Chapter 9: Township of Severn

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9 Township of Severn

9.1 Introduction

This chapter contains information on four drinking water systems for the Township of Severn. 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 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 S) for a more in depth description of the methods used, as well as the Glossary for any unfamiliar terms.

9.2 Drinking Water Systems

The Township of Severn operates groundwater based water supplies in three (3) communities and surface water based supplies in three (3). As shown in Table 9-1 and Figure 9-1 all of the groundwater and surface water supplies are within the South Georgian Bay – Lake Simcoe (SGBLS) Source Protection Region (SPR). Table 9-1 also indicates the SPR and corresponding lead Source Protection Authority (SPA) for the municipal water supplies.

Table 9-1: Municipal Surface and Groundwater Supplies in the Township of Severn (~~Those included in this report are highlighted in grey).~~

Source Protection Region; Source Protection Authority	Local Municipality	Groundwater / Surface Water	Community Water Supply	Drinking Water Information System (DWIS) Number	Source Water Body / Aquifer	Number of Intakes/ Wells
SGBLS SPR; Lakes Simcoe and Couchiching / Black River SPA	Township of Severn	Surface Water	Sand Castle Estates Water Treatment Plant (in this chapter)	220010654	Lake Couchiching	1
SGBLS SPR; Lakes Simcoe and Couchiching / Black River SPA	Township of Severn	Surface Water	Washago Water Treatment Plant (in this chapter)	220005161	Lake Couchiching	1
SGBLS SPR; Lakes Simcoe and Couchiching / Black River SPA	Township of Severn	Surface Water	West Shore Water Treatment Plant (in this chapter)	260061958	Lake Couchiching	1
SGBLS SPR; Lakes Simcoe and Couchiching / Black River SPA	Township of Severn	Groundwater	Severn Estates (in this chapter)	220005152	Bedrock (Granite)	1
SGBLS SPR; Lakes Simcoe and Couchiching / Black River SPA	Township of Severn	Groundwater	Bass Lake Woodlands	220005143	Confined Artesian Overburdened Aquifer	3
SGBLS SPR; Lakes Simcoe and Couchiching / Black River SPA	Township of Severn	Groundwater	Coldwater	220001110	Confined Artesian Overburdened Aquifer	3

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While still in the Township of Severn and in the SGBLS SPR, the Bass Lake Woodlands and Coldwater Water Supply systems are located in the Severn Sound watershed and can be found in the Severn Sound Assessment Report (Chapter 10). Two IPZs, for surface intakes located outside the Township, extend into Severn. These being the IPZs for the Robe Subdivision Surface Intake (Township of Tay), and the Port Severn Surface Intake (Muskoka). Further, the Intake Protection Zones for Washago and Sandcastle Estates surface water intakes, located within Lake Couchiching, extend into the Town of Ramara (Table 9-9-2).

Table 9-9-2: IPZs that cross into or out of the Township of Severn in the SGBLS SPR.

Local Municipality that IPZ extends into	Municipality where intake is located	Name of Water Supply	Source Protection Region / Lead Conservation Authority (CA)	Location where entire Assessment can be obtained
Township of Ramara	Township of Severn (Lake Couchiching)	Washago Water Treatment Plant	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	This Chapter
Township of Ramara	Township of Severn (Lake Couchiching)	Sandcastle Water Treatment Plant	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	This Chapter
Township of Oro-Medonte	Township of Severn	Bass Lake Woodlands	SGBLS SPR & Severn Sound SPA	Severn Sound Assessment Report (Chapter 10)
Township of Oro-Medonte	Township of Severn	Coldwater	SGBLS SPR & Severn Sound SPA	Severn Sound Assessment Report (Chapter 10)
Township of Severn	District Municipality of Muskoka (Little Lake)	Port Severn Water Treatment Plant	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	This Report (Chapter 10)
Township of Severn	Township of Tay	Rope Subdivision Water Treatment Plant	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	Severn Sound Assessment Report (Chapter 12)

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9.3 Severn Estates Well Supply

The Severn Estates Well Supply supplies a community with a population of approximately 58 (23 lots) located in the Township of Severn. The Severn Estates Well Supply consists of one water supply well, Well 1, located on Lot 13, Concession 15. The well was constructed in 1971.

According to the current Permit to Take Water (PTTW) 5223-5W3S4A, issued on February 20, 2004 and which expires on December 31, 2009. The maximum daily taking is 185.7 m^3/day for Well 1.

The well is drilled into an unconfined to marginally confined granite bedrock aquifer. Well 1 is a nominal 152 mm diameter well constructed to a depth of 65.8 mbgl. The casing is set to a depth of 3.4 m.

Well 1 is drilled into a granite bedrock aquifer (A5), which is under unconfined to marginally confined conditions at this location. Well 1 is a nominal 152 mm diameter well constructed to a depth of 65.8 mbgl. The casing is set to a depth of 3.4 m. The bedrock aquifer in the vicinity of the municipal well is exposed at surface with a thin (<2 m) of clay deposits overlaying the aquifer to the south-east. The static water levels in the wells are generally within 3 to 5 m of surface. The adjacent Severn River and Trent Canal is located 100 and 400 m away, respectively.

The screen interval for Well 1 has been assigned to the A5 Aquifer, in the draft regional hydrostratigraphic model prepared by Golder and Aquaresource (2009). The groundwater vulnerability rating will be determined for the A5 Aquifer.

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

9.3.1 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 Severn Estates water supply has been delineated following the process recommended in the Technical Rules (MOE, 2008a). The areas that determined to contribute groundwater to the wells within 25 years were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and consideration was included to consider 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 Severn Estates WHPA. Details of the methods for the Vulnerability Analysis are provided in Technical Memorandum A1 – Groundwater Vulnerability Assessment Methods (Appendix MO).

9.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Well 1 in Severn Estates Well Supply were delineated in 2005 by Golder using a fixed radius method. An updated survey of well locations was commissioned by SGBLS in 2009 to provide improved accuracy for delineation of the WHPA. A minor translation was required to adjust the Severn Estates well locations and the WHPA. The updated well locations and the WHPA are shown in Figure 9a-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 (2005) study delineated time-of-travel zones (TOT) for 50 days, 2 years, 10 years and 25 years. For the pumping rates used by Golder Associates, the well was observed to be effectively at steady-state for the 2 year capture zone. WHPA-C to represent the 5 year TOT zone, was re-calculated under this study as per Technical Memorandum A2 – 5 year Time-of-Travel Estimation Methods (Appendix MO). The distance between the calculated 2-year TOT and 5-year TOT distances are very small. The 25-year TOT distance is effectively the same as the 5 year TOT distance, therefore a WHPA-D is not shown on Figure 9a-1.

The WHPA for Well 1 reflect groundwater flow radially from all directions towards the well. This is reasonable based on available data describing regional groundwater flow patterns.

9.3.1.2 Groundwater Vulnerability

The Severn Estates wells draw water from an unconfined bedrock aquifer layer (regional aquifer systems A5). The Groundwater Vulnerability for the municipal bedrock aquifer 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 B2 – Regional AVI Mapping.

The Groundwater Vulnerability within the WHPA of the municipal wells in the Severn Estates Water Supply is shown in Figure 9a-2. The Groundwater Vulnerability for the municipal water supply aquifer within the WHPA is considered to be High.

9.3.1.3 Transport Pathway Increase

Technical Memorandum A2 (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 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.

In accordance with the Technical Rules, a Groundwater Vulnerability rating of High cannot be increased further. No Vulnerability increase has been considered for the Severn Estates Water Supply System. Figure 9a-2 is proposed for use to determine Vulnerability Scores.

9.3.1.4 WHPA-E~~ / WHPA-F~~

None of the wells in this study have been identified as Groundwater Under the Direct Influence (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.~~

9.3.1.5 Vulnerability Score

The WHPA zones for the Severn Estates Water Supply, as shown in Figure 9a-1, and the Groundwater Vulnerability, as shown in Figure 9a-2, were used to assign a Vulnerability Score by using the matrix from Table 5.2 (Chapter 5: Methods Overview, Section 5.2.4). Figure 9a-3 illustrates the Vulnerability Scores for the Severn Estates WHPA. Figure 9a-3 will be used to assess Drinking Water Threats in Section 9.3.3.

9.3.1.6 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 Severn Estates WHPAs was determined by peer reviewers from Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Severn Estates WHPAs is High. The full results of the WHPA delineation Peer Review process, for Severn Estates is available in Appendix S 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 Vulnerability Assessment components, and the nature of the groundwater flow system.

The Uncertainty Rating assigned for the Vulnerability Assessment component for the Severn Estates WHPA is High. The Vulnerability Rating for the Severn Estates 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).

9.3.2 Drinking Water Issues Evaluation

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) 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 Severn Estates Well Supply have 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 Township of Severn Groundwater are provided in Technical Memorandum N1 – Drinking Water Issues Evaluation – Severn Groundwater (Appendix S).

No Drinking Water Issues were identified with the Severn Estates Water Supply.

Parameters whose concentrations occasionally exceed Aesthetic/Operational guidelines under the Ontario Drinking Water Quality Standards include iron, manganese 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 Couchiching and 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.

Lead concentrations have exceeded ODWQS objectives under rare conditions that are not considered to be consistent. Concentrations have consistently shown to be under ODWQS during other sampling events and are not increasing.

9.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Severn Estates 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 Severn Estates Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes 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.

9.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Severn Estates 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.

9.3.3.2 List of Drinking Water Threats – Conditions

Methods used to assess Conditions are described in Technical Memorandum A5 (Appendix MO). The following information sources were consulted to identify existing Conditions that could affect the Severn Estates Water Supply system:

- Files provided by the 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, 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 Township of Severn staff to identify potential conditions within the identified WHPA for the drinking water supply.

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

9.3.3.3 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 prepared by MECP 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

9.3.3.3.1 Pathogen Parameters

~~The~~ The Technical Rules can be used in conjunction with the Vulnerability Scores ~~Key Table~~ on Figure 9a-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 Severn Estates 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.

9.3.3.3.2 Chemical Parameters

~~The~~ The Technical Rules can be used in conjunction with the Vulnerability Scores ~~Key Table~~ on Figure 9a-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 Severn Estates 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.

9.3.3.3.3 DNAPL Chemical Parameters

Figure 9a-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 Severn Estates Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 9a-6 to identify the circumstances in which these Activities would be Significant Drinking Water Threats.

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

Further to Section 9.3.3.2, no Conditions have been confirmed within the WHPA for the Severn Estates 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 9a-3 illustrates the Vulnerability Score map for Severn Estates Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

9.3.3.5 Enumerating Drinking Water Threats

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The number of Significant Drinking Water Threats for the Severn Estates 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) of this Assessment Report. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 9-3 documents the refined enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Severn Estates Well Supply. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is 10.

Sixty-nine (69) activities that are considered to be potential Significant Drinking Water Threats were identified in association with 69 land parcels in the WHPA for the Severn Estates Well Supply. Sixty-eight (68) parcels were identified as having potential Significant Threat activities relating to residential land use and 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.

Table 9-3: Number of Significant Drinking Water Threats for the Severn Estates 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.	0
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	0
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.	68
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:**	**69*** significant threats (on **69** properties)

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***65 verified existing Threats and 4 potential Threats that require further verification (2015)**

9.3.3.5.1 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 ~~Table of Drinking Water Threats~~Technical Rules.

Managed Lands were identified and the Managed Lands proportions were determined for the Severn Estates WHPA as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 9.3.3.5). 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 9a-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Severn Estates Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

9.3.3.5.2 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 Severn Estates WHPA as outlined in Technical Memorandum A5 (Appendix MO). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 9.3.3.5). 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 9a-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Severn Estates Water Supply where Vulnerability Scores were 6 or greater 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).

9.3.3.5.3 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 Severn Estates WHPA 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 9.3.3.5). The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).

Figure 9a-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Severn Estates Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

9.4 Surface Water Vulnerability Methods and Uncertainties

9.4.1.1 Surface Water Vulnerability

The Sandcastle Estates, Washago and West Shore intakes are 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. The Vulnerability Assessment of the surface water source for the Sandcastle Estates, Washago and West Shore Water Treatment Plants was completed by Baird and Associates (Baird, 2009f) on behalf of the SGBLS SPR. Subsequently, the IPZ-1 and 2 for the Sandcastle Estates and Washago WTPs were revised by LSRCA to be in accordance with the Technical Rules. These revisions were approved by the SGBLS SPC and are recorded in Appendix S.

9.4.1.2 Delineating IPZ-1 and IPZ-2

Within Baird, 2009f, the IPZ-1 was delineated according to the Technical Rules and as outlined in Chapter 5. For the Western Shore Surface Water Intake the IPZ-1 was based on the 1km radius and the 120m setback from the shoreline and was prepared using GIS. For the Washago and Sandcastle Estates Surface Water Intake, the entire 1km radius was considered to be within the IPZ-1, and no 120m setback was applied. The entire 1km radius, with no 120m setback, was assigned due to the complexity of the waterways in the area and associated uncertainties in relation to location of waterways and direction of flow. This rationale for this approach is also in alignment with the cautionary principal for all work being undertaken in this Assessment Report and is accordance with Technical Rule 64 that allows modifications to reflect local conditions. During consultation of the draft proposed Assessment Report it became apparent that the approach taken in Baird, 2009f did not meet the requirements of the Technical Rules. Further work was done to more accurately delineate the IPZ-1 for the Sandcastle and Washago WTPs. In the case of the Washago system, LSRCA's hydrologist completed a field survey to assess current flows and existence of control structures. The Sandcastle IPZ-1was revised to only extend 120 m inland, reducing it in size. Similarly, the Washago IPZ-1 was revised to only extend 120 m inland, and due to a control structure, was not extended to the full 1 km radius in the central waterway (parallel to Grist Mill road).

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). Because of the revisions to the IPZ-1, the IPZ-2 for the Sandcastle and Washago WTPs increased in size (reducing the size of the IPZ-1 had the effect of increasing the IPZ-2, as areas that were previously covered by the IPZ-1 are now within the IPZ-2). The two hour minimum response time was used for the Sandcastle Estates, Washago and West Shore WTP intakes, as the operator response time to shut-down the intake was within 1 hour 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.

9.4.1.2.1 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 (2010f). 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 for both the Lake Simcoe and Lake Couchiching models (Baird 2010f, Appendix S). 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. 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 (2010f). 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 S – Table 5.1, Baird 2010f.

9.4.1.2.2 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.

The Sandcastle Estates, Washago and West Shore WTPs have four, five and two tributaries located within their IPZ-2s, respectively. All of the tributaries were assumed to have velocities of 1.0 m/s. (Appendix S –Baird, 2010f). Tributary velocities provided by the LSRCA where 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.

The shorelines of Lake Couchiching 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 (now, the MECP). MOE, 2009b, defines the HWM for water bodies where a long term water level record exists, as the 80$_{th}$ 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 (2010d) report. The review found the two shorelines to be comparable. More information on the difference between these two approaches is documented in Baird (2010) report which is located in Appendix S.

9.4.1.2.3 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). However, there are no regulated areas for the lake Couchiching watershed.

9.4.1.2.4 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 2010f.

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 modelled 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 Sandcastle Estates, Washago and West Shore can be found in Baird 2010f. 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.

9.4.1.3 Delineating IPZ-3

For intakes on Lake Couchiching, the IPZ-3 delineation is not associated with an extreme event, as it is for intakes on Lake Simcoe.

For the intakes in Lake Couchiching, the IPZ-3 includes the watershed upstream of the intake, which does not fall within the IPZ-1 or IPZ-2. Lake Couchiching lies within the Black-Severn Watershed. The total drainage area is 2,805 km^2. The Black River watershed is divided into seven sub-watersheds, one of which is Lake Couchiching. The area of the Lake Couchiching subwatershed is 98 km_2 as described in Chapter 2: Watershed Characterization.

Based on discussions with LSRCA, the IPZ-3 for the intakes in Lake Couchiching has been defined as the entire Lake Couchiching sub-watershed. Because Lake Simcoe drains into Lake Couchiching, the Lake Simcoe watershed has also been included in the IPZ-3 for Orillia. The IPZ-3 has been divided into sub-areas, reflecting varying levels of vulnerability. The sub-areas include the Lake Couchiching watershed, Lake Couchiching (waterbody including islands), Lake Simcoe (waterbody including islands) and the Lake Simcoe sub-watersheds.

9.4.1.4 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 5-4, Section 5.3.2 of Chapter 5: Methods Overview.

9.4.1.4.1 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 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, 2010f).

The IPZ-2 base Area Vulnerability Factor, modifiers and final Area Vulnerability Factor for the Sandcastle Estates, Washago and West Shore WTPs are listed in Table 9-4.

Table 9-4: Derivation of IPZ-2 Area Vulnerability Factor (B) for Sandcastle Estates, Washago and West Shore WTPs Intakes.

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)
Sandcastle Estates	Lake Couchiching	8	1	-1	0	0	0	8
Washago	Lake Couchiching	8	0	-1	0	0	0	7
West Shore	Lake Couchiching	8	0	-1	0	0	0	7

[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, 2010f.

The IPZ-3 sub-area base Area Vulnerability Factors, modifiers and final Area Vulnerability Factors for the Sandcastle Estates, Washago and West Shore WTPs are listed in Table 9.5.

Table 9-5: Derivation of IPZ-3 Area Vulnerability Factors for Sandcastle Estates, Washago and West Shore WTPs Intakes.

IPZ-3 Sub-areas	Base Area Vulnerability Factor (Sandcastle Estates/ Washago and West Shore)	Distance Modifer[1]	Drainage Density Modifier[2]	SCS Curve Number Modifer[3]	Land Use Modifer[4]	Reflief Length Modifier[5]	Final Area Vulnerability Score (B)[6] (Sandcastle Estates/ Washago and West Shore)
Lak Couchiching waterbody (including Islands)	7/6	0	-	-	-	-	7/6/6
Lake Simcoe waterbody (including islands)	7/7	0	-	-	-	-	7/6/6
Lake Couchiching subwatershed	7/8	0	-1	0	0	0	6/5/5
Oro North Creeks subwatershed	7/9	-1	0	0	1	1	7/6/6
Ramara Creeks subwatershed	7/10	-1	0	0	0	0	6/5/5
Hawkestone Creek subwatershed	7/11	-2	0	-1	0	1	5/4/4
Oro South Creeks subwatershed	7/12	-2	0	0	0	0	5/4/4

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IPZ-3 Sub-areas	Base Area Vulnerability Factor (Sandcastle Estates/ Washago and West Shore)	Distance Modifer[1]	Drainage Density Modifier[2]	SCS Curve Number Modifer[3]	Land Use Modifer[4]	Reflief Length Modifier[5]	Final Area Vulnerability Score (B)[6] (Sandcastle Estates/ Washago and West Shore)
Upper & Lower Talbot River subwatershed	7/13	-2	0	-1	0	-1	3/2/2
Whites Creek subwatershed	7/14	-2	0	0	0	0	5/4/4
Beaver River subwatershed	7/15	-2	0	-1	0	0	4/3/3
Black River Subwatershed	7/16	-3	0	0	0	0	3/2/2
Pefflerlaw Brook & Uxbridge Brook subwatershed	7/17	-3	0	0	-1	0	3/2/2
Georgina Creeks subwatershed	7/18	-3	-1	1	-1	0	4/3/3
Hewitts Creek subwatershed	7/19	-3	0	0	0	0	4/3/3
Lovers Creek subwatershed	7/20	-3	0	0	0	0	4/3/3
Innisfil Creeks Subwatershed	7/21	-3	0	0	0	0	4/3/3
Barrie Creeks subwatershed	7/22	-3	0	0	1	1	6/5/5
Maskinonge subwatershed	7/23	-4	0	1	0	0	4/3/3

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IPZ-3 Sub-areas	Base Area Vulnerability Factor (Sandcastle Estates/ Washago and West Shore)	Distance Modifer[1]	Drainage Density Modifier[2]	SCS Curve Number Modifer[3]	Land Use Modifer[4]	Reflief Length Modifier[5]	Final Area Vulnerability Score (B)[6] (Sandcastle Estates/ Washago and West Shore)
West Holland subwatershed	7/24	-4	1	0	0	0	4/3/3
East Holland subwatershed	7/25	-4	0	0	1	0	4/3/3

[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

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9.4.1.4.2 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 9-6 were taken directly from MDEQ (2004), while the fourth row lists the corresponding vulnerability factor assigned for the Sandcastle Estates, Washago and West Shore WTPs.

Table 9-6: 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	0.9	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 Sandcastle Estates intake is located 330 m from shore in water depth 2.2 m, while the Washago intake is located 18 m from shore in a water depth of 2.1 m and the West Shore intake is located 870 m from shore in a water depth of 8.0 m. Source Vulnerability Factors (C) of 1.00~~.9~~, 1.0 and 0.8 were assigned respectively, based on the values presented in Table 9-6 (MDEQ, 2004).

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9.4.1.5 Uncertainty Assessment

This section summarizes some of the uncertainty identified by Baird (2010f) when delineating IPZs and the assigning vulnerability scores; the entire discussion of uncertainties is presented in Appendix S, Baird 2010f. This assessment was used by Baird (2010f) to assign Uncertainty Ratings of either "High" or "Low" for the IPZ and Vulnerability Scores.

9.4.1.5.1 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 raw water quality data is available. Complete list of data quality and gaps listed in Baird 2010f, Appendix S.

9.4.1.5.2 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: (A complete list and description of model uncertainties is provided by Baird (2010f) Appendix S)

- 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.

9.4.1.5.3 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; Discussion of Quality Assurance procedures to be used during the project life cycle.

9.4.1.5.4 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.

9.4.1.5.5 Area and Source Vulnerability Factors

The factors considered in assigning the Area Vulnerability Factors 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. Jagger Hims Ltd (2009) did not report any water quality Issues in their Issues Evaluation report, however limited data were available for the analysis.

9.5 Sandcastle Estates Water Treatment Plant

The Sandcastle Estates Water Treatment Plant is located on the north shore of Lake Couchiching near the Community of Sandcastle Estates in the Township of Severn, Simcoe County. Construction of the Sandcastle Estates Water Treatment Plant and associated intake pipe was approved in March 1986. The WTP is classified as Small Municipal Residential (Township of Severn, 2006a). The plant currently supplies water to approximately 170 residents in the community (Township of Severn, 2006a).

The Sandcastle Estates Water Treatment Plant is a conventional full treatment plant that provides screening of raw water, clarification, filtration and disinfection. Sodium Hypochlorite and SternPAC are added prior to direct filtration. Water is disinfected with ultraviolet (UV) and then chlorinated before going to a reservoir. The facility uses up to date technology to treat the water from Lake Couchiching including surface water supply system, low lift pumping station, package treatment plant, and high lift pumping station. There is currently no zebra mussel control at the inlet structure.

The intake is a 100 mm diameter polyethylene pipe, extending 400 m from the shoreline and terminating at the inlet structure at a maximum depth of 2.2 m. Upon review, the municipality indicated that the intake is located 330 m from shore.

Based on the interview with representatives of the WTP, conducted by personnel from SGBLS on February 28, 2007, the WTP can be shut-down within 1 hour upon notification.

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

9.5.1.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the Sandcastle Estates WTP are shown in Figure 9b-1. IPZ-1 consists of a 1 km radius centered on the crib of the intake, extending 120 m inland. The Sandcastle Estate IPZ-1 also overlaps the Washago IPZ-1. The IPZ-2 includes Transport Pathways, such as drains and ditches that extend the IPZ-2 in various locations within the Sandcastle Estates community. The IPZ-3 for Sandcastle Estates WTP, as with all intakes in Lake Couchiching, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 9b-2). The Lake Couchiching water body and watershed were included as IPZ-3 sub-areas because current flow measurements show reverse flow (i.e. from Lake Couchiching to Lake Simcoe), do occur.

9.5.1.2 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 9-7 and Figure 9b-1 and Figure 9b-2.

Table 9-7: Summary of Vulnerability Factors and Scores for Sandcastle Estates WTP Intake.

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	~~0.9~~1.0	10~~9~~
IPZ-2	8	1.0~~0.9~~	8~~7.2~~
IPZ-3 Sub-areas			-
Lake Couchiching waterbody (incl. islands)	7	~~0.9~~1.0	7~~6.3~~
Lake Simcoe waterbody (incl. islands)	7	1.0~~0.9~~	7~~6.3~~
Lake Couchiching subwatershed	6	1.0~~0.9~~	6~~5.4~~
Oro North Creeks subwatershed	7	1.0~~0.9~~	7~~6.3~~
Ramara Creeks subwatershed	6	1.0~~0.9~~	6~~5.4~~
Hawkestone Creek subwatershed	5	~~0.9~~1.0	5~~4.5~~
Oro South Creeks subwatershed	5	1.0~~0.9~~	5~~4.5~~
Upper + Lower Talbot River subwatershed	3	1.0~~0.9~~	3~~2.7~~
Whites Creek subwatershed	5	1.0~~0.9~~	5~~4.5~~
Beaver River subwatershed	4	1.0~~0.9~~	4~~3.6~~
Black River subwatershed	3	1.0~~0.9~~	3~~2.7~~
Pefferlaw Brook + Uxbridge Brook subwatershed	3	1.0~~0.9~~	3~~2.7~~
Georgina Creeks subwatershed	4	1.0~~0.9~~	4~~3.6~~
Hewitts Creek subwatershed	4	1.0~~0.9~~	4~~3.6~~
Lovers Creek subwatershed	4	~~0.9~~1.0	4~~3.6~~
Innisfil Creeks subwatershed	4	1.0~~0.9~~	4~~3.6~~
Barrie Creeks subwatershed	6	1.0~~0.9~~	6~~5.4~~
Maskinonge subwatershed	4	1.0~~0.9~~	4~~3.6~~
West Holland subwatershed	4	1.0~~0.9~~	4~~3.6~~
East Holland subwatershed	4	1.0~~0.9~~	4~~3.6~~

9.5.1.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010f) 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 9-8).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see Section 9.5.2) based on the data analyzed, limited data were available for the

Issues Analysis and the operator raised some concerns (Baird, 2010f). 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 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, 2008a) do not provide specific guidance.

