Chapter 2: Watershed Characterization

Table of Contents

List of Tables

List of Figures

Formatted: Font: (Default) +Body (Calibri)
Field Code Changed
Field Code Changed
Formatted: Font: (Default) +Body (Calibri)
Field Code Changed
Field Code Changed
Formatted: Font: (Default) +Body (Calibri)
Field Code Changed
Field Code Changed
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Default Paragraph Font, Font: (Default) +Body (Calibri)
Formatted: Font: (Default) +Body (Calibri)

2 Watershed Characterization

2.1 Introduction

This chapter provides a brief background on the characteristics of the Nottawasaga Valley watershed, including the natural, human and physical features and their interactions. The chapter concludes by summarizing drinking water systems in the Nottawasaga Valley watershed, as a prelude to the more in-depth assessment presented in Chapters 6-17. Watershed characteristics related to hydrologic and hydrogeologic conditions are presented in the following chapter (Chapter 3; conceptual water budget). Understanding the characteristics of the Nottawasaga Valley watershed is essential in understanding how quality and quantity of drinking water is affected by both human and natural interactions.

The large geography covered by the Nottawasaga Valley watershed is quite diverse in terms of population density, economy, and land use. Human characteristics across the watershed vary from the more densely populated urban centers such as Collingwood and Wasaga Beach along the shoreline of Georgian Bay, to the prominent agricultural communities in most other areas. Despite over 181,000 people living in the watershed, agricultural activities are the largest single land use in the watershed, including large areas of hay/pastures and row crops.

In 2007 the Nottawasaga Valley Conservation Authority (NVCA) released a series of watershed and subwatershed report cards that summarize the health of the area (NVCA, 2007). These report cards include a detailed assessment of forest, wetland and water quality condition. While some of this information has been incorporated into this chapter, the reader is directed to these report cards for a detailed assessment forest, wetlands and water quality condition.

The MOE Assessment Report Technical Rules (MOE, 2008a) clearly define what information is required in the watershed characterization chapter the assessment report, where the information is available. Substantial effort has been taken to obtain the required information and in only once instance (fish community) was a gap in information identified.

In general, watershed characterization, and the conceptual water budget (provided in the following chapter) are described as a ‘drinking water focused’ watershed plan, comprised of five main components as outlined in the following ~~schematic~~list. It must be noted however, that the information provided in this watershed characterization is not used to determine Issues and Threats to specific municipal drinking water systems – See municipal chapters (chapter 6-17) for details on individual drinking water systems.

Characterization

The five main components are:

1. **Watershed Boundaries**
   Delineates the area within the watershed, encompassing both the natural and human features

2. **Water Budget**
   Describes the movement of water through the hydrologic cycle and quantifies the amount of water flowing through the Source Protection Region

3. **Physical Geography**
   Describes the natural features in the watershed, how they have changed over time and the interactions that occur

4. **Drinking Water Systems**
   Details the location and population served by municipal and non-municipal wells, as well as the pumping rates

5. **Natural Geography and Ecology**
   Depicts the flora and fauna present within the watershed, highlighting important details, such as the current status of habitats

2.2 Watershed and Subwatershed Boundaries

The Nottawasaga Valley watershed is one of four watersheds with the South Georgian Bay-Lake Simcoe Source Protection Region. The three other watersheds within the Source Protection Region include the Lake Simcoe, the Severn Sound and the Black-Severn River watersheds (Figure 2-1; figures are located at the end of the chapter). The Nottawasaga Valley Source Protection Area (SPA) is located in the south-west quarter of the South Georgian Bay-Lake Simcoe (SGBLS) SWP region and is bounded to the south by the Humber and Credit River watersheds and the east by the numerous small streams which drain into Lake Simcoe. The Niagara Escarpment forms part of the western boundary, separating the Nottawasaga from the Grand, Grey Sauble and Saugeen watersheds. The Nottawasaga River is approximately 122 km in length along its main channel and has a drainage area of 3,147 km^2. The main branch of the river's source is in the till moraines of Amaranth Township at an elevation of almost 490 meters. The Nottawasaga River has a total drop of 310 meters to its outlet into Georgian Bay and has an average gradient of 2.6 meters per km. However, in the upper reaches of the river, the gradient is as much as 19 meters per km. The Nottawasaga Valley has 9 subwatersheds (Figure 2-2), the largest subwatershed being the Lower Nottawasaga River at 455 km^2, and the smallest being the Blue Mountains subwatershed at 220 km^2 (Table 2-1). The Blue Mountains subwatershed, does not flow into the Nottawasaga River, but consists of a number of smaller rivers that drain directly into Georgian Bay. An unusual characteristic of the Nottawasaga Valley watershed is its virtual lack of natural lakes.

Table 2-1: Drainage areas of Nottawasaga Valley subwatersheds (Data source: NVCA).

Subwatershed	Drainage Area (km^2)
Upper Nottawasaga River	338.13
Lower Nottawasaga River	455.43
Blue Mountains	220.72
Innisfil Creek	490.03
Boyne River	239.94
Mad River	451.94
Pine River	347.17
Willow Creek	306.53
Middle Nottawasaga River	296.78
Total	**3,146.66**

2.3 Physical and Natural Geography

2.3.1 Natural Vegetation – wetlands, woodlands and riparian areas.

An understanding of type and location of natural vegetated areas is important for Source Water Protection as these areas represent locations where natural rates of groundwater recharge can occur and where threats to drinking water system supply is likely to be low. In some instances natural features such as wetlands and riparian zones may also reduce threats by acting as natural filters, taking up and assimilating contaminants such as nutrients.

Overall, 1,541~~086~~ km^2 of the Nottawasaga Valley watershed is considered natural vegetative cover[1], or approximately 43.2~~34.5~~% of the total area (Figure 2-3). Natural vegetative cover in this watershed was classified into various~~six~~ community types, shown in Table 2-2. The percentage of natural vegetative cover within each subwatershed varies from as low as 27~~1~~% in the Innisfil Creek subwatershed, to the highest in the Willow Creek subwatershed, with almost 52~~47~~%. ~~Both wetlands and woodlands fall into the 30 m riparian area recommended for water courses. Vegetated riparian areas control erosion from overland flow, limit the sedimentation of surface waters, and reduce the concentrations of nutrients, pesticides and some pathogens entering the watercourse. While there are many benefits of reduced contamination to the aquatic ecosystems, the reduction is also important for ensuring quality drinking water. Almost 158 km^2 is listed as riparian area in the Nottawasaga Valley watershed. This mean that 13% of the natural heritage features listed in Table 2-2 is within the 30 m buffer. The Boyne River subwatershed has the highest amount (19%) of natural vegetative cover within riparian areas and the Middle Nottawasaga had the lowest (7%).~~

Wetlands occupy approximately 14~~2~~% of the Nottawasaga Valley watershed with large expanses of wetlands being found on poorly drained lands on the Dundalk Plain above the Niagara Escarpment and the Lake Simcoe Lowlands in the central portion of the watershed. Long, narrow wetlands on the other hand, are often found along river valleys as well as along Georgian Bay shoreline (NVCA, 2007). A number of wetland groupings within the watershed have been identified as provincially significant by the Ontario Ministry of Natural Resources and Forestry. Provincial and municipal planning policies protect these wetlands from development and site alteration. The Minesing Wetlands, located in the heart of the watershed, is recognized as an internationally significant wetland. It supports a number of rare plant and wildlife species as well as protecting Wasaga Beach from flooding. The wetland marshes along the Collingwood shoreline are found only in certain areas along the Great Lakes shorelines and are considered globally rare.

Forest cover in the Nottawasaga Valley watershed is generally healthy and covers just over 21~~2.5~~% of the watershed (32~~4~~% if woody wetlands are included). Significant forest cover is

---

[1] Natural vegetated areas within the Nottawasaga Valley watershed are based on a loose 1996 Greenbelt land use layer with the majority of its features replaced by more accurate information - SOLRIS Phase1 Wooded and Urban, NVCA GenRegs Wetlands, Photo Interp Agriculture areas, NVCA ponds (July 2007 land use layer, NVCA).

generally found on lands that are unsuitable for agriculture. Areas with highly productive farmland, such as the Innisfil Creek Subwatershed, have relatively low forest cover (NVCA, 2007). Large forest blocks provide significant habitat for wildlife species which require undisturbed, deep forest habitat to thrive. Over the past seventy years, reforestation of marginal agricultural lands has increased forest cover in the watershed; however, forest cover is still under pressure from urban development and farmland expansion in some areas. Woodland cover percentage is lowest in the Innisfil Creek subwatershed (10~~2~~.6~~8~~%) and highest in the Pine River subwatershed with approximately 33.6~~7~~%.

The forest cover extending northeastward from the Pine River subwatershed through the Severn Sound Headwaters is an integral part of a natural corridor that extends northeast from the Niagara Escarpment to the Canadian Shield. This provincial-scale corridor is highly significant but is under pressure from urban development. The Nottawasaga Valley watershed has 16 Earth Science Areas of Natural and Scientific Interest (ANSIs) and 32 Life Science ANSIs. The Earth Science ANSIs occupy 10,027 ha of the watershed, while the Life Science ANSIs cover 15,284 ha~~[2]~~.

While some of the forests within the watershed are managed for forestry, many are protected. For example, the Simcoe County Official Plan states that "Forested land within the County of Simcoe shall continue to be protected in accordance with the County of Simcoe Tree By-law." The County encourages sustainable forestry practices throughout. Dufferin County manages a series of forests, and encourages sustainable forestry practices[3].

Both wetlands and woodlands fall into the 30 metre riparian area recommended for watercourses. Vegetated riparian areas control erosion from overland flow, limit the sedimentation of surface waters, and reduce the concentrations of nutrients, pesticides and some pathogens entering the watercourse. While there are many benefits of reduced contamination to the aquatic ecosystems, the reduction is also important for ensuring quality drinking water. Almost 158 km^2 is listed as riparian area in the Nottawasaga Valley watershed. This means that 13% of the natural heritage features listed in Table 2-2 is within the 30 m buffer. The Boyne River Subwatershed has the highest amount (19%) of Natural Vegetative cover within riparian areas and the Middle Nottawasaga had the lowest (7%).

Table 2-2: Natural Vegetative Cover in the Nottawasaga Valley Watershed (Data Source: NVCA 2007 land use layer 2007 and Orthos 2008 [riparian]).

Community Type	Total Area (km2)	% of Watershed Area	% of Vegetative Cover
Coniferous Woodlands	28.98~~199.59~~	0.81~~6.35~~	1.88~~18.37~~
Deciduous Woodlands	202.93~~230.76~~	5.68~~7.34~~	13.17~~21.24~~
Mixed Woodland	402.29~~281.04~~	11.27~~8.94~~	26.11~~25.87~~

Formatted Table

~~[2] http:/nhic.mnrMNRF.gov.on.ca/~~

[3] http://www.dufferincounty.on.ca/document_info.aspx?id=240

Community Type	Total Area (km2)	% of Watershed Area	% of Vegetative Cover
Successional VegetationEmergent Wetlands	254.8211.11	7.140.35	16.541.02
Meadow	10.36	0.29	0.67
Plantation Forest	126.60	3.55	8.22
Open Wetland	120.65	3.38	7.83
Woody Wetlands	363.74394.41	11.0557	25.5933.49
Natural Vegetative Cover within the 30m riparian area*	157	5.0	13.0
TOTALS:	**1541.031086.24**	**43.1734.54**	**100**

**Note: the Natural Vegetative Cover within the 30m Riparian area is not included in the TOTAL as it is not an additional ''community type', but the area with natural heritage features that are within the 30m riparian area of a watercourse.*

Please note that the values displayed in the above table may differ slightly from those presented in the Nottawasaga Valley Conservation Authority subwatershed report cards. Because of their nature, woody wetlands could be categorized as either wetland, woodland or both. In this report woody wetlands were incorporated with emergent wetlands for a total percentage of wetlands in the Nottawasaga Valley watershed. Minor variations in analysis could also account for slight differences.

2.3.2 Surface Water Quality

The chemical, physical and microbiological characteristics of natural water make up an integrated index we define as “water quality”. Water quality is a function of both natural processes and anthropogenic impacts. For example, natural processes such as weathering of minerals and various kinds of erosion are two actions that can affect the quality of surface water. There are also several types of anthropogenic influences, including point source and non-point sources of pollution. Point sources of pollution are specific, identifiable sources of contaminants to the surface water or groundwater system. Examples include municipal and industrial wastewater discharges, ruptured underground storage tanks, and landfills. Non-point sources are diffuse sources of pollution such as agricultural drainage, urban runoff, land clearing, construction activity or land application of waste that typically travel to waterways through surface runoff and infiltration. Contaminants delivered by point and non-point sources can travel in suspension and/or solution and are monitored by routine sampling of surface waters in the Nottawasaga Valley watershed.

Since the 1960s, there has been monitoring of surface water quality at different sites through the watershed. Currently the NVCA has 18 PWQMN sites (Figure 2-4, Appendix-WC Table 1) that are monitored in partnership with the Ministry of the Environment, Conservation and Parks. Sampling generally consists of eight samples being collected at each station annually during ice-free period. While some water quality parameters are measured *in situ* using a probe (e.g. temperature and conductivity), samples are also collected for laboratory analysis by

~~MOE~~MECP. These include nutrients, suspended solids, cations and/or metals (NVCA, 2007). In 2005 the methodology for collecting samples changed. Before 2005, samples were collected on a somewhat random basis on pre-selected days regardless of weather. After (and including) 2005, staff specifically went out half the time and sampled baseflow, while the other half they sampled during storm events. As the PWQMN is a regional scale, ambient program the information provided does not relate to any specific drinking water system—quality of surface water being used as a source for drinking water is presented in the Issues Evaluation sections of the municipal vulnerability and threats chapters (chapter 6 to 17).

The 20018~~7~~ Nottawasaga Valley watershed Health Check~~Report Card~~ provides a good overview of the current surface water quality conditions. This report analyzed water quality samples in each subwatershed~~, then proceeded to "grade" each subwatershed based on its results~~ (Table 2-3). Methods for assessing water quality were based on that developed by Conservation Ontario (Conservation Ontario, 2006). From the list of parameters normally analyzed, four indicators (Benthic invertebrate indices, total phosphorus, total suspended solids and fecal bacteria (*E. coli*)) were chosen that best represent the stream health in the watershed.~~. Benthic analysis used data collected from 1996 to 2006. BioMAP was the original protocol used, with proto-OBBN used from 2000 to 2003 and OBBN used thereafter. Baseflow water quality, total phosphorus and total suspended solids, reflects 2004 to 2006 (averaged) data. In 2004-2005, sampling collection method were switched from random monthly sampling to event-based sampling (i.e. targeting seasonal baseflow and storm events). The collected *E. coli* data is the averaged geometric means from CURB[4] data and has not been sampled since 1998. While fecal bacteria is deemed to be an important indicator for recreational use it is not directly related to ecological health of stream systems and therefore final stream health grading analysis presented in Table 2-4, is based on benthic invertebrates, total phosphorus and total suspended solids data only. By totaling the point scores for the three main indicators (*E. coli* not included in final grading) a final grade was generated for the nine subwatersheds and for the whole Nottawasaga Valley watershed (Table 2-4). (Note: For analysis and grading, each indicator was weighted the same; NVCA, 2007).~~

~~[4] Clean up Rural Beaches Program (CURB) – Began in 1993 in the Nottawasaga Valley watershed to evaluate possible stream sources of bacterial contamination that could affect water quality at recreational beaches (NVCA, 2007).~~

Table 2-33: Surface Water Quality Grading System (Source: NVCA, 201807).

Rating Scale	Description	Benthic Indices	Total Phosphorus (mg/L)	Corresponding Grade
Very Good	an environment that is at or close to natural conditions	2.6-3.0	< 0.01	A
Good	an environment that is close to natural conditions with minor disturbances	2.2-2.59	0.01-0.019	B
Fair	a disturbed environment	1.8-2.19	0.02-0.025	C
Poor	a highly disturbed environment	1.4-1.79	0.026-0.029	D
Very Poor	an environment that lacks natural features	< 1.4	>=0.03	F

Benthic Indices[a]	Total Phosphorus[b] (mg/L)	Total Suspended Solids[c] (mg/L)	*E. coli*[d] (CFU/100ml)	Points	Grade	Final Points Grade	
2.6-3.0	<0.01	<5	<=10	5	A	=>14	A
2.2-2.59	0.01-0.019	5-14	11-100	4	B	11-13	B
1.8-2.19	0.02-0.025	15-19	101-1,000	3	C	8-10	C
1.4-1.79	0.026-0.029	20-24	1,001-10,000	2	D	5-7	D
<1.4	>=0.03	>=25	>10,000	1	F	3-4	F

a calculated from benthic health mapping where impaired reaches = 1; unimpaired reaches = 3; and below-potential reaches = 2. Score reflects average of all mapped reaches within subwatershed.

b as measured during baseflow conditions. Provincial Water Quality Objective (MOE, 1994)) guidelines suggest that stream concentrations should be <0.03 mg/L.

c as measured during baseflow conditions. Environment Canada guidelines suggest that TSS should be <25 mg/L to maintain healthy stream conditions

d based on geometric mean of 5 samples taken over a 30 day period. Not used for stream health scoring.

The stream health within the Nottawasaga Valley watershed varies by location and is strongly linked to the surrounding land uses and physical geography. Streams are generally healthy in areas where they are going through relatively un-touched, forested areas and tend to dip down to below potential or even impaired when in close proximity to agricultural or urbanized regions. The Upper Nottawasaga River subwatershed was given a stream health status of 'very good,' while the Pine River and Blue Mountains subwatersheds stream health status was reported as 'good.' The Boyne River subwatershed was deemed to have 'fair' and stable stream health from 2013 to 2018, the Mad River, Middle Nottawasaga River, and Willow Creek subwatersheds also received a status of 'fair' stream health, however they say stream health declines between 2013 and 2018. The Lower Nottawasaga River subwatershed was reported as having a 'poor' stream health status, while Innisfil Creek was listed as 'very poor.' Both reported declining stream health when comparing their 2018 health check to that of 2013. The report card shows that the majority of subwatersheds in the Nottawasaga Valley have overall water

Formatted: Font: (Default) Calibri, 12 pt
Formatted: Font: (Default) Calibri, 12 pt
Formatted: Font: (Default) Calibri, 12 pt
Formatted: Font: (Default) Calibri, 12 pt
Formatted: Font: (Default) Calibri, 12 pt
Formatted: Font color: White
Formatted: Font color: White
Formatted Table

~~quality graded as a 'B'. The highest scoring subwatershed was the Upper Nottawasaga scoring an 'A' grade, while the lowest scoring subwatershed was the Innisfil Creek, scoring an 'F' grade. All subwatersheds received a similar grade for *Escherichia coli* (*E. coli*), scoring a 'C' grade.~~

Table 2-4: 2018 NVCA Watershed Health Check - Surface Water QualitySubwatershed Results and Grading (Data Source: NVCA, 2007).

