PINE RIVER WATERSHED
Assessment Report

Lakehead Region
Conservation Authority
Conserve Today...For A Better Tomorrow

2011

Pine River Watershed Assessment Report

August 2011

Written and Published by:

Lakehead Region Conservation Authority
Conserve Today...For A Better Tomorrow

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Acknowledgements

The Lakehead Region Conservation Authority would like to acknowledge the residents of the Pine River watershed who allowed Lakehead Region Conservation Authority staff access to their property and who were eager to share valuable information about the condition and health of the Pine River.

Thank you to the Thunder Bay Field Naturalists, the Ministry of Natural Resources, and Lakehead University Forestry Department who assisted in the report by providing information regarding various aspects of the watershed.

The 2011 Pine River Watershed Assessment was completed by Lara Welch and Allison Buonocore, Assistant Water Resource Technologists. Scott Drebit, GIS Technician/Planner of the Lakehead Region Conservation Authority and Tammy Cook, Watershed Manager, provided guidance, input and revisions towards the completion of this report.

This report has been prepared in-house at the Lakehead Region Conservation Authority for internal purposes to document the condition of the Pine River in 2011.

Executive Summary

The Pine River watershed is located within the organized Township of Gillies, the Municipality of Neebing (Geographic Townships of Pearson, Pardee, Crooks, Blake and Scoble) and the unorganized Townships of Lybster, Fraleigh and Devon. The watershed covers a drainage area of approximately 404 square kilometres. The Pine River is 62.19 kilometres in length and is a meandering river which travels through lowland areas. The general slope of the watershed is 0.69 percent. The Pine River is fed by many lakes which include Pine, Matson, Fallingsnow, Crystal, Ball and Bearpad Lake.

The majority of the Pine River watershed is privately owned land (61.6 percent). Provincially owned crown land constitutes 37.6 percent of the watershed and 0.5 percent of the watershed is a Federal First Nations Reserve. Significant features of the watershed include the Pearson Wetland, which is an Area of Natural and Scientific Interest as well as a Provincially Significant Wetland, a very small portion of the Pine Bay Provincially Significant Wetland and the Pine Bay Nature Reserve which is owned by the Thunder Bay Field Naturalists.

The surficial geology of the Pine River watershed is mainly glaciolacustrine plains from the Rove Formation. Other landform features not associated with glacial activity that are present in the watershed include bedrock, organic accumulations and alluvial deposits. The prevailing soil type throughout the watershed is shallow till over bedrock, although lacustrine clay deposits exist in the middle reaches. The Pine River watershed is composed of nine different soil types. The most abundant type of soil is Jarvis River which covers 115.18 square kilometres of the watershed. Rockland, Oskondoga and Nolalu soils comprise a significant portion of the watershed covering 220.71 square kilometres. The remaining soil is made up of Lappe, Marsh, Arthur, Organic – Cabett and Organic – Penassen which covers 68.23 square kilometres.

The Pine River watershed is located within the boundaries of the Great Lakes forest region. The most common tree species in the watershed are black spruce, jack pine, white birch and trembling aspen. There are a variety of other plants present in the watershed including ferns, shrubs, herbs, mosses and lichens. There are also spruce and cedar swamps within the watershed that support a number of rare plants and orchids.

For this report, ten sample sites located within the Pine River watershed were chosen based on a variety of attributes including: accessibility, physical features, land use designation, and proximity to man-made features that may alter water quality, as well as headwaters used as a base reference.

At each of the ten sample locations, surface water samples and field measurements were collected on June 14-16 and July 25, 2011. Surface water samples were analyzed by ALS Laboratory Group for conductivity, total dissolved solids, turbidity, total ammonia, nitrate, nitrite, total phosphorus, *Escherichia coli (E. coli,)* and a full metal scan. Field

measurements included water temperature, pH, conductivity and dissolved oxygen. Field and laboratory results were compared to the Ministry of Environment's *Provincial Water Quality Objectives* (PWQO), 1994.

Phosphorus exceeded the PWQO criterion (0.03 mg/L) at every site with the exception of sites 5, 6, 8 and 10 in June, with exceedances ranging from 0.319 mg/L at Site 2 on June 15 to 0.0764 at Site 7 on July 25. The high levels of phosphorous are likely due to natural causes.

PWQO criterion for *E. coli* bacteria is that levels be below 100 counts per 100 mL of water for safe swimming and bathing. During the June sampling, all sample sites were below the PWQO criterion. On July 25, 2011, Site 3 (250 counts/100 mL), Site 8 (690 counts/100 mL), Site 9 (100 counts/100 mL) and Site 10 (410 counts/100 mL) exceeded the criterion.

As there is no current PWQO for total coliform results were compared to the pre-1994 PWQO criterion (1,000 MPN/100 mL). Every site in 2011 for both sampling periods exceeded the criterion with the exception of Site 5 (920 MNP/100 mL) and Site 10 (340 MPN/100 mL) in June 2011. The total coliform concentrations in 2011 ranged from 340 to greater than 2,400 MPN/100 mL for the watershed.

All sites were above the PWQO criterion of 0.075 mg/L for aluminum during both sampling months. Aluminum concentrations ranged from 0.090 mg/L to 0.938 mg/L.

All sites were above the PWQO criterion of 0.30 mg/L for iron during both the sampling months of June and July, 2011. Iron concentrations ranged from 0.596 mg/L to 4.45 mg/L for the entire sampling year of 2011.

Copper exceeded the criterion (0.005 mg/L) at Site 1 on June 16, 2011 (0.0059 mg/L) and at Site 2 (0.0054 mg/L) on June 15, 2011. Copper did not exceed the PWQO criterion during the month of July 2011 at any site.

Cobalt exceeded the PWQO (0.0009 mg/L) on July 25, 2011 at Site 5 (0.00203 mg/L), Site 8 (0.00199 mg/L) and Site 10 (0.00096 mg/L).

The flora and fauna inventory indicated that the Pine River watershed supports a healthy population of diverse plants and animals. The stream banks, with the exception of Site 3, were stable and showed little signs of erosion. The water crossings appeared to be functional; however, Bridge 2 and Bridge 6 were beginning to show effects from erosion and weathering. Culvert 1 was undersized for the volume of water in the area and was completely submerged during both site visits.

At the time of sampling in 2011 the Pine River Watershed was considered to be in good health.

Upon completion of the 2011 Pine River Watershed Assessment, the following recommendations have been made for consideration:

- Staff and funding permitting it is recommended that an update to the 2011 Pine River Watershed Assessment be completed in the next five to ten years.
- Benthic analysis indicates water quality over an extended period of time and should be considered for future watershed assessments.
- Additional sampling should be conducted in the spring to observe the water quality differences between high and low flow seasons.
- Bridges 2 and 6 should be regularly monitored to ensure bank erosion and degrading wood does not compromise the structure by the owner of the structure.
- Culvert 1 should be regularly monitored to study its capacity to move water during high and low periods of water flow by the owner of the culvert.

A copy of this report should be provided to the Township of Gillies and the Municipality of Neebing for reference purposes. The Report should be kept on file at the LRCA Administration Office for review by interested parties.

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1 Introduction

The Pine River watershed is located within the organized Township of Gillies, the Municipality of Neebing (Geographic Townships of Pearson, Pardee, Crooks, Blake and Scoble), and the unorganized Townships of Lybster, Fraleigh, and Devon as shown on the Key Plan Map, M-1. Areas regulated by the Lakehead Region Conservation Authority and Township boundaries can be found on Map M-9: Regulated Areas.

A watershed can be defined as all the land and water within the confines of a drainage divide. Numerous tributaries (i.e. streams and creeks) and six significant lakes (Crystal, Fallingsnow, Matson, Bell, Bearpad and Pine Lake) join together into a main channel and flow into Lake Superior. In essence, the Pine River watershed consists of all the surrounding land that naturally drains its lakes, streams, wetlands and precipitation runoff into the Pine River which then flows into Lake Superior. The headwaters of the main branch initiate near the intersection of the Township of Gilles, Lybster, Pearson and Fraleigh Township boundaries. Pine Lake, the headwaters, is located in the Township of Devon. The watershed covers a drainage area of approximately 404 square kilometres. The prevailing soil type throughout the watershed is shallow till over bedrock, although lacustrine clay deposits exist in the middle reaches. Since Crystal Lake, Fallingsnow Lake and Pine Lake are all located at the upper end of the tributary basins; their storage capacity has a minimal effect on the runoff into the river. Approximately ten percent of the land is used as hobby farms due to the lack of productive soil and suitable topography. Most of the watershed is dominated by black spruce, jack pine, white birch and trembling aspen. The Pine River is primarily bedrock-controlled and runs 62.19 kilometres in length and meanders through swampy lowlands. In numerous areas the river widens and appears similar to long narrow lakes.

The goal of this report is to document the conditions of the watershed, especially surface water quality, as observed in June and July of 2011, and ultimately use the information to develop and maintain programs to sustain a healthy ecosystem consistent with the Natural Hazards and Natural Heritage Policies of the Province of Ontario. The main objectives of this report are to:

- Summarize the physical, biological and socio-economic attributes of the watershed
- Collect surface water quality data
- Collect field measurements
- Conduct an inventory of the forest ecosystem and fauna observed within the watershed
- Conduct an inventory of soil, streambed substrate and streambank cover observed within the watershed
- Document active erosion sites

- Document the physical condition of all Pine River water crossings (bridges/culverts)
- Interpret results to record the health status of the watershed

2 Background

2.1 Physical Attributes

2.1.1 Topography

The Pine River originates in Pine Lake. The water from the lake drains into the Pine River and meanders its way in an easterly direction to Lake Superior. The highest point in the watershed is approximately 608 metres above sea level bordering the mid-western boundary of the watershed (5340373 N 290773 E). The lowest point in elevation can be found near the confluence at 184 metres above sea level (5324205 N 312957 E). The general slope of the watershed is 0.69 percent. This area is characterized by predominately flat to gently rolling topography with minor occurrences of diabase dikes and sills (LRCA, 2008). Map M-3 illustrates the Pine River watershed topography.

2.1.2 Geology and Soils

Bedrock

The Pine River watershed's bedrock geology is a product of two geological eras. The first is the Precambrian era which took place between 600,000 and over 3.5 billion years ago. The second is the Pleistocene period which ended approximately 10,000 years ago. The area is underlain by ancient Precambrian rocks of the Canadian Shield. The Gunflint and Rove formations of the Animikie series are one of the rock formations that compose the Canadian Shield, including the Pine River watershed. The Gunflint formations are made up of taconite, algalchert, chert-carbonate, sandstone, shale, minor limestone and small amounts of volcanic rock. Rove formations are made up of greywackes and black shale. The Keweenawan intrusion of igneous material into the Gunflint formation rock masses was the most recent episode in the Proterozoic era which occurred approximately 100 to 110 million years ago. This intrusion formed vertical diabase dikes and horizontal diabase sills which are responsible for the relief of the immediate and surrounding area. The dikes stick up as massive ridges trending north-easterly and the sills are formed as resistant caprocks that form the large mesa landforms known as the Nor'Wester Mountains.

The watershed is comprised of sedimentary rocks from the Paleoproterozoic era (2,500 – 1,600 million years ago) and mafic intrusive rocks from the Mesoproterozoic era (1,600 – 1,000 million years ago). More specifically, 72 percent of the rock type is from the paleoproterozoic era which is composed of the Animikie Group rocks which include wacke, shale, iron formation, limestone and minor volcanic rocks. The remaining 28 percent of the rocks are from the mesoproterozoic era and these include the Logan and Nipogon sills, diabase sills, ultramafic, gabbroic and granophyric intrusions. Map M-4: Bedrock Geology illustrates the rock types present in the watershed.

Surficial Geology and Soils

Throughout northwestern Ontario there is a close relationship between landform features and sediment types. During the advance of the Laurentide Ice Sheet subglacial till was deposited in the form of drumlins, drumlinoid ridges, crag and tail features and undifferentiated ground moraine which resulted in a structured topographic grain to landscape. Roughly 20,000 years ago when the ice sheet began to recede, entrained materials in the ice melted out as ablation till. Meltwaters left behind sands and gravels within esker outwash systems and moraines. These esker outwash systems cover about 0.2 percent of the watershed and the moraines about 11 percent. In addition to these glacial features, 4.7 percent of the watershed is slope/talus piles. The majority of the surficial geology, at 41 percent, is composed of glaciolacustrine plains. Other landform features not associated with glacial activity that are present in the watershed include bedrock, organic accumulations and alluvial deposits. A visual representation of the surficial geology of the watershed is shown on map M-5: Surficial Geology. Due to the large occurrence of bedrock many of the surficial deposits are relatively thin throughout the area and are usually less than 14 metres thick.

The Pine River watershed is composed of nine different soil types. The most abundant type of soil is Jarvis River which covers 115.18 square kilometres of the watershed. Rockland, Oskondoga and Nolalu soils cover 220.71 square kilometres of the watershed. The remaining soil is made up of Lappe, Marsh, Arthur, Organic – Cabett and Organic – Penassen which cover 68.23 square kilometres. The distribution of soil types throughout the watershed is illustrated on Map M-6: Soils and a description of each type of soil present are given in Appendix J.

2.1.3 Climate

The climate of the Pine River watershed is similar to the Thunder Bay region, in that it is a modified continental climate influenced by Lake Superior. From the months of July to March the westerly winds prevail whereas the easterly winds prevail the rest of the year (LRCA, 1985). These winds modify the climate of Thunder Bay and the surrounding regions. The mean daily temperatures in degrees Celsius and precipitation levels in millimetres for Thunder Bay were recorded at the Thunder Bay Airport from 1971 to 2000 (Environment Canada, 2011) as shown in Table 2.1-1. This table also summarizes the extreme daily precipitation in millimetres recorded within a 24-hour period the year and number of days in which it occurred.

Table 2.1-1: Average Monthly Temperature and Precipitation for Thunder Bay, 1971-2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily (degrees Celsius)	-14.8	-12	-5.5	2.9	9.5	14	17.6	16.6	11	5	-3	-11.6
Precipitation												
Total Precip. (millimetres)	31.3	24.9	41.6	41.5	66.5	85.7	89	87.5	88	62.6	55.6	37.5
Extreme Max. Daily Precip. (millimetres)	51.6	33.5	41.9	69.3	76.2	49.3	53.8	87.1	131.2	47.8	63	42.7
Date (year / # of days)	1956 /20	1951 /26	1957 /14	1954 /30	1971 /24	1947 /04	1973 /27	1973 /19	1977 /08	1968 /09	1973 /21	1948 /05

The average monthly temperatures (degrees Celsius) and precipitation levels (millimetres) for Thunder Bay were recorded at the Thunder Bay Airport for 2011 (Environment Canada, 2011), as shown below.

Table 2.1-2: Average Monthly Temperature and Precipitation for Thunder Bay, January-July 2011

	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature							
Daily (degrees Celsius)	-16.7	-11.5	-6.2	1.9	9.3	13.6	18.9
Precipitation							
Total Precipitation (millimetres)	54.7	13.5	24.4	71.6	45.7	91.7	119.2

The average monthly temperature for the June and July sampling periods was 16.3 degrees Celsius and the average monthly precipitation was 105.5 millimetres. In comparison with the historical data, the 2011 temperature was within one degree Celsius. The 2011 precipitation for June was 6 millimetres greater than recorded historical average precipitation. The precipitation for July 2011 was 30.2 millimetres greater than recorded historical average precipitation.

2.1.4 Hydrology

The Pine River is 62.19 kilometres long from the headwaters at Pine Lake to the confluence with Lake Superior. The drainage area for the Pine River watershed is 404 square kilometres. The general slope of the watershed is 0.69 percent. The Pine River is fed by six named lakes which include: Pine, Matson, Fallingsnow, Crystal, Ball and Bearpad Lake. These water bodies cover an area of 6.86 square kilometres. There are three major tributaries to the Pine River which include Crystal Creek, Moore Creek and Aulds Creek. Crystal Creek has its own headwaters originating in Crystal Lake which flows directly into the Pine River. The creek is 9.96 kilometres long and covers a

drainage area of 54.53 square kilometers. Moore Creek is 10.5 kilometres long and has a watershed area of 40.31 square kilometres. Aulds Creek is 11.9 kilometres long with a watershed area of 27.59 square kilometers. Wetlands are also present throughout the watershed covering an area of 8.78 square kilometres. In total wetlands make up 2.2 percent of the drainage area of the watershed and waterbodies make up 1.7 percent of the area.

2.2 Biological Attributes

2.2.1 Flora

The Pine River watershed is located within the boundaries of the Great Lakes forest region as shown on the Forest Regions of Canada map (Refer to Figure 1). The trees which comprise the Great Lakes forest region are primarily white pine, red pine and yellow birch. Although the watershed is geographically located in this forest region, the tree species observed are more indicative of a Boreal forest region. The trees present are predominantly black spruce, jack pine, white birch and trembling aspen as opposed to the white pine, red pine and yellow birch of the Great Lakes forest region. This discrepancy is likely due to the fact that the watershed is relatively close to the Boreal forest region and mechanisms such as local climate (slope, aspect), site condition (soil characteristics), disturbance regimes and species interaction can affect the species distribution in the area. The coarse scale of the Forest Regions of Canada distribution map is only a basic division of the forest types there is no discrete line which separates the two zones. Factors such as the ones mentioned above could easily alter forest types which are located between two zones.

There are a variety of other plants present in the Pine River watershed including ferns, shrubs, herbs, mosses and lichens. There are spruce and cedar swamps which provide suitable habitats for a number of rare plants and orchids. The Thunder Bay Field Naturalists compiled a list of vascular plants found within their Pine Bay Phase I Nature Reserve which is located within part of the Pine River watershed (refer to Map 2: Site Plan). A complete list of the vascular plants located in this area is given in Appendix D.

2.2.2 Fauna

The Pine River watershed provides breeding grounds for a variety of wildlife. Some of the more common species that live in the watershed include otters, beavers, deer and Peregrine Falcons. The Thunder Bay Field Naturalists compiled a list of the butterflies, dragonflies, amphibians, reptiles and mammals of the Pine Bay Phase I Nature Reserve located within part of the Pine River watershed. A complete list of the wildlife located in this area is given in Appendix E.

2.3 Socio-Economic Attributes

2.3.1 Planning & Development Controls

Land Tenure

The majority of the Pine River watershed is privately owned land (61.6 percent). Provincially owned crown land constitutes 37.6 percent of the watershed and 0.5 percent of the watershed is a Federal Land Indian Reserve. Land ownership in the watershed is illustrated on Map M-8: Land Use.

Areas of Jurisdiction

The hydrological boundaries of the Pine River watershed fall within nine Geographic Townships which include: the organized Township of Gillies; the organized Municipality of Neebing which includes the Geographic Townships of Scoble, Blake, Pearson, Pardee and Crooks; and the unorganized Townships of Lybster, Fraleigh and Devon. Map M-2, Site Plan, illustrates the location of the Pine River watershed within the Geographic Township boundaries. Table 2.3-1 outlines the watershed area within each Township boundary.

Table 2.3-1: Areas of Jurisdiction within the Pine River Watershed

Geographic Boundaries	Total Area (km^2)	Municipal Area within Pine River Watershed (km^2)	Municipal Area within Pine River Watershed (%)
Township of Gillies	93.86	32.96	8.16
Municipality of Neebing			
Township of Scoble	102.05	0.85	0.21
Township of Blake	252.64	0.68	0.17
Township of Pearson	141.25	120.78	29.90
Township of Crooks	164.54	27.24	6.74
Township of Pardee	187.45	132.44	32.78
Unorganized Townships			
Unorganized Township of Lybster	93.45	9.52	2.35
Unorganized Township of Fraleigh	71.58	30.21	7.48
Unorganized Township of Devon	236.61	49.32	12.21
Total	1343.43	404	100

Within the boundaries of the Pine River watershed the Lakehead Region Conservation Authority (LRCA) Area of Jurisdiction extends within the Township of Gilles and the Municipality of Neebing. Of the total Pine River watershed area, 89.05 square kilometers (22 percent) is outside the LRCA Area of Jurisdiction. Conversely, 314.95 square kilometers (78 percent) of the watershed is located within the LRCA Area of Jurisdiction. Within the LRCA Area of Jurisdiction the Authority administers the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses O. Reg.

180/06 under the *Conservation Authorities Act*. Areas considered regulated include Provincially Significant Wetlands and 120 metres adjacent, all watercourses, all land zoned Hazard Land or Use Limitation, steep slopes and 15 metres landward and one kilometre lakeward from the 100 year flood level on Lake Superior (i.e. 184.0 metres Geodetic Survey of Canada). Activities within the approximate regulated area may require a permit from the Authority.

Land Use Designation/Zoning

Municipal Official Plans contain long term goals and policies that serve as guidelines for future land use and development. The Pine River watershed is affected by two Official Plans; Municipality of Neebing and the Township of Gillies. Land use designations within the Pine River watershed can be found on Map M-7: Zoning.

Within the Unorganized Townships of Lybster, Fraleigh, and Devon, there is no official designation to the land.

Within the Municipality of Neebing, the Pine River watershed has been zoned:

- Extractive Industrial Zone
- Institutional Zone
- Rural Zone
- Recreation 2 Zone
- Use Limitation Zone

The policies of the Official Plan and all land use designations are implemented through zoning by-laws. Zoning provides an additional level of detail, particularly with respect to the range of permitted uses and any specific conditions which must be satisfied such as buffering, suitable distances between uses and parking requirements. The following is a description of each zone.

Extractive Industrial Zone

Extractive Industrial zones are more regulated than General Industrial Zones. Permitted uses within extractive zones are pits and quarries and/or stockpiling of extracted materials (including washing, screening, sorting and crushing). Accessory uses for the above activities, such as buildings and structures, are also permitted. No excavation, building, equipment or stockpile shall be located within 120 metres of a building used for residential, recreational, institutional or commercial purposes. Extractive Industrial activity must also be 30 metres away from any public road or allowance, not also zoned Extractive Industrial. There are two areas zoned Extractive Industrial within the Pine River watershed which are located directly east of Memory Road near the confluence as well as on the boundary line of the watershed east of Savoie Road.

Institutional Zone

The intent of Institutional zones is to provide for appropriately located public and private institutions that are accessible to the people they serve, while not having an adverse effect on the surrounding area. Permitted institutional uses include government buildings, public service facilities, churches, schools, libraries, cemeteries, fire stations, community halls and other similar buildings. Within the Pine River watershed, there is a fire hall, skating rink and baseball diamond that are part of the Institutional zone designation.

Rural Zone

A Rural zone designation is intended to preserve low density rural residential character for Townships and Municipalities. Rural designations allow for a variety of compatible land uses including agriculture, guest cottages, wind farms, mineral exploration, forestry, stables and riding academies, parks, conservation uses and home occupation. Rural zones are located throughout the watershed and make up the largest zoning type.

Recreation 2 Zone

The intent of Recreation 2 zones is to provide residents with a pastime, diversion, exercise, or other resource affording relaxation and enjoyment. Permitted Recreation 2 uses include a recreational dwelling, a recreational modular home, a guest cottage, a bed and breakfast, a boat house, and buildings, structures and uses accessory to the above uses. The Recreation 2 zone within the watershed is a municipally owned boat launch located at the watershed boundary near where the Pine River meets Lake Superior.

Use Limitation Zone

Use Limitation zones are those lands which because of their physical characteristics or location may be susceptible to flooding, eroding or instability which conditions may result in loss of life or destruction of property. The uses permitted in Use Limitation lands are limited to agriculture, conservation, forestry, wind farms, public parks, watershed management and protection, mineral exploration and outdoor recreational uses. No buildings or structures are permitted in these areas except where such are intended for flood or erosion control or watercourse protection or bank stabilization projects. Use Limitation zones are found throughout the Pine River watershed around rivers, lakes, wetlands and steep slopes.

Within the Township of Gillies, the Pine River watershed has been zoned:

- Rural Zone

Rural Zone

The rural area is characterized as a low density, multi-purpose area in which a variety of land uses can be accommodated in a compatible manner. It is the intent of the Rural land

use designation to maintain the low density rural character of the Township, provide flexibility by permitting a variety of land uses, allow development of natural resources and economic activities in a manner compatible with the rural character and to protect existing agricultural operations from incompatible land uses and ensure their long term viability.

2.3.2 Areas of Natural and Scientific Interest/Provincially Significant Wetlands

Areas of Natural and Scientific Interest (ANSI) are "areas of land and water containing natural landscapes or features which have been identified as having values related to protection, natural heritage appreciation, scientific study or education" (Ontario Ministry of Natural Resources, 1983). The Pine River watershed contains one ANSI which is also designated as a Provincially Significant Wetland, which is known as the Pearson Wetland. The Pearson Wetland/ANSI is located in the eastern portion of the Pine River watershed (as shown on Map M-2: Site Plan). This wetland plays an important role in maintaining summer water levels. The wetland evaluation was prepared for the Ontario Ministry of Natural Resources Thunder Bay District by Robert Foster and Allan Harris in 1998. Provincially Significant Wetlands are determined by a science-based ranking system known as the Ontario Wetland Evaluation System (OWES). The Pearson Wetland is 7.29 square kilometers in area and is fed by streams consisting of series of beaver meadows extending for many kilometres upstream from the core wetland area. The wetland vegetation community consists of four classes: fen, marsh, open-water marsh and swamp (Refer to Figures 2 and 3). In order for an area of land to be considered a Provincially Significant Wetland four components must be analyzed and 600 cumulative points must be allocated throughout the components. It was concluded that this area was a Provincially Significant Wetland with a total score of 682.5 out of a possible 1,000 points.

In addition a small portion (i.e. 4.56 hectares) of the Pine River Provincially Significant Wetland is located on the west side of the confluence of the Pine River and Lake Superior.

In determining this classification, the result was that development and site alteration shall be not permitted under the Provincial Policy Statement (PPS). In addition, Provincially Significant Wetlands are regulated by the Conservation Authority under Ontario Regulation 180/06 Development, Interference with Wetlands and Alterations to Shorelines and Watercourses.

2.3.3 Pine Bay Nature Reserve

The Pine Bay Nature Reserve, as shown on Map M-2, Site Plan, was acquired by the Thunder Bay Field Naturalists on August 28, 2009. The protected reserve is 369 hectares in size and is located at the confluence of the Pine River and Lake Superior. The reserve features a portion of the Pine Bay Provincially Significant Wetland, diverse habitat, including a mesa which forms part of the Nor'Wester chain. To date the field naturalists

have catalogued over 250 different plant species including many regionally rare plants and orchids (Thunder Bay Field Naturalists, 2009). Appendices D and E provide a list of identified flora and fauna as documented by the Thunder Bay Field Naturalists.

3 Methods and Materials

A summary of the sampling techniques used is included in Appendix C: Techniques for Data Collection.

3.1 Site Selection

Ten sites were chosen along the Pine River to assess the overall health of the watershed. Each site was chosen based on its accessibility and its proximity to natural or man-made features that may alter water quality.

Site 10 was located on Falling Snow Road in order to obtain water samples from the far west portion of the watershed. Site 9 was located on Lankinen Road in order to obtain water samples as close to the Pine Lake headwater as possible. Sampling directly out of Pine Lake was not possible due to inaccessibility to the area. Site 8 was located on Wamsley Road adjacent to the northern part of the Pine River. From this site water samples would reflect the water draining into the Pine River from the northwestern part of the watershed. Site 7, also located on Wamsley Road just west of Site 8, represented water entering the Pine River from the northeastern part of the watershed. Site 6 was located on Highway 597 just west of the Pearson Wetland. This site was chosen to represent eastern portion of the watershed – specifically the Pearson Wetland. Site 5 was located on Highway 595 just west of Coulson Road. This site was chosen for the water it receives from the lower drainage area of the Pine River which included seven small unnamed lakes. Site 4 was located at the intersection of Highway 597 and Highway 595 and sampled water directly from the Pine River. This site encompassed drainage water from Sites 5-10 which depicted the overall quality of the northern, eastern and western portions of the watershed. Site 3 was located on Pardee Road west of Crystal Creek. This site included the drainage from Matson Lake, which then entered Crystal Creek and continued on into the Pine River. Site 2 was located on Highway 61 just south of Memory Road. This site was chosen to represent the water quality for the entire watershed prior to the confluence. Site 1 was located as close as possible to the confluence of the Pine River with Lake Superior in order to represent the cumulative water quality data for the entire watershed. If any significant changes were noted between sites 1 and 2 it could then be determined that the change was likely caused by a factor between these two sites. The UTM coordinates and elevation of each site were marked using the Trimble Geo XH GPS unit as shown on Map M-2: Site Plan.

3.2 Quantitative Assessment

Several parameters were measured to assess surface water quality of the Pine River. Surface water samples were collected in laboratory supplied new bottles by LRCA staff and summer students and transported on ice, to ALS Laboratory Group, 1081 Barton Street, Thunder Bay, Ontario for analysis of conductivity, total dissolved solids (TDS),

turbidity, nutrients (ammonia-total nitrogen, nitrate, nitrite and phosphorus), bacteria (*Escherichia coli* and total coliforms) and total metals (notable iron and lead). Sampling for the first data set was conducted on June 14, 15 and 16, 2011. The second set was collected on July 25, 2011.

Methodology for water sample collection was based on the Provincial Water Quality Monitoring Network (PWQMN), Ministry of the Environment, protocol. Grab samples were collected away from the stream bank in the main current by wading or by using a reaching pole. Effort was taken to enter the stream downstream of the sampling location in order to disturb as little sediment as possible. Additionally, samples were taken upstream from any water crossings and/or outlet culverts and were taken facing upstream into the current. In cases where current was not detectable (stagnant water) or current was flowing in the opposite direction (influenced by wind direction), samples were still collected facing upstream. Samples were collected at a depth of 0.3 metres below the surface of the water to avoid capturing any floating debris.

ALS Laboratory Group provided four collection bottles for each site: routine, nutrient, metal and bacterial analysis. The sample bottles and lids were rinsed twice before a true sample was collected. Sulfuric acid and nitric acid were added as preservatives on site to the nutrient and metal bottles, respectively. Bottles for bacterial analysis were not rinsed as they were pre-charged with sodium thiosulphate preservative and special care was taken not to open the bottle until the true sample was to be filled. All filled sample bottles were transported on ice for delivery to the laboratory.

Field parameters of water temperature, pH, conductivity and dissolved oxygen were measured using an YSI 6000 QS multi-parameter water quality sampler at the same time as water sample collection. The following additional field parameters were also measured: air temperature by mercury thermometer, channel width using a measuring-tape reel, channel depth using a weighted measuring tape reel and velocity was measured using a stick, measuring tape, stop watch and appropriate calculations. Velocity was only measured for water running downstream (not in ponds producing only windblown results). Description of the water quality parameters are attached in Appendix A.

3.3 Applicable Criteria

Surface water quality results were compared to applicable criteria published in the *Provincial Water Quality Objectives* (PWQO) by the Ontario Ministry of Environment and Energy (MOEE), July 1994. The goal of the PWQO is to "ensure that the surface waters of the province are of the quality which is satisfactory for aquatic life and recreation". Applicable criteria published in the *Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary Table* by the Canadian Council of Resource and Environment Ministers (CCREM), September 2007 were also used for comparison to surface water quality results for the Pine River watershed. The information in these guidelines and supporting text is used to complement the PWQO and Interim Objectives.

The applicable criteria published in the PWQO and CCREM water quality guidelines are attached in Appendix B. Total Coliform results were compared to the pre-1994 PWQO, as there are no current criteria.

3.4 Qualitative Assessment

Watershed health can also be assessed by qualitative monitoring (i.e. visual inspection). The composition of in-stream substrate, forest soil, stream bank riparian community, shoreline vegetation and condition of the stream bank can all affect water quality. The presence or absence of certain flora and fauna can indicate the status of the watershed to provide suitable habitat. Several field guides were used to identify terrestrial and aquatic species. Each site was given a Vegetation Type (V-type) allocation based on the *Field Guide to the Forest Ecosystem Classification for Northwestern Ontario* (Sims *et al.* 1997). Sites were assessed in a 10 by 10 metre transect using a dichotomous key. It is important to note that these classifications are a general overview of a larger area and no site was exactly the same as another and differences or inconsistencies between the V-types should be expected. Vegetation Types for each site are attached in Appendix F. Common and Latin names of plant species are attached in Appendix G. Fauna was assessed by identifying the species and number of individuals observed at each site.

An inventory of Pine River water crossings (bridges and culverts) was conducted. Physical dimensions were measured, Universal Transverse Mercator (UTM) coordinates and pictures were taken and general observations were noted including high water marks, stability of fill and any restriction of flow. Culvert and bridge locations can be found on Map M-10: Bridges and Culverts Sites. The bridge and culvert assessments are attached in Appendices H and I.

3.5 Materials

Materials used during the assessment included:

- Chest waders
- Cooler and ice packs
- Clipboard and observation chart paper
- Dip net
- Digital camera
- Field guides
- Fluorescent orange vests
- Latex gloves
- Measuring tape reel
- Measuring tape reel with lead weights (for measuring depth)
- Mercury thermometer
- Metre stick
- Pens and pencils

- Reaching pole
- Road map
- Sampling bottles and preservative provided by ALS Laboratory Group
- Scissors
- Shovel
- Stick (to measure velocity)
- Stopwatch
- Trimble Geo XH GPS
- Tweezers
- YSI 556 MPS metre
- Ziploc bags

Field Guides:

- Field Guide to the Forest Ecosystem Classification for Northwestern Ontario (Sims *et al.,* 1997)
- Field Guide to Trees and Shrubs 2nd Edition (Petrides, 1958)
- Native Trees of Canada 8th Edition (Hosie, 1990)
- ROM Field Guide to Wildflowers of Ontario (Dickinson *et al.,* 2004)
- Wetland Plants of Ontario (Newmaster *et al.,* 1997)
- Atlas of the Breeding Birds of Ontario (Cadman *et al.,* 2007)

4 Results

Site photos and site descriptions from each sampling site are attached in Appendix K. A summary of all laboratory water quality results for all sampled sites are summarized in Appendix L. The original Laboratory Certificates of Analysis and Analytical Reports have been attached in Appendix M.

Figures 4-10 graphically represent and compare the following parameters: elevation, water temperature, pH, dissolved oxygen, total dissolved solids, conductivity, turbidity, total phosphorus and *E. coli* for both sampling periods.

Results for each site are summarized in the following tables.

