Chapter 13: Regional Municipality of York

Table of Contents

Field Code Changed

Field Code Changed

List of Tables

Field Code Changed

Field Code Changed

Field Code Changed

Field Code Changed

Field Code Changed

Field Code Changed

List of Figures

Field Code Changed

Aurora/Newmarket Well Supply

Field Code Changed

Holland Landing Well Supply

Field Code Changed

Mount Albert Well Supply

Queensville Well Supply

Ansnorveldt Well Supply

Schomberg Well Supply

Ballantrae Well Supply

Field Code Changed

Keswick Water Treatment Plant

Field Code Changed

Georgina Water Treatment Plant

Field Code Changed

Stouffville Well Supply

Formatted: Space Before: 6 pt

Formatted: Font: Not Bold, Font color: Auto

13 York Region

13.1 Introduction

This chapter contains information on ten drinking water systems for the Regional Municipality of York in the South Georgian Bay-Lake Simcoe Source Protection Region. 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. This report has been updated with information gathered from residents and property owners at the Assessment Report Open Houses hosted by South Georgian Bay Lake Simcoe Source Water Protection Staff as well from calls to South Georgian Bay Lake Simcoe Source Water Protection Staff and the Regional Municipality of York in the months of September and October 2010. The updated information is current up to and inclusive of March 5th, 2021.

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 Y) for a more in depth description of the methods used, as well as the Glossary for any unfamiliar terms.

13.2 Drinking Water Systems

York Region operates surface and groundwater based drinking water supplies in fourteen (14) communities. As shown below, eight (8) of the groundwater supplies and two (2) surface water intakes are within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR), the remainder are in the Credit Valley, Toronto and Region, Central Lake Ontario (CTC) SPR. The lead conservation authority (CA) for the municipal water supplies within the SGBLS SPR is Lakes Simcoe and Couchiching / Black River Source Protection Authority (SPA), while the Toronto and Region CA is the lead conservation authority for municipal water supplies within the CTC SPR.

York Region Municipal Water Supplies within the South Georgian Bay Lake Simcoe Source Protection Region:

- Georgina Surface Water Intake; Keswick Surface Water Intake (Town of Georgina)
- Aurora (Town of Aurora)
- Holland Landing; Mount Albert; Queensville (Town of East Gwillimbury)
- Ansnorveldt; Schomberg (Township of King)
- Newmarket (Town of Newmarket)
- Ballantrae-Musselmans (Town of Whitchurch-Stouffville)

York Region Municipal Water Supplies within the Credit Valley, Toronto and Region and Central Lake Ontario Source Protection Region:

- King City; Nobleton (Township of King)
- Stouffville (Town of Whitchurch-Stouffville)
- Kleinberg (City of Vaughan)

Studies conducted for the Toronto and Region Conservation Authority Source Protection Region have identified that the WHPAs for the Stouffville Well Supply extend into the SGBLS Source Protection Region. The WHPAs, which are primarily within the Toronto and Region Source Protection area, extend to the north and a small portion crosses the boundary with the SGBLS SPR. Also, two wells of the Bradford/Bondhead Distribution and Supply Wells are located within York Region. Information on these is presented with the rest of the system within this report, Chapter 9.

Table 13-~~13-1~~: WHPAs that cross into York Region in the SGBLS SPR

Local Municipality that WHPA extends into	Municipality where wellhead is located	Name of Water Supply	Source Protection Region / Lead Conservation Authority (CA)	Location where entire Assessment can be obtained
York Region	Town of Bradford West- Gwillimbury	Bradford/Bondhead Distribution and Supply Wells	SGBLS SPR & Lakes Simcoe and Couchiching / Black River SPA	This report (Chapter 9)
York Region	Stouffville	Stouffville Well Supply	CTC SPR Toronto and Region CA	CTC SPR Assessment Report

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

13.3 Aurora/Newmarket Well Supplies

The Town of Aurora is located on the northern flank of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). The Town is almost entirely within the SGBLS SPR but borders the CTC SPR. Approximately 52,000 residents in the Town of Aurora are serviced through a blended municipal supply, which includes surface water from Lake Ontario and groundwater supply for seven (7) municipal wells: Wells 1, 2, 3, 4, 5,6 and 7.

The Aurora wells are grouped together with the Newmarket, Holland Landing, and Queensville wells as the Yonge Street Area (YSA) wells. As noted in Kassenaar and Wexler (2006), the "Yonge Street Aquifer" is part of a larger regional flow system that is locally influenced by a combination of three geologic features, including a topographic basin, tunnel channel and bedrock valley. The topographic basin cuts into the ORM deposits and the associated streams (tributaries of the East Holland River) induce groundwater flow from outside the basin. The tunnel channel cross connects the aquifer zones, both vertically and horizontally, increasing the effective transmissivity in the vicinity of several of the Yonge Street Area production wells. Finally, the underlying bedrock valley further extends the zone of influence of the deeper (Scarborough) production wells along the valley axis.

Aurora's groundwater water system lies within a large tunnel channel with fine-grained glaciolacustrine sediments and possibly a thin clay till unit - the Kettleby Till – at or near surface. The channel fill sediments consist mainly of silt and sandy silt underlain by fine sand and gravel. The screens for closely grouped wells 1 to 4 and well 6 and 7 are in gravels in what is interpreted as the Thorncliffe Formation, but could be the base of the channel fill sequence. The Newmarket Till is entirely absent. Well 6 and 7 are on the eastern margin of the tunnel channel where there is thick Newmarket Till capped by thin glaciolacustrine silt and clay and Kettleby Till. This well is screened in the Thorncliffe Formation (or its equivalent). Table 13- 2 provides more information on the Aurora municipal wells.

Table 13-~~213-~~2: Municipal Well Information - Aurora

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
1	98.45	92.35 to 98.45	Thorncliffe Formation	Calcium bicarbonate	3,270
2	103.63	91.44 to 103.63	Thorncliffe Formation	Calcium bicarbonate	5,892
3	102.11	91.44 to 102.11	Thorncliffe Formation	Calcium bicarbonate	5,237

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

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
4	101.19	89.00 to 101.19	Thorncliffe Formation	Calcium bicarbonate	7,856
5	101.80	89.60 to 101.80	Scarborough Formation	Calcium bicarbonate	5,892
6	91.80	79.99 to 91.80	Thorncliffe Formation	Calcium bicarbonate	3,470
7	99.70	89.60 to 97.50	Thorncliffe Formation	Calcium bicarbonate	4,752

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

Notes for the table above:

1. Information provided by York Region
2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009**)**
4. Genivar (2007)

The Town of Newmarket is located on the northern flank of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). The Town is entirely within the SGBLS SPR. Approximately 81,800 residents in the Town of Newmarket are serviced through a groundwater supply consisting of five (5) municipal wells: Wells 1, 2, 13, 15 and 16. The previous groundwater supply well, Newmarket well 14, was removed in 2019 due to poor performance and water quality issues. Periodically, the southern portion of Newmarket may also receive potable water through a small feed from the Aurora water supply system.

The Newmarket wells are grouped together with the Aurora, Holland Landing, and Queensville wells as the Yonge Street Area (YSA) wells. As noted in Kassenaar and Wexler (2006), the "Yonge Street Aquifer" is part of a larger regional flow system that is locally influenced by a combination of three geologic features, including a topographic basin, tunnel channel and bedrock valley. The topographic basin cuts into the ORM deposits and the associated streams (tributaries of the East Holland River) induce groundwater flow from outside the basin. The tunnel channel cross connects the aquifer zones, both vertically and horizontally, increasing the effective transmissivity in the vicinity of several of the Yonge Street Area production wells. Finally, the underlying bedrock valley further extends the zone of influence of the deeper (Scarborough) production wells along the valley axis.

Most of the wells in Newmarket are near the margins of a major north-south tunnel channel, but the wells penetrate thick Newmarket Till. Three of the wells are screened in the Scarborough Formation and two are screened in the Thorncliffe Formation. The sandy ORAC sediments overlying the Newmarket Till vary greatly in thickness, ranging from less than 5 m to

more than 20 m thick. Surface sediments in the area are glaciolacustrine silt and clay in low lying areas, Newmarket and Kettleby Till, and glaciofluvial deposits. Table 13- 3 provides more information on the Newmarket municipal wells.

Table 13-~~313~~ 3: Municipal Well Information - Newmarket

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
1	91.90	84.3 to 91.9	Thorncliffe Formation	Calcium bicarbonate	2,290
2	94.18	86.2 to 94.2	Thorncliffe Formation	Calcium bicarbonate	4,580
13	109.11	100.4 to 108.2	Scarborough Formation	Calcium bicarbonate	5,890
15	-	84.12 to 85.65	Scarborough Formation	Calcium bicarbonate	3,270
16	106.68	98.76 to 106.68	Scarborough Formation	Calcium bicarbonate	5,630

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

Notes for the table above:

1. Information provided by York Region
2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009)
4. Genivar (2007)

WHPA delineation, Vulnerability and the Issues and Threats Assessment presented in this section was updated in 2021 and is based on the Golder, 2021 report.

13.3.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area to be delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability is assessed to provide an indication, within the WHPA, which current (or future) Activities 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 anthropogenic activities, 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 land use or activity could affect the

drinking water supply aquifer. 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 Towns of Aurora and Newmarket water supplies have been delineated by following the process recommended in the MOE[1] Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The Intrinsic Vulnerability within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Towns of Aurora and Newmarket WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Golder, 2021.

13.3.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPAs for the Towns of Aurora and Newmarket well systems, as delineated by Golder in 2021 are shown in Figure 13a-1.

The time-of-travel (TOT) method is the approach specified by MOE Guidance Module 3 (MOE, 2006) for delineating Wellhead Protection Areas around municipal supply wells. The WHPA were delineated using a 3-dimensional numerical groundwater flow model. Because the model covers all of York Region, mutual interference between supply wells and the effect of surface water features on the groundwater flow patterns can also be represented. The U.S. Geological Survey (USGS) MODFLOW code was selected for use in this study because this code is recognized worldwide and has been extensively tested and verified. To simulate groundwater flow paths and travel times which, in turn, were used to define TOT zones for the York Region municipal wells, the U.S. Geological Survey MODPATH code was used.

MODFLOW/MODPATH results were used to delineate the primary WHPAs for each municipal well (2-, 5- and 25-year TOT zones, which correspond to the WHPA sensitivity zones B, C, and D, respectively). WHPA-A was created by drawing a circle with a 100-metre radius around each well.

The maximum pumping rates used in the simulations were determined on the basis of the current Permit To Take Water (PTTW) issued by the MOE. For each well or wellfield, the PTTW specifies limits on the maximum daily pumping rates and maximum peak pumping rates.

Historically, the Newmarket, Aurora, Holland Landing, and Queensville wells have been grouped together as the “Yonge Street Aquifer” wells. The term implies that there is a single, bounded aquifer that supplies these wells. In reality, permeable deposits in these areas are part of three

[1] Now, the MECP (The Ministry of the Environment, Conservation and Parks)

different regional aquifer complexes that may or may not be separated locally by the regional aquitards. In this report, the wells are referred to as the Yonge Street Area (YSA) wells. The permit for the YSA wells has a limit on the total annual withdrawal which translates to an average daily limit of 42,000 cubic metres per day (m^3/d). To be conservative, it was assumed that any well could, for operational reasons, be pumped at its maximum permitted rate for an extended period of time (as long as the pumping rates at other wells were adjusted to keep the total withdrawal below the maximum limit). Therefore, each YSA well was simulated at its maximum permitted rate even though the combined rates used in the model exceed the maximum allowable taking. The WHPAs delineated using these rates will be larger and more conservative than if reduced pumping rates were used.

The municipal wellfields and their reported annual average pumping rates for 2006 (data provided by York Region) along with maximum permitted average pumping rates are provided in Earthfx and Azimuth, 2007 (revised 2009).

13.3.1.2 Groundwater Vulnerability

The intrinsic Groundwater Vulnerability within the WHPAs of the municipal wells in Aurora and Newmarket are shown in Figure 13a-2.

The Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. The WWAT method calculates travel time from the water table to the well screen but does not factor in unsaturated zone travel time. While there are approximate methods available to estimate the additional time-of-travel through the unsaturated zone, the amount of data available to accurately assess UZAT (Unsaturated Zone Advective Time) is minimal and the level of uncertainty involved is high. Accordingly, York Region decided to take a conservative approach (i.e. resulting in higher groundwater vulnerabilities then otherwise expected) and not include UZAT in the Vulnerability Analysis.

Since the WWAT method is not listed as an approved method of assessing Groundwater Vulnerability under Technical Rule 37 (MOE, 2008a), a request (under Technical Rule 15.1 (MOE, 2008a)) was submitted April 1, 2009. Director's Approval was given on July 17, 2009 to use an alternate method of determining Groundwater (intrinsic) Vulnerability based on the following reasons (see Appendix Y for approval letter):

1. There is a high degree of uncertainty in determining unsaturated zone advective times (UZATs) due to numerous variables and limited data associated with them.
2. The WWAT may provide a more realistic approach for representing water supply vulnerability where the potential contaminant is located below ground.

3. Where potential sources of contamination are located at ground surface, the WWAT would be a conservative estimation of travel time to the well, which favorable when protecting municipal drinking water well supplies.

The calculation of WWAT times within the WHPAs allows the Vulnerability results to be compared to the TOT zones with a common unit of measure. It should be noted that the travel times are advective travel times and are therefore independent of the nature of the potential contaminants, release mechanisms, and attenuation processes (e.g., diffusion, dispersion, adsorption and chemical transformation). Appendix 4 of Guidance Module 3 (MOE, 2006) recommends translating the travel times obtained from the WWAT analyses into relative measures of intrinsic vulnerability as summarized in Table 13- 4.

Table 13-~~413-4~~: High, Medium and Low intrinsic Vulnerability categories as related to WWAT values (from MOE, 2006)

WWAT Value	Intrinsic Vulnerability Category
> 25 years	Low
5 to 25 years	Medium
0 to 5 years	High

Formatted: Centered

Formatted: Centered

Formatted: Centered

Formatted: Centered

With regards to the Aurora and Newmarket wells, the resulting WWAT travel times indicate that the entire area has a Low Intrinsic Vulnerability, with travel times from the water table to the well being greater than 25 years. The long travel times are likely a result of the multiple confining units overlaying the screened aquifers.

13.3.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec (2010) report for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at ground surface. Future adjustments to the IVS may be required in future to account

for the presence of constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.3.1.4 WHPA-E~~/ WHPA-F~~

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

13.3.1.5 Vulnerability Score

The Vulnerability Scoring and mapping originally from Earthfx and Azimuth (2007; updated in 2009) was revised by Golder, 2021 as a result of an increased understanding of the hydrostratigraphy and hydrogeology within the region. The WHPAs for the Aurora and Newmarket water supplies, as shown in Figure 13a-1, and the intrinsic Groundwater Vulnerability (Figure 13a-2) were used to assign a Vulnerability Score by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Figure 13a-3 illustrates the Vulnerability Scores for the Aurora and Newmarket water supplies and will be used to assess Drinking Water Threats in Section 13.3.3.

13.3.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. The Uncertainty Assessment for WHPA delineation was undertaken by both Earthfx and Azimuth, 2007, (revised 2009) and through an independent peer review commissioned by the SGBLS Region. In situations where different uncertainty estimates are provided (i.e. Low and High), the most conservative (High uncertainty) has been applied. Uncertainty of the Vulnerability Assessment was only undertaken by Earthfx and Azimuth (2009).

The independent peer review of WHPA delineation was undertaken by Dillon Consulting using a standard scoring matrix (Table 1, Appendix MO). The Uncertainty Rating assigned for the Barrie WHPAs is High. The full results of the WHPA delineation Peer Review process, for York is available in Appendix B and discussed in Chapter 5 (Methods Overview). Based on the rationale provided for the Vulnerability Assessment (see below), Earthfx and Azimuth, 2007 (revised 2009) characterized uncertainty of the WHPA delineation as Low. As this differs from that

provided by the peer review, the most conservative, 'High' Uncertainty ranking will currently apply.

The Earthfx and Azimuth, 2007 (revised 2009), approach to determining WHPA delineation and Vulnerability Uncertainty also used a qualitative process (see reports for full details). The uncertainty in the analyses can be ascribed to the three processes involved in developing the final intrinsic Vulnerability Scores: (1) the numerical groundwater flow model, (2) the TOT delineation, and (3) the WWHAT assessment.

Appendix 6 of the MOE Guidance Module indicates that it would be reasonable to expect a Low level of uncertainty in areas where data density is high, where hydrogeologic studies have been conducted, and where numerical models have been developed. The study completed by Earthfx and Azimuth, 2007 (revised 2009), generally satisfies all three of these MOE criteria. It is recognized, however, that all hydrogeologic analyses have an intrinsic level of uncertainty because one can never have enough data to fully know how conditions vary in the subsurface.

There are one or two monitoring wells in the immediate vicinity of each pumping well. However, there are few shallow or deep wells within the 25-year TOT zones. There are some clusters of monitoring wells outside the 25-year TOT south and east of Aurora Well 1. The geology of the Yonge Street Area is complex but it has had a great deal of attention as part of the YPDT-CAMC and earlier studies. There are also a large number of high quality wells in the area. Overall, this resulted in a Low Uncertainty Rating for Vulnerability Assessment.

The Uncertainty Rating for the Aurora/Newmarket well supplies was not changed as part of the 2021 update and was left as a Low Uncertainty Rating. Although additional knowledge has been obtained since the original Uncertainty Analysis, the current rating was maintained in order to be conservative.

13.3.2 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.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region.

The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues methods can be found in Technical Memorandum A1 (Appendix Y).

Aurora Municipal Wells

The Genivar (2007) results indicate that the groundwater supply from Aurora municipal wells 1 to 6 met the ODWQS (MOE, 2006) with the exception of iron which exceeded the Aesthetic Objective (AO), and manganese, which generally met but occasionally exceeded the ODWQS AO. However, Genivar (2007) reported that elevated iron and manganese concentrations are common to the deep aquifers in York Region and are related to natural rock-water interactions. The results also indicated that sodium concentrations in wells 1 to 6 were consistently near 20 mg/L. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of E.coli at this well field. For Aurora municipal well 7, Golder (2021) results indicate that the well met the ODWQS (MOE, 2006) for all parameters with the exception of hardness (as $CaCO_3$) and iron.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Aurora municipal wells from as early as February 1995 to February 2009 for evaluation in the current study. The results of the water quality Issues identification and evaluation process for the Aurora municipal wells are summarized in Stantec, 2010**.**

No Drinking Water Issues were identified with the Aurora Water Supply.

Newmarket Municipal Wells

The Genivar (2007) results indicated that the groundwater supply from the Newmarket municipal wells met the ODWQS (MOE, 2006). Concentrations of all key indicator parameters showed a consistently stable trend with time in all wells. Sodium concentrations in all wells were consistently near 20 mg/L, which is the Medical Officer of Health reporting limit. Elevated

concentrations of iron in exceedance of the AO were reported in all wells, with manganese occasionally detected near the AO in select wells. Genivar (2007) reported that elevated iron and manganese concentrations are common in deep aquifers in York Region. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of E. coli at this well field.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Newmarket municipal wells from January 1993 to February 2009 for evaluation in the current study. The results of the water quality Issues identification and evaluation process for the Newmarket municipal wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Newmarket Water Supply.

13.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Aurora and Newmarket Water Supplies was originally completed in accordance with the detailed methodology presented in Stantec, 2010 and Technical Memorandums A2 to A4 (Appendix Y). Since the effective date of the Source Protection Plan (July 1, 2015), risk management officials within the Regional Municipality of York have conducted threats verification for all existing and potential significant threats to determine if they exist. In 2021 following threats verification and updates to the WHPA mapping and vulnerability scoring the assessment of existing Drinking Water Threats for the Aurora and Newmarket Water Supplies was updated. 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 Aurora and Newmarket Drinking Water Supplies 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.

13.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Aurora and Newmarket Drinking Water Supplies 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.

13.3.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

- Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)
- National Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)
- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009), York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. As part of the 2021 update, significant condition threats were re-evaluated with

new information obtained since the Stantec (2010 report), and no potential conditions were identified (Golder, 2021).

No confirmed Conditions have been identified for the Aurora and Newmarket Water Supplies.

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

The areas where Activities are or would be Drinking Water Threats are illustrated on a series of maps based on the Vulnerability Scores and Vulnerable Area delineations. The maps combined with the Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The circumstances can be found at: https://threats.swpip.ca/. ~~The maps combined with the table of drinking water threat circumstances prepared by MECP can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. The tables can be found at Ontario.ca: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.3.3.3.1 Pathogen Parameters

The Technical Rules ~~MECP table of drinking water threats~~ can be used in conjunction with the Vulnerability Scores on Figure 13a-4 to identify the areas where Activities associated with pathogen Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Aurora and Newmarket Water Supplies. 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 Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.3.3.3.2 Chemical Parameters

The Technical Rules ~~MECP table of drinking water threats~~ can be used in conjunction with the Vulnerability Scores on Figure 13a-5 to identify the areas where activities associated with chemical Threats are or would be Significant, Moderate, or Low Drinking Water Threats for the Aurora and Newmarket Water Supplies. 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.

13.3.3.3.3 DNAPL Chemical Parameters

Figure 13a-6 illustrates the area of the 5-year time-of-travel zone (WHPA-C) and areas with a Vulnerability Score of at least 6, where activities associated with DNAPL parameters are

considered to be a Significant Drinking Water Threat for the Aurora and Newmarket Water Supplies. The Technical Rules ~~MECP table of drinking water threats~~ can be used in conjunction with the Vulnerability Scores on Figure 13a-6 to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

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

Further to Section 13.3.3.2, no Conditions have been confirmed within the WHPA for the Aurora and Newmarket Water Supplies.

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 A4 (Appendix Y). 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 13a-3 illustrates the Vulnerability Score map for the Aurora and Newmarket well supplies that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.3.3.5 Enumerating Drinking Water Threats

~~13.3.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of existing and potential activities that were considered to be Significant Drinking Water Threats for the Aurora and Newmarket Water Supply was originally determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. Since the effective date of the Source

Protection Plan (July 1, 2015), risk management officials within the Regional Municipality of York have conducted threats verification for all existing and potential significant threats to determine if they exist. As such, Table 13- 5 documents the enumeration of existing and confirmed activities that are considered to be Significant Drinking Water Threats within the WHPA for the Aurora and Newmarket Water Supply. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Within the Aurora and Newmarket well fields, a total of 151 significant threats were originally identified on a total of 133 land parcels. The Threat and parcel counts differ due to the fact that multiple Significant Threats may exist on a single parcel. As of 2021 following threats verification, and updates to the WHPA mapping and vulnerability scoring, there are now a total of 60 significant threats on a total of 55 land parcels within the Aurora and Newmarket well fields. The current Significant Threats identified were related to systems that store or transmit sewage (2), handling and storage of pesticide (1),), handling and storage of DNAPLs (56), and handling and storage of commercial fertilizer (1).

Table 13-~~513 5~~: Number of Significant Drinking Water Threats for the Aurora and Newmarket Drinking Water Supplies. ~~Enumeration of Significant Threats (Wellhead Protection Areas)~~

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.	16~~0~~
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	3~~2~~
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

Threat Number	Threat	Significant threat counts Number of threats
7	The handling and storage of non-agricultural source material.	0
8	The application of commercial fertilizer to land.	1
9	The handling and storage of commercial fertilizer to land.	0
10	The application of pesticide to land.	1
11	The handling and storage of pesticide.	0
12	The application of road salt.	170
13	The handling and storage of road salt.	170
14	The storage of snow.	170
15	The handling and storage of fuel.	0
16	The handling and storage of dense non-aqueous phase liquid.	56
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
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**	12260 significant threats (on 89 properties)

Formatted: Font: Bold

Formatted: Font: Bold

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.

13.3.3.5.1 Managed Lands

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

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Aurora and Newmarket Water Supplies as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.3.3.5). Figure 13a-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Aurora and Newmarket Water Supplies.

13.3.3.5.2 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~~the Table of Drinking Water Threats~~.

The Livestock Density was determined for the delineated WHPA zones for the Aurora and Newmarket Water Supplies as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.3.3.5). As described in the memorandum, estimation of Livestock Density was initially undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities. In 2019, livestock densities were re-calculated using aerial imagery and then confirmed with a windshield survey.

Figure 13a-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Aurora and Newmarket Water Supplies. The Livestock Density figure reflects the distribution of Agricultural Managed Lands as determined in accordance with Technical Memorandum A3 (Appendix Y).

13.3.3.5.3 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~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Aurora and Newmarket Water Supplies was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). 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 13.3.3.5).

Figure 13a-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Aurora and Newmarket Water Supplies.

13.4 Holland Landing Well Supply

Holland Landing is located in the Town of East Gwillimbury, north of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). Holland Landing is entirely within the SGBLS SPR. Approximately 7,500 residents in the community are serviced by two (2) municipal groundwater wells: Well No. 1 and Well No.2.

The Holland Landing wells are grouped together with the Newmarket, Aurora, and Queensville wells as the Yonge Street Area wells as noted in Kassenaar and Wexler (2006), the "Yonge Street Aquifer" is part of a larger regional flow system that is locally influenced by a combination of three geologic features, including a topographic basin, tunnel channel and bedrock valley. The topographic basin cuts into the ORM deposits and the associated streams (tributaries of the East Holland River) induce groundwater flow from outside the basin. The tunnel channel cross connects the aquifer zones, both vertically and horizontally, increasing the effective transmissivity in the vicinity of several of the Yonge Street Area production wells. Finally, the underlying bedrock valley further extends the zone of influence of the deeper (Scarborough) production wells along the valley axis.

At Holland Landing, the two municipal wells are in or adjacent to a small tunnel channel in an area of Kettleby Till outcrop. Well 1 penetrates thick sandy silt channel fill and possible ORAC equivalent sediments and is screened in sands of the Thorncliffe Formation. Newmarket Till is absent. However, well 2 passes through about 45 m of till with no ORAC or equivalent sediments present. This well is screened in the Scarborough Formation. Table 13- 6 provides more information on the Holland Landing municipal wells.

Table 13-~~613-6~~: Municipal Well Information - Newmarket

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
1	79.28	70.13 to 79.28	Thorncliffe Formation	Calcium bicarbonate	2,291
2	71.63	63.82 to 71.63	Scarborough Formation	Calcium bicarbonate	3,600

Note for the table above:

1. Information provided by York Region
2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009)
4. Genivar (2007)

Formatted: Font: 11 pt, Bold

Formatted Table

Formatted: Font: 11 pt

Formatted: Font: 11 pt

WHPA delineation and Vulnerability presented in this section is based on Earthfx and Azimuth (2007) and Earthfx (2009), while the Issues and Threats Assessment is based on the Stantec, 2010 report – See Technical Memorandums A1 to A4 (Appendix Y).

13.4.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability has been assessed to provide an indication, within the WHPA, which current (or future) Activities 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 Community of Holland Landing water supply has been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The intrinsic Vulnerability of the groundwater within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and the Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Holland Landing WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Earthfx and Azimuth, 2007 and Earthfx, 2009.

13.4.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Holland Landing Municipal Water Supply wells, as delineated by Earthfx Incorporated and Azimuth Environmental Consulting, Inc, is shown in Figure 13b-1. Please refer to section 13.3.1.1 for more information on WHPA delineation methods.

13.4.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPA of the two municipal wells in Holland Landing is shown in Figure 13b-2.

The Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. Please refer to section 13.3.1.2 for more information on this method and the rationale for using it.

The results of this analysis show the Holland Landing Wells generally have small areas of Medium Intrinsic Vulnerability surrounded by areas of Low Vulnerability. The simulated water table lies below the base of this thin Newmarket Till, and as a result, particles in this area were started in Layer 5. The analysis shows that, even though the 25-year TOT zones from the different wellfields coalesce, much of the 25-year TOT for the Holland Landing wellfield has Low Intrinsic Vulnerability.

13.4.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec, 2010 for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at ground surface. Future adjustments to the IVS may be required in future to account for the presence of constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.4.1.4 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.~~

13.4.1.5 Vulnerability Score

The Vulnerability Scoring and mapping from Earthfx and Azimuth (2007) was revised by Earthfx in 2009 due to an update of the Vulnerability Scoring values in the Technical Rules (as amended in December 2008). The WHPAs for the Holland Landing Water Supply, as shown in Figure 13b-1, and the Groundwater Vulnerability (Figure 13b-2) were used to assign a Vulnerability Score by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was

determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Figure 13b-3 illustrates the Vulnerability Scores for the Holland Landing water supply and will be used to assess Drinking Water Threats in Section 13.4.3.

13.4.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. Uncertainty assessment for WHPA delineation was undertaken by both Earthfx and Azimuth, 2007 (revised 2009) and through an independent peer review commissioned by the SGBLS Region—See Section 13.3.1.6. As a result of these two assessments, the Uncertainty of WHPA delineation was ranked as High, and for Vulnerability Assessment, Low.

13.4.2 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.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region. The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues Evaluation methods can be found in Technical Memorandum A1 (Appendix Y).

The Genivar (2007) results indicated that the groundwater supply from Holland Landing municipal wells met the ODWQS (Ontario Drinking Water Quality Standards: MOE, 2006), with the exception of iron, which exceeded the AO (Aesthetic Objectives) for both production wells. Manganese concentrations were generally near the ODWQS AO. As reported by Genivar

(2007), elevated iron and manganese are common in deep aquifers in York Region. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of E. coli at this well field.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Holland Landing municipal wells from March 1999 to February 2009 for evaluation in the current study. The results of the water quality issues identification and evaluation process for the Holland Landing municipal wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Holland Landing Water Supply.

Sodium concentrations were observed to be consistently above 20 mg/L at both Holland Landing municipal wells. The AO for sodium in drinking water is 200 mg/L. In accordance with the ODWQS, York Region notifies the local medical officer of health when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets (MOE, 2006).

13.4.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Holland Landing Water Supply was completed in accordance with the detailed methodology presented in Stantec, 2010 and Technical Memorandums A2 to A4 (Appendix Y). 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 Holland Landing Drinking 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.

13.4.3.1 List of Drinking Water Threats – Activities

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

13.4.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential Conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)

- National Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)
- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009**),** York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. Refer to Stantec, 2010 for the full list of reports.

No confirmed Conditions have been identified for the Holland Landing Water Supply. Stantec, 2010, identified five (5) potential Conditions (e.g. spills, all of which are outside WHPA-A, that may require further investigation

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

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

13.4.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13b-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 Holland Landing 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 Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.4.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13b-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 Holland Landing 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.

13.4.3.3.3 DNAPL Chemical Parameters

Figure 13b-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 Holland Landing Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13b-6 ~~can be used to can be used~~ to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

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

Further to Section 13.4.3.2, no Conditions have been confirmed within the WHPA for the Holland Landing 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 A4 (Appendix Y). 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 13b-3 illustrates the Vulnerability Score map for the Holland Landing Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.4.3.5 Enumerating Drinking Water Threats

~~13.4.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of Significant Drinking Water Threats for the Holland Landing Water Supply has been determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 13- 7 documents the enumeration of existing activities that are considered to be potential Significant Drinking Water Threats within the WHPA for the Holland Landing Well Supply.

Within the Holland Landing well field, a total of ten (10) significant threats were identified on a total of nine (9) land parcels. The Threat and parcel counts differ due to the fact that multiple Significant Threats may exist on a single parcel. Significant Threats were related to systems which store or transmit sewage (8) and the handling and storage of fuel (2).

Within each delineated WHPA with a Vulnerability Score of 10, one Threat activity has been assigned to address the potential presence of municipal sanitary sewers and one threat activity has been included to represent the potential for subsurface storage of fuel for home heating purposes. These Threats are included in the counts above and in Table 13- 7.

Table 13-~~713-7~~: Number of Significant Drinking Water Threats for the Holland Landing Drinking Water Supply. ~~Enumeration of Significant Threats (Wellhead Protection Areas)~~

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.	8
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

Formatted Table

Threat Number	Threat	Significant Threat Counts Number of threats
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
14	The storage of snow.	0
15	The handling and storage of fuel.	2
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
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**	**10*** significant threats (on **9** properties)

*10 potential threats that require further verification.

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. ~~*10 potential threats that require further verification.~~

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

13.4.3.5.1 Managed Lands

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

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Holland Landing Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.4.3.5). Figure 13b-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Holland Landing Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

13.4.3.5.2 Livestock Density

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

The Livestock Density was determined for the delineated WHPA zones for the Holland Landing Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.4.3.5). As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

Figure 13b-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Holland Landing 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 A3 (Appendix Y).

13.4.3.5.3 Impervious Surfaces

Technical Rule 16(11) ~~(August 2009)~~ requires the Assessment Report to include maps showing the percentage of surface area where road salt could be applied to Impervious Surfaces within WHPA-A, -B, -C, -D, and –E. This mapping is not required where the Vulnerability Scores for the

area are less than the Vulnerability Score necessary for the Activity to be considered a Threat in the Technical Rules~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Holland Landing Water Supply was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). 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 13.4.3.5).

Figure 13b-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Holland Landing Water Supply.

13.5 Mount Albert Well Supply

The Community of Mount Albert is located on the northern flank of Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). Approximately 4,200 residents in the community are serviced through threewo (32) municipal wells: Well 1, and Well 2 and Well 3.

Commented [MT1]: Not sure why this was missing?

Mount Albert wells 1 and 2 are near the eastern margin of a large tunnel channel and are both screened in the Thorncliffe Formation. The thickness of the overlying Newmarket Till is variable and it appears to pinch out west of the wells. Locally, the Newmarket Till appears as two units separated by thick sands. Water quality characteristics were not similar to those for either the ORAC or the deep aquifer wells. This was attributed to possible mixing of groundwater facilitated by the presence of the nearby tunnel channels (Genivar, 2007). Table 13- 8 provides more information on the Mount Albert municipal wells.

Table 13-813-8: Municipal Well Information - Mount Albert

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
1	64.31	54.56 to 64.31	Thorncliffe Formation	Calcium bicarbonate	3,273
2	64.00	54.86 to 64.00	Thorncliffe Formation	Calcium bicarbonate	3,273
3	85.50	74.67 to 85.50	Thorncliffe Formation	Unknown	3,273

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

Note for the table above:

1. Information provided by York Region
2. Metres below ground surface (mbgs)
3. Earthfx (2009). Please note that the maximum permitted capacity for the individual well is provided. However, the combined permitted capacity from any combination of Mount Albert Wells (Well Nos. 1, 2, or 3) is limited to 4,990 m^3/day (Earthfx, 2009)
4. Genivar (2007)

WHPA delineation and Vulnerability presented in this section is based on Earthfx and Azimuth (2007) and Earthfx (2009), while the Issues and Threats Assessment is based on the Stantec, 2010 report.

13.5.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area to be delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability is assessed to provide an indication, within the WHPA, which current (or future) Activities 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 anthropogenic activities, 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 land use or activity could affect the drinking water supply aquifer. 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 Mount Albert water supply has been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The Intrinsic Vulnerability of the groundwater within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and the Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Mount Albert WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Earthfx and Azimuth, 2007 and Earthfx, 2009.

13.5.1.1 Well Head Protection Area (WHPA) Delineation

The WHPA for the Mount Albert Municipal Water Supply wells was originally delineated by Earthfx Incorporated and Azimuth Environmental Consulting Inc (2007). This was updated (Earthfx, 2009) with the addition of a new well. An Environmental Assessment (EA) report was completed for the wellfield (MMM Group 2006).

In the Mount Albert EA report (MMM Group, 2006, App. E. Groundwater Resource Exploration) all three wells are pumped at their permitted rates. However, for the Earthfx (2009) report, a new simulation was performed, with only wells 1 and 3 pumping at their individual permitted rates (permitted rates were only used at wells 1 and 3 because well 2 is located on the same site as well 1). Although it was recognized that the combined pumping rate is still above the PTTW, it represents a conservative approach and at any given time, any one well could be pumping at its maximum permitted rate (Table 13- 9).

Table 13-~~913-9~~: Pumping rates for Mount Albert well fields.

Municipal Well	Permitted Maximum Pumping Rate (m^3/d)	Simulated Pumping Rate (m^3/d)
Well 1	3273[1]	3273
Well 2	3273[1]	0
Well 3	3273[1]	3273

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

Note for the table above: For the Mount Albert Wells, the maximum permitted rate is shown for each well; however, the maximum combined daily taking from any combination of Mount Albert Wells 1, 2 or 3 shall NOT exceed 4990 m^3/day.

The Mount Albert WHPA is shown in Figure 13c-1.

The Time-of-Travel (TOT) method is the approach specified by MOE Guidance Module 3 (MOE, 2006) for delineating wellhead protection areas around municipal supply wells. As described in the November 2007 report (Earthfx, 2007), three-dimensional advective flow modelling was applied, which is the "preferred method" because numerical models can represent spatial variability of aquifer and aquitard properties and recharge rates. Furthermore, because the model covers all of York Region, mutual interference between supply wells and the effect of surface water features on the groundwater flow patterns can also be represented.

The U.S. Geological Survey (USGS) MODFLOW code was selected for use in this study because this code is recognized worldwide and has been extensively tested and verified. To simulate groundwater flow paths and travel times which, in turn, were used to define TOT zones for the York Region municipal wells, the U.S. Geological Survey MODPATH code was used.

MODFLOW/MODPATH results were used to delineate the primary wellhead protection TOT zones for each municipal well (2-, 5- and 25-year TOT zones, which correspond to the WHPA sensitivity zones B, C, and D, respectively). WHPA-A was created by drawing a circle with a 100-metre radius around each well.

13.5.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the municipal wells in Mount Albert is shown in Figure 13c-2.

The Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. Please refer to section 13.3.1.2 for more information on this method and the rationale for using it.

For the Mount Albert wells, the Vulnerability map Medium zones around the wells, and another Medium zone to the south, with the remaining area shown as Low.

13.5.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec 2010 for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at ground surface. Future adjustments to the IVS may be required in future to account for the presence of constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.5.1.4 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.~~

13.5.1.5 Vulnerability Score

The Vulnerability Scoring and mapping from Earthfx and Azimuth (2007) was revised by Earthfx in 2009 due to an update of the Vulnerability Scoring values in the Technical Rules (as amended in December 2008). The WHPAs for the Mount Albert Water Supply, as shown in Figure 13c-1, and the Groundwater Vulnerability (Figure 13c-2) were used to assign a Vulnerability Score by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Figure 13c-3 illustrates the Vulnerability Scores for the Mount Albert Water Supply and will be used to assess Drinking Water Threats in Section 13.5.3.

13.5.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. Uncertainty assessment for WHPA delineation was undertaken by both and Azimuth, 2007 (revised 2009) and through an independent peer review commissioned by the SGBLS Region—See Section 13.3.1.6. As a result of these two assessments, the Uncertainty of WHPA delineation was ranked as High, and for Vulnerability Assessment, Low.

13.5.2 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.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region. The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues Evaluation methods can be found in Technical Memorandum A1 (Appendix Y).

The Genivar (2007) results indicated a slight increasing trend with time for chloride and sodium concentrations in Mount Albert Well No. 1 and 2 as Well 3 is under construction, anticipated to be online in Fall 2010. Concentrations of nitrate and sulphate were stable in Mount Albert Well No. 1 and 2 over the same period of time. Genivar (2007) reported that the groundwater quality from the Mount Albert Well No. 1 and 2 generally met the ODWQS (MOE, 2006), with the exception of iron and manganese which exceeded the AO in both wells. Elevated iron and manganese concentrations are common in deep aquifers in York Regions and are generally considered to be caused by natural rock and groundwater interaction. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred

occasionally in raw water throughout York Region, there are no recorded detections of E. coli at this well field.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Mount Albert municipal wells from February 1999 to February 2009 for evaluation in the current study. Mount Albert Well No. 3 was constructed recently and limited data (less than 5 years) was available for the analysis. Therefore, Mount Albert Well No. 3 was not included in the current study. The results of the water quality issues identification and evaluation process for the Mount Albert municipal wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Mount Albert Water Supply.

Chloride concentrations show slight upward trend over time. However, observed chloride concentrations were several magnitudes lower than the AO of 250 mg/L (MOE, 2006) and the conservative issues benchmark of 125 mg/L (50% of the AO of ODWQS (MOE, 2006) for chloride). Therefore, drinking water quality issues were not identified for the Mount Albert municipal wells.

