Wolf River

Watershed Assessment

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

2009

Wolf River Watershed Assessment Report

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Conserve Today...For A Better Tomorrow

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This Report has been prepared in-house at the Lakehead Region Conservation Authority for internal purposes to document the condition of the Wolf River in 2009.

Executive Summary

The Wolf River watershed is located within the unorganized Townships of Cockeram, McMaster, Glen, Stirling and the organized Township of Dorion. The majority of the Wolf River watershed, approximately ninety-eight percent, is located within unorganized Townships on provincially-owned Crown land. The Wolf River watershed drains an area of 729 square kilometres including 51 named waterbodies and 13 named watercourses including Greenwich, Abigogami, Wolfpup, Wolf and Moraine Lakes and the major tributary, Furcate Creek. The Wolf River runs 65.75 kilometers from its headwaters at Upper Wolf Lake to its confluence with Lake Superior. The Wolf River watershed can be characterized into two distinct physiographic systems; the upper watershed has a large dendritic drainage pattern while the lower watershed, downstream of Wolf Lake, is confined to the Wolf River stream channel.

Within the boundaries of the Wolf River watershed, the Lakehead Region Conservation Authority Area of Jurisdiction extends within the Township of Dorion. Of the total Wolf River watershed area, 54.37 square kilometres or 7.45 percent of the watershed is located inside the Lakehead Region Conservation Authority Area of Jurisdiction. Hurkett Cove Conservation Area is owned and maintained by the Lakehead Region Conservation Area, which is located partly within the Wolf River watershed.

The surficial geology of the Wolf River watershed is mainly exposed bedrock (46.4 percent) from the Sibley Group and moraines (29.4 percent). The Wolf River watershed is located within the Boreal forest region and is subject to historical and present forestry and mining activities.

In 1985, fill line mapping, was conducted for the lower reaches of Wolf River. This mapping depicts the approximate regulated area associated with the Wolf River, which is subject to the Authority's Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulations. Other areas regulated include Provincially Significant Wetlands and 120 metres adjacent, areas around watercourses, steep slopes and 15 metres landward and one kilometre lakeward from the 100 year flood level on Lake Superior.

In 1996 during a high water event, the Wolf River cut a new stream channel near the confluence with Lake Superior approximately 815 metres south along the Lake Superior shoreline from the original confluence location. Hurkett Cove Provincially Significant Coastal Wetland lies within the watershed along the shoreline of the original confluence. Discussion with local residents and aerial photography reveal that the original confluence channel is subject to sedimentation and the increased growth of wetlands. As well, the extent of the coastal wetland appears to be expanding further south to the new mouth of the Wolf River.

The majority of the watershed does not have municipal land use designations as it lies within unorganized townships. The lower watershed is designated as Hazard Land and Rural under the Township of Dorion Official Plan.

For this Assessment, ten sample sites located along the Wolf River were chosen based on a variety of attributes: accessibility, physical features, land use designation, proximity to man-made or natural features that may alter water quality as well as headwaters, which were used as a base reference.

At each of the ten sample locations, two sets of surface water samples and field measurements were collected over a three day period due to the size of the watershed. Sampling for the first data set was conducted on June 15, 16 and 17, 2009. The second set was collected on July 13, 14 and 15, 2009. Surface water samples were analyzed by ALS Laboratory Group for conductivity, total dissolved solids, turbidity, nutrients (nitrate, nitrite, ammonia and total phosphorus), bacteria (*Escherichia coli* and total coliforms) and total metals. Field measurements included water temperature, pH, conductivity and dissolved oxygen. Field and laboratory results were compared to the Ministry of Environment's Provincial Water Quality Objectives (PWQO).

Total phosphorus marginally exceeded the PWQO criterion (0.03 milligrams per liter) once at Site 2 on July 13, 2009 with a value of 0.0304 milligrams per liter and was likely the result of natural decomposition of in-stream woody debris and detritus.

Aluminum exceeded the PWQO criterion (0.075 milligrams per liter) at Sites 2, 4 and 10. At Site 2, aluminum concentrations were 0.098 and 0.158 milligrams per liter on June 17, 2009 and July 13, 2009, respectively. At Site 4 the aluminum concentration was 0.104 milligrams per liter on July 13, 2009. At Site 10 the aluminum concentrations were 0.107 and 0.109 on June 17, 2009 and July 15, 2009, respectively. For all sample sites, aluminum values ranged between 0.031 to 0.158 mg/L with a mean concentration of 0.066 mg/L.

Iron exceeded the PWQO criterion (0.3 milligrams per liter) at Sites 2 and 10. At Site 2 iron concentrations were 0.313 and 0.455 milligrams per liter on June 17, 2009 and July 13, 2009, respectively. At Site 10 the iron concentration was 0.321 milligrams per liter on July 15, 2009. Iron values ranged between 0.084 to 0.455 mg/L with a mean concentration of 0.178 mg/L.

High aluminum and iron concentrations are most likely due to the natural dissociation of metal cations from mineral-rich rocks.

The pH values measured in the field ranged from 7.85 to 10.29 with an average reading of 8.99. All pH values were above the acceptable PWQO range of 6.5 to 8.5 to protect aquatic life, except in two cases; pH was 7.85 at Site 3 on June 15, 2009 and pH was 8.45 at Site 7 on June 16, 2009. High pH values may be due to the underlying geology.

Upland, riparian and in-stream habitat characterization indicates that the Wolf River at the time of sampling can support a healthy population of bird and cold water fish species. Vegetation Type (V-type) and correlating Soil Type (S-type) classifications, indicate an abundance of varying vegetation types, which can provide for a diverse amount of wildlife habitats.

Due to the overall size of the watershed not all water crossings were documented. Only bridges crossing the main Wolf River channel were documented because of time restraints. All bridges were in good condition at the time of sampling with the exception of a bridge off the Dorion Cut-off Road, where only the cribbing was left in place.

Various types of erosion were documented throughout the watershed. These ranged from the dramatic rockslides at Wolf Lake to the slope failures near the confluence. Erosion appeared to be more abundant in the lower watershed and frequently occurred along river banks located within a glacial lacustrine plain. The upper watershed is mostly characterized by frequent bedrock outcrops, which help provide protection against erosion.

At the time of assessment in 2009 the Wolf River watershed was considered to be in excellent condition. Factors such as active erosion, abundant forestry operations and natural geologic setting all have had minimal impacts on this large watershed, allowing it to maintain a relatively pristine state.

Additional testing is recommended to create a more thorough assessment of the Wolf River watershed. LRCA resources and time permitting, the Wolf River watershed should be reassessed by the LRCA within the next 10 years, to monitor any changes in water quality as well as for any changes in confluence structure and migration. Due to the creation of the new confluence, it is recommended that prior to any new development in the area of the confluence, the Wolf River Fill Line Mapping is updated to assess hazards. It is also recommended that future assessments include additional monitoring of the confluence area to further assess hazard lands (such as further movement of the confluence and other break through points) and the growth of the coastal Provincially Significant Wetland. It is recommended that the Township of Dorion include the new Wolf River confluence area as an area of concern in flood Emergency Plans.

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1 Introduction

The Wolf River watershed is located partially within the unincorporated Townships of Cockeram, Glen, McMaster and Stirling and the incorporated Township of Dorion along the north shore of Lake Superior. The majority of the watershed, seventy-eight percent, lies in unorganized territory as provincial Crown land. The jurisdictional boundary of the Lakehead Region Conservation Authority (LRCA) extends within the municipal boundary of the Township of Dorion, which covers approximately seven and a half percent of the Wolf River watershed. The municipal and jurisdictional boundaries of the Wolf River watershed are shown on the Key Plan Map, M-1. A watershed can be defined as all land and water within the confines of a drainage divide. Essentially, the Wolf River watershed is comprised of all the surrounding land that naturally drains its lakes, streams, wetlands and precipitation runoff directly into Lake Superior. The Wolf River is 25.45 kilometres (km) in length and has a total drainage area of 729 square kilometres (km^2). The Wolf River is fed by many lakes and rivers in the upper watershed. There are 51 named lakes (or large waterbodies) and 13 named rivers, creeks or streams in the Wolf River watershed. There are many other waterbodies and watercourses that remain unnamed. The Wolf River is highly channelized in the lower watershed where channel bed and bank erosion by watercourse flow is common along its meanders. In 1996, the Wolf River overflowed its banks and cut a new confluence channel into Lake Superior. Map M-2, Site Plan displays the main features of the watershed.

The goal of this Report is to document the conditions of the watershed, especially surface water quality, as observed in June and July of 2009, and ultimately use the information to develop and maintain programs to sustain a healthy ecosystem, consistent with the Natural Hazards and Natural Heritage Policies of the Province of Ontario. The main objectives of this Report are to:

- Summarize the physical, biological and socio-economic attributes of the watershed
- Collect surface water quality data
- Collect field measurements
- Conduct an inventory of the forest ecosystem and fauna observed within the watershed
- Conduct an inventory of soil, streambed substrate and streambank cover observed within the watershed
- Document active erosion sites
- Document the physical condition of all Wolf River water crossings (bridges/culverts)
- Interpret results to record the health status of the watershed

2 Background

2.1 Physical Attributes

2.1.1 Topography

The Wolf River watershed can be characterized into two distinct physiographic systems. The upper watershed has a large dendritic drainage pattern dotted with many lakes and tributaries that funnel into Wolf Lake. Wolf Lake, in turn, drains into the Wolf River, a confined channel with steep slopes and a narrow floodplain. The highest point in the watershed is approximately 540 metres above sea level (masl) along the south-west boundary of the upper watershed (366991 E 5401905 N) which drains into Greenwich Lake. The lowest point in elevation can be found near the confluence at 190 masl. The general slope of the watershed is 0.47 percent. The Wolf River originates from Upper Wolf Lake along the north-west boundary of the upper watershed (354282 E 5426094 N) at 430 masl. It meanders across the watershed in an easterly direction until it drains into Venice Lake. Wolf River enters Venice Lake in the first of two sets of waterfalls dropping approximately 12 metres with a crest approximately 6 metres across (319958 E 5487929 N). The second set of waterfalls occurs approximately two kilometres downstream of the Wolf Lake Dam at approximately 240 metres above sea level (383630 E 5412501 N). Sections of Wolf Lake and Wolf River have rock faces, talus slopes and steep slopes representative of the last glacial retreat. Near the confluence, the original meandering channel pattern of the Wolf River is evident by the presence of oxbow lakes. Map M-3 illustrates Wolf River watershed topography.

2.1.2 Geology and Soils

Bedrock

The Wolf River watershed falls within the geological Proterozoic era (542 million to 2.5 billion years ago) Southern Province of the Thunder Bay region. The constituent groups of Proterozoic rocks are situated around the Lake Superior basin. They consist of a variety of relatively undeformed, flat-lying sedimentary and igneous rocks and associated intrusive rock complexes. The rocks of the Southern Province rest on or intrude into the older Archean (> 2.5 billion years ago) rocks of the underlying Superior Province (Ministry of Northern Development, Mines & Forestry 2008).

The watershed is comprised largely of rocks from the Mesoproterozoic era (1.54 billion years ago) Sibley Group of the Southern Province. See Figure 1. These rocks formed when sediment eroded from the Superior Province and washed into a shallow lake on top of an older rock complex (Ministry of Northern Development & Mines, Ontario, 1994). The Sibley Group now contains layers of conglomerate, sandstone, dolomite, shale and greywacke (a variety of sandstone with dark color and poorly-sorted, angular grains of quartz, feldspar, and small rock fragments set in a compact, clay-fine matrix). Diabase

sills and dykes also cut through these layers of sedimentary rock. Many of the rock outcrops of the Sibley Group exhibit a bright red color due to the oxidization of iron in the rocks over one billion years ago. Other Mesoproterozoic formations in the watershed include muscovite (mica with aluminum and potassium), mafic (rich in magnesium and iron) and metasedimentary rocks. In the south-west of the upper watershed, older Neoarchean to Mesoarchean era (2.5 to 3.25 billion years ago) intrusive rocks include granite, granodiorite and foliated tonalite. Maps M-4 and M-5 illustrate the Wolf River watershed bedrock geology.

Surficial Geology and Soils

Eight thousand years ago, at the time when a glacial ice front stretched along the west shore of Lake Nipigon, the channel which Wolf River follows now, once carried the waters of the glacial Lake Minong. A large amount of water required an exit from Lake Minong; water level at this time was 91.5 metres above the present day elevation of Hurkett Cove (~ 200 msl) and carried large quantities of sediment towards Nipigon (LRCA 1985). As the glacial lake retreated, thick beds of loose material were deposited in the Wolf River watershed. The watershed at present consists largely of bedrock (46.4%), moraine (29.4%), esker/kame/outwash plain (13.1%), organics (5.5%), glaciolacustrine plain (3.0%), alluvial plain (1.4%) and slope/talus pile (1.2%). The majority of exposed bedrock is located in the south-west of the upper watershed surrounding Greenwich and Hicky Lakes. Morainal deposits accumulated down the middle of the upper watershed which now surrounds Upper Wolf Lake, Upper and Lower Clearwater Lake, Wolf River, Furcate Creek and the upper half of Wolf Lake. Glacialacustrine plain and organics are found closer to Lake Superior, in the lower watershed floodplain. Maps M-6 and M-7 illustrate the Wolf River watershed surficial geology. At the time of report staff had difficultly finding background information on the soils in the Wolf River area; however, Maps M-8 and M-9 illustrate some of the soils in the area.

2.1.3 Confluence

Prior to 1996, the original Wolf River confluence channel meandered north-east before it met with Lake Superior. The lower Wolf River may be classified as having tortuous meanders in a confined pattern based on its sinuosity, floodplain and oxbow lakes (Ontario Ministry of Natural Resources, 2002). After a major flood event in 1996, the Wolf River cut a new confluence channel (390272 E 5407700 N) along the floodplain approximately 815 metres south of the original confluence (390898 E 5408216 N) along the Lake Superior shoreline. According to Environment Canada's Wolf River streamflow gauge, an extreme maximum discharge of ~182 m^3/s was reached on May 19, 1996. Map M-13 provides a 2006 aerial photograph of the Wolf River with its historical and present convergence with Lake Superior. The suspected theory behind the change in course is that an increased amount of force was applied to the apex of an acute, more southern, meander. This southerly meander was also the last bend in the river channel before the river made the sharp turn northward.

The reason behind this theory is that the rapid change in discharge (a jump from ~ 78 m^3/s to ~ 182 m^3/s in a matter of one to two days) with its correlated high water levels (as discharge increases, water levels increases (see Figure 5 and 6) put excess force upon the outer (apex) bank of an acute angled meander. The acute angle of the meander would have rendered it difficult for a large amount of fast flowing water to make the sharp turn northward. As a result the flowing water may have hit the apex bank first, before attempting to flow north. This would have placed an increased amount of force on the outer apex bank. Field reconnaissance by LRCA staff revealed sandy soils typically dominate this region of the watershed. The apex meander's normal helicoidal flow (flow found in meanders that cause erosion on the outer bank) may have been accelerated by the increasingly high discharge rates. Consequently, this perhaps caused increased rates of erosion along the outer bank, which may have been adequate enough to reshape the meander and allow for a total breach of the outer bank. This would have granted the Wolf River a shorter route of travel to Lake Superior.

As documented by LRCA staff, at the time of assessment, the new southern confluence had accumulated a substantial amount of interesting features. Most noteworthy are the formation of a well defined wetland delta and the formation of a narrow land bridge (See M-13). The wetland delta is a result of materials (trees, sand and silt) carried out into Lake Superior during the channel formation of the new confluence. As evidence of the rapid velocity experienced during the new confluence formation, the remains of whole trees angled towards Lake Superior can be found underwater with roots intact. Vegetation within the delta is predominantly cattails with very few shrubs and grasses. LRCA staff documented an abundance of birds within the area. Aerial photographs (See M-13) reveal that the delta is growing, with the possibility of a merge with the nearby Provincially Significant Wetland found at the original northern confluence.

The other feature of interest is the narrow land bridge separating the main channel from a smaller overflow tributary. Aerial photographs indicate that the smaller tributary does indeed meet with Lake Superior, but does not possess a fully developed channel. As investigated by LRCA staff, the land bridge separating the tributary from the main channel is composed of fine to coarse grain sand material and is roughly three metres in width. The top of the bridge is well vegetated, however, the bank facing the main channel is the site of active erosion, indicating another possible site of confluence diversion. In the occurrence of another event with record discharge and water levels the possibility exists that the narrow land bridge could give way, creating a shorter more direct route of travel for the river. GPS points (taken 20-07-09) reveal that the elevation of the top of the land bridge is 189.31 msl. Elevation at the water's edge of the main channel is 180.77 msl. Though there is a substantial elevation difference between both GPS points, the bank is composed of an easily erodible material. Additionally, the bank on the opposite side of the land bridge is partially submerged with some undercutting, indicates that there is still a potential for the land bridge to give way during an event of record discharge and water levels.

Possible consequences of the further southerly movement of the confluence could include the isolation of property (by means of island formation), property damage (small trailers and a cabin were found in the area) and increased siltation of the shoreline which could accelerate the growth of wetlands.

2.1.4 Climate

The Wolf River watershed is similar to the Thunder Bay region, in that it is a modified continental climate influenced by Lake Superior. Westerly winds predominate from July to March whereas easterly winds predominate the rest of the year (LRCA 1985). In addition, both the Wolf River watershed and Thunder Bay region shorelines are protected by the Black Bay and Sibley Peninsulas, respectively. The mean daily temperatures in degrees Celsius (°C) and precipitation levels in millimeters (mm) for Thunder Bay were recorded at the Thunder Bay Airport from 1971-2000 (Environment Canada 2009). The table below also summarizes the extreme daily precipitation in millimeters (mm) recorded within a 24-hour period, the year and number of days it occurred.

Table 1.0: Mean temperature and total precipitation for Thunder Bay, 1971-2000

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

The mean daily temperatures (°C) and precipitation levels (mm) were recorded at the Dorion TCPL 70 climate station from 1969-1984 (Environment Canada 2009).

Table 2.0: Mean temperature and total precipitation for Dorion, 1969-1984

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily (ºC)	-17.5	-13.6	-7.3	1.1	8.2	12.9	16.7	15.6	10.3	4.8	-3.0	-12.3
Precipitation												
Total Precip. (mm)	41.3	27.6	41.5	35.1	60.6	80.0	79.3	83.0	83.4	79.5	54.7	46.0

The mean daily temperatures (°C) and precipitation levels (mm) for Thunder Bay were recorded at the Thunder Bay Airport for 2009 (Environment Canada 2009).

Table 3.0: Mean temperature and total precipitation for Thunder Bay, January-July 2009

	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature							
Daily (ºC)	-17.3	-12.0	-6.6	2.4	7.7	13.7	15.7
Precipitation							
Total Precipitation (mm)	22.5	16.0	28.0	32.0	49.5	40.0	94.5

From two weeks prior to sampling to the end of the sampling period (June 1-July 15, 2009), the mean daily temperature was 15.9°C with a maximum temperature of 30.9ºC on June 23, 2009 and a minimum temperature of 3.3ºC on July 8, 2009. In comparison with historical data, the 2009 sampling period had approximately normal daily air temperatures and approximately half the normal June and July total precipitation levels.

2.1.5 Hydrology

Watershed Characteristics

The Wolf River is 25,452.04 metres or 25.45 km long from the head waters at Upper Wolf Lake (354282 E 5426094 N) to the original (prior to 1996) confluence (390898 E 5408216 N) with Lake Superior. The drainage area for the Wolf River watershed is 729 square kilometres (km^2). The general slope of the watershed is 0.47 percent. The Wolf River is fed by many lakes and rivers in the upper watershed. There are 51 named lakes or large waterbodies and 13 named rivers, creeks or streams in the Wolf River watershed. There are many other waterbodies and watercourses that remain unnamed. The table below summarizes the largest named waterbodies and longest named watercourses based on surface area in square kilometres (km^2) and length in kilometres (km), respectively. Maps M-10 through M-12 illustrate all the named waterbodies and watercourses in the Wolf River watershed and the approximate Regulated Areas (under the Conservation Authority's Development Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation).

Table 4.0: Named Waterbodies/Watercourses

Name	Type	Thermal Condition	Surface Area (km^2)	Length (km)
Waterbodies				
Greenwich Lake	Standing	Cold Water	4.786414	-
Abigogami Lake	Standing	Cold Water	4.292453	-
Wolfpup Lake	Standing	Cool Water	3.41408	-
Wolf Lake	Standing	Cool Water	2.810528	-
Moraine Lake	Standing	Cold Water	2.808818	-
Little Moraine Lake	Flowing	Cold Water	2.341451	-
Innes Lake	Standing	Cold Water	2.172209	-
Pringle Lake	Standing	Cold Water	1.79264	-
Beatty Lake	-	-	0.916189	-
Hicky Lake	-	-	0.904973	-
Unknown Lake	Standing	Cool Water	0.749907	-
Upper Wolf Lake	-	-	0.488366	-
Lynch Lake	-	-	0.439163	-

Twinredblox Lake	Standing	Cool Water	0.415751	-
Cliff Lake	Flowing	Cold Water	0.41084	-
Lower Clearwater Lake	-	-	0.330437	-
Henderson Lake	-	-	0.298076	-
Upper Clearwater Lake	-	-	0.295962	-
Furcate Lake	Standing	Cold Water	0.27043	-
Little Hicky Lake	-	-	0.27028	-
Venice Lake	Flowing	Cool Water	0.248192	-
Schmoo Lake	-	-	0.238382	-
Moraine Creek	-	-	0.238047	-
Wolf River	-	-	0.21987	-
Cavern Lake	Standing	-	0.217245	-
Greenwich Creek	-	-	0.194715	-
Scarp Lake	-	-	0.177463	-
Moonshine Lake	-	-	0.163586	-
Golden Gate Lake	Standing	Cool Water	0.156074	-
Sirecho Lake	-	-	0.147906	-
Pickett's Lake	-	-	0.126653	-
Mac's Lake	-	-	0.125519	-
Ring Lakes	-	-	0.112628	-
Yea Lake	Flowing	Cold Water	0.111913	-
Mirror Lake	-	-	0.106693	-
Cavern Creek	-	-	0.098882	-
Rat Lake	-	-	0.089285	-
Fisher Lake	-	-	0.083108	-
Beaverhide Lake	Flowing	Cold Water	0.082927	-
Sandybeach Lake	Flowing	Cold Water	0.068284	-
Springlet Lake	-	-	0.045834	-
MacDonalds Lake	-	-	0.036201	-
Ada Lake	-	-	0.034399	-
Grande Lake	Flowing	Cold Water	0.032472	-
Lost Lake	Flowing	Cold Water	0.027375	-
Bishops Lake	Standing	Cold Water	0.023745	-
Abigogami Creek	-	-	0.019748	-
Shale Lake	-	-	0.00783	-
Pocket Lake	Standing	Cold Water	0.006934	-
Mirror Lake	-	-	0.003681	-
Cliff Lake	-	-	0.002211	-
Watercourses				
Furcate Creek	Creek	Cold Water	-	23.26034
Wolf River	River	Cold Water	-	11.29677
Unknown Creek	Creek	-	-	6.593687
Beaverhide Creek	Creek	-	-	5.964826
McGaw Creek	Creek	-	-	5.330621
Hicky Creek	Creek	-	-	4.920302
Springlet Creek	Creek	-	-	4.399521
Henderson Creek	Creek	-	-	3.669246
Moraine Creek	Creek	-	-	2.694644
Greenwich Creek	Creek	Cold Water	-	2.401343
Abigogami Creek	Creek	-	-	2.215877
Wolfpup Creek	Creek	-	-	2.057918
Cavern Creek	Creek	-	-	1.325072

Wetlands

The Wolf River watershed contains 11.9705 km^2 of wetlands. Wetlands cover 1.64% of the total watershed area. The largest wetland area is 333,608.71 square metres (m^2) or 0.334 km^2, which drains into Lynch Lake in McMaster Township (377738 E 5430510 N). The only evaluated wetland in the watershed is Hurkett Cove Provincially Significant Wetland (PSW) located three kilometers (km) east of the Trans Canada Highway 11/17 on the shore of Black Bay in Lake Superior which abuts the original confluence of the Wolf River. See Figure 8. Hurkett Cove PSW covers 20.83 km^2. The PSW, as well as the 120 m buffer around the PSW, is regulated under the Development, Interference with Wetlands and Alterations to Watercourses Regulations (Ontario Regulation 180/06 under the Conservation Authorities Act) Map 12 illustrates the PSW location.

Discharge and Water Level

Environment Canada (2009) maintains a hydrometric monitoring station on the Wolf River at Highway No. 17 (Station ID: 02AC001) (387368 E 5408767 N). It has been in operation since 1971 and records streamflow (1971-present) and water level (2004-present) statistics. The following table summarizes the mean, maximum and minimum discharge and water levels in cubic metres per second (m^3/s) and metres, respectively for the period of 1971 to 2008. Stream discharge refers to the total volume of water in the stream and is a function of the stream width, depth and velocity.

Table 5.0: Mean discharge and water level for Wolf River, 1971-2008

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Discharge, 1971-2008												
Daily (m^3/s)	2.09	1.42	1.57	14.8	22.3	10.7	5.63	3.03	4.06	6.54	6.43	3.83
Water Level, 2004-2008												
Daily (m)	190.019	---	---	190.525	190.431	190.389	190.189	189.992	190.085	190.281	190.271	---

Table 6.0: Monthly extremes of daily discharges for Wolf River, January 1971-December 2008

	Maximum Daily	Minimum Daily	
JAN	9.40 m^3/sec on Jan 01, 2006	0.183 m^3/sec on Jan 15, 2003	**JAN**
FEB	6.63 m^3/sec* on Feb 25, 1971	0.140 m^3/sec on Feb 09, 2007	**FEB**
MAR	13.6 m^3/sec* on Mar 28, 2000	0.399 m^3/sec* on Mar 08, 1982	**MAR**
APR	119 m^3/sec on Apr 20, 1976	0.439 m^3/sec on Apr 01, 1982	**APR**
MAY	184 m^3/sec on May 19, 1996	1.72 m^3/sec on May 15, 1987	**MAY**
JUN	103 m^3/sec on Jun 08, 2008	0.911 m^3/sec on Jun 30, 1987	**JUN**

JUL	43.1 m^3/sec on Jul 30, 1993	0.292 m^3/sec on Jul 11, 1972	**JUL**
AUG	25.5 m^3/sec on Aug 01, 1993	0.409 m^3/sec on Aug 10, 1998	**AUG**
SEP	54.1 m^3/sec on Sep 11, 1977	0.227 m^3/sec on Sep 30, 1972	**SEP**
OCT	67.7 m^3/sec on Oct 11, 2007	0.164 m^3/sec on Oct 02, 1972	**OCT**
NOV	29.6 m^3/sec on Nov 23, 1982	0.668 m^3/sec on Nov 09, 1976	**NOV**
DEC	15.4 m^3/sec* on Dec 02, 2005	0.433 m^3/sec on Dec 31, 1976	**DEC**
EXTREME	**184 m^3/sec* on May 19, 1996**	**0.140 m^3/sec on Feb 09, 2007**	**EXTREME**

Table 7.0: Monthly extremes of daily water levels for Wolf River, January 2004-December 2008

	Maximum Daily	**Minimum Daily**	
JAN	190.322 m on Jan 01, 2005	189.802 m on Jan 25, 2007	**JAN**
FEB	--------	--------	**FEB**
MAR	--------	--------	**MAR**
APR	191.015 m* on Apr 14, 2006	189.960 m on Apr 13, 2007	**APR**
MAY	190.843 m on May 05, 2008	190.037 m on May 13, 2007	**MAY**
JUN	191.440 m on Jun 08, 2008	189.983 m on Jun 30, 2006	**JUN**
JUL	190.711 m on Jul 01, 2008	189.884 m on Jul 30, 2006	**JUL**
AUG	190.240 m on Aug 13, 2004	189.847 m on Aug 31, 2006	**AUG**
SEP	190.798 m on Sep 21, 2007	189.838 m on Sep 09, 2006	**SEP**
OCT	191.200 m on Oct 11, 2007	189.910 m on Oct 01, 2005	**OCT**
NOV	190.605 m on Nov 09, 2008	190.082 m on Nov 30, 2008	**NOV**
DEC	--------	--------	**DEC**
EXTREME	**191.440 m on Jun 08, 2008**	**189.802 m on Jan 25, 2007**	**EXTREME**

Stream discharge and water levels of the Wolf River are highly correlated and follow a yearly pattern of spring snowmelt highs (April-June), summer draw down (July-September), late autumn spikes (October-November) and steady winter draw down. Figures 3 and 4 illustrate the daily discharge and water levels of the Wolf River taken at Highway No.17 monitoring station.

From November 2006 until July 3, 2007 the LRCA Area of Jurisdiction was in a confirmed Level II Low Water Condition since received precipitation was less than 60 percent of the monthly average. On February 9, 2007, the Wolf River gauge recorded an extreme minimum discharge of 0.140 m^3/sec and an extreme minimum water level of 189.802 metres above sea level on January 25, 2007.

On June 6, 2008 a Flood Warning was issued for the LRCA Area of Jurisdiction. Between 56.5 millimeters (mm) and 105 mm were recorded at area gauges. The Regional Storm or the 100-year flood event used by the LRCA to determine the flooding hazard limit is the "Timmins Storm" of 1961 which had 193 millimeters of rainfall in 12-hours. The LRCA also issued Flood Advisories from June 10 to June 12, 2008 as waterways were still high. Wolf River gauge recorded an extreme maximum water level of 191.440 metres above sea level on June 8, 2008. Figure 2 shows the extent of the flooding event.

According to Environment Canada's Real-Time Hydrometric Data site, from June 1 to July 15, 2009 (two weeks prior to the end of the 2009 sampling period) Wolf River discharge declined from 9.11 to 2.34 m^3/s and water level decreased from 190.264 to 190.02 metres above sea level.

Fill Line Mapping

In August 1985, the Wolf River Fill Line Mapping Study was completed for the LRCA by Proctor and Redfern Limited. The final report outlines both the hydrologic and hydraulic procedures used to estimate the flood flows and flood levels and criteria used to estimate fill line mapping. The fill line mapping can be used to identify potentially hazardous areas along the lower portion of the Wolf River within the Township of Dorion for which construction activities may have a potential impact on the floodplain. Map M-12 delineates the Approximate Regulated Area based on the original fill line mapping. Presently, there has been no flood line mapping conducted for the Wolf River. Due to changes in the confluence of the Wolf River, the fill line in this area may not accurately identify the current regulated area.

Groundwater

The base of Wolf Lake and the lower part of the Wolf River lies within a glaciofluvial meltwater deposit. The glaciofluvial meltwater deposit is bordered on either side by topographic highs comprised of bedrock. This geological setting acts as a funnel for south flowing groundwater with the foci of the funnel (outlet where the groundwater discharges) located at the north end of the Dorion Fish Culture Station (FCS) main station head pond along Spring Creek outside the Wolf River surface water watershed boundaries. This glaciofluvial deposit consists of coarse well sorted sand, gravel and cobbles. Consequently, it can transmit groundwater very easily. The report by Webster & Durant (2009) concludes that the time for groundwater to travel from Wolf Lake to the FCS station on Spring Creek is 20 to 30 days. This is very quick in respect to groundwater travels rates. The rate was calculated using the hydraulic gradient (water table slope), hydraulic conductivity of the sediments present and the distance between the station and Wolf Lake. According to the report, the quality of groundwater in the area is highly susceptible to surface contamination because of the significantly rapid travel time, the high permeability and transmissivity of the geological material and the funnel-like configuration of the geological setting. Rural residents in the Township of Dorion and surrounding area obtain their private drinking water from groundwater sources.

2.2 *Biological Attributes*

2.2.1 Vegetation

The Wolf River watershed is located within the vegetative boundaries of the Boreal forest and Great Lakes St. Lawrence region. Conifer tree species such as white spruce, black spruce, jack pine, white pine, red pine, balsam fir, tamarack and cedar are dominant throughout the watershed with deciduous tree species such a trembling aspen, balsam poplar and white birch growing in areas with past logging activity (LRCA SPC 2008). Hurkett Cove Conservation Area to the north of the watershed contains northern wild rice (*Zizania pulustris*). Wild rice creates a marsh environment that attracts birds and provides shelter for aquatic species (LRCA HCCA 1985). A portion of Ouimet Canyon in the Township of Dorion falls within the watershed boundaries. The steep walls of the canyon provide shelter to the canyon floor and create a dry, cold environment that allows rare arctic-alpine disjuncts to exist. For example, Ouimet Canyon represents the most southerly known location for the very Arctic wintergreen (*Pyrola grandiflora*) (Ontario Ministry of Natural Resources n.d.). Other arctic-alpine disjuncts found in the surrounding landscape include the alpine woodsia, arctic pyrola, encrusted saxifrage and fragrant shield fern. Outside of the LRCA Area of Jurisdiction, but within the watershed boundaries lies the Harvais-Barclay Orchid Reserve (374319.45 E 5416783.56 N); an Environmentally Sensitive Area (ESA) of 0.175 km^2 located 11.5 kilometres north-west from Wolf Lake Road.

2.2.2 Fish & Wildlife

Fish

The Wolf River watershed represents important sport angling opportunities and falls within the Ontario Ministry of Natural Resources Zone 6 Fisheries Management Zones. According to a summary table produced by Hartviken & Momot (1989) there were fourteen (14) fish species recorded to date (1988) on the Wolf River sampled over fifteen (15) stations. These species included: blacknose dace, brook stickleback, brook trout, Johnny darter, lake chub, longnose dace, mottled sculpin, northern redbelly dace, northern pike, rainbow trout (also known as steelhead trout), slimy sculpin, trout-perch, white sucker and yellow perch. As an exception to Zone 6 fishing regulations, any brook trout caught on the Wolf River, downstream of the Lower Falls, that is smaller than 56 centimeters (cm) must be released (MNR 2008).

Cavern Lake (378021 E 5410263 N) within the Wolf River watershed boundary was stocked with brook trout by the MNR on a put-grow-take basis. As of 2002, there was no known natural reproduction of brook trout within Cavern Lake (MNR 2002). The lake was stocked with yearlings (16 months old). Brook trout fishing is open all year with no size limit. Cavern Lake was subjected to a lake survey in 1967, a creel survey in 1971 and a netting assessment in 1999. A second lake which was part of the MNR stocking program within the Wolf River watershed boundary is Lost Lake (376552 E 5409692 N).

Lost Lake was originally stocked with brook trout fry (5 months old) but stocking efforts failed due to insufficient habitat requirements. The lake shoreline was too steep to support riparian vegetation. Consequently, there was poor streamcover/canopy cover. In 2001 Lost Lake was stocked with splake for the first time. Splake is a mix between brook and lake trout. Reportedly, the lake will be stocked every two years with splake yearlings. Lost Lake was subjected to a lake survey in1967 and a winter creel survey in 1999 (MNR 2002).

As part of the Cooperative Rainbow Trout Angling Program, biological information from adult rainbow trout is collected by recreational anglers, many whom are North Shore Steelhead Association (NSSA) members, during the spring spawning period (April-June) in Canadian tributaries of Lake Superior, including Wolf River. The data collected through this program enables management biologists to examine various fishery or population dynamics such as, the age and size structure, the repeat-spawning rate (i.e. the number of rainbow trout that have spawned more than once in their lifetime), the ratio of first-time spawners (i.e. "maiden" spawners) to repeat spawners, the number of years spent in the stream, the number of lake years to reach maturity, the age at maturity, and the number of times a rainbow trout has spawned. The Co-op program was originally initiated in 1991 and was essential to the review and revision of angling regulations in 1996 and 1999. Wolf River 2008 data was insufficient due to a sample size less than the minimum forty individuals (Bobrowicz 2008). Besides fisheries population dynamics, the study of Rainbow trout is of importance as they may be considered an ecological indicator species. Rainbow trout, normally a cold water species, are considered to be the most tolerant of the trout species to high water temperatures (Grabarkiewicz 2008). They have been reported to survive in water temperatures exceeding twenty-five degrees Celsius. The sole presence of rainbow trout in a river where temperatures exceed twenty degrees Celsius could be an indicator of a possible disturbance.

Birds

Wolf River watershed has a diverse population of breeding birds. According to personal communication, the following species have been observed in the last five years in the watershed: ruffed grouse, Canada goose, cedar waxwing (Figure 9), mallard, merganser, spruce grouse, prairie chicken, red-breasted nuthatch, blackcapped chickadee, dark-eyed junco, red poll, purple finch, warbler and ruby throated hummingbird (Maki 2009).

At the first annual Canyon Country Birding Festival held May 16-17, 2009 at Hurkett Cove Conservation Area, Dorion Fish Culture Station, Ouimet Canyon and the Nipigon River Trail, 102 bird species were sighted including: wilson warbler, chestnut-sided warbler, bald eagle, golden eagle, peregrine falcon, black-and-white warbler, northern parula, blackburnian warbler, broad-winged hawk and double-crested cormorant. A snowy plover, though rare in this region was also sighted. According to Birds Ontario, Hurkett Cove is recognized as one of the top birding locations in the Boreal forest (Bezener 2000).

As reported by the Thunder Bay Field Naturalists, a variety of bird species have been documented within the Dorion and Hurkett area. Some of the rare bird species observed in or near to the Wolf River watershed in 2008 include the: pacific loon, western tanager, eastern towhee and blue grosbeak (Escott 2008).

The American white pelican has been observed near the Wolf River en route to Hurkett Cove Conservation Area (LRCA SPC 2008). The American White Pelican is listed as *threatened* under the Ministry of Natural Resources *Species at Risk in Ontario* regulation (O. Reg. 230/08). The American White Pelican is listed under Ontario's *Endangered Species Act*, 2007, which protects the species and its habitat. This bird is also protected by the province's *Fish and Wildlife Conservation Act*.

Mammals

The Wolf River watershed contains many of the typical Boreal forest mammals including black bear, moose, white-tailed deer, field mice, European cotton tail rabbit, red fox and grey wolf.

Within the caves along Cavern Lake at least four species of bat have been documented which include the: little brown bat, big brown bat, red bat and Keen's long-eared bat (Ontario Parks 2002). The rarer Keen's long-eared bat was once listed as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1988 but that status was revoked in November of 2003. It was then placed in the Data Deficient category because of a lack of information on population sizes, trends and reproduction. It is unknown if this species is a distinct taxon (COSEWIC 2003).

The cougar, also known as the puma or the mountain lion, has been sighted in the Wolf River watershed historically and within the last ten years (Ontario Puma Foundation 2009). Data was collected by sighting, tracks, scat and vocalization by several organizations including the Ontario Puma Foundation, Natural Heritage Information Centre, Ministry of Natural Resources and regional and provincial police. The cougar is listed as *endangered* under the Ministry of Natural Resources *Species at Risk in Ontario* regulation (O.Reg. 230/08). The subspecies formerly classified as Eastern cougar (*Felis concolor couguar*) is listed under Ontario's *Endangered Species Act*, 2007, which protects the species and its habitat. The disappearance of cougars can be attributed to human disturbance such as land clearing for settlement, agriculture and forestry.

2.2.3 Benthic Invertebrates

On September 16, 2007 aquatic benthic macroinvertebrates were sampled in Furcate Creek (372248 E 5417755 N), a major tributary of the Wolf River, by EcoSuperior Environmental Programs. The Furcate Creek site had a high Richness (10.67), and a moderately low Shannon's H' Diversity (1.47). The Hilsenhoff Biotic Index (6.06) was high, as was the % Dominants (55.10), and % Chironomids (55.10). The % EPT (28.11)

was low but so was the % Worms (2.50) (Deacon & Lavoie 2008). Researchers concluded that Furcate Creek was a healthy ecosystem at the time of sampling and that the site should be included in the Ontario Benthos Biomonitoring Network (OBBN) Reference Site database. Benthic macroinvertebrates may be considered an indicator species to assess the health of aquatic ecosystems since their population and community structure responds to ecosystem changes faster than other members of the aquatic community.

2.3 Socio-Economic Attributes

2.3.1 Planning & Development Controls

Land Tenure

The majority of the Wolf River watershed is provincially owned crown land (97.84%). Private land constitutes 2.16% of the watershed and is located almost entirely along the lower Wolf River, downstream of Wolf Lake and inside the Township of Dorion. Public and private land located in the upper watershed includes: Ouimet Canyon Provincial Park, Cavern Lake Provincial Park and a few parcels west of Innes Lake. Maps M-14 and M-15 show land ownership in the watershed.

Areas of Jurisdiction

The hydrological boundaries of the Wolf River watershed fall within the municipal boundaries of the unincorporated Townships of Cockeram, McMaster, Glen, Stirling and the incorporated Township of Dorion. Map M-1 the Site Plan, illustrates the location of the Wolf River watershed within the Geographic Township boundaries. The following table outlines the watershed area in kilometres squared (km^2) and as a percent of the total municipal area within each municipal boundary.

Table 8.0: Areas of Jurisdiction within the Wolf River Watershed

Municipality	Total Area (km^2)	Municipal Area within Wolf River Watershed (km^2)	Municipal Area within Wolf River Watershed (%)
Unorganized Township of Cockeram	110.21	2.41	0.33
Unorganized Township of McMaster	128.93	58.79	8.06
Unorganized Township of Glen	65.6	41.01	5.62
Unorganized Township of Stirling	84.07	3.64	0.50
Township of Dorion	218.72	54.37	7.45
Other	n/a	569.5	78.04
Total	n/a	729.72	100.00

Within the boundaries of the Wolf River watershed, the LRCA Area of Jurisdiction only extends within the Township of Dorion. Of the total Wolf River watershed area, 674.63 km^2 or 92.54% is outside the LRCA Area of Jurisdiction. Conversely, 54.37 km^2 or

7.45% of the watershed is located inside the LRCA Area of Jurisdiction. Within the LRCA Area of Jurisdiction it administers the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses O. Reg. 180/06 under the *Conservation Authorities Act*. Areas considered regulated include: Provincially Significant Wetlands and 120 metres adjacent, all watercourses (i.e. fill line mapped areas), all land zoned Hazard Land or Use Limitation, steep slopes and 15 metres landward and one kilometre lakeward from the 100 year flood level on Lake Superior. Activities within the approximate regulated area may require a permit from the Authority. In addition

Official Plan for the Township of Dorion

Municipal Official Plans contain long term goals and policies that serve as guidelines for future land use and development. The Wolf River watershed is affected by one Official Plan; the Township of Dorion (2005).

