The
Porcupine River Watershed
Remedial Action Plan

Mark Clement

Stage 1 Report

Mattagami Region Conservation Authority

Moving Forward

Acknowledgements

Porcupine River Watershed Remedial Action Plan Management Team

The following people are members of the Porcupine River Watershed RAP Management Team, partner groups and stakeholders. Their hours of volunteer service, their input and ideas, as well as their endless patience have been invaluable. The outcome of the Porcupine River Watershed RAP reflects their **c**ommitment.

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Ministry of the Environment Ontario Community Environmental Fund

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Acronyms

CABIN = ???

DFO = Department of Fisheries and Oceans Canada

MNDM = Ministry of Northern Development and Mines

MNR = Ministry of Natural Resources

MOE = Ministry of the Environment

MRCA = Mattagami Region Conservation Authority

NGO = Non-government Organizations

ODWO = Ontario Drinking Water Objective

PAC = Porcupine River Watershed RAP Public Advisory Committee

PRW RAP = Porcupine River Watershed Remedial Action Plan

PSW = Provincially Significant Wetland

PWQO = Ontario's Provincial Water Quality Objective

Units of Measurement

$kg*day^{-1}$ = kilogram per day

km^2 = square kilometer

m^3*sec^{-1} = cubic meters per second

$mg*L^{-1}$ = milligrams per litre

mm^3*L^{-1} = cubic millimetre per litre

$\mu g*g^{-1}$ = nanogram per gram

$pg*g^{-1}$ = picogram per gram

$\mu g*L^{-1}$ = microgram per litre

THE PORCUPINE RIVER WATERSHED REMEDIAL ACTION PLAN

STAGE 1 REPORT

Actions recommended to restore the beneficial uses
and enhance the ecosystem of the Porcupine River Watershed

Prepared by
Aide Badilla Porcupine River Watershed Project Biologist

With input and assistance granted by Kees Pols, Mattagami Region Conservation Authority General Manager and Glen McFarlane, Ministry of Natural Resources Supervisor

April 2014

CHAPTER 1

1.0 INTRODUCTION

The aim of this First Phase of the Remedial Action Plan (RAP) is to develop a management framework for the long term assessment and monitoring of the Porcupine River Watershed. This framework would also detail a program of remediation and restoration through the implementation of specific programs and projects directed at impaired beneficial uses. Impaired beneficial uses are referred to as ecosystem services whose integrity is jeopardized due to changes in the chemical, physical, or biological ecological constituents, which are identified and discussed further in Chapter 3.

The Second Phase of the RAP will continue to work with all stakeholders from the First Phase, including provincial ministries, local government, local industry and concerned NGO's, to move forward with the short and long term remediation and restoration projects. Past studies and surveys, current management programs and identified data gaps would continue to be catalogued, analyzed and used towards the development and implementation of long term project initiatives. The Second Phase of the RAP will benefit the entire community by improving water quality and rejuvenating impacted shoreland areas throughout the Porcupine River Watershed.

As part of the RAP, a public and stakeholders collaborative would be established, meetings would be scheduled and the education and outreach program would continue. It is anticipated that in the long term the RAP will bring the watershed back to health while still supporting the needs of the many current users.

In addition, the program will engage the watershed residents in the planning and implementation process through a program of education and outreach. This E&O program will be of benefit to students and adults alike, and will consist of day trips, information sessions and activity days.

The single most important outcome of the Final Remedial Action Plan will be the development and implementation of a management strategy that will provide for the future management of the Porcupine River Watershed. Short, medium, and long term goals and objectives will be identified along with those actions needed to meet them. The Plan will provide the framework for a multi-agency/citizens stakeholder Committee which would be responsible for implementing the recommendations and monitoring the results. The commencement of the Porcupine River Watershed Remedial Action Plan was made possible by in-kind funding from the Ministry of Natural Resources and funding from the Ontario Community Environment Fund (OCEF) from the Ministry of the Environment (MOE).

The Ontario Community Environment Fund uses money collected from environmental penalties for mining operations located in the watersheds where the violation(s) occurred. Environmental penalties are issued for spills and other violations such as failing to comply with regulatory requirements. These penalties encourage industrial facilities to plan ahead to prevent spills and mitigate any effects when spills do occur. OCEF money funds projects focused on environmental

remediation, research and education relating to spills and restoration of the environment, and projects related to spill preparedness.

The mandate of the Mattagami Region Conservation Authority (MRCA) is the protection, management, restoration and development of the natural resources within its watershed area. The focus is primarily on water management including flood and erosion control, water quality and strategic watershed planning. The MRCA also has a mandate in land and forest management, outdoor recreation and conservation education. The MRCA is a community-based conservation organization focused on watershed resource management programs and projects. It was established in 1962 and has been involved in a variety of watershed studies over the years. Recently, the MRCA managed the Source Water Protection Program for the Mattagami Region Source Protection Area under the guidance of the Ministry of the Environment.

The Conservation Authority often works in partnership with other local and provincial organizations in order to fulfill its water and land management goals and objectives.

CHAPTER 2

2.0 DESCRIPTION OF THE PORCUPINE RIVER WATERSHED

2.1 HISTORICAL PERSPECTIVE

The initial stages of development of Northeastern Ontario can be dated back to 4,000 years ago with the arrival of the nomadic tribes known as the Shield Archaic Culture. In the late 1600's the first Europeans arrived in the Porcupine River watershed area, and they were able to co-exist with the Algonkian First Nations by means of fur trade. By the 1900's the economic potential of Northeastern Ontario sparked the interest of the provincial government. The discovery of valuable minerals marked the advent of the mining industry in Northern Ontario. This led to the development of the Temiskaming and Northern Ontario Railway in 1902. From 1909 onward there was extraordinary commercial and industrial growth in the "Porcupine Camp". This former "company town" subsequently developed into a vibrant and diverse community.

The Porcupine River Watershed is a heavily impacted watershed. Over the past century it has had to absorb the effects of mining, forestry and urbanization. The Remedial Action Plan (RAP) process was adopted from Annex 2 of the 1987 Great Lakes Water Quality Agreement (GLWQA). The RAP process is a common approach used to define the beneficial watershed uses which have been impaired and to develop an "action plan" to restore these uses. In 2013, the Mattagami Region Conservation Authority hired a Project Biologist to develop the Porcupine River Watershed RAP through a parallel process of technical evaluation and public participation.

The First Phase of the Porcupine River Watershed RAP, consisted of the identification of a comprehensive action plan to restore and protect the Porcupine River Watershed ecosystem. This First Phase has been completed and the information is outlined in this report - the Porcupine River Watershed RAP Stage 1 Report: Moving Forward.

2.2 GEOGRAPHIC SETTING

The Porcupine River Watershed spans nine townships. It is characterized by gently rolling terrain with a drainage area composed mostly of wetlands overlaying clay plains with generally slow-flowing and meandering rivers (Figure 1). The Upper Porcupine River, upstream of Porcupine Lake, is comprised of two branches. The first branch, located in the Township of Tisdale, originates at Pearl Lake and drains eastward until it converges with the Porcupine River south branch. The Porcupine River south branch, located in the Township of Deloro, originates as drainage from Simpsons and McDonald Lakes. It flows north-easterly where it joins the Porcupine River upper branch and subsequently flows into Porcupine Lake.

Porcupine Lake is a 280 hectare water-body located in the Township of Whitney, with a combined drainage area of 87 km². It receives inflow from the Upper Porcupine River as well as Bob's Creek, which drains Bob's Lake located northeast of Porcupine Lake. With a flat topography, the maximum depth of Porcupine Lake is 5 metres. This shallow depth results in no thermal stratification and an orthograde dissolved oxygen profile. The bottom of the lake is composed of sandy-clay and clay-silt.

The Porcupine River begins at Porcupine Lake at an elevation of 277 m and flows northeast under Ontario Highway 101 out of the lake at the community of Porcupine. It continues to flow northeast where it joins with the left tributary, the North Porcupine River. It then flows southeast through the Township of Hoyle and again under Ontario Highway 101 where it reaches its mouth at the northwest corner of Night Hawk Lake at an elevation of 247 m.

The length of the Porcupine River from its outlet at the northeast end of Porcupine Lake to its mouth at Night Hawk Lake is approximately 35 km in total.

The North Porcupine River tributary originates at Bigwater Lake and flows eastward for approximately 25 km to its confluence with the Porcupine River. Bell Creek enters the North Porcupine River from the south and is a major tributary. Bigwater Lake and the portion of the North Porcupine River located upstream of Bell Creek have been considered representative of background quality as there is little development and no mining activity in the area.

The south branch of the Porcupine River originates as drainage from the area northwest of Three Nations Lake. Three Nations Lake is a small 57 ha headwater lake with no major inflowing streams or tributaries. The primary outflow at the north end, known as Three Nations Creek, flows approximately 6 km to its junction with the main branch of the Porcupine River. Three Nations Creek was altered by the Pamour Mine Pit Expansion. The expansion drained and excavated 14 ha of the Three Nations Lake north basin. This resulted in an indirect alteration of approximately 2.5 km of the headwaters of Three Nations Creek due to diversion of flows. The lake replacement basin is located adjacent to the southeastern side of Three Nations Lake. The realignment of the Three Nations Creek drains Three Nations Lake including this replacement basin and reinstates the lake outlet flow to tie into the existing Three Nations Creek system at a point 4.6 kilometres downstream.

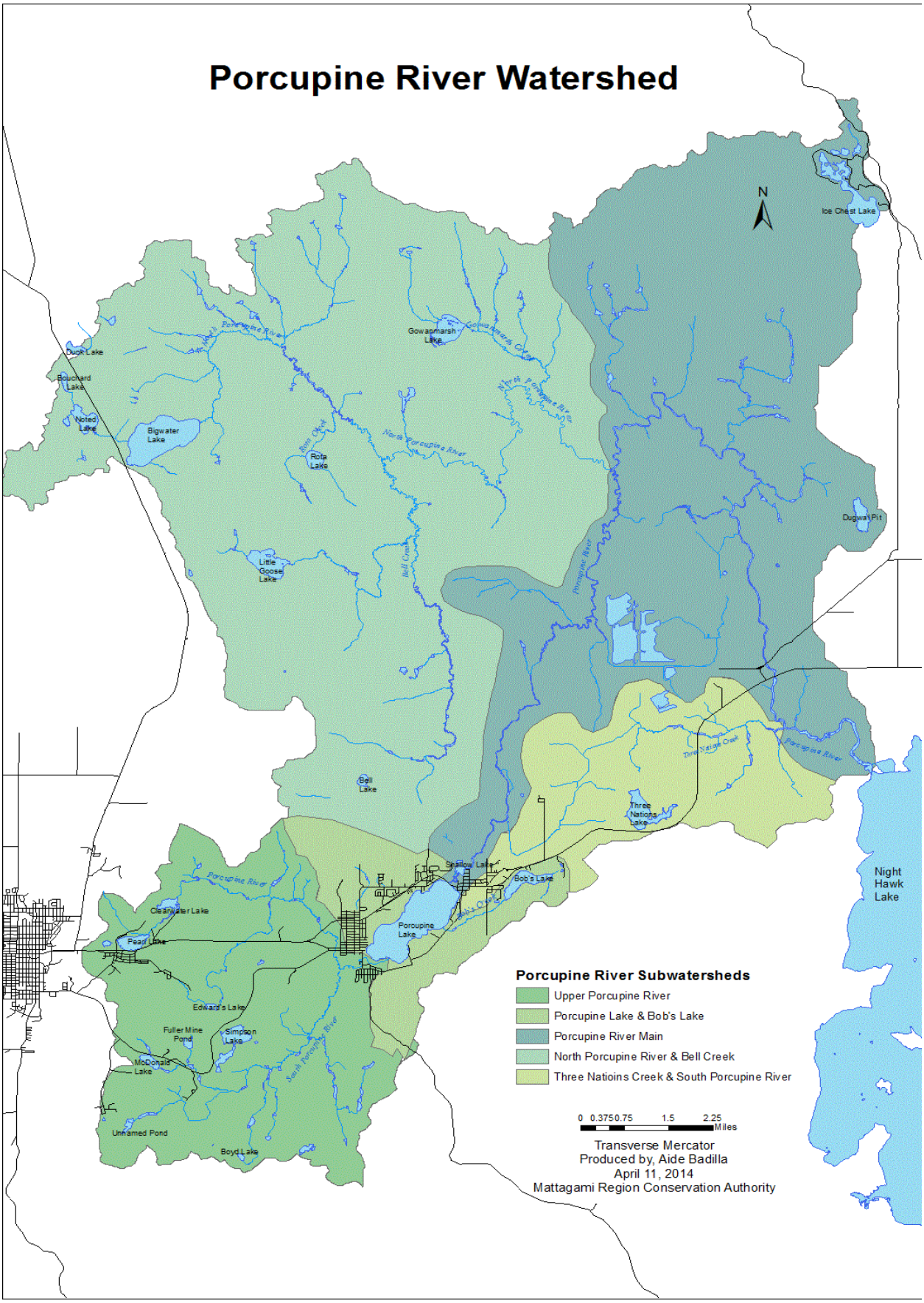


Figure 1. Porcupine River Watershed and its Subwatersheds.

2.2.1 Geology & Physiography

The watershed is characterized as being a low-relief plain (peneplain) comprised of rocks from the great Precambrian Shield region. Erosion throughout geologic time has been the responsible mechanism for the peneplanation of the Archean rocks. As a result of peneplanation the topography throughout the area became subdued and the watercourse developed meandering and braiding characteristics.

The watershed is underlined by felsic rocks (igneous rocks formed by the cooling and solidification of magma) of Early Precambrian Age representing the Abitibi/Wawa Sub-province of the Superior Province. This is one of the oldest known rock sequences in North America. These are lithologically diverse metavolcanic rocks with a wide variety of intrusive suites and lesser amounts of chemical and clastic metasedimentary rocks. Individual greenstone belts within the sub-provinces are intruded, deformed and truncated by intervening felsic batholiths. Most of the northern portion of the watershed consists of intensely folded metasedimentary and metavolcanic rocks with some felsic intrusions. The southern portion consists of Precambrian felsic intrusives, mignatites, highly metamorphosed gneisses and schists with infusions of diabase dikes. The allocation of the mineral-rich rocks containing feldspar and quartz minerals, gold, silver, copper, lead, and zinc, is one of the major contributors to the wealth in the Porcupine region since the early 1900's.

2.2.2 Surficial Geology

Over the years there have been multiple glacial advances and retreats that shaped the watershed's bedrock surface.

The Laurentide ice sheet (~100,000 years ago) deglaciation caused the greatest landscape differentiation of landforms and soil types in the watershed. As the ice sheet retreated northward it created glaciofluvial deposits. These deposits consisted of material that had been transported, sorted and deposited by melt water. The melt water carried substrate ranging from clay particles to boulders. Material was sorted and deposited based on grain size; hence the southern region consists of sandy till deposits and the northern region of lacustrine till deposits. Glacial retreat also formed extensive features such as kames and eskers which are visible throughout the landscape. In areas of poor drainage the formation of swamps and peat areas was observed.

2.2.3 Soil Characteristics

Glacial abrasion has been largely responsible for the evolution and distribution of soil types in the watershed.

The northern region consists of soils with unsorted clay material deposited directly by glacial ice, overlain by annual sedimentary layers of lacustrine deposits with low lying pockets of organic

material. Clay soil is made up of closely packed particles that have strong affinity for one another. Individual particles are negatively charged which allows them to attract and hold positively charged elements like calcium and potassium. This capacity makes clay soil a fertile soil. However, the particle interactions do not allow effective root or air penetration. This soil can also become water logged due to its low porosity and permeability, which results in decreased root and air penetration. Clay soils therefore, are limited in their capacity for agricultural land use without extensive and costly work. In the southern region the common soil type is Hanna an acidic medium course sandy till with traces of aluminum, iron and other metal ions. These forested soils are commonly derived from quartz rich sands or sedimentary debris from magmatic rocks; characteristics consistent with the watershed geological history. The sandy glacial sediment derived from igneous rocks typically has an acidic pH because of the mineralogical composition of the sediments. This is further increased by the organic decomposition products from the coniferous leaf litter. These soil characteristics allow for coniferous-dominated communities to develop and are poor for agricultural land use.

2.2.4 Climate

The Porcupine River Watershed has a modified continental climate, characterized by cold dry winters due to a cold continental Arctic air mass and warm wet summers due to the Maritime Tropic air mass that bring a wave of warm air causing convectional precipitation. The temperature ranges from ±30 ºC with an average annual precipitation of 900 mm.

2.3 SOCIO-ECONOMIC PROFILE

2.3.1 Population Trends

The major urban centre found within the watershed is the City of Timmins. Smaller communities such as Porcupine, South Porcupine and Schumacher are also considered to be part of the City of Timmins. The City of Timmins, located in the District of Cochrane on the Mattagami River and Ontario Highways 101 and 655, has a population of approximately 45,845 people including those living in Porcupine, South Porcupine and Schumacher.

The Porcupine community is located at the east end of Porcupine Lake on Ontario Highway 101, 13km east of the City of Timmins and has a population of ~ 7,858 people. The South Porcupine community is located on the west shore of Porcupine Lake on Ontario Highway 101, 9 km east of the City of Timmins and has a population of ~ 4,219 people. The community of Schumacher is located on Ontario Highway 101, 2 km east of the City of Timmins, and has a population of ~ 2,421 people. Schumacher was originally called Aura Lake, but was renamed after the Ohio druggist Frederick Schumacher, who bought and sold property on the town site. Land uses and economic activities in these areas have had a measurable and significant impact on contaminant loadings to the watershed.

Between 2006 and 2011 the population change of the watershed was 0.4 percent compared to the national growth of 5.9 percent. The city has a regular annual market draw of 120,000+ people, which has been steadily growing in recent years with the discovery of diamonds in the region. Economic projections suggest a slow but steady growth in the economy of Northeastern Ontario over the next two years.

2.3.1.1 The Labour Force

As per figures 2, 3, 4, and 5. the City of Timmins highest level of education for individuals 25 to 64 years of age is that of a University degree with the largest percentage holding a college degree; approximately 14.1 % of employment occurs in retail trade; as of 2011 Xstrata, now Glencore, was the top private sector employer with 723 employees and the City of Timmins the top public sector employer with 940 employees.

Highest level of education, 25 to 64 years of age	
University, Bachelor's or higher	10.7%
College	26.8%
Apprenticeship or trades certificate	13.3%
High school or equivalent	24.4%

Figure 2. Highest level of education, 25 to 64 years of age (McSweeney & Associates Consulting Inc., 2011).

Employment by Industry		
		Percentage of total
Total Labour Force	25,104	100%
Retail Trade	3,541	14.1%
Health care & social assistance	2,916	11.6%
Mining, oil and gas extraction	2,630	10.5%
Educational services	1,828	7.3%
Construction	1,723	6.9%
Accommodation & food services	1,664	6.6%
Manufacturing	1,354	5.4%
Public administration	1,346	5.4%
Administrative support	1,309	5.2%
Transportation & warehousing	1,293	5.2%
All other occupations	5,500	21.9%

Figure 3. City of Timmins Employment by Industry (McSweeney & Associates Consulting Inc., 2011).

Top Private Sector Employers*	
Employer	**Employees**
Xstrata Copper	723
Goldcorp Porcupine Gold Mines	646
Dumas Contracting Ltd	499
Lakeshore Gold Corporation	453
Wal-Mart Department Store	340
RLP Machine & Steel Fabrication Inc.	250

*September 2011

Figure 4. City of Timmins Top Private Sector Employers as of September 2011.

Top Public Sector Employers*	
Employer	**Employees**
City of Timmins	940
Timmins & District Hospital	850
Northeastern Catholic District School Board	450
District School Board Ontario North East	408
Conseil scolaire catholique du district des Grandes Rivières	405

*September 2011

Figure 5. City of Timmins Top Public Sector Employers.

2.3.2 Economic Activity

2.3.2.1 Historic

European settlement on the Porcupine River Watershed began in the late 1600's. Early economy activity was driven mainly by fur trade and fishing. Mining activities began contributing significantly to the watershed's economy during the 1900's and are still currently the main economic driver. The residual and existing environmental effects of mining are apparent in virtually all drainages of the area, affecting water quality, fish and wildlife health/habitat and to a lesser extent drainage patterns. As well, logging activities still contribute to the region's economy.

2.3.2.2 Industrial

Timmins is a resource-based economy with mining and forestry activity, but the service and tourism sectors add to the diversity of Timmins' economy. Being the only major centre in the far northeast, Timmins draws consumers from throughout the Cochrane District, the James Bay Coastal area and nearby communities such as Chapleau and Kirkland Lake for a total regional market of approximately 118,000.

The City's economic state is heavily influenced by the mining industry. Further, Timmins' economy is stabilized by the diversity of minerals available in the community and region. There are currently 4 active mining operations discharging to the watershed and earlier inactive mine sites, whose tailing disposal areas and waste rock piles are still potential sources of contaminants. A summary of these sites is provided in Table 1 on the following page.

In January 2012, the mining company Goldcorp received approval from their Board of Directors to start the Hollinger Project. The construction phase of this project will take 12-18 months at a cost of $65 million. This new project will sustain employment throughout the project duration.