Table 9-8: Summary of uncertainty Ratings for the Sandcastle Estates WTP 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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The IPZ-3 limits have been defined based on [Rule 70; MOE, 2009a]. The entire watersheds of Lake Couchiching and Lake Simcoe were included in the IPZ-3. Although not required, an analysis to determine whether a spill would result in a contaminant reaching the intake in a concentration that could compromise the drinking water would be beneficial. 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.

9.5.2 Drinking Water Issues

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) 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 Sandcastle Estates Water Treatment Plant 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 Township of Severn Surface Water are provided in Technical Memorandum N1 – Drinking Water Issues Evaluation – Severn Surface Water (Appendix S).

No Drinking Water Issues were identified with the Sandcastle Estates WTP.

Parameters whose concentrations occasionally exceed Aesthetic/Operational guidelines under the Ontario Drinking Water Quality Standards include aluminum. This parameter is likely present as a by-product of the treatment process.

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 Couchiching.

Trihalomethanes and other disinfection by-products 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 Couchiching 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.

9.5.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Sandcastle Estates Water Supply was completed in accordance with the methodology described in GENIVAR (2010a) and the detailed methodology presented in Technical Memorandum 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 Sandcastle Estates Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes 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.

9.5.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Sandcastle Estates 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.

9.5.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing conditions that could affect the Sandcastle Estates Water Supply:

- Files provided by the Ministry of the Environment, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated IPZs.

- Records available from the 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 Township of Severn staff to identify potential Conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the Sandcastle Water Treatment Plant. No potential Conditions have been identified for consideration at this time.

9.5.3.3 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

9.5.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 9b-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 Sandcastle Estates 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 9 or greater.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 9b-4).

9.5.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 9b-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 Sandcastle Estates Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is 9 or greater.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 9b-6).

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

Further to Section 9.5.3.2, no Conditions have been confirmed within the WHPA for the Sandcastle Estates 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 9b-1 and Figure 9b-2 illustrates the Vulnerability Score maps for Sandcastle Estates WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

9.5.3.5 Enumerating Drinking Water Threats

~~9.5.3.5~~

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The number of Significant Drinking Water Threats for the Sandcastle Estates 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.

~~No landuse activities that would result in potential Significant Drinking Water Threats were identified for the Sandcastle Estates Water Treatment Plant. Private sewage disposal systems are not considered to be Significant Drinking Water Threats where the Vulnerability Score is 9.~~

Table 9. Number of Significant Drinking Water Threats for the Sandcastle Estates Water Treatment Plant

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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.	67
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

Threat Number	Threat	Significant threat counts Number of threats
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
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:**	* significant threats (on properties)

~~9.5.3.6~~9.5.3.5.1 Managed Lands

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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 ~~Table of Drinking Water Threats~~Technical Rules.

Managed Lands were identified and the Managed Lands proportions were determined for IPZ-1 and IPZ-2 for the water supply to the Sandcastle Estates 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 9.5.3.5). The Managed Lands is used in the identification of Threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 9b-7 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Sandcastle Estates Surface Water Supply. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 9b-8.

~~9.5.3.7~~9.5.3.5.2 Livestock Density

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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 ~~Table of Drinking Water Threats~~Technical Rules.

The Livestock Density was determined for IPZ-1 and IPZ-2 for the water supply to the Sandcastle Estates 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 9.5.3.5). 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 9b-9 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Sandcastle Estates Surface Water Supply 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 9b-10.

~~9.5.3.8~~9.5.3.5.3 Impervious Surfaces

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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 ~~Table of Drinking Water Threats~~Technical Rules.

The proportion of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Sandcastle Estates 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 9.5.3.5). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 9b-11 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the Sandcastle Estates Surface Water Supply where the 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 9b-12.

9.6 Washago Water Treatment Plant

The Washago Water Treatment Plant is located on the north shore of Lake Couchiching in the Community of Washago. The ultimate design capacity of the facility is 0.54ML/day (RG Robinson, 2001b). Based on the 2006 Annual Report (Township of Severn, 2006b), the plant currently supplies approximately 300 residents in the Community of Washago in Severn Township and 20 houses in the Township of Ramara.

Construction of the Washago Water Treatment Plant and associated intake pipe was completed in 1984 (SSEA, 2005). Water for the Washago Water Treatment Plant is pumped from Lake Couchiching to a conventional full treatment plant that provides screening of raw water, clarification, filtration and disinfection. Sodium Hypochlorite and SternPAC are added prior to direct filtration. The filtered water is chlorinated before being sent to the reservoir. There is currently no zebra mussel control at the inlet structure.

The intake consists of 95 m of 200 mm diameter polyethylene pipe, extending 18 m from the shoreline and terminating at the inlet structure at a water depth of 2.1 m.

Based on the interview with the representative of the WTP, conducted by personnel from LSRCA on February 28, 2007, the WTP can be shut-down within 1 hour upon notification.

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

9.6.1.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the Washago WTP are shown in Figure 9b-13. The IPZ-1 was revised from that presented in Baird, 2009f to only extend 120 m inland, and due to a control structure, was not extended to the full 1 km radius in the central waterway (parallel to Grist Mill road). The IPZ-2 includes Transport Pathways, such as drains and ditches that extend the IPZ-2 in various locations within the Washago community. It should be noted that the north end of Lake Couchiching is a very complex area and there is very limited gauge data, which resulted in a high level of uncertainty. The IPZ-3 for Washago WTP, as with all intakes in Lake Couchiching, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 9b-14). The Lake Couchiching water body and watershed were included as IPZ-3 sub-areas because current flow measurements show reverse flow (i.e. from Lake Couchiching to Lake Simcoe), do occur.

9.6.1.2 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 9-9 and Figure 9b-13 and Figure 9b-14.

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

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	1.0	10.0
IPZ-2	7	1.0	7.0
IPZ-3 Sub-areas			
Lake Couchiching waterbody (incl. islands)	6	1.0	6.0
Lake Simcoe waterbody (incl. islands)	6	1.0	6.0
Lake Couchiching subwatershed	5	1.0	5.0
Oro North Creeks subwatershed	6	1.0	6.0
Ramara Creeks subwatershed	5	1.0	5.0
Hawkestone Creek subwatershed	4	1.0	4.0
Oro South Creeks subwatershed	4	1.0	4.0
Upper + Lower Talbot River subwatershed	2	1.0	2.0
Whites Creek subwatershed	4	1.0	4.0
Beaver River subwatershed	3	1.0	3.0
Black River subwatershed	2	1.0	2.0
Pefferlaw Brook + Uxbridge Brook subwatershed	2	1.0	2.0
Georgina Creeks subwatershed	3	1.0	3.0
Hewitts Creek subwatershed	3	1.0	3.0
Lovers Creek subwatershed	3	1.0	3.0
Innisfil Creeks subwatershed	3	1.0	3.0
Barrie Creeks subwatershed	5	1.0	5.0
Maskinonge subwatershed	3	1.0	3.0
West Holland subwatershed	3	1.0	3.0
East Holland subwatershed	3	1.0	3.0

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9.6.1.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010f) 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 9-10).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see Section 9.6.2) based on the data analyzed, limited data were available for the Issues Analysis and the operator raised some concerns (Baird, 2010f). 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 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, 2008a) do not provide specific guidance.

Table 9-11~~10~~: Summary of uncertainty Ratings for the Washago WTP 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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The IPZ-3 limits have been defined based on [Rule 70; MOE, 2009a]. The entire watersheds of Lake Couchiching and Lake Simcoe were included in the IPZ-3. Although not required, an analysis to determine whether a spill would result in a contaminant reaching the intake in a concentration that could compromise the drinking water would be beneficial. 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.

9.6.2 Drinking Water Issues

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) 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 Washago Water Treatment Plant 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 Township of Severn Surface Water are provided in Technical Memorandum N1 – Drinking Water Issues Evaluation – Severn Surface Water (Appendix S).

No Drinking Water Issues were identified with the Washago WTP.

Parameters whose concentrations occasionally exceed Aesthetic/Operational guidelines under the Ontario Drinking Water Quality Standards include aluminum. This parameter is likely present as a by-product of the treatment process.

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 Couchiching.

Trihalomethanes and other disinfection by-products 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 Couchiching 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.

9.6.3 Drinking Water Threats Evaluation

An assessment of drinking water threats for the Washago Water Supply was completed in accordance with the methodology described in GENIVAR (2010a) and 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 Washago Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes 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.

9.6.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Washago 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.

9.6.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing conditions that could affect the Washago Water Supply:

- Files provided by the Ministry of the Environment, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated IPZs.

- Records available from the 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 Severn Township staff to identify potential conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the Washago water supply. No potential Conditions have been identified for consideration at this time.

9.6.3.3 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/. ~~https://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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9.6.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 9b-15 ~~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 Washago 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 9 or greater.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 9b-16).

9.6.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores~~The Key Table~~ on Figure 9b-17 ~~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 Washago Water Supply, Activities that are or would be

Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is 9 or greater.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 9b-18).

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

Further to Section 9.6.3.2, no Conditions have been confirmed within the WHPA for the Washago 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 9b-13 and Figure 9b-14 illustrates the Vulnerability Score maps for Washago WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

9.6.3.5 Enumerating Drinking Water Threats

~~9.6.3.5~~

The number of Significant Drinking Water Threats for the Washago Water Supply has been determined using the methodology outlined in Technical Memorandum A5 (Appendix MO) and

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refined using the methodology outlined in Chapter 5 (Section 5.5.6.4) of this Assessment Report. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 9-11 documents the refined enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the IPZ for the Washago Water Treatment Plant. Potential Significant Drinking Water Threats were identified within areas where the Vulnerability Score is greater than 8 in IPZ-1.

143 activities that are potentially Significant Drinking Water Threats were identified on 141 land parcels within IPZ-1 for the Washago Water Treatment Plant. Potential Significant Drinking Water Threats on these parcels include 132 parcels with private residential sewage systems, nine (9) parcels with potential for storage of more than 2500 L of fuel above grade, and two (2) parcels with potential for handling and storage of Dense Non-Aqueous Phase Liquids (DNAPLs).

Table 9-1211: Number of Significant Drinking Water Threats for the Washago Surface 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.	10
2.	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	132
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.	10
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.	9
16.	The handling and storage of dense non-aqueous phase liquid.	1~~2~~
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:**	**14~~43~~*** significant threats (on **142** properties)

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*18 verified existing Threats and 125 potential Threats that require further verification (2015)

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

9.6.3.6 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 Washago 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 9.6.3.5). The Managed Lands is used in the identification of Threat activities associated with the application of Agricultural Source Material, Non-Agricultural Source Material and commercial fertilizer.

Figure 9b-19 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Washago Surface Water Supply. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 9b-8.

9.6.3.7 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 ~~Table of Drinking Water Threats~~Technical Rules.

The Livestock Density was determined for IPZ-1 and IPZ-2 for the water supply to the Washago 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 9.6.3.5). 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 9b-20 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Washago Surface Water Supply 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 9b-10.

9.6.3.8 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 ~~Table of Drinking Water Threats~~Technical Rules.

The proportion of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Washago 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 9.6.3.5). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 9b-21 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the Washago Surface Water Supply where the 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 9b-12.

9.7 West Shore Water Treatment Plant

The West Shore Water Treatment Plant is located on the west shore of Lake Couchiching near the community of Cumberland Beach. The West Shore Water Treatment Plant is classified as Large Municipal Residential system that serves the Community of West Shore and Cumberland Beach and has a maximum facility capacity of 2.78 ML/day (Township of Severn, 2006c). Based on information provided by the municipality, the WTP currently (June 2008) supplies 800 homes and businesses.

Construction of the West Shore Water Treatment Plant and associated intake pipe was completed in December 2005. The most recent C of A provided was dated November 2006. The West Shore Water Treatment Plant is a package water treatment plant. Alum, polymer and soda ash are added prior to filtration. The filtered water flows through a granular activated carbon tank before being disinfected with UV light and sodium hypochlorite (Township of Severn, 2006c).

The intake consists of 950 m of 300 mm diameter polyethylene pipe, extending from the shoreline and terminating at the inlet structure at a water depth of approximately 7.0 m. The intake is located 870 m offshore in a total depth of 8.0 m with the top of the intake located 7.0 m below the average lake level over the last 100 year period (218.95 m, above sea level, ASL). For the purposes of this report, the intake is assumed to be 870 m offshore in 8 m of water.

Based on the interview with representatives of the WTP, conducted by personnel from LSRCA on February 28, 2007, the WTP can be shut-down within 1 hour upon notification.

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

9.7.1.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the West Shore WTP are shown in Figure 9c-1. IPZ-1 consists of a 1 km radius centered on the crib of the intake, extending 120m inland. The IPZ-2 includes Transport Pathways, such as drains and ditches that extend the IPZ-2 in various locations within the community. The IPZ-3 for West Shore WTP, as with all intakes in Lake Couchiching, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 9c-2). The Lake Couchiching water body and watershed were included as IPZ-3 sub-areas because current flow measurements show reverse flow (i.e. from Lake Couchiching to Lake Simcoe), do occur.

9.7.1.2 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 9-12 and Figure 9c-1 and Figure 9c-2.

Table 9-1312: Summary of Vulnerability Factors and Scores for West Shore WTP Intake.

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
IPZ-1	10	0.8	8.0
IPZ-2	7	0.8	5.6
IPZ-3 Sub-areas			
Lake Couchiching waterbody (incl. islands)	6	0.8	4.8
Lake Simcoe waterbody (incl. islands)	6	0.8	4.8
Lake Couchiching subwatershed	5	0.8	4.0
Oro North Creeks subwatershed	6	0.8	4.8
Ramara Creeks subwatershed	5	0.8	4.0
Hawkestone Creek subwatershed	4	0.8	3.2
Oro South Creeks subwatershed	4	0.8	3.2
Upper + Lower Talbot River subwatershed	2	0.8	1.6
Whites Creek subwatershed	4	0.8	3.2
Beaver River subwatershed	3	0.8	2.4
Black River subwatershed	2	0.8	1.6
Pefferlaw Brook + Uxbridge Brook subwatershed	2	0.8	1.6
Georgina Creeks subwatershed	3	0.8	2.4
Hewitts Creek subwatershed	3	0.8	2.4
Lovers Creek subwatershed	3	0.8	2.4
Innisfil Creeks subwatershed	3	0.8	2.4
Barrie Creeks subwatershed	5	0.8	4.0
Maskinonge subwatershed	3	0.8	2.4
West Holland subwatershed	3	0.8	2.4
East Holland subwatershed	3	0.8	2.4

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9.7.1.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010f) 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 9-13).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see Section 9.7.2) based on the data analyzed, limited data were available for the Issues Analysis and the operator raised some concerns (Baird, 2010f). 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 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, 2008a) do not provide specific guidance.

Table 9-~~14~~13: Summary of uncertainty Ratings for the West Shore WTP 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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The IPZ-3 limits have been defined based on [Rule 70; MOE, 2009a]. The entire watersheds of Lake Couchiching and Lake Simcoe were included in the IPZ-3. Although not required, an analysis to determine whether a spill would result in a contaminant reaching the intake in a concentration that could compromise the drinking water would be beneficial. 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.

9.7.2 Drinking Water Issues

The intent of the Issues Evaluation is to identify parameters (e.g. chemicals or pathogen) 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 West Shore Water Treatment Plant 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 Township of Severn Surface Water are provided in Technical Memorandum N1 – Drinking Water Issues Evaluation – Severn Surface Water (Appendix S).

No Drinking Water Issues were identified with the West Shore WTP.

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 Couchiching and Lake Simcoe.

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.

9.7.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the West Shore Water Supply was completed in accordance with the methodology described in GENIVAR (2010a) and 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 West Shore Water Supply builds on the information from the Vulnerability Analysis and Issues Evaluation and includes 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.

9.7.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for West Shore 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.

9.7.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing conditions that could affect the West Shore WTP:

- Files provided by the Ministry of the Environment, Conservation and Parks local offices pertaining to licenses, and records of spills in the area of the delineated IPZs.
- Records available from the 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 Severn Township staff to identify potential conditions within the identified IPZs for the drinking water supply.

No confirmed Conditions have been identified for the West Shore water supply. No potential Conditions have been identified for consideration at this time.

9.7.3.3 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~~

9.7.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table on Figure 9c-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 West Shore 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 8.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 9c-4).

9.7.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores~~The Key Table on Figure 9c-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 West Shore Water Supply, Activities that are or would be Significant Drinking Water Threats for chemicals can be observed within areas where the Vulnerability Score is 8.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 9c-6).

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

Further to Section 9.7.3.2, no Conditions have been confirmed within the WHPA for the West Shore 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 9c-1 and Figure 9c-2 illustrates the Vulnerability Score maps for West Shore WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

9.7.3.5 Enumerating Drinking Water Threats

~~9.7.3.5~~

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The number of Significant Drinking Water Threats for the West Shore WTP 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.

No activities that can be considered to be potential Significant Drinking Water Threats were identified for the IPZs delineated for the West Shore Water Treatment Plant. The enumeration of potential Significant Drinking Water Threats included consideration for storm sewer outfalls within the delineated IPZ.

9.7.3.6 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 West Shore 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 9.7.3.5). 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 9c-7 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the West Shore Surface Water Supply where Vulnerability Scores were greater than 4. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 9b-8.

9.7.3.7 Livestock Density

Technical Rule 16(10) ~~(August 2009) r~~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 West Shore 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 9.7.3.5). 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 9c-8 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the West Shore Surface Water Supply where Vulnerability Scores were greater than 4. The Livestock Density for the IPZ-3 associated with the surface water intakes in Lake Simcoe is presented Figure 9b-10.

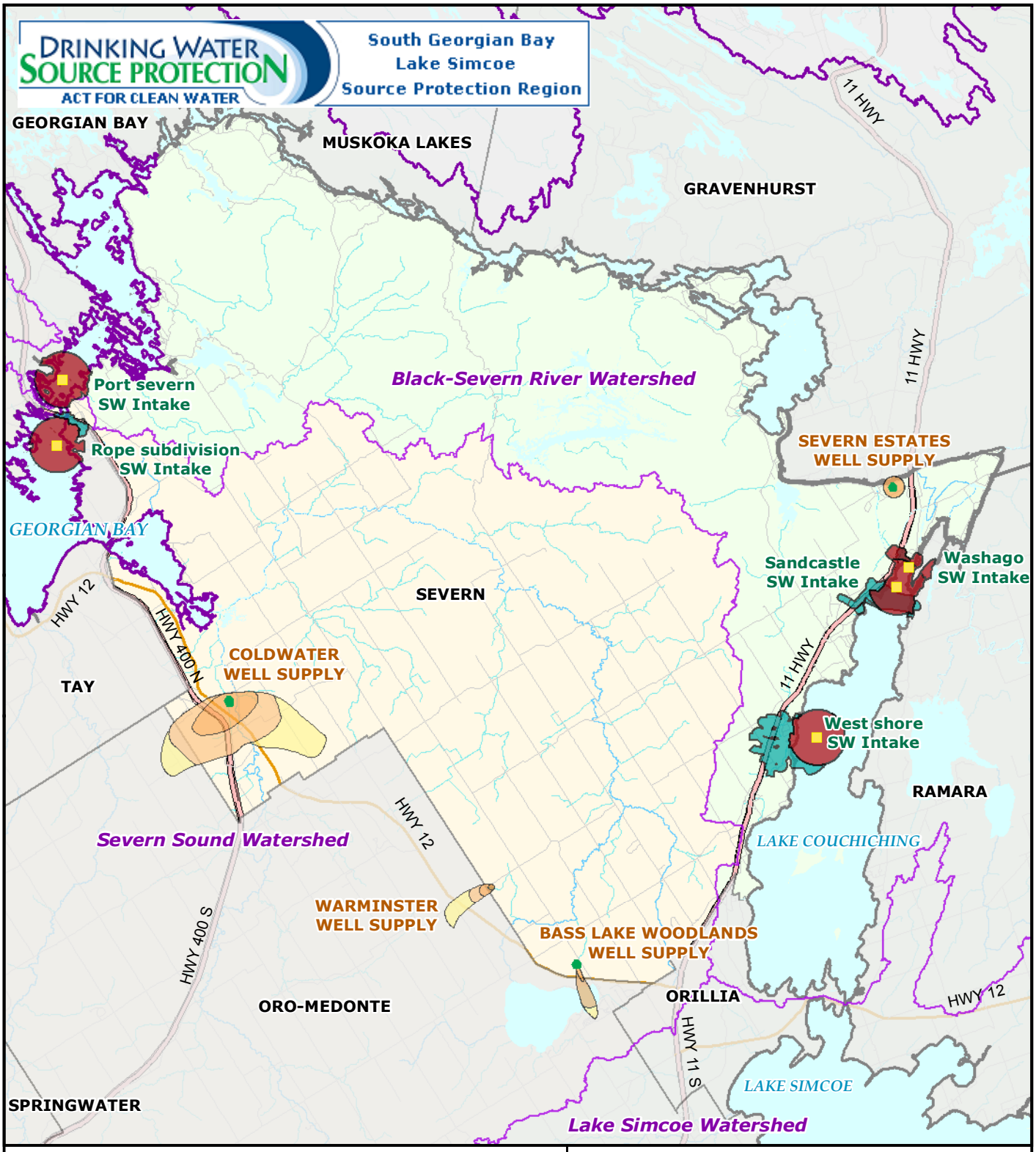
9.7.3.8 Impervious Surfaces

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 West Shore 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 9.7.3.5). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 9c-9 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the West Shore Surface Water Supply where the Vulnerability Scores were greater than 4. The proportion of Impervious Surfaces for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 9b-12.



- Municipal Surface Water Intakes
- IPZ-1 (1000m on water or 120m inland)
- IPZ-2 (2 hr time of travel)
- Municipal Supply Well in Township of Severn
- 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 Vulnerable Areas in Township of Severn

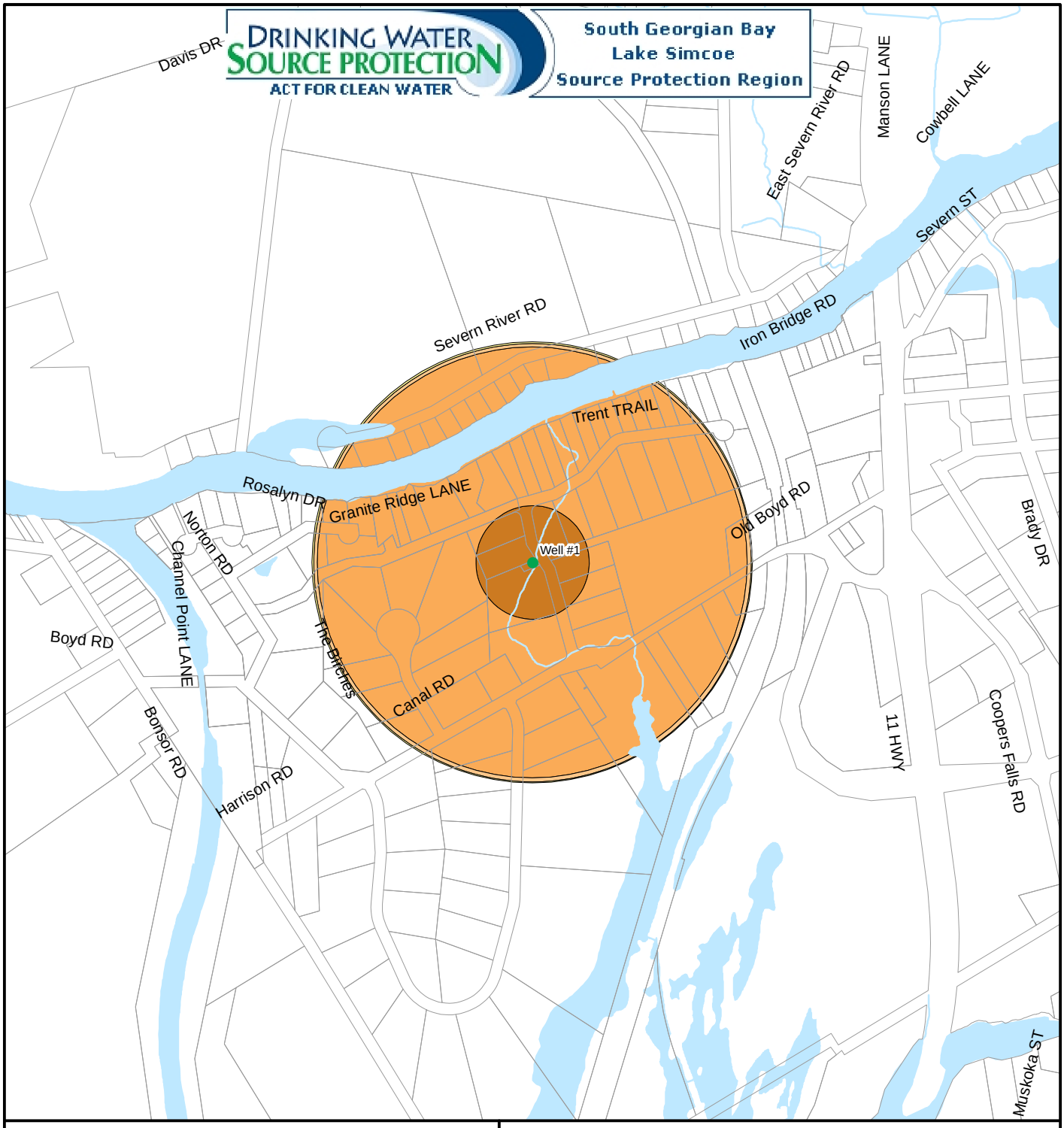
Created by: LSRCA
Date: 2011-04-01

Scale: 1:200,000
0 2 4km
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 9-1



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 AREAS - SEVERN ESTATES, SEVERN

