

Reach #	Units	Brook trout		Burbot		Lake chub		Sculpin	
		Habitat Suitability	HEU	Habitat Suitability	HEU	Habitat Suitability	HEU	Habitat Suitability	HEU
1	3.47	0.55	1.90	0.35	1.21	0.55	1.91	0.95	3.30
2	3.08	0.37	1.12	0.53	1.64	0.55	1.69	0.92	2.82
3	2.20	0.40	0.88	0.50	1.10	0.55	1.21	0.90	1.98
4	1.34	0.72	0.96	0.65	0.87	0.90	1.21	0.79	1.05
5	3.50	0.87	3.03	0.32	1.10	0.95	3.33	0.85	2.98
6	0.54	0.26	0.14	0.67	0.37	0.58	0.31	0.96	0.52
7	2.12	0.86	1.83	0.76	1.62	1.00	2.12	0.77	1.63
8	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	2.33	0.85	1.98	0.60	1.40	0.95	2.22	0.80	1.87
10	1.70	0.88	1.49	0.73	1.23	0.81	1.38	0.83	1.42
11	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	2.23	0.94	2.09	0.74	1.64	0.81	1.81	0.87	1.94
13	1.51	0.55	0.83	0.77	1.16	0.93	1.40	0.93	1.40
14	3.17	0.66	2.10	0.66	2.10	0.93	2.93	0.89	2.81
15	2.73	0.78	2.12	0.63	1.71	0.83	2.25	0.66	1.80
16	2.49	0.93	2.31	0.78	1.94	0.90	2.24	0.77	1.92
17	2.10	0.78	1.63	0.70	1.48	0.95	2.00	0.76	1.60
18	2.70	0.89	2.40	0.69	1.86	0.71	1.93	0.83	2.24
19	3.97	0.86	3.40	0.71	2.81	0.85	3.37	0.81	3.20
20	1.60	0.94	1.50	0.49	0.78	0.75	1.20	0.83	1.33
21	3.10	0.75	2.33	0.53	1.63	0.73	2.25	0.68	2.09
22	3.70	0.77	2.86	0.50	1.84	0.73	2.68	0.68	2.52
23	2.40	0.78	1.87	0.41	0.98	0.69	1.66	0.57	1.36
24	2.90	0.95	2.77	0.63	1.84	0.63	1.84	0.59	1.71
25	0.01	0.83	0.01	0.71	0.01	0.89	0.01	0.76	0.01
26	2.84	0.93	2.63	0.80	2.28	0.93	2.62	0.69	1.97
27	5.08	0.79	4.02	0.44	2.24	0.70	3.56	0.61	3.10
28	1.10	0.58	0.64	0.30	0.33	0.43	0.47	0.52	0.57
29	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	2.90	0.63	1.83	0.60	1.75	0.83	2.41	0.74	2.14
31	4.02	0.89	3.57	0.54	2.17	0.72	2.90	0.67	2.70
32	2.36	0.60	1.41	0.48	1.12	0.66	1.56	0.55	1.29
33	2.54	0.83	2.10	0.65	1.65	0.70	1.78	0.79	2.01
34	2.38	0.78	1.86	0.56	1.33	0.71	1.69	0.73	1.74
35	5.70	0.81	4.61	0.68	3.90	0.74	4.24	0.65	3.69
36	4.68	0.75	3.51	0.61	2.85	0.93	4.33	0.63	2.93
37	4.35	0.83	3.62	0.53	2.32	0.73	3.15	0.66	2.87
38	0.89	0.80	0.71	0.65	0.58	0.88	0.78	0.68	0.60
39	0.97	0.77	0.75	0.72	0.70	0.95	0.92	0.76	0.74
Total	**95.74**		**72.83**		**55.51**		**73.35**		**69.84**

Tributary T2B

Tributary T2B is located just north (upstream) of Leg Lake and is approximately 571 m in length and contains 8.52 units of fish habitat. Tributary T2B drains a bog from the north of Leg Lake ibto Leg Lake; no other streams or water bodies exist upstream. Channel widths ranged from 0.8-9.1 m and depths ranged from 0.04-0.35 m. Water velocities were low and ranged from 0.00-0.31 m/s. Table 5.19 presents a summary of habitat characteristics and classification for the tributary. The Beak habitat classification quantifies the river as a total of 6.91 units of Type IV (Sheltering and Feeding) or Pool type habitat, 0.07 units of Type III and 1.54 units of Type II (Rearing, Limited Spawning). The tributary ends in a series of intermittent pools with no defined channel. The new classification system (McCarthy et al. 2007) identifies 6.91 units of Pool habitat, 1.54 units of Run habitat and 0.07 units of Falls.

Table 5.20 summarizes the species suitability for each reach of Tributary T2B for all species found in the watershed, as well as the calculations of the HEU. For Tributary T2B, Brook trout give an overall HEU value of 2.09 units, burbot give an overall HEU value of 5.21 units, lake chub give an overall HEU value of 4.83 units and sculpin give an overall HEU value of 7.08 units.

Table 5.19: Summary of habitat measurements and classifications for Tributary T2B, north of Leg Lake.

Transect #	Section Length (m)	Wetted Width (m)	Channel Width (m)	Area (units)	Bank Height (m)		Average Depth (m)	Average Velocity (m/s)	Slope %	Substrate (%)[1]												Classification	
					L	R				B	LgB	SmB	R	C	G	S	S	C	D	M	AqV	Beak	New
1	100.0	1.0	1.2	1.00	0.17	0.13	0.13	0.09	8.00			75	10	5						10		II	Run
2	34.8	0.9	1.6	0.30	0.30	0.31	0.08	0.13	6.72		5	70	10	10						5		IV	Debris Pool
3	36.7	2.0	2.3	0.73	0.16	0.18	0.13	0.00	0.00				5							95		IV	Pool
4	51.5	1.0	1.1	0.54	0.27	0.25	0.04	0.31	14.44		10	50	30			5				5		II	Run
5	8.5	0.8	0.8	0.07						40	50	10										III	Falls
6	60.0	1.5	2.5	0.91	0.47	0.37	0.13	0.04				45	30		15						10	IV	Pool
7	28.4	1.7	2.0	0.49	0.15	0.19	0.35	0.00	1.86			10	15							75		IV	Pool
8	67.8	1.4	1.6	0.95	0.08	0.14	0.20	0.04	4.31			35			15					20	30	IV	Pool
9	100.0	1.2	1.5	1.21	0.16	0.19	0.20	0.00	6.87			20	20							50	10	IV	Pool
10	67.4	1.3	1.5	0.84	0.18	0.18	0.22	0.00	0.26											100		IV	Pool
11	16.3	9.1	9.1	1.48			0.27	0.00	0.00				5							95		IV	Pool
12[2]																				100		N/A	N/A

[1] Be-Bedrock, LgB-Large Boulder, SmB–Small Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, St-Silt, D-Detritus, M-Mud, AqV-Aquatic Vegetation.

[2] Stream disappears into a large boggy area with no defined channel. Bog contains unconnected intermittent pools.

Table 5.20: Summary habitat suitability information and HEUs for Tributary T2B, north of Leg Lake.

Reach #	Units	Brook trout		Burbot		Lake chub		Sculpin	
		Habitat Suitability	HEU	Habitat Suitability	HEU	Habitat Suitability	HEU	Habitat Suitability	HEU
1	1.00	0.53	0.53	0.48	0.48	0.73	0.73	0.54	0.54
2	0.30	0.65	0.19	0.41	0.12	0.67	0.20	0.54	0.16
3	0.73	0.00	0.00	0.67	0.49	0.53	0.39	1.00	0.73
4	0.54	0.81	0.43	0.48	0.26	0.68	0.36	0.57	0.30
5	0.07	0.87	0.06	0.45	0.03	0.60	0.04	0.53	0.04
6	0.91	0.54	0.49	0.62	0.57	0.75	0.69	0.70	0.64
7	0.49	0.00	0.00	0.67	0.33	0.58	0.29	0.95	0.46
8	0.95	0.40	0.37	0.60	0.56	0.63	0.60	0.83	0.78
9	1.21	0.00	0.00	0.67	0.81	0.63	0.77	0.90	1.09
10	0.84	0.00	0.00	0.67	0.56	0.00	0.00	1.00	0.84
11	1.48	0.00	0.00	0.67	1.00	0.53	0.78	1.00	1.48
12	0.00	0.33	0.00	0.33	0.00	0.00	0.00	1.00	0.00
Total	**8.52**		**2.09**		**5.21**		**4.83**		**7.08**

Tributary T2-4

Tributary T2-4 is located to the east of Leg Lake and is approximately 986 m in length and contains 15.81 units of riverine habitat. The tributary contains two main water bodies; Drum Lake and Pumphouse Pond, located in the middle and head of the tributary respectively. Channel widths ranged from 0.5-3.7 m and depths ranged from 0.05-0.30 m. Water velocities were low and ranged from 0.00-0.31 m/s.

Table 5.21 presents a summary of habitat characteristics and classification for the tributary. The Beak habitat classification quantifies the stream as 0.99 units of Type I (Spawning and Rearing) or riffle type habitat, 1.42 units of Type II, 4.12 units of Type III and and 9.28 units of Type IV (Sheltering and Feeding) or pool type habitat. The new habitat classification (McCarthy et al. 2007) quantifies the stream as 0.73 units of Run, 3.22 units of Cascade, 1.83 units of Riffle and 10.03 units of Pool habitat.

Table 5.22 summarizes the species suitability for each reach of Tributary T2-4 for all species found in the watershed, as well as the calculations of the HEU. For Tributary T2-4, Brook trout give an overall HEU value of 8.12 units, burbot give an overall HEU value of 10.26 units, lake chub give an overall HEU value of 11.68 units and sculpin give an overall HEU value of 12.62 units.

Table 5.21: Summary of habitat measurements and classifications for Tributary T2-4 east of Leg Lake.

Transect #	Section Length (m)	Wetted Width (m)	Channel Width (m)	Area (units)	Bank Height (m)		Average Depth (m)	Average Velocity (m/s)	Slope (%)	Substrate												Classification	
					L	R				B	LgB	SmB	R	C	G	S	St	C	D	M	AqV	Beak	New
1	55.0	2.1	2.8	1.14	0.33	0.39	0.09	0.12	4.06			30	50	10		10						II	Riffle
2	100.0	1.9	2.8	1.90	0.23	0.49	0.09	0.15	8.74		5	60	10	5	20							III	Cascade
3	100.0	1.3	1.6	1.32	0.28	0.27	0.11	0.12	8.61		10	20	60	10								III	Cascade
4	42.8	1.7	2.1	0.73	0.07	0.24	0.08	0.12	9.11		10	60		10		20						III	Run
5	67.5	1.4	2.3	0.97	0.16	0.23	0.09	0.01	0.17			10			15	25				50		IV	Pool
6	102.6	2.5	2.7	2.57	0.23	0.15	0.14	0.01	0.00			10	10			20				60		IV	Pool
Drum Lake (Pond P01)																							
7	6.6	1.5	2.0	0.10	0.32	0.19	0.05	0.31	2.73				30		70							I	Riffle
8	4.8	2.2	2.0	0.11	0.28	0.31	0.08	0.06	1.46			20	5	50	20	5						I	Riffle
9	6.1	0.5	0.5	0.03	0.38	0.01	0.14	0.07	1.48					80	10	10						I	Riffle
10	3.2	2.5	2.5	0.08	0.28	0.47	0.18	0.04	0.00				10			80				10		IV	Pool
11	5.6	2.2	2.0	0.12	0.43	0.44	0.23	0.02	0.00			20	30	40		10						IV	Pool
12	6.9	1.1	0.9	0.08	0.26	0.24	0.15	0.06	0.87			80				10				10		IV	Pool
13	7.4	1.5	1.7	0.11	0.08	0.45	0.20	0.01	1.35			5	10	10		75						IV	Pool
14	6.7	1.1	1.0	0.07	0.24	0.21	0.20	0.00	2.39			95			5							IV	Pool
15	23.4	1.2	1.2	0.28	0.35	0.33	0.14	0.01	3.48				80	20								II	Riffle
16	21.1	0.8	1.1	0.17	0.36	0.29	0.08	0.11	2.56			20	60		20							III	Riffle
17	3.8	2.8	-	0.11	-	-	-	-	-			5	50		25	20						I	Pool
18	17.4	1.0	1.2	0.17	0.35	0.27	0.18	0.01	6.98			30	30		20	20						I	Pool
19	12.7	3.7	3.8	0.47	0.26	0.14	0.30	0.00	0.39				10						20	70		I	Pool
20	41.7	1.7	2.0	0.71	0.32	0.26	0.10	0.03	0.00				30	15	15	40						IV	Pool
21	5.9	3.6	-	0.21	-	-	-	-	-				25	10	20	45						IV	Pool
22	100.0	1.0	1.6	1.00	0.35	0.21	0.09	0.03	0.00											100		IV	Pool
23	100.0	1.0	1.6	1.04	0.29	0.27	0.16	0.00	0.89			10		20		30				40		IV	Pool
24	145.0	1.6	2.4	2.32	0.09	0.28	0.10	0.02	3.14			10	10	50		30						IV	Pool
Pumphouse Pond (Pond P03)																							

Table 5.22: Summary habitat suitability information and HEUs for Tributary T2-4 east of Leg Lake.

Reach #	Units	Brook trout		Burbot		Lake chub		Sculpin	
		Habitat Suitability	HEU	Habitat Suitability	HEU	Habitat Suitability	HEU	Habitat Suitability	HEU
1	1.14	0.67	0.76	0.58	0.67	0.85	0.97	0.68	0.78
2	1.90	0.70	1.33	0.45	0.86	0.68	1.28	0.58	1.09
3	1.32	0.78	1.03	0.57	0.76	0.85	1.12	0.74	0.98
4	0.73	0.75	0.55	0.40	0.29	0.65	0.47	0.57	0.41
5	0.97	0.35	0.34	0.68	0.66	0.70	0.68	0.95	0.92
6	2.57	0.32	0.81	0.68	1.75	0.65	1.67	0.65	1.67
Drum Lake (Pond P01)									
7	0.10	1.00	0.10	1.00	0.10	1.00	0.10	0.88	0.09
8	0.11	0.67	0.07	0.71	0.07	0.90	0.10	0.90	0.10
9	0.03	0.67	0.02	0.83	0.02	1.00	0.03	1.00	0.03
10	0.08	0.59	0.05	0.81	0.06	0.95	0.07	0.95	0.08
11	0.12	0.60	0.07	0.75	0.09	0.90	0.11	0.90	0.11
12	0.08	0.70	0.05	0.40	0.03	0.77	0.06	0.60	0.05
13	0.11	0.57	0.06	0.93	0.10	0.98	0.10	0.98	0.10
14	0.07	0.00	0.00	0.53	0.04	0.84	0.06	0.53	0.04
15	0.28	0.60	0.17	0.70	0.20	1.00	0.28	1.00	0.28
16	0.17	0.79	0.13	0.69	0.12	0.90	0.15	0.45	0.08
17	0.11	1.00	0.11	0.79	0.08	1.00	0.11	0.98	0.11
18	0.17	0.60	0.10	0.70	0.12	0.85	0.14	0.85	0.14
19	0.47	0.00	0.00	0.68	0.32	0.55	0.26	1.00	0.47
20	0.71	0.62	0.44	0.81	0.57	1.00	0.71	1.00	0.71
21	0.21	1.00	0.21	0.88	0.19	1.00	0.21	1.00	0.21
22	1.00	0.47	0.47	0.37	0.37	0.00	0.00	1.00	1.00
23	1.04	0.00	0.00	0.78	0.81	0.75	0.78	0.95	0.99
24	2.32	0.55	1.27	0.85	1.98	0.95	2.20	0.95	2.20
Pumphouse Pond (Pond P03)									
Total	**15.81**		**8.12**		**10.26**		**11.68**		**12.62**

5.1.4 Watershed Hydrology

Due to the location of a proposed mine pit expansion (e.g., Wabush 3) the Leg lake watershed was sub-divided for generation of pro-rated hydrologies; the Tributary T2-4 drainage, the total Tributary T2 drainage and the remainder of T2 with sub-drainage Tributary T2-4 removed (Figures 5.11, 5.12 and 5.13).

Each of the hydrographs has been pro-rated from the Wabush Lake gauging station, illustrating monthly flow variations for mean, maximum, and minimum flow rates. Typically, lowest flows are observed in the summer months (July and August) with highest flows observed in the springtime (April and May). For Labrador West, the lowest flows are observed in winter from January to April and the highest flows are observed in the late spring months May and June. There is another peak in flows observed in the fall months September and October. These high flows are presumably high from spring snowmelt runoff and large amounts of rainfall. It should also be noted that many smaller tributaries may be frozen to the bottom in winter or dry in mid summer.

Flow duration curves were also derived from prorated Wabush Lake flows (Figures 5.14, 5.15 and 5.16) for the Leg Lake watersheds. Table 5.23 tabulates various flow estimates for each catchment: maximum flow estimate, mean annual flow estimates, and the upper limit flow in which 90 percent of the time the flow is below.

Table 5.23: Flow Estimates for delineated Leg Lake catchments in Labrador West, NL

Catchment	Maximum Flow Estimate (m^3/s)	Mean Annual Flow Estimate (m^3/s)	90% of the time, the flow is less than: (m^3/s)
Leg Lake: TributaryT2-4 Sub-Drainage Inflow	0.23	0.06	0.12
Leg Lake: Remainder of Tributary T2 Sub-Drainage Outflow	0.72	0.18	0.35
Leg Lake: Tributary T2 Total Outflow	0.94	0.24	0.46

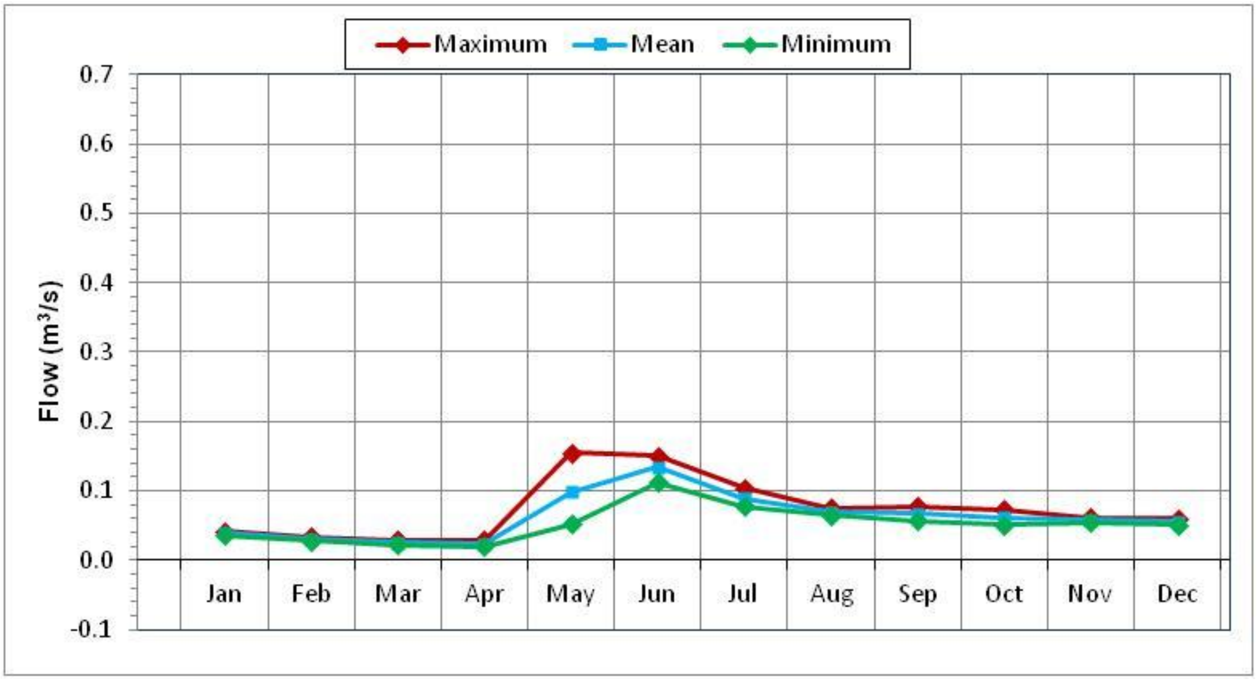


Figure 5.11: Leg Lake Tributary T2-4 sub-drainage outflow hydrograph, Labrador.

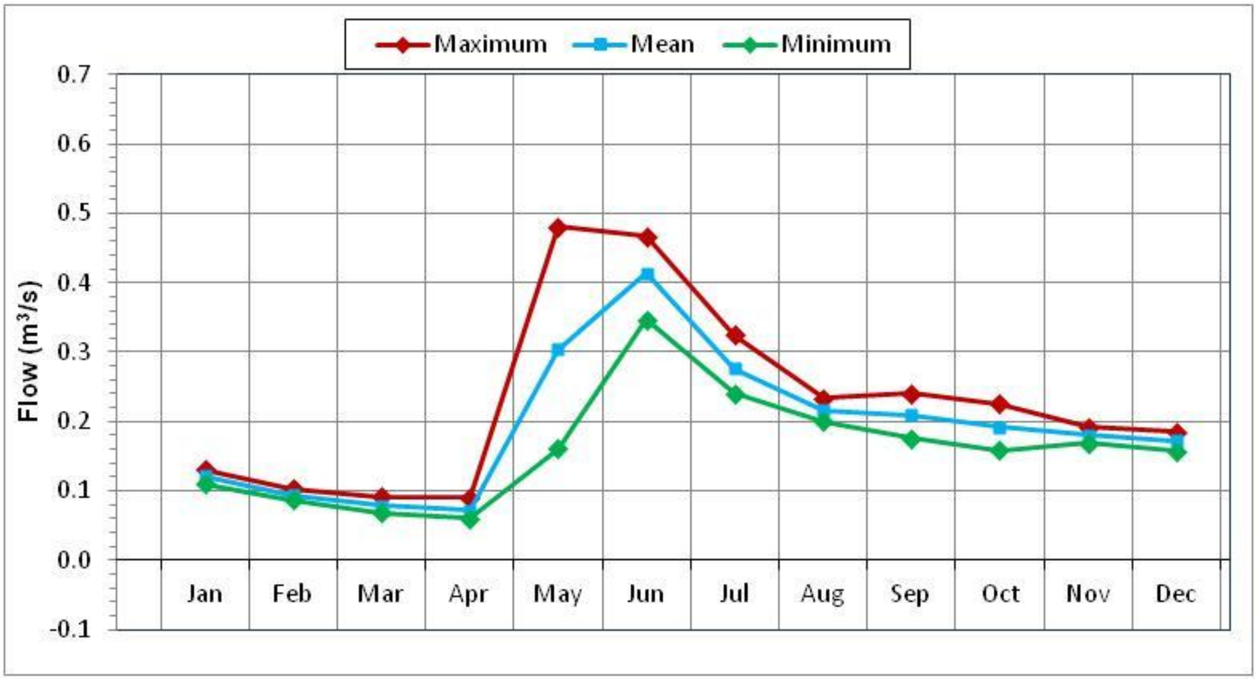


Figure 5.12: Leg Lake Tributary T2 remaining outflow with Tributary T2-4 flows removed, Labrador.

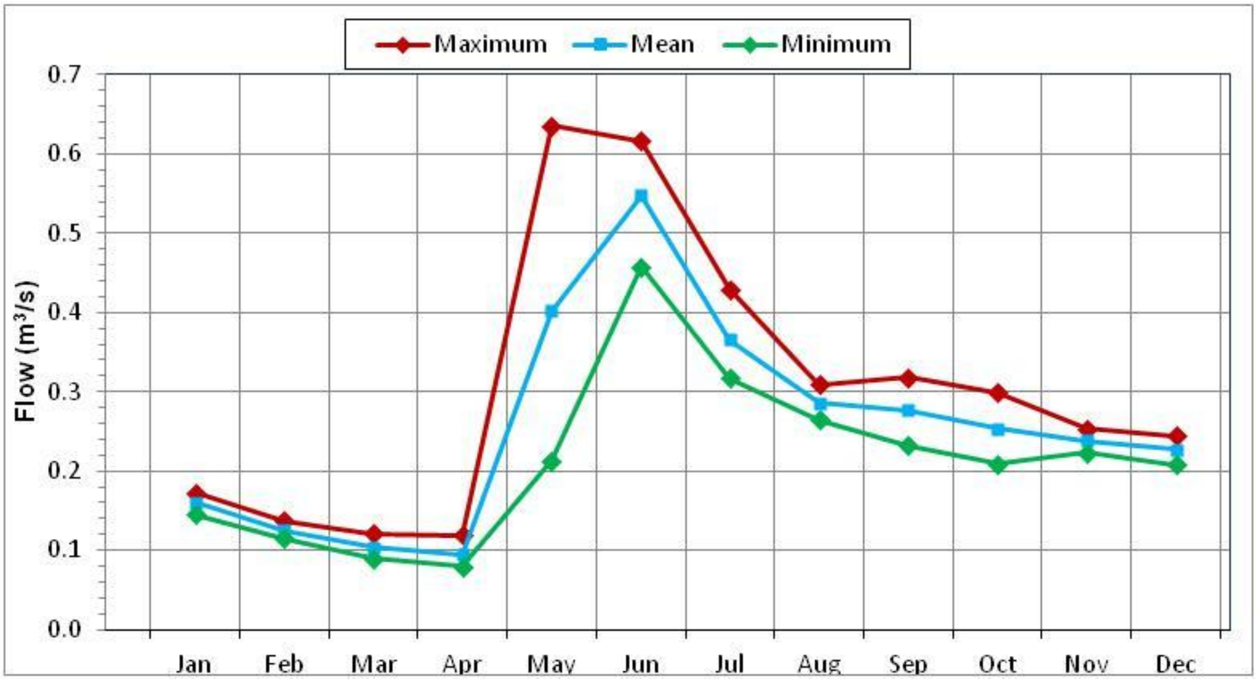


Figure 5.13: Leg Lake tributary T2 total outflow hydrograph, Labrador.

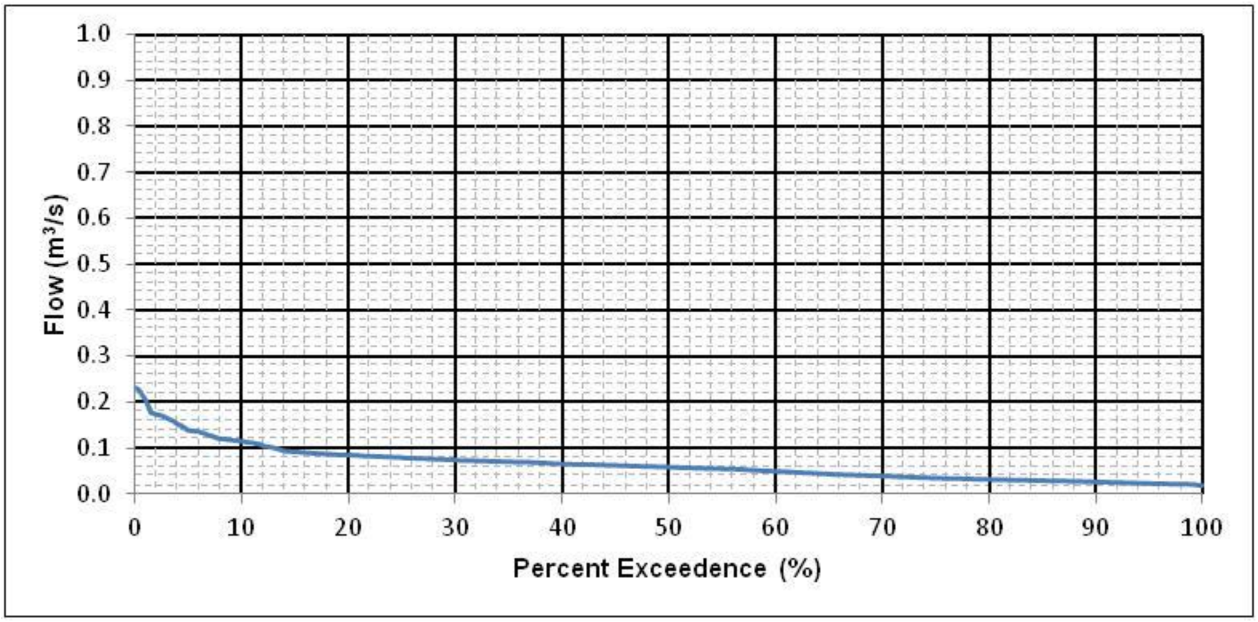


Figure 5.14: Flow duration curve for Leg Lake Tributary T2-4 outflow, Labrador.

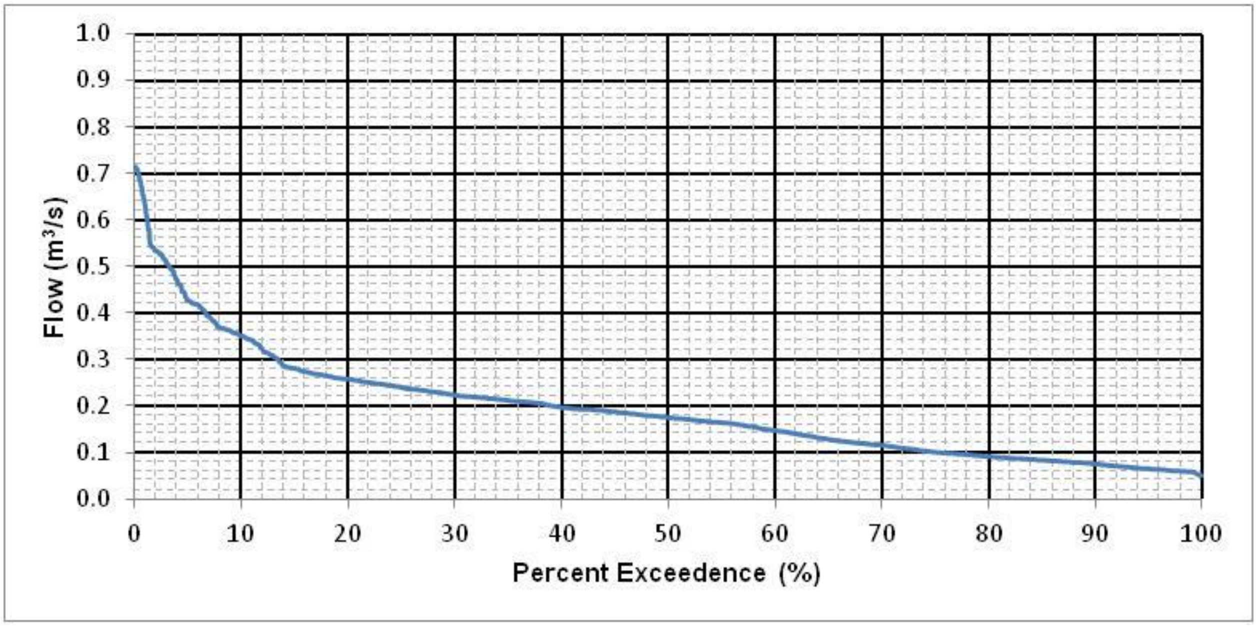


Figure 5.15: Flow duration curve for Leg Lake Tributary T2 with Tributary T2-4 drainage removed, Labrador.

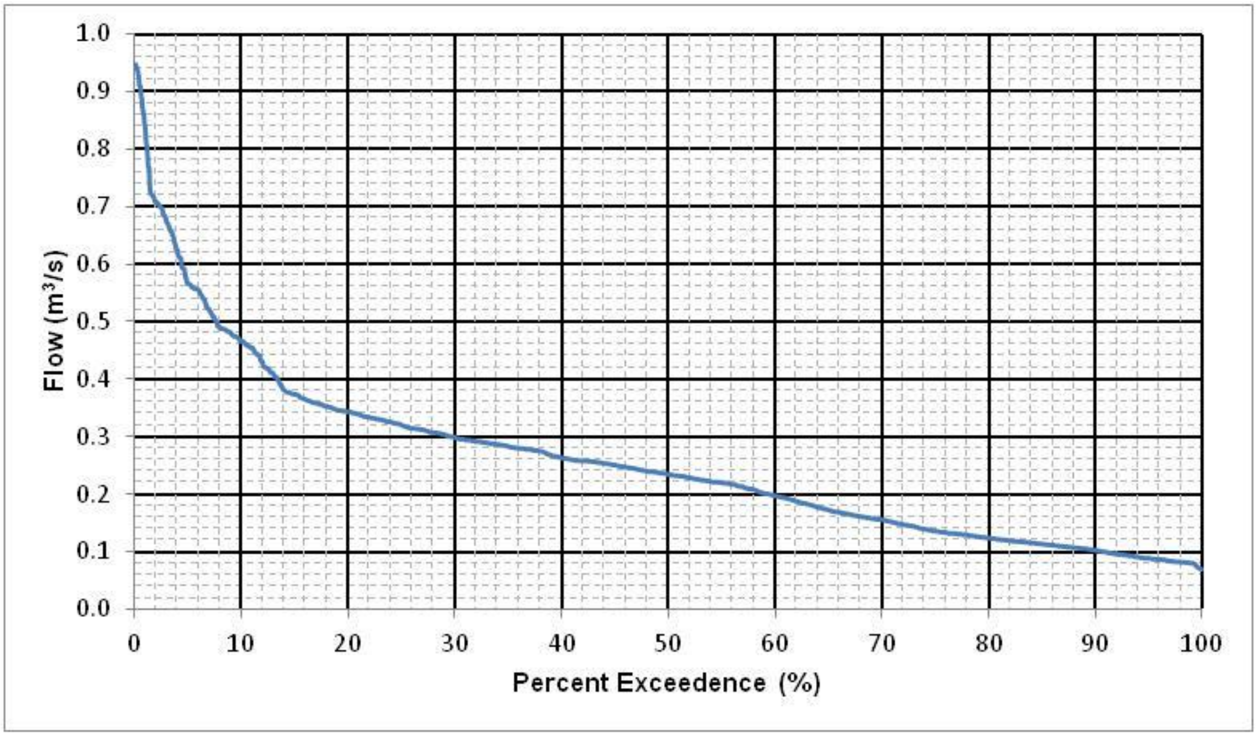


Figure 5.16: Flow duration curve for Leg Lake Tributary T2 total outflow, Labrador.

