

Blind Creek and Wild Goose Creek Watershed Assessment Update



Lakehead Region
Conservation Authority **2010**
Conserve Today...For A Better Tomorrow

Blind Creek and Wild Goose Creek Watershed Assessment Updates

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Conserve Today...For A Better Tomorrow

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Executive Summary

The Blind Creek and Wild Goose Creek watersheds are located within the Geographic Township of McGregor in the Municipality of Shuniah. Both watersheds are adjacent to one another and separately drain into Lake Superior. The 2010 Blind Creek and Wild Goose Creek Watershed assessment was completed as an update to the 1999 Blind Creek and Wild Goose Creek Watershed Reports completed by the Lakehead Region Conservation Authority.

The 2010 Watershed Assessment Updates included water quality analysis as well as documentation of the physical and biological attributes of four sampling locations within the Blind Creek watershed and three sampling locations within the Wild Goose Creek watershed. Surface water sampling, photo documentation and comprehensive field notes were completed for each sampling location. Each site was chosen based upon accessibility and the proximity to any natural and manmade features which may have affected surface water quality. All 2010 sampling locations were sites that were not previously sampled in 1999 due to the inaccessibility of the prior sites.

Water quality analysis completed for the 2010 Blind Creek and Wild Goose Creek Watershed Updates indicated that both watersheds were in excellent condition at the time of sampling, exceeding only minimal Provincial Water Quality Objectives (PWQO). The 2010 laboratory results reported only two parameters, iron and *Escherichia* (*E. coli*) that exceeded PWQO criteria at many of the sites. Total coliforms also exceeded pre-1994 PWQO criteria at every site for both watersheds. Total coliforms and iron commonly occur at high concentrations under natural conditions, and concentrations reported from the 2010 study were likely from natural processes within the watershed.

Total coliforms exceeded pre-1994 PWQO criterion (1,000 MPN/100 mL) at every sampling site from both the Blind Creek and Wild Goose Creek watershed during 2010. The total coliform concentrations for the Blind Creek watershed were all greater than 2,420 MPN/100 mL. Total coliform concentrations for the Wild Goose Creek watershed ranged from 1,700 MPN/100 mL to greater than 2,420 MPN/100 mL.

Iron was the only metal to exceed the PWQO from the 2010 sampling of both Wild Goose Creek and Blind Creek. All other metals were within the PQWO criteria. Iron concentrations reported from the Wild Goose Creek watershed ranged from less than 0.050 mg/L to 1.18 mg/L, exceeding PWQO (0.3 mg/L) with an overall average of 0.62 mg/L. These iron concentrations were comparable to the overall average reported from the 1999 Wild Goose Creek results (0.836 mg/L). Iron concentrations reported from 2010 Blind Creek sampling ranged from 0.156 mg/L to 0.562 mg/L exceeding PWQO criterion (0.3 mg/L) with an overall average of 0.34 mg/L.

pH was not in exceedance of the PWQO criterion of 6.5-8.5 for either watershed in 2010. The Blind Creek watershed was in exceedance of the PWQO criterion for pH in 1999 with



a single exceedance of 6.48. The Wild Goose Creek watershed was also in exceedance in 1999 with exceedances between 6.29 and 8.87.

Comparison of 1999 and 2010 water quality results indicated that between the two study periods there had been minimal change in water quality for both the Blind Creek and Wild Goose Creek watersheds. Average values indicated a decrease in phosphorus concentrations from 1999 to 2010 for the Blind Creek and Wild Goose Creek watersheds. A slight decrease in dissolved oxygen (DO) concentrations from the 1999 Wild Goose Creek sampling to the 2010 Wild Goose Creek sampling was also found.

Phosphorus was not in exceedance at any of the site for either watershed in 2010, where 1999 Blind Creek sampling reported an average of 0.062 mg/L which exceeded PWQO criterion (0.03 mg/L). The average phosphorus concentration for the Blind Creek watershed in 2010 was 0.009 mg/L and 0.01 mg/L for the Wild Goose Creek watershed.

DO concentrations from the 2010 Blind Creek and Wild Goose Creek watershed sampling were found to be within healthy limits without a single site from either watershed exceeding the PWQO criteria. The average DO concentration in 1999 was 8.28 mg/L and the average concentration in 2010 was 8.05 mg/L, indicating little change.

Staff and funding permitting it is recommended that an update to the 2010 Blind Creek and Wild Goose Creek Watershed Assessment be completed in the next five to ten years. To minimize variability caused by point source contamination future sampling should consider two sampling periods, in which laboratory analysis and field measurements are completed. Because benthic analysis indicates water quality over an extended period of time, benthic analysis should also be considered for future watershed assessments.



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1 Introduction

The Blind Creek and Wild Goose Creek watersheds are located within the Geographic Township of McGregor in the Municipality of Shuniah. Both watersheds are adjacent to one another and separately drain into Lake Superior. Municipal and jurisdictional boundaries of the Blind Creek and Wild Goose Creek watersheds are illustrated on map M-1: Key Plan. Both watersheds reside within the Lakehead Region Conservation Authority (LRCA) Area of Jurisdiction. The general features found within the Blind Creek and Wild Goose Creek watersheds are shown on maps M-2a/M-2b: Site Plan. Map M-7a/M-7b: Approximate Regulated Areas, shows the area considered to be regulated by the LRCA under the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Ontario Regulation 180/06.

The Thunder Bay Region contains a diverse array of watersheds, each composed of a unique assemblage of ecological communities. A watershed, also known as a catchment or drainage basin, is essentially the area of land drained by a river system. A watershed is composed of tributaries (i.e. streams and creeks) which join together into a main channel and then into a lake.

The purpose of this report is to document the physical and chemical conditions of the Blind Creek and Wild Goose Creek watersheds in the month of August, 2010 and compare observations to the Blind Creek and Wild Goose Creek Assessments previously completed by the LRCA in 1999. The information gained will be used to maintain programs 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 and biological attributes of the watershed
- Collect surface water quality samples
- Collect field measurements
- Conduct an inventory of the flora and fauna observed from each sampling location
- Conduct an inventory of soil, streambed substrate and stream bank cover for each sampling location
- Document active erosion sites
- Interpret results to record the health status of the watershed
- Compare and contrast 2010 results with results observed from the Blind Creek and Wild Goose Creek Assessments completed by the LRCA in 1999



2 Background

2.1 Physical Attributes

2.1.1 Topography

The varied topography and hydrology of the Thunder Bay Region is primarily a result of previous glaciations which molded and transformed the landscape into what it is today. The Blind Creek watershed has a maximum elevation of 430 metres above sea level and a minimum elevation of 184 metres above sea level. The topography of the region can be found on map M-3a: Topography.

The Wild Goose Creek watershed has a maximum elevation of 520 metres above sea level and a minimum elevation of 184 metres above sea level. The topography of the region can be found on map M-3b: Topography.

2.1.2 Geology and Soils

Bedrock

The Thunder Bay Region lies within a 3,219,000 square kilometre area known as the Canadian Shield. The Canadian Shield is composed of ancient sedimentary, igneous and metamorphic rocks dating back to the Precambrian era. The Precambrian era is composed of two main divisions: the Archaean Period, where rocks are greater than 2,470 million years old (McGlynn, 1970) and the Proterozoic Period, which dates back 570 million years (Stockwell, 1964) to 2,480 million years ago. The Thunder Bay area hosts rocks from both periods, with the youngest rocks dating back approximately 1,100 million years (Palmer, 1970). Rock type and bedrock distribution for the Blind Creek and Wild Goose Creek watersheds can be found in Table 1.0 and 2.0, as well as on maps: M-4a/M-4b: Bedrock Geology



Table 1.0: Blind Creek Bedrock Geology				
General	Rock Type	Eon	Era	Area km²
Massive granodiorite to granite	Massive to foliated granodiorite to granite	Archean	Neo to meso-archean (2.5 to 3.4 Ga)	6.63
Mafic to intermediate metavolcanic rocks	Basaltic and andesitic flows, tuffs and breccias, chert, iron formation, minor metasedimentary and intrusive rocks and related migmatites	Archean	Neo to meso-archean (2.5 to 3.4 Ga)	5.25

Table 2.0: Wild Goose Creek Bedrock Geology				
General	Rock Type	Eon	Era	Area km²
Massive granodiorite to granite	Massive to foliated granodiorite to granite	Archean	Neo to meso-archean (2.5 to 3.4 Ga)	9.23
Mafic to intermediate metavolcanic rocks	Basaltic and andesitic flows, tuffs and breccias, chert, iron formation, minor metasedimentary and intrusive rocks and related migmatite	Archean	Neo to meso-archean (2.5 to 3.4 Ga)	4.41

Surficial Geology and Deposits

The surface deposits in the area are the results of the prior glacial events. Kame moraines and eskers, often flattened by subsequent lake action are found throughout the area and commonly consist of gravelly, sandy, outwash deposits. The distributions of surface deposits within the Blind Creek watershed are located in Table 3.0 and distributions of surface deposits within the Wild Goose Creek watershed are located in Table 4.0. The distribution of surface deposits can be found on maps M-5a/M-5b: Surficial Geology, for the Blind Creek and Wild Goose Creek watersheds.



Geology	Area km ²
Esker/Kame/Outwash plain	2.45
Glaciolacustrine plain	0.89
Moraine	1.91
Bedrock	6.63

Geology	Area km ²
Esker/Kame/Outwash plain	0.94
Glaciolacustrine plain	0.96
Moraine	2.18
Bedrock	9.56

Soils

Rockland soils cover nearly the entire area of both the Blind Creek and Goose Creek watersheds, with the exception of a small portion in the southern end near the Lake Superior outlets. Rockland soils are composed of less than ten centimetres of soil material overlying bedrock. Muck soils are isolated at the far southern end of both watershed areas. The distribution of soil within the watersheds is located in Tables 5.0 and 6.0 and illustrated on Blind Creek and Wild Goose Creek maps M-6a/M-6b: Soils.

Soil Type	Area km ²
Rockland	11.83
Muck	0.05

Soil Type	Area km ²
Rockland	13.26
Muck	0.37

2.1.3 Climate

Climate throughout the watersheds is characterized by a continental climate influenced and modified by Lake Superior. Westerly winds predominate from July to March whereas easterly winds predominate the rest of the year (LRCA 1985). Table 7.0 displays the average daily temperature, total precipitation and extreme max daily temperatures for the Thunder Bay Region from 1971-2000. Table 8.0 displays the average daily temperature and total precipitation for the 1999 sampling year and Table 9.0 displays the average daily temperature and total precipitation for the 2010 sampling year.



Table 7.0: Mean Temperature and Total Precipitation from the Thunder Bay International Airport, 1971-2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily (°C)	-14.8	-12	-5.5	2.9	9.5	14	17.6	16.6	11	5	-3	-11.6
Precipitation												
Total Precipitation (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 Precipitation (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

Table 8.0: Mean Temperature and Total Precipitation from the Thunder Bay International Airport, January-July 1999

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Temperature								
Daily (°C)	-15.39	-7.65	-4.9	4.39	10.56	15.29	19.1	15.98
Precipitation								
Total Precipitation (mm)	12.5	30.0	50.5	38.0	95.5	44.5	116.5	98.5

Table 9.0: Mean Temperature and Total Precipitation from the Thunder Bay International Airport, January-July 2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Temperature								
Daily (°C)	-12.09	-9.78	1.4	6.04	11.14	14.41	19.19	18.65
Precipitation								
Total Precipitation (mm)	27.0	9.0	18.0	37.5	38.5	83.0	43.0	51.5

2.1.4 Hydrology

The Blind Creek watershed is located within the Geographic Township of McGregor in the Municipality of Shuniah and is approximately seven kilometres in length, draining an area of approximately 12 square kilometres with a cold water thermal property classification.

The Wild Goose Creek watershed drains an area of approximately 14 square kilometres and is located within the Geographic Township of McGregor in the Municipality of Shuniah. Wild Goose Creek originates approximately two kilometres north of Highway 11/17 and flows south into Lake Superior. The overall length of Wild Goose Creek is nine kilometres with a cold water thermal property classification.



3 Methods and Materials

3.1 Site Selection

Blind Creek

Four Sites within the Blind Creek watershed were chosen for sampling in 2010. Sites previously sampled in 1999 were not sampled in 2010 due to accessibility. Site 9 was located downstream of Highway 11/17. Site 10 was located downstream of Highway 11/17 on a tributary east of Site 9. Site 11 was located downstream of Lakeshore Drive and was chosen for reasons of accessibility, as well as to collect runoff from Lakeshore Drive. Site 12 for the Blind Creek assessment was chosen to represent the confluence with Lake Superior.

Wild Goose Creek

Three sites within the Wild Goose Creek watershed were chosen for sampling in 2010. Sites previously sampled in 1999 were not resampled in 2010. This was largely due to the inaccessibility of the sites chosen for sampling in 1999. Forestry practices prevented access to the upper reaches of the watershed. Site 9 was located downstream of Highway 11/17 and was also chosen for reasons of accessibility and to collect runoff from the road. Site 8 was located downstream of Lakeshore Drive. This site was chosen based on accessibility, but also to collect and runoff from Lakeshore Drive. Site 7 for the Wild Goose Creek assessment was chosen to represent the confluence with Lake Superior.

3.2 Quantitative Assessment

Several parameters were measured to assess surface water quality of the Blind Creek and Wild Goose Creek watersheds. Surface water samples were collected for laboratory analysis in new, clean bottles provided by ALS Laboratory Group, 1081 Barton Street, Thunder Bay, Ontario. 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.

Methodology for water sample collection was based on the Provincial Water Quality Monitoring Network (PWQMN), Ministry of Environment Protocol (2006). Grab samples were collected away from the stream bank (facing upstream) in the main current either by wading or by using a reaching pole. In order to avoid disturbing the sediment, effort was taken to enter the river downstream of the sampling location.

ALS Laboratory Group provided four collection bottles for each site: routine, nutrient, metal and bacterial analysis. Sulfuric acid and nitric acid were added as preservative on site to the nutrient and metal bottles after the samples were collected. Bottles for bacterial analysis were pre-charged with sodium thiosulphate preservative and care was taken not



to open these bottles until the true sample was to be filled. All sample bottles were transported using a cooler and ice packs.

Field parameters for water temperature, pH, conductivity and dissolved oxygen were measured using a YSI 600 MDS multi parameter water quality sampler at the same time and location as the grab sample collection. Other standard field measurements were also taken, such as air temperature, channel width, channel depth and velocity. Air temperature was measured using a mercury thermometer. Channel width was measured using a measuring tape and channel depth using a metre stick. Velocity was measured using a floatation device, measuring tape, stop watch and appropriate calculations. This was only measured for water running downstream (not in ponds producing only windblown results). Detailed techniques for data collection can be found in Appendix A.

3.3 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 1994. The goal of the PWQO is to ensure that surface waters across the province are of a quality which is satisfactory for aquatic life and recreation. It is noted that the pre-1994 criterion for total coliform of 1,000 count per 100 mL has been referenced as there is no current PWQO. 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. The information in these guidelines and supporting text was 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.

3.4 Qualitative Assessment

Watershed health can 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 watersheds ability to provide a suitable habitat.

Flora was assessed using the Field Guide to Forest Ecosystem Classification for Northwestern Ontario (Sims et al. 1997). Each site was evaluated based on a 50 metre proximity to the creek. Each site with a significant number of trees was given a vegetation type or FEC V-Type. Common and scientific names can be found in Appendix G.

Fauna was assessed by identifying the species and number of individuals observed at each site. This process did not utilize netting of any kind and therefore fish and insect species are only identified to their genus. Physical dimensions, such as Universal



Transverse Mercator (UTM) coordinates, pictures and general observations were recorded and/or measured.

Erosion potential, slope stability and culverts were recorded only when outstanding cases could be observed. These observations were completed using a camera and short hand notes. Soil observations were completed by digging a small pit approximately 30 x 30 x 30 centimetres. Due to the lack of in depth data, (which could be provided through further testing) only general descriptions of the soils characteristics were noted. Documentation of culverts throughout the Blind Creek and Wild Goose Creek watersheds was completed for the 1999 watershed assessments. Wherever possible, significant changes were noted between photos from 1999 and photos taken in 2010. Photo documentation and can be found in Appendix H.

3.5 Materials

The following materials were used during the study:

- Chest waders
- Cooler
- Underwater digital camera
- GPS camera
- Field guides
- Fluorescent orange vests
- Ice packs
- Knife
- Latex gloves
- Lined paper
- Measuring tape reel
- Mercury thermometer
- Meter stick
- Paper towel
- Pens and pencils
- Reaching pole
- Road map
- Sampling bottles provided by ALS Laboratory Group
- Shovel
- Squeeze Bottles
- Stopwatch
- Topographic map
- Trimble Geo XH GPS
- Whistle
- Work gloves
- YSI 600 MDS multi parameter water quality sampler
- 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)



- Newcombs Wildflower Guide (Newcomb, 1977)
- ROM Field Guide to Wildflowers of Ontario (Dickinson *et al.* 2004)
- Wetland Plants of Ontario (Newmaster *et al.* 1997)

4 Results

Laboratory results from ALS Laboratory Group for the 2010 Assessments are summarized in Appendix D and all results from the 1999 Assessments are summarized in Appendix E. Site photos from both 1999 and 2010 are included in Appendix H. The Certificate of Analysis from ALS Laboratory Group is attached in Appendix I.

4.1 Blind Creek

4.1.1 Sites Not Reassessed in 2010

The following sites in the Blind Creek watershed were sampled in 1999 but not selected for resampling in 2010:

- Site 1: TransCanada Pipeline, Forestry Access Road Running Northwest, Kilometre 4.5
- Site 2: Forestry Access Road Running Northwest, Kilometre 4.0
- Site 3: Forestry Access Road Running Northwest, Kilometre 3.5
- Site 4: Mrakic Road, Upstream 200 Meters of CN Bridge
- Site 5: Forestry Access Road Running Northwest, East Arm, Kilometre 4.0
- Site 6: Forestry Access Road Running Northwest, East Arm, Kilometre 4.25
- Site 7: Highway 11/17 Bridge
- Site 8: Blind Creek Drive, South of Lakeshore Drive

Laboratory results and field observations from 1999 are located in Appendix E

4.1.2 Site 9: Highway 11/17, West Tributary

Location Reference for Site 9	
Location Description	Located off of Highway 11/17 downstream
UTM Coordinates	Northing 5374449/ Easting 348862
Altitude/Elevation	230 metres above sea level



Field Measurements for Site 9		
Parameter	Unit	Date: August 4, 2010
		Time: 1:00 pm
Water Temperature	°C	23.28
Conductivity	µS/cm	198
Dissolved Oxygen	mg/L	7.87
Dissolved Oxygen	%	92.4
pH		7.88
Air Temperature	°C	29
Channel Width	m	2.4
Channel Depth	m	0.21
Velocity	m/s	0.08

Laboratory Water Quality Results for Site 9		
Parameter	Unit	Date: August 4, 2010
		Time: 1:00 pm
Bacteriological		
<i>Escherichia Coli</i>	MPN/100mL	88
Total Coliforms	MPN/100mL	> 2420
Physical		
Conductivity (EC)	µS/cm	191
Total Dissolved Solids	mg/L	135
Turbidity	NTU	1.62
Nutrients		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	3.28
Nitrate-N (NO ₃ -N)	mg/L	<0.030
Nitrite-N (NO ₂ -N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	0.0086
Sulphate (SO ₄)	mg/L	1.50
Metals		
Aluminum (Al)	mg/L	0.038
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	<0.0010
Iron (Fe)	mg/L	0.418
Lead (Pb)	mg/L	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines



Flora Observed at Site 9	
FEC V-Type: V-6: Trembling Aspen (White Birch)- Balsam Fir/ Mountain Maple	
Dominant Species *	
Species	
Trees	Trembling Aspen Balsam Fir
Shrubs	Speckled Alder Sweet Gale* Red Currant
Ground Cover	Pearly Everlasting Golden Hawkweed Lady Fern Moss Marsh Marigold Slender White Aster Dark Green Bulrush Canada Goldenrod* Swamp Milkweed Blue Joint Grass Water Hemlock
Aquatic Macrophytes and Algae	Water Plantain Algae

Fauna Observed at Site 9		
Species		# Observed
Birds	-	-
Mammals	-	-
Amphibians	-	-
Fish	Minnows	>10
Mollusca	-	-
Crustaceans	-	-
Insects	Water Striders	>10
Other	Leech	1

Substrate Observations for Site 9		Soil Pit Observations	
Percentage Shaded	5-10%	Soil Characteristics	Organics, loam and road fill.
Substrate Classification	Cobbles, bedrock and boulders.		
Abundance of aquatic vegetation	Algae abundant.		