Within the Township of Dorion, the Wolf River watershed has been designated:

- Rural (RU)
- Residential 1 (R1)
- Seasonal Residential (SR)
- Open Space (OS)
- General Industrial (I)
- Extractive Industrial (EX)
- Tourist Commercial (TC)
- Hazard Land (HL)
- Environmental Protection (EP)

The policies of the Official Plan and all land use designations are implemented through the use of zoning by-laws. Zoning provides additional detail with respect to permitted uses and any specific conditions. Map M-16 illustrates the Township of Dorion Official Plan Schedule "A" Land Use Designations. Map M-17 illustrates the Township of Dorion Schedule "A" By-law Zoning and M-18 shows the Township of Dorion Schedule "B" Mineral Aggregate Potential Areas and Environmental Restraints. The following is a description of each land use designation:

Rural

The Council of the Township of Dorion wishes to maintain the rural character of the Dorion area and to promote resource and recreation based land activities that will have no negative impact upon adjacent land uses. The rural zoning designation allows agriculture, commercial fishing, fish hatchery, forestry and bush camp for staff, fishing and hunting, certain institutional uses, parks and conservation uses, railway, gas pipeline, utilities, mining exploration, wayside pit quarry, and portable asphalt plant. Dwellings should be capable of supporting individual private sewage disposal and potable water supply systems.

Residential 1

Residential zone zoning reflects typical residential uses. Uses permitted under this zoning designation include one single detached residential dwelling, group home, park, existing agricultural land, garden suites, home occupation or profession and accessory buildings.

Seasonal Residential

Seasonal residential dwellings may be built on Lake Superior, the Wolf River and large inland lakes. They may not be used for permanent residential use and care must be taken to ensure that no negative impacts will occur on any nearby sensitive lands. Seasonal residential dwellings may not be built on or within 50 metres of such lands. As well no chemical fertilizers will be utilized on any lot within 100 metres of sensitive lands. The only parcel of land zoned Seasonal Residential within the Wolf River watershed is located at the end of Bible Camp Road beside the new confluence; Site #1 and #2 were located on the parcel of Seasonal Residential land.

Open Space

Open Space zoning refers to the use of land, buildings and/or structures as park or recreation areas. They are controlled or owed by a public authority and are normally open for public use. Uses within open space zoning include public or private parks, community centers, cemeteries, marina, wildlife preserve, watershed management and conservation uses. Within the Wolf River watershed, there are six areas zoned Open Space which are Cavern Lake Provincial Park, Ouimet Canyon Provincial Park, Hurkett Cove Conservation Area, a cemetery on Fish Hatchery Road directly before Mon Abri Lane, Wolf River Campground at the end of Wolf River Road and the Department of Fisheries & Oceans weir off Wolf River Road.

General Industrial

General Industrial zoning refers to land utilized for light industrial uses. Other uses that would merit general industrial zoning would be truck depots, equipment sales /rental, warehouses, auto body shops, wood storage, forest products plant, wood chipping and saw mill planning. If an industrial zone abuts a Residential, Institutional, or an Open Space zone a vegetative buffer with a minimum buffer of 7.5 meters shall be provided along the lot line of the adjoining zone. Within the Wolf River watershed there are four areas zoned General Industrial which include: a poultry farm, a pumping station, a CNR right-of-way and a parcel of land owned by West Bay Development.

Extractive Industrial

Extractive Industrial zones are more regulated than general industrial zones. Permitted uses within extractive zones are pits and quarries, processing and/or stockpiling of extracted materials (including washing, screening sorting and crushing). Accessory uses

for the above activities, such as buildings and structures, are also permitted. As with general industrial zoning, a minimum buffer of 7.5 meters shall be provided along boundaries with residential, institutional, or open space zoning. Additionally, no excavation, building, equipment or stockpiling shall be located within 120 meters of a lot line abutting residential, institutional, or open space zoning. Extractive industrial activity must also be 60 meters away from any public road or allowance, not also zoned extractive or industrial. There is one area zoned Extractive Industrial within the watershed that is north of the Wolf River directly off Highway 11/17.

Tourist Commercial

Tourist Commercial zoning is land designated for uses related to the tourism industry. Uses permitted within this section of zoning include hotel, motels, lodges, resorts, tourist cabins, tourist outfitters, sale of tourist goods and fishing baits. Accessory dwellings for these uses are also allowed. A minimum buffer strip of 40 meters shall be provided if a tourist commercial zone abuts a Residential, Institutional or Open Space zone. There is one area zoned Tourist Commercial within the Wolf River Watershed; it is a registered Bed & Breakfast at the end of Bible Camp Road; Assessment Parcel 451.

Hazard Lands

Areas designated as Hazard Land are selected so as a means of protection against developing on lands having inherent hazards such as flood susceptibility, potential for erosion, soils instability or steep topography, former mine workings or similar hazardous sites where the current or potential condition of the lands may be severe enough to pose a risk to life or property. Permitted uses within this zoning area include public parks, agriculture, outdoor recreation, watercourse protection, bank stabilization, flood or erosion control, conservation and fish hatcheries. Hazard Lands are found along the floodplain of the Wolf River.

Environmental Protection

All lakes, rivers, streams and their associated tributaries within the Township of Dorion have been identified as fish and wildlife habitat areas. They are considered areas of Environmental Protection with uses limited to natural resource management, conservation, outdoor education and recreational uses. It is the intent of Council to establish setbacks in the zoning by-law along the shorelines of waterbodies and watercourses to protect fish and wildlife habitat and to assist in protecting the stability of lake and watercourse banks. A setback of 15 metres from the 183.9 metres Geodetic Survey of Canada (gsc) contour level (100-year shoreline Flood level) along the Lake Superior shoreline is zoned as Environmental Protection.

2.3.2 Existing Land Uses

Fish Culture Station

The Ministry of Natural Resources operates the Dorion Fish Culture Station (FCS) at the headwaters of the south-east flowing Spring Creek which lies just outside the Wolf River watershed boundary. The area is designated and managed by the municipality as an Environmentally Sensitive Area (ESA); it represents the habitat of valuable fish species. The fish are intended to provide additional fishing opportunities through put-grow-and-take stocking and to rehabilitate degraded fisheries. For example, the majority of lake trout stocked in the Great Lakes are intended to restore populations which were destroyed by sea lamprey predation and overfishing in the 1950s. In 2008, the Dorion FCS released approximately 700,000 fry (18-19 months old) of the following species: speckled (brook) trout, rainbow trout, lake trout and splake into the Lake Superior watershed.

Wolf Lake Dam

The Wolf Lake Dam in the Unorganized Township of Glen (381427 E 5413276 N) was built (year unknown) by the Ministry of Natural Resources to increase groundwater flow from the lake into the adjacent sand and gravel overburden to the south. As the water level in the lake rises, more water is pushed into the sand and gravel resulting in increased flow at the Dorion FCS headwater springs (Webster & Durant 2009). Consequently, the water flow out of the lake and down Wolf River is reduced. Wolf Lake Dam has a length of 262.1 metres, a maximum height of 7.3 metres and a maximum head of 3 metres. The embankment is rock fill. There are no control gates; the outlet method is an overflow spillway 115.8 metres across. The reservoir has a surface area of 4 km^2, a drainage area of 720 km^2 and volume of 9.25 x 10^9 litres. The dam does not have a fish ladder.

Permits to Take Water

In 2009, there were two Permits to Take Water (PTTW) issued by the Ministry of Environment within the Wolf River watershed. Both permits are used by the Dorion FCS at three surface water sources; two are within the watershed boundaries. Water is taken from the Wolf River directly and from the groundwater seepage head pond beside the Fish Culture Sub-Station (less than 20 metres from Wolf River).

Table 9.0: Permits To Take Water within the Wolf River Watershed, 2009

Major Category	Specific Purpose	Taking Type	Source	Max Litres per Day	Max Litres per Minute	Max Days per Year	Expiry Date	Date Issued	Client Name
Commercial	Aquaculture	Surface Water	Wolf River	11,808,000	27,276	365	Sept. 17, 2018	Oct. 10, 2008	Ministry of Natural Resources
			Main Station Head Pond	39,277,000	10,500		Sept. 14, 2018	Sept. 17, 2008	
			Sub-Station Head Pond	15,120,000	8,200				

Wolf River Weir

In 1986 the Wolf River Weir was built upstream of Highway 11/17, Lot 12, Concession 2 in the Township of Dorion (382298 E 5411096 N) by the Department of Fisheries & Oceans Canada as a sea lamprey migration barrier. Wolf River Weir has a dam height of 1.22 metres and a maximum head of 0.61 metres. The embankment is bedrock. The weir is free flowing with no control gates. Its reservoir has a drainage area of 736 km^2. The LRCA is contracted to maintain a posted warning on behalf on Department of Fisheries & Oceans Canada that states: Fast Current Keep Clear. The Wolf River has been identified as being a river frequented by spawning lamprey (Kelso 1998). The study entitled "Phase I Development of an Improved Sea Lamprey Barrier" (Mazurek *et al.* 2008) concluded that the Wolf River weir did not provide a necessary drop of at least 30 centimeters for 80 % of the time during sea lamprey runs. Additionally, a 20 centimeter drop was not provided 62 % of the time or a 10 centimeter drop was not provided 43 % of the time. Compared with observations of barrier effectiveness provided in Lavis *et al.* (2003), Mazurek *et al.* concluded that the Wolf River Weir may be undersized and not performing its function as a sea lamprey barrier.

Forestry

Forestry activities are a very prominent feature within the Wolf River watershed. Evidence of past forestry operations are indicated by the abundance of old clear cuts and young tree plantations. At the time of Report, active forestry operations were being carried out in both the upper and lower watershed. The upper region of the watershed falls within a section of the Spruce River Forest. Forestry activities in this region are conducted by AbitibiBowater. Activities within the lower watershed or Lakehead Forest region are carried out by Greenmantle Forest Incorporated (NOFC 2009).

Mining

Mining opportunities within the watershed have existed in both the past and present. Along with fishing and agriculture, mining was one of the first industries established in the area. Abundant deposits within the region include: amethyst, copper, dolomite, lead,

molybdenum, uranium and zinc (MNDM-MDI 2008). Several Active Mining Claims have been issued for the unincorporated Townships of Glen, McMaster, Cockeram and Stirling and in the organized Township of Dorion in the last five years (MNDM2 2008). Past mining operations are outlined on Map M-18. These include two sites within the vicinity of Cavern Lake, one adjacent to MacDonald's Lake. Just outside the north-east watershed boundaries along Black Sturgeon River there is a uranium exploration project headed by Rampart Ventures Inc. (Township of Dorion 2009). At the time of Report, Rampart was in the two-phase process of preliminary drilling. Drilling results indicate the likelihood of a large uranium deposit, which has the possibility of extending into the Wolf River watershed.

Recreation

The Wolf River watershed offers opportunities for outdoor recreational activities such as camping, hiking, kayaking/canoeing, river tubing, fishing and hunting. Within the watershed boundaries there are two Provincial Parks: Cavern Lake Nature Reserve and Ouimet Canyon Provincial Park. The LRCA owns and maintains Hurkett Cove Conservation Area (located on the Black Bay Superior shoreline) and the privately-owned and operated Wolf River Campground off Wolf River Road (upstream of the Highway 11/17 crossing) are also located within the watershed.

2.3.3 Proposed Land Uses

Greenwich Wind Farm

Renewable Energy Systems Canada Incorporated (RES) has proposed the development of a wind farm within the vicinity of Greenwich Lake. The wind farm is anticipated to consist up to 72 wind turbines and generate 165.6 megawatts of electricity. "RES has been awarded a contract by the Ontario Power Authority (OPA) to provide an initial 98.9 megawatts of electricity from the Greenwich Wind Farm from 43 turbines" (RES 2009). At the time of this Report an Environmental Screening Report/Environmental Impact Statement (ESR/EIS) for the larger 165.6 megawatt project had been completed. Essentially the 165.6 megawatt project is a combination of the 98.9 megawatt project with an addition of a future 66.7 megawatt project, subject to the awarding of a future contract. The conclusion of the Greenwich Wind Farm ESR/EIS is that the "project can be constructed, operated and decommissioned without any significant impacts to the environment, including the natural and social environment" (RES 2009).

2.3.4 Erosion Control

As observed by LRCA staff in the summer of 2009, stream bank erosion is a prominent feature of the Wolf River. A permit was issued in 2008 by the LRCA to a private land owner for erosion protection along a stretch of river off of Mon Abri Lane. The work was required to reduce the rate of erosion along the banks of the Wolf River. See Figures 12 and 13.

3 Methods and Materials

3.1 Site Selection

Ten sites were chosen within the watershed boundaries to assess the overall health of the Wolf River. Each site was chosen based upon its accessibility and its proximity to any natural and/or man made features that may affect surface water quality. Site 1 was located as close as possible to the confluence of Wolf River with Lake Superior to represent the cumulative water quality data for the entire watershed. Site 2 was located along the original (prior to 1996) confluence channel, approximately 200 meters downstream from the channel fork. At the time of this Report, the original confluence channel was in-filling through natural sedimentation processes. Sites 3-6 were located along the most developed reaches of the Wolf River in the lower watershed. This section of the Wolf River has been susceptible to active erosion such as stream bank slumping. Sites 3 to 6 were all located on private property and required landowners permission to access. In addition, Site 5 has been the location of previous erosion control work (rip-rap protection). Site 7 was located immediately adjacent to the Wolf Lake Dam. It was chosen to represent the cumulative water quality from the upper watershed and its many tributaries as it enters the single channel, Wolf River, in the lower watershed. Site 8, an outlet pool off Cavern Lake approximately 10 meters off Cavern Lake Road, was chosen to assess the impact of uranium mining in the surrounding area. Cavern Lake drains into a tributary of Wolf Lake. Site 9 was located on the Wolf River in the approximate center of the upper watershed upstream of a bridge that crosses Dorion Cut-off Road. Site 10 was located as close as possible to the headwaters of the Wolf River at Upper Clearwater Lake in an attempt to obtain baseline water quality data. The true headwaters of the Wolf River are located at Upper Wolf Lake, approximately 3.2 km further north-west. However, Upper Wolf Lake was not accessible at the time of sampling in 2009. The UTM coordinates and elevation of each site were marked using the Trimble Geo XH GPS unit as shown on Map M-2, Site Plan.

3.2 Quantitative Assessment

Several parameters were measured to assess surface water quality for the Wolf River. Surface water samples were collected in new clean bottles provided by ALS Laboratory Group, 1081 Barton Street, Thunder Bay, Ontario, for laboratory analysis. The parameters analyzed were conductivity, total dissolved solids, turbidity, nutrients (nitrate, nitrite, ammonia and total phosphorus), bacteria (Escherichia coli and total coliforms), and total metals. Each set of samples were conducted over a three day period due to the size of the watershed. Sampling for the first data set was conducted on June 15, 16 and 17, 2009. The second set was collected on July 13, 14 and 15, 2009.

Methodology for water sample collection was based on the Provincial Water Quality Monitoring Network (PWQO), Ministry of Environment Protocol (2006). Grab samples

were collected away from the stream bank (facing upstream) within the main current either by wading or by using a reaching pole. In order to avoid disturbing as little sediment as possible, effort was taken to enter the river downstream of the sampling location. Additionally, samples were taken upstream of any water crossings and/or outlet culverts. When sampling took place at lakes and pools, such as Upper Clearwater Lake, Wolf Lake and Cavern Lake Outlet Pool, samples were taken away from the shore and facing into wind created currents. Samples were collected at a depth of 0.3 meters below the surface to avoid capturing any floating debris.

ALS Laboratory Group provided four collection bottles for each site: routine, nutrient, metal and bacterial analysis. The sample bottles and lids were rinsed twice before a true sample was collected. Sulfuric acid and nitric acid was added as preservative on site to the nutrient and metal bottles, respectively. Bottles for bacterial analysis 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 sample bottles were transported on ice.

Field parameters of water temperature, pH, conductivity and dissolved oxygen were measured using an YSI 556 MPS meter at the same time as water sample collection. The following additional field parameters were also measured: air temperature by mercury thermometer; channel width using the Bushnell® Yardage Pro™ Sport 450® Laser Rangefinder; channel depth using either the Swoffer Model 2100 Current Velocity Meter (provided by Department of Fisheries & Oceans, Northern Ontario District) or a meter stick. Velocity was also measured using the Swoffer Model 2100 Current Velocity Meter.

Applicable Criteria

Surface water quality results were compared to applicable criteria published in the Provincial Water Quality Objectives (PWQO) protocol by the Ministry of the Environment and Energy (MOEE), July 2004. The goal of the PWQO is to "ensure that the surface waters of the province are of the quality which is satisfactory for aquatic life and recreation". Applicable criteria published in the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Summary Table by the Canadian Council of Resource and Environment Ministers (CCREM), September 2007, were also used for comparison to surface water quality results for the Wolf River watershed. The information in these guidelines and supporting text is used to compliment the PWQO and Interim Objectives.

The applicable criteria published in the PWQO and CCREM water quality guidelines are attached in Appendix C.

3.3 Qualitative Assessment

Watershed health can also be assessed by qualitative monitoring; visual inspection. The composition of in-stream substrate, forest soil and the stream bank riparian community can affect surface water quality. The presence or absence of certain flora and fauna can indicate the status of the watershed to provide suitable habitat.

Flora was assessed using the Field Guide to Forest Ecosystem Classification for Northwestern Ontario (Sims et al. 1997). Each site was evaluated by marking one 10 x 10 metre transect and identifying the species and estimated percent cover within the plot. Each site was given a vegetation type or FEC V-Type. Fauna was assessed by identifying the species and number of individuals observed at each site.

In collaboration with EcoSuperior Environmental Programs, benthic macro invertebrate samples were collected on June 23, 2009 at Site 4 – Wolf River Campground. Samples were collected following the Ontario Benthos Biomonitoring Network (OBBN): Protocol Manual (Jones et al. 2007). Three sub-samples were collected at representative riffle-pool-riffle transects using a 500µm mesh D-net and the Traveling Kick & Sweep Method. Samples were rinsed, placed in glass jars, covered with the preservative ethyl alcohol and delivered to EcoSuperior Environmental Programs, 212 Miles Street East, Thunder Bay for identification and enumeration at a later date. Figures 14, 15 and 16 show the riffle-pool-riffle sub-sample locations and in-stream cobble substrate. Appendix L contains the completed OBBN Stream Field Sheet for Site 4 and results (raw results) from the benthic macro invertebrate samples. In addition, the OBBN Stream Field Sheet was used as a template for each Wolf River sample site (Sites 1-10) to classify the in-stream substrate, riparian vegetative community, aquatic macrophyte, algae and organic matter areal coverage.

Erosion potential and slope stability were assessed using the Slope Stability Rating Chart provided in the Ontario Ministry of Natural Resources Rivers and Stream Systems: Erosion Hazard Limit Technical Guide (2002). A slope instability rating value was given to each site based upon scores for slope inclination, soil stratigraphy, seepage from slope face, slope height, vegetation cover on slope face, table land drainage, proximity of watercourse to slope toe and previous landslide activity. Completed Slope Stability Rating Charts for each sample sites (Sites 1 -10) can be found in Appendix I Soil type (S-Type) was also determined using the Field Guide to Forest Ecosystem Classification for Northwestern Ontario (Sims et al. 1997). In depth soil classification for each site can be found in Appendix F. Soil horizons were observed on a core sample taken with a hand-powered soil auger (provided by the Lakehead University Geology Department). Soil classification should be considered subjective due to sampling error; the presence of large coarse fragments prevented a minimum soil pit/core depth of one metre to sample the parent material.

An inventory of Wolf River water crossings was conducted. Physical dimensions were measured, UTM Coordinates and pictures were taken, and general observations were noted including any barriers to flow, high water marks or fill instability. Bridge locations are shown on Map M-2, the Site Plan. Bridge assessments are attached in Appendix K.

Techniques for data collection can be found in Appendix A.

3.4 Materials

- 500 µm Dip nets
- Bear Bells
- Binoculars
- Bucket
- Bushnell® Yardage Pro™ Sport 450® Laser Rangefinder
- Canoe
- Chest waders
- Clipboard
- Cooler
- Digital camera
- Ethyl alcohol
- Field guides
- Fishing pole with lead and weights
- Flagging Tape
- Fluorescent Orange Vests
- Hand lens
- Hiking shoes
- Ice packs
- Jars
- Knife
- Latex gloves
- Life Jackets
- Lined Paper
- Measuring tape reel
- Mercury thermometer
- Meter stick
- Nets
- OBBN Field Sheets
- OMNR Erosion Sheets
- Paddles
- Paper towel
- Pens and pencils
- Reaching pole
- Road map
- Rope
- Rubber gloves
- Sampling bottles provided by ALS Laboratory Group
- Scissors
- Shovel
- Soil Auger
- Squeeze Bottles
- Stopwatch
- Swoffer Model 2100 Current Velocity Meter

- Topographic map
- Trimble Geo XH GPS
- Tweezers
- Whistle
- Work gloves
- YSI 556 MPS meter
- Ziploc © bags

Field Guides:

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

4 Results

Laboratory water quality results and PWQO criteria have been compared and attached in Appendix D. The original Laboratory Certificates of Analysis and Analytical Reports have been attached in Appendix M.

Results are summarized in the tables below. Legends to the summary tables can be found in Appendix A Techniques for Data Collection.

4.1 Site 1

Location Reference for Site 1	
Location Description	New confluence channel; private property at the end of Bible Camp Road
UTM Coordinates	5407818.657 Northing/ 390163.858 Easting
Altitude/Elevation	182.24 metres above sea level

Field Measurements for Site 1			
Parameter	Unit	Date: 17-JUN-09	Date: 13-JUL-09
		Time: 14:15	Time: 10:55
Water Temperature	ºC	15.88	17.02
Conductivity	uS/cm	140	171
Dissolved Oxygen	mg/L	11.61	10.59
Dissolved Oxygen	%	118.4	108.6
pH		8.63	10.29
Turbidity	NTU	10.10	13.75
Air Temperature	ºC	23	24
Channel Width	m	34	36
Channel Depth	m	1.0m	.45
Flow Rate	m/s	0.18	0.17

Laboratory Water Quality Results for Site 1			
Parameter	Unit	Date: 17-JUN-09	Date: 13-JUL-09
		Time: 14:25	Time: 11:00
Bacteriological			
Escherichia Coli	MPN/100mL	4	26
Total Coliforms	MPN/100mL	440	610
Physical			
Conductivity (EC)	uS/cm	173	204
Total Dissolved Solids	mg/L	103	139
Turbidity	NTU	1.05	2.01
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	1.13	1.50
Nitrate-N (NO3-N)	mg/L	0.064	0.036
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	<0.0050	0.0066
Sulphate (SO4)	mg/L	2.77	3.07

Metals			
Aluminum (Al)	mg/L	0.048	0.071
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0017	0.0021
Iron (Fe)	mg/L	0.136	0.159
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 1					
FEC V-Type: V4 White Birch Hardwood and Mixed Wood					
Species				**% Cover**	
Trees	White Birch			50	
	Balsam Fir			30	
	Trembling Aspen			10	
Shrubs	Mountain Maple			85	
	Salix Spp.			60	
	Balsam Fir			25	
	Red Osier Dogwood			10	
	Speckled Alder			10	
	Trembling Aspen			5	
	Prickly Wild Rose			1	
	Honeysuckle Spp.			<1	
Ground Cover	Lady Fern			50	
	Northern Sweet Coltsfoot			15	
	Canada Anemone			15	
	Common Strawberry			10	
	Red Clover			1	
	Nodding Trillium			<1	
	Pink Pyrola			<1	
	Wild Columbine			<1	
	Northern Bluebell			<1	
	Wild Lily-of-the-valley			<1	
	Gooseberry Spp.			<1	
	Northern Blue Violet			<1	
	Spikemoss			<1	
	Meadow Horsetail			<1	
	Dandelion			<1	
	White Baneberry			<1	
	Early Meadow-Rue			<1	
Aquatic Macrophytes and Algae	Emergent	Abundant	Floating Algae	Absent	
	Rooted Floating	Absent	Filaments	Absent	
	Submergent	Present	Attached Algae	Absent	
	Free Floating	Absent	Slimes or Crusts	Present	

Fauna Observed at Site 1		
Species		**# Observed**
Birds	American Robin	2
	American White Pelican	1
	Bald Eagle	2
	Belted Kingfisher	3
	Common Merganser	1

	Double-crested Cormorant Herring Gull Lesser Scaup Red-winged Blackbird Ruffed Grouse (w/chicks) Spotted Sandpiper Turkey Vulture Wood Duck	1 4 3 2 7 3 1 1
Mammals	Boreal Redback Vole North American River Otter‡	1 1
Reptiles	-	-
Amphibians	Wood Frog	1
Fish	Shorthead Redhorse	2
Mollusca	Freshwater Clams	12
Crustaceans	-	-

Physical Features Observed at Site 1			
FEC S-Type: S2 Fresh/Fine Sandy			
Moderately fresh, fine or very fine sandy deep mineral soils. Developed mainly in glaciofluvial and morainal parent materials. S2 is a common and diverse Type throughout NW Ontario. Although high proportions of coarse fragments can occur, soils of this Type are often pure sands. S2 soils are most commonly associated with jack pine/black spruce stands (this is especially true in the NW Region).			
Slope Stability Rating/ Erosion Potential	42/ Moderate		
In-stream Substrate	Dominant	3 Sand	
	Second Dominant	2 Silt	
	Woody Debris	Present	
	Detritus	Present	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	6	6
	10-30 m	6	6
	30-100 m	6	6
	% Canopy Cover	0-24	

Sample Site 1 resides away from the boundaries of the merging of the Wolf River with Lake Superior, on private property. The area was accessed via a private drive off Bible Camp Road. Water quality samples were taken from a sandbar approximately 100m away from the true confluence. They provide an indication of the quality of water entering Lake Superior at the time of sampling.

The true confluence area itself has formed a delta characterized by small shallow channels and large deeper channels. The delta can be described as a thriving wetland community with cattails being the most dominant form of vegetation. Many varieties of birds have been documented within the area, such as red-winged blackbirds, herring gulls and common cormorants. The remains of many whole trees can be found within the delta and well into Lake Superior, brought there in the past by the confluence breakthrough.

Erosion and bank slumping were frequently encountered within the confluence area (See Appendix I for bank stability results).

All laboratory water quality test parameters for Site 1 were below PWQO Guidelines. This is excellent as water entering the confluence passes through several nearby locations containing residences, agriculture and the Trans Canada Highway. The state of these results show that these nearby factors, including the prominent erosion in the area, are not affecting the quality of water in the Wolf River before it enters Lake Superior.

4.2 Site 2

Location Reference for Site 2	
Location Description	Original Confluence, site almost cut-off from newer main river channel, shallow waters throughout
UTM Coordinates	5407818.657 Northing/ 390163.858Easting
Altitude/Elevation	182.24 meters above sea level

Field Measurements for Site 2			
Parameter	Unit	Date: 17-JUN-09 Time: 14:50	Date: 13-JUL-09 Time: 12:25
Water Temperature	ºC	18.73	19.55
Conductivity	uS/cm	158	196
Dissolved Oxygen	mg/L	10.15	8.14
Dissolved Oxygen	%	108.2	88.2
pH		8.59	9.55
Turbidity	NTU	8.90	22
Air Temperature	ºC	28	20
Channel Width	m	27	26
Channel Depth	m	2	1.4
Flow Rate	m/s	n/a	n/a

Laboratory Water Quality Results for Site 2			
Parameter	Unit	Date: 17-JUN-09 Time: 14:55	Date: 13-JUL-09 Time: 12:30
Bacteriological			
Escherichia Coli	MPN/100mL	23	12
Total Coliforms	MPN/100mL	870	870
Physical			
Conductivity (EC)	uS/cm	186	218
Total Dissolved Solids	mg/L	95	141
Turbidity	NTU	3.25	6.02
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	0.98	1.41
Nitrate-N (NO3-N)	mg/L	<0.030	<0.030
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0120	0.0304
Sulphate (SO4)	mg/L	2.69	2.85
Metals			
Aluminum (Al)	mg/L	0.098	0.158
Cadmium (Cd)	mg/L	<0.000090	<0.000090

Copper (Cu)	mg/L	0.0030	0.0029
Iron (Fe)	mg/L	0.313	0.455
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 2				
FEC V-Type: V4White Birch Hardwood and Mixedwood				
Species			**% Cover**	
Trees	Cedar		20	
	White Spruce		20	
	Black Spruce		10	
	White Birch		5	
	Trembling Aspen		5	
Shrubs	Speckled Alder		60	
	Red Osier Dogwood		15	
	Prickly Wild Rose		5	
	Swamp Red Current		5	
	Balsam		5	
Ground Cover	Grasses		75	
	Moss		50	
	Meadow Horsetail		40	
	Wood Anemone		30	
	Wild Sarsaparilla		10	
	Cow parsnip		>1	
	Early Meadow Rue		>1	
	Large Leaf Spirea		>1	
	White Pea spp.		>1	
	Fragrant Bedstraw		>1	
Aquatic Macrophytes and Algae	Emergent	Abundant	Floating Algae	Absent
	Rooted Floating	Present	Filaments	Absent
	Submergent	Present	Attached Algae	Present
	Free Floating	Present	Slimes or Crusts	Present

Fauna Observed at Site 2		
Species		**# Observed**
Birds	Alder Flycatcher	1
Mammals	-	-
Reptiles	-	-
Amphibians	Tadpoles	50+
Fish	Various juveniles ranging from 2cm-10cm	100+
Mollusca	Fresh Water Clams	6
Crustaceans	-	-

Physical Features Observed at Site 2		
FEC S-Type: S2 Fresh/Fine Sandy		
Moderately fresh, fine or very fine sandy deep mineral soils. Developed mainly in glaciofluvial and morainal parent materials. S2 is a common and diverse Type throughout NW Ontario. Although high proportions of coarse fragments can occur, soils of this Type are often pure sands. S2 soils are most commonly associated with jack pine/black spruce stands (this is especially true in the NW Region).		
Slope Stability Rating/ Erosion Potential	20/ Low	
In-stream Substrate	Dominant	3 Sand
	Second Dominant	2 Silt
	Woody Debris	Present

	Detritus	Present	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	6	6
	10-30 m	6	6
	30-100 m	6	6
	% Canopy Cover	0-24	

Sampling at Site 2 was conducted within a meander of the original confluence. The meander was reached by portaging over a heavily vegetated land bridge, across from Site 1. Site 2 is characterized by warm shallow waters, sandy substrate and dense aquatic vegetation that borders the shoreline. The near shore vegetation provides habitation for numerous juvenile fish, ranging in size from 2 to 6 cm, as well as tadpoles. Erosion was encountered infrequently (See Appendix I for bank stability results).

Phosphorus (P), Aluminum (Al), and Iron (Fe) were above the PWQO Guidelines at Site 2. Phosphorus, at a concentration of 0.0304 mg/L, exceeded PWQO Guidelines of 0.03 mg/L on July 13, 2009. Aluminum, at concentrations of 0.098 mg/L and 0.158 mg/L, exceeded PWQO Guidelines of 0.075 mg/L on June 17 and July 13, 2009. Iron exceeded PWQO Guidelines, guideline of 0.3 mg/L, with concentrations of 0.313 and 0.455 mg/L. Probable sources for the elevated concentrations of these parameters include the large amount of submerged aquatic vegetation encountered at this site and natural geological formations. Though the substrate of Site 2 is composed mainly of sand, the substrate overlies igneous parent material which has been shown to contain substantial amounts of these metals. Sand grains in the area also appeared to contain iron oxides.

4.3 Site 3

Location Reference for Site 3	
Location Description	Decommissioned CNR rail bridge, private property off Bible Camp Road
UTM Coordinates	5408050.517 Northing/ 388921.444 Easting
Altitude/Elevation	186.13 meters above sea level

Field Measurements for Site 3			
Parameter	Unit	Date: 15-JUN-09 Time: 14:35	Date: 13-JUL-09 Time: 13:29
Water Temperature	ºC	17.69	17.90
Conductivity	uS/cm	160	176
Dissolved Oxygen	mg/L	10.81	11.50
Dissolved Oxygen	%	113.5	121.1
pH		7.85	9.18
Turbidity	NTU	14.30	14.85
Air Temperature	ºC	30	26
Channel Width	m	29	33
Channel Depth	m	0.55	0.84
Flow Rate	m/s	1.70	1.08

Laboratory Water Quality Results for Site 3			
Parameter	Unit	Date: 15-JUN-09 Time: 14:41	Date: 13-JUL-09 Time: 13:30
Bacteriological			
Escherichia Coli	MPN/100mL	4	23
Total Coliforms	MPN/100mL	440	340
Physical			
Conductivity (EC)	uS/cm	165	205
Total Dissolved Solids	mg/L	123	129
Turbidity	NTU	0.93	1.34
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	0.99	1.56
Nitrate-N (NO3-N)	mg/L	0.062	0.040
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0095	0.0169
Sulphate (SO4)	mg/L	2.79	3.09
Metals			
Aluminum (Al)	mg/L	0.048	0.070
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0024	0.0018
Iron (Fe)	mg/L	0.150	0.144
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 3		
FEC V-Type: V2 Black Ash Hardwood and Mixedwood		
Species		**% Cover**
Trees	White Birch	15
	White Spruce	15
	Trembling Aspen	5
	Eastern White Cedar	2
	Black Ash	2
Shrubs	Mountain Maple	90
	Balsam Fir	80
	Speckled Alder	50
	White Birch	10
	Red Osier Dogwood	10
	Salix Spp.	5
	Swamp Red Current	5
	Prickly Wild Rose	1
	Pin Cherry	<1
	Pussy Willow	<1
	Slender Willow	<1
	Current Spp.	<1
Ground Cover	Wild Sarsaparilla	70
	Bog Moss	50
	Common Strawberry	15
	Lady Fern	15
	Red Clover	5
	Dandelion	<1
	Purple Vetch	<1
	Wood Anemone	<1

	Wild Columbine		<1	
	Northern Blue Violet		<1	
	Nodding Trillium		<1	
	Northern Bluebell		<1	
	Meadow Horsetail		<1	
	Bunch Berry		<1	
	Rose-Twisted Stalk		<1	
	Cow Parsnip		<1	
	Early Meadow Rue		<1	
	Water Plantain		<1	
	Star-Flowered-Solomon's-Seal		<1	
	Wild Lily-of-the-valley		<1	
	Large Leaved aster		<1	
Aquatic Macrophytes and Algae	Emergent	Absent	Floating Algae	Absent
	Rooted Floating	Absent	Filaments	Absent
	Submergent	Absent	Attached Algae	Absent
	Free Floating	Absent	Slimes or Crusts	Absent

Fauna Observed at Site 3		
Species		**# Observed**
Birds	American Robin	1
	Barred Owl	1
	Belted Kingfisher	3
	Chipping Sparrow	3+
	Common Merganser	3
	Rock Pigeon	2
Mammals	-	-
Reptiles	-	-
Amphibians	-	-
Fish	Shorthead Redhorse	3
	White Sucker	10+
	Yellow Perch (Juveniles)	20+
Mollusca	-	-
Crustaceans	-	-

Physical Features Observed at Site 3			
FEC S-Type: S1 Dry/Coarse Sandy			
Moderately dry, medium to very coarse sandy soils. Developed primarily in glaciofluvial parent materials. S1 is a diverse Type found commonly throughout NW Ontario. On bedrock controlled topography, soils of S1 may intergrade with those of SS5.			
Slope Stability Rating/ Erosion Potential	24/low		
In-stream Substrate	Dominant	5 Cobbles	
	Second Dominant	2 Gravel	
	Woody Debris	Absent	
	Detritus	Absent	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	5	2
	10-30 m	5	2
	30-100 m	5	3
	% Canopy Cover	0-24	

Site 3 was also located on private property, downstream of an abandoned CNR Rail Bridge. The site was defined by relatively steep sandy slopes and cobble stream bottom. Large piles of instream woody debris have also been creating sandbars in the immediate area of the rail bridge. The deeper channels bordering the sandbar have become habitat for a variety of fish including white suckers and trout. Bald Eagles and Belted Kingfishers have also been observed frequenting the area.

Laboratory water quality parameters for this site did not exceed PWQO guidelines. The low levels of the laboratory parameters show that past activities on the CNR Bridge do not appear to be affecting water quality. Additionally, an old hollow drum was located in the river channel, half submerged in sediment. The water quality results indicate that the drum does not appear to be releasing any large traceable amounts metals into the river.

4.4 Site 4

Location Reference for Site 4	
Location Description	Wolf River Campground, upstream from DFO Sea Lamprey Weir, site of benthic collection
UTM Coordinates	5408782.928 Northing/387163.628 Easting
Altitude/Elevation	188.55 meters above sea level

Field Measurements for Site 4			
Parameter	Unit	Date: 16-JUN-09 Time: 10:30	Date: 13-JUN-09 Time: 14:16
Water Temperature	ºC	12.72	18.05
Conductivity	uS/cm	122	171
Dissolved Oxygen	mg/L	12.31	11.06
Dissolved Oxygen	%	116.0	117.0
pH		9.15	8.86
Turbidity	NTU	10.30	13.85
Air Temperature	ºC	22	21.5
Channel Width	m	24	22
Channel Depth	m	0.55	0.36
Flow Rate	m/s	0.8	0.42

Laboratory Water Quality Results for Site 4			
Parameter	Unit	Date: 16-JUN-09 Time: 10:36	Date: 13-JUL-09 Time: 14:18
Bacteriological			
Escherichia Coli	MPN/100mL	3	20
Total Coliforms	MPN/100mL	520	610
Physical			
Conductivity (EC)	uS/cm	160	199
Total Dissolved Solids	mg/L	123	130
Turbidity	NTU	0.93	1.49
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	0.72	0.89
Nitrate-N (NO3-N)	mg/L	0.070	0.041

Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0058	0.0141
Sulphate (SO4)	mg/L	2.77	3.01
Metals			
Aluminum (Al)	mg/L	0.042	0.104
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0019	0.0018
Iron (Fe)	mg/L	0.142	0.141
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 4					
FEC V-Type: V1 Balsam Poplar Hardwood and Mixedwood					
Species			**% Cover**		
Trees	Balsam Poplar White Spruce Trembling Aspen White Birch White Pine Red Pine		30 10 10 5 1 1		
Shrubs	Balsam Fir Speckled Alder Mountain Maple Salix Spp. Red Osier Dogwood Gooseberry Spp. Honeysuckle Spp.		75 20 10 5 2 1 1		
Ground Cover	Wild Sarsaparilla Naked Mitrewort Violet Dandelion Birdsfoot Trefoil Wild Columbine Red Clover Grasses White Sweet Clover Cow Vetch Pineapple Weed Wild Strawberry		20 10 10 5 <1 <1 <1 <1 <1 <1 <1 <1		
Aquatic Macrophytes and Algae	Emergent	Absent	Floating Algae	Absent	
	Rooted Floating	Absent	Filaments	Absent	
	Submergent	Absent	Attached Algae	Absent	
	Free Floating	Absent	Slimes or Crusts	Absent	

Fauna Observed at Site 4		
Species		**# Observed**
Birds	American Crow	1
	American Robin	1
	Bald Eagle	1
	Herring Gull	2
	Red-tailed Hawk	1
	Ruffed Grouse	1
	Tennessee Warbler	3

Mammals	Eastern Chipmunk Eastern Cottontail	1 1
Reptiles	-	-
Amphibians	American Toad	1
Fish	Moltted Sculpin Brook Trout (fry)	1 4
Mollusca	-	-
Crustaceans	Northern Clearwater Crayfish	2

Physical Features Observed at Site 4			
FEC S-Type: S5 Fresh Fine Loamy			
Fresh, fine loamy soils. Most commonly developed in lacustrine parent materials. S5 soil are most commonly associated with shrub rich, hardwood dominated stands. S5 is uncommon throughout NW Ontario. In the NW Region, S5 soils develop primarily in lacustrine deposits.			
Slope Stability Rating/ Erosion Potential	68/ Moderate (VERY HIGH)		
In-stream Substrate	Dominant	5 Cobbles	
	Second Dominant	4 Gravel	
	Woody Debris	Absent	
	Detritus	Absent	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	2	6
	10-30 m	2	6
	30-100 m	2	6
	% Canopy Cover	0-24	

Site 4 was located on the property of the Wolf River Campground. This site was chosen to represent any impacts from the campground and due to the high rate of erosion that is occurring along the meanders of the river. High water marks indicated that water levels have encroached on the campground property at certain times of the year. Downstream of Site 4 the Wolf River lamprey weir was constructed by the Department of Fisheries and Oceans.

All laboratory water quality parameters, with the exception of aluminum, were below PWQO Guidelines. On July 13, 2009 aluminum, at a concentration of 0.104 mg/L, exceeded guidelines of 0.75 mg/L. This is higher than the June 16th sample of 0.042 mg/L.

