North Current River Watershed

Assessment Report

LAKEHEAD REGION
CONSERVATION AUTHORITY

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2019

PREPARED BY:

Rachael Kuipery (Assistant Water Resources Technologist)
Lydia Johnson (Assistant Water Resources Technologist)

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The 2019 North Current River Watershed Assessment was prepared by Rachael Kuipery and Lydia Johnson, Assistant Water Resources Technologists of the Lakehead Region Conservation Authority. Scott Drebit, GIS/Water Resources Technologist of the Lakehead Region Conservation Authority, produced the maps for this report and provided input and revisions towards the final copy. Tammy Cook, Chief Administrative Officer, and Gail Willis, Watershed Manager, also 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 North Current River Watershed in 2019.

EXECUTIVE SUMMARY

The North Current River Watershed Assessment Report provides baseline data to track progress and water quality over time, and provides the LRCA with a better understanding of the local environment to focus future actions where needed. The results from the collected data were analyzed, and the North Current River Watershed was given an overall watershed grade rating; thereby, determining the health status of the watershed.

Background

The North Current River Watershed is located within the City of Thunder Bay, the Municipality of Shuniah (Geographic Township of MacGregor), the unorganized Township of Gorham and the unorganized area north of the Municipality of Shuniah. The watershed covers a drainage area of approximately 119.5 square kilometres. The North Current River runs approximately 50.0 kilometres in length from its headwaters in Kingfisher Lake to its confluence with the Current River in the southwestern portion of the watershed. The general slope of the watershed is approximately 0.54 percent.

The majority of the North Current River Watershed is crown land (65.8 percent) with the remainder privately owned land (34.2 percent). Site 1 was located within Trowbridge Falls Municipal Campground and Site 4 was located in Kingfisher Outdoor Education Centre. Site 2 and 3 were publicly accessible areas.

Physical and Biological Attributes

The surficial geology distribution of the North Current River Watershed changes from bedrock in the north and central area, to moraine further south, to esker/kame/outwash plain in the southern most portion of the watershed. There is a small band of moraine in the headwater area of Kingfisher Lake. The surficial geology can be seen on Map M-5: Surficial Geology.

The North Current River Watershed is located within the boundaries of the Great Lakes and Boreal forest regions. The most common tree species in the watershed are white spruce, trembling aspen, tamarack, white birch, and black spruce. There are a variety of other plants present in the watershed including ferns, shrubs, herbs, mosses and lichens.

No invasive plant species were seen at the sample sites within the North Current River Watershed. The only species at risk that was seen in the North Current River Watershed was a Monarch at Site 1.

Watershed Site Assessment

Four sample sites located within the North Current River Watershed were chosen based on a variety of attributes including: accessibility, physical features, land use designation, proximity to man-made features (that may alter water quality), as well as headwaters used for baseline conditions. Site 1 is located near the confluence of the North Current River and the Current River. Site 2 and 3 are located north of Site 1 on the main channel. Site 4 is located at the headwaters of the North Current River as it exits Kingfisher Lake.

Surface Water Quality – PWQO Comparison

At each of the four sample locations, surface water samples and field measurements were collected in 2019 on June 12th and July 9th. Subsequently, the surface water samples were analyzed by ALS Laboratory Group for physical parameters (conductivity, pH, total dissolved solids, and turbidity), nutrients and anions (total alkalinity, total ammonia, chloride, nitrate, nitrite, total Kjeldahl Nitrogen, total phosphorus, and sulfate), bacteriological tests (*Escherichia coli (E. coli)*, total coliforms), and a full metal scan. Field measurements were taken using an YSI Pro DSS Multi-Parameter Probe, which included sampling of water temperature, pH, conductivity, turbidity, total dissolved solids, oxidation-reduction potential and dissolved oxygen. Field and laboratory results were compared to the Ministry of Environment and Energy's *Provincial Water Quality Objectives* (PWQO), 1994. Parameters that exceeded the PWQOs include; total coliforms, aluminum, copper, and iron.

a) Bacteriological Exceedance

PWQO criterion for *E. coli* bacteria levels is 100 counts per 100 mL. *E. coli*. Counts greater than the criterion indicate that bacterial contamination may be a problem with a waterbody. During the June and July sampling period the levels of *E. coli* were not in exceedance.

As there is no current PWQO for total coliforms, results were compared to the pre-1994 PWQO criterion (1,000 MPN/100 mL). During the July sampling period Sites 3 and 4 were above the criterion. Total coliform concentrations in 2019 ranged from 365 MPN/100 mL (Site 4) to >2,420 MPN/100 mL (Site 4) for the watershed.

Coliform bacteria are living organisms and can multiply quickly when conditions are favorable for growth, or die in large numbers when conditions are not. Additionally, coliform bacteria is a common occurrence in nature from the predatory community. Bacterial concentrations are dependent on specific conditions such as precipitation, temperature, and stream substrate. The 2019 average temperature during the sampling period was 0.7 degree Celsius higher than the Thunder Bay historical average. The total precipitation in 2019 was 24 millimetres below average compared to the historical total

precipitation. Higher temperatures and lower precipitation can affect bacteriological counts in watersheds.

b) Metals Exceedance

The PWQO criterion for aluminum is 0.075 mg/L. During the June sampling period Site 3 was above the criterion with a value of 0.1030 mg/L. Aluminum concentrations ranged from 0.0320 mg/L to 0.1030 mg/L.

The PWQO criterion for copper is 0.001 mg/L (0-20 mg/L $CaCO_3$) and 0.005 mg/L (>20 mg/L $CaCO_3$). During the June sampling period Site 3 was above the criterion with a value of 0.00121 mg/L. Copper concentrations ranged from 0.00079 mg/L to 0.00121 mg/L.

The PWQO criterion for iron is 0.30 mg/L. During the June sampling period Sites 2 and 3 were above the criterion with values of 0.344 mg/L and 0.543 mg/L. During the July sampling period Sites 1, 2, and 3 were above the criterion with values of 0.348 mg/L, 0.555 mg/L, and 0.786 mg/L. Iron concentrations ranged from 0.127 mg/L to 0.786 mg/L for the watershed. Iron exceedances are common in the region, due to natural, geological, sources.

Site Observations

The flora and fauna inventory indicated that the North Current River Watershed supports a healthy population of diverse plants and animals. The stream banks were stable and showed little signs of erosion. The culvert located at Sites 3 was in good and stable condition. The bridges located at Sites 2 and 4 were also in good and stable condition.

Watershed Report Card Rating

The North Current River Watershed was also assessed using the *Guide to Developing Conservation Authority Watershed Report Cards*, 2017. Using the guide, surface water quality, forest conditions, and wetland conditions for the North Current River Watershed were used to determine a grade rating for the watershed. Surface water quality maintained a good rating with a zero exceedances of *E. coli* present and zero exceedances for phosphorous within the North Current River Watershed. Forest condition scored an overall excellent rating with high forest coverage, forest interior, and riparian forest cover. Wetland conditions scored a good rating with high wetland coverage.

Overall the quality of the North Current River Watershed in 2019 was determined to be in excellent health, and has a grade of ‘A’ based on the surface water quality, an ‘A’ based on the forest conditions, and a ‘B’ based on the wetland conditions.

Recommendations

Upon completion of the watershed assessment, the following recommendations are proposed for consideration:

- Staff and funding permitting, it is recommended that an update to the 2019 North Current River Watershed Assessment be completed in the next five to ten years.
- Benthic sampling and monitoring should be considered for future watershed assessments because it is a useful indicator of water quality over time.
- Additional sampling should be conducted in the spring to observe the water quality differences between high and low flow seasons.
- A copy of this report should be provided to the Municipality of Shuniah and the City of Thunder Bay 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 North Current River Watershed is located within the Municipality of Shuniah, The City of Thunder Bay, and the unorganized Township of Gorham as shown on Map M-1: Key Plan Map. Areas regulated by the Lakehead Region Conservation Authority (LRCA) and Municipal boundaries can be found on Map M-2: Regulated Area Map.

A watershed can be defined as all the land and water within the confines of a drainage divide. In essence, the North Current River Watershed consists of all the surrounding land that naturally drains its lakes, streams, wetlands and precipitation runoff into the North Current River which then joins the Current River.

The headwaters of the main branch begin at Kingfisher Lake, which is north of the Municipality of Shuniah. The watershed covers a drainage area of approximately 119.5 square kilometres. Most of the watershed is dominated by white spruce, white birch, tamarack, black spruce, and trembling aspen. The North Current River runs approximately 50.0 kilometres in length through well-defined drainage courses and valleys.

The goal of this report is to document the conditions of the watershed, especially surface water quality, as observed in June and July of 2019. Four sampling sites were chosen to access the health of the watershed as a whole. This information will ultimately be used 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 assessment 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 stream bank cover observed within the watershed,
- Document active erosion sites,
- Document the physical condition of all North Current River water crossings (bridges/culverts), and
- Interpret results to record the health status of the watershed.

2 BACKGROUND

2.1 Physical Attributes

2.1.1 Topography

The North Current River originates in the northeastern area of the watershed and flows in a southwest direction through to its confluence with the Current River. The highest elevation is approximately 555.7 metres above sea level (347673 E, 5381926 N) (see Map M-3: Topography) to the east, which is underlain by bedrock. The lowest elevation is approximately 251.3 metres above sea level (337856 E, 5373130 N) at the confluence of the North Current River and the Current River. The overall slope of the North Current River is approximately 0.54 percent, having a channel length of 50.0 kilometres. The overall North Current River Watershed topography is shown on Map M-3: Topography.

2.1.2 Geology & Soils

2.1.2.1 Bedrock

Map M-4: Bedrock Geology shows the bedrock geology of the North Current River watershed and the surrounding area. The North Current River Watershed headwater area is composed of massive granodiorite to granite (33.8%) and diorite- monzonite-granodiorite suite (34.9%). There are multiple bands of mafic to intermediate metavolcanic rocks (15.4%) throughout the watershed. The central portion is made up of massive granodiorite to granite and diorite- monzonite- granodiorite suite. The southern portion and the confluence of the North Current River and the Current River is composed of coarse clastic metasedimentary rocks (7.1%), felsic to intermediate metavolcanic rocks (6.4%), and sedimentary rocks (2.4%).

2.1.2.2 Surficial Geology

Map M-5: Surficial Geology shows the surficial geology of the North Current River watershed and the surrounding area. The surficial geology distribution changes from bedrock (72.1%) in the headwater and central portion of the North Current River watershed. A small portion of the headwater area is also made up of moraine (20.7%) in the northeast portion of the watershed. Further southwest in the watershed there is moraine with esker/kame/outwash plain (7.3%) in the southernmost portion of the watershed at the confluence of the North Current River and the Current River. There is one sand and gravel pit within the watershed.

2.1.2.3 Soils

Soil logging for this Watershed Assessment Report was completed to test the extent of the Northern Ontario Engineering Geology Terrain Study (NOEGTS) soil types. The soil logging was completed using criteria derived from the "Field Guide to the Substrates of Ontario" (MNRF, March 2015). Soil samples were taken and logged using a 1.2 metre soil auger. The depth of the organic layer as well as depth, composition and characteristics of the A, B and C soil horizons were logged at the four sampling sites along the North Current River (see Appendix A: Soil Logging Summary and Photography). Map M-6: Soils illustrates the location of the four soil sampling sites.

At Site 1 and 2 field identification of the soil horizon revealed a parent material of sand. Site 3 revealed an "A" horizon of sandy loam and a "C" horizon of silty clay. Site 4 revealed an "A" horizon and a "C" horizon of sandy loam (see Appendix A: Soil Logging Summary and Photography).

Map M-6: Soils revealed that Site 1 was classified as gravelly sand loam (4.1%). Site 2 was classified as moderately coarse sandy loam (19.9%). Site 3 was classified as organic (4.9%). Site 4 was classified as rock (67.7%).

The soil testing results and photographs of each soil profile are shown in Appendix A: Soil Logging Summary and Photography.

2.1.3 Climate

The climate of the North Current 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 March to July the westerly winds prevail, whereas the easterly winds prevail the remainder of the year (LRCA, 1985). These winds modify the climate of Thunder Bay and the surrounding regions. The mean daily temperatures (degrees Celsius) and precipitation levels (millimetres) were recorded at the Thunder Bay Airport from 1971 to 2000 (Environment Canada, 2018) as shown in Table 2.1-1 Average Monthly Temperature and Precipitation for Thunder Bay, 1971-2000. This table also summarizes the extreme daily precipitation in millimetres recorded within a 24-hour period and the date it occurred. Average monthly temperatures from Thunder Bay in 2019 are recorded in Table 2.1-2: Average Monthly Temperature and Precipitation for Thunder Bay, January-July 2019

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 (° C)	-14.8	-12.0	-5.5	2.9	9.5	14.0	17.6	16.6	11.0	5.0	3.0	-11.6
Precipitation												
Total Precipitation (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 Precipitation (millimetres)	51.6	33.5	41.9	69.3	76.2	49.3	53.8	87.1	131.2	47.8	63.0	42.7
Date (yyyy /dd)	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) were recorded at the Thunder Bay Airport for 2019 (Environment Canada, 2019), as shown below.

Table 2.1-2: Average Monthly Temperature and Precipitation for Thunder Bay, January-July 2019

	Jan	Feb	Mar	Apr	May	June	July
Average Temperature							
Daily (° C)	-15.9	-13.9	-5.4	2.2	7.5	13.7	19.2
Precipitation							
Total Precipitation (millimetres)	29.5	37.2	32.1	63.6	43.1	67.5	83.2

The average monthly temperature for the June and July sampling periods was 16.5 degrees Celsius and the average monthly precipitation was 75.4 millimetres. In comparison with the historical data, the 2019 temperature was approximately 1.0 degree Celsius higher than the average for June and July. The 2019 precipitation for June was 18.2 millimetres lower than the historical average precipitation. The 2019 precipitation for July was 29.4 millimetres higher than the historical average precipitation. In general, temperatures in June and July were near normal while the received precipitation for June was below average and the received precipitation for July was above average.

There was no Low Water Condition declared by the Lakehead Region Conservation Authority during 2019.

2.1.4 Hydrology

The main channel of the North Current River Watershed is 50.0 kilometres in length and the watershed itself covers an area of approximately 119.5 square kilometres which flows, generally, in a south-westerly direction to its confluence with the Current River. The surface water area has been estimated at 4.9 square kilometres and the

wetland area has been estimated to be 10.7 square kilometres. There are no identified provincially significant wetlands within the watershed.

2.2 Biological Attributes

2.2.1 Flora

The North Current River Watershed is located within the boundaries of the Great Lakes forest region and the Boreal forest region as shown on the Canada's Forest Regions map (Figure 2: Canada's Forest Regions). 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, as the trees present are predominantly black spruce, white spruce, tamarack, white birch and trembling aspen. 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 Canada's Forest Regions distribution map is only a basic division of the forest types, and there is no discrete line that separates the two zones. Factors mentioned above could easily alter forest types, which are located between two zones.

There are a variety of other plant species present in the North Current River Watershed including ferns, shrubs, herbs, mosses and lichens. Plant species identified at the sample sites are listed in Appendix B: Common and Scientific Names of Identified Flora and Fauna.

2.2.2 Fauna

The North Current River Watershed provides breeding grounds for a variety of wildlife. Species of amphibians, reptiles, and butterflies that have been sighted in the watershed and surrounding area historically, and recently, are listed below in Table 2.2-1: Common Reptiles, Amphibians and Butterflies. The North Current River Watershed is part of the Ontario Ministry of Natural Resources and Forestry (OMNRF) Wildlife Management Unit 13 and Fisheries Management Zone 6.

A complete list of the wildlife observed in the watershed is shown in Appendix B: Common and Scientific Names of Identified Flora and Fauna.

Table 2.2-1 : Common Reptiles, Amphibians, and Butterflies	
Species Name	
Common Name	**Scientific Name**
Amphibians and Reptiles	
Blue-Spotted Salamander	*Ambystoma laterale*
Jefferson Salamander	*Ambystoma jeffersonianum*
Snapping Turtle	*Chelydra serpentine*
Western Painted Turtle	*Chrysemys picta bellii*
Eastern Garter Snake	*Thamnophis sirtalis sirtalis*
Eastern Newt	*Notophthalmus viridescens viridescens*
Mudpuppy	*Necturus maculosus*
American Toad	*Anaxyrus americanus*
Boreal Chorus Frog	*Pseudacris maculata*
Gray Tree Frog	*Hyla versicolor*
Green Frog	*Lithobates clamitans*
Mink Frog	*Lithobates septentrionalis*
Northern Leopard Frog	*Lithobates pipiens*
Spring Peeper	*Pseudacris crucifer*
Wood Frog	*Lithobates sylvaticus*
Butterflies	
Juvenal's Duskywing	*Erynnis juvenalis*
European Skipper	*Thymelicus lineola*
Common Branded Skipper	*Hesperia comma*
Long Dash Skipper	*Polites mystic*
Canadian Tiger Swallowtail	*Papilio Canadensis*
Mustard White	*Pieris oleracea*
Cabbage White	*Pieris oleracea*
Clouded Sulphur	*Colias philodice*
Atlantis Fritillary	*Speyeria atlantis*
Northern Crescent	*Phyciodes cocyta*
Satyr Comma	*Polygonia satyrus*
Mourning Cloak	*Nymphalis antiopa*
Milbert's Tortoiseshell	*Algais milberti*
American Lady	*Vanessa virginiensis*
Painted Lady	*Vanessa cardui*
Red Admiral	*Vanessa atalanta*
White Admiral	*Limenitis arthemis*
Northern Pearly-Eye	*Lethe anthedon*
Common Wood-Nymph	*Cercyonis pegala*
Monarch	*Danaus plexippus*

Source: Ontario Butterfly Atlas & Reptile and Amphibian Atlas, 2015

2.2.3 Species at Risk

Ontario has more than 200 species at risk living in its forests and lakes, all at varying degrees of risk. There are approximately 19 species at risk in the Thunder Bay region that have potential to exist within the North Current River Watershed. In addition to the watershed boundary limits, the surrounding area is considered Boreal forest region, which would allow for movement of individuals in and out of the watershed boundary.

Table 2.2-2: Species at Risk, below, shows the species at risk in the Thunder Bay and Northern Ontario region.

Table 2.2-2: Species at Risk

Species Name		Status of Risk
Common Name	**Scientific Name**	
American Badger *jacksoni* subspecies	*Tixidea taxus jacksoni*	Endangered
American White Pelican	*Pelecanus erythrorhynchos*	Threatened
Bald Eagle	*Haliaeetus leucocephalus*	Special Concern
Bank Swallow	*Riparia riparia*	Threatened
Barn Swallow	*Hirundo rustica*	Threatened
Black Tern	*Chlidonias niger*	Special Concern
Blanding's Turtle	*Emydoidea blandingii*	Threatened
Bobolink	*Dolichonyx oryzivorus*	Threatened
Canada Warbler	*Cardellina canadensis*	Special Concern
Chimney Swift	*Chaetura pelagica*	Threatened
Common Nighthawk	*Chordeiles minor*	Special Concern
Cougar (Mountain Lion)	*Puma concolor*	Endangered
Deepwater Sculpin	*Myoxocephalus thompsonii*	Special Concern
Eastern Meadowlark	*Sturnella magna*	Threatened
Eastern Milksnake	*Lampropeltis triangulum*	Special Concern
Eastern Whip-poor-will	*Antrostomas vociferus*	Threatened
Eastern Wolf	*Canis lupus lycaon*	Special Concern
Eastern Wood-pewee	*Contopus virens*	Special Concern
Golden Eagle	*Aquila chrysaetos*	Endangered
Golden-winged Warbler	*Vermivora chrysoptera*	Special Concern
Gray Fox	*Urocyon cinereoargenteus*	Threatened
Horned Grebe	*Podiceps auritus*	Special Concern
Kiyi	*Coregonus kiyi kiyi*	Special Concern
Lake Sturgeon	*Acipenser fulvescens*	Threatened and Special Concern
Least Bittern	*Ixobrychus exilis*	Threatened
Little Brown Bat	*Myotis lucifugus*	Endangered
Loggerhead Shrike	*Lanius ludovicianus*	Endangered
Monarch Butterfly	*Danaus plexippus*	Special Concern
Northern Brook Lamprey	*Ichthyomyzon fossor*	Special Concern
Northern Map Turtle	*Graptemys geographica*	Special Concern
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern
Peregrine Falcon	*Falco peregrinus anatum/tundrius*	Special Concern
Piping Plover	*Charadrius melodus circumcinctus*	Endangered
Pitcher's Thistle	*Cirsium pitcheri*	Threatened

Table 2.2-2: Species at Risk		
Species Name		Status of Risk
Common Name	Scientific Name	
Pygma Snaketail	*Ophiogomphus howei*	Endangered
Rusty Blackbird	*Euphagus carolinus*	Special Concern
Short-eared Owl	*Asio flammeus*	Special Concern
Shortjaw Cisco	*Coregonus zenithicus*	Threatened
Showy Goldenrod	*Solidago speciose*	Threatened and Endangered
Small-flowered Lipocarpha	*Licocarpha micrantha*	Threatened
Snapping Turtle	*Chelydra serpentina*	Special Concern
Wolverine	*Gulo gulo*	Threatened
Woodland Caribou, Boreal population	*Rangifer tarandus caribou*	Threatened
Wood Thrush	*Hylocichla mustelina*	Special Concern
Western Silvery Aster	*Symphyotrichum sericeum*	Endangered
Yellow Rail	*Coturnicops noveboracensis*	Special Concern

Source: Ontario Ministry of Natural Resources and Forestry - Species at Risk in Thunder Bay Region, 2016 and Ontario Nature- Species at Risk in Northern Ontario, 2017

One Monarch Butterfly was observed during the watershed site assessments.

2.2.4 Invasive Species

Invasive species are a threat to native plants and animals and can disturb entire ecosystems. They are introduced and spread as a result of movement of people and goods around the world, increased urbanization, improved transportation routes and through recreational activities.

Some of the ways invasive species can enter Ontario include, but are not limited to;

- All-terrain vehicles,
- Aquarium, water garden and pet trades,
- Ballast water of ships,
- Canals and changes to waterways,
- Gardening and landscaping,
- Release of live fish and bait,
- Transport of topsoil,
- Recreational and commercial boating,
- Transport of animal carcasses or products made from them, and
- Transport of raw wood and other forest products.

Invasive species that were observed in the Lake Superior or District of Thunder Bay area may be present in the North Current River Watershed according to the Canada/Ontario Invasive Species Centre, OMNRF and the Ontario Federation of Anglers and Hunters' Early Detection and Distribution Mapping System. These invasive species are listed below in Table 2.2-3: Invasive Species.

Table 2.2-3 : Invasive Species	
Species Name	
Common Name	**Scientific Name**
Canada Thistle	*Cirsium arvense*
Chinese Mitten Crab	*Eriocheir sinensis*
Common Reed	*Phragmites australis*
Dog-Strangling Vine	*Cynanchum rossicum & C. nigrum*
Emerald Ash Borer	*Agrilus planipennis*
Eurasian Ruffe	*Gymnocephalus cernua*
European or Black Alder	*Alnus glutinosa*
European Common Reed	*Phragmites australis ssp. australis*
European Flounder	*Platichthys flesus*
European Spindletree	*Euonymus europaeus*
Flowering-Rush	*Butomus umbellatus*
Garlic Mustard	*Alliaria Petiolata*
Giant Hogweed	*Heracleum mantegazzianum*
Goldfish	*Carassius auratus*
Goutweed	*Aegopodium podagraria*
Glossy Buckthorn	*Rhamnus frangula*
Himalayan Balsam	*Impatiens glandulifera*
Hybrid Cattail	*Typha x glauca*
Japanese Knotweed	*Polygonum cuspidatum*
Manitoba Maple	*Acer negundo*
Narrow-leaved Cattail	*Typha angustifolia*
New Zealand Mud Snail	*Potamopyrgus antipodarum*
Non-native Bush Honeysuckle	*Lonicera spp.*
Norway Maple	*Acer platanoides*
Periwinkle	*Vinca minor*
Phragmites	*Phragmites australis*
Purple Loosestrife	*Lythrum salicaria*
Rainbow Smelt	*Osmerus mordax*
Reed or Giant Manna Grass	*Glyceria maxima*
Round Goby	*Neogobius melanostomus*
Rusty Crayfish	*Orconectes rusticus*
Spiny Water Flea	*Bythotrephes longimanus*
Tatarian honeysuckle	*Lonicera tatarica*
Three Spine Stickleback	*Gasterosteus aculeatus*
Tubenose Goby	*Proterorhinus marmoratus*
White Perch	*Morone Americana*
Wild Chervil	*Anthriscus sylvestris*
Wild Parsnip	*Pastinaca sativa*
Winged Euonymus	*Euonymus alatus*
Yellow Sweet-Clover	*Melilotus officinalis*
Yellow Iris	*Iris pseudacorus*
Zebra Mussel	*Dreissena polymorpha*

Source: Early Detection & Distribution Mapping System for Ontario, 2019

No invasive species were observed during the watershed assessments.

2.3 Socio-Economic Attributes

2.3.1 Planning & Development Controls

Land Tenure

The majority of the North Current River Watershed is designated as provincially owned Crown land (65.8 percent) with the remainder designated as privately owned land (34.2 percent). Land ownership in the watershed is illustrated on Map M-7: Land Ownership.

Areas of Jurisdiction

The hydrological boundaries of the North Current River Watershed falls within the City of Thunder Bay, the Municipality of Shuniah (Geographic Township of MacGregor), unorganized Township of Gorham, and the unorganized area north of the Municipality of Shuniah. The north portion of the waterhed falls outside of the LRCA jurisdiction. Map M-7: Land Ownership, illustrates the location of the North Current River Watershed within these areas.

Within Regulated Areas of 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 Conservations Authorities Act. Areas considered regulated include: Provincially Significant Wetlands and 120 metres adjacent, all watercourses, all land zoned Hazard Land, Use Limitation or Environmental Protection, steep slopes, and 15 metres landward and one kilometre lakeward from the 100-year flood level on Lake Superior (i.e. 183.90 metres Geodetic Survey of Canada), as shown on Map M-2: Regulated Area. Activities within the approximate regulated area may require a permit from the Authority.

2.3.1.1 Land Use Designation/Zoning

Municipal Official Plans contain long term goals and policies that serve as guidelines for future land use and development. The North Current River Watershed is affected by the City of Thunder Bay Official Plan and Zoning by-laws as well as the Municipality of Shuniah Official Plan and Zoning by-laws. The zoning designation within the North Current River Watershed can be found on Map M-8: Zoning.

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 that must be satisfied such as buffering, suitable distances between uses and parking requirements.

Within the City of Thunder Bay, the North Current River Watershed has been identified for the following land-use zones:

- Environmental Protection Zone (EP)
- Rural Area Zone (RU1)
- Open Space Zone (OS)

The following definitions are taken from the City of Thunder Bay Zoning By-Law 100-2010, dated October 18, 2010.

Environmental Protection Zone (EP)

No person shall use any land or erect or use any building or structure within any EP ZONE for any purpose or use other than the uses listed: (a) Docks; (b) Boat launches; (c) Flood control; (d) Erosion control; (e) Marina; or (f) Park exclusive of buildings or structures.

Rural Area Zone (RU1)

No person shall, within an RU1 ZONE, use any land, or erect or use any building or structure for any purpose or use other than the uses listed: (a) Agricultural use; (b) Animal boarding facility; (c) Animal care facility; (d) Emergency services facility; (e) Kennel; (f) Nursery; (g) Park; (h) Recreational facility; (i) Residential care facility one; (j) Residential care facility two; (k) Riding and/or boarding stables; or (l) Single detached dwelling which may include a personal farm.

Open Space Zone (OS)

No person shall within any OS ZONE use any land or erect or use any building or structure for any purpose or use other than the uses listed: (a) Community Centre; (b) Cultural Facility; (c) Golf Course; (d) Marina; (e) Nursery; (f) Park; (g) Recreational Facility; (h) Ski Resort; or (i) Zoo.

Within the Municipality of Shuniah, the North Current River Watershed has been identified for the following land-use zones

- Aggregate Extraction (AG)
- Rural (RU)
- Heavy Industrial (HI)
- Light Industrial (LI)
- Recreational Cottage Zone -Remote (REC-RE)

The following definitions are taken from the Municipality of Shuniah's Zoning By-Law No. 20138-00, dated June 28, 2005.

Aggregate Extraction (AG)

No use of land building, building, or structure shall be permitted within this zone except as follows; (a) Pits and/or quarries for extracting sand, clay, gravel, earth, soil, stone, shale, or peat; (b) Stockpiling or excavated materials; (c) Screening, sorting, and washing or other processing of excavated material, excluding crushing; (d) Wayside pits and/or quarries; (e) Buildings, structures, and/or uses accessory, subordinate, and exclusively devoted to a permitted use, which shall not include a dwelling unit.

Rural (RU)

No use of land building, building, or structure shall be permitted within this zone except as follows; (a) Agriculture, which may include only one permanent dwelling; (b) Forestry harvesting; (c) One only permanent dwelling; (d) Home occupation; (e) Conservation use; (f) Park; (g) Wayside pit, quarry; (h) Accessory sale of fish baits; (i) Buildings, structures, and/or uses accessory, subordinate, and exclusively devoted to a permitted use, which may include a kennel, riding academy or stable.; (j) On properties that front onto Highway 527 only, up to three pulp trucks, or other such large commercial vehicles shall be permitted to be maintained and operated in association with a permitted residence.

Heavy Industrial (HI)

No use of land building, building, or structure shall be permitted within this zone except as follows; (a) Asphalt plant; (b) Bulk fuel storage and distribution; (c) Public utility; (d) Open storage; (e) Heavy industrial use; (f) Industrial centre; (g) Truck depot; (h) Transportation or truck operation; (i) Salvage yard, automobile scrap yard or wrecking yard; (j) Service, repair shop, commercial garage; (k) Waste disposal facility; (l) Buildings, structures, and/or uses accessory, subordinate, and exclusively devoted to a permitted use, which shall not include a dwelling unit.

Light Industrial (LI)

No use of land building, building, or structure shall be permitted within this zone except as follows: (a) automobile gas bar and/or automobile service station which may include the sale of propane or diesel fuel; (b) body repair shop; (c) car wash; (d) construction yard; (e) greenhouses; (f) kennel, veterinary clinic; (g) lumbar yard; (h) industrial centre; (i) weigh station; (j) building supply outlet, hardware store; (k) equipment rental; (l) light industrial use operating totally contained within a building; (m) public service facility; (n) service or repair shop, commercial garage; (o) transportation or truck operation; (p) the existing woodlands operation located north of the Expressway and SW of Highway 527, so long as such use continues to exist; (p) buildings, structures, and/or uses accessory, subordinate, and exclusively devoted to a permitted use, which shall not include a dwelling unit.