The City of Timmins' retail sector is one of the larger economic sectors in the city. According to Statistics Canada, this sector alone employs 3,130 people or nearly 15% of the workforce in Timmins. Most recent statistics show that despite the downturn in the Canadian and worldwide

economy, the Timmins' economy continues to demonstrate strength. The current unemployment rate is 6.1%, significantly lower than the 7.5% rate for Canada and 7.7% rate for Ontario.

2.3.2.3 Fishing

The Sport Fishery – Sport fishing is a major component of the local tourist industry. The Porcupine River Watershed sport fishery largely depends on walleye (*Stizostedion vitreum*), white sucker (*Catostomus commersoni*), yellow perch (*Perca flavescens*) and northern pike (*Esox lucius*). The 2010 Goldcorp small-bodied fish community study showed a total of 12 different fish species throughout the watershed. The small-bodied fish community in all study areas was dominated by brook stickleback (*Culaea inconstans*), pearl dace (*Semotilus margarita*) and finescale dace (*Phoxinus neogaeus*). Blacknose shiners (*Notropis heterolepis*) were common in shallow areas with sand and gravel bottom in clear, quiet streams throughout the watershed.

The Commercial Fishery **–** There are no commercial fishing activities in this region.

Table 1. Active & Abandoned Mine Sites Discharges to the Porcupine River System			
Mine	**Status**	**Mineral**	**Primary Receiver**
Hollinger	1910-1968 2014-currently undergoing a new open pit mining operation	Gold, Au	Upper Porcupine, North arm through Pearl Lake
McIntyre	~1900-1988	Gold, Au Copper, Cu	Upper Porcupine River North arm & Pearl Lake
Dome (includes original Dome site & former Preston & Paymaster mines)	1910-present	Gold, Au	Upper Porcupine River South branch, 2 km u/s of confluence with upper branch
Delnite	1937-1988	Gold, Au Silver, Ag	Upper Porcupine South arm
Cincinnati	1914-1924	Gold, Au	n/a
Coniaurum	1913-1961	Gold, Au	Upper Porcupine North arm
Crown (shaft is now part of the Hollinger property and is situated near Fairway Village)	1913-1921	Gold, Au Silver, Ag	n/a
Aunor	1940-1968	Gold, Au	Upper Porcupine River South arm
Naybob Gold	1932-1964	Gold, Au	n/a
Hoyle Pond (ore is discharged into Bell Creek Mine)	1985-present	Gold, Au	Bell Creek
Pamour	1936-present	Gold, Au	West to Porcupine River (main) 2 km d/s of Porcupine Lake, & East to Three Nations Lake & Three Nations Creek
Broulan Reef (considered part of Pamour Site)	1915-1965	Gold, Au	Main arm d/s of Porcupine River
Buffalo Ankerite	1926-1978	Gold, Au	Upper Porcupine River South arm
Bell Creek	1987-present	Gold, Au	Through bog to Bell Creek (the Bell Creek discharge was discontinued in 2000 & routed 4 km to the Owl Creek pit, which discharges to the Porcupine River)
Aquarius	1988-89	Gold, Au	n/a
Kidd Creek “Metsite” & TMA	1966-present	Copper, Cu Zink, Zn	North via Kidd Metsite tributary streams to Porcupine River (main), & South to Three Nations Creek
Owl Creek (part of Kidd TMA)	1981-89	Gold, Au	West to Porcupine River (main) & East to Porcupine River (main) via Owl Creek
ERG Mill Site	1987-89	Gold, Au	The north basin releases contaminated effluent to Bell Creek which flows into North Porcupine River. The south basin discharges clean effluent to the Porcupine River.

2.3.2.4 Porcupine River Watershed Tourism

Tourism is a strong component of the watershed's economy. Tourists are offered a wide range of services and facilities including:

- 11 resorts with rental accommodations
- 16 hiking and biking trails
- 12 canoe and kayak routes
- 8 provincial parks and campgrounds
- 3 golf courses, and
- ~ 49 restaurants.

In addition to fine resorts, hotels and restaurants, the Porcupine River Watershed also offers endless outdoor recreation opportunities such as:

- Dog sledding
- Hunting
- Snowmobiling
- Cross-country skiing
- Canoeing/ kayaking
- Snowshoeing
- Swimming
- Ice fishing, and
- Experiencing direct interaction with Canadian wildlife.

2.4 WATER RESOURCE USES IN THE PORCUPINE RIVER WATERSHED AREA OF CONCERN

2.4.1 Drinking Water Supply

The City of Timmins depends on the Mattagami River for their drinking water supply and on a water filtration plant that is completely computerized. It is operated and maintained 24 hours a day, 7 days a week. The plant has a capacity to treat 54 500 cubic meters per day. Treated water is stored in three reservoirs at the plant, which have a capacity of 4500 cubic meters per reservoir. The Timmins Water Filtration plant also pumps water into the Tisdale reservoir in South Porcupine. The reservoir has the capacity of 4500 cubic meters. A Source Protection Plan was developed for the City of Timmins drinking water source, the Mattagami River. The Mattagami Region Source Protection Committee submitted the Proposed Plan to the Ministry of the Environment in August

2012. The Mattagami Region Source Protection Plan was approved on April 10, 2014. After the approval, the next step is preparing for the implementation of the Plan and the related policies.

2.4.2 Wastewater Disposal

Porcupine Lake and the downstream Porcupine River have been impacted by a combination of municipal and industrial (Table 1) inputs as documented in the Ministry of the Environment Environmental Monitoring Study on the Porcupine River. One of these sources continues to be bypasses from the Whitney & Tisdale wastewater treatment plant, which are a source of phosphorous and bacterial loadings. This facility treats approximately 3200 cubic meters of wastewater per day, with the capacity of 6800 cm/day. Wastewater is pumped through seven pumping stations. It is treated, tested and disinfected, and the effluent is discharged into the Porcupine River within MOE guidelines. The sludge is hauled to a private approved landfill site for proper disposal. The plant is a secondary treatment facility that serves the communities of South Porcupine and Porcupine. In addition, Bob's lake lagoon is a separate biological treatment facility that serves Bob's Lake subdivision. This facility consists of a pumping station, where the sewage is collected and pumped to a stabilization pond and is treated by a natural process. The effluent goes to Porcupine Lake via a drainage creek. The rectangular pond has a volume of 9100 cubic meters, 1.5 meters deep, and a retention time of 102 days.

The watershed has experienced a significant amount of bypass events from the Whitney & Tisdale Sewage Treatment Plant from 2005 to 2011. Recent data compiled from the City's website shows that close to 94635.3 cubic meters have overflowed into Porcupine Lake since April 2013 alone. These bypasses typically occur during spring melt and high precipitation events.
Bypasses have occurred in order to reduce or prevent sewage from backing up into residences surrounding Porcupine Lake. Some bypasses have resulted in the discharge of untreated sewage directly to Porcupine Lake. Some of the bypasses have occurred during periods of recreational use on Porcupine Lake and may present a potential risk to human health. Some of the bypasses are chlorinated at two of the six lift stations, including lift station 2. However, the bypass overflow discharge from lift station 3 is located within 50 meters of a public beach. The City of Timmins currently has a limited, though not well addressed, online public notification procedure in place to make the public aware of potential human health risks as a result of these bypass events.

The City of Timmins received an Order from the Ministry of Environment to avoid and reduce the aforementioned bypasses and to prevent further discharge of contaminants into the environment. As a part of the action plan, the City intends to upgrade the Porcupine/South Porcupine Sanitary System (PSPSS) as recommended in the RV Anderson (RVA) Associates Limited assessment of the PSPSS report. The PSPSS upgrades to be completed by 2017 are:

- upgrading the pumping capacity to accommodate future developments and extraneous flows,
- upgrading the force main capacity at various locations, to accommodate future developments and extraneous flows,
- constructing a new storm storage facility of an approximate volume of 8000 cubic meters at station # 4, to buffer wet weather peak flows,

- upsizing existing wet wells to help equalize flow to the plant while buffering extreme wet weather flows,
- upgrading electrical supply and standby power to accommodate the pumping capacity and upgrade of instruments and systems,
- lift station building modifications to incorporate the new pumps and electrical works and electrical upgrades,
- monitoring of flows and system response throughout the upgrade process,
- wastewater plant review as recommended in the RVA report. This includes review of the hydraulics at the headwork and review of the peak daily capacity of the plant in accordance with the upgraded capacity of Lift Station #6 and effluent objectives,
- all other upgrades recommended in the RVA report.

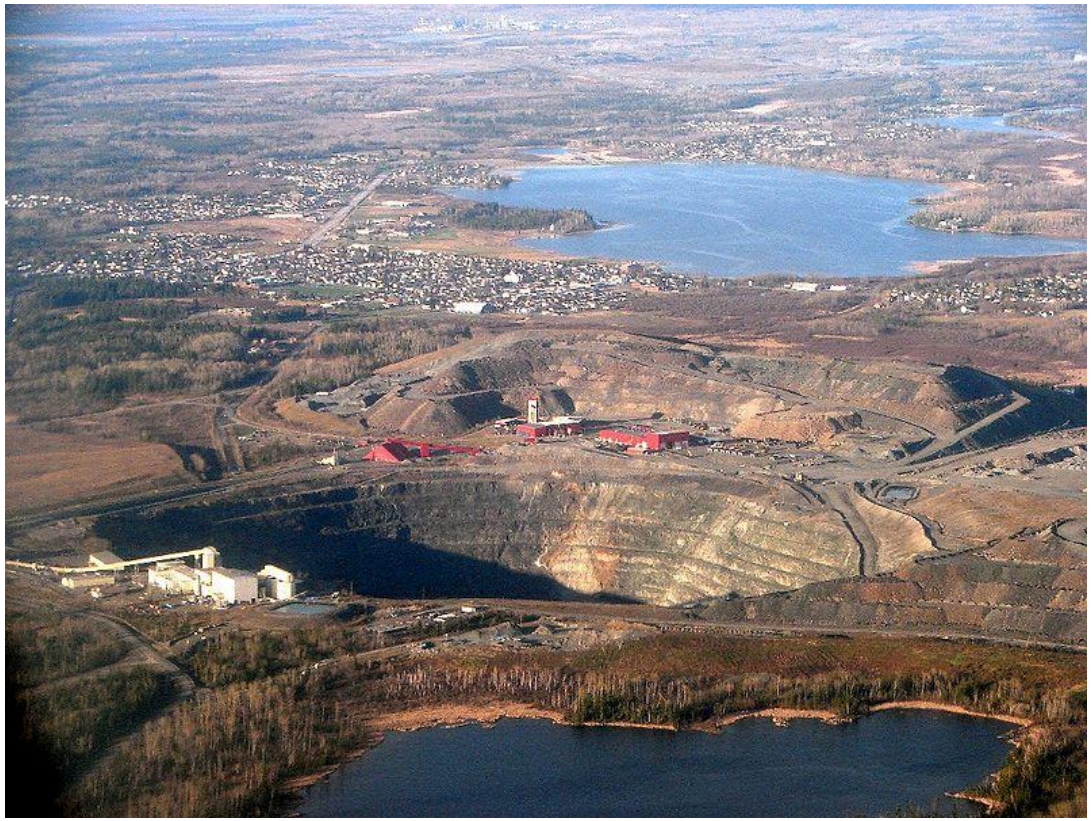
The Many Uses of the Porcupine River Watershed

Dan Morley

Sport Fishing

The Many Uses of the Porcupine River Watershed

Past, Present and Future Commercial Activities and Opportunities



Northern Ontario Business

Mining Industry

The Many Uses of the Porcupine River Watershed

Dough Zarkovich

Hunting

Fannie Manseau

Kayaking and Other Recreational Pursuits

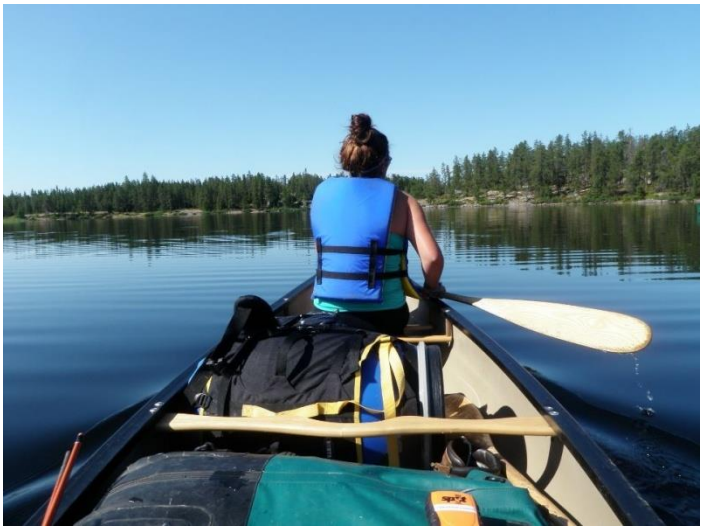
The Many Uses of the Porcupine River Watershed

Dog Sledding

The Weather Network

Shamus Snell

Aesthetics and Nature Appreciation



Shamus Snell

The Many Uses of the Porcupine River Watershed

Cornell University

Canadian Wildlife Federation

Fish and Wildlife Habitat – A Place to Call Home

CHAPTER 3

3.0 THE PORCUPINE RIVER WATERSHED ECOSYSTEM PROBLEMS AND IMPAIRED BENEFICIAL USES

The Porcupine River Watershed Stage 1 Report identifies impairment of**:**

i. restriction on fish and wildlife consumption;

ii. degradation of fish and wildlife populations;

iii. degradation of stream and lake benthos;

iv. accelerated eutrophication of lakes and streams;

v. impairment of drinking water sources;

vi. degradation of aesthetics;

vii. proliferative diseases in fish;

viii. loss of fish and wildlife habitat; and

ix. restriction on recreational uses such as canoeing and swimming.

A summary and the status of the impaired beneficial uses are provided **in** Table 2.

The impaired beneficial uses were summarized in four general working 'ecosystem problem' categories:

1. excessive nutrient enrichment;
2. bacteriological contamination;
3. persistent toxic contaminants; and
4. habitat destruction & ecosystem instability.

Ecosystem problems associated with the physical destruction of fish and wildlife habitat and the watershed's high level of nutrient enrichment are believed to be linked and both responsible in part for the beneficial use impairment numbers ii, iii, iv, vi, vii, viii, and ix. The watershed's persistent toxic contaminant problem is responsible for impairment of beneficial use i, ii, iii, and vii, and bacterial contamination is responsible for the loss of beneficial use number v, vi, and ix. These links are illustrated in Table 3.

Table 2. Summary of Impairment of Potential Beneficial Uses and their Significance to The Porcupine River Watershed	
Potential Impaired Use	**Significance to the Watershed**
i. Restrictions on fish and wildlife consumption	**I** The 2010 Environmental Effects Monitoring (EEM) study for the Dome Mine, Pamour Mine, and Owl Creek Pit by Minnow Environmental Inc. indicated that sediment concentrations of arsenic (As), copper (Cu), iron (Fe), manganese (Mn), and nickel (Ni) were greater than Provincial Sediment Quality Guideline Severe Effect Levels (PSQG SEL), indicative of historical mining activities. Chromium (Cr) and lead (Pb) concentrations were also higher in the upstream areas, indicating that Whitney-Tisdale Waste Water Treatment Plant (WWTP) effluent is an ongoing source of these metals to the Porcupine River. The 2012 EEM study for the Kidd Creek Metallurgic Site (Metsite) by Minnow Environmental Inc. indicated that water and sediment quality in the Porcupine River downstream of the Metsite treated effluent discharge have shown some improvement since the partial shutdown of Metsite operations in 2010; however, Metsite effluent discharge continues to adversely affect the chemistry and biology of the Porcupine River. As well the upstream reference location used by this study has shown some degradation since 2004, suggesting that upstream sources of contamination (i.e. mines, municipal sewage) are affecting it. Water chemistry studies in the 2012 EEM study for the Kidd Metallurgic Site, showed that the river downstream of the Metsite effluent discharge had elevated concentrations of nitrite (NO_2^-), selenium (Se), zinc (Zn), and Cadmium (Cd). The study also showed elevated conductivity, total dissolved solids, sulphate, and hardness, including calcium (Ca) and magnesium (Mg). Sediment chemistry samples downstream of the Metsite effluent discharge had elevated concentrations of antimony (Sb), As, Cd, Ca, Cr, Cu, Pb, mercury (Hg), molybdenum (Mo), P, Se, silver (Ag), thallium (Tl), and Zn. Many of those elements exceed the lowest effect level (LEL) but not the severe effect level (SEL) concentrations. Of the ones that exceed the SEL concentrations the Metsite is a major source of Cd and Zn, but also contributes to elevated levels of As and Cu. Sediment concentrations of As, Cd, Cu, Se, and Zn downstream of the Metsite have declined since 2007, but only Se decreased between 2009 and 2012. Concentrations in the sediment at sampling stations further downstream tended to decline with distance from the Metsite via dilution effect. Taken together, these results indicate that further progress in reducing the contamination from the Metsite and also other upstream sources in the watershed would benefit the Porcupine River. The Metsite's effluent quality has improved since 2001 due to enhanced treatment, but the Porcupine River continues to be adversely affected and Glencore should be encouraged to further improve the Metsite effluent quality. Wildlife consumption is not restricted.
LEGEND **I = Impaired** **NI = Not Impaired** **RFA = Requires Further Assessment**	

Table 2 con't. Summary of Impairment of Potential Beneficial Uses and their Significance to The Porcupine River Watershed	
Potential Impaired Use	**Significance to the Watershed**
ii. Degradation of fish and wildlife populations	**I** The fish communities in the watershed are self-reproducing and atypical of oligotrophic Canadian Shield systems. Due to anthropogenic pressure they resemble eutrophic and mesotrophic systems; however, they are not diverse. A collapse of one or more species could translate into lost angling opportunities and a further unbalanced ecosystem. Up until the 1960's Porcupine Lake supported a natural population of walleye. Due to an unrestricted influx of raw sewage into the lake the walleye species died out. In 1988, a onetime introduction of 400 adult walleye was instituted to the lake; however, a negative aspect in the form of walleye poaching appeared which resulted in the establishment of sanctuaries to protect these fish during spawning season and allow for a healthy resident population to flourish. Dissolved oxygen varies throughout the system periodically falling below the Provincial Water Quality Objective (PWQO) of 47% saturation. On the other hand, oxygen supersaturation is also known to occur in the Porcupine River downstream of Porcupine Lake, likely as a product of photosynthesis by aquatic plants and algae. Conductivity was high in the South Porcupine River upstream of the Dome Mine and in the north branch of the Porcupine River as a result of closed mine inputs, but it was further elevated downstream of the effluent discharge from the Dome Mine. In 2012 sublethal toxicity studies in the EEM for the Kidd Metallurgical Site by Minnow Environmental Inc. estimated that effluent concentration in the river is about 18% at 500 m distance from the effluent discharge. Thus, within the near-field zone downstream of the Metsite effluent discharge there is expected to be impairment to sensitive aquatic biota
iii. Degradation of stream and lake benthos	**I** Scientific evidence indicates the watershed benthic communities are degraded. In recent years, some improvements have been observed and species composition has shifted away from more pollution tolerant oligochaetes, although the community still remains altered. Ecological understanding is improving. Previous EEM studies 2004, 2007 and an Investigation of Clause 2009 found that Metsite treated effluent discharge was responsible for elevated concentrations of Cadmium, Selenium and Zinc in Porcupine River water and sediment was a factor responsible for observed adverse effects on benthic invertebrates. The 2011 Environmental Effects Monitoring (EEM) study for the Dome Mine, Pamour Mine, and Owl Creek Pit by Minnow Environmental Inc. indicated that overall, the differences in benthic community structure observed throughout the Porcupine River Watershed appeared to be largely attributable to the influence of contaminants from closed mines in the upper watershed and sewage inputs in the lower watershed. The 2012 Environmental Effects Monitoring (EEM) study for the Kidd Metallurgic Site by Minnow Environmental Inc. indicated that relative to upstream reference, the exposure stations closest to the Metsite effluent discharge had a lower density (mass per unit volume), lower mean number of taxa, and lower evenness (how close in numbers each species is in an environment; it is a measure of biodiversity, i.e. a population that contains 40 cats and 1000 dogs is not even). The decline in these metrics is suggestive of a shift in composition at one or both stations, possibly due to changes at the reference community causing it to become more like the exposure community.
LEGEND **I = Impaired**	**NI = Not Impaired** **RFA = Requires Further Assessment**

Table 2 con't. Summary of Impairment of Potential Beneficial Uses and their Significance to The Porcupine River Watershed	
Potential Impaired Use	**Significance to the Watershed**
iv. Accelerated eutrophication of lakes and streams	Excessive growth of phytoplankton and zooplankton are characteristic of eutrophication. Eutrophication is a phenomenon, in which the excess trophic substances (i.e., nitrogen and phosphorous) in waterbodies and watercourses cause a great increase in algae and a decrease in dissolved oxygen, thus, leading to the death of a lot of fish and other hydrophytes. In the lower Porcupine River, phosphorous loadings associated with the Whitney-Tisdale WWTP discharge appear to have the greatest impact on water quality, causing proliferation of primary producers and anoxia within the Porcupine River, particularly during periods of low precipitation and flow. Periodic sewage treatment by-pass events also contribute to excess nutrient loadings in the Porcupine River. This was particularly evident in late summer 2010, when large blooms of algae, duckweed and anaerobic purple sulphur bacteria were evident downstream of the WWTP. The Porcupine system has also experienced unrelated periodic fish kills and presence of blue-green algae blooms.
v. Impairment of drinking water sources	**NOTE: waiting on Health Unit contact for data**
vi. Degradation of aesthetics	**I** Degraded aesthetics have been reported (e.g. algae blooms and after weed overgrowth, fish kills).
vii. Proliferative diseases in fish populations	**RFA** On the basis of professional observations and public anecdotal reports, tumours in fish or other deformities have been identified as an impaired beneficial use in the Porcupine River Watershed. Ecological understanding is improving. Studies have shown that female brook stickleback from downstream of Kidd Metsite were older, smaller, had reduced condition (body weight relative to length) and higher relative liver weight. Male brook sticklebacks in the exposure area were older, shorter and had larger testes relative to body weight. Similar body weight relative to length, and higher relative liver weight results were observed on the fish health survey performed downstream of the Dome Mine where brook sticklebacks had greater relative liver size along with spinal deformities, bulgy eyes, and external tumour abnormalities**.**
viii. Loss of fish and wildlife habitat	**I** Loss of fish and wildlife habitat is an impaired beneficial use. Wetlands make up about one-third of the province's land base, are among the most productive habitats for fish and wildlife, and are most prevalent in the North. Yet the majority still remain unassessed and as a consequence unprotected by legislation. Due to the lack of wetlands assessment in this region, it is hard to provide a concrete number of wetland areas that has been converted to other uses. Losses are due to human activities including growth pressures, lack of adequate legislation, no available management policies, no concept or process of ecosystem management, and/or changes in long term water levels. Tributaries have been affected by past and present flash floods, improper municipal planning, and shoreline development causing erosion of stream banks and therefore high levels of sediment and other pollutants in the water, smothering spawning beds.
ix. Restriction on recreational uses such as canoeing and swimming	**I** Please refer to Potential Impaired Use 4, 6 & 8.
LEGEND **I = Impaired** **NI = Not Impaired** **RFA = Requires Further Assessment**	

The watershed's persistent toxic contaminant problem is linked to the impairment of beneficial uses and these links are illustrated in Table 3 below:

Table 3. Matrix of The Porcupine River Watershed 'Impaired Beneficial Uses' and 'Ecosystem Problem' Categories

Impaired Beneficial Use	The Porcupine River Watershed Ecosystem Problem			
	Excessive Nutrient Enrichment	Bacteriological Contamination	Persistent Toxic Contamination	Habitat Destruction Ecosystem Instability
i. Restrictions on fish and wildlife consumption			x	
ii. Degradation of fish and wildlife populations	x		x	x
iii. Degradation of stream and lake benthos	x		x	x
iv. Accelerated eutrophication of lakes and streams	x			x
v. Impairment of drinking water sources		x		
vi. Degradation of aesthetics	x	x		x
vii. Proliferative diseases in fish populations	x		x	x
viii. Loss of fish and wildlife habitat	x			x
ix. Restriction on recreational uses such as canoeing swimming	x	x		x

The actions recommended to improve the health of the Porcupine River Watershed and restore the beneficial uses are summarized in Table 4.

