Chapter 2

WATERSHED CHARACTERIZATION

APPROVED ASSESSMENT REPORT
for the
Northern Bruce Peninsula Source Protection Area

October 15, 2015

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2.0 Watershed Characterization

The watershed characterization is a general assessment of the Northern Bruce Peninsula Source Protection Area's (Northern Bruce Peninsula SPA or NBPSPA) fundamental natural and man-made characteristics, including current status and trends. It generally describes the physical and human qualities of the watershed by providing a compilation of existing information. Available background studies and documents were used in compiling the report and any major gaps requiring future research were identified.

A variety of land use activities occur throughout the region. Forestry activities, aggregate extraction, tourism, agricultural activities and recreational areas are prominent in the Source Protection Area (SPA).

2.1 Source Protection Region

The Northern Bruce Peninsula Source Protection Area is part of the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region (SPR or planning region). The Saugeen, Grey Sauble, Northern Bruce Peninsula SPR consists of three Source Protection Areas (SPA): Saugeen Valley SPA; Grey Sauble SPA; and Northern Bruce Peninsula SPA (Figures 1.2.1 and 1.3.1). The Source Protection Areas and Region were established under the *Clean Water Act* by O. Reg. 284/07.

The Municipality of Northern Bruce Peninsula Council sits as the Source Protection Authority in the Northern Bruce Peninsula SPA. The Saugeen Valley Conservation Authority Board sits as the Source Protection Authority in the Saugeen Valley SPA and the Grey Sauble Conservation Authority Board sits as the Source Protection Authority in the Grey Sauble SPA. The three agencies have representatives on a Management Committee that helps to oversee the technical and financial aspects of the Drinking Water Source Protection work within the SPR.

The SPR represents approximately 8400 km^2 and has approximately 160,000 residents. The area is very diverse with two Conservation Authorities, two First Nations and 21 lower-tier municipalities. Activities by provincial, federal, and non-governmental organizations are prevalent within the region as well. The physical characteristics of the region are equally as varied. The climate is greatly influenced by Lake Huron, which includes Georgian Bay. Prominent features include the Niagara Escarpment, karst topography, various types of wetlands and the Saugeen River system, to name a few.

Three other Source Protection Regions share a boundary with the Saugeen, Grey Sauble, Northern Bruce Peninsula SPR. To the south is the Ausable Bayfield Maitland Valley SPR, while to the east are the Lake Erie SPR and the South Georgian Bay Lake Simcoe SPR.

2.2 Northern Bruce Peninsula Source Protection Area

Northern Bruce Peninsula SPA encompasses the Municipality of Northern Bruce Peninsula (Map 2.1) with an area of 761 km^2 and a population of 3,850 residents (StatCan Census, 2006). It contains a large number of smaller catchments with complex hydrologic regimes related to extensive karst features (see section 2.3.2.1). In the late 1880's and early 1900's, widespread

logging occurred on the peninsula. This boom period was followed by a decline in the population through to the middle of the 20th century. Population increases in the last few decades can be attributed in part to employment opportunities in the tourism sector and servicing of growing cottage developments, as well as the conversion of cottage properties to full-time residences.

The Municipality of Northern Bruce Peninsula was created in 1999 by an amalgamation of the Village of Lion's Head, Township of St. Edmunds, Township of Lindsay and Township of Eastnor. The islands and waters off the northern tip of the Bruce Peninsula are part of Fathom Five National Marine Park. Extensive portions of the Northern Bruce Peninsula SPA near Tobermory (in the former St. Edmunds Township) are designated Bruce Peninsula National Park.

2.2.1 Jurisdictions

The area encompassed by the Northern Bruce Peninsula SPA also comes under other jurisdictions, as detailed in the following sections.

2.2.1.1 Provincial Ministries

The Ministry of the Environment and Climate Change (MOECC) is the lead provincial Ministry for Drinking Water Source Protection. MOECC is responsible for legislation and regulations, such as the *Clean Water Act*, 2006, and *Safe Drinking Water Act*, 2002. A regional office is located in London, Ontario with an area office located in Owen Sound that houses both drinking water inspectors and environmental officers. The Ministry works to provide all Ontarians with safe and clean air, land and water. The MOECC provides funding and guidance for wellhead protection area and intake protection zone delineation and drinking water systems. The MOECC is a source of information about municipal water systems and water well records.

A field office for the Ministry of Natural Resources and Forestry (MNRF) is located in Owen Sound, with the district office in Midhurst and the regional office in Peterborough. MNRF has a long working relationship with Conservation Authorities in resource management, such as forestry and flood warning.

The Ministry of Municipal Affairs and Housing (MMAH) is responsible for the policies and programs of the Government of Ontario in relation to municipal affairs, including: coordination of programs of financial assistance to municipalities; community planning; community development; maintenance and improvement of the built environment and land development; and housing and related matters. The Western Municipal Services Office is located in London. MMAH's role in Source Protection is primarily in guidance on integrating recommendations of source protection plans into municipal by-laws and official plans.

The Ministry of Agriculture, Food and Rural Affairs (OMAFRA) provides services to rural communities, farmers and the agri-food industries. Among its roles are assisting farmers to responsibly manage chemical inputs and animal waste to protect the environment, as well as administrating and enforcing the *Nutrient Management Act*. A resource centre is located in Clinton and satellite offices are in Walkerton and Owen Sound.

The Ministry of Northern Development and Mines (MNDM) develops and administers the *Mining Act* and provides valuable information about the province's geology. Quaternary and bedrock geology data from the Ministry will assist in the delineation of wellhead protection zones, aquifers and other groundwater features relevant to Source Protection. The nearest MNDM office is located in Sudbury.

2.2.1.2 Federal Government

Fisheries and Oceans Canada administers section 35 of the *Fisheries Act,* which deals with the management and protection of fish habitat. Under agreements with Grey Sauble Conservation and Saugeen Conservation, the Conservation Authorities conduct the initial review of proposed projects to identify any impacts to fish and fish habitat. As well, the Conservation Authority determines how the proponent can mitigate any potential impacts to fish and fish habitat. If impacts to fish and fish habitat can be mitigated, then the Conservation Authority issues a letter of advice. If impacts to fish and fish habitat cannot be fully mitigated, the project is forwarded to the local DFO office for further review.

These agreements were developed to streamline day-to-day referrals in Ontario for projects that may have a shared regulatory interest between DFO and the Conservation Authorities. These agreements were put in place to improve client service with a one-window approach. Therefore, Conservation Authorities are the first point of contact for the majority of projects in and around water in Ontario (Fisheries and Oceans Canada, 2005).

Environment Canada has been an important partner in several wildlife management initiatives in the region. Perhaps the best known function of Environment Canada is weather forecasting. Conservation Authority staff utilise weather data from Environment Canada to determine the likelihood of precipitation or snowmelt as part of the Conservation Authority's flood forecasting program. As well, many of the streamflow gauges on local watercourses are operated by the Canadian Hydrographic Service of Environment Canada. The gauges provide real-time data on the water level and flows, which can be used, in turn, to assess when levels will peak and whether they may reach flood stage. Over the long-term, streamflow data can be used to model the behaviour of the river and improve flood forecasting abilities.

2.2.1.3 First Nations

The Chippewas of Nawash Unceded First Nation 27 reserve is at Neyaashiinigmiing (Cape Croker) near Wiarton and its related Hunting Ground 60B abuts the Bruce Peninsula National Park. The Chippewas of Saugeen First Nation 28 and 29 reserves are on the Lake Huron shoreline near Southampton and Sauble Beach, and its related Hunting Ground 60A also abuts Bruce Peninsula National Park.

The Chippewas of Saugeen First Nation and the Chippewas of Nawash Unceded First Nation, together known as the Saugeen Ojibway Nations, meet in joint council and share land claims. They passed a resolution in joint council in September 2003 relating to Ontario's then proposed Source Protection framework. The resolution advocates for the use of the precautionary principle and traditional environmental knowledge in developing Source Protection Plans.

As part of the communication procedures for Drinking Water Source Protection, information is being provided to the First Nations about the program. To date this information has included agendas and minutes of Source Protection Committee meetings, notices about the Terms of Reference, notices about the Assessment Report and notices about the Source Protection Plan. The Source Protection Committee structure allows for two representatives from First Nations if the communities so choose.

2.2.2 Non-Governmental Organizations and the Public

Source Protection will use a broad scale, interdisciplinary approach to managing and protecting sources of drinking water. This implies bringing together a wide range of technical expertise, along with organizations and individuals with differing mandates and interests, in order to build a process that can incorporate analyses and values from the purely technical to the socio-political. The level of stakeholder involvement may range from invitations to contribute and the receipt of information/documentation up to extensive participation in plan development through committees and working groups.

Many non-governmental organizations (NGOs) have mandates and program activities that are relevant to Source Protection. Some will be significant stakeholders in the Source Protection planning process. A representative listing of NGOs in the Northern Bruce Peninsula SPA is shown in Table 2.2.1. This list is not exhaustive, but is intended to show the range of groups interested in water- and land-related issues. The information about each organization was derived from their own websites wherever possible.

A contact database will be maintained and enhanced throughout the project to support engagement of NGOs and the public at large. There are many members of the public who have taken part in watershed-related activities and many possess extensive technical or local knowledge.

TABLE 2.2.1 – Non-Governmental Organizations in the Northern Bruce Peninsula SPA

Name of Organization	***Main Interests and Activities***
Bruce County Federation of Agriculture	- promote best management practices - encourage stewardship
Bruce County Woodlot Association	- encourage sustainable management of the forests in Bruce County - promote sustainable forest management by increasing awareness of the social, economic and environmental values - support community involvement in forest protection/conservation and sustainability - provide and support community workshops/activities and educational opportunities about the forest ecosystem and sustainable forestry
Bruce Peninsula Bird Observatory	- promote and foster the study, appreciation and conservation of birds and their habitats on the Bruce Peninsula - monitoring, research and education projects - operate bird banding station at Cabot Head

Name of Organization	Main Interests and Activities
Bruce Peninsula Biosphere Association	- community committee to implement the concepts of UNESCO World Biosphere Reserves along the Niagara Escarpment - promote a healthy, sustainable community with a balance between local development and ecological conservation - build local capacity by providing support for research, monitoring, education and information exchange related to local issues
Bruce Peninsula Environment Group	- preserve the unique ecology of the Bruce Peninsula - promote a greater awareness of the diverse flora, fauna, geology, and cultural history of the Bruce Peninsula - encourage sustainable development - utilize education, presentations and open dialogue to communicate importance of and means to maintaining a healthy natural environment
Bruce Trail Conservancy	- public access to Niagara Escarpment - conservation corridor containing a public footpath along the Niagara Escarpment
Christian Farmers Federation of Ontario	- public policy development - enabling farmers to work out their Christian faith in their vocation as citizens - agricultural programs
Ducks Unlimited Canada	- wetland enhancement projects, such as Bognor Marsh - assist landowners with habitat improvement projects
Escarpment Biosphere Conservancy	- preserve the landscape, ecology and wildlife of the Niagara Escarpment - develop and manage a system of nature reserves on which only ecologically sustainable recreational activities are permitted - secure significant habitat features through land purchase, donation or negotiation of conservation agreements
Girl Guides	- environmental education and community service - programs to develop life, leadership and learning skills
Grey Bruce Children's Water Festival	- annual festival educates 2,000 Grade 4 students about water issues and the physical properties of water - promote maintenance of ground and surface water quality and quantity
Lake Huron Centre for Coastal Conservation	- protect and restore Lake Huron's coastal environment - promote a healthy coastal ecosystem lake-wide - help local groups with environmental issues in their own communities
Nature Conservancy of Canada	- protect areas of biological diversity for their intrinsic value and for the benefit of future generations. - secure ecologically significant natural areas through purchases, donations, conservation agreements or other mechanisms - achieve long-term stewardship through management plans and monitoring arrangements
Ontario Nature	- conservation and restoration of natural habitats - education and advocacy - nature reserves - environmental projects, research

Name of Organization	Main Interests and Activities
Scouts Canada	- involve youth throughout their formative years in a non-formal educational process - assisting youth to establish a value system based upon spiritual, social and personal principles as expressed in the Promise and Law - environmental awareness, social responsibility, tree planting
Stewardship Grey Bruce	- partner with natural resources related community organizations - link landowners with information on best practices, expertise and resources - encourage individuals and local groups to be good stewards - plan and manage natural resources in a responsible manner

2.3 Physical Description

A broad overview of the physical character of the Northern Bruce Peninsula SPA is provided in this section. The topics include geology, topography and soils. A more in-depth analysis can be found in the Conceptual Water Budget Report for the SPR (SC, 2007). Two excellent information sources are the Grey and Bruce Counties Groundwater Study (Waterloo Hydrogeologic, 2003) and "Geology and Landforms of Grey and Bruce Counties" (Owen Sound Field Naturalists, 2004).

