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Chapter 10: Town of Innisfil

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10.1 Introduction

This chapter contains information on three drinking water systems for the Town of Innisfil. Various consultants have completed the work presented, which has also been reviewed by South Georgian Bay-Lake Simcoe Source Water Protection staff and members of the Technical Work Group or the Source Protection Committee~~Various consultants have completed the work presented, all of which was reviewed by South Georgian Bay-Lake Simcoe Source Water Protection staff and members of the Technical Work Group~~. In this chapter, each of the groundwater systems and surface water systems is discussed separately for easier readability.

Each municipal system section begins with an introduction of the characteristics of the drinking water system. This includes an overview of the location, number of people served, and source of the water supply. The sections following the system introductions are comprised of a Vulnerability Assessment and Issues and Threats evaluation of the system. The Vulnerability assessment includes the delineation of the Vulnerable Area(s) (Wellhead Protection Area or Intake Protection Zone), and the assignment of a Vulnerability Score for the delineated area. An Uncertainty Rating is also provided for the Vulnerable Area delineation and the Vulnerability Assessment as per Technical Rules 13-15 [Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)] to express the level of confidence in the results based on the information that was available for the study.

The Issues evaluation is intended to identify chemical parameters or pathogens in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now or in the future. Any Issues identified for the systems will be listed in this section, along with a map illustrating the Issues Contributing Area if an Issue is known. The Threats evaluation identifies potential Significant Drinking Water Threats within the delineated Vulnerable Areas. This process includes creating lists for Drinking Water Threats for Activities and Conditions, generating maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats, and a final enumeration of Significant Drinking Water Threats.

For more information, readers are encouraged to read Chapter 5: Methods Overview as well as the responsible consultant reports and memos (found in Appendix MO and I) for a more in depth description of the methods used, as well as the Glossary for any unfamiliar terms.

10.2 Drinking Water Systems

The Town of Innisfil, located in the southeastern portion of Simcoe County, operates groundwater based water supplies in three (3) communities and surface water based supplies in one (1).

As shown in

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Table 10-1~~Table 10-1~~ and Figure 10-1~~Figure 10-1~~ all of the groundwater supplies and the surface water supply are within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR). Table 10-1 also indicates the SPR and corresponding lead Source Protection Authority (SPA) for the municipal water supplies.

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It should be noted that the Golf Haven system previously included in the list of water supplies for the Town of Innisfil, was decommissioned in November 2013. The decommissioned system consisted of two wells (Well 1 and 2) located in the southeast part of the Town of Innisfil on the shore of Cook's Bay. The two wells served the subdivision of Golf Haven located within the community of Gilford. The subdivision is now supplied surface water from the Alcona Water Treatment Plant, further discussed in this chapter (Section 10.5~~10.5~~). Before the decommissioned Golf Haven system could be removed from the Assessment Report, the Town of Innisfil was obligated to satisfy a set of requirements outlined in Section 14 of Ontario Regulation 287/07. As all of the Section 14 requirements were met successfully, the Golf Haven system is no longer subject to the Clean Water Act, and all associated technical information has been removed from the Assessment Report.

It also should be noted that, the two wells comprising the Goldcrest drinking water system, previously included in the list of water supplies for the Town of Innisfil, were decommissioned in May and June of 2017. The decommissioned system consisted of two wells (Well 1 and Well 2) located approximately 12 km south of Stroud, near the intersection of Highway 11 and Gilford Road. The two wells served the Goldcrest subdivision between Gilford Road and Shore Acres Drive. The subdivision is now supplied surface water from the Alcona Water Treatment Plant which is further discussed in Section 10.5. Before the decommissioned Goldcrest Water Supply System could be removed from the Assessment Report, the Town of Innisfil was obligated to satisfy a set of requirements outlined in Section 14 of Ontario Regulation 287/07. As all of the Section 14 requirements were met successfully, the Goldcrest system is no longer subject to the Clean Water Act, and all associated technical information has been removed from the Assessment Report.

Table 10-1: Municipal Surface and Groundwater Supplies in the Town of Innisfil

Local Municipality	Community Water Supply	Drinking Water Information System (DWIS) Number	Source Water Body/ Aquifer	Number of Intakes/ Wells	Source Protection Region & Source Protection Authority (SPA)
Town of Innisfil	Alcona Surface Intake	220007472	Lake Simcoe	1	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
Town of Innisfil	Innisfil Heights Wells	220005081	Confined Overburden Aquifer (A2)	2	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
Town of Innisfil	Stroud Wells	220006204	Confined Overburden Aquifer (A3)	3	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA
Town of Innisfil	Churchill Wells	220005063	Confined Overburden Aquifers (A1, A4)	3	SGBLS SPR & Nottawasaga Valley SPA

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While the Churchill Water Supply system is within Innisfil and the SGBLS SPR, it is located in the Nottawasaga Valley watershed. A non-operational system, referred to as the Cookstown well supply is also located in Innisfil within the Nottawasaga Valley watershed, but is excluded from the list of municipal supplies above. In 2013, the Town of Innisfil discontinued the use of the Cookstown system, and the community previously serviced by the system was connected to the Alcona Surface Water Treatment Plant. More details regarding the Churchill wells and non-operational Cookstown system can be found in Chapter 13 of the Nottawasaga Valley Assessment Report.

WHPAs from the Barrie (City of Barrie) and Glen Ave (Township of Essa) Well Supplies also extend into the Town of Innisfil. Information on the Barrie system can be found in Chapter 8 of this Assessment Report, while information about the Glen Ave supplies can be found in Chapter 12 of the Nottawasaga Valley Assessment Report.

Table 10-2: WHPA that cross into the Town of Innisfil in the SGBLS SPR.

Local Municipality that WHPA extends into	Municipality where wellhead is located	Name of Water Supply	Source Protection Region & Source Protection Authority (SPA)	Location where entire Assessment can be obtained
Town of Innisfil	City of Barrie	Barrie	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	This report (Chapter 8)
Town of Innisfil	Township of Essa	Glen Ave	SGBLS SPR & Nottawasaga Valley SPA	Nottawasaga Valley AR (Chapter 12)

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10.3 Innisfil Heights Well Supply

The Innisfil Heights Water Supply is located approximately 6 km southwest of Stroud, at the intersection of Highway 400 and Innisfil Beach Road. The Innisfil Heights Water Supply consists of two wells: Well 2 and Well 3. The wellfield serves the residential subdivision located to the southwest; commercial and industrial operations located to the northeast and southeast; and the Georgian Downs racetrack to the northwest. The wells are located to the northeast of the Highway 400 Market. Well 2 is located approximately 550 metres north of Innisfil Beach Road and 200 metres east of Highway 400. Well 3 is located approximately 150 metres south of Well 2. Well 2 has been in operation since 1974 and Well 3 has been in operation since 1990.

According to the current Permit to Take Water (PTTW), 1007-63JP54, issued on October 8, 2008, the wells each have a maximum rated capacity of 324 m^3/day.

Both wells were drilled into a confined aquifer. Well 2 is a 254 mm diameter well that is 77.4 m deep with 9.1 m of 20-slot stainless steel screen. The original static level of the well was 25.6 m below ground level (mbgl). Well 3 is a 304 x 608 mm diameter double cased well that is 68.6 m deep with 7.84 m of 50-slot pipe size stainless steel screen. The well originally had a static level of 27.1 mbgl.

The Innisfil Heights wells are located in a confined aquifer found locally in the elevation range of approximately 210 to 240 masl. The aquifer is regionally extensive, particularly to the east and north. A shallower aquifer is found above the municipal aquifer and is unconfined in this area.

The screen interval for Wells 2 and 3 has been assigned to the A2 Aquifer in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The Groundwater Vulnerability Rating will be determined for the A2 Aquifer.

Information presented for the Innisfil Heights section of this Chapter is based on Genivar 2010a report.

10.3.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a “Vulnerability Score” within the WHPA. Conversion of Vulnerability

categories (High, Medium, and Low) to Vulnerability Scores (10, 8, 6, 4, and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the drinking water supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the Innisfil Heights water supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that were determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration of the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Innisfil Heights WHPA. Details of the methods for the vulnerability analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Innisfil Heights wells was delineated in 2004 by Golder using a 2-dimensional analytical groundwater flow model. An updated survey of well locations was commissioned by LSRCA in 2009 to provide improved accuracy for delineation of the WHPA. A minor translation was required to adjust the Innisfil Heights well locations and the WHPA. The updated well locations and the WHPA are shown in

Figure 10a-1~~Figure 10b-1~~. WHPA delineation and adjustment details are documented in Genivar, 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2004) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years, and 25 years. WHPA-C, representing the 5 year TOT zone, was estimated under this study as per Technical Memorandum A2 – 5 year Time-of-Travel Estimation Methods (Appendix MO).

The WHPA reflect groundwater flow from west to east. This is reasonable based on available data describing regional groundwater flow patterns.

10.3.1.2 Groundwater Vulnerability

The Innisfil Heights wells draw water from a confined overburden aquifer layer (regional aquifer system A2). The Groundwater Vulnerability for the municipal overburden aquifers in the area was determined using the regional Aquifer Vulnerability Index (AVI) methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

The regional Groundwater Vulnerability is illustrated in Technical Memorandum B1 – Regional Groundwater Vulnerability Mapping (Appendix MO).

The Groundwater Vulnerability within the WHPA of the two municipal wells in the Innisfil Heights Water Supply is shown in Figure 10a-2~~Figure 10b-2~~. The Groundwater Vulnerability for the municipal water supply aquifers within the WHPA is considered to be Low.

10.3.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial transport pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe or wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have the potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

No wells were identified within the Innisfil Heights WHPA that are considered to have the potential to be a Transport Pathway. Figure 10a-2~~Figure 10b-2~~ is therefore proposed to be used to generate the Vulnerability Scores.

10.3.1.4 WHPA-E ~~/ WHPA-F~~

None of the wells in this study have been identified as GUDI, therefore delineation of a WHPA-E was not required. ~~Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.~~

10.3.1.5 Vulnerability Score

The WHPA zones for the Innisfil Heights Water Supply as shown in

Figure 10a-1~~Figure 10b-1~~, and the Groundwater Vulnerability, as shown in Figure 10a-2~~Figure 10b-2~~, were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 10a-3~~Figure 10b-3~~ illustrates the Vulnerability Scores

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for the Innisfil Heights WHPA. Figure 10a-3~~Figure 10b-3~~ will be used to assess Drinking Water Threats in Section 10.3.3~~10.5.3~~.

10.3.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned with each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty Rating is to be provided for the WHPA delineation by the technical peer review consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the Innisfil Heights WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Innisfil Heights WHPAs is High. The full results of the WHPA delineation Peer Review process for Innisfil Heights is available in Appendix I and discussed in Chapter 5 (Methods Overview).

The assessment of uncertainty for the Vulnerability Assessment considers the type, quantity, and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the Innisfil Heights WHPA is High. The Vulnerability Rating for the Innisfil Heights Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness, and types of soils within the delineated WHPA could potentially be used to improve the understanding of local hydrostratigraphy and to increase the confidence in the Vulnerability Analysis. For further information, refer to Technical Memorandum A1 (Appendix MO).

10.3.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogens) in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the Innisfil Heights Well Supply has been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for the Innisfil Heights Well Supply are provided in Technical Memorandum H2 – Drinking Water Issues Evaluation – Innisfil Groundwater (Appendix I).

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed.

No Drinking Water Issues were identified for the Innisfil Heights Well Supply.

The occasional presence of coliform bacteria in raw or treated water is not considered to represent a specific Drinking Water Issue as these parameters have only been rarely observed under circumstances that are not considered to be persistent. Aesthetic/operational parameters that exceed guidelines include hardness, iron, organic nitrogen, and turbidity, which are likely to be naturally-occurring.

The raw water quality data were reviewed with specific attention to potential water quality signatures or trends that may be related to the position of a municipal sewage treatment facility within the WHPA. No evidence of water quality influence by the sewage treatment facility was observed.

10.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Innisfil Heights Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as “an Activity or Condition that adversely affects, or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any Activity or Condition that is prescribed by the regulations as a drinking water threat.” An Activity is one or a series of related processes, natural or anthropogenic, that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Innisfil Heights Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes the preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Innisfil Heights Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.3.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Innisfil Heights Water Supply system:

- Files provided by the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks local offices pertaining to licenses and records of spills in the area of the delineated WHPA.
- Records available from the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Town of Innisfil staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Innisfil Heights Water Supply. No potential Conditions have been identified for consideration at this time.

10.3.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps combined with the Technical Rules threat circumstances can be used to correlate activities that are or

would be Drinking Water Threats with the Vulnerability Scores. The circumstances can be found at: https://threats.swpip.ca/. ~~The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php~~

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10.3.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10a-4~~Figure 10b-4 can be used in conjunction with the Vulnerability Scores~~ to identify the areas where Activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Innisfil Heights Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate, or Low Threat within WHPA-A and WHPA-B.

10.3.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10a-5~~Figure 10b-5 can be used in conjunction with the Vulnerability Scores~~ to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Innisfil Heights Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.3.3.3.3 DNAPL Chemical Parameters

Figure 10a-6~~Figure 10b-6~~ illustrates the area of the 5-year time-of-travel zone (WHPA-C) areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Innisfil Heights Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10a-6~~Figure 10b-6 can be used to can be used~~ to identify the circumstances in which these Activities would be Significant, or Moderate, or Low Drinking Water Threats.

10.3.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.3.3.2~~10.5.3.2~~, no Conditions have been confirmed within the WHPA for the Innisfil Heights Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview)

and Technical- Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10a-3~~Figure 10b-3~~ illustrates the Vulnerability Score map for Innisfil Heights well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.3.3.5 Enumerating Drinking Water Threats

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The number of Significant Drinking Water Threats for the Innisfil Heights Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO) and refined using the methodology outlined in Chapter 5 (Section 5.5.6.4.1) of this Assessment Report. There are no significant threats associated with Conditions or Drinking Water Issues.

Table 10-3~~Table 10-5~~ documents the refined enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Innisfil Heights Well Supply. Potential Significant Drinking Water Threats were only identified within areas where the Vulnerability Score is 10.

Three (3) activities that are considered to be potential Significant Drinking Water Threats were identified in association with two (2) land parcels in the WHPA for the Innisfil Heights Well Supply. One parcel is identified as having a Threat related to the application of pesticide to land. One parcel is identified as having potential for one (1) Significant Drinking Water Threat for specific circumstances relating to use as a waste disposal site as well as one (1) Threat related to a stormwater management facility.

The municipal wastewater treatment facility is not within an area with a Vulnerability Score that is sufficiently high to be considered a Significant Threat to Drinking Water. Additionally, no municipal sanitary sewage system components or hookups are located within an area with a sufficient Vulnerability Score to be considered a Significant Drinking Water Threat.

Table 10-~~3~~4: Number of Significant Drinking Water Threats for the Innisfil Heights Drinking Water Supply.

Threat Number	Threat	Significant threat counts Number of threats
1.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	~~5~~1
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	1
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	1
11.	The handling and storage of pesticide.	0

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Threat Number	Threat	Significant threat counts Number of threats
12.	The application of road salt.	18~~0~~
13.	The handling and storage of road salt.	18~~0~~
14.	The storage of snow.	12~~0~~
15.	The handling and storage of fuel.	0
16.	The handling and storage of dense non-aqueous phase liquid.	0
17.	The handling and storage of an organic solvent.	0
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals:**	**12~~3~~*** significant threats (on 6 properties)

~~*2 verified exisiting Threats and 1 potential Threat that requires further investigation~~

Note for the table above: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel

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10.3.3.5.1 Managed Lands

Technical Rule 16(9) ~~(August 2009)~~ requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and -E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~Table of Drinking Water Threats~~.

Managed Lands were identified and the managed lands proportions were determined for the WHPA of the Innisfil Heights Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.3.3.5~~10.5.3.5~~). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material, and commercial fertilizer.

Figure 10a-7~~Figure 10b-7~~ illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Innisfil Heights Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.3.3.5.2 Livestock Density

Technical Rule 16(10) ~~(August 2009)~~ requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and -E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~Table of Drinking Water Threats~~.

The Livestock Density was determined for the delineated WHPA zones of the Innisfil Heights Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.3.3.5~~10.5.3.5~~). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material and the grazing and/or confinement of livestock.

Figure 10a-8~~Figure 10b-8~~ illustrates the distribution of Livestock Density within the delineated WHPA zones for the Innisfil Heights Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density was estimated for the identified Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

10.3.3.5.3 Impervious Surfaces

Technical Rule 16(11) ~~(August 2009)~~ requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within

WHPA-A, -B, -C, -D, and -E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~Table of Drinking Water Threats~~.

The proportion of impervious surfaces within the delineated WHPA zones for the Innisfil Heights Well Supply was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.3.3.5~~10.5.3.5~~). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 10a-9~~Figure 10b-9~~ illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Innisfil Heights Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.4 Stroud Well Supply

The Stroud Well Supply is located in the north-central portion of Town of Innisfil, at the intersection of Highway 11 and the 10th Line, approximately 5 km south of Kempenfelt Bay and 7 km west of Cook's Bay. The Stroud Well Supply consists of three wells: Well 1, Well 2, and Well 3. The wellfield services the Community of Stroud and is located in the northeast part of the community, between Newholme and Sunset Crescent. The wells have been in operation since 1971, 1974, and 1986, respectively. Well 2 is used as a standby well only.

According to the current Permit to Take Water (PTTW), 00-P-1368, which expires February 15 2011, Well 1 has a maximum rated capacity of 677.16 m^3/day, Well 2 has a maximum rated capacity of 397.44 m^3/day and Well 3 has a maximum rated capacity of 1,637.28 m^3/day.

The three municipal wells are drilled in a deep confined aquifer found locally in the elevation range of approximately 155 to 195 masl. The aquifer is regionally extensive, particularly to the east and north. Two shallower aquifers and a deeper aquifer are also found at this location. Well 1 has a total depth of 110.4 m and is a 203 mm diameter well that has 4.6 m of 20 slot stainless steel screen. The original static water level at this well is of 45.7 mbgl. Well 2 has a total depth of 107 m and is a 152 mm diameter well that has 4.88 m of stainless steel 16-slot screen. The original static water level at this well was 37.5 mbgl. Well 3 has a total depth of 109.7 m and is a 203 mm diameter well that has 5.8 m of stainless steel 12-slot screen. The original static water level at this well was 39.9 mbgl.

The screen interval for Wells 1, 2, and 3 has been assigned to the A3 Aquifer in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The groundwater vulnerability rating will be determined for the A3 Aquifer.

Information presented for the Stroud section of this Chapter is based on Genivar 2010a report.

10.4.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Threats at the surface present the greatest risk to contaminate the water supply. The Vulnerability Analysis considers the WHPA and the Groundwater Vulnerability, as well as the potential for the vulnerability to be increased by man-made (anthropogenic) structures, through Transport Pathways, by developing a "Vulnerability Score" within the WHPA. Conversion of Vulnerability categories (High, Medium, and Low) to Vulnerability Scores (10, 8, 6, 4, and 2) results in a new map for each WHPA that expresses the relative degree to which a Threat could affect the

drinking water supply. A higher value Vulnerability Score will always be assigned to the immediate vicinity of the well and to any areas that are shown to be vulnerable.

The Groundwater Vulnerability for the Stroud water supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that were determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and included consideration of the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Stroud WHPA. Details of the methods for the vulnerability analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

10.4.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Stroud wells was delineated in 2004 by Golder using a 3-dimensional analytical groundwater flow model. An updated survey of well locations was commissioned by LSRCA in 2009 to provide improved accuracy for delineation of the WHPA. A minor translation was required to adjust the Stroud well locations and the WHPA. The WHPA were relocated by Golder (2010). The updated well locations and the WHPA are shown in Figure 10b-1~~Figure 10c-1~~. WHPA delineation and adjustment details are documented in Genivar, 2010a.

WHPA-A has been added to include the 100 m radius from each municipal well. The Golder (2004) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years, and 25 years. As the WHPA were created using a 3-D numerical model, the 5-year TOT line is not available and the 10-year TOT estimate will be used as WHPA-C1 in the Vulnerability Analysis.

The WHPA reflect groundwater flow from southeast to northwest. This is reasonable based on available data describing regional groundwater flow patterns.

10.4.1.2 Groundwater Vulnerability

The Stroud wells draw water from a confined overburden aquifer layer (regional aquifer system A3). The Groundwater Vulnerability for the municipal overburden aquifers in the area was determined using the regional Aquifer Vulnerability Index (AVI) methods outlined in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO). The regional groundwater vulnerability is illustrated in Technical Memorandum B1 – Regional AVI Mapping (Appendix MO).

The Groundwater Vulnerability within the WHPA of the three municipal wells in the Stroud Water Supply is shown in Figure 10b-2~~Figure 10c-2~~. The Groundwater Vulnerability for the municipal water supply aquifers within the WHPA is considered to be Low.

10.4.1.3 Transport Pathway Increase

Technical Memorandum A3 (Appendix MO) documents the consideration of Transport Pathways to increase the Vulnerability Rating as per the Technical Rules. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial transport pathways to increase the observed vulnerability.

Private wells, and particularly wells that either do not contain seals that will prevent water from moving down around the outside of the well pipe, and wells that are no longer used and/or that have not been sealed present the greatest potential for increasing the rated Vulnerability. The available data from the Provincial Water Well Information System (WWIS) database was screened to identify wells that penetrate to the water supply aquifers and have the potential to increase the Vulnerability of the natural stratigraphic profile. There is potential that other wells may exist that are not included in the database, particularly in areas now serviced by municipal water that formerly obtained water supply from private wells.

No wells were identified within the Stroud WHPA are considered to have the potential to be a Transport Pathway. Figure 10b-2~~Figure 10c-2~~ is therefore proposed to be used to generate the Vulnerability Scores.

10.4.1.4 WHPA-E ~~/ WHPA-F~~

None of the wells in this study have been identified as GUDI, therefore delineation of a WHPA-E was not required. ~~Since a WHPA-E was not required for any of the wells, the delineation of a WHPA-F was also not required.~~

10.4.1.5 Vulnerability Score

The WHPA zones for the Stroud Water Supply, as shown in Figure 10b-1~~Figure 10c-1~~, and the Groundwater Vulnerability, as shown in Figure 10b-2~~Figure 10c-2~~, were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 10b-3~~Figure 10c-3~~ illustrates the Vulnerability Scores for the Stroud Water Supply. Figure 10b-3~~Figure 10c-3~~ will be used to assess Drinking Water Threats in Section 10.4.3~~10.6.3~~.

10.4.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating of either High or Low be assigned to each Vulnerable Area as outlined in Technical Rules 13-15 (Part I.4 – Uncertainty Analysis – Water Quality (MOE, 2008a)). A component of the Uncertainty Rating is to be provided for the WHPA delineation by the technical peer review consultant. A second component of the Uncertainty Rating is to be provided in association with the Vulnerability Assessment.

The uncertainty delineation of the Stroud WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Stroud WHPAs is High. The full results of the WHPA delineation Peer Review process for Stroud is available in Appendix I and discussed in Chapter 5 (Methods Overview).