5.2 Throne Lake Watershed

The Throne Lake watershed is the most southerly of those surveyed and may be affected, or near, the footprint of the proposed Knight South pit (see Figure 1.1). The watershed is a total of 8.5 km2 in size and drains to the south into Duley Lake (Figure 5.17). A total of two waterbodies were surveyed and quantified within the Throne Lake watershed; Throne Lake (Pond P04) and Highway Pond (Pond P05). The stream habitat consists of three separate tributary sections totaling 5,573m long; Tributary T9, Tributary T9-2 and Tributary T9-3.

5.2.1 Lacustrine Habitat Characterization / Quantification

5.2.1.1 Throne Lake (Pond P04)

Throne Lake (Pond P04) is the headwaters of the T9-2 tributary of the Throne Lake watershed (Figure 5.17) it is 50.14 ha in size with a maximum depth measured at 46.6 m. Figure 5.18 presents the bathymetric contours and outlines the littoral and profundal areas as modeled from the data.

Substrate is a mixture of sand, large boulder, small boulder, cobble, rubble with small bedrock outcrops and gravel pockets. Table 5.24 presents the overall composition of each substrate type.

Figure 5.17: Lacustrine and riverine sampling locations (yellow dots), Throne Lake Watershed.

Figure 5.18: Throne Lake Bathymetric contours with littoral and profundal zones indicated, August 2011.

Table 5.24: Substrate composition across habitat zones for Throne Lake.

Substrate Type	Depth Zone Area (m^2)	
	Littoral	Profundal
Bedrock	6992.23	
Boulder	61,619.05	
Rubble	24,909.83	
Cobble	27,531.92	
Gravel	6,992.23	
Sand	55,500.85	
Muck/Detritus (organic)		317,864.66
Total	**183,546.11**	**317,864.66**

5.2.1.2 Surface Water Quality

Water quality results are provided in Appendix C. There were no exceedances of the CCME water quality guidelines for Throne Lake.

5.2.1.3 Sediment Quality

Sediment quality results are provided in Appendix C. There were no exceedances of the CCME interim sediment quality guidelines for Throne Lake.

5.2.1.4 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified three individuals, belonging to two groups (family or order) within Throne Lake. Shannon-Weiner index and species evenness were both calculated to be 0.918. Complete results are provided in Appendix D.

5.2.1.5 Fish Species within Throne Lake

A total of three fyke nets (six net-nights effort) were deployed throughout the pond over a period of two days. Brook trout was the only species captured. A brief general life history of brook trout was provided previously in Section 5.1.1.1. A total of 12 brook trout were captured and ranged from 120-218 mm in length and 15.7-103.9 g in weight. The length-weight relationship for those captured is presented in Figure 5.19.

5.2.1.6 Habitat Quantification

The determined Secchi depth of Throne Lake was 5.5 m. Throne Lake is comprised of littoral and profundal habitat. Table 5.25 presents the overall areal extent of the delineation between habitat types.

Habitat Suitabilities

The field habitat and species presence data collected was used within the DFO spreadsheet for calculating lacustrine habitat suitabilities and habitat equivalent units. Table 5.26 presents an overview of the habitat information used to determine habitat areas. Table 5.27 shows the habitat suitabilities of each habitat type for brook trout.

Habitat Equivalent Units

DFO spreadsheet calculations were used to determine final HEUs of each habitat type present. Table 5.28 presents the results for brook trout. Total HEU is calculated at 21.9 ha.

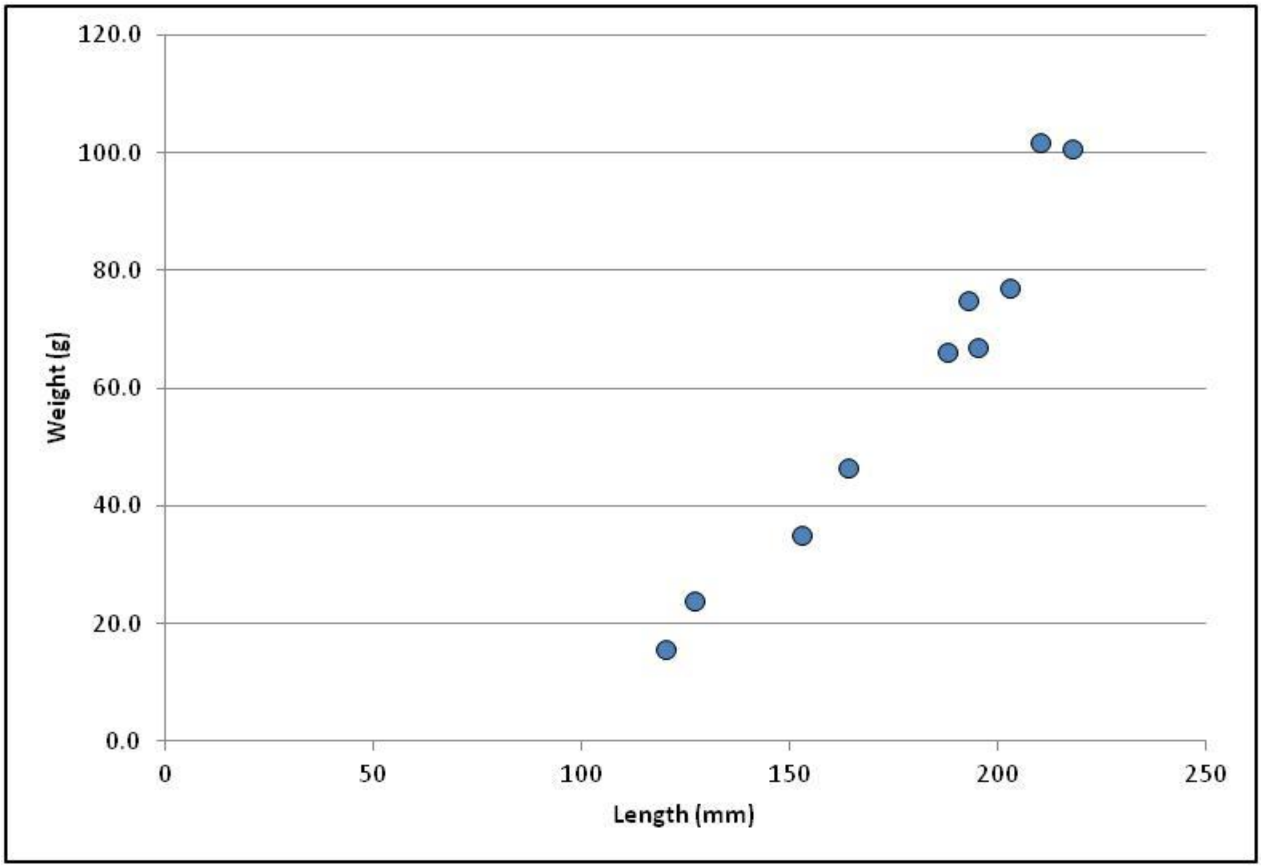


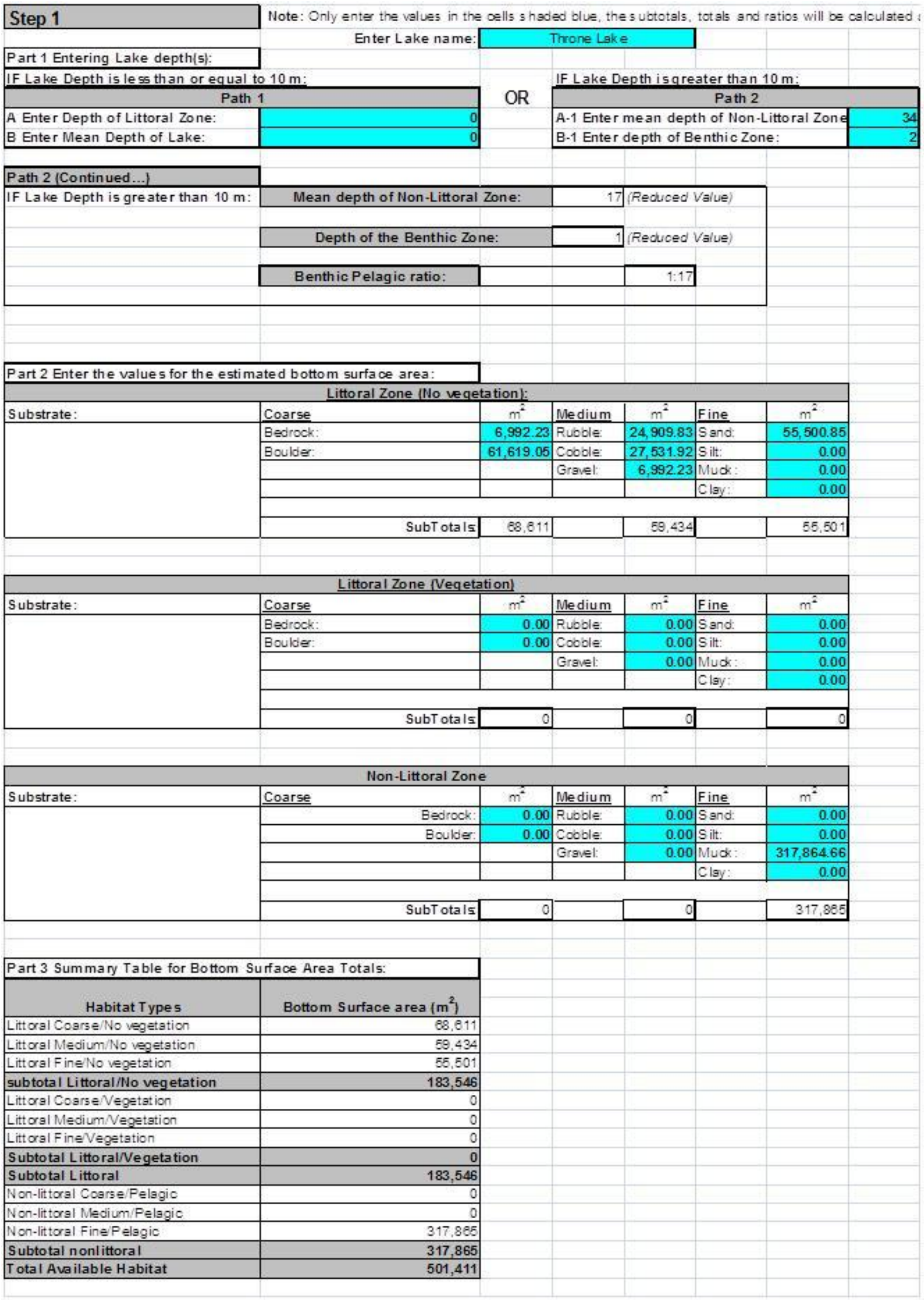
Figure 5.19: Length-weight relationship for brook trout captured in Throne Lake, 2011.

Table 5.25: The calculated total area of each habitat type within Throne Lake.

Habitat Type	Area (ha)
P - Profundal Zone	**31.79**
Lc - Littoral Zone - Coarse	6.86
Lm - Littoral Zone - Medium	5.94
Lf - Littoral Zone – Fine, no aquatic vegetation	5.55
Sub Total, Littoral Zone	**18.35**
Total Habitat	**50.14**

Littoral Coarse (comprising a majority of bedrock, boulder);
Littoral Medium (comprising a majority of rubble, cobble and gravel);
Littoral Fine (comprising a majority of sand and organics/detritus); and
Profundal (comprising a majority of organics/detritus).

Table 5.26: Summary of Throne Lake habitat values used to calculate aerial extents.



Step 1

Note: Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated

Enter Lake name: Throne Lake

Part 1 Entering Lake depth(s):

IF Lake Depth is less than or equal to 10 m: Path 1		OR	IF Lake Depth is greater than 10 m: Path 2	
A Enter Depth of Littoral Zone:	0		A-1 Enter mean depth of Non-Littoral Zone	34
B Enter Mean Depth of Lake:	0		B-1 Enter depth of Benthic Zone:	2

Path 2 (Continued...)

IF Lake Depth is greater than 10 m:

Mean depth of Non-Littoral Zone:	17	*(Reduced Value)*
Depth of the Benthic Zone:	1	*(Reduced Value)*
Benthic Pelagic ratio:	1:17	

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	6,992.23	Rubble:	24,909.83	Sand:	55,500.85
	Boulder:	61,619.05	Cobble:	27,531.92	Silt:	0.00
			Gravel:	6,992.23	Muck:	0.00
					Clay:	0.00
	SubTotals:	68,611		59,434		55,501

Littoral Zone (Vegetation)

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	0.00
					Clay:	0.00
	SubTotals:	0		0		0

Non-Littoral Zone

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	317,864.66
					Clay:	0.00
	SubTotals:	0		0		317,865

Part 3 Summary Table for Bottom Surface Area Totals:

Habitat Types	Bottom Surface area (m²)
Littoral Coarse/No vegetation	68,611
Littoral Medium/No vegetation	59,434
Littoral Fine/No vegetation	55,501
subtotal Littoral/No vegetation	**183,546**
Littoral Coarse/Vegetation	0
Littoral Medium/Vegetation	0
Littoral Fine/Vegetation	0
Subtotal Littoral/Vegetation	**0**
Subtotal Littoral	**183,546**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	317,865
Subtotal nonlittoral	**317,865**
Total Available Habitat	**501,411**

Table 5.27: Habitat suitabilities for all species, Throne Lake.

			Littoral Zone						Non-Littoral Zone		
	Species	Life Stage	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic
1	Brook Trout (freshwater resident)	Spawning	0.00	0.84	0.67	0.00	0.84	0.67	NA	NA	0.17
		YOY	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.00
		Juvenile	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.17
		Adult	0.00	0.67	0.00	0.00	0.67	0.00	NA	NA	0.17

Table 5.28: Habitat equivalent units for all species, Throne Lake.

		Littoral Zone						Non-Littoral Zone			
	Species	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic	Total Available Habitat
☐ 1	Brook Trout (freshwater resident)	68611	59434	37186	0	0	0	0	0	54037	219268.3

5.2.1.7 Highway Pond (Pond P05)

Highway Pond (Pond P05) is the smallest pond within the Throne Lake watershed (Figure 5.15). Highway Pond is 2.16 ha in size with a maximum depth measured at 2.65 m. Figure 5.20 presents the bathymetric contours and outlines the littoral and profundal areas of Highway Pond as modeled from the data.

The pond has a shoreline comprised primarily of mud with smaller pockets of sand. Table 5.29 presents the overall composition of each substrate type (m2).

Table 5.29: Substrate composition across areas of depth zones for Highway Pond.

Substrate Type	Depth Zone Area (m^2)	
	Littoral	Profundal
Bedrock	0	0
Boulder	0	0
Rubble	0	0
Cobble	0	0
Gravel	0	0
Sand	423.71	0
Muck/Detritus (organic)	20,761.86	370.54
Total	**128,000**	**370.54**

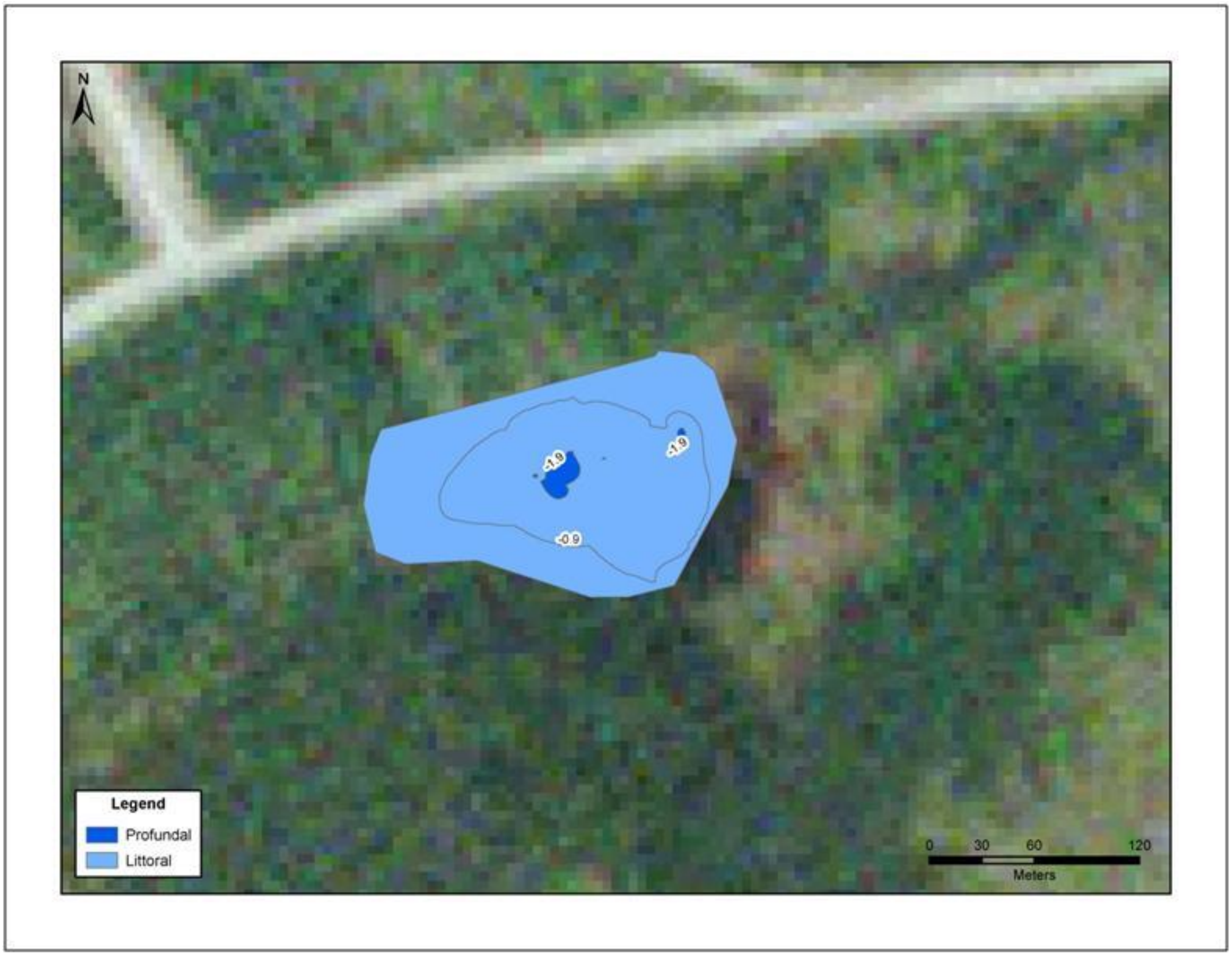


Figure 5.20: Highway Pond bathymetric contours with littoral and profundal zones indicated, August 2011.

5.2.1.8 Water Quality

Water quality results are provided in Appendix C. The only parameters which exceeded the CCME guidelines were aluminum (243 µg/L; CCME guideline 100 µg/L) and iron (554 µg/L; CCME guideline 300 µg/L) in Highway Pond). All others were either non-detectable or below CCME guideline values.

5.2.1.9 Sediment Quality

Sediment quality results are provided in Appendix C. There were no exceedances of the CCME interim sediment quality guidelines for Highway Pond.

5.2.1.10 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified 139 individuals, belonging to eight groups (family or class with a further six incidences of unidentified egg masses) within Throne Lake. Shannon-Weiner index and species evenness were calculated to be 1.66 and 0.552, respectively. Complete results are provided in Appendix D.

5.2.1.11 Fish Species within Highway Pond

A total of three fyke nets were deployed throughout the pond over a period of two days (six net-nights effort). Brook trout and lake chub were the only species captured (Section 5.1.1.1 provides brief life history for brook trout, whereas Section 5.1.2.4 provides a brief life history for lake chub). A total of 95 brook trout were captured and ranged from 94-210 mm in length and 5.4-97.5 g in weight. The length-weight relationship is presented in Figure 5.21.

A total of 40 lake chub were captured and ranged from 63-140 mm in length and 5.8-31.1 g in weight. The length-weight relationship is presented in Figure 5.22.

5.2.1.12 Habitat Quantification

Secchi depth was averaged over two samples and determined to be 0.5 m. Highway Pond is comprised of 2.16 ha, of which 2.12 ha is littoral and 0.04 ha is profundal. Table 5.30 presents the overall areal extent of the delineation between the littoral as well as profundal habitat types.

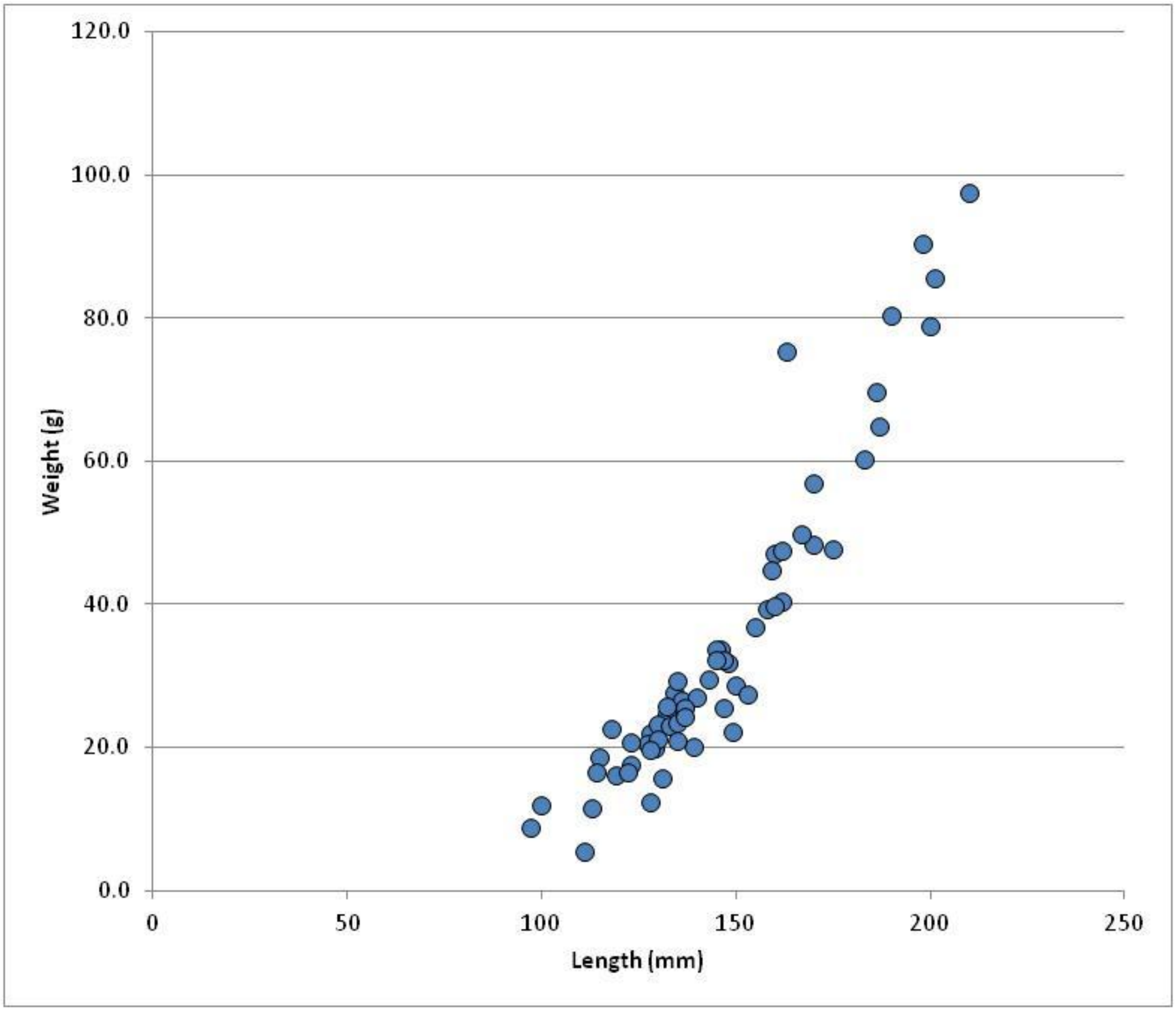


Figure 5.21: Length-weight relationship for brook trout captured in Highway Pond, 2011.

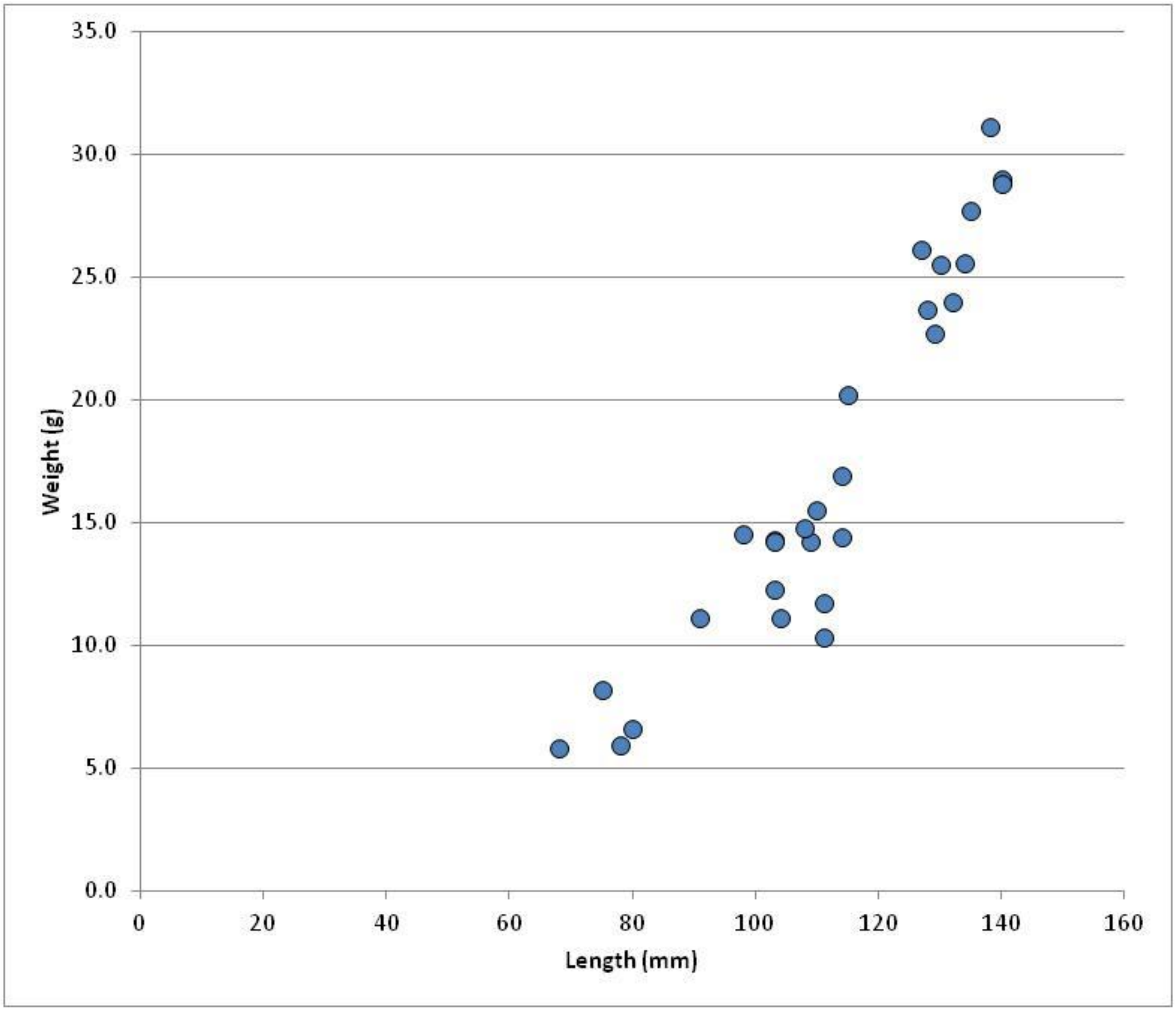


Figure 5.22: Length-weight relationship for lake chub captured in Highway Pond, 2011.

Table 5.30: The calculated total area of each habitat type within Highway Pond.

Habitat Type	Area (ha)
P - Profundal Zone	**0.037**
Lc - Littoral Zone - Coarse	0
Lm - Littoral Zone - Medium	0
Lf - Littoral Zone – Fine, no aquatic vegetation	2.12
Sub Total, Littoral Zone	**2.12**
Total Habitat	**2.16**

Littoral Coarse (comprising a majority of bedrock, boulder);
Littoral Medium (comprising a majority of rubble, cobble and gravel);
Littoral Fine (comprising a majority of sand and organics/detritus); and
Profundal (comprising a majority of organics/detritus).

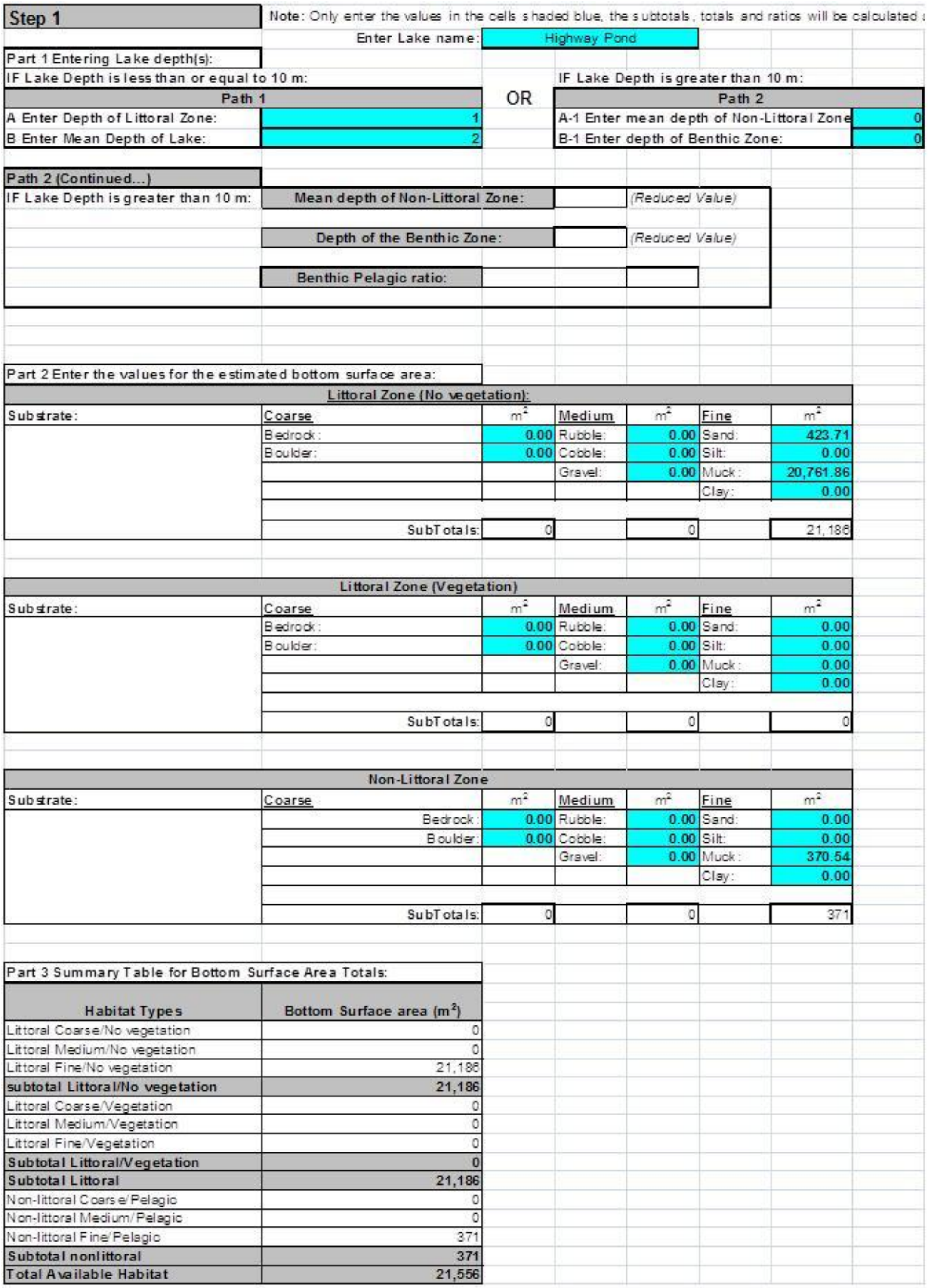
Habitat Suitabilities

The field habitat and species presence data collected was used within DFO spreadsheet for calculating lacustrine habitat suitabilities and habitat equivalent units. Table 5.31 presents an overview of the habitat information used to determine habitat areas. Table 5.32 shows the habitat suitabilities of each habitat type for lake chub and brook trout.

Habitat Equivalent Units

DFO spreadsheet calculations were used to determine final HEUs of each habitat type present. Table 5.33 presents the results for lake chub and brook trout. Total HEU are calculated at 1.78 ha for lake chub and 1.62 ha for brook trout.

Table 5.31: Summary of Highway Pond habitat values used to calculate aerial extents.



Step 1

Note: Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated

Enter Lake name: Highway Pond

Part 1 Entering Lake depth(s):

IF Lake Depth is less than or equal to 10 m:			IF Lake Depth is greater than 10 m:	
Path 1		OR	**Path 2**	
A Enter Depth of Littoral Zone:	1		A-1 Enter mean depth of Non-Littoral Zone	0
B Enter Mean Depth of Lake:	2		B-1 Enter depth of Benthic Zone:	0

Path 2 (Continued...)