4.5 Site 5

Location Reference for Site 5	
Location Description	Privately owned property, bailey bridge, in proximity to an escarpment.
UTM Coordinates	5409977.073 Northing/385377.260 Easting
Altitude/Elevation	199.65 meters above sea level

Field Measurements for Site 5			
Parameter	Unit	Date: 16-JUN-09	Date: 14-JUL-09
		Time: 11:10	Time: 10:56
Water Temperature	ºC	13.02	15.56
Conductivity	uS/cm	122	160
Dissolved Oxygen	mg/L	11.89	11.24
Dissolved Oxygen	%	112.8	112.8
pH		8.69	9.60
Turbidity	NTU	9	6.45
Air Temperature	ºC	22	26
Channel Width	m	23	22
Channel Depth	m	1.2	0.9
Flow Rate	m/s	0.37	.04

Laboratory Water Quality Results for Site 5			
Parameter	Unit	Date: 16-JUN-09	Date: 14-JUL-09
		Time: 11:16	Time: 11:00
Bacteriological			
Escherichia Coli	MPN/100mL	4	21
Total Coliforms	MPN/100mL	440	460
Physical			
Conductivity (EC)	uS/cm	159	197
Total Dissolved Solids	mg/L	126	128
Turbidity	NTU	0.72	0.80
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	0.69	0.85
Nitrate-N (NO3-N)	mg/L	0.067	0.037
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0065	<0.0050
Sulphate (SO4)	mg/L	2.70	2.90
Metals			
Aluminum (Al)	mg/L	0.034	0.032
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0018	0.0015
Iron (Fe)	mg/L	0.133	0.087
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 5		
FEC V-Type: V 35 Black Spruce/Speckled Alder/Sphagnum		
Species		**% Cover**
Trees	Black Spruce	40
	White Birch	10
	Balsam Fir	5
	White Spruce	1
	Balsam Poplar	1
	Eastern White Cedar	1
	Trembling Aspen	1
Shrubs	Speckled Alder	80
	Mountain Maple	50

	Red Osier Dogwood		10	
	Prickly Wild Rose		10	
	Balsam Willow		5	
	Balsam Poplar		5	
	Wild Red Raspberry		1	
Ground Cover	Sphagnum Spp.		90	
	Naked Mitrewort		80	
	Red Twisted Stalk		75	
	Wild Sarsaparilla		75	
	Dwarf Raspberry		60	
	Field Horsetail		40	
	Bunchberry		15	
	Common Strawberry		15	
	Cream Colored Vetchling		<1	
	Forest Vetchling		<1	
	Water Horsetail		<1	
	Red Sweet Clover		<1	
	Canada Mayflower		<1	
	Thyme Leaved Sandwort		<1	
	Common Plantain		<1	
	Golden Rod		<1	
	Cinnamon Fern		<1	
	Feather Moss		<1	
	Twin Flower		<1	
	Common Yarrow		<1	
	Orange Hawkweed		<1	
	Buttercup		<1	
	Leather Leaf		<1	
	Tall White Bog Orchid		<1	
Aquatic Macrophytes and Algae	Emergent	Absent	Floating Algae	Absent
	Rooted Floating	Absent	Filaments	Absent
	Submergent	Absent	Attached Algae	Absent
	Free Floating	Absent	Slimes or Crusts	Present

Fauna Observed at Site 5		
Species		**# Observed**
Birds	Cedar Waxwing	2
	Common Merganser	1
	Common Raven	1
	Northern Flicker	1
	Ring-necked Duck	1
	Tennessee Warbler	3
	White Throated Sparrow	1
Mammals	Eastern Cottontail	1
	Raccoon (Identified by tracks)	1
	Red Fox (Identified by tracks)	1
Reptiles	-	-
Amphibians	-	-
Fish	Brook Trout (fry)	30+
	Lake Chub	5
Mollusca	-	-
Crustaceans	Northern Clearwater Crayfish	1

Physical Features Observed at Site 5			
FEC S-Type: S7 Moist/Sandy			
Moderately moist to very moist, sandy soils. S7 soils develop mainly in glaciofluvial deposits. S7 soils are most frequently associated with stands containing a significant component of jack pine and/or black spruce.			
Slope Stability Rating/ Erosion Potential	22/ Low		
In-stream Substrate	Dominant	3 Sand	
	Second Dominant	5 Cobble	
	Woody Debris	Absent	
	Detritus	Absent	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	5	1
	10-30 m	5	2
	30-100 m	5	3
	% Canopy Cover	0-24	

Site 5 resides on privately owned property but was chosen as a sampling site based on a request from the property owner. The request was based on previous reports that indicated that erosion was a reoccurring problem within the area. These reports included photo documentation of slope failures, indicating that large amounts of sediment could be entering the water. Remediation for some of the slopes included the use of large boulders to stabilize the slope. Test results for TDS and turbidity indicated that the potential sedimentation effects upstream where not effecting water quality in the immediate area of the bridge or Site 5. This was also confirmed by the abundance of juvenile trout and mature minnows documented within the immediate area of the bridge.

Though this is a semi-urbanized location, Site 5 provides habitat for a variety of wildlife. Across to the north side of the bridge, the integrity of the forest has been preserved by having minimal disturbance with the exception of the small dirt road.

All laboratory water quality parameters were under PWQO Guidelines. pH was again relatively high but appeared to be posing no threat to aquatic communities.

4.6 Site 6

Location Reference for Site 6	
Location Description	MNR Fish Hatchery Sub-station and rapids
UTM Coordinates	5410861.574 Northing/384054.706 Easting
Altitude/Elevation	201.92 meters above sea level

Field Measurements for Site 6			
Parameter	Unit	Date:16-JUN-09 Time: 12:13	Date: 14-JUN-09 Time: 12:15
Water Temperature	ºC	14.41	16.13
Conductivity	uS/cm	130	178
Dissolved Oxygen	mg/L	12.05	11.39
Dissolved Oxygen	%	118.0	114
pH		8.66	9.00

Turbidity	NTU	10.55	13.70
Air Temperature	ºC	23	27
Channel Width	m	20	17
Channel Depth	m	0.55	0.21
Flow Rate	m/s	1.19	0.84

Laboratory Water Quality Results for Site 6			
Parameter	Unit	Date: 16-JUN-09 Time: 12:20	Date: 14-JUL-09 Time: 12:15
Bacteriological			
Escherichia Coli	MPN/100mL	1	12
Total Coliforms	MPN/100mL	520	490
Physical			
Conductivity (EC)	uS/cm	163	185
Total Dissolved Solids	mg/L	121	128
Turbidity	NTU	0.58	0.81
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	0.61	0.76
Nitrate-N (NO3-N)	mg/L	0.060	0.032
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0056	<0.0050
Sulphate (SO4)	mg/L	2.79	2.83
Metals			
Aluminum (Al)	mg/L	0.031	0.042
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0018	0.0014
Iron (Fe)	mg/L	0.127	0.091
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 6		
FEC V-Type: V 6 Trembling Aspen (White Birch)-Balsam Fir/Mountain Maple		
Species		**% Cover**
Trees	Trembling Aspen	70
	Balsam Fir	40
	White Pine	15
	White Birch	1
Shrubs	Mountain Maple	40
	Salix Spp.	20
	Prickly Wild Rose	15
	Red Osier Dogwood	5
	Wild Raspberry	1
Ground Cover	Large Leaf Aster	75
	Wild Sarsaparilla	40
	Dwarf Raspberry	40
	Common Strawberry	30
	Dandelion	5
	Sweet Red Clover	<1
	Buttercup	<1
	Cow Parsnip	<1
	Mountain Blue-eyed Grass	<1
	Northern Bluebell	<1

	Fragrant Bedstraw Bunchberry		<1 <1	
Aquatic Macrophytes and Algae	Emergent	Absent	Floating Algae	Absent
	Rooted Floating	Absent	Filaments	Absent
	Submergent	Absent	Attached Algae	Absent
	Free Floating	Absent	Slimes or Crusts	Absent

Fauna Observed at Site 6		
Species		**# Observed**
Birds	American Robin Downy Woodpecker	1 1
Mammals	-	-
Reptiles	-	-
Amphibians	-	-
Fish	Brook Trout	2
Mollusca	-	-
Crustaceans	-	-

Site 6 was located on the grounds of the Ministry of Natural Resources Fish Hatchery Sub-Station. Samples were collected downstream from the prominent set of rapids that characterize this section of the river. The site was accessed via a steep dirt road that showed signs of erosion in the form of rills and mild gulling. The immediate area of Site 6 showed no signs of erosion and appeared to be well stabilized by large rock fill and vegetation. Erosion materials from the road did not appear to be making their way into the river either, as represented by TDS and turbidity parameters. Also present was a large bedrock outcrop which aids in stabilizing the bank in the immediate area of the sample site. The outcrop also creates a pool adjacent to the rapids where trout have been documented. Small amounts of attached algae were also observed at the site.

Additionally, groundwater seepage was visibly present on bedrock outcrops and was entering the river in some locations. This is expected as the Sub-station uses groundwater springs as the source of water for fisheries pools. The rationale behind this is that the ground water provides a source of water at a relatively constant cool temperature.

Laboratory water quality results for Site 6, as with the majority of sites, remained under PWQO Guidelines; however, pH remained relatively high.

4.7 Site 7

Location Reference for Site 7	
Location Description	Wolf Lake, sampling done in lake before dam. Several bonfire pits close to water's edge, lots of broken beer bottles.
UTM Coordinates	5413281.590 Northing/381345.897 Easting
Altitude/Elevation	259.01 meters above sea level

Field Measurements for Site 7			
Parameter	Unit	Date: 16-JUN-09 Time: 13:42	Date: 14-JUL-09 Time: 13:48
Water Temperature	ºC	14.89	18.44
Conductivity	uS/cm	123	152
Dissolved Oxygen	mg/L	11.25	10.87
Dissolved Oxygen	%	111.3	115.9
pH		8.45	8.71
Turbidity	NTU	4.90	7.50
Air Temperature	ºC	25	28
Channel Width	m	90	96
Channel Depth	m	n/a	n/a
Flow Rate	m/s	n/a*	n/a*

* Flow in river immediately after dam was 0.166 m/s on 16-JUN-09 and 0.08463279 m/s on 14-JUL-09.

Laboratory Water Quality Results for Site 7			
Parameter	Unit	Date: 16-JUN-09 Time: 13:48	Date: 14-JUL-09 Time: 13:53
Bacteriological			
Escherichia Coli	MPN/100mL	3	0
Total Coliforms	MPN/100mL	36	82
Physical			
Conductivity (EC)	uS/cm	153	176
Total Dissolved Solids	mg/L	125	123
Turbidity	NTU	1.29	1.22
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	0.58	0.77
Nitrate-N (NO3-N)	mg/L	0.056	<0.030
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0055	0.0052
Sulphate (SO4)	mg/L	2.73	2.88
Metals			
Aluminum (Al)	mg/L	0.047	0.047
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0018	0.0014
Iron (Fe)	mg/L	0.152	0.105
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 7		
FEC V-Type: V 5 Aspen Harwood		
Species		**% Cover**
Trees	Trembling Aspen	70
	Balsam Poplar	10
	White Spruce	2
	White Birch	1
	Red Pine	1
	Black Ash	<1
Shrubs	Red Osier Dogwood	40

	Prickly Wild Rose Wild Red Raspberry Speckled Alder Beaked Hazel Salix Spp. Balsam Fir Current Spp. Saskatoon		30 30 20 15 10 5 1 1	
Ground Cover	Common Strawberry Large Leaf Aster Wild Sasparilla Dwarf Raspberry Canada Anemone Canada Mayflower Fragrant Bedstraw Buttercup Meadow Horsetail Dandelion Sphagnum Spp.		75 50 30 20 2 1 1 <1 <1 <1 <1	
Aquatic Macrophytes and Algae	Emergent	Present	Floating Algae	Absent
	Rooted Floating	Absent	Filaments	Absent
	Submergent	Absent	Attached Algae	Present
	Free Floating	Absent	Slimes or Crusts	Abundant

Fauna Observed at Site 7		
Species		**# Observed**
Birds	American Robin American White Pelican Blue Jay Cedar Waxwing† Common Raven Chipping Sparrow Hairy Woodpecker Turkey Vulture White Throated Sparrow	1 2 2 7 1 3 1 1 1
Mammals	Eastern Chipmunk Wolves (howling/barking heard away from dam near sloppy talus)	1 2+
Reptiles	-	-
Amphibians	-	-
Fish	Yellow Perch	2
Mollusca	-	-
Crustaceans	-	-

Physical Features Observed at Site 7		
FEC S-Type: SS1 Discontinuous Organic Mat on Bedrock		
Discontinuous moss and lichen cover, with no mineral soil matrix, overlying bedrock. Bedrock is typically exposed. Developing on bedrock outcrops. SS1 is encountered through NW Ontario, frequently associated with severe topography and steep slopes. Soils of this Type may intergrade with those of other shallow soil types across, for example, ridge and swale bedrock landscapes.		
Slope Stability Rating/ Erosion Potential	17/ Low	
In-stream Substrate	Dominant	6 Boulder
	Second Dominant	3 Sand

	Woody Debris	Absent	
	Detritus	Absent	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	6	3
	10-30 m	6	3
	30-100 m	6	6
	% Canopy Cover	0-24	

Site 7 sampling location was conducted at Wolf Lake, before the Wolf River Dam. Wolf Lake is the largest water body that the Wolf River flows through. The water levels appear to be sustained by the Wolf River Dam, which allows for lake elevation to be much higher than that of the elevation of the downstream river channel. This lake provides habitat for many fish and birds, including the rare American White Pelican. Two were documented resting on a bedrock island.

Soil erosion around the sample site, next to the dam, was minimal due to the use of large boulders as fill. All banks near the sample site were comprised of distributed vegetation zones with grasses, shrubs and small trees. Laboratory water quality results were below PWQO Guidelines indicating the excellent health of Wolf Lake.

4.8 Site 8

Location Reference for Site 8	
Location Description	Cavern Lake outlet pool. Pool appears to be created by beaver dams. Outflows across Cavern Lake Road and reforms a channel in adjacent forest.
UTM Coordinates	5410766 Nothing/378078 Easting
Altitude/Elevation	-

Field Measurements for Site 8			
Parameter	Unit	Date: 16-JUN-09	Date: 30-July
		Time: 15:00	Time: 13:20
Water Temperature	ºC	21.68	21.28
Conductivity	uS/cm	93	89
Dissolved Oxygen	mg/L	10.56	8.94
Dissolved Oxygen	%	120.1	100.7
pH		8.64	9.00
Turbidity	NTU	9.10	-
Air Temperature	ºC	25	-
Channel Width	m	13	-
Channel Depth	m	0.5	-
Flow Rate	m/s	n/a*	-

*No flow measurements taken in outlet pool. A measurement of 0.622 m/s was taken from water exiting the beaver dam closest to the road.

Laboratory Water Quality Results for Site 8			
Parameter	Unit	Date: 16-JUN-09	n/a
		Time: 15:13	n/a

Bacteriological			
Escherichia Coli	MPN/100mL	1	n/a
Total Coliforms	MPN/100mL	250	n/a
Physical			
Conductivity (EC)	uS/cm	99.2	n/a
Total Dissolved Solids	mg/L	96	n/a
Turbidity	NTU	0.29	n/a
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	n/a
Chloride (Cl)	mg/L	0.30	n/a
Nitrate-N (NO3-N)	mg/L	0.049	n/a
Nitrite-N (NO2-N)	mg/L	<0.020	n/a
Phosphorus (P)-Total	mg/L	0.0115	n/a
Sulphate (SO4)	mg/L	2.31	n/a
Metals			
Aluminum (Al)	mg/L	0.052	n/a
Cadmium (Cd)	mg/L	<0.000090	n/a
Copper (Cu)	mg/L	0.0026	n/a
Iron (Fe)	mg/L	0.084	n/a
Lead (Pb)	mg/L	<0.0010	n/a

Flora Observed at Site 8		
FEC V-Type: V 22 Cedar/Speckled Alder/Sphagnum		
Species		**% Cover**
Trees	Eastern White Cedar	70
	Balsam Fir	40
	Black Spruce	30
	Black Ash	5
	Trembling Aspen	2
	White Birch	1
Shrubs	Early Meadow-rue	40
	Speckled Alder	20
	Wild Red Raspberry	20
	Sweet Gale	15
	Red Osier Dogwood	15
	Mountain Maple	10
	Salix. Spp.	10
	Prickly Wild Rose	1
	Buffalo Berry	1
	Canada Elderberry	<1
Ground Cover	Peat Moss	90
	Common Strawberry	40
	Wild Columbine	20
	Northern Marsh Violet	15
	Spirea	15
	Large Leaf Aster	10
	Sedges	10
	Sweet Coltsfoot	5
	Ox Eyed Daisy	<1
	Silverwort	<1
	Fragrant Bedstraw	<1
	Northern Blueflag	<1
	Wood Lily	<1

Aquatic Macrophytes and Algae	Emergent	Present	Floating Algae	Absent
	Rooted Floating	Abundant	Filaments	Absent
	Submergent	Absent	Attached Algae	Absent
	Free Floating	Absent	Slimes or Crusts	Abundant

Fauna Observed at Site 8		
Species		**# Observed**
Birds	Pileated Woodpecker White Throated Sparrow	1 1
Mammals	Beaver	1 (lodge, dam)
Reptiles	-	-
Amphibians	Wood Frog	15+
Fish	Brook Stickleback Northern Redbelly Dace	2 20+
Mollusca	-	-
Crustaceans	Rusty Crayfish	3

Physical Features Observed at Site 8			
FEC S-Type: SS9 Shallow – Moderately Deep/Organic – Peaty Phase			
Shallow to moderately deep, organic and peaty phase (mineral) soils. Bedrock is generally encountered between 50 and 100 cm below the soil surface. SS9 is an uncommon soil throughout NW Ontario. These shallow, organic/peaty phase soils are limited in extent, generally developing in depressional landscape positions where drainage is impeded by bedrock.			
Slope Stability Rating/ Erosion Potential	2/ Low (VERY LOW)		
In-stream Substrate	Dominant	5 Cobble	
	Second Dominant	6 Boulder	
	Woody Debris	Absent	
	Detritus	Absent	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	5	5
	10-30 m	5	5
	30-100 m	5	5
	% Canopy Cover	50-74	

Site 8 resides on the edge of the meeting of the Cavern Lake outlet pool with Cavern Lake Road. The outlet pool, and the section that overflows the road, has been documented as providing habitat for a healthy population of wood frogs. A variety of minnow species including dace and sticklebacks have been observed in large numbers within the pool itself.

LRCA staff documented two beaver dams, one on the western side of the pool and one on the eastern side bordering the road. These dams sustain water levels within the outlet pool and allow water to overflow the low-lying land in this area. This creates for a variety of forest pools.

Collection of a second set of samples on July 14th 2009 was impeded by the construction of a bridge on Cavern Lake Road. Construction was administered by the MNR, as

indicated by a road sign. The completed project, viewed on July 30th 2009, consisted of a small wooden bridge. Straw mats were used to prevent erosion until the natural growth of vegetation took over. Water quality parameters, by means of YSI, were collected on July 30th 2009. A full set of laboratory samples were not collected.

All laboratory water quality parameters from the one set of samples were under the PWQO Guidelines. YSI measurements were also indicative of good water quality. Dissolved oxygen levels, DO%, indicated an abundance of oxygen with measurements of 120.1 % and 100.7%.

4.9 Site 9

Location Reference for Site 9	
Location Description	Bridge crossing the Wolf River, found on the lower part of the Dorion cut-off road. Several bedrock outcrops encountered.
UTM Coordinates	5419798.200 Northing/368261.738 Easting
Altitude/Elevation	329.64 meters above sea level

Field Measurements for Site 9			
Parameter	Unit	Date: 17-JUN-09	Date: 15-JUL-09
		Time: 12:47	Time: 11:50
Water Temperature	ºC	18.31	18.14
Conductivity	uS/cm	100	139
Dissolved Oxygen	mg/L	10.29	9.26
Dissolved Oxygen	%	109.2	98.4
pH		8.67	9.14
Turbidity	NTU	13.00	8.20
Air Temperature	ºC	29	21
Channel Width	m	20	19
Channel Depth	m	0.5	0.17
Flow Rate	m/s	1.56	0.25

Laboratory Water Quality Results for Site 9			
Parameter	Unit	Date: 17-JUN-09	Date: 15-JUL-09
		Time: 12:54	Time: 12:00
Bacteriological			
Escherichia Coli	MPN/100mL	23	8
Total Coliforms	MPN/100mL	770	330
Physical			
Conductivity (EC)	uS/cm	117	159
Total Dissolved Solids	mg/L	82	109
Turbidity	NTU	0.78	0.95
Nutrients and Anions			
Ammonia-N, Total	mg/L	0.021	<0.020
Chloride (Cl)	mg/L	0.34	0.49
Nitrate-N (NO3-N)	mg/L	0.041	<0.030
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	<0.0050	<0.0050
Sulphate (SO4)	mg/L	2.03	2.17

Metals			
Aluminum (Al)	mg/L	0.065	0.058
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0019	0.0014
Iron (Fe)	mg/L	0.186	0.177
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 9					
FEC V-Type: V 23 Tamarack (Black Spruce)/Speckled Alder/Labrador Tea					
Species				**% Cover**	
Trees	Eastern White Cedar			50	
	Tamarack			40	
	Balsam Fir			10	
	White Spruce			2	
	White Birch			1	
	Trembling Aspen			1	
Shrubs	Balsam Fir			25	
	Ninebark			15	
	Prickly Wild Rose			2	
	Speckled Alder			2	
	Salix Spp.			<1	
	High Bush Cranberry			<1	
	Red Osier Dogwood			<1	
	Chokecherry			<1	
	Bush Honeysuckle			<1	
	Saskatoon			<1	
	Dwarf Raspberry			<1	
	Buffalo Berry			<1	
	Bearberry			<1	
Ground Cover	Common Fern Moss			90	
	Stair Step Moss			90	
	Wavy Moss			90	
	Sphagnum Moss			90	
	Woodland Strawberry			30	
	Wood Lily			5	
	Wild Sasparilla			5	
	Large Leafed Aster			2	
	Kidney-leaved Violet			2	
	Montane Blueeyed Grass			<1	
	Wild Chives			<1	
	Early Meadowrue			<1	
	Ox Eyed Daisy			<1	
	Stone Crop			<1	
	Orange Hawkweed			<1	
	Corn Sow Thistle			<1	
	Red Clover			<1	
	Hop Clover			<1	
	Field Chickweed			<1	
	Conifer Leaf Litter			<1	
Aquatic Macrophytes and Algae	Emergent	Present	Floating Algae	Absent	
	Rooted Floating	Present	Filaments	Absent	
	Submergent	Present	Attached Algae	Absent	
	Free Floating	Absent	Slimes or Crusts	Present	

Fauna Observed at Site 9		
Species		**# Observed**
Birds	American Crow Eastern Kingbird Mallard Duck (w/Ducklings)	2 1 6
Mammals	-	-
Reptiles	-	-
Amphibians	-	-
Fish	-	-
Mollusca	-	-
Crustaceans	-	-

Physical Features Observed at Site 9			
FEC S-Type: SS1 Discontinuous Organic Mat on Bedrock			
Discontinuous moss and lichen cover, with no mineral soil matrix, overlying bedrock. Bedrock is typically exposed. Developing on bedrock outcrops. SS1 is encountered through NW Ontario, frequently associated with severe topography and steep slopes. Soils of this Type may intergrade with those of other shallow soil Types across, for example, ridge and swale bedrock landscapes.			
Slope Stability Rating/ Erosion Potential	10/ Low		
In-stream Substrate	Dominant	5 Cobbles	
	Second Dominant	7 Bedrock	
	Woody Debris	Absent	
	Detritus	Absent	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	5	5
	10-30 m	5	5
	30-100 m	5	5
	% Canopy Cover	0-24	

At Site 9, water quality samples were taken in a relatively fast flowing area characterized by an outcropping of the iron rich Sibley Formation. The stream bed and bank material was composed of bedrock and broken off fragments. This created for a section of river with low turbidity and high dissolved oxygen percent levels. The area in the immediate area of the sample site possessed very little soil cover and supported a well defined community of tamarack. Frequent bedrock exposures were found within the stand. Due to the lack of easily erodible material, this site has a very low erosion potential. As evident by bonfire pits, angling and hunting equipment, Site 9 is also a frequent stopover for outdoor enthusiasts.

Also characteristic of Site 9 is the presence of a bridge, which is a segment of the well traveled Dorion Cut-Off Road. The bridge acts as a shelter creating a calmer downstream aquatic environment, which supports a large community of aquatic macrophytes. Upstream of the bridge a female Mallard Duck was observed with ducklings. This suggests that the area may provide a potential food source for ducklings.

Water quality parameters do not appear to be affected by the area's frequent traffic, as indicative by all laboratory parameters being under the PWQO Guideline limits. YSI parameters also suggest a healthy aquatic system.

4.10 Site 10

Location Reference for Site 10	
Location Description	Upper Clearwater Lake. Natural forest conditions immediate of lake. 50m away to NE, evidence of tree plantation. Across lake to SW appears to be a clear cut.
UTM Coordinates	5424329.145 Northing/ 360417.757 Easting
Altitude/Elevation	371.80 meters above sea level

Field Measurements for Site 10			
Parameter	Unit	Date: 17-JUN-09 Time: 11:39	Date: 15-JUL-09 Time: 10:26
Water Temperature	ºC	20.04	17.36
Conductivity	uS/cm	98	127
Dissolved Oxygen	mg/L	9.77	9.28
Dissolved Oxygen	%	107.5	96.8
pH		9.37	9.86
Turbidity	NTU	7.90	8.90
Air Temperature	ºC	24	19
Channel Width	m	150	205
Channel Depth	m	1.5	0.5
Flow Rate	m/s	n/a	n/a

Laboratory Water Quality Results for Site 10			
Parameter	Unit	Date: 17-JUN-09 Time: 11:48	Date: 15-JUL-09 Time: 10:30
Bacteriological			
Escherichia Coli	MPN/100mL	17	2
Total Coliforms	MPN/100mL	310	310
Physical			
Conductivity (EC)	uS/cm	110	148
Total Dissolved Solids	mg/L	82	121
Turbidity	NTU	1.57	2.53
Nutrients and Anions			
Ammonia-N, Total	mg/L	<0.020	<0.020
Chloride (Cl)	mg/L	0.27	0.44
Nitrate-N (NO3-N)	mg/L	<0.030	<0.030
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0067	0.0060
Sulphate (SO4)	mg/L	1.91	2.00
Metals			
Aluminum (Al)	mg/L	0.107	0.109
Cadmium (Cd)	mg/L	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0026	0.0023
Iron (Fe)	mg/L	0.282	0.321
Lead (Pb)	mg/L	<0.0010	<0.0010

Flora Observed at Site 10				
FEC V-Type: V 19 Black Spruce Mixedwood/Herb Rich				
Species			**% Cover**	
Trees	Black Spruce		30	
	White Birch		30	
	Balsam Poplar		20	
	White Spruce		20	
	Eastern White Cedar		10	
	Trembling Aspen		10	
Shrubs	Speckled Alder		60	
	Wild Prickly Raspberry		40	
	Red Osier Dogwood		40	
	Red Berried Elder		20	
	Wild Prickly Rose		20	
	Salix Spp.		10	
	Hairy Honeysuckle		<1	
Ground Cover	Sedges/Grasses		80	
	Wild Saspirilla		75	
	Narrow-leaf Spirea		20	
	Large-leaf Aster		15	
	Fireweed		<1	
	Wild Columbine		<1	
	Cow's Vetch		<1	
	Ox Eyed Daisy		<1	
	Woodland Strawberry		<1	
	Heal-all		<1	
	Pearly Everlasting		<1	
	Buttercup		<1	
	Red Clover		<1	
	Pale Vetching		<1	
	Hairy Honeysuckel		<1	
	Club Moss		<1	
	Northern Bluebell		<1	
	Hawkbrush		<1	
Aquatic Macrophytes and Algae	Emergent	Abundant	Floating Algae	Absent
	Rooted Floating	Present	Filaments	Absent
	Submergent	Present	Attached Algae	Absent
	Free Floating	Absent	Slimes or Crusts	Abundant

Fauna Observed at Site 10		
Species		**# Observed**
Birds	Bald Eagle	1
	Barn Owl	1
	Chipping Sparrow	4
	Common Loon	1
	Eastern Kingbird‡	2
	Common Grackle	5
	Herring Gull	1
	Northern Harrier‡	1
	Red Breasted Nuthatch	1

	Turkey Vulture	1
Mammals	Beaver Black Bear Eastern Cottontail European Hare	1 2 4 1
Reptiles	Common Garter Snake	1
Amphibians	American Toad	1
Fish	Northern Pike†	6
Mollusca	-	-
Crustaceans	-	-

Physical Features Observed at Site 10			
FEC S-Type: SS4 Very Shallow Soil on Boulder Pavement			
Varying proportions of organic matter and mineral soil overlying boulder pavement. Developed primarily in morainal parent materials. When they form a boulder cap overlying a (usually deep) mineral soil, SS4 soils may grade into bouldery tills. This variation on SS4 soils can be observed around Upper Clearwater Lake.			
Slope Stability Rating/ Erosion Potential	6/ Low		
In-stream Substrate	Dominant	3 Sand	
	Second Dominant	2 Silt	
	Woody Debris	Abundant	
	Detritus	Present	
Riparian Vegetative Community	Zone (Dist. from water's edge)	Left Bank	Right Bank
	1.5-10 m	5	5
	10-30 m	3	5
	30-100 m	5	5
	% Canopy Cover	0-24	

‡ An Eastern Kingbird was witnessed chasing a Northern Harrier over Upper Clearwater Lake and into a nearby cutover.
† Approximately 6 Northern Pike heads along with skins had been found in and on the shore of the lake. Assumed to be left by fisherman.

Site 10 was located at Upper Clearwater Lake and was chosen as the control site not based upon its proximity to the headwaters but because of availability of safe access points. As previously stated, the true headwaters lie at Upper Wolf Lake, but no safe access route could be found to this point. Since Upper Clearwater Lake resides far away from any potential major points of contamination, such as highways, it was still considered an adequate point for baseline water quality parameters. Access to the lake was granted via an old logging road.

The most distinguishing feature of Upper Clearwater Lake is the thin layer of lake bottom sediment overlying a boulder pavement. The layer of sediment primarily consisted of decomposing organic materials and silt. The lake was also surrounded by a densely vegetated area, with terrestrial vegetation encroaching on the lake. Away from the lake, to the North East, there was evidence of a mature conifer tree plantation. Adjacent to the plantation was a small meadow inhabited by Common Garter Snakes and Chipping Sparrows. Other notable wildlife of Upper Clearwater Lake included a Northern Harrier

and a Turkey Vulture. Aquatic macrophytes were also present in small pockets throughout the lake.

Laboratory water quality results concluded that aluminum exceeded PWQO guidelines on both sampling occasions. The June 17, 2009 and July 15, 2009 samples indicated concentrations of 0.107 mg/L and 0.109 mg/L, respectively, above the criterion of 0.075 mg/L. Iron exceeded PWQO Guidelines on July 15, 2009 with an observed concentration of 0.321 mg/L above the criterion of 0.3 mg/L.

Quality Assurance

Due to the reoccurrence of unusually high pH results, a third set of field data was collected on July 30, 2009 at Sites 4, 6 and 8 to compare readings from the YSI 556 MDS, the sonde used for this study, and the newer YSI 600 QS. It was suspected that the high pH readings were a malfunction with the pH probe on the YSI 556; however, the field test indicate that the probe used in the study was operating within acceptable limits.

Site #4		10:58 July 30, 2009
Field Parameter	**YSI 556 MDS**	**YSI 600 QS**
Water Temperature (°C)	18.12	18.05
Conductivity (µS/cm)	174	204
Dissolved Oxygen (mg/L)	9.37	9.18
Dissolved Oxygen (%)	99.3	97.1
pH	8.64	8.02

Site #6		11:51 July 30, 2009
Field Parameter	**YSI 556 MDS**	**YSI 600 QS**
Water Temperature (°C)	17.65	17.89
Conductivity (µS/cm)	169	199
Dissolved Oxygen (mg/L)	9.97	9.39
Dissolved Oxygen (%)	105.30	98.50
pH	8.52	8.10

Site #8		12:44 July 30, 2009
Field Parameter	**YSI 556 MDS**	**YSI 600 QS**
Water Temperature (°C)	21.22	21.28
Conductivity (µS/cm)	97	89
Dissolved Oxygen (mg/L)	8.67	8.94
Dissolved Oxygen (%)	97.60	100.70
pH	7.79	9.00

5 Discussion

The highest point of elevation sampled was at Site 10 – Upper Clearwater Lake, which was 371.8 metres above sea level. As seen in Figure 7, the upper watershed slope was considerably greater than the slope downstream of Wolf Lake. Sample Sites 1 and 2, the new and original confluences both had an elevation of 182.24 metres above sea level. Between Sites 1-10 the elevation changed by 189.56 metres. Elevation plays an important role in direction of water drainage and stream velocity. The Wolf River had an overall slope of 0.47 percent.

After a major flood event in 1996, the Wolf River cut a new confluence channel along the floodplain approximately 815 metres south of the original confluence along the Lake Superior shoreline. Since it is possible for further southerly movement of the confluence which may include the isolation of property (by means of island formation), property damage and increased siltation of the shoreline, the Wolf River Fill Line Mapping should be updated to assess hazards prior to any new development in this area.

For the initial sampling set (June 15 to 17, 2009) the mean recorded air temperature was 25.1 ºC and the mean water temperature was 16.74 ºC. For the second round of sampling (July 13 to 15, 2009) the mean air temperature was 23.61 ºC and mean water temperature was 17.94 ºC. The highest water temperatures of 21.68 ºC and 21.28 ºC were observed at Site #8 – Cavern Lake Outlet Pool.

The Wolf River ranged from 17 to 36 metres wide with an average width of 25 metres across (not including lake or tributary sampling conducted at Sites 7, 8 and 10). The average depth of the Wolf River was 0.76 metres during the time of sampling. Stream velocity during the June sampling round ranged from 0.18 to 1.70 metres per second (m/s) with an average velocity of 0.97 m/s. Stream velocity during the July sampling round ranged from 0.17 to 1.01 m/s with an average velocity of 0.53 m/s. Velocity, in both cases was slowest at Site 1 – New Confluence and fastest at Site 3 – Abandoned CNR Crossing where flow was restricted in a braided channel. Recorded fast flow rates were highly correlated to narrow stream width and depth measurements.

The pH values measured in the field ranged from 7.85 to 10.29 with an average reading of 8.99. All pH values were above the acceptable PWQO range (6.5 to 8.5 to protect aquatic life) with the exception of two cases. pH was 7.85 at Site 3 – Abandoned CNR Crossing (June sampling round) and pH was 8.45 at Site 7 – Wolf Lake (June sampling round). Due to the reoccurrence of unusually high (alkaline) pH results, a third set of field data was collected on July 30, 2009 at Sites 4, 6 and 8 to compare readings from the YSI 556 MDS, the multi-parameter sonde used for this study, and the newer YSI 600 QS. Initially, it was suspected that a malfunction with the pH probe on the YSI 556 MDS was responsible for incorrect readings. However, July 30, 2009 readings were also relatively high (alkaline) ranging from 7.79 to 9.00 with little difference between sonde readings. It was therefore concluded that the pH readings were considered acceptable. The high pH

may have been caused by the regional geology. Characteristic of the Sibley Group are deposits of shale, sandstone and dolomite which as calcium-rich sedimentary rocks can influence surface water alkalinity through ion transfer. A study by Alberta Water Quality Awareness states that "Alberta streams and rivers tend to be alkaline and have a pH of between 7 and 9" (AWQA 2009) if they flow through carbonate-rich areas. The report also states that these rivers and streams can have a pH increase "above 9 on occasion" but that "these episodes are usually very short in duration before returning to normal range". This could be the case in the Wolf River watershed. Other causes of high pH could be from human activities such as septic system failure or agricultural runoff; however bacterial, nutrient and metal results do not indicate altered water quality through human impact.

Dissolved oxygen was within the PWQO guidelines for all samples recorded in the Wolf River watershed. Dissolved oxygen levels ranged from 88.2% at Site 2 to 121.1% at Site 3 which are well above the criteria of 54% and 47% minimum dissolved oxygen saturation at 15ºC for cold and warm water biota, respectively.

Total dissolved solids (TDS) analyzed in the laboratory ranged from 82 to 141 mg/L with an average value of 117 mg/L. Conductivity values analyzed in the laboratory ranged from 99.2 to 218 µs/cm with an average value of 167 µs/cm. Values measured in the field ranged from 89 to 196 µs/cm with an average value of 140 µs/cm. TDS and conductivity, in both cases were highest at Site 2 – Original Confluence and lowest at Sites 8 through 10 in the upper watershed. The only objective in place for TDS is <500 mg/L for drinking water published in the Canadian Drinking Water Quality guidelines to prevent unpalatable taste and excessive scaling in water pipes and boilers (Health Canada 1996).

Turbidity values analyzed in the laboratory ranged from 0.29 to 6.02 NTU. Values measured in the field ranged from 4.90 to 22 NTU. The highest value in both cases was recorded at Site 2 – Original Confluence. Provincial Water Quality Objective (PWQO) Guidelines state that there should be no more than 10 percent change in Secchi disk (depth) readings. When comparing each site between sampling dates to itself and all sites to each other, Wolf River water quality fell within this criterion. In addition, all sites were well below the Canadian Recreational Water Quality guidelines of 50 NTU (Health Canada 1992).

Nitrogen was analyzed in three biologically-useable forms: nitrate (NO_3), nitrite (NO_2) and ammonia. All three forms of nitrogen were below the maximum concentrations published in the PWQO and CCREM guidelines at the time of sampling. In the case of nitrite-N (NO_2-N), all analyzed samples were below the <0.02 mg/L detection limit with a CCREM criterion of 0.06 mg/L.

Total phosphorus was below the PWQO criterion of 0.03 mg/L for rivers or streams at all sampling sites except for one; on July 13, 2009 Site 2 – Original Confluence exceeded the criterion with a value of 0.0304 mg/L which is most likely due to the natural decomposition of in-stream woody debris and detritus.

Escherichia coli levels ranged from 0 to 26 counts per 100 mL of water. All sites were well below the PWQO criterion of 100 counts per 100 mL of water for safe swimming and bathing. Prior to 1994, the provincial Ministry of Environment also monitored and enforced total coliform bacteria counts. All sites were below the past PWQO criterion of 1000 counts per 100 mL of water. The highest total coliform value was recorded at Site #2 – Original Confluence with a concentration of 870 counts per 100 mL of water.
Aluminum values ranged between 0.031 to 0.158 mg/L with a mean concentration of 0.066 mg/L. Aluminum was above the PWQO criterion of 0.075 mg/L at Site 2 (both sampling dates - 0.098 mg/L and 0.158 mg/L), Site 4 (July sampling round – 0.104 mg/L) and Site10 (both sampling dates – 0.107 mg/L and 0.109 mg/L). Iron values ranged between 0.084 to 0.455 mg/L with a mean concentration of 0.178 mg/L. Iron was above the PWQO criterion of 0.3 mg/L at Site 2 (both sampling dates – 0.313 mg/L and 0.455 mg/L) and Site 10 (July sampling round – 0.321 mg/L). The highest values in both cases were recorded at Site 2 – Original Confluence. These concentrations are most likely due to the natural dissociation of aluminum and iron cations from mineral-rich rocks. All other metals analyzed by the laboratory were below the PWQO guidelines including lead, copper, cadmium and uranium. All uranium values were below the PWQO criterion and detection limit of <0.005 mg/L including Site 8 – Cavern Lake Outlet Pool where uranium mining has occurred in the past.

Upland, riparian and in-stream habitat at each sample site was characterized using niche habitat variables such as: percent areal coverage of dominant tree, shrub and herb species to help build a representation of reference (baseline) conditions in the Wolf River watershed at the time of sampling for future monitoring and comparison. Sample site V-types spanned a broad range of classifications, indicating diverse opportunities for wildlife habitat. Stream coverage by riparian vegetation was generally less then 24%. Riparian vegetation in the immediate area of the sample sites typically consisted of deciduous forest, with mixed wood forest being found further inland. Macrophytes were common within the slower moving sections of river, where algae was typically sparse.

The typical in-stream substrate of sites consisted of a cobble-gravel mix, with very little organic matter. This allowed for waters to remain cool with relatively low turbidity. Some areas, most often downstream of erosion sites, experienced sections of substrate where thick layers of sand and silt covered the typical cobble-gravel substrate. These sandy substrate regions, normally only lasted for a maximum of 20 metres and were found on the inner regions of the meanders downstream of active erosion sites. Water quality results revealed that these regions did not have an effect on turbidity. The only sites that differentiated from typical stream substrate characteristics were sites 1 and 2. Sand and silt were the predominant substrate types found at each of the sites. This was mostly due in part to their location within the confluence region which was dominated by a sandy soil composition.

Soil composition also varied between sites and was assessed to help provide information regarding erosion and its potential impacts on the river. During sampling, as with V-type

classification, no consistent S-type was encountered between sites. Since vegetation is heavily correlated with the type of soil present, it was expected that diversity in soils would be encountered.

Benthic samples that were collected by the LRCA during this study were counted by Eco Superior and raw counts are attached in Appendix L; however a detailed analysis of the results were not completed.

Due to processing times, results from benthic sampling would not be completed until the Fall of 2009, alongside Eco Superior's other sampling dates for the river. In general a wide variety of benthos were observed by LRCA staff indicating a healthy and productive aquatic ecosystem.

In agreement with the variety of benthos collected in sampling, the Wolf River can also be said to possess suitable fish habitat. Water temperatures typically stayed below 20 °C indicating ideal water temperature for cold water species. Only the very shallow and most often stagnant Cavern Lake outlet pool exceeded water temperatures of 20 °C on both sampling occasions. Upper Clearwater Lake exceeded 20 °C on the first round of sampling. Turbidity and sedimentation were low throughout the watershed, allowing waters to remain clear and thus not pose a threat to harming the gills of fish. Furthermore, the presents of brook trout within the watershed was seen as an indicator of good health. As viewed by LRCA staff, the most inland section of the old northern confluence harbors shallow waters with large amounts of aquatic macrophytes. Numerous juvenile fish were documented throughout this area indicating that the original confluence is an important nursery for young fish.

Despite all other parameters indicating suitable fish habitat, the high pH values encountered are of concern. The most likely cause of the high pH readings are natural conditions and processes and the natural pH fluctuations of the river. The readings do not appear to be affecting fish populations as numerous fish, ranging from adults to juveniles, were documented within the watershed.

Water quality results indicate that erosion hasn't been greatly affecting stream health. However erosion sites, ranging from rock slides to light slope failure, were encountered throughout the watershed. Slope stability rating charts indicate that most of the slopes possess adequate amounts of vegetation to impede erosion but the soil composition of the banks, most often sand, make them easily erodible.

Due to the size of the watershed, all water crossings for the entire watershed were not documented; however, all water crossings that transected the named Wolf River stream channel were assessed during July 2009. All bridges, except for one off the main road, were in good condition with proper fill protecting against erosion. The bridge off the main road was no longer in operation at the time of report, only the cribbing remained. At this location traffic appeared fording the river during low water levels, as evident by a second road adjacent to the cribbing.