Subwatershed	Benthic Score	Benthic Rating	Benthic Trend (2012-2016)	Total Phosphorus (low flow; mg/L)	Total Phosphorus Rating	Total Phosphorus Trend (2012-2016)	Stream Health Status	Stream Health Trend
Blue Mountains	2.06	Fair	Insufficient Data	0.01	Good	No Change	Good	No Change
Boyne River	1.92	Fair	No Change	0.019	Good	No Change	Fair	No Change
Innisfil Creek	1.37	Very Poor	Down	0.04	Very Poor	No Change	Very Poor	Declining
Lower Nottawasaga River	1.17	Very Poor	Down	0.027	Poor	No Change	Poor	Declining
Mad River	2.17	Fair	Down	0.012	Good	No Change	Fair	Declining
Middle Nottawasaga River	1.58	Poor	Down	0.027	Poor	No Change	Fair	Declining
Pine River	2.39	Good	Insufficient Data	0.013	Good	No Change	Good	No Change
Upper Nottawasaga River	2.48	Good	No Change	0.009	Very Good	No Change	Very Good	No Change
Willow Creek	2.06	Fair	Down	0.015	Good	No Change	Fair	Declining
Watershed Overall	**1.17**	**Very Poor**	**Down**	**0.027**	**Poor**	**No Change**	**Poor**	**Declining**

Formatted: Font: 11 pt, Bold, Font color: White
Formatted: Font: 11 pt
Formatted Table
Formatted: Font: 11 pt
Formatted: Font: 11 pt
Formatted: Font: 11 pt
Formatted: Font: 11 pt
Formatted: Font: 11 pt
Formatted: Font: 11 pt
Formatted: Font: 11 pt
Formatted: Font: 11 pt
Formatted: Font: 11 pt, Bold

Subwatershed	Benthic Indices		Total Phosphorus		Total Suspended Solids		*E. coli**		Final	
	Score	Pts	mg/l	Pts	mg/l	Pts	CFU/100ml	Grade	Pts	Grade
Lower Nottawasaga	1.85	3	0.036	1	13.89	3	300	C	7	D
Middle Nottawasaga	2.08	3	0.022	3	8.29	4	361	C	10	C
Upper Nottawasaga	2.4	4	0.007	5	1.98	5	281	C	14	A
Willow	2.52	4	0.019	4	7.97	4	365	C	12	B
Mad	2.39	4	0.013	4	8.33	4	239	C	12	B
Pine	2.52	4	0.022	3	10.4	4	281	C	11	B
Boyne	1.89	3	0.022	3	3.61	5	219	C	11	B
Innisfil	1.66	2	0.045	1	54.48	1	405	C	4	F
Blue Mountain[a]	2.49	4	0.009	5	3.91	5	384	C	14	B
Severn Sound	2.47	4	0.007	5	N/A		N/A	C		B
Watershed[b]	**1.85**	**3/C**	**0.036**	**1/F**	**13.89**	**3/C**	**300**	**C**	**7**	**D**

* *Based on 1990s stream data. Does not reflect beach health. Major beaches (Wasaga Beach, Earl Rowe, Tottenham, New Lowell) are regularly monitored by Park/Health Unit staff and posted if necessary.*

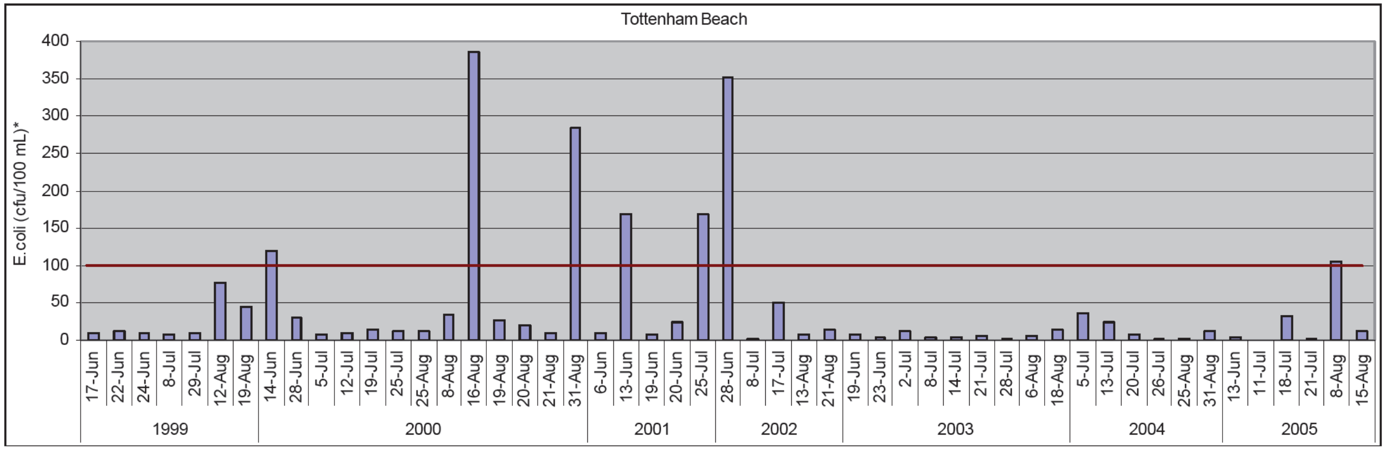
a *Although the Blue Mountain watershed is a marginal "A", water quality sampling reflects Silver Creek and Pretty River only (the two healthiest systems) and does not reflect water quality of Black Ash Creek and Batteaux Creek. Staff recommend that overall health be considered "B" until additional water quality data is collected from these systems.*

b *Lower Nottawasaga values were used instead of a watershed average since water quality in the lower river integrates the cumulative effects of land use activities throughout the watershed.*

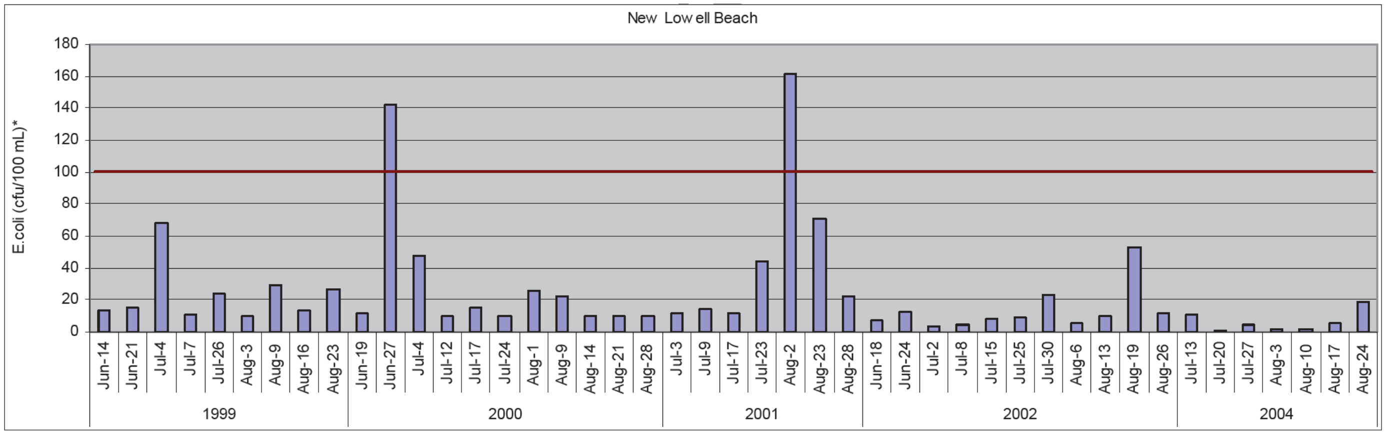
Bacteria

Municipal health units monitor the health of local beaches at regular intervals throughout the summer to ensure that they are safe for human contact. The Provincial Water Quality Objective for body-contact recreation has been defined by the Ministry of the Environment, Conservation and Parks by using the relative numbers of *Escherichia coli* (*E. coli*) bacteria as an indicator to assess the risk to human health. When the *E. coli* population exceeds the PWQO, the beach is designated unsafe for bathing activities. *E. coli* are fecal bacteria found in the intestines of mammals, and can cause serious illness and even death in humans.

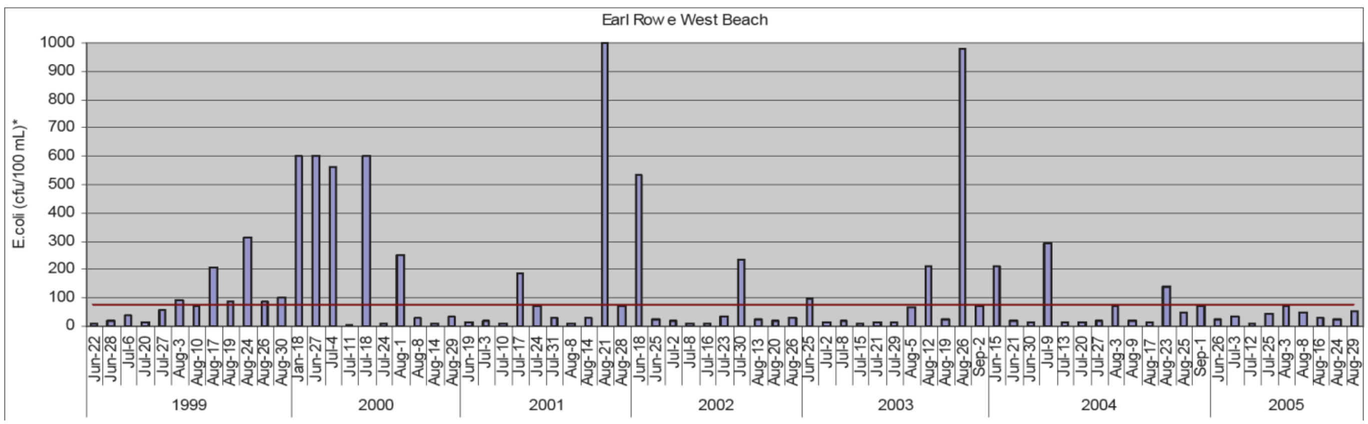
Incidences of high levels of *E. coli* in lake waters indicate contamination by human sewage or animal wastes. While there are other reasons for beach postings, including water turbidity, the presence of blue-green algae or poor aesthetics, closures in the Nottawasaga Valley watershed beaches are generally due to high levels of *E. coli*. Beach water quality monitoring usually begins mid-June and continues to the end of August. Beaches are tested for levels of indicator bacteria, including *E. coli*. The number of beach closures due to high concentrations of *E. coli* varies from year to year. Graph 2-1 to Graph 2-4 shows the 2005 beach postings results for NVCA lakes (*Note: Red line represents Provincial Water Quality Objective, * = Geometric Mean*). They are heavily influenced by precipitation levels. High levels of *E. coli* are often associated with periods of high rainfall and flow. Storm water carries with it animal waste from farms with livestock, as well as from pet and waterfowl waste. Saturated soils can transport waste leaking from malfunctioning septic systems, resulting in high levels in the near shore bathing areas.



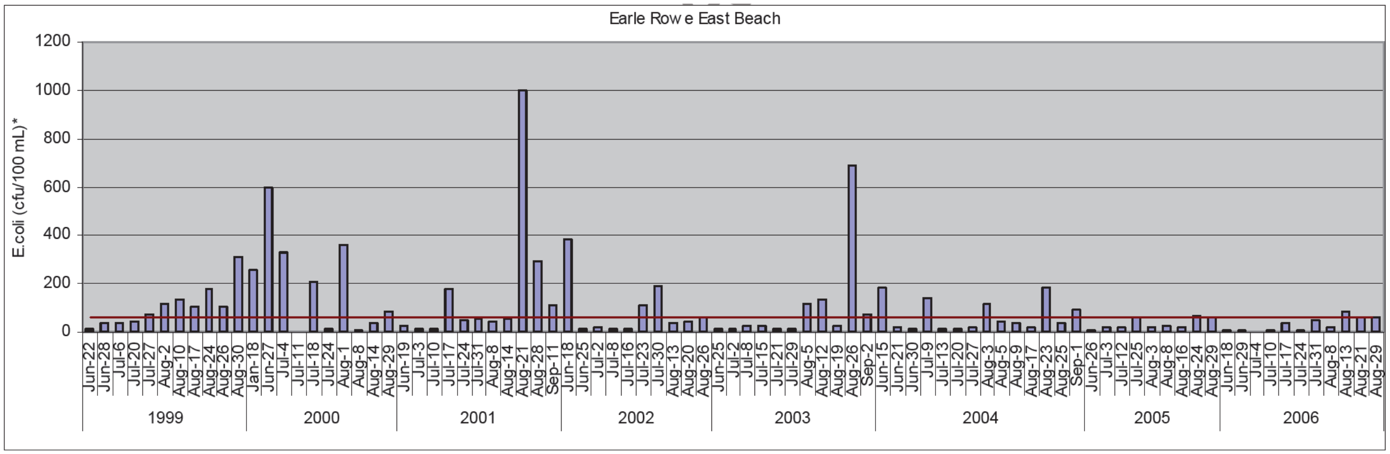
Graph 2-1: NVCA Beach Testing – Tottenham Beach (1999-2005) (Data Source: Simcoe Health Unit).



Graph 2-2: NVCA Beach Testing – New Lowell Beach (1999-2005) (Data Source: Simcoe Health Unit).



Graph 2-3: NVCA Beach Testing – Earl Rowe West Beach (1999-2005) (Data Source: Simcoe Health Unit).



Graph 2-4: NVCA Beach Testing – Earl Rowe East Beach (1999-2005) (Data Source: Simcoe Health Unit).

2.3.3 Groundwater Quality

This assessment of groundwater quality is presented for the purpose of characterizing the Nottawasaga Valley watershed and is based on Provincial Groundwater Monitoring Network (PGMN). The PGMN was established to monitor ambient groundwater levels and quality to help set baseline conditions and assess how groundwater is affected by land use and water use. Monitoring helps identify trends and emerging issues, and provides a basis for making informed resource management decisions. It also helps measure the effectiveness of programs and policies that are designed to manage and protect the groundwater resource. As the PGMN is a regional scale, ambient program the information provided does not relate to any specific drinking water system – quality of groundwater being used as a source for drinking water is presented in the Issues Evaluation sections of the municipal vulnerability and threats chapters (Chapter 6 to 17).

Starting in 2003, the NVCA, in partnership with the MOE, initiated sampling in a select number of Provincial Groundwater Monitoring Network (PGMN) wells located within the watershed (NVCA, 2009). The first time a PGMN well is sampled the following parameter groups are analyzed: volatile organics, phenolics, pesticides, general chemistry, nutrients and metals. Future sampling consists of general chemistry, nutrients and metals. Beginning in 2008, it was determined that all 15 wells in the Nottawasaga Valley watershed (Figure 2-4, Appendix-WC Table 1) would be sampled on an annual basis, with sampling taking place in the fall. The collection of samples is done using the protocol developed by the Ministry of the Environment (MOE, 2009). Results are then compared to the Ontario Drinking Water Quality Standards, Objectives and Guidelines (ODWSOG).

~~Given the limited data set available, it is not possible to derive trends from the data. However,~~ Table 2-5 gives a general overview of the groundwater quality results from 2010 to 2019 for a selected number of parameters including: sodium, chloride, iron, aluminum, manganese, nitrite, nitrite + nitrate and alkalinity. Listed beside each well is the years in which they were sampled and the total number of samples (indicated by the number of *).

Of the 18~~15~~ wells, seven~~four~~ did not exceed any parameters listed in Table 2-5~~. Wells W223-1, W224-1, W291-1, W244-2, W245-2 and W323-3 all exceeded the aesthetic (not health-related) objectives for iron and manganese. These results can be attributed to natural background levels in the aquifer sediments (NVCA, 2009). Well W323-3 also exceeded the aesthetic objective for aluminum.~~ Wells W230-1~~(0.4105mg/L)~~, W232-2, and~~ and~~ W480-1~~(0.631 mg/L)~~ only exceeded the objectives for iron (0.3 mg/L), while well W281-1~~323-2 (0.0971 mg/L)~~ only exceeded the objectives for manganese (0.05 mg/L).

While none of the wells exceeded the ODWSOGs for sodium (200 mg/L), the concentrations in wells ~~W223-1,~~ W224-1, W244-2, W245-2,~~W232-2 and~~ W323-4, and W507-1 were above the guideline of 20 mg/L for those on a sodium-restricted diet. None of the wells were over the ODWSOGs for nitrite~~, nitrite + nitrate~~ or alkalinity. One well, W486-1, exceeded the standard for nitrate + nitrite. W224-1 is the only well to exceed the standard for aluminum, while only W244-2 is the only well to exceed the drinking water standard for chloride.

~~Overall, the groundwater quality did show some exceedences of the ODWSOGs, mainly in iron and manganese (not health related), with a few (W223-1, W224-1, W232-2 and W323-4) exceeding the lower chloride limit.~~ Wells W224-1, W291-1, and W245-1 exceeded multiple drinking water standards. Iron and manganese were the most common exceedances.

Concentration~~s~~ levels are carefully monitored, ~~exceedences~~exceedances noted and appropriate actions are taken to determine the source and prevent contamination of drinking water. For information on the water quality of specific drinking water systems, see the Issues Evaluation in the municipal vulnerability and threats chapters (Chapters 6 to 17).

Table 2-5: Summary of PGMN water quality monitoring results, 2010-2019 (Data source: NVCA).

Station	Statistic	Na	Cl	Fe	Al	Mn	Nitrite	Nitrate + Nitrite	Alkalinity (CaCO3)
W224-1 (2010-2019)	Min	23.0*	25.4	0.73**	0	0.037	0.001	0.02	191
W224-1 (2010-2019)	Max	49.8*	29	1.10**	0.191**	0.050**	0.15	0.9	216
W224-1 (2010-2019)	Median	26.1*	26.5	0.87**	0	0.042	0.002	0.03	208
W230-1 (2010-2019)	Min	5.1	0.3	0.24	0	0.02	0.001	0.02	162
W230-1 (2010-2019)	Max	6	2	0.35**	0.001	0.025	0.05	0.5	185
W230-1 (2010-2019)	Median	5.3	1.3	0.30**	0	0.021	0.002	0.02	177
W292-1 (2010)	-	4.2	0.5	0.01	0.003	0.003	0.05	0.06	214
W231-1 (2010-2019)	Min	5.2	3.4	0	0	0.002	0.001	1.12	229
W231-1 (2010-2019)	Max	6.4	6.6	0.12	0.001	0.009	0.05	3.3	262
W231-1 (2010-2019)	Median	5.6	5.1	0.02	0	0.004	0.004	1.74	248
W281-1 (2010-2019)	Min	4.2	11.6	0	0.001	0.005	0.001	0.02	213
W281-1 (2010-2019)	Max	6.8	37.8	0	0.001	0.068**	0.05	0.7	239
W281-1 (2010-2019)	Median	4.7	26.2	0	0.001	0.015	0.004	0.12	225
W232-2 (2010-2019)	Min	13.7	3.6	0.21	0.001	0.013	0.001	0.02	138
W232-2 (2010-2019)	Max	16.4	7.9	0.31**	0.001	0.015	0.05	0.6	191
W232-2 (2010-2019)	Median	15.1	4.9	0.23	0.001	0.014	0.002	0.03	150
W291-1 (2010-2019)	Min	1.2	0.2	0.44**	0.001	0.055**	0.001	0.02	179
W291-1 (2010-2019)	Max	1.4	1.6	0.52**	0.002	0.065**	0.05	0.8	226
W291-1 (2010-2019)	Median	1.3	1.2	0.48**	0.001	0.061**	0.003	0.02	213
W244-2 (2010-2019)	Min	20.3*	93	0.48**	0.001	0.04	0.001	0.02	190
W244-2 (2010-2019)	Max	67.4*	447**	0.87**	0.001	0.075**	0.05	0.5	214
W244-2 (2010-2019)	Median	32.1*	142	0.54**	0.001	0.048	0.004	0.05	203

Formatted Table

Station	Statistic	Na	Cl	Fe	Al	Mn	Nitrite	Nitrate + Nitrite	Alkalinity (CaCO3)
W245-2 (2010-2019)	Min	9.4	9.2	0.22	0	0.052**	0.001	0.02	184
W245-2 (2010-2019)	Max	23.4*	51	0.32**	0.001	0.066**	0.05	0.8	205
W245-2 (2010-2019)	Median	10.4	20.7	0.25	0.001	0.055**	0.002	0.03	198
W323-3 (2010-2019)	Min	6	6	0	0	0	0.001	0.34	205
W323-3 (2010-2019)	Max	6.6	29	0.01	0.001	0.014	0.05	1.2	233
W323-3 (2010-2019)	Median	6.4	14.1	0	0.001	0	0.004	0.54	226
W323-4 (2010-2019)	Min	73.7*	1	0.08	0.001	0.004	0.001	0.02	177
W323-4 (2010-2019)	Max	81.6*	7.8	0.11	0.001	0.004	0.05	1	243
W323-4 (2010-2019)	Median	78.1*	2.8	0.09	0.001	0.004	0.003	0.04	232
W479-1 (2010-2019)	Min	4.7	3	0.1	0.001	0.022	0.001	0.02	182
W479-1 (2010-2019)	Max	5.8	8.3	0.21	0.002	0.04	0.05	0.5	204
W479-1 (2010-2019)	Median	4.9	4.8	0.16	0.001	0.027	0.001	0.02	197
W480-1 (2010-2019)	Min	7.8	13	0.51**	0	0.017	0.001	0.02	195
W480-1 (2010-2019)	Max	9.1	16.3	0.70**	0.002	0.021	0.05	0.9	247
W480-1 (2010-2019)	Median	8.3	14.6	0.64**	0.001	0.02	0.003	0.04	208
W486-1 (2010-2019)	Min	2.8	6	0	0	0	0.001	8.26	208
W486-1 (2010-2019)	Max	3.3	14.8	0	0.001	0	0.05	14.20**	270
W486-1 (2010-2019)	Median	3.1	11	0	0.001	0	0.002	10.60**	230
W505-1 (2014-2019)	Min	3	27.2	0	0	0	0.001	3.15	266
W505-1 (2014-2019)	Max	3.5	35.1	0	0.003	0	0.003	4.54	306
W505-1 (2014-2019)	Median	3.4	29.1	0	0	0	0.001	3.87	279
W206-1 (2014-2019)	Min	1.3	1.5	0	0.001	0	0.001	0.96	192
W206-1 (2014-2019)	Max	1.5	2.1	0	0.001	0	0.002	1.13	215

Formatted Table

Station	Statistic	Na	Cl	Fe	Al	Mn	Nitrite	Nitrate + Nitrite	Alkalinity (CaCO3)
W206-1 (2014-2019)	Median	1.4	1.9	0	0.001	0	0.001	1.09	203
W507-1 (2014-2017)	Min	84.1*	74.9	0.02	0.002	0.009	0.004	0.02	225
W507-1 (2014-2017)	Max	194*	177	0.17	0.004	0.014	0.01	0.59	278
W507-1 (2014-2017)	Median	147*	139	0.03	0.003	0.01	0.008	0.22	245
W508-1 (2015-2019)	Min	9.8	0.3	0.13	0.001	0.01	0.001	0.02	151
W508-1 (2015-2019)	Max	11.1	2	0.17	0.001	0.01	0.002	0.14	162
W508-1 (2015-2019)	Median	10.1	1.3	0.15	0.001	0.01	0.001	0.03	156
Ontario Drinking Water Standard	**-**	**20-200 mg/L**	**250 mg/L**	**0.3 mg/L**	**0.1 mg/L**	**0.05 mg/L**	**1 mg/L**	**10 mg/L**	**30-500 mg/L**

**not good for those on low sodium diets*
***exceeds Ontario Drinking Water Standard*

Formatted Table

Formatted: Font: (Default) Calibri, 10 pt, Italic

Formatted: Font: (Default) Calibri

While not mentioned in the water quality sections above, there has been increased interest and concern of the levels of pharmaceuticals and personal care products accumulating in the environment through the movement of water (surface and ground) and what the possible impacts are on ecosystems and humans. Pharmaceuticals and Personal Care Products (PPCPs) are a group of chemicals commonly referred to as 'emerging contaminants' and 'contaminants of emerging concern'. The ~~MOE~~MECP defines these terms as the presence of chemicals that were previously, or are currently, unknown, unrecognized and/or unregulated in the environment.

