Approved

Chapter 2

WATERSHED CHARACTERIZATION

APPROVED ASSESSMENT REPORT
for the
Saugeen Valley Source Protection Area

October 15, 2015

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2.0 Watershed Characterization

The watershed characterization is a general assessment of the Saugeen Valley Source Protection Area's (Saugeen Valley SPA or SVSPA) fundamental natural and synthetic characteristics, including current status and trends. It describes the physical and human qualities of the watershed by providing a compilation of existing information. Available background studies and documents were used to compile the report, and any major gaps requiring future research were identified.

A variety of land use activities occur throughout the region. Agricultural activities are the most prevalent across the SPA. Various types of livestock and crop farming exist in the SPA, with cattle farming representing the most common type. Forestry activities, aggregate extraction and recreational areas are also prominent in the SPA.

2.1 Source Protection Region

The Saugeen Valley 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 Saugeen Valley Conservation Authority Board sits as the Source Protection Authority in the Saugeen Valley SPA. The Grey Sauble Conservation Board sits as the Source Protection Authority in the Grey Sauble SPA and the Municipality of Northern Bruce Peninsula Council sits as the Source Protection Authority in the Northern Bruce Peninsula 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 and to the east are the Lake Erie SPR and the South Georgian Bay Lake Simcoe SPR.

2.2 Saugeen Valley Source Protection Area

The Saugeen Valley SPA encompasses the jurisdiction of Saugeen Conservation. About 90,000 people (StatCan Census, 2006) live in this area, which covers approximately 4632 km^2 (Map 2.1 and Map 2.2). The major watershed is the Saugeen River and its major sub-watersheds are the

North Saugeen River, Rocky Saugeen River, Beatty Saugeen River, South Saugeen River and Teeswater River. The Saugeen River is the third largest watershed in Southern Ontario, draining 4052 km^2 into Lake Huron. The Penetangore River, Pine River and other smaller lake fringe watersheds also drain into Lake Huron and are part of the Saugeen Valley SPA. (Map 2.3)

2.2.1 Jurisdictions

The area encompassed by the Saugeen Valley SPA also comes under other jurisdictions, as detailed in the following sections.

2.2.1.1 Conservation Authorities

Conservation Authorities (CAs) are local environmental agencies that undertake a broad range of programs for watershed management. For more than 50 years, CAs have protected and restored resources in their watersheds using a science-based approach. CAs work in partnership with all levels of government, agricultural and rural organizations, environmental groups, landowners, businesses, and residents to ensure the proper management of land and water resources. Areas of expertise and service include watershed management, water quality and water quantity management, flooding and erosion, afforestation, natural heritage, recreation, environmental education, and agriculture and rural landowner assistance.

Saugeen Conservation, formally Saugeen Valley Conservation Authority, (SC or SVCA) was established in 1950 because of increased flooding problems in and around the communities that had developed along the Saugeen River. From its start in the Saugeen River watershed, Saugeen Conservation's jurisdiction has expanded over the years to include the Pine River, Penetangore River and several smaller watersheds draining into Lake Huron. Significant flooding events on the Saugeen River occurred in 1947, 1948, 1970, 1977, 1981, 1986, and 1997. Efforts to control flooding include dyke systems at Walkerton, Paisley and Pinkerton, as well as channelization at Durham and Neustadt. An extensive flood forecasting system has been developed. Large-scale erosion control projects have been completed at Southampton and Kincardine (SC, 2000).

Saugeen Conservation's vision is "a watershed where human needs are met in balance with the needs of the natural environment." In addition, its mission is "to provide leadership through co-ordination of watershed planning, implementation of resource management programs and promotion of conservation awareness, in co-operation with others" (SC, 2000). A Watershed Plan was developed in 1983 and a Strategic Plan was completed in 1993. Resource management activities include forestry work and extensive land holdings.

Figure 2.2.1 - Durham Conservation Area

Grey Sauble Conservation, formally Grey Sauble Conservation Authority, (GSC or GSCA) was established in 1985 through the amalgamation of the North Grey Region Conservation Authority (est. 1957) and the Sauble Valley Conservation Authority (est. 1958). GSC operates several water control structures as part of its comprehensive water management program, including a flood-forecasting network. The GSC's vision is "a healthy watershed environment in balance with the needs of society." Its mission is "in partnership with stakeholders of the watershed, to promote and undertake sustainable management of renewable natural resources and to provide responsible leadership to enhance biodiversity and environmental awareness." (GSC, 2005)

The Maitland Valley Conservation Authority (MVCA) lies to the south of the SC jurisdiction. Along SC's eastern boundary is the Grand River Conservation Authority. The Nottawasaga Valley Conservation Authority borders the eastern edge of the GSC and a small section of the SC jurisdiction. The jurisdictional boundaries mark the height of land that separates one watershed from another.

There is a history of cooperative activities with adjacent Conservation Authorities and this approach will be important to Source Protection. Examples of collaborative projects between neighbouring Conservation Authorities include the My Land, Our Water website from SC and MVCA; Healthy Futures from SC and GSC; and the Grey-Bruce Forestry Services program of SC and GSC. Due to shared issues in water sources, it is expected that CAs will work collaboratively in Source Protection.

Conservation Ontario is the provincial association of Conservation Authorities and plays a coordinating and administrative role regarding Source Protection. Regular meetings along with workshop and working group activities are important in setting standards and sharing experience and approaches.

2.2.1.2 Municipalities

Municipalities are crucial to describing and assessing watersheds for the purposes of Source Protection planning. The municipalities provide drinking water, many treat sewage, and all have a range of activities and mandates, which affect water quantity and quality.

There are 15 municipalities in the SVSPA. Many of these municipalities are also part of neighbouring Source Protection Areas: three in the Grey Sauble SPA (part of the Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region), six in the Maitland Valley SPA (part of the Ausable Bayfield Maitland Valley Source Protection Region), two in the Grand River SPA (part of the Lake Erie Source Protection Region), and two in the Nottawasaga Valley SPA (part of the South Georgian Bay Lake Simcoe Source Protection Region). The SVSPA encompasses parts of Grey and Bruce Counties, with six municipalities in Bruce and five in Grey, as well as two municipalities in each of Wellington and Huron Counties (Table 2.2.1). In addition, a small area of the SVSPA is in Dufferin County. Map 2.1 shows jurisdictions and Map 2.2 shows municipal boundaries and the communities within those municipalities.

TABLE 2.2.1 – Municipalities within the Saugeen Valley Source Protection Area

Municipality	*County*	*Source Protection Area(s)*
Municipality of Arran-Elderslie	Bruce	Saugeen Valley SPA Grey Sauble SPA
Municipality of Brockton	Bruce	Saugeen Valley SPA
Township of Huron-Kinloss	Bruce	Saugeen Valley SPA Maitland Valley SPA
Municipality of Kincardine	Bruce	Saugeen Valley SPA
Town of Saugeen Shores	Bruce	Saugeen Valley SPA
Municipality of South Bruce	Bruce	Saugeen Valley SPA Maitland Valley SPA
Township of Chatsworth	Grey	Saugeen Valley SPA Grey Sauble SPA
Municipality of Grey Highlands	Grey	Saugeen Valley SPA Grey Sauble SPA Nottawasaga Valley SPA
Town of Hanover	Grey	Saugeen Valley SPA
Township of Southgate	Grey	Saugeen Valley SPA Grand River SPA
Municipality of West Grey	Grey	Saugeen Valley SPA
Township of Howick	Huron	Saugeen Valley SPA Maitland Valley SPA
Municipality of Morris-Turnberry	Huron	Saugeen Valley SPA Maitland Valley SPA
Township of Minto	Wellington	Saugeen Valley SPA Maitland Valley SPA
Township of Wellington North	Wellington	Saugeen Valley SPA Grand River SPA Maitland Valley SPA

2.2.1.3 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. 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 CAs in resource management, such as forestry and flood warning. The Ministry has a Conservation Authorities branch that oversees transfer payment allocation and guidance to CAs.

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 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*, provides valuable information about the province's geology and supports the forest products industry. 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.

2.2.1.4 Federal Government

Fisheries and Oceans Canada has signed an agreement with both Saugeen Conservation and Grey Sauble Conservation to review proposed projects under section 35 of the *Fisheries Act*. Section 35 of the *Fisheries Act* deals with the management and protection of fish habitat. The Conservation Authority conducts the initial review of the project 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 Department of Fisheries and Oceans (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. CA staff utilise weather data from Environment Canada to determine the likelihood of precipitation or snowmelt as part of the CA'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.

2.2.1.5 First Nations

The Chippewas of Nawash Unceded First Nation 27 reserve is at Cape Croker (Neyaashiinigmiing) 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 FN and the Chippewas of Nawash Unceded FN, 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 Saugeen Valley SPA is shown in Table 2.2.2. 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 2.2.2 – Non-Governmental Organizations in the Saugeen Valley 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 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
Concerned Walkerton Citizens	- advocate for compensation to people affected by Walkerton water tragedy - support holistic stewardship of Ontario's drinking water
Ducks Unlimited Canada	- wetland enhancement projects, such as Bognor Marsh - assist landowners with habitat improvement projects
Escarpment Biosphere Conservancy	- established to 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
Friends of MacGregor Point	- enhance public awareness, education and understanding of MacGregor Point Provincial Park - supplement interpretive and education programs
Girl Guides	- environmental education and community service
Grey Association for Better Planning	- encourage better land use planning and policy in Grey County - identify and take action on land use that is unwise or illegal - inform the public on planning issues
Grey Bruce Children's Water Festival	- annual festival educates 2000 Grade four students about water issues and the physical properties of water - promote maintenance of ground and surface water quality and quantity
Grey County Federation of Agriculture	- promote best management practices - encourage stewardship
Grey County Woodlot Association	- promote sustainable forest management by increasing awareness of the forest's inherent social, economic and environmental values - provide technical advice about forest management and marketing
Huron Fringe Field Naturalists	- preserve wildlife and natural habitat - natural history education
Kincardine Fishing Club	- stream rehabilitation and fisheries management

Name of Organization	*Main Interests and Activities*
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 (Federation of Ontario Naturalists)	- conservation and restoration of natural habitats - education and advocacy - nature reserves - environmental projects, research
Owen Sound Field Naturalists	- natural history education - naturalization project - assist in purchase of environmentally sensitive lands - record local flora and fauna
Pine River Watershed Initiative Network	- promote dialogue and education about watershed processes in the Pine River watershed - promote programs that can improve the Pine River watershed - raise awareness of the needs of the Pine River watershed and coordinate activities
Saugeen Conservation Foundation	- trail development at Greenock Swamp and improvements at Conservation Areas - support conservation education program - support wetland and fish habitat projects
Saugeen Field Naturalists	- develop an appreciation and understanding of all aspects of nature - promote wise use and conservation of natural resources - encourage preservation of wild species and natural areas, especially in Grey and Bruce counties
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 and tree planting
Stewardship Grey-Bruce	- encourage individuals and local groups to be good stewards by planning and managing the natural resources on their land in a responsible manner - link landowners with information on best practices, expertise and modest resources for a wide range of environmental initiatives - restore, protect and enhance wildlife and fisheries habitat and the rich diversity of plants and animals found in Grey and Bruce counties - offer tools and resources to help landowners practice effective stewardship on the land

2.3 Physical Description

A broad overview of the physical character of the Saugeen Valley 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. 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 Saugeen Valley SPA exhibits diversity that ranges from flat to heavily rolling, as shown on Map 2.4. Overall, elevations trend from high ground in the east to low in the west. The lowest surface elevation in the SPA is Lake Huron with a low water datum level of 176.0 masl (Canadian Hydrographic Service, 2010). The maximum elevation in the SPA occurs in the eastern end of the Saugeen River watershed, near Grey Road 2 east of Flesherton, where the land rises to over 540 masl (MNR, Digital Elevation Model, 2007). This area forms the divide between the Saugeen Valley SPA, Grey Sauble SPA and Nottawasaga Valley SPA.

The coastal fringe along Lake Huron is relatively flat and generally less than 220 masl. Central and eastern parts of the Saugeen Valley SPA have lightly to heavily rolling terrain.

2.3.2 Bedrock Geology

Knowledge of bedrock geology is necessary to understand 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 Saugeen Valley 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).

Three boreholes were drilled by the OGS in the spring of 2006 near Hanover and Walkerton. The cores collected at these sites will help to increase the knowledge and understanding of geological units in the area. The boreholes extend more than 125 metres below the surface.

Figure 2.3.1 - Exposed limestone bedrock at McGowan Falls in Durham

General bedrock stratigraphy (that is, the character, thickness and sequence of rock units) in the Saugeen Valley SPA is summarized in Table 2.3.1 (Stratigraphy) and illustrated on Map 2.5. The bedrock layers shown on Map 2.5 represent the uppermost formation underlying a particular site and ranges

from the Amabel Formation to the Detroit River group. Other formations, as shown on Table 2.3.1, lie below the uppermost formation.

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 five to seven metres per kilometre. There is a general thinning of the overburden from west to east, resulting in bedrock exposure along the Niagara Escarpment. An indication of the depth to bedrock is also shown in the distribution of historical quarry operations. Only a few quarry operations are known in the Saugeen Valley SPA near Kincardine and Walkerton.

TABLE 2.3.1 – Stratigraphy of Bedrock in the Saugeen Valley SPA (Waterloo Hydrogeologic, 2003)

Period	***Group***	***Formation***	***Material Type***
Quaternary	Overburden (glacially-derived gravel, sand, silt and clay)		
Middle Devonian		Dundee	Brown limestone
	Detroit River	Lucas	Grey-brown limestone and dolostone
		Amherstburg	Tan to grey-brown bituminous limestone, dolostone
Lower Devonian		Bois Blanc	Grey-green to grey-brown limestone, dolostone
Upper Silurian		Bass Island	Dark-brown to buff dolostone
		Salina	Interbedded grey-brown limestone and bituminous shale
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
		Dyers 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

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 occupy a band up to 30 km wide, which extends northwest of Shelburne to Sauble Beach and up the western side of the Bruce Peninsula. Poor, natural water quantity and quality characterize the shale of the Queenston Formation. Poor, natural water quality also characterizes the Salina Formation, which has elevated hardness, sulphate and chloride.

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 that 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).

Groundwater flow in karst areas is significantly different from that of other aquifers because of the 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).