IF Lake Depth is greater than 10 m:			
	Mean depth of Non-Littoral Zone:		*(Reduced Value)*
	Depth of the Benthic Zone:		*(Reduced Value)*
	Benthic Pelagic ratio:		

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	423.71
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	20,761.86
					Clay:	0.00
	SubTotals:	0		0		21,186

Littoral Zone (Vegetation)

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	0.00
					Clay:	0.00
	SubTotals:	0		0		0

Non-Littoral Zone

Substrate:	Coarse	m²	Medium	m²	Fine	m²
	Bedrock:	0.00	Rubble:	0.00	Sand:	0.00
	Boulder:	0.00	Cobble:	0.00	Silt:	0.00
			Gravel:	0.00	Muck:	370.54
					Clay:	0.00
	SubTotals:	0		0		371

Part 3 Summary Table for Bottom Surface Area Totals:

Habitat Types	Bottom Surface area (m²)
Littoral Coarse/No vegetation	0
Littoral Medium/No vegetation	0
Littoral Fine/No vegetation	21,186
subtotal Littoral/No vegetation	**21,186**
Littoral Coarse/Vegetation	0
Littoral Medium/Vegetation	0
Littoral Fine/Vegetation	0
Subtotal Littoral/Vegetation	**0**
Subtotal Littoral	**21,186**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	371
Subtotal nonlittoral	**371**
Total Available Habitat	**21,556**

Table 5.32: Habitat suitabilities for all species, Highway Pond.

			Littoral Zone						Non-Littoral Zone		
	Species	Life Stage	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic
1	Lake Chub	Spawning	NA	NA	0.84	NA	NA	0.84	NA	NA	0.00
		YOY	NA	NA	0.84	NA	NA	0.84	NA	NA	0.00
		Juvenile	NA	NA	0.00	NA	NA	0.00	NA	NA	0.00
		Adult	NA	NA	0.42	NA	NA	0.42	NA	NA	0.00
2	Brook Trout (freshwater resident)	Spawning	NA	NA	0.76	NA	NA	0.76	NA	NA	0.17
		YOY	NA	NA	0.00	NA	NA	0.00	NA	NA	0.00
		Juvenile	NA	NA	0.00	NA	NA	0.00	NA	NA	0.17
		Adult	NA	NA	0.34	NA	NA	0.39	NA	NA	0.17

Table 5.33: Habitat equivalent units for all species, Highway Pond.

		Littoral Zone						Non-Littoral Zone			
	Species	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic	Total Available Habitat
☐ 1	Lake Chub	0	0	17796	0	0	0	0	0	0	17796.0
☐ 2	Brook Trout (freshwater resident)	0	0	16101	0	0	0	0	0	63	16164.0

5.2.1.13 Catch-per-unit-effort Comparison Between Ponds

Figure 5.23 presents a comparison of CPUE between ponds surveyed within the Throne Lake watershed. As shown in the graph, Highway Pond has the highest CPUE for brook trout (15.8 fish/net-night) while Throne Lake had the lowest (2.0 fish/net-night). Lake chub were only caught in Highway Pond with a catch per unit effort of 6.7 fish/net night.

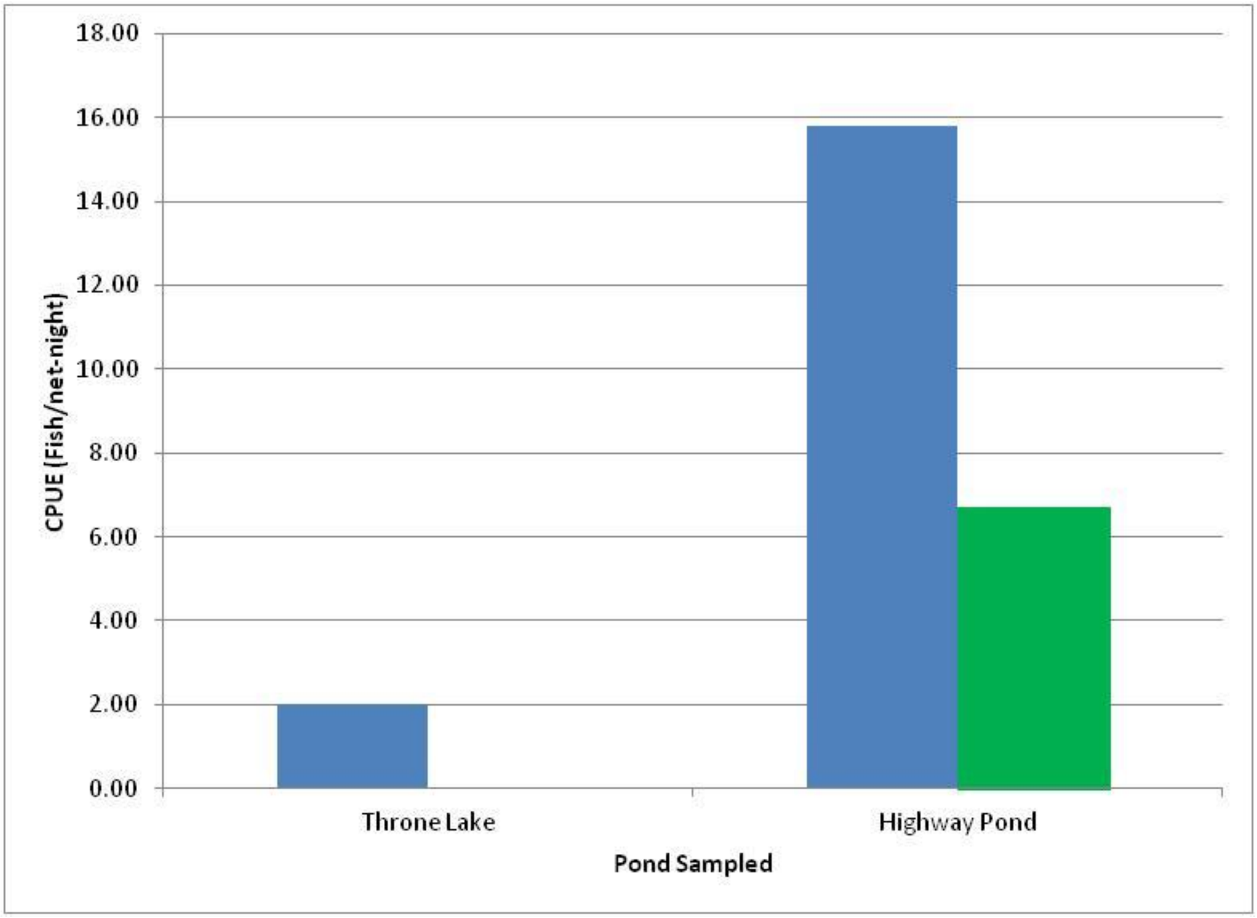


Figure 5.23: Summary of CPUE from Throne Lake watershed's lacustrine habitat (blue bars are CPUE for brook trout and green bars are CPUE for lake chub)

5.2.2 Riverine Habitat Classification

Survey data collected from riverine sites within the Throne lake watershed were analyzed to determine the type of habitat or habitat classification of each site. In total, three tributaries are located within the Throne lake watershed; Tributary T9, Tributary T9-2 and Tributary T9-3.

5.2.2.1 Surface Water Quality

All water parameter results have been compared to applicable CCME Water Quality Guidelines for the Protection of FWAL (CCME 2001). Surface water quality results are provided in Appendix C. There were no exceedances of CCME water quality guidelines for any parameter within the Throne Lake stream (Tributary T9).

5.2.2.2 Sediment Quality

Sediment quality results are provided in Appendix C. There were no exceedances of CCME interim sediment quality guidelines for any parameter within the Throne Lake stream.

5.2.2.3 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified five individuals, belonging to five groups (family or order) within Tributary T9. Shannon-Weiner index and species evenness was calculated to be 2.32 and 1.0, respectively. Complete tabulated results are provided in Appendix D for all sample sites.

5.2.2.4 Fish Species within the Throne Lake Watershed Streams

During the riverine habitat survey the only species identified within the Throne Lake watershed was brook trout. Recent DFO documents summarize the general biology of brook trout for use in habitat quantification (see Bradbury et al. 1999 and Grant and Lee 2004). A brief life history description for brook trout was previously provided in Sections 5.1.1.1.

5.2.2.5 Productivity Estimates

In the Throne Lake watershed, index electrofishing was completed. A total of two index station were sampled. Table 5.34 presents a standardized CPUE (# fish/300s of electrofishing) for brook trout captured in Throne Lake and, for comparison, Leg Lake watershed streams. In order to compare to the Leg Lake quantitative station results, the first pass of each station was standardized to 300 seconds. As shown, the CPUE is similar from both watersheds. For riverine habitat quantification, all fish were measured for length and weight. A length-weight relationship was established for each station to determine total biomass within each habitat. Figure 5.24 presents the length-weight relationship for brook trout recorded in the electrofishing stations completed within the Throne Lake watershed.

Table 5.34: Standardized CPUE for Throne Lake watershed index electrofishing stations and Leg Lake watershed quantitative electrofishing stations.

Station	Time Fished	Species	Total catch	Standardized CPUE (#/300sec)
Index Stations: Throne Lake Watershed				
Throne Lake Station 1	**330**	**Brook Trout**	**5**	**4.5**
Throne Lake Station 2	**300**	**Brook Trout**	**5**	**5**
Quantitative Stations: Leg Lake				
Leg Lake Station 1	**1320**	**Brook Trout**	**23**	**5.2**
Leg Lake Station 2	**1649**	**Brook Trout**	**20**	**3.6**

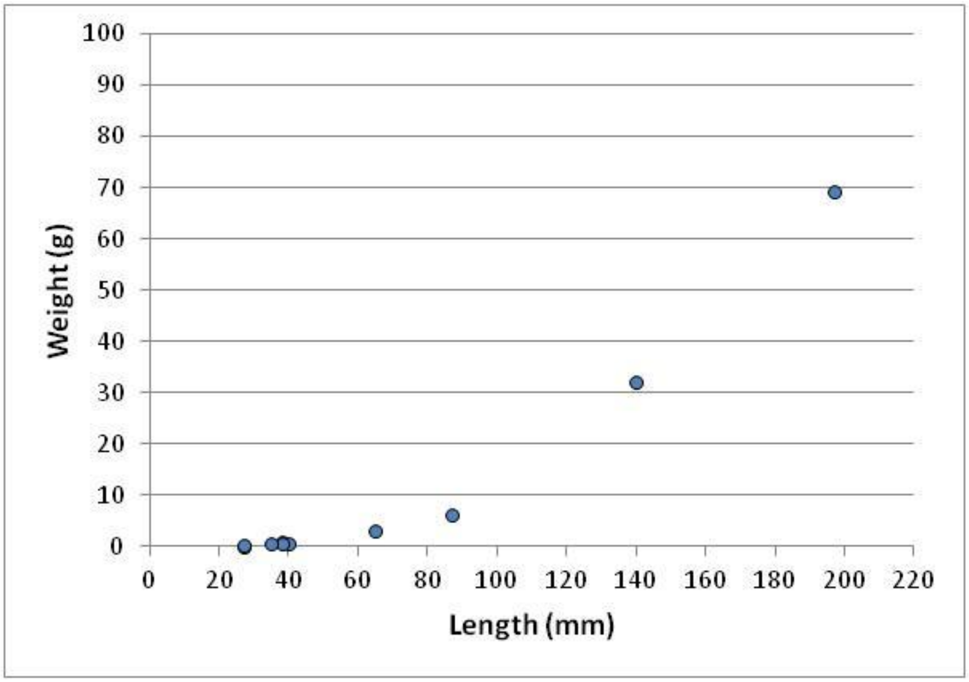


Figure 5.24: Length-weight relationship, brook trout, Index Electrofishing (Tributary-9), 2011.

5.2.3 Riverine Habitat Quantification

Tributary T9

The Throne Lake drainage is classified as a second order tributary that drains into Walsh River. It has been given the tributary label T9. Subsequent sub-divisions of the tributary are T9, T9-2 and T9-3. Each is described below. Photos of each stream survey reach are provided in Appendix B.

Tributary T9

Tributary T9 is the main stem of the Throne Lake watershed that tranverses the entire drainage. This stream section has no waterbody. It is approximately 2,893 m in length and contains 69.7 units of riverine fish habitat. Channel widths ranged from 0.6-4.0 m and depths ranged from 0.0-0.86 m. Water velocities ranged from 0.0-0.89 m/s.

Table 5.35 presents a summary of habitat characteristics as well as the habitat classification in both the Beak and proposed new riverine classifications for each stream reach. The Beak habitat classification quantifies the river as a total of 4.89 units of Type I (Spawning and Rearing), 30.29 units of Type II (Rearing, Limited Spawning) and 34.51 units of Type IV (Sheltering and Feeding) habitat. The new classification system (McCarthy et al. 2007) identifies a total of 14.18 units of Riffle, 16.04 units of Run, 3.99 units of Pool/small pond, 30.02 units of Steady, 4.10 units of Rapid, and 1.37 units of Cascade, habitat types.

Table 5.36 summarizes the species suitability for each reach of Tributary T9 (i.e. highest life-cycle stage value) for all species found in the tributary, as well as the calculations of the HEUs. For Tributary T9, Brook trout give an overall HEU value of 44.69 units.

Table 5.35: Summary of habitat measurements and classifications for Tributary T9 south of Throne Lake.

Transect #	Section Length (m)	Wetted Width (m)	Channel Width (m)	Area (units)	Bank Height		Average Depth (m)	Average Velocity (m/s)	Slope (%)	Substrate[1] (%)												Classification	
					L	R				B	LgB	SmB	R	C	G	S	St	Cl	D	M	AqV	Beak	New
1	120	3.90	3.90	4.68	0.01	0.70	0.66	0.00	0.00							10				90		IV	Steady
2	100	3.50	3.50	3.50	0.00	0.00	0.66	0.01	0.00											100		IV	Steady
3	-	-	-	0.00	-	-	-	-	-										10	90		IV	Pool
4	100	2.50	2.50	2.50	0.05	0.08	0.40	0.00	0.00										15	85		IV	Steady
5	100	2.50	2.50	2.50	0.00	0.00	0.63	0.04	0.00											100		IV	Steady
6	141	3.70	3.70	5.22	0.00	0.00	0.40	0.07	0.00						5	40			2	53		IV	Steady
7	120	2.40	2.52	2.88	0.23	0.16	0.40	0.15	0.16							60			20	20		IV	Steady
8	17	2.00	2.50	0.34	0.45	0.07	0.20	0.52	10.41		30	30		20	20							II	Rapid
9	76	1.80	2.70	1.37	0.40	0.22	0.34	0.32	1.56		5	10	10		40	35						II	Run
10	22	14.40	-	3.10	-	-	-	-	-		10	10								80		IV	Pool
11	50	-	-	0.00	-	-	-	-	-													Culvert	Culvert
12	100	2.90	3.40	2.90	0.15	0.31	0.41	0.13	0.00						10	60	5		15	10		IV	Riffle
13	100	2.80	3.30	2.80	0.27	0.15	0.34	0.28	2.86			20	40		10	30						II	Run
14	100	2.27	3.10	2.27	0.28	0.15	0.35	0.33	0.54			15			5	70			10			II	Run
15	100	1.80	2.00	1.80	0.28	0.23	0.49	0.34	2.11		10			10	15	50	0		15			II	Run
16	80	1.90	2.20	1.52	0.20	0.21	0.43	0.11	0.97			5		15	20	55			5			I	Riffle
17	100	3.37	4.00	3.37	0.35	0.22	0.34	0.06	0.52			5		15	20	60						I	Run
18	114	1.87	2.40	2.13	0.30	0.25	0.19	0.25	3.53			50	15	10		20			5			II	Run
19	100	1.89	2.20	1.89	0.24	0.31	0.23	0.50	2.18		5	30	10		25	20			10			II	Riffle
20	100	2.10	2.70	2.10	0.30	0.33	0.27	0.41	0.75			10		20	20	40			10			II	Riffle
21	114	2.00	2.60	2.28	0.37	0.29	0.26	0.30	3.08			5	15	25	20	35						II	Riffle
1	100	1.80	2.20	1.80	0.60	0.64	0.33	0.16	0.40			5	15	5	5	50				20		II	Steady
23	100	1.75	2.10	1.75	0.50	0.32	0.28	0.21	1.07			5	20	20	10	35			10			II	Riffle
24	75	1.85	2.50	1.39	0.35	0.44	0.26	0.20	0.97					10	30	50	0		10			II	Steady
25	100	1.20	1.30	1.20	0.30	0.17	0.32	0.17	0.14				5	5	20	30			40			II	Steady
26	100	3.15	3.60	3.15	0.20	0.20	0.21	0.05	0.00				10	15	25	30			20			IV	Steady
27	60	0.50	0.90	0.30	0.18	0.14	0.20	0.50	5.00			5	20	20	23	23			10			II	Run
28	120	1.00	1.60	1.20	0.29	0.35	0.45	0.16	0.00				5	5					30	60		IV	Steady
29	100	1.40	1.70	1.40	0.21	0.28	0.36	0.26	1.32				5			15			30	50		IV	Run
30	60	1.00	1.20	0.60	0.33	0.31	0.47	0.21	4.05			10	15		5	5			30	35		IV	Run
31	100	1.60	2.10	1.60	0.25	0.28	0.25	0.20	1.67	10		20	30			30			10			II	Rapid
32	120	1.80	1.90	2.16	0.15	0.14	0.28	0.09	7.50	60	5	10	20						5			II	Rapid
33	38	3.60	3.80	1.37	0.00	0.00	0.12	0.37	37.04	70		20	5	5								II	Cascade
34	7	7.20	-	0.49	-	-	-	-	-	5		10	10						5	65	5	IV	Pool
35	80	2.18	2.68	1.74	0.24	0.20	0.21	0.22	10.26	60		5	20	5	5	5						II	Riffle
36	100	0.40	0.62	0.40	0.10	0.16	0.31	0.00	0.00										33	33	34	IV	Steady

[1] Be-Bedrock, LgB-Large Boulder, SmB–Small Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, St-Silt, Cl-Clay, D-Detritus, M-Mud, AqV-Aquatic Vegetation.

Table 5.36: Summary habitat suitability information and HEUs for Tributary T9 south of Throne Lake.

Reach #	Units	Brook Trout	
		Habitat Suitability	HEU
1	4.68	0.00	0.00
2	3.50	0.22	0.75
3	0.00	0.33	0.00
4	2.50	0.00	0.00
5	2.50	0.30	0.75
6	5.22	0.63	3.31
7	2.88	0.78	2.23
8	0.34	1.00	0.34
9	1.37	1.00	1.37
10	3.10	0.46	1.44
11	0.00	0.00	0.00
12	2.90	0.72	2.08
13	2.80	0.82	2.29
14	2.27	0.90	2.04
15	1.80	0.88	1.58
16	1.52	0.84	1.27
17	3.37	0.79	2.67
18	2.13	0.98	2.08
19	1.89	0.95	1.80
20	2.10	0.95	2.00
21	2.28	0.86	1.97
22	1.80	0.80	1.44
23	1.75	0.80	1.40
24	1.39	0.83	1.15
25	1.20	0.70	0.84
26	3.15	0.61	1.92
27	0.30	0.95	0.29
28	1.20	0.70	0.84
29	1.40	0.58	0.82
30	0.60	0.69	0.41
31	1.60	0.90	1.44
32	2.16	0.77	1.67
33	1.37	0.63	0.87
34	0.49	0.48	0.24
35	1.74	0.81	1.41
36	0.40	0.00	0.00
Total	**69.69**		**44.69**

Tributary T9-2

Tributary T9-2 flows in a south east direction from Throne Lake into Tributary T9 (Figure 5.17). Tributary T9-2 is approximately 1,360 m in length and contains 16.25 units of riverine fish habitat. Mean channel widths ranged from 1.0-3.3 m and mean depths ranged from 0.08-0.48 m. Water velocities ranged from 0.09-0.50 m/s. Table 5.37 presents a summary of habitat characteristics as well as the habitat classification in both the Beak and proposed new riverine classifications for each stream reach. The Beak habitat classification quantifies the river as a total of 7.54 units of Type I, 3.45 units of Type II, 3.08 of Type III and 2.18 units of Type IV habitat. The new classification system (McCarthy et al. 2007) identifies a total of 5.98 units of Pool, 4.82 units of Riffle, 2.15 units of Rapid, 1.80 units of Steady and 1.5 units of Cascade habitat types.

Table 5.38 summarizes the species suitability for each reach of Tributary T9-2 (i.e. highest life-cycle stage value) for all species found in the tributary, as well as the calculations of the HEU. For Tributary T9-2, brook trout give an overall HEU value of 11.61 units.

Table 5.37: Summary of habitat measurements and classifications for Tributary T9-2 west of Tributary T9.

Transect #	Section Length (m)	Wetted Width (m)	Channel Width (m)	Area (Units)	Bank Height (m)		Average Depth (m)	Average Velocity (m/s)	Slope	Substrate[1] (%)												Classification	
					L	R			%	Be	LgB	SmB	R	C	G	S	St	C	D	M	AqV	Beak	New
1	60	1.0	1.1	0.58	0.18	0.14	0.19	0.38	5.47	20		10	40	20					10			II	Rapid
2	100	1.1	1.5	1.10	0.37	0.35	0.13	0.19	1.14			5	5						30	60		IV	Pool
3	100	0.9	1.2	0.85	0.18	0.20	0.35	0.23	0.33	5		5	15	5	10	20			15	25		I	Steady
4	100	1.6	2.2	1.60	0.15	0.10	0.32	0.11	0.00	5		5	15	10		20			20	25		I	Pool
5	100	1.0	1.5	1.00	0.20	0.12	0.40	0.09	0.00	5		5	10	10		25			20	25		I	Pool
6	100	0.9	1.5	0.91	0.10	0.13	0.20	0.35	0.60			5	15			60			15	5		II	Riffle
7	100	1.3	1.7	1.30	0.17	0.16	0.20	0.32	0.75			5	5			70			10	10		II	Riffle
8	95	0.7	1.0	0.67	0.20	0.20	0.20	0.50	0.00			5	10			60			15	10		II	Riffle
9	72	2.7	3.3	1.94	0.60	0.13	0.09	0.25	0.55					10	15	70			5			I	Riffle
10	100	1.2	1.6	1.20	0.16	0.17	0.16	0.10	0.50			20	15	5		20			20	20		I	Pool
11	100	1.0	1.2	0.95	0.38	0.22	0.32	0.10	2.00		2	8	15	15		20			20	20		I	Steady
12	90	1.2	1.6	1.08	0.28	0.22	0.48	0.09	0.00		10	15	20	10	5				15	25		IV	Pool
13	100	1.5	2.0	1.50	0.11	0.22	0.12	0.20	22.73	60		10								30		III	Cascade
14	143	1.1	1.5	1.57	0.20	0.25	0.08	0.37	5.74	50		5	5						10	30		III	Rapid

[1] **Be-Bedrock, LgB-Large Boulder, SmB–Small Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, St-Silt, D-Detritus, M-Mud, AqV-Aquatic Vegetation.**

Table 5.38: Summary habitat suitability information and HEUs for Tributary T9-2 west of Tributary T9

Transect #	Area (Units)	Brook trout	
		HSI	**HEU**
1	0.58	0.77	0.44
2	1.10	0.56	0.61
3	0.85	0.82	0.70
4	1.60	0.62	0.99
5	1.00	0.72	0.72
6	0.91	0.90	0.82
7	1.30	0.84	1.09
8	0.67	0.88	0.58
9	1.94	0.92	1.79
10	1.20	0.69	0.83
11	0.95	0.67	0.63
12	1.08	0.72	0.78
13	1.50	0.52	0.78
14	1.57	0.53	0.84
Total	**16.25**		**11.61**

Tributary T9-3

Tributary T9-3 is located to the east of the main stem and flows in a southwest direction where it converges with Tributary T9. Tributary T9-3 is approximately 1,320 m in length and contains 14.9 units of riverine fish habitat. Channel widths ranged from 0.7-1.8 m and depths ranged from 0.16-0.47 m. Water velocities ranged from 0.10-0.90 m/s. The tributary is east of Tributary T9 and Highway Pond is at its headwater.

Table 5.39 presents a summary of habitat characteristics as well as the habitat classification in both the Beak and proposed new riverine classifications for each stream reach. The Beak habitat classification quantifies the river as a total of 5.08 units of Type I, 6.90 units of Type II, and 2.90 units of Type IV habitat. The new classification system (McCarthy et al. 2007) identifies a total of 4.44 units of Riffle, 4.44 units of Steady, 2.90 units of Pool, 2.00 units of Run, and 1.50 units of Rapid habitat types.

Table 5.40 summarizes the species suitability for each reach of Tributary T9-3 (i.e. highest life-cycle stage value) for brook trout, as well as the calculations of the HEU. For Tributary T9-3, brook trout give an overall HEU value of 10.10 units.

Table 5.39: Summary of habitat measurements and classifications for Tributary T9-3 east of Tributary T9.

Transect #	Section Length (m)	Wetted Width (m)	Channel Width (m)	Area (units)	Bank Width (m)		Average Depth (m)	Average Velocity (m/s)	Slope	Substrate[1] (%)												Classification	
					L	R			%	Be	LgB	SmB	R	C	G	S	St	C	D	M	AgV	Beak	New
1	100	1.0	1.0	1.0	0.00	0.00	0.41	0.70	2.22			5	30	25	15				10	15		II	Run
2	100	1.0	1.0	1.0	0.00	0.00	0.28	0.48	3.00			10	30	15		10			20	15		II	Riffle
3	100	1.0	1.0	1.0	0.00	0.00	0.27	0.49	1.49			10	15	5		5			15	50		II	Riffle
4	100	1.3	1.3	1.3	0.00	0.00	0.47	0.19	1.00			10	25	5		10			30	20		IV	Pool
5	100	1.4	1.5	1.4	0.15	0.09	0.32	0.30	1.79			10	35	25	10	10			10			I	Steady
6	100	1.0	1.3	1.0	0.15	0.13	0.16	0.90	5.00	70		10	5						15			II	Rapid
7	100	1.6	1.6	1.6	0.00	0.00	0.46	0.11	0.00			5	25			10			30	30		IV	Pool
8	100	0.5	0.7	0.5	0.15	0.18	0.22	0.60	4.25			5	10			30			40	15		II	Rapid
9	100	1.0	1.3	1.0	0.16	0.14	0.30	0.23	6.25				10			30			30	30		II	Run
10	100	1.0	1.4	1.0	0.15	0.14	0.26	0.29	1.80				20	10		30			10	30		I	Riffle
11	100	1.1	1.5	1.1	0.19	0.20	0.24	0.10	1.82				40	10					30	20		I	Steady
12	130	1.2	1.4	1.6	0.16	0.15	0.29	0.26	1.43			10	40	5		10			20	15		I	Steady
13	90	1.6	1.8	1.4	0.09	0.12	0.23	0.15	4.51	10	5	5	50						20	10		II	Riffle

[1] **Be-Bedrock, LgB-Large Boulder, SmB–Small Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, St-Silt, D-Detritus, M-Mud, AqV-Aquatic Vegetation.**

Table 5.40: Summary habitat suitability information and HEUs for Tributary T9-3 east of Tributary T9.

Transect #	Area (units)	Brook trout	
		Habitat Suitability Index	HEU
1	1.00	0.88	0.88
2	1.00	0.83	0.83
3	1.00	0.68	0.68
4	1.30	0.63	0.82
5	1.38	0.95	1.31
6	1.00	0.50	0.50
7	1.60	0.57	0.91
8	0.50	0.74	0.37
9	1.00	0.75	0.75
10	1.00	0.72	0.72
11	1.10	0.40	0.44
12	1.56	0.75	1.18
13	1.44	0.51	0.73
Total	**14.88**		**10.10**

5.2.4 Watershed Hydrology

Figure 5.25 presents the pro-rated hydrograph illustrating the monthly flow variations for mean, maximum, and minimum flows for the Throne Lake watershed. Typical, seasonal variation is observed with the lowest flows observed in winter from January to April and the highest flows are observed in the late spring months May and June. There is another peak in flows observed in the fall months September and October. These high flows are presumably high from spring snowmelt runoff and large amounts of rainfall.

A flow duration curve was also derived from pro-rated Wabush Lake flows (Figure 5.26) for the Throne Lake watershed. Maximum flow estimate is 0.68 m3/s, whereas the mean annual flow estimate for the watershed is 0.16 m3/s. The upper limit flow in which 90 percent of the time the flow is below is 0.33 m3/s.

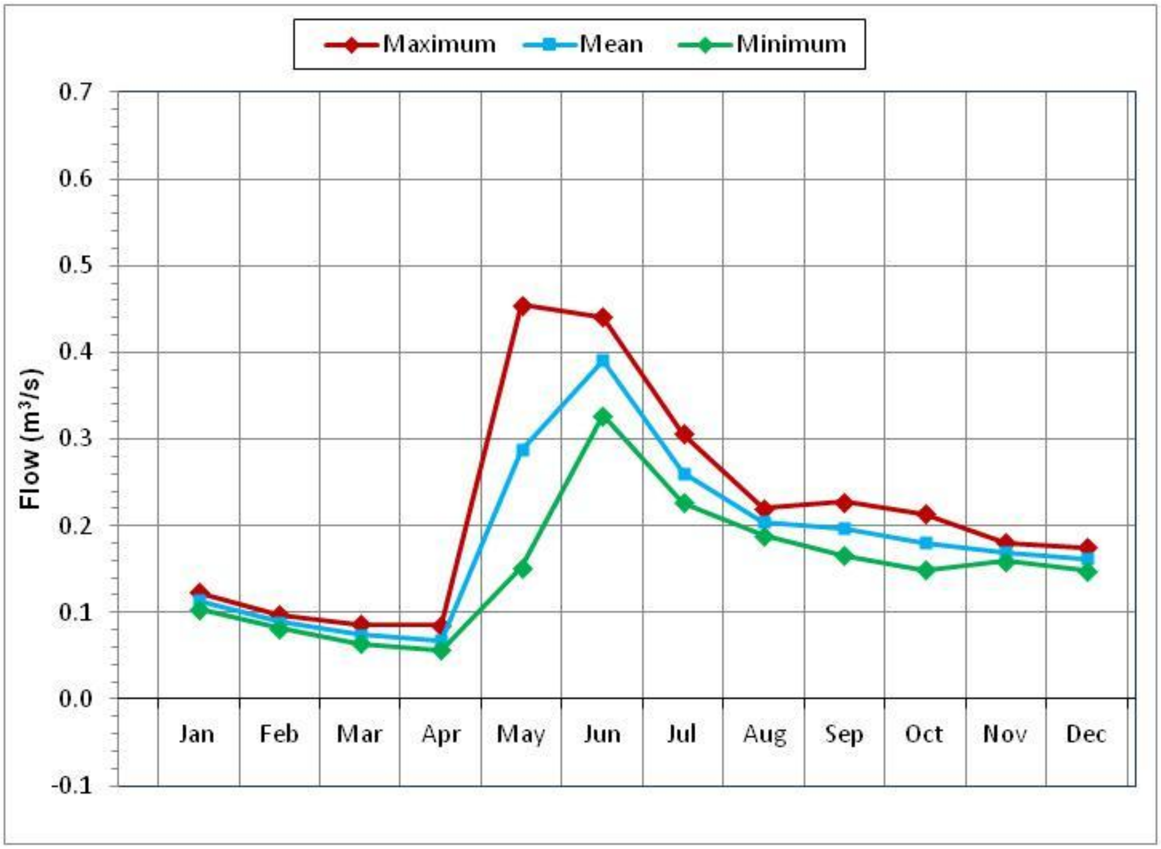


Figure 5.25: Throne Lake watershed hydrograph-Wabush Lake flow gauge (prorated), Labrador.

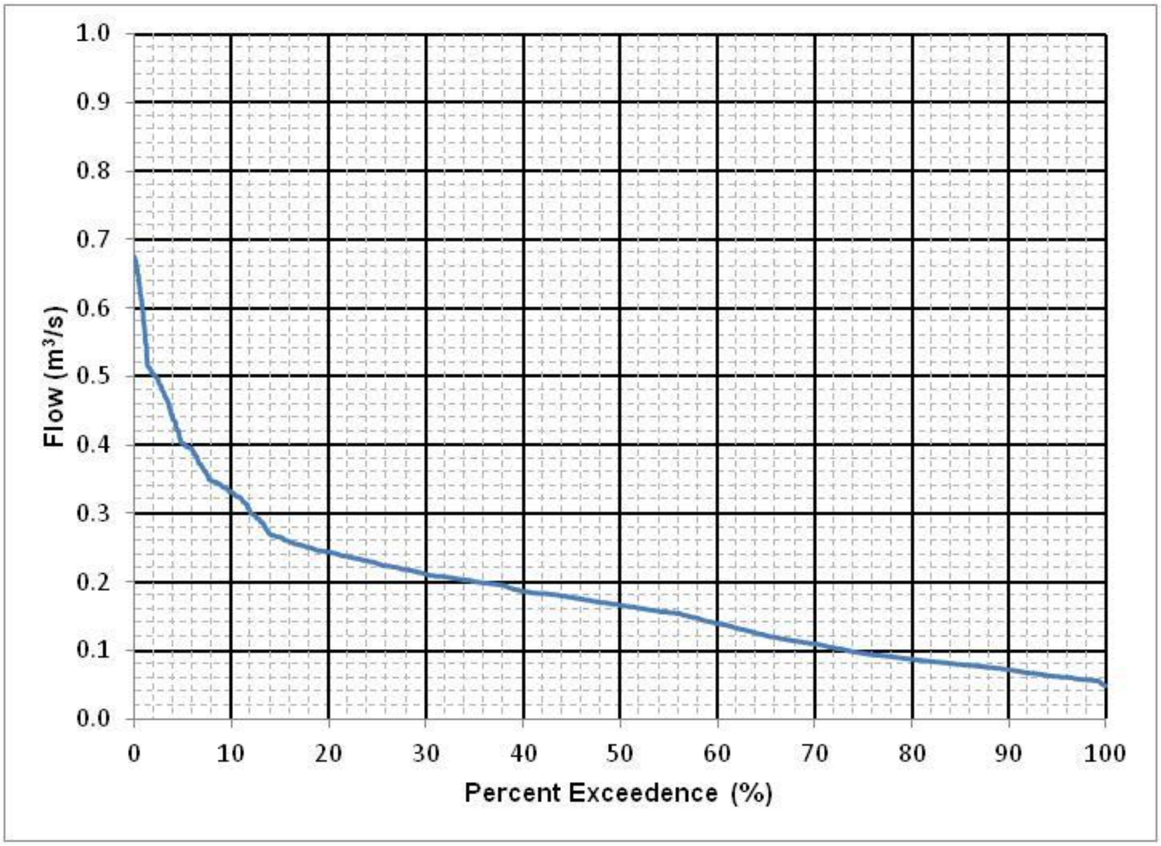


Figure 5.26: Flow duration curve for Throne Lake watershed-Wabush Lake flow gauge (prorated), Labrador.