Recreational Cottage Zone -Remote (REC-RE)

No use of land building, building, or structure shall be permitted within this zone except as follows; (a) recreational dwelling; (b) buildings, structures, and/or accessory, subordinate, and exclusively devoted to a permitted use.

3 WATERSHED SITE ASSESSMENT

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

3.1 Site Selection

Four sites were chosen within the North Current River Watershed to assess the health of the watershed as a whole. Each site was chosen based on its accessibility and its proximity to natural or man-made features that may alter water quality. Site locations can be found on Map M-9: Site Plan.

3.2 Quantitative Assessment – Surface Water Quality

Several parameters were measured to assess surface water quality of the North Current River. Surface water samples were collected in laboratory supplied bottles by LRCA staff and summer students and transported on ice, to ALS Laboratory Group, 1081 Barton Street, Thunder Bay, Ontario. An analysis was conducted on the samples to determine conductivity, total dissolved solids (TDS), turbidity, nutrients (ammonia-N total nitrogen, alkalinity, chloride, sulfate, nitrate, nitrite and phosphorus), bacteria (*E. coli* and total coliforms) and total metals.

Sampling was conducted on two separate occasions for each site, to enable comparisons and reveal discrepancies. The first data set was collected on June 12, 2019. The second data set was collected on July 9, 2019.

Methodology for water sample collection was based on the Provincial Water Quality Monitoring Network (PWQMN), Ministry of the Environment, Conservation and Parks, 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 six collection bottles for each site to conduct the following tests: physical parameters (routine and solids), anions and nutrients, bacteriological, dissolved metals, and total metals. The physical analysis sample bottles and lids were rinsed three times before a true sample was collected. The ALS Laboratory

Group pre-charged the anion and nutrients sample bottles with sulfuric acid and the total metals bottles were pre-charged with nitric acid to preserve the samples taken, and were not rinsed before filling. Bottles for bacteriological analysis were also 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, turbidity, dissolved oxygen, total dissolved solids, and oxygen reduction potential were measured using an YSI ProDSS multi-parameter water quality sampler at the time of 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, stopwatch and appropriate calculations. Velocity was only measured for water running downstream (not in ponds producing only windblown results). A description of the water quality parameters is attached in Appendix D: Summary of Water Quality Parameters.

3.3 Applicable Criteria – Provincial Water Quality Objectives

Surface water quality results from the North Current River Watershed were compared to applicable criteria published in the *Provincial Water Quality Objectives* (PWQO) by the Ontario Ministry of Environment and Energy, July 1994. The goal of the PWQO is to ensure that the surface waters of the province are of the quality that is satisfactory for aquatic life and recreation.

The applicable criteria published in the PWQO water quality guidelines are attached in Appendix E: Water Quality Guidelines. Total Coliform results were compared to the pre-1994 PWQO, as there are no current criteria.

3.4 Qualitative Assessment – Site Observations

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. Seven 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 based on vegetation that could be seen from the site, with no distinct sample area, 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. Differences or inconsistencies between the V-types should be expected.

Vegetation Types for each site are attached in Appendix F: Forest Ecosystem Classification. Common and Latin names of plant species are attached in Appendix B: Common and Scientific Names of Identified Flora and Fauna. Fauna was assessed by identifying the species and number of individuals observed at each site.

An inventory of the North Current 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. Bridge and culvert locations can be found on Map M-10: Bridge and Culvert Sites. The culvert assessments are attached in Appendix G: Culvert Assessments. Bridge assessments are attached in Appendix H: Bridge Assessments.

3.5 Watershed Report Card Rating

The Conservation Authorities in Ontario have developed the Watershed Report Card (WRC) as a means of reporting and designating watershed health through the use of environmental indicators and to utilize the information to better target programs and measure environmental change. Four resource categories are measured in the Watershed Report Cards, which include surface water quality, forest conditions, wetland conditions, and groundwater quality. The grading system for each resource category is recognized as A-Excellent; B-Good; C-Fair; D-Poor; F-Very Poor.

Surface water quality, forest conditions, and wetland cover was measured for the North Current River Watershed. The three indicators used to assess surface water quality for the watershed are total phosphorus, *Escherichia coli (E. coli),* and benthic macroinvertebrates (See Table 3.5-1: 2011 Surface Water Quality Indicator Guidelines). Benthic macroinvertebrates were not studied in this watershed assessment so the data is not available for the assessment. The average point score of the surface water indicators is used to determine the overall surface water quality grade. No groundwater data was available for the watershed.

Forest conditions utilize three indicators to determine the grade for the quality of the forest, which include forest coverage, forest interior percentage and percentage of riparian zone forested (see Table 3.5-2: 2011 Forest Conditions Indicator Guidelines). Forest cover is the percentage of the watershed that is forested. Forest interior is the area of forest that lies more than 100 metres from a forest edge. Forest riparian zone measures the amount of forest cover within 30 metres adjacent to all open watercourses. Northern Ontario Forest Cover criteria requires a different scoring system because the targets used for the Watershed Report Card were set by Environment Canada for southern Ontario. The minimum threshold set by Environment Canada for forest cover in Northern Ontario is probably well over 30 percent because it must be able to sustain species such as bear, moose, and boreal birds. A preliminary grading system for

percentage forest cover in Northern Ontario has been suggested for the Watershed Report Card.

Percent wetland cover is the percentage of the watershed that is in wetland cover (see Table 3.5-3: 2017 Grading System for Percentage Wetland Cover). Wetlands include swamps (treed and thicket), bogs, fens, and marshes.

Table 3.5-1: 2011 Surface Water Quality Indicator Guidelines

					Overall Surface Water Quality Grade	
Total Phosphorus (mg/L)	***E. coli* (#100 mL)**	**Benthic Invertebrates**	**Point Score**	**Grade**	**Final Points**	**Final Grade**
<0.020	0-30	0.00-4.25	5	A	>4.4	A
0.020-0.030	31-100	4.26-5.00	4	B	3.5 - 4.4	B
0.031-0.060	101-300	5.01-5.75	3	C	2.5 - 3.4	C
0.061-0.180	301-1000	5.76-6.50	2	D	1.5 - 2.4	D
>0.180	>1000	6.51-10.00	1	F	<1.5	F

Table 3.5-2: 2011 Forest Conditions Indicator Guidelines

					Overall Forest Conditions	
% Forest Cover (N. Ontario Grading Option 1)	**% Forest Interior**	**% Riparian Zone Forested**	**Point Score**	**Grade**	**Final Points**	**Final Grade**
>75.0	>11.5	>57.5	5	A	>4.4	A
65.1 - 75.0	8.6 - 11.5	42.6- 57.5	4	B	3.5 - 4.4	B
55.1 - 65.0	5.6 - 8.5	27.6 - 42.5	3	C	2.5 - 3.4	C
45.1 – 55.0	2.5 - 5.5	12.5 - 27.5	2	D	1.5 - 2.4	D
<45.1	<2.5	<12.5	1	F	<1.5	F

Table 3.5-3: 2017 Grading System for Percentage Wetland Cover

Grade	% Wetland Cover
A	>11.5
B	8.6-11.5
C	5.6-8.5
D	2.5-5.5
F	<2.5

3.6 Materials

Materials used during the assessment included:

- Auger,
- Chest waders,
- Clipboard and observation chart paper,
- Cooler and ice packs,
- Digital underwater camera,
- Field guides,
- High visibility vests,
- Latex gloves,
- Measuring tape reel,
- Mercury thermometer,
- Metre stick,
- Road map,
- Sampling bottles and preservative provided by ALS Laboratory Group,
- Stopwatch,
- Tarp,
- Trimble Geo XH GPS,
- Writing utensils, and
- YSI Pro DSS metre.

Field Guides:

- Field Guide to the Forest Ecosystem Classification for Northwestern Ontario (Sims *et al.,* 1997),
- Wetland Plants of Ontario (Newmaster *et al.*, 1997),
- Forest Plants of Northeastern Ontario (Legasy *et al*.,1995),
- Bugs of Ontario (Acorn, 2003),
- Forest Plants of Central Ontario (Chambers *et al.*,1996),
- Birds of Ontario (Bezener, 2000), and
- INaturalist app (California Academy of Sciences, 2008).

4 RESULTS

Site photos from each sampling site are attached in Appendix H: Site Photography. The laboratory water quality results and PWQO criteria have been compared and attached in Appendix I: Laboratory Water Quality Results Summary Tables June and Appendix J: Laboratory Water Quality Results Summary Tables July. The original Laboratory Certificates of Analysis and Analytical Reports have been attached in Appendix L: Laboratory Certificates of Analysis and Test Results.

The results for the North Current River Watershed are summarized in the tables below for each site.

4.1 Site 1

Site 1 was located at the confluence of the North Current River and the Current River. The site is located in Trowbridge Falls Municipal Campground. The substrate at this site consisted of predominantly sand. The banks of the creek were stable with abundant vegetation in the riparian zone including: white spruce, black spruce, tamarack, speckled alder, and red-osier dogwood. There was no erosion present along the banks. The soil type present at this site was a sand in the "C" Horizon.

The laboratory results from the June sampling period showed no exceedances of the PWQO guidelines. The laboratory results from the July 2019 sampling periods showed that iron exceeded the PWQO guidelines.

Iron exceeded the PWQO criterion (0.3 mg/L) with a value of 0.348 mg/L on July 9, 2019.

Table 4.1-1: Location References for Site 1

Location Description	Confluence of North Current River and Current River. Trowbridge Falls Municipal Campground.
UTM Coordinates	Northing 5373145 Easting 337879
Altitude/Elevation	254 metres above sea level

Table 4.1-2: Field Measurements for Site 1

Parameter	**Unit**	**Date:** 12-JUN-19 **Time:** 14:10	**Date**: 9-JUL-19 **Time**: 13:45
Water Temperature	°C	18.2	22.4
Conductivity	uS/cm	106.7	149.3
Dissolved Oxygen	mg/L	9.19	8.84
Dissolved Oxygen	%	97.5	101.8
pH		7.64	7.93
Turbidity	NTU	1.6	1.1
Air Temperature	°C	17	23
Total Dissolved Solids	mg/L	69.390	96.905
Channel Width	m	N/A	N/A
Channel Depth	m	0.29	0.17
Velocity	m/s	N/A	N/A

Table 4.1-3: Select Laboratory Water Quality Results for Site 1				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**12-JUN-19 **Time:** 14:10	**Date:** 9-JUL-19 **Time:** 13:45
Bacteriological				
Escherichia coli	MPN/100mL	100	20	6
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	411	921
Physical				
Conductivity (EC)	uS/cm	-	96.6	134
pH		6.5-8.5	7.59	7.35
Total Dissolved Solids	mg/L	-	83	88
Turbidity	NTU	-	0.68	0.83
Anions and Nutrients				
Alkalinity, Total (as $CaCO_3$)	mg/L	8.1 (June); 9.825 (July)	31.9	47.2
Ammonia-N, Total	mg/L	-	0.012	<0.020
Un-ionized Ammonia	mg/L	0.02	0.000179	N/A
Chloride (Cl)	mg/L	-	8.81	10.8
Nitrate-N (NO3-N)	mg/L	-	0.032	0.040
Nitrite-N (NO2-N)	mg/L	-	<0.010	<0.010
Phosphorus (P)-Total	mg/L	0.03	0.0086	0.0086
Sulfate (SO4)	mg/L	-	1.78	2.19
Total Metals				
Aluminum (Al)	mg/L	0.075	0.0564	0.0320
Cadmium (Cd)	mg/L	0.0001 (0-100 mg/L $CaCO_3$)	<0.0000050	0.0000064
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	-
Cobalt (Co)	mg/L	0.0009	<0.00010	<0.00010
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	-	-
	mg/L	0.005 (>20 mg/L $CaCO_3$)	0.00104	0.00099
Iron (Fe)	mg/L	0.300	0.287	**0.348**
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	-	-
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	0.000056	<0.000050
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	-
Sodium (Na)	mg/L	-	5.60	6.86
Vanadium (V)-Total	mg/L	0.006	0.00070	0.00067
Zinc (Zn)-Total	mg/L	0.02 (interim)	<0.0030	<0.0030

Bold indicates exceedance above PWQO guidelines

Table 4.1-4: Flora Observed at Site 1			
FEC V-Type: V15 White Spruce Mixedwood			
Forest Density / Stream Cover	10% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Black Spruce Tamarack White Spruce	Bog Rosemary Green Alder Pin Cherry Red Osier Dogwood Smooth gooseberry Speckled Alder Sweetgale Willow spp.	Dandelion Downy Yellow Violet Lupine spp. Multicolored Blue Flag Northern Bluebell Northern Blue Violet Sweet Coltsfoot Woodland Strawberry	Grasses spp. Meadow Horsetail

Table 4.1-4: Flora Observed at Site 1			
FEC V-Type: V15 White Spruce Mixedwood			
Forest Density / Stream Cover	10% stream cover		
Aquatic Macrophytes and Algae			
Emergent	-	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.1-5: Fauna Observed at Site 1	
Fauna Species	
Amphibians	-
Birds	Common Merganser
Crustaceans	-
Fish	Minnow spp.
Insects/ Arachnids **Insects/Arachnids**	Black fly, Deer fly, Dragonfly spp., Eastern Tiger Swallowtail, Monarch, Mosquito, White Admiral,
Mammals	-
Mollusca	-
Reptiles	-
Animal Tracks	-

Table 4.1-6: Physical Features Observed at Site 1							
In-stream Substrate							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	20%	20%	50%	10%	-	-	-
Bank Stability/Erosion	No erosion – stable, vegetated						

4.2 Site 2

Site 2 was located approximately 2 kilometres west of Highway 527 on Mitchell Road. The substrate at this site included: sand. The banks of the creek were stable with abundant vegetation in the riparian zone including: white spruce, black spruce, white birch, beaked hazel, and speckled alder. The soil type present at this site in the "C" Horizon was sand.

The laboratory results from both the June and July 2019 sampling periods showed that iron exceeded the PWQO guidelines.

Iron exceeded the PWQO criterion (0.3 mg/L) with a value of 0.344 mg/L on June 12, 2019 and a value of 0.555 mg/L on July 9, 2019.

Table 4.2-1: Location References for Site 2	
Location Description	Approximately 2 kilometres west of Highway 527 on Mitchell Road.
UTM Coordinates	Northing 5377317 Easting 339625
Altitude/Elevation	340 metres above sea level

Table 4.2-2: Field Measurements for Site 2			
Parameter	**Unit**	**Date:** 12-JUN-19 **Time:** 13:25	**Date**: 9-JUL-19 **Time**: 13:00
Water Temperature	°C	17.9	20.4
Conductivity	uS/cm	91.7	133.3
Dissolved Oxygen	mg/L	9.39	8.91
Dissolved Oxygen	%	98.9	98.6
pH		7.60	7.80
Turbidity	NTU	1.5	1.4
Air Temperature	°C	16	22
Total Dissolved Solids	mg/L	59.605	86.633
Channel Width	m	N/A	N/A
Channel Depth	m	0.16	0.07
Velocity	m/s	0.36	0.14

Table 4.2-3: Select Laboratory Water Quality Results for Site 2				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**12-JUN-19 **Time:** 13:25	**Date:** 9-JUL-19 **Time:** 13:00
Bacteriological				
Escherichia coli	MPN/100mL	100	41	13
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	488	980
Physical				
Conductivity (EC)	uS/cm	-	83.6	120
pH		6.5-8.5	7.05	7.20
Total Dissolved Solids	mg/L	-	73	90
Turbidity	NTU	-	0.95	0.89
Nutrients and Anions				
Alkalinity, Total (as $CaCO_3$)	mg/L	8.1 (June); 9.825 (July)	25.3	38.9
Ammonia-N, Total	mg/L	-	0.051	<0.020
Un-ionized Ammonia	mg/L	0.02	0.000679	N/A
Chloride (Cl)	mg/L	-	8.24	11.4
Nitrate-N (NO3-N)	mg/L	-	0.035	0.055
Nitrite-N (NO2-N)	mg/L	-	<0.010	<0.010
Phosphorus (P)-Total	mg/L	0.03	0.0100	0.0097
Sulfate (SO4)	mg/L	-	1.69	2.14
Metals				
Aluminum (Al)	mg/L	0.075	0.0634	0.0421
Cadmium (Cd)	mg/L	0.0001 (0-100 mg/L $CaCO_3$)	0.0000050	<0.0000050
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	-
Cobalt (Co)	mg/L	0.0009	0.00011	0.00011
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	-	-
	mg/L	0.005 (>20 mg/L $CaCO_3$)	0.00112	0.00100
Iron (Fe)	mg/L	0.300	**0.344**	**0.555**
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	<0.000050	-
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	-	0.000060
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	-

Table 4.2-3: Select Laboratory Water Quality Results for Site 2				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**12-JUN-19 **Time:** 13:25	**Date:** 9-JUL-19 **Time:** 13:00
Sodium (Na)	mg/L	-	5.46	7.48
Vanadium (V)-Total	mg/L	0.006	0.00078	0.00098
Zinc (Zn)-Total	mg/L	0.02 (interim)	<0.0030	<0.0030

Bold indicates exceedance above PWQO guidelines

Table 4.2-4: Flora Observed at Site 2			
FEC V-Type: V19 Black Spruce Mixedwood/ Herb Rich			
Forest Density / Stream Cover	<10% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Black Spruce Tamarack White Spruce	Beaked Hazel Green Alder Red Osier Dogwood Showy Mountain Ash Speckled Alder Wild Red Raspberry	Clover spp. Cow Parsnip Cow Vetch Dandelion Large Leaved Aster Ox-eye Daisy Pearly Everlasting Rough Bedstraw Swamp Thistle Yellow Hawkweed Woodland Strawberry	Canada Bluegrass Meadow Horsetail
Aquatic Macrophytes and Algae			
Emergent	-	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.2-5: Fauna Observed at Site 2	
Fauna Species	
Amphibians	-
Birds	-
Crustaceans	-
Fish	-
Insects/Arachnids	Black Fly, Mosquito, Dragonfly spp., Deer Fly
Mammals	-
Mollusca	-
Reptiles	-
Animal Tracks	-

Table 4.2-6: Physical Features Observed at Site 2							
In-stream Substrate (%)							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	10%	40%	50%	-	-	-	-
Bank Stability/ Erosion	No erosion – stable, vegetated						

4.3 Site 3

Site 3 was located approximately 13 kilometres north of Highway 11/17 on Highway 527. Site 3 was located at a road crossing of Highway 527 over the North Current River. The substrate at this site included: sand and silty. The banks of the creek were stable with abundant vegetation in the riparian zone including: white spruce, trembling aspen, and sweetgale. The soil type present at this site in the "A" Horizon was a sandy loam and the "C" Horizon was a silty clay.

The laboratory results from both the June and July 2019 sampling periods showed that iron exceeded the PWQO guidelines. The June sampling period had additional exceedances in aluminum and copper. The July sampling period had additional exceedances in total coliforms.

Aluminum results exceeded the PWQO criterion (0.075 mg/L) with a value of 0.1030 mg/L on June 12, 2019.

Copper results exceeded the PWQO criterion (0.001 mg/L as CaCO3) with a value of 0.00121 mg/L on June 12, 2019.

Iron results exceeded the PWQO criterion (0.300 mg/L) with a value of 0.543 mg/L on June 12, 2019 and 0.786 mg/L on July 9, 2019.

Total coliforms were above the pre-1994 PWQO criterion (1,000 MPN/100 mL) with a value of 1050 MPN/100 mL on July 9, 2019.

Table 4.3-1: Location References for Site 3

Location Description	Approximately 13 kilometres north of Highway 11/17 on Highway 527.
UTM Coordinates	Northing 582985 Easting 343307
Altitude/Elevation	395 metres above sea level

Table 4.3-2: Field Measurements for Site 3

Parameter	**Unit**	**Date:** 12-JUN-19 **Time:** 12:40	**Date**: 9-JUL-19 **Time**: 12:15
Water Temperature	°C	16.6	22.4
Conductivity	uS/cm	88.1	95.1
Dissolved Oxygen	mg/L	8.11	7.29
Dissolved Oxygen	%	83.3	82.4
pH		7.06	7.38
Turbidity	NTU	2.1	4.2
Air Temperature	°C	15	21
Total Dissolved Solids	mg/L	57.264	60.055
Channel Width	m	N/A	N/A
Channel Depth	m	0.59	0.25
Velocity	m/s	N/A	N/A

Table 4.3-3: Select Laboratory Water Quality Results for Site 3				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**12-JUN-19 **Time:** 12:40	**Date:**9-JUL-19 **Time:** 12:15
Bacteriological				
Escherichia coli	MPN/100mL	100	27	27
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	727	**1050**
Physical				
Conductivity (EC)	uS/cm	-	79.0	83.1
pH		6.5-8.5	6.91	6.93
Total Dissolved Solids	mg/L	-	71	69
Turbidity	NTU	-	1.30	1.28
Nutrient and Anions				
Alkalinity, Total (as $CaCO_3$)	mg/L	8.1 (June); 9.825 (July)	14.7	22.2
Ammonia-N, Total	mg/L	-	0.017	0.088
Un-ionized Ammonia	mg/L	0.02	0.000060	0.0010
Chloride (Cl)	mg/L	-	11.3	9.39
Nitrate-N (NO3-N)	mg/L	-	<0.020	<0.020
Nitrite-N 2-N)	mg/L	-	<0.010	<0.010
Phosphorus (P)-Total	mg/L	0.03	0.0155	0.0138
Sulfate (SO4)	mg/L	-	1.60	1.40
Metals				
Aluminum (Al)	mg/L	0.075	**0.1030**	0.0645
Cadmium (Cd)	mg/L	0.0001 (0-100 mg/L $CaCO_3$)	0.0000057	<0.0000050
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	-
Cobalt (Co)	mg/L	0.0009	0.00029	0.00026
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	**0.00121**	-
	mg/L	0.005 (>20 mg/L $CaCO_3$)	-	0.00104
Iron (Fe)	mg/L	0.300	**0.543**	**0.786**
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	0.000088	0.000112
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	-	-
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	-
Sodium (Na)	mg/L	-	6.95	6.88
Vanadium (V)-Total	mg/L	0.006	0.00093	0.00096
Zinc (Zn)-Total	mg/L	0.02 (interim)	0.0037	<0.0030

Bold indicates exceedance above PWQO guidelines

Table 4.3-4: Flora Observed at Site 3			
FEC V-Type: V9 Trembling Aspen Mixedwood			
Forest Density / Stream Cover	10% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Balsam Poplar Trembling Aspen White Birch White Spruce	Smooth Serviceberry Sweetgale Willow spp.	Bird's-foot trefoil Dandelion Evening Primrose Ox-eye Daisy	Canada Blue Grass Sedges spp.

Table 4.3-4: Flora Observed at Site 3			
Aquatic Macrophytes and Algae			
Emergent	-	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.3-5: Fauna Observed at Site 3	
Fauna Species	
Amphibians	Tadpole/ frog spp.
Birds	Hawk spp.
Crustaceans	-
Fish	Minnow spp.
Insects/Arachnids	Black Fly, Mosquito, Dragonfly spp.
Mammals	-
Mollusca	-
Reptiles	-
Animal Tracks	-

Table 4.3-6: Physical Features Observed at Site 3							
In-stream Substrate							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	-	-	-	70%	30%	-	-
Bank Stability/ Erosion	Stable/abundant vegetation						

4.4 Site 4

Site 4 was located at the headwaters; at Kingfisher Lake. The site can be accessed on the Forest Demonstration Trail at the Kingfisher Outdoor Education Centre. The substrate at this site included: boulders, gravel, sand, and silt. The banks of the creek were stable with abundant vegetation in the riparian zone including: black spruce, white spruce, white birch, beaked hazel, and bush honeysuckle. The soil type present at this site in the "A" Horizon was a sandy loam and the "C" Horizon was also a sandy loam.

The laboratory results from both the July 2019 sampling periods showed that total coliforms exceeded the PWQO guidelines.

Total coliforms were above the pre-1994 PWQO criterion (1,000 MPN/100 mL) with a value of >2,420 MPN/100 mL on July 9, 2019.

Table 4.4-1: Location References for Site 4	
Location Description	Forest Demonstration Trail at Kingfisher Outdoor Education Centre at head waters as river exits Kingfisher Lake
UTM Coordinates	Northing 5391679 Easting 347960
Altitude/Elevation	471 metres above sea level

Table 4.4-2: Field Measurements for Site 4			
Parameter	**Unit**	**Date:** 12-JUN-19 **Time:** 11:00	**Date**: 9-JUL-19 **Time**: 12:15
Water Temperature	°C	18.6	23.4
Conductivity	uS/cm	35.3	37.0
Dissolved Oxygen	mg/L	8.88	8.55
Dissolved Oxygen	%	95.0	100.6
pH		7.79	7.94
Turbidity	NTU	4.7	4.2
Air Temperature	°C	16	24
Total Dissolved Solids	mg/L	22.988	24.068
Channel Width	m	4.01	N/A
Channel Depth	m	0.25	0.20
Velocity	m/s	N/A	N/A

Table 4.4-3: Select Laboratory Water Quality Results for Site 4				
Parameter	**Unit**	**PWQO Guidelines**	**Date:**12-JUN-19 **Time:** 11:00	**Date:**19-JUL-19 **Time:** 12:15
Bacteriological				
Escherichia coli	MPN/100mL	100	10	2
Total Coliforms	MPN/100mL	1,000 (prior to 1994)	365	**>2420**
Physical				
Conductivity (EC)	uS/cm	-	30.8	33.7
pH		6.5-8.5	6.87	6.79
Total Dissolved Solids	mg/L	-	46	40
Turbidity	NTU	-	1.09	1.74
Nutrients and Anions				
Alkalinity, Total (as $CaCO_3$)	mg/L	8.1 (June); 9.825 (July)	10.8	13.1
Ammonia-N, Total	mg/L	-	0.064	0.175
Un-ionized Ammonia	mg/L	0.02	0.001379	0.0074
Chloride (Cl)	mg/L	-	0.35	0.45
Nitrate-N (NO3-N)	mg/L	-	0.033	<0.020
Nitrite-N (NO2-N)	mg/L	-	<0.010	<0.010
Phosphorus (P)-Total	mg/L	0.03	0.0116	0.0128
Sulfate (SO4)	mg/L	-	1.37	1.04
Metals				
Aluminum (Al)	mg/L	0.075	0.0650	0.0601
Cadmium (Cd)	mg/L	0.0001 (0-100 $CaCO_3$)	<0.0000050	<0.0000050
	mg/L	0.0005 (>100 mg/L $CaCO_3$)	-	-
Cobalt (Co)	mg/L	0.0009	<0.00010	<0.00010
Copper (Cu)	mg/L	0.001 (0-20 mg $CaCO_3$)	0.00079	0.00090
	mg/L	0.005 (>20 mg/L $CaCO_3$)	-	-
Iron (Fe)	mg/L	0.300	0.127	0.175
Lead (Pb)	mg/L	0.001 (<30 mg/L $CaCO_3$)	0.000053	0.000071
	mg/L	0.003 (30- 80 mg/L $CaCO_3$)	-	-
	mg/L	0.005 (>80 mg/L $CaCO_3$)	-	-
Sodium (Na)	mg/L	-	0.783	0.872
Vanadium (V)-Total	mg/L	0.006	<0.00050	<0.00050
Zinc (Zn)-Total	mg/L	0.02 (interim)	<0.0030	<0.0030

Bold indicates exceedance above PWQO guidelines

Table 4.4-4: Flora Observed at Site 4			
FEC V-Type: V15- Black Spruce Mixedwood/ Herb Rich			
Forest Density / Stream Cover	65% stream cover		
Terrestrial Species			
Trees	**Shrubs**	**Herbs**	**Ferns / Horsetails / Mosses / Grasses**
Black Spruce White Birch White Spruce	American Mountain Ash Beaked Hazel Bush Honeysuckle Mountain Maple Prickly Wild Rose Red-Osier Dogwood Showy Mountain Ash Sweetgale Twinflower	Blue Bead Lily Bunchberry Canada Goldenrod Dandelion Field Mint Large-leaved Aster Multicolored Blue Flag Pearly Everlasting Starflower Wild Sarsaparilla Yellow Hawk Weed	Interrupted Fern Sedge spp. Wolf's Claw Club-Moss
Aquatic Macrophytes and Algae			
Emergent	-	**Floating Algae**	-
Rooted Floating	-	**Filaments**	-
Submergent	-	**Attached Algae**	-
Free Floating	-	**Slimes or Crusts**	-

Table 4.4-5: Fauna Observed at Site 4	
Fauna Species	
Amphibians	American Toad, Wood Frog, Tadpole spp.
Birds	Ovenbird
Crustaceans	-
Fish	-
Insects/Arachnids	Black Fly, Mosquito, Deer fly, Bumblebee spp., Dragonfly spp.
Mammals	Snowshoe Hare
Mollusca	-
Reptiles	-
Animal Tracks	-

Table 4.4-6: Physical Features Observed at Site 4							
In-stream Substrate							
Bedrock	**Boulder**	**Cobbles**	**Gravel**	**Sand**	**Silt**	**Organic**	**Clay**
-	10%	-	20%	50%	20%	-	-
Bank Stability/ Erosion	Stable/abundant vegetation						

4.5 Watershed Report Card Results

The overall surface water quality for the North Current River Watershed maintained a total averaged point score of 5. With zero exceedances for phosphorus and zero exceedances for *E. coli*, the rating of the surface water quality for the North Current River Watershed was determined to have a grade of A, which is considered excellent quality.

The forest coverage for the North Current River Watershed was 104.5 square kilometres (87.5 percent), interior forest coverage was 78.7 square kilometres (65.9 percent) and the riparian forest cover was 11.0 square kilometres (54.7 percent). These percentages generated a total point score of fourteen (average of 4.7) for the forest conditions, which is determined to have a grade of A, and is considered to be of excellent quality.

The wetland coverage for the North Current River Watershed was 11.2 square kilometres (9.4 percent). This generated a grade of B, which is considered to be good quality.

Table 4.5-1: North Current River Watershed Surface Water Indicators and Overall Grade Calculation

Site Number	Average Total Phosphorus (mg/L)	Average *E. coli* (MPN/ 100mL)	Average of Benthic Invertebrates	Total Point Score	Grade	Overall Surface Water Quality Grade	
						Final Points	Grade
1	0.0086	13	-	10	A	5	A
2	0.0099	27	-	10	A	5	A
3	0.0147	27	-	10	A	5	A
4	0.0122	6	-	10	A	5	A
					Overall	5	A

Table 4.5-2: North Current River Watershed Forest Conditions and Overall Grade Calculation

					Overall Forest Conditions	
% Forest Cover	% Forest Interior	% Riparian Zone Forested	Total Point Score	Grade	Final Points	Final Grade
87.5	65.9	54.7	14	A	**4.7**	**A**

Table 4.5-3: North Current River Watershed Wetland Conditions

% Wetland cover	Final Grade
9.4	B

5 DISCUSSION

The North Current River Watershed was sampled at four different locations, chosen based on accessibility and possible contamination sources, as well as attempting to reach all areas of the watershed. The first sampling period was on June 12, 2019 and the second sampling period on July 9, 2019.