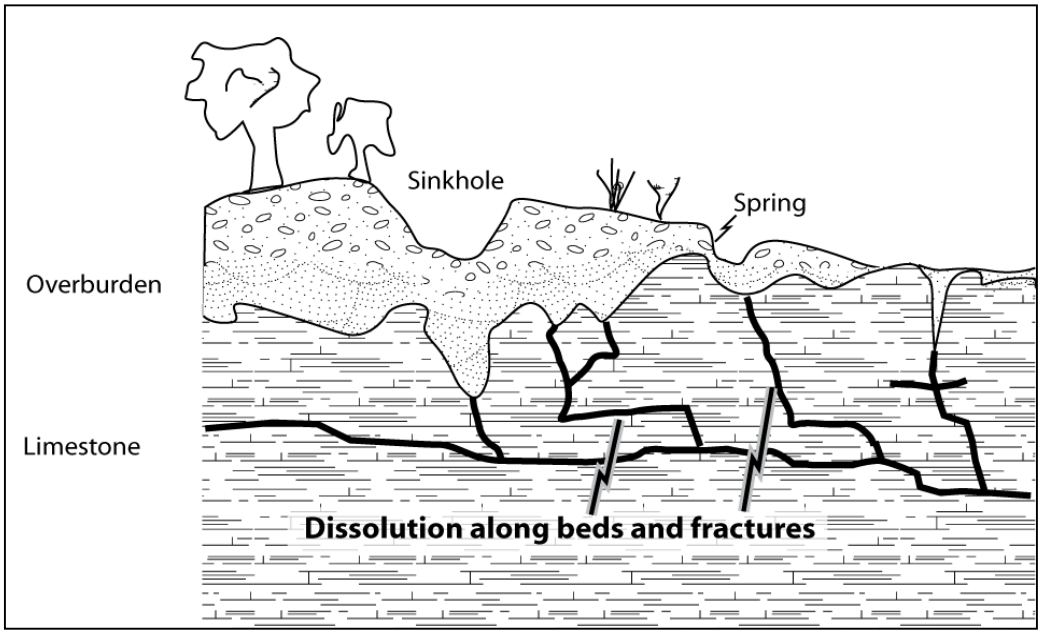


Figure 2.3.2 - Karst formation (after USDI, 2006)

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.

In the Saugeen Valley SPA, karst occurs in the eastern part of the SPA near Berkeley, Markdale and Flesherton. Other areas of the SPA may also have karst, such as areas near Walkerton. A study on karst in the planning region, that contains a Geographic Information Systems (GIS) database of karst areas, was completed by Waterloo Hydrogeologic (2005). 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).

The Grey County Official Plan states: "A Special Policy Area is applied to those lands, which possess or are expected to possess shallow overburden with karst topography. The combination of the two features have the potential of being extremely sensitive, thus requiring further in-depth study through an Environmental Impact Study prior to any development being permitted" (Grey County Official Plan, 2.8.4).

2.3.3 Surficial Geology

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. Much of the Saugeen Valley SPA is covered by till, which typically transmits water slowly (i.e. has a low hydraulic conductivity) because of its fine-textured character. In contrast, there are also sand plains and glaciofluvial sand deposits (spillways), which have higher hydraulic conductivities because of their coarse-textured character (Waterloo Hydrogeologic, 2003). A summary of the Quaternary deposits in the Saugeen Valley SPA is presented in Table 2.3.2.

TABLE 2.3.2 – Summary of Quaternary Deposits and Events in the Saugeen Valley SPA (Waterloo Hydrogeologic, 2003; after Karrow, 1993; 1977)

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
St. Joseph Till	Calcareous, silt to silty clay till	Surficial till
Elma Till	Silt till	Lower stony till
Dunkeld Till	Calcareous silt till	Surficial till
Elma Till	Calcareous, silt, sandy silt and clayey silt till	Surficial till, ground moraine, Teeswater Drumlins, Singhampton Moraine
Lacustrine deposits	Silts	Wildwood Silt deposits
Catfish Creek Till	Stony, sandy silt to silt till	Buried

The surficial geology left by the glaciers is highly varied over the Saugeen Valley SPA, as shown on Map 2.6. The physical features of the land surface are shown on Map 2.7 - Physiography.

The Catfish Creek Till is the oldest till in the planning region and outcrops in a small area of the SPA between Dundalk and Flesherton. The Elma Till and the Dunkeld Till, which are carbonate-derived silty to sandy tills, occur extensively in the Saugeen River watershed. The Elma Till occurs as ground moraine and in the drumlins of the Teeswater drumlin field. The Elma Till is also associated with the Singhampton Moraine. The Dunkeld Till occurs as ground moraine within the Saugeen River watershed and is the core of the Walkerton Moraine.

The St. Joseph Till is a glaciolacustrine-derived till that occurs over most of the southwestern part of the Saugeen Valley SPA. It is found in the Wyoming Moraine running south from Ripley and in the Williscroft Moraine north of Chesley. Glaciolacustrine shoreline deposits occupy a large part of the western half of the Saugeen Valley SPA, as well as by the Lake Huron shore from MacGregor Point to north of Southampton. These are largely well-sorted glaciolacustrine sand deposits that host a significant shallow aquifer.

Glaciofluvial ice-contact and outwash deposits are represented in the middle and upper parts of the Saugeen River watershed. These deposits are generally composed of sand and gravel and host numerous small, shallow aquifers. These aquifers are the source for a large portion of the base flow in the Saugeen River.

Modern alluvial deposits are found in the floodplains of many rivers in the Saugeen Valley SPA, while organic deposits are associated with wetlands.

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.

A maximum overburden thickness of up to 80 metres is associated chiefly with bedrock depressions. A swath of thick overburden extends from near Flesherton as far southwest as Mount Forest, indicating a possible bedrock depression in this area. Another area of thick overburden is associated with the bedrock valley underlying the Saugeen River from Hanover to the Lake Huron shore at Southampton. Overburden thickness of up to 80 m occurring at the Lake Huron shore indicates that the underlying bedrock valley likely extends farther northwest, under the lake. Two additional areas of thick overburden occur in the region, one is between Walkerton and Kincardine, reflected in an area of higher ground surface elevations, and the other is along the Lake Huron shore south of Kincardine. Neither area is associated with a bedrock depression.

Sand and gravel thickness throughout much of the Saugeen Valley SPA is less than 10 metres. However, there are extensive areas of sand and gravel thicker than 20 metres in the Saugeen

Valley SPA. The highest values are located near Hanover, Durham, Mount Forest, and the Greenock Swamp.

2.3.4 Physiography

The dominant surficial features of the planning region are shown on Map 2.7 and are based on the Physiography of Southern Ontario (Chapman and Putnam, 1984).

Coarse-textured glaciolacustrine deposits make up the sand plains of the Huron Fringe. This area comprises wave-cut terraces of glacial Lakes Algonquin and Nipissing along the Lake Huron shore.

The Port Huron Moraine system, consisting of glaciofluvial and ice-contact stratified deposits (kames), extends southwest from Markdale and Dornoch through the central part of the Saugeen Valley SPA. Meltwater stream deposits and spillways also occur throughout this physiographic region, as do drumlins in the vicinity of Dornoch.

The southeast part of Grey County, extending from near Priceville and Mount Forest eastward toward Dundalk, consists mainly of drumlinized till plains, with a small drumlin field in the area of Dundalk. The till is a stone-poor, carbonate-derived, silty to sandy deposit. Another drumlin field is located near Teeswater and Mildmay.

An area of fine-textured, glaciolacustrine deposits of the Saugeen Clay Plain extends from Glammis and Elmwood through Paisley and Chesley to the northern edge of the Saugeen Valley SPA. It is underlain by deep stratified clay. The Saugeen River, Teeswater River and Deer Creek have cut valleys through the clay up to 38 m deep.

West of the Saugeen Clay Plain, and extending south along the Lake Huron shore, is an area of silty to clayey till of the Huron Slope. The till is generally up to 3 m thick, and overlies stratified clay. The clay matrix of the till is likely reworked material from the underlying clay beds.

2.3.5 Soil Characteristics

Soil conditions in the Saugeen Valley SPA are shown on 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 Saugeen Valley SPA have developed under a temperate climate. These soils, which are part of the Grey-Brown Podzolic Soil Group, are well-drained and generally form underneath a layer of mixed hardwood and deciduous vegetation. Harriston silt loam is the predominant soil type of the Grey-Brown Podzolic group. This type of soil has developed in medium-textured, moderately stony materials and tends to appear in drumlinized areas.

Southwest areas of the Saugeen Valley SPA are composed mainly of the Perth series and the northwest region is composed of the Elderslie series of soils. These series are characterized by soils with imperfect drainage, smooth gentle slopes, and slow internal and external drainage

(Gillespie & Richards, 1954). Huron clay loam is a common soil type on the moraine ridges of the Port Huron Moraine System.

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 Saugeen Valley SPA, as well as the water control structures on the watercourses. Table 2.4.1 summarizes statistics about the watercourses. The Water Budget Report (SC, 2008) gives a thorough treatment of watercourses, aquifers, climatic normals and climatic trends.

TABLE 2.4.1 – River Systems in the Saugeen Valley SPA (MNR, Digital Elevation Model, 2007)

Subwatershed	*Area of Sub-watershed (km^2)*	*Elevation at Headwaters (masl)*	*Elevation at Mouth (masl)**	*Change in Elevation (m)*	*Length of Stream (km)*	*Slope of Stream (m/km)*
Saugeen Valley SPA						
Beatty Saugeen River	272.8	451.4	260.9	190.5	52.1	3.7
Main Saugeen River	1695.3	519.8	176.0	343.8	209.3	1.6
North Saugeen River	269.2	374.5	212.0	162.5	69.9	2.3
Penetangore River	181.7	281.9	176.0	105.9	37.3	2.8
Pine River	160.1	285.4	176.0	109.4	34.4	3.2
Rocky Saugeen River	281.7	424.5	304.4	120.1	46.8	2.6
South Saugeen River	795.0	494.2	259.8	234.4	115.7	2.0
Teeswater River	682.1	348.5	213.2	135.3	89.5	1.5

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

The Saugeen Valley SPA is dominated by the Saugeen River. The land is characterized by undulating topography, except for flatter terrain near Lake Huron and Dundalk. Lakes are rare here due to the permeable nature of underlying glacial deposits. Close to Lake Huron, the Pine River, Penetangore River and other small watercourses cut deeply into the soft materials as they flow westwards into Lake Huron.

The Saugeen River is one of the major river systems in southern Ontario. The main branch of the Saugeen River flows for 209 km from near Dundalk (520 masl) to Lake Huron at Southampton (176 masl). Its main tributaries are the North Saugeen River, Rocky Saugeen River, South Saugeen River, Beatty Saugeen River and Teeswater River.

The North Saugeen River runs from the east side of the Township of Chatsworth through Chesley and connects with the main river at Paisley. The Rocky Saugeen River begins south of Markdale and flows west to join the Saugeen River east of Hanover. The South Saugeen River extends from Dundalk and through Mount Forest before connecting with the main river on the

west side of Hanover. The Beatty Saugeen River has a relatively short run from its source east of Durham until it meets the South Saugeen River just south of Hanover. The Teeswater River begins south of Mildmay and meanders its way through Teeswater and Cargill before entering the main Saugeen River at Paisley. From Paisley northward, the Saugeen River occupies a fairly broad valley through to its mouth at Southampton.

Most local rivers show strong flows in the fall and spring, which are due to rainfall and snow melting respectively. During the rest of the year, the rivers and small creeks are subjected to groundwater base flow.

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 extensive river systems of the Saugeen Valley SPA, and the lands adjacent to them, are home to a diverse and abundant variety of plant and animal species. The zone where water meets land, the riparian zone, is of particular importance because these areas can be one of 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 farmland 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 wetland features 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 to farm or build on. 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 riverbanks. This situation provides no natural erosion protection and 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 caused degrading of our riparian zones due to the filling and development of these areas, which makes them prone to erosion and flooding from the river or from storm water.

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

2.5.1 Wetlands

The Saugeen Valley SPA has a diverse mix of wetland types that cover approximately 339 km^2 (7.25% of the SPA) as shown on Map 2.9. Table 2.5.1 lists the percentage of land area that wetlands occupy within 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. Fens are peat lands 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 acidic than in bogs. 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. 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 the surface during the remainder of the year.

Approximately half of the wetland areas on Map 2.9 are classed by the four types, while the remainder have not been delineated under the classification system.

There are few coastal marshes in the SPA. The Lake Huron shoreline is exposed to wave action and does not afford the shallow and sheltered waters that promote marsh development. Similarly, riverine marshes are not very common in the SPA. The largest marshlands in the SPA are the Wodehouse Marsh Wetland Complex (48 ha) in the far eastern part of the SPA and the Clifford-Harriston Complex (47 ha) to the west of Mount Forest.

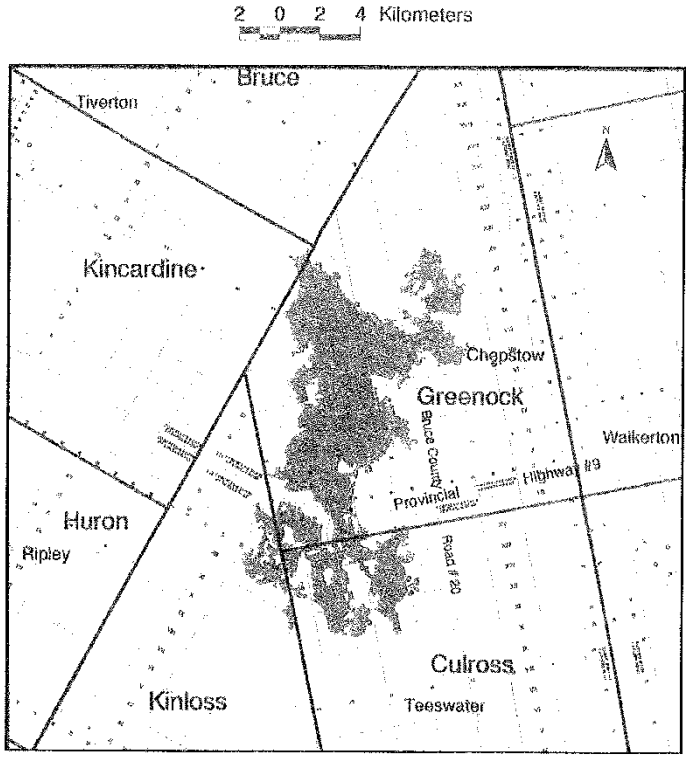
Swamp is the most abundant wetland type and is a component of the majority of wetland complexes in the SPA. Pockets of swamp can be observed in low-lying areas near watercourses where they provide storage capacity and alleviate downstream flooding in times of high water. The Greenock Swamp, located in the western parts of the Municipality of Brockton and Municipality of South Bruce, covers nearly 9000 hectares and is the largest forested wetland in Southern Ontario (Figure 2.5.1). Other notable sites are in the headwaters of the Saugeen River (Map 2.9).

The Greenock Swamp has a long history of logging, which contributed significantly to the local economy from 1879 to 1920. Every year for 25 years, over 5,000,000 board feet of white pine was extracted from the swamp.

In 1982, the MNR selected the Greenock Swamp as a life science Candidate Nature Reserve (CNR). In 1983, the swamp was identified as a provincially significant Area of Natural and Scientific Interest (ANSI). In 1989, the swamp was classified as a Class 1 wetland, the highest provincial ranking of a wetland system.

There are many biological highlights in the Greenock Swamp. A number of ferns, four trillium species and 22 different orchid species reside in the swamp. There are eight provincially rare plant species in the Greenock Swamp, of which six are nationally rare and two are threatened.

