



Updated Assessment Report

Sault Ste. Marie Region Source Protection Area

CHAPTER 5

ISSUES EVALUATION AND THREATS INVENTORY

With Support Provided By



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ASSESSMENT REPORT

ISSUES EVALUATION AND THREATS INVENTORY

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List of Acronyms

ACR	Algoma Central Railway
AVI	Aquifer Vulnerability Index
CWA	<i>Clean Water Act, 2006</i>
DEM	Digital Elevation Model
DNAPL	Dense Non-Aqueous Phase Liquids
DWSP	Drinking Water Source Protection
DWSP	Drinking Water Source Protection Process
GIS	Geographic Information System
GW	Groundwater
GWVA	Groundwater Vulnerability Analysis
HVA/s	Highly Vulnerable Aquifer/Aquifers
IPZ/s	Intake Protection Zone/Zones
ISI	Intrinsic Susceptibility index
km	kilometre
km ²	square kilometre
LIO	Land Information Ontario
m	metre
m ³ /s	cubic metres per second
MGD	Million gallons per day
mm	millimetre
MOE	Ministry of the Environment
MECP	Ministry of Environment, Conservation and Parks (formerly MOE and MOECC)
PGMN	Provincial Groundwater Monitoring Network
PSOC	Potential Sources of Contamination
PTTW	Permit to Take Water
SGRA	Significant Groundwater Recharge Area
SPC	Source Protection Committee
SPA	Source Protection Area
SSM	Sault Ste. Marie
SSMR SPA	Sault Ste. Marie Region Source Protection Area
TOT	Time of Travel
WHPAs	Wellhead Protection Areas
WTP	Water Treatment Plant
WWIS	Water Well Information System

Glossary

Items included in the glossary of definitions are found in *ITALICS* in the main text.

Agricultural Source Material

Material(s) applied to land as nutrients that originate from agricultural activities such as livestock operations. These include manure, livestock bedding, runoff water from animal yards or manure storage and compost (see *Nutrient Management Act, 2002* for legal description).

Non-agricultural Source Material

Material(s) applied to land as nutrients that do not originate from agricultural activities including: pulp and paper biosolids, sewage biosolids, non-agricultural compost and any other material capable of being applied to land as a nutrient that is not from an agricultural source (see *Nutrient Management Act, 2002* for legal description).

Aquifer Vulnerability Index (AVI)

A numerical indicator of an aquifer's intrinsic or inherent vulnerability to contamination expressed as a function of the thickness and permeability of overlying layers.

Assessment Report

The report that is to be produced by Source Protection Committees according to the Technical Rules that will be used to prepare the Source Protection Plans.

Census Consolidated Subdivisions

A census consolidated subdivision (CCS) is a group of adjacent census subdivisions. Generally, the smaller, more urban census subdivisions (towns, villages, etc.) are combined with the surrounding, larger, more rural census subdivision, in order to create a geographic level between the census subdivision and the census division.

Chemical Contaminant

A substance used in conjunction with, or associated with, a land use activity or a particular entity, and with the potential to adversely affect water quality.

Clean Water Act

The *Clean Water Act, 2006* was passed as Bill 43 to protect drinking water at the source. The Act requires the development of a watershed based source protection plan.

Cosmetic Pesticide Ban Act

The *Cosmetic Pesticide Ban Act, 2008 (Act)* recognizes that the cosmetic use of pesticides to improve the appearance of lawns and gardens presents health and environmental risks. The Act restricts the use and sale of specific pesticides for cosmetic purposes on specific land uses.

Dense Non-Aqueous Phase Liquid

An organic chemical in concentrations greater than its aqueous solubility and is more dense than water. Such a chemical will sink in groundwater and accumulate in depressions in an aquifer.

Drinking Water Issue

A substantiated condition relating to the quality of water that interferes or is anticipated to soon interfere with the use of a drinking water source by a municipality. As defined in

Technical Rule 114, regarding the quality of water in a vulnerable area: 1) The presence of a parameter in water at a surface water intake or well, at a concentration that may result in deterioration of the water quality or where there is a trend of increasing concentrations of a parameter. 2) The presence of a pathogen at a concentration that may result in deterioration of the water quality or there is a trend of increasing concentrations of the pathogen.

Drinking Water Threat

A threat is defined as a chemical or pathogen contaminant that poses a potential risk to the drinking water sources.

Freedom of Information and Protection of Privacy Act (FIPPA)

The FIPPA was created for the following purposes:

- To provide a right of access to information under the control of institutions in accordance with the principals that information should be available to the public, necessary exemptions from the right of access should be limited and specific, and decisions on the disclosure of government information should be reviewed independently of the government.
- To protect the privacy of individuals with respect to personal information about themselves held by institution and to provide individuals with a right of access to that information (R.S.O. 1990, c. F31, s1.)

Hazard Rating

A numeric value that represents the relative potential for a contaminant of concern to impact drinking water sources at concentrations significant enough to cause human illness. This numeric value is determined for each contaminant of concern in the Issues Evaluation and Threats Inventory of the Assessment Report.

Highly Vulnerable Aquifers (HVA)

An aquifer on which, external sources have or are likely to have a significant adverse effect; and includes the land above the aquifer (*Clean Water Act, 2006*).

Intrinsic Susceptibility Index (ISI)

A numeric indicator of an aquifer's intrinsic susceptibility to contamination expressed as a function of the thickness and permeability of overlying layers.

Intake Protection Zones (IPZs)

Areas as described in the *Clean Water Act, 2006*, that are related to a surface water intake and within which it is desirable to regulate or monitor drinking water threats.

Livestock Density

The number of farm animals grown, produced or raised per square kilometre of an area, separated by type of farm animals specified in section 3.1 of the Nutrient Management Protocol.

Managed Land

Land where materials are applied as nutrients.

Nutrient Unit

The amount of nutrients that give the fertilizer replacement value of the lower of 43 kg of nitrogen or 55 kg of phosphate as nutrient as referenced in the Nutrient Management Protocol (*Nutrient Management Act, 2002*).

Parcel

A parcel is a conveyable property, in accordance with the provisions of the *Land Titles Act*. The parcel is the smallest geographic scale at which risk assessment and risk management are conducted.

Pathogenic Contaminant

A microscopic organism that is capable of producing infection or infectious disease in humans.

Pesticides

Chemicals include insecticides, fungicides, and herbicides that are used to kill living organisms.

Regulatory Limit

The "Regulatory Limit" is the area defined by the Conservation Authority for floodplain mapping purposes. Regulated areas are those areas for which Conservation Authorities delineate and restrict land uses by making regulations under subsection 28(1) of the *Conservation Authority Act*. This subsection applies to water courses, streams, lakes, valleys, flood plains, and wetlands in Ontario.

Safe Drinking Water Act (SDWA)

The *Safe Drinking Water Act, 2002* provides for the protection of human health and prevention of drinking water health hazards through the control and regulation of drinking water systems and drinking water testing.

Significant Groundwater Recharge Areas (SGRA)

An area within which it is desirable to regulate or monitor drinking water threats that may affect the recharge of an aquifer (*Clean Water Act, 2006*). These are defined as the areas that annually recharge water to the underlying aquifer at a rate that is greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more. For the purposes of the current study, these areas also need to have a water supply source within them.

Transport / Preferential Pathways

Any structure, land alteration or condition resulting from a naturally occurring process or human activity, which would increase the probability of a contaminant reaching a drinking water source.

Type I, Type II and Type III Systems

Water supply systems as described in the *Clean Water Act, 2006*. Type I systems are municipal residential drinking water systems that serve a major residential development (15(2) (e) (ii)). Type II systems are water supply systems that have been included in the source protection planning process by municipal or band council resolution (15(2) (e) (iii)). Type III systems are water supply systems that are included in the source protection process by the Ministry of the Environment (15(2) (e) (IV)).

Vulnerable Areas

Areas related to a water supply source that are susceptible to contamination and for which it is desirable to regulate or monitor drinking water threats that may affect the water supply source.

Waste Disposal Site

Any land upon, into, in or through which, or building or structure in which, waste is deposited, disposed of, handled, stored, transferred, treated or processed, and any operation carried out or machinery or equipment used in connection with the depositing, disposal, handling, storage, transfer, treatment or processing of the waste (*Environmental Protection Act, R.S.O. 1990*).

Watershed Characterization Report

The Watershed Characterization Report is the foundation for subsequent steps in the Assessment Report and pulls together all available information on the watershed including natural characteristics, land uses, water quality, location of municipal drinking water systems, and preliminary list of drinking water threats.

Wellhead Protection Area

The surface and subsurface areas surrounding a water well or well field that supplies a municipal residential system or other designated system through which contaminants are reasonably likely to enter from the surface so as to eventually reach the water well or well field.

WHPA-A, being the surface and subsurface area centred on the well with an outer boundary identified by a radius of 100 metres;

WHPA-B, being the surface and subsurface areas within which the time of travel to the well is less than or equal to two years but excluding WHPA-A;

WHPA-C, being the surface and subsurface areas within which the time of travel to the well is less than or equal to five years but greater than two years;

WHPA-D, being the surface and subsurface areas within which the time of travel to the well is less than or equal to twenty-five years but greater than five years;

Definitions Used for Land Use Classifications

Within the report land use was classified using the definitions outlined below. Each land use definition is based primarily on classifications of the North American Industry Classification System (NAICS) with some refinements and amalgamations to suit the purposes of the report. These definitions should be used to identify land uses outlined in the Issues Evaluation and Threats Inventory Report, CRA (final March 2016) for the Sault Ste. Marie Region Conservation Authority and the City of Sault Ste. Marie.

Agricultural

This is assigned to land use that is associated with crop or animal production and any associated activities. For the purposes of the study forestry and logging, hunting, fishing and trapping are also included in this category.

Commercial

Activities involving the trade and exchange of goods and services in the retail, wholesale and services sectors are assigned to this category. The category also includes transportation services.

Institutional

These land uses are associated with activities in the educational, governmental and health care sectors. This classification would include features such as schools, health centres and public administration buildings.

Manufacturing

This category refers to land uses that are associated with the mechanical, physical or chemical transformation of materials, substances or components into new products. Facilities within this classification are often referred to as plants, factories or mills.

Resources Extraction

Establishments that extract naturally occurring solid minerals and or liquid minerals. This category includes mining, crushing, screening and washing of these minerals.

Utilities

Establishments engaged in the provision of utility services such as electric power, natural gas, water supply and sewage removal. Storm water management infrastructure is also included in this category.

Waste Management

Land uses in this category are engaged in the collection, treatment and disposal of waste materials. This category also includes the modification, recycling or reuse of these materials. It is noted that this category does not include household or private septic systems.