The assessment of uncertainty for the Vulnerability Assessment considers the type, quantity and quality of available data, the methods used to determine the Groundwater Vulnerability, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment Component for the Stroud WHPA is High. The Vulnerability Rating for the Stroud Water Supply has been determined using decisions and assumptions that would err on the conservative side (higher Vulnerability Scores). In this case, the High Uncertainty Rating reflects that additional data to describe the continuity, thickness, and types of soils within the delineated WHPA could potentially be used to improve the understanding of local hydrostratigraphy and to increase the confidence in the Vulnerability Analysis.

10.4.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogens) in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the Stroud Water Supply has been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the

Drinking Water Issues Evaluation for Stroud are provided in Technical Memorandum H2 – Drinking Water Issues Evaluation – Innisfil (Appendix I).

No Drinking Water Issues were identified for the Stroud Water Supply.

Several parameters were observed on occasion or in low concentrations that are consistently less than the Ontario Drinking Water Quality Standard (ODWQS) values. Trends of increasing concentrations that would exceed the ODWQS value within 50 years were not observed.

The occasional presence of coliform bacteria in raw or treated water is not considered to represent a specific Drinking Water Issue as these parameters have only been rarely observed under circumstances that are not repeated or persistent. Aesthetic/operational parameters whose concentrations may exceed guideline values include hardness, colour, manganese, aluminium, and organic nitrogen are considered to be naturally-occurring.

10.4.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Stroud Water Supply was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO). A Drinking Water Threat is defined as "an Activity or Condition that adversely affects, or has the potential to adversely affect, the quality and quantity of any water that is or may be used as a source of drinking water, and includes any Activity or Condition that is prescribed by the regulations as a drinking water threat." An Activity is one or a series of related processes, natural or anthropogenic, that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Stroud Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes the preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.4.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Stroud Drinking Water Supply is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.4.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Stroud Water Supply system:

- Files provided by the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks local offices pertaining to licenses and records of spills in the area of the delineated WHPA.
- Records available from the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of the Town of Innisfil staff to identify potential conditions within the identified WHPA for the drinking water supply.

No confirmed Conditions have been identified for the Stroud Water Supply. No potential Conditions have been identified for consideration at this time.

10.4.3.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps combined with the Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The circumstances can be found at: https://threats.swpip.ca/. ~~The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php~~

Field Code Changed

10.4.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10b-4~~Figure 10c-4 can be used in conjunction with the Vulnerability Scores~~ to identify

the areas where Activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Stroud Water Supply. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate, or Low Threat within WHPA-A and WHPA-B.

10.4.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10b-5~~Figure 10c-5 can be used in conjunction with the Vulnerability Scores~~ to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Stroud Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is equal to or greater than 8.

10.4.3.3.3 DNAPL Chemical Parameters

Figure 10b-6~~Figure 10c-6~~ illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of 6, where activities associated with DNAPL parameters are considered to be a Significant Drinking Water Threat for the Stroud Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10b-6~~Figure 10c-6 can be used~~ to can be used to identify the circumstances in which these Activities would be Significant, Moderate, or Low Drinking Water Threats.

10.4.3.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.4.3.2~~10.6.3.2~~, no Conditions have been confirmed within the WHPA for the Stroud Water Supply.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.

- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10b-3~~Figure 10c-3~~ illustrates the Vulnerability Score map for Stroud Well Supply that can be used to determine where a Condition is or would be a Significant, Moderate, or Low Threat to Drinking Water.

10.4.3.5 Enumerating Drinking Water Threats

~~**10.4.3.5**~~

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The number of Significant Drinking Water Threats for the Stroud Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO). There are no significant threats associated with Conditions or Drinking Water Issues.

Table 10-4~~Table 10-6~~ documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Stroud Well Supply. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10 and for parcels within WHPA B and C that are identified as potentially having a threat related to DNAPL.

Thirty-two (32) activities that are considered to be potential Significant Drinking Water Threats were identified in association with 32 land parcels in the WHPA for the Stroud Well Supply. Thirty-one (31) parcels were identified as having significant threat activities relating to residential land use via the use of private individual sewage disposal systems. One (1) threat activity and parcel has been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is 10. There are 31 residential parcels within this area.

Table 10-~~45~~: Number of Significant Drinking Water Threats for the Stroud Drinking Water Supply.

Threat Number	Threat	Significant threat counts Number of threats
1.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	~~1~~0
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	31
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	0
11.	The handling and storage of pesticide.	0
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0

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Threat Number	Threat	Significant threat counts Number of threats
14.	The storage of snow.	0
15.	The handling and storage of fuel.	1
16.	The handling and storage of dense non-aqueous phase liquid.	0
17.	The handling and storage of an organic solvent.	0
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals:**	**33** significant threats (on **33** properties)

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10.4.3.5.1 Managed Lands

Technical Rule 16(9) (August 2009) requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including WHPA-A, -B, -C, -D, and -E . This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical RulesTable of Drinking Water Threats.

Managed Lands were identified and the managed lands proportions were determined for the WHPA of the Stroud Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.4.3.5~~10.6.3.5~~). The Managed Lands are used in the identification of threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material, and commercial fertilizer.

Figure 10b-7~~Figure 10c-7~~ illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Stroud Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.4.3.5.2 Livestock Density

Technical Rule 16(10) ~~(August 2009)~~ requires the Assessment Report to include maps showing the livestock density within WHPA-A, -B, -C, -D, and -E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~Table of Drinking Water Threats~~.

The Livestock Density was determined for the delineated WHPA zones of the Stroud Well Supply as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.4.3.5~~10.6.3.5~~). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material and the grazing and/or confinement of livestock.

Figure 10b-8~~Figure 10c-8~~ illustrates the distribution of Livestock Density within the delineated WHPA zones for the Stroud Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A5 (Appendix MO).

10.4.3.5.3 Impervious Surfaces

Technical Rule 16(11) ~~(August 2009)~~ requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and -E. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~Table of Drinking Water Threats~~.

The proportion of impervious surfaces within the delineated WHPA zones for the Stroud Well Supply was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated WHPA zones using the

2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.4.3.5~~10.6.3.5~~). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 10b-9~~Figure 10c-9~~ illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Stroud Water Supply where Vulnerability Scores were greater than 6 for WHPA-A to WHPA-D.

10.5 Alcona Water Treatment Plant

The Alcona Water Treatment Plant is located on the south-west shore of Lake Simcoe at the inlet to Cook's Bay. The treatment plant has a current capacity of 28.4 ML/day (Town of Innisfil, 2006) and future plant improvements will ultimately provide a design capacity of 56.0 ML/day based on the operator interview. The Alcona Water Treatment Plant was expanded in 2008 and currently supplies communities in Innisfil and the Town of Bradford West Gwillimbury. The Alcona Water Treatment Plant also services the communities previously served by the decommissioned Golf Haven wells, and the non-operational Cookstown wells. The current population of Innisfil that is supplied by the Alcona Water Treatment Plant is approximately 20, 397 (Town of Innisfil, 2014).

The Alcona Water Treatment Plant began operation in June 1996 (Town of Innisfil, 2003). The WTP is classified as a large Municipal residential water system as defined by Ontario Regulation 170/03, and the most recent Certificate of Approval provided was issued on Dec. 11, 2002 (Town of Innisfil, 2006). The WTP chlorinates Lake Simcoe water with chlorine gas (Town of Innisfil, 2006). A powdered activated carbon system was added in 1999 to help control taste and odour problems associated with algae growth (Town of Innisfil, 2003).

The intake consists of a 300 m long, 900 mm diameter concrete pipe, extending from the shoreline and terminating at the inlet structure (Town of Innisfil, 2003). The location of the intake was established from MOE/MECP's *Permit to Take Water* database, and Construction Drawings. Since the intake is located 1.6 m above the lakebed, the drawings show that the intake is 10.8 m below the average water level surface. The intake was assumed to be located in a total water depth of 12.4 m throughout this report.

Based on the interview with the representative of the Town of Innisfil - Alcona WTP, conducted by personnel from LSRCA on Aug 30, 2006, the WTP can be shut down within minutes upon notification (the WTP is not staffed during evenings and on weekends and a 30 minute response time is expected). WTP personnel estimated notification time (by MOE) in the event of a spill to be in the range of a couple of hours.

IPZ delineation and Vulnerability presented in this section is based on Baird (2010c) while the Issues and Threats Assessment is based on Genivar 2010a report.

10.5.1 Methods and Uncertainties

10.5.1.1 Surface Water Vulnerability

The following section describes the methods used to assess the Vulnerability of the Alcona WTP. Intake Protection Zones and Vulnerability Scores for the Alcona WTP were delineated by

Baird and Associates (Baird, 2010c). The Alcona intake is classified as Type D surface water intake (Rule 55; MOE, 2008a). For Type D intakes, three zones are to be delineated: the IPZ-1 is based on a fixed radius around the intake crib; the IPZ-2 acts as a secondary protection zone around the IPZ-1; and the IPZ-3 is considered an additional protection zone. For the purposes of delineating the IPZ-3, the Lake Simcoe intakes are also identified as a special case (Rule 68) and those rules applicable to Type A and B intakes also apply in this regard.

10.5.1.2 Delineating IPZ-1 and IPZ-2

IPZ-1 was delineated according to the Technical Rules and as outlined in Chapter 5. The IPZ-1 was based on the 1 km radius and the 120 m setback from the shoreline and was prepared using GIS.

The IPZ-2 is defined based on the area that may contribute water to the intake where the time of travel to the intake is equal to or less than the time that is sufficient to allow the operator of the system to respond to an adverse condition in the quality of the surface water (Rule 65; MOE, 2008a). The two hour minimum response time was used for the Alcona WTP, as the operator response time to shut-down the intake was within 30 minutes of receiving notification.

The IPZ-2 is comprised of four areas:

1. In-lake IPZ-2: the area within each surface water body and an extension up tributaries flowing into the IPZ-2;
2. Up-tributary: IPZ-2 is extended up tributary to the 2-hour time of travel limit;
3. Inland setback: Greater of either the 120 m setback inland along the abutted land or the regulation limit;
4. Transport pathways: an extension to include areas that contribute water to the IPZ-2 through a transport pathway.

10.5.1.2.1 In-lake IPZ-2 delineation

The approach used in this study was to define the in-water IPZ-2 based on the currents predicted by the MIKE3 hydrodynamic model as described in Baird (2010c). The Lake Simcoe model is based on the original model developed for the Assimilative Capacity Studies as described in Baird (2006). This previous work demonstrated that DHI's MIKE3 model could successfully simulate both wind driven currents and thermocline development in Lake Simcoe.

For delineating IPZ-2, currents were developed for 10 year return period wind events, for eight wind directions, run at 45^{o} intervals (Appendix I – Table 2.2, Baird 2010c). For each wind

condition, the model was run with a constant wind applied to the surface of the lake, until the currents in the lake were fully developed. Reverse particle tracking was used to track the paths that the currents would have transported neutrally buoyant particles to the intake over a 2 hour period. Although the intakes are located near the lakebed, particles were introduced at the surface and near the lakebed. The particles released at both depths were considered in delineating the IPZ-2, as this is a more conservative approach. The impact of the water withdrawn by the intake on the local currents was also investigated, with the model indicating that the intake only significantly influences the currents within a 2 m to 5 m radius of the intake.

Currents inshore of the breaker or surf zone are complex and are not well defined by existing numerical models. Comparison of the intake depth with the depth at the estimated lakeward limit of the surf zone suggests that most of the intakes are likely located lakeward of the surf zone. However, it is recognized that there is potential for currents in the surf zone to transport a contaminant in an offshore direction from the shoreline. The significance of this increases for intakes located in high wave energy environments and for intakes located within the surf zone. A preliminary assessment of the location of the surf zone was undertaken by Baird (2010c). The assumption is that mixing processes inside the surf zone could transport a contaminant to the offshore limit of the surf zone. Estimated depth at offshore limit of surf zones is presented in Appendix I – Table 5.1, Baird 2010c.

10.5.1.2.2 Up Tributary

The upstream limit of the IPZ-2 was calculated as (2 hours minus the travel time from the intake to tributary mouth) multiplied by the tributary velocity. Tributary velocity was based on velocity at bank full stage as per the MOE (2006a) recommendation and it was assumed that bank full flow is equivalent to the 2 year return period event.

There are three tributaries located within the IPZ-2 for the Town of Innisfil - Alcona WTP intake with velocities of 0.44 m/s (Appendix I – Baird, 2010c). Tributary velocities provided by the LSRCA were used where available. Alternatively, the velocity was estimated from bank full discharge divided by the approximate area of the cross-section at the mouth of the tributary.

10.5.1.2.3 Inland Setback

Where the IPZ-2 abuts land, it includes the greater of either (1) a setback of not more than 120 m inland along the abutted land measured from the high water mark of the surface water body; or (2) the area of land within the Conservation Authority Regulation Limit along the abutted land (Rule 65; MOE, 2008a). The Regulation Limit for Lake Simcoe was provided by LSRCA, and is the April 24, 2009 Board of Directors approved version.

The shorelines of Lake Simcoe were used in lieu of the high water mark (HWM). The shoreline was developed by digitizing the lake boundary from the 2002 colour 20 cm orthorectified aerial photography.

It must be noted however that the definition of HWM used in this assessment differs to that provided by the MOE/MECP. MOE, 2009b, defines the HWM for water bodies where a long term water level record exists, as the 80th percentile for the month within which the highest water level occurs, or where a long term record of water levels does not exist, the level at which flood plains are flooded and leave a mark where natural vegetation changes from predominantly aquatic vegetation to terrestrial vegetation. The HWM is defined by LSRCA in terms of fish habitat, as the average annual high water which is 219.15 m above sea level (masl). A review of the shoreline used to define the HWM for the IPZ delineation and the HWM provided by LSRCA (219.15 masl) was completed in the Baird (2010c) report and can be found in Appendix I. The review found the two shorelines to be comparable.

10.5.1.2.4 Transport Pathways

The IPZ-2s were modified to include potential transport pathways based on Rules 72 to 74. A complete description of the methodology, analysis, and transport pathway delineation is provided in Baird 2010c.

Data were acquired by LSRCA from field surveys, in-house development, and from participating municipalities. Datasets included (but were not limited to) Storm sewersheds;Storm water pond locations; Sewershed outfall locations, diameters, flows, and velocities; Ditch locations and cross-sections; Rural drainage networks;Impervious areas;Subsurface tile drains; Watercourse engineered and modeled cross-sections; Soils and land use data; and Ortho-imagery.

The sewersheds discharging into the IPZ-2 were identified from LSRCA and municipal storm water network datasets. Residence time and the velocity were then used to estimate a maximum within-sewershed travel distance. A summary of travel distance calculations for Alcona can be found in Baird 2010c. In all sewersheds, the travel distance was greater than the assumed longest flow path in the sewershed, so the entire sewershed was included in the revised IPZ-2.

10.5.1.3 Delineating IPZ-3

The MIKE3 model was used to delineate the area within the surface water body through which contaminants released during an extreme event could be transported to the intake. An

extreme event is defined in MOE (2008a) as: a period of heavy precipitation or winds up to a 100 year storm event; a freshet; or a surface water body exceeding its high water mark.

Three events were initially selected for modeling: a 100 year return period wind event with average flows in tributaries; a 10 year return period wind event with 2 year return period non-freshet flows; and a 2 year return period freshet with average winds.

Preliminary test runs with the MIKE3 model showed that the effects of the tributary flows on currents within the lake were very localized (limited to close proximity to the mouth of the tributary). Desktop calculations showed that for the tributaries in the Lake Simcoe watershed, a contaminant could be transported from the headwaters to Lake Simcoe during a freshet or extreme non-freshet flow event. Evaluating the spatial distribution of potential transport within the lake therefore became the focus of the modeling investigations. The details of these investigations can be found in Baird, 2010c.

The modeling demonstrates that a contaminant could reach an intake from anywhere in Lake Simcoe, during extreme events. The size and irregular shape of the lake, with two large bays (Cook's Bay and Kempenfelt Bay) means that movement of the contaminant across the lake, behind islands, and in and out of bays is highly dependent on the directionality of the wind. To complicate matters further, there are eight intakes in Lake Simcoe, and there is substantial overlapping of the IPZ-3s. Based on discussions with LSRCA and MOE, it was agreed that the modeling supports the original direction in MOE (2006a), to extend the IPZ-3 to the watershed limits. Additional site specific contaminant modeling will be undertaken in the next phase. It will consider specific threats to determine whether or not a contaminant could reach the intake that is of sufficient concentration to compromise the drinking water at the intake (MOE, 2008a; Rule 130).

The IPZ-3 sub-areas, used to define areas with varying Vulnerability Scores, were delineated based on the sub-watershed boundaries. The Lake Simcoe water body was also delineated as one sub-area. Although Lake Simcoe generally flows into Lake Couchiching through Atherley Narrows, data showed that reverse flow does occur, with water flowing from Lake Couchiching into Lake Simcoe. The Lake Couchiching water body and watershed were therefore included as IPZ-3 sub-areas. The IPZ-3 was extended up tributaries from the lake, to the watershed limit. A setback of 120 m was applied on Lake Couchiching (as there is no Regulation Limit) and the Regulation limit was used to define the setback within the Lake Simcoe watershed.

10.5.1.4 IPZ Vulnerability Scores

The Vulnerability Score ranks the relative Vulnerability of the intake to contaminants. Vulnerability Score is based on the Area Vulnerability Factor and the Source Vulnerability Factor using the formula below:

B x C

where,

B = the Area Vulnerability Factor of the area of the IPZ

C = the Source Vulnerability Factor of the surface water of the IPZ

The range of possible Vulnerability Scores can be found in Table 5-5, Section 5.3.2 of Chapter 5: Methods Overview.

10.5.1.4.1 Area Vulnerability Factor

Each of the Intake Protection Zones is assigned an Area Vulnerability Factor (B) with the IPZs closest to the intake having the highest factor.

For IPZ-1s, the Area Vulnerability Factor is assigned a value of 10 due to its close proximity to the intake (Rule 88; MOE, 2008a).

For the IPZ-2, a 'base' Area Vulnerability Factor of B=8 (the median factor for an IPZ-2) was initially assigned, and then altered by four modifier scores based factors such as land cover, hydrology, slope, and the characteristics of the subwatershed that the IPZ-2 is located in (the four potential modifiers can be found in Baird, 2010c).

The IPZ-2 base Area Vulnerability Factor, modifiers, and final Area Vulnerability Factor for the Alcona WTP intake are listed in Table 10-5~~Table 10-7~~.

Table 10-~~5~~6: Derivation of IPZ-2 Area Vulnerability Factor (B) for Alcona WTP Intake.

Intake	Sub-watershed Closest to Intake	Base Area Vuln. Factor	IPZ-2 Land % Modifier[1]	Drainage Density Modifier[1]	SCS Curve Number Modifier	Land Use Modifier	Relief/ Length Ratio Modifier	IPZ-2 Final Area Vuln. Factor (B)
Innisfil	Innisfil Creeks	8	0	0	0	0	0	8

[1] The IPZ-2 Land Modifier and Drainage Density Modifier both reflect the ratio of water to land. The sum of these two modifiers cannot change the Area Vulnerability Factor by more than +/- 1.

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The Area Vulnerability Factors for the IPZ-3 sub-areas were determined, using the same methodology as IPZ-2, with some minor additions. IPZ-3 sub-areas were defined as the sub-watersheds within the Lake Simcoe watershed and Lake Couchiching subwatershed. The Lake Simcoe and Lake Couchiching waterbodies were also defined as IPZ-3 sub-areas. As stated previously, the Area Vulnerability Factors that are assigned to the IPZ-3 sub-areas cannot be greater than the Area Vulnerability Factor assigned to the IPZ-2 (Rule 91; MOE, 2008a). Methodology can be found in Baird, 2010c.

The IPZ-3 sub-zone base Area Vulnerability Factors, modifiers, and final Area Vulnerability Factors for the Alcona WTP are listed in Table 10-6~~Table 10-8~~.

Table 10-~~6~~7: Derivation of IPZ-3 Area Vulnerability Factors for Alcona WTP Intake.

IPZ-3 Sub-zones	Base Area Vulnerability Factor	Distance Modifier[1]	Drainage Density Modifier[2]	SCS Curve Number Modifier[3]	Land Use Modifer[4]	Relief-Length Modifier[5]	Final Area Vulnerability Factor (B)[6]
Lake Simcoe Waterbody (including islands)	7	0	-	-	-	-	7
Lake Couchiching (Including islands)	7	0	-	-	-	-	7
Hewitts Creek Subwatershed	7	0	0	0	0	0	7
Lovers Creek Subwatershed	7	0	0	0	0	0	7
Barrie Creeks Subwatershed	7	-1	0	0	1	1	7
Oro South Creeks Subwatershed	7	-2	0	0	0	0	5
Hawkestone Creek Subwatershed	7	-2	0	-1	0	1	5
Innisfil Creeks Subwatershed	7	-2	0	0	0	0	5
Georgina Creeks Subwatershed	7	-2	-1	1	0	0	5
Black River Subwatershed	7	-3	0	0	-1	0	3

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IPZ-3 Sub-zones	Base Area Vulnerability Factor	Distance Modifier[1]	Drainage Density Modifier[2]	SCS Curve Number Modifier[3]	Land Use Modifer[4]	Relief-Length Modifier[5]	Final Area Vulnerability Factor (B)[6]
Oro North Creeks Subwatershed	7	-3	0	0	1	1	6
Maskinonge Subwatershed	7	-3	0	1	0	0	5
East Holland Subwatershed	7	-3	1	0	1	0	6
West Holland Subwatershed	7	-3	0	0	0	0	3
Lake Couchiching Subwatershed	7	-3	-1	0	0	0	3
Ramara Creeks Subwatershed	7	-3	0	0	0	0	4
Pefferlaw Brook + Uxbridge Brook Subwatershed	7	-3	0	0	-1	0	3
Beaver River Subwatershed	7	-3	0	-1	0	0	3
Upper + Lower Talbot River Subwatershed	7	-4	0	-1	0	-1	1
Whites Creek Subwatershed	7	-4	0	0	0	0	3

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[1] If waterbody area or nearest subwatershed, Modifier = 0. If further subwatershed, Modifier: Within: <-1 S.D. of mean = -1,>-1 S.D. and mean = -2, mean and <+1 S.D. = -3, >+1 S.D. = -4.

[2] Drainage density = (Total Length of Streams)/(Subwatershed Area).Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1

[3] Adjusted SCS Curve Number. Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1. Lake Couchiching CN is average of all other subwatersheds since no data was available.

[4] Land use: Natural/Forested = -1: Agricultural = 0: Urban/Developed = +1, coarsely interpreted from 1999 LandSat Imagery

[5] Relief-Length Ratio = (Relief)/(Subwatershed Length). Modifier: Within +/-1 S.D. of mean = 0: >+1 S.D. of mean = +1: <-1 S.D. of mean = -1

[6] Final Area Vulnerability Factor plus/minus all modifiers

10.5.1.4.2 Source Vulnerability Factor

A Source Vulnerability Factor is assigned to each surface water intake (Rule 94; MOE, 2008a). Source Vulnerability for intakes within the SGBLS Source Protection Region was based on that developed by the Michigan Department of Environmental Quality (MDEQ). The first three rows in Table 10-7~~Table 10-9~~ were taken directly from MDEQ (2004), while the fourth row lists the corresponding Vulnerability Factor assigned for the Alcona WTP.