General Observations

Site 9 for the Blind Creek watershed was located downstream of Highway 11/17. Parking was available one kilometre away from the site. The two upstream culverts were perched 30 centimetres above the water and algae growth was abundant on the downstream sides of the culverts. The creek was narrow with sweet gale and speckled alder on either side.



There was swift flow in the relatively shallow channel and considerable suspended matter with large boulders and cobble somewhat obstructing flow. Bedrock was also visible in a portion of the channel.

Results and Discussion

Site 9 was in good condition at the time of sampling, exceeding one PWQO parameter in 2010. Iron exceeded PWQO criterion (0.3 mg/L) with a concentration of 0.418 mg/L. Total coliforms do not currently have a PWQO; however, prior to 1994 the PWQO objective was 1,000 MPN/100 mL, which was exceeded at Site 9 in 2010 with a concentration greater than 2,420 MPN/100 mL.

4.1.3 Site 10: Highway 11/17, East Tributary

Location Reference for Site 10	
Location Description	Located off of Highway 11/17
UTM Coordinates	Northing 5374650/ Easting 348973
Altitude/Elevation	227 metres above sea level

Field Measurements for Site 10		
Parameter	Unit	Date: August 10, 2010
		Time: 2:10 pm to 2:30 pm
Water Temperature	°C	21.07
Conductivity	µS/cm	123
Dissolved Oxygen	mg/L	8.35
Dissolved Oxygen	%	93.8
pH		7.92
Air Temperature	°C	30
Channel Width	m	1.8
Channel Depth	m	0.21
Velocity	m/s	No flow



Laboratory Water Quality Results from Site 10		
Parameter	Unit	Date: August 10 2010
		Time: 2:10 pm
Bacteriological		
<i>Escherichia Coli</i>	MPN/100mL	110
Total Coliforms	MPN/100mL	> 2420
Physical		
Conductivity (EC)	µS/cm	118
Total Dissolved Solids	mg/L	90
Turbidity	NTU	1.16
Nutrients		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	2.31
Nitrate-N (NO ₃ -N)	mg/L	0.126
Nitrite-N (NO ₂ -N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	0.0110
Sulphate (SO ₄)	mg/L	1.56
Metals		
Aluminum (Al)	mg/L	0.017
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	<0.0010
Iron (Fe)	mg/L	0.229
Lead (Pb)	mg/L	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

Flora Observed at Site 10	
FEC V-Type: NA	
Dominant Species *	
Species	
Trees	Black Ash Balsam Fir Pin Cherry
Shrubs	Speckled Alder* Wild Red Raspberry Sweet Gale* Bog Willow
Ground Cover	Canada Goldenrod Purple Stemmed Aster Bog Willow Evening Primrose Reed Canary Ostrich Fern Spike Rush Green Sedge
Aquatic Macrophytes and Algae	Slender Naiad, Water Nymph Floating Leaved Pond Weed Water Plantain Great Water Dock



Fauna Observed at Site 10		
Species		# Observed
Birds	-	-
Mammals	-	-
Amphibians	Frog	1
Fish	Minnows	>10
Mollusca	-	-
Crustaceans	-	-
Insects	Water Striders	>10
Other	-	-

Substrate Observations from Site 10		Soil Pit Observations	
Percentage Shaded	0-25%	Soil Characteristics	Thick organic layer, overlying loam.
Substrate Classification	Sand, muck and cobble		
Abundance of aquatic vegetation	High density of emergent, low density of submergent.		

General Observations

Site 10 was located downstream of Highway 11/17 on the tributary east of Site 9. This site was characterized by a small drop from the concrete structure into the channel below. The water in the structure was shallow with almost no flow. This was likely in response to beaver activity upstream. Downstream from the structure there was a relatively deep, nearly stagnant pool. The pool then narrowed into a small channel where the sampling was conducted. The substrate consisted of sand with organic material and cobble. The terrestrial vegetation surrounding the site was thick and diverse relative to other locations with shrubs and sedges being the dominant vegetation and sweet gale being the dominant species. Emergent aquatic vegetation was also abundant at this site with water plantain and floating leaved pondweed surrounding the pool.

Results and Discussion

Site 10 exceeded the PWQO criteria for one parameter in 2010. *E. coli* exceeded PWQO criterion (100 MPN/100 mL) with a concentration of 110 MPN/100mL. Total coliforms exceeded the pre-1994 PWQO (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL. This site had nearly stagnant water which may have contributed to the high *E. coli* concentrations. With exception to bacteriological parameters, all other laboratory results and field measurements indicated that Site 10 was in relatively good condition at the time of sampling.



4.1.4 Site 11: Lakeshore Drive, Downstream

Location Reference for Site 11	
Location Description	Located off of Lakeshore Drive
UTM Coordinates	Northing 5374245/ Easting 349466
Altitude/Elevation	204 metres above sea level

Field Measurements for Site 11		
Parameter	Unit	Date: August 10, 2010
		Time: 12:30 pm to 1:00 pm
Water Temperature	°C	21.58
Conductivity	µS/cm	196
Dissolved Oxygen	mg/L	8.21
Dissolved Oxygen	%	93.4
pH		7.96
Air Temperature	°C	29
Channel Width	m	In flowing channel 1.1 Stream bed 6.4
Channel Depth	m	0.21
Velocity	m/s	0.07

Laboratory Water Quality Results for Site 11		
Parameter	Unit	Date: August 10, 2010
		Time: 12:30 pm
Bacteriological		
<i>Escherichia Coli</i>	MPN/100mL	110
Total Coliforms	MPN/100mL	> 2420
Physical		
Conductivity (EC)	µS/cm	192
Total Dissolved Solids	mg/L	138
Turbidity	NTU	1.67
Nutrients		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	5.24
Nitrate-N (NO ₃ -N)	mg/L	0.042
Nitrite-N (NO ₂ -N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	0.0119
Sulphate (SO ₄)	mg/L	1.59
Metals		
Aluminum (Al)	mg/L	0.039
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	0.0013
Iron (Fe)	mg/L	0.562
Lead (Pb)	mg/L	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines



Flora Observed at Site 11	
FEC V-Type: V-4: White Birch Hardwood and Mixedwood	
Dominant Species *	
Species	
Trees	White Birch
Shrubs	Speckled Alder* Mountain Maple Wild Rose Mountain Ash
Ground Cover	Slender White Aster Redtop Grass Canada Goldenrod Cow Vetch Golden Hawkweed Fireweed Large Leaved Aster Dark Green Bulrush
Aquatic Macrophytes and Algae	Slender Naiad, Water Nymph Floating Leaved Pond Weed Water Plantain Great Water Dock

Fauna Observed at Site 11		
Species		# Observed
Birds	-	-
Mammals	-	-
Amphibians	-	-
Fish	-	-
Mollusca	-	-
Crustaceans	-	-
Insects	-	-
Other	-	-

Substrate Observations from Site 11		Soil Pit Observations	
Percentage Shaded	0-25%	Soil Characteristics	Thick organic layer, overlying loam.
Substrate Classification	Bedrock and some cobble.		
Abundance of aquatic vegetation	High density of emergent, low density of submergent.		

General Observations

Site 11 of Blind Creek was characterized by a very large structure situated on bedrock. This site was relatively difficult to access due to private property on either side. The soil consisted of sand overlying bedrock. Speckled alder was the dominant terrestrial shrub with many herbs also present. Due to the bedrock substrate there was little aquatic vegetation at the site. Scattered patches of algae were the only aquatic plants observed.



Results and Discussion

Site 11 exceeded PWQO criteria for two parameters in 2010. *E. coli* exceeded PWQO criterion (100 MPN/100 mL) with a concentration of 110 MPN/100 mL and iron exceeded PWQO criterion (0.3 mg/L) with a concentration of 0.56 mg/L. Total coliforms exceeded the pre-1994 PWQO criterion (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL. All other laboratory results and field measurements indicate that, with the exception to bacteriological parameters, this site was in relatively good condition at the time of sampling.

4.1.5 Site 12: Confluence with Lake Superior

Location Reference for Site 12	
Location Description	Confluence with Lake Superior, access gained through private property
UTM Coordinates	Northing 5373877/ Easting 349676
Altitude/Elevation	184 metres above sea level

Field Measurements for Site 12		
Parameter	Unit	Date: August 10, 2010 Time: 2:10 pm to 2:30 pm
Water Temperature	°C	20.03
Conductivity	µS/cm	203
Dissolved Oxygen	mg/L	8.97
Dissolved Oxygen	%	98.7
pH		7.78
Air Temperature	°C	27
Channel Width	m	2.2
Channel Depth	m	0.17
Velocity	m/s	0.1

Laboratory Water Quality Results for Site 12		
Parameter	Unit	Date: August 9, 2010 Time: 12:30 pm
Bacteriological		
<i>Escherichia Coli</i>	MPN/100mL	26
Total Coliforms	MPN/100mL	> 2420
Physical		
Conductivity (EC)	µS/cm	215
Total Dissolved Solids	mg/L	149
Turbidity	NTU	0.65
Nutrients		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	6.52
Nitrate-N (NO ₃ -N)	mg/L	0.103
Nitrite-N (NO ₂ -N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	0.0051
Sulphate (SO ₄)	mg/L	1.39



Metals		
Aluminum (Al)	mg/L	0.014
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	0.0017
Iron (Fe)	mg/L	0.156
Lead (Pb)	mg/L	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

Flora Observed at Site 12	
FEC V-Type: V-19 Black Spruce Mixedwood/ Herb Rich	
Dominant Species *	
Species	
Trees	Black Spruce
Shrubs	Ninebark Wild Red Raspberry Sweet Gale* Slender Willow
Ground Cover	Hawkweed Jewelweed Ox-eye Daisy Red Osier Dogwood Yarrow Balsam Willow Swamp Milkweed Cow Vetch Canada Goldenrod Evening Primrose Purple Stemmed Aster Lady's Thumb Bell Flower Slender White Aster
Aquatic Macrophytes and Algae	Algae

Fauna Observed at Site 12		
Species		# Observed
Birds	Ducks	4
Mammals	-	-
Amphibians	-	-
Fish	Minnows	>10
Mollusca	-	-
Crustaceans	-	-
Insects	-	-
Other	-	-



Substrate Observations from Site 12		Soil Pit Observations	
Percentage Shaded	0-25%	Soil Characteristics	Sand and gravel
Substrate Classification	Bedrock and Cobble		
Abundance of aquatic vegetation	High density of Algae.		

General Observations

Site 12, the Lake Superior confluence, was located on private property. This site was characterized by cobble and boulders both in the channel and on the banks adjacent to the site. The channel was shallow, with very little water flowing from the creek into Lake Superior. The substrate was nearly covered with thin filamentous algae. The vegetation above the cobble beach was unique to this location and not observed elsewhere at any of the 2010 watershed assessments. Shrub growth was thick and ninebark was the dominant species. Creeping bellflower was also abundant and black spruce was observed upstream from the site.

Results and Discussion

Site 12 was in good condition at the time of sampling with no parameters exceeding current PWQO criteria on August 9, 2010. Total coliforms exceeded the pre-1994 PWQO (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL. All other laboratory results and field measurements indicated that, with the exception to bacteriological parameters, this site was in relatively good condition at the time of sampling.



4.1.6 Overall Site Summary

Table 4.0: Summary of 2010 Blind Creek Field Measurements

Parameter	Unit	Blind Creek Site #9	Blind Creek Site #10	Blind Creek Site #11	Blind Creek Site #12
		Date: August 10 2010	Date: August 10, 2010	Date: August 10, 2010	Date: August 10, 2010
		Time: 1:00 pm	Time: 2:10 pm	Time: 12:30 pm	Time: 2:10 pm
Water Temperature	°C	23.28	21.07	21.58	20.03
Conductivity	µS/cm	198	123	196	203
Dissolved Oxygen	mg/L	7.87	8.35	8.21	9.87
Dissolved Oxygen	%	92.4	93.8	93.4	89.7
pH		7.88	7.92	7.96	7.78
Air Temperature	°C	29	30	29	27
Channel Width	m	2.4	1.8	1.1	2.2
Channel Depth	m	0.21	0.21	0.21	0.17
Velocity	m/s	0.08	No flow	0.07	0.1

Summary of Averages for 1999 and 2010 Blind Creek Field Measurements

Parameter	Unit	Averages for all 1999 Data	Averages for all 2010 Data
Water Temperature	°C	20.00	21.49
Conductivity	µS/cm	182	180
Dissolved Oxygen	mg/L	8.00	8.35
Dissolved Oxygen	%	NA	94.58
pH		7.25	7.89
Air Temperature	°C	26.13	28.75
Channel Width	m	NA	2.13
Channel Depth	m	0.17	0.2
Velocity	m/s	NA	0.06

Summary of 2010 Blind Creek Laboratory Results

Parameter	Unit	Blind Creek Site #9	Blind Creek Site #10	Blind Creek Site #11	Blind Creek Site #12
		Date: August 10, 2010	Date: August 10 2010	Date: August 10, 2010	Date: August 10, 2010
		Time: 1:00 pm	Time: 2:10 pm	Time: 12:30 pm	Time: 12:30 pm
Bacteriological Tests					
<i>Escherichia Coli</i>	MPN/100mL	88	110	110	26
Total Coliforms	MPN/100mL	> 2420	> 2420	> 2420	> 2420
Physical Tests					
Conductivity (EC)	µS/cm	191	118	192	215
Total Dissolved Solids	mg/L	135	90	138	149
Turbidity	NTU	1.62	1.16	1.67	0.65



Anions and Nutrients					
Ammonia-N, Total	mg/L	<0.020	<0.020	<0.020	<0.020
Chloride (Cl)	mg/L	3.28	2.31	5.24	6.52
Nitrate-N (NO3-N)	mg/L	<0.030	0.126	0.042	0.103
Nitrite-N (NO2-N)	mg/L	<0.020	<0.020	<0.020	<0.020
Phosphorus (P)	mg/L	0.0086	0.0110	0.0119	0.0051
Sulphate (SO4)	mg/L	1.50	1.56	1.59	1.39
Total Metals					
Aluminum (Al)	mg/L	0.038	0.017	0.039	0.014
Cadmium (Cd)	mg/L	<0.000090	<0.000090	<0.000090	<0.000090
Copper (Cu)	mg/L	<0.0010	<0.0010	0.0013	0.0017
Iron (Fe)	mg/L	0.418	0.229	0.562	0.156
Lead (Pb)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

Summary of 1999 and 2010 Blind Creek Laboratory Results			
Parameter	Unit	Averages from all 1999 Samples	Averages from all 2010 Samples
Bacteriological			
<i>Escherichia Coli</i>	MPN/100mL	65.7	83.5
Total Coliforms	MPN/100mL	NA	> 2420
Physical			
Conductivity (EC)	µS/cm	NA	179
Total Dissolved Solids	mg/L	NA	128
Turbidity	NTU	3.0	1.275
Nutrients			
Ammonia-N, Total	mg/L	NA	<0.020
Chloride (Cl)	mg/L	NA	4.3375
Nitrate-N (NO3-N)	mg/L	NA	0.090333
Nitrite-N (NO2-N)	mg/L	NA	<0.020
Phosphorus (P)-Total	mg/L	0.062	0.009
Sulphate (SO4)	mg/L	NA	1.51
Metals			
Aluminum (Al)	mg/L	NA	0.027
Cadmium (Cd)	mg/L	<0.0002	<0.000090
Copper (Cu)	mg/L	NA	0.0015
Iron (Fe)	mg/L	1.35	0.34
Lead (Pb)	mg/L	0.0001	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

During the 2010 sampling period Blind Creek appeared to be in good health. Total coliform was the only parameter to consistently exceed pre-1994 PWQO (1,000 MPN/100 mL) criterion at all sampling locations. Water quality averages from 1999 and 2010 did not indicate any significant changes to water quality within the Blind Creek watershed.



4.2 Wild Goose Creek

4.2.1 Sites Not Reassessed in 2010

The following sites in the Blind Creek watershed were sampled in 1999 but not selected for resampling in 2010:

- Site 1: Lakeshore Drive, Upstream Culvert
- Site 2: CN Railroad Tracks, Downstream Southwest of Bridge on Highway 11/17
- Site 3: Mrakic Road, Upstream 1 Kilometre West of CN Bridge on Highway 11/17
- Site 4: Forestry Access Road Running Northwest, Kilometre 3.5
- Site 5: Forestry Access Road Running Northwest, Kilometre 4.0
- Site 6: TransCanada Pipeline, 300 Metres Northwest of Savela House

Laboratory results and field observations from 1999 are located in Appendix E

4.2.2 Site 7: Confluence with Lake Superior

Location Reference for Site 7	
Location Description	Confluence with Lake Superior
UTM Coordinates	Northing 5372934/ Easting 347383
Altitude/Elevation	184 metres above sea level

Field Measurements for Site 7		
Parameter	Unit	Date: August 9 2010
		Time: 12:40 pm
Water Temperature	°C	20.75
Conductivity	µS/cm	223
Dissolved Oxygen	mg/L	7.19
Dissolved Oxygen	%	80.0
pH		7.66
Air Temperature	°C	30
Channel Width	m	11.9
Channel Depth	m	0.67
Velocity	m/s	No flow

Laboratory Water Quality Results for Site 7		
Parameter	Unit	Date: August 9, 2010
		Time: 12:40 pm
Bacteriological		
<i>Escherichia Coli</i>	MPN/100mL	120
Total Coliforms	MPN/100mL	> 2420
Physical		
Conductivity (EC)	µS/cm	226
Total Dissolved Solids	mg/L	151
Turbidity	NTU	1.63



Nutrients		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	11.7
Nitrate-N (NO3-N)	mg/L	0.050
Nitrite-N (NO2-N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	0.0140
Sulphate (SO4)	mg/L	2.14
Metals		
Aluminum (Al)	mg/L	0.082
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	0.0022
Iron (Fe)	mg/L	0.635
Lead (Pb)	mg/L	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

Flora Observed at Site 7	
FEC V-Type: NA	
Dominant Species *	
Species	
Trees	White Birch White Spruce
Shrubs	Speckled Alder
Ground Cover	Canada Goldenrod Evening Primrose
Aquatic Macrophytes and Algae	Floating Leaved Pondweed Cattail Vasey's Pondweed

Fauna Observed at Site 7		
Species		# Observed
Birds	Seagulls	>10
Mammals	-	-
Amphibians	Leopard frog	1
Fish	Minnows	>10
Mollusca	-	-
Crustaceans	-	-
Insects	-	-
Other	-	-

Substrate Observations for Site 7		Soil Pit Observations	
Percentage Shaded	5-10%	Soil Characteristics	Sandy beach
Substrate Classification	Sandy clay		
Abundance of aquatic vegetation	Abundant, thick matted vegetation just downstream of sampling site.		



General Observations

Site 7, the confluence with Lake Superior, was located on private property. This site was characterized by a large pool of water just before the confluence. On the west bank there was abundant shrub growth with some larger trees present. The substrate of the sampling site was entirely sand and silts causing the water to appear murky. Low water levels had caused sand to surround the mouth of the confluence, which reduced flow into a small channel cutting through the sand. While at the sight, one of the local residents also mentioned that swimmers itch was known to be present in the area

Results and Discussion

Site 7 exceeded two PWQO parameters in 2010. *E. coli* exceeded PWQO criterion (100 MPN/100 mL) with a concentration of 120 MPN/100 mL and iron exceeded PWQO criterion (0.3 mg/L) with a concentration of 0.64 mg/L. Total coliforms exceeded pre-1994 the PWQO criterion (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL.

This site had nearly stagnant water and was located adjacent to a residential area. The high *E. coli* and coliform concentrations source was not readily apparent. The iron concentration was slightly higher than other sites but was still relatively low and likely a result of natural processes.