Compared to previous area sub-watershed assessments such as Brule Creek (2007) and Slate River (2008), the Wolf River is in excellent condition. The Wolf River rarely exceeded water quality guidelines, except for pH, and demonstrated relatively low iron concentrations despite being located within a geological formation known for its high iron content. In comparison to the Slate River, the Wolf River possesses dramatically lower concentrations of coli forms and overall iron content. This is most likely do to the lack of agriculture in the region.

6 Conclusion

To conclude, the Wolf River watershed was in excellent condition at the time of study. All water quality parameters, with the exception of pH, were relatively low and at acceptable levels. pH was considered to be high due to the river's natural geologic setting, such as large amounts of calcium bearing bedrock. Though erosion is abundant throughout the watershed, its impacts appear to be minimal given the water quality results. At the time of this report, the change in course of the confluence appeared to be creating a variety of new habitats used by a variety of fish, birds and mammals.

7 Recommendations

The Wolf River watershed was in excellent health at the time of study during June and July 2009. However, additional testing is recommended to create a more thorough assessment. LRCA resources and time permitting, the Wolf River watershed should be reassessed by the LRCA within the next 10 years, to monitor any changes in water quality as well as for any changes in confluence structure and migration. Due to the creation of the new confluence, it is recommended that prior to any new development in the area of the confluence; the Wolf River Fill Line Mapping is updated to assess hazards. It is also recommended that future additional monitoring should include assessment of the confluence area to further assess hazard lands (such as further movement of the confluence and other break through points) and the growth of the coastal Provincially Significant Wetland. It is recommended that the Township of Dorion include the new Wolf River confluence area as an area of concern in flood Emergency Plans.

A copy of this Report should be made available to the residents of the unorganized Townships of Cockeram, McMaster, Glen, Stirling and the organized Township of Dorion. The report should be kept on file at the LRCA Administrative Office for review by interested parties. Copies will be made available on a cost recovery basis.

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FIGURES

Figure 1: Sibley Group Outcrop Near Site 9 (LRCA 2009)

Figure 2: High Water Levels – Wolf River Weir (Ed Chambers 06-09)

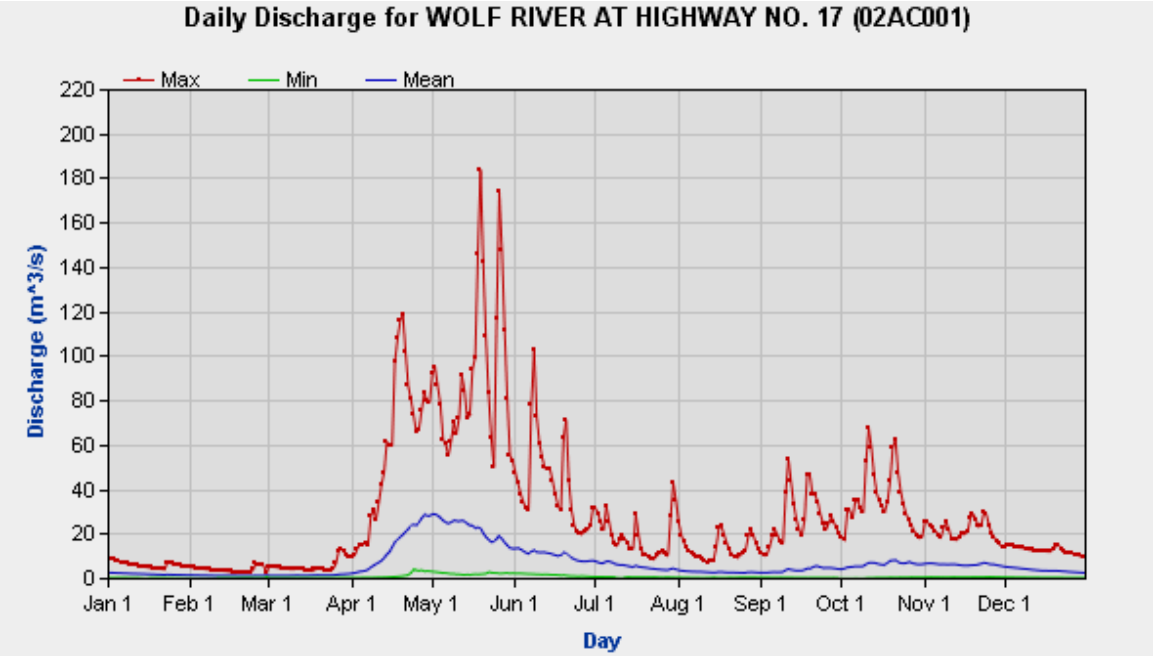


Figure 3: Discharge Rate 2008 (Env. Canada 2009)

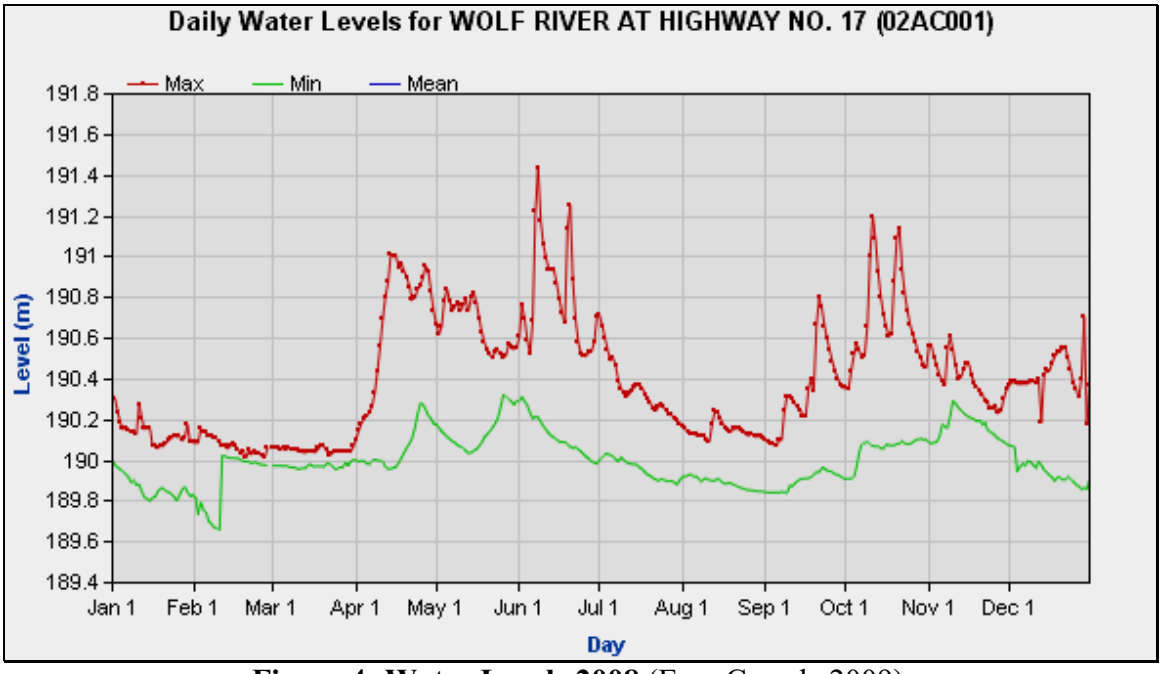


Figure 4: Water Levels 2008 (Env. Canada 2009)

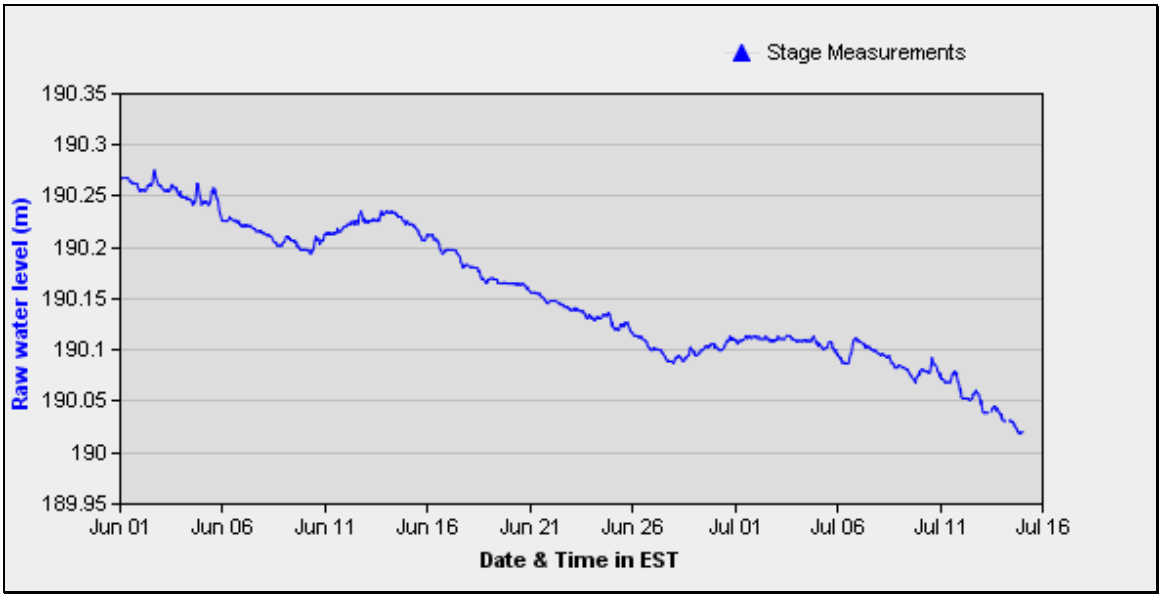


Figure 5: Raw Water Levels (Env. Canada 2009)

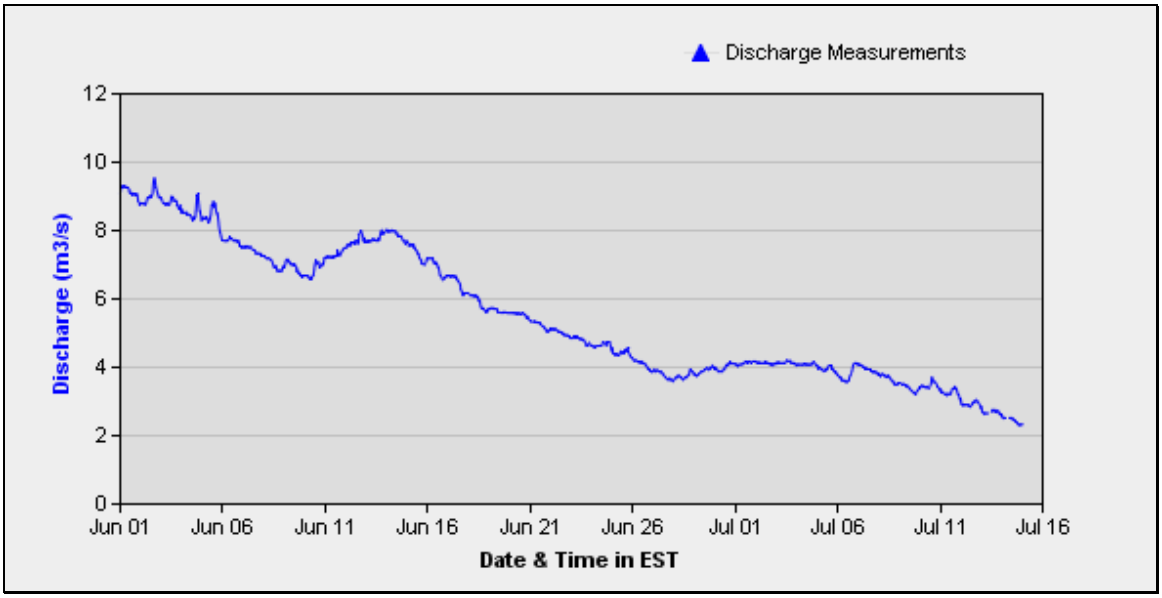


Figure 6: Discharge (Env. Canada 2009)

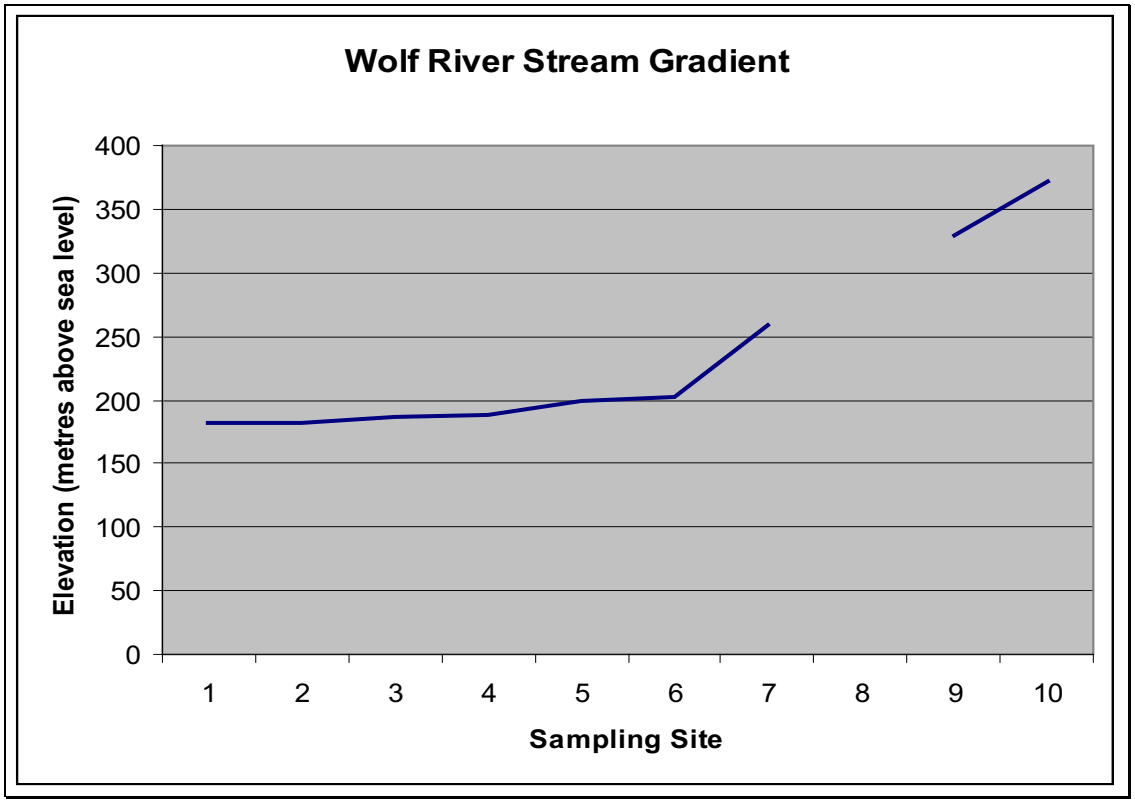


Figure 7: Stream Gradient (LRCA 2009)

Figure 8: Hurkett Cove (LRCA 2009)

Figure 9: Cedar Waxwings (LRCA 2009)

Figure 10: New Southern Confluence Wetlands (LRCA 2009)

Figure 11: Shallow Wetland Habitat of the Original Northern Confluence (LRCA 2009)

Figure 12: Bank Failure Prior to Remediation (LRCA 2008)

Figure 13: Bank Failure Further Upstream (LRCA 2009)

Figure 14: Benthic Sampling Riffle #1 (LRCA 2009)

Figure 15: Benthic Sampling Pool (LRCA 2009)

Figure 16: Benthic Sampling Riffle #2 (LRCA 2009)

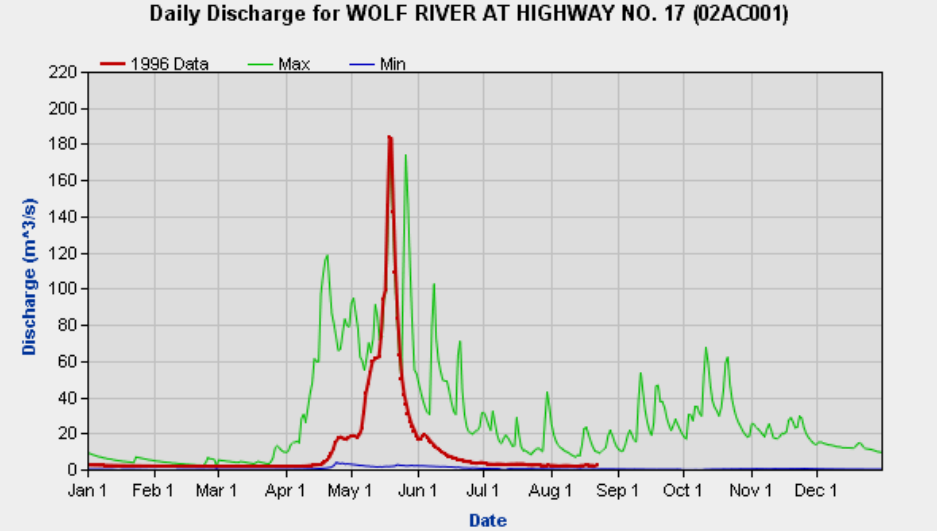
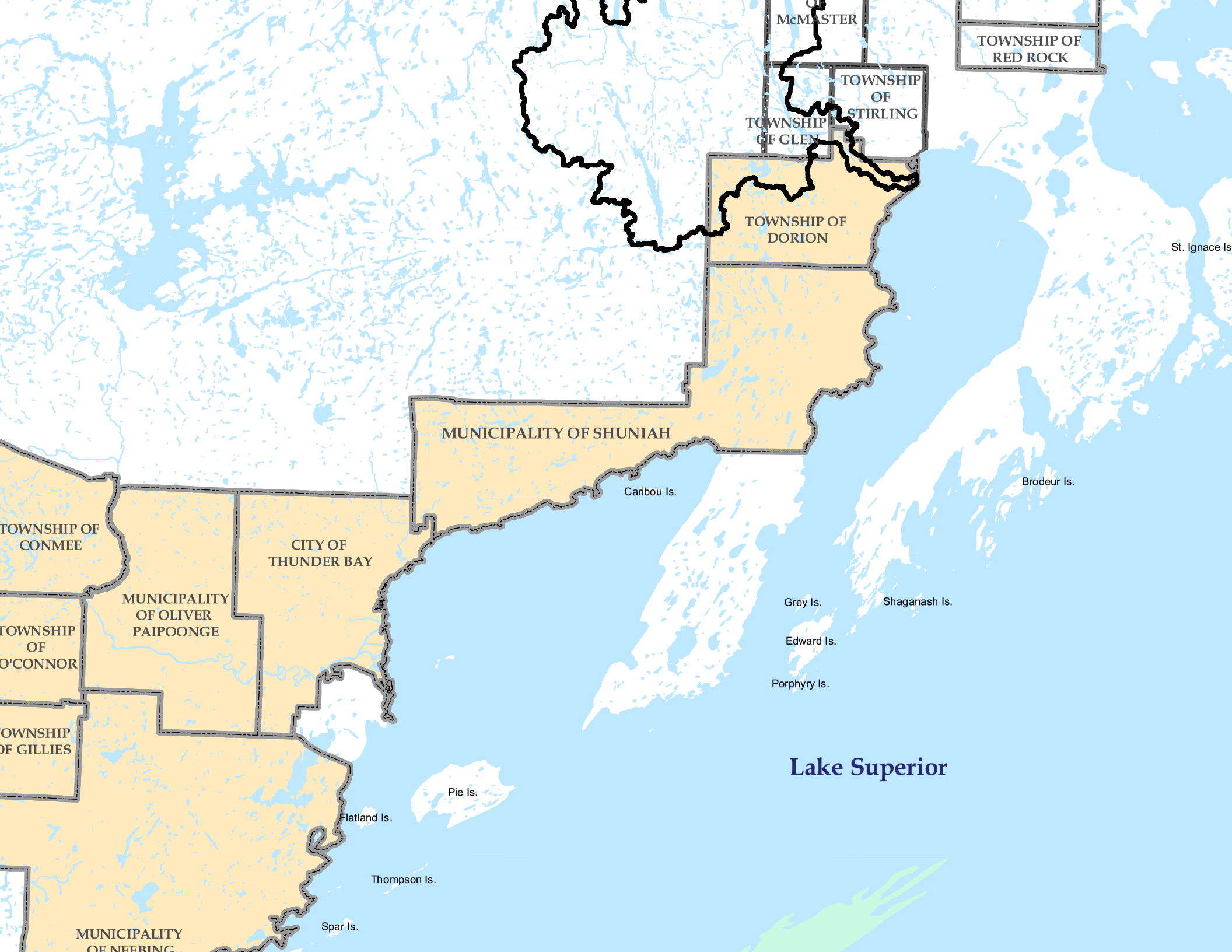


Figure 17: 1996 Record Daily Discharge (Env. Canada 2009)

MAPS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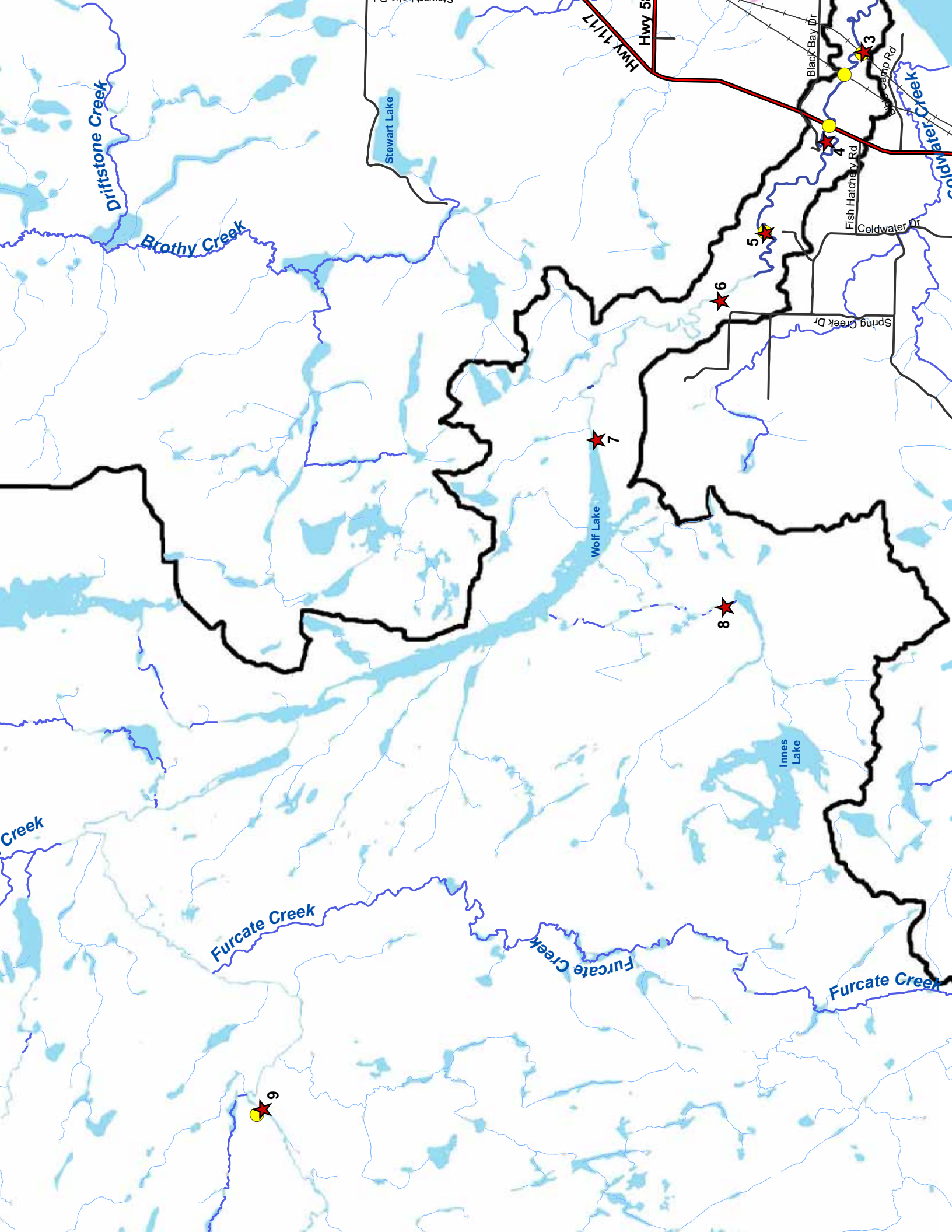
TOWNSHIP OF RED ROCK
TOWNSHIP OF STIRLING
TOWNSHIP OF GLEN
TOWNSHIP OF DORION
St. Ignace Is
MUNICIPALITY OF SHUNIAH
Caribou Is.
Brodeur Is.
TOWNSHIP OF CONMEE
CITY OF THUNDER BAY
MUNICIPALITY OF OLIVER PAIPOONGE
TOWNSHIP OF O'CONNOR
OWNSHIP OF GILLIES
Grey Is.
Shaganash Is.
Edward Is.
Porphyry Is.
Lake Superior
Pie Is.
Flatland Is.
Thompson Is.
Spar Is.
MUNICIPALITY OF NEEBING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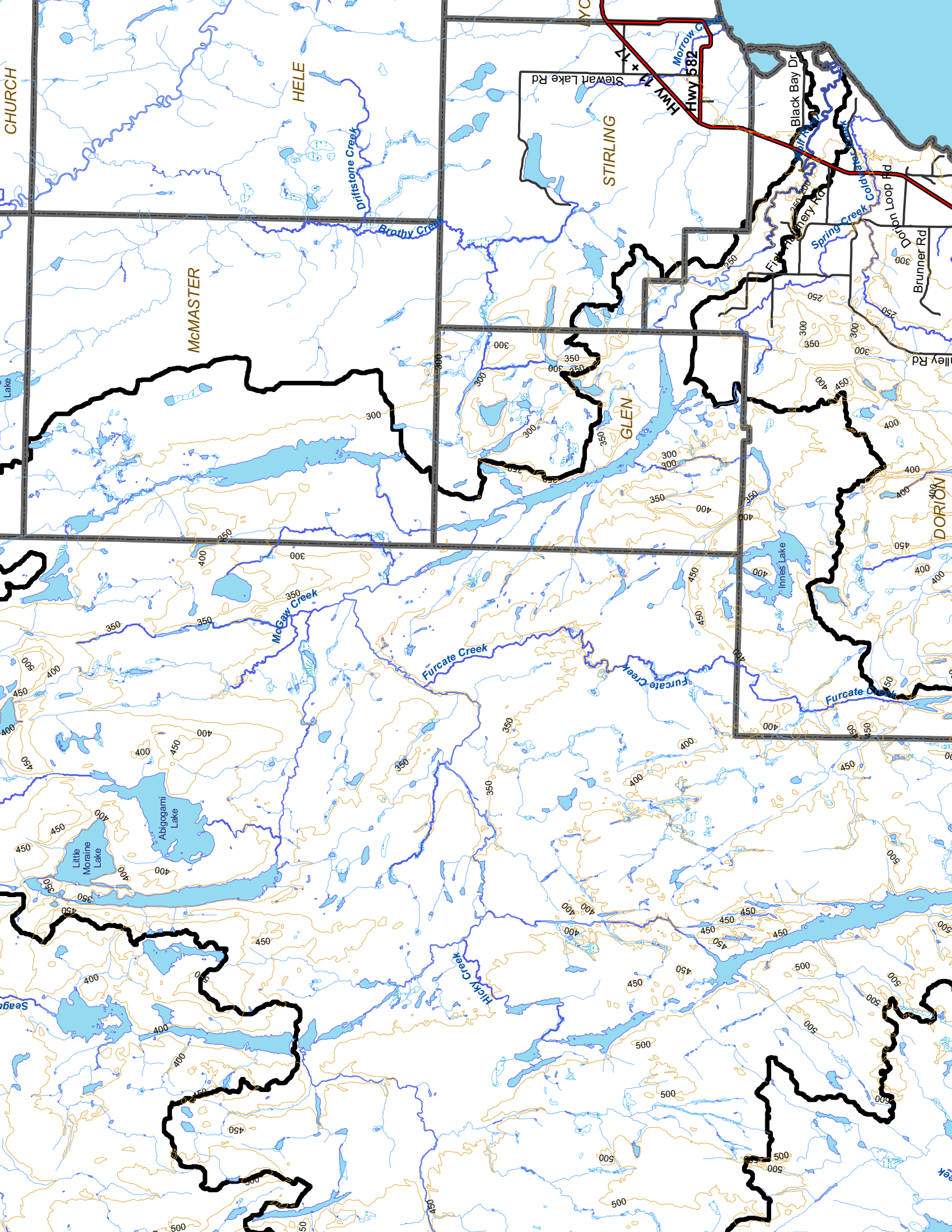
Fish Hatchery Rd
Coldwater Dr
Spring Creek Dr
Stewart Lake
Driftstone Creek
Brothy Creek
Wolf Lake
Innes Lake
Furcate Creek
Furcate Creek
Furcate Creek
Creek
1
2
3
4
5
6
7
8
9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HELE
McMASTER
STIRLING
GLEN
DORION
Hwy 17
Hwy 582
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Black Bay Dr
Driftstone Creek
Brothy Creek
Morrow Creek
Spring Creek
Cold Water Creek
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Brunner Rd
McGaw Creek
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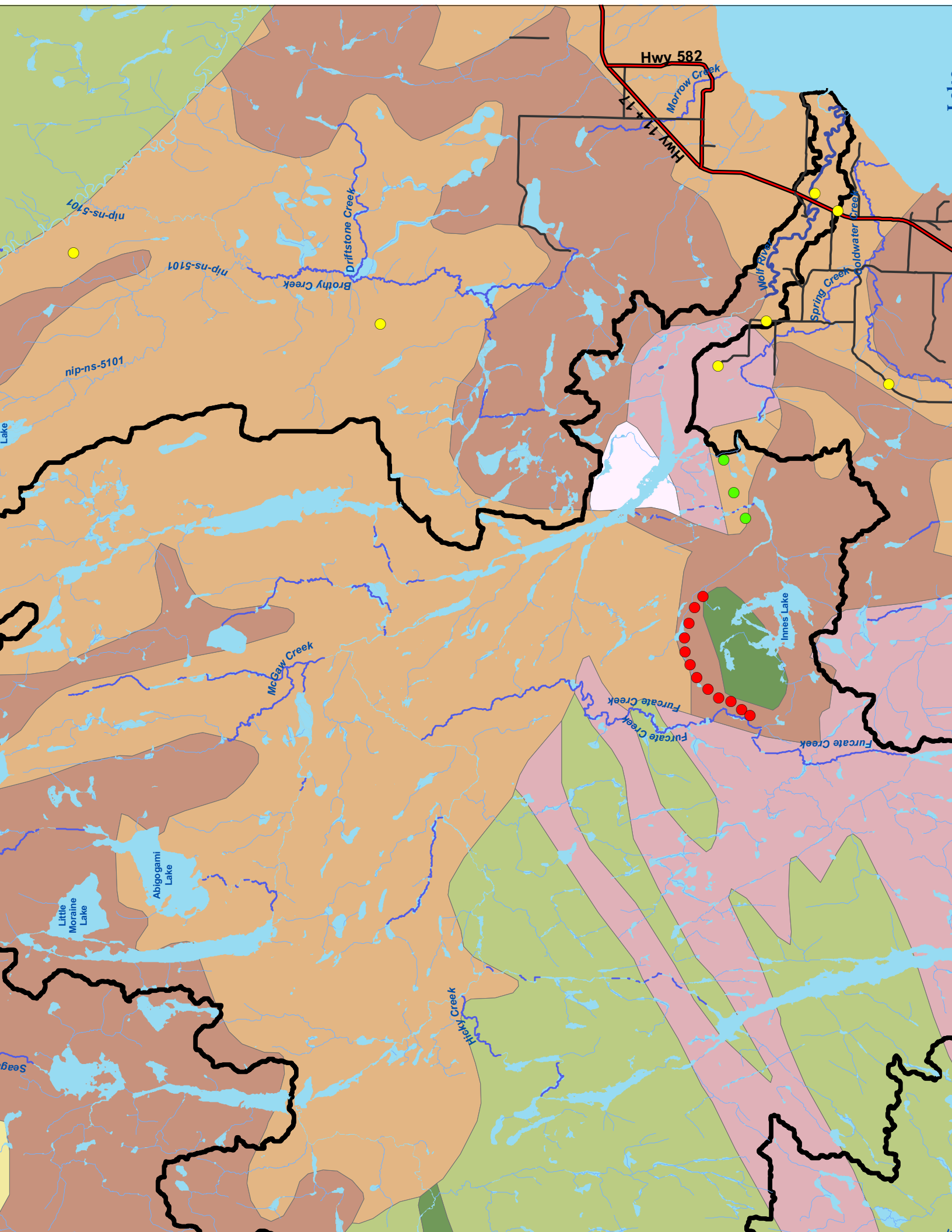
Hicky Creek
Innes Lake
Abigogami Lake
Little Moraine Lake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HWY 11 + 17
Driftstone Creek
Brotty Creek
nip-ns-5101
nip-ns-5101
nip-ns-5101
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McGaw Creek
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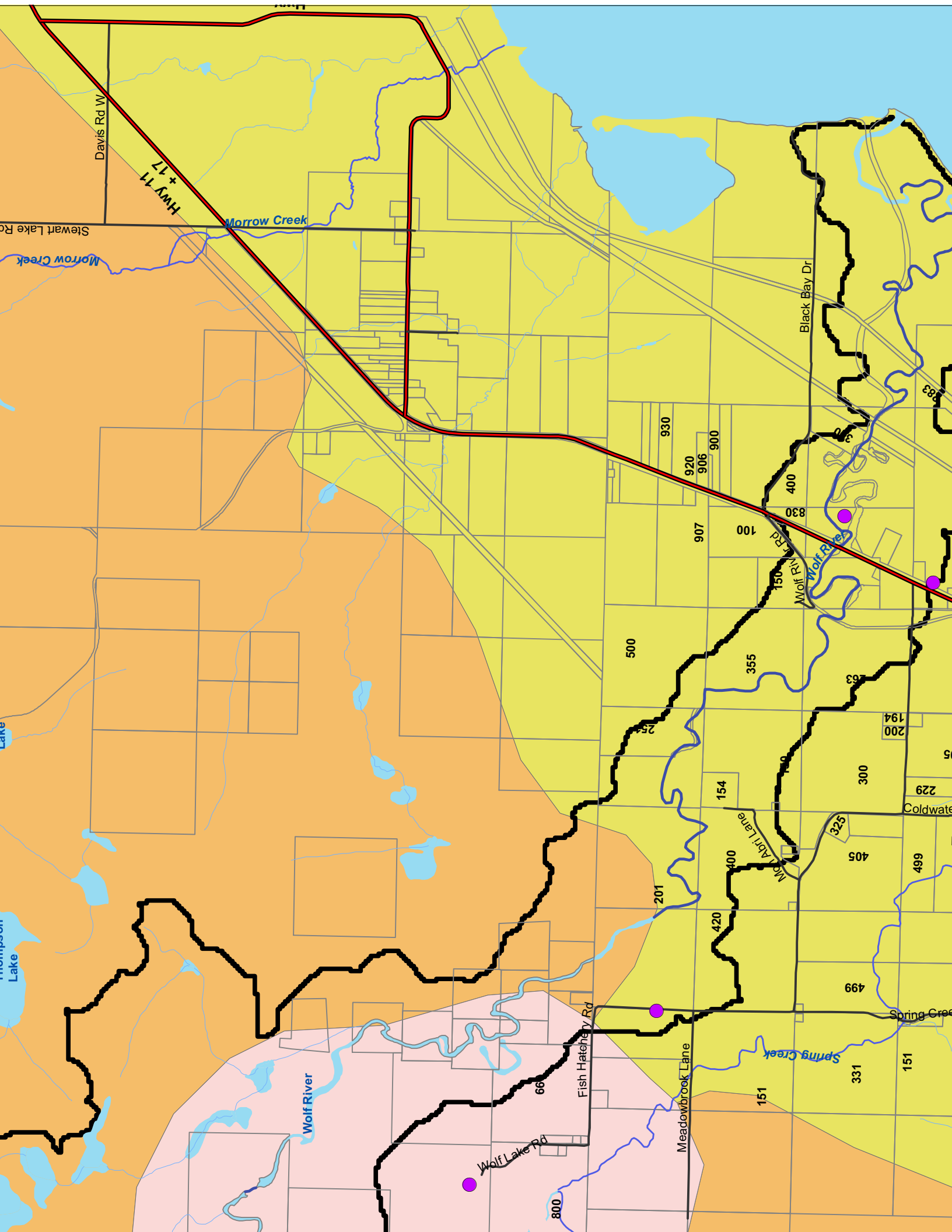
Abigogami Lake
Little Moraine Lake
Hicky Creek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Hwy 11 + 17
Morrow Creek
Stewart Lake Rd
Black Bay Dr
Wolf River
Wolf River Rd
Coldwater
Mc Abri Lane
Spring Creek
Fish Hatchery Rd
Meadowbrook Lane
Wolf Lake Rd
Thompson Lake
930
920
906
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907
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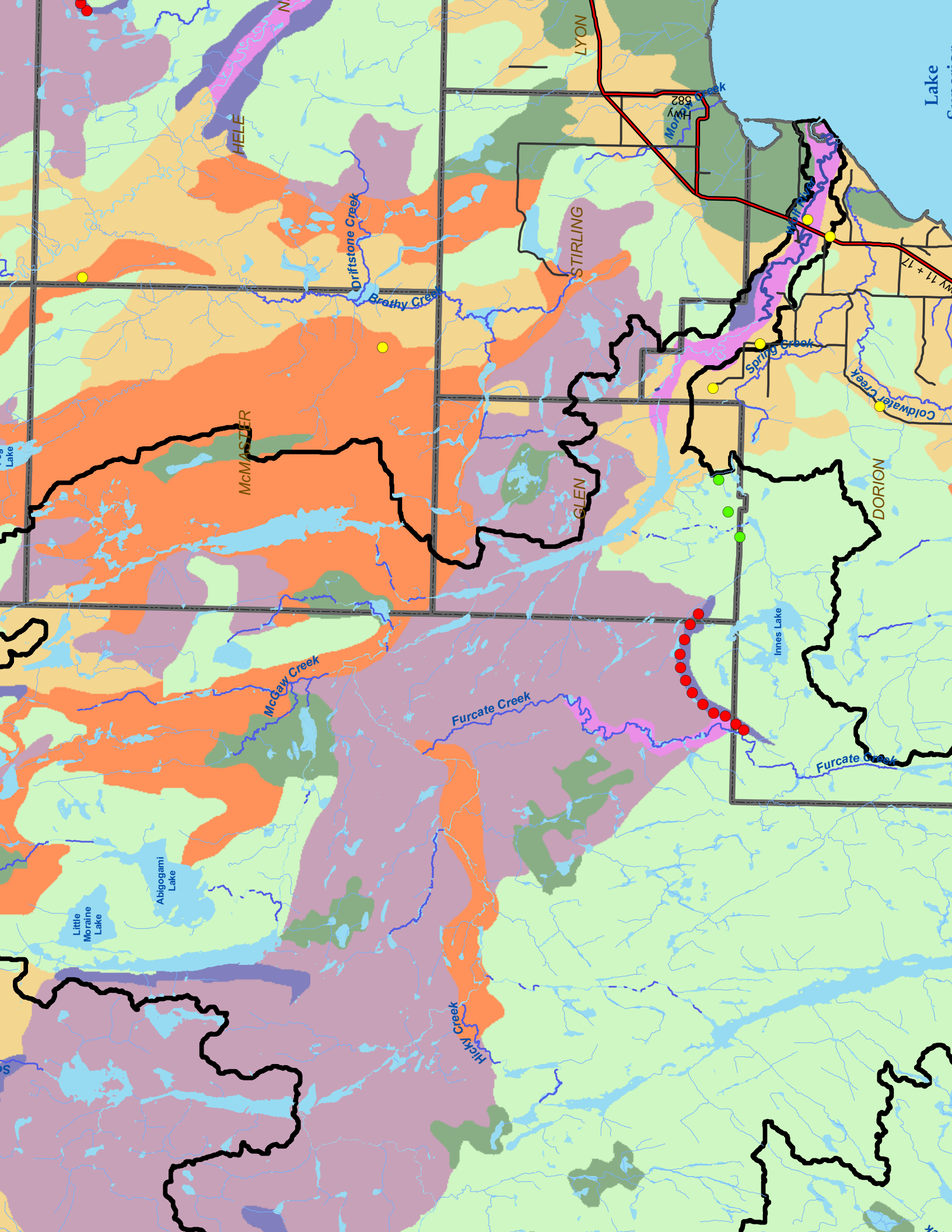
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HELE
STIRLING
McMASTER
GLEN
DORION
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Coldwater Creek
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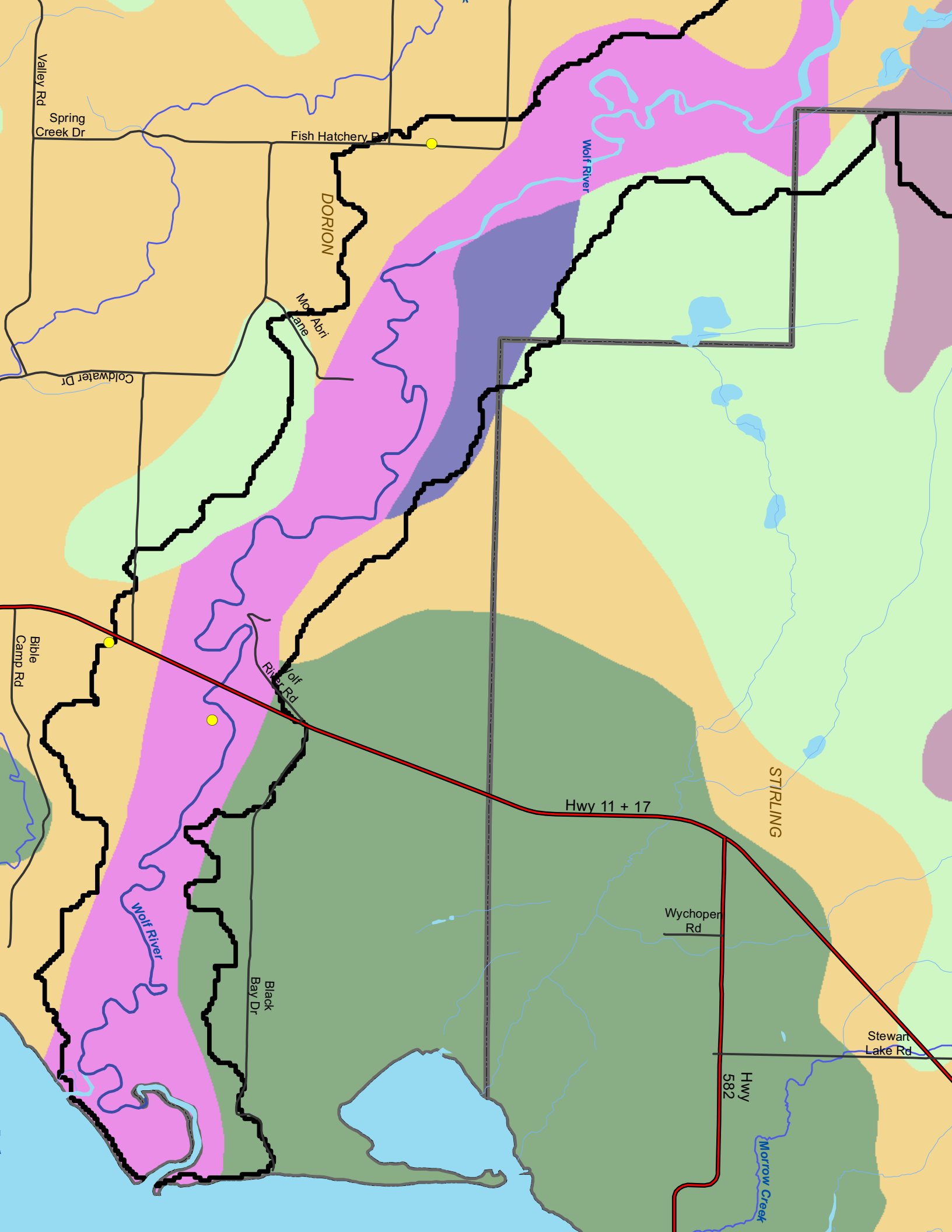
Innes Lake
Abigogami Lake
Little Moraine Lake
Hwy 582
Lake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Fish Hatchery Rd
Wolf River
DORION
Coldwater Dr
Bible Camp Rd
Wolf River Rd
Hwy 11 + 17
STIRLING
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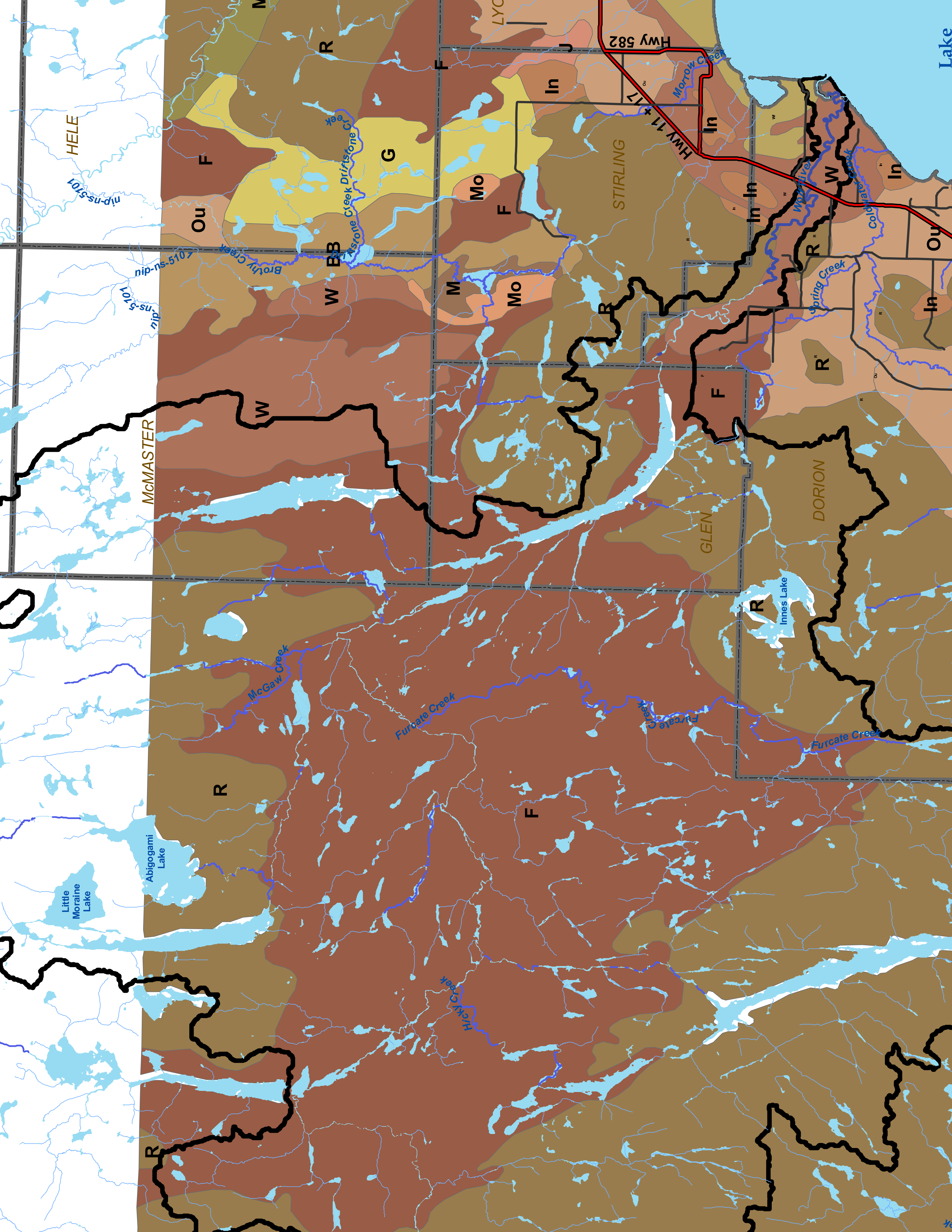
Black Bay Dr
Wychoper Rd
Stewart Lake Rd
Hwy 582
Morrow Creek