The average air temperature for the June 12, 2019 sampling period was 16.0 degrees Celsius, which exceeded the monthly average temperature of 13.7 degrees Celsius for June 2019 as well as the historical average of 14.0 degrees Celsius for June 1971-2000 in Thunder Bay. The average air temperature for the July 9, 2019 sampling period was 22.5 degrees Celsius, which was above the monthly average temperature of 19.2 degrees Celsius and exceeded the historical average of 17.6 degrees Celsius for July 1971-2000.

Precipitation for the month of June totaled 67.5 millimetres, which was below the historical monthly average of 85.7 millimetres for Thunder Bay from June 1971-2000. In July, precipitation totaled 83.2 millimetres, which was below the historical monthly average of 89.0 millimetres for July 1971-2000.

There was no Low Water Condition declared by the Lakehead Region Conservation Authority during 2019.

Water temperatures ranged from 16.6 to 18.6 degrees Celsius in June and 20.4 to 23.4 degrees Celsius in July, which can be seen on Figure 3: Water Temperature at North Current River Sample Sites. The site with the lowest recorded water temperature, 16.6 degrees Celsius, was Site 3 in June. The stream depths observed ranged from 0.07 metres to 0.59 metres for both June and July. The shallowest of all the stream depths was located at Site 2 in July (0.07 metres) and the deepest at Site 3 in July (0.59 metres).

Two of the sample locations were water crossings that required a bridge to support the road. One of the sample locations was a water crossing that required a culvert to support the road. The bridge present at Site 2 was made up of wood, stone, and metal. The bridge present at Site 4 was made up of wood, metal, rocks, and concrete. All bridges were in good, stable condition and will not require extensive monitoring in the future. The bridges did not appear to alter flow in a significant way or change the natural stream course. The culvert present at Site 3 was made of galvanized steel and was in excellent, stable condition and will not require extensive monitoring in the future. Monitoring of the culverts should be carried out to ensure no vegetation blockages cause problems in the future.

A vegetation assessment was carried out at each site, recording species present within view of each site. A summary of each site is included in Appendix F: Forest Ecosystem

Classification. Forest Ecosystem Classification (FEC) type V-19 Black Spruce Mixedwood/ Herb Rich, was the most common and occurred at Sites 2 and 4. The remaining sites had a similar mixedwood forest type with some favouring coniferous species, like white spruce, and some favouring hardwood species like trembling aspen. Site 1 was classified as V-15: White Spruce Mixedwood and Site 3 was classified as V-9: Trembling Aspen Mixedwood. The dominant tree species within the North Current River Watershed included: white spruce, trembling aspen, tamarack, white birch, and black spruce. The shrub layer was very diverse throughout the watershed, with many species present. Some commonly observed species in the shrub layer were: green alder, prickly wild rose, red osier dogwood, speckled alder, and wild red raspberry. The most commonly observed herb and wildflower species included dandelions, sweet coltsfoot, common reed, woodland and meadow horsetail, cow vetch, wild strawberry, and large leaf aster.

No invasive plant species were seen at the sample sites within the North Current River Watershed. The only species at risk that was seen in the North Current River Watershed was a Monarch Butterfly at Site 1.

Overall, the stream banks documented within the North Current River Watershed were stable. The main soil type was sandy loam; however, almost all sites had some element of sand present. These type of substrates aid the banks by helping with slope stability and keeping erosion to a minimum; however, some soil types are more effective than others. For example, a combination of sand, clay, and loam works quite effectively at mitigating the effects of erosion caused by the flowing rivers/creeks/streams because the clay content aids in cohesion and prevents the sand from eroding easily (in comparison to a strictly sand substrate).

The PWQO acceptable pH range is 6.5-8.5. The range within the North Current River Watershed was 7.06 to 7.94, as illustrated on Figure 4: pH Level at North Current River Sample Sites. The average pH of the watershed was 7.64, which is within an acceptable water quality range.

Total Dissolved Solids (TDS) can be related to conductivity since the dissolved solids help to conduct an electric current through the water. The more dissolved solids present in a solution, the greater the conductive potential, as there are more ions present to carry the charge. The relationship can be seen in the watershed data when comparing between Figure 5: Total Dissolved Solids at North Current River Sample Sites and Figure 6: Conductivity at North Current River Sample Sites. The highest measured levels of TDS and conductivity were at Site 1, and the lowest for both parameters were at Site 4. In regards to drinking water, TDS levels are a secondary drinking water standard, meaning that this standard is based on aesthetic properties such as odour, colour, taste, corrosivity, foaming, and staining, and not based on health considerations.

Monitoring of bacterial levels in surface water is often limited to *E. coli*, as this is the most common water-borne pathogen that can cause illness and death. During the June and July sampling period the levels of *E. coli* were not in exceedance of the PWQO of 100 MPN/100 mL. The *E. coli* results are illustrated on Figure 7: *Escherichia coli* Bacteria Counts at North Current River Sample Sites.

Presence of *E. coli* generally indicates a fecal contamination source nearby and many studies have shown that the presence of farm animals near a stream can significantly influence bacteria counts. *E. coli* could also enter the watershed from leaking residential septic tanks and/or from manure.

Total coliforms are among the flora present in the intestinal tract of animals and are often present in much greater numbers than potential pathogens, such as *E. coli*. Therefore, coliforms are easier to isolate and identify within a water sample. In order to better determine the possibility of contamination, total coliforms are measured in surface water as indicators of pathogenic bacterial contamination. No current PWQO exists for total coliforms; however, total coliforms exceeded the pre-1994 PWQO of 1,000 MPN/100 mL at Sites 3 and 4 during the July 2019 sampling period. The highest level of total coliforms present was >2,420 MPN/100 mL at Site 4 on July 9, 2019. Total coliforms for all sampling results ranged from 365 to >2,420 MPN/100 mL.

The PWQO criterion of 0.075 mg/L for aluminum was exceeded at Site 3 during the June sampling period. Aluminum concentrations for all sampling results ranged from 0.03 mg/L to 0.1030 mg/L. The average concentration of aluminum was 0.0720 mg/L for all sites during the June sampling period and 0.0497 mg/L during the July sampling period, which are both below the PWQO criterion.

The PWQO criterion of 0.3 mg/L for iron was exceeded at Sites 2 and 3 during the June sampling period and at Sites 1, 2, and 3 during the July sampling period. Iron concentrations for all sampling results ranged from 0.127 mg/L to 0.786 mg/l. The average concentration of iron was calculated to be 0.325 mg/L for the June sampling period and 0.466 mg/L for the July sampling period, which are both above the PWQO criterion.

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 and are commonly high within the region.

The PWQO criterion of 0.001 mg/L for copper when $CaCO_3$ is 0-20 mg/L was exceeded at Site 3 during the June sampling period. Copper concentrations for all sampling results ranged from 0.00079 mg/L to 0.00121 mg/L. The average concentration of copper was calculated to be 0.00100 mg/L and 0.00108 mg/L for the June sampling period and 0.00090 mg/L and 0.00101 mg/L for the July sampling period.

The overall health of the North Current River Watershed was determined using the ratings from surface water quality, forest conditions, and wetland conditions, which are combined to give a grade rating for the Watershed Report Card. Given that there were zero exceedances of *E. coli* and zero exceedances of phosphorus, the overall health of the North Current River Watershed surface water quality has received a rating of 'A' for its Watershed Report Card rating which is of excellent quality. The North Current River forest conditions based on forest coverage, forest interior, and riparian zone forested, were determined to result in a rating of 'A'. The North Current River wetland conditions based on percentage wetland cover was determined to result in a rating of 'B'.

Based on these ratings and other observed conditions, the North Current River Watershed has been determined to be in good to excellent overall health.

6 CONCLUSION

The North Current River Watershed was determined to be in good to excellent overall health. Surface water quality at the time of the study was good, with the exceedances of the Provincial Water Quality Objectives being mostly attributed to natural sources. Plant species composition seems characteristic of the boreal forest, with diversity at each site among the overstory, understory, and herb layer. A more comprehensive fauna study would give a clear indication of the species and populations present, but at the time of the study multiple species were observed giving a good representation of a typical boreal forest area. Water levels appeared consistent with previous water markings. Erosion was not typically a concern, as the stream banks were stable. Stream cover was often provided by shrubs and trees growing along the river banks which also helped prevent erosion. Culverts and bridges were in stable condition with no immediate concern for maintenance.

7 RECOMMENDATIONS

Upon completion of the 2019 North Current River Watershed Assessment Report, the following recommendations are provided for consideration:

- Staff and funding permitting, it is recommended that an update to the 2019 North Current River Watershed Assessment be completed in the next five to ten years.
- Benthic sampling and monitoring should be considered for future watershed assessments because it is a useful indicator of water quality over time.
- Additional sampling should be conducted in the spring to observe the water quality differences between high and low flow seasons.
- A copy of this report should be provided to the Municipality of Shuniah and the City of Thunder Bay for reference purposes. The Report should be kept on file at the LRCA Administration Office for review by interested parties.

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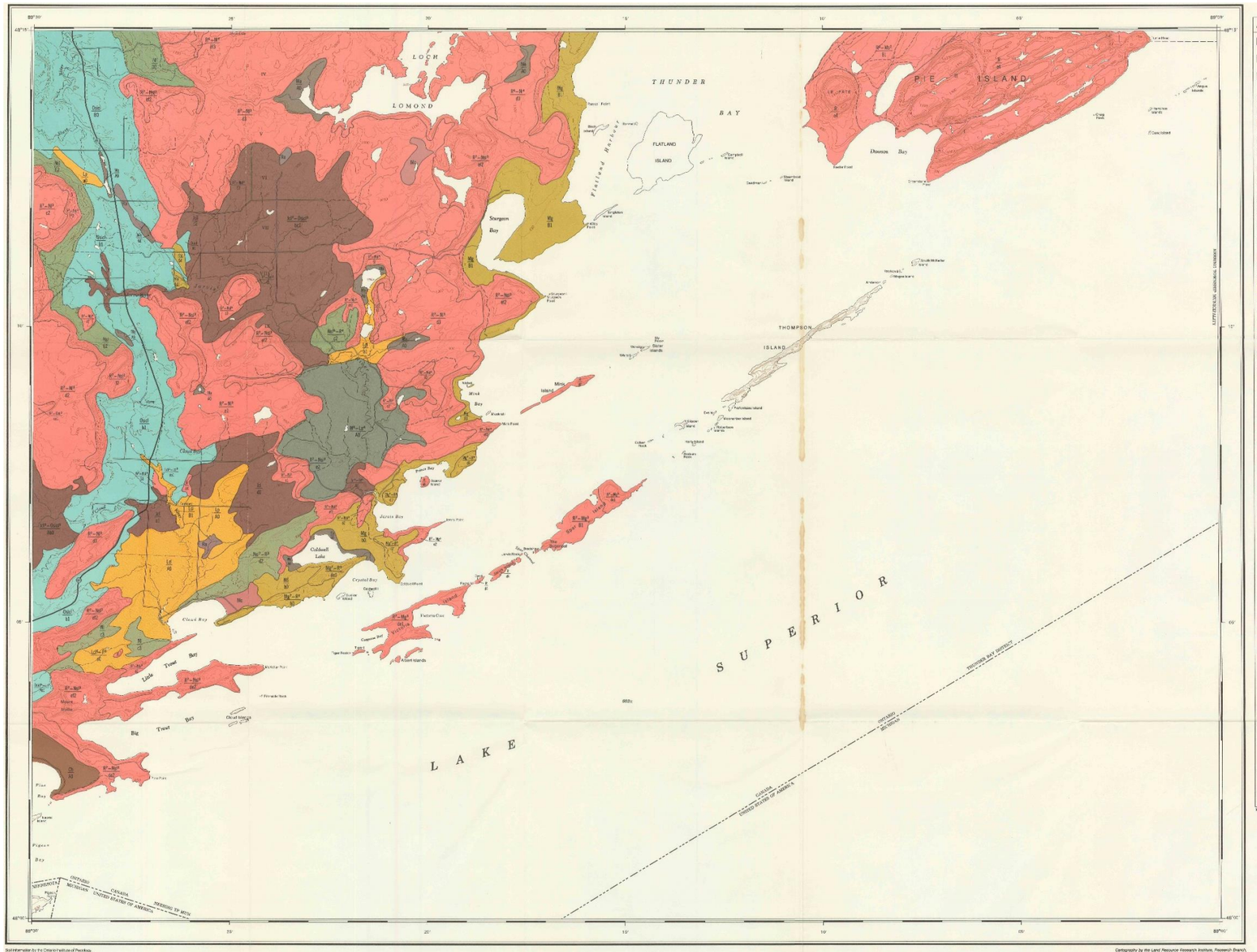
Figures



LEGEND

MAP COLOR	MAP SYMBOL	SOIL NAME	SURFACE TEXTURE	SUBGROUP	SOIL MATERIALS	DRAINAGE
	Ab, A	ARTHUR	fine sandy loam	Gleyed Eutric Brunisol	Noncalcareous very fine sand lacustrine 10 to 20 cm thick over calcareous lacustrine silt and clay.	Imperfect
	Bz	BAIRD		Terric Humisol	Well decomposed organic material derived from sedges underlain by gravel at approximately 60 cm.	Poor
	Bf, Bfd	BINABICH	fine sandy loam, sandy loam	Orthic Eutric Brunisol	Noncalcareous very fine sand outwash or deltaic, approximately 50 cm thick over lying clay loam, clay or silty clay reddish calcareous lacustrine.	Good
	BBd, BBsd, BB	BLACK BAY	clay loam, silty clay loam, loam	Orthic Humic Gleysol	Calcareous gray clay loam, clay or silty clay varved lacustrine.	Poor
	Bfl, Bl, Bld	BLAKE	fine sandy loam, loam, sandy loam	Gleyed Eutric Brunisol	Noncalcareous very fine sandy outwash or deltaic.	Imperfect
	Cb	CASETT		Terric Humisol	Well decomposed organic material derived from sedges underlain by clay at 30 to 150 cm.	Very Poor
	Cl, Csl, Csi, Cs	CURRENT RIVER	loam, silt loam, sandy loam, sand	Gleyed Eutric Brunisol	Noncalcareous stony fine sandy loam glacial till.	Imperfect
	Do, Dfl, Sl, Dsl	DORION	clay loam, fine sandy loam, loam, silt loam	Gleyed Gray Luvisol	Calcareous brownish silt loam and clay varved lacustrine.	Imperfect
	Ed, Esl	EVERARD	clay loam, silt loam	Orthic Gray Luvisol	Calcareous grayish silt and silty clay varved lacustrine.	Good
	Fgsl, Fl, Fsl, Fg	FORMAL	gravelly sandy loam, loam, sandy loam, gravel	Orthic Eutric Brunisol	Medium and coarse sand or sandy loam stony glacial till derived from igneous materials.	Good
	FWl, FWs, FWsl	FORT WILLIAM	loam, sand, sandy loam	Gleyed Eutric Brunisol	Noncalcareous fine sand outwash.	Imperfect
	Gl, Gfsl	GIANTE	loam, silt loam	Orthic Gray Luvisol	Noncalcareous gravel outwash derived from red shale.	Good
	Ggsl, Gs, Csl, Gg	GLEN	gravelly sandy loam, sand, sandy loam, peaty phase	Gleyed Eluviated Eutric Brunisol	Noncalcareous sand and gravel outwash of shale origin.	Imperfect
	In	INNES LAKE		Typic Humisol	Well decomposed organic material, derived from sedges and grasses greater than 160 cm thick.	Very Poor
	Jc, Jcl, Jsl	JARVIS RIVER	clay, clay loam, silt loam	Orthic Gray Luvisol	Calcareous reddish clay loam, clay or silty clay, varved lacustrine.	Moderately well
	Jc	JUMBON		Terric Humisol	Well decomposed organic material derived from sedges and grasses, 40 to 90 cm thick, underlain by loam till.	Very Poor
	Lc, Lcl, Lsi, Lp	LAPPE	clay, clay loam, silt loam, peaty phase	Orthic Humic Gleysol	Calcareous reddish clay loam, clay or silty clay varved lacustrine.	Poor
	Ln	LINKOR		Fibric Mesisol	Partially decomposed organic material's derived from Hypnum moss and reeds greater than 160 cm thick.	Very Poor
	Mc	MACINTYRE		Terric Fibrisol	Undecomposed organic material derived from sphagnum mosses 40 to 80 cm thick underlain by silt.	Very Poor
	M	MUCK		Unclassified	Well decomposed thick organic materials.	Very Poor
	Ma	MARSH		Unclassified	Shallow inundated land, less than 30 cm of organic material over mineral material.	Very Poor
	MKl, Mkd, Mkl, Mfp	MCKELLAR	fine sandy loam, sandy loam, loam, peaty phase	Orthic Humic Gleysol	Noncalcareous very fine sand outwash.	Poor
	Mly, Mls, Mld, Mls	MIETZLE	gravel, loamy sand, sandy loam, sand	Orthic Eutric Brunisol	Noncalcareous sand and gravel fluvial outwash.	Good
	Mlo	MURILLO		Fibric Mesisol	Partially decomposed organic materials derived from Hypnum moss and reeds greater than 160 cm thick.	Very Poor
	Mls, Mlsl, Mlp	MISSION	sand, sandy loam, peaty phase	Orthic Humic Gleysol	Noncalcareous sand and gravel fluvial outwash.	Poor
	Nlgsl, Nld	NEEBING	gravelly sandy loam, sand loam	Gleyed Eutric Brunisol	Noncalcareous sand and gravel fluvial outwash.	Imperfect
	N, Nsl, Nlv, Nlgsl	NOLALU	loam, silt loam, sandy loam, gravelly sandy loam	Orthic Eutric Brunisol	Noncalcareous fine sandy loam stony glacial till derived from shale.	Good
	Or	ORBIT LAKE		Terric Mesisol	Partially decomposed organic materials derived from Hypnum moss and reeds, 40 to 90 cm thick underlain by loamy material.	Very Poor
	Oc, Ocsl, Odl, Ol	OSKONDOGA	clay, silty clay loam, silt loam, sand	Gleyed Gray Luvisol	Calcareous reddish clay loam, clay or silty clay varved lacustrine.	Imperfect
	Ouc, Oucl, Ousl	OUIMET	clay, clay loam, silt loam	Gleyed Gray Luvisol	Calcareous grayish clay loam, clay or silty clay varved lacustrine.	Imperfect
	P	PEAT		Unclassified	Undecomposed thick organic materials.	Very Poor
	Pssl, Pasl	PAPOONGE	silty clay loam, silt loam	Orthic Gray Luvisol	Calcareous brownish silt loam and silty clay loam varved lacustrine.	Good
	Ps	PASSER		Terric Mesisol	Partially decomposed organic material derived from Hypnum moss and reeds 90 to 130 cm thick underlain by coarse textured material.	Very Poor
	Pngsl, Psl, Pes	PEARL	gravelly sandy loam, sandy loam, sand	Eluviated Eutric Brunisol	Noncalcareous, coarse textured, stony and bouldery kame-like materials.	Good
	Pgsl	PEARSON	gravelly sandy loam	Gleyed Eutric Brunisol	Noncalcareous stony gravelly sand and sandy loam glacial till.	Imperfect
	Ps	PENASSEN		Terric Mesisol	Partially decomposed organic material derived from Hypnum moss and reeds 40 to 90 cm thick underlain by lacustrine clay.	Very Poor
	R	ROCKLAND		Nonsoil	Less than 10 cm soil material overlying bedrock, and exposed bedrock.	
	Ra	RAITHE		Typic Fibrisol	Undecomposed organic material derived from Sphagnum moss greater than 160 cm thick.	Very Poor
	Sesil	SELLARS	silt loam	Orthic Gray Luvisol	Brownish silt loam or silty clay loam more than 50 cm thick overlying calcareous reddish clay loam, clay or silty clay varved lacustrine.	Good
	Sbsl	SIBLEY	silt loam	Orthic Humic Gleysol	Calcareous brownish silt loam and silty clay loam varved lacustrine.	Poor
	Sscl, Ssil	SILVER	silty clay loam, silt loam	Gleyed Gray Luvisol	Brownish silt loam or silty clay loam more than 50 cm thick overlying calcareous reddish clay loam, clay or silty clay varved lacustrine.	Imperfect
	SRsl, SRs, SRsl	SLATE RIVER	fine sandy loam, sand, sandy loam	Orthic Eutric Brunisol	Noncalcareous fine sandy loam to sand outwash or deltaic materials.	Good
	Stl, Sts, Tsl	STRAWBERRY	loam, sandy loam, peaty phase	Orthic Humic Gleysol	Noncalcareous fine sandy loam stony glacial till.	Poor
	Tl, Tp	TWIN CITIES	fine sandy loam, peaty phase	Orthic Humic Gleysol	Noncalcareous fine sandy loam to sand outwash or deltaic materials.	Poor
	Wsl, Wsll, Wsls, Wsvl	WAMSLEY	loam, fine sandy loam, loamy sand, very fine sandy loam	Orthic Eutric Brunisol	Noncalcareous fine and very fine sandy loam outwash or deltaic material.	Good
	Wgsl, Wgs, Wsl	WOLFPUP	gravelly, sandy loam, gravelly sand, sandy loam	Eluviated Eutric Brunisol	Noncalcareous sand and gravel outwash material of shale origin.	Good
	Wf	WOLF RIVER		Terric Fibrisol	Undecomposed organic material derived from grasses, sedges and mosses greater than 160 cm thick.	Very Poor

Mapping units with blank colour boxes do not occur on this sheet.

MISCELLANEOUS MAPPING UNITS

SYMBOL	UNITS
G.P.	Gravel pit
F.ll	Sand fill
Q.	Quarry

TOPOGRAPHIC CLASSES

SIMPLE TOPOGRAPHY SIMPLE SLOPES	SLOPE %	COMPLEX TOPOGRAPHY MULTIPLE SLOPES	SLOPE %
A. Smooth basin	0 - 0.5	a. Irregular basin	0 - 0.5
B. Smooth level	0.5 - 2	b. Irregular level	0.5 - 2
C. Smooth very gently sloping	2 - 5	c. Irregular very gently sloping	2 - 5
D. Smooth gently sloping	6 - 9	d. Irregular gently sloping	6 - 9
E. Smooth moderately sloping	10 - 15	e. Irregular moderately sloping	10 - 15
F. Smooth steeply sloping	16 - 30	f. Irregular steeply sloping	16 - 30
G. Smooth very steeply sloping	31 - 60	g. Irregular very steeply sloping	31 - 60
H. Smooth hilly	>60	h. Irregular hilly	>60

STONINESS CLASSES

0	Stone free
1	Slightly stony
2	Moderately stony
3	Very stony
4	Exceedingly stony

CONVENTION

Examples: Ntd/B1 — Surface Texture / Topography - Stoniness; $\frac{B^{7}-Fg^{3}}{C2}$ — Surface Texture % - Surface Texture % / Topography - Stoniness

Soil information by the Ontario Institute of Pedology.

Main highway
Secondary road
Other roads
Cart track
Trail
Railway
Height of control point
Bench mark (feet)
Spot elevation (feet)
Cemetery

International boundary
Provincial boundary
County boundary
Township boundary
Indian reserve, park boundary, etc.
Power transmission line
Stream
Contour interval 50 feet
Contours
Depression contours

SOILS OF THE THUNDER BAY AREA

ONTARIO

SOIL SURVEY REPORT No 48

1:50,000

Kilometres 1 0 1 2 3 4 Kilometres
Miles 1 0 1 2 3 Miles

KEY MAP

Cartography by the Land Resource Research Institute, Research Branch, Agriculture Canada, 1981.
Base information and printing supported by the Map Reproduction Centre, Surveys and Mapping Branch, Department of Energy, Mines and Resources.

JARVIS RIVER 52 A/3

Figure 1: Soils of the Thunder Bay Area

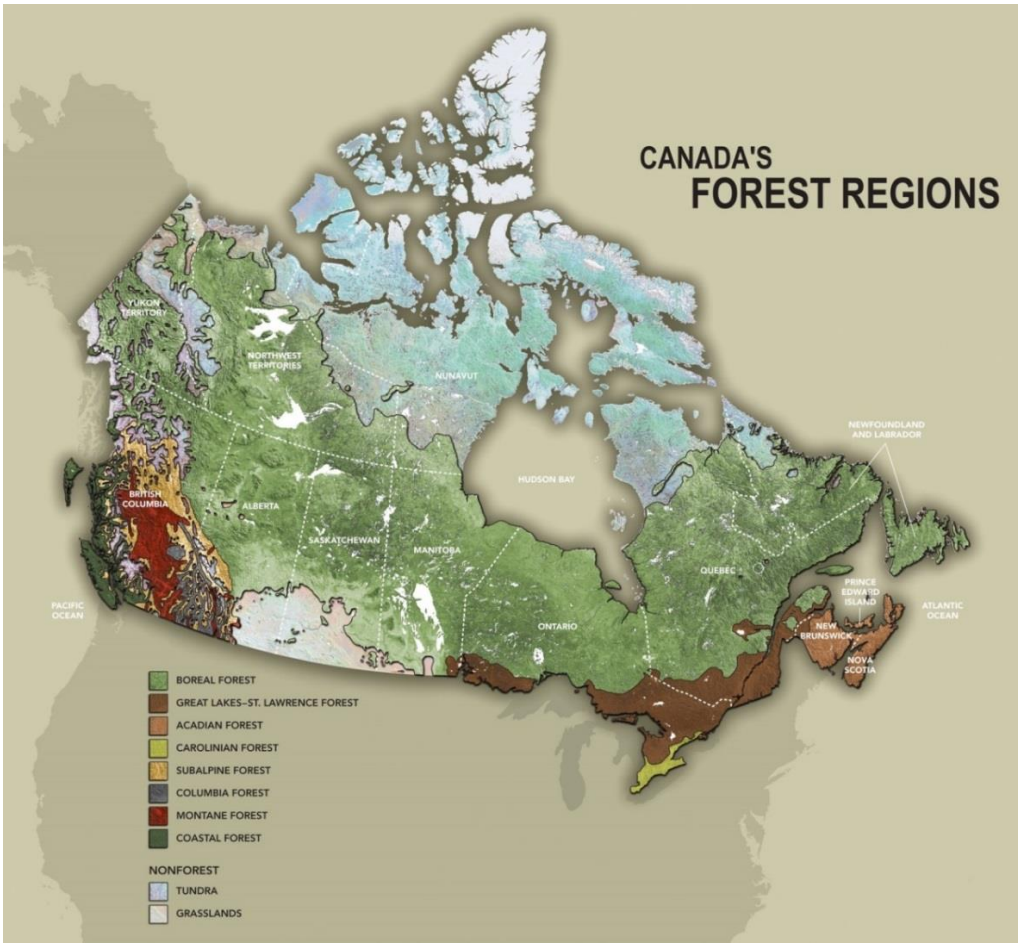


Figure 2: Canada's Forest Regions (Canadian Forest Service, 2013)