Table 4. Summary of recommendations and Proposed Schedules, Implementer and Partners, and Total Estimated Cost ($,000) of Porcupine River Watershed Remedial Action Plan

Recommendation	Proposed Schedule	Proposed Implementer	Proposed Partners	Estimated Total Cost ($,000.)	
				One Time Capital Cost	Ongoing Cost
Ecosystem Approach					
1. The Porcupine River Watershed community should give priority to developing, promoting and implementing a code of ecosystem ethics to (1) guide and influence the actions of its residents and commercial enterprises, and (2) protect environmental quality and human health in the area.	**I**	- The Porcupine River Watershed Committee	- The Porcupine River Watershed RAP Committee	n/a	Included in Recommendation # 43
2. The ecosystem approach, which includes concepts such as sustainable development, should be integrated into future land use and economic planning processes within the Porcupine River Watershed.	**I**	- All sectors	- City of Timmins - Industries - All federal & provincial agencies - MRCA	n/a	No new costs identified
3. The federal, provincial and municipal governments, as well as the MRCA and all other Porcupine River Watershed stakeholders, should endorse the Porcupine River Watershed RAP implementation structure as presented in Chapter 8 of this report, and should participate fully as partners.	**I**	- The Porcupine River Watershed Committee	- Government of Canada Agencies - Government of Ontario Agencies - City of Timmins - MRCA - All Porcupine River Watershed RAP - stakeholders groups	n/a	No new costs identified
4. The principles of polluter-pays, user-pays and beneficiary-pays should apply, where appropriate, to the recommended pollution prevention and ecosystem protection measures described herein.	**I**	- The polluter - The user - The beneficiary		n/a	No direct costs identified
5. Specific government funding programs should continue to be established for RAP implementation and these funds targeted for use only in the Porcupine River Watershed region.	**I**	- Government of Canada - Government of Ontario	- Agencies of the Government of Canada - Agencies of the Government of Ontario	n/a	Costs of The Porcupine River Watershed RAP noted below
Excessive Nutrient Enrichment					
6. Responsible parties within the watershed should co-operate in the development of innovative cost effective strategies for achieving and maintaining the Porcupine River Watershed total phosphorus loading limits.	**I**	- Municipality - Industries - Institutions - The Porcupine River Watershed RAP Committee	- MRCA - OMNR - City of Timmins - OMOE - DOE	n/a	65
7. Official Plans in the Porcupine River Watershed drainage basin should be amended at the time of their next cyclical review to include a strategy to prevent increased phosphorous loading to the watershed associated with the jurisdiction planned growth and development.	**S**	- Municipality	- OMOE - The Porcupine River Watershed RAP Committee - City of Timmins	Part of regular municipal planning process No new cost identified	n/a

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Table 4 con't. Summary of recommendations and Proposed Schedules, Implementer and Partners, and Total Estimated Cost ($,000) of Porcupine River Watershed Remedial Action Plan

Recommendation	Proposed Schedule	Proposed Implementer	Proposed Partners	Estimated Total Cost ($,000.)	
				One Time	Ongoing Cost

				Capital Cost	
8. The Whitney & Tisdale sewage treatment plant and Bob's Lake Lagoon should limit the concentration of phosphorous in their effluent to a monthly average of <0.5 mg/L.	**S**	- Municipality	- OMOE	11,244	Plus annual operating and maintenance of 162
9. The City of Timmins should develop a progressive plan for reduction/elimination of lift stations bypasses.	**M**	- Municipality	- OMOE	16	n/a
10. The Whitney & Tisdale water treatment plants should stop discharging untreated wastewater to the watershed.	**S**	- Municipality	- OMOE	700	n/a
11. The Whitney & Tisdale sewage treatment plant should be assigned, as a compliance limit on their Operating Certificate of Approval, a not-to-be-exceeded phosphorus load limit. This load limit should be defined as the product of an effluent concentration of 0.5 mg/l multiplied by the sewage treatment plant's approved hydraulic capacity on the date that the Porcupine River Watershed RAP receives provincial government endorsement for implementation.	**S**	- OMOE - Correctional Services Canada	- City of Timmins	n/a	No new costs identified Operating cost to maintain P load – to be determined
12. The Whitney & Tisdale sewage treatment plant, Bob's Lake Lagoon, & Ontario Government Complex Lagoon effluent sampling should be conducted in accordance with the Minimum Municipal Sampling Program for Seasonal Discharge Sewage Treatment Plants and Lagoons.	**I**	- OMOE	- City of Timmins	n/a	No new costs identified
13. The City of Timmins should develop a plan to monitor impacts from bypass events on the Porcupine River and Porcupine Lake.	Initiated and ongoing	- Municipality	- City of Timmins	16	n/a
Bacteriological Contamination					
14. The City of Timmins should undertake Pollution Control Planning Studies to identify and, where required, implement actions to eliminate the sources of bacterial contamination and other pollutants along the waterfront.	Initiated and ongoing	- Municipality	- OMOE	313.5	n/a
15. The municipality in the Porcupine River Watershed should implement long range strategies for sewer system inspection, rehabilitation and maintenance.	**I**	- Municipality - The Porcupine River Watershed RAP Committee - DND	- OMOE - DOE - OMMA	n/a	7,340
16. The municipality in the Porcupine River Watershed should implement water conservation programs to reduce the wastage of water.	**I**	- Municipality - DND - The Porcupine River Watershed RAP Committee	- OMOE - Ministry of Government Services - DOE - OMNR	570	n/a

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Recommendation	**Proposed Schedule**	**Proposed Implementer**	**Proposed Partners**	**Estimated Total Cost ($,000.)**	
				One Time Capital Cost	**Ongoing Cost**

17. Operating authorities for public beaches in the Porcupine River Watershed should take measures to discourage waterfowl feeding presence of gulls and prohibit the presence of dogs at swimming areas.	**I**	- Beach operating authorities	- OMOE - Porcupine Health Unit - DOE	n/a	50
18. The Ontario Ministries of the Environment and Natural Resources should cooperatively develop and implement a program which ensures the proper disposal of human wastes and litter associated with the watershed's ice-fishing community.	**S**	- OMNR - OMOE	- Conservation Authorities - City of Timmins	Part A Program development - no new cost identified	Part B To be determined
19. The Province of Ontario's subwatershed Planning Process should be adopted and employed by the City of Timmins municipality to provide direction for the preparation of Secondary Official Plans for areas slated for new urban development.	**I**	- Municipality - The Porcupine River Watershed RAP Committee	- OMOE - Conservation Authorities - OMNR -OMMA	8	n/a
20. An investigation program should be undertaken to investigate the private waste disposal systems (e.g., septic tanks) on all properties having frontage on the Porcupine River Watershed and where required, corrective actions are implemented.	**S**	- OMOE	- OMNR - OMOE - Porcupine Health Unit	263	n/a
21. The Porcupine River Watershed RAP Committee should provide awareness kits and promote stewardship amongst all shoreline property owners in the watershed.	**I**	- Porcupine River Watershed RAP Committee	- OMNR - OMOE - Conservation Authorities - DOE - Porcupine Health Unit	n/a	Included in Recommendation # 79
Persistent Toxic Contaminants					
22. The federal and provincial governments should show more tangible evidence of commitments to the goals of virtual elimination and zero discharge of persistent toxic contaminants by making greater use of their legislative authority to ban the production and use of such substances.	**S**	- DOE - OMOE	-Health and Welfare Canada (HWC)	n/a	Internal costs only
23. A comprehensive communications pr should be initiated to provide consumers information about the persistent toxic compounds contained in marked products and safe alternative choices	**S**	- The Porcupine River Watershed RAP Committee	- OMOE - HWC - DOE	n/a	No new costs identified
24. The watershed's municipality and jurisdictions should cooperatively develop permanent programs, facilities and schedules for the collection and safe disposal of household hazardous wastes.	**I**	- Municipality - The Porcupine River Watershed RAP Committee.	- OMOE - DOE	n/a	Total cost to be determined

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Table 4 con't. Summary of recommendations and Proposed Schedules, Implementer and Partners, and Total Estimated Cost ($,000) of Porcupine River Watershed Remedial Action Plan

Recommendation	Proposed Schedule	Proposed Implementer	Proposed Partners	Estimated Total Cost ($,000.)	
				One Time Capital Cost	Ongoing Cost

25. Efforts should be directed towards source control at a number of closed tailings areas along the Upper Porcupine River (both south and north arms), which appear to be contributing elevated metal levels in both the water column and the sediment.	**I**	- OMNR - OMOE	- Industry - The Porcupine River Watershed RAP Committee	n/a	Post monitoring after source control measures are implemented
26. Efforts should be directed towards source control at the Dome active tailings discharge, which had elevated levels of copper and nickel **in** the discharge.	**I**	- OMNR - OMOE	- Industry - The Porcupine River Watershed RAP Committee	n/a	Post monitoring after source control measures are implemented
27. Efforts should be directed towards source control at the Kidd TMA, which had contributed to elevated metals as well as gypsum **in** the Porcupine River sediments, resulting in impacts on the benthic community downstream of the site and elevated metals in fish tissue from Night Hawk Lake.	**I**	- OMNR - OMOE	- Industry - The Porcupine River Watershed RAP Committee	n/a	Post monitoring after source control measures are implemented
28. Efforts should be directed towards source control at the area around Three Nations Creek, which had elevated levels of cadmium and zinc.	**I**	- OMNR - OMOE	- Industry - The Porcupine River Watershed RAP Committee	n/a	Post monitoring after source control measures are implemented
29. All snow disposal sites in the watershed should be properly designed to retain solids and prevent off-site release of persistent toxic contaminants and salt.	**S**	- Municipality - The Porcupine River Watershed RAP Committee	- OMOE - DOE	n/a	To be determined
30. All authorities involved in managing public lands, transportation routes and transmission corridors in the Porcupine River Watershed should (1) provide **an** inventory of their herbicide and pesticide use and (2) develop and implement strategies that will reduce their use of these chemicals in the watershed by 50 % by 2022.	**L**	- Municipality - **Hydro One** - Pipeline Companies - Ontario Ministry of Transportation - MRCA - OMNR - All other managers of public land	- OMOE	No new cost identified- internal administration	n/a
Habitat destruction & ecosystem instability					
31. The Porcupine River Watershed and its supporting agencies should foster and support the establishment of tributary improvement associations.	**L**	- OMNR - MRCA	- Tributary residents - Environmental Associations - Sports Clubs - OMOE - DOE	n/a	400
32. The federal and provincial governments should aid in the acquisition of the resources necessary to (1) complete the inventory and classification of the watershed's littoral zone and wetlands, (2) develop a comprehensive management plan for littoral zone and wetlands rehabilitation and protection, (3) undertake wildlife inventories in the Porcupine River Watershed and (4) develop wildlife protection strategies.	**I**	- OMNR	- DOE - DFO - OMOE - MRCA	235	n/a

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Table 4 con't. Summary of recommendations and Proposed Schedules, Implementer and Partners, and Total Estimated Cost ($,000) of Porcupine River Watershed Remedial Action Plan

Recommendation	**Proposed Schedule**	**Proposed Implementer**	**Proposed Partners**	**Estimated Total Cost ($,000.)**	
				One Time Capital Cost	**Ongoing Cost**

33. The federal and provincial governments should cooperate to deliver the comprehensive Porcupine River Watershed fish and wildlife habitat and wetland rehabilitation and management referred to in # 32.	**L**	- OMNR - DFO - DOE - Province of Ontario - Government of Canada	- MRCA - **Hydro One**	To be determined in Recommendation # 32	n/a
34. Fisheries and Oceans Canada and the Ontario Ministry of Natural Resources should continue to vigorously enforce the fish habitat protection provisions of the Fisheries Act to ensure there is no further net loss of the Porcupine River Watershed habitat and continue to actively pursue net gains.	**L**	- OMNR - DFO	- The Porcupine River Watershed RAP Committee	n/a	No new costs identified
35. The Ontario Ministry of Natural Resources, the Ontario Ministry of Municipal Affairs, the Porcupine River Watershed Committee, Mattagami Region Conservation Authority, City of Timmins, local industries, Non- Government Organizations (NGO's), the private sector and individuals should cooperatively prevent any further loss of the integrity of the watershed's remaining wetland ecosystems. **They should also** speed up wetland identification and evaluation **and ensure** that **PSWs** are incorporated into municipal official plans.	**S**	- OMNR	- City of Timmins - NGO's - Industry - MRCA - Private sector and individuals - The Porcupine River Watershed RAP Committee - DOE	n/a	To be determined in Recommendation # 32
36. The Ontario Ministry of Natural Resources should prepare and information pamphlet outlining the methods by which individual landowners can restore and protect their shoreline by planting native vegetation.	**I**	- OMNR	- MRCA	10	n/a
37. **The** Porcupine River Watershed municipality should provide protection of the shoreline and streambanks within its jurisdiction by designating **a buffer zone of 15 metres or greater** in their Official Plan to be maintained undisturbed as a natural protection zone.	**I**	- Municipality	- OMNR - MRCA - City of Timmins	n/a	Administration and internal costs only Additional cost to be borne by user
Other					
38. The governments of Canada and Ontario should commit long term resources to the Porcupine River Watershed RAP to maintain the program and its ecosystem database.	**L**	- Government of Canada - Government of Ontario	- DFO - OMNR - DOE	n/a	Included in Recommendation # 39
39. The Porcupine River Watershed RAP Committee should coordinate and deliver the ecosystem research and monitoring component of the Porcupine River Watershed RAP.	**L**	- DFO	- OMNR - OMOE - DOE	n/a	100

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Recommendation	**Proposed Schedule**	**Proposed Implementer**	**Proposed Partners**	**Estimated Total Cost ($,000.)**	
				One Time Capital Cost	**Ongoing Cost**

40. The Porcupine River Watershed RAP should evaluate the watershed ecosystem response to remedial actions and report annually on the water quality status of the watershed.	**L**	- DFO	- OMNR - OMOE - DOE	n/a	Included in Recommendation # 38
41. Public involvement should be mai throughout the implementation phase of **the** Porcupine River Watershed RAP and should include an opportunity for the public participants to report independently to the public-at-large on the progress of the Porcupine River Watershed RAP implementation.	**L**	- The Porcupine River Watershed RAP Committee		n/a	Included in Recommendation # 43
42. The local Porcupine Region Boards of Education and the Porcupine River Watershed RAP Committee should work cooperativ develop, produce and distribute, throughout the watershed, Porcupine River Watershed ecosystem educational materials for all grades, and that these materials are prepared so t existing education curriculum requirement employed.	**S**	- The Porcupine River Watershed RAP Committee - Porcupine Region School Boards		270	n/a
43. The Porcupine River Watershed RAP Committee should with government support, maintain active involvement in all aspects of the Porcupine RAP's public informatio consultation activities including promotion of the Porcupine RAP and its implementation.	**L**	- The Porcupine River Watershed RAP Committee	- OMOE - DOE - Other government agencies	n/a	50 annually
44. Remediation of the watershed's sediments **s**hould be left to natural processes.	Not applicable	Not applicable		n/a	No cost

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CHAPTER 4

4.0 SCOPE OF THE PORCUPINE RIVER WATERSHED RAP STAGE 1 DOCUMENT

4.1 PORCUPINE RIVER WATERSHED STAGE 1 RAP REQUIREMENTS

The Remedial Action Plan shall be developed and implemented in the watershed; the plan will include:

- an evaluation of remedial measures in place;
- an evaluation of alternative additional measures to restore beneficial uses;
- a selection of additional remedial measures to restore beneficial uses and a schedule for their implementation;
- an identification of the persons or agencies responsible for implementation of remedial measures.

In addition there are General Principles in the Great Lakes Water Quality Agreement that can be adopted to guide the RAP development process.

The first General Principle states that RAP's "embody a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses." The ecosystem approach requires that the Porcupine River Watershed be examined as a geographic entity which has physical, chemical and biological components, including people that are all interrelated and interdependent.

CHAPTER 5

5.0 THE PORCUPINE RIVER WATERSHED RAP DEVELOPMENT

In the 1990's, prior to the advent of the RAP program, the community of the watershed designated the Porcupine River Watershed as a 'problem area' because of excessive nutrient enrichment, excessive macrophyte growth, low concentrations of dissolved oxygen, high levels of metal concentration in the water column and sediments, fungi infections on fish populations, and localized bacteriological contamination. Abatement actions were introduced, including an annual weed harvest, removal of blockages along the river, and changes in fishing quotas for certain recovering lakes, among others. Due to these actions, water quality conditions generally improved.

In 2013, the review of data identified nine beneficial water uses of the watershed that were judged to be impaired, thus designating the Porcupine River Watershed as an area of concern.

5.1 PORCUPINE RIVER WATERSHED RAP PARTNERSHIP NETWORK

5.1.1 Partnership Network Composition and Responsibilities

To address the impaired beneficial uses, the Mattagami Region Conservation Authority and the Ministry of Natural Resources agreed to undertake a RAP program. A RAP process for the watershed was initiated in 2013 with the formation of a Porcupine River Watershed RAP partnership network. The Mattagami Region Conservation Authority, Ministry of Natural Resources, Ministry of the Environment, and the Department of Fisheries and Oceans were present (see the Acknowledgment Section for a detailed breakdown of past and present members).

The Mattagami Region Conservation Authority Project Biologist was charged with the responsibility of developing a Remedial Action Plan (RAP) for the Porcupine River Watershed, adapting the requirements of Annex 2 of the Great Lakes Water Quality Agreement. The project biologist was also mandated to seek a broad public consensus for action, provide alternative and innovative cleanup solutions, and apply, to the greatest extent possible, ecosystem management and sustainable development approaches to any remedial undertakings.

5.1.2 Technical Program

As a first step, the Mattagami Region Conservation Authority (MRCA) applied for funding from the Ontario Community Environment Fund (OCEF). This program is offered by the Ministry of the Environment, and it collects money from environmental penalties for mining operations located in the watersheds where the violation(s) occurred. After achieving funding from OCEF, a project biologist was hired by the MRCA, who was subsequently provided with in-kind support (administrative, vehicle access) from the MNR. The project biologist had to gather baseline data on the Porcupine River Watershed to identify areas of concern and develop rehabilitation strategies. The

project biologist grouped the impaired beneficial uses into four working categories: excessive nutrient enrichment, bacteriological contamination, persistent toxic contaminants, and habitat destruction & ecosystem instability. At the outset, each working category was evaluated. The historic persistent toxic contaminant database was compiled and summarized, and field studies were planned to update persistent toxic contaminant and bacteriological data. A preliminary database of fish habitat, coastal wetland and shoreline use was compiled.