13.5.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Mount Albert Water Supply was completed in accordance with the detailed methodology presented in Stantec, 2010 and Technical Memorandums A2 to A4 (Appendix Y). 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 Mount Albert 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.

13.5.3.1 List of Drinking Water Threats – Activities

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

13.5.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

- Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)
- National Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)
- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009), York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. Refer to Stantec, 2010 for the full list of reports.

No confirmed Conditions have been identified for the Mt Albert Water Supplies. Stantec, 2010, identified five (5) potential Conditions (e.g. spills), all of which are not within WHPA-A, but may require further investigation.

13.5.3.3 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: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.5.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13c-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 Mount Albert 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 Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.5.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13c-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 Mount Albert 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.

13.5.3.3.3 DNAPL Chemical Parameters

Figure 13c-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 Mount Albert Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13c-6 ~~can be used to can be used~~ to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

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

Further to Section 13.5.3.2, no Conditions have been confirmed within the WHPA for the Mount Albert 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 A4 (Appendix Y). 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 13c-3 illustrates the Vulnerability Score map for the Mount Albert Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.5.3.5 Enumerating Drinking Water Threats

~~13.5.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of Significant Drinking Water Threats for the Mount Albert Water Supply has been determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 13- 10 documents the enumeration of existing and potential activities that are considered to be Significant Drinking Water Threats within the WHPA for the Mount Albert Water Supply.

Within the Mount Albert well field, a total of nineteen (19) Significant Threats were identified on a total of eighteen (18) land parcels. The Threat and parcel counts differ due to the fact that

multiple Significant Threats may exist on a single parcel. Significant Threats were related to systems that store or transmit sewage (15), handling and storage of fuel (1), handling and storage of DNAPLs (1), application of commercial fertilizer to land (1), and application of pesticides to land (1).

Within each delineated WHPA with a Vulnerability Score of 10, one Threat activity has been assigned to address potential for subsurface storage of fuel for home heating purposes. In total, one (1) Significant Threat was included for residential and commercial heating fuel tanks within the WHPA for the Mount Albert Water Supply, representing up to 17 potential threats (Significant, Moderate or Low) on all identified parcels where the vulnerability score is 10. This Threat is included in the counts above and in Table 13- 10. No threats were identified relating to the transmission of sewage through underground pipelines.

Table 13-10~~13-10~~: Number of Significant Drinking Water Threats for the Mount Albert Water Supply. ~~Enumeration of Significant Threats (Wellhead Protection Areas)~~

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.	2~~0~~
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	15
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.	1

Formatted Table

Threat Number	Threat	Significant Threat Counts Number of threats
9	The handling and storage of commercial fertilizer to land.	0
10	The application of pesticide to land.	1
11	The handling and storage of pesticide.	0
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.	1
16	The handling and storage of dense non-aqueous phase liquid.	1
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
21	The use of land as livestock grazing or pasturing land, and outdoor confinement area, or a farm-animal yard.	0
22.	The establishment and operation of a liquid hydrocarbon pipeline	0
-	**Totals**	21~~19~~* significant threats (on **20** properties)

*2 verified existing threats and 17 potential threats that require further verification.

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. ~~* 2 verified existing threats and 17 potential threats that require further verification.~~

Formatted Table

Formatted: Font: Bold

13.5.3.5.1 Managed Lands

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

Managed Lands were identified, and the Managed Lands proportions were determined for the WHPA of the Mount Albert Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.5.3.5). Figure 13c-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Mount Albert Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

13.5.3.5.2 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~~the Table of Drinking Water Threats~~.

The Livestock Density was determined for the delineated WHPA zones for the Mount Albert Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.5.3.5). As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

Figure 13c-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Mount Albert 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 A3 (Appendix Y).

13.5.3.5.3 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~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Mount Albert Water Supply was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). 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 13.5.3.5).

Figure 13c-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Mount Albert Water Supply.

13.6 Queensville Well Supply

Queensville is located on the northern flank of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). The aquifer/aquitard system beneath the Queensville area consists of three laterally extensive regional aquifers: Oak Ridges Moraine Complex, Thorncliffe Formation, and Scarborough Formation. Approximately 3,700 residents in the Community of Queensville obtain potable water supply from four (4) municipal wells: Wells 1, 2, 3 and 4. The wells also supply a portion of the drinking water for the Communities of Newmarket, Aurora and Holland Landing. The wells from these four communities operate as a combined system and are permitted as such.

The Queensville wells are grouped together with the Newmarket, Holland Landing, and Aurora wells as the Yonge Street Area (YSA) wells. As noted in Kassenaar and Wexler (2006), the "Yonge Street Aquifer" is part of a larger regional flow system that is locally influenced by a combination of three geologic features, including a topographic basin, tunnel channel and bedrock valley. The topographic basin cuts into the ORM deposits and the associated streams (tributaries of the East Holland River) induce groundwater flow from outside the basin. The tunnel channel cross connects the aquifer zones, both vertically and horizontally, increasing the effective transmissivity in the vicinity of several of the Yonge Street Area production wells. Finally, the underlying bedrock valley further extends the zone of influence of the deeper (Scarborough) production wells along the valley axis.

The Queensville wells pass through very thick Newmarket Till, which either outcrops or is overlain by thin sands or fine-grained glaciolacustrine deposits. The well screens are in the sandy Thorncliffe and Scarborough Formations. Table 13- 11 provides more information on the Queensville municipal wells.

Table 13-11~~13-11~~: Municipal Well Information - Queensville

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
1	81.48	69.49 to 81.48	Thorncliffe Formation	Calcium bicarbonate	6,546
2	79.60	66.63 to 79.60	Thorncliffe Formation	Calcium bicarbonate	6,546[5]
3	115.51	103.02 to 115.51	Scarborough Formation	Calcium bicarbonate	6,546[6]

Formatted: Font: 11 pt, Bold

Formatted: Font: 11 pt, Bold

Formatted: Font: 11 pt

Formatted Table

Formatted: Font: 11 pt

Formatted: Font: 11 pt

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
4	116.73	104.24 to 116.73	Scarborough Formation	Calcium bicarbonate	6,546

Formatted: Font: 11 pt, Bold

Formatted: Font: 11 pt, Bold

Formatted: Font: 11 pt

Note for the table above:

1. Information provided by York Region
2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009)
4. Genivar (2007)
5. Queensville Well 2 generally does not operate at the same time as Well No. 1. Pumping was applied to Queensville 1. Queensville Well 2 is in the same model cell as Queensville 1 (Earthfx, 2007)
6. Queensville Well 3 generally does not operate at the same time as Well 3. Pumping was applied to Queensville 3. Queensville 4 is in the same model cell as Queensville 3 (Earthfx, 2007)

WHPA delineation and Vulnerability presented in this section is based on Earthfx and Azimuth (2007) and Earthfx (2009), while the Issues and Threats Assessment is based on the Stantec, 2010 report.

13.6.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area to be delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability is assessed to provide an indication, within the WHPA, which current (or future) Activities 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 anthropogenic activities, 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 land use or activity could affect the drinking water supply aquifer. 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 Queensville water supply has been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The Intrinsic Vulnerability

of the groundwater within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and the Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Queensville WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Earthfx and Azimuth, 2007 and Earthfx, 2009.

13.6.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Queensville Municipal Water Supply wells, as delineated by Earthfx Incorporated and Azimuth Environmental Consulting, Inc, is shown in Figure 13d-1. Please refer to section 13.3.1.1 for more information on WHPA delineation methods.

13.6.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPA of the four municipal wells in Queensville is shown in Figure 13d-2.

The Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. Please refer to section 13.3.1.2 for more information on this method and the rationale for using it.

The Queensville wells generally have small areas of Medium Intrinsic Vulnerability surrounded by areas of Low Vulnerability. A small area of High Intrinsic Vulnerability lies to the south of Queensville Wells 3 and 4. This is associated with a small zone of thin Newmarket Till interpreted to be present in this area. The simulated water table lies below the base of this thin Newmarket Till, and as a result, particles in this area were started in Layer 5. The analysis shows that, even though the 25-year TOT zones from the different wellfields coalesce, much of the 25-year TOT for the Queensville wellfields have Low Intrinsic Vulnerability.

13.6.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec 2010 for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at

ground surface. Future adjustments to the IVS may be required in future to account for the presence of constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.6.1.4 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.~~

13.6.1.5 Vulnerability Score

The Vulnerability Scoring and mapping from Earthfx and Azimuth (2007) was revised by Earthfx in 2009 due to an update of the Vulnerability Scoring values in the Technical Rules (as amended in December 2008). The WHPAs for the Queensville Water Supply, as shown in Figure 13d-1, and the Groundwater Vulnerability (Figure 13d-2) were used to assign a Vulnerability Score by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Figure 13d-2 illustrates the Vulnerability Scores for the Queensville Water Supply and will be used to assess Drinking Water Threats in Section 13.6.3.

13.6.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. Uncertainty assessment for WHPA delineation was undertaken by both and Azimuth, 2007 (revised 2009) and through an independent peer review commissioned by the SGBLS Region—See Section 13.3.1.6. As a result of these two assessments, the Uncertainty of WHPA delineation was ranked as High, and for Vulnerability Assessment, Low.

13.6.2 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.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region. The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues Evaluation methods can be found in Technical Memorandum A1 (Appendix Y).

The Genivar (2007) results indicated that the groundwater supply from Queensville municipal wells met the ODWQS (MOE, 2006), with the exception of the iron and manganese, which exceeded their AO. As reported by Genivar (2007), elevated iron and manganese are common in deep aquifers in York Region. An examination of microbiological data by Genivar (2007) indicated consistently elevated microbial presence at Queensville Well No. 4, which was attributed to a cracked well casing. Repairs to the well casing were carried out in April and May, 2007, and by August 2007 the microbial detections had ceased (York Region, 2009a). It should be noted that sodium concentrations were observed to be consistently near or slightly above 20 mg/L in Queensville, which is well below the AO of 200 mg/L. However, since the concentrations are consistently at or above 20 mg/L York Region notifies the local medical officer so that physicians can notify patients on sodium restricted diets (MOE, 2006).

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Microbial parameters were not considered as the detections historically observed in Queensville Well No. 4 have ceased since well repair was completed in 2007 (York Region, 2009). Raw groundwater quality data was provided by York Region in electronic format for the Queensville municipal wells from March 1999 to February 2009 for evaluation in the current study. The results of the water quality issues identification and evaluation process for the Community of Queensville wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Queensville Water Supply.

13.6.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Queensville Water Supply was completed in accordance with the detailed methodology presented in Stantec, 2010 and Technical Memorandums A2 to A4 (Appendix Y). 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 Queensville 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.

13.6.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Queensville Water Supply Drinking Water Supplies 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.

13.6.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential Conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained

in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

- Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)
- National Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)
- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009), York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. Refer to Stantec, 2010 for the full list of reports.

No confirmed Conditions have been identified for the Queensville Water Supply. Stantec, 2010, identified four (4) potential Conditions (e.g. spills), all outside of WHPA-C, that may require further investigation.

13.6.3.3 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/. ~~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: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.6.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13d-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 Queensville 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 Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.6.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13d-4 ~~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 Queensville 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.

13.6.3.3.3 DNAPL Chemical Parameters

Figure 13d-5 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 Queensville Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13d-5 ~~can be used to can be used~~ to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

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

Further to Section 13.6.3.2, no Conditions have been confirmed within the WHPA for the Queensville 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 ~~M~~emorandum A4 (Appendix Y). 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 13d-2 illustrates the Vulnerability Score map for the Queensville Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.6.3.5 Enumerating Drinking Water Threats

~~13.6.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of Significant Drinking Water Threats for the Queensville Water Supply has been determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. There are no Significant Threats associated with Conditions or Drinking Water Issues.

documents the enumeration of existing and potential activities that are considered to be Significant Drinking Water Threats within the WHPA for the Queensville Water Supply.

Within the Queensville well field, a total of thirty-one (31) potential Significant Threats were identified on a total of seventeen (17) land parcels. The Threat and parcel counts differ due to the fact that multiple Significant Threats may exist on a single parcel. Significant Threats were related to systems that store or transmit sewage (10), handling and storage of commercial fertilizer (1), handling and storage of pesticide (1), handling and storage of fuel (4), handling and storage of DNAPLs (2), application of agricultural source material to land (3), application of commercial fertilizer to land (5), and application of pesticide to land (5).

Within each delineated WHPA with a Vulnerability Score of 10, one Threat activity has been assigned to address the potential for subsurface storage of fuel for home heating purposes. In total, two (2) significant threats were included for residential and commercial heating fuel tanks within the WHPA for the Queensville Water Supply, representing up to 8 potential threats (Significant, Moderate or Low) on all identified parcels where the vulnerability score is 10. These Threats are included in the counts above and in Table 13- 12. No threats were identified relating to the transmission of sewage through underground pipelines.

Table 13-12~~13 12~~: Number of Significant Drinking Water Threats for the Queensville Water Supply. ~~Enumeration of Significant Threats (Wellhead Protection Areas)~~

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.	2~~0~~
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	10
3	The application of agricultural source material to land.	3
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.	5
9	The handling and storage of commercial fertilizer to land.	1
10	The application of pesticide to land.	4~~5~~
11	The handling and storage of pesticide.	0
12	The application of road salt.	0
13	The handling and storage of road salt.	0
14	The storage of snow.	0

Formatted Table

Threat Number	Threat	Significant Threat Counts Number of threats
15	The handling and storage of fuel.	4
16	The handling and storage of dense non-aqueous phase liquid.	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
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**	**310*** significant threats (on **18** properties)

*14 verified existing threats and 17 potential threats that require further verification.

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. ~~*14 verified existing threats and 17 potential threats that require further verification.~~

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

Formatted: Font: Bold

13.6.3.5.1 Managed Lands

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

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Queensville Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.6.3.5). Figure 13d-6 illustrates the location and proportion of Queensville Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

13.6.3.5.2 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~~the Table of Drinking Water Threats~~.

The Livestock Density was determined for the delineated WHPA zones for the Queensville Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.6.3.5). As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

Figure 13d-7 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Queensville 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 A3 (Appendix Y).

13.6.3.5.3 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~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Queensville Water Supply was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). 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 13.6.3.5).

Figure 13d-8 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Queensville Water Supply.

13.7 Ansnorveldt Well Supply

Ansnorveldt is located on the northern flank of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). Approximately 231 residents in the Community of Ansnorveldt are serviced through a groundwater supply of two (2) municipal wells: Wells 1 and 2.

At Ansnorveldt, the municipal wells are located in an area of fine-grained glaciolacustrine sediments at surface that overlie a major tunnel channel which contains infill sediments composed mainly of silt. The well is screened in sands near the top of the Scarborough Formation (or its stratigraphic equivalent) below what is interpreted to be the Sunnybrook Drift. The geochemical signature was unique compared to all other SAC wells in York Region and was attributed to a local change in bedrock type in the Ansnorveldt area (Genivar, 2007).

Table 13- 13 provides more information on the Ansnorveldt municipal wells.

Table 13-13~~13 13~~: Municipal Well Information - Ansnorveldt

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
1	73.76	72.54 to 73.76	Scarborough Formation	Sodium bicarbonate	101
2	87.4	84.7 to 87.4	Scarborough Formation	Magnesium bicarbonate	184

Formatted: Font: 11 pt, Bold

Formatted Table

Formatted: Font: 11 pt

Formatted: Font: 11 pt

Note for the table above:

1. Information provided by York Region
2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009)
4. Genivar (2007)

WHPA delineation and Vulnerability presented in this section is based on Earthfx and Azimuth (2007) and Earthfx (2009), while the Issues and Threats Assessment is based on the Stantec, 2010 report.

13.7.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area to be delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability is

assessed to provide an indication, within the WHPA, which current (or future) Activities 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 anthropogenic activities, 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 land use or activity could affect the drinking water supply aquifer. 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 Community of Ansnorveldt water supply has been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The Intrinsic Vulnerability of the groundwater within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and the Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Ansnorveldt WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Earthfx and Azimuth, 2007 and Earthfx, 2009.

13.7.1.1 Wellhead Protection Area (WHPA) Delineation

The WHPA for the Ansnorveldt Municipal Water Supply wells, as delineated by Earthfx Incorporated and Azimuth Environmental Consulting, Inc, is shown in Figure 13e-1. Please refer to section 13.3.1.1 for more information on WHPA delineation methods.

13.7.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the municipal wells in Ansnorveldt is shown in Figure 13e-2. The Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. Please refer to section 13.3.1.2 for more information on this method and the rationale for using it. It should be noted that the Figure 13e-2 indicates that there is no Groundwater Vulnerability within the WHPA. Through the WWAT analysis no particles within the WHPA reached the well. For the purpose of determining the Vulnerability Score these areas were assumed to have a Groundwater Vulnerability of Low.

13.7.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec 2010 for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at ground surface. Future adjustments to the IVS may be required in future to account for the presence of constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.7.1.4 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.~~

13.7.1.5 Vulnerability Score

The Vulnerability Scoring and mapping from Earthfx and Azimuth (2007) was revised by Earthfx in 2009 due to an update of the Vulnerability Scoring values in the Technical Rules (as amended in December 2008). The WHPAs for the Ansnorveldt Water Supply, as shown in Figure 13e-1, and the Groundwater Vulnerability (Figure 13e-2) were used to assign a Vulnerability Score by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Figure 13e-3 illustrates the Vulnerability Scores for the Ansnorveldt Water Supply and will be used to assess Drinking Water Threats in Section 13.7.3.

13.7.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. Uncertainty assessment for WHPA delineation was undertaken by both and Azimuth, 2007 (revised 2009) and through an independent peer review commissioned by the SGBLS Region—See Section 13.3.1.6. As a result

of these two assessments, the Uncertainty of WHPA delineation was ranked as High, and for Vulnerability Assessment, Low.

13.7.2 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.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region. The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was also reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues Evaluation methods can be found in Technical Memorandum A1 (Appendix Y).

The Genivar (2007) results indicated that the groundwater supply from the Ansnorveldt municipal wells met the ODWQS (MOE, 2006) for all four key indicator parameters (chloride, sodium, nitrate, and sulphate) as well manganese. For iron the ODWQS aesthetic object is occasionally exceeded at Ansnorveldt Well No. 2. All four key indicator parameters were reported to show consistently stable trends with time. Sodium concentrations were consistently above 20 mg/L, which is the Medical Officer of Health reporting limit. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of E. coli at this well field.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate, based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. York Region provided the raw groundwater quality data in electronic

format from December 2000 to January 2009 for the Ansnorveldt municipal wells. The results of the water quality issues identification and evaluation process for the Ansnorveldt municipal wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Ansnorveldt Water Supply.

Sodium concentrations were observed to be consistently above 20 mg/L at both Ansnorveldt municipal wells. The AO for sodium in drinking water is 200 mg/L. In accordance with the ODWQS, York Region notifies the local medical officer of health when the sodium concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets (MOE, 2006).

13.7.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Ansnorveldt Water Supply was completed in accordance with the detailed methodology presented in Stantec, 2010 and Technical Memorandums A2 to A4 (Appendix Y). 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 Ansnorveldt 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.

13.7.3.1 List of Drinking Water Threats – Activities

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

13.7.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential Conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

- Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)
- National -Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)
- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009), York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. Refer to Stantec, 2010 for the full list of reports.

No confirmed Conditions have been identified for the Ansnorveldt Water Supply. No potential Conditions have been identified.

13.7.3.3 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: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.7.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13e-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 Ansnorveldt 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 Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.7.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13e-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 Ansnorveldt 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.

13.7.3.3.3 DNAPL Chemical Parameters

Figure 13e-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 Ansnorveldt Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13e-6 ~~can be used to can be used~~ to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

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

Further to Section 13.7.3.2, no Conditions have been confirmed within the WHPA for the Ansnorveldt 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 A4 (Appendix Y). 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 13e-3 illustrates the Vulnerability Score map for the Ansnorveldt Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.7.3.5 Enumerating Drinking Water Threats

~~13.7.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of Significant Drinking Water Threats for the Ansnorveldt Water Supply has been determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 13- 14 documents the enumeration of existing and potential activities that are considered to be Significant Drinking Water Threats within the WHPA for the Ansnorveldt Well Supply.

Within the Ansnorveldt well field, a total of forty-four (44) Significant Threats were identified on a total of seventeen (17) land parcels. The Threat and parcel counts differ due to the fact that multiple Significant Threats may exist on a single parcel. Significant Threats were related to systems which store or transmit sewage (13), handling and storage of fuel (5), application of agricultural source material to land (2), application of commercial fertilizer to land (16), application of pesticide to land (4) handling and storage of commercial fertilizer (2), and handling and storage of pesticide (2).

Within each delineated WHPA with a Vulnerability Score of 10, one Threat activity has been assigned to address the potential for subsurface storage of fuel for home heating purposes. In total, one (1) significant threat was included for residential and commercial heating fuel tanks within the WHPA for the Ansnorveldt Water Supply, representing up to 15 potential Threats (Significant, Moderate or Low) on all identified parcels where the vulnerability score is 10. This

Threat is included in the counts above and in Table 13- 14. No Threats were identified relating to the transmission of sewage through underground pipelines.

Table 13-14~~13 14~~: Number of Significant Drinking Water Threats for the Ansnorveldt Water Supply. ~~Enumeration of Significant Threats (Wellhead Protection Areas)~~

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.	13
3	The application of agricultural source material to land.	2
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.	16
9	The handling and storage of commercial fertilizer to land.	2
10	The application of pesticide to land.	4
11	The handling and storage of pesticide.	2
12	The application of road salt.	0
13	The handling and storage of road salt.	0

Formatted Table

Threat Number	Threat	Significant Threat Counts Number of threats
14	The storage of snow.	0
15	The handling and storage of fuel.	5
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
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**	**44*** significant threats (on **17** properties)

*11 verified existing threats and 33 potential threats that require further verification.

Note: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel. ~~*11 verified existing threats and 33 potential threats that require further verification.~~

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

13.7.3.5.1 Managed Lands

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

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Ansnorveldt Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.7.3.5). Figure 13e-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Ansnorveldt Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

13.7.3.5.2 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~~the Table of Drinking Water Threats~~.

The Livestock Density was determined for the delineated WHPA zones for the Ansnorveldt Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.7.3.5). As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

Figure 13e-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Ansnorveldt 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 A3 (Appendix Y).

13.7.3.5.3 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~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Ansnorveldt Water Supply was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). 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 13.7.3.5).

Figure 13e-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Ansnorveldt Water Supply.

13.8 Schomberg Well Supply

The Community of Schomberg is located on the northern flank of the Oak Ridges Moraine within the Lake Simcoe drainage basin (Genivar, 2007). Approximately 1,763 residents in Schomberg are serviced through a groundwater supply of three (3) municipal wells: Wells 2, 3 and 4.

In the Schomberg area, the major surficial sediments are the fine-grained Kettleby Till and glaciolacustrine silts and clays, which are up to 10 m thick. These overlie up to 16 metres (m) of silt and silty sand of the ORAC in the area of the pumping wells. The Newmarket Till is quite thick at Schomberg, ranging from about 15 to more than 30 m, and contains notable local layers or lenses of sand and silt. The wells are screened in sand near the base of the Thorncliffe Formation, which is quite silty in its upper portions and is up to 50 m thick. The Sunnybrook Drift is very thin or may be absent at this location. The Scarborough Formation is interpreted to be present and appears to vary considerably in thickness. The Core Model had the Schomberg wells assigned to the Scarborough Formation to represent that the wells were in the lower part of a locally-connected Thorncliffe/Scarborough unit. Table 13- 15 provides more information on the Schomberg municipal wells.

Table 13-15~~13 15~~: Municipal Well Information - Schomberg

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
2	88.70	82.42 to 88.70	Thorncliffe Formation	Calcium bicarbonate	1,637
3	89.00	79.65 to 89.00	Thorncliffe Formation	Calcium bicarbonate	2,290
4[5]	90.83	81.69 to 90.83	Thorncliffe Formation	Unknown	1,508

Note for the table above:

1. Information provided by York Region
2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009)
4. Genivar (2007)
5. Online production started in Fall 2009

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

WHPA delineation and Vulnerability presented in this section is based on Earthfx and Azimuth (2007) and Earthfx (2009), while the Issues and Threats Assessment is based on the Stantec, 2010 report.

13.8.1 Groundwater Vulnerability Assessment

The Wellhead Protection Area (WHPA) is the primary Vulnerable Area to be delineated to ensure the protection of the municipal water supply wells. The Groundwater Vulnerability is assessed to provide an indication, within the WHPA, which current (or future) Activities 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 anthropogenic activities, 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 land use or activity could affect the drinking water supply aquifer. 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 Community of Schomberg water supply has been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The Intrinsic Vulnerability of the groundwater within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and the Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Mount Albert WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Earthfx and Azimuth, 2007 and Earthfx, 2009.

13.8.1.1 Well Head Protection Area (WHPA) Delineation

The WHPA for the Schomberg Municipal Water Supply wells was originally delineated by Earthfx Incorporated and Azimuth Environmental Consulting Inc (2007). Since then a new production well has been constructed. An Environmental Assessment (EA) report (Genivar, 2007) was completed for this system. The report used the maximum permitted rates at each well. These pumping rates and the resulting WHPA are used for the Vulnerability Assessment in Earthfx, 2009.

The Schomberg WHPA is shown in Figure 13f-1.

The Time-of-Travel (TOT) method is the approach specified by MOE Guidance Module 3 (MOE, 2006) for delineating wellhead protection areas around municipal supply wells. As described in the November 2007 report (Earthfx, 2007), three-dimensional advective flow modelling was applied, which is the "preferred method" because numerical models can represent spatial variability of aquifer and aquitard properties and recharge rates. Furthermore, because the model covers all of York Region, mutual interference between supply wells and the effect of surface water features on the groundwater flow patterns can also be represented.

The U.S. Geological Survey (USGS) MODFLOW code was selected for use in this study because this code is recognized worldwide and has been extensively tested and verified. To simulate groundwater flow paths and travel times which, in turn, were used to define TOT zones for the York Region municipal wells, the U.S. Geological Survey MODPATH code was used.

MODFLOW/MODPATH results were used to delineate the primary wellhead protection TOT zones for each municipal well (2-, 5- and 25-year TOT zones, which correspond to the WHPA sensitivity zones B, C, and D, respectively). WHPA-A was created by drawing a circle with a 100-metre radius around each well.

13.8.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the municipal wells in Schomberg is shown in Figure 13f-2.

The Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. Please refer to section 13.3.1.2 for more information on this method and the rationale for using it.

The pumping rates from the EA report (Genivar, 2007) and the resulting WHPA were used for the Vulnerability Assessment completed by Earthfx, 2009. The analysis shows that there are areas of Low Vulnerability near the wells.

13.8.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec 2010 for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at ground surface. Future adjustments to the IVS may be required in future to account for the

presence of constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.8.1.4 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.~~

13.8.1.5 Vulnerability Score

The Vulnerability Scoring and mapping from Earthfx and Azimuth (2007) was revised by Earthfx in 2009 due to an update of the Vulnerability Scoring values in the Technical Rules (as amended in December 2008). The WHPAs for the Schomberg Water Supply, as shown in Figure 13f-1, and the Groundwater Vulnerability (Figure 13f-2) were used to assign a Vulnerability Score by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Figure 13f-3 illustrates the Vulnerability Scores for the Schomberg Water Supply and will be used to assess Drinking Water Threats in Section 13.8.3.

13.8.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. Uncertainty assessment for WHPA delineation was undertaken by both and Azimuth, 2007 (revised 2009) and through an independent peer review commissioned by the SGBLS Region—See Section 13.3.1.6. As a result of these two assessments, the Uncertainty of WHPA delineation was ranked as High, and for Vulnerability Assessment, Low.

13.8.2 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.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region. The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues Evaluation methods can be found in Technical Memorandum A1 (Appendix Y).

The Genivar (2007) results indicated that the groundwater supply from Schomberg municipal wells Nos. 2 and 3 met the ODWQS (MOE, 2006) with the exception of the aesthetic parameters iron and manganese. Elevated iron and manganese concentrations are common in deep aquifers in York Region (Genivar, 2007). Elevated methane was also noted. Schomberg Well No. 4 was brought online in the Fall of 2009 and is screened in the same aquifer unit and is expected to have the same geochemistry as Schomberg Well 3. This geochemical signature is reportedly natural and related to rock and water interaction (Genivar, 2007). An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of E. coli at this well field.

Parameters considered for the current study included calcium, chloride, hardness, sodium, and sulphate. The selection of the parameters was based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Schomberg municipal wells from January 1992 to February 2009 for evaluation in the current study. The results of the water quality issues identification and evaluation process for the Schomberg municipal wells are summarized in Stantec, 2010.

No Drinking Water Issues were identified with the Schomberg Water Supply.

Sodium concentrations were observed to be consistently near or above 20 mg/L at Schomberg municipal wells 2 and 3. The AO for sodium in drinking water is 200 mg/L. In accordance with the ODWQS, York Region notifies the local medical officer of health when the sodium

concentration exceeds 20 mg/L so that this information may be communicated to local physicians for their use with patients on sodium restricted diets (MOE, 2006).

13.8.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Schomberg Water Supply was completed in accordance with the detailed methodology presented in Stantec, 2010 and Technical Memorandums A2 to A4 (Appendix Y). 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 Schomberg 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.

13.8.3.1 List of Drinking Water Threats – Activities

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

13.8.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential Conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

- Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)
- National Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)
- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009), York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. Refer to Stantec, 2010 for the full list of reports.

No confirmed Conditions have been identified for the Schomberg Water Supply. Stantec, 2010, identified 4 potential Conditions (e.g. spills) within Schomberg WHPAs that may require further investigation.

13.8.3.3 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: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.8.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13f-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 Schomberg 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 Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.8.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13f-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 Schomberg 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.

13.8.3.3.3 DNAPL Chemical Parameters

Figure 13f-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 Schomberg Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13f-6 ~~can be used to can be used~~ to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

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

Further to Section 13.8.3.2, no Conditions have been confirmed within the WHPA for the Schomberg 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 A4 (Appendix Y). 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 13f-3 illustrates the Vulnerability Score map for the Schomberg Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.8.3.5 Enumerating Drinking Water Threats

~~13.8.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of Significant Drinking Water Threats for the Schomberg Water Supply has been determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 13- 16 documents the enumeration of existing and potential activities that are considered to be Significant Drinking Water Threats within the WHPA for the Schomberg Well Supply.

Within the Schomberg well field, a total of eleven (11) Significant Threats were identified on a total of ten (10) land parcels. The Threat and parcel counts differ due to the fact that multiple Significant Threats may exist on a single parcel. The Significant Threats were related to systems that store or transmit sewage (2), handling and storage of DNAPLs (6), application of commercial fertilizer to land (1), and handling and storage of fuel (2).

Within each delineated WHPA with a Vulnerability Score of 10, one Threat activity has been assigned to address the potential presence of municipal sanitary sewers and one threat activity has been included to represent the potential for subsurface storage of fuel for home heating purposes. These Threats are included in the counts above and in Table 13- 16.

Table 13-16~~13-16~~: Number of Significant Drinking Water Threats for the Schomberg Water Supply. ~~Enumeration of Significant Threats (Wellhead Protection Areas)~~

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.	2
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.	1
9	The handling and storage of commercial fertilizer to land.	0
10	The application of pesticide to land.	0
11	The handling and storage of pesticide.	0
12	The application of road salt.	0
13	The handling and storage of road salt.	0
14	The storage of snow.	0

Formatted Table

Threat Number	Threat	Significant Threat Counts Number of threats
15	The handling and storage of fuel.	2
16	The handling and storage of dense non-aqueous phase liquid.	6
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
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**	**11*** significant threats (on **10** properties)

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

*5 verified existing threats and 6 potential threats that require further verification.

Note about the table above: The total number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel. ~~*5 verified existing threats and 6 potential threats that require further verification.~~

13.8.3.5.1 Managed Lands

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

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Schomberg Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.8.3.5). Figure 13f-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Schomberg Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

13.8.3.5.2 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~~the Table of Drinking Water Threats~~.

The Livestock Density was determined for the delineated WHPA zones for the Schomberg Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.8.3.5). As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

Figure 13f-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Schomberg 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 A3 (Appendix Y).

13.8.3.5.3 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~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Schomberg Water Supply was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). 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 13.8.3.5).

Figure 13f-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Schomberg Water Supply.

13.9 Ballantrae/ Musselmans Well Supply

Ballantrae is a hamlet located in the Township of Whitchurch-Stouffville, on the northern flank of the Oak Ridges Moraine (ORM), near the summit of the drainage divide between Lake Simcoe and Lake Ontario (Genivar, 2007). Approximately 4,532 residents in the community are serviced through a groundwater supply consisting of four (4) large municipal wells. Wells 1, 2, and 3are currently in operation. Well 4 is a newly constructed production well that will assist in meeting the water demand for the community by serving as a backup to Well 3.

Ballantrae Municipal Wells 1 and 2 are situated in a deep tunnel channel, with the well screen near the base of the infill sediment sequence in gravels and gravelly sands, overlain by silts and silty sands. The Newmarket Till has been entirely eroded in this area. Surface materials in the area are mainly glaciofluvial sands. Water quality characteristics were not similar to those for either the ORAC or the deep aquifer wells. This was attributed to possible mixing of groundwater facilitated by the presence of the nearby tunnel channels (Genivar, 2007).

Wells 3 and 4 are situated in a relatively uniform sand and gravel unit, northeast of municipal wells 1 and 2. It is screened within the Thorncliffe aquifer and is separated from the overlying ORM deposits by the Newmarket aquitard (Golder, 2013).Table 13- 17 provides more information on the Ballantrae municipal wells.

Table 13-17~~13-17~~: Municipal Well Information - Ballantrae

Well No.	Depth[1] (mbgs[2])	Screened Interval[1] (mbgs[2])	Aquifer[3]	Geochemical Type of Water[4]	Permitted Capacity (m^3/day)[3]
1	108.81	96.39 to 108.81	Thorncliffe Formation	Calcium bicarbonate	4,580[5]
2	110.34	102.57 to 110.34	Thorncliffe Formation	Calcium bicarbonate	4,580[5]
3	108.5	95.1 to 100.6	Thorncliffe Formation	Calcium bicarbonate	4,580[5]
4	109.73	91.36 to 99.64	Thorncliffe Formation	Calcium bicarbonate	4,580[5]

Note about the above table:

1. Information provided by York Region

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

2. Metres below ground surface (mbgs)
3. Earthfx (2007 and 2009). Short-term (21days) maximum combined daily
4. Genivar (2007)
5. Ballantrae Wells are allowed to pump a combined average of 4,580 m^3/day. Pumping was assigned to Ballantrae Wells 1,2, and 3 with well 1 and 2 each assigned a value of 2,290 m^3/day, while well 3 was assigned a value of 2,618 m^3/day (Golder, 2013)

The WHPA delineation and vulnerability assessment presented in this section are based on the technical work presented in reports by Golder (2013), Earthfx and Azimuth (2007), and Earthfx (2009), while the Issues and Threats Assessment is primarily based on Stantec (2010). Much of the threats enumeration work has been updated based on threats verification worked carried out across the source protection region, as well as by work done by Golder (2013) as a result of the new WHPA delineation that resulted from the addition of Well 3, and later 4.

13.9.1 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) activities 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 Community of Ballantrae water supply has been delineated by following the process recommended in the MOE Guidance Module 3 (MOE, 2006). The areas that contribute groundwater to the wells were delineated as WHPA. The Intrinsic Vulnerability of the groundwater within the WHPA was assessed using the Water Table to Well Advection Time (WWAT) and the Intrinsic Vulnerability Scoring (IVS) methods. The WHPA and the Intrinsic Vulnerability were then considered together as per the Technical Rules (MOE, 2008a) to determine a Vulnerability Score for the Ballantrae WHPAs. Details of the methods for the Vulnerability Analysis and details of the work performed to assess the Groundwater Vulnerability are provided in Earthfx and Azimuth, 2007, Earthfx, 2009, and Golder, 2013.

13.9.1.1 Well Head Protection Area (WHPA) Delineation

The WHPA for the Ballantrae-Musselmans Municipal Water Supply wells, as delineated by Golder Associates (2013), is shown in Figure 13g-1. The WHPA-A,-B,-C zones for Wells 1 and 2, and Wells 3 and (now) 4, are separate from each other. However, as shown in Figure 13g-1, the WHPA-D zones for wells 1 and 2, and wells 3 and (now) 4 overlap, and are therefore characterized as a single combined WHPA. Please refer to section 13.3.1.1 for more information on WHPA delineation methods.

Well 4 was added to the Ballantrae drinking water system in 2020, as shown in Figure 13g-1. As Well 4 does not represent an increase in water takings, and is screened at a similar depth in the same aquifer as Well 3, the WHPA delineated for Well 3 will also suffice to represent the well head protection area for Well 4, with the exception of WHPA-A, which has been added as shown in Figure 13g-1.

13.9.1.2 Groundwater Vulnerability

The Groundwater Vulnerability within the WHPAs of the municipal wells in Ballantrae is shown in Figure 13g-2. Groundwater Vulnerability has been determined using the Water table to Well Advective Time (WWAT) analysis. Please refer to section 13.3.1.2 for more information on this method and the rationale for using it.

Figure 13g-2 indicates a high Groundwater Vulnerability around Wells 3 and 4. Areas of medium and low vulnerability characterize the remaining WHPA zones. Generally, vulnerability decreases as distance from the wells increases. Groundwater Vulnerability serves as a good indication of the vulnerability of the supply wells to surface sources of contamination.

13.9.1.3 Transport Pathway Increase

Transport Pathways and any resulting Vulnerability increases were not considered at this phase of the study. This decision was made in consultation with MOE – See Stantec 2010 for more information. York Region determined that completing adjustments to the vulnerability scoring to account for the presence of constructed preferential pathways was not required because the assessment was completed using the water-table-to-well advection time (WWAT) method to estimate the total travel time (both horizontal and vertical) from the water table to the well. Travel time through the unsaturated zone (UZAT) was not considered in these analyses, and therefore it was conservatively assumed in the model that the water table was located at ground surface.

The updated study completed by Golder, 2013 also made no adjustments to vulnerability scoring to account for the presence of constructed preferential pathways around Wells 1 and 2.

To identify the possible presence of preferential transport pathways around the newly constructed well, Golder (2013) carried out a review of ortho-imagery and land use designations within the Well 3 area. The review did not reveal any transport pathways in the vicinity of Wells 3 and 4, and as such no adjustments were made to vulnerability scoring around Wells 3 and 4 to account for the presence of constructed transport pathways. Future adjustments to groundwater vulnerability scoring may be required to account for the presence of newly constructed pathways (i.e. deep wells, improperly decommissioned wells, and pits and quarries).

13.9.1.4 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.~~

13.9.1.5 Vulnerability Score

The Vulnerability Scoring and mapping completed by Earthfx and Azimuth (2007) was revised by Earthfx in 2009 due to an update of the Vulnerability Scoring values in the Technical Rules (as amended in December 2008). The scoring was revised by Golder Associates again in February 2013 to account for the addition of Well 3 (and later 4) to the municipal supply system. The WHPAs for the Ballantrae water supply, as shown in Figure 13g-1, and the Groundwater Vulnerability (Figure 13g-2) were used to assign Vulnerability Scores by using the matrix from Table 5.4 (Chapter 5: Methods Overview, Section 5.2.4). While this matrix is generally used for the SAAT and SWAT Groundwater Vulnerability methods, it was determined to be appropriate to use in this situation, where WWAT methods were used to determine Groundwater Vulnerability.

Figure 13g-3 illustrates the Vulnerability Scores for the Ballantrae water supply and will be used to assess Drinking Water Threats in Section 13.9.3. As illustrated in Figure 13g-3, higher vulnerability (10) can be observed directly around the production wells. Vulnerability generally tends to decrease towards the outer parts of the WHPA.

13.9.1.6 Uncertainty Rating

The Technical Rules require that an Uncertainty Rating, characterized as High or Low, be assigned for completed Vulnerability and WHPA assessments. Uncertainty assessment for WHPA delineation was undertaken by both EarthFx and Azimuth, 2007 (revised 2009) and through an independent peer review commissioned by the SGBLS Region—See Section 13.3.1.6.