4.1 Site 1

Table 4.1-1: Location Reference for Site 1

Location Description	Confluence of Pine River, Memory Road
UTM Coordinates	5325256.11 metres north / 313210.61 metres east
Altitude/Elevation	186.43 metres above sea level

Table 4.1-2: Field Measurements for Site 1

Field Parameter	Date: June 16, 2011 Time: 10:45	Date: July 25, 2011 Time: 15: 15
Water Temperature (ºC)	18.96	21.78
Conductivity (µS/cm)	147	128
Turbidity (NTU)	10.9	8.97
Dissolved Oxygen (mg/L)	3.38	8.65
Dissolved Oxygen (%)	35.7	N/A
pH	7.40	8.18
Air Temperature (ºC)	16	23
Channel Width (m)	24.90	25.13
Channel Depth (m)	0.22	0.64
Velocity (m/s)	0.32	0.70

Table 4.1-3: Laboratory Water Quality Results for Site 1

Variable	PWQO Guidelines	Date: June 16, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	150	131
Total Dissolved Solids (mg/L)	N/A	145	134
Turbidity (NTU)	<10% of Natural	15.8	15.5
Ammonia-N, Total (mg/L)	N/A	<0.020	0.026
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	**0.0323**	**0.0513**
Escherichia coli (MPN/100mL)	100	93	73
Aluminum (Al) (mg/L)	0.075	**0.689**	**0.560**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00051
Copper (Cu) (mg/L)	0.0005(interim)	**0.0059**	0.0038
Iron (Fe) (mg/L)	0.300	**1.27**	**1.80**
Lead (Pb) (mg/L)	0.0001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.1-4: Flora and Fauna Observed at Site 1

Terrestrial	Trees	Black spruce* White spruce White birch Trembling aspen Balsam poplar Balsam fir
	Shrubs	Green alder Willow Red-osier dogwood
	Herbs	Cow parsnip Buttercup American vetch
	Ferns/Horsetails/ Mosses	Horsetail Sensitive fern
	Mammals	Black bear
	Birds	-
	Insects	Dragonflies Cabbage white butterfly Mosquitoes
Aquatic	Plants	Horsetail Green algae Floating-leaved burreed
	Animals	-

*Dominant Species

Table 4.1-5: Physical Features Observed at Site 1

In-stream Material	Large boulders Aquatic plants Woody debris
Stream Bed Description	Large boulders Cobbles
Bank Stability/Erosion	Very stable – abundant vegetation
Stream Cover/ Forest Density	Partly open – stream 5% cover along banks
Soil Type (Texture/Drainage)	Sandy loam

Site 1 was located on Memory Road and was chosen to represent the confluence of the Pine River with Lake Superior. There was no structure (bridge/culvert) at this site due to the road running parallel to the Pine River. Large boulders and cobbles were dominant within the river and the water was shallow but swiftly moving. There was little debris in the channel; however, floating-leaved burreed was observed in the water near the banks along with woody debris. The banks appeared stable and were covered by abundant shrub and herb growth on sandy loam soil, with no apparent erosion. Access to the sampling site was down a steep gradient from Memory Road across from telephone pole # 45. A small, partially overgrown trail led down to the sampling site. During the June sampling period a young black bear was seen in the distance upstream from the sampling site.

The pH at Site 1 was 7.40 on June 16, 2011 and 8.18 on July 25, 2011. pH values were within the PWQO criterion of 6.5 to 8.5. Phosphorus, aluminum, copper and iron all exceeded the PWQO criteria of their respective values. On June 16, 2011 phosphorus

exceeded the PWQO of 0.03 milligrams per litre (mg/L) with a value of 0.0323 mg/L as well as on July 25, 2011 with a value of 0.0513 mg/L. Aluminum exceeded the PWQO criterion of 0.075 mg/L on both June 16, 2011 and July 25, 2011 with values of 0.689 mg/L and 0.560 mg/L, respectively. Copper only exceeded the PWQO of 0.005 mg/L (interim) on June 16, 2011 with a value of 0.0059 mg/L. Iron which has a PWQO of 0.3 mg/L was exceeded on June 16, 2011 (1.270 mg/L) and on July 25, 2011 (1.800 mg/L). Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 2,000 MPN/100 mL in June and >2,420 MPN/100 mL in July. Nutrients, metals and *E. coli* for this site were all within their PWQO criterion for both sample dates.

4.2 Site 2

Table 4.2-1: Location Reference for Site 2

Location Description	On Highway 61 south of Memory Road
UTM Coordinates	5326934.95 metres north / 311146.13 metres east
Altitude/Elevation	214.70 metres above sea level

Table 4.2-2: Field Measurements for Site 2

Field Parameter	Date: June 15, 2011 Time: 13:30	Date: July 25, 2011 Time: 14:55
Water Temperature (ºC)	21.49	21.93
Conductivity (µS/cm)	134	126
Turbidity (NTU)	9.36	7.44
Dissolved Oxygen (mg/L)	2.72	8.75
Dissolved Oxygen (%)	31.0	N/A
pH	7.40	8.02
Air Temperature (ºC)	21	25
Channel Width (m)	18.00	17.97
Channel Depth (m)	0.83	0.79
Velocity (m/s)	Not measurable due to wind influence	Not measurable due to wind influence

Table 4.2-3: Laboratory Water Quality Results for Site 2

Variable	PWQO Guidelines	Date: June 15, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	136	130
Total Dissolved Solids (mg/L)	N/A	168	136
Turbidity (NTU)	<10% of Natural	15.8	13.3
Ammonia-N, Total (mg/L)	N/A	<0.020	0.033
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	**0.0319**	**0.053**
Escherichia coli (MPN/100mL)	100	37	31
Aluminum (Al) (mg/L)	0.075	**0.629**	**0.454**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	<0.00050
Copper (Cu) (mg/L)	0.005(interim)	**0.0054**	0.0034
Iron (Fe) (mg/L)	0.300	**1.270**	**1.630**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.2-4: Flora and Fauna Observed at Site 2

Terrestrial	Trees	Balsam fir Jack pine Trembling aspen Mountain ash White spruce
	Shrubs	Red-osier dogwood Willow Green alder
	Herbs	Red clover Dandelion American vetch Bluebead lily
	Ferns/Horsetails/ Mosses	Ostrich fern
	Mammals	Wolf tracks
	Birds	Swallows
	Insects	-
Aquatic	Plants	Horsetails Arrowhead Green algae
	Animals	-

Table 4.2-5: Physical Features Observed at Site 2

In-stream Material	Horsetails throughout the cobbles
Stream Bed Description	Muck Cobbles Boulders
Bank Stability/Erosion	Stable- Lots of grass and shrub coverage on banks
Stream Cover/ Forest Density	Approximately 5% stream cover
Soil Type (Texture/Drainage)	Silty clay

Site 2 was located on Highway 61 south of Memory Road and was characterized by a large cement bridge. The water was murky with a subtle orange colour. The dominant substrate observed was muck and cobbles with boulders visible above the surface of the river. Aquatic and terrestrial vegetation were abundant with many shrubs and herbs present along the banks of the river; horsetails, arrowheads and green algae were present in the water. Wolf tracks were observed under the bridge in the silty clay soil near the side of the river. There were many swallows observed at the site with seven swallows' nests underneath the bridge.

During both site visits, the water velocity was not measurable due to the significant wind influence. At this site the parameters which exceeded the PWQO criteria were the same as observed at Site 1. Phosphorus exceeded the PWQO of 0.030 mg/L on both June 15, 2011 and July 25, 2011 with values of 0.0313 mg/L and 0.053 mg/L, respectively. Aluminum exceeded the PWQO of 0.075 mg/L on June 15, 2011 (0.629 mg/L) and on July 25, 2011 (0.454 mg/L). Copper exceeded PWQO criterion of 0.005 mg/L (interim) with a value of 0.0054 mg/L on June 15, 2011. The PWQO of 0.300 mg/L for iron was exceeded on June 15, 2011 and July 25, 2011 with values of 1.270 mg/L and 1.630 mg/L, respectively. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000

MPN/100 mL with a concentration of 1,100 MPN/100 mL in June and >2,420 MPN/100 mL in July. *E. coli* values were well under the PWQO value of 100 MPN/100 mL for both sample dates.

4.3 Site 3

Table 4.3-1: Location Reference for Site 3

Location Description	On Pardee Road west of Crystal Creek
UTM Coordinates	5329466.42 metres north / 303442.56 metres east
Altitude/Elevation	278.32 metres above sea level

Table 4.3-2: Field Measurements for Site 3

Field Parameter	Date: June 15, 2011 Time: 12:20	Date: July 25, 2011 Time: 14:30
Water Temperature (ºC)	19.81	20.51
Conductivity (µS/cm)	162	147
Turbidity (NTU)	16.0	14.0
Dissolved Oxygen (mg/L)	2.89	8.24
Dissolved Oxygen (%)	32.1	N/A
pH	7.05	7.74
Air Temperature (ºC)	19	25
Channel Width (m)	8.60	8.62
Channel Depth (m)	0.34	0.71
Velocity (m/s)	No measurable flow	No measurable flow

Table 4.3-3: Laboratory Water Quality Results for Site 3

Variable	PWQO Guidelines	Date: June 15, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	163	153
Total Dissolved Solids (mg/L)	N/A	171	136
Turbidity (NTU)	<10% of Natural	20.3	13.3
Ammonia-N, Total (mg/L)	N/A	<0.020	0.028
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	**0.0476**	**0.0603**
Escherichia coli (MPN/100mL)	100	17	**250**
Aluminum (Al) (mg/L)	0.075	**0.938**	**0.824**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	0.00074	0.00069
Copper (Cu) (mg/L)	0.005(interim)	0.0049	0.0050
Iron (Fe) (mg/L)	0.300	**1.680**	**1.890**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.3-4: Flora and Fauna Observed at Site 3

Terrestrial	Trees	Jack pine Balsam fir Balsam poplar Trembling aspen White birch White spruce
	Shrubs	Alder, willow Red-osier dogwood Prickly wild rose
	Herbs	Bush honeysuckle Canada anemone Red clover Orange hawkweed Thistle Wild red raspberry Cow parsnip
	Ferns/Horsetails/ Mosses	Ostrich fern
	Mammals	-
	Birds	-
	Insects	Butterfly Horseflies Deerflies
Aquatic	Plants	Horsetail Green algae
	Animals	-

Table 4.3-5: Physical Features Observed at Site 3

In-stream Material	Horsetails; murky water prevented further in-stream observation
Stream Bed Description	Muck
Bank Stability/Erosion	Partly stable – slope was fairly steep, muddy banks were beginning to be undercut when water levels were higher
Stream Cover/ Forest Density	20% upstream, 30-50% downstream
Soil Type (Texture/Drainage)	Silty clay

Site 3 was located on Pardee Road west of Crystal Creek and was characterized by a thick clay soil with murky brown water flowing slowly due to a beaver dam directly underneath the bridge. The beaver dam beneath the bridge appeared to be affecting the water depth on the upstream and downstream sides of the bridge. The upstream water level was deeper and nearly stagnant compared to the downstream side where the water was shallow with some movement. No measurable velocity could be determined due to the nearly stagnant water. A high water mark was observed on both sides of the exposed banks, indicating a fluctuating water level. Vegetation along the banks was primarily grasses, herbs and shrubs. The soil was silty clay and erosion on the banks of the river on the upstream side of the bridge was apparent. The downstream side did not appear to be eroding; however, vegetation along the banks was abundant which was likely aiding in bank stability. No substrate photo was available for Site 3 due to insufficient water clarity.

The water at Site 3 had a pH of 7.05 (June 15, 2011) and 7.74 (July 25, 2011) and was within the PWQO criterion (6.5 to 8.5). Phosphorus, aluminum, and iron were in exceedance of the PWQO. Phosphorous exceeded the PWQO (0.03mg/L) on June 15, 2011 (0.0476 mg/L) and on July 25, 2011 (0.0603 mg/L). Aluminum exceeded PWQO criterion of 0.075 mg/L on June 15, 2011 (0.938 mg/L) and again on July 25, 2011 (0.824 mg/L). Iron values were 1.680 mg/L (June 15, 2011) and 1.890 mg/L (July 25, 2011) which exceeded the PWQO criterion of 0.300 mg/L. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 1,400 MPN/100 mL in June and >2,420 MPN/100 mL in July. *E. coli* was well under the PWQO of 100 MPN/100 mL on June 15, 2011, which had a value of 17 MPN/100 mL. On July 25, 2011 the value for *E. coli* was 75 MPN/100 mL. All other variables were within the PWQO guidelines.

4.4 Site 4

Table 4.4-1: Location Reference for Site 4

Location Description	Intersection of Highway 595 and Highway 597
UTM Coordinates	5337727.73 metres north / 305999.29 metres east
Altitude/Elevation	333.29 metres above sea level

Table 4.4-2: Field Measurements for Site 4

Field Parameter	Date: June 15, 2011 Time: 10:55	Date: July 25, 2011 Time: 14:00
Water Temperature (ºC)	20.32	20.31
Conductivity (µS/cm)	101	120
Turbidity (NTU)	4.07	2.42
Dissolved Oxygen (mg/L)	2.55	5.92
Dissolved Oxygen (%)	29.2	N/A
pH	6.76	7.18
Air Temperature (ºC)	15	23
Channel Width (m)	9.60	9.93
Channel Depth (m)	0.38	0.65
Velocity (m/s)	0.04	1.2

Table 4.4-3: Laboratory Water Quality Results for Site 4

Variable	PWQO Guidelines	Date: June 15, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	103	125
Total Dissolved Solids (mg/L)	N/A	148	137
Turbidity (NTU)	<10% of Natural	6.68	4.21
Ammonia-N, Total (mg/L)	N/A	<0.020	0.054
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	**0.0391**	**0.0601**
Escherichia coli (MPN/100mL)	100	23	73
Aluminum (Al) (mg/L)	0.075	**0.372**	**0.209**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00052
Copper (Cu) (mg/L)	0.005(interim)	0.0034	0.0020
Iron (Fe) (mg/L)	0.300	**1.210**	**1.630**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.4-4: Flora and Fauna Observed at Site 4

Terrestrial	Trees	Black spruce Jack pine White birch Balsam fir Black ash
	Shrubs	Red-osier dogwood Slender willow Saskatoon berry
	Herbs	Dandelion
	Ferns/Horsetails/ Mosses	-
	Mammals	-
	Birds	Blue jay
	Insects	Water strider Dog ticks
Aquatic	Plants	Green algae Floating burreed
	Animals	Frog Minnows (few)

Table 4.4-5: Physical Features Observed at Site 4

In-stream Material	Bedrock Algae
Stream Bed Description	Bedrock
Bank Stability/Erosion	Stable but steep- lots of vegetation growth on banks
Stream Cover/ Forest Density	No cover
Soil Type (Texture/Drainage)	Bedrock

Site 4 was located at the intersection of Highway 595 and Highway 597 and characterized by a large concrete bridge. The water at this site was clear and shallow, flowing over bedrock and boulders. There were many wood ticks observed at this site during both site visits. There was no apparent erosion as the banks, although steep, consisting of boulders with shrubs and herbs growing abundantly. The velocity of the river at this site increased from the first visit to the second, likely a result of higher water levels due to rain events prior to the second site visit.

The pH at site 4 was within the 6.5 to 8.5 PWQO criterion during both site visits with 6.76 on June 15, 2011 and 7.18 on July 25, 2011. All metals and nutrients as well as *E. coli* were all within their respective PWQO values with the exception of phosphorus, aluminum and iron. Phosphorus exceeded the PWQO criterion (0.030 mg/L) on June 15, 2011 (0.0391 mg/L) and on July 25, 2011 (0.0601 mg/L). Aluminum exceeded the PWQO criterion (0.075 mg/L) on June 15, 2011 (0.372 mg/L) and on July 25, 2011 (0.209 mg/L). The iron PWQO criterion of 0.300 mg/L was exceeded on both June 15, 2011 and July 25, 2011 with values of 1.210 mg/L and 1.630 mg/L, respectively. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 1,100 MPN/100 mL in June and >2,420 MPN/100 mL in July.

4.5 Site 5

Table 4.5-1: Location Reference for Site 5

Location Description	On Highway 595 west of Coulson Road
UTM Coordinates	5337278.80 metres north / 303587.30 metres east
Altitude/Elevation	336.93 metres above sea level

Table 4.5-2: Field Measurements for Site 5

Field Parameter	Date: June 15, 2011 Time: 10:00	Date: July 25, 2011 Time: 13:40
Water Temperature (ºC)	18.38	22.82
Conductivity (µS/cm)	96	114
Turbidity (NTU)	-	2.50
Dissolved Oxygen (mg/L)	2.12	2.74
Dissolved Oxygen (%)	24.7	N/A
pH	6.58	6.66
Air Temperature (ºC)	18	23
Channel Width (m)	No defined width – swamp pools on both sides	No defined width – swamp pools on both sides
Channel Depth (m)	1.82	1.51
Velocity (m/s)	No measurable flow	No measurable flow

Table 4.5-3: Laboratory Water Quality Results for Site 5

Variable	PWQO Guidelines	Date: June 15, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	98.3	115
Total Dissolved Solids (mg/L)	N/A	131	123
Turbidity (NTU)	<10% of Natural	1.74	4.82
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0264	**0.0751**
Escherichia coli (MPN/100mL)	100	1	93
Aluminum (Al) (mg/L)	0.075	**0.950**	**0.116**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	**0.00203**
Copper (Cu) (mg/L)	0.005(interim)	0.0011	<0.0010
Iron (Fe) (mg/L)	0.300	**0.912**	**3.45**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.5-4: Flora and Fauna Observed at Site 5

Terrestrial	Trees	Black spruce Jack pine Balsam fir Tamarack
	Shrubs	Willow Red-osier dogwood Speckled alder Wild gooseberry Prickly wild rose
	Herbs	Red clover White clover Canada anemone Bush honeysuckle Buttercup American vetch Ox-eye daisy Strawberry
	Ferns/Horsetails/ Mosses	-
	Mammals	-
	Birds	Partridge Woodpecker
	Insects	Snails
Aquatic	Plants	Yellow pond lily Horsetails Common cattails Wild calla
	Animals	Wood frogs

Table 4.5-5: Physical Features Observed at Site 5

In-stream Material	Water was too murky for accurate observations
Stream Bed Description	Rock and muck (could not see directly)
Bank Stability/Erosion	No defined bank
Stream Cover/ Forest Density	Approximately 5% cover
Soil Type (Texture/Drainage)	No soil, swamp

Site 5 was located on Highway 595 west of Coulson Road and resembled a marsh. A soil type could not be determined due to the nature of this submerged lowland area. Abundant aquatic vegetation was observed in the nearly stagnant water, consisting of yellow pond lilies, horsetails, common cattails and wild calla. Along the sides of the road there were many shrubs, herbs and grasses. Along the edges of the lowland area there were many black spruce and jack pine observed. The culvert at Site 5 was completely submerged on both the upstream and downstream side of the road during both site visits; therefore, measurements were not completed. Due to the low visibility in the water, a substrate photo was not available at this site.

The parameters which exceeded the PWQO guidelines were phosphorus, aluminum and iron. Phosphorus exceeded the PWQO criterion (0.030 mg/L) on July 25, 2011 (0.0751 mg/L). On June 15, 2011 the phosphorus value was within the PWQO guideline with a value of 0.0264 mg/L. Aluminum exceeded the PWQO criterion (0.075 mg/L) on both

June 15, 2011 and July 25, 2011 with values of 0.950 mg/L and 0.116 mg/L, respectively. Cobalt exceeded the PWQO criterion (0.0009 mg/L) with a concentration of 0.00203 mg/L on July 25, 2011. Iron exceeded the PWQO criterion (0.3 mg/L) on June 15, 2011 with a value of 0.912 mg/L and again on July 25, 2011 with a value of 3.450 mg/L. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of >2,420 MPN/100 mL in July. *E. coli* was within the PWQO guideline of 100 MPN/100 mL with values of 1 MPN/100 mL and 93 MPN/100 mL on June 15, 2011 and July 25, 2011. pH was also within the PWQO guideline of 6.5 to 8.5, with a value of 6.58 on June 15, 2011 and 6.66 on July 25, 2011.

4.6 Site 6

Table 4.6-1: Location Reference for Site 6

Location Description	On Highway 597 west of the Pearson Wetland
UTM Coordinates	5339544.93 metres north / 306445.52 metres east
Altitude/Elevation	340.23 metres above sea level

Table 4.6-2: Field Measurements for Site 6

Field Parameter	Date: June 14, 2011 Time: 14:15	Date: July 25, 2011 Time: 13:25
Water Temperature (ºC)	19.81	21.31
Conductivity (µS/cm)	55	83
Turbidity (NTU)	N/A	1.45
Dissolved Oxygen (mg/L)	2.24	4.95
Dissolved Oxygen (%)	24.6	N/A
pH	7.01	6.74
Air Temperature (ºC)	24	23
Channel Width (m)	21.53	21.08
Channel Depth (m)	1.72	1.96
Velocity (m/s)	No measurable flow	No measurable flow

Table 4.6-3: Laboratory Water Quality Results for Site 6

Variable	PWQO Guidelines	Date: June 14, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	57.0	87.1
Total Dissolved Solids (mg/L)	N/A	106	137
Turbidity (NTU)	<10% of Natural	8.91	4.18
Ammonia-N, Total (mg/L)	N/A	<0.020	0.023
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0297	**0.0327**
Escherichia coli (MPN/100mL)	100	60	16
Aluminum (Al) (mg/L)	0.075	**0.495**	**0.263**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	<0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0024	0.0011
Iron (Fe) (mg/L)	0.300	**0.805**	**1.25**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines

Table 4.6-4: Flora and Fauna Observed at Site 6

Terrestrial	Trees	Black spruce Jack pine Balsam poplar Trembling aspen Tamarack
	Shrubs	Speckled alder Wild red raspberry
	Herbs	Thistle Cow vetch Buttercup Canada anemone Red clover
	Ferns/Horsetails/ Mosses	-
	Mammals	-
	Birds	-
	Insects	Damselflies
Aquatic	Plants	Bulrush Yellow pond lily Floating arrowhead Wild calla Pondweed
	Animals	Minnows

Table 4.6-5: Physical Features Observed at Site 6

In-stream Material	Bulrush Yellow pond lily Floating arrowhead Wild calla Pondweed
Stream Bed Description	Could not see bed
Bank Stability/Erosion	No defined bank
Stream Cover/ Forest Density	Approximately 5% cover
Soil Type (Texture/Drainage)	No soil, swamp

Site 6 was located on Highway 597 west of the Pearson Provincially Significant Wetland. The site had no defined channel boundaries as it was located in a lowland area. No soil type could be determined due to the submersion of the soil. The dominant vegetation observed in the lowland area were bulrushes, yellow pond lilies, floating arrowheads and wild calla. A variety of shrubs and herbs were observed along the edge of the road. The water was relatively deep compared to the other sample sites in the watershed. No measurable velocity could be determined due to the nearly stagnant water. A substrate photo was not possible due to the abundant growth of aquatic vegetation.

At Site 6, phosphorus, aluminum and iron all exceeded the PWQO guidelines. On June 14, 2011 phosphorus was within the PWQO criterion (0.030 mg/L) with a value of 0.0297 mg/L. On July 25, 2011 phosphorus exceeded this criterion with a value of 0.0327 mg/L. Aluminum exceeded the PWQO criterion (0.075 mg/L) on June 14, 2011 with a value of 0.495 mg/L and again on July 25, 2011 with a value of 0.263 mg/L. Iron

exceeded PWQO criterion (0.300 mg/L) on both June 14, 2011 and July 25, 2011 with values of 0.805 mg/L and 1.250 mg/L, respectively. pH was 7.01 on June 14, 2011 and 6.74 on July 25, 2011, which were within the pH PWQO criterion of 6.5 to 8.5. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 2,000 MPN/100 mL in June and >2,420 MPN/100mL in July. *E. coli* was within the PWQO of 100 MPN/100mL with 60 MPN/100mL (June 14, 2011) and 16 MPN/100mL (July 25, 2011).

4.7 Site 7

Table 4.7-1: Location Reference for Site 7

Location Description	On Wamsley Road west of Site 8
UTM Coordinates	5342036.84 metres north / 303835.06 metres east
Altitude/Elevation	338.10 metres above sea level

Table 4.7-2: Field Measurements for Site 7

Field Parameter	Date: June 14, 2011 Time: 13:30	Date: July 25, 2011 Time: 13:00
Water Temperature (ºC)	20.34	20.43
Conductivity (µS/cm)	190	204
Turbidity (NTU)	N/A	3.81
Dissolved Oxygen (mg/L)	2.49	5.06
Dissolved Oxygen (%)	28.6	N/A
pH	6.81	7.35
Air Temperature (ºC)	24	23
Channel Width (m)	10.82	8.90
Channel Depth (m)	1.16	1.18
Velocity (m/s)	No measurable flow	No measurable flow

Table 4.7-3: Laboratory Water Quality Results for Site 7

Variable	PWQO Guidelines	Date: June 14, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	190	209
Total Dissolved Solids (mg/L)	N/A	167	175
Turbidity (NTU)	<10% of Natural	14.6	8.30
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	**0.0575**	**0.0764**
Escherichia coli (MPN/100mL)	100	65	58
Aluminum (Al) (mg/L)	0.075	**0.632**	**0.340**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.00090
Cobalt (Co)-Total (mg/L)	0.0009	0.00056	<0.00050
Copper (Cu) (mg/L)	0.005(interim)	0.0049	0.0035
Iron (Fe) (mg/L)	0.300	**1.53**	**1.59**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.7-4: Flora and Fauna Observed at Site 7

Terrestrial	Trees	Black spruce Balsam poplar Tamarack
	Shrubs	Red-osier dogwood Willow Wild red raspberry
	Herbs	Coe vetch Cow parsnip Canada bluejoint Canada anemone Red clover Evening primrose Thistle
	Ferns/Horsetails/ Mosses	- -
	Mammals	-
	Birds	-
	Insects	Bee (unknown species)
Aquatic	Plants	Green algae Pondweed Horsetail
	Animals	Frog

Table 4.7-5: Physical Features Observed at Site 7

In-stream Material	Horsetails Pondweed Murky water
Stream Bed Description	Silt Sand Muck
Bank Stability/Erosion	Stable - no significant bank erosion
Stream Cover/ Forest Density	Approximately 0-5% along banks
Soil Type (Texture/Drainage)	Silty sand

Site 7 was located on Wamsley Road west of Site 8. This site had a culvert installed underneath the road. This culvert was relatively large compared to the water level present and the water level in the past as could be seen by the rust line inside the culvert. There was no measurable velocity present at the site; however, water movement was present as a result of wind influence. There was no significant bank erosion observed; however, a high water mark was noticeable in the vegetation. Rip rap was placed on both sides of the road when the culvert was installed. There was a clear definition to the channel width which was meandering on both sides of the culvert. There was fairly little (0-5 percent) stream cover. The stream cover came from shrubs which were growing tall enough to cover a small portion of the river.

All the parameters tested for were within their PWQO guidelines, excluding phosphorus, aluminum and iron. pH was 6.81 on June 14, 2011 and 7.35 on July 25, 2011, which were both within the guideline of 6.5 to 8.5. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100 mL with a concentration of 1,400 MPN/100 mL in

June and >2,420 MPN/100mL in July. *E. coli* was within the PWQO criterion of 100 MPN/100mL during both sampling periods with values of 65 MPN/100mL (June 14, 2011) and 58 MPN/100mL (July 25, 2011). Phosphorus exceeded the PWQO criterion of 0.030 mg/L on June 14, 2011 with a value of 0.0575 mg/L and again on July 25, 2011 with a value of 0.0764 mg/L. Aluminum exceeded PWQO criterion of 0.075 mg/L on June 14, 2011 (0.632 mg/L) and on July 25, 2011 (0.340 mg/L). Iron exceeded PWQO criterion of 0.300 mg/L on June 14, 2011 (1.530 mg/L) and again on July 25, 2011 (1.590 mg/L).

4.8 Site 8

Table 4.8-1: Location Reference for Site 8

Location Description	On Wamsley Road adjacent to northern part of the Pine River
UTM Coordinates	5341684.49 metres north / 301560.78 metres east
Altitude/Elevation	359.71 metres above sea level

Table 4.8-2: Field Measurements for Site 8

Field Parameter	Date: June 14, 2011 Time: 12:45	Date: July 25, 2011 Time: 11:40
Water Temperature (ºC)	17.40	19.26
Conductivity (µS/cm)	90	136
Turbidity (NTU)	N/A	2.18
Dissolved Oxygen (mg/L)	1.92	0.45
Dissolved Oxygen (%)	20.5	N/A
pH	6.48	6.52
Air Temperature (ºC)	24	20
Channel Width (m)	No defined width – swamp pools on both sides	No defined width – swamp pools on both sides
Channel Depth (m)	0.84	1.16
Velocity (m/s)	No measurable flow	No measurable flow

Table 4.8-3: Laboratory Water Quality Results for Site 8

Variable	PWQO Guidelines	Date: June 14, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	91.7	141
Total Dissolved Solids (mg/L)	N/A	126	205
Turbidity (NTU)	<10% of Natural	0.76	5.86
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.015	**0.0651**
Escherichia coli (MPN/100mL)	100	58	**690**
Aluminum (Al) (mg/L)	0.075	**0.090**	**0.101**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	**0.00199**
Copper (Cu) (mg/L)	0.005(interim)	0.0016	<0.0010
Iron (Fe) (mg/L)	0.300	**0.596**	**4.45**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.8-4: Flora and Fauna Observed at Site 8

Terrestrial	Trees	Black spruce Balsam fir Eastern white cedar Tamarack
	Shrubs	Speckled alder Red-osier dogwood Wild red raspberry Prickly wild rose
	Herbs	Northern blue flag
	Ferns/Horsetails/ Mosses	-
	Mammals	-
	Birds	-
	Insects	Dragonflies Leeches
Aquatic	Plants	Common cattails Common reed Green algae Fragrant white water lily
	Animals	-

Table 4.8-5: Physical Features Observed at Site 8

In-stream Material	Cat tails Common reed Fragrant white water lily
Stream Bed Description	Muck Organic material
Bank Stability/Erosion	No defined bank
Stream Cover/ Forest Density	Approximately 0-5% cover
Soil Type (Texture/Drainage)	No soil sample, middle of a swamp

Site 8 was located on Wamsley Road adjacent to the northern part of the Pine River. This site was distinguished by a marsh which surrounded the road and culvert, with no defined banks observed on either side. There were aquatic plants growing in the water which included cat tails, common reed and fragrant white water lily. Dead trees scattered throughout the marsh were observed. There was little stream cover at this site. The little amount of stream cover came from the dead trees which were present in the water which covered a small portion of the river. The majority of the trees were situated further back from the river on terrestrial soil and therefore did not greatly affect the stream cover. A soil type could not be identified due to the lowland area submerged by water. Water at this site was almost completely stagnant (except for minimal wind influence on the surface) and velocity was therefore not determined.

Water quality exceedances at Site 8 were similar to the previous sites. The pH was within the PWQO guidelines of 6.5 to 8.5 with values of 6.48 on June 14, 2011 and 6.52 on July 25, 2011. Phosphorus only exceeded the PWQO criterion (0.030 mg/L) on July 25, 2011 with a level of 0.0651 mg/L. On June 14, 2011 it remained within the PWQO with a value of 0.015 mg/L. Aluminum exceeded PWQO criterion of 0.075 mg/L on June 14, 2011 (0.090 mg/L) and on July 25, 2011 (0.101 mg/L). Cobalt exceeded the PWQO of

0.0009 mg/L with a concentration of 0.00199 mg/L on July 25, 2011. Iron exceeded the PWQO (0.300 mg/L) on June 14, 2011 (0.596 mg/L) and again on July 25, 2011 (4.450 mg/L). On June 14, 2011 the total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100mL with a concentration of >2,420 MPN/100mL in June and July 2011. There was a significant difference in the amount of *E. coli* present between June and July: 58 MPN/100mL (June 14, 2011) and 690 MPN/100mL (July 25, 2011). This was the highest level of *E. coli* taken at any of the sampling sites, exceeded the PWQO of 100 MNP/100mL.

4.9 Site 9

Table 4.9-1: Location Reference for Site 9

Location Description	On Lankinen Road
UTM Coordinates	5341684.49 metres north / 301560.78 metres east
Altitude/Elevation	359.04 metres above sea level

Table 4.9-2: Field Measurements for Site 9

Field Parameter	Date: June 14, 2011 Time: 11:40	Date: July 25, 2011 Time: 11:20
Water Temperature (ºC)	18.80	19.31
Conductivity (µS/cm)	114	97
Turbidity (NTU)	-	1.38
Dissolved Oxygen (mg/L)	2.38	4.14
Dissolved Oxygen (%)	26.1	N/A
pH	6.63	6.83
Air Temperature (ºC)	22	16
Channel Width (m)	10.45	10.55
Channel Depth (m)	3.61	2.04
Velocity (m/s)	No measurable flow	No measurable flow

Table 4.9-3: Laboratory Water Quality Results for Site 9

Variable	PWQO Guidelines	Date: June 14, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	96.9	104
Total Dissolved Solids (mg/L)	N/A	115	132
Turbidity (NTU)	<10% of Natural	5.52	3.95
Ammonia-N, Total (mg/L)	N/A	<0.020	0.030
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	**0.040**	**0.0485**
Escherichia coli (MPN/100mL)	100	81	100
Aluminum (Al) (mg/L)	0.075	**0.277**	**0.247**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	<0.00050	0.00054
Copper (Cu) (mg/L)	0.005(interim)	0.0030	0.0030
Iron (Fe) (mg/L)	0.300	**1.05**	**1.97**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.9-4: Flora and Fauna Observed at Site 9

Terrestrial	Trees	Black spruce White spruce Jack pine Trembling aspen
	Shrubs	Red-osier dogwood Willow Prickly wild rose
	Herbs	Canada anemone Cow vetch Yarrow
	Ferns/Horsetails/ Mosses	-
	Mammals	-
	Birds	Woodpecker Geese
	Insects	Butterflies
Aquatic	Plants	Yellow lilies Green algae
	Animals	-

Table 4.9-5: Physical Features Observed at Site 9

In-stream Material	Yellow lily Boulders Cobbles
Stream Bed Description	Muck Cobbles Boulders
Bank Stability/Erosion	Stable
Stream Cover/ Forest Density	Approximately 15-20% cover
Soil Type (Texture/Drainage)	Clay loam

Site 9 was located on Lankinen Road near two residences. There was shrub growth right to the water's edge which made it difficult for photo documentation and sampling. There did not seem to be significant erosion present; however, any erosion present would have been difficult to see due to the abundant shrub growth covering the banks. There was a cleared portion of the bank on the upstream side of the bridge which was located on private property. Site 9 had a fairly deep channel with no measurable flow. There was approximately 15-20 percent stream cover from the shrub growth along the both sides of the water. Stream cover was mainly located on the downstream side of the bridge and was covered by the trees and shrubs present in the area. The soil type at this site was a clay loam.