5.1.2.1 Excessive Nutrient Enrichment

The City of Timmins and the Mattagami Region Conservation Authority partnership problem assessment and remedial action evaluation will focus primarily on eutrophication in the next five years, which is the area of greatest scientific understanding.

The City of Timmins Water Monitoring Plan for Porcupine River and Porcupine Lake will generate a historic database from earlier studies on the watershed and use it to establish realistic short, medium and long-term priorities, tasks and water use goals regarding nutrient enrichment. Linkages between natural (e.g. precipitation, tributary flows) and introduced factors (e.g. nutrient loads, manipulation of water levels) and the watershed's ecosystem will be determined. This information plus phosphorous dynamics in the system will be modelled by the City of Timmins environmental team. The model will be used to assess the effectiveness of pollution abatement activities. Costs of remedial actions will be estimated, and uncertainties identified.

The predictions will be summarized for public consideration, and later reproduced as Geographic Information System (GIS) output. The most likely phosphorous load control scenario that could substantially reduce phosphorous levels in the Porcupine system would be one that combines various remedial actions.

5.1.2.2 Bacteriological Contamination

Bacteriological contamination is positively correlated with nutrient loading; therefore please refer to section 5.1.2.1 Excessive Nutrient Enrichment. Aside from the City of Timmins Water Monitoring Plan for Porcupine River and Porcupine Lake, small corrective measures can be implemented to increase the rehabilitation of the watershed. Such incentives include:

- proper disposal of human waste and garbage from the ice fishing community (e.g. pack-it-out bag system),

- don't feed the waterfowl initiative, and

- the restriction of dogs on local beach recreational areas.

The implementation of small corrective measures in one ecosystem component will hopefully result in 'desirable' changes, which will encourage the same actions in other ecosystem functions.

5.1.2.3 Persistent Toxic Contaminants

Please refer to Table 4.

5.1.2.4 Habitat Destruction & Ecosystem Instability

Please refer to Table 4.

5.1.3 Products

To date, the Porcupine River Watershed RAP Stage 1 Report has been prepared. Three additional reports for the Porcupine River Watershed are pending – fresh water mussel metal contamination study in the Porcupine River system by MOE; salamander populations study in the Northeastern Region by the Wildlife Assessment Program; and the benthic macroinvertebrate study in the Porcupine system using the CABIN protocol by MOE.

This upcoming field season (April 2014), population data of amphibian and bird marsh species, worms, diatoms and owls in the Porcupine system will be collected and inputted into their corresponding databases. Fish and wildlife habitat such as wetlands and riparian zones will be assessed in order to develop proper protection and rehabilitation programs. The latter will include an assessment and rehabilitation of spawning beds and wetlands, and the Porcupine River duck box maintenance and use inventory program. In partnership with industry and the Timmins Fur Council, a flow restriction removal project will commence, including the removal of woody debris jams and nuisance beavers. In the winter months, in partnership with the Timmins Fur Council, a bioaccumulation of metals in furbearing animals study will take place. Data collected from all former studies will be analyzed and reports will be made available.

5.2 PORCUPINE RIVER WATERSHED RAP PUBLIC ADVISORY COMMITTEE

5.2.1 Committee Membership and Role

To assist the partnership network, a Porcupine River Watershed RAP Advisory Committee needs to be established. People will be selected to represent the various interests in the area.

The Public Advisory Committee (PAC) will serve primarily as an avenue for public input and RAP communications. It promotes the RAP and encourages local ownership of the cleanup initiatives. The PAC will also function as an advisor and review board to the Partnership Network, e.g. PAC reviews and comments on the Porcupine River Watershed RAP technical reports. In many instances, PAC will supplement the scientific database with its local understanding of the Porcupine system. Lastly, PAC will be a major contributor to the ***Stage 2 Report***.

5.2.2 Programs and Products

The PAC will be instrumental in establishing local water use goals and gaining broad public consensus for a set of preferred remedial actions.

The magnitude of public outreach and Porcupine River Watershed RAP consultation process needs to be substantial. Public meetings, open houses, stakeholders and interested groups need to be contacted, and presentations to interest groups made. This way the public will be able to endorse the technical options proposed by the partnership network and potentially provide additional recommendations.

It is recommended that the PAC have five working subcommittees: eutrophication/bacteria, toxic contaminants, fish habitat, budget and communications/ education. The subcommittees will monitor progress, review the partnership network reports, make recommendations and report to the larger PAC organization.

The communications/education subcommittee will serve both PAC and the partnership network. This group will prepare a newsletter, brochures, posters, and other communication items on an ongoing basis for public consultation.

The PAC would be an active and sponsoring partner in most of the Porcupine River Watershed RAP remedial activities.

5.3 Porcupine River Watershed Stage 1 Consultation Process

The Porcupine River Watershed RAP Stage 1 consultation process will have two facets: agency (or implementer) review and public consultation. Agency review has been ongoing during preparation of the report. Technical advice was received from the partnership network members representing various provincial agencies. Formal presentations have been given to management personnel from lead provincial agencies. Ongoing consultation is planned; public consultation will be continuous throughout the development and implementation of the RAP.

CHAPTER 6

6.0 THE PORCUPINE RIVER WATERSHED ECOSYSTEM PROBLEMS, CAUSES, RESTORATION OBJECTIVE AND POTENTIAL SOLUTION

6.1 DESTRUCTION OF HABITAT AND ECOSYSTEM STABILITY

6.1.1 Habitat – Problems and Their Causes

Over 100 years of settlement has altered the watershed's landscape and the watershed's ecosystem. The watershed's aquatic community has lost stability and diversity. Fish migration and spawning routes have been altered and degraded. Natural tributary flows that maintained summer water exchanges and the self-cleaning capacity of the watershed have been disrupted. Natural water level fluctuations required to maintain the diversity of wetland have been permanently modified. Siltation of fish spawning areas has occurred; wetland and low lying areas have been degraded, drained or filled; and shoreline alterations have destroyed critical fish habitat.

The cumulative effect of these and other human influences has adversely impacted the watershed's aquatic communities. Particularly noteworthy are the construction and expansion of the major mining companies Goldcorp and Glencore, as well as, the lack of infrastructure upkeep of the Whitney & Tisdale Wastewater Treatment Plant and Bob's Lagoon. The cumulative effects of the latter have caused sediment transports which have altered the composition, diversity and stability of much of the watershed's near-shore fish, wildlife and plant communities. As a result, the watershed's fringe wetlands have been converted, at an accelerated rate, to vast acreages of dense cattail marshes.

In summary, significant destruction of aquatic habitat has occurred because anthropogenic changes have altered the watershed's ecosystem and affected its stability. The Porcupine River Watershed beneficial uses that have been affected are shown in Table 2.

6.1.2 Habitat – Remediation to Date

Until recently, fish and shoreline habitat concerns plus associated loss of ecosystem stability in the Porcupine River Watershed have been attributed almost exclusively to poor water quality conditions. Most efforts to restore damaged habitat have been directed towards water quality improvement, reducing urban and industrial point-source contaminant loads, and restricting sewage treatment plant phosphorous inputs. This work has indirectly helped to restore fish and shoreline habitat.

Now the programs to restore damaged habitats emphasize direct local action, stewardship and awareness. On a small, yet consistent manner since 1989, many near shore fish habitats

have been enhanced or created. These works coincide with the changes to the province of Ontario's Public Lands Act. Now all shoreline works require a work permit. MNR staff are able to review all work plans to ensure no net loss of fish habitat and, if possible, achieve net gains.

6.1.3 Habitat – Porcupine River Watershed RAP Goals and Objectives

As a first step in developing a meaningful action plan, goals and objectives must be set that:

1) restore, rehabilitate and protect the ecosystem, and
2) are realistic and attainable.

The Porcupine River Watershed RAP has developed a habitat goal:
to re-establish and maintain aquatic shoreline and wildlife habitat conditions and sites within the Porcupine Watershed ecosystem capable of supporting healthy, diverse, stable and self-sustaining aquatic and terrestrial communities while offering recreational and educational opportunities.

Physical alterations to the watershed's natural habitats, for the most part, are not amenable to restoration. This is particularly true of the major historical changes made for social benefit (i.e. flow diversions and land alterations for the mining industry). Reversal of this type of development, while technically feasible, is not an acceptable option in most cases. Restoration of water quality plus a continuation of watershed reforestation, tributary stream rehabilitation projects and an increase in recreational opportunities are practical and beneficial.

To promote habitat restoration, the Porcupine River Watershed RAP has established a general objective:
to support, promote and encourage all feasible actions to restore damaged aquatic and shoreline habitats in the Porcupine watershed.

Resource management techniques can improve habitat conditions and enhance ecosystem stability. While reluctant to endorse engineered ecosystem improvements, the Porcupine River Watershed RAP recognizes that some engineered solutions may be necessary to achieve the primary habitat goal.

The second habitat objective reflects this position:
to limit the use of artificial habitat enhancement measures to situations where it is necessary to offset habitat damage caused by irreversible past destruction.

The Porcupine River Watershed must be protected from actions or activities that would damage aquatic habitat types or pose a further threat to the ecosystem's integrity.

The Porcupine River Watershed RAP adopts the principle of no net loss of habitat as one of its essential habitat objectives. It aims:

to protect and conserve remaining aquatic habitats by applying the 'no net loss of habitat principle' to all urban, rural, and shoreline development or redevelopment.

6.1.4 Habitat – Potential Rehabilitation Measures

Pollution is only one factor contributing to the watershed's degraded habitats and ecosystem instability. The physical, chemical and biological linkages within the aquatic environment are important processes that act as natural internal controls. Human disruption and alteration of these interactions have affected the watershed's attributes. Moreover, our failure to recognize these linkages has limited the scope of our remedial actions and, thus, the extent to which the ecosystem has recovered. Basic information is needed to develop a comprehensive strategy to restore, protect and manage the ecosystem's aquatic habitats. As a first step the Porcupine River Watershed's wetlands, near-shore and aquatic habitats must be inventoried, evaluated and classified. Some work of this nature has been completed; however there are areas that still need to be assessed.

Some engineering solutions may be available for inclusion in a habitat strategy including:

- rehabilitation of spawning beds,
- stabilization of stream banks through re-vegetation of eroded areas that result in sediment deposition, and
- restoration of natural flow via removal of woody debris jams and nuisance beavers.

Since these techniques, in themselves, would introduce physical change to the ecosystem, some environmental impact assessments will be required before considering their implementation.

Habitat restoration by water quality enhancement need not await completion of physical habitat studies. Remedial actions to reduce nutrient loads will alter algal densities, improve water clarity and increase macrophyte acreage. In turn, this will enhance pike, walleye and bass habitat. Similarly, actions to reduce persistent toxic contaminants loads could improve fish quality and stocks. The anticipated net effect from all the undertakings will be a more diverse and stable aquatic community.

6.2 NUTRIENT ENRICHMENT AND ECOSYSTEM INSTABILITY

6.2.1 Nutrient Enrichment – The Problems and Causes

The watershed's trophic state shifted from a moderately enriched, mesotrophic condition in the early stages of development to a highly enriched and productive hyper-eutrophic state today. This shift occurred gradually at first and then in surges. The gradual change resulted from the ongoing discarding of raw sewage effluent into the watershed and land alteration by

settlers. As a result, soil erosion and nutrient runoff were increased. The watershed, stimulated by an increased supply of nutrients combined with modified water flow moved to a more productive, eutrophic state. As towns and cities grew, urban inputs of nutrients and sediments increased. Initially, the loads were small, diffuse, and associated with erosion and land runoff. The load increased in production **due** to urban population growth and then accelerated as urban centres built sewers to convey sewage to the watershed.

The nutrient load was inflated more between 1940 and 1975 with the introduction of laundry detergents with high phosphate concentrations of up to 50 percent phosphorous (as P_2O_5) by weight.
The Whitney and Tisdale sewage treatment plant was constructed in the 1970's. The plant was not equipped to remove phosphorous, and quickly became the watershed's primary summer source of nutrient supply.

The problem grew worse when the Porcupine River Watershed sediments ceased to be a phosphorous sink. Historically, most of the phosphorous entering the watershed settled and was retained in the sediments, but with the onset of the watershed's highly enriched condition**;** physical and chemical processes at the bottom of the water triggered the release of phosphorous back to the water column. This internal source further contributed to the new hyper-eutrophic state. Other sources of phosphorous to the watershed include inputs from industrial wastewater discharges, water treatment plant sludge discharges, and filter backwashes.

In the watershed, a substantial increase in nutrient (i.e. Total Kjeldahl Nitrogen, orthophosphate and total phosphorous) concentrations in sediments was noted immediately downstream of Porcupine Lake likely related to sewage inputs to Porcupine Lake**.** In the lower Porcupine River, phosphorous loadings associated with the Whitney-Tisdale WWTP discharge appears to have the greatest impact on water quality, causing proliferation of primary producers and anoxia within the Porcupine River, particularly during periods of low precipitation and flow. Periodic sewage treatment by-pass events also contribute to excess nutrient loadings in the Porcupine River. This was particularly evident in late summer 2010, when large blooms of algae, duckweed and anaerobic purple sulphur bacteria were evident downstream of the WWTP.

The Porcupine system has also experienced periodic fish kills and presence of blue-green algae blooms.

6.2.2 Nutrient Enrichment – Restoration Goals and Objectives

In conjunction with the City of Timmins**'** Porcupine Lake and Porcupine River study**,** the common goal is to develop an economically feasible strategy that combines a desire and intent to prevent future deterioration of the watershed through the reduction of:

- average water concentration of total phosphorous,
- average the algal and duck weed density, and

- increase the area of submerged aquatic macrophytes.

If these objectives are attained, the watershed's water quality would improve significantly, although evidence of nutrient enrichment would remain. For example, there would still likely be periods of high algal densities. Algal blooms might still occur, although less frequently. Water clarity would increase; the Porcupine River watershed's aquatic community will become healthier, more diverse and stable but the number of rooted plants in some portions of the watershed will increase.

6.2.3 Nutrient Enrichment – Potential Remedial Measures

A number of remedial options and combinations of options exist to improve the watershed's nutrient status and attain the RAP's restoration goal and objectives. The City of Timmins will continue to upgrade the PSPSS as recommended in the RV Anderson Associates Limited assessment of the PSPSS report until its completion in 2017.

Furthermore, it is recommended that a phosphorous-ecosystem simulation model be developed to assess remedial options for nutrient enrichment and their anticipated environmental benefits. Each of the remedial options or combination of options should predict three parameters: phosphorous concentration, abundance of algae and potential area of rooted plant growth. These predictions should then be compared to the City of Timmins Porcupine Lake and River study restoration goals and objectives, so they can be evaluated for technical and cost effectiveness, and discussed with government, public and stakeholder representatives.

These strategies should be developed to allow for future growth and development without an associated increase in contaminant loadings to the watershed. This is possible, and affordable treatment technology already exists to allow the existing sewage treatment plants to almost triple their hydraulic capacity. Other cases may require some new and innovative approaches to land use planning and greater willingness for cooperation among involved entities to achieve a common goal. Sustainable development need no longer be just a concept. It can and must become a reality in the Porcupine River Watershed.

The Pollution Problems – As We See Them

Blue-Green Algal Growth & Duck Weed Dean Touchette

6.3 BACTERIAL CONTAMINATION

6.3.1 Bacterial Contamination – Problems and Causes

6.3.1.1 The Problems

Zones of bacterial contamination have been periodically detected in the watershed. In the past, public swimming areas in the Porcupine River Watershed have been posted on more than one occasion. Porcupine Lake still remains as a potential area of concern due to high bacteriological concentrations in the middle of the lake on summer days.

6.3.1.2 The Causes

Today, diseases caused by contaminated drinking water have been largely eliminated. Water treatment provides safe drinking water from the Mattagami River. However, bacterial pollution still threatens human health and water contact recreational opportunities are restricted.

The spatial pattern of contamination around the Porcupine River Watershed, suggests that urban discharge and runoff are the primary sources of in-watershed bacterial contamination.

The combined storm and sewage collector system problem still persists and adequate sewage treatment plant capacity to avoid overflows is non-existent. Combined sewer overflows are therefore frequent and are a major factor after major storm events or during spring runoff. By-passing of inadequately treated sewage occurs at the Whitney & Tisdale sewage treatment plant. This facility does not have the capacity to treat all wet weather flows. Flows in excess of the plant capacity bypass parts of the treatment process. These sewage treatment plant by-passes are chlorinated before discharging. Urban diffuse sources also contribute to the watershed's bacterial contamination problem. These sources are primarily from domestic pet and bird droppings and may also include faulty septic systems. Sanitary wastes from ice fishing are another source of bacteria, but are unlikely to affect summer bacteriological conditions.

6.3.2 Bacterial Contamination – Remediation to Date

Historically, bacterial contamination occurred at the municipality where sewer systems simply conveyed sanitary wastes to the most convenient surface water for discharge without any form of treatment. The initial sewage treatment plants were built to engineering standards designed to treat dry weather flows. Generally, wet weather flows were not considered. Overflow locations were necessary to relieve the build-up of pressure in sewers during rainfall events. In this regard, the Porcupine River Watershed municipality was not unique. The Whitney & Tisdale plant has since been upgraded to provide more efficient treatment and has been expanded to handle most of the wet weather flow. In addition, the assessment and some remedial work to overcome the hydraulic capacity problems at the Whitney & Tisdale sewage facility are in progress.

6.3.3 Bacterial Contamination – Restoration Goal and Objective

Substantial progress has been made to eliminate bacterial pollution in the Porcupine River Watershed. The Porcupine River Watershed RAP Committee believes that it is desirable and achievable to eliminate the bacterial contamination of Porcupine Lake and thus restore the water quality.

6.3.4 Bacterial Contamination – Required and Potential Remedial Measures

6.3.4.1 Treatment of Sewage

The impact and status of by-pass and combined sewer overflows at inland sewage treatment plants had not been assessed until it was recently completed as part of the City of Timmins Porcupine Lake and Porcupine River Study.

6.3.4.2 Storm and Sanitary Sewer Systems

Measures to reduce inflow and infiltration need to be established. Along with the improvements to the sewage works being implemented at the Whitney and Tisdale sewage treatment plant, measures are required to reduce the inflow and infiltration of extraneous water into the sewer collector systems.

Other options have been identified as follows:

1. municipal sewer systems need to be evaluated and, if and where warranted, rehabilitated – this is currently in progress. Short term actions should be directed at land owners bordering directly on or within 50 km of the watershed.

2. water conservation measures such as home shower flow restrictions and toilet tank dams can substantially reduce flows from private homes and commercial operations.

The municipality, commercial establishments and the Porcupine River Watershed RAP can work cooperatively to implement these programs.

6.3.5 Bacterial Contamination – Prevention

As a minimum requirement, the municipality will need to make a long term commitment to sewer systems maintenance and initiate stormwater quality control programs for new urban development.

The most cost effective means of accomplishing stormwater quality control in developing sub-watersheds should be determined by means of the Subwatershed Planning (formerly called Master

Drainage Planning) process. These plans should be undertaken by the municipality to guide the development of Official Plan policies for stormwater management.

6.4 PERSISTENT TOXIC CONTAMINANTS

6.4.1 Toxic Substances – Understanding the Problem

Persistent trace metals and organic compounds resist breakdown or degradation in the ecosystem. In some cases toxic substances as heavy metals occur naturally and are essential components of the environment which become pollutants when excessively used. The other persistent toxic pollutants include some, but not all manufacturer's organic compounds, and/or by-products of industrial and domestic activities. Persistent substances can move upward through the food chain and both human and ecosystem health are threatened.

Contaminants move through the food chain via many different pathways, depending on the chemical properties of the contaminant of concern. Water solubility, for example, regulates contaminant movement through one pathway. Water in insoluble (hydrophobic) contaminants will adsorb to particles of solids (suspended solids) in the water and, eventually, sink to the bottom. Animal life that lives in sediments at the bottom of the water column (bottom dwellers) consumes the contaminants and, in turn, is consumed by other aquatic organisms. At each stage in the aquatic food chain, the toxic contaminants may become more concentrated in their host. This process of Biomagnification continues up to the top predator fish species. Another pathway of contaminant movement is direct uptake by fish and other aquatic life exposed to water soluble contaminants suspended in the water column.

6.4.2 Persistent Toxic Contaminants in the Porcupine River Watershed

6.4.2.1 Persistent Toxic Contaminants in Drinking Water

Under the province of Ontario's Drinking Water Surveillance Program (DWSP), raw and treated drinking water at the municipality is monitored monthly for trace metals and organic compounds of human health significance. Several thousand analyses for trace metals and organic compounds have been completed. No violations of health related drinking water consumption guidelines have been recorded.

6.4.2.2 Persistent Toxic Contaminants in the Water Column

The aqueous concentrations of some metals (i.e. Al, As, B, Co, Cu, and Fe) may be sufficiently elevated above water quality criteria, which may affect biological communities in some areas of the South Porcupine and Porcupine Rivers. The aqueous concentrations of most metals, (Al, Ar, B, and Fe) are primarily attributable to sources other than the operating mines. Receiving waters

concentrations of most of the metals contributed by the operating mines (i.e. Co, Cu, Ni and Se at Dome Mine, and aluminum and iron at Pamour and Owl Creek Pit) have declined over time. However, cobalt from the Dome Mine continues to be elevated well above the Provincial Water Quality Objective upstream of Porcupine Lake.