As a result of these two assessments, the Uncertainty of the WHPA delineation was ranked as High, and for Vulnerability Assessment, Low.

The study by Golder Associates (2013) was completed to assess the Vulnerability of newly constructed Well 3, and document any updates to Wells 1 and 2 occurring as a result of the addition. Golder Associates utilized the same peer reviewed numerical model used by EarthFx and Azimuth in 2007 and 2009. The model applied made the same assumptions as the previous model, with the exception of new hydrogeologic information that was added only within the immediate vicinity of the wellhead. As a result, an uncertainty ranking of high was also applied to the updated WHPA delineation. Golder Associates (2013) also assigned an uncertainty ranking of high to the updated Vulnerability Assessment. The Vulnerability Assessment uses the same data, and models as the WHPA delineation and therefore, involves the same uncertainties.

13.9.2 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.

The data used for the identification of issues in this study comprised raw groundwater (untreated groundwater from the source aquifer) quality information provided by York Region. The Water Quality Characterization and Issues Identification for Municipal Groundwater Supply System report completed by Genivar (2007) was reviewed to understand existing water quality trends and their applicability to the current study. Water quality parameters reviewed in the Genivar Study (2007) included organic, inorganics, microbiological parameters, and radionuclides. The Genivar (2007) report identified natural geochemical signatures of regional aquifers in York Region and temporal trends in water quality parameters. Summary of Issues Evaluation methods can be found in Technical Memorandum A1 (Appendix Y).

The Genivar (2007) results indicated that the groundwater supply from Ballantrae municipal wells 1 and 2 met the ODWQS (MOE, 2006) with the exception of few aesthetic parameters such as iron and manganese. However, elevated iron and manganese are reportedly common in deep aquifers in York Region (Genivar, 2007). This geochemical signature is reportedly natural and related to rock and water interaction (Genivar, 2007). The Genivar (2007) results

also indicated a slight increasing trend in sodium and chloride (aesthetic and non-human health related parameters) in the Ballantrae municipal wells. An examination of microbiological data by Genivar (2007) indicated that while presence of coliforms has occurred occasionally in raw water throughout York Region, there are no recorded detections of E. coli at this well field.

Parameters considered for the study included calcium, chloride, hardness, sodium, and sulphate based on a review of the Genivar Report (2007) results. Water quality parameters related to anthropogenic sources (chloride and sodium) were selected based on noted increasing trends in several production wells within York Region. The remaining parameters (hardness, calcium and sulphate) were considered to investigate any potential changes in source water composition. Raw groundwater quality data was provided by York Region in electronic format for the Ballantrae municipal wells 1 and 2 from January 1997 to February 2009 for evaluation in the study. The results of the water quality issues identification and evaluation process for the Ballantrae municipal wells based on this data are summarized in Stantec, 2010.

An increasing trend over time was observed in chloride at both Ballantrae municipal wells 1 and 2 from 1997 to 2009. Stable trends were observed for all other parameters (calcium, hardness, sodium and sulphate) for the same twelve year period. All observed parameter concentrations were well below the ODWQS (MOE, 2006) and the conservative issues benchmark.

Water quality data at Wells 1 and 2, was reviewed again in the updated study completed by Golder, 2013. From the time of Stantec's 2010 Assessment to Golder's 2013 Assessment, no changes in water quality were found that would indicate a drinking water issue. Sampling was also conducted during the construction of Well 3s and 4. Sampling results indicated that the water quality at Well 3 was excellent and met the Ontario Drinking Water Standards and Schedule 23 and 24 of Ontario Regulation 170/03 (as amended) for the parameters tested.

No Drinking Water Issues were identified with the Ballantrae Water Supply.

13.9.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Ballantrae Water Supply was completed in accordance with the detailed methodology presented in Golder, 2013 and Technical Memorandums A2 to A4 (Appendix Y). Additionally, the document entitled "Reducing Inconsistencies in Threat Subcategory Enumeration", prepared by the South Georgian Bay Lake Simcoe Source Protection Region (2010) was also used during the assessment.

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 Ballantrae 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.

13.9.3.1 List of Drinking Water Threats – Activities

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

13.9.3.2 List of Drinking Water Threats – Conditions

Detailed methodology used to identify Conditions or potential Conditions is provided in Technical Memorandum A4 (Appendix Y). As part of this study a database search was conducted by EcoLog Environmental Risk Information Services Ltd (EcoLog ERIS) in May, 2009 (EcoLog ERIS, 2009). Below is a summary of the list of databases from which data was obtained in the EcoLog ERIS report that was considered relevant when identifying Conditions in York Region:

- Contaminated Sites on Federal Land June 2000-Feb 2009 (FCS)
- National Environmental Emergencies System 1974-2003 (NEES)
- Record of Site Condition 1997-Sept, 2001, Oct 2004-Feb 009 (RSC)
- Ontario Spills 1988-2007 (SPL)

- Anderson's Waste Disposal Sites 1860s-Present (ANDR)

In addition to the sites identified by EcoLog ERIS (2009), York Region also supplied a series of reports related to locations throughout York Region that could potentially be identified as Conditions. Refer to Stantec, 2010 for the full list of reports. The data available was insufficient to allow for the definitive classification of a condition. The report completed by Golder (2013) also determined that all identified potential conditions would require further investigation to be confirmed as conditions.

No confirmed Conditions have been identified for the Ballantrae Water Supply. Stantec, 2010, identified four (4) potential Conditions (e.g. spills), all of which were outside of WHPA-B, that may require further investigation.

13.9.3.3 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: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.9.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13g-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 Ballantrae 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 Significant, Moderate or Low Threats within WHPA-A and WHPA-B.

13.9.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13g-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 Ballantrae 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.

13.9.3.3.3 DNAPL Chemical Parameters

Figure 13g-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 Ballantrae Water Supply. The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13g-6 ~~can be used to can be used~~ to identify the circumstances in which these Activities associated with DNAPL threats would be Significant Drinking Water Threats.

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

Further to Section 13.9.3.2, no Conditions have been confirmed within the WHPA for the Ballantrae 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 A4 (Appendix Y). 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 13g-3 illustrates the Vulnerability Score map for the Ballantrae Water Supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water. Potential conditions were identified and summarized by Stantec 2010. It was determined that insufficient data was available to allow for definitive classification of a

condition, and all sites were identified as potential conditions. These potential conditions will require further investigation to confirm if they can be classified as actual threats.

13.9.3.5 Enumerating Drinking Water Threats

~~13.9.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of Significant Drinking Water Threats for the Ballantrae Water Supply has been determined using the methodology outlined in Technical Memorandums A2 and A3 (Appendix Y) and refined by staff members of the Regional Municipality of York. There are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 13- 9 documents the enumeration of existing and potential activities that are considered to be Significant Drinking Water Threats within the WHPA for the Ballantrae Water Supply.

Within the Ballantrae well field, a total of five (5) Significant Threats were identified on a total of five (5) land parcels. Significant Threats were related to systems that store or transmit sewage (4), and the handling and storage of fuel (1).

Within each delineated WHPA with a Vulnerability Score of 10, one Threat activity has been assigned to address the potential for subsurface storage of fuel for home heating purposes. In total, one (1) Significant Threat was included for residential heating fuel tanks within the WHPA for the Ballantrae Water Supply, representing up to 6 potential Threats (Significant, Moderate or Low) on all identified parcels where the vulnerability score is 10. This Threat is included in the counts above and in

Table 13- 18. No threats were identified relating to the transmission of sewage through underground pipelines.

Table 13-18~~13-18~~: Number of Significant Drinking Water Threats for the Ballantrae Water Supply. ~~Enumeration of Significant Threats (Wellhead Protection Areas)~~

Formatted Table

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.	3~~0~~

Threat Number	Threat	Significant Threat Counts Number of threats
2	The establishment, operation or maintenance of a system that collects, stores, transmits, treats or disposes of sewage.	4
3	The application of agricultural source material to land.	0
4	The storage of agricultural source material to land.	0
5	The management of agricultural source material.	0
6	The application of non-agricultural source material to land.	0
7	The handling and storage of non-agricultural source material.	0
8	The application of commercial fertilizer to land.	0
9	The handling and storage of commercial fertilizer to land.	0
10	The application of pesticide to land.	0
11	The handling and storage of pesticide.	0
12	The application of road salt.	0
13	The handling and storage of road salt.	0
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

Formatted Table

Threat Number	Threat	Significant Threat Counts Number of threats
18	The management of runoff that contains chemicals used in the de-icing of aircraft.	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**	~~85~~* significant threats (on **8** properties)

Formatted Table

Formatted: Font: Bold

Formatted: Font: Bold

*5 potential threats that require further verification.

Note for the above table: The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel. ~~*5 potential threats that require further verification.~~

13.9.3.5.1 Managed Lands

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

Managed Lands were identified and the Managed Lands proportions were determined for the WHPA of the Ballantrae Water Supply as outlined in Technical Memorandum A3 (Appendix Y) and Golder, 2013. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.9.3.5). Figure 13g-7 illustrates the location and proportion of Managed Lands within the delineated WHPA zones for the Ballantrae Water Supply where Vulnerability Scores were 6 or greater for WHPA-A to WHPA-D.

13.9.3.5.2 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 Rulesthe Table of Drinking Water Threats.

The Livestock Density was determined for the delineated WHPA zones for the Ballantrae Water Supply as outlined in Technical Memorandum A3 (Appendix Y). The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 13.9.3.5). As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

Figure 13g-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Ballantrae 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 A3 (Appendix Y) and Golder, 2013. Generally, there is a minimal amount of agricultural managed land in this area. The results of the livestock density analysis are presented in Figure 13g-8.

13.9.3.5.3 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 Rulesthe Table of Drinking Water Threats.

The proportion of Impervious Surfaces within the delineated WHPA zones for the Ballantrae Water Supply was determined in accordance with the methodology in Technical Memorandum A3 (Appendix Y). 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 13.9.3.5).

Figure 13g-9 illustrates the distribution of Impervious Surfaces within the delineated WHPA zones for the Ballantrae Water Supply.

13.10 -Surface Water Vulnerability Methods and Uncertainties

13.10.1.1 Surface Water Vulnerability

The following section describes the methods used to assess Vulnerability of Keswick and Georgina Water Treatment Plants. Intake Protection Zones for the Keswick and Georgina WTPs were delineated by Baird and Associates (Baird, 2010e). The Keswick and Georgina 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; 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.

13.10.1.2 Delineating IPZ-1 and IPZ-2

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

The IPZ-2 is defined based on the area that may contribute water to the intake where the time-of-travel to the intake is equal to or less than the time that is sufficient to allow the operator of the system to respond to an adverse condition in the quality of the surface water (Rule 65; MOE, 2008a). The two hour minimum response time was used for the Keswick and Georgina WTPs, as the operator response time to shut-down the intake was within 5 minutes of receiving notification.

The IPZ-2 is comprised of four areas:

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

13.10.1.2.1 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 (2010e). The Lake Simcoe model is based on the original model developed for the Assimilative Capacity Studies as described in Baird (2006). This previous work demonstrated that DHI's MIKE3 model could successfully simulate both wind driven currents and thermocline development in Lake Simcoe.

For delineating IPZ-2, currents were developed for 10 year return period wind events, for eight wind directions, run at 45^{o} intervals (Appendix Y – Table 2.2, Baird 2010e). 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 (2010e). 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 Y – Table 5.1, Baird 2010e.

13.10.1.2.2 Up Tributary

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

There are no tributaries located within the Georgina WTP IPZ-2. The four tributaries within the Keswick WTP IPZ-2 have velocities that range from 0.09 m/s to 0.46 m/s (Appendix Y – Baird, 2010e). 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.

13.10.1.2.3 Inland Setback

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

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

It must be noted however that the definition of HWM used in this assessment differs to that provided by the MOE. 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 Y.

13.10.1.2.4 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 2010e.

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; Impervious areas; Subsurface tile drains; Watercourse engineered and modeled cross-sections; Soils and land use data; and Ortho-imagery

The sewersheds discharging into the IPZ-2 were identified from LSRCA and municipal storm water network datasets. For Keswick and Georgina, outlet diameters were extracted from municipal drawings provided by LSRCA. The pipe diameter closest to the outlet was assumed to be representative of the entire sewershed. Residence time and the velocity were then used to estimate a maximum within-sewershed travel distance. A summary of travel distance

calculations for Keswick and Georgina can be found in Baird 2010e. 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.

13.10.1.3 Delineating IPZ-3

The MIKE3 model was used to delineate the area within the surface water body through which contaminants released during an extreme event could be transported to the intake. An extreme event is defined in MOE (2008a) as: a period of heavy precipitation or winds up to a 100 year storm event; a freshet; or a surface water body exceeding its high water mark.

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

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

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

The IPZ-3 sub-areas, used to define areas with varying Vulnerability Scores, were delineated based on the sub-watershed boundaries. The Lake Simcoe water body was also delineated as one sub-area. Although Lake Simcoe generally flows into Lake Couchiching through Atherley Narrows, data showed that reverse flow does occur, with water flowing from Lake Couchiching into Lake Simcoe. The Lake Couchiching water body and watershed were therefore included as IPZ-3 sub-areas. The IPZ-3 was extended up tributaries from the lake, to the watershed limit. A

setback of 120 m was applied on Lake Couchiching (as there is no Regulation Limit) and the Regulation limit used to define the setback within the Lake Simcoe watershed.

13.10.1.4 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.

13.10.1.4.1 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 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, 2010e).

The IPZ-2 base Area Vulnerability Factor, modifiers and final Area Vulnerability Factor for the Keswick and Georgina WTP intakes are listed in Table 13- 19.

Table 13--1913-19: Derivation of IPZ-2 Area Vulnerability Factor (B) for Keswick and Georgina WTP 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)
Keswick	Georgina	8	0	-1	1	0	0	8
Georgina	Georgina	8	-1	-1	1	0	0	8

Formatted: Font: 11 pt, Bold

Formatted Table

Formatted: Font: 11 pt

Formatted: Font: 11 pt

Note for the table above: 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.

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 water bodies 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, 2010e.

The IPZ-3 sub-area base Area Vulnerability Factors, modifiers and final Area Vulnerability Factors for the Keswick and Georgina WTPs are listed in Table 13- 20.

Table 13-~~-2013-20~~: Derivation of IPZ-3 Area Vulnerability Factors for Keswick and Georgina WTPs Intakes.

IPZ-3 Sub-zones	Base Area vuln. Factor	Distance Modifier[1] (Keswick/ Georgina)	Drainage Density Modifier[2]	SCS Curve Number Modifier[3]	Land Use Modifier[4]	Relief-Length Modifier[5]	Final Area Vuln. Factor (B)[6] (Keswick/ Georgina)
Lake Simcoe waterbody (incl. islands)	7	0	-	-	-	-	7/7
Lake Couchiching water body (incl. islands)	7	0	-	-	-	-	7/7
Maskinonge subwatershed	7	-1/-2	0	1	0	0	7/6
West Holland subwatershed	7	-1/-2	1	0	0	0	7/6
East Holland subwatershed	7	-1/-2	1	0	1	0	7/7
Innisfil Creeks subwatershed	7	-1/-1	0	0	0	0	6/6
Geogina Creeks subwatershed	7	-1/-1	-1	1	0	0	6/6
Black River subwatershed	7	-2/-1	0	0	-1	0	4/5
Oro South Creeks subwatershed	7	-2/-2	0	0	0	0	5/5
Hawkestone Creek subwatershed	7	-3/-2	0	-1	0	1	4/5

Formatted: Font: Bold

Formatted Table

IPZ-3 Sub-zones	Base Area vuln. Factor	Distance Modifier[1] (Keswick/ Georgina)	Drainage Density Modifier[2]	SCS Curve Number Modifier[3]	Land Use Modifier[4]	Relief-Length Modifier[5]	Final Area Vuln. Factor (B)[6] (Keswick/ Georgina)
Hewitts Creek subwatershed	7	-3/-3	0	0	0	0	4/4
Pefferlaw Brook + Uxbridge Brook subwatershed	7	-3/-2	0	0	-1	0	¾
Lovers Creek subwatershed	7	-3/-3	0	0	0	0	4/4
Barrie Creeks subwatershed	7	-3/-3	0	0	1	1	6/6
Beaver Creek subwatershed	7	-3/-3	0	-1	0	0	3/3
Whites Creek subwatershed	7	-3/-3	0	0	0	0	4/4
Upper + Lower Talbot River subwatershed	7	-3/-3	0	-1	0	-1	2/2
Oro North Creeks subwatershed	7	-4/-4	0	0	1	1	5/5
Lake Couchiching subwatershed	7	-4/-4	-1	0	0	0	2/2
Ramara Creeks subwatershed	7	-4/-4	0	0	0	0	3/3

Formatted: Font: Bold

Formatted Table

Note for the table above:

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.

1. 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
2. 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.
3. Land use: Natural/Forested = -1: Agricultural = 0: Urban/Developed = +1, coarsely interpreted from 1999 LandSat Imagery
4. 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
5. Final Area Vulnerability Factor plus/minus all modifiers

13.10.1.4.2 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 13- 21 were taken directly from MDEQ (2004), while the fourth row lists the corresponding Vulnerability Factor assigned for the Keswick and Georgina WTPs.

Table 13-2113-21: 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

Note for the table above: Category, parameters and vulnerability based on MDEQ (2004).

Formatted: Font: Bold

Formatted Table

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 Keswick WTP intake is located 365m from shore in a water depth 10.6 m. A Source Vulnerability Factor (C) of 0.8 was therefore assigned, based on the values presented in Table 7 (MDEQ, 2004). The Georgina WTP intake is located 1050 m from shore in a water depth 19 m. A Source Vulnerability Factor (C) of 0.8 was therefore assigned, based on the values presented in Table 13- 11 (MDEQ, 2004).

13.10.1.5 Uncertainty Assessment

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

13.10.1.5.1 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 2010e (Appendix Y).

13.10.1.5.2 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 2010e (Appendix Y).

- 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.

13.10.1.5.3 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.

13.10.1.5.4 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.

13.10.1.5.5 Area and Source Vulnerability Factors

The factors considered in assigning the Area Vulnerability values include: the percentage of the area of the IPZ-2 or IPZ-3, as the case may be that is composed of land; the land cover, soil type, permeability of the land and the slope of any setbacks; the hydrological and hydrogeological conditions in the area that contributes water to the area through Transport Pathways; and in respect of an IPZ-3, the proximity of the area of the IPZ-3 to the intake. The only subwatershed characteristic that is relatively uncertain is the SCS Curve, with the uncertainty arising from the fact that the SCS Curve No. is based on many parameters including rainfall, land cover, soil permeability and slope. The parameters considered in assigning the Source Vulnerability Factors were the distance of the intake from shore and the depth of water that it is located in, and the history of water quality concerns. Genivar (2010) did not report any water quality Issues in their Issues Evaluation report, however limited data were available for the analysis.

13.11 Keswick Water Treatment Plant

The Keswick WTP is located on the east shore of Cook's Bay in southern Lake Simcoe. It is in the Orchard Beach area near the community of Keswick. The design capacity of the Keswick WTP is 16.2 ML/day (Regional Municipality of York, 2001). As of June 2007, the population supplied is 25,700 (MOE, 2007b).

Construction of the Keswick WTP and associated intake pipe was completed between 1982 and 1983 (Regional Municipality of York, 2006). The Keswick Treatment Plant uses conventional filtration to treat the water from Lake Simcoe. Two dual media gravity filters containing granular activated carbon are used and then the water is disinfected using chlorine. Chlorine is also added at the intake when the water temperature rises above 12 degrees Celsius to deter zebra mussel growth.

The intake consists of 365 m of 630 mm diameter polyethylene pipe, extending from the shoreline and terminating at the inlet structure. While there are some minor discrepancies in the reported depth of the intake it was assumed to be in a total water depth of 10.6 m for this study.

Based on the interview with the representative of the Keswick WTP, conducted by personnel from LSRCA on September 22, 2006, the WTP can be shut down within 5 minutes upon notification (staff are on call 24/7). The WTP representative estimated the notification time (by MOE) in the event of a spill to be in the order of hours.

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

13.11.1.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the Keswick WTP are shown in Figure 13h-1. IPZ-1 consists of a 1 km radius centered on the intake, extending 120 m inland. The IPZ-2 includes Transport Pathways, such as drains and ditches that extend the IPZ-2 in various locations within the Keswick community. However, there were some sewersheds with storm water ponds that were excluded, since it was determined that sewersheds with ponds are not considered as contributors of water to intake within 2 hr. The IPZ-3 for the Keswick WTP, as with all intakes in Lake Simcoe, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 13h-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.

13.11.1.2 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 13- 22 and Figure 13h-1 and Figure 13h-2.

Table 13--2213 22: Summary of Vulnerability Factors and Scores for Keswick 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	8	0.8	6.4
IPZ-3 Sub-areas	-	-	-
Lake Simcoe waterbody (incl. islands)	7	0.8	5.6
Lake Couchiching waterbody (incl. islands)	7	0.8	5.6
Maskinonge subwatershed	7	0.8	5.6
West Holland subwatershed	7	0.8	5.6
East Holland subwatershed	7	0.8	5.6
Innisfil Creeks subwatershed	6	0.8	4.8
Georgina Creeks subwatershed	6	0.8	4.8
Black River subwatershed	4	0.8	3.2
Oro South Creeks subwatershed	5	0.8	4
Hawkestone Creek subwatershed	4	0.8	3.2
Hewitts Creek subwatershed	4	0.8	3.2
Pefferlaw Brook + Uxbridge Brook subwatershed	3	0.8	2.4

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
Lovers Creek subwatershed	4	0.8	3.2
Barrie Creeks subwatershed	6	0.8	4.8
Beaver Creek subwatershed	3	0.8	2.4
Whites Creek subwatershed	4	0.8	3.2
Upper + Lower Talbot River subwatershed	2	0.8	1.6
Oro North Creeks subwatershed	5	0.8	4
Lake Couchiching subwatershed	2	0.8	1.6
Ramara Creeks subwatershed	3	0.8	2.4

13.11.1.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010e) 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 13- 23).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see section 13.11.2) based on the data analyzed, limited data were available for the Issues Analysis and the operator raised some concerns (Baird, 2010e). 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, 2009a) do not provide specific guidance.

Table 13-23~~13 23~~: Summary of Uncertainty Ratings for the Keswick WTP Intake IPZs and Vulnerability Scores.

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

Formatted: Font: Bold

Formatted Table

Contaminant specific modeling to determine if an activity represents a Significant Drinking Water Threat [Rule 130; MOE, 2008a] has not been completed as part of this project. This modeling is required to determine if release of a chemical or pathogen would be transported through the surface water IPZ to the intake and result in deterioration of the water for use as a drinking water source. Concentration, specific gravity, decay rate and the size of the spill must all be considered. Contaminant specific modeling should be undertaken in the future to improve the level of certainty in the IPZ-3 delineation. A High level of Uncertainty has therefore been assigned to the IPZ-3 delineation.

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

13.11.2 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, treated water quality, and water quality monitoring in sentry wells in the area around the Keswick WTP 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 Keswick are provided in Technical Memorandum G1 – Drinking Water Issues Evaluation– Georgina (Appendix Y).

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

The occasional presence of E. coli and coliform bacteria in the surface water are not considered to be a Drinking Water Issue as these parameters are being treated effectively and in accordance with Safe Drinking Water Act regulations. Sodium concentrations are observed to be slightly increasing in Lake Simcoe but are not projected to exceed the ODWQS of 200 mg/L within 50 years. Trihalomethanes are present in treated water in trace concentrations as a by-product of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and are not observed to be increasing.

Trace concentrations of organic parameters that are associated with pesticides were occasionally detected in the source water to the Keswick Water Supply System. The measured concentrations were typically near method detection limits and were consistently less than the Ontario Drinking Water Quality Standards and did not show increasing trends.

13.11.3 Drinking Water Threats Evaluation

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

The Drinking Water Threats Assessment for the Keswick WTP 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.

13.11.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Keswick WTP is provided in Chapter 5, section 5.3.5.1.

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

13.11.3.2 List of Drinking Water Threats – Conditions

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

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

No confirmed Conditions have been identified for Keswick WTP. No potential Conditions have been identified for consideration at this time.

13.11.3.3 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: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.11.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13h-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 Keswick WTP. 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 13h-4).

13.11.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores~~The Key Table~~ on Figure 13h-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 Keswick WTP. Activities that are or would be significant Drinking Water Threats for chemicals can be observed within areas where the vulnerability score is greater than 8.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 13h-6).

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

Further to Section 13.11.3.2, no Conditions have been confirmed within the WHPA for the Keswick WTP.

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

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

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

Figure 13h-1 and Figure 13h-2 illustrates the Vulnerability Score maps for Keswick WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.11.3.5 Enumerating Drinking Water Threats

~~13.11.3.5~~

Formatted: Font: Italic

Formatted: Normal, Space Before: 0 pt

The number of Significant Drinking Water Threats for the Keswick WTP has been determined using the methodology outlined in Technical Memorandum A5 (Appendix M). There are no Significant Threats associated with Conditions or Drinking Water Issues.

No land use activities that would result in potential Significant Drinking Water Threats were identified for the Keswick WTP.

13.11.3.5.1 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 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~~the 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 Keswick 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 13.11.3.5). 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 13h-7 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Keswick WTP. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 13h-8.

13.11.3.5.2 Livestock Density

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

The Livestock Density was determined for IPZ-1 and IPZ-2 for the water supply to the Keswick 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 13.11.3.5). 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. As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

Figure 13h-9 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Keswick WTP. The Livestock Density for the IPZ-3 associated with the surface water intakes in Lake Simcoe is presented Figure 13h-10.

13.11.3.5.3 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 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~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Keswick 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 13.11.3.5). The

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

Figure 13h-11 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Keswick WTP. The proportion of Impervious Surfaces for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 13h-12.

13.12 Georgina Water Treatment Plant

The Georgina WTP is located on the south shore of Lake Simcoe in the Willow Beach area between the communities of Keswick and Sutton. The current capacity is 20 ML/day (serving the Community of Sutton) and the ultimate design capacity of the facility is 47.2 ML/day (Regional Municipality of York, 2000). It is intended that this WTP will ultimately supply Keswick, Sutton and Willow Beach. The existing (2004) population supplied is 4,580 and the planned population to be served in 2011 is 10,230 (Regional Municipality of York, 2005).

Construction of the Georgina Water Treatment Plant and associated intake pipe was completed in 2004. The Georgina Treatment Plant uses Zenon's Zeeweed Ultrafiltration Process to treat water from Lake Simcoe. This process removes suspended solids, Cryptosporidium, Giardia and other potentially harmful parasites by drawing the raw water through membranes. The water is also passed through granular activated carbon to reduce taste and odour incidents and uses chlorine as a disinfectant. Chlorine is also applied at the intake when temperatures rise above 12 degrees Celsius to combat zebra mussel colonization. The treatment process is monitored with an on-line Supervisory Control And Data Acquisition (SCADA) system.

The intake consists of 1,477 m of 1067 mm diameter pipe, extending from the plant and terminating at the inlet structure. When the intake is measured perpendicularly to the closest point on the shoreline, it is located approximately 1050 m from shore. The intake is assumed to be in a total depth of 19.4m for this study.

Based on the interview with the representative of the York Region WTP, conducted by personnel from LSRCA on September 22, 2006, the WTP can be shut down within 5 minutes upon notification, however (staff are on call 24/7), WTP personnel estimated the notification time (by MOE/MECP) in the event of a spill is in the order of hours.

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

13.12.1.1 Intake Protection Zones (IPZ)

The IPZ-1 and IPZ-2 for the Georgina WTP are shown in Figure 13i-1. IPZ-1 consists of a 1 km radius centered on the intake, extending 120 m 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 the Georgina WTP, as with all intakes in Lake Simcoe, has been defined as the entire Lake Simcoe and Lake Couchiching sub-watershed (Figure 13i- 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.

13.12.1.2 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 13- 24 and Figure 13i-1 and Figure 13i- 2.

Table 13--2413- 24: Summary of Vulnerability Factors and Scores for Georgina 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	8	0.8	6.4
IPZ-3 Sub-areas	-	-	-
Lake Simcoe waterbody (incl. islands)	7	0.8	5.6
Lake Couchiching waterbody (incl. islands)	7	0.8	5.6
Maskinonge subwatershed	6	0.8	4.8
West Holland subwatershed	6	0.8	4.8
East Holland subwatershed	7	0.8	5.6
Innisfil Creeks subwatershed	6	0.8	4.8
Georgina Creeks subwatershed	6	0.8	4.8
Black River subwatershed	5	0.8	4
Oro South Creeks subwatershed	5	0.8	4
Hawkestone Creek subwatershed	5	0.8	4
Hewitts Creek subwatershed	4	0.8	3.2
Pefferlaw Brook + Uxbridge Brook subwatershed	4	0.8	3.2

IPZ and IPZ-3 sub-zones	Area Vulnerability Factor (B)	Source Vulnerability Factor (C)	Vulnerability Score (V)
Lovers Creek subwatershed	4	0.8	3.2
Barrie Creeks subwatershed	6	0.8	4.8
Beaver Creek subwatershed	3	0.8	2.4
Whites Creek subwatershed	4	0.8	3.2
Upper + Lower Talbot River subwatershed	2	0.8	1.6
Oro North Creeks subwatershed	5	0.8	4
Lake Couchiching subwatershed	2	0.8	1.6
Ramara Creeks subwatershed	3	0.8	2.4

13.12.1.3 Uncertainty for IPZ Delineation and Vulnerability

Based on the factors discussed above, Baird (2010e) 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 13- 25).

While the location of the intake was relatively well defined and no Drinking Water Issues were reported (see Section 13.12.2) based on the data analyzed, limited data were available for the Issues Analysis and the operator raised some concerns (Baird, 2010e). 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, 2009a) do not provide specific guidance.

Table 13-25: Summary of Uncertainty Ratings for the Georgina WTP Intake IPZs and Vulnerability Scores.

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

Formatted: Font: Bold
Formatted Table

Contaminant specific modeling to determine if an activity represents a Significant Drinking Water Threat [Rule 130; MOE, 2008a] has not been completed as part of this project. This modeling is required to determine if release of a chemical or pathogen would be transported through the surface water IPZ to the intake and result in deterioration of the water for use as a drinking water source. Concentration, specific gravity, decay rate and the size of the spill must all be considered. Contaminant specific modeling should be undertaken in the future to improve the level of certainty in the IPZ-3 delineation. A High level of Uncertainty has therefore been assigned to the IPZ-3 delineation.

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

13.12.2 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, treated water quality, and water quality monitoring in sentry wells in the area around the Georgina WTP 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 Georgina are provided in Technical Memorandum G1 – Drinking Water Issues Evaluation– Georgina (Appendix Y).

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

The occasional presence of E. coli and coliform bacteria in the surface water are not considered to be a Drinking Water Issue as these parameters are being treated effectively and in accordance with Safe Drinking Water Act regulations. Sodium concentrations are observed to be slightly increasing in Lake Simcoe but are not projected to exceed the ODWQS of 200 mg/L within 50 years. Trihalomethanes are present in treated water in trace concentrations as a by-product of disinfection by chlorination. Trihalomethane concentrations are typically well below ODWQS values and are not observed to be increasing.

13.12.3 Drinking Water Threats Evaluation

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

The Drinking Water Threats Assessment for the Georgina WTP 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.

13.12.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for Georgina WTP is provided in Chapter 5, section 5.3.5.1.

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

13.12.3.2 List of Drinking Water Threats – Conditions

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

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

No confirmed Conditions have been identified for Georgina WTP. No potential Conditions have been identified for consideration at this time.

13.12.3.3 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: https://www.ontario.ca/page/tables-drinking-water-threats~~

13.12.3.3.1 Pathogen Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13i-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 Georgina WTP. Activities that are or would be significant Drinking Water Threats for pathogens can be observed within the areas where the vulnerability score is 8. This area is primarily within Lake Simcoe.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 13i- 4).

13.12.3.3.2 Chemical Parameters

The Technical Rules can be used in conjunction with the Vulnerability Scores ~~The Key Table~~ on Figure 13i-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 Georgina WTP. Activities that are or would be significant Drinking Water Threats for chemicals can be observed within areas where the vulnerability score is greater than 8. This area is primarily in Lake Simcoe.

Within the IPZ-3, Activities can be a Threat where the Vulnerability Score is greater than 4 (Figure 13i- 6).

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

Further to Section 13.12.3.2, no Conditions have been confirmed within the WHPA for the Georgina WTP.

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

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

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

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

Figure 13i-1 and Figure 13h-2 illustrates the Vulnerability Score maps for Georgina WTP that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

13.12.3.5 Enumerating Drinking Water Threats

~~13.12.3.5~~13.12.3.5.1

Formatted: Heading 5, Space Before: 0 pt

The number of significant Drinking Water Threats for the Georgina 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 land use activities that would result in potential Significant Drinking Water Threats were identified for the Georgina WTP.

~~13.12.3.5.1~~13.12.3.5.2 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~~the 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 Georgina 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 13.12.3.5). 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 13i-7 illustrates the location and proportion of Managed Lands within the delineated IPZ-1 and IPZ-2 for the Georgina WTP. The Managed Lands proportions for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 13h-8.

~~13.12.3.5.2~~13.12.3.5.3 Livestock Density

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

The Livestock Density was determined for IPZ-1 and IPZ-2 for the water supply to the Georgina 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 13.12.3.5). 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. As described in the memorandum, estimation of Livestock Density was undertaken using interpretation of aerial photography and limited field survey. This approach relies on a number of assumptions resulting in a high degree of uncertainty in the final Livestock Density estimates. Consequently, actual Livestock Densities may be higher or lower than that reported. Door to door survey is required to obtain the most accurate current Livestock Densities.

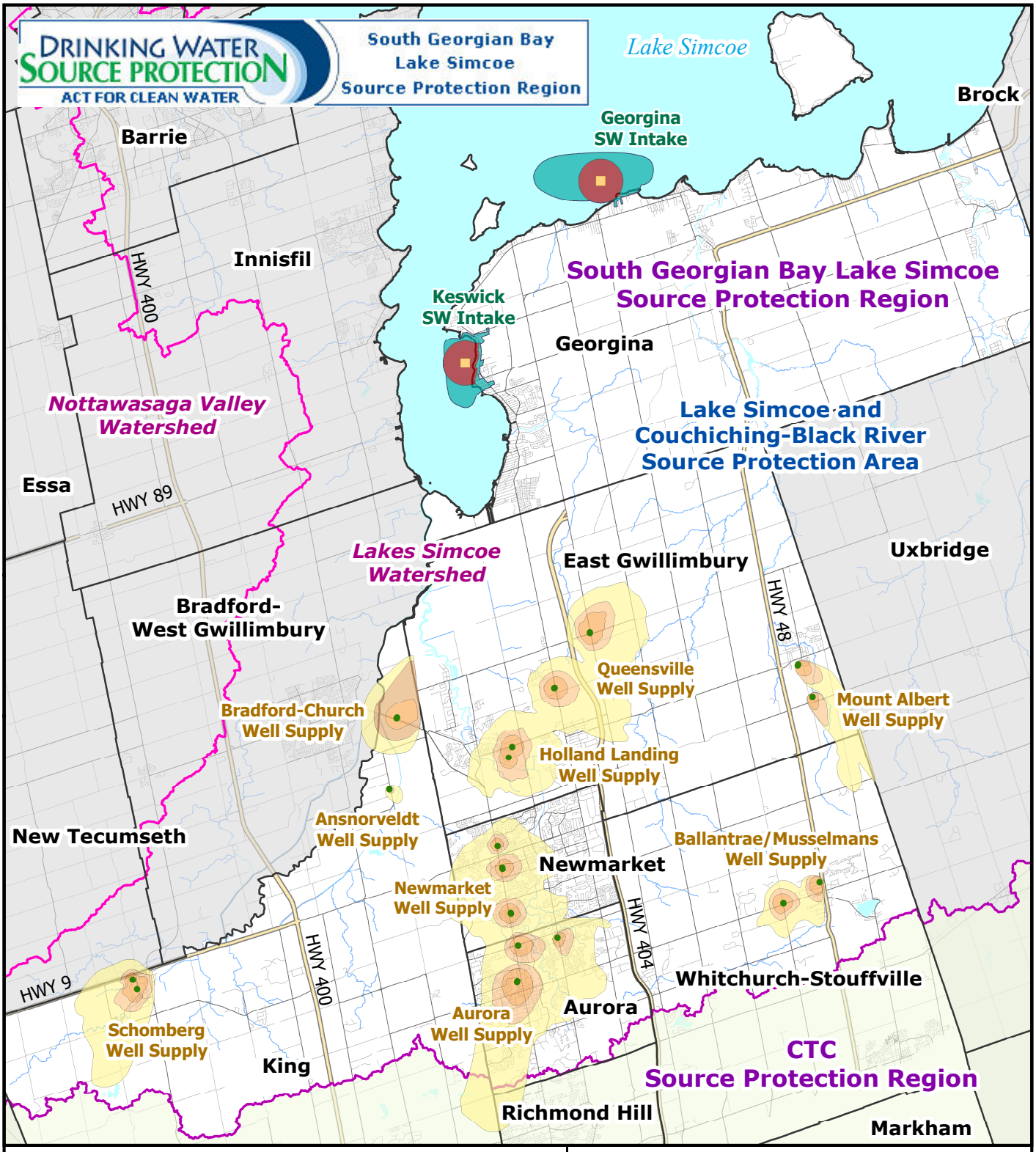
Figure 13i-8 illustrates the distribution of Livestock Density within the delineated IPZ-1 and IPZ-2 for the Georgina WTP. The Livestock Density for the IPZ-3 associated with the surface water intakes in Lake Simcoe is presented Figure 13h-10.

~~13.12.3.5.3~~13.12.3.5.4 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~~the Table of Drinking Water Threats~~.

The proportion of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to Georgina 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 13.12.3.5). The Impervious Surfaces are used in the identification of Threat activities associated with the application of winter de-icing agents (salt).

Figure 13i-9 illustrates the distribution of Impervious Surfaces within the delineated IPZ-1 and IPZ-2 for the water supply to the Georgina WTP. The proportion of Impervious Surfaces for the IPZ-3 associated with the surface water intakes in Lake Simcoe are presented in Figure 13h-12.