PPCP compounds are typically found where people use personal care products (such as their homes) or where people and animals are being treated medicinally (i.e. hospitals, veterinary clinics, etc). PPCP enter the environment through a number of channels including:

- residual pharmaceutical compounds which pass through the body into sewers;
- topical medications and personal care products that get washed off; and
- any products that are unused or expired and are improperly disposed of.

The result is these compounds are frequently found in water that is influenced by sewage (streams, rivers, ground water) and are appearing in some sources of drinking water.

T~~Recently t~~he Ministry of the Environment carried out a study -that involved the collection and analysis of over 250 water samples (both surface and ground) from 17 drinking water systems (full results can be found in *Survey of the Occurrence of Pharmaceuticals and Other Emerging Contaminants in Untreated Source and Finished Drinking Water in Ontario* (MOE, 2010b). Samples were tested for 46 different pharmaceuticals, antibiotics, and hormones. Results showed that the concentration of these compounds was in the nanogram per litre (ng/L) or parts per trillium range (MOE, 2010b).

Currently there is no Canadian Drinking Water Quality Guidelines (CDWQG), Ontario Drinking Water Quality Standards (ODWQS) or Provincial Water Quality Objectives (PWQO) for pharmaceuticals, nor are there any standards in North America or Europe to go by. Since there is very little information and research on how PPCPs interact in the environment, the possible short- and long-term impacts they have on both ecosystems and humans are unknown. The Ministry of the Environment- has conducted studies in the past that show that current drinking water treatments being used can reduce the amount of some pharmaceuticals and other contaminants of emerging concern in raw water (MOE, 2010b).

In terms of Source Water Protection, many activities that are potential sources of these compounds (e.g. sewage treatment plants, landfills) have been identified as prescribed Drinking Water Threats in the Region and may therefore be indirectly managed under the *Clean Water Act, 2006.* That being said, the current circumstances for identifying Significant Threats do not identify PCPPs as a potential hazardous chemicals and this is a shortcoming that may need to be addressed in the future as more information becomes available.

2.3.4 Aquatic Habitats – fisheries and macroinvertebrate communities.

Habitat can be described as a place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic. All living things have a number of basic requirements in their habitats including space, shelter, food, and reproduction. In an aquatic system, good water quality is an additional requirement. In a river system, water affects all of these habitat factors. Its movement and quantity affects the usability of the space in the channels, it can provide shelter and refuge by creating an area of calm in a deep pool, it carries small organisms, organic debris and sediments downstream which can provide food for many organisms and its currents incorporate air into the water column which provides oxygen for both living creatures and chemical processes in the water and sediments. Habitat features also frequently affect and are affected by other features and functions in a system. For instance, the materials comprising a channel bed can affect the amount of erosion that will take place over time. This, in turn affects the channel shape and the flow dynamics of the water. The coarseness of the channel's bed load can also affect the suitability for fish habitat – some species require coarse, gravelly deposits for spawning substrates, while finer sediments in the shallow fringes of slow moving watercourses often support wetland plants that are required by other species. These ideal habitats are not always available to organisms and the aquatic communities throughout the watershed are slowly degrading due to the increased pressures of an expanding human population.

The aquatic communities impacted by anthropogenic factors tend to see a gradual and permanent change in the surrounding aquatic habitat. Normally, fish tend to be able to avoid getting diseases but, when faced with situations such as rising temperatures, murky waters and loss of habitat, they become stressed, making them susceptible to pathogens and diseases. Similarly, benthic invertebrates have a ranging tolerance to different conditions, but when these are exceeded they are unable to move to different habitats quickly, making them very vulnerable.

Degradation and loss of aquatic habitat can be attributed to numerous factors both within the watercourse and the surrounding subwatershed. Stressors to aquatic habitat include change in land use, discharge of pollutants (e.g. Wastewater treatment plants) and recreational activities. Impacts from recreational activities in these areas, for example, can include increased bank erosion and instability, loss of riparian area resulting in an increase in input of total suspended solids (TSS) and pollution. Results from recreational activities in these areas can include increased bank erosion and instability, loss of riparian area resulting in an increase in input of total suspended solids (TSS) and pollution. Silt in the water can get trapped in the gills of fish and cause permanent damage. The sediment that settles on the bottom can cover the eggs of organisms, reducing the future population of a species, and can smother the benthic invertebrates living on the streambed.

Removal of riparian vegetation can also impact the communities living within watercourses. Not only does the vegetation act as a filter for debris and runoff, but shrubs and their roots provide shelter and shade to the organisms living in the water. When removed, species become vulnerable to predation and the watercourse can experience an increase in temperature. Increased water temperatures further stress the aquatic communities as this causes the levels of dissolved oxygen to decrease and forces species with specific temperature tolerance levels to leave the area, if capable of doing so. Warmer waters also provide new growth habitat for algae, further decreasing oxygen levels.

While having sites that are heavily degraded, municipalities, conservation authorities and nature groups in the Nottawasaga Valley watershed are continuously working towards improving and restoring streams and rivers to their historical conditions.

2.3.4.1 Fish Communities

All major streams in the Nottawasaga Valley watershed have been classified as coldwater, coolwater or warmwater fisheries habitats based on the fish communities supported. Coldwater fisheries habitats support brook, rainbow or brown trout and may exhibit coldwater, coolwater or warmwater temperature regimes. Many streams exhibiting a warmwater temperature regimes support brook trout populations which use groundwater discharge sites as temperature refuges during the hot summer months. Cool-water fisheries habitats do not contain trout species but support indicator organisms such as mottled sculpin and burbot, or exhibit a coolwater or coldwater temperature regime. Unclassified streams in the Nottawasaga Valley watershed include both warmwater baitfish fisheries habitats and watercourses which have not been sampled. Figure 2-5 illustrates the location of cold and warmwater watercourses.

Benthic invertebrate monitoring provides the basis for generating trend through time data for stream health and fisheries habitat status in the Nottawasaga Valley watershed. Qualitative (presence/absence) fish community data is collected in most years however in order to continually improve the available information regarding the distribution of various fish species. Exploratory surveys are regularly completed for new sample stations, particularly for small headwater tributary streams which may contain native brook trout.

The historical extent of cool and coldwater habitats in the watershed has been restricted by: loss of forest cover along streams, construction of ponds on streams and conversion of wetlands to agricultural lands.

2.3.4.1.1 Coldwater

Coldwater species are generally intolerant of increased temperatures, preferring a range between 10 and 18 degrees C. Cold temperatures are often maintained by groundwater discharge (i.e. baseflow, which is the portion of stream flow supplied by groundwater discharge). If baseflow levels decline, the temperature of the watercourse will increase, encouraging warmwater species to replace the coldwater species. Coldwater species also require high levels of dissolved oxygen (which is in higher concentration in coldwater) and cannot tolerate high turbidity levels, as the suspended sediment clogs the gills and impairs the ability of the fish to breathe. Examples of coldwater species found within the Nottawasaga Valley watershed are brook trout (*Salvelinus fontinalis)* and rainbow trout *(Oncorhynchus mykiss).* Cool and coldwater habitats are strongly associated with groundwater discharge areas, particularly those along the Niagara Escarpment, Oak Ridges Moraine and Oro Moraine.

2.3.4.1.2 Warmwater

Warmwater fish species are more tolerant of higher temperatures, with most being able to tolerate temperatures up to 30 degrees C. As they are accustomed to higher temperatures, they do not require the high concentrations of dissolved oxygen that coldwater species do. Warmwater species can also survive in habitats with increased levels of suspended sediment and nutrient levels. Examples of warmwater species found within the Nottawasaga Valley watershed are largemouth bass (*Micropterus salmoides)* and brown bullhead *(Ameiurus nebulosus).* Naturally occurring warmwater habitats are present along the middle and lower portions of the Nottawasaga River.

Changes in water quality and aquatic habitat conditions can result in a shift in the aquatic community. Continued monitoring of fish communities, which has been completed in the rivers and creeks of the Nottawasaga Valley watershed since 1961, can help to identify the occurrences that changed the habitat, and also to potential remedial strategies to help the affected community recover.

Despite some land use changes and development pressures, many of the watershed's watercourses are still able to support self-sustaining coldwater communities. In fact, the Nottawasaga Valley watershed has one of the biggest self-sustaining populations of chinook salmon and rainbow trout in southern Ontario. The main part of the Nottawasaga River also provides spawning habitat and a migratory corridor for Lake Sturgeon (NVCA, 2007). Creeks that have been impacted by harmful land uses such as agriculture tend to have less diversity of species, and contain less sensitive fish species. These watercourses often contain minnow species that are more tolerant of degraded conditions, and larger species that are more tolerant of increased water temperatures and nutrient enriched conditions, including some of the bass species and the exotic common carp (*Cyprinus carpio*). Table 2-6 provides a list of some of the warmwater, coolwater and coldwater fish species found in the Nottawasaga Valley watershed.

Table 2-6: Fish Species Identified within the NVCA Area of Jurisdiction~~Fish Species Captured in the Nottawasaga Valley watershed.~~

Confirmed Fish Species	Scientific Name	Thermal Regime	Preferred Temp (°C)
American Brook Lamprey	*Lethenteron appendix*	Coldwater	9 - 12°C
Brook Trout	*Salvelinus fontinalis*	Coldwater	< 22°C
Brown Trout+	*Salmo trutta*	Coldwater	15 -18°C

Formatted: Font color: White

Formatted Table

Confirmed Fish Species	Scientific Name	Thermal Regime	Preferred Temp (°C)
Burbot	*Lota lota*	Coldwater	7 - 18°C
Chinook Salmon+	*Oncorhynchus tshawytscha*	Coldwater	12 - 16°C
Coho Salmon+	*Oncorhynchus kisutch*	Coldwater	11 - 17°C
Lake Trout	*Salvelinus namaycush*	Coldwater	9 - 13°C
Lake Whitefish	*Coregonus Clupeaformis*	Coldwater	8 - 14°C
Longnose Sucker	*Catostomus Catostomus*	Coldwater	8 - 17°C
Pink Salmon+	*Oncorhynchus gorbuscha*	Coldwater	13 - 17°C
Rainbow Trout+	*Oncorhynchus mykiss*	Coldwater	12 - 18°C
Slimy Sculpin	*Cottus Cognatus*	Coldwater	9 - 14°C
Sea Lamprey+	*Petromyzon marinus*	Coldwater	6 - 15°C
Trout-perch	*Percopsis omiscomaycus*	Coldwater	10 - 16°C
Black Crappie	*Pomoxis nigromaculatus*	Coolwater	21 - 25°C
Blackside Darter	*Percina maculata*	Coolwater	n/a
Brassy Minnow	*Hybognathus hankinsoni*	Coolwater	n/a
Brook Stickleback	*Culaea inconstans*	Coolwater	21.3°C
Central Mudminnow	*Umbra limi*	Coolwater	n/a
Central Stoneroller	*Campostoma anomalum*	Coolwater	19 - 27°C
Common Shiner	*Luxilus cornutus*	Coolwater	21.9°C
Creek Chub	*Semotilus atromaculatus*	Coolwater	20.8°C
Golden Shiner	*Notemigonus crysoleucas*	Coolwater	17 - 24°C
Hornyhead Chub	*Nocomis biguttatus*	Coolwater	n/a
Iowa Darter	*Etheostoma exile*	Coolwater	12 - 25°C
Johnny Darter	*Etheostoma nigrum*	Coolwater	22.8°C
Longnose Dace	*Rhinichthys cataractae*	Coolwater	13 - 21°C
Mottled Sculpin	*Cottus bairdii*	Coolwater	13 - 18°C
Northern Pearl Dace	*Margariscus nachtriebi*	Coolwater	16.2°C
Northern Pike	*Esox lucius*	Coolwater	17 - 24°C
Northern Redbelly Dace	*Chrosomus eos*	Coolwater	25.3°C
Rainbow Darter	*Etheostoma Caeruleum*	Coolwater	19.8°C
River Chub	*Nocomis micropogon*	Coolwater	21.7°C
Rock Bass	*Ambloplites rupestris*	Coolwater	21 - 26°C
Round Goby+	*Neogobius melanostomus*	Coolwater	23 - 26°C
Smallmouth Bass	*Micropterus dolomieu*	Coolwater	20 - 27°C
White Sucker	*Catostomus Commersonii*	Coolwater	17 - 24°C
Yellow Perch	*Perca flavescens*	Coolwater	18 - 24°C
Blacknose Dace	*Rhinichthys obtusus*	Coolwater	19 - 25°C
Lake Sturgeon	*Acipenser fulvescens*	Coolwater	15 - 17°C
Walleye	*Sander vitreus*	Coolwater	19 - 23°C

Formatted: Font color: White

Confirmed Fish Species	Scientific Name	Thermal Regime	Preferred Temp (°C)
Bluntnose Minnow	*Pimephales notatus*	Warmwater	26 - 29°C
Bowfin	*Amia Calva*	Warmwater	28 - 32°C
Brown Bullhead	*Ameiurus nebulosus*	Warmwater	25 - 31°C
Channel Catfish	*Ictalurus punctatus*	Warmwater	25 - 31°C
Common Carp+	*Cyprinus Carpio*	Warmwater	27 - 32°C
Fathead Minnow	*Pimephales promelas*	Warmwater	21 - 29°C
Golden Redhorse	*Moxostoma erythrurum*	Warmwater	26 - 27.5°C
Largemouth Bass	*Micropterus salmoides*	Warmwater	26 - 30°C
Log Perch	*Percina Caprodes*	Warmwater	n/a
Longnose Gar	*Lepisosteus osseus*	Warmwater	25.3 - 33.1°C
Mimic Shiner	*Notropis volucellus*	Warmwater	n/a
Pumpkinseed	*Lepomis gibbosus*	Warmwater	22 - 30°C
Rosyface Shiner	*Notropis rubellus*	Warmwater	22 - 28°C
Shorthead Redhorse	*Moxostoma macrolepidotum*	Warmwater	26 - 27.5°C

~~Common Name~~	~~Scientific Name~~	~~Thermal Status~~
~~Walleye~~	~~*Sander vitreus*~~	~~Warmwater~~
~~Rainbow Trout ^~~	~~*Oncorhynchus mykiss*~~	~~Coldwater~~
~~Northern Pike~~	~~*Esox lucius*~~	~~Coldwater~~
~~Brown Bullhead~~	~~*Ameiurus nebulosus*~~	~~Warmwater~~
~~Channel Catfish~~	~~*Ictalurus punctatus*~~	~~Warmwater~~
~~Longnose Sucker~~	~~*Catastomus catastomus*~~	~~Coolwater~~
~~Yellow Perch~~	~~*Perca flavescens*~~	~~Warmwater~~
~~Largemouth Bass~~	~~*Micropterus salmoides*~~	~~Warmwater~~
~~Smallmouth Bass~~	~~*Micropterus dolomieu*~~	~~Coolwater~~
~~Rock Bass~~	~~*Ambloplites rupertris*~~	~~Warmwater~~
~~Black Crappie ^~~	~~*Pomoxis nigromaculatus*~~	~~Warmwater~~
~~Pumpkinseed~~	~~*Lepomis gibbosus*~~	~~Warmwater~~
~~Creek Chub~~	~~*Semotilus atromaculatus*~~	~~Warmwater~~
~~Common Carp*~~	~~*Cyprinis carpio*~~	~~Warmwater~~
~~Minnow (various species)~~	~~-~~	~~-~~
~~Brook Trout~~	~~*Salvelinus fontinalis*~~	~~Coldwater~~
~~Mottled Sculpin~~	~~*Cottus bairdi*~~	~~Coldwater~~
~~Brown Trout~~	~~*Salmo trutta*~~	~~Coldwater~~
~~Lake Sturgeon~~~	~~*Acipenser fulvescens*~~	~~Coldwater~~
~~Chinook Salmon~~	~~*Oncorhynchus tshawytscha*~~	~~Coldwater~~

1. non-native and naturalized +
*2. non-native and not naturalized **
~~*^ = non-native*~~
~~** = non-native, invasive species*~~
~~*~ = species at risk (in Ontario)*~~

2.3.4.2 Macroinvertebrate Communities

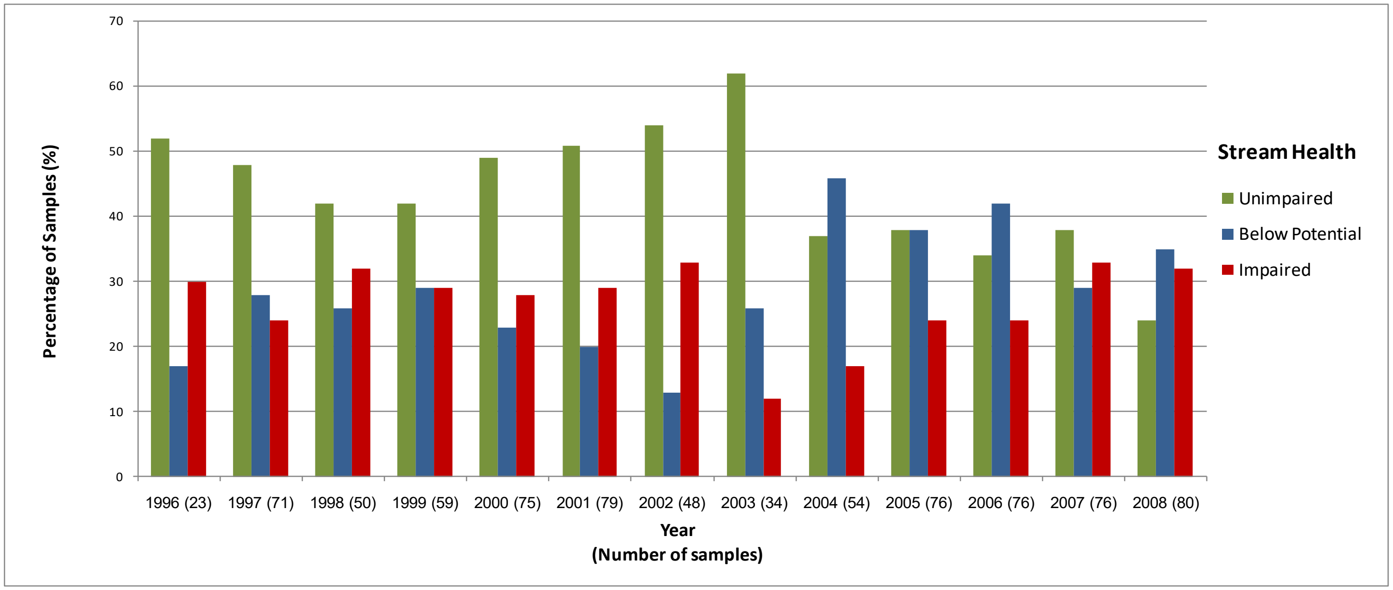
Aquatic insects, or benthic invertebrates, are an ideal indicator of water quality as different species have different tolerances to factors such as nutrient enrichment, dissolved solids, dissolved oxygen and temperature. Benthics are defined as organisms living near or at the bottom of streams or lakes for at least part of their life cycle; including crayfish, leaches, clams, snails and the larval stages of insects. The presence or absence of certain species can be used to determine water quality at a given site.