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McMASTER
STIRLING
GLEN
DORION
Hwy 582
Hwy 11 + 17
Lake
Morrow Creek
Wolf River
Coldwater Creek
Spring Creek
Driftstone Creek
Brothy Creek
nip-ns-5101
McGaw Creek
Furcate Creek
Hicky Creek
Innes Lake
Abigogami Lake
Little Moraine Lake
R
F
G
W
BB
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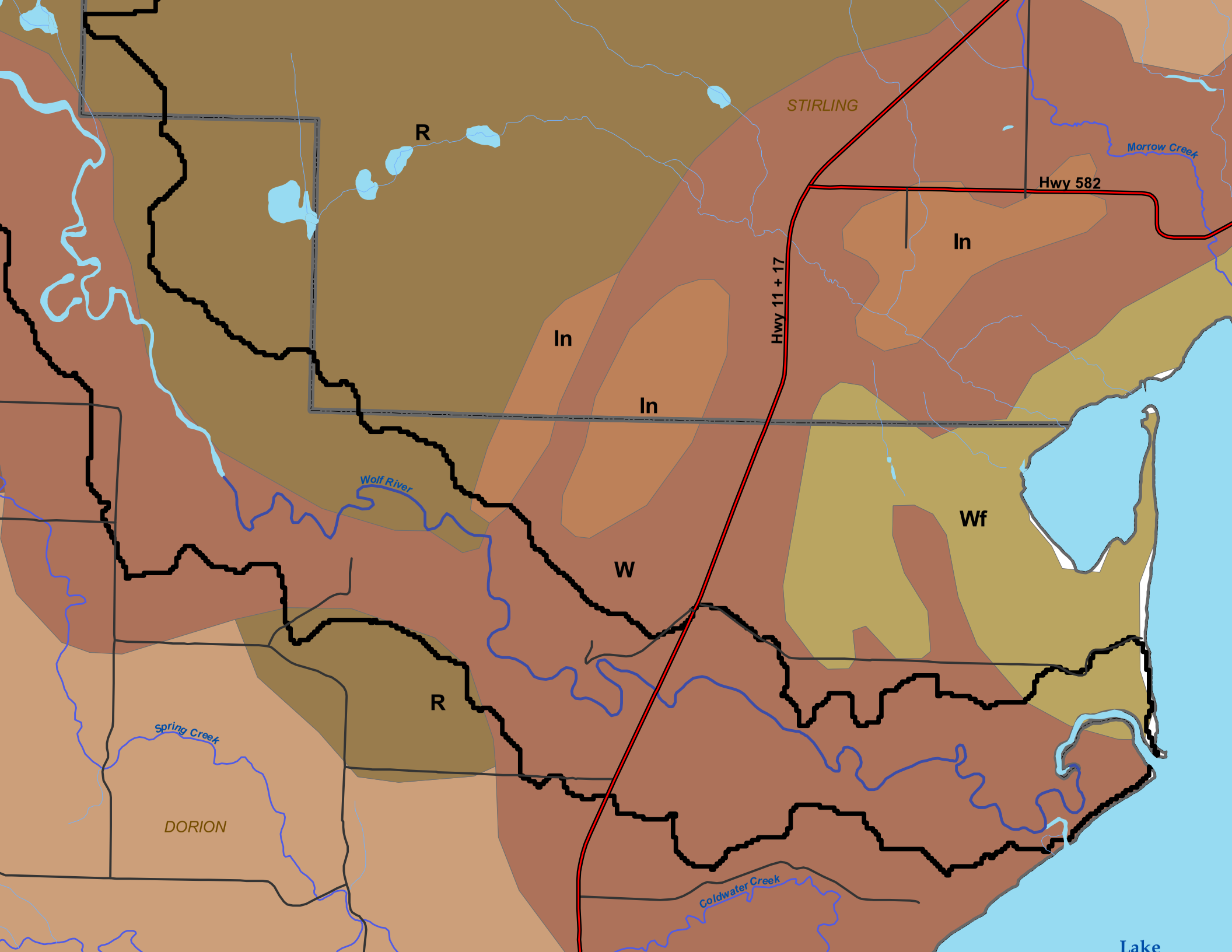
J


STIRLING
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Hwy 11 + 17
In
In
Wolf River
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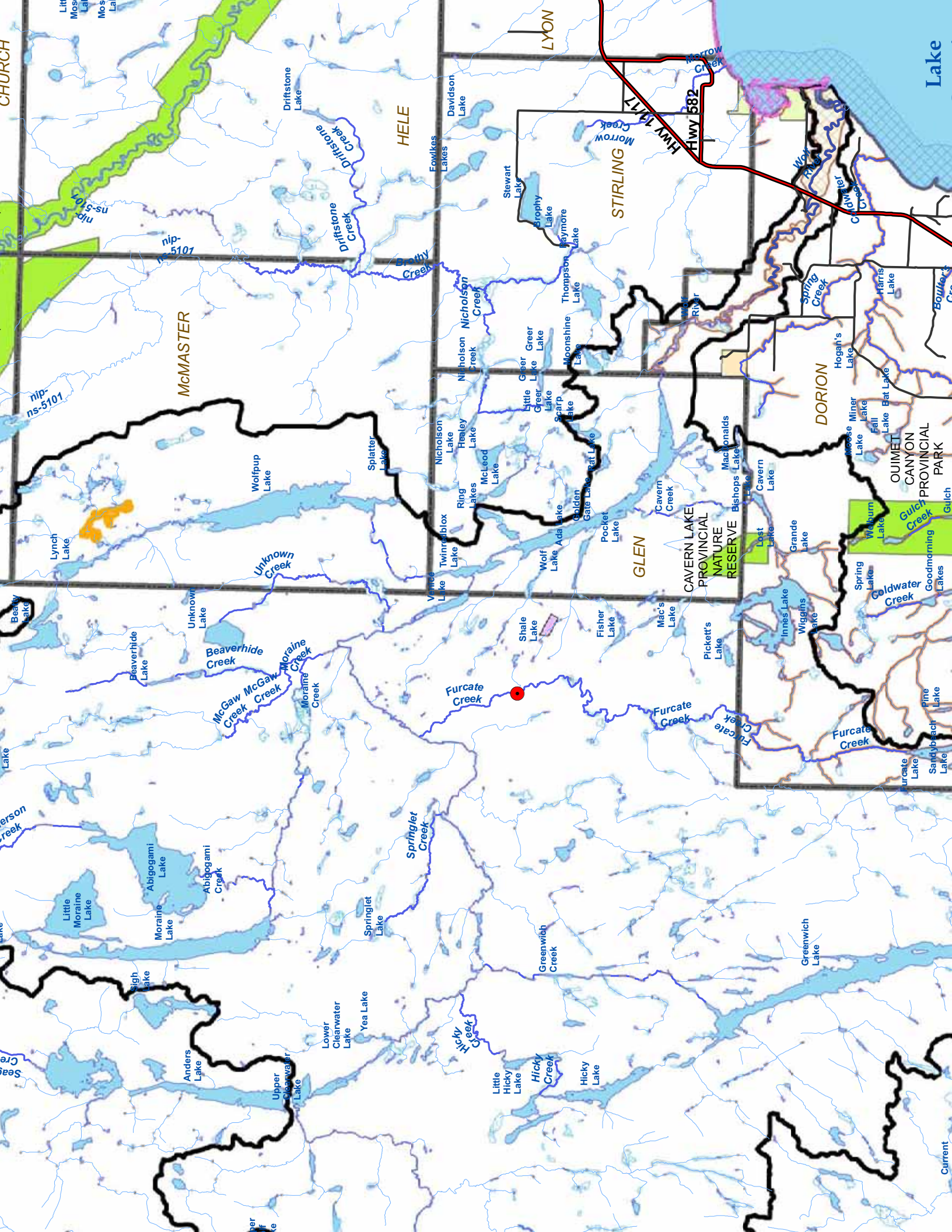
W
R
Spring Creek
DORION
Coldwater Creek
Lake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HELE
STIRLING
McMASTER
DORION
GLEN
CHURCH
Hwy 582
HWY 1/AT
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Morrow Creek
Driftstone Creek
Driftstone Lake
Davidson Lake
Fowlkes Lakes
Stewart Lake
Brophy Lake
Raymore Lake
Thompson Lake
Moonshine Lake
Greer Lake
Little Greer Lake
Scarp Lake
Nicholson Creek
Nicholson Lake
Healey Lake
McLeod Lake
Ring Lakes
Splatter Lake
Wolfpup Lake
Lynch Lake
Unknown Creek
Unknown Lake
Twinnyblox Lake
Wolf Lake
Ada Lake
Golden Gate Lake
Pocket Lake
Cavern Creek
Cavern Lake
Bishops Lake
Macdonalds Lake
Lost Lake
Grande Lake
Walburn Lake
Gulch Creek
Spring Lake
Goodmorning Lakes
Coldwater Creek
Innes Lake
Wiggins Lake
Pickett's Lake
Mac's Lake
Fisher Lake
Shale Lake
Beaverhide Creek
Beaverhide Lake
McGaw Creek
Moraine Creek
Furcate Creek
Furcate Lake
Sandybeach Lake
Pine Lake
Springlet Creek
Springlet Lake
Abigogami Creek
Abigogami Lake
Little Moraine Lake
Moraine Lake
Greenwich Creek
Greenwich Lake
Yea Lake
Lower Clearwater Lake
Upper Clearwater Lake
Anders Lake
Hicky Creek
Little Hicky Lake
Hicky Lake
Brophy Creek
Nicholson Creek
Spring Creek
Harris Lake
Hogan's Lake
Bat Lake
Miner Lake
Moose Lake
Fall Lake
Boulder Creek
Wolf River
Coldwater Creek
OUIMET CANYON PROVINCIAL PARK
CAVERN LAKE PROVINCIAL NATURE RESERVE
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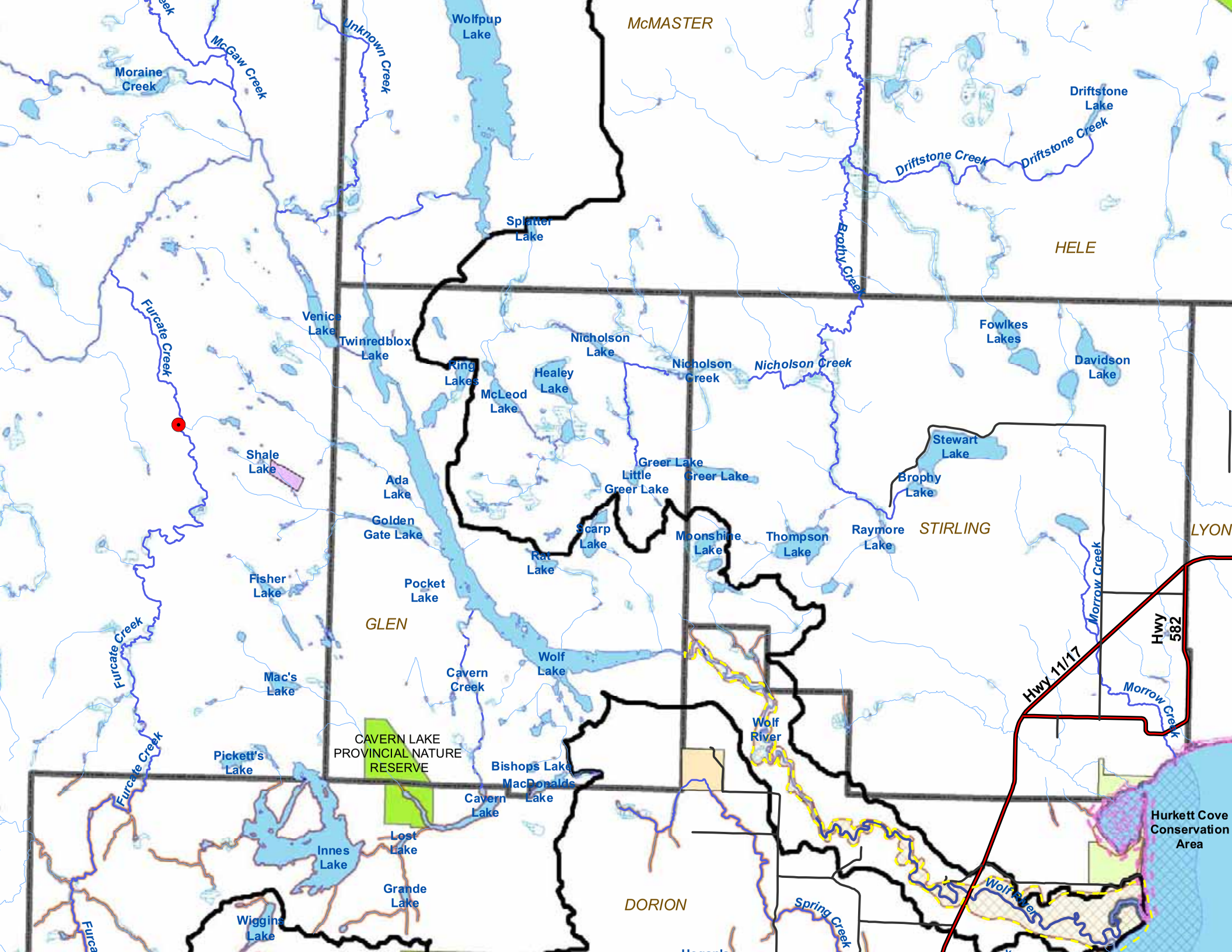
nip-ns-5101
nip-ns-5101


McMASTER
HELE
STIRLING
LYON
GLEN
DORION
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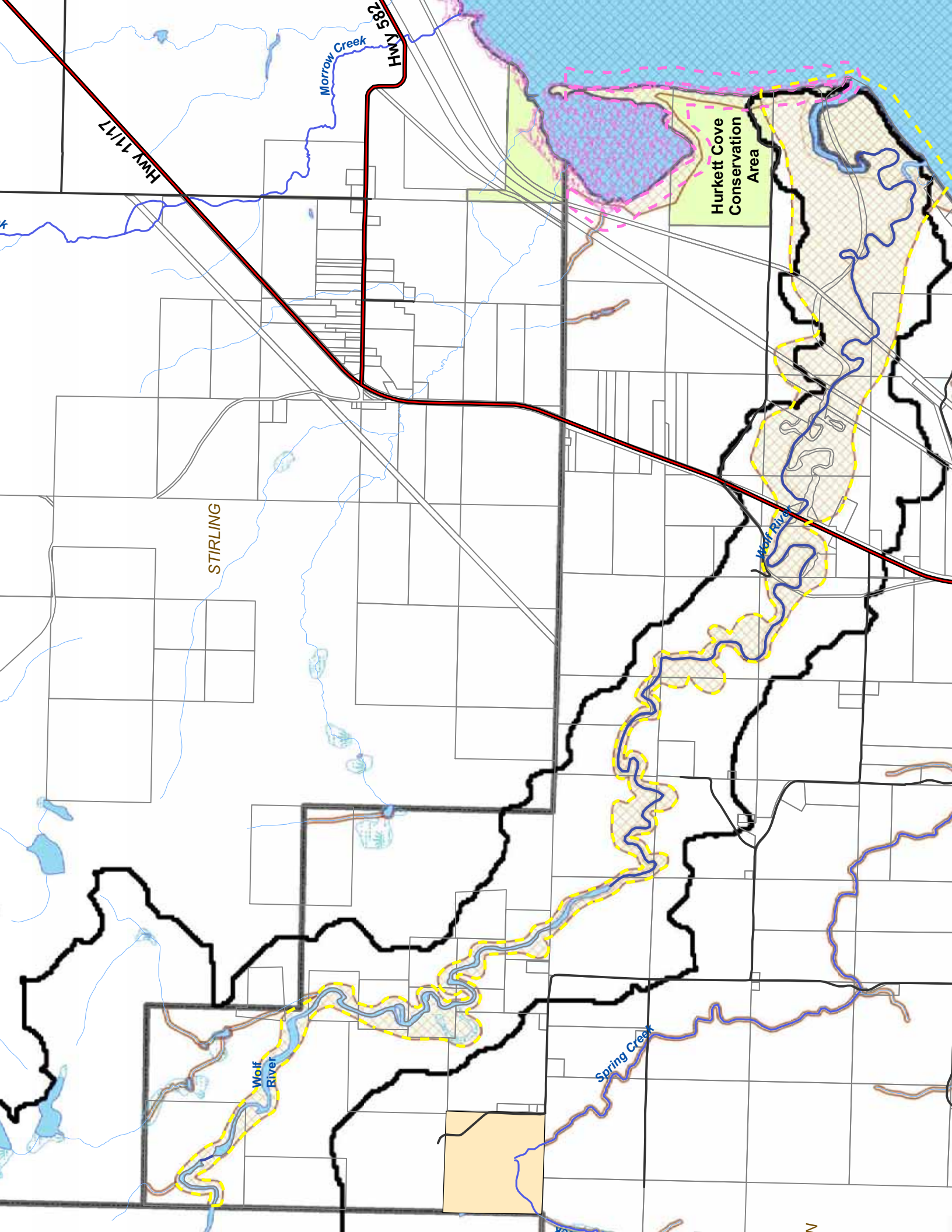
Unknown Creek
McGaw Creek
Moraine Creek
Splatter Lake
Brophy Creek
Driftstone Lake
Driftstone Creek
Driftstone Creek
Fowlkes Lakes
Davidson Lake
Nicholson Lake
Nicholson Creek
Nicholson Creek
Venice Lake
Twinredblox Lake
Furcate Creek
Ring Lakes
Healey Lake
McLeod Lake
Shale Lake
Ada Lake
Golden Gate Lake
Greer Lake
Little Greer Lake
Greer Lake
Stewart Lake
Brophy Lake
Scarp Lake
Rat Lake
Moonshine Lake
Thompson Lake
Raymore Lake
Morrow Creek
Hwy 582
Hwy 11/17
Morrow Creek
Fisher Lake
Pocket Lake
Furcate Creek
Mac's Lake
Cavern Creek
Wolf Lake
Wolf River
CAVERN LAKE PROVINCIAL NATURE RESERVE
Pickett's Lake
Furcate Creek
Bishops Lake
MacDonalds Lake
Cavern Lake
Hurkett Cove Conservation Area
Lost Lake
Innes Lake
Grande Lake
Wiggins Lake
Wolf River
Spring Creek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HWY 11/17
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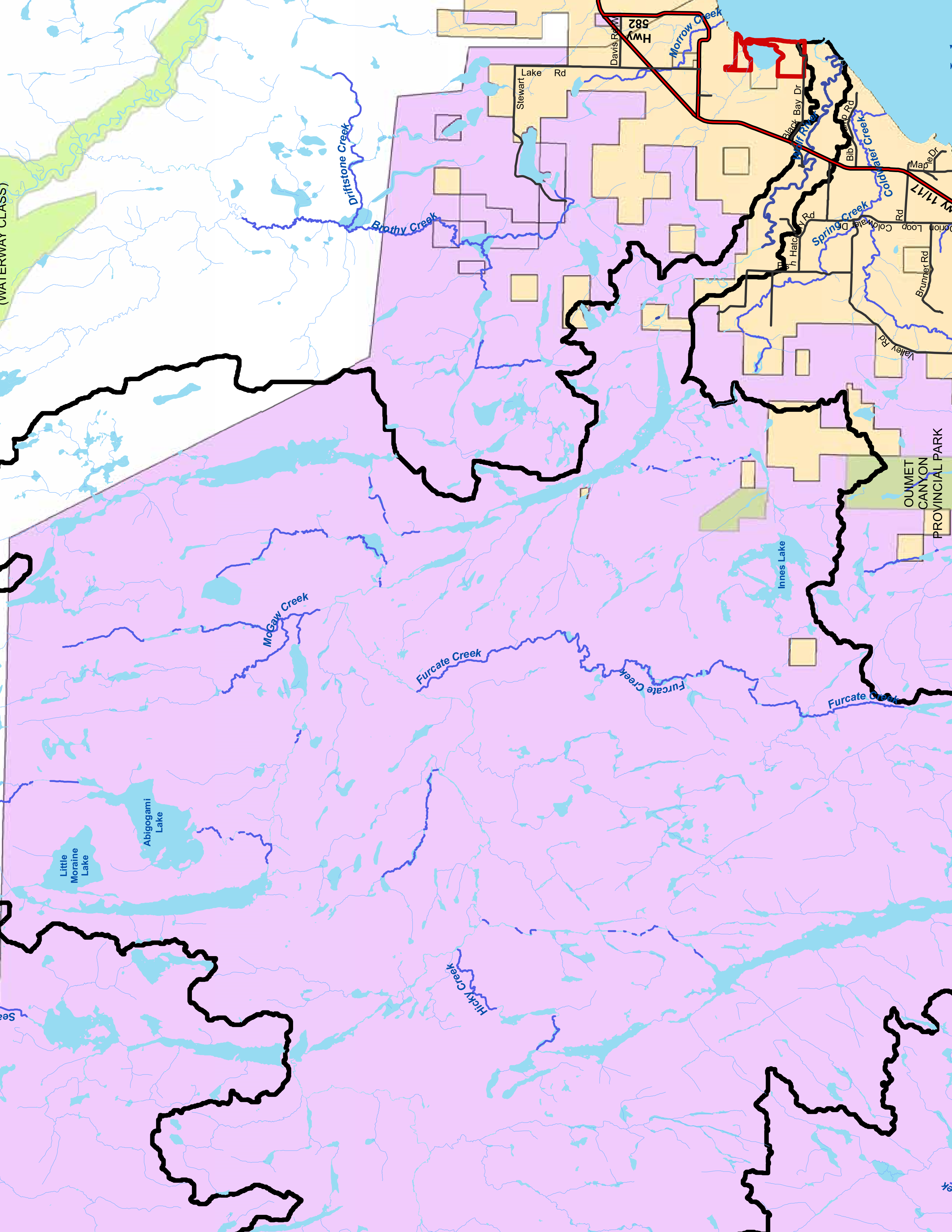
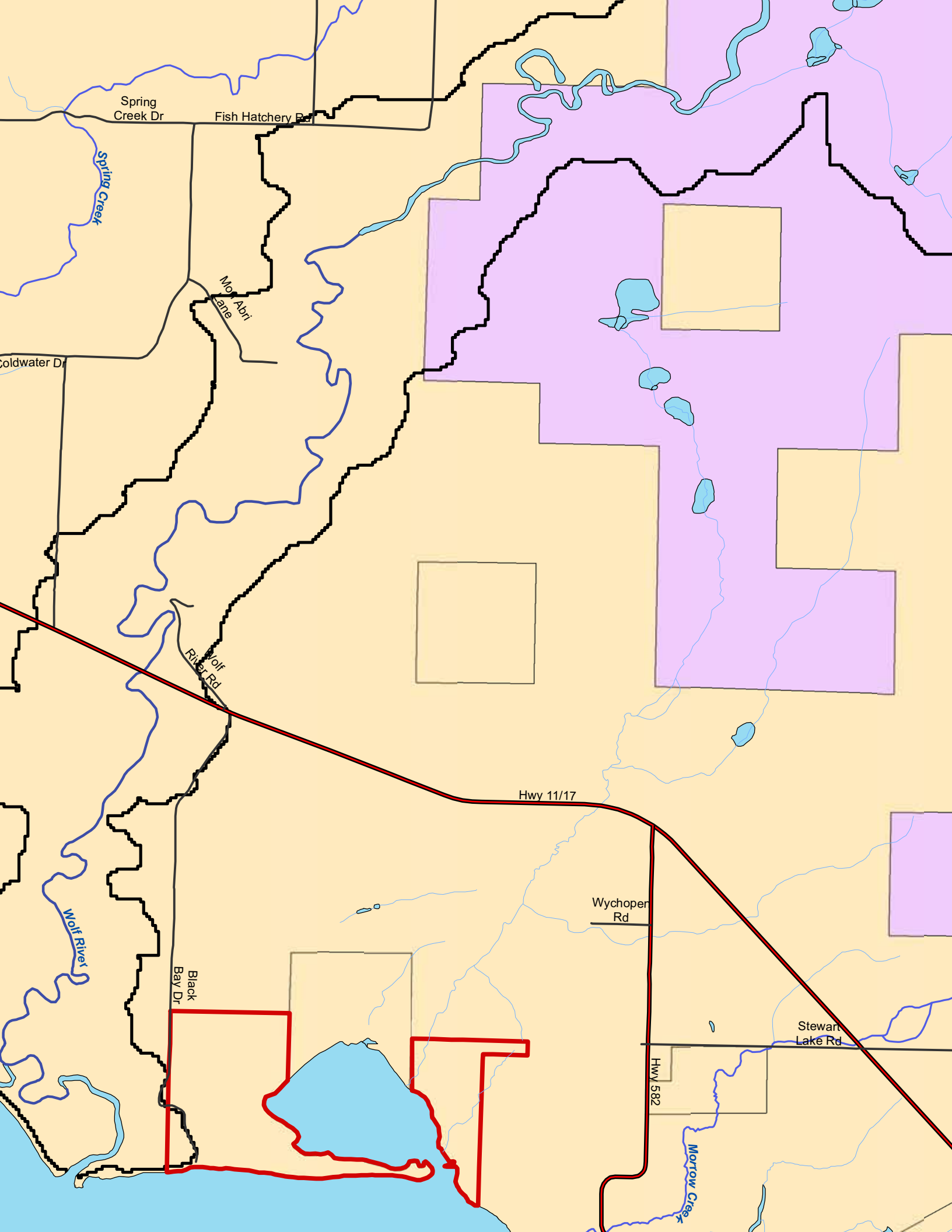
STIRLING
Wolf River
Wolf River
Spring Creek


Black Bay Dr
Original Confluence
New Confluence



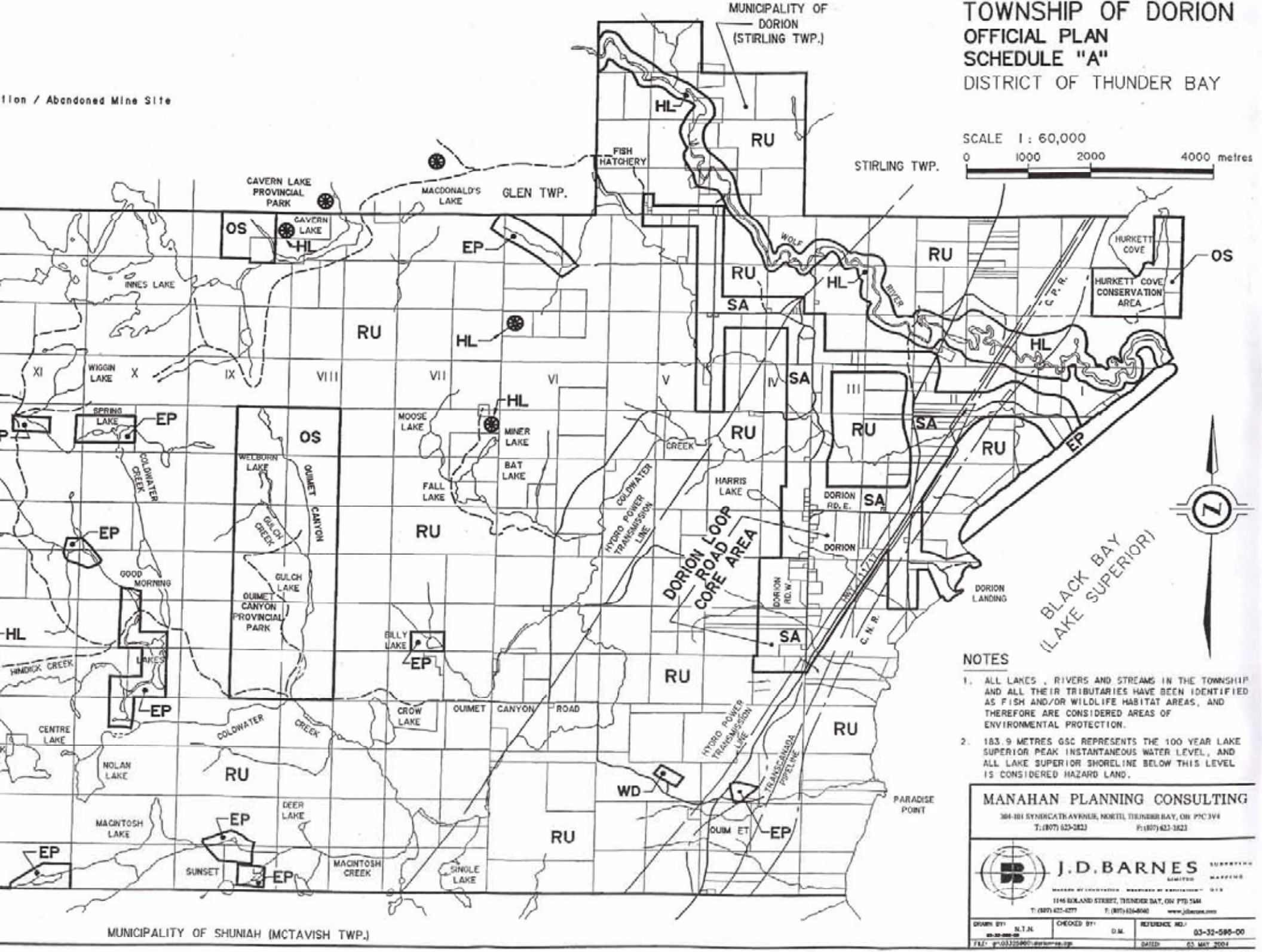
(WATERWAY CLASS)
Driftstone Creek
Brothy Creek
Lake Rd
Stewart
Hwy 582
Morrow Creek
Black Bay Dr
Wolf River
Coldwater Creek
Spring Creek
Orion Loop
Brunner Rd
Valley Rd
OUIMET CANYON PROVINCIAL PARK
Innes Lake
McGaw Creek
Furcate Creek
Furcate Creek
Furcate Creek
Abigogami Lake
Little Moraine Lake
Hicky Creek


Spring Creek Dr
Fish Hatchery Rd
Spring Creek
Mon Abri Lane
Coldwater Dr
Wolf River Rd
Hwy 11/17
Wychopen Rd
Wolf River
Black Bay Dr
Stewart Lake Rd
Hwy 582
Morrow Creek

TOWNSHIP OF DORION
OFFICIAL PLAN
SCHEDULE "A"
DISTRICT OF THUNDER BAY

tion / Abandoned Mine Site

SCALE 1 : 60,000
0 1000 2000 4000 metres



MUNICIPALITY OF SHUNIAH (MCTAVISH TWP.)

NOTES

1. ALL LAKES , RIVERS AND STREAMS IN THE TOWNSHIP AND ALL THEIR TRIBUTARIES HAVE BEEN IDENTIFIED AS FISH AND/OR WILDLIFE HABITAT AREAS, AND THEREFORE ARE CONSIDERED AREAS OF ENVIRONMENTAL PROTECTION.
2. 183.9 METRES GSC REPRESENTS THE 100 YEAR LAKE SUPERIOR PEAK INSTANTANEOUS WATER LEVEL, AND ALL LAKE SUPERIOR SHORELINE BELOW THIS LEVEL IS CONSIDERED HAZARD LAND.

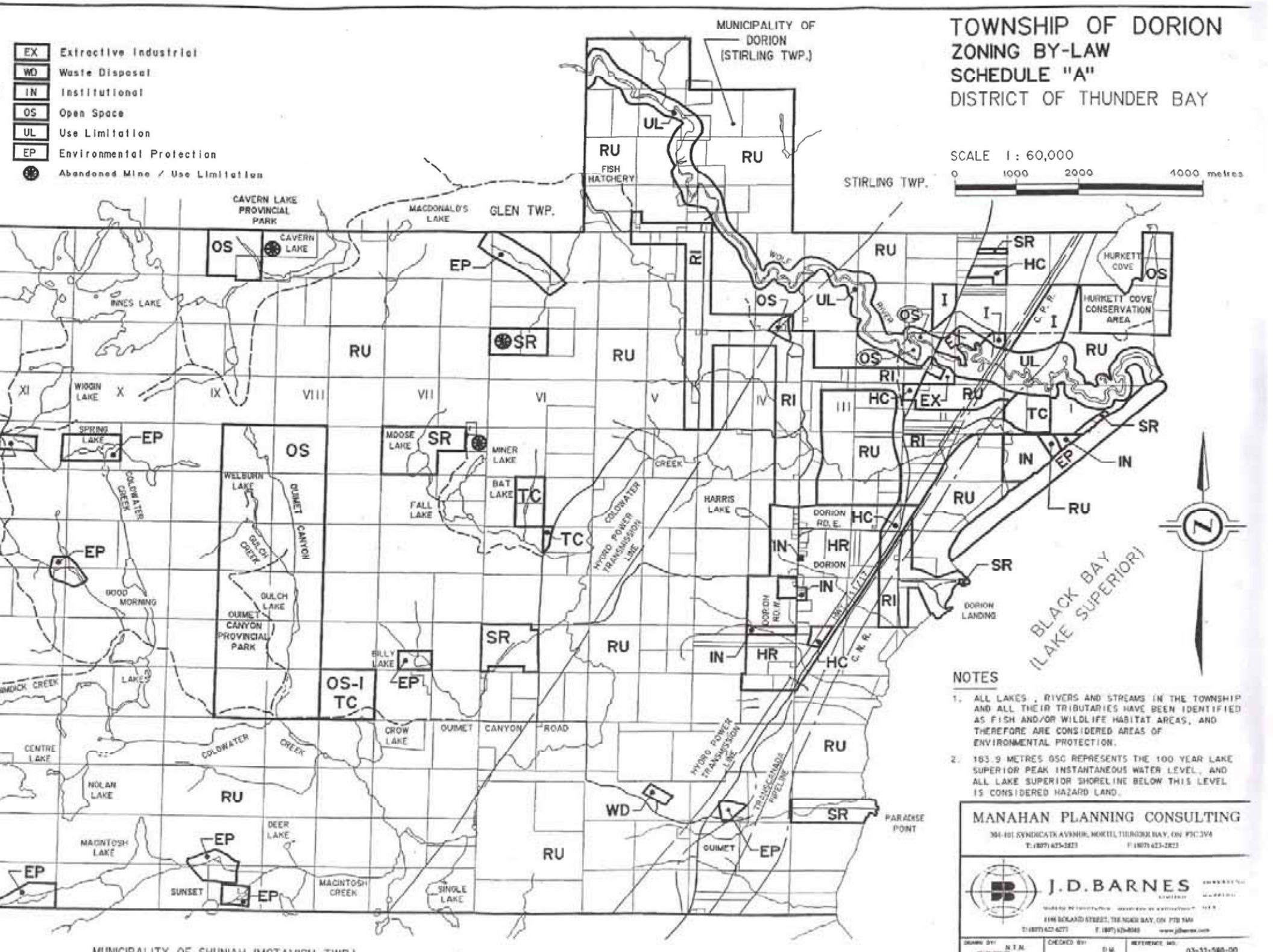
MANAHAN PLANNING CONSULTING
304-101 SYNDICATE AVENUE, NORTH, THUNDER BAY, ON P7C 3V8
T: (807) 623-3823 F: (807) 623-3823

J.D. BARNES LIMITED
1145 ROLAND STREET, THUNDER BAY, ON P7B 5M4
T: (807) 623-4277 F: (807) 626-8040 www.jdbarnes.com

DRAWN BY: N.T.M.	CHECKED BY: D.M.	REFERENCE NO.: 03-32-595-00
FILE: p:\03\32\595\arcview\ap		DATED: 03 MAY 2004

MAY 31/04

TOWNSHIP OF DORION
ZONING BY-LAW
SCHEDULE "A"
DISTRICT OF THUNDER BAY



NOTES

1. ALL LAKES , RIVERS AND STREAMS IN THE TOWNSHIP AND ALL THEIR TRIBUTARIES HAVE BEEN IDENTIFIED AS FISH AND/OR WILDLIFE HABITAT AREAS, AND THEREFORE ARE CONSIDERED AREAS OF ENVIRONMENTAL PROTECTION.
2. 183.9 METRES OSC REPRESENTS THE 100 YEAR LAKE SUPERIOR PEAK INSTANTANEOUS WATER LEVEL, AND ALL LAKE SUPERIOR SHORELINE BELOW THIS LEVEL IS CONSIDERED HAZARD LAND.