EXECUTIVE SUMMARY

The Ontario Clean Water Act as it came into effect on July 3rd, 2006, is a legislation to protect the drinking water at the source, as part of an overall commitment to human health and the environment. A key focus of the legislation is the production of locally-developed, science-based assessment reports and source protection plan. The Sault Ste. Marie Region Source Protection Committee (SSMR SPC) is representative of the watershed community and includes members from municipal governments, local aggregate industry, the environmental sector, water distributors and landowners. The SPC in conjunction with the Drinking Water Source Protection (DWSP) staff has prepared the Assessment Report's Chapter 5 on "*Issues Evaluation and Threats Inventory*" of the Sault Ste. Marie Region Source Protection Area. The Assessment Report will be used to develop the source water protection plan as part of multi barrier approach and to establish the measures to protect both the quality and quantity of sources of drinking water within the Sault Ste. Marie Region watershed.

Issues and Threats can be considered to be complementary parts of the source protection planning. Issues are problems that currently exist in the source water, or that can be reasonably predicted to be a problem in the near future if rising trends continue. Threats are activities on the landscape that, if managed improperly, may cause an issue to occur in the future.

An inventory of drinking water threats that may have the potential to adversely affect the quality of Sault Ste. Marie's drinking water source has been carried out. Threats includes landfills, activities resulting in the transport, disposal, or generation of hazardous waste, and land application of materials such as manure or pesticide were located. Threats are identified for wellhead protection areas (WHPAs), highly vulnerable aquifers (HVAs) and significant groundwater recharge areas (SGRAs). For surface water, the vulnerable areas are designated as the surface water Intake Protection Zones (IPZs). Of all the potential sources of contamination sixteen are located within WHPAs and three threats identified within IPZs (IPZ-1 and IPZ-2).

Hazard ratings (pathogenic and chemical) for each contaminant of concern associated with the identified threats were also evaluated. A hazard rating is a scientifically based value which represents the relative potential for a contaminant of concern to impact drinking water sources at concentrations significant enough to cause human illness. The rating scheme gives each contaminant of concern a high, medium, or low ranking. Transport pathways (constructed or naturally occurring preferential pathways) were also identified. These pathways have the capacity to move a contaminant more quickly toward a drinking water source. The inventories and evaluation of drinking water threats and issues and associated hazard ratings will be used as an input to the Water Quality Risk Assessment, Chapter 6 of the Assessment Report (AR).

1.0 INTRODUCTION

1.1 BACKGROUND

The community of Sault Ste. Marie is located at the southeast corner of Lake Superior, in north-eastern Ontario. Sault Ste. Marie is dependent on both surface and groundwater for its municipal water supply. The surface water source is Lake Superior at Gros Cap and the groundwater source is from six (6) municipal wells located within the City (**Figure 1**). Wells for the Municipal Water Supply System are supplied from two deep bedrock aquifers.

The Ministry of the Environment (MOE) initiated the Municipal Groundwater Studies program in 2001 to support groundwater source protection and management throughout Ontario. The program was also undertaken at a regional scale across the Sault Ste. Marie (SSM) watershed and built on previous work to improve the understanding of groundwater resources in the watershed. Capture zones up to the 25 year time of travel for all four municipal well fields were delineated as part of the study.

In 2006, the MOE initiated the Source Protection Studies program to protect the source water quality and sustainability of municipal drinking water supplies. Through the analysis of the results of a series of technical studies, source protection plans will be developed for the municipal drinking water systems for the City of Sault Ste. Marie.

As per requirement of the *Clean Water Act 2006*, an issues evaluation and threats inventory was completed for the Sault Ste. Marie municipal groundwater supply system and Gros Cap Intake.

This chapter presents the results of the threats inventory, potential pathways inventory and issues evaluation undertaken at the SSM municipal well fields and surrounding area. The study was undertaken in general accordance with the Ontario Clean Water Act, Technical Rules: Assessment Report, December 2008.

1.2 OBJECTIVE

The chapter was completed in accordance with the *Technical Rules: Assessment Report, Clean Water Act, 2006* (November 2009).

The main objectives of the study are to assess the threats, transport pathways and existing issues with regards to drinking water contamination within the Sault Ste. Marie Region Source Protection Area. This assessment is based on existing provincial groundwater studies, field evaluation/surveys, existing reports/data and new studies of the Gros Cap IPZs. Specifically, the current report sets out to provide:

- An inventory of issues that are impacting (or may impact) drinking water sources;
- An inventory of drinking water threats in vulnerable areas and, where possible, an identification of those drinking water threats contributing to drinking water issues.

- List all of the threats and associated circumstances that are or would be significant, moderate and low drinking water threats in Vulnerable Areas from Ministry of Environment's provided Tables of Circumstances.¹
- Maps and summary sheets of the above compilation.
- An inventory of constructed transport pathways, or short cuts through which contaminants can travel faster and reach drinking water sources.

Based on previous and current studies, gaps have been identified throughout. A result of the assessment process will be a continuous improvement plan to improve the confidence in the assessment of future source water planning cycle.

1.3 STUDY AREA

The study area consists of the Sault Ste. Marie Region Source Protection Area (SSMR Source Protection Area) shown in **Figure 1**. Major residential settlements in this Area, are the City of Sault Ste. Marie, Prince Township, Garden River First Nation and the Batchewana First Nation Reserve. The SSMR Source Protection Area covers approximately 775 square kilometres (km²) include land and water area.

Sault Ste. Marie is located at the southern portion of the watershed. The Sault Ste. Marie Region Source Protection Area consists of Prince Township and portions of surrounding unorganized townships as well as Batchewana First Nation and Garden River First Nation. People living outside the city limit and within Prince Township rely on their own well systems. With a population of approximately 80,000², the City of Sault Ste. Marie is a major regional industrial, commercial and institutional centre.

1.4 PREVIOUS STUDIES

A number of reports and studies have been completed for the study area. The following reports were utilized in the preparation of this chapter:

- Sault Ste. Marie Area Groundwater Management and Protection Study, June 2003, (R.J. Burnside & Associates Ltd.)
- Vulnerability of Municipal Groundwater Study, June 2005, (R. J. Burnside & Associate Ltd.)
- Sault Ste. Marie Watershed Characterization Final Report for the Sault Ste. Marie Region Source Protection Area, June 2008, (SSMRCA)

¹ The 76 Provincial Tables of Circumstances are not longer available from Ontario.ca. These 76 Tables are derived entirely from the Tables of Drinking Water Threats, which are accessible via the source protection homepage of Ontario.ca. The information that appears in the 76 Provincial Tables of Circumstances (i.e., drinking water threats that are significant in a given vulnerable zone and score) can also be generated by searching the Source Water Protection Threats Tool, accessible via <http://swpip.ca/>. Alternative formats of these two sources are available upon request from the local conservation authority.

² 2006 Census Canada

- SSMRCA Water Budget Conceptual Understanding Final Report, November 2006, (MacViro – Genivar Ontario Inc.)
- Tier 1 and Tier 2 Water Budget and Water Quantity Stress Assessment Final Report, May 2008, (MacViro – Genivar Ontario Inc.)
- Transport Pathways (previously Constructed Preferential Pathways) Study, City of Sault Ste. Marie Municipal Well Capture Zone, February 2007, (TSH and Burnside Associates Ltd.)
- Gros Cap Intake Protection Zone Study, Final Phase 1 Report, January 2008, (W.F. Baird & Associates Coastal Engineers Ltd., and Conestoga-Rovers & Associates)
- Gros Cap Intake Protection Zone Study, Numerical Modeling in Support of IPZ-2 Delineation, October 2008, (W.F. Baird & Associates Coastal Engineers Ltd.)
- Threats Inventory within IPZs (I, II and III), 2009, (W.F. Baird & Associates Coastal Engineers Ltd., and Conestoga-Rovers & Associates)
- Additional Information was collected during various field surveys.

2.0 METHODOLOGY

2.1 ISSUES EVALUATION

Issue is defined as “A substantiated condition relating to the quality of water that interferes or is anticipated to soon interfere with the use of a drinking water source by a municipality”. As defined in Technical Rule 114, regarding the quality of water in a vulnerable area: 1) The presence of a parameter in water at a surface water intake or well, at a concentration that may result in deterioration of the water quality or where there is a trend of increasing concentrations of a parameter. 2) The presence of a pathogen at a concentration that may result in deterioration of the water quality or there is a trend of increasing concentrations of the pathogen. Issues were identified through consultation with the municipality and review of chemistry data. The historical raw water quality was reviewed and compared to the Ontario Drinking Water Standards, Objectives and Guidelines (ODWS) to identify parameters approaching or exceeding the standard.

2.2 THREATS INVENTORY

The MECP describes a drinking water threat as “an activity or condition that adversely affects or has the potential to adversely affect the quality of any water that is or may be used as a source of drinking water, and includes an activity or condition that is prescribed by the Regulations as a drinking water threat”. Threats to Sault Ste. Marie source water were identified based on the information provided in the previous groundwater and surface water studies, review of previous inventories and from data collected during windshield surveys. The study examined potential contaminant sources within the time of travel (TOT) capture zones. A detailed door-to-door survey and inspection of properties within the capture areas was undertaken.

Threat inventories were carried out in the Intake Protection Zone at the Gros Cap intake as well as within the 2 year TOT of the Wellhead Protection Areas (WHPA-B).

After an extensive historical investigation of settlement patterns and infrastructure development a door-to-door survey was undertaken by TSH Engineers to identify suspected transport pathways, septic systems that could possibly pose a threat to the groundwater within the WHPAs.

2.3 TRANSPORT PATHWAYS

Local transportation pathways may include existing or abandoned wells, pits and quarries, mines, construction activities, storm water infiltration, septic systems and aging sanitary sewer infrastructure. Constructed preferential pathways were identified during the field investigation.

3.0 VULNERABLE AREAS

Based on the existing guidance and Assessment Report Technical Rules (December 2008), vulnerable areas have been delineated within SSMR Source Protection Area in previous groundwater management studies. These areas included *wellhead protection areas (WHPAs)*, *significant groundwater recharge areas (SGRAs)*, *highly vulnerable aquifers (HVAs)*, and *intake protection zones (IPZs)*.

3.1 MUNICIPAL WATER SUPPLY SYSTEMS

There are four types of water supply system listed in the *Clean Water Act 2006*:

- (i) existing and planned municipal drinking water systems that serve or are planned to serve major residential developments,
- (ii) existing and planned drinking water systems that, pursuant to resolutions passed under subsection 8 (3), the terms of reference provide for the assessment report to consider,
- (iii) existing and planned drinking water systems that, pursuant to an amendment to the terms of reference that was required or made by the Minister under subsection 10 (6), the terms of reference provide for the assessment report to consider,
- (iv) existing and planned drinking water systems prescribed by the regulations that serve or are planned to serve reserves as defined in the *Indian Act* (Canada);

All of these systems may be included in the Drinking Water Source Protection process.