2.3.1 Surface Elevation

The topography (surface elevation) of the Northern Bruce Peninsula SPA exhibits diversity from high cliffs to gently sloping plains, as shown on Map 2.4. Overall, elevations trend from higher ground close to the Georgian Bay shoreline to lower in the west. The lowest surface elevation in the SPA is Lake Huron and Georgian Bay with a low water datum level of 176.0 masl (metres above sea level) (Canadian Hydrographic Service, 2007). The maximum elevations in the Northern Bruce Peninsula SPA occur at Cabot Head (280 masl), Lion's Head and the southeastern corner of the SPA near Hope Bay (279 masl) (MNR, Digital Elevation Model, 2007).

One of the dominant natural features of the Northern Bruce Peninsula SPA is the Niagara Escarpment. The escarpment stays fairly close to the Georgian Bay shoreline as it winds its way through the Peninsula to Tobermory. Sheer cliffs up to 60 m high make for spectacular lookouts. The central part of the Bruce Peninsula consists of a rugged, bedrock plain, while the coastal fringe along Lake Huron is relatively flat and generally less than 200 masl. On the west side of the Peninsula, the land slopes very gradually toward Lake Huron. The Lake Huron coast is highly indented and numerous small islands and shoals are located offshore.

Figure 2.3.1 – Niagara Escarpment cliffs near Lion's Head

2.3.2 Bedrock Geology

Knowledge of bedrock geology is necessary for understanding bedrock aquifers and regional groundwater movement. Descriptions of the bedrock units, and an awareness of groundwater quality parameters like hardness and salinity, help to identify regional aquifers and aquitards. Information on bedrock geology in the Northern Bruce Peninsula SPA includes mapping from the Ontario Geological Survey (OGS), reports on Paleozoic geology from various authors and well records in the Water Well Information System (WWIS).

General bedrock stratigraphy (that is, the character, thickness and sequence of rock units) in the Northern Bruce Peninsula SPA is summarized in Table 2.3.1 (Stratigraphy) and illustrated in Map 2.5. The bedrock layers shown on Map 2.5 represent the uppermost formation underlying a particular site and ranges from the Clinton group to the Guelph Formation. Other formations as shown on Table 2.3.1 lie below the uppermost formation.

TABLE 2.3.1 – Stratigraphy of Bedrock in the Northern Bruce Peninsula SPA (Waterloo Hydrogeologic, 2003)

Period	*Group*	*Formation*	*Material Type*
Quaternary	Overburden (glacially-derived gravel, sand, silt and clay)		
Middle Silurian		Guelph	Buff to brown medium-bedded dolostone
		Amabel	Blue-grey thick-bedded dolostone
		Fossil Hill	Buff to grey-brown fossiliferous dolostone
		St. Edmund	Cream-buff thin-bedded dolostone
		Wingfield	Olive-green argillaceous dolostone and shale
		Dyer Bay	Grey-brown dolostone
Lower Silurian	Clinton/ Cataract	Cabot Head	Maroon to green-grey non-calcareous shale
		Manitoulin	Grey fossiliferous dolostone
Upper Ordivician		Queenston	Maroon shale, interbeds of limestone and calcareous siltstone
		Georgian Bay	Blue-grey shale, interbeds of siltstone and limestone
		Blue Mountain	Blue-grey non-calcareous shale
Middle Ordivician	Simcoe	Lindsay	Limestone, argillaceous limestone, calcareous shale

Bedrock consists mainly of carbonate (limestone and dolostone) rocks, as well as some shale units that are interbedded with the limestone and dolostone. Dolostone is a hard, resistant rock and differs from limestone in that some of the calcium ions have been replaced by magnesium. The presence of dolostone promotes the formation of vertical cliffs and waterfalls as it acts to shield softer, underlying layers of rock from erosion.

The bedrock dips to the southwest at a regional slope of 5 to 7 m/km and there is a general thinning of the overburden from west to east, resulting in bedrock exposure along the Niagara Escarpment. The bedrock is very close to the surface over large sections of the SPA. An

indication of the depth to bedrock is also shown in the distribution of quarry operations, which are found in the Northern Bruce Peninsula SPA near its boundary with the Grey Sauble SPA and north of Ferndale near the Lindsay Tract Forest.

Most of the limestone and dolostone units have the potential to supply adequate quantities of water. However, the water has elevated hardness due to the carbonate composition of the bedrock. The Guelph and Amabel Formations are important bedrock aquifers that almost entirely occupy the Northern Bruce Peninsula SPA.

2.3.2.1 Karst Features

Karst is a distinctive type of topography, formed primarily by the dissolution of carbonate rocks, such as limestone and dolostone. These rocks are dissolved by the action of weak carbonic acid which is formed when carbon dioxide from the atmosphere or from within the soil environment dissolves in water (Owen Sound Field Naturalists, 2004). The chemical action pits the surface of rocks and enlarges vertical cracks and horizontal bedding planes. Over time, groundwater flow conduits increase in size and aquifers with large conduits are created, thereby lowering the water table below the level of surface streams. These surface streams and drains may begin to lose water to developing cave systems underground. As more surface drainage is diverted underground, streams may disappear and become replaced by closed basins called sinkholes. Sinkholes vary from small cylindrical pits to large conical or parabolic basins that collect and funnel runoff into karst aquifers (Ford and Williams, 1989).

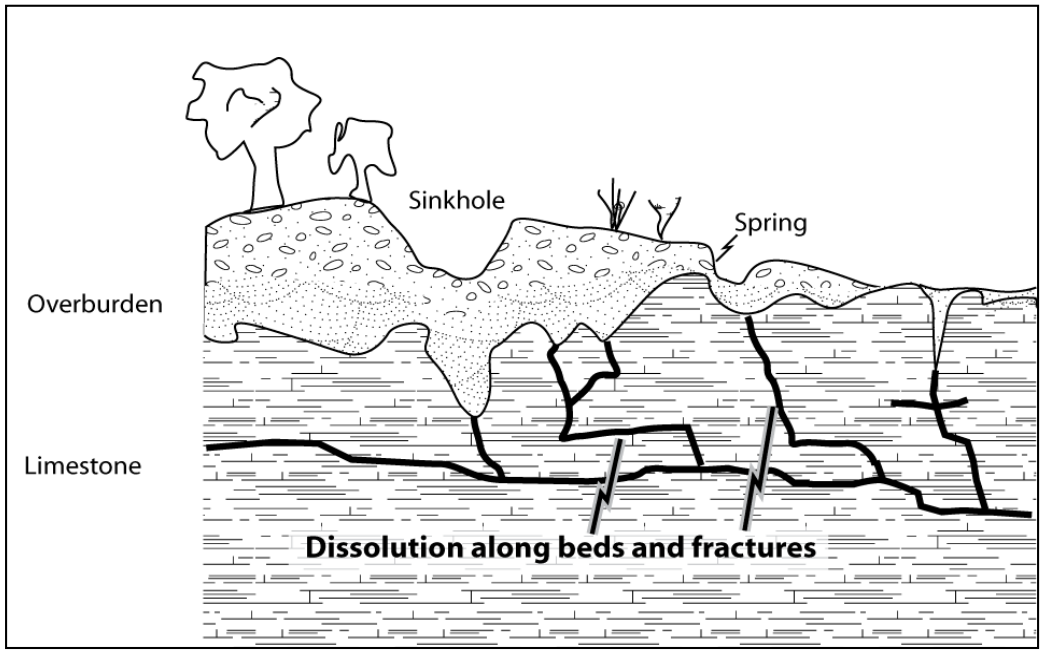

Figure 2.3.2 - Karst formation (after USDI, 2006)

Groundwater flow in karst areas is significantly different from that of other aquifers because of the solutionally enlarged conduits. Groundwater in bedrock aquifers generally moves slowly. In karst aquifers, groundwater flowing in enlarged conduits can have velocities approaching those

of surface streams. The nature of this flow system makes karst areas highly susceptible to groundwater contamination (Ford and Williams, 1989).

Shallow karst aquifers are vulnerable to contamination because they can receive recharge in two ways. They can receive surficial recharge through the soil profile, and concentrated recharge from surface streams and drains that flow directly into the aquifer at sinkholes.

Extensive areas of karst occur in the Northern Bruce Peninsula SPA from Miller Lake to Dyers Bay and northward to Tobermory. Other karst areas can be found to the north and the south of Lion's Head. A study on karst in the planning region was completed by Waterloo Hydrogeologic (2005), which contains a Geographic Information Systems (GIS) database of karst areas. For a good description of karst landforms, see the Guide to the Geology and Landforms of Grey and Bruce Counties (Owen Sound Field Naturalists, 2004).

2.3.3 Surficial Geology

The surficial geology of the Northern Bruce Peninsula SPA is illustrated in Map 2.6. A summary of the Quaternary deposits in the Northern Bruce Peninsula SPA is presented in Table 2.3.2.

Limestone plain is the predominant surficial geology in the Northern Bruce Peninsula SPA, covering 81.4% of the land area. The soil layer is thin to non-existent in the limestone plain.

Escarpment is the classification for 3.1% of the SPA. It encompasses virtually the entire eastern edge of the SPA along the Georgian Bay shoreline. Pockets of beach and shorecliff occur on the Georgian Bay shore at Wingfield Basin (Cabot Head), Dyer's Bay, Lion's Head and Barrow Bay, as well as inland sites south of Lion's Head, west of Ferndale and east of Pike Bay.

TABLE 2.3.2 – Summary of Quaternary Deposits and Events in the Northern Bruce Peninsula SPA (Waterloo Hydrogeologic, 2003; after Karrow, 1993 and 1977; also Metcalfe et al, 2005)

Deposit or Event	*Lithology*	*Morphologic Expression*
Modern alluvium and organic deposits	Silt, sand, gravel, peat, muck, marl	Present day rivers and flood plains
Lacustrine deposits	Silt and clay	Flat-lying surficial deposits
Outwash	Sand, gravel, some silt	Mainly buried (end moraine)
Ice Contact	Sand, gravel	Kames and eskers
Bruce Till	Stony, sandy silt to silt till	Surficial till

Clay plains occupy 10.4% of the Northern Bruce Peninsula SPA. Locations include Little Pike Bay to Spry (west of Ferndale), Lindsay Road 5 near the Municipal office and a large area that extends from north of Ferndale to Lion's Head and south to the Pike Bay Road area. Sand plain is found south of Pike Bay and south of Tobermory in the vicinity of the Tobermory Airport. One area of peat and muck is found near Highway 6 along the border between the Municipality of Northern Bruce Peninsula and Town of South Bruce Peninsula.

Glacial material covers one-quarter of the Northern Bruce Peninsula SPA. Glacial deposits remaining after the last glaciation determine the current physiography of the region, the nature and distribution of surficial aquifers, groundwater discharge and recharge areas, and the sand and gravel deposits. Only about one-quarter of the Northern Bruce Peninsula SPA is covered by till or lacustrine deposits. In other parts of the SPA, the bedrock is either covered by a thin veneer of till or is exposed at the surface. Till typically transmits water slowly (i.e. has a low hydraulic conductivity) because of its fine-textured character. In contrast, the lacustrine deposits from shallow water or shoreline areas have higher hydraulic conductivities because of their coarse-textured character (Waterloo Hydrogeologic, 2003).

Bruce Till, which is a stony, sandy silt to silt till, occurs in patches to the west and to the south of Dyer's Bay, as well as south of Barrow's Bay and near the Tobermory Airport. One site of ice-contact stratified drift occurs just south of Lion's Head. Lacustrine and glacio-lacustrine deposits are the most common glacial material in the SPA. Material deposited in a deep water environment, which may be sandy, silty or clayey in texture, is found from the southern end of the SPA northward to Ferndale, with another area just south of Tobermory. Shallow water environments deposited sandy material in areas north of Pike Bay, north of Stokes Bay, west of Lion's Head and south of Tobermory. Material from old shorelines, which may be sand, gravel or larger in size, can be found in small pockets inland from the Lake Huron coast and more extensively on the Georgian Bay coast at Cabot Head, Dyer's Bay, Smokey Point, Lion's Head and Barrow Bay.

About 5% of the Northern Bruce Peninsula SPA is covered by modern deposits. These deposits include alluvial material along rivers and gravel along shorelines, such as at Dyer's Bay and south of Dorcas Bay. Two small areas of aeolian, or windblown, material occur near Dorcas Bay and west of Miller Lake. Organic material occurs in the wetlands that are scattered throughout the Northern Bruce Peninsula SPA.

2.3.3.1 Overburden Thickness

Overburden thickness is essentially the thickness of the unconsolidated glacial sediments over top of bedrock. Overburden thickness is an important hydrogeologic parameter to review, because it is one of the major parameters that control the amount of protection for underlying surficial and bedrock aquifers. Overburden thickness and grain size distribution control the infiltration rate, and the rate of movement of surface contamination, into these aquifers.

Nearly all the Northern Bruce Peninsula SPA has overburden that is less than 10 metres thick. Areas of minimal overburden and exposed bedrock occur over large sections of the Bruce Peninsula.