Phosphorus, aluminum and iron exceeded PWQO criteria at Site 9. Phosphorus levels exceeded the PWQO criterion (0.03 mg/L) on June 14, 2011 (0.040 mg/L) and on July 25, 2011 (0.0485 mg/L). Aluminum exceeded the PWQO of 0.075 mg/L on both June 14, 2011 and July 25, 2011 with values of 0.277 mg/L and 0.247 mg/L, respectively. Iron exceeded the PWQO criterion (0.300 mg/L) on June 14, 2011 (1.05 mg/L) and on July 25, 2011 (1.97 mg/L). The pH was within the PWQO guideline of 6.5 to 8.5, with levels of 6.63 (June 14, 2011) and 6.83 (July 25, 2011). Total coliforms exceeded the

pre-1994 PWQO guideline of 1,000 MPN/100mL with a concentration of 2,400 MPN/100mL in June and >2,420 MPN/100mL in July. *E. coli* did not exceed the PWQO guideline of 100 MPN/100 mL on June 14, 2011 (81 MPN/100mL) or on July 25, 2011 (100 MPN/100mL).

4.10 Site 10

Table 4.10-1: Location Reference for Site 10

Location Description	On Falling Snow Road
UTM Coordinates	5338960.53 metres north / 291645.03 metres east
Altitude/Elevation	364.22 metres above sea level

Table 4.10-2: Field Measurements for Site 10

Field Parameter	Date: June 14, 2011 Time: 10:30	Date: July 25, 2011 Time: 10: 45
Water Temperature (ºC)	22.3	20.32
Conductivity (µS/cm)	97	106
Turbidity (NTU)	N/A	3.16
Dissolved Oxygen (mg/L)	2.89	1.21
Dissolved Oxygen (%)	31.8	N/A
pH	7.16	6.68
Air Temperature (ºC)	22	16
Channel Width (m)	4.74	5.13
Channel Depth (m)	0.51	0.60
Velocity (m/s)	No measurable flow	No measurable flow

Table 4.10-3: Laboratory Water Quality Results for Site 10

Variable	PWQO Guidelines	Date: June 14, 2011	Date: July 25, 2011
Conductivity (µS/cm)	N/A	96.4	110
Total Dissolved Solids (mg/L)	N/A	103	117
Turbidity (NTU)	<10% of Natural	3.22	6.93
Ammonia-N, Total (mg/L)	N/A	<0.020	<0.020
Nitrate-N (NO_3-N) (mg/L)	N/A	<0.030	<0.030
Nitrite-N (NO_2-N) (mg/L)	N/A	<0.020	<0.020
Phosphorus (P), Total (mg/L)	0.030	0.0249	**0.0476**
Escherichia coli (MPN/100mL)	100	9	**0.410**
Aluminum (Al) (mg/L)	0.075	**0.100**	**0.144**
Cadmium (Cd) (mg/L)	0.0001(interim)	<0.000090	<0.000090
Cobalt (Co)-Total (mg/L)	0.0009	0.00061	**0.00096**
Copper (Cu) (mg/L)	0.005(interim)	<0.0010	<0.0010
Iron (Fe) (mg/L)	0.300	**1.510**	**3.020**
Lead (Pb) (mg/L)	0.001(interim)	<0.0010	<0.0010

Bold indicates exceedance above PWQO guidelines.

Table 4.10-4: Flora and Fauna Observed at Site 10

Terrestrial	Trees	White spruce Trembling aspen Balsam poplar Jack pine White pine
	Shrubs	Wild red raspberry Prickly wild rose Red-osier dogwood Green alder,
	Herbs	Ox-eye daisy Thistle Reed canary grass Wild strawberry Skunk currant Canada anemone
	Ferns/Horsetails/ Mosses	-
	Mammals	Groundhog Eastern chipmunk Fox Deer Beaver dam under bridge and upstream
	Birds	Geese Mallard
	Insects	Water striders Deerflies Yellow butterfly Dragonflies
Aquatic	Plants	Green algae Yellow lily Common cattail
	Animals	Painted turtle

Table 4.10-5: Physical Features Observed at Site 10

In-stream Material	Yellow lilies Common cattails Murky water Beaver dam upstream
Stream Bed Description	Muck
Bank Stability/Erosion	High watermark visible, banks covered with grasses
Stream Cover/ Forest Density	Approximately 50% upstream, 0-5% downstream
Soil Type (Texture/Drainage)	Silty clay

Site 10 was located on Falling Snow Road and was characterized by a beaver dam which was located on the upstream side of the bridge. There were abundant common cattails on the downstream side of the bridge. There was relatively little stream cover downstream; however, shade on the upstream side of the bridge was approximately 50 percent from trees, shrubs and aquatic plants. The downstream side of the bridge was very narrow compared to the upstream side. The upstream side of the bridge was an open area with significantly less shrub and tree growth close to the water's edge. Grasses and herbs

were the dominant plant species on the upstream side of the bridge. Bank erosion was observed on the upstream side of the bridge, likely due to the presence of the beaver dam.

On July 25, 2011, observed *E. coli* was the second highest recorded during the sampling periods, with a level of 410 MPN/100mL, which exceeded the PWQO criterion of 100 MPN/100mL. The *E. coli* value on June 14, 2011 was within the criterion with a value of 9 MPN/100mL. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 MPN/100mL with a concentration of >2,420 in July 2011. The pH values recorded were within the pH PWQO criteria of 6.5 to 8.5; 7.16 (June 14, 2011) and 6.68 (July 25, 2011). Phosphorus did not exceed the PWQO guideline of 0.030 mg/L on June 14, 2011 (0.0249 mg/L); however, exceeded the PWQO criteria on July 25, 2011 (0.0476 mg/L). Aluminum exceeded the PWQO criterion (0.075 mg/L) on June 14, 2011 (0.100 mg/L) and on July 25, 2011 (0.144 mg/L). Iron exceeded the PWQO criterion (0.3 mg/L) on June 14, 2011 (1.510 mg/L) and on July 25, 2011 (3.020 mg/L). Cobalt exceeded the PWQO of 0.0009 mg/L with a concentration of 0.00096 mg/L on July 25, 2011.

5 Discussion

The highest point of elevation sampled in the Pine River Watershed was Site 10 which was 364.22 metres above mean sea level. From here, elevation gradually decreased from site to site. Site 1 was the lowest elevation at 186.43 metres above mean sea level. The difference between the Site 10 and Site 1 was 177.79 metres above mean sea level. Elevation plays an important role in direction of water drainage and steam velocity. The Pine River watershed has an average slope of 0.69 percent.

Water levels in seven of the ten sites displayed an increase in water depth from the first sampling event to the second. The largest increase occurred at Site 1, where the depth increased 0.42 metres. Three of the ten sites displayed a decrease in water depth from the first sampling period to the second. The largest decrease occurred at Site 9 where the depth decreased 1.57 metres. Depths throughout the watershed ranged from 0.22 metres to 3.61 metres. Average stream velocity was 0.57 metres per second. This average was calculated from Site 1 and Site 4 which were the only sites with measurable flow. Velocity was not measurable at the other eight sites due to either a lack of flow or wind influence.

On June 14, 2011 the average water temperature was 19.73 degrees Celsius with an average air temperature of 23.2 degrees Celsius. Conditions were sunny with minimal cloud cover. On June 15, 2011 the average water temperature was 20.00 degrees Celsius with average air temperature of 18.25 degrees Celsius. Conditions were again sunny with minimal cloud cover. On June 16, 2011 only one site was sampled, with a water temperature of 18.96 degrees Celsius and an air temperature of 16 degrees Celsius. Weather conditions were sunny and clear. On July 25, 2011 an average water temperature of 20.80 degrees Celsius with an average air temperature of 21.7 degrees Celsius which exceeded the average monthly temperatures for Thunder Bay from the years 1971 to 2000. The average monthly temperature for the month of June from the years 1971-2000 was 14 degrees Celsius and the average monthly temperature for the month of July from the years 1971-2000 was 17.6 degrees Celsius.

The pH for all sites during both sampling periods fell within the PWQO criteria of 6.5 to 8.5 for healthy aquatic life. During the study period pH ranged from 6.48 to 8.18.

Due to equipment malfunctions, dissolved oxygen percentage results could not be taken into consideration for this report. The results for dissolved oxygen in milligrams per litre, however, are reliable and can be used for comparison in future studies. The range of values for dissolved oxygen were 0.45 mg/L at Site 8 (July 25, 2011) and 8.75 mg/L at Site 2 (July 25, 2011).

Total dissolved solids (TDS) at Site 10 were the lowest amount from both sampling periods with an average of 110 mg/L between the two months. The highest level of total dissolved solids during the June sampling was 171 mg/L at Site 3 and during the July sampling was 205 mg/L at Site 8. On average the total dissolved solids were fairly

similar between all ten sampling sites during both sampling periods. The June average was 138 mg/L and the average for July was 143.1 mg/L. Since TDS is highly variable due to underlying geology, the only objective in place is <500 mg/L for drinking water published in the *Canadian Drinking Water Quality* guidelines to prevent unpalatable tastes and excessive scaling in water pipes and boilers (Health Canada, 1996).

Observed conductivity concentrations were highest at Site 7 (204 µS/cm) on July 25, 2011 and lowest (55 µS/cm) at Site 6 on June 14, 2011. Conductivity measurements displayed a difference of 149 µS/cm.

Turbidity in the Pine River watershed ranged from 0.76 to 21.4 NTU. All sites were well below the *Canadian Recreational Water Quality* drinking guidelines of 50 NTU (Health Canada, 1992). The lowest turbidity was recorded on June 14, 2011 at Site 8 with 0.76 NTU and the highest from Site 3 with 21.4 NTU on July 25, 2011.

Nitrogen was analyzed in three biologically-usable forms: nitrate (NO_3), nitrite (NO_2), and ammonia (NH_3). All three forms of nitrogen in the Pine River watershed were below the maximum concentrations published in the PWQO and CCREM guidelines. All nitrate concentrations at the sampled sites were <0.030 mg/L (with a CCREM criterion of 2.900 mg/L). All nitrite concentrations at the sampled sites were <0.020 mg/L (with a CCREM criterion of 0.060 mg/L). Total ammonia ranged from <0.020 mg/L to 0.054 mg/L. Total ammonia does not have a singular criterion because its speciation between the un-ionized (NH_3) and (NH_4^+) forms is dependent on pH and temperature parameters. Total ammonia concentrations reported by the laboratory were converted into un-ionized (NH_3) ammonia concentrations using the conversion table provided in the PWQO guidelines. All un-ionized ammonia concentrations in the Pine River watershed were <0.0003 mg/L (with a PWQO criterion of 0.020 mg/L). These guidelines were put in place for protection from direct toxic effects and do not consider indirect effects due to eutrophication (large algae blooms).

There were four occasions in which total phosphorus did not exceed the PWQO criterion of 0.030 mg/L for rivers/streams. These sites were 5, 6, 8, and 10 and were all during the June sampling month. Phosphorus exceeded the PWQO criterion at every site on every other occasion with a range of 0.0319 mg/L at Site 2 on June 15 to 0.0764 at Site 7 on July 25. The high concentrations of phosphorous were likely due to natural causes. There was no evidence of nitrogen or phosphorus levels altering water quality through excessive algal/plant growth and no explicit evidence of agricultural nutrient loading into the Pine River watershed during June and July 2011.

PWQOs recommend *E. coli* bacteria levels below 100 counts per 100 mL of water for safe swimming and bathing. During the June sampling, all sites were below the PWQO criterion. On July 25, 2011, Sites 3, 8 and 10 were above the criterion with 250, 690 and 410 counts per 100 mL of water, respectively. Site 9 was exactly 100 counts per 100 mL. *E. coli* is present in the intestines of warm-blooded animals such as humans, livestock and wildlife, and is indicative of recent fecal contamination. Many studies have shown

that the presence of farm animals near a stream can significantly influence bacteria counts. *E. coli* could also potentially enter the watershed from leaking residential septic tanks and/or from manure. The presence of *E. coli* can cause skin and eye irritation and when ingested can cause severe gastro-intestinal disorders. One such strain is *E. coli* O157:H7, which is found in the digestive tract of cattle.

Total coliforms exceeded the pre-1994 PWQO criterion (1,000 MPN/100 mL) at every site in 2011 for both sampling months with the exception of Site 5 and Site 10 in June 2011 with counts of 920 and 340. No current PWQO exists for total coliforms. The total coliform concentrations in 2011 ranged from 340 to greater than 2,400 MPN/100 mL for the watershed.

All sites were above the PWQO criterion of 0.075 mg/L for aluminum during both sampling months. During the sampling period, aluminum concentrations ranged from 0.090 mg/L at Site 8 on June 14, 2011 to 0.938 mg/L at Site 3 on June 15, 2011. The average concentration of aluminum was 0.432 mg/L for all sites during the June sampling month and 0.3258 mg/L during the July sampling month.

All sites were above the PWQO criterion of 0.300 mg/L for iron during both the sampling months of June and July, 2011. Iron concentrations ranged between 0.596 mg/L at Site 8 on June 14 and 4.45 mg/L at Site 8 on July 25 with an average concentration of 1.726 mg/L for the sampling season. High aluminum and iron levels may be caused by the underlying geology. These metals may naturally dissociate from mineral-rich rocks. The exceedances are likely a result of natural sources.

On July 25, 2011 cobalt exceeded the PWQO of 0.0009 mg/L at Site 5 (0.00203 mg/L), Site 8 (0.00199 mg/L) and at Site 10 (0.00096 mg/L).

Copper was above the PWQO of 0.005 mg/L at Sites 1 and 2. On June 16, 2011 copper concentrations were 0.0059 mg/L at Site 1 and on June 15, 2011 were 0.0054 mg/L at Site 2. Copper concentrations were exactly 0.0050 mg/L at Site 3 on July 25, 2011. Copper concentrations did not exceed PWQO criterion of 0.005 mg/L (interim) during the month of July 2011 at any site. High copper levels could be a result of natural sources as copper occurs in nature as a metal or an ore (sulphide, oxide or carbonate minerals in rock). Copper is also used in pesticide formulation and as an anti-fungal, anti-microbial agent for treated wood.

Lead concentrations were found to be below the PWQO criterion of 0.001 mg/L at each site. Lead can occur naturally from the weathering of rock ores or from human sources such as historical atmospheric emissions from leaded gasoline, batteries, alloys, pigments, chemicals, and solid and liquid waste discharge (usually from landfills). There was no evidence at the ten sites sampled that any of these factors significantly affected the concentrations of lead in the watershed.

Forest composition was characteristic of the Boreal forest region. Similar tree and shrub species were identified at each sampling site. The most common tree species observed included black spruce, balsam fir, trembling aspen, white birch and jack pine. The shrub layer was dominated by red-osier dogwood and a variety of willow species. Dogwood and willow are characteristic of wetland/riparian zone habitat and are most valuable in controlling stream bank erosion. The herb layer was dominated by species characteristic of disturbed areas (such as roadsides and ditches), open fields, wet meadows, stream banks or marshes. The most common herb species observed were goldenrod, cow vetch, red clover and common yarrow.

The most common observed aquatic species included yellow pond lily, cattail, common reed, pondweed, horsetails, wildcalla, bulrushes, floating arrowhead and algae. The presence of these aquatic species are good indicators of healthy water quality, although more data should be collected on the benthic macroinvertebrate community since its composition changes in response to ecosystem stress faster than other members of the aquatic community. Fish populations were not observed, although this does not mean they were not present as physical water quality parameters are healthy enough to support fish populations. Lack of any observed fish could be due to the fact that numerous beaver dams were present which cut off flow of water and pathways for fish to migrate.

The Pine River watershed had a diverse population of birds. The most common species identified included Canadian geese, mallards, woodpecker, swallows and blue jays. There was also the sighting of a belted kingfisher which may suggest the Pine River watershed is an important habitat for nesting water birds.

Overall, the stream banks documented within the Pine River watershed were stable. The silty clay loam did not display significant erosion, as it is a compacting type of soil which aids in river bank stability. Three of the ten sites did not have defined channels and therefore had minimal potential for erosion. Site 3 had the greatest potential for erosion and unstable banks as the beginning of an undercut was observed along the steepening sides. Although there were a few other steep banked sites, abundant vegetation was observed, aiding in slope stability which decreases the risk of significant erosion in the near future.

Bridges assessed within the watershed appeared to be in good condition and were well maintained. All the bridges appeared to have appropriate fill to protect against erosion which included cobbles, boulders and other types of rock fill. If the bridge did not use rock fill as a stabilizer, a wooden retaining wall was present on the banks at each end of the bridge. With the exception of Bridge 6 and Bridge 2, all bridges looked to be in excellent condition. The wooden planks on Bridge 6 were beginning to splinter and the wood appeared to be deteriorating. Bridge 2 was located in an area where high water levels were causing bank erosion, which could cause the bridge supports to become unstable over time. Regular maintenance of these two bridges should be considered. There were three culverts assessed during June and July 2011. Culverts 2 and 3 were in excellent condition and evidence from the rust line indicated they are able to sustain the

fluctuating water levels flowing through them. Culvert 1, although not blocked by any observable debris, was completely submerged on the upstream and downstream side of the road. If water levels were to increase, the road would likely be submerged due to the culvert being undersized and not able to allow the high volume of water to flow through it. Culvert 1 should be a point of interest and should be monitored.

6 Conclusion

The overall health of the Pine River watershed was in excellent condition at the time of sampling. The majority of water quality parameters, with the exception of those that are naturally affected by the geology of the area, were relatively low and at acceptable levels based on the PWQO criterion. The flora and fauna indicated that the watershed was a sustainable habitat for many forms of life. The bridges and culverts, with the exception of culvert 1, were in very stable condition. There did not appear to be any human activities (industrial or agricultural) significantly affecting the watershed.

7 Recommendations

Upon completion of the 2011 Pine River Watershed Assessment, the following recommendations have been made for consideration:

- Staff and funding permitting it is recommended that an update to the 2011 Pine River Watershed Assessment be completed in the next five to ten years.
- Benthic analysis indicates water quality over an extended period of time and should be considered for future watershed assessments.
- Additional sampling should be conducted in the spring to observe the water quality differences between high and low flow seasons
- Bridges 2 and 6 should be regularly monitored to ensure bank erosion and degrading wood does not compromise the structure by the owner of the structure.
- Culvert 1 should be regularly monitored to study its capacity to move water during high and low periods of water flow by the owner of the structure.

A copy of this report should be provided to the Township of Gillies and the Municipality of Neebing for reference purposes. The Report should be kept on file at the LRCA Administration Office for review by interested parties.

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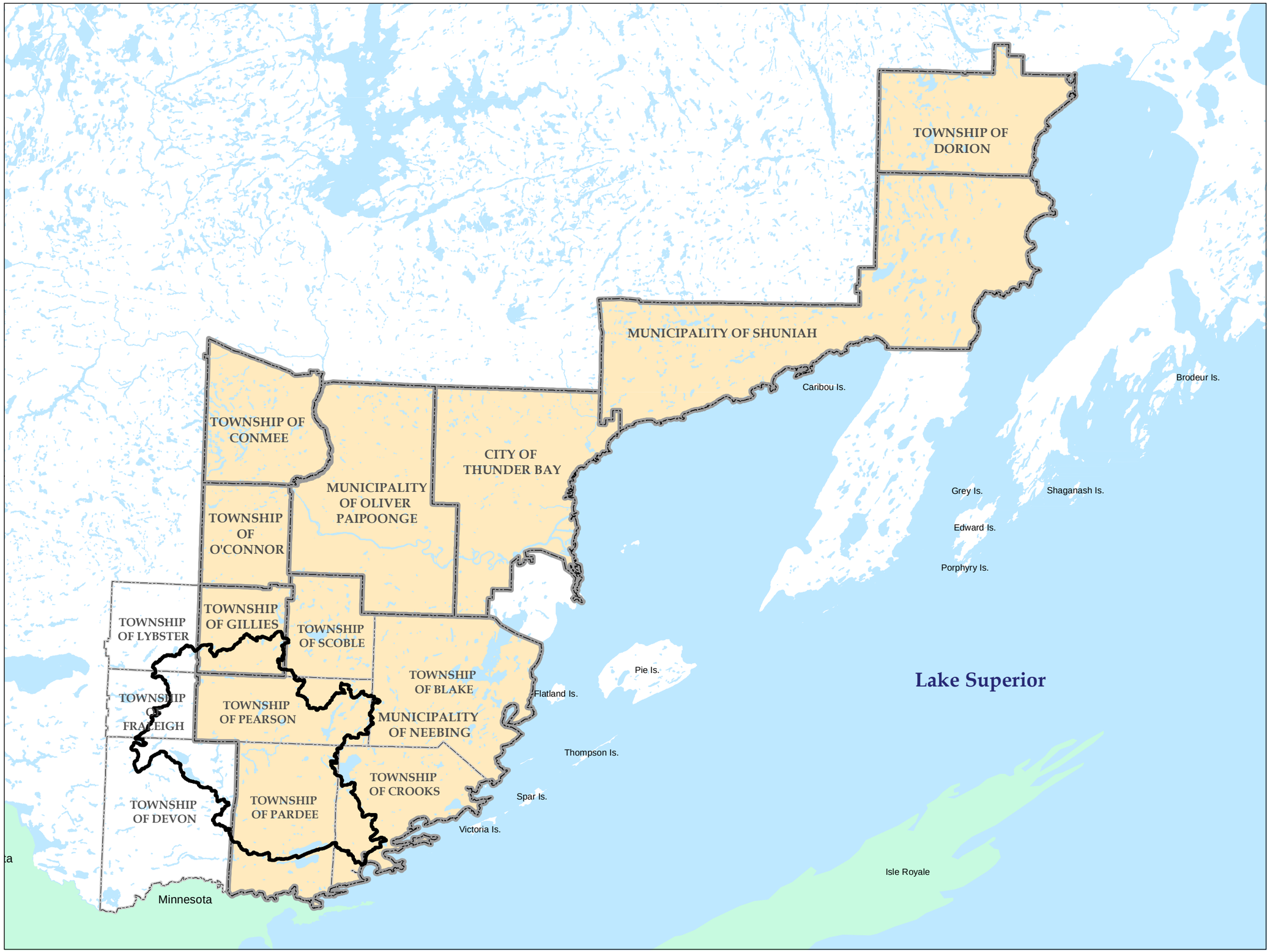
MAPS

Lakehead Region Conservation Authority
Conserve Today...For A Better Tomorrow

Pine River Watershed

M-1: Key Plan



N

Legend

- Watershed
- Municipal Boundary
- Township Boundary
- LRCA Jurisdiction Boundary
- Water Body

0 10 20 km

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Date: August, 2011

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Pine River Watershed

M-2: Site Plan

N

Legend

- Sampling Sites
- Pine River Watershed
- Township Boundary
- TBFN Reserve

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland
- Provincially Significant Wetland

0 1 2 3 4 5 km

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Pine River Watershed

M-3: Topography

N

Legend

- Pine River Watershed
- Township Boundary

Contour Lines

- 10m Contour Intervals
- 50m Contour Intervals

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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Pine River Watershed

M-4: Bedrock Geology

N

Legend

- Pine River Watershed
- Township Boundary

Surficial Points Features

- QUARRY/MINE WORKINGS
- SAND/GRAVEL PIT
- TALUS

Bedrock Formation

PALEOPROTEROZOIC

- 22a, Sedimentary rocks

MESOPROTEROZOIC

- 31c, Mafic and related intrusive rocks (Keweenawan age)
- 31a, Mafic and related intrusive rocks (Keweenawan age)

NEO-TO MESOARCHEAN Intrusive Rocks

- 15, Massive granodiorite to granite

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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Pine River Watershed

M-5: Surficial Geology

N

Legend

- Pine River Watershed
- Township Boundary

Surficial Points Features

- QUARRY/MINE WORKINGS
- SAND/GRAVEL PIT
- TALUS

Surficial Geology

- Moraine
- Esker/Kame/Outwash plain
- Glaciolacustrine plain
- Alluvial
- Slope/Talus pile
- Organics
- Bedrock

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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Pine River Watershed

M-6: Soils

N

Legend

- Pine River Watershed
- Township Boundary

Thunder Bay Soils

- ARTHUR (A)
- FORMAL (F)
- JARVIS RIVER (J)
- LAPPE (L)
- MARSH (Ma)
- MUCK (M)
- NEEBING (Ne)
- NOLALU (N)
- ORGANICS - CABETT (Cb)
- ORGANICS - PENASSEN (Pn)
- ORGANICS - WOLF RIVER (Wf)
- OSKONDOGA (O)
- ROCKLAND (R)
- STRAWBERRY (S)

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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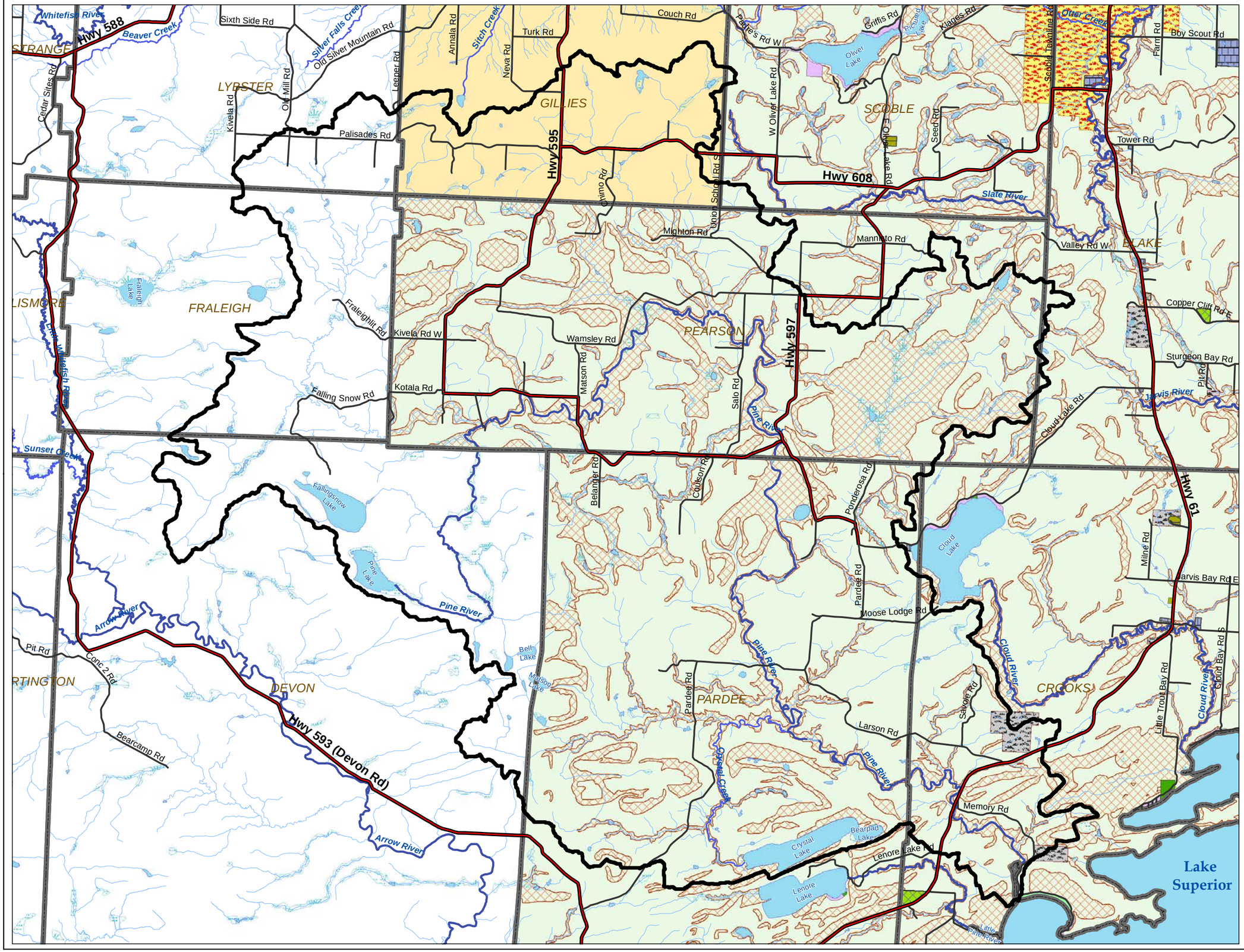

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Pine River Watershed

M-7: Zoning

N

Legend

- Pine River Watershed
- Township Boundary

Municipality of Neebing Zoning

- A - Agricultural Zone
- C1 - General Commercial Zone
- C2 - Recreation Commercial Zone
- D - Disposable Industrial Zone
- E - Extractive Industrial Zone
- I - Institutional Zone
- M1 - Light Industrial Zone
- OS - Open Space Zone
- S1 - Recreation 1 Zone
- S2 - Recreation 2 Zone
- S3 - Remote Recreation 3 Zone
- S4 - Recreation Back Lot 4
- WR - Watershed Reserve Zone
- UL - Use Limitation Zone
- Rural Zone

Township of Gillies Zoning

- Rural Zone

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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Pine River Watershed

M-8: Land Ownership

N

Legend

- Pine River Watershed
- Township Boundary
- LRCA Owned Lands

Land Ownership

- Crown Land
- Federal Land Indian Reserve
- Private Land

Roads

- Highway
- Road

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland

0 1 2 3 4 5 km

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Date: August, 2011

Lakehead Region Conservation Authority
Conserve Today...For A Better Tomorrow

Pine River Watershed

M-9: Regulated Area

N

Legend

- Approximate Regulated Area
- Pine River Watershed
- LRCA Owned Lands
- Township Boundary
- LRCA Jurisdiction Boundary

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland
- Provincially Significant Wetland

0 1 2 3 4 5 km

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Date: August, 2011

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Pine River Watershed

M-10: Bridge & Culvert Sites

N

Legend

- Bridge (B)
- Culvert (C)
- Confluence
- Pine River Watershed
- Township Boundary

Permanent Watercourse

- River
- Creek
- Stream

Drainage

- Waterbody
- Wetland
- Provincially Significant Wetland

0 1 2 3 4 5 km

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Datum: NAD 83
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FIGURES

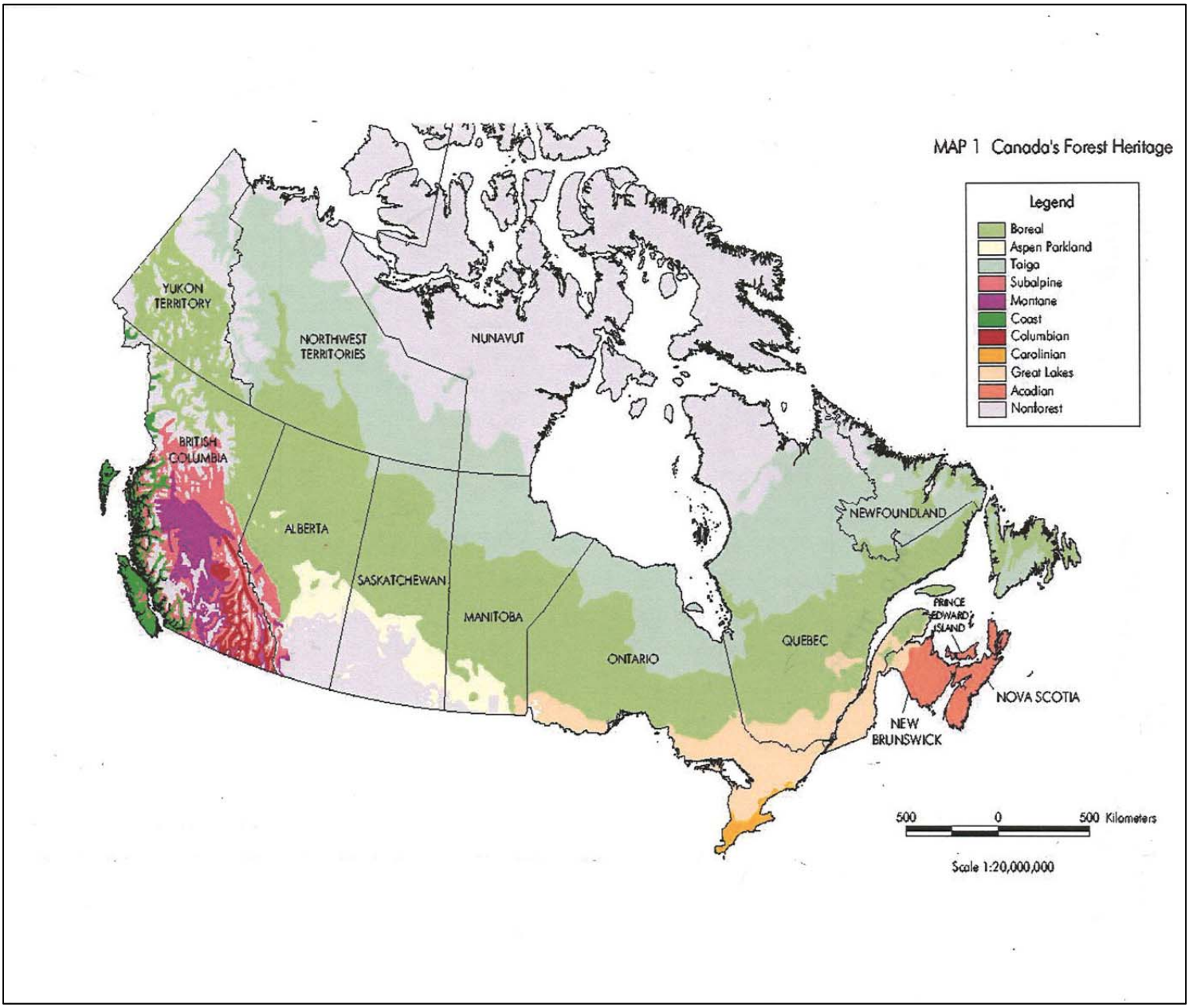

Figure 1: Canada's Forest Heritage (Global Forest Watch, 1977)