The river downstream of the Metsite effluent discharge has elevated concentrations of nitrate (NO_2^-), Se, Zn, and Cd. It also has elevated conductivity, total dissolved solids, sulphate, and hardened metals, including Ca and Mg. Elevated levels of other contaminants (As, Co, Cu, Fe and P) in the river downstream of the Metsite can be attributed to non-Metsite sources because concentrations were higher at the upstream reference station.

6.4.2.3 Persistent Toxic Contaminants in the Sediment

Provincial Sediment Quality Guideline Severe Effect Levels were surpassed on sediment upstream of the Dome Mine for As, Cu, Fe, Mn, and N. This is indicative of historical mining activities. Downstream of the Dome Mine, higher concentrations of Cu, TKN and to a lesser extent, Ni, reflected additional contributions from the Dome effluents. Sediment concentrations of most metals have decreased over time, which is consistent with the trends observed in the receiving water. Downstream of the confluence of the Porcupine River with the South Porcupine River, concentrations of most metals were lower than immediately downstream of the Dome discharge. The primary exceptions were Cd, Hg, and Zn (and to a lesser extent, Pb), for which higher concentrations were attributable to sources (i.e., closed mines and exposed tailings) located along the north branch of the Porcupine River.

6.4.2.4 Persistent Toxic Contaminants in the Porcupine River Watershed Sport Fish

As part of the Province of Ontario's Sport Fish Contaminants Monitoring program, the Porcupine River Watershed fish have been tested for mercury among other contaminants. Consumption advisories in 2013-14 are in effect for fish species in five Porcupine River Watershed Lakes due to elevated levels of contaminants. These species have recommended consumption limits at lengths greater than those listed below:

Pearl Lake
Yellow Perch & Rock Bass – length > 14 cm

Porcupine Lake
Northern Pike & White Sucker – length > 24 cm

Walleye – length > 34 cm

Yellow Perch – length > 14 cm

Bob's Lake
Northern Pike – length > 24 cm

Bigwater Lake
Northern Pike – length > 29 cm

Walleye – length > 19 cm

White Sucker – length > 24 cm

Three Nations Lake
Northern Pike, Walleye, & White Sucker – length > 24 cm

The Porcupine River Watershed brook stickleback, blacknose shiner, and common shiner have been examined for occurrence of cancer and cancerous growths. In 2011, brook stickleback, blacknose shiner, and common shiner collected from the watershed had greater relative liver sizes, and abnormalities such as spinal deformities, external tumours, and bulgy eye.

6.4.3 Persistent Toxic Contaminants – Sources

Trace metals are a natural component of the watershed's ecosystem. Natural concentrations, however, have been augmented by human inputs such as past and recent mining activities in the watershed. The mining industry is the most significant contributor of trace metals. Leachate entering the Porcupine River from abandoned and active mining sites contains elevated levels of persistent toxic contaminants. Other historic sources of trace metals include arsenic based pesticides, mercury based fungicides, lead emissions from automobile exhausts, and inputs from industrial and municipal wastewater discharges and active/abandoned waste disposal sites. Metal input from industrial wastewater and sewage treatment plant discharges continues to contribute small loadings of metals to the watershed. Atmospheric deposition is also a continuing source.

Leachate from illegal waste disposal sites and contaminated soil at industrial sites where spills have occurred are sources of toxic inputs to the watershed. The domestic use and improper disposal of pesticides is a source of organic compounds. Individuals, municipality, Hydro One, pipeline companies and road authorities use herbicides to control undesired plant growth. The loads or percent contributions from these sources have not been determined.

Contaminants already deposited in the watershed sediments are potentially available for recycling through the aquatic ecosystem. This group of contaminants is referred to as in-place pollutants. In-place pollutants and sediment reflux have not been fully assessed at this time. Additional sources of persistent toxic contaminants include atmospheric inputs, the discharge of wastewater from water treatment plants and leaching landfills. Further research on this topic is required.

6.4.4 Toxic Substances – Remediation to Date

Under the Province of Ontario's Pesticides Act, the marketing, storage and use of pesticides are regulated.
Lead emission from automobile exhausts was eliminated with the phasing out of its use in Ontario as a fuel additive.

The Ontario Ministry of Environment and Energy has established stormwater quality control as a requirement for new urban development for the municipality located in the Porcupine River Watershed.

6.4.5 Toxic Substances – Restoration Goals and Objectives

The goal of the Porcupine River Watershed RAP is to restore the watershed ecosystem to a condition in which its fish and wildlife are healthy and its water and the food produced in it are safe for human consumption.

The objective of the Porcupine River Watershed RAP is to accomplish the virtual elimination of persistent toxic contaminant inputs to the Porcupine River Watershed.

CHAPTER 7

7.0 THE PORCUPINE RIVER WATERSHED RAP RESEARCH AND SURVEILLANCE PROGRAM

In essence, the research and surveillance component of the Porcupine River Watershed RAP is already being delivered through industrial, municipal, federal and provincial monitoring programs. However, it is limited by resources and endangered by declining agency commitment. A more effective, flexible and comprehensive monitoring program is needed to overcome these limitations, provide evidence of the success or failure of remedial actions, protect the integrity of the ecosystem, assess sustainability of the natural resources, and address changing implementation priorities and schedules. In order to succeed, the program should include a variety of features and integrate research, modelling and communications activities with a planning and management process. In turn, these features, activities and processes should be linked by a central information system which is updated regularly. Therefore, it is recommended that a geographic information system (GIS) be a component of this central information system.

Much of the research and surveillance program is already in place. It employs components of broader-based regional or provincial monitoring activities in which information sharing is encouraged. The recommended research and surveillance program is outlined in Table 5. Numerous environmental and resource protection programs exist within the federal and provincial governments and the public service. These programs often address needs specific to an agency's mandate, and are maintained by administrative structures and policies designed to execute that mandate. The Porcupine River Watershed implementation structure simply attached on top of these existing programs may produce some favourable results.

Table 5. Watershed Recommended Research, Monitoring, and Fieldwork Program								
PROJECT NAME	**BIOINDICCATOR**	**SAMPLE SIZE**	**SAMPLING INTENSITY**	**DURATION c= sampling collection; p= sample processing**	**SAMPLING TIME**	**METRIC**	**SAMPLING LOCATION**	**NOTES**
Northern Marsh Monitoring Program	Amphibians	1 route, 8 stations	3 surveys/year (with at least 15 days between each survey)	3 min/survey/station , c begin surveying one half-hour after sunset and end by midnight during evenings with little wind and minimum night air temperatures of 5, 10 and 17 C for each of the 3 respective survey periods	Apr-Jul 5	Relative Abundance	Refer to figure 6	This project can integrate the public at various steps, all dependant on ID knowledge
Northern Marsh Monitoring Program	Birds	1 route, 16 stations	2 surveys/year (with at least 10 days between each survey)	15 min/survey/station, c morning surveys can begin as early as 30 min before sunrise and must be completed by 10AM evening surveys can begin as early as four hours before sunset and must be completed by the onset of darkness all surveys occur when the weather conditions are warm and dry with little wind	Mid May & Early July	Relative Abundance	Refer to figure 6	This project can integrate the public at various steps, all dependant on ID knowledge
Canadian Aquatic Biomonitoring Network Assessment	Benthic Macroinvertebrates (organisms without backbones, which are visible to the eye without the aid of a microscope)	?	1 survey/ year	3 min/sample/station, c Site Description 1 hr Reach Characteristics 30 min Water Chemistry 20 min Channel Measurements 1 hr Substrate Data 2 hrs	Late summer or fall	Relative Abundance	?	Craig Logan Consulting Taxonomy Lab $280/sample Ed Snucins tested the CABIN protocol in the Porcupine River with a report in preparation
Freshwater Mussel Biomonitoring Study	Bivalve mollusks	25 tentative stations 2 cages/station 8 mussels/ cage	1 survey/ 3 years 3-6 week waiting period (mollusks are left in the water for this period of time)	30 min/station set up 30 min/station, c	Aug 30- Sep 14	Bioaccumulation of metals & other contaminants	Refer to figure 7	MOE has recently put a request to perform this study

Table 5. Watershed Recommended Research, Monitoring, and Fieldwork Program								
PROJECT NAME	**BIOINDICCATOR**	**SAMPLE SIZE**	**SAMPLING INTENSITY**	**DURATION c= sampling collection; p= sample processing**	**SAMPLING TIME**	**METRIC**	**SAMPLING LOCATION**	**NOTES**
Algal Bioassessment	Diatoms	44 tentative stations, 5 samples/station	1 survey/year	10-15 min/sample/station, c 45-1 hr/sample, p	Late summer	Taxonomic Composition # of algal species (Species Richness) Diversity (Shannon Index) Eastern Canadian Diatom Index (IDEC) Sensitivity & Tolerance Pollution Tolerance Index (PTI)	TBD	Dr. P. Hamilton Canadian Museum of Nature $50/sample if <100 samples $45/sample if >100 samples
Wildlife Assessment Program Salamander Study	Salamanders	2 monitoring plots Min 40 artificial cover object (ACO's) at each 20x20 m forest health monitoring plot	ACO's initially need to weather for at least one full winter 1 survey/ year 8 checks/season/plot Sampling should occur every 2 weeks	8 hrs/ plot, c & p	Spring	Index of population size (counts)	Refer to Wildlife Assessment Program Study 2014	Spring monitoring should take place when temperatures are above 5 C and the ground is wet (mornings are recommended) ~ within the first 5 weeks following winter thaw. Survey should be avoided on days following frosty nights Dean Phoenix currently has an ongoing study in this region
Nocturnal Owl Survey	Owls	2 routes, 40 stations	1 survey/year	45 min/ route	April	Relative Abundance	Refer to figure 8	
Northern Worm Watch	Worms	2 plots, 2 stations 1 sample/station	3 surveys/year	10 min/sample/station, c 1 hr/sample, p	Summer or fall	Species richness	TBD	This project is design for public outreach
Bioaccumulation of Metals in Furbearing Animals Study	Liver of beavers, wolves, & muskrats	TBD	1 study/ 3 years	1 trapping season	Winter	Bioaccumulation of metals & other contaminants	TBD	

Table 5. Watershed Recommended Research, Monitoring, and Fieldwork Program								
PROJECT NAME	**BIOINDICCATOR**	**SAMPLE SIZE**	**SAMPLING INTENSITY**	**DURATION c= sampling collection; p= sample processing**	**SAMPLING TIME**	**METRIC**	**SAMPLING LOCATION**	**NOTES**
Flow Restriction Removal	n/a	43 tentative blockages	1 time removal & subsequent years up-keep	dependent on number & size of blockages	After June 21	n/a	Refer to figure 9	Mechanical (excavator) removal of blockages deems far better results
Porcupine River Watershed Survey	n/a	n/a	1 survey/year	9 hrs total	Spring	n/a	Refer to figure 1	The survey can be split off into two days of 4.5 hrs portaging
Porcupine River Duck Box Maintenance and Use Inventory	n/a	25 boxes	Maintained 1/year	5 hrs total	Late Summer or fall	Occupancy	Refer to figure 10	
Wetland Evaluation	n/a	5 locations	One Time Evaluation	9-10 hours/ location	After June 21	Refer to OWES Manual	Refer to figure 11 Clearwater Lake, Bell Lake, Bob's Lake, Little Goose Creek, & Gowanmarsh Lake	
Assessment & Remediation of Spawning Beds	Fish Species in PRW	8 locations	1 assessment/ year Redial work determined from assessment	4 hours/ assessment 7 hours/ remediation	Assessment in spring & Remediation after June 21	n/a	Refer to figure 12	
Bathymetry Study of Porcupine River Segment	n/a	n/a	One Time Study	TBD	Summer	n/a	From Hoyle via Porcupine river to Gowanmarsh	
Riparian Habitat Assessment and Erosion Control Remediation	n/a	TBD	1 assessment/ year Redial work determined from assessment	TBD	Spring	n/a	TBD	

CHAPTER 8

8.0 SUMMARY

Prior to European settlement, the area was inhabited by various aboriginal tribes and used for hunting and trapping. Water quality in the Porcupine River Watershed was not degraded. More than two centuries have passed since Europeans began to settle in the Porcupine River Watershed area. Throughout most of this brief period, the watershed's ecosystem has been sadly neglected and abused. The process of water quality deterioration and ecosystem damage – slow at first – accelerated to its peak during the second and third quarters of this century when most of the damaged occurred.

By the early 1970's, the Porcupine River Watershed physical features had been significantly altered; its fish and wildlife damaged; its plant and animal life changed; its waters polluted with bacteria and enriched with nutrients; its sediments and biota contaminated with man-made chemicals; and **its** value **as** a natural resource greatly diminished.

Since then, the process of recovering this valuable resource has begun. Substantial progress has already been made and we believe the community now has within its grasp the ability to **initiate** a more concentrated and enthused phase of the recovery process. We are confident that the watershed can be made safe for recreational use, that the nutrient enrichment problem can be reduced to an acceptable level and that a healthy and stable aquatic community structure can be re-established. Furthermore, we believe it is technically and economically feasible to accomplish these restoration objectives before the end of this century.

The Porcupine River Watershed Remedial Action Plan, the recommendations and the suggested implementation structure, as presented in this report, are designed to improve, enhance and protect the water resources and uses of the watershed. Throughout the report, existing government programs are utilized to the greatest extent possible, and the concepts of ecosystem and sustainability are highlighted and incorporated. A degree of flexibility has also been provided (i.e. Porcupine River Watershed RAP actions can be contrasted with other concerns – flooding – and the scheduling of events negotiated to an extent). At the same time, the benefits of pursuing and implementing the recommended actions for the watershed area are substantial. These include reduced algal growth, improved water clarity, increased recreational opportunities; protection and enhancement of fish and wildlife habitats. Implementation of the Porcupine River Watershed RAP is strongly recommended.

APPENDIX I 2014 Project Descriptions & Reference Maps

Project	Rehabilitation of Spawning Beds	**Project #**	1
Project Biologist	Aide Badilla	**Sponsor**	Ministry of the Environment
Project artifacts	Ecological Restoration of Degraded Aquatic Habitats: A watershed Approach	**Updated**	March 11th 2014
Background	Fish habitat restoration projects had been carried out in an effort to regain lost fish habitat productivity, and restore ecological functions in damaged ecosystems. The Porcupine River Watershed Remedial Action Plan is a more holistic approach that aims at conserving, protecting or enhancing aquatic species and their habitats in a geographical unit within a watershed. It also considers the entire spectrum of social, economic, and environmental factors that contribute to deteriorating conditions that were often overlooked in past restoration activities. Aquatic habitat conservation issues are often rooted in complex combinations of economic development and land-use activities, which are not easy to resolve. The watershed approach to restoration seeks to correct the underlying causes of habitat degradation rather than just treating site-specific symptoms.		
Project need and project benefits	Since the first European settlement in the 1600's, our region's riparian zones and watercourses have been extensively altered. The resulting decreases in diversity and function of riparian and aquatic ecosystems have weakened their integrity and productivity. This tops the list of ecosystem concerns, since these habitats are among our most productive and contain critical habitats for fish and wildlife. The most important factor contributing to the decline of aquatic biodiversity is degradation of habitats. The assessment and rehabilitation of spawning beds will help increase the productivity and overall health of the fish community.		
Objectives	The goal of the restoration project is to ensure that the dynamic process of natural ecosystems (i.e. structure and function) is re-established.		
Scope	**In Scope**	**Out of Scope**	
	Spawning beds located in the Porcupine River Watershed	Spawning beds located outside the Porcupine River Watershed	
Deliverables	**Deliverable**	**Due Date**	
	Assessment of the spawning beds	Early spring	
	Rehabilitation of the spawning beds	Late summer	

Project	Rehabilitation of Spawning Beds	**Project #**	1
Flexibility matrix	**Scope**	Moderately flexible	
	Schedule	Least flexible	
	Cost	Moderately flexible	
Key considerations	**Assumptions & Constraints**	**Risks**	
		Category	**Risk Description**
	C, water temperature	Environmental	The rehabilitation of spawning beds must have a concrete sediment control plan in order to avoid harmful alteration, disruption or destruction (HADD) of fish habitat.
	C, time of year restrictions	Personnel	Trips, working on steep, slippery, or unstable, debris covered ground which may cause staff to fall into water
	C, adequate sediment control plan	Personnel	Working in waders, especially if they fill with water
	A, available rock material	Personnel	Accidental immersion in the water, either partial or total
	A, partnership with MNR fire crews is a success		
	A, partnership with MNR SYR program is a success		
	A, permits and letters of approval are obtain in time		
Success criteria	1 - Develop project management plan		
	2 - Acquire required Fisheries and Oceans Canada authorization and Transport Canada, letter of approval		
	3 - Acquire required permits from the Ministry of Natural Resources, work permit, work on shoreland, works within a waterbody		
	4 - Obtain assistance from the Ministry of Natural Resources Fire Crews for the removal of accumulated material		
	5 - Completion of the project within budget and timeframe guidelines		
Project manager			
	Signature		
	Aide Badilla		
	March 11th, 2014		

Project	Erosion Control Areas	**Project #**	2
Project Biologist	Aide Badilla	**Sponsor**	Stakeholders
Project artifacts	Ecological Restoration of Degraded Aquatic Habitats: A watershed Approach	**Updated**	March 12th 2014
Background	Fish habitat restoration projects had been carried out in an effort to regain lost fish habitat productivity, and restore ecological functions in damaged ecosystems. The Porcupine River Watershed Remedial Action Plan is a more holistic approach that aims at conserving, protecting or enhancing aquatic species and their habitats in a geographical unit within a watershed. It also considers the entire spectrum of social, economic, and environmental factors that contribute to deteriorating conditions that were often overlooked in past restoration activities. Aquatic habitat conservation issues are often rooted in complex combinations of economic development and land-use activities, which are not easy to resolve. The watershed approach to restoration seeks to correct the underlying causes of habitat degradation rather than just treating site-specific symptoms.		
Project need and project benefits	Degradation of riparian zones and aquatic ecosystems diminishes their capacity to provide critical ecosystem functions, including the cycling and chemical transformation of nutrients purification of water, attenuation of floods, **maintenance** of habitats for fish and wildlife. The recovery process from soil erosion in a watershed will start only after sediment yield from the watershed is reduced back to natural levels. NOTE: woody debris can be used as retaining/stakes walls to stabilize any bank erosion.		
Objectives	The goal is to stabilize stream banks, reducing erosion and resulting sediment deposition. To regulate stream flow. For example, in winter, tree cover (forest or buffer strip) reduces the penetration of frost, retains surface snow for a longer period and allows for a slow spring melt. During summer, in the headwater areas, trees allow for rain water to seep into the ground for storage, and then to be released slowly to **maintain** a steady summer stream flow. To provide stream quality conditions that are favourable to various fish species. To provide aesthetically pleasing vegetative cover. To provide conditions for attracting certain wildlife and insect species.		

Project	Erosion Control Areas	**Project #**	2
Scope	**In Scope**	**Out of Scope**	
	Where stream side vegetation has been removed by human activities in the Porcupine River Watershed	Where stream side vegetation has been removed by human activities outside the Porcupine River Watershed	
	Where stream water quality is being impaired because of the removal of the streamside vegetation. For example, water temperatures may be too high to support certain fish species; or sediment and contaminants may be entering the watercourse because of the lack of a buffer strip to filter out the eroded soil particles and associated contaminants in the Porcupine River Watershed	Where stream water quality is being impaired because of the removal of the streamside vegetation. For example, water temperatures may be too high to support certain fish species; or sediment and contaminants may be entering the watercourse because of the lack of a buffer strip to filter out the eroded soil particles and associated contaminants outside of the Porcupine River Watershed	
Deliverables	**Deliverable**	**Due Date**	
	Stabilization of stream banks	early spring after frost	
Flexibility matrix	**Scope**	Moderately flexible	
	Schedule	Least flexible	
	Cost	Moderately flexible	
Key considerations	**Assumptions & Constraints**	**Risks**	
		Category	**Risk Description**
	C, time of year restrictions	Personnel	Trips, working on steep, slippery, or unstable, debris covered ground which may cause staff to fall into water
	C, adequate sediment control plan	Personnel	Working in waders, especially if they fill with water
	C, need to perform proper soil conditioning	Personnel	Accidental immersion in the water, either partial or total
	A, permits and letters of approval are obtain in time		
	A, stream vegetation should consist of a mixture of grasses, shrubs and trees		
	A, follow the implementation a steps from the Ecological Restoration of Degraded Aquatic Habitats: A Watershed Approach		
	A, partnership with Stewardship Youth Rangers is a success		

Project	Erosion Control Areas	**Project #**	2
Success criteria	1 - Develop project management plan		
	2 - Acquire required Fisheries and Oceans Canada authorization		
	3 - Acquire required permits from the Ministry of Natural Resources, work permit, work on shoreland		
	4 - Obtain assistance from the Ministry of Natural Resources Stewardship Youth Rangers for watering the seedlings		
	5 - Completion of the project within budget and timeframe guidelines		
Project manager			
	Signature		
	Aide Badilla		
	March 12th, 2014		

Project	Removal of Woody Debris Jams	**Project #**	3.1
Project Biologist	Aide Badilla	**Sponsor**	Stakeholders
Project artifacts	Ecological Restoration of Degraded Aquatic Habitats: A watershed Approach	**Updated**	March 12th 2014
Background	Fish habitat restoration projects had been carried out in an effort to regain lost fish habitat productivity, and restore ecological functions in damaged ecosystems. The Porcupine River Watershed Remedial Action Plan is a more holistic approach that aims at conserving, protecting or enhancing aquatic species and their habitats in a geographical unit within a watershed. It also considers the entire spectrum of social, economic, and environmental factors that contribute to deteriorating conditions that were often overlooked in past restoration activities. Aquatic habitat conservation issues are often rooted in complex combinations of economic development and land-use activities, which are not easy to resolve. The watershed approach to restoration seeks to correct the underlying causes of habitat degradation rather than just treating site-specific symptoms.		
Project need and project benefits	Large woody debris (LWD) plays a role in the development of fish habitat and provides instream cover. Only excessive amounts of LWD should be removed because it may became: a barrier to fish migration; lower the water's oxygen content through decay; trap silt; creating build-ups leading to decreased flow or upstream flooding; cover and destroy clean gravel substrate; cause bank erosion; flood adjacent lands. The advantages are as **follows**: aesthetically pleasing; can remove contaminants; can prevent bank erosion; can permit fish passage. To avoid depositing debris on the flood plain where it could get washed away, MNR fire crews will clear an area above the flood plain where the debris can get deposited.		
Objectives	The goal is to remove excess branches, logs, and fallen trees that are hindering fish passage or altering the stream's hydrology.		