4.2.3 Site 8: Lakeshore Drive, Downstream

Location Reference for Site 8	
Location Description	Located off of Lakeshore Drive
UTM Coordinates	Northing 5373174/ Easting 347337
Altitude/Elevation	195 metres above sea level

Field Measurements for Site 8		
Parameter	Unit	Date: August 4, 2010
		Time: 11:15 am
Water Temperature	°C	21.4
Conductivity	µS/cm	175
Dissolved Oxygen	mg/L	7.74
Dissolved Oxygen	%	86.9
pH		7.79
Air Temperature	°C	25
Channel Width	m	2.4
Channel Depth	m	0.24
Velocity	m/s	0.09



Laboratory Water Quality Results for Site 8		
Parameter	Unit	Date: August 4, 2010
		Time: 11:15 am
Bacteriological		
<i>Escherichia Coli</i>	MPN/100mL	31
Total Coliforms	MPN/100mL	> 2420
Physical		
Conductivity (EC)	µS/cm	172
Total Dissolved Solids	mg/L	114
Turbidity	NTU	0.42
Nutrients		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	6.76
Nitrate-N (NO ₃ -N)	mg/L	0.057
Nitrite-N (NO ₂ -N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	<0.0050
Sulphate (SO ₄)	mg/L	1.66
Metals		
Aluminum (Al)	mg/L	0.014
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	0.0017
Iron (Fe)	mg/L	<0.050
Lead (Pb)	mg/L	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

Flora Observed at Site 8	
FEC V-Type: V-1 Balsam Poplar Hardwood and Mixedwood	
Dominant Species *	
Species	
Trees	Balsam Fir
	Black Ash
	White Birch
Shrubs	Green Alder*
Ground Cover	Fowl Meadow Grass
	Red Top Grass
	Wire Grass
	Reed Canary Grass
	Hawkweed
	Slender White Aster
	Swamp Milkweed
	Jewelweed
	Cow Vetch
	Dark Green Bulrush
	Horsetail
	Canada Goldenrod
Aquatic Macrophytes and Algae	Algae
	Starwort



Fauna Observed at Site 8		
Species		# Observed
Birds	-	-
Mammals	-	-
Amphibians	Green Frog	-
Fish	Speckled Trout	>5
Mollusca	-	-
Crustaceans	-	-
Insects	-	-
Other	-	-

Substrate Observations for Site 8		Soil Pit Observations	
Percentage Shaded	25-50%	Soil Characteristics	Thin organic overlying bedrock
Substrate Classification	Cobble and gravel		
Abundance of aquatic vegetation	Low density		

General Observations

Site 8 of the Wild Goose Creek watershed was located off Lakeshore Drive. This site was characterized by a bedrock substrate upstream followed by a sandy cobble substrate downstream from the culvert. Vegetation at this site was approximately one metre back from the shore due to the presence of large boulders and cobble. The vegetation that was growing in the area was largely shrub dominated with slender willow and alder. Large quantities of brook trout and rainbow trout were observed. Flow was swift and the water was very clear. No photo documentation was collected in 1999.

Results and Discussion

Site 8 was in good condition at the time of sampling with no parameters exceeding current PWQO criteria on August 4, 2010. Total coliforms exceeded the pre-1994 PWQO (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL.

4.2.4 Site 9: Highway 11/17, Downstream

Location Reference for Site 9	
Location Description	Located downstream side of Highway 11/17
UTM Coordinates	Northing 5374290/ Easting 347529
Altitude/Elevation	248 metres above sea level



Field Measurements for Site 9		
Parameter	Unit	Date: August 9 2010
		Time: 1:40 pm to 2:30 pm
Water Temperature	°C	21.10
Conductivity	µS/cm	154
Dissolved Oxygen	mg/L	8.32
Dissolved Oxygen	%	93.2
pH		7.58
Air Temperature	°C	30
Channel Width	m	1.5
Channel Depth	m	0.14
Velocity	m/s	No Flow

Laboratory Water Quality Results for Site 9		
Parameter	Unit	Date: August 9, 2010
		Time: 1:40 pm
Bacteriological		
<i>Escherichia Coli</i>	MPN/100mL	8
Total Coliforms	MPN/100mL	1700
Physical		
Conductivity (EC)	µS/cm	161
Total Dissolved Solids	mg/L	137
Turbidity	NTU	1.63
Nutrients		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	2.68
Nitrate-N (NO3-N)	mg/L	0.057
Nitrite-N (NO2-N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	0.0206
Sulphate (SO4)	mg/L	0.67
Metals		
Aluminum (Al)	mg/L	0.027
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	<0.0010
Iron (Fe)	mg/L	1.18
Lead (Pb)	mg/L	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

Flora Observed at Site 9	
FEC V-Type: V-9 Trembling Aspen Mixedwood	
Dominant Species *	
Species	
Trees	Black Ash Balsam Poplar Trembling Aspen White Birch Balsam Fir White Spruce



Shrubs	Speckled Alder Wild Rose Slender Willow
Ground Cover	Canada Goldenrod Evening Primrose Swamp Milkweed Joe-Pye Weed Green Sedge Wild Mint Purple Stemmed Aster Slender White Aster Drooping Woodreep Wooly Blue Violet Marsh Timothy Water Hemlock Sensitive Fern Bracken Fern
Aquatic Macrophytes and Algae	Water Plantain Algae

Fauna Observed at Site 9		
Species		# Observed
Birds	Seagulls	>10
Mammals	-	-
Amphibians	Leopard frog	1
Fish	Minnows	>10
Mollusca	-	-
Crustaceans	-	-
Insects	-	-
Other	-	-

Substrate Observations for Site 9		Soil Pit Observations	
Percentage Shaded	5-10%	Soil Characteristics	Sand beach
Substrate Classification	Sandy clay		
Abundance of aquatic vegetation	Abundant, thick matted vegetation just downstream of sampling site.		

General Observations

Site 9 was located downstream of Highway 11/17. This site was characterized by a small drop from the concrete structure into a large pool. The pool was nearly stagnant, flowing into the small channel where the sampling site was located. Substrate was characterized by silt covered boulders and an abundance of algae but low abundance of other aquatic vegetation. Boulders with woody debris trapped throughout were downstream from the sampling site. The vegetation consisted of grasses and sedges with birch, poplar and ash trees scattered throughout the area, providing little to no shade over the stream. Many of



the poplars were dead, possibly due to a prior flood event. The water was slightly murky at the sampling site with no flow.

Results and Discussion

Site 9 was in good condition at the time of sampling with one parameter exceeding current PWQO criteria in 2010. Iron exceeded PWQO criterion (0.3 mg/L) with a concentration of 1.18 mg/L. The high iron concentration was likely from natural processes. Total coliforms exceed the pre-1994 PWQO (1,000 MPN/100 mL) with a concentration greater than 1,700 MPN/100 mL. This was the lowest coliform concentration observed in both the Wild Goose Creek and Blind Creek 2010 assessments.

4.2.5 Overall Site Summary

Parameter	Unit	Wild Goose Creek Site #7	Wild Goose Creek Site #8	Wild Goose Creek Site #9
		Date: August 9, 2010	Date: August 4, 2010	Date: August 9, 2010
		Time: 12:40 pm	Time: 11:15 am	Time: 1:40 pm
Water Temperature	°C	20.75	21.4	21.10
Conductivity	µS/cm	223	175	154
Dissolved Oxygen	mg/L	7.19	7.74	8.32
Dissolved Oxygen	%	80.0	86.9	93.2
pH		7.66	7.79	7.58
Air Temperature	°C	29	25	30
Channel Width	m	2.4	2.4	1.5
Channel Depth	m	0.21	0.24	0.14
Velocity	m/s	No flow	0.09	No flow

Parameter	Unit	Averages for all 1999 Data	Averages for all 2010 Data
Water Temperature	°C	19.04	21.08
Conductivity	µS/cm	150.41	184
Dissolved Oxygen	mg/L	8.56	7.75
Dissolved Oxygen	%	NA	86.7
pH		7.22	7.68
Air Temperature	°C	25.38	28
Channel Width	m	N/A	2.1
Channel Depth	m	0.23	0.2
Velocity	m/s	NA	0.03



Table 5.0: Summary of 2010 Wild Goose Creek Laboratory Results				
Parameter	Unit	Wild Goose Creek Site #7	Wild Goose Creek Site #8	Wild Goose Creek Site #9
		Date: August 9, 2010	Date: August 4, 2010	Date: August 9, 2010
		Time: 12:40 pm	Time: 11:15 pm	Time: 1:40 pm
Bacteriological Tests				
Escherichia Coli	MPN/100mL	120	31	8
Total Coliforms	MPN/100mL	> 2420	> 2420	1700
Physical Tests				
Conductivity (EC)	µS/cm	226	172	161
Total Dissolved Solids	mg/L	151	114	137
Turbidity	NTU	1.63	0.42	1.63
Anions and Nutrients				
Ammonia-N, Total	mg/L	<0.020	<0.020	<0.020
Chloride (Cl)	mg/L	11.7	6.76	2.68
Nitrate-N (NO ₃ -N)	mg/L	0.050	0.057	0.057
Nitrite-N (NO ₂ -N)	mg/L	<0.020	<0.020	<0.020
Phosphorus (P)-Total	mg/L	0.0140	<0.0050	0.0206
Sulphate (SO ₄)	mg/L	2.14	1.66	0.67
Total Metals				
Aluminum (Al)	mg/L	0.082	0.014	0.027
Cadmium (Cd)	mg/L	<0.000090	<0.000090	<0.000090
Copper (Cu)	mg/L	0.0022	0.0017	<0.0010
Iron (Fe)	mg/L	0.635	<0.050	1.18
Lead (Pb)	mg/L	<0.0010	<0.0010	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines



Table 7.0: Summary of Averages of 1999 and 2010 Wild Goose Creek Laboratory Results			
Parameter	Unit	Averages from all 1999 Samples	Averages from all 2010 Samples
Bacteriological			
<i>Escherichia Coli</i>	MPN/100mL	22	53
Total Coliforms	MPN/100mL	NA	> 2180
Physical			
Conductivity (EC)	µS/cm	NA	186.33
Total Dissolved Solids	mg/L	NA	134
Turbidity	NTU	1.6	1.23
Nutrients			
Ammonia-N, Total	mg/L	NA	<0.020
Chloride (Cl)	mg/L	NA	7.05
Nitrate-N (NO ₃ -N)	mg/L	NA	0.05
Nitrite-N (NO ₂ -N)	mg/L	NA	<0.020
Phosphorus (P)-Total	mg/L	0.036	0.01
Sulphate (SO ₄)	mg/L	NA	1.49
Metals			
Aluminum (Al)	mg/L	NA	0.04
Cadmium (Cd)	mg/L	<0.0002	<0.000090
Copper (Cu)	mg/L	NA	0.002
Iron (Fe)	mg/L	0.836	0.62
Lead (Pb)	mg/L	<0.0010	<0.0010

*Bold #'s indicate exceedance of PWQO guidelines

Wild Goose Creek appeared to be in relatively good health regarding nearly all parameters during the 2010 sampling period. The only consistent exceedance observed at the three sampling sites was total coliform concentrations. When comparing water quality averages from 1999 to 2010, no significant changes to the water chemistry were indicated. Due to the inability to overlap sampling sites from 1999 to 2010, only an overall assessment of the watersheds quality could be determined. Site specific changes between 1999 and 2010 could not be assessed.



5 Overall Discussion

Laboratory results from the 2010 Blind Creek and Wild Goose Creek Watershed Assessment Update indicated that both watersheds were in overall good condition with minimal exceedances of the PWQO criteria. Results indicated comparable concentrations between the two watersheds as well as between the two sampling periods.

5.1 Climate

Meteorological data located in Table 1.0, Table 2.0 and Table 3.0 depict that in 2010 higher than average air temperatures and lower than average total precipitation were recorded. The LRCA area of jurisdiction and Thunder Bay District were in a declared Level I Low Water Condition (i.e. received precipitation was between 60-80% of average) for the months of April, July and August and was in a declared Level II Low Water Condition (i.e. received precipitation between 40-60% of average) for the months of May and June. Lower levels of precipitation are known to affect *E. coli* concentrations due to less mixing throughout the water column. From January to July in 1999 the average temperature was 4.26 degrees Celsius, with a total of 183.5 millimetres of precipitation. From January to July in 2010 the average temperature was 4.33 degrees Celsius with a total of 256 millimetres of precipitation. Water temperatures recorded in 2010 ranged from 20.03 degrees Celsius to 23.28 degrees Celsius and water temperatures recorded for 1999 ranged from 13.5 degrees Celsius to 25.5 degrees Celsius.

5.2 Dissolved Oxygen

DO concentrations from the 2010 Blind Creek and Wild Goose Creek watershed sampling were found to be within healthy limits without a single site from either watershed exceeding the PWQO criteria. The average DO concentration in 1999 was 8.28 mg/L and the average in 2010 was 8.05 mg/L, indicating little change in concentrations between the two years.

5.3 Bacteriological

Total coliforms exceeded pre-1994 PWQO criterion (1,000 MPN/100 mL) at every sampling site from both Blind Creek and Wild Goose Creek during the 2010 sampling period. The total coliform concentrations in the Blind Creek watershed were all greater than 2,420 MPN/100 mL. Total coliform concentrations for the Wild Goose Creek watershed ranged from 1,700 MPN/100 mL to greater than 2,420 MPN/100 mL. High total coliform concentrations can be derived from a variety of sources both natural and anthropogenic in origin. The natural niches for members of coliform bacteria range from being fecal specific, such as *E. coli*, to being widely distributed in the water, soil, and vegetation (Leclerc *et al.*, 2001; Rompré *et al.*, 2002). If densities of warm blooded wildlife are high, natural sources of fecal coliforms can often be concentrated in wetlands and along the shorelines of lakes and rivers. Other sources such as human or livestock



waste may also be common and can cause concentrated amounts to occur through runoff or poor waste water management techniques.

5.4 Metals

Laboratory results indicated that iron was the only metal to exceed PWQO criteria in 2010 for both the Wild Goose Creek and Blind Creek watersheds. All other metals were within the PWQO criteria. Iron concentrations reported from the Wild Goose Creek watershed in 2010 ranged from less than 0.050 mg/L to 1.18 mg/L, exceeding PWQO (0.3 mg/L) with an overall average of 0.62 mg/L. These iron concentrations were comparable to the overall average reported from the 1999 Wild Goose Creek sampling (0.836 mg/L) and were higher than the average iron concentration reported from the 2010 Blind Creek sampling (0.34 mg/L). Iron concentrations reported from 2010 Blind Creek sampling ranged from 0.156 mg/L to 0.562 mg/L exceeding PWQO criterion (0.3 mg/L) with an overall average of 0.34 mg/L.

5.5 Nutrients

Laboratory results indicated a decrease in phosphorus concentrations from 1999 to 2010 from both the Wild Goose Creek and Blind Creek watersheds. Phosphorus was not in exceedance at any of the sites for either watershed in 2010, where 1999 Blind Creek sampling reported an average of 0.062 mg/L which exceeded PWQO criterion (0.03 mg/L). The average phosphorus concentration for the Blind Creek watershed in 2010 was 0.009 mg/L and 0.01 mg/L for the Wild Goose Creek watershed.

5.6 pH

pH was not in exceedance of the PWQO criterion of 6.5-8.5 for either watershed in 2010. The Blind Creek watershed was in exceedance of the PWQO criterion for pH in 1999 with a single exceedance of 6.48. The Wild Goose Creek watershed was also in exceedance in 1999 with exceedances between 6.29 and 8.87.



6 Conclusion

In conclusion, water quality analysis completed for the 2010 Blind Creek and Wild Goose Creek Watershed Assessment Updates indicated that both watersheds were in excellent condition with minimal exceedances of PWQO at the time of sampling. The 2010 laboratory results indicated two parameters, iron and total coliforms exceeded PWQO criteria at many of the sites for both watersheds. Total coliforms and iron commonly occur at high concentrations under natural conditions and concentrations reported from the 2010 study were likely from natural processes within the watershed. *E. coli* also exceeded PWQO criterion at Site 7 in the Wild Goose Creek watershed and Sites 10 and 11 in the Blind Creek Watershed.

Comparison of 1999 and 2010 water quality indicated minimal change between the two years. Average values indicated a decrease in iron and phosphorus concentrations from both Blind Creek and Wild Goose Creek in 2010. Any changes in physical parameters reported from 1999 to 2010 (i.e. conductivity, water temperature and depth) were likely caused by natural variation.



7 Recommendations

Upon completion of the 2010 Blind Creek and Wild Goose Creek Watershed Assessment Updates, the following recommendations were made for consideration:

- Staff and funding permitting it is recommended that an update to the 2010 Wild Goose Creek and Blind Creek Watershed Assessments be completed in the next five to ten years.
- To minimize variability in the occurrence of point source contamination, future studies should consider two sampling periods in which both physical and chemical analyses are completed.
- Benthic analysis indicates water quality over an extended period of time and should be considered for future watershed assessments.
- Future documentation of biological attributes should consider the use of transects to quantify site vegetation.

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



8 References

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


MAPS

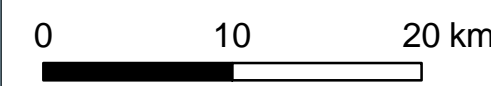
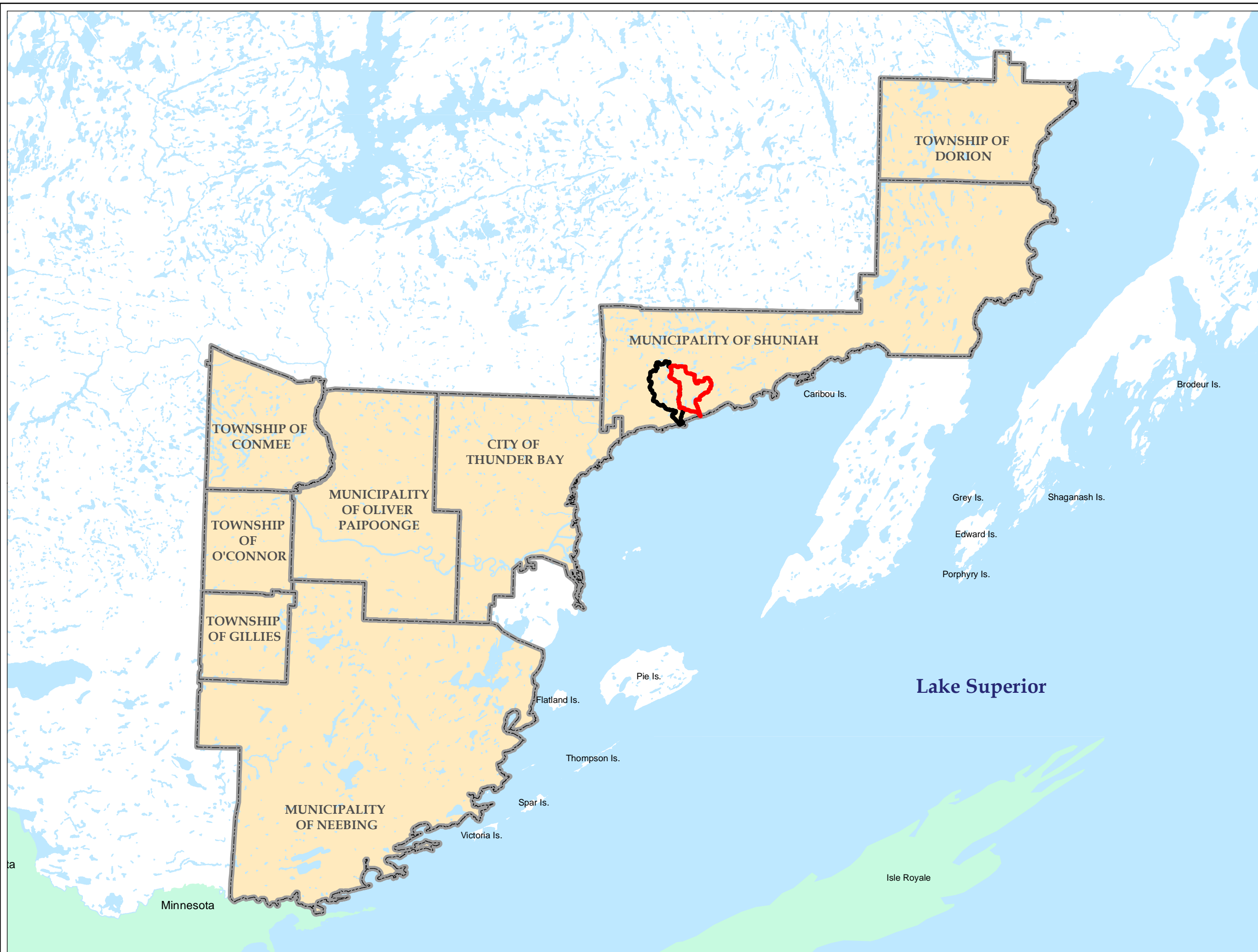
Blind Creek and Wild Goose Creek Watershed