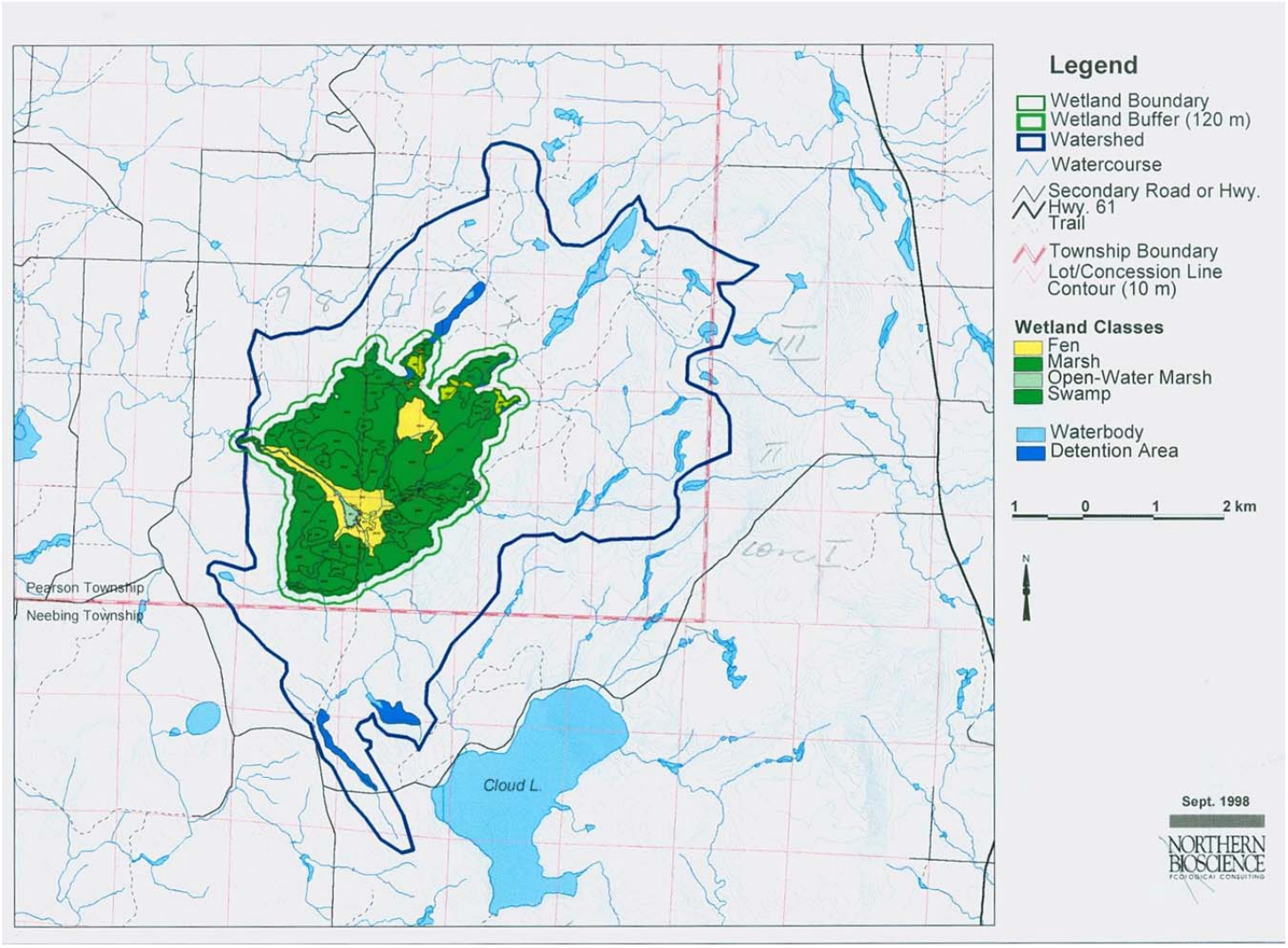

Figure 2: General Location of Pearson Township Wetland (Foster, R., Harris, A, 1988)

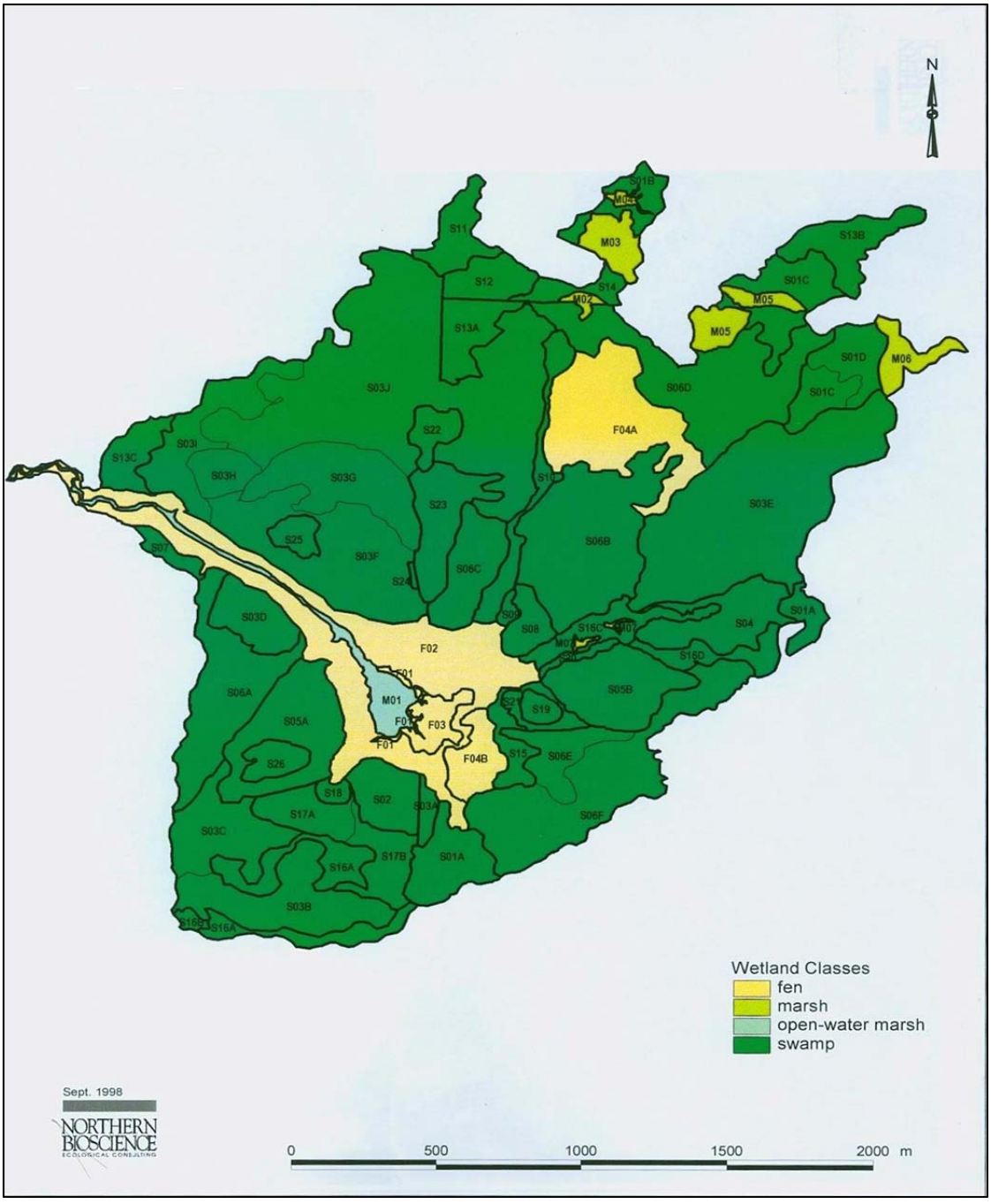

Figure 3: Pearson Township Wetland Vegetation Community Map (Foster, R., Harris, A, 1988)

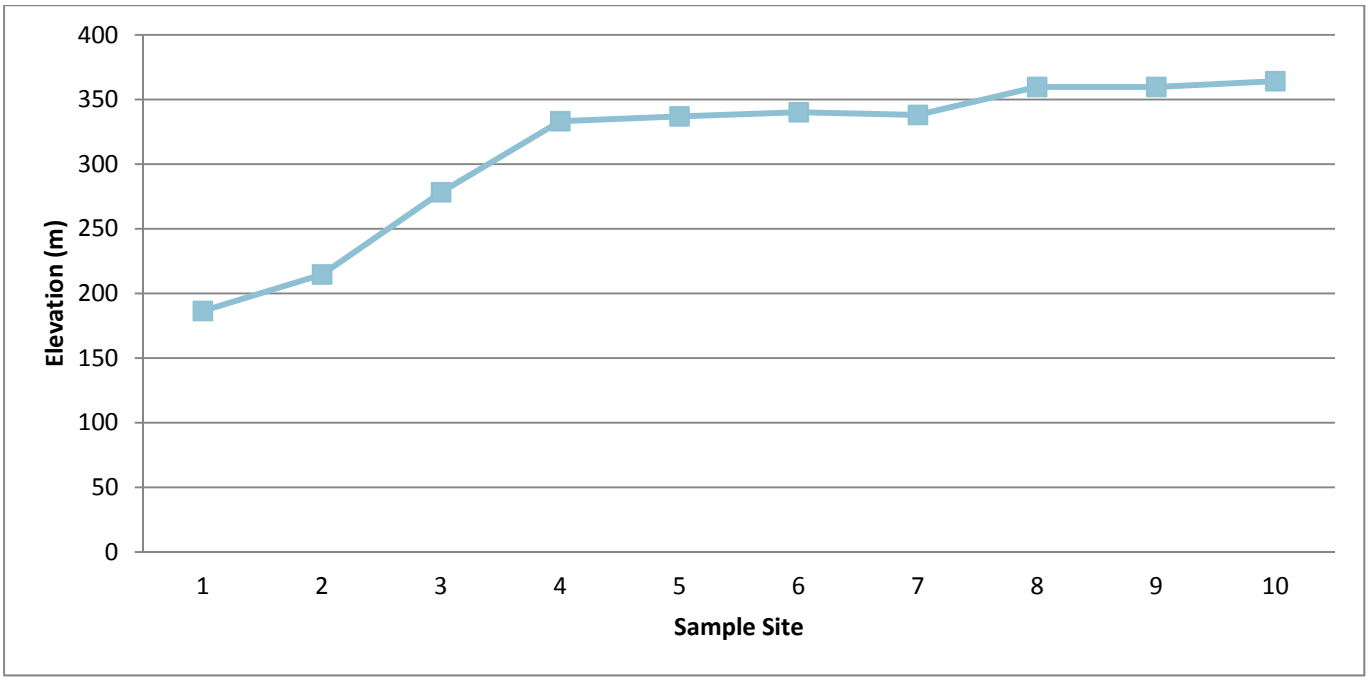

Figure 4: Pine River Stream Gradient

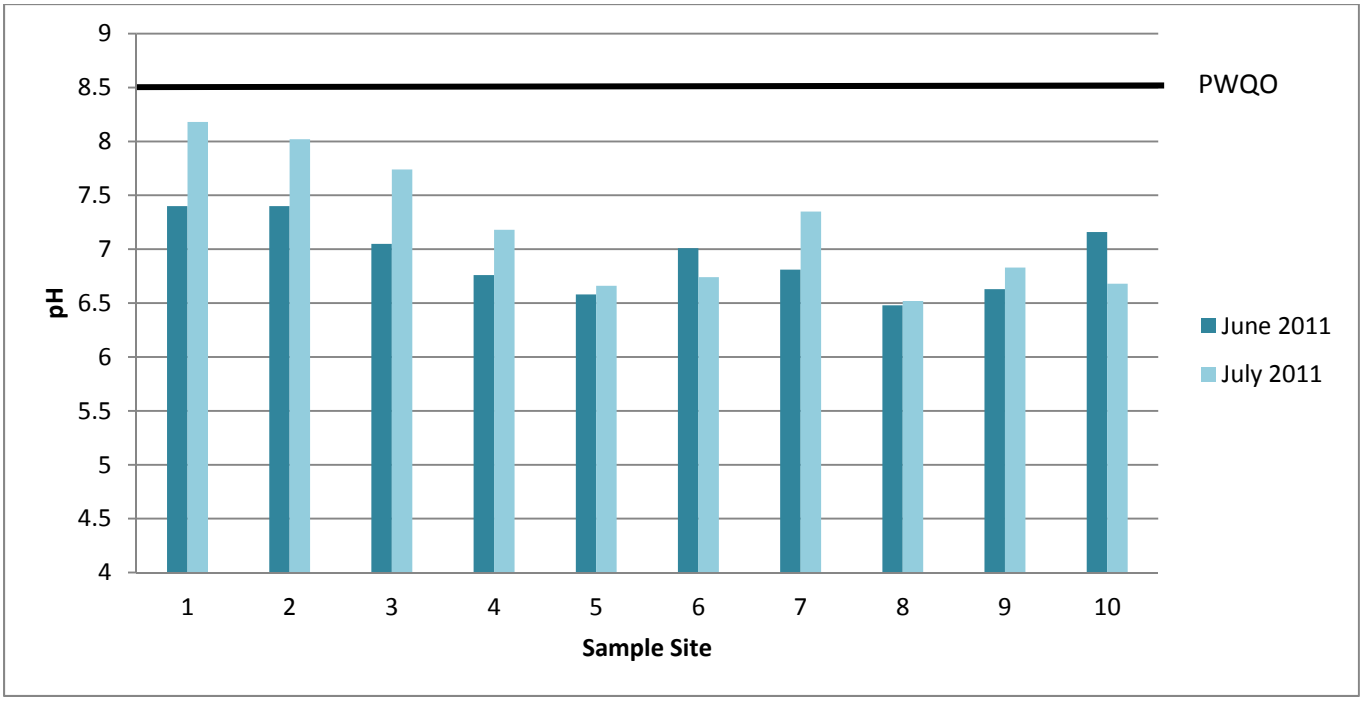

Figure 5: pH Level at Pine River Sample Sites

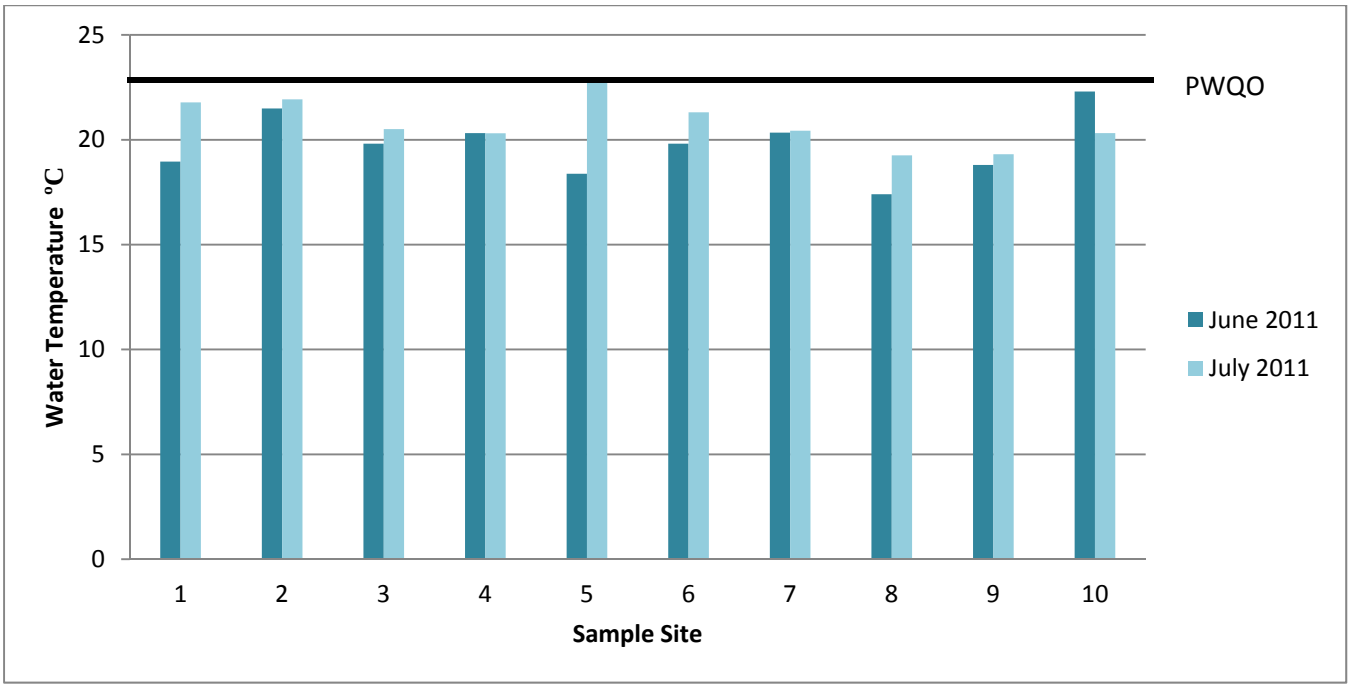

Figure 6: Water Temperature at Pine River Sample Sites

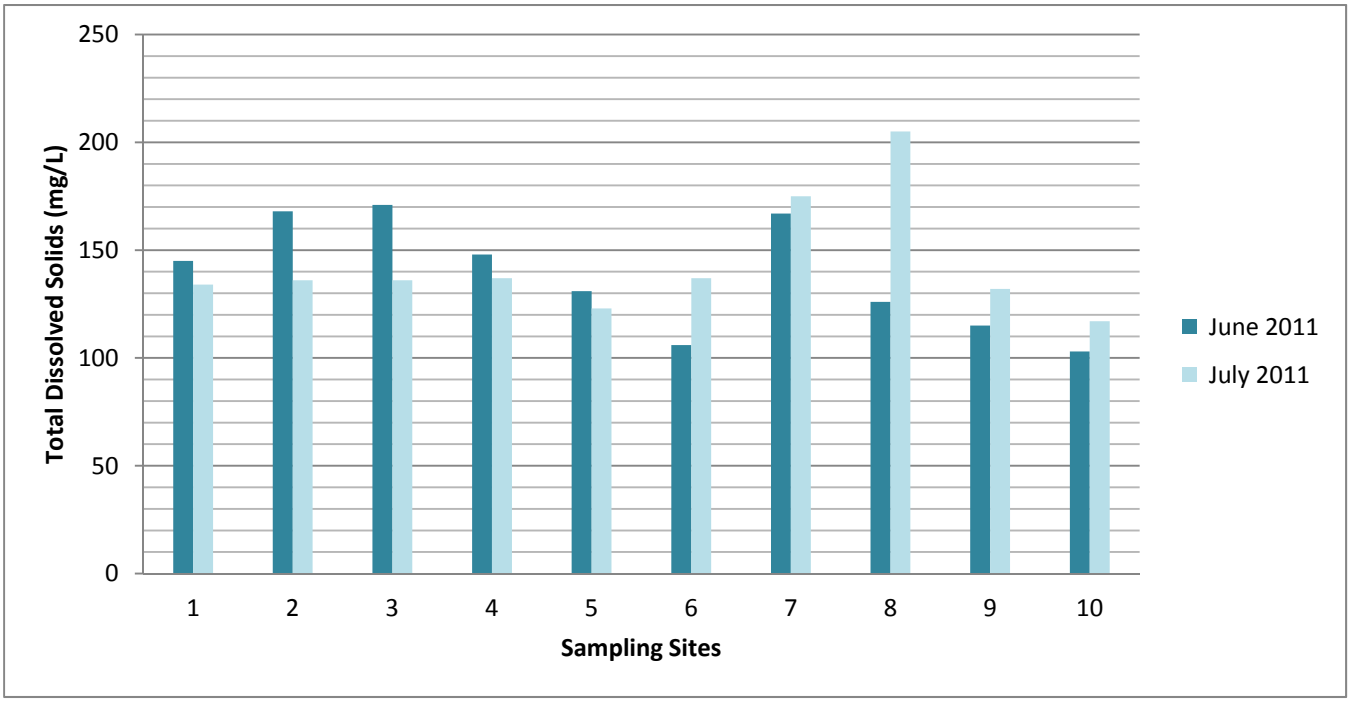

Figure 7: Total Dissolved Solids at Pine River Sample Sites

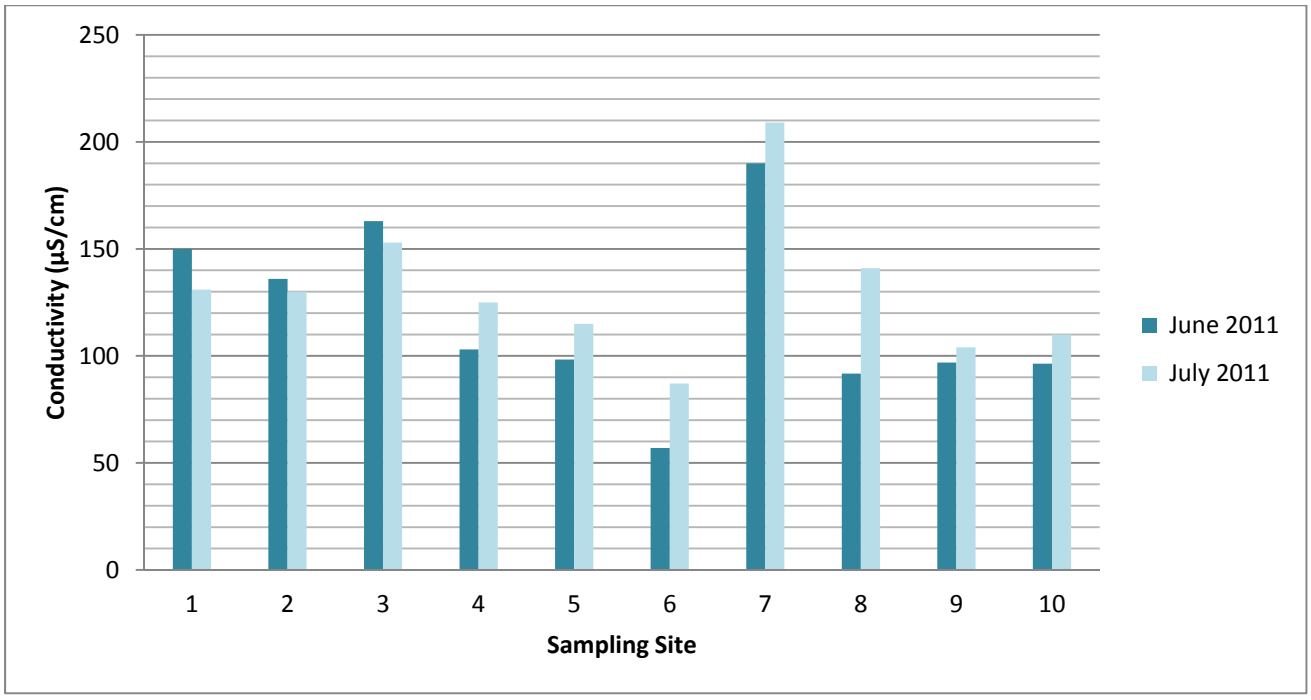

Figure 8: Conductivity at Pine River Sample Sites

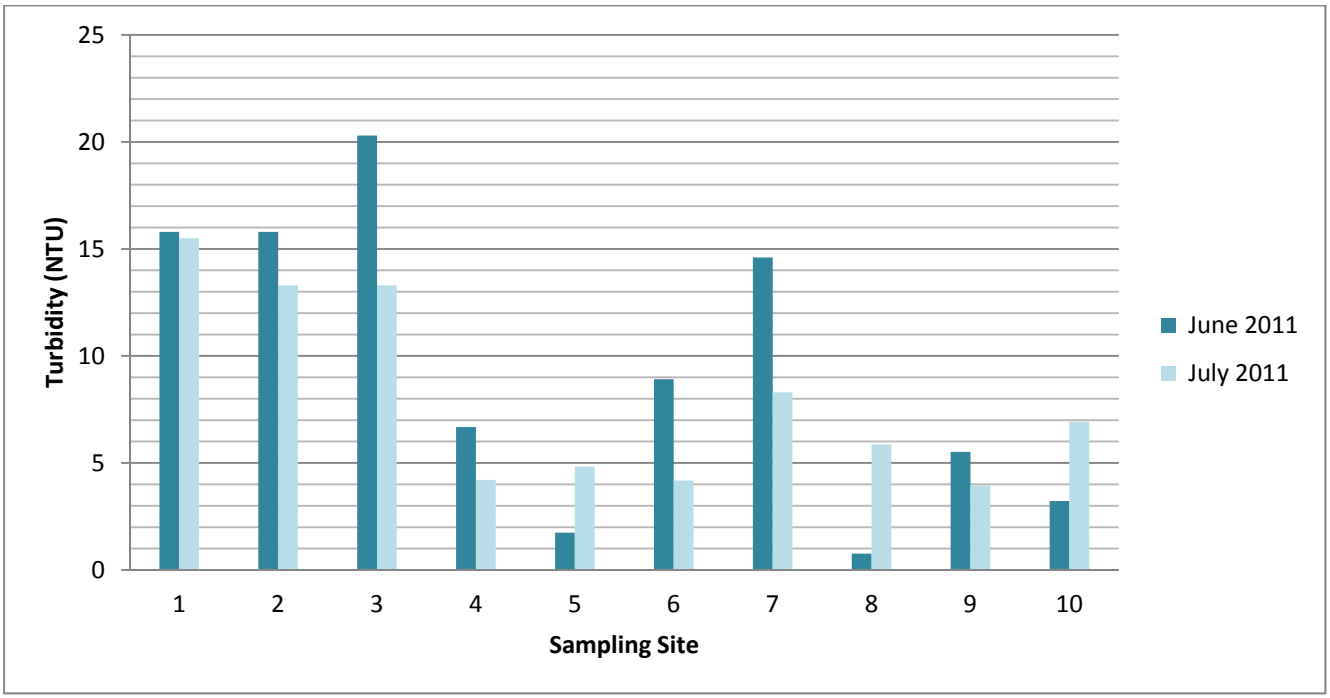

Figure 9: Turbidity at Pine River Sample Sites

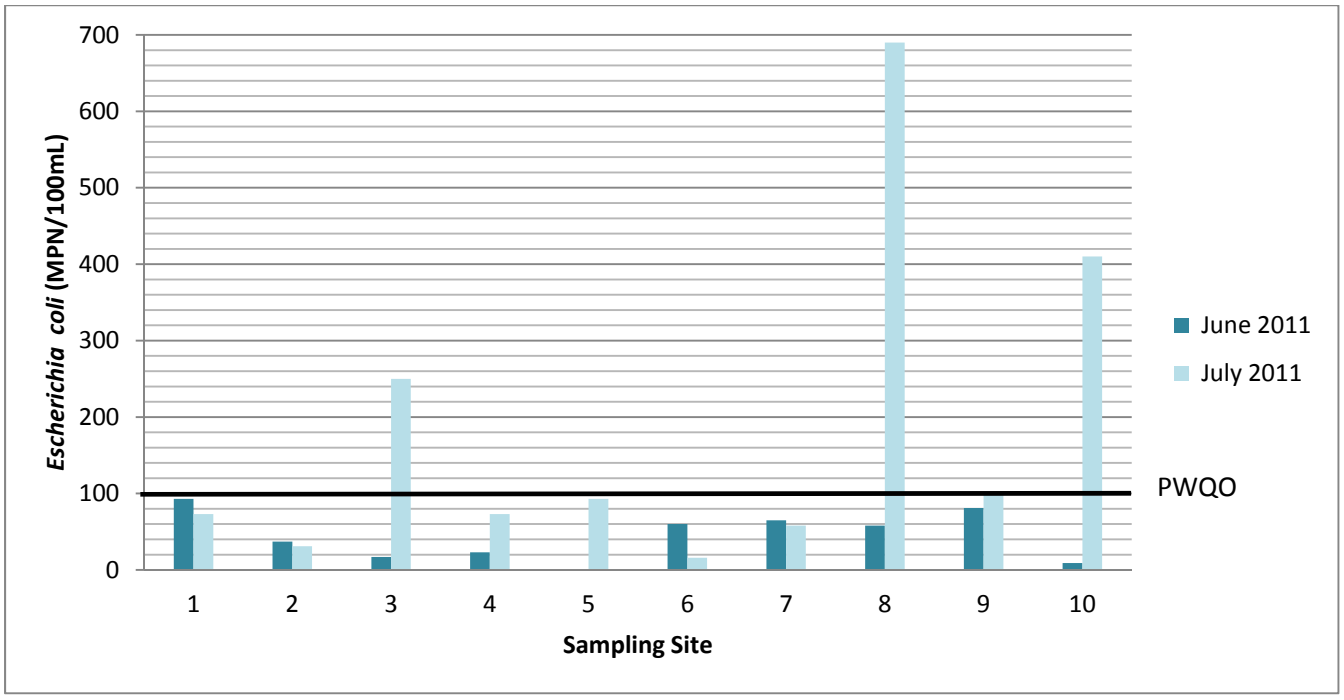

Figure 10: *Escherichia coli* bacteria counts at Pine River Sample Sites

Figure 11: Painted Turtle found at Site 10 on July 25, 2011

Figure 12: Degrading and Splintering Wood on Deck of Bridge 6

APPENDIX A:

WATER QUALITY PARAMETERS

Appendix A: Water Quality Parameters

Temperature

Water temperature is important because it dictates the kind of aquatic life that can live in a stream. Fish, insects, plankton and other aquatic species all have a preferred temperature range. If the temperature goes too far above or below their preferred range, then the number of species will decrease until there is none. Temperature also influences water chemistry which in turn affects biological activity. Chemical reactions generally speed up with warmer temperatures. Temperature is important, as warmer water holds less dissolved oxygen and warmer water will allow bacteria to reproduce and grow more quickly. Temperature can vary depending on the source of the water, depth and velocity of the stream, sunlight intensity and the amount of shade by the shoreline vegetation.

Dissolved Oxygen

Like terrestrial animals, fish and other aquatic species require oxygen to breathe. It is not the mere presence of dissolved oxygen that is important; the gas has to be above a certain concentration in order to sustain life. As well, oxygen is required to decompose organic matter in the stream. Dissolved oxygen levels will be highest if the water is colder, turbulent (a lot of mixing at the air-water interface) and during the day when aquatic plants have had time to produce oxygen during photosynthesis. PWQO's have an acceptable range for dissolved oxygen in water dependent upon temperature. At 20 degrees Celsius the minimum amount of dissolved oxygen is 5 milligrams per liter.

pH

The pH measures the concentration of hydrogen ions in the water based on a logarithmic scale of 0 to 14. Lower pH is acidic (many free hydrogen ions) and higher pH is alkaline (few free hydrogen ions). The pH of water determines the solubility and biological availability of chemicals constituents such as nutrients (eg. nitrogen, phosphorus) and heavy metals (eg. lead, copper). Geology of the watershed can give the river some buffering capacity to resist changes in pH but overall the range has to stay between 6.5 and 8.5 to protect aquatic life.

Total Dissolved Solids

Total dissolved solids (TDS) measure the amount of inorganic salts and small amounts of organic matter that is dissolved in water. The principal constituents are usually calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate, and nitrate (from agricultural use). Most of these originate from natural geological sources yet high levels may indicate runoff from of road salts, runoff from agricultural and erosion from exposed soil/no stream bank vegetation. There is no PWQO for TDS.

Conductivity

Conductivity is the measure of the ability of water to carry an electrical current expressed in micro seimens per centimeter. The reading is used to determine the total dissolved solids (TDS) in the water sample. There is no PWQO for conductivity.

Turbidity
Turbidity is the measure of the relative clarity of water. Turbidity in water is caused by suspended matter such as silt, clay and algae that scatter the sunlight. The diversity of species will be affected by how far the sunlight can penetrate the water column. Fish gills will become clogged with a lot of suspended material, as well the material can settle on top of fish spawning grounds (and their eggs). Highly turbid water will appear murky or dirty. Turbidity will be higher after heavy rainfall, but high levels may also indicate soil erosion.

Nutrients
Like terrestrial plants, aquatic plants and algae require nutrients for growth and productivity. The main nutrients of concern are phosphorus and nitrogen.

Phosphorus
Total phosphorus gives a measurement of all forms of phosphorus in the water, but the most important form within this measurement is soluble inorganic phosphate (PO_4) or orthophosphate ion (PO_4^{-3}) because it is the fraction utilized by aquatic plants.

While phosphorus is essential to life, too much of it will increase algae growth attached to rocks in the river. Excessive growths of attached algae can use up all the dissolved oxygen leaving other species, like fish, with anoxic (no oxygen) conditions. Nutrient loading may cause a decrease in biodiversity and a decrease in the most ecologically sensitive species. Natural decomposition of organic matter such as leaves, twigs, grass that is washed into the stream during the winter does constitute an important source of nutrients. However, high levels of phosphorus may indicate unnatural sources such as detergent, pesticide and fertilizer runoff from developed watersheds. Milkhouse waste from dairy farms is also a large source of phosphorus and has become one of the main environmental issues surrounding dairy farming.

Nitrogen
Nitrogen (N) is one of the most common gases in our atmosphere. It makes up approximately 78% of the earth's atmosphere. Like phosphorus, these nutrients are often applied to agricultural crops as fertilizers and having too much in the river can increase plant growth and productivity to unhealthy levels. Nitrogen is constantly being recycled through the environment through decomposition, etc. The most important forms that plants can readily use are ammonia, nitrate (NO_3) and nitrite (NO_2). There are many different ways to report nitrogen so it is necessary to note that the results from ALS Laboratory Group were given in Total ammonia-nitrogen (mg/L), Nitrate-nitrogen (NO_3-N mg/L), and Nitrite-nitrogen (NO_2-N mg/L).

Bacteria
Escherichia coli (*E. coli*) are naturally found in the intestines of humans and warm-blooded animals. Unlike other bacteria in this family, *E. coli* does not usually occur naturally on plants or in soil and water. The inability of *E. coli* to grow in water combined with its short survival time in water environments means that the detection of *E. coli* in a

water system is a good indicator of recent fecal contamination. Potential sources of *E. coli* include: leaking septic systems, runoff from manure storage facilities or wild animal waste (i.e. beavers and Canadian Geese). These bacteria can cause irritation of the skin and eyes when contact is made and can cause gastro-intestinal disorders.

Metals
The following is a complete list of the total metal scan performed on the water samples:

Aluminum (Al)
Antimony (Sb)
Arsenic (As)
Barium (Ba)
Beryllium (Be)
Bismuth (Bi)
Boron (B)
Cadmium* (Cd)
Chromium (Cr)
Cobalt (Co)
Copper (Cu)
Iron (Fe)
Lead (Pb)
Manganese (Mn)
Molybdenum (Mo)
Nickel (Ni)
Selenium (Se)
Silicon (Si)
Silver (Ag)
Strontium (Sr)
Thallium (TI)
Tin (Sn)
Titanium (Ti)
Tungsten (W)
Uranium (U)
Vanadium (V)
Zinc (Zn)
Zirconium (Zr)

Most of these metals are found naturally within the earth's crust and weathering of rock can transport them into surface water.