2.3.4 Physiography

The physiographic features of the Northern Bruce Peninsula SPA are shown on Map 2.7 and are based on the Physiography of Southern Ontario (Chapman and Putnam, 1984). Chapman and Putnam identify that the Bruce Peninsula physiographic region occurs in the SPA. Escarpment comprises 3.1% of the land area and extends along the Georgian Bay shoreline from Hope Bay to Tobermory. Beaches and shore cliffs occur south of Lion's Head, west of Ferndale and east of Pike Bay. Some sections of beach and shorecliff occur on the Georgian Bay shore at Wingfield

Basin (Cabot Head), Dyer's Bay, Lion's Head and Barrow Bay. Clay plains are found east of Pike Bay, north of Ferndale and south of Ferndale to the south edge of the SPA. A total of 10.0% of the SPA is occupied by clay plains.

The Bruce Peninsula consists largely of exposed dolostone plains, with thin overburden throughout. These limestone plains account for 85% of the Northern Bruce Peninsula SPA. The irregular topography of the bedrock surface results in many small lakes and swamps on the Peninsula.

2.3.5 Soil Characteristics

Soil conditions in the Northern Bruce Peninsula SPA are illustrated in Map 2.8 - Soil Texture. Texture refers to the size of the particles making up the soil, such as clay, silt and sand. Drainage describes the relative rate at which water will pass through the soil horizon. Soil type refers to the named categories of soil based upon texture, parent material, drainage and other characteristics.

The soils in the Northern Bruce Peninsula SPA have developed under a temperate climate. A broad range of soil types are represented from the following soil groups: Dark Grey Gleisolic; Grey-Brown Podzolic; Dry Sand; intergrade of Podzol and Grey-Brown Podzolic; and intergrades of the Grey-Brown Podzolic and Brown Forest. The combination of climate, soil materials and age has resulted in reduced weathering and, therefore, a much more shallow profile. These types of soils are typically well-drained and leaching of soluble materials is not very marked.

The Northern Bruce Peninsula SPA has slightly varying soil characteristics due to a high degree of bedrock exposure. This area is dominated by the Breypen land type, which does not consist of any particular soil type but is largely exposed bedrock with small pockets of soil materials and muck. Drainage in this area is variable. In the Northern Bruce Peninsula SPA, the Breypen series covers over 76% of the landscape.

A large area of poorly drained soils occurs near Ferndale and Lion's Head southward to Pike Bay Road, an area known locally as the Ferndale Flats, as well as north of Ferndale near the Municipal office in an area known locally as the Lindsay Flats. The Ferndale series occurs as a clay loam south of Ferndale in the Judges Creek area and also occurs as a silty loam at Ferndale. The Chesley series is a silty loam that occurs north of Ferndale and in the vicinity of the Municipal office. The Wauseon series is more sandy and is found near Ferndale, Lion's Head and Little Pike Bay.

Organic soils, which are associated with the numerous wetlands and poorly-drained sites, occupy 9.0% of the SPA. Near the Tobermory airport is an area of sandy loam soils from the Grey-Brown Podzolic group.

2.4 Surface Water Hydrology

Surface water hydrology refers to the way water flows over the land surface. Map 2.3 illustrates the watersheds in the Northern Bruce Peninsula SPA, while Table 2.4.1 summarizes statistics about the watercourses. Section 3.2.1 of this report provides information about precipitation and temperatures. The Water Budget Report (SC, 2008) gives a thorough treatment of watercourses, aquifers, climatic normals and climatic trends.

Much of the Northern Bruce Peninsula SPA consists of rugged bedrock. Along its east side, sharp cliffs of the Niagara Escarpment dominate. From the brow of the escarpment, the surface of the Bruce Peninsula slopes very gradually in a south-westerly direction. This allows the numerous small creeks of the Bruce Peninsula to drain into Lake Huron. The loss of surface water and rain into the bedrock greatly limits the size of streams on the Bruce Peninsula. Some watercourses are captured underground by sinkholes and directed underground. Karst in the Northern Bruce Peninsula is evidenced by disappearing streams, bedrock outcrops, grykes (fissures) and caves. Understanding the hydrology of a karst system is extremely difficult.

Due to its impermeable dolostone bed, the peninsula is home to over 30 lakes, including Cameron, Gillies and Miller in the north. Most of the lakes are shallow and underlain by amorphous glacial deposits, such as marl. However, Gillies Lake is one of the deepest inland waterbodies in southern Ontario, with a depth of over 35 m near its eastern end.

TABLE 2.4.1 – River Systems in the Northern Bruce Peninsula SPA (MNR, Digital Elevation Model, 2007)

Subwatershed	*Area of Subwatershed (km^2)*	*Elevation at Headwaters (masl)*	*Elevation at Mouth (masl)**	*Change in Elevation (m)*	*Length of Stream (km)*	*Slope of Stream (m/km)*
Northern Bruce Peninsula SPA						
Black Creek	10.8	196.4	176.0	20.4	7.0	2.9
Brinkman's Creek	32.0	200.8	176.0	24.8	9.4	2.6
Crane River	83.4	225.8	176.0	49.8	22.2	2.2
Judges Creek	85.8	194.0	181.8	12.2	12.0	1.0
Old Woman's River	29.2	189.7	176.0	13.7	7.6	1.8
Sadler Creek	17.9	206.2	176.0	30.2	9.6	3.2
Sideroad Creek	45.3	212.2	176.0	36.2	10.4	3.5
Spring Creek	53.8	210.9	176.0	34.9	22.6	1.5
Stokes River	77.1	200.0	176.0	24.0	18.0	1.3
Willow Creek	18.7	198.4	176.0	22.4	40.5	0.6

* Chart Datum for Lake Huron and Georgian Bay is 176.0 m based on IGLD 1985 (Canadian Hydrographic Service, 2007)

2.5 Naturally Vegetated Areas

Wetlands, wooded areas and vegetated buffers are part of a healthy watershed. The natural capacity to filter or alter contaminants, as well as trap sediments and soil, can help protect drinking water sources.

The river systems of the Northern Bruce Peninsula SPA, and the lands adjacent to them, are home to a diverse and abundant variety of plant and animal species. The zones where water meets land, the riparian zones, are of particular importance, as these areas can be among the richest and most productive ecological zones within a watershed. The riparian zone protects a river by providing a buffer between the river and the intensively used urban and farm land on which much of our economy depends. They also protect people and property by keeping floodplain land intact.

Riparian zones are ecological water users. The health and extent of all the plant and animal components of these zones rely on the water. A better quality of water available to the species within these zones makes for healthier riparian zones.

Like the riparian zones along our shorelines, the wetlands throughout the watershed region are also important ecological features and an ecological water user. They provide habitat for an array of plants and animals. Wetlands play a role in preventing floods and droughts and also improve the quality of water.

Our society has not always respected riparian zones and wetlands. Over the years, many of the wetlands and riparian zones have been cleared and farmed or built upon. It has been estimated that 70% of the wetlands within the region have been lost. In some cases, cultivated land extends to the very top of stream and river banks. This situation provides no natural erosion protection and provides an opportunity for direct runoff from agricultural land into rivers and streams. Many farm operations still provide cattle access to watercourses, which further accelerates erosion rates and degrades water quality. Many of our urban areas have also degraded riparian zones by filling and developing these areas, thus making them prone to erosion and flooding from either the river or from storm water.

By working to protect, preserve, and rehabilitate these ecological features and users of water, and by providing them with exceptional water quality, we in turn will have a healthier watershed where sources of water are more easily protected.

2.5.1 Wetlands

The Northern Bruce Peninsula SPA has a diverse mix of wetland types that cover approximately 54 km^2 (7.1% of the SPA) as shown on Map 2.9. Table 2.5.1 lists the percentage of land area that wetlands occupy in the subwatersheds of the SPA. There are several sites that have been classified as provincially significant and are highly regarded for their natural features.

Four types of wetlands are recognized under the Ontario Wetland Classification System: bog, fen, marsh and swamp. Swamps are wooded wetlands with 25% cover or more of trees or tall shrubs. Standing to gently flowing water occurs seasonally or persists for long periods on the

surface. Marshes are wet areas periodically inundated with standing or slowly moving water, and/or permanently inundated areas characterized by robust emergents and, to a lesser extent, anchored floating plants and submergents. Fens are peatlands characterized by surface layers of poorly to moderately decomposed peat, often with well-decomposed peat near the base. The waters and peat in fens are less acid than in bogs. Bogs are peat-covered areas or peat-filled depressions with a high water table and a surface carpet of mosses, chiefly *Sphagnum*. The water table is at or near the surface in the spring, and slightly below during the remainder of the year.

Only about two-thirds of the wetland areas shown on Map 2.9 are classed by the four types, while the remainder have not been assessed under the classification system.

TABLE 2.5.1 – Wetlands as a Percentage of Land Area in Subwatersheds in the Northern Bruce Peninsula SPA (Derived from data in MNRF's Natural Resources Values Information System (NRVIS))

Subwatershed	***Area of Subwatershed (km^2)***	***Total Area of Wetlands (km^2)***	***% of Subwatershed Covered by Wetlands***
Northern Bruce Peninsula SPA			
Black Creek	10.77	1.85	17.14
Brinkman's Creek	31.98	1.69	5.27
Crane River	83.44	4.82	5.78
Judges Creek	85.85	5.03	5.86
Old Woman's River	29.15	1.62	5.57
Sadler Creek	17.93	1.52	8.48
Sideroad Creek	45.28	3.07	6.78
Spring Creek	53.83	6.68	12.40
Stokes River	77.09	7.95	10.31
Willow Creek	18.68	0.87	4.65
TOTAL	454.0	35.1	7.73

There are few coastal marshes in the SPA, with the exception of Pike Bay and Stokes Bay, as well as Wingfield Basin (near Cabot Head). The Lake Huron and Georgian Bay shorelines in general are exposed to wave action and do not afford the shallow and sheltered waters that promote marsh development. Lacustrine marshes are located along the margins of many lakes in the SPA, such as: Gillies-Lymburner Lakes Wetland Complex (144 ha marsh); William Henry Marsh near Dorcas Bay (33 ha marsh); Scugog Lake Wetland west of Miller Lake (37 ha marsh); Horseshoe Marsh/Bartley Lake Wetland (73 ha) near Cyprus Lake; and the Lower Andrew/ Upper Andrew Lakes- Wetland, east of Cyprus Lake (92 ha marsh). The largest marshland in the SPA is the Otter Lake- Cherry Hill- Ira Lake Wetland Complex southeast of Miller Lake, of which 23% or 159 ha is classified as marsh and the remainder is primarily swamp.

Swamp is the most abundant wetland type and is a component of the majority of wetland complexes in the SPA. Pockets of swamp can be observed in low-lying areas near watercourses where they provide storage capacity and alleviate downstream flooding in times of high water.

The Eastnor Swamp, located at the southernmost end of the SPA, covers over 416 ha. Other notable sites are: Spring Creek Wetland Complex north of Stokes Bay (360 ha swamp); Otter Lake- Cherry Hill- Ira Lake Wetland Complex (511 ha swamp); and Stokes Bay Wetland (154 ha swamp). (Map 2.9)

Very few bogs are located in the Northern Bruce Peninsula SPA. The only evaluated bogs in the SPA are within the Tobermory Bog Wetland (20 ha bog) and a portion of the Otter Lake- Cherry Hill- Ira Lake Wetland Complex (3 ha bog). Plant species found within the Tobermory Bog include leatherleaf, Labrador tea and roundleaved sundew.

Fens are found at more than fifteen sites in the Northern Bruce Peninsula SPA, but generally occur as part of larger wetland complexes. The largest fen areas are found at: Dorcas Bay Wetland (24 ha fen); and Lower Andrew/ Upper Andrew Lakes Wetland (60 ha); Gauley Bay (24 ha); Scugog Lake Wetland (35 ha); and Sadler Creek (21 ha). The Barney Lake Wetland Complex, located south of Tobermory, has a 28 ha component with bog rosemary and pitcher plants.

Table 2.5.2 contains a listing of the features of evaluated wetlands in the SPA. The table was compiled from information from the Natural Heritage Information Centre of the MNRF and includes information only about those wetlands in the Northern Bruce Peninsula SPA for which evaluations have been completed.