Monitoring of benthic invertebrates has been conducted since 1996 at various sites throughout the watershed (Figure 2-6), with the number of samples collected each year varying from 23 to 80. The methodology used for evaluating benthic communities has changed over the past 14 years. The NVCA Biomonitoring Program started using the BioMap protocol (Griffiths, 1999) in 1996 and continued until 1999. From 2000 to 2003, "kick and sweep" collection methods (modified version of the BioMAP protocol) were implemented. In 2004, the Ontario Benthos Biomonitoring Network (OBBN) protocol (Jones *et al.*, 2005) was adopted by the Biomonitoring Program and has continued to be used since (NVCA, 2007). The limitations with benthic data are mostly associated with specimen identification. Also, since the stream health assessment relies on professional judgment, there is a possibility of bias that occurs with staff turnover.

The benthic invertebrate data collected by NVCA is used in combination with other indicators of stream condition to derive an overall stream health index rating. This rating for each watercourse is based on the pollution tolerance of species of benthic invertebrates found during sampling, as well as stream baseflow, water temperature, land use and professional judgment. Stream health using this approach is categorized as either "unimpaired", "below potential" or "impaired". Stream health across the NVCA watershed between 1996 and 2008 (Graph 2-5) shows that between 1996 and 2003, the majority of samples collected indicate unimpaired stream health and benthic condition. After 2004 the number of unimpaired sites declined, leading to a similar number of impaired, unimpaired and below potential samples between 2005 and 2008.

The majority of streams classified as unimpaired were relatively unaffected by detrimental land uses, as many flow through forests, wetlands, or conservation lands. Some have residential or commercial areas as the adjacent land use, but almost all of these had a forested or heavily vegetated buffer, which would help to minimize the impacts of these uses. On the other hand, areas with minimal vegetation in the riparian buffer zone, including golf courses, some parks, residential areas and agricultural lands, tend to have a detrimental impact on the quality of the stream in the area.

There is a marked change in the land uses adjacent to streams rated below potential or impaired. Many of these had been channelized, causing unnatural flow patterns and bank erosion. The majority of sites going through agricultural areas were rated as impaired, as they are impacted by erosion, non-point source runoff of nutrients, and stream alterations. Vegetated buffers can help decrease some of these impacts, but most areas allow for only minimal buffers, if any. Other land uses associated with impaired ratings include the presence of dams or online ponds, the presence of a stormwater pond or stormwater outlet or commercial, residential and urban land uses (which have a high coefficient and very little buffer to attenuate any overland flow).



Graph 2-5: Stream health in the Nottawasaga Valley Watershed, this assessment of health includes condition of benthic community. (Data source: NVCA survey data, 1996-2009).

2.4 Human Geography – population and land use

2.4.1 Population and Municipal Boundaries

The Nottawasaga Valley watershed lies within the Counties of Simcoe (74%), Dufferin (22%), and Grey (4%), not including a very small area of Peel in the south. Overall, there are 10 municipal governments operating within the Nottawasaga Valley watershed: 5 regions and counties and numerous municipalities and cities as outlined on Figure 2-2. Municipal populations within the Nottawasaga watershed are presented in Table 2-7 and Figure 2-7. Many of the municipalities are only partially withing the South Georgian Bay Lake Simcoe Source Protection Region. The area of each municipality within the Source Protection Region is also shown in Table 2-7.

As many municipalities are only partially within the Source Protection Region, and Statistics Canada data was provided on a census consolidated subdivision (CCS) scale[5], it was necessary to estimate the actual municipal population within the SPR using GIS[6]. This calculation used a combination of several datasets, including assessment parcel fabric, municipal population figures from Statistics Canada[7] and the SPR boundary. The approach involved allocating municipal populations through an area-weighted proportioning for the municipalities that are not entirely within the SPR. This is intended to be a preliminary estimation of population, rather than a conclusive census, and should be treated accordingly.

There are no First Nation Reserves in the Nottawasaga Valley watershed.

Table 2-7: Municipal population and population density (Data Source: Statistics Canada, Census 202106).

Upper Tier Municipality	Lower Tier Municipality	Total municipal Population	% of CCS area within Watershed
County of Dufferin	Township of Amaranth	4,3273,845	16
County of Dufferin	Township of Melancthon	3,1322,895	42
County of Dufferin	Town of Mono	7,0719,421	87
County of Dufferin	Township of Mulmur	3,5713,318	100
County of Dufferin	Town of Shelburne	8,9945,149	100
County of Grey	Town of Blue Mountains	9,3906,825	14
County of Grey	Municipality of Grey Highlands	9,48010,424	11
Regional Municipality of Peel	Town of Caledon	57,05076,581	2
City of Barrie		128,430147,829	29
County of Simcoe	Adjala-Tosorontio	10,98910,695	94

[5] Grouping of adjacent census municipalities

[6] Geographic Information System (GIS) is a computer system that can analyze and manipulate date to produce geographic representations (i.e. a map). Different information can be layered and depicted visually by using this method.

[7] https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

Upper Tier Municipality	Lower Tier Municipality	Total municipal Population	% of CCS area within Watershed
County of Simcoe	Town of Bradford-West Gwillimbury	42,880~~24,039~~	31
County of Simcoe	Township of Clearview	14,814~~088~~	99
County of Simcoe	Town of Collingwood	24,811~~17,290~~	96
County of Simcoe	Township of Essa	22,970~~16,901~~	100
County of Simcoe	Town of Innisfil	~~31,175~~43,326	42
County of Simcoe	Township of New Tecumseth	~~27,701~~43,948	92
County of Simcoe	Township of Oro-Medonte	2~~0,031~~3,017	20
County of Simcoe	Township of Springwater	~~17,456~~21,701	79
County of Simcoe	Town of Wasaga Beach	~~15,029~~24,862	100
County of Simcoe	Township of Tiny	1~~0,784~~2,966	0.1
Regional Municipality of York	Township of King	~~74,295~~27,333	0.1
TOTAL		**~~503,547~~587,286**	

~~**2.4.2**~~

~~2.4.3~~2.4.2 Land use

It is important to consider land use when implementing Source Water Protection measures because land cover, and changes to it, will affect several aspects of the water budget including surface water runoff, evaporation and infiltration. Often land being developed will have higher proportion of impervious surfaces, such as roadways, parking lots and building roofs. This, in turn increases runoff rates, resulting in erosion and reduced infiltration to recharge groundwater reserves. The potential for the introduction of contaminants to both groundwater and surface water must be a consideration when a new land use is proposed.

The Nottawasaga Valley watershed is largely rural in character though urban areas such as Barrie, Shelburne, Wasaga Beach and Collingwood continue to grow. ~~Land use is dominated by hay/pasture (27%) and row crops (27%); however, compared to many areas in southern Ontario, natural areas are a significant part of the landscape (Table 2-8, Figure 2-8)~~. Forests and wetlands are generally found in areas that are unsuitable for farming—where soils are too wet, dry, rocky or steep (NVCA 2007).

Aggregate resources constitute the major raw material used in the road building and constructions industries. As of approximately 2010,~~Currently~~ in the Nottawasaga watershed, there we~~a~~re 79 active licensed aggregate operations: 11 class B (<20,000 tonnes annually) & 59 class A (>20,000 tonnes annually) licenses. Nine of the active operations have no recorded annual tonnage limits. The total area licensed for aggregate extraction within the Nottawasaga Valley watershed is 2060.5 ha (data source: MNR).

Table 2-8: Land Use in the Nottawasaga Valley watershed (Data Source: NVCA land use layer, 2007).

~~Land~~Land Use~~ Use~~	Area (km2)~~Area (km2)~~	%of Total~~% of total~~
Natural Features~~Beaches~~	1,541.0~~0.1~~	43.2~~0.003~~
Open Spaces~~Golf Course~~	9.1~~15.0~~	0.26~~0.476~~
Residential~~Hay/Pasture~~	117.9~~841.6~~	3.3~~26.763~~
Commercial~~High-Intensity Development~~	12.4~~116.6~~	0.35~~3.709~~
Industrial~~Low-Intensity Development~~	14..0~~4.5~~	0.39~~0.144~~
Institutional~~Natural Vegetative Cover~~	19.8~~1086.2~~	0.56~~34.541~~
Golf Courses~~Probable Agriculture~~	19.1~~19.3~~	0.54~~0.614~~
Cemeteries~~Quarries~~	0.44~~26.6~~	0.01~~0.847~~
Waterbodies~~Roads~~	21.7~~83.9~~	0.61~~2.669~~
Quarry~~Row Crops~~	7.32~~851.9~~	0.21~~27.090~~
Beaches~~Sod Farms~~	0.79~~29.8~~	0.02~~0.947~~
Road~~Transitional~~	94.1~~61.8~~	2.6~~1.965~~
Row Crops~~Water~~	1,640.5~~7.3~~	46.0~~0.232~~
Pasture~~TOTALS:~~	4.4~~3,144.8~~	0.12~~100~~
Solar Farm	2.0	0.06
Recreational	13.5	0.38
Orchard	2.3	0.07
Hedgerows	29.1	0.82
Railroad	2.26	0.06
Undeveloped Woodlot	15.8	0.44
TOTALS	**3,569.5**	**100**

~~2.4.3.1~~2.4.2.1 *Areas of Settlement*

The main urban areas within the Source Protection Area include: Barrie, Collingwood and Wasaga Beach, with smaller areas of settlement occurring across the watershed in municipalities such as Essa, New Tecumseth and Bradford West Gwillimbury. Urban development activities have subsequently increased to keep pace with the increasing population.The manufacturing and construction industries dominate the work force in Simcoe and Dufferin County. This is followed by 'other services', wholesale and resale trade, health, education and business services. Similarly, Grey County also has a large portion of the workforce in the manufacturing sectors, with 'other services', wholesale and resale trade, education and health services making up a significant portion as well (Statistics Canada, 2006).

Figure 2-9 represents designated Areas of Settlement and was generated from municipal Official Plans (OPs). This compilation of OP settlement data was prepared for the Assimilative Capacity Study in 2006 (LSRCA and NVCA, 2006). The majority of the OPs used in the map were finalized in the early to mid-2000s, although in a few of instances (e.g. Springwater, Newmarket and East Gwillimbury) OPs from the late 1990 were used. As Collingwood was not included in the original mapping exercise, the Area of Settlement for this region was based on the Draft 2007 Simcoe County OP. Many of the municipalities had differing designated settlement types and it was necessary to standardize these for consistency across the area. This standardization process was completed for the study by the Ministry of Municipal Affairs and Housing. In some instances, the Areas of Settlement, as provided in Figure 2-9, may now be out of date as municipalities have either revised their OPs or have draft OPs in review. Future versions of this Assessment Report will include updated OP Areas of Settlement information.

~~2.4.3.2~~2.4.2.2 *Total Impervious Surface*

The hardening of the land's surface through paving and the construction of buildings significantly alters the hydrologic properties or drainage characteristics of an area. The result is reduced groundwater recharge and increased surface runoff. For the purpose of characterizing the Nottawasaga Valley watershed, we provide a map of impervious surfaces using the typical definition where all hardened surfaces are shown, including roads, parking lots and buildings. Figure 2-10 shows that the areas with the most impervious surface cover are the major urban areas such as Barrie, Collingwood and Wasaga Beach. Rural areas typically have very little impervious surface cover.

In the context of identifying risks to municipal drinking water systems, a slightly different definition of impervious surface area is applied to that described above. Source Water Protection defines total impervious surface area as "the surface area of all highways and other impervious land surfaces used for vehicular traffic and parking, and all pedestrian paths" (MOE, 2008a). This definition of total impervious surface is essentially used as a proxy for the application of road salt, a potential Threat to municipal drinking water, as excess sodium is linked to a number of negative health issues (such as high blood pressure) and is of particular concern to those on low-sodium diets. The technical rules (MOE, 2008a) requires that the percentage of total impervious surface be calculated for each vulnerable area, including the Highly Vulnerable Aquifers (HVAs), Significant Groundwater Recharge Areas (SGRAs), Wellhead Protection Areas (WHPAs) and Intake Protection Zones (IPZs).

Total impervious surface calculations for WHPAs and IPZs were conducted as a component of the technical studies undertaken to investigate potential Drinking Water Threats to individual municipal drinking water supplies. The methods and results of the WHPA and IPZ impervious surface calculations can be found in Chapters 6 to 17. Similarly, methods and results for total impervious surface cover for the two broad scale vulnerable areas—HVAs and SGRAs—can be found in Chapter 4.

~~2.4.3.3~~2.4.2.3 Agriculture and the Raising of Livestock

Agriculture in the watershed remains a productive and dynamic industry throughout the study area. The areas in the most southerly portion of the County have the highest values of farm capital per acres, gross farm receipts and expenses. Potential for growth in the agricultural industry remains strongest in this area. Attempts to manage growth in both Grey and Simcoe Counties include amendments to the Official Plans to protect agricultural land. The Grey County Official Plan states that “farm operations are, and will continue to be the dominant land use”. Assuming a secure land base, aspects of agriculture in this area will remain provincial leaders. The central part of the County also has positive aspects, including the highest level of agricultural activity (number of farms, farm operators and acres of farmland). Prospects for long term growth in this area are also strong. The northern areas of Simcoe County have some agricultural operations but long-term growth, unlike the south and central portions of Simcoe, is limited due to soil conditions.

There are approximately 3,000 farms in Grey County and over 500,000 farmed acres. Although prime agricultural areas and rural locations are afforded some protection from development (Simcoe County OP), development pressure in south Simcoe is significant as a result of the Green Belt and Oak Ridges Moraine acts restricting major development to the south. There were 898 farms in Dufferin County in 2001 (Statistics Canada, 2001). A portion of the county’s economy is still dependent on agriculture, but the economy is diversifying[8].

Highest livestock densities in the Nottawasaga Valley watershed during the 2006 census occurred in Adjala-Tosorontio, followed by Clearview. High density in this area is due to the raising of hens and chickens. Excluding the raising of chickens and hens, areas with the highest livestock densities (cattle, pig, sheep) are Amaranth, Essa and Springwater. No data was reported for the urban areas of Shelburne, Barrie, Collingwood and Wasaga Beach. The location of livestock farms is presented in Figure 2-11, and the density of livestock within census consolidated subdivisions (CCS) are presented in Table 2-9.

[8] ~~http://www.dufferincounty.on.ca/government_section.aspx?id=90~~

Table 2-9: Livestock density (per km^2) within Nottawasaga Valley census consolidated subdivisions (CCS). Only those CCS regions with available data are presented. (Data source: Statistics Canada, 2006 Census).

Census Consolidated Subdivision	% of CCS area within watershed	Cattle and calves	Pigs	Sheep and lambs	Horses and ponies	Hens and chickens	All others	All livestock
Grey Highlands	11	29.3	15.6	4.6	1.3	68.9	11.8	131.4
Adjala-Tosorontio	94	13.4	0.0	3.1	2.4	459.3	76.4	554.6
Blue Mountains	14	8.2	0.0	2.3	0.8	0.0	1.8	13.1
Caledon	2	19.6	0.0	1.3	2.4	255.8	0.6	279.7
Amaranth	16	32.4	26.0	10.0	1.6	0.0	0.5	70.4
Mulmur	100	15.6	0.0	6.0	1.1	0.0	1.9	24.5
Melancthon	42	28.8	6.6	3.3	0.9	0.0	1.0	40.5
Oro-Medonte	20	15.4	6.7	8.4	1.5	2.0	1.7	35.7
Clearview	99	24.1	37.1	5.5	1.0	262.8	1.5	332.0
Bradford West Gwillimbury	31	10.6	8.2	5.7	0.9	0.0	0.9	26.4
Innisfil	42	13.2	0.0	6.2	0.9	0.0	1.8	22.0
Springwater	79	20.5	17.7	3.1	0.8	236.3	2.3	280.8
Essa	100	18.8	17.8	4.1	2.0	0.0	0.4	43.1
New Tecumseth	92	9.3	0.5	6.2	1.6	97.1	1.7	116.5
Mono	87	12.9	0.0	2.2	2.7	5.8	4.1	27.7

Estimating the number of livestock being raised in vulnerable areas is an important task in determining risks to municipal drinking water supply. Livestock and associated activities, such as the storage or application of agricultural source material (i.e. manure spreading), have the potential to be a risk to drinking water due to both the pathogens (e.g. *E. coli*) and chemicals (e.g. nitrogen) the material contains. The Technical Rules (MOE, 2008a) require that livestock density be calculated for each vulnerable area – Wellhead Protection Area (WHPA), Intake Protection Zone (IPZ), Significant Groundwater Recharge Area (SGRA) and Highly Vulnerable Aquifer (HVA). The methods used for these vulnerable areas is based on a Technical Bulletin provided by the Province (MOE, 2009b), and require interpretation of aerial photography to estimate capacity of a farm to house livestock. Methods and results of the WHPA and IPZ livestock density calculation, and whether these result in potential significant risks, can be found in Chapters 6 to 17. Similarly, livestock density for the broad scale vulnerable areas (HVAs and SGRAs) can be found in Chapter 4. To enable comparison of risk for different livestock types (e.g. hens versus cattle), livestock density estimates within these sections are presented as nutrient units per acre.

~~2.4.3.4~~2.4.2.4 *Managed Lands*

Managed Land means land to which agricultural source material, commercial fertilizer, or non-agricultural source material (i.e. sewage or meat plant effluent) is applied (MOE 2008a). Managed lands include pasture, golf courses, residential areas, and areas where biosolids are applied. Managed Lands do not include areas such as forests, wetlands and commercial properties. The Technical Rules require that the percentage of managed lands within each vulnerable area (WHPA, IPZ, SGRA and HVA) be determined so that it can be established whether activities such as application of source material and fertilizer is a potential Significant, Moderate or Low Drinking Water Threat to the municipal water supply.

Methods and results of the WHPA and IPZ managed land calculation, and whether these result in potential significant threats, can be found in Chapters 6 to 17. Similarly, managed land information for the broad scale vulnerable areas—HVAs and SGRAs— can be found in Chapter 4.

For the purposes of characterizing the Nottawasaga Valley watershed, Figure 2-12provides a broad scale overview of managed lands in the area. This figure is based on the methods prescribed by Province in a Technical Bulletin (MOE, 2009b) and shows the Municipal Property Assessment Corporation (MPAC) land use and property codes identified as having activities that have the potential to apply nutrients. Figure 2-12 illustrates that areas of the watershed are classified as being managed lands. These include both urban (e.g. residential lawns) and rural (farms) areas.