Aluminum
Aluminum is the most abundant metal on Earth, comprising about 8% of the Earth's crust. It is found in a variety of minerals, such as feldspars and micas, which, with time, weather to clays and exposure is inevitable. High levels of aluminum will put strain on the kidneys of animals when they attempt to excrete it but it is not normally fatal. Aluminum and its compounds are often used in food as additives, in drugs, in consumer products and in the treatment of drinking water. Aluminum poisoning has been linked to neurological dementia in kidney dialysis patients and, in recent years, its role in Alzheimer's disease, Parkinson's disease and Lou Gehrig's disease. The intake of large amounts of aluminum can also cause anaemia, osteomalacia (brittle or soft bones), glucose intolerance, and cardiac arrest in humans. The PWQO guideline for aluminum varies with pH, the maximum concentration being 75 μg/L.

Antimony
Antimony is a metallic element that is a blue-white colour in its stable form. Acute intoxication is characterized by abdominal pain, vomiting, diarrhea, dehydration, muscular pain, shock, haemoglobinuria, anuria and uraemia. In addition, severe myocardial symptoms and convulsions have been observed with acute doses of

antimonials, as well some deaths were attributed to liver necrosis. The maximum concentration of antimony under PWQO guidelines is 20 μg/L.

Arsenic

Arsenic is a natural element abundantly found within the earth's crust. It may be found in some drinking water supplies, including wells. Long-term exposure (over many years or decades) to high levels of arsenic in drinking water may cause thickening and discoloration of the skin; nausea and diarrhea; decreased production of blood cells; abnormal heart rhythm and blood vessel damage, or numbness in the hands and feet. Short term exposure (days/weeks) to very high levels of arsenic can result in abdominal pain, vomiting and diarrhea, muscular cramping or pain, weakness and flushing of skin, skin rash, numbness, burning or tingling sensation on the palms of the hands and soles of the feet, or loss of movement and sensory response. The maximum concentration of arsenic under PWQO guidelines is 5 μg/L.

Barium

Barium is present as a trace element in both igneous and sedimentary rocks. Although it is not found free in nature, barium occurs in a number of compounds. Barium compounds have a wide variety of industrial applications. They are used in the plastics, rubber, electronics and textiles industries. At high concentrations, barium causes strong vasoconstriction by its direct stimulation of arterial muscle, peristalsis due to the violent stimulation of smooth muscle, and convulsions and paralysis following stimulation of the central nervous system. Depending on the dose and solubility of the barium salt, death may occur in a few hours or a few days. There are currently no PWQO guidelines for barium.

Beryllium

Beryllium is a hard grey metal that is extracted from the earth, refined and reduced to a very fine powder. It occurs as a chemical component of certain rocks, coal and oil, soil, and volcanic dust. People exposed to beryllium are at risk of developing serious debilitating diseases. Chronic beryllium disease (CBD or berylliosis) is a painful scarring of the lung tissue. Less common than CBD, acute (short—term) beryllium disease, causes lung inflammation resembling pneumonia. In severe cases, both diseases may be fatal. The maximum concentration of beryllium under PWQO guidelines depends on hardness. If $CaCO_3$ is >75 mg/L the maximum concentration of beryllium is 1100 μg/L and if the $CaCO_3$ is <75 mg/L the maximum concentration of Beryllium is 11 μg/L.

Bismuth

Bismuth is a brittle metal with a pinkish colour, often found in its native form. Exposure to bismuth at low doses may cause gastrointestinal disorders, low stomach acid, heartburn, bloating, calcification, warts, diarrhea, and gastric ulcers. At large doses it may cause mental confusion, memory problems, tremors, staggering gait, muscle twitching, slurring speech, joint problems, hypoadrenalism, hearing and visual disturbances, hallucinations and coma. There are currently no PWQO guidelines limiting the intake of bismuth.

Boron
Boron is a non-metallic element that is not found in nature in its elemental form but can be found in a number of compounds. Exposure to boron in small doses may cause irritation to the nose, throat and eyes. In larger doses, boron can affect the stomach, liver, kidneys and brain, and may eventually lead to death. The maximum level of boron under PWQO guidelines is 200 μg/L.

Cadmium
Cadmium is an extremely toxic metal even in low concentrations. It is used commercially as a stabilizer in plastic, fungicides for golf courses, television picture tube phosphors, nickel–cadmium batteries, motor oils, and curing agents for rubber. Cadmium poisoning can lead to itai-itai disease, which initiates bone softening, joint pain and kidney failure. The maximum concentration of cadmium under PWQO guidelines is 0.2 μg/L. The interim PWQO guideline states if hardness as $CaCO_3$ is 0-100 the maximum cadmium concentration is 0.1 μg/L and if hardness is >100, the maximum cadmium concentration is 0.5 μg/L.

Calcium
Calcium is the third most abundant metal in the Earth's crust. Calcium is also the most abundant metal in the human body and is the main constituent of bones. Calcium is a dietary requirement and there are no adverse health effects from intake of large doses of calcium. There are currently no PWQO guidelines for calcium.

Chromium
Chromium is a lustrous, hard metal. Chromium (III) is an essential nutrient, but higher intake may cause skin rashes. Chromium (VI) is known to cause various health effects such as skin rashes, upset stomachs and ulcers, respiratory problems, weakened immune systems, kidney and liver damage, alteration of genetic material, lung cancer and death. The maximum concentration of chromium under PWQO guidelines is 1 μg/L for Chromium (VI) and 8.9 μg/L for Chromium (III).

Cobalt
Cobalt is a hard, lustrous, silver-grey metal and is found in various ores. Health effects resulting from exposure to high concentrations include vomiting and nausea, vision problems, heart problems and thyroid damage. The maximum concentration of cobalt under PWQO guidelines is 0.9 μg/L.

Copper
Copper occurs in nature as a metal and in minerals. Copper is an essential element to human metabolism, although intake at higher doses can cause adverse health effects. Acute copper poisoning health effects include vomiting, diarrhea, jaundice, haemolysis, haemoglobinuria, haematuria, and oliguria. In severe cases, the stool and saliva may appear green or blue. In the terminal phases, anuria, hypotension, and coma precede death. The maximum concentration of copper under PWQO guidelines is 5 μg/L.

Iron
Iron is also an abundant metal found in rock. The precipitation of excessive iron creates an objectionable reddish-brown colour to water. Iron may also stain laundry and plumbing fixtures, produce undesirable tastes in beverages, and promote the growth of certain iron-bacteria, leading to the deposition of a slimy coating in water distribution pipes. The PWQO guideline stipulates that the levels of iron in the water must be below 300 μg/L.

Lead
Lead is a very toxic metal to all forms of life, causing neurological damage and even death. Although natural occurrences can occur from precipitation and the weathering of ores, the majority of lead in watercourses comes from anthropogenic sources. The PWQO requirement for lead varies with different alkalinity as $CaCO_3$ (mg/L). The maximum lead concentration is 25 μg/L.

Magnesium
Magnesium is very abundant in nature and is found in many minerals. It is a dietary requirement, but too much can lead to muscle weakness, lethargy and confusion. There are no current PWQO guidelines for magnesium.

Manganese
Manganese is a very common compound that can be found everywhere on earth. It is essential for humans to survive, but toxic when concentrations in the body are too high. Manganese can cause Parkinson, lung embolism and bronchitis. There are currently no PWQO guidelines for manganese.

Molybdenum
Molybdenum is a by-product of copper and tungsten mining. It is used as an alloy for various metals and occurs naturally in soil and rock. Potential health impacts associated with molybdenum include neurotoxicity and reproductive toxicity. The maximum concentration of molybdenum under PWQO guidelines is 40 μg/L.

Nickel
Nickel is a compound that occurs in the environment only at very low levels. An uptake of large quantities of nickel may cause higher risks of cancer, respiratory failure, birth defects and heart disorders. The maximum concentration of nickel under PWQO guidelines is 25 μg/L.

Potassium:
Potassium is a soft silvery white metal, which is a key plant element and is found in most fertilizers. Potassium is also a dietary requirement, but many potassium compounds may cause adverse health effects. Such compounds include potassium alum or potassium cyanide. There are currently no PWQO guidelines for potassium.

Selenium
Selenium is one of the rarer elements on the surface of the earth. It occurs naturally in the environment and is also released by human activities. The health effects of various forms of selenium can vary from brittle hair and deformed nails, to rashes, heat, swelling of the skin and severe pains. Selenium poisoning may become so severe in some cases that it can even cause death. The maximum concentration of selenium under PWQO guidelines is 100 μg/L.

Silicon
Silicon is the most abundant element on earth after oxygen. In drinking water only silicic acid is present, which is relatively safe. However, there are a number of silicon compounds that are carcinogenic. There are currently no PWQO guidelines for silicon.

Silver
Silver does not react with pure water. It is stable in both water and air. Moreover, it is acid and base resistant, but it corrodes when it comes in contact with sulphur compounds. Silver oxide is harmful upon swallowing, because it irritates the eyes, respiratory tract and skin. Silver nitrate is much more harmful, because it is a strong oxidant. It causes corrosion, and an oral uptake can lead to vomiting, dizziness and diarrhea. The maximum concentration of silver under PWQO guidelines is 0.1 μg/L.

Strontium
Strontium is a bright silvery metal that is softer than calcium and even more reactive in water. Acute effects of strontium include vomiting and diarrhea if ingested, and may also cause irritation to the skin. Chronic skin contact may cause dermatitis. There are currently no PWQO guidelines for strontium.

Thallium
Thallium is a silvery-grey metal that is very toxic by inhalation, ingestion and skin absorption. It may act as a systemic poison, neurotoxin, and may cause birth abnormalities. It is also a respiratory and eye irritant. The maximum concentration of thallium under PWQO guidelines is 0.3 μg/L.

Tin
Tin is a soft, pliable, silvery-white metal. Acute effects of tin include skin or eye irritation, headaches, stomach aches, dizziness, and breathlessness. Long-term effects include liver damage, malfunctioning of immune systems, chromosomal damage, shortage of red blood cells, and brain damage. There are currently no PWQO guidelines limiting the intake of tin.

Titanium
Titanium is a white-silvery metallic colour and is always found bound to other elements in nature. There are no known health hazards of titanium in water, but it is known to have

adverse health effects in powder form. There are currently no PWQO guidelines for titanium.

Tungsten
Tungsten is a lustrous, silvery-white metal. Acute health effects include irritation to the skin and eyes causing watering and redness. There are no known long-term health effects. The maximum concentration of tungsten under PWQO guidelines is 30 μg/L.

Uranium
Uranium is a hard, dense, malleable, ductile, silver-white, radioactive metal. No harmful radiation effects of natural levels of uranium have been found. However, chemical effects may occur after the uptake of large amounts of uranium, which can cause health effects such as kidney disease. Exposure to uranium radionuclides that form during radioactive decay may cause cancer. The maximum concentration of uranium under PWQO guidelines is 5 μg/L.

Vanadium
Vanadium is a rare, soft, ductile grey-white element found combined in certain minerals and used mainly to produce certain alloys. The uptake of vanadium by humans mainly takes place through foodstuffs, such as buckwheat, soy beans, olive oil, sunflower oil, apples and eggs. Some acute health effects associated with the high intake of vanadium include inflammation of stomach and intestines, sickness and headaches, dizziness, skin rashes, nosebleeds and throat pain. Chronic exposure may cause eye, skin and respiratory problems. The maximum concentration of vanadium under PWQO guidelines is 6 μg/L.

Zinc
Zinc is a lustrous bluish-white metal. Overdoses do not occur very often. Symptoms include nausea, vomiting, dizziness, fevers and diarrhea. The maximum concentration of zinc under PWQO guidelines is 20 μg/L.

Zirconium
Zirconium is a very strong, malleable, ductile, lustrous silver-grey metal. Zirconium and its salts generally have low systemic toxicity. The maximum concentration of Zinc under PWQO guidelines is 4 μg/L.

APPENDIX B:

WATER QUALITY GUIDELINES

Appendix B: Water Quality Guidelines

The following are taken from the Ministry of the Environment water quality guidelines, Provincial Water Quality Objectives (PWQO), July 1994.

Physical

Alkalinity:
Alkalinity should not be decreased by more than 25% of the natural concentration.

Dissolved oxygen:
Dissolved oxygen concentrations should not be less than the values specified below for cold water biota (e.g. salmonid fish communities) and warm water biota (e.g. centrarchid fish communities):

Dissolved Oxygen Concentration				
Temperature	Cold Water Biota		Warm Water Biota	
°C	% Saturation	mg/L	% Saturation	mg/L
0	54	8	47	7
5	54	7	47	6
10	54	6	47	5
15	54	6	47	5
20	57	5	47	4
25	63	5	48	4

In waters inhabited by sensitive biological communities, or in situations where additional physical or chemical stressors are operating, more stringent criteria may be required. For example, a sensitive species such as lake trout may require more specific water quality objectives.

In some hypolimnetic waters, dissolved oxygen is naturally lower than the concentrations specified in the above table. Such a condition should not be altered by adding oxygen-demanding materials causing a depletion of oxygen.

pH:
The pH should be maintained in the range of 6.5 – 8.5:

- to protect aquatic life
- both alkaline and acidic waters may cause irritation to anyone using the water for recreational purposes

Temperature:
The natural thermal regime of any body of water shall not be altered so as to impair the quality of the natural environment. In particular, the diversity, distribution and abundance of plant and animal life shall not be significantly changed.

Waste Heat Discharge

1. Ambient Temperature Changes

   The temperature at the edge of a mixing zone shall not exceed the natural ambient water temperature at a representative control location by more than 10°C (18°F). However, in special circumstances, local conditions may require a significantly lower temperature difference than 10°C (18°F). Potential dischargers are to apply to the MOEE for guidance as to the allowable temperature rise for each thermal discharge. This ministry will also specify the nature of the mixing zone and the procedure for the establishment of a representative control location for temperature recording on a case-by-case basis.

2. Discharge Temperature Permitted

   The maximum temperature of the receiving body of water, at any point in the thermal plume outside a mixing zone, shall not exceed 30°C (86°F) or the temperature of a representative control location plus 10°C (18°F) or the allowed temperature difference, whichever is the lesser temperature. These maximum temperatures are to be measured on a mean daily basis from continuous records.

3. Taking and Discharging of Cooling Water

   Users of cooling water shall meet both the Objectives for temperature outlined above and the "Procedures for the Taking and Discharge of Cooling Water" as outlined in the MOEE publication *Deriving Receiving-Water Based, Point-Source Effluent Requirements for Ontario Waters (1994).*

Turbidity:
Suspended matter should not be added to surface water in concentrations that will change the natural Secchi disc reading by more than **10 percent**.

Nutrients

Ammonia (un-ionized):
The amount of un-ionized ammonia should not exceed 20 µg/L.

The percentages of un-ionized ammonia (NH3) in aqueous ammonia solution for different temperature and pH conditions are listed in the table below. For example, at 20°C and pH of 8.0, a total ammonia concentration of 500 µg/L would give an un-ionized ammonia concentration of 500 x 3.8/100 = 19 µg/L which is less than the un-ionized ammonia Objective of 20 µg/L.

The table below is taken from Emerson et al. 197511 but percentages are rounded to two significant figures. The equations given by Emerson et al. may be used to interpolate values between those given in the table:

$f = 1/(10^{pKa-pH} + 1)$, where f is the fraction of NH3

pKa = 0.09018 + 2729.92/T, where T = ambient water temperature in Kelvin (K = °C + 273.16)

Results should be converted to percent and rounded to two significant figures. Extrapolations should not be made beyond the ranges of the table.

Note: Under certain temperature and pH conditions, the total ammonia criteria for the protection of aquatic life may be less stringent than the criteria for other beneficial uses (e.g. public water supply).

Percent NH3 in aqueous ammonia solutions for 0-30 °C and pH 6-10

Temp.	**pH**								
°C	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
0	.0083	.026	.083	.26	.82	2.6	7.6	21.	45.
1	.0090	.028	.090	.28	.89	2.8	8.3	22.	47.
2	.0098	.031	.098	.31	.97	3.0	8.9	24.	49.
3	.011	.034	.11	.34	1.1	3.3	9.6	25.	52.
4	.012	.036	.12	.36	1.1	3.5	10.	27.	54.
5	.013	.040	.13	.39	1.2	3.8	11.	28.	56.
6	.014	.043	.14	.43	1.3	4.1	12.	30.	58.
7	.015	.046	.15	.46	1.5	4.4	13.	32.	60.
8	.016	.050	.16	.50	1.6	4.8	14.	34.	61.

Temp.	pH								
°C	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
9	.017	.054	.17	.54	1.7	5.2	15.	35.	63.
10	.019	.059	.19	.59	1.8	5.6	16.	37.	65.
11	.020	.064	.20	.63	2.0	6.0	17.	39.	67.
12	.022	.069	.22	.68	2.1	6.4	18.	41.	69.
13	.024	.074	.24	.74	2.3	6.9	19.	43.	70.
14	.025	.080	.25	.80	2.5	7.4	20.	45.	72.
15	.027	.087	.27	.86	2.7	8.0	22.	46.	73.
16	.030	.093	.29	.93	2.9	8.5	23.	48.	75.
17	.032	.10	.32	1.0	3.1	9.1	24.	50.	76.
18	.034	.11	.34	1.1	3.3	9.8	26.	52.	77.
19	.037	.11	.37	1.2	3.6	11.	27.	54.	79.
20	.040	.13	.40	1.2	3.8	11.	28.	56.	80.
21	.043	.14	.43	1.3	4.1	12.	30.	58.	81.
22	.046	.15	.46	1.4	4.4	13.	32.	59.	82.
23	.049	.16	.49	1.5	4.7	14.	33.	61.	83.
24	.053	.17	.53	1.7	5.0	14.	35.	63.	84.
25	.057	.18	.57	1.8	5.4	15.	36.	64.	85.
26	.061	.19	.61	1.9	5.8	16.	38.	66.	86.
27	.065	.21	.65	2.0	6.2	17.	40.	67.	87.
28	.070	.22	.70	2.2	6.6	18.	41.	69.	88.
29	.075	.24	.75	2.3	7.0	19.	43.	70.	88.
30	.081	.25	.80	2.5	7.5	20.	45.	72.	89.

Phosphorus:

Current scientific evidence is insufficient to develop a firm Objective at this time. Accordingly, the following phosphorus concentrations should be considered as general guidelines, which should be supplemented by site-specific studies:

To avoid nuisance concentrations of algae in lakes, average total phosphorus concentrations for the ice-free period should not exceed 20 µg/L;

A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10 µg/L or less. This should apply to all lakes naturally below this value.

Excessive plant growth in rivers and streams should be eliminated at a total phosphorus concentration below 30 µg/L.

Bacteriological

Escherichia coli:
The amount of *Escherichia coli* should not exceed 100 counts per 100 mL of water (based on a geometric mean of at least 5 samples).

Based on a recreational water quality guideline published by the Ontario Ministry of Health in 1992, this Ministry of Health guideline was specifically intended for application by the local Medical Officer of Health to swimming and bathing beaches. It is based upon a geometric mean of levels of *E. coli* determined from a minimum of 5 samples per site taken within a given swimming area and collected within a one month period. If the geometric mean *E. coli* level for the sample series at a given site exceeds 100 per 100 mL, the site should be considered unsuitable for swimming and bathing. *E. coli* was selected for the guideline because studies have determined that, among bacteria of the coliform group, *E. coli* is the most suitable and specific indicator of fecal contamination.

An analytical test with a high degree of specificity for *E. coli* regardless of water sample source, requiring no confirmation procedures, and which produces results in 21 hours has been developed and adopted by both the Ministry of Health, and Ministry of Environment and Energy laboratories.

Where testing indicates sewage or fecal contamination, a site-specific judgment must be made as to the severity of the problem and the appropriate course of action.

As of May 1, 1994, MOEE staff has been advised to base all **new** compliance, enforcement and monitoring activities on the *E. coli* test. Some water managers may find it necessary to continue testing for fecal coliforms or total coliforms. For example, where testing at a long term water quality monitoring station requires a continuous record of results using either the fecal or total coliform test to monitor trends in water quality. As a benchmark for the long term monitoring results, the former objectives for fecal coliforms and total coliforms are referenced for your information. For fecal coliforms the objective was 100 counts per 100 ml (based on a geometric mean density for a series of water samples). For total coliforms the objective was 1000 counts per 100 ml (based on a geometric mean density for a series of water samples).

Metals

Aluminum:
Aluminum amounts should not exceed the following:

PH values	**Interim PWQO (µg/L)**
4.5 to 5.5	15
>5.5 to 6.5	No more than 10 % of natural background
> 6.5 to 9.0	75

Antimony:
The amount of Antimony should not exceed 20 µg/L.

Arsenic:
The amount of Arsenic should not exceed 5 µg/L.

Barium:
There are currently no PWQO guidelines for Barium.

Beryllium:
Beryllium amounts should not exceed the following:

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
< 75	11
>75	1100

Bismuth:
There are currently no PWQO guidelines for Bismuth.

Boron:
The amount of Boron should not exceed 200 µg/L.

Cadmium:
Cadmium amounts should not exceed 0.2 µg/L.

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
0 - 100	0.1
>100	0.5

Calcium:
There are currently no PWQO guidelines for Calcium.

Chromium:
Chromium amounts should not exceed the following:

	Interim PWQO (µg/L)
Hexavalent Chromium (Cr VI)	1
Trivalent Chromium (Cr III)	8.9

Cobalt:
The amount of Cobalt should not exceed 0.9 µg/L.

Copper:
The amount of Copper should not exceed 5 µg/L.

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
0-20	1
>20	5

Iron:
The amount of Iron should not exceed 300µg/L.

Lead:
Lead amounts should not exceed the following:

Hardness as CaCO3 (mg/L)	Interim PWQO (µg/L)
< 30	1
30 to 80	3
> 80	5

Lithium:
There are currently no PWQO guidelines for Lithium.

Magnesium:
There are currently no PWQO guidelines limiting the intake of Magnesium.

Manganese:
There are currently no PWQO guidelines for Manganese.

Molybdenum:
The amount of Molybdenum should not exceed 40 µg/L.

Nickel:
The amount of Nickel should not exceed 25 µg/L.

Potassium:
There are currently no PWQO guidelines for Potassium.

Selenium:
The amount of Selenium should not exceed 100 µg/L.

Silicon:
There are currently no PWQO guidelines for Silicon.

Silver:
The amount of Silver should not exceed 0.1 µg/L.

Sodium:
There are currently no PWQO guidelines for Sodium.

Strontium:
There are currently no PWQO guidelines for Strontium.

Tellurium:
There are currently no PWQO guidelines for Tellurium.

Thallium:
The amount of Thallium should not exceed 0.3 μg/L.

Tin:
There are currently no PWQO guidelines for Tin.

Titanium:
There are currently no PWQO guidelines for Titanium.

Tungsten:
The amount of Tungsten should not exceed 30 μg/L.

Uranium:
The amount of Uranium should not exceed 5 μg/L.

Vanadium:
The amount of Vanadium should not exceed 6 μg/L.

Zinc:
The amount of Zinc should not exceed 20 μg/L.

Zirconium:
The amount of Zirconium should not exceed 4 μg/L.

The following are taken from the Canadian Council of Resource and Environment Ministers (CCREM) Canadian water quality guidelines for the protection of aquatic life: Summary table, September 2007.

The information in these guidelines and supporting text is used to complement the Provincial Water Quality Objectives and Interim Objectives.

Nitrate:
The amount of nitrate in freshwater should not exceed 2900 μg NO_3-N/ L.
For protection from direct toxic effects: the guidelines do not consider indirect effects due to eutrophication.

Nitrite:
The amount of nitrite in freshwater should not exceed 60 μg NO_2-N/L.
For protection from direct toxic effects: the guidelines do not consider indirect effects due to eutrophication.

APPENDIX C:

TECHNIQUES FOR DATA COLLECTION

Appendix C: Techniques for Data Collection

Location
The sample sites were chosen using a 1:50,000 scale topographic map. The sample sites were also described in terms of road access and road crossings.

Latitude, Longitude, and Elevation
The Universal Transverse Mercator (UTM) coordinates for each site were measured with a Trimble Geo XH 2005 hand held GPS unit.

Photographs
Photographs were taken at each site using both the Stylus 1030SW shock and water proof camera and the Capilo 500SE GPS Camera. Upstream and downstream photographs as well as culvert, bridge, and outstanding litter or erosion photographs were all taken at each site. Substrate photographs were attempted at each site with the waterproof camera.

Channel Width & Depth
The width of the stream was measured using a nylon measuring-tape reel. Channel depth was measured by using a stainless steel meter stick.

Flow
The velocity of river flow at sites was measured using a leaf and nylon measuring-tape reel. Distances measured varied depending upon stream obstructions and variable depth. The flow was then calculated using the equation **Q=V*A**, where **Q** is flow/ discharge, **V** is velocity (distance divided by time), and **A** is the cross sectional area of the stream.

Air Temperature
The air temperature was measured with a basic mercury thermometer.

Water Temperature
Water temperature was measured with the YSI 600 QS. The readings were taken after the probe was submerged and all variables on the meter were stabilized.

Conductivity
Conductivity was measured with the YSI 600 QS. The accuracy of the reading was ±0.001 mS/cm or ±1.0%; whichever was greater. The readings were recorded once the probe was completely submerged and all readings stabilized. In addition to conductivity readings taken in the field, laboratory analysis of the samples provided a second reading of conductivity which is included within the results.

Total Dissolved Solids
The total dissolved solids (TDS) were measured in laboratory.

Dissolved Oxygen
The YSI 600 QS measured dissolved oxygen for the samples. The readings were recorded once the probe was submerged in the water and all variables were stabilized.

Tree, Shrub & Herb Species
Identification was made in the vicinity of the sample sites, no transects were made. Observations were made approximately 50 metres from either stream edge were taken.

Aquatic Plants
Aquatic plants were determined through careful observation and identification via a field guide.

OBBN In-Stream Materials Key

Stream Bed Description
The bed description was given a set of categories of varying grain sizes.

Grain Size	Description
Boulder	> 25.6 cm in diameter
Cobbles	6.4 - 25.6 cm in diameter
Gravel	0.2 – 6.4 cm in diameter
Sand	< 0.2 cm in diameter
Silt	Finer inorganic material than sand
Muck	Mainly organic combination of silt and clay
Clay	Inorganic origin with no apparent structure

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Stream Cover
Stream cover describes the vegetation density along the river bank no more than 5 metres from the water's edge. Stream cover was divided into three categories of density:

Description	% Cover
Dense	75-100% shaded by canopy
Partly Open	25-75% shaded by canopy
Open	0-25% shaded by canopy

Soil Type
Like stream bed description, soil type on land will impact vegetation and erosion potential. Soil type was categorized based on its grain size using the FEC Manual for North Western Ontario.

APPENDIX D:

COMMON AND LATIN NAMES OF IDENTIFIED PINE BAY PHASE I NATURE RESERVE VASCULAR PLANT SPECIES

Appendix D: Common and Latin Names of Identified Pine Bay Phase I Nature Reserve Vascular Plant Species

Source: Thunder Bay Field Naturalists

DIVISION PTERIDOPHYTA	
CLASS EQUISETOPSIDA	
FAMILY EQUISETACEAE	**Horsetail Family**
Equisetum arvense	Field Horsetail
Equisetum fluviatile	Water Horsetail
Equisetum pratense	Meadow Horsetail
Equisetum scirpoides	Dwarf Scouring Rush
Equisetum sylvaticum	Woodland Horsetail
CLASS PTEROPSIDA	
FAMILY ASPLENIACEAE	**Spleenwort Family**
Asplenium trichomanes	Maidenhair Spleenwort
FAMILY DENNSTAETIACEAE	**Bracken Family**
Pteridium aquilinum	Bracken Fern
FAMILY DRYOPTERIDACEAE	**True Fern Family**
Athyrium filix-femina	Lady Fern
Cystopteris fragilis	Fragile Fern
Dryopteris carthusiana	Spinulose Shield-fern
Dryopteris cristata	Crested Shield-fern
Dryopteris expansa	Spreading Woodfern
Dryopteris fragrans (+)	Fragrant Cliff Woodfern
Dryopteris intermedia	Evergreen Woodfern
Gymnocarpium dryopteris	Oak Fern
Matteuccia struthiopteris	Ostrich Fern
Onoclea sensibilis	Sensitive Fern
Woodsia ilvensis	Rusty Woodsia
Woodsia oregana	Western Cliff Fern
Woodsia scopulina	Rocky Mountain Woodsia
FAMILY OPHIOGLOSSACEAE	**Succulent Fern Family**
Botrychium virginianum	Rattlesnake Fern
FAMILY OSMUNDACEAE	**Flowering Fern Family**
Osmunda cinnamomea (R)	Cinnamon Fern
Osmunda claytoniana	Interrupted Fern
FAMILY POLYPODIACEAE	**Polypody Family**
Polypodium virginianum	Rock Polypody
FAMILY PTERIDACEAE	**Cliffbrake Family**
Cryptogramma stelleri	Fragile Rockbrake
FAMILY THELYPTERIDACEAE	
Phegopteris connectilis	Northern Beech Fern
Thelypteris palustris	Marsh Fern

CLASS LYCOPODIOPSIDA	
FAMILY LYCOPODIACEAE	**Clubmoss Family**
Diphasiastrum complanatum	Trailing Clubmoss
Huperzia lucidula	Shining Clubmoss
Lycopodium annotinum	Stiff Clubmoss
Lycopodium clavatum	Common Clubmoss
Lycopodium obscurum	Tree Clubmoss
DIVISION SPERMOPHYTA	
CLASS GYMNOSPERMAE	
FAMILY CUPRESSACEAE	**Juniper Family**
Juniperus communis	Ground Juniper
Thuja occidentalis	Eastern White Cedar
FAMILY PINACEAE	**Pine Family**
Abies balsamea	Balsam Fir
Larix laricina	American Larch
Picea glauca	White Spruce
Picea mariana	Black Spruce
Pinus banksiana	Jack Pine
Pinus resinosa	Red Pine
Pinus strobus	Eastern White Pine
CLASS ANGIOSPERMAE	
SUBCLASS MONOCOTYLEDONEAE	
FAMILY ALISMATACEAE	**Water Plantain Family**
Alisma plantago-aquatica	Broad-leaved Water Plantain
Sagittaria cuneata	Wapatum Arrowhead
Sagittaria latifolia	Broadleaf Arrowhead
FAMILY ARACEAE	**Arum Family**
Calla palustris	Wild Calla
FAMILY CYPERACEAE	**Sedge Family**
Carex aquatilis	Water Sedge
Carex aurea	Golden-fruited Sedge
Carex disperma	Softleaf Sedge
Carex intumescens	Bladder Sedge
Carex lacustris	Lake-bank Sedge
Carex lasiocarpa	Slender Sedge
Carex magellanica	Boreal Bog Sedge
Carex pauciflora	Few-flowered Sedge
Carex retrorsa	Retrorse Sedge
Carex stipata	Stalk-grain Sedge
Carex trisperma	Threeseeded Sedge
Carex utriculata	Bottle Sedge
Carex vulpinoidea	Fox Sedge
Eleocharis acicularis	Least Spikerush
Eleocharis smallii	Creeping Spikerush
Eriophorum vaginatum	Tussock Cottongrass

Schoenoplectus acutus	Hard-stem Clubrush
Schoenoplectus tabernaemontani	Soft-stem Club-rush
Scirpus atrovirens	Black Bulrush
Scirpus cyperinus	Cottongrass Bulrush
Scirpus microcarpus	Red-tinge Bulrush
FAMILY IRIDACEAE	**Iris Family**
Iris versicolor	Blueflag
Sisyrinchium montanum	Strict Blue-eyed-grass
FAMILY JUNCACEAE	**Rush Family**
Juncus balticus	Baltic Rush
Juncus nodosus	Knotted Rush
Luzula acuminata	Hairy Woodrush
FAMILY LEMNACEAE	**Duckweed Family**
Lemna minor	Lesser Duckweed
FAMILY LILIACEAE	**Lily Family**
Clintonia borealis	Blue Bead-lily
Maianthemum canadense	Wild-lily-of-the-valley
Maianthemum stellatum	Starflower FALSE Solomon's-seal
Maianthemum trifolium	Three-leaf Solomon's-seal
Streptopus amplexifolius	White Mandarin
Streptopus lanceolatus	Rose Twisted-stalk
Trillium cernuum	Nodding Trillium
FAMILY ORCHIDACEAE	**Orchid Family**
Coeloglossum viride	Long-bract Green Orchid
Corallorhiza maculata	Spotted Coralroot
Corallorhiza trifida	Early Coralroot
Cypripedium acaule	Pink Lady's-slipper
Goodyera repens	Dwarf Rattlesnake-plantain
Goodyera tesselata	Checkered Rattlesnake-plantain
Liparis loeselii (R)	Loesel's Twayblade
Listera auriculata (*)	Auricled Twayblade
Listera cordata	Heartleaf Twayblade
Platanthera aquilonis	Leafy Northern Green Orchid
Platanthera hookeri (*)	Hooker's Orchid
Platanthera obtusata	Small Northern Bog-orchid
Platanthera orbiculata	Large Round-leaved Orchid
Platanthera psycodes (R)	Small Purple-fringed Orchid
FAMILY POACEAE	**Grass Family**
Beckmannia syzigachne	American Sloughgrass
Bromus ciliatus	Fringed Brome
Calamagrostis canadensis	Blue-joint Reedgrass
Cinna latifolia	Slender Wood Reedgrass
Elymus hystrix (R)	Bottlebrush Grass
Glyceria grandis	American Mannagrass
Glyceria striata	Fowl Mannagrass
Hierochloe odorata	Holy Grass