The Greenock Swamp is home to over 25 species of mammals, 17 species of amphibians and reptiles and at least 100 bird species. The Barred Owl (Boreal species) and the Red-Shouldered Hawk are two provincially rare species both located in the Greenock Swamp. Two other provincially rare birds live in the swamp: the American Coot and the Cerulean Warbler (SVCA, 2003).



(Copied from the "Greenock Swamp, Area of Natural & Scientific Interest (A.N.S.I.), a Life Science Inventory", J. Johnson 1994, Ministry of Natural Resources.)

Figure 2.5.1 – Local setting of the Greenock Swamp

A small number of bogs are located in the Saugeen Valley SPA. They are typically found in the company of swamp and marsh habitats, with the bog comprising less than a third of the wetland complex area. One of the largest bogs is found in the Beaverdale Bog Wetland north of Markdale. It hosts such interesting species as pitcher plant, black spruce, buckbean, cranberry, and goldthread. Other notable bogs are the Glammis Bog near Glammis and the Letterbreen Bog north of Mount Forest.

TABLE 2.5.1 – Wetlands as a Percentage of Land Area in Subwatersheds in the Saugeen Valley SPA (Derived from data in MNR's Natural Resources Values Information System (NRVIS))

Subwatershed	***Area of Subwatershed (km^2)***	***Total Area of Wetlands (km^2)***	***% of Subwatershed Covered by Wetlands***
Saugeen Valley SPA			
Beatty Saugeen River	272.81	22.07	8.09
Main Saugeen River	1695.26	81.96	4.83
North Saugeen River	269.19	18.65	6.93
Penetangore River	181.69	1.82	1.00
Pine River	160.14	0.89	0.56
Rocky Saugeen River	281.75	19.45	6.90
South Saugeen River	795.00	66.48	8.36
Teeswater River	682.07	120.20	17.62
Other	293.78	7.36	2.51
TOTAL	4631.69	338.88	7.32

Fens are relatively uncommon in the Saugeen Valley SPA, being found at only six sites. Harrison Lake is the only wetland complex in the SPA where fen is the dominant wetland type. Generally, fen habitat occurs in conjunction with swamp or marsh dominated sites. At Baie du Dore, adjacent to Bruce Power, the 62 ha fen is dominated by grasses and sedges, as is typical of fen habitat. The North Lakelet Complex between Clifford and Mildmay has the largest fen area at 252 ha, while the Portlaw Fen south of Flesherton is 142 ha in size.

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 MNR and includes information only about those wetlands in the Saugeen Valley SPA for which evaluations have been completed.

TABLE 2.5.2 – Wetlands Database for the Saugeen Valley SPA (Natural Heritage Information Centre, 2010)

Name	*NHIC ID*	*Area (ha)*	*Significance*	*UTM Centroid (Zone 17)*		*County*
				Easting	*Northing*	
Saugeen Valley SPA						
Baie Du Dore Wetland	7175	95	Provincial	455700	4909200	Bruce
Beaver Meadow Wetland	8133	67	Provincial	526300	4893200	Grey
Bell's Lake Wetland	10497	431.2	Provincial	521000	4907400	Grey
Binns Lake Wetland Complex	10498	51	Provincial	526800	4913200	Grey
Boothville Swamp	7907	152.8	Provincial	528500	4889300	Grey
Camp Creek Wetland Complex	10508	464.5	Provincial	510500	4887500	Grey
Carlsruhe East Wetland Complex	10509	0	Local	495600	4881700	Bruce
Chepstow Swamp	8105	308.6	Provincial	476000	4885000	Bruce
Dickies Creek Wetland Complex	9172	784	Provincial	467500	4865000	Bruce & Huron
Dornoch Swamp	10490	183.6	Local	513000	4907500	Grey
Dromore Swamp Wetland Complex	9001	183.6	Local	530900	4884600	Grey
East Formosa Wetland Complex	10511	83	Local	487500	4877500	Bruce
East Holyrood Wetland Complex	10512	50	Local	469300	4872800	Bruce
Eden Grove Wetland Complex	8107	105.8	Provincial	483500	4895500	Bruce
Elderslie Swamp	10479	477.4	Local	483300	4908700	Bruce
Glammis Bog	10518	79.3	Provincial	469000	4898000	Bruce
Greenock Swamp Wetland	8110	8947.6	Provincial	471700	4884700	Bruce
Harrison Lake Fen	9002	49.5	Local	508000	4908200	Grey
Kingarf Wetland Complex	10510	111	Local	464500	4885500	Bruce
Kinghurst Swamp	10489	507.5	Local	501500	4907500	Grey
Kinloss Creek Wetland Complex	10503	917	Provincial	465400	4874200	Bruce
Lakelet Lake Wetland Complex	9175	740	Provincial	496400	4866200	Huron
Letterbreen Bog	8117	129.3	Provincial	516700	4875800	Grey

Name	NHIC ID	Area (ha)	Significance	UTM Centroid (Zone 17)		County
				Easting	Northing	
Lorne Beach Swamp	7173	28	Local	451500	4898500	Bruce
Louise Swamp	8993	54.7	Local	498300	4901800	Grey
Louise, Boyd and McDonald Lakes	8120	289.2	Provincial	504300	4901000	Grey
MacGregor Point Wetland Complex	7492	420.2	Provincial	461000	4916000	Bruce
McKechnie Creek Wetland	10492	124.9	Provincial	513500	4901500	Grey
McLean Lake Wetland	8122	141.1	Provincial	509800	4898000	Grey
Melancthon #36 Wetland	10548	304	Local	457400	4884500	Dufferin
Mountain Creek Wetland	8126	174.4	Provincial	509400	4905400	Grey
Muskrat Creek Wetland Complex	8761	251	Local	480300	4866800	Huron
Negro Lakes Wetland	8128	29.3	Provincial	512200	4909600	Grey
North Lakelet Wetland Complex	8763	289.5	Local	497000	4872000	Bruce
North Teeswater Wetland Complex	10516	18	Local	474600	4872300	Bruce
Nuttley Fen	10480	7.5	Provincial	480800	4911500	Bruce
Portlaw Fen	7878	134.4	Provincial	540500	4893600	Grey
Proton Station Wetland Complex	7879	816.8	Provincial	539900	4892000	Grey
Robson Lakes-Hamilton Creek-Lily Oak Wetland	10484	876.7	Provincial	520900	4919300	Grey
Scott Point Wetland Complex	7422	201.8	Provincial	457000	4911600	Bruce
South Saugeen River Wetland	9429	146	Provincial	509200	4872700	Grey
South Walkerton Wetland Complex	10515	92	Local	486100	4881800	Bruce
Stewart and Minkes Lakes Wetland	7884	97.2	Provincial	506500	4913800	Grey
Stewart Swamp	10523	47.5	Local	447500	4888500	Bruce
Teeswater Wetland Complex	9178	862	Provincial	472000	4868000	Huron
The Sinkhole Wetland	10485	138.3	Local	525000	4909500	Grey
Topcliff Swamp Wetland Complex	10506	291	Provincial	526600	4889000	Grey
Traverston Creek Wetland	10477	213.6	Provincial	524000	4901000	Grey
Turner-Gillies-Wilcox Wetland Complex	7888	408	Provincial	535200	4893700	Grey
Welbeck Wetland Complex	7889	318	Provincial	510800	4901700	Grey
West Kinlough Wetland Complex	10513	129	Local	463500	4881500	Bruce
West Neustadt Wetland Complex	10517	41	Local	497900	4879300	Bruce
Westford Complex Wetland	10514	19	Local	468500	4874700	Bruce
Yoevil Swamp Wetland Complex	10507	752	Provincial	524900	4881600	Grey

2.5.2 Woodlands and Vegetated Riparian Areas

Woodlands can increase infiltration to shallow groundwater areas and decrease the speed of overland flow. 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 floodwaters, control erosion, and may contribute to groundwater recharge.

Map 2.10 shows the naturally vegetated areas in the Saugeen Valley SPA.

2.5.2.1 Woodlands

The SPA features hardwood forests characteristic of the Great Lakes - St. Lawrence Lowlands forest type. There is a marked decrease in the percentage of forested areas on the landscape from east to west.

Prior to and at the time of settlement, extensive forests covered the SPA. Across a large portion of the watershed, forests were removed to make way for agricultural crops. As a result, by the early 1880's these once-forested areas were reduced to the farm woodlots that can be observed today. In many places, the cleared land proved to be marginal farmland and was later abandoned or removed from farming. A small fraction of this land has since been returned to forest cover. Most of the Greenock Swamp, the Osprey Wetlands and other smaller wetlands were never cleared due to excessive soil moisture.

In eastern parts of the Saugeen Valley SPA, land clearing has created a more fragmented set of woodlands. However, many of the rolling hillsides and swampy lowlands remain forested. The western half of the Saugeen Valley SPA has the lowest percentage of woodland. Much of the land has been cleared for pasture and crops. The remaining pockets of forest tend to be isolated woodlots away from roadways, sometimes referred to as “the back forty”. These smaller blocks do not provide “interior” habitat that is preferred by certain wildlife and plant species; however, the woodlands still provide valuable ecological functions.

2.5.2.2 Vegetated Riparian Areas

Generally, most watercourses in the Saugeen Valley SPA have natural vegetation in the riparian zone along a large proportion of their length. Eastern parts of the Saugeen Valley SPA have the highest occurrence of forest in riparian areas. Parts of the Pine River and watercourses in the western Saugeen Valley SPA have the lowest proportion of vegetated riparian area. However, extension programs and the promotion of best management practices have increased the occurrence of vegetated riparian buffers and reduced the number of farms where cattle are allowed direct access to watercourses and riparian areas.

A buffer strip is a strip of vegetation that has been planted or left beside a natural area to protect it from surrounding land uses. A buffer strip has many important functions and benefits. A properly function buffer strip acts as a living filter, trapping and treating sediments and other minerals. Buffer strips also help to stabilize stream banks and prevent soil erosion. They also increase the soil’s water-holding capacity, reducing the impacts of flooding and droughts. A healthy riparian and buffer zone provides fish and wildlife habitat through added shade, cleaner and cooler water, and superior plant variety (Ontario Cattlemen’s Association, 2005).

Map 2.10 shows riparian areas in the Saugeen Valley 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.

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 DFO and other consultant companies. Saugeen Conservation does not have a fisheries department. The SPA has a diverse amount of fish inhabiting the water. For example, brown trout and brook trout can be found in the headwaters of the Saugeen River.

There was a fish community study completed in 2005-2006 at 25 sites throughout the Saugeen watershed. The goal was to update the species list and verify the presence/absence of species-at-risk. There were 1,344 fish captured, representing 45 species – two of which are at risk, the black redhorse shiner and the pugnosed shiner (D. Marson, N.E Mandrak and A. Drake, 2007). A drain classification study was carried out by SVCA in 2000-2002, which was funded by the DFO. The purpose of the project was to produce fish habitat classifications for all the municipal drains within Saugeen Conservation's jurisdiction. 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 Saugeen Valley SPA is shown on 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. Many of the streams within the SPA do have excellent naturally sheltered segments (SVCA website). 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.

TABLE 2.6.1 – Classification by Thermal Regime of Streams in the Saugeen Valley SPA (MNR, 2000)

Saugeen Valley SPA	
Subwatershed Name	***Thermal Regime: Streams***
Beatty Saugeen River	**Cold:** Beatty Saugeen River, McGillvary Creek, Norman Reeves Creek, Skunk Creek
Main Saugeen River	**Cold:** Allen's Creek, Bluewater Lakes Tributary, Brown's Creek, Bunessan Creek, Cameron Creek, Camp Creek, Deer Creek, Durham Creek, Habermehl Creek, Little Spring Creek, Louise Creek, McDonald Lake Tributary, McMillan Creek, Mountain Creek, Otter Creek, Ruhl Creek, Silver Creek, Snake Creek Tributary, Styx River, Varney Creek, Vesta Creek, Willow Creek **Cold /Cool:** Pearl Creek, Saugeen River **Cool:** Burgoyne Creek, Little Mill Creek, Mill Creek, Snake Creek
North Saugeen River	**Cold:** Hamilton Creek, Middleton Creek, Negro Creek **Cold /Cool:** North Saugeen River **Cool:** Walker Lake Tributary **Warm:** Stewart Lake Tributary
Penetangore River	**Cold:** Kincardine Creek, North Penetangore River, Penetangore River
Pine River	**Cold:** Clark Creek **Cool:** Pine River **Warm:** South Pine River
Rocky Saugeen River	**Cold:** Barhead Creek, Black's Creek, Markdale Creek, Rocky Saugeen River, Traverston Creek **Cold /Cool:** McKechnie Creek **Cool:** Bell's Lake Tributary
South Saugeen River	**Cold:** Bell's Creek, Carrick Creek, Cemetery Creek, Fairbanks Creek, Letterbreen Creek, South Saugeen River, Woodland Springs Creek **Cold/Cool/Warm:** Meux Creek **Cold/Warm:** Coon Creek **Warm:** South Saugeen River Tributary
Teeswater River	**Cold:** Allen's Creek, Alps Creek, Black Snake Creek, Formosa Creek, Muskrat Creek **Cold/Cool:** Greenock Creek, Teeswater River **Cold/Warm:** Belmore Creek **Cool:** Kinlough Creek, Plum Creek, Schmidt Creek, Snake Creek
Lake Fringe	**Cold:** Andrews Creek, Little Sauble River, Tiverton Creek, Underwood 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. Biomonitoring 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.

Map 2.11 shows the location of biomonitoring sites in the Saugeen Valley SPA.

Saugeen Conservation participates in the Ontario Benthos Biomonitoring Network (OBBN) as a means of measuring water quality conditions and overall ecological health within the various watersheds. The OBBN is a provincially standardized program that was jointly developed with Environment Canada – Environmental Monitoring and Assessment, Environment Canada – National Water Research Institute, and the Ontario Ministry of the Environment and Climate Change. The OBBN uses a reference condition approach that compares reference sites to test sites. Reference sites may not be pristine, but serve as a measure to test sites that may represent a site showing a particular stress. Test sites can be statistically compared to reference sites to determine if they are similar or not.

TABLE 2.6.2 – Family Biotic Index (FBI) Values for Benthic Macroinvertebrates in Subwatersheds in the Saugeen Valley SPA (derived from Watershed Report Cards, Saugeen Conservation, 2008)

Subwatershed	***Family Biotic Index (FBI) Score***
Beatty Saugeen River	4.27
Main Saugeen River - Lower (downstream of Walkerton)	5.68
Main Saugeen River – Upper (upstream of Walkerton)	4.09
North Saugeen River	3.76
Penetangore River	6.02
Pine River	6.01
Rocky Saugeen River	5.20
South Saugeen River	5.11
Teeswater River	5.52
Lake Fringe	6.19

A system called the “Hilsenhoff Family Biotic Index” is used by Saugeen Conservation to assess water quality based on the number and type of invertebrates found in a sample. Each invertebrate species is given a score that relates to its pollution-tolerance. A larger score indicates an organism that is more tolerant to pollution. Further information can be found in Watershed Report Cards published by Saugeen Conservation in 2008. Family Biotic Index (FBI) values range from one (healthy) to ten (degraded). The data shown in Table 2.6.2 are the average benthic values calculated for samples taken from 2002-2006 for each subwatershed.