- Municipal Surface Water Intake
- IPZ-1 (1000m on water or 120m inland)
- IPZ-2 (2 hours time of travel)
- Municipal Supply Well in Regional Municipality of York
- 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 Regional Municipality of York

Created by: LSRCA, 2021-02-24

Scale 1:250,000

N

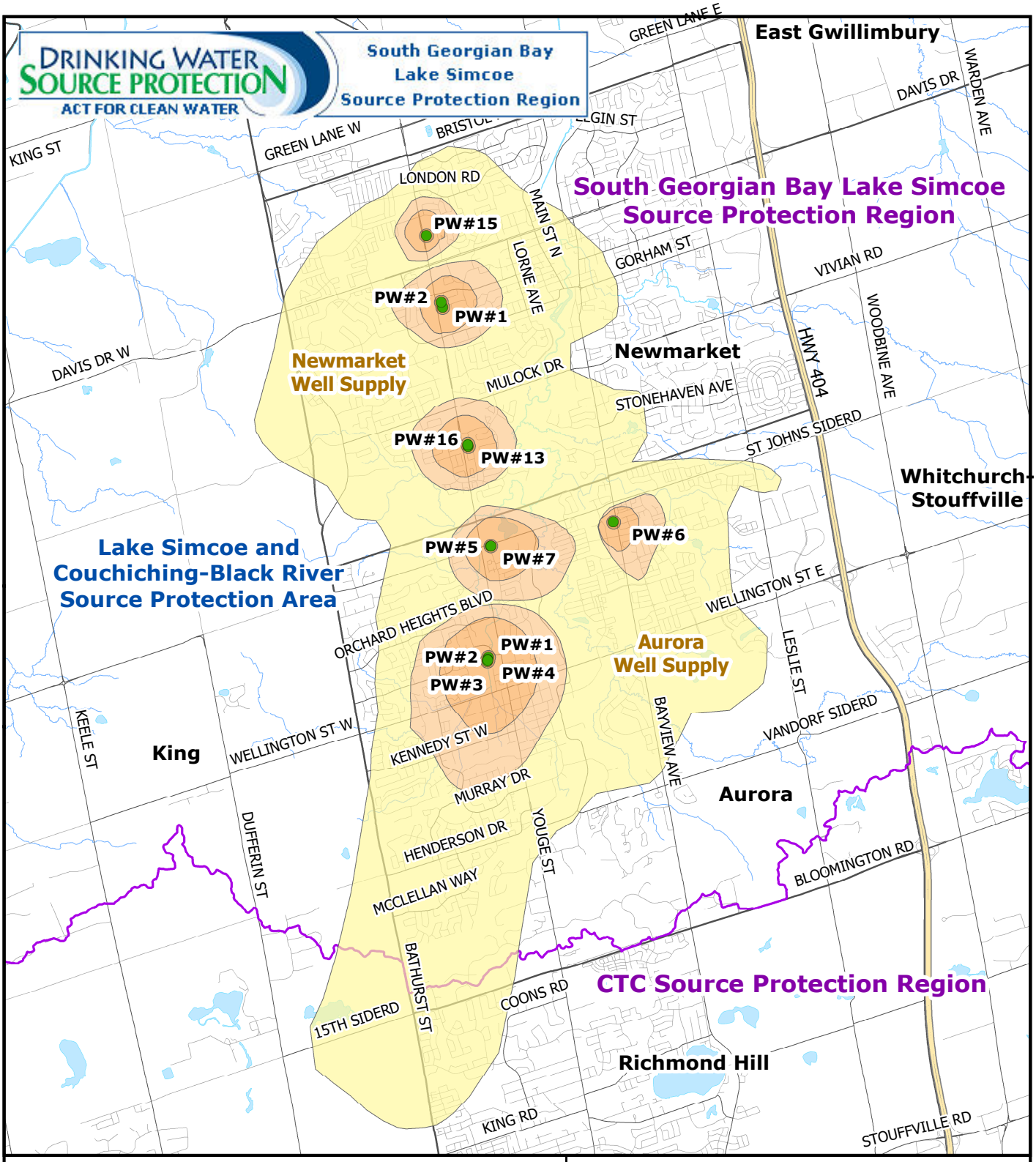
0 3 6 9 km

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 13-1



- Municipal Supply Wells in Aurora and Newmarket (12)
- WHPA-A (100m) (1)
- WHPA-B (2 years time of travel) (6)
- WHPA-C (5 years time of travel) (6)
- WHPA-D (25 years time of travel) (1)
- Source Protection Region Boundary (2)

Wellhead Protection Areas
Aurora/Newmarket

Created by: LSRCA, 2021-02-25

Scale 1:80,000

N

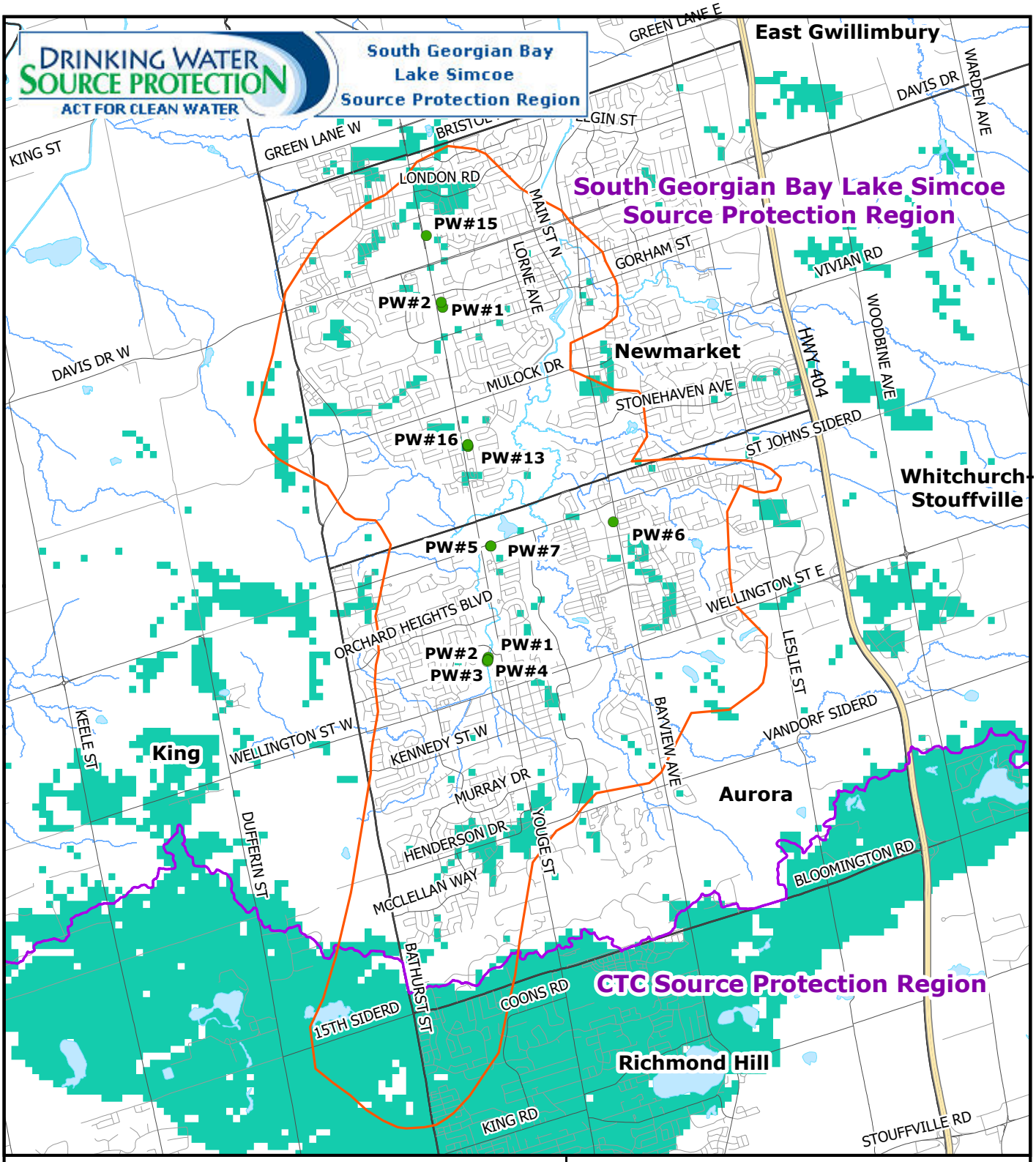
0 1 2 3 km

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 13a-1



- Municipal Supply Wells in Aurora and Newmarket
- 25-Year Time of Travel
- WWAT Ranking - Low
- Source Protection Region Boundary
- Municipality Boundary

High, Medium, and Low vulnerability areas based on WWAT values for the Aurora and Newmarket wells

Created by: LSRCA, 2021-02-25

Scale 1:80,000

N

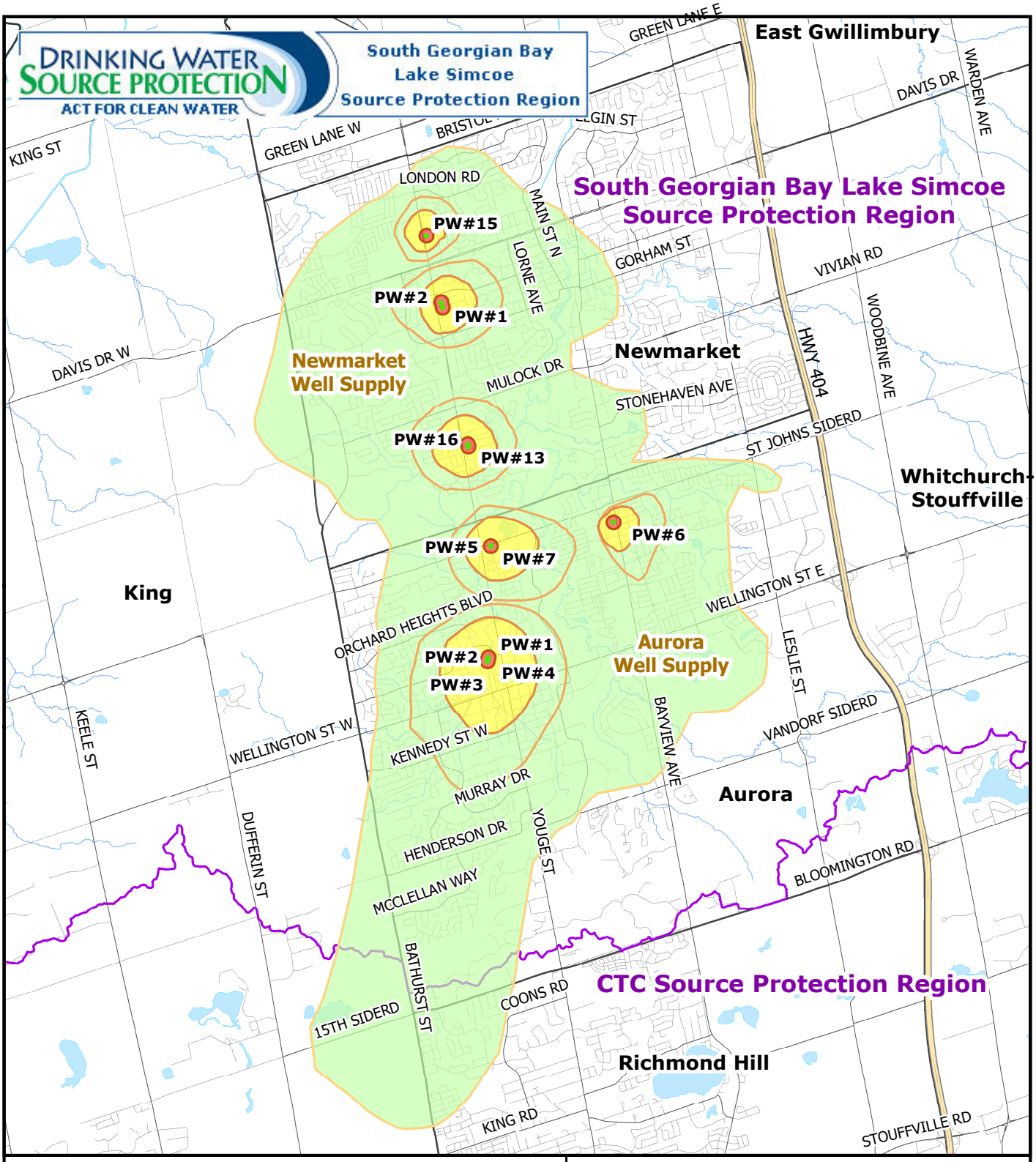
0 1 2 3 km

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 13a-2



- Municipal Supply Wells in Aurora and Newmarket
- Vulnerability Score: 10 - High
- Vulnerability Score: 6 - Medium
- Vulnerability Score: 2 - Low
- WHPA-A (100m)
- WHPA-B (2 years time of travel)
- WHPA-C (5 years time of travel)
- WHPA-D (25 years time of travel)

Vulnerability Score Area
Aurora / Newmarket

Created by: LSRCA, 2021-02-25

Scale 1:80,000

N

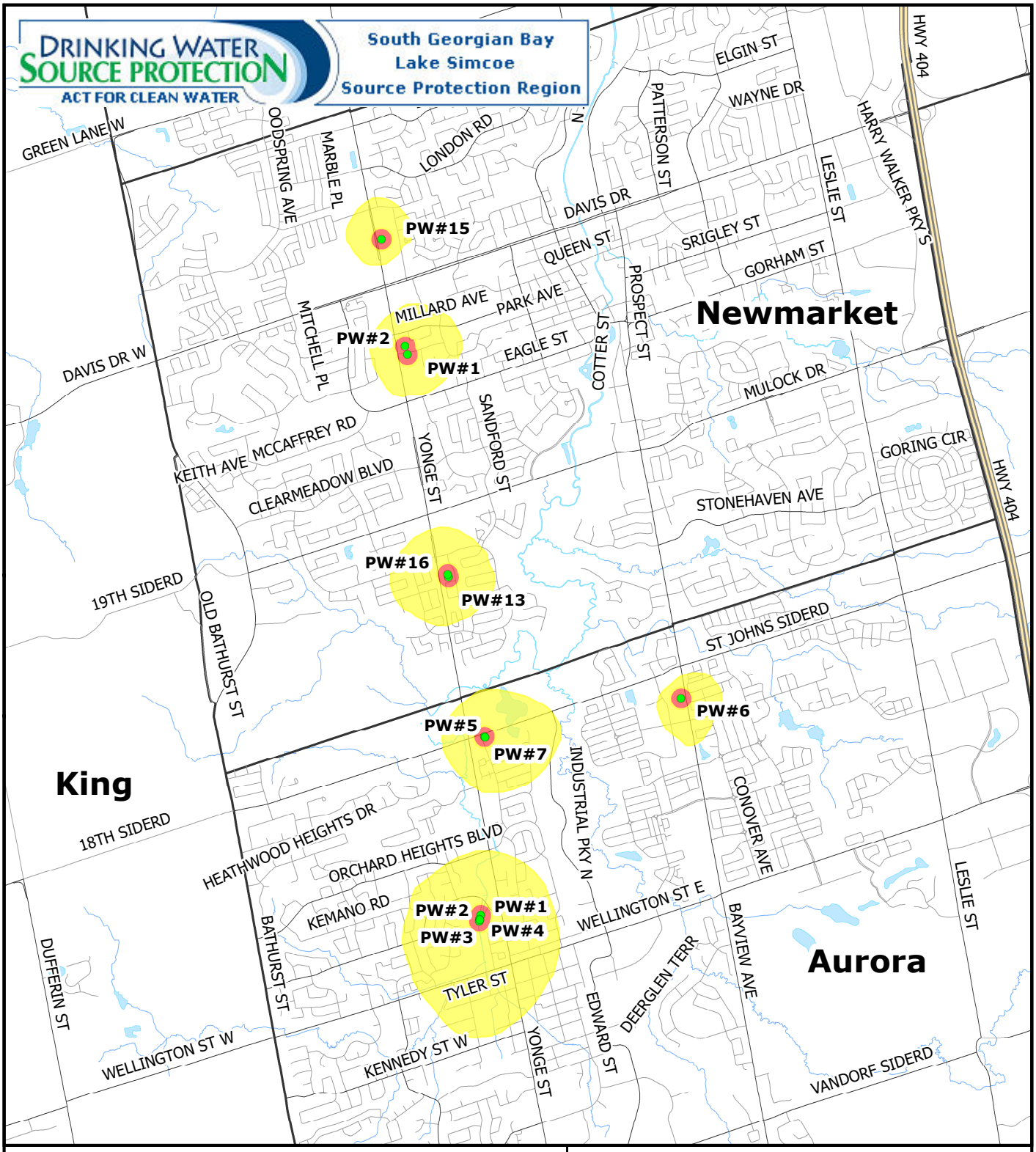
0 1 2 3 km

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 13a-3



Municipal Supply Wells
Vulnerability Score: 6
Vulnerability Score: 10

Areas of Significant, Moderate, or Low Threats - Pathogens

Created by: LSRCA, 2021-02-25

N

Scale 1:50,000

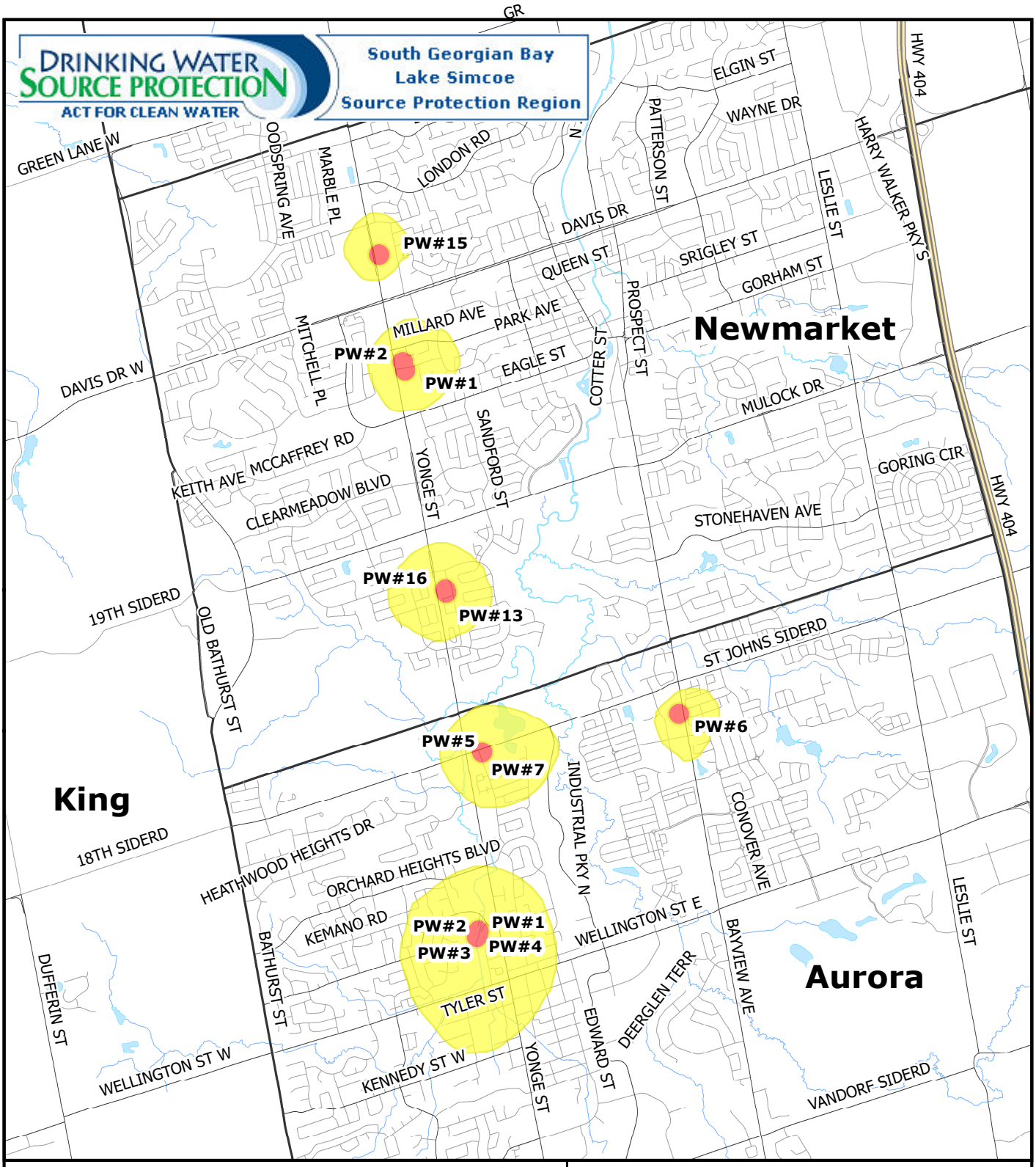
0 600 1,200 1,800 m

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 13a-4



Municipal Supply Wells
Vulnerability Score: 6
Vulnerability Score: 10

Areas of Significant, Moderate, or Low Threats - Chemicals

Created by: LSRCA, 2021-02-25

N

Scale 1:50,000

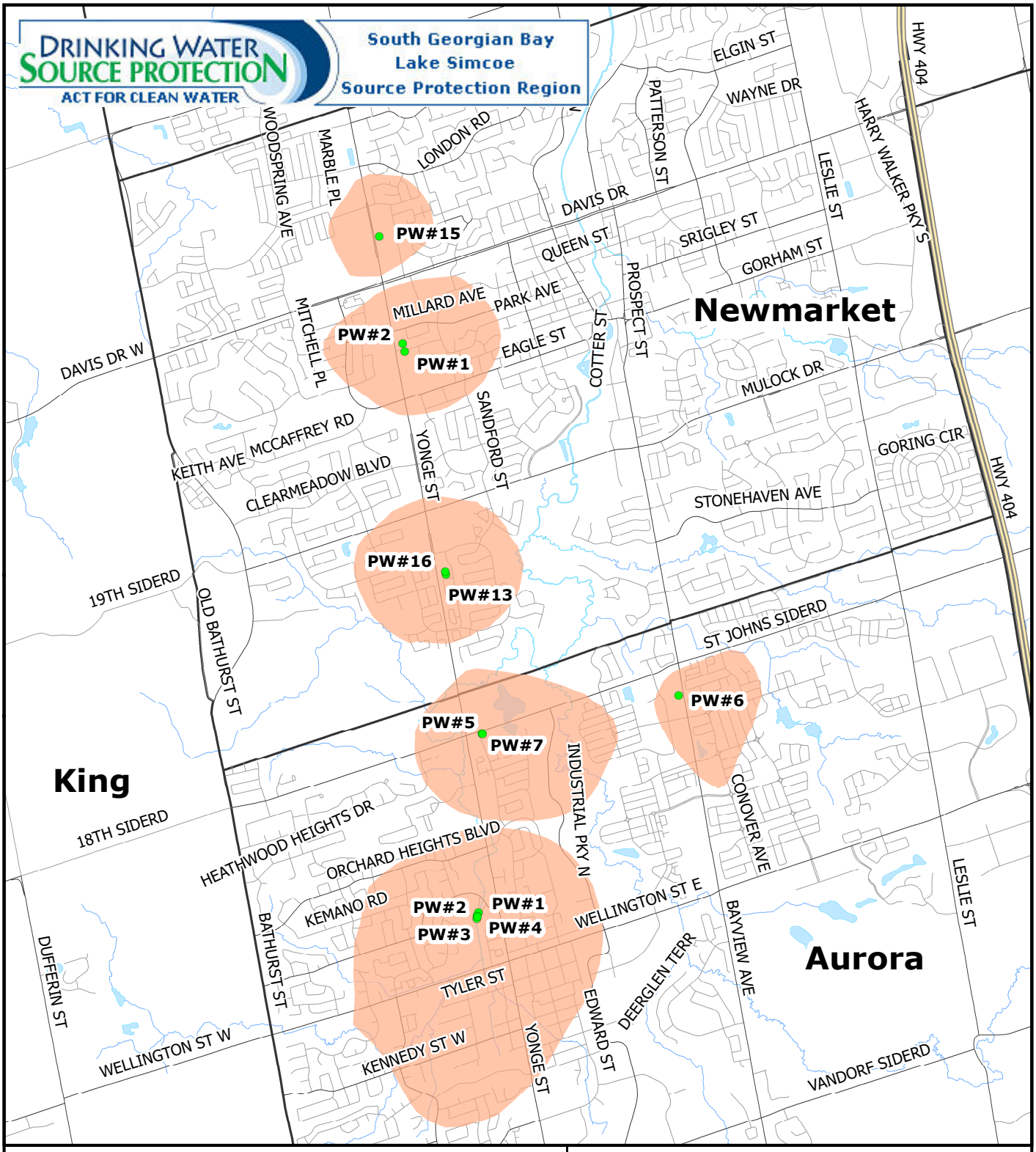
0 600 1,200 1,800 m

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 13a-5



- Municipal Supply Wells
- WHPA-C: 5 year time of travel
- Vulnerability Scoring: 6
- Vulnerability Scoring: 10

Areas of Significant, Moderate, or Low Threats - DNAPLS

Created by: LSRCA, 2021-02-25

Scale 1:50,000

N

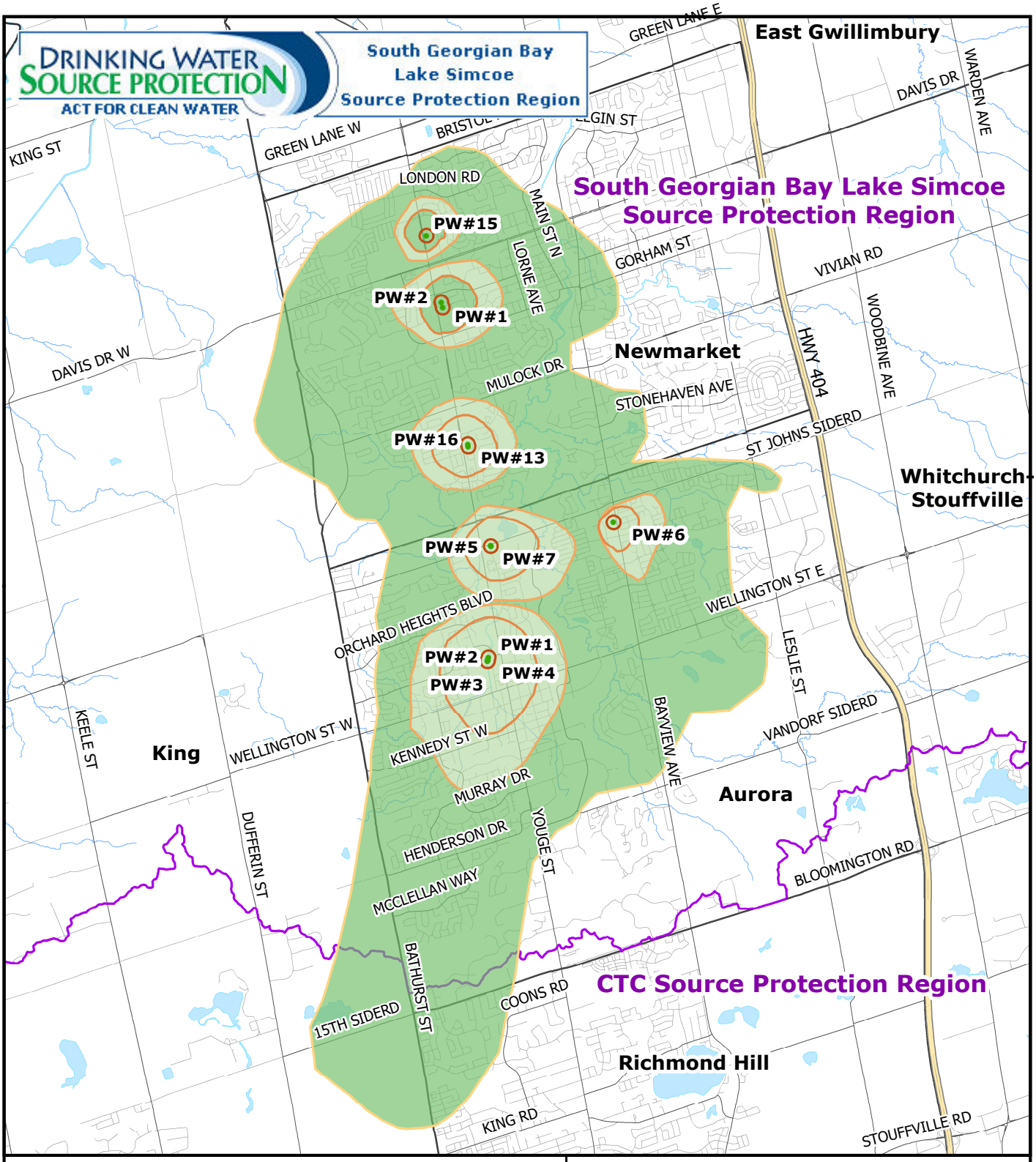
0 600 1,200 1,800 m

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 13a-6



- Municipal Supply Wells in Aurora and Newmarket
- Managed Lands: <= 40 %
- Managed Lands: 40% ~ 80%
- Managed Lands: >= 80%
- WHPA-A (100m)
- WHPA-B (2 years time of travel)
- WHPA-C (5 years time of travel)
- WHPA-D (25 years time of travel)

Managed Lands
Aurora / Newmarket

Created by: LSRCA, 2021-02-25

Scale 1:80,000

N

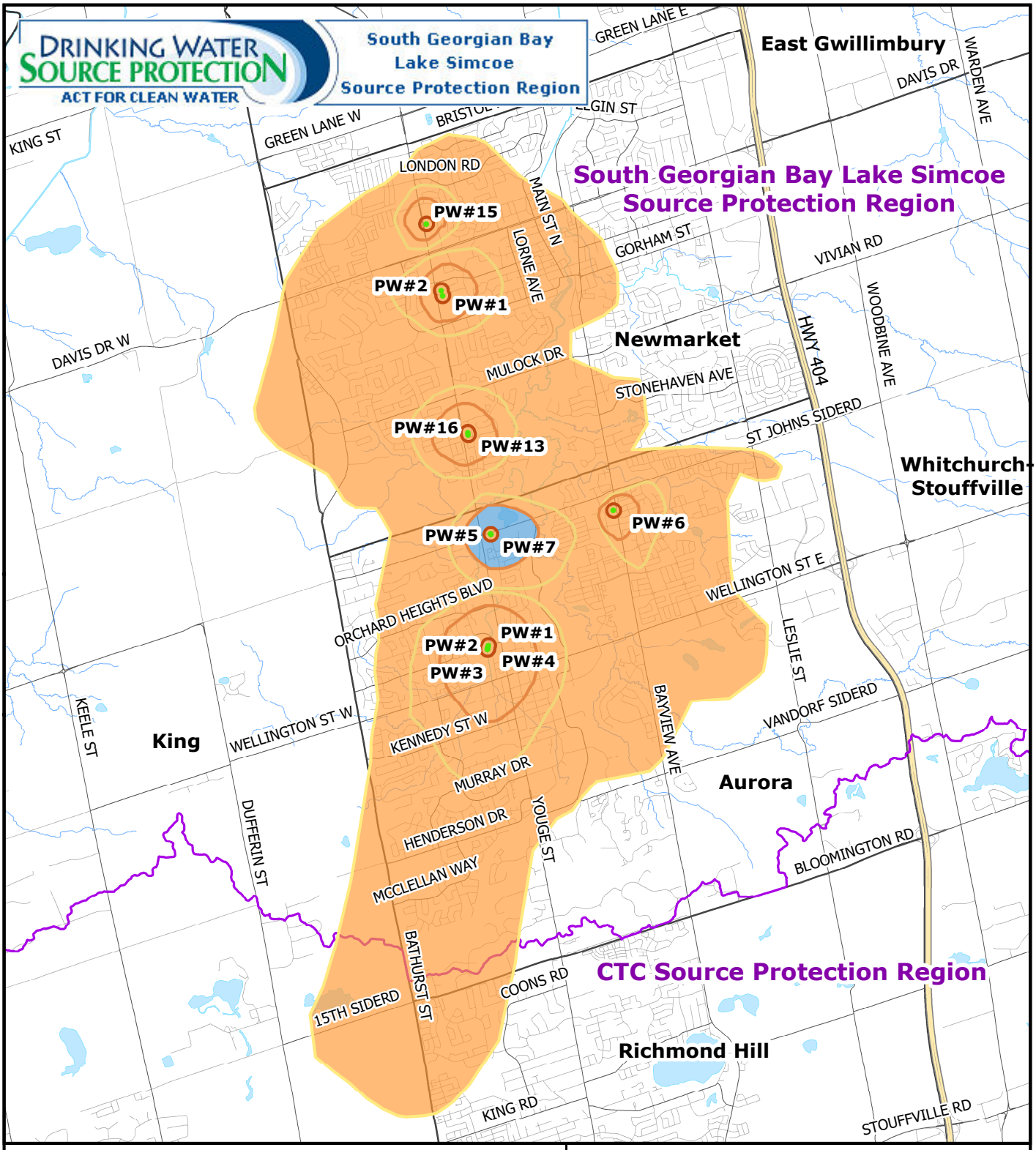
0 1 2 3 km

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 13a-7



- Municipal Supply Wells in Aurora and Newmarket
- Livestock Density: < 0.5
- Livestock Density: 0.5 ~ 1.0
- Livestock Density: > 1.0
- WHPA-A (100m)
- WHPA-B (2 years time of travel)
- WHPA-C (5 years time of travel)
- WHPA-D (25 years time of travel)

Livestock Density
Aurora / Newmarket

Created by: LSRCA, 2021-02-25

Scale 1:80,000

N

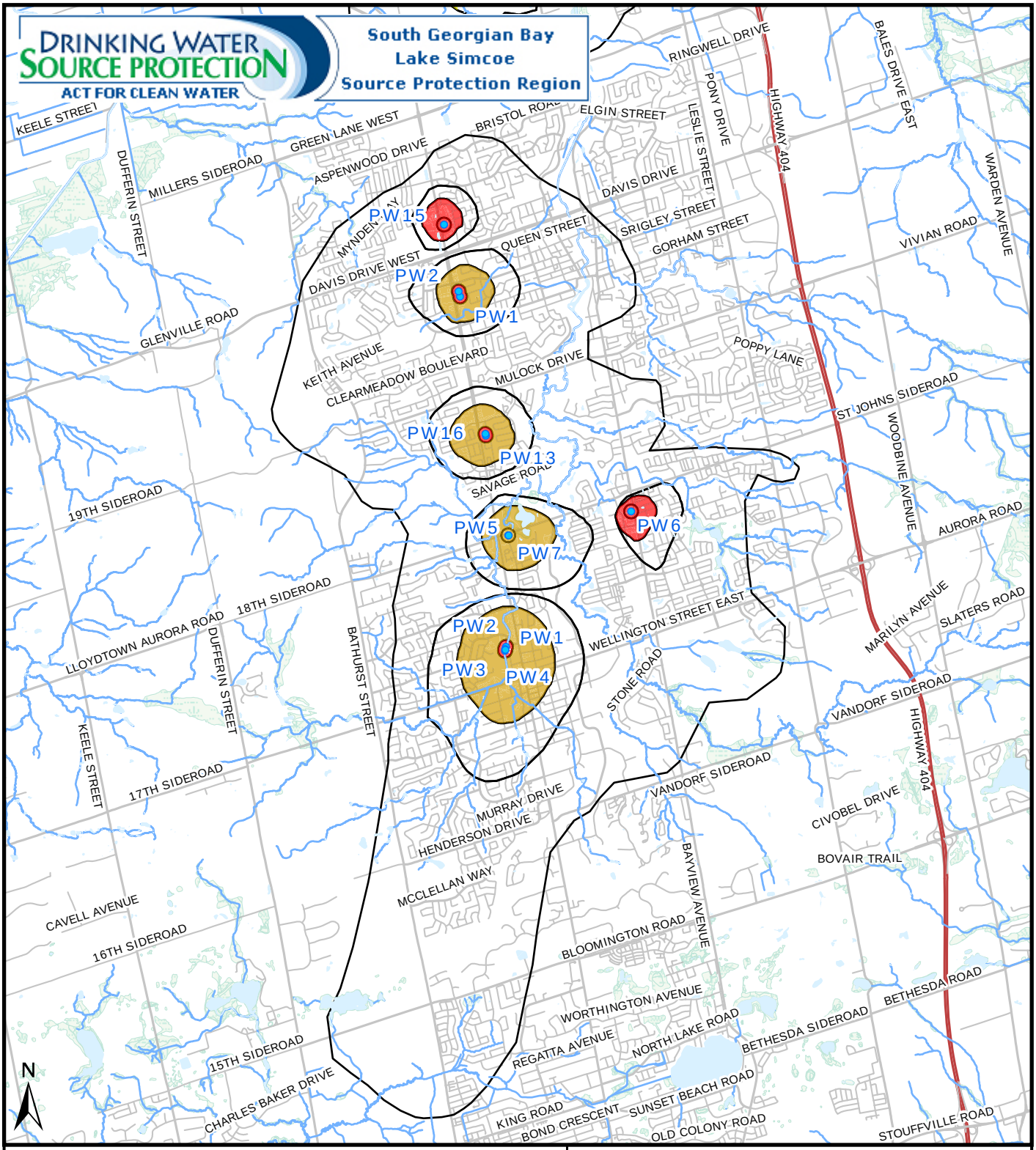
0 1 2 3 km

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 13a-8



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Aurora / Newmarket WHPA

Created by: LSRCA, 2025-08-05

Scale 1:80,000

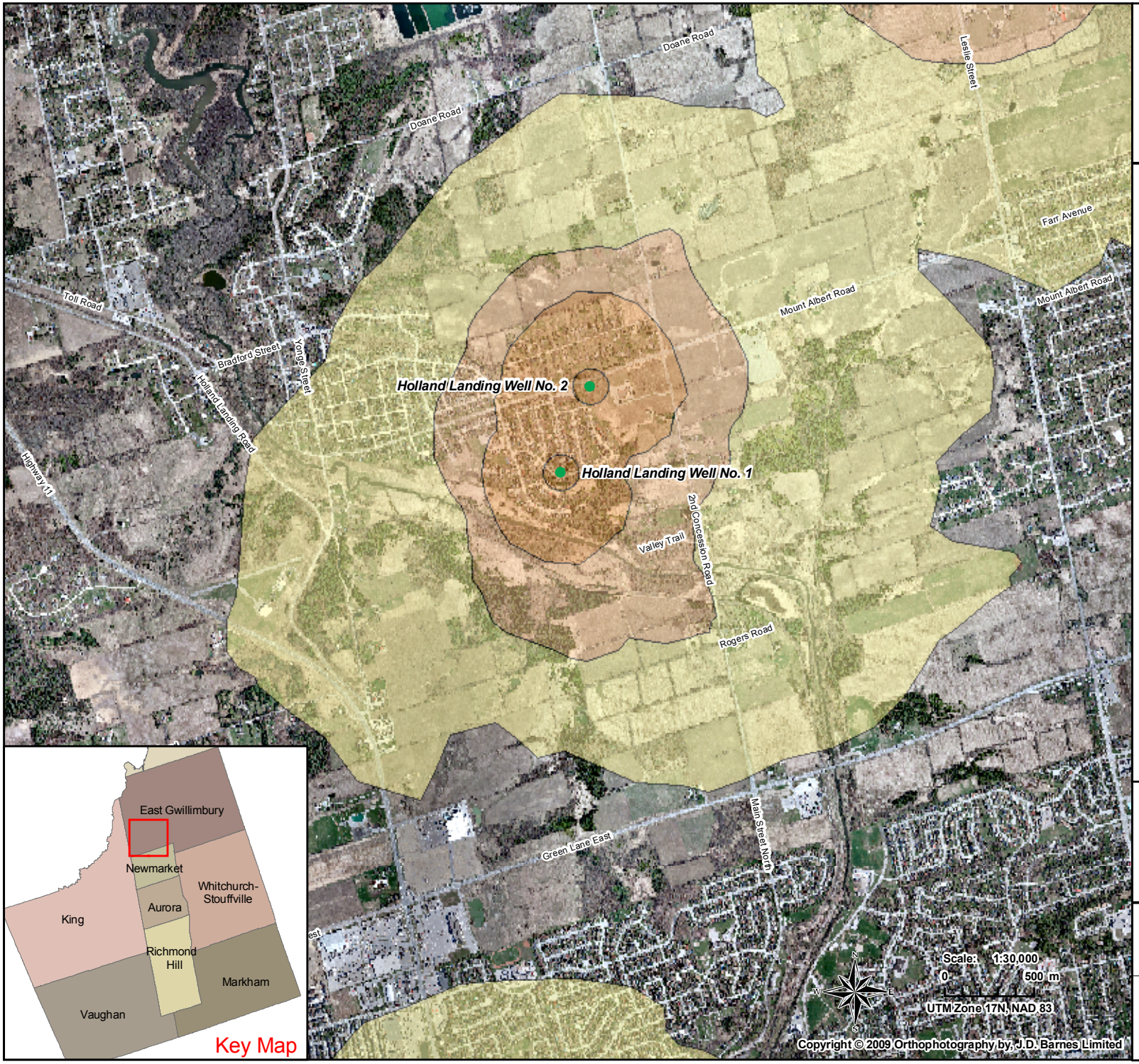
0 650 1,300 2,600 m

UTM Zone 17N, NAD83

Ontario

Figure 13a-9

Wellhead Protection Areas - Holland Landing



- Municipal Well Type 1

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

NOTES

1. WHPA zone delineations provided by Earthfx, 2007 & 2009.

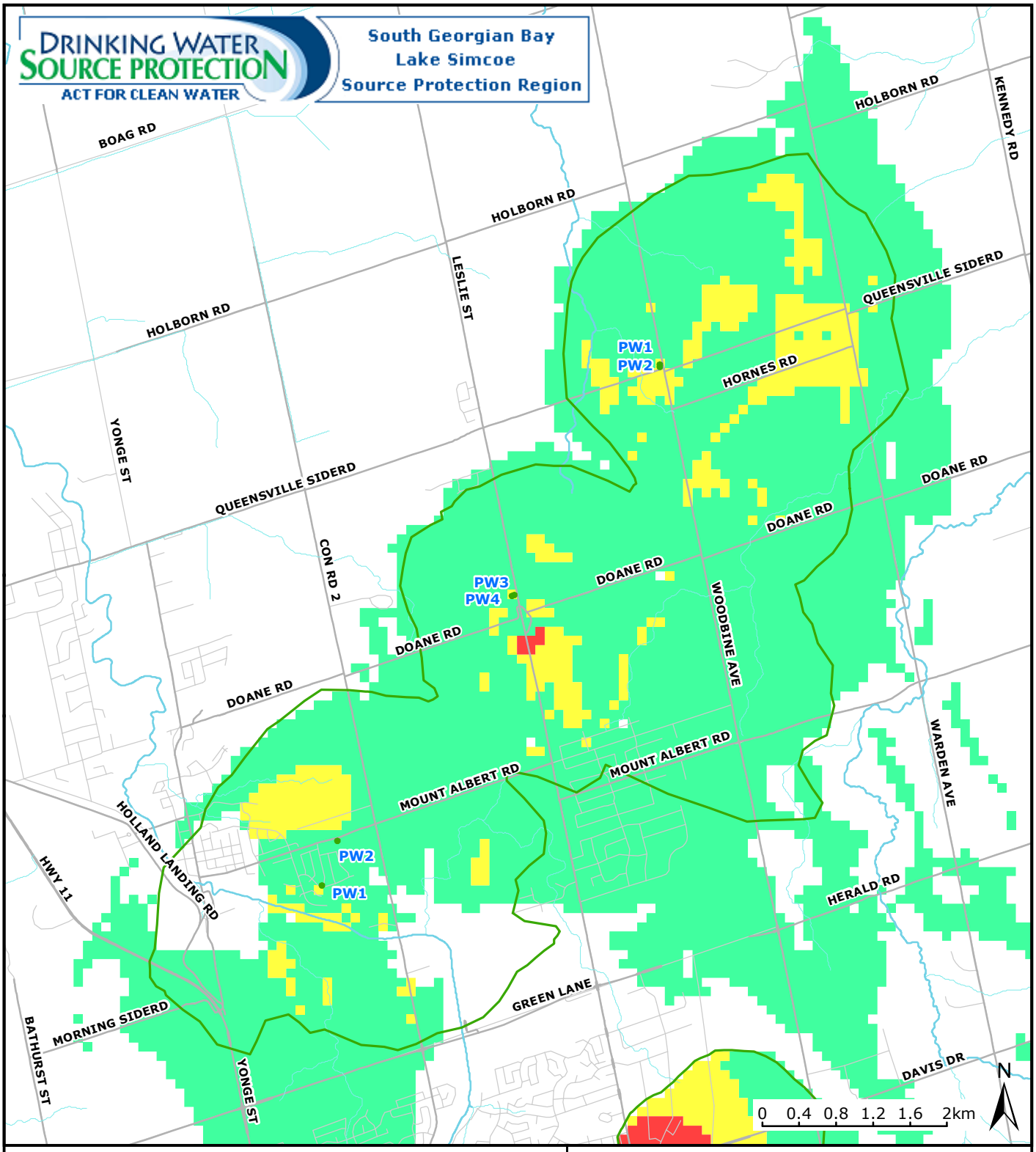
Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13b-1

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.