Table 10-7~~8~~: Intake Vulnerability Criteria based on Intake Distance from Shore and Depth (adapted from MDEQ, 2004).

Category[1]	Nearshore-Shallow Water	Nearshore-Deep Water	Offshore-Shallow Water	Offshore-Deep Water
Parameters[1]	<3500 m offshore <6 m depth	<3500 m offshore >6 m depth	>3500 m offshore <6 m depth	>3500 m offshore >6 m depth
Vulnerability [1] (MDEQ)	High	High to Moderate	High to Moderate	Moderate
Recommended Source Vulnerability Factor based on Intake Offset and Depth	1.0	0.9	1.00.9	0.8

[1]Category, parameters and vulnerability based on MDEQ (2004).

None of the water treatment plant operators interviewed by LSRCA for this study reported a plant shut down due to water quality issues, similarly the Issues Evaluation (below) did not identify any Issues for this intake. As no Water Quality Issues were identified the Source vulnerability Score was based on the water depth and distance offshore only. The Town of Innisfil - Alcona WTP intake is located 300 m from shore in a water depth 12.4 m. A Source Vulnerability Factor (C) ~~of 0.8 or 0.9 could be assigned, based on the values presented in Table 10-9 (MDEQ, 2004), because the intake is located 300 m from shore a value~~ of 0.9 was assigned ~~– this is the more conservative option~~.

10.5.1.5 Uncertainty Assessment

This section summarizes some of the uncertainty identified by Baird (2010c) when delineating IPZs and the assigning of Vulnerability Scores; the entire discussion of uncertainties is presented

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in Baird 2010c, Appendix I. This assessment was used by Baird (2010c) to assign Uncertainty Ratings of either "High" or "Low" for each area and source Vulnerability Score.

10.5.1.5.1 Data Quality and Gaps:

Data gaps and data quality issues identified during the study included: bathymetry and shoreline delineation data sets that may be out of date or too low resolution; wind data from a single location (Lagoon City Buoy) being applied to the entire lake; tributary flow data being limited to the major tributaries; lower level of confidence in the calibration for the Lake Couchiching model, due to the limited measured current data used in the model calibration; and limited availability of raw water quality data. A complete list of data quality and gaps listed in Appendix I, Baird 2010c.

10.5.1.5.2 Model Capabilities and Application

A model is a tool that is used to improve our understanding of the physical processes. It is important to understand the model limitations, as well as the limitations of the application, that is how the model was set up, the data was used as input to the model, the model runs undertaken, and the interpretation of the results. The limitations of the model used in this study include:

- The MIKE3 model does not consider waves and wave induced currents;
- Separate models for Lake Simcoe and Lake Couchiching means that flow through Atherley Narrows may not be accurately modeled since the Narrows are considered as an open boundary;
- Wind direction (45° intervals) and speed (10 year return periods) data that enables consistency between projects was used, but this does not capture actual shifts in wind speed and direction;
- Complex river networks and flow patterns at the north end of Lake Couchiching with limited gauge data and tributary cross-sections in this area;
- Flow velocities were estimated using either measured cross-section data from the mouth of the tributary or approximated cross-sections developed from the bathymetry field sheets for the lake. However, modeling indicated that the effect of tributary flow was localized, and did not significantly impact the in-lake IPZs
- Model application does not consider temperature induced density currents or lake stratification. Where the temperature of a tributary flowing into a lake differs from the

lake temperature, there is potential for reduced travel times to the intake, as a result of density driven currents.

A complete list and description of model uncertainties is provided by Baird, 2010c (Appendix I).

10.5.1.5.3 Quality Assurance/Quality Control

In completing this project, Baird followed their established *Project Quality Control Program (QCP),* which includes: Preparation of the Project Control Plan (PCP); Identification of the Project Manager (PM), Project Team (PT), Quality Control Reviewers (QCRs) and Quality Assurance Manager (QAM); Schedule and Budget; Description of tasks, project phases and/or deliverables to be reviewed; Identification of checklists to be utilized during reviews; and Discussion of Quality Assurance procedures to be used during the project life cycle.

10.5.1.5.4 Extent and Level of Model Calibration/Validation

The MIKE3 model was calibrated with measured current data from two locations on Lake Simcoe, and one location in Lake Couchiching. It is important to note that the ADCP data sets are of limited duration and spatial coverage. They did not include the extreme events that were modeled for the matrix runs. The level of calibration was based on the available data and, in general, the models captured the trends in the surface currents. Based on the calibration undertaken, the model seemed to capture the general trends in current speed and direction.

10.5.1.5.5 Area and Source Vulnerability Factors

The factors considered in assigning the Area Vulnerability values include: the percentage of the area of the IPZ-2 or IPZ-3, as the case may be, that is composed of land; the land cover, soil type, permeability of the land and the slope of any setbacks; the hydrological and hydrogeological conditions in the area that contributes water to the area through Transport Pathways; and, in respect of an IPZ-3, the proximity of the area of the IPZ-3 to the intake. The only subwatershed characteristic that is relatively uncertain is the SCS Curve, with the uncertainty arising from the fact that the SCS Curve No. is based on many parameters including rainfall, land cover, soil permeability, and slope. The parameters considered in assigning the Source Vulnerability Factors were the distance of the intake from shore and the depth of water that it is located in, and the history of water quality concerns. Technical Memorandum H2 (Appendix I) did not report any water quality Issues in their Issues Evaluation report, however limited data were available for the analysis.

10.5.2 Results – Alcona Water Treatment Plant

10.5.2.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the Alcona WTP are shown in Figure 10c-1~~Figure 10d-1~~. IPZ-1 consists of a 1 km radius centered on the crib of the intake, extending not more than 120 m inland. IPZ-2 extends along the shoreline, and for a short distance along Innisfil Creeks and a couple of unnamed tributaries. Transport Pathways, such as drains and ditches extend the IPZ-2 in various locations within the community. The IPZ-3 for Alcona WTP, as with all intakes in Lake Simcoe, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 10c-2~~Figure 10d-2~~). The Lake Couchiching water body and watershed were included as IPZ-3 sub-areas because current flow measurements show that reverse flow (i.e. from Lake Couchiching to Lake Simcoe), does occur.

10.5.2.2 Intake Protection Zone (IPZ) Vulnerability Scores

The Vulnerability Factors and scores for the IPZ-1, IPZ-2, and IPZ-3 sub-areas are summarized below in Table 10-8~~Table 10-10~~ and Figure 10c-1~~Figure 10d-1~~ and Figure 10c-2~~Figure 10d-2~~.

Table 10-~~8~~9: Summary of Vulnerability Factors and Scores for Alcona WTP Intake.

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	0.9	9
IPZ-2	8	0.9	7.2
IPZ-3 Sub-areas	-	-	-
Lake Simcoe waterbody (incl. islands)	7	0.9	6.3
Lake Couchiching waterbody (incl. islands)	7	0.9	6.3
Innisfil Creeks subwatershed	6	0.9	5.4
Georgina Creeks subwatershed	6	0.9	5.4
Maskinonge subwatershed	6	0.9	5.4
West Holland subwatershed	6	0.9	5.4

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
East Holland subwatershed	7	0.9	6.3
Oro South Creeks subwatershed	5	0.9	4.5
Black River subwatershed	4	0.9	3.6
Hawkestone Creek subwatershed	5	0.9	4.5
Hewitt's Creek subwatershed	5	0.9	4.5
Lover's Creek subwatershed	4	0.9	3.6
Barrie Creeks subwatershed	6	0.9	5.4
Pefferlaw Brook + Uxbridge Brook subwatershed	3	0.9	2.7
Oro Creeks North subwatershed	6	0.9	5.4
Beaver River subwatershed	3	0.9	2.7
Whites Creek subwatershed	3	0.9	2.7
Upper + Lower Talbot River subwatershed	1	0.9	0.9
Lake Couchiching subwatershed	2	0.9	1.8
Ramara Creeks Subwatershed	3	0.9	2.7

10.5.2.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010c) recommended an IPZ delineation Uncertainty Rating for the IPZ-1 as low and IPZ-2 and IPZ-3 as High. The Uncertainty Rating for the IPZ-1, -2 and -3 Vulnerability Scores are all High (Table 10-9~~Table 10-11~~).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see Section 10.5.3~~10.7.3~~) based on the data analyzed, limited data were available for the Issues Analysis and the operator raised some concerns (Baird, 2010c). A High Uncertainty was therefore assigned to the Vulnerability Score for the IPZ-1.

The IPZ-2 delineation is based on current velocities in the vicinity of the intake. Based on the data, model, model application, and model calibration limitations presented in this section, a High rating of Uncertainty is recommended. The High levels of Uncertainty are not a reflection of the quality of work, but a recognition of the limitations presented. With respect to extension of the IPZ-2 up tributaries, the velocities in small tributaries, in many cases, were assumed, due to lack of data. Similarly, no fieldwork was undertaken to define the characteristics of Transport Pathways and there are significant data gaps. A High level of Uncertainty was therefore assigned to the IPZ-2 delineation. Vulnerability Scores for the IPZ-2 were assigned based on the Area and Source Vulnerability Factors. The Uncertainty Rating for the data used to define the Source Vulnerability Factor (offset from shore, depth, and history of water quality concerns) is High as discussed for the IPZ-1. The level of Uncertainty for the Area Vulnerability for the IPZ-2 is also High due to the degree of uncertainty in the methodology used to develop the Area Vulnerability Factor. This in part stems from the fact that the Rules (MOE, 2009a) do not provide specific guidance.

Table 10-9~~10~~: Summary of uncertainty Ratings for Town of Innisfil - Alcona WTP Intake IPZs and Vulnerability Scores.

IPZ	Uncertainty For IPZ Delineation	Uncertainty For Vulnerability Scores
IPZ-1	Low	High
IPZ-2	High	High
IPZ-3	High	High

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Contaminant specific modeling to determine if an activity represents a Significant Drinking Water Threat [Rule 130; MOE, 2008a] has not been completed as part of this project. This modeling is required to determine if the release of a chemical or pathogen would be

transported through the surface water IPZ to the intake and result in deterioration of the water for use as a drinking water source. Concentration, specific gravity, decay rate, and the size of the spill must all be considered. Contaminant specific modeling should be undertaken in the future to improve the level of certainty in the IPZ-3 delineation. A High level of Uncertainty has therefore been assigned to the IPZ-3 delineation.

A High level of Uncertainty has also been assigned to the Vulnerability Scoring for the IPZ-3 subareas, for the reasons discussed with respect to the IPZ-1 and IPZ-2.

10.5.3 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogens) in the raw drinking water that will limit the ability of the water to serve as a drinking water source either now or in the future. To be considered a Drinking Water Issue, a parameter needs to be at a concentration that may result in the deterioration of the quality of the water for use as a source of drinking water or if there is a trend of increasing concentrations of the parameter and a continuation of that trend that would result in the deterioration of the quality of the water as a source of drinking water (Technical Rule 114.(1)(a-b)). However, a parameter may not be considered an Issue in cases where it is naturally occurring or effective treatment is in place.

Available data describing raw water quality and treated water quality for the Alcona Water Treatment Plant for the Town of Innisfil has been reviewed to identify Drinking Water Issues that are considered likely to result in a deterioration of the quality of water for use as a source of drinking water. Details of the Drinking Water Issues Evaluation for the Alcona Water Treatment Plant in the Town of Innisfil are provided in Technical Memorandum H2 – Drinking Water Issues Evaluation – Innisfil Surface Water (Appendix I).

No Drinking Water Issues were identified for the Alcona Water Treatment Plant

Parameters whose concentrations occasionally exceed Aesthetic/Operational guidelines under the Ontario Drinking Water Quality Standards include hardness, colour, dissolved organic carbon, organic nitrogen, and turbidity. These parameters are likely naturally-occurring.

Sodium concentrations have exceeded the guideline of 20 mg/L used by the Medical Officer of Health for sodium restricted diets but are not projected to exceed the ODWQS objective of 200 mg/L within 50 years. Increasing sodium concentrations have been observed through several of the water intakes in Lake Simcoe.

Trihalomethanes are present in trace concentrations in the treated water as by-products of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and do not display increasing trends.

Surface water in Lake Simcoe was observed to have variable concentrations of pathogen parameters typically indicated by presence of total coliform or *E. coli* bacteria. Treatment consisting of adequate filtration and disinfection is in place and maintained in accordance with Provincial standards set under the Safe Drinking Water Act. As this treatment is effective, the coliform and *E. coli* bacteria are not considered to be Drinking Water Issues. The water quality of the surface water source will be benefited by any measures within the contributing area to the water supply intake that will reduce the concentrations of bacterial parameters within the surface water system.

10.5.4 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Alcona WTP was completed in accordance with the detailed methodology presented in Technical Memo – A5 (Appendix MO) . A Drinking Water Threat is defined as "an Activity or Condition that adversely affects or has the potential to adversely affect the quality and quantity of any water that is or may be used as a source of drinking water, and includes any Activity or Condition that is prescribed by the regulations as a drinking water threat." An Activity is one or a series of related processes, natural or anthropogenic, that occurs within a geographical area and may be related to a particular land use, whereas a Condition refers to the presence of a contaminant in the soil, sediment, or groundwater resulting from past activities. Therefore, it is not only presently existing Threats that must be regulated, but future ones as well.

The Drinking Water Threats Assessment for the Alcona WTP builds on the information from the Vulnerability Analysis and Issues Evaluation and includes the preparation of:

- A list of Drinking Water Threats for Activities,
- A list of Drinking Water Threats for Conditions,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Activities,
- Maps showing areas that are or would be Significant, Moderate, or Low Drinking Water Threats for Conditions, and
- An enumeration of Drinking Water Threats.

10.5.4.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Alcona WTP is provided in Chapter 5, section 5.5.1.

No additional Drinking Water Threats were identified for consideration. No local circumstances for prescribed Threats were identified.

10.5.4.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the water supply for the Alcona WTP:

- Files provided by the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks local offices pertaining to licenses and records of spills in the area of the delineated WHPA.
- Records available from the ~~Ministry of the Environment~~Ministry of the Environment, Conservation and Parks website containing registry of Brownfield Sites.
- Records from available technical studies and previous contaminant source inventories that identified situations that may qualify as conditions.
- Interviews of Town of Innisfil staff to identify potential conditions within the identified IPZs for the drinking water supply

No confirmed Conditions have been identified for the IPZs delineated for the Alcona WTP. No potential Conditions have been identified for consideration at this time.

10.5.4.3 Identifying Areas of Significant/Moderate/Low Threats – Activities

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps combined with the Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The circumstances can be found at: https://threats.swpip.ca/. ~~The maps include references to a series of tables prepared by MOE to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at: http://www.ene.gov.on.ca/en/water/cleanwater/provincialTables.php~~

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10.5.4.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10c-3~~Figure 10d-3 can be used in conjunction with the Vulnerability Scores~~ to identify the areas where Activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Alcona WTP. Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 9.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 10c-4~~Figure 10d-4~~).

10.5.4.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 10c-5~~Figure 10d-5 can be used in conjunction with the Vulnerability Scores~~ to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Alcona WTP, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is 9.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 10c-6~~Figure 10d-6~~).

10.5.4.4 Identifying Areas of Significant/Moderate/Low Threats – Conditions

Further to Section 10.5.4.2~~10.7.4.2~~, no Conditions have been confirmed within the IPZs for the Alcona WTP.

A Condition or potential Condition that has not been identified would potentially be a Significant, Moderate, or Low Threat to Drinking Water based on the combination of Hazard Rating and Vulnerability Rating as described in Section 5.5.5 (Chapter 5: Methods Overview) and Technical ~~-~~Memorandum A5 (Appendix MO). The Hazard Rating is dependent on whether there is evidence the Condition is causing off-site contamination, and whether the Condition is located on the same property as the supply well.

A Condition would be a threat to municipal drinking water in the following situations:

- **Significant**: where the Vulnerability Score is ≥ 8 and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well.
- **Moderate**: (1) where the Vulnerability Score ≥ 6 and < 8, and there is evidence that the Condition is causing off-site contamination, and/or that the Condition is located on the same property as the supply well; or (2) Where the Vulnerability Score is 10, and there is no evidence of off-site contamination.
- **Low**: Where the Vulnerability Score ≥ 8 and < 10 and there is no evidence of off-site contamination.

Figure 10c-1~~Figure 10d-1~~ and Figure 10c-2~~Figure 10d-2~~ illustrate the Vulnerability Score maps for Alcona WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

10.5.4.5 Enumerating Drinking Water Threats

~~10.5.4.5~~

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The number of Significant Drinking Water Threats for the IPZs for the Alcona WTP has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO) and refined using the methodology outlined in Chapter 5 (Section 5.5.6.4.1) of this Assessment Report.

Table 10-10~~Table 10-12~~ documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the IPZ for the Alcona Water Treatment Plant. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 9 in IPZ-1. There are no significant threats associated with Conditions or Drinking Water Issues.

One (1) activity/parcel is assigned to acknowledge the municipal sanitary sewage system and hook-ups within IPZ-1. No other activities were identified within the IPZ-1 for the Alcona WTP that would be considered Significant Drinking Water Threats.

Table 10-10~~11~~: Number of Significant Drinking Water Threats for the Alcona WTP.

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Threat Number	Threat	Significant threat counts Number of threats
1.	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V or the Environmental Protection Act.	0
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	1
3.	The application of agricultural source material to land.	0
4.	The storage of agricultural source material to land.	0

Threat Number	Threat	Significant threat counts Number of threats
5.	The management of agricultural source material.	0
6.	The application of non-agricultural source material to land.	0
7.	The handling and storage of non-agricultural source material.	0
8.	The application of commercial fertilizer to land.	0
9.	The handling and storage of commercial fertilizer to land.	0
10.	The application of pesticide to land.	1~~0~~
11.	The handling and storage of pesticide.	0
12.	The application of road salt.	0
13.	The handling and storage of road salt.	0
14.	The storage of snow.	0
15.	The handling and storage of fuel.	0
16.	The handling and storage of dense non-aqueous phase liquid.	0
17.	The handling and storage of an organic solvent.	0
18.	The management of runoff that contains chemicals used in the de-icing of aircraft.	0
19.	An activity that takes water from an aquifer or a surface water body without returning the water taken to the safe aquifer or surface water body.	0

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Threat Number	Threat	Significant threat counts Number of threats
20.	Any activity that reduces the recharge of an aquifer.	0
21.	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals:**	~~21~~* significant threats (on 2 properties)

*1 potential Threat that requires further verification (2015)

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10.5.4.5.1 Managed Lands

Technical Rule 16(9) ~~(August 2009)~~ requires the Assessment Report to include maps showing the location of Managed Lands and the percentage of Managed Lands within a Vulnerable Area, including IPZ-1, -2 and -3. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a threat in the Technical Rules~~Table of Drinking Water Threats~~.

Managed Lands were identified and the Managed Lands proportions were determined for IPZ-1 and IPZ-2 for the water supply to the Alcona WTP as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.5.4.5~~10.7.4.5~~). The Managed Lands are used in the identification of Threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material, and commercial fertilizer.

Figure 10c-7~~Figure 10d-7~~ illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Alcona WTP. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 10c-8~~Figure 10d-8~~.

10.5.4.5.2 Livestock Density

Technical Rule 16(10) ~~(August 2009)~~ requires the Assessment Report to include maps showing the livestock density within including IPZ-1, -2 and -3. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~Table of Drinking Water Threats~~.

The Livestock Density was determined for IPZ-1 and IPZ-2 for the water supply to the Alcona WTP as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.5.4.5~~10.7.4.5~~). Nutrient Units per farm are used in the identification of Threat activities associated with the storage of Agricultural Source Material and the grazing and/or confinement of livestock.

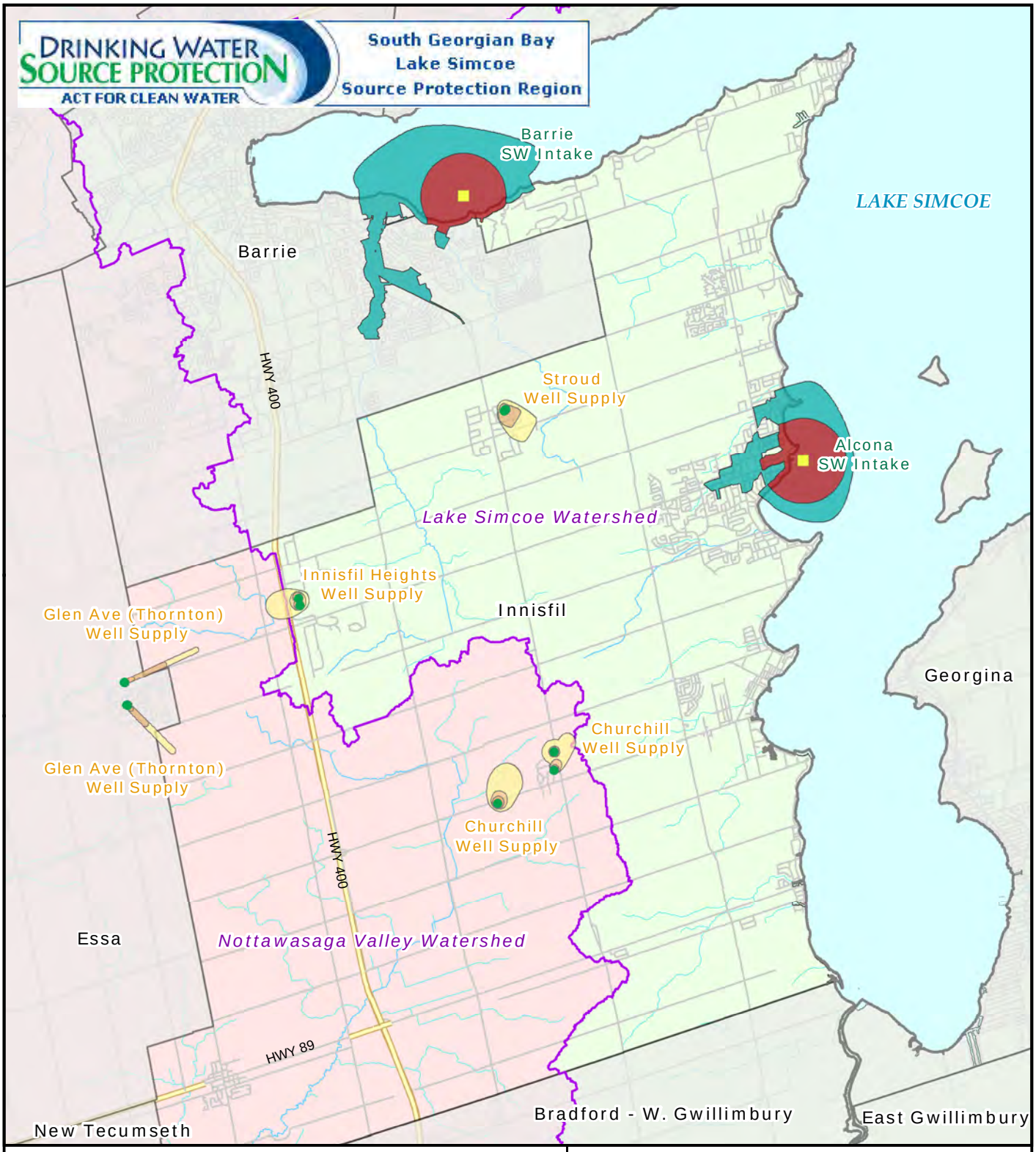
Figure 10c-9~~Figure 10e-9~~ illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Alcona WTP where Vulnerability Scores were greater than 6. The Livestock Density for the IPZ-3 associated with the surface water intakes in Lake Simcoe is presented Figure 10c-10~~Figure 10d-10~~.