MANAHAN PLANNING CONSULTING
304-101 SYNDICATE AVENUE, NORTH, THUNDER BAY, ON P7C 3V4
T: (807) 623-2823 F: (807) 623-2823

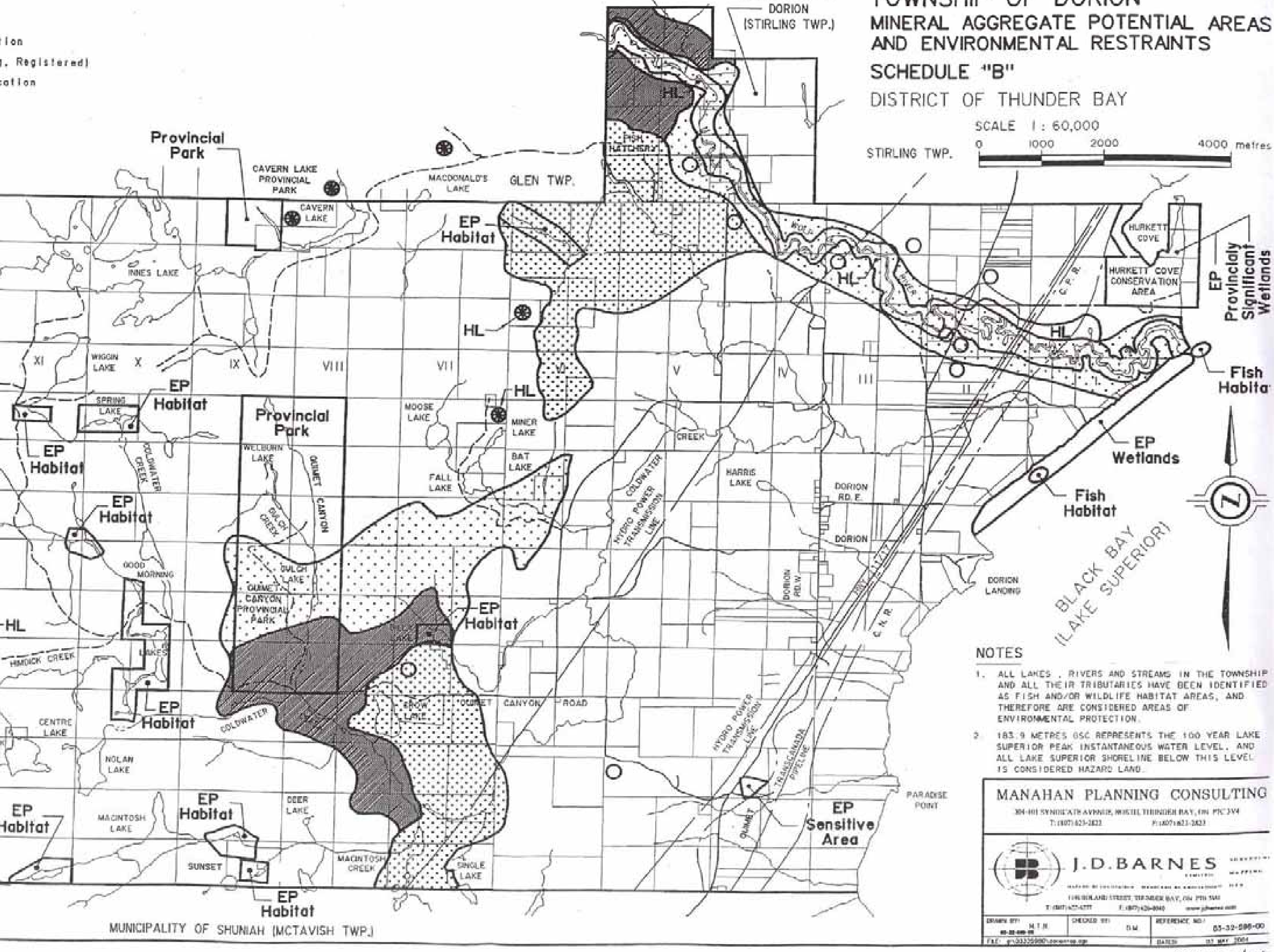
J.D. BARNES
199 BOWARD STREET, THUNDER BAY, ON P7B 5M4
T: (807) 622-6272 F: (807) 626-8060 www.jdbarnes.com

DRAWN BY: N.T.M.	CHECKED BY: D.M.	REFERENCE NO.: 03-33-580-00
FILE: g:\03335800\dorion-zon.dgn		DATED: 15 MAY 2004

MAY 3/04

TOWNSHIP OF DORION
MINERAL AGGREGATE POTENTIAL AREAS AND ENVIRONMENTAL RESTRAINTS
SCHEDULE "B"
DISTRICT OF THUNDER BAY

SCALE 1 : 60,000



NOTES

1. ALL LAKES, RIVERS AND STREAMS IN THE TOWNSHIP AND ALL THEIR TRIBUTARIES HAVE BEEN IDENTIFIED AS FISH AND/OR WILDLIFE HABITAT AREAS, AND THEREFORE ARE CONSIDERED AREAS OF ENVIRONMENTAL PROTECTION.
2. 183.9 METRES GSC REPRESENTS THE 100 YEAR LAKE SUPERIOR PEAK INSTANTANEOUS WATER LEVEL, AND ALL LAKE SUPERIOR SHORELINE BELOW THIS LEVEL IS CONSIDERED HAZARD LAND.

MANAHAN PLANNING CONSULTING

J.D. BARNES

REFERENCE NO.: 03-32-096-00

APPENDIX A:

TECHNIQUES FOR DATA COLLECTION

Appendix A: Techniques for Data Collection

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

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

Channel width & depth
The width was measured using the Bushnell® Yardage Pro™ Sport 450® Laser Rangefinder. Channel depth was measured by using a stainless steel meter stick.

Flow
The velocity of river flow at sites was measured using the Swoffer Model 2100 Current Velocity Meter.

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

Water Temperature
Water temperature was measured with the YSI 556 MPS. The readings were taken after the probe was submerged and all variables on the meter were stabilized.

Conductivity
Conductivity was measured with the YSI 556 MPS. 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.

Total Dissolved Solids
The total dissolved solids (TDS) are measured from the conductivity reading.

Dissolved Oxygen
The YSI 556 MPS measured dissolved oxygen for the samples. The readings were recorded once the probe was submerged in the water and all variables were stabilized.

Tree, Shrub & Herb Species
Identification was made in the vicinity of the sample sites, approximately 10 metre by 10 metre transects.

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

OBBN Aquatic Macrophytes and Algae Key

Abundance of Aquatic Macrophytes and Algae

Occurrence of aquatic macrophytes and algae were given a class.

Class	Occurrence
1	Abundant
2	Present
3	Absent

Benthic/Terrestrial Species

Through the use of dip nets and observations, species were identified by observation and verified by the use of field guides. Benthos kept for picking and enumeration at a later date were preserved in ethyl alcohol.

In-stream Material

In-stream material refers to logs, rocks and organic/vegetative debris that are found within the river. This is important to record as it greatly affects the diversity of benthic life. The in-stream material was described through observation and recorded for each site.

OBBN In-Stream Materials Key

In-Stream Substrate

In-stream substrate was assigned a class based on substrate composition.

Class	Description
1	Clay (hard pan)
2	Silt (gritty,<0.06mm particle diameter)
3	Sand (grainy,0.06-2mm)
4	Gravel (2-65mm)
5	Cobble (65-250mm)
6	Boulder (>250mm)
7	Bedrock
8	Organic

OBBN Organic Matter-Aerial Coverage Key

Abundance of Woody Debris and Detritus

The occurrence of in-stream woody debris and detritus was assigned a class.

Class	Occurrence
1	Abundant
2	Present
3	Absent

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

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

Stream Bank Stability / Erosion
Evidence of erosion or the potential of erosion was observed, categorized as either stable or unstable. A bank was categorized stable if there was little to no erosion present, well vegetated or had a low slope. Unstable was defined as having visible signs of erosion, little to no vegetation on the bank or a steep slope.

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	25-74% shaded by canopy
Open	0-24% shaded by canopy

OBBN Stream Cover Key
Riparian Vegetative Community
Riparian vegetation was assigned a class based on occurring species composition.

Class	Description
1	None
2	Cultivated
3	Meadow
4	Scrubland
5	Forest, mainly coniferous
6	Forest, mainly deciduous

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 table above and its moisture content. For example, clay with poor drainage will have a low erosion hazard.

Stream Sinuosity Classification

The sinuosity of the Wolf River was given an estimate based on the following information:

Class	Sinuosity Index
Straight	SI < 1.05
Sinuous	SI 1.05-1.5
Meandering	SI > 1.5

Mount. 1995

The Sinuosity Indexes are based of the following equations:

SI = thalweg length/valley length

or

SI = length of channel axis/length of meander belt axis

Note: LRCA staff did not use these formulas to determine a sinuosity index. Estimated sinuosity was based off of aerial photographs of the meandering river pattern.

APPENDIX B:

WATER QUALITY PARAMETERS

Appendix B: Water Quality Parameters

Temperature

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

Dissolved Oxygen

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

pH

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

Total Dissolved Solids

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

Conductivity

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

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

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

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

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

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

Bacteria
Escherichia coli is naturally found in the intestines of humans and warm-blooded animals. Unlike other bacteria in this family, *E. coli* does not usually occur naturally on plants or in soil and water. The inability of *E. coli* to grow in water combined with its short survival time in water environments means that the detection of *E. coli* in a water system is a good indicator of recent fecal contamination. Sources of *E. coli* could be

leaking septic systems, runoff from manure storage facilities or wild animal waste (i.e. beavers and Canadian Geese). These bacteria can cause irritation of the skin and eyes when contact is made and can cause gastro-intestinal disorders.

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

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

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

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

Antimony
Antimony is a metallic element that is a blue-white colour in its stable form. Acute intoxication is characterized by abdominal pain, vomiting, diarrhea, dehydration, muscular pain, shock, haemoglobinuria, anuria and uraemia. In addition, severe myocardial symptoms and convulsions have been observed with acute doses of antimonials, and some deaths were attributed to liver necrosis. The maximum concentration of antimony under PWQO guidelines is 20 μg/L.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Titanium
Titanium is a white-silvery metallic colour and is always found bound to other elements in nature. There are no known health hazards of titanium in water, but it has 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 and these can cause health effects such as kidney disease. Exposure to uranium radionuclides that form during radioactive decay may cause cancer. The maximum concentration of uranium under PWQO guidelines is 5 μg/L.

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

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

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

APPENDIX C:

WATER QUALITY GUIDELINES

Appendix C: Water Quality Guidelines

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

Physical

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

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

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

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

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

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

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

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

Waste Heat Discharge

1. Ambient Temperature Changes

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

2. Discharge Temperature Permitted

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

3. Taking and Discharging of Cooling Water

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

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

Nutrients

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

The percentages of un-ionized ammonia (NH3) in aqueous ammonia solution for different temperature and pH conditions are listed in the table below. For example, at 20°C and pH of 8.0,

a total ammonia concentration of 500µg/L would give an un-ionized ammonia concentration of 500 x 3.8/100 = 19µg/L which is less than the un-ionized ammonia Objective of 20µg/L.

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

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

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

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

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

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

Temp.	**pH**								
°C	**6.0**	**6.5**	**7.0**	**7.5**	**8.0**	**8.5**	**9.0**	**9.5**	**10.0**
0	.0083	.026	.083	.26	.82	2.6	7.6	21.	45.
1	.0090	.028	.090	.28	.89	2.8	8.3	22.	47.
2	.0098	.031	.098	.31	.97	3.0	8.9	24.	49.
3	.011	.034	.11	.34	1.1	3.3	9.6	25.	52.
4	.012	.036	.12	.36	1.1	3.5	10.	27.	54.
5	.013	.040	.13	.39	1.2	3.8	11.	28.	56.
6	.014	.043	.14	.43	1.3	4.1	12.	30.	58.
7	.015	.046	.15	.46	1.5	4.4	13.	32.	60.
8	.016	.050	.16	.50	1.6	4.8	14.	34.	61.
9	.017	.054	.17	.54	1.7	5.2	15.	35.	63.
10	.019	.059	.19	.59	1.8	5.6	16.	37.	65.
11	.020	.064	.20	.63	2.0	6.0	17.	39.	67.
12	.022	.069	.22	.68	2.1	6.4	18.	41.	69.
13	.024	.074	.24	.74	2.3	6.9	19.	43.	70.
14	.025	.080	.25	.80	2.5	7.4	20.	45.	72.
15	.027	.087	.27	.86	2.7	8.0	22.	46.	73.
16	.030	.093	.29	.93	2.9	8.5	23.	48.	75.
17	.032	.10	.32	1.0	3.1	9.1	24.	50.	76.
18	.034	.11	.34	1.1	3.3	9.8	26.	52.	77.
19	.037	.11	.37	1.2	3.6	11.	27.	54.	79.
20	.040	.13	.40	1.2	3.8	11.	28.	56.	80.

Temp.	pH								
°C	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
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 20µg/L;

A high level of protection against aesthetic deterioration will be provided by a total phosphorus concentration for the ice-free period of 10µg/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 30µg/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 judgement 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 a 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

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

Bismuth:
There are currently no PWQO guidelines for Bismuth.

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

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

Calcium:
There are currently no PWQO guidelines for Calcium.

Chromium:
Chromium amounts should not exceed the following:

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

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

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

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

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

Lead:
Lead amounts should not exceed the following:

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

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.

Strontium:
There are currently no PWQO guidelines for Strontium.

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

Tin:
There are currently no PWQO guidelines for Tin.

Titanium:
There are currently no PWQO guidelines for Titanium.

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

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

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

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

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

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

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

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

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

APPENDIX D:

LABORATORY WATER QUALITY RESULTS

Appendix D: Laboratory Water Quality Results

Bold indicates above PWQO Guidelines

Laboratory Water Quality Results for Site 1: New Confluence				
Parameter	Unit	PWQO	17-JUN-09 14:25	13-JUL-09 11:00
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	4	26
Total Coliforms	MPN/100mL	1000 (prior to 1994)	440	610
Physical Tests				
Conductivity (EC)	uS/cm	n/a	173	204
Total Dissolved Solids	mg/L	n/a	103	139
Turbidity	NTU	<10% of natural	1.05	2.01
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	1.13	1.50
Nitrate-N (NO3-N)	mg/L	n/a	0.064	0.036
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	<0.0050	0.0066
Sulphate (SO4)	mg/L	n/a	2.77	3.07
Total Metals				
Aluminum (Al)	mg/L	0.075	0.048	0.071
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.139	0.160
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	20.3	22.3
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0017	0.0021
Iron (Fe)	mg/L	0.3	0.136	0.159
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	8.80	11.4
Manganese (Mn)	mg/L	n/a	0.0110	0.0221
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	<0.0020
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.74	3.16
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0356	0.0395
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	<0.0020	0.0027
Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	0.0014

Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0042
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 2: Old Confluence Channel				
Parameter	Unit	PWQO	17-JUN-09 14:55	13-JUL-09 12:30
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	23	12
Total Coliforms	MPN/100mL	1000 (prior to 1994)	870	870
Physical Tests				
Conductivity (EC)	uS/cm	n/a	186	218
Total Dissolved Solids	mg/L	n/a	95	141
Turbidity	NTU	<10% of natural	3.25	6.02
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	0.98	1.41
Nitrate-N (NO3-N)	mg/L	n/a	<0.030	<0.030
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0120	**0.0304**
Sulphate (SO4)	mg/L	n/a	2.69	2.85
Total Metals				
Aluminum (Al)	mg/L	0.075	**0.098**	**0.158**
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.147	0.171
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	23.3	25.2
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0030	0.0029
Iron (Fe)	mg/L	0.3	**0.313**	**0.455**
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	8.79	12.5
Manganese (Mn)	mg/L	n/a	0.0422	0.0616
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	0.0022
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.51	3.17
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0366	0.0417
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	0.0037	0.0078
Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050

Vanadium (V)	mg/L	0.006	0.0011	0.0019
Zinc (Zn)	mg/L	0.02 (interim)	0.0074	0.0051
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 3: Abandoned CNR Crossing				
Parameter	Unit	PWQO	15-JUN-09 14:41	13-JUL-09 13:30
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	4	23
Total Coliforms	MPN/100mL	1000 (prior to 1994)	440	340
Physical Tests				
Conductivity (EC)	uS/cm	n/a	165	205
Total Dissolved Solids	mg/L	n/a	123	129
Turbidity	NTU	<10% of natural	0.93	1.34
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	0.99	1.56
Nitrate-N (NO3-N)	mg/L	n/a	0.062	0.040
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0095	0.0169
Sulphate (SO4)	mg/L	n/a	2.79	3.09
Total Metals				
Aluminum (Al)	mg/L	0.075	0.048	0.070
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.130	0.161
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	20.0	22.1
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0024	0.0018
Iron (Fe)	mg/L	0.3	0.150	0.144
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	7.69	11.4
Manganese (Mn)	mg/L	n/a	0.0096	0.0145
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	<0.0020
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.66	3.24
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0353	0.0393
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	0.0020	0.0029
Tungsten (W)	mg/L	0.03	<0.010	<0.010

Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	0.0013
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0033
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 4: Wolf River Campground				
Parameter	Unit	PWQO	16-JUN-09 10:36	13-JUL-09 14:18
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	3	20
Total Coliforms	MPN/100mL	1000 (prior to 1994)	520	610
Physical Tests				
Conductivity (EC)	uS/cm	n/a	160	199
Total Dissolved Solids	mg/L	n/a	123	130
Turbidity	NTU	<10% of natural	0.93	1.49
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	0.72	0.89
Nitrate-N (NO3-N)	mg/L	n/a	0.070	0.041
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0058	0.0141
Sulphate (SO4)	mg/L	n/a	2.77	3.01
Total Metals				
Aluminum (Al)	mg/L	0.075	0.042	**0.104**
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.124	0.161
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	19.8	21.8
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0019	0.0018
Iron (Fe)	mg/L	0.3	0.142	0.141
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	7.53	11.4
Manganese (Mn)	mg/L	n/a	0.0089	0.0103
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	0.0024	<0.0020
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.66	3.21
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0339	0.0396
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	<0.0020	0.0023

Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	0.0013
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0037
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 5: Mon Abri Lane Bridge				
Parameter	Unit	PWQO	16-JUN-09 11:16	14-JUL-09 11:00
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	4	21
Total Coliforms	MPN/100mL	1000 (prior to 1994)	440	460
Physical Tests				
Conductivity (EC)	uS/cm	n/a	159	197
Total Dissolved Solids	mg/L	n/a	126	128
Turbidity	NTU	<10% of natural	0.72	0.80
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	0.69	0.85
Nitrate-N (NO3-N)	mg/L	n/a	0.067	0.037
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0065	<0.0050
Sulphate (SO4)	mg/L	n/a	2.70	2.90
Total Metals				
Aluminum (Al)	mg/L	0.075	0.034	0.032
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.125	0.173
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	19.9	22.8
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0018	0.0015
Iron (Fe)	mg/L	0.3	0.133	0.087
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	7.32	11.3
Manganese (Mn)	mg/L	n/a	0.0086	0.0082
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	<0.0020
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.66	3.72
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0340	0.0375
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010	<0.0010

Titanium (Ti)	mg/L	n/a	<0.0020	<0.0020
Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0052
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 6: MNR Fish Hatchery Sub-station				
Parameter	Unit	PWQO	16-JUN-09 12:20	14-JUL-09 12:15
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	1	12
Total Coliforms	MPN/100mL	1000 (prior to 1994)	520	490
Physical Tests				
Conductivity (EC)	uS/cm	n/a	163	185
Total Dissolved Solids	mg/L	n/a	121	128
Turbidity	NTU	<10% of natural	0.58	0.81
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	0.61	0.76
Nitrate-N (NO3-N)	mg/L	n/a	0.060	0.032
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0056	<0.0050
Sulphate (SO4)	mg/L	n/a	2.79	2.83
Total Metals				
Aluminum (Al)	mg/L	0.075	0.031	0.042
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.138	0.163
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	21.7	22.7
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0018	0.0014
Iron (Fe)	mg/L	0.3	0.127	0.091
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	8.16	11.3
Manganese (Mn)	mg/L	n/a	0.0098	0.0083
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	<0.0020
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.87	3.76
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0361	0.0373
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030

Tin (Sn)	mg/L	n/a	<0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	<0.0020	<0.0020
Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0036
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 7: Wolf Lake Dam				
Parameter	Unit	PWQO	16-JUN-09 13:48	14-JUL-09 13:53
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	3	0
Total Coliforms	MPN/100mL	1000 (prior to 1994)	36	82
Physical Tests				
Conductivity (EC)	uS/cm	n/a	153	176
Total Dissolved Solids	mg/L	n/a	125	123
Turbidity	NTU	<10% of natural	1.29	1.22
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	0.58	0.77
Nitrate-N (NO3-N)	mg/L	n/a	0.056	<0.030
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0055	0.0052
Sulphate (SO4)	mg/L	n/a	2.73	2.88
Total Metals				
Aluminum (Al)	mg/L	0.075	0.047	0.047
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.118	0.147
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	18.7	20.2
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0018	0.0014
Iron (Fe)	mg/L	0.3	0.152	0.105
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	7.04	10.3
Manganese (Mn)	mg/L	n/a	0.0094	0.0079
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	<0.0020
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.56	3.45
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0334	0.0352

Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	<0.0020	<0.0020
Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0038
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 8: Cavern Lake Tributary Outlet Pool				
Parameter	Unit	PWQO	16-JUN-09	14-JUL-09
			15:13	-
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	1	-
Total Coliforms	MPN/100mL	1000 (prior to 1994)	250	-
Physical Tests				
Conductivity (EC)	uS/cm	n/a	99.2	-
Total Dissolved Solids	mg/L	n/a	96	-
Turbidity	NTU	<10% of natural	0.29	-
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	-
Chloride (Cl)	mg/L	n/a	0.30	-
Nitrate-N (NO3-N)	mg/L	n/a	0.049	-
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	-
Phosphorus (P)-Total	mg/L	0.03	0.0115	-
Sulphate (SO4)	mg/L	n/a	2.31	-
Total Metals				
Aluminum (Al)	mg/L	0.075	0.052	-
Antimony (Sb)	mg/L	0.02	<0.0050	-
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	-
Barium (Ba)	mg/L	n/a	0.077	-
Beryllium (Be)	mg/L	0.011	<0.0010	-
Bismuth (Bi)	mg/L	n/a	<0.0010	-
Boron (B)	mg/L	0.2	<0.050	-
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	-
Calcium (Ca)	mg/L	n/a	12.4	-
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	-
Cobalt (Co)	mg/L	0.0009	<0.00050	-
Copper (Cu)	mg/L	0.005 (interim)	0.0026	-
Iron (Fe)	mg/L	0.3	0.084	-
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	-
Magnesium (Mg)	mg/L	n/a	4.76	-
Manganese (Mn)	mg/L	n/a	0.0040	-
Molybdenum (Mo)	mg/L	0.04	<0.0010	-
Nickel (Ni)	mg/L	0.025	<0.0020	-
Potassium (K)	mg/L	n/a	<1.0	-
Selenium (Se)	mg/L	0.1	<0.00040	-
Silicon (Si)	mg/L	n/a	1.83	-
Silver (Ag)	mg/L	0.0001	<0.00010	-

Strontium (Sr)	mg/L	n/a	0.0195	-
Thallium (Tl)	mg/L	0.0003	<0.00030	-
Tin (Sn)	mg/L	n/a	<0.0010	-
Titanium (Ti)	mg/L	n/a	<0.0020	-
Tungsten (W)	mg/L	0.03	<0.010	-
Uranium (U)	mg/L	0.005	<0.0050	-
Vanadium (V)	mg/L	0.006	<0.0010	-
Zinc (Zn)	mg/L	0.02 (interim)	0.0035	-
Zirconium (Zr)	mg/L	0.004	<0.0040	-

Laboratory Water Quality Results for Site 9: Wolf Lake Road Bridge				
Parameter	Unit	PWQO	17-JUN-09	15-JUL-09
			12:54	12:00
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	23	8
Total Coliforms	MPN/100mL	1000 (prior to 1994)	770	330
Physical Tests				
Conductivity (EC)	uS/cm	n/a	117	159
Total Dissolved Solids	mg/L	n/a	82	109
Turbidity	NTU	<10% of natural	0.78	0.95
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	0.021	<0.020
Chloride (Cl)	mg/L	n/a	0.34	0.49
Nitrate-N (NO3-N)	mg/L	n/a	0.041	<0.030
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	<0.0050	<0.0050
Sulphate (SO4)	mg/L	n/a	2.03	2.17
Total Metals				
Aluminum (Al)	mg/L	0.075	0.065	0.058
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.100	0.142
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	13.5	20.2
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0019	0.0014
Iron (Fe)	mg/L	0.3	0.186	0.177
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	6.13	10.3
Manganese (Mn)	mg/L	n/a	0.0101	0.0176
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	<0.0020
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040
Silicon (Si)	mg/L	n/a	2.22	2.55

Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0234	0.0332
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	<0.0020	<0.0020
Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	<0.0010
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0036
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

Laboratory Water Quality Results for Site 10: Upper Clearwater Lake Headwaters				
Parameter	Unit	PWQO	17-JUN-09 11:48	15-JUL-09 10:30
Bacteriological Tests				
Escherichia Coli	MPN/100mL	100	17	2
Total Coliforms	MPN/100mL	1000 (prior to 1994)	310	310
Physical Tests				
Conductivity (EC)	uS/cm	n/a	110	148
Total Dissolved Solids	mg/L	n/a	82	121
Turbidity	NTU	<10% of natural	1.57	2.53
Anions and Nutrients				
Ammonia-N, Total	mg/L	n/a	<0.020	<0.020
Chloride (Cl)	mg/L	n/a	0.27	0.44
Nitrate-N (NO3-N)	mg/L	n/a	<0.030	<0.030
Nitrite-N (NO2-N)	mg/L	n/a	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0067	0.0060
Sulphate (SO4)	mg/L	n/a	1.91	2.00
Total Metals				
Aluminum (Al)	mg/L	0.075	**0.107**	**0.109**
Antimony (Sb)	mg/L	0.02	<0.0050	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010	<0.0010
Barium (Ba)	mg/L	n/a	0.084	0.120
Beryllium (Be)	mg/L	0.011	<0.0010	<0.0010
Bismuth (Bi)	mg/L	n/a	<0.0010	<0.0010
Boron (B)	mg/L	0.2	<0.050	<0.050
Cadmium (Cd)	mg/L	0.0001 (interim)	<0.000090	<0.000090
Calcium (Ca)	mg/L	n/a	13.6	18.8
Chromium (Cr)	mg/L	0.001 for Cr(VI)	<0.0010	<0.0010
Cobalt (Co)	mg/L	0.0009	<0.00050	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0026	0.0023
Iron (Fe)	mg/L	0.3	0.282	**0.321**
Lead (Pb)	mg/L	0.001 (interim)	<0.0010	<0.0010
Magnesium (Mg)	mg/L	n/a	5.95	9.48
Manganese (Mn)	mg/L	n/a	0.0129	0.0261
Molybdenum (Mo)	mg/L	0.04	<0.0010	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020	0.0024
Potassium (K)	mg/L	n/a	<1.0	<1.0
Selenium (Se)	mg/L	0.1	<0.00040	<0.00040

Silicon (Si)	mg/L	n/a	2.48	2.97
Silver (Ag)	mg/L	0.0001	<0.00010	<0.00010
Strontium (Sr)	mg/L	n/a	0.0218	0.0299
Thallium (Tl)	mg/L	0.0003	<0.00030	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010	<0.0010
Titanium (Ti)	mg/L	n/a	<0.0020	0.0022
Tungsten (W)	mg/L	0.03	<0.010	<0.010
Uranium (U)	mg/L	0.005	<0.0050	<0.0050
Vanadium (V)	mg/L	0.006	<0.0010	0.0011
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030	0.0036
Zirconium (Zr)	mg/L	0.004	<0.0040	<0.0040

APPENDIX E:

FOREST ECOSYSTEM CLASSIFCATION

Appendix E: Forest Ecosystem Classification

Site 1: V4 White Birch Hardwood and Mixedwood
Site 2: V4White Birch Hardwood and Mixedwood
Site 3: V2 Black Ash Hardwood and Mixedwood
Site 4: V1 Balsam Poplar Hardwood and Mixedwood
Site 5: V35 Black Spruce/Speckled Alder/Sphagnum
Site 6: V 6 Trembling Aspen (White Birch)-Balsam Fir/Mountain Maple
Site 7: V 5 Aspen Harwood
Site 8: V 22 Cedar/Speckled Alder/Sphagnum
Site 9: V 23 Tamarack (Black Spruce)/Speckled Alder/Labrador Tea
Site 10: V 19 Black Spruce Mixedwood/Herb Rich

V1 Balsam Poplar Hardwood and Mixedwood
Description: Hardwood and mixedwood stands containing balsam poplar in overstory. The understory is typically herb and shrub rich with a broad diversity of species. Occurring on deep, fresh to moist mineral soils, often of lacustrine origin.

V2 Black Ash Hardwood and Mixedwood
Description: Hardwood and mixedwood stands containing black ash in the overstory. The understory is typically dense and floristically diverse. Of limited areal extent; occurring in low-lying locations on deep, moist to wet, usually no-calcareous substrates.

V4 White Birch Hardwood and Mixed Wood
Description: Mixedwood stands, often with a tall overstory of white pine and a secondary canopy of other tree species. The understory is typically shrub and herb rich. Occurring on deep, fresh, non-calcareous, coarse-textured, upland mineral sites.

V5 Aspen Harwood
Description: Hardwood stands containing trembling and/or large-toothed aspen (usually trembling aspen). The understory is characteristically herb and shrub rich.
Occurring mostly on deep, fresh, upland mineral soils.

V6 Trembling Aspen (White Birch) – Balsam Fir/Mountain Maple
Description: Hardwood mixedwood stands with balsam fir as the main conifer tree species. The canopy is typically diffuse and two-tiered with aspen or aspen-birch in the overstory and balsam fir constituting a secondary stratum.

V 19 Black Spruce Mixedwood/Herb Rich
Description: A black spruce mixedwood Type with several potential species in the overstory. The understory is typically dominated by a rich herb/dwarf layer. The shrub stratum ranges from dense to open, usually with balsam fir and black spruce as important components.

V 22 Cedar/Speckled Alder/Sphagnum
Description: Lowland white cedar stands, including mixedwoods, often containing black spruce in the canopy. The shrub layer is generally dominated by balsam fir and white cedar.

V 23 Tamarack (Black Spruce)/Speckled Alder/Labrador Tea
Description: Wet tamarack stands, often with black spruce in the overstory. The shrub layer is typically dominated by low, ericaceous species although thickets of balsam fir or black spruce may occur.

V35 Black Spruce/Speckled Alder/Sphagnum
Description: Wet, shrub rich black spruce stands, occasionally with other conifers in the canopy. Alnus rugosa, often in association with black spruce and balsam fir, is abundant in tall shrub layer. Species diversity in the herb/ dwarf shrub layer can be high. Ground cover consists of sphagnum and feathermoss, often with large patches of broadleaf litter.

APPENDIX F:

SOILS

Appendix F: Soil Type Classification

Site 1- 2: S2 Fresh/Fine Sandy

General Description (n=234)
Moderately fresh, fine or very fine sandy soils. Developed mainly in glaciofluvial and morainal parent materials.

Soil/Site Characteristics

Thickness of Organic Layer:	[LFH]-(6-15)7, (1-5)2
Forest Humus Form:	fibrimor7, humufibrimore2
Surface Texture:	fine sand2, loamy fine sand2, sandy loam1, silty sand1, v. fine sand1, loamy v. fine sand1, medium sand1, silt loam1.
C Texture:	fine sand5, loamy fine sand3, v. fine sand2.
Depth to Mottles/Gley:	none8, (51-75)1
Depth to Carbonates:	none9, (>50)1
Moisture Regime/Drainage:	mod.fresh6, fresh2, v.fresh2, mod.dry/rapid6, well2, v, rapid1, imperfect1, mod. Well1 Mode of Deposition: glaciofluvial5, morainal3, lacustrine2

Typical Horizons
L. F. Ae. Bf. Bm, BC, C

Forest Floor Cover and Associated Vegetation
S2 soils are most commonly associated with jack pine/black spruce stands (this is especially true in the NW Region). The forest floor is covered predominantly by feathermosss, with scattered patches of broadleaf litter.

Additional Comments
S2 is a common and diverse Type throughout NW Ontario. Although high proportions of coarse fragments can occur, soils of this Type are often pure sands. The forest conditions are usually thin fibrimore. In the NW Region, S2 soils develop primarily in glaciofluvial deposits. Surface textures tend to be coarser in the NW Region. On bedrock controlled topography these soils may intergrade with soils SS5.

Site 3: S1 Dry/Coarse Sandy

General Description (n=281)
Moderately dry, medium to very coarse sandy soils. Developed primarily in glaciofluvial parent materials.

Soil/Site Characteristics

Thickness of Organic Layer:	[LFH] – (6-15)7, (1-5)3
	Forest Humus Form: fibrimor6, humifibrimor2, raw moder1
Surface Texture:	silty sand2, sandy loam2, loamy medium sand1, fine sand1, medium sand1, loamy fine sand1, other2.
C Texture:	medium sand4, coarse sand3, v. coarse sand2, loamy medium sand1.
Depth to Mottles/Gley:	none9, (>50)1
Depth to Carbonates:	none9, (≤50)1, (>50)1
Moisture Regime/Drainage:	mod. Dry7, mod.fresh1, fresh1/rapid5, v. rapid4, well1
Mode of Deposition:	glaciofluvial6, morainal3, lacustrine1

Typical Horizons
L,F, Ae, Bf, Bm,BC,C

Forest Floor Cover and Associated Vegetation
S1 soil are most commonly associated with Mixedwood and conifer stands containing a significant component of jack pine. Black spruce and, in the NW Region, red pine dominated stands are also common. Forest floor cover is usually feathermoss dominated, with varying proportions of broadleaf and conifer litter.

Additional Comments
S1 is a diverse Type found commonly throughout NW Ontario. Coarse fragment content ranges from none to over 50% of the soil volume. The forest humus condition is typically a thin fibrimor. Surface textures of this Type tend to be coarser in the NW Region. On bedrock controlled topography, soils of S1 may intergrade with those of SS5.

Site 4: S5 Fresh Fine Loamy

General Description
Fresh, fine loamy soils. Most commonly developed in lacustrine parent materials.

Soil/Site Characteristics

Thickness of Organic Layer:	(LFH) – (6-15)7, (1-5)2, (16-25)1
Forest Humus Form:	fibrimor5, humifibrimor3, raw moder1
Surface Texture:	sandy loam2, clay2, loam1, silty clay1, silt loam1, silty sand1, other3.
C Texture:	silty clay loam5, sandy clay loam3, clay loam1.
Depth to Mottles/Gley:	none8, (76-100)1, (51-75)1
Depth to Carbonates:	none3, (≤50)4, (>50)3
Moisture Regime/Drainage:	fresh8, V. fesh2/well5, mod. Well4, imperfect1
Mode of Deposition: 1	acustrine6, morainal2, glaciofluvial2.

Typical Horizons
L, F, Ae, Bt, Bm, Ck

Forest Floor Cover and associated Vegetation
S5 soil are most commonly associated with shrub rich, hardwood dominated stands. The forest floor cover typically has a high component of broadleaf litter.

Additional Comments
S5 is uncommon throughout NW Ontario. These are fine-textured soils, frequently with Bt horizons. Coarse fragment content content is typically low (<20%). Carbonates are present in the majority of S5 soils, occurring at any depth in the profile. In the NW Region, S5 soils develop primarily in lacustrine deposits.

Site 5: S7 Moist/Sandy

General Description (n=101)
Moderately moist to very moist, sandy soils. Developed in a range of parent materials.

Soil/Site Characteristics

Thickness of Organic Layer:	[LFH] – (6-15)6, (16-25)2, (1-5)2
Forest Humus Form:	humifibrimor4, fibrimor4, fibrihumimor1
Surface Texture:	silty sand2, v. fine sand2, loamy, fine sand1, fine sand1, sandy loam1, medium sand1, silt loam1, loamy fine sand3, v. fine sand2, fine sand2, medium sand1, coarse sand1
Depth to Mottles/Gley:	(≤ 15)3, (16-30)3, (31-50)2, (51-75)2
Depth to Carbonates:	none9, present1
Moisture Regime/Drainage:	mod.moist3, v.moist3, moist3/imperfect6, poor3, mod. Well1, morainal3, glaciofluvial3, lacustrine3, fluvial1.
Mode of Deposition:	morainal3, glaciofluvial3, lacustrine3, fluvial1.

Typical Horizons
L, F, H, Ae, Bf, Bm, Cg

Forest Floor Cover and Associated Vegetation
S7 soils are most frequently associated with stands containing a significant component of jack pine and/or black spruce. Forest floor cover is often dominated by feathermoss, usually with patches of broadleaf litter.

Additional Comments
S7 soils are most common in the Central Plateau and Superior sections of the NC Region. Coarse fragment content is generally low (< 20%). Mottles can occur at any depth in the

profile. S7 soils develop mainly in glaciofluvial deposits. Note: Site 5 is bordered by a glacial lacustrine plain and talus.

Site 6: N/A

Site 7: SS1 Discontinuous Organic Mat on Bedrock

General Description (n=8)
Discontinuous moss and lichen cover, with no mineral soil matrix, overlying bedrock. Bedrock is typically exposed. Developing on bedrock outcrops.

Soil/Site Characteristics

Thickness of Organic Layer:	[LFH] – (1-5)8, (6-15)[1], (0)[1]
Forest Humus Form:	fibrimor9, fibrihumimor1
Surface Texture:	no mineral soil 10
Depth to Carbonates:	none 10
Moisture Regime/Drainage:	dry8, mod, dry2/ v. rapid 10
Mode of Deposition (Landform Type):	bedrock

Typical Horizons
L, F, Bedrock

Forest Floor Cover and Associated Vegetation
Dominated by feathermoss and lichen with patches of conifer litter. Bedrock is typically exposed (to varying degrees). SS1 soils are usually associated with sparse jack pine / black spruce or red and white pine stands, although aspen or birch may provide a hardwood component.

Additional Comments
SS1 is encountered through NW Ontario, frequently associated with severe topography and steep slopes. Bare rock outcroppings, characteristic of SS1 soils, are variable in their areal extent. Mineral soil may be present in crevices or small depressions in the bedrock. The forest humus condition is typically a very thin fibrimor. Soils of this Type may intergrade with those of other shallow soil Types across, for example, ridge and swale bedrock landscapes.

Site 8: SS9 Shallow – Moderately Deep/Organic – Peaty Phase

General Description (n=15)
Shallow to moderately deep, organic and peaty phase (mineral) soils. Bedrock is generally encountered between 50 and 100 cm below the soil surface. Ground cover may be dominated by either Sphagnum or feathermoss. The forest humus form is typically a fibric peatymor.

Soil/Site Characteristics

Thickness of Organic Layer:	[O] – (≥40)8, (16-25)1, (26-39)1
Forest Humus Form:	fibric peatymor 7, humic peatymor2, mesic peatymor 1
Decomposition Class (top):	fibric8, mesic1, humic1
Decomposition Class (bottom):	mesic5, fibric3, humic2
Depth to Mineral Contact:	(40-60)3, (81-100)3, (61-80)2, (<40)2
Moisture Regime/Drainage:	mod.wet7, moist1, v. fresh1, mod. Dry1/v.poor7,imperfect1, mod.well1, rapid1
Mode of Deposition:	organic9, glaciofluvial1,fluvial1

Typical Horizons
Of, Om, Bedrock

Forest Floor Cover and Associated Vegetation
SS9 soils are associated with moisture-tolerant vegetation conditions. Black spruce, white cedar, tamarack and black ash stands are typical. Forest floor cover is dominated by a continuous Sphagnum/feathermoss carpet.

Additional Comments
SS9 is an uncommon soil throughout NW Ontario. These shallow, organic/peaty phase soils are limited in areal extent, generally developing in depressional landscape positions where drainage is impeded by bedrock. Although mineral soil may be present, the majority of SS9 soils sampled in NW Ontario consisted of organic material overlying bedrock.

Site 9: SS1 Discontinuous Organic Mat on Bedrock

* Reference Site 7 for SS1 soil description.

Site 10: SS4 Very Shallow Soil on Boulder Pavement

General Description
Varying proportions of organic matter and mineral soil overlying boulder pavement. Boulders are encountered within 20cm of the mineral soil surface. Developed primarily in morainal parent materials.

Soil/Site Characteristics

Thickness of Organic Layer:	[LFH] – (6-15)7, (26-39)2, (16-25)1, (1-5)1
Forest Humus Form:	firimor8, fibrihumimor1, mull-like moder.
Surface Texture:	no mineral soil6, silt loam2, silty sand1, loamy v. fine sand1, silty clay loam1
Depth to Mottles/Gley:	none 10
Depth to Carbonates:	none 10
Moisture Regime/Drainage:	mod. Dry7, dry3/v. rapid8, rapid 2
Mode of Deposition:	moraine 7, organic 3.

Typical Horizons
L, F, Boulder Pavement

Forest Floor Cover and Associated Vegetation
SS4 soil are primarily associated with black spruce dominated stand conditions. Forest floor cover is mainly feathermoss with varying proportions of broadleaf and conifer litter.

Additional Comments
SS4 is encountered infrequently throughout NW Ontario. Of limited areal extent, these soils develop across a wide range of topographic positions. Soils of this type have a significant (> 50%) coarse fragment component. The forest humus condition is typically a thin fibrimor. When they form a boulder cap overlying a (usually deep) mineral soil, SS4 soils may grade into bouldery tills. This variation on SS4 soils can be observed around Upper Clearwater Lake.