TABLE 2.5.2 – Wetlands Database for the Northern Bruce Peninsula SPA (Natural Heritage Information Centre, 2010)

Name	*NHIC ID*	*Area (ha)*	*Significance*	*UTM Centroid (Zone 17)*		*County*
				Easting	*Northing*	
Northern Bruce Peninsula SPA						
Barney Lake Wetland Complex	7418	151.1	Provincial	447000	5006400	Bruce
Black Creek Swamp Wetland	7176	37.9	Provincial	471500	4980000	Bruce
Brinkman Creek Wetland	10532	83.5	Provincial	462600	4995300	Bruce
Britain Lake Wetland Complex	10531	175.1	Provincial	472500	4997700	Bruce
Cemetary Bog	8999	56.2	Local	478500	4978000	Bruce
Corisande Bay Wetland	7179	59.6	Provincial	456000	4997700	Bruce
Crane Lake Wetland	10538	4	Provincial	467500	5002200	Bruce
Dorcas Bay Wetland	7180	110.1	Provincial	455000	5004500	Bruce
Eastnor Swamp	10501	442.8	Local	481000	4971000	Bruce
Gauley Bay Wetland Complex	7420	199.1	Provincial	468000	4983500	Bruce
Gillies Lymburner Lakes Wetland Complex	10530	209.3	Provincial	473500	5005500	Bruce
Greenhouse Harbour Wetland	7183	27.4	Provincial	466600	4982100	Bruce
Horseshoe/Bartley Wetland	10536	81.3	Local	460000	5006300	Bruce

Name	NHIC ID	Area (ha)	Significance	UTM Centroid (Zone 17) Easting	Northing	County
Lower Andrew/Upper Andrew Lakes Wetland	10537	167.5	Provincial	464500	5006400	Bruce
Old Woman's River Wetland	10500	72.9	Local	473500	4980200	Bruce
Otter Lake/Cherry Hill/Ira Lake Wetland Complex	10528	693.1	Provincial	477200	4990000	Bruce
Sadler Creek Wetland Complex	7423	261.4	Provincial	462700	4990700	Bruce
Scugog Lake Wetland	10535	73.9	Provincial	458400	4996100	Bruce
Spring Creek Wetland Complex	10529	514.2	Provincial	466000	4987000	Bruce
Stokes Bay Wetland	8131	236.8	Provincial	469500	4982400	Bruce
Tobermory Bog Wetland	8997	56.4	Provincial	449000	5008000	Bruce
Whiskey Still Marsh	10534	14.7	Provincial	455800	5001000	Bruce
William Henry Marsh	10533	36.2	Local	452200	5005100	Bruce
Wingfield Basin Wetland	7163	71.4	Provincial	476500	5009000	Bruce

2.5.2 Woodlands and Vegetated Riparian Areas

Woodlands can increase infiltration to shallow groundwater areas and decrease the speed of overland flow. Map 2.10 shows the naturally vegetated areas in the Northern Bruce Peninsula SPA.

The riparian zone is the land adjacent to rivers and streams. The riparian zone has no definite boundaries, but is the larger transitional area between the water surface and the upland (Ontario Cattlemen's Association, 2005). Vegetation contributes to the functions of the riparian zone and can vary greatly from lush forest or dense brush to grassy meadow or muddy bank. Riparian areas control the flow of water, sediments, nutrients and organisms between the upland and aquatic communities. They act as wildlife corridors, help in-stream water quality, serve as reservoirs for flood waters, control erosion and may contribute to groundwater recharge.

2.5.2.1 Woodlands

The SPA features hardwood forests characteristic of the Great Lakes - St. Lawrence Lowlands forest type and many sections of forest dominated by cedar. Prior to and at the time of settlement, extensive forests covered the SPA. Across a large portion of the watershed, forests were heavily logged in the late 1800's. Meanwhile, other areas were cleared to make way for agricultural crops. In many places, the cleared land proved to be marginal farm land and was later abandoned or removed from farming. Natural regeneration and tree planting programs have returned some of this land to forest cover.

The Northern Bruce Peninsula SPA has more than 80% forest cover according to the SOLRIS data (Southern Ontario Land Resource Information System). The exceptions to this extensive forest cover are the agricultural area north of Ferndale near the Municipal office, locally referred

to as the Lindsay Flats, and near Highway 6 from the southern edge of the SPA to north of Ferndale, locally referred to as the Ferndale Flats. The forest cover is classed as 71% coniferous forest and 17% deciduous forest, with the remainder being mixed forest or not classified.

2.5.2.2 Vegetated Riparian Areas

Map 2.10 shows riparian areas in the Northern Bruce Peninsula SPA. Forest and other vegetation classes were intersected with stream corridors throughout the watershed to determine the spatial extent of the riparian areas that had vegetative cover.

More than two-thirds of the Northern Bruce Peninsula SPA has treed riparian zones along the length of the streams. Sections of the Stokes River and Judges Creek that pass through agricultural areas have the least proportion of treed riparian zone.

2.6 Aquatic Ecology

Comprehensive Source Protection offers ancillary benefits beyond protecting water for drinking purposes. Maintaining high standards for drinking water also provides a necessary medium for healthy aquatic flora and fauna, terrestrial wildlife, and recreational opportunities. Aquatic plants and animals (fish, macroinvertebrates) serve as a feedback, or indicator, of present water quality characteristics. Having a good understanding of species richness and diversity provides information on water quality trends within streams over time based on the presence and/or absence of aquatic organisms. Aquatic organisms can be an initial indication of perturbations within a stream network.

2.6.1 Fisheries

The fisheries studies completed in the SPA are done by the MNR, the federal Department of Fisheries and Oceans and consultant companies. The SPA has a diverse amount of fish inhabiting the water. Categorization (i.e. coldwater vs. warmwater) of streams in Grey and Bruce Counties is provided in the Owen Sound District Fisheries Management Plan, 1986-2000, Ontario Ministry of Natural Resources. This document serves as the primary tool for planning purposes in this region.

The thermal regime for streams in the Northern Bruce Peninsula SPA is illustrated in Map 2.11 and listed in Table 2.6.1.

Most streams and inland lakes in the SPA would be categorized as coldwater from the significant input of groundwater in the SPA. Although coolwater and warmwater fish species are important from a management perspective, the most desirable and the highest level of management typically required in streams and inland lakes is for coldwater species. The Fisheries Management Plan strives for ideal conditions that support healthy fish stocks, which indirectly helps maintain stream water quality by providing essential forest cover, protection of recharge areas, wetlands, and other natural features. As the regime of the stream changes, most often the fish species will change, which may be an indicator of degradation in suitable aquatic and drinking water conditions. Limited thermal studies exist in the watershed region and few are recent.

TABLE 2.6.1 – Classification by Thermal Regime of Streams in the Northern Bruce Peninsula SPA (MNR, 2000)

Northern Bruce Peninsula SPA	
Subwatershed Name	***Thermal Regime: Streams***
Black Creek	Cool: Black Creek
Brinkman's Creek	Cool: Brinkman's Creek
Crane River	Cold: Crane River
Judges Creek	Cold: Judges Creek
Old Woman's River	Cool: Old Woman's River
Sadler Creek	Cold: Sadler Creek
Sideroad Creek	Cool: Sideroad Creek
Spring Creek	Cold: Spring Creek
Stokes River	Cool: Stokes River Warm: Chin Creek
Willow Creek	Cold: Willow Creek
Lake Fringe	Cold: Dorcas Bay Creek

2.6.2 Aquatic Macroinvertebrates

Macroinvertebrates (MIs) are easy to study and serve as a good indicator of water quality conditions. MIs are readily available within the stream network, exhibit different responses among species, are not highly mobile, and can provide evidence of conditions over time. Bio-monitoring of this sort is not without its problems. Although most problems can be overcome with the correct experimental design, MIs may not necessarily react to all stresses within the stream, and distribution and abundance can be affected seasonally and by multiple unknown perturbations.

Limited biomonitoring work has been undertaken in the Northern Bruce Peninsula SPA. However, the Bruce Peninsula Biosphere Association collected data in 2003-2006 from multiple sites on the Crane River, Willow Creek and Spring Creek.

2.6.3 Species and Habitats at Risk

Recovery and management of species population and conservation of vital habitat are essential to preventing the loss of biodiversity In Ontario, the Committee on the Status of Species at Risk in Ontario (COSSARO) is responsible for assessing whether plant and animal species are at some risk of disappearing from the wild in Ontario. After research and careful consideration by the committee, species classified as "at risk" are placed on the Species at Risk in Ontario (SARO) list. The various designations are: endangered - regulated; endangered - not regulated; threatened; and special concern (formerly vulnerable). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses species across Canada.

Sustainable development is necessary to prevent degradation and loss of habitat for the species at risk, and help to prevent extinction. The greatest stressors now facing the region’s natural communities and wildlife are those related to human activity. Development, water management

conflicts, invasive species, agricultural runoff and climate change each have major consequences for species, ecosystems, and habitats throughout the region.

Sources of information about species at risk within the Northern Bruce Peninsula SPA include: Natural Heritage Information Centre; Species at Risk website of the Ministry of Natural Resources; and the Royal Ontario Museum's species at risk website. Range maps and species descriptions were used to compile Table 2.6.2 – Species at Risk in the Northern Bruce Peninsula SPA. The list includes species of bird, fish, insect, mammal, plant and reptile.

TABLE 2.6.2 – Species at Risk in the Northern Bruce Peninsula Source Protection Area (Species at Risk webpage, Ontario Ministry of Natural Resources, 2010)

Status	***Endangered***	***Threatened***	***Special Concern***
Bird	• Henslow's Sparrow *(Ammodramus henslowii)* • Loggerhead Shrike *(Lanius ludovicianus)*	• Whip-poor-will *(Caprimlugus vociferous)* • Chimney swift *(Chaetura pelagic)* • Peregrine Falcon *(Falco peregrines)* • Least Bittern *(Ixobrychus exilis)*	• Short-eared Owl *(Asio flammeus)* • Black Tern *(Chlidonias niger)* • Common nighthawk *(Chordeiles minor*) • Cerulean Warbler *(Dendroica cerulean)*
Fish	• Redside Dace *(Clinostomus elongates)* • Shortnose Cisco *(Coregonus reighardi)* - likely extirpated	• Lake Sturgeon *(Acipenser fulvescens)*	• Northern Brook Lamprey *(Ichthyomyzon fossor)*
Insect			• Monarch Butterfly *(Danaus plexippus)* • West Virginia White *(Pieris virginiensis)*
Mammal	• Mountain Lion or Cougar *(Puma concolor)*		
Plant	• Lakeside Daisy *(Hymenoxys herbacea)* • Butternut *(Juglans cinerea)* • American Ginseng *(Panax quinquefolius)*	• Hill's Thistle *(Cirsium hillii)* • Dwarf Lake Iris *(Iris lacustris)* • Houghton's Goldenrod *(Solidago houghtonii)*	• Tuberous Indian-plantain *(Arnoglossum plantagineum)* • Hart's-tongue Fern *(Asplenium scolopendrium americanum)* • Hill's Pondweed *(Potamogeton hillii)*
Reptile	• Spotted Turtle *(Clemmys guttata)*	• Massasauga Rattlesnake *(Sistrurus catenatus)*	• Snapping turtle *(Chelydra serpentine)* • Milksnake *(Lampropeltis triangulum)* • Eastern Ribbonsnake *(Thamnophis sauritus)*

Excerpted from http://www.mnr.gov.on.ca/en/Business/Species/2ColumnSubPage/276503.html

The redside dace is a species at risk in Ontario and inhabits streams within the Source Protection Region. Maintaining adequate water quality and understanding water quantity within areas that provide habitat for the redside dace is paramount in protecting the species.

2.6.4 Invasive Species

Non-native, aquatic species have been introduced over the years into Ontario's lake and stream systems. Typically, these species can affect water quality negatively, compete for food resources and damage vegetation and stream substrate that serves as habitat. The potential result is a decrease in the numbers of native species, which can upset the "natural" interaction amongst trophic levels.

More than 160 non-indigenous species have become established in the Great Lakes Basin, including species of plants, molluscs, invertebrates, insects and fish. Little is known about the number of species or distribution in the Northern Bruce Peninsula SPA. This lack of knowledge can be considered a data gap and makes it difficult to identify potential areas that are subject to the indirect degradation of water quality.

Invasive species that have been identified in the Northern Bruce Peninsula SPA are listed in Table 2.6.3.

TABLE 2.6.3 – Invasive Species in the Northern Bruce Peninsula SPA (OFAH, MNR, 2010)

Latin Name	***Common Name***
Gymnocephalus cernuus (fish)	Ruffe
Cyprinus carpio (fish)	Common Carp
Osmerus mordax (fish)	Smelt
Neogobius melanostomus (fish)	Round Goby
Petromyzon marinus (fish)	Sea Lamprey
Bythotrephes longimanus (planktonic crustacean)	Spiny Water Flea
Dreissena polymorpha (mollusk)	Zebra Mussels
Dreissena bugensis (mollusk)	Quagga Mussels
Myriophyllum spicatum (plant)	Eurasian water-milfoil
Lythrum salicaria (plant)	Purple Loosestrife
Phragmites australis (plant)	Common Reed
Heracleum mantegazzianum (plant)	Giant Hogweed
Alliara petiolata (plant)	Garlic Mustard

2.7 Human Characterization

Land use and population are significant elements in Source Protection Planning. A spatial analysis of what human activities are occurring in relation to sources of drinking water will help reveal potential risks. As well, understanding the distribution of people will further show the reliance on particular water sources and potential impacts.