2.5 Drinking Water Systems

Drinking water systems in Ontario are classified under O.Reg 170/03 (Drinking Water Systems) made under the *Safe Drinking Water Act, 2002*. The drinking water system classifications are:

(i) large municipal residential system;

(ii) small municipal residential system;

(iii) large municipal non-residential system;

(iv) small municipal non-residential system;

(v) non-municipal year-round residential system;

(vi) non-municipal seasonal residential system;

(vii) large non-municipal non-residential system; and

(viii) small non-municipal non-residential system;

The *Safe Drinking Water Act (SDWA), 2002*, came out of the recommendations from the Walkerton Inquiry to address the issues pertaining to the treatment and distribution of drinking water. The Act helps to protect drinking water through regulating the operation of drinking water systems and the testing of drinking water. The systems that are covered under O.Reg. 170/03 of the SDWA are listed below in Table 2-10 and include year-round municipal and private water systems that provide drinking water to residential developments and designated facilities that supply water to 'vulnerable populations' (elderly, children). These facilities consist of schools (both public and private), universities, colleges or institutions that grant degrees, health and social care facilities, children's camps, and child and youth care facilities.

The *Clean Water Act (CWA), 2006*, differs from the SDWA, in that it focuses more on protecting drinking water at the source rather than relying on the treatment system. In addition, the CWA focuses only on large and small municipal residential drinking water systems, where the SDWA focuses on municipal non-residential and non-municipal year round residential systems as well. Other drinking water systems (as previously mentioned) are regulated under the *Safe Drinking Water Act* and the *Health Protection and Promotion Act (HPPA), 1990*. For more information on the CWA and the assessment report process, please refer to Chapter 1 of this report.

Table 2-10: Drinking Water Systems and the legislation they are protected under.

Drinking Water System	Definition	Legislative Protection
Large Municipal Residential System	• Municipal • Serves major residential development & more than 100 private residences	SDWA, CWA
Small Municipal Residential System	• Municipal • Serves a major residential development & fewer than 101 private residences	SDWA, CWA
Large Municipal Non-Residential System	• Municipal • Non-residential • Capable of supplying drinking water at a rate of more than 2.9 L/s	SDWA, HPPA
Small Municipal Non-Residential System	• Municipal • Non-residential • Not capable of supplying drinking water at a rate of more than 2.9 L/s	SDWA, HPPA
Non-Municipal Year-Round Residential System	• Non-municipal • Year-round • Serves a major residential development or trailer park or campground & has more than 5 service connections	SDWA
Non-Municipal Seasonal Residential System	• Non-municipal • Seasonal • Serves a major residential development or trailer park or campground & has more than 5 service connections	HPPA
Large Non-Municipal Non-Residential System	• Non-municipal • Does not serves major residential development/trailer park or campground that has more than 5 service connections • Capable of supplying drinking water at a rate of more than 2.9 L/s	HPPA
Small Non-Municipal Non-Residential System	• Non-municipal • Serves a designated facility or public facility • Does not serves major residential development/trailer park or campground that has more than 5 service connections • Not capable of supplying drinking water at a rate of more than 2.9 L/s	HPPA

The Terms of Reference (ToR) for the SGBLS Assessment Reports identifies all the drinking water systems and associated wells and surface intakes required in this Assessment Report. In accordance with the ToR, only drinking water systems classified as large municipal residential, and small municipal residential have been included (Type i and ii) in this report. Within the entire SGBLS Source Protection Region there are 108 drinking water systems within the ToR and these are serviced by 277 wells and 16 surface water intakes. Within the Nottawasaga Valley area there are 34 drinking water systems, serviced by 103 municipal wells and 1 surface water intake at Collingwood (Figure 2-13). Location of non-municipal and non-residential drinking water systems that are not included in this report are shown in Figure 2-14. Locations of these drinking water systems were provided by the ~~MOE~~MECP and represent those systems that are registered with the ~~MOE~~MECP under the former O.Reg 252 (now Reg 318 of the Health Promotion and Protection Act).

Information pertaining to each municipal drinking water system, such as the location, population served and pumping rates are presented in Table 2-11 and monthly average pumping rates are presented in Appendix WB-3B. A few of the drinking water systems in the South Georgian Bay-Lake Simcoe Protection Region are spread across more than one watershed. In the Nottawasaga Valley watershed, the Barrie Well Supply System is in both the Nottawasaga Valley and the Lake Simcoe watershed. Four of the wells (Well #9, #13, #16 and #19) are in the Nottawasaga Valley watershed, while the other eleven wells are located in the Lake Simcoe watershed and reported rates can be found in Part 1 (Lake Simcoe) of the Lakes Simcoe and Couchiching-Black River Assessment Report. Where current average pumping rates were not available, maximum permitted rates were used (denoted by *).

Information presented in these tables has been sourced either directly from the municipality, or obtained through previously published reports including; North Simcoe Groundwater Study (Golder, 2005), South Simcoe Groundwater Study (Golder, 2004), Groundwater Modelling of the ORM (Earthfx and Gerber, 2008; Kassenaar and Wexler, 2006), and various other well head protection reports from across the Source Protection Region.

Table 2-11: Municipal Drinking Water Systems in the Nottawasaga Valley watershed.

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of…
The Township of Adjala-Tosorontio	Innisfil Creek	Colgan Well Supply	2	213 combined (Colgan wells [3])	Well #1	592170	4875467	28,698*	2012
The Township of Adjala-Tosorontio	Innisfil Creek	Colgan Well Supply	2	213 combined (Colgan wells [3])	Well #2	592166	4875464	28,698*	2012
The Township of Adjala-Tosorontio	Innisfil Creek	Colgan Well Supply	2	213 combined (Colgan wells [3])	Well #3	592177	4875248	95,995*	2012
The Township of Adjala-Tosorontio	Pine River	Everett Well Supply	1	1,563 combined (Everett wells [3])	Well #1/88	585122	4894208	68,255	2012
The Township of Adjala-Tosorontio	Pine River	Everett Well Supply	1	1,563 combined (Everett wells [3])	Well #3/78	585123	4894177	0	2012
The Township of Adjala-Tosorontio	Pine River	Everett Well Supply	1	1,563 combined (Everett wells [3])	Well 1/90	584431	4893685	90,885	2012
The Township of Adjala-Tosorontio	Upper Nottawasaga River	Hockley Well Supply	2	42	PW1	582853	4874533	6,935	2012
The Township of Adjala-Tosorontio	Pine River	Lisle Well Supply	2	138	Well #1 / Well #2	581167 / 581175	4901779 / 4901762	83,950	2012
The Township of Adjala-Tosorontio	Innisfil Creek	Loretto Heights Well Supply	2	78	Well #1	588744	4877836	9,490	2012
The Township of Adjala-Tosorontio	Boyne River	Rosemont Well Supply	2	141 combined (Rosemont wells [2])	PW1A	580929	4886111	12,045*	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of...
The Township of Adjala-Tosorontio	Boyne River	Rosemont Well Supply	2	141 combined (Rosemont wells [2])	PW3A	581230	4886410	18,980*	2012
The Township of Adjala-Tosorontio	Innisfil Creek	Weca Well Water Supply	2	246 combined (Weca wells [2])	Weca Well1	589041	4877806	12,045	2012
The Township of Adjala-Tosorontio	Innisfil Creek	Weca Well Water Supply	2	246 combined (Weca wells [2])	Weca Well2	589245	4877667	32,120	2012
The City of Barrie	Willow Creek	Barrie Well Supply	1	78,500 combined (Barrie all wells #9, #13, #36, #19)	Well #9	607034	4917647	2,482,000	2012
The City of Barrie	Willow Creek	Barrie Well Supply	1	78,500 combined (Barrie all wells #9, #13, #36, #19)	Well #13	607016	4917663	728,175	2012
The City of Barrie	Willow Creek	Barrie Well Supply	1	78,500 combined (Barrie all wells #9, #13, #36, #19)	Well #16	604025	4919588	1,744,335	2012
The City of Barrie	Middle Nottawasaga River	Barrie Well Supply	1	78,500 combined (Barrie allwells #9, #13, #36, #19)	Well #19	601324	4912941	2,869,776*	2012
The Township of Clearview	Blue Mountains Water	Buckingham Woods Well Supply	2	45 combined (Buckingham Woods wells [3])	Well #1	557447	4925686	4,329	2012
The Township of Clearview	Blue Mountains Water	Buckingham Woods Well Supply	2	45 combined (Buckingham Woods wells [3])	Well #2	557450	4925688	47,815*	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of…
The Township of Clearview	Blue Mountains Water	Buckingham Woods Well Supply	2	45 combined (Buckingham Woods wells [3])	Well #3	557344	4925160	1,514	2012
The Township of Clearview	Blue Mountains Water	Colling-woodlands Well Supply	2	156 combined (Colling-woodlands wells [5])	Well #1	558877	4924663	4,954	2012
The Township of Clearview	Blue Mountains Water	Colling-woodlands Well Supply	2	156 combined (Colling-woodlands wells [5])	Well #2R	558903	4924689	4,971	2025
The Township of Clearview	Blue Mountains Water	Colling-woodlands Well Supply	2	156 combined (Colling-woodlands wells [5])	Well #3	558866	4924693	4,911	2012
The Township of Clearview	Blue Mountains Water	Colling-woodlands Well Supply	2	156 combined (Colling-woodlands wells [5])	Well #4	558855	4924705	619	2012
The Township of Clearview	Blue Mountains Water	Colling-woodlands Well Supply	2	156 combined (Colling-woodlands wells [5])	Well #5	558767	4924629	527	2012
The Township of Clearview	Mad River	Creemore Well Supply	1	556 combined (Creemore wells [2])	Well #1	571696	4908649	80,675	2012
The Township of Clearview	Mad River	Creemore Well Supply	1	556 combined (Creemore wells [2])	Well #2	571709	4908655	101,230	2012

Formatted Table

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m³/a)	Data current as of…
The Township of Clearview	Blue Mountains Water	McKean Subdivision Well Supply	1	283 combined (McKean wells [3])	Well #1	563347	4922759	11,574	2012
The Township of Clearview	Blue Mountains Water	McKean Subdivision Well Supply	1	283 combined (McKean wells [3])	Well #2	563358	4922762	8,751	2012
The Township of Clearview	Blue Mountains Water	McKean Subdivision Well Supply	1	283 combined (McKean wells [3])	Well #3	563358	4922663	20,697	2012
The Township of Clearview	Mad River	New Lowell Well Supply	1	746 combined (New Lowell wells [3])	Well #1	580749	4912137	39,420*	2012
The Township of Clearview	Mad River	New Lowell Well Supply	1	746 combined (New Lowell wells [3])	Well #2	580744	4912133	39,055*	2012
The Township of Clearview	Mad River	New Lowell Well Supply	1	746 combined (New Lowell wells [3])	Well #6	581770	4912057	91,615*	2012
The Township of Clearview	Lower Nottawasaga River	Stayner Well Supply	1	4,2003,586 combined (Stayner all wells [3])	Well #1	574212	4919076	214,333	2012
The Township of Clearview	Lower Nottawasaga River	Stayner Well Supply	1	3,5864,200 combined (Stayner all wells) [3])	Well #2	572416	4916311	326,678	2012
The Township of Clearview	Lower Nottawasaga River	Stayner Well Supply	1	3,5864,200 combined (Stayner all wells [3])	Well #3	574218	4919060	334,835	2012
The Township of Clearview	Lower Nottawasaga River	Stayner (Klondike) Well Supply	1	4,200 combined (Stayner all wells) Data Gap	Well 5	579425	4923718	Data Gap	2022

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of...
The Township of Clearview	Lower Nottawasaga River	Stayner (Klondike) Well Supply~~Klondike Well Supply~~	1	4,200 combined (Stayner all wells) ~~Data Gap~~	Well 6	579396	4923731	Data Gap	2022
The Township of Clearview	Lower Nottawasaga River	Stayner (Klondike) Well Supply~~Klondike Well Supply~~	1	4,200 combined (Stayner all wells) ~~Data Gap~~	Well 7	5794551	4923733	Data Gap	2022
The Township of Clearview	Lower Nottawasaga River	Stayner (Klondike) Well Supply~~Klondike Well Supply~~	1	4,200 combined (Stayner all wells) ~~Data Gap~~	Well 8	579374	4923729	Data Gap	2022
Collingwood Public Utilities	*Blue Mountains Water*	*Collingwood (Raymond A. Barker Ultrafiltration Plant) Water Treatment Plant*	*1*	*16000*	*SW*	-	-	-	*2012*
The Township of Essa	Middle Nottawasaga River	Angus Well Supply	1	6,210 combined (Angus wells [6])	Well #1	591726	4909075	111,690	2012
The Township of Essa	Middle Nottawasaga River	Angus Well Supply	1	6,210 combined (Angus wells [6])	Well #2	591729	4909074	103,295	2012
The Township of Essa	Middle Nottawasaga River	Angus Well Supply	1	6,210 combined (Angus wells [6])	Well #4	591558	4907673	590,935	2012

Formatted Table

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of…
The Township of Essa	Middle Nottawasaga River	Angus Well Supply	1	6,210 combined (Angus wells [6])	Well #5	591587	4907673	0	2012
The Township of Essa	Middle Nottawasaga River	Angus Well Supply	1	6,210 combined (Angus wells [6])	Well #6	591567	4907632	0	2012
The Township of Essa	Pine River	Angus Well Supply	1	6,210 combined (Angus wells [6])	Well 3	589104	4906875	0	2012
The Township of Essa	Middle Nottawasaga R	Glen Ave (Thornton) Well Supply	1	775 combined (Glen Ave/Thornton wells [4])	Well #1	601514	4902565	39,055	2012
The Township of Essa	Middle Nottawasaga R	Glen Ave (Thornton) Well Supply	1	775 combined (Glen Ave/Thornton wells [4])	Well #2	601522	4902548	44,530	2012
The Township of Essa	Middle Nottawasaga R	Glen Ave (Thornton) Well Supply	1	775 combined (Glen Ave/Thornton wells [4])	Well #3	601422	4903061	29,930	2012
The Township of Essa	Middle Nottawasaga R	Glen Ave (Thornton) Well Supply	1	775 combined (Glen Ave/Thornton wells [4])	Well #4	601412	4903071	21,900	2012
The Town of Innisfil	Innisfil Creek	Churchill Well Supply	1	550 combined (Churchill Wells [3])	Well #1	611523	4901018	42,925 combined (Churchill Wells [3])	2012
The Town of Innisfil	Innisfil Creek	Churchill Well Supply	1	550 combined (Churchill Wells [3])	Well #2	611483	4901438	42,925 combined (Churchill Wells [3])	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of…
The Town of Innisfil	Innisfil Creek	Churchill Well Supply	1	550 combined (Churchill Wells [3])	Well #3	610182	4900216	42,925 combined (Churchill Wells [3])	2012
The Town of Mono	Upper Nottawasaga River	Cardinal Woods Subdivision Well Supply	1	680	MW-3	571586	4866336	573,415*	2012
The Township of Mulmur	Pine River	Mansfield Well Supply	1	454 combined (Mansfield wells [3])	Well 1	576944	4891124	59,495	2012
The Township of Mulmur	Boyne River	Mansfield Well Supply	1	454 combined (Mansfield wells [3])	Well 2	576808	4891205	95,630	2012
The Township of Mulmur	Pine River	Mansfield Well Supply	1	454 combined (Mansfield wells [3])	Well 3	577739	4891263	33,580	2012
The Town of New Tecumseth	Boyne River	Alliston Water Supply System	1	26,000 combined (Alliston wells [6])	Well #1	590243	4889786	183	2012
The Town of New Tecumseth	Upper Nottawasaga River	Alliston Water Supply System	1	26,000 combined (Alliston wells [6])	Well #4	593161	4886781	43,045	2012
The Town of New Tecumseth	Boyne River	Alliston Water Supply System	1	26,000 combined (Alliston wells [6])	Well #5	592053	4888333	40,559	2012
The Town of New Tecumseth	Upper Nottawasaga River	Alliston Water Supply System	1	26,000 combined (Alliston wells [6])	Well #6	593203	4886676	25,201	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of…
The Town of New Tecumseth	Upper Nottawasaga River	Alliston Water Supply System	1	26,000 combined (Alliston wells [6])	Well #7	590276	4886479	19,121	2012
The Town of New Tecumseth	Boyne River	Alliston Water Supply System	1	26,000 combined (Alliston wells [6])	Well #8	592756	4890263	828	2012
The Town of New Tecumseth	Middle Nottawasaga River	Hillcrest Subdivision Well Supply	2	0	Hillcrest Well	589953	4890316	299,665*	2012
The Town of New Tecumseth	Innisfil Creek	Tottenham Well Supply	1	4,850 combined (Tottenham wells [4])	Well #4	595482	4875402	99,645	2012
The Town of New Tecumseth	Innisfil Creek	Tottenham Well Supply	1	4,850 combined (Tottenham wells [4])	Well #5	595511	4875421	117,530	2012
The Town of New Tecumseth	Innisfil Creek	Tottenham Well Supply	1	4,850 combined (Tottenham wells [4])	Well #6	594867	4875770	36,500	2012
The Town of New Tecumseth	Innisfil Creek	Tottenham Well Supply	1	4,850 combined (Tottenham wells [4])	Well #7	594870	4875765	290,540	2012
The Township of Oro-Medonte	Willow Creek	Craighurst Well Supply	2	127 combined (Criaghurst wells [4~~3~~])	Well #2~~1~~	600812	4931473	0	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of...
The Township of Oro-Medonte	Willow Creek	Craighurst Well Supply	2	127 combined (Criaghurst wells [3])	Well #32	600813	4931476	4,015	2012
The Township of Oro-Medonte	Willow Creek	Craighurst Well Supply	2	127 combined (Criaghurst wells [3])	Well #4 & 53	600812	4931480	7,665	2012
The Regional Municipality of Peel	Innisfil Creek	Palgrave Well Supply	1	3,592	Well #3	594072	4868346	626,444	2012
The Town of Shelburne	Boyne River	Shelburne Well Supply	1	4,000 combined (Shelburne wells [5])	PW1	564339	4881039	152,935	2012
The Town of Shelburne	Boyne River	Shelburne Well Supply	1	4,000 combined (Shelburne wells [5])	PW3	563064	4881673	200,750	2012
The Town of Shelburne	Boyne River	Shelburne Well Supply	1	4,000 combined (Shelburne wells [5])	PW5	562398	4880655	109,500	2012
The Town of Shelburne	Boyne River	Shelburne Well Supply	1	4,000 combined (Shelburne wells [5])	PW6	562447	562447	117,530	2012
The Town of Shelburne	Boyne River	Shelburne Well Supply	1	4,000 combined (Shelburne wells [5])	PW7	-	-	0	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of...
The Township of Springwater	Lower Nottawasaga River	Anten Mills Well Supply	1	220 combined (Anten Mills wells [3])	Well #1	593949	4926082	201	2012
The Township of Springwater	Lower Nottawasaga River	Anten Mills Well Supply	1	220 combined (Anten Mills wells [3])	Well #2	593935	4926073	401	2012
The Township of Springwater	Lower Nottawasaga River	Anten Mills Well Supply	1	220 combined (Anten Mills wells [3])	Well #3	593928	4926081	55,423	2012
The Township of Springwater	Willow Creek	Del Trend Subdivision Well Supply	1	300 combined (Del Trend wells [3])	Well #1	601772	4920229	4,015	2012
The Township of Springwater	Willow Creek	Del Trend Subdivision Well Supply	1	300 combined (Del Trend wells [3])	Well #2	601784	4920233	6,570	2012
The Township of Springwater	Willow Creek	Del Trend Subdivision Well Supply	1	300 combined (Del Trend wells [3])	Well #3	601764	4920253	27,740	2012
The Township of Springwater	Willow Creek	Midhurst Well Supply	1	2,867 combined (Midhurst Wells #2, #3, #4, #5)	Well #2	601908	4921972	47,085	2012
The Township of Springwater	Willow Creek	Midhurst Well Supply	1	2,867 combined (Midhurst Wells #2, #3, #4, #5)	Well #3	601894	4921949	159,505	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of...
The Township of Springwater	Willow Creek	Midhurst Well Supply	1	2,867 combined (Midhurst Wells #2, #3, #4, #5)	Well #4	601425	4921887	76,650	2012
The Township of Springwater	Willow Creek	Midhurst Well Supply	1	2,867 combined (Midhurst Wells #2, #3, #4, #5)	Well #5	601512	4920127	110,960	2012
The Township of Springwater	Willow Creek	Midhurst Valley (Carson Rd)	1	Data Gap	TW19	598614	4920118	1,274,054 combined (wells TW19 & TW22)	2022
The Township of Springwater	Willow Creek	Midhurst Valley (Carson Rd)	1	Data Gap	TW22	598682	4920161	1,274,054 combined (wells TW19 & TW22)	2022
The Township of Springwater	Lower Nottawasaga River	Minesing Well Supply	1	640 combined (Minesing wells [4])	Well #1	592368	4921832	29,485	2012
The Township of Springwater	Lower Nottawasaga River	Minesing Well Supply	1	640 combined (Minesing wells [4])	Well #2	592404	4921832	26,010	2012
The Township of Springwater	Lower Nottawasaga River	Minesing Well Supply	1	640 combined (Minesing wells [4])	Well #3	592377	4921822	1,252	2012
The Township of Springwater	Lower Nottawasaga River	Minesing Well Supply	1	640 combined (Minesing wells [4])	Well #4	592390	4921797	0	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of…
The Township of Springwater	Lower Nottawasaga River	Phelpston Well Supply	2	160 combined (Phelpston wells [2])	Well #1	591979	4929879	9,003	2012
The Township of Springwater	Lower Nottawasaga River	Phelpston Well Supply	2	160 combined (Phelpston wells [2])	Well #2	591987	4929883	8,975	2012
The Township of Springwater	Willow Creek	Snow Valley Highlands Well Supply	1	850 combined (Snow Valley wells [4])	Well #1	597076	4919325	19,345	2012
The Township of Springwater	Willow Creek	Snow Valley Highlands Well Supply	1	850 combined (Snow Valley wells [4])	Well #2	597075	4919340	19,710	2012
The Township of Springwater	Willow Creek	Snow Valley Highlands Well Supply	1	850 combined (Snow Valley wells [4])	Well #3	596715	4918634	64,240	2012
The Township of Springwater	Willow Creek	Snow Valley Highlands Well Supply	1	850 combined (Snow Valley wells [4])	Well #4	596699	4918618	365	2012
The Township of Springwater	Lower Nottawasaga River	Vespra Downs Subdivision Well Supply	2	120 combined (Vespra Downs wells [2])	Well #1	594204	4911276	14,235	2012
The Township of Springwater	Lower Nottawasaga River	Vespra Downs Subdivision Well Supply	2	120 combined (Vespra Downs wells [2])	Well #2	594176	4911266	0	2012