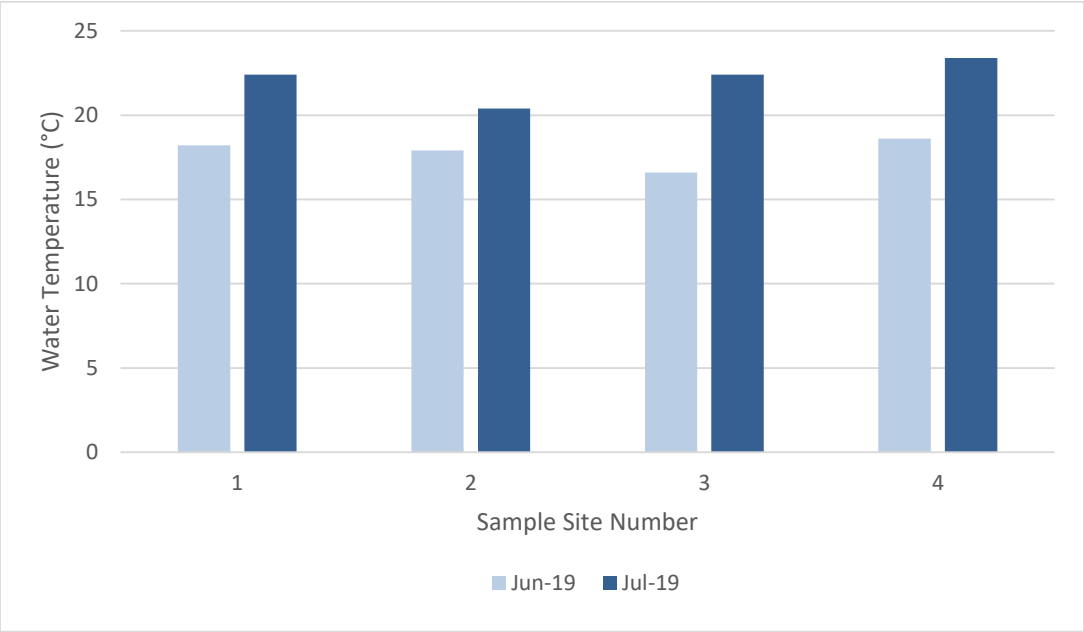


Figure 3: Water Temperature at North Current River Sample Sites

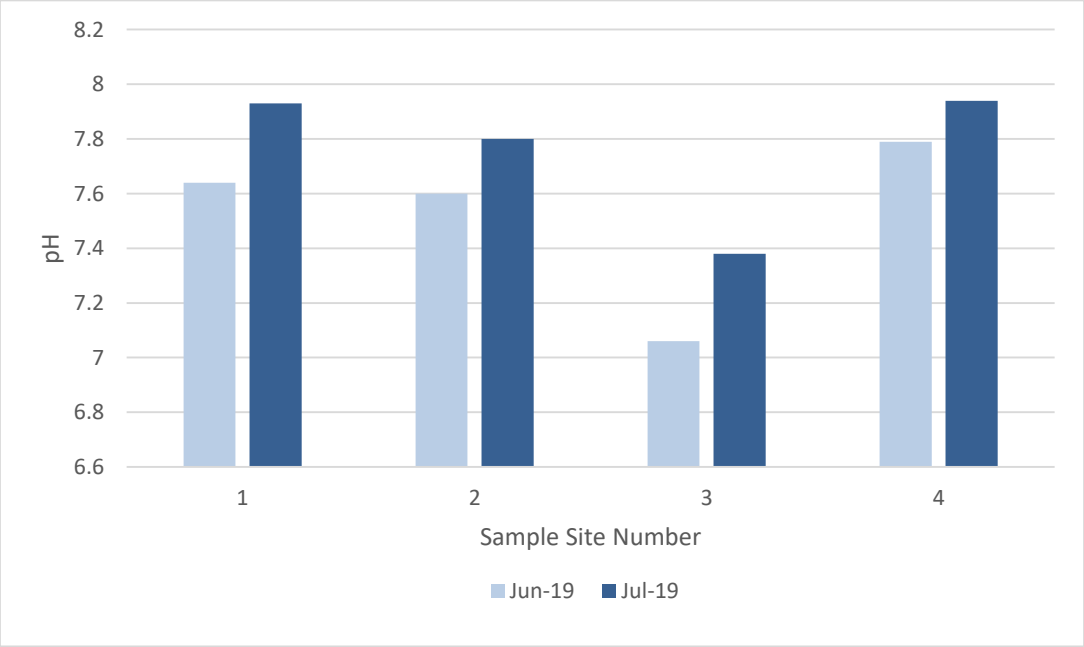


Figure 4: pH Level at North Current River Sample Sites

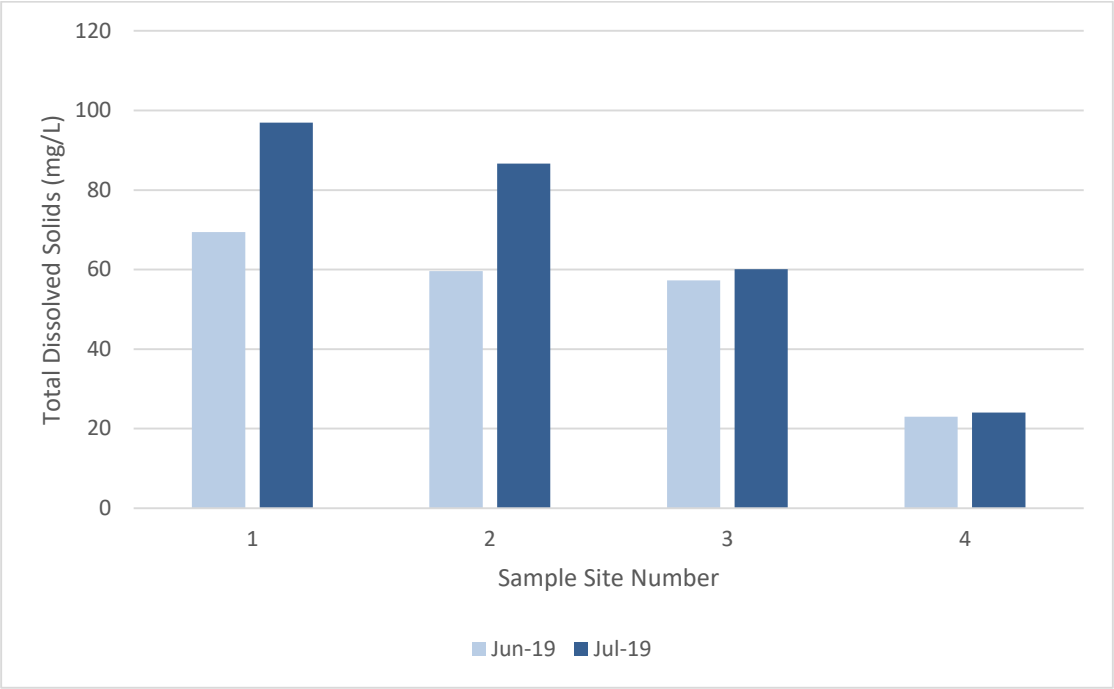


Figure 5: Total Dissolved Solids at North Current River Sample Sites

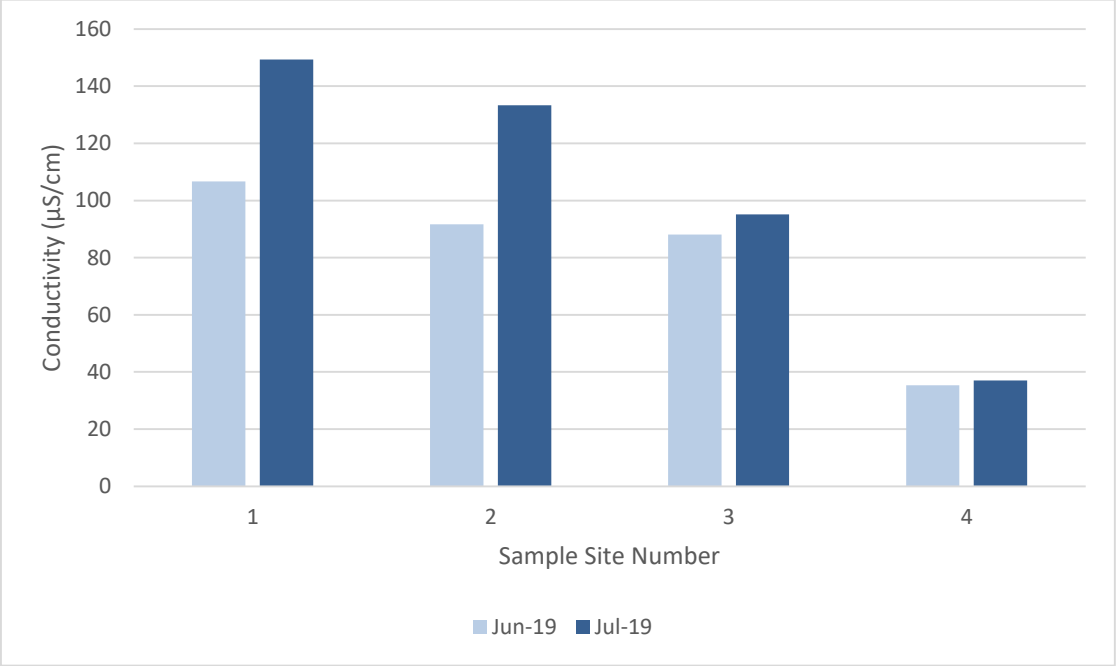


Figure 6: Conductivity at North Current River Sample Sites

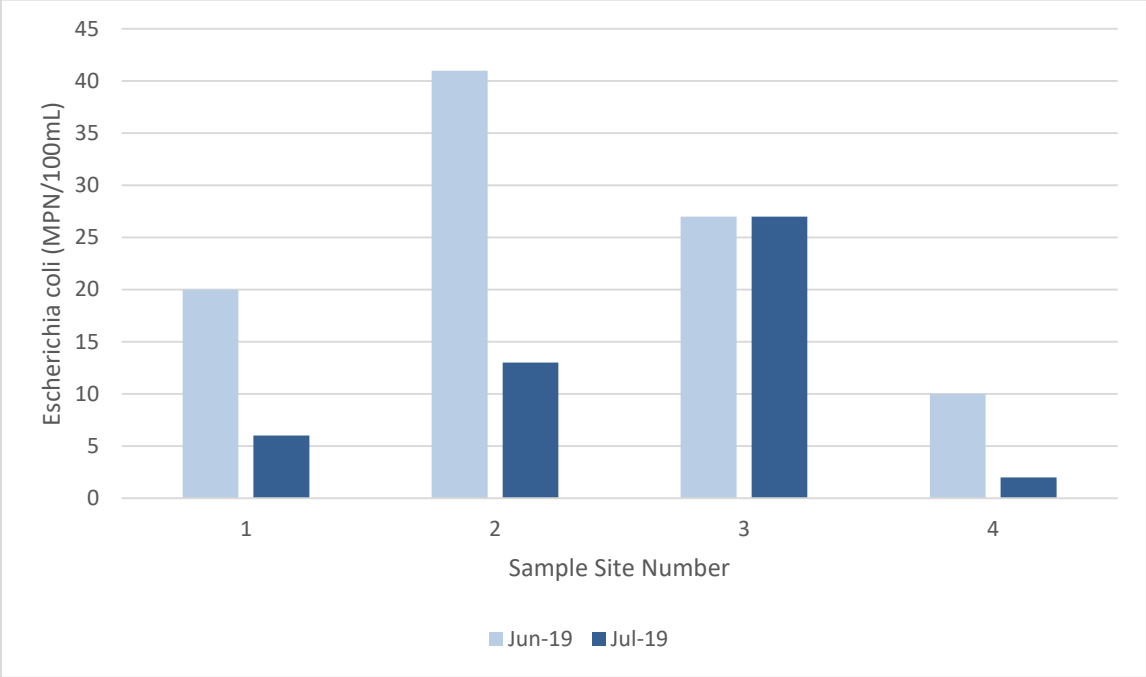


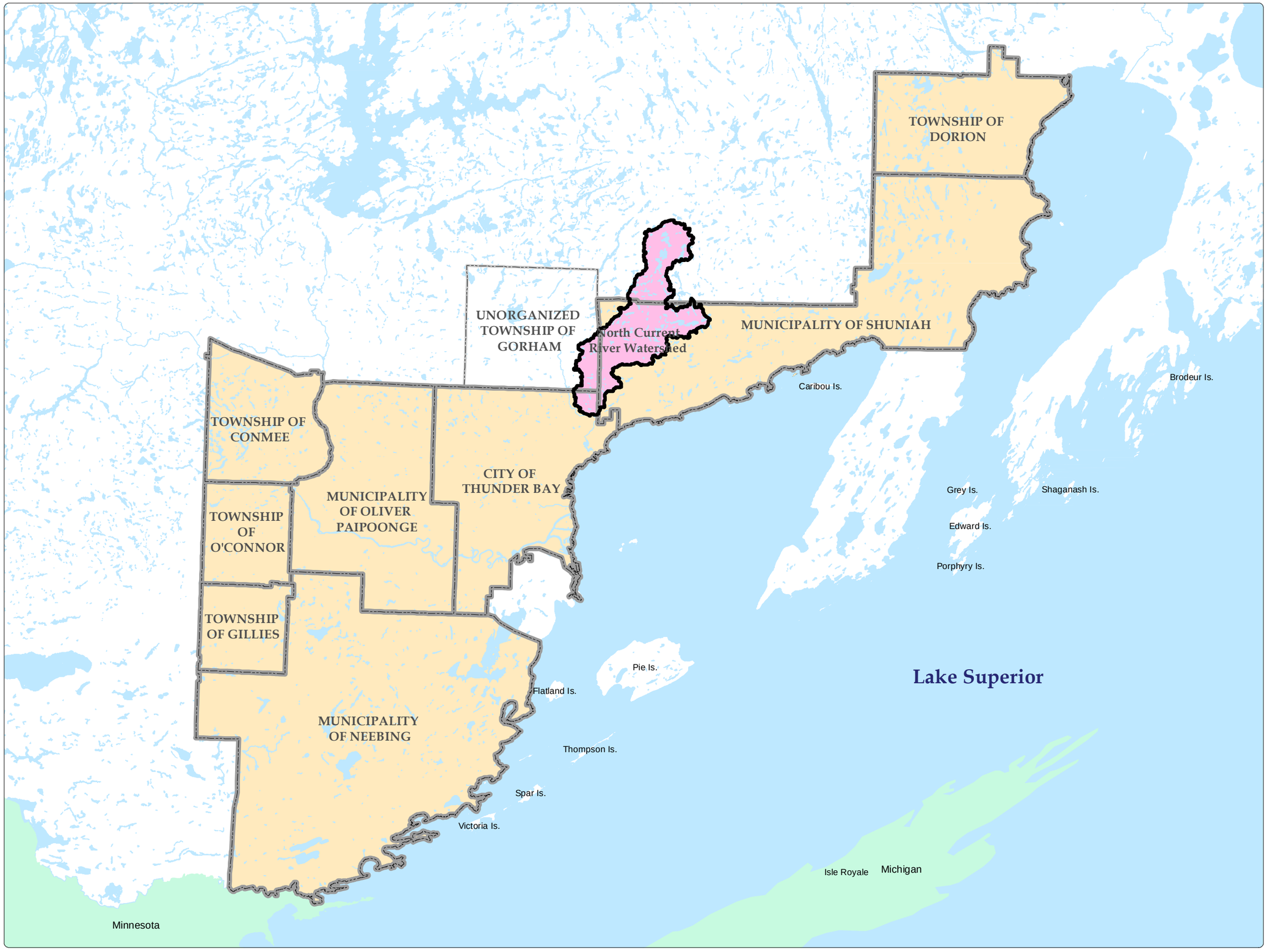
Figure 7: *Escherichia coli* Bacteria Counts at North Current River Sample Sites

Maps

LAKEHEAD REGION
CONSERVATION AUTHORITY

North Current River Watershed

M-1: Key Plan



N

Legend

- North Current River Watershed
- Municipal Boundary
- Township Boundary
- LRCA Jurisdiction Boundary
- Water Body

0 10 20 km

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Thunder Bay, ON
P7B 6T8

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Datum: NAD 83
Projection: UTM Zone 16N
Date: July, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-2: Regulated Area

N

Legend

- Approximate Regulated Area
- Approximate Regulated Area within Lake Superior
- North Current River Watershed
- Municipal Boundary
- Township Boundary

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street

0 1 2 3 4 km

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LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-3: Topography

N

Legend

- Highest Point in Watershed
- North Current River Watershed
- Municipal Boundary
- Township Boundary

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Contour Lines

- 10m Contour Intervals
- 50m Contour Intervals

Roads

- Highway
- Road
- Street
- Bush Roads

0 1 2 3 4 km

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LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-4: Bedrock Geology

N

Legend

- Abandoned Mines Points
- North Current River Watershed
- Municipal Boundary
- Township Boundary

Bedrock Formation

PALEOPROTEROZOIC

- 9, Coarse clastic metasedimentary rocks
- 7a, Metasedimentary rocks
- 5, Mafic to intermediate metavolcanic rocks
- 6, Felsic to intermediate metavolcanic rocks
- 15, Massive granodiorite to granite
- 14, Diorite - monzonite - granodiorite suite
- 22a, Sedimentary rocks

MESOPROTEROZOIC

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

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 1 2 3 4 km

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LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-5: Surficial Geology

N

Legend

- North Current River Watershed
- Municipal Boundary
- Township Boundary

Surficial Geology

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

Surficial Points Features

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

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 1 2 3 4 km

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LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-6: Soils

N

Legend

- Sampling Sites
- North Current River Watershed
- Municipal Boundary
- Township Boundary

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

OMAFRA Soils

- Organic (O)
- Clay (c)
- Clay Loam (cl)
- Fine Sandy Loam (fsl)
- Gravel (g)
- Gravelly Sand (gs)
- Gravelly Sand Loam (gsl)
- Medium to Moderately Fine Loam (l)
- Loamy Sand (ls)
- Peaty Phase (pp)
- Rock (r)
- Coarse Sand and Loamy Sand (s)
- Silty Clay Loam (sicl)
- Silt Loam (sil)
- Moderately Coarse Sandy Loam (sl)
- Very Fine Sandy Loam (vfsl)

Roads

- Highway
- Road
- Street
- Bush Roads

0 1 2 3 4 km

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Date: July, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-7: Land Ownership

N

Legend

- North Current River Watershed
- Municipal Boundary

Land Ownership

- Crown Land
- Private Land

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 1 2 3 4 km

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LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-8: Zoning

N

Legend

- North Current River Watershed

City of Thunder Bay Zoning

- EP, Environmental Protection Zone
- IN2, Medium Industrial Zone
- IN4, Extractive Industrial Zone
- OS, Open Space Zone
- RU1, Rural Area Zone

Muncipality of Shuniah Zoning

- AG, Aggregate Extraction
- AG-P, Aggregate Extraction/Processing
- CC, Community Commercial
- CH, Highway Commercial
- CR, Recreational Commercial
- HI, Heavy Industrial
- LI, Light Industrial
- MHR, Mobile Home Residential
- OS, Open Space
- RC, Community Residential
- REC-A, Recreational - Association
- REC-RE, Recreational - Remote
- RU, Rural
- SR, Shoreline Residential

Drainage

- Water Body
- Provincially Significant Wetland
- Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 1 2 3 4 km

Zoning Information based on the best available information, not all zones may be depicted.

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Date: August, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-9: Site Plan

N

Legend

- Sampling Sites
- North Current River Watershed
- Municipal Boundary
- Household Waste Disposal Site
- Inactive Waste Disposal Site

Drainage

- Water Body
- Wetland
- Provincially Significant Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street
- Bush Roads

0 1 2 3 4 km

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Thunder Bay, ON
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Projection: UTM Zone 16N
Date: July, 2019

LAKEHEAD REGION CONSERVATION AUTHORITY

North Current River Watershed

M-10: Bridge & Culvert Sites

N

Legend

- Confluence
- Bridge
- Culvert
- North Current River Watershed
- Municipal Boundary

Drainage

- Water Body
- Wetland
- Provincially Significant Wetland
- Stream
- River
- Ditch

Roads

- Highway
- Road
- Street

0 1 2 3 4 km

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Datum: NAD 83
Projection: UTM Zone 16N
Date: August, 2019

Appendix A:

Soil Logging Summary and Photography

Appendix A: Soil Logging Summary and Photography

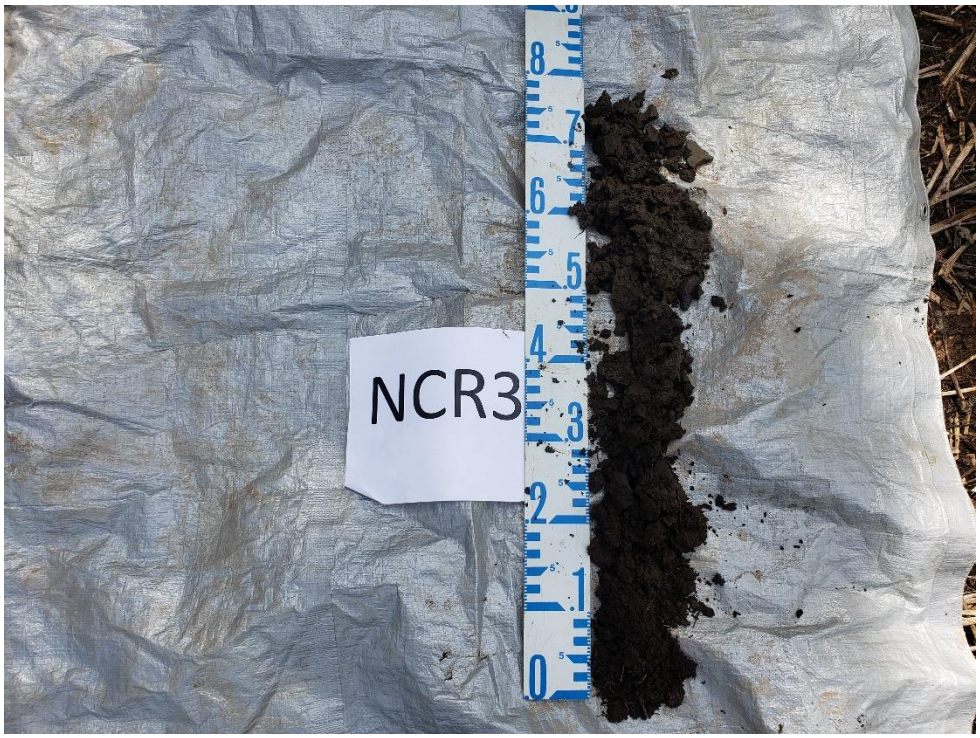
Soil Logging Summary

SITE ID	Organic Layer "O"	"A" Horizon	"B" Horizon	"C" Horizon
NCR1				0-40 cm Sand
NCR2				0-40 cm Sand
NCR3		0-32 cm Sandy loam		32-70 cm Silty Clay
NCR4		0-28 cm Sandy loam		23-56 cm Sandy loam

Soil Photography

Site 1

Site 2



Site 3

Site 4

Appendix B:

Common and Scientific Names of Identified Flora and Fauna

Appendix B: Common and Scientific Names of Identified Flora and Fauna

Flora	
Common Name	**Scientific (Latin) Name**
Trees	
Balsam poplar	*Populus balsamifera*
Black spruce	*Picea mariana*
Tamarack	*Larix laricina*
Trembling aspen	*Populus tremuloides*
White birch	*Betula papyrifera*
White spruce	*Picea glauca*
Shrubs	
American mountain ash	*Sorbus americana*
Beaked hazel	*Corylus cornuta*
Bog rosemary	*Andromeda polifolia* ssp. *glaucophylla*
Bush honeysuckle	*Diervilla lonicera*
Green alder	*Alnus viridis*
Mountain maple	*Acer spicatum*
Pin cherry	*Prunus pensylvanica*
Prickly wild rose	*Rosa acicularis* ssp. *sayi*
Red-osier dogwood	*Cornus stolonifera*
Showy mountain ash	*Sorbus decora*
Smooth gooseberry	*Ribes hirtellum*
Smooth serviceberry	*Amelanchier laevis*
Speckled alder	*Alnus rugosa*
Sweetgale	*Myrica gale*
Twinflower	*Mitchella repens*
Wild red raspberry	*Rubus idaeus ssp. melanolasius*
Willow spp.	*Salix spp.*
Herbs	
Blue bead lily	*Clintonia borealis*
Bird's-foot trefoil	*Lotus corniculatus*
Bunchberry	*Cornus canadensis*
Canada goldenrod	*Solidago canadensis*
Clover spp.	*Trifolium spp.*
Cow parsnip	*Heracleum lanatum*
Cow vetch	*Vicia cracca*
Dandelion	*Taraxacum officinale*
Downy yellow violet	*Viola pubescens*
Evening primrose	*Oenothera biennis*
Field mint	*Mentha arvensis* ssp. *borealis*

Flora	
Common Name	**Scientific (Latin) Name**
Fragrant bedstraw	*Galium triflorum*
Large-leaved aster	*Eurybia macrophyllus*
Lupines	*Lupinus albus*
Multicolored blue flag	*Iris versicolor*
Northern bluebell	*Mertensia paniculata*
Northern blue violet	*Viola septentrionalis*
Ox-eye daisy	*Leucanthemum vulgare*
Pearly everlasting	*Anaphalis margaritacea*
Red clover	*Trifolium pratense*
Rough bedstraw	*Gallium asprellum*
Starflower	*Trientalis borealis*
Swamp thistle	*Cirsium muticum*
Sweet coltsfoot	*Petasites frigidus*
Wild sarsaparilla	*Aralia nudicaulis*
Woodland strawberry	*Fragaria vesca*
Yellow hawkweed	*Hieracium pratense*
Ferns/Mosses/Graminoids/Lichens	
Canada bluegrass	*Poa compressa*
Horsetail- meadow	*Equisetum pratense*
Interrupted fern	*Osmunda claytoniana*
Wolf's claw club-moss	*Lycopodium clavatum*

Fauna	
Common Name	**Scientific (Latin) Name**
Amphibians	
American toad	*Anaxyrus americanus*
Frog spp.	*Rana spp.*
Wood frog	*Lithobates sylvaticus*
Birds	
Common merganser	*Mergus merganser*
Hawk spp.	Accipiter spp.
Ovenbird	*Seiurus aurocapilla*
Fish	
Minnow spp.	*Phoxinus spp.*
Invertebrates	
Black fly	*Simuliidae spp.*
Carpenter ant	*Camponotus spp.*
Deer fly	*Chrysops spp.*
Dragonfly spp.	*Anisoptera spp.*

Fauna	
Common Name	**Scientific (Latin) Name**
Eastern tiger swallowtail	*Papilio glaucus*
Grasshopper	*Melanoplus spp.*
Honeybee	*Apis spp.*
Horse fly	*Hybomitra spp.*
*Monarch Butterfly	*Danaus plexippus*
Mosquito	*Culicidae spp.*
Wasp spp.	*Vespula spp.*
Water strider	*Gerridae spp.*
White admiral	*Limenitis arthemis*
Mammals	
Snowshoe hare	*Lepus americanus*
Annelids	
Leech spp.	*Clitellata spp.*

*Species at Risk – Special Concern

Appendix C:

Techniques for Data Collection

Appendix C: Techniques for Data Collection

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

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.

Conductivity
Conductivity was measured with the YSI Pro DSS. 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.

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

Flora and Fauna Identification
Identification was made in the vicinity of the sample sites, no transects were made. Observations were made approximately 50 metres from either stream edge. Field guides and the INaturalist app were used to accurately identify species.

Flow
The velocity of river flow at sites was measured using a stick 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.

Latitude, Longitude, and Elevation
The Universal Transverse Mercator (UTM) coordinates for each site were measured with a Trimble Geo XH 2008 hand held GPS unit.

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.

pH
The YSI Pro DSS measured pH for the water sample sites. The readings were recorded once the probe was submerged in the water and all the variables were stabilized. A pH reading was also taken during the analysis at the laboratory.

Photographs
Photographs were taken at each site using the Olympus Tough TG-5 shock and water proof camera. Upstream, downstream, soil, and vegetation photographs as well as culvert and outstanding litter or erosion photographs were all taken at each site. Substrate photographs were attempted at each site with the waterproof camera.

Surface Water Sampling
Samples were taken at the same position at each site wherever possible. Grab sampling technique was used when conducting surface water sampling. Sample bottles were pre-charged with preservatives, so this did not have to be done in the field. Sample bottles were submerged 15 to 30 centimetres below the surface of the water body and positioned towards the flow of the water source. Samples were kept cool and delivered to ALS Laboratory for analyzing.

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

Turbidity
Turbidity of the water was measured with the YSI Pro DSS. The readings were taken after the probe was submerged and all variables on the meter were stabilized.

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

OBBN In-Stream Materials Key

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.

Stream Bed Description

The bed description was described by means of a visual scan of the sample site area, with percentages assigned to the appropriate 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
Organic	Mainly organic combination of silt and clay
Clay	Inorganic origin with no apparent structure

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

Appendix D:

Summary of Water Quality Parameters

Appendix D: Summary of Water Quality Parameters

Physical Properties

The abiotic factors of water quality are very influential on aquatic plants and animals and can have a significant impact on the ecosystem. The following physical parameters were measured either in the field or in the laboratory.

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

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 during the day when aquatic plants have had time to produce oxygen during photosynthesis, as well as in cold and turbulent (a lot of mixing at the air-water interface) water. PWQO's have an acceptable range for dissolved oxygen in water dependent upon temperature. At 15 degrees Celsius the minimum amount of dissolved oxygen is 5 milligrams per litre (mg/L) and at 20 degrees Celsius the minimum amount of dissolved oxygen is 4 mg/L for cold water biota.

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). Extreme pH levels can increase the solubility of elements and compounds and it can make potentially toxic chemicals more mobile and increase the risk of absorption by aquatic life (Frondriest Environmental Inc.). The natural factors that can affect pH are interactions with surrounding rocks and other materials, precipitation (especially acid rain), and CO_2 concentrations. The anthropogenic factors that influence pH include wastewater and mining discharges, acid rain as a result of emissions from mining or fossil fuel combustion, and point source pollution from agricultural runoff (Frondriest Environmental Inc.). Geology of the watershed can give the river some buffering capacity to resist changes in pH but overall the range should stay between 6.5 and 8.5 to protect aquatic life, and avoid irritation to anyone using the water for recreational purposes.

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, the number of species may decrease. Temperature also influences water chemistry, generally causing chemical reactions to increase with higher temperatures. Temperature can also affect biological activity because warmer water holds less dissolved oxygen which can harm fish and aquatic life that require a high dissolved oxygen to live. Warmer temperatures also encourage 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. There is no PWQO for temperature.

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 road salts, runoff from agricultural and erosion from exposed soil/no stream bank vegetation. There is no PWQO for TDS.

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 can often be seen in the sunlight. The diversity of species can be affected by how far the sunlight can penetrate the water column. Fish gills can become clogged with this suspended material, and the material may also settle on top of fish spawning grounds (and their eggs). Highly turbid water appears murky or dirty. Turbidity will often become higher after heavy rainfall, but high levels may also indicate soil erosion. There is no PWQO for turbidity.

Nutrients

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

Nitrogen

Nitrogen (N) is one of the most common gases in the earth's atmosphere making up approximately 78%. Nitrogen nutrients are often applied to agricultural crops as fertilizers, but having too much in a watershed can increase plant growth and productivity to unhealthy levels. Nitrogen is constantly being recycled through the environment through the nitrogen cycle which includes fixation, ammonification, nitrification, and denitrification. The most important forms that plants can readily use are ammonia, nitrate

(NO_3) and nitrite (NO_2). Nitrogen levels can be reported in several ways, 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). There is no PWQO for ammonia total. The PWQO for un-ionized ammonia is 0.02 mg/L.

Phosphorus

Total phosphorus gives a measurement of all forms of phosphorus found in the watershed, but the most important form within this measurement is soluble inorganic phosphate (PO_4) or orthophosphate ion (PO_4^{-3}). These two forms are of utmost importance because they are utilized by aquatic plants. While phosphorus is essential to life, too much can increase algae growth within the watershed. Excessive growths or build ups of algae on abiotic features (like rocks) 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 ecologically sensitive species. Natural decomposition of organic matter such as leaves, twigs, and 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 or waste from farms contaminating the watershed. The PWQO criteria for phosphorus is 0.03 mg/L.

Bacteria

Escherichia coli

Escherichia coli (*E. coli*) are bacteria 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 aquatic environments, combined with its short survival time 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. American beavers and Canadian geese). These bacteria can cause irritation of the skin and eyes when contact is made, and can cause gastro-intestinal disorders in humans. The PWQO for *E. coli* is 100 *E. coli* per 100 mL.

Total Coliforms

Total coliforms are a group of bacteria that are naturally found on plants, in soils, water, and the intestines of humans and warm-blooded animals. Due to the fact that total coliforms are widespread in the environment, they can be used as one of the many operational tools to determine the efficiency of a drinking water treatment system. The total coliform group contains various species of the genera *Escherichia, Klebsiella, Enterobacte, Citrobacter, Serratia,* and many others. There is no current PWQO for total coliforms; however, the previous guideline from prior to 1994 was 1000 MPN per 100 mL.

Metals

Most of the metals listed below are found naturally within the earth's crust and weathering of rock can transport them into surface water. The following is a complete list of the metals analysis performed on the water samples and their qualities.

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. Aluminum in the aquatic environment comes from both natural and anthropogenic sources but the amount of aluminum found naturally in the environment exceeds aluminum from anthropogenic sources. Soil derived dusts from activities like farming, mining, and coal combustion can directly release aluminum into aquatic environments. Wind and water erosion from agricultural lands also release aluminum into the aquatic environment. Acid rain can also lower environmental pH and make aluminum more soluble in the environment (Environment and Climate Change, 2017). 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, 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, 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 at pH >6.5.