10.5.4.5.3 Impervious Surfaces

Technical Rule 16(11) ~~(August 2009)~~ requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within including IPZ-1, -2 and -3. This mapping is not required where the Vulnerability Scores for the area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Alcona WTP was determined in accordance with the methodology in Technical Memorandum A5 (Appendix MO). Methodology in Technical Memorandum A5.1 (Appendix MO) was used in 2023 to update the proportion of Impervious Surfaces within the delineated Intake Protection Zones using the 2021 Technical Rules. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 10.5.4.5~~10.7.4.5~~). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 10c-11~~Figure 10d-11~~ illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the Alcona WTP where Vulnerability Scores were greater than 6. The proportion of Impervious Surfaces for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 10c-12~~Figure 10d-12~~.



Municipal Surface Water Intakes
IPZ-1 (1000m on water or 120m inland)
IPZ-2 (2 hr time of travel)
Municipal Supply Well in Town of Innisfil
WHPA-A (100m)
WHPA-B (2 years time of travel)
WHPA-C (5 years time of travel)
WHPA-C1 (10 years time of travel)
WHPA-D (25 years time of travel)

Drinking Water System Vunerable Areas in Town of Innisfil

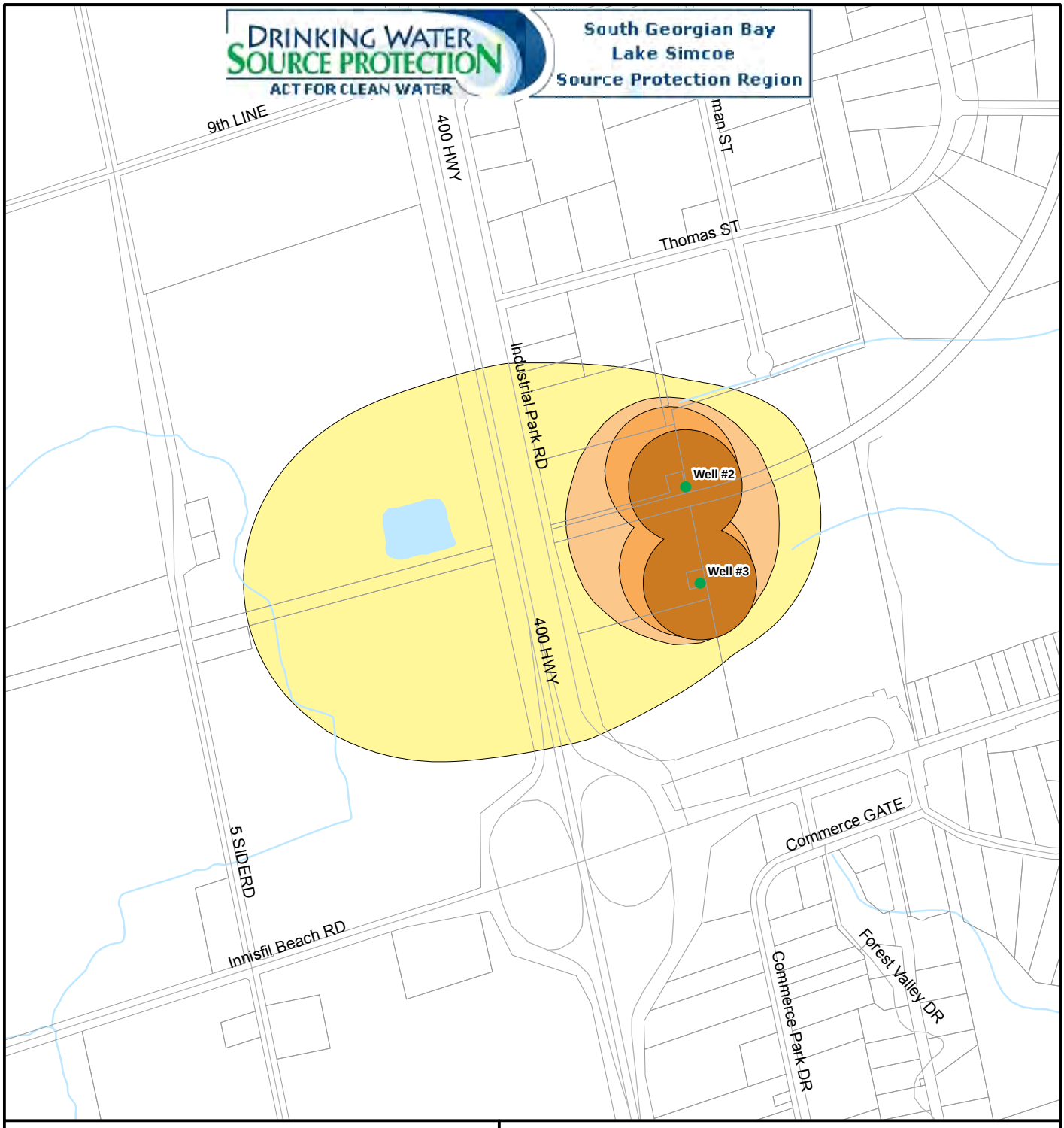
Created by: LSRCA
Date: 2017-07-14

Scale: 1:130,000
0 1.5 3km
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 10-1



Legend

- MUNICIPAL WELL LOCATION
- WHPA-A: 100 m RADIUS
- WHPA-B: 2-YEAR TIME-OF-TRAVEL
- WHPA-C: 5-YEAR TIME-OF-TRAVEL
- WHPA-D: 25-YEAR TIME-OF-TRAVEL

N W E S

100 50 0 100 Metres

WELLHEAD PROTECTION AREA - INNISFIL HEIGHTS, INNISFIL

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-1

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 **10a-1**

LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N
W E
S

100 50 0 100 Metres

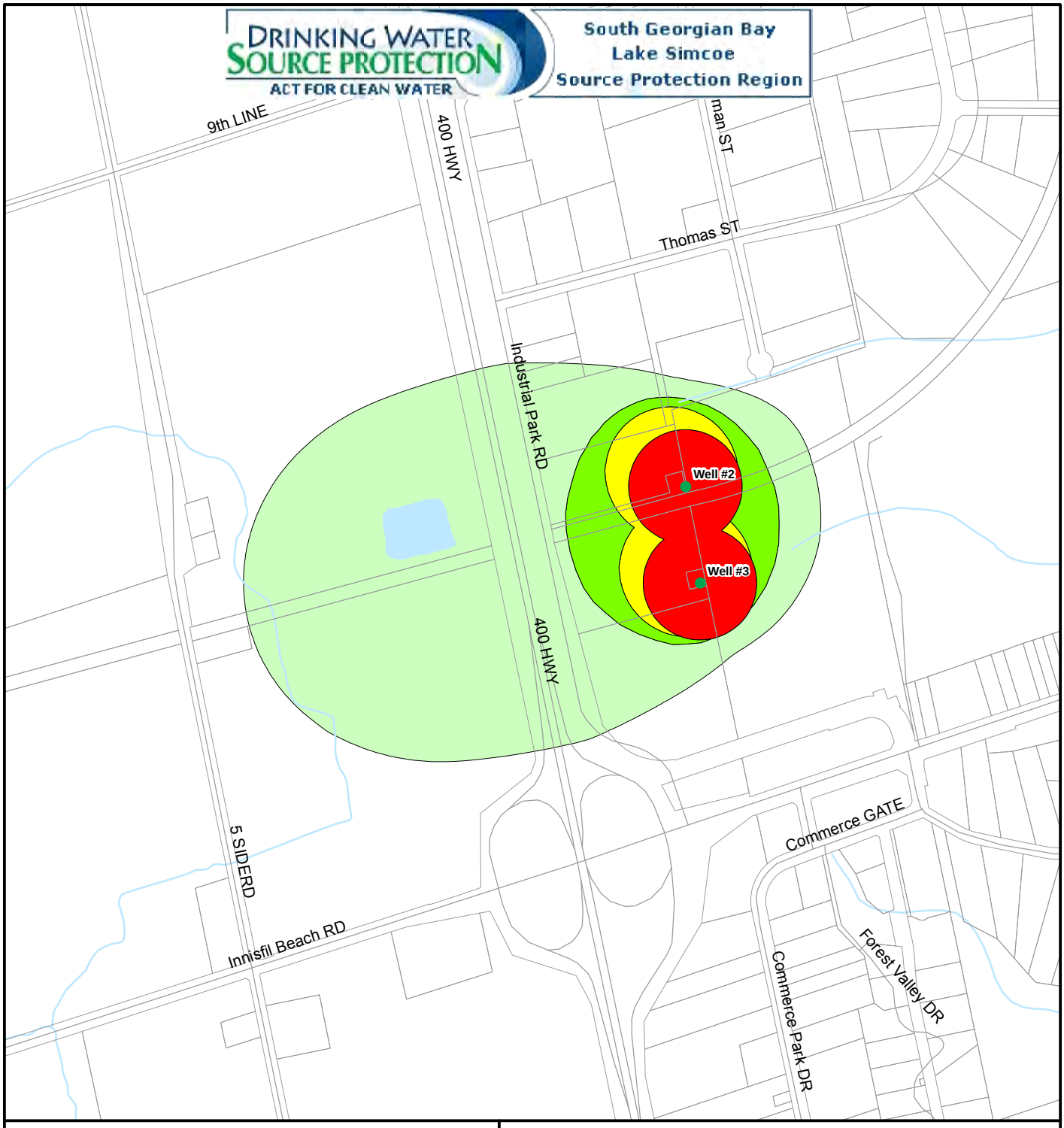
GROUNDWATER VULNERABILITY - INNISFIL HEIGHTS

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-2

GENIVAR Ontario

FIGURE **10a-2**



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

100 50 0 100 Metres

VULNERABILITY SCORES - INNISFIL HEIGHTS

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-3

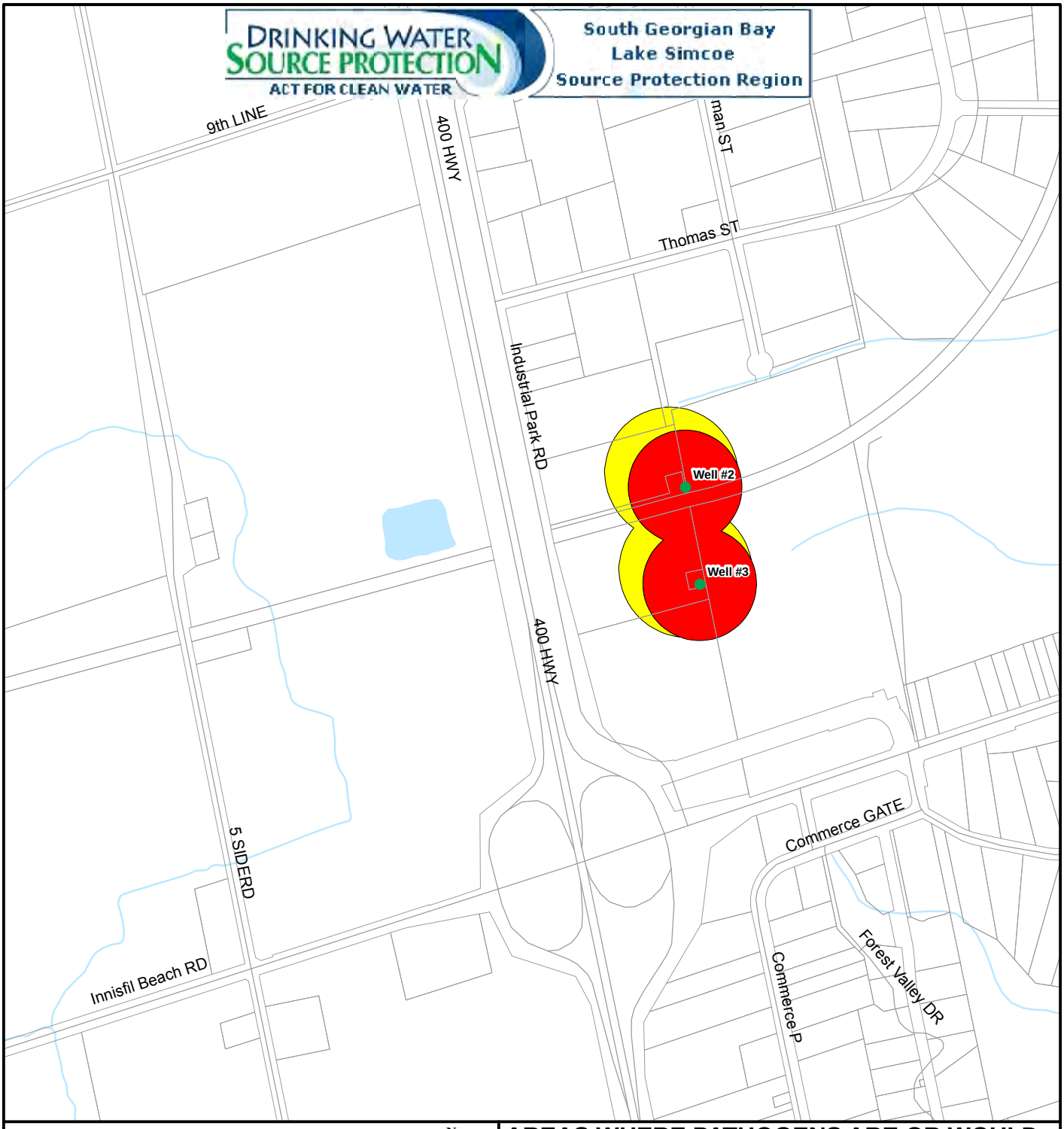
This map was produced for the South Georgian Bay Lake Simcoe Source Protection Region for the purposes of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict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

GENIVAR Ontario

FIGURE **10a-3**

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N
W E
S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

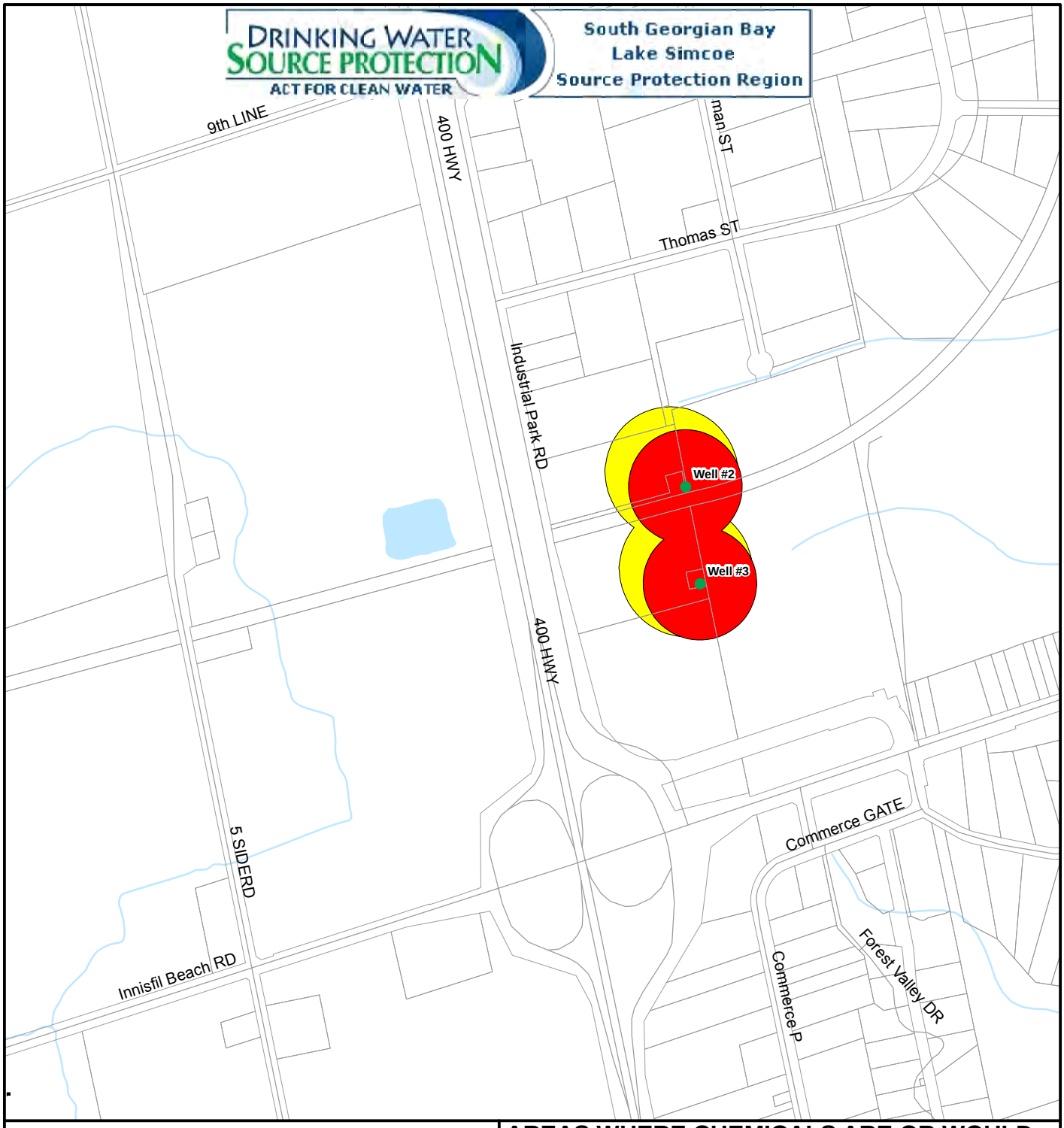
AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - INNISFIL HEIGHTS

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-4

GENIVAR Ontario

FIGURE 10a-4



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - INNISFIL HEIGHTS

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-5

GENIVAR Ontario

FIGURE **10a-5**

Legend

- MUNICIPAL WELL LOCATION
- WHPA-C: 5-YEAR TIME-OF-TRAVEL

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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.

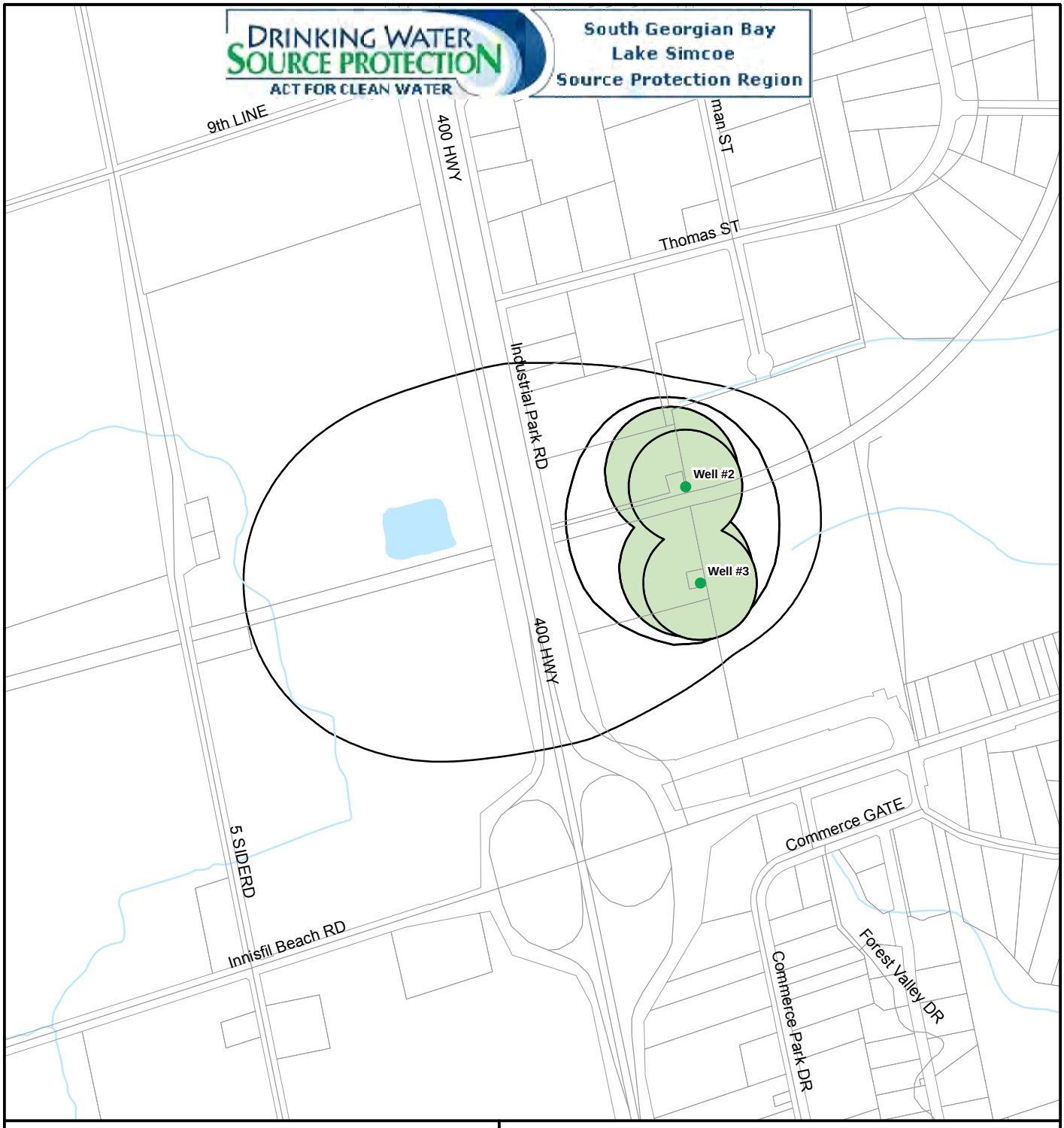
AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - INNISFIL HEIGHTS