WWAT Ranking
- High
- Medium
- Low
- 25-Year Time-of-Travel
- SWP Watershed Area
- Water Body
- Main Water Course
- Roads

High, Medium, and Low vulnerability areas based on WWAT values for the Holland Landing and Queensville wells

Created by: LSRCA
Date: 2010-08-03

Scale: 1:60,000
UTM Zone 17N, NAD83

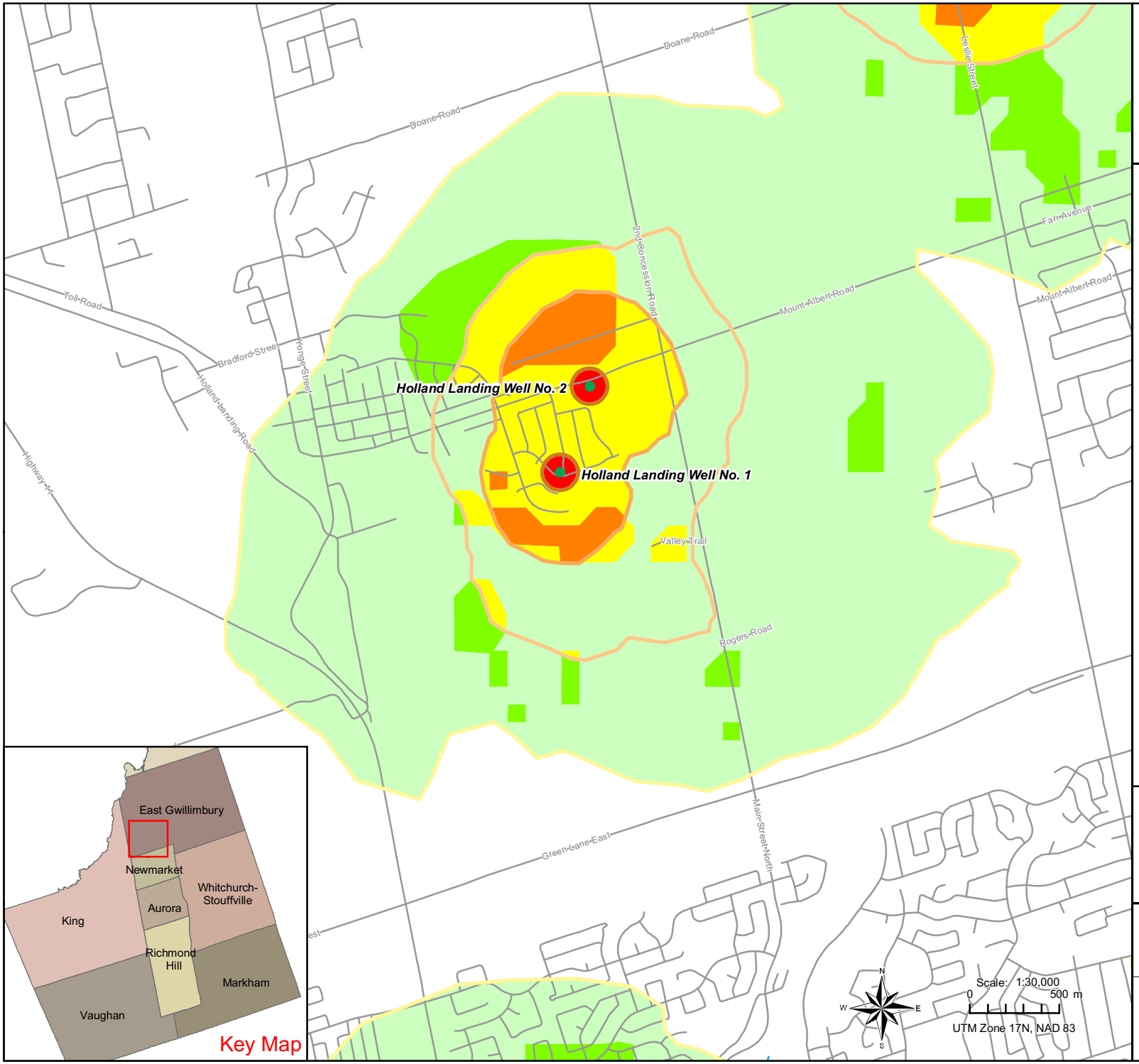
Earthfx Incorporated

Ontario

Figure 13b-2

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.

Vulnerability Score
Holland Landing



- Municipal Well Type 1
- Roads

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Vulnerability Scoring

- 2 (Low)
- 4
- 6
- 8
- 10 (High)

NOTES

1. Vulnerability Scoring provided by Earthfx, 2007 and 2009.

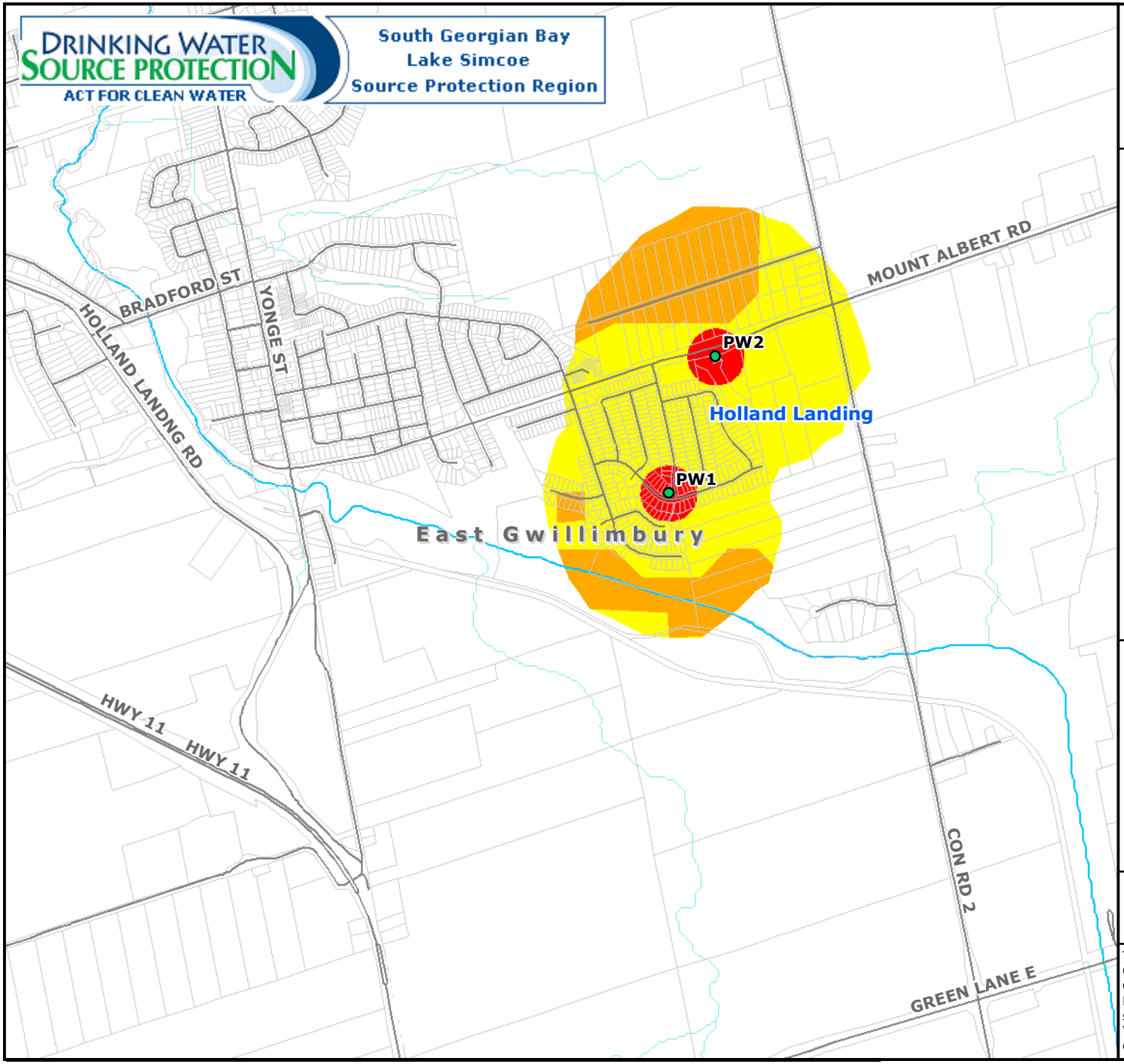
Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13b-3

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the base data, errors may exist.



Areas of Significant, Moderate, or Low Threats - Pathogens

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

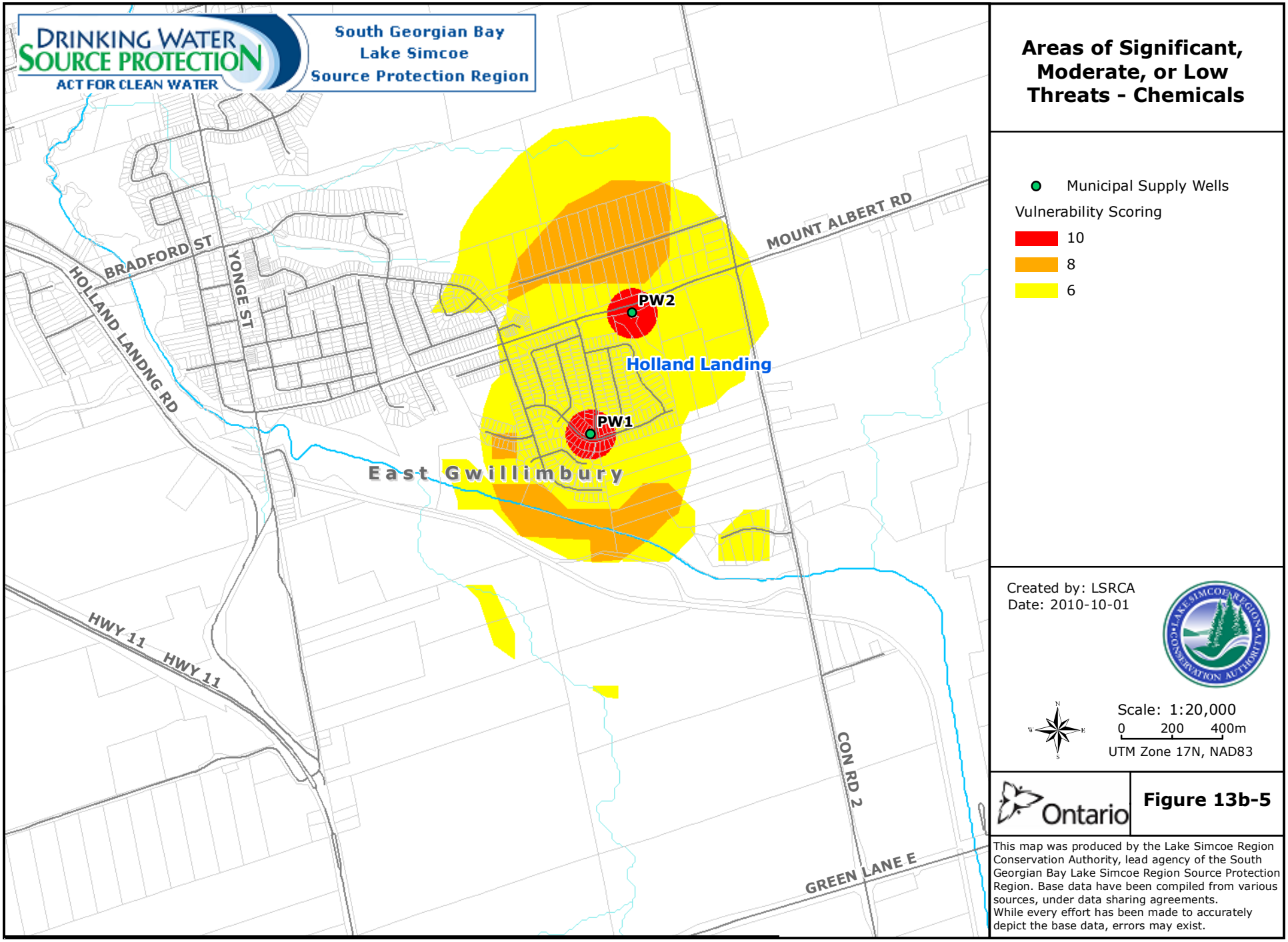
Created by: LSRCA
Date: 2010-10-01

Scale: 1:20,000
0 200 400m
UTM Zone 17N, NAD83

Ontario

Figure 13b-4

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.



Areas of Significant, Moderate, or Low Threats - Chemicals

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

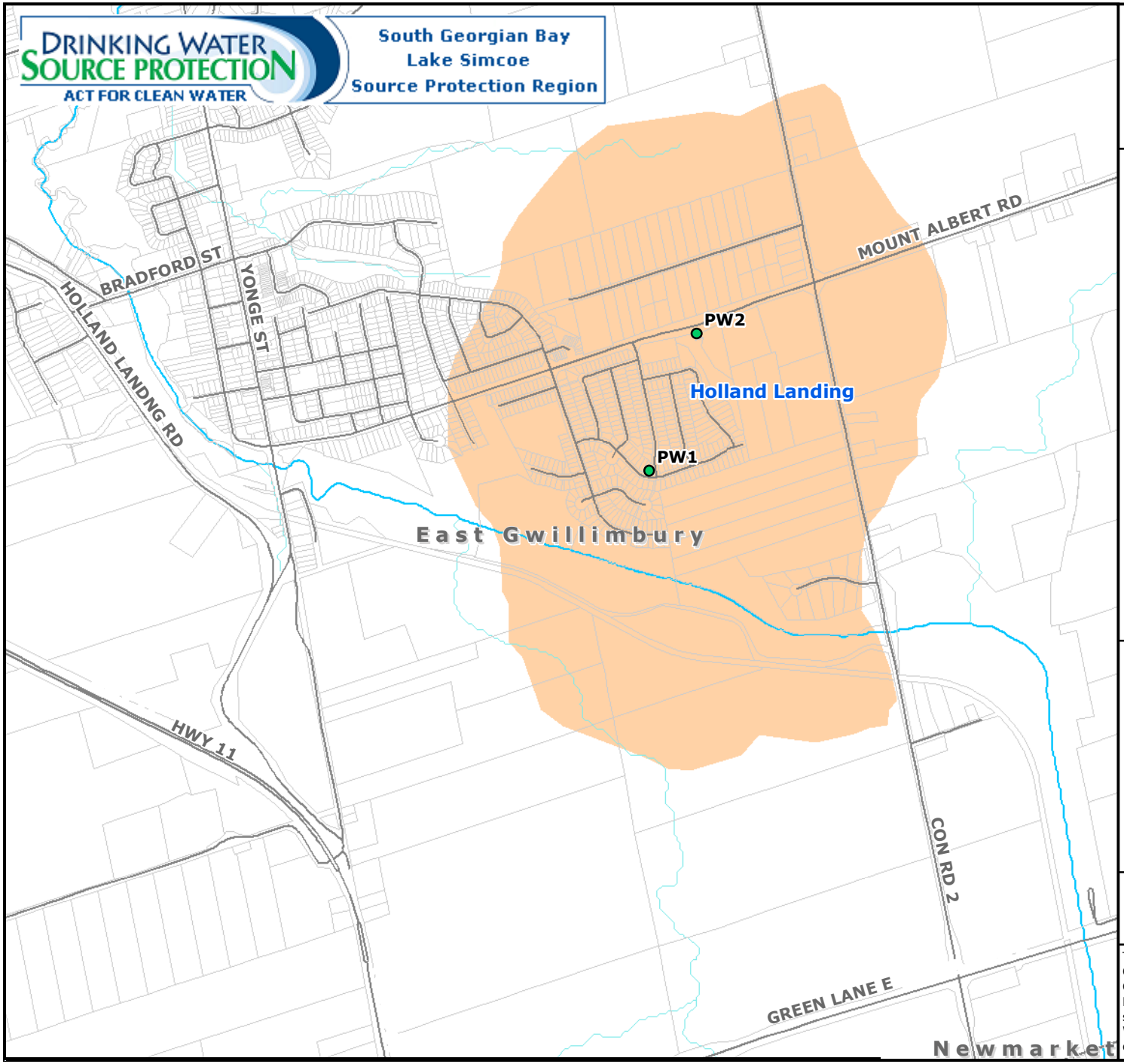
Created by: LSRCA
Date: 2010-10-01

Scale: 1:20,000
0 200 400m
UTM Zone 17N, NAD83

Ontario

Figure 13b-5

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.



Areas of Significant, Moderate, or Low Threats - DNAPLS

- Municipal Supply Wells
- WHPA-C: 5 year time-of-travel

Vulnerability Scoring

- 10
- 8
- 6

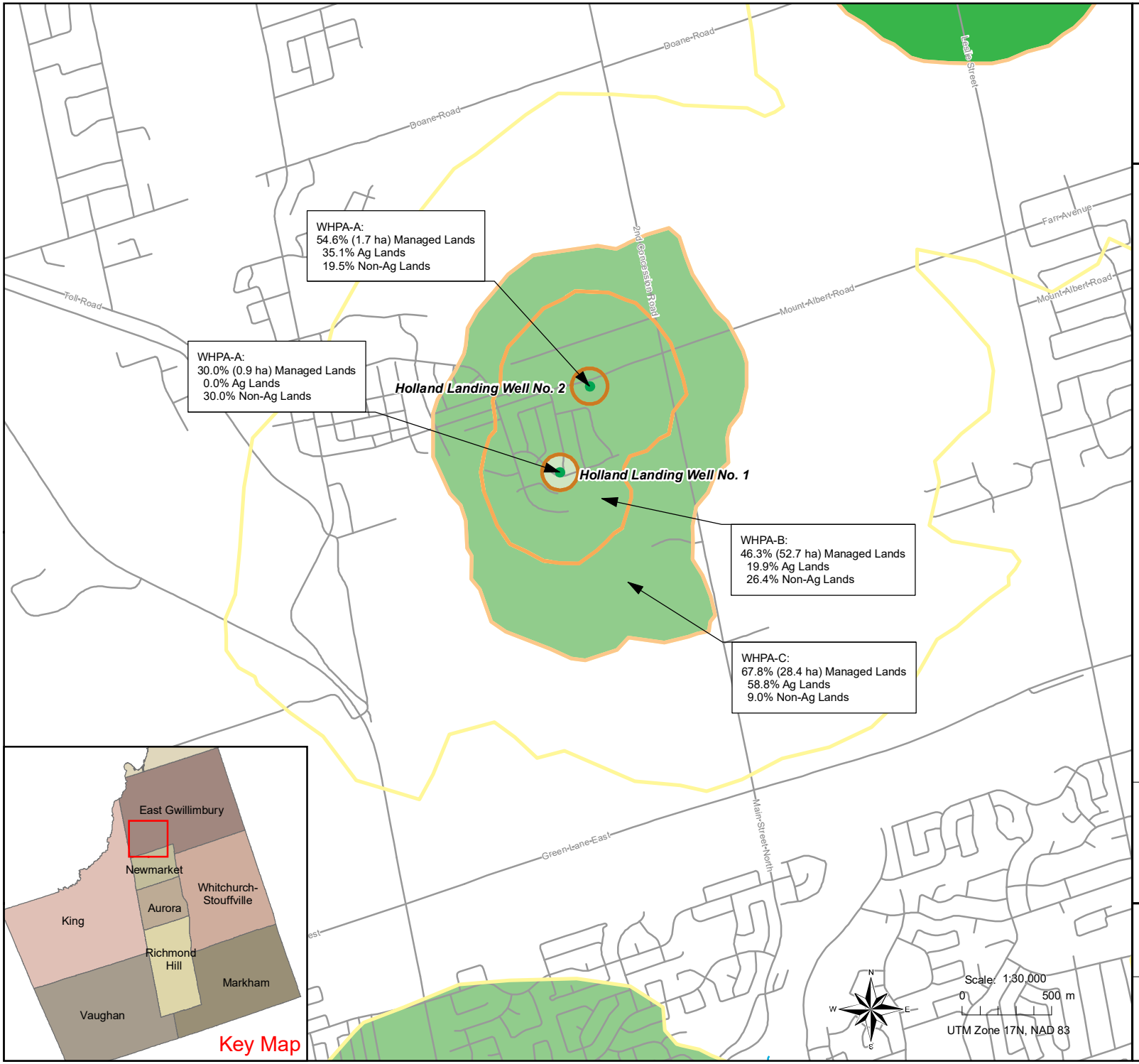
Created by: LSRCA
Date: 2010-10-01

Scale: 1:20,000
0 200 400m
UTM Zone 17N, NAD83

Ontario

Figure 13b-6

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.



Managed Lands - Holland Landing

- Municipal Well Type 1
- Roads

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Percent Total Managed Lands

- ≤ 40%
- > 40% - 80%
- ≥ 80%

NOTES

1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li

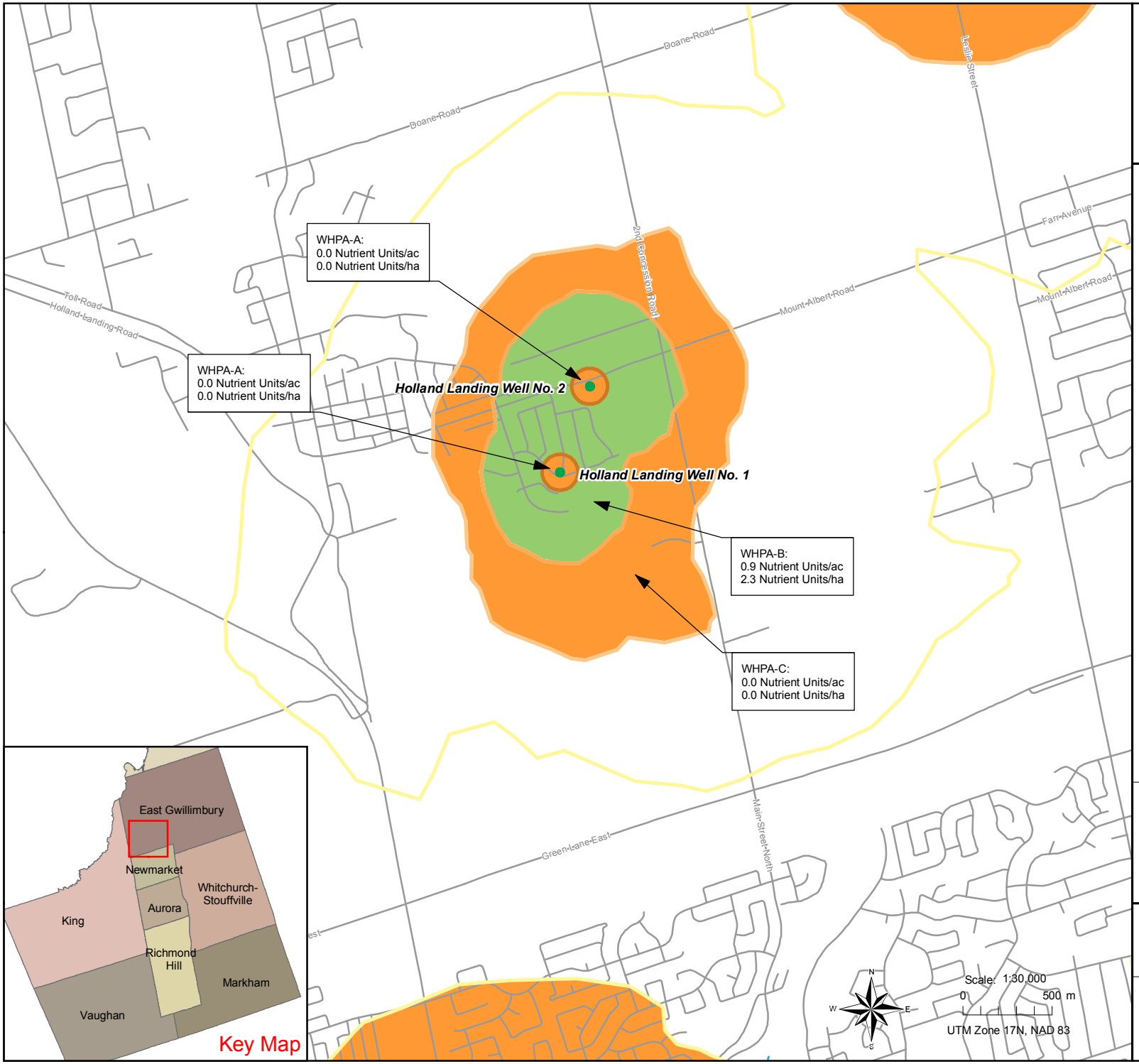
Project #: 122510019
Date: June 2010

Stantec

Ontario

13b-7

Livestock Density - Holland Landing



- Municipal Well Type 1
- Roads

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Nutrient Units / Acre

- ≤ 0.5
- >0.5 - 1.0
- ≥ 1.0

NOTES

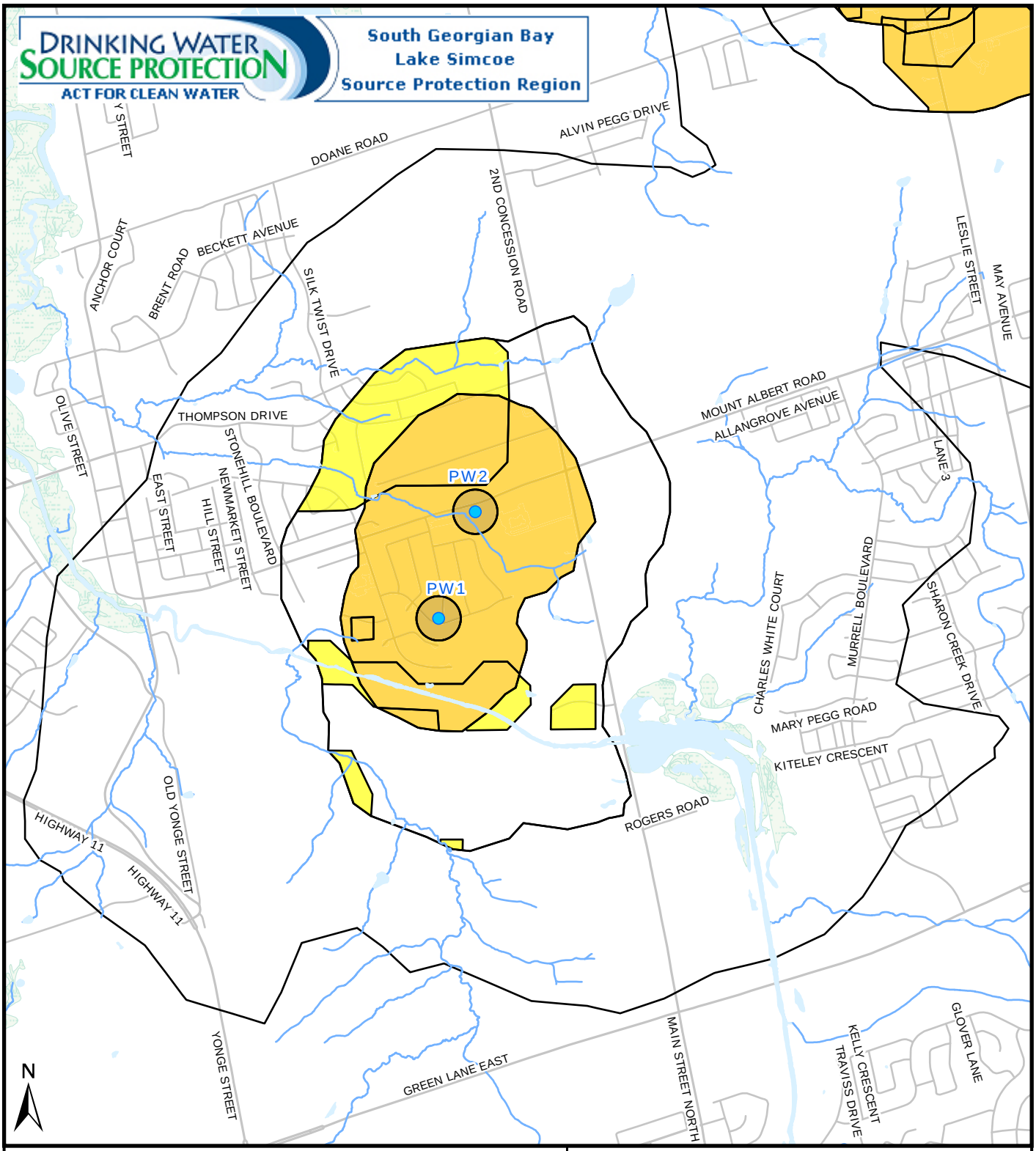
1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13b-8



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Holland Landing WHPA

Created by: LSRCA, 2025-08-05

Scale 1:25,000

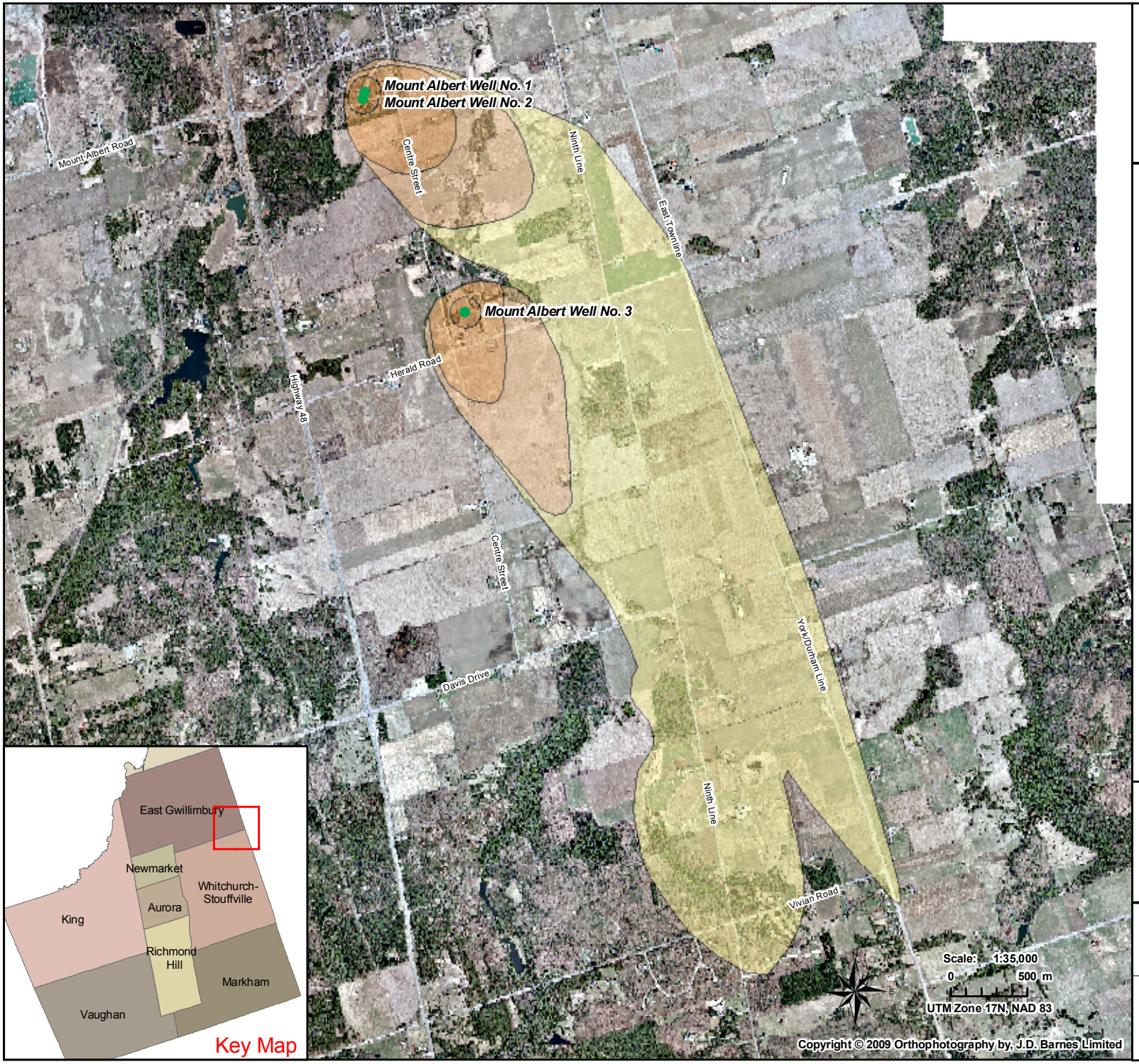
0 220 440 880 m

UTM Zone 17N, NAD83

Ontario

Figure 13b-9

Wellhead Protection Areas - Mount Albert



- Municipal Well Type 1

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

NOTES

1. WHPA zone delineations provided by Earthfx, 2007 & 2009.

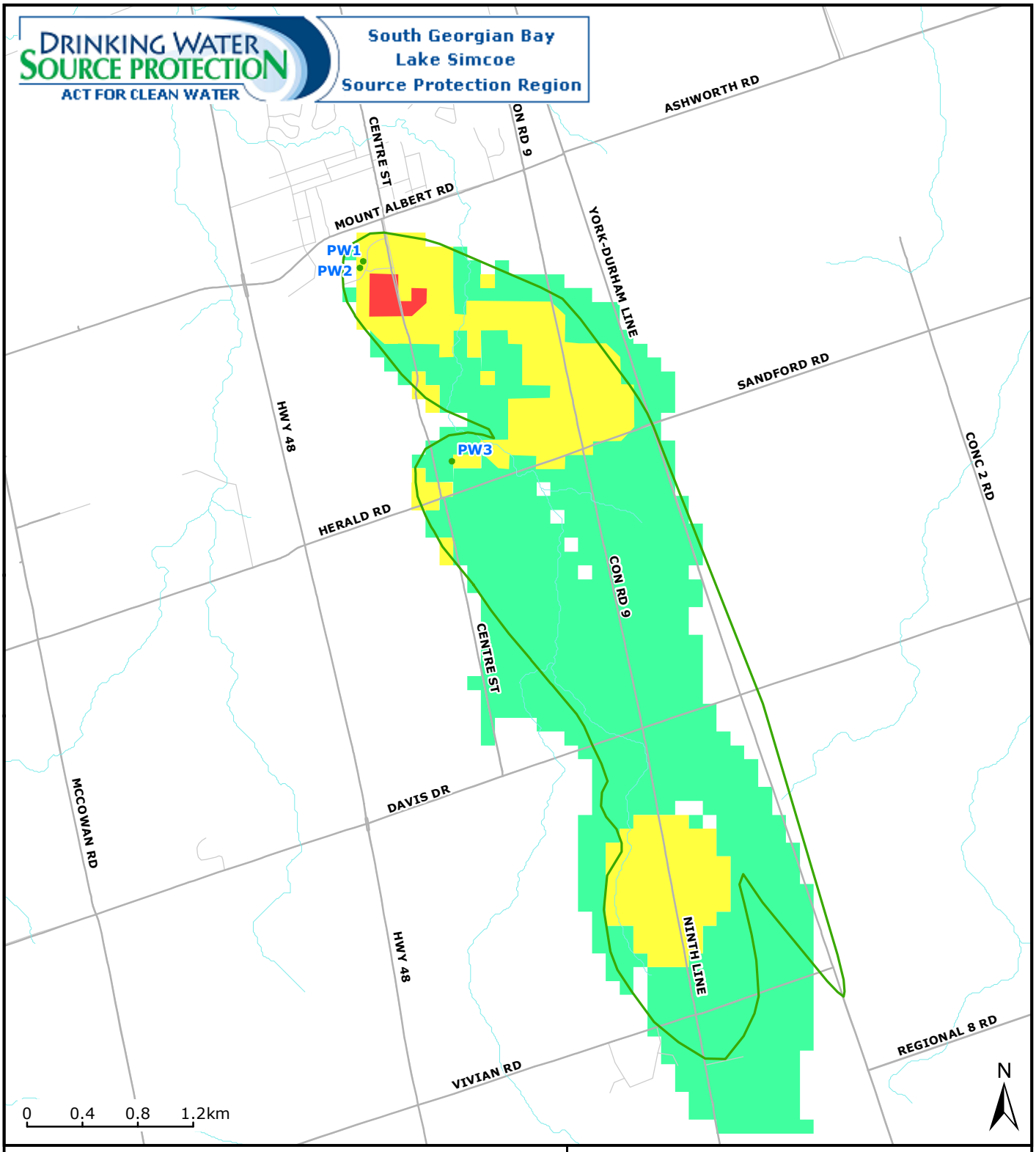
Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13c-1

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.