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 to help 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. No thorough study of the occurrence of these species has been compiled for the Saugeen Valley SPA.

Sources of information about species at risk within the Saugeen Valley 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 2.6.3 – Species at Risk in the Saugeen Valley SPA. The list includes species of bird, fish, insect, mammal, mollusc, plant and reptile.

TABLE 2.6.3 – Species at Risk in the Saugeen Valley Source Protection Area (Species at Risk webpage, Ontario Ministry of Natural Resources, 2010)

Status	***Endangered***	***Threatened***	***Special Concern***
Amphibian	• Jefferson Salamander		
Bird	• Henslow's Sparrow *(Ammodramus henslowii)*	• Whip-poor-will *(Caprimlugus vociferous)* • Chimney swift *(Chaetura pelagic)* • Least Bittern *(Ixobrychus exilis)*	• Black Tern *(Chlidonias niger)* • Common nighthawk *(Chordeiles minor*) • Cerulean Warbler *(Dendroica cerulean)* • Yellow-breasted Chat *(Icteria virens)* • Red-headed Woodpecker *(Melanerpes erythrocephalus)* • Louisiana Waterthrush *(Seiurus motacilla)* • Short-eared Owl *(Asio flammeus)*
Fish	• Redside Dace *(Clinostomus elongates)* • Shortnose Cisco *(Coregonus reighardi)* - likely extirpated • Pugnosed Shiner *(Notropis anogenus)*	• Lake Sturgeon *(Acipenser fulvescens)* • Shortjaw Cisco *(Coregonus zenithicus)* • Black Redhorse Shiner *(Moxostoma duquesnei)*	• Northern Brook Lamprey *(Ichthyomyzon fossor)* • Deepwater Sculpin

Status	Endangered	Threatened	Special Concern
Insect			• Monarch Butterfly *(Danaus plexippus)* • West Virginia White *(Pieris virginiensis)* • Hungerford's Crawling Water Beetle*
Mammal	• Mountain Lion or Cougar *(Puma concolor)*		
Mollusc		• Rainbow Mussel *(Villosa iris)*	
Plant	• Butternut *(Juglans cinerea)* • American Ginseng *(Panax quinquefolius)* • Pitcher's Thistle *(Cirsium pitcheri)*	• Dwarf Lake Iris *(Iris lacustris)*	• Tuberous Indian-plantain *(Arnoglossum plantagineum)* • Hart's-tongue Fern *(Asplenium scolopendrium americanum)* • Hill's Pondweed *(Potamogeton hillii)*
Reptile	• Spotted Turtle *(Clemmys guttata)*	• Queensnake *(Regina septemvittata)* • Butler's Gartersnake *(Thamnophis butleri)*	• 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
* Not officially "at risk" in Ontario; endangered in USA

The redside dace is a species at risk in Ontario and inhabits streams within the Saugeen Valley SPA. In 2004, the MNR and Ontario Streams, undertook a monitoring project for the redside dace in the Saugeen Valley SPA. The study consisted of 27 sites, 24 of which were based on historical evidence that the redside dace inhabited the site, and three of which were added due to the lack of historical data of the present of the dace. Results from the study demonstrate that only three of the 27 sites still supported the redside dace. Maintaining adequate water quality and understanding quantity within areas that provide habitat for the redside dace is paramount in protecting the species.

While not officially designated as "at risk" in Ontario, the Hungerford's Crawling Water Beetle is only found in Canada at sites within the Grey Sauble SPA and the Saugeen Valley SPA, such as in the North Saugeen River near Chesley. The beetle species is classified as endangered by the U.S. Fish and Wildlife Service.

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 serve 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, invertebrates, insects, and fish. Little is known about the number of species or distribution in the Saugeen Valley 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 Saugeen Valley SPA are listed in Table 2.6.4.

TABLE 2.6.4 – Invasive Species in the Saugeen Valley 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

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 90,000 people live in the Saugeen Valley SPA (StatCan Census, 2006). The population figures for each municipal jurisdiction that lies wholly or partially within the SPA are given in Table 2.7.1. The Municipality of West Grey is the most populated municipality in the Saugeen Valley SPA with three other municipalities also being over 11,000 in population. With the exception of Hanover, each municipality is comprised of settlement areas surrounded by extensive rural areas.

Population density is shown on Map 2.12. The largest concentration in the SPA occurs in Hanover where there are more than 700 people per square kilometre. Similar concentrations can be found in the larger urban centres, such as Port Elgin, Kincardine, Walkerton, Durham, and Southampton. The vast majority of the Saugeen Valley SPA averages less than 20 people per km^2. The lowest population densities occur in the farmlands away from Lake Huron and in the eastern portions of the SPA.

TABLE 2.7.1 – Population and Densities for Municipalities in the Saugeen Valley SPA (StatCan Census, 2006)

Municipality	***Total Population*****	***Total Area (km^2)*** # +	***Population Density*** *(people per km^2)*
Municipality of Arran-Elderslie*	6,747	466.4	14.47
Municipality of Brockton	9,641	570.0	16.91
Municipality of Grey Highlands*	9,480	891.9	10.63
Municipality of Kincardine	11,173	660.5	16.91
Municipality of Morris-Turnberry*	3,403	379.1	8.98
Municipality of South Bruce	5,939	488.2	12.17
Municipality of West Grey	12,193	884.3	13.79
Town of Hanover	7,147	10.0	716.55
Town of Minto*	8,504	301.5	28.21
Town of Saugeen Shores	11,720	266.5	43.98
Township of Chatsworth*	6,392	600.1	10.65
Township of Howick*	3,882	288.8	13.44
Township of Huron-Kinloss*	6,515	477.0	13.66
Township of Southgate*	7,167	645.6	11.10
Township of Wellington North*	11,175	535.1	20.88

Notes for Table 2.7.1

* Population figures, area and population density are for the entirety of the municipality and do not reflect the fact that only a portion of the municipality lies within the Saugeen Valley SPA.

** Population figures derived from the Statistics Canada 2006 Census of Population: Statistics Canada GeoSuite 2006 Census.

\# Area of municipalities derived from the Statistics Canada 2006 Census of Population Census Subdivision Cartographic Boundary File. Statistics Canada 2006 Cartographic Boundary Files. © Minister of Industry, 2007

\+ The cartographic boundary files provided with the census data are not intended for detailed and accurate mapping. Therefore, the reader is cautioned that values for municipal surface areas shown in the above table may differ from those used elsewhere in this document.

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 1800s and 1900s 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 shoreline, but can be

found at Kincardine and Southampton. Water was also a significant source of power for industries, such as sawmills, gristmills and manufacturing plants. Many small and medium size communities in the SPA owe their beginnings to the waterpower afforded by their riverside setting.

The west half of the planning region is expected to grow in population by 10% over the next 20 years, whereas the eastern half is projected to have double that rate, or 20% growth (Climans, 2007). The Ministry of Finance (2000) forecast projected growth from 1999 to 2021 at 7.5% in Bruce County and 8.3% in Grey County. "The County of Grey Development Charges Study" (Hemson, 2006) gives a projected increase in the number of housing units for Grey County. For the period from 2006 to 2025, housing units would increase by 37%.

Urban areas near Bruce Power are anticipating population growth in connection to construction and long-term employment prospects at the facility.

2.7.2 Land Use

Assessing the current and future land-use needs of our society in general, and within the Saugeen Valley SPA in particular, is a difficult task. When the different and conflicting values related to land use, including ecological values, are also taken into account, the task becomes even more daunting.

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 wastewater 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 apply 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 it 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. They provide a broad policy framework for other planning documents, such as bylaws.

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 also have a stated objective to establish policies that will protect groundwater recharge areas, coldwater streams, lakes and other surface waters for their habitat, and 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 Saugeen Valley SPA. Note that some land use classes have been harmonized to account for differing categories between the various counties' official plans.

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, street lighting, gas, cable, sewer and water. They also act as service centres for the rural areas.

There are a dozen communities in the Saugeen Valley SPA with over one thousand residents and more than a dozen with several hundred residents. Only a small percentage of land in the SPA is classed as 'urban residential'. Interspersed with the residential are the other urban land uses. Parks and amenities are located nearby for the enjoyment of the urban residents, as well as people in the outlying areas.

A diverse mix of residential housing stock occurs in the larger centres where turn-of-the-century brick homes, modern bungalows, townhouses, duplexes and apartment blocks are located.

2.7.2.2 Rural Areas

Rural areas are lands outside settlement areas. The Saugeen Valley 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 plans, 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.

The historic settlement pattern was rectangular blocks of land with a farmhouse and barn at the end of the lane. In the last few decades, the trend has been to sever a parcel from the road frontage for residential construction and for homes to be built on previously undeveloped blocks of rural land. This has had the effect of distributing more people (and their wells) into agricultural areas.

2.7.2.3 Rural Residential

Dozens of small settlement areas with up to a few hundred people occur in the Saugeen Valley SPA. The typical configuration may include a church, a few commercial establishments and several homes focussed near a crossroads. Alternatively, houses on estate-size lots line sections of the county roads. Nearly all of these rural residential sites are serviced by private wells and septic fields.

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 as well as the inland lakes. Lake Huron sites occur around Kincardine, Port Elgin and Southampton. Lake Rosalind, Marl Lakes, Pike Lake, and McCullough Lake are among the popular inland lakes. Commercial campgrounds exist, some with upwards of a few hundred sites. Some of these have the benefit of municipal sewer and water.

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. The Town of Hanover has development of one kind or another over most of the land within its municipal boundaries, but is not yet 'built out'.

2.7.2.6 Industrial/Commercial Sectors Distribution

Major industrial sites include Bruce Power near Kincardine, manufacturing facilities in Walkerton and wood products industries in Durham. Other industries are widely scattered and are located in rural areas in some instances. Industrial parks have been developed in some of the larger centres. A cross-section of this sector would include Bruce Power (Tiverton), Ontario Power Generation (Tiverton), Commercial Alcohols (Tiverton), Pine River Cheese (Kincardine), Gay Lea Foods (Teeswater), Energizer (Walkerton), West Bros Furniture (Hanover), Durham Furniture (Durham, Hanover), Chapman's Ice Cream (Markdale), Neustadt Spring Brewery (Neustadt), and Brick Brewing Company (Formosa). This list is by no means exhaustive, but serves to illustrate the diversity of firms operating in the SPA.

The traditional downtowns still thrive in communities throughout the SPA. The big box stores, strip malls and shopping centres are limited in scope, with the exception of Port Elgin, Kincardine and Hanover.

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 preferential 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. Several pit or quarry locations in the Saugeen Valley SPA currently have permits to take water for aggregate washing purposes. The majority of these operations are located in the Teeswater and Saugeen River watersheds and draw water from surrounding rivers, lakes and groundwater sources. 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.

Table 2.7.2 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

Saugeen Valley SPA. As shown on this map, active quarry operations are scattered across the SPA with some concentrations near Port Elgin, Durham and Teeswater.

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 and a Class "B" license is issued for extractions below this amount. Under the Bruce County and Grey County Official Plans, proposals for expansions or new operations are to be accompanied by the appropriate license and a detailed report on the related impacts to adjacent land uses, physical and natural environment, ground and surface water sources, and to potential and existing municipal supply systems (Grey County Official Plan – Section 2.7; Bruce County Official Plan – Section 4.8).

TABLE 2.7.2 – Pits and Quarries by Subwatershed in the Saugeen Valley SPA

Subwatershed	***Area of Subwatershed (km^2)***	***Area of Active Pits/Quarries (km^2)***	***% of Subwatershed Used for Pits/Quarries***
Beatty Saugeen River	272.81	1.99	0.73
Main Saugeen River	1695.26	17.71	1.04
North Saugeen River	269.19	3.25	1.21
Penetangore River	181.69	0.28	0.16
Pine River	160.14	0.05	0.03
Rocky Saugeen River	281.75	1.84	0.65
South Saugeen River	795.00	2.03	0.26
Teeswater River	682.07	7.13	1.05
Lake Fringe	299.39	4.22	1.41
TOTAL and Average%	4637.30	38.50	0.83

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.

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

2.7.2.8 Transportation

The road network is illustrated on Map 2.2 - Settlement Areas and Communities. The principal north-south roadways are Highway 21 near Lake Huron, Highway 6 in the central portion of the SPA and Highway 10 in the east. The Highway 9 and 89 corridors in the southern portion of the Saugeen Valley SPA run east and west from Lake Huron to the eastern most edge of the SPA. County roads provide vital links between communities, while municipal roads provide the access to businesses and properties across rural and urban areas.

Railway access across the SPA was extensive at one time, but these routes have been abandoned. Some of the former railway corridors have been converted to trail systems for recreational purposes.

Water transportation continues to play both a commercial and recreational role in the planning region. The nearest commercial facilities for lake freighters and ocean-going vessels are Owen Sound in the north and Goderich in the south. Fishing tugs operate from Port Elgin and Southampton. Marinas are located in Port Elgin, Southampton and Kincardine.

There are approximately 10 small airfields scattered across the Saugeen Valley SPA. The majority of these are municipally funded airports that, in some cases, offer small charter and passenger flights, sightseeing tours and flying schools. They are also available for storage and flights of privately owned planes.

2.7.2.9 Utilities

Utilities and the associated corridors and infrastructure extend across the SPA to supply electricity, gas, phone, cable and water to businesses and residents. The energy sector is a significant one in the Saugeen Valley SPA. Bruce Power, located between Port Elgin and Kincardine, was the first nuclear power facility in Canada. It contributes a considerable portion of Ontario's electrical capacity. Production will increase with the refurbishing of reactor units at the facility. Wind power is growing significantly with the development of several wind turbine projects near the Lake Huron shore and at other proposed sites.

2.7.2.10 Institutional Lands

Institutional properties occur in nearly every community in the SPA and include churches, schools and community halls. Municipal and government offices also form part of the institutional land use. These facilities are significant because of their public functions and role as a venue for community events. The buildings are often considerable in size and are situated on large parcels of land. In rural portions of the SPA, institutional facilities may operate on their own well and septic system.

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 Grey County Official Plan states that Hazard Land includes "…floodplains, steep or erosion prone slopes, organic or unstable soils, poorly drained areas, and lands along the Georgian Bay shoreline impacted by flooding, erosion, and/or dynamic beach hazards" (Sec 2.8.1). Similar wording can be found in the Bruce County Official plan (Sec. 5.8). 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.

Conservation Authorities regulate development near watercourses, slopes and wetlands. Under the Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation, permits may be required for works within or adjacent to rivers, streams, wetlands,

and the shorelines of Lake Huron and inland lakes. The intent of the regulation is to ensure public safety with regard to natural hazards.