5.3 Tup Lake Watershed

The Tup Lake watershed is located between the Leg Lake watershed to the north east and the Throne Lake watershed to the southwest and may be affected, or near, the footprint of the proposed Knight Pit (see Figure 1.1). The watershed is a total of 3.4 km2 in size and contains a single waterbody; Tup Lake (Pond P06), which drains to the southwest. Figure 5.27 presents the Tup Lake watershed and its lacustrine and stream habitat. The stream habitat consists of a single stretch of habitat; Tributary T14-3.

5.3.1 Lacustrine Habitat Characterization / Quantification

Tup Lake is the only waterbody within the watershed and it was surveyed and quantified during the 2001 field surveys.

5.3.1.1 Tup Lake (Pond P06)

Tup Lake (Pond P06) is the only pond located within the T14-3 tributary (Figure 5.27). Tup Lake is 7.2 ha in size with a maximum depth measured at 16.3 m. Figure 5.28 presents the bathymetric contours and outlines the littoral and profundal areas as modeled from the data.

The substrate present throughout the pond was primarily a mixture of mud (30.42%) and rubble (23.33%), with small boulder (15.42%), cobble (13.75%), gravel (7.08%) and large boulder (7.08%) in lesser amounts, while organics were found in isolated pockets (2.92%). Table 5.41 presents the overall composition of each substrate type.

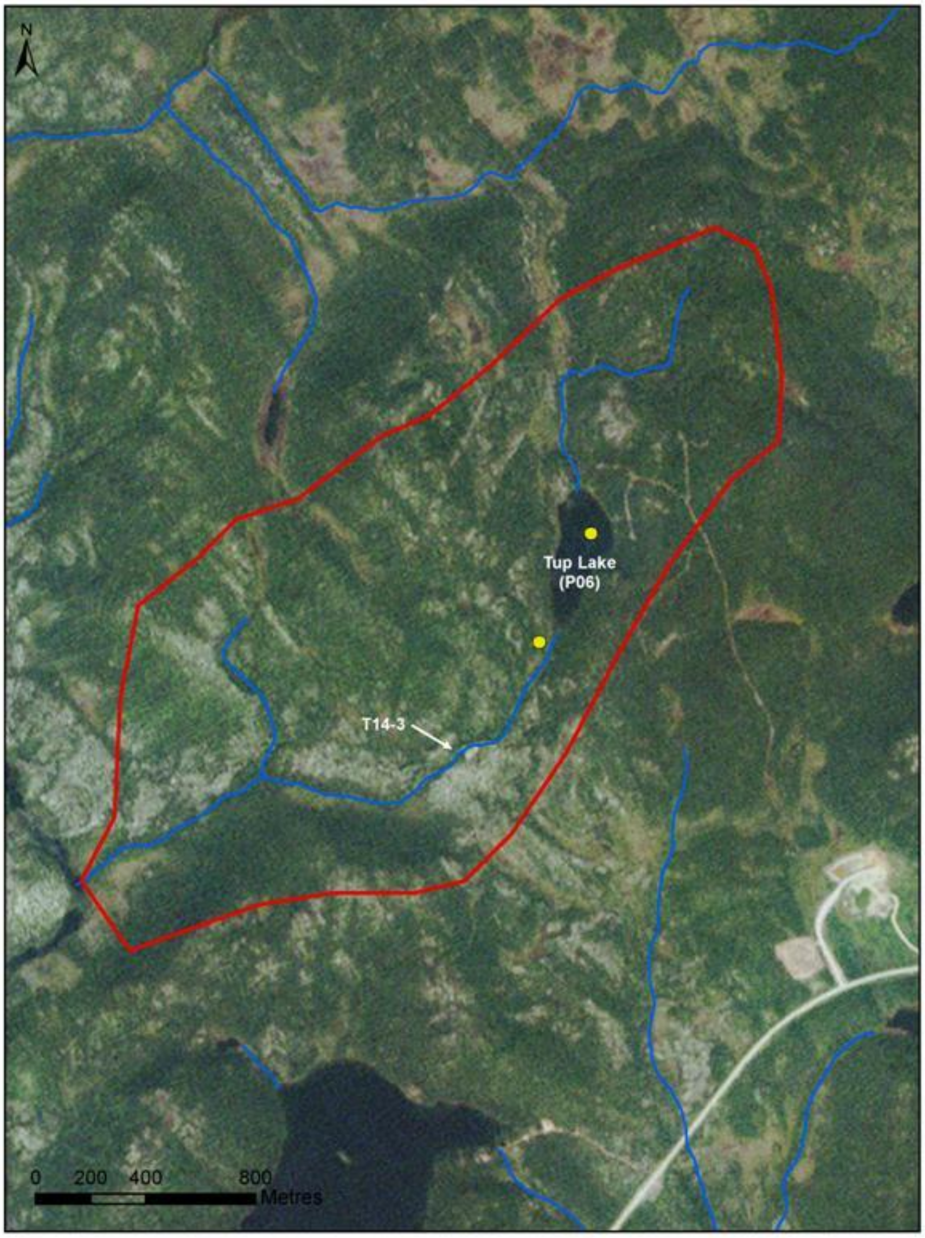


Figure 5.27: Lacustrine and riverine sampling locations (yellow dots), Tup Lake watershed.

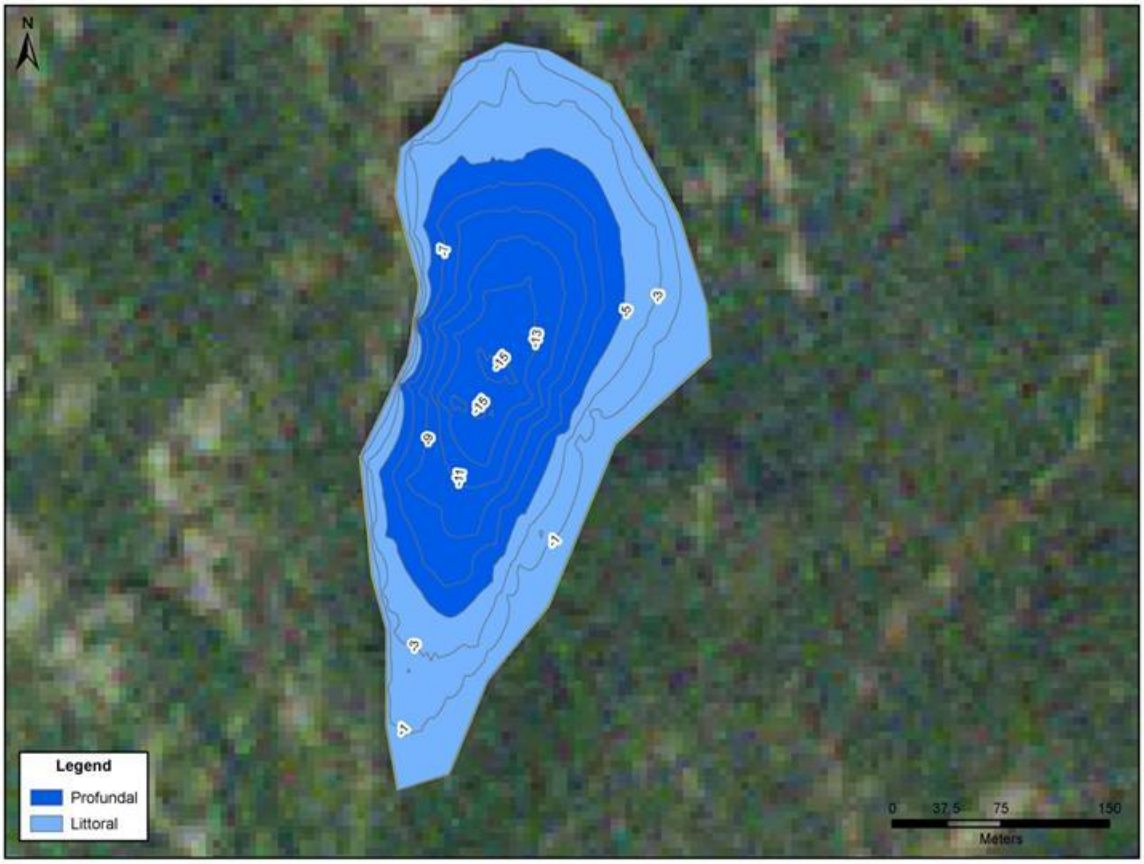


Figure 5.28: Tup Lake bathymetric contours with littoral and profundal zones indicated, August 2011.

Table 5.41: Substrate composition habitat zones for Tup Lake.

Substrate Type	Depth Zone Area (m^2)	
	Littoral	Profundal
Bedrock	0.00	
Boulder	8,485.37	
Rubble	8,799.64	
Cobble	5,185.50	
Gravel	2,761.32	
Sand	0	
Muck/Detritus (organic)	12,570.91	34,288.43
Total	**37,802.74**	**34,288.43**

5.3.1.2 Water Quality

Water quality results are provided in Appendix C. The only parameters which exceeded the CCME guidelines in Tup Lake were cadmium (0.025 μg/L; CCME guideline 0.013 μg/L) and lead (28.7 μg/L; CCME guideline 1 μg/L). All others were either below Method Detection Limits of the lab analysis or below CCME guideline values.

5.3.1.3 Sediment Quality

All sediment parameter results have been compared to applicable CCME Interim Sediment Quality Guidelines for the Protection of FWAL (CCME 2011). Complete results are provided in Appendix C. There were no parameters which exceeded the CCME sediment quality guidelines in Tup Lake. The only parameter which exceeded the CCME guidelines in Tup Lake was acid extractable chromium (45 mg/kg; CCME guideline 37.3 mg/kg). All others were either non-detectable or below CCME guideline values.

5.3.1.4 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified 23 individuals, belonging to five groups (family, order or class) within Tup Lake. Shannon-Weiner index and species evenness was calculated to be 1.01 and 0.437, respectively. Complete tabulated results are provided in Appendix D for all samples.

5.3.1.5 Fish Species within Tup Lake

A total of three fyke nets (six net-nights effort) were deployed throughout the pond over a period of two days. A total of 68 brook trout were captured for a CPUE of 11.3 fish/net night. A brief general life history of brook trout was previously provided in Section 5.1.1.1. Figure 5.29 provides a length weight relationship for brook trout caught in Tup Lake.

5.3.1.6 Habitat Quantification

The determined Secchi depth of Tup Lake was 3.1 m. Tup Lake is almost comprised of equal proportions of littoral and profundal habitat. Table 5.42 presents the overall areal extent of the delineation between habitat types.

Habitat Suitabilities

The field habitat and species presence data collected was used within the DFO spreadsheet for calculating lacustrine habitat suitabilities and habitat equivalent units. Table 5.43 presents an overview of the habitat information used to determine habitat areas. Table 5.44 shows the habitat suitabilities of each habitat type for brook trout.

Habitat Equivalent Units

DFO spreadsheet calculations were used to determine final HEU of each habitat type present. Table 5.45 presents the results for brook trout. Total HEU is calculated at 4.35 ha.

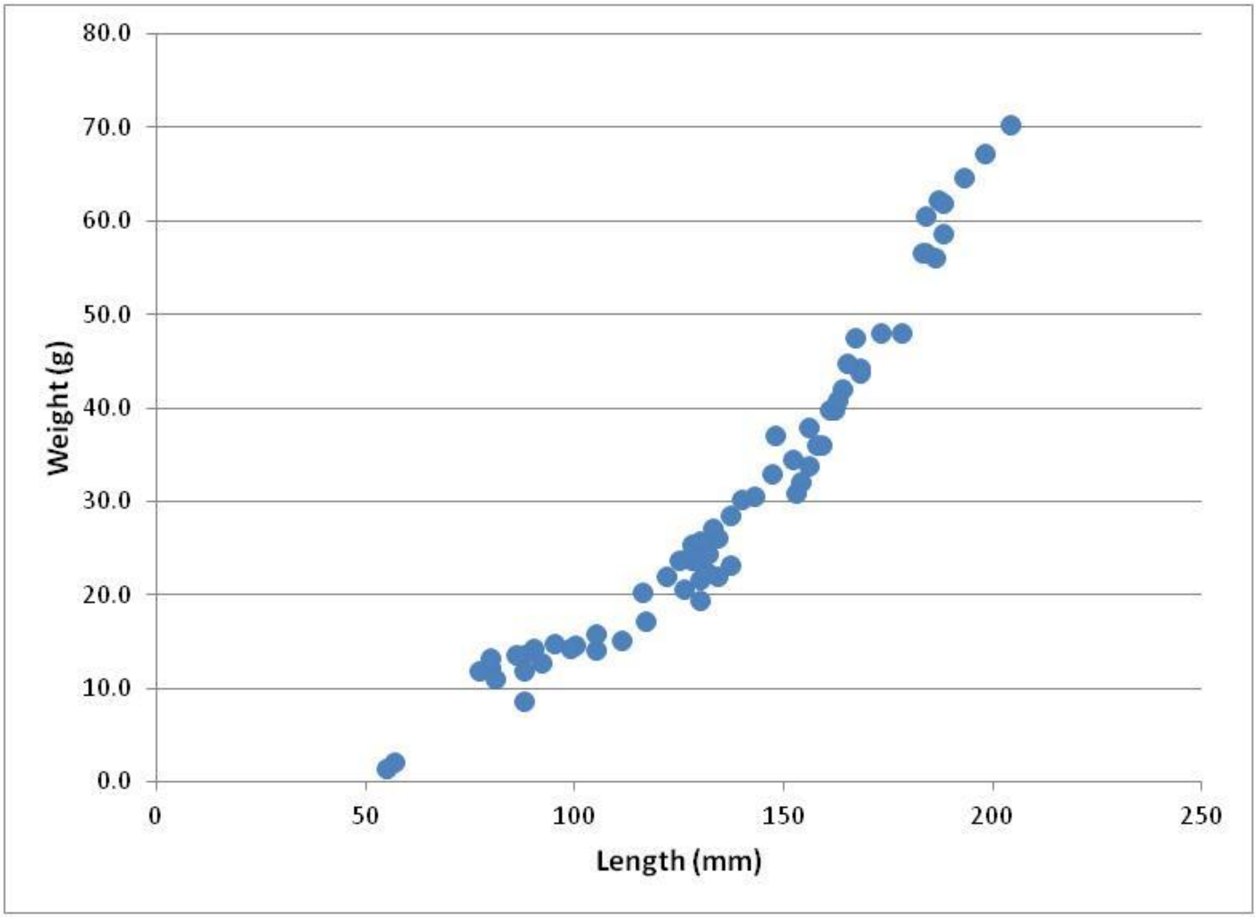


Figure 5.29: Length-weight relationship for brook trout captured in Tup Lake, 2011.

Table 5.42: The calculated total area of each habitat type within Tup Lake.

Habitat Type	Area (ha)
P - Profundal Zone	**3.43**
Lc - Littoral Zone - Coarse	0.85
Lm - Littoral Zone - Medium	1.67
Lf - Littoral Zone – Fine, no aquatic vegetation	1.26
Sub Total, Littoral Zone	**3.78**
Total Habitat	**7.21**

Littoral Coarse (comprising a majority of bedrock, boulder);
Littoral Medium (comprising a majority of rubble, cobble and gravel);
Littoral Fine (comprising a majority of sand and organics/detritus); and
Profundal (comprising a majority of organics/detritus).

Table 5.43: Summary of Tup Lake habitat values used to calculate aerial extents.

Step 1

Note: Only enter the values in the cells shaded blue, the subtotals, totals and ratios will be calculated autor

Enter Lake name: Tup Lake

Part 1 Entering Lake depth(s):

IF Lake Depth is less than or equal to 10 m:

Path 1	
A Enter Depth of Littoral Zone:	5
B Enter Mean Depth of Lake:	6

OR

IF Lake Depth is greater than 10 m:

Path 2	
A-1 Enter mean depth of Non-Littoral Zone:	
B-1 Enter depth of Benthic Zone:	

Path 2 (Continued…)

IF Lake Depth is greater than 10 m:

Mean depth of Non-Littoral Zone:		*(Reduced Value)*
Depth of the Benthic Zone:		*(Reduced Value)*
Benthic Pelagic ratio:		

Part 2 Enter the values for the estimated bottom surface area:

Littoral Zone (No vegetation):

Substrate:	**Coarse**	m^2	**Medium**	m^2	**Fine**	m^2
	Bedrock:	**0.00**	Rubble:	**8,799.64**	Sand:	**0.00**
	Boulder:	**8,485.37**	Cobble:	**5,185.50**	Silt:	**0.00**
			Gravel:	**2,671.32**	Muck:	**12,570.91**
					Clay:	**0.00**
	SubTotals:	8,485		16,656		12,571

Littoral Zone (Vegetation)

Substrate:	**Coarse**	m^2	**Medium**	m^2	**Fine**	m^2
	Bedrock:	**0.00**	Rubble:	**0.00**	Sand:	**0.00**
	Boulder:	**0.00**	Cobble:	**0.00**	Silt:	**0.00**
			Gravel:	**0.00**	Muck:	**0.00**
					Clay:	**0.00**
	SubTotals:	0		0		0

Non-Littoral Zone

Substrate:	**Coarse**	m^2	**Medium**	m^2	**Fine**	m^2
	Bedrock:	**0.00**	Rubble:	**0.00**	Sand:	**0.00**
	Boulder:	**0.00**	Cobble:	**0.00**	Silt:	**0.00**
			Gravel:	**0.00**	Muck:	**34,288.43**
					Clay:	**0.00**
	SubTotals:	0		0		34,288

Part 3 Summary Table for Bottom Surface Area Totals:

Habitat Types	**Bottom Surface area (m^2)**
Littoral Coarse/No vegetation	8,485
Littoral Medium/No vegetation	16,656
Littoral Fine/No vegetation	12,571
subtotal Littoral/No vegetation	**37,713**
Littoral Coarse/Vegetation	0
Littoral Medium/Vegetation	0
Littoral Fine/Vegetation	0
Subtotal Littoral/Vegetation	**0**
Subtotal Littoral	**37,713**
Non-littoral Coarse/Pelagic	0
Non-littoral Medium/Pelagic	0
Non-littoral Fine/Pelagic	34,288
Subtotal nonlittoral	**34,288**
Total Available Habitat	**72,001**

Table 5.44: Habitat suitabilities for all species, Tup Lake.

			Littoral Zone						Non-Littoral Zone		
	Species	Life Stage	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic
1	Brook Trout (freshwater resident)	Spawning	0.00	0.84	0.56	0.00	0.84	0.56	NA	NA	0.00
		YOY	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.00
		Juvenile	1.00	1.00	0.00	1.00	1.00	0.00	NA	NA	0.33
		Adult	0.00	0.67	0.00	0.00	0.67	0.00	NA	NA	0.33

Table 5.45: Habitat equivalent units for all species, Tup Lake.

		Littoral Zone						Non-Littoral Zone			
	Species	Coarse/No Vegetation	Medium/No Vegetation	Fine/No Vegetation	Coarse/Vegetation	Medium/Vegetation	Fine/Vegetation	Coarse/Pelagic	Medium/Pelagic	Fine/Pelagic	Total Available Habitat
☐ 1	Brook Trout (freshwater resident)	8485	16656	7040	0	0	0	0	0	11315	43496.8

5.3.2 Riverine Habitat Classification

Survey data collected from riverine sites within the Tup Lake watershed were analyzed to determine the habitat classification of each site. In total, the Tup Lake drainage contains only one tributary; Tributary T14-3.

5.3.2.1 Surface Water Quality

Surface water quality results are provided in Appendix C. The only parameters which exceeded the CCME guideline in the Tup Lake stream (Tributary T14-3) was cadmium (0.019 µg/L; CCME guideline 0.011 µg/L). All others were either non-detectable or below CCME guideline values.

5.3.2.2 Sediment Quality

All others were either non-detectable or below CCME guideline values. Complete results are provided in Appendix C.

5.3.2.3 Benthic Invertebrates

Invertebrate sampling was conducted during the August 2011 surveys. Analysis of benthic invertebrates identified 11 individuals, belonging to four families within Tributary T14-3. Shannon-Weiner index and species evenness was calculated to be 1.82 and 0.912, respectively. Complete tabulated results are provided in Appendix D for all sample locations.

5.3.2.4 Fish Species within Tup Lake Watershed Streams

During the survey only brook trout were identified within the Tup Lake watershed. Please see section 5.1.1.1 for a life history summary for brook trout.

5.3.2.5 Productivity Estimates

In the Tup Lake watershed index electrofishing was completed. A total of two index stations were sampled. Table 5.46 presents a standardized CPUE (# fish/300s of electrofishing) for brook trout captured in Tup Lake and, for comparison, the Leg Lake watershed stream. As shown, CPUE are similar from both watersheds. For riverine habitat quantification, all fish were measured for length and weight. A length-weight relationship was established for each station to determine total biomass within each habitat. Figure 5.30 presents the length-weight relationship for brook trout recorded in the electrofishing stations completed within the Tup Lake watershed.

Table 5.46: Standardized CPUE for Tup Lake watershed index electrofishing stations and Leg Lake watershed quantitative electrofishing stations.

Station	Time Fished	Species	Total catch	Standardized CPUE (#/300sec)
Index Stations: Throne Lake Watershed				
Tup Lake Station 1	**619**	**Brook Trout**	**7**	**3.4**
Quantitative Stations: Leg Lake				
Leg Lake Station 1	**1320**	**Brook Trout**	**23**	**5.2**
Leg Lake Station 2	**1649**	**Brook Trout**	**20**	**3.6**

5.3.3 Riverine Habitat Quantification

Tributary T14-3

The Tup Lake drainage is classified as a second order tributary that drains into Ironstone River. It has been given the tributary label Tributary T14-3. Tributary T14-3 is described below. Photos of each stream survey reach are provided in Appendix B. Tributary T14-3 is approximately 2,467 m in length and contains 30.1 units of riverine fish habitat below Tup Lake. Channel widths ranged from 1.3-14.1 m and depths ranged from 0.04-0.39 m. Water velocities ranged from 0.00-0.83 m/s. The stream upstream of Tup Lake was dry.

Table 5.47 presents a summary of habitat characteristics as well as the habitat classification in both the Beak and proposed new riverine classifications for each stream reach. The Beak habitat classification quantifies the river as a total of 14.35 units of Type I, 13.46 units of Type II, and 2.28 units of Type IV habitat. The new classification system (McCarthy et al. 2007) identifies a total of 10.75 units of Riffle, 6.56 units of Pool/small pond, 6.30 units of Steady, 2.29 units of Rapid, 1.0 unit of Run and 3.19 units of Cascade, habitat types.

Table 5.48 summarizes the species suitability for each reach of Tributary T14-3 (i.e. highest life-cycle stage value) for species found in the tributary, as well as the calculations of the HEU. Within tributary T14-3 only brook trout were encountered during electrofishing. Furthermore, brook trout were the only species caught within the watershed (within T14-3 and within Tup Lake) and gave an overall HEU value of 20.21 units.

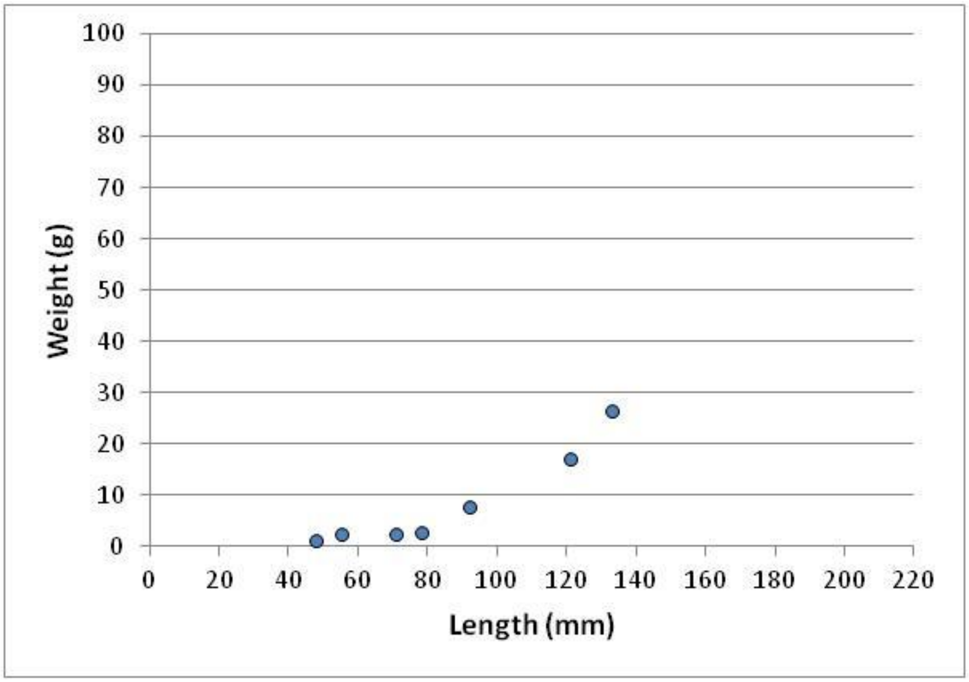


Figure 5.30: Length-weight relationship, brook trout, index electrofishing (Tributary T14-3), 2011.

Table 5.47: Summary of habitat measurements and classifications for Tributary T14-3.

Transect #	Section Length (m)	Wetted Width (m)	Channel Width (m)	Area (Units)	Bank height (m)		Average Depth (m)	Average Velocity (m/s)	Slope (%)	Substrate (%)												Classification	
					L	R				B	Lg. B	Sm. B	R	C	G	S	St	C	D	M	Aq.V	Beak	New
1	60	1.5	2.4	0.90	0.25	0.22	0.28	0.26	0.93	5		15	30		10	20			20			I	Riffle
2	100	1.4	1.7	1.40	0.30	0.34	0.33	0.22	0.00				5		10	70			15			I	Riffle
3	100	1.0	1.3	1.00	0.22	0.20	0.48	0.17	0.00			5	15		10	50			20			IV	Pool
4	100	0.9	1.4	0.85	0.16	0.19	0.43	0.42	0.00			5			10	70			15			II	Steady
5	100	1.1	1.3	1.10	0.35	0.35	0.22	0.42	2.25	5	5	20	15		10	20			25			II	Riffle
6	100	1.6	1.9	1.60	0.29	0.35	0.28	0.24	10.50	10	10	25	30		5	5			15			II	Cascade
7	100	0.8	1.2	0.84	0.17	0.11	0.44	0.32	7.96	20		30	30		5	5			10			II	Cascade
8	100	1.8	2.3	1.75	0.22	0.25	0.27	0.33	1.16			10	5		10	65			10			I	Riffle
9	100	0.8	1.6	0.83	0.28	0.27	0.31	0.40	1.18			20	30			35			15			II	Steady
10	100	1.1	1.4	1.10	0.27	0.18	0.25	0.47	1.79			20	25	5		20			30			II	Riffle
11	100	0.9	1.2	0.90	0.29	0.39	0.10	0.80	6.04	20	5	25	20	5	5				20			II	Rapid
12	100	0.8	1.0	0.75	0.25	0.25	0.16	0.83	9.38	20		25	20	5	5				25			II	Cascade
13	100	1.4	1.7	1.39	0.27	0.39	0.16	0.56	6.67	5	5	10	40	25					15			II	Rapid
14	100	0.9	1.5	0.93	0.11	0.23	0.44	0.11	0.49			20	30	5		15			30			I	Pool
15	100	1.0	1.3	1.00	0.14	0.19	0.23	0.40	4.44			5	15		5	60			15			II	Riffle
16	100	1.6	1.9	1.60	0.21	0.18	0.32	0.18	0.88			5	5		5	60			25			I	Pool
17	100	1.1	1.3	1.07	0.15	0.19	0.32	0.22	0.63			5	10			65			20			I	Steady
18	132	1.0	1.3	1.25	0.11	0.10	0.25	0.47	0.00			10	30		10	30			10		10	II	Riffle
19	100	1.8	2.4	1.75	0.14	0.34	0.35	0.11	0.00			5	5		10	50			10	20		I	Pool
20	100	0.9	1.2	0.85	0.25	0.28	0.21	0.45	2.67	5		10	15	15	5	20			20	10		II	Riffle
21	100	1.0	1.3	1.00	0.10	0.10	0.23	0.57	0.92	20		10	30	5	5	10			20			II	Run
22	75	1.7	1.9	1.28	0.25	0.21	0.32	0.00	0.23		10	15	5			10			35	25		IV	Pool
23	100	2.2	2.4	2.15	0.11	0.12	0.30	0.21	1.54			15				15			20	30	20	I	Steady
24	100	1.4	2.1	1.40	0.16	0.13	0.20	0.27	1.03			15				15			20	30	20	I	Riffle
25	100	1.4	1.8	1.40	0.06	0.10	0.37	0.20	0.00				5	15		10			20	20	30	I	Steady

[1] Be-Bedrock, LgB-Large Boulder, SmB–Small Boulder, R-Rubble, C-Cobble, G-Gravel, S-Sand, St-Silt, D-Detritus, M-Mud, AqV-Aquatic Vegetation.

Table 5.48: Summary habitat suitability information and HEUs for Tributary T14-3.

Transect #	Area (Units)	Brook trout	
		Habitat Suitability Index	HEU
1	0.90	0.60	0.54
2	1.40	0.80	1.12
3	1.00	0.82	0.82
4	0.85	0.83	0.70
5	1.10	0.78	0.86
6	1.60	0.65	1.04
7	0.84	0.68	0.57
8	1.75	0.85	1.49
9	0.83	0.93	0.77
10	1.10	0.78	0.86
11	0.90	0.63	0.57
12	0.75	0.78	0.58
13	1.39	0.83	1.15
14	0.93	0.54	0.50
15	1.00	0.84	0.84
16	1.60	0.60	0.96
17	1.07	0.61	0.66
18	1.25	0.73	0.92
19	1.75	0.65	1.14
20	0.85	0.74	0.63
21	1.00	0.80	0.80
22	1.28	0.00	0.00
23	2.15	0.48	1.04
24	1.40	0.57	0.79
25	1.40	0.62	0.87
Total	**30.09**		**20.21**

5.3.4 Watershed Hydrology

Figure 5.31 presents the pro-rated monthly mean, maximum, and minimum flow rates for the Tup Lake watershed . Typical, seasonal variation is observed with the lowest flows observed in winter from January to April and the highest flows are observed in the late spring months May and June. These high flows are presumably from spring snowmelt runoff and large amounts of rainfall.

A flow duration curve was also derived from prorated Wabush Lake flows (Figure 5.32) for the Tup Lake watershed. Maximum flow estimate is 0.28 m3/s, whereas the mean annual flow estimate for the watershed is 0.06 m3/s. The upper limit flow in which 90 percent of the time the flow is below is 0.13 m3/s.

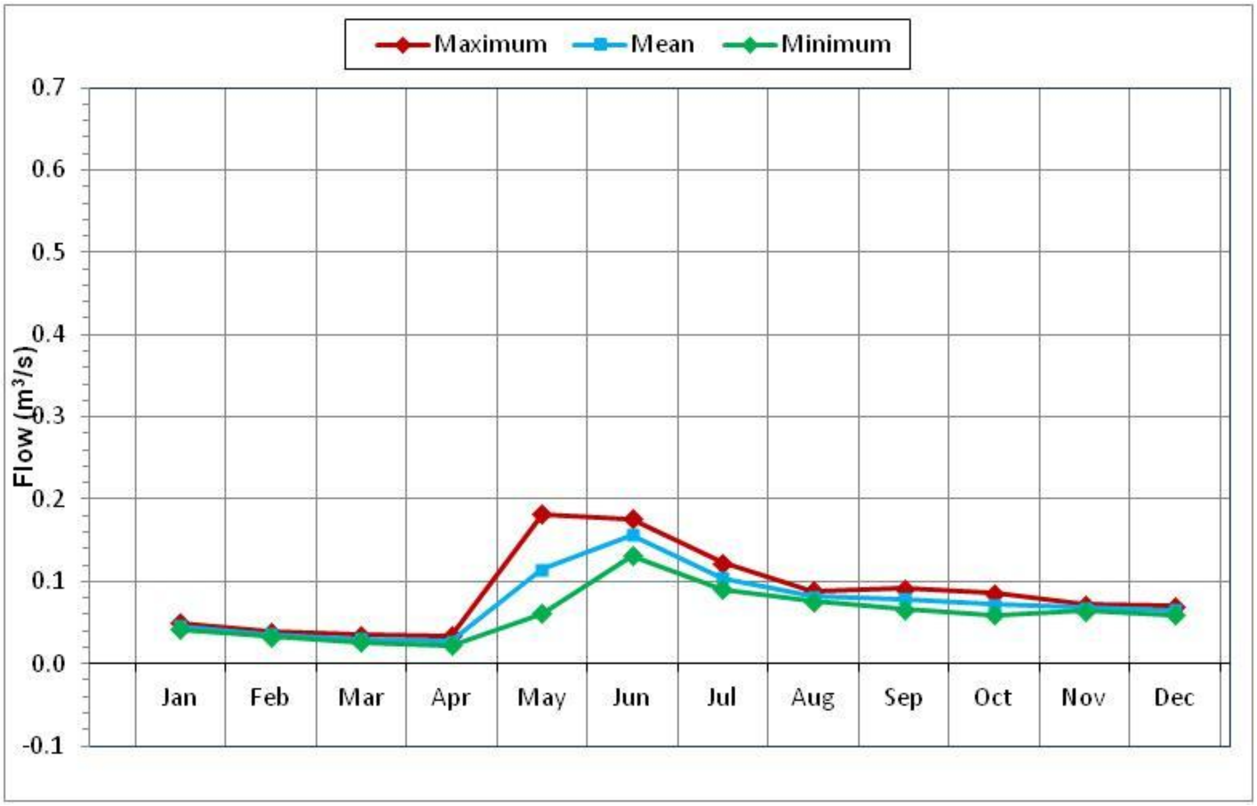


Figure 5.31: Tup Lake watershed hydrograph-Wabush Lake flow gauge (prorated), Labrador.