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-6

GENIVAR Ontario

FIGURE **10a-6**



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

100 50 0 100 Metres

MANAGED LANDS - INNISFIL HEIGHTS

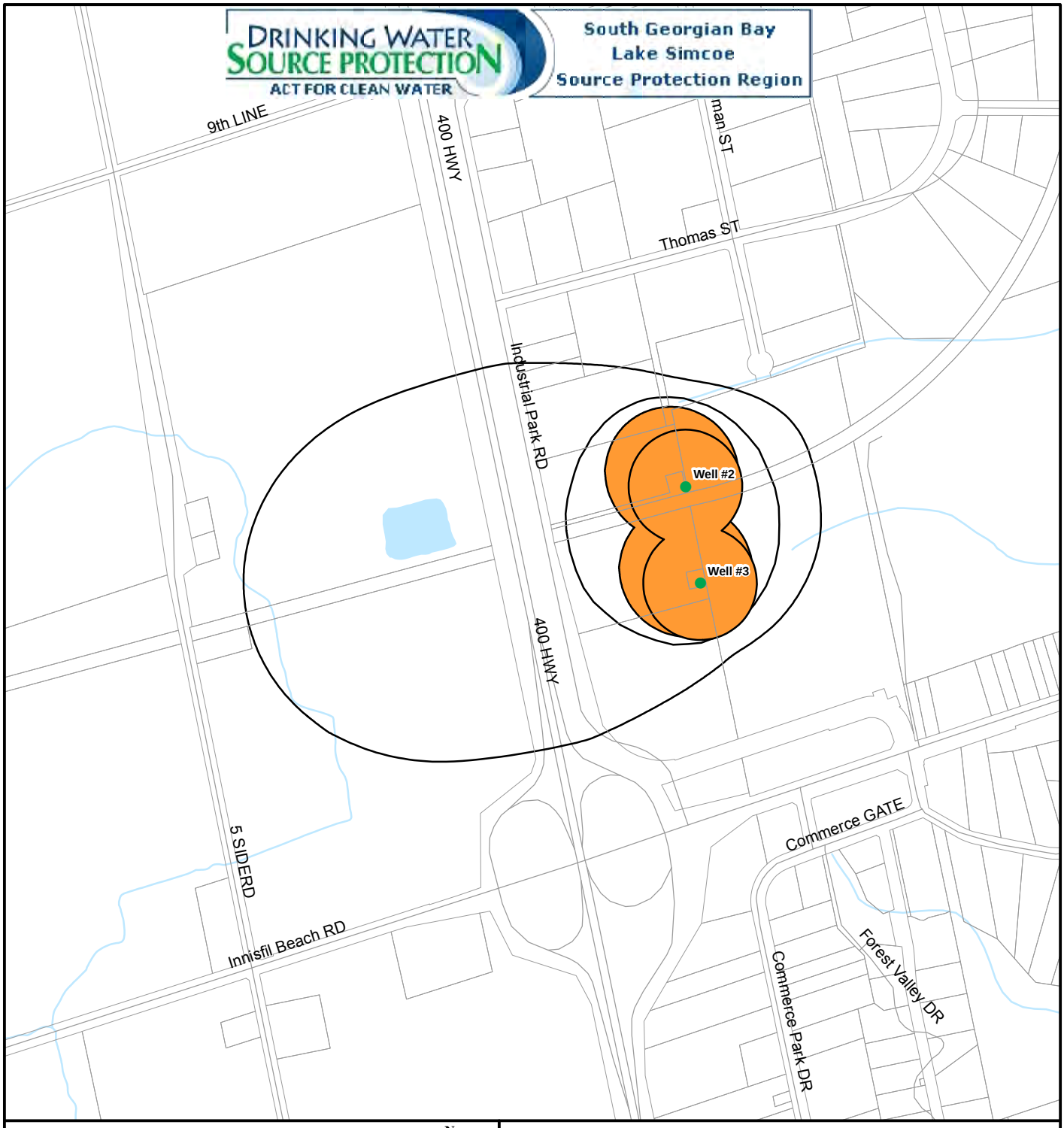
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-7

GENIVAR Ontario

FIGURE **10a-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

100 50 0 100 Metres

LIVESTOCK DENSITY - INNISFIL HEIGHTS

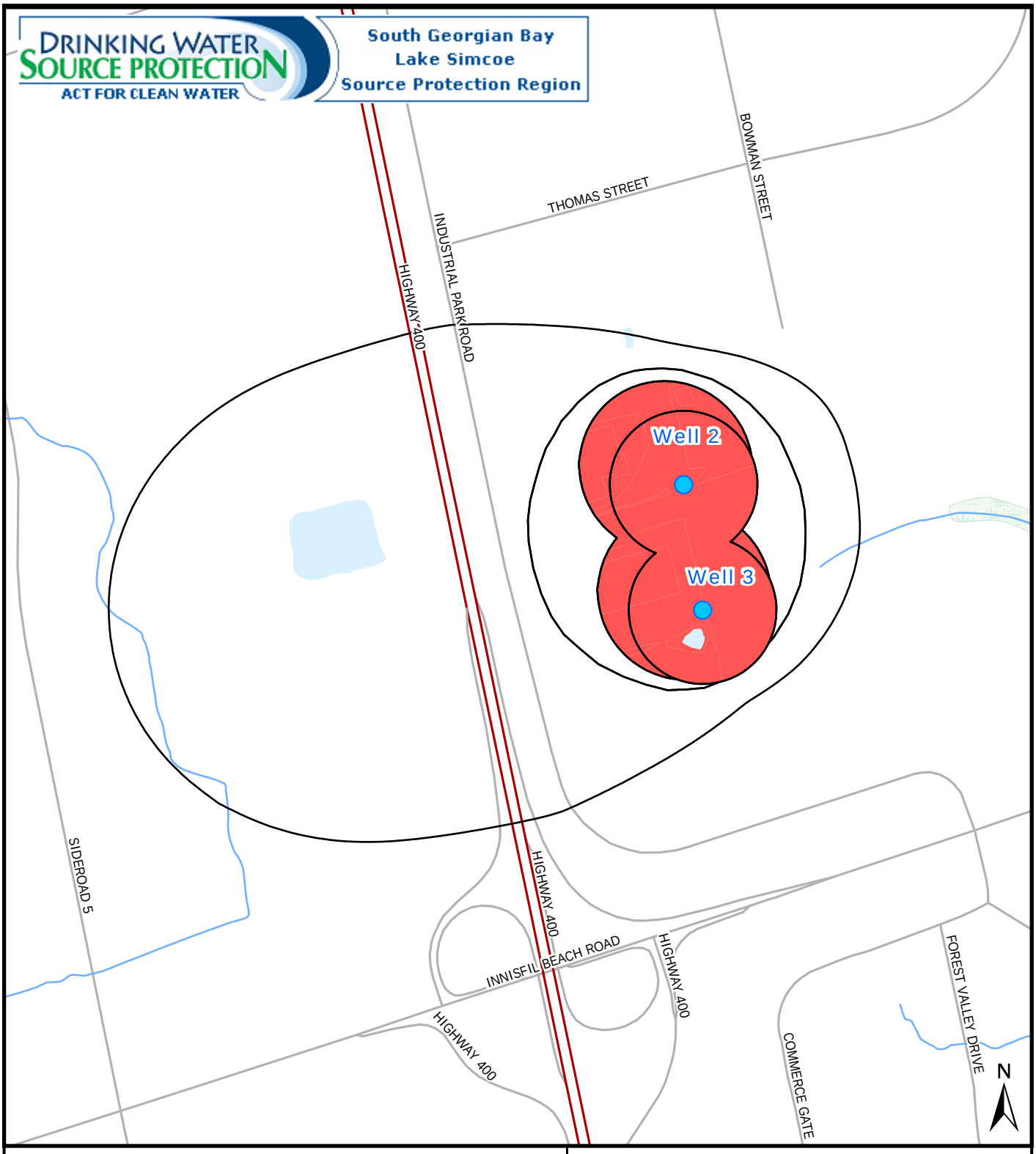
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.6-8

GENIVAR Ontario

FIGURE **10a-8**



Well

Impervious Surfaces in WHPA

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - Innisfil Heights WHPA

Created by: LSRCA, 2025-08-05

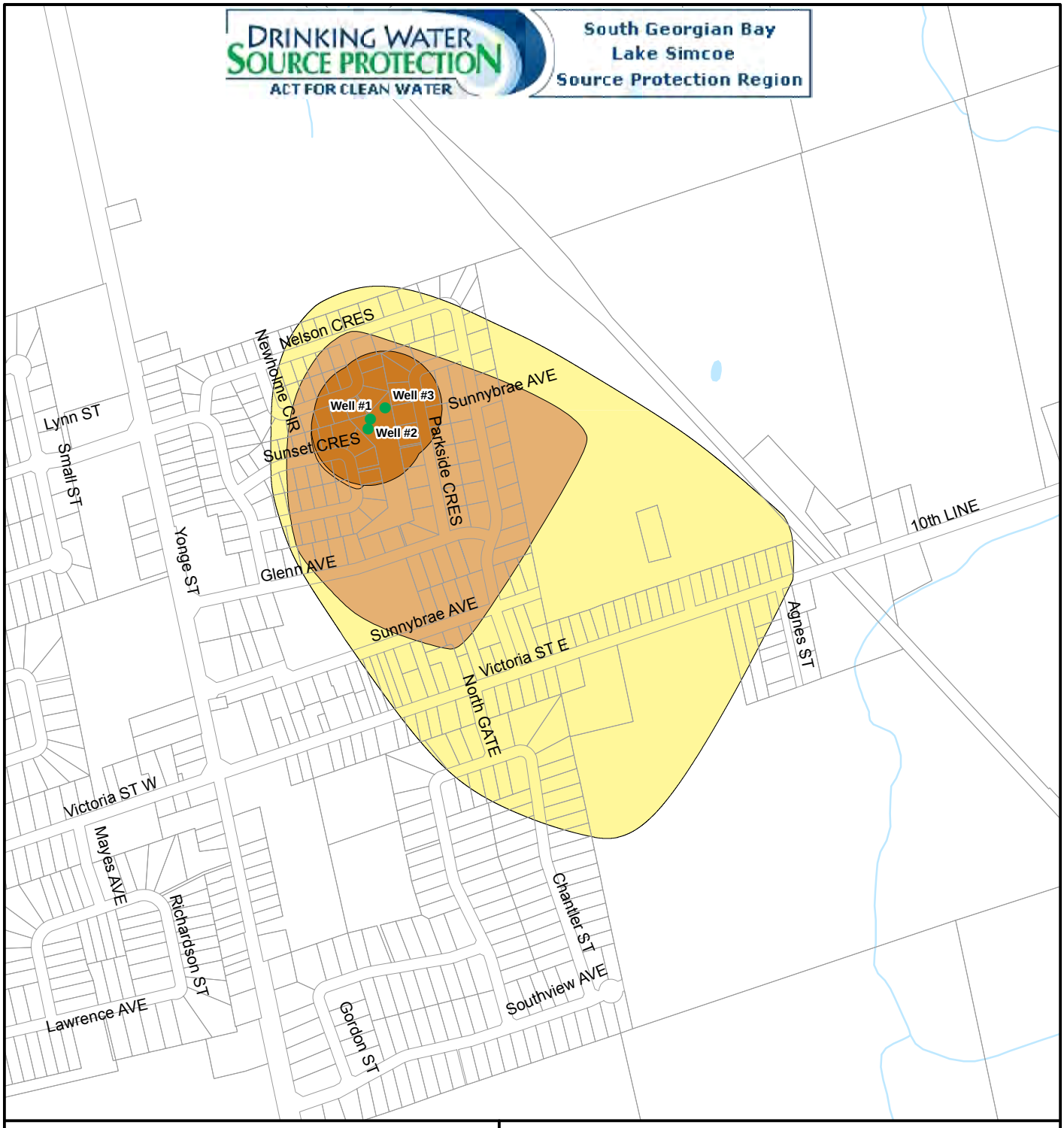
Scale 1:7,500

0 65 130 260 m

UTM Zone 17N, NAD83

Ontario

Figure 10a-9



WELLHEAD PROTECTION AREA - STROUD, INNISFIL

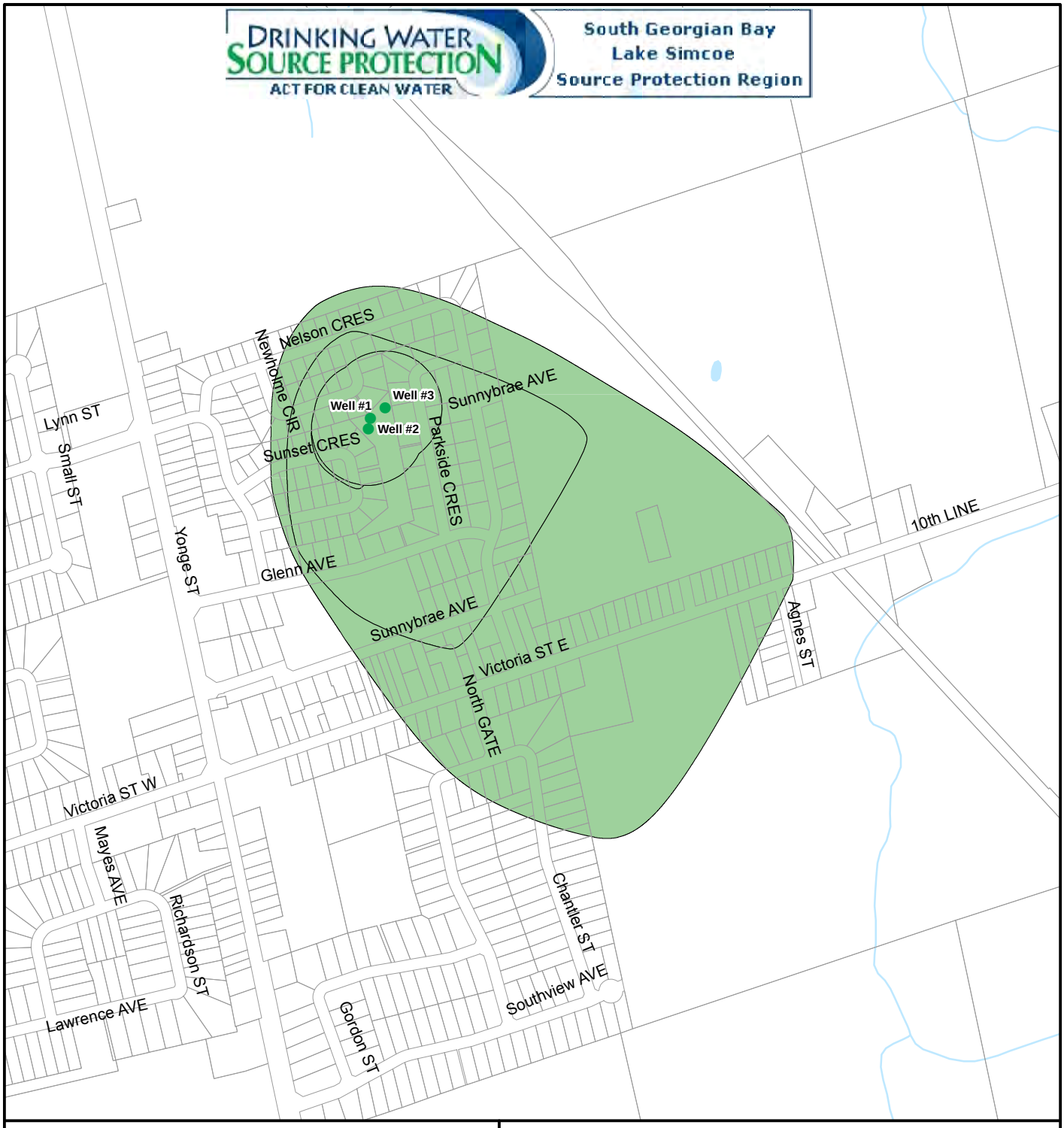
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-1

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 **10b-1**



LEGEND

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N
W E
S

100 50 0 100 Metres

GROUNDWATER VULNERABILITY - STROUD

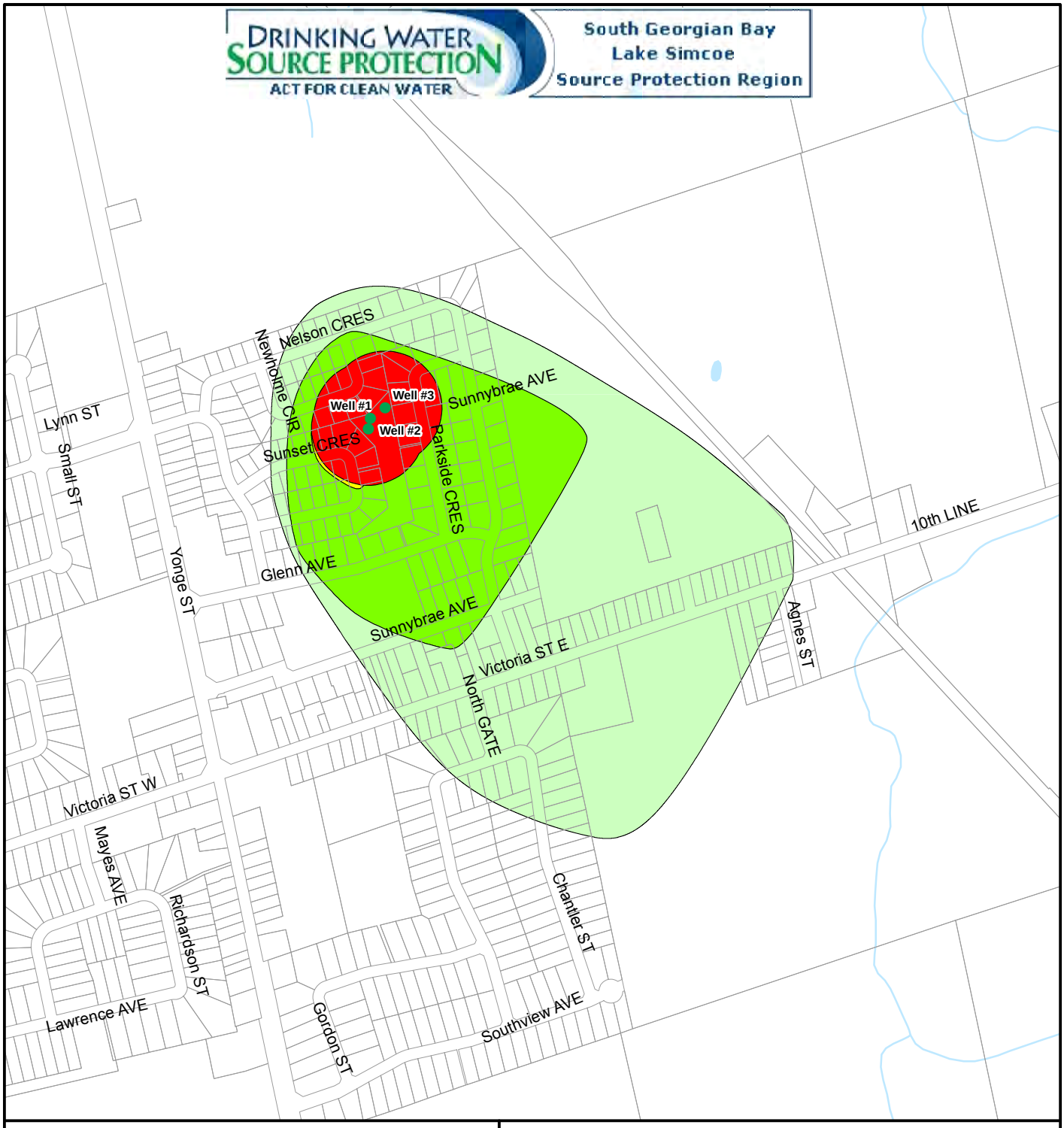
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-2

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 **10b-2**



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N
W E
S

100 50 0 100 Metres

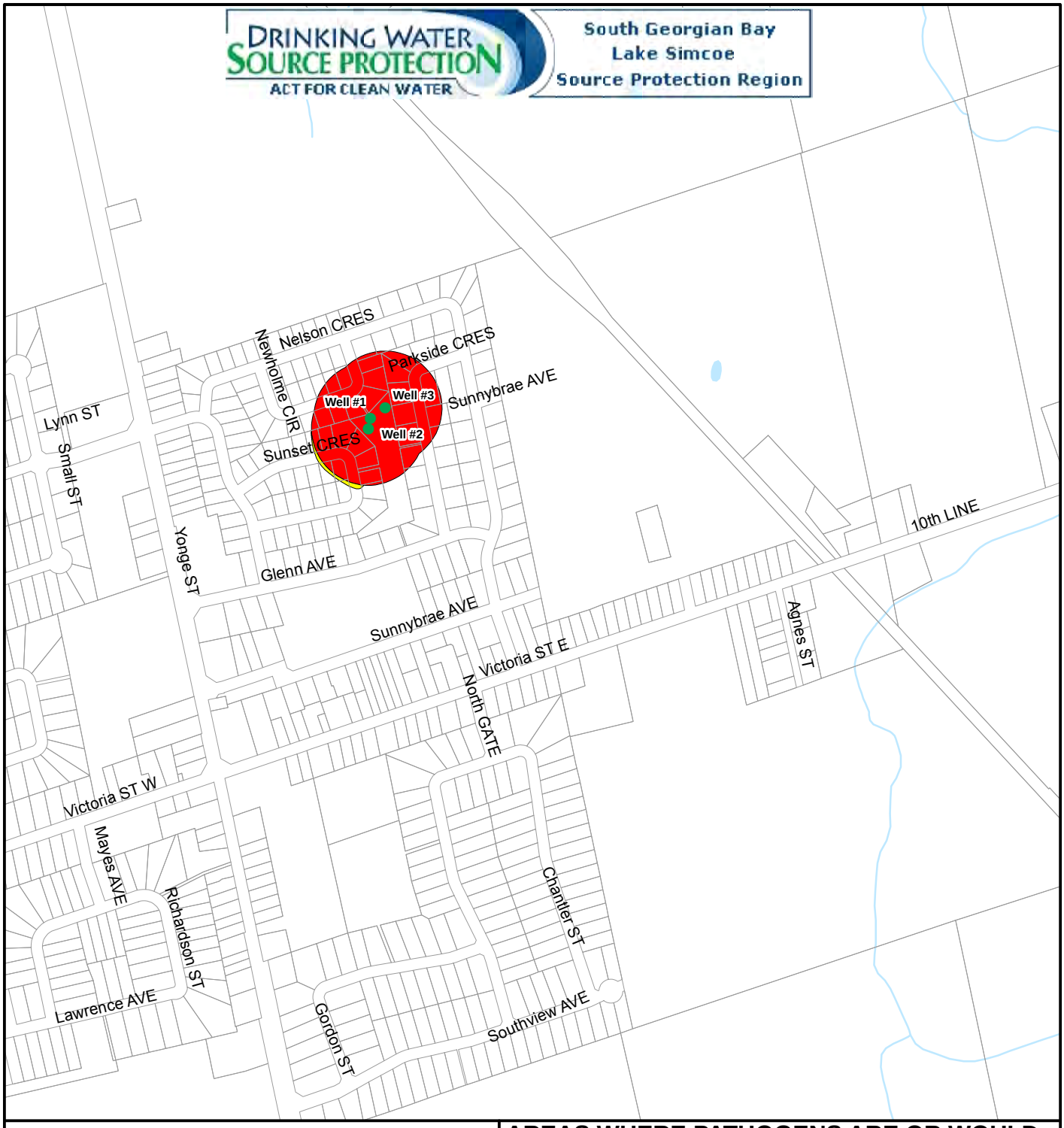
VULNERABILITY SCORES - STROUD

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-3

GENIVAR Ontario

FIGURE **10b-3**



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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.

AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - STROUD

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

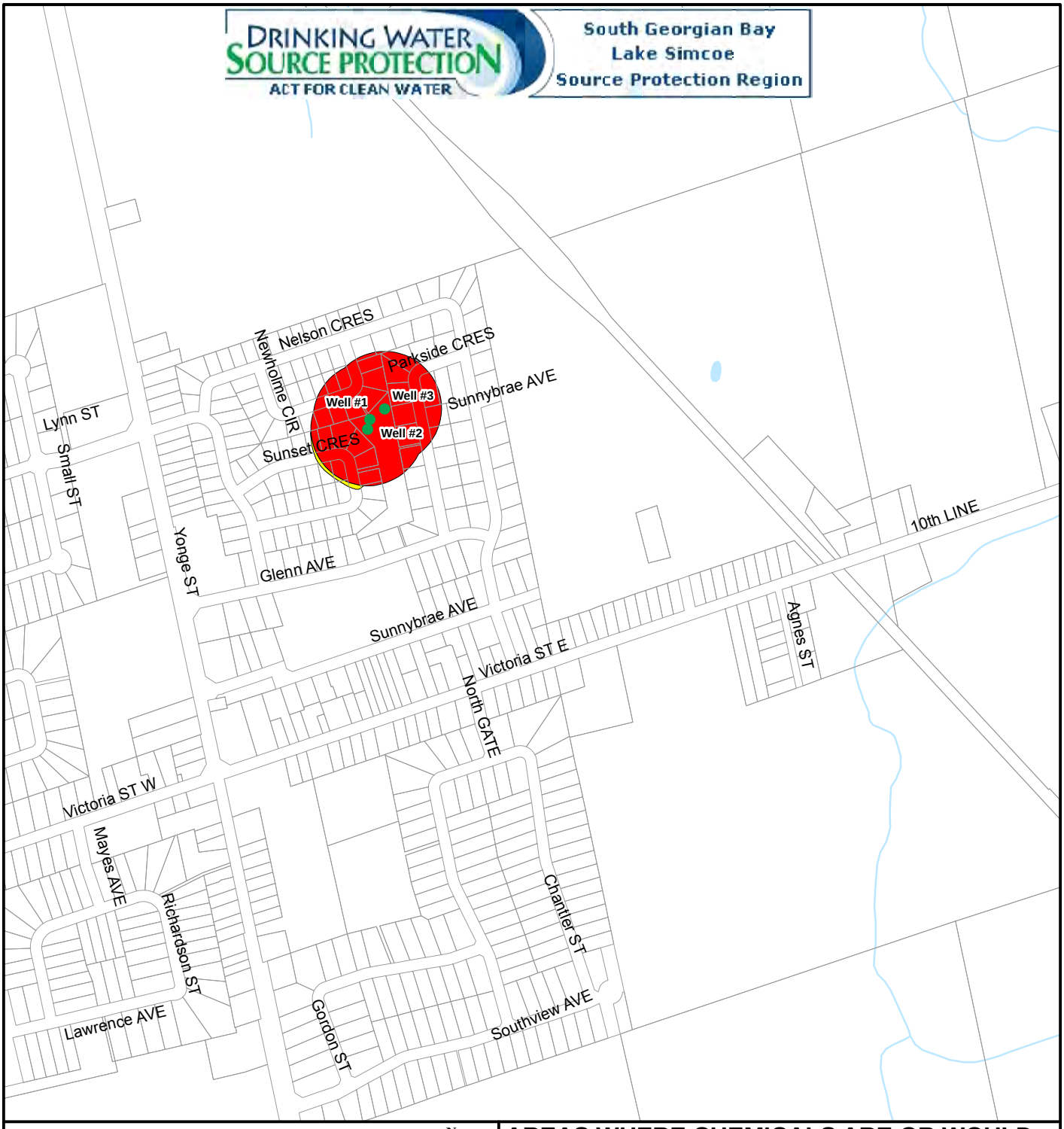
DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-4

GENIVAR Ontario

FIGURE **10b-4**

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N
W E
S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

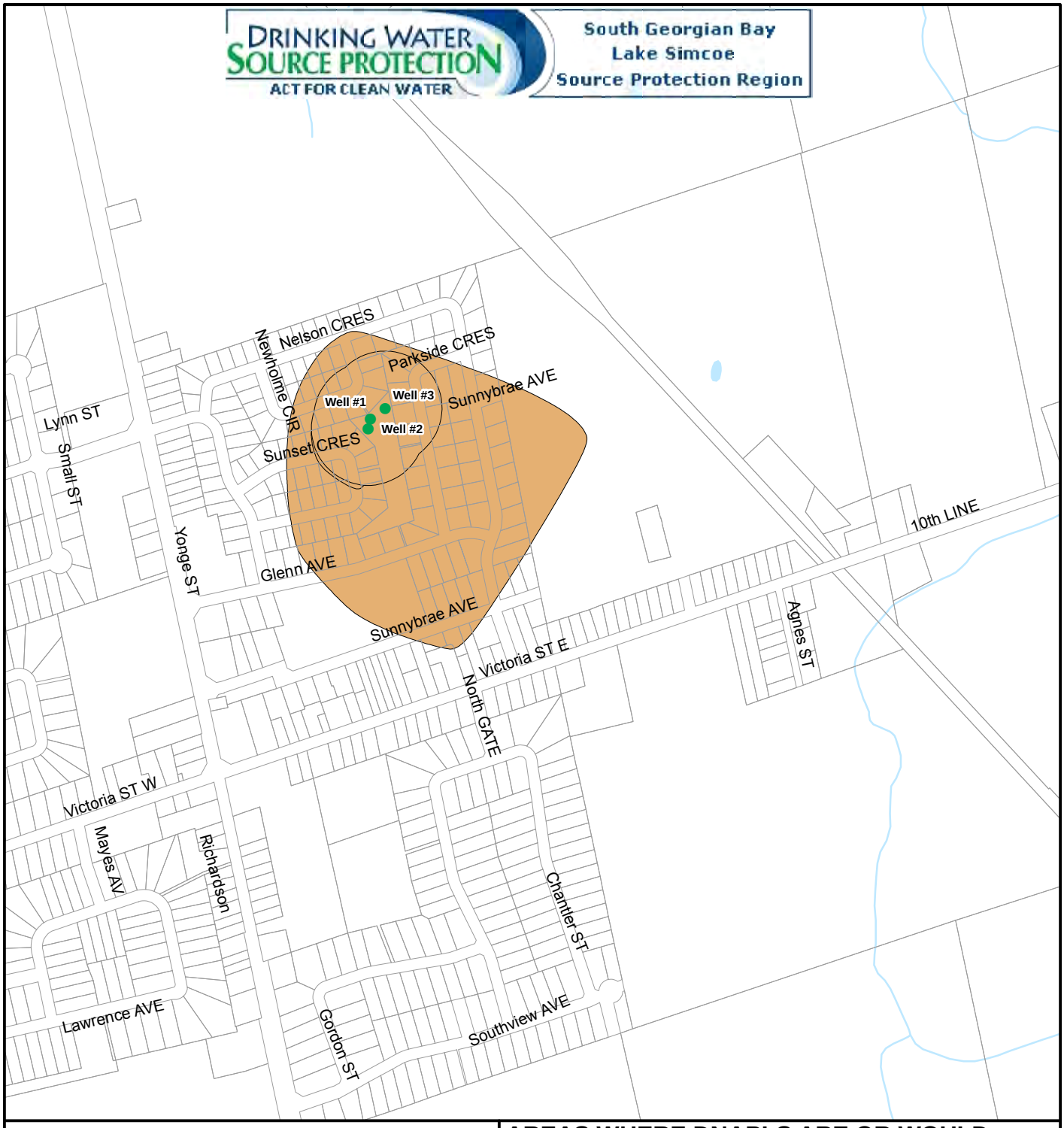
AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - STROUD

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-5

GENIVAR Ontario

FIGURE **10b-5**



Legend

- MUNICIPAL WELL LOCATION
- WHPA-C1: 10-YEAR TIME-OF-TRAVEL

N W E S

100 50 0 100 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

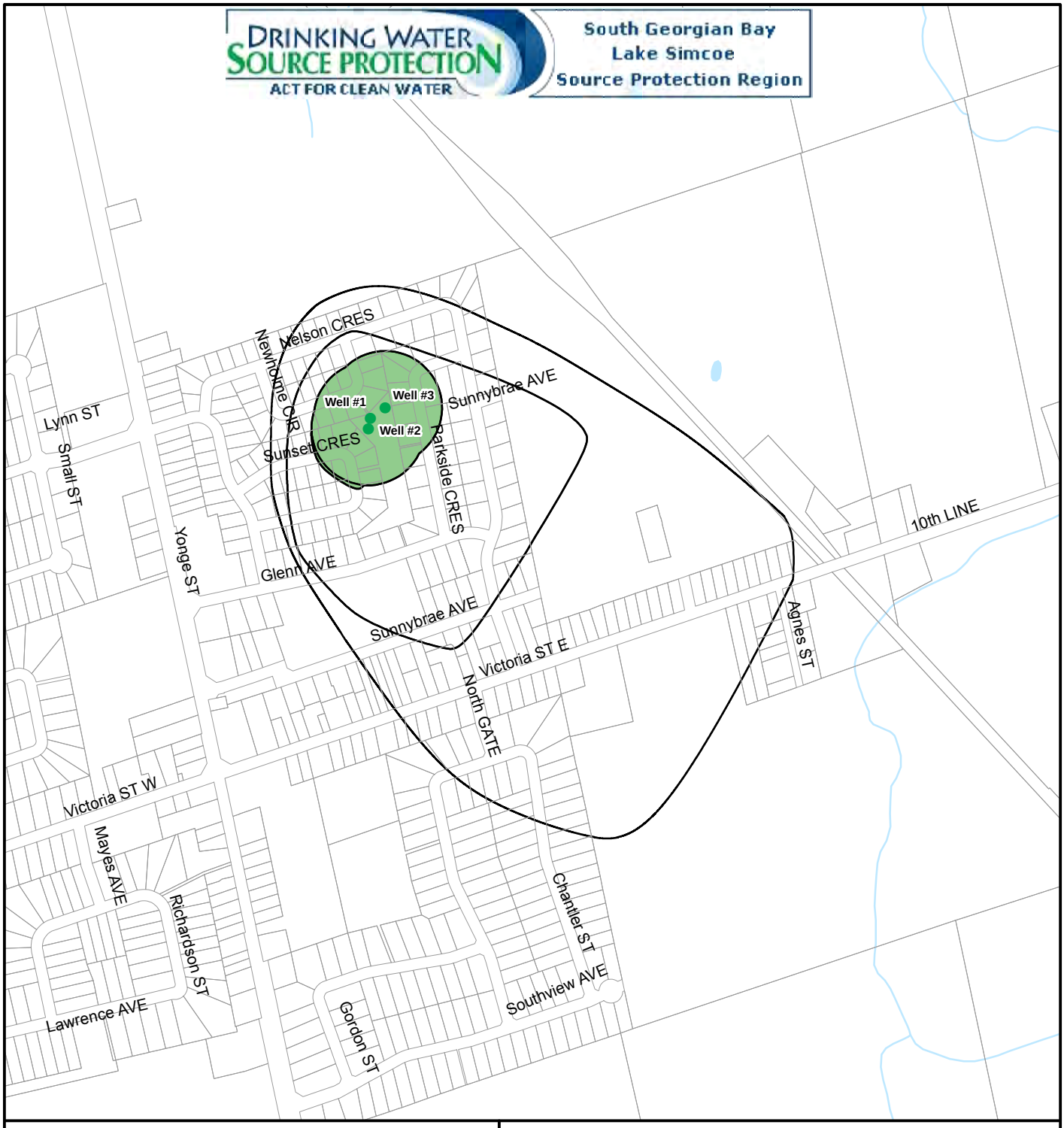
AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - STROUD

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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-6

GENIVAR Ontario

FIGURE **10b-6**



Legend

- MUNICIPAL WELL LOCATION
- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)

N W E S

100 50 0 100 Metres

MANAGED LANDS - STROUD

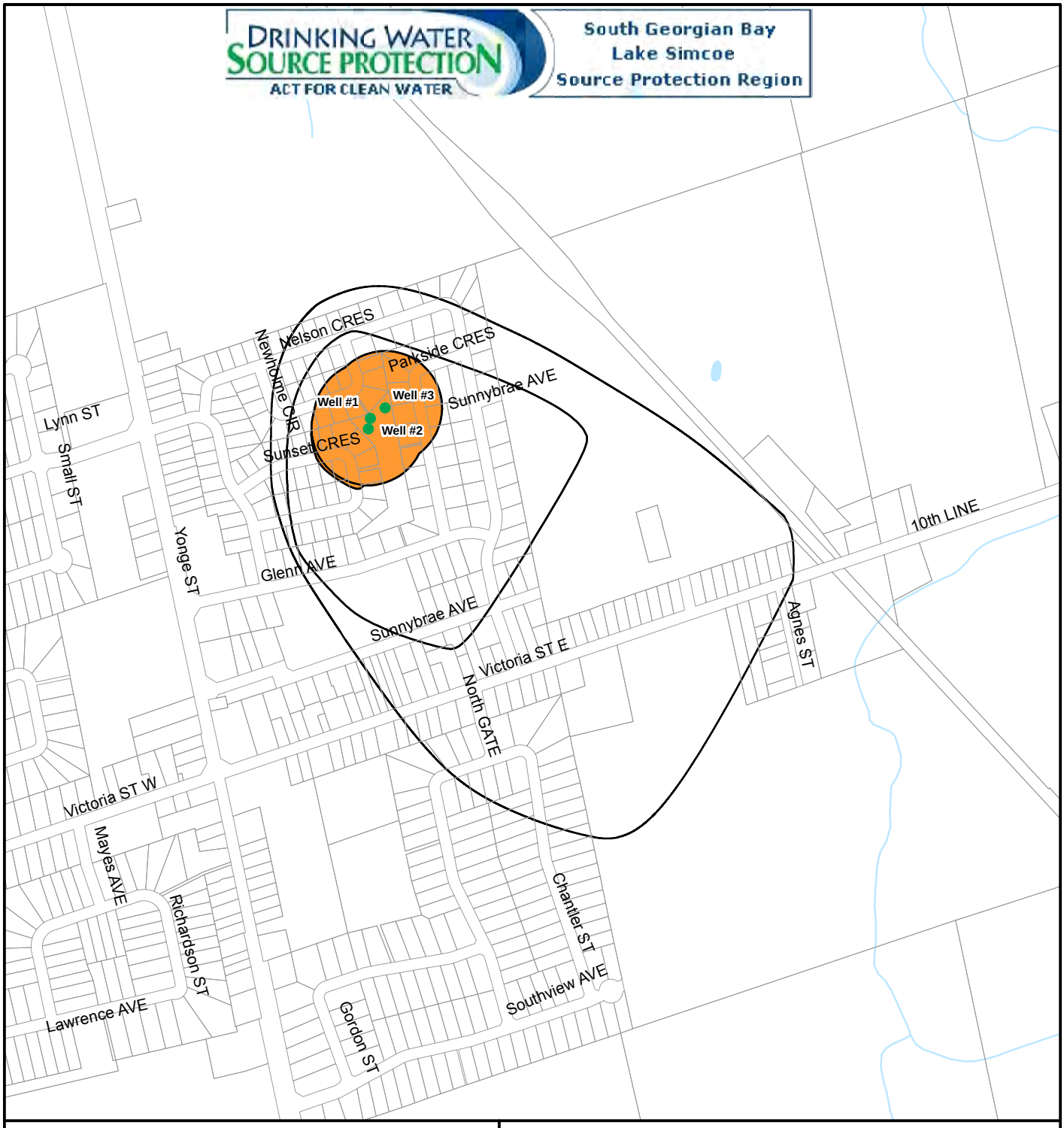
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-7

GENIVAR Ontario

FIGURE **10b-7**



Legend

- MUNICIPAL WELL LOCATION
- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)

N W E S

100 50 0 100 Metres

LIVESTOCK DENSITY - STROUD

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

The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

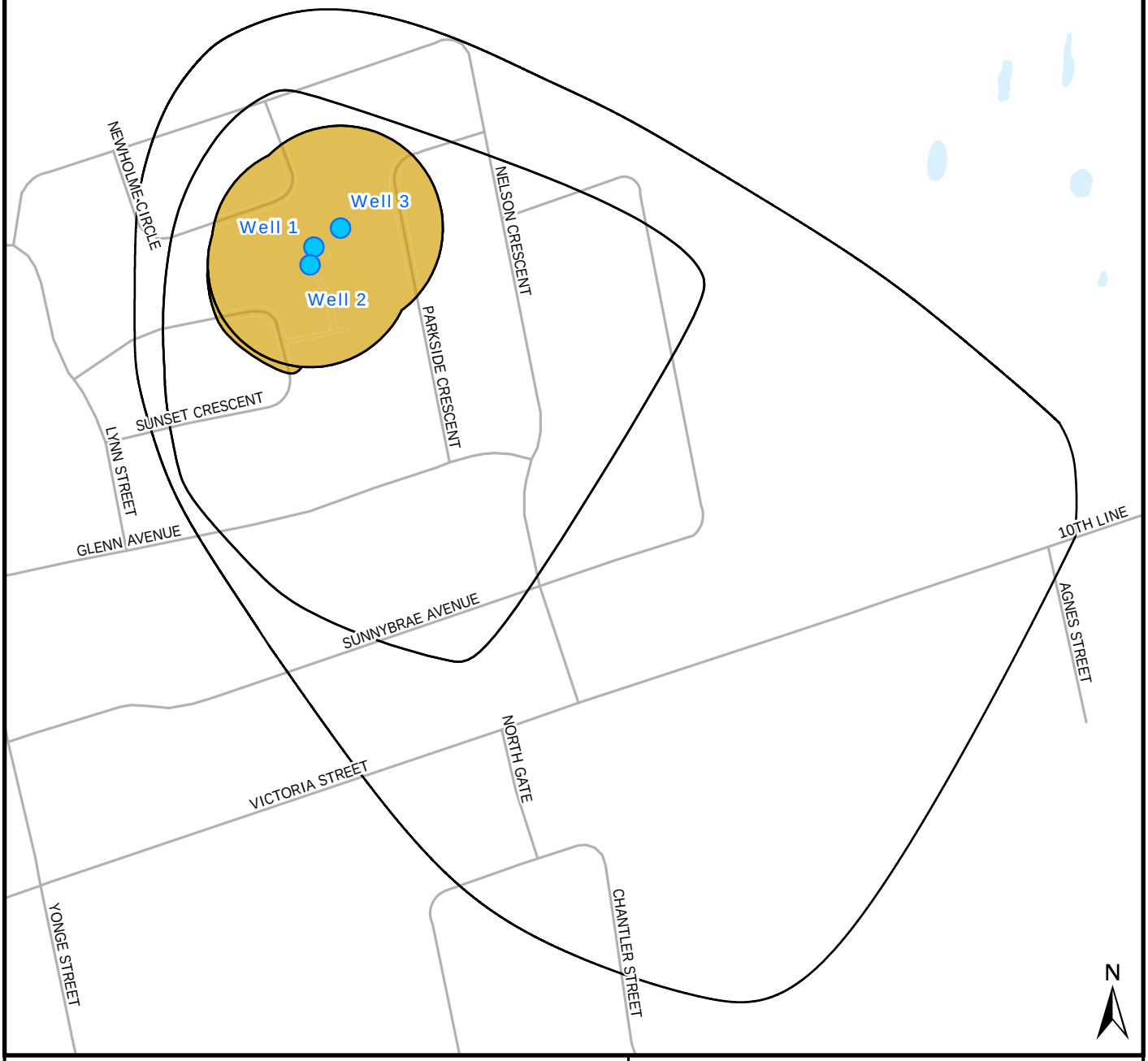
DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.7-8

GENIVAR Ontario

FIGURE **10b-8**

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Well

Impervious Surfaces in WHPA

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - Stroud WHPA

Created by: LSRCA, 2025-08-05

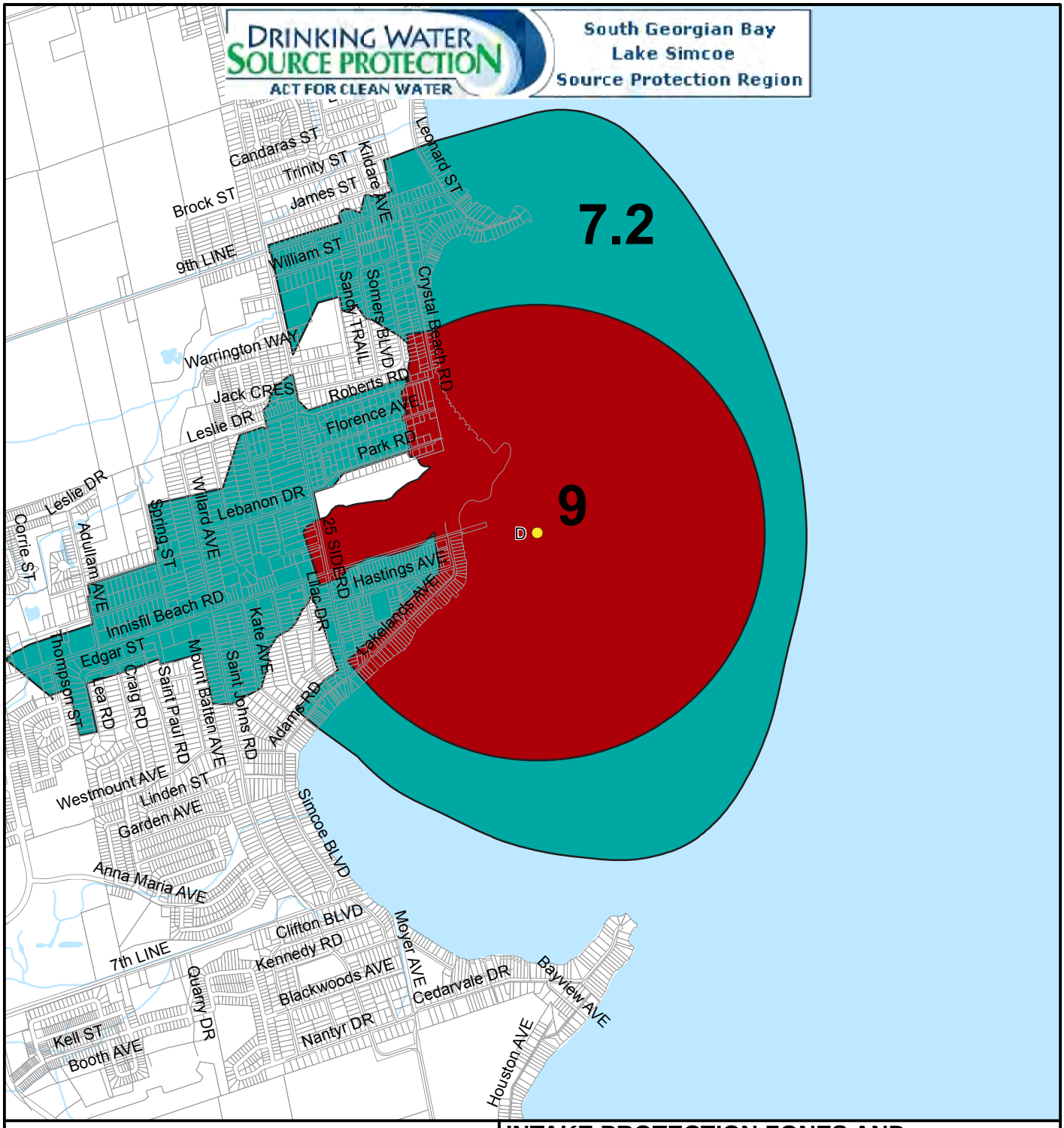
Scale 1:6,000

0 50 100 200 m

UTM Zone 17N, NAD83

Ontario

Figure 10b-9



Legend

- 10 IPZ 1 AND VULNERABILITY SCORE
- 8 IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)