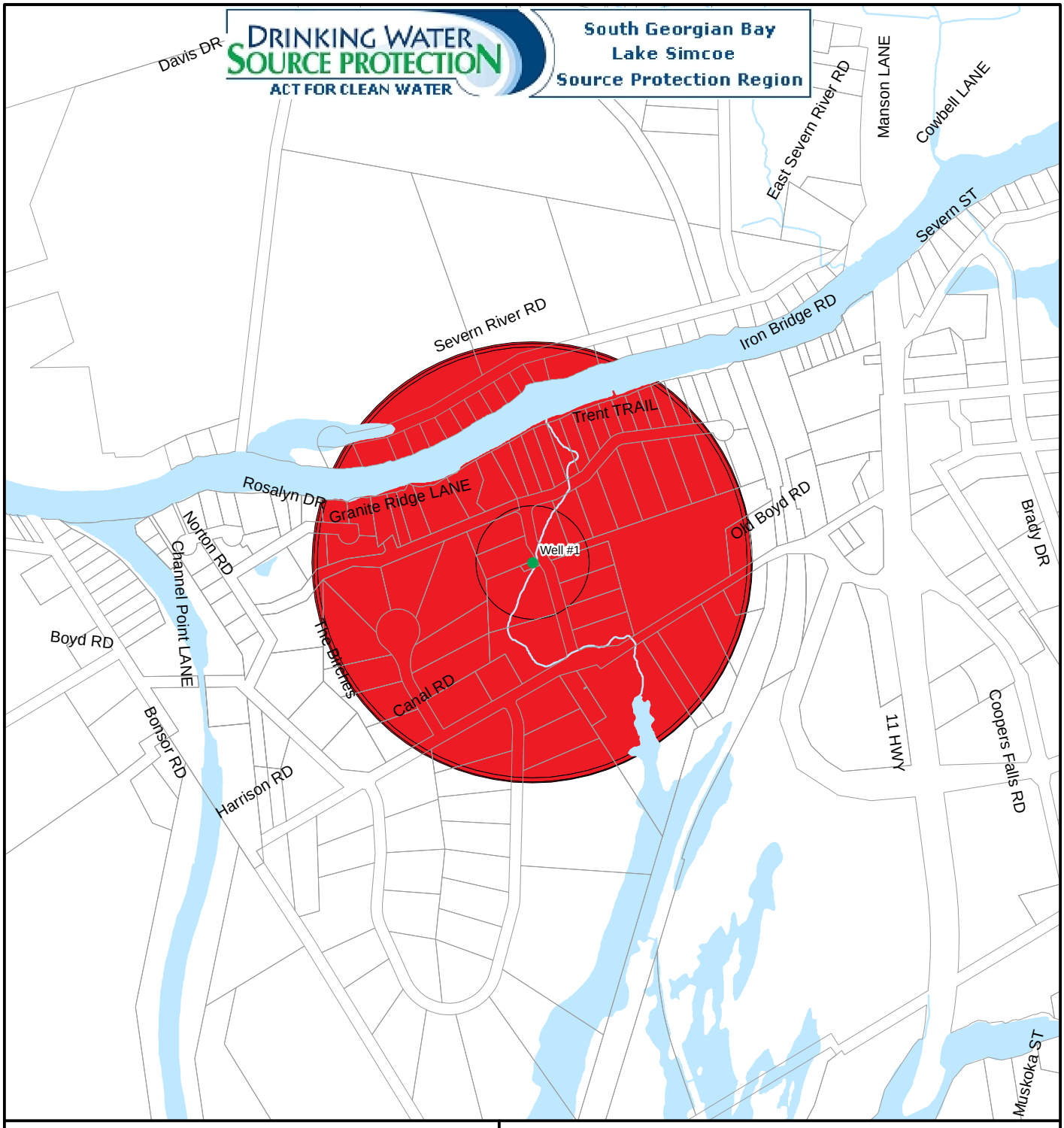
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-1

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 **9a-1**



Legend

- MUNICIPAL WELL LOCATION

AQUIFER VULNERABILITY INDEX

- HIGH
- MEDIUM
- LOW

N W E S

100 50 0 100 Metres

GROUNDWATER VULNERABILITY - SEVERN ESTATES

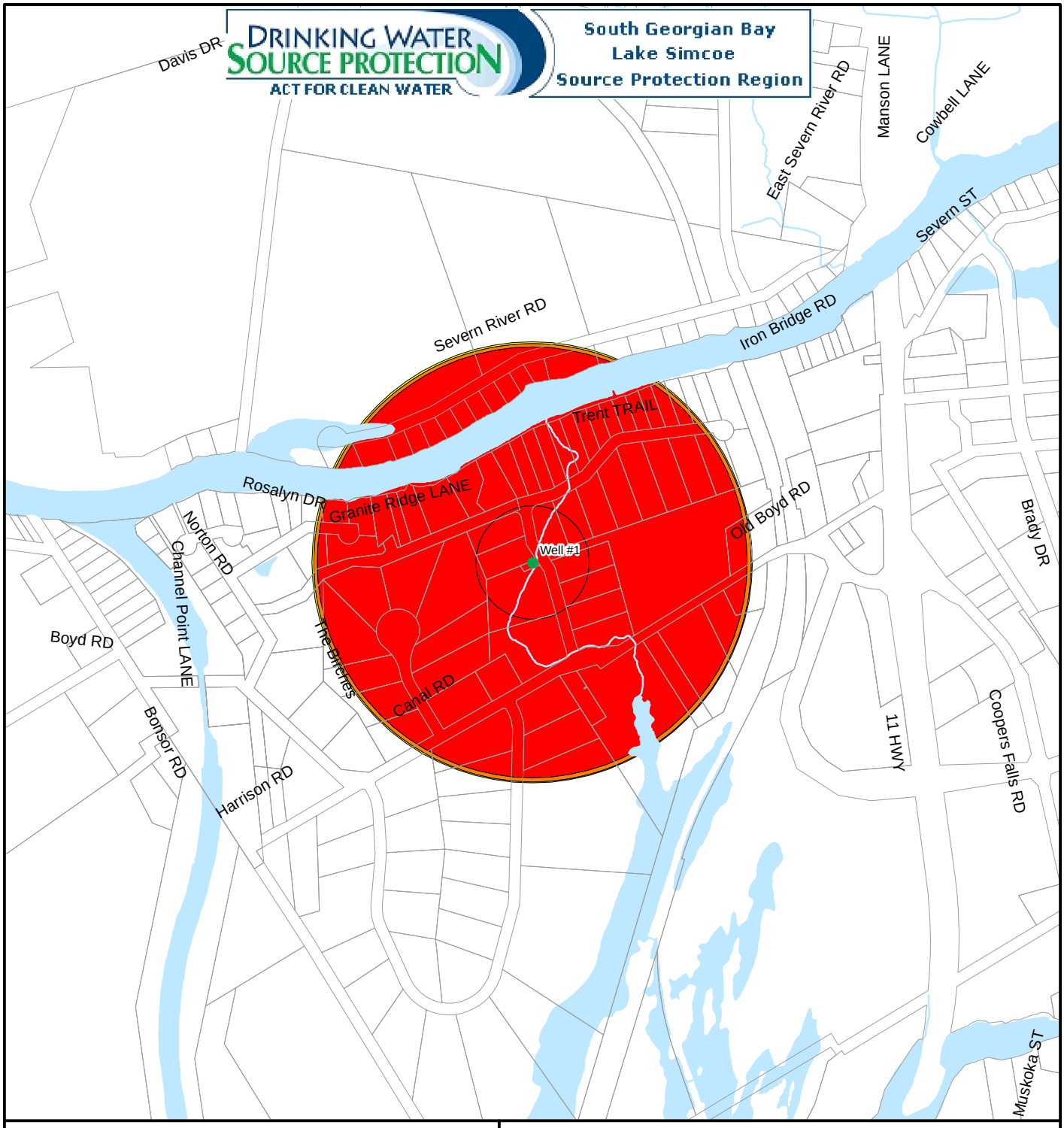
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-2

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GENIVAR Ontario

FIGURE **9a-2**



Legend

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6
- 4
- 2

N W E S

100 50 0 100 Metres

VULNERABILITY SCORE - SEVERN ESTATES

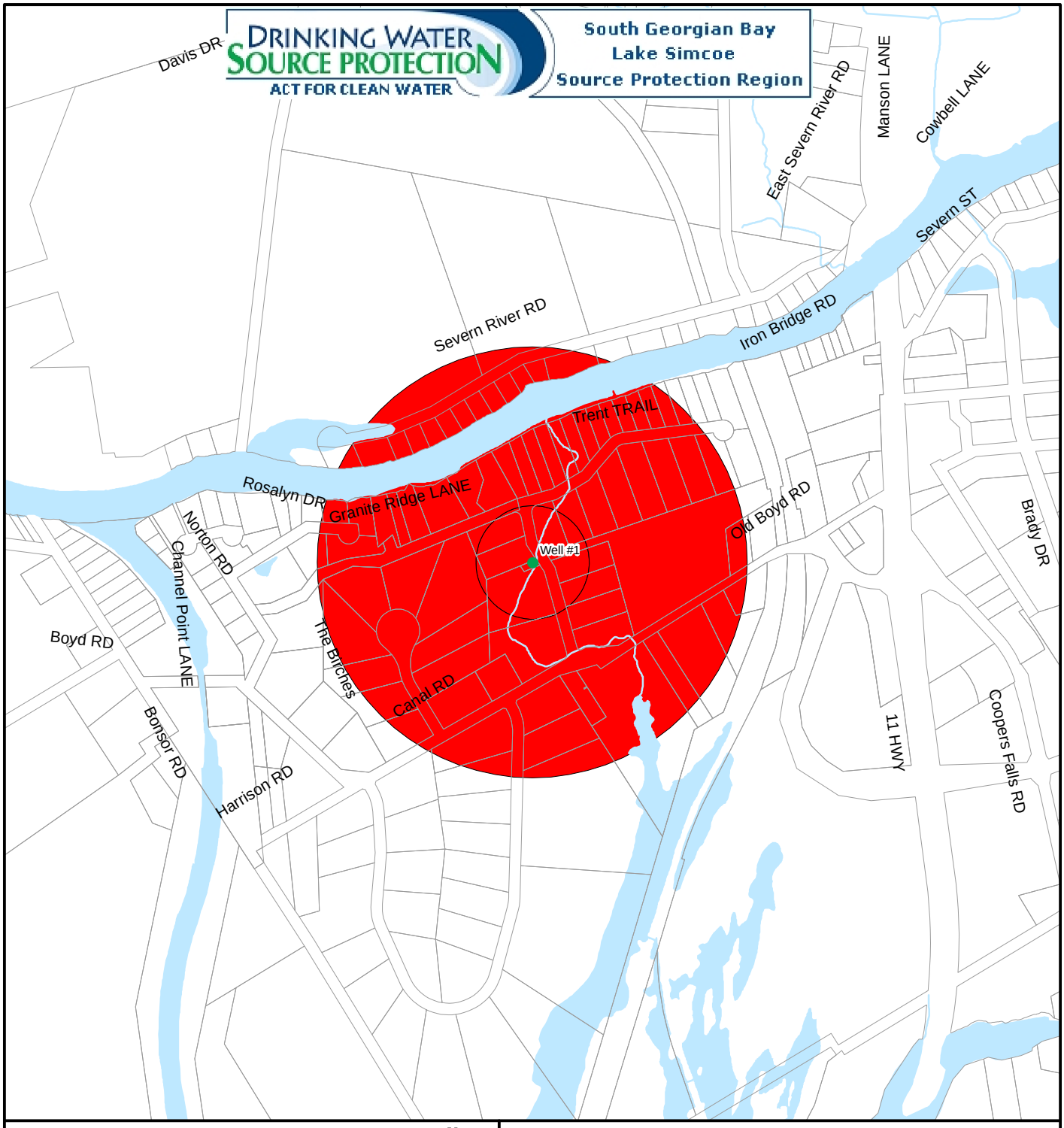
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-3

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GENIVAR Ontario

FIGURE 9a-3



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

100 50 0 100 Metres

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

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

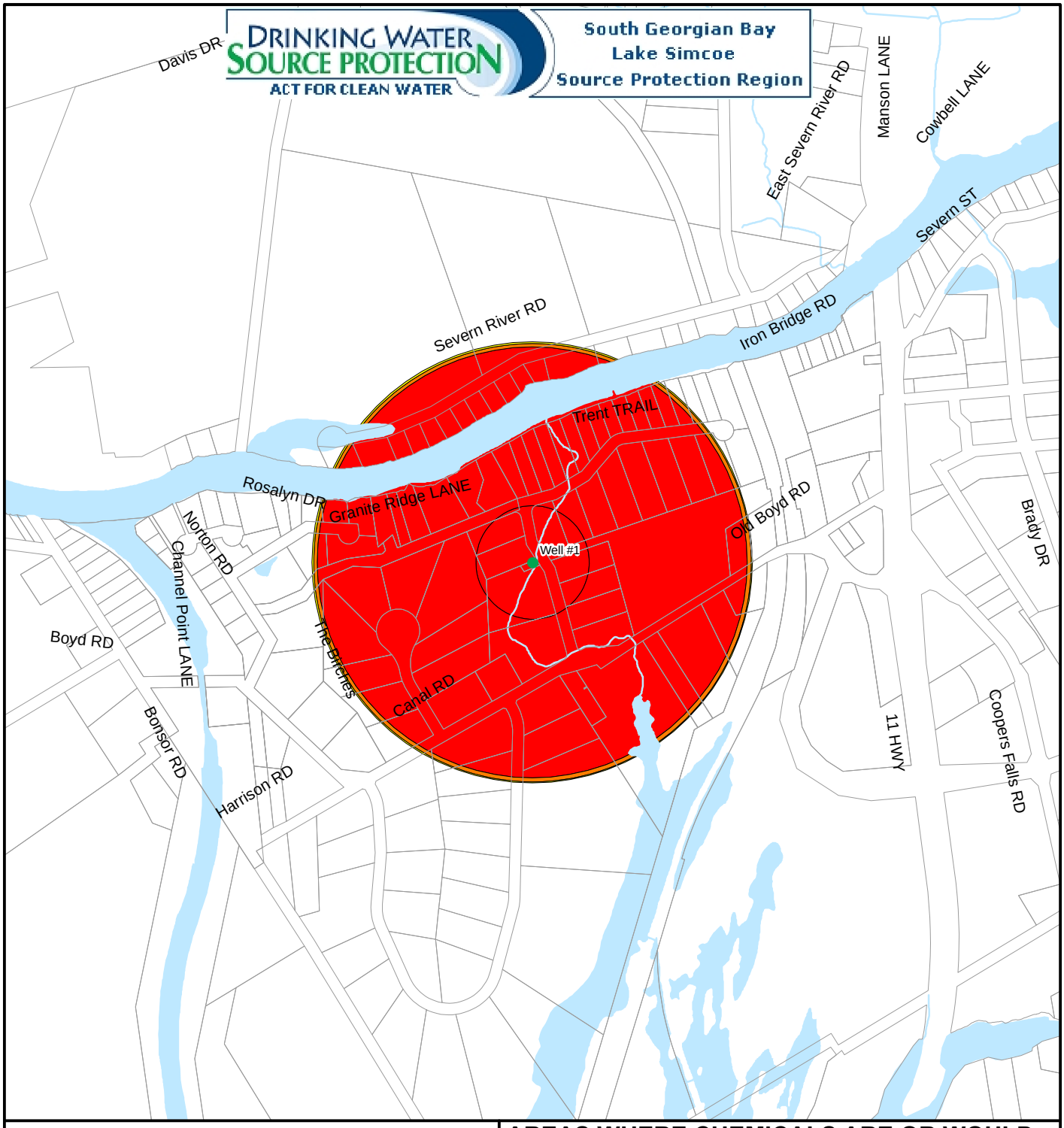
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-4

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GENIVAR Ontario

FIGURE **9a-4**



LEGEND

- MUNICIPAL WELL LOCATION

VULNERABILITY SCORING

- 10
- 8
- 6

N W E S

100 50 0 100 Metres

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

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

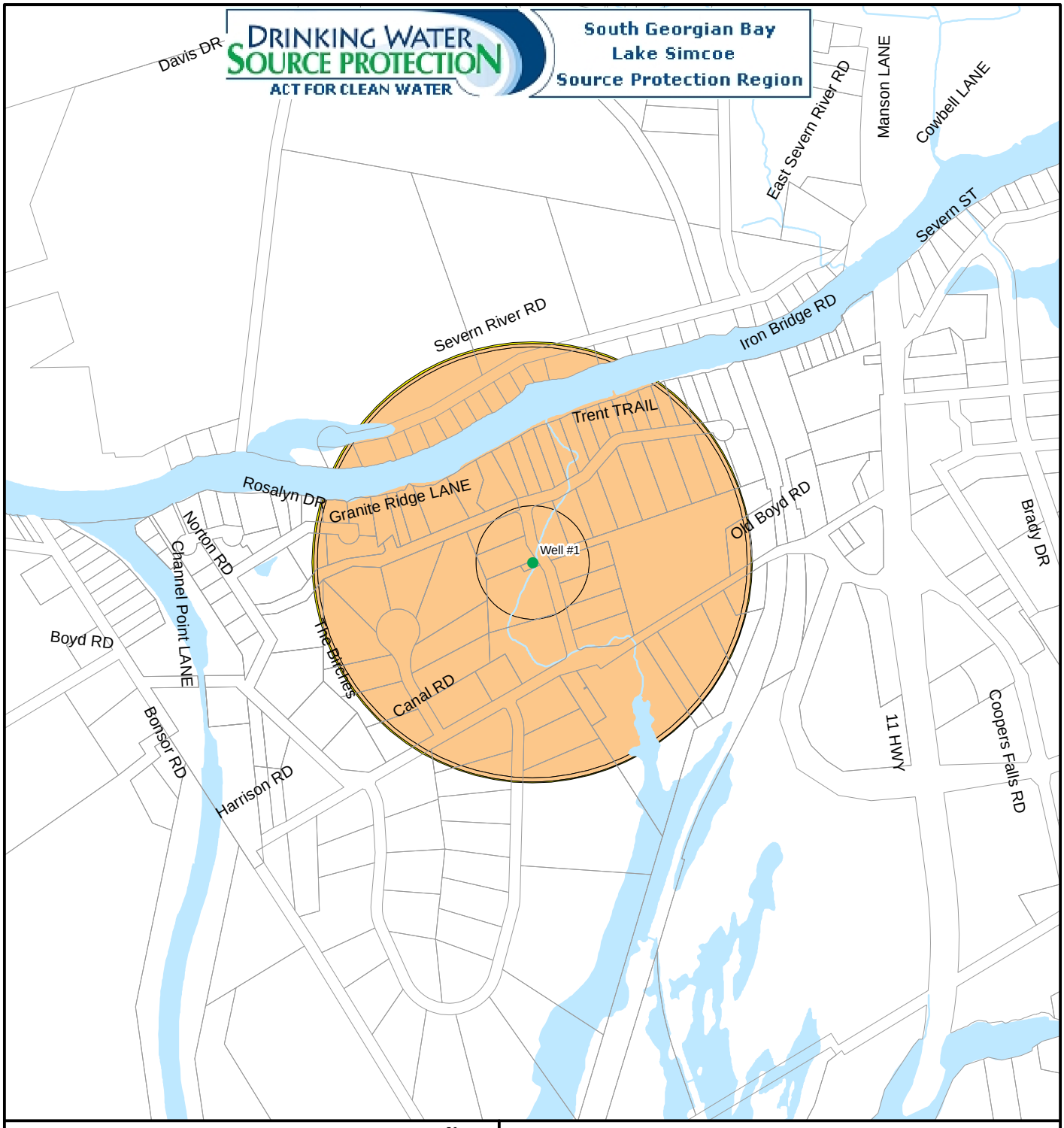
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-5

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GENIVAR Ontario

FIGURE **9a-5**



LEGEND

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

VULNERABILITY SCORING

- 6

N W E S

100 50 0 100 Metres

AREAS WHERE DNAPLs ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - SEVERN ESTATES

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

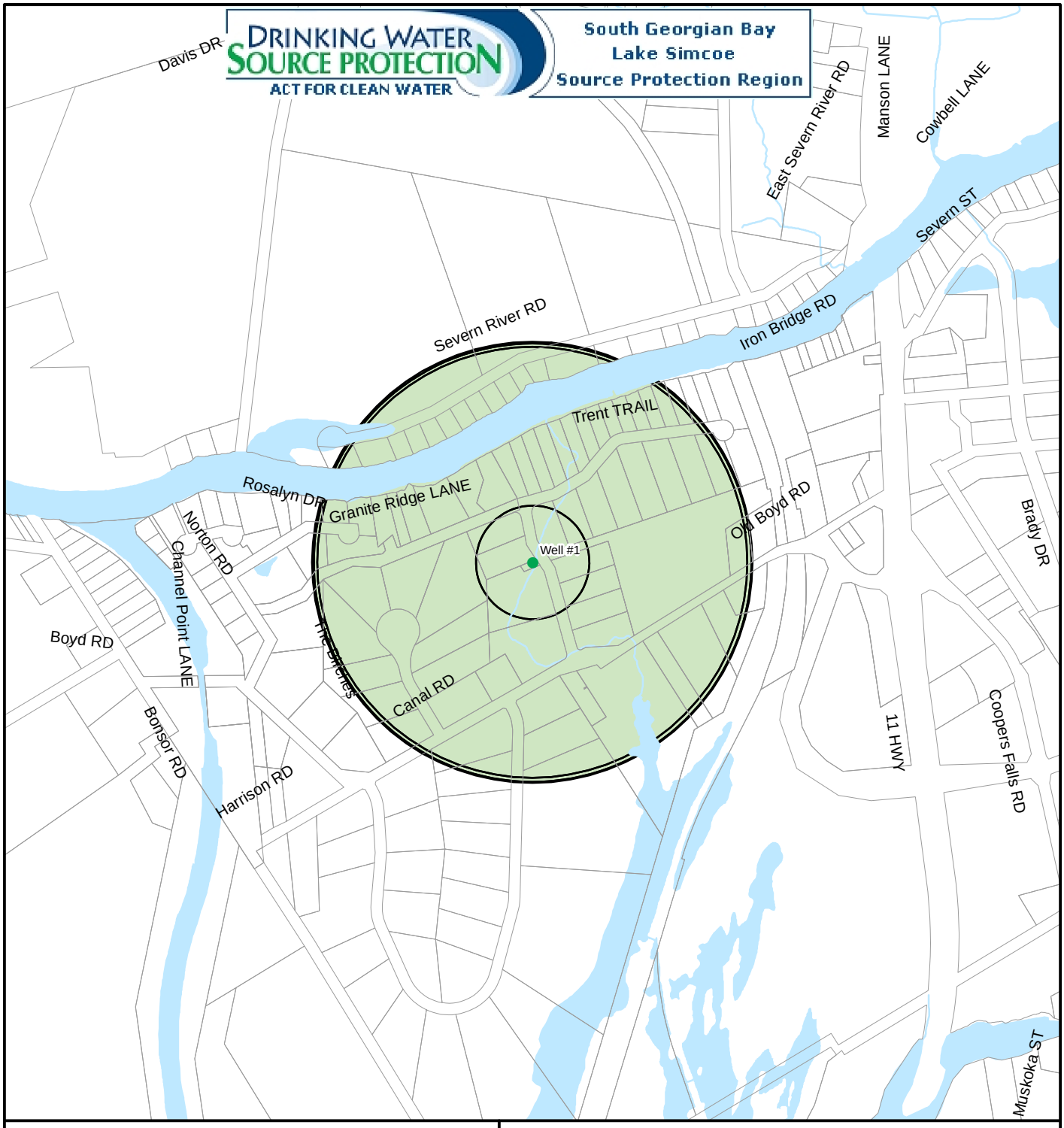
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-6

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GENIVAR Ontario

FIGURE 9a-6



Legend

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

N W E S

90 45 0 90 Metres

MANAGED LANDS - SEVERN ESTATES

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

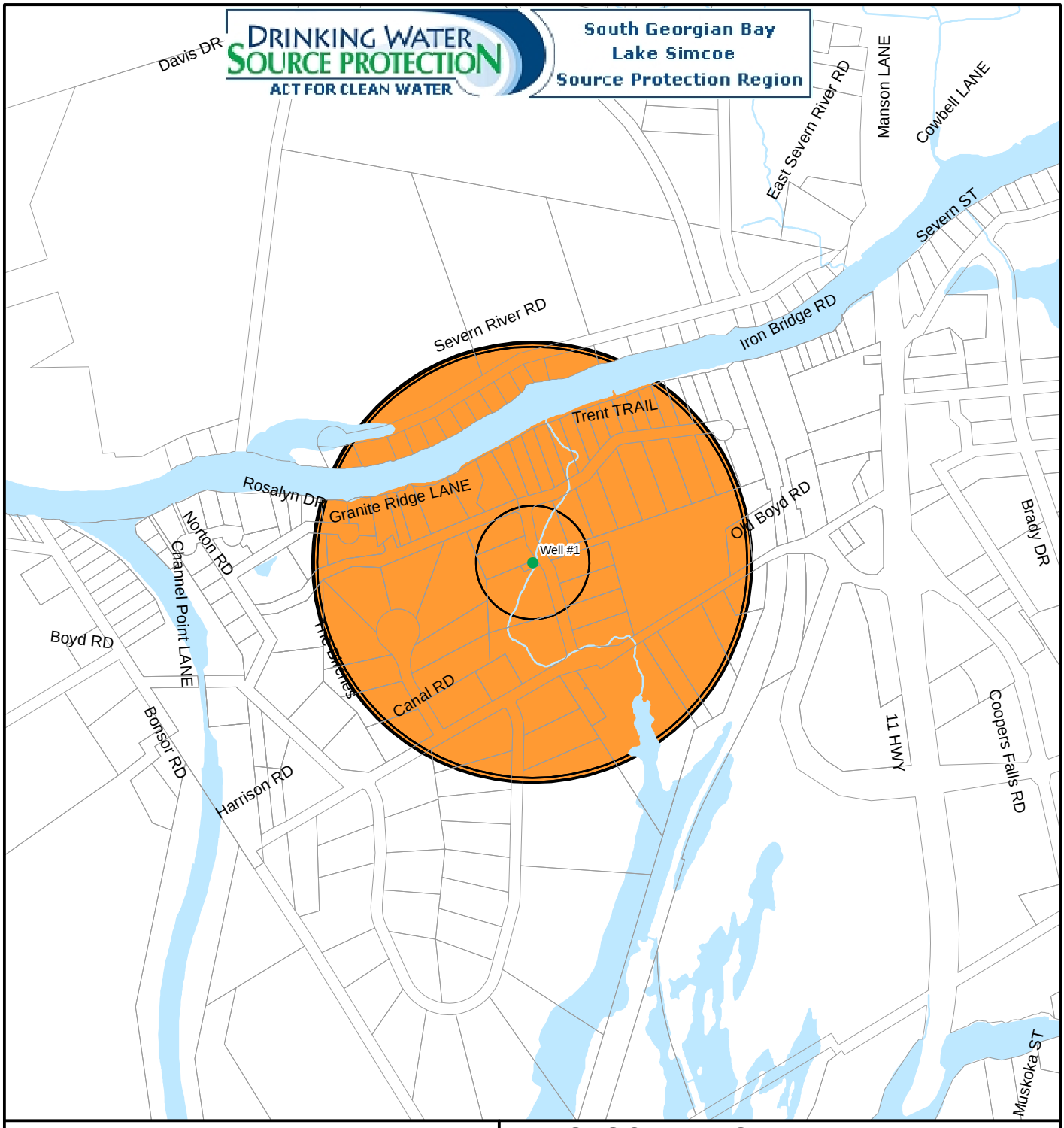
The Managed Land proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-7