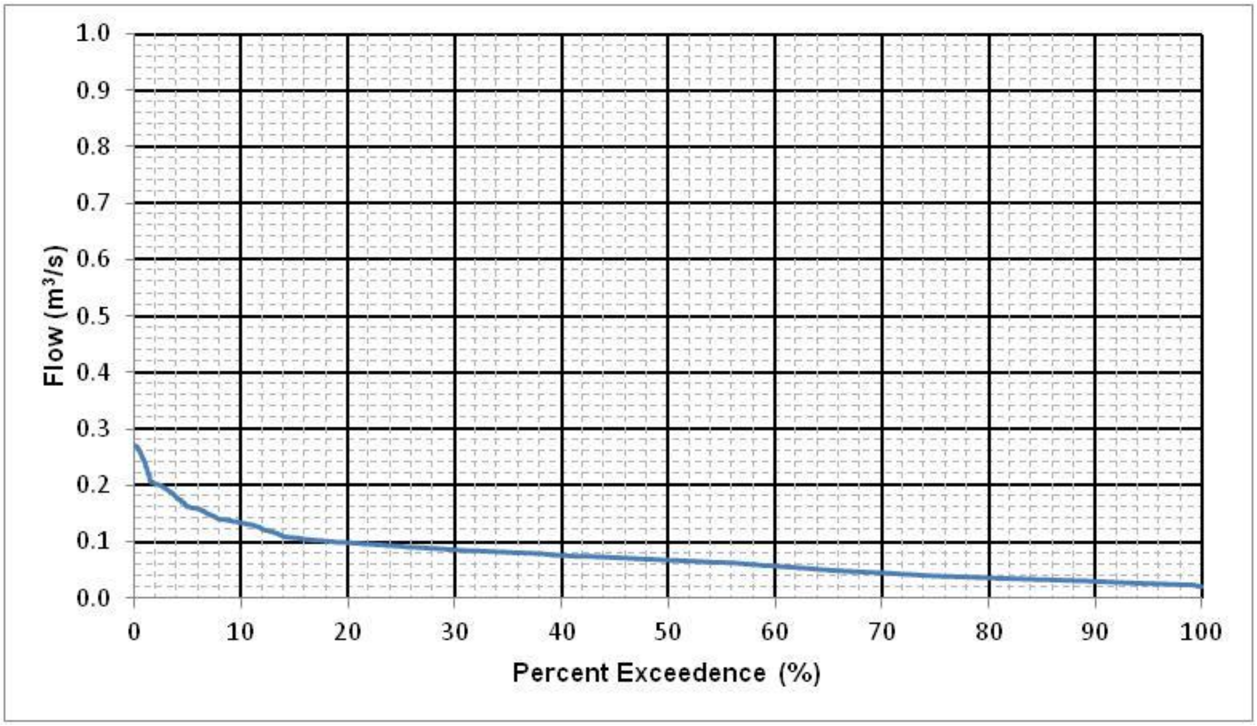


Figure 5.32: Flow duration curve for Tup Lake watershed- Wabush Lake flow gauge (prorated), Labrador.

6.0 CLOSURE

This report has been prepared for the exclusive use of Iron Ore Company of Canada. The project was conducted using standard practices and in accordance with verbal and written requests from the client. No further warranty, expressed or implied, is made. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our contract. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. AMEC Environment and Infrastructure accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Regards,

AMEC Environment & Infrastructure,

a division of AMEC Americas Limited

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Appendix A
Pond Photos

Leg Lake Watershed

Drum Lake (Pond P01)

Leg Lake (Pond P02)

Pumphouse Pond (Pond P03)

Throne Lake Watershed

Throne Lake (Pond P04)

Highway Pond (Pond P05)

Tup Lake Watershed

Tup Lake (Pond P06)

Appendix B
Stream Survey Photos

Leg Lake Watershed

Tributary T2A

Transect 1

Transect 2

Transect 3

Transect 4

Transect 5

Transect 6

Transect 7

Transect 8

Transect 9

Transect 10

Transect 11

Transect 12

Transect 13

Transect 14

Transect 15

Transect 16

Transect 17

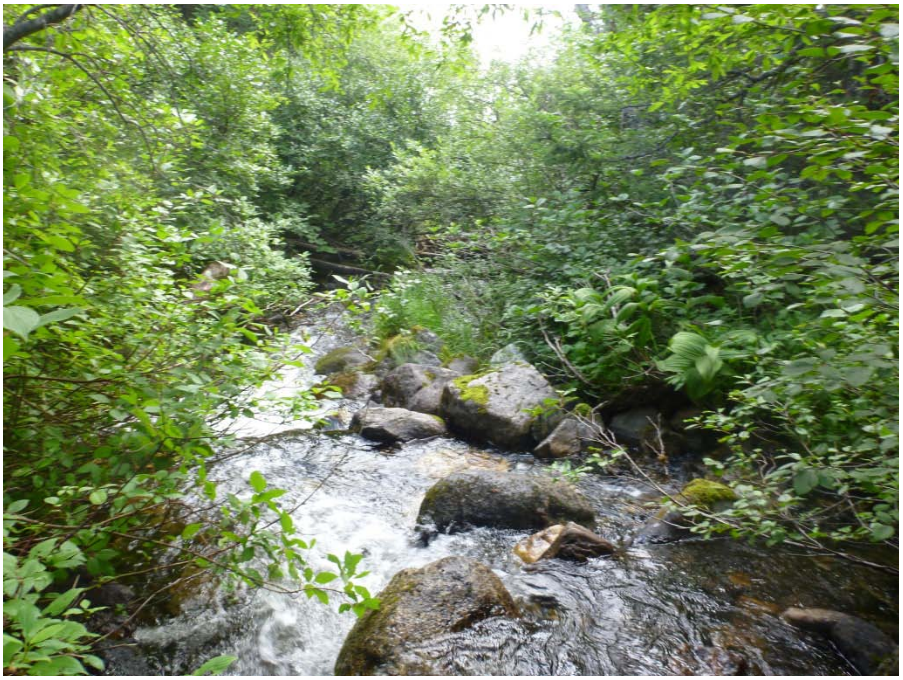
Transect 18

Transect 19

Transect 20

Transect 21

Transect 22



Transect 23

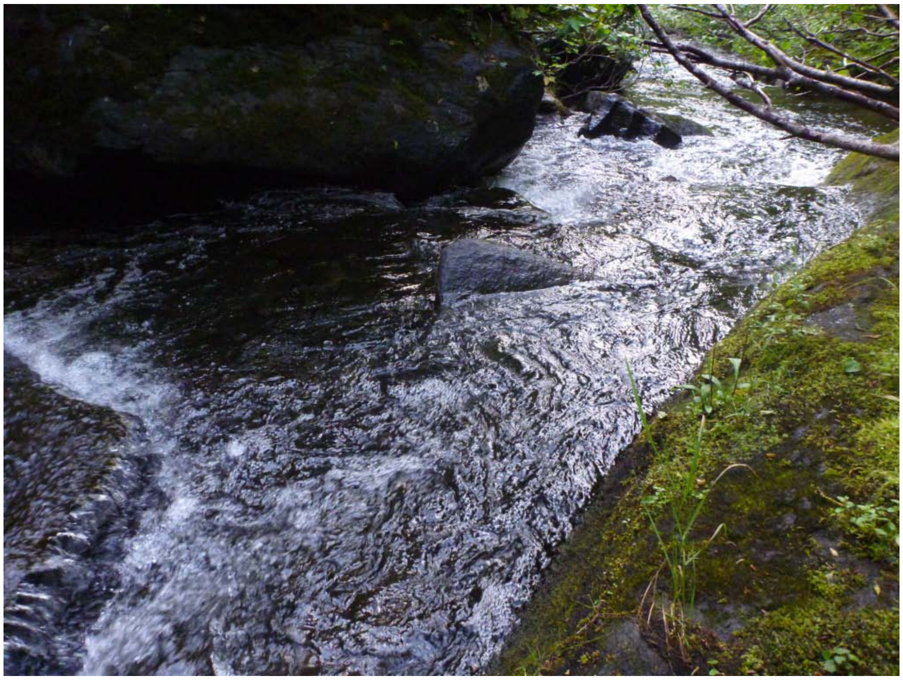
Transect 24

Transect 25

Transect 26

Transect 27

Transect 28



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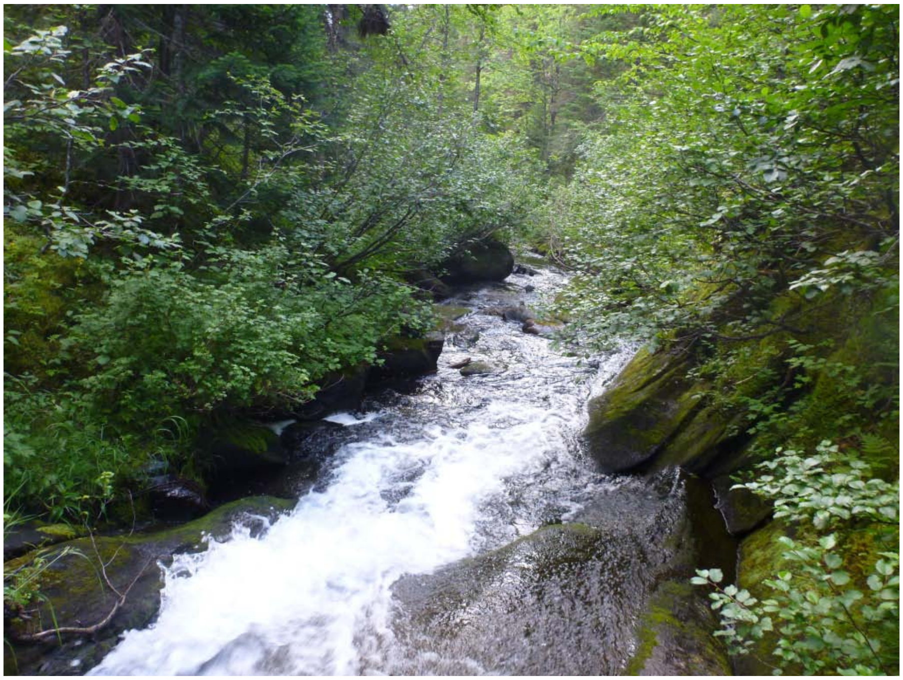


Transect 30

Transect 31

Transect 32

Transect 33

Transect 34

Transect 35

Transect 36

No Transect 36 Photos Available

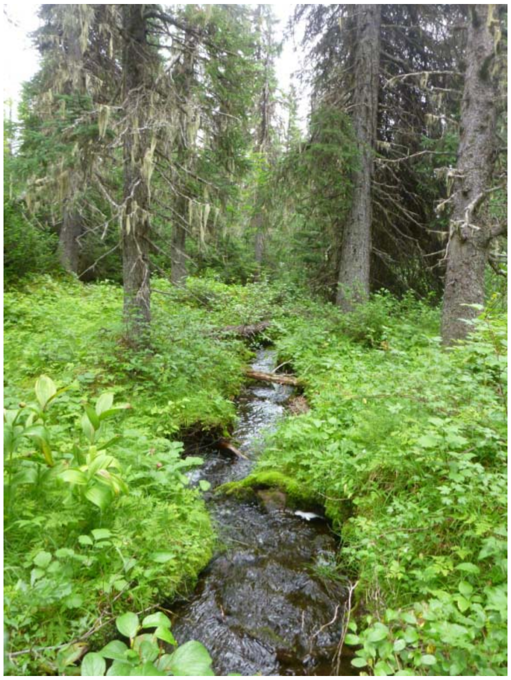
Transect 37

Transect 38

Transect 39

Tributary T2B

Transect 1

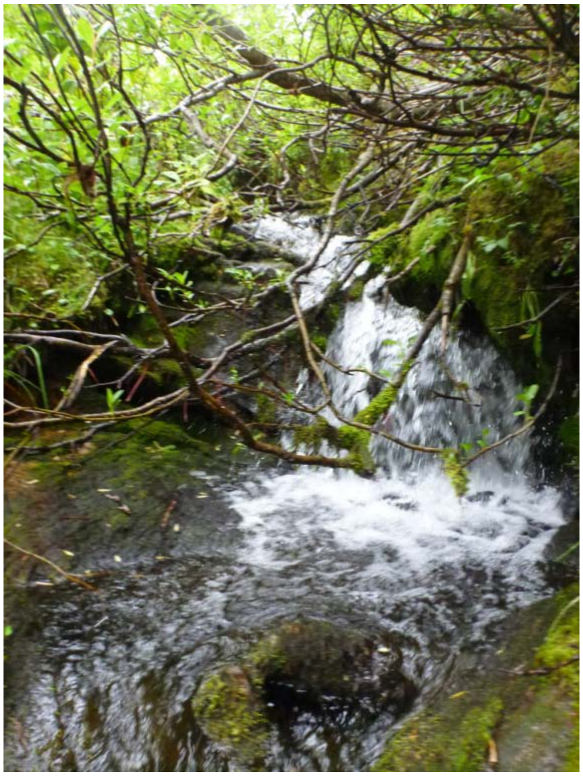


Transect 2

Transect 3
No Transect 3 Photos Available

Transect 4

Transect 5



Transect 6

Transect 7

Transect 8

Transect 9

Transect 10

Transect 11

Transect 12

Tributary T2-4

Transect 1

Transect 2

Transect 3

Transect 4

Transect 5

Transect 6

Transect 7

Transect 8

Transect 9

Transect 10

No Transect 10 Photos Available

Transect 11

Transect 12

Transect 13

Transect 14

Transect 15

Transect 16

Transect 17

Transect 18

Transect 19

Transect 20

Transect 21

Transect 22

Transect 23

Transect 24

Throne Lake Watershed

Tributary T9

Transect 1

No Transect 1 Photos Available

Transect 2

Transect 3

No Transect 3 Photos Available

Transect 4

Transect 5

Transect 6

Transect 7

Transect 8

Transect 9

Transect 10

Transect 11

No Transect 11 Photos Available

Transect 12

Transect 13

Transect 14

Transect 15

Transect 16

Transect 17

Transect 18

Transect 19

Transect 20

Transect 21

Transect 22

Transect 23

Transect 24

Transect 25

Transect 26

Transect 27

Transect 28

Transect 29

Transect 30

Transect 31

Transect 32

Transect 33

Transect 34

Transect 35

Transect 36

Tributary T9-2

Transect 1

Transect 2

Transect 3

Transect 4

Transect 5

Transect 6

Transect 7

Transect 8

Transect 9

Transect 10

Transect 11

Transect 12

Transect 13

Transect 14

Tributary T9-3

Transect 1

Transect 2

Transect 3

Transect 4

Transect 5

Transect 6

Transect 7

Transect 8

Transect 9

Transect 10

Transect 11

Transect 12

Transect 13

Tup Lake Watershed

Tributary T14-3

Transect 1

Transect 2

Transect 3

Transect 4

Transect 5

Transect 6

Transect 7

Transect 8

Transect 9

Transect 10

Transect 11

Transect 12

Transect 13

Transect 14

Transect 15

Transect 16

Transect 17

Transect 18

Transect 19

Transect 20

Transect 21

Transect 22

Transect 23

Transect 24

Transect 25

Appendix C
Analytical Results

Your Project #: TF1143025
Site Location: LAB. CITY
Your C.O.C. #: 06601

Attention: Matthew Gosse
AMEC Environment & Infrastructure
St John's - Standing Offer
PO Box 13216
133 Crosbie Rd, Suite 202
St John's, NL
A1B 4A5

Report Date: 2012/01/17
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1D4364
Received: 2011/09/01, 10:02

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Chloride in Soil by Auto. Colourimetry	2	N/A	2011/09/13	ATL SOP 00014	Based on SM4500-Cl-
Conductance - soil	2	2011/09/09	2011/09/12	ATL SOP 00006	Based on SM2510B
Total Metals Analysis by ICP ①	2	2011/09/10	2011/09/12	CAM SOP-00408	EPA 6010
Metals Solid Avail. Unified MS - Nper	1	2011/09/02	2011/09/02	ATL SOP 00024	Based on EPA6020A
Metals Solid Avail. Unified MS - Nper	1	2011/09/06	2011/09/06	ATL SOP 00024	Based on EPA6020A
Moisture	2	N/A	2011/09/01	ATL SOP 00001	MOE Handbook 1983
Nitrogen Ammonia - soil (as N)	2	2011/09/07	2011/09/08	ATL SOP 00015	Based on EPA 350.1
Nitrogen - Nitrate + Nitrite	2	2011/09/09	2011/09/12	ATL SOP 00016	Based on USGS enz.
Nitrogen - Nitrite by auto colourimetry	2	2011/09/09	2011/09/12	ATL SOP 00017	Based on SM4500-NO2B
pH (5:1 DI Water Extract)	2	2011/09/09	2011/09/12	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho by auto Colourimetry	2	2011/09/09	2011/09/12	ATL SOP 00021	Based on EPA 365.1
Sulphate in Soil by Auto Colourimetry	2	2011/09/09	2011/09/13	ATL SOP 00023	Based on EPA 375.4
Total Organic Carbon in Soil	2	2011/09/10	2011/09/10	ATL SOP 00044/00045	LECO 203-601-224

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Carbonate, Bicarbonate and Hydroxide	2	N/A	2011/09/08	CAM SOP-00102	APHA 4500-CO2 D
Alkalinity	2	N/A	2011/09/12	ATL SOP 00013	Based on EPA310.2
Chloride	2	N/A	2011/09/12	ATL SOP 00014	Based on SM4500-Cl-
Colour	2	N/A	2011/09/13	ATL SOP 00020	Based on SM2120C
Conductance - water	2	N/A	2011/09/07	ATL SOP 00004/00006	Based on SM2510B
Hardness (calculated as CaCO3)	2	N/A	2011/09/06	ATL SOP 00048	Based on SM2340B
Metals Water Diss. MS	2	N/A	2011/09/02	ATL SOP 00059	Based on EPA6020A
Ion Balance (% Difference)	2	N/A	2011/09/13		
Anion and Cation Sum	2	N/A	2011/09/13		
Nitrogen Ammonia - water	1	N/A	2011/09/12	ATL SOP 00015	Based on USEPA 350.1
Nitrogen Ammonia - water	1	N/A	2011/09/13	ATL SOP 00015	Based on USEPA 350.1
Nitrogen - Nitrate + Nitrite	2	N/A	2011/09/12	ATL SOP 00016	Based on USGS - Enz.
Nitrogen - Nitrite	2	N/A	2011/09/12	ATL SOP 00017	Based on SM4500-NO2B
Nitrogen - Nitrate (as N)	2	N/A	2011/09/12	ATL SOP 00018	Based on ASTMD3867
pH	2	N/A	2011/09/07	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho	2	N/A	2011/09/12	ATL SOP 00021	Based on USEPA 365.1
Sat. pH and Langelier Index (@ 20C)	2	N/A	2011/09/13		
Sat. pH and Langelier Index (@ 4C)	2	N/A	2011/09/13		
Reactive Silica	2	N/A	2011/09/09	ATL SOP 00022	Based on EPA 366.0
Sulphate	2	N/A	2011/09/13	ATL SOP 00023	Based on EPA 375.4
Total Dissolved Solids (TDS calc)	2	N/A	2011/09/13		

../2

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Organic carbon - Total (TOC)	2	N/A	2011/09/11	ATL SOP 00037	Based on SM5310C
Turbidity	2	N/A	2011/09/09	ATL SOP 00011	based on EPA 180.1

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MICHELLE HILL, Project Manager
Email: MHill@maxxam.ca
Phone# (902) 420-0203

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

RESULTS OF ANALYSES OF SOIL

Maxxam ID		KT1706		KT1710		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 SEDIMENT**	**RDL**	**P6 SEDIMENT**	**RDL**	**QC Batch**
Inorganics						
Ammonia-N	mg/kg	0.5	0.4	ND	0.3	2606238
Chloride (Cl)	mg/kg	14	5	12	5	2609245
Conductivity	uS/cm	26	1	9	1	2610938
Moisture	%	26	1	16	1	2601836
Nitrate + Nitrite	mg/kg	0.47	0.25	ND	0.25	2609252
Nitrite (N)	mg/kg	ND	0.05	ND	0.05	2609253
Organic Carbon (TOC)	g/kg	3.3	0.2	1.5	0.2	2610321
Orthophosphate (P)	mg/kg	0.62	0.05	0.13	0.05	2609250
Soluble (5:1) pH	pH	6.91	N/A	6.60	N/A	2610935
Sulphate (SO4)	mg/kg	ND	10	ND	10	2609246

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KT1706		KT1710		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 SEDIMENT**	**QC Batch**	**P6 SEDIMENT**	**RDL**	**QC Batch**
Metals						
Acid Extractable Aluminum (Al)	ug/g	3600	2610143	8800	50	2610143
Acid Extractable Barium (Ba)	ug/g	39	2610143	80	2.0	2610143
Acid Extractable Beryllium (Be)	ug/g	ND	2610143	ND	0.50	2610143
Acid Extractable Cadmium (Cd)	ug/g	ND	2610143	ND	0.50	2610143
Acid Extractable Calcium (Ca)	ug/g	4900	2610143	3700	50	2610143
Acid Extractable Chromium (Cr)	ug/g	15	2610143	45	1.0	2610143
Acid Extractable Cobalt (Co)	ug/g	4.0	2610143	8.0	2.0	2610143
Acid Extractable Copper (Cu)	ug/g	4.9	2610143	39	2.0	2610143
Acid Extractable Iron (Fe)	ug/g	67000	2610143	82000	500	2610143
Acid Extractable Lead (Pb)	ug/g	ND	2610143	11	5.0	2610143
Acid Extractable Magnesium (Mg)	ug/g	1800	2610143	6200	50	2610143
Acid Extractable Manganese (Mn)	ug/g	600	2610143	630	1.0	2610143
Acid Extractable Molybdenum (Mo)	ug/g	ND	2610143	ND	2.0	2610143
Acid Extractable Nickel (Ni)	ug/g	11	2610143	33	5.0	2610143
Acid Extractable Phosphorus (P)	ug/g	1700	2610143	970	20	2610143
Acid Extractable Potassium (K)	ug/g	270	2610143	1800	200	2610143
Acid Extractable Silver (Ag)	ug/g	ND	2610143	ND	1.0	2610143
Acid Extractable Sodium (Na)	ug/g	ND	2610143	ND	100	2610143
Acid Extractable Strontium (Sr)	ug/g	12	2610143	8.6	1.0	2610143
Acid Extractable Sulphur (S)	ug/g	180	2610143	ND	50	2610143
Acid Extractable Tin (Sn)	ug/g	ND	2610143	ND	20	2610143
Acid Extractable Vanadium (V)	ug/g	15	2610143	32	5.0	2610143
Acid Extractable Zinc (Zn)	ug/g	23	2610143	32	5.0	2610143
Available Aluminum (Al)	mg/kg	3500	2604821	5600	10	2602561
Available Antimony (Sb)	mg/kg	ND	2604821	ND	2	2602561
Available Arsenic (As)	mg/kg	ND	2604821	ND	2	2602561
Available Barium (Ba)	mg/kg	48	2604821	57	5	2602561
Available Beryllium (Be)	mg/kg	ND	2604821	ND	2	2602561
Available Bismuth (Bi)	mg/kg	ND	2604821	ND	2	2602561
Available Boron (B)	mg/kg	ND	2604821	ND	5	2602561
Available Cadmium (Cd)	mg/kg	ND	2604821	ND	0.3	2602561
Available Chromium (Cr)	mg/kg	12	2604821	27	2	2602561
Available Cobalt (Co)	mg/kg	7	2604821	7	1	2602561
Available Copper (Cu)	mg/kg	5	2604821	23	2	2602561

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KT1706		KT1710		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 SEDIMENT**	**QC Batch**	**P6 SEDIMENT**	**RDL**	**QC Batch**
Available Iron (Fe)	mg/kg	70000	2604821	68000	500	2602561
Available Lead (Pb)	mg/kg	1.6	2604821	3.5	0.5	2602561
Available Lithium (Li)	mg/kg	5	2604821	9	2	2602561
Available Manganese (Mn)	mg/kg	880	2604821	560	2	2602561
Available Mercury (Hg)	mg/kg	ND	2604821	ND	0.1	2602561
Available Molybdenum (Mo)	mg/kg	ND	2604821	ND	2	2602561
Available Nickel (Ni)	mg/kg	12	2604821	23	2	2602561
Available Rubidium (Rb)	mg/kg	4	2604821	16	2	2602561
Available Selenium (Se)	mg/kg	ND	2604821	ND	2	2602561
Available Silver (Ag)	mg/kg	ND	2604821	ND	0.5	2602561
Available Strontium (Sr)	mg/kg	9	2604821	8	5	2602561
Available Thallium (Tl)	mg/kg	0.1	2604821	0.1	0.1	2602561
Available Tin (Sn)	mg/kg	ND	2604821	ND	2	2602561
Available Uranium (U)	mg/kg	0.5	2604821	0.8	0.1	2602561
Available Vanadium (V)	mg/kg	12	2604821	19	2	2602561
Available Zinc (Zn)	mg/kg	23	2604821	25	5	2602561

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

RESULTS OF ANALYSES OF WATER

Maxxam ID		KT1654		KT1709		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 WATER**	**RDL**	**P6 WATER**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L	0.570	N/A	0.810	N/A	2601547
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	29	1	31	1	2601544
Calculated TDS	mg/L	34	1	47	1	2601550
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1	ND	1	2601544
Cation Sum	me/L	0.620	N/A	0.710	N/A	2601547
Hardness (CaCO3)	mg/L	28	1	33	1	2601545
Ion Balance (% Difference)	%	4.20	N/A	6.58	N/A	2601546
Langelier Index (@ 20C)	N/A	-1.44		-1.32		2601548
Langelier Index (@ 4C)	N/A	-1.70		-1.57		2601549
Nitrate (N)	mg/L	ND	0.05	2.5	0.05	2603003
Saturation pH (@ 20C)	N/A	8.97		8.89		2601548
Saturation pH (@ 4C)	N/A	9.23		9.14		2601549
Inorganics						
Total Alkalinity (Total as CaCO3)	mg/L	29	5	32	5	2608974
Dissolved Chloride (Cl)	mg/L	ND	1	ND	1	2608976
Colour	TCU	32	5	20	5	2608980
Nitrate + Nitrite	mg/L	ND	0.05	2.5	0.05	2608983
Nitrite (N)	mg/L	ND	0.01	ND	0.01	2608984
Nitrogen (Ammonia Nitrogen)	mg/L	ND	0.05	ND	0.05	2610772
Total Organic Carbon (C)	mg/L	19	1	11	0.5	2610484
Orthophosphate (P)	mg/L	ND	0.01	ND	0.01	2608982
pH	pH	7.53	N/A	7.57	N/A	2606311
Reactive Silica (SiO2)	mg/L	4.8	0.5	4.5	0.5	2608979
Dissolved Sulphate (SO4)	mg/L	ND	2	ND	2	2608978
Turbidity	NTU	0.1	0.1	1.7	0.1	2609095
Conductivity	uS/cm	57	1	67	1	2606316

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ICP/MS (WATER)

Maxxam ID		KT1654	KT1709		
Sampling Date		2011/08/28	2011/08/28		
	Units	**T-14-3 WATER**	**P6 WATER**	**RDL**	**QC Batch**
Metals					
Dissolved Aluminum (Al)	ug/L	39.0	26.5	5.0	2602739
Dissolved Antimony (Sb)	ug/L	ND	ND	1.0	2602739
Dissolved Arsenic (As)	ug/L	ND	ND	1.0	2602739
Dissolved Barium (Ba)	ug/L	13.9	11.5	1.0	2602739
Dissolved Beryllium (Be)	ug/L	ND	ND	1.0	2602739
Dissolved Bismuth (Bi)	ug/L	ND	ND	2.0	2602739
Dissolved Boron (B)	ug/L	ND	ND	50	2602739
Dissolved Cadmium (Cd)	ug/L	0.019	0.025	0.017	2602739
Dissolved Calcium (Ca)	ug/L	7300	8400	100	2602739
Dissolved Chromium (Cr)	ug/L	ND	ND	1.0	2602739
Dissolved Cobalt (Co)	ug/L	ND	ND	0.40	2602739
Dissolved Copper (Cu)	ug/L	ND	ND	2.0	2602739
Dissolved Iron (Fe)	ug/L	51	ND	50	2602739
Dissolved Lead (Pb)	ug/L	ND	28.7	0.50	2602739
Dissolved Magnesium (Mg)	ug/L	2470	2900	100	2602739
Dissolved Manganese (Mn)	ug/L	3.0	ND	2.0	2602739
Dissolved Molybdenum (Mo)	ug/L	ND	ND	2.0	2602739
Dissolved Nickel (Ni)	ug/L	ND	ND	2.0	2602739
Dissolved Phosphorus (P)	ug/L	ND	ND	100	2602739
Dissolved Potassium (K)	ug/L	1080	1050	100	2602739
Dissolved Selenium (Se)	ug/L	ND	ND	1.0	2602739
Dissolved Silver (Ag)	ug/L	ND	ND	0.10	2602739
Dissolved Sodium (Na)	ug/L	610	573	100	2602739
Dissolved Strontium (Sr)	ug/L	11.3	11.4	2.0	2602739
Dissolved Thallium (Tl)	ug/L	ND	ND	0.10	2602739
Dissolved Tin (Sn)	ug/L	ND	ND	2.0	2602739
Dissolved Titanium (Ti)	ug/L	ND	ND	2.0	2602739
Dissolved Uranium (U)	ug/L	ND	ND	0.10	2602739
Dissolved Vanadium (V)	ug/L	ND	ND	2.0	2602739
Dissolved Zinc (Zn)	ug/L	ND	15.0	5.0	2602739

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Package 1	12.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Revised report: Revised to correct acid extractable metals data for samples KT1706 and KT1710. January 17, 2012 MHL

Sample KT1709-01: RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2602561	Available Aluminum (Al)	2011/09/02	NC	75 - 125	103	75 - 125	ND, RDL=10	mg/kg	6.4	35	101	75 - 125
2602561	Available Antimony (Sb)	2011/09/02	72(1, 2)	75 - 125	109	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Arsenic (As)	2011/09/02	NC	75 - 125	109	75 - 125	ND, RDL=2	mg/kg	15.2	35	122	75 - 125
2602561	Available Barium (Ba)	2011/09/02	80	75 - 125	105	75 - 125	ND, RDL=5	mg/kg	24.9	35	119	75 - 125
2602561	Available Beryllium (Be)	2011/09/02	107	75 - 125	100	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Bismuth (Bi)	2011/09/02	99	75 - 125	110	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Boron (B)	2011/09/02	98	75 - 125	96	75 - 125	ND, RDL=5	mg/kg	NC	35		
2602561	Available Cadmium (Cd)	2011/09/02	103	75 - 125	107	75 - 125	ND, RDL=0.3	mg/kg	NC	35		
2602561	Available Chromium (Cr)	2011/09/02	NC	75 - 125	114	75 - 125	ND, RDL=2	mg/kg	4.4	35	107	75 - 125
2602561	Available Cobalt (Co)	2011/09/02	NC	75 - 125	111	75 - 125	ND, RDL=1	mg/kg	20.9	35	104	75 - 125
2602561	Available Copper (Cu)	2011/09/02	NC	75 - 125	112	75 - 125	ND, RDL=2	mg/kg	6.5	35	99	75 - 125
2602561	Available Iron (Fe)	2011/09/02	NC	75 - 125	105	75 - 125	ND, RDL=50	mg/kg	1.7	35	105	75 - 125
2602561	Available Lead (Pb)	2011/09/02	NC	75 - 125	107	75 - 125	ND, RDL=0.5	mg/kg	3.4	35	104	75 - 125
2602561	Available Lithium (Li)	2011/09/02	NC	75 - 125	108	75 - 125	ND, RDL=2	mg/kg	4.1	35		
2602561	Available Manganese (Mn)	2011/09/02	NC	75 - 125	106	75 - 125	ND, RDL=2	mg/kg	53.5(1, 3)	35	121	75 - 125
2602561	Available Mercury (Hg)	2011/09/02	107	75 - 125	123	75 - 125	ND, RDL=0.1	mg/kg				
2602561	Available Molybdenum (Mo)	2011/09/02	98	75 - 125	110	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Nickel (Ni)	2011/09/02	NC	75 - 125	113	75 - 125	ND, RDL=2	mg/kg	16.4	35	107	75 - 125
2602561	Available Rubidium (Rb)	2011/09/02	95	75 - 125	107	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Selenium (Se)	2011/09/02	88	75 - 125	94	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Silver (Ag)	2011/09/02	102	75 - 125	106	75 - 125	ND, RDL=0.5	mg/kg	NC	35		
2602561	Available Strontium (Sr)	2011/09/02	86	75 - 125	107	75 - 125	ND, RDL=5	mg/kg	NC	35	92	75 - 125
2602561	Available Thallium (Tl)	2011/09/02	98	75 - 125	104	75 - 125	ND, RDL=0.1	mg/kg	NC	35		
2602561	Available Tin (Sn)	2011/09/02	99	75 - 125	106	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Uranium (U)	2011/09/02	110	75 - 125	112	75 - 125	ND, RDL=0.1	mg/kg	9.1	35		
2602561	Available Vanadium (V)	2011/09/02	NC	75 - 125	121	75 - 125	ND, RDL=2	mg/kg	7.3	35	123	75 - 125
2602561	Available Zinc (Zn)	2011/09/02	104	75 - 125	107	75 - 125	ND, RDL=5	mg/kg	11.3	35	110	75 - 125
2602739	Dissolved Aluminum (Al)	2011/09/02	104	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L				
2602739	Dissolved Antimony (Sb)	2011/09/02	101	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Arsenic (As)	2011/09/02	100	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Barium (Ba)	2011/09/02	95	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Beryllium (Be)	2011/09/02	96	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Bismuth (Bi)	2011/09/02	97	80 - 120	98	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Boron (B)	2011/09/02	90	80 - 120	90	80 - 120	ND, RDL=50	ug/L				
2602739	Dissolved Cadmium (Cd)	2011/09/02	96	80 - 120	97	80 - 120	ND, RDL=0.017	ug/L				
2602739	Dissolved Calcium (Ca)	2011/09/02	NC	80 - 120	103	80 - 120	ND, RDL=100	ug/L	1.5	25		
2602739	Dissolved Chromium (Cr)	2011/09/02	96	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Cobalt (Co)	2011/09/02	95	80 - 120	96	80 - 120	ND, RDL=0.40	ug/L				
2602739	Dissolved Copper (Cu)	2011/09/02	93	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Iron (Fe)	2011/09/02	104	80 - 120	106	80 - 120	ND, RDL=50	ug/L				