WWAT Ranking
- High
- Medium
- Low
- 25-Year Time-of-Travel
- SWP Watershed Area
- Water Body
- Main Water Course
- Roads

High, Medium, and Low vulnerability areas based on WWAT values for the Mount Albert

Created by: LSRCA
Date: 2010-08-03

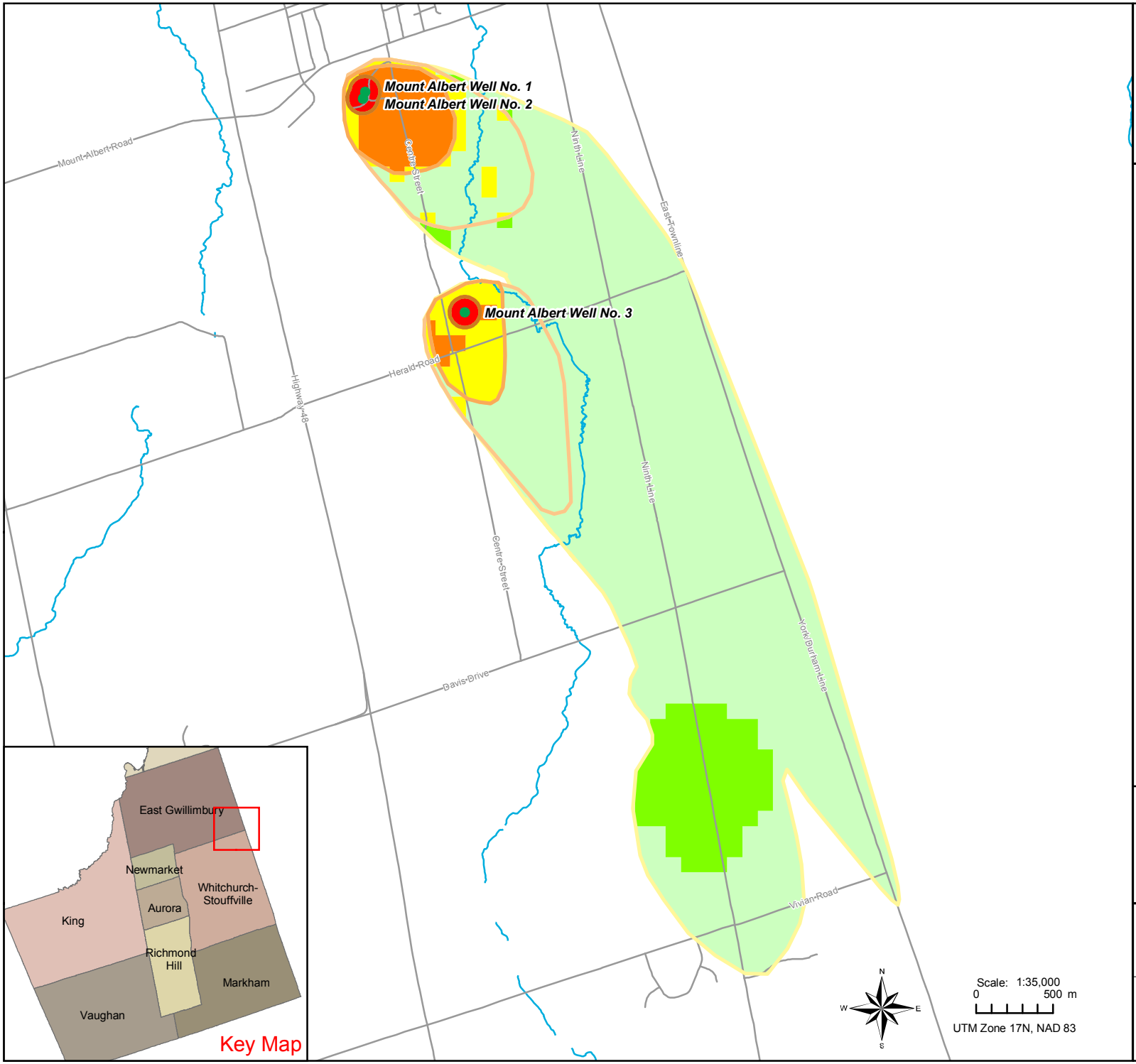
Scale: 1:40,000
UTM Zone 17N, NAD83

Earthfx Incorporated

Ontario

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.

Figure 13c-2



Vulnerability Score
Mount Albert

- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Vulnerability Scoring

- 2 (Low)
- 4
- 6
- 8
- 10 (High)

NOTES

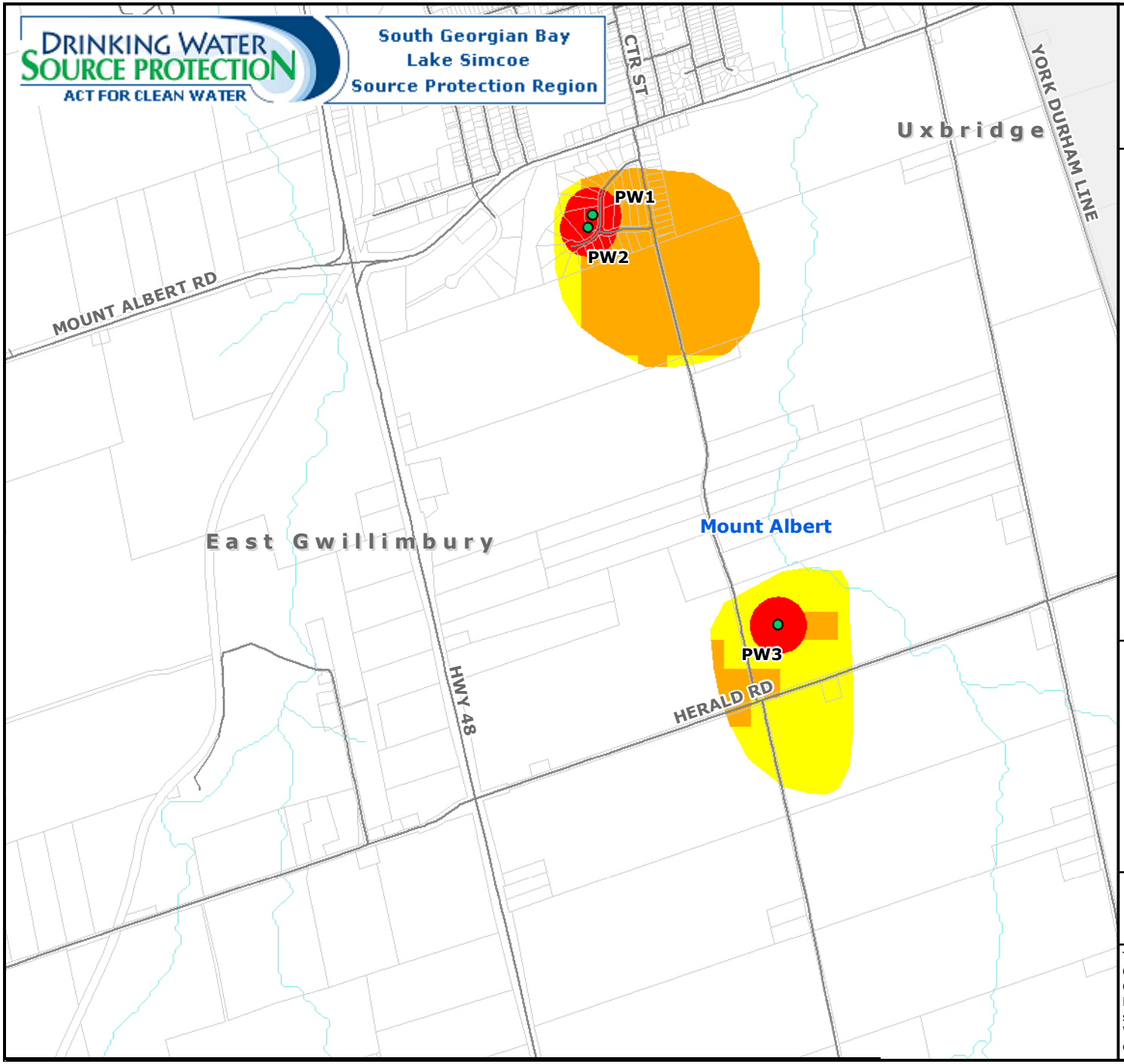
1. Vulnerability Scoring provided by Earthfx, 2007 and 2009.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13c-3



Areas of Significant, Moderate, or Low Threats - Pathogens

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-01

Scale: 1:20,000

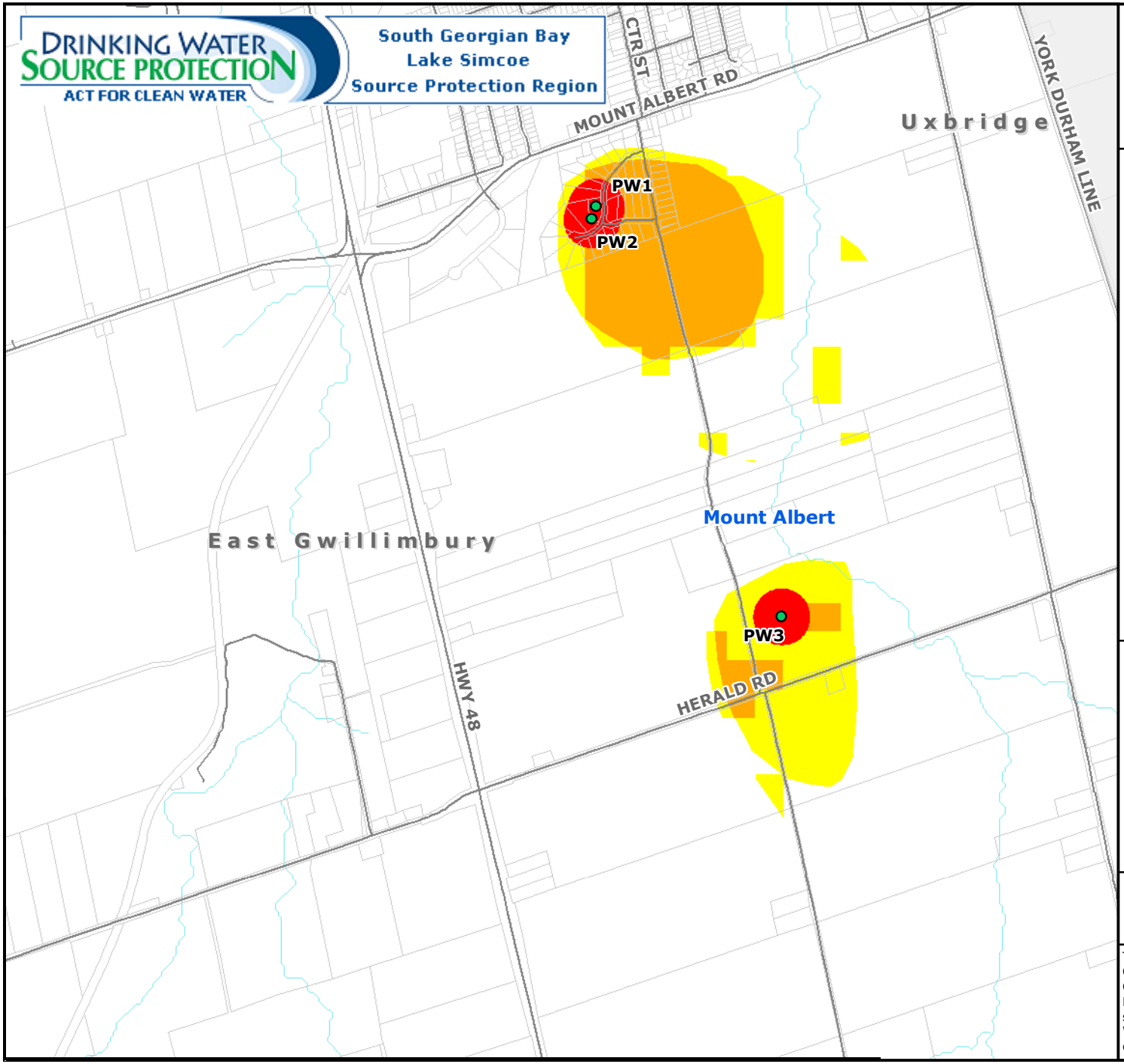
0 200 400 600m

UTM Zone 17N, NAD83

Ontario

Figure 13c-4

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.



Areas of Significant, Moderate, or Low Threats - Chemicals

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-01

Scale: 1:20,000

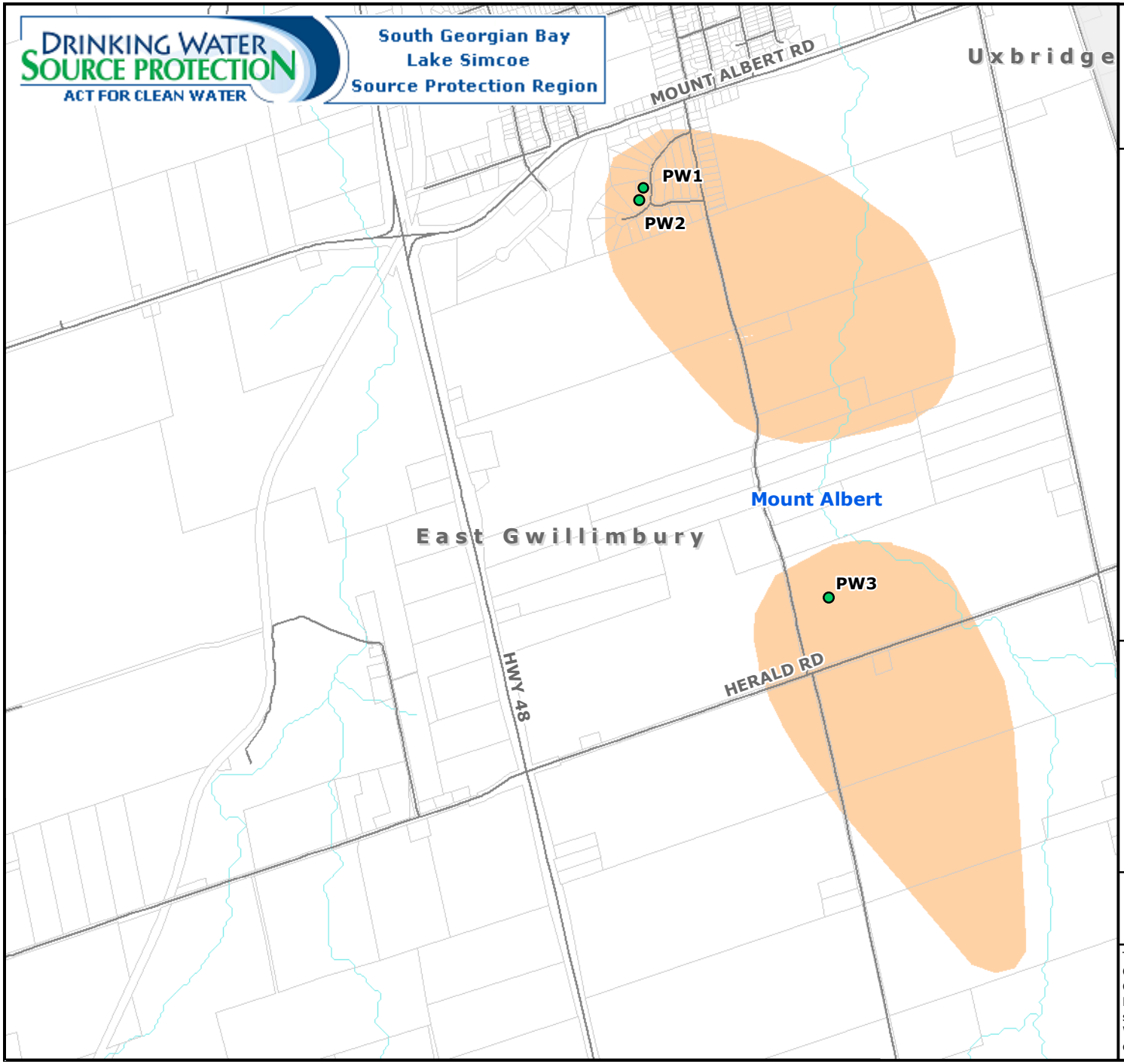
0 200 400 600m

UTM Zone 17N, NAD83

Ontario

Figure 13c-5

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.



Areas of Significant, Moderate, or Low Threats - DNAPLS

- Municipal Supply Wells
- WHPA-C: 5 year time-of-travel

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-01

Scale: 1:20,000

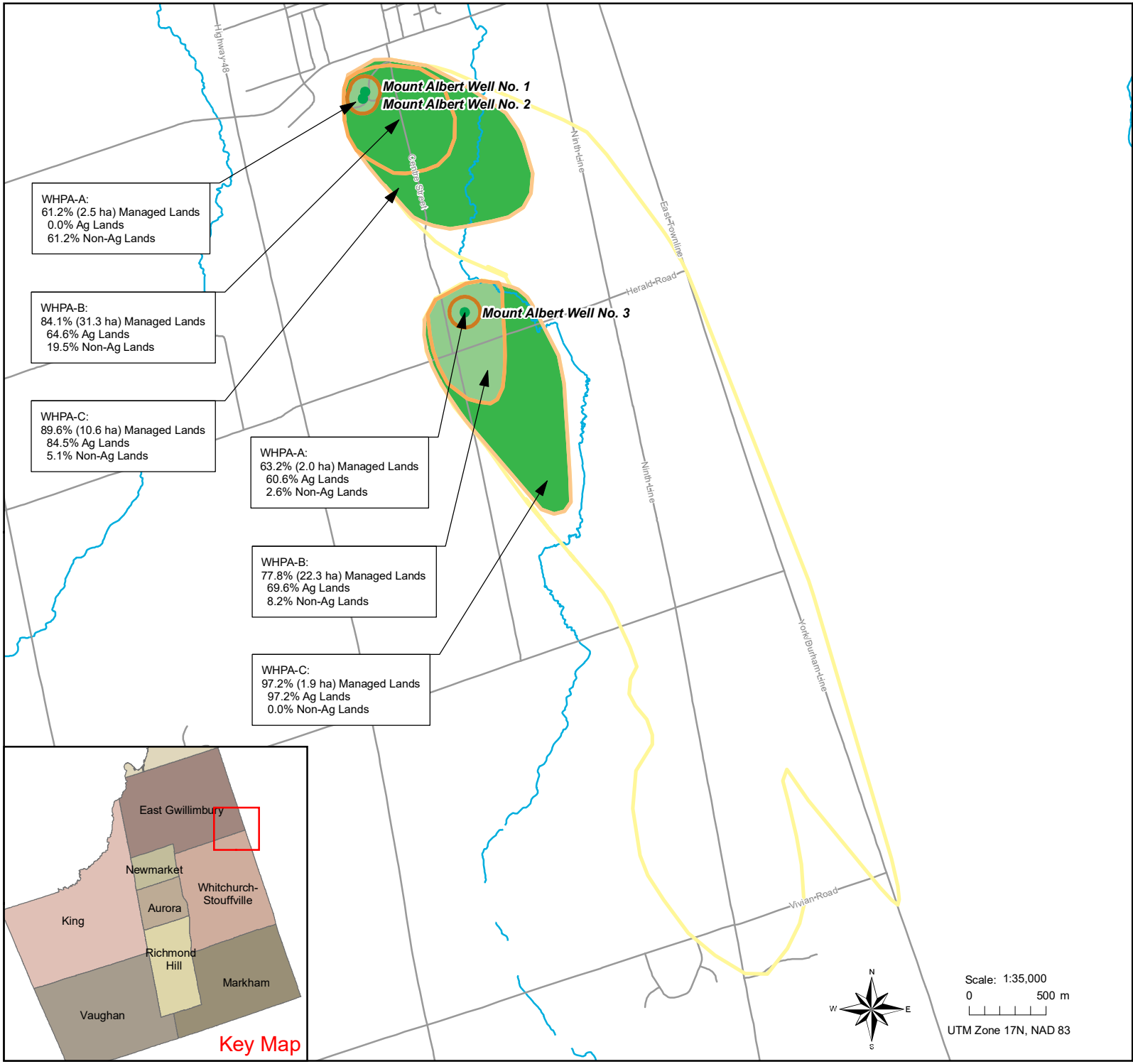
0 200 400 600m

UTM Zone 17N, NAD83

Ontario

Figure 13c-6

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.



Managed Lands - Mount Albert

- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Percent Total Managed Lands

- ≤ 40%
- > 40% - 80%
- ≥ 80%

NOTES

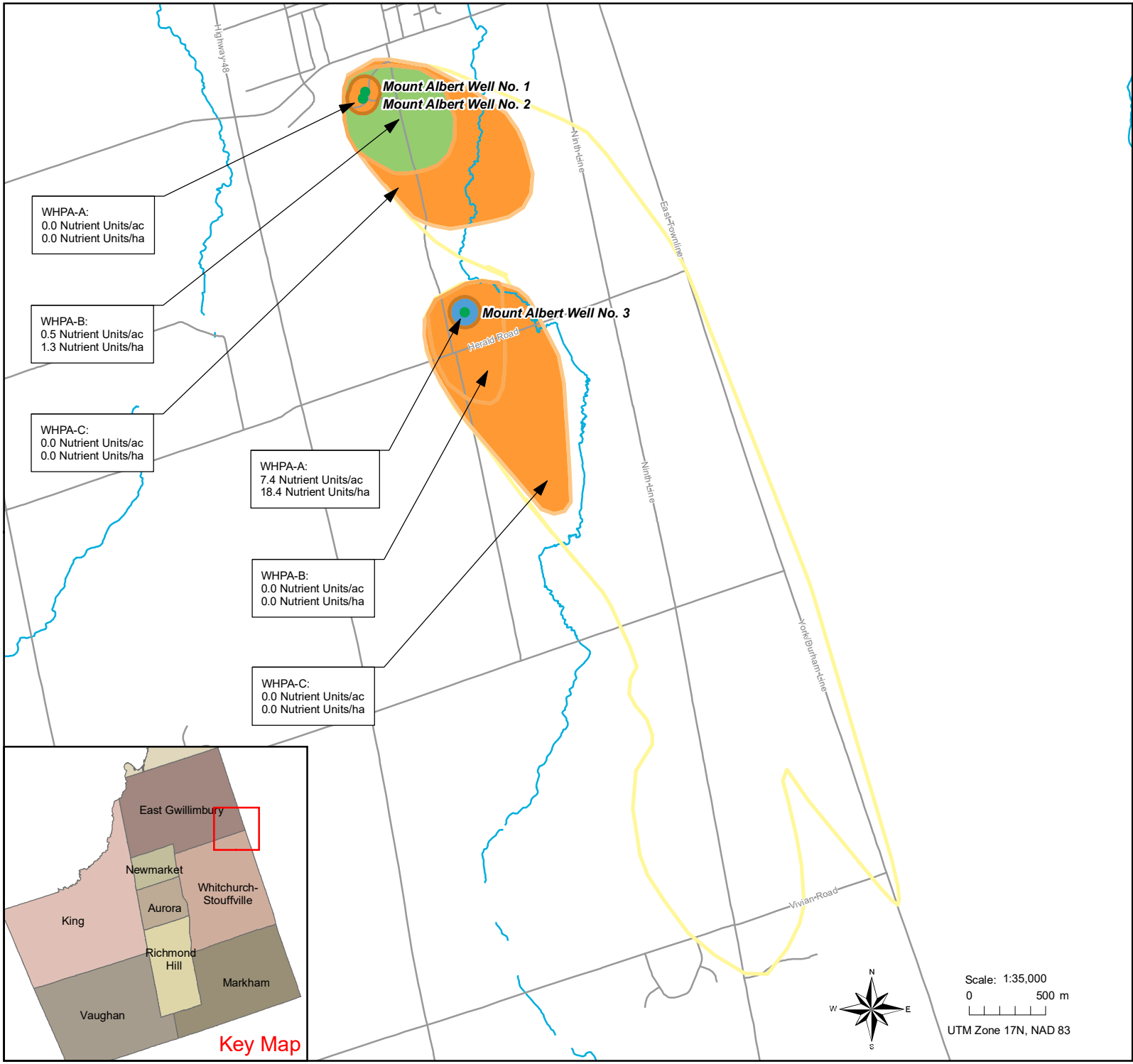
1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13c-7



Livestock Density - Mount Albert

- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Nutrient Units / Acre

- ≤ 0.5
- >0.5 - 1.0
- ≥ 1.0

NOTES

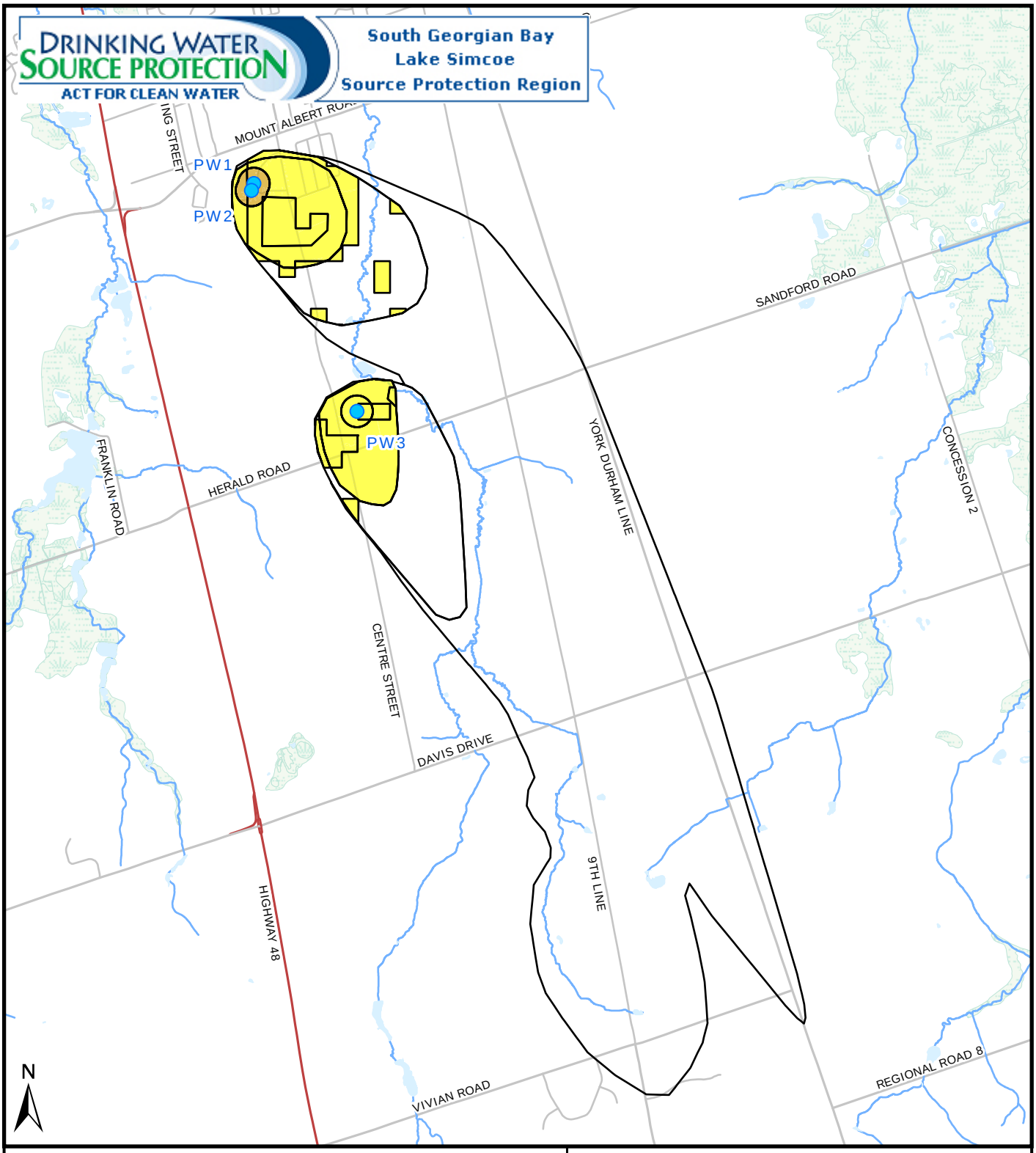
1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13c-8



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Mount Albert WHPA

Created by: LSRCA, 2025-08-05

Scale 1:35,000

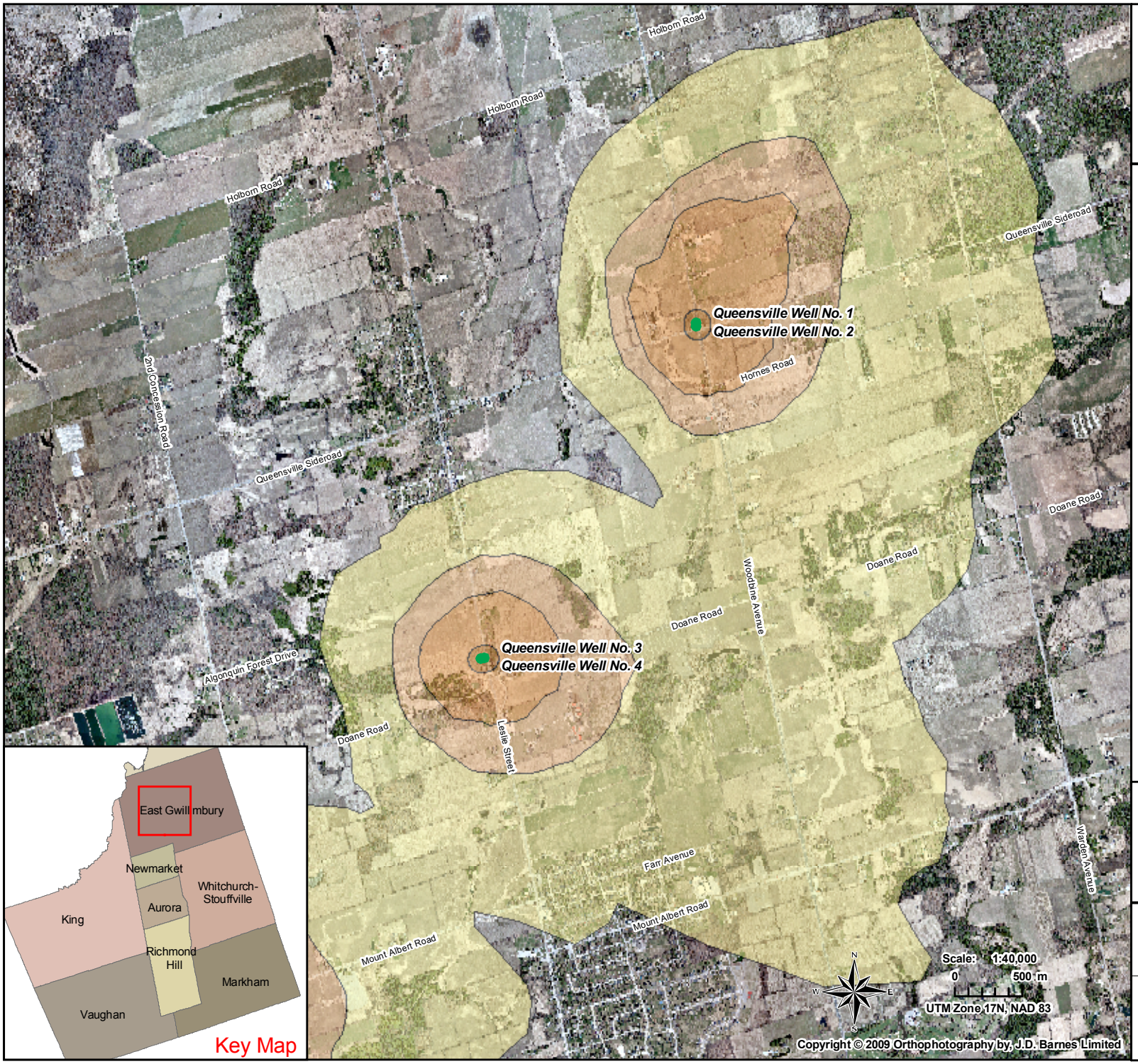
0 300 600 1,200 m

UTM Zone 17N, NAD83

Ontario

Figure 13c-9

Wellhead Protection Areas - Queensville



- Municipal Well Type 1

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

NOTES

1. WHPA zone delineations provided by Earthfx, 2007 & 2009.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

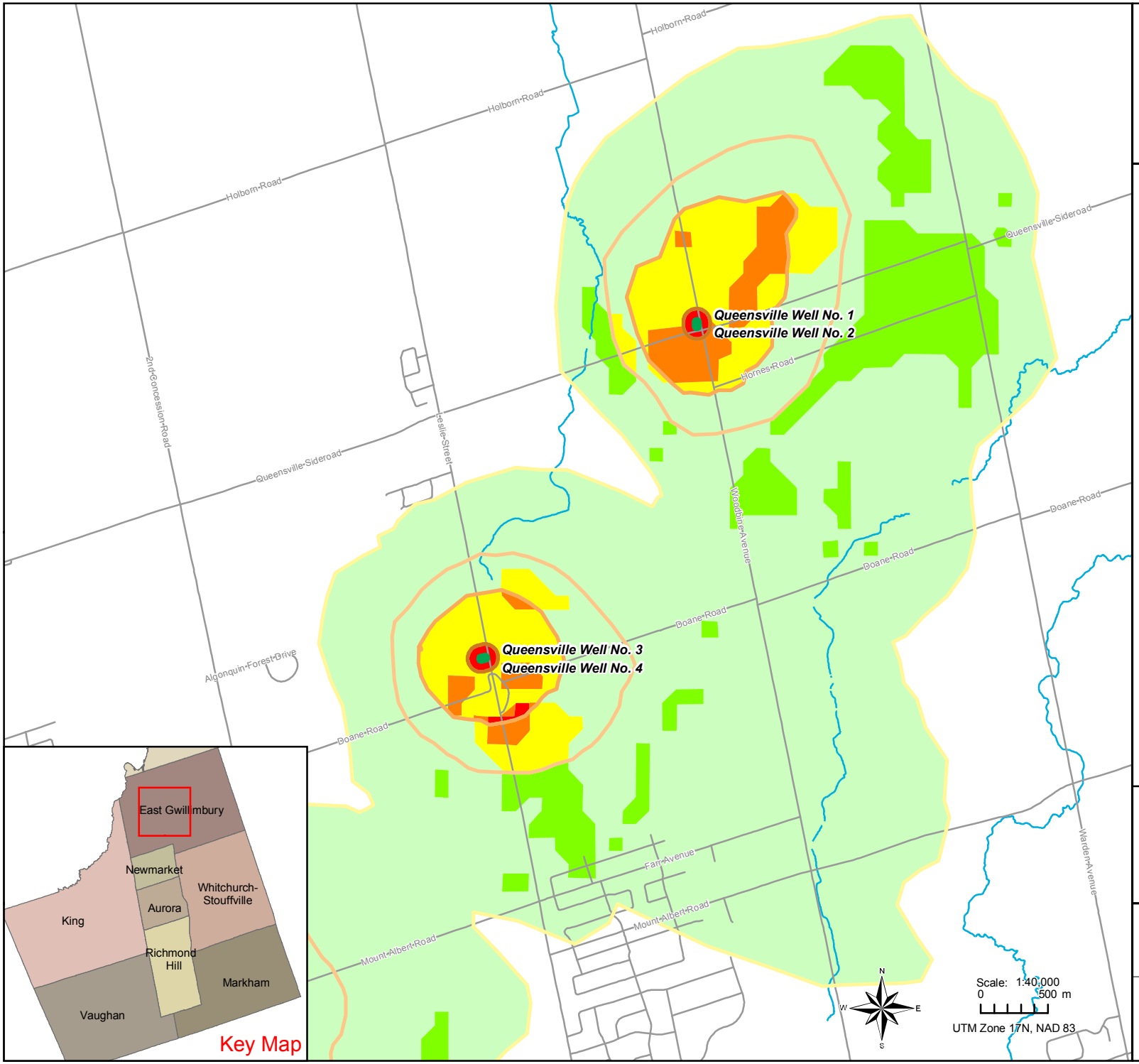
Stantec

Ontario

13d-1

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.

Vulnerability Score
Queensville



- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Vulnerability Scoring

- 2 (Low)
- 4
- 6
- 8
- 10 (High)

NOTES

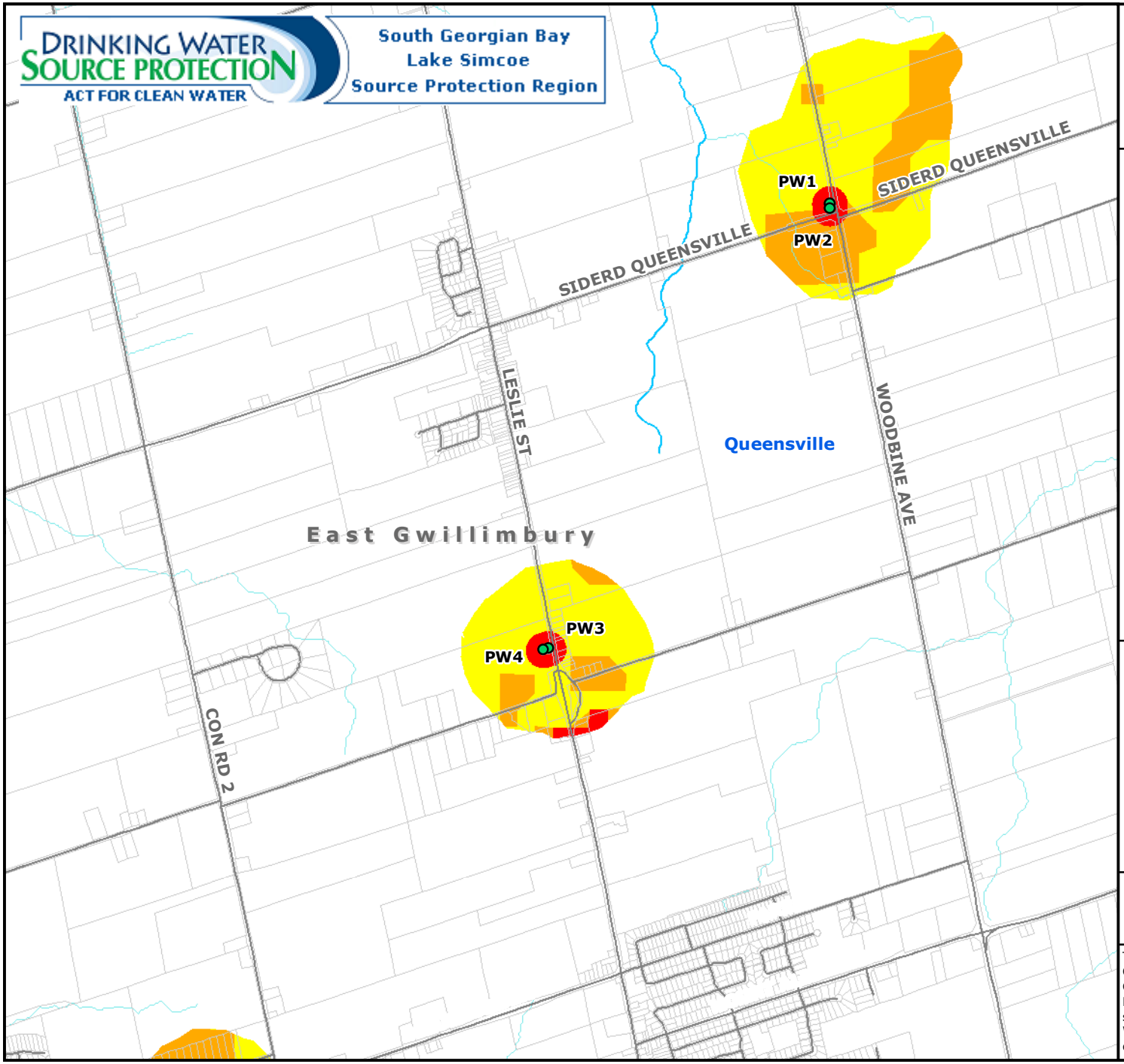
1. Vulnerability Scoring provided by Earthfx, 2007 and 2009.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13d-2



Areas of Significant, Moderate, or Low Threats - Pathogens

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-04

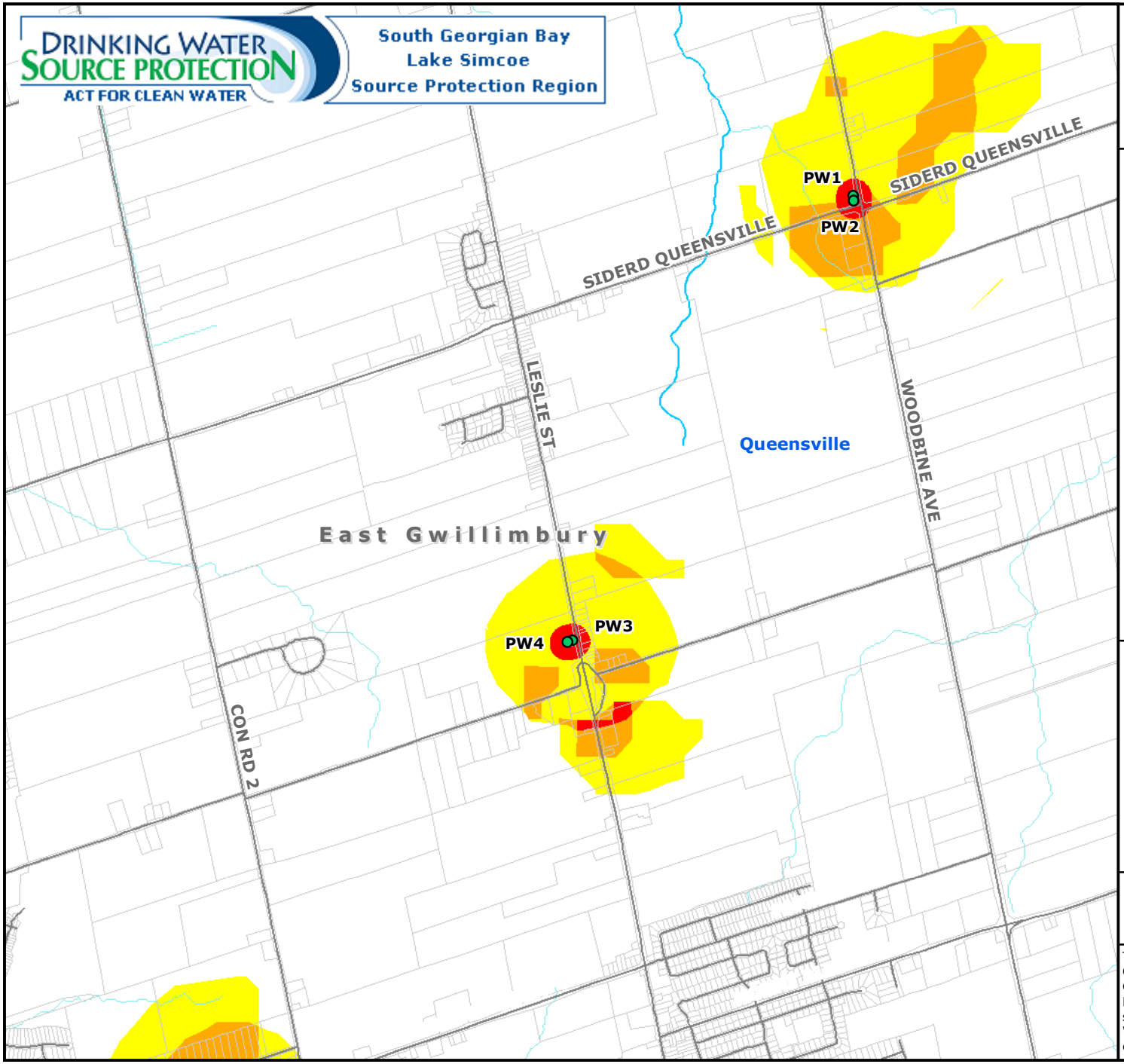
Scale: 1:32,000
0 200 400 600m

UTM Zone 17N, NAD83

Ontario

Figure 13d-3

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.