Municipality	Subwatershed	Drinking Water System (DWS) Name	DWS Classification	Population served by DWS	Well Name	Easting	Northing	Current Average Pumping (m^3/a)	Data current as of…
The Town of Wasaga Beach	Lower Nottawasaga River	Wasaga Beach Well Supply	1	16,000 combined (Wasaga Beach wells [7])	Well 1	576754	4926959	1,911,140*	2012
The Town of Wasaga Beach	Lower Nottawasaga River	Wasaga Beach Well Supply	1	16,000 combined (Wasaga Beach wells [7])	Well 1	578047	4930716	1,911,140*	2012
The Town of Wasaga Beach	Lower Nottawasaga River	Wasaga Beach Well Supply	1	16,000 combined (Wasaga Beach wells [7])	Well 2	576756	4926952	1,911,140*	2012
The Town of Wasaga Beach	Lower Nottawasaga River	Wasaga Beach Well Supply	1	16,000 combined (Wasaga Beach wells [7])	Well 2	578075	4930714	1,911,140*	2012
The Town of Wasaga Beach	Lower Nottawasaga River	Wasaga Beach Well Supply	1	16,000 combined (Wasaga Beach wells [7])	Well 3	576757	4926945	1,911,140*	2012
The Town of Wasaga Beach	Lower Nottawasaga River	Wasaga Beach Well Supply	1	16,000 combined (Wasaga Beach wells [7])	Well 3	578065	4930729	1,911,140*	2012
The Town of Wasaga Beach	Lower Nottawasaga River	Wasaga Beach Well Supply	1	16,000 combined (Wasaga Beach wells [7])	Well 4	576763	4926946	1,911,140*	2012

1 – Large Municipal System
2 – Small Municipal System
** Maximum permitted value*

2.6 Interaction between Physical and Human Geography

Humans are dependent on the environment in a number of ways and the manner in which they work the land is determined by the physical geography of the surrounding environment. As technology advances more of the landscape can be modified to accommodate the needs of a community. On one hand, newer technology and methods allow for more sophisticated measures to be used to extract resources (such as drinking water) while minimizing impacts on the local environment. On the other hand, it also provides ways to supply resources to more people, encouraging population growth. By increasing the demands and stress put on an ecological system, the natural balance is altered with resulting consequences that will need to be studied and addressed.

Interactions between human and physical geography within the Nottawasaga Valley watershed, pertaining to drinking and Source Protection, are numerous. Many of the communities in the watershed have been growing quickly over the past decade and are projected to continue growing. These population increases come with increased development, more urbanization, and an associated loss of vegetative cover.Two towns that have had the greatest increase in population between the 2001 and 2006 census years (and are entirely in the SWP region) are the Towns of Shelburne and Wasaga Beach with an increase in population of 22% and 23 % respectively. The Town of Shelburne is located in the Boyne River subwatershed, while Wasaga Beach is mainly found in the Lower Nottawasaga River subwatershed. As areas, like the Towns of Shelburne and Wasaga Beach, become more urbanized there is an associated loss of natural vegetative cover. By removing the natural vegetation, the water quality and quantity of available drinking water can be altered.

Natural Features

Natural features in the environment generally serve to maintain water quality conditions. Naturally vegetated areas including grasslands, meadows, and woodland areas tend to improve the quality of water as it flows over land. The stems and roots of the vegetation slow the flow of water, enabling soil particles and other contaminants to be deposited and increase the amount of runoff that infiltrates into the soil. Water is filtered as it flows through the soil to the groundwater. Wetlands slow the flow of water, provide storage and can absorb some contaminants, including nutrients such as phosphorus and thus have a natural filtering ability.

With the removal of natural features there is increased access for people and contaminants to waterways. As the quality of water decreases, it is not only human populations that are impacted. Through 1996 to 2008, there were approximately 800 sites sampled to assess the health of watercourses and the fish and benthic communities living within them. Results showed over the year the number of unimpaired sites decreased while sites classified as below potential and impaired increased.

Agriculture

There are a number of water quality issues that are associated with agriculture. Runoff from pasture and cropland can contain high levels of nutrients, sediment, and bacteria. Wind can erode topsoil with its associated contaminants. All of these substances can end up in local watercourses if the appropriate Best Management Practices (BMPs) are not implemented. These BMPs can include conservation tillage, cover cropping, maintaining vegetated riparian buffers, cattle fencing, and the appropriate use of fertilizers and pesticides.

Urbanization

An increase in urbanization also leads to an increase in impervious surface areas, such as roads and rooftops. These have a significant effect on both water quality and quantity. Hardened or impervious surfaces reduce the amount of surface water infiltrating into the ground, causing an increase the volume and velocity of surface runoff, which leads to streambank erosion. This contributes more sediment to watercourses, and can even contribute to flooding. Runoff from imperious surfaces, particularly those built prior to the requirement for stormwater management, can carry a host of pollutants to local watercourses. These pollutants build up on roads, driveways and parking lots and even lawns, and are washed to watercourses when it rains. Current water quality results indicate that the majority of waterways in the Nottawasaga Valley watershed are being impacted in some way. There are many pollutants that can be carried by urban stormwater runoff. Some examples include nutrients and pesticides from lawns, parks and golf courses; road salts, tire residue, oil and gas, sediment, as well as nutrients and bacteria from pet and wild animal feces. The requirement for stormwater management facilities in all new developments will help to mitigate these issues in urban areas, however, the ongoing maintenance of these facilities is crucial to ensuring that they continue to reduce sediment and nutrient loads as designed, otherwise these new developments would be contributing additional phosphorus to the system.

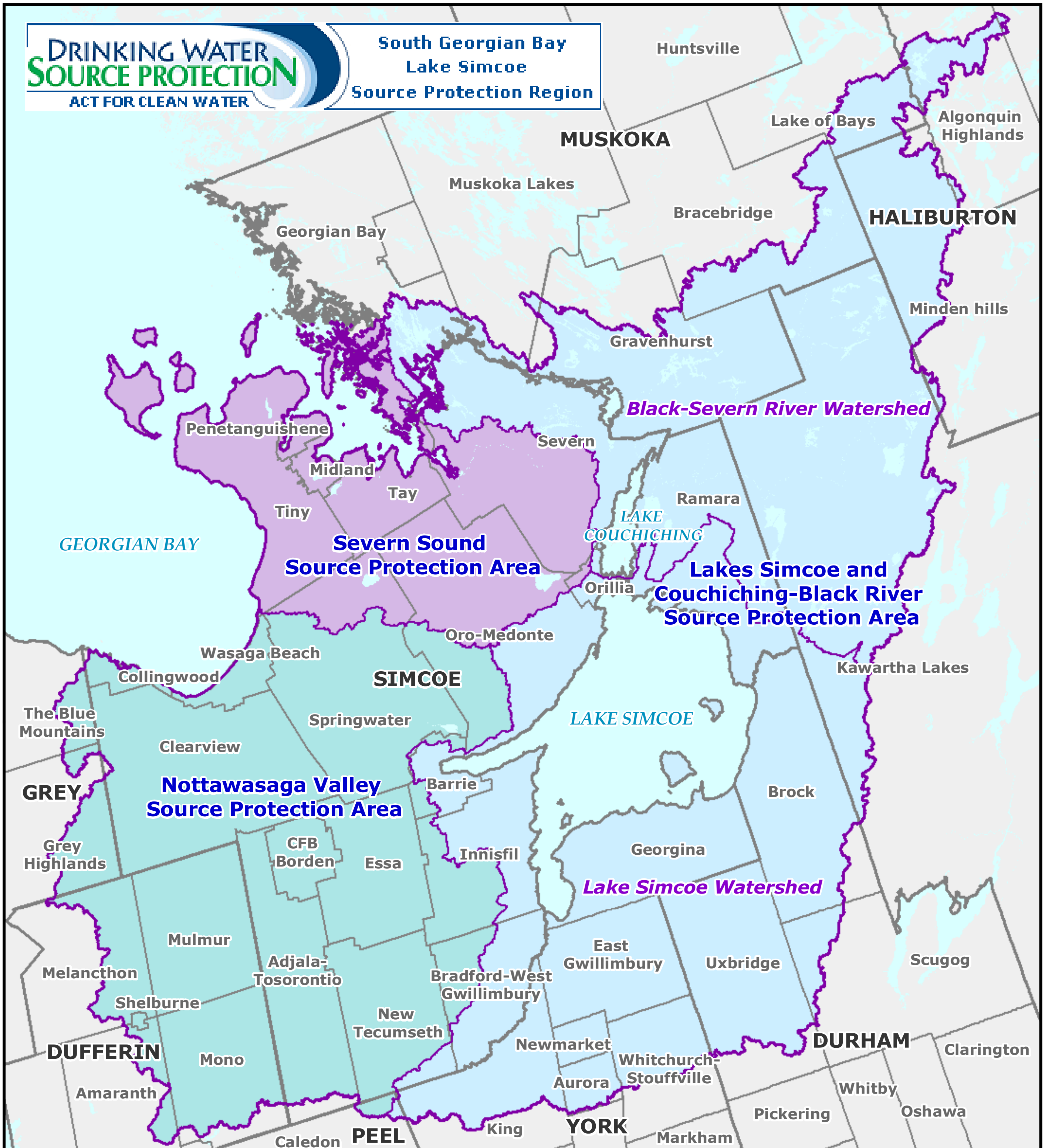
By characterizing the watershed, and the different elements within it, it gives a general overview of the health of the area. It puts into context the location of different features of the watershed and gives an understanding of the current pressures on drinking water supplies. By providing a broad analysis of the watershed it sets the stage for further in-depth analysis of water quantity stressors (Chapter 3) and the details for specific municipal systems (Chapters 6-17).

2.7 Data and Knowledge Gaps

Significant efforts have been made by all levels of government to collect and interpret environmental data for the watershed area. However, throughout the development of this report, data and knowledge gaps with respect to watershed characterization have been identified. The knowledge gap identified in this chapter is:

- Assessment of fish communities

A key task for the technical team and the Source Protection Committee will be to fill these gaps for inclusion in the future Assessment Reports.



Source Water Protection Region

Source Protection Area (SPA)

Lakes Simcoe and Couchiching-Black River SPA

Nottawasaga Valley SPA

Severn Sound SPA

Watershed Boundaries

Upper Tier Municipality

Lower Tiers Municipality

Water Body

Source Water Protection Region Areas and Municipalities

Created by: LSRCA
Date: 2010-01-21

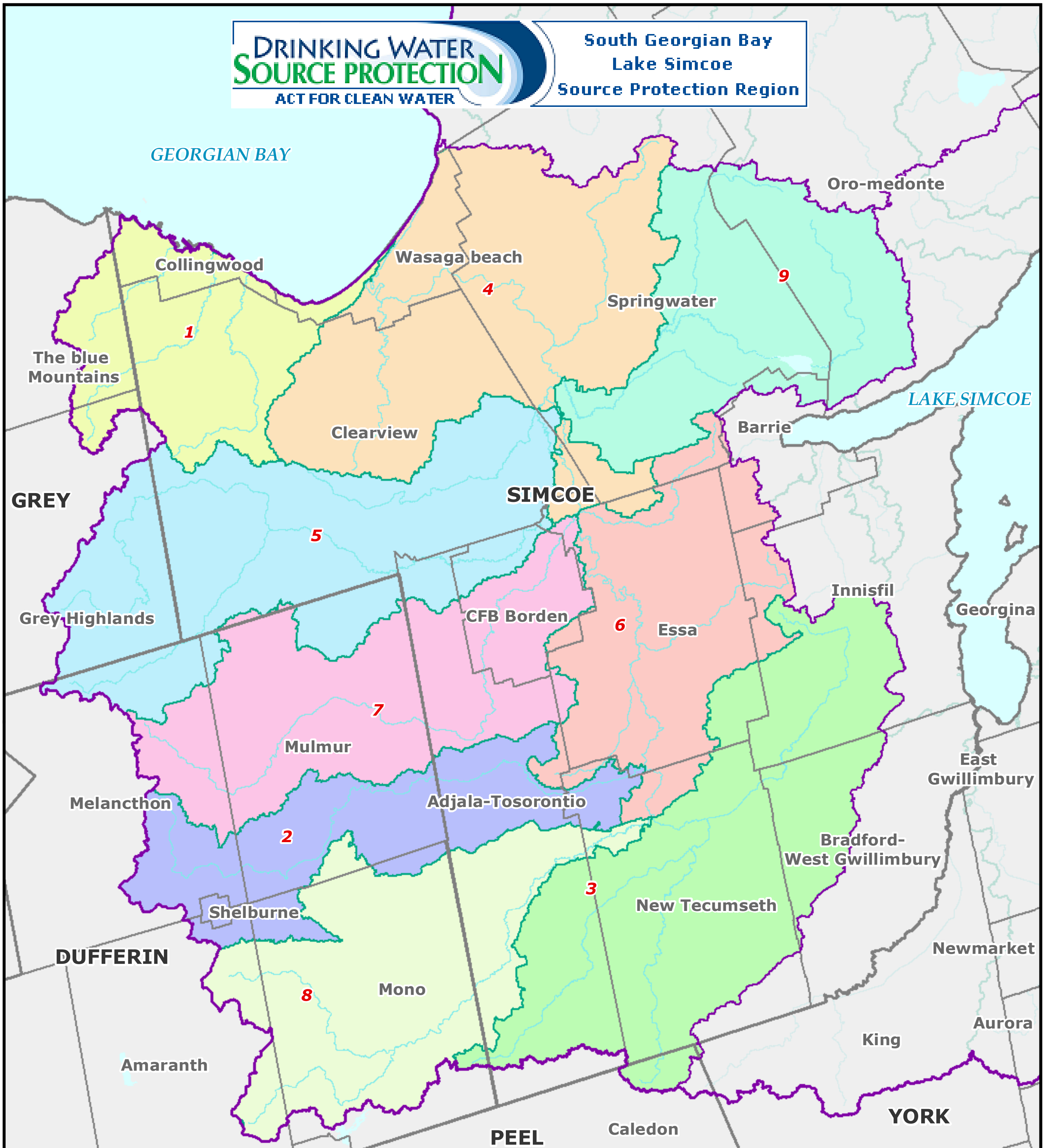
N E S W

Scale: 1:750,000
0 5 10 15 20km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-1



- 1, Blue Mountains W.
- 2, Boyne R.
- 3, Innisfil Cr.
- 4, Lower Nottawasaga R.
- 5, Mad R.
- 6, Middle Nottawasaga R.
- 7, Pine R.
- 8, Upper Nottawasaga R.
- 9, Willow Cr.
- SWP Watershed Region
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tiers Municipality
- Subwatershed Boundary
- Water Body
- Main Water Courses

Watershed and Subwatershed Boundaries and Municipality Boundaries

Created by: LSRCA
Date: 2009-11-25

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

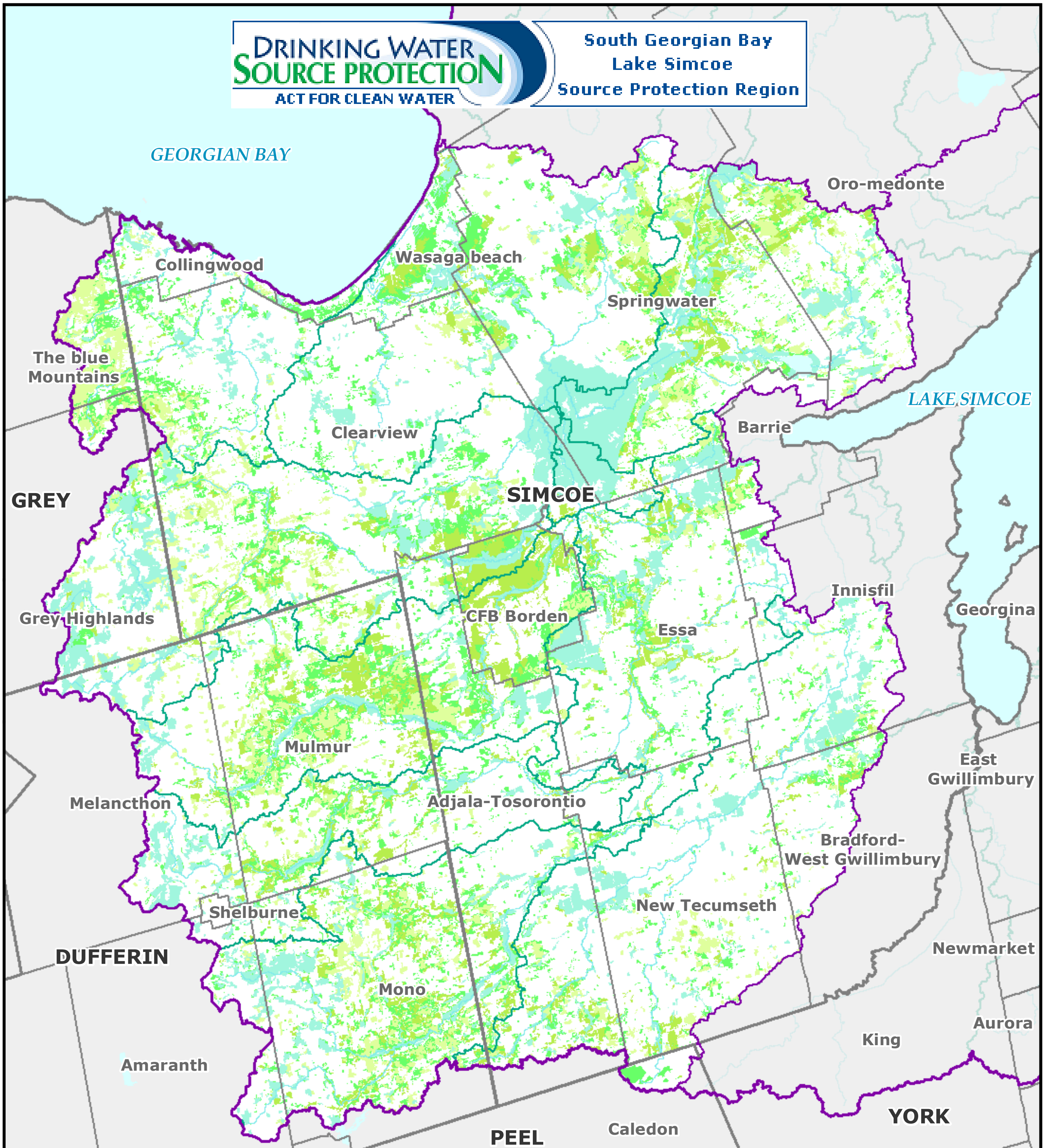
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-2