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2602739	Dissolved Lead (Pb)	2011/09/02	95	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L				
2602739	Dissolved Magnesium (Mg)	2011/09/02	103	80 - 120	107	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Manganese (Mn)	2011/09/02	NC	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Molybdenum (Mo)	2011/09/02	102	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Nickel (Ni)	2011/09/02	93	80 - 120	93	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2602739	Dissolved Phosphorus (P)	2011/09/02	105	80 - 120	106	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Potassium (K)	2011/09/02	103	80 - 120	104	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Selenium (Se)	2011/09/02	98	80 - 120	101	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Silver (Ag)	2011/09/02	102	80 - 120	105	80 - 120	ND, RDL=0.10	ug/L				
2602739	Dissolved Sodium (Na)	2011/09/02	NC	80 - 120	101	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Strontium (Sr)	2011/09/02	NC	80 - 120	98	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Thallium (Tl)	2011/09/02	97	80 - 120	98	80 - 120	ND, RDL=0.10	ug/L				
2602739	Dissolved Tin (Sn)	2011/09/02	104	80 - 120	102	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Titanium (Ti)	2011/09/02	104	80 - 120	106	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Uranium (U)	2011/09/02	111	80 - 120	110	80 - 120	ND, RDL=0.10	ug/L				
2602739	Dissolved Vanadium (V)	2011/09/02	97	80 - 120	98	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Zinc (Zn)	2011/09/02	98	80 - 120	101	80 - 120	ND, RDL=5.0	ug/L				
2604821	Available Aluminum (Al)	2011/09/06			100	75 - 125	ND, RDL=10	mg/kg			103	75 - 125
2604821	Available Arsenic (As)	2011/09/06			91	75 - 125	ND, RDL=2	mg/kg			112	75 - 125
2604821	Available Barium (Ba)	2011/09/06			96	75 - 125	ND, RDL=5	mg/kg			121	75 - 125
2604821	Available Chromium (Cr)	2011/09/06			104	75 - 125	ND, RDL=2	mg/kg			108	75 - 125
2604821	Available Cobalt (Co)	2011/09/06			105	75 - 125	ND, RDL=1	mg/kg			106	75 - 125
2604821	Available Copper (Cu)	2011/09/06			105	75 - 125	ND, RDL=2	mg/kg			96	75 - 125
2604821	Available Iron (Fe)	2011/09/06			101	75 - 125	ND, RDL=50	mg/kg			104	75 - 125
2604821	Available Lead (Pb)	2011/09/06			103	75 - 125	ND, RDL=0.5	mg/kg			112	75 - 125
2604821	Available Manganese (Mn)	2011/09/06			103	75 - 125	ND, RDL=2	mg/kg			117	75 - 125
2604821	Available Nickel (Ni)	2011/09/06			104	75 - 125	ND, RDL=2	mg/kg			109	75 - 125
2604821	Available Strontium (Sr)	2011/09/06			99	75 - 125	ND, RDL=5	mg/kg			94	75 - 125
2604821	Available Vanadium (V)	2011/09/06			105	75 - 125	ND, RDL=2	mg/kg			127(1, 4)	75 - 125
2604821	Available Zinc (Zn)	2011/09/06			101	75 - 125	ND, RDL=5	mg/kg			111	75 - 125
2604821	Available Antimony (Sb)	2011/09/06			86	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Beryllium (Be)	2011/09/06			99	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Bismuth (Bi)	2011/09/06			95	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Boron (B)	2011/09/06			104	75 - 125	ND, RDL=5	mg/kg				
2604821	Available Cadmium (Cd)	2011/09/06			97	75 - 125	ND, RDL=0.3	mg/kg				
2604821	Available Lithium (Li)	2011/09/06			108	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Mercury (Hg)	2011/09/06			121	75 - 125	ND, RDL=0.1	mg/kg				
2604821	Available Molybdenum (Mo)	2011/09/06			99	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Rubidium (Rb)	2011/09/06			96	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Selenium (Se)	2011/09/06			78	75 - 125	ND, RDL=2	mg/kg				

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2604821	Available Silver (Ag)	2011/09/06			106	75 - 125	ND, RDL=0.5	mg/kg				
2604821	Available Thallium (Tl)	2011/09/06			105	75 - 125	ND, RDL=0.1	mg/kg				
2604821	Available Tin (Sn)	2011/09/06			93	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Uranium (U)	2011/09/06			100	75 - 125	ND, RDL=0.1	mg/kg				
2606238	Ammonia-N	2011/09/08	105	80 - 120			ND, RDL=0.3	mg/kg	NC	25		
2606311	pH	2011/09/07							0.9	25	101	80 - 120
2606316	Conductivity	2011/09/07			100	80 - 120	ND, RDL=1	uS/cm	0.4	25		
2608974	Total Alkalinity (Total as CaCO3)	2011/09/12	102	80 - 120	112	80 - 120	ND, RDL=5	mg/L	NC	25	106	80 - 120
2608976	Dissolved Chloride (Cl)	2011/09/12	NC	80 - 120	106	80 - 120	ND, RDL=1	mg/L	0.2	25	102	80 - 120
2608978	Dissolved Sulphate (SO4)	2011/09/13	NC	80 - 120	103	80 - 120	ND, RDL=2	mg/L	4.0	25	107	80 - 120
2608979	Reactive Silica (SiO2)	2011/09/09	NC	80 - 120	102	80 - 120	ND, RDL=0.5	mg/L	2.2	25	100	75 - 125
2608980	Colour	2011/09/13					ND, RDL=5	TCU	NC	25	110	80 - 120
2608982	Orthophosphate (P)	2011/09/12	83	80 - 120	103	80 - 120	ND, RDL=0.01	mg/L	NC	25	102	80 - 120
2608983	Nitrate + Nitrite	2011/09/12	102	80 - 120	103	80 - 120	ND, RDL=0.05	mg/L	1.4	25	107	80 - 120
2608984	Nitrite (N)	2011/09/12	96	80 - 120	102	80 - 120	ND, RDL=0.01	mg/L	NC	25	100	80 - 120
2609095	Turbidity	2011/09/09					ND, RDL=0.1	NTU	6.1	25	100	80 - 120
2609245	Chloride (Cl)	2011/09/13					ND, RDL=5	mg/kg				
2609246	Sulphate (SO4)	2011/09/13					ND, RDL=10	mg/kg				
2609250	Orthophosphate (P)	2011/09/12	16(1, 5)	80 - 120			ND, RDL=0.05	mg/kg	NC	25		
2609252	Nitrate + Nitrite	2011/09/12	108	75 - 125			0.47, RDL=0.25	mg/kg	NC	35		
2609253	Nitrite (N)	2011/09/12	101	80 - 120			ND, RDL=0.05	mg/kg	NC	35		
2610143	Acid Extractable Aluminum (Al)	2011/09/12	NC(6)	75 - 125			ND, RDL=50	ug/g			100	75 - 125
2610143	Acid Extractable Barium (Ba)	2011/09/12	100	75 - 125			ND, RDL=2.0	ug/g			95	75 - 125
2610143	Acid Extractable Beryllium (Be)	2011/09/12	101	75 - 125			ND, RDL=0.50	ug/g			98	75 - 125
2610143	Acid Extractable Cadmium (Cd)	2011/09/12	102	75 - 125			ND, RDL=0.50	ug/g			98	75 - 125
2610143	Acid Extractable Calcium (Ca)	2011/09/12	123	75 - 125			ND, RDL=50	ug/g			100	75 - 125
2610143	Acid Extractable Chromium (Cr)	2011/09/12	102	75 - 125			ND, RDL=1.0	ug/g			100	75 - 125
2610143	Acid Extractable Cobalt (Co)	2011/09/12	100	75 - 125			ND, RDL=2.0	ug/g			101	75 - 125
2610143	Acid Extractable Copper (Cu)	2011/09/12	97	75 - 125			ND, RDL=2.0	ug/g			97	75 - 125
2610143	Acid Extractable Iron (Fe)	2011/09/12	80	75 - 125			ND, RDL=50	ug/g			103	75 - 125
2610143	Acid Extractable Lead (Pb)	2011/09/12	103	75 - 125			ND, RDL=5.0	ug/g	NC	35	103	75 - 125
2610143	Acid Extractable Magnesium (Mg)	2011/09/12	102	75 - 125			ND, RDL=50	ug/g			101	75 - 125
2610143	Acid Extractable Manganese (Mn)	2011/09/12	98	75 - 125			ND, RDL=1.0	ug/g			98	75 - 125
2610143	Acid Extractable Molybdenum (Mo)	2011/09/12	95	75 - 125			ND, RDL=2.0	ug/g			95	75 - 125
2610143	Acid Extractable Nickel (Ni)	2011/09/12	99	75 - 125			ND, RDL=5.0	ug/g			100	75 - 125
2610143	Acid Extractable Phosphorus (P)	2011/09/12	99	75 - 125			ND, RDL=20	ug/g			92	75 - 125
2610143	Acid Extractable Potassium (K)	2011/09/12	115	75 - 125			ND, RDL=200	ug/g			97	75 - 125
2610143	Acid Extractable Silver (Ag)	2011/09/12	96	75 - 125			ND, RDL=1.0	ug/g			100	75 - 125
2610143	Acid Extractable Sodium (Na)	2011/09/12	102	75 - 125			ND, RDL=100	ug/g			102	75 - 125
2610143	Acid Extractable Strontium (Sr)	2011/09/12	94	75 - 125			ND, RDL=1.0	ug/g			95	75 - 125

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2610143	Acid Extractable Sulphur (S)	2011/09/12	107	75 - 125			ND, RDL=50	ug/g			101	75 - 125
2610143	Acid Extractable Tin (Sn)	2011/09/12	103	75 - 125			ND, RDL=20	ug/g			101	75 - 125
2610143	Acid Extractable Vanadium (V)	2011/09/12	101	75 - 125			ND, RDL=5.0	ug/g			95	75 - 125
2610143	Acid Extractable Zinc (Zn)	2011/09/12	99	75 - 125			ND, RDL=5.0	ug/g			99	75 - 125
2610321	Organic Carbon (TOC)	2011/09/10					ND, RDL=0.2	g/kg	1.1	35	95	75 - 125
2610484	Total Organic Carbon (C)	2011/09/11	100	80 - 120	93	80 - 120	ND, RDL=0.5	mg/L	NC	25	98	80 - 120
2610772	Nitrogen (Ammonia Nitrogen)	2011/09/13	113	80 - 120	107	80 - 120	ND, RDL=0.05	mg/L	NC	25	100	80 - 120
2610935	Soluble (5:1) pH	2011/09/12							1.8	N/A		
2610938	Conductivity	2011/09/12					ND, RDL=1	uS/cm	0.4	35		

QUALITY ASSURANCE REPORT

			Reagent Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits
2610935	Soluble (5:1) pH	2011/09/12	5.56	N/A
2610938	Conductivity	2011/09/12	1	N/A

N/A = Not Applicable
RDL = Reportable Detection Limit
RPD = Relative Percent Difference
Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.
Reagent Blank: A blank matrix containing all reagents used in the analytical procedure. Used to determine any analytical contamination.
Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.
QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.
Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.
NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.
(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.
(2) - Low recovery due to sample matrix.
(3) - Poor RPD due to sample inhomogeneity.
(4) - Secondary RM is acceptable.
(5) - Poor spike recovery due to sample matrix
(6) - The recovery in the matrix spike was not calculated (NC). Spiked concentration was less than 2x that native to the sample.

Validation Signature Page

Maxxam Job #: B1D4364

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CAcker

COLLEEN ACKER

Cristina Carriere

CRISTINA CARRIERE, Scientific Services

Mike Mac Gilli

MIKE MACGILLIVRAY, Scientific Specialist (Inorganics)

RoseMarie MacDonald

ROSE MACDONALD, Scientific Specialist (Organics)

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Client: AMEC

COC# 06601

HOLD TIME :month ______ day >10

6K COC time stamped

RUSH(1,2,3Day,IOL,Chlorine, MICRO)

Urgent Stamp

Rush Okayed by:	For:	Date:

If no Maxxam COC - Sign&Print ______________________

If no Maxxam COC Temp °C ___ ___ ___

Critical Flag

_____Temp >10C [2] Exceptions -Inorganic, Organic received sameday, Coliform <1hr old

____ No COC[4] or no analysis requested [10]

_____Hold time Up [13]

Sample #	Coliform/Bacteria 300/100mL (Sodium Thiosulfate)	RCAp 200mL plastic	Metals 50mL plastic	Hg 100mL KCr_2 & HNO_3	TKN/PHENOL/COD/TP/AOX 100mL H_2SO_4	BOD / TSS 500mL plastic	Cyanide/Cr+6 60mL NaOH	Chlorine 40mL no headspace	Sulphide 200mL ZnAcetate/HNO_3	MUST/RBCA 250mL $NaHSO_4$	MUST /RBCA/ VOC 40mL NaHSO4- no headspace	TPH Fractionation 1L $NaHSO_4$	NBMUST 500mL $NaHSO_4$	PAH / PCB 250mL glass	Oil&Grease/Pesticides 1L glass	Soil 250mL glass	Soil 60mL glass	Other
1		(	(		(													
2																/		
3		(	(		(													
4																/		
5																		
6																		
7																		
8																		
9																		
10																		

Bottle Types & # Listed on COC are Correct- Initial _____ (No need to fill in table above)

Critical Flag

____**Incorrect preservation or headspace** [15]
(In all 40ml, in 60ml, in 250ml with no 60ml received)

____**Sample requiring filtration preserved** [19]

Flag Supervisor Init:____

____Labelling issue [11] (bottle Ids & Project# don't match COC)

____Bottles/Samples listed on COC but not received [8]
(CS initials ______, Login Manager Initials _______)

____Broken Bottle[3]-Note if insufficient Packing or cooler/box damaged
(Internal Maxxam Shipment No FLAG,add info to Job Remark,notify PM to call&initial____)

____Cap Missing or Cap Broken [20], Empty Bottle [21]

____Insufficient Volume [18],wrong bottle [14], insufficient bottles no flag[16]

____Bottles/Samples received but not listed on COC [9]

____>1cm sediment in Organic groundwater sample[23]

____Organic samples received >5d after sampling [12] (not over hold time)

Green Flag

____COC not current [7] or COC not complete [5], COC not signed/dated[6]

____Sample Frozen[22]

FLAG Yes / [✓ No] Initials GK (Need to indicate Yes/No on COC too)

Resolution: ______________________

Sticker/Stamp

Sticker/ Stamp

if IOL use IOL Checklist	
if Heat treat place sticker on this sheet	
if Prep Step Required place sticker on this sheet	

Notes:

Required for Non Maxxam COC		Required for Non Current Maxxam COC	
Client#	Maxxam Job#	Labelled by:	WIF/DRY/[✓ RCAP]/Bin/CART
		Temp Storage	WSF-334
Login Date:	Login Initials:	ZN	RCap 820

Maxxam Analytics Inc

49-55 Elizabeth Avenue, Suite 101A, St. John's, NL A1A 1W9 Tel: 709-754-0203 Fax: 709-754-8612 Toll Free: 1-888-492-7227
www.maxxamanalytics.com

CHAIN OF CUSTODY RECORD

06601

INVOICE INFORMATION:
Company Name: AMEC
Contact Name: Matthew Gosse
Address: 133 Crosbie Rd.
St. John's
Email: matthew.gosse@amec.com
Ph: (709) 722-7023 Fax:

REPORT INFORMATION (if differs from invoice):
Company Name:
Contact Name:
Address:
Email:
Ph: Fax:

PO #:
Project #: TF1143025
Proj. Name:
Location: Lab. City
Quotation#:
Submitted By: Matthew Gosse
Site Task #:

MAXXAM JOB NUMBER: B1D4364
ENTERED BY, Init: BD
Client Code: 10970

Specify Guideline Requirements:

*Specify Matrix: Surface/Salt/Ground/Tapwater/Sewage/Effluent/Seawater Potable/NonPotable/Tissue/Soil/Sludge/Metal

Sample Identification	Matrix*	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAp-30 Choose Total or Diss Metals	RCAp-MS Choose Total or Diss Metals	Metals Water: Total Digest (Default Method)	Metals Water: Dissolved	Mercury: Mercury is not included in soil or water metals scan	Metals Soil: Available Metals Digest Default Method (HNO_3/H_2O_2)	Metals Soil: Total Digest - for sediments ($HNO_3/HF/HCLO_4$)	Metals Soil: Tin (required for CCME soils)	Metals Soil: Selenium (low level) Req'd for CCME Residential, Parklands, Agricultural	Metals Soil: Hot Water soluble Boron (required for CCME Agricultural)	TPH MUST (BTEX, C_6-C_{32})	Soil (Potable), TPH MUST, NS Fuel Oil Spill Policy Low Level BTEX & C_6-C_{32}	NB Potable Water BTEX, VPH, Low Level TEH	TPH Fractionation	~~PAHs~~ TOC	PCB's	VOC's EPA 624,8260	Other Analysis or Comments/Hazards
T-14-3	Water	August 28	3		X		X													X			
T-14-3	Sediment	"	1		X		X													X			
P6	Water	"	3		X		X													X			
P6	Sediment	"	1		X		X													X			

DUE DATE:
STANDARD: ☑
RUSH Due Date:
For extra cost rush, specify Due Date. Rush analysis must be scheduled prior to sample submission.
Client will be contacted if Rush date cannot be met.

SHIPPED FROM
[illegible]
MAXXAM-NL

RELINQUISHED BY: (Signature/Print)	RECEIVED BY: (Signature/Print)	DATE / TIME	PURPOSE OF CHANGE / REMARKS
Matthew Gosse	M Dalton	2011.08.31	
Matthew Gosse		11:30	

TEMP @ Maxxam Receipt: 13.8/12.4/11.9
INTEGRITY Init: GK
Yes [✓ No]

KEENVROCOC St.John's 05/05

Cooler 1 = 0, 1, 0
Cooler 2 = 0, 2, 1
Cooler 3 = 0, 2, 2

Purolator

FROM/DE

Maxxam Analytics
49 Elizabeth AVE

St. John's, NL A1A 1W9
(709) 754-0203

REF:

TO/À

Sample Reception
Maxxam Analytics Inc

200 Bluewater RD
SUITE 105

Bedford, NS B4B 1G9
(902) 420-0203

NOTE:

DATE	PIECES	WEIGHT/POIDS
31 Aug 2011	2 of/de 3	60.00 lb.

10402878/31/2011 12:00:00 AM

PIN: 329 469 748 969

10 30 AM/h

YHZ

11

Fold the Bill of Lading on the dotted line and insert into the labelope. Attach a Bill of Lading to each package.
Veuillez plier ce connaissement sur la ligne pointillée et l'insérer dans l'enveloppe autoadhésive. Veuillez joindre un connaissement à chaque colis.

Description: coolers

No Declared Value Entered By Sender / Aucune valeur déclarée entrée par l'expéditeur

CONDITIONS OF CARRIAGE

IMPORTANT - PLEASE READ: The consignor agrees that the act of tendering the shipment to the carrier for transportation shall be sufficient to constitute signature of this bill of lading by the consignor and shall bind the consignor to the conditions of carriage stated below.

RECEIPT Carrier acknowledges receiving from the shipper, at the point of origin and on the date specified, the shipment described in this bill of lading in apparent good order, except as noted (contents and conditions of contents of shipment unknown), and agrees to carry and deliver the shipment to the receiver at the destination set out in this bill of lading, subject to payment of all lawful charges. "Carrier" refers to Purolator Courier Ltd. and any connecting and/or successive carriers involved in the transportation of the shipment herein described, including any of their respective subsidiaries, controlled entities, and their respective employees, agents and independent contractors.

LIMITATION ON LIABILITY Carrier's liability in respect of the shipment described in this bill of lading (including for any loss, damage, delay, misdelivery, non-delivery or failure to deliver) is limited to $2.00 per pound ($4.41 per kilogram) computed on the total weight of the shipment, unless a higher value is declared in the specially marked Purolator Online Shipping user entry field, "Declared Value for Insurance ($)". Notwithstanding any disclosure of the nature or value of the goods carried or any special agreement to the contrary, carrier is not liable under any circumstances for the consequences of delay, or for any indirect or consequential damages (including lost profits) howsoever caused.

NOTICE OF CLAIM Carrier is not liable for any loss, damage or delay to any goods carried under this bill of lading unless notice of the claim setting out particulars of the origin, destination and date of shipment of the goods and the estimated amount claimed in respect of such loss, damage or delay is given in writing to the carrier within sixty (60) days after the delivery of the goods, or, in the case of failure to make delivery, within nine (9) months from the date of shipment. Subject to any overriding statutory provisions, the final statement of the claim must be filed within nine (9) months from the date of shipment, together with a copy of the paid freight bill. If the Convention applies, other notice periods may govern. No claim will be entertained until all transportation charges due in connection with this bill of lading have been paid in full. All claims are subject to proof of amount of loss.

TERMS INCORPORATED BY REFERENCE Every service to be performed under this bill of lading is subject to the conditions of carriage contained in this bill of lading, including the terms and conditions contained in Purolator Courier Ltd.'s published terms and conditions of carriage and the terms and conditions prescribed by the law of the jurisdiction where the goods originate (including the uniform conditions of carriage thereunder, if any). If the carriage involves an ultimate destination or a stop in a country other than the country of departure, the Convention (as defined below) may apply and limit the liability of the carrier in respect of loss of, damage to or delay of cargo. "Convention" means the Convention for the Unification of Certain Rules relating to International Carriage by Air, signed at Warsaw, Poland, 12 October, 1929, or the Convention for the Unification of Certain Rules for International Carriage by Air, signed at Montreal, Canada, 28 May, 1999, or those Conventions as amended or supplemented as may be applicable to the carriage hereunder.

MISCELLANEOUS Unless otherwise indicated, the consignor's name and address is the sender's name and address indicated on this bill of lading, and the latter is the place of execution and the place of departure; the consignee's name and address is the receiver's name and address indicated on this bill of lading, and the latter is the place of destination; and the date indicated on this bill of lading is the date of execution. There are no specific stopping places which are agreed to, and the carrier reserves the right to select the route and the mode of transportation that the carrier deems appropriate. The consignor warrants that the shipment is properly described on this bill of lading and on any accompanying documentation, and that the shipment is properly marked, addressed and packed to ensure safe transportation in accordance with the carrier's ordinary care in handling. Unless otherwise indicated on this bill of lading, the consignor waives its right to determine the volume or dimensions of the shipment, and to indicate same on this bill of lading. The consignor appoints the carrier as its agent for the performance of customs clearance and selecting a customs broker.

ENTIRE AGREEMENT The terms and conditions contained in this bill of lading, including those incorporated herein by reference, constitute the entire agreement relating to the carriage of the shipment described in this bill of lading, and no agent, servant or representative of the carrier or consignor has the authority to alter, waive or otherwise modify any provision of this agreement. In tendering the shipment described herein for carriage, the consignor agrees to these terms and conditions on his own behalf and on behalf of the consignee and any other party claiming an interest in this shipment.

Client: Health Canada COC# N/A

RUSH(1,2,3Day,IOL,Chlorine, MICRO)

URGENT!

Rush Okayed by:	For:	Date:
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______
______	______	______

HOLD TIME :month Sept day 2 ✓ COC time stamped

If no Maxxam COC - Sign&Print ____________________

If no Maxxam COC Temp °C ______

Critical Flag

_____Temp >10C ² Exceptions -Inorganic, Organic received sameday, Coliform <1hr old

____ **No COC⁴ or no analysis requested** ¹⁰

_____**Hold time Up** ¹³

Sample #	**Coliform**/Bacteria 300/100mL (Sodium Thiosulfate)	**RCAp** 200mL plastic	**Metals** 50mL plastic	**Hg** 100mL KCr$_2$ & HNO$_3$	**TKN/PHENOL/COD/TP/AOX** 100mL H$_2$SO$_4$	**BOD / TSS** 500mL plastic	**Cyanide/Cr+6** 60mL NaOH	**Chlorine** 40mL no headspace	**Sulphide** 200mL ZnAcetate/HNO$_3$	**MUST/RBCA** 250mL NaHSO$_4$	MUST /RBCA/ VOC 40mL NaHSO4- no headspace	**TPH Fractionation** 1L NaHSO$_4$	NBMUST 500mL NaHSO$_4$	**PAH / PCB** 250mL glass	**Oil&Grease**/Pesticides 1L glass	**Soil** 250mL glass	**Soil** 60mL glass	**Other**
1	1																	
2	1																	
3	1																	
4	1																	
5																		
6																		
7																		
8																		
9																		
10																		

Bottle Types & # Listed on COC are Correct- Initial _____ (No need to fill in table above)

Critical Flag

____**Incorrect preservation or headspace** ¹⁵
(In all 40ml, in 60ml, in 250ml with no 60ml received)

____**Sample requiring filtration preserved** ¹⁹

Flag Supervisor Init:____

____Labelling issue ¹¹ (bottle Ids & Project# don't match COC)

____Bottles/Samples listed on COC but not received ⁸
(CS initials _____, Login Manager Initials ______)

____Broken Bottle³-Note if insufficient Packing or cooler/box damaged
(Internal Maxxam Shipment No FLAG,add info to Job Remark,notify PM to call&initial____)

____Cap Missing or Cap Broken ²⁰, Empty Bottle ²¹

____Insufficient Volume ¹⁸,wrong bottle ¹⁴, insufficient bottles no flag¹⁶

____Bottles/Samples received but not listed on COC ⁹

____>1cm sediment in Organic groundwater sample²³

____Organic samples received >5d after sampling ¹² (not over hold time)

Green Flag

____COC not current⁷ or COC not complete ⁵, COC not signed/dated⁶

____Sample Frozen²²

FLAG Yes [✓ No] Initials MC (Need to indicate Yes/No on COC too)

Resolution: ____________________

Sticker/Stamp

Sticker/ Stamp

if IOL use IOL Checklist

if Heat treat place sticker on this sheet

if Prep Step Required place sticker on this sheet

Notes:

Required for Non Maxxam COC	
Client#	Maxxam Job#
Login Date:	Login Initials:

Required for Non **Current** Maxxam COC	
Labelled by:	WIF/DRY/RCAP/Bin/CART
Temp Storage	

Maxxam

200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax:902-420-8612 Toll Free :1-800-565-7227
www.maxxamanalytics.com E-mail: clientservicesbedford@maxxamanalytics.com

Chain of Custody Record

REPORT & INVOICE INFORMATION:

Company Name: Health Canada
Contact Name: Melissa Young
Address: Suite 1525 1505 Barrington St. Halifax
Postal Code B3J 3Y6
Email: melissa.young@hc-sc.gc.ca
Ph: 902 426 4645 Fax: 902 426 4208

Watertrax ID# 5143
First Nations Community Name:
Sampled By: Melissa Young
Quotation #: **Standing Offer**

DUE DATE: ☒ **STANDARD:** ☐ **RUSH**
RUSH Due Date: ______
Extra cost for rush. Rush analysis should be scheduled prior to sample submission.
Client will be contacted if Rush date cannot be met.

This column for lab only
Client Code: 12959
Maxxam Job #: B1D4372

Special Notes:

Sample Identification	SPL # (Maxxam Login will add SPL# to the COC # field)	Cl_2 Residue (Maxxam Login will add Cl2 Residue Value to On-Site code)	# & type of bottles	Date/Time Sampled	Matrix	TC/E.coli-MPN	P.aerginosa	S.aureus	RCAP-MS Total	THM	ARSENIC	HAA	Other
Band Office	2310C	1.01	1/300 ml	Sept. 1, 2011 @ 10:55	Water	X							
Annapolis Gas Bar (38 Leo Drive)	E4F8	1.03	1/300 ml	Sept. 1, 2011 @ 11:30	Water	X							
Bingo Hall	2310B	0.81	1/300 ml	Sept. 1, 2011 @ 11:50	Water	X							
93 Goo-zow	552B	0.55	1/300 ml	Sept. 1, 2011 @ 12:01 pm	Water	X							
					Water								
					Water								
					Water								
					Water								
					Water								
					Water								

Temp 1	Temp 2	Temp 3	Integrity
10	11	9	Yes
			No

Labelled by:
Location/Bin#

2011 SEP 1 PM 2:04

RELINQUISHED BY:
Signature Melissa Young
Print Melissa Young
Date Sept 1/11
Time

Received By: (Signiture/Print)
Signature M Lomea
Print M Lomea
Date
Time

Page ___ of ___

Success Through Science®

Your Project #: TF1143025
Site Location: GENESIS
Your C.O.C. #: B 082772

Attention: Matthew Gosse
AMEC Environment & Infrastructure
St John's - Standing Offer
PO Box 13216
133 Crosbie Rd, Suite 202
St John's, NL
A1B 4A5

Report Date: 2011/12/21

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1J5283
Received: 2011/12/12, 12:53

Sample Matrix: Soil
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Chloride in Soil by Auto. Colourimetry	7	N/A	2011/12/13	ATL SOP 00014	Based on SM4500-Cl-
Conductance - soil	7	2011/12/13	2011/12/14	ATL SOP 00006	Based on SM2510B
Total Metals Analysis by ICP (1)	7	2011/12/19	2011/12/19	CAM SOP-00408	EPA 6010
Metals Solid Avail. Unified MS - Nper	7	2011/12/13	2011/12/13	ATL SOP 00024	Based on EPA6020A
Moisture	7	N/A	2011/12/12	ATL SOP 00001	MOE Handbook 1983
Nitrogen Ammonia - soil (as N)	7	2011/12/13	2011/12/14	ATL SOP 00015	Based on EPA 350.1
Nitrogen - Nitrate + Nitrite	7	2011/12/13	2011/12/14	ATL SOP 00016	Based on USGS enz.
Nitrogen - Nitrite by auto colourimetry	7	2011/12/13	2011/12/14	ATL SOP 00017	Based on SM4500-NO2B
pH (5:1 DI Water Extract)	7	2011/12/13	2011/12/14	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho by auto Colourimetry	7	2011/12/13	2011/12/14	ATL SOP 00021	Based on EPA 365.1
Sulphate in Soil by Auto Colourimetry	7	2011/12/13	2011/12/14	ATL SOP 00023	Based on EPA 375.4

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MICHELLE HILL, Project Manager
Email: MHill@maxxam.ca
Phone# (902) 420-0203

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 1

RESULTS OF ANALYSES OF SOIL

Maxxam ID		LY2454	LY2454		LY2512		
Sampling Date		2011/08/23	2011/08/23		2011/08/14		
	Units	**T-9 (P#KR5833)**	**T-9 (P#KR5833) Lab-Dup**	**RDL**	**P2 (P#KR5835)**	**RDL**	**QC Batch**
Inorganics							
Ammonia-N	mg/kg	ND	0.5	0.4	ND	3	2711460
Chloride (Cl)	mg/kg	10	7	5	34	10	2711284
Conductivity	uS/cm	22	24	1	40	1	2712432
Moisture	%	25		1	91	1	2709674
Nitrate + Nitrite	mg/kg	ND	ND	0.25	1.5	0.50	2711290
Nitrite (N)	mg/kg	ND	ND	0.05	ND	0.1	2711291
Orthophosphate (P)	mg/kg	0.20	0.19	0.05	0.6	0.1	2711289
Soluble (5:1) pH	pH	7.18	7.24	N/A	6.43	N/A	2712431
Sulphate (SO4)	mg/kg	ND	ND	10	65	20	2711286

Maxxam ID		LY2513		LY2514		LY2515	LY2516	LY2517		
Sampling Date		2011/08/18		2011/08/17		2011/08/24	2011/08/24	2011/08/24		
	Units	**T2 (P#KR5842)**	**RDL**	**P3 (P#KR5844)**	**RDL**	**P5 (P#KR5846)**	**P4 (P#KR5896)**	**P1 (P#KR5898)**	**RDL**	**QC Batch**
Inorganics										
Ammonia-N	mg/kg	ND	0.3	4	2	ND	ND	ND	0.3	2711460
Chloride (Cl)	mg/kg	8	5	20	10	11	14	5	5	2711284
Conductivity	uS/cm	17	1	50	1	37	16	80	1	2712432
Moisture	%	13	1	87	1	13	14	13	1	2709674
Nitrate + Nitrite	mg/kg	0.49	0.25	3.3	0.50	1.4	0.49	0.31	0.25	2711290
Nitrite (N)	mg/kg	ND	0.05	0.1	0.1	ND	ND	ND	0.05	2711291
Orthophosphate (P)	mg/kg	0.23	0.05	0.3	0.1	0.18	0.25	0.13	0.05	2711289
Soluble (5:1) pH	pH	7.13	N/A	6.13	N/A	7.13	7.15	6.82	N/A	2712431
Sulphate (SO4)	mg/kg	ND	10	75	20	ND	12	140	10	2711286