APPENDIX G:

PLANT SPECIES COMMON AND LATIN NAMES

Appendix G: Common and Latin Names of Identified Species

Common and Latin Names of Identified Plants

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

Shrubs

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

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

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

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

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

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

Aquatic Plants	
Common Names	**Latin Names**
Broad-leaved Arrowhead	*Sagittaria latifolia*
Common Cattail	*Typha latifolia*
Green Algae	*Chlorophyta*
Pondweed	*Potamogeton spp.*
Water Smartweed	*Polygonum amphibium*
Yellow Pond Lily	*Nuphar lutea*

APPENDIX H:

FISH AND WILDLIFE SPECIES COMMON AND LATIN NAMES

Appendix H: Fish and Wildlife Species Common and Latin Names

Aves	
Common Name	**Latin Name**
Alder Flycatcher	*Empidonax alnorum*
American Crow	*Corvus brachyrhynchos*
American Robin	*Turdus migratorius*
American White Pelican	*Pelecanus erythrorhynchos*
Bald Eagle	*Haliaeetus leucocephalus*
Barred Owl	*Strix varia*
Belted Kingfisher	*Ceryle alcyon*
Blue Jay	*Cyanocitta cristata*
Cedar Waxwing	*Bombycilla cedrorum*
Chipping Sparrow	*Spizella passerina*
Common Loon	*Gavia immer*
Common Merganser	*Mergus merganser*
Common Raven	*Corvus corax*
Double-crested Cormorant	*Phalacrocorax auritus*
Downy Woodpecker	*Picoides pubescens*
Eastern Kingbird	*Tyrannus tyrannus*
Grackle	*Quiscalus quiscula*
Herring Gull	*Larus argentatus*
Hairy Woodpecker	*Picoides villosus*
Lesser Scaup	*Aythya affinis*
Mallard	*Anas platyrhynchos*
Northern Flicker	*Colaptes auratus*
Northern Harrier	*Circus cyaneus*
Pileated Woodpecker	*Dryocopus pileatus*
Red Breasted Nuthatch	*Sitta canadensis*
Red-winged Blackbird	*Agelaius phoeniceus*
Red-tailed Hawk	*Buteo jamaicensis*
Ring-necked Duck	*Aythya collaris*
Rock Pigeon	*Columa livia*
Ruffed Grouse	*Bonasa umbellus*
Spotted Sandpiper	*Actitis macularia*
Spruce Grouse	*Falcipennis canadensis*
Tennessee Warbler	*Vermivora peregrina*
Turkey Vulture	*Cathartes aura*
White Throated Sparrow	*Zonotrichia albicollis*
Wood Duck	*Aix sponsa*

Mammals	
Common Name	**Latin Name**
North American Beaver	*Castor canadensis*
American Black Bear	*Ursus americanus*
Boreal Redback Vole	*Clethrionomys gapperi*
Eastern Chipmunk	*Tamias striatus*
Eastern Cottontail	*Sylvilagus floridanus*
European Hare	*Lepus europaeus*
Grey Wolf	*Canis lupus*
Raccoon	*Procyon lotor*
Red Fox	*Vulpes vulpes*
North American River Otter	*Lontra canadensis*

Reptiles	
Common Names	**Latin Names**
Common Garter Snake	*Thamnophis sirtalis*

Amphibians	
Common Names	**Latin Names**
American Toad	*Bufo americanus*
Boreal Chorus Frog	*Pseudacris maculata*
Wood Frog	*Rana sylvatica*

Fish	
Common Names	**Latin Names**
Brook Stickleback	*Culaea inconstans*
Brook Trout	*Salvelinus fontinalis*
Lake Chub	*Couesius plumbeus*
Moltted Sculpin	*Cottus bairdi*
Northern Redbelly Dace	*Phoxinus eos*
Shorthead Redhorse	*Moxostoma macrolepidotum*
Northern Pike	*Esox lucius*
White Sucker	Catostomus commersoni
Yellow Perch	*Perca flavescens*

Crustaceans	
Common Names	**Latin Names**
Northern Clearwater Crayfish	*Orconectes propinquus*
Rusty Crayfish	*Orconectes rusticus*

Mollusca	
Common Names	**Latin Names**
Fresh Water Clam Spp.	Corbicula fuminea

APPENDIX I:

EROSION AND SLOPE STABILITY

Appendix I Erosion and Bank Stability

Slope Stability Ratings for Each Site

Charts simplified from the OMNR Technical Guide-River and Streams Systems: Erosion Hazard Limit rating system sheets.

Slope Stability Rating Chart **Site Location:** Site 1 New Confluence **Inspection Date:** July 21, 2009 **Weather: Sunny**		
1. Slope Inclination		
degrees	**horiz : vert.**	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 42**

Slope Stability Rating Chart **Site Location:** Site 2 Old Confluence **Inspection Date:** July 21, 2009 **Weather:** Sunny		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 20**

Slope Stability Rating Chart **Site Location:** Site 3 CNR Rail Bridge off Bible Camp Road **Inspection Date:** July 27, 2009 **Weather:** Sunny		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 24**

Slope Stability Rating Chart **Site Location:** Site 4 Wolf River Campground **Inspection Date:** July 21, 2009 **Weather: Sunny**		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 68**

Slope Stability Rating Chart **Site Location:** Site 5 Bailey Bridge **Inspection Date:** July 21, 2009 **Weather:** Sunny		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 22**

Slope Stability Rating Chart **Site Location:** Site 6 Sub-Fish Hatchery Station **Inspection Date:** July 30, 2009 **Weather:** Sunny with periods of clouds		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 44**

Slope Stability Rating Chart **Site Location:** Site 7 Wolf Lake Dam **Inspection Date:** July 14, 2009 **Weather:** Sunny		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 17**

Slope Stability Rating Chart **Site Location:** Site 8 Cavern Lake Outlet Pool **Inspection Date:** July 6, 2009 **Weather:** Sunny		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 2**

Slope Stability Rating Chart **Site Location:** Site 9 Dorion Cutoff Road Bridge **Inspection Date:** July 6, 2009 **Weather:** Grey/Cloudy		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 10**

Slope Stability Rating Chart **Site Location:** Site 10 Upper Clearwater Lake **Inspection Date:** July 8, 2009 **Weather:** Cloudy/Sunny		
1. Slope Inclination		
degrees	horiz : vert.	
a) 18 or less	3 : 1 or flatter	0
b) 18-26	2 :1 to more than 3 : 1	6
c) – more than 26	steeper than 2 : 1	16
2. Soil Stratigraphy		
a) Shale, Limestone, Granite (Bedrock)		0
b) Sand, Gravel		6
c) Glacial Till		9
d) Clay, Silt		12
e) Fill		16
f) Leda Clay		24
3. Seepage From Slope Face		
a) None or Near bottom only		0
b) Near mid-slope only		6
c) Near crest only or, From several levels		12
4. Slope Height		
a) 2m or less		0
b) 2.1 to 5m		2
c) 5.1 to 10m		4
d) more than 10m		8
5. Vegetation Cover on Slope Face		
a) Well vegetated; heavy shrubs or forested with mature trees		0
b) Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
c) No vegetation, bare		8
6. Table Land Drainage		
a) Table flat, no apparent drainage over slope		0
b) Minor drainage over slope, no active erosion		2
c) Drainage over slope, active erosion, gullies		4
7. Proximity of watercourse to Slope Toe		
a) 15 meters or more from slope toe		0
b) Less than 15 meters from slope toe		6
8. Previous Landslide Activity		
a) No		0
b) Yes		6
Slope Instability Rating Values Investigation Rating Summary		**Total 6**

Summary of Rating Values
1. Low potential <24
2. Slight potential 25-35
3. Moderate potential >35

Active Erosion Sites

Site 1
Erosion and bank undercutting.

Site 6
Rills forming after rain on slope near sample Site 6.

APPENDIX J

SITE PHOTOGRAPHY AND DESCRIPTIONS

Appendix J: Site Photography of Upstream, Downstream and Substrate Conditions

Site 1 – New Confluence	
Upstream	**Downstream**
	

Substrate


Comments

Immediate of the river mouth, small sections of well developed wetlands can be found. Red-winged black birds appear to be the dominant species in the area. The wetlands, becoming less developed, continue out into Lake Superior for approximately 175 m. The section of the wetlands furthest out into the lake consist predominantly of old trees, remains from the confluence divergence, and small amounts of aquatic macrophytes set on a sandy bottom. The main inhabitants of this wetland niche are Herring Gulls and Cormorants.

Away from the river mouth, wetlands quickly change to sandy banks featuring active erosion. Large amounts of submerged woody debris can also be found near the river banks. The debris has been documented as provide shelter for fish and habitat for both Spotted Sand Pipers and American River Otters. Substrate is dominated by a sand/silt mix.

Site 2 – Original Confluence Channel	
Upstream	**Downstream**
	

Substrate


Comments

Site 2 is characterized by shallow waters bordered by dense aquatic vegetation. Cattails are the predominant type of aquatic vegetation found in the area. The dominant substrate is silt/sand. As evidence of the slow velocity experienced within the original confluence channel, fresh water clams were frequently encountered. Though water levels are shallow within the original confluence, due to being cut off from the new main channel, water temperatures remain cool because of inflow from Lake Superior.

Site 3 - CNR Rail Bridge	
Upstream	**Downstream**
	

Substrate


Comments

The upstream and downstream segments of the river channel possessed large amounts of woody debris and fallen trees. Both piles of debris appear to be causing elevated sandbars, by interrupting stream flow. This did not appear to be affecting stream health as the sandbars were causing the formation of small deep channels with riffles. Various fish species have been documented utilizing these channels. The common substrate upstream and downstream of the sandbar was a gravel cobble mix.

Site 4 – Wolf River Campground	
Upstream	**Downstream**
	

Substrate


Comments

The meander bend closest to Site 4 acts as a transition zone for the river's substrate. In this location the substrate quickly changes from fine sand and clay to cobbles. The substrate transition zone is a product of the rapid drop in velocity, standard of an inner meander bend, which quickly deposits the eroded sediment from a bank further upstream. Cobbles, the dominant substrate of the area, are covered by the sand creating a substrate defined by roughly 80% sand/clay and 20% cobbles. This mixed substrate lasts for approximately one metre, and then quickly becomes composed of nearly 98% cobbles.

Site 5 - Bailey Bridge	
Upstream	**Downstream**
	

Substrate


Comments

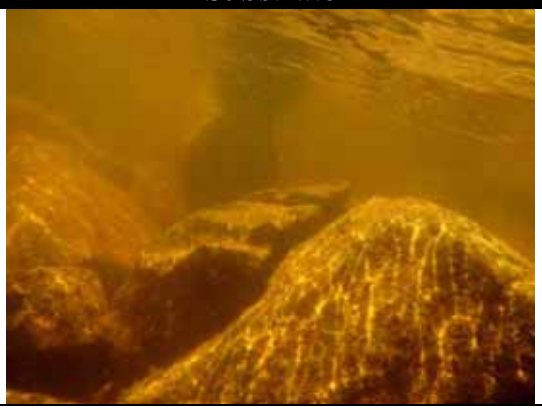
The stream banks and substrate up stream of the bridge are characterized by fine to medium sized sand that is well sorted. The sand appears to be a product of eroding stream banks. Downstream of the bridge the substrate quickly changes to cobbles. This is presumably because the fill under the bridge has been preventing erosion and therefore no large amounts of sand have been entering the river. Additionally, the banks on either side of the bridge are well vegetated preventing further erosion hazards.

Site 6 – MNR Sub-Fish Hatchery Station	
Upstream	**Downstream**
	

Substrate

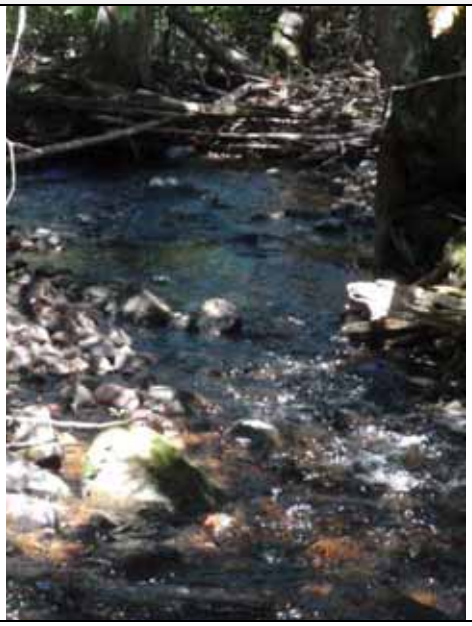

Site 6 is characterized by a set of rapids immediately up stream of the sample site. Also of interest is the large bedrock outcrop that creates a pool frequented by brook trout. The bank opposite of the sample site is well vegetated and has evidence of minimal erosion. The Site 6 bank consists of fill and is vegetated by grasses with few shrubs. Groundwater seepage into the river is visible beside the bedrock outcrop. The sub-station adjacent to Site 6 uses the cold groundwater as a natural means of replenishing their fisheries pond.

Site 7 – Wolf Lake Dam	
Upstream	**Downstream**
	

Substrate


Comments

Sampling was conducted within the immediate area of the Wolf Lake Dam. Either side of the Dam is bordered by fill consisting of large boulders. The fill extends at least 2 metres into the lake. Downstream fill extends approximately 75 metres. Water drainage over the dam is governed by water levels in the lake as well as being heavily affected by wind. The top of the dam also possessed a variety of woody debris. Natural lake substrate can be observed from the shores and consists primarily of cobbles.

Site 8 - Cavern Lake Outlet Pool	
Upstream	**Downstream**
	

Substrate


Comments

Site 8 is an outlet pool and part of the Cavern Lake tributary system. The outlet pool is bordered by marshy land and possessed two beaver dams, one at the headwaters the second where the pool overflowed onto Cavern Lake Road. The substrate in the immediate area of the sampling site was a mixture of fine organic matter, sand, gravel and boulders. Downstream substrate material consists of cobbles. After flowing over Cavern Lake Road, water from the outlet pool flowed into a swamp, then formed a separate cobble stream which meandered throughout the surrounding forest.

Site 9 - Dorion Cutoff Road Bridge	
Upstream	**Downstream**
	

Substrate


Comments

Site 9 is characterized by frequent exposed bedrock, large gravel and boulders. River substrate also is characterized by exposed bedrock and gravel. Due to the resilience of the bedrock, very little erosion was observed at this site. A point of interest at Site 9 is that the site is an exposed part of the Sibley Formation and the ancient oxidized iron particles characteristic of the formation were clearly visible.

Site 10 – Upper Clearwater Lake	
Upstream	**Downstream**
	

Substrate

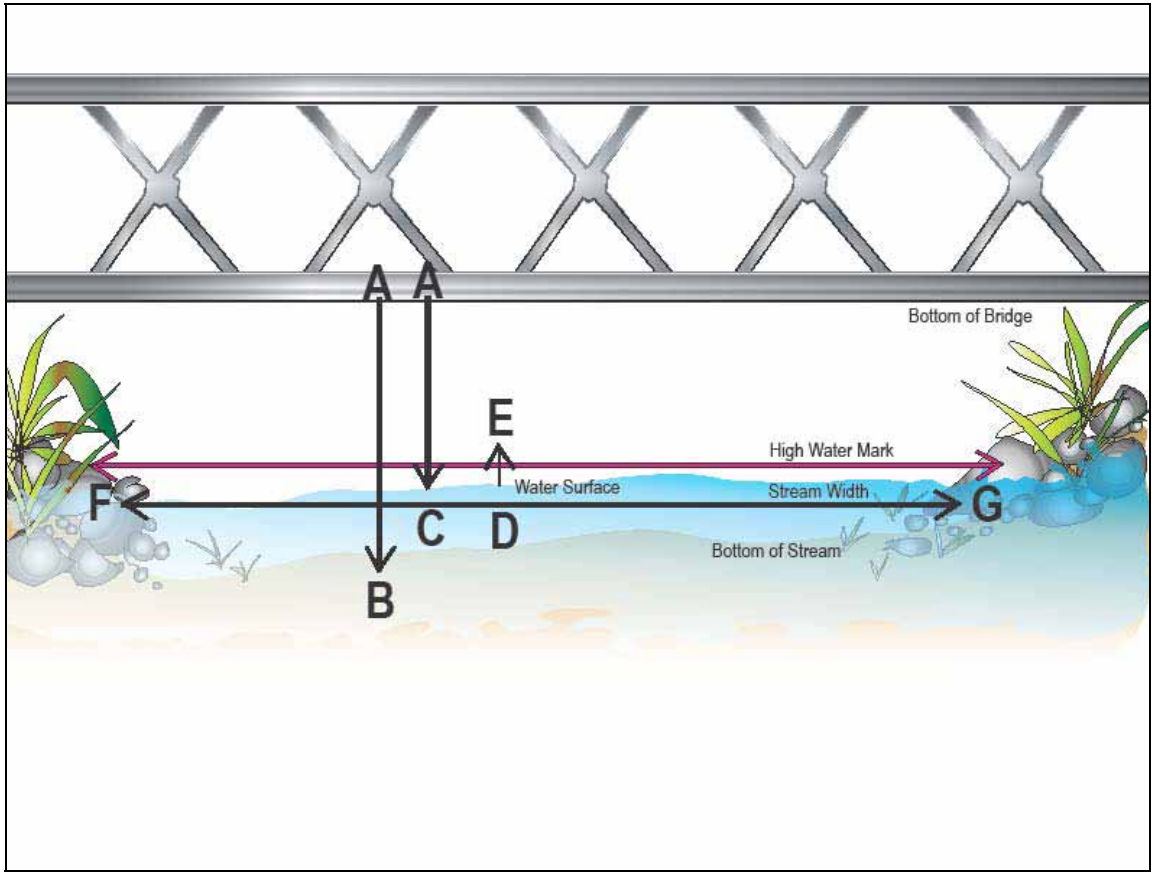

Comments

The banks of Upper Clearwater Lake were very well vegetated and are responsible for the lack of erosion in the area. However, the large amount of onshore vegetation has created a thick layer of organic matter overlying exposed boulder pavement. The boulder pavement can be found by disturbing the layer of decaying organic matter. Additionally the water of the lake had taken on a dark tea color as a result of the organic dyes found in the vegetation. The tea coloration and in water material do not seem to have a negative impact as the area was abundant with wildlife.

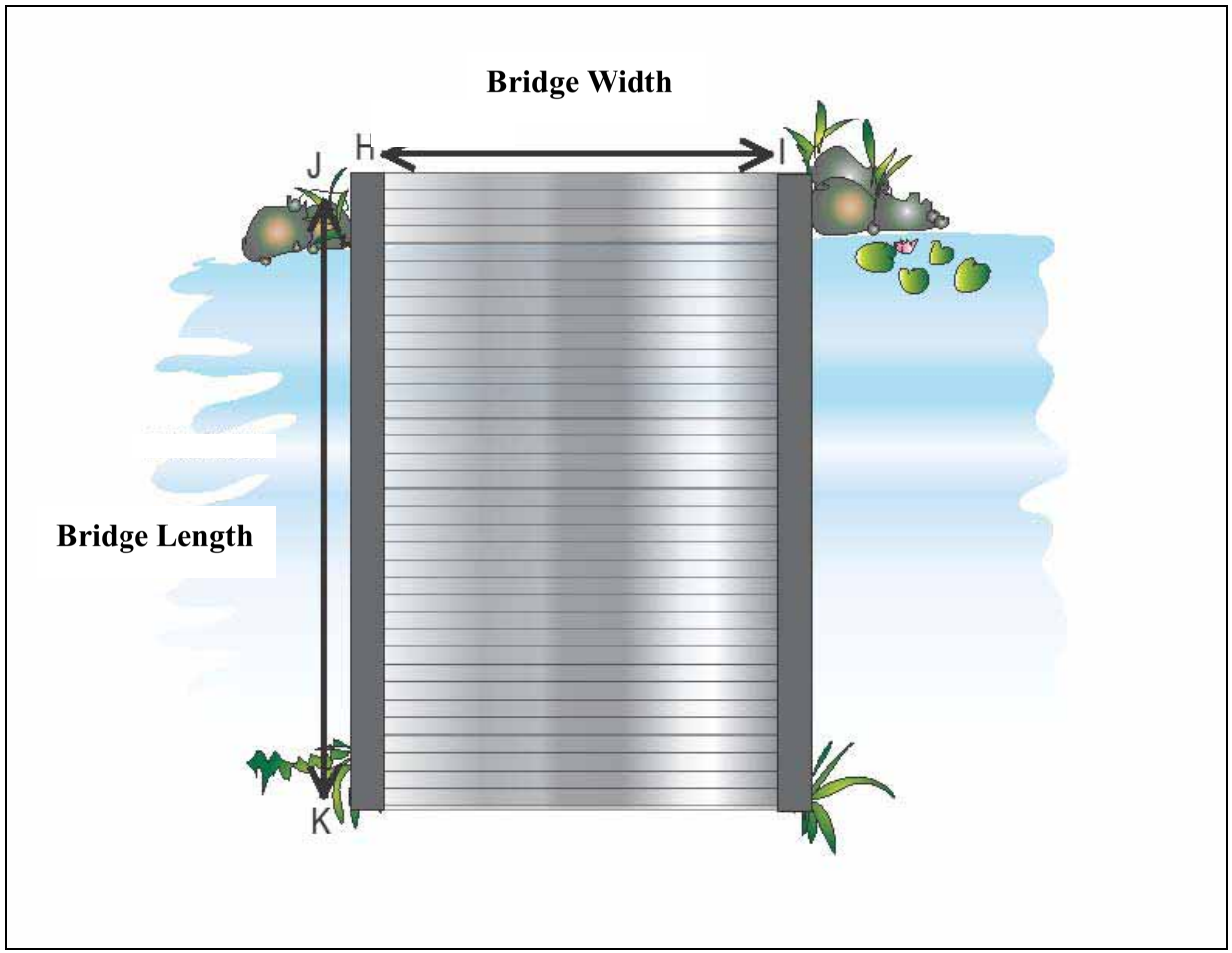
APPENDIX K

BRIDGES

Appendix K: Bridges



Bridge Measurement Parameters 1.0



Bridge Measurement Parameters 1.2

Bridge Number	A – B Bottom of Bridge to Water Surface (m)	A – C Bottom of Bridge to Bottom of Stream (m)	D – E Outlet Pool Water Surface to Outlet Pool High Water Mark (m)	F – G Width of Stream (m)	H – I Length of Bridge (m)	J – K Width of Bridge (m)	Elevation at Water's Edge	Elevation at Top of Bridge	Date of GPS Point Taken
1	4.1	6.08	2.5	23	40	3.3	186.42	189.25	21-JUL-09
2	4.5	4.86	1.0	27.3	40.77	7.8	186.06	191.49	21-JUL-09
3	3.0	3.6	0.4	30.5	45.3	11	187.12	193.86	21-JUL-09
4	4.6	5.9	1.5	22.5	34.7	5.7	200.40	202.11	21-JUL-09
5	3.60	3.99	-	13.8	19.5	5.4	NA	NA	NA
6	2.35	2.86	-	11.6	19.3	5.5	NA	333.81	06-JUL-09
Maximum Value	4.6	6.08	2.5	30.5	45.3	7.8			
Minimum Value	2.35	2.86	0.4	11.6	19.3	3.3			
Average	3.69	4.54	1.35	21.45	33.26	6.45			

Bridge 1

Location: Site 3
GPS Coordinates: 5408071.458 Northing / 388893.508 Easting

Description: Abandoned CNR Rail Bridge. Constructed in 1977, decommission date is unknown. Bridge consists of wooden rail-tails overlying a steel base. The bridge is supported by concrete pillars and concrete side supports. The support pillars are in good condition with no visible cracks in the concrete. Fill on either side of the bridge consists of crushed rock and the area is heavily vegetated. The wooden tails have experienced some weathering, brought on by age, but are still functional. This is evident by the crossing of CNR employees on a work truck.

Upstream

Downstream

Bridge 2

Location: Lower quarter of watershed, near Pumping Station
GPS Coordinates: 5408414.762 Northing/ 388480.781 Easting

Description: Operating CPR bridge. Construction date was unknown at the time of Report. Bridge is constructed of concrete supports with brick siding. Wooden and steel tracks were laid down on gravel reinforced by concrete siding. Downstream side of bridge harbored a walkway for pedestrians/rail workers. The walkway consisted of a steel grate with steel safety bars. Fill for this site is large crushed imported boulders. The top sides of the bridge are abutted by large rectangles made of metal fencing and filled with large pieces of gravel.

Upstream

Downstream

Bridge 3

Location: Trans Canada Highway
GPS Coordinates: 5409970.199 Northing/ 385411.472 Easting

Description: A Concrete bridge with steel side rails and asphalt surface. The bridge is in good condition with no signs of cracks in the concrete. No fill has also been placed under the bridge; the wingwalls are angled to prevent erosion directly into the river. There is no dense vegetation within the immediate area of the bridge. Sides of the bridge are occupied by grasses and thistles.

Upstream	Downstream
	

Bridge 4

Location: Mon Abri Lane
GPS Coordinates: 5408713.115 Northing/ 387481.955 Easting

Description: Fairly new bridge built on private property by local resident concerned about the river's health. This bridge is classified as a bailey bridge. Fill consisted of large imported boulders with vegetation occupying voids.

Upstream

Downstream

Bridge 5

Location: Wolf Lake Road
GPS Coordinates: - NA

Description: Bridge crossing the Wolf River within the mid-watershed. Bridge construction consists of wood, iron and steel. Fill consists of large boulders originating from parent material surrounding the bridge. The wood components do not appear to be subjected to rot. Mild rusting is occurring on the underneath of the bridge.

Upstream	Downstream
	

Bridge 6

Location: Dorion Cut-off Road
GPS Coordinates: 5419821.694 Northing/ 368310.161 Easting

Description: Bridge crossing the Wolf River in the upper watershed. Construction materials consist of wood, steel and iron. Bridge supports consists of pressure treated wood cribbing. The cribbaging is filled with local gravel and sand. The sides of the bridge have been experiencing some mild erosion. The path of the erosion indicates the sediment has been reaching the river. Vegetation cover around the bridge is adequate.

Upstream

Downstream

Bridge 7

Location: Side road in upper watershed, off Dorion Cut-off road.
GPS Coordinates: NA

Description: Presumably once used for forestry activities, only the side cribbing of this bridge remains. Pieces of debris have been observed on river banks suggesting that the low level of this bridge allowed it to be subjected to damage caused by high water levels. The failure of this bridge does not appear to be hindering the flow of traffic as evident by a road way crossing the shallow part of the river. This is of concern as vehicles crossing directly into the water have the potential to expose this segment of the river to larger amounts of petroleum hydrocarbons and erosion.

Upstream Cribbage

Downstream New Road

APPENDIX L

OBBN BENTHIC MONITORING SHEETS AND RESULTS

Benthic macroinvertebrates from Wolf River, Ontario, 2009.				
		Wolf River	**Wolf River**	**Wolf River**
		WR-4-1	**WR-4-2**	**WR-4-3**
		Riffle	Pool	Riffle
		22-Jun	22-Jun	22-Jun
COELENTERATA				
PLATYHELMINTHES				
NEMATODA			1	
MOLLUSCA				
Gastropoda				
Ancylidae				
Bithyniidae				
Hydrobiidae				
Lymnaeidae				
Physidae				
Planorbidae				
Valvatidae				
Bivalvia				
Sphaeriidae			1	
ANNELIDA				
Oligochaeta		1		1
Hirudinea				
ARTHROPODA				
Hydracarina				
Amphipoda				
Hyalellidae	*Hyalella*			
Gammaridae	*Gammarus*			
Decapoda				
Cambaridae				
Isopoda				
Asellidae	*Caecidotea*			
Insecta				
Ephemeroptera	Juvenile			
Amelitidae	*Ameletus*			
Siphlonuridae	*Parameletus*			1
Metretopodidae	*Siphloplecton*			
Baetidae	Juvenile/damaged	3	11	5
	Acentrella			
	Baetis	1		
	Plauditus			
Isonychiidae				
	Isonychia			
Heptageniidae	Juvenile/damaged			
	Cinygmula			
	Epeorus (Iron)			1
	Heptagenia			
	Leucrocuta	1		
	Maccaffertium			
	Rhithrogena			
	Stenacron			
	Stenonema			
Ephemerellidae	Juvenile/damaged			

	Attenella			2
	Ephemerella			
	Eurylophella (s str.)		2	
	Drunella			
	Serratella			
	Timpanoga			
Caenidae	*Caenis*			
Baetiscidae	*Baetisca*			
Leptophlebiidae	Juvenile/damaged			
	Leptophlebia			
	Paraleptophlebia			1
Ephemeridae	*Ephemera*			
	Hexagenia			
Odonata				
Gomphidae	Juvenile/damaged			
	Dromogomphus		1	
	Gomphus			
	Ophiogomphus	1		1
Aeshnidae	*Aeshna*			
	Boyeria			
Cordulegastridae	*Cordulegaster*			
Corduliidae	Juvenile			
	Epitheca (Tetragoneuria)			
Calopterygidae	*Calopteryx*			
Coenagrionidae				
Plecoptera	Juvenile/damaged			
Pteronarcyidae	*Pteronarcys*			
Taeniopterygidae				
	Oemopteryx			
	Strophopteryx			
	Taeniopteryx			
Nemouridae	Juvenile/damaged			
	Nemoura			
	Shipsa			
Leuctridae	Juvenile/damaged			
	Despaxia			
	Leuctra			
	Paraleuctra			
Capniidae	Juvenile/damaged			
	Allocapnia			
	Paracapnia			
Perlidae	Juvenile/damaged			
	Acroneuria			
	Agnetina			
	Claassenia			
	Paragnetina			
	Perlinella			
Perlodidae	Juvenile/damaged			
	Helopicus			
	Isoperla			
Chloroperlidae				

	Alloperla			
	Suwallia			
Hemiptera				
Corixidae	Juvenile/damaged			
	Callicorixa			
	Corisella			
	Hesperocorixa			
	Sigara/Callicorixa			
	Trichocorixa			
Notonectidae	*Notonecta*			
Megaloptera				
Sialidae	*Sialis*			
Corydalidae	Juvenile/damaged			
	Nigronia			
Neuroptera				
Sisyridae	*Climacia*			
Coleoptera				
Gyrinidae	*Gyrinus*			
Haliplidae	*Haliplus*			
Dytiscidae				
Elmidae	Juvenile/damaged			
	Dubiraphia			
	Gonielmis			
	Optioservus			
	Ordobrevia			
	Stenelmis			
Trichoptera	Juvenile/damaged/ Pupa			1
Philopotamidae	Pupa			
	Dolophilodes			
	Chimarra			2
Polycentropodidae	Juvenile/damaged			
	Neureclipsis			
	Polycentropus			
Dipseudopsidae	*Phylocentropus*			
Hydropsychidae	Juvenile			
	Cheumatopsyche			1
	Hydropsyche	5		4
Rhyacophilidae	*Rhyacophila*			
Glossosomatidae	*Glossosoma*			
Hydroptilidae	Juvenile/damaged			
	Hydroptila			
	Ithytrichia			
	Leucotrichia			
	Ochrotrichia			
	Oxyethira			
Phryganeidae	*Agyrpnia*			
	Fabria			
	Ptilostomis			
Brachycentridae	Juvenile			
	Micrasema			

Lepidostomatidae	*Lepidostoma*	1		2
Limnephilidae	Juvenile/damaged			
	Limnephilus			
	Onocosmoecus			
	Platycentropus			
	Pycnopsyche			
Helicopsychidae	*Helicopsyche*			
Leptoceridae	Juvenile/damaged			
	Ceraclea			
	Mystacides			
	Oecetis			
	Triaenodes			
Lepidoptera				
Crambidae				
Diptera	Damaged/pupa			
Blephariceridae	*Blepharicera*			
Ceratopogonidae	Juvenile/damaged			
	Bezzia/Palpomyia			
	Ceratopogon			
	Dasyhelea			1
	Monohelea			
	Probezzia			
	Stilobezia			
Chironomidae		5	72	12
Psychodidae	*Psychoda*			
Simuliidae	Pupa/damaged			
	Prosimulium			
	Simulium	103	13	76
	Twinnia			
Tipulidae	Juvenile/damaged			
	Antocha			
	Dicronata			
	Hexatoma	1		
	Tipula			
Athericidae	*Atherix*			
Dolichopodidae				
Empididae	Juvenile/pupa			
	Chelifera			
	Chelifera/Metachela			1
	Dolicocephala			
	Hemerodromia	3	1	5
Tabanidae				
	Chrysops			
Phoridae				
Total number of individuals		125	102	117

APPENDIX M

LABORATORY CERTIFICATES OF ANALYSIS AND ANALYTICAL REPORTS

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: TAMMY COOK

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 21-JUN-09 12:28 (MT)
Version: FINAL

Lab Work Order #: **L779096** **Date Received:** **17-JUN-09**

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

TRICIA SAMPSON
Account Manager

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L779096-1	L779096-2	L779096-3	L779096-4	L779096-5
	Description	RAW WATER	RAW WATER	RAW WATER	RAW WATER	RAW WATER
	Sampled Date	15-JUN-09	16-JUN-09	16-JUN-09	16-JUN-09	16-JUN-09
	Sampled Time	14:41	10:36	11:16	12:20	13:48
	Client ID	WOLF RIVER SITE 3	WOLF RIVER SITE 4	WOLF RIVER SITE 5	WOLF RIVER SITE 6	WOLF RIVER SITE 7
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Escherichia Coli (MPN/100mL)	4	3	4	1	3
	Total Coliforms (MPN/100mL)	440	520	440	520	36

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L779096-6				
	Description	RAW WATER				
	Sampled Date	16-JUN-09				
	Sampled Time	15:13				
	Client ID	WOLF RIVER SITE 8				
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Escherichia Coli (MPN/100mL)	1				
	Total Coliforms (MPN/100mL)	250				

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
TC,EC-QT97-TB	Water	Total Coliform and E.coli	APHA SM 9223B C-24

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

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

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

PO: 7522 Quote: Q20965 Lake

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

ALS Thunder Bay, 1081 Barton Street. Thunder Bay, ON P7B 5N3
Ph: 807-623-6463 Fax: 807-623-7598 Toll-Free 1-800-668-9878 wsintern@lakeheadca.com

DRINKING WATER CHAIN OF CUSTODY

PLEASE CIRCLE IF SAMPLES ARE SUBJECT TO REGULATION:
Reg 170/03 Reg 318/08 319/08 C of A Not Regulated
Please place regulated and non-regulated samples in SEPARATE SUBMISSIONS

WORKS / CLIENT NAME: Lakehead Region Conservation Authority	AFTER HOURS PHONE NUMBER AND EMAIL: 345-5857
WORKS ADDRESS: 130 Conservation Rd, Box 10427.	HEALTH UNIT:
WORKS CATEGORY:	WORKS NUMBER: 345-5857
WORKS / CLIENT CONTACT: Jennifer Grinstead	PHONE NO/FAX NO/EMAIL: P: 344-5857 F: 345-9156
	HEALTH UNIT PHONE / FAX:
	Requested Service (Circle One): (Reg) Pri (50%) Emerg (100%)

SAMPLE DESCRIPTION (This description will appear on the report)	Chlorine Residual (mg/L)	Sampling Date / Time: Date (yy/mm/dd)	Sampling Date / Time: Time	Regulated Sample Type (R/T/D)	P/A-24 (TC, EC)	P/A-24 "Plus" (TC/EC)	P/A-MOE (TC, EC, Det. Org.)	Het. Plate Count (HPC)	Other:		Nitrate/Nitrite	THM (Max. Res. Time)	Sched 23 Inorganics	Sched 24 Organics	Sodium	Fluoride	Other:	LAB ID
Wolf River - Site 3		09/06/15	2:41 p.m.	R		X												
Wolf River - Site 4		09/06/16	10:36 am			X												
Wolf River - Site 5			11:16 am			X												
Wolf River - Site 6			12:20 pm			X												
Wolf River - Site 7			1:48 pm			X												
Wolf River - Site 8			3:13 pm			X												

ANALYSES REQUESTED
Please indicate test for each sample by Checkmark in the box below

FOR LAB USE ONLY
SUBMISSION NO. L779096
LOGGED BY BB
DATE/TIME 17 Jun 09 1045
TEMPERATURE AT RECEIPT [C] 8.7°C

* **Sample Type Legend: R - Raw Water T - Treated Source D - Distribution Sample**

SAMPLED BY (print & sign): J. Grinstead J Grinstead
SUBMITTED TO LAB BY: (print & sign) J Grinstead J Grinstead
DATE RECEIVED AT LAB: 17 June-09 9:25am.
RECEIVED AT LAB BY: BPB

Other Comments/Cautions (Please identify known or suspected hazards)
9.1, 8.3

Original with Submission; Please Photocopy for your Records

Form: C207 DW Chain of Custody All Regulations
Date: 03-DEC-08

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: JENNIFER GRINSTEAD/CALLIN MAKI

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 26-JUN-09 15:02 (MT)
Version: FINAL

Lab Work Order #: L779183 **Date Received:** 17-JUN-09

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers: 08-058763

Other Information:

Comments:

RICHARD CLARA
General Manager, Thunder Bay

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L779183-1	L779183-2	L779183-3	L779183-4	L779183-5
	Description	GRAB	GRAB	GRAB	GRAB	GRAB
	Sampled Date	15-JUN-09	16-JUN-09	16-JUN-09	16-JUN-09	16-JUN-09
	Sampled Time	14:41	10:36	11:16	12:00	13:48
	Client ID	WOLF RIVER - SITE 3	WOLF RIVER - SITE 4	WOLF RIVER - SITE 5	WOLF RIVER - SITE 6	WOLF RIVER - SITE 7
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (EC) (uS/cm)	165	160	159	163	153
	Total Dissolved Solids (mg/L)	123	123	126	121	125
	Turbidity (NTU)	0.93	0.93	0.72	0.58	1.29
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	0.99 *	0.72 *	0.69	0.61 *	0.58 *
	Nitrate-N (NO3-N) (mg/L)	0.062	0.070	0.067	0.060	0.056
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Phosphorus (P)-Total (mg/L)	0.0095	0.0058	0.0065	0.0056	0.0055
	Sulphate (SO4) (mg/L)	2.79	2.77	2.70	2.79	2.73
Total Metals	Aluminum (Al) (mg/L)	0.048	0.042	0.034	0.031	0.047
	Antimony (Sb) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Arsenic (As) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Barium (Ba) (mg/L)	0.130	0.124	0.125	0.138	0.118
	Beryllium (Be) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd) (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
	Calcium (Ca) (mg/L)	20.0	19.8	19.9	21.7	18.7
	Chromium (Cr) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (Cu) (mg/L)	0.0024	0.0019	0.0018	0.0018	0.0018
	Iron (Fe) (mg/L)	0.150	0.142	0.133	0.127	0.152
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg) (mg/L)	7.69	7.53	7.32	8.16	7.04
	Manganese (Mn) (mg/L)	0.0096	0.0089	0.0086	0.0098	0.0094
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni) (mg/L)	<0.0020	0.0024	<0.0020	<0.0020	<0.0020
	Potassium (K) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Selenium (Se) (mg/L)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Silicon (Si) (mg/L)	2.66	2.66	2.66	2.87	2.56
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Strontium (Sr) (mg/L)	0.0353	0.0339	0.0340	0.0361	0.0334
	Thallium (Tl) (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Titanium (Ti) (mg/L)	0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Tungsten (W) (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn) (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040

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

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L779183-6				
	Description	GRAB				
	Sampled Date	16-JUN-09				
	Sampled Time	15:13				
	Client ID	WOLF RIVER - SITE 8				
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (EC) (uS/cm)	99.2				
	Total Dissolved Solids (mg/L)	96				
	Turbidity (NTU)	0.29				
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020				
	Chloride (Cl) (mg/L)	0.30				
	Nitrate-N (NO3-N) (mg/L)	0.049				
	Nitrite-N (NO2-N) (mg/L)	<0.020				
	Phosphorus (P)-Total (mg/L)	0.0115				
	Sulphate (SO4) (mg/L)	2.31				
Total Metals	Aluminum (Al) (mg/L)	0.052				
	Antimony (Sb) (mg/L)	<0.0050				
	Arsenic (As) (mg/L)	<0.0010				
	Barium (Ba) (mg/L)	0.077				
	Beryllium (Be) (mg/L)	<0.0010				
	Bismuth (Bi) (mg/L)	<0.0010				
	Boron (B) (mg/L)	<0.050				
	Cadmium (Cd) (mg/L)	<0.000090				
	Calcium (Ca) (mg/L)	12.4				
	Chromium (Cr) (mg/L)	<0.0010				
	Cobalt (Co) (mg/L)	<0.00050				
	Copper (Cu) (mg/L)	0.0026				
	Iron (Fe) (mg/L)	0.084				
	Lead (Pb) (mg/L)	<0.0010				
	Magnesium (Mg) (mg/L)	4.76				
	Manganese (Mn) (mg/L)	0.0040				
	Molybdenum (Mo) (mg/L)	<0.0010				
	Nickel (Ni) (mg/L)	<0.0020				
	Potassium (K) (mg/L)	<1.0				
	Selenium (Se) (mg/L)	<0.00040				
	Silicon (Si) (mg/L)	1.83				
	Silver (Ag) (mg/L)	<0.00010				
	Strontium (Sr) (mg/L)	0.0195				
	Thallium (Tl) (mg/L)	<0.00030				
	Tin (Sn) (mg/L)	<0.0010				
	Titanium (Ti) (mg/L)	<0.0020				
	Tungsten (W) (mg/L)	<0.010				
	Uranium (U) (mg/L)	<0.0050				
	Vanadium (V) (mg/L)	<0.0010				
	Zinc (Zn) (mg/L)	0.0035				
	Zirconium (Zr) (mg/L)	<0.0040				

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

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AIN	Approximate Result: Interference Suspected

Samples with Qualifiers for Individual Parameters as listed above:

Sample Number	Client Sample ID	Parameters	Qualifier
L779183-1	WOLF RIVER - SITE 3	Chloride (Cl)	AIN
L779183-2	WOLF RIVER - SITE 4	Chloride (Cl)	AIN
L779183-4	WOLF RIVER - SITE 6	Chloride (Cl)	AIN
L779183-5	WOLF RIVER - SITE 7	Chloride (Cl)	AIN

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-electrode
MET-ONT-PWQO-WT	Water	Metals, Total PWQO	EPA 200.8 (ICP/MS)
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - Colourimetry
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
TB	ALS LABORATORY GROUP - THUNDER BAY, ONTARIO, CANADA	WT	ALS LABORATORY GROUP - WATERLOO, ONTARIO, CAN

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

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

COC # **08-058763**

Page 1 of 1

Report to:	**Report Format / Distribution**	**Service Requested:** (rush - subject to availability)
Company: L.R.C.A.	Standard: ✓ Other:	✓ Regular (Default)
Contact: Jennifer Grinstead / Cailin Maki	Select: PDF ✓ Excel ___ Digital ___	Priority (2-3 Business Days) - 50% Surcharge
Address: 130 Conservation Rd, Box 10427	Email 1: wsintern@lakeheadca.com	Emergency (1 Business Day) - 100% Surcharge
Thunder Bay, ON P7B 6T8	Email 2: info@lakeheadca.com	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: 344-5587 Fax: 345-9156		
Invoice To: Same as Report ? (Yes) / No ?	**Client / Project Information:**	**Analysis Request** L779183
Company:	Job #:	(Indicate Filtered or Preserved, F/P)
Contact:	PO / AFE: 7500	
Address:	Legal Site Description:	
Phone: Fax:	Quote #: Q20965	
Lab Work Order # (lab use only)	ALS Contact:	Sampler: J. Grinstead

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Routine	Metals, total	NH4, TP/Nutrients	Number of Containers
1	Wolf River - Site 3	09/06/15	2:41 pm	Grab	✓	✓	✓	
2	Wolf River - Site 4	09/06/16	10:36 am					
3	Wolf River - Site 5		11:16 am					
4	Wolf River - Site 6		12:00 pm					
5	Wolf River - Site 7		1:48 pm					
6	Wolf River - Site 8.		3:13 pm					
	~~Wolf Riv~~							

Special Instructions / Regulations / Hazardous Details

9.1,93

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

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

SHIPMENT RELEASE (client use)		SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)		
Released by:	Date & Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date & Time:	Observations: Yes / No ? If Yes attach SIF
J. Grinstead	09/06/17 9:55 Am.	BPB	17-June-09	9:25am	8.7°C			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF 18.00 Front

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: TAMMY COOK

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 21-JUN-09 12:30 (MT)
Version: FINAL

Lab Work Order #: **L779960** **Date Received:** **18-JUN-09**

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers: L779960

Other Information:

Comments:

Tricia Sampson

TRICIA SAMPSON
Account Manager

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS Canada Ltd.
Part of the ALS Laboratory Group
1081 Barton Street, Thunder Bay, ON P7B 5N3
Phone: +1 807 623 6463 Fax: +1 807 623 7598 www.alsglobal.com
A Campbell Brothers Limited Company

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L779960-2	L779960-3	L779960-4	L779960-5	
	Description	RAW WATER	RAW WATER	RAW WATER	RAW WATER	
	Sampled Date	17-JUN-09	17-JUN-09	17-JUN-09	17-JUN-09	
	Sampled Time	14:25	14:55	12:54	11:48	
	Client ID	WOLF RIVER - SITE 1	WOLF RIVER - SITE 2	WOLF RIVER - SITE 9	WOLF RIVER - SITE 10	
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Escherichia Coli (MPN/100mL)	4	23	23	17	
	Total Coliforms (MPN/100mL)	440	870	770	310	

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA SM 9223B C-18

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

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

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

PO: 7522 Quote: Q20965

Lake/River sampling

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

ALS Thunder Bay, 1081 Barton Street. Thunder Bay, ON P7B 5N3
Ph: 807-623-6463 Fax: 807-623-7598 Toll-Free 1-800-668-9878 wsintern@lakeheadca.com

DRINKING WATER CHAIN OF CUSTODY

PLEASE CIRCLE IF SAMPLES ARE SUBJECT TO REGULATION:
Reg 170/03 Reg 318/08 319/08 C of A Not Regulated
Please place regulated and non-regulated samples in SEPARATE SUBMISSIONS

WORKS / CLIENT NAME	AFTER HOURS PHONE NUMBER AND EMAIL
Lakehead Region Conservation Authority	345-5857
WORKS ADDRESS: 130 Conservation Rd Box 10427	HEALTH UNIT
WORKS CATEGORY / WORKS NUMBER: 345-5857	HEALTH UNIT PHONE / FAX
WORKS / CLIENT CONTACT: Jennifer Grinstead	PHONE NO/FAX NO/EMAIL: P: 345-5857 F: 345-9156

Requested Service (Circle One): (Reg) Pri (50%) Emerg (100%)

SAMPLE DESCRIPTION (This description will appear on the report)	Chlorine Residual (mg/L)	Sampling Date / Time: Date (yy/mm/dd)	Sampling Date / Time: Time	Regulated Sample Type (R/T/D)	P/A-24 (TC, EC)	P/A-24 "Plus" (TC/EC)	P/A-MOE (TC, EC, Det. Org.)	Het. Plate Count (HPC)	Other:		Nitrate/Nitrite	THM (Max. Res. Time)	Sched 23 Inorganics	Sched 24 Organics	Sodium	Fluoride	Other:		LAB ID
Wolf River - Site 1		09/06/17	2:25 p.m.	R		X													
Wolf River - Site 2		↓	2:55 p.m.	↓		X													
Wolf River - Site 9		↓	12:54 p.m.	↓		X													
Wolf River - Site 10		↓	11:48 am	↓		X													

PA18 or PA18 "Plus" performed due to time of sample analysis/receipt

* **Sample Type Legend : R - Raw Water T - Treated Source D - Distribution Sample**

FOR LAB USE ONLY	
SUBMISSION NO.	L779960
LOGGED BY	A.G
DATE/TIME	18-JUN-09 12:20
TEMPERATURE AT RECEIPT [C]	16.6°C.