Antimony
Antimony is a metallic element that is a blue-white colour in its stable form. Antimony is present in the aquatic environment as a result of rock weathering, soil runoff, and anthropogenic activities (Filella, M., Belzile, N., & Chen, Y., 2001). 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. Concentrations of antimony in freshwater systems typically range from a few ng/l to a few μg/l (Filella, M., Belzile, N., & Chen, Y., 2001). 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. The largest natural source of arsenic is from weathered rocks and soils. The main anthropogenic source is from smelting and refining industries. Arsenic is used in manufacturing wood preservatives, herbicides, pharmaceuticals, glass manufacturing, and metallurgical applications (Canadian Council

of Ministers of the Environment, 2001). 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 the PWQO guideline 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 plastic, rubber, electronic, and textile industries. Barium can anthropogenically enter surface water during coal processing as the effluent from a coal conversion plant contains high concentrations of barium, also through barium ore processing and subsequent industrial chemical processes involving barium. Barium can enter freshwater systems naturally through leaching and eroding of sedimentary rocks (CCME, 2013). At high concentrations, barium causes strong vasoconstriction (increase in blood pressure) by its direct stimulation of arterial muscle, peristalsis (radial contraction and relaxation of muscles) 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 (under activity of adrenal glands), 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 over 80 compounds. High concentrations of boron are found in sediments and sedimentary rocks, especially in clay rich marine sediments. (Canadian Council of Ministers of the Environment, 2009). Natural sources of boron to the aquatic environment is through atmospheric deposition, natural weathering processes, volcanic emissions, soil dust, and plant aerosols. Anthropogenic sources of boron include fossil fuel combustion, biomass burning, municipal sewage, waste waters from coal-burning power plants, irrigation, copper smelters, and industries that use boron. Natural weathering of boron releases more boron into the environment than industrial sources due to the high occurrence of clay-rich sedimentary rocks on the Earth's surface. Boron concentrations in freshwater are more likely dependent on the leaching of boron from the surrounding geology than from waste water or pollution (Canadian Council of Ministers of the Environment, 2009). 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, brain, and may eventually lead to death. The maximum level of boron under PWQO guidelines is 200 µg/L.

Cadmium

Cadmium is a relatively rare element and an extremely toxic metal even in low concentrations. It is used commercially as a stabilizer in plastic, in fungicides for golf courses, in televisions, in nickel–cadmium batteries, in motor oils, and in curing agents for rubber. Anthropogenic sources of cadmium are industrial wastes from metallurgical plants, plating works, plants manufacturing cadmium pigments, textile operations, cadmium-stabilized plastics, or nickel-cadmium batteries, or by effluents from sewage treatment plants (Health Canada). Natural sources of cadmium include dissolution of sediment containing cadmium, especially in more acidic waters (Health Canada). Cadmium poisoning can lead to itai-itai disease, which initiates bone softening, joint pain, and kidney failure. The interim PWQO guideline states if hardness as $CaCO_3$ is 0-100 mg/L, the maximum cadmium concentration is 0.1 µg/L, and if hardness is >100 mg/L, 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, grey metal. Natural sources of chromium include volcanic emissions, forest fires, vegetative debris, and marine aerosols (Canadian Council of Ministers of the Environment, 1999). Anthropogenic sources of chromium to the aquatic environment include tanneries, cooling towers, steel and nonferrous foundries, metal finishing and plating operations, flat glass and asbestos producing plants, wood treatment facilities, paint and chemical works, oil drilling and recovery rigs, as well as wastes from pulp and paper mills, cement and fertilizer plants, textile mills, power plants, chlor-alkali plants, petrochemical industries, as well as urban runoff and industrial storm waters (Canadian Council of Ministers of the Environment, 1999). Chromium (III) is an essential nutrient for the human body, but higher intake may cause skin rashes. Chromium (VI) is known to cause various health effects such as upset stomachs and ulcers, skin rashes, 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. Cobalt is an essential element for the growth of various marine algae species and it is shown to enhance the growth of plant at low concentrations. In high concentrations, cobalt can be toxic to humans as well as terrestrial and aquatic plants and animals. Cobalt is present naturally in rock, soil, water, plants, animals, and the air in small concentrations. It is often associated with nickel, silver, lead, copper, and iron ores. Cobalt can also have anthropogenic sources in the aquatic environment such as through cobalt mining, production of alloys and chemicals containing cobalt, sewage effluent, as well as urban and agricultural run-off (Nagpal, 2004). 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 can also be found in various minerals. Copper is an essential element to human metabolism, although intake at higher doses can cause adverse health effects. Acute copper poisoning can cause health effects including vomiting, diarrhea, and jaundice. In severe cases, stool and saliva may appear green or blue. In the terminal phases, anuria (kidney failure), hypotension (low blood pressure), and coma precede death. The PWQO criterion for copper is dependent upon the hardness of the water and so varies between 0.001 mg/L to 0.005 mg/L.

Iron

Iron is an abundant metal found in all types of rock. The precipitation of excessive iron creates an objectionable reddish-brown colour to water. Iron may stain plumbing fixtures, produce undesirable tastes in beverages, and promote the growth of certain iron-

bacteria, which can lead 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, and can cause neurological damage or death. Although natural occurrences can result 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 5 μg/L.

Lithium

Lithium is a soft, silver-white metal belonging to the alkali metal group of chemical elements. Like all alkali metals, lithium is highly reactive and flammable. Lithium forms a minor part of igneous rocks, with the largest concentrations in granites. Lithium and its compounds have a range of effects on the human body. For instance, compounds of lithium tend to harm the kidneys and lithium carbonate can affect a person's mental health. There are no current PWQO guidelines for lithium.

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’s disease, lung embolism, and bronchitis. There are currently no PWQO guidelines for manganese.

Molybdenum

Molybdenum is an element that is found in minerals containing iron, bismuth, or copper and it is a by-product of copper and tungsten mining. It is commonly associated with coal or uranium deposits. Natural sources of molybdenum to the aquatic environment includes weathering of ores from igneous or sedimentary rocks (shale), and subsequent runoff to streams and lakes (Canadian Council of Ministers of the Environment, 1999). Anthropogenic sources of molybdenum to the aquatic environment includes use of fertilizers containing molybdenum, atmospheric wet deposition, leaching processes near molybdenum mines, and burning of fossil fuels It is used as an alloy for various metals and occurs naturally in soil and rock (Canadian Council of Ministers of the Environment, 1999). 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 an essential element in humans and is seldom found in drinking water at levels that could be a concern for healthy humans. It is present in all animal and plant tissues so it is found in all foods. 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 earth. It occurs naturally in the environment and is also released by human activities. Natural sources of selenium in the environment are volcanoes, biogenic processes, atmospheric release, and forest fires. The main source of selenium in surface water today is the result of weathering and sedimentary processes acting on volcanic parent rocks that have high concentrations of selenium (Beatty & Russo, 2014). Anthropogenic sources of selenium in the environment are industrial, agricultural, mining, and petrochemical operations, wastewater discharges from municipal sewage treatment plants, landfills, combustion of coal and fossil fuels, and emissions from smelting and manufacturing of pyritic ores (Beatty & Russo, 2014). Depending on the form of selenium varying health effects can occur including brittle hair and deformed nails, rashes, swelling of the skin, and severe pain. Selenium poisoning may become so severe that it may cause death. Background selenium concentrations in surface waters range from 0.1 to 0.4 µg/L (Beatty & Russo, 2014). The maximum concentration of selenium under PWQO guidelines is 100 µg/L.

Silver

Silver is stable in both water and air and is acid and base resistant, but corrodes when it comes in contact with sulphur compounds. Silver oxide may irritate the eyes and is harmful upon swallowing, affecting the 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.

Sodium

Sodium is a soft, silvery-white, highly reactive metal. It is the sixth most abundant element in the Earth's crust, and exists in numerous minerals such as feldspars, sodalite and rock salt. Sodium has a number of important functions in plants, humans, and animals. In humans, it is involved in controlling the amount of fluid present in cells. An excess or lack of sodium can cause cells to gain or lose water. Either of these changes can prevent cells from carrying out their normal functions. There are currently no PWQO guidelines for sodium.

Strontium

Strontium is a bright silvery metal that is reactive in water. Natural sources of strontium include leaching from limestone. Anthropogenic sources of strontium include release into the environment as a by-product of other mining operations, air deposition from coal burning and phosphate fertilizers (Federal-Provincial-Territorial Committee on Drinking Water, 2018). 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.

Tellurium

Tellurium is a brittle, mildly toxic, rare, silver-white metalloid. It is chemically related to selenium and sulfur. It is occasionally found in native form as elemental crystals. Tellurium is far more common in the universe as a whole than on Earth. When taken internally, tellurium can have harmful effects. It may cause nausea, vomiting, and damage to the central nervous system. There are currently no PWQO guidelines for tellurium.

Thallium

Thallium is a silvery-grey metal that is very toxic by inhalation, ingestion and skin absorption. Natural inputs of thallium into the aquatic environment includes weathering processes. Anthropogenic inputs of thallium into the aquatic environment includes potash, effluents production of sulphuric acid, the mining and smelting of copper, gold, zinc, lead, and cadmium, and combustion of coal and oil (Canadian Council of Ministers of the Environment, 1999). 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. Zinc is an essential element for all living things (Health Canada, 1987) and overdoses do not occur very often. Anthropogenic sources of zinc include primary iron and steel production, primary copper and nickel production, fuel combustion, transportation, solid waste incineration, and pesticide applications (Health Canada, 1987). 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, and 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 E:

Water Quality Guidelines

Appendix E: Water Quality Guidelines

The following are taken from the Ministry of the Environment, Provincial Water Quality Objectives (PWQO), July 1994 and was updated March 2019.

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 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 MOECC 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).*

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 20ºC 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 the PWQO; percentages are rounded to two significant figures. The equations given by may be used to interpolate values between those given in the table:

ƒ = $1/(10^{pKa-pH}+1)$, where **ƒ 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.
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.

Temp.	pH								
°C	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
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 the following:

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 the following:

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

Iron

The amount of Iron should not exceed 300 µg/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.

Appendix F:

Forest Ecosystem Classification

Appendix F: Forest Ecosystem Classification

Site 1: V15 White Spruce Mixedwood

Description: A variable mixedwood Type with white spruce as the main canopy species. The understory ranges from herb and shrub 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 (in descending order):
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 decora, Linnaea borealis, Diervilla lonicera, Rosa acicularis, Amelanchier* spp., trembling aspen
Herbs:	*Aralia nudicaulis, Cornus Canadensis, Clintonia borealis, Maianthemum canadense, Streptopus roseus, Trientalis borealis, Galium triflorum, Aster macrophyllus, Mitella nuda, Viola renifolia, Anemone quinquefolia, Petasites palmatus*
Mosses:	*Pleurozium schreberi, Ptilium crista-castrensis, Rhytidiadelphus triquestrus, Plagiomnium cuspidatum*

Forest Floor Cover:

Species	Broadleaf Litter	Moss	Conifer Litter	Wood
Forest Floor Cover (%)	61	16	13	5

Site 2 and 4: 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 an herb rich / 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 on site conditions mostly on fresh to moist, mineral soils

.

Site 2

Site 4

Common Overstory Species (in descending order):
Black spruce, trembling aspen, jack pine, balsam fir, white birch, white spruce, balsam poplar

Common Understory Species:

Shrubs:	*Linnae borealis,* balsam fir, *Rubus pubescens, Vaccinium myrtilloides,* black spruce, *Rosa acicularis, Amelanchier* spp., *Vaccinium angustifolium, Sorbus decora, Gaultheria bispidula, 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, Viola renifolia*
Mosses:	*Pleurozium schreberi, Ptilium crista-castrensis, Dicranum polystum, Hylocomium splendens, Rhytidiadelphus triquestrus*

Forest Floor Cover:

Species	Broadleaf Litter	Moss	Conifer Litter
Forest Floor Cover (%)	33	49	12

Site 3: 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. Occuring mainly on deep, fresh, well-drained mineral soils.

Common Overstory Species (in descending order):
trembling aspen, white spruce, white birch, balsam fir, black spruce, jack pine, red maple

Common Understory Species:

Shrubs:	*Rubus pubescens, Acer spicatum,* balsam fir*, Corylus cornuta, Diervilla lonicera, Amelanchier* spp., *Rosa acicularis,* trembling aspen, *Linnaea borealis*
Herbs:	*Viola renifolia, Mitella nuda, Maianthemum canadense, Cornus Canadensis, Aralia nudicaulis, Aster macrophyllus, Streptopus roseus, Clintonia borealis, Trientalis borealis, Galium triflorum, Viola renifolia, Petasites palmatus, Anemone quinquefolia*
Mosses:	*Plagiomnium cuspidatum, Pleurozium schreberi, Rhytidiadelphus triquetrus, Ptilium crista-castrensis*

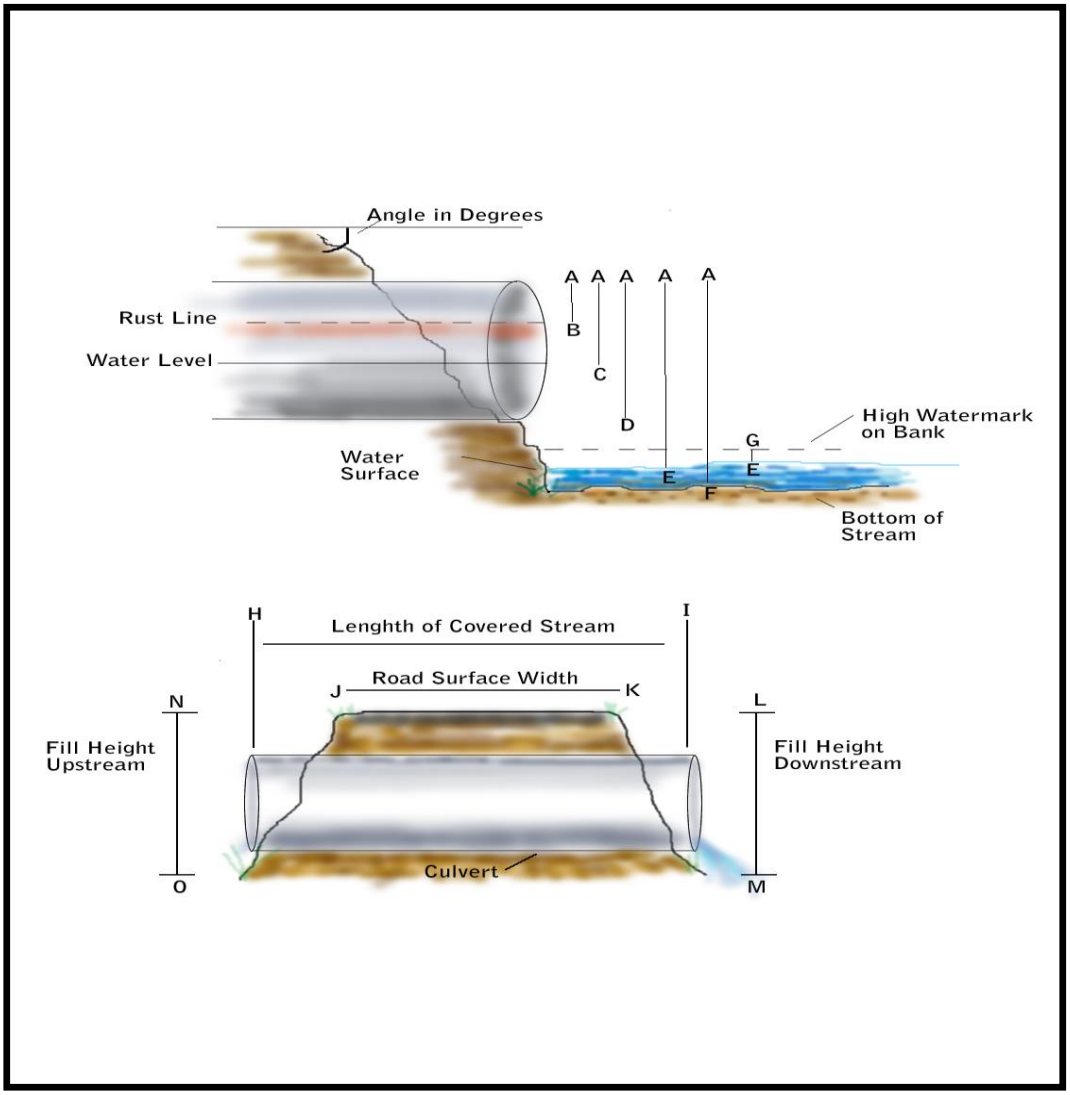
Forest Floor Cover:

Species	Broadleaf Litter	Moss	Conifer Litter
Forest Floor Cover (%)	84	5	5

Appendix G:

Culvert Assessments

Appendix G: Culvert Assessments



North Current River 2019 Culvert Assessments

Culvert Number/ Site Number	**J-K** Road Surface Width (m)	**H-I** Length of Covered Stream (m)	**N-O** Fill Height Upstream (m)	**L-M** Fill Height Downstream (m)		**A-D** Width of Opening (m)	**A-B** Inside Top to Rust Line (m)	**A-C** Inside Top to Water Surface (m)	**A-E** Height Above Outlet Pool (m)	**E-G** Water Surface to High Water Mark (m)	**A-F** Inside Top to Bottom of Stream (m)
C1/Site 3 – Highway 527											
Culvert	-	-	4.504	-	Upstream	2.27	-	1.58	-	0.5	2.27
					Downstream	-	-	-	-	-	-

*Some culvert measurements were not completed due to safety concerns.

Culvert 1 / Site 3

Location: Approximately 13 kilometres north of Highway 11/17 on Highway 527. Site 3 was located at a road crossing of Highway 527 over the North Current River.

GPS Coordinates: Northing 5382985 Easting 343307

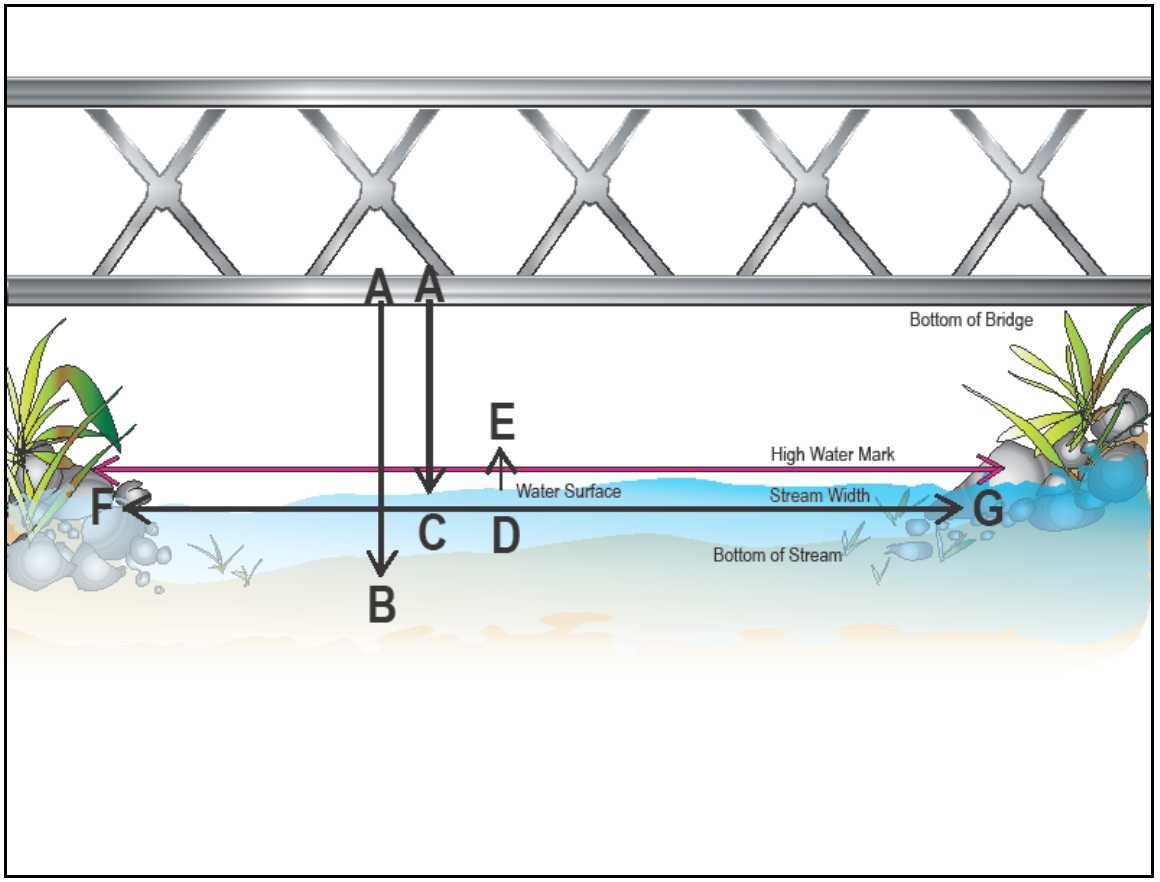
Description: The large corrugated steel culvert is in excellent condition. It was large enough to be able to support water flow during times of both high water level and low water level. There was little rust and the culvert was surrounded by concrete and fill made up of large cobbles. There is vegetation surrounding the culvert and the banks appear to be stable. Downstream culvert measurements, road surface width, and length of covered stream were not recorded due to safety concerns.

Upstream

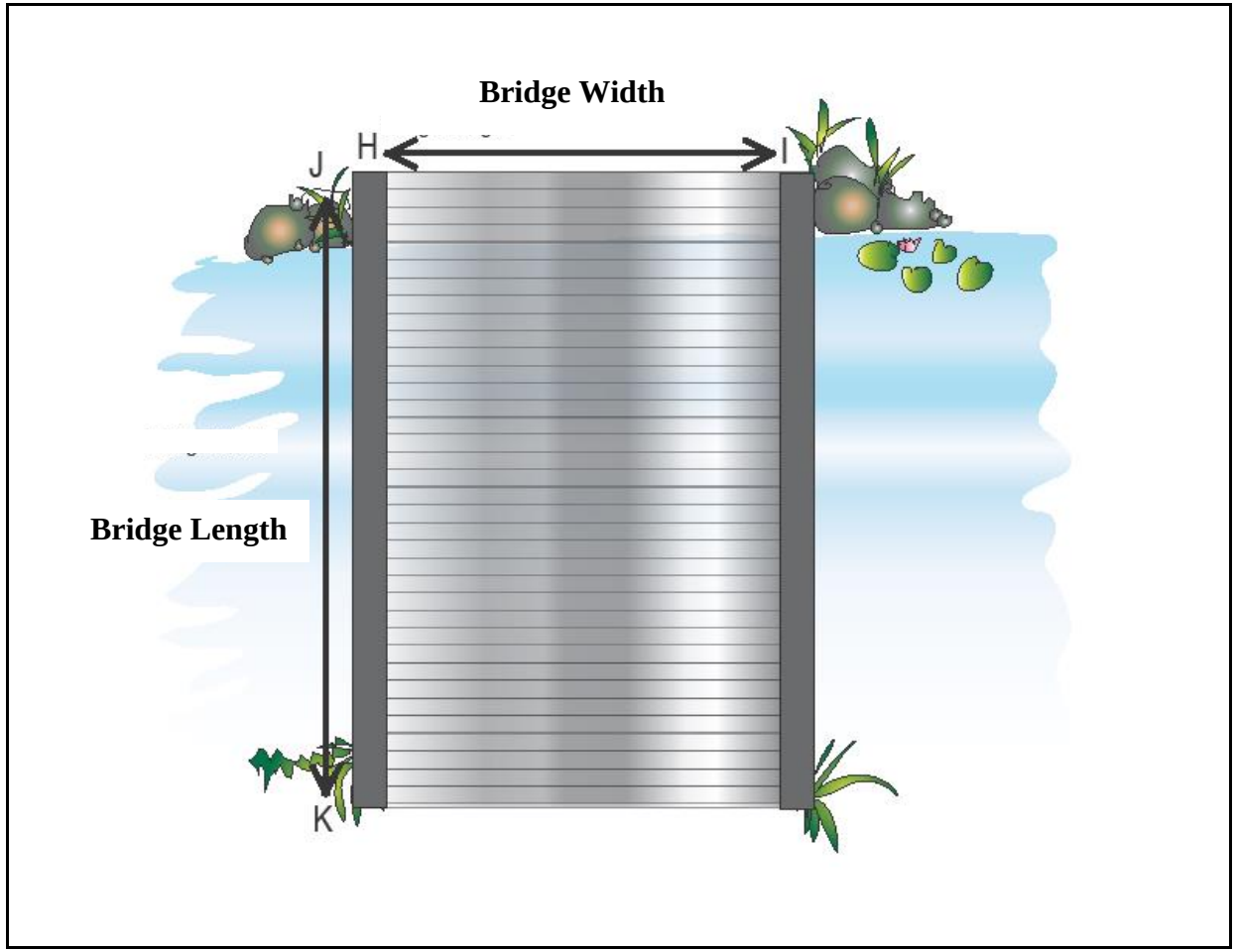
Downstream

Appendix H: Bridge Assessments

Appendix H: Bridge Assessments



Bridge Measurement Parameters


Bridge Width
H
I
J
K
Bridge Length

North Current River 2019 Bridge Measurements

Site Number	Bridge Number	**A-C** Bottom of Bridge to Water Surface (m)	**A-B** 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)
2 - Mitchell Road	B1	3.432	4.518	0.20	7.178	9.560	4.003
4 – Kingfisher Lake	B2	1.482	-	0.902	2.30	6.070	2.502

Bridge 1 / Site 2

Location: Approximately 2 kilometres west of Highway 527 on Mitchell Road.

GPS Coordinates: Northing 5377317 Easting 339625

Description: This bridge is a vehicle and pedestrian bridge made with wood, stone, and metal. The condition of the bridge was good and there was abundant vegetation on both banks.

Upstream

Downstream

Bridge 2 / Site 4

Location: Located at the headwaters; at Kingfisher Lake. The site can be accessed on the Forest Demonstration Trail at the Kingfisher Outdoor Education Centre.

GPS Coordinates: Northing 5391679 Easting 347960

Description: This bridge is a small pedestrian bridge made up of wood, rocks, metal, and concrete. A beaver dam directly upstream of the bridge could cause significant erosion if it was removed or broke. Very little water flowed beneath the bridge due to presence of two beaver dams and pooling of water before bridge was present.

Upstream

Appendix I:

Site Photography

Appendix I: Site Photography

Site 1 – Confluence of North Current River with Current River, Trowbridge Falls Municipal Campground	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Site 2 – Approximately 2 kilometres down Mitchell Road from Highway 527	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Site 3 – Approximately 13 kilometres down Highway 527 from Highway 11/17 at road crossing of Highway 527 over the North Current River	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Site 4 – Headwaters; at Kingfisher Lake. The site can be accessed on the Forest Demonstration Trail at the Kingfisher Outdoor Education Centre	
A: Upstream	**B: Downstream**
	
C: Vegetation	**D: Substrate**
	

Appendix J:

Laboratory Water Quality Results Summary Tables June

North Current River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables June

Laboratory Water Quality Results for June 12, 2019

Parameter	Units	PWQO Criterion	NCR1 North Current River - SITE#1	NCR2 North Current River - SITE#2	NC3 North Current River - SITE#3	NCR4 North Current River - SITE#4	Average
			12-Jun-19	12-Jun-19	12-Jun-19	12-Jun-19	June
Physical Tests							
Conductivity (EC)	(uS/cm)	N/A	96.6	83.6	79.0	30.8	72.5
pH		6.5-8.5	7.59	7.05	6.91	6.87	7.11
Total Dissolved Solids	(mg/L)	N/A	83	73	71	46	68
Turbidity	(NTU)	N/A	0.68	0.95	1.30	1.09	1.01
Anions and Nutrients							
Alkalinity, Total (as $CaCO_3$)*	(mg/L)	8.1	31.9	25.3	14.7	10.8	20.7
Ammonia-N, Total	(mg/L)	N/A	0.012	0.051	0.017	0.064	0.036
Un-ionized Ammonia (calculated)**	(mg/L)	0.02	0.000179	0.000679	0.000060	0.001379	0.000574
Chloride (Cl)	(mg/L)	N/A	8.81	8.24	11.3	0.35	7.18
Nitrate-N (NO_3-N)	(mg/L)	N/A	0.032	0.035	<0.020	0.033	0.033
Nitrite-N (NO_2-N)	(mg/L)	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Total Kjeldahl Nitrogen	(mg/L)	N/A	0.41	0.45	0.51	0.59	0.49
Phosphorus (P)-Total	(mg/L)	0.03	0.0086	0.0100	0.0155	0.0116	0.0114
Sulphate (SO_4)	(mg/L)	N/A	1.78	1.69	1.60	1.37	1.61
Bacteriological Tests							
Escherichia Coli	(MPN/100mL)	100	20	41	27	10	25
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	411	488	727	365	498
Total Metals							
Aluminum (Al)-Total***	(mg/L)	0.075	0.0564	0.0634	**0.1030**	0.0650	0.0720
Antimony (Sb)-Total	(mg/L)	0.02	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	(mg/L)	0.005 (interim)	0.00023	0.00023	0.00026	0.00025	0.00024
Barium (Ba)-Total	(mg/L)	N/A	0.0165	0.0176	0.0222	0.0110	0.0168
Beryllium (Be)-Total****	(mg/L)	0.011 (<75 mg/L $CaCO_3$)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	(mg/L)	1.10 (>75 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Bismuth (Bi)-Total	(mg/L)	N/A	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	(mg/L)	0.2	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total****	(mg/L)	0.0001 (0-100 mg/L $CaCO_3$)	<0.0000050	0.0000050	0.0000057	<0.0000050	0.0000054
	(mg/L)	0.0005 (>100 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Calcium (Ca)-Total	(mg/L)	N/A	9.46	7.39	5.64	3.57	6.52
Chromium (Cr)-Total	(mg/L)	0.0089	0.00038	0.00045	0.00060	0.00029	0.00043
Cobalt (Co)-Total	(mg/L)	0.0009	<0.00010	0.00011	0.00029	<0.00010	0.00020
Copper (Cu)-Total****	(mg/L)	0.001 (0-20 mg/L CaCO3)	N/A	N/A	**0.00121**	0.00079	0.00100
	(mg/L)	0.005 (>20 mg/L CaCO3)	0.00104	0.00112	N/A	N/A	0.00108

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

North Current River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables June