N W E S

260 130 0 260 Metres

INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - ALCONA WTP, TOWN OF INNISFIL

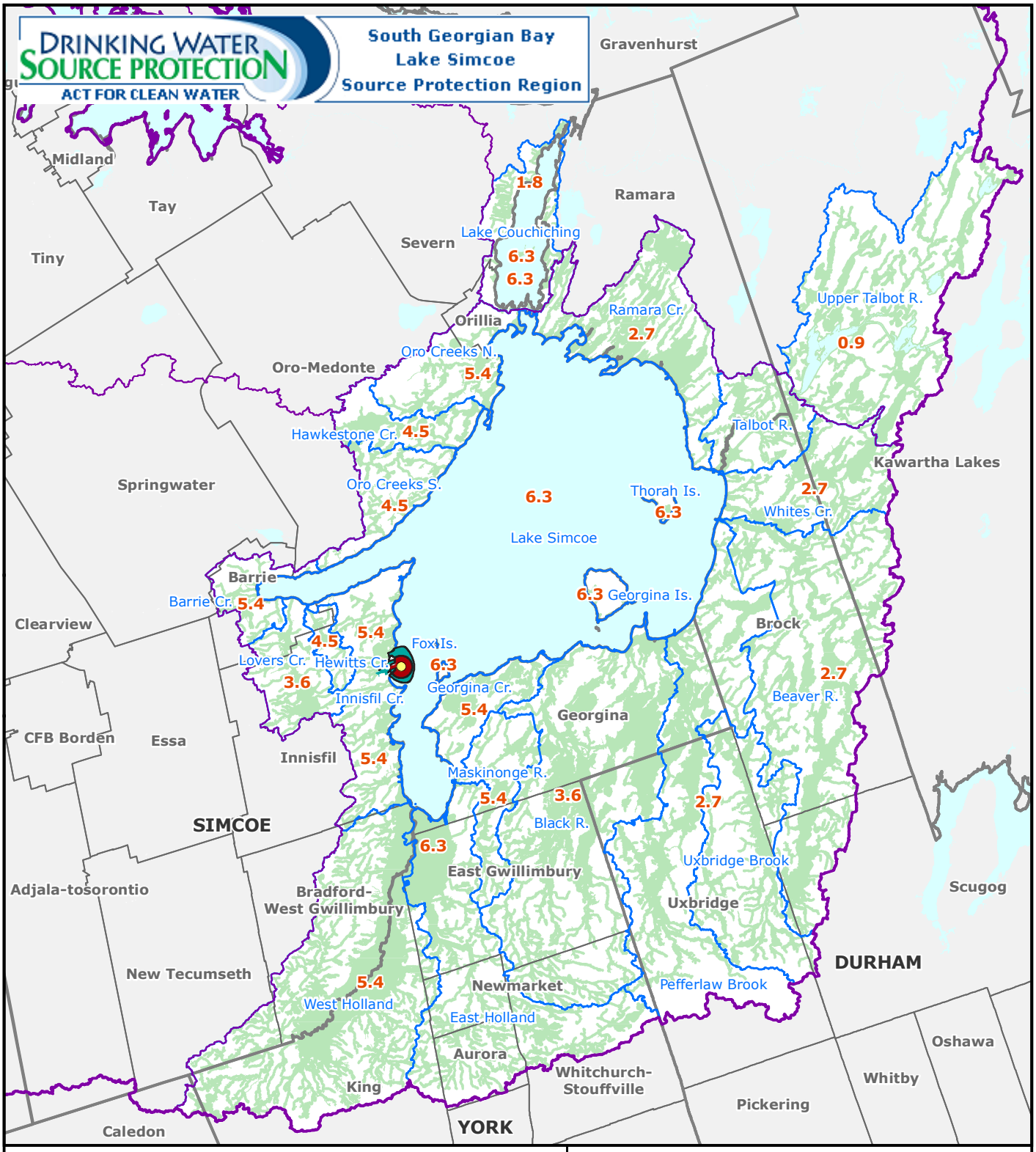
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.1-1

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 **10c-1**



Surface Water Intake
IPZ-1
IPZ-2
IPZ-3 and Vulnerability Score
SWP Watershed Region
SWP Watershed Area
Subwatershed Boundary

Intake Protection Zone 3 and Vulnerability Scores
Alcona, Town of Innisfil

Created by: LSRCA
Date: 2010-10-20

GENIVAR

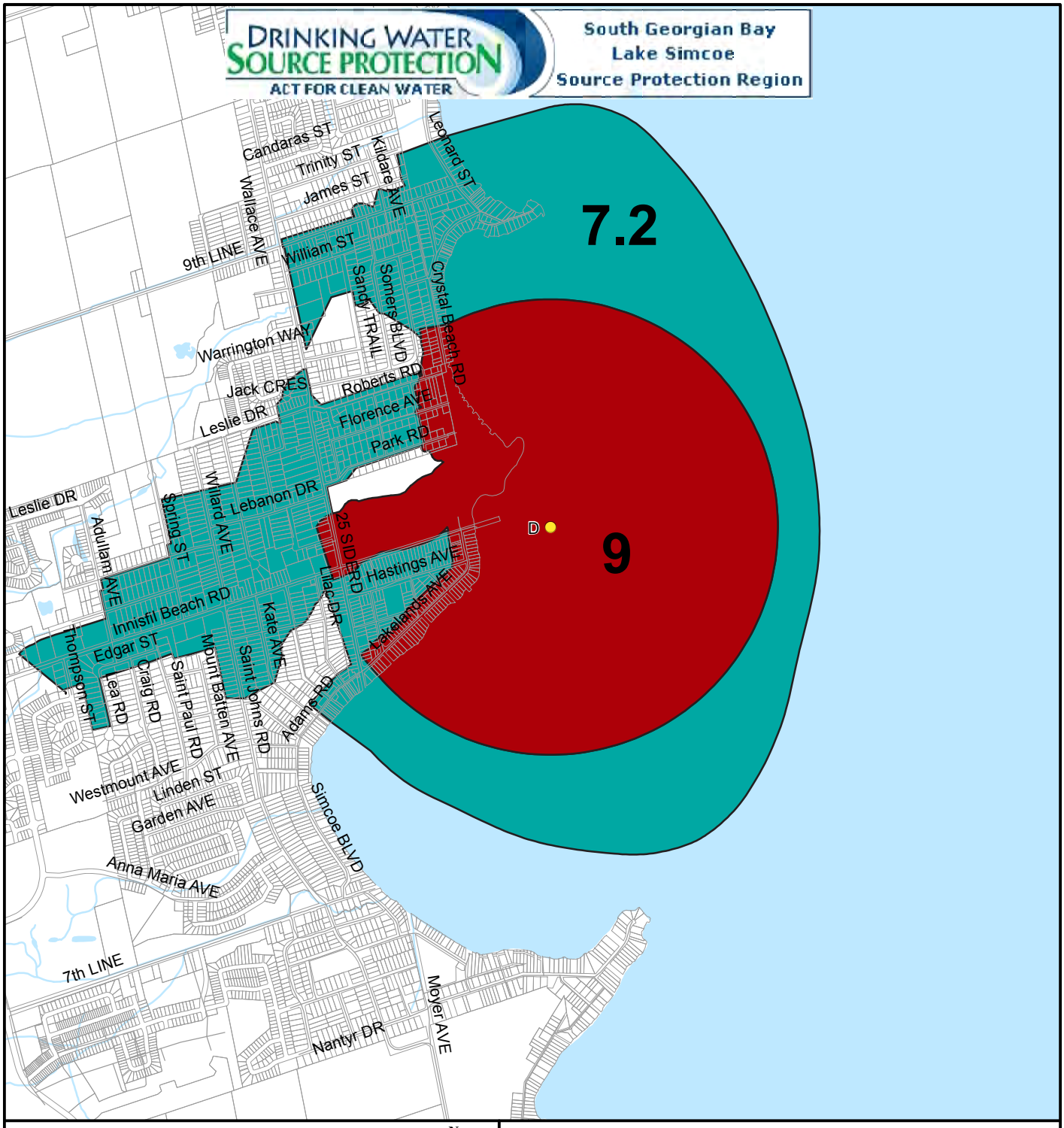
Scale: 1:500,000 0 2 4 6 8 10km

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 10c-2



This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

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.

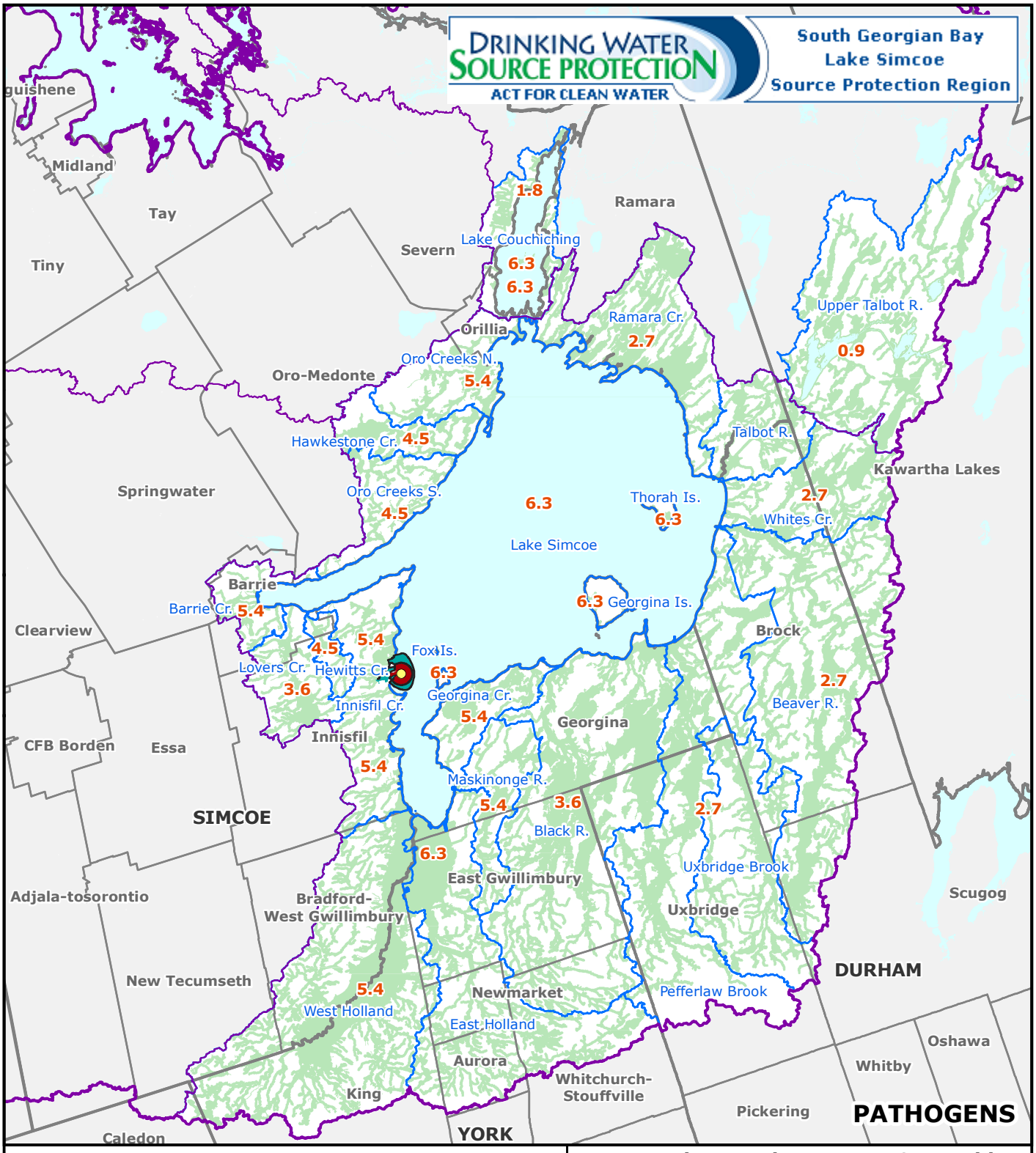
AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - ALCONA WTP

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

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.1-2

GENIVAR Ontario

FIGURE **10c-3**



- Surface Water Intake
- IPZ-1
- IPZ-2
- IPZ-3 and Vulnerability Score
- SWP Watershed Region
- SWP Watershed Area
- Subwatershed Boundary

Areas Where Pathogens Are Or Would Be Significant, Moderate, Or Low Threats
Alcona, Town of Innisfil

Created by: LSRCA
Date: 2010-10-20

GENIVAR

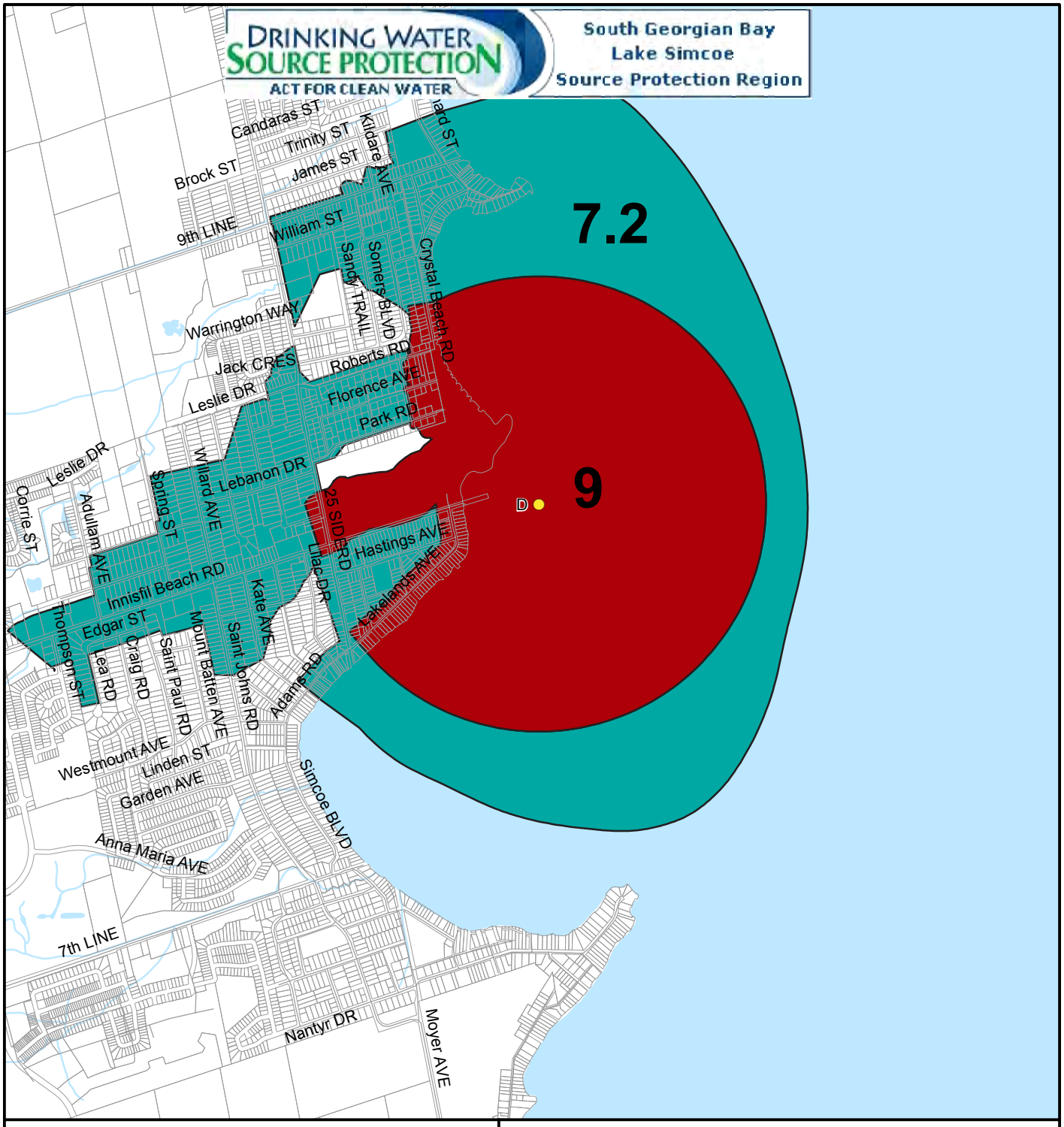
Scale: 1:500,000 0 2 4 6 8 10km

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 10c-4



Legend

- 10 — IPZ 1 AND VULNERABILITY SCORE
- 8 — IPZ 2 AND VULNERABILITY SCORE
- SURFACE WATER INTAKE (TYPE D)

N W E S

250 125 0 250 Metres

This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water Threats. The table shows the number of circumstances and references the table designation in the Provincial Tables of Circumstances for each threat category.

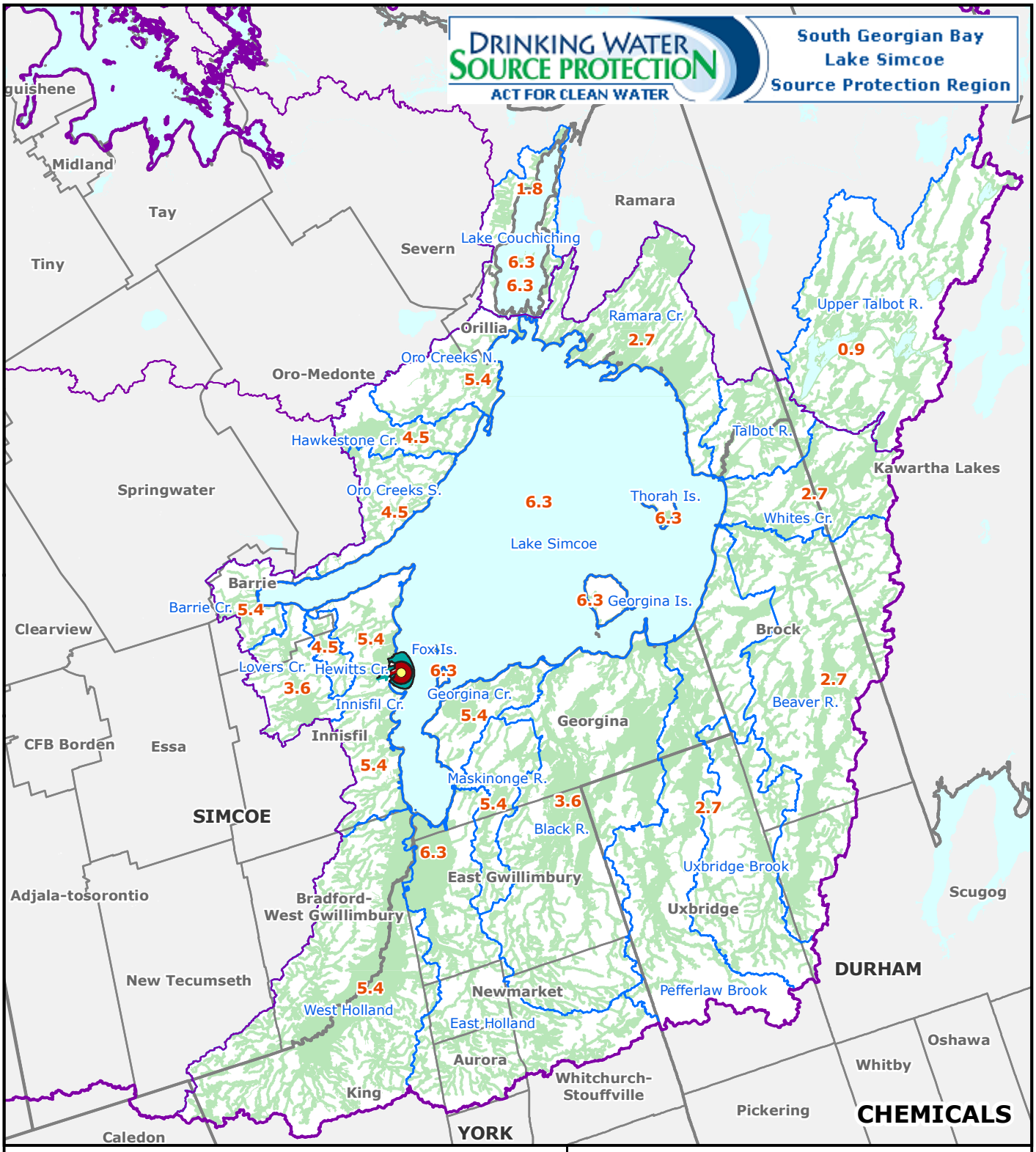
AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - ALCONA WTP

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

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.1-3

GENIVAR Ontario

FIGURE 10c-5



- Surface Water Intake
- IPZ-1
- IPZ-2
- IPZ-3 and Vulnerability Score
- SWP Watershed Region
- SWP Watershed Area
- Subwatershed Boundary

Areas Where Chemicals Are Or Would Be Significant, Moderate, Or Low Threats
Alcona, Town of Innisfil