Project	Removal of Woody Debris Jams	**Project #**	3.1
Scope	**In Scope**	**Out of Scope**	
	Woody Debris Jams found in the Porcupine River Watershed	Woody Debris Jams found outside the Porcupine River Watershed	
Deliverables	**Deliverable**	**Due Date**	
	Removal of Woody Debris Jams	late summer/ autumn	
	Rehabilitation of Cleared Areas	late summer/ autumn	
Flexibility matrix	**Scope**	Moderately flexible	
	Schedule	Moderately flexible	
	Cost	Least flexible	
Key considerations	**Assumptions & Constraints**	**Risks**	
		Category	**Risk Description**
	C, time of year restrictions	Environmental	The removal of woody debris jams must have a concrete sediment control plan in order to avoid harmful alteration, disruption or destruction (HADD) of fish habitat.
	C, adequate sediment control plan	Personnel	Trips, working on steep, slippery, or unstable, debris covered ground which may cause staff to fall into water
	A, obtain proper equipment for removal of debris	Personnel	Working in waders, especially if they fill with water
	A, permits and letters of approval are obtain in time	Personnel	Accidental immersion in the water, either partial or total
	C, material must be winched out of the streambed by machinery or equipment stationed a minimum of 15 m from the edge of the bank of the watercourse	Environmental	Improper disposal of woody debris causing it to wash back into the stream
	A, all garbage should be disposed of according to local, provincial and/or municipal procedures and in approved dumps	Environmental	Improper removal of large woody debris can destabilize the stream and lower the productivity of fish habitat
	A, partnership with MNR Fire Crews is a success		

Project	Removal of Woody Debris Jams	**Project #**	3.1
Success criteria	1 - Develop project management plan		
	2 - Acquire required Fisheries and Oceans Canada authorization and Transport Canada, letter of approval through an MNR Class EA assessment		
	3 - Acquire required permits from the Ministry of Natural Resources, work permit, work on shoreland, works within a waterbody		
	4 - Obtain assistance from the Ministry of Natural Resources Fire Crews for the removal of shrubs to create a suitable location for debris deposition		
	5 - Completion of the project within budget and timeframe guidelines		
Project manager			
	Signature		
	Aide Badilla		
	March 12th, 2014		

Project	Beaver Dams (Active and Old)	**Project #**	3.2
Project Biologist	Aide Badilla	**Sponsor**	Stakeholders
Project artifacts	Ecological Restoration of Degraded Aquatic Habitats: A watershed Approach	**Updated**	March 12th 2014
Background	Fish habitat restoration projects had been carried out in an effort to regain lost fish habitat productivity, and restore ecological functions in damaged ecosystems. The Porcupine River Watershed Remedial Action Plan is a more holistic approach that aims at conserving, protecting or enhancing aquatic species and their habitats in a geographical unit within a watershed. It also considers the entire spectrum of social, economic, and environmental factors that contribute to deteriorating conditions that were often overlooked in past restoration activities. Aquatic habitat conservation issues are often rooted in complex combinations of economic development and land-use activities, which are not easy to resolve. The watershed approach to restoration seeks to correct the underlying causes of habitat degradation rather than just treating site-specific symptoms.		
Project need and project benefits	The decision to remove beaver dams will be made in consultation with the local Ministry of Natural Resources wildlife biologist. Since not all beaver dams are fish passage problems under normal migration flows; instead they provide holding pools that are refuge for fish in low periods and during winter. Beaver dams are not considered to be debris. The advantages of their removal are: the opening of passage for migrating fish; it drains the pond and restores stream habitats; it reduces silt accumulation. As well as, facilitating the passage of duck weed through the river system preventing back-up of organic material which creates anoxic conditions when it decomposes. Facilitates use as a canoe route and improves aesthetics. Beavers should be trapped ahead of dam removal.		
Objectives	The goal is to remove or breach beaver dams in order to provide fish passage and prevent erosion or damage to property or infrastructure.		

Project	Beaver Dams (Active and Old)	**Project #**	3.2
Scope	**In Scope**	**Out of Scope**	
	Beaver dams (active or old) found in the Porcupine River Watershed	Beaver dams (active or old) found outside the Porcupine River Watershed	
Deliverables	**Deliverable**	**Due Date**	
	Removal of Beaver dams (active or old)	**late summer/ autumn**	
Flexibility matrix	**Scope**	Moderately flexible	
	Schedule	Moderately flexible	
	Cost	Least flexible	
Key considerations	**Assumptions & Constraints**	**Risks**	
		Category	**Risk Description**
	C, time of year restrictions	Environmental	The removal of beaver dams (active or old) must have a concrete sediment control plan in order to avoid harmful alteration, disruption or destruction (HADD) of fish habitat. Beaver Dams are a natural process, therefore proper assessment must be made by MNR biologist to determine if removal detrimental or beneficial.
	C, adequate sediment control plan	Personnel	Trips, working on steep, slippery, or unstable, debris covered ground which may cause staff to fall into water
	A, obtain proper equipment for removal of debris	Personnel	Working in waders, especially if they fill with water
	A, permits and letters of approval are obtain in time	Personnel	Accidental immersion in the water, either partial or total
	A, partnership with MNR Biologist and MNR fire crews is a success	Environmental	Improper disposal of woody debris causing it to wash back into the stream
	A, debris will be placed on a cleared area above the floodplain to avoid wash back	Environmental	Improper removal of large woody debris can destabilize the stream and lower the productivity of fish habitat
	C, trapping of beavers may need to take place outside of the regulated trapping season		

Project	Beaver Dams (Active and Old)	**Project #**	3.2
Success criteria	1 - Develop project management plan		
	2 - Acquire required Fisheries and Oceans Canada authorization and Transport Canada, letter of approval through an MNR Class EA assessment		
	3 - Acquire required permits from the Ministry of Natural Resources, work permit, work on shoreland, works within a waterbody, and water alteration		
	4 - Obtain assistance from the Ministry of Natural Resources Fire Crews for the cutting down of large trees with chainsaws		
	5 - Obtain support from local trappers, Fur Council and Wildlife specialist to trap outside of regulated trapping season		
Project manager			
	Signature		
	Aide Badilla		
	March 12th, 2014		

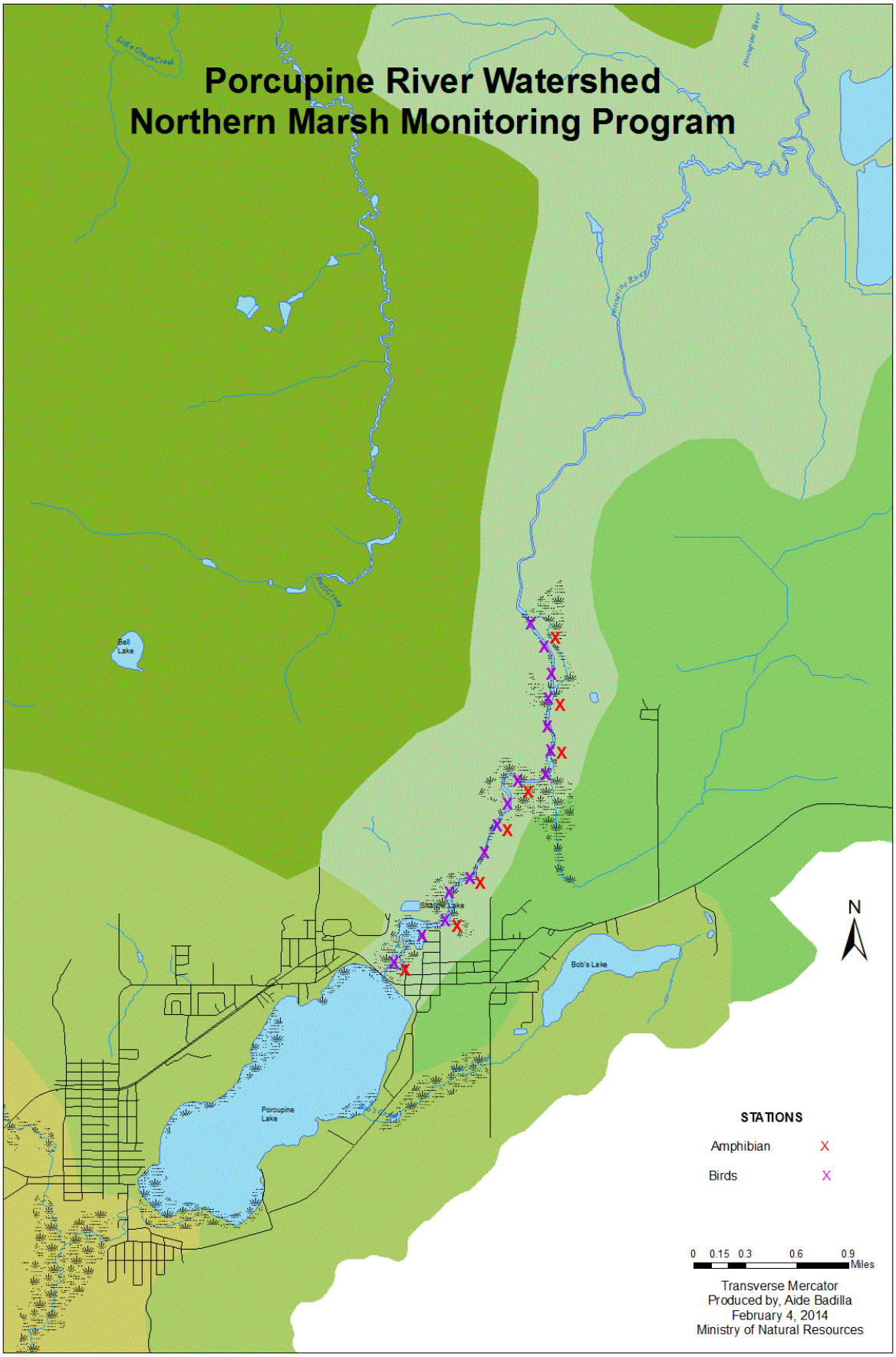


Figure 6. Northern Marsh Monitoring Program Stations for Amphibian and Bird Studies.

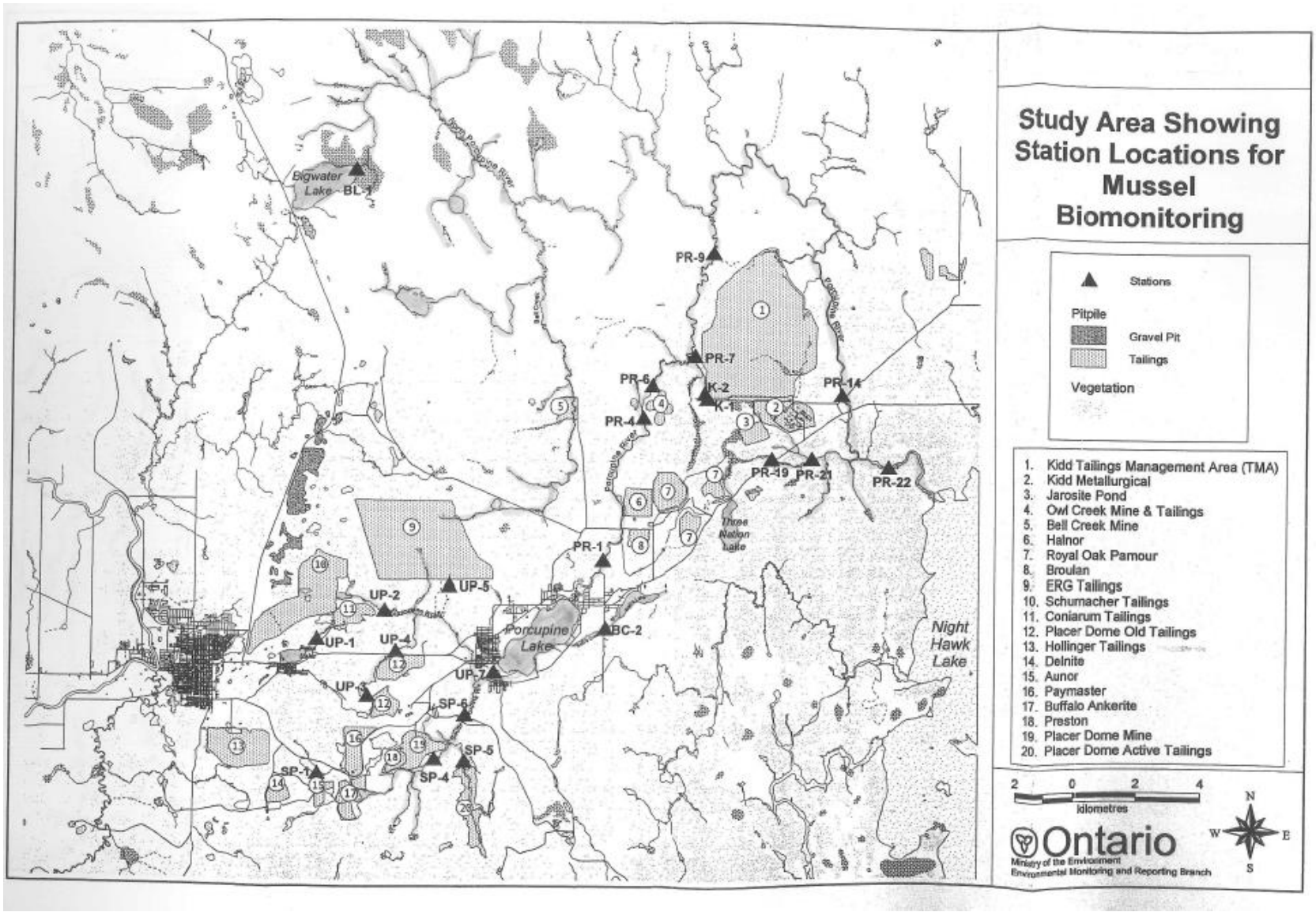


Figure 7. Study Area Showing Station Locations for Mussel Biomonitoring (Jaagumagi, et al., 2001).

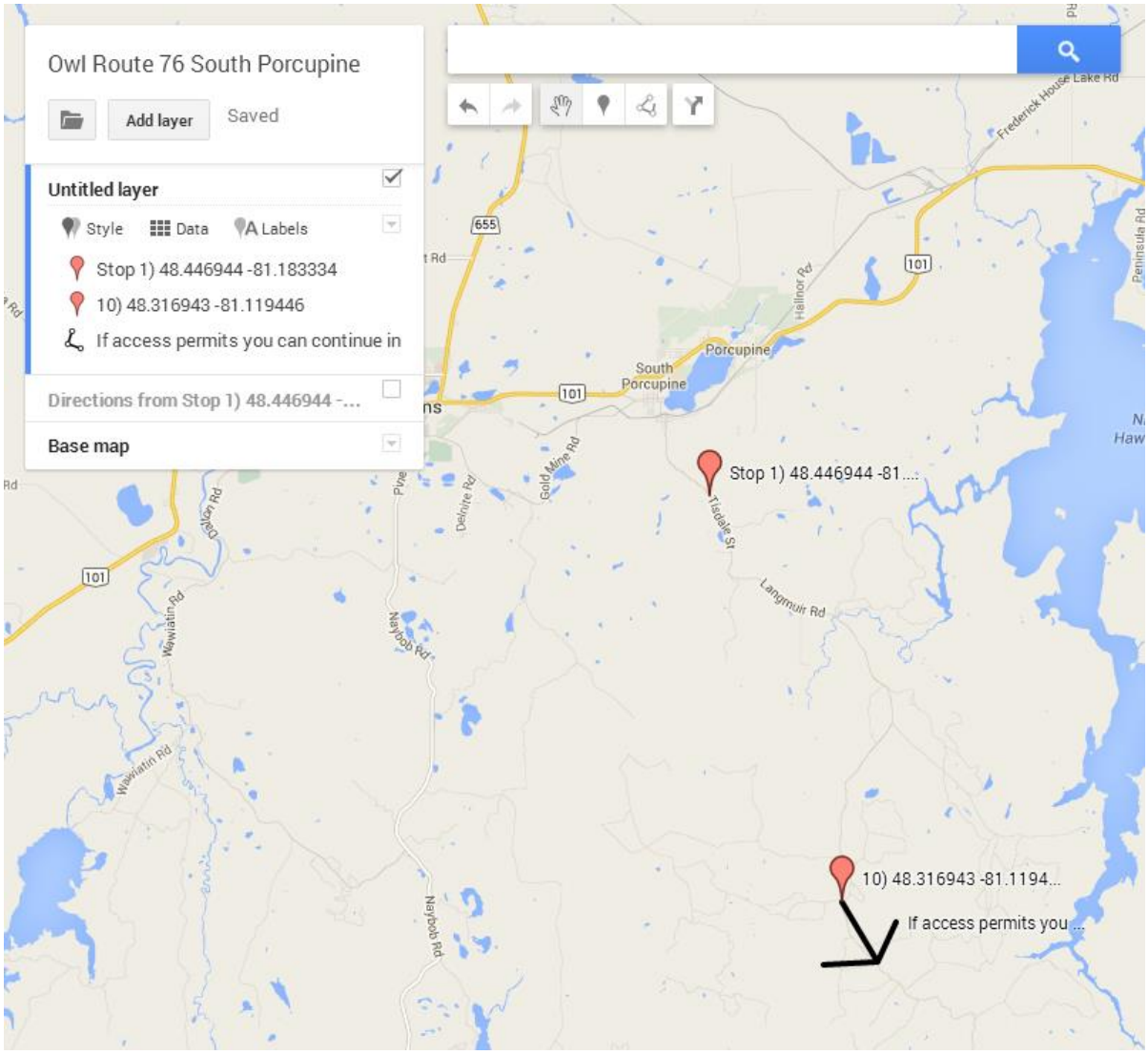


Figure 8. Nocturnal Owl Survey Route.

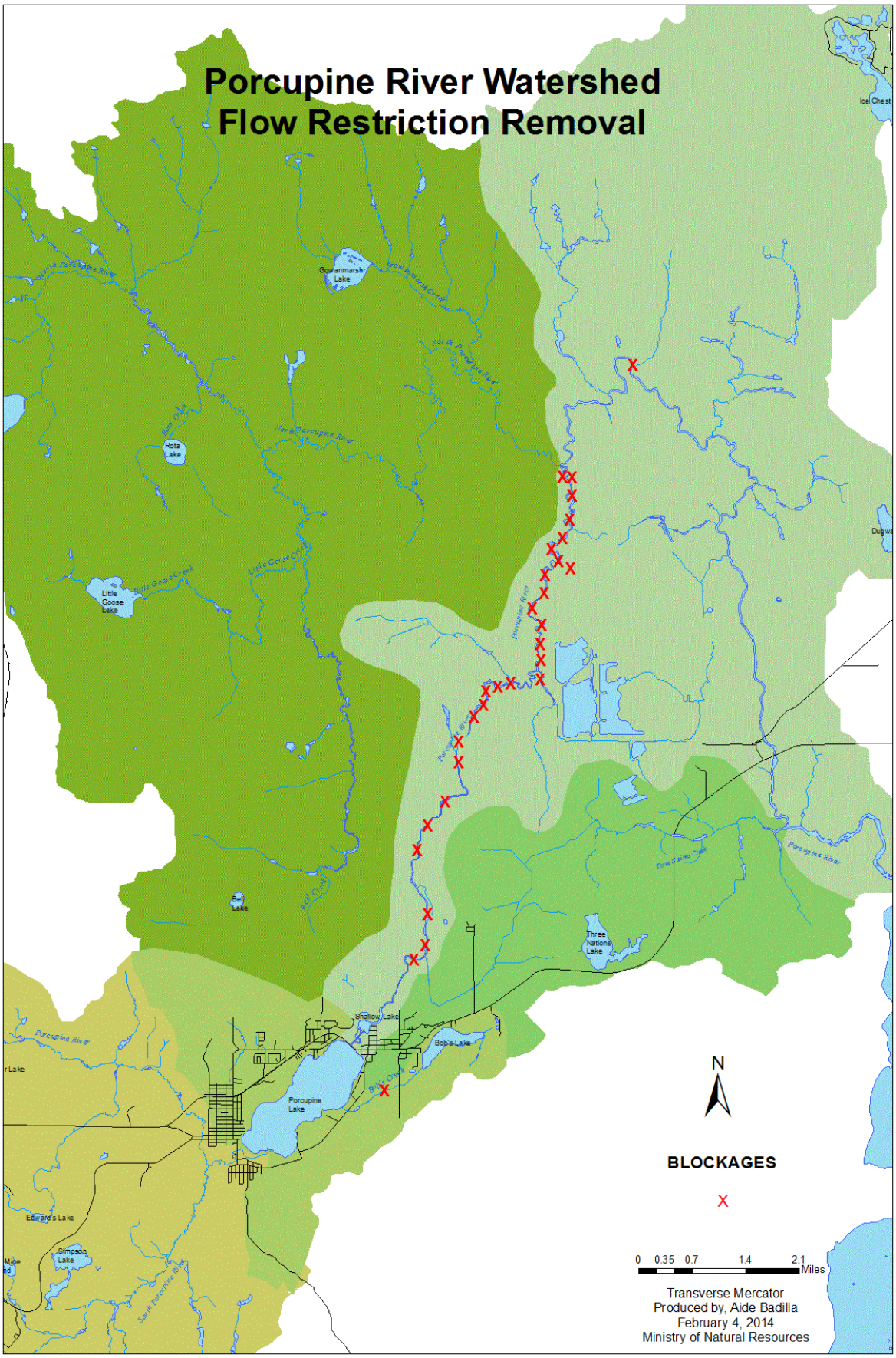


Figure 9. Flow Restriction Removal Project Blockages Locations.

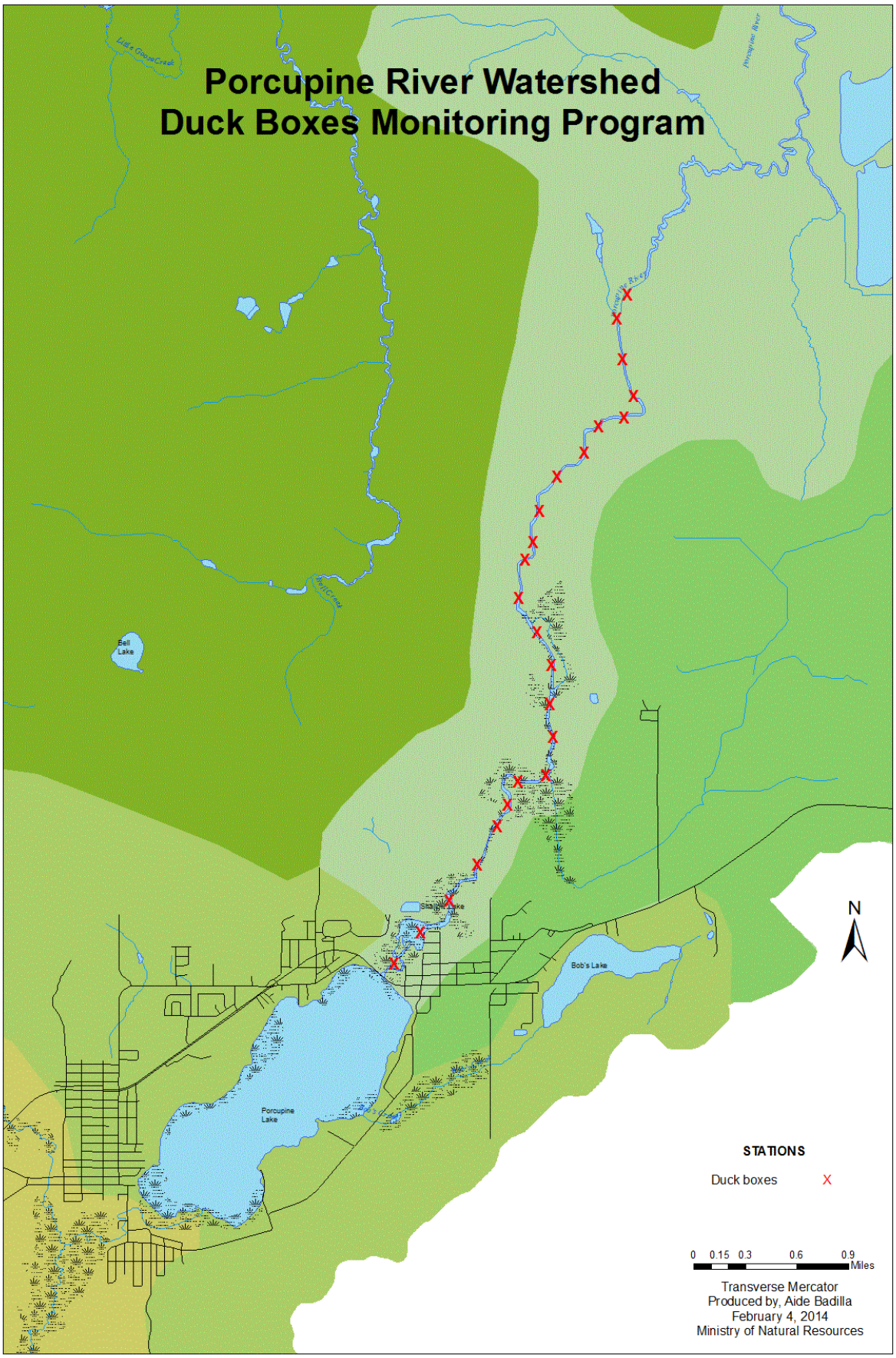


Figure 10. Duck Boxes Maintenance and Use Inventory Stations.

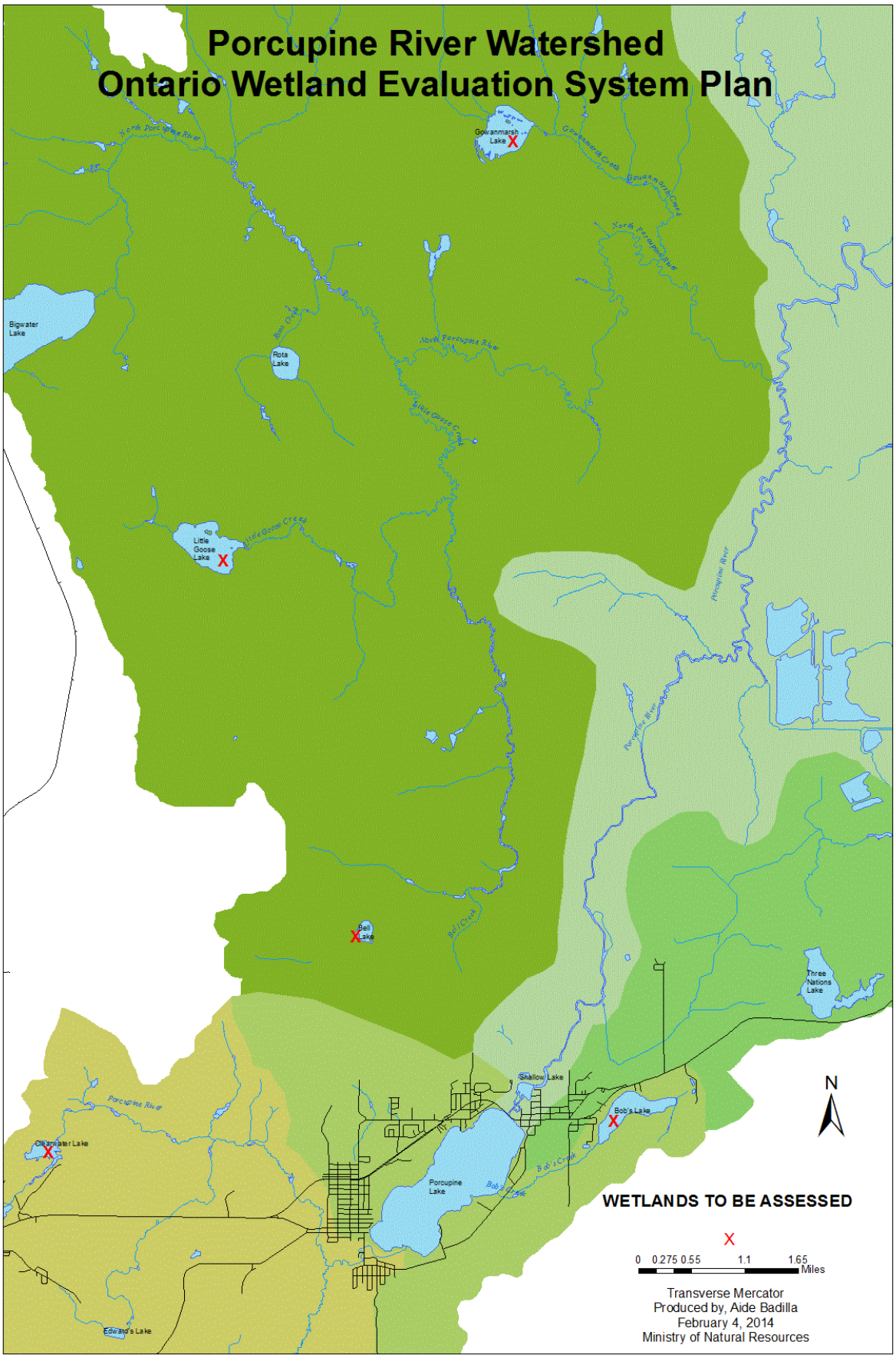


Figure 11. Wetlands to be Assessed Using the Ontario Wetland Evaluation System.

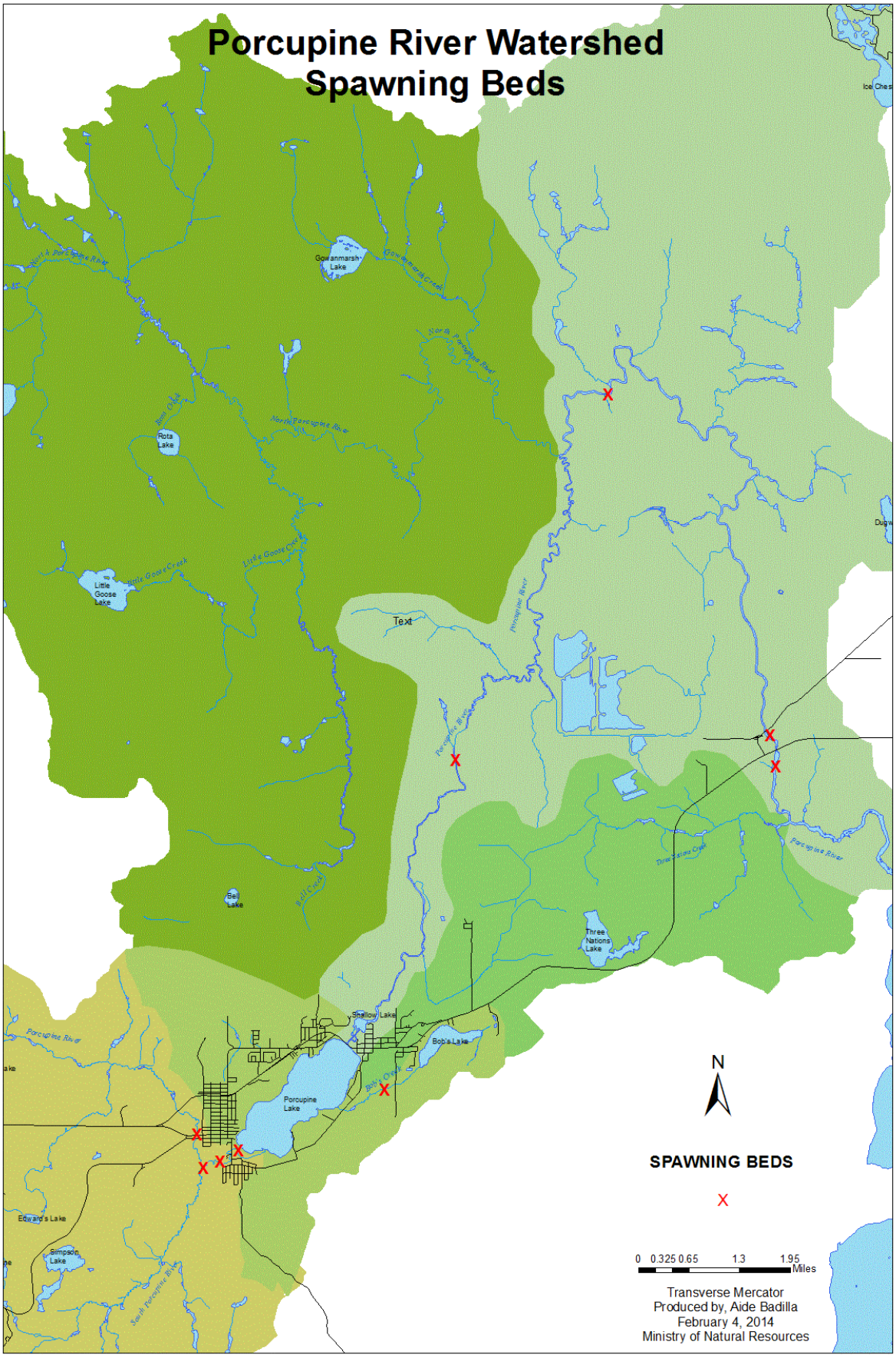


Figure 12. Spawning Beds Assessment and Remedial Project Locations.

APPENDIX II Public Outreach

PUBLIC SERVICE ANNOUNCEMENT FOR NORTHERN MARSH MONITORING PROGRAM

"The Mattagami Region Conservation Authority and the Ministry of Natural Resources would like to invite you to take part in their upcoming volunteer opportunities with the Porcupine River Watershed Remedial Action Plan; a plan to restore the watershed to a healthy system. Volunteers will help collect information on Northern marsh bird and amphibian species, identification skills training will be offered free of charge the first week of May. Interested individuals please contact the Project Biologist at 289-795-5657."

Moose FM OR KiSS 99.3

PUBLIC SERVICE ANNOUNCEMENT FOR WORM WATCH

"The Mattagami Region Conservation Authority and the Ministry of Natural Resources would like to invite you to take part in their upcoming family event with the Porcupine River Watershed Remedial Action Plan; a plan to restore the watershed to a healthy system. The whole family, especially kids, can come and enjoy collecting information on Northern worms, identification skills training will be offered free of charge at the event. Interested individuals please contact the Project Biologist at 289-795-5657."

Moose FM OR KiSS 99.3

OUR GOAL

NMMP volunteers monitor birds and amphibians in marshes. Established bi-nationally in 1995, the survey provides information on the population status of marsh birds and amphibians, information about their habitat requirements, and an assessment of wetland restoration efforts.

Data collected by NMMP volunteers are an important contribution to the conservation and management of wetlands and their wildlife.

What we have learned

To date, data submitted by MMP volunteers have been used to detect significant changes in population trends of marsh birds and amphibians, develop indicators of wetlands health, and to provide practical information for marsh habitat management.

IT'S EASY TO BE A NMMP SURVEYOR!

- Volunteers receive a training kit containing: written instructions for surveying marsh birds, amphibians and their habitat; data forms; and an instructional tape with examples of songs and calls of birds and amphibians occurring in wetlands within their region.
- Surveys are conducted at appropriate marshes located in Northern Ontario. Volunteers survey existing routes or establish new ones at sites chosen with NMMP staff assistance.
- Volunteers participate during spring and early summer to survey birds, amphibians or both.
- Data forms are sent back to Birds Studies Canada for analysis.
- Participants of the NMMP receive an annual newsletter that summarizes survey results and includes articles about marsh ecology, amphibians and marsh birds.

The NMMP was developed by BSC and Environment Canada, and receives support from:

NORTHERN MARSH MONITORING PROGRAM

CALLING ALL NATURALISTS

Bird Studies Canada

Marsh Monitoring Program

ph 519-586-3531 or 1-888-448-BIRD (2473)
fx 519-586-3532
mo 555.555.5555

www.birdscanada.org/mmpmain.html

Aide Badilla
Porcupine River Watershed RAP
Project Manager Biologist

CALLING ALL NATURALISTS

JOIN THE NORTHERN MARSH MONITORING PROGRAM!

HOW CAN YOU HELP?

Join the Northern Marsh Monitoring Program (NMMP). The NMMP offers everyone – from amateur naturalists to professional biologists – a unique and rewarding opportunity to contribute toward understanding and conserving wetlands, one of North America's most threatened ecosystems.

Facts about wetlands.

- Wetlands have been drained, filled, and polluted for decades, resulting in a reduction in population levels of many dependent species.
- Wetlands provide habitat critical for sustaining many fish and wildlife species, improve water quality, help stabilize shorelines, and absorb excess nutrients.
- A marsh is a low-lying wetland with vegetation. The water can be still or slowly moving, permanent or temporary. Small numbers of trees or shrubs may occur but commonly the vegetation consists of plants such as cattails, rushes, reeds, grasses or sedges. In open water areas submerged and floating aquatic plants such as lily pads will flourish.

Facts about marsh birds.

- Marsh birds are one of the most species rich groups that breed in marshes.
- Marsh birds are an ecologically significant component in there ecosystems and play and important role in human recreational uses of natural resources.

Facts about marsh amphibians.

- Amphibians depend on wetlands for one or more stages of their life.
- Amphibians found in marshes are critical members are critical members of wetland food webs.
- There have been many unexplained population declines in amphibians.

- Initially, a couple of hours are needed to establish routes. Conducting the surveys and tallying results usually requires about 10 hours per year.

- Upon registration, participants receive a selected marsh to survey. In which, with help from NMMP staff and a detailed Training Kit, they establish a route, consisting of up to 8 semi-circular sample stations.

- Each amphibian survey route is visited 3 nights during the year, no less than 15 days apart. Each station is surveyed 3 minutes.

- Bird routes are surveyed twice a year, no less than 10 days apart. Each station is surveyed for 15 minutes.

- Habitats in and around each sample station are described annually by volunteers.

NORTHERN MARSH MONITORING PROGRAM
PORCUPINE RIVER WATERSHED REMEDIAL ACTION PLAN
Surveying Marsh Amphibians and Birds 2014

Term: Spring 2014
Instructor: Aide Badilla + Guest
Office: Ministry of Natural Resources District Office
Telephone: 289-795-5657
E-mail: aide.badilla@ontario.ca
Office Hours: 8:00 AM – 5:00 PM; lunch 12:00 – 12:30 PM

DESCRIPTION
The Northern Marsh Monitoring Program monitors birds and amphibians in marshes to provide information on their population status and habitat requirements, as well as, an assessment of wetland health. Data collected are used to aid in sound conservation strategies and management of wetlands and their wildlife.

OBJECTIVES
Collection of marsh amphibian and bird population data.

MATERIALS
The following is a list of materials that should be included in a NMMP Participant's Package:

- MMP Participant's Handbook: Getting started
- Training CD
- Contact and Route Information Form (1 per route)
- Habitat Description Forms
- MMP Participant's Handbook for Surveying Amphibians
- Amphibian Route Summary Form (1 per route)
- 3 Amphibian Data Form sets (1 set per visit)
- MMP Participant's Handbook for Surveying Birds
- 8 Bird Data Forms (4 per visit)
- MMP Broadcast CD 2010
- Bird Survey Reference Card
- Vehicle Sign

TOPICS TO BE COVERED

- Introduction
    - What is the Northern Marsh Monitoring Program
    - Habitat Description

- Surveying Marsh Amphibians
    - Identifying and differentiating different amphibian species calls
    - Visually identifying different amphibian species

- Surveying Marsh Birds
    - Identifying and differentiating different bird species calls
    - Visually identifying different bird species

IMPORTANT DATES AND COURSE EVALUATION
May 1st Introduction & Surveying Marsh Amphibians
May 2nd Surveying Marsh Birds & Final Evaluation (in groups of 2)
Note: a minimum of 95% grade required for the focal species in order to be assigned as a lead

MODIFICATION TO COURSE
The instructor and Mattagami Region Conservation Authority reserve the right to modify elements of the course during the term. The instructor may change the dates for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the volunteers will be given with explanation and the opportunity to comment on changes. It is the responsibility of the volunteer to check their email weekly during the term and to note any changes.

FEEDBACK
It really helps us improve our services when we hear from our volunteers about what we can do better. A feedback process brings to our attention situations in which we may not have adequately considered accessibility and allows us to better plan for accessibility in the future.

WORM watch

WHAT IS WORMWATCH?

WormWatch is a science based education program that makes learning about the soil ecosystem fun. It is also part of a national volunteer monitoring program used to identify ecological changes that may be affecting our environment.

When we are standing on the ground, we are really standing on the rooftop of another world. Living in the soil are plant roots, viruses, bacteria, fungi, algae, amoebae, protozoa, mites, nematodes, worms, ants, beetles, insect larvae (grubs and maggots), and larger animals. Soil is a habitat: let the WormWatch earthworms lead you through the maze of micro- and macro-pores that are the soil's super-highways. The WormWatch Web site has specific projects that invite participants to collect data on earthworm species and habitats, and more general multidisciplinary curriculum-linked kindergarten to grade 12 activities and investigations for teachers and students.

WHY MONITOR WORMS?

The WormWatch National Earthworm Survey will help scientists determine how many earthworm species are in Canada, and where they live.

This information is important. The number of worms in a specific volume of earth can tell us a lot about how the habitat is being managed, because earthworms are very sensitive to soil disturbance. Learning more about the distribution of earthworm species can be used to help improve soil health and reclaim degraded sites. Gardeners, naturalists, farmers, schoolchildren — everyone can participate in the WormWatch survey. The data you collect will be used to create a Canadian database of earthworm species and habitat distribution. We can't see the big picture without you!

DID YOU KNOW...?

Over half a million earthworms can live in just one hectare of soil. Together, they can eat nine tonnes of leaves, stems and dead roots a year, and turn over 36 tonnes of soil. Imagine how much dead matter would accumulate if all of the earthworms went on strike!

Most members of the earthworm family (Lumbricidae) are thought to have disappeared from Canada during the last ice age. Native earthworms survived only in areas that were unglaciated, such as the west coast of British Columbia, parts of the Yukon, and the most southern parts of Eastern and Atlantic Canada. Many of the earthworms we find in Canada today were introduced by European settlers, who valued the ecosystem services provided by earthworms, particularly their role in producing good crops.

Worms are also beneficial to gardeners and fishers. The Dew-worm, or Nightcrawler (*Lumbricus terrestris* L.), is most favoured by these people. However, when introduced into new areas, this species can disrupt the native biodiversity. For example, forests in the northeastern United States of America are not regenerating because of changes caused to the soil habitat by this long-lived earthworm species (www.nrri.umn.edu/worms). When you are finished fishing, what do you think you should do with the worms that are left over?

Many famous people have recognized the ecosystem services that earthworms provide. Cleopatra declared earthworms to be sacred, and forbade Egyptian farmers from removing them from the land. Aristotle called them the "intestines of the soil." Charles Darwin, who studied earthworms for 39 years, said, "It may be doubted whether there are many other animals in the world which have played so important a part in the history of the world than the earthworm."

WHAT ARE EARTHWORMS?

Earthworms are annelids (phylum Annelida) because they have segmented bodies, and Oligochaetes (class Oligochaeta) because they crawl using both circular and longitudinal muscles located under the skin, while a series of bristles, or setae, anchors each segment. The first segment is the peristomium or mouth. Protruding from the mouth is a tongue-like lobe called the prostomium: a very important characteristic for identifying earthworms to genus. About one-third of the way down the body from the earthworm's head is the clitellum. This saddle or band is definitely swollen and may be coloured white, orange, or reddish brown. Only adult earthworms that are ready to have offspring have a clitellum. And we all know what happens out of the last segment (the periproct) where the anus is located!

How many new words have you found so far?
Which words are written in Latin?

THE DIRT ON EARTHWORM BIOLOGY

The earthworm brain is actually a fused pair of nerve ganglia, mostly located in the third segment. There are three giant nerve fibres that run the length of the body, around the gut. These fibres transmit impulses from the brain which control rapid body movements. Unlike many other invertebrates, the circulatory system is fully closed. One large blood vessel runs the length of the body, immediately beside the gut. Two to five pairs of muscular blood vessels extend from the central vessel and function as hearts to drive the circulatory system. Earthworms, like other Oligochaetes, lack specialised organs for breathing; instead they breathe through their skin. The skin is kept moist by mucus and fluid secreted from the dorsal pore between segments allowing for continuous gas exchange.

Worms are hermaphrodites, which means they are both male and female. Does that mean earthworms can reproduce without another earthworm partner or mate?

Earthworms reproduce from cocoons that contain embryos or fertilised eggs inside a shell made from the hardened gelatin-like material produced from the clitellum that insulated the mating earthworms. Some earthworm species, like *Aporrectodea trapezoides* do not require a mate to reproduce, but most species do require a mate to produce cocoons. Cocoons look a lot like popcorn seeds when they are first deposited, and are very resistant to drought, floods and freezing. When the temperature and moisture conditions are just right, there can be as few as one and as many as five tiny thread-like hatchlings that emerge. The WormWatch Web site has a fun classroom activity that demonstrates earthworm reproduction.

EATING RIGHT

Earthworms mostly eat organic matter (dead plant material and in some cases dung) that is in various stages of decay. There is good evidence that live bacteria and fungi, protozoa, nematodes and mites, and their dead tissues are also an important part of the earthworm diet. Earthworms don't have teeth. They suck food into their mouths with a very muscular pharynx. The virtual worm on the WormWatch Web site demonstrates earthworm digestion.

Earthworms have been further classified by what they eat. Those that live on and near the soil surface, feeding on plant litter, dead roots and/or animal dung in the rich organic matter layer of the soil, are called epigeic. Endogeic earthworms live deeper beneath the soil surface and feed mostly on soil and soil-enriched organic matter. The deep vertical burrowing earthworms, like *Lumbricus terrestris*, feed mostly on surface plant litter, dragging it down into the burrow or piles known as middens. They are called anecic.

Which earthworms on the front of the poster belong to these different ecological categories?

MYTHS ABOUT EARTHWORMS

Is it true that you can cut an earthworm in half and get two earthworms?

No, this is a myth. If you cut close to the end of the tail, the earthworm will regrow another tail. If the earthworm is severed anywhere else on its body, it will die. **Please don't test this myth ...all living creatures deserve our respect!**

MAKING THE SOIL HOME

Earthworms are known to scientists as "ecosystem engineers" because their presence and activities have such a dramatic effect on the soil habitat. The underground burrowing systems that they create increase the amount of water and air that reaches the plant roots and other soil organisms, helping their growth. Most earthworms also mix the plant litter and organic matter into the soil, increasing the speed at which they decay and release nutrients into the soil. In these ways, earthworms recycle nutrients from dead plants and other soil organisms so that they can be used again.

COOL PROJECTS THAT YOU CAN DO WITH THIS POSTER

This poster explains and demonstrates how to use the WormWatch taxonomic key. Once you can identify earthworms, we want to know where you found them. If you don't know which species you found, no worries! On the Web site, just put your cursor on the map at the point closest to where you found the worm, and click.

HOW TO IDENTIFY DIFFERENT EARTHWORMS

WormWatch uses a new taxonomic key that classifies the earthworms by size, colour, and the pattern of genital tumescences (GT) and tubercula pubertatis (TP) within the region of the clitellum on adult earthworms. Currently, 25 different earthworm species have been found and identified in Canada. Perhaps with your help we can find more! Seven of the 25 species are highlighted on this poster. They are the most common and widely distributed species. If the worms you find are not on this poster, use the key at www.wormwatch.ca.

ID TIPS TO REMEMBER...

Adult earthworms have a band, saddle, swelling or dark discolouration about one-quarter to one-third of the way from the head. Any worm that does not have a clitellum is a juvenile.

Earthworms reproduce by laying a cocoon – a sac that contains the earthworm's eggs. The cocoon is formed at the clitellum and travels to the head. There it slides off the earthworm's body and is deposited into the soil. Cocoons have a slightly hard shell and look like a tiny seed when they are first deposited.

Earthworms can enter into periods of inactivity, or dormancy, as the result of unfavourable conditions (e.g. dry, cold or hot periods). This is known as aestivation. During aestivation the earthworm loses most of the water in its body, and curls up in a knot inside a mucus-sealed chamber.

An Aestivating Earthworm

HOW TO MONITOR WORMS

PICK A SITE

Your back yard, school yard, farmland, forest, grassland – anywhere will do! But remember, earthworms like moist, cool soil. You will probably find the most worms around at wetter, cooler times of the year, or near waterways, ponds, rivers, lakeshores and other consistently wet places.

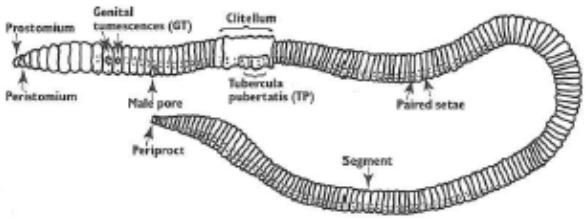
If it is not your land, seek permission from the landowners or proper authorities to sample. Please never sample or remove anything from a national park. There should be very little evidence of your sampling efforts after you are done. Try to put everything back as you found it.

FLIP, STRIP AND DIG

WormWatch requires you to use the standardized National Sampling Method so that all participants collect data in the same way. Some earthworm species live on or very near the soil surface while others live under the bark of fallen trees and shrubs. To find these earthworms, you need to flip over rocks, logs and other bits of deadfall, and strip back the bark on the soil side of fallen logs that are within your sampling frame. For more information on sampling methods, educational activities and support materials, please see the WormWatch Web site.

EQUIPMENT YOU'LL NEED:

- clothes and shoes that can get dirty;
- partner(s);
- soil thermometer (if you have one – do not use a glass thermometer);
- a shovel or spade (or other tool to flip or strip);
- an Observation Form (for each location);
- a pencil;
- a sampling frame (25 x 50 cm);
- the taxonomic key to adult earthworms found on the WormWatch Web site. You can practice using the taxonomic key with the earthworms depicted on this poster;
- a camera (optional).



RECORDING YOUR OBSERVATIONS

Check the Web site for new monitoring protocols and projects!

1. When you arrive at your site, fill out as much information about it as you can on the Observation Form.
2. Rocks, pieces of wood, logs and old dung pats often have earthworms living under them in the cool, moist soil. Rocks beside streams and lakes are good places to look. Place the sampling frame on the ground and gently flip all the rocks that are within the frame to look for epigeic (shallow burrowing) worms. If you are searching under rotting wood, strip back the bark in moist areas and check for bark worms. They are usually small and very red. (Instructions to make a simple sampling frame are on the Web site.) We encourage you to sample several times in the same general area. Keep the data from each frame location separate.
3. Sort the worms into colour and appearance in a shady spot. Count the total number of adult worms of each species, and the total number of juveniles and cocoons and record the numbers on the data sheet.
4. If you have nothing to flip (rocks) or strip (bark on fallen trees), push the spade as far as you can into the soil, flip it and count the worms in the hole. When you're finished, put the soil back as you found it.
5. If you have a camera, take a picture of yourselves and your sites and submit them with your data sheets.
6. You can also illustrate the pattern of GT and TP in the area of the clitellum and include any other noticeable features.
7. Finish filling out the Observation Form and send us your information via the WormWatch Web site at www.wormwatch.ca or by mail.

GET INVOLVED

The Canadian WormWatch program is a joint venture between Agriculture and Agri-Food Canada, Environment Canada's Ecological Monitoring and Assessment Network Coordinating Office (EMAN CO) and Nature Canada. The information you collect should be submitted directly via the Internet or by mailing your information to the address on the Observation Form.

For more information about earthworm monitoring in your area, go to the National WormWatch Web site at **http://www.wormwatch.ca** (English) or **http://www.attentionvers.ca** (French). Visit the site to register as a WormWatcher on-line, and to find out how to sample and identify earthworms using the taxonomic key provided. You can also use the site to send us your data electronically, which helps to cut costs and saves on paper use.

For additional copies of the WormWatch poster and Observation Form, contact Environment Canada's Ecological Monitoring and Assessment Network Coordinating Office 867 Lakeshore Road, Burlington Ontario, L7R 4A6 phone (905) 336-4411; fax (905) 336-4499; e-mail: info@eman-rese.ca

WORM watch OBSERVATION FORM

WormWatch, c/o Agriculture Agri-Food Canada,
Lethbridge Research Station, P.O. Box 3000
Lethbridge, AB T1J 4B1

Observer's Name(s): _____

Mailing Address: _____

Postal Code: _____ Telephone: _____ Fax/Email: _____

LOCATION OF YOUR SITE (please fill out a separate Observation Form for each site):

Site Number: _____ Latitude: ___° ___' ___" N Longitude: ___° ___' ___" W

Name of nearest road: _____ Name of nearest town: _____

Province: _____

Date (YYYY/MM/DD): _____ Time: _____ a.m. p.m. (circle one)

Habitat Description (Please check the descriptions that apply to your site. You can choose more than one):

☐ Hardwood Forest (deciduous) ☐ Softwood Forest (coniferous) ☐ Mixed Wood Forest
☐ Grassland ☐ Farmland ☐ Abandoned Farmland
☐ Marsh, Bog or Wetland ☐ Residential Gardens and Lawns ☐ School Yard ☐ Empty Lot

Soil Type (Please check the descriptions that apply to your site. You can choose more than one):

☐ Rich and loamy ☐ Rocky ☐ Sandy ☐ Water saturated/muddy ☐ Clay ☐ Moist ☐ Dry
☐ Other (please describe): _____

Soil Colour (Please check the descriptions that apply to your site. You can choose more than one):

☐ Light brown ☐ Dark brown ☐ Black ☐ Red
☐ Other (please describe): _____

Soil Temperature (if available): _____°C

Weather Conditions:

Air Temperature: ____°C Overcast (estimate cloud cover): ____% Raining Y or N Dry Y or N Sunny Y or N Windy Y or N
Other: _____

WORM SPECIES	Samples Enclosed	Number of Worms	Aestivating (Dormant)
Species A _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species B _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species C _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species D _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species E _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N
Species F _____	Y or N	cocoons ___ juveniles ___ adults ___	Y or N

If you find an earthworm that cannot be identified using the taxonomic key, or if you need your earthworm identifications verified, please go to the WormWatch Web site for instructions.

APPENDIX III Meetings

The following is an outline of several stakeholders engagement meetings conducted by the Project Manager Biologist throughout the development of the Remedial Action Plan.

MEETING	DATE	PARTICIPANTS	SUMMARY
Local Citizen Committee	Sep 25, 2013	- Mattagami Region Conservation Authority (MRCA), - Ministry of Natural Resources (MNR), - Local Citizens Committee (LCC), - Timmins Fur Council, - First Resource Management Group (FRMG), - Club Navigateur, - Stewardship Youth Rangers (SYR), and - Timmins Snowmobile Club	- Introduction of the PRW RAP to the members of the public
PRW RAP Partners	Oct 04, 2013	- MRCA - MNR - Ministry of the Environment (MOE)	- Introduction of the PRW RAP to the members of MOE - Acquired contact information - Collected baseline data - Partnerships were established
PRW RAP Partners	Oct 11, 2013	- MRCA - MNR - City of Timmins (Environmental Compliance Coordinator)	- Introduction of the PRW RAP to the Environmental Compliance Coordinator - Acquired contact information - Collected baseline data - Partnership was established
PRW RAP Partners	Oct 11, 2013	- Ministry of Northern Development and Mines (MNDM; Regional Resident Geologist)	- Introduction of the PRW RAP to the Regional Resident Geologist - Acquired contact information - Collected baseline data - Partnership was established
PRW RAP Management Team Project Update	Oct 30, 2013	- MRCA - MNR	- Presented up-to-date collected baseline data - Discussed future rehabilitation projects - Revised and adjusted timeline to meet project goals - Explored possible meeting dates with the mining industry

MEETINGS	DATE	PARTICIPANTS	SUMMARY
Local Citizens Committee	Oct 30, 2013	- MRCA - MNR - LCC - Timmins Fur Council - Timmins Naturalists - MNDM - FRMG - Club Navigateur - SYR - Timmins Snowmobile Club	- Presented up-to-date collected baseline data and project ideas to members of the public - Clarified the goal of the project to the members of the public - Received excellent positive feedback from public - Partnerships were established
PRW RAP Partners	Nov 14, 2013	- MRCA - MNR - Goldcorp (Senior Environmental Coordinator)	- Introduction of the PRW RAP to the Senior Environmental Coordinator - Acquired contact information - Collected baseline data - Partnership was established
PRW RAP Partners	Nov 26, 2013	- MRCA - MNR District - MNR (Regional Operations Northeast Region Aquatic Biologist)	- Introduction of the PRW RAP to the Aquatic Biologist - Acquired contact information - Collected baseline data - Partnership was established
Local Citizen Committee	Nov 27, 2013	- MRCA - MNR - LCC - Timmins Fur Council - Timmins Naturalists - MNDM - FRMG - Club Navigateur - Timmins Snowmobile Club	- PRW RAP update on possible future remedial projects and baseline data pictorial representation using GIS software - Volunteer possibilities were discussed and positive feedback attained
PRW RAP Management Team Project Update	Nov 28, 2013	- MRCA - MNR	- Discussed baseline data pictorial representation using GIS software - Executive summary letter for Goldcorp was developed
PRW RAP Partners	Dec 04, 2013	- MRCA - MNR - Glencore (Superintendent, Environment, Kidd Operations)	- Introduction of the PRW RAP to the Superintendent, Environment, Kidd Operations - Acquired contact information - Collected baseline data - Partnership was established

MEETING	DATE	PARTICIPANTS	SUMMARY
PRW RAP Partners	Dec 09, 2013	- MRCA - Volunteer	- Discussed and performed Provincial Significant Wetland survey
PRW RAP Partners	Dec 11, 2013	- MRCA - MNR - MOE	- Discussed upcoming remedial projects and baseline data pictorial representation using GIS software - Ideas for additional potential partners were discussed and implemented
PRW RAP Partners	Dec 12, 2013	- MRCA - Volunteer	- Northern Marsh Monitoring Program Route was scoped and developed
PRW RAP Partners	Dec 17, 2013	- MRCA - Volunteer	- Developed draft for PRW RAP remedial projects
PRW RAP Management Team Project Update	Dec 17, 2013	- MRCA - MNR	- Discussed and implemented formatting and content changes to the PRW RAP report
PRW RAP Management Team Project Update	Jan 20, 2014	- MRCA - MNR	- Discussed and approved finalized PRW RAP monitoring programs
PRW RAP Partners	Jan 20, 2014	- MRCA - MNR District - MNR (Forest Wildlife Habitat Specialist, Regional Resources Section – Northeast Region) - Ducks Unlimited Canada	- Introduction of the PRW RAP to Ducks Unlimited Canada - Acquired contact information - Collected baseline data - Partnership was established - Discussed possible PRW RAP involvement with their recently announced Northern Wetland Projects
PRW RAP Partners	Jan 30, 2014	- MRCA - MNR District - MNR (Wildlife Assessment Program Leader, Provincial Services Division, Science and Research Branch)	- Introduction of the PRW RAP to Wildlife Assessment Program Leader - Acquired contact information - Collected baseline data - Partnership was established
PRW RAP Management Team Project Update	Feb 13, 2014	- MRCA - MNR	- Discussed possible public outreach programs and RAP draft - Obtained Health Unit contact

MEETING	DATE	PARTICIPANTS	SUMMARY
PRW RAP Management Team Project Update	Mar 05, 2014	- MRCA - MNR	- Discussed and developed remedial projects for 2014-15 field season - Concluded with 5 project divisions: fisheries, recreational, forestry, wetland habitat, river flow obstruction removal
PRW RAP Partners	Mar 05, 2014	- MRCA - MNDM (Mine Rehabilitation, Inspection and Compliance Officer)	- Introduction of the PRW RAP to Mine Rehabilitation, Inspection and Compliance Officer Acquired contact information - Collected baseline data - Partnership was established
Local Citizens Committee	Mar 26, 2013	- MRCA - MNR - LCC - Timmins Fur Council - Timmins Naturalists - MNDM - FRMG - Club Navigateur - Timmins Snowmobile Club	- Discussed proposed remedial, public outreach and assessment projects for 2014-15 field season - Discussed involvement volunteers on each project - Provided Project Biologist contact information to commence the recruitment of volunteers
PRW RAP Stakeholders Update	Mar 27, 2014	- MRCA - MNR - Goldcorp (Senior Environmental Coordinator) - City of Timmins (Environmental Compliance Coordinator) - MNR (Wildlife Assessment Program Leader, Provincial Services Division, Science and Research Branch) - MNDM (Mine Rehabilitation, Inspection and Compliance Officer) - MNR (Regional Operations Northeast Region Aquatic Biologist)	- Discussed proposed remedial, public outreach, and assessment projects for 2014-15 field season - Discussed involvement of individual partners on each project - Received positive feedback and ideas for future involvement of a fluvial geomorphologist
PRW RAP Partners	Apr 02, 2014	- MRCA - MNR Resource Liaisons	- Introduction of the PRW RAP to Resource Liaison - Acquired contact information - Collected baseline data - Partnership was established

MEETING	DATE	PARTICIPANTS	SUMMARY
PRW RAP Partners	Apr 03, 2014	- MRCA - MNR (Planning Management Biologist)	- Introduction of the PRW RAP to Planning Management Biologist - Acquired contact information - Collected baseline data - Partnership was established - Nocturnal Owl Surveys dates were established
PRW RAP Partners	Apr 03, 2014	- MRCA - Mattagami First Nation Counselor, Lands and Resources Co-ordinator	- Introduction of the PRW RAP to Mattagami First Nation Counselor, Lands and Resources Co-ordinator Acquired contact information - Collected baseline data - Partnership was established
PRW RAP Partners	Apr 04, 2014	- MRCA - MNDM (Mine Rehabilitation, Inspection and Compliance Officer)	- Northern Marsh Monitoring Program station locations were finalized and arrangement made for the PRW survey
PRW RAP Partners	Apr 08, 2014	- MRCA - MNR (Area Management Biologist)	- Introduction of the PRW RAP to Area Management Biologist - Acquired contact information - Collected baseline data - Partnership was established - Spawning bed remedial work was discussed and sediment control procedure developed
PRW RAP Management Team Project Update	Apr 09, 2014	- MRCA - MNR	- Discussed final PRW RAP draft submission to MOE and formatting and content changes - Further developed public outreach project through open discussion of offering training courses and different advertisement avenues

APPENDIX IV References

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APPENDIX V Budget