Leersia oryzoides (R)	Rice Cutgrass
Phleum pratense	Meadow Timothy
Poa palustris	Fowl Bluegrass
FAMILY POTAMOGETONACEAE	**Pondweed Family**
Potamogeton epihydrus	Ribbon-leaf Pondweed
Potamogeton gramineus	Grass-like Pondweed
Potamogeton natans	Floating Pondweed
Potamogeton richardsonii	Richardson's Pondweed
FAMILY SPARGANIACEAE	**Bur-reed Family**
Sparganium emersum	Greenfruit Bur-reed
Sparganium eurycarpum	Large Bur-reed
Sparganium fluctuans	Floating Bur-reed
Sparganium natans	Small Bur-reed
FAMILY TYPHACEAE	**Cattail Family**
Typha latifolia	Broad-leaf Cattail
SUBCLASS DICOTYLEDONEAE	
FAMILY ACERACEAE	**Maple Family**
Acer negundo	Box Elder
Acer spicatum	Mountain Maple
FAMILY ANACARDIACEAE	**Sumac Family**
Toxicodendron radicans	Poison Ivy
FAMILY APIACEAE	**Parsley Family**
Cicuta bulbifera	Bulb-bearing Water-hemlock
Heracleum lanatum	Cow-parsnip
Osmorhiza depauperata	Blunt-fruited Sweet-cicely
Osmorhiza longistylis	Smoother Sweet-cicely
Sanicula marilandica	Black Snake-root
Sium suave	Hemlock Water-parsnip
FAMILY APOCYNACEAE	**Dog Bane Family**
Apocynum androsaemifolium	Spreading Dogbane
FAMILY ARALIACEAE	**Ginseng Family**
Aralia hispida	Bristly Sarsaparilla
Aralia nudicaulis	Wild Sarsaparilla
FAMILY ARISTOLOCHIACEAE	**Birthwort Family**
Asarum canadense	Canada Wild-ginger
FAMILY ASTERACEAE	**Sunflower Family**
Achillea millefolium	Yarrow
Anaphalis margaritacea	Pearly Everlasting
Antennaria neglecta	Field Pussytoes
Antennaria parlinii	Parlin's Pussytoes
Aster umbellatus	Flat-topped Aster
Eurybia macrophylla	Large-leaf Wood-aster

Symphyotrichum ciliolatum	Ciliate wood aster
Symphyotrichum lanceolatum	Panicled Aster
Symphyotrichum lateriflorum	Small White Aster
Symphyotrichum puniceum	Swamp Aster
Bidens frondosa (R)	Devil's Beggar-ticks
Chrysanthemum leucanthemum	Oxeye Daisy
Cirsium arvense	Crepping Thistle
Cirsium muticum	Swamp Thistle
Cirsium vulgare	Bull Thistle
Conyza canadensis	Canadian Horseweed
Erigeron philadelphicus	Philadelphia Fleabane
Erigeron strigosus	Daisy Fleabane
Eupatorium maculatum	Spotted Joepyeweed
Euthamia graminifolia	Grass-leaved Goldenrod
Hieracium aurantiacum	Orange Hawkweed
Hieracium canadense	Canada Hawkweed
Hieracium piloselloides	Tall Hawkweed
Hieracium praealtum	King Devil
Lactuca biennis	Tall Blue Lettuce
Lactuca canadensis	Canada Lettuce
Petasites frigidus	Sweet Coltsfoot
Prenanthes alba	White Rattlesnakeroot
Solidago canadensis	Canada Goldenrod
Solidago hispida	Hairy Goldenrod
Solidago juncea	Early Goldenrod
Solidago nemoralis	Gray Goldenrod
Solidago uliginosa	Bog Goldenrod
Tanacetum vulgare	Common Tansy
Taraxacum officinale	Brown-seed Dandelion
FAMILY BALSAMINACEAE	**Touch-me-not Family**
Impatiens capensis	Spotted Jewel-weed
FAMILY BERBERIDACEAE	**Barberry Family**
Caulophyllum thalictroides (R)	Blue Cohosh
FAMILY BETULACEAE	**Birch Family**
Alnus incana	Speckled Alder
Alnus viridis	Green Alder
Betula papyrifera	Paper Birch
Corylus cornuta	Beaked Hazelnut
FAMILY BORAGINACEAE	**Borage Family**
Hackelia deflexa	Northern Stickseed
Mertensia paniculata	Tall Bluebells
FAMILY BRASSICACEAE	**Mustard Family**
Arabis divaricarpa	Limestone Rockcress
Arabis glabra	Tower-mustard
Arabis hirsuta	Hairy Rockcress
Arabis lyrata	Lyre-leaf Rockcress
Barbarea vulgaris	Yellow Rocket

Cardamine parviflora	Small-flower Bitter-cress
Erysimum cheiranthoides	Worm-seed Mustard
Rorippa palustris	Bog Yellowcress
FAMILY CALLITRICHACEAE	**Water Starwort Family**
Callitriche hermaphroditica	Autumnal Water-starwort
FAMILY CAMPANULACEAE	**Harebell Family**
Campanula rotundifolia	American Harebell
Lobelia inflate (R)	Indian-tobacco
FAMILY CAPRIFOLIACEAE	**Honeysuckle Family**
Diervilla lonicera	Northern Bush-honeysuckle
Linnaea borealis	Twinflower
Lonicera canadensis	American Fly-honeysuckle
Lonicera hirsuta	Hairy Honeysuckle
Lonicera villosa	Mountain Fly-honeysuckle
Sambucus racemosa	Red-berried Elderberry
Symphoricarpos albus	Common Snowberry
Viburnum edule	Squashberry
Viburnum rafinesquianum	Downy Arrowwood
Viburnum trilobum	Highbush Cranberry
FAMILY CARYOPHYLLACEAE	**Pink Family**
Cerastium arvense	Field Mouse-ear Chickweed
Dianthus armeria	Deptford-pink
Silene antirrhina	Sleepy Catchfly
Stellaria longifolia	Longleaf Stitchwort
FAMILY CONVOLVULACEAE	**Morning Glory Family**
Calystegia sepium	Hedge Bindweed
Calystegia spithamaea	Low Bindweed
FAMILY CORNACEAE	**Dogwood Family**
Cornus alternifolia	Alternate-leaf Dogwood
Cornus canadensis	Bunchberry
Cornus rugosa	Roundleaf Dogwood
Cornus stolonifera	Red-osier Dogwood
FAMILY DROSERACEAE	**Sundew Family**
Drosera rotundifolia	Roundleaf Sundew
FAMILY ELAEAGNACEAE	**Oleaster Family**
Shepherdia canadensis	Canada Buffalo-berry
FAMILY ERICACEAE	**Heath Family**
Andromeda polifolia	Glaucophylla - Bog Rosemary
Arctostaphylos uva-ursi	Bearberry
Chamaedaphne calyculata	Leatherleaf
Gaultheria hispidula	Creeping Snowberry
Kalmia polifolia	Pale Laurel
Ledum groenlandicum	Common Labrador Tea

Vaccinium angustifolium	Late Lowbush Blueberry
Vaccinium myrtilloides	Velvetleaf Blueberry
Vaccinium oxycoccos	Small Cranberry
Vaccinium vitis-idaea (+)	Mountain Cranberry
FAMILY FABACEAE	**Pea Family**
Lathyrus ochroleucus	Pale Vetchling Peavine
Lathyrus venosus	Smooth Veiny Peavine
Lotus corniculatus	Birds-foot Trefoil
Melilotus alba	White Sweetclover
Trifolium aureum	Yellow Clover
Trifolium hybridum	Alsike Clover
Trifolium pratense	Red Clover
Vicia americana	American Purple Vetch
Vicia cracca	Tufted Vetch
FAMILY FUMARIACEAE	**Fumitory Family**
Corydalis sempervirens	Pale Corydalis
FAMILY GENTIANACEAE	**Gentian Family**
Halenia deflexa	Spurred Gentian
FAMILY GERANIACEAE	**Geranium Family**
Geranium bicknellii	Bicknell Northern Crane's-bill
FAMILY GROSSULARIACEAE	**Currant Family**
Ribes americanum	Wild Black Currant
Ribes glandulosum	Skunk Currant
Ribes hirtellum	Smooth Gooseberry
Ribes lacustre	Bristly Black Currant
Ribes oxyacanthoides	Canada Gooseberry
Ribes triste	Swamp Red Currant
FAMILY HALORAGACEAE	**Water Milfoil Family**
Myriophyllum verticillatum	Whorled Water-milfoil
FAMILY LAMIACEAE	**Mint Family**
Galeopsis tetrahit	Brittle-stem Hempnettle
Lycopus americanus	American Bugleweed
Lycopus uniflorus	Northern Bugleweed
Mentha arvensis	Common Mint
Physostegia virginiana	False Dragon-head
Prunella vulgaris	Self-heal
Scutellaria galericulata	Hooded Skullcap
Scutellaria lateriflora	Mad Dog Skullcap
Stachys palustris	Marsh Hedge-nettle
FAMILY MONOTROPACEAE	**Indian Pipe Family**
Monotropa hypopithys (R)	American Pinesap
Monotropa uniflora	Indian-pipe
FAMILY MYRICACEAE	**Bayberry Family**

Myrica gale	Sweet Bayberry
FAMILY NYMPHAEACEAE	**Water Lily Family**
Nuphar variegata	Yellow Cowlily
FAMILY OLEACEAE	**Olive Family**
Fraxinus nigra	Black Ash
FAMILY ONAGRACEAE	**Evening Primrose Family**
Circaea alpina	Small Enchanter's Nightshade
Circaea lutetiana (R)	Southern Broadleaf Enchanter's Nightshade
Epilobium angustifolium	Fireweed
Epilobium ciliatum	Hairy Willow-herb
Oenothera biennis	Common Evening-primrose
FAMILY PAPAVERACEAE	**Poppy Family**
Sanguinaria canadensis	Bloodroot
FAMILY PLANTAGINACEAE	**Plantain Family**
Plantago major	Nipple-seed Plantain
FAMILY POLYGALACEAE	**Milkwort Family**
Polygala paucifolia	Gay-wing Milkwort
FAMILY POLYGONACEAE	**Buckwheat Family**
Polygonum cilinode	Fringed Black Bindweed
Polygonum lapathifolium	Dock-leaf Smartweed
Polygonum persicaria	Lady's Thumb
Rumex orbiculatus	Water Dock
Rumex triangulivalvis	Triangular-valve Dock
FAMILY PRIMULACEAE	**Primrose Family**
Lysimachia ciliata	Fringed Loosestrife
Lysimachia terrestris	Swamp Loosestrife
Lysimachia thyrsiflora	Water Loosestrife
Trientalis borealis	Northern Starflower
FAMILY PYROLACEAE	**Wintergreen Family**
Chimaphila umbellata	Common Wintergreen
Moneses uniflora	One-flower Wintergreen
Orthilia secunda	One-side Wintergreen
Pyrola asarifolia	Pink Wintergreen
Pyrola chlorantha	Greenish-flowered Wintergreen
Pyrola elliptica	Shinleaf
Pyrola minor	Lesser Wintergreen
FAMILY RANUNCULACEAE	**Buttercup Family**
Actaea rubra	Red Baneberry
Anemone canadensis	Canada Anemone
Anemone quinquefolia	Wood Anemone
Anemone virginiana	Virginia Anemone
Aquilegia canadensis	Wild Columbine

Caltha palustris	Marsh Marigold
Clematis occidentalis	Purple Clematis
Clematis virginiana	Virginia Virgin-bower
Coptis trifolia	Goldthread
Ranunculus abortivus	Kidney-leaved Buttercup
Ranunculus acris	Tall Butter-cup
Ranunculus hispidus	Bristly Buttercup
Ranunculus lapponicus (+)	Lapland Buttercup
Ranunculus macounii	Macoun Buttercup
Ranunculus pensylvanicus	Bristly Crowfoot
Thalictrum dasycarpum	Purple Meadowrue
Thalictrum dioicum	Early Meadowrue
Thalictrum venulosum	Veiny Meadowrue
FAMILY RHAMNACEAE	**Buckthorn Family**
Rhamnus alnifolia	Alderleaf Buckthorn
FAMILY ROSACEAE	**Rose Family**
Agrimonia striata	Woodland Agrimony
Amelanchier sp.	Saskatoon sp.
Crataegus douglasii (R)	Douglas's Hawthorn
Fragaria vesca	Woodland Strawberry
Fragaria virginiana	Virginia Strawberry
Geum aleppicum	Yellow Avens
Potentilla anserine	Silverweed
Potentilla arguta	Tall Cinquefoil
Potentilla norvegica	Norwegian Cinquefoil
Potentilla palustris	Marsh Cinquefoil
Potentilla pensylvanica	Pennsylvania Cinquefoil
Prunus virginiana	Choke Cherry
Rosa acicularis	Prickly Rose
Rosa blanda	Smooth Rose
Rubus chamaemorus	Cloudberry
Rubus idaeus	Common Red Raspberry
Rubus parviflorus	Thimbleberry
Rubus pubescens	Dwarf Raspberry
Sorbus Americana	American Mountain-ash
Sorbus decora	Northern Mountain-ash
Spiraea alba	Narrow-leaved Meadow-sweet
FAMILY RUBIACEAE	**Bedstraw Family**
Galium asprellum	Rough Bedstraw
Galium boreale	Northern Bedstraw
Galium trifidum	Small Bedstraw
Galium triflorum	Sweet-scent Bedstraw
FAMILY SALICACEAE	**Willow Family**
Populus balsamifera	Balsam Poplar
Populus tremuloides	Trembling Aspen
Salix bebbiana	Bebb's Willow
Salix discolor	Pussy Willow

Salix humilis	Tall Prairie Willow
Salix pyrifolia	Balsam Willow
FAMILY SANTALACEAE	**Sandalwood Family**
Geocaulon lividum	Northern Comandra
FAMILY SAXIFRAGACEAE	**Saxifrage Family**
Mitella nuda	Naked Bishop's-cap
Parnassia palustris	Marsh Grass-of-parnassus
Saxifraga paniculata (+)	White Mountain-saxifrage
Saxifraga virginiensis	Virginia Saxifrage
FAMILY SCROPHULARIACEAE	**Figwort Family**
Melampyrum lineare	American Cow-wheat
Mimulus ringens	Square-stem Monkeyflower
Veronica Americana	American Speedwell
FAMILY ULMACEAE	**Elm Family**
Ulmus americana	American Elm
FAMILY URTICACEAE	**Nettle Family**
Laportea Canadensis (R)	Wood Nettle
FAMILY VIOLACEAE	**Violet Family**
Viola conspersa	American Bog Violet
Viola nephrophylla	Northern Bog Violet
Viola palustris	Alpine Marsh Violet
Viola pubescens	Downy Yellow Violet
Viola renifolia	Kidney-leaf White Violet
Viola sororia	Woolly Blue Violet

The following species were found at Pine Bay during fieldwork in the summers of 2009 and 2010. Scientific nomenclature and provincially rare status (*) are as published on the Natural Heritage Information Centre website. Assessment of the regional rarity (R) of these plants is based on the Checklist of Vascular Plants of the Thunder Bay District. Arctic alpine disjunct species (+) are as referenced in Thunder Bay Field Naturalists 2003.

*	Provincially rare species
R	Regionally rare species
+	Arctic alpine disjunct species

APPENDIX E:

COMMON AND LATIN NAMES OF IDENTIFIED PINE BAY PHASE I NATURE RESERVE WILDLIFE SPECIES

Appendix E: Common and Latin Names of Identified Pine Bay Phase I Nature Reserve Wildlife Species

Source: Thunder Bay Field Naturalists

Butterflies	
Common Names	**Latin Names**
Dreamy Duskywing	*Erynnis icelus*
European Skipper	*Thymelicus lineola*
Hobomok Skipper	*Poanes hobomak*
Canadian Tiger Swallowtail	*Papillio canadensis*
Western White *	*Pontia occidentalis*
Cabbage White	*Pieris rapae*
Large Marble *	*Euchloe ausonides*
Spring Azure	*Celastrina ladon*
Silvery Blue	*Glaucopsyche lygdamus*
Atlantis Fritillary	*Speyeria atlantis*
Silver-bordered Fritillary	*Boloria selene*
Northern Crescent	*Phyciodes cocyta*
Green Comma	*Polygonia faunus*
Compton Tortoiseshell	*Nymphalis vaualbum*
Mourning Cloak	*Nymphalis antiopa*
Red Admiral	*Vanessa atalanta*
Northern Pearly-Eye	*Enodia anthedon*
American Lady	*Vanessa virginiensis*

Dragonflies	
Common Names	**Latin Names**
Canada Darner	*Aeshna Canadensis*
Crimson-riged Whiteface	*Leucorrhinia glacialis*
Dot-tailed Whiteface	*Leucorrhinia intacta*
Chalk-fronted Skimmer	*Ladona Julia*
Four-spotted Simmer	*Libellula quadrimaculata*
White-faced Meadowfly	*Sympertrum obtrusum*
River Jewelwing	*Calopteryx aequabile*

Amphibians and Reptiles	
Common Names	**Latin Names**
American Toad	*Bufo americanus*
Gray Treefrog	*Hyla versicolor*
Spring Peeper	*Pseudacris crucifer*
Green Frog	*Rana clamitans melanota*
Wood Frog	*Rana sylvatica*
Eastern Gartersnake	*Thamnophis sirtalis sirtalis*

Mammals	
Common Names	**Latin Names**
Northern Gray Wolf	*Canis lupus occidentalis*
Snowshoe Hare	*Lepus americanus*
Least Chipmunk	*Neotamias minimus*
Eastern Chipmunk	*Tamius striatus*
Red Squirrel	*Tamiasciurus hudsonicus*
Beaver	*Castor Canadensis*
Star-nosed Mole	*Condylura cristata*
Moose	*Alces alces*
Northern American River Otter	*Lontra Canadensis*
American Marten	*Martes Americana*
White-tailed Deer	*Odocoileus virginianus*
Southern Bog Lemming	*Synaptomys cooperi*
American Black Bear	*Ursus americanus*

The following species were observed at Pine Bay during fieldwork in 2009 and 2010. Observations were made on a casual basis and no trapping or specific surveys were conducted. Common and scientific names as well as provincially rare species (*) and taxonomic order are as used on the Natural Heritage Information Centre website.

*	Provincially rare species

APPENDIX F:

FOREST ECOSYSTEM CLASSIFICATION

Appendix F: Forest Ecosystem Classification

Site 1: V7 Trembling Aspen – Balsam Fir/Balsam Fir Shrub

Description: Hardwood mixed woods, typically with a two tiered canopy. In general, trembling aspen constitutes the overstory with balsam fir in the secondary canopy. Understory development is variable with balsam fir, *Aralia nudicaulis* and *Diervilla lonicera* often abundant. This occurs mainly on deep, fresh, well-drained, fine-textured mineral soils.

Common Overstory Species:

balsam fir, trembling aspen, white birch, white spruce, black spruce, jack pine

Common Understory Species:

Shrubs: *Abies balsamia, Rubus pubescens, Diervilla lonicera, Acer spicatum, Rosa acicularis, Populus tremuloides, Corylus cornuta, Linnaea borealis, Sorbus decora*

Herbs: *Maianthemum canadense, Aralia nudicaulis, Cornus Canadensis, Clintonia borealis, Aster macrophyllus, Streptopus roseus, Trientalis borealis, Viola renifolia, Mitella nuda, Petasites palmatus, Anemone quinquefolia, Gallium triflorum*

Mosses: *Pleurozium schreberi, Rhytidiadelphus triquetrus*

Forest Floor Cover:

Broadleaf litter: 81 Moss: 7 Conifer litter: 6 Wood: 5

Site 2, Site 4: V15 White Spruce Mixedwood

Description: A variable mixedwood Type with white spruce as the main canopy species. The understory ranges from herb and shrub rich to poor, with balsam fir commonly abundant in the shrub layer. Occurring over a broad range of soil and site conditions but primarily on deep, fresh to moist, mineral soils.

Common Overstory Species:

white spruce, balsam fir, trembling aspen, white birch, black spruce, balsam poplar, red maple, jack pine

Common Understory Species:

Shrubs: balsam fir, Acer spicatum, *Rubus pubescens, Corylus cornuta, Sorbus décor, Linnaea borealis, Diervilla lonicera, Rose acicularis, Amelanchier spp., trembling aspen*

Herbs*: Aralia nudicaulis, Cornus Canadensis, Clintonia borealis, Maianthemum canadense, Streptopus roseus, Trientalis borealis, Calium triforum, Aster macrophyllus, Mitella nuda, Viola renifolia, Anemone quinquefolia, Petasites palmatus*

Mosses*: Pleurozium schreberi, Ptilium crista-castrensis, Rhytidiadelphus triquetrus, Plagiomnium cuspidatum*

Forest Floor Cover:

Broadleaf litter: 61 Moss: 16 Conifer litter: 13 Wood: 5

Site 3, Site 10: V9 Trembling Aspen Mixedwood

Description: Hardwood mixedwoods with a shrub and herb rich understory. Typically, trembling aspen is the main tree species. *Corylus cornuta,* balsam fir, *Alnus crispa, Diervilla lonicera, Aralia nudicaulis* and *Aster macrophyllus* can be abundant in the understory. Occurring mainly on deep, fresh, well-drained mineral soils.

Common Overstory Species:

trembling aspen, white spruce, white birch, balsam fir, black spruce, jack pine, red maple

Common Understory Species:

Shrubs: *Rubus pubescens,* balsam fir, *Diervilla lonicera, Corylus cornuta, Amelanchier spp., Rosa acicularis,* trembling aspen, *Linnaea borealis, Acer spicatum*

Herbs*: Maianthemum canadense, Cornus Canadensis, Aralia nudicaulis, Aster macrophyllus, Steptopus roseus, Clintonia borealis, Trientalis borealis, Galium triflorum, Mitella nuda, Viola renifolia, Petasites palmatus, Anemone quinquefolia*

Mosses*: Pleurozium schreberi, Ptilium crista-castrensis, Rhytidiadelphus triquetrus, Plagiomnium cuspidatum*

Forest Floor Cover:

Broadleaf litter: 84 Conifer litter: 5 Moss: 5

Site 5, Site 9: V19 Black Spruce Mixedwood / Herb Rich

Description: A black spruce mixedwood type with several potential species in the overstory. The understory is typically dominated by a rich herb/dwarf shrub layer. The shrub stratum ranges from dense to open, usually with balsam fir and black spruce as important components. Forest floor cover varies from moss rich to mainly broadleaf litter. Occurring on a range of site conditions although mostly on fresh to moist, mineral soils.

Common Overstory Species:

black spruce, trembling aspen, jack pine, balsam fir, white birch, white spruce, balsam poplar

Common Understory Species:

Shrubs: *Linnaea borealis, balsam fir, Rubus pubescens, Vaccinium myrtilloides, black spruce, Rosa acicularis, Amelanchier spp., Vaccinium angustifolium, Sorbus decora, Gaultheria hispidula, Diervilla lonicera, Ledum groenlandicum, trembling aspen*

Herbs: *Cornus Canadensis, Maianthemum canadense, Clintonia borealis, Trientalis borealis, Aralia nudicaulis, Coptis trifolia, Petasites palmatus, Aster macrophyllus, Streptopus roseus, Voila renifolia*

Mosses: *Pleurozium schreberia, Ptilium crista-castrensis, Dicranum polysetum, Hylocomium splendens, Rhytidiadephus triquetrus*

Forest Floor Cover:

Moss: 49 Broadleaf litter: 33 Conifer litter: 12

Site 6, Site 7: V10 Trembling Aspen – Black Spruce – Jack Pine/Low Shrub

Description: Hardwood mixedwoods with black spruce and jack pine as the primary conifer tree species. The herb and low shrub layers are usually rich in broadleaved species, often with abundances of *Diervilla lonicera* and *Aster macrophyllus.* Occurring mainly on deep, fresh, well to rapidly drained mineral soils.

Common Overstory Species:

Trembling aspen, black spruce, jack pine, white birch, balsam fir, white spruce

Common Understory Species:

Shrubs: *Diervilla lonicera, Linnaea borealis, Rubus pubescens,* balsam fir, *Vaccinium myrilloides, V. angustifolium,* trembling aspen, *Rosa acicularis, Amelanchier spp.,* black spruce, *Alnus crispa, Sorbus decora*

Herbs: *Cornus Canadensis, Maianthemum canadense, Aralia nudicaulis, Clintonia borealis, Streptopus roseus, Aster macrophyllus, Trientalis borealis, Viola renifolia, Coptis trifolia, Epilobium angustifolium, Lycopodium clavatum*

Mosses: *Pleurozium schreberia, Ptilium crista-castrensis, Dicranum polysetum,*

Forest Floor Cover:

Broadleaf litter: 73 Conifer litter: 10 Moss:10 Wood:6

Site 8: V35 Black Spruce/Speckled Alder/Sphagnum

Description: Wet, shrub rich black spruce stands, occasionally with other conifers in the canopy. *Alnus rugosa*, often in association with black spruce and balsam fir, is abundant in the tall shrub layer. Species diversity in the herb/dwarf shrub layer can be high. Ground cover consists of *Sphagnum* and feathermoss, often with large patches of broadleaf litter. Occurring on wet, lowland sites.

Common Overstory Species:

black spruce, balsam fir, tamarack, white cedar

Common Understory Species:

Shrubs: *Alnus rugosa, Gaultheria hispidula, Ledum groenlandicum, black spruce, Linnaea borealis, Vaccinium myrtilloides, Rubus pubescens,* balsam fir, *Vaccinium angustifolium, Sorbus decora, Oxycoccus microcarpus*

Herbs: *Cornus Canadensis, Equisetum sylvaticum, Smilacina trifolia, Trientalis borealis, Mitella nuda, Coptis trifolia, Mainanthemum canadense, Viola renifolia, Clintonia borealis, Petasites palmatus, Carex trisperma*

Mosses: *Pleurozium schreberia, Sphagnum girgensohnii, S. nemoreum, Ptilium crista-castrensis, Sphagnum magellanicum, Hylocomium splendens, Aulacomnium palustre, Dicranum polysetum*

Forest Floor Cover:

Moss:79 Graminoid litter:6 Broadleaf litter:5 Conifer litter:5

APPENDIX G:

PLANT SPECIES COMMON AND LATIN NAMES

Appendix G: Plant Species Common and Latin Names

Trees	
Common Names	**Latin Names**
Balsam Fir	*Abies balsamea*
Balsam Poplar	*Populus balsamifera*
Black Ash	*Fraxinus nigra*
Black Spruce	*Picea mariana*
Eastern White Cedar	*Thuja occidentalis*
Jack Pine	*Pinus banksiana*
Manitoba Maple	*Acer negundo*
Mountain Ash	*Sorbus americana*
Mountain Maple	*Acer spicatum*
Red Ash	*Fraxinus pennsylvanica*
Red Pine	*Pinus resinosa*
Speckled Alder	*Alnus rugosa*
Tamarack/Eastern Larch	*Larix laricina*
Trembling Aspen	*Populus tremuloides*
White Birch	*Betula papyrifera*
White Pine	*Pinus strobus*
White Spruce	*Picea glauca*

Shrubs	
Common Names	Latin Names
Balsam Poplar	*Populus balsamifera*
Beaked Hazel	*Corylus cornuta*
Bear Berry	*Arctostaphylos uva-ursi*
Buffalo Berry	*Shepherdia canadensis*
Bush Honeysuckle	*Diervilla lonicera*
Canada Elderberry	*Sambucus canadensis*
Chokecherry	*Prunus virginiana*
Currant Spp.	*Ribes spp.*
Gooseberry	*Ribes spp.*
Hairy Honeysuckle	*Lonicera hispidula*
High-bush Cranberry	*Viburnum trilobum*
Honeysuckle Spp.	*Lonicera spp.*
Ninebark	*Physocarpus Spp.*
Pincherry	*Prunus pensylvanica*

Prickly Wild rose	*Rosa acicularis*
Pussy Willow	*Salix discolor*
Red Berried Elder	*Sambucus racemosa*
Red-osier Dogwood	*Cornus stolonifera*
Saskatoon (serviceberry)	*Amelanchier alnifolia*
Slender Willow	*Salix petiolaris*
Swamp Red Currant	*Ribes triste*
Sweet Gale	*Myrica gale*
Wild Red Raspberry	*Rubus idaeus var. strigosus*
Willow	*Salix spp.*
Leather Leaf	*Chamaedaphne calyculata*

Herbs	
Common Names	**Latin Names**
Aster	*Symphyotrichum spp.*
Birdsfoot Trefoil	*Lotus cornicutatus*
Meadowsweet	*Latifolia*
Bunch Berry	*Cornus canadensis*
Buttercup	*Ranunculus repens*
Canada Anemone	*Anemone Canadensis*
Canada Goldenrod	*Solidago Canadensis*
Canada Mayflower	*Maianthemum*
Canada Thistle	*Cirsium arvense*
Common Evening Primose	*Oenothera biennis*
Common Plantain	*Plantago major*
Common Strawberry	*Fragaria virginiana*
Common Yarrow	*Achillea millefolium*
Corn Sow Thistle	*Sonchus arvensis*
Cow Parsnip	*Heracleum lanatum*
Cow Vetch	*Vivia cracca*
Cream Colored Vetchling	*Lathyrus ochroleucus*
Creeping Bellflower	*Campanula rapunculoides*
Crown Vetch	*Coronilla varia*
Dandelion	*Taraxacum officinale*
Dwarf Raspberry	*Rubus pubesiens*
Early Meadow-Rue	*Thalictrum dioicum*
Heal-All	*Prunella vulgaris*
Hop Clover	*Trifolium aureum*

Kidney-leaved Violet	*Viola renifolia*
Jewelweed	*Impatiens capensis*
Large Leaf Aster	*Aster macrophyllus*
Fragrant Bedstraw	*Galium triflorum*
Golden Rod	*Solidago spp.*
Grasses	*Poaceae spp.*
Lily	*Liliaceace spp.*
Lupine	*Lupinus polyphyllus*
Meadow-rue	*Thalictrum*
Mountain Blueeyed Grass	*Sisyrinchium montanum*
Naked Mitrewort	*Mitella nuda*
Narrowleaf Spirea	*Spiraea alba*
Northern Bluebell	*Mertensia paniculata*
Northern Blueflag	*Iris versicolor*
Northern Blue Violet	*Viola septentrionalis*
Northern Marsh Violet	*Viola epipsila*
Northern Sweet Coltsfoot	*Petasites frigidus*
Nodding Trillum	*Trillium cernum*
Orange Hawkweed	*Hieracium aurantiacum*
Ox-eye Daisy	*Leucanthemum vulgare*
Pearly Everlasting	*Anaphalis margaritacea*
Pineapple Weed	*Matricaria discoidea*
Pink Pyrola	*Pyrola asarifolia*
Red Clover	*Trifolium pratense*
Rose-Twisted Stalk	*Streptopus amplexifolius*
Wild Sasparilla	*Aralia nudicaulis*
Sedges	*Cyperaceae spp.*
Silverwort	*Hepatica triloba*
Stone Crop	*Sedum spp.*
Sweet Coltsfoot	*Petasites frigidus*
Tall White Bog Orchid	*Platanthera dilotata*
Twin Flower	*Linnaea borealis*
Thyme Leaved Sandwort	*Arenaria serphyllifolia*
Violet	*Viola spp.*
Water Horsetail	*Equisetum fluviatile*
Wild Columbine	*Aquilegia canadensis*
Wild Lily-of-the-valley	*Maianthemum canadense*
Wood Lily	*Lilium philadelphicum*

White Baneberry	*Actaea pachypoda*
White Pea Spp.	*Lathyrus sativa*
White Sweet-Clover	*Melilotus alba*
Wild Chamomile	*Matricaria chamomilla*
Wild Chives	*Allium schoenoprasum*
Wood Aneome	*Anemone quinquefolia*
Woodland Strawberry	*Fragaria Vesca*

Ferns/Mosses	
Common Names	**Latin Names**
Spike Moss	*Selaginella spp.*
Central Peat Moss	*Sphagnum centrale*
Cinnamon Fern	*Osmunda cinnamomea*
Common Fern Moss	*Thuidium delicatulum*
Horsetail	*Equisetum spp.*
Lady Fern	*Athyrium filix-femina*
Meadow Horsetail	*Equisetum pratense*
Plume Moss	*Ptilium crista-castrensis*
Sensitive Fern	*Onoclea sensibilis*
Stair Step Moss	*Hylocomium splendens*
Wavy Moss	*Dicranum polysetum*
Field Horsetail	*Equisetum arvense*

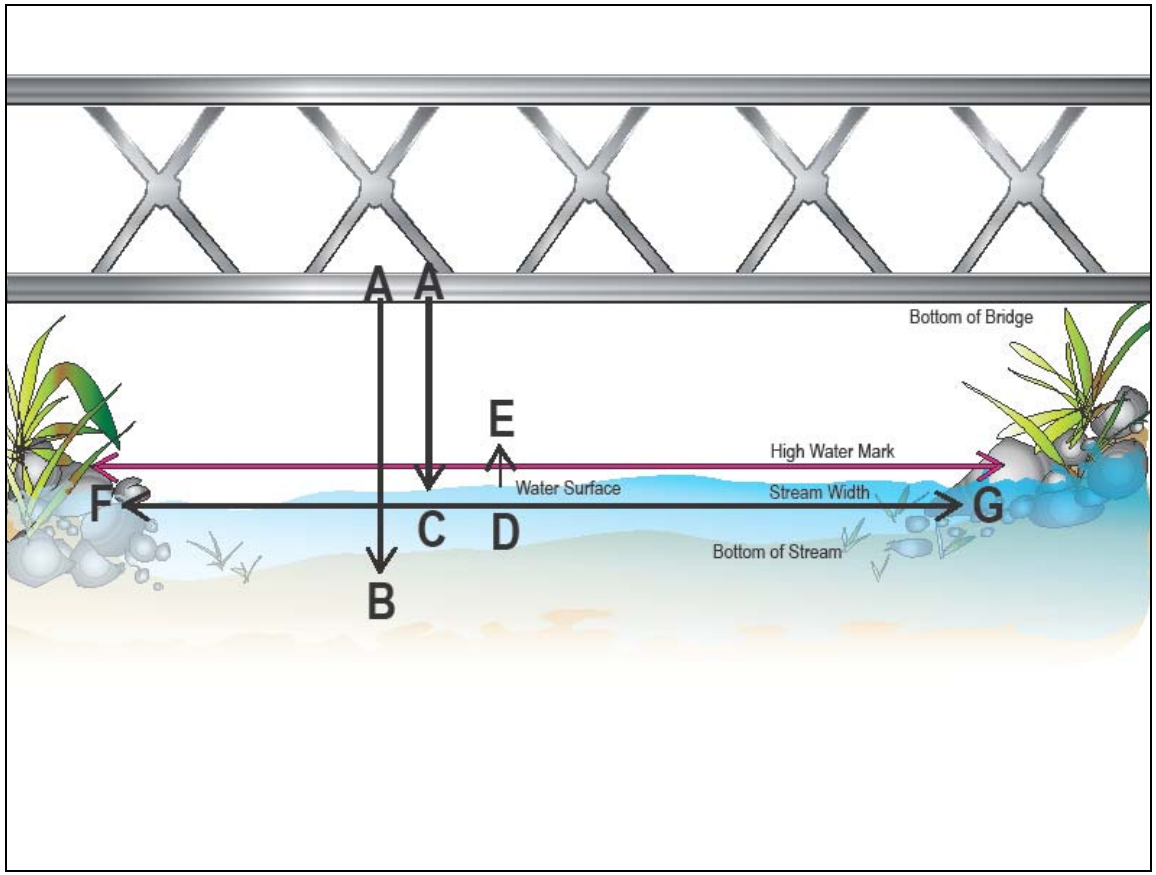
Aquatic Plants	
Common Names	**Latin Names**
Broad-leaved Arrowhead	*Sagittaria latifolia*
Common Cattail	*Typha latifolia*
Green Algae	*Chlorophyta*
Pondweed	*Potamogeton spp.*
Water Smartweed	*Polygonum amphibium*
Yellow Pond Lily	*Nuphar lutea*
Common Bladderwort	*Utricularia vulgaris*
Water Plantain	*Alisma plantago-aquatica*
Floating Arrowhead	*Saggitaria cuneata*
Broad Leaved Arrowhead	*Saggitaria latifolia*
Water Arum, Wild Calla	*Calla palustis*
Pickerelweed	*Pontederia cordata*
Floating Leaved Burreed	*Sparganium fluctuans*