M-1: Key Plan



Legend

-  Blind Creek Watershed
-  Wild Goose Creek Watershed
-  Municipal Boundary
-  LRCA Jurisdiction Boundary
-  Water Body



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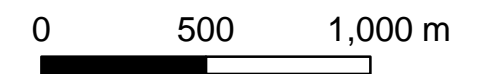
Blind Creek Watershed

M-2a: Site Plan



Legend

- Sampling Site 1999
- New Sampling Site 2010
- Blind Creek Watershed
- Railway
- Roads**
- Highway
- Road
- Permanent Watercourse**
- River
- Creek
- Stream
- Drainage**
- Waterbody
- Wetland
- Provincially Significant Wetland

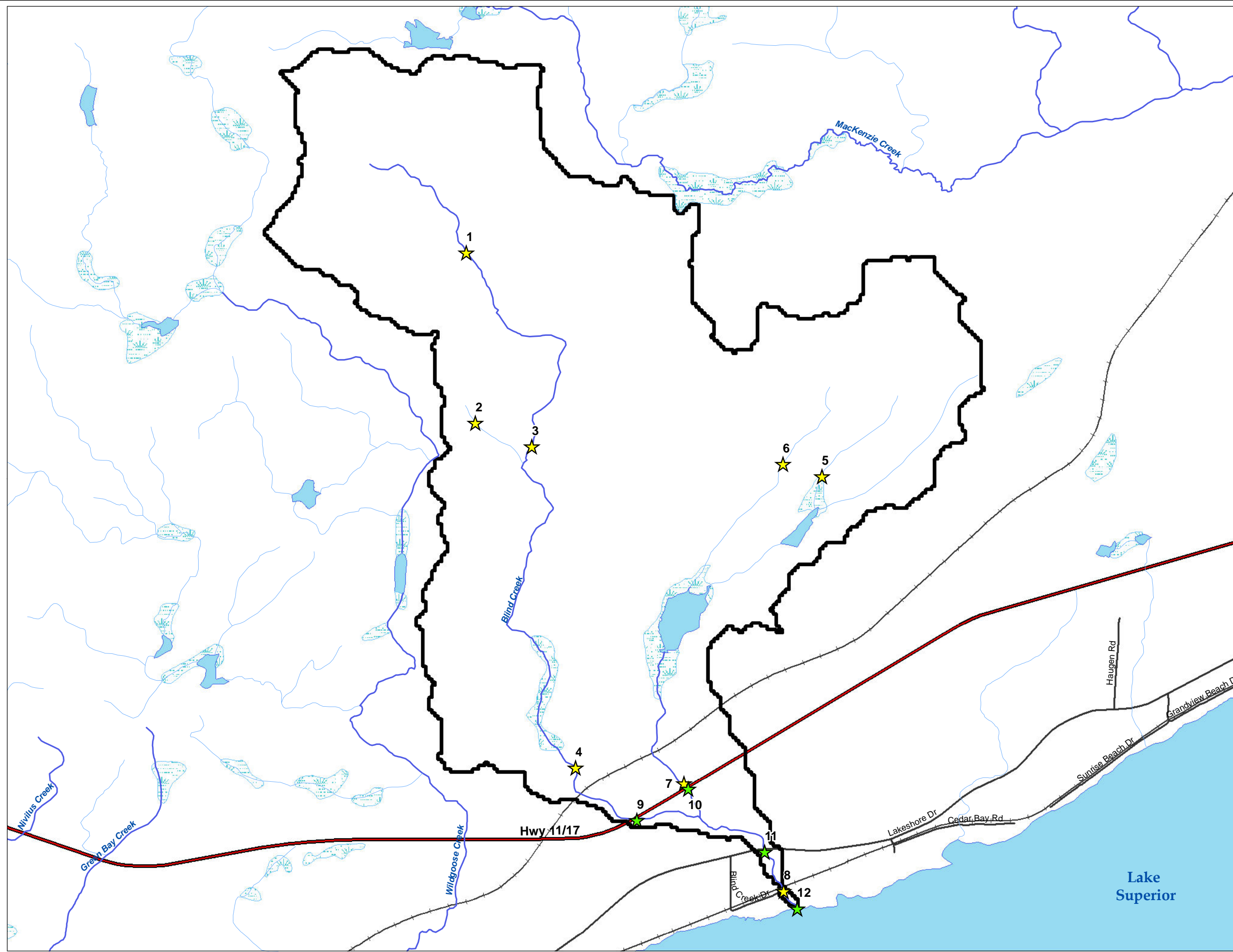


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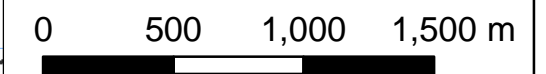
*Wild Goose Creek
Watershed*

M-2b: Site Plan



Legend

-  New Sampling Site 2010
-  Sampling Site 1999
-  Wild Goose Creek Watershed
-  Railway
- Roads**
-  Highway
-  Road
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland
-  Provincially Significant Wetland

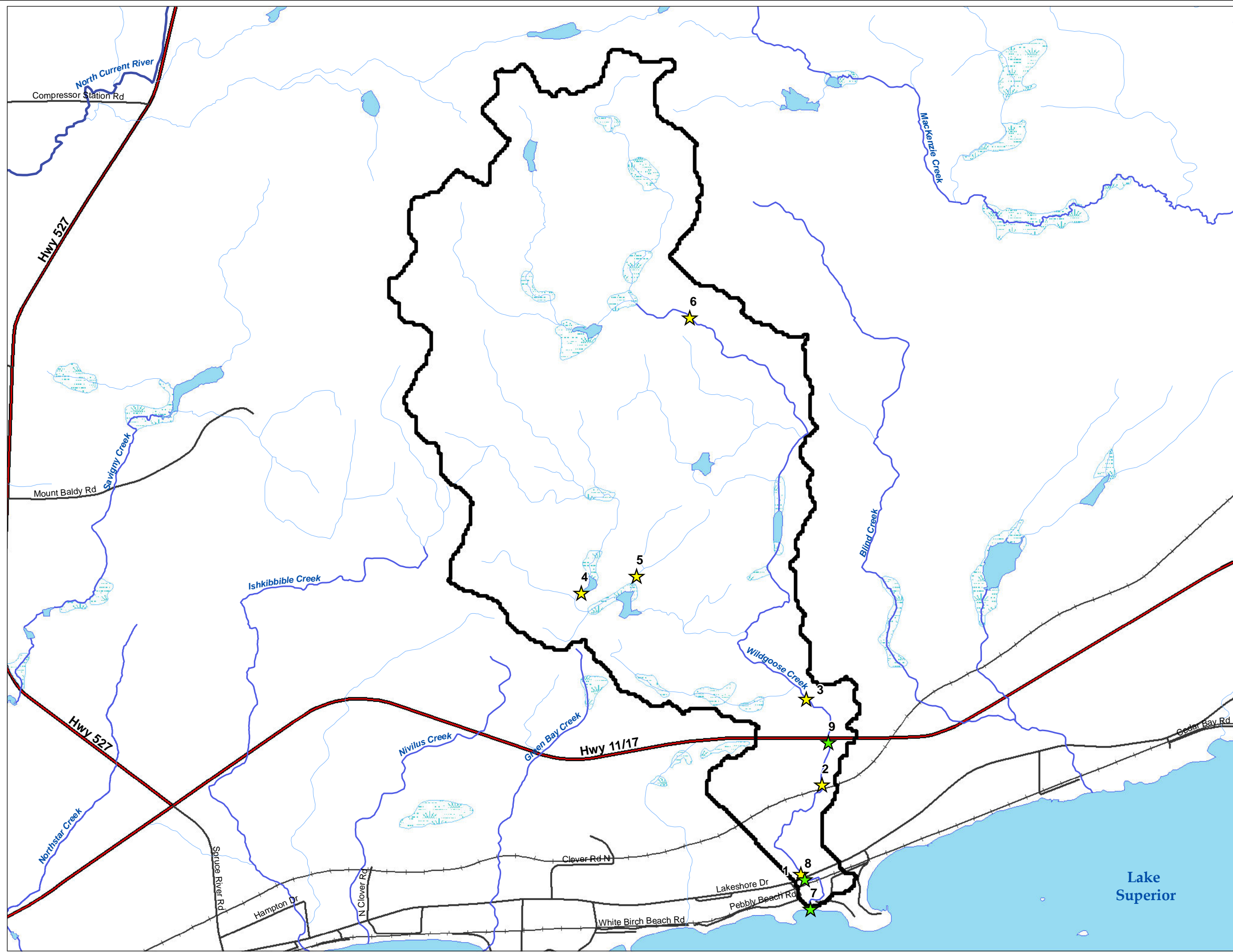


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


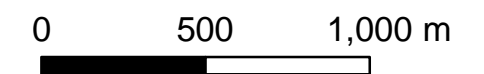
Blind Creek Watershed

M-3a: Topography



Legend

-  Blind Creek Watershed
-  Township Boundary
- Roads**
-  Highway
-  Road
- Contour Lines**
-  50m Contour Intervals
-  10m Contour Intervals
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland

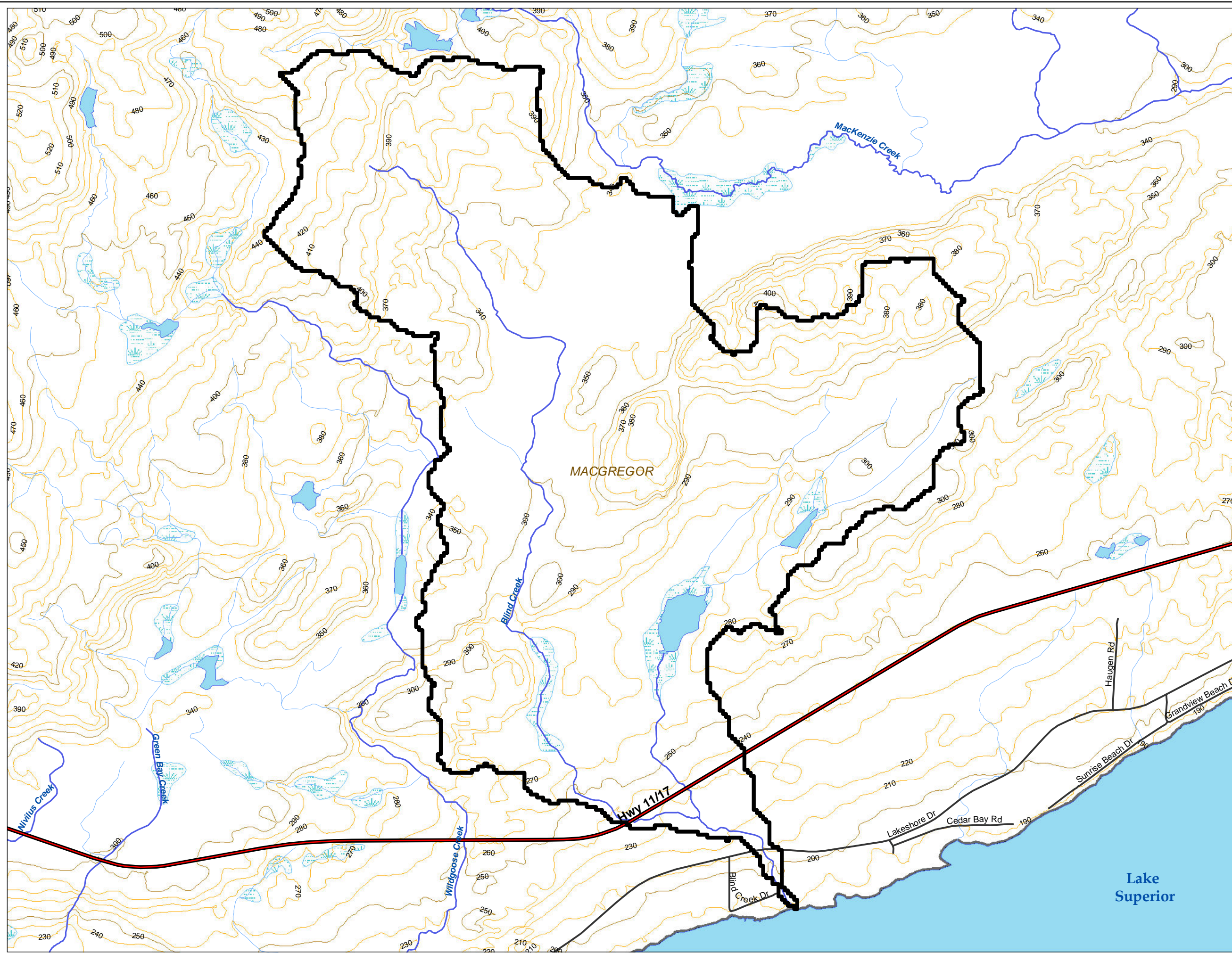


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




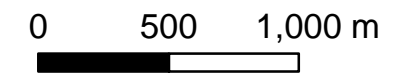
*Wild Goose Creek
Watershed*

M-3b: Topography



Legend

-  Wild Goose Creek Watershed
-  Township Boundary
- Roads**
-  Highway
-  Road
- Contour Lines**
-  50m Contour Intervals
-  10m Contour Intervals
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland

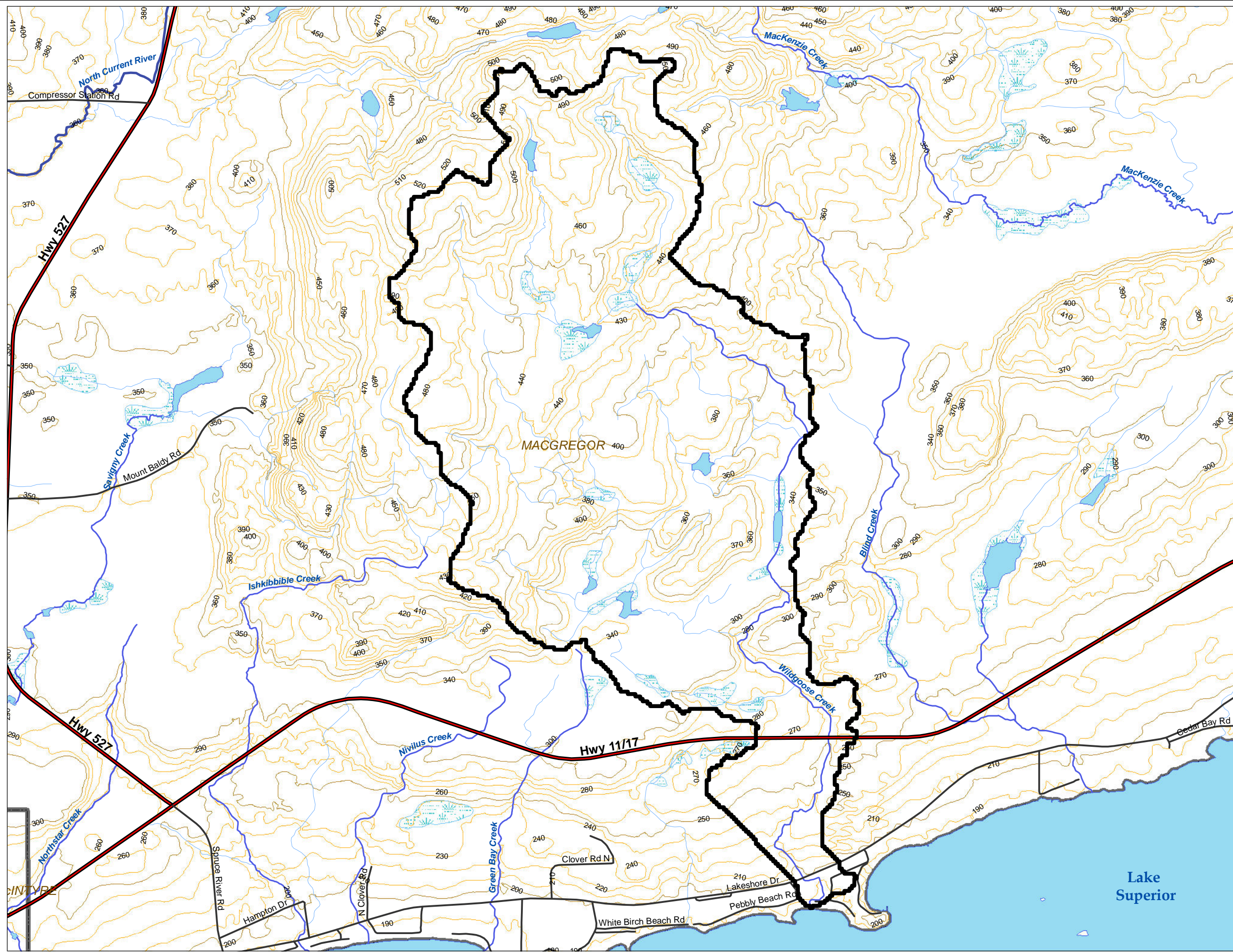


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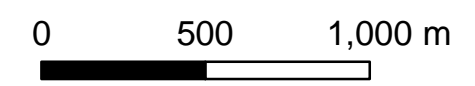
Blind Creek Watershed

M-4a: Bedrock Geology



Legend

- Blind Creek Watershed
- Surficial Points Features**
- QUARRY/MINE WORKINGS
- SAND/GRAVEL PIT
- TALUS
- Roads**
- Highway
- Road
- Permanent Watercourse**
- River
- Creek
- Stream
- Drainage**
- Waterbody
- Wetland
- Bedrock Formation**
- PALEOPROTEROZOIC**
- 22a, Sedimentary rocks
- NEO-TO MESOARCHEAN**
- 5, Mafic to intermediate metavolcanic rocks
- 15, Massive granodiorite to granite

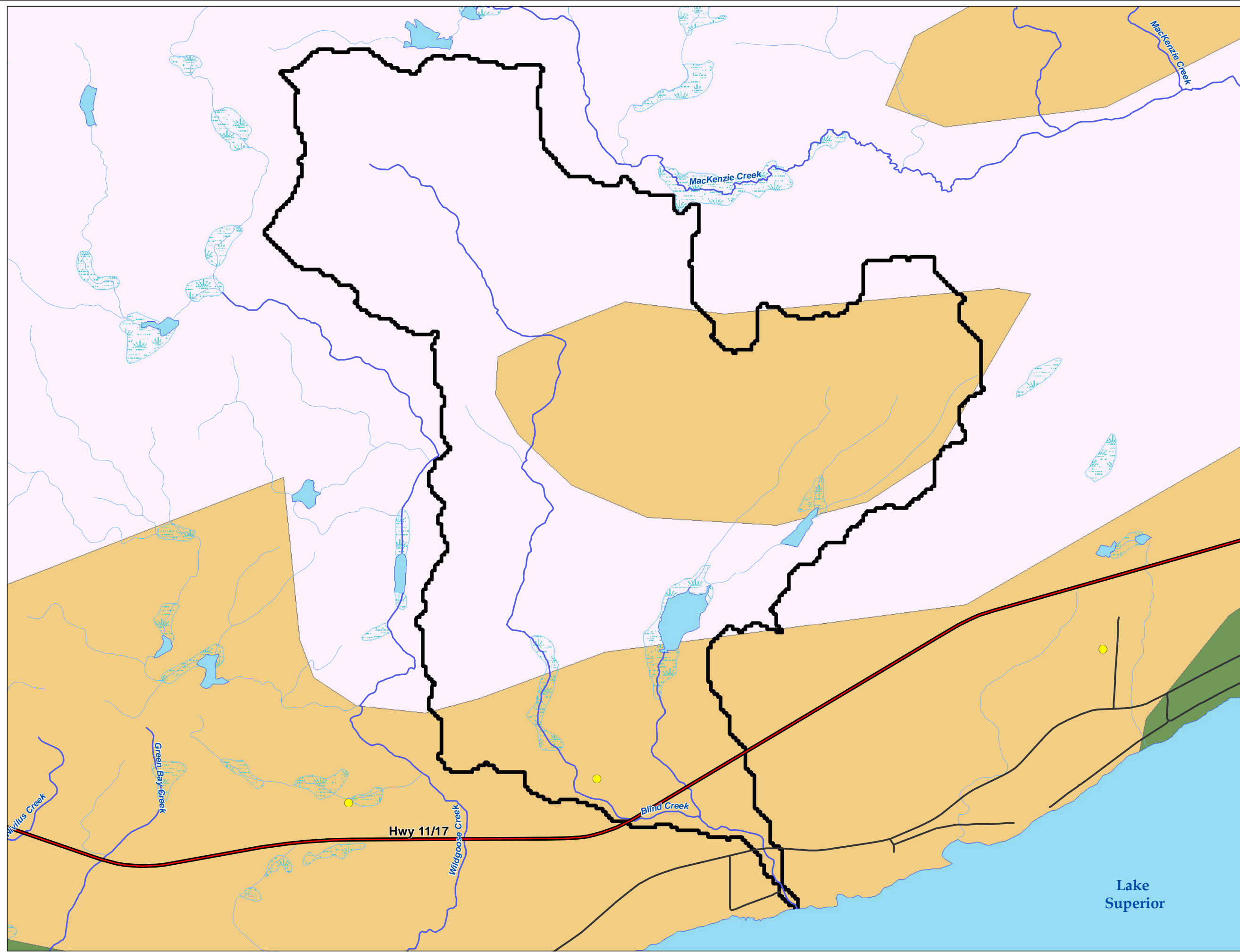


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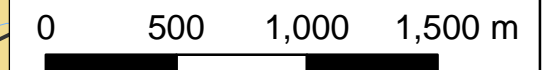
*Wild Goose Creek
Watershed*

M-4b: Bedrock Geology



Legend

- Wild Goose Creek Watershed
- Surficial Points Features**
- QUARRY/MINE WORKINGS
- SAND/GRAVEL PIT
- TALUS
- Roads**
- Highway
- Road
- Permanent Watercourse**
- River
- Creek
- Stream
- Drainage**
- Waterbody
- Wetland
- Bedrock Formation**
- PALEOPROTEROZOIC**
- 22a, Sedimentary rocks
- NEO-ARCHEAN**
- 9, Coarse clastic metasedimentary rocks
- NEO-TO MESOARCHEAN**
- 5, Mafic to intermediate metavolcanic rocks
- 6, Felsic to intermediate metavolcanic rocks
- 15, Massive granodiorite to granite
- MESOPROTEROZOIC**
- 31a, Mafic and related intrusive rocks (Keweenaw age)

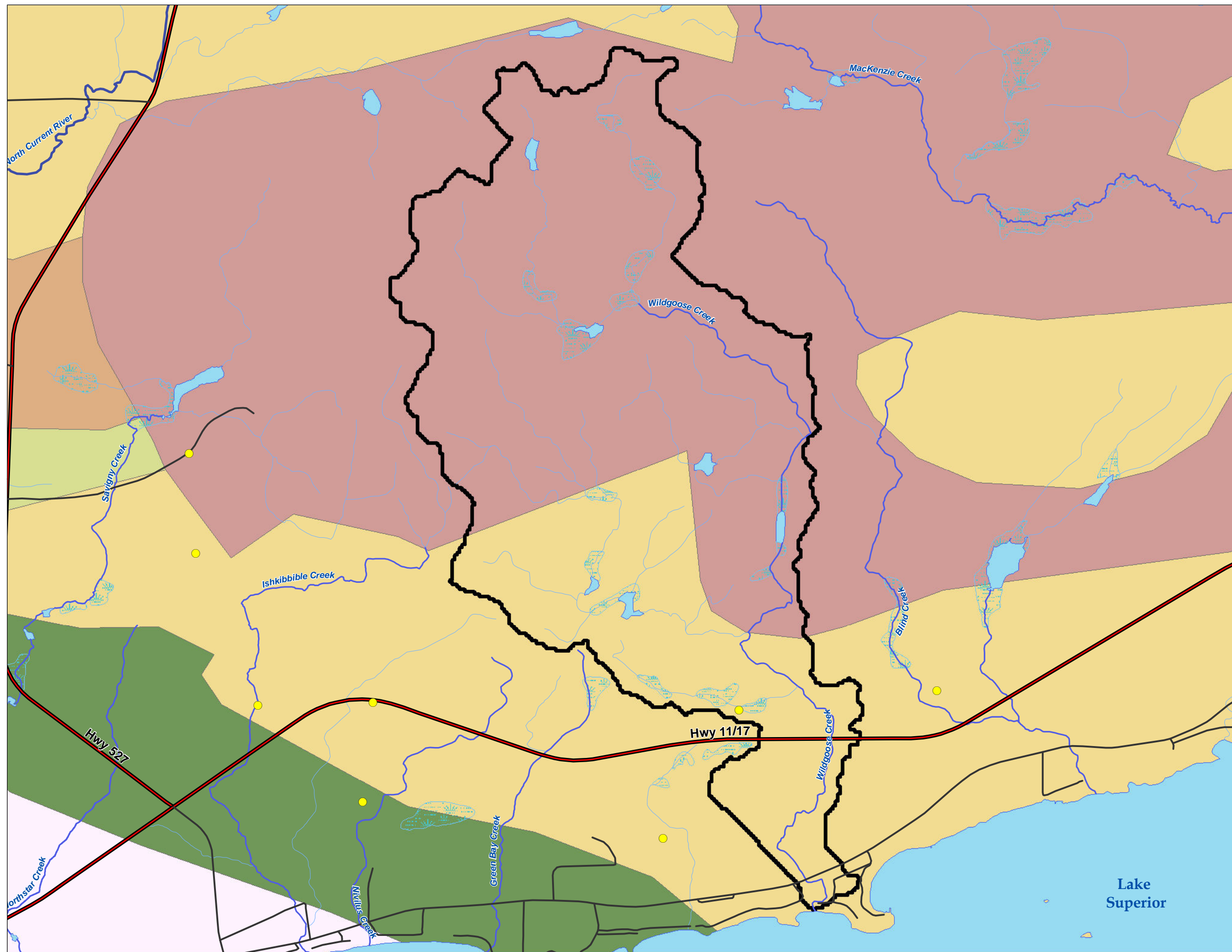


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











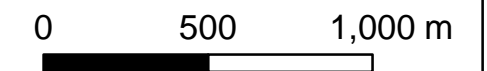
Blind Creek Watershed

M-5a: Surficial Geology



Legend

-  Blind Creek Watershed
-  Township Boundary
- Surficial Points Features**
-  QUARRY/MINE WORKINGS
-  SAND/GRAVEL PIT
-  TALUS
- Roads**
-  Highway
-  Road
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland
- Surficial Geology**
-  Moraine
-  Esker/Kame/Outwash plain
-  Glaciolacustrine plain
-  Alluvial
-  Slope/Talus pile
-  Organics
-  Bedrock

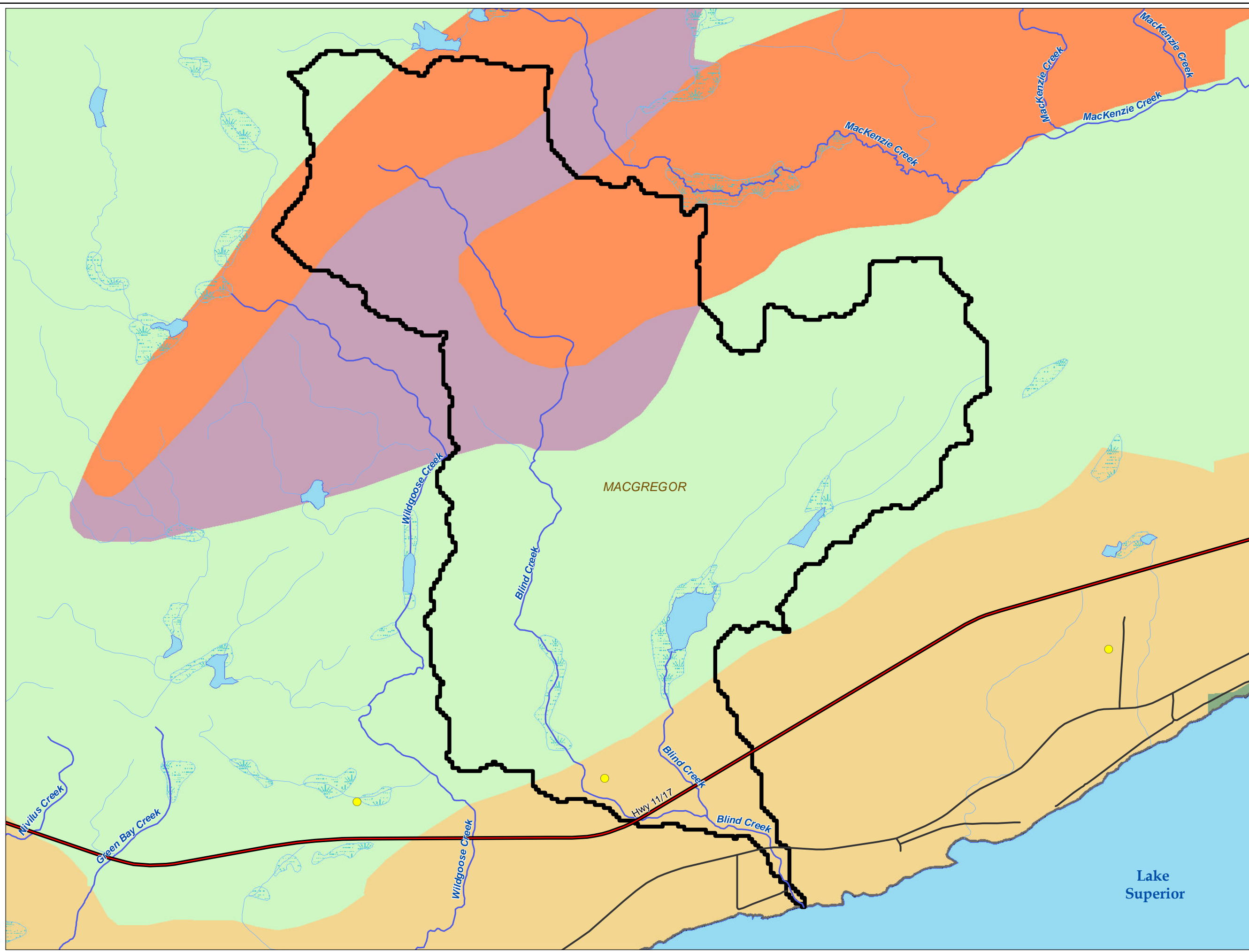


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 Date: August, 2010





















Wild Goose Creek Watershed

M-5b: Surficial Geology



Legend

-  Wild Goose Creek Watershed
-  Township Boundary
- Surficial Points Features**
-  QUARRY/MINE WORKINGS
-  SAND/GRAVEL PIT
-  TALUS
- Roads**
-  Highway
-  Road
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland
- Surficial Geology**
-  Moraine
-  Esker/Kame/Outwash plain
-  Glaciolacustrine plain
-  Alluvial
-  Slope/Talus pile
-  Organics
-  Bedrock

0 500 1,000 m

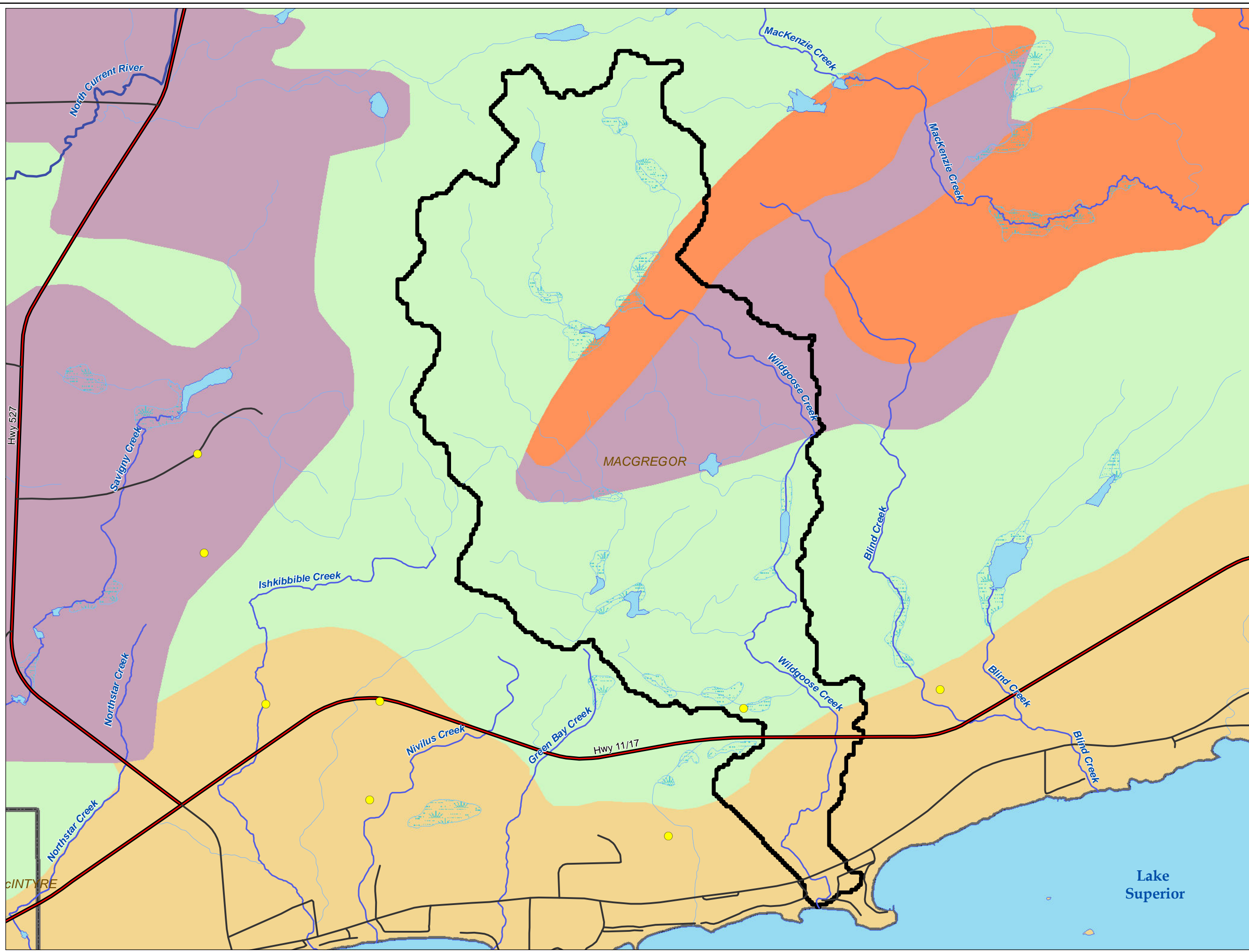


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


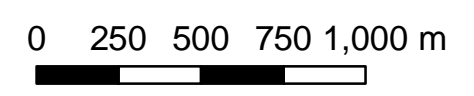
Blind Creek Watershed

M-6a: Soils



Legend

-  Blind Creek Watershed
-  Township Boundary
- Roads**
-  Highway
-  Road
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland
- Thunder Bay Soils**
-  MUCK (M)
-  ROCKLAND (R)
-  WOLFPUP (W)



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 Projection: UTM Zone 16N
 Date: August, 2010





*Wild Goose Creek
Watershed*

M-6b: Soils



Legend

-  Wild Goose Creek Watershed
-  Township Boundary



Roads

-  Highway
-  Road


Permanent Watercourse

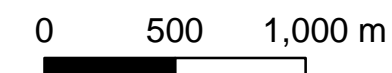
-  River
-  Creek
-  Stream

Drainage

-  Waterbody
-  Wetland

Thunder Bay Soils

-  FORMAL (F)
-  MISSION (Mi)
-  MUCK (M)
-  NOLALU (N)
-  ORGANICS - INNES LAKE (In)
-  ROCKLAND (R)
-  WOLFPUP (W)

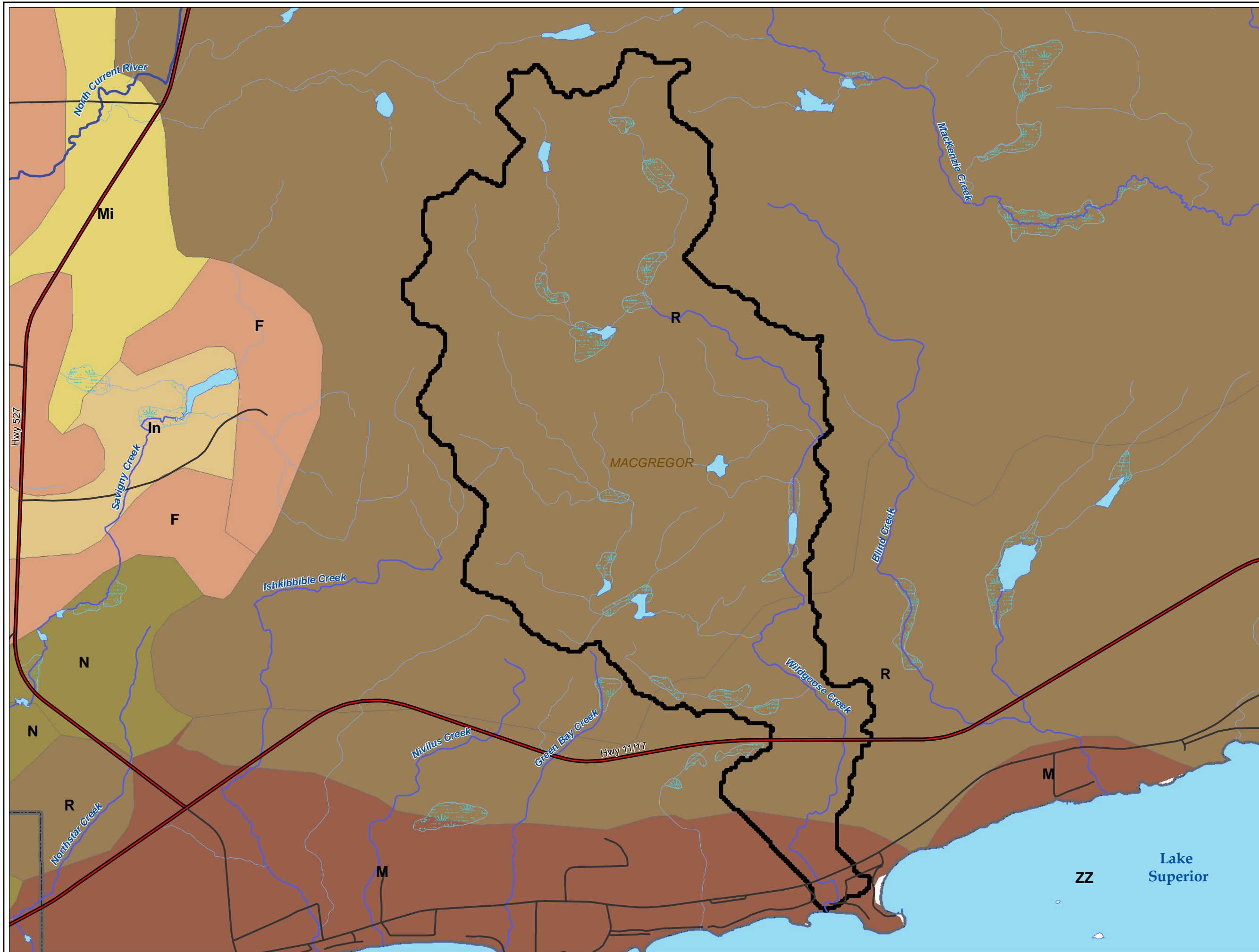


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Blind Creek Watershed

M-7a: Approximate Regulated Areas



Legend

-  Blind Creek Watershed
-  Township Boundary
- Roads**
-  Highway
-  Road
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland
-  Approximate Regulated Area
-  Provincially Significant Wetland (PSW) (Regulated)
-  PSW 120 Metre Regulated Area
-  Approximate Regulated Area within Lake Superior
-  LRCA Owned Property

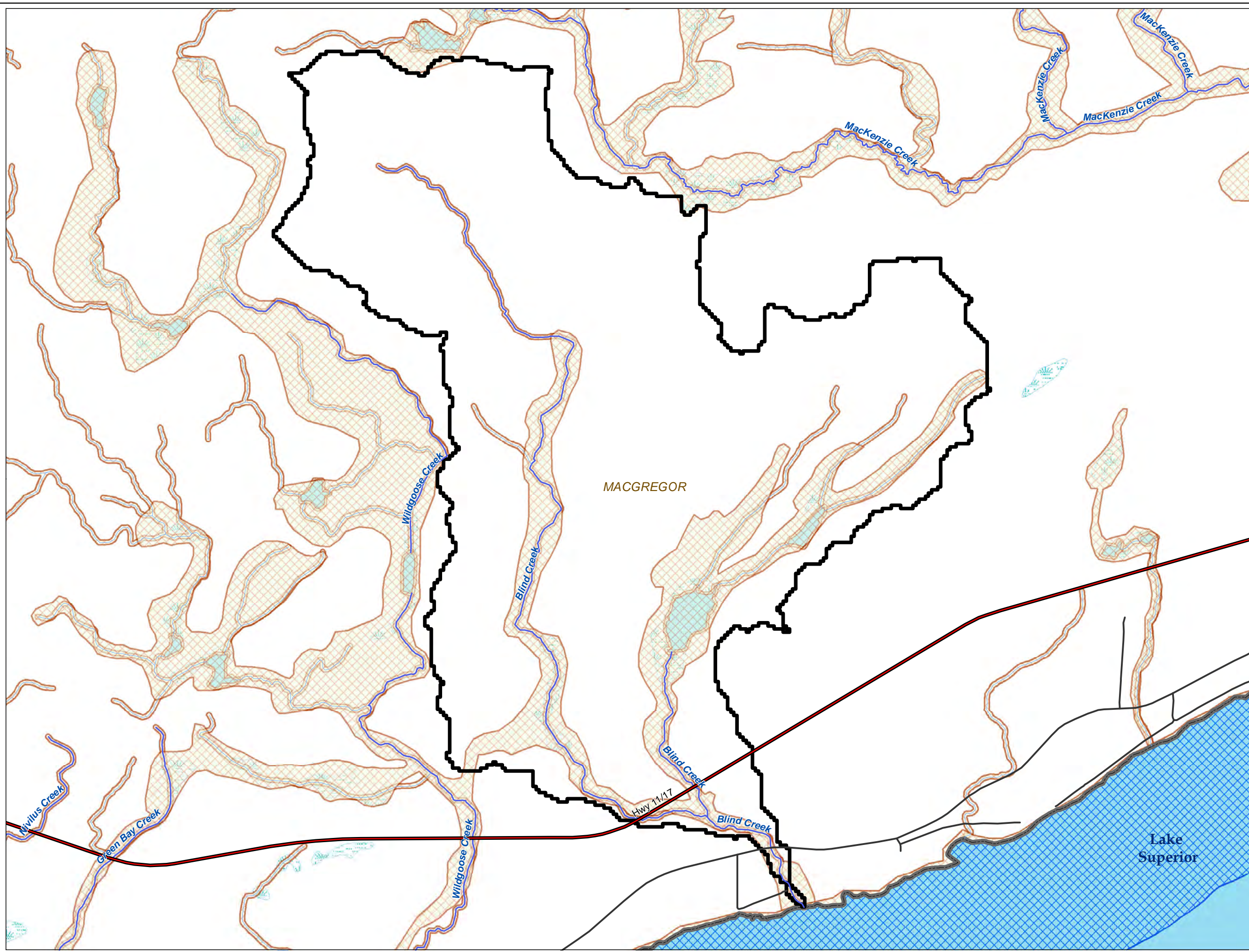


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


*Wild Goose Creek
Watershed*

*M-7b: Approximate
Regulated Areas*



Legend

-  Wild Goose Creek Watershed
-  Township Boundary
- Roads**
-  Highway
-  Road
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland
-  Approximate Regulated Area
-  Provincially Significant Wetland (PSW) (Regulated)
-  PSW 120 Metre Regulated Area
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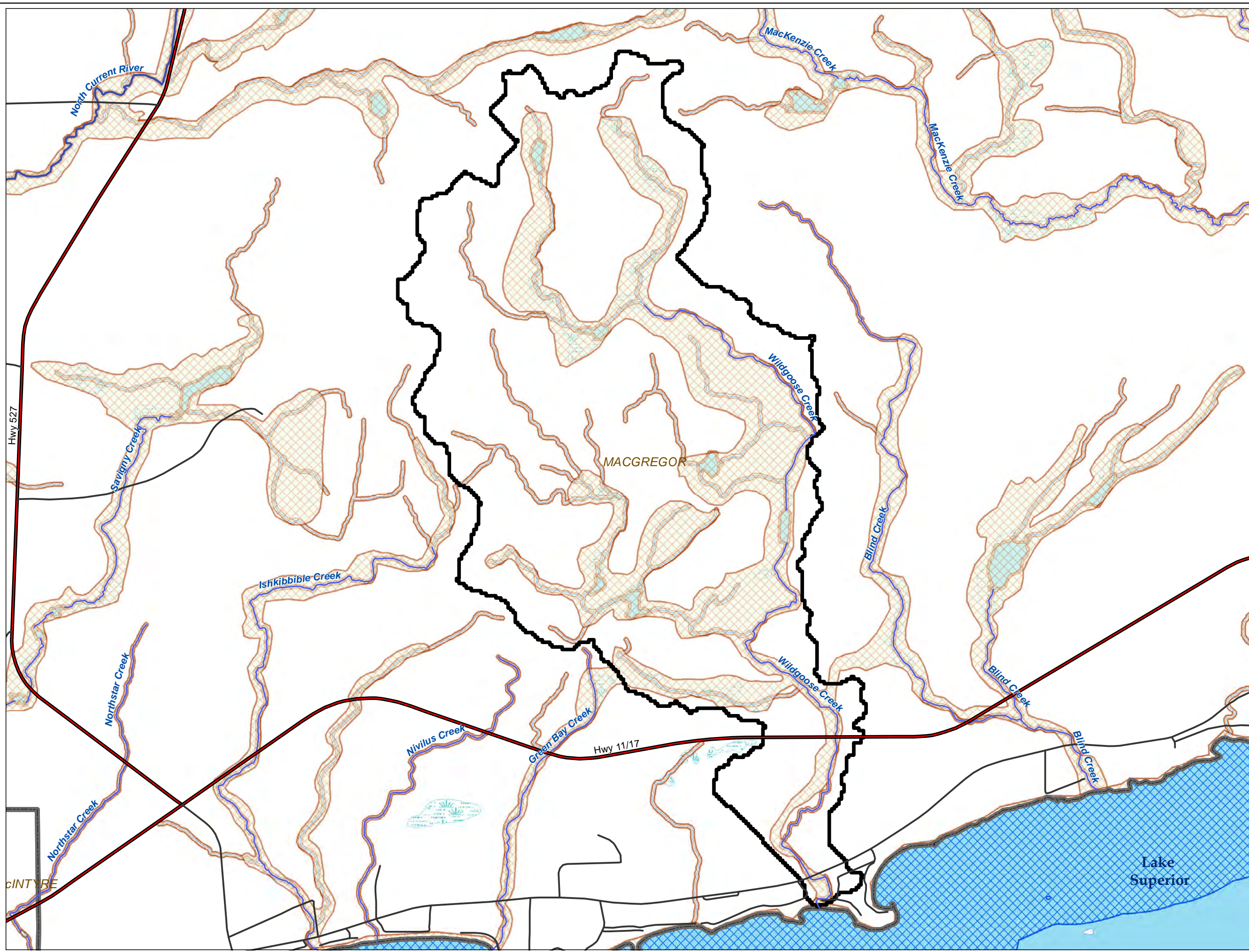


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APPENDIX A:
TECHNIQUES FOR DATA
COLLECTION



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 2005 hand held GPS unit.

Photographs

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

Channel width & depth

The width of the Stream was done using a 100 m fibreglass measuring tape. Channel depth was measured by using a stainless steel meter stick.

Flow

The velocity of river flow at sites was measured using a bobber and 100 m fibreglass measuring tape. Distances measured varied depending upon stream obstructions and variable depth. The flow was then calculated using the equation $Q=V*A$, where **Q** is flow/ discharge, **V** is velocity (distance divided by time), and **A** is the cross sectional area of the stream.

Air Temperature

The air temperature was measured with a basic mercury thermometer.

Water Temperature

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

Conductivity

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

Total Dissolved Solids

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



Dissolved Oxygen

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

Tree, Shrub & Herb Species

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

Aquatic Plants

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

OBBN In-Stream Materials Key

Stream Bed Description

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

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

Stream Cover

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

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

Soil Type

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

APPENDIX 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. Temperature is important, as warmer water holds less dissolved oxygen and warmer water will allow bacteria to reproduce and grow more quickly. Temperature can vary depending on the source of the water, depth and velocity of the stream, sunlight intensity and the amount of shade by the shoreline vegetation.

Dissolved Oxygen

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

pH

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

Total Dissolved Solids

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

Conductivity

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



Turbidity

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

Nutrients

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

Phosphorus

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

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

Nitrogen

Nitrogen (N) is one of the most common gases in our atmosphere. It makes up approximately 78% of the earth's atmosphere. Like phosphorus, these nutrients are often applied to agricultural crops as fertilizers and having too much in the river can increase plant growth and productivity to unhealthy levels. Nitrogen is constantly being recycled through the environment through decomposition, etc. The most important forms that plants can readily use are ammonia, nitrate (NO_3) and nitrite (NO_2). There are many different ways to report nitrogen so it is necessary to note that the results from ALS Laboratory Group were given in Total ammonia-nitrogen (mg/L), Nitrate-nitrogen ($\text{NO}_3\text{-N}$ mg/L), and Nitrite-nitrogen ($\text{NO}_2\text{-N}$ mg/L).

Bacteria

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



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

Metals

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

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

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

Aluminum

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

Antimony

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



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

Arsenic

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

Barium

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

Beryllium

Beryllium is a hard grey metal that is extracted from the earth, refined and reduced to a very fine powder. It occurs as a chemical component of certain rocks, coal and oil, soil, and volcanic dust. People exposed to beryllium are at risk of developing serious debilitating diseases. Chronic beryllium disease (CBD or berylliosis) is a painful scarring of the lung tissue. Less common than CBD, acute (short—term) beryllium disease, causes lung inflammation resembling pneumonia. In severe cases, both diseases may be fatal. The maximum concentration of beryllium under PWQO guidelines depends on hardness. If CaCO₃ is >75 mg/L the maximum concentration of beryllium is 1100 µg/L and if the CaCO₃ is <75 mg/L the maximum concentration of Beryllium is 11 µg/L.

Bismuth

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



Boron

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

Cadmium

Cadmium is an extremely toxic metal even in low concentrations. It is used commercially as a stabilizer in plastic, fungicides for golf courses, television picture tube phosphors, nickel-cadmium batteries, motor oils, and curing agents for rubber. Cadmium poisoning can lead to itai-itai disease, which initiates bone softening, joint pain and kidney failure. The maximum concentration of cadmium under PWQO guidelines is 0.2 µg/L. The interim PWQO guideline states if hardness as CaCO₃ is 0-100 the maximum cadmium concentration is 0.1 µg/L and if hardness is >100, the maximum cadmium concentration is 0.5 µg/L.

Calcium

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

Chromium

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

Cobalt

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

Copper

Copper occurs in nature as a metal and in minerals. Copper is an essential element to human metabolism, although intake at higher doses can cause adverse health effects. Acute copper poisoning health effects include vomiting, diarrhea, jaundice, haemolysis, haemoglobinuria, haematuria, and oliguria. In severe cases, the stool and saliva may



appear green or blue. In the terminal phases, anuria, hypotension, and coma precede death. The maximum concentration of copper under PWQO guidelines is 5 µg/L.

Iron

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

Lead

Lead is a very toxic metal to all forms of life, causing neurological damage and even death. Although natural occurrences can occur from precipitation and the weathering of ores, the majority of lead in watercourses comes from anthropogenic sources. The PWQO requirement for lead varies with different alkalinity as CaCO₃ (mg/L). The maximum lead concentration is 25 µg/L.

Magnesium

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

Manganese

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

Molybdenum

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

Nickel

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

Potassium:

Potassium is a soft silvery white metal, which is a key plant element and is found in most fertilizers. Potassium is also a dietary requirement, but many potassium compounds may



cause adverse health effects. Such compounds include potassium alum or potassium cyanide. There are currently no PWQO guidelines for potassium.

Selenium

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

Silicon

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

Silver

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

Strontium

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

Thallium

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

Tin

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



Titanium

Titanium is a white-silvery metallic colour and is always found bound to other elements in nature. There are no known health hazards of titanium in water, but it is known to have adverse health effects in powder form. There are currently no PWQO guidelines for titanium.

Tungsten

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

Uranium

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

Vanadium

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

Zinc

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

Zirconium

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

APPENDIX 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 10°C (18°F). However, in special circumstances, local conditions may require a significantly lower temperature difference than 10°C (18°F). Potential dischargers are to apply to the MOEE for guidance as to the allowable temperature rise for each thermal discharge. This ministry will also specify the nature of the mixing zone and the procedure for the establishment of a representative control location for temperature recording on a case-by-case basis.

2. Discharge Temperature Permitted

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

3. Taking and Discharging of Cooling Water

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



Turbidity:

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

Nutrients

Ammonia (un-ionized):

The amount of un-ionized ammonia should not exceed 20 µg/L.

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

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

$$f = 1/(10^{pK_a - pH} + 1), \text{ where } f \text{ is the fraction of } NH_3$$

$$pK_a = 0.09018 + 2729.92/T, \text{ where } T = \text{ambient water temperature in Kelvin (K} = \text{°C} + 273.16)$$

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



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

Phosphorus:

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

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

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

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



Bacteriological

Escherichia coli:

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

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

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

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

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

Metals

Aluminum:

Aluminum amounts should not exceed the following:

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

Antimony:

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



Arsenic:

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

Barium:

There are currently no PWQO guidelines for Barium.

Beryllium:

Beryllium amounts should not exceed the following:

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

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 NO₃-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 NO₂-N/L.

For protection from direct toxic effects: the guidelines do not consider indirect effects due to eutrophication.

APPENDIX D:

**LABORATORY WATER
QUALITY RESULTS**



2010 Blind Creek Laboratory Results

Blind Creek Laboratory Results: Site 9-Highway 11/17 West Tributary			
Parameter	Units	PWQO	04-AUG-10
Physical Tests			
Conductivity (EC)	uS/cm	n/a	191
Total Dissolved Solids	mg/L	n/a	135
Turbidity	NTU	<10% of natural	1.62
Anions and Nutrients			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	3.28
Nitrate-N (NO3-N)	mg/L	n/a	<0.030
Nitrite-N (NO2-N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0086
Sulphate (SO4)	mg/L	n/a	1.50
Bacteriological Tests			
Escherichia Coli	MPN/100mL	100	88
Total Coliforms	MPN/100mL	1000 (prior to 1994)	> 2420
Total Metals			
Aluminum (Al)	mg/L	0.075	0.038
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.039
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	27.4
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)	<0.0010
Iron (Fe)	mg/L	0.3	0.418
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	8.51
Manganese (Mn)	mg/L	n/a	0.0470
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.6
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	7.2
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0771
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	0.0015
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030
Zirconium (Zr)	mg/L	0.004	<0.0040

*Bold #'s Indicate Exceedance of PWQO Guidelines



Blind Creek Laboratory Results: Site 10 Highway 11/17, East Tributary			
Parameter	Units	PWQO	04-AUG-10
Physical Tests			14:10
Conductivity (EC)	uS/cm	n/a	118
Total Dissolved Solids	mg/L	n/a	90
Turbidity	NTU	<10% of natural	1.16
Anions and Nutrients			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	2.31
Nitrate-N (NO3-N)	mg/L	n/a	0.126
Nitrite-N (NO2-N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0110
Sulphate (SO4)	mg/L	n/a	1.56
Bacteriological Tests			
Escherichia Coli	MPN/100mL	100	110
Total Coliforms	MPN/100mL	1000 (prior to 1994)	> 2420
Total Metals			
Aluminum (Al)	mg/L	0.075	0.017
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.026
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	13.7
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)	<0.0010
Iron (Fe)	mg/L	0.3	0.229
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	5.10
Manganese (Mn)	mg/L	n/a	0.0578
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	0.0021
Potassium (K)	mg/L	n/a	2.2
Selenium (Se)	mg/L	0.1	0.00084
Silicon (Si)	mg/L	n/a	4.0
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0542
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)	<0.0030
Zirconium (Zr)	mg/L	0.004	<0.0040

*Bold #'s Indicate Exceedance of PWQO Guidelines



Blind Creek Laboratory Results: Site 11 Lakeshore Drive, Downstream			
Parameter	Units	PWQO	04-AUG-10
Physical Tests			12:30
Conductivity (EC)	uS/cm	n/a	192
Total Dissolved Solids	mg/L	n/a	138
Turbidity	NTU	<10% of natural	1.67
Anions and Nutrients			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	5.24
Nitrate-N (NO ₃ -N)	mg/L	n/a	0.042
Nitrite-N (NO ₂ -N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0119
Sulphate (SO ₄)	mg/L	n/a	1.59
Bacteriological Tests			
Escherichia Coli	MPN/100mL	100	110
Total Coliforms	MPN/100mL	1000 (prior to 1994)	> 2420
Total Metals			
Aluminum (Al)	mg/L	0.075	0.039
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	0.0010
Barium (Ba)	mg/L	n/a	0.040
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	26.1
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)	0.0013
Iron (Fe)	mg/L	0.3	0.562
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	8.15
Manganese (Mn)	mg/L	n/a	0.119
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.6
Selenium (Se)	mg/L	0.1	0.00095
Silicon (Si)	mg/L	n/a	6.9
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0721
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	0.0018
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030
Zirconium (Zr)	mg/L	0.004	<0.0040

*Bold #'s Indicate Exceedance of PWQO Guidelines



Blind Creek Laboratory Results: Site 12- Lake Superior Outlet			
Parameter	Units	PWQO	09-AUG-10
Physical Tests			11.45
Conductivity (EC)	uS/cm	n/a	215
Total Dissolved Solids	mg/L	n/a	149
Turbidity	NTU	<10% of natural	0.65
Anions and Nutrients			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	6.52
Nitrate-N (NO3-N)	mg/L	n/a	0.103
Nitrite-N (NO2-N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0051
Sulphate (SO4)	mg/L	n/a	1.39
Bacteriological Tests			
Escherichia Coli	MPN/100mL	100	26
Total Coliforms	MPN/100mL	1000 (prior to 1994)	> 2420
Total Metals			
Aluminum (Al)	mg/L	0.075	0.014
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.040
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	27.2
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)	0.0017
Iron (Fe)	mg/L	0.3	0.156
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	8.35
Manganese (Mn)	mg/L	n/a	0.0308
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.5
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	6.5
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0698
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)	<0.0030
Zirconium (Zr)	mg/L	0.004	<0.0040

*Bold #'s Indicate Exceedance of PWQO Guidelines

Wild Goose Creek Laboratory Results

Wild Goose Creek Laboratory Results: Site 7- Lake Superior Outlet			
Parameter	Units	PWQO	04-AUG-10
Physical Tests			11:15
Conductivity (EC)	uS/cm	n/a	172
Total Dissolved Solids	mg/L	n/a	114
Turbidity	NTU	<10% of natural	0.42
Anions and Nutrients			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	6.76
Nitrate-N (NO3-N)	mg/L	n/a	0.057
Nitrite-N (NO2-N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	<0.0050
Sulphate (SO4)	mg/L	n/a	1.66
Bacteriological Tests			
Escherichia Coli	MPN/100mL	100	31
Total Coliforms	MPN/100mL	1000 (prior to 1994)	> 2420
Total Metals			
Aluminum (Al)	mg/L	0.075	0.014
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.029
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	21.8
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)	0.0017
Iron (Fe)	mg/L	0.3	<0.050
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	7.17
Manganese (Mn)	mg/L	n/a	0.0232
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.4
Selenium (Se)	mg/L	0.1	0.00088
Silicon (Si)	mg/L	n/a	5.8
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0468
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)	<0.0030
Zirconium (Zr)	mg/L	0.004	<0.0040