Laboratory Water Quality Results for June 12, 2019

Parameter	Units	PWQO Criterion	NCR1 North Current River - SITE#1	NCR2 North Current River - SITE#2	NCR3 North Current River - SITE#3	NCR4 North Current River- SITE#4	Average
			12-Jun-19	12-Jun-19	12-Jun-19	12-Jun-19	June
Total Metals Continued							
Iron (Fe)-Total	(mg/L)	0.3	0.287	**0.344**	**0.543**	0.127	**0.325**
Lead (Pb)-Total****	(mg/L)	0.001 (<30 mg/L CaCO3)	N/A	<0.000050	0.000088	0.000053	0.000071
	(mg/L)	0.003 (30-80 mg/L CaCO3)	0.000056	N/A	N/A	N/A	0.00006
	(mg/L)	0.005 (>80 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Lithium (Li)-Total	(mg/L)	N/A	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Magnesium (Mg)-Total	(mg/L)	N/A	3.11	2.58	2.02	1.34	2.26
Manganese (Mn)-Total	(mg/L)	N/A	0.0267	0.0258	0.0849	0.0121	0.0374
Molybdenum (Mo)-Total	(mg/L)	0.04	0.000111	0.000087	0.000099	<0.000050	0.000099
Nickel (Ni)-Total	(mg/L)	0.025	0.00057	0.00064	0.00078	<0.00050	0.00066
Potassium (K)-Total	(mg/L)	N/A	0.566	0.552	0.582	0.329	0.507
Selenium (Se)-Total	(mg/L)	0.1	0.000080	0.000088	0.000063	0.000069	0.000075
Silver (Ag)-Total	(mg/L)	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	(mg/L)	N/A	5.60	5.46	6.95	0.783	4.70
Strontium (Sr)-Total	(mg/L)	N/A	0.0290	0.0273	0.0364	0.0105	0.0258
Tellurium (Te)-Total	(mg/L)	N/A	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	(mg/L)	0.0003	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Total	(mg/L)	N/A	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	(mg/L)	N/A	0.00084	0.00102	0.00139	0.00031	0.00089
Tungsten (W)-Total	(mg/L)	0.03	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	(mg/L)	0.005	0.000043	0.000045	0.000046	0.000054	0.000047
Vanadium (V)-Total	(mg/L)	0.006	0.00070	0.00078	0.00093	<0.00050	0.00080
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	<0.0030	<0.0030	0.0037	<0.0030	0.0037
Zirconium (Zr)-Total	(mg/L)	0.004	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

Appendix K:

Laboratory Water Quality Results Summary Tables July

North Current River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables July

Laboratory Water Quality Results for July 9, 2019

Parameter	Units	PWQO Criterion	NCR1 North Current River - SITE#1	NCR2 North Current River - SITE#2	NCR3 North Current River - SITE#3	NCR4 North Current River - SITE#4	Average
			09-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	July
Physical Tests							
Conductivity (EC)	(uS/cm)	N/A	134	120	83.1	33.7	92.7
pH		6.5-8.5	7.35	7.20	6.93	6.79	7.07
Total Dissolved Solids	(mg/L)	N/A	88	90	69	40	72
Turbidity	(NTU)	N/A	0.83	0.89	1.28	1.74	1.19
Anions and Nutrients							
Alkalinity, Total (as $CaCO_3$)*	(mg/L)	9.825	47.2	38.9	22.2	13.1	30.4
Ammonia-N, Total	(mg/L)	N/A	<0.020	<0.020	0.088	0.175	0.132
Un-ionized Ammonia (calculated)**	(mg/L)	0.02	N/A	N/A	0.0010	0.0074	0.0042
Chloride (Cl)	(mg/L)	N/A	10.8	11.4	9.39	0.45	8.01
Nitrate-N (NO_3-N)	(mg/L)	N/A	0.040	0.055	<0.020	<0.020	0.048
Nitrite-N (NO_2-N)	(mg/L)	N/A	<0.010	<0.010	<0.010	<0.010	<0.010
Total Kjeldahl Nitrogen	(mg/L)	N/A	0.29	0.44	0.71	0.65	0.52
Phosphorus (P)-Total	(mg/L)	0.03	0.0086	0.0097	0.0138	0.0128	0.0112
Sulphate (SO_4)	(mg/L)	N/A	2.19	2.14	1.40	1.04	1.69
Bacteriological Tests							
Escherichia Coli	(MPN/100mL)	100	6	13	27	2	12
Total Coliforms	(MPN/100mL)	1000 (prior to 1994)	921	980	**1050**	**>2420**	984
Total Metals							
Aluminum (Al)-Total***	(mg/L)	0.075	0.0320	0.0421	0.0645	0.0601	0.0497
Antimony (Sb)-Total	(mg/L)	0.02	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Total	(mg/L)	0.005 (interim)	0.00031	0.00031	0.00034	0.00031	0.00032
Barium (Ba)-Total	(mg/L)	N/A	0.0200	0.0223	0.0257	0.0116	0.0199
Beryllium (Be)-Total****	(mg/L)	0.011 (<75 mg/L $CaCO_3$)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	(mg/L)	1.10 (>75 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Bismuth (Bi)-Total	(mg/L)	N/A	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Boron (B)-Total	(mg/L)	0.2	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Total****	(mg/L)	0.0001 (0-100 mg/L $CaCO_3$)	0.0000064	<0.0000050	<0.0000050	<0.0000050	0.0000064
	(mg/L)	0.0005 (>100 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Calcium (Ca)-Total	(mg/L)	N/A	14.3	11.9	6.79	4.08	9.27
Chromium (Cr)-Total	(mg/L)	0.0089	0.00027	0.00038	0.00049	0.00034	0.00037
Cobalt (Co)-Total	(mg/L)	0.0009	<0.00010	0.00011	0.00026	<0.00010	0.00019
Copper (Cu)-Total****	(mg/L)	0.001 (0-20 mg/L $CaCO_3$)	N/A	N/A	N/A	0.00090	0.00090
	(mg/L)	0.005 (>20 mg/L $CaCO_3$)	0.00099	0.00100	0.00104	N/A	0.00101

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

North Current River Watershed Assessment 2019
Laboratory Water Quality Results Summary Tables July

Laboratory Water Quality Results for July 9, 2019

Parameter	Units	PWQO Criterion	NCR1 North Current River - SITE#1	NCR2 North Current River - SITE#2	NCR3 North Current River - SITE#3	NCR4 North Current River - SITE#4	Average
			09-Jul-19	09-Jul-19	09-Jul-19	09-Jul-19	July
Total Metals Continued							
Iron (Fe)-Total	(mg/L)	0.3	**0.348**	**0.555**	**0.786**	0.175	**0.466**
Lead (Pb)-Total****	(mg/L)	0.001 (<30 mg/L CaCO3)	N/A	N/A	0.000112	0.000071	0.000092
	(mg/L)	0.003 (30-80 mg/L CaCO3)	<0.000050	0.000060	N/A	N/A	0.00006
	(mg/L)	0.005 (>80 mg/L $CaCO_3$)	N/A	N/A	N/A	N/A	N/A
Lithium (Li)-Total	(mg/L)	N/A	0.0012	<0.0010	<0.0010	<0.0010	0.0012
Magnesium (Mg)-Total	(mg/L)	N/A	4.33	3.53	2.24	1.42	2.88
Manganese (Mn)-Total	(mg/L)	N/A	0.0339	0.0398	0.0839	0.0321	0.0474
Molybdenum (Mo)-Total	(mg/L)	0.04	0.000193	0.000159	0.000108	<0.000050	0.000153
Nickel (Ni)-Total	(mg/L)	0.025	0.00053	0.00059	0.00081	<0.00050	0.00064
Potassium (K)-Total	(mg/L)	N/A	0.636	0.611	0.589	0.352	0.547
Selenium (Se)-Total	(mg/L)	0.1	0.000101	0.000104	0.000078	0.000102	0.000096
Silver (Ag)-Total	(mg/L)	0.0001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Total	(mg/L)	N/A	6.86	7.48	6.88	0.872	5.52
Strontium (Sr)-Total	(mg/L)	N/A	0.0384	0.0357	0.0416	0.0120	0.0319
Tellurium (Te)-Total	(mg/L)	N/A	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020
Thallium (Tl)-Total	(mg/L)	0.0003	0.000023	<0.000010	<0.000010	<0.000010	0.000023
Tin (Sn)-Total	(mg/L)	N/A	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Total	(mg/L)	N/A	0.00062	<0.0015	0.00120	0.00050	0.00077
Tungsten (W)-Total	(mg/L)	0.03	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Uranium (U)-Total	(mg/L)	0.005	0.000053	0.000055	0.000045	0.000056	0.000052
Vanadium (V)-Total	(mg/L)	0.006	0.00067	0.00098	0.00096	<0.00050	0.00087
Zinc (Zn)-Total	(mg/L)	0.02 (interim)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Zirconium (Zr)-Total	(mg/L)	0.004	<0.000060	<0.000060	0.000087	<0.000060	0.000087

Notes:

PWQO - Provincial Water Quality Objectives. **Bold indicates exceedance of PWQO criteria**

* - Alkalinity should not be decreased by more than 25% of the natual conditions

** - indicates criterion is pH and temperature dependent

*** - indicates criterion is pH dependent

**** - indicates criteria are Alkalinity dependent

Appendix L:

Laboratory Certificates of Analysis and Test Results

LAKEHEAD REGION CONSERVATION AUTHORITY-TB
ATTN: Scott Drebit
130 Conservation Road
P.O. Box 10427
Thunder Bay ON P7B 6T8

Date Received: 13-JUN-19
Report Date: 26-JUN-19 15:18 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L2290713

Project P.O. #: 275
Job Reference: NORTH CURRENT RIVER
C of C Numbers:
Legal Site Desc:

Christina Shepherd
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-1 NCR1-NORTH CURRENT RIVER - SITE #1 Sampled By: Client on 12-JUN-19 @ 14:10 Matrix: Grab							
Physical Tests							
Conductivity (EC)	96.6		1.0	uS/cm		15-JUN-19	R4671060
Hardness (as CaCO3)	35.3		0.50			17-JUN-19	
pH	7.59		0.10	pH		15-JUN-19	R4671060
Total Dissolved Solids	83		13	mg/L		19-JUN-19	R4678107
Turbidity	0.68		0.10	NTU		13-JUN-19	R4668286
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	31.9		2.0	mg/L		15-JUN-19	R4671060
Ammonia, Total (as N)	0.012		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	8.81		0.10	mg/L		15-JUN-19	R4671603
Nitrate (as N)	0.032		0.020	mg/L		15-JUN-19	R4671603
Nitrite (as N)	<0.010		0.010	mg/L		15-JUN-19	R4671603
Total Kjeldahl Nitrogen	0.41		0.15	mg/L	24-JUN-19	25-JUN-19	R4684508
Phosphorus (P)-Total	0.0086		0.0030	mg/L	20-JUN-19	21-JUN-19	R4681361
Sulfate (SO4)	1.78		0.30	mg/L		15-JUN-19	R4671603
Bacteriological Tests							
Escherichia Coli	20		0	MPN/100mL		13-JUN-19	R4670031
Total Coliforms	411		0	MPN/100mL		13-JUN-19	R4670031
Total Metals							
Aluminum (Al)-Total	0.0564		0.0030	mg/L		21-JUN-19	R4681832
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Arsenic (As)-Total	0.00023		0.00010	mg/L		21-JUN-19	R4681832
Barium (Ba)-Total	0.0165		0.00010	mg/L		21-JUN-19	R4681832
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4681832
Boron (B)-Total	<0.010		0.010	mg/L		21-JUN-19	R4681832
Cadmium (Cd)-Total	<0.0000050		0.0000050	mg/L		21-JUN-19	R4681832
Calcium (Ca)-Total	9.46		0.050	mg/L		21-JUN-19	R4681832
Cesium (Cs)-Total	0.000012		0.000010	mg/L		21-JUN-19	R4681832
Chromium (Cr)-Total	0.00038		0.00010	mg/L		21-JUN-19	R4681832
Cobalt (Co)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Copper (Cu)-Total	0.00104		0.00050	mg/L		21-JUN-19	R4681832
Iron (Fe)-Total	0.287		0.010	mg/L		21-JUN-19	R4681832
Lead (Pb)-Total	0.000056		0.000050	mg/L		21-JUN-19	R4681832
Lithium (Li)-Total	<0.0010		0.0010	mg/L		21-JUN-19	R4681832
Magnesium (Mg)-Total	3.11		0.0050	mg/L		21-JUN-19	R4681832
Manganese (Mn)-Total	0.0267		0.00010	mg/L		21-JUN-19	R4681832
Molybdenum (Mo)-Total	0.000111		0.000050	mg/L		21-JUN-19	R4681832
Nickel (Ni)-Total	0.00057		0.00050	mg/L		21-JUN-19	R4681832
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4681832
Potassium (K)-Total	0.566		0.050	mg/L		21-JUN-19	R4681832
Rubidium (Rb)-Total	0.00137		0.00020	mg/L		21-JUN-19	R4681832
Selenium (Se)-Total	0.000080		0.000050	mg/L		21-JUN-19	R4681832

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-1 NCR1-NORTH CURRENT RIVER - SITE #1 Sampled By: Client on 12-JUN-19 @ 14:10 Matrix: Grab							
Total Metals							
Silicon (Si)-Total	2.44		0.10	mg/L		21-JUN-19	R4681832
Silver (Ag)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Sodium (Na)-Total	5.60		0.050	mg/L		21-JUN-19	R4681832
Strontium (Sr)-Total	0.0290		0.00020	mg/L		21-JUN-19	R4681832
Sulfur (S)-Total	0.88		0.50	mg/L		21-JUN-19	R4681832
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Thallium (Tl)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Titanium (Ti)-Total	0.00084		0.00030	mg/L		21-JUN-19	R4681832
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Uranium (U)-Total	0.000043		0.000010	mg/L		21-JUN-19	R4681832
Vanadium (V)-Total	0.00070		0.00050	mg/L		21-JUN-19	R4681832
Zinc (Zn)-Total	<0.0030		0.0030	mg/L		21-JUN-19	R4681832
Zirconium (Zr)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					20-JUN-19	R4679271
Aluminum (Al)-Dissolved	0.0397		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Arsenic (As)-Dissolved	0.00022		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Barium (Ba)-Dissolved	0.0154		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Boron (B)-Dissolved	<0.010		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cadmium (Cd)-Dissolved	<0.0000050		0.0000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Calcium (Ca)-Dissolved	9.41		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Cesium (Cs)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Chromium (Cr)-Dissolved	0.00029		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Copper (Cu)-Dissolved	0.00098		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Iron (Fe)-Dissolved	0.174		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Lithium (Li)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Magnesium (Mg)-Dissolved	2.86		0.0050	mg/L	20-JUN-19	21-JUN-19	R4679848
Manganese (Mn)-Dissolved	0.00575		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Molybdenum (Mo)-Dissolved	0.000098		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Nickel (Ni)-Dissolved	<0.00050		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Potassium (K)-Dissolved	0.551		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Rubidium (Rb)-Dissolved	0.00133		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Selenium (Se)-Dissolved	0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-1 NCR1-NORTH CURRENT RIVER - SITE #1 Sampled By: Client on 12-JUN-19 @ 14:10 Matrix: Grab							
Dissolved Metals							
Silicon (Si)-Dissolved	2.45		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Sodium (Na)-Dissolved	5.65		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Strontium (Sr)-Dissolved	0.0263		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Sulfur (S)-Dissolved	0.81		0.50	mg/L	20-JUN-19	21-JUN-19	R4679848
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Titanium (Ti)-Dissolved	<0.00060	DLM	0.00060	mg/L	20-JUN-19	21-JUN-19	R4679848
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Uranium (U)-Dissolved	0.000037		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Vanadium (V)-Dissolved	<0.00050		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Zirconium (Zr)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
L2290713-2 NCR2-NORTH CURRENT RIVER - SITE #2 Sampled By: Client on 12-JUN-19 @ 13:25 Matrix: Grab							
Physical Tests							
Conductivity (EC)	83.6		1.0	uS/cm		15-JUN-19	R4671060
Hardness (as CaCO3)	29.0		0.50			17-JUN-19	
pH	7.05		0.10	pH		15-JUN-19	R4671060
Total Dissolved Solids	73		10	mg/L		19-JUN-19	R4678107
Turbidity	0.95		0.10	NTU		13-JUN-19	R4668286
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	25.3		2.0	mg/L		15-JUN-19	R4671060
Ammonia, Total (as N)	0.051		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	8.24		0.10	mg/L		15-JUN-19	R4671603
Nitrate (as N)	0.035		0.020	mg/L		15-JUN-19	R4671603
Nitrite (as N)	<0.010		0.010	mg/L		15-JUN-19	R4671603
Total Kjeldahl Nitrogen	0.45		0.15	mg/L	24-JUN-19	25-JUN-19	R4684508
Phosphorus (P)-Total	0.0100		0.0030	mg/L	20-JUN-19	21-JUN-19	R4681361
Sulfate (SO4)	1.69		0.30	mg/L		15-JUN-19	R4671603
Bacteriological Tests							
Escherichia Coli	41		0	MPN/100mL		13-JUN-19	R4670031
Total Coliforms	488		0	MPN/100mL		13-JUN-19	R4670031
Total Metals							
Aluminum (Al)-Total	0.0634		0.0030	mg/L		21-JUN-19	R4681832
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Arsenic (As)-Total	0.00023		0.00010	mg/L		21-JUN-19	R4681832
Barium (Ba)-Total	0.0176		0.00010	mg/L		21-JUN-19	R4681832
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-2 NCR2-NORTH CURRENT RIVER - SITE #2 Sampled By: Client on 12-JUN-19 @ 13:25 Matrix: Grab							
Total Metals							
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4681832
Boron (B)-Total	<0.010		0.010	mg/L		21-JUN-19	R4681832
Cadmium (Cd)-Total	0.0000050		0.0000050	mg/L		21-JUN-19	R4681832
Calcium (Ca)-Total	7.39		0.050	mg/L		21-JUN-19	R4681832
Cesium (Cs)-Total	0.000013		0.000010	mg/L		21-JUN-19	R4681832
Chromium (Cr)-Total	0.00045		0.00010	mg/L		21-JUN-19	R4681832
Cobalt (Co)-Total	0.00011		0.00010	mg/L		21-JUN-19	R4681832
Copper (Cu)-Total	0.00112		0.00050	mg/L		21-JUN-19	R4681832
Iron (Fe)-Total	0.344		0.010	mg/L		21-JUN-19	R4681832
Lead (Pb)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4681832
Lithium (Li)-Total	<0.0010		0.0010	mg/L		21-JUN-19	R4681832
Magnesium (Mg)-Total	2.58		0.0050	mg/L		21-JUN-19	R4681832
Manganese (Mn)-Total	0.0258		0.00010	mg/L		21-JUN-19	R4681832
Molybdenum (Mo)-Total	0.000087		0.000050	mg/L		21-JUN-19	R4681832
Nickel (Ni)-Total	0.00064		0.00050	mg/L		21-JUN-19	R4681832
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4681832
Potassium (K)-Total	0.552		0.050	mg/L		21-JUN-19	R4681832
Rubidium (Rb)-Total	0.00136		0.00020	mg/L		21-JUN-19	R4681832
Selenium (Se)-Total	0.000088		0.000050	mg/L		21-JUN-19	R4681832
Silicon (Si)-Total	2.15		0.10	mg/L		21-JUN-19	R4681832
Silver (Ag)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Sodium (Na)-Total	5.46		0.050	mg/L		21-JUN-19	R4681832
Strontium (Sr)-Total	0.0273		0.00020	mg/L		21-JUN-19	R4681832
Sulfur (S)-Total	0.69		0.50	mg/L		21-JUN-19	R4681832
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Thallium (Tl)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Titanium (Ti)-Total	0.00102		0.00030	mg/L		21-JUN-19	R4681832
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Uranium (U)-Total	0.000045		0.000010	mg/L		21-JUN-19	R4681832
Vanadium (V)-Total	0.00078		0.00050	mg/L		21-JUN-19	R4681832
Zinc (Zn)-Total	<0.0030		0.0030	mg/L		21-JUN-19	R4681832
Zirconium (Zr)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					20-JUN-19	R4679271
Aluminum (Al)-Dissolved	0.0448		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Arsenic (As)-Dissolved	0.00020		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Barium (Ba)-Dissolved	0.0168		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-2 NCR2-NORTH CURRENT RIVER - SITE #2 Sampled By: Client on 12-JUN-19 @ 13:25 Matrix: Grab							
Dissolved Metals							
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Boron (B)-Dissolved	<0.010		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cadmium (Cd)-Dissolved	<0.0000050		0.0000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Calcium (Ca)-Dissolved	7.79		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Cesium (Cs)-Dissolved	0.000012		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Chromium (Cr)-Dissolved	0.00030		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Copper (Cu)-Dissolved	0.00100		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Iron (Fe)-Dissolved	0.202		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Lithium (Li)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Magnesium (Mg)-Dissolved	2.32		0.0050	mg/L	20-JUN-19	21-JUN-19	R4679848
Manganese (Mn)-Dissolved	0.00815		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Molybdenum (Mo)-Dissolved	0.000102		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Nickel (Ni)-Dissolved	0.00053		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Potassium (K)-Dissolved	0.525		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Rubidium (Rb)-Dissolved	0.00132		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Selenium (Se)-Dissolved	0.000053		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silicon (Si)-Dissolved	2.11		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Sodium (Na)-Dissolved	5.34		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Strontium (Sr)-Dissolved	0.0256		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Sulfur (S)-Dissolved	0.68		0.50	mg/L	20-JUN-19	21-JUN-19	R4679848
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Titanium (Ti)-Dissolved	0.00046		0.00030	mg/L	20-JUN-19	21-JUN-19	R4679848
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Uranium (U)-Dissolved	0.000040		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Vanadium (V)-Dissolved	<0.00050		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Zirconium (Zr)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
L2290713-3 NCR3-NORTH CURRENT RIVER - SITE #3 Sampled By: Client on 12-JUN-19 @ 12:40 Matrix: Grab							
Physical Tests							
Conductivity (EC)	79.0		1.0	uS/cm		15-JUN-19	R4671060
Hardness (as CaCO3)	21.7		0.50			17-JUN-19	
pH	6.91		0.10	pH		15-JUN-19	R4671060
Total Dissolved Solids	71		10	mg/L		19-JUN-19	R4678107

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-3 NCR3-NORTH CURRENT RIVER - SITE #3 Sampled By: Client on 12-JUN-19 @ 12:40 Matrix: Grab							
Physical Tests							
Turbidity	1.30		0.10	NTU		13-JUN-19	R4668286
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	14.7		2.0	mg/L		15-JUN-19	R4671060
Ammonia, Total (as N)	0.017		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	11.3		0.10	mg/L		15-JUN-19	R4671603
Nitrate (as N)	<0.020		0.020	mg/L		15-JUN-19	R4671603
Nitrite (as N)	<0.010		0.010	mg/L		15-JUN-19	R4671603
Total Kjeldahl Nitrogen	0.51		0.15	mg/L	24-JUN-19	25-JUN-19	R4684508
Phosphorus (P)-Total	0.0155		0.0030	mg/L	20-JUN-19	21-JUN-19	R4681361
Sulfate (SO4)	1.60		0.30	mg/L		15-JUN-19	R4671603
Bacteriological Tests							
Escherichia Coli	27		0	MPN/100mL		13-JUN-19	R4670031
Total Coliforms	727		0	MPN/100mL		13-JUN-19	R4670031
Total Metals							
Aluminum (Al)-Total	0.103		0.0030	mg/L		21-JUN-19	R4681832
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Arsenic (As)-Total	0.00026		0.00010	mg/L		21-JUN-19	R4681832
Barium (Ba)-Total	0.0222		0.00010	mg/L		21-JUN-19	R4681832
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4681832
Boron (B)-Total	<0.010		0.010	mg/L		21-JUN-19	R4681832
Cadmium (Cd)-Total	0.0000057		0.0000050	mg/L		21-JUN-19	R4681832
Calcium (Ca)-Total	5.64		0.050	mg/L		21-JUN-19	R4681832
Cesium (Cs)-Total	0.000018		0.000010	mg/L		21-JUN-19	R4681832
Chromium (Cr)-Total	0.00060		0.00010	mg/L		21-JUN-19	R4681832
Cobalt (Co)-Total	0.00029		0.00010	mg/L		21-JUN-19	R4681832
Copper (Cu)-Total	0.00121		0.00050	mg/L		21-JUN-19	R4681832
Iron (Fe)-Total	0.543		0.010	mg/L		21-JUN-19	R4681832
Lead (Pb)-Total	0.000088		0.000050	mg/L		21-JUN-19	R4681832
Lithium (Li)-Total	<0.0010		0.0010	mg/L		21-JUN-19	R4681832
Magnesium (Mg)-Total	2.02		0.0050	mg/L		21-JUN-19	R4681832
Manganese (Mn)-Total	0.0849		0.00010	mg/L		21-JUN-19	R4681832
Molybdenum (Mo)-Total	0.000099		0.000050	mg/L		21-JUN-19	R4681832
Nickel (Ni)-Total	0.00078		0.00050	mg/L		21-JUN-19	R4681832
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4681832
Potassium (K)-Total	0.582		0.050	mg/L		21-JUN-19	R4681832
Rubidium (Rb)-Total	0.00159		0.00020	mg/L		21-JUN-19	R4681832
Selenium (Se)-Total	0.000063		0.000050	mg/L		21-JUN-19	R4681832
Silicon (Si)-Total	1.54		0.10	mg/L		21-JUN-19	R4681832
Silver (Ag)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Sodium (Na)-Total	6.95		0.050	mg/L		21-JUN-19	R4681832
Strontium (Sr)-Total	0.0364		0.00020	mg/L		21-JUN-19	R4681832

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-3 NCR3-NORTH CURRENT RIVER - SITE #3 Sampled By: Client on 12-JUN-19 @ 12:40 Matrix: Grab							
Total Metals							
Sulfur (S)-Total	0.78		0.50	mg/L		21-JUN-19	R4681832
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Thallium (Tl)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Titanium (Ti)-Total	0.00139		0.00030	mg/L		21-JUN-19	R4681832
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Uranium (U)-Total	0.000046		0.000010	mg/L		21-JUN-19	R4681832
Vanadium (V)-Total	0.00093		0.00050	mg/L		21-JUN-19	R4681832
Zinc (Zn)-Total	0.0037		0.0030	mg/L		21-JUN-19	R4681832
Zirconium (Zr)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					20-JUN-19	R4679271
Aluminum (Al)-Dissolved	0.0754		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Arsenic (As)-Dissolved	0.00022		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Barium (Ba)-Dissolved	0.0216		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Boron (B)-Dissolved	<0.010		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cadmium (Cd)-Dissolved	0.0000061		0.0000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Calcium (Ca)-Dissolved	5.69		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Cesium (Cs)-Dissolved	0.000018		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Chromium (Cr)-Dissolved	0.00049		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Copper (Cu)-Dissolved	0.00111		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Iron (Fe)-Dissolved	0.292		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Lithium (Li)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Magnesium (Mg)-Dissolved	1.83		0.0050	mg/L	20-JUN-19	21-JUN-19	R4679848
Manganese (Mn)-Dissolved	0.0324		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Molybdenum (Mo)-Dissolved	0.000082		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Nickel (Ni)-Dissolved	0.00077		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Potassium (K)-Dissolved	0.547		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Rubidium (Rb)-Dissolved	0.00153		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Selenium (Se)-Dissolved	0.000096		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silicon (Si)-Dissolved	1.57		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Sodium (Na)-Dissolved	7.05		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Strontium (Sr)-Dissolved	0.0330		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-3 NCR3-NORTH CURRENT RIVER - SITE #3 Sampled By: Client on 12-JUN-19 @ 12:40 Matrix: Grab							
Dissolved Metals							
Sulfur (S)-Dissolved	0.72		0.50	mg/L	20-JUN-19	21-JUN-19	R4679848
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Titanium (Ti)-Dissolved	0.00081		0.00030	mg/L	20-JUN-19	21-JUN-19	R4679848
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Uranium (U)-Dissolved	0.000040		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Vanadium (V)-Dissolved	0.00053		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Zinc (Zn)-Dissolved	0.0023		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Zirconium (Zr)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
L2290713-4 NCR4-NORTH CURRENT RIVER - SITE #4 Sampled By: Client on 12-JUN-19 @ 11:00 Matrix: Grab							
Physical Tests							
Conductivity (EC)	30.8		1.0	uS/cm		15-JUN-19	R4671060
Hardness (as CaCO3)	14.2		0.50	mg/L		26-JUN-19	
pH	6.87		0.10	pH		15-JUN-19	R4671060
Total Dissolved Solids	46		10	mg/L		19-JUN-19	R4678107
Turbidity	1.09		0.10	NTU		13-JUN-19	R4668286
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	10.8		2.0	mg/L		15-JUN-19	R4671060
Ammonia, Total (as N)	0.064		0.010	mg/L		19-JUN-19	R4678331
Chloride (Cl)	0.35		0.10	mg/L		18-JUN-19	R4673567
Nitrate (as N)	0.033		0.020	mg/L		18-JUN-19	R4673567
Nitrite (as N)	<0.010		0.010	mg/L		15-JUN-19	R4671603
Total Kjeldahl Nitrogen	0.59		0.15	mg/L	24-JUN-19	25-JUN-19	R4684508
Phosphorus (P)-Total	0.0116		0.0030	mg/L	20-JUN-19	21-JUN-19	R4681361
Sulfate (SO4)	1.37		0.30	mg/L		15-JUN-19	R4671603
Bacteriological Tests							
Escherichia Coli	10		0	MPN/100mL		13-JUN-19	R4670031
Total Coliforms	365		0	MPN/100mL		13-JUN-19	R4670031
Total Metals							
Aluminum (Al)-Total	0.0650		0.0030	mg/L		21-JUN-19	R4681832
Antimony (Sb)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Arsenic (As)-Total	0.00025		0.00010	mg/L		21-JUN-19	R4681832
Barium (Ba)-Total	0.0110		0.00010	mg/L		21-JUN-19	R4681832
Beryllium (Be)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4681832
Boron (B)-Total	<0.010		0.010	mg/L		21-JUN-19	R4681832
Cadmium (Cd)-Total	<0.0000050		0.0000050	mg/L		21-JUN-19	R4681832
Calcium (Ca)-Total	3.57		0.050	mg/L		21-JUN-19	R4681832