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GENIVAR Ontario

FIGURE **9a-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 - SEVERN ESTATES

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

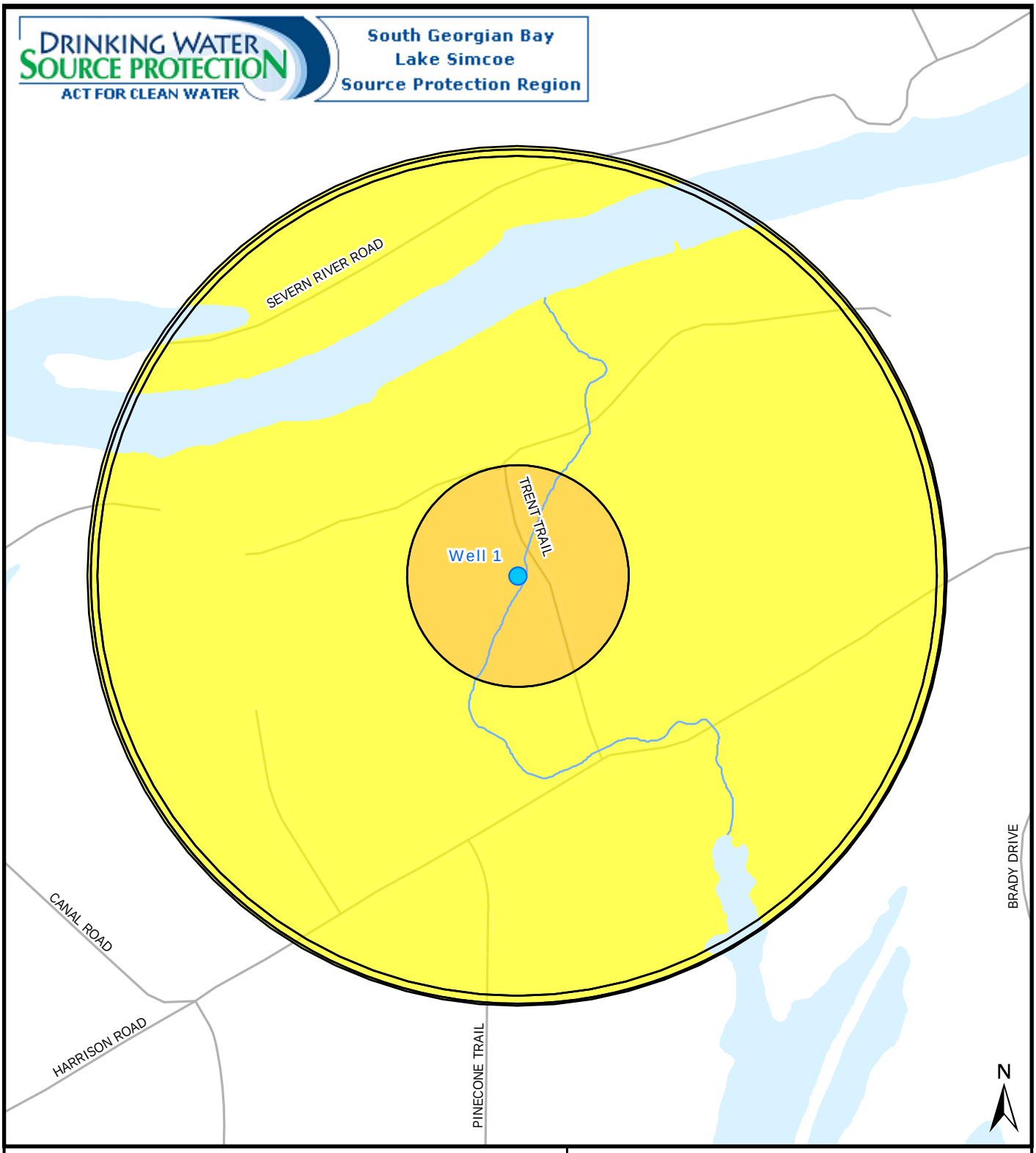
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

DATE: JUNE 2010	SCALE: 1:10000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.5-8

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GENIVAR Ontario

FIGURE **9a-8**



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Severn Estates WHPA

Created by: LSRCA, 2025-08-05

Scale 1:5,000

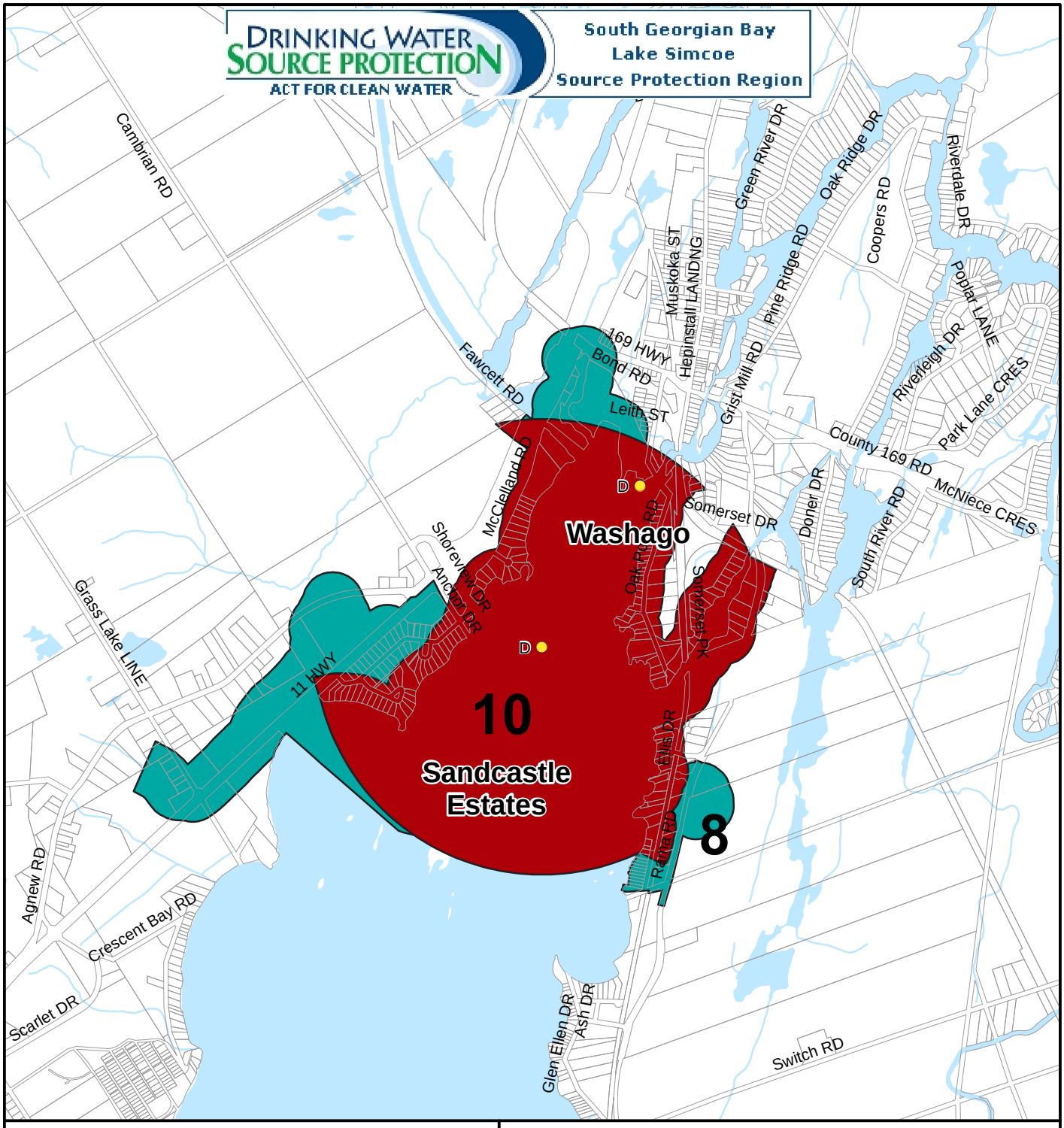
0 40 80 160 m

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 9a-9



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

INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - SANDCASTLE ESTATES, SEVERN

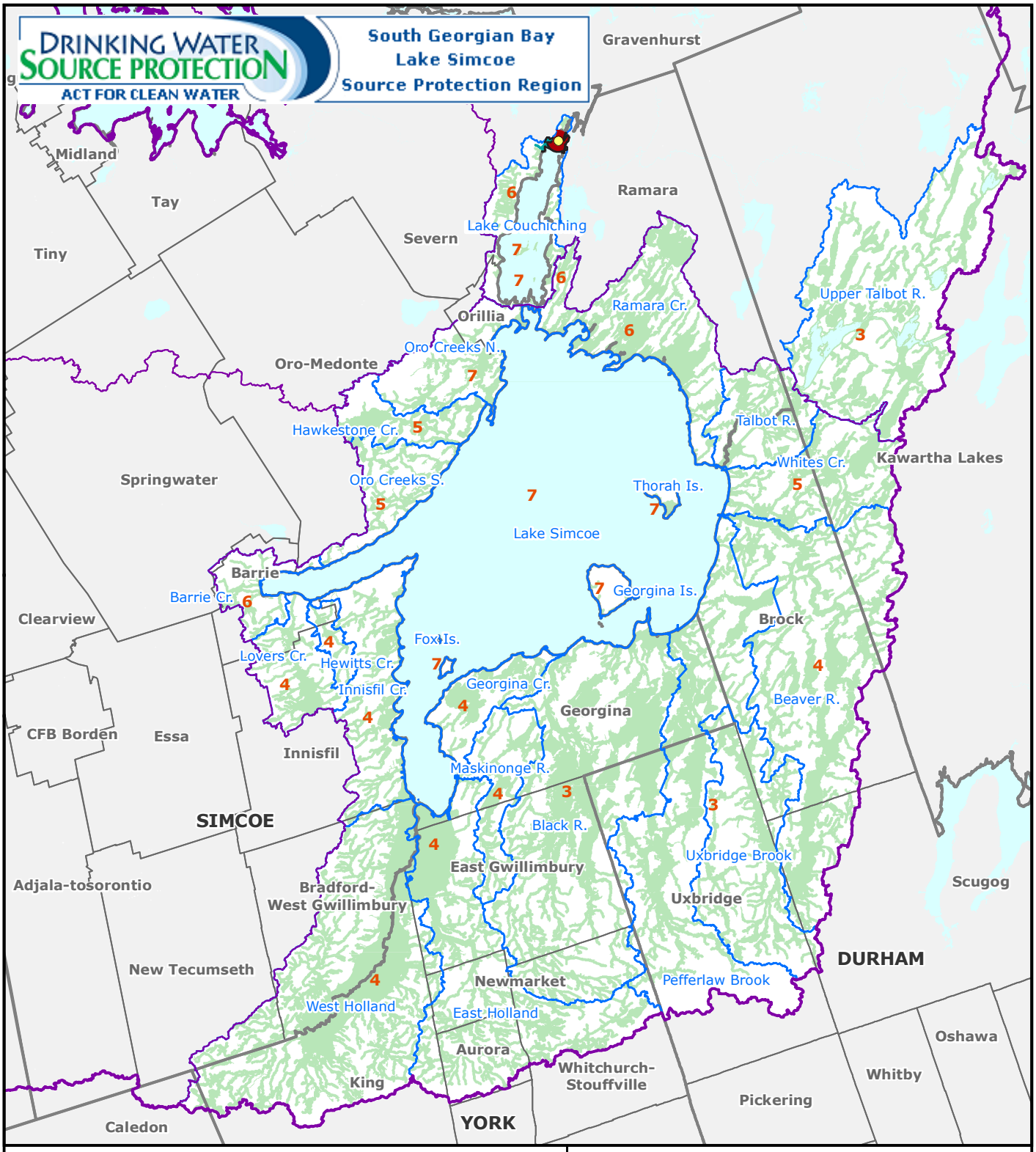
SELECTED MUNICIPAL GROUNDWATER SUPPLIES

DATE: APRIL 2011	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.1-1a

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 **9b-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
Sandcastle Estates, Severn

Created by: LSRCA
Date: 2011-04-04

GENIVAR

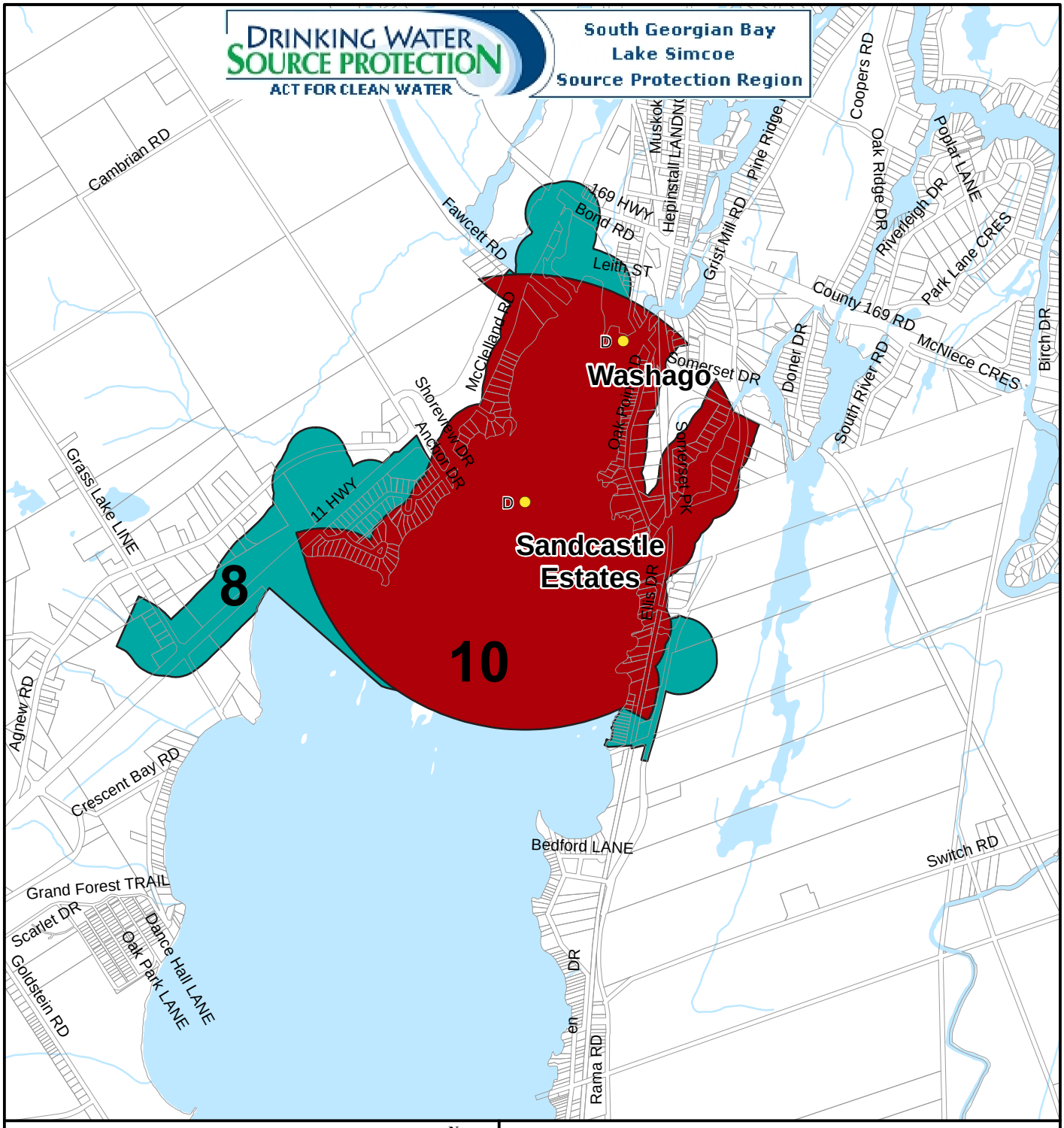
Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

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While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 9b-2



Legend

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

250 125 0 250 Metres

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

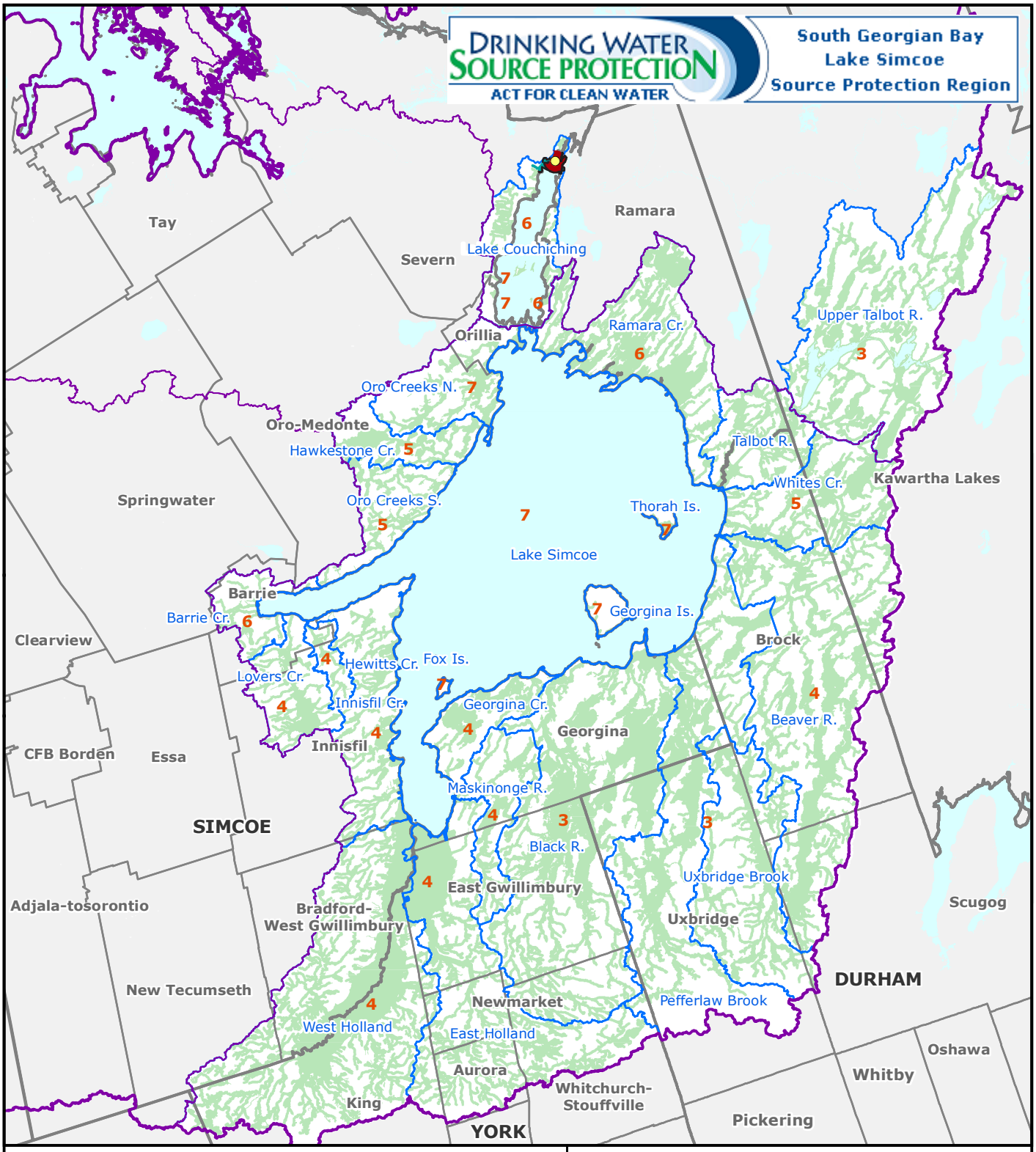
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: APRIL 2011	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.1-2a

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GENIVAR Ontario

FIGURE **9b-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
Sandcastle Estates, Severn

Created by: LSRCA
Date: 2011-04-19

GENIVAR

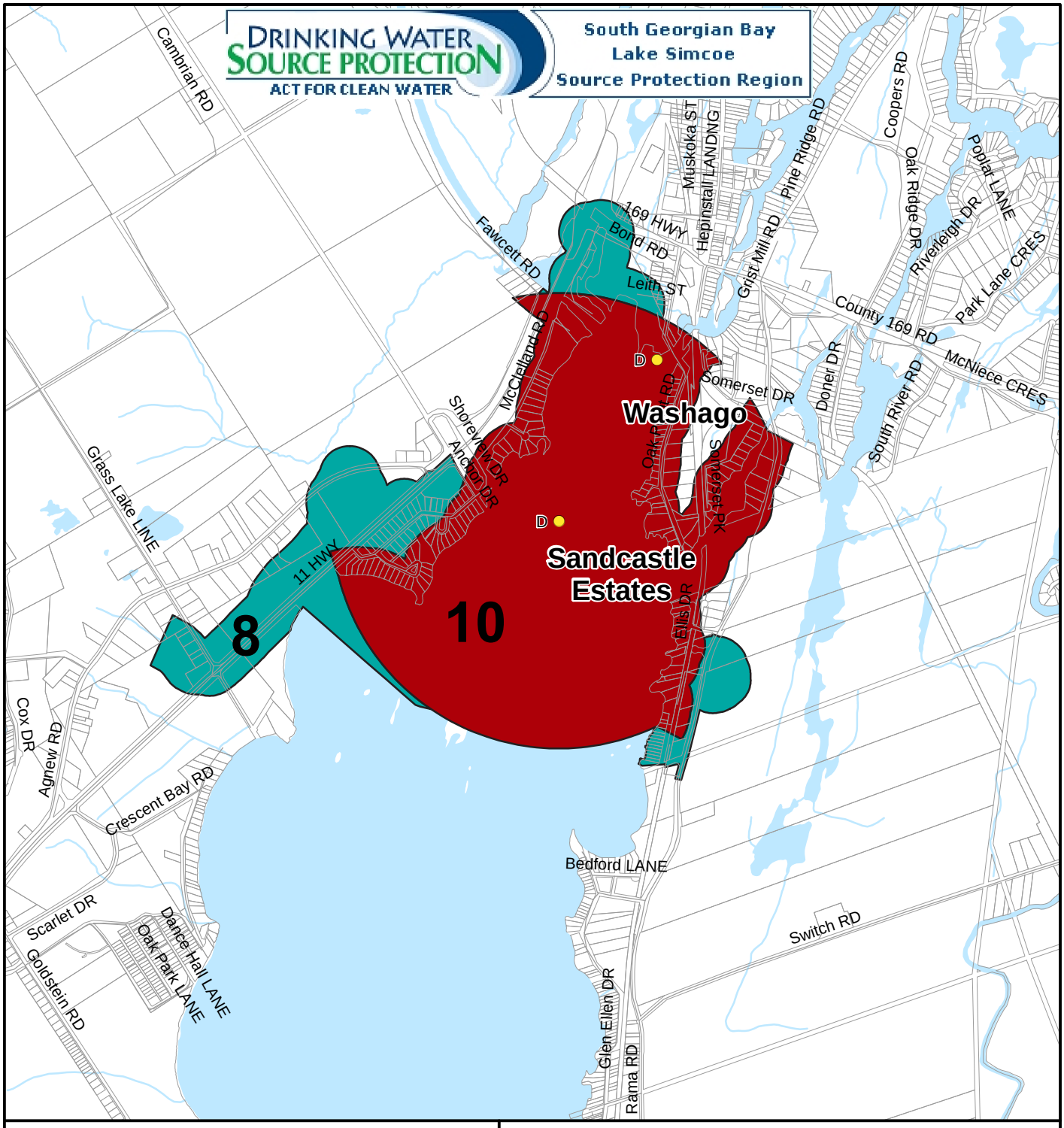
Scale: 1:500,000 0 2 4 6 8 10km

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 9b-4



Legend

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

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

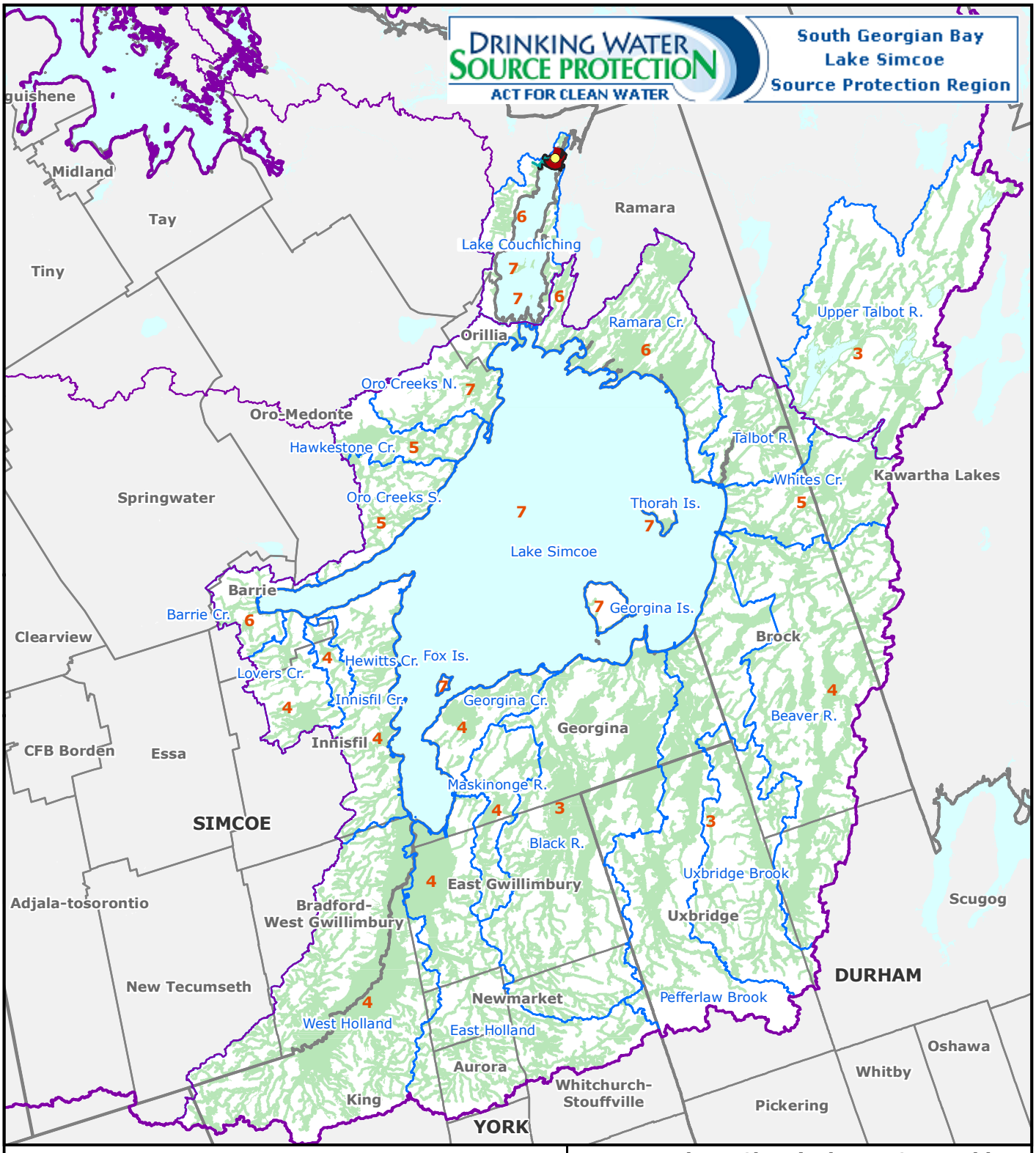
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: APRIL 2011	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-0719480915.1-3a