2.7.1 Population Distribution and Density

Approximately 3,850 people live in the Northern Bruce Peninsula SPA (StatCan Census, 2006). Lion's Head and Tobermory are the largest settlement areas in the SPA. There are extensive rural areas and cottage development on the Lake Huron and Georgian Bay shorelines and some inland lakes. An estimated 2,678 seasonal residences also exist in the Municipality of Northern Bruce Peninsula according to the Municipal Property Assessment Corporation (MPAC) (Climans, 2007)

Population density is illustrated in Map 2.12. The Northern Bruce Peninsula SPA averages five people per square kilometre.

The role of topography, hydrology, soils, transportation and historic settlement are reflected in the present distribution of population. The importance of water-based transportation in the 1800's and 1900's resulted in the emergence of communities with good natural harbours and river links to inland areas. These natural features are uncommon on the Lake Huron and Georgian Bay shorelines, but can be found at Tobermory and Lion's Head.

Population growth in the Northern Bruce Peninsula SPA is expected to be modest through 2021 with growth projected at 2.1% over 2006 levels. (SHS Consulting, 2009)

2.7.2 Land Use

Assessing the current and future land use needs of our society in general or even within a particular region, such as the Northern Bruce Peninsula SPA, is a difficult task. The task may be further complicated when the different and conflicting values related to land use, including ecological values, are also taken into account.

As this region is developed, and land use changes are made, they are followed by other changes on the landscape. Infrastructure must be improved and utility corridors upgraded and expanded. Development also means more demand on our resources. Not only will we require more water from our current sources, we may also need to find additional sources of water. Greater efforts will be required to protect these sources of water as we continue to generate waste requiring more landfill facilities and waste water treatment systems.

Land use in Ontario is guided by several pieces of legislation and accompanying regulations. The *Planning Act* and Provincial Policy Statement (PPS) are two significant components of the planning system and have application across Ontario. The *Planning Act* sets out the ground rules for land use planning in Ontario and describes how land uses may be controlled, and who may control them (MMAH, 2010).

The Provincial Policy Statement is issued under the authority of Section 3 of the *Planning Act*. It provides direction on matters of provincial interest related to land use planning and development, and promotes the provincial "policy-led" planning system. The Provincial Policy Statement recognizes the complex inter-relationships among economic, environmental and social factors in planning and embodies good planning principles. It includes enhanced policies on key issues that affect our communities, such as: the efficient use and management of land and infrastructure; protection of the environment and resources; and ensuring appropriate opportunities for employment and residential development, including support for a mix of uses (MMAH, 2010).

One of the most important tools available when making land use decisions is the Official Plan document. Official Plans are produced by upper and single-tier municipalities in Ontario and are used to guide development in the area over which the municipality has jurisdiction. They also guide future economic, social and land use changes within a municipality. Official Plans provide a broad policy framework for other planning documents such as by-laws.

It is important that Official Plans strive to consider and protect all interests in our society, including environmental, social, and economic, by integrating them into the decision making process. Respecting the natural environment, minimizing adverse impacts on the environment, and protecting significant features and water quality are goals of Official Plans in the Source Protection Region.

Official Plans may also have a stated objective to establish policies that will protect groundwater recharge areas, coldwater streams, lakes and other surface waters for their habitat, recreational, ecological and drinking water benefits (Grey County Official Plan, 1997).

Numerous classes and sub-classes are designated, but can generally be divided into residential, commercial, industrial, institutional, agricultural, rural and environmental. Permitted uses and other development controls are described in the Official Plans and zoning by-laws.

Map 2.13 illustrates land use in the Northern Bruce Peninsula SPA. Note that some land use classes have been harmonized from the county's Official Plan.

2.7.2.1 Settlement Areas

Settlement areas are the built-up areas of municipalities and the lands that have been designated for future development in an Official Plan. Rural lands separate the built-up pockets within the SPA. Settlement areas are characterized as having a high population to area ratio (density). They are distinguished by an increased percentage of impervious surfaces and a greater demand on water resources, although the density often means per capita water costs are lower and infrastructure is more efficient where these services are available. The urban areas enjoy the normal amenities of paved roads, sidewalks and street lighting. They also act as service centres for the rural areas.

The principal urban areas in the NBPSPA are Lion's Head and Tobermory along with Ferndale on Highway 6.

2.7.2.2 Rural Areas

Rural areas are lands outside settlement areas. The Northern Bruce Peninsula SPA is predominantly rural. The population is widely dispersed in the rural areas, which is reflected by the low population densities discussed in Section 2.7.1 and shown in Map 2.12. In the Official Plan, the most productive agricultural land classes are distinguished on the maps and subject to more development constraints than the more generic 'rural' land use classification. Other land use designations, such as extractive, rural commercial, rural industrial and resort, occur in the rural areas.

2.7.2.3 Rural Residential

Several smaller communities occur in the Northern Bruce Peninsula SPA and include Miller Lake, Stokes Bay and Pike Bay. Residential land use is also found along the numerous municipal roadways. These rural residential sites are serviced by private wells and septic systems.

2.7.2.4 Cottage and Camp Development

The wonderful recreational opportunities and scenic beauty of the area have attracted tourists and seasonal residents for many years. This brings a large influx of people during the warmer months, particularly to shoreline areas. In the winter, skiers and snowmobilers are drawn to the area. In many parts of the SPA, the population increases significantly seasonally. This presents different water protection challenges, especially since many of the users are not on municipal systems but are taking water directly from shallow or deep wells, or surface water in some instances. In addition, some areas planned for seasonal use now have year-round occupancy.

Cottage communities exist along Lake Huron and Georgian Bay as well as the inland lakes. Some of the larger sites occur near Pike Bay, Stokes Bay, Dyer's Bay and Barrow Bay. Miller, Gillies and Cameron Lakes are among the popular inland lakes. Commercial campgrounds up to a hundred sites or more in size also occur.

Small lots serviced by wells and septic fields can create potential risks in these cottage areas for water quality in the lakes and for drinking water supplies. Proper maintenance and site selection, as well as appropriate sizing of septic fields, are crucial.

Some of the older wood-frame cottages are being torn down and replaced by larger, permanent homes. The change in use places substantial additional demands on water supply and increases the volume of septage needing treatment.

2.7.2.5 Planned Development

Planned development areas are areas within the municipal boundary that are designated for future development but have not yet been developed. The proposed uses in these areas are important because they will add to water demand.

Growth can occur in vacant land parcels, through redevelopment or by conversion to denser uses. Often it is land fringing the urban areas that is designated for residential, commercial and industrial use in anticipation of future growth. In some cases this is contentious because of neighbouring land uses or encroachment onto prime agricultural land.

In the Northern Bruce Peninsula SPA, some of the planned development sites are located at the edge of Tobermory, at Pine Tree Harbour, and along the shoreline north and west of Stokes Bay.

2.7.2.6 Industrial/Commercial Sectors Distribution

Industrial activities in the Northern Bruce Peninsula include quarry operations, lumber mills and machine shops.

Commercial areas in Tobermory, Lion's Head and Ferndale offer a good range of retail stores and services. Many stores in these communities, as well as shops across other parts of the SPA, cater to the large tourist market.

2.7.2.7 Quarries and Aggregate Extraction

Quarries and aggregate extraction locations are important to consider, as they can have potentially significant impacts on the surrounding natural and physical environment. In terms of Source Protection, it is necessary to have an understanding of the locations of these operations, as they have the potential to create adverse effects on local wetlands and can cause disturbances to the water table. Aggregate operations typically represent constructed transport pathways to aquifers. Sand and gravel deposits, which make up the resources used for mining and aggregate extraction, also play a role in the formation of the aquifers for groundwater storage and recharge. Generally, there is a great deal of uncertainty about the overall effects of aggregate operations on groundwater flows (Baker et al, 1995).

In addition to the effects that aggregate operations could have on groundwater sources, these types of operations can also require significant amounts of water-taking for their day-to-day activities. A few pit or quarry locations in the Northern Bruce Peninsula SPA currently have permits to take water for aggregate washing purposes. Water-takings for these types of operations are generally discharged back into groundwater and surface water systems after use. This recycled water has the potential to be high in suspended solids, which could have associated impacts on nearby streams and aquatic life.

Below, Table 2.7.1 provides a summary of the total land area composed of pits and quarries for each subwatershed in the SPA. Map 2.14 illustrates the locations of pit and quarry activities in the Northern Bruce Peninsula SPA. As shown in this map, active operations are scattered across the SPA with some concentrations south of Tobermory and south of Lion's Head.

As can be seen in Table 2.7.1, more than 4% of the total land area in the Old Woman's River and Judges Creek subwatersheds is utilized for aggregate activities. Areas are characterized by the Guelph and Amabel bedrock formations of the middle and lower Silurian groups. These formations are primarily composed of dolostone, a high quality aggregate resource used primarily for construction, landscaping, and architectural purposes. Quarry operations in this area, particularly for Blue-Grey and Brown dolostone, have been conducted since the early 1900's. The region continues to be a major source of patio stone, flagstone, and polished marble (MNDMF, 2003).

TABLE 2.7.1 – Pits and Quarries by Subwatershed in the Northern Bruce Peninsula SPA

Subwatershed	*Area of Subwatershed (km^2)*	*Area of Active Pits/Quarries (km^2)*	*% of Subwatershed Used for Pits/Quarries*
Northern Bruce Peninsula SPA			
Black Creek	10.77	0.00	N/A
Brinkman's Creek	31.98	0.00	N/A
Crane River	83.44	0.00	N/A
Judges Creek	85.85	3.85	4.48
Old Woman's River	29.15	1.30	4.45
Sadler Creek	17.93	0.00	N/A
Sideroad Creek	45.28	0.00	N/A
Spring Creek	53.83	0.00	N/A
Stokes River	77.09	0.29	0.37
Willow Creek	18.68	0.00	N/A
Lake Fringe	340.03	0.99	0.29
TOTAL and Average%	794.03	6.43	0.81

Notes for Table 2.7.3

Active Pit/Quarry Source: Ontario Ministry of Natural Resources "Pit or Quarry" data layer, 2005

Baker, Douglas and Darryl Shoemaker. Environmental Assessment and Aggregate Extraction in Southern Ontario: The Puslinch Case. University of Waterloo: Waterloo, Ontario, 1995. Document located at X:\SourceWater\Reports and Studies\AggregateExtractionSouthOnt.pdf

Ministry of Northern Development & Mines (MNDMF).). http://www.mndmf.gov.on.ca/mines/mg/dimstone/default_e.asp.Last modified: 07/11/03. Last accessed: 08/05/06.

Current controls on pit and quarry development are covered in the *Aggregate Resources Act*, which was implemented in January 1990. This Act controls pit development and rehabilitation through a licensing system that is administered by the Ontario Ministry of Natural Resources. Under the Act, a Class "A" license is issued for extractions of aggregates in excess of 20,000 tonnes, while a Class "B" license is issued for extractions below this amount. Under the Bruce County Official Plan, proposals for expansions or new operations are to be accompanied by the appropriate license, as well as a detailed report on the related impacts to adjacent land uses, to the physical and natural environment, to ground and surface water sources, as well as impacts to potential and existing municipal supply systems (Bruce County Official Plan – Section 4.8).

2.7.2.8 Transportation

The road network is illustrated on Map 2.2 - Settlement Areas and Communities. The principal north-south roadway is Highway 6, which runs through the central portion of the SPA. County roads provide vital links between communities in the southern half of the SPA, while municipal roads provide the access to businesses and properties across rural and urban areas.

Water transportation continues to play both a commercial and recreational role in the SPA. Tobermory is a vital port and serves as a base for fishing tugs, SCUBA diving charter operators and tour boats. Marinas for recreational vessels are located in Lion's Head and Tobermory.

Tobermory is also the southern terminus for the MS Chi-Cheemaun ferry service that transports vehicles and passengers to South Baymouth on Manitoulin Island.

One small airport in the Northern Bruce Peninsula SPA is the municipally operated airport located just south of Tobermory.

2.7.2.9 Utilities

Utilities and the associated corridors and infrastructure extend across the SPA to supply electricity, phone and cable service to businesses and residents. The Municipality of Northern Bruce Peninsula operates a drinking water system in Lion's Head and Tobermory is serviced by a wastewater treatment plant. Natural gas service is not available. Wind power has the potential to grow significantly. Three turbines presently operate at a site south of Ferndale.

2.7.2.10 Institutional Lands

Institutional properties occur in nearly every community in the form of churches and community halls. Lion's Head has an elementary school, high school and hospital. The municipal office is located north of Ferndale on Lindsay Road 5. Tobermory has an elementary school. These facilities are significant because of their public functions and role as a venue for community events. In rural portions of the SPA, institutional facilities operate either their own well or septic system, or both.