Within the Sault Ste. Marie Region Source Protection Area, vulnerable areas associated with Type I systems qualified for analysis. The Gros Cap Intake and six groundwater wells are the two municipal drinking water supply sources.

Surface Water Intakes are classified as follows in the technical rules 55. A surface water intake associated with a type I, II or III system shall be classified as a:

- (1) Type A intake if the intake is or, if the intake is associated with a planned drinking water system, would be located in a Great Lake;
- (2) Type B intake if the intake is or, if the intake is associated with a planned drinking water system, would be located in a connecting channel;
- (3) Type C intake if the intake is or, if the intake is associated with a planned drinking water system, would be located in a river and neither the direction nor rate of the flow of the water at the intake is affected by a water impoundment structure; or
- (4) Type D intake if the intake is not described in subrule (1) (2) or (3).

Gros Cap is classified as a Type A intake of a Type I system.

3.2 SAULT STE. MARIE GROS CAP INTAKE

The City of Sault Ste. Marie is supplied with water from both surface and groundwater. Surface water is supplied from the Gros Cap intake and on average annually contributes approximately 50% of the municipal drinking water supply. The remainder of the water supply to the city comes from four groundwater well fields known as Goulais (two wells), Shannon, Lorna (two wells), and Steelton. Goulais and Steelton well fields are located within the Central Basin aquifer while Lorna and Shannon wells draw water from the East Basin aquifer (Burnside, 2003).

The water intake in Lake Superior is located at Gros Cap. It extends 860 meters into Lake Superior and is at a depth of approximately 15 metres. The Gros Cap pumping station delivers water to the Marshall Drive control tanks. Raw water then flows by gravity to the inlet of the water filtration plant. Three water storage reservoirs located in the distribution system hold up to 52 ML (52,000 m³) of finished drinking water (PUC, 2008).

3.3 SAULT STE. MARIE GROUNDWATER SUPPLY

A previous groundwater supply study (IWS, 1978) identified three groundwater basins located between the Precambrian uplands to the north and St. Mary's River. These basins are depressions in the Cambrian bedrock, in-filled with unconsolidated surficial material. These basins are referred to as East, Central and West Basins. The Basins are separated by topographic highs in the Precambrian bedrock.

3.3.1 Groundwater Wells

According to the Sault Ste Marie Public Utilities Commission (PUC), the total volume of water pumped from all the wells in 2006 was approximately 18 ML (18 700 m³)/day and 17 ML (17 600 m³)/day in 2005, indicating well below the permitted limits.

3.3.2 East Basin – Shannon and Lorna Wells

The lower confined aquifer combines a sand and gravel layer of varying thickness and permeability with the upper portion of the underlying sandstone. The aquifer is mainly recharged through glaciolacustrine sands and gravels adjacent to the Precambrian uplands to the north.

Two municipal wellheads, Lorna (two wells) and Shannon (one well) are located within the East Basin. Approximate natural groundwater recharge in this basin is estimated to range from 16-20 ML (15 900 to 20 000 m³)/day. The total permitted rate of withdrawal for the Shannon and Lorna municipal well sites in the east basin is 21 ML (21 000 m³/day (IWS, 1978).

3.3.3 Central Basin – Goulais and Steelton Wells

A north-south trending, pre-glacial valley defines the aquifer of the central basin. It also consists of a combination of sand and gravel overburden material and the upper portion of the underlying Jacobsville Sandstone.

As with the east basin, the central basin appears to be directly connected to the “recharge area” adjacent to the Precambrian uplands to the north, with a number of streams from the uplands draining into this basin.

Two municipal wellheads, Goulais (two wells) and Steelton (one well) are drawing water from the Central Basin aquifer. Approximate natural groundwater recharge is estimated to range from 28-30 ML (28 600 to 30 000 m³)/d (IWS, 1978). The total permitted withdrawal rate from the Goulais and Steelton municipal wells in the central basin is 18 ML (18 188 m³)/day. There are numerous additional private wells and a number of artesian wells that are left to discharge year-round.

According to the Sault Ste. Marie Public Utilities Commission (PUC), the total volume of water pumped from all the wells in 2006 was approximately 18 ML (18 700 m³)/day and 17 ML (17 600 m³)/day in 2005, indicating well below the permitted limits.

3.4 FUTURE MUNICIPAL WATER SUPPLY

As there are no areas officially defined and incorporated with the Sault Ste. Marie Region Source Protection Area for any future municipal water supply sites. The Water Budget Chapters of the Assessment Report examines predicted trends in future water supply and incorporates drought scenarios to predict future water quantity in the region.

3.5 OTHER DESIGNATED SYSTEMS

Other Designated Systems (ODSs) may include systems such as wells supplying trailer parks, or wells supplying arenas, the municipal airport, or a “cluster” of private wells supplying water to a number of houses. A municipality may designate any of these systems to be included in the Source Protection planning. To date, none of these systems has been designated by the City of Sault Ste. Marie to be included in the Source Protection program.

3.6 INTAKE PROTECTION ZONES

The surface water *Intake Protection Zones (IPZs)* have been delineated for surface water intakes that form *Type I*, *Type II*, or *Type III* sources. The Sault Ste. Marie water treatment plant is a *Type I* system, for which the *IPZs* were delineated as per the Technical Rules: Assessment Report (November 2009).

The *IPZs* consist of three different risk zones – *Intake Protection Zone 1 (IPZ-1)*, *Intake Protection Zone 2 (IPZ-2)* and *Intake Protection Zone 3 (IPZ-3)*, which represents a decreasing risk of contamination with distance away from the intake. The delineation of these Intakes has been completed in accordance with guidance from the Technical Rules: Assessment Report (December 2008). Delineation of *IPZ-2* was completed with numeric – 3D numerical modelling.

The IPZ-1 phase I was completed in January 2008, which is the delineation of Gros Cap Intake for Sault Ste. Marie Water Treatment Plant (WTP). A hydraulic modeling study to delineate the IPZ-2 was completed in October 2008 by Baird & Associates in conjunction with Conestoga Rovers & Associates.

3.6.1 Delineation of Intake Protection Zones

The Gros Cap intake and pumping station are located at the western extent of Highway 550 (known as Second Line within the limits of the City of Sault Ste. Marie). Refer to **Figure 5** for the study area map. The intake is located in Lake Superior northwest of the St. Marys River. Local industry and wastewater treatment plants are located downstream of the intake along the St. Marys River.

The Lake Superior shoreline within 5 km of the intake consists of residential homes and one marina. The mouth of the intake is located approximately 830 m from shore and consists of a circular fibreglass structure in a depth of approximately 15 m. Refer to **Figure 5** entitled 'Intake and Municipal Well Location' for a locator map. The intake screen openings are approximately 2.0 m above the lake bottom. The intake diameter is 1.2 metres and has a hydraulic capacity of 150 ML (150 000 cubic metres) per day.

According to an inspection of the intake structure performed by Watech Services Inc. in August 2006 (WSI, 2006), the intake structure was in good condition at that time. Watech's report did not recommend any immediate remedial actions over and above the existing annual inspection program.

The Gros Cap intake is classified as a Great Lakes intake as defined in Technical Rules: Assessment Report (November 2009). The Technical Rules also state that the purpose of delineating zones around the Great Lakes intakes is to protect them from immediate contaminants of concern that might enter from nearby areas or known sources. Drinking water intakes on the Great Lakes may be influenced by several environmental factors including winds, waves and currents.

Intake Protection Zone 1 (IPZ-1) is the area (1000 m radius circle) immediately around the intake crib. Due to its close proximity to the intake, this area is considered the most vulnerable to any contaminant of concern that may be released in this zone (**Figure 6**). Any contaminants released in this zone will have the highest potential to impact water quality (**Figure 11**).

IPZ-2 extends from the IPZ-1 and is the second highest priority zone. This zone is based on travel time, that is the time it takes for a contaminant to travel to the intake. The delineation of the IPZ-2 must be broad enough to permit a treatment plant operator sufficient time to shut down the intake in the event of the spill of a contaminant.

The IPZ-2 is defined based on the response time required for the plant operator to respond to adverse conditions or a spill and the travel time in the lake and/or tributaries. A 3-hour response time has been used on this project based on the operator survey. The operator indicated an allowance of at least 2 hours is required to shut the WTP down upon notification of a spill (**Figure 12**).

The IPZ-2 includes all land area and stream mixing zones that could potentially influence the intake within the required response time. There are three components to the IPZ-2: in lake, upstream and inland. Delineation of the IPZ-2 considering these three components is described below:

3.6.1.1 In-Lake IPZ-2

There is no indication in the Technical Rules: Assessment Report (November 2009) regarding the return periods to be used to determine the current velocities used to define the in-lake IPZ-2. An IPZ-2 was delineated for the Gros Cap water supply intake using a time of travel of 3 hours. The 3 hour time of travel was deemed appropriate by Sault Ste. Marie Water Treatment Plant staff for sufficient operator response. Operators stated in interviews that the intake could be shut down within 3 hours without negative impact to ongoing plant operations upon notification or awareness of an imminent threat that could impair the quality of water supply at the intake or negatively affect the water treatment plant's ability to produce safe water.

A reverse particle-tracking model was run with the 10-year return period winds for directions N clockwise through NW (at 45 degree intervals). The model was run until steady state was reached, for each direction (in each case this occurred within 24 hours). A 2-year return period flow (approximating bank full conditions) was used in tributaries for all runs. This provides a scientifically defensible definition of the hydrodynamic conditions used to delineate the IPZ-2. This zone crosses into the International Shipping Lane.

3.6.1.2 Upstream Limit of IPZ-2

Where tributaries flowing into the lake lie within the IPZ-2, the zone will extend up the tributaries a distance calculated as (shut down time minus travel time from the intake to shore) multiplied by the stream flow velocity. The stream velocity was estimated based on the actual flow and tributary cross-section data.

There are two tributaries visible in the mapping that flows into Lake Superior, within the in-lake limits of the IPZ-2: Jackson Creek and an unnamed tributary east of the Gros Cap intake. The tributaries are identified in **Figure 7**. There is a third tributary immediately north of Jackson Creek that lies on the 3 hour travel contour, and the IPZ-2 does not therefore extend up this tributary.

It is important to recognize that the delineation of the IPZ-2 is based on a 3-hour travel time to the intake. There are a number of tributaries that lie beyond the 3-hour travel time that may potentially impact water quality at the intake if longer time periods are considered.