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GENIVAR Ontario

FIGURE **9b-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
Sandcastle Estates, Severn

Created by: LSRCA
Date: 2011-04-19

GENIVAR

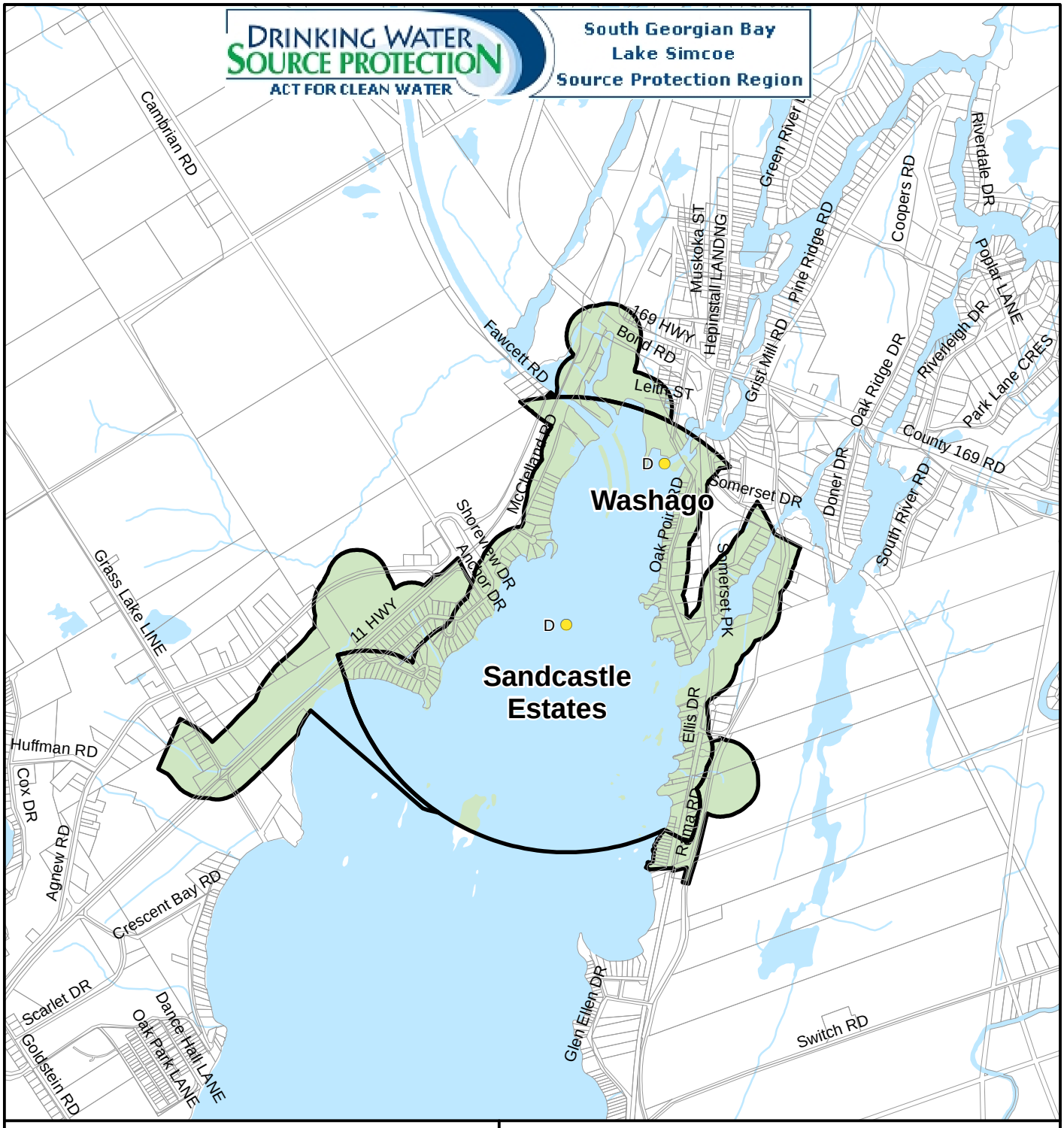
Scale: 1:500,000 0 2 4 6 8 10km

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 9b-6



Legend

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

N W E S

250 125 0 250 Metres

MANAGED LANDS - SANDCASTLE ESTATES

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: APRIL 2011

SCALE: 1:25000

PROJECT: 0-071948.09

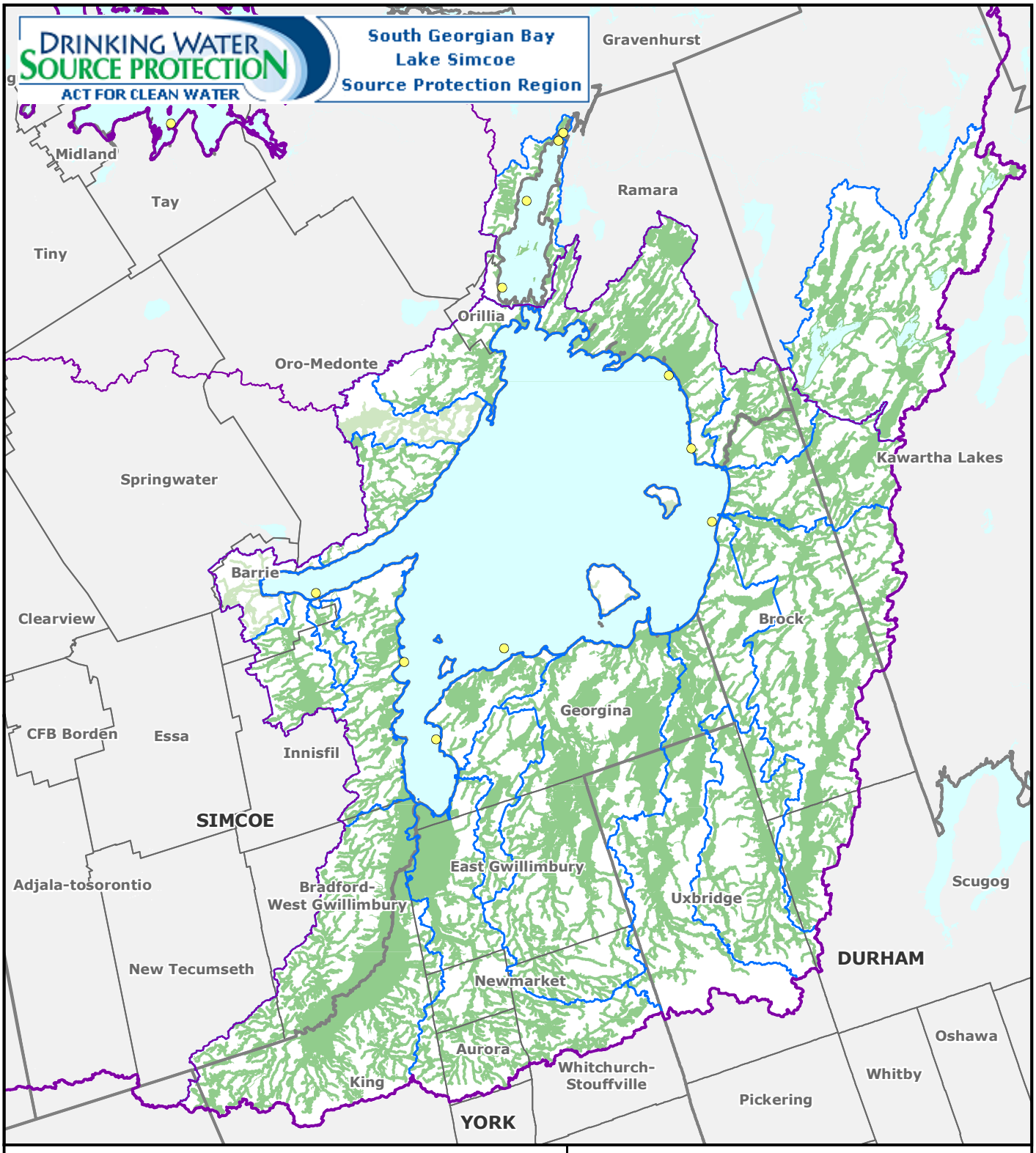
FILE. NO.:0-07194809F15.1-4a

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 9b-7



Surface Water Intake (Type D)

Managed Lands
- < 40 %
- 40 - 80 %
- > 80 %

SWP Watershed Region
SWP Watershed Area
Subwatershed Boundary

Managed Lands
Intake Protection Zone 3

Created by: LSRCA
Date: 2011-04-19

GENIVAR

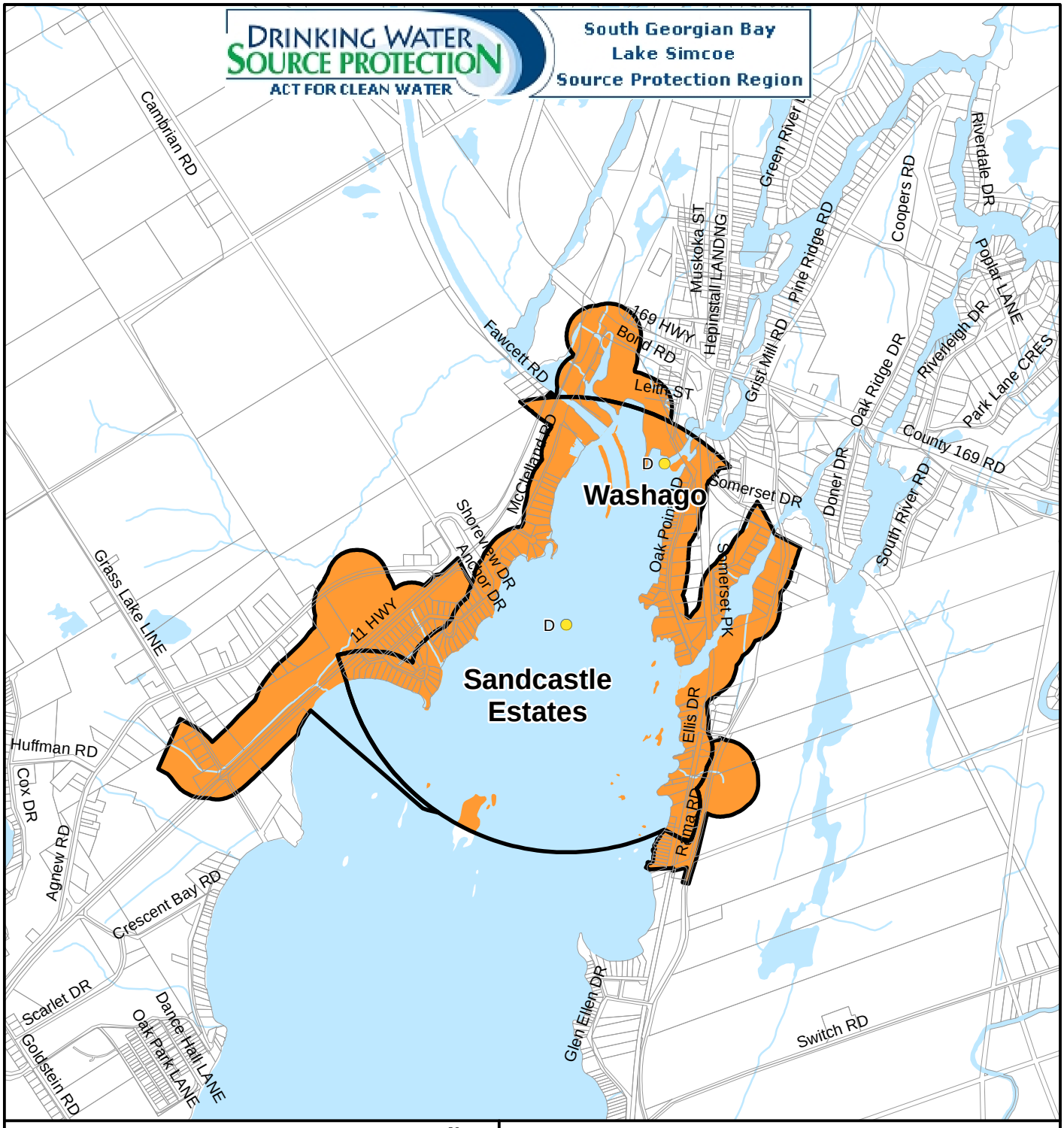
Scale: 1:500,000 0 2 4 6 8 10km

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 9b-8



LIVESTOCK DENSITY - SANDCASTLE ESTATES

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

DATE: APRIL 2011

SCALE: 1:25000

PROJECT: 0-071948.09

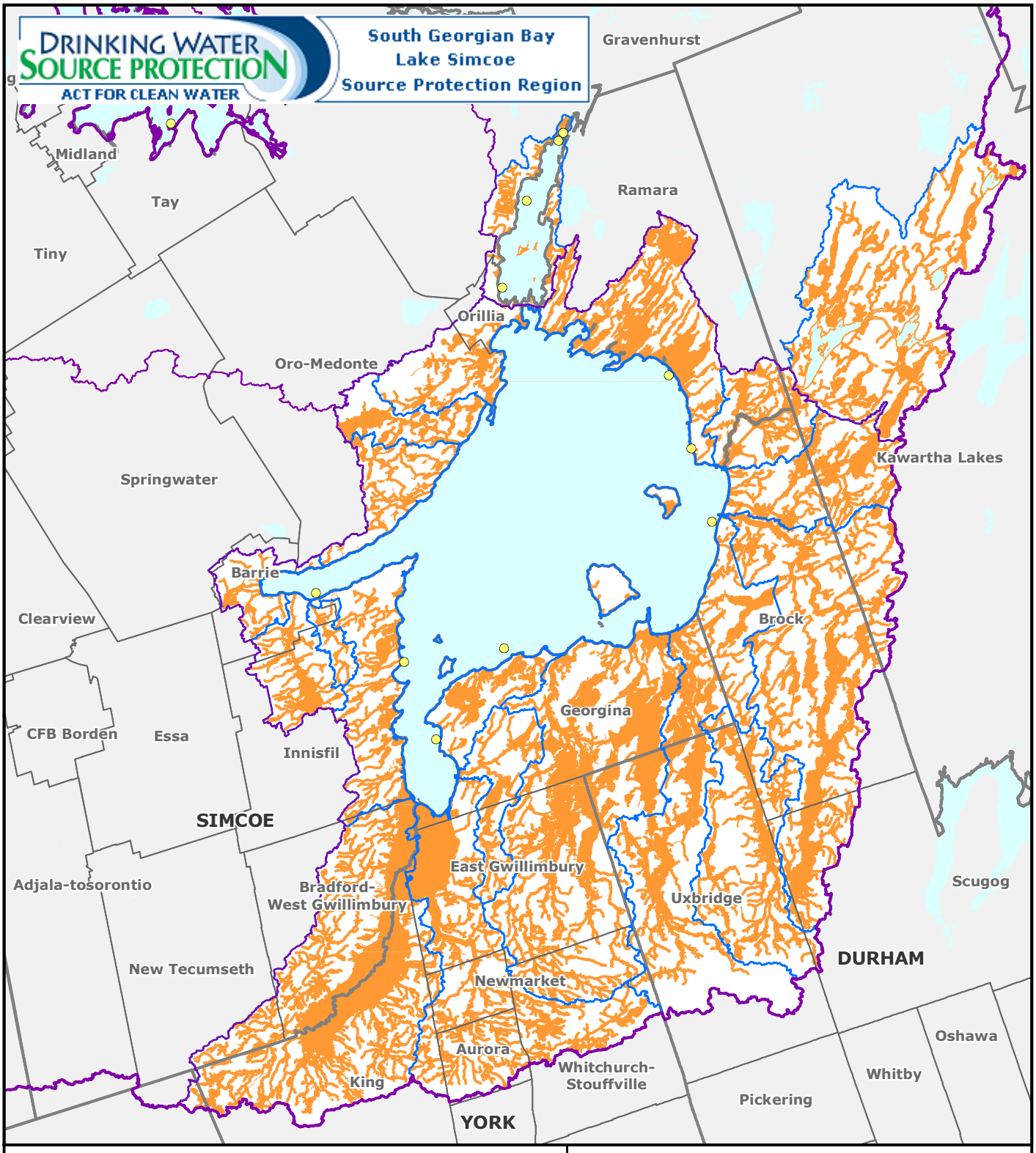
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GENIVAR

Ontario

FIGURE 9b-9



Surface Water Intake (Type D)

Livestock Density (nutrient units per acre)

- < 0.5
- 0.5 - 1.0
- > 1.0
- SWP Watershed Region
- SWP Watershed Area
- Subwatershed Boundary

Livestock Density
Intake Protection Zone 3

Created by: LSRCA
Date: 2011-04-19

GENIVAR

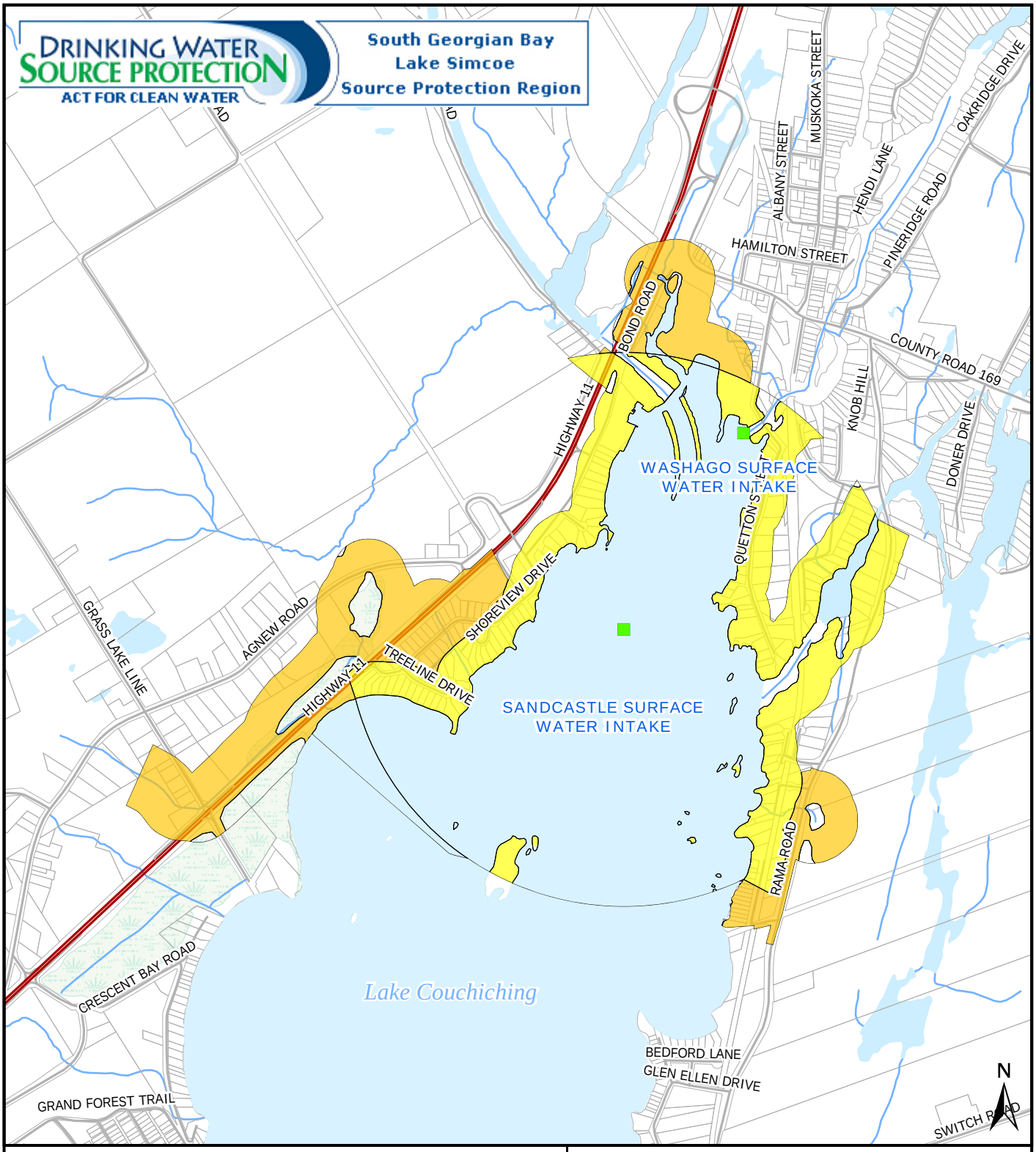
Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

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While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 9b-10



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

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

Impervious Surfaces - Sandcastle Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

Scale 1:20,000

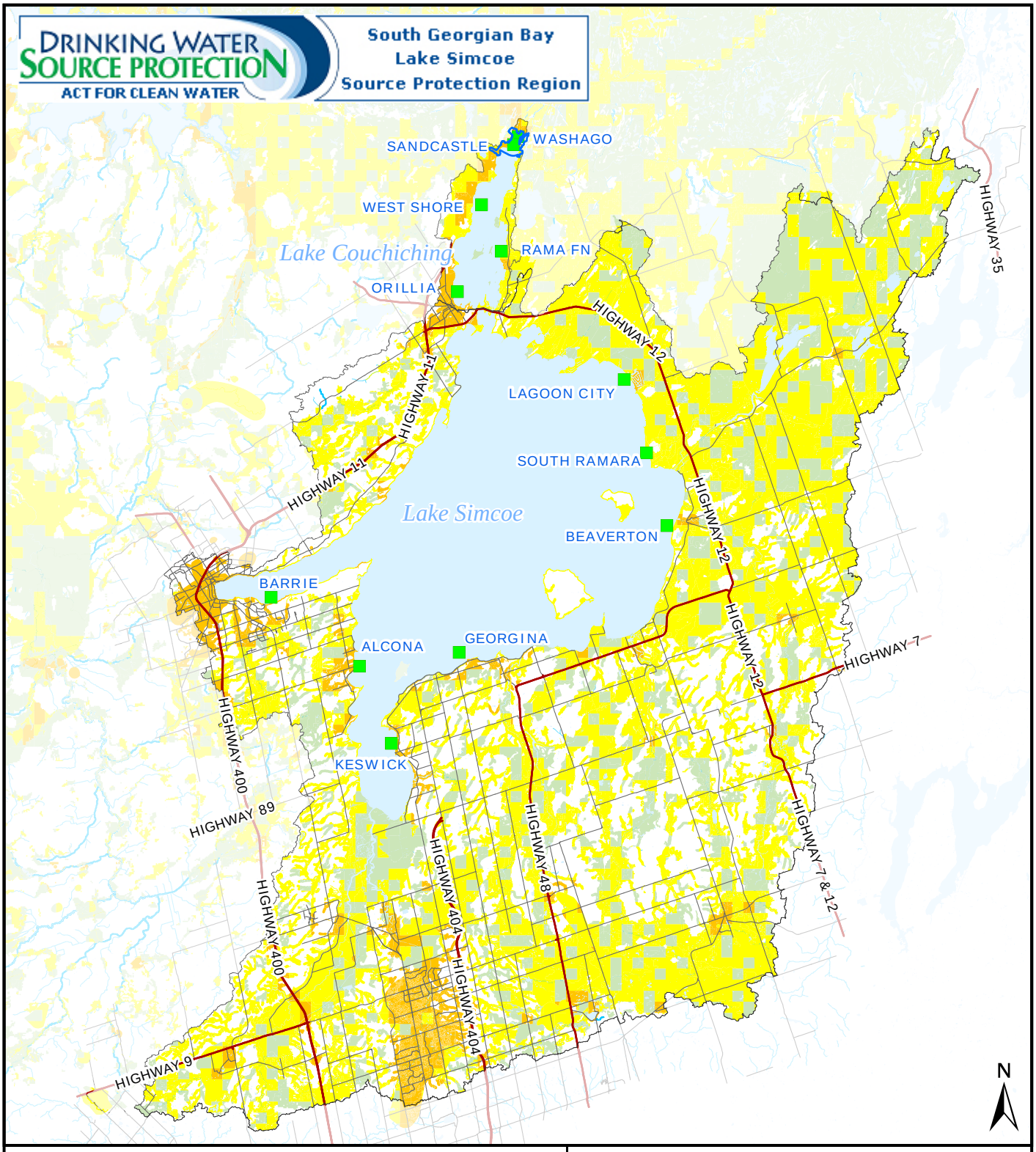
0 0.15 0.3 0.6 km

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 9b-11



Surface Water Intake

Impervious Surfaces in IPZ 3

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

Impervious Surfaces - Sandcastle Intake Protection Zone 3

Created by: LSRCA, 2025-08-05

Scale 1:500,000

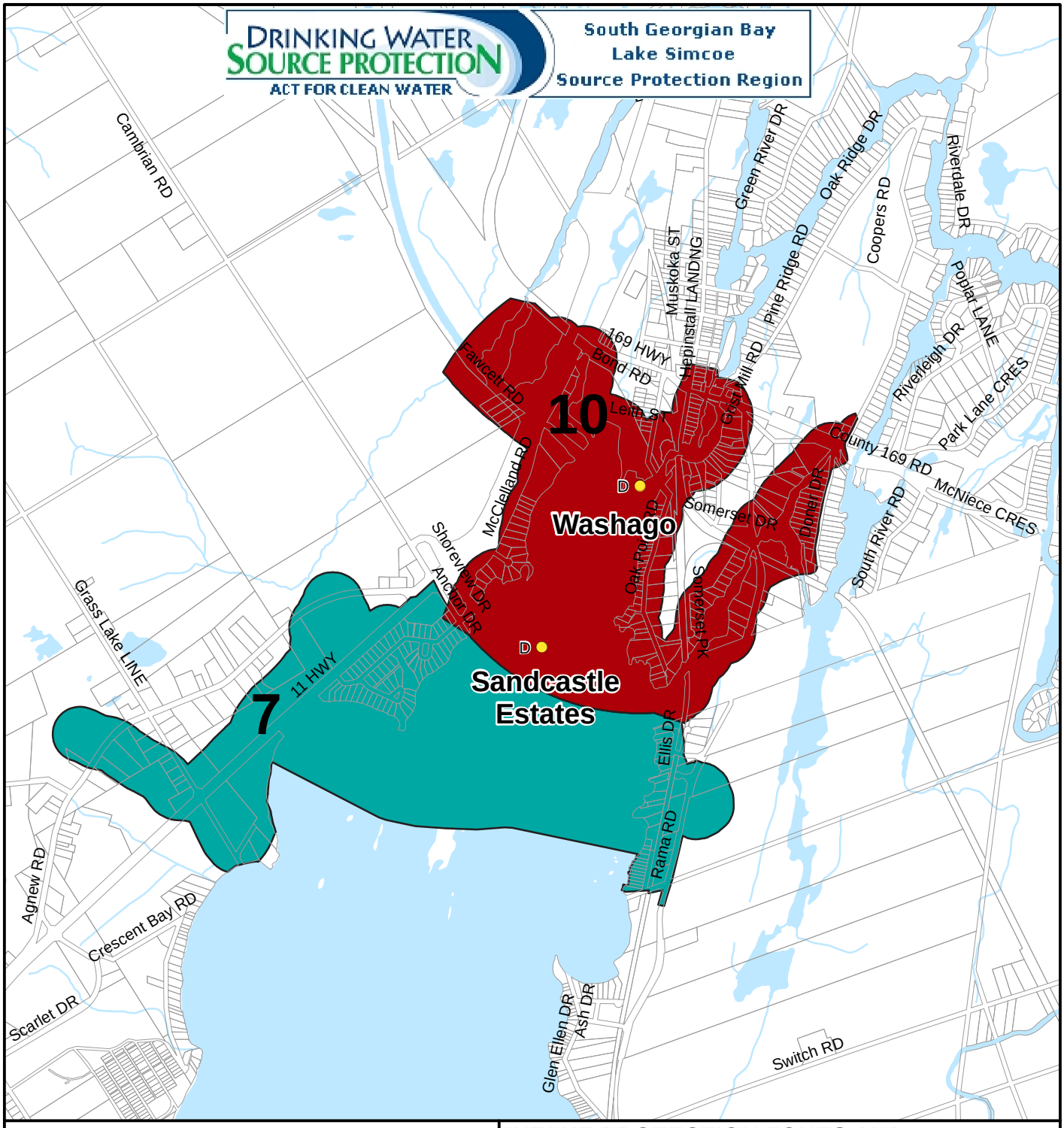
0 5 10 15 20km

UTM Zone 17N, NAD83

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While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 9b-12



Legend

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

N
W E
S

250 125 0 250 Metres

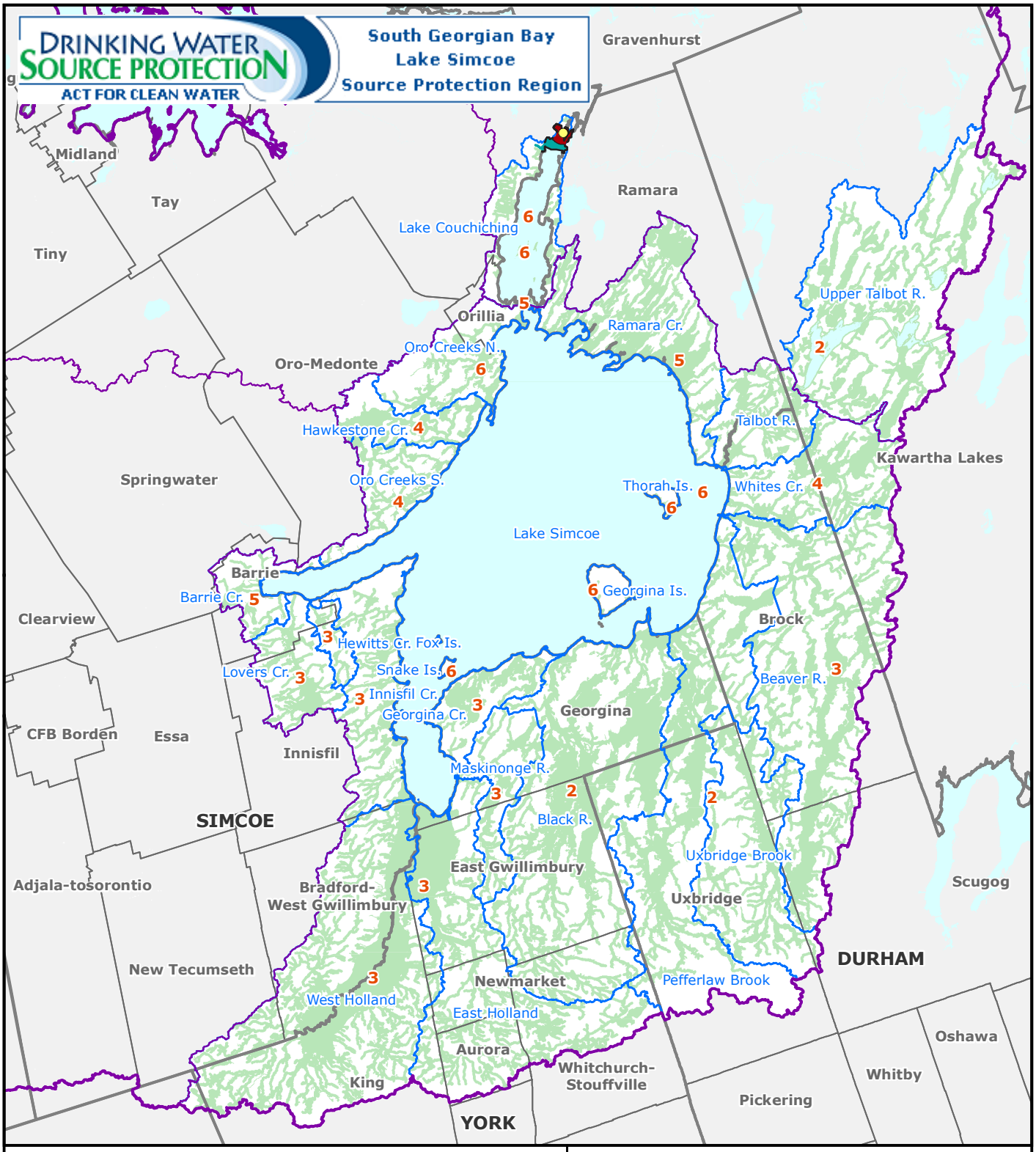
INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - WASHAGO, SEVERN

DATE: MARCH 2011	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.1-1b

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 **9c-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
Washago, Severn

Created by: LSRCA
Date: 2011-04-19

GENIVAR

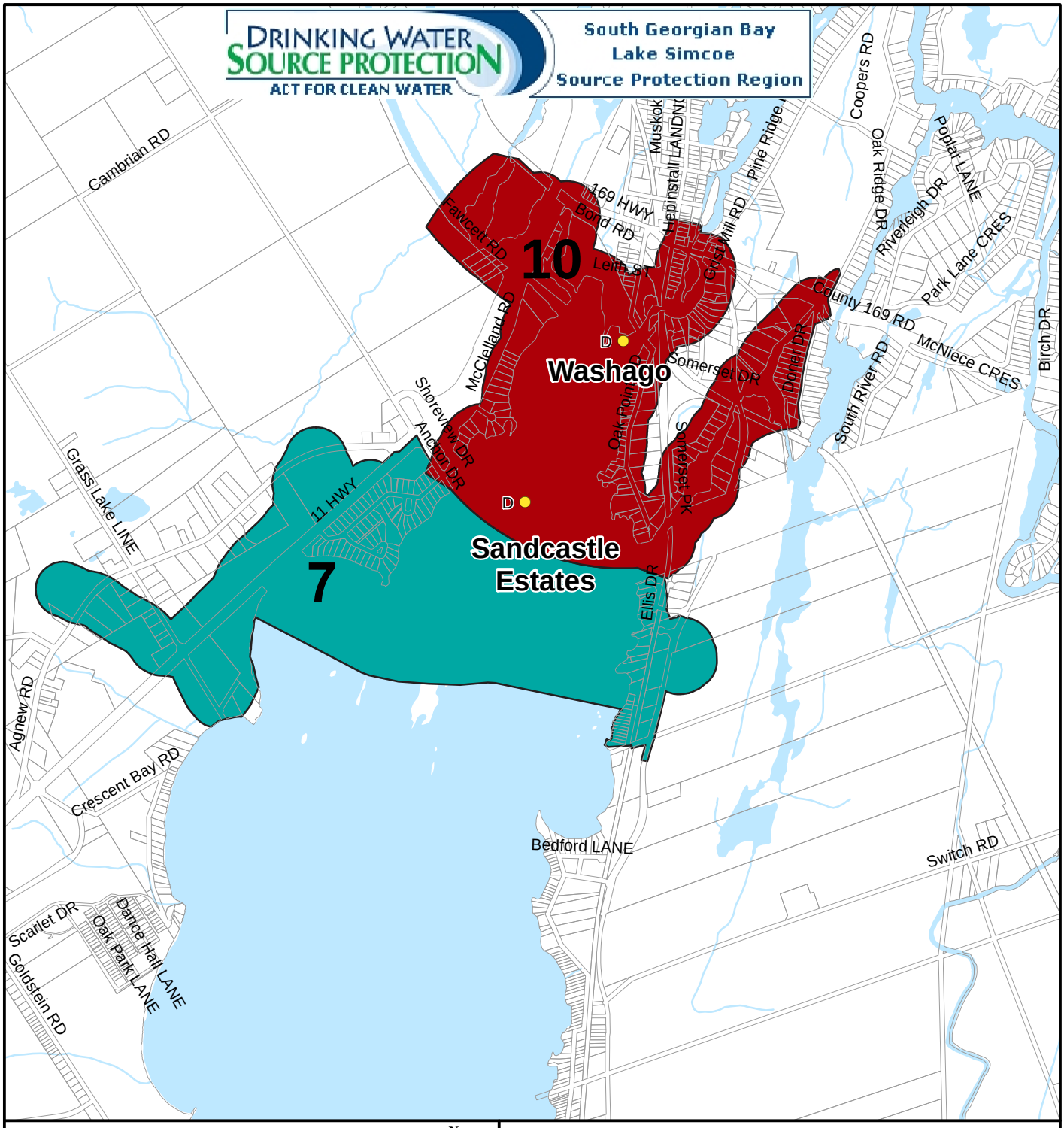
Scale: 1:500,000 0 2 4 6 8 10km

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 9c-2



Legend

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

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

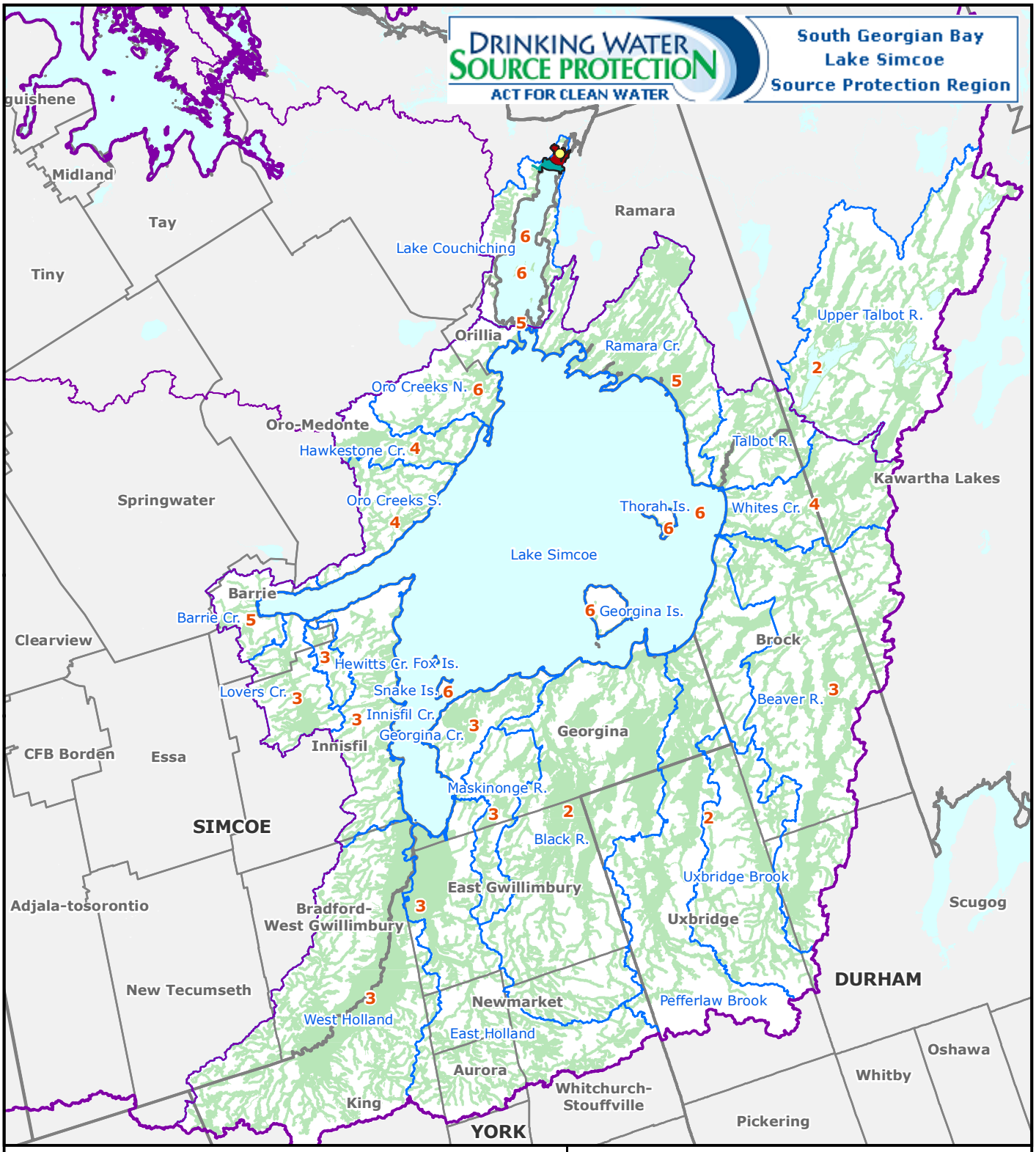
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: MARCH 2011	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.1-2b

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 **9c-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
Washago, Severn

Created by: LSRCA
Date: 2011-04-19

GENIVAR

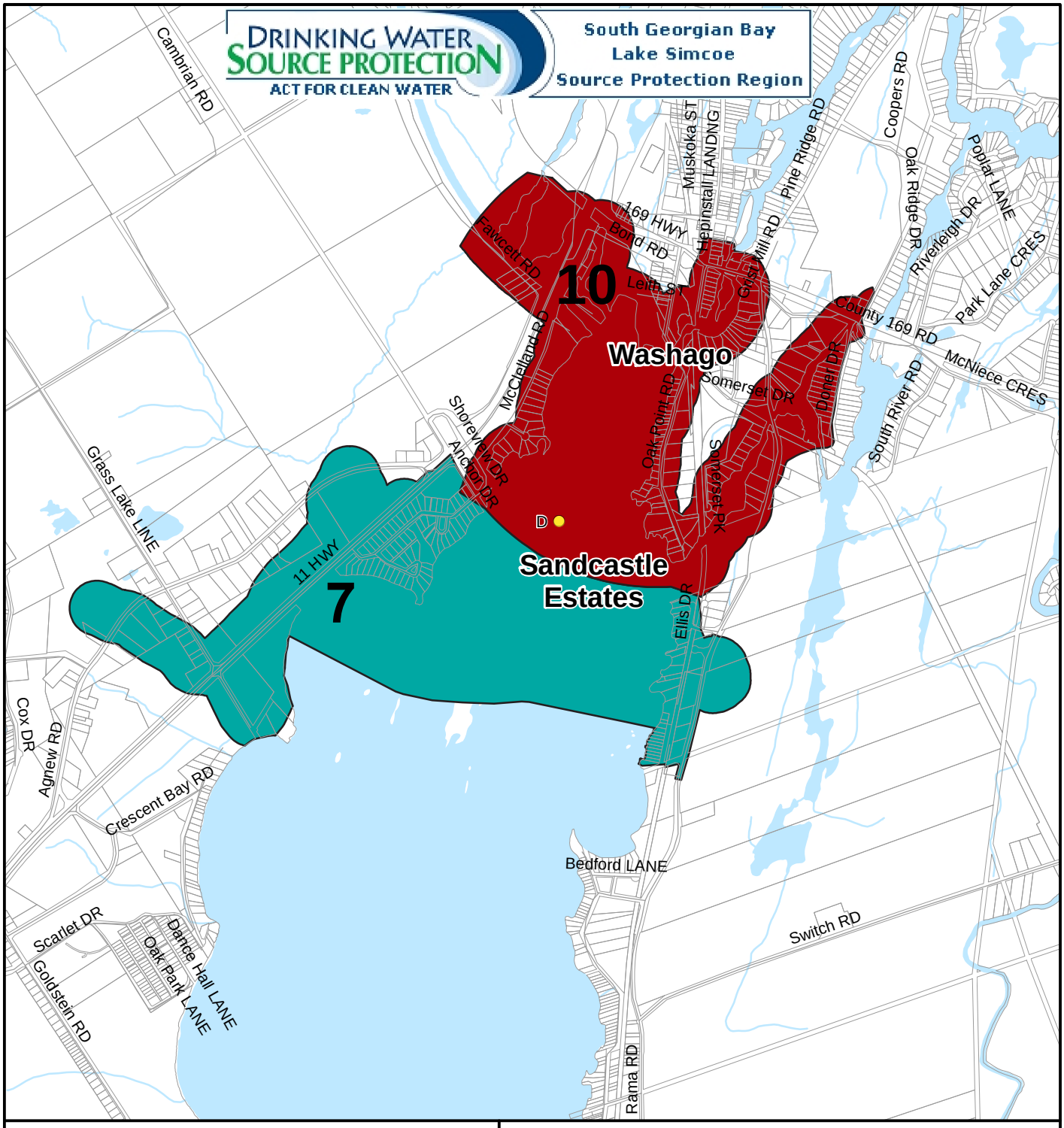
Scale: 1:500,000 0 2 4 6 8 10km

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 9c-4



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

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.

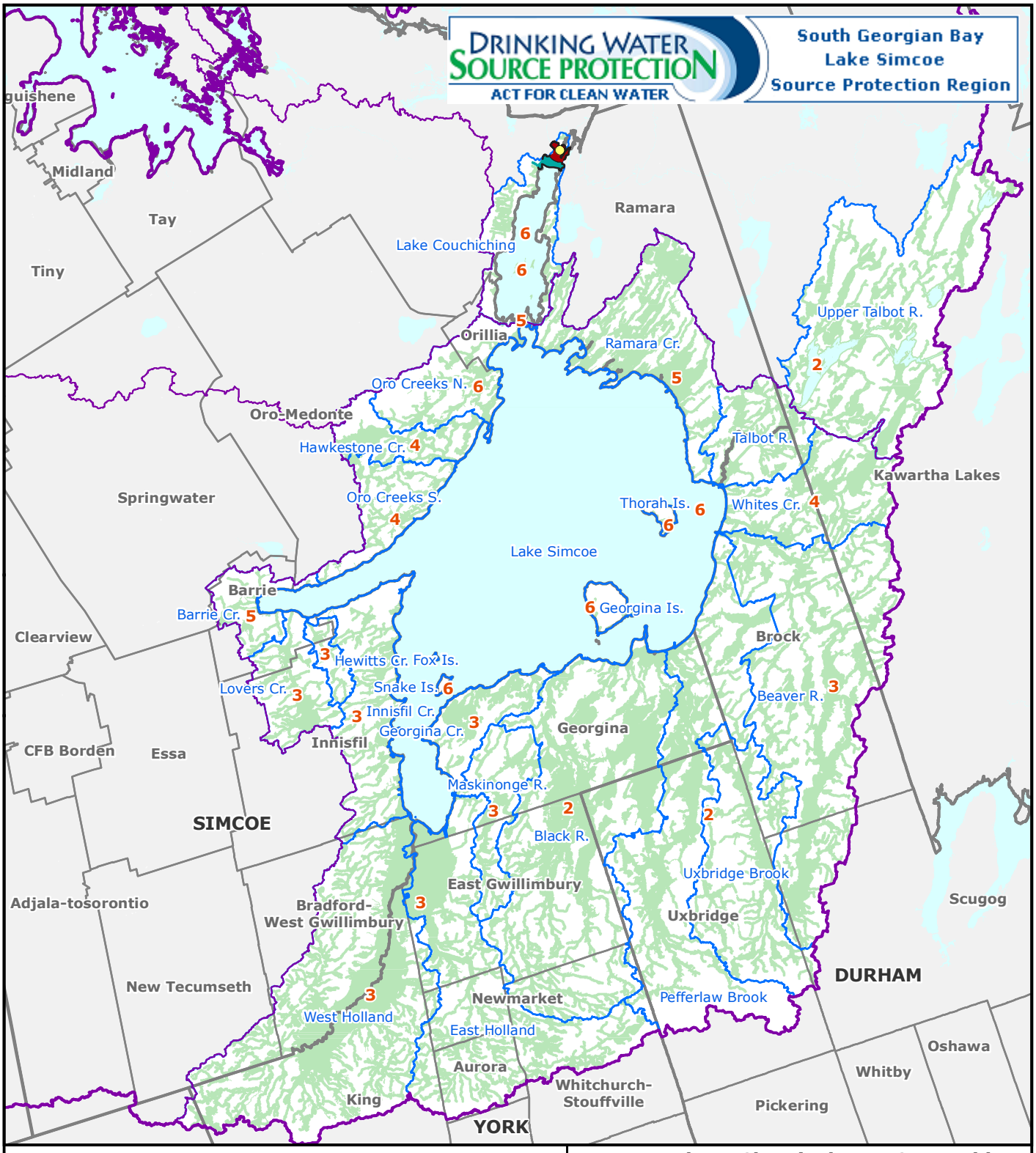
DATE: MARCH 2011	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-0719480915.1-3b