Areas of Significant, Moderate, or Low Threats - Chemicals

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-04

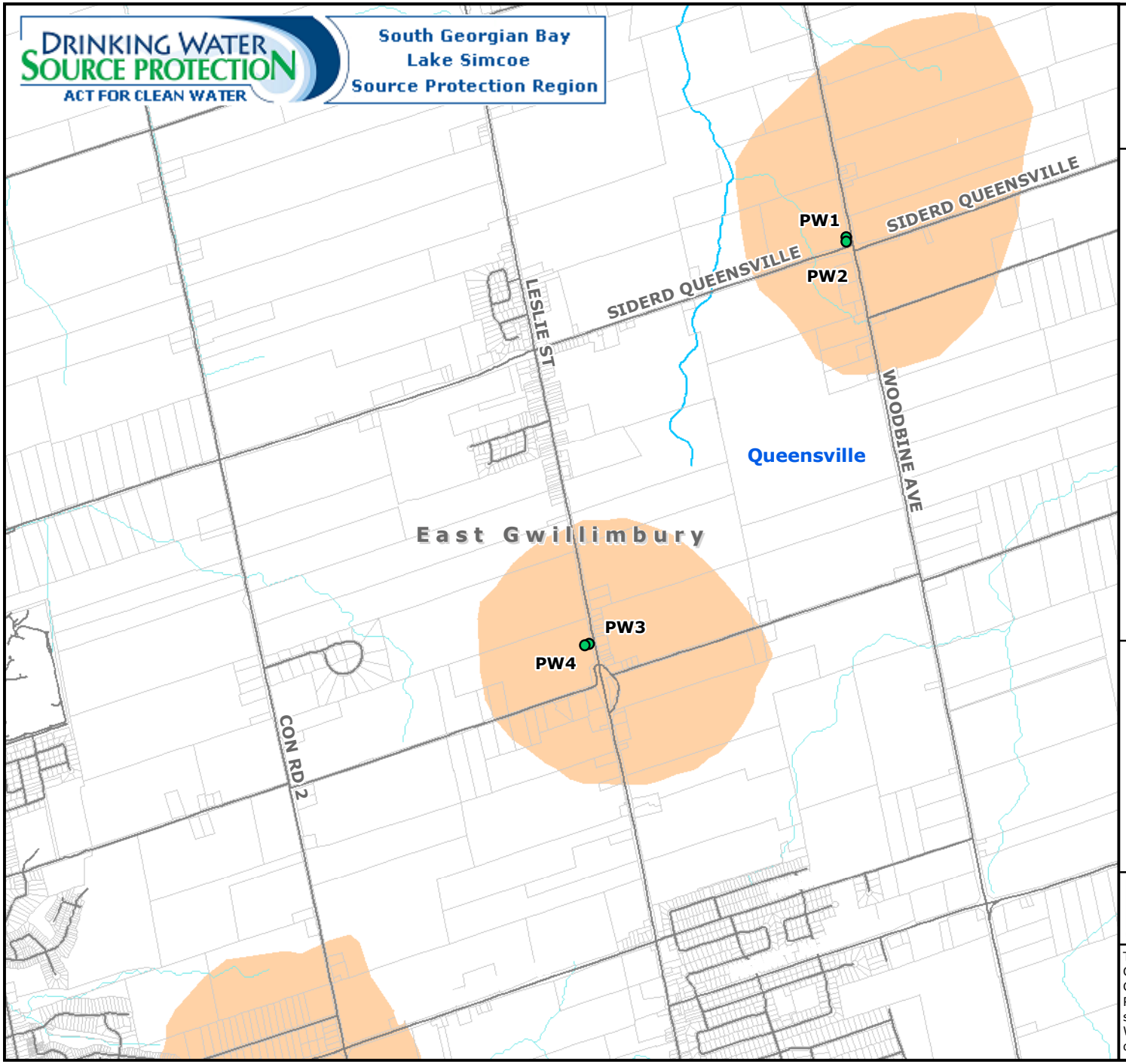
Scale: 1:32,000
0 200 400 600m

UTM Zone 17N, NAD83

Ontario

Figure 13d-4

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.



Areas of Significant, Moderate, or Low Threats - DNAPLS

Municipal Supply Wells

WHPA-C: 5 year time-of-travel

Vulnerability Scoring

10

8

6

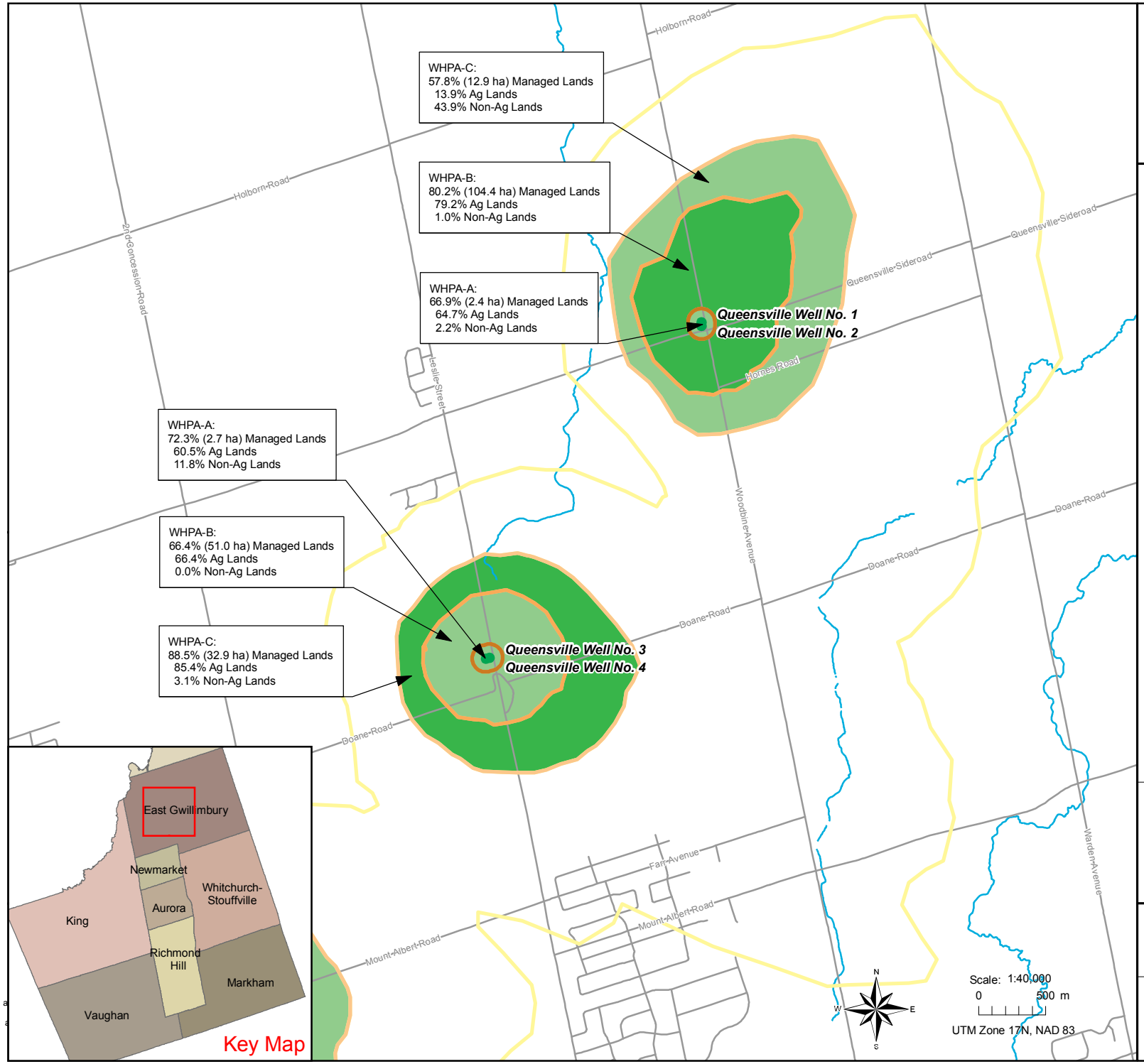
Created by: LSRCA
Date: 2010-10-04

Scale: 1:35,000
0 200 400 600m
UTM Zone 17N, NAD83

Ontario

Figure 13d-5

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.



Managed Lands - Queensville

- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Percent Total Managed Lands

- ≤ 40%
- > 40% - 80%
- ≥ 80%

NOTES

1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

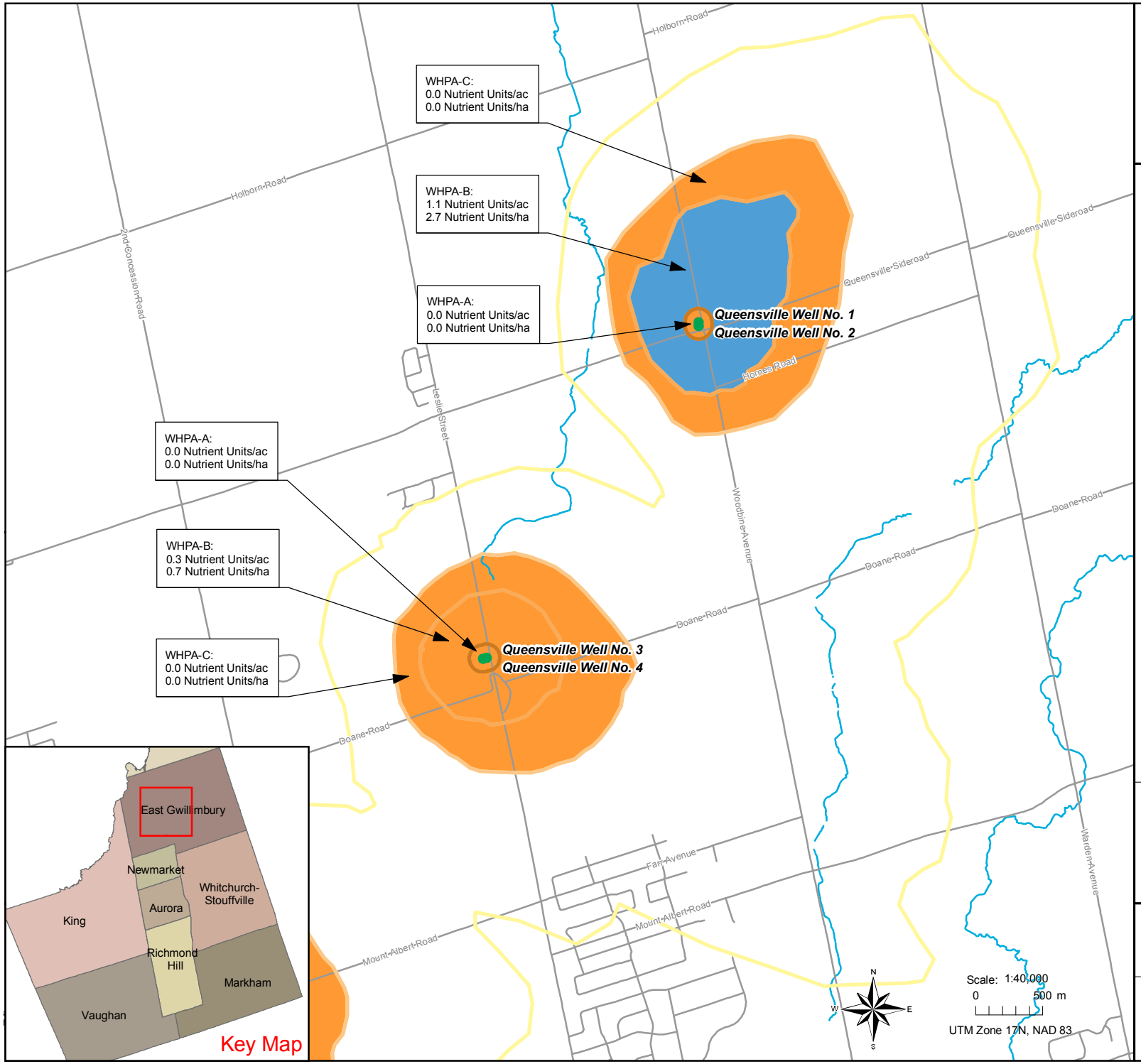
Stantec

Ontario

13d-6

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.

Livestock Density - Queensville



- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Nutrient Units / Acre

- ≤ 0.5
- >0.5 - 1.0
- ≥ 1.0

NOTES

1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

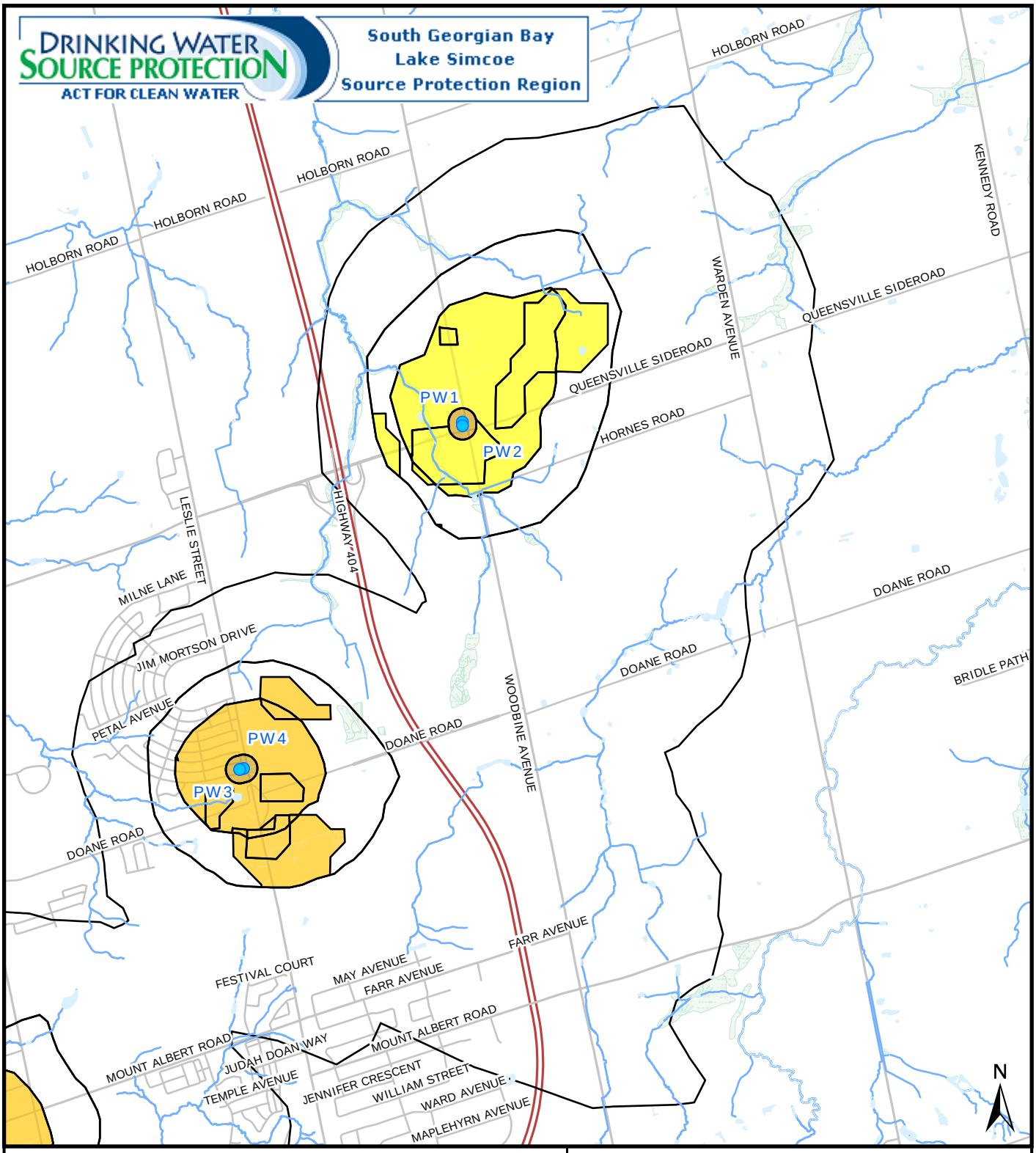
Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13d-7

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Queensville WHPA

Created by: LSRCA, 2025-08-05

Scale 1:40,000

0 0.33 0.65 1.3 km

UTM Zone 17N, NAD83

Ontario

Figure 13d-8

Wellhead Protection Areas - Ansnorveldt

- Municipal Well Type 1

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

NOTES

1. WHPA zone delineations provided by Earthfx, 2007 & 2009.

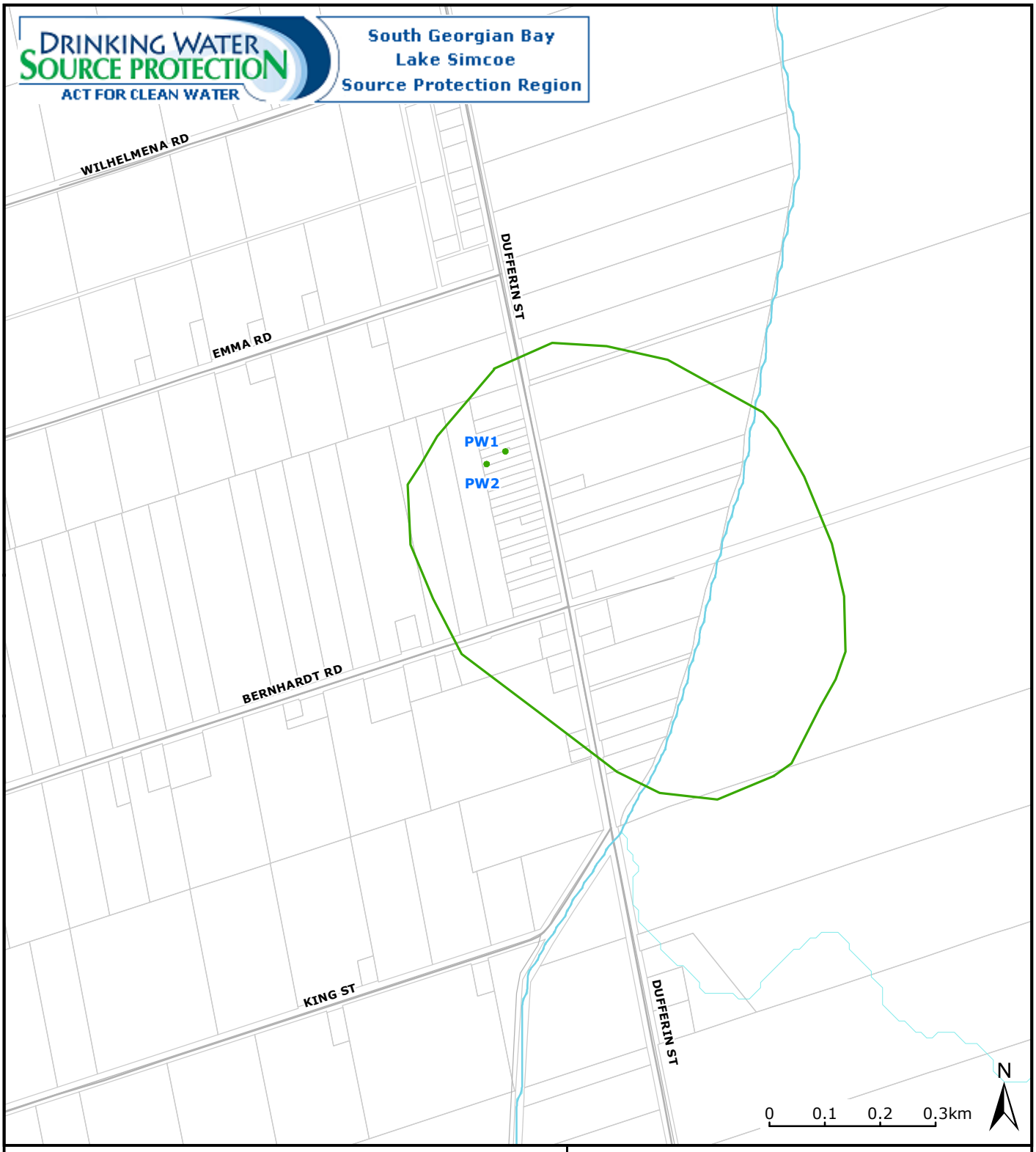
Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13e-1

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.



WWAT Ranking
- High
- Medium
- Low
- 25-Year Time-of-Travel
- SWP Watershed Area
- Water Body
- Main Water Course
- Roads

High, Medium, and Low vulnerability areas based on WWAT values for the Ansnorvedlt

Created by: LSRCA
Date: 2010-08-03

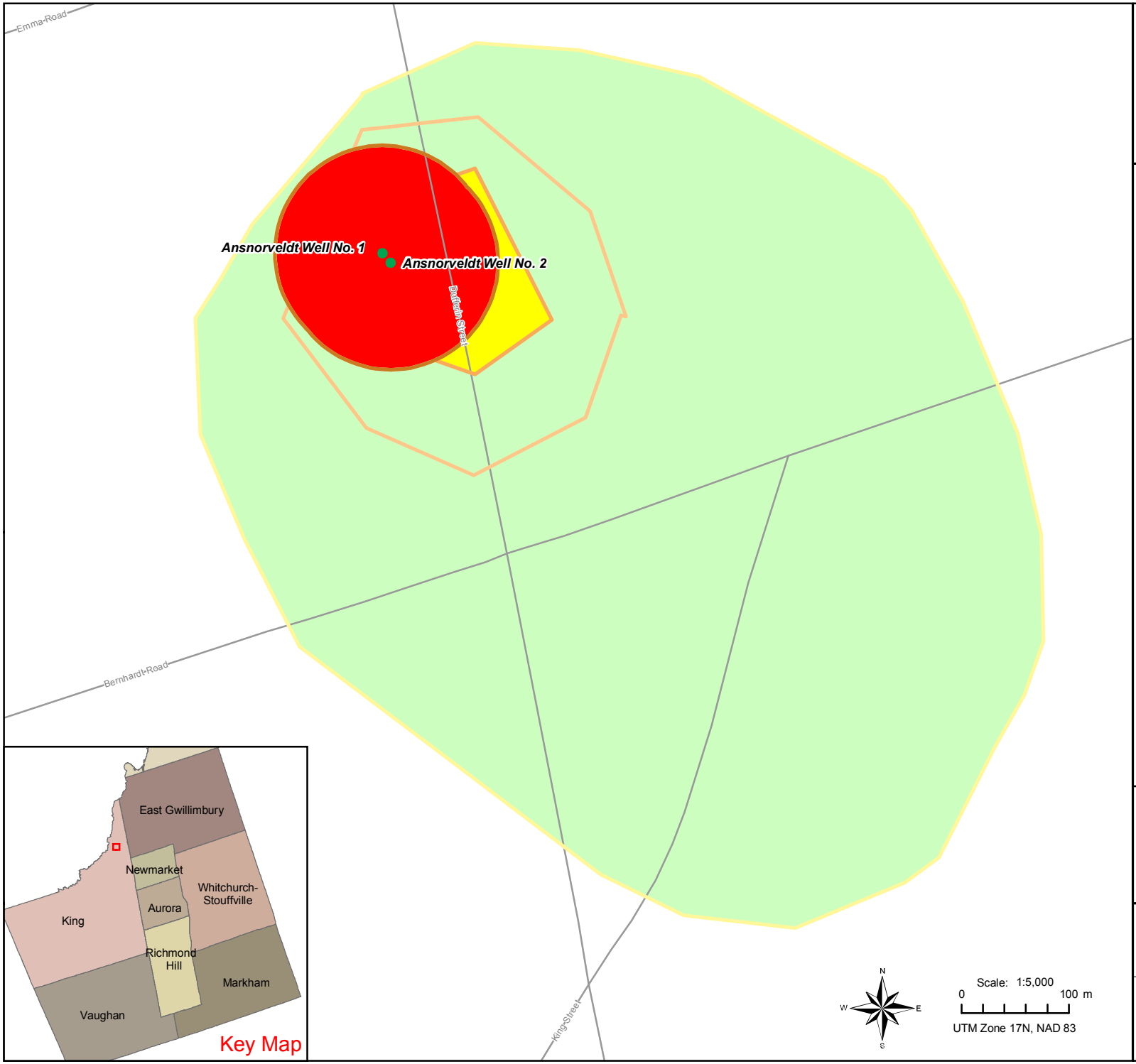
Scale: 1:10,000
UTM Zone 17N, NAD83

Earthfx Incorporated

Ontario

Figure 13e-2

Vulnerability Score
Ansnorveldt



- Municipal Well Type 1
- Roads

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Vulnerability Scoring

- 2 (Low)
- 4
- 6
- 8
- 10 (High)

N, W, E, S

Scale: 1:5,000

0 100 m

UTM Zone 17N, NAD 83

NOTES

1. Vulnerability Scoring provided by Earthfx, 2007 and 2009.

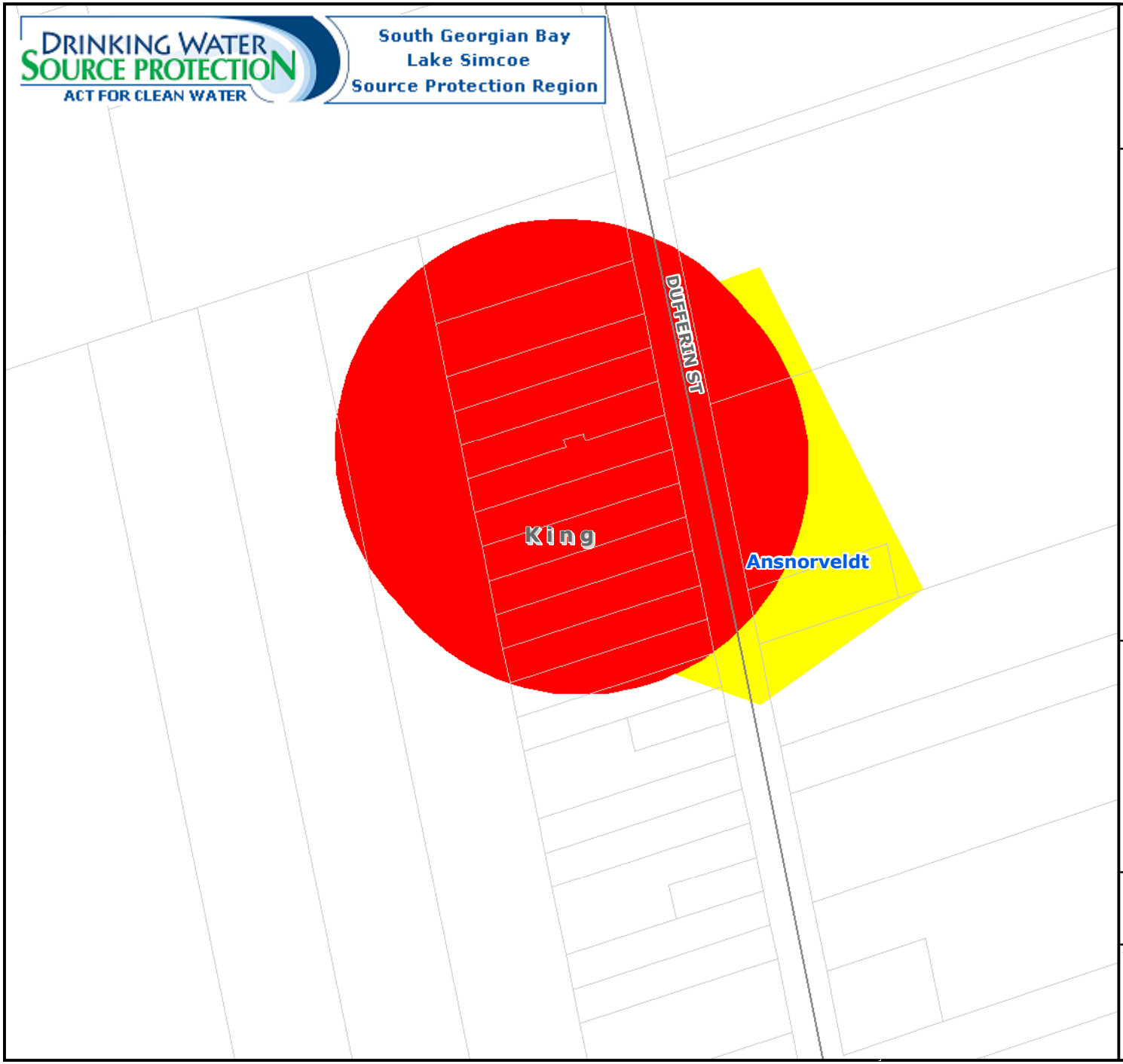
Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13e-3

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

Areas of Significant, Moderate, or Low Threats - Pathogens

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-04

Scale: 1:2,500

0 25 50m

UTM Zone 17N, NAD83

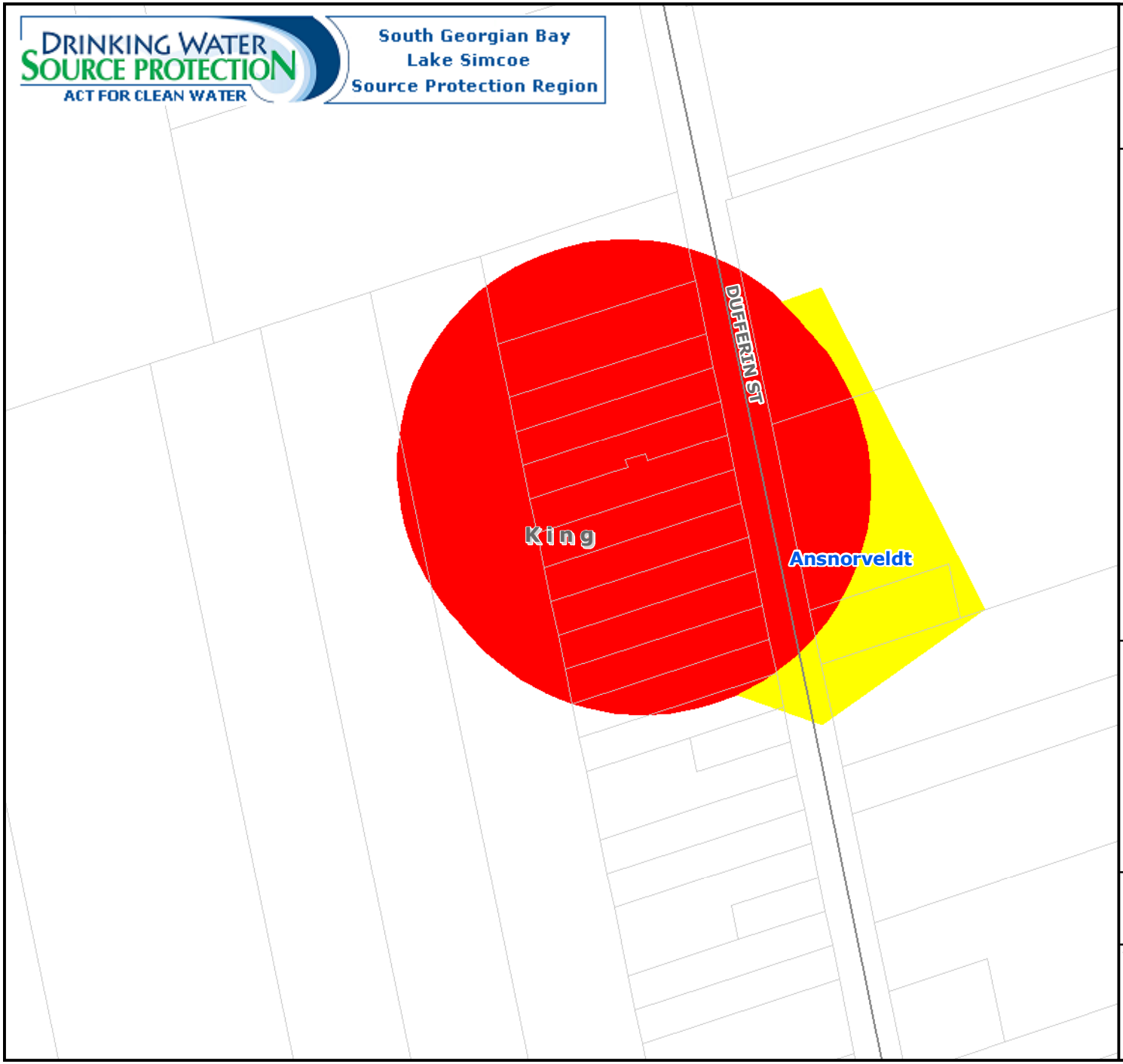
Ontario

Figure 13e-4

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.

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Areas of Significant, Moderate, or Low Threats - Chemicals

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-04

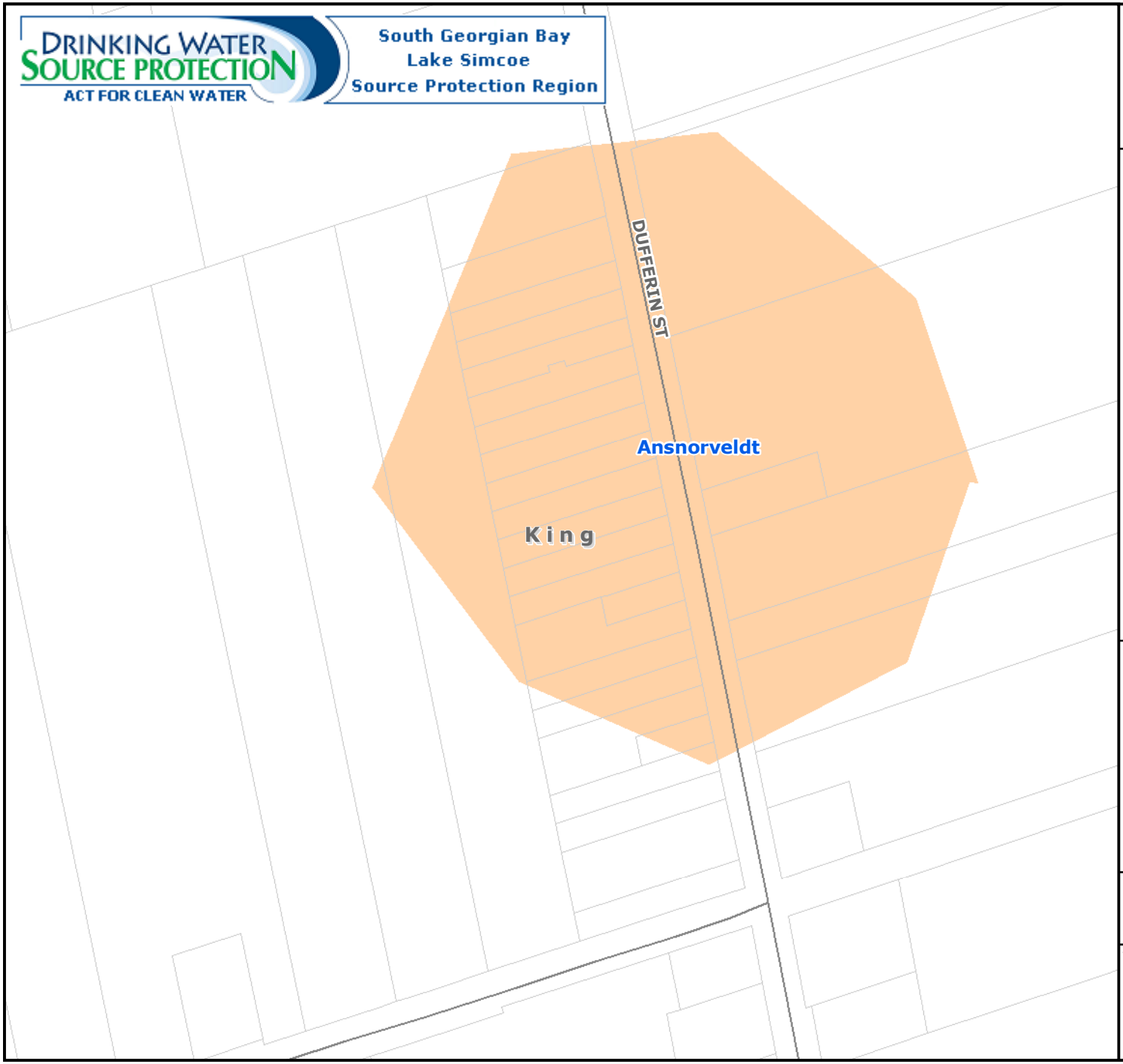
Scale: 1:2,500
0 25 50m

UTM Zone 17N, NAD83

Ontario

Figure 13e-5

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.



DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

Areas of Significant, Moderate, or Low Threats - DNAPLS

Municipal Supply Wells

WHPA-C: 5 year time-of-travel

Vulnerability Scoring

10

8

6

Created by: LSRCA
Date: 2010-10-04

Scale: 1:3,000

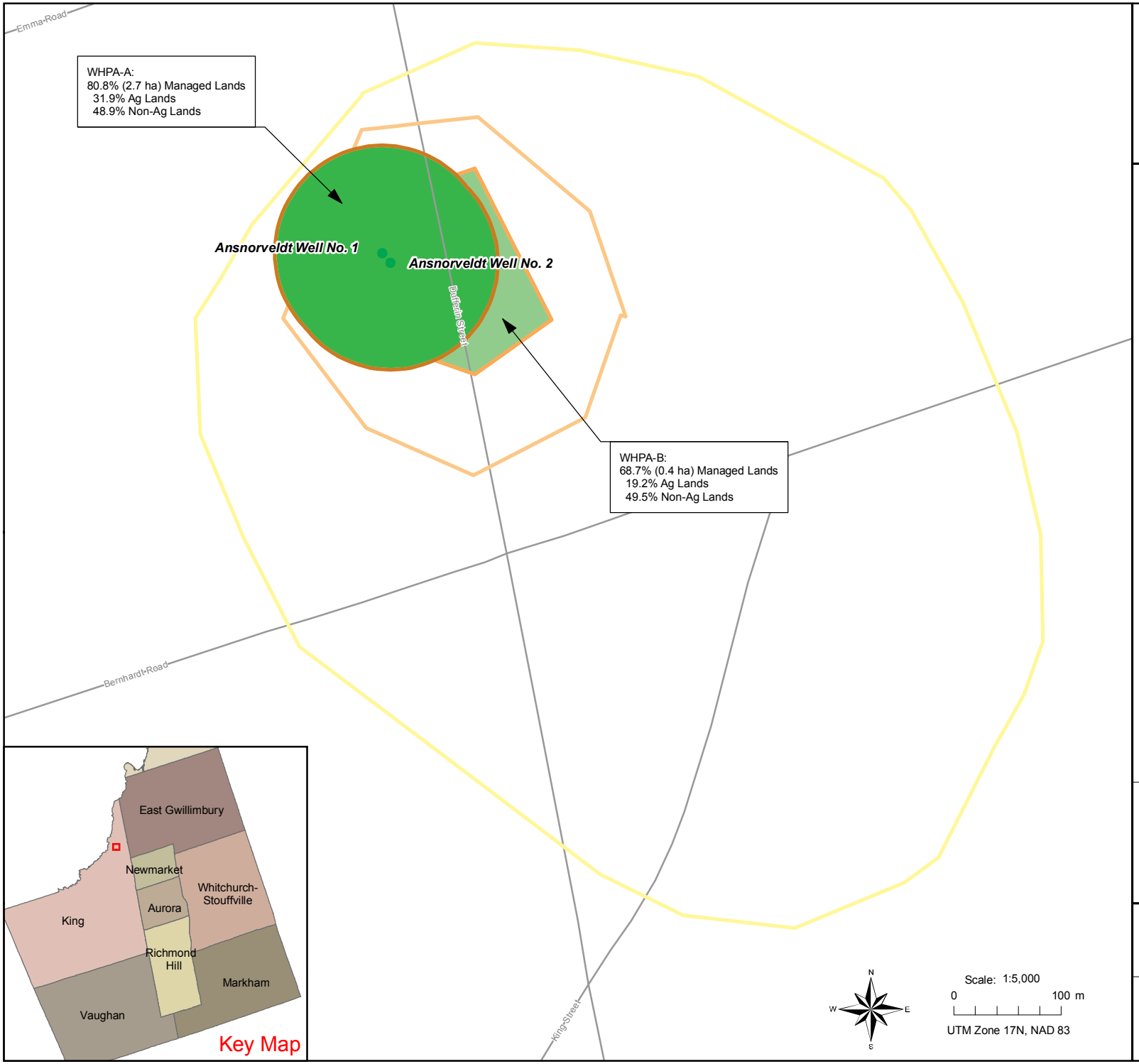
0 25 50m

UTM Zone 17N, NAD83

Ontario

Figure 13e-6

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.



Managed Lands - Ansnorveldt

- Municipal Well Type 1
- Roads

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Percent Total Managed Lands

- ≤ 40%
- > 40% - 80%
- ≥ 80%

NOTES

1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

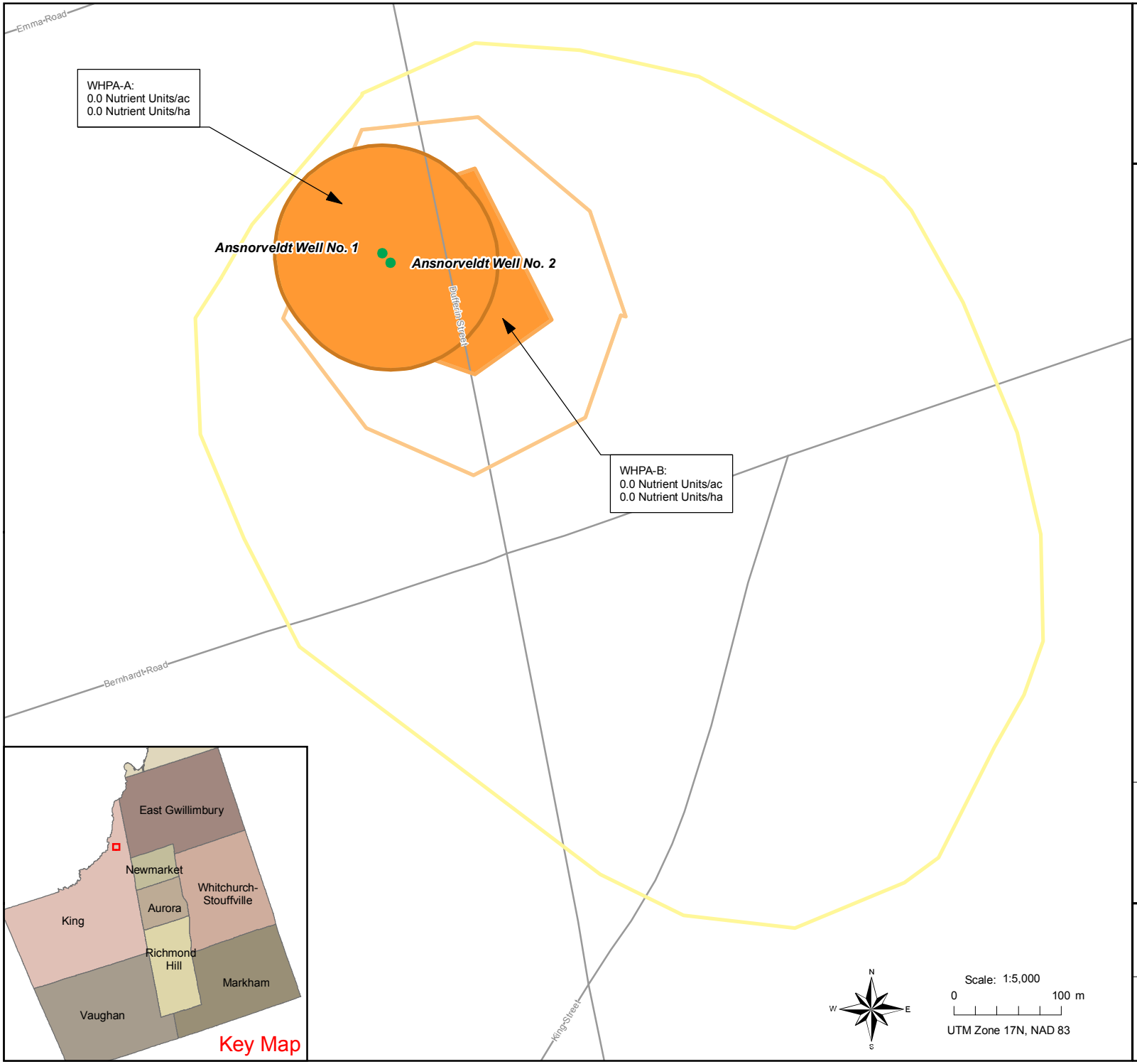
Stantec

Ontario

13e-7

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.

Livestock Density - Ansnorveldt



- Municipal Well Type 1
- Roads

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Nutrient Units / Acre

- ≤ 0.5
- >0.5 - 1.0
- ≥ 1.0

NOTES

1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li

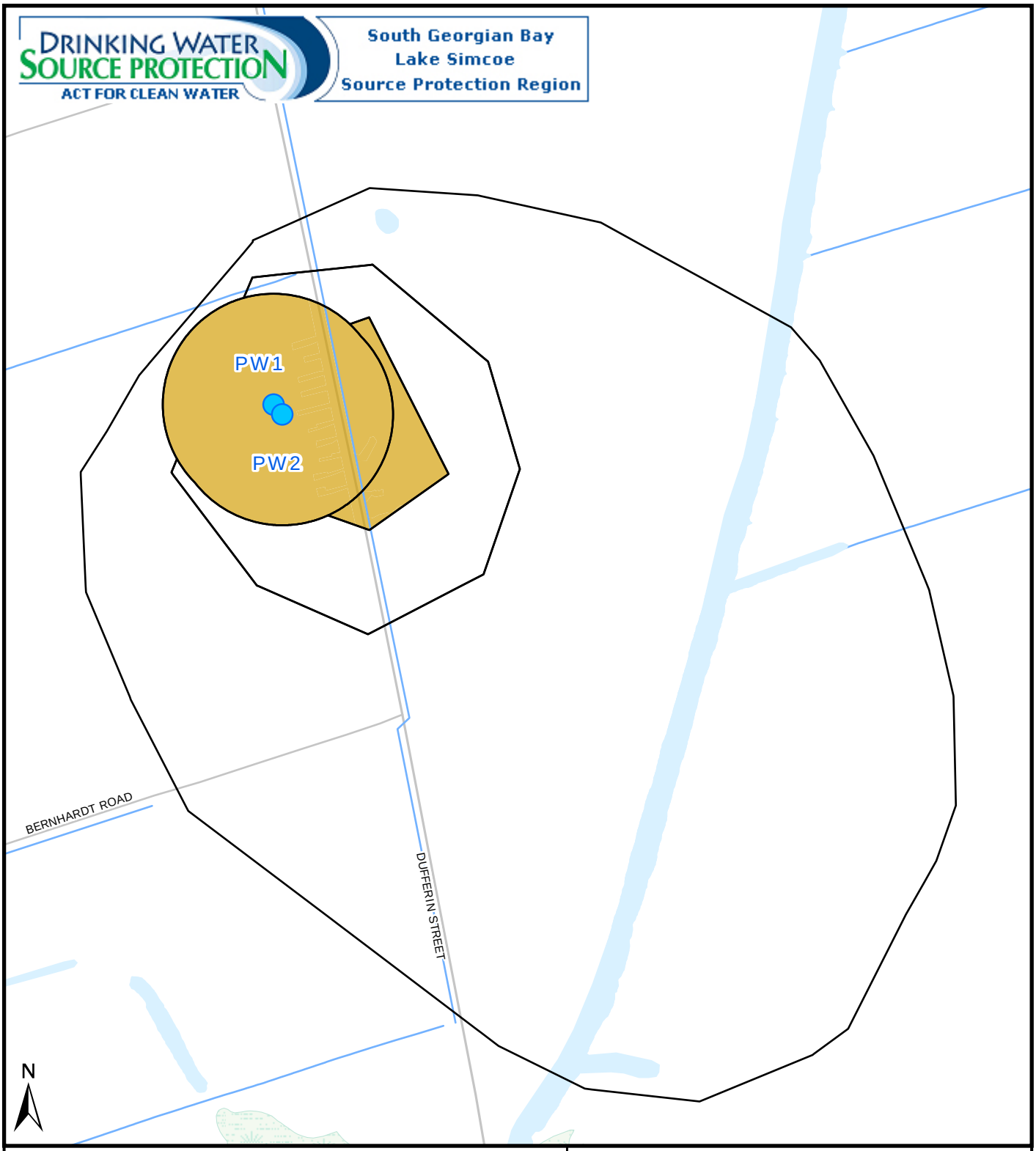
Project #: 122510019

Date: June 2010

Stantec

Ontario

13e-8



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Ansnorveldt WHPA

Created by: LSRCA, 2025-08-05

Scale 1:5,000

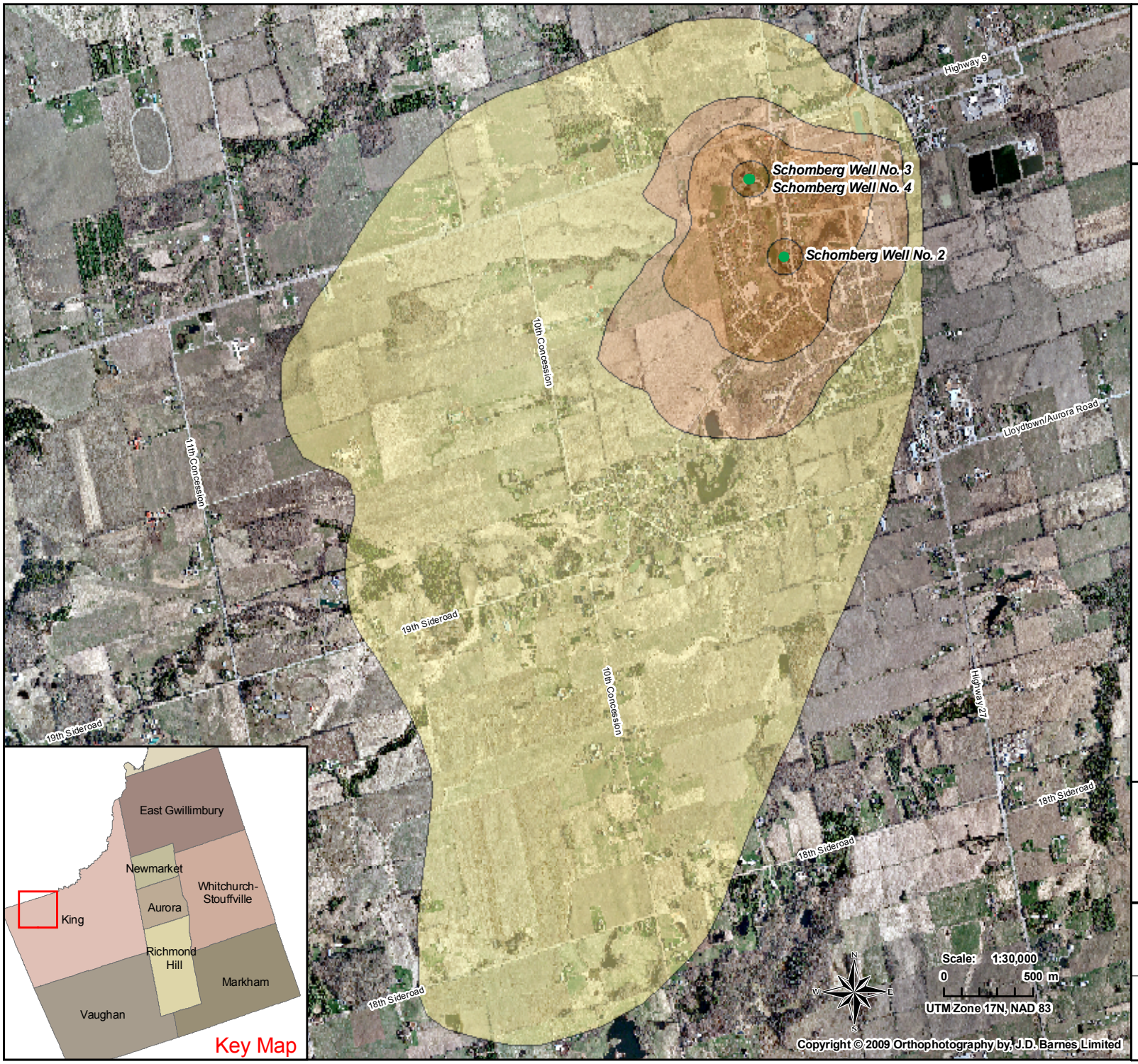
0 40 80 160 m

UTM Zone 17N, NAD83

Ontario

Figure 13e-9

Wellhead Protection Areas - Schomberg



- Municipal Well Type 1

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

NOTES

1. WHPA zone delineations provided by Earthfx, 2007 & 2009.

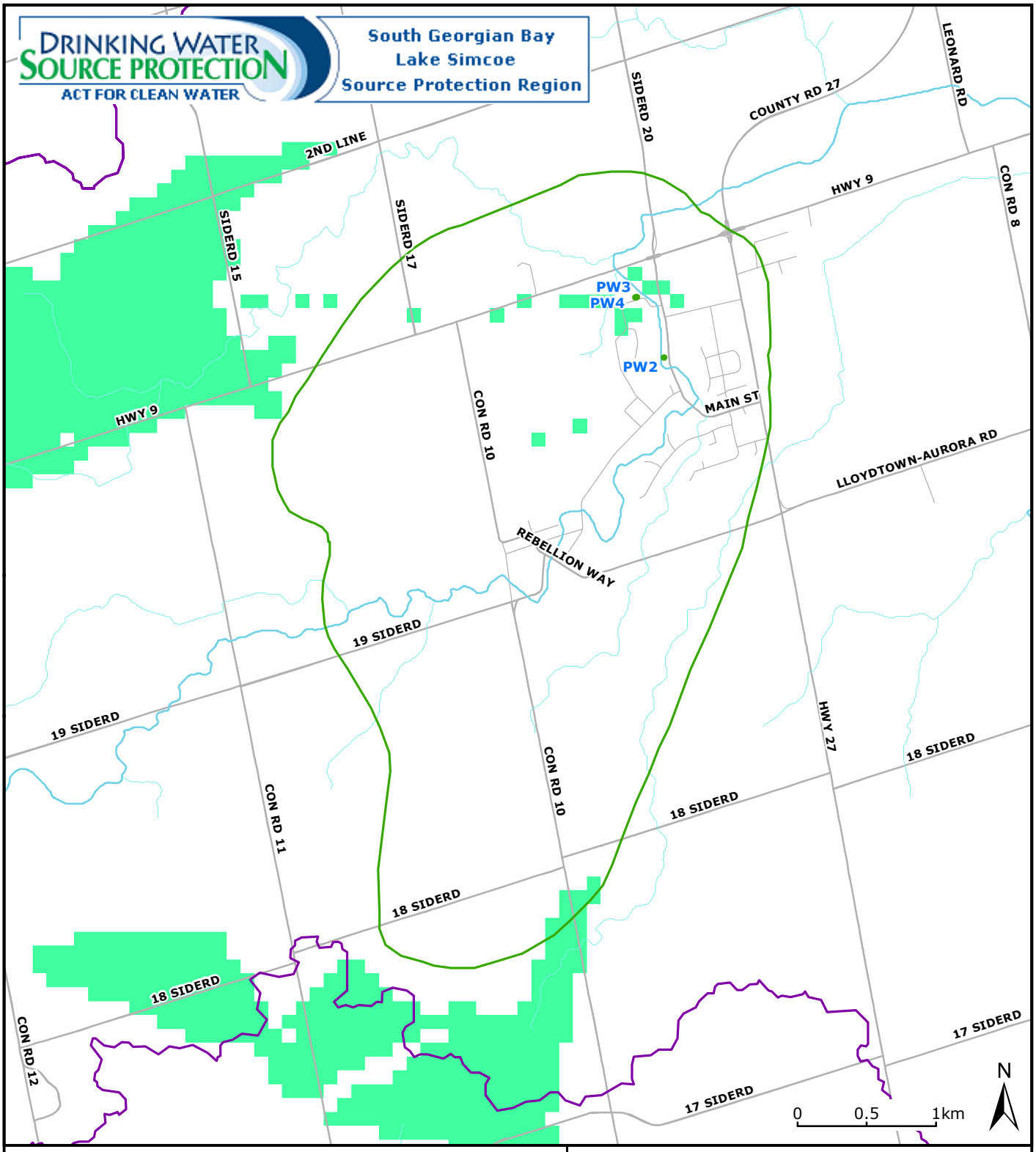
Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13f-1

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.



WWAT Ranking
- High
- Medium
- Low
- 25-Year Time-of-Travel
- SWP Watershed Area
- Water Body
- Main Water Course
- Roads

Groundwater Vulnerability - Schomberg

Created by: LSRCA
Date: 2010-08-03

Scale: 1:40,000
UTM Zone 17N, NAD83

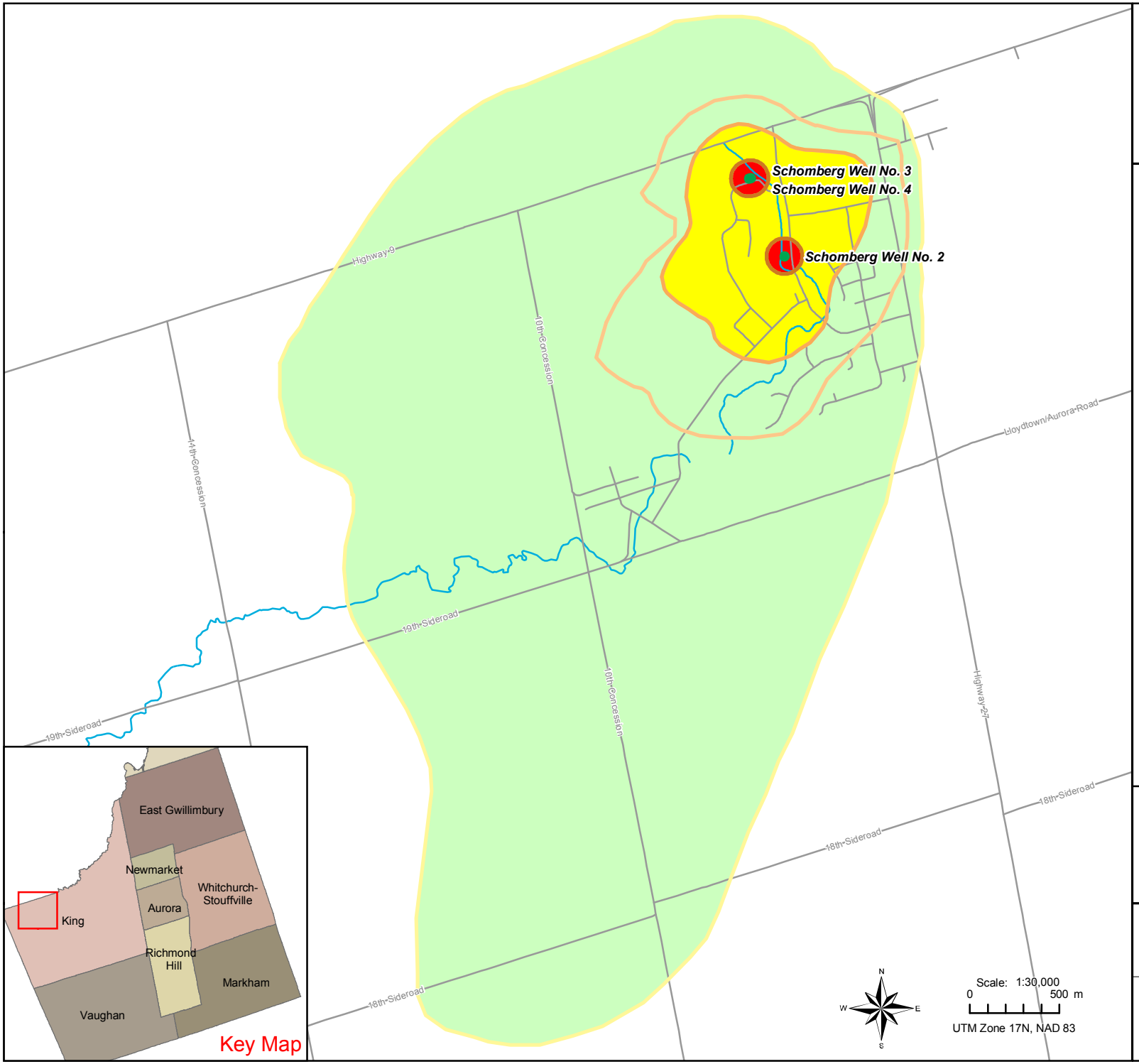
Earthfx Incorporated

Ontario

Figure 13f-2

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.

Vulnerability Score
Schomberg



- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Vulnerability Scoring

- 2 (Low)
- 4
- 6
- 8
- 10 (High)

NOTES

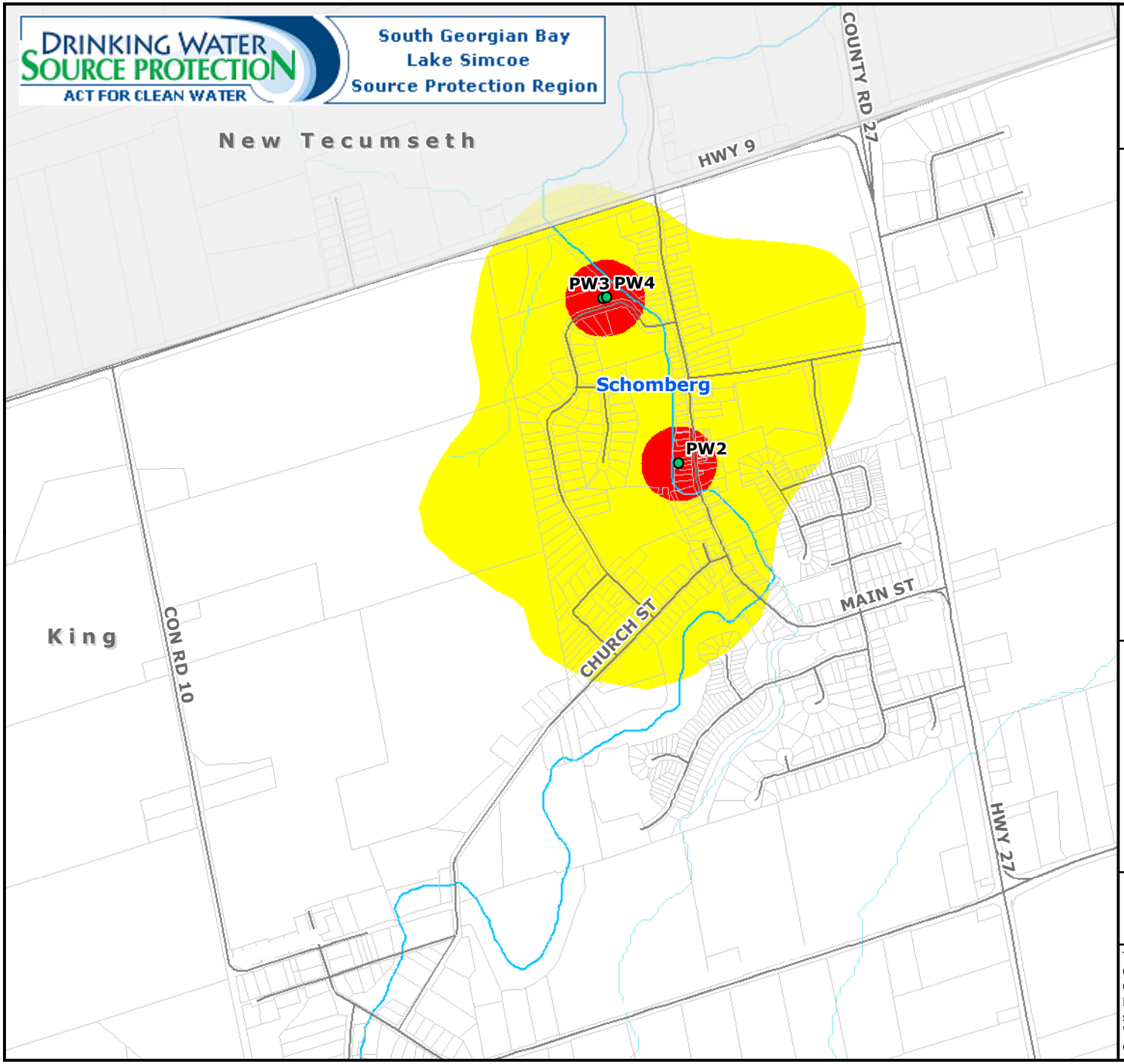
1. Vulnerability Scoring provided by Earthfx, 2007 and 2009.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13f-3



Areas of Significant, Moderate, or Low Threats - Pathogens

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-04

Scale: 1:15,000

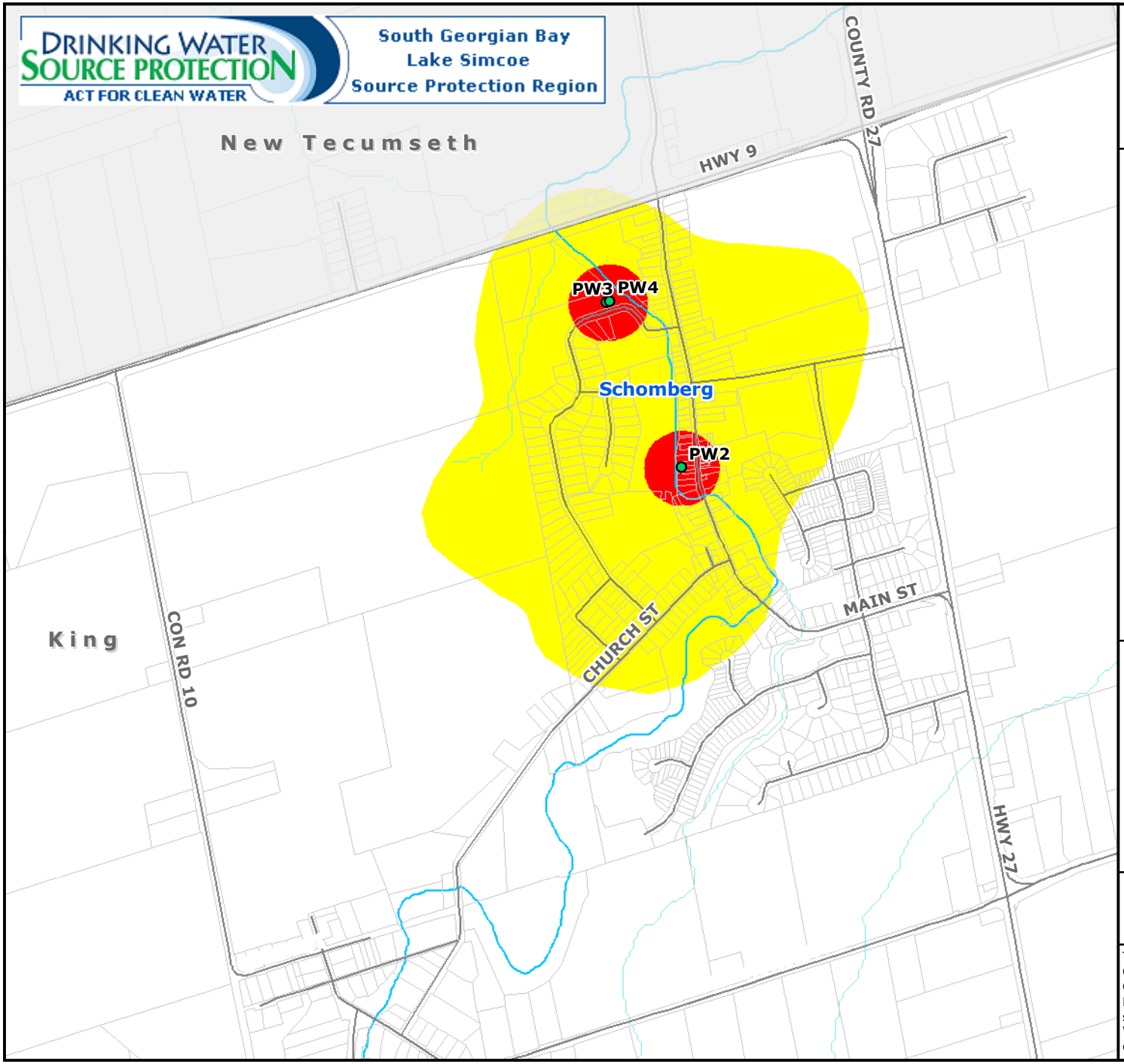
0 100 200 300m

UTM Zone 17N, NAD83

Ontario

Figure 13f-4

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.



Areas of Significant, Moderate, or Low Threats - Chemicals

Municipal Supply Wells

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-04

Scale: 1:15,000

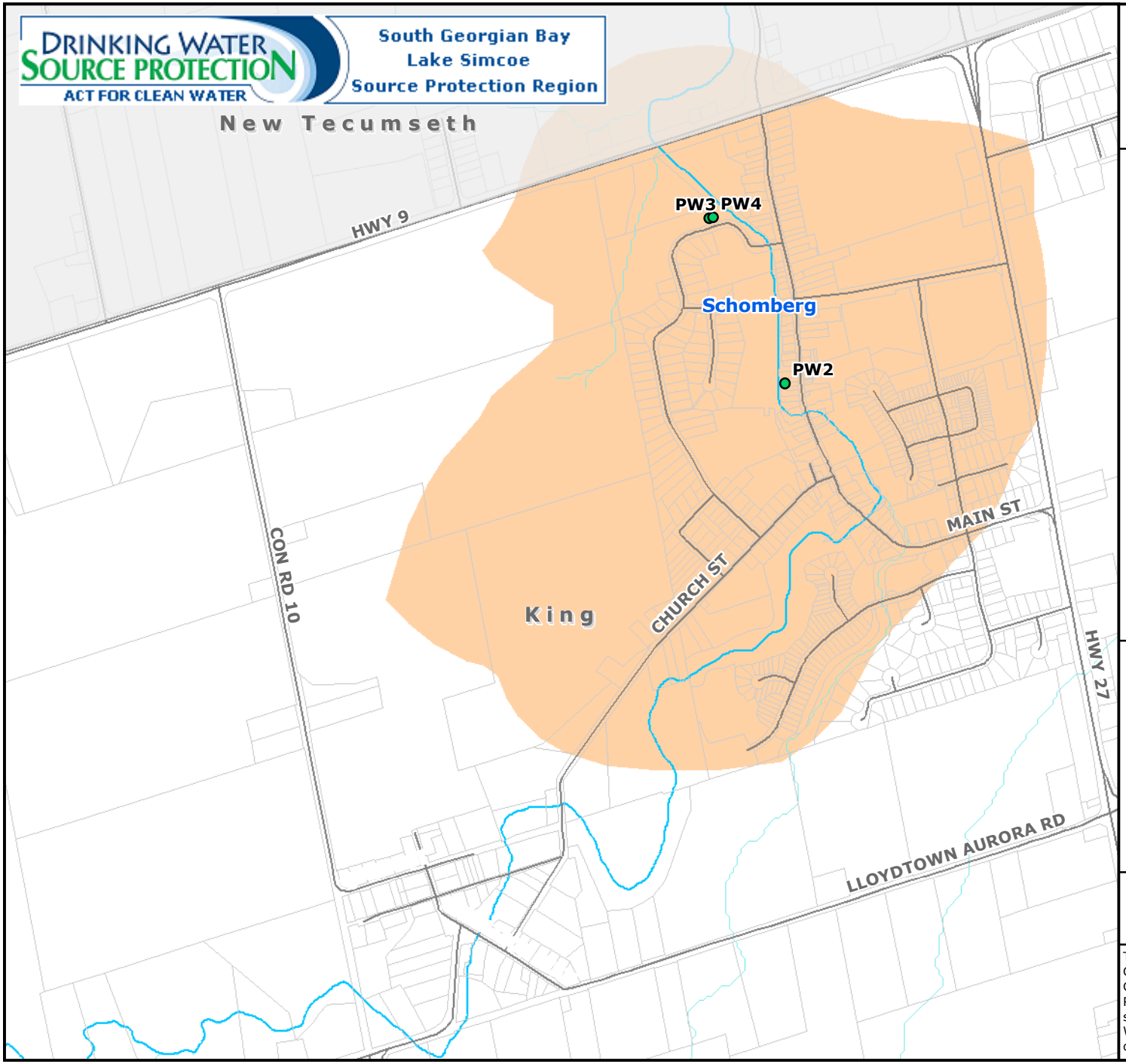
0 100 200 300m

UTM Zone 17N, NAD83

Ontario

Figure 13f-5

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.



Areas of Significant, Moderate, or Low Threats - DNAPLS

- Municipal Supply Wells
- WHPA-C: 5 year time-of-travel

Vulnerability Scoring

- 10
- 8
- 6

Created by: LSRCA
Date: 2010-10-04

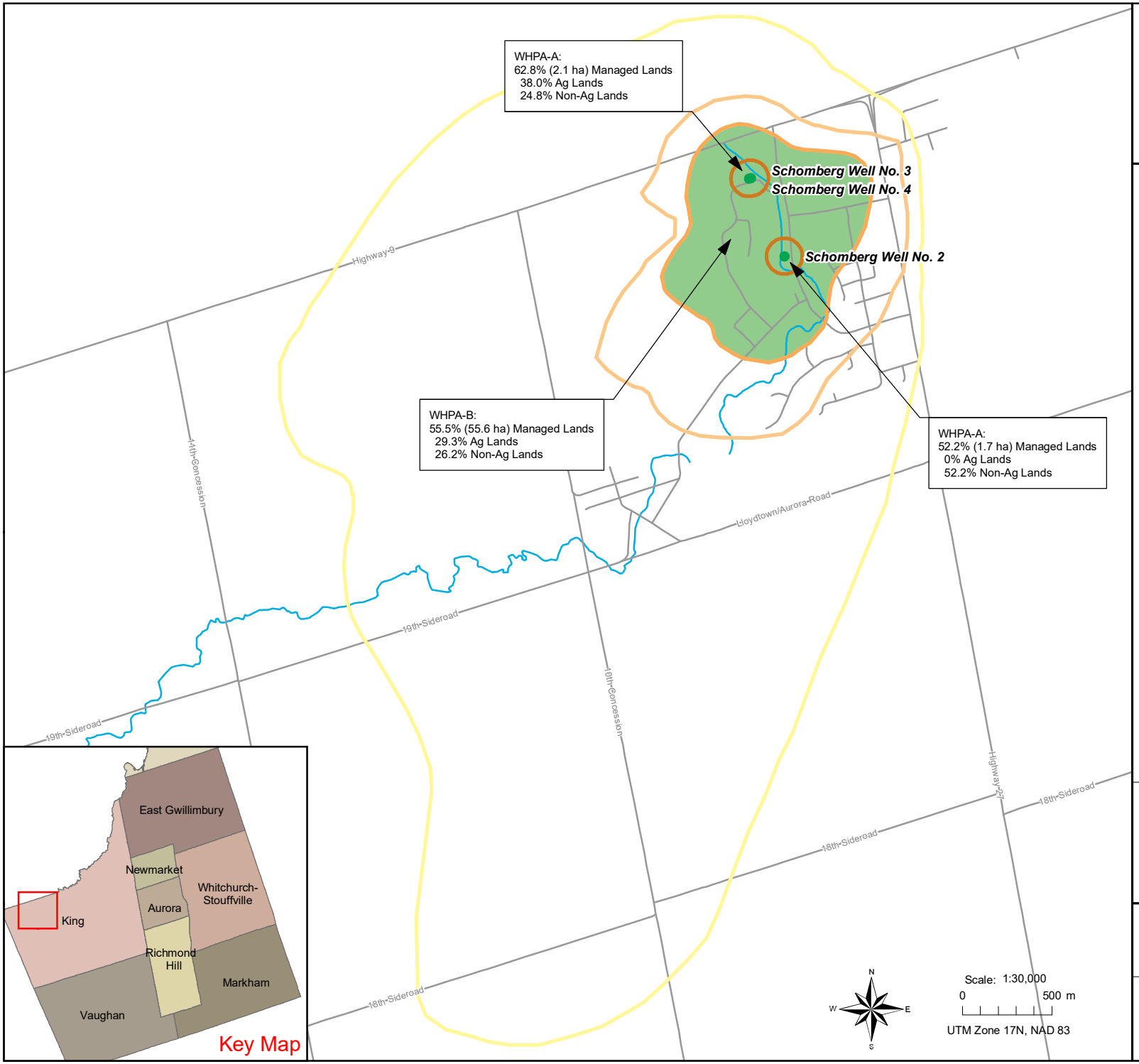
Scale: 1:15,000
0 100 200 300m
UTM Zone 17N, NAD83

Ontario

Figure 13f-6

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.

Managed Lands - Schomberg



- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Percent Total Managed Lands

- ≤ 40%
- > