

# *Cedar Creek Watershed Assessment Update*



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

# **2010 Cedar Creek Watershed Assessment Update**

## **September 2010**

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

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## Executive Summary

The Cedar Creek watershed is located within the organized Townships of Conmee, O'Connor and the Municipality of Oliver Paipooonge (minimally) and the unorganized Townships of Marks and Adrian, covering an area of approximately 94 square kilometres. The purpose of the 2010 Cedar Creek Watershed Update Report was to update the 1998 Cedar Creek Watershed Report completed by the Lakehead Region Conservation Authority.

The 2010 Cedar Creek Watershed Assessment Update included water quality analysis and documentation of the physical and biological attributes of eight sampling locations. Surface water sampling, photo documentation and comprehensive field notes were completed for each of these locations.

Each site was chosen based upon accessibility and proximity to natural and manmade features that may affect surface water quality. Site selection was also completed based on previous locations sampled from the 1998 Cedar Creek Watershed Report. Of the nine locations sampled in 1998, six sites (i.e. Sites 2, 4, 5, 6, 7 and 9) were re-sampled during the 2010 sampling period.

Water quality analysis completed for the 2010 Cedar Creek Watershed Assessment Update indicated that the Cedar Creek Watershed was in good condition, with minimal exceedances of the Provincial Water Quality Objectives (PWQO) at the time of sampling. Parameters exceeding the PWQO during 2010 included: dissolved oxygen (DO), *Escherichia coli* (*E. coli*), total coliforms, phosphorus, iron and aluminum. Parameters exceeding the PWQO as observed in 1998 included: DO, pH, *E. coli*, iron and lead

DO concentrations throughout the watershed during the 2010 sampling indicated relatively healthy sites. Excluding Site 11, DO concentrations from 2010 ranged from 6.74 mg/L and 8.81 mg/L. The DO concentration reported from Site 11 exceeded PWQO criterion (minimum of 5 mg/L) with a DO concentration of 4.20 mg/L.

In 2010 *E. coli* ranged from 3 MPN/100 mL to 440 MPN/100 mL, exceeding PWQO criterion (100 MPN/100 mL).

Total coliforms exceeded the pre-1994 PWQO criterion (1,000 MPN/100 mL) at every site in 2010; however, no current PWQO exists for total coliforms. The total coliform concentrations in 2010 ranged from 2,000 to greater than 2,400 MPN/100 mL with an average of 2,300 MPN/100 mL for the watershed.

Iron concentrations from all 2010 sampling sites, with the exception of Site 9, exceeded PWQO criterion (0.3 mg/L) at the time of sampling in 2010. Iron concentrations ranged from 0.125 mg/L to 2.31 mg/L with an average of 0.636 mg/L. The highest iron concentration in 2010 was from Site 11, with a concentration of 2.13 mg/L. Site 7



followed with an iron concentration of 0.633 mg/L. Iron commonly occurs at high concentrations in nature. Concentrations observed were likely from natural sources.

Aluminum was the only other metal to exceed PWQO criterion (0.075 mg/L) in 2010 with a concentration of 0.265 mg/L at Site 11. Aluminum is the most abundant metal found in nature and its presence may be caused naturally or by local industry and residents.

The 2010 laboratory results identified Site 11 to have the poorest water quality of the sampling locations, exceeding PWQO criteria for DO, *E. coli*, total coliforms, phosphorus, iron and aluminum. The high *E. coli* concentrations at this site may have been caused by the close proximity of agricultural activity.

Lead exceeded PWQO criterion (0.001 mg/L to 0.005 mg/L dependent upon hardness) in 1998 with an average concentration of 0.028 mg/L, but did not exceed the criterion in 2010 with an average concentration of <0.0010 mg/L.

Nutrient concentrations observed throughout the watershed in 2010 were relatively low, with only one exceedance. Phosphorus concentrations were low for nearly all sites, with the exception of Site 11, which exceeded PWQO criterion (0.03 mg/L) with a concentration of 0.116 mg/L. Ammonia concentrations were low at all sites with no exceedances of PWQO criterion. The highest concentration was observed at Site 11 with a concentration of 0.021 mg/L which was still below PWQO criterion (0.036 mg/L). Chloride, nitrate and nitrite were below PWQO criteria as well, with many of the concentrations at less than detectable levels.

Between the 1998 and 2010 studies, water quality results from the Cedar Creek Watershed indicate that minimal change had occurred. Average values between the two study periods displayed close correlation to one another, with few site specific changes observed. Changes to physical parameters reported from 1998 to 2010 (i.e. conductivity, water temperature and depth) were likely caused by natural processes and common variation.

Staff and funding permitting, it is recommended that an update to the 2010 Cedar Watershed Assessment be completed in the next five to ten years in order to ensure the health of the watershed is maintained. To minimize variability in the occurrence of point source contamination, future sampling should consider two sampling periods, where laboratory analysis and field measurements are completed. Future documentation of biological attributes should consider the use of transects to quantify site vegetation. In addition, benthic analysis should be considered for future watershed assessments as it indicates water quality over an extended period of time. All future assessments should include Site 11 as a point of interest.



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## 1 Introduction

The Cedar Creek watershed is located within the organized Townships of Conmee, O'Connor, the Municipality of Oliver Paipoonge (minimally) and the unorganized Townships of Marks and Adrian, covering an area of approximately 94 square kilometres. The jurisdictional boundaries of the Cedar Creek watershed are shown on map M-1: Key Plan. The general features found within the Cedar Creek watershed are shown on map M-2: Site Plan. Approximately one half of the watershed resides within the Lakehead Region Conservation Authority (LRCA) Area of Jurisdiction. Map M-7: 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 Cedar Creek watershed drains into the Whitefish River, which then flows into one of the region's largest rivers, the Kaministiquia River, and then into Lake Superior.

The purpose of this report is to document the physical and chemical conditions of the Cedar Creek watershed as observed in July 2010, and compare observations to the Cedar Creek Assessment completed by the LRCA in 1998. 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 results obtained in 2010 with results from the 1998 Cedar Creek Watershed Assessment





## **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 Cedar Creek watershed is relatively large, spanning four Townships and covering 93.71 square kilometres. The watershed has a maximum elevation of 580 metres above sea level, and a maximum elevation of 495 metres above sea level along the Creek and a minimum elevation of 216 metres above sea level, for a total difference in elevation of 364 metres. The topography of the region can be found on map M-3: 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). The bedrock found in the Cedar Creek watershed region is composed of a relatively diverse assemblage of Neo-Archean, Neo to Meso-Archean and Paleoproterozoic rock formations. Bedrock formations within the Cedar Creek watershed are shown on map M-4: Bedrock Geology.

##### **Paleoproterozoic Formations:**

Sedimentary rocks in the region cover 20.48 square kilometres of the watersheds. This sedimentary rock is composed of animikie grey-pan, wacke, shale, iron formation, limestone and minor volcanic rocks.

##### **Neo-Archean**

Coarse clastic metasedimentary rocks cover an area of 1.25 square kilometres of the watershed. This type of rock is mainly composed of coarse clastic metasedimentary rocks with minor alkalic, mafic to felsic metavolcanic flows, as well as tuffs and breccias.



## **Neo to Meso-Archean**

Mafic to intermediate metavolcanic rocks are the dominant bedrock type and cover 23.18 square kilometres of the watershed. This bedrock is composed of a variety of rock formations, including basaltic and andesitic flows, tuffs and breccias, iron formation, minor sedimentary and intrusive rocks.

Massive to foliate granodiorite to granite formations are an abundant bedrock formation within the study area, covering 22.44 square kilometres of the watershed.

Metasedimentary rocks cover 13.69 square kilometres of the watershed. These formations are composed of many rock varieties including wacke, arkose, argillite, slate, marble, chert, iron formation and minor metavolcanic rocks.

Mafic and ultramafic rocks cover 10.86 square kilometres of the watershed. These formations are composed of gabbro, anorthosite and ultramafic rocks.

Mafic to ultramafic metavolcanic rocks cover an area of 1.8 square kilometres. These formations are composed of mafic metavolcanic rocks with minor occurrences of komalite, metasedimentary and pyroclastic rocks.

## ***Surficial Geology and Deposits***

Surface deposits in the Thunder Bay region are the results of previous 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, especially in the Kaministiquia River Valley (LRCA, 1975). The locations of surficial deposits within the Cedar Creek watershed are shown on map M-5: Surficial Geology. The surficial geology of the area is mainly composed of moraine deposit which covers 43.99 square kilometres of the watershed. Glaciolacustrine plains also comprise a considerable portion of the watershed, covering 10.45 square kilometres. Outwash, eskers and kame terraces account for 14.26 square kilometres. Organics compose a large area of the watershed, covering 12.2 square kilometres. Bedrock accounts for 1.92 square kilometres, and alluvial surface deposits account for 0.66 square kilometres of the watershed.



## *Soils*

The Cedar Creek watershed is composed of 12 different soil types. The three most abundant soil types are Rockland, Jarvis and Nolalu. The distribution of soils throughout the watershed can be found on map M-6: Soils.

The predominant soil type present in the Cedar Creek watershed is Rockland soil, which covers an area of 38.99 square kilometres. This soil is un-fragmented in the northwest portion of the watershed. Rockland soils are composed of less than 10 centimetres of soil material overlying bedrock and exposed bedrock.

Jarvis River soils cover 22.67 square kilometres of the watershed. Jarvis River soils are concentrated in the central and southeastern portions of the watershed. Jarvis River soil is characterized by calcareous reddish clay loam, clay or silty clay and varved lacustrine. This soil type has moderate drainage.

Nolalu soils cover 19.79 square kilometres of the watershed. Nolalu soils are non-calcareous, fine sandy loam and stony glacial till derived from shale and provide good drainage.

Oskondoga soils cover 3.42 square kilometres. Oskondoga soils are composed of calcareous reddish clay loam, clay or silty clay and varved lacustrine, providing imperfect drainage.

Marsh soils cover 2.25 square kilometres. Marsh soils are common of hallow inundated land, with less than 30 centimetres of organic material over mineral material, providing very poor drainage.

Lappe soils covers 1.84 square kilometres. These soils are made of calcareous reddish clay loam, clay or silty clay and varved lacustrine. These soils provide poor drainage.

Paipoonge soils cover 1.76 square kilometres. Paipoonge soils have good drainage with calcareous, brownish silt loam and silty clay loam varved lacustrine.

Current river soils cover 1.43 square kilometres. Current River soils are non-calcareous composed of stony fine sandy loam, providing imperfect drainage.

Baird, organic soils cover 0.59 square kilometres. Baird soils are characterized by well decomposed organic material derived from sedges underlain by gravel, providing poor drainage.

Slate River soils cover 0.49 square kilometres of the watershed. Slate River soils are non-calcareous fine sandy loam to sand outwash or deltaic materials and provide good drainage. This soil type is located in a small pocket in the far southeastern portion of the watershed.



Muck covers 0.33 square kilometres of the watershed. Muck consists of well decomposed organic materials, which provide very poor drainage. This soil type is located in a small pocket in the far northeastern portion of the watershed.

Pennassen Organic soils cover 0.15 square kilometres. Pennassen soils have very poor drainage and are made of partially decomposed organic material derived from hypnum moss and reeds 40-90 centimetres thick and is underlain by lacustrine clay.

### 2.1.3 Climate

Climate throughout the watershed can be characterized by a continental climate that is 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 1.0 displays the average daily temperature, total precipitation and extreme max daily temperatures for the Thunder Bay Region from 1971-2000. Table 2.0 displays the average daily temperature and total precipitation for the 1998 sampling year and Table 3.0 displays the average daily temperature and total precipitation for the 2010 sampling year.

**Table 1.0: 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 2.0: Mean Temperature and Total Precipitation from the Thunder Bay International Airport, January-July 1998**

	Jan	Feb	Mar	Apr	May	Jun	Jul
Temperature							
Daily (°C)	-12.02	-3.84	-3.73	5.64	10.95	14.48	18.36
Precipitation							
Total Precipitation (mm)	15.5	9.0	28.0	8.5	43.0	41.0	38.5

**Table 3.0: Mean Temperature and Total Precipitation for Thunder Bay International Airport, January-July 2010**

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

### 2.1.4 Hydrology

The Cedar Creek watershed has an average slope of 1.11 percent and an overall length of 24.16 kilometres. Cedar Creek and South Cedar Creek are the two main tributaries of the watershed, both of which originate in the unorganized Township of Adrian. South Cedar Creek originates east of Twist Lake and Marks Lake before joining Cedar Creek just east of Strom Road. Cedar Creek originates farther north than South Cedar Creek in an area dominated by wetlands. The watershed drains northwest to southeast from the northwestern edge of the unorganized Township of Adrian to the southeastern edge of Township of O'Connor.



## 3 Methods and Materials

### 3.1 Site Selection

Eight sites were chosen to assess the overall health of the Cedar Creek watershed. Each site was chosen based upon accessibility and proximity to natural and/or manmade features that may affect surface water quality. Site selection was also based on previous sites sampled during the 1998 Cedar Creek Watershed Assessment completed by the LRCA. Six of the nine sites sampled for the 1998 report were sampled for the 2010 update. Sites 1, 3 and 8 were sampled in 1998 but were not chosen for sampling in 2010. The location of the sites for both 1998 and 2010 can be found on map M-2: Site Plan.

With the exception of the headwaters site, samples were taken downstream of bridges and culverts in order to collect runoff from local roadways. Site 2 was located in the LRCA Cedar Falls Conservation Area. This site was previously sampled in 1998. Site 4 was located off Highway 595 and previously sampled in 1998. Site 5 and Site 6 were also previously sampled, with easy access off Highway 590. Site 5 was located downstream of where Cedar Creek and South Cedar Creek join. Site 6 was located on Cedar Creek just upstream of where South Cedar Creek and the Cedar Creek join. Site 7 was sampled previously in 1998 and was located off Adrian Lake Road. Site 9 was considered the headwaters sampling site. This site was located off Adrian Lake Road and was previously sampled in 1998. Site 10 was the confluence of Cedar Creek and the Whitefish River and was not previously sampled. Site 11, a new sampling site, was located off Garbutt Road and was chosen based on its location within a highly agricultural area. Site 11 was located on a tributary of Cedar Creek in the northeastern portion of the watershed.

### 3.2 Quantitative Assessment

Several parameters were measured to assess surface water quality of the Cedar Creek watershed. 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 was 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. 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 of this report.

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 described 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 Cedar Creek watershed was completed for the 1998 Cedar Creek Watershed Assessment. Wherever possible, significant changes were noted between photos from 1998 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 2<sup>nd</sup> 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

All results from the 1998 assessment are attached in Appendix E and all laboratory results from ALS laboratories for the 2010 assessment are located in Appendix D. Photo documentation from all 2010 sampling locations is located in Appendix H.

### 4.1 Site 1: Highway 590, between Winslow Road and Garbutt Road

Site 1 was sampled July 16, July 29 and August 12, 1998 for the Cedar Creek Watershed Assessment Report. This site was not sampled in 2010. The 1998 laboratory results and field observations from 1998 Site 1 are located in Appendix E.

### 4.2 Site 2: Cedar Falls Conservation Area, Upstream of Falls

Location Reference for Site 2	
Location Description	Site 2 was located within the LRCA Cedar Falls Conservation Area, upstream of falls
UTM Coordinates	Northing 5360072/ Easting 303227
Altitude/Elevation	245 metres above sea level

Field Measurements for Site 2						
Parameter	Unit	Date: July 16, 1998	Date: July 29, 1998	Date: August 12, 1998	Average of 1998 Data	Date: July 29, 2010
		Time: 10:40 am	Time: 11:15 am	Time: 10:50 am		Time: 10:40 am
Water Temperature	°C	19.4	17.0	17.4	17.9	18.23
Conductivity	µS/cm	225	200	230	218	202
Dissolved Oxygen	mg/L	9.0	9.6	9.8	9.47	8.9
Dissolved Oxygen	%	NA	NA	NA	NA	94.7
pH		8.05	7.81	8.00	7.95	8.21
Air Temperature	°C	28.0	21.0	18.5	22.5	21
Channel Width	m	NA	NA	NA	NA	6.4
Channel Depth	m	0.2	0.10	0.15	0.15	0.23
Velocity	m/s	swift	swift	swift	0.42	0.46



<b>Laboratory Water Quality Results for Site 2</b>				
Parameter	Unit	Date:	Date:	Date: July 29, 2010
		July 16, 1998	August 12, 1998	Time: 10:40 am
<b>Bacteriological</b>				
<i>Escherichia Coli</i>	MPN/100mL	70	30	10
Total Coliforms	MPN/100mL	NA	NA	<b>2400</b>
<b>Physical</b>				
Conductivity (EC)	µS/cm	NA	NA	213
Total Dissolved Solids	mg/L	NA	NA	122
Turbidity	NTU	1.12	1.06	1.43
<b>Nutrients and Anions</b>				
Ammonia-N, Total	mg/L	NA	NA	<0.020
Chloride (Cl)	mg/L	NA	NA	2.25
Nitrate-N (NO <sub>3</sub> -N)	mg/L	NA	NA	<0.030
Nitrite-N (NO <sub>2</sub> -N)	mg/L	NA	NA	<0.020
Phosphorus (P)-Total	mg/L	<0.01	0.03	0.0161
Sulphate (SO <sub>4</sub> )	mg/L	NA	NA	4.87
<b>Metals</b>				
Aluminum (Al)	mg/L	NA	NA	0.014
Cadmium (Cd)	mg/L	0.0004	<0.0002	<0.000090
Copper (Cu)	mg/L	NA	NA	<0.0010
Iron (Fe)	mg/L	0.51	0.04	<b>0.346</b>
Lead(Pb)	mg/L	0.05	<0.025	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines

<b>Flora Observed at Site 2</b>	
<b>FEC V-Type: V-19- Black Spruce Mixedwood/Herb Rich</b>	
<b>Species</b>	
<b>Trees</b>	White Birch
	White Spruce
	Poplar
	Balsam Fir
	Black Spruce*
	Black Ash
	Jack Pine
<b>Shrubs</b>	Beaked Hazel
	Alder*
	Mountain Maple*
<b>Ground Cover</b>	Large Leaved Aster*
	Nodding Trillium
	Ostrich Fern
	Bracken Fern
	Lady Fern*
	Goldenrod
	Jewel Weed
	Marsh Marigold
	Slender White Aster
	Joe-Pye Weed
	Cow Parsnip
Horsetail	



	Blue Bead Lily
	Bunch Berry
	Northern Sweet Coltsfoot
	Strawberry
	Pink Pyrola
	Sarsaparilla
	Wild Mint
<b>Aquatic Macrophytes and Algae</b>	Algae

\*Indicates dominant species

<b>Fauna Observed at Site 2</b>		
<b>Species</b>		<b># Observed</b>
<b>Birds</b>	-	-
<b>Mammals</b>	-	-
<b>Amphibians</b>	-	-
<b>Fish</b>	-	-
<b>Mollusca</b>	-	-
<b>Crustaceans</b>	-	-
<b>Insects</b>	-	-
<b>Other</b>	-	-

<b>Substrate Observations for Site 2</b>		<b>Soil Pit Observations</b>	
<b>Percentage Shaded</b>	50-75%	<b>Soil Characteristics</b>	Thin organic layer overlying bedrock
<b>Substrate Classification</b>	Bedrock		
<b>Abundance of aquatic vegetation</b>	Low abundance of algae		

## General Observations

Site 2 was located in the LRCA Cedar Falls Conservation Area and was previously sampled in 1998. The site was characterized by a waterfall and pool directly downstream from the sampling location. The substrate was primarily composed of bedrock. Vegetation observed was rich in diversity, dominated by a mixedwood forest containing black and white spruce, mountain maple, speckled alder, ferns and large leaved aster. The flow of water was quick relative to other sampling locations, with a shallow and wide channel. No wildlife was observed at this site. The soil was characterized by a thin organic layer overlying bedrock. Photo documentation of 2010 observations can be found in Appendix H.



## Results and Discussion

At the time of sampling, Site 2 appeared to be in relatively good condition, exceeding two PWQO parameters, total coliforms and iron, on July 29, 2010. Total coliforms exceeded the pre-1994 PWQO guideline of 1,000 counts per 100 ml of water (1,000 MPN/100 mL), with a concentration of 2,400 MPN/100 mL. Iron exceeded the PWQO guideline of 0.3 milligrams per litre (mg/L) with a concentration of 0.346 mg/L. The high iron concentration was likely of geologic origin.

In regards to the 1998 watershed study, much of the data from the 2010 sampling period fell within a similar range. The dissolved oxygen (DO) levels observed in 2010 decreased slightly from the 1998 concentrations. Dissolved oxygen levels in 1998 ranged from 9.0 mg/L to 9.8 mg/L, compared to the 2010 concentration of 8.9 mg/L. The depth and flow had not changed significantly between the two periods. The 2010 and 1998 laboratory water quality results fell within a similar range of each other, with no significant changes noted.

The vegetation at Site 2 appeared to have changed between 1998 and 2010. In 1998 the vegetation was classified as a V-20: Black Spruce Mixedwood/Feathermoss, with black spruce, balsam poplar, white birch, aspen, and river birch identified. In 2010 the vegetation was classified as a V-19: Black Spruce Mixedwood/Herb Rich forest with birch, jack pine, black ash, poplar, balsam fir, white spruce, and black spruce. Black spruce remained to be the dominant species for both sampling periods.

### 4.3 Site 3: Broome Road, between Garbutt Road and Cedar Falls Conservation Area

Site 3 was sampled July 16, July 29 and August 12, 1998 for the Cedar Creek Watershed Assessment Report. This site was not sampled in 2010. All 1998 results for this site can be found in Appendix E.

### 4.4 Site 4: Highway 595, Near Cronk Road

Location Reference for Site 4	
Location Description	Highway 595, near Cronk Road. Adjacent to church property.
UTM Coordinates	Northing 5362628/ Easting 300050
Altitude/Elevation	306.332 metres above sea level



Field Measurements for Site 4						
Parameter	Unit	Date: July 16, 1998	Date: July 29, 1998	Date: August 12, 1998	Average of 1998 Data	Date: July 28, 2010
		Time: 11:30 am	Time: 12:30 pm	Time: 11:20 am		Time: 1:00 pm
Water Temperature	°C	20.5	18.5	16.4	18.5	20.62
Conductivity	µS/cm	220	180	210	203	196
Dissolved Oxygen	mg/L	9.2	9.4	9.8	9.47	8.43
Dissolved Oxygen	%	NA	NA	NA	NA	93.9
pH		8.29	8.05	8.20	8.18	8.10
Air Temperature	°C	29.0	22.0	19.3	23.4	24
Channel Width	m	NA	NA	NA	NA	3.6
Channel Depth	m	0.2	0.40	0.35	0.32	0.36
Velocity	m/s	swift	slow	slow	0.08	0.21

Laboratory Water Quality Results for Site 4				
Parameter	Unit	Date: July 16, 1998	Date: August 12, 1998	Date: July 28, 2010
		Time: 11:30 am	Time: 11:20 am	Time: 1:10 pm
<b>Bacteriological</b>				
<i>Escherichia Coli</i>	MPN/100mL	30	70	91
Total Coliforms	MPN/100mL	NA	NA	> <b>2420</b>
<b>Physical</b>				
Conductivity (EC)	µS/cm	NA	NA	200
Total Dissolved Solids	mg/L	NA	NA	116
Turbidity	NTU	NA	NA	2.04
<b>Nutrients and Anions</b>				
Ammonia-N, Total	mg/L	NA	NA	<0.020
Chloride (Cl)	mg/L	NA	NA	1.85
Nitrate-N (NO <sub>3</sub> -N)	mg/L	NA	NA	<0.030
Nitrite-N (NO <sub>2</sub> -N)	mg/L	NA	NA	<0.020
Phosphorus (P)-Total	mg/L	NA	NA	0.0208
Sulphate (SO <sub>4</sub> )	mg/L	NA	NA	4.61
<b>Metals</b>				
Aluminum (Al)	mg/L	NA	NA	0.028
Cadmium (Cd)	mg/L	NA	NA	<0.000090
Copper (Cu)	mg/L	NA	NA	<0.0010
Iron (Fe)	mg/L	NA	NA	<b>0.425</b>
Lead (Pb)	mg/L	NA	NA	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines



<b>Flora Observed at Site 4</b>	
<b>FEC V-Type: V-1 Balsam Poplar Hardwood and Mixedwood</b>	
<b>Dominant Species*</b>	
<b>Species</b>	
<b>Trees</b>	Balsam Poplar
	White Pine
	Black Ash
	Trebling Aspen
	Black Spruce
<b>Shrubs</b>	Red Osier Dogwood
	Gooseberry
	Speckled Alder*
	Slender Willow
	Choke Cherry
<b>Ground Cover</b>	Lady Fern
	Swamp Milkweed
	Fireweed
	Yellow Hawkweed
	Canada Anemone
	Bog Aster
	Cow Parsnip
	Thistle
	Slender White Aster
	Marsh Marigold
	Wild Mint
	Blue Joint Grass
	Horsetail
	Northern Sweet Coltsfoot
Joe-Pye Weed	
<b>Aquatic Macrophytes and Algae</b>	-

\*Indicates dominant species

<b>Fauna Observed at Site 4</b>		
<b>Species</b>		<b># Observed</b>
<b>Birds</b>	-	-
<b>Mammals</b>	-	-
<b>Amphibians</b>	-	-
<b>Fish</b>	Minnows	>50
<b>Mollusca</b>	-	-
<b>Crustaceans</b>	-	-
<b>Insects</b>	Water striders	>100
<b>Other</b>	-	-



Substrate Observations for Site 4		Soil Pit Observations	
Percentage Shaded	50-75%	Soil Characteristics	Mostly organic content within silt and clay distributed throughout
Substrate Classification	Cobble and boulder with sand distributed throughout		
Abundance of aquatic vegetation	None		

## General Observations

Site 4 was located off Highway 595 and was previously sampled in 1998. This sampling location had relatively easy access, with parking at a nearby church. The south bank was characterized by a manicured lawn with a small patch of vegetation in the center. The north bank was characterized by a dense wooded area, with thick shrub growth on the stream bank. The flow of the stream was fairly swift, with no apparent obstructions upstream or downstream. Soil observed at the site was mostly organic with some sandy silt integrated throughout. Photo documentation of 2010 observations can be found in Appendix H.

There were no significant physical changes to the culvert in 2010 based on photo comparison from 1998. The substrate consisted of large boulders and cobble, remaining unchanged from the substrate description in the 1998 report.

## Results and Discussion

Site 4 was in good condition at the time of sampling, exceeding PWQO criteria for two parameters on July 28, 2010. Total coliforms exceeded pre-1994 PWQO criterion (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL. Iron exceeded PWQO criterion (0.3 mg/L) with a concentration of 0.425 mg/L. The DO was high at this site, which may have been a result of the flowing shallow water. Laboratory analysis was not completed for any parameters in 1998, with the exception of *E. coli*. *E. coli* concentrations from 1998 and 2010 appeared to be within a similar range of each other.

The vegetation at Site 4 appeared to have changed between the two sampling periods, with the presence of black ash and the absence of white birch in 2010 being the most noticeable change. The 1998 study classified the site as a V-1: Balsam Poplar Hardwood and Mixedwood. The 2010 inventory reported poplar to be the dominant tree species and classified Site 4 as a V-1: Balsam Poplar Hardwood and Mixedwood.





#### 4.5 Site 5: Highway 590, Downstream of Pool Road

Location Reference for Site 5	
Location Description	Located off of Highway 590 downstream of Pool Road.
UTM Coordinates	Northing 5364123/ Easting 297890
Altitude/Elevation	371.588 metres above sea level

Field Measurements for Site 5						
Parameter	Unit	Date: July, 16 1998	Date: July, 29 1998	Date: August, 12 1998	Average of 1998 Data	Date: July, 28 2010
		Time: 12:00 pm	Time: 1:15 pm	Time: 1:35 pm		Time: 12:12pm
Water Temperature	°C	21.0	19.1	20.0	20.0	19.82
Conductivity	µS/cm	225	200	215	213	196
Dissolved Oxygen	mg/L	9.0	9.9	8.4	9.10	8.12
Dissolved Oxygen	%	NA	NA	NA	NA	89.0
pH		7.92	7.96	7.79	7.89	7.83
Air Temperature	°C	29.0	24.5	23.0	25.5	23
Channel Width	m	NA	NA	NA	NA	5.6
Channel Depth	m	0.2	0.25	0.30	0.25	0.4
Velocity	m/s	swift	slow	swift	0.10	0.3

Laboratory Water Quality Results for Site 5				
Parameter	Unit	Date: July 16, 1998	Date: August 12, 1998	Date: July 28, 2010
		Time: 12:00 pm	Time: 1:35 pm	Time: 12:20 pm
<b>Bacteriological</b>				
<i>Escherichia Coli</i>	MPN/100mL	60	<b>130</b>	71
Total Coliforms	MPN/100mL	NA	NA	<b>&gt; 2420</b>
<b>Physical</b>				
Conductivity (EC)	µS/cm	NA	NA	201
Total Dissolved Solids	mg/L	NA	NA	120
Turbidity	NTU	NA	NA	2.40
<b>Nutrients and Anions</b>				
Ammonia-N, Total	mg/L	NA	NA	<0.020
Chloride (Cl)	mg/L	NA	NA	1.93
Nitrate-N (NO <sub>3</sub> -N)	mg/L	NA	NA	<0.030
Nitrite-N (NO <sub>2</sub> -N)	mg/L	NA	NA	<0.020
Phosphorus (P)-Total	mg/L	NA	NA	0.0183
Sulphate (SO <sub>4</sub> )	mg/L	NA	NA	4.61
<b>Metals</b>				
Aluminum (Al)	mg/L	NA	NA	0.028
Cadmium (Cd)	mg/L	NA	NA	<0.000090
Copper (Cu)	mg/L	NA	NA	<0.0010
Iron (Fe)	mg/L	NA	NA	<b>0.532</b>
Lead (Pb)	mg/L	NA	NA	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines



<b>Flora Observed at Site 5</b>	
<b>FEC V-Type: V-4 White Birch Hardwood and Mixedwood</b>	
<b>Dominant Species *</b>	
<b>Species</b>	
<b>Trees</b>	White Spruce
	Balsam Fir
	Black Ash
	White Birch
	Balsam Fir
	Trembling Aspen
	Balsam Poplar
<b>Shrubs</b>	Wild Red Raspberry*
	Red Osier Dogwood
	Alder
<b>Ground Cover</b>	Thistle
	Hawkweed
	Red Top Grass
	Common Reed
	Birdsfoot Trefoil
	Canada Anemone
	Tall Buttercup
	Slender White Aster
	Large Leaved Avens
	Fowl Meadow Grass
	Floating Leaved Burweed
	Bog Aster
	White Sweet Clover
	Joe-Pye Weed
Yarrow	
Wild Mint	
<b>Aquatic Macrophytes and Algae</b>	-

\*Indicates dominant species

<b>Fauna Observed at Site 5</b>		
<b>Species</b>		<b># Observed</b>
<b>Birds</b>	Sparrow hawk	1
<b>Mammals</b>	-	-
<b>Amphibians</b>	-	-
<b>Fish</b>	-	-
<b>Mollusca</b>	-	-
<b>Crustaceans</b>	-	-
<b>Insects</b>	Wasps	Abundant
	Water striders	Abundant
<b>Other</b>	-	-



Substrate Observations for Site 5		Soil Pit Observations	
Percentage Shaded	50-75%	Soil Characteristics	Thin organic layer overlying bedrock
Substrate Classification	Cobble and boulder with sand distributed throughout		
Abundance of aquatic vegetation	Low density of emergent vegetation		

## General Observations

Site 5 was previously sampled on July 16, July 29 and August 12 for the 1998 Cedar Creek Watershed Assessment Report. Site 5 was chosen for the 2010 Cedar Creek update and was sampled July 29, 2010. This site was located downstream from Site 6 off Highway 590. The site was characterized by bedrock outcrops and cobble along the banks. The bridge upstream was relatively large and in good condition, with no apparent decay. Gabion baskets had been placed above the structure in an effort to prevent erosion. Vegetation at the site was dominated by low lying shrubs, herbs and grasses on the north bank, with larger shrubs and conifers dominating the south bank. The substrate consisted of cobble, bedrock and sand, with the flow of the water being relatively swift. Soil observed at the site was characterized by a thin organic layer overlying bedrock. Photo documentation of 2010 observations can be found in Appendix H.

When comparing structure photos from 1998 and 2010, this site appeared to have undergone little physical change. Grasses remain the dominant species on the north bank and the bridge appeared to be in similar physical condition with no obvious deterioration. The substrate was also remained unchanged, with cobble continuing to be the most abundant grain size.

## Results and Discussion

Site 5 was in good health at the time of sampling, exceeding two parameters on July 28, 2010. Total coliforms exceeded pre-1994 PWQO criterion (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL and iron exceeded PWQO criterion (0.3 mg/L) with a concentration of 0.532 mg/L. The DO observed in 2010 was relatively high, with a reading of nearly 90% saturation.

Many results from the 1998 and 2010 studies were within a similar range of each other. Observed depth increased from 1998 to 2010, which was consistent with the upstream sites. Cobble and boulder substrate were common to both study periods and the *E. coli* concentration observed at this site in 2010 was comparable to the 1998 results, with levels that were above the average for the watershed. The range of values observed in both 1998 and 2010 suggest there may be a consistent local source impacting the stream.

The vegetation at Site 5 appeared to have changed from the previous sampling period. The FEC classifications in the 1998 study classified a V-1 Balsam Poplar Hardwood Mixedwood, where the 2010 inventory observed an FEC of V-15 White Spruce



Mixedwood. The dominant species changed from poplar to white spruce, but the assemblage remained similar, reporting raspberries, poplar, black spruce, and white spruce as common species for both periods.

#### 4.6 Site 6: Highway 590, Downstream of Strom Road

Location Reference for Site 6	
Location Description	Located off of Highway 590 downstream of Strom Road.
UTM Coordinates	Northing 5364160/ Easting 297078
Altitude/Elevation	374.495 metres above sea level

Field Measurements for Site 6						
Parameter	Unit	Date: July 16, 1998	Date: July 29, 1998	Date: August 12, 1998	Average of 1998 Data	Date: July 28, 2010
		Time: 1:00 pm	Time: 1:40 pm	Time: 1:50 pm		Time: 11:45am
Water Temperature	°C	18.5	17.3	18.4	18.1	18.39
Conductivity	µS/cm	185	180	215	193	190
Dissolved Oxygen	mg/L	8.6	9.0	8.5	8.7	8.81
Dissolved Oxygen	%	NA	NA	NA	NA	94
pH		7.96	7.87	7.98	7.94	7.93
Air Temperature	°C	29.0	25.0	23.0	25.7	22
Channel Width	m	NA	NA	NA	NA	4.6
Channel Depth	m	0.2	0.25	0.30	0.25	0.19
Velocity	m/s	swift	slow	swift	0.12	0.4

Laboratory Water Quality Results for Site 6				
Parameter	Unit	Date: July 16, 1998	Date: August 12, 1998	Date: July 28, 2010
		Time: 1:00 pm	Time: 1:50 pm	Time: 11:45 pm
<b>Bacteriological</b>				
<i>Escherichia Coli</i>	MPN/100mL	20	<10	16
Total Coliforms	MPN/100mL	NA	NA	> 2420
<b>Physical</b>				
Conductivity	µS/cm	NA	NA	194
Total Dissolved Solids	mg/L	NA	NA	118
Turbidity	NTU	0.55	0.64	1.02
<b>Nutrients and Anions</b>				
Ammonia-N, Total	mg/L	NA	NA	<0.020
Chloride (Cl)	mg/L	NA	NA	0.53
Nitrate-N (NO3-N)	mg/L	NA	NA	<0.030
Nitrite-N (NO2-N)	mg/L	NA	NA	<0.020
Phosphorus (P)-Total	mg/L	<0.01	0.04	0.0128
Sulphate (SO4)	mg/L	NA	NA	5.97



<b>Metals</b>				
Aluminum (Al)	mg/L	NA	NA	0.020
Cadmium (Cd)	mg/L	NA	NA	<0.000090
Copper (Cu)	mg/L	NA	NA	<0.0010
Iron (Fe)	mg/L	<b>0.25</b>	0.03	<b>0.201</b>
Lead (Pb)	mg/L	0.030	<0.025	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines

<b>Flora Observed at Site 6</b>	
<b>FEC V-Type: NA</b>	
<b>Dominant Species *</b>	
<b>Species</b>	
<b>Trees</b>	White Spruce
	Black Spruce
	Black Ash
<b>Shrubs</b>	Red Osier Dogwood
	Speckled Alder
<b>Ground Cover</b>	Dark Green Bulrush
	Sensitive Fern
	Birdsfoot Trefoil
	Bog Aster
	Common Reed
	Thistle
	Red Top Grass
	Pickerel Weed
	Yellow Hawkweed
	Fireweed
	Water Hemlock
	White Sweet Clover
<b>Aquatic Macrophytes and Algae</b>	Algae*

\*Indicates dominant species

<b>Fauna Observed at Site 6</b>		
<b>Species</b>		<b># Observed</b>
<b>Birds</b>	Warblers	3
	Crows	Multiple (call identification)
<b>Mammals</b>	Chipmunk	1
<b>Amphibians</b>	Frogs	3
<b>Fish</b>	Minnows	>10
<b>Mollusca</b>	-	-
<b>Crustaceans</b>	-	-
<b>Insects</b>	Water striders	>100
	Butterfly	1
	Bumble bee	1
<b>Other</b>	-	-



Substrate Observations for Site 6		Soil Pit Observations	
Percentage Shaded	0-25 %	Soil Characteristics	Thin organic layer of ~4 cm, with silty clay for ~20 cm and then a silt dominated layer.
Substrate Classification	Cobble with sand farther upstream		
Abundance of aquatic vegetation	Abundant algae ~40% substrate cover.		

## General Observations

Site 6 was located off Highway 590 directly downstream of the 590 bridge. The channel was fairly shallow and produced a moderate flow. The bridge upstream was decaying, with concrete fragments landing into the stream bed below (Appendix H). There was agricultural activity in close proximity to the south side of the stream. The vegetation on either side of the creek was dominated by tall grasses and herbs. The vegetation provided little to no shade for the sampling site. In contrast, further downstream the vegetation was dominated by alder, which provided almost complete shade. The substrate was mostly shale and cobble, with abundant amounts of algae. The water was shallow and very clear relative to other sites. Soil was characterized by a thin organic layer of approximately four centimetres, with silty clay for approximately 20 centimetres. Photo documentation of 2010 observations can be found in Appendix H.

When comparing the 1998 and 2010 photos, Site 6 appeared to have changed very little. The bridge had noticeably decayed since 1998, with cracking concrete on the top north portion, exposing rebar. The substrate of this site appeared to have changed significantly as well, with the 1998 photo displaying what appeared to consist of cobble and the 2010 photo displaying what appears to be sand in the same location. The substrate likely altered during a significant flood event which occurred in June 2008.

## Results and Discussion

Site 6 was in overall good health, exceeding two PWQO criteria, total coliforms and iron, on July 28, 2010. Total coliforms exceeded pre-1994 PWQO criterion (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL. The *E. coli* count of 16 MPN/100 mL was very low. Iron exceeded PWQO criterion (0.3 mg/L) with a concentration of 0.201 mg/L.

Regarding the variation between 1998 and 2010 observations, all parameters displayed similar results. The pH remained very consistent, with almost no variation between sampling periods. This location appeared to have maintained relatively healthy levels for all parameters.

Despite the similarities in laboratory results for water quality, vegetation at this site had shown considerable change from 1998 to 2010. The FEC classification was not applicable in 2010, as the site was completely dominated by grasses, shrubs and herbs. There were only a few trees present, with no dominant tree species in close proximity to the site. In 1998 the vegetation from Site 6 was classified as a V-1: Balsam Poplar



Hardwood and Mixedwood. The 1998 report indicated poplar, birch, and wild red raspberries as common species, where none of these species were present during 2010 sampling.

#### 4.7 Site 7: Adrian Lake Road, Downstream of MNR Landfill Site

Location Reference for Site 7	
Location Description	Located downstream of MNR landfill site, easy access off of Adrian Lake Road.
UTM Coordinates	Northing 5363590/ Easting 293183
Altitude/Elevation	446.041 metres above sea level

Field Measurements for Site 7						
Parameter	Unit	Date: July 16, 1998	Date: August 2, 1998	Date: August 12, 1998	Average of 1998 Data	Date: July 28, 2010
		Time: 1:30 pm	Time: 2:00 pm	Time: 2:30 pm		Time: 11:00am
Water Temperature	°C	21.2	19.8	20.9	20.6	19.44
Conductivity	µS/cm	188	115	205	169	130
Dissolved Oxygen	mg/L	9.2	9.8	10.6	9.87	7.38
Dissolved Oxygen	%	NA	NA	NA	NA	80.3
pH		7.56	7.33	7.90	7.6	7.5
Air Temperature	°C	30.0	25.0	25.0	26.7	19.44
Channel Width	m	NA	NA	NA	NA	3.9
Channel Depth	m	0.2	0.25	0.15	0.20	0.47
Velocity	m/s	slow	slow	slow	0.01	0.6

Laboratory Water Quality Results for Site 7				
Parameter	Unit	Date: July 16, 1998	Date: August 12, 1998	Date: July 28, 2010
				11:00 am
<b>Bacteriological</b>				
<i>Escherichia Coli</i>	MPN/100mL	40	<10	29
Total Coliforms	MPN/100mL	NA	NA	<b>2400</b>
<b>Physical</b>				
Conductivity (EC)	µS/cm	NA	NA	135
Total Dissolved Solids	mg/L	NA	NA	89
Turbidity	NTU	NA	NA	2.30
<b>Nutrients and Anions</b>				
Ammonia-N, Total	mg/L	NA	NA	<0.020
Chloride (Cl)	mg/L	NA	NA	0.75
Nitrate-N (NO3-N)	mg/L	NA	NA	0.072
Nitrite-N (NO2-N)	mg/L	NA	NA	<0.020
Phosphorus (P)-Total	mg/L	NA	NA	0.0250
Sulphate (SO4)	mg/L	NA	NA	2.45



<b>Metals</b>				
Aluminum (Al)	mg/L	NA	NA	0.017
Cadmium (Cd)	mg/L	NA	NA	<0.000090
Copper (Cu)	mg/L	NA	NA	<0.0010
Iron (Fe)	mg/L	NA	NA	<b>0.633</b>
Lead (Pb)	mg/L	NA	NA	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines

<b>Flora Observed at Site 7</b>	
<b>FEC V-Type: V-2 Black Ash Hardwood and Mixedwood</b>	
<b>Dominant Species *</b>	
<b>Species</b>	
<b>Trees</b>	Black Ash
	Balsam Fir
	Balsam Poplar
<b>Shrubs</b>	Mountain Maple
	Red Osier Dogwood
	Balsam Willow
	Wild Red Raspberry
	Speckled Alder
<b>Ground Cover</b>	Purple Stemmed Aster
	Blue Joint Grass
	Water Hemlock
	Canada Goldenrod
	White Sweet Gale
	Wild Mint
	Sensitive Fern
	Lady Fern
	Dandelion
	Strawberry
	Yarrow
	Cow Vetch
	Red Top Grass
	Oxe-Eye Daisy
	Timothy Grass
	Canada Anemone
	Large Leaved Aster
Swamp Milkweed	
Evening Primrose	
<b>Aquatic Macrophytes and Algae</b>	Submerged Water Starwort
	Floating Leaved Pondweed





<b>Fauna Observed at Site 7</b>		
<b>Species</b>		<b># Observed</b>
<b>Birds</b>	Warblers	~3
	Crows	Unknown
<b>Mammals</b>	Chipmunk	1
<b>Amphibians</b>	-	-
<b>Fish</b>	Stickleback	
	Minnows	>10
<b>Mollusca</b>	-	-
<b>Crustaceans</b>	-	-
<b>Insects</b>	Water striders	>100
<b>Other</b>	Stick insect	~10

<b>Substrate Observations for Site 7</b>		<b>Soil Pit Observations</b>	
<b>Percentage Shaded</b>	25-50 %	<b>Soil Characteristics</b>	-Gravel and sand dominant
<b>Substrate Classification</b>	Muck, large boulders, silt and sand		
<b>Abundance of aquatic vegetation</b>	Very little aquatic vegetation		

## General Observations

Site 7 was located off Adrian Lake Road and was previously sampled in 1998. This site was characterized by a shallow flowing channel downstream and an extensive wetland habitat upstream. There was a single culvert flowing under the road with a stick jam partially obstructing the flow. The obstruction was large, but did not appear to be significantly affecting the flow. This was likely a recent blockage due to the lack of sediment build up. The sampling site was directly downstream from the road, with flow running perpendicular to the road. Site 7 had considerable gravel washout within the stream bed as well as along the stream banks. The majority of the vegetation at this site was herb dominated. The soil was composed of gravel washout. Photo documentation of 2010 observations can be found in Appendix H of this report.

The culvert photo taken in 1998 displayed no noticeable changes; however, changes in both the colour of the water and vegetation were apparent. The colour of the water in 1998 appeared orange in colour when compared to the water observed in 2010. It is important to note that colour change can be subjective and may be a result of camera quality and not a change in the quality of the water itself. Vegetation appeared denser in 1998, with shrub growth on the banks adjacent to the culvert, where no shrub growth was observed during the 2010 survey.

## Results and Discussion

Site 7 appeared to be in good condition at the time of sampling, exceeding two PWQO parameters on July 28, 2010. Total coliforms exceeded pre-1994 PWQO criterion (1,000



MPN/100 mL) with a concentration of 2,400 MPN/100 mL and iron exceeded the PWQO criterion (0.3 mg/L) with a concentration of 0.633 mg/L.

Stream depth measurements at Site 7 displayed an increase from 1998. The average depth of the 1998 study was 0.2 metres while the 2010 study recorded a depth of 0.47 metres. Increased flow was also observed, with a substantial increase in velocity from 0.01 metres per second in 1998 to 0.6 metres per second in 2010. The DO concentrations at Site 7 appeared to have decreased in response to the change in channel characteristics. This may be explained by the relatively shallow depth of Site 7 in the 1998 study. *E. coli* levels have shown a decrease from 1998 to 2010, with the average for 1998 exceeding PWQO criterion (100 MPN/100 mL) with a concentration of 103.3 MPN/100 mL and a concentration of 29 MPN/100 mL in 2010. The lack of laboratory results in addition to *E. coli* prevents further comparison regarding water quality for Site 7.

The vegetation of Site 7 also appeared to have changed significantly. In 1998 the vegetation from Site 7 was classified as an FEC of V-10: Trembling Aspen – Black Spruce-Jack Pine/ Low Shrub. The 2010 classification was a V-2: Black Ash Hardwood and Mixedwood with no Jack Pine or Black Spruce present. Common tree species present between the two sampling periods were black ash and poplar.

#### 4.8 Site 8: Strom Road, at the end of Strom Road, Downstream

Site 8 was sampled July 16, July 29 and August 12 for the 1998 Cedar Creek Watershed Assessment Report. This site was not sampled in the 2010 sampling period All 1998 results for this site can be found in Appendix E.

#### 4.9 Site 9: Headwaters - Adrian Lake Road

Location Reference for Site 9	
Location Description	Headwaters of the site located just downstream of Twist Lake. Easy access off of Adrian Lake Road.
UTM Coordinates	Northing 5366353/ Easting 290876
Altitude/Elevation	494.187 metres above sea level



Field Measurements for Site 9						
Parameter	Unit	Date: July 16, 1998	Date: July 29, 1998	Date: August 12, 1998	Average of 1998 Data	Date: July 28,2010
		Time: 3:00 pm	Time: 10:00 am	Time: 10:35 am		Time: 10:05 am
Water Temperature	°C	26.0	18.3	20.3	21.5	20.42
Conductivity	µS/cm	75	85	75	78	92
Dissolved Oxygen	mg/L	<b>4.5</b>	<b>3.0</b>	<b>3.8</b>	<b>3.77</b>	6.74
Dissolved Oxygen	%	NA	NA	NA	NA	74.8
pH		<b>6.38</b>	<b>6.14</b>	<b>6.41</b>	<b>6.31</b>	7.86
Air Temperature	°C	31.0	19.0	18.0	22.6	20
Channel Width	m	NA	NA	NA	NA	3.2
Channel Depth	m	0.5	0.42	0.30	0.41	0.82
Velocity	m/s	slow	slow	none	slow	0

\*Bold #'s indicate exceedance of PWQO guidelines

Laboratory Water Quality Results for Site 9				
Parameter	Unit	Date: July 16, 1998	Date: August 12, 1998	Date: July 28, 2010 10:05 am
		<b>Bacteriological</b>		
<i>Escherichia Coli</i>	MPN/100mL	>10	30	3
Total Coliforms	MPN/100mL	NA	NA	<b>2400</b>
<b>Physical</b>				
Conductivity (EC)	µS/cm	NA	NA	96.3
Total Dissolved Solids	mg/L	NA	NA	76
Turbidity	NTU	1.21	4.32	0.97
<b>Nutrients and Anions</b>				
Ammonia-N, Total	mg/L	NA	NA	<0.020
Chloride (Cl)	mg/L	NA	NA	0.78
Nitrate-N (NO <sub>3</sub> -N)	mg/L	NA	NA	<0.030
Nitrite-N (NO <sub>2</sub> -N)	mg/L	NA	NA	<0.020
Phosphorus (P)-Total	mg/L	<0.01	0.02	0.0235
Sulphate (SO <sub>4</sub> )	mg/L	NA	NA	3.83
<b>Metals</b>				
Aluminum (Al)	mg/L	NA	NA	0.031
Cadmium (Cd)	mg/L	0.0005	<0.0002	<0.000090
Copper (Cu)	mg/L	NA	NA	<0.0010
Iron (Fe)	mg/L	<b>0.46</b>	0.08	<b>0.125</b>
Lead (Pb)	mg/L	<0.025	<0.025	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines



<b>Flora Observed at Site 9</b>	
<b>FEC V-Type: V-19 Black Spruce Mixedwood/ Herb Rich</b>	
<b>Dominant Species *</b>	
<b>Species</b>	
<b>Trees</b>	Black Spruce*
	Balsam Fir
	White Spruce*
	White Birch
<b>Shrubs</b>	Speckled Alder*
	Sweet Gale
	Slender Willow*
	Bog Willow
	Wild Raspberry
	Bog Laurel
<b>Ground Cover</b>	Purple Stemmed Aster
	Yarrow
	Horsetail
	Thistle
	Fireweed
	Canada Goldenrod
	Blue Joint Grass
	Pearly Everlasting
	Rough Daisy Fleabane
	Yellow Hawkweed
	Marsh Timothy
	Timothy Grass
	Dark Green Bulrush
	Tall Buttercup
	Large Leaved Aster
	Common Reed
	Evening Primrose
	Lady Fern
	Wild Mint
	White Sweet Clover
	Red Top Grass*
<b>Aquatic Macrophytes and Algae</b>	Cattail
	Yellow Pond Lily
	Floating Leaved Arrowhead
	Bladderwort
	Coons Tail
	Arrowhead Wapato
	Algae

\*Indicates dominant species



Fauna Observed at Site 9		
Species		# Observed
Birds	-	-
Mammals	-	-
Amphibians	-	-
Fish	minnows	~10
Mollusca	-	-
Crustaceans	-	-
Insects	-	-
Other	-	-

Substrate Observations for Site 9		Soil Pit Observations	
Percentage Shaded	0-25%	Soil Characteristics	~20 cm of organics followed by considerable concrete gravel and sandy loam
Substrate Classification	Thick muck		
Abundance of aquatic vegetation	Abundant emergent plants and considerable submergent		

## General Observations

Site 9, the headwaters, was located off Adrian Lake Road north of Highway 590. This was a low traffic area with a narrow gravel road used by the forestry industry. The site was connected by a wetland to Twist Lake, located west of the site location. With the exception of forestry, the sampling site was fairly isolated from any community activities or industrial practices. Characterized by a large wetland pool upstream which then narrowed into the culvert downstream of the sampling location, the wetland habitat surrounding the site consisted of abundant aquatic plants and reeds. Flow was perpendicular to road, with considerable debris in the culvert downstream from the sampling site. It was noted in the 1998 study that the culvert had been blocked. The water was relatively deep and exhibited no surface water flow. The muck substrate appeared to have an orange tint with abundant submergent and emergent plant growth. Terrestrial vegetation consisted of grasses and herbs, with speckled alder and slender willow as the dominant shrubs. The sampling site was surrounded by a conifer mixedwood stand of black spruce, balsam fir and white birch. Soil was characterized by an organic layer approximately eight centimetres thick, overlying what appeared to be gravel from construction. Photo documentation of 2010 observations for Site 9 can be found in Appendix H.

## Results and Discussion

Site 9 appeared to be in good condition, exceeding one PWQO criteria on July 28, 2010. Total coliforms exceeded the pre-1994 PWQO guideline (1,000 MPN/100 mL) with a concentration of 2,400 MPN/100 mL. With a low *E. coli* count of 3 MPN/100 mL, it is



likely that the high coliform concentration was in response to the decomposition of vegetative matter. Conductivity observed at this site was the lowest of all sites in 2010, with a concentration of 92  $\mu\text{S}/\text{cm}$ .

Overall, few changes were observed between 1998 and 2010 for Site 9. The channel depth displayed an increase in relation to the 1998 measurements, with the average depth from 1998 being 0.41 metres compared to 0.82 metres in 2010. DO at the site appeared to have improved from the previous study, with an average concentration of 6.74 mg/L observed in 2010, compared to 3.77 mg/L observed in 1998. Assuming the location of Site 9 in 2010 was the same as 1998, the depth of the channel had nearly doubled. The flow appeared to be similar between studies, with the 1998 study reporting slow to no flow and the 2010 study reporting no flow. This was likely in response to the blocked culvert. The pH of water at the site increased from an average pH of 6.31 in 1998 to a pH of 7.86 in 2010, which indicated that pH had improved and no longer exceeded the PWQO criterion of 6.5-9.0. The conductivity results for Site 9 in both 1998 and 2010 reported concentrations under 100  $\mu\text{S}/\text{cm}$ .

Site 9 appeared to have improved with no exceedance of the PWQO observed in 2010 compared to 1998 there were exceedances of both pH and DO. This improvement may be a result of many factors, but was likely in response to a change in climate and channel characteristics. The maximum water temperature in 1998 was 26 degrees Celsius. Higher temperatures affect DO levels in water by not allowing oxygen to be absorbed as quickly. The 1998 report also reported high turbidity levels and murky water, which in turn lead to minimal submerged aquatic vegetation. During the 2010 study, vegetation was abundant and turbidity was low. Given that no change in flow was apparent and depth appeared to have increased, the abundant aquatic vegetation may account for the increase in DO.

The terrestrial vegetation reported from 1998 and 2010 displayed little change. Both the 2010 and 1998 report classified the site as a V-19 Black Spruce Mixedwood/ Herb Rich. White spruce, black spruce and white birch as well as yarrow, white sweet clover and wild red raspberry were recorded during 1998 and 2010.



#### 4.10 Site 10: Confluence with Whitefish River

Location Reference for Site 10	
Location Description	Located at the confluence with the Whitefish River, easy access off of Harstone Road with a parking space on the south side of the creek
UTM Coordinates	Northing 5359296/ Easting 304655
Altitude/Elevation	217.225 metres above sea level

Field Measurements for Site 10		
Parameter	Unit	Date: July 29, 2010
		Time: 12:05 pm to 1:00 pm
Water Temperature	°C	20.56
Conductivity	µS/cm	214
Dissolved Oxygen	mg/L	8.49
Dissolved Oxygen	%	94.1
pH		7.93
Air Temperature	°C	26
Channel Width	m	5.9
Channel Depth	m	0.2
Velocity	m/s	0.55

Laboratory Water Quality Results for Site 10		
Parameter	Unit	Date: July 29, 2010
		Time: 12:05 pm
<b>Bacteriological</b>		
<i>Escherichia Coli</i>	MPN/100mL	<b>200</b>
Total Coliforms	MPN/100mL	<b>2000</b>
<b>Physical</b>		
Conductivity (EC)	µS/cm	218
Total Dissolved Solids	mg/L	128
Turbidity	NTU	2.78
<b>Nutrients</b>		
Ammonia-N, Total	mg/L	<0.020
Chloride (Cl)	mg/L	2.44
Nitrate-N (NO <sub>3</sub> -N)	mg/L	<0.030
Nitrite-N (NO <sub>2</sub> -N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	0.0155
Sulphate (SO <sub>4</sub> )	mg/L	4.83
<b>Metals</b>		
Aluminum (Al)	mg/L	0.044
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	0.0011
Iron (Fe)	mg/L	<b>0.518</b>
Lead (Pb)	mg/L	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines



<b>Flora Observed at Site 10</b>	
<b>FEC V-Type: V-2 Black Ash Hardwood and Mixedwood</b>	
<b>Dominant Species *</b>	
<b>Species</b>	
<b>Trees</b>	Jack Pine
	White Spruce
	Balsam Fir
<b>Shrubs</b>	Willow
	Alder*
<b>Ground Cover</b>	Cow Vetch
	Oxe-Eye Daisy
	Wild Mint
	Inland Sedge
	Fireweed
	Reed Canary Grass
	Timothy Grass
	Red Top Grass
	Canada Anemone
	Bulrush
	Swamp Milkweed
<b>Aquatic Macrophytes and Algae</b>	-

\*Indicates dominant species

<b>Fauna Observed at Site 10</b>		
<b>Species</b>		<b># Observed</b>
<b>Birds</b>	-	-
<b>Mammals</b>	-	-
<b>Amphibians</b>	-	-
<b>Fish</b>	Minnows	>50
<b>Mollusca</b>	-	-
<b>Crustaceans</b>	-	-
<b>Insects</b>	Water striders	>100
<b>Other</b>	-	-

<b>Substrate Observations for Site 10</b>		<b>Soil Pit Observations</b>	
<b>Percentage Shaded</b>	25-50 %	<b>Soil Characteristics</b>	-The soil was largely sandy loam, with thinner layers of clay rich soil throughout the profile. The soils had a red tinge suggesting iron rich. -Sandy Loam
<b>Substrate Classification</b>	Mixture of cobble, gravel and boulder with sand dominant just downstream		
<b>Abundance of aquatic vegetation</b>	None		





## General Observations

Site 10, which was not sampled in 1998, was the confluence with Whitefish River. This site had easy access off Harstone Road with a parking space on the south side of the creek. The vegetation at this site was abundant and diverse along the bank. The confluence was characterized by the dispersion of the main creek channel into several independent flowing channels. Flow was swift in the relatively shallow channel. The substrate was mainly composed of gravel and small cobble, with larger boulders distributed throughout the bed. There appeared to be remnants from construction activity upstream from the sampling site. On the north side of the creek, both upstream and downstream, the banks were a dark red/orange colour, possibly an indication of iron rich sediments. The soil was composed of sandy loam, with thinner layers of clay rich soil throughout the profile. Photo documentation of 2010 observations can be found in Appendix H. Note that bridge photos at this site were not taken in 1998.

## Results and Discussion:

Site 10 appeared to be in relatively good condition during the 2010 study. This site exceeded PWQO criterion (100 MPN/100 mL) for *E. coli* with 200 MPN/100 mL and total coliforms exceeding PWQO criterion (1,000 MPN/100mL) with 2,000 MPN/100 mL on July 29, 2010. Iron also slightly exceeded PWQO criterion (0.3 mg/L) with 0.518 mg/L on July 29, 2010. This low exceedance was likely caused by naturally occurring geologic formations, with many observations of iron rich sediments in the surrounding area.

### 4.11 Site 11: Garbutt Road

Location Reference for Site 11	
Location Description	Located off of Garbutt Road in a highly rural area, adjacent to agricultural activity.
UTM Coordinates	Northing 5363198/ Easting 301704
Altitude/Elevation	302.343 metres above sea level



<b>Field Measurements for Site 11</b>		
Parameter	Unit	Date: July 29, 2010
		Time: 9:40 am to 10:10 am
Water Temperature	°C	18.91
Conductivity	µS/cm	474
Dissolved Oxygen	mg/L	<b>4.20</b>
Dissolved Oxygen	%	44.5
pH		7.58
Air Temperature	°C	25
Channel Width	m	1.9
Channel Depth	m	0.6
Velocity	m/s	No flow

\*Bold #'s indicate exceedance of PWQO guidelines

<b>Laboratory Water Quality Results for Site 11</b>		
Parameter	Unit	Date: July 29, 2010
		Time: 9:40 am
<b>Bacteriological</b>		
<i>Escherichia Coli</i>	MPN/100mL	<b>440</b>
Total Coliforms	MPN/100mL	<b>&gt; 2420</b>
<b>Physical</b>		
Conductivity (EC)	µS/cm	470
Total Dissolved Solids	mg/L	329
Turbidity	NTU	11.3
<b>Nutrients</b>		
Ammonia-N, Total	mg/L	0.021
Chloride (Cl)	mg/L	14.9
Nitrate-N (NO <sub>3</sub> -N)	mg/L	<0.030
Nitrite-N (NO <sub>2</sub> -N)	mg/L	<0.020
Phosphorus (P)-Total	mg/L	<b>0.116</b>
Sulphate (SO <sub>4</sub> )	mg/L	<0.30
<b>Metals</b>		
Aluminum (Al)	mg/L	<b>0.265</b>
Cadmium (Cd)	mg/L	<0.000090
Copper (Cu)	mg/L	0.0022
Iron (Fe)	mg/L	<b>2.31</b>
Lead (Pb)	mg/L	<0.0010

\*Bold #'s indicate exceedance of PWQO guidelines

<b>Flora Observed at Site 11</b>	
<b>FEC V-Type: NA</b>	
<b>Species</b>	
<b>Trees</b>	White Birch
	Balsam Poplar
	White Spruce
	Balsam Fir
<b>Shrubs</b>	Bog Willow*
	Raspberry*
	Speckled Alder



<b>Ground Cover</b>	Fireweed
	Jewel Weed
	Water Hemlock
	Wild Mint
	Yarrow
	Oxe-Eye Daisy
	Fowl Meadow Grass
	Cow Parsnip
	Blue Joint Grass
	Meadowsweet
	Thistle
	Yellow Hawkweed
	Cow Vetch
	Joe-Pye Weed
	Canada Goldenrod
Birdsfoot Trefoil	
<b>Aquatic Macrophytes and Algae</b>	Algae
	Broad-leaved Arrowhead Wapato
	Water Arum
	Floating Leaved Burweed
	Water Plantain
	Horsetail*

\* Indicates dominant species

<b>Fauna Observed at Site 11</b>		
<b>Species</b>		<b># Observed</b>
<b>Birds</b>	-	-
<b>Mammals</b>	Horses	2
<b>Amphibians</b>	-	-
<b>Fish</b>	Minnows	~10
<b>Mollusca</b>	-	-
<b>Crustaceans</b>	-	-
<b>Insects</b>	Dragon flies	1
	Water striders	~10
<b>Other</b>	-	-

<b>Substrate Observations for Site 11</b>		<b>Soil Pit Observations</b>	
<b>Percentage Shaded</b>	25-50 %	<b>Soil Characteristics</b>	Construction gravel
<b>Substrate Classification</b>	Muck and boulders		
<b>Abundance of aquatic vegetation</b>	Abundant emergent, few submergent		



## General Observations

Site 11 was located off Garbutt Road and was not previously sampled in 1998. This site was located in a rural area with agricultural activity in close proximity. The flow of water ran perpendicular to the road and samples were taken adjacent to the road. Site 11 was located within a tributary of the northeast portion of the watershed north of Cedar Creek. The water at the sampling site was stagnant, with vegetation obstructing flow upstream of the culvert. The culvert was considerably rusted and cracked and it appeared that flow had been blocked for a significant period of time. The water at the sampling site was highly turbid with considerable algae growth present. Upon arrival at the site, two horses were standing in the stagnant pool downstream of the sampling location. The substrate appeared to be organic muck with boulders and some cobble. Vegetation along the stream bank was very thick, predominately composed of shrubs and herbs which provided some shade over the stream. Upstream of the culvert was wetland habitat with thick vegetation. The dominant vegetation was bog willow and wild red raspberry. A lack of trees prevented an FEC classification to be made. Photo documentation of 2010 observations can be found in Appendix H.

Total coliforms and *E. coli* concentrations were considerably greater than other sites sampled in the watershed. This suggests there may have been a local source of contamination upstream from Site 11, causing the exceedingly high concentrations of fecal coliforms. The site was located in a rural region, suggesting the cause may have been from an anthropogenic (i.e. livestock, sewage) source.

## Results and Discussion

Site 11 exceeded more PWQO criteria than the other sites sampled in 2010. The DO concentration recorded at this site was the lowest observed in the watershed, exceeding PWQO criterion (minimum of 5 mg/L) with a concentration of 4.20 mg/L on July 29, 2010. Laboratory results reported several exceedances of PWQO criteria, including *E. coli*, total coliforms, phosphorus, iron, and aluminum. *E. coli* concentrations were the highest observed at any site with a concentration of 440 MPN/100 mL, significantly above the PWQO criterion (100 MPN/100 mL) and total coliforms exceeded pre 1994 PWQO criterion (1,000 MPN/100 mL) with a concentration greater than 2,420 MPN/100 mL. The presence of two horses in the stagnant body of water prior to sampling may be responsible for the exceedance of both total coliforms and *E. coli* concentrations. The high coliform concentrations along with the stagnant water reported from Site 11 may also have been responsible for the exceedingly low DO concentrations.

Phosphorus exceeded PWQO criterion (0.03 mg/L) with a concentration of 0.116 mg/L. This concentration may be associated with the decay of organic matter from either plant material or fecal matter. It may also have been in response to agricultural practices, such as the use of fertilizers.



Aluminum exceeded PWQO (0.075 mg/L) with a concentration of 0.265 mg/L on July 29, 2010. Iron concentrations for Site 11 were the highest of any site, exceeding the PWQO (0.3 mg/L) with a concentration of 2.31 mg/L. The exceedance of the two metals was likely in response to a localized source. These metals commonly occur in nature. The stagnant nature of the sampling site may have also allowed for the buildup of metals over time and rusting observed within the culvert may have contributed to the higher than average iron concentrations.



## 4.12 Overall Site Summary

		<b>Site 2</b>	<b>Site 4</b>	<b>Site 5</b>	<b>Site 6</b>	<b>Site 7</b>	<b>Site 9</b>	<b>Site 10</b>	<b>Site 11</b>
		Date: July 29, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 29, 2010	Date: July 29, 2010
Parameter	Unit	Time: 10:40 am	Time: 11:20 am	Time: 12:12 pm	Time: 11:45 am	Time: 11:00 am	Time: 10:05 am	Time: 12:05 pm	Time: 9:40 am
Water Temperature	°C	18.23	20.62	19.82	18.39	19.44	20.42	20.56	18.91
Conductivity	µS/cm	202	196	196	190	130	92	214	474
Dissolved Oxygen	mg/L	8.9	8.43	8.12	8.81	7.38	6.74	8.49	<b>4.20</b>
Dissolved Oxygen	%	94.7	93.9	89.0	94	80.3	74.8	94.1	44.5
pH		8.21	8.10	7.83	7.93	7.5	7.86	7.93	7.58
Air Temperature	°C	21	24	23	22	19.44	20	26	25
Channel Width	m	6.4	3.6	5.6	4.6	3.9	3.2	5	1.9
Channel Depth	m	0.23	0.36	0.4	0.19	0.47	0.82	0.2	0.6
Velocity	m/s	0.46	0.21	0.3	0.4	0.6	0	0.55	0

\*Bold #'s indicate exceedance of PWQO guidelines

Parameter	Unit	Averages from 1998 Field Measurements	Averages for all 2010 Field Measurements
Water Temperature	°C	19.19	19.55
Conductivity	µS/cm	221.2	211.75
Dissolved Oxygen	mg/L	8.29	7.6
Dissolved Oxygen	%	NA	83.16
pH		7.6	7.87
Air Temperature	°C	24	22.13
Channel Width	m	NA	4.28
Channel Depth	m	0.38	0.41
Velocity	m <sup>3</sup> /s	NA	0.53



**Table 6.0: Summary of 2010 Laboratory Results**

Parameter	Unit	Site 2	Site 4	Site 5	Site 6	Site 7	Site 9	Site 10	Site 11	
		Date: July 29, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 28, 2010	Date: July 29, 2010	Date: July 29, 2010
		Time: 10:40 am	Time: 11:20 am	Time: 12:12 pm	Time: 11:45 am	Time: 11:00 am	Time: 10:05 am	Time: 12:05 pm	Time: 9:40 am	
<b>Bacteriological</b>										
<i>Escherichia Coli</i>	MPN/ 100 mL	10	91	71	16	29	3	<b>200</b>	<b>440</b>	
Total Coliforms	MPN/ 100 mL	<b>2400</b>	> <b>2420</b>	> <b>2420</b>	> <b>2420</b>	<b>2400</b>	<b>2400</b>	<b>2000</b>	> <b>2420</b>	
<b>Physical</b>										
Conductivity (EC)	µS/ cm	213	200	201	194	135	96.3	218	470	
Total Dissolved Solids	mg/L	122	116	120	118	89	76	128	329	
Turbidity	NTU	1.43	2.04	2.40	1.02	2.30	0.97	2.78	11.3	
<b>Nutrients</b>										
Ammonia-N, Total	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.021	
Chloride (Cl)	mg/L	2.25	1.85	1.93	0.53	0.75	0.78	2.44	14.9	
Nitrate-N (NO <sub>3</sub> -N)	mg/L	<0.030	<0.030	<0.030	<0.030	0.072	<0.030	<0.030	<0.030	
Nitrite-N (NO <sub>2</sub> -N)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	
Phosphorus (P)-Total	mg/L	0.0161	0.0208	0.0183	0.0128	0.0250	0.0235	0.0155	<b>0.116</b>	
Sulphate (SO <sub>4</sub> )	mg/L	4.87	4.61	4.61	5.97	2.45	3.83	4.83	<0.30	
<b>Metals</b>										
Aluminum (Al)	mg/L	0.014	0.028	0.028	0.020	0.017	0.031	0.044	<b>0.265</b>	
Cadmium (Cd)	mg/L	<0.000 090	<0.000 090	<0.000 090	<0.000 090	<0.000 090	<0.000 090	<0.000 090	<0.000 090	
Copper (Cu)	mg/L	<0.001 0	<0.001 0	<0.001 0	<0.001 0	<0.001 0	<0.001 0	0.0011	0.0022	
Iron (Fe)	mg/L	<b>0.346</b>	<b>0.425</b>	<b>0.532</b>	<b>0.201</b>	<b>0.633</b>	0.125	<b>0.518</b>	<b>2.31</b>	
Lead (Pb)	mg/L	<0.001 0	<0.001 0	<0.001 0	<0.001 0	<0.001 0	<0.001 0	<0.001 0	<0.001 0	

\*Bold #'s indicate exceedance of PWQO guidelines



<b>Table 7.0: Summary of Averages of 1998 and 2010 Laboratory Results</b>			
Parameter	Unit	Averages from all 1998 Laboratory Results	Averages from all 2010 Laboratory Results
<b>Bacteriological</b>			
<i>Escherichia Coli</i>	MPN/100mL	65.9	<b>107.5</b>
Total Coliforms	MPN/100mL	NA	<b>2300</b>
<b>Physical</b>			
Conductivity (EC)	µS/cm	NA	215.91
Total Dissolved Solids	mg/L	NA	137.25
Turbidity	NTU	2.422	3.03
<b>Nutrients</b>			
Ammonia-N, Total	mg/L	NA	0.021
Chloride (Cl)	mg/L	NA	3.18
Nitrate-N (NO3-N)	mg/L	NA	0.072
Nitrite-N (NO2-N)	mg/L	NA	<0.02
Phosphorus (P)-Total	mg/L	0.02	<b>0.031</b>
Sulphate (SO4)	mg/L	NA	4.453
<b>Metals</b>			
Aluminum (Al)	mg/L	NA	0.056
Cadmium (Cd)	mg/L	<0.001	<0.00009
Copper (Cu)	mg/L	NA	0.00165
Iron (Fe)	mg/L	<b>0.273</b>	<b>0.636</b>
Lead (Pb)	mg/L	<b>0.028</b>	<0.0011

\*Bold #'s indicate exceedance of PWQO guidelines

## 5 Overall Discussion

Overall, the watershed was in good condition with minimal exceedances based on the water quality analysis completed during the 2010 Cedar Creek Watershed Assessment. Significant changes to the water quality from 1998 to 2010 were found only in regard to point sources and site specific locations.

### 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 1998 the average temperature was 4.26 degrees Celsius, with a total of 183.5 millimetres of precipitation. From January to July 2010 the average temperature was 4.33 degrees Celsius with a total





of 256 millimetres of precipitation. There was significantly more precipitation in 2010, with temperatures comparable to 1998 observations. Water temperatures recorded in 2010 ranged from 18.23 degrees Celsius to 20.62 degrees Celsius and water temperatures recorded for 1998 ranged from 17.9 degrees Celsius to 21.5 degrees Celsius.

## **5.2 Hydrology**

Elevation plays an important role in the direction of water drainage and stream velocity. The highest point of elevation recorded for the 2010 sampling period was Site 9 (headwaters), which was 494.19 metres above sea level. The lowest point of elevation was Site 10 (confluence with the Whitefish River) which was 217.23 metres above sea level. Between Sites 10 and 9 the difference in elevation was 276.96 metres.

The channel characteristics have shown negligible change from 1998 to 2010. The average velocity measured in 2010 was 0.47 metres per second. Sites 9 and 11 had no flow, while Site 2 had the fastest velocity. Velocity recorded in 1998 ranged from no flow to 0.42 metres per second and velocity recorded in 2010 ranged from no flow to 0.55 metres per second. Channel depth recorded in 2010 ranged from 0.2 metres to 0.82 metres, while depth recorded in 1998 ranged from 0.15 metres to 0.68 metres. The average depth recorded in 1998 was 0.38 metres, compared to an average in 2010 of 0.41 metres. Channel widths measured during the 2010 sampling were highly variable, ranging from 1.9 metres to 6.4 metres. Width was not measured in 1998.

## **5.3 Dissolved Oxygen**

With the exception of Site 11, DO concentrations throughout the watershed during the 2010 sampling indicated relatively healthy sites. Excluding Site 11, DO concentrations from 2010 ranged from 6.74 mg/L to 8.81 mg/L. The DO concentration reported from Site 11 exceeded PWQO criterion (minimum of 5 mg/L) with a DO concentration of 4.20 mg/L. The water at Site 11 was stagnant, with high levels of coliform bacteria. Results indicated little change of DO from 1998 to 2010. In 1998 Site 9 exceeded DO PWQO criteria (must be greater than 5 mg/L) with an average concentration of 3.77 mg/L. During sampling in 1998, minimal aquatic vegetation was observed at Site 9. In 2010 a high density of aquatic vegetation was observed with a healthy DO concentration of 6.74 mg/L. The increase in aquatic vegetation may be responsible for the improvement of the DO concentration at this location.

## **5.4 pH**

Similar pH values were recorded for both the 1998 and 2010 reports. Results from 1998 had pH values ranging from 6.31 to 8.18, with an average pH of 7.6 for the watershed. Results from 2010 indicated basic pH values ranging from 7.5 to 8.21, with an average of 7.87. Site 9 was the only site in 1998 to exceed PWQO criterion of pH (6.5-8.5) with an average pH of 6.31. The pH from Site 9 appeared to have improved from 1998 to 2010, increasing in pH to 7.86.



## 5.5 Bacteriological

Total coliforms exceeded pre-1994 PWQO criterion (1,000 MPN/100 mL) at every sampling site in 2010. The total coliform concentrations in 2010 ranged from 2,000 to greater than 2,400 MPN/100 mL with an average of 2,300 MPN/100 mL for the watershed. Natural sources of fecal coliforms are often concentrated in wetlands and along the shorelines of lakes and rivers if there is an abundance of warm blooded wildlife. Other sources, such as human or livestock waste, are known to cause concentrated amounts of coliforms to occur through runoff or poor waste water management techniques. The headwaters, Site 9, located in a relatively pristine location isolated from anthropogenic inputs, still produced a total coliform concentration of 2,400 MPN/100 mL, which exceeded pre-1994 PWQO (1,000MPN/100 mL). The high total coliform concentrations were likely the product of natural processes.

Laboratory results from 2010 sampling reported two sites with concentrations of *E. coli* which exceeded PWQO guideline (100 MPN/100 mL). Site 11 produced an *E. coli* concentration of 440 MPN/100 mL on July 29, 2010, where Site 10 produced a concentration of 200 MPN/100mL. The high *E. coli* concentration at Site 11 may have been from the horses observed standing in the stagnant water at the sampling location.

Results from the 1998 sampling period indicated exceedances of *E. coli* PWQO at Site 5 with an average of 250 MPN/100 mL and from Site 7 with an average of 103.3 MPN/100 mL. During 2010 neither Site 5 (71 MPN/100 mL) or Site 7 (29 MPN/100 mL) resulted in *E. coli* concentrations above the PWQO.

## 5.6 Metals

Iron concentrations from all 2010 sampling sites, with the exception of Site 9, exceeded PWQO criterion (0.3 mg/L) at the time of sampling in 2010. Iron concentrations ranged from 0.125 mg/L to 2.31 mg/L with an average of 0.636 mg/L. The highest iron concentration in 2010 was from Site 11, with a concentration of 2.13 mg/L. Site 7 followed with an iron concentration of 0.633 mg/L. The range of values observed throughout the watershed between 1998 and 2010 were similar. The 1998 sampling reported iron concentrations ranging from 0.03 mg/L to 0.96 mg/L with an average of 0.273 mg/L.

In the 1998 report the highest iron concentration was from Site 1, exceeding PWQO criterion (0.3mg/L) with a concentration of 0.96 mg/L. On August 12, 1998 Site 1, the iron concentration decreased to 0.04mg/L. The 1998 data indicated the variable nature of iron concentrations found in aquatic environments. The high iron concentrations and iron rich soils found at every site suggest the concentrations are likely of geologic origin.

Aluminum was the only other metal to exceed PWQO criterion (0.075 mg/L) in 2010 with a concentration of 0.265 mg/L at Site 11. Aluminum is the most abundant metal found in nature and its presence may be caused naturally or by local industry and



residents. Lead and cadmium were tested in 1998 and 2010, with no significant changes observed between the two years. The 2010 laboratory results found lead concentrations to be within PWQO criterion (0.001 mg/L to 0.005mg/L dependent upon hardness) for all sites. The 1998 report indicated that two sites exceeded PWQO criterion for lead. The exceedances observed at Site 2 (0.05 mg/L) and at Site 6 (0.03 mg/L), both of which were sampled on July 16, 1998. Cadmium did not exceed the PWQO criterion (0.001 mg/L to 0.005 mg/L dependent upon hardness) at any site for either study period.

## **5.7 Nutrients**

Nutrient concentrations observed throughout the watershed in 2010 were relatively low, with only one exceedance. Phosphorus concentrations were low for nearly all sites, with the exception of Site 11, which exceeded PWQO criterion (0.03 mg/L) with a concentration of 0.116 mg/L. Site 11 was adjacent to agricultural activity and concentrations of phosphorus may have been increased by inputs of organic matter. The 1998 sampling period reported relatively low concentrations of phosphorus from all sites. Ammonia concentrations were low at all sites with no exceedances of PWQO criterion. The highest concentration was observed at Site 11 with a concentration of 0.021 mg/L which was still below PWQO criterion (0.036 mg/L). Chloride, nitrate and nitrite were below PWQO criteria as well, with many of the concentrations at less than detectable levels. The chloride concentration observed at Site 11 was significantly higher than any other sites, with a concentration of 14.9 mg/L. Ammonia, chloride, nitrate and nitrite were not tested in 1998, therefore no comparison could be made.

## **5.8 Conductivity and Turbidity**

Laboratory results for conductivity ranged from 96.3  $\mu\text{S}/\text{cm}$  to 470  $\mu\text{S}/\text{cm}$  with an average of 215.91  $\mu\text{S}/\text{cm}$ , while field measurements of conductivity ranged from 92  $\mu\text{S}/\text{cm}$  to 474  $\mu\text{S}/\text{cm}$  with an average of 211.75  $\mu\text{S}/\text{cm}$ . In 2010 turbidity ranged from 0.97 to 2.78 NTU, which in 1998 turbidity ranged from 0.55 to 4.16 NTU. Both study period results for turbidity are considered low. Site 11 appeared to have considerably higher turbidity values than any other site. The turbidity at Site 11 was 11.3 NTU with the next highest turbidity found at Site 10, with a value of 2.78 NTU. The general trend of increasing conductivity was also reported in 1998. Conductivity averages observed in 1998, ranged from 78  $\mu\text{S}/\text{cm}$  to 505  $\mu\text{S}/\text{cm}$ .

## **5.9 Substrate**

Substrate observations were highly variable throughout the watershed, consisting of muck, cobble, boulders, sand, and bedrock. Sites 11 and 9 were the only sites with silty muck substrate and were also the only two sites capable of supporting aquatic vegetation other than algae. Wildlife observations were highly variable as well, with no trend or outstanding observations of any kind. The 2010 vegetation survey did not yield any species which were invasive or endangered at the time of sampling, however, changes to



the structure and composition of vegetation from 1998 and 2010 were noticeable, with the only site maintaining the same FEC classification for both sampling periods being Site 9.



## 6 Conclusion

In conclusion, water quality analysis completed for the 2010 Cedar Creek Watershed Assessment indicated that overall the Cedar Creek Watershed was in good condition with minimal exceedances of PWQO at the time of sampling. The 2010 laboratory results indicated two parameters, iron and total coliforms, that consistently exceeded PWQO criteria at every sampling site, with the exception of iron at Site 9. It was likely the exceedingly high total coliform and iron concentrations were the result of naturally occurring processes within the watershed. *E. coli* also exceeded PWQO criterion at two sites. Laboratory results indicated that Site 11 had the poorest water quality of all sampling locations, exceeding PWQO criteria of DO, *E. coli*, total coliforms, phosphorus, iron and aluminum. The high concentrations reported from this location may have been caused by agricultural activity located adjacent to the sampling site. During the 2010 study, horses were observed standing in the water at Site 11. The low DO concentrations reported from Site 11 may have been caused by the stagnant water at the site, as well as the high bacteria concentrations. Lead exceeded PWQO criterion (0.001 mg/L to 0.005 mg/L dependent upon hardness) in 1998 with an average concentration of 0.028 mg/L, but did not exceed the criterion in 2010 with an average concentration of <0.0010 mg/L.

Furthermore, comparison of 1998 and 2010 water quality results from the Cedar Creek Watershed indicated minimal change between the two study periods. Any changes in physical parameters reported from 1998 to 2010 (i.e. conductivity, water temperature and depth) were likely caused by natural variation.



## 7 Recommendations

Upon completion of the 2010 Cedar Creek Watershed Assessment, the following recommendations have been made for consideration:

- Staff and funding permitting it is recommended that an update to the 2010 Cedar Creek Watershed Assessment 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.
- Site 11 should be a key point of interest for future studies of the watershed.

A copy of this report should be provided to the Townships of O'Connor and Conmee for reference purposes. The Report should be kept on file at the LRCA Administration Office for review by interested parties.



## 8 References

- CEQE. 1999. Canadian Water Quality Guidelines for the Protection of Aquatics Life: Dissolved Oxygen (Fresh Water). Canadian Council of Ministers of the Environment.
- Dillon Consulting Engineers and Planners. 1975. Rosslyn Village Drainage Study, Prepared for the Lakehead Region Conservation Authority. M. M. Dillon Limited
- Edberg, S.C., Rice, E.W., Karlin, R.J., and Allen, M.J. (2000) *Escherichia coli*: the best biological drinking water indicator for public health protection. *J. Appl. Microbiology*, 88: 106S–116S.
- Gartner Lee Limited (GLL). 2007. Lake of Bays – 2006 Water Quality Monitoring Program. Gartner Lee Limited.
- Hartley, B. 1985. Cedar Falls Conservation Area. Lakehead Region Conservation Authority.
- Hartviksen, C., W. Momot. 1987. Fishes of the Thunder Bay Area of Ontario. A Guide for Identifying and Locating the Local Fish Fauna. Wildwood Publications, R.R. 13, Box 65, Thunder Bay Ontario. P7B 5E4.
- Leclerc, H., Mossel, D.A.A., Edberg, S.C., and Struijk, C.B. (2001) Advances in the bacteriology of the coliform group: their suitability as markers of microbial water safety. *Annual Review Microbiology*, 55: 201–234.
- TBFN. 2010. Thunder Bay Field Naturalists Birding Page. Retrieved September 2, 2010 from <http://www.tbfn.net/birding.htm>
- LRCA. 1985. Cedar Falls Conservation Area Master Plan. Lakehead Region Conservation Authority, Thunder Bay Ontario, Canada
- LRCA. 1998. Cedar Creek Watershed Study. Lakehead Region Conservation Authority, Thunder Bay Ontario, Canada
- LRCA. 2008. Watershed Characterization Report. Lakehead Region Conservation Authority, Thunder Bay Ontario, Canada
- MNR. 2010. Ontario's Forest Regions. Retrieved September 2, 2010 from [http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02\\_163390.html](http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_163390.html). Ministry of Natural Resources.
- Rompré, A., Servais, P., Baudart, J., de-Roubin, M., and Laurent, P. (2002) Detection and enumeration of coliforms in drinking water: current methods and emerging approaches. *J. Microbiology*, 49: 31–54.

# MAPS








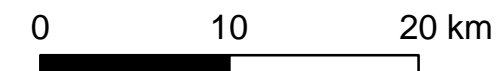
*Cedar Creek Watershed*

*M-1: Key Plan*



**Legend**

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

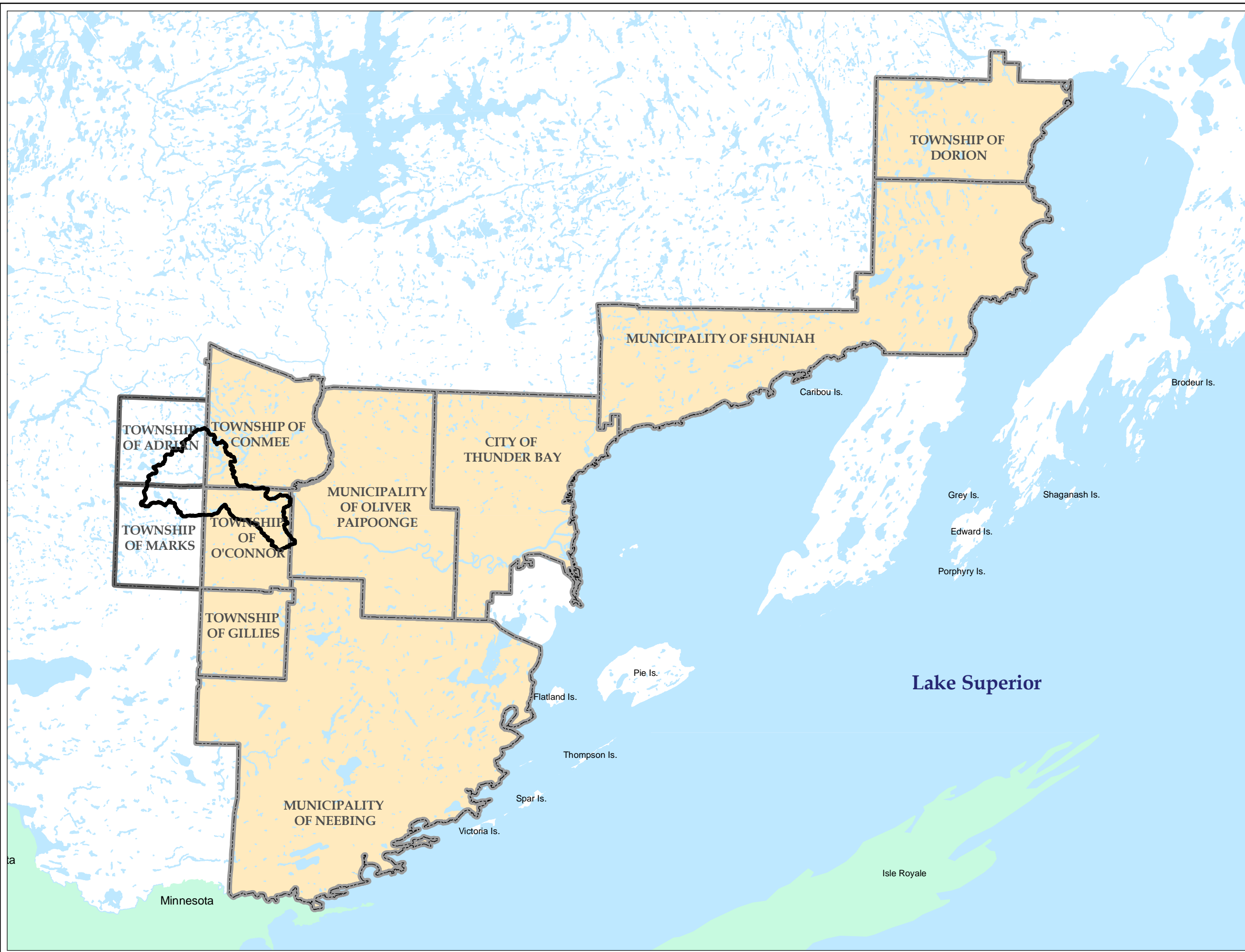


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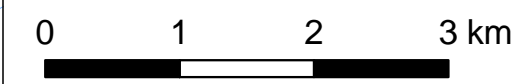
# Cedar Creek Watershed

## M-2: Site Plan



**Legend**

-  Sampling Site 1998
-  Sampling Site 1998 & 2010
-  New Sampling Site 2010
-  Cedar Creek Watershed
-  Conservation Authority Area
-  Landfill Area
-  Railway
- Roads**
-  Highway
-  Road
- Permanent Watercourse**
-  River
-  Creek
-  Stream
- Drainage**
-  Waterbody
-  Wetland

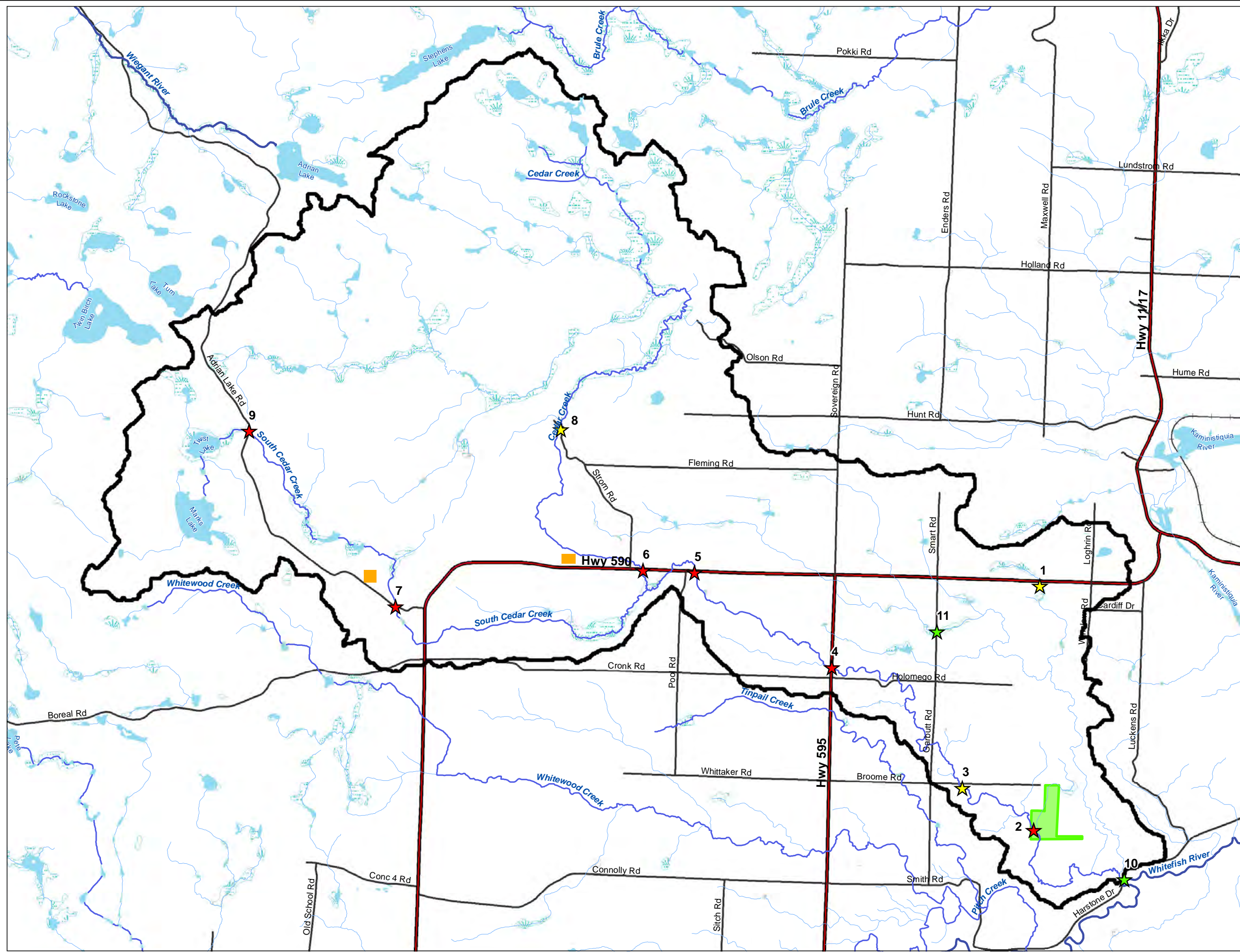


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# Cedar Creek Watershed

M-3: Topography



**Legend**

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

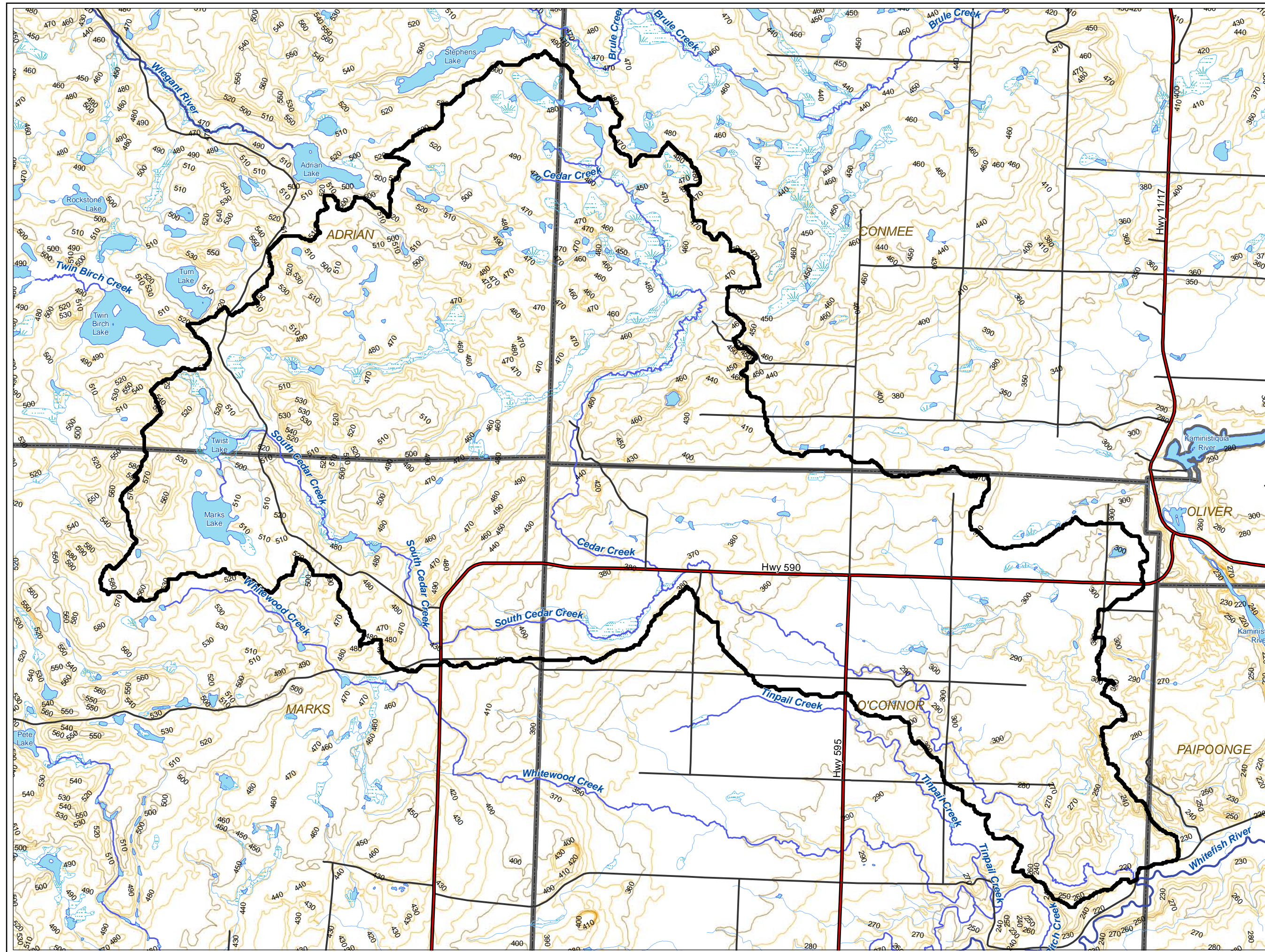


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Date: August, 2010



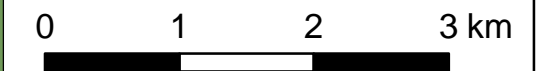
*Cedar Creek Watershed*

*M-4: Bedrock Geology*



**Legend**

- Cedar 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**
- 4, Mafic to ultramafic metavolcanic rocks
- 5, Mafic to intermediate metavolcanic rocks
- 6, Felsic to intermediate metavolcanic rocks
- 7, Metasedimentary rocks
- 10, Mafic and ultramafic rocks
- 11, Gneissic tonalite suite
- 14, Diorite - monzonite - granodiorite suite
- 15, Massive granodiorite to granite

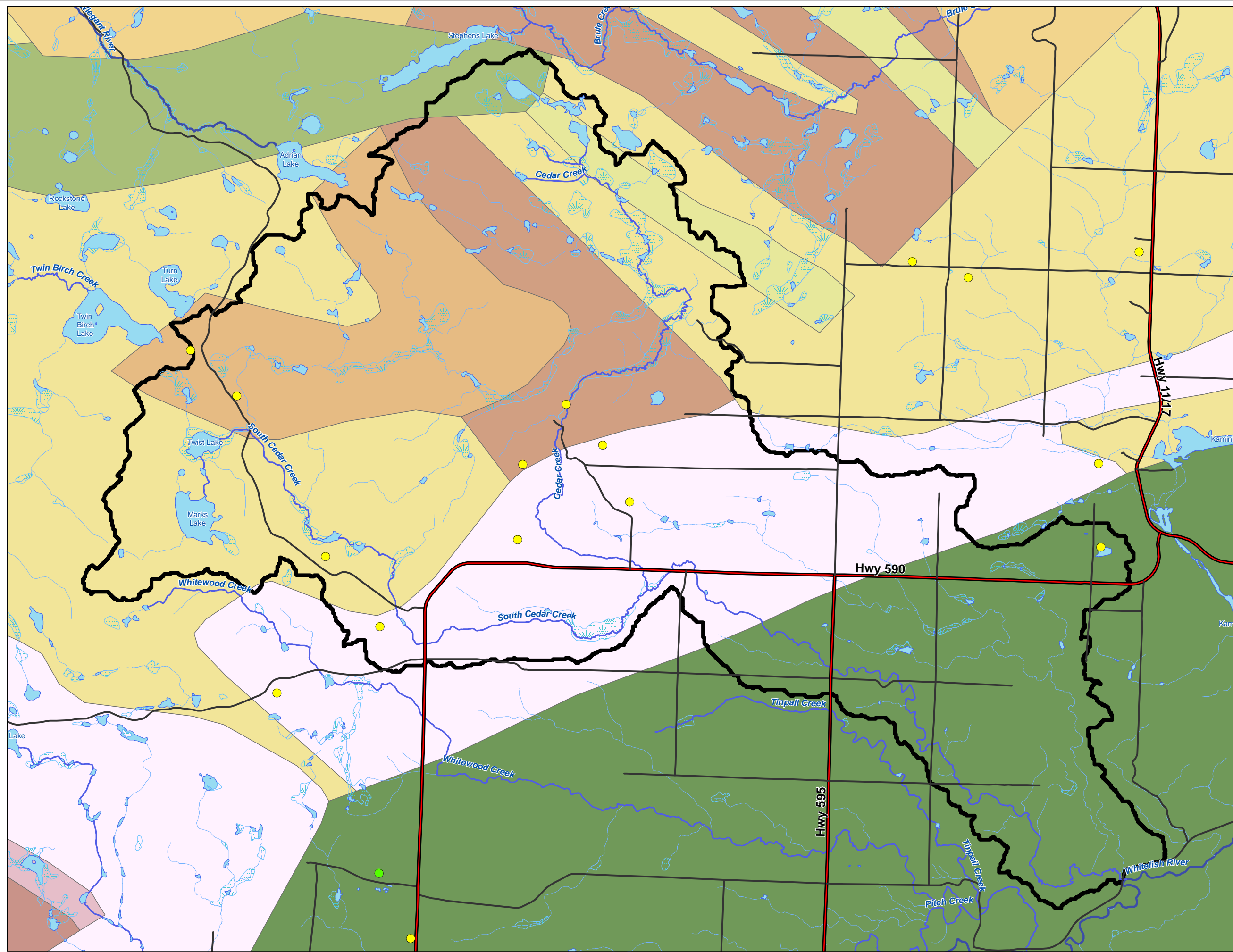


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Projection: UTM Zone 16N  
Date: August, 2010



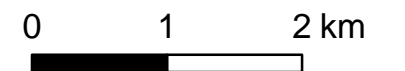
*Cedar Creek  
Watershed*

*M-5: Surficial Geology*



**Legend**

- Cedar 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

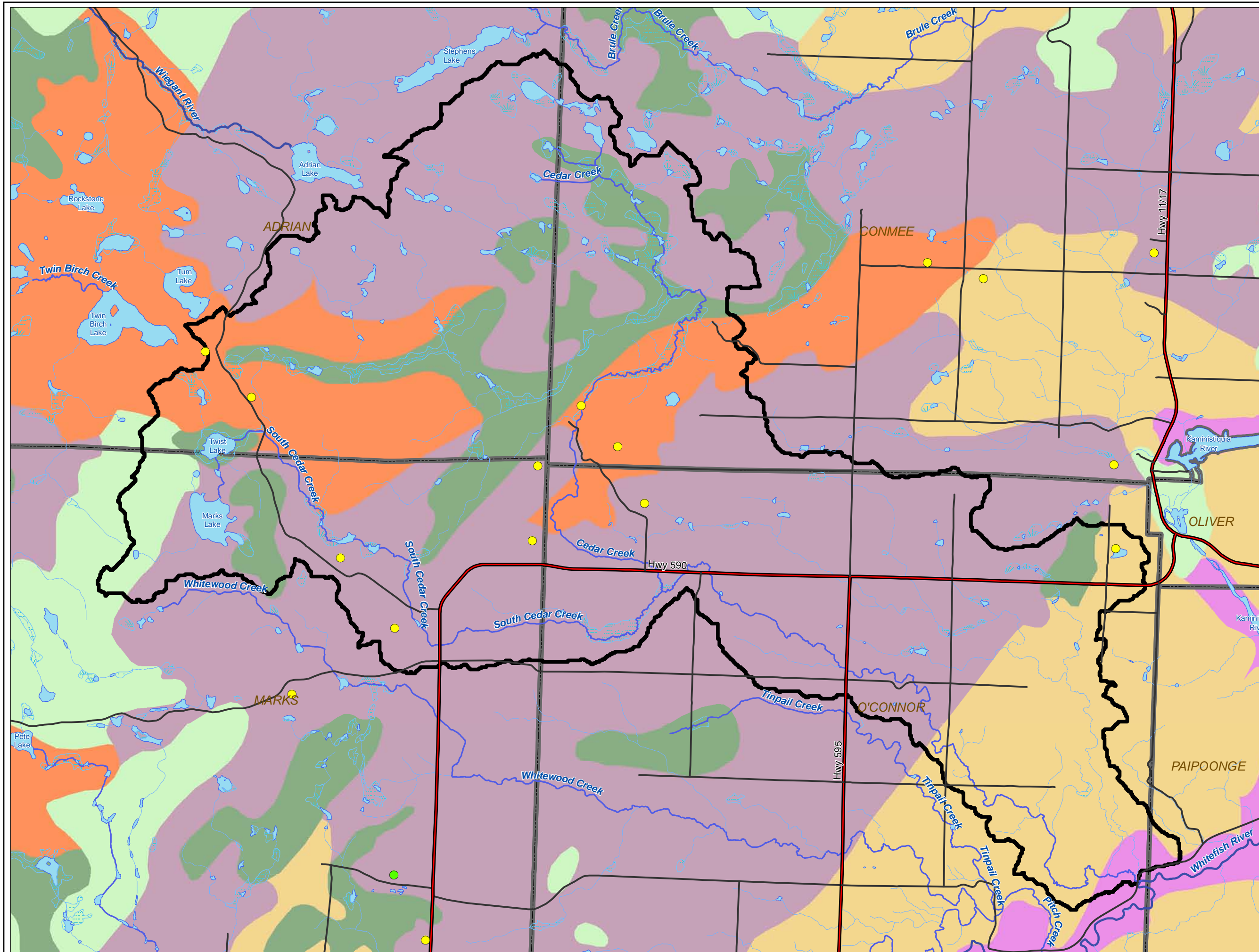


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Projection: UTM Zone 16N  
Date: August, 2010



# Cedar Creek Watershed

M-6: Soils



**Legend**

- Cedar Creek Watershed
- Township Boundary

**Roads**

- Highway
- Road

**Permanent Watercourse**

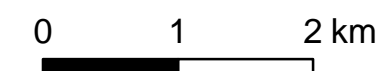
- River
- Creek
- Stream

**Drainage**

- Waterbody
- Wetland

**Thunder Bay Soils**

- CURRENT RIVER (C)
- DORION (D)
- FORMAL (F)
- JARVIS RIVER (J)
- LAPPE (L)
- MARSH (Ma)
- MCKELLAR (Mk)
- MUCK (M)
- NOLALU (N)
- ORGANICS - BAIRD (Bd)
- ORGANICS - PENASSEN (Pn)
- OSKONDOGA (O)
- PAIPOONGE (Pa)
- ROCKLAND (R)
- SLATE RIVER (SR)
- WOLFPUF (W)

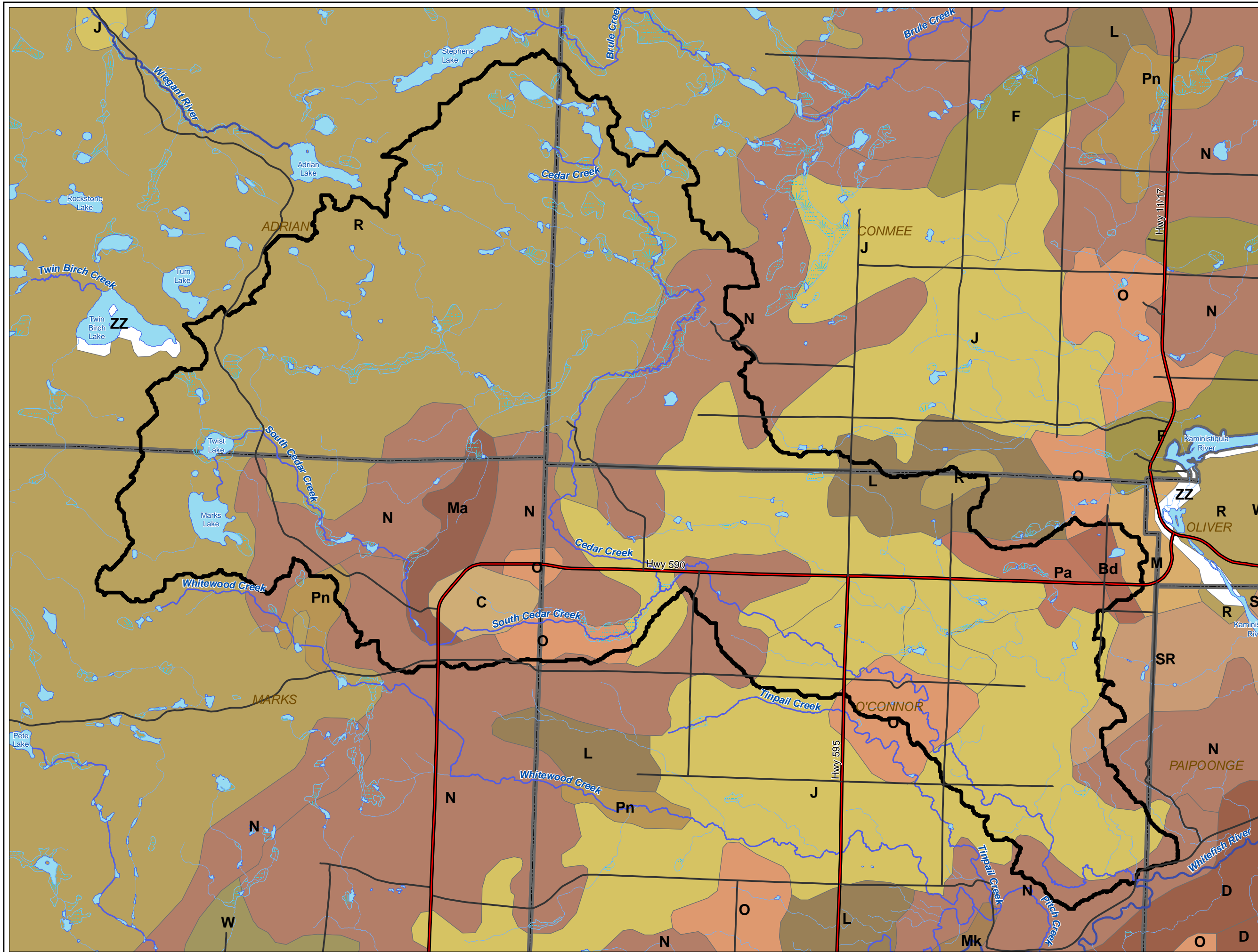


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 Projection: UTM Zone 16N  
 Date: August, 2010



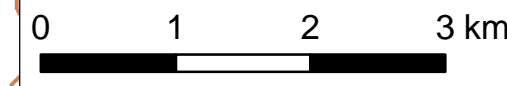
# Cedar Creek Watershed

*M-7: Approximate Regulated Areas*



**Legend**

- Cedar 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
- LRCA Owned Property

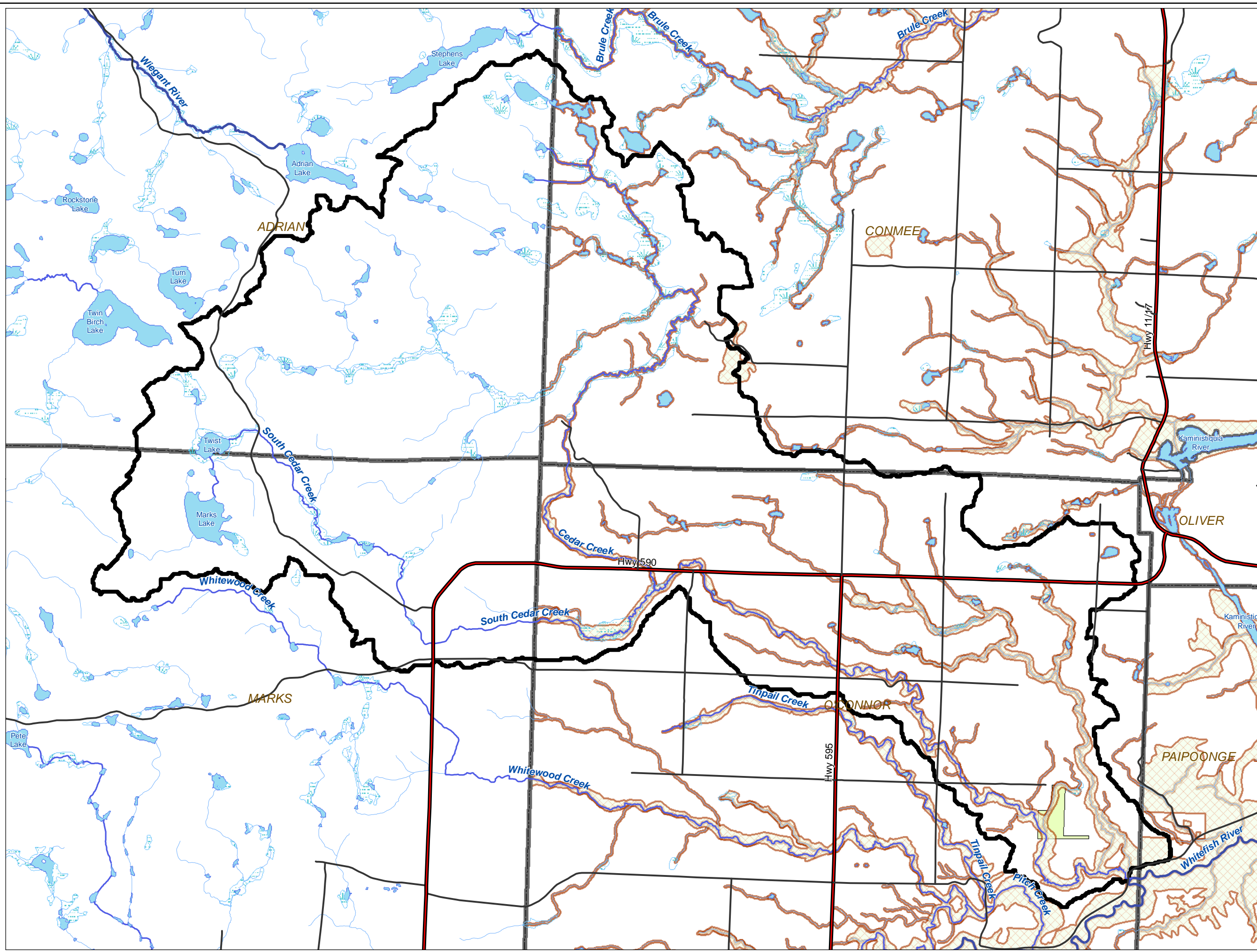


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Datum: NAD 83  
 Projection: UTM Zone 16N  
 Date: August, 2010



**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  $\pm 0.001$  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.

<b>Grain Size</b>	<b>Description</b>
<b>Boulder</b>	> 25.6 cm in diameter
<b>Cobbles</b>	6.4 - 25.6 cm in diameter
<b>Gravel</b>	0.2 – 6.4 cm in diameter
<b>Sand</b>	< 0.2 cm in diameter
<b>Silt</b>	Finer inorganic material than sand
<b>Muck</b>	Mainly organic combination of silt and clay
<b>Clay</b>	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:

<b>Description</b>	<b>% Cover</b>
<b>Dense</b>	75-100% shaded by canopy
<b>Partly Open</b>	25-75% shaded by canopy
<b>Open</b>	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**



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## 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 ( $\text{PO}_4$ ) or orthophosphate ion ( $\text{PO}_4^{-3}$ ) 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 ( $\text{NO}_3$ ) and nitrite ( $\text{NO}_2$ ). 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



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

### **Arsenic**

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

### **Barium**

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

### **Beryllium**

Beryllium is a hard grey metal that is extracted from the earth, refined and reduced to a very fine powder. It occurs as a chemical component of certain rocks, coal and oil, soil, and volcanic dust. People exposed to beryllium are at risk of developing serious debilitating diseases. Chronic beryllium disease (CBD or berylliosis) is a painful scarring of the lung tissue. Less common than CBD, acute (short—term) beryllium disease, causes lung inflammation resembling pneumonia. In severe cases, both diseases may be fatal. The maximum concentration of beryllium under PWQO guidelines depends on hardness. If CaCO<sub>3</sub> is >75 mg/L the maximum concentration of beryllium is 1100 µg/L and if the CaCO<sub>3</sub> is <75 mg/L the maximum concentration of Beryllium is 11 µg/L.

### **Bismuth**

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



### **Boron**

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

### **Cadmium**

Cadmium is an extremely toxic metal even in low concentrations. It is used commercially as a stabilizer in plastic, fungicides for golf courses, television picture tube phosphors, nickel-cadmium batteries, motor oils, and curing agents for rubber. Cadmium poisoning can lead to itai-itai disease, which initiates bone softening, joint pain and kidney failure. The maximum concentration of cadmium under PWQO guidelines is 0.2 µg/L. The interim PWQO guideline states if hardness as CaCO<sub>3</sub> 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





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

### **Iron**

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

### **Lead**

Lead is a very toxic metal to all forms of life, causing neurological damage and even death. Although natural occurrences can occur from precipitation and the weathering of ores, the majority of lead in watercourses comes from anthropogenic sources. The PWQO requirement for lead varies with different alkalinity as CaCO<sub>3</sub> (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



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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 (NH<sub>3</sub>) 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:

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

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

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 NH<sub>3</sub> 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. °C	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:

<b>PH values</b>	<b>Interim PWQO (µg/L)</b>
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 CaCO <sub>3</sub> (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 CaCO <sub>3</sub> (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 CaCO <sub>3</sub> (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:

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

***Magnesium:***

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

***Manganese:***

There are currently no PWQO guidelines for Manganese.

***Molybdenum:***

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

***Nickel:***

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

***Potassium:***

There are currently no PWQO guidelines for Potassium.

***Selenium:***

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

***Silicon:***

There are currently no PWQO guidelines for Silicon.

***Silver:***

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

***Strontium:***

There are currently no PWQO guidelines for Strontium.

***Thallium:***

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

***Tin:***

There are currently no PWQO guidelines for Tin.

***Titanium:***

There are currently no PWQO guidelines for Titanium.



***Tungsten:***

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

***Uranium:***

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

***Vanadium:***

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

***Zinc:***

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

***Zirconium:***

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

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

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

***Nitrate:***

The amount of nitrate in freshwater should not exceed 2900 µg NO<sub>3</sub>-N/ L.

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

***Nitrite:***

The amount of nitrite in freshwater should not exceed 60 µg NO<sub>2</sub>-N/L.

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

**APPENDIX D:**

**LABORATORY WATER  
QUALITY RESULTS**



## Appendix D: Laboratory Water Quality Results

<b>Laboratory Results from Site 2: Cedar Falls Conservation Area</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>29-JUL-10</b>
<b>Physical Tests</b>			10:40
Conductivity (EC)	uS/cm	n/a	213
Total Dissolved Solids	mg/L	n/a	122
Turbidity	NTU	<10% of natural	1.43
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	2.25
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	0.0161
Sulphate (SO4)	mg/L	n/a	4.87
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	10
Total Coliforms	MPN/100mL	1000 (prior to 1994)	<b>2400</b>
<b>Total Metals</b>			
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	0.011
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	32.0
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	<b>0.346</b>
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	6.79
Manganese (Mn)	mg/L	n/a	0.0142
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.2
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	5.3
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0453
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 indicates exceedance of PWQO criterion



<b>Laboratory Results from Site 4- Hwy 595, Before Cronk Road, Downstream</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>28-JUL-10</b>
<b>Physical Tests</b>			13:10
Conductivity (EC)	uS/cm	n/a	200
Total Dissolved Solids	mg/L	n/a	116
Turbidity	NTU	<10% of natural	2.04
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	1.85
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	0.0208
Sulphate (SO4)	mg/L	n/a	4.61
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	91
Total Coliforms	MPN/100mL	1000 (prior to 1994)	<b>&gt; 2420</b>
<b>Total Metals</b>			
Aluminum (Al)	mg/L	0.075	0.028
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	<0.010
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	30.5
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	<b>0.425</b>
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	6.25
Manganese (Mn)	mg/L	n/a	0.0293
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.1
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	0.0452
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 indicates exceedance of PWQO criterion



<b>Laboratory Results from Site 5 – HWY 590, Before Pool Road, Downstream</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>28-JUL-10</b>
<b>Physical Tests</b>			12:20
Conductivity (EC)	uS/cm	n/a	201
Total Dissolved Solids	mg/L	n/a	120
Turbidity	NTU	<10% of natural	2.40
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	1.93
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	0.0183
Sulphate (SO4)	mg/L	n/a	4.61
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	71
Total Coliforms	MPN/100mL	1000 (prior to 1994)	> <b>2420</b>
<b>Total Metals</b>			
Aluminum (Al)	mg/L	0.075	0.028
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	<0.010
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	29.4
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	<b>0.532</b>
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	5.99
Manganese (Mn)	mg/L	n/a	0.0393
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.0
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	5.5
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0440
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 indicates exceedance of PWQO criterion





<b>Laboratory Results from Site 6 - Highway 590, Before Strom Road, Downstream</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>28-JUL-10</b>
<b>Physical Tests</b>			
Conductivity (EC)	uS/cm	n/a	11:45
Total Dissolved Solids	mg/L	n/a	194
Turbidity	NTU	<10% of natural	118
			1.02
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	0.53
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	0.0128
Sulphate (SO4)	mg/L	n/a	5.97
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	16
Total Coliforms	MPN/100mL	1000 (prior to 1994)	<b>&gt; 2420</b>
<b>Total Metals</b>			
Aluminum (Al)	mg/L	0.075	0.020
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	<0.010
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	31.2
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)	<0.0010
Iron (Fe)	mg/L	0.3	0.201
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	6.05
Manganese (Mn)	mg/L	n/a	0.0236
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.1
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	5.5
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0422
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 indicates exceedance of PWQO criterion



<b>Laboratory Results from Site 7 –Adrian Lake Road, Downstream</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>28-JUL-10</b>
<b>Physical Tests</b>			10:55
Conductivity (EC)	uS/cm	n/a	135
Total Dissolved Solids	mg/L	n/a	89
Turbidity	NTU	<10% of natural	2.30
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	0.75
Nitrate-N (NO3-N)	mg/L	n/a	0.072
Nitrite-N (NO2-N)	mg/L	n/a	<0.020
Phosphorus (P)-Total	mg/L	0.03	0.0250
Sulphate (SO4)	mg/L	n/a	2.45
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	29
Total Coliforms	MPN/100mL	1000 (prior to 1994)	<b>2400</b>
<b>Total Metals</b>			
Aluminum (Al)	mg/L	0.075	0.017
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	0.0013
Barium (Ba)	mg/L	n/a	<0.010
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	23.2
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)	<0.0010
Iron (Fe)	mg/L	0.3	<b>0.633</b>
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	2.99
Manganese (Mn)	mg/L	n/a	0.139
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	<1.0
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	4.7
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0408
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 indicates exceedance of PWQO criterion



<b>Laboratory Results from Site 9 – Headwaters, Adrian Lake Road</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>28-JUL-10</b>
<b>Physical Tests</b>			10:05
Conductivity (EC)	uS/cm	n/a	96.3
Total Dissolved Solids	mg/L	n/a	76
Turbidity	NTU	<10% of natural	0.97
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	0.78
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	0.0235
Sulphate (SO4)	mg/L	n/a	3.83
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	3
Total Coliforms	MPN/100mL	1000 (prior to 1994)	<b>2400</b>
<b>Total Metals</b>			
Aluminum (Al)	mg/L	0.075	0.031
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.011
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	16.8
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)	<0.0010
Iron (Fe)	mg/L	0.3	0.125
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	2.04
Manganese (Mn)	mg/L	n/a	0.0492
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	<1.0
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	3.1
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0329
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 indicates exceedance of PWQO criterion



<b>Laboratory Results from Site 10– Confluence with Whitefish River</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>29-JUL-10</b>
<b>Physical Tests</b>			12:05
Conductivity (EC)	uS/cm	n/a	218
Total Dissolved Solids	mg/L	n/a	128
Turbidity	NTU	<10% of natural	2.78
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	<0.020
Chloride (Cl)	mg/L	n/a	2.44
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	0.0155
Sulphate (SO4)	mg/L	n/a	4.83
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	<b>200</b>
Total Coliforms	MPN/100mL	1000 (prior to 1994)	<b>2000</b>
<b>Total Metals</b>			
Aluminum (Al)	mg/L	0.075	0.044
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	<0.0010
Barium (Ba)	mg/L	n/a	0.014
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	33.9
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)	0.0011
Iron (Fe)	mg/L	0.3	<b>0.518</b>
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	7.34
Manganese (Mn)	mg/L	n/a	0.0426
Molybdenum (Mo)	mg/L	0.04	<0.0010
Nickel (Ni)	mg/L	0.025	<0.0020
Potassium (K)	mg/L	n/a	1.3
Selenium (Se)	mg/L	0.1	<0.00040
Silicon (Si)	mg/L	n/a	5.9
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.0485
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 indicates exceedance of PWQO criterion



<b>Laboratory Results from Site 11- Garbutt Road, Downstream</b>			
<b>Parameter</b>	<b>Units</b>	<b>PWQO</b>	<b>29-JUL-10</b>
<b>Physical Tests</b>			09:40
Conductivity (EC)	uS/cm	n/a	470
Total Dissolved Solids	mg/L	n/a	329
Turbidity	NTU	<10% of natural	11.3
<b>Anions and Nutrients</b>			
Ammonia-N, Total	mg/L	n/a	0.021
Chloride (Cl)	mg/L	n/a	14.9
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	0.116
Sulphate (SO4)	mg/L	n/a	<0.30
<b>Bacteriological Tests</b>			
Escherichia Coli	MPN/100mL	100	<b>440</b>
Total Coliforms	MPN/100mL	1000 (prior to 1994)	<b>&gt; 2420</b>
<b>Total Metals</b>			
Aluminum (Al)	mg/L	0.075	<b>0.265</b>
Antimony (Sb)	mg/L	0.02	<0.0050
Arsenic (As)	mg/L	0.005 (interim)	0.0016
Barium (Ba)	mg/L	n/a	0.032
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	68.1
Chromium (Cr)	mg/L	0.001 for Cr(VI)	0.0013
Cobalt (Co)	mg/L	0.0009	<0.00050
Copper (Cu)	mg/L	0.005 (interim)	0.0022
Iron (Fe)	mg/L	0.3	<b>2.31</b>
Lead (Pb)	mg/L	0.001 (interim)	<0.0010
Magnesium (Mg)	mg/L	n/a	20.5
Manganese (Mn)	mg/L	n/a	0.890
Molybdenum (Mo)	mg/L	0.04	0.0020
Nickel (Ni)	mg/L	0.025	0.0031
Potassium (K)	mg/L	n/a	1.8
Selenium (Se)	mg/L	0.1	0.00048
Silicon (Si)	mg/L	n/a	8.9
Silver (Ag)	mg/L	0.0001	<0.00010
Strontium (Sr)	mg/L	n/a	0.105
Thallium (Tl)	mg/L	0.0003	<0.00030
Tin (Sn)	mg/L	n/a	<0.0010
Titanium (Ti)	mg/L	n/a	0.0087
Tungsten (W)	mg/L	0.03	<0.010
Uranium (U)	mg/L	0.005	<0.0050
Vanadium (V)	mg/L	0.006	0.0024
Zinc (Zn)	mg/L	0.02 (interim)	0.0057
Zirconium (Zr)	mg/L	0.004	<0.0040

\*Bold indicates exceedance of PWQO criterion

# APPENDIX E:

## 1999 LABORATORY, FIELD AND INVENTORY RESULTS



**Appendix E: 1998 Laboratory, Field and Inventory Results**

<b>July 16, 1998 Water Quality Analysis</b>									
Site	1	2	3	4	5	6	7	8	9
Time	10:00 am	10:40 am	11:00 am	11:30 am	12:00 am	1:00 am	1:30 am	2:00 am	3:00 am
Air Temp (°C)	27	28	28	29	29	29	30	31	31
Water Temp(°C)	18.3	19.4	20.2	20.5	21.0	18.5	21.2	18.5	26.0
pH	7.26	8.05	7.87	8.29	7.92	7.96	7.56	7.69	6.38
Conductivity μS/cm	445	225	240	220	225	185	188	175	75
DO (mg/L)	5.7	9.0	8.4	9.2	9.0	8.6	9.2	9.0	4.5
Depth (m)	0.5	0.2	0.5	0.2	0.2	0.2	0.2	0.2	0.5
E.coli (MPN/100 mL)	40	70	60	30	60	20	40	10	>10
Flow	slow	swift	slow	swift	swift	swift	slow	swift	slow

<b>July 29, 1998 Water Quality Analysis</b>									
Site	1	2	3	4	5	6	7	8	9
Time	10:35 am	11:15 am	11:50 am	12:30 pm	1:15 pm	1:40 pm	2:00 pm	2:20 pm	10:00 pm
Air Temp (°C)	21	21	21	22	24.5	25	25	25	19
Water Temp(°C)	17	17	19.9	18.5	19.1	17.3	19.8	18.1	18.3
pH	7.14	7.81	7.53	8.05	7.96	7.87	7.33	7.80	6.14
Conductivity μS/cm	650	200	220	180	200	180	115	170	85
DO (mg/L)	6.0	9.6	8.6	9.4	9.9	9.0	9.8	9.1	3.0
Depth (m)	0.55	0.10	0.80	0.40	0.25	0.25	0.25	0.54	0.42
E.coli (MPN/100 mL)	10	<10	30	70	560	20	260	<10	60
Flow	none	swift	slow	slow	slow	slow	slow	slow	slow



<b>August 12, 1998 Water Quality Analysis</b>									
Site	1	2	3	4	5	6	7	8	9
Time	9:35 am	10:50 am	9:55 am	11:20 am	1:35 pm	1:50 pm	2:30 pm	1:15 pm	10:35 am
Air Temp (°C)	16.5	18.5	16.8	19.3	23.0	23.0	25.0	22.5	18.0
Water Temp (°C)	17.9	17.4	17.8	16.4	20.0	18.4	20.9	17.0	20.3
pH	6.97	8.0	7.54	8.20	7.79	7.98	7.9	7.9	6.41
Conductivity $\mu$ S/cm	420	230	235	210	215	215	205	195	75
DO (mg/L)	8.6	9.8	8.4	9.8	8.4	8.5	10.6	9.0	3.8
Depth (m)	0.55	0.15	0.75	0.35	0.3	0.3	0.15	0.7	0.3
E.coli (MPN/100 mL)	70	30	50	70	130	<10	<10	10	30
Flow	none	swift	slow	slow	swift	swift	slow	slow	none

<b>Averages of 1998 Water Quality Analysis</b>								
Site #	Air Temp (°C)	Water Temp (°C)	pH	Conductivity	DO (mg/L)	Depth (m)	Flow (m/s)	E.coli (MPN/100 mL)
1	21.5	18.3	7.12	505	6.77	0.53	0.00	40
2	22.5	17.9	7.95	218	9.47	0.15	0.42	36.7
3	21.9	19.3	7.61	232	8.47	0.68	0.03	46.7
4	23.4	18.5	8.18	203	9.47	0.32	0.08	56.7
5	25.5	20.0	7.89	213	9.10	0.25	0.1	250.0
6	25.7	18.1	7.94	193	8.7	0.25	0.12	16.7
7	26.7	20.6	7.60	169	9.87	0.20	0.01	103.3
8	26.2	17.9	7.80	180	9.03	0.61	0.06	10.0
9	22.6	21.5	6.31	78	3.77	0.41	0.00	33.3





<b>Laboratory Water Quality Results for all 1998 data collection. Collected July 16, 1998.</b>								
Analytical Parameters	Units	Site 1	Site 2	Site 3	Site 6	Site 9	Range	Average
Cadmium	mg/L	0.0008	0.0004	0.0003	0.0002	0.0005	0.0006	0.00044
Iron	mg/L	0.96	0.51	0.34	0.25	0.46	0.71	0.50
Lead	mg/L	<0.025	0.050	<0.025	0.030	<0.025	0.050	0.031
Total Alkalinity	mg/L	94.4	122.0	118.0	95.8	40.6	81.4	94.2
Total Phosphorus	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	0	<0.01
Total Suspended Solids	mg/L	4.5	<0.1	<0.1	<0.1	8.0	9.0	2.6
Turbidity	mg/L	4.16	1.12	1.54	0.55	1.21	3.61	1.72

<b>Laboratory Water Quality Results for all 1998 data collection. Collected August 12, 1998.</b>								
Analytical Parameters	Units	Site 1	Site 2	Site 3	Site 6	Site 9	Range	Average
Cadmium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0	<0.0002
Iron	mg/L	0.04	0.04	0.04	0.03	0.08	0.05	0.046
Lead	mg/L	<0.025	<0.025	<0.025	<0.025	<0.025	0	<0.025
Total Alkalinity	mg/L	53.8	110	116	105.6	46.2	69.8	86.32
Total Phosphorus	mg/L	0.03	0.03	0.03	0.04	0.02	0.02	0.03
Total Suspended Solids	mg/L	7.5	<0.1	2.0	<0.1	4.5	7.40	2.84
Turbidity	mg/L	8.09	1.06	1.51	0.64	4.32	7.03	3.124

<b>Forest Ecosystem Classification for all 1998 Sampling Locations</b>	
<b>Site</b>	<b>Vegetation Type</b>
1	V-2: Black Ash Hardwood and Mixedwood
2	V-20: Black Spruce Mixedwood/ Feathermoss
3	V-19: Black Spruce Mixedwood/Herb Rich
4	V-1: Balsam Poplar Hardwood and Mixedwood
5	V-1: Balsam Poplar Hardwood and Mixedwood
6	V-1: Balsam Poplar Hardwood and Mixedwood
7	V-10: Trembling Aspen- Black Spruce - Jack Pine/Low Shrubs
8	V-1: Balsam Poplar Hardwood and Mixedwood
9	V-19: Black Spruce Mixedwood/Herb Rich



<b>Terrestrial Vegetation for 1998 Survey</b>			
<b>Site #</b>	<b>Tree species</b>	<b>Shrub species</b>	<b>Herb species</b>
1	black ash black spruce poplar	yarrow river birch	quack grass green foxtail birdsfoot trefoil swamp thistle purple loosestrife sweet white clover perennial cow thistle cattails cow vetch field horsetail new england aster
2	black spruce white birch balsam poplar	wild red raspberries aspen wild blueberries river birch	emetic russula red clover saskatoon black ferns cow vetch green foxtail ox-eye daisy grasses common ragweed rugels plantain bog goldenrod creeping bellflower flat topped white aster chicory
3	black spruce tamarack jack pine poplar	yarrow river birch balsam willow	grasses sweet white clover birdsfoot trefoil cow vetch ox-eye daisy bog goldenrod chicory
4	poplar black spruce white birch	wild red raspberries river birch red osier dogwood	grasses moss perennial sow thistle cow vetch chicory
5	poplar black spruce white spruce	wild red raspberries river birch	perennial sow thistle grasses purple loosestrife chicory



			ox-eye daisy daisy flea bane fox-tail barley swamp thistle cow vetch
6	poplar black spruce white spruce	yarrow river birch wild red raspberries	grasses cow vetch bog goldenrod purple loosestrife birdsfoot trefoil cattails swamp thistle perennial sow thistle ox-eye daisy
7	poplar black ash jack pine black spruce	river birch yarrow wild red raspberries highbush blueberry	grasses cow vetch cattails bog golden rod purple loosestrife arrowhead
8	poplar jack pine black spruce	river birch yarrow	cow vetch grasses moss bog golden rod
9	black spruce poplar balsam poplar white spruce white birch	wild red raspberries river birch yarrow shrubby St-John's wort autumn willow sandbar willow	grasses bog goldenrod red clover white sweet clover white clover green foxtail field horsetail tall wormseed mustard ox-eye daisy white water lilies little water lily bladderworts broad-leaved arrowhead

# APPENDIX F:

## FOREST ECOSYSTEM CLASSIFICATION



## Appendix F: Forest Ecosystem Classification

**Site 2: V-19 Black Spruce Mixedwood/Herb Rich**

**Site 4: V-1 Balsam Poplar Hardwood and Mixedwood**

**Site 5: V-4 White Birch Hardwood and Mixedwood**

**Site 6: NA**

**Site 7: V14 Balsam Fir Mixedwood**

**Site 9: V-19 Black Spruce Mixedwood/Herb Rich**

**Site 10: V-2 Black Ash Hardwood and Mixedwood**

**Site 11: NA**

### *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-2 Black Ash Hardwood and Mixedwood*

**Description:** Hardwood and mixedwood stands containing black ash in the overstory. The understory is typically dense and floristically diverse. Of limited areal extent; occurring in low-lying locations on deep, moist to wet, usually non-calcareous substrates.

### *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-14 Balsam Fir Mixedwood*

**Description:** An extremely variable mixedwood type. The canopy, comprising mainly of balsam fir, may contain a mixture of several species. The understory varies from shrub rich to moderately herb and shrub poor. Usually occurs on deep, fresh to moist, mineral soils but encompassing a wide range of soil and site conditions.

### *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**

<b>Trees</b>	
<b>Common Names</b>	<b>Latin Names</b>
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>

<b>Shrubs</b>	
<b>Common Names</b>	<b>Latin Names</b>
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>

<b>Herbs</b>	
<b>Common Names</b>	<b>Latin Names</b>
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 cernum</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 dilotata</i>
Twin Flower	<i>Linnaea borealis</i>
Thyme Leaved Sandwort	<i>Arenaria serphyllifolia</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 Aneome	<i>Anemone quinquefolia</i>
Woodland Strawberry	<i>Fragaria Vesca</i>

<b>Ferns/Mosses</b>	
<b>Common Names</b>	<b>Latin Names</b>
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>

<b>Aquatic Plants</b>	
<b>Common Names</b>	<b>Latin Names</b>
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>



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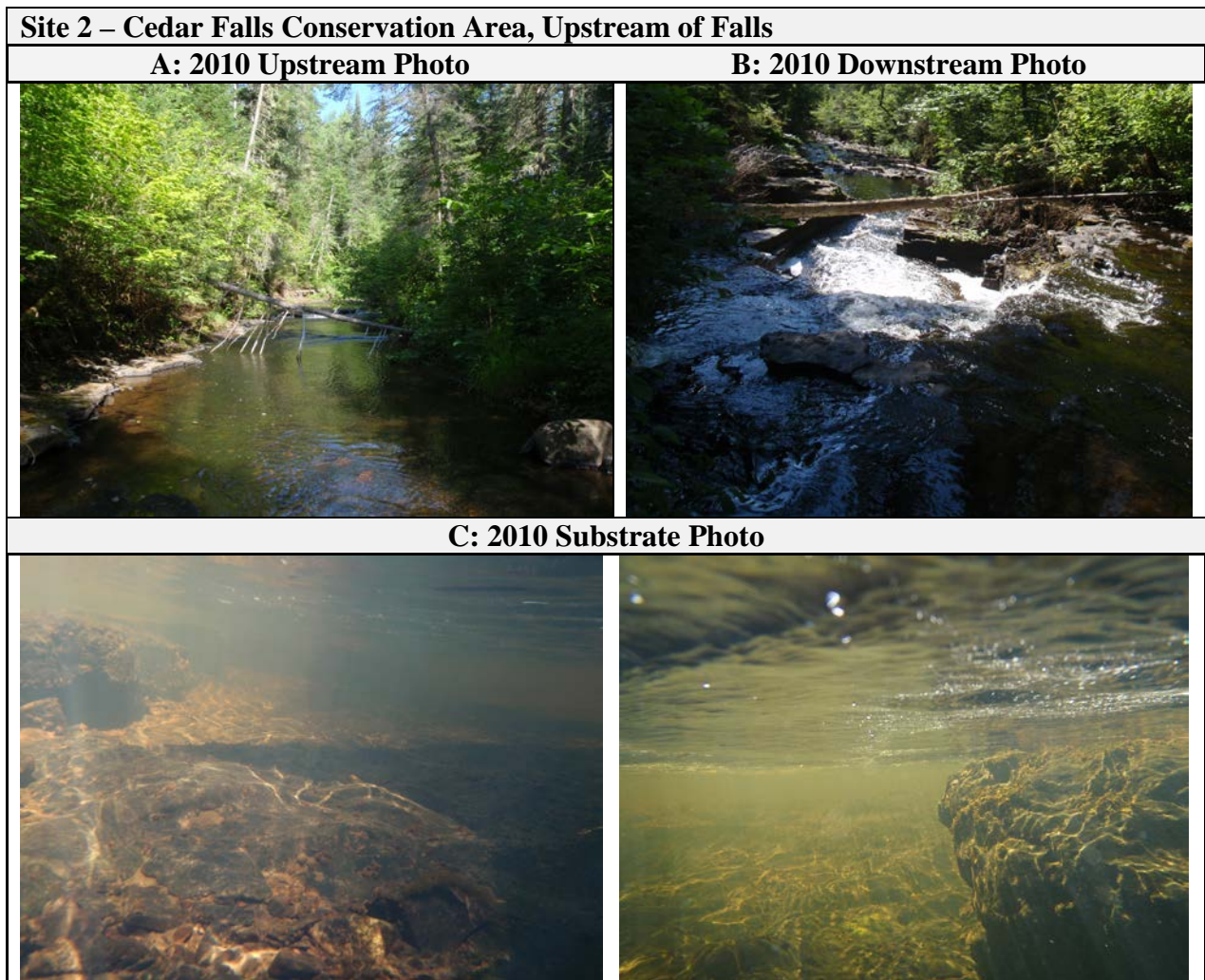
Pickerelweed	<i>Pontederia cordata</i>
Floating Leaved Burreed	<i>Sparganium fluctuans</i>
Duckweed	<i>Lemna spp</i>
Large Leaved Pondweed	<i>Potamogeton amplifolius</i>
Floating Leaved Pondweed	<i>Potamogeton natans</i>
Submerged Water Starwort	<i>Callitriche hermaphroditica</i>
Coontail	<i>Ceratophyllum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

# APPENDIX H

## SITE PHOTOGRAPHY AND DESCRIPTIONS



## Appendix H: Site Photography and Descriptions



### Comments

Site 2 was previously sampled July 16, July 29 and August 12 for the 1998 Cedar Creek Watershed Assessment Report. Site 2 was chosen for the 2010 update report as well, and was sampled July 29, 2010. This site was located within the LRCA Cedar Falls Conservation Area. The Cedar Falls Conservation Area covers an area of 22.4 hectares. The site was characterized by a bedrock substrate with a waterfall and pool directly downstream. Vegetation at this site was rich in diversity and primarily composed of black and white spruce, mountain maple, speckled alder, ferns, and large leaved aster. The flow of water was fast relative to other sites, with a shallow and wide channel. No wildlife was observed at this site. Photo documentation of this site was not completed during 1998 sampling.