2.7.2.12 Other Land Use

Zoning maps and official plans can contain categories of land use other than those described in Section 2.7.2. Educational properties, such as Scout camps and church camps, can be found near some of the lakes and rivers in the Saugeen Valley SPA. Reference should be made to the Official Plans 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. Primary and secondary settlement areas tend to have wastewater treatment plants, whereas tertiary settlement areas and rural areas depend on septic systems.

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 are one dozen municipally owned wastewater treatment facilities in the Saugeen Valley SPA. Most communities in the Saugeen Valley SPA, such as Kincardine and Markdale, use sewage lagoons.

Non-Serviced Areas

In non-serviced areas, waste is typically discharged to private septic systems and holding tanks. Septic systems are suitable for treating household septage provided the system is properly constructed and maintained. In Ontario, septic systems are regulated under the Building Code by the Ministry of Municipal Affairs and Housing. 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 (www.ene.gov.on.ca, MOE, 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 encounters 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). 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). 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. Some of the old tanneries, mills and factory sites for furniture and other goods can be found in most medium to large size communities across the Saugeen Valley 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 Ontario Regulation 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 October 2009, 11 such sites in the Saugeen Valley SPA were in the Brownfields Environmental Site Registry. Eight former industrial sites were converted to residential use. Two sites were reused for commercial purposes after rehabilitation work, while one residential site was rehabilitated.

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 Saugeen Valley SPA are shown on Map 2.14.

The Saugeen Valley SPA has one known, active private gas well located southwest of Robbtown in the Township of Southgate. The remaining 36 wells within the region have been abandoned. The Municipality of Kincardine, the Township of Huron-Kinloss, the Municipality of Brockton and the Municipality of Southgate have the heaviest concentrations of abandoned and dry wells.

2.7.6 Agricultural Resources

Agriculture across the Saugeen Valley SPA is highly prevalent and, for the most part, accounts for the largest percentage of total land use. Map 2.13 shows the extent of agricultural land use as compared to other land use classes in the SPA. Pasture and forage crops are the most common agricultural land uses. The largest proportion of field crops occurs in the western portions of the Saugeen Valley SPA. This area is also characterized by a high degree of tile drainage, which assists in the drainage of excess water from the soil, thereby improving overall crop productivity. Approximately 20 percent of the total land area of the Saugeen Valley SPA is on a tile drainage system (OMAF – Tile Drainage dataset, 2005). These activities tend to diminish toward the more eastern portions of the region.

Land capability for agriculture has been measured by the Canada Land Inventory, which is based on soil characteristics derived from various soil surveys. The Saugeen Valley SPA has less than one percent of land classified as incapable of supporting agriculture.

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

According to this census, between 50 and 75 percent of farmland is used for crops. Livestock production is very strong and makes the region one of the top producers in Ontario, particularly for beef cattle (Statistics Canada, 2006 Census of Agriculture). Dairy farms also directly support two major dairy processing companies in the region: Gay Lea Foods in Teeswater and Pine River Cheese in the Township of Huron-Kinloss.

TABLE 2.7.3(a) – Number of Farms by Commodity in the Saugeen Valley SPA (StatCan Census of Agriculture, 2006)

Commodity (Number of Farms)	***Census Subdivision***						
	South Bruce	**Huron-Kinloss**	**Kincardine**	**Brockton**	**Arran-Elderslie**	**Saugeen Shores**	**West Grey**
Dairy cattle and milk production	82	25	24	37	21	2	52
Beef cattle ranching and farming, including feedlots	159	91	118	159	211	31	212
Hog and pig farming - # of farms	25	18	14	19	9	1	16
Chicken egg production	2	2	0	2	1	0	3
Broiler and other meat-type chicken production	10	2	5	6	3	1	3
Turkey production	1	0	0	1	0	0	3
Poultry hatcheries	0	0	0	0	0	0	1
Combination poultry and egg production	0	0	0	0	0	0	0
Other poultry production	0	0	0	0	0	0	1
Sheep farming	12	5	15	11	7	4	28
Goat farming	3	4	4	6	4	3	8
Apiculture	1	1	1	0	4	2	6
Horse and other equine production	16	12	18	25	12	6	51
Fur-bearing animal and rabbit production	2	0	0	3	0	1	1
Livestock combination farming	22	42	20	13	10	0	40
All other miscellaneous animal production	0	0	2	3	0	0	6
Soybean farming	26	31	22	29	9	11	14
Oilseed (except soybean) farming	0	0	1	0	0	0	0
Dry pea and bean farming	1	2	4	0	0	0	0
Wheat farming	8	7	5	6	1	4	4
Corn farming	13	5	2	10	4	3	1
Other grain farming	46	56	36	37	8	8	17
Potato farming	1	0	1	1	1	0	1
Other vegetables (except potato) and melon farming	3	2	1	4	2	3	6
Fruit and tree-nut farming	0	3	0	1	2	3	4
Mushroom production	0	0	0	0	0	0	1
Other foods grown under cover	0	2	0	0	0	0	0
Nursery and tree production	2	0	2	2	3	0	14
Floriculture production	1	1	1	1	0	1	4
Tobacco farming	0	0	0	0	0	0	0

Commodity (Number of Farms)	*Census Subdivision*						
	South Bruce	Huron-Kinloss	Kincardine	Brockton	Arran-Elderslie	Saugeen Shores	West Grey
Hay farming	28	8	21	42	33	10	81
Fruit and vegetable combination farming	0	1	0	0	1	0	1
All other miscellaneous crop farming	12	9	15	18	9	5	25
Total area of farms							
#of farms reporting	476	329	332	436	355	99	604
Hectares	40,830	40,800	32,014	45,031	42,885	8,477	44,992
Land use Table 4.3-2							
#of farms reporting	450	309	292	400	316	88	531
Hectares	29,193	31,978	21,677	30931	23,102	5,512	25,683

+ data is for entire municipality and not just the portion that lies within the Saugeen Valley SPA.
x data 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(b) – Number of Farms by Commodity in the Saugeen Valley SPA (StatCan Census of Agriculture, 2006)

Commodity (Number of Farms)	*Census Subdivision*						
	Southgate	Grey Highlands	Chatsworth	Minto	Wellington North	Howick	Morris-Turnberry
Dairy cattle and milk production	34	29	13	45	66	36	14
Beef cattle ranching and farming, including feedlots	194	215	150	70	121	70	104
Hog and pig farming - # of farms	19	15	2	32	28	48	33
Chicken egg production	1	3	2	2	7	3	3
Broiler and other meat-type chicken production	6	0	3	5	19	6	2
Turkey production	1	1	0	0	1	0	1
Poultry hatcheries	0	0	0	0	0	0	0
Combination poultry and egg production	0	0	0	0	1	0	1
Other poultry production	0	1	0	0	3	2	0
Sheep farming	18	12	18	5	7	8	8

Commodity (Number of Farms)	*Census Subdivision*						
	Southgate	Grey Highlands	Chatsworth	Minto	Wellington North	Howick	Morris-Turnberry
Goat farming	5	1	5	2	4	3	5
Apiculture	2	1	5	2	2	0	2
Horse and other equine production	30	28	32	19	37	16	18
Fur-bearing animal and rabbit production	2	2	2	2	0	0	0
Livestock combination farming	33	36	40	20	23	53	30
All other miscellaneous animal production	2	9	4	0	2	1	0
Soybean farming	2	4	5	16	30	16	30
Oilseed (except soybean) farming	0	2	0	0	1	0	0
Dry pea and bean farming	0	0	0	0	0	0	2
Wheat farming	1	4	0	2	9	5	1
Corn farming	1	1	0	5	6	9	16
Other grain farming	13	15	6	26	29	34	29
Potato farming	2	2	0	0	2	0	1
Other vegetables (except potato) and melon farming	1	1	5	0	3	1	3
Fruit and tree-nut farming	1	4	3	1	2	0	0
Mushroom production	0	1	1	0	0	0	0
Other foods grown under cover	1	0	0	1	0	0	1
Nursery and tree production	10	9	5	3	4	0	1
Floriculture production	1	3	2	2	3	0	1
Tobacco farming	0	0	0	0	0	0	0
Hay farming	61	85	53	21	34	7	13
Fruit and vegetable combination farming	0	1	0	0	0	0	0
All other miscellaneous crop farming	13	22	19	7	21	5	0
Total area of farms							
#of farms reporting	454	507	375	288	465	323	319
Hectares	40,381	46,897	28,879	28,563	88,899	27,368	30,361
Land use Table 4.3-2							
#of farms reporting	401	469	332	263	410	285	289
Hectares	24,343	25,668	14,227	23,101	30,534	20,565	20,998

\+ data is for entire municipality and not just the portion that lies within the Saugeen Valley SPA.
x data 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 (a) – Agricultural Crops by Acreage in Saugeen Valley SPA (StatCan Census of Agriculture, 2006)

Crop (values in acres)	*Census Subdivision*						
	Minto	Wellington North	Howick	Morris-Turnberry	South Bruce	Huron-Kinloss	Kincardine
Annual Crops							
Total wheat	12,341	13,943	7,740	6,484	7,882	17,339	9,762
Oats	239	650	302	227	543	1,567	647
Barley	3,159	5,138	2,009	1,999	5,937	1,634	3,011
Mixed Grains	1,844	4,202	2,767	1,826	2,116	3,155	3,365
Total corn	13,675	13,400	16,951	15,860	16,900	14,419	6,051
Total Rye	x	185	43	0	x	x	136
Canola	x	449	46	x	0	397	x
Soybeans	13,962	13,815	10,732	14,109	12,936	18,106	10,832
Flaxseed	0	x	0	0	x	x	352
Dry field peas	x	94	78	0	447	145	x
Dry White Beans	189	x	x	1348	2,330	3,993	1,934
Other Dry Beans	386	177	x	528	x	2,783	x
Potatoes	5	140	18	5	9	24	x
Sunflowers	0	0	0	0	0	0	0
Triticale	0	0	0	0	x	150	0
Other field crops	0	0	0	0	619	858	664
Total vegetables (excluding greenhouse vegetables)	x	98	x	67	116	437	54
Perennial Crops							
Alfalfa and alfalfa mixtures	8,880	16,206	7,744	7732	17,917	11,313	13,324
All other tame hay and fodder crops	1,447	5,155	1,064	1,543	3,508	2,223	3,180
Total area of fruits, berries and nuts	10	41	5	9	x	34	19
Tame or seeded pasture	2,116	3,915	3,345	6,974	6,340	8,211	10,369
Natural land for pasture	1,619	2,958	x	2,299	3,725	3,713	4,964
Summerfallow land	40	152	x	94	185	x	x
Land in crops	57,084	75,450	50,817	51,886	72,137	79,019	53,566

+ data is for entire municipality and not just the portion that lies within the Saugeen Valley SPA.
x data 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 (b) – Agricultural Crops by Acreage in Saugeen Valley SPA (StatCan Census of Agriculture, 2006)

Crop (values in acres)	*Census Subdivision*						
	Brockton	**Arran-Elderslie**	**Saugeen Shores**	**West Grey**	**Southgate**	**Grey Highlands**	**Chatsworth**
Annual Crops							
Total wheat	9,136	6,650	2,543	3,537	3,771	3,295	1,246
Oats	1,033	1,015	91	836	1,013	1,151	814
Barley	3,087	3,021	906	4,184	6,103	5,895	2,302
Mixed Grains	4,242	3,027	409	6,336	7,022	5,741	2,704
Total corn	16,436	9,975	1,456	7,561	9,698	4,007	2,708
Total Rye	75	42	x	85	257	x	97
Canola	x	x	0	39	x	347	0
Soybeans	15,029	7,103	2,924	4,676	3,069	2,117	2,399
Flaxseed	0	0	0	x	x	104	x
Dry field peas	x	0	0	x	0	x	0
Dry White Beans	1149	x	x	179	x	x	0
Other Dry Beans	0	x	0	x	0	x	0
Potatoes	x	9	x	26	23	36	10
Sunflowers	0	0	0	x	x	x	x
Triticale	115	x	0	0	95	91	0
Other field crops	x	x	x	x	360	350	170
Total vegetables (excluding greenhouse vegetables)	151	127	x	96	24	38	44
Perennial Crops							
Alfalfa and alfalfa mixtures	20,251	18,389	3,616	28,545	20,591	31,339	16,784
All other tame hay and fodder crops	5,266	7,075	694	6,854	7,335	8,212	5,735
Total area of fruits, berries and nuts	54	19	46	91	15	128	31
Tame or seeded pasture	10,987	25,574	2,499	11,800	9,199	16,089	11,560
Natural land for pasture	6,398	8,175	1,375	7,380	5,342	9,982	7,049
Summerfallow land	227	x	155	130	356	239	72
Land in crops	76,431	57,086	13,621	63,465	60,152	63,426	35,155

+ data is for entire municipality and not just the portion that lies within the Saugeen Valley SPA.
x data 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 2.7.5 (a) – Number of Livestock in Saugeen Valley SPA (StatCan Census of Agriculture, 2006)

Livestock (number of animals)	***Census Subdivision***						
	Minto	**Wellington North**	**Howick**	**Morris-Turnberry**	**South Bruce**	**Huron-Kinloss**	**Kincardine**
Calves Under 1 Year	4,437	6,182	4,729	4,062	7,964	5,969	4,878
Steers 1 year and over	3,527	5,428	7,933	6,546	4,223	4,312	4,290
Total heifers 1 year and over	2,964	5,656	4,860	6,536	5,451	3,815	3,947
Beef Cows	1,518	3,283	1,266	2,899	4,727	4,009	3,145
Dairy Cows	2,204	4,147	1,664	818	4,459	1,541	1,284
Bulls 1 year and over	118	206	95	123	242	191	176
# of Rams	37	84	55	86	84	38	108
# of Ewes	603	1,447	1,285	2,550	2,274	1,119	3,754
# of Lambs	230	1,198	1,106	1,903	1,731	701	1,708
Goats	355	1,035	539	1,656	1,892	1,840	482
Horses and Ponies	451	833	857	644	481	800	465
Wild Boars	x	0	0	x	0	0	x
Bison	0	0	0	x	x	0	0
Llamas and alpacas	x	x	x	9	18	x	15
Deer (excluding wild deer)	x	x	505	0	0	0	x
Elk	x	x	0	0	0	0	x
Boars	97	85	184	142	68	51	96
Sows and gilts for breeding	4,107	2,621	7,337	10,238	2,686	1,927	7,969
Nursing and weaner pigs	33,927	17,952	33,009	26,854	9,324	5,964	14,280
Grower and finishing pigs	30,492	18,301	32,464	57,539	27,508	9,815	7,432
Broilers Roasters and Cornish hens	150,571	x	156,926	148,510	x	x	145,594
Pullets under 19 weeks	x	x	122	x	x	x	806
Laying Hens 19 weeks and over	x	x	30,335	x	x	20,154	2,826
Turkeys	34	12,337	62	x	x	49	53
Other Poultry	2,373	14,563	x	357	718	359	606

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

Source: Statistics Canada, 2006 Census of Agriculture, Farm Data and Farm Operator Data, catalogue no. 95-629-XWE.