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Vegetation Area (%)

- Coniferous Woodlands (6.347%)
- Deciduous Woodlands (7.338%)
- Mixed Woodland (8.937%)
- Woody Wetlands (11.567%)
- Water Body
- Main Water Courses

Location of Natural Vegetative Cover

Created by: LSRCA
Date: 2009-11-26

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-3

PGMN Stations
PWQMN Stations
Subwatershed Boundary

Groundwater and Surface Water Monitoring Stations

Created by: LSRCA
Date: 2009-11-26

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-4

Drinking Water Source Protection — Act for Clean Water

South Georgian Bay Lake Simcoe Source Protection Region

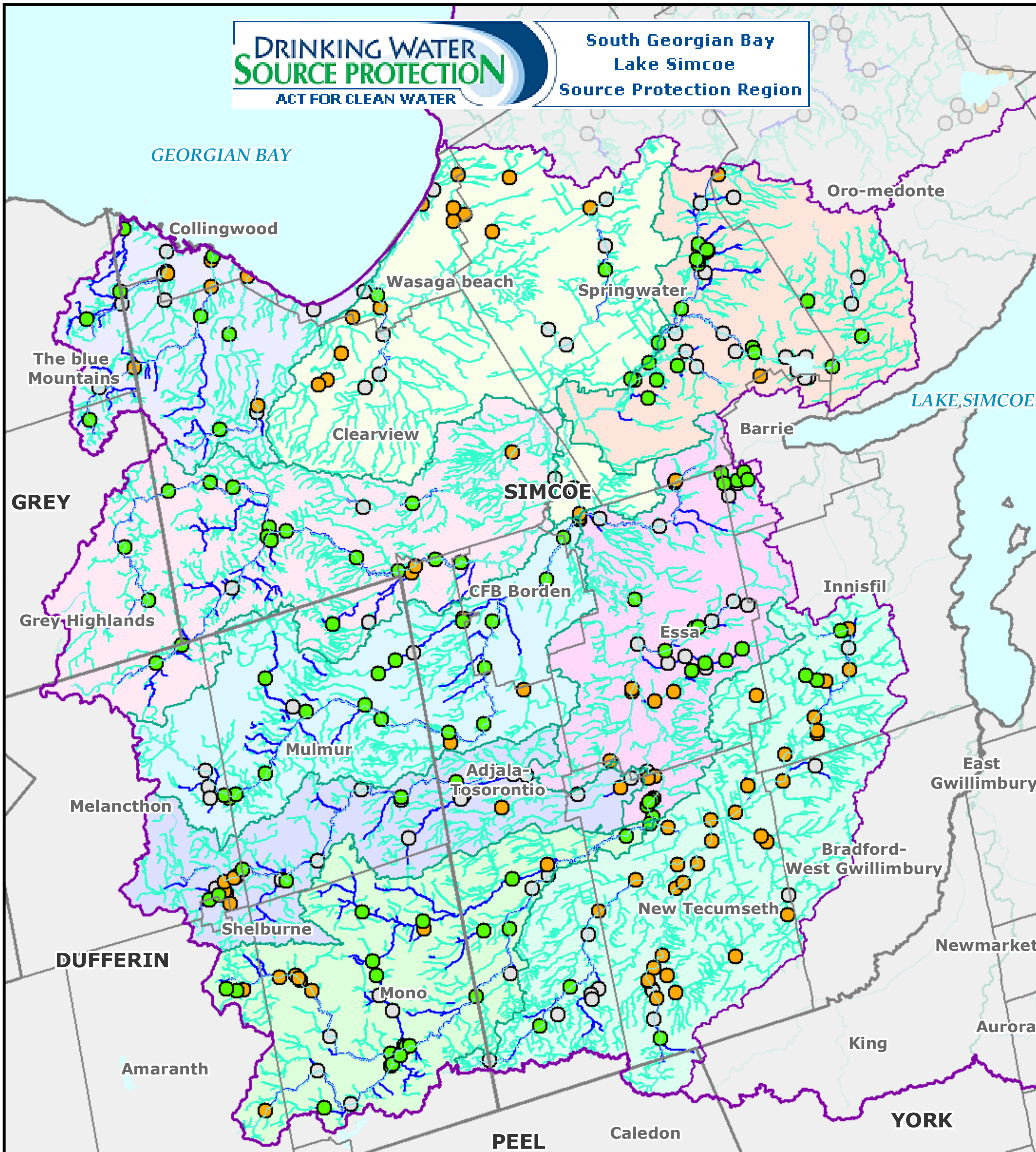
Location and Types of Aquatic Habitat

Created by: LSRCA
Date: 2009-11-24

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-5



Watercourse Thermal
- Cold Watercourse
- Warm Watercourse

Benthic Sampling (1996 - 2008)
- Unimpaired
- Impaired
- Inconclusive

Location and Condition of Aquatic Invertebrates

Created by: LSRCA
Date: 2009-11-26

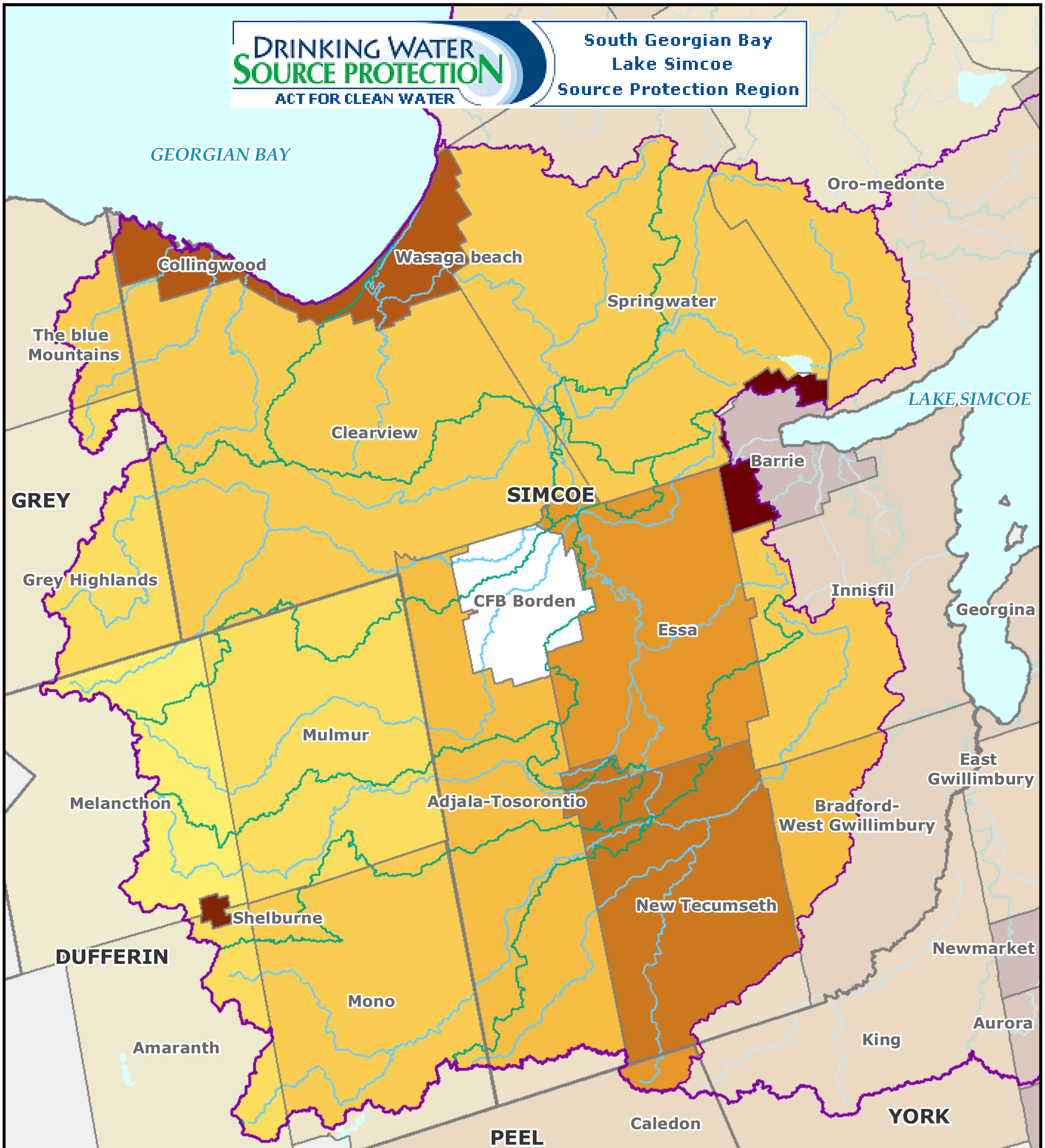
Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

Nottawasaga Valley Conservation Authority

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-6



Population Density (person/km2)
(Based on 2006 Census)

- < 5.0
- 5.1 - 10.0
- 10.1 - 20.0
- 20.1 - 30.0
- 30.1 - 40.0
- 40.1 - 50.0
- 50.1 - 100.0
- 100.1 - 200.0
- 200.1 - 500.0
- 500.1 - 1000.0
- 1000.1 - 1500.0
- > 1500.1
- No Data

Municipal Population Density in the Nottawasaga Valley Watershed

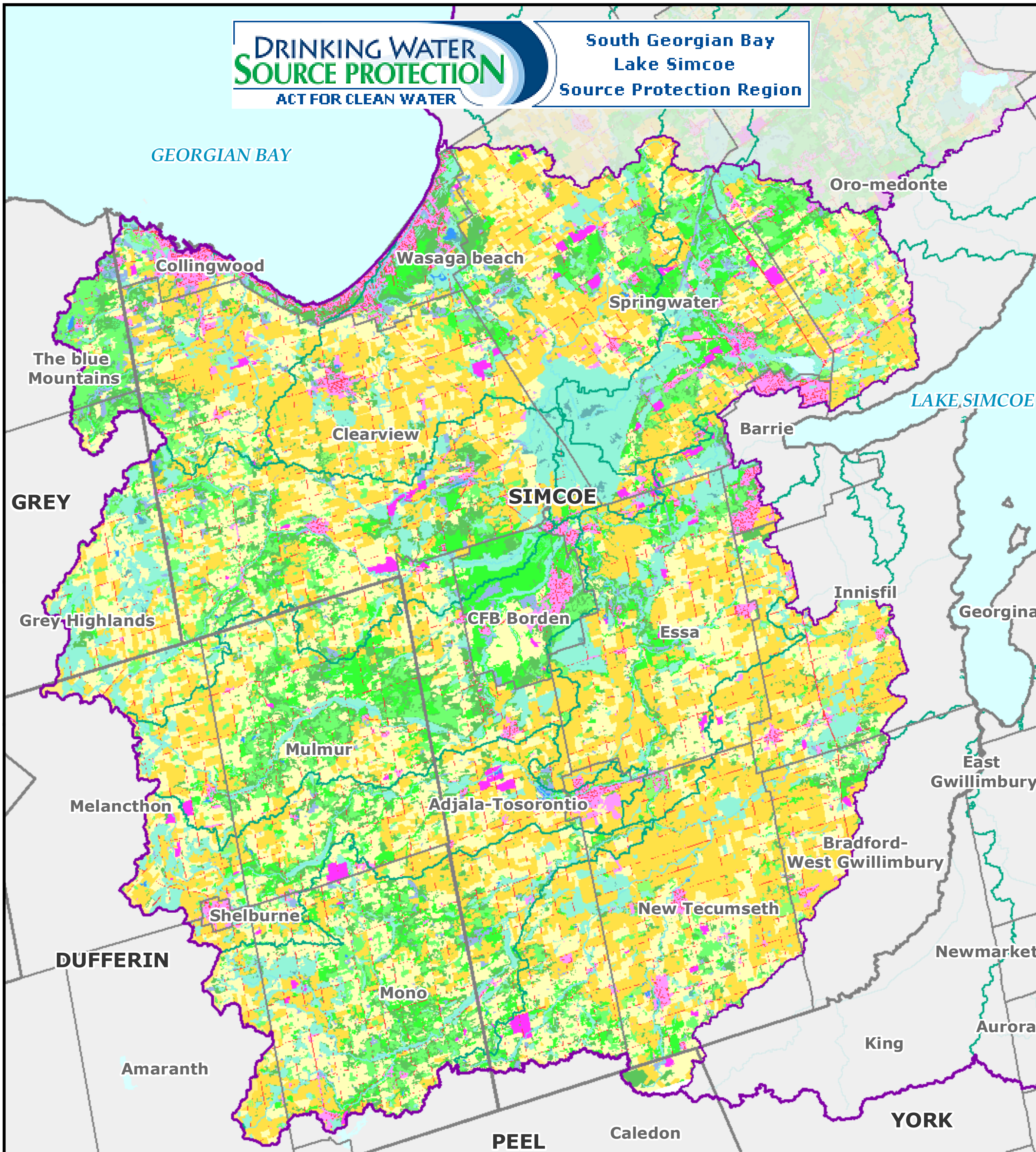
Created by: LSRCA
Date: 2010-01-26

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-7



Beaches
Coniferous Woodlands
Deciduous Woodlands
Emergent Wetlands
Golf Course
Hay/Pasture
High-Intensity Devel
Low-Intensity Devel
Mixed Woodland
Probable Agriculture
Quarries
Roads
Row Crops
Sod Farms
Transitional
Water
Woody Wetlands

Areas of Land Use

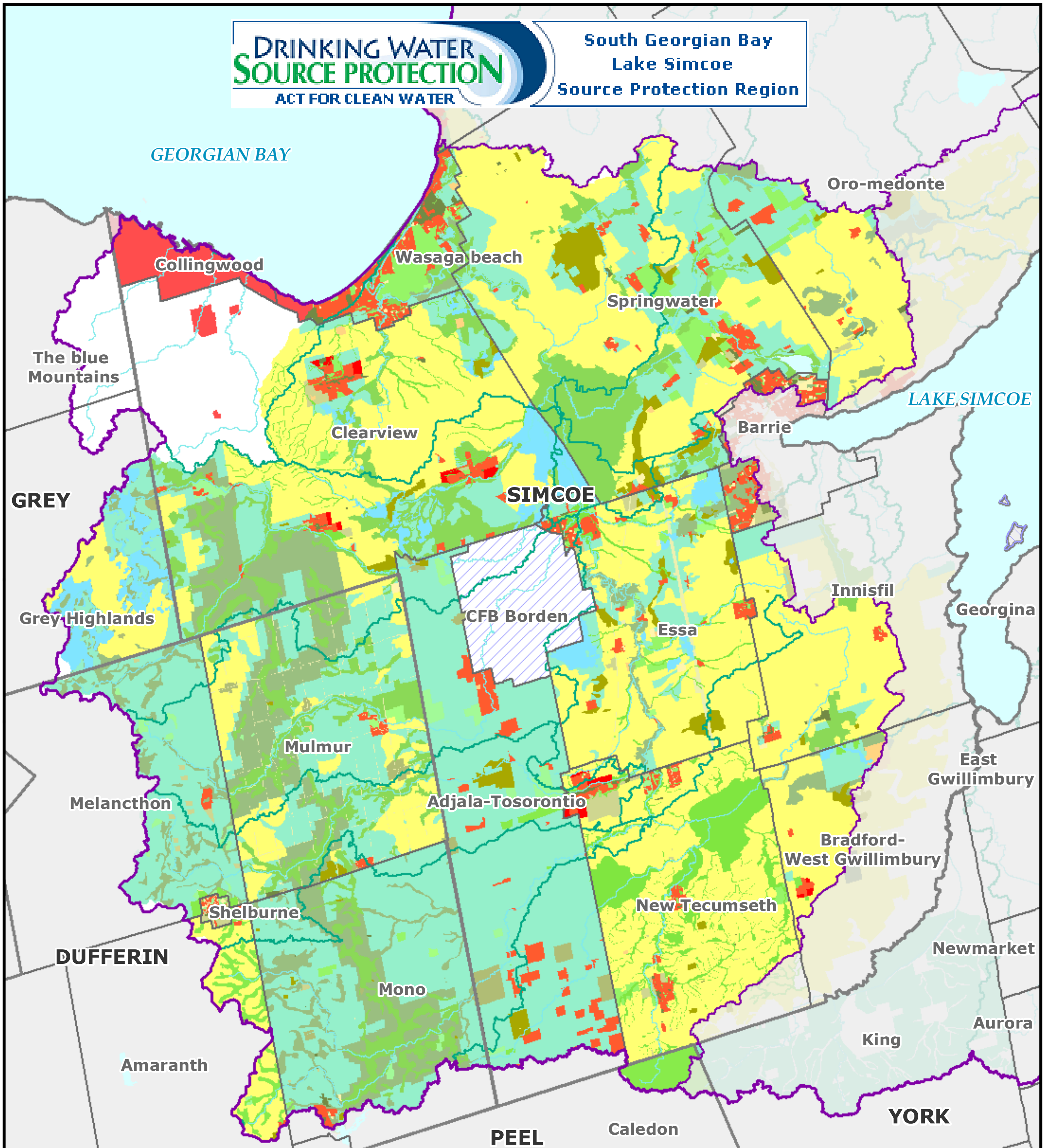
Created by: LSRCA
Date: 2010-01-13

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-8



Land Owner
- Indian Reserve
- Federal Lands

1-Designated settlement; 2-None
- 1 Commercial
- 1 Employment
- 1 Hamlet
- 1 Industrial
- 1 Infrastructure And Utility
- 1 Institutional
- 1 Landfill And Waste Disposal
- 1 Mixed Use
- 1 Residential
- 1 Urban
- 2 Aggregates And Extraction
- 2 Agricultural
- 2 Environmental Protection / Sensitive Areas
- 2 Greenlands / Natural Heritage
- 2 Hazard
- 2 None
- 2 Opa
- 2 Open Space
- 2 Park
- 2 Recreational
- 2 Recreational-Open
- 2 Referral/Deferral
- 2 Rural
- 2 Water
- 2 Wetland