**Site 4- Highway 595, before Cronk Road, Downstream**

**A: 2010 Upstream Photo**



**B: 2010 Downstream Photo**



**C: Substrate; Taken July 28, 2010**



**D: 1998 Upstream Photo**



**Comments**

Site 4 was located off Highway 595 with relatively easy access and parking at a nearby church. The south bank had a manicured lawn with only a small patch of vegetation in the center of the property. The north bank consisted of a dense wooded area, with thick shrub growth on the stream bank. Water flow in the stream was fairly swift with no apparent obstructions upstream or downstream. When compared to the culvert photo taken in 1998 there were no obvious physical changes. The substrate appeared unchanged with large boulders and cobble. The concrete structure appeared to have remained unchanged as well.



**Site 5 – Highway 590, before Pool Road , Downstream**

**A: 2010 Upstream Photo**



**B: 2010 Downstream Photo**



**C: 2010 Substrate Photo**



**D: 1998 Upstream Photo**



**Comments**

Site 5 was located downstream of Highway 590, east of Site 6. This site was characterized by bedrock outcrops, cobble shore and abundant vegetation. The concrete structure upstream was considerably large and in relatively good shape with no visible decay. Gabion baskets had been placed on top of the structure in order to prevent erosion. The vegetation at the site was dominated by low lying shrubs, herbs and grasses on the north bank, and larger shrubs and conifers dominating the south bank. The substrate was mostly cobble and bedrock, and flow was relatively swift. With the exception of algae, there was no aquatic vegetation present. When compared to the culvert photo taken in 1998 there appeared to be little physical change. Grasses continue to dominate the north bank.



**Site 6 - Highway 590, before Strom Road , Downstream**

**A: 2010 Upstream Photo**



**B: 2010 Downstream Photo**



**C: 2010 Substrate Photo**



**D: 1998 Upstream Photo**



**Comments**

Site 6 was located directly downstream of Highway 590, west of sampling Site 5. The channel was fairly shallow with moderate flow. Vegetation on both sides of the creek was dominated by various grasses and herbs. This provided little to no shade over the stream. Further downstream vegetation was dominated by alder, creating considerably more shade over the channel. The substrate was mostly composed of cobble and sand, with abundant algae growth. When compared to the 1998 photo there are some obvious changes. The bridge had noticeably decayed since 1998, cracking and degradation of the concrete on the top exposing rebar.





**Site 7 –Adrian Lake Road , Downstream**

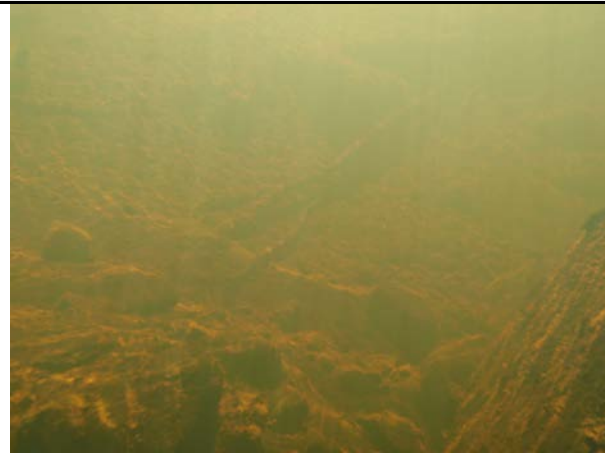
**A: 2010 Upstream Photo**



**B: 2010 Downstream Photo**



**C: 2010 Substrate Photo**



**D: 2010 Culvert Photo**



**E: 1998 Culvert Photo**





## Comments

Site 7 was located off Adrian Lake Road and characterized by a shallow flowing channel downstream and an extensive wetland and bog habitat upstream. There was a single culvert flowing under the road with a stick jam somewhat obstructing the flow on the upstream side of the culvert. The obstruction was large but did not appear to be significantly affecting flow through the culvert. The sampling site was directly downstream of the road with flow running perpendicular to the road. This site had considerable gravel washout present in the stream bed as well as along the stream banks. When compared to the culvert photo taken in 1998 there appears to be noticeable changes regarding both the colour of the water and vegetation. The colour of the water in 1998 appeared more turbid and orange in colour than the water observed in the 2010 sampling. Colour change, however, can be very subjective and may be a result of camera quality and not a change to the quality of the water itself. Vegetation appeared to have been denser in 1998, with shrub growth on the banks adjacent to the culvert compared to the 2010 study where there was none.



**Site 9 – Headwaters - Adrian Lake Road**

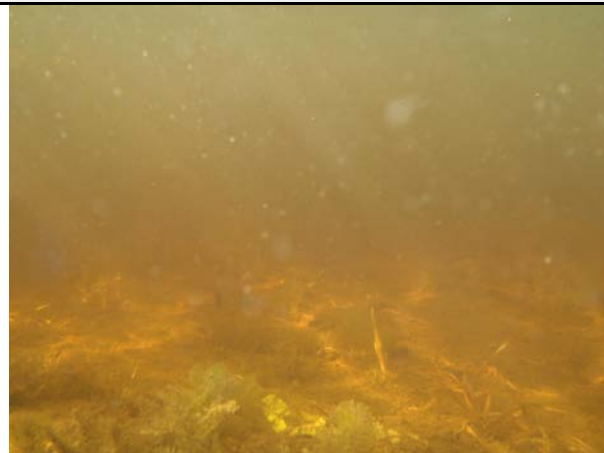
**A: 2010 Upstream Photo**



**B: 2010 Downstream Photo**



**C: 2010 Substrate Photo**



**D: 2010 Culvert Photo**



**E: 1998 Culvert Photo**





## Comments

Site 9 was the headwaters, and was located off Adrian Lake Road, north of Highway 590. This was a low traffic area and could be characterized as a narrow gravel road used by the forestry industry. There was easy access and a wide shoulder to park on. This site was connected by a wetland to Twist Lake which was located west of the site location. With the exception of forestry operations, the sampling site was fairly isolated from community activities and industrial practices. The sampling location was characterized by large wetland pools upstream and downstream. The wetland habitat surrounding the site supported abundant aquatic plants and reeds.

The muck substrate appeared to be orange in colour, with abundant submergent and emergent plants. Terrestrial vegetation in the area was mostly grass and herb dominated, with speckled alder and slender willow shrubs. Surrounding the sampling site was a conifer mixedwood stand of black spruce, balsam fir and white birch. The culvert downstream of the site had been completely buried.

When comparing 2010 observations to the culvert photo taken in 1998 it is evident that the culvert had been blocked for a considerable period of time, since both 1998 and 2010 noted the blocked culvert. It was also noted that sweet gale, the most dominant shrub observed in 2010, was also present in 1998.



### Comments

Site 10, the confluence of Cedar Creek and Whitefish River, had easy access off Harstone Road and parking on the south side of the creek. Vegetation at this site was highly abundant along the shoreline, composed mostly of shrubs. The confluence was characterized by the dispersion of the main creek channel into several independent flowing channels. The flow was relatively swift in the shallow channel and there were large amounts of cobble deposits at the mouth of Cedar Creek. The substrate was mostly composed of small cobble with some larger boulders distributed throughout. Remnants of an old bridge were observed at the sampling site, downstream of the current pipe arch location. The bank on the north side of the creek was characterized by a dark red to orange colour, indicating iron rich sediments were present. Photo documentation was not completed at this location in 1998.



<b>Site 11- Garbutt Road , Downstream</b>	
<b>A: 2010 Upstream Photo</b>	<b>B: 2010 Downstream Photo</b>
	
<b>C: 2010 Substrate Photo</b>	<b>D: 2010 Substrate Photo</b>
	
<b>E: 2010 Upstream Photo; Blockage</b>	<b>F: 2010 Downstream Photo; Blockage</b>
	



Site 11 was located off of Garbutt Road in a rural area adjacent to agricultural activity. Sampling was completed adjacent to the road. The water at the site was stagnant on the upstream side of the culvert with vegetation growth. A portion of the culvert was completely dry and had become rusted and cracked.

Upon arrival, two horses were observed standing in the stagnant pool downstream of the sampling location. The substrate consisted mainly of organic/muck with boulders and some cobble. Vegetation along the stream bank was thick, predominately composed of shrubs and herbs which provided some shade. The dominant vegetation at the site was bog willow and wild red raspberry. A wetland was located upstream from the culvert.

When compared to photos from 1998 to the present study, there were significant changes in the vegetation. The 1998 photographs displayed flow through the culvert. The 2010 photos show stagnant water with vegetation growth obstructing flow.

# APPENDIX I

## LABORATORY CERTIFICATES OF ANALYSIS AND ANALYTICAL REPORTS





Environmental Division

**Certificate of Analysis**

LAKEHEAD REGION CONSERVATION AUTHORITY

Report Date: 09-AUG-10 09:07 (MT)

ATTN: TAMMY COOK

Version: FINAL

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

Lab Work Order #: **L914373**

Date Received: **29-JUL-10**

Project P.O. #: NOT SUBMITTED

Job Reference:

Legal Site Desc:

CofC Numbers: L914373

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

	<b>Sample ID Description Sampled Date Sampled Time Client ID</b>	L914373-1	L914373-2	L914373-3	L914373-4	L914373-5
		WATER GRAB 28-JUL-10 10:05 CE9 CEDAR CREEK -SITE#9	WATER GRAB 28-JUL-10 10:55 CE7 CEDAR CREEK -SITE#7	WATER GRAB 28-JUL-10 11:45 CE6 CEDAR CREEK -SITE#6	WATER GRAB 28-JUL-10 12:20 CE5 CEDAR CREEK -SITE#5	WATER GRAB 28-JUL-10 13:10 CE4 CEDAR CREEK -SITE#4
<b>Grouping</b>	<b>Analyte</b>					
<b>WATER</b>						
<b>Physical Tests</b>	Conductivity (EC) (uS/cm)	96.3	135	194	201	200
	Total Dissolved Solids (mg/L)	76	89	118	120	116
	Turbidity (NTU)	0.97	2.30	1.02	2.40	2.04
<b>Anions and Nutrients</b>	Ammonia-N, Total (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Chloride (Cl) (mg/L)	0.78	0.75	0.53	1.93	1.85
	Nitrate-N (NO3-N) (mg/L)	<0.030	0.072	<0.030	<0.030	<0.030
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	<0.020	<0.020
	Phosphorus (P)-Total (mg/L)	0.0235	0.0250	0.0128	0.0183	0.0208
	Sulphate (SO4) (mg/L)	3.83	2.45	5.97	4.61	4.61
<b>Bacteriological Tests</b>	Escherichia Coli (MPN/100mL)	3	29	16	71	91
	Total Coliforms (MPN/100mL)	2400	2400	> 2420	> 2420	> 2420
<b>Total Metals</b>	Aluminum (Al) (mg/L)	0.031	0.017	0.020	0.028	0.028
	Antimony (Sb) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Arsenic (As) (mg/L)	<0.0010	0.0013	<0.0010	<0.0010	<0.0010
	Barium (Ba) (mg/L)	0.011	<0.010	<0.010	<0.010	<0.010
	Beryllium (Be) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Bismuth (Bi) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Boron (B) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Cadmium (Cd) (mg/L)	<0.000090	<0.000090	<0.000090	<0.000090	<0.000090
	Calcium (Ca) (mg/L)	16.8	23.2	31.2	29.4	30.5
	Chromium (Cr) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Cobalt (Co) (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Copper (Cu) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Iron (Fe) (mg/L)	0.125	0.633	0.201	0.532	0.425
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Magnesium (Mg) (mg/L)	2.04	2.99	6.05	5.99	6.25
	Manganese (Mn) (mg/L)	0.0492	0.139	0.0236	0.0393	0.0293
	Molybdenum (Mo) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Nickel (Ni) (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Potassium (K) (mg/L)	<1.0	<1.0	1.1	1.0	1.1
	Selenium (Se) (mg/L)	<0.00040	<0.00040	<0.00040	<0.00040	<0.00040
	Silicon (Si) (mg/L)	3.1	4.7	5.5	5.5	5.6
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Strontium (Sr) (mg/L)	0.0329	0.0408	0.0422	0.0440	0.0452
	Thallium (Tl) (mg/L)	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Tin (Sn) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	

## ALS LABORATORY GROUP ANALYTICAL REPORT

	<b>Sample ID</b> <b>Description</b> <b>Sampled Date</b> <b>Sampled Time</b> <b>Client ID</b>	L914373-6 WATER GRAB 29-JUL-10 09:40 CE11 CEDAR CREEK -SITE#11	L914373-7 WATER GRAB 29-JUL-10 10:40 CE2 CEDAR CREEK -SITE#2	L914373-8 WATER GRAB 29-JUL-10 12:05 CE10 CEDAR CREEK -SITE#10	
Grouping	Analyte				
<b>WATER</b>					
<b>Physical Tests</b>	Conductivity (EC) (uS/cm)	470	213	218	
	Total Dissolved Solids (mg/L)	329	122	128	
	Turbidity (NTU)	11.3	1.43	2.78	
<b>Anions and Nutrients</b>	Ammonia-N, Total (mg/L)	0.021	<0.020	<0.020	
	Chloride (Cl) (mg/L)	14.9	2.25	2.44	
	Nitrate-N (NO3-N) (mg/L)	<0.030	<0.030	<0.030	
	Nitrite-N (NO2-N) (mg/L)	<0.020	<0.020	<0.020	
	Phosphorus (P)-Total (mg/L)	0.116	0.0161	0.0155	
	Sulphate (SO4) (mg/L)	<0.30	4.87	4.83	
<b>Bacteriological Tests</b>	Escherichia Coli (MPN/100mL)	440	10	200	
	Total Coliforms (MPN/100mL)	> 2420	2400	2000	
<b>Total Metals</b>	Aluminum (Al) (mg/L)	0.265	0.014	0.044	
	Antimony (Sb) (mg/L)	<0.0050	<0.0050	<0.0050	
	Arsenic (As) (mg/L)	0.0016	<0.0010	<0.0010	
	Barium (Ba) (mg/L)	0.032	0.011	0.014	
	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)	68.1	32.0	33.9	
	Chromium (Cr) (mg/L)	0.0013	<0.0010	<0.0010	
	Cobalt (Co) (mg/L)	<0.00050	<0.00050	<0.00050	
	Copper (Cu) (mg/L)	0.0022	<0.0010	0.0011	
	Iron (Fe) (mg/L)	2.31	0.346	0.518	
	Lead (Pb) (mg/L)	<0.0010	<0.0010	<0.0010	
	Magnesium (Mg) (mg/L)	20.5	6.79	7.34	
	Manganese (Mn) (mg/L)	0.890	0.0142	0.0426	
	Molybdenum (Mo) (mg/L)	0.0020	<0.0010	<0.0010	
	Nickel (Ni) (mg/L)	0.0031	<0.0020	<0.0020	
	Potassium (K) (mg/L)	1.8	1.2	1.3	
	Selenium (Se) (mg/L)	0.00048	<0.00040	<0.00040	
	Silicon (Si) (mg/L)	8.9	5.3	5.9	
	Silver (Ag) (mg/L)	<0.00010	<0.00010	<0.00010	
	Strontium (Sr) (mg/L)	0.105	0.0453	0.0485	
	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

	<b>Sample ID</b> <b>Description</b> <b>Sampled Date</b> <b>Sampled Time</b> <b>Client ID</b>	L914373-1 WATER GRAB 28-JUL-10 10:05 CE9 CEDAR CREEK -SITE#9	L914373-2 WATER GRAB 28-JUL-10 10:55 CE7 CEDAR CREEK -SITE#7	L914373-3 WATER GRAB 28-JUL-10 11:45 CE6 CEDAR CREEK -SITE#6	L914373-4 WATER GRAB 28-JUL-10 12:20 CE5 CEDAR CREEK -SITE#5	L914373-5 WATER GRAB 28-JUL-10 13:10 CE4 CEDAR CREEK -SITE#4
<b>Grouping</b>	<b>Analyte</b>					
<b>WATER</b>						
<b>Total Metals</b>	Titanium (Ti) (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Tungsten (W ) (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U) (mg/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	Vanadium (V) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn) (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
	Zirconium (Zr) (mg/L)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040

# ALS LABORATORY GROUP ANALYTICAL REPORT

	<b>Sample ID</b> <b>Description</b> <b>Sampled Date</b> <b>Sampled Time</b> <b>Client ID</b>	L914373-6 WATER GRAB 29-JUL-10 09:40 CE11 CEDAR CREEK -SITE#11	L914373-7 WATER GRAB 29-JUL-10 10:40 CE2 CEDAR CREEK -SITE#2	L914373-8 WATER GRAB 29-JUL-10 12:05 CE10 CEDAR CREEK -SITE#10	
Grouping	Analyte				
<b>WATER</b>					
<b>Total Metals</b>	Titanium (Ti) (mg/L)	0.0087	<0.0020	<0.0020	
	Tungsten (W ) (mg/L)	<0.010	<0.010	<0.010	
	Uranium (U) (mg/L)	<0.0050	<0.0050	<0.0050	
	Vanadium (V) (mg/L)	0.0024	<0.0010	<0.0010	
	Zinc (Zn) (mg/L)	0.0057	<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
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
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
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:

L914373

### 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.

1914373

Page 1 of 1

Report to: Tammy Cook

Company: Lakehead Region Conservation Authority

Contact: Scott Drebit

Address: 130 Conservation Rd Box 10427

Thunder Bay ON P7B-6T8

Phone: 344-5857 Fax: 245-9156

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@lakeheadca.com

Email 2: Scott@lakeheadca.com

Client / Project Information

Job #:

PO / AFE:

LSD:

Quote #: Q 93274

ALS Contact:

Sampler: S. Drebit

D. Brazza

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

Analysis Request

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

F  P  F/P

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mm-yy)	Time (hh:mm)	Sample Type	Number of Containers
CE9	Cedar Creek - Site #9	28-Jul-10	10:05	Grab	4
CE7	Cedar Creek - Site #7	28-Jul-10	10:55	Grab	4
CE6	Cedar Creek - Site #6	28-Jul-10	11:45	Grab	4
CE5	Cedar Creek - Site #5	28-Jul-10	12:30	Grab	4
CE4	Cedar Creek - Site #4	28-Jul-10	13:10	Grab	4
CE11	Cedar Creek - Site #11	29-Jul-10	09:40	Grab	4
CE2	Cedar Creek - Site #2	29-Jul-10	10:40	Grab	4
CE10	Cedar Creek - Site #10	29-Jul-10	12:05	Grab	4

Special Instructions / Regulations / Hazardous Details

**NOT CONSUMED**

Reg 153 Table 1 2 3 TCLP MISA  F/MCO 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 (check use)		RECEPTION (lab use only)		DISPATCHION (lab use only)	
Released by:	Date:	Received by:	Date:	Observed by:	Date:
	<u>July 29/10</u>		<u>July 29/10 2:15</u>		<u>July 29/10 2:15</u>