*Bold #'s Indicate Exceedance of PWQO Guidelines



Wild Goose Creek Laboratory Results: Site 8- Lakeshore Drive, Downstream			
Parameter	Units	PWQO	04-AUG-10
Physical Tests			11:15
Conductivity (EC)	uS/cm	n/a	172
Total Dissolved Solids	mg/L	n/a	114
Turbidity	NTU	<10% of natural	0.42
Anions and Nutrients			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	6.76
Nitrate-N (NO ₃ -N)	mg/L	n/a	0.057
Nitrite-N (NO ₂ -N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	<0.0050
Sulphate (SO ₄)	mg/L	n/a	1.66
Bacteriological Tests			
Escherichia Coli	MPN/100mL	100	31
Total Coliforms	MPN/100mL	1000 (prior to 1994)	> 2420
Total Metals			
Aluminum (Al)	mg/L	0.075	0.014
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.029
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	21.8
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)	0.0017
Iron (Fe)	mg/L	0.3	<0.050
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	7.17
Manganese (Mn)	mg/L	n/a	0.0232
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.4
Selenium (Se)	mg/L	0.1	0.00088
Silicon (Si)	mg/L	n/a	5.8
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0468
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)	<0.0030
Zirconium (Zr)	mg/L	0.004	<0.0040

*Bold #'s Indicate Exceedance of PWQO Guidelines



Wild Goose Creek Laboratory Results: Site 9- Highway 11/17, Downstream			
Parameter	Units	PWQO	09-AUG-10
Physical Tests			13:40
Conductivity (EC)	uS/cm	n/a	161
Total Dissolved Solids	mg/L	n/a	137
Turbidity	NTU	<10% of natural	1.63
Anions and Nutrients			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	2.68
Nitrate-N (NO3-N)	mg/L	n/a	0.057
Nitrite-N (NO2-N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0206
Sulphate (SO4)	mg/L	n/a	0.67
Bacteriological Tests			
Escherichia Coli	MPN/100mL	100	8
Total Coliforms	MPN/100mL	1000 (prior to 1994)	1700
Total Metals			
Aluminum (Al)	mg/L	0.075	0.027
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.027
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	21.2
Chromium (Cr)	mg/L	0.001 for Cr(VI)	0.0011
Cobalt (Co)	mg/L	0.0009	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	<0.0010
Iron (Fe)	mg/L	0.3	1.18
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	6.32
Manganese (Mn)	mg/L	n/a	0.0826
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	0.0023
Potassium (K)	mg/L	n/a	1.4
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	5.6
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0506
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	0.0011
Zinc (Zn)	mg/L	0.02 (interim)	<0.0030
Zirconium (Zr)	mg/L	0.004	<0.0040

*Bold #'s Indicate Exceedance of PWQO Guidelines

APPENDIX E:
1999 RESULTS



Wild Goose Creek Water Sampling – July 21, 1999

Site #	Time Sampled	Flow (m/s)	Depth (m)	Air Temp. (°C)	Water Temp. (°C)	PH	D.O. (mg/L)	Conductivity (µmhos/cm)
1	1:10 pm	0.25	0.30	30	25.5	8.87	8.1	175
2	1:45 pm	0.3	0.13	25.1	22.7	8.18	8.3	200
3	11:45 am	0.33	0.36	32	24.7	7.43	7.0	205
4	11:40 am	0.15	0.46	32	24.1	6.93	5.6	340
5	11:25 am	0.17	0.18	32	25	7.55	7.7	455
6	10:45 am	0.3	0.17	31	22	7.4	8.6	80

Wild Goose Creek Water Sampling – July 28, 1999

Site #	Time Sampled	Flow (m/s)	Depth (m)	Air Temp. (°C)	Water Temp. (°C)	PH	D.O. (mg/L)	Conductivity (µmhos/cm)
1	2:05 pm	0.75	0.25	32	23.6	7.76	8.2	145
2	2:45 pm	0.25	0.1	32.1	23.1	7.54	8.1	125
3	11:31 am	0.37	0.21	32	22.5	6.96	7.2	120
4	10:30 am	0.18	0.10	26	20.6	6.29	5.3	145
5	10:20 am	0.19	0.19	26	20.1	6.55	7.1	105
6	1:30 pm	0.33	0.17	32	20	7.21	8.7	100

Wild Goose Creek Water Sampling – July 28, 1999

Analytical parameters	Units	Site 1	Site 3	Site 4	Site 5	Site 6	Range	Average
Cadmium (Cd)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0	<0.0002
Iron (Fe)	mg/L	0.21	1.07	2.40	0.26	1.43	2.19	1.074
Lead (Pb)	mg/L	<0.0001	0.0002	0.0004	0.0002	0.0001	0.0004	0.00018
Total Alkalinity	mg/L	60.5	57	50	40	42.5	20.5	50
Total Phosphorus	mg/L	0.15	0.04	0.02	<0.01	<0.01	0.15	0.046
Total Suspended Solids	mg/L	1.5	>0.1	4.5	4.0	1.5	4.5	2.32
Turbidity	NTU	0.33	1.60	4.44	1.36	1.60	4.11	1.866
<i>E. Coli</i>	#/ 100 ml	20	20	30	10	10	20	18



Wild Goose Creek Water Sampling – Aug. 6, 1999								
Site #	Time Sampled	Flow (m/s)	Depth (m)	Air Temp. (°C)	Water Temp. (°C)	PH	D.O. (mg/L)	Conductivity (µmhos/cm)
1	1:15 pm	0.29	0.28	24	18.5	7.82	11.0	165
2	1:50 pm	0.33	0.14	28	19.1	7.78	9.4	150
3	11:05 am	0.34	0.25	25	19.6	7.06	9.0	140
4	10:25 am	0.17	0.46	24	16.3	6.54	7.0	100
5	10:10 am	0.17	0.11	24	17.4	7.09	9.1	100
6	2:25 pm	0.35	0.17	25	16.5	7.37	11.3	110

Wild Goose Creek Sampling - Aug. 12, 1999								
Site #	Time Sampled	Flow (m/s)	Depth (m)	Air Temp. (°C)	Water Temp. (°C)	PH	D.O. (mg/L)	Conductivity (µmhos/cm)
1	10:55 am	0.33	0.3	16	15.5	7.45	13	125
2	10:16 am	0.33	0.16	16	15.4	7.19	12	130
3	10:35 am	0.38	0.26	15	16.3	6.71	11.3	115
4	2:15 pm	0.21	0.46	17	15.5	6.41	7.9	95
5	1:45 pm	0.2	0.15	17	14.4	6.36	9.6	100
6	9:30 am	0.37	0.21	16	13.5	6.80	11.8	85

Wild Goose Creek Analysis #2 - Aug. 12, 1999								
Analytical parameters	Units	Site 1	Site 3	Site 4	Site 5	Site 6	Range	Average
Cadmium (Cd)	mg/L	NA	NA	NA	NA	NA	NA	NA
Iron (Fe)	mg/L	0.28	0.91	0.60	0.23	0.97	74	0.598
Lead (Pb)	mg/L	NA	NA	NA	NA	NA	NA	NA
Total Alkalinity	mg/L	57	50.5	36	35.5	38	21	43.4
Total Phosphorus	mg/L	0.01	0.01	0.01	0.01	>0.01	0.01	0.008
Total Suspended Solids	mg/L	1.0	>0.1	3.5	4.0	2.0	4.0	2.12
Turbidity	NTU	0.55	1.89	1.67	0.87	1.6	1.43	1.316
<i>E. Coli</i>	#/ 100 ml	10	10	<10	30	70	70	25



Physical Attributes of Wild Goose Creek, 1999				
Site #	In Creek Materials	Creek Bed Characteristics	Bank Stability	Terrain Characteristics
1	Large rocks, bedrock, no growth	Sand deposits	Some erosion on south side of culvert , mainly stable	Poplar, White Pine, Birch, Willows, Speckled Alder
2	Grass, slime, generally free of debris	Small rocks, pebbles	Bank erosion from high water levels, replacement cement blocks placed in the middle of culvert to maintain height	Trembling Aspen, Poplar, Mountain Maple, Birch
3	Small to large rocks	Very rocky, some boulders	Stable, some gravel, some rock sliding from road	Birch, Speckled Alder, Dogwood, Trembling Aspen, Poplar
4	Some debris, trees in creek, water plant growth	Small – large rock, sand	Erosion from road, culvert blocked with debris	Mountain Ash, Poplar, Birch, forest debris piles surrounding the area
5	Large slash pile directly on top of creek's natural path	Large rocks, coarse sand, creek runs over logging road	Stable banks, except the segment that runs over the road	Dogwood, Balsam Fir, White Birch
6	Minimal in-creek vegetation, covered cable running through & under creek	Small rocks, boulders, sand	Stable	Speckled Alder, Birch, Balsam Fir



Blind Creek Water Quality Analysis #1 - July 22, 1999								
Site #	Time Sampled	Flow m/s	Depth (m)	Air Temp. °C	Water Temp °C	pH	D.O. (mg/L)	Conductivity (µmhos)
A	10:00 am	0.19	0.05	29	15.9	7.76	10.9	300
B	10:20 am	0.21	0.19	28	23.2	7.55	6.6	100
C	11:00 am	0.40	0.29	30	22.8	8.02	8.2	365
D	2:55 pm	0.41	0.15	29	26.4	6.84	6.5	225
E	2:15 pm	0.09	0.09	31	23.6	6.78	6.7	325
F	2:35 pm	0.11	0.12	31	23.7	7.26	4.0	225
G	11:25 am	0.29	0.30	29	21.3	7.77	9.0	160
H	1:00 pm	0.34	0.11	32	25.0	7.95	8.3	150

Blind Creek Water Quality Analysis #2 - July 27, 1999								
Site #	Time Sampled	Flow m/s	Depth (m)	Air Temp. °C	Water Temp. °C	pH	D.O. (mg/L)	Conductivity (µmhos)
A	9:30 am	0.21	0.06	31	17.2	7.39	10.2	200
B	2:30 pm	0.2	0.17	33	23.4	7.49	6.7	125
C	10:05 am	0.41	0.28	31	23.1	7.79	7.9	350
D	10:45 am	0.38	0.13	31	22.7	6.91	7.2	235
E	1:30 pm	0.1	0.1	33	23.2	6.69	4.6	195
F	1:50 pm	0.11	0.11	34	22.9	6.74	4.5	195
G	1:15 pm	0.33	0.28	34	21.4	7.43	12.6	90
H	11:15 am	0.31	0.1	33	22.4	7.74	11.5	165

Blind Creek Water Quality Analysis #3 - August 3, 1999								
Site #	Time Sampled	Flow m/s	Depth (m)	Air Temp. °C	Water Temp °C	pH	D.O. (mg/L)	Conductivity (umhos)
A	9:45 am	0.17	0.04	19	11.5	7.52	11.6	180
B	10:20 am	0.2	0.17	19	18.3	6.59	7.2	125
C	10:45 pm	0.42	0.27	22	19.5	7.42	8.4	180
D	11:15 pm	0.45	0.14	30	22.6	7.01	7.0	175
E	2:10 am	0.04	0.09	23	19.9	6.48	3.0	180
F	1:50 pm	0.10	0.1	26	19.3	6.56	4.9	180
G	1:20 pm	0.27	0.27	24	20.1	7.55	9.1	80
H	1:00 pm	0.35	0.09	24	23.1	7.90	8.0	160



Blind Creek Water Quality Analysis #4 - August 10, 1999								
Site #	Timed Sampled	Flow m/s	Depth (m)	Air Temp. °C	Water Temp. °C	pH	D.O. (mg/L)	Conductivity (µmhos)
A	11:40 am	0.36	0.06	19	10.9	7.24	13.8	200
B	12:00 pm	0.22	0.21	19	17.0	6.82	9.9	80
C	12:05 pm	0.46	0.33	19	16	7.28	9.2	150
D	1:45 pm	0.47	0.20	18	16.9	7.02	7.5	145
E	1:00 pm	0.07	0.12	19	16.7	6.66	6.9	165
F	1:15 pm	0.11	0.11	19	16.2	6.60	5.5	180
G	2:05 pm	0.32	0.31	18	16.3	7.31	9.6	80
H	3:10 pm	0.39	0.09	18	17.4	7.81	9.0	155

Blind Creek Water Chemical Analysis #1 - July 27, 1999								
Analytical Parameters	Units	Site A	Site B	Site D	Site E	Site F	Site G	Site H
Cadmium (Cd)	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Iron (Fe)	mg/L	0.08	1.98	1.12	2.29	3.30	0.62	0.34
Lead (Pb)	mg/L	<0.0001	0.0002	0.0002	0.0002	<0.0001	<0.0001	<0.0001
Total Alkalinity	mg/L	92.0	49.0	72.5	85.0	97.5	39.5	70.0
Total Phosphorus (P)	mg/L	0.08	0.15	0.11	<0.01	0.11	0.13	0.09
Total Suspended Solids	mg/L	0.40	0.80	<0.10	0.40	0.10	<0.10	<0.10
Turbidity	NTU	0.39	4.54	1.75	2.75	10.1	0.98	0.53
<i>E. coli</i>	#/100mL	NA	NA	NA	NA	NA	NA	NA

Blind Creek Water Chemical Analysis #2 August 10, 1999								
Analytical Parameters	Units	Site A	Site B	Site D	Site E	Site F	Site G	Site H
Cadmium (Cd)	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Iron (Fe)	mg/L	0.09	1.58	0.58	2.61	3.30	0.63	0.33
Lead (Pb)	mg/L	<0.0001	0.0002	0.0001	0.0001	<0.0001	0.0001	<0.0001
Total Alkalinity	mg/L	88	36	64.7	75	90	33	32
Total Phosphorus	mg/L	0.01	0.01	0.01	0.05	0.09	>0.01	>0.01
Total Suspended Solids	mg/L	<0.10	<0.10	<0.10	<0.10	1.0	<0.10	<0.10
Turbidity	NTU	0.61	4.80	1.71	6.79	4.4	1.87	0.82
<i>E. coli</i>	#/100mL	10	10	10	60	180	150	40



Physical Attributes of Blind Creek, 1999					
Site #	In Creek Materials	Creek Bed Materials	Bank Stability	Terrain Characteristics	Creek Cover
A	Beaver dam, horsetails, dead/dying trees in creek	Few pebbles, deep organic muck	unstable	Low land Swamp	25 – 75%
B	Fallen trees downstream	Pebbles to boulders	Culvert washed out, creek bed stable disregarding the washed out culvert	Cut area	25 – 75%
C	Many fallen trees, logs in creek, no veg in water	Sand, pebbles, boulders, bedrock	Erosion around culvert, undercutting, unstable in high water	Mixed wood	75 – 100%
D	Minimal grass in creek	Boulders, bedrock, sand	Erosion around culvert, undercutting downstream, otherwise stable	Mainly hardwood	75 – 100%
E	Decaying organic materials, reeds, fallen trees, oil residue on surface	Mucky, detritus, rocks and gravel downstream	stable	Lowland swamp	25 – 75%
F	Oily film on creek surface, reeds and bull rushes overgrowing into creek	Detritus bottom, mucky bottom, rocks, pebbles and sand	Erosion from road around culvert, otherwise stable	Cut area/lowland swamp	0 – 25% open
G	Fallen trees, logs, culvert support material erodes into creek, south side of culvert has an area of pebble and rock buildup (the creek apparently flows over it when water levels are high)	Bedrock upstream, pebbles down- stream	Undercutting downstream, severe erosion on east bank, unstable in high water	Mixed wood	0 – 25% open
H	Water grasses, rocks, pebbles	Boulders, rocks, sand	Stable, some erosion on east bank due to high water levels	Mixed wood	25 – 75%

APPENDIX F:

FOREST ECOSYSTEM CLASSIFICATION



Appendix F: Forest Ecosystem Classification

Blind Creek FEC:

Site 9: V-6: Trembling Aspen (White Birch) - Balsam Fir/ Mountain Maple

Site 10: NA

Site 11: V-4: White Birch Hardwood and Mixedwood

Site 12: V-19 Black Spruce Mixedwood/ Herb Rich

Wild Goose Creek FEC:

Site 7: NA

Site 8: V-1 Balsam Poplar Hardwood and Mixedwood

Site 9: V-9 Trembling Aspen Mixedwood

V-1 Balsam Poplar Hardwood and Mixedwood

Description: Hardwood and mixedwood stands containing balsam poplar in the 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.

V-4 White Birch Hardwood and Mixedwood

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.

V-6 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-9 Trembling Aspen Mixedwood

Description: Hardwood mixedwoods with a shrub and herb rich understory. Typically, trembling aspen is the main tree species. Occurs mainly on deep, fresh, well drained mineral soils.

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.

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

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



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

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



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



Wild Lily-of-the-valley	<i>Maianthemum canadense</i>
Wood Lily	<i>Lilium philadelphicum</i>
White Baneberry	<i>Actaea pachypoda</i>
White Pea Spp.	<i>Lathyrus sativa</i>
White Sweet-Clover	<i>Melilotus alba</i>
Wild Chamomile	<i>Matricaria chamomilla</i>
Wild Chives	<i>Allium schoenoprasum</i>
Wood Anemone	<i>Anemone quinquefolia</i>
Woodland Strawberry	<i>Fragaria Vesca</i>

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

Aquatic Plants	
Common Names	Latin Names
Broad-leaved Arrowhead	<i>Sagittaria latifolia</i>
Common Cattail	<i>Typha latifolia</i>
Green Algae	<i>Chlorophyta</i>
Pondweed	<i>Potamogeton spp.</i>
Water Smartweed	<i>Polygonum amphibium</i>
Yellow Pond Lily	<i>Nuphar lutea</i>
Common Bladderwort	<i>Utricularia vulgaris</i>
Water Plantain	<i>Alisma plantago-aquatica</i>
Floating Arrowhead	<i>Sagittaria cuneata</i>
Broad Leaved Arrowhead	<i>Sagittaria latifolia</i>
Water Arum, Wild Calla	<i>Calla palustis</i>



Pickerelweed	<i>Pontederia cordata</i>
Floating Leaved Burreed	<i>Sparganium fluctuans</i>
Duckweed	<i>Lemna spp</i>
Large Leaved Pondweed	<i>Potamogeton amplifolius</i>
Floating Leaved Pondweed	<i>Potamogeton natans</i>
Submerged Water Starwort	<i>Callitriche hermaphroditica</i>
Coontail	<i>Ceratophyllum demersum</i>
Small Yellow Water Crowfoot	<i>Ranunculus gmelinii</i>

APPENDIX H

SITE PHOTOGRAPHY AND DESCRIPTIONS



Appendix H: Site Photography and Descriptions

Blind Creek

Blind Creek Site 9: Highway 11/17, West Tributary

A: 2010 Upstream Photo



B: 2010 Downstream Photo



C: 2010 Substrate Photo



D: 2010 Culverts Photo



Comments

Site 9 for the Blind Creek watershed was located downstream of Highway 11/17. Parking was available one kilometre away from the site. The two upstream culverts were perched 30 centimetres above the water and algae growth was abundant on the downstream sides of the culverts. The creek was narrow with sweet gale and speckled alder on either side. There was swift flow in the relatively shallow channel and considerable suspended matter with large boulders and cobble somewhat obstructing flow. Bedrock was also visible in a portion of the channel.



Blind Creek Site-10: Highway 11/17, East Tributary

A: 2010 Upstream Photo



B: 2010 Downstream Photo



C: 2010 Substrate Photo



Comments

Site 10 was located downstream of Highway 11/17 on the tributary east of Site 9. This site was characterized by a small drop from the concrete structure into the channel below. The water in the structure was shallow with almost no flow. This was likely in response to beaver activity upstream. Downstream from the structure there was a relatively deep, nearly stagnant pool. The pool then narrowed into a small channel where the sampling was conducted. The substrate consisted of sand with organic material and cobble. The terrestrial vegetation surrounding the site was thick and diverse relative to other locations with shrubs and sedges being the dominant vegetation and sweet gale being the dominant species. Emergent aquatic vegetation was also abundant at this site with water plantain and floating leaved pondweed surrounding the pool.



Blind Creek Site 11 – Lakeshore Drive, Downstream

A: 2010 Upstream Photo



B: 2010 Downstream Photo



C: 2010 Substrate Photo



Comments

Site 11 of Blind Creek was characterized by a very large structure situated on bedrock. This site was relatively difficult to access due to private property on either side. The soil consisted of sand overlying bedrock. Speckled alder was the dominant terrestrial shrub with many herbs also present. Due to the bedrock substrate there was little aquatic vegetation at the site. Scattered patches of algae were the only aquatic plants observed.