TABLE 2.7.5 (b) – Number of Livestock in Saugeen Valley SPA (StatCan Census of Agriculture, 2006)

Livestock (number of animals)	***Census Subdivision***						
	Brockton	**Arran-Elderslie**	**Saugeen Shores**	**West Grey**	**Southgate**	**Grey Highlands**	**Chatsworth**
Calves Under 1 Year	8,564	7,816	972	6,988	7,735	7,219	4,717
Steers 1 year and over	8,423	15,455	794	6,657	11,319	5,055	4,603
Total heifers 1 year and over	8,795	16,251	1436	5,591	7,808	5,179	2,053
Beef Cows	5,871	4,602	x	7,159	4,662	6,884	3,987
Dairy Cows	2,714	1,005	x	2,415	1,664	1,485	825
Bulls 1 year and over	279	202	24	361	252	320	220
# of Rams	116	69	24	169	101	82	100
# of Ewes	2,419	1,439	975	3,135	2,595	2,019	1,965
# of Lambs	2,006	1,297	623	2,922	14,984	1,985	1,646
Goats	1,228	747	x	2,388	2,168	272	2,012
Horses and Ponies	563	510	126	1,311	1,009	1,133	941
Wild Boars	0	0	0	0	x	x	0
Bison	x	0	0	0	0	x	x
Llamas and alpacas	x	x	0	58	10	99	45
Deer (excluding wild deer)	0	x	0	x	x	x	x
Elk	0	0	0	0	0	x	0
Boars	66	x	x	52	77	41	16
Sows and gilts for breeding	5,107	x	x	4,461	1,287	968	x
Nursing and weaner pigs	16,587	x	x	4,860	3,367	5,582	x
Grower and finishing pigs	16,138	x	x	8,517	8,968	7,314	x
Broilers Roasters and Cornish hens	x	x	x	178,736	195,881	x	21,905
Pullets under 19 weeks	x	x	x	245,719	298	x	519
Laying Hens 19 weeks and over	25,907	7,863	x	482,209	7,952	16,644	13,444
Turkeys	x	x	x	99,265	1,592	3,312	263
Other Poultry	1,175	265	104	548	339	6,330	1,168

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

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 Saugeen Valley SPA is shown in Map 2.10.

Saugeen Conservation owns thousands of hectares of forest parcels that are actively managed. As well, Saugeen Conservation and Grey Sauble Conservation have a long-standing partnership in Grey Bruce Forestry Services, which offers tree planting, managed forest plans, tending and pest control.

The County of Grey owns 3475 hectares of forest property in more than forty different tracts. These areas are managed for multiple purposes, including wildlife habitat, recreation, aesthetics, environmental protection, economics, and sustainable timber supply. Bruce County owns 4850 hectares of land under its "Bruce County Forest" program, such as the Brant Tract near Paisley. Grey County has passed a Forest Management By-law and Bruce County has a Forest Conservation By-law to encourage the use of good forestry practices.

2.7.8 Protected Areas

Within the Saugeen Valley 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, county forests, and local conservation areas. Map 2.15 identifies the locations of parks and protected areas throughout the Saugeen Valley SPA. Map 2.16 illustrates lands that have been designated as Areas of Natural and Scientific Interest (ANSI).

Provincially Owned Lands

Two Provincial Parks are located in the Saugeen Valley SPA. Inverhuron Provincial Park is on the Lake Huron shoreline just south of Bruce Power. MacGregor Point Provincial Park is south of Port Elgin, also along the Lake Huron shoreline. Both parks offer visitors swimming and camping opportunities while still protecting the natural features of the area (Ontario Parks, 2002).

Other Provincially owned crown lands occupy portions of land in the Saugeen Valley SPA, such as near Priceville. Ontario Ministry of Natural Resources (MNR), who facilitate government control over land uses in these areas, manages these crown lands. The primary goals associated with these management policies are to protect terrestrial and aquatic ecosystems, preserve wildlife and habitat, ensure access by the public and resource based industries, and ensure the sustainable development of natural resources on crown lands (MNR, 1993).

Conservation Authority Properties

In addition to lands that are provincially or federally protected, there are those that are managed by the local Conservation Authorities. These properties provide a broad range of benefits including habitat, wetland conservation, flood control, education, recreation and forest management.

Saugeen Conservation has total land holdings of 9058 hectares, with 8490 hectares that are management lands and 568 hectares that are Conservation Areas (Map 2.15).

Conservation Areas are available to the public and provide outdoor recreational facilities, such as waterfalls, scenic lookouts, caves and trails. In addition to day-use areas, Saugeen Conservation offers overnight camping facilities at Durham, Brucedale, Saugeen Bluffs, McBeath and Denny's Dam Conservation Areas.

Saugeen Conservation also owns properties that are designated for specific management and conservation purposes. Conservation Lands in the Saugeen Valley SPA include Conservation forests, management units and significant wetlands. These lands are designated as areas that will be conserved, preserved and managed in order to benefit future generations (Saugeen Conservation, 2003). Approximately 8575 hectares of land in the Saugeen hold this designation and are intended for passive recreational uses, such as hiking or cross-country skiing.

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 organization currently owns and manages a nature reserve property near Dornoch, which was acquired in order to protect the imperilled and vulnerable habitats. The Kinghurst Forest nature reserve in the Saugeen Valley SPA serves to protect open bogs, fens and forested wetlands with unique vegetation and wildflower communities. The property is open to the public for activities such as photography, scientific research and hiking and snowshoeing on marked trails. 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 landowners 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).

Areas of Natural and Scientific Interest

Areas of Natural and Scientific Interest are significant natural features that have been identified by the Ministry of Natural Resources (MNR). 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 Saugeen Valley SPA.

2.7.9 Recreation

Recreation and tourism is very prevalent in the Saugeen Valley SPA, as it offers a wealth of opportunity for outdoor activities year round (see Map 2.17). Located on the shores of Lake Huron and reaching inland over rolling uplands of the Saugeen River watershed, the region offers tourists numerous water activities during the summer months including swimming, sailing, boating, fishing, canoeing, and cottaging. Innumerable beaches can be found along Lake Huron and the various inland lakes. The Saugeen River is host to some of the best trout and fly-fishing in Ontario and major fishing tournaments are hosted, such as the annual tournament in Kincardine.

The area is also particularly attractive to hikers, as it is home to several large trail networks, including County Forest trails, Provincial Park trails, Conservation Authority trails and the nearby Bruce Trail. High-quality mountain bike parks have been developed at the Brant Tract (south of Paisley) and the Carrick Tract (south of Mildmay).

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.

Camping is a popular pastime in the region. There are dozens of privately operated campgrounds, as well as five properties run by Saugeen Conservation and two Provincial Parks.

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.

Golf courses also require large water-takings for irrigation of greens and fairways. There are approximately 19 golf courses spread across the SPA (see Map 2.17). Courses located along the shorelines tend to draw irrigation water from surface sources, such as Lake Huron and local rivers, while inland courses tend to draw from groundwater sources.

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 Saugeen Valley 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. Generally, guidelines for both human health and ecological functions are 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 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, 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 in this section are arsenic, fluoride, hardness, iron, sodium, total phosphorus, nitrate, copper, lead, suspended solids and chloride. Typical sources of these 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

2.8.1.1 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.

2.8.1.2 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.

2.8.1.3 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.

2.8.1.4 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.

2.8.1.5 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.

2.8.1.6 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 due to chemically reducing underground conditions, which cause mineral deposits. Iron can also leach into groundwater through industrial practices.

2.8.1.7 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, stormwater runoff, direct discharge into a stream, or industrial processes where lead is emitted into the air and is later deposited into watercourses.

2.8.1.8 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, which is used as a benchmark for aquatic health.

2.8.1.9 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 must be notified. Anthropogenic sources of sodium include road salt, runoff from fertilizers and domestic water softeners.

2.8.1.10 Total Phosphorus (SW)

Total phosphorus represents all forms of phosphorus present in a water sample. Phosphorus is a nutrient required 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.

2.8.1.11 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.

2.8.1.12 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 Saugeen Valley SPA on a subwatershed basis where water chemistry data exists from the PWQMN (Map 2.18). The data analysis within the SPA spans from the early 1970s to 2005 depending on the number of years that data was collected at each monitoring station on a particular stream.

Stream water chemistry data exists for all eight subwatersheds in the Saugeen Valley SPA. With the exception of the Pine and Penetangore Rivers, the other six subwatersheds contribute to the water quality of the Saugeen River at various points within the reach.

Sampling Uncertainties

The reported values of copper, lead and zinc in the 1970s and 1980s are often given higher than actual, 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. Therefore, the reported values 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. Caution must be exercised when assessing trends or identifying exceedences even with these improvements, as there is a +/- 0.011 mg/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 Beatty Saugeen River

Water samples analyzed were collected from 2002 to 2005. Initial observations indicate that lead and total phosphorus concentrations were near or above recommended concentrations for most samples (Table 2.8.2). The median concentration of lead values appears to be decreasing annually. Total phosphorus annual median values appear to remain constant.

TABLE 2.8.2 – Summary of Water Chemistry Exceedences for the Beatty Saugeen River

Beatty Saugeen River			
Year	***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences
2002-2005	30	3	10
TOTAL	30	3	10

Note: Limit for parameter - Total Phosphorus: guideline of 0.03 mg/L (PWQO)

2.8.2.2 Main Saugeen River

The Saugeen River has been separated into three segments in order to deal with the size of the Saugeen River watershed. The segments chosen were approximately three equal lengths of the stream channel and based on the locations of sampling points. The segments represent the headwaters of the Saugeen River to above Durham, above Durham to below Walkerton, and below Walkerton to the mouth of the Saugeen River. Water chemistry is also provided at the headwaters.

Water chemistry data for the headwaters was available from 2002-2005. During this time period, there were three exceedences of phosphorus. The limited temporal availability of data at the headwaters prevents identifying any trends for the chemical parameters analyzed.

Data for the first segment (headwaters to above Durham) has chloride, total suspended solids and total phosphorus data from 1973 to 1995 and from 2002 to 2005. Copper, lead and zinc data is available from approximately 1980 to 1995 and from 2002 to 2005. Nitrate data is only available from 2002 to 2005. The middle segment (above Durham to below Walkerton) has chloride, total suspended solids and total phosphorus data from 1970 to present. Metals nitrate data is only available from 2002 to 2005. The third segment (below Walkerton to the mouth) has chloride data from 2002 to present. Metals, total suspended solids and total phosphorus data is available from 1975 to present.

Table 2.8.3 identifies the exceedences for the data that was analyzed. There were exceedences in total phosphorus concentrations throughout the Saugeen River. In recent years (2002-2005), the frequency of total phosphorus concentrations has decreased in the first and middle segments. The third segment has concentrations regularly exceeding the PWQO of 0.03 mg/L during this time.

TABLE 2.8.3 – Summary of Water Chemistry Exceedences for the Main Saugeen River

Main Saugeen River - Headwaters			
Year	***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences
2002-2005	30	3	10.0
TOTAL	30	3	10.0

Main Saugeen River - Headwaters to above Durham						
Year	***Lead***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1973-1977	0	0	N/A	50	5	10.0
1978-1982	28	2	7.1	60	1	1.7
1983-1987	55	11	20.0	59	1	1.7
1988-1992	51	0	0.0	52	2	3.8
1993-1995	33	0	0.0	31	2	6.5
2002-2005	14	0	0.0	30	0	0.0
TOTAL	181	13	7.2	282	11	3.9

Main Saugeen River - Durham to Walkerton			
Year	*Total Phosphorus*		
	Total # Samples	# of Exceedences	% Exceedences
1970-1972	35	18	51.4
1973-1977	57	18	31.6
1978-1982	59	15	25.4
1983-1987	52	14	26.9
1988-1992	52	7	13.5
1993-1995	31	2	6.5
2002-2005	30	0	0.0
TOTAL	316	74	23.4

Main Saugeen River - Walkerton to Mouth									
Year	*Lead*			*Suspended Solids*			*Total Phosphorus*		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1975-1977	637	22	3.5	91	1	1.1	578	264	45.7
1978-1982	372	96	25.8	111	0	0.0	366	217	59.3
1983-1987	179	51	28.5	184	0	0.0	190	121	63.7
1988-1992	299	17	5.7	295	0	0.0	298	97	32.6
1993-1996	206	8	3.9	179	0	0.0	201	62	30.8
1997-2001	28	1	3.6	56	0	0.0	55	14	25.5
2002-2005	21	5	23.8	48	0	0.0	48	17	35.4
TOTAL	1742	200	11.5	964	1	0.1	1736	792	45.6

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS)

The frequency of lead concentration exceedences has increased for the same time period compared to previous year groupings. It appears that the concentration of lead in the Saugeen River is influenced the most by the Teeswater River, because a similar trend exists there. At this point, it is difficult to establish a causal relationship with the lead exceedences and surrounding land use activities.

Concentrations typically increase for all indicator parameters from the headwaters to the mouth of the river, which is evident in the median concentrations spatially and temporally. The increase in chloride concentrations is most notable in recent years.

2.8.2.3 Mill Creek

Samples were collected between 2002 and 2005. With the exception of total phosphorus (Table 2.8.4), all indicator parameters were within acceptable concentrations for the dates sampled. Based on the data available, it is difficult to establish trends, but there does not appear to be water quality issues or substantial impacts of land use activities in the watershed.

TABLE 2.8.4 – Summary of Water Chemistry Exceedences for Mill Creek

Mill Creek			
Year	***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences
2002-2005	30	2	6.7
TOTAL	30	2	6.7

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS)

2.8.2.4 North Saugeen River

Water samples were collected midstream and near the mouth of the river between 2002 and 2005. With the exception of lead and total phosphorus, concentrations of the other indicator parameters were within acceptable levels. The number of exceedences for each indicator parameter is provided in Table 2.8.5.

TABLE 2.8.5 – Summary of Water Chemistry Exceedences for the North Saugeen River

North Saugeen River - Midstream			
Year	***Lead***		
	Total # Samples	# of Exceedences	% Exceedences
2002-2005	12	1	8.3
TOTAL	12	1	8.3

North Saugeen River Mouth						
Year	***Lead***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
2002-2005	18	1	5.6	30	4	13.3
TOTAL	18	1	5.6	30	4	13.3

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

Midstream concentrations of lead and zinc are higher than concentrations near the mouth. This may be a result of dilution from increased discharge downstream. The data presented indicates minimal effects of land use activities within the watershed.

2.8.2.5 Penetangore River

Water chemistry data from 2002 to 2005 have been summarized. Exceedences were observed for lead and total phosphorus (Table 2.8.6). With the exception of lead concentrations, indicator parameters are within acceptable limits. It is evident that the Penetangore River is influenced by local soil and land use activities relative to other watersheds in the region.