Duckweed	*Lemna spp*
Large Leaved Pondweed	*Potamogeton amplifolius*
Floating Leaved Pondweed	*Potamogeton natans*
Submerged Water Starwort	*Callitriche hermaphroditica*
Coontail	*Ceratophyllum demersum*
Small Yellow Water Crowfoot	*Ranunculus gmelinii*

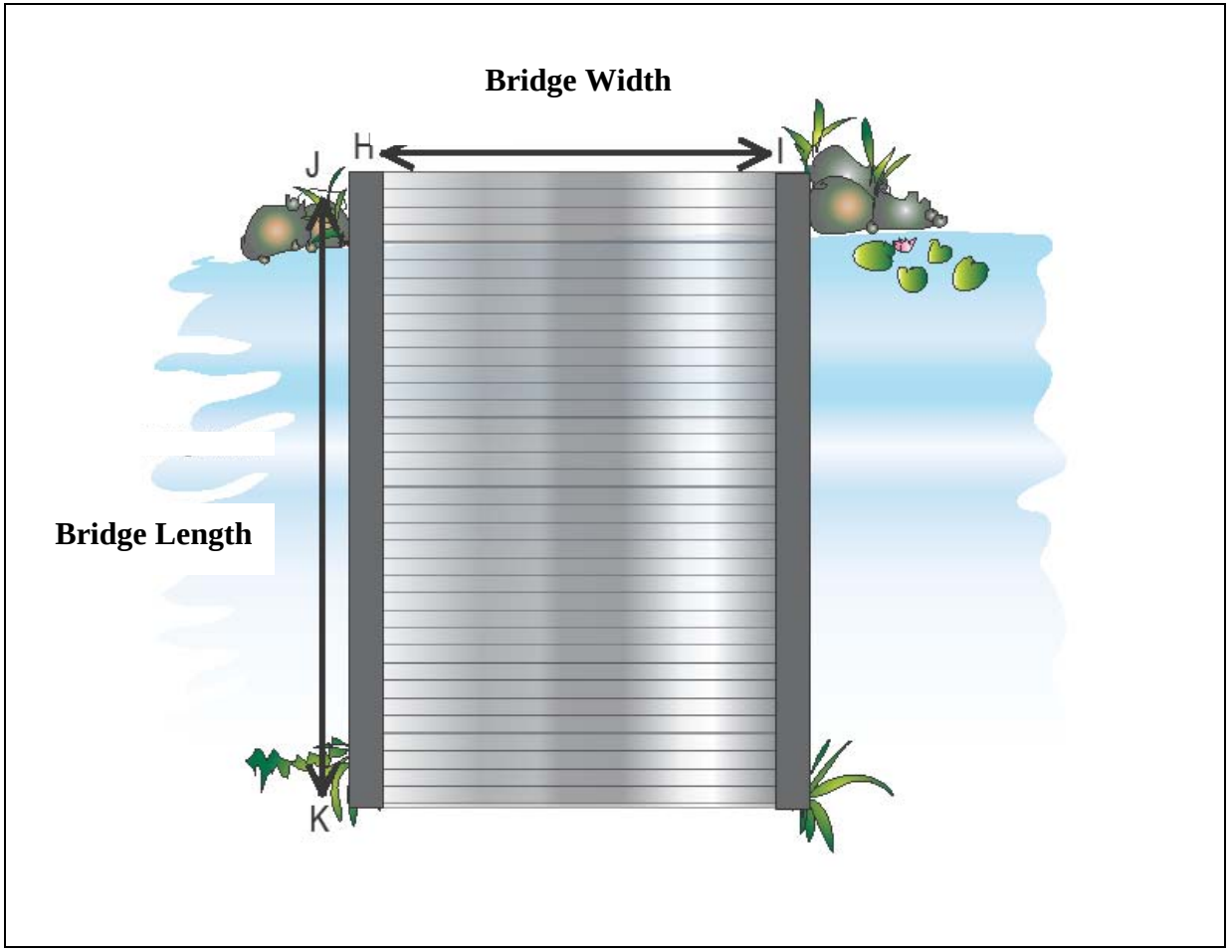
APPENDIX H:

BRIDGE ASSESSMENTS

Appendix H: Bridge Assessments



Bridge Measurement Parameters



Bridge Measurement Parameters

Pine River 2011 Bridge Measurements

Bridge Number	**A-B** Bottom of Bridge to Water Surface (m)	**A-C** Bottom of Bridge to Bottom of Stream (m)	**D-E** Outlet Pool Water Surface to Outlet Pool High Water Mark (m)	**F-G** Width of Stream (m)	**H-I** Length of Bridge (m)	**J-K** Width of Bridge (m)
1	6.58	7.41	2.12	19.00	45.20	13.80
2	2.60	2.95	1.90	9.60	17.60	7.00
3	7.74	8.08	2.80	11.40	41.20	9.70
4	8.92	9.30	N/A	22.50	21.73	6.79
5	2.43	6.04	1.10	11.45	16.13	7.01
6	1.80	2.31	0.95	5.74	10.57	6.75
7	1.69	2.60	N/A	18.35	26.71	4.63
8	5.87	6.96	N/A	11.20	29.14	7.22
9	5.50	6.01	N/A	12.92	31.30	5.93
Maximum Value	8.92	9.30	2.80	22.50	45.20	13.80
Minimum Value	1.69	2.31	0.95	5.74	10.57	4.63
Average	4.79	5.74	1.77	13.57	26.62	7.65

Bridge 1

Location: On Highway 61 south of Memory Road (Site 2)

GPS Coordinates: 5326934 metres North/ 311146 metres East

Description: This bridge was located on a major highway. It was built by reinforced concrete and appeared to be in good condition. The height of the bridge did not appear to alter natural channel characteristics; however, the width of the bridge came into contact with the water on the west side. There was no visible stabilizing fill for this bridge. The banks surrounding the bridge were fairly steep, yet appeared to be stable due to the density of vegetation. A number of swallows nest were noted beneath the deck of the bridge.

Upstream

Downstream

Bridge 2

Location: On Pardee Road west of Crystal Creek (Site 3)

GPS Coordinates: 5329466 metres North / 303442 metres East

Description: This was a steel framed bridge with wooden planks for the base and deck. A new layer of wood was laid on top of the older layer. A wooden retaining wall on both ends of the bridge was used as support on each side of the water. There were two guard rails running along the length of the bridge. Ten wooden posts, five on each end of the bridge, were used for support. Wooden planks were crossed over these posts for additional reinforcement. Shrubs and grasses dominated each side of the banks. A beaver dam on the downstream side of the bridge restricted water flow and resulted in a higher water level on the upstream side of the bridge. Overall, the bridge was in fairly good shape but regular maintenance should be conducted as this bridge was located in an area where high water levels cause visible bank erosion.

Upstream

Downstream

Bridge 3

Location: Intersection of Highway 597 and Highway 595 (Site 4)

GPS Coordinates: 5337727 metres North/ 305999 metres East

Description: This bridge was made of concrete and included a metal rail on each side of the bridge. Large concrete slabs supported and covered by rip rap were located on each side of the bridge. The bridge was still in fairly good condition. There were a few minor concrete filled patches on the deck of the bridge.

Upstream

Downstream

Bridge 4

Location: On Highway 597 west of the Pearson Wetland (Site 6)

GPS Coordinates: 5339544 metres North/ 306445 metres East

Description: This bridge was a Bailey Bridge design: lattice steel designed for rapid assemble from prefabricated standard parts, and was in excellent condition. The bridge deck was steel grating with open holes which would be beneficial during times of high water because the bridge surface will not deteriorate collapse. There were concrete slabs on both sides of the bridge providing the support. There was a metal guard rail located on each side of the bridge. This bridge was located in a very marshy area and was dominated by many aquatic plants as well as terrestrial shrubs and grasses.

Upstream

Downstream

Bridge 5

Location: On Lankinen Road (Site 9)

GPS Coordinates: 5338133 metres North/ 297207 metres East

Description: This was a steel framed bridge which had wooden planks on the deck. A new layer of wood had been laid down on top of the older layer. The steel frame was covered in rust but still appeared to be in good condition. The supports on the side of the bridge were built in a triangular shape. Two steel guard rails were present along the frame. The sides of the bridge were dominated by thick shrubs and grasses.

Upstream

Downstream

Bridge 6

Location: On Falling Snow Road (Site 10)

GPS Coordinates: 5338960 metres North/ 291645 m East

Description: This bridge was composed of wood. The wooden planks were starting to degrade as could be seen by the splintering and breaking apart of the wood. On each side of the bridge timber cribs were used as support. There was a dam located on the upstream side of the bridge which made a significant difference in water depth between both sides of the bridge. Abundant vegetation growth was present around the bridge and surrounding area. Fish and other aquatic life could be seen in the water and there was clear evidence from the beaver dam that one or more beavers were present in the area.

Upstream

Downstream

Bridge 7

Location: On Highway 595 straddling Matson Road and Belanger Road

GPS Coordinates: 5338336 metres North / 299969 metres East

Description: This bridge was a Bailey Bridge design: lattice steel designed for rapid assemble from prefabricated standard parts, and was in excellent condition. The deck of the bridge was made of wooden planks. The bridge was well maintained and looked to be fairly new. Rock and gravel fill was used underneath the two ends of the bridge for support. The vegetation on the sides of the bridge was shrubs and grasses. The bridge was in a lowland area.

Upstream

Downstream

Bridge 8

Location: On Salo Road crossing the Pine River

GPS Coordinates: 5340591 metres North / 304867 metres East

Description: This bridge consisted of a concrete deck with metal and wood guard rails. There were four woods posts, one on each end of the bridge. Wooden support beams were used beneath the bridge in a triangular shape. Large boulders were used underneath the ends of the bridge for support. Willow and alder were the dominant species which surrounded the bridge.

Upstream

Downstream

Bridge 9

Location: On Pardee Road crossing the Pine River

GPS Coordinates: 5331056 metres North / 305460 metres East

Description: This was a new bridge built in 2010 and was in excellent condition. It consisted of wood and had metal guard rails and wooden cribs held together by metal on either side for support. Rip rap was placed around the wooden cribs to prevent erosion and to support the cribs. There was no vegetation directly underneath the bridge because of the presence of the rock fill. A metal beam was placed underneath the wood deck of the bridge for further support.

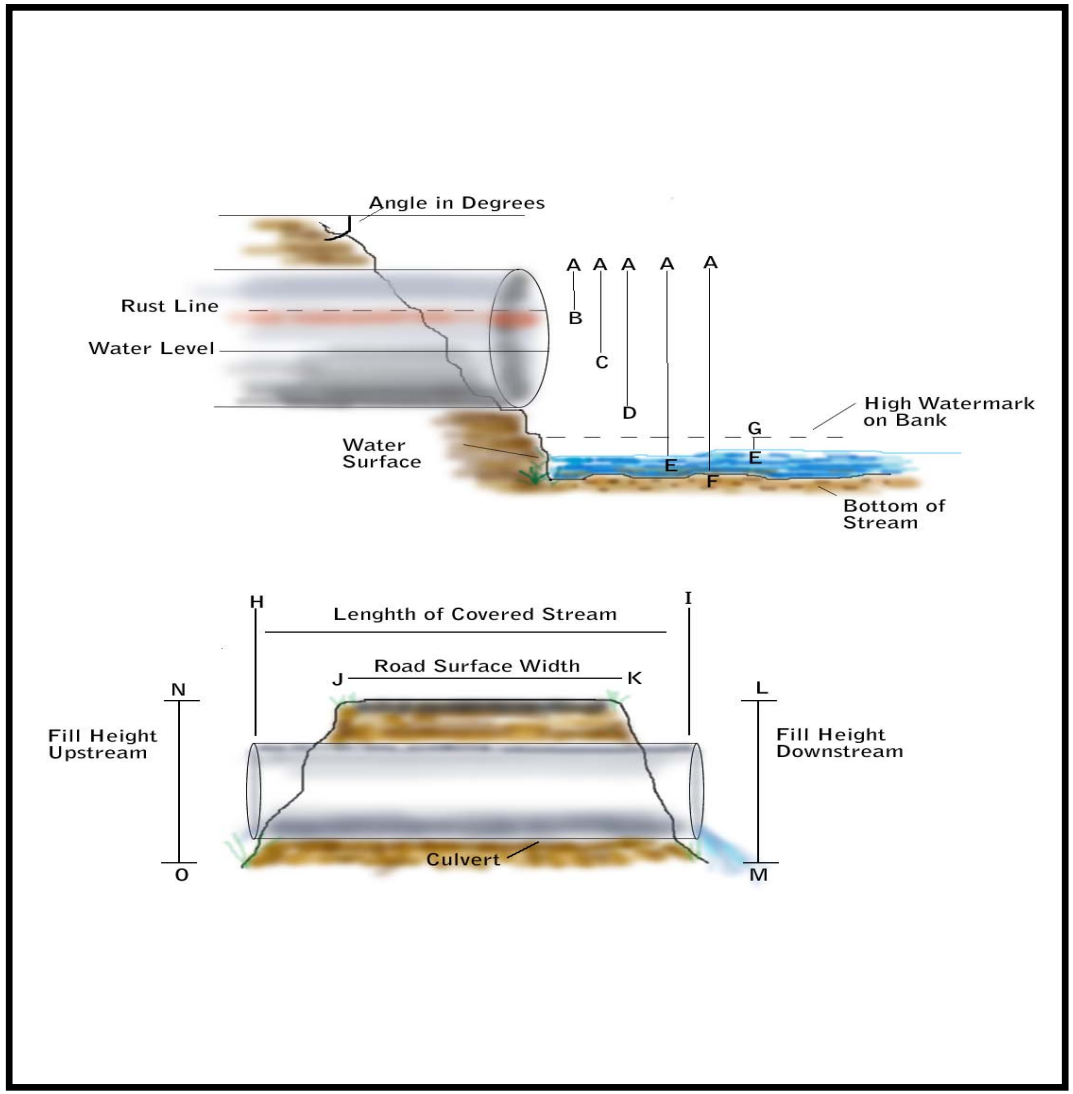
Upstream

Downstream

APPENDIX I:

CULVERT ASSESSMENTS

Appendix I: Culvert Assessments



Pine River 2011 Culvert Measurements

Culvert Number	**J-K** Road Surface Width (m)	**H-I** Length of Covered Stream (m)	**N-O** Fill Height Downstream (m)	**L-M** Fill Height Downstream (m)		**A-D** Width of Opening (cm)	**A-B** Inside Top to Water Surface (cm)	**A-C** Inside Top to Water Surface (cm)	**A-E** Height Above Outlet Pool (cm)	**E-G** Water Surface to High Water Mark (cm)	**A-F** Inside Top to Bottom of Stream (cm)
1	8.80	18.30	>1	>1	Upstream	N/A	N/A	N/A	N/A	N/A	N/A
					Downstream	N/A	N/A	N/A	N/A	N/A	N/A
2	8.50	21.30	6.19	5.67	Upstream	335	N/A	214	214	120	336
					Downstream	460	N/A	218	218	N/A	460
3	10.30	20.35	3.15	3.00	Upstream	260	230	176	176	N/A	260
					Downstream	280	N/A	160	160	N/A	280

Culvert 1

Location: On Highway 595 west of Coulson Road (Site 5)

GPS Coordinates: 5337278 metres North / 303587 metres East

Description: This culvert was located in an area which resembled a wetland as opposed to a river. The culvert did not appear to have any damage or clogging that would restrict water flow, although the current water level was high enough to completely submerge both ends of the culvert. This culvert may not be able to handle the larger volume of water on either side of the road and the road may be at risk of washing out. As shown in the photograph, the culvert was difficult to locate due to its submersion. Flow rate was stagnant and the surrounding vegetation was dominated by grasses and herbs. Regular monitoring of this culvert is recommended as a larger one may need to be installed.

Upstream

Downstream

Culvert 2

Location: On Wamsley Road west of Site 8 (Site 7)

GPS Coordinates: 5342036 metres North/ 303835 metres East

Description: This was an aluminum culvert that appeared to be in excellent condition and seemed large enough to be able to support water flow during times of both high water level and low water level. No rust line was observed during either month. The water level was relatively low compared to the size of the culvert opening, but the culvert was not perched. Rip rap was used to prevent erosion around the culvert

Upstream

Downstream

APPENDIX J:

SOILS

Appendix J: Soils

Soil Name	***Surface Texture***	***Soil Materials***	***Drainage***
Arthur	fine sandy loam, loam	Noncalcareous very fine sand lacustrine 10 to 20 cm thick over calcareaous lacustrine silt and clay	Imperfect
Jarvis River	clay, clay loam, silt loam	Calcareous reddish clay loam, clay or silty clay, varved lacustrine	Moderately well
Lappe	clay, clay loam, silt loam, peaty phase	Calcareous reddish clay loam, clay or silty clay varved lacustrine	Poor
Marsh	N/A	Shallow inundated land, less than 30 cm of organic material over mineral material	Very poor
Nolalu	loam, silt loam, sandy loam, gravelly sandy loam	Noncalcareous fine sandy loam stony glacial till derived from shale	Good
Oskondoga	clay, silty clay loam, silt loam, sand	Calcareous reddish clay loam, clay or silty clay varved lacustrine	Imperfect
Organics-Cabett	N/A	Well decomposed organic material derived from sedges underlain by clay at 30 to 150 cm	Very poor
Organic-Penassen	N/A	Partially decomposed organic material derived from Hypnum moss and reeds 40 to 90 cm thick underlain by lacustrine clay	Very poor

APPENDIX K:

SITE PHOTOGRAPHY AND DESCRIPTIONS

Appendix K: Site Photography and Descriptions

Site 1 – Confluence of Pine River, Memory Road

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

Sample Site 1 was located on Memory Road and was chosen to represent the confluence of the Pine River with Lake Superior. There was no structure (bridge/culvert) at this site due to the road running parallel to the Pine River. Large boulders and cobbles were dominant within the river and the water was shallow but swiftly moving. There was little debris in the channel, however, floating-leaved burreed was observed in the water near the banks along with woody debris. The banks appeared stable and were covered by abundant shrub and herb growth on sandy loam soil, display no apparent erosion. Access to the sampling site was down a steep gradient from Memory road across from telephone pole # 45. A small, partially overgrown trail led down to the sampling site. During the June sampling period a young black bear was seen in the distance upstream from the sampling site.

Site 2 – On Highway 61 south of Memory Road

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:
Sample Site 2 was located on Highway 61 south of Memory Road and was characterized by a large cement bridge. The water was murky with a subtle orange colour. The dominant substrate observed was muck and cobbles with boulders visible above the surface of the river. Aquatic and terrestrial vegetation was abundant both, with many shrubs and herbs present along the banks of the river. There were horsetails, arrowheads and green algae present in the water. Wolf tracks were observed under the bridge in the silty clay soil near the side of the river. There were many swallows observed at the site with seven swallows' nests underneath the bridge.

Site 3 – On Pardee Road west of Crystal Creek	
A: Upstream Photo	**B: Downstream Photo**
	

Comments:

Site 3 was located on Pardee Road west of Crystal Creek and was characterized by a thick clay soil with murky brown water flowing slowly due to a beaver damn directly underneath the bridge. There was evidence of erosion at this site on each side of the bridge. The beaver dam beneath the bridge appeared to be affecting the water depth on the upstream and downstream sides of the bridge. The upstream water level was deeper and nearly stagnant compared to the downstream side where the water was shallow with some movement. An accurate velocity could not be recorded due to wind interference. A high water mark was observed on both sides of the exposed banks, indicating a fluctuating water level. Vegetation along the banks was primarily grasses, herbs and shrubs. The soil was silty clay and erosion on the banks of the river on the upstream side of the bridge was apparent. The downstream side did not appear to be eroding; however, vegetation along the banks was abundant which was likely aiding in bank stability. No substrate photo was available for Site 3 due to insufficient water clarity.

Site 4 – Intersection of Highway 595 and Highway 597

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

Site 4 was located at the intersection of Highway 595 and Highway 597 and characterized by a large concrete bridge. The water at this site was clear and shallow flowing over bedrock and boulders. There were many wood ticks observed at this site during both site visits. There was no apparent erosion as the banks, although steep, consisting of boulders with shrubs and herbs growing abundantly. The velocity of the river at this site increased from the first visit to the second, likely a result of higher water levels due to rain events prior to the second site visit.

Site 5 – On Highway 595 west of Coulson Road	
A: Upstream Photo	**B: Downstream Photo**
	

Comments:

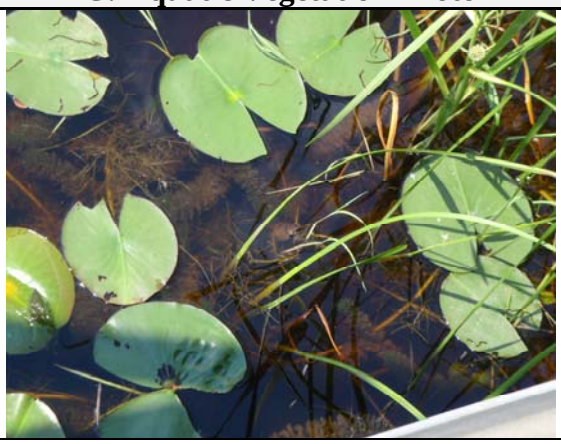
Site 5 was located on Highway 595 west of Coulson Road and resembled a marsh. A soil type could not be determined due to the nature of this submerged lowland area. Abundant aquatic vegetation was observed in the nearly stagnant water, consisting of yellow pond lilies, horsetails, common cattails and wild calla. Along the sides of the road there were many shrubs, herbs and grasses. Along the edges of the lowland area there were many black spruce and jack pine observed. The culvert at Site 5 was completely submerged on both the upstream and downstream side of the road during both site visits. Measurements for this culvert were therefore unable to be completed. Due to the low visibility in the water, a substrate photo was not available at this site.

Site 6 – On Highway 597 west of the Pearson Wetland

A: Upstream Photo

B: Downstream Photo

C: Aquatic Vegetation Photo



Comments:

Site 6 was located on Highway 597 west of the Pearson Wetland and had no defined channel boundaries as it was located in a lowland area. No soil type which could be determined due to the submersion of the soil. The dominant vegetation observed in the lowland area were bulrushes, yellow pond lilies, floating arrowheads and wild calla. A variety of shrubs and herbs were observed along the edge of the road. The water was relatively deep compared to the other sample sites in the watershed. No measurable velocity could be determined due to the nearly stagnant water. A substrate photo was not possible due to the abundant growth of aquatic vegetation.

Site 7 – On Wamsley Road west of Site 8

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

Site 7 was located on Wamsley Road west of Site 8. This site had a culvert installed underneath the road. This culvert was relatively large compared to the water level present and the water level in the past as could be seen by the rust line inside the culvert. There was no measurable velocity present at the site; however, water movement was present as a result of wind influence. There was no significant bank erosion observed; only a high water mark was noticeable in the vegetation. Rip rap was placed on both sides of the road when the culvert was installed. There was a clear definition to the channel width which was meandering on both sides of the culvert. There was fairly little (0-5 percent) stream cover. The stream cover came from shrubs which were growing tall enough to cover a small portion of the river.

Site 8 – On Wamsley Road adjacent to northern part of the Pine River

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

Site 8 was located on Wamsley Road adjacent to the northern part of the Pine River. This site was distinguished by a marsh which surrounded the road and culvert, with no defined banks observed on either side. There were aquatic plants growing in the water which included cat tails, common reed and fragrant white water lily. Dead trees scattered throughout the swamp were observed. There was little stream cover at this site. The little amount of stream cover came from the dead trees which were present in the water which covered a small portion of the river. The majority of the trees were situated further back from the river on terrestrial soil and therefore did not greatly affect the stream cover. A soil type could not be identified due to the lowland area submerged by water. Water at this site was almost completely stagnant (except for minimal wind influence on the surface) and velocity was therefore not determined.

Site 9 – On Lankinen Road

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo

Comments:

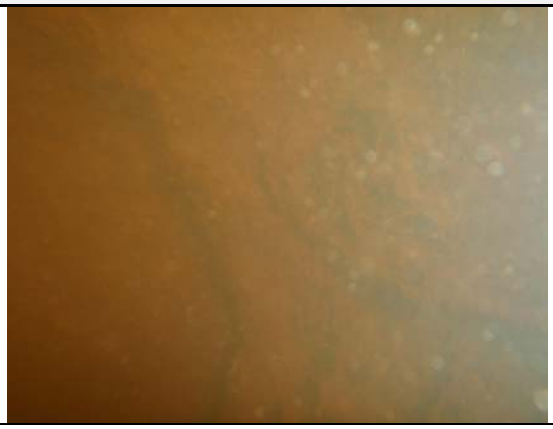
Site 9 was located on Lankinen Road near two residences. There was shrub growth right to the water's edge which made it difficult for photo documentation and sampling. There did not seem to be significant erosion present, however, any erosion present would have been difficult to see due to the abundant shrub growth covering the banks. There was a cleared portion of the bank on the upstream side of the bridge which was located on private property. Site 9 had a fairly deep channel with no measurable flow. There was approximately 15-20 percent stream cover from the shrub growth along the both sides of the water. Stream cover was mainly located on the downstream side of the bridge and was covered by the trees and shrubs present in the area. The soil type at this site was a clay loam.

Site 10 – On Falling Snow Road

A: Upstream Photo

B: Downstream Photo

C: Substrate Photo



Comments:

Site 10 was located on Falling Snow Road and was characterized by a beaver dam which was located on the upstream side of the bridge. There were abundant common cattails on the downstream side of the bridge. There was relatively little stream cover downstream; however, shade on the upstream side of the bridge was approximately 50 percent from trees, shrubs and aquatic plants. The downstream side of the bridge was very narrow compared to the upstream side. The upstream side of the bridge was an open area with significantly less shrub and tree growth close to the water's edge. Grasses and herbs were the dominant plant species on the upstream side of the bridge. Bank erosion was observed on the upstream side of the bridge, likely due to the presence of the beaver damn.

APPENDIX L:

LABORATORY WATER QUALITY RESULTS

Pine River Watershed Assessement 2011
Laboratory Water Quality Results Summary

Laboratory Water Quality Results for June 14-16, 2011

Parameter	Units	PWQO Criterion	PR1 PINE RIVER - SITE#1 16-Jun-11 10:50	PR2 PINE RIVER - SITE#2 15-Jun-11 13:30	PR3 PINE RIVER - SITE#3 15-Jun-11 12:25	PR4 PINE RIVER - SITE#4 15-Jun-11 10:55	PR5 PINE RIVER - SITE #5 15-Jun-11 10:00	PR6 PINE RIVER - SITE #6 14-Jun-11 14:15	PR7 PINE RIVER - SITE #7 14-Jun-11 13:30	PR8 PINE RIVER - SITE #8 14-Jun-11 12:45	PR9 PINE RIVER - SITE #9 14-Jun-11 11:40	PR10 PINE RIVER - SITE #10 14-Jun-11 10:30	Average June
Physical Tests													
Conductivity (EC)	(uS/cm)	N/A	150	136	163	103	98.3	57.0	190	91.7	96.9	96.4	118.2
pH		6.5-8.5	7.92	7.80	7.68	7.21	6.84	6.74	7.50	6.69	7.09	6.70	7.22
Total Dissolved Solids	(mg/L)	N/A	145	168	171	148	131	106	167	126	115	103	138
Turbidity	(NTU)	<10% of natural	15.8	15.8	20.3	6.68	1.74	8.91	14.6	0.76	5.52	3.22	9.33
Anions and Nutrients													
Alkalinity, Total (as CaCO3)	(mg/L)	25% of natural	67.3	61.3	80.0	46.4	46.8	24.2	87.0	38.9	42.4	41.5	53.6
Ammonia-N, Total	(mg/L)	N/A	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Chloride (Cl)	(mg/L)	N/A	3.54	2.63	0.79	1.16	0.52	0.58	4.53	1.53	1.40	1.71	1.84
Nitrate-N (NO3-N)	(mg/L)	N/A	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.03
Nitrite-N (NO2-N)	(mg/L)	N/A	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.02
Total Kjeldahl Nitrogen	(mg/L)	N/A	0.784	0.801	0.609	0.943	0.874	0.977	0.908	0.899	0.807	0.654	0.826
Phosphorus (P)-Total	(mg/L)	0.03	**0.0323**	**0.0319**	**0.0476**	**0.0391**	0.0264	0.0297	**0.0575**	0.0150	**0.0400**	0.0249	**0.0344**
Sulphate (SO4)	(mg/L)	N/A	3.60	3.16	4.07	1.85	0.75	0.48	2.52	1.77	2.68	2.67	2.36
Bacteriological Tests													
Escherichia Coli	(MPN/100mL)	100	93	37	17	23	1	60	65	58	81	9	44
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	**2000**	**1100**	**1400**	**1100**	920	**2000**	**1400**	**> 2420**	**2400**	340	**1407**
Total Metals													
Aluminum (Al)-Total	(mg/L)	0.075	**0.689**	**0.629**	**0.938**	**0.372**	**0.095**	**0.495**	**0.632**	**0.090**	**0.277**	**0.100**	**0.432**
Antimony (Sb)-Total	(mg/L)	0.02	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.0060
Arsenic (As)-Total	(mg/L)	0.005 (interim)	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	0.0016	<0.0010	<0.0010	<0.0010	0.001
Barium (Ba)-Total	(mg/L)	N/A	0.017	0.016	0.020	0.013	<0.010	<0.010	0.021	0.011	0.012	<0.010	0.016
Beryllium (Be)-Total	(mg/L)	0.011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth (Bi)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron (B)-Total	(mg/L)	0.2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium (Cd)-Total	(mg/L)	0.0001	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
Calcium (Ca)-Total	(mg/L)	N/A	19.4	17.5	21.4	13.8	12.5	7.41	23.4	12.7	12.8	10.8	15.171
Chromium (Cr)-Total	(mg/L)	N/A	0.0012	0.0012	0.0016	<0.0010	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	0.001
Cobalt (Co)-Total	(mg/L)	0.0009	<0.00050	<0.00050	0.00074	<0.00050	<0.00050	<0.00050	0.00056	<0.00050	<0.00050	0.00061	0.001
Copper (Cu)-Total	(mg/L)	0.005 (interim)	**0.0059**	**0.0054**	0.0049	0.0034	0.0011	0.0024	0.0049	0.0016	0.0030	<0.0010	0.004
Iron (Fe)-Total	(mg/L)	0.3	**1.27**	**1.27**	**1.68**	**1.21**	**0.912**	**0.805**	**1.53**	**0.596**	**1.05**	**1.51**	**1.183**
Lead (Pb)-Total	(mg/L)	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	(mg/L)	N/A	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	(mg/L)	N/A	7.94	7.42	8.84	6.15	6.04	3.54	9.79	5.43	5.61	4.89	6.565

Bold indicated exccedance of PWQO criteria

Pine River Watershed Assessement 2011
Laboratory Water Quality Results Summary

Laboratory Water Quality Results for June 14-16, 2011

Parameter	Units	PWQO Criterion	PR1 PINE RIVER - SITE#1 16-Jun-11 10:50	PR2 PINE RIVER - SITE#2 15-Jun-11 13:30	PR3 PINE RIVER - SITE#3 15-Jun-11 12:25	PR4 PINE RIVER - SITE#4 15-Jun-11 10:55	PR5 PINE RIVER - SITE #5 15-Jun-11 10:00	PR6 PINE RIVER - SITE #6 14-Jun-11 14:15	PR7 PINE RIVER - SITE #7 14-Jun-11 13:30	PR8 PINE RIVER - SITE #8 14-Jun-11 12:45	PR9 PINE RIVER - SITE #9 14-Jun-11 11:40	PR10 PINE RIVER - SITE #10 14-Jun-11 10:30	Average June
Total Metals Continued													
Manganese (Mn)-Total	(mg/L)	N/A	0.0407	0.0426	0.0947	0.0977	0.0675	0.0214	0.111	0.0499	0.0511	0.173	0.075
Molybdenum (Mo)-Total	(mg/L)	0.004	<0.0010	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.001
Nickel (Ni)-Total	(mg/L)	0.025	0.0033	0.0033	0.0034	0.0028	0.0023	<0.0020	0.0035	<0.0020	0.0021	<0.0020	0.003
Potassium (K)-Total	(mg/L)	N/A	1.1	1.0	1.2	<1.0	<1.0	<1.0	1.5	<1.0	<1.0	<1.0	1.200
Selenium (Se)-Total	(mg/L)	0.1	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver (Ag)-Total	(mg/L)	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)-Total	(mg/L)	N/A	3.63	3.23	3.12	2.41	2.05	1.36	3.95	2.36	2.34	2.25	2.670
Strontium (Sr)-Total	(mg/L)	N/A	0.0490	0.0448	0.0466	0.0345	0.0297	0.0193	0.0528	0.0287	0.0363	0.0370	0.038
Tellurium (Te)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Thallium (Tl)-Total	(mg/L)	0.0003	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tin (Sn)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	(mg/L)	N/A	0.0185	0.0163	0.0258	0.0097	0.0029	0.0130	0.0191	<0.0020	0.0089	0.0039	0.013
Tungsten (W)-Total	(mg/L)	0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	(mg/L)	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vanadium (V)-Total	(mg/L)	N/A	0.0026	0.0025	0.0041	0.0017	<0.0010	0.0014	0.0033	<0.0010	0.0016	<0.0010	0.002
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	0.0036	0.0033	0.0043	<0.0030	<0.0030	0.0032	0.0035	<0.0030	<0.0030	<0.0030	0.004
Zirconium (Zr)-Total	(mg/L)	0.004	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Pine River Watershed Assessment 2011
Laboratory Water Quality Results Summary