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-4 NCR4-NORTH CURRENT RIVER - SITE #4 Sampled By: Client on 12-JUN-19 @ 11:00 Matrix: Grab							
Total Metals							
Cesium (Cs)-Total	0.000012		0.000010	mg/L		21-JUN-19	R4681832
Chromium (Cr)-Total	0.00029		0.00010	mg/L		21-JUN-19	R4681832
Cobalt (Co)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Copper (Cu)-Total	0.00079		0.00050	mg/L		21-JUN-19	R4681832
Iron (Fe)-Total	0.127		0.010	mg/L		21-JUN-19	R4681832
Lead (Pb)-Total	0.000053		0.000050	mg/L		21-JUN-19	R4681832
Lithium (Li)-Total	<0.0010		0.0010	mg/L		21-JUN-19	R4681832
Magnesium (Mg)-Total	1.34		0.0050	mg/L		21-JUN-19	R4681832
Manganese (Mn)-Total	0.0121		0.00010	mg/L		21-JUN-19	R4681832
Molybdenum (Mo)-Total	<0.000050		0.000050	mg/L		21-JUN-19	R4681832
Nickel (Ni)-Total	<0.00050		0.00050	mg/L		21-JUN-19	R4681832
Phosphorus (P)-Total	<0.050		0.050	mg/L		21-JUN-19	R4681832
Potassium (K)-Total	0.329		0.050	mg/L		21-JUN-19	R4681832
Rubidium (Rb)-Total	0.00100		0.00020	mg/L		21-JUN-19	R4681832
Selenium (Se)-Total	0.000069		0.000050	mg/L		21-JUN-19	R4681832
Silicon (Si)-Total	1.99		0.10	mg/L		21-JUN-19	R4681832
Silver (Ag)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Sodium (Na)-Total	0.783		0.050	mg/L		21-JUN-19	R4681832
Strontium (Sr)-Total	0.0105		0.00020	mg/L		21-JUN-19	R4681832
Sulfur (S)-Total	0.55		0.50	mg/L		21-JUN-19	R4681832
Tellurium (Te)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Thallium (Tl)-Total	<0.000010		0.000010	mg/L		21-JUN-19	R4681832
Thorium (Th)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Tin (Sn)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Titanium (Ti)-Total	0.00031		0.00030	mg/L		21-JUN-19	R4681832
Tungsten (W)-Total	<0.00010		0.00010	mg/L		21-JUN-19	R4681832
Uranium (U)-Total	0.000054		0.000010	mg/L		21-JUN-19	R4681832
Vanadium (V)-Total	<0.00050		0.00050	mg/L		21-JUN-19	R4681832
Zinc (Zn)-Total	<0.0030		0.0030	mg/L		21-JUN-19	R4681832
Zirconium (Zr)-Total	<0.00020		0.00020	mg/L		21-JUN-19	R4681832
Dissolved Metals							
Dissolved Metals Filtration Location	LAB					20-JUN-19	R4679271
Aluminum (Al)-Dissolved	0.0741		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Arsenic (As)-Dissolved	0.00024		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Barium (Ba)-Dissolved	0.0105		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Boron (B)-Dissolved	<0.010		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cadmium (Cd)-Dissolved	0.0000063		0.0000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Calcium (Ca)-Dissolved	3.59		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2290713-4 NCR4-NORTH CURRENT RIVER - SITE #4 Sampled By: Client on 12-JUN-19 @ 11:00 Matrix: Grab							
Dissolved Metals							
Cesium (Cs)-Dissolved	0.000011		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Chromium (Cr)-Dissolved	0.00031		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Copper (Cu)-Dissolved	0.00086		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Iron (Fe)-Dissolved	0.130		0.010	mg/L	20-JUN-19	21-JUN-19	R4679848
Lead (Pb)-Dissolved	0.000095		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Lithium (Li)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Magnesium (Mg)-Dissolved	1.26		0.0050	mg/L	20-JUN-19	21-JUN-19	R4679848
Manganese (Mn)-Dissolved	0.0157		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Molybdenum (Mo)-Dissolved	<0.000050		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Nickel (Ni)-Dissolved	<0.00050		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Potassium (K)-Dissolved	0.310		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Rubidium (Rb)-Dissolved	0.00095		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Selenium (Se)-Dissolved	0.000073		0.000050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silicon (Si)-Dissolved	1.90		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Silver (Ag)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Sodium (Na)-Dissolved	0.772		0.050	mg/L	20-JUN-19	21-JUN-19	R4679848
Strontium (Sr)-Dissolved	0.00997		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Sulfur (S)-Dissolved	<0.50		0.50	mg/L	20-JUN-19	21-JUN-19	R4679848
Tellurium (Te)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Thorium (Th)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Titanium (Ti)-Dissolved	0.00064		0.00030	mg/L	20-JUN-19	21-JUN-19	R4679848
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	20-JUN-19	21-JUN-19	R4679848
Uranium (U)-Dissolved	0.000056		0.000010	mg/L	20-JUN-19	21-JUN-19	R4679848
Vanadium (V)-Dissolved	<0.00050		0.00050	mg/L	20-JUN-19	21-JUN-19	R4679848
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L	20-JUN-19	21-JUN-19	R4679848
Zirconium (Zr)-Dissolved	<0.00020		0.00020	mg/L	20-JUN-19	21-JUN-19	R4679848

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Escherichia Coli	DUP-H	L2290713-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2290713-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2290713-1, -2, -3, -4

Sample Parameter Qualifier key listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
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-TITR-TB	Water	Alkalinity	APHA 2320B modified

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CL-L-IC-N-TB	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-TITR-TB	Water	Conductivity	APHA 2510 B

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-TB	Water	Hardness (as CaCO3)	CALCULATION
MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020A (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-COL-WP	Water	Ammonia by colour	APHA 4500 NH3 F

Ammonia in water samples forms indophenol when reacted with hypochlorite and phenol. The intensity is amplified by the addition of sodium nitroprusside and measured colourmetrically.

NO2-IC-N-TB	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-N-TB	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-COL-TB	Water	Total Phosphorus by Discrete Analyzer	APHA 4500-P B, F, G (modified)

Phosphorus in aqueous matrices is analyzed using discrete Analyzer with colourimetric detection.

PH-TITR-TB	Water	pH	APHA 4500-H

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

SO4-IC-N-TB	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TC,EC-QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture of hydrolyzable substrates and then sealed in a multi-well packet. The packet is

Reference Information

incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

TDS-TB Water Total Dissolved Solids APHA 2540 C (modified)
Aqueous matrices are analyzed using gravimetry and evaporation

TKN-COL-TB Water Total Kjeldahl Nitrogen APHA 4500-Norg (modified)
Total Kjeldahl Nitrogen in aqueous matrices is analyzed using a discrete analyzer with colourimetric detection.

TURBIDITY-TB Water Turbidity APHA 2130 B-Nephelometer
Aqueous matrices are analyzed using nephelometry with the light scatter measured at a 90" angle.

** 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
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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 weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

Quality Control Report

Workorder: L2290713 Report Date: 26-JUN-19

Client: LAKEHEAD REGION CONSERVATION AUTHORITY-TB
130 Conservation Road P.O. Box 10427
Thunder Bay ON P7B 6T8
Contact: Scott Drebit

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-TB	**Water**							
Batch R4671060								
WG3078372-11 LCS								
Alkalinity, Total (as CaCO3)			96.9		%		85-115	15-JUN-19
WG3078372-8 LCS								
Alkalinity, Total (as CaCO3)			96.5		%		85-115	15-JUN-19
WG3078372-10 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	15-JUN-19
WG3078372-7 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	15-JUN-19
CL-L-IC-N-TB	**Water**							
Batch R4671603								
WG3077848-14 LCS								
Chloride (Cl)			100.7		%		90-110	15-JUN-19
WG3077848-13 MB								
Chloride (Cl)			<0.10		mg/L		0.1	15-JUN-19
Batch R4673567								
WG3077848-16 DUP		**L2290713-4**						
Chloride (Cl)		0.35	0.33		mg/L	4.9	20	18-JUN-19
WG3080435-6 LCS								
Chloride (Cl)			93.9		%		90-110	18-JUN-19
WG3080435-5 MB								
Chloride (Cl)			<0.10		mg/L		0.1	18-JUN-19
EC-TITR-TB	**Water**							
Batch R4671060								
WG3078372-11 LCS								
Conductivity (EC)			98.4		%		90-110	15-JUN-19
WG3078372-8 LCS								
Conductivity (EC)			97.8		%		90-110	15-JUN-19
WG3078372-10 MB								
Conductivity (EC)			<1.0		uS/cm		1	15-JUN-19
WG3078372-7 MB								
Conductivity (EC)			<1.0		uS/cm		1	15-JUN-19
MET-D-CCMS-VA	**Water**							
Batch R4679848								
WG3083480-2 LCS								
Aluminum (Al)-Dissolved			106.6		%		80-120	21-JUN-19
Antimony (Sb)-Dissolved			98.8		%		80-120	21-JUN-19
Arsenic (As)-Dissolved			97.9		%		80-120	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch	**R4679848**							
WG3083480-2	**LCS**							
Barium (Ba)-Dissolved			94.4		%		80-120	21-JUN-19
Beryllium (Be)-Dissolved			98.9		%		80-120	21-JUN-19
Bismuth (Bi)-Dissolved			102.3		%		80-120	21-JUN-19
Boron (B)-Dissolved			101.3		%		80-120	21-JUN-19
Cadmium (Cd)-Dissolved			100.3		%		80-120	21-JUN-19
Calcium (Ca)-Dissolved			99.3		%		80-120	21-JUN-19
Cesium (Cs)-Dissolved			97.4		%		80-120	21-JUN-19
Chromium (Cr)-Dissolved			95.9		%		80-120	21-JUN-19
Cobalt (Co)-Dissolved			101.1		%		80-120	21-JUN-19
Copper (Cu)-Dissolved			98.0		%		80-120	21-JUN-19
Iron (Fe)-Dissolved			97.3		%		80-120	21-JUN-19
Lead (Pb)-Dissolved			99.3		%		80-120	21-JUN-19
Lithium (Li)-Dissolved			100.0		%		80-120	21-JUN-19
Magnesium (Mg)-Dissolved			101.0		%		80-120	21-JUN-19
Manganese (Mn)-Dissolved			101.7		%		80-120	21-JUN-19
Molybdenum (Mo)-Dissolved			97.4		%		80-120	21-JUN-19
Nickel (Ni)-Dissolved			98.5		%		80-120	21-JUN-19
Phosphorus (P)-Dissolved			93.3		%		70-130	21-JUN-19
Potassium (K)-Dissolved			99.2		%		80-120	21-JUN-19
Rubidium (Rb)-Dissolved			102.8		%		80-120	21-JUN-19
Selenium (Se)-Dissolved			97.3		%		80-120	21-JUN-19
Silicon (Si)-Dissolved			102.2		%		60-140	21-JUN-19
Silver (Ag)-Dissolved			95.2		%		80-120	21-JUN-19
Sodium (Na)-Dissolved			101.0		%		80-120	21-JUN-19
Strontium (Sr)-Dissolved			98.7		%		80-120	21-JUN-19
Sulfur (S)-Dissolved			84.4		%		80-120	21-JUN-19
Tellurium (Te)-Dissolved			99.1		%		80-120	21-JUN-19
Thallium (Tl)-Dissolved			99.8		%		80-120	21-JUN-19
Thorium (Th)-Dissolved			98.4		%		80-120	21-JUN-19
Tin (Sn)-Dissolved			95.5		%		80-120	21-JUN-19
Titanium (Ti)-Dissolved			89.6		%		80-120	21-JUN-19
Tungsten (W)-Dissolved			100.9		%		80-120	21-JUN-19
Uranium (U)-Dissolved			100.9		%		80-120	21-JUN-19
Vanadium (V)-Dissolved			100.7		%		80-120	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4679848								
WG3083480-2 LCS								
Zinc (Zn)-Dissolved			97.0		%		80-120	21-JUN-19
Zirconium (Zr)-Dissolved			96.2		%		80-120	21-JUN-19
WG3083480-1 MB		**LF**						
Aluminum (Al)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Beryllium (Be)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Boron (B)-Dissolved			<0.010		mg/L		0.01	21-JUN-19
Cadmium (Cd)-Dissolved			<0.000005C		mg/L		0.000005	21-JUN-19
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Cesium (Cs)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	21-JUN-19
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Lithium (Li)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	21-JUN-19
Manganese (Mn)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	21-JUN-19
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Potassium (K)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Rubidium (Rb)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	21-JUN-19
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	21-JUN-19
Strontium (Sr)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	21-JUN-19
Tellurium (Te)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R4679848								
WG3083480-1 MB		**LF**						
Thorium (Th)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	21-JUN-19
Tungsten (W)-Dissolved			<0.00010		mg/L		0.0001	21-JUN-19
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	21-JUN-19
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	21-JUN-19
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	21-JUN-19
Zirconium (Zr)-Dissolved			<0.00020		mg/L		0.0002	21-JUN-19
MET-T-CCMS-VA	**Water**							
Batch R4681832								
WG3083497-2 LCS								
Aluminum (Al)-Total			103.7		%		80-120	21-JUN-19
Antimony (Sb)-Total			106.7		%		80-120	21-JUN-19
Arsenic (As)-Total			97.5		%		80-120	21-JUN-19
Barium (Ba)-Total			102.2		%		80-120	21-JUN-19
Beryllium (Be)-Total			92.8		%		80-120	21-JUN-19
Bismuth (Bi)-Total			98.0		%		80-120	21-JUN-19
Boron (B)-Total			95.5		%		80-120	21-JUN-19
Cadmium (Cd)-Total			99.1		%		80-120	21-JUN-19
Calcium (Ca)-Total			92.9		%		80-120	21-JUN-19
Cesium (Cs)-Total			102.6		%		80-120	21-JUN-19
Chromium (Cr)-Total			99.6		%		80-120	21-JUN-19
Cobalt (Co)-Total			99.7		%		80-120	21-JUN-19
Copper (Cu)-Total			97.1		%		80-120	21-JUN-19
Iron (Fe)-Total			96.3		%		80-120	21-JUN-19
Lead (Pb)-Total			98.2		%		80-120	21-JUN-19
Lithium (Li)-Total			93.6		%		80-120	21-JUN-19
Magnesium (Mg)-Total			103.3		%		80-120	21-JUN-19
Manganese (Mn)-Total			103.7		%		80-120	21-JUN-19
Molybdenum (Mo)-Total			103.1		%		80-120	21-JUN-19
Nickel (Ni)-Total			99.5		%		80-120	21-JUN-19
Phosphorus (P)-Total			106.6		%		80-120	21-JUN-19
Potassium (K)-Total			101.9		%		80-120	21-JUN-19
Rubidium (Rb)-Total			95.3		%		80-120	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4681832								
WG3083497-2 LCS								
Selenium (Se)-Total			96.0		%		80-120	21-JUN-19
Silicon (Si)-Total			106.7		%		80-120	21-JUN-19
Silver (Ag)-Total			98.8		%		80-120	21-JUN-19
Sodium (Na)-Total			105.5		%		80-120	21-JUN-19
Strontium (Sr)-Total			104.1		%		80-120	21-JUN-19
Sulfur (S)-Total			113.6		%		80-120	21-JUN-19
Tellurium (Te)-Total			107.4		%		80-120	21-JUN-19
Thallium (Tl)-Total			93.5		%		80-120	21-JUN-19
Thorium (Th)-Total			94.2		%		80-120	21-JUN-19
Tin (Sn)-Total			100.9		%		80-120	21-JUN-19
Titanium (Ti)-Total			98.4		%		80-120	21-JUN-19
Tungsten (W)-Total			99.4		%		80-120	21-JUN-19
Uranium (U)-Total			102.1		%		80-120	21-JUN-19
Vanadium (V)-Total			101.2		%		80-120	21-JUN-19
Zinc (Zn)-Total			97.6		%		80-120	21-JUN-19
Zirconium (Zr)-Total			101.2		%		80-120	21-JUN-19
WG3083497-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	21-JUN-19
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Arsenic (As)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Barium (Ba)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Boron (B)-Total			<0.010		mg/L		0.01	21-JUN-19
Cadmium (Cd)-Total			<0.000005(		mg/L		0.000005	21-JUN-19
Calcium (Ca)-Total			<0.050		mg/L		0.05	21-JUN-19
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	21-JUN-19
Iron (Fe)-Total			<0.010		mg/L		0.01	21-JUN-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Lithium (Li)-Total			<0.0010		mg/L		0.001	21-JUN-19
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	21-JUN-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R4681832								
WG3083497-1 MB								
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	21-JUN-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	21-JUN-19
Potassium (K)-Total			<0.050		mg/L		0.05	21-JUN-19
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	21-JUN-19
Selenium (Se)-Total			<0.000050		mg/L		0.00005	21-JUN-19
Silicon (Si)-Total			<0.10		mg/L		0.1	21-JUN-19
Silver (Ag)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Sodium (Na)-Total			<0.050		mg/L		0.05	21-JUN-19
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	21-JUN-19
Sulfur (S)-Total			<0.50		mg/L		0.5	21-JUN-19
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	21-JUN-19
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Thorium (Th)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Tin (Sn)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	21-JUN-19
Tungsten (W)-Total			<0.00010		mg/L		0.0001	21-JUN-19
Uranium (U)-Total			<0.000010		mg/L		0.00001	21-JUN-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	21-JUN-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	21-JUN-19
Zirconium (Zr)-Total			<0.00020		mg/L		0.0002	21-JUN-19
NH3-COL-WP	**Water**							
Batch R4678331								
WG3083227-18 LCS								
Ammonia, Total (as N)			101.1		%		85-115	19-JUN-19
WG3083227-17 MB								
Ammonia, Total (as N)			<0.010		mg/L		0.01	19-JUN-19
NO2-IC-N-TB	**Water**							
Batch R4671603								
WG3077848-16 DUP		**L2290713-4**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	20	15-JUN-19
WG3077848-14 LCS								
Nitrite (as N)			99.6		%		90-110	15-JUN-19
WG3077848-13 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO2-IC-N-TB	**Water**							
Batch R4671603								
WG3077848-13 MB								
Nitrite (as N)			<0.010		mg/L		0.01	15-JUN-19
NO3-IC-N-TB	**Water**							
Batch R4671603								
WG3077848-14 LCS								
Nitrate (as N)			99.7		%		90-110	15-JUN-19
WG3077848-13 MB								
Nitrate (as N)			<0.020		mg/L		0.02	15-JUN-19
Batch R4673567								
WG3077848-16 DUP		**L2290713-4**						
Nitrate (as N)		0.033	0.028		mg/L	15	20	18-JUN-19
WG3080435-6 LCS								
Nitrate (as N)			92.6		%		90-110	18-JUN-19
WG3080435-5 MB								
Nitrate (as N)			<0.020		mg/L		0.02	18-JUN-19
P-T-COL-TB	**Water**							
Batch R4681361								
WG3083071-3 DUP		**L2290713-1**						
Phosphorus (P)-Total		0.0086	0.0085		mg/L	1.2	20	21-JUN-19
WG3083071-2 LCS								
Phosphorus (P)-Total			99.6		%		80-120	21-JUN-19
WG3083071-1 MB								
Phosphorus (P)-Total			<0.0030		mg/L		0.003	21-JUN-19
WG3083071-4 MS		**L2290713-2**						
Phosphorus (P)-Total			108.8		%		70-130	21-JUN-19
PH-TITR-TB	**Water**							
Batch R4671060								
WG3078372-11 LCS								
pH			6.93		pH		6.9-7.1	15-JUN-19
WG3078372-8 LCS								
pH			6.94		pH		6.9-7.1	15-JUN-19
SO4-IC-N-TB	**Water**							
Batch R4671603								
WG3077848-16 DUP		**L2290713-4**						
Sulfate (SO4)		1.37	0.86	J	mg/L	0.52	0.6	15-JUN-19
WG3077848-14 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
SO4-IC-N-TB	**Water**							
Batch R4671603								
WG3077848-14 LCS								
Sulfate (SO4)			101.7		%		90-110	15-JUN-19
WG3077848-13 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	15-JUN-19
TC,EC-QT97-TB	**Water**							
Batch R4670031								
WG3076625-2 DUP		**L2290713-4**						
Total Coliforms		365	308		MPN/100mL	17	65	13-JUN-19
Escherichia Coli		10	3	DUP-H	MPN/100mL	108	65	13-JUN-19
WG3076625-1 MB								
Total Coliforms			0		MPN/100mL		1	13-JUN-19
Escherichia Coli			0		MPN/100mL		1	13-JUN-19
TDS-TB	**Water**							
Batch R4678107								
WG3081347-2 LCS								
Total Dissolved Solids			95.8		%		85-115	19-JUN-19
WG3081347-1 MB								
Total Dissolved Solids			<10		mg/L		10	19-JUN-19
TKN-COL-TB	**Water**							
Batch R4684508								
WG3084491-2 LCS								
Total Kjeldahl Nitrogen			109.5		%		75-125	25-JUN-19
WG3084491-1 MB								
Total Kjeldahl Nitrogen			<0.15		mg/L		0.15	25-JUN-19
TURBIDITY-TB	**Water**							
Batch R4668286								
WG3076181-3 DUP		**L2290713-3**						
Turbidity		1.30	1.37		NTU	5.3	15	13-JUN-19
WG3076181-2 LCS								
Turbidity			99.0		%		85-115	13-JUN-19
WG3076181-1 MB								
Turbidity			<0.10		NTU		0.1	13-JUN-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2290713-COFC

COC Number: 14 - SF

Page 1 of 1

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Lakehead Region Conservation Authority	Select Report Format:	PDF EXCEL EDD (DIGITAL)	R Regular (Standard TAT if received by 3 pm - business days)
Contact:	Scott Drebit	Quality Control (QC) Report with Report	Yes No	P Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	130 Conservation Road	Criteria on Report - provide details below if box checked		E Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	807-344-5857	Select Distribution:	EMAIL MAIL FAX	E2 Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax	~~tammy@lakeheadca.com~~	Specify Date Required for E2,E or P:
		Email 2	scott@lakeheadca.com	

Invoice To		Invoice Distribution	
	Same as Report To: Yes No	Select Invoice Distribution:	EMAIL MAIL FAX
	Copy of Invoice with Report: Yes No	Email 1 or Fax	
Company:		Email 2	
Contact:			

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q74345	Approver ID:	Cost Center:
Job #:	~~Jarvis River~~ North Current River	GL Account:	Routing Code:
PO / AFE:	275	Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): L2290713 | ALS Contact: | Sampler:

Analysis Request — indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Alkalinity, Conductivity, pH	Chloride, Nitrate, Nitrite, Sulphate	TDS, Turbidity	NH_3, TKN, TP	Metals, Total & Hardness	TTC/EC	Number of Containers
	NCR1-North Current River - Site #1	12-06-19	14:10	Grab	X	X	X	X	X	X	6
	NCR2-North Current River- Site #2	12-06-19	13:25	Grab	X	X	X	X	X	X	6
	NCR3-North Current River- Site #3	12-06-19	12:40	Grab	X	X	X	X	X	X	6
	NCR4-North Current River- Site #4	12-06-19	11:00	Grab	X	X	X	X	X	X	6

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? Yes No	
Are samples for human drinking water use? Yes No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen		SIF Observations	Yes	No	✓
Ice packs	Yes No	Custody seal intact	Yes	No	
Cooling Initiated					

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
8.9					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received By	Date	Time	Received by:	Date:	Time:
Lydia Johnson	June 13/19		SD	June 13/19	10:49am			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-00264 v09 Front/04 January 2014

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.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

SD

LAKEHEAD REGION CONSERVATION AUTHORITY-TB
ATTN: Scott Drebit
130 Conservation Road
P.O. Box 10427
Thunder Bay ON P7B 6T8

Date Received: 10-JUL-19
Report Date: 16-JUL-19 12:09 (MT)
Version: FINAL

Client Phone: 807-344-5857

Certificate of Analysis

Lab Work Order #: L2306864

Project P.O. #: 275
Job Reference: NORTH CURRENT RIVER
C of C Numbers:
Legal Site Desc:

Christina Shepherd
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2306864-1 NCR #1 - NORTH CURRENT RIVER - SITE #1 Sampled By: Client on 09-JUL-19 @ 13:45 Matrix: Grab							
Physical Tests							
Conductivity (EC)	134		1.0	uS/cm		10-JUL-19	R4707016
Hardness (as CaCO3)	56.1		0.50	mg/L		12-JUL-19	
pH	7.35		0.10	pH		10-JUL-19	R4707016
Total Dissolved Solids	88		13	mg/L		10-JUL-19	R4707916
Turbidity	0.83		0.10	NTU		10-JUL-19	R4705208
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	47.2		2.0	mg/L		10-JUL-19	R4707016
Ammonia, Total (as N)	<0.020		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	10.8		0.10	mg/L		10-JUL-19	R4706649
Nitrate (as N)	0.040		0.020	mg/L		10-JUL-19	R4706649
Nitrite (as N)	<0.010		0.010	mg/L		10-JUL-19	R4706649
Total Kjeldahl Nitrogen	0.29		0.15	mg/L	12-JUL-19	14-JUL-19	R4712321
Phosphorus (P)-Total	0.0086		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708676
Sulfate (SO4)	2.19		0.30	mg/L		10-JUL-19	R4706649
Bacteriological Tests							
Escherichia Coli	6		0	MPN/100mL		10-JUL-19	R4707877
Total Coliforms	921		0	MPN/100mL		10-JUL-19	R4707877
Total Metals							
Aluminum (Al)-Total	0.0320		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Antimony (Sb)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Arsenic (As)-Total	0.00031		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Barium (Ba)-Total	0.0200		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Beryllium (Be)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Boron (B)-Total	<0.010		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cadmium (Cd)-Total	0.0000064		0.0000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Calcium (Ca)-Total	14.3		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Cesium (Cs)-Total	0.000017		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Chromium (Cr)-Total	0.00027		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cobalt (Co)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Copper (Cu)-Total	0.00099		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Iron (Fe)-Total	0.348		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Lead (Pb)-Total	<0.000050		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Lithium (Li)-Total	0.0012		0.0010	mg/L	11-JUL-19	11-JUL-19	R4708812
Magnesium (Mg)-Total	4.33		0.0050	mg/L	11-JUL-19	11-JUL-19	R4708812
Manganese (Mn)-Total	0.0339		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Molybdenum (Mo)-Total	0.000193		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Nickel (Ni)-Total	0.00053		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Phosphorus (P)-Total	<0.050		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Potassium (K)-Total	0.636		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Rubidium (Rb)-Total	0.00176		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Selenium (Se)-Total	0.000101		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2306864-1 NCR #1 - NORTH CURRENT RIVER - SITE #1 Sampled By: Client on 09-JUL-19 @ 13:45 Matrix: Grab							
Total Metals							
Silicon (Si)-Total	2.61		0.10	mg/L	11-JUL-19	11-JUL-19	R4708812
Silver (Ag)-Total	<0.000010		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Sodium (Na)-Total	6.86		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Strontium (Sr)-Total	0.0384		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Sulfur (S)-Total	0.57		0.50	mg/L	11-JUL-19	11-JUL-19	R4708812
Tellurium (Te)-Total	<0.00020		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Thallium (Tl)-Total	0.000023		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Thorium (Th)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Tin (Sn)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Titanium (Ti)-Total	0.00062		0.00030	mg/L	11-JUL-19	11-JUL-19	R4708812
Tungsten (W)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Uranium (U)-Total	0.000053		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Vanadium (V)-Total	0.00067		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Zinc (Zn)-Total	<0.0030		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Zirconium (Zr)-Total	<0.000060		0.000060	mg/L	11-JUL-19	11-JUL-19	R4708812
Dissolved Metals							
Calcium (Ca)-Dissolved	14.9		0.050	mg/L	10-JUL-19	11-JUL-19	R4708951
Magnesium (Mg)-Dissolved	4.59		0.0050	mg/L	10-JUL-19	11-JUL-19	R4708951
L2306864-2 NCR #2 - NORTH CURRENT RIVER - SITE #2 Sampled By: Client on 09-JUL-19 @ 13:00 Matrix: Grab							
Physical Tests							
Conductivity (EC)	120		1.0	uS/cm		10-JUL-19	R4707016
Hardness (as CaCO3)	45.4		0.50	mg/L		12-JUL-19	
pH	7.20		0.10	pH		10-JUL-19	R4707016
Total Dissolved Solids	90		13	mg/L		10-JUL-19	R4707916
Turbidity	0.89		0.10	NTU		10-JUL-19	R4705208
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	38.9		2.0	mg/L		10-JUL-19	R4707016
Ammonia, Total (as N)	<0.020		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	11.4		0.10	mg/L		10-JUL-19	R4706649
Nitrate (as N)	0.055		0.020	mg/L		10-JUL-19	R4706649
Nitrite (as N)	<0.010		0.010	mg/L		10-JUL-19	R4706649
Total Kjeldahl Nitrogen	0.44		0.15	mg/L	12-JUL-19	14-JUL-19	R4712321
Phosphorus (P)-Total	0.0097		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708676
Sulfate (SO4)	2.14		0.30	mg/L		10-JUL-19	R4706649
Bacteriological Tests							
Escherichia Coli	13		0	MPN/100mL		10-JUL-19	R4707877
Total Coliforms	980		0	MPN/100mL		10-JUL-19	R4707877
Total Metals							
Aluminum (Al)-Total	0.0421		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Antimony (Sb)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2306864-2 NCR #2 - NORTH CURRENT RIVER - SITE #2 Sampled By: Client on 09-JUL-19 @ 13:00 Matrix: Grab							
Total Metals							
Arsenic (As)-Total	0.00031		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Barium (Ba)-Total	0.0223		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Beryllium (Be)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Boron (B)-Total	<0.010		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cadmium (Cd)-Total	<0.0000050		0.0000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Calcium (Ca)-Total	11.9		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Cesium (Cs)-Total	0.000015		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Chromium (Cr)-Total	0.00038		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cobalt (Co)-Total	0.00011		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Copper (Cu)-Total	0.00100		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Iron (Fe)-Total	0.555		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Lead (Pb)-Total	0.000060		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Lithium (Li)-Total	<0.0010		0.0010	mg/L	11-JUL-19	11-JUL-19	R4708812
Magnesium (Mg)-Total	3.53		0.0050	mg/L	11-JUL-19	11-JUL-19	R4708812
Manganese (Mn)-Total	0.0398		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Molybdenum (Mo)-Total	0.000159		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Nickel (Ni)-Total	0.00059		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Phosphorus (P)-Total	<0.050		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Potassium (K)-Total	0.611		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Rubidium (Rb)-Total	0.00163		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Selenium (Se)-Total	0.000104		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Silicon (Si)-Total	2.33		0.10	mg/L	11-JUL-19	11-JUL-19	R4708812
Silver (Ag)-Total	<0.000010		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Sodium (Na)-Total	7.48		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Strontium (Sr)-Total	0.0357		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Sulfur (S)-Total	0.57		0.50	mg/L	11-JUL-19	11-JUL-19	R4708812
Tellurium (Te)-Total	<0.00020		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Thallium (Tl)-Total	<0.000010		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Thorium (Th)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Tin (Sn)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Titanium (Ti)-Total	<0.0015	DLM	0.0015	mg/L	11-JUL-19	11-JUL-19	R4708812
Tungsten (W)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Uranium (U)-Total	0.000055		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Vanadium (V)-Total	0.00098		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Zinc (Zn)-Total	<0.0030		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Zirconium (Zr)-Total	<0.000060		0.000060	mg/L	11-JUL-19	11-JUL-19	R4708812
Dissolved Metals							
Calcium (Ca)-Dissolved	12.1		0.050	mg/L	10-JUL-19	11-JUL-19	R4708951
Magnesium (Mg)-Dissolved	3.68		0.0050	mg/L	10-JUL-19	11-JUL-19	R4708951
L2306864-3 NCR #3 - NORTH CURRENT RIVER - SITE #3							