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GENIVAR

Ontario

FIGURE
9c-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
Washago, Severn

Created by: LSRCA
Date: 2011-04-19

GENIVAR

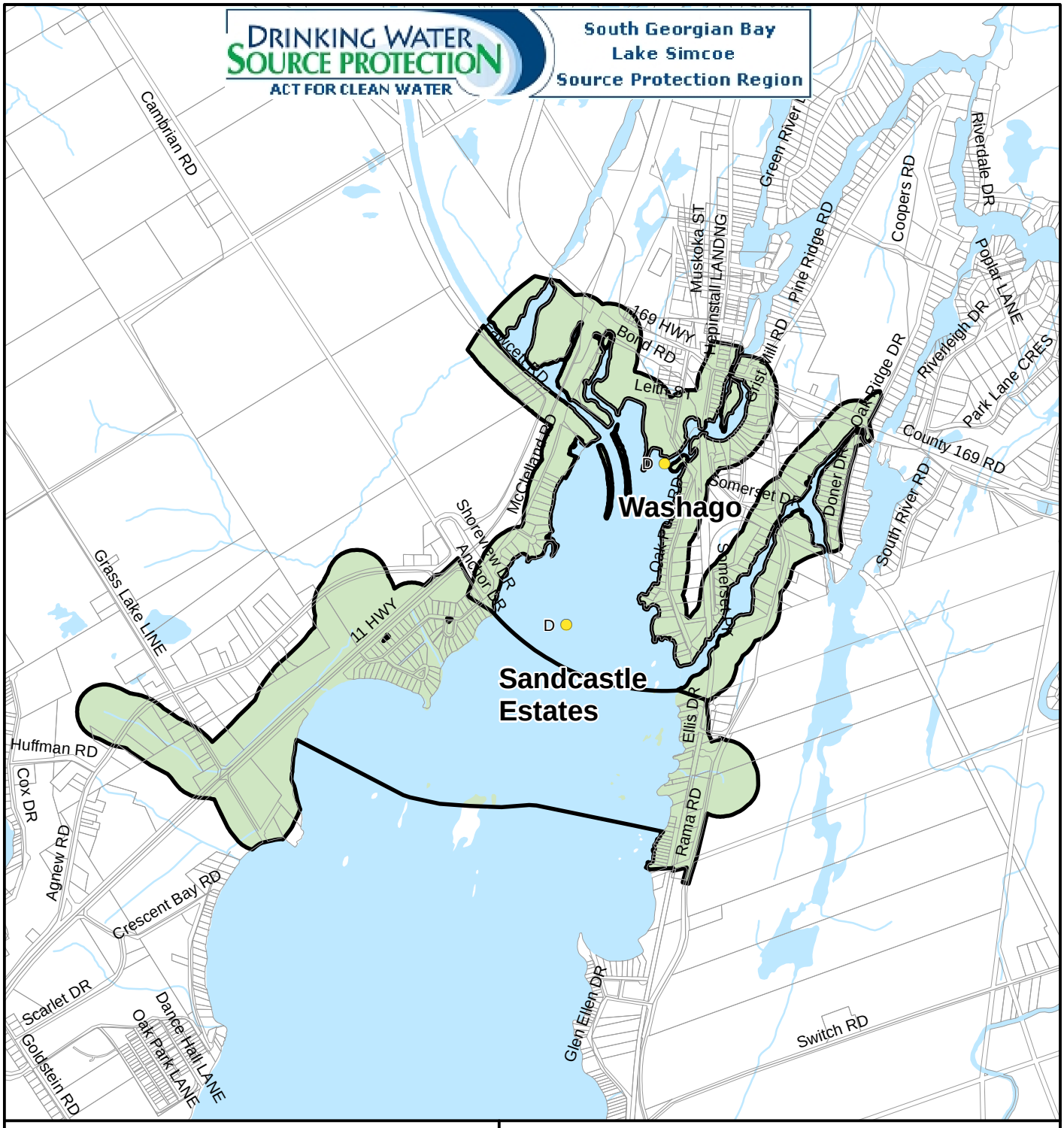
Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

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Ontario

Figure 9c-6



MANAGED LANDS - WASHAGO

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: MARCH 2011

SCALE: 1:25000

PROJECT: 0-071948.09

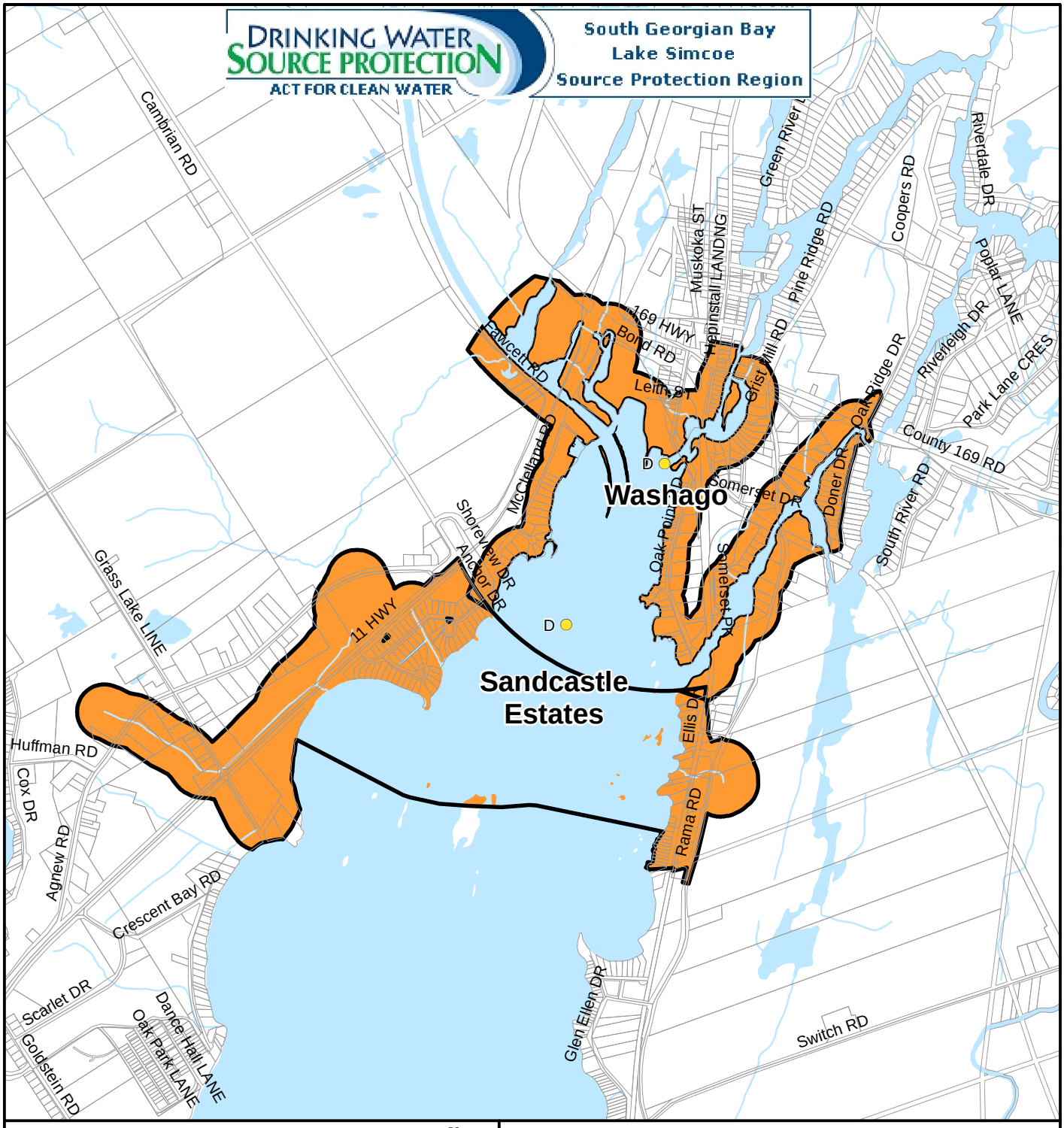
FILE. NO.:0-07194809F15.1-4b

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GENIVAR

Ontario

FIGURE 9c-7



LIVESTOCK DENSITY - WASHAGO

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

DATE: MARCH 2011

SCALE: 1:25000

PROJECT: 0-071948.09

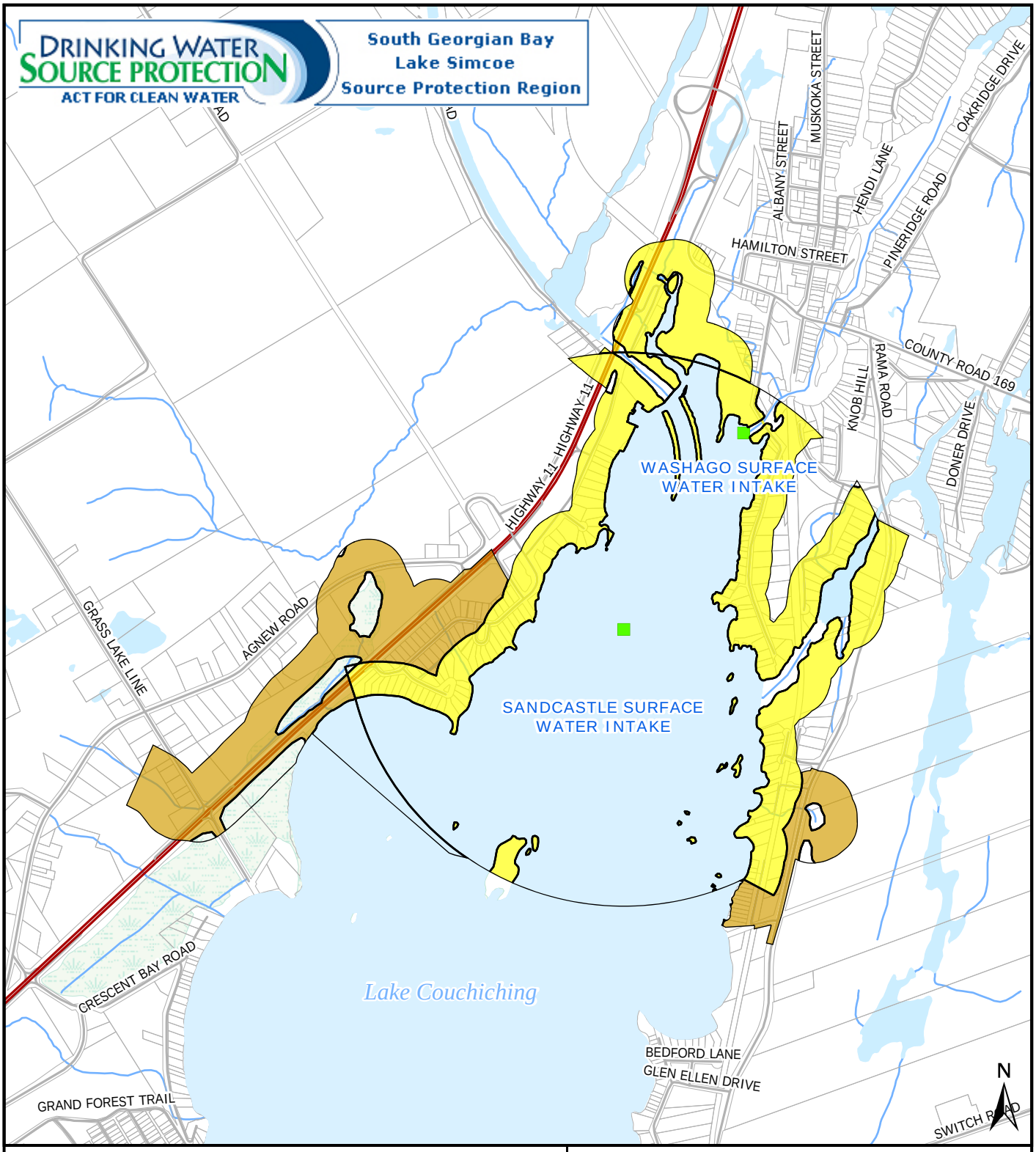
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GENIVAR

Ontario

FIGURE 9c-8



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

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

Impervious Surfaces - **Washago** Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

Scale 1:20,000

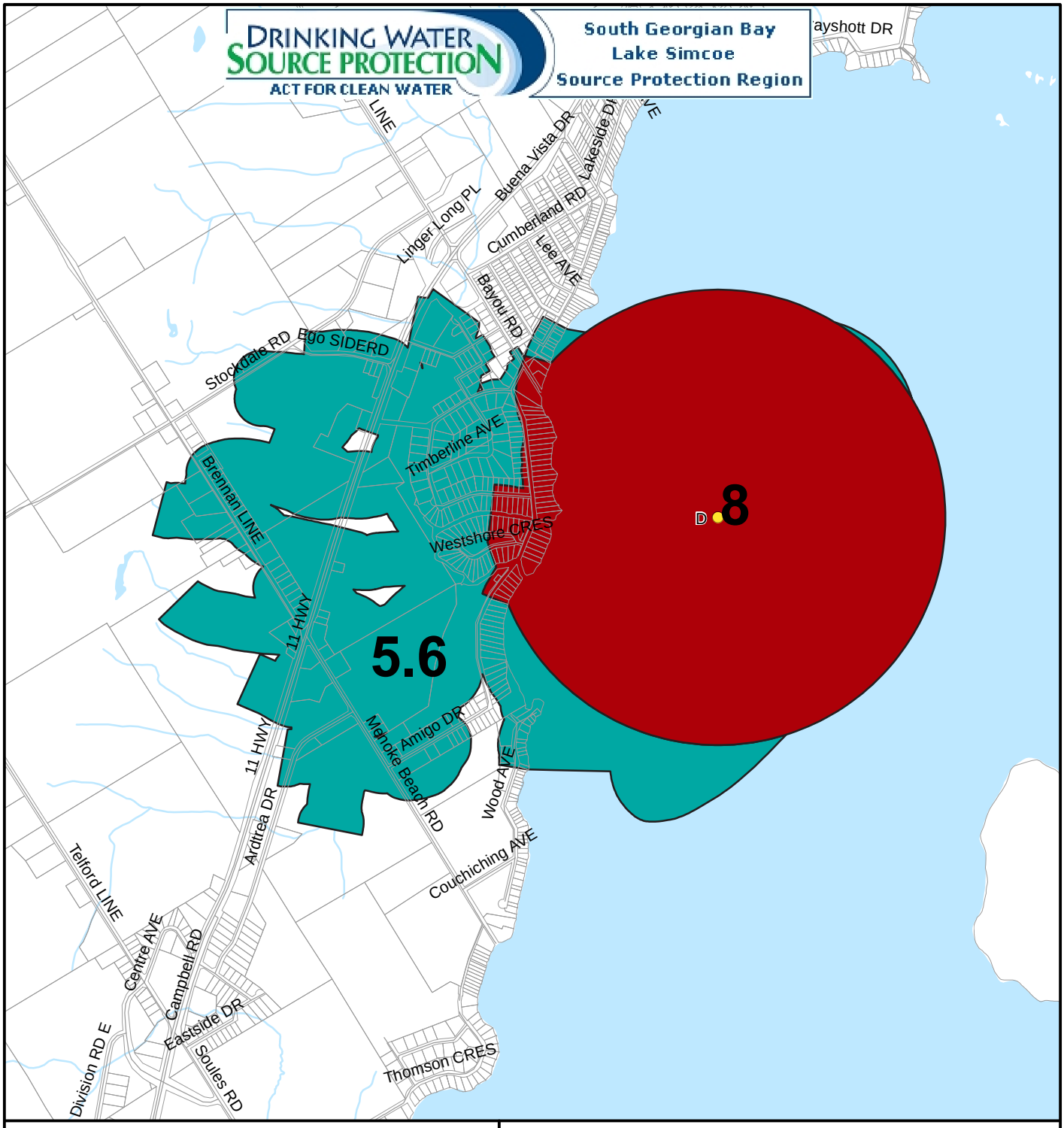
0 0.15 0.3 0.6 km

UTM Zone 17N, NAD83

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While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 9**c-9**



Legend

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

N W E S

250 125 0 250 Metres

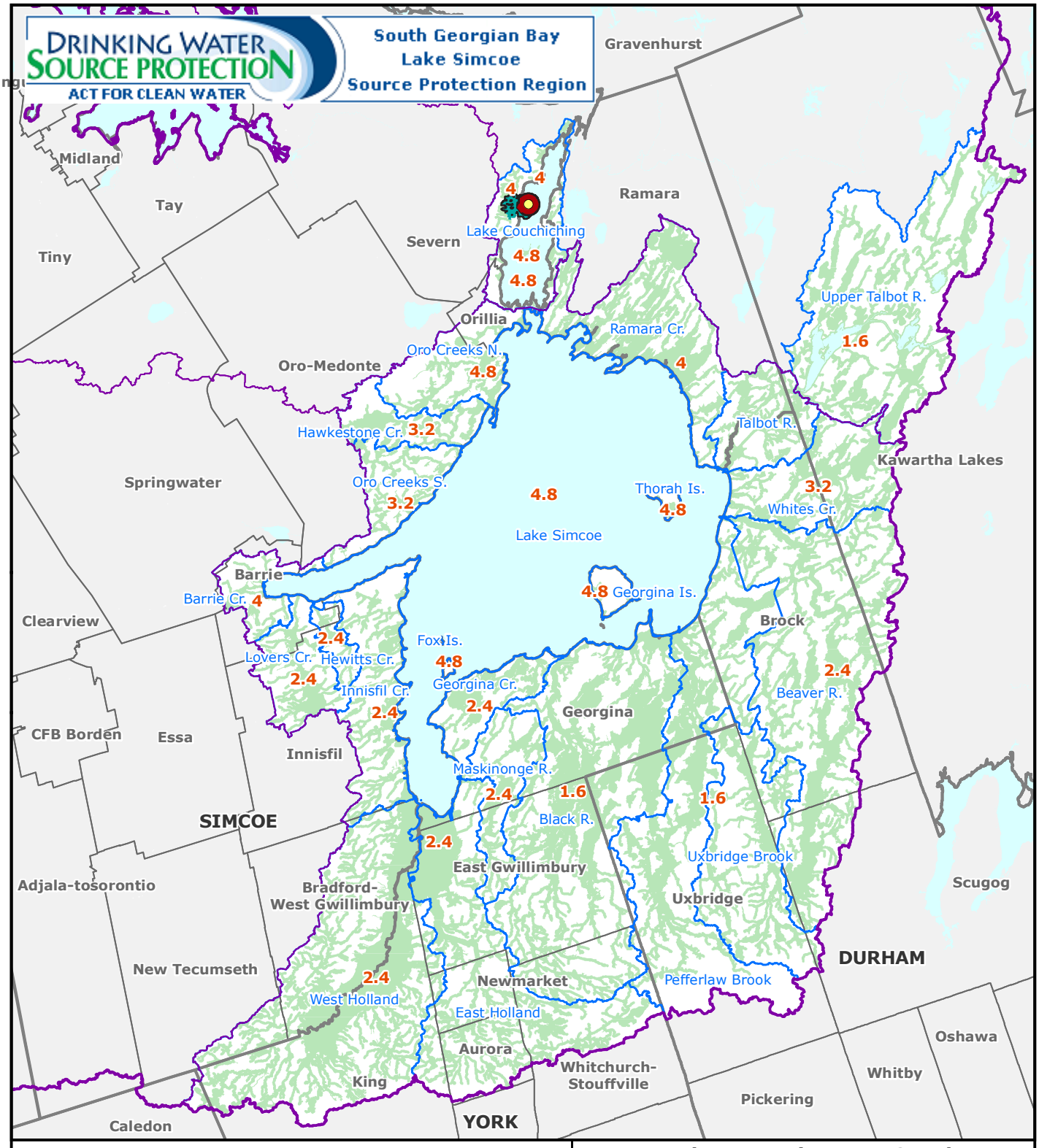
INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - WEST SHORE, SEVERN

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.2-1

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 **9d-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
West Shore, Severn

Created by: LSRCA
Date: 2010-10-20

GENIVAR

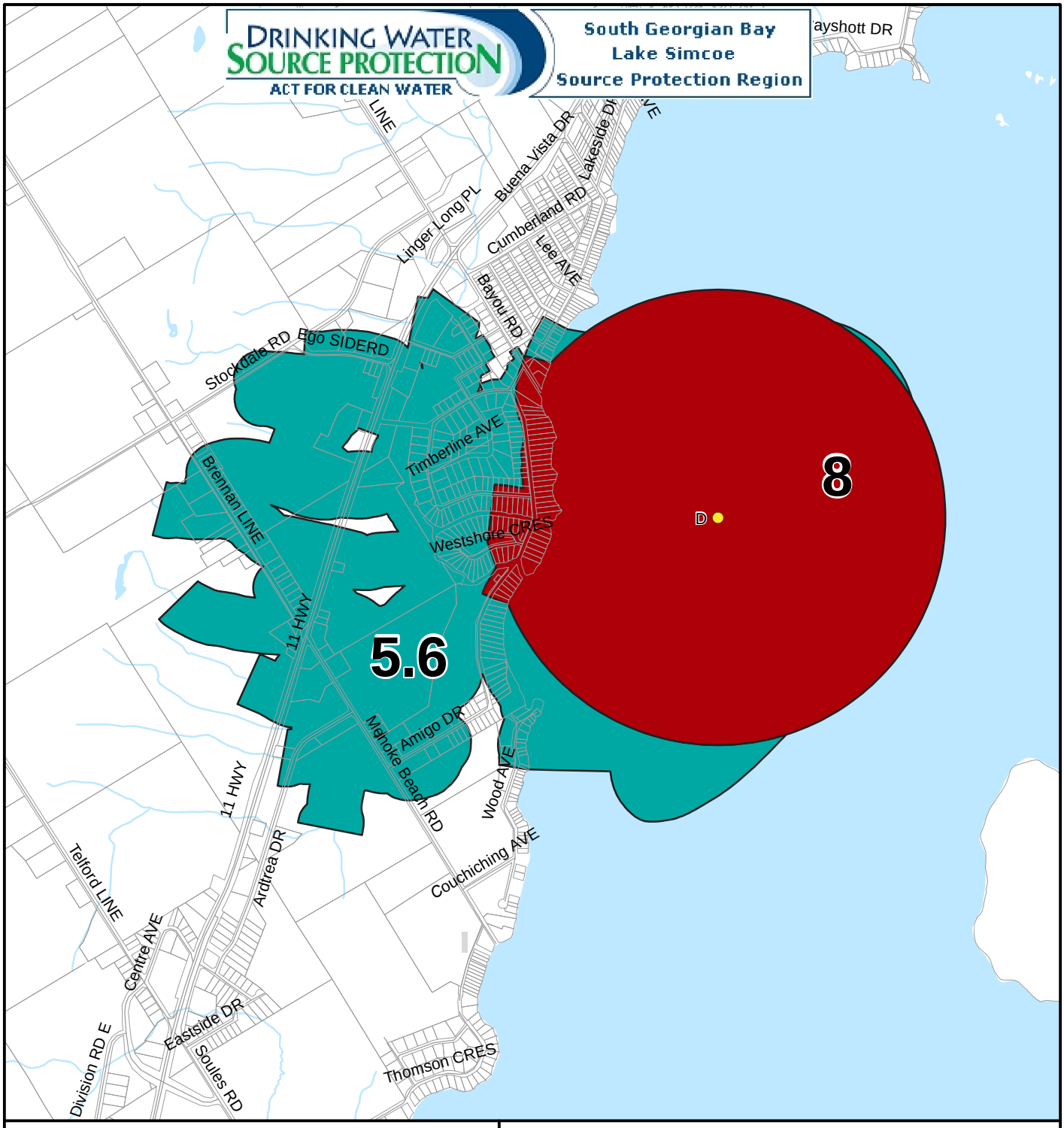
Scale: 1:500,000 0 2 4 6 8 10km

UTM Zone 17N, NAD83

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While every effort has been made to accurately depict the base data, errors may exist.