TABLE 2.8.6 – Summary of Water Chemistry Exceedences for the Penetangore River

Penetangore River			
Year	***Lead***		
	Total # Samples	# of Exceedences	% Exceedences
2002-2005	15	1	6.7
TOTAL	15	1	6.7

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS)

2.8.2.6 Pine River

Water chemistry data for the Pine River have been collected from 1970 to 1978 and from 2002 to 2005. Chloride, total suspended solids and total phosphorus data have been collected for both periods. Metals, which have a few data points from 1970 to 1978, and nitrates data are available from 2002 to 2005. Nitrate, lead and total phosphorus had at least one sample above drinking water standards/objectives for the 2002-2005 time period. Annual exceedences are provided in Table 2.8.7. The temporal availability of samples makes it difficult to identify trends. The fine textured soils in the Pine River watershed make it susceptible to erosional processes and to the transport of material into the reach.

TABLE 2.8.7 – Summary of Water Chemistry Exceedences for the Pine River

Pine River									
Year	***Nitrate***			***Lead***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1970-1978	0	0	N/A	4	3	75.0	103	89	86.4
2002-2005	22	2	9.1	10	1	10.0	23	13	56.5
TOTAL	22	2	9.1	14	4	28.6	126	102	81.0

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS); Nitrate: MAC of 10mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

2.8.2.7 Rocky Saugeen River

Data have been collected from 1973 to 1975 and from 2002 to 2005. Levels of chloride and total suspended solids from 1973 to 1975 appear to be trace or at the detection limit, as most of the values are the same. Metals and nitrate data is available from 2002 to 2005. With the exception of lead concentrations and total phosphorus, the concentrations of the other indicator parameters are well below recommended concentrations. Annual exceedences are provided in Table 2.8.8. The period of time analyzed does not allow trends to be identified.

TABLE 2.8.8 – Summary of Water Chemistry Exceedences for the Rocky Saugeen River

Rocky Saugeen River						
Year	***Lead***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1973-1975	0	0	N/A	20	4	20.0
2002-2005	14	1	7.1	30	0	0.0
TOTAL	14	1	7.1	50	4	8.0

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

2.8.2.8 South Saugeen River

Water chemistry data have been summarized from 1973 to 1995 and from 2002 to 2005. Chloride, total suspended solids and total phosphorus data are the most complete for these time periods. Metals data is sparse from the late 1970s to the mid-1980s. Nitrate data is only available from 2002 to 2005. There were exceedences for total suspended solids (>500mg/L) in the first grouping, but statistically they are considered outliers. The numbers of annual exceedences are provided in Table 2.8.9. It appears that the number of lead concentration exceedences have increased in the 2002-2005 time period.

TABLE 2.8.9 – Summary of Water Chemistry Exceedences for the South Saugeen River

South Saugeen River									
Year	***Lead***			***Suspended Solids***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1973-1977	88	11	12.5	137	2	1.5	151	30	19.9
1978-1982	0	0	N/A	54	0	0.0	54	11	20.4
1983-1987	52	16	30.8	56	0	0.0	56	8	14.3
1988-1992	47	0	0.0	51	0	0.0	50	8	16.0
1993-1995	31	0	0.0	30	0	0.0	31	4	12.9
2002-2005	12	2	16.7	30	0	0.0	30	5	16.7
TOTAL	230	29	12.6	358	2	0.6	372	66	17.7

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO); Total Suspended Solids: AO of 500 mg/L (ODWS)

2.8.2.9 Teeswater River

Water chemistry data were summarized from two different stations. Data are from the headwaters and mouth of the Teeswater River.

Chloride, total suspended solids and total phosphorus data have been collected from 1977 to 1995 and from 2002 to 2005. Metals and nitrate data are available from 2002 to 2005. The median values of lead and total phosphorus are above recommended concentrations for the various yearly groupings. Annual exceedences of water chemistry parameters are given in Table 2.8.10. The grouped data show that the number of total phosphorus exceedences has decreased.

TABLE 2.8.10 – Summary of Water Chemistry Exceedences for the Teeswater River

Teeswater River- Headwaters						
Year	***Lead***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
2002-2005	12	2	16.7	30	2	6.7
TOTAL	12	2	16.7	30	2	6.7

Teeswater River- Mouth						
Year	***Lead***			***Total Phosphorus***		
	Total # Samples	# of Exceedences	% Exceedences	Total # Samples	# of Exceedences	% Exceedences
1977-1981	0	0	N/A	52	27	51.9
1982-1986	0	0	N/A	59	31	52.5
1987-1991	0	0	N/A	53	18	34.0
1992-1995	0	0	N/A	41	15	36.6
2002-2005	16	3	18.8	30	9	30.0
TOTAL	16	3	18.8	235	100	42.6

Note: Limits for parameters - Lead: MAC of 0.01 mg/L (ODWS); Total Phosphorus: guideline of 0.03 mg/L (PWQO)

2.8.3 Groundwater Quality Data Analysis and Reporting

Saugeen Conservation joined the Provincial Groundwater Monitoring Network (PGMN) in 2000 in partnership with the Ontario Ministry of the Environment and Climate Change. Map 11 depicts the sampling locations within the Saugeen Valley SPA. Areas of interest were selected based on the groundwater issues relevant to the times. Where possible within these areas, existing wells were evaluated for long term monitoring. Where suitable existing wells were not available, new wells were drilled in these areas. Monitoring wells were then equipped with data loggers that record water levels and temperature on an hourly basis.

Initial sampling of wells for water quality was undertaken in 2003 throughout the region, with additional sampling performed on an annual basis for wells operated by Saugeen Conservation. All wells were sampled according to protocols established by the MOECC, and samples were analyzed at a common certified laboratory. Subsequent, more frequent samples were taken from wells with water quality objective exceedences.
The PGMN wells are a reliable source of water quality data for the SPA. These samples were all collected using a standard, rigorous protocol designed to minimize or eliminate any contamination of samples. In addition, the samples from these wells were all analyzed for a comprehensive suite of parameters at a single lab, using identical analytical methods, which make them ideal for comparing results between wells.

The major limitation of the PGMN data is the length of record for these analyses. The typical length of record for these samples is limited to the three years of the program's existence, and for the majority of these wells only four samples have been taken at the time of writing.

Under the Provincial Groundwater Monitoring Network, there are 23 groundwater wells being tested once per year within the Saugeen Valley SPA (Map 2.18). Table 2.8.11. identifies the various geological materials that the respective monitoring wells represent.

TABLE 2.8.11 – Attributing Wells to Formations

Formation/Aquifer	***Wells***
Bass Islands	SVCA188-2; SVCA188-3; SVCA221-1
Bois Blanc	SVCA-2
Guelph	SVCA314-1; SVCA177-1; SVCA177-2; SVCA177-3
Lake Warren Shoreline OB	SVCA302-2
Lucas	SVCA242-1; SVCA302-3
Nipissing Shoreline OB	SVCA240-1
Salina	SVCA301-1; SVCA176-1; SVCA246-1
Unknown Overburden Aquifer	SVCA303-2; SVCA303-3; SVCA305-1; SVCA304-1
Wyoming Moraine OB	SVCA299-1

2.8.3.1 Bass Islands Formation/Aquifer

There are two monitoring stations west of Walkerton: 188-2 and 188-3. The land surrounding the wells is mainly used for agriculture. Water quality samples were taken in 2003 and twice in 2005 for both wells. Both years showed exceedences of hardness. In 2005, at well 188-2 there were two exceedences of nitrates.

Monitoring station 221-1 is located in Walkerton, which is primarily an urban community. Water quality samples were taken once per year in 2003, 2005 and 2006. There were exceedences of fluoride and hardness in each sample. In 2005, there was an exceedence of iron.

TABLE 2.8.12 – Monitoring Wells in the Bass Islands Formation/Aquifer

Bass Islands Formation/Aquifer	***ODWS MAC (mg/L)***	***ODWS OA (mg/L)***	***188-2***			***188-3***			***221-1***		
			2003	***2005***	***2006***	***2003***	***2005***	***2006***	***2003***	***2005***	***2006***
Arsenic (µg/L)	0.025		0.6	0.2	0.2	0.1	0.8	1	0.1	<3	<0.5
Chloride (mg/L)		250	2.9	21.4	23.6	23.8	2.9	3	0.9	2.39	1.3
Fluoride (mg/L)	1.5		0.83	0.02	0.05	0.08	0.75	0.78	1.66	1.57	2.05
Hardness (mg/L)		500	299	395	438	392	274	319	328	305	328
Iron (µg/L)		0.3	4	6	6	6	28	28	41	354	30
Nitrate (mg/L)	10.0		0.05	11.5	11.2	--	0.05	0.045	0.013	0.05	0.045
Sodium (mg/L)		200	1.6	8	8.8	9	1.6	1.4	1.6	1.67	1.80

2.8.3.2 Bois Blanc Formation/Aquifer

Monitoring station SVCA-2 is located southwest of Walkerton. The land surrounding the well is primarily farmland. A sample was taken in 2007, which had an exceedence of hardness and sodium.

TABLE 2.8.13 – Monitoring Wells in the Bois Blanc Formation/Aquifer

Bois Blanc Formation/Aquifer	***ODWS MAC (mg/L)***	***ODWS OA (mg/L)***	***SVCA-2***
			2007
Arsenic (µg/L)	0.025		ND
Chloride (mg/L)		250	5
Fluoride (mg/L)	1.5		0.2
Hardness (mg/L)		500	320
Iron (µg/L)		0.3	ND
Nitrate (mg/L)	10.0		3
Sodium (mg/L)		200	2200

2.8.3.3 Guelph Formation/Aquifer

Monitoring station 314-1 is located in Sullivan Township, south of Williamsford near McCullough Lake. The well is located in a rural forested area. A water quality sample was taken in 2003, which had an exceedence of hardness.

TABLE 2.8.14 – Monitoring Wells in the Guelph Formation/Aquifer

Guelph Formation/Aquifer	***ODWS MAC (mg/L)***	***ODWS OA (mg/L)***	***177-1***				***177-2***			
			2002	***2003***	***2005***	***2006***	***2002***	***2003***	***2005***	***2006***
Arsenic (µg/L)	0.025		N/A	48.2	<3	1.9	2.60	N/A	2	1.7
Chloride (mg/L)		250	N/A	10.4	8.65	7.8	9.40	N/A	9.3	8.9
Fluoride (mg/L)	1.5		N/A	0.05	<0.05	0.05	0.03	N/A	0.07	0.06
Hardness (mg/L)		500	N/A	237	282	300	250	N/A	265	288
Iron (µg/L)		0.3	N/A	2100	630	450	1360	N/A	10	590
Nitrate (mg/L)	10.0		N/A	0.05	<0.05	<0.05	--	N/A	0.013	<0.05
Sodium (mg/L)		200	N/A	4.20	4.35	4.55	3.80	N/A	4.16	4.69

Guelph Formation/Aquifer	*ODWS MAC (mg/L)*	*ODWS OA (mg/L)*	*177-3*				*314-1*			
			2002	*2003*	*2005*	*2006*	*2002*	*2003*	*2005*	*2006*
Arsenic (µg/L)	0.025		0.00	N/A	2	<0.5	N/A	0.4	N/A	N/A
Chloride (mg/L)		250	10.5	N/A	0.07	12	N/A	0.69	N/A	N/A
Fluoride (mg/L)	1.5		0.06	N/A	14	0.06	N/A	0.03	N/A	N/A
Hardness (mg/L)		500	264	N/A	252	276	N/A	248	N/A	N/A
Iron (µg/L)		0.3	180	N/A	10	110	N/A	15	N/A	N/A
Nitrate (mg/L)	10.0		--	N/A	0.386	0.48	N/A	0.305	N/A	N/A
Sodium (mg/L)		200	5.60	N/A	5.55	6.86	N/A	1.4	N/A	N/A

There are three monitoring sites 177-1, 177-2 and 177-3 located in Sullivan Township, south of Williamsford near McCullough Lake. The wells are located in a rural forested area. Water quality samples were taken once per year in 2002, 2003, 2005 and 2006. There were exceedences of hardness in each sample. There were five exceedences of iron within all wells and all years of sampling. At site 177-1, there was an exceedence of arsenic in 2003. At site 177-3, there was exceedence of fluoride in 2005.

2.8.3.4 Lake Warren Shoreline OB Formation/Aquifer

Monitoring station 302-2 is an overburden well located east of Ripley. The well is in a rural area surrounded by woodlots and farmland. Water quality samples were taken once per year in 2003 and 2005, which had exceedences of hardness both years and an exceedence of fluoride in 2003.

TABLE 2.8.15 – Monitoring Wells in the Lake Warren Shoreline OB Formation/Aquifer

Lake Warren Shoreline OB Formation/Aquifer	*ODWS MAC (mg/L)*	*ODWS OA (mg/L)*	*302-2*	
			2003	*2005*
Arsenic (µg/L)	0.025		1.8	<3
Chloride (mg/L)		250	7.1	11.3
Fluoride (mg/L)	1.5		1.71	1.27
Hardness (mg/L)		500	177	223
Iron (µg/L)		0.3	7	151
Nitrate (mg/L)	10.0		0.031	0.89
Sodium (mg/L)		200	6.66	6.09

2.8.3.5 Lucas Formation/Aquifer

Monitoring station 242-1 is a bedrock well located in Tiverton, which is primarily an urban community. Water quality samples were taken once per year in 2003, 2005 and 2006. In all three years, there were exceedences of hardness and iron. In 2003 and 2006, there were exceedences of fluoride.

Monitoring station 302-3 is in an overburden well located east of Ripley. The well is in a rural area surrounded by woodlots and farmland. Water quality samples were taken in 2003 and 2006. Both years had exceedences of hardness. In 2006, an exceedence of fluoride occurred.

TABLE 2.8.16 – Monitoring Wells in the Lucas Formation/Aquifer

Lucas Formation/Aquifer	*ODWS MAC (mg/L)*	*ODWS OA (mg/L)*	*242-1*			*302-3*		
			2003	*2005*	*2006*	*2003*	*2005*	*2006*
Arsenic (µg/L)	0.025		4.5	<3	3.89	0.4	N/A	<0.5
Chloride (mg/L)		250	9.2	8.39	8.1	11.3	N/A	10
Fluoride (mg/L)	1.5		1.65	1.01	1.59	1.34	N/A	1.60
Hardness (mg/L)		500	373	336	211	254	N/A	260
Iron (µg/L)		0.3	620	1150	710	1	N/A	<10
Nitrate (mg/L)	10.0		<0.05	<0.05	0.045	1.173	N/A	--
Sodium (mg/L)		200	58.2	71.3	57.7	6.4	N/A	6.45

2.8.3.6 Nipissing Shoreline OB Formation/Aquifer

Monitoring station 240-1 is an overburden well located in Port Elgin, which is primarily an urban community on the shore of Lake Huron. A water quality sample was taken in 2003, which had an exceedence of hardness.