2.7.2.11 Hazard and Natural Environment Land Use

Planning policies contain a broad class of land use that encompasses hazard lands and natural features that pose a barrier to development or have significant environmental values worth protecting from development. The Bruce County Official Plan states in section 5.8 that Natural Environment Areas include "...flood and erosion susceptibility areas, steep slopes, organic soils, or other physical conditions which are severe enough to cause property damage or potential loss of life if the lands were to be developed." Use of the land may still occur, such as forestry or recreation, but the construction of buildings is generally not permitted. Provincially significant wetlands (class 1 to 3) and Areas of Natural and Scientific Interest are also included.

2.7.2.12 Other Land Use

Zoning maps and official plans can contain categories of land use other than those described in other parts of Section 2.7.2. Reference should be made to the Bruce County Official Plan for complete land use categories and their current application.

2.7.3 Wastewater Treatment

Wastewater that is generated from toilets, showers, tubs, sinks and other uses requires treatment before it can be discharged.

Serviced Areas

In serviced areas, wastewater is discharged through a sanitary sewer system to municipal wastewater facilities, where it is undergoes a number of treatment processes. Various treatment technologies are used in municipal wastewater treatment facilities to achieve a significant

reduction in the amount of organic matter, solids, nutrients, and pollutants prior to the effluent re-entering a body of water or being applied to land. The processes may involve screening, filtering, biological digestion, settling, chemical treatment, UV treatment and other methods. There is one municipally-owned wastewater treatment facility in the Northern Bruce Peninsula SPA at Tobermory. Sewage lagoons are used to treat the wastewater.

Non-Serviced Areas

All of the Northern Bruce Peninsula SPA, with the exception of a section of Tobermory, is a non-serviced area in terms of wastewater treatment. In non-serviced areas, waste is typically discharged to private septic systems and holding tanks. Septic systems are suitable for treating household septage provided that the system is properly constructed and maintained. In Ontario, septic systems are regulated by the Ministry of Municipal Affairs and Housing under the Building Code. Typical septic systems have a tank where solid materials settle to the bottom and lighter wastewater stays at the top. The liquid drains out of the tank and passes through a leaching bed made up of perforated pipes buried underground. Bacteria and other organisms help to digest the wastewater and the water slowly filters into the ground. Several other septic system designs are also available on the market.

The matter that is pumped from holding tanks is raw and untreated and is classified as hauled sewage. This septage may be land applied or disposed of at a sewage treatment plant, waste stabilization lagoon or landfill site (MOE, www.ene.gov.on.ca, 2008). Determining locations and conditions of these septic systems is of importance to source protection planning. Inadequate systems or improper treatment of sewage can lead to infiltration of pollutants and bacteria into ground and surface water sources, which may have adverse effects on overall water quality within the region.

Stormwater Management

Another area of importance to Source Protection in terms of wastewater treatment is stormwater management policies and procedures. Stormwater is the term used to describe the rainfall and other sources of water that are generated by urban runoff from areas such as streets, parking lots and roof drains on houses and other buildings. During storm events or floods, water flows across impervious surfaces, such as asphalt and concrete, and often comes into contact with several contaminants, such as oil, fertilizers, sediment and animal waste. Prior to discharging to a creek, wetland, pond, or lake, stormwater should be treated.

Stormwater management is the application of practices that are designed to protect downstream receiving waters from negative impacts of urban development, such as flooding, erosion, and degraded water quality (Ministry of Municipal Affairs and Housing, 2008). There are many benefits to stormwater pollution prevention including: minimizing or avoiding the creation of pollutants; using materials more efficiently; minimizing health risks; avoiding costly clean-ups; and enhancing the local environment (MOE, 2008). Stormwater management practices are much more prevalent in larger urban centres than in small rural locations.

2.7.4 Brownfields

Brownfields are abandoned, idle, or under-utilized industrial and commercial properties where the previous property use caused environmental contamination. The land may need to be cleaned up before it can be redeveloped (MOE, 2007). Brownfields are often in desirable locations, such as in communities, near downtown or along the waterfront. Tanneries, mills, and factory sites for furniture and other goods are usually found in most medium- to large-size communities not present in the Northern Bruce Peninsula SPA. Derelict gas stations and other places that are possibly contaminated with petroleum or chemical residues would also be classed as brownfields.

The provincial government encourages the redevelopment of brownfield sites as a way of putting the land back into productive use. As many brownfield sites are located on serviced, urban property, finding new uses reduces the need for municipalities to expand services. Additional benefits include new employment, increased economic development and, in some cases, greater retail, tourism or housing opportunities.

The Brownfields Environmental Site Registry was established under O.Reg. 153/04 and is administered by the MOECC. Property owners may file a Record of Site Condition to show that a brownfield has been appropriately remediated and the required technical documents submitted. Once the Record is approved by the MOECC, the property owner will get general protection from environmental cleanup orders for historic contamination. The public can access information about brownfields that have been registered.

As of March 2010, no such sites in the Northern Bruce Peninsula SPA were in the Brownfields Environmental Site Registry.

2.7.5 Oil, Gas and Salt Facilities

Boreholes that have been abandoned and wells with unknown status can be seen as potential areas of concern for groundwater contamination. Boreholes create a direct path into groundwater aquifers and are potentially high risk areas for contamination, particularly in the event that these wells were not properly sealed and capped.

The locations of oil, gas and salt wells in the Northern Bruce Peninsula SPA are shown on Map 2.14. A total of 22 sites are scattered across the Northern Bruce Peninsula SPA. Heavier concentrations of wells are found near Hope Bay and from Ferndale to Pike Bay. One-half of the wells have a current status of unknown, while the remainder are abandoned. Only one well, located 4 km south of Tobermory, is listed as suspended.

2.7.6 Agricultural Resources

Agriculture in the Northern Bruce SPA is focussed primarily in two areas: one north of Ferndale and the other from Ferndale southward to the southern end of the SPA. Map 2.13 shows the extent of agricultural land use as compared to other land use classes in the SPA. Cattle ranching and hay crops are the most common agricultural land uses.

Land capability for agriculture has been measured by the Canada Land Inventory, which is based on soil characteristics derived from various soil surveys. This data indicates that approximately 73% of the total area of the Northern Bruce Peninsula SPA has no capability for agriculture, which has been attributed to issues with surface stoniness and bedrock outcrops, topography, and excess water due to poor soil drainage.

Table 2.7.2 presents the number of farms from the 2006 Census of Agriculture by Statistics Canada in the Northern Bruce Peninsula SPA. The acreage of crop types in shown in Table 2.7.3 and the number of livestock is presented in Table 2.7.4.

TABLE 2.7.2 – Number of Farms in Northern Bruce Peninsula SPA (StatCan Census of Agriculture, 2006)

Number of Farms	***Census Subdivision***
	Northern Bruce Peninsula
Dairy cattle and milk production	0
Beef cattle ranching and farming, including feedlots	52
Hog and pig farming- # of farms	0
Chicken egg production	0
Broiler and other meat-type chicken production	0
Turkey production	0
Poultry hatcheries	0
Combination poultry and egg production	0
Other poultry production	0
Sheep farming	1
Goat farming	0
Apiculture	1
Horse and other equine production	4
Fur-bearing animal and rabbit production	0
Livestock combination farming	1
All other miscellaneous animal production	1
Soybean farming	0
Oilseed (except soybean) farming	0
Dry pea and bean farming	0
Wheat farming	1
Corn farming	0
Other grain farming	1
Potato farming	1
Other vegetables (except potato) and melon farming	1
Fruit and tree-nut farming	1

Number of Farms	*Census Subdivision*
	Northern Bruce Peninsula
Mushroom production	0
Other foods grown under cover	0
Nursery and tree production	0
Floriculture production	2
Tobacco farming	0
Hay farming	17
Fruit and vegetable combination farming	0
All other miscellaneous crop farming	1
Total area of farms	
#of farms reporting	85
Hectares	16,471
Land use Table 4.3-2	
#of farms reporting	73
Hectares	4,529

x=suppressed to meet the confidentiality requirements of the Statistics Act
Source: Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data, catalogue no. 95-629-XWE.

TABLE 2.7.3 – Agricultural Crops by Acreage in Northern Bruce Peninsula SPA (StatCan Census of Agriculture, 2006)

Crop (values in acres)	*Census Subdivision*
	Northern Bruce Peninsula
Annual Crops	
Total wheat	310
Oats	84
Barley	1,118
Mixed Grains	429
Total corn	123
Total Rye	0
Canola	0
Soybeans	x
Flaxseed	0
Dry field peas	0
Dry White Beans	0
Other Dry Beans	0
Potatoes	x
Sunflowers	0
Triticale	0
Other field crops	x
Total vegetables (excluding greenhouse vegetables)	x
Perennial Crops	
Alfalfa and alfalfa mixtures	4,371
All other tame hay and fodder crops	4,592
Total area of fruits, berries and nuts	x
Tame or seeded pasture	8,477
Natural land for pasture	9,619
Summerfallow land	x
Land in crops	11,191

x=suppressed to meet the confidentiality requirements of the Statistics Act
Source: Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data, catalogue no. 95-629-XWE.

TABLE 2.7.4 – Number of Livestock in Northern Bruce Peninsula SPA (StatCan Census of Agriculture, 2006)

Livestock (number of animals)	***Census Subdivision***
	Northern Bruce Peninsula
Calves Under 1 Year	3299
Steers 1 year and over	1606
Total heifers 1 year and over	949
Beef Cows	3938
Dairy Cows	0
Bulls 1 year and over	168
# of Rams	x
# of Ewes	x
# of Lambs	x
Goats	x
Horses and Ponies	147
Wild Boars	0
Bison	x
Llamas and alpacas	0
Deer (excluding wild deer)	0
Elk	0
Boars	0
Sows and gilts for breeding	0
Nursing and weaner pigs	0
Grower and finishing pigs	0
Broilers Roasters and Cornish hens	0
Pullets under 19 weeks	x
Laying Hens 19 weeks and over	x
Turkeys	x
Other Poultry	0

x=suppressed to meet the confidentiality requirements of the Statistics Act
1. "Total heifers 1 year and over" includes "Heifers for slaughter or feeding," "Heifers for beef herd replacement" and "Heifers for dairy herd replacement."
Bulls assumed a NU of 1 as per OMAFRA staff
Mink and Fox did not have any values for this region
Calculation of nutrients used=Divide # of animals by NU conversion factor
Source: Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data, catalogue no. 95-629-XWE.

2.7.7 Forestry

Harvesting of forest resources has occurred since settlement times when wood was a primary source of fuel and building materials. Numerous sawmills, operated by the abundant waterpower of the region, helped establish communities across the landscape. In the middle part of the twentieth century, many woodlots were 'high-graded' through the removal of large healthy trees. As a result, some of the remaining forests contain many poor quality trees. More recently, careful forest management has been undertaken in an attempt to improve forest health and residual tree quality.

The location of forested areas in the Northern Bruce Peninsula SPA is shown in Map 2.10.

Bruce County owns 4850 hectares of land under its "Bruce County Forest" program and has a Forest Conservation By-law to encourage the use of good forestry practices. The Lindsay Tract is a large County Forest parcel located west of Highway 6 near Miller Lake.

2.7.8 Protected Areas

Within the Northern Bruce Peninsula SPA, specific areas are protected and managed in order to deter development changes that could alter the natural character of the region. These protected sites are typically designated through national parks, provincial parks, crown lands and county forests. Map 2.15 identifies the locations of parks and protected areas throughout the Northern Bruce Peninsula SPA. Map 2.16 illustrates lands that have been designated as Areas of Natural and Scientific Interest (ANSI) or are under the jurisdiction of the Niagara Escarpment Commission (NEC).

Provincially Owned Lands

The Northern Bruce Peninsula SPA is home to approximately 76 km^2 of Provincial Park lands, the majority of which are classified as nature reserves. Half a dozen Provincial Nature Reserves are located in the Northern Bruce Peninsula SPA. Cabot Head and Lion's Head are two sites well-known for the outstanding scenery of the Niagara Escarpment and rugged Georgian Bay shoreline. Parks with the nature reserve classification are generally established to represent and protect natural habitat and land formations. Due to the fragility of the natural environment, these sites are usually intended for education and research purposes, or passive recreational activities such as hiking or nature appreciation (MNR, 1993).

Federal Government Lands

Parks Canada operates two parks in the Northern Bruce Peninsula SPA as shown on Map 2.15. The parks were established in 1987. The islands and waters off the northern tip of the Bruce Peninsula are part of Fathom Five National Marine Park, which was Canada's first national marine park. One of the significant features is the pillars of limestone that jut from the blue waters, such as at Flowerpot Island. The area is known for its numerous islands, lighthouses, 22 shipwrecks and recreational activities, such as scuba diving. A visitor's centre is located at the edge of Tobermory.

Extensive portions of the Municipality of Northern Bruce Peninsula near Tobermory (in the former St. Edmunds Township) are designated Bruce Peninsula National Park. The National

Park encompasses an area of approximately 156 km^2; however, not all of this land is federally owned. As of 2003, approximately 22 percent is privately owned, 37 percent is owned by Parks Canada and 32 percent is provincially owned, but managed by Parks Canada under agreement with the Ontario Ministry of Natural Resources (Wildlands League, 2005). The primary visitor facilities are focussed around Cyprus Lake and the visitor centre near Tobermory. The area is famous for its scenic landscape with clifftop views over Georgian Bay and an incredible diversity of plants, including over 40 species of orchids and more than 20 species of ferns.

Non-Government Organization Protected Areas

Ontario Nature (Federation of Ontario Naturalists) is a non-government organization that is actively involved in the protection and restoration of natural habitats through research, education, and conservation. The Bruce Alvar, Baptist Harbour, and Lyal Island properties in the Northern Bruce Peninsula are significant habitats for the provincially threatened eastern massassauga rattlesnake, and are characterized by unique alvars composed of dolostone bedrock formations. These properties are open to the public for activities such as hiking and snowshoeing on marked trails, photography, and scientific research. Activities such as hunting, use of motorized vehicles, camping, cycling, and trimming of vegetation are not permitted in these areas (Ontario Nature, 2010).

Another non-profit organization with protected land holdings in the planning region is the Nature Conservancy of Canada (NCC). The agency is the largest private steward of lands conserving species at risk in Canada. The main goal of this organization is to protect threatened or ecologically rare sites through the application of conservation sciences on properties that have been donated by private land owners or purchased outright by the agency. The NCC also works with individual landowners to secure conservation easements, which limit or restrict certain types of development in order to protect the natural features of an area. Restrictions are tailored to fit the particular property, the interest of the landowner, and the natural features that are to be protected (Nature Conservancy of Canada, 2010).

The Bruce Trail Conservancy seeks to provide public access to the Niagara Escarpment. The organization is best known for the Bruce Trail, which is a public footpath along the Niagara Escarpment from Tobermory to Niagara Falls. Their goal is for the Bruce Trail route to be part of a conservation corridor. In places, the Bruce Trail Conservancy has purchased the land parcels through which the trail passes. Many sections traverse private property and the Conservancy has secured agreements with the property owners. In the Northern Bruce Peninsula SPA, the Bruce Trail crosses many protected areas, including the Bruce Peninsula National Park and the Lion's Head Provincial Nature Reserve.

Areas of Natural and Scientific Interest

Areas of Natural and Scientific Interest (ANSIs) are significant natural features that have been identified by the Ministry of Natural Resources and Forestry (MNRF). These areas may represent either geological features (earth science ANSI) or biological features (life science ANSI). Earth science ANSIs include areas that contain examples of rock, fossil and landform features. Life science ANSIs are areas that contain examples of the many natural landscapes, communities, plants and animals found in the 14 natural regions of the province (MNR,

www.mnr.gov.on.ca, Oct23, 2009). Map 2.16 shows the location of ANSIs in the Northern Bruce Peninsula SPA.

Niagara Escarpment Commission Plan Area

A significant protected area in the Northern Bruce Peninsula SPA is the Niagara Escarpment, which is protected under the *Greenbelt* legislation. The escarpment is a provincially significant geological formation stretching from Niagara Falls to Tobermory at the northern tip of the Bruce Peninsula. The *Niagara Escarpment Planning and Development Act*, passed in 1973, identifies seven land-use zones within the Niagara Escarpment planning region. These zones are intended to ensure that the natural features of the escarpment are maintained and that development practices within the area are compatible with the natural environment.

The Niagara Escarpment planning area covers the entire length of the Northern Bruce Peninsula SPA close to the shores of Georgian Bay. Escarpment Natural Area is the most protective designation under the plan. This core area includes escarpment cliffs, forested lands, river and stream valleys, and significant ANSIs and allows for very limited types of development in these areas. Away from the cliff face, other land-use designations are identified, which are intended to minimize the impacts of certain land uses, while at the same time maintain the natural features of the area. Certain types of development and land uses are permitted within these zones, but are subject to some restrictions (Niagara Escarpment Commission, 2009).

2.7.9 Recreation

Recreation and tourism is very prevalent in the Northern Bruce Peninsula SPA, as it offers a wealth of opportunity for outdoor activities year round (see Map 2.17). With both the Lake Huron and Georgian Bay shorelines, the region offers tourists numerous water activities during the summer months including swimming, sailing, boating, fishing, canoeing and cottaging. Beaches can be found along Lake Huron and the various inland lakes. SCUBA diving is excellent in the crystal clear waters along the Bruce Peninsula, particularly at dive sites in and around Fathom Five National Marine Park.

The area is also particularly attractive to hikers as it is home to several large trail networks, including County Forest trails, Provincial Park trails and the Bruce Trail (see section 2.7.8 above). High-quality mountain bike trails have been developed at the Lindsay Tract Trails off Highway 6 near Miller Lake.

An extensive network of dedicated snowmobile trails attracts enthusiastic sledders to the region. Some of the walking trails are also used during the winter months for cross-country skiing activities.

Camping is a popular pastime in the region. There are dozens of privately operated campgrounds, a municipal campground in Lion’s Head and the Cyprus Lake campground within Bruce Peninsula National Park. There is also a golf course located near Tobermory.

While these activities offer both residents and tourists of the SPA a wide variety of recreational opportunities, it is important to note the effects that some of these activities have on water

sources. Some recreational activities may have adverse effects on water quality, such as fuel, oil, and other pollutants entering water systems from boating or other water-based activities.

2.8 Water Quality

The purpose of the water quality section is to compile, organize, and present an anthology of significant sources of water quality data within the Northern Bruce Peninsula SPA. These sources represent sampling programs that have produced reliable and extensive water quality data. The data serves to identify potentially problematic areas that may be susceptible to less than desired water quality.

Understanding the quality of water within the study area is an essential part of Source Protection Planning. For the purposes of defining water quality for Drinking Water Source Protection, the salient properties are chemical and biological. Chemical properties are most commonly measured as instantaneous concentrations of a given parameter, and guidelines for both human health and ecological functions are generally based on the effects of a given concentration on the suitability of the water for a chosen use.

A more detailed examination of water quality information is provided in the Water Quality chapter of the Watershed Characterization Report (SC, 2008)

2.8.1 Indicator Parameters

Water chemistry parameters were selected based on the Conservation Ontario Discussion Paper: Recommendations for Monitoring Ontario's Water Quality (March 2003). To address the potential for human health issues associated with the chosen indicator parameters, the corresponding acceptable concentrations (for human health or aesthetic purposes) are given in Table 2.8.1. Aesthetic objectives are not considered to be health related, but can make drinking water undesirable for drinking and other domestic uses. The Canadian Drinking Water Quality Guidelines (DWQG) and the Ontario Drinking Water Standards (ODWS) are specific to human consumption while the Canadian Water Quality Guidelines and the Ontario Provincial Water Quality Objectives (PWQO), and the Canadian Environmental Quality Guidelines (CEQG) are provided for the protection of aquatic life.

The indicator parameters that will be reported on in this section are arsenic, fluoride, hardness, iron, sodium, total phosphorus, nitrate, copper, lead, suspended solids and chloride. Typical sources of the parameters are provided, but are not meant to be exhaustive. The indicator parameters are identified as being applied to surface water (SW) or groundwater (GW).

TABLE 2.8.1 – Summary of objectives, standards, and guidelines for chosen indicators

	Canadian DWQG		ODWS		PWQO
Parameter	***MAC (mg/L)***	***AO (mg/L)***	***MAC (mg/L)***	***AO (mg/L)***	***(mg/L)***
Arsenic			(Interim) ≤0.025		≤0.1
Chloride		≤250		≤250	
Copper				≤1.0	≤0.005
Fluoride	≤1.5		≤1.5		
Hardness				≤500	
Iron				0.3	≤0.3
Lead	≤0.01		≤0.01		Hardness as CaCO3 (mg/L) / Interim PWQO: <30 : 0.001 30-80 : 0.003 > 80 : 0.005
Nitrate-N	≤10.0		≤10.0		
Sodium		≤200		≤200	
Total Phosphorus					≤0.03*
Total Suspended Solids		≤500		≤500	
Zinc		≤5.0		≤5.0	Interim PWQO ≤ 0.02

*Concentration provided to prevent aesthetic deterioration in lakes

Arsenic (GW)

The interim maximum acceptable concentration (IMAC) for arsenic in drinking water is 0.025mg/L (ODWS). The source of arsenic in groundwater is largely the result of minerals dissolving from weathered rocks and soils. Anthropogenic sources include industrial waste, phosphates, fertilizers and coal.

Chloride (SW and GW)

The aesthetic objective for chloride is 250 mg/L (ODWS) and will be used to assess any exceedences. The sources of the chloride ion include sodium chloride (salting of highways), potassium chloride (potash fertilizers), and calcium chloride (wastewater treatment). Other anthropogenic sources of chloride include oil well operations and sewage and irrigation drainage.

Copper (SW)

The aesthetic objective for copper is 1.0 mg/L (ODWS) and will be used to assess any exceedences. Typical sources of copper are from soil erosion, commercial activities (marine paints), agricultural and domestic activities (fungi pesticides, wood preservatives) and wastewaters.

Fluoride (GW)

The maximum acceptable concentration (MAC) for fluoride is 1.5mg/L (ODWS) and will be used to assess any exceedences. Where fluoride is added to drinking water it is recommended that the concentration be adjusted to 1.0 (+/- 0.2) mg/L, which is the optimum level to control tooth decay (ODWS). The sources of fluoride in groundwater include industrial processes, and phosphorus fertilizers.

Hardness ($CaCO_3$) (GW)

The chemical/physical objective for total hardness operational guideline is 80-100 mg/L (ODWS). This objective is not health related. Any value over 500 mg/L will be treated as an exceedence, as it is considered unacceptable for most domestic purposes. Hardness is caused by dissolved calcium and magnesium, and is expressed as the equivalent quantity of calcium carbonate.

Iron (GW)

The aesthetic objective for iron is 0.30 mg/L (ODWS) and will be used to assess any exceedences. Iron may be present in groundwater as a result of chemically reducing underground conditions which cause mineral deposits. Iron can also leach into groundwater through industrial practices.

Lead (SW)

The maximum acceptable concentration for lead in drinking water is 0.01 mg/L (ODWS) and will be used to assess any exceedences. Typically, the sources of lead are from soil erosion or from industrial processes where lead is emitted into the air and is later deposited into water courses, from stormwater runoff, or directly discharged into a stream.

Nitrate (SW and GW)

Elevated nitrates in drinking water can cause serious health issues with infants. Typically, high nitrate levels can be attributed to lawn fertilizers, leaking septic tanks, animal wastes, and landfills. The ODWS maximum acceptable concentration for nitrates in drinking water is 10 mg/L as NO_3-N and will be used to assess any exceedences. The Canadian Environmental Quality Guidelines have a limit of 2.9 mg/L NO_3-N and areused as a benchmark for aquatic health.

Sodium (GW)

The aesthetic objective for sodium in drinking water is 200 mg/L (ODWS). Sodium occurs naturally, and is slowly released from rocks and soils. When levels exceed 20 mg/L, the local Medical Officer of Health is required to be notified. Anthropogenic sources of sodium include road salt, runoff from fertilizers, and domestic water softeners.

Total Phosphorus (SW)

Total phosphorus represents all forms of phosphorus present in a water sample. Phosphorus is a required nutrient for all organisms and is naturally occurring in rocks, soils, and organic matter. Elevated total phosphorus relative to ambient levels can be indicative of excessive inputs of fertilizers, detergents, or animal wastes. High levels of phosphorus can be associated with algal blooms and subsequent decreases in dissolved oxygen and a degradation of suitable aquatic conditions.

The Ontario Provincial Surface Water Quality Objectives do not have a firm objective for total phosphorus because of insufficient scientific evidence, but general guidelines are provided. To prevent nuisance algae in lakes and excessive plant growth in streams, total phosphorus levels should remain below 0.02 mg/L, and 0.03 mg/L, respectively. To prevent aesthetic deterioration, levels should remain below 0.01 mg/L (PWQO). Any concentration greater than 0.03 mg/L will be treated as an exceedence.

Total Suspended Solids (SW)

There is no standard or guideline for total suspended solids (TSS), but there is an aesthetic objective for total dissolved solids being less than 500 mg/ L (ODWS). High values of TSS can make drinking water undesirable, affect other domestic uses, and be harmful to aquatic organisms. Suspended solids (silt, clay, organic/inorganic matter, plankton, and other microscopic particles) also allow for the transport of phosphorus, metals and other contaminants.

Zinc (SW)

To maintain the aesthetic objective for zinc, concentrations in drinking water should not exceed 5 mg/L (ODWS; Interim PWQO is 0.02 mg/L for aquatic life). Sources of zinc include corrosion of galvanized materials, electroplaters, domestic and industrial sewage, combustion of solid waste and fossil fuels, stormwater runoff, and soil erosion.

2.8.2 Surface Water Quality Data Analysis

The Provincial Water Quality Monitoring Network (PWQMN) was established in 1964 to collect water chemistry data in streams of Ontario. Water quality parameters were examined for the Northern Bruce Peninsula SPA on a subwatershed basis where water chemistry data exists from the PWQMN. The data analyses within the SPA spans from the early 1970s to 2005 depending on the number of years data was collected at each monitoring station on a particular stream.

Limited data has been collected from the PWQMN sites in the Northern Bruce Peninsula SPA. Data exists for Spring Creek and the Stokes River, which account for two of the eleven subwatersheds mapped for the Northern Bruce Peninsula. These PWQMN stations are no longer active, with data collection for the Stokes River ending in 1995 and data collection for Spring Creek ending in 1979.

Sampling Uncertainties

The reported values of copper, lead, and zinc in the 1970s and 1980s are often given as higher than the actual values, as concentrations were below detection limits of the laboratory equipment. In these instances, metal concentrations were reported at detection limits, when actual concentrations were less than the reported value. The reported values, therefore, may skew how the results are interpreted or used in identifying trends. For this report, the concentrations provided were not modified and were used as provided.

This is also the case for more recent reporting of metals, but better laboratory methods/ equipment and the resulting lower detection limit have greatly reduced the margin of error. Even with these improvements, caution must be exercised when assessing trends or identifying exceedences, as there is a +/-0.011mg/L for lead concentrations, which can greatly influence the results. Any exceedences will be identified as such, but the reader must be cognizant that the discrepancy between reported and actual concentrations is unknown and analytical limitations must be understood.

2.8.2.1 Spring Creek

Chloride, total suspended solids and total phosphorus data was collected from 1975 to early 1979. Total phosphorus concentrations generally exceeded 0.03 mg/L for the samples that were collected.

TABLE 2.8.2 – Summary of water chemistry exceedences for Spring Creek

Spring Creek			
Year	**Total Phosphorus**		
	Total # Samples	# of Exceed	% Exceed
1975-1979	36	2	5.6
TOTAL	36	2	5.6

Note: Limits for parameters - - Total Phosphorus: guideline of 0.03 mg/L (PWQO)

2.8.2.2 Stokes River

Chloride, total suspended solids and total phosphorus data was collected from 1975 to 1979 and again from 1982 to 1996. Chloride and total suspended solids concentrations were within acceptable limits, but total phosphorus concentrations were typically above the operational objective of 0.03 mg/L.

TABLE 2.8.3 – Summary of water chemistry exceedences for Stokes River

Stokes River Headwaters						
Year	**Suspended Solids**			**Total Phosphorus**		
	Total # Samples	# of Exceed	% Exceed	Total # Samples	# of Exceed	% Exceed
1975-1979	32	0	0.0	32	24	75.0
1982-1986	65	1	1.5	65	48	73.8
1987-1991	51	0	0.0	51	32	62.7
1992-1996	44	0	0.0	44	27	61.4
TOTAL	192	1	0.5	192	131	68.2

Note: Limits for parameters - - Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS)

2.8.3 Great Lakes Index Stations (GLIS) Monitoring

The Great Lakes Index Stations (GLIS) monitor water quality in the Great Lakes. It is one of several programs by the Ontario Ministry of the Environment and Climate Change to monitor near shore water quality within the Great Lakes. There are 57 sites located in the Great Lakes and two of those are located in proximity to the Northern Bruce Peninsula SPA, specifically the stations at Stokes Bay and near Tobermory (Map 2.18).

Samples are taken in the spring, summer and fall months. There were five samples taken between 2002 and 2003. This was the first sampling session for the Lake Huron/Georgian Bay basin. The chemical/physical parameters being discussed at each site and their respective upper limits, given in parentheses, are: chloride (250 mg/L, ODWS); total phosphorus (0.03 mg/L, PWQO); copper (1 mg/L, ODWS); nitrate (10 mg/L, ODWS); total suspended solids (500 mg/L, ODWS); and zinc (5 mg/L, ODWS).

Figures 2.8.1 and 2.8.2 summarize the water chemistry/physical parameters for the relevant monitoring stations. No exceedences were observed.

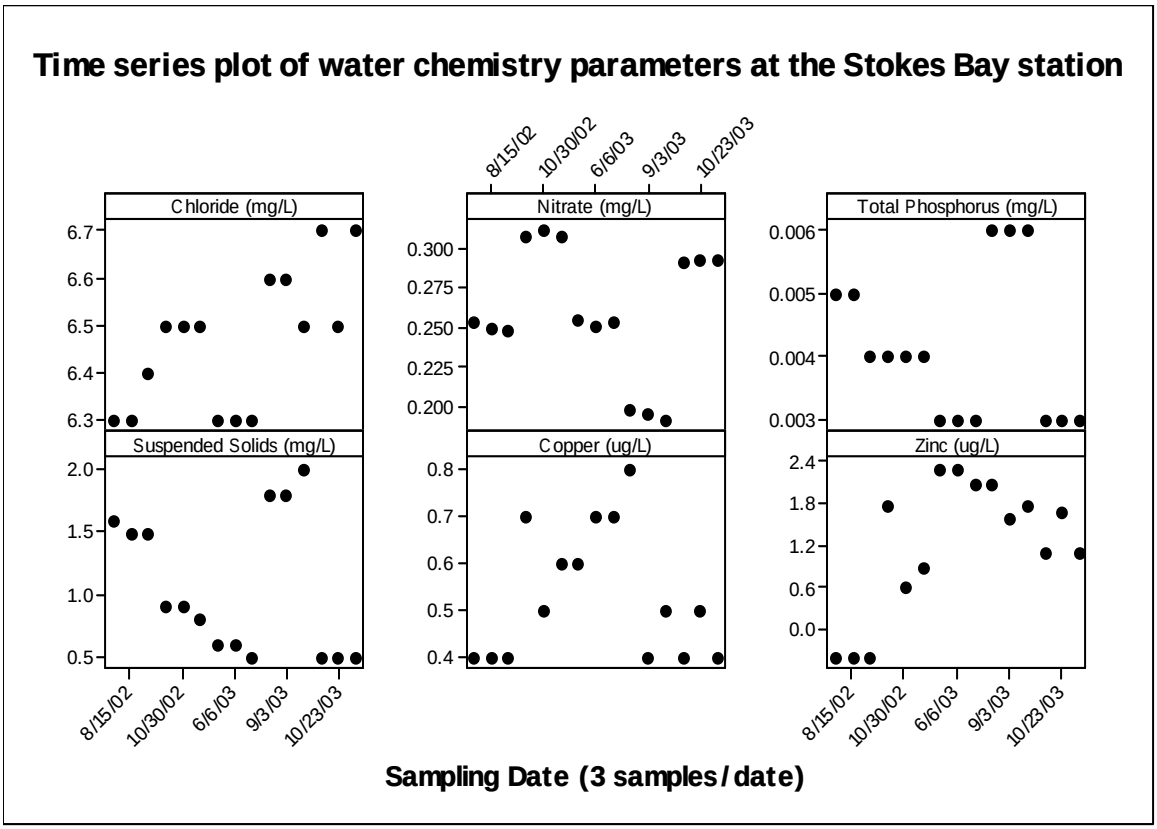

Figure 2.8.1 *Summary of selected water quality parameters from the Great Lakes Index Station monitoring program at the Stokes Bay location*

Note: Limits for parameters - - Chloride: AO of 250 mg/L (ODWS); Copper: AO of 1.0 mg/L (ODWS); Nitrate: MAC of 10mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS); Zinc: AO of 5.0 mg/L (ODWS)

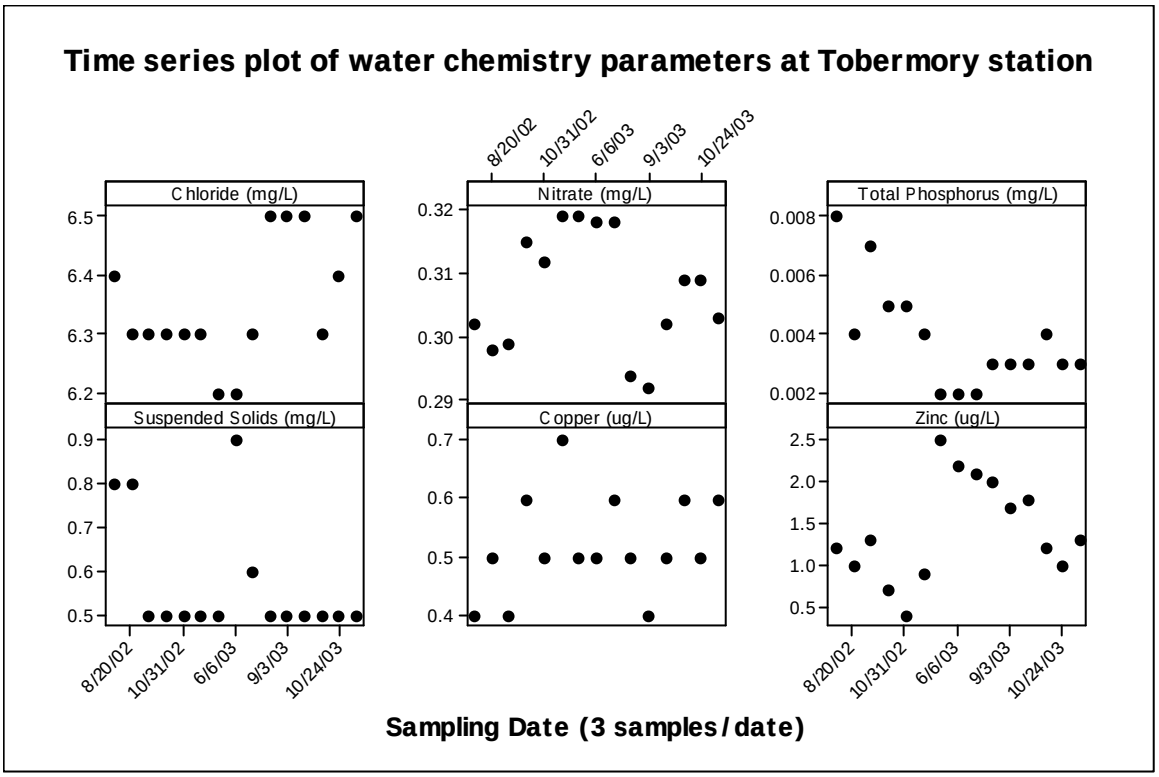

Figure 2.8.2 *Summary of selected water quality parameters from the Great Lakes Index Station monitoring program at the Tobermory location*

Note: Limits for parameters - - Chloride: AO of 250 mg/L (ODWS); Copper: AO of 1.0 mg/L (ODWS); Nitrate: MAC of 10mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS); Zinc: AO of 5.0 mg/L (ODWS)

2.9 Water Use

Water that enters the Northern Bruce Peninsula SPA is put to many uses, including human consumption, agriculture, industrial, commercial, recreational and ecological. Water takings for municipal drinking water supplies include the surface water intake for the Lion's Head drinking water system. Agriculture, including livestock feeding operations, relies upon the bedrock aquifers as a water supply, with relatively few takings from surface water. Private consumption within the SPA almost exclusively exploits overburden and bedrock aquifers. The typical taking utilizes a drilled or, less commonly, bored well, which is then redirected into shallow overburden aquifers via a septic system.

Recreational water use is a large economic driver within the SPA. These uses include outdoor recreation, hobby fishing, canoeing/kayaking and tourism and are focused on Lake Huron, Georgian Bay and the inland lakes. Recreational usage of water is generally non-consumptive and is not considered to impact the quantity of water in the system. However, adequate availability of water is required for the continued recreational use of these resources.

Further discussion on water usage can be found in Chapter 3 of this report. For a detailed analysis of water use, refer to the Saugeen, Grey Sauble, Northern Bruce Peninsula Planning Region Draft Conceptual Water Budget (2007).

2.10 Data and Knowledge Gaps for Watershed Characterization

There is sparse information on fish species and a lack of thermal and fish population studies. Benthic data collection is too sparse and there are gaps in the time series. Little information is available on the extent of invasive species within the Northern Bruce Peninsula SPA. Much of the forestry information is older; however, new aerial photography is now available that could help to fill this gap. The MOECCwells data set is partially populated and contains spatial inaccuracies.

WC Deliverable	*Data Set Name*	*Data Gap Problem*	*Comment*
Fish Species		Too sparse	Lack of thermal and fish population studies
Species at risk		Too sparse	Little to no info on spatial extent of species or habitats at risk
Invasive Species		Too sparse	Little to no info on spatial extent of invasive species or habitats at risk
Wells	MOECC Wells	Spatially inaccurate; partially populated	Well type not classified (municipal, communal, etc.) per Regulations 170/03 and 252/05 of SDWA
Forestry		Dated information on forest cover	Lack of recent information on extent of forest cover and composition
Water Quality	PWQMN	Spatial availability of monitoring locations	Watersheds too large to capture potential issues
Water Quality	PGMN	Spatial and temporal availability of data is limited	No sites currently in the Northern Bruce Peninsula SPA

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