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		LY2454		LY2512		LY2513		LY2514		
Sampling Date		2011/08/23		2011/08/14		2011/08/18		2011/08/17		
	Units	**T-9 (P#KR5833)**	**RDL**	**P2 (P#KR5835)**	**RDL**	**T2 (P#KR5842)**	**RDL**	**P3 (P#KR5844)**	**RDL**	**QC Batch**
Metals										
Acid Extractable Calcium (Ca)	ug/g	3000	50	7500	500	3000	50	6700	50	2717355
Acid Extractable Magnesium (Mg)	ug/g	3400	50	5400	500	3400	50	4900	50	2717355
Acid Extractable Phosphorus (P)	ug/g	760	20	2600	200	1000	20	860	20	2717355
Acid Extractable Potassium (K)	ug/g	720	200	ND	2000	1100	200	710	200	2717355
Acid Extractable Sodium (Na)	ug/g	ND	100	ND	1000	ND	100	ND	100	2717355
Available Aluminum (Al)	mg/kg	6300	10	17000	10	3100	10	9900	10	2711921
Available Antimony (Sb)	mg/kg	ND	2	ND	2	ND	2	ND	2	2711921
Available Arsenic (As)	mg/kg	ND	2	ND	2	ND	2	ND	2	2711921
Available Barium (Ba)	mg/kg	760	5	2300	5	34	5	85	5	2711921
Available Beryllium (Be)	mg/kg	ND	2	ND	2	ND	2	ND	2	2711921
Available Bismuth (Bi)	mg/kg	ND	2	ND	2	ND	2	ND	2	2711921
Available Boron (B)	mg/kg	ND	5	ND	5	ND	5	ND	5	2711921
Available Cadmium (Cd)	mg/kg	0.4	0.3	1.4	0.3	ND	0.3	0.6	0.3	2711921
Available Chromium (Cr)	mg/kg	22	2	48	2	12	2	38	2	2711921
Available Cobalt (Co)	mg/kg	9	1	19	1	5	1	7	1	2711921
Available Copper (Cu)	mg/kg	9	2	27	2	4	2	15	2	2711921
Available Iron (Fe)	mg/kg	33000	50	51000	500	31000	50	50000	500	2711921
Available Lead (Pb)	mg/kg	2.0	0.5	10	0.5	2.2	0.5	62	0.5	2711921
Available Lithium (Li)	mg/kg	8	2	13	2	3	2	6	2	2711921
Available Manganese (Mn)	mg/kg	12000	2	89000	20	1800	2	560	2	2711921
Available Mercury (Hg)	mg/kg	ND	0.1	0.2	0.1	ND	0.1	0.1	0.1	2711921
Available Molybdenum (Mo)	mg/kg	10	2	18	2	ND	2	ND	2	2711921
Available Nickel (Ni)	mg/kg	47	2	64	2	9	2	27	2	2711921
Available Rubidium (Rb)	mg/kg	10	2	17	2	6	2	7	2	2711921
Available Selenium (Se)	mg/kg	ND	2	2	2	ND	2	ND	2	2711921
Available Silver (Ag)	mg/kg	ND	0.5	0.7	0.5	ND	0.5	ND	0.5	2711921
Available Strontium (Sr)	mg/kg	11	5	11	5	6	5	10	5	2711921
Available Thallium (Tl)	mg/kg	0.8	0.1	1.4	0.1	ND	0.1	0.2	0.1	2711921
Available Tin (Sn)	mg/kg	ND	2	ND	2	ND	2	ND	2	2711921
Available Uranium (U)	mg/kg	1.2	0.1	3.7	0.1	0.3	0.1	1.5	0.1	2711921
Available Vanadium (V)	mg/kg	16	2	26	2	10	2	20	2	2711921
Available Zinc (Zn)	mg/kg	67	5	180	5	16	5	99	5	2711921

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		LY2514		LY2515		LY2516		LY2517		
Sampling Date		2011/08/17		2011/08/24		2011/08/24		2011/08/24		
	Units	**P3 (P#KR5844) Lab-Dup**	**RDL**	**P5 (P#KR5846)**	**RDL**	**P4 (P#KR5896)**	**RDL**	**P1 (P#KR5898)**	**RDL**	**QC Batch**
Metals										
Acid Extractable Calcium (Ca)	ug/g	6300	50	3600	50	1300	50	2700	50	2717355
Acid Extractable Magnesium (Mg)	ug/g	4800	50	5800	50	590	50	2800	50	2717355
Acid Extractable Phosphorus (P)	ug/g	830	20	770	20	370	20	900	20	2717355
Acid Extractable Potassium (K)	ug/g	750	200	2400	200	ND	200	860	200	2717355
Acid Extractable Sodium (Na)	ug/g	ND	100	ND	100	ND	100	ND	100	2717355
Available Aluminum (Al)	mg/kg		10	7300	10	1100	10	3600	10	2711921
Available Antimony (Sb)	mg/kg		2	ND	2	ND	2	ND	2	2711921
Available Arsenic (As)	mg/kg		2	ND	2	ND	2	ND	2	2711921
Available Barium (Ba)	mg/kg		5	270	5	ND	5	28	5	2711921
Available Beryllium (Be)	mg/kg		2	ND	2	ND	2	ND	2	2711921
Available Bismuth (Bi)	mg/kg		2	ND	2	ND	2	ND	2	2711921
Available Boron (B)	mg/kg		5	ND	5	ND	5	ND	5	2711921
Available Cadmium (Cd)	mg/kg		0.3	ND	0.3	ND	0.3	ND	0.3	2711921
Available Chromium (Cr)	mg/kg		2	34	2	3	2	13	2	2711921
Available Cobalt (Co)	mg/kg		1	10	1	1	1	3	1	2711921
Available Copper (Cu)	mg/kg		2	10	2	ND	2	2	2	2711921
Available Iron (Fe)	mg/kg		500	22000	50	87000	500	9500	50	2711921
Available Lead (Pb)	mg/kg		0.5	3.2	0.5	0.7	0.5	2.2	0.5	2711921
Available Lithium (Li)	mg/kg		2	9	2	ND	2	4	2	2711921
Available Manganese (Mn)	mg/kg		2	5300	2	150	2	74	2	2711921
Available Mercury (Hg)	mg/kg		0.1	ND	0.1	ND	0.1	ND	0.1	2711921
Available Molybdenum (Mo)	mg/kg		2	4	2	ND	2	ND	2	2711921
Available Nickel (Ni)	mg/kg		2	31	2	ND	2	7	2	2711921
Available Rubidium (Rb)	mg/kg		2	16	2	ND	2	7	2	2711921
Available Selenium (Se)	mg/kg		2	ND	2	ND	2	ND	2	2711921
Available Silver (Ag)	mg/kg		0.5	ND	0.5	ND	0.5	ND	0.5	2711921
Available Strontium (Sr)	mg/kg		5	13	5	ND	5	9	5	2711921
Available Thallium (Tl)	mg/kg		0.1	0.4	0.1	ND	0.1	ND	0.1	2711921
Available Tin (Sn)	mg/kg		2	ND	2	ND	2	ND	2	2711921
Available Uranium (U)	mg/kg		0.1	0.8	0.1	0.1	0.1	0.4	0.1	2711921
Available Vanadium (V)	mg/kg		2	18	2	5	2	9	2	2711921
Available Zinc (Zn)	mg/kg		5	41	5	6	5	18	5	2711921

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Package 1	6.3°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Mercury results for Job B1J5283 have been tested past the recommended hold time.

Sample LY2512-01: Metals Analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Maxxam Job #: B1J5283
Report Date: 2011/12/21

AMEC Environment & Infrastructure
Client Project #: TF1143025
Site Location: GENESIS

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2711284	Chloride (Cl)	2011/12/13	100	80 - 120			ND, RDL=5	mg/kg	NC	35		
2711286	Sulphate (SO4)	2011/12/14	100.9%	80 - 120			ND, RDL=10	mg/kg	NC	25		
2711289	Orthophosphate (P)	2011/12/14	90	80 - 120			ND, RDL=0.05	mg/kg	NC	25		
2711290	Nitrate + Nitrite	2011/12/14	102	75 - 125			ND, RDL=0.25	mg/kg	NC	35		
2711291	Nitrite (N)	2011/12/14	43(1, 2)	80 - 120			ND, RDL=0.05	mg/kg	NC	35		
2711460	Ammonia-N	2011/12/14	99	80 - 120			ND, RDL=0.3	mg/kg	NC	25		
2711921	Available Antimony (Sb)	2011/12/13	NC	75 - 125	92	75 - 125	ND, RDL=2	mg/kg	NC	35		
2711921	Available Arsenic (As)	2011/12/13	108	75 - 125	95	75 - 125	ND, RDL=2	mg/kg	NC	35		
2711921	Available Barium (Ba)	2011/12/13	NC	75 - 125	96	75 - 125	ND, RDL=5	mg/kg	1.8	35		
2711921	Available Beryllium (Be)	2011/12/13	113	75 - 125	103	75 - 125	ND, RDL=2	mg/kg	NC	35		
2711921	Available Bismuth (Bi)	2011/12/13	98	75 - 125	90	75 - 125	ND, RDL=2	mg/kg	NC	35		
2711921	Available Boron (B)	2011/12/13	84	75 - 125	98	75 - 125	ND, RDL=5	mg/kg	NC	35		
2711921	Available Cadmium (Cd)	2011/12/13	109	75 - 125	96	75 - 125	ND, RDL=0.3	mg/kg	NC	35		
2711921	Available Chromium (Cr)	2011/12/13	NC	75 - 125	100	75 - 125	ND, RDL=2	mg/kg	6.3	35		
2711921	Available Cobalt (Co)	2011/12/13	108	75 - 125	97	75 - 125	ND, RDL=1	mg/kg	9.0	35		
2711921	Available Copper (Cu)	2011/12/13	NC	75 - 125	96	75 - 125	ND, RDL=2	mg/kg	4.5	35		
2711921	Available Lead (Pb)	2011/12/13	NC	75 - 125	103	75 - 125	ND, RDL=0.5	mg/kg	6.3	35		
2711921	Available Lithium (Li)	2011/12/13	111	75 - 125	106	75 - 125	ND, RDL=2	mg/kg	1.0	35		
2711921	Available Manganese (Mn)	2011/12/13	NC	75 - 125	104	75 - 125	ND, RDL=2	mg/kg	16.8	35		
2711921	Available Mercury (Hg)	2011/12/13	112	75 - 125	97	75 - 125	ND, RDL=0.1	mg/kg	NC	35		
2711921	Available Molybdenum (Mo)	2011/12/13	115	75 - 125	98	75 - 125	ND, RDL=2	mg/kg	NC	35		
2711921	Available Nickel (Ni)	2011/12/13	113	75 - 125	99	75 - 125	ND, RDL=2	mg/kg	1.2	35		
2711921	Available Rubidium (Rb)	2011/12/13	106	75 - 125	100	75 - 125	ND, RDL=2	mg/kg	8.9	35		
2711921	Available Selenium (Se)	2011/12/13	101	75 - 125	99	75 - 125	ND, RDL=2	mg/kg	NC	35		
2711921	Available Silver (Ag)	2011/12/13	107	75 - 125	98	75 - 125	ND, RDL=0.5	mg/kg	NC	35		
2711921	Available Strontium (Sr)	2011/12/13	107	75 - 125	103	75 - 125	ND, RDL=5	mg/kg	NC	35		
2711921	Available Thallium (Tl)	2011/12/13	101	75 - 125	94	75 - 125	ND, RDL=0.1	mg/kg	NC	35		
2711921	Available Tin (Sn)	2011/12/13	113	75 - 125	107	75 - 125	ND, RDL=2	mg/kg	NC	35		
2711921	Available Uranium (U)	2011/12/13	107	75 - 125	93	75 - 125	ND, RDL=0.1	mg/kg	9.8	35		
2711921	Available Vanadium (V)	2011/12/13	NC	75 - 125	100	75 - 125	ND, RDL=2	mg/kg	6.6	35		
2711921	Available Zinc (Zn)	2011/12/13	NC	75 - 125	93	75 - 125	ND, RDL=5	mg/kg	1.9	35		
2711921	Available Aluminum (Al)	2011/12/13					ND, RDL=10	mg/kg	11.3	35		
2711921	Available Iron (Fe)	2011/12/13					ND, RDL=50	mg/kg	8.5	35		
2712431	Soluble (5:1) pH	2011/12/14							0.8	N/A		
2712432	Conductivity	2011/12/14							8.6	35		
2717355	Acid Extractable Calcium (Ca)	2011/12/19	NC	75 - 125			ND, RDL=50	ug/g	5.6	35	106	75 - 125
2717355	Acid Extractable Magnesium (Mg)	2011/12/19	NC	75 - 125			ND, RDL=50	ug/g	2.8	35	100	75 - 125
2717355	Acid Extractable Phosphorus (P)	2011/12/19	NC	75 - 125			ND, RDL=20	ug/g	4.4	35	102	75 - 125

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2717355	Acid Extractable Potassium (K)	2011/12/19	98	75 - 125			ND, RDL=200	ug/g	NC	35	99	75 - 125
2717355	Acid Extractable Sodium (Na)	2011/12/19	101	75 - 125			ND, RDL=100	ug/g	NC	35	102	75 - 125

N/A = Not Applicable

RDL = Reportable Detection Limit

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) - Poor spike recovery due to sample matrix.

Validation Signature Page

Maxxam Job #: B1J5283

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Cristina Carriere

CRISTINA CARRIERE, Scientific Services

Kevin A. MacDonald

KEVIN MACDONALD, Inorganics Supervisor

Mike MacGillivray

MIKE MACGILLIVRAY, Scientific Specialist (Inorganics)

RoseMarie MacDonald

ROSE MACDONALD, Scientific Specialist (Organics)

==

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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MAXXAM Chain of Custody Record

COC #: B 082772
Page 1 of 1

This column for lab use only:
Client Code 10970
Maxxam Job # B1J5283

Cooler ID	Seal Present	Seal Intact	Temp 1	Temp 2	Temp 3	Average Temp

Integrity: YES [✓ NO]
Integrity / Checklist by: NB
Labelled by:
Location / Bin #: B2

INVOICE INFORMATION:
Company Name: AMEC
Contact Name: Matthew Gosse
Address: St. John's, NL
Postal Code:
Email:
Ph: Fax:

REPORT INFORMATION (if differs from invoice):
Company Name:
Contact Name:
Address:
Postal Code:
Email:
Ph: Fax:

PO #
Project # / Phase # TF1143025
Project Name / Site Location Genesis
Quote
Site #
Task Order #
Sampled by

TURNAROUND TIME
Standard ☐
10 day ☐
If RUSH Specify Date: WED. DEC 14th
Pre-schedule rush work
Charge for # Jars used but not submitted

Guideline Requirements / Detection Limits / Special Instructions

*Specify Matrix: Surface/Salt/Ground/Tapwater/Sewage/Effluent/Potable/NonPotable/Tissue/Soil/Sludge/Metal/Seawater

This column for lab use only	Field Sample Identification	Matrix*	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAP-30 Choose Total or Diss Metals	RCAP-MS Choose Total or Diss Metals	Metals Water: Total Digest (Default Method) for well water, surface water	Metals Water: Dissolved for ground water	Metals Water: Mercury	Metals Soil: Metals & Mercury Default Available Digest Method	Metals Soil: Metals Total Digest - for Ocean sediments (HNO3/HF/HCLO4)	Metals Soil: Mercury Low level by Cold Vapour AA	Metals Soil: Selenium (low level) Req'd for CCME Residential, Parklands, Agricultural	Metals Soil: Hot Water soluble Boron (required for CCME Agricultural)	Hydrocarbons: RBCA Hydrocarbons (BTEX, C6-C32)	Hydrocarbons: Hydrocarbons Soil (Potable), NS Fuel Oil Spill Policy Low Level BTEX, C6-C32	Hydrocarbons: NB Potable Water	Hydrocarbons: BTEX, VPH, Low level T.E.H.	Hydrocarbons: TPH Fractionation	Hydrocarbons: PAH's	Hydrocarbons: PAH's with Acridine, Quinoline	GENERAL CHEMISTRY			
WIF: 350	1 T-9 (P# KR5833)	Sediment	Aug 23 2011																					✓			
	2 P2 (P# KR 5835)		Aug 14 2011																					✓			
	3 T2 (P# KR 5842)		Aug 18 2011																					✓			
	4 P3 (P# KR 5844)		Aug 17 2011																					✓			
	5 P5 (P# KR 5846)		Aug 24 2011																					✓			
	6 P4 (P# KR 5896)		Aug 24 2011																					✓			
	7 P1 (P# KR 5898)		Aug 24 2011																					✓			
	8																										
	9																										
	10																										

2011 DEC 12 PM 12:53

Rush OK'd by Arlene, Mary, Kara

RELINQUISHED BY: (Signature/Print) Michelle Hill Date Dec 12/11 Time

RECEIVED BY: (Signature/Print) Date Time

Your Project #: TF1143025
Site Location: LAB. CITY
Your C.O.C. #: 06601

Attention: Matthew Gosse
AMEC Environment & Infrastructure
St John's - Standing Offer
PO Box 13216
133 Crosbie Rd, Suite 202
St John's, NL
A1B 4A5

Report Date: 2012/01/17
This report supersedes all previous reports with the same Maxxam job number

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B1D4364
Received: 2011/09/01, 10:02

Sample Matrix: Soil
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Chloride in Soil by Auto. Colourimetry	2	N/A	2011/09/13	ATL SOP 00014	Based on SM4500-Cl-
Conductance - soil	2	2011/09/09	2011/09/12	ATL SOP 00006	Based on SM2510B
Total Metals Analysis by ICP ◍	2	2011/09/10	2011/09/12	CAM SOP-00408	EPA 6010
Metals Solid Avail. Unified MS - Nper	1	2011/09/02	2011/09/02	ATL SOP 00024	Based on EPA6020A
Metals Solid Avail. Unified MS - Nper	1	2011/09/06	2011/09/06	ATL SOP 00024	Based on EPA6020A
Moisture	2	N/A	2011/09/01	ATL SOP 00001	MOE Handbook 1983
Nitrogen Ammonia - soil (as N)	2	2011/09/07	2011/09/08	ATL SOP 00015	Based on EPA 350.1
Nitrogen - Nitrate + Nitrite	2	2011/09/09	2011/09/12	ATL SOP 00016	Based on USGS enz.
Nitrogen - Nitrite by auto colourimetry	2	2011/09/09	2011/09/12	ATL SOP 00017	Based on SM4500-NO2B
pH (5:1 DI Water Extract)	2	2011/09/09	2011/09/12	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho by auto Colourimetry	2	2011/09/09	2011/09/12	ATL SOP 00021	Based on EPA 365.1
Sulphate in Soil by Auto Colourimetry	2	2011/09/09	2011/09/13	ATL SOP 00023	Based on EPA 375.4
Total Organic Carbon in Soil	2	2011/09/10	2011/09/10	ATL SOP 00044/00045	LECO 203-601-224

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Carbonate, Bicarbonate and Hydroxide	2	N/A	2011/09/08	CAM SOP-00102	APHA 4500-CO2 D
Alkalinity	2	N/A	2011/09/12	ATL SOP 00013	Based on EPA310.2
Chloride	2	N/A	2011/09/12	ATL SOP 00014	Based on SM4500-Cl-
Colour	2	N/A	2011/09/13	ATL SOP 00020	Based on SM2120C
Conductance - water	2	N/A	2011/09/07	ATL SOP 00004/00006	Based on SM2510B
Hardness (calculated as CaCO3)	2	N/A	2011/09/06	ATL SOP 00048	Based on SM2340B
Metals Water Diss. MS	2	N/A	2011/09/02	ATL SOP 00059	Based on EPA6020A
Ion Balance (% Difference)	2	N/A	2011/09/13		
Anion and Cation Sum	2	N/A	2011/09/13		
Nitrogen Ammonia - water	1	N/A	2011/09/12	ATL SOP 00015	Based on USEPA 350.1
Nitrogen Ammonia - water	1	N/A	2011/09/13	ATL SOP 00015	Based on USEPA 350.1
Nitrogen - Nitrate + Nitrite	2	N/A	2011/09/12	ATL SOP 00016	Based on USGS - Enz.
Nitrogen - Nitrite	2	N/A	2011/09/12	ATL SOP 00017	Based on SM4500-NO2B
Nitrogen - Nitrate (as N)	2	N/A	2011/09/12	ATL SOP 00018	Based on ASTMD3867
pH	2	N/A	2011/09/07	ATL SOP 00003	Based on SM4500H+B
Phosphorus - ortho	2	N/A	2011/09/12	ATL SOP 00021	Based on USEPA 365.1
Sat. pH and Langelier Index (@ 20C)	2	N/A	2011/09/13		
Sat. pH and Langelier Index (@ 4C)	2	N/A	2011/09/13		
Reactive Silica	2	N/A	2011/09/09	ATL SOP 00022	Based on EPA 366.0
Sulphate	2	N/A	2011/09/13	ATL SOP 00023	Based on EPA 375.4
Total Dissolved Solids (TDS calc)	2	N/A	2011/09/13		

../2

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Method Reference
Organic carbon - Total (TOC)	2	N/A	2011/09/11	ATL SOP 00037	Based on SM5310C
Turbidity	2	N/A	2011/09/09	ATL SOP 00011	based on EPA 180.1

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
* Results relate only to the items tested.

(1) This test was performed by Maxxam Analytics Mississauga

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

MICHELLE HILL, Project Manager
Email: MHill@maxxam.ca
Phone# (902) 420-0203

==
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Total cover pages: 2

RESULTS OF ANALYSES OF SOIL

Maxxam ID		KT1706		KT1710		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 SEDIMENT**	**RDL**	**P6 SEDIMENT**	**RDL**	**QC Batch**
Inorganics						
Ammonia-N	mg/kg	0.5	0.4	ND	0.3	2606238
Chloride (Cl)	mg/kg	14	5	12	5	2609245
Conductivity	uS/cm	26	1	9	1	2610938
Moisture	%	26	1	16	1	2601836
Nitrate + Nitrite	mg/kg	0.47	0.25	ND	0.25	2609252
Nitrite (N)	mg/kg	ND	0.05	ND	0.05	2609253
Organic Carbon (TOC)	g/kg	3.3	0.2	1.5	0.2	2610321
Orthophosphate (P)	mg/kg	0.62	0.05	0.13	0.05	2609250
Soluble (5:1) pH	pH	6.91	N/A	6.60	N/A	2610935
Sulphate (SO4)	mg/kg	ND	10	ND	10	2609246

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KT1706		KT1710		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 SEDIMENT**	**QC Batch**	**P6 SEDIMENT**	**RDL**	**QC Batch**
Metals						
Acid Extractable Aluminum (Al)	ug/g	3600	2610143	8800	50	2610143
Acid Extractable Barium (Ba)	ug/g	39	2610143	80	2.0	2610143
Acid Extractable Beryllium (Be)	ug/g	ND	2610143	ND	0.50	2610143
Acid Extractable Cadmium (Cd)	ug/g	ND	2610143	ND	0.50	2610143
Acid Extractable Calcium (Ca)	ug/g	4900	2610143	3700	50	2610143
Acid Extractable Chromium (Cr)	ug/g	15	2610143	45	1.0	2610143
Acid Extractable Cobalt (Co)	ug/g	4.0	2610143	8.0	2.0	2610143
Acid Extractable Copper (Cu)	ug/g	4.9	2610143	39	2.0	2610143
Acid Extractable Iron (Fe)	ug/g	67000	2610143	82000	500	2610143
Acid Extractable Lead (Pb)	ug/g	ND	2610143	11	5.0	2610143
Acid Extractable Magnesium (Mg)	ug/g	1800	2610143	6200	50	2610143
Acid Extractable Manganese (Mn)	ug/g	600	2610143	630	1.0	2610143
Acid Extractable Molybdenum (Mo)	ug/g	ND	2610143	ND	2.0	2610143
Acid Extractable Nickel (Ni)	ug/g	11	2610143	33	5.0	2610143
Acid Extractable Phosphorus (P)	ug/g	1700	2610143	970	20	2610143
Acid Extractable Potassium (K)	ug/g	270	2610143	1800	200	2610143
Acid Extractable Silver (Ag)	ug/g	ND	2610143	ND	1.0	2610143
Acid Extractable Sodium (Na)	ug/g	ND	2610143	ND	100	2610143
Acid Extractable Strontium (Sr)	ug/g	12	2610143	8.6	1.0	2610143
Acid Extractable Sulphur (S)	ug/g	180	2610143	ND	50	2610143
Acid Extractable Tin (Sn)	ug/g	ND	2610143	ND	20	2610143
Acid Extractable Vanadium (V)	ug/g	15	2610143	32	5.0	2610143
Acid Extractable Zinc (Zn)	ug/g	23	2610143	32	5.0	2610143
Available Aluminum (Al)	mg/kg	3500	2604821	5600	10	2602561
Available Antimony (Sb)	mg/kg	ND	2604821	ND	2	2602561
Available Arsenic (As)	mg/kg	ND	2604821	ND	2	2602561
Available Barium (Ba)	mg/kg	48	2604821	57	5	2602561
Available Beryllium (Be)	mg/kg	ND	2604821	ND	2	2602561
Available Bismuth (Bi)	mg/kg	ND	2604821	ND	2	2602561
Available Boron (B)	mg/kg	ND	2604821	ND	5	2602561
Available Cadmium (Cd)	mg/kg	ND	2604821	ND	0.3	2602561
Available Chromium (Cr)	mg/kg	12	2604821	27	2	2602561
Available Cobalt (Co)	mg/kg	7	2604821	7	1	2602561
Available Copper (Cu)	mg/kg	5	2604821	23	2	2602561

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KT1706		KT1710		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 SEDIMENT**	**QC Batch**	**P6 SEDIMENT**	**RDL**	**QC Batch**
Available Iron (Fe)	mg/kg	70000	2604821	68000	500	2602561
Available Lead (Pb)	mg/kg	1.6	2604821	3.5	0.5	2602561
Available Lithium (Li)	mg/kg	5	2604821	9	2	2602561
Available Manganese (Mn)	mg/kg	880	2604821	560	2	2602561
Available Mercury (Hg)	mg/kg	ND	2604821	ND	0.1	2602561
Available Molybdenum (Mo)	mg/kg	ND	2604821	ND	2	2602561
Available Nickel (Ni)	mg/kg	12	2604821	23	2	2602561
Available Rubidium (Rb)	mg/kg	4	2604821	16	2	2602561
Available Selenium (Se)	mg/kg	ND	2604821	ND	2	2602561
Available Silver (Ag)	mg/kg	ND	2604821	ND	0.5	2602561
Available Strontium (Sr)	mg/kg	9	2604821	8	5	2602561
Available Thallium (Tl)	mg/kg	0.1	2604821	0.1	0.1	2602561
Available Tin (Sn)	mg/kg	ND	2604821	ND	2	2602561
Available Uranium (U)	mg/kg	0.5	2604821	0.8	0.1	2602561
Available Vanadium (V)	mg/kg	12	2604821	19	2	2602561
Available Zinc (Zn)	mg/kg	23	2604821	25	5	2602561

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

RESULTS OF ANALYSES OF WATER

Maxxam ID		KT1654		KT1709		
Sampling Date		2011/08/28		2011/08/28		
	Units	**T-14-3 WATER**	**RDL**	**P6 WATER**	**RDL**	**QC Batch**
Calculated Parameters						
Anion Sum	me/L	0.570	N/A	0.810	N/A	2601547
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	29	1	31	1	2601544
Calculated TDS	mg/L	34	1	47	1	2601550
Carb. Alkalinity (calc. as CaCO3)	mg/L	ND	1	ND	1	2601544
Cation Sum	me/L	0.620	N/A	0.710	N/A	2601547
Hardness (CaCO3)	mg/L	28	1	33	1	2601545
Ion Balance (% Difference)	%	4.20	N/A	6.58	N/A	2601546
Langelier Index (@ 20C)	N/A	-1.44		-1.32		2601548
Langelier Index (@ 4C)	N/A	-1.70		-1.57		2601549
Nitrate (N)	mg/L	ND	0.05	2.5	0.05	2603003
Saturation pH (@ 20C)	N/A	8.97		8.89		2601548
Saturation pH (@ 4C)	N/A	9.23		9.14		2601549
Inorganics						
Total Alkalinity (Total as CaCO3)	mg/L	29	5	32	5	2608974
Dissolved Chloride (Cl)	mg/L	ND	1	ND	1	2608976
Colour	TCU	32	5	20	5	2608980
Nitrate + Nitrite	mg/L	ND	0.05	2.5	0.05	2608983
Nitrite (N)	mg/L	ND	0.01	ND	0.01	2608984
Nitrogen (Ammonia Nitrogen)	mg/L	ND	0.05	ND	0.05	2610772
Total Organic Carbon (C)	mg/L	19	1	11	0.5	2610484
Orthophosphate (P)	mg/L	ND	0.01	ND	0.01	2608982
pH	pH	7.53	N/A	7.57	N/A	2606311
Reactive Silica (SiO2)	mg/L	4.8	0.5	4.5	0.5	2608979
Dissolved Sulphate (SO4)	mg/L	ND	2	ND	2	2608978
Turbidity	NTU	0.1	0.1	1.7	0.1	2609095
Conductivity	uS/cm	57	1	67	1	2606316

N/A = Not Applicable
ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

ELEMENTS BY ICP/MS (WATER)

Maxxam ID		KT1654	KT1709		
Sampling Date		2011/08/28	2011/08/28		
	Units	**T-14-3 WATER**	**P6 WATER**	**RDL**	**QC Batch**
Metals					
Dissolved Aluminum (Al)	ug/L	39.0	26.5	5.0	2602739
Dissolved Antimony (Sb)	ug/L	ND	ND	1.0	2602739
Dissolved Arsenic (As)	ug/L	ND	ND	1.0	2602739
Dissolved Barium (Ba)	ug/L	13.9	11.5	1.0	2602739
Dissolved Beryllium (Be)	ug/L	ND	ND	1.0	2602739
Dissolved Bismuth (Bi)	ug/L	ND	ND	2.0	2602739
Dissolved Boron (B)	ug/L	ND	ND	50	2602739
Dissolved Cadmium (Cd)	ug/L	0.019	0.025	0.017	2602739
Dissolved Calcium (Ca)	ug/L	7300	8400	100	2602739
Dissolved Chromium (Cr)	ug/L	ND	ND	1.0	2602739
Dissolved Cobalt (Co)	ug/L	ND	ND	0.40	2602739
Dissolved Copper (Cu)	ug/L	ND	ND	2.0	2602739
Dissolved Iron (Fe)	ug/L	51	ND	50	2602739
Dissolved Lead (Pb)	ug/L	ND	28.7	0.50	2602739
Dissolved Magnesium (Mg)	ug/L	2470	2900	100	2602739
Dissolved Manganese (Mn)	ug/L	3.0	ND	2.0	2602739
Dissolved Molybdenum (Mo)	ug/L	ND	ND	2.0	2602739
Dissolved Nickel (Ni)	ug/L	ND	ND	2.0	2602739
Dissolved Phosphorus (P)	ug/L	ND	ND	100	2602739
Dissolved Potassium (K)	ug/L	1080	1050	100	2602739
Dissolved Selenium (Se)	ug/L	ND	ND	1.0	2602739
Dissolved Silver (Ag)	ug/L	ND	ND	0.10	2602739
Dissolved Sodium (Na)	ug/L	610	573	100	2602739
Dissolved Strontium (Sr)	ug/L	11.3	11.4	2.0	2602739
Dissolved Thallium (Tl)	ug/L	ND	ND	0.10	2602739
Dissolved Tin (Sn)	ug/L	ND	ND	2.0	2602739
Dissolved Titanium (Ti)	ug/L	ND	ND	2.0	2602739
Dissolved Uranium (U)	ug/L	ND	ND	0.10	2602739
Dissolved Vanadium (V)	ug/L	ND	ND	2.0	2602739
Dissolved Zinc (Zn)	ug/L	ND	15.0	5.0	2602739

ND = Not detected
RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Package 1	12.7°C

Each temperature is the average of up to three cooler temperatures taken at receipt

GENERAL COMMENTS

Revised report: Revised to correct acid extractable metals data for samples KT1706 and KT1710. January 17, 2012 MHL

Sample KT1709-01: RCAp Ion Balance acceptable. Anion/cation agreement within 0.2 meq/L.