Created by: LSRCA
Date: 2010-10-20

GENIVAR

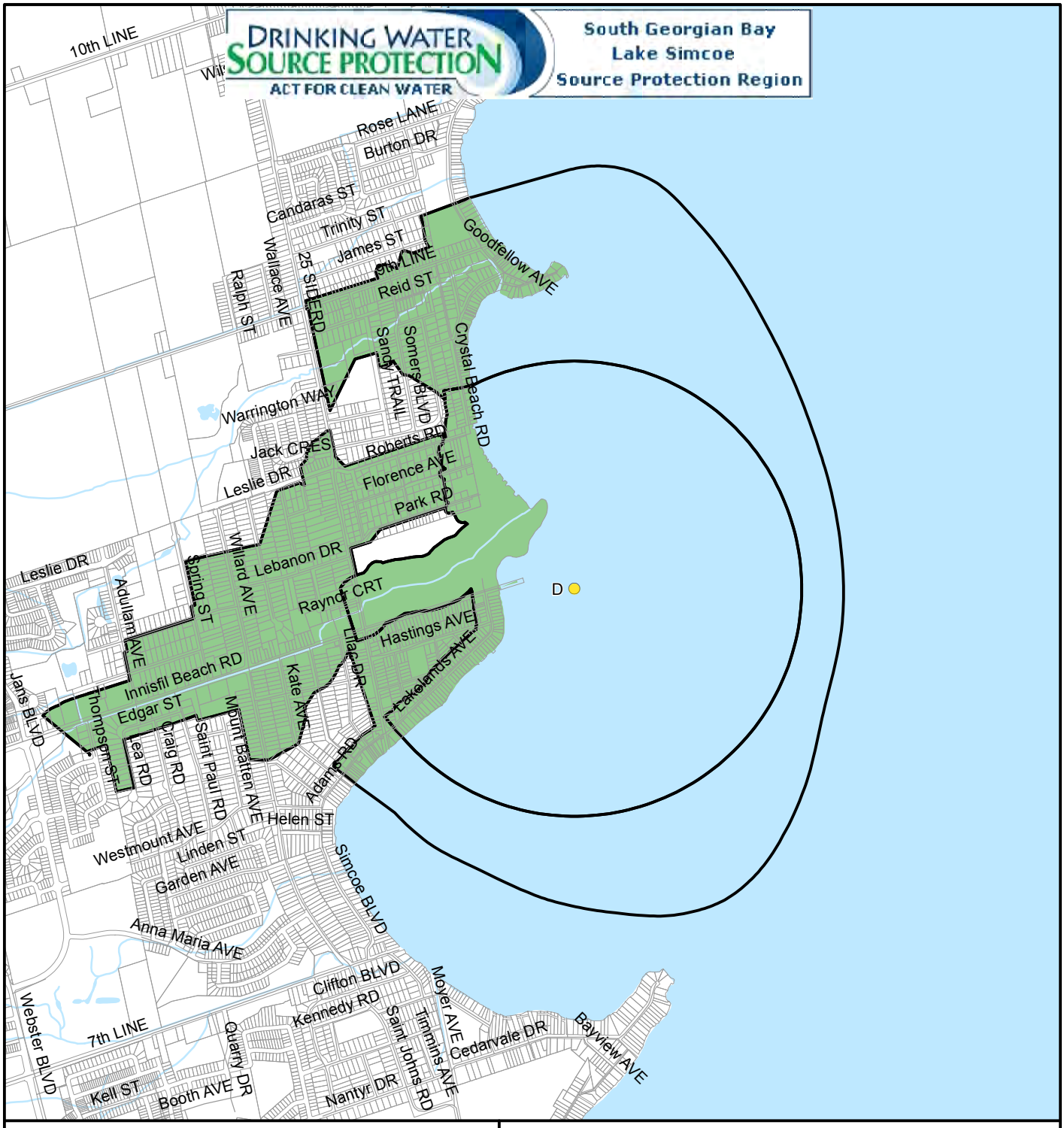
Scale: 1:500,000 0 2 4 6 8 10km

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 10c-6



Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- SURFACE WATER INTAKE (TYPE D)

250 125 0 250 Metres

N W E S

MANAGED LANDS - ALCONA WTP

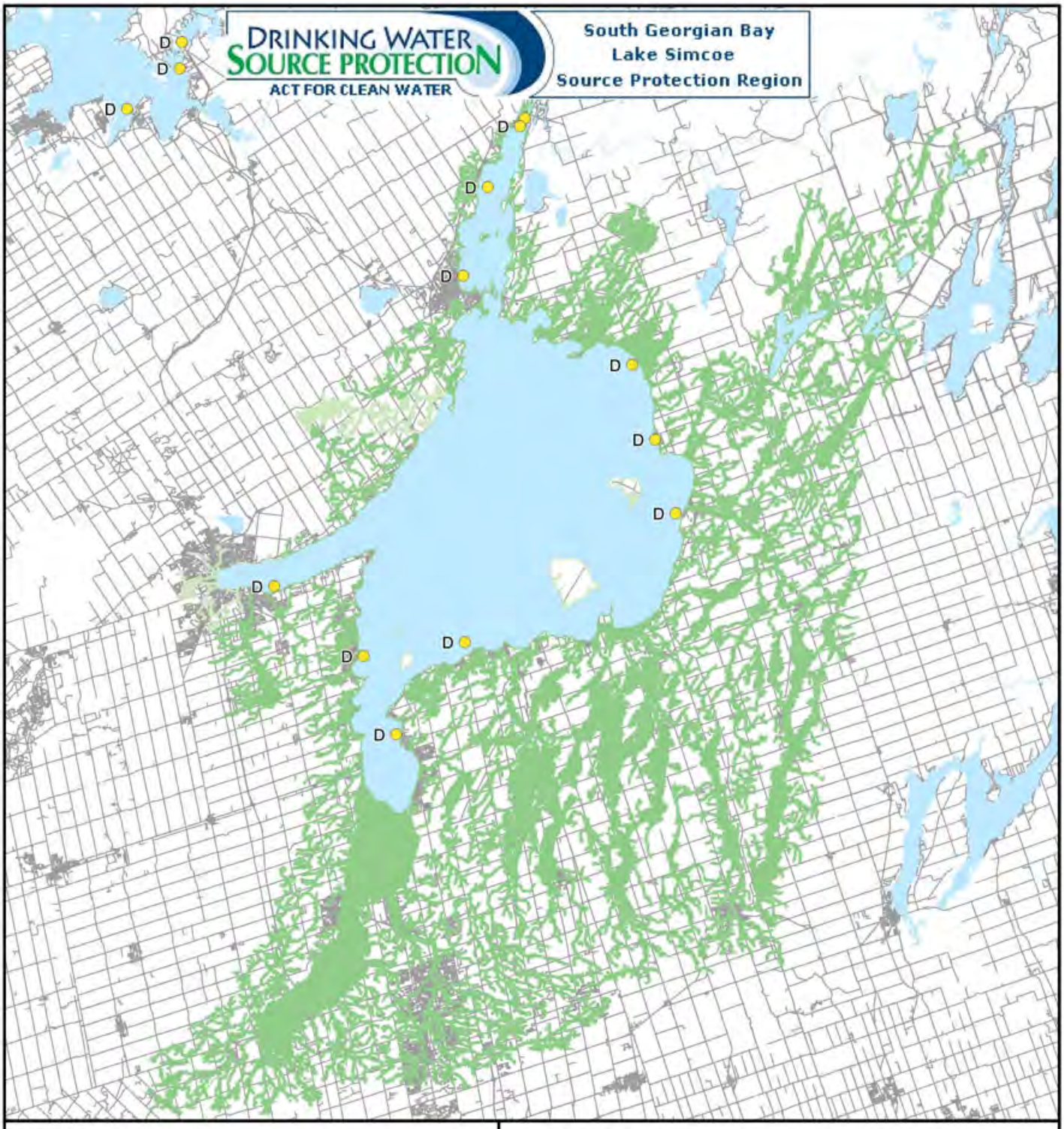
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.1-4

GENIVAR Ontario

FIGURE **10c-7**



Legend

- MANAGED LANDS (<40%)
- MANAGED LANDS (40-80%)
- MANAGED LANDS (>80%)
- SURFACE WATER INTAKE (TYPE D)

N W E S

5,300 2,650 0 5,300 Metres

MANAGED LANDS - INTAKE PROTECTION ZONE 3

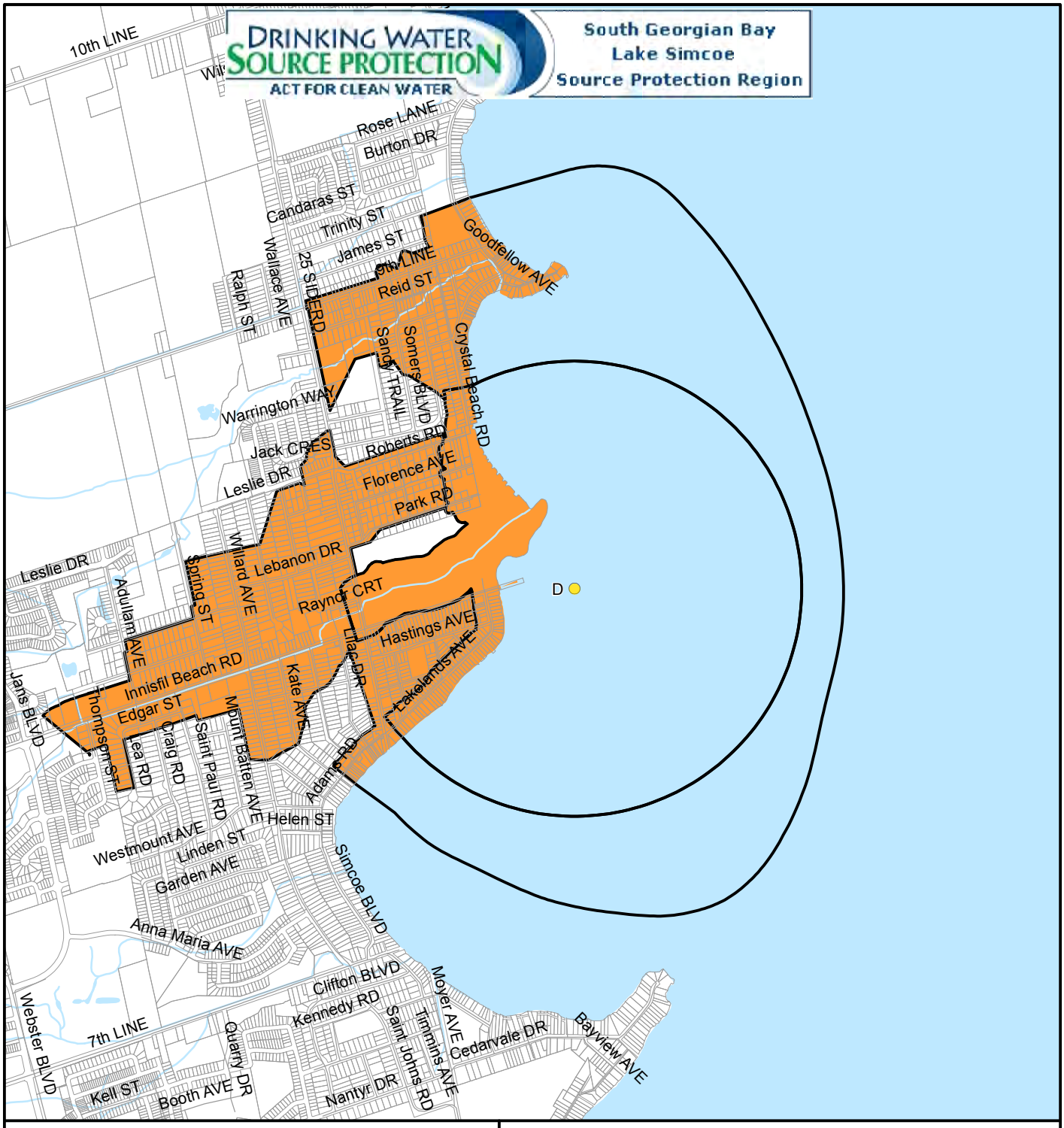
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Managed Land proportion is illustrated for the parts of IPZ 3 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010	SCALE: 1:505000
PROJECT: 0-071948.00	FILE. NO.:0-07194800F3.3-4

GENIVAR Ontario

FIGURE 10c-8



Legend

- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)
- SURFACE WATER INTAKE (TYPE D)

N W E S

250 125 0 250 Metres

LIVESTOCK DENSITY - ALCONA WTP

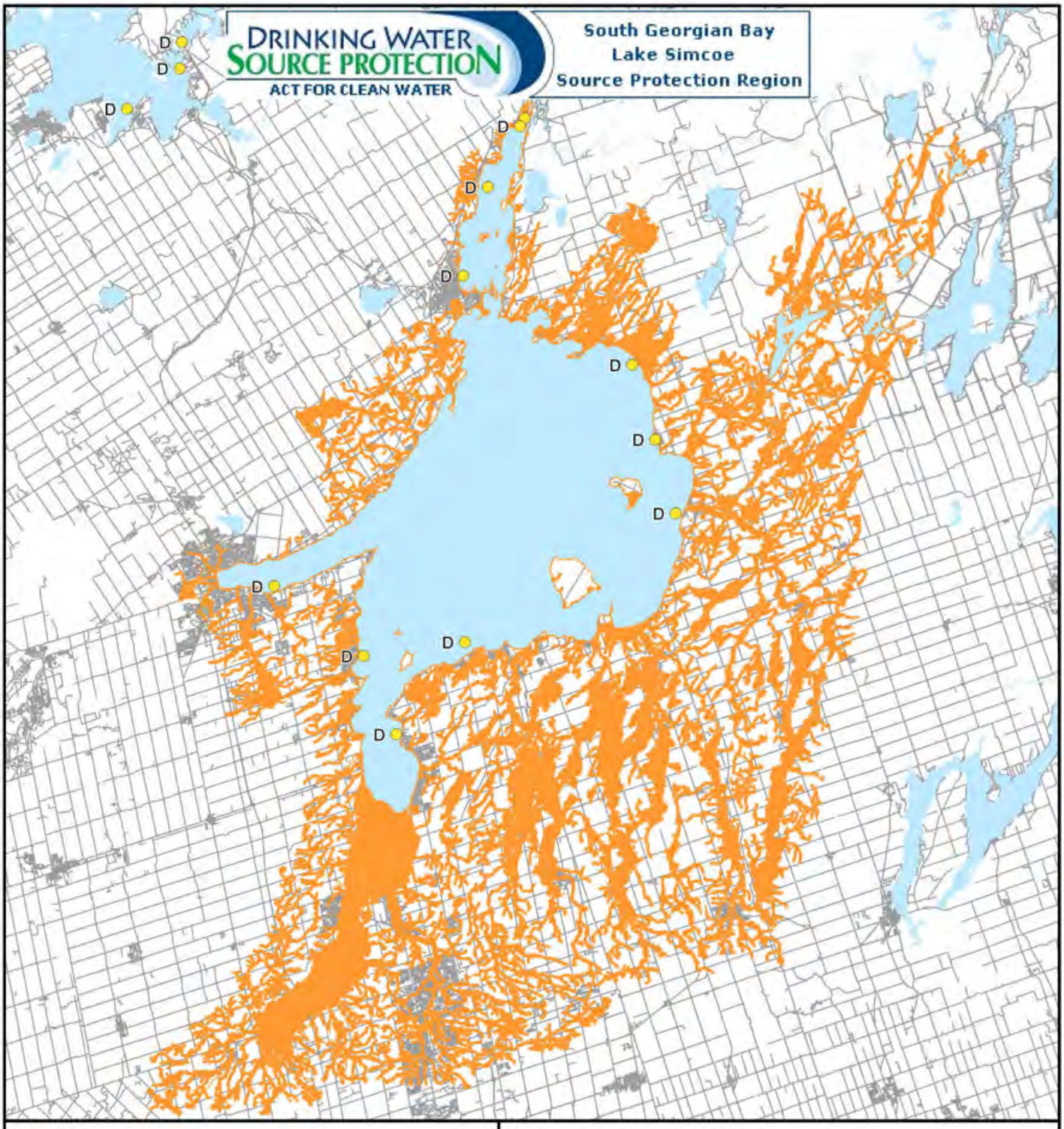
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.03	FILE. NO.:0-07194803F9.1-5

GENIVAR Ontario

FIGURE **10c-9**



Legend

- LIVESTOCK DENSITY (<0.5 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (0.5-1.0 NUTRIENT UNITS/ACRE)
- LIVESTOCK DENSITY (>1.0 NUTRIENT UNITS/ACRE)
- SURFACE WATER INTAKE (TYPE D)

N W E S

5,300 2,650 0 5,300 Metres

LIVESTOCK DENSITY - INTAKE PROTECTION ZONE 3

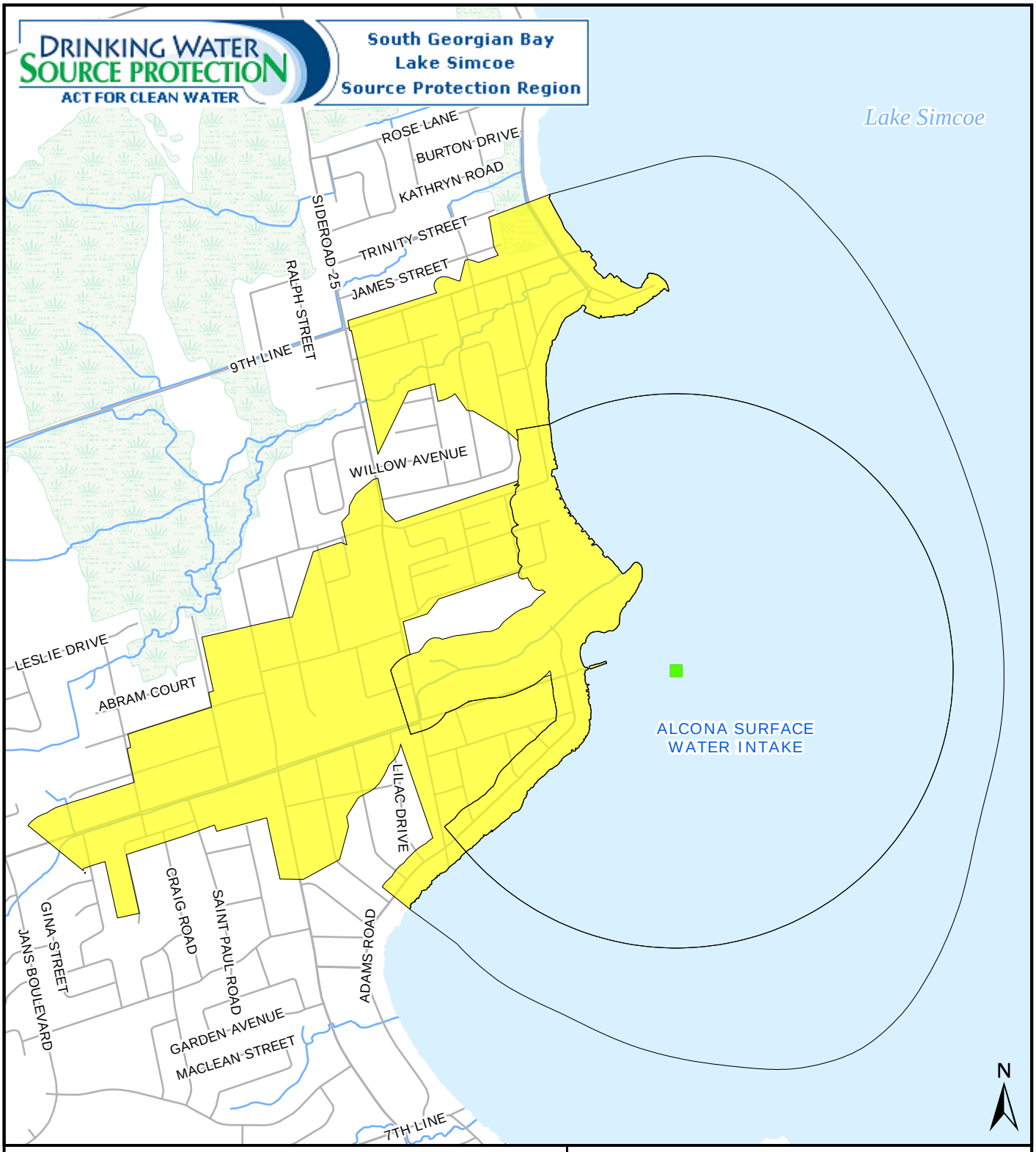
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

The Livestock Density proportion is illustrated for the parts of IPZ 3 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010	SCALE: 1:505000
PROJECT: 0-071948.00	FILE. NO.:0-07194800F3.3-5

GENIVAR Ontario

FIGURE 10c-10



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - Alcona Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

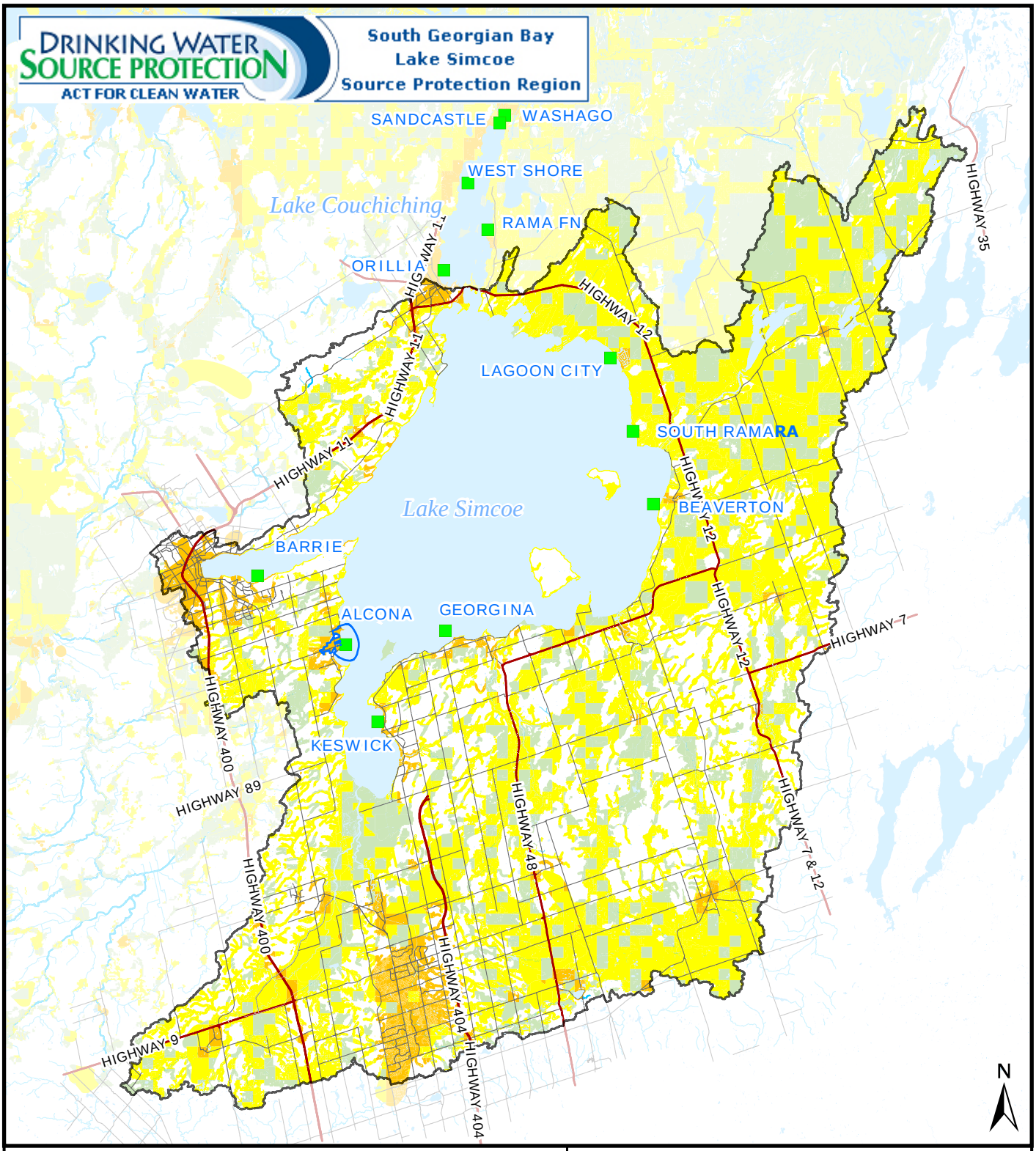
Scale 1:20,000

0 0.2 0.4 0.8 km

UTM Zone 17N, NAD83

Ontario

Figure 10d-11



Surface Water Intake

Impervious Surfaces in IPZ 3

- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- >=30%

Impervious Surfaces - Alcona Intake Protection Zone 3

Created by: LSRCA, 2025-08-05

Scale 1:500,000

0 5 10 15 20km

UTM Zone 17N, NAD83

Ontario

Figure 10d-12