Ontario

Figure 9d-2



Legend

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

N W E S

250 125 0 250 Metres

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

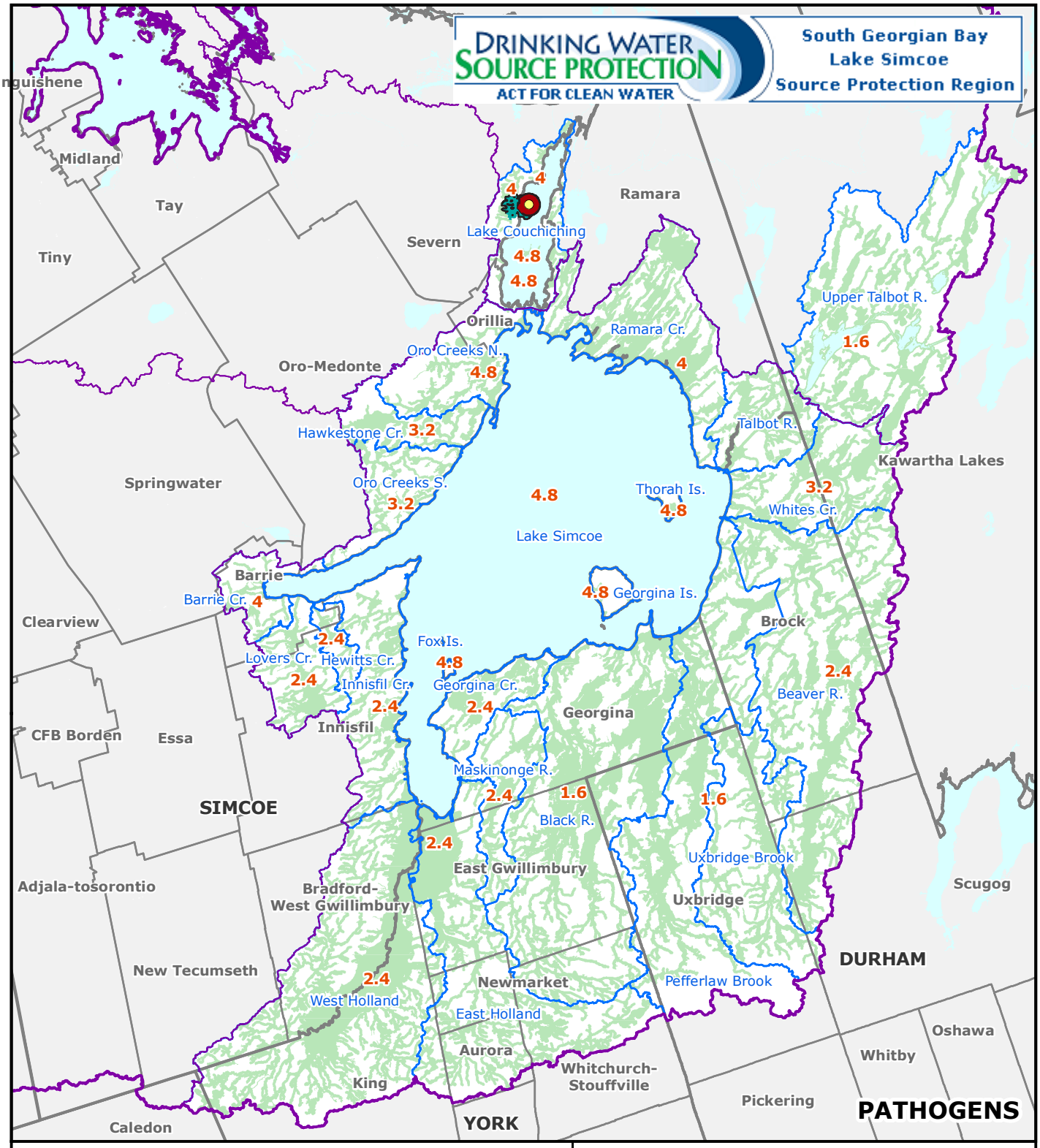
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.2-3

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GENIVAR Ontario

FIGURE **9d-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 West Shore, Severn

Created by: LSRCA
Date: 2010-10-20

GENIVAR

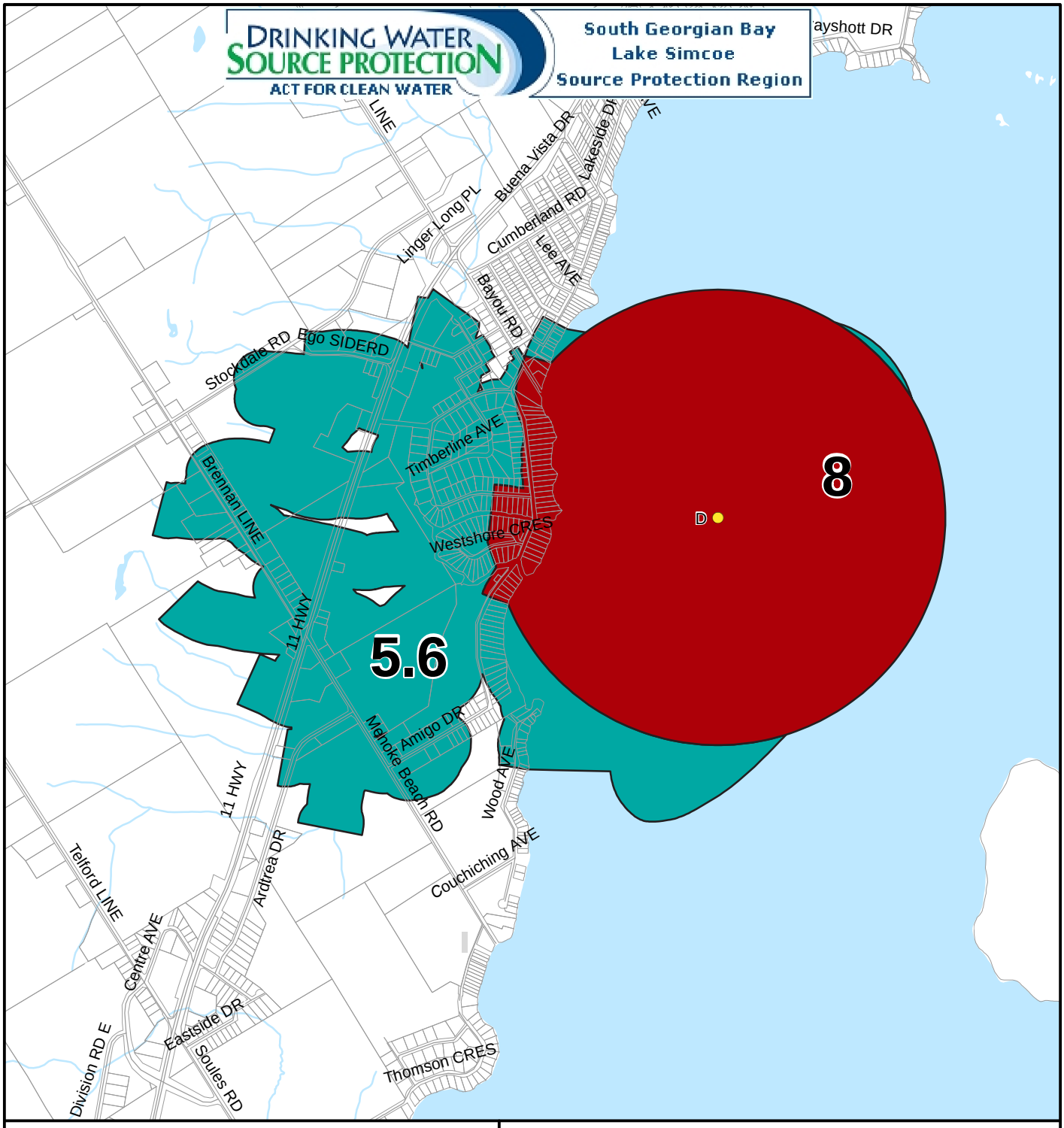
Scale: 1:500,000 0 2 4 6 8 10km

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 9d-4



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

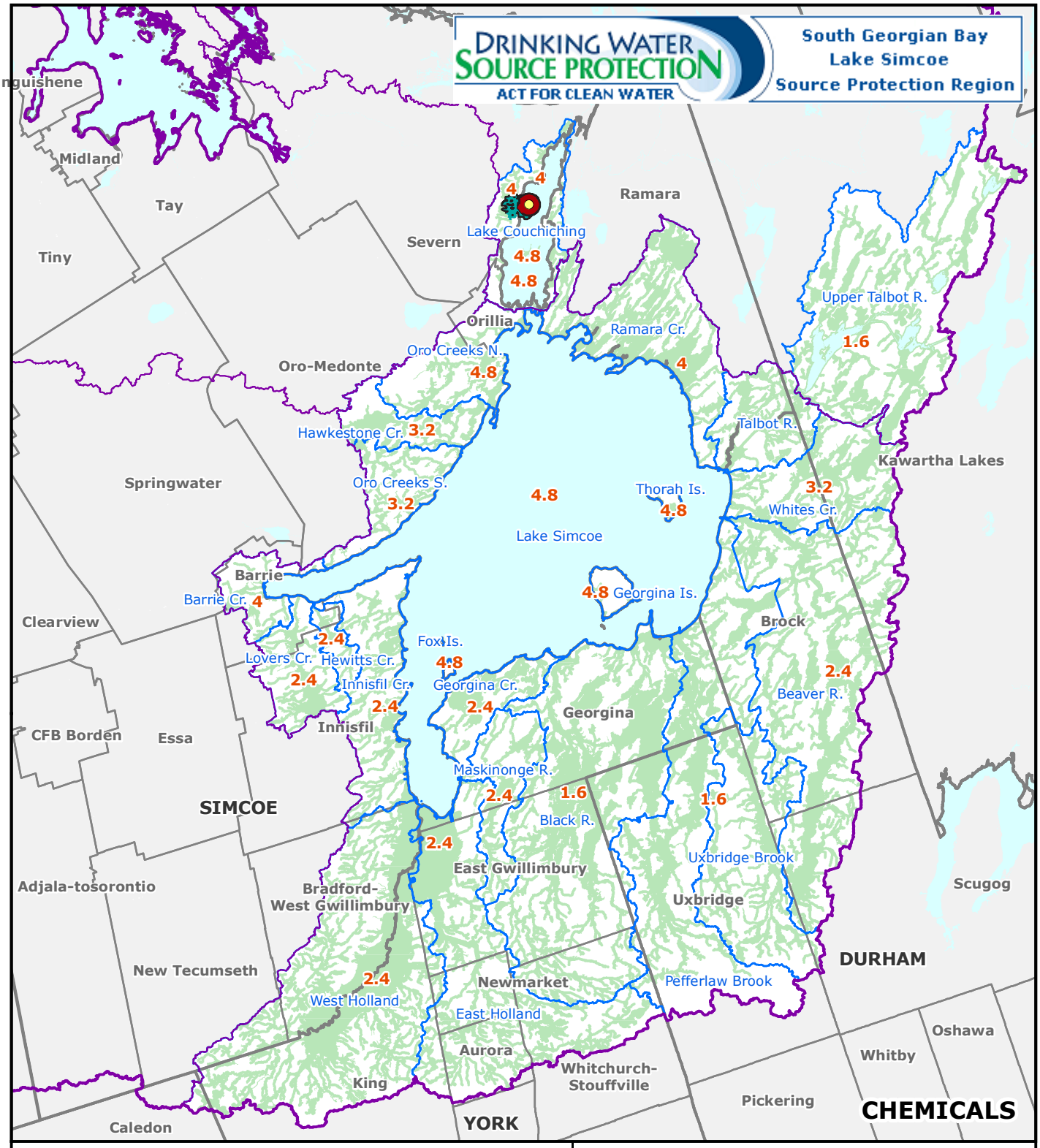
This figure is to be used to identify the areas where a landuse activity is or would be a drinking water threat based on the Technical Rules. The key table is intended to correlate the vulnerability score with circumstances that are significant, moderate, or low threats in the Table of Drinking Water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

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.09	FILE. NO.:0-07194809F15.2-3

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GENIVAR Ontario

FIGURE **9d-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 West Shore, Severn

Created by: LSRCA
Date: 2010-10-20

GENIVAR

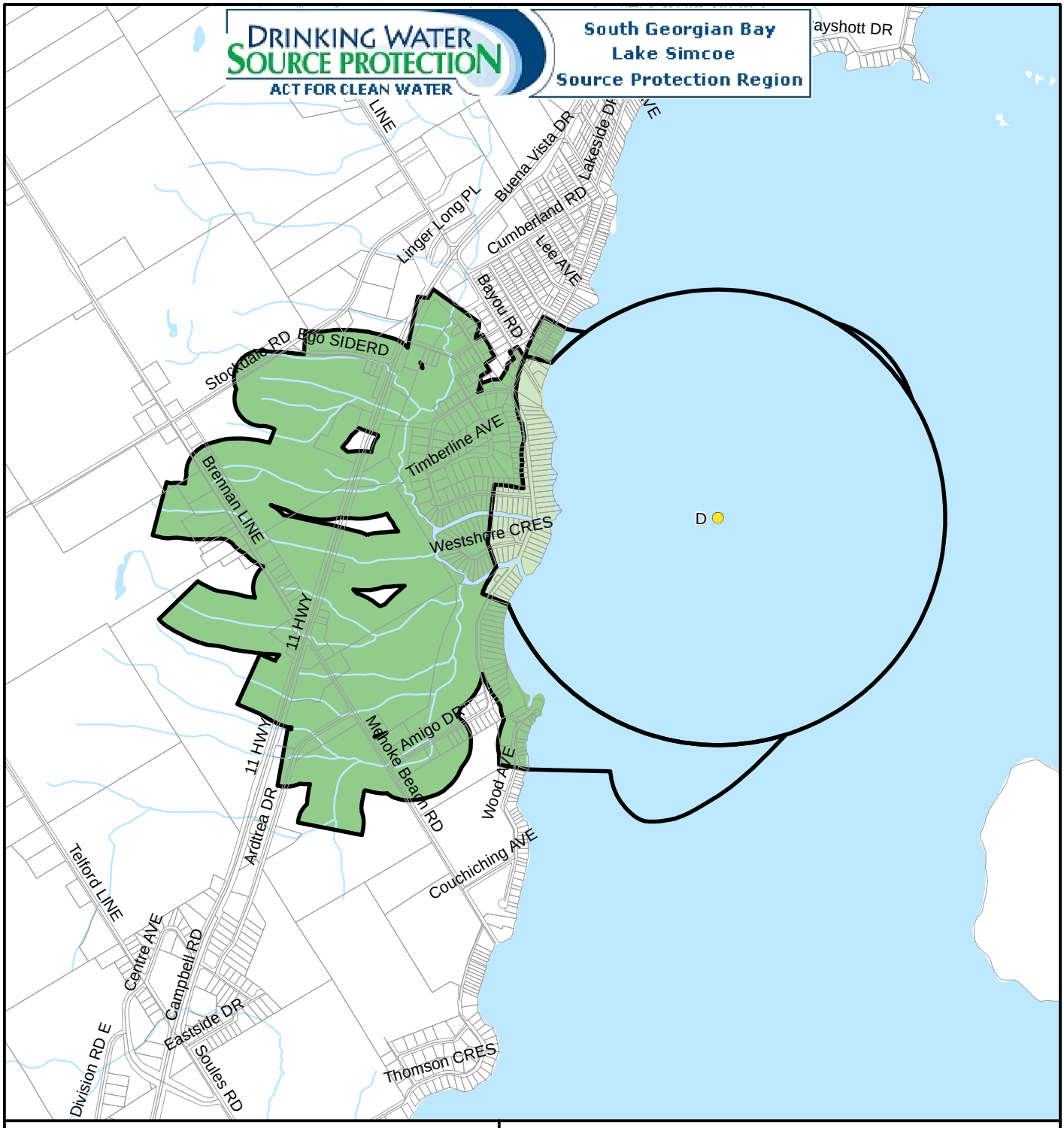
Scale: 1:500,000 0 2 4 6 8 10km

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 9d-6



MANAGED LANDS - WEST SHORE

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: 0-071948.09

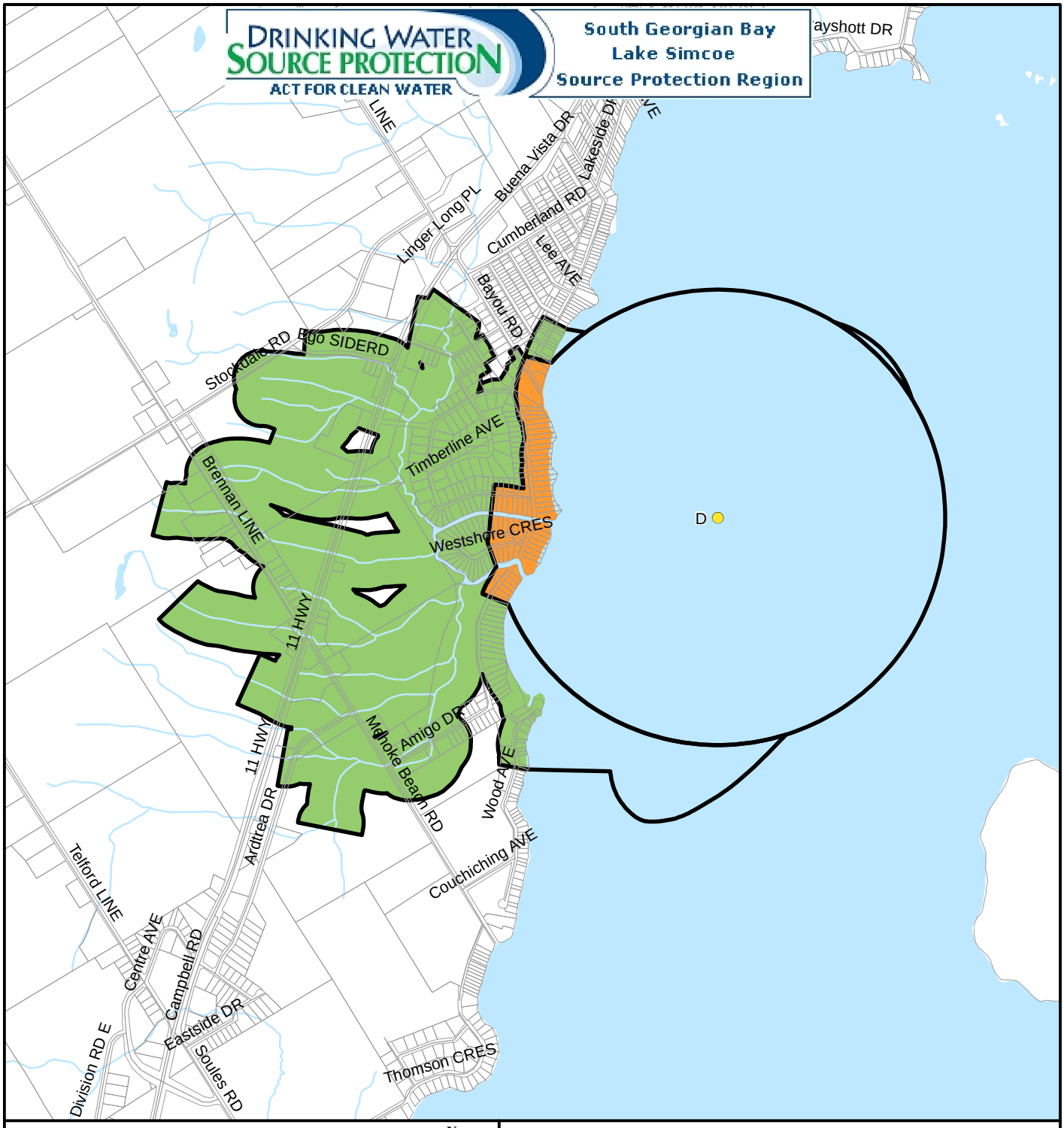
FILE. NO.:0-07194809F15.2-4

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 9d-7



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 - WEST SHORE

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

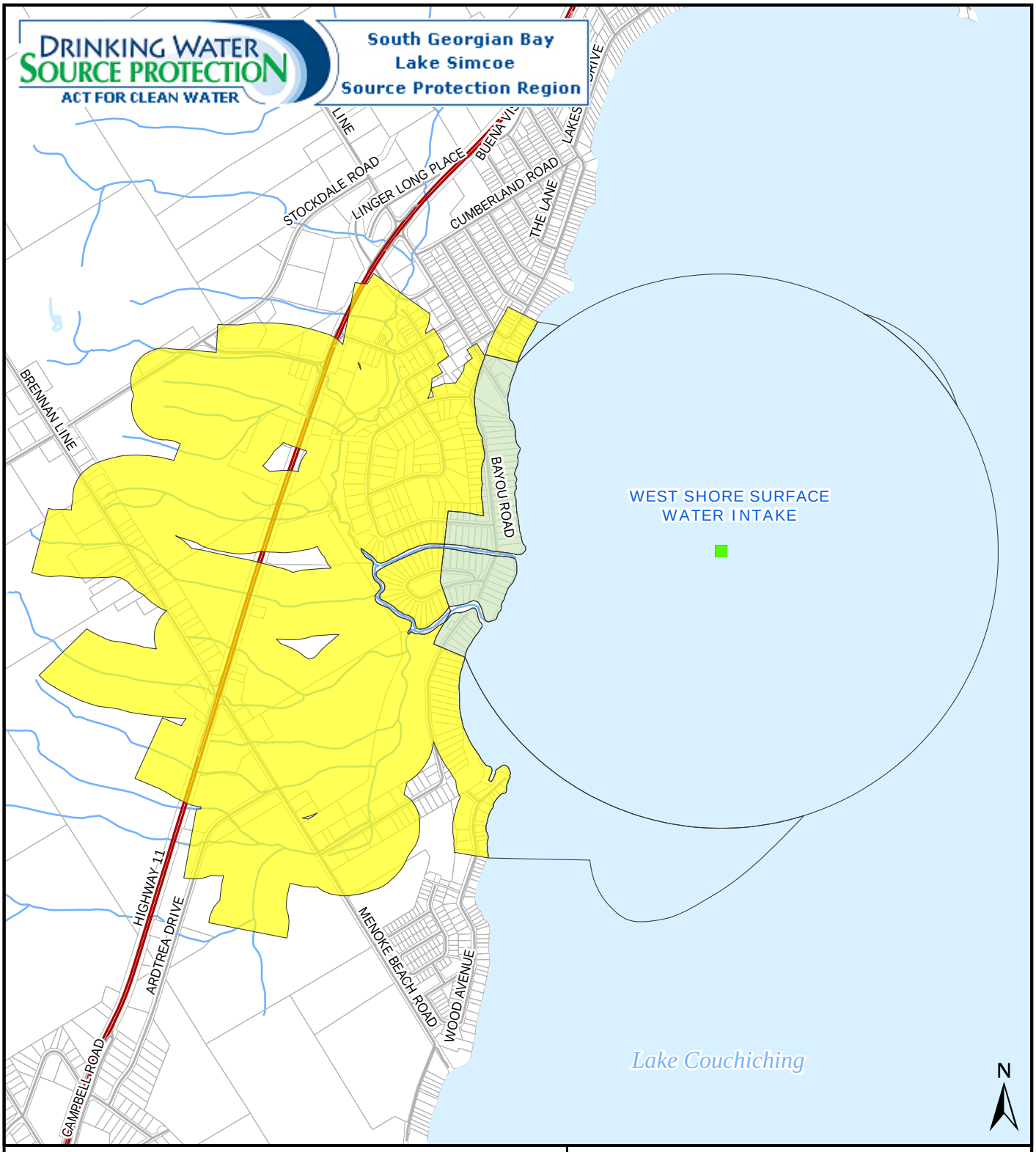
DATE: JUNE 2010 | SCALE: 1:25000

PROJECT: 0-071948.09 | FILE. NO.:0-07194809F15.2-5

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 9d-8



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

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

Impervious Surfaces - West Shore Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

Scale 1:20,000

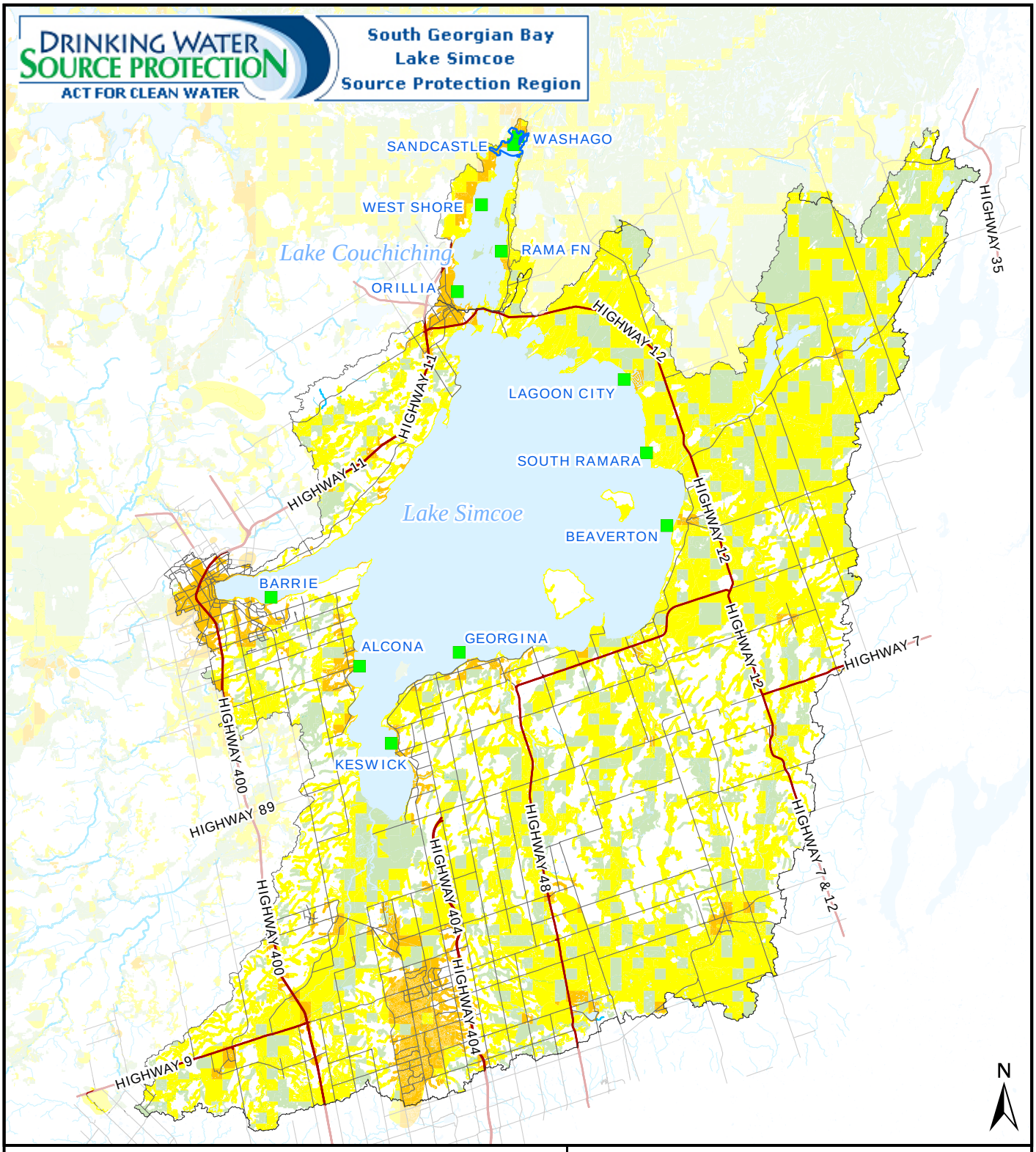
0 0.15 0.3 0.6 km

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 9**d**-9



Surface Water Intake

Impervious Surfaces in IPZ 3

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

Impervious Surfaces - **West Shore** Intake Protection Zone 3

Created by: LSRCA, 2025-08-05

Scale 1:500,000

0 5 10 15 20km

UTM Zone 17N, NAD83

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Ontario

Figure 9**d**-1**0**