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2306864-3 NCR #3 - NORTH CURRENT RIVER - SITE #3 Sampled By: Client on 09-JUL-19 @ 12:15 Matrix: Grab							
Physical Tests							
Conductivity (EC)	83.1		1.0	uS/cm		10-JUL-19	R4707016
Hardness (as CaCO3)	27.7		0.50	mg/L		12-JUL-19	
pH	6.93		0.10	pH		10-JUL-19	R4707016
Total Dissolved Solids	69		10	mg/L		10-JUL-19	R4707916
Turbidity	1.28		0.10	NTU		10-JUL-19	R4705208
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	22.2		2.0	mg/L		10-JUL-19	R4707016
Ammonia, Total (as N)	0.088		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	9.39		0.10	mg/L		10-JUL-19	R4706649
Nitrate (as N)	<0.020		0.020	mg/L		10-JUL-19	R4706649
Nitrite (as N)	<0.010		0.010	mg/L		10-JUL-19	R4706649
Total Kjeldahl Nitrogen	0.71		0.15	mg/L	12-JUL-19	14-JUL-19	R4712321
Phosphorus (P)-Total	0.0138		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708676
Sulfate (SO4)	1.40		0.30	mg/L		10-JUL-19	R4706649
Bacteriological Tests							
Escherichia Coli	27		0	MPN/100mL		10-JUL-19	R4707877
Total Coliforms	1050		0	MPN/100mL		10-JUL-19	R4707877
Total Metals							
Aluminum (Al)-Total	0.0645		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Antimony (Sb)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Arsenic (As)-Total	0.00034		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Barium (Ba)-Total	0.0257		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Beryllium (Be)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Boron (B)-Total	<0.010		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cadmium (Cd)-Total	<0.0000050		0.0000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Calcium (Ca)-Total	6.79		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Cesium (Cs)-Total	0.000028		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Chromium (Cr)-Total	0.00049		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cobalt (Co)-Total	0.00026		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Copper (Cu)-Total	0.00104		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Iron (Fe)-Total	0.786		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Lead (Pb)-Total	0.000112		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Lithium (Li)-Total	<0.0010		0.0010	mg/L	11-JUL-19	11-JUL-19	R4708812
Magnesium (Mg)-Total	2.24		0.0050	mg/L	11-JUL-19	11-JUL-19	R4708812
Manganese (Mn)-Total	0.0839		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Molybdenum (Mo)-Total	0.000108		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Nickel (Ni)-Total	0.00081		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Phosphorus (P)-Total	<0.050		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Potassium (K)-Total	0.589		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Rubidium (Rb)-Total	0.00189		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Selenium (Se)-Total	0.000078		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2306864-3 NCR #3 - NORTH CURRENT RIVER - SITE #3 Sampled By: Client on 09-JUL-19 @ 12:15 Matrix: Grab							
Total Metals							
Silicon (Si)-Total	0.56		0.10	mg/L	11-JUL-19	11-JUL-19	R4708812
Silver (Ag)-Total	<0.000010		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Sodium (Na)-Total	6.88		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Strontium (Sr)-Total	0.0416		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Sulfur (S)-Total	<0.50		0.50	mg/L	11-JUL-19	11-JUL-19	R4708812
Tellurium (Te)-Total	<0.00020		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Thallium (Tl)-Total	<0.000010		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Thorium (Th)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Tin (Sn)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Titanium (Ti)-Total	0.00120		0.00030	mg/L	11-JUL-19	11-JUL-19	R4708812
Tungsten (W)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Uranium (U)-Total	0.000045		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Vanadium (V)-Total	0.00096		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Zinc (Zn)-Total	<0.0030		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Zirconium (Zr)-Total	0.000087		0.000060	mg/L	11-JUL-19	11-JUL-19	R4708812
Dissolved Metals							
Calcium (Ca)-Dissolved	7.08		0.050	mg/L	10-JUL-19	11-JUL-19	R4708951
Magnesium (Mg)-Dissolved	2.43		0.0050	mg/L	10-JUL-19	11-JUL-19	R4708951
L2306864-4 NCR #4 - NORTH CURRENT RIVER - SITE #4 Sampled By: Client on 09-JUL-19 @ 10:30 Matrix: Grab							
Physical Tests							
Conductivity (EC)	33.7		1.0	uS/cm		10-JUL-19	R4707016
Hardness (as CaCO3)	16.3		0.50	mg/L		12-JUL-19	
pH	6.79		0.10	pH		10-JUL-19	R4707016
Total Dissolved Solids	40		10	mg/L		10-JUL-19	R4707916
Turbidity	1.74		0.10	NTU		10-JUL-19	R4705208
Anions and Nutrients							
Alkalinity, Total (as CaCO3)	13.1		2.0	mg/L		10-JUL-19	R4707016
Ammonia, Total (as N)	0.175		0.020	mg/L		12-JUL-19	R4708981
Chloride (Cl)	0.45		0.10	mg/L		10-JUL-19	R4706649
Nitrate (as N)	<0.020		0.020	mg/L		10-JUL-19	R4706649
Nitrite (as N)	<0.010		0.010	mg/L		10-JUL-19	R4706649
Total Kjeldahl Nitrogen	0.65		0.15	mg/L	12-JUL-19	14-JUL-19	R4712321
Phosphorus (P)-Total	0.0128		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708676
Sulfate (SO4)	1.04		0.30	mg/L		10-JUL-19	R4706649
Bacteriological Tests							
Escherichia Coli	2		0	MPN/100mL		10-JUL-19	R4707877
Total Coliforms	>2420		0	MPN/100mL		10-JUL-19	R4707877
Total Metals							
Aluminum (Al)-Total	0.0601		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Antimony (Sb)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2306864-4 NCR #4 - NORTH CURRENT RIVER - SITE #4 Sampled By: Client on 09-JUL-19 @ 10:30 Matrix: Grab							
Total Metals							
Arsenic (As)-Total	0.00031		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Barium (Ba)-Total	0.0116		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Beryllium (Be)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Bismuth (Bi)-Total	<0.000050		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Boron (B)-Total	<0.010		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cadmium (Cd)-Total	<0.0000050		0.0000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Calcium (Ca)-Total	4.08		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Cesium (Cs)-Total	0.000011		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Chromium (Cr)-Total	0.00034		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Cobalt (Co)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Copper (Cu)-Total	0.00090		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Iron (Fe)-Total	0.175		0.010	mg/L	11-JUL-19	11-JUL-19	R4708812
Lead (Pb)-Total	0.000071		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Lithium (Li)-Total	<0.0010		0.0010	mg/L	11-JUL-19	11-JUL-19	R4708812
Magnesium (Mg)-Total	1.42		0.0050	mg/L	11-JUL-19	11-JUL-19	R4708812
Manganese (Mn)-Total	0.0321		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Molybdenum (Mo)-Total	<0.000050		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Nickel (Ni)-Total	<0.00050		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Phosphorus (P)-Total	<0.050		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Potassium (K)-Total	0.352		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Rubidium (Rb)-Total	0.00109		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Selenium (Se)-Total	0.000102		0.000050	mg/L	11-JUL-19	11-JUL-19	R4708812
Silicon (Si)-Total	1.64		0.10	mg/L	11-JUL-19	11-JUL-19	R4708812
Silver (Ag)-Total	<0.000010		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Sodium (Na)-Total	0.872		0.050	mg/L	11-JUL-19	11-JUL-19	R4708812
Strontium (Sr)-Total	0.0120		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Sulfur (S)-Total	<0.50		0.50	mg/L	11-JUL-19	11-JUL-19	R4708812
Tellurium (Te)-Total	<0.00020		0.00020	mg/L	11-JUL-19	11-JUL-19	R4708812
Thallium (Tl)-Total	<0.000010		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Thorium (Th)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Tin (Sn)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Titanium (Ti)-Total	0.00050		0.00030	mg/L	11-JUL-19	11-JUL-19	R4708812
Tungsten (W)-Total	<0.00010		0.00010	mg/L	11-JUL-19	11-JUL-19	R4708812
Uranium (U)-Total	0.000056		0.000010	mg/L	11-JUL-19	11-JUL-19	R4708812
Vanadium (V)-Total	<0.00050		0.00050	mg/L	11-JUL-19	11-JUL-19	R4708812
Zinc (Zn)-Total	<0.0030		0.0030	mg/L	11-JUL-19	11-JUL-19	R4708812
Zirconium (Zr)-Total	<0.000060		0.000060	mg/L	11-JUL-19	11-JUL-19	R4708812
Dissolved Metals							
Calcium (Ca)-Dissolved	4.12		0.050	mg/L	10-JUL-19	11-JUL-19	R4708951
Magnesium (Mg)-Dissolved	1.45		0.0050	mg/L	10-JUL-19	11-JUL-19	R4708951

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Thallium (Tl)-Total	DUP-H	L2306864-1, -2, -3, -4
Duplicate	Escherichia Coli	DUPM	L2306864-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2306864-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2306864-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Total	MS-B	L2306864-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Total	MS-B	L2306864-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Total	MS-B	L2306864-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Total	MS-B	L2306864-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Total	MS-B	L2306864-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Total	MS-B	L2306864-1, -2, -3, -4

Sample Parameter Qualifier key listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity).
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
DUPM	MPN duplicate results were outside default ALS Data Quality Objective, but within 95% confidence interval for MPN reference method. Sample results are reliable.
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-TITR-TB	Water	Alkalinity	APHA 2320B modified

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

CL-L-IC-N-TB	Water	Chloride in Water by IC (Low Level)	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

EC-TITR-TB	Water	Conductivity	APHA 2510 B

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-TB	Water	Hardness (as CaCO3)	CALCULATION
MET-D-CCMS-TB	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020B (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

MET-T-CCMS-TB	Water	Total Metals in Water by CRC ICPMS	EPA 200.2/6020B (mod)

Water samples are digested with nitric and hydrochloric acids, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

NH3-COL-TB	Water	Ammonia by Discrete Analyzer	APHA 4500-NH3 G. (modified)

Ammonia in aqueous matrices is analyzed using discrete analyzer with colourimetric detection.

NO2-IC-N-TB	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-N-TB	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

P-T-COL-TB	Water	Total Phosphorus by Discrete Analyzer	APHA 4500-P B, F, G (modified)

Phosphorus in aqueous matrices is analyzed using discrete Analyzer with colourimetric detection.

PH-TITR-TB	Water	pH	APHA 4500-H

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

SO4-IC-N-TB	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

TC,EC-QT97-TB	Water	Total Coliform and E.coli	APHA 9223 B

This analysis is carried out using procedures adapted from APHA Method 9223 "Enzyme Substrate Coliform Test". E. coli and Total Coliform are determined simultaneously. The sample is mixed with a mixture of hydrolyzable substrates and then sealed in a multi-well packet. The packet is

Reference Information

incubated for 18 or 24 hours and then the number of wells exhibiting a positive response are counted. The final result is obtained by comparing the positive responses to a probability table.

TDS-TB Water Total Dissolved Solids APHA 2540 C (modified)
Aqueous matrices are analyzed using gravimetry and evaporation

TKN-COL-TB Water Total Kjeldahl Nitrogen APHA 4500-Norg (modified)
Total Kjeldahl Nitrogen in aqueous matrices is analyzed using a discrete analyzer with colourimetric detection.

TURBIDITY-TB Water Turbidity APHA 2130 B-Nephelometer
Aqueous matrices are analyzed using nephelometry with the light scatter measured at a 90" angle.

** 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

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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 weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

Quality Control Report

Client: LAKEHEAD REGION CONSERVATION AUTHORITY-TB
130 Conservation Road P.O. Box 10427
Thunder Bay ON P7B 6T8
Contact: Scott Drebit

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-TITR-TB	**Water**							
Batch R4707016								
WG3101041-14 LCS								
Alkalinity, Total (as CaCO3)			101.5		%		85-115	10-JUL-19
WG3101041-13 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	10-JUL-19
CL-L-IC-N-TB	**Water**							
Batch R4706649								
WG3101281-6 LCS								
Chloride (Cl)			100.1		%		90-110	10-JUL-19
WG3101281-5 MB								
Chloride (Cl)			<0.10		mg/L		0.1	10-JUL-19
EC-TITR-TB	**Water**							
Batch R4707016								
WG3101041-14 LCS								
Conductivity (EC)			96.4		%		90-110	10-JUL-19
WG3101041-13 MB								
Conductivity (EC)			<1.0		uS/cm		1	10-JUL-19
MET-D-CCMS-TB	**Water**							
Batch R4708951								
WG3101097-2 LCS								
Calcium (Ca)-Dissolved			104.0		%		80-120	11-JUL-19
Magnesium (Mg)-Dissolved			107.4		%		80-120	11-JUL-19
WG3101097-1 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	11-JUL-19
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	11-JUL-19
WG3101097-4 MS		**L2306864-1**						
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	11-JUL-19
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	11-JUL-19
MET-T-CCMS-TB	**Water**							
Batch R4708812								
WG3101968-3 DUP		**L2306864-1**						
Aluminum (Al)-Total		0.0320	0.0338		mg/L	5.6	20	11-JUL-19
Antimony (Sb)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-JUL-19
Arsenic (As)-Total		0.00031	0.00028		mg/L	9.0	20	11-JUL-19
Barium (Ba)-Total		0.0200	0.0205		mg/L	2.3	20	11-JUL-19
Beryllium (Be)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-JUL-19
Bismuth (Bi)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	11-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-TB	**Water**							
Batch R4708812								
WG3101968-3 DUP		**L2306864-1**						
Boron (B)-Total		<0.010	<0.010	RPD-NA	mg/L	N/A	20	11-JUL-19
Cadmium (Cd)-Total		0.0000064	<0.0000050	RPD-NA	mg/L	N/A	20	11-JUL-19
Calcium (Ca)-Total		14.3	14.3		mg/L	0.3	20	11-JUL-19
Cesium (Cs)-Total		0.000017	0.000015		mg/L	9.6	20	11-JUL-19
Chromium (Cr)-Total		0.00027	0.00029		mg/L	7.4	20	11-JUL-19
Cobalt (Co)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-JUL-19
Copper (Cu)-Total		0.00099	0.00099		mg/L	0.3	20	11-JUL-19
Iron (Fe)-Total		0.348	0.353		mg/L	1.5	20	11-JUL-19
Lead (Pb)-Total		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	11-JUL-19
Lithium (Li)-Total		0.0012	0.0011		mg/L	7.6	20	11-JUL-19
Magnesium (Mg)-Total		4.33	4.31		mg/L	0.3	20	11-JUL-19
Manganese (Mn)-Total		0.0339	0.0345		mg/L	1.8	20	11-JUL-19
Molybdenum (Mo)-Total		0.000193	0.000187		mg/L	3.1	20	11-JUL-19
Nickel (Ni)-Total		0.00053	0.00056		mg/L	5.8	20	11-JUL-19
Phosphorus (P)-Total		<0.050	<0.050	RPD-NA	mg/L	N/A	20	11-JUL-19
Potassium (K)-Total		0.636	0.646		mg/L	1.6	20	11-JUL-19
Rubidium (Rb)-Total		0.00176	0.00175		mg/L	0.4	20	11-JUL-19
Selenium (Se)-Total		0.000101	0.000104		mg/L	2.5	20	11-JUL-19
Silicon (Si)-Total		2.61	2.64		mg/L	1.3	20	11-JUL-19
Silver (Ag)-Total		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	11-JUL-19
Sodium (Na)-Total		6.86	6.88		mg/L	0.3	20	11-JUL-19
Strontium (Sr)-Total		0.0384	0.0384		mg/L	0.0	20	11-JUL-19
Sulfur (S)-Total		0.57	0.60		mg/L	4.6	20	11-JUL-19
Tellurium (Te)-Total		<0.00020	<0.00020	RPD-NA	mg/L	N/A	20	11-JUL-19
Thallium (Tl)-Total		0.000023	<0.000010	DUP-H	mg/L	N/A	20	11-JUL-19
Thorium (Th)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-JUL-19
Tin (Sn)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-JUL-19
Titanium (Ti)-Total		0.00062	0.00069		mg/L	11	20	11-JUL-19
Tungsten (W)-Total		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	11-JUL-19
Uranium (U)-Total		0.000053	0.000056		mg/L	4.2	20	11-JUL-19
Vanadium (V)-Total		0.00067	0.00068		mg/L	2.7	20	11-JUL-19
Zinc (Zn)-Total		<0.0030	<0.0030	RPD-NA	mg/L	N/A	20	11-JUL-19
Zirconium (Zr)-Total		<0.000060	<0.000060	RPD-NA	mg/L	N/A	20	11-JUL-19
WG3101968-2 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-TB	**Water**							
Batch R4708812								
WG3101968-2 LCS								
Aluminum (Al)-Total			102.0		%		80-120	11-JUL-19
Antimony (Sb)-Total			103.1		%		80-120	11-JUL-19
Arsenic (As)-Total			97.6		%		80-120	11-JUL-19
Barium (Ba)-Total			100.6		%		80-120	11-JUL-19
Beryllium (Be)-Total			103.3		%		80-120	11-JUL-19
Bismuth (Bi)-Total			104.8		%		80-120	11-JUL-19
Boron (B)-Total			87.9		%		80-120	11-JUL-19
Cadmium (Cd)-Total			100.7		%		80-120	11-JUL-19
Calcium (Ca)-Total			100.9		%		80-120	11-JUL-19
Cesium (Cs)-Total			99.5		%		80-120	11-JUL-19
Chromium (Cr)-Total			100.5		%		80-120	11-JUL-19
Cobalt (Co)-Total			100.1		%		80-120	11-JUL-19
Copper (Cu)-Total			96.2		%		80-120	11-JUL-19
Iron (Fe)-Total			102.4		%		80-120	11-JUL-19
Lead (Pb)-Total			102.8		%		80-120	11-JUL-19
Lithium (Li)-Total			99.8		%		80-120	11-JUL-19
Magnesium (Mg)-Total			104.6		%		80-120	11-JUL-19
Manganese (Mn)-Total			101.1		%		80-120	11-JUL-19
Molybdenum (Mo)-Total			101.4		%		80-120	11-JUL-19
Nickel (Ni)-Total			98.2		%		80-120	11-JUL-19
Phosphorus (P)-Total			106.0		%		80-120	11-JUL-19
Potassium (K)-Total			104.8		%		80-120	11-JUL-19
Rubidium (Rb)-Total			100.8		%		80-120	11-JUL-19
Selenium (Se)-Total			99.2		%		80-120	11-JUL-19
Silicon (Si)-Total			98.6		%		80-120	11-JUL-19
Silver (Ag)-Total			100.2		%		80-120	11-JUL-19
Sodium (Na)-Total			109.5		%		80-120	11-JUL-19
Strontium (Sr)-Total			101.4		%		80-120	11-JUL-19
Sulfur (S)-Total			86.6		%		80-120	11-JUL-19
Tellurium (Te)-Total			101.7		%		80-120	11-JUL-19
Thallium (Tl)-Total			103.9		%		80-120	11-JUL-19
Thorium (Th)-Total			102.6		%		80-120	11-JUL-19
Tin (Sn)-Total			102.3		%		80-120	11-JUL-19
Titanium (Ti)-Total			98.1		%		80-120	11-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-TB	**Water**							
Batch R4708812								
WG3101968-2 LCS								
Tungsten (W)-Total			106.0		%		80-120	11-JUL-19
Uranium (U)-Total			101.5		%		80-120	11-JUL-19
Vanadium (V)-Total			100.1		%		80-120	11-JUL-19
Zinc (Zn)-Total			100.2		%		80-120	11-JUL-19
Zirconium (Zr)-Total			98.5		%		80-120	11-JUL-19
WG3101968-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	11-JUL-19
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Arsenic (As)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Barium (Ba)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Beryllium (Be)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Bismuth (Bi)-Total			<0.000050		mg/L		0.00005	11-JUL-19
Boron (B)-Total			<0.010		mg/L		0.01	11-JUL-19
Cadmium (Cd)-Total			<0.0000050		mg/L		0.000005	11-JUL-19
Calcium (Ca)-Total			<0.050		mg/L		0.05	11-JUL-19
Cesium (Cs)-Total			<0.000010		mg/L		0.00001	11-JUL-19
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Copper (Cu)-Total			<0.00050		mg/L		0.0005	11-JUL-19
Iron (Fe)-Total			<0.010		mg/L		0.01	11-JUL-19
Lead (Pb)-Total			<0.000050		mg/L		0.00005	11-JUL-19
Lithium (Li)-Total			<0.0010		mg/L		0.001	11-JUL-19
Magnesium (Mg)-Total			<0.0050		mg/L		0.005	11-JUL-19
Manganese (Mn)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	11-JUL-19
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	11-JUL-19
Phosphorus (P)-Total			<0.050		mg/L		0.05	11-JUL-19
Potassium (K)-Total			<0.050		mg/L		0.05	11-JUL-19
Rubidium (Rb)-Total			<0.00020		mg/L		0.0002	11-JUL-19
Selenium (Se)-Total			<0.000050		mg/L		0.00005	11-JUL-19
Silicon (Si)-Total			<0.10		mg/L		0.1	11-JUL-19
Silver (Ag)-Total			<0.000010		mg/L		0.00001	11-JUL-19
Sodium (Na)-Total			<0.050		mg/L		0.05	11-JUL-19
Strontium (Sr)-Total			<0.00020		mg/L		0.0002	11-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-TB	**Water**							
Batch R4708812								
WG3101968-1 MB								
Sulfur (S)-Total			<0.50		mg/L		0.5	11-JUL-19
Tellurium (Te)-Total			<0.00020		mg/L		0.0002	11-JUL-19
Thallium (Tl)-Total			<0.000010		mg/L		0.00001	11-JUL-19
Thorium (Th)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Tin (Sn)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Titanium (Ti)-Total			<0.00030		mg/L		0.0003	11-JUL-19
Tungsten (W)-Total			<0.00010		mg/L		0.0001	11-JUL-19
Uranium (U)-Total			<0.000010		mg/L		0.00001	11-JUL-19
Vanadium (V)-Total			<0.00050		mg/L		0.0005	11-JUL-19
Zinc (Zn)-Total			<0.0030		mg/L		0.003	11-JUL-19
Zirconium (Zr)-Total			<0.000060		mg/L		0.00006	11-JUL-19
WG3101968-4 MS		**L2306864-2**						
Aluminum (Al)-Total			98.4		%		70-130	11-JUL-19
Antimony (Sb)-Total			102.4		%		70-130	11-JUL-19
Arsenic (As)-Total			97.9		%		70-130	11-JUL-19
Barium (Ba)-Total			N/A	MS-B	%		-	11-JUL-19
Beryllium (Be)-Total			98.0		%		70-130	11-JUL-19
Bismuth (Bi)-Total			98.4		%		70-130	11-JUL-19
Boron (B)-Total			90.7		%		70-130	11-JUL-19
Cadmium (Cd)-Total			101.1		%		70-120	11-JUL-19
Calcium (Ca)-Total			N/A	MS-B	%		-	11-JUL-19
Cesium (Cs)-Total			100.1		%		70-130	11-JUL-19
Chromium (Cr)-Total			100.4		%		70-130	11-JUL-19
Cobalt (Co)-Total			99.9		%		70-130	11-JUL-19
Copper (Cu)-Total			98.8		%		70-130	11-JUL-19
Iron (Fe)-Total			95.9		%		70-130	11-JUL-19
Lead (Pb)-Total			99.5		%		70-130	11-JUL-19
Lithium (Li)-Total			92.3		%		70-130	11-JUL-19
Magnesium (Mg)-Total			N/A	MS-B	%		-	11-JUL-19
Manganese (Mn)-Total			N/A	MS-B	%		-	11-JUL-19
Molybdenum (Mo)-Total			103.5		%		70-130	11-JUL-19
Nickel (Ni)-Total			100.5		%		70-130	11-JUL-19
Phosphorus (P)-Total			102.3		%		70-130	11-JUL-19
Potassium (K)-Total			103.4		%		70-130	11-JUL-19

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-TB	**Water**							
Batch R4708812								
WG3101968-4 MS		**L2306864-2**						
Rubidium (Rb)-Total			98.3		%		70-130	11-JUL-19
Selenium (Se)-Total			98.4		%		70-130	11-JUL-19
Silicon (Si)-Total			89.9		%		70-130	11-JUL-19
Silver (Ag)-Total			99.7		%		70-130	11-JUL-19
Sodium (Na)-Total			N/A	MS-B	%		-	11-JUL-19
Strontium (Sr)-Total			N/A	MS-B	%		-	11-JUL-19
Sulfur (S)-Total			96.2		%		70-130	11-JUL-19
Tellurium (Te)-Total			99.7		%		70-130	11-JUL-19
Thallium (Tl)-Total			98.1		%		70-130	11-JUL-19
Thorium (Th)-Total			101.9		%		70-130	11-JUL-19
Tin (Sn)-Total			100.9		%		70-130	11-JUL-19
Titanium (Ti)-Total			95.3		%		70-130	11-JUL-19
Tungsten (W)-Total			103.2		%		70-130	11-JUL-19
Uranium (U)-Total			98.8		%		70-130	11-JUL-19
Vanadium (V)-Total			100.0		%		70-130	11-JUL-19
Zinc (Zn)-Total			101.4		%		70-130	11-JUL-19
Zirconium (Zr)-Total			99.0		%		70-130	11-JUL-19
NH3-COL-TB	**Water**							
Batch R4708981								
WG3103214-3 DUP		**L2306864-1**						
Ammonia, Total (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	12-JUL-19
WG3103214-2 LCS								
Ammonia, Total (as N)			100.5		%		85-115	12-JUL-19
WG3103214-1 MB								
Ammonia, Total (as N)			<0.020		mg/L		0.02	12-JUL-19
WG3103214-4 MS		**L2306864-2**						
Ammonia, Total (as N)			90.8		%		75-125	12-JUL-19
NO2-IC-N-TB	**Water**							
Batch R4706649								
WG3101281-6 LCS								
Nitrite (as N)			101.7		%		90-110	10-JUL-19
WG3101281-5 MB								
Nitrite (as N)			<0.010		mg/L		0.01	10-JUL-19
NO3-IC-N-TB	**Water**							

Quality Control Report

Workorder: L2306864 Report Date: 16-JUL-19

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NO3-IC-N-TB	**Water**							
Batch R4706649								
WG3101281-6 LCS								
Nitrate (as N)			99.6		%		90-110	10-JUL-19
WG3101281-5 MB								
Nitrate (as N)			<0.020		mg/L		0.02	10-JUL-19
P-T-COL-TB	**Water**							
Batch R4708676								
WG3101934-7 DUP		**L2306864-3**						
Phosphorus (P)-Total		0.0138	0.0143		mg/L	3.9	20	11-JUL-19
WG3101934-6 LCS								
Phosphorus (P)-Total			94.9		%		80-120	11-JUL-19
WG3101934-5 MB								
Phosphorus (P)-Total			<0.0030		mg/L		0.003	11-JUL-19
WG3101934-8 MS		**L2306864-4**						
Phosphorus (P)-Total			101.5		%		70-130	11-JUL-19
PH-TITR-TB	**Water**							
Batch R4707016								
WG3101041-14 LCS								
pH			7.01		pH		6.9-7.1	10-JUL-19
SO4-IC-N-TB	**Water**							
Batch R4706649								
WG3101281-6 LCS								
Sulfate (SO4)			103.7		%		90-110	10-JUL-19
WG3101281-5 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	10-JUL-19
TC,EC-QT97-TB	**Water**							
Batch R4707877								
WG3100938-1 MB								
Total Coliforms			0		MPN/100mL		1	10-JUL-19
Escherichia Coli			0		MPN/100mL		1	10-JUL-19
TDS-TB	**Water**							
Batch R4707916								
WG3101284-3 DUP		**L2306864-1**						
Total Dissolved Solids		88	83		mg/L	5.5	20	10-JUL-19
WG3101284-2 LCS								
Total Dissolved Solids			93.5		%		85-115	10-JUL-19
WG3101284-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TDS-TB	**Water**							
Batch R4707916								
WG3101284-1 MB								
Total Dissolved Solids			<10		mg/L		10	10-JUL-19
TKN-COL-TB	**Water**							
Batch R4712321								
WG3102714-3 DUP		**L2306864-2**						
Total Kjeldahl Nitrogen		0.44	0.34	J	mg/L	0.10	0.3	14-JUL-19
WG3102714-2 LCS								
Total Kjeldahl Nitrogen			102.2		%		75-125	14-JUL-19
WG3102714-1 MB								
Total Kjeldahl Nitrogen			<0.15		mg/L		0.15	14-JUL-19
WG3102714-4 MS		**L2306864-3**						
Total Kjeldahl Nitrogen			97.3		%		70-130	14-JUL-19
TURBIDITY-TB	**Water**							
Batch R4705208								
WG3101453-3 DUP		**L2306864-1**						
Turbidity		0.83	0.84		NTU	1.4	15	10-JUL-19
WG3101453-2 LCS								
Turbidity			100.5		%		85-115	10-JUL-19
WG3101453-1 MB								
Turbidity			<0.10		NTU		0.1	10-JUL-19

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2306864-COFC

COC Number: 14 - 9

Page ___ of ___

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	Lakehead Region Conservation Authority	Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)	R ☒ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Scott Drebit	Quality Control (QC) Report with Report ☐ Yes ☒ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	130 Conservation Road	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	807 - 344 - 5857	Email 1 or Fax tammy@lakeheadca.com	Specify Date Required for E2,E or P:
		Email 2 Scott@lakeheadca.com	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q74345	Approver ID:	Cost Center:
Job #:	~~Jarvis River~~ North Current River	GL Account:	Routing Code:
PO / AFE:	275	Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)	L2306864	ALS Contact:	Sampler:

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Alkalinity, Conductivity, pH	Chloride, Nitrate, Nitrite, Sulphate	TDS, Turbidity	NH_3, TKN, TP	Metals, total + hardness	TC / EC	Number of Containers
	NCR#1 - North Current River - Site #1	09-07-19	13:45	Grab	X	X	X	X	X	X	6
	NCR#2 - North Current River - Site #2	09-07-19	13:00	Grab	X	X	X	X	X	X	6
	NCR#3 - North Current River - Site #3	09-07-19	12:15	Grab	X	X	X	X	X	X	6
	NCR#4 - North Current River - Site #4	09-07-19	10:30	Grab	X	X	X	X	X	X	6

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☒ No	
Are samples for human drinking water use? ☐ Yes ☒ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No	☑
Ice packs	Yes ☑	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☑				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
2.7					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: Rachael	Date: 10-07-19	Time:	Received By: SD.	Date: July 10/19	Time: 9:11	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326a v09 Front/04 January 2014

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.

1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form.**

SD