Blind Creek Site 12 – Confluence with Lake Superior

A: 2010 Upstream Photo



B: 2010 Downstream Photo



C: 2010 Substrate Photo

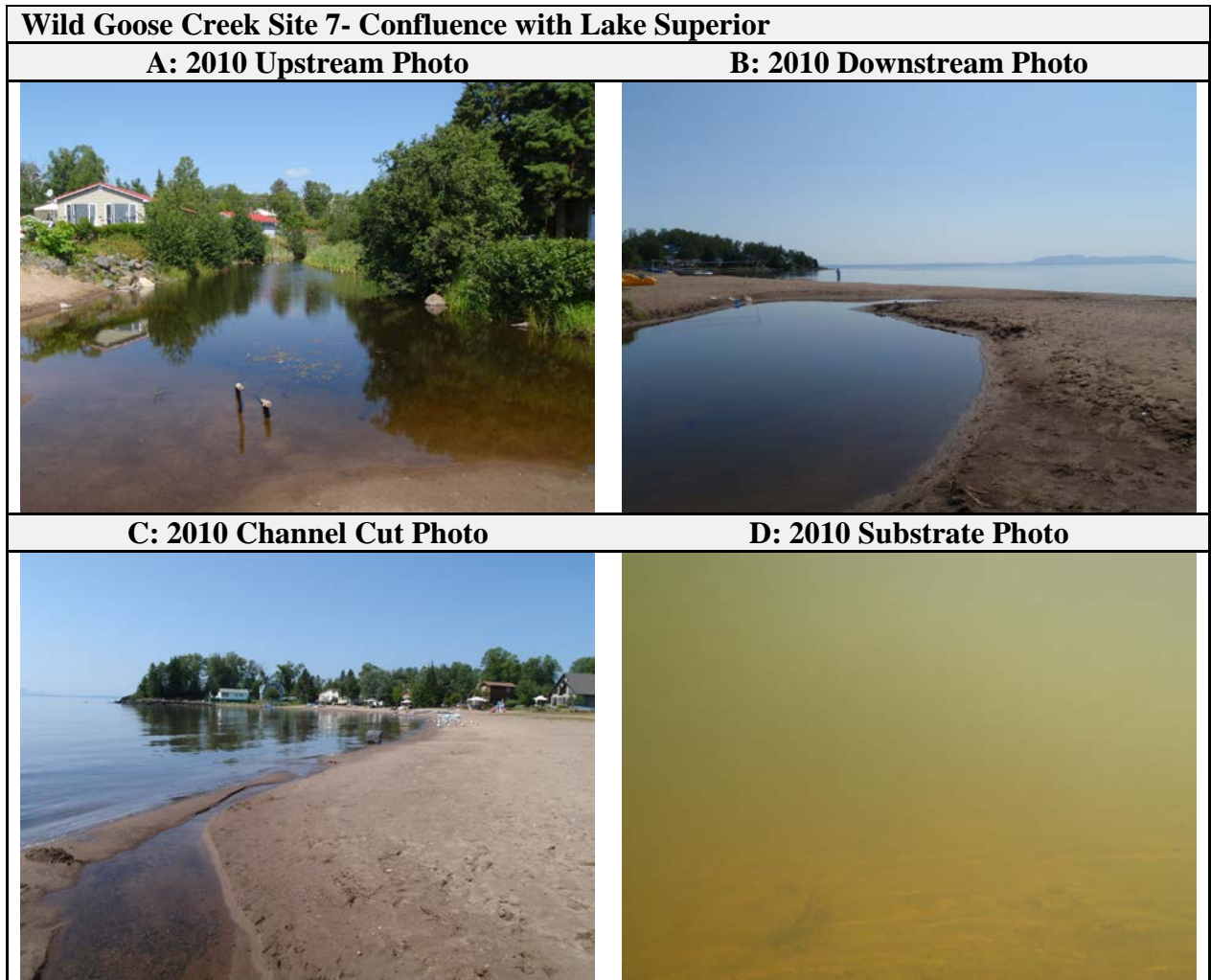


Comments

Site 12, the Lake Superior confluence, was located on private property. This site was characterized by cobble and boulders both in the channel and on the banks adjacent to the site. The channel was shallow, with very little water flowing from the creek into Lake Superior. The substrate was nearly covered with thin filamentous algae. The vegetation above the cobble beach was unique to this location and not observed elsewhere at any of the 2010 watershed assessments. Shrub growth was thick and ninebark was the dominant species. Creeping bellflower was also abundant and black spruce was observed upstream from the site.



Wild Goose Creek



Comments

Site 7, the confluence with Lake Superior, was located on private property. This site was characterized by a large pool of water just before the confluence. On the west bank there was abundant shrub growth with some larger trees present. The substrate of the sampling site was entirely sand and silts causing the water to appear murky. Low water levels had caused sand to surround the mouth of the confluence, which reduced flow into a small channel cutting through the sand. While at the sight, one of the local residents also mentioned that swimmers itch was known to be present in the area



Wild Goose Creek Site 8 - Lakeshore Drive, Downstream

A: 2010 Upstream Photo



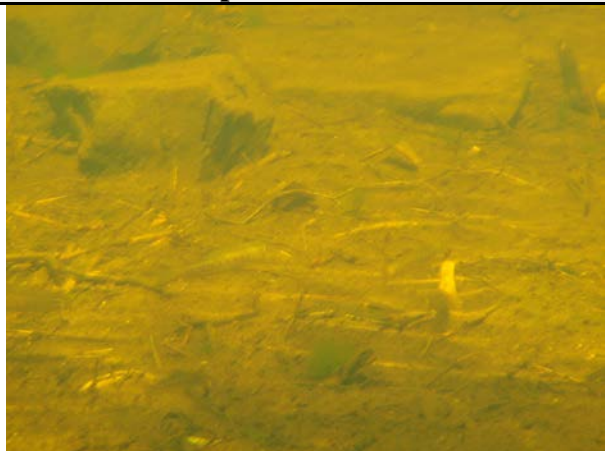
B: 2010 Downstream Photo



C: 2010 Substrate Photo



D: 2010 Upstream Substrate Photo



Comments

Site 8 of the Wild Goose Creek watershed was located off Lakeshore Drive. This site was characterized by a bedrock substrate upstream followed by a sandy cobble substrate downstream from the culvert. Vegetation at this site was approximately one metre back from the shore due to the presence of large boulders and cobble. The vegetation that was growing in the area was largely shrub dominated with slender willow and alder. Large quantities of brook trout and rainbow trout were observed. Flow was swift and the water was very clear. No photo documentation was collected in 1999.



Wild Goose Creek Site 9 - Highway 11/17, Downstream

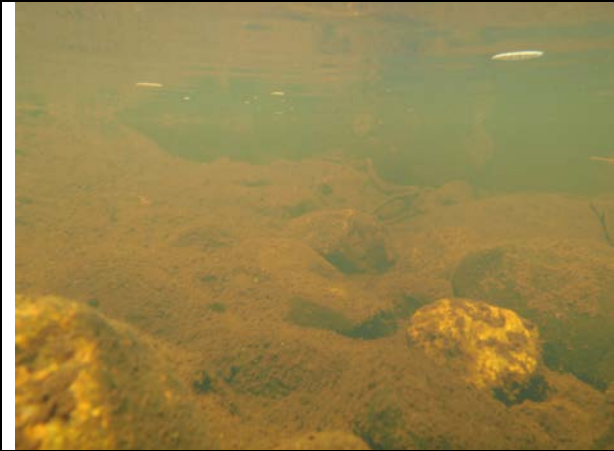
A: 2010 Upstream Photo



B: 2010 Downstream Photo



C: 2010 Substrate Photo



Comments

Site 9 was located downstream of Highway 11/17. This site was characterized by a small drop from the concrete structure into a large pool. The pool was nearly stagnant, flowing into the small channel where the sampling site was located. Substrate was characterized by silt covered boulders and an abundance of algae but low abundance of other aquatic vegetation. Boulders with woody debris trapped throughout were downstream from the sampling site. The vegetation consisted of grasses and sedges with birch, poplar and ash trees scattered throughout the area, providing little to no shade over the stream. Many of the poplars were dead, possibly due to a prior flood event. The water was slightly murky at the sampling site with no flow.

APPENDIX I

LABORATORY CERTIFICATES OF ANALYSIS AND ANALYTICAL REPORTS



Environmental Division

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

Report Date: 16-AUG-10 15:09 (MT)

ATTN: TAMMY COOK

Version: FINAL

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

Lab Work Order #: **L916676**

Date Received: **05-AUG-10**

Project P.O. #: NOT SUBMITTED

Job Reference:

Legal Site Desc:

CofC Numbers: L916676

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 Description Sampled Date Sampled Time Client ID	L916676-1 WATER 04-AUG-10 11:15 WG2 WILD GOOSE CREEK - SITE #2	L916676-2 WATER 04-AUG-10 12:30 BC11 BLIND CREEK - SITE #11	L916676-3 WATER 04-AUG-10 13:00 BC9 BLIND CREEK - SITE #9	L916676-4 WATER 04-AUG-10 14:10 BC10 BLIND CREEK - SITE #10
Grouping	Analyte				
WATER					
Physical Tests	Conductivity (EC) (uS/cm)	172	192	191	118
	Total Dissolved Solids (mg/L)	114	138	135	90
	Turbidity (NTU)	0.42	1.67	1.62	1.16
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	6.76	5.24	3.28	2.31
	Nitrate-N (NO3-N) (mg/L)	0.057	0.042	<0.030	0.126
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020
	Phosphorus (P)-Total (mg/L)	<0.0050	0.0119	0.0086	0.0110
	Sulphate (SO4) (mg/L)	1.66	1.59	1.50	1.56
Bacteriological Tests	Escherichia Coli (MPN/100mL)	31	110	88	110
	Total Coliforms (MPN/100mL)	> 2420	> 2420	> 2420	> 2420
Total Metals	Aluminum (Al) (mg/L)	0.014	0.039	0.038	0.017
	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)	0.029	0.040	0.039	0.026
	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)	21.8	26.1	27.4	13.7
	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	0.0013	<0.0010	<0.0010
	Iron (Fe) (mg/L)	<0.050	0.562	0.418	0.229
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg) (mg/L)	7.17	8.15	8.51	5.10
	Manganese (Mn) (mg/L)	0.0232	0.119	0.0470	0.0578
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni) (mg/L)	<0.0020	<0.0020	<0.0020	0.0021
	Potassium (K) (mg/L)	1.4	1.6	1.6	2.2
	Selenium (Se) (mg/L)	0.00088	0.00095	<0.00040	0.00084
	Silicon (Si) (mg/L)	5.8	6.9	7.2	4.0
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010
	Strontium (Sr) (mg/L)	0.0468	0.0721	0.0771	0.0542
	Thallium (Tl) (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030
	Tin (Sn) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L916676-1 WATER 04-AUG-10 11:15 WG2 WILD GOOSE CREEK - SITE #2	L916676-2 WATER 04-AUG-10 12:30 BC11 BLIND CREEK - SITE #11	L916676-3 WATER 04-AUG-10 13:00 BC9 BLIND CREEK - SITE #9	L916676-4 WATER 04-AUG-10 14:10 BC10 BLIND CREEK - SITE #10
Grouping	Analyte				
WATER					
Total Metals	Titanium (Ti) (mg/L)	<0.0020	<0.0020	<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	0.0018	0.0015	<0.0010
	Zinc (Zn) (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040	<0.0040	<0.0040

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA SM 9223B C-18
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

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

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

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

Chain of Custody Numbers:

L916676

GLOSSARY OF REPORT TERMS

Surrogate A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg milligrams per kilogram based on dry weight of sample.

mg/kg wwt milligrams per kilogram based on wet weight of sample.

mg/kg lwt milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L milligrams per litre.

< - Less than.

D.L. The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Report To **Tammy Cook**
 Company: **Lakehead Region Conservation Authority**
 Contact: **Scott Drebit**

Standard Other (specify):
 PDF Excel Digital
 Fax

Regular (Default)
 Priority (Specify Date Required -> ->)
 Emergency (1 Business Day) - 100% Surcharge
 For Emergency < 1 Day, ASAP or Weekend - Contact ALS
 Analysis Request
 Surcharges apply

Address: **130 Conservation Rd Box 10427**
Thunder Bay ON P7B 6T8
 Phone: **244-5857** Fax: **345-9156**

Email 1: **Info@lakehead.ca**
 Email 2: **Scott@lakehead.ca**

Client / Project Information
 Job #: _____
 PO / AFE: _____
 LSD: _____
 Quote #: **QA3274**
 ALS Contact: _____
 Sampler: **S. Drebit**
 D. Brazear

Invoice To Same as Report? Yes No
 THE QUESTIONS BELOW MUST BE ANSWERED FOR WATER SAMPLES (circle Yes or No)
 Are any samples taken from a regulated DW System? Yes **(NO)**
 If yes, an authorized Drinking Water COC MUST be used for this submission.
 Is the water sampled intended to be potable for human consumption? Yes **(NO)**

Lab Work Order # _____
 (lab use only)

Sample Identification
 (This description will appear on the report)

Date (dd-mm-yy) Time (hh:mm) Sample Type
 04-Aug-16 11:15 Grab
 04-Aug-16 12:30 Grab
 04-Aug-16 13:00 Grab
 04-Aug-16 14:10 Grab

Sample #	Sample Identification	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	Routine	Total Metals	Nutrients	Total Calcium/Ecol	Number of Containers
1	WGA Wild Goose Creek - Site # 9	04-Aug-16	11:15	Grab	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4
2	BC11 Blind Creek - Site # 11	04-Aug-16	12:30	Grab	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4
3	BC9 Blind Creek - Site # 9	04-Aug-16	13:00	Grab	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4
4	BC10 Blind Creek - Site # 10	04-Aug-16	14:10	Grab	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4

NOT CONSUMED

Special Instructions / Regulations / Hazardous Details

Reg 153 Table 1 2 3 TCLP MISA **(FWQO)** OTHER (please specify):
 Circle one - Note drinking water samples MUST USE DW Chain of Custody
 Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.
 By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

Released by: **Dan Brazear** Date: **Aug 05, 2016** Time: **14:18**
 Received by: **ATC** Date: **5-AUG-16** Time: **02:15** Temperature: **13.4°C**
 Date: **5/10** Time: **2:35**
 Observations: **Yes (No)**
 If Yes and SIF
 13.8/12.9
 OFM014 26-Mar-10



Environmental Division

Certificate of Analysis

LAKEHEAD REGION CONSERVATION AUTHORITY

Report Date: 19-AUG-10 14:17 (MT)

ATTN: SCOTT DREBIT

Version: FINAL

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

Lab Work Order #: **L918252**

Date Received: **10-AUG-10**

Project P.O. #: NOT SUBMITTED

Job Reference:

Legal Site Desc:

CofC Numbers: I918252

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 Description Sampled Date Sampled Time Client ID	L918252-1 WATER 09-AUG-10 11:45 BC12 BLIND CREEK - SITE #12	L918252-2 WATER 09-AUG-10 12:40 WG1 WILD GOOSE CREEK - SITE #1	L918252-3 WATER 09-AUG-10 13:40 WG3 WILD GOOSE CREEK - SITE #3	
Grouping	Analyte				
WATER					
Physical Tests	Conductivity (EC) (uS/cm)	215	226	161	
	Total Dissolved Solids (mg/L)	149	151	137	
	Turbidity (NTU)	0.65	1.63	1.63	
Anions and Nutrients	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020	
	Chloride (Cl) (mg/L)	6.52	11.7	2.68	
	Nitrate-N (NO3-N) (mg/L)	0.103	0.050	0.057	
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	
	Phosphorus (P)-Total (mg/L)	0.0051	0.0140	0.0206	
	Sulphate (SO4) (mg/L)	1.39	2.14	0.67	
Bacteriological Tests	Escherichia Coli (MPN/100mL)	26	120	8	
	Total Coliforms (MPN/100mL)	> 2420	> 2420	1700	
Total Metals	Aluminum (Al) (mg/L)	0.014	0.082	0.027	
	Antimony (Sb) (mg/L)	<0.0050	<0.0050	<0.0050	
	Arsenic (As) (mg/L)	<0.0010	<0.0010	<0.0010	
	Barium (Ba) (mg/L)	0.040	0.042	0.027	
	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)	27.2	27.5	21.2	
	Chromium (Cr) (mg/L)	<0.0010	<0.0010	0.0011	
	Cobalt (Co) (mg/L)	<0.00050	<0.00050	<0.00050	
	Copper (Cu) (mg/L)	0.0017	0.0022	<0.0010	
	Iron (Fe) (mg/L)	0.156	0.635	1.18	
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg) (mg/L)	8.35	7.88	6.32	
	Manganese (Mn) (mg/L)	0.0308	0.222	0.0826	
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010	<0.0010	
	Nickel (Ni) (mg/L)	<0.0020	<0.0020	0.0023	
	Potassium (K) (mg/L)	1.5	1.5	1.4	
	Selenium (Se) (mg/L)	<0.00040	<0.00040	<0.00040	
	Silicon (Si) (mg/L)	6.5	5.1	5.6	
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010	
	Strontium (Sr) (mg/L)	0.0698	0.0566	0.0506	
	Thallium (Tl) (mg/L)	<0.00030	<0.00030	<0.00030	
Tin (Sn) (mg/L)	<0.0010	<0.0010	<0.0010		

ALS LABORATORY GROUP ANALYTICAL REPORT

	Sample ID Description Sampled Date Sampled Time Client ID	L918252-1 WATER 09-AUG-10 11:45 BC12 BLIND CREEK - SITE #12	L918252-2 WATER 09-AUG-10 12:40 WG1 WILD GOOSE CREEK - SITE #1	L918252-3 WATER 09-AUG-10 13:40 WG3 WILD GOOSE CREEK - SITE #3	
Grouping	Analyte				
WATER					
Total Metals	Titanium (Ti) (mg/L)	<0.0020	0.0042	<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	0.0011	0.0011	
	Zinc (Zn) (mg/L)	<0.0030	<0.0030	<0.0030	
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040	<0.0040	

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
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
TC,EC-18QT97-TB	Water	Total Coliform and E.coli	APHA SM 9223B C-18
TURBIDITY-TB	Water	Turbidity	APHA 2130 B-Nephelometer

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

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

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

Chain of Custody Numbers:

I918252

GLOSSARY OF REPORT TERMS

Surrogate A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg milligrams per kilogram based on dry weight of sample.

mg/kg wwt milligrams per kilogram based on wet weight of sample.

mg/kg lwt milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L milligrams per litre.

< - Less than.

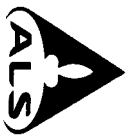
D.L. The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Environmental

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

COC #

1918252

Page 1 of 1

Report to Tammy Cook

Company: Lakehead Region Conservation Authority

Contact: Scott Drebit

Address: 130 Consecration Rd Box 10477
Thunder Bay ON P7B 6T8

Phone: 3445957 Fax: 3459156

Invoice To Same as Report? Yes No

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

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

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

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

Report Format / Distribution

Standard Other (specify):

PDF Excel Digital Fax

Email 1: info@lakehead.ca
Email 2: scott@lakehead.ca

Client / Project Information

Job #:

PO / AFE:

LSD:

Quote #: Q23274

ALS Contact: S. Drebit
D. Brazner

Service Requested (Rush for routine analysis subject to availability)

Regular (Default)

Priority (Specify Date Required --)

Emergency (1 Business Day) - 100% Surcharge

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

Surcharges apply

Analysis Request

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

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	ALS Contact	Filtered	Preserved	Both (F, P, F/P)	Number of Containers
BC12	Blind Creek - Site # 12	09-Aug-10	11:45	Grab					4
WG1	Wild Goose Creek - Site # 1	09-Aug-10	12:40	Grab					4
WG3	Wild Goose Creek - Site # 3	09-Aug-10	13:40	Grab					4
NOT CONSUMED									

Special Instructions / Regulations / Hazardous Details

Reg 153 Table 1.2.3 TCLP MISA (PMO) OTHER (please specify):
Circle one - Note drinking water samples MUST USE DW Chain of Custody

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

SHIPMENT RELEASE (Client use)

Released by: [Signature]

Date: Aug 10, 2010 Time: 2:30 pm

SHIPMENT RECEPTION (Lab use only)

Received by: ATC

Date: 10-AUG-10 Time: 2:30 Temperature: 7.8°C

SHIPMENT VERIFICATION (Lab use only)

Verified by: [Signature]

Date: Aug 10/10 Time: 2:45

Observations: Yes (No) If Yes add SIF

6.818.8