Laboratory Water Quality Results for July 25, 2011

Parameter	Units	PWQO Criterion	PR1 PINE RIVER - SITE#1 25-Jul-11 14:30	PR2 PINE RIVER - SITE#2 25-Jul-11 13:50	PR3 PINE RIVER - SITE#3 25-Jul-11 13:15	PR4 PINE RIVER - SITE#4 25-Jul-11 12:55	PR5 PINE RIVER - SITE #5 25-Jul-11 12:30	PR6 PINE RIVER - SITE #6 25-Jul-11 12:10	PR7 PINE RIVER - SITE #7 25-Jul-11 11:55	PR8 PINE RIVER - SITE #8 25-Jul-11 11:30	PR9 PINE RIVER - SITE #9 25-Jul-11 11:10	PR10 PINE RIVER - SITE #10 25-Jul-11 10:30	Average July
Physical Tests													
Conductivity (EC)	(uS/cm)	N/A	131	130	153	125	115	87.1	209	141	104	110	130.5
pH		6.5-8.5	7.97	7.88	7.77	7.29	7.04	6.91	7.52	6.84	7.01	6.87	7.31
Total Dissolved Solids	(mg/L)	N/A	134	136	135	137	123	137	175	205	132	117	143
Turbidity	(NTU)	<10% of natural	15.5	13.3	21.4	4.21	4.82	4.18	8.3	5.86	3.95	6.93	8.85
Anions and Nutrients													
Alkalinity, Total (as CaCO3)	(mg/L)	N/A	60.6	59.8	74.6	57	54.6	38.6	100	65.3	45.9	49.8	60.6
Ammonia-N, Total	(mg/L)	N/A	0.026	0.033	0.028	0.054	<0.020	0.023	<0.020	<0.020	0.03	<0.020	0.032
Chloride (Cl)	(mg/L)	N/A	1.68	1.68	0.45	1.78	0.37	0.5	3.05	1.3	1.2	0.93	1.29
Nitrate-N (NO3-N)	(mg/L)	N/A	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.03
Nitrite-N (NO2-N)	(mg/L)	N/A	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.02
Total Kjeldahl Nitrogen	(mg/L)	N/A	1	1.01	0.793	1.12	1.26	1.29	1.08	1.65	1.07	0.973	1.125
Phosphorus (P)-Total	(mg/L)	0.03	**0.0513**	**0.053**	**0.0603**	**0.0601**	**0.0751**	**0.0327**	**0.0764**	**0.0651**	**0.0485**	**0.0476**	**0.0570**
Sulphate (SO4)	(mg/L)	N/A	1.24	1.16	2.05	0.74	<0.30	<0.30	0.88	<0.30	1.19	0.94	1.17
Bacteriological Tests													
Escherichia Coli	(MPN/100mL)	100	73	31	**250**	73	93	16	58	**690**	**100**	**410**	179
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**	**>2420**
Total Metals													
Aluminum (Al)-Total	(mg/L)	0.075	**0.56**	**0.454**	**0.824**	**0.209**	**0.116**	**0.263**	**0.34**	**0.101**	**0.247**	**0.144**	**0.326**
Antimony (Sb)-Total	(mg/L)	0.02	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.0060
Arsenic (As)-Total	(mg/L)	0.005 (interim)	0.0014	0.0014	0.0013	0.0014	0.0013	0.0012	0.0026	0.0021	0.0013	0.0011	0.002
Barium (Ba)-Total	(mg/L)	N/A	0.014	0.014	0.019	0.013	0.017	<0.010	0.016	0.023	0.012	0.011	0.015
Beryllium (Be)-Total	(mg/L)	0.011	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Bismuth (Bi)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Boron (B)-Total	(mg/L)	0.2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Cadmium (Cd)-Total	(mg/L)	0.0001	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
Calcium (Ca)-Total	(mg/L)	N/A	16.8	16.4	18.5	16	14.7	12.1	26.2	19.4	13.7	12.3	16.6
Chromium (Cr)-Total	(mg/L)	N/A	0.0013	0.001	0.0016	<0.0010	<0.0010	<0.0010	0.0011	<0.0010	<0.0010	<0.0010	0.001
Cobalt (Co)-Total	(mg/L)	0.0009	0.00051	<0.00050	0.00069	0.00052	**0.00203**	<0.00050	<0.00050	**0.00199**	0.00054	**0.00096**	**0.001**
Copper (Cu)-Total	(mg/L)	0.005 (interim)	0.0038	0.0034	0.005	0.002	<0.0010	0.0011	0.0035	<0.0010	0.003	<0.0010	0.003
Iron (Fe)-Total	(mg/L)	0.3	**1.8**	**1.63**	**1.89**	**1.63**	**3.45**	**1.25**	**1.59**	**4.45**	**1.97**	**3.02**	**2.268**
Lead (Pb)-Total	(mg/L)	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Lithium (Li)-Total	(mg/L)	N/A	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Magnesium (Mg)-Total	(mg/L)	N/A	7.25	7.03	7.74	6.86	6.81	5.8	11.3	7.82	5.81	5.57	7.20

Bold indicated exccedance of PWQO criteria

Pine River Watershed Assessment 2011
Laboratory Water Quality Results Summary

Laboratory Water Quality Results for July 25, 2011

Parameter	Units	PWQO Criterion	PR1 PINE RIVER - SITE#1 25-Jul-11 14:30	PR2 PINE RIVER - SITE#2 25-Jul-11 13:50	PR3 PINE RIVER - SITE#3 25-Jul-11 13:15	PR4 PINE RIVER - SITE#4 25-Jul-11 12:55	PR5 PINE RIVER - SITE #5 25-Jul-11 12:30	PR6 PINE RIVER - SITE #6 25-Jul-11 12:10	PR7 PINE RIVER - SITE #7 25-Jul-11 11:55	PR8 PINE RIVER - SITE #8 25-Jul-11 11:30	PR9 PINE RIVER - SITE #9 25-Jul-11 11:10	PR10 PINE RIVER - SITE #10 25-Jul-11 10:30	Average July
Total Metals Continued													
Manganese (Mn)-Total	(mg/L)	N/A	0.0484	0.0478	0.0886	0.0821	0.359	0.0541	0.158	0.488	0.0818	0.294	0.170
Molybdenum (Mo)-Total	(mg/L)	0.004	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0014	<0.0010	<0.0010	<0.0010	0.001
Nickel (Ni)-Total	(mg/L)	0.025	0.0033	0.003	0.0031	0.0028	0.0026	0.0022	0.0036	0.0027	0.0028	0.0021	0.003
Potassium (K)-Total	(mg/L)	N/A	1	1	1.1	<1.0	<1.0	<1.0	1.3	<1.0	<1.0	<1.0	1.1
Selenium (Se)-Total	(mg/L)	0.1	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Silver (Ag)-Total	(mg/L)	0.0001	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Sodium (Na)-Total	(mg/L)	N/A	2.63	2.63	2.54	2.48	1.9	1.47	4.26	2.75	2.12	2	2.478
Strontium (Sr)-Total	(mg/L)	N/A	0.0443	0.0432	0.0405	0.046	0.0475	0.0307	0.0602	0.0496	0.0441	0.0422	0.045
Tellurium (Te)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Thallium (Tl)-Total	(mg/L)	0.0003	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tin (Sn)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Titanium (Ti)-Total	(mg/L)	N/A	0.0155	0.0121	0.0242	0.0062	0.0042	0.007	0.0107	0.0036	0.0067	0.0048	0.010
Tungsten (W)-Total	(mg/L)	0.03	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Total	(mg/L)	0.005	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Vanadium (V)-Total	(mg/L)	N/A	0.0024	0.0021	0.0047	0.0011	0.0013	<0.0010	0.0025	0.0012	0.0014	<0.0010	0.002
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	0.0031	<0.0030	0.0034	<0.0030	<0.0030	0.0038	<0.0030	0.0042	0.0041	<0.0030	0.004
Zirconium (Zr)-Total	(mg/L)	0.004	<0.0010	<0.0010	<0.0010	0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.001

Bold indicated exccedance of PWQO criteria

APPENDIX M:

LABORATORY CERTIFICATES OF ANALYSIS AND TEST RESULTS

LAKEHEAD REGION CONSERVATION AUTHORITY
ATTN: TAMMY COOK
130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Date Received: 15-JUN-11
Report Date: 24-JUN-11 15:01 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L1017541
Project P.O. #: NOT SUBMITTED
Job Reference:
Legal Site Desc:
C of C Numbers: L1017541

Richard Clara
General Manager, Thunder Bay

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1017541-1	L1017541-2	L1017541-3	L1017541-4	L1017541-5
Description	WATER	WATER	WATER	WATER	WATER
Sampled Date	14-JUN-11	14-JUN-11	14-JUN-11	14-JUN-11	14-JUN-11
Sampled Time	10:30	11:45	12:45	13:30	14:20
Client ID	PR10 PINE RIVER - SITE #10	PR9 PINE RIVER - SITE #9	PR8 PINE RIVER - SITE #8	PR7 PINE RIVER - SITE #7	PR6 PINE RIVER - SITE #6
Grouping / Analyte					
WATER					
Physical Tests	Color, True (T.C.U.)	84.3	138	155	75.8	42.7
	Conductivity (EC) (uS/cm)	96.4	96.9	91.7	190	57.0
	Hardness (as CaCO3) (mg/L)	47.1	55.2	54.0	98.7	33.1
	pH (pH)	6.70	7.09	6.69	7.50	6.74
	Total Dissolved Solids (mg/L)	103	115	126	167	106
	Turbidity (NTU)	3.22	5.52	0.76	14.6	8.91
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	41.5	42.4	38.9	87.0	24.2
	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	1.71	1.40	1.53	4.53	0.58
	Nitrate-N (NO3-N) (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	0.654	0.807	0.899	0.908	0.977
	Phosphorus (P)-Total (mg/L)	0.0249	0.0400	0.0150	0.0575	0.0297
	Sulphate (SO4) (mg/L)	2.67	2.68	1.77	2.52	0.48
Bacteriological Tests	Escherichia Coli (MPN/100mL)	9	81	58	65	60
	Total Coliforms (MPN/100mL)	340	2400	> 2420	1400	2000
Total Metals	Aluminum (Al)-Total (mg/L)	0.100	0.277	0.090	0.632	0.495
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0016	<0.0010
	Barium (Ba)-Total (mg/L)	<0.010	0.012	0.011	0.021	<0.010
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
	Calcium (Ca)-Total (mg/L)	10.8	12.8	12.7	23.4	7.41
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0015	<0.0010
	Cobalt (Co)-Total (mg/L)	0.00061	<0.00050	<0.00050	0.00056	<0.00050
	Copper (Cu)-Total (mg/L)	<0.0010	0.0030	0.0016	0.0049	0.0024
	Iron (Fe)-Total (mg/L)	1.51	1.05	0.596	1.53	0.805
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/L)	4.89	5.61	5.43	9.79	3.54
	Manganese (Mn)-Total (mg/L)	0.173	0.0511	0.0499	0.111	0.0214
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	<0.0020	0.0021	<0.0020	0.0035	<0.0020
	Potassium (K)-Total (mg/L)	<1.0	<1.0	<1.0	1.5	<1.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1017541-1	L1017541-2	L1017541-3	L1017541-4	L1017541-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	14-JUN-11	14-JUN-11	14-JUN-11	14-JUN-11	14-JUN-11
	Sampled Time	10:30	11:45	12:45	13:30	14:20
	Client ID	PR10 PINE RIVER - SITE #10	PR9 PINE RIVER - SITE #9	PR8 PINE RIVER - SITE #8	PR7 PINE RIVER - SITE #7	PR6 PINE RIVER - SITE #6
Grouping	Analyte					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	2.25	2.34	2.36	3.95	1.36
	Strontium (Sr)-Total (mg/L)	0.0370	0.0363	0.0287	0.0528	0.0193
	Tellurium (Te)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	0.0039	0.0089	<0.0020	0.0191	0.0130
	Tungsten (W)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)	<0.0010	0.0016	<0.0010	0.0033	0.0014
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	0.0035	0.0032
	Zirconium (Zr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-CAP-TB	Water	Alkalinity, Total (as CaCO3)	APHA 2320 B-Auto-Pot. Titration
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
COLOUR-TB	Water	Colour, True	CPPA H.5P Spectrophotometry
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-ELECTRODE
MET-T-MS-TB	Water	Total Metals in Water by ICPMS	APHA 3120 B-ICPMS
N-TOTKJ-TB	Water	Total Kjeldahl Nitrogen	APHA 4500-Norg B/NH3 G Colourimetry
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - COLOURIMETRY
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
PH-CAP-TB	Water	pH	APHA 4500-H-ELECTRODE
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B C18
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
TB	ALS ENVIRONMENTAL - THUNDER BAY, ONTARIO, CANADA

Chain of Custody Numbers:

L1017541

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environm

L10175 41-COFC

ain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # L10175 41

Page 1 of 1

Report To	Tammy Cook
Company:	Lakehead Region Conservation Authority
Contact:	Scott Drebit
Address:	130 Conservation Rd Box 10427
	Thunder Bay ON P7B 6T8
Phone:	344-5857 Fax: 345-9156
Invoice To	Same as Report ? (Yes) No

Report Format / Distribution

Standard ✓ Other (specify):

PDF ✓ Excel ✓ Digital Fax

Email 1: INFO@lakeheadca.com

Email 2: Scott@lakeheadca.com

Service Requested (Rush for routine analysis subject to availability)

✓ Regular (Default)

Priority (Specify Date Required → →) Surcharges apply

Emergency (1 Business Day) - 100% Surcharge

For Emergency < 1 Day, ASAP or Weekend - Contact ALS

THE QUESTIONS BELOW MUST BE ANSWERED FOR WATER SAMPLES (circle Yes or No)

Are any samples taken from a regulated DW System? Yes (No)

If yes, an authorized Drinking Water COC MUST be used for this submission.

Is the water sampled intended to be potable for human consumption? Yes (No)

Client / Project Information

Job #:

PO / AFE:

LSD:

Quote #: Q29978

Lab Work Order # (lab use only)

ALS Contact:

Sampler: L. Welch A. Bunnacore

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Total Metals	Nutrients	Total Coliform, E. coli (TC/EC)	Number of Containers
PR 10	Pine River - Site #10	14-JUN-11	10:30	Grab	✓	✓	✓	✓	5
PR 9	Pine River - Site # 9	14-JUN-11	11:45	Grab	✓	✓	✓	✓	5
PR 8	Pine River - Site #8	14-JUN-11	12:45	Grab	✓	✓	✓	✓	5
PR 7	Pine River - Site #7	14-JUN-11	13:30	Grab	✓	✓	✓	✓	5
PR 6	Pine River - Site #6	14-JUN-11	14:20	Grab	✓	✓	✓	✓	5

Special Instructions / Regulations / Hazardous Details

Reg 153 Table 1 2 3 TCLP MISA (PWQO) OTHER (please specify):
Circle one - Note drinking water samples MUST USE DW Chain of Custody

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / (No ?) If Yes add SIF
			15-Jun-11 MD		8:00	6.4 °C		JUN 15/11	9:32	

5.5 7.3

TYFM014 26-Mar-10

LAKEHEAD REGION CONSERVATION AUTHORITY
ATTN: TAMMY COOK
130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Date Received: 16-JUN-11
Report Date: 30-JUN-11 07:06 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L1018705
Project P.O. #: NOT SUBMITTED
Job Reference:
Legal Site Desc:
C of C Numbers: L1018705

Richard Clara
General Manager, Thunder Bay

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1018705-1	L1018705-2	L1018705-3	L1018705-4	L1018705-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	15-JUN-11	15-JUN-11	15-JUN-11	15-JUN-11	16-JUN-11
	Sampled Time	10:10	10:55	12:25	13:30	10:50
	Client ID	PR5 PINE RIVER - SITE #5	PR4 PINE RIVER - SITE#4	PR3 PINE RIVER - SITE#3	PR2 PINE RIVER - SITE#2	PR1 PINE RIVER - SITE#1
Grouping	Analyte					
WATER						
Physical Tests	Color, True (T.C.U.)	140	157	62.6	123	129
	Conductivity (EC) (uS/cm)	98.3	103	163	136	150
	Hardness (as CaCO3) (mg/L)	56.0	59.9	89.8	74.2	81.1
	pH (pH)	6.84	7.21	7.68	7.80	7.92
	Total Dissolved Solids (mg/L)	131	148	171	168	145
	Turbidity (NTU)	1.74	6.68	20.3	15.8	15.8
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	46.8	46.4	80.0	61.3	67.3
	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	0.52	1.16	0.79	2.63	3.54
	Nitrate-N (NO3-N) (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	0.874	0.943	0.609	0.801	0.784
	Phosphorus (P)-Total (mg/L)	0.0264	0.0391	0.0476	0.0319	0.0323
	Sulphate (SO4) (mg/L)	0.75	1.85	4.07	3.16	3.60
Bacteriological Tests	Escherichia Coli (MPN/100mL)	1	23	17	37	93
	Total Coliforms (MPN/100mL)	920	1100	1400	1100	2000
Total Metals	Aluminum (Al)-Total (mg/L)	0.095	0.372	0.938	0.629	0.689
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	<0.0010	<0.0010	0.0011	<0.0010	<0.0010
	Barium (Ba)-Total (mg/L)	<0.010	0.013	0.020	0.016	0.017
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
	Calcium (Ca)-Total (mg/L)	12.5	13.8	21.4	17.5	19.4
	Chromium (Cr)-Total (mg/L)	<0.0010	<0.0010	0.0016	0.0012	0.0012
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00050	0.00074	<0.00050	<0.00050
	Copper (Cu)-Total (mg/L)	0.0011	0.0034	0.0049	0.0054	0.0059
	Iron (Fe)-Total (mg/L)	0.912	1.21	1.68	1.27	1.27
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/L)	6.04	6.15	8.84	7.42	7.94
	Manganese (Mn)-Total (mg/L)	0.0675	0.0977	0.0947	0.0426	0.0407
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	0.0023	0.0028	0.0034	0.0033	0.0033
	Potassium (K)-Total (mg/L)	<1.0	<1.0	1.2	1.0	1.1

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1018705-1	L1018705-2	L1018705-3	L1018705-4	L1018705-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	15-JUN-11	15-JUN-11	15-JUN-11	15-JUN-11	16-JUN-11
	Sampled Time	10:10	10:55	12:25	13:30	10:50
	Client ID	PR5 PINE RIVER - SITE #5	PR4 PINE RIVER - SITE#4	PR3 PINE RIVER - SITE#3	PR2 PINE RIVER - SITE#2	PR1 PINE RIVER - SITE#1
Grouping	Analyte					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	2.05	2.41	3.12	3.23	3.63
	Strontium (Sr)-Total (mg/L)	0.0297	0.0345	0.0466	0.0448	0.0490
	Tellurium (Te)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	0.0029	0.0097	0.0258	0.0163	0.0185
	Tungsten (W)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)	<0.0010	0.0017	0.0041	0.0025	0.0026
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	0.0043	0.0033	0.0036
	Zirconium (Zr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-CAP-TB	Water	Alkalinity, Total (as CaCO3)	APHA 2320 B-Auto-Pot. Titration
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
COLOUR-TB	Water	Colour, True	CPPA H.5P Spectrophotometry
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-ELECTRODE
MET-T-MS-TB	Water	Total Metals in Water by ICPMS	APHA 3120 B-ICPMS
N-TOTKJ-TB	Water	Total Kjeldahl Nitrogen	APHA 4500-Norg B/NH3 G Colourimetry
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - COLOURIMETRY
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
PH-CAP-TB	Water	pH	APHA 4500-H-ELECTRODE
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B C18
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
TB	ALS ENVIRONMENTAL - THUNDER BAY, ONTARIO, CANADA

Chain of Custody Numbers:

L1018705

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

COC # L1018705

Page 1 of 1

Report To	Tammy Cook
Company:	Lakehead Region Conservation Authority
Contact:	Scott Drebit
Address:	130 Conservation Rd Box 10427 Thunder Bay ON P7B 6T8
Phone:	344 5857 Fax: 345 9156

Report Format / Distribution

Standard ✓ Other (specify):

PDF ✓ Excel ✓ Digital Fax

Email 1: info@lakeheadca.com

Email 2: Scott@lakeheadca.com

Service Requested (Rush for routine analysis subject to availability)

✓ Regular (Default)

Priority (Specify Date Required → →) Surcharges apply

Emergency (1 Business Day) - 100% Surcharge

For Emergency < 1 Day, ASAP or Weekend - Contact ALS

Invoice To Same as Report ? (Yes) No

THE QUESTIONS BELOW MUST BE ANSWERED FOR WATER SAMPLES (circle Yes or No)

Are any samples taken from a regulated DW System? Yes (No)

If yes, an authorized Drinking Water COC MUST be used for this submission.

Is the water sampled intended to be potable for human consumption? Yes (No)

Client / Project Information

Job #:

PO / AFE:

LSD:

Quote #: Q29478

Lab Work Order # (lab use only)

ALS Contact:

Sampler: L. Welch A. Buonocore

Analysis Request

Please indicate below Filtered, Preserved or both (F, P, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Total Metals	Nutrients	Total Coliform/E.coli	Number of Containers
					P	P	P		
PR5	Pine River - Site # 5	15-JUN-11	10:10	Grab	✓	✓	✓	✓	5
PR4	Pine River - Site # 4	15-JUN-11	10:55	Grab	✓	✓	✓	✓	5
PR3	Pine River - Site # 3	15-JUN-11	12:25	Grab	✓	✓	✓	✓	5
PR2	Pine River - Site # 2	15-JUN-11	13:30	Grab	✓	✓	✓	✓	5
PR1	Pine River - Site # 1	16-JUN-11	10:50	Grab	✓	✓	✓	✓	5

Special Instructions / Regulations / Hazardous Details

Reg 153 Table 1 2 3 TCLP MISA (PWQO) OTHER (please specify):
Circle one - Note drinking water samples MUST USE DW Chain of Custody

8,3 & 7.5

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
	June/16/11	13:30		June/16/11	1:30	7.9 °C		June/16/11	1:30pm	

TYFM014 26-Mar-10

LAKEHEAD REGION CONSERVATION AUTHORITY
ATTN: TAMMY COOK
130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Date Received: 26-JUL-11
Report Date: 09-AUG-11 09:29 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L1035948

Project P.O. #: NOT SUBMITTED
Job Reference:
C of C Numbers:
Legal Site Desc:

Richard Clara
General Manager, Thunder Bay

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1035948-1 WATER 25-JUL-11 14:30 PINE RIVER - SITE # 1	L1035948-2 WATER 25-JUL-11 13:50 PINE RIVER - SITE # 2	L1035948-3 WATER 25-JUL-11 13:15 PINE RIVER - SITE # 3	L1035948-4 WATER 25-JUL-11 12:55 PINE RIVER - SITE # 4	L1035948-5 WATER 25-JUL-11 12:30 PINE RIVER - SITE # 5
WATER						
Physical Tests	Color, True (T.C.U.)	189	191	114	228	211
	Conductivity (EC) (uS/cm)	131	130	153	125	115
	Hardness (as CaCO3) (mg/L)	71.7	70.0	78.2	68.3	64.8
	pH (pH)	7.97	7.88	7.77	7.29	7.04
	Total Dissolved Solids (mg/L)	134	136	135	137	123
	Turbidity (NTU)	15.5	13.3	21.4	4.21	4.82
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	60.6	59.8	74.6	57.0	54.6
	Ammonia-N, Total (mg/L)	0.026	0.033	0.028	0.054	<0.020
	Chloride (Cl) (mg/L)	1.68	1.68	0.45	1.78	0.37
	Nitrate-N (NO3-N) (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	1.00	1.01	0.793	1.12	1.26
	Phosphorus (P)-Total (mg/L)	0.0513	0.0530	0.0603	0.0601	0.0751
	Sulphate (SO4) (mg/L)	1.24	1.16	2.05	0.74	<0.30
Bacteriological Tests	Escherichia Coli (MPN/100mL)	73	31	250	73	93
	Total Coliforms (MPN/100mL)	> 2420	> 2420	> 2420	> 2420	> 2420
Total Metals	Aluminum (Al)-Total (mg/L)	0.560	0.454	0.824	0.209	0.116
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	0.0014	0.0014	0.0013	0.0014	0.0013
	Barium (Ba)-Total (mg/L)	0.014	0.014	0.019	0.013	0.017
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
	Calcium (Ca)-Total (mg/L)	16.8	16.4	18.5	16.0	14.7
	Chromium (Cr)-Total (mg/L)	0.0013	0.0010	0.0016	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	0.00051	<0.00050	0.00069	0.00052	0.00203
	Copper (Cu)-Total (mg/L)	0.0038	0.0034	0.0050	0.0020	<0.0010
	Iron (Fe)-Total (mg/L)	1.80	1.63	1.89	1.63	3.45
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/L)	7.25	7.03	7.74	6.86	6.81
	Manganese (Mn)-Total (mg/L)	0.0484	0.0478	0.0886	0.0821	0.359
	Molybdenum (Mo)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	0.0033	0.0030	0.0031	0.0028	0.0026
	Potassium (K)-Total (mg/L)	1.0	1.0	1.1	<1.0	<1.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1035948-6 WATER 25-JUL-11 12:10 PINE RIVER - SITE # 6	L1035948-7 WATER 25-JUL-11 11:55 PINE RIVER - SITE # 7	L1035948-8 WATER 25-JUL-11 11:30 PINE RIVER - SITE # 8	L1035948-9 WATER 25-JUL-11 11:10 PINE RIVER - SITE # 9	L1035948-10 WATER 25-JUL-11 10:30 PINE RIVER - SITE # 10
WATER						
Physical Tests	Color, True (T.C.U.)	317	120	366	292	189
	Conductivity (EC) (uS/cm)	87.1	209	141	104	110
	Hardness (as CaCO3) (mg/L)	54.0	112	80.6	58.1	53.5
	pH (pH)	6.91	7.52	6.84	7.01	6.87
	Total Dissolved Solids (mg/L)	137	175	205	132	117
	Turbidity (NTU)	4.18	8.30	5.86	3.95	6.93
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	38.6	100	65.3	45.9	49.8
	Ammonia-N, Total (mg/L)	0.023	<0.020	<0.020	0.030	<0.020
	Chloride (Cl) (mg/L)	0.50	3.05	1.30	1.20	0.93
	Nitrate-N (NO3-N) (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Total Kjeldahl Nitrogen (mg/L)	1.29	1.08	1.65	1.07	0.973
	Phosphorus (P)-Total (mg/L)	0.0327	0.0764	0.0651	0.0485	0.0476
	Sulphate (SO4) (mg/L)	<0.30	0.88	<0.30	1.19	0.94
Bacteriological Tests	Escherichia Coli (MPN/100mL)	16	58	690	100	410
	Total Coliforms (MPN/100mL)	> 2420	> 2420	> 2420	> 2420	> 2420
Total Metals	Aluminum (Al)-Total (mg/L)	0.263	0.340	0.101	0.247	0.144
	Antimony (Sb)-Total (mg/L)	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060
	Arsenic (As)-Total (mg/L)	0.0012	0.0026	0.0021	0.0013	0.0011
	Barium (Ba)-Total (mg/L)	<0.010	0.016	0.023	0.012	0.011
	Beryllium (Be)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B)-Total (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd)-Total (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
	Calcium (Ca)-Total (mg/L)	12.1	26.2	19.4	13.7	12.3
	Chromium (Cr)-Total (mg/L)	<0.0010	0.0011	<0.0010	<0.0010	<0.0010
	Cobalt (Co)-Total (mg/L)	<0.00050	<0.00050	0.00199	0.00054	0.00096
	Copper (Cu)-Total (mg/L)	0.0011	0.0035	<0.0010	0.0030	<0.0010
	Iron (Fe)-Total (mg/L)	1.25	1.59	4.45	1.97	3.02
	Lead (Pb)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Lithium (Li)-Total (mg/L)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/L)	5.80	11.3	7.82	5.81	5.57
	Manganese (Mn)-Total (mg/L)	0.0541	0.158	0.488	0.0818	0.294
	Molybdenum (Mo)-Total (mg/L)	<0.0010	0.0014	<0.0010	<0.0010	<0.0010
	Nickel (Ni)-Total (mg/L)	0.0022	0.0036	0.0027	0.0028	0.0021
	Potassium (K)-Total (mg/L)	<1.0	1.3	<1.0	<1.0	<1.0

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID	L1035948-1	L1035948-2	L1035948-3	L1035948-4	L1035948-5
		Description	WATER	WATER	WATER	WATER	WATER
		Sampled Date	25-JUL-11	25-JUL-11	25-JUL-11	25-JUL-11	25-JUL-11
		Sampled Time	14:30	13:50	13:15	12:55	12:30
		Client ID	PINE RIVER - SITE # 1	PINE RIVER - SITE # 2	PINE RIVER - SITE # 3	PINE RIVER - SITE # 4	PINE RIVER - SITE # 5
WATER							
Total Metals	Selenium (Se)-Total (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Silver (Ag)-Total (mg/L)		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)		2.63	2.63	2.54	2.48	1.90
	Strontium (Sr)-Total (mg/L)		0.0443	0.0432	0.0405	0.0460	0.0475
	Tellurium (Te)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)		<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)		0.0155	0.0121	0.0242	0.0062	0.0042
	Tungsten (W)-Total (mg/L)		<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)		<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)		0.0024	0.0021	0.0047	0.0011	0.0013
	Zinc (Zn)-Total (mg/L)		0.0031	<0.0030	0.0034	<0.0030	<0.0030
	Zirconium (Zr)-Total (mg/L)		<0.0010	<0.0010	<0.0010	0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1035948-6	L1035948-7	L1035948-8	L1035948-9	L1035948-10
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	25-JUL-11	25-JUL-11	25-JUL-11	25-JUL-11	25-JUL-11
	Sampled Time	12:10	11:55	11:30	11:10	10:30
	Client ID	PINE RIVER - SITE # 6	PINE RIVER - SITE # 7	PINE RIVER - SITE # 8	PINE RIVER - SITE # 9	PINE RIVER - SITE # 10
Grouping	Analyte					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Silver (Ag)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Sodium (Na)-Total (mg/L)	1.47	4.26	2.75	2.12	2.00
	Strontium (Sr)-Total (mg/L)	0.0307	0.0602	0.0496	0.0441	0.0422
	Tellurium (Te)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Thallium (Tl)-Total (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti)-Total (mg/L)	0.0070	0.0107	0.0036	0.0067	0.0048
	Tungsten (W)-Total (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V)-Total (mg/L)	<0.0010	0.0025	0.0012	0.0014	<0.0010
	Zinc (Zn)-Total (mg/L)	0.0038	<0.0030	0.0042	0.0041	<0.0030
	Zirconium (Zr)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-TOT-CAP-TB	Water	Alkalinity, Total (as CaCO3)	APHA 2320 B-Auto-Pot. Titration
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
COLOUR-TB	Water	Colour, True	CPPA H.5P Spectrophotometry
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-ELECTRODE
MET-T-MS-TB	Water	Total Metals in Water by ICPMS	APHA 3120 B-ICPMS
N-TOTKJ-TB	Water	Total Kjeldahl Nitrogen	APHA 4500-Norg B/NH3 G Colourimetry
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - COLOURIMETRY
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
PH-CAP-TB	Water	pH	APHA 4500-H-ELECTRODE
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B C18
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
TB	ALS ENVIRONMENTAL - THUNDER BAY, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environme

-L1035948-COFC-

of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

COC # _____

Page 1 of 1

Report To: Tammy Cook	Report Format / Distribution		Service Requested (Rush for routine analysis subject to availability)
Company: Lakehead Region Conservation Authority	Standard ✓ Other (specify):		✓ Regular (Default)
Contact: Scott Drebit	PDF ✓ Excel ✓ Digital Fax		Priority (Specify Date Required → —) Surcharges apply
Address: 130 Conservation Rd. Box 10427	Email 1: info@lakeheadca.com		Emergency (1 Business Day) - 100% Surcharge
Thunder Bay ON P7B 6T8	Email 2: Scott@lakeheadca.com		For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: 344-5857 Fax: 345 9156			Analysis Request
Invoice To Same as Report ? (Yes) No	Client / Project Information		Please indicate below Filtered, Preserved or both (F, P, F/P)
THE QUESTIONS BELOW MUST BE ANSWERED FOR WATER SAMPLES (circle Yes or No)	Job #:		
Are any samples taken from a regulated DW System? Yes (No)	PO / AFE:		
If yes, an authorized Drinking Water COC MUST be used for this submission.	LSD:		
Is the water sampled intended to be potable for human consumption? Yes (No)			
	Quote #: Q29978		
Lab Work Order # (lab use only)	ALS Contact:	Sampler: L. Welch, A. Buonacore	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Total Metals	Nutrients	Total Coliform E coli									Number of Containers
						P	P	P									
PR 1	Pine River - Site #1	25-July-11	14:30	Grab	✓	✓	✓	✓									
PR 2	Pine River - Site #2	25-July-11	13:50	Grab	✓	✓	✓	✓									
PR 3	Pine River - Site #3	25-July-11	13:15	Grab	✓	✓	✓	✓									
PR 4	Pine River - Site #4	25-July-11	12:55	Grab	✓	✓	✓	✓									
PR 5	Pine River - Site #5	25-July-11	12:30	Grab	✓	✓	✓	✓									
PR 6	Pine River - Site #6	25-July-11	12:10	Grab	✓	✓	✓	✓									
PR 7	Pine River - Site #7	25-July-11	11:55	Grab	✓	✓	✓	✓									
PR 8	Pine River - Site #8	25-July-11	11:30	Grab	✓	✓	✓	✓									
PR 9	Pine River - Site #9	25-July-11	11:10	Grab	✓	✓	✓	✓									
PR 10	Pine River - Site #10	25-July-11	10:30	Grab	✓	✓	✓	✓									

Special Instructions / Regulations / Hazardous Details

Reg 153 Table 1 2 3 TCLP MISA (PWQO) OTHER (please specify):
Circle one - Note drinking water samples MUST USE DW Chain of Custody

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
A Buonacore	July 26/11		K Lee	26/07/11	9:15	10.7 °C	K Lee	26/07/11	9:53	

cooler 1: 10.7 - 10.7 : 10.7
cooler 2: 9.8 - 11.1 : 10.5

TYFM014 26-Mar-10