3.6.1.3 Inland Extent of IPZ-2

The IPZ-2 extends inland to the limit of the Regulation Limit or 120 m from the high water mark, where overland flow drains into the surface water body (MOE, 2008). The Regulation Limit is delineated with respect to the Provincial Policy Statement and the CA Act Regulation 97/04. They include flood plains, streams, valleys, wetlands and shorelines. These areas are

of significant risk for loss of life, property damage, infrastructure damage and social disruption. Flood and erosion lines are determined based on regional extreme events and local conditions. The Conservation Authority has delineated the Regulation Limit as under the Conservation Authority Act, Subsection 28(1) - Ontario Regulation 176/06.

3.6.1.4 IPZ-3

The transportation of specific substances along transportation corridors was added as a local threat which was approved by the Director. The risk of this activity was evaluated using Event Based Modelling approach at a point where the international shipping channel crosses the IPZ-2 and the risk deemed significant. Should the event-based modelling be used to evaluate other spills outside IPZ-2, IPZ-3 may be delineated. If IPZ-3 is delineated it will need to extend outward from the IPZ-2 to the head water of inland streams within the delineated limits of IPZ-2 and include the drainage area within 120m measured from the high water mark or regulation limits whichever is greater along the abutted land (Technical Rules, Assessment Report March, 2017).

3.7 SIGNIFICANT GROUNDWATER RECHARGE AREAS (SGRAS)

SGRAS were delineated by overlying the area that annually recharges water to the underlying aquifer at a rate greater than the rate of recharge across the whole of the related groundwater recharge area by a factor of 1.15 or more from the Tier 1 & 2 Water Quantity Risk Assessment Report (MacViro, 2008). In this study, the “1.15 recharge areas” were identified as those areas with an estimated recharge of over 150 mm per year.

One significant recharge zone is located within the Precambrian uplands. This zone is a bedrock valley filled with sand and gravel, corresponding to the valley hosting the Algoma Central Railway (ACR) and Hwy 17 North corridor. Recharge zones within the uplands occur along surface watercourses, as well as the area of sand and gravel located along the northern contact of the uplands.

Two groundwater recharge areas occur within the City limits; one in the area of Gros Cap along the shore of Lake Superior in the west (approximately 312 ha), and a major area at the bedrock/overburden contact along the southern contact of the Precambrian uplands to the north of the City (approximately 3750 ha/37.5 km²). This larger zone of high groundwater recharge is associated with the gravel-rich glaciolacustrine beaches deposited adjacent to the uplands and covers an area approximately 20 km long and 2 to 3 km wide. This is recognized as the main recharge zone within the study area, providing recharge to both confined and unconfined aquifers in the vicinity of the City. Groundwater recharge through these beach deposits occurs by direct infiltration of precipitation, and recharge from surface streams and wetlands flowing south from the bedrock highs in the north. It is noted that the SGRAs make up about 5% of the watershed area.

Analysis of Water Well Inventory System (WWIS) database indicates that there are 780 water wells present within the SGRAs. 764 out of these are domestic water wells (summary results are presented in Table 1). The remaining 16 water wells are either test

wells, abandoned, industrial or belong to the Provincial Groundwater Monitoring Network (PGMN).

It is noted that sources of the domestic water supply could be at risk if the water quality threats are located within the significant recharge area. Within the context of current study, no further analysis of these sources for private domestic wells have been carried out as further analysis would require the delineation of WHPAs for each well. Only analysis of significant and moderate threats within SGRAs has been carried out.

Table1: Summary of Well Type in SGRA's

Well Type	Number of Wells
Domestic	764
Irrigation (Golf Course)	4
Industrial	1
Municipal	-
Commercial	-
Water Supply non Municipal	7
Undefined or Remediation	4
Total	780

Ref: Map 16 Water Use PTTW (SSMRCA Watershed Characterization)

3.8 HIGHLY VULNERABLE AQUIFER (HVAS)

HVAs were delineated based on the previous work that had been completed by SSMR SPA staff and peer reviewed by Breen GeoScience Inc. as part of the Groundwater Vulnerability Analysis (SSMRCA, 2009). This analysis had identified some portions of the watershed as highly vulnerable based on a computed intrinsic susceptibility index (ISI) rating of high. For this study, HVAs were considered as areas having High ISI score.

Based on the completed ISI for the watershed, it is noted that approximately 39.5 percent of watershed or just over 306 km² is considered as highly vulnerable. This interpretation is consistent with the geological interpretation of the watershed as the large northern portion consists of exposed bedrock. The interpretation used in the current study is that the fractured bedrock forms the northern portion of the aquifer in the watershed and where a significant over burden cover is absent; the aquifer is vulnerable due to the lack of a protective cover. Based on the available data and previous groundwater studies, the vast majority of the watershed north of Sault Ste. Marie, known as Precambrian upland, is covered by very thin over burden, which is generally less than 5 m thick.

It is noted from the map that HVAs are located throughout the northern portion of the Watershed on Precambrian upland area. Some HVAs areas are also present in the areas of watershed near the intersection of 5th line - Hwy 17N and Root River, in Prince Township (in between Bennet and Leighs Bay Creek), around the lower portion of the Big Carp River watershed, and area around the Sault Ste. Marie airport.

The delineation of the HVAs doesn't require the presence of a water source (well) within the aquifer. In the present study and evaluation of the presence of wells in these areas of

the watershed is seen as providing the insight of significance of these vulnerable areas. A summary of well type located within HVAs is illustrated in Table 2.

Table 2: Summary of Well Type in HVAs

Well Type	Number of Wells
Domestic	793
Industrial / Commercial	6
Municipal	-
Water Supply non Municipal	2
Undefined or Remediation	1
Bottled Water Commercial	1
Agriculture Research	1
Total	804

3.9 VULNERABILITY SCORE

Vulnerability scores were assigned to vulnerable areas in groundwater vulnerability analysis (SSMRCA, 2009) based on the anticipated vulnerability to contamination in that area. Vulnerability scores were developed on a scale of 1 – 10 with a 10 representing the higher vulnerability with 1 representing the lowest vulnerability to contamination.

Based on the guidance provided by the MOE, a maximum vulnerability score of 6 is assigned to HVAs as outlined in Technical Rules Part VII.i, rule 79. The vulnerability scores of SGRAs are determined based on the areas of groundwater vulnerability identified in accordance with Part IV rule 38 and provided in the groundwater assessment (SSMRCA, 2009). A maximum score of 6 is assigned to a SGRA where the underlying groundwater vulnerability is high, a score of 4 where the groundwater vulnerability is medium and a score of 2 where the groundwater vulnerability is low.

For the IPZs, vulnerability scores were assigned as part of the Surface Water Vulnerability Analysis (W.F. Baird & Associates Coastal Engineers Ltd., January 2008). Scores were updated to reflect changes to the delineation of the IPZ-2 as undertaken with the application of numeric modeling study (W.F. Baird & Associates Coastal Engineers Ltd., October 2008). The IPZ vulnerability scores used in the study are based on the guidance from the Assessment Report Technical Rules Dec 2008 and professional judgment. The Rules indicated that for the Gros Cap Intake (which is a *type -A* intake located in the Lake Superior), vulnerability could range from 5 – 7 in IPZ-1. Within IPZ-2, vulnerability could range from 3.5 – 6.3 and no scoring for the IPZ-3 (Part VIII.1 rule 86: 86 which states that “*A vulnerability score shall be assigned to each IPZ-1 and IPZ-2 associated with a type A, B, C or D intake and to each area of an IPZ-3 associated with a type C or type D intake*”). Professional judgement was used in the determination of the specific factors (source vulnerability factor) for each zone. Vulnerability scores for the SGRAs, HVAs and IPZs within the SSMR Source Protection Area are shown in **Figure 10A**, **Figure 10B** and **Figure 10C** respectively.

It is noted from the map of HVAs and SGRAs that high sensitivity and a vulnerability score of 6 dominate the vulnerable areas of the watershed. Within SGRAs, there are also areas

having scores of 4 and 2. The vulnerability scoring developed for these areas will be combined with the *hazard rating* of the threats that may be located within these areas to generate a *ranking of threats*. The combination of hazard rating and vulnerability score was carried out as part of the Risk Assessment component of the required Assessment Report.

The vulnerability scores for IPZs are seen to range from 4 to 5. The vulnerability for IPZ-1 and IPZ-2 (5 and 4 respectively) indicate a lower vulnerability than that for the HVAs and SGRAs. Calculation of vulnerability score is not applicable to the IPZ-3 area. In the current study, when calculating the risk for a threat that is located in more than one vulnerable area, the highest vulnerability score will be used for the overall rating. This is calculated as the most conservative approach.

The vulnerability score and its related area within each of the vulnerable areas of the SSMR Source Protection Area are summarized in Table 3.

Table 3: Vulnerability Score in Source Protection Area

Vulnerability Score	Area (km ²)				
	IPZ-1	IPZ-2	IPZ-3	SGRAs	HVAs
10	0	0	0	0	0
9	0	0	0	0	0
8	0	0	0	0	0
7	0	0	0	0	0
6	0	0	0	17.23	360.81
5	3.09	0	0	0	0
4	0	22.46	0	28.76	0
2	0	0	0	4.73	0

4.0 ISSUES EVALUATION

A substantiated condition relating to the quality of water that interferes or is anticipated to soon interfere with the use of a drinking water source by a municipality. As defined in Technical Rule 114, regarding the quality of water in a vulnerable area: 1) The presence of a parameter in water at a surface water intake or well, at a concentration that may result in deterioration of the water quality or where there is a trend of increasing concentrations of a parameter. 2) The presence of a pathogen at a concentration that may result in deterioration of the water quality or there is a trend of increasing concentrations of the pathogen. Issues in the Sault Ste. Marie Region Source Protection Area were identified using water monitoring information, research studies, existing reports and interviews with the Public Utility Commission (PUC) staff. Issues were considered in relation to the Water Treatment Plant (WTP), SGRAs and HVAs.

4.1 ISSUES INVENTORY

4.1.1 SSM Water Treatment Plant

A water quality review was undertaken for the Sault Ste. Marie WTP. As part of the Issues Evaluation and Threat Inventory (final March 2016), Conestoga Rovers & Associates (CRA) assessed the raw water quality of the intake in their IPZ delineation study as to whether any contaminants are impacting or have the potential to impact or interfere with this source.

Previous water quality summary reports (2004-2008) have been reviewed in this assessment. The reports were prepared by PUC staff and provide a comprehensive summary of a number of raw water quality indicator parameters for the City of Sault Ste. Marie water supply including:

- Raw Water Schedule 10 Bacteriological Results;
- Raw Water Schedule 23 Inorganic Summary;
- Raw Water Schedule 24 Organic Summary; and
- Raw Water Miscellaneous Summary.

Raw water samples are collected weekly by PUC staff. Table 4 summarizes the raw water bacteriological results:

Table 4: Gros Cap Raw Water Bacteriological Results

Parameter	2005	2006	2007	2008
Total Coliforms Samples	51	35	53	53
Zero Samples	35	27	53	49
Percentage of Zero Samples	68.6	77.1	100	92.4
E. Coli Samples	51	36	53	53
Zero Samples	49	35	53	50
Percentage of Zero Samples	96.1	97.2	100	94.3

The results for the period 2004- 2008 indicate that the raw water does contain bacteria in excess of Ontario Drinking Water Standards. It is not uncommon to find bacteria in a surface water source. The design of the WTP includes filtration and disinfection processes to remove harmful bacteria and to make it suitable for domestic uses. Results from the sampling of treated water and raw water show that the plant is adequately treating the water to Ontario Drinking Water Standards (Table 5). Data in Table 5 was taken from the Sault Ste. Marie Water Quality, Annual Report 2008 for the MOE Drinking Water Regulation (O. Reg. 170/03).

Table 5: Raw versus Treated Bacteriological Results 2008

	Number of Samples	Range of E.Coli or Fecal Results	Range of Total Coliforms Results
Raw Water	53	0 – 3	0 – 21
Treated Water	52	absent	absent

The presence of bacteria is a common feature of surface water and may be attributed to the existence of natural and anthropogenic sources of bacteria and other pathogens in the water source. As noted in Table 5, levels of E.Coli contamination are low, and raw water quality is relatively unimpaired, in relation to other municipal supplies. Anthropogenic sources of bacteria include activities such as septic systems and other activities.

A summary of the results of schedule 24 is shown in Table A.1 in Appendix A. Review of schedule 10, 23, and miscellaneous raw water quality parameters tested for under the tables of the ODWS for volatile organics, inorganic and pesticides showed no exceedances. It can be interpreted from these results that no real water quality issues are apparent in the data that was reviewed for the Sault Ste. Marie WTP.

In addition to the PUC's Water Quality Summary Reports, four composite surface water samples were collected at different circumference intervals around the intake and three surface water grab samples were collected from tributaries flowing into IPZ-2. Table A.1 shows the water analytical results in comparison to the Surface Water Quality Objectives. The full surface water analytical results are provided in Appendix A.

4.1.2 Issues Associated with Drinking Water Systems

A water quality review of all six groundwater wells has been undertaken. As part of the issues evaluation, previous groundwater management studies, data from the Drinking Water Surveillance Program and PUC's water quality reports have been reviewed to determine whether any contaminants are impacting or have the potential to impact or interfere with these sources.

Review results from previous water quality summary reports (2004-2008) are presented in Table 6 for this assessment. The reports were prepared by PUC staff and provide a comprehensive summary of a number of raw water quality indicator parameters for the City of Sault Ste. Marie groundwater supply:

Table 6: Municipal Groundwater Raw Water Bacteriological Results (2006)

Parameter	Goulais	Steelton	Lorna	Shannon
Total Coliforms Samples	27	27	26	7
Zero Samples	27	27	26	7
Percentage of Zero Samples	100	100	100	100
E. Coli Samples	27	27	26	7
Zero Samples	27	27	26	7
Percentage of Zero Samples	100	100	100	100

It is noted from the above table that the raw water from all four wellheads is categorized as a very good quality against the bacteriological criteria as there is zero count per 100 ml in raw water. Results from the 2008 annual report are presented in the following Table 7.

Table 7: Raw versus Treated Bacteriological Results (2008) for Groundwater

Well	Description	Number of samples	Range of E.Coli or Fecal Results	Range of Total Coliforms Results	Range of HPC Results
Goulais	Raw Water	45	absent	absent	-
	Treated Water	45	absent	absent	0-12
Steelton	Raw Water	27	0-1	0-1	-
	Treated Water	25	absent	absent	0-4
Lorna	Raw Water	53	absent	absent	-
	Treated Water	52	absent	absent	0-3
Shannon	Raw Water	53	absent	absent	-
	Treated Water	52	absent	absent	0-3

There are no bacteriological issues present as defined in the Technical Rules.

5.0 THREATS INVENTORY PROCESS

One of the responsibilities of the Source Protection Committee (SPC) is to evaluate threats to the sustainability of municipal drinking water supplies from both a quantity and quality perspective. Threats are classified as low, moderate, or significant, according to criteria provided by the Province.

Part X (Quantity threats) of the Technical Rules (MOE, Nov. 2009) outlines a process that endorses using the best science available and making continuous improvements. This process evaluates the ability of a water supply system to support a municipality's current and planned drinking water needs. Under the Technical Rules, water quantity threats are associated with municipal groundwater and inland surface water systems. These threats are defined and assessed through the water budget process. The Great Lakes sources are exempt from water quantity threat assessment.

Under Part XI (Quality Threats) of the Technical Rules, the SPC must describe the circumstances associated with various activities under which the presence of a specified chemical or pathogen could threaten the water quality of a drinking water source now or in the future in any of the delineated vulnerable areas (HVAs, WHPAs or IPZs).

5.1 THREATS FROM ACTIVITIES

The Province has identified 21 activities that, if present in vulnerable areas, now or in the future, could pose a threat. The following list was assembled by the MOE using input from multiple stakeholder groups and committees:

- 1) The establishment, operation, or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act* (EPA)
- 2) The establishment, operation, or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage
- 3) The application of agricultural source material to land
- 4) The storage of agricultural source material
- 5) The management of agricultural source material
- 6) The application of non-agricultural source material (NASM) to land
- 7) The handling and storage of non-agricultural source material (NASM)
- 8) The application of commercial fertilizer to land
- 9) The handling and storage of commercial fertilizer
- 10) The application of pesticide to land
- 11) The handling and storage of pesticide
- 12) The application of road salt
- 13) The handling and storage of road salt
- 14) The storage of snow
- 15) The handling and storage of fuel
- 16) The handling and storage of a dense non-aqueous phase liquid
- 17) The handling and storage of an organic solvent
- 18) The management of runoff that contains chemicals used in the de-icing of aircraft
- 19) An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body
- 20) An activity that reduces the recharge of an aquifer

- 21) The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm animal yard

Nineteen of these activities are relevant to water quality threats, while two are related to water quantity threats. Water quality threats are referenced below. If the drinking water threat is identified as significant, the SPC is required to identify where these activities are located and count the instances. If the drinking water threat is moderate or low, the Province simply requires all the circumstances that could pose a drinking water threat be identified. It should be noted that these moderate or low threat circumstances are not counted or located in the assessment and may not actually exist in the vulnerable area discussion. These are listed in Section 1.1 (1)—Appendix E. 1, of Ont, Reg. 287/07 (CWA, 2006) and in the Provincial Tables of Circumstances. ¹

There may be additional local threats which are not included in this list. *Technical Rule 119* allows the SPC to seek permission from the Director to include other threats, provided that all of the following apply:

- The SPC has identified the activity as a potential threat to a source of drinking water;
- In the opinion of the Director,
 - the chemical hazard rating of the activity is greater than 4; or
 - the pathogen hazard rating of the activity is greater than 4; and
- The risk score for the activity in the vulnerable area is greater than 40 (calculated as per *Rule 122*).

For each vulnerable area, the SPC lists and describes the threats and conditions related to drinking water, in accordance with Part XI of the *Technical Rules*. The SPC has not applied to the Director to include any additional potential threats for the Sault Ste. Marie Region Source Protection Area .

5.2 THREATS FROM CONDITIONS

Conditions are defined under the *Clean Water Act* as existing instances of deteriorated water quality caused by past/historic activities classified as threats. Conditions must pass one of the five tests set out in *Technical Rule 126*, which indicates:

The presence of a *non-aqueous phase liquid (NAPL)* in groundwater in a highly vulnerable aquifer (HVA) or wellhead protection area (WHPA);

- The presence, in surface water of a single mass of more than 100 litres, of one or more *dense non-aqueous phase liquids (DNAPLs)* in a surface water intake protection zone (IPZ);
- The presence of a contaminant in groundwater in an HVA or a WHPA, provided that the contaminant is listed in Table 2 of the “Soil, Groundwater and Sediment Standards” and is present at a concentration that exceeds the potable groundwater standard set for the contaminant in the table;
- The presence of a contaminant in surface soil in a surface water IPZ, provided that the contaminant listed in Table 4 of the “Soil, Groundwater and Sediment Standards” is

present at a concentration that exceeds the surface soil standard for industrial/commercial/community property use set for the contaminant in the table;

- The presence of a contaminant in sediment, provided that the contaminant is listed in Table 1 of the “Soil, Groundwater and Sediment Standards” and is present at a concentration that exceeds the sediment standard set out for the contaminant in the table.

To identify potential conditions, a review of available data regarding potential contamination within the WHPAs was completed. Data available included databases from the previous groundwater studies results such as Record of Site Condition, MOE Spills Database, Occurrence Reporting Information System and Historical Waste Disposal Site’s Database. The review process also included information obtained during consultations with municipal staff.

5.3 IDENTIFICATION OF THREATS

Once complete lists of threats have been compiled, the next step is to determine circumstances under which the threats may be low, moderate, or significant for each vulnerable area. The MECP Provincial Tables of Circumstances¹ show the threat for circumstances under which a given activity is classified as a low, moderate, or significant. These are provincial tables that list specific descriptions of situations where chemicals and pathogens pose threats to sources of drinking water.

The MECP tables can be used along with **Maps** and **Tables** to help the public determine where activities are or would be significant, moderate and low drinking water threats.

5.4 INVENTORY OF THREATS

The *threats* inventory process identified *threats* within the *IPZs* of the Gros Cap Intake as well as those located in *HVAs* and *WHPAs* across the study area. The inventory was based on data compiled during the processes described below.

5.4.1 Historical Aerial Photography Review

Historical aerial photographs were obtained from the SSMRCA’s air photo database and these photographs were reviewed to identify land use changes and potential high-risk activities such as waste disposal sites within the *IPZs*, *HVAs* and *WHPAs*. Photographs from 1980 to 2008 were reviewed. While the resolution of the photographs limits the detail that can be interpreted regarding the surface conditions, there were no potential *threats* identified. Current (2008) aerial photographs of the *IPZs* were reviewed and field reconnaissance done by the Conestoga Rovers & Associates (CRA) staff.

5.4.2 Municipal Planning Documents

The City of Sault Ste. Marie’s Official Plan (1996) was reviewed regarding the position on drinking water resources. Part V section 4.1 of the Official Plan outlines the need for protection of surface water and groundwater resources. There were no proposed land

uses in the plan identified that may have an impact on SSM's drinking water resources (SSM, 1996).

5.4.3 Technical Standards and Safety Association Database Review

A review of the *Technical Standards and Safety Association (TSSA)* fuel storage tank database was completed for the study area. The search identified businesses with registered fuel storage tanks and provided information on the type of fuel tank, the capacity and the fuels stored in them. The database identified 271 fuel tanks (Burnside, 2003), all located in *IPZ-2*, *HVAs* and *WHPAs*. The locations of these tanks are mapped on **Figures 11 to 14**.

5.5 INTAKE PROTECTION ZONE ISSUES EVALUATION AND THREATS INVENTORY

The Issues Evaluation and Threats Inventory was prepared by CRA to identify drinking water issues associated with the drinking water intake located within Lake Superior at Gros Cap, Ontario (Gros Cap Intake) and to create an inventory of threats (past and present) that may adversely affect the drinking water source. The Issues Evaluation and Threats Inventory, prepared in accordance with the Technical Rules (MOE, 2008), will be included as part of the Technical Assessment Report for the Sault Ste. Marie source water protection area.

In this study, a review of the various background documents, environment database search, the study team undertook a reconnaissance level survey within *IPZ-1* and *IPZ-2* to document land uses and activities. During the survey, field notes, photographs as well as GPS coordinates were obtained for noted points of interest.

In fall 2008 and spring 2009 CRA conducted a field program to gather/verify information regarding property uses and potential land based threats within *IPZ-1* and *IPZ-2*. The field reconnaissance consisted of a site by site inspection. Questionnaires were delivered to each home and business and where possible, owners/residents were interviewed. A drop box was placed at the Prince Township office for owners/residents to return questionnaires.

During the field reconnaissance, properties were inspected to determine activities conducted at each site, identify the locations of above ground storage tanks (ASTs) and underground storage tanks (USTs), septic systems, outhouses, and drinking water wells. Locations of these features were recorded in UTM coordinates (Zone 16) using a Leica model DF500 GPS unit with sub-metre (m) accuracy. Study Report and Figures are presented in Appendix - 1 of Chapter 4, Surface Water Vulnerability Analysis.

The SSMR Source Protection Area staff conducted a field reconnaissance survey to identify points of interest. The inspections were conducted to verify and complement the dataset compiled during the records review portion of the assessment. The inspections consisted of a fence line/roadside documentation of the properties and their land uses within the *IPZs*.

It is noted that the inventory process uses the total number of *threats* identified to enumerate the *threats* while for mapping purposes uses only one point for each parcel land use activity. The numbers provided in the summary tables below will differ from the number of points mapped. This is a result of more than one *threat* being associated to a parcel land use activity.

5.5.1 Intake Protection Zone 1 & 2

Within *IPZ-1 and 2*, land uses include residential, recreational and natural. On the north side of the Gros Cap Intake, the *IPZ-1 & 2* areas consist of lands associated with the City of Sault Ste. Marie WTP's pump house and initial filtration system. On further north-east side, mostly residential homes are located. The threat level for each particular circumstance was assessed as significant, moderate or low based on the vulnerability score for the IPZ-1 or 2.

Based on the current and potential future property uses within the IPZ-1, none of the prescribed or identified threats was significant or moderate. Low level threats were identified for 11 properties within IPZ-1, which are listed on Table 5. No threats were identified for IPZ-2.

Considering any potential future development, without restriction, review of the entire list of chemical and pathogen threats provided in the Tables of Drinking Water Threats (MOE, 2008) reveals that there are 584 circumstances (543 Chemical and 41 Pathogen)¹ that represent a low threat level within IPZ-1. Due to the low vulnerability scores this assessment did not reveal any significant or moderate threats for IPZ-1. No threats were identified for IPZ-2. For any threats listed within the Tables of Drinking Water Threats to be classified as moderate or significant. The required minimum vulnerability scores for drinking water threats are 6 and 8, respectively (It is noted that for SSM Gros Cap Intake, the vulnerability scores are 5 & 4 for IPZ-1 & 2, respectively). Drinking water threats were assessed for the Gros Cap IPZs based on the Technical Rules: through the identification of activities and associated prescribed threats. No significant or moderate drinking water threats were identified for the Gros Cap IPZ-1 and -2. A complete report on Issues Evaluation and Threats Inventory for IPZs done by CRA is presented in Appendix-C.

As required under O.Reg. 287/07 subsection 13, a list of all is or would be significant, moderate or low threats in each vulnerable area is listed in the Chapter 6, section 3.2.3. The areas where a potential threat is or would be significant, moderate or low are illustrated on **Figure 7** of Chapter 6. According to the technical rules, an area that has a vulnerability score of 8 or higher has the potential for a significant threat to occur. Areas with a score of 6 and greater may have moderate or low threats, and areas with a score of 4 and greater may have low threats.

5.5.1.1 Other Activities

In accordance with the Technical Rules, where an undefined activity is identified by the Source Protection Committee, it can be considered a potential drinking water threat upon approval of the Director.

5.5.1.2 The International Shipping Channel

The International Shipping Channel that passes through the IPZ-2 and has been approved for inclusion by the Director as a result of the IPZ-3 study indicates that a contaminant is present that represents a sufficient threat potential for additional consideration.

5.5.1.3 Taxidermy

Based on information gathered during the field reconnaissance a taxidermy business is located within IPZ-2 at 4703 Second Line West. This business uses an underground storage tank (UST) to hold spent chemicals including sulphuric acid, bleach, and formaldehyde. A business representative indicated that the tank is approximately 5,600 litres in size and is pumped out three times a year.

5.5.2 Threats in Highly Vulnerable Aquifers (HVAs)

There was a total of 11 *threats* identified within the *HVAs*. Table 8 summarizes the threats within *HVAs* that are not in an SGRA. The majority of the *threats* identified were aggregate extraction, auto wreckage and septic systems. Locations of *threats* are shown in **Figure 13**.

Table 8: Summary of Threats within HVAs

Land Use Type	No. of Threats Identified
Waste Management	8
Miscellaneous	3
Total	11

Activities and conditions that are or would be drinking water threats in Highly Vulnerable Aquifer areas cannot be significant threats, given that the vulnerability score is 6. However, moderate and low drinking water threats and conditions could be identified within highly vulnerable aquifers (**Figure 9**).

As required under O.Reg. 287/07 subsection 13, a list of all is or would be significant, moderate or low threats in each vulnerable area is listed in Ch-6 AR, section 3.2.5. The areas where a potential threat is or would be significant, moderate or low are illustrated in **Figure 8** of Chapter 6. According to the technical rules, an area that has a vulnerability score of 8 or higher has the potential for a significant threat to occur. Areas with a score of 6 are moderate and areas with a score of 4 are low.

5.5.3 Threats in Wellhead Protection Areas (WHPAs)

The identification of specific groundwater quality threats in the SSMR Source Protection Area vulnerable areas was based on inputs from several sources including published environmental and land-use databases (maintained, for example, by the Ministry of the Environment, Technical Standards and Safety Authority and the Municipality), field reconnaissance work by Sault Ste. Marie Region Conservation Authority staff, air photo interpretation, previous groundwater management studies and land use mapping reviews.

Each occurrence of an activity prescribed to be a drinking water threat was evaluated as significant, moderate or low based on the circumstances of that occurrence and using the MECP Tables of Drinking Water Threats.

Based on a review of the above information, the field work and a subsequent review of initial findings, four (4) activities prescribed by MECP were confirmed as significant drinking water threats. The three significant threats within the SSMR Wellhead Protection Areas are chemical threats related to fuel storage and handling, snow storage and municipal sewage infrastructure which is also a pathogenic threat.

A total of 17 activities were identified as posing a moderate threat and 14 were identified as low.

5.5.4 Non-Point Source Threats

Non-point source *threats* are drinking water *threats* that originate from broad areas and often from several similar sources. To identify non-point source threats within the general SSMR SPA and *IPZs*, potential *threats* associated with specific land uses were identified. These *threats* are described below.

5.5.5 Corridor Source Threats

A corridor source threat is a transport route or other linear feature (e.g. sanitary sewer pipes, roads, railways, and shipping routes) upon which chemical or pathogenic contaminants are transported. Within the *IPZs*, *HVAs*, *SGRAs*, and *WHPAs*, explanation of corridor source threats include sanitary sewers, hydro corridor, railways and roads are as follows:

Sanitary Sewers

Sanitary sewers transport the City of Sault Ste. Marie's wastewater to Wastewater Treatment Plants (East End & West End). The facilities treat approximately 38,200 m³/day of wastewater (SSMRCA, 2008). These sewers and their connections are considered *threats* as there is the potential for leaks to occur. Within the current context leaks in the sewage system could go to the groundwater or make their way to the St. Marys River. The treatment plant discharges downstream of the Gros Cap water intake (which is in Lake Superior and is far away upstream of these treatment facilities) and is not a *threat* to the water quality of the intake.

Roads

Road salt used during winter road maintenance is regarded as a *threat*. It is noted that roads are located in *IPZs, HVAs, SGRAs and WHPAs*. Generally road salts are applied depending on the amount of traffic a road receives and weather conditions. The percentage of total impervious surface areas within each square kilometre of vulnerable areas is shown in **Figure 4**.

The major highways located within the SSMR Source Protection Area are Highway 17, Highway 550 and Highway 556. These highways connect the region to the Trans Canada Highway, namely Highway 17 to the north and Highway 17 to the East. Locally serviced roads provide access to residential and recreational areas outside of the urban area of Sault Ste. Marie. There are numerous forest access roads throughout the region that provide access to the area's many rivers and lakes.

The Huron Central Railway (formerly CP Railway) passes through Sault Ste. Marie, crossing the southern portion of the watershed region from Sault Ste. Marie to Sudbury. The Algoma Central Railway (CN Railway) connects Sault Ste Marie to the U.S. and north to Hearst.

A major Shipping Channel is located within the south side of the IPZ-2 of the Gros Cap Intake, which could be a threat to the intake.

A summary of the values of impervious surfaces for the Vulnerable Areas (VAs) i.e. *IPZs, HVAs, SGRAs and WHPAs* is given in Table 10. The percentage of impervious surfaces is an indicator for the potential for impacts due to road salts. In areas with high levels of impervious surfaces (roads) there is an increased likelihood that road salts would be applied.

To comply with the Technical Rules; Assessment Report (November 2009), the percentage to total impervious area within each kilometre of the watershed is shown in **Figure 4**. This figure illustrates the impervious surface within SSMR SPA where sodium chloride (road salt) may be applied.

Table 10: Percentage of Impervious Surfaces (per km²) within Vulnerable Areas

Intake Protection Zone	Percent Impervious per km ²
IPZ-1	<1
IPZ-2	1 to 8
IPZ-3	--
HVAs	<1
SGRAs	1 to 8
WHPAs	1 to 8

Hydro and Railway Corridor Threats

Tall-growing vegetation on or near distribution corridors are a major cause of electrical outages, can create wildfires, and is a public safety hazard. Hydro One controls the vegetation under, above and near its distribution lines in order to maintain the safe, reliable and continuous distribution of electricity to its customers. Hydro and railways corridors exist within the vulnerable areas especially within the SGRAs and HVAs. The herbicide

known as Garlon 4 is applied to control the growth of plants, trees, shrubs and broadleaf weeds without harming the grass (HydroOne, 2009). The frequency of herbicide application is unknown at this time. The application of herbicide along these corridors within vulnerable areas could be considered as *threat* as there might be potential for spill to occur. The spill or long term application of herbicide could go to the groundwater especially in a small sensitive area where the 25 Year TOT of WHPA overlap with the SGRA zone.

The Huron Central Railway (formerly CP Railway) passes through Sault Ste. Marie, crossing the southern portion of the watershed region from Sault Ste. Marie to Sudbury. The Algoma Central Railway (CN Railway) connects Sault Ste Marie to the U.S. and north to Hearst. Herbicide is being applied along the railway lines to control the weed and tree growth. The frequency and amount is unknown.

A study to access the base line quantity in surface water streams within SSMRCA was conducted in 2007 to analyze 2,4-D Chlorphenol, Atrazine, Glyphosate and Metachlore chemicals. These chemicals were not found within the samples and that leads to the assumption that the quantity of these chemicals was below method detection limits. Only Glyphosate and Metachlore were detected at low levels, between 0.05 to 0.27 µg/L compared against the interim maximum acceptable concentration (IMAC) of 280 µg/L.

5.6 MANAGED LANDS

The percent managed land was calculated based on the zoning that the City of Sault Ste. Marie had in place including rural area, parks and recreation, environmentally managed, aggregate extraction, residential, commercial, industrial, institutional, highway zone, Precambrian and miscellaneous. In the case of the Township of Prince, the categories of Summer Cottage, Hamlet and Rural Residential were grouped as residential; Shield was defined as Precambrian and Commercial as commercial.

The methods to calculate the managed lands and livestock density calculations closely follow the Technical Bulletin entitled "*Proposed Methodology for Calculating Percentage of Managed Lands and Livestock Density for Land Application of Agricultural Source of Material, Non-Agricultural Source of Material and Commercial Fertilizers*" issued by the Ontario Ministry of the Environment in September 2009.

From the resultant zoning layer the rural area (potential farm land) and parks and recreation would be calculated on a land base of 80% of the total. The resultant layer would then have the percentages applied using the example within the Technical Bulletin: Managed Lands and Livestock Density, December 2009. For example the rural area (remaining portion is likely to be vacant land) to be applied at 5%, environmental managed at 0%, aggregate extraction at 0%, residential at 20%, reflective of a City of Sault Ste. Marie pesticide/herbicide prohibition bylaw, commercial at 20%, industrial at 20%, highway zone at 20%, institutional at 20%, Precambrian at 0% and miscellaneous at 30%.

Thresholds for threat levels for managed lands are as follows:

- Low - areas less than 40% managed lands have a low potential for nutrient application to be causing contamination

- Moderate - areas with between 40% and 80% managed lands have a moderate - potential for nutrient application to be causing contamination
- High - areas with managed lands greater than 80% have a high potential for nutrient application to be causing contamination

Figure 2 shows that in the highly vulnerable aquifer areas in the Sault Ste. Marie watershed, the managed lands percentage is between 4 to 27% (low).

5.6.1 Livestock Density

Livestock density is used as a measure of the potential for application of agricultural source material within a defined area. Livestock density is estimated by comparing nutrient units (NU) to the total area of agricultural managed lands. Livestock density is expressed as nutrient units/acre (NU/Acre).

NUs are expressed as either the number of animals housed or pastured at one time on a farm unit, or where no animals are housed the weight or volume of manure/other biosolids used annually on a Farm Unit. The number of animals was obtained for the most part by using Stats Canada's data.

Livestock density in an area, expressed in terms of nutrient units/acre (NU/Acre), was determined by dividing the NUs generated in each vulnerable area by the number of acres of agricultural managed land in that area where agricultural source material is applied.

The thresholds for evaluating the risk of nutrient application of ASM within vulnerable areas are:

- Low - less than 0.5 NU/acre is considered a low potential for exceeding crop requirements
- Moderate - over 0.5 and less than 1.0 NU/acre has a moderate potential for exceeding crop requirements
- High - greater than 1.0 NU/acre is considered a high potential for exceeding crop requirements

Livestock density within the entire Sault Ste. Marie Region Source Protection Area is <0.5 nutrient units per acre (low). This area does not have an industrial agricultural operation that requires a Nutrient Management Plan.

Livestock Density	Lorna Well	Shannon Well	Steelton Well	Goulais Well
WHPA – A	0.0	0.0	0.0	0.0
WHPA – B	0.0	0.0	0.0	0.0

5.6.1.1 Generation and Storage of Agricultural Source Material

Evaluation of properties where livestock exist has determined that there are no livestock operations present within the vulnerable areas that would result in a significant threat with respect to generation and storage of agricultural source material based on the Provincial Table of Circumstances.

5.6.2 Brownfields and Abandoned Mine Sites

The MECP defines *Brownfields* as “those sites where industrial and commercial activities have occurred in the past and which must be rehabilitated before they can be redeveloped”. In the City of SSM, *Brownfields* are associated with Algoma (formerly Essar Steel Inc.). The largest *Brownfield* in the area is the tailing or private dump of Algoma (formerly Essar Steel Inc.) on the western portion of their property. The existing provincial regulations require that property owners of Brownfields submit a “*Record of Site Conditions*” under Ontario Regulation 153/04 as part of the process preceding a change of land use, clean up or redevelopment. All “*Records of Site Conditions*” that are filed with the Ministry of the Environment, Conservation and Parks become a public document on the Environmental Registry.

5.6.3 Forestry

Forests cover the majority of the watershed and are an integral part of the watershed’s physical and biological environment as well as play an important role in the economy of SSM. There are nine different companies dealing with forest management, products, cleanup for driveways etc. within the watershed. Forest management practices such as spraying of pesticides under the Hydro lines can be considered a non-point source of contamination. Herbicides are often used on young growth stands to reduce, eliminate or suppress the growth of competing vegetation. The chemicals are applied through on-ground treatments involving vehicle mounted equipment, backpack sprayers or other hand application tools (SSMRCA Watershed Characterization, 2008). Water quality review from the Sault Ste. Marie WTP and treated groundwater well quality did not show any impacts from forestry *pesticide* application within the vulnerable areas.

5.7 POINT SOURCE THREATS

Point source *threats* are drinking water *threats* that originate from a known source. To identify point source threats within the general SSMR Source Protection Area (includes *IPZs*, *HVAs*, *WHPAs*), potential *threats* associated with specific land uses were identified. These *threats* are described below.

5.7.1 Landfills

The sites consider for solid waste disposal are known as landfills. In 1998, the Ministry of the Environment released standards, which apply to all new and expanding landfill sites, to regulate the size, location and operation of these facilities. The nature of these facilities naturally makes them a potential threat to surface and groundwater quality if managed maintained or designed incorrectly.

5.7.2 Existing

Solid waste disposal in the City is restricted to sanitary landfill sites. Site selection, development and use are carried out under Ministry of the Environment guidelines so as to ensure minimal contamination of surface and subsurface water resources.

The Ministry of the Environment, Conservation and Parks maintains a database of all known active and closed landfill sites in Ontario. This includes information on transfer stations and processing locations. Based on the database, there is one municipal landfill site and one private landfill on file in the City. The municipal landfill is located in the former Township of Tarentorus, Algoma District. A private landfill and a sludge disposal area are located on the property of Algoma (formerly Essar Steel Algoma Inc.).

The city landfill was privately operated from the early 1950's to the early 1980's. The Municipality of Sault Ste. Marie has operated the landfill since the early 1980's, with both solid waste and sewage sludge from the City's water pollution control plant land filled at the site. The City's waste management program includes refuse collection, recycling programs, and sanitary landfill management. It is reported that the recycling, coupled with the municipal composting initiative, have quantifiably reduced the volume of material coming to the Municipal Landfill Site, potentially extending the life of the site.

Hazardous materials such as used batteries and refrigerators are collected and disposed of safely. Used tires and gas cylinders are collected and sold as scrap. Wood waste is collected and reused as fuel and bi products. Leaves are collected and deposited at a composting facility, annually.

5.7.3 Proposed

As the number of people residing in a community increases, municipalities must plan for the change in the volume of refuse that is generated. Sites for future landfill facilities must be selected and approved through a proper selection process that includes the Environmental Assessment Act and the City of Sault Ste. Marie Official Plan. The proposed site for future landfill use is currently under review as according to Environment Site Assessment Phase-I.

5.7.4 Abandoned

Landfill facilities that have reached their capacity are formally closed and decommissioned using the guidelines provided by the Ministry of the Environment. These closed sites are designated as abandoned landfill facilities and are recorded by the Municipality.

Two such facilities in the City of Sault Ste. Marie have previously been closed. There is one inactive landfill west of the presently active landfill site. At present, there is no information available about its cleanup and/or closure process. There may be an abandoned incinerator site located at the corner of Black and Trunk Roads in the east-end of the City. People complained about "getting slug kind stuff" when they excavate site for construction. No information is available about dump sites located within the Prince Township.

5.8 SEPTIC SYSTEMS

A majority of the area residences, businesses, and the industries within the City limits are serviced by municipal utilities such as water and sewer. However, the residential developments on the west side and to the north are not serviced. As a part of the septic systems were located in these surveys. In general, most of the residences that were surveyed had a septic disposal system. It should be noted that the septic systems information was not provided by a number of residents. Of the 1,353 systems, septic problems were reported at 67 systems. The age of these systems ranges from <5 years to >50 years and it appears that a majority of the problems may be due to infrequent pumping of the tanks and possible lack of maintenance of the systems (Burnside, 2003).

It is important to recognize that septic systems may impact groundwater quality given that these systems potentially discharge bacteria and nitrates as well as other household chemicals (cleaning products, paints, oils and water softener backwash) into the environment. Malfunctioning and/or improperly designed septic systems could pose a threat to groundwater quality and human health because of potential for bacterial contamination. The potential impacts associated with a given system, however, are best addressed on a case-by-case basis requiring site-specific studies. The residents should be made aware of potential threats arising from the septic systems, the need for setbacks between the well and disposal beds, and the need for regular maintenance of the systems etc (Burnside, 2003).

In addition to the previous review of municipal groundwater studies, a field reconnaissance was also carried out to identify properties that were not municipally serviced. These parcels were assumed to have a septic system. **Figure 15** identifies the areas within IPZs, HVAs, SGRAs and WHPAs serviced with municipal sewers. The total municipal serviced area within SSMR Source Protection Area is about 62.75 km² which is almost 12 % of the total SSMR Source Protection Area. All properties with a building outside of these areas are assumed to have a septic system. Within SGRAs and HVAs, all buildings are not municipally serviced and therefore have individual wastewater treatment systems (septic systems). This includes the cottages located along the waterways.

Because of the large number of properties within the study area with septic systems, therefore, these systems have not been mapped individually and are considered a non-point source for mapping purposes. A summary of this information is provided in Table 10. There might be some duplication in number of properties having potential septic system located within HVA with SGRAs.

Table 9: Properties with Potential Septic Systems

	IPZ-1	IPZ-2	IPZ-3	SGRA	HVA
Properties with Septic Systems	6	89	-	1585	2648

No record of status or inspection information for septic systems is available from the municipal records. It is known that septic systems are more likely to deteriorate in performance with age. In the absence of information on the status of these systems it is assumed that water quality data from the area is indicative of the impact of these sources on the water supply.

6.0 REVIEW OF ISSUES AND THREATS

Under the existing provincial Technical Rules: Assessment Report, it is anticipated that the *issues* and *threats* (Potential Sources of Contamination, PSOC) inventoried as part of this study will undergo further evaluation. The identified PSOCs will be evaluated as part of the Water Quality Risk Assessment (WQRA). The WQRA is a semi-quantitative risk assessment (SQRA) tiered process, part of Chapter 6 of the *Assessment Report*. This process will combine an assessment of *threats* (PSOC's) to water quality with the vulnerability of the source water. In the SSMR SPA, the WQRA will be conducted as a follow up to this study.

6.1 REVIEW OF ISSUES

As is the case with any surface water source, it has been noted that there is no occurrence of bacteria impacting the raw water quality at the Gros Cap Intake. Table 5 illustrates the ability of the filtration plant to provide safe drinking water for distribution. The occurrence of this bacterial impact does however suggest that sources for these pathogens exist within the vulnerable areas of the treatment plant. The SSMR SPC will be developing a Source Protection Plan for the enhanced protection of the municipal residential drinking water supply in the area. The SSMR SPC may wish to consider regulations or policies to further protect the level of any bacterial impact on the raw water at the Gros Cap Intake.

Other locations throughout the watershed have shown some impact due to various occurrences. The more significant impacts noted as part of this report include; elevated Chloride in wells in the east end aquifer and in the PGMN well located at the northern side of the watershed. Other areas of concern have been associated with leachate from the City's Landfill and the sewage lagoons from one of trailer park. It is noted that monitoring program is in place for City's landfill site and a semi-annual water quality assessment is carried out. Based on existing information for the SSM WTP and groundwater wells, there is currently no recorded impact of other *issues* at these sites.

6.2 REVIEW OF THREATS

A number of potential threats have been identified by the City of SSM and by its citizens. These other considerations surround the potential impact of local activities on the quality of the water supply. It is notable that the City of SSM has taken action in appropriate cases to ensure that no impact from these PSOCs will occur at the SSM WTP and groundwater wells. These measures have been put in place for PSOCs that can be defined as point sources. Some of these measures include water quality sampling at different sites within the watershed as part of the Provincial Water Quality Monitoring Network (PWQMN). The City of SSM has also developed a spill contingency plan in the event of a spill on Highway 17, which crosses the vulnerable area of groundwater wells.

The land use map developed during the Groundwater Management Study for City of Sault Ste. Marie Report (2003) identifies areas of aggregate extraction activities in the vicinity of significant recharge zone for all municipal wells. Gravel pit extraction and development in the proximity of this zone could pose a risk to the well water quality and quantity if proper handling and management practices are not followed.

There are some farming activities that exist at the upper portion of the Root River, which might have an impact on the surface water quality of the river. This could be seen from the high nutrient and phosphorous loadings at the two upstream monitoring locations on Root River. As at those locations, this river flows through the SGRA.

As a transformer station at one of the groundwater wells is present. A potential for the transformer oil to leak or be spilled which could subsequently impair the subsurface soils and it could follow the transport pathways to enter into the groundwater. Another transformer station was removed from another groundwater well. While it will not have the potential for contamination the subsurface soils could contain past contamination events.

There are two Potential Source of Contamination (PSOC) sites exist with in the 2-year TOT of Lorna well. Goulais, Steelton and Shannon wells have four PSOC at each location within 2-year TOT zone. It is important to implement measures that will address the risk to the wells posed by these potential sources of contamination.

The *threats* inventory indicates that a number of potential *threats* exist within the vulnerable areas of the Gros Cap intake and groundwater wells that are associated with various land uses within this area. The land uses include Industrial, Commercial, Agricultural/hobby farming, Residential and Municipal. There are also a number of corridor *threats* and transport (preferential) pathways. The occurrence of these features indicates that there is the potential from one or more of these PSOCs to impact the water quality of the Gros Cap intake and groundwater wells.

All of the *threats* have been ranked based on their *hazard rating*. The *hazard rating* having been developed based on guidance from the Technical Rules.

It is known that the risk associated with a particular *threat* is higher when the *hazard rating* for that *threat* is higher. The Clean Water Act Technical Rules: Assessment Report (Part XI.2, page 53) indicates that *a threat with a hazard rating of 4 and above is considered a threat of concern and should therefore be considered*. The list of *threats* compiled as part of this study shows that many of the *threats* were of this value and higher.

It is noted from the Technical Rules: Assessment Report (November 2009) that the *hazard rating* calculated as part of this study will be multiplied by the vulnerability score to produce the final Risk category for each *threat*. Risk score will be used to rank *threats* as significant (80-100), moderate (≥ 60 to < 80) or low (≥ 40 to < 60). The categorization of *threats* as significant, moderate or low will create the list of priorities for the handling of the *threats*. The aim of the *threat* inventory process is the determination of the category of each threat as low, moderate or significant and the establishment of a list of priorities based on the significant, moderate and low risks. The categorization of *threats* will be completed in the next component of the Drinking Water Source Protection program, specifically the Water Quality Risk Assessment (Chapter 6 of the Assessment Report). It is anticipated that the SSM Source Protection Committee will take actions on *threats* that are categorized as significant.

7.0 UNCERTAINTY ANALYSIS

A number of components of the modeling process have a low to high degree of uncertainty. The uncertainty in the WHPA-A and WHPA-B delineations is low. Generally, the uncertainty in delineating the WHPAs decreases closer to the wellhead as there is less compounding of errors. The overall uncertainty for the WHPA-C and WHPA-D was assessed to be high. The modeling approach involves a number of assumptions that limit the accuracy of their final size and shape. Two of these assumptions include the equivalent porous medium concept used to represent bedrock layers, and the simplification of the overburden model layers.

Most of area over the lowlands covered by thick clay and silt deposits has been identified as having low ISI. Also, artesian flowing well conditions exists over parts of this low land area, which effectively protecting the deeper aquifer. There is a great amount of reliability in this information; therefore, the uncertainty of this score is low.

8.0 CONCLUSIONS

The following is a summary of the conclusions that can be derived from this report;

Within the SSMR Source Protection Area, the Gros Cap Intake, SSM WTP, and four Groundwater Wellhead Protection Areas (Goulais, Steelton, Lorna and Shannon) are the only municipal residential drinking water systems that are included as part of the Source Protection program. Inventories of locations of other sources, both communal and private have been included as part of this report.

There are no water quality *issues* found at the SSM WTP related to the bacteriological quality of raw water. There is adequate treatment within the plant to allow for the production of safe drinking water for distribution. Other *future potential issues* that have been identified as part of the study include Chloride concentration at the Lorna Well (max 76.6 mg/L), although these are below the Ontario Drinking Water Standards (250 mg/L) but the trend analysis for the data 1998 to 2004 shows the concentration is increasing @ 1.78 mg/L per year.

Threats have been identified for the *vulnerable areas* within the SSMR Source Protection Area including the *IPZs* and the *HVAs* and these *threats* have been incorporated into a database.

Four (4) activities prescribed by MECP were confirmed as significant drinking water threats. Three significant threats are within the SSMR Wellhead Protection Areas are chemical threats related to fuel storage and handling, snow storage and municipal sewage infrastructure which is also a pathogenic threat. The fourth threat is the spill threat of oil or fertilizer in the IPZ-2 for the Gros Cap intake.

9.0 RECOMMENDATIONS

A potential contaminant source inventory was developed that identifies sources of contamination and land use activities that might pose a threat to the drinking water sources. The followings are the recommendations based on the information gathered and analyzed in this report:

It is noted that as a follow up to the current study, the SSMR Source Protection Area and the City of Sault Ste. Marie will be implementing a Water Quality Risk Assessment (WQRA) of the *threats* identified with the current study. This WQRA will further evaluate the *issues* and *threats* identified as part of this report to determine their significance to the maintenance of a safe drinking water supply for the SSM WTP. The results of this process will create a categorization of the risk from the various *threats*.

Based on the outcome of the risk categorization process the City of Sault Ste. Marie should consider the implementation of various measures and policies that would seek to enhance the level of protection offered to the SSM WTP and municipal groundwater wells. These policies and measures would be developed by the SSMR SPC based on local knowledge and may consider some of the following practices:

- Development within the *IPZs* should be consistent with local Source Water Protection objectives.
- Future land use planning should consider restricting high-risk land use activities in *IPZ-1*, *IPZ-2*, *SGRAs* and *WHPAs* and other areas with high vulnerability.
- If *pesticides* are used, care should be taken that they are applied according to product specific application instructions and Ministry of the Environment regulations.
- Public education on proper maintenance of septic systems will reduce the potential water quality impacts.
- The use of road salt in the significant recharge area should continue to be carefully managed by the City of Sault Ste. Marie and the Ontario Ministry of Transportation according to which jurisdiction the application applies.
- The City of Sault Ste. Marie and SSMRCA should initiate an awareness campaign to educate the public and industry about Drinking Water Source Protection initiatives.
- Monitoring of Provincial Groundwater Monitoring Network (PGMN) wells should be continued with scheduled water quality sampling at least once a year.

10.0 REFERENCES

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