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2602561	Available Aluminum (Al)	2011/09/02	NC	75 - 125	103	75 - 125	ND, RDL=10	mg/kg	6.4	35	101	75 - 125
2602561	Available Antimony (Sb)	2011/09/02	72 (1, 2)	75 - 125	109	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Arsenic (As)	2011/09/02	NC	75 - 125	109	75 - 125	ND, RDL=2	mg/kg	15.2	35	122	75 - 125
2602561	Available Barium (Ba)	2011/09/02	80	75 - 125	105	75 - 125	ND, RDL=5	mg/kg	24.9	35	119	75 - 125
2602561	Available Beryllium (Be)	2011/09/02	107	75 - 125	100	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Bismuth (Bi)	2011/09/02	99	75 - 125	110	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Boron (B)	2011/09/02	98	75 - 125	96	75 - 125	ND, RDL=5	mg/kg	NC	35		
2602561	Available Cadmium (Cd)	2011/09/02	103	75 - 125	107	75 - 125	ND, RDL=0.3	mg/kg	NC	35		
2602561	Available Chromium (Cr)	2011/09/02	NC	75 - 125	114	75 - 125	ND, RDL=2	mg/kg	4.4	35	107	75 - 125
2602561	Available Cobalt (Co)	2011/09/02	NC	75 - 125	111	75 - 125	ND, RDL=1	mg/kg	20.9	35	104	75 - 125
2602561	Available Copper (Cu)	2011/09/02	NC	75 - 125	112	75 - 125	ND, RDL=2	mg/kg	6.5	35	99	75 - 125
2602561	Available Iron (Fe)	2011/09/02	NC	75 - 125	105	75 - 125	ND, RDL=50	mg/kg	1.7	35	105	75 - 125
2602561	Available Lead (Pb)	2011/09/02	NC	75 - 125	107	75 - 125	ND, RDL=0.5	mg/kg	3.4	35	104	75 - 125
2602561	Available Lithium (Li)	2011/09/02	NC	75 - 125	108	75 - 125	ND, RDL=2	mg/kg	4.1	35		
2602561	Available Manganese (Mn)	2011/09/02	NC	75 - 125	106	75 - 125	ND, RDL=2	mg/kg	53.5 (1, 3)	35	121	75 - 125
2602561	Available Mercury (Hg)	2011/09/02	107	75 - 125	123	75 - 125	ND, RDL=0.1	mg/kg				
2602561	Available Molybdenum (Mo)	2011/09/02	98	75 - 125	110	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Nickel (Ni)	2011/09/02	NC	75 - 125	113	75 - 125	ND, RDL=2	mg/kg	16.4	35	107	75 - 125
2602561	Available Rubidium (Rb)	2011/09/02	95	75 - 125	107	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Selenium (Se)	2011/09/02	88	75 - 125	94	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Silver (Ag)	2011/09/02	102	75 - 125	106	75 - 125	ND, RDL=0.5	mg/kg	NC	35		
2602561	Available Strontium (Sr)	2011/09/02	86	75 - 125	107	75 - 125	ND, RDL=5	mg/kg	NC	35	92	75 - 125
2602561	Available Thallium (Tl)	2011/09/02	98	75 - 125	104	75 - 125	ND, RDL=0.1	mg/kg	NC	35		
2602561	Available Tin (Sn)	2011/09/02	99	75 - 125	106	75 - 125	ND, RDL=2	mg/kg	NC	35		
2602561	Available Uranium (U)	2011/09/02	110	75 - 125	112	75 - 125	ND, RDL=0.1	mg/kg	9.1	35		
2602561	Available Vanadium (V)	2011/09/02	NC	75 - 125	121	75 - 125	ND, RDL=2	mg/kg	7.3	35	123	75 - 125
2602561	Available Zinc (Zn)	2011/09/02	104	75 - 125	107	75 - 125	ND, RDL=5	mg/kg	11.3	35	110	75 - 125
2602739	Dissolved Aluminum (Al)	2011/09/02	104	80 - 120	103	80 - 120	ND, RDL=5.0	ug/L				
2602739	Dissolved Antimony (Sb)	2011/09/02	101	80 - 120	100	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Arsenic (As)	2011/09/02	100	80 - 120	99	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Barium (Ba)	2011/09/02	95	80 - 120	98	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Beryllium (Be)	2011/09/02	96	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Bismuth (Bi)	2011/09/02	97	80 - 120	98	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Boron (B)	2011/09/02	90	80 - 120	90	80 - 120	ND, RDL=50	ug/L				
2602739	Dissolved Cadmium (Cd)	2011/09/02	96	80 - 120	97	80 - 120	ND, RDL=0.017	ug/L				
2602739	Dissolved Calcium (Ca)	2011/09/02	NC	80 - 120	103	80 - 120	ND, RDL=100	ug/L	1.5	25		
2602739	Dissolved Chromium (Cr)	2011/09/02	96	80 - 120	96	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Cobalt (Co)	2011/09/02	95	80 - 120	96	80 - 120	ND, RDL=0.40	ug/L				
2602739	Dissolved Copper (Cu)	2011/09/02	93	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Iron (Fe)	2011/09/02	104	80 - 120	106	80 - 120	ND, RDL=50	ug/L				

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
2602739	Dissolved Lead (Pb)	2011/09/02	95	80 - 120	95	80 - 120	ND, RDL=0.50	ug/L				
2602739	Dissolved Magnesium (Mg)	2011/09/02	103	80 - 120	107	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Manganese (Mn)	2011/09/02	NC	80 - 120	95	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Molybdenum (Mo)	2011/09/02	102	80 - 120	101	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Nickel (Ni)	2011/09/02	93	80 - 120	93	80 - 120	ND, RDL=2.0	ug/L	NC	25		
2602739	Dissolved Phosphorus (P)	2011/09/02	105	80 - 120	106	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Potassium (K)	2011/09/02	103	80 - 120	104	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Selenium (Se)	2011/09/02	98	80 - 120	101	80 - 120	ND, RDL=1.0	ug/L				
2602739	Dissolved Silver (Ag)	2011/09/02	102	80 - 120	105	80 - 120	ND, RDL=0.10	ug/L				
2602739	Dissolved Sodium (Na)	2011/09/02	NC	80 - 120	101	80 - 120	ND, RDL=100	ug/L				
2602739	Dissolved Strontium (Sr)	2011/09/02	NC	80 - 120	98	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Thallium (Tl)	2011/09/02	97	80 - 120	98	80 - 120	ND, RDL=0.10	ug/L				
2602739	Dissolved Tin (Sn)	2011/09/02	104	80 - 120	102	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Titanium (Ti)	2011/09/02	104	80 - 120	106	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Uranium (U)	2011/09/02	111	80 - 120	110	80 - 120	ND, RDL=0.10	ug/L				
2602739	Dissolved Vanadium (V)	2011/09/02	97	80 - 120	98	80 - 120	ND, RDL=2.0	ug/L				
2602739	Dissolved Zinc (Zn)	2011/09/02	98	80 - 120	101	80 - 120	ND, RDL=5.0	ug/L				
2604821	Available Aluminum (Al)	2011/09/06			100	75 - 125	ND, RDL=10	mg/kg			103	75 - 125
2604821	Available Arsenic (As)	2011/09/06			91	75 - 125	ND, RDL=2	mg/kg			112	75 - 125
2604821	Available Barium (Ba)	2011/09/06			96	75 - 125	ND, RDL=5	mg/kg			121	75 - 125
2604821	Available Chromium (Cr)	2011/09/06			104	75 - 125	ND, RDL=2	mg/kg			108	75 - 125
2604821	Available Cobalt (Co)	2011/09/06			105	75 - 125	ND, RDL=1	mg/kg			106	75 - 125
2604821	Available Copper (Cu)	2011/09/06			105	75 - 125	ND, RDL=2	mg/kg			96	75 - 125
2604821	Available Iron (Fe)	2011/09/06			101	75 - 125	ND, RDL=50	mg/kg			104	75 - 125
2604821	Available Lead (Pb)	2011/09/06			103	75 - 125	ND, RDL=0.5	mg/kg			112	75 - 125
2604821	Available Manganese (Mn)	2011/09/06			103	75 - 125	ND, RDL=2	mg/kg			117	75 - 125
2604821	Available Nickel (Ni)	2011/09/06			104	75 - 125	ND, RDL=2	mg/kg			109	75 - 125
2604821	Available Strontium (Sr)	2011/09/06			99	75 - 125	ND, RDL=5	mg/kg			94	75 - 125
2604821	Available Vanadium (V)	2011/09/06			105	75 - 125	ND, RDL=2	mg/kg			127(1, 4)	75 - 125
2604821	Available Zinc (Zn)	2011/09/06			101	75 - 125	ND, RDL=5	mg/kg			111	75 - 125
2604821	Available Antimony (Sb)	2011/09/06			86	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Beryllium (Be)	2011/09/06			99	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Bismuth (Bi)	2011/09/06			95	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Boron (B)	2011/09/06			104	75 - 125	ND, RDL=5	mg/kg				
2604821	Available Cadmium (Cd)	2011/09/06			97	75 - 125	ND, RDL=0.3	mg/kg				
2604821	Available Lithium (Li)	2011/09/06			108	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Mercury (Hg)	2011/09/06			121	75 - 125	ND, RDL=0.1	mg/kg				
2604821	Available Molybdenum (Mo)	2011/09/06			99	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Rubidium (Rb)	2011/09/06			96	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Selenium (Se)	2011/09/06			78	75 - 125	ND, RDL=2	mg/kg				

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2604821	Available Silver (Ag)	2011/09/06			106	75 - 125	ND, RDL=0.5	mg/kg				
2604821	Available Thallium (Tl)	2011/09/06			105	75 - 125	ND, RDL=0.1	mg/kg				
2604821	Available Tin (Sn)	2011/09/06			93	75 - 125	ND, RDL=2	mg/kg				
2604821	Available Uranium (U)	2011/09/06			100	75 - 125	ND, RDL=0.1	mg/kg				
2606238	Ammonia-N	2011/09/08	105	80 - 120			ND, RDL=0.3	mg/kg	NC	25		
2606311	pH	2011/09/07							0.9	25	101	80 - 120
2606316	Conductivity	2011/09/07			100	80 - 120	ND, RDL=1	uS/cm	0.4	25		
2608974	Total Alkalinity (Total as CaCO3)	2011/09/12	102	80 - 120	112	80 - 120	ND, RDL=5	mg/L	NC	25	106	80 - 120
2608976	Dissolved Chloride (Cl)	2011/09/12	NC	80 - 120	106	80 - 120	ND, RDL=1	mg/L	0.2	25	102	80 - 120
2608978	Dissolved Sulphate (SO4)	2011/09/13	NC	80 - 120	103	80 - 120	ND, RDL=2	mg/L	4.0	25	107	80 - 120
2608979	Reactive Silica (SiO2)	2011/09/09	NC	80 - 120	102	80 - 120	ND, RDL=0.5	mg/L	2.2	25	100	75 - 125
2608980	Colour	2011/09/13					ND, RDL=5	TCU	NC	25	110	80 - 120
2608982	Orthophosphate (P)	2011/09/12	83	80 - 120	103	80 - 120	ND, RDL=0.01	mg/L	NC	25	102	80 - 120
2608983	Nitrate + Nitrite	2011/09/12	102	80 - 120	103	80 - 120	ND, RDL=0.05	mg/L	1.4	25	107	80 - 120
2608984	Nitrite (N)	2011/09/12	96	80 - 120	102	80 - 120	ND, RDL=0.01	mg/L	NC	25	100	80 - 120
2609095	Turbidity	2011/09/09					ND, RDL=0.1	NTU	6.1	25	100	80 - 120
2609245	Chloride (Cl)	2011/09/13					ND, RDL=5	mg/kg				
2609246	Sulphate (SO4)	2011/09/13					ND, RDL=10	mg/kg				
2609250	Orthophosphate (P)	2011/09/12	16(1, 5)	80 - 120			ND, RDL=0.05	mg/kg	NC	25		
2609252	Nitrate + Nitrite	2011/09/12	108	75 - 125			0.47, RDL=0.25	mg/kg	NC	35		
2609253	Nitrite (N)	2011/09/12	101	80 - 120			ND, RDL=0.05	mg/kg	NC	35		
2610143	Acid Extractable Aluminum (Al)	2011/09/12	NC(6)	75 - 125			ND, RDL=50	ug/g			100	75 - 125
2610143	Acid Extractable Barium (Ba)	2011/09/12	100	75 - 125			ND, RDL=2.0	ug/g			95	75 - 125
2610143	Acid Extractable Beryllium (Be)	2011/09/12	101	75 - 125			ND, RDL=0.50	ug/g			98	75 - 125
2610143	Acid Extractable Cadmium (Cd)	2011/09/12	102	75 - 125			ND, RDL=0.50	ug/g			98	75 - 125
2610143	Acid Extractable Calcium (Ca)	2011/09/12	123	75 - 125			ND, RDL=50	ug/g			100	75 - 125
2610143	Acid Extractable Chromium (Cr)	2011/09/12	102	75 - 125			ND, RDL=1.0	ug/g			100	75 - 125
2610143	Acid Extractable Cobalt (Co)	2011/09/12	100	75 - 125			ND, RDL=2.0	ug/g			101	75 - 125
2610143	Acid Extractable Copper (Cu)	2011/09/12	97	75 - 125			ND, RDL=2.0	ug/g			97	75 - 125
2610143	Acid Extractable Iron (Fe)	2011/09/12	80	75 - 125			ND, RDL=50	ug/g			103	75 - 125
2610143	Acid Extractable Lead (Pb)	2011/09/12	103	75 - 125			ND, RDL=5.0	ug/g	NC	35	103	75 - 125
2610143	Acid Extractable Magnesium (Mg)	2011/09/12	102	75 - 125			ND, RDL=50	ug/g			101	75 - 125
2610143	Acid Extractable Manganese (Mn)	2011/09/12	98	75 - 125			ND, RDL=1.0	ug/g			98	75 - 125
2610143	Acid Extractable Molybdenum (Mo)	2011/09/12	95	75 - 125			ND, RDL=2.0	ug/g			95	75 - 125
2610143	Acid Extractable Nickel (Ni)	2011/09/12	99	75 - 125			ND, RDL=5.0	ug/g			100	75 - 125
2610143	Acid Extractable Phosphorus (P)	2011/09/12	99	75 - 125			ND, RDL=20	ug/g			92	75 - 125
2610143	Acid Extractable Potassium (K)	2011/09/12	115	75 - 125			ND, RDL=200	ug/g			97	75 - 125
2610143	Acid Extractable Silver (Ag)	2011/09/12	96	75 - 125			ND, RDL=1.0	ug/g			100	75 - 125
2610143	Acid Extractable Sodium (Na)	2011/09/12	102	75 - 125			ND, RDL=100	ug/g			102	75 - 125
2610143	Acid Extractable Strontium (Sr)	2011/09/12	94	75 - 125			ND, RDL=1.0	ug/g			95	75 - 125

QUALITY ASSURANCE REPORT

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**% Recovery**	**QC Limits**	**Value**	**Units**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
2610143	Acid Extractable Sulphur (S)	2011/09/12	107	75 - 125			ND, RDL=50	ug/g			101	75 - 125
2610143	Acid Extractable Tin (Sn)	2011/09/12	103	75 - 125			ND, RDL=20	ug/g			101	75 - 125
2610143	Acid Extractable Vanadium (V)	2011/09/12	101	75 - 125			ND, RDL=5.0	ug/g			95	75 - 125
2610143	Acid Extractable Zinc (Zn)	2011/09/12	99	75 - 125			ND, RDL=5.0	ug/g			99	75 - 125
2610321	Organic Carbon (TOC)	2011/09/10					ND, RDL=0.2	g/kg	1.1	35	95	75 - 125
2610484	Total Organic Carbon (C)	2011/09/11	100	80 - 120	93	80 - 120	ND, RDL=0.5	mg/L	NC	25	98	80 - 120
2610772	Nitrogen (Ammonia Nitrogen)	2011/09/13	113	80 - 120	107	80 - 120	ND, RDL=0.05	mg/L	NC	25	100	80 - 120
2610935	Soluble (5:1) pH	2011/09/12							1.8	N/A		
2610938	Conductivity	2011/09/12					ND, RDL=1	uS/cm	0.4	35		

QUALITY ASSURANCE REPORT

			Reagent Blank	
QC Batch	Parameter	Date	% Recovery	QC Limits
2610935	Soluble (5:1) pH	2011/09/12	5.56	N/A
2610938	Conductivity	2011/09/12	1	N/A

N/A = Not Applicable

RDL = Reportable Detection Limit

RPD = Relative Percent Difference

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Reagent Blank: A blank matrix containing all reagents used in the analytical procedure. Used to determine any analytical contamination.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Spiked Blank: A blank matrix to which a known amount of the analyte has been added. Used to evaluate analyte recovery.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

NC (RPD): The RPD was not calculated. The level of analyte detected in the parent sample and its duplicate was not sufficiently significant to permit a reliable calculation.

(1) - Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) - Low recovery due to sample matrix.

(3) - Poor RPD due to sample inhomogeneity.

(4) - Secondary RM is acceptable.

(5) - Poor spike recovery due to sample matrix

(6) - The recovery in the matrix spike was not calculated (NC). Spiked concentration was less than 2x that native to the sample.

Validation Signature Page

Maxxam Job #: B1D4364

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

CAcker

COLLEEN ACKER

Cristina Carriere

CRISTINA CARRIERE, Scientific Services

MIKE MACGILLIVRAY, Scientific Specialist (Inorganics)

RoseMarie MacDonald

ROSE MACDONALD, Scientific Specialist (Organics)

===

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Client: AMEC　　COC# 06601

HOLD TIME :month ______ day >10　　GK COC time stamped

RUSH(1,2,3Day,IOL,Chlorine, MICRO)

Urgent Stamp

Rush Okayed by:	For:	Date:

If no Maxxam COC - Sign&Print ____________________

If no Maxxam COC Temp °C ____ ____ ____

Critical Flag

- _____Temp >10C [2]　Exceptions -Inorganic, Organic received sameday, Coliform <1hr old
- ____ No COC[4] or no analysis requested [10]
- _____Hold time Up [13]

Sample #	Coliform/Bacteria 300/100mL (Sodium Thiosulfate)	RCAp 200mL plastic	Metals 50mL plastic	Hg 100mL KCr_2 & HNO_3	TKN/PHENOL/COD/TP/AOX 100mL H_2SO_4	BOD / TSS 500mL plastic	Cyanide/Cr+6 60mL NaOH	Chlorine 40mL no headspace	Sulphide 200mL ZnAcetate/HNO_3	MUST/RBCA 250mL $NaHSO_4$	MUST /RBCA/ VOC 40mL NaHSO4- no headspace	TPH Fractionation 1L $NaHSO_4$	NBMUST 500mL $NaHSO_4$	PAH / PCB 250mL glass	Oil&Grease/Pesticides 1L glass	Soil 250mL glass	Soil 60mL glass	Other
1		/	/		/													
2																/		
3		/	/		/													
4																/		
5																		
6																		
7																		
8																		
9																		
10																		

Bottle Types & # Listed on COC are Correct- Initial _____ (No need to fill in table above)

Critical Flag

- ____**Incorrect preservation or headspace** [15]
  (In all 40ml, in 60ml, in 250ml with no 60ml received)
- ____**Sample requiring filtration preserved** [19]

Flag Supervisor Init:____

- ____Labelling issue [11] (bottle Ids & Project# don't match COC)
- ____Bottles/Samples listed on COC but not received [8]
  (CS initials ______, Login Manager Initials _______)
- ____Broken Bottle[3]-Note if insufficient Packing or cooler/box damaged
  (Internal Maxxam Shipment No FLAG,add info to Job Remark,notify PM to call&initial____)
- ____Cap Missing or Cap Broken [20], Empty Bottle [21]
- ____Insufficient Volume [18],wrong bottle [14], insufficient bottles no flag[16]
- ____Bottles/Samples received but not listed on COC [9]
- ____>1cm sediment in Organic groundwater sample[23]
- ____Organic samples received >5d after sampling [12] (not over hold time)

Green Flag

- ____COC not current [7] or COC not complete [5], COC not signed/dated[6]
- ____Sample Frozen[22]

FLAG　Yes [✓ No]　Initials GK　(Need to indicate Yes/No on COC too)

Resolution: ____________________

Sticker/Stamp

Sticker/ Stamp

if IOL use IOL Checklist	
if Heat treat place sticker on this sheet	
if Prep Step Required place sticker on this sheet	

Notes:

Required for Non Maxxam COC		Required for Non **Current** Maxxam COC	
Client#	Maxxam Job#	Labelled by:	[✓ WIF]/DRY/[✓ RCAP]/Bin/CART
		Temp Storage	WSF - 334
Login Date:	Login Initials:	ZN	RCap 820

Maxxam Analytics Inc

49-55 Elizabeth Avenue, Suite 101A, St. John's, NL A1A 1W9 Tel: 709-754-0203 Fax: 709-754-8612 Toll Free: 1-888-492-7227
www.maxxamanalytics.com

CHAIN OF CUSTODY RECORD

06601

INVOICE INFORMATION:
Company Name: AMEC
Contact Name: Matthew Gosse
Address: 133 Crosbie Rd.
St. John's
Email: matthew.gosse@amec.com
Ph: (709) 722-7023 Fax:

REPORT INFORMATION (if differs from invoice):
Company Name:
Contact Name:
Address:
Email:
Ph: Fax:

PO #:
Project #: TF 1143025
Proj. Name:
Location: Lab. City
Quotation#:
Submitted By: Matthew Gosse
Site Task #:

MAXXAM JOB NUMBER: B1D4364
ENTERED BY, Init: RD
Client Code: 10970

Specify Guideline Requirements:

*Specify Matrix: Surface/Salt/Ground/Tapwater/Sewage/Effluent/Seawater Potable/NonPotable/Tissue/Soil/Sludge/Metal

DUE DATE:
STANDARD: ☑
RUSH Due Date:
For extra cost rush, specify Due Date. Rush analysis must be scheduled prior to sample submission.
Client will be contacted if Rush date cannot be met.

Sample Identification	Matrix*	Date/Time Sampled	# & type of bottles	Field Filtered & Preserved	Lab Filtration Required	RCAp-30 Choose Total or Diss Metals	RCAp-MS Choose Total or Diss Metals	Metals Water: Total Digest (Default Method)	Metals Water: Dissolved	Mercury: Mercury is not included in soil or water metals scan	Metals Soil: Available Metals Digest Default Method (HNO_3/H_2O_2)	Metals Soil: Total Digest - for sediments ($HNO_3/HF/HCLO_4$)	Metals Soil: Tin (required for CCME soils)	Metals Soil: Selenium (low level) Req'd for CCME Residential, Parklands, Agricultural	Metals Soil: Hot Water soluble Boron (required for CCME Agricultural)	TPH MUST (BTEX, C_6-C_{32})	Soil (Potable), TPH MUST, NS Fuel Oil Spill Policy Low Level BTEX & C_6-C_{32}	NB Potable Water BTEX, VPH, Low Level TEH	TPH Fractionation	~~PAHs~~ TOC	PCB's	VOC's EPA 624,8260	Other Analysis or Comments/Hazards
T-14-3	Water	August 28	3		X		X													X			
T-14-3	Sediment	"	1		X		X													X			
P6	Water	"	3		X		X													X			
P6	Sediment	"	1		X		X													X			

SHIPPED FROM
[illegible]
MAXXAM-NL

RELINQUISHED BY: (Signature/Print)	RECEIVED BY: (Signature/Print)	DATE / TIME	PURPOSE OF CHANGE / REMARKS	TEMP @ Maxxam Receipt
Matthew Gosse	M Dalton	2011-08-31		13.8/12.4/11.9
Matthew Gosse		11:30		INTEGRITY Init: GK Yes [✓ No]

KEENVROCOC St. John's 05/05

Cooler 1 = 0, 1, 0

Cooler 2 = 0, 2, 1

Cooler 3 = 0, 2, 2

Purolator

FROM/DE

Maxxam Analytics
49 Elizabeth AVE

St. John's, NL A1A 1W9
(709) 754-0203

REF:

TO/À

Sample Reception
Maxxam Analytics Inc

200 Bluewater RD
SUITE 105

Bedford, NS B4B 1G9
(902) 420-0203

NOTE:

DATE	PIECES	WEIGHT/POIDS
31 Aug 2011	2 of/de 3	60.00 lb.

10402878/31/2011 12:00:00 AM

PIN: 329 469 748 969

10 30 AM/h **YHZ** 11

Fold the Bill of Lading on the dotted line and insert into the labelope. Attach a Bill of Lading to each package.
Veuillez plier ce connaissement sur la ligne pointillée et l'insérer dans l'enveloppe autoadhésive. Veuillez joindre un connaissement à chaque colis.

Description: coolers

No Declared Value Entered By Sender / Aucune valeur déclarée entrée par l'expéditeur

CONDITIONS OF CARRIAGE

IMPORTANT - PLEASE READ: The consignor agrees that the act of tendering the shipment to the carrier for transportation shall be sufficient to constitute signature of this bill of lading by the consignor and shall bind the consignor to the conditions of carriage stated below.

RECEIPT Carrier acknowledges receiving from the shipper, at the point of origin and on the date specified, the shipment described in this bill of lading in apparent good order, except as noted (contents and conditions of contents of shipment unknown), and agrees to carry and deliver the shipment to the receiver at the destination set out in this bill of lading, subject to payment of all lawful charges. "Carrier" refers to Purolator Courier Ltd. and any connecting and/or successive carriers involved in the transportation of the shipment herein described, including any of their respective subsidiaries, controlled entities, and their respective employees, agents and independent contractors.

LIMITATION ON LIABILITY Carrier's liability in respect of the shipment described in this bill of lading (including for any loss, damage, delay, misdelivery, non-delivery or failure to deliver) is limited to $2.00 per pound ($4.41 per kilogram) computed on the total weight of the shipment, unless a higher value is declared in the specially marked Purolator Online Shipping user entry field, "Declared Value for Insurance ($)". Notwithstanding any disclosure of the nature or value of the goods carried or any special agreement to the contrary, carrier is not liable under any circumstances for the consequences of delay, or for any indirect or consequential damages (including lost profits) howsoever caused.

NOTICE OF CLAIM Carrier is not liable for any loss, damage or delay to any goods carried under this bill of lading unless notice of the claim setting out particulars of the origin, destination and date of shipment of the goods and the estimated amount claimed in respect of such loss, damage or delay is given in writing to the carrier within sixty (60) days after the delivery of the goods, or, in the case of failure to make delivery, within nine (9) months from the date of shipment. Subject to any overriding statutory provisions, the final statement of the claim must be filed within nine (9) months from the date of shipment, together with a copy of the paid freight bill. If the Convention applies, other notice periods may govern. No claim will be entertained until all transportation charges due in connection with this bill of lading have been paid in full. All claims are subject to proof of amount of loss.

TERMS INCORPORATED BY REFERENCE Every service to be performed under this bill of lading is subject to the conditions of carriage contained in this bill of lading, including the terms and conditions contained in Purolator Courier Ltd.'s published terms and conditions of carriage and the terms and conditions prescribed by the law of the jurisdiction where the goods originate (including the uniform conditions of carriage thereunder, if any). If the carriage involves an ultimate destination or a stop in a country other than the country of departure, the Convention (as defined below) may apply and limit the liability of the carrier in respect of loss of, damage to or delay of cargo. "Convention" means the Convention for the Unification of Certain Rules relating to International Carriage by Air, signed at Warsaw, Poland, 12 October, 1929, or the Convention for the Unification of Certain Rules for International Carriage by Air, signed at Montreal, Canada, 28 May, 1999, or those Conventions as amended or supplemented as may be applicable to the carriage hereunder.

MISCELLANEOUS Unless otherwise indicated, the consignor's name and address is the sender's name and address indicated on this bill of lading, and the latter is the place of execution and the place of departure; the consignee's name and address is the receiver's name and address indicated on this bill of lading, and the latter is the place of destination; and the date indicated on this bill of lading is the date of execution. There are no specific stopping places which are agreed to, and the carrier reserves the right to select the route and the mode of transportation that the carrier deems appropriate. The consignor warrants that the shipment is properly described on this bill of lading and on any accompanying documentation, and that the shipment is properly marked, addressed and packed to ensure safe transportation in accordance with the carrier's ordinary care in handling. Unless otherwise indicated on this bill of lading, the consignor waives its right to determine the volume or dimensions of the shipment, and to indicate same on this bill of lading. The consignor appoints the carrier as its agent for the performance of customs clearance and selecting a customs broker.

ENTIRE AGREEMENT The terms and conditions contained in this bill of lading, including those incorporated herein by reference, constitute the entire agreement relating to the carriage of the shipment described in this bill of lading, and no agent, servant or representative of the carrier or consignor has the authority to alter, waive or otherwise modify any provision of this agreement. In tendering the shipment described herein for carriage, the consignor agrees to these terms and conditions on his own behalf and on behalf of the consignee and any other party claiming an interest in this shipment.

Client: Health Canada COC# N/A

RUSH(1,2,3Day,IOL,Chlorine, MICRO)

Rush Okayed by:	For:	Date:

Maxxam Stamp

URGENT!

HOLD TIME :month Sept day 2 ✓ COC time stamped

If no Maxxam COC - Sign&Print ____________________

If no Maxxam COC Temp °C ______

Critical Flag

_____Temp >10C [2] Exceptions -Inorganic, Organic received sameday, Coliform <1hr old

____ No COC[4] or no analysis requested [10]

_____Hold time Up [13]

Sample #	Coliform/Bacteria [✓ 300] 100mL (Sodium Thiosulfate)	RCAp 200mL plastic	Metals 50mL plastic	Hg 100mL KCr_2 & HNO_3	TKN/PHENOL/COD/TP/AOX 100mL H_2SO_4	BOD / TSS 500mL plastic	Cyanide/Cr+6 60mL NaOH	Chlorine 40mL no headspace	Sulphide 200mL ZnAcetate/HNO_3	MUST/RBCA 250mL $NaHSO_4$	MUST /RBCA/ VOC 40mL NaHSO4- no headspace	TPH Fractionation 1L $NaHSO_4$	NBMUST 500mL $NaHSO_4$	PAH / PCB 250mL glass	Oil&Grease/Pesticides 1L glass	Soil 250mL glass	Soil 60mL glass	Other
1	1																	
2	1																	
3	1																	
4	1																	
5																		
6																		
7																		
8																		
9																		
10																		

Bottle Types & # Listed on COC are Correct- Initial _____ (No need to fill in table above)

Critical Flag

____**Incorrect preservation or headspace** [15]
(In all 40ml, in 60ml, in 250ml with no 60ml received)

____**Sample requiring filtration preserved** [19]

Flag Supervisor Init:____

____Labelling issue [11] (bottle Ids & Project# don't match COC)

____Bottles/Samples listed on COC but not received [8]
(CS initials _____, Login Manager Initials _____)

____Broken Bottle[3]-Note if insufficient Packing or cooler/box damaged
(Internal Maxxam Shipment No FLAG,add info to Job Remark,notify PM to call&initial____)

____Cap Missing or Cap Broken [20], Empty Bottle [21]

____Insufficient Volume [18],wrong bottle [14], insufficient bottles no flag[16]

____Bottles/Samples received but not listed on COC [9]

____>1cm sediment in Organic groundwater sample[23]

____Organic samples received >5d after sampling [12] (not over hold time)

Green Flag

____COC not current[7] or COC not complete [5], COC not signed/dated[6]

____Sample Frozen[22]

FLAG Yes [✓ No] Initials MC (Need to indicate Yes/No on COC too)

Resolution: ____________________

Sticker/Stamp

Sticker/ Stamp

if IOL use IOL Checklist

if Heat treat place sticker on this sheet

if Prep Step Required place sticker on this sheet

Notes:

Required for Non Maxxam COC
Client# Maxxam Job#
Login Date: Login Initials:

Required for Non **Current** Maxxam COC
Labelled by: WIF/DRY/RCAP/Bin/CART
Temp Storage

Maxxam

200 Bluewater Road, Suite 105, Bedford, Nova Scotia B4B 1G9 Tel: 902-420-0203 Fax:902-420-8612 Toll Free :1-800-565-7227
www.maxxamanalytics.com E-mail: clientservicesbedford@maxxamanalytics.com

Chain of Custody Record

REPORT & INVOICE INFORMATION:

Company Name: Health Canada
Contact Name: Melissa Young
Address: Suite 1525 1505 Barrington St. Halifax
Postal Code B3J 3Y6
Email: melissa.young@hc-sc.gc.ca
Ph: 902 426 4645 Fax: 902 426 4208

Watertrax ID# 5143
First Nations Community Name:
Sampled By: Melissa Young
Quotation #: **Standing Offer**

DUE DATE: ☒ **STANDARD:** ☐ **RUSH**
RUSH Due Date:
Extra cost for rush. Rush analysis should be scheduled prior to sample submission.
Client will be contacted if Rush date cannot be met.

This column for lab only
Client Code: 12959
Maxxam Job #: B1D4372

Temp 1	Temp 2	Temp 3	Integrity
10	11	9	Yes
			No

Labelled by:
Location/Bin#

Special Notes:

Sample Identification	SPL #	Cl2 Residue	# & type of bottles	Date/Time Sampled	Matrix	TC/E.coli-MPN	P.aerginosa	S.aureus	RCAP-MS Total	THM	ARSENIC	HAA	Other
	Maxxam Login will add SPL# to the COC # field	Maxxam Login will add Cl2 Residue Value to On-Site code											
Band Office	2310 C	1.01	1/300 ml	Sept. 1, 2011 @ 10:55	Water	X							
Annapolis Gas Bar (38 Leo Drive)	E4F8	1.03	1/300 ml	Sept. 1, 2011 @ 11:30	Water	X							
Binge Hall	2310 B	0.81	1/300 ml	Sept. 1, 2011 @ 11:50	Water	X							
93 Goo-wow	552B	0.55	1/300 ml	Sept. 1, 2011 @ 12:01 pm	Water	X							
					Water								
					Water								
					Water								
					Water								
					Water								
					Water								

2011 SEP 1 PM 2:04

RELINQUISHED BY:
Signature Melissa Young
Print Melissa Young
Date Sept 1/11
Time

Received By: (Signiture/Print)
Signature
Print M Lomea
Date
Time

Page ___ of ___

Appendix D
Invertebrate Sample Results

Phylum	Class	Order	Family	Drum Lake	Leg lake	Pumphouse Pond	Throne Lake	Highway Pond	Tup lake	Tributary T2	Tributary T9	Tributary T14-3	Total
Annelida	Hirudinea	-	-					1					1
Annelida	Oligochaeta	-	-		1			16	1				18
Annelida	Aeolosomata	Aeolosomata	Aeolosomatidae						1				
Arthropoda	Arachnida	Actinedida	Hydrachnidia								1		
Arthropoda	Insecta	Coleoptera	-								1		
Arthropoda	Insecta	Diptera	Ceratopogonidae		2			3					5
Arthropoda	Insecta	Diptera	Chironomidae	1	1	14		91	1	3		2	112
Arthropoda	Insecta	Diptera	Empididae							1			
Arthropoda	Insecta	Diptera	Tipulidae								1		
Arthropoda	Insecta	Ephemeroptera	Caenidae					1					1
Arthropoda	Insecta	Ephemeroptera	Ephemerellidae			1				2	1	4	8
Arthropoda	Insecta	Ephemeroptera	Ephemeridae										0
Arthropoda	Insecta	Ephemeroptera	Heptageniidae							1			
Arthropoda	Insecta	Ephemeroptera	Polymitarcyidae										0
Arthropoda	Insecta	Ephemeroptera	Siphlonuridae							2			
Arthropoda	Insecta	Ephemeroptera	-			3							
Arthropoda	Insecta	Trichoptera	Brachycentridae							1			1
Arthropoda	Insecta	Trichoptera	Phryganeidae								1		
Arthropoda	Insecta	Trichoptera	Polycentropodidae							1			
Arthropoda	Insecta	Trichoptera	Gossosomatidae							6		1	
Arthropoda	Insecta	Trichoptera	-	7		1	2						
Arthropoda	Insecta	Odonata	Anisoptera				1						
Arthropoda	Malacostraca	Amphipoda	-						19				19
Mollusca	Bivalvia	-	-	6	1	2		19	1				23
Mollusca	Gastropoda	-	-	17		2		2					4
Mollusca	Gastropoda	Prosobranchia	Valvatidae							2		4	
Egg Mass								6					

Only the cases were found for all 7 Trichoptera in the P1 sample.
There may have been inadequate preservative in the P1 sample
There may have been inadequate preservative in the P3 sample.
Only cases were found for the trichoptera and chironomidae in the P3 sample. Ephemeroptera were identified by the heads of their exoskeletons.
There may have been inadequate preservative in the P4 sample. 2 Caddisfly cases were found. Cases resemble Odonoceridae sand construction.
Part of a dragonfly exoskeleton was found in sample P4.