SAMPLED BY (print & sign): J. Grinstead J. Grinstead

DATE RECEIVED AT LAB: 17-Jun-09 4:40pm

SUBMITTED TO LAB BY: (print & sign) J. Grinstead J. Grinstead

RECEIVED AT LAB BY: BPB

Other Comments/Cautions (Please identify known or suspected hazards): 17.0, 16.2

Original with Submission; Please Photocopy for your Records

Form: C207 DW Chain of Custody All Regulations
Date: 03-DEC-08

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: JENNIFER GRINSTEAD/CAILIN MAKI

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 25-JUN-09 14:06 (MT)
Version: FINAL

Lab Work Order #: L779788 **Date Received:** 17-JUN-09

Project P.O. #: 7522
Job Reference:
Legal Site Desc: WOLF RIVER WATERSHED ASSESSMENT
CofC Numbers: 08-062413

Other Information:

Comments:

RICHARD CLARA
General Manager, Thunder Bay

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L779788-1	L779788-2	L779788-3	L779788-4	
	Description	GRAB	GRAB	GRAB	GRAB	
	Sampled Date	17-JUN-09	17-JUN-09	17-JUN-09	17-JUN-09	
	Sampled Time	14:25	14:55	12:54	11:48	
	Client ID	WOLF RIVER - SITE 1	WOLF RIVER - SITE 2	WOLF RIVER - SITE 9	WOLF RIVER - SITE 10	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (EC) (uS/cm)	173	186	117	110	
	Total Dissolved Solids (mg/L)	103	95	82	82	
	Turbidity (NTU)	1.05	3.25	0.78	1.57	
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020	<0.020	0.021	<0.020	
	Chloride (Cl) (mg/L)	1.13 *	0.98 *	0.34 *	0.27 *	
	Nitrate-N (NO3-N) (mg/L)	0.064	<0.030	0.041	<0.030	
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	
	Phosphorus (P)-Total (mg/L)	<0.0050	0.0120	<0.0050	0.0067	
	Sulphate (SO4) (mg/L)	2.77	2.69	2.03	1.91	
Total Metals	Aluminum (Al) (mg/L)	0.048	0.098	0.065	0.107	
	Antimony (Sb) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Arsenic (As) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Barium (Ba) (mg/L)	0.139	0.147	0.100	0.084	
	Beryllium (Be) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Bismuth (Bi) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Boron (B) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Cadmium (Cd) (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	
	Calcium (Ca) (mg/L)	20.3	23.3	13.5	13.6	
	Chromium (Cr) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Cobalt (Co) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Copper (Cu) (mg/L)	0.0017	0.0030	0.0019	0.0026	
	Iron (Fe) (mg/L)	0.136	0.313	0.186	0.282	
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg) (mg/L)	8.80	8.79	6.13	5.95	
	Manganese (Mn) (mg/L)	0.0110	0.0422	0.0101	0.0129	
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Nickel (Ni) (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	
	Potassium (K) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Selenium (Se) (mg/L)	<0.00040	<0.00040	<0.00040	<0.00040	
	Silicon (Si) (mg/L)	2.74	2.51	2.22	2.48	
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Strontium (Sr) (mg/L)	0.0356	0.0366	0.0234	0.0218	
	Thallium (Tl) (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Tin (Sn) (mg/L)	0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti) (mg/L)	<0.0020	0.0037	<0.0020	<0.0020	
	Tungsten (W) (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Vanadium (V) (mg/L)	<0.0010	0.0011	<0.0010	<0.0010	
	Zinc (Zn) (mg/L)	<0.0030	0.0074	<0.0030	<0.0030	
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040	<0.0040	<0.0040	

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

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AIN	Approximate Result: Interference Suspected

Samples with Qualifiers for Individual Parameters as listed above:

Sample Number	Client Sample ID	Parameters	Qualifier
L779788-1	WOLF RIVER - SITE 1	Chloride (Cl)	AIN
L779788-2	WOLF RIVER - SITE 2	Chloride (Cl)	AIN
L779788-3	WOLF RIVER - SITE 9	Chloride (Cl)	AIN
L779788-4	WOLF RIVER - SITE 10	Chloride (Cl)	AIN

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-electrode
MET-ONT-PWQO-WT	Water	Metals, Total PWQO	EPA 200.8 (ICP/MS)
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - Colourimetry
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

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The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
TB	ALS LABORATORY GROUP - THUNDER BAY, ONTARIO, CANADA	WT	ALS LABORATORY GROUP - WATERLOO, ONTARIO, CAN

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

GLOSSARY OF REPORT TERMS
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mg/kg (units) - unit of concentration based on mass, parts per million
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N/A - Result not available. Refer to qualifier code and definition for explanation

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ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

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

COC # **08-062413**

L779788

Page 1 of 1

Report to:	**Report Format / Distribution**	**Service Requested:** (rush - subject to availability)
Company: L.R.C.A.	Standard: ✓ Other:	✓ Regular (Default)
Contact: Jennifer Grinstead / Cailin Maki	Select: PDF ✓ Excel ___ Digital ___	Priority (2-3 Business Days) - 50% Surcharge
Address: 130 Conservation Rd, Box 10427	Email 1: wsintern@lakeheadca.com	Emergency (1 Business Day) - 100% Surcharge
Thunder Bay, ON P7B 6T8	Email 2: info@lakeheadca.com	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: 344-5857 Fax: 345-9156		
Invoice To: Same as Report ? (Yes / No ?)	**Client / Project Information:**	**Analysis Request**
Company:	Job #:	(Indicate Filtered or Preserved, F/P)
Contact:	PO / AFE: 7522	
Address:	Legal Site Description: Wolf River watershed assessment	
Phone: Fax:	Quote #: Q20965	
Lab Work Order # (lab use only)	**ALS Contact:** Karen Rutledge	**Sampler:** J. Grinstead

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Routine	Metals, total (F)	Nutrients (NH4, TP) (F)									Number of Containers
1	Wolf River – Site 1	09/06/17	2:25 pm	Grab	✓	✓	✓									3
2	Wolf River – Site 2	↓	2:55 pm	↓	✓	✓	✓									3
3	Wolf River – Site 9		12:54 pm		✓	✓	✓									3
4	Wolf River – Site 10		11:48 am		✓	✓	✓									3

Special Instructions / Regulations / Hazardous Details

17.0, 16.2

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

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

SHIPMENT RELEASE (client use)		**SHIPMENT RECEPTION (lab use only)**				**SHIPMENT VERIFICATION (lab use only)**		
Released by: J. Grinstead	Date & Time: 09/06/17 4:45 pm.	Received by: BPB	Date: 17-Jun-09	Time: 4:40pm	Temperature: 16.6°C	Verified by:	Date & Time:	Observations: Yes / No ? If Yes attach SIF

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: TAMMY COOK/CAILIN MAKI/JENNIFE GRINSTEAD

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 22-JUL-09 08:17 (MT)
Version: FINAL

Lab Work Order #: L791159 **Date Received:** 14-JUL-09

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers: 08-056445

Other Information:

Comments:

RICHARD CLARA
General Manager, Thunder Bay

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L791159-1	L791159-2	L791159-3	L791159-4	
	Description	WATER	WATER	WATER	WATER	
	Sampled Date	13-JUL-09	13-JUL-09	13-JUL-09	13-JUL-09	
	Sampled Time	11:00	12:30	13:30	14:18	
	Client ID	WOLF RIVER-SITE #1	WOLF RIVER-SITE #2	WOLF RIVER-SITE #3	WOLF RIVER-SITE #4	
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (EC) (uS/cm)	204	218	205	199	
	Total Dissolved Solids (mg/L)	139	141	129	130	
	Turbidity (NTU)	2.01	6.02	1.34	1.49	
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020	<0.020	
	Chloride (Cl) (mg/L)	1.50 *	1.41 *	1.56 *	0.89 *	
	Nitrate-N (NO3-N) (mg/L)	0.036	<0.030	0.040	0.041	
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	
	Phosphorus (P)-Total (mg/L)	0.0066	0.0304	0.0169	0.0141	
	Sulphate (SO4) (mg/L)	3.07	2.85	3.09	3.01	
Total Metals	Aluminum (Al) (mg/L)	0.071	0.158	0.070	0.104	
	Antimony (Sb) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Arsenic (As) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Barium (Ba) (mg/L)	0.160	0.171	0.161	0.161	
	Beryllium (Be) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Bismuth (Bi) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Boron (B) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Cadmium (Cd) (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	
	Calcium (Ca) (mg/L)	22.3	25.2	22.1	21.8	
	Chromium (Cr) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Cobalt (Co) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Copper (Cu) (mg/L)	0.0021	0.0029	0.0018	0.0018	
	Iron (Fe) (mg/L)	0.159	0.455	0.144	0.141	
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg) (mg/L)	11.4	12.5	11.4	11.4	
	Manganese (Mn) (mg/L)	0.0221	0.0616	0.0145	0.0103	
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Nickel (Ni) (mg/L)	<0.0020	0.0022	<0.0020	<0.0020	
	Potassium (K) (mg/L)	<1.0	<1.0	<1.0	<1.0	
	Selenium (Se) (mg/L)	<0.00040	<0.00040	<0.00040	<0.00040	
	Silicon (Si) (mg/L)	3.16	3.17	3.24	3.21	
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Strontium (Sr) (mg/L)	0.0395	0.0417	0.0393	0.0396	
	Thallium (Tl) (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	
	Tin (Sn) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Titanium (Ti) (mg/L)	0.0027	0.0078	0.0029	0.0023	
	Tungsten (W) (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	
	Vanadium (V) (mg/L)	0.0014	0.0019	0.0013	0.0013	
	Zinc (Zn) (mg/L)	0.0042	0.0051	0.0033	0.0037	
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040	<0.0040	<0.0040	

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

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AIN	Approximate Result: Interference Suspected

Samples with Qualifiers for Individual Parameters as listed above:

Sample Number	Client Sample ID	Parameters	Qualifier
L791159-1	WOLF RIVER-SITE #1	Chloride (Cl)	AIN
L791159-2	WOLF RIVER-SITE #2	Chloride (Cl)	AIN
L791159-3	WOLF RIVER-SITE #3	Chloride (Cl)	AIN
L791159-4	WOLF RIVER-SITE #4	Chloride (Cl)	AIN

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-electrode
MET-ONT-PWQO-WT	Water	Metals, Total PWQO	EPA 200.8 (ICP/MS)
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - Colourimetry
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
TB	ALS LABORATORY GROUP - THUNDER BAY, ONTARIO, CANADA	WT	ALS LABORATORY GROUP - WATERLOO, ONTARIO, CAN

Reference Information

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

Report to: Tammy Cook	**Report Format / Distribution**
Company: Lakehead Region Conservation Authority	Standard: ✓ Other:
Contact: Cailin Maki / Jennifer Grinstead	Select: PDF ✓ Excel ✓ Digital
Address: 130 Conservation Rd Box 10427	Email 1: info@lakeheadca.com
Thunder Bay, ON P7B 6T8	Email 2: wsintern@lakeheadca.com
Phone: 807-344-5857 Fax: 807-345-9156	
Invoice To: Same as Report ? (Yes) No ?	**Client / Project Information:**
Company:	Job #:
Contact:	PO / AFE: 7522
Address:	Legal Site Description:
Phone: Fax:	Quote #: Q20965
Lab Work Order # (lab use only)	**ALS Contact:** Karen Rutledge **Sampler:** J. Grinstead

Service Requested: (rush - subject to availability)

- ✓ Regular (Default)
- Priority (2-3 Business Days) - 50% Surcharge
- Emergency (1 Business Day) - 100% Surcharge
- For Emergency < 1 Day, ASAP or Weekend - Contact ALS

Analysis Request

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Routine	F/P Total Metals	F/P Nutrients (P, P)	Number of Containers
1	Wolf River - Site #1	July 13/09	11:00	Grab	✓	✓	✓	
2	Wolf River - Site #2	↓	12:30	↓	✓	✓	✓	
3	Wolf River - Site #3		13:30		✓	✓	✓	
4	Wolf River - Site #4		14:18		✓	✓	✓	

Special Instructions / Regulations / Hazardous Details

follow Quote for Tests 7°C 4.5°C

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

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

SHIPMENT RELEASE (client use)		SHIPMENT RECEPTION (lab use only)			SHIPMENT VERIFICATION (lab use only)		
Released by: J. Grinstead	Date & Time: July 14/09 9:08 AM.	Received by:	Date: July 14/09	Time: 9:05	Temperature: 5.8°C	Verified by:	Date & Time:	Observations: Yes / (No) ? If Yes attach SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF 18.00 Front

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: TAMMY COOK

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 20-JUL-09 13:48 (MT)
Version: FINAL

Lab Work Order #: **L792444** **Date Received:** **15-JUL-09**

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

Tricia Sampson

TRICIA SAMPSON
Account Manager

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L792444-1	L792444-2			
	Description	RAW RIVER WA	RAW RIVER WA			
	Sampled Date	15-JUL-09	15-JUL-09			
	Sampled Time	12:00	10:30			
	Client ID	WOLF RIVER SITE #9	WOLF RIVER SITE #10			
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Escherichia Coli (MPN/100mL)	8	2			
	Total Coliforms (MPN/100mL)	330	310			

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA SM 9223B C-18

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

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

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
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PO: 7522 QUOTE: Q20965

Raw river water

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

ALS Thunder Bay, 1081 Barton Street. Thunder Bay, ON P7B 5N3
Ph: 807-623-6463 Fax: 807-623-7598 Toll-Free 1-800-668-9878

DRINKING WATER CHAIN OF CUSTODY

PLEASE CIRCLE IF SAMPLES ARE SUBJECT TO REGULATION:
Reg 170/03 Reg 318/08 319/08 C of A Not Regulated
Please place regulated and non-regulated samples in SEPARATE SUBMISSIONS

WORKS / CLIENT NAME	AFTER HOURS PHONE NUMBER AND EMAIL
L.R.C.A.	344-5857
WORKS ADDRESS	**HEALTH UNIT**
130 Conservation Rd	Thunder Bay District
WORKS CATEGORY / **WORKS NUMBER**	**HEALTH UNIT PHONE / FAX**
WORKS / CLIENT CONTACT / **PHONE NO/FAX NO/EMAIL**	Requested Service (Circle One): Reg Pri (50%) Emerg (100%)
	344-5857

SAMPLE DESCRIPTION (This description will appear on the report)	Chlorine Residual (mg/L)	Sampling Date / Time: Date (yy/mm/dd)	Sampling Date / Time: Time	Regulated Sample Type (R/T/D)	P/A-24 (TC, EC)	P/A-24 "Plus" (TC/EC)	P/A-MOE (TC, EC, Det. Org.)	Het. Plate Count (HPC)	Other:		Nitrate/Nitrite	THM (Max. Res. Time)	Sched 23 Inorganics	Sched 24 Organics	Sodium	Fluoride	Other:		LAB ID
Wolf River - Site #9		09/07/15	12:00	R		✓													
Wolf River - Site #10		"	~~11:00~~	R		✓													
			10:30																
PA18 or PA18 "Plus" performed due to time of sample analysis/receipt																			

ANALYSES REQUESTED
Please indicate test for each sample by Checkmark in the box below

FOR LAB USE ONLY
SUBMISSION NO. L792444
LOGGED BY BB
DATE/TIME 15/07/09 1530
TEMPERATURE AT RECEIPT [C] 12.9

* **Sample Type Legend : R - Raw Water T - Treated Source D - Distribution Sample**

SAMPLED BY (print & sign):	DATE RECEIVED AT LAB:	Other Comments/Cautions (Please identify known or suspected hazards)
J. Grinstead	July 15/09 15:15	
SUBMITTED TO LAB BY: (print & sign)	**RECEIVED AT LAB BY:**	
J. Grinstead	REB	

Original with Submission; Please Photocopy for your Records

11.4 + 14.4 = 25.8

Form: C207 DW Chain of Custody All Regulations
Date: 03-DEC-08

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: TAMMY COOK

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 20-JUL-09 13:30 (MT)
Version: FINAL

Lab Work Order #: L791978 **Date Received:** 14-JUL-09

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers:

Other Information:

Comments:

TRICIA SAMPSON
Account Manager

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
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ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L791978-1	L791978-2	L791978-3		
	Description	RAW RIVER WA	RAW RIVER WA	RAW RIVER WA		
	Sampled Date	14-JUL-09	14-JUL-09	14-JUL-09		
	Sampled Time	11:00	12:15	13:53		
	Client ID	WOLF RIVER - SITE #5	WOLF RIVER - SITE #6	WOLF RIVER - SITE #7		
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Escherichia Coli (MPN/100mL)	21	12	0		
	Total Coliforms (MPN/100mL)	460	490	82		

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA SM 9223B C-18

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

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The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
N/A - Result not available. Refer to qualifier code and definition for explanation

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PO: 7522 QUOTE: Q20965 RAW RIVER WATER

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division
ALS Thunder Bay, 1081 Barton Street. Thunder Bay, ON P7B 5N3
Ph: 807-623-6463 Fax: 807-623-7598 Toll-Free 1-800-668-9878

DRINKING WATER CHAIN OF CUSTODY

PLEASE CIRCLE IF SAMPLES ARE SUBJECT TO REGULATION:
Reg 170/03 Reg 318/08 319/08 C of A Not Regulated
Please place regulated and non-regulated samples in SEPARATE SUBMISSIONS

WORKS / CLIENT NAME: L.R.C.A.
WORKS ADDRESS: 130 Conservation Rd
WORKS CATEGORY:
WORKS NUMBER:
WORKS / CLIENT CONTACT: Tammy Cook
PHONE NO/FAX NO/EMAIL: 344-5857 info@lakeheadca.com
AFTER HOURS PHONE NUMBER AND EMAIL: 344-5857
HEALTH UNIT: Thunder Bay District
HEALTH UNIT PHONE / FAX:
Requested Service (Circle One): Reg - Pri (50%) Emerg (100%)

FOR LAB USE ONLY
SUBMISSION NO.: L791978
LOGGED BY: BB
DATE/TIME: 15 Jul 09 0740
TEMPERATURE AT RECEIPT [C]: 7.1°C
LAB ID

SAMPLE DESCRIPTION (This description will appear on the report)	Chlorine Residual (mg/L)	Sampling Date / Time: Date (yy/mm/dd)	Sampling Date / Time: Time	Regulated Sample Type (R/T/D)	P/A-24 (TC, EC)	P/A-24 "Plus" (TC/EC)	P/A-MOE (TC, EC, Det. Org.)	Het. Plate Count (HPC)	Other:		Nitrate/Nitrite	THM (Max. Res. Time)	Sched 23 Inorganics	Sched 24 Organics	Sodium	Fluoride	Other:	LAB ID
Wolf River - Site #5		09/07/14	11:00	R		✓												
Wolf River - Site #6		↓	12:15	↓		✓												
Wolf River - Site #7		↓	13:53	↓		✓												

PA18 or PA "Plus" performed during time of sample and time of receipt

ANALYSES REQUESTED — Please indicate test for each sample by Checkmark in the box below

* Sample Type Legend : R - Raw Water T - Treated Source D - Distribution Sample

SAMPLED BY (print & sign): J. Grinstead
SUBMITTED TO LAB BY: (print & sign)
DATE RECEIVED AT LAB: 14 JUL 09 16:00
RECEIVED AT LAB BY: BB

Other Comments/Cautions (Please identify known or suspected hazards)
6.4, 7.7.

Form: C207 DW Chain of Custody All Regulations
Date: 03-DEC-08

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: TAMMY COOK/CAILIN MAKI/JENNIFER GRINSTEA

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 22-JUL-09 12:19 (MT)
Version: FINAL

Lab Work Order #: L791792 **Date Received:** 14-JUL-09

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers: 08-056446

Other Information:

Comments:

RICHARD CLARA
General Manager, Thunder Bay

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ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L791792-1	L791792-2	L791792-3		
	Description	WATER	WATER	WATER		
	Sampled Date	14-JUL-09	14-JUL-09	14-JUL-09		
	Sampled Time	11:00	12:15	13:53		
	Client ID	WOLF RIVER - SITE #5	WOLF RIVER - SITE #6	WOLF RIVER - SITE #7		
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (EC) (uS/cm)	197	185	176		
	Total Dissolved Solids (mg/L)	128	128	123		
	Turbidity (NTU)	0.80	0.81	1.22		
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020		
	Chloride (Cl) (mg/L)	0.85 *	0.76 *	0.77		
	Nitrate-N (NO3-N) (mg/L)	0.037	0.032	<0.030		
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020		
	Phosphorus (P)-Total (mg/L)	<0.0050	<0.0050	0.0052		
	Sulphate (SO4) (mg/L)	2.90	2.83	2.88		
Total Metals	Aluminum (Al) (mg/L)	0.032	0.042	0.047		
	Antimony (Sb) (mg/L)	<0.0050	<0.0050	<0.0050		
	Arsenic (As) (mg/L)	<0.0010	<0.0010	<0.0010		
	Barium (Ba) (mg/L)	0.173	0.163	0.147		
	Beryllium (Be) (mg/L)	<0.0010	<0.0010	<0.0010		
	Bismuth (Bi) (mg/L)	<0.0010	<0.0010	<0.0010		
	Boron (B) (mg/L)	<0.050	<0.050	<0.050		
	Cadmium (Cd) (mg/L)	<0.000090	<0.000090	<0.000090		
	Calcium (Ca) (mg/L)	22.8	22.7	20.2		
	Chromium (Cr) (mg/L)	<0.0010	<0.0010	<0.0010		
	Cobalt (Co) (mg/L)	<0.00050	<0.00050	<0.00050		
	Copper (Cu) (mg/L)	0.0015	0.0014	0.0014		
	Iron (Fe) (mg/L)	0.087	0.091	0.105		
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010		
	Magnesium (Mg) (mg/L)	11.3	11.3	10.3		
	Manganese (Mn) (mg/L)	0.0082	0.0083	0.0079		
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010	<0.0010		
	Nickel (Ni) (mg/L)	<0.0020	<0.0020	<0.0020		
	Potassium (K) (mg/L)	<1.0	<1.0	<1.0		
	Selenium (Se) (mg/L)	<0.00040	<0.00040	<0.00040		
	Silicon (Si) (mg/L)	3.72	3.76	3.45		
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010		
	Strontium (Sr) (mg/L)	0.0375	0.0373	0.0352		
	Thallium (Tl) (mg/L)	<0.00030	<0.00030	<0.00030		
	Tin (Sn) (mg/L)	<0.0010	<0.0010	<0.0010		
	Titanium (Ti) (mg/L)	<0.0020	<0.0020	<0.0020		
	Tungsten (W) (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U) (mg/L)	<0.0050	<0.0050	<0.0050		
	Vanadium (V) (mg/L)	<0.0010	<0.0010	<0.0010		
	Zinc (Zn) (mg/L)	0.0052	0.0036	0.0038		
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040	<0.0040		

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

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AIN	Approximate Result: Interference Suspected

Samples with Qualifiers for Individual Parameters as listed above:

Sample Number	Client Sample ID	Parameters	Qualifier
L791792-1	WOLF RIVER -SITE #5	Chloride (Cl)	AIN
L791792-2	WOLF RIVER -SITE #6	Chloride (Cl)	AIN

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-electrode
MET-ONT-PWQO-WT	Water	Metals, Total PWQO	EPA 200.8 (ICP/MS)
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - Colourimetry
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location	Laboratory Definition Code	Laboratory Location
TB	ALS LABORATORY GROUP - THUNDER BAY, ONTARIO, CANADA	WT	ALS LABORATORY GROUP - WATERLOO, ONTARIO, CAN

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
N/A - Result not available. Refer to qualifier code and definition for explanation

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Although test results are generated under strict QA/QC protocols, any unsigned test reports, faxes, or emails are considered preliminary.

ALS Laboratory Group has an extensive QA/QC program where all analytical data reported is analyzed using approved referenced procedures followed by checks and reviews by senior managers and quality assurance personnel. However, since the results are obtained from chemical measurements and thus cannot be guaranteed, ALS Laboratory Group assumes no liability for the use or interpretation of the results.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

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

COC # **08- 056446**

Page 1 of 1

Report to:	Tammy Cook
Company:	Lakehead Region Conservation Authority
Contact:	Cailin Maki / Jennifer Grinstead
Address:	130 Conservation Rd Box 10427
	Thunder Bay, ON P7B 6T8
Phone:	344-5857 Fax: 345-9156
Invoice To:	Same as Report ? Yes / No ?
Company:	
Contact:	
Address:	
Phone:	Fax:
Lab Work Order # (lab use only)	

Report Format / Distribution	
Standard:	✓ Other:
Select: PDF	✓ Excel Digital
Email 1:	info@lakeheadca.com
Email 2:	wsinkin@lakeheadca.com
Client / Project Information:	
Job #:	
PO / AFE:	7582
Legal Site Description:	
Quote #:	Q20965
ALS Contact:	K. Rutledge
Sampler:	J. Grinstead

Service Requested: (rush - subject to availability)

- ✓ Regular (Default)
- Priority (2-3 Business Days) - 50% Surcharge
- Emergency (1 Business Day) - 100% Surcharge
- For Emergency < 1 Day, ASAP or Weekend - Contact ALS

Analysis Request L791792

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Routine	Total metals (F)	Nutrients (N,P) (P)	Number of Containers
1	Wolf River — Site #5	July 14/09	11:00	Grab	✓	✓	✓	
2	Wolf River — Site #6	↓	12:15	↓	✓	✓	✓	
3	Wolf River — Site #7	↓	13:53	↓	✓	✓	✓	

Special Instructions / Regulations / Hazardous Details

6.4, 7.7.

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

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

SHIPMENT RELEASE (client use)		SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)		
Released by:	Date & Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date & Time:	Observations: Yes / No ? If Yes attach SIF
		BPB	14JUL09	16:00.	7.1°C.			

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

ATTN: TAMMY COOK

130 CONSERVATION ROAD
P.O. BOX 10427
THUNDER BAY ON P7B 6T8

Report Date: 20-JUL-09 12:41 (MT)
Version: FINAL

Lab Work Order #: **L791175** **Date Received:** **14-JUL-09**

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers: L791175

Other Information:

Comments:

TRICIA SAMPSON
Account Manager

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L791175-1	L791175-2	L791175-3	L791175-4	
	Description	RAW WATER	RAW WATER	RAW WATER	RAW WATER	
	Sampled Date	13-JUL-09	13-JUL-09	13-JUL-09	13-JUL-09	
	Sampled Time	11:00	12:30	13:30	14:18	
	Client ID	WOLF RIVER - SITE #1	WOLF RIVER - SITE #2	WOLF RIVER - SITE #3	WOLF RIVER - SITE #4	
Grouping	**Analyte**					
WATER						
Bacteriological Tests	Escherichia Coli (MPN/100mL)	26	12	23	20	
	Total Coliforms (MPN/100mL)	610	870	340	610	

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA SM 9223B C-18

** Laboratory Methods employed follow in-house procedures, which are generally based on nationally or internationally accepted methodologies.
The last two letters of the above ALS Test Code column indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

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

GLOSSARY OF REPORT TERMS
Surr - A surrogate is an organic compound that is similar to the target analyte(s) in chemical composition and behavior but not normally detected in enviromental samples. Prior to sample processing, samples are fortified with one or more surrogate compounds.
The reported surrogate recovery value provides a measure of method efficiency.
mg/kg (units) - unit of concentration based on mass, parts per million
mg/L (units) - unit of concentration based on volume, parts per million
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.
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ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

ALS Thunder Bay, 1081 Barton Street. Thunder Bay, ON P7B 5N3
Ph: 807-623-6463 Fax: 807-623-7598 Toll-Free 1-800-668-9878

PO: 7522
Quote: Q20965

Raw Lake / River Water Samples

DRINKING WATER CHAIN OF CUSTODY

PLEASE CIRCLE IF SAMPLES ARE SUBJECT TO REGULATION:
Reg 170/03 Reg 318/08 319/08 C of A **Not Regulated**
Please place regulated and non-regulated samples in SEPARATE SUBMISSIONS

WORKS / CLIENT NAME: Lakehead Region Conservation Authority	AFTER HOURS PHONE NUMBER AND EMAIL: 344-5857
WORKS ADDRESS: 130 Conservation Rd	HEALTH UNIT: Thunder Bay District
WORKS CATEGORY:	WORKS NUMBER: 3
	HEALTH UNIT PHONE / FAX:
WORKS / CLIENT CONTACT: Tammy Cook	PHONE NO/FAX NO/EMAIL: 344-5857 info@lakeheadca.com

Requested Service (Circle One): (Reg) Pri (50%) Emerg (100%)

SAMPLE DESCRIPTION (This description will appear on the report)	Chlorine Residual (mg/L)	Sampling Date / Time: Date (yy/mm/dd)	Sampling Date / Time: Time	Regulated Sample Type (R/T/D)	P/A-24 (TC, EC)	P/A-24 "Plus" (TC/EC)	P/A-MOE (TC, EC, Det. Org.)	Het. Plate Count (HPC)	Other:		Nitrate/Nitrite	THM (Max. Res. Time)	Sched 23 Inorganics	Sched 24 Organics	Sodium	Fluoride	Other:	
Wolf River - Site #1		09/07/13	11:00	R		✓												
Wolf River - Site #2		↓	12:30	↓		✓												
Wolf River - Site #3		↓	13:30	↓		✓												
Wolf River - Site #4		↓	14:18	↓		✓												

ANALYSES REQUESTED
Please indicate test for each sample by Checkmark in the box below

PA18 or PA18 "Plus" performed due to time of sample analysis/receipt

FOR LAB USE ONLY
SUBMISSION NO.: L791175
LOGGED BY: A.G
DATE/TIME: 14-Jul-09 10:00
TEMPERATURE AT RECEIPT [C]: 4.5°C
LAB ID

* Sample Type Legend : R - Raw Water T - Treated Source D - Distribution Sample

SAMPLED BY (print & sign): J. Grinstead J. Grinstead
SUBMITTED TO LAB BY: (print & sign) J. Grinstead J. Grinstead
DATE RECEIVED AT LAB: July 14/09
RECEIVED AT LAB BY: 9:05am

Other Comments/Cautions (Please identify known or suspected hazards)

Original with Submission; Please Photocopy for your Records

Form: C207 DW Chain of Custody All Regulations
Date: 03-DEC-08

Certificate of Analysis

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

Report Date: 23-JUL-09 14:53 (MT)
Version: FINAL

Lab Work Order #: L792446 **Date Received:** 15-JUL-09

Project P.O. #: 7522
Job Reference:
Legal Site Desc:
CofC Numbers: 08-059163

Other Information:

Comments:

RICHARD CLARA
General Manager, Thunder Bay

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN AUTHORITY OF THE LABORATORY.
ALL SAMPLES WILL BE DISPOSED OF AFTER 30 DAYS FOLLOWING ANALYSIS. PLEASE CONTACT THE LAB IF YOU REQUIRE ADDITIONAL SAMPLE STORAGE TIME.

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID	L792446-1	L792446-2			
	Description	GRAB	GRAB			
	Sampled Date	15-JUL-09	15-JUL-09			
	Sampled Time	12:00	11:00			
	Client ID	WOLF RIVER - SITE #9	WOLF RIVER - SITE #10			
Grouping	**Analyte**					
WATER						
Physical Tests	Conductivity (EC) (uS/cm)	159	148			
	Total Dissolved Solids (mg/L)	109	121			
	Turbidity (NTU)	0.95	2.53			
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020	<0.020			
	Chloride (Cl) (mg/L)	0.49 *	0.44 *			
	Nitrate-N (NO3-N) (mg/L)	<0.030	<0.030			
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020			
	Phosphorus (P)-Total (mg/L)	<0.0050	0.0060			
	Sulphate (SO4) (mg/L)	2.17	2.00			
Total Metals	Aluminum (Al) (mg/L)	0.058	0.109			
	Antimony (Sb) (mg/L)	<0.0050	<0.0050			
	Arsenic (As) (mg/L)	<0.0010	<0.0010			
	Barium (Ba) (mg/L)	0.142	0.120			
	Beryllium (Be) (mg/L)	<0.0010	<0.0010			
	Bismuth (Bi) (mg/L)	<0.0010	<0.0010			
	Boron (B) (mg/L)	<0.050	<0.050			
	Cadmium (Cd) (mg/L)	<0.000090	<0.000090			
	Calcium (Ca) (mg/L)	20.2	18.8			
	Chromium (Cr) (mg/L)	<0.0010	<0.0010			
	Cobalt (Co) (mg/L)	<0.00050	<0.00050			
	Copper (Cu) (mg/L)	0.0014	0.0023			
	Iron (Fe) (mg/L)	0.177	0.321			
	Lead (Pb) (mg/L)	<0.0010	<0.0010			
	Magnesium (Mg) (mg/L)	10.3	9.48			
	Manganese (Mn) (mg/L)	0.0176	0.0261			
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010			
	Nickel (Ni) (mg/L)	<0.0020	0.0024			
	Potassium (K) (mg/L)	<1.0	<1.0			
	Selenium (Se) (mg/L)	<0.00040	<0.00040			
	Silicon (Si) (mg/L)	2.55	2.97			
	Silver (Ag) (mg/L)	<0.00010	<0.00010			
	Strontium (Sr) (mg/L)	0.0332	0.0299			
	Thallium (Tl) (mg/L)	<0.00030	<0.00030			
	Tin (Sn) (mg/L)	<0.0010	<0.0010			
	Titanium (Ti) (mg/L)	<0.0020	0.0022			
	Tungsten (W) (mg/L)	<0.010	<0.010			
	Uranium (U) (mg/L)	<0.0050	<0.0050			
	Vanadium (V) (mg/L)	<0.0010	0.0011			
	Zinc (Zn) (mg/L)	0.0036	0.0036			
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040			

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

Reference Information

Additional Comments for Sample Listed:

Samplenum	Matrix	Report Remarks	Sample Comments

Qualifiers for Individual Parameters Listed:

Qualifier	Description
AIN	Approximate Result: Interference Suspected

Samples with Qualifiers for Individual Parameters as listed above:

Sample Number	Client Sample ID	Parameters	Qualifier
L792446-1	WOLF RIVER - SITE #9	Chloride (Cl)	AIN
L792446-2	WOLF RIVER - SITE #10	Chloride (Cl)	AIN

Methods Listed (if applicable):

ALS Test Code	Matrix	Test Description	Analytical Method Reference(Based On)
CL-TB	Water	Chloride (Cl)	APHA 4110 B-Ion Chromatography
EC-CAP-TB	Water	Conductivity (EC)	APHA 2510 B-electrode
MET-ONT-PWQO-WT	Water	Metals, Total PWQO	EPA 200.8 (ICP/MS)
NH4-TB	Water	Ammonia-N, Total	APHA 4500-NH3 G - Colourimetry
NO2-TB	Water	Nitrite-N	APHA 4110 B-Ion Chromatography
NO3-TB	Water	Nitrate-N	APHA 4110 B-Ion Chromatography
P-TOT-TB	Water	Phosphorus (P)-Total	APHA 4500-P B,F Colourimetry
SO4-TB	Water	Sulphate (SO4)	APHA 4110 B-Ion Chromatography
SOLIDS-TDS-TB	Water	Total Dissolved Solids	APHA 2540 C
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

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ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

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

COC # **08-059163**

Page 1 of 1

Report to: Tammy Cook	**Report Format / Distribution**	**Service Requested:** (rush - subject to availability)
Company: Lakehead Region Conservation Authority	Standard: ✓ Other:	✓ Regular (Default)
Contact: Jennifer Grinstead	Select: PDF ✓ Excel ✓ Digital	Priority (2-3 Business Days) - 50% Surcharge
Address: 130 Conservation Rd Box 10427	Email 1: info@lakeheadca.com	Emergency (1 Business Day) - 100% Surcharge
Thunder Bay, ON P7B 6T8	Email 2: wsintern@lakeheadca.com	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: 344-5857 Fax: 345-9156		**Analysis Request** L792446
Invoice To: Same as Report ? Yes / No ?	**Client / Project Information:**	(Indicate Filtered or Preserved, F/P)
Company:	Job #: 7	
Contact:	PO / AFE: 7522	
Address:	Legal Site Description:	
Phone: Fax:	Quote #: Q20965	
Lab Work Order # (lab use only)	ALS Contact: K. Rutledge	Sampler: J. Grinstead

Sample #	Sample Identification (This description will appear on the report)	Date	Time	Sample Type	Routine	Total Metals (F)	Nutrients (N, P) (F)									Number of Containers
1	Wolf River – Site #9	July 15/09	12:00	Grab	✓	✓	✓									
2	Wolf River – Site #10	"	11:00	"	✓	✓	✓									

Special Instructions / Regulations / Hazardous Details

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

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

SHIPMENT RELEASE (client use)		SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)		
Released by:	Date & Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date & Time:	Observations: Yes / No ? If Yes attach SIF
	15/07/09 3:20pm	REB	July 15/09	15:15	12.9			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF 18.00 Front

11.4 + 14.4