Areas of Settlement and Land Owners as Defined in the *Places to Grow Act, 2005*

Created by: LSRCA
Date: 2010-02-26

Scale: 1:400,000

0 2 4 6 8 10km

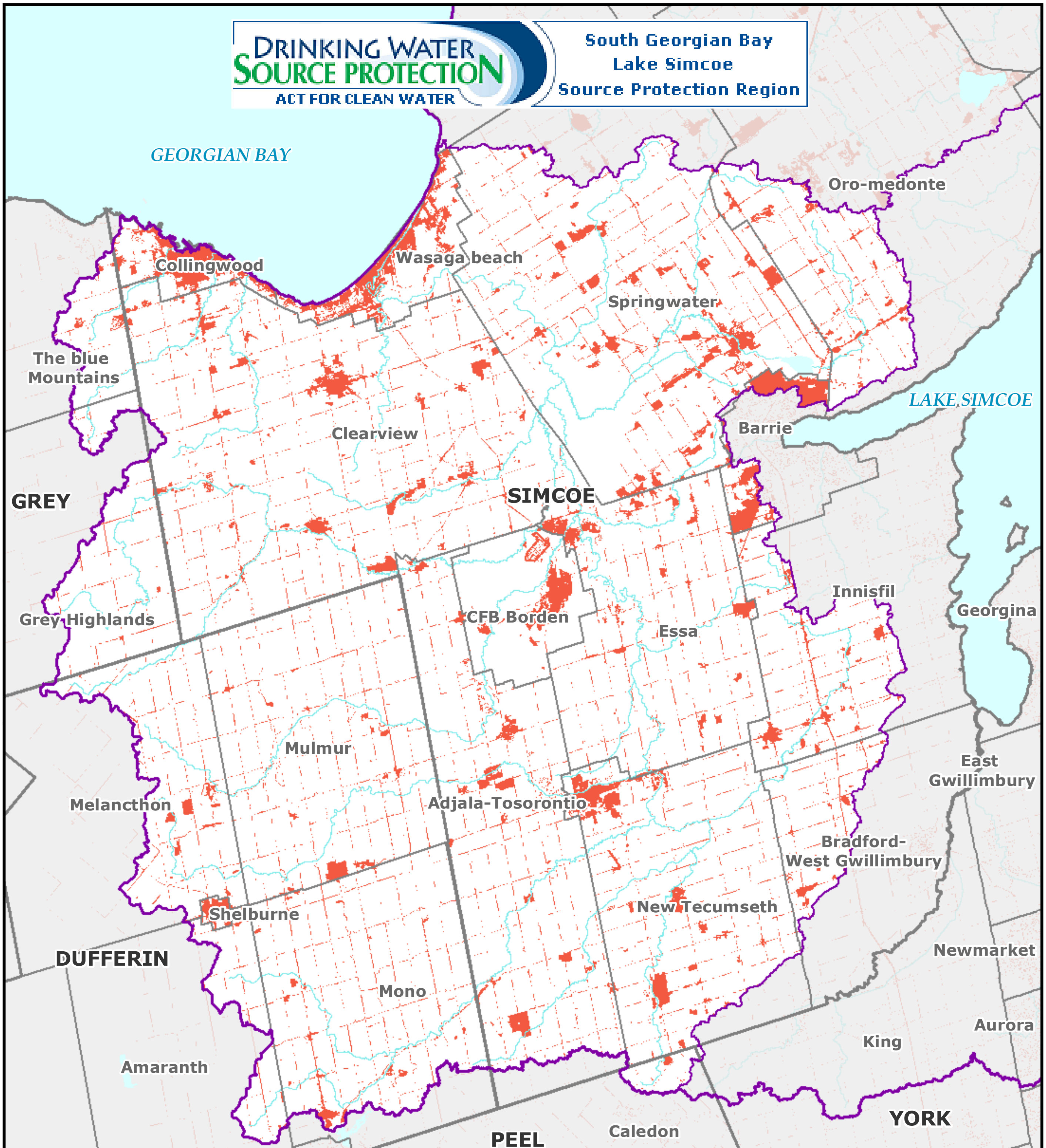
UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-9



Impervious Areas
(Hardened Surface such as roads and buildings)
SWP Watershed Region
SWP Watershed Area
Upper Tier Municipality
Lower Tiers Municipality
Water Body
Main Water Courses

Impervious Areas in Nottawasaga Valley Watershed

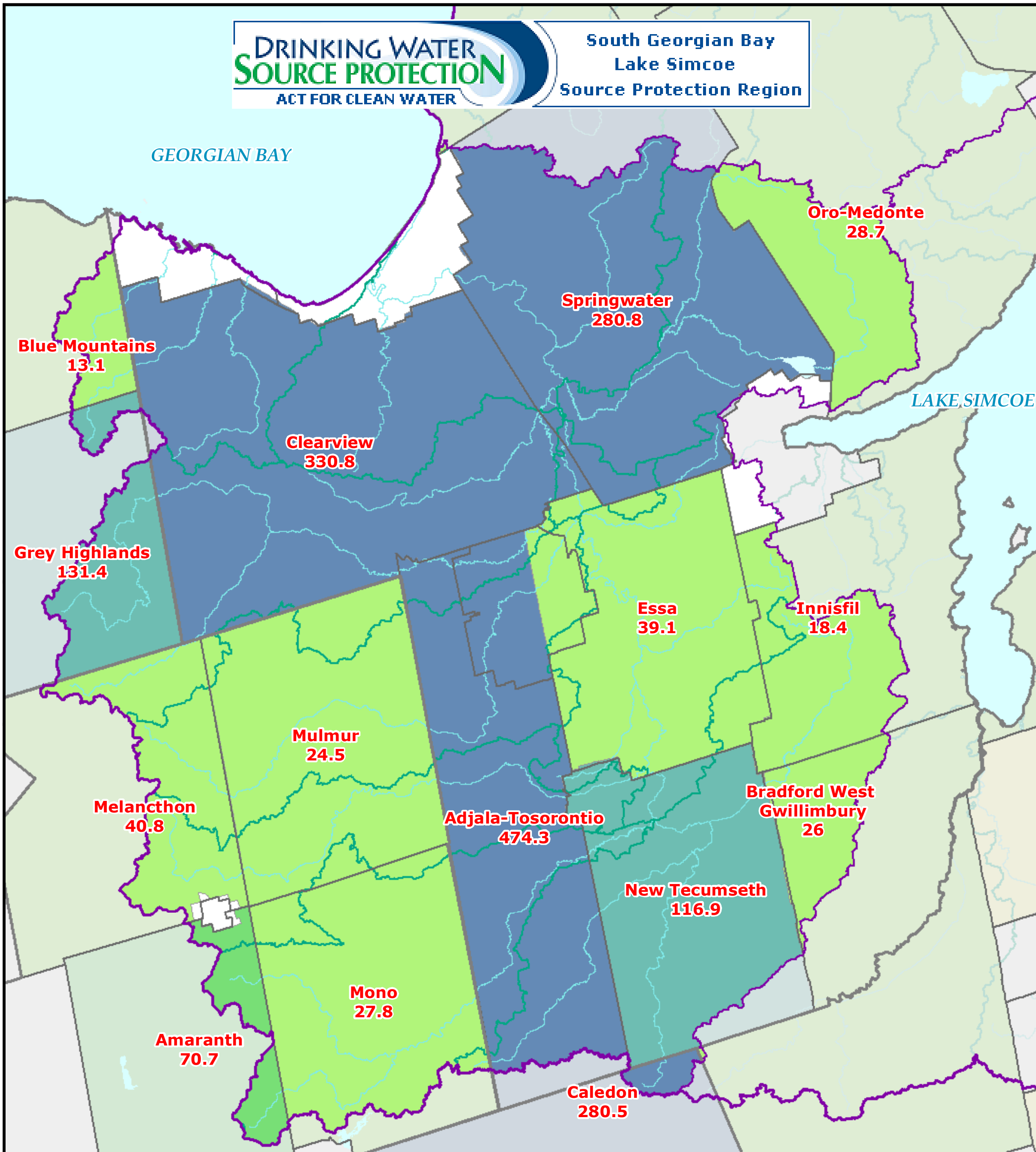
Created by: LSRCA
Date: 2010-02-17

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-10



Livestock Density (heads/km2)
- 1 - 10
- 11 - 50
- 51 - 100
- 101 - 200
- 201 - 500
- 501 - 1000

- SWP Watershed Region
- SWP Watershed Area
- Upper Tier Municipality
- Lower Tiers Municipality
- Water Body
- Main Water Courses

Location and Density of Livestock

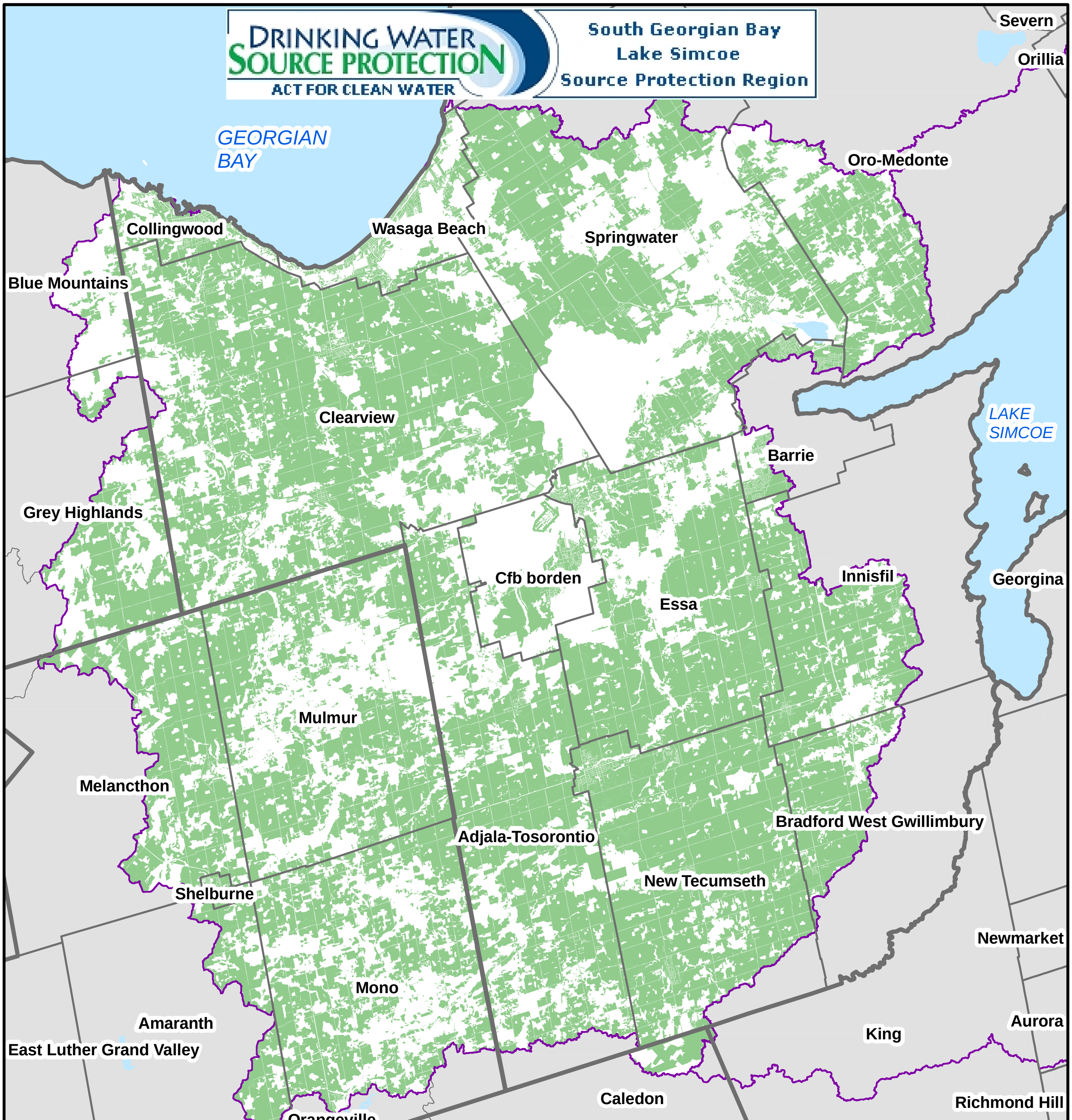
Created by: LSRCA
Date: 2010-02-17

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-11



Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- UPPER TIER MUNICIPALITY
- LOWER TIER MUNICIPALITY
- SOURCE PROTECTION WATERSHED REGION

N W E S

3,7001,850 0 3,700 Metres

Managed Lands in the Nottawasaga Valley Watershed

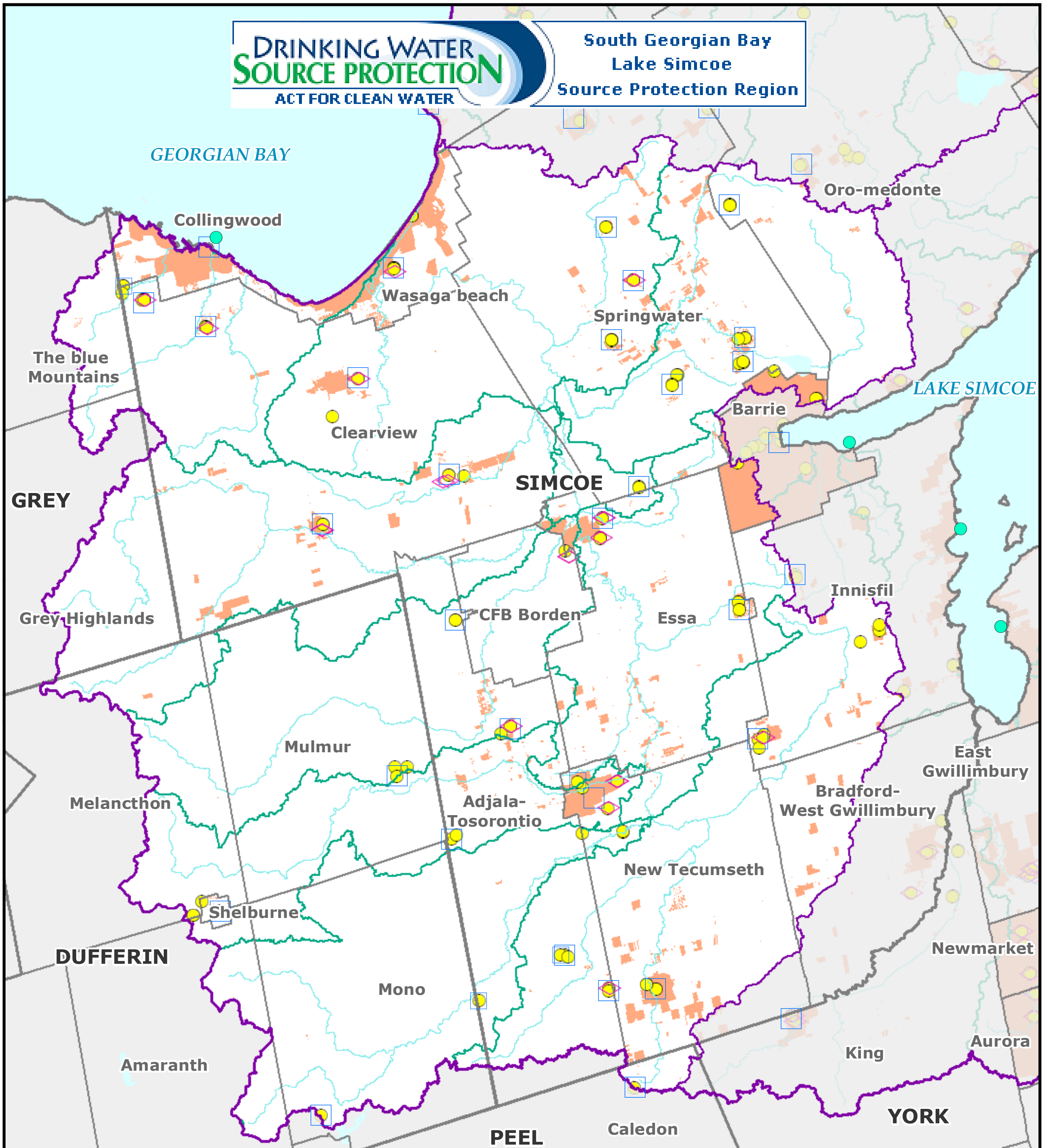
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:400000
PROJECT: 0-071948.00	FILE. NO.:0-07194800F2-12

This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.

GENIVAR Ontario

FIGURE **2-12**



- Large Municipal Residential
- Small Municipal Residential
- Serviced Areas
- Municipal SW Intakes
- Municipal Supply Wells
- Monitoring Wells

Drinking Water System - Intakes, Supply Wells, and Monitoring Wells in Term of Reference

Created by: LSRCA
Date: 2010-02-17

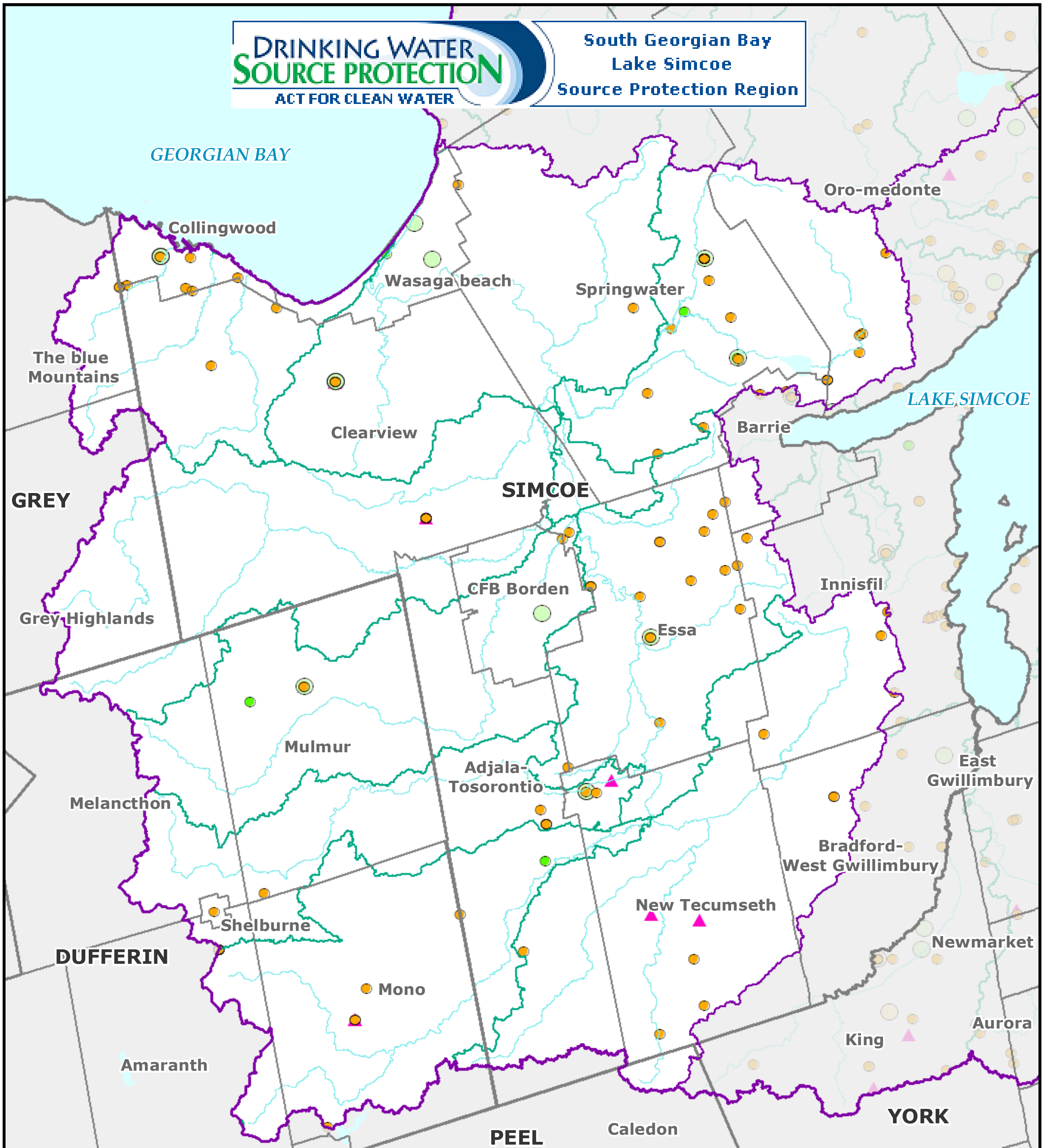
Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

NOTTAWASAGA VALLEY CONSERVATION AUTHORITY

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-13



Drinking Water System (Non-Residential and Non-Municipal)

Large Municipal Non-Residential
Small Municipal Non-Residential
Large Non-Municipal Non-Residential
Small Non-Municipal Non-Residential
Non-Municipal Year-Round Residential
Non-Municipal Seasonal Residential

Created by: LSRCA
Date: 2010-02-17

Scale: 1:400,000
0 2 4 6 8 10km
UTM Zone 17N, NAD83

This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 2-14