TABLE 2.8.17 – Monitoring Wells in the Nipissing Shoreline OB Formation/Aquifer

Nipissing Shoreline OB Formation/Aquifer	*ODWS MAC (mg/L)*	*ODWS OA (mg/L)*	*240-1*
Arsenic (µg/L)	0.025		1.1
Chloride (mg/L)		250	61
Fluoride (mg/L)	1.5		0.13
Hardness (mg/L)		500	274
Iron (µg/L)		0.3	122
Nitrate (mg/L)	10.0		0.245
Sodium (mg/L)		200	56.8

2.8.3.7 Salina

Monitoring station 301-1 is an overburden well that is located northeast of Paisley. The land surrounding the well is agricultural land. Water quality samples were taken once per year in 2003 and 2006, which had exceedences of hardness.

Monitoring station 176-1 is a bedrock well located at the Saugeen Conservation Headquarters, south of Hanover. The land surrounding this well is farmland and woodlots. Water quality samples were taken once per year in 2003, 2005 and 2006. There were exceedences of hardness in each sample and of iron in 2003 and 2006.

Monitoring station 246-1 is a bedrock well located in Allan Park, east of Hanover. Allan Park is a hamlet that is surrounded by woodlots and farmland. A water quality sample was taken in 2003 for well 246-1, which had exceedences of iron and hardness.

TABLE 2.8.18 – Monitoring Wells in the Salina Formation/Aquifer

Salina Formation/Aquifer	*ODWS MAC (mg/L)*	*ODWS OA (mg/L)*	*301-1*			*176-1*			*246-1*		
			2003	*2005*	*2006*	*2003*	*2005*	*2006*	*2003*	*2005*	*2006*
Arsenic (µg/L)	0.025		0.4	N/A	<0.5	4.7	<2	0.60	0.1	N/A	N/A
Chloride (mg/L)		250	0.6	N/A	0.5	5.2	6.3	7.1	1.8	N/A	N/A
Fluoride (mg/L)	1.5		0.41	N/A	0.42	1.11	1.14	1.18	1.09	N/A	N/A
Hardness (mg/L)		500	115	N/A	117	1670	1560	--	223	N/A	N/A
Iron (µg/L)		0.3	45	N/A	19.9	3460	298	3280	313	N/A	N/A
Nitrate (mg/L)	10.0		0.105	N/A	<0.05	0.008	<0.05	0.05	0.242	N/A	N/A
Sodium (mg/L)		200	25.8	N/A	24.4	10.4	10.3	11.9	2.2	N/A	N/A

2.8.3.8 Wyoming Moraine OB Formation/Aquifer

Monitoring station 299-1 is an overburden well located south of Kinloss. The land use surrounding the well is rural, agricultural land. Water quality samples were taken once per year in 2003, 2005 and 2006. There were exceedences of fluoride and hardness in each sample.

TABLE 2.8.19 – Monitoring Wells in the Wyoming Moraine OB Formation/Aquifer

Wyoming Moraine OB Formation/Aquifer	***ODWS MAC (mg/L)***	***ODWS OA (mg/L)***	***302-2***		
			2003	***2005***	***2006***
Arsenic (µg/L)	0.025		5.5	10.0	4.4
Chloride (mg/L)		250	7.2	6.77	8.0
Fluoride (mg/L)	1.5		1.86	1.76	1.68
Hardness (mg/L)		500	194	227	123
Iron (µg/L)		0.3	154	210	210
Nitrate (mg/L)	10.0		0.045	<0.05	<0.05
Sodium (mg/L)		200	22.2	26.8	15.1

2.8.3.9 Unknown Overburden Aquifer

Monitoring stations 303-2 and 303-3 are located south of Hopeville. The land surrounding the wells is mostly wetlands and hazard lands. Water quality samples were taken once a year in 2003, 2005 and 2006. Hardness was only tested in 2003 and 2005 and there were exceedences in both wells for both years. Well 303-3 had an exceedence of iron in 2003. In 2006, well 303-2 had an exceedence of iron.

TABLE 2.8.20 – Monitoring Wells in Unknown Overburden Aquifer

Unknown Overburden Aquifer	***ODWS MAC (mg/L)***	***ODWS OA (mg/L)***	***303-2***			***303-3***		
			2003	***2005***	***2006***	***2003***	***2005***	***2006***
Arsenic (µg/L)	0.025		4.8	4	6.09	6.4	4	4.2
Chloride (mg/L)		250	8.4	<2	1.1	1.6	7.4	7.4
Fluoride (mg/L)	1.5		0.81	0.08	0.10	0.1	0.77	0.78
Hardness (mg/L)		500	204	224	--	234	200	--
Iron (µg/L)		0.3	123	<10	320	302	<10	140
Nitrate (mg/L)	10.0		0.045	<0.013	<0.05	--	<0.013	<0.05
Sodium (mg/L)		200	12.6	4.09	4.31	3.8	12.4	11.8

Unknown Overburden Aquifer	*ODWS MAC (mg/L)*	*ODWS OA (mg/L)*	*305-1*			*304-1*		
			2003	*2005*	*2006*	*2003*	*2005*	*2006*
Arsenic (µg/L)	0.025		0.1	<2	<0.5	0.2	0.2	0.3
Chloride (mg/L)		250	4.1	2.9	2.8	44.9	55.9	54.5
Fluoride (mg/L)	1.5		0.06	0.05	0.05	0.13	0.06	0.03
Hardness (mg/L)		500	284	323	--	420	350	--
Iron (µg/L)		0.3	0	<10	<10	3	6	6
Nitrate (mg/L)	10.0		9.55	5.92	4.65	8.45	7.12	7.14
Sodium (mg/L)		200	1.8	1.69	1.92	16.6	20	--

Monitoring station 305-1 is an overburden well in Osprey Township, south of Maxwell. The area surrounding the well is mainly wetlands. Water quality samples were taken once per year in 2003, 2005 and 2006. Exceedences of hardness occurred in 2003 and 2005.

Monitoring station 304-1 is located west of Walkerton. The land surrounding the well is mainly agricultural. Water quality samples were taken once in 2003 and twice in 2005. In both years, there were exceedences of hardness.

2.8.3.10 Unassigned Overburden Aquifers

Monitoring station 300-2 and 300-3 are both overburden wells located in Allan Park, east of Hanover. Allan Park is a hamlet, surrounded by woodlots and farmland. Water quality samples were taken once per year in 2003, 2005 and 2006. There were exceedences of hardness in 2003 and 2005.

Monitoring stations 324-2 and 324-3 are overburden wells located southeast of Glammis on the edge on the Greenock Swamp. Water quality samples were taken once per year in 2003, 2005 and 2006, each having exceedences of hardness. In 2003, each well had an exceedence of iron.

TABLE 2.8.21 – Monitoring Wells in Unassigned Overburden Aquifers

Unassigned Overburden Aquifers	ODWS MAC (mg/L)	ODWS OA (mg/L)	300-2			300-3		
			2003	2005	2006	2003	2005	2006
Arsenic (µg/L)	0.025		0.1	<2	<0.5	0.7	<2	0.7
Chloride (mg/L)		250	3.9	<2	1.6	1.8	<2	1.9
Fluoride (mg/L)	1.5		0.06	0.06	0.06	0.55	0.46	0.42
Hardness (mg/L)		500	220	313	--	234	269	--
Iron (µg/L)		0.3	1	<10	<10	129	<10	210
Nitrate (mg/L)	10.0		0.495	0.321	0.33	--	<0.013	<0.05
Sodium (mg/L)		200	8.8	0.33	3.76	2.2	2.03	2.10

Unassigned Overburden Aquifers	ODWS MAC (mg/L)	ODWS OA (mg/L)	324-2			324-3		
			2003	2005	2006	2003	2005	2006
Arsenic (µg/L)	0.025		0.5	<2	0.5	8.9	18	10.2
Chloride (mg/L)		250	1.2	1.7	1.4	0.4	0.6	0.5
Fluoride (mg/L)	1.5		0.26	0.19	0.21	0.91	0.81	0.86
Hardness (mg/L)		500	233	247	--	163	160	--
Iron (µg/L)		0.3	427	153	240	338	120	180
Nitrate (mg/L)	10.0		0.045	0.045	<0.05	--	0.013	<0.05
Sodium (mg/L)		200	2.6	2.6	2.59	12.6	11.8	12

2.8.4 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 Saugeen Valley SPA, specifically the stations at Kincardine and Southampton (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, which are 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 in Lake Huron. No exceedences were observed.

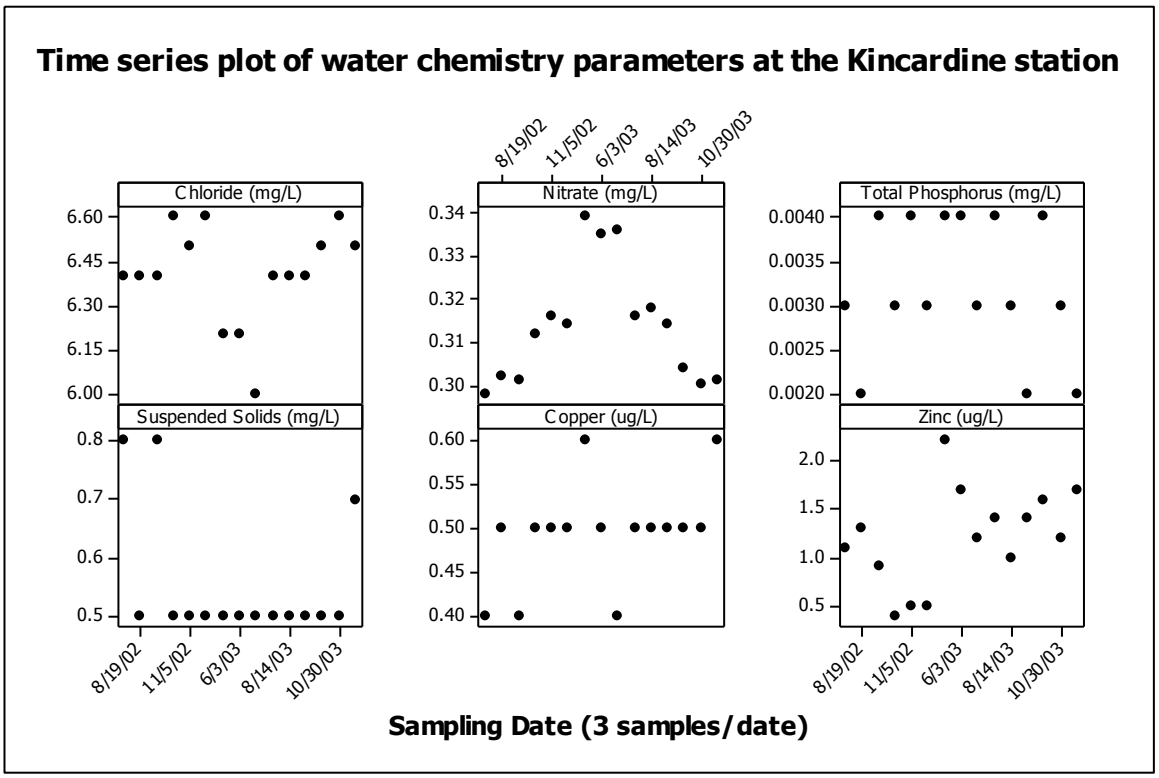


Figure 2.8.1 *Summary of selected water quality parameters from the Great Lakes Index Station monitoring program at the Kincardine (Lake Huron) location*

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)

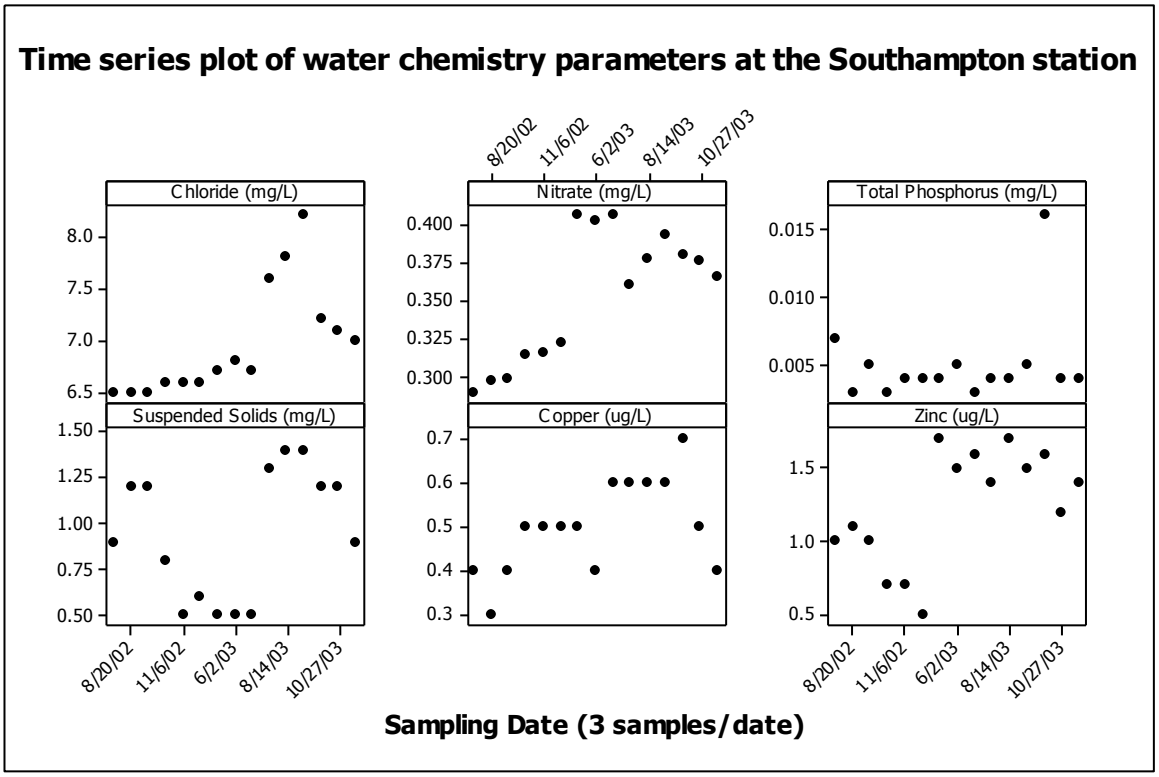


Figure 2.8.2 *Summary of selected water quality parameters from the Great Lakes Index Station monitoring program at the Southampton (Lake Huron) location*

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 Saugeen Valley SPA is put to many uses, including human consumption, agriculture, industrial, commercial, recreational and ecological. Water takings for municipal drinking water supplies include six surface water intakes from Lake Huron and Georgian Bay and more than 15 groundwater wells. 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. The uses include outdoor recreation, hobby fishing, canoeing/kayaking, and tourism and are focused on Lake Huron, Georgian Bay, the larger rivers, and the inland lakes. Recreational usage of water is generally non-consumptive and is not considered to influence 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

The information on fish species is sparse. There is 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 SPA. Much of the forestry information is older; however, new aerial photography is now available that could help to fill this gap. The MOECC wells 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	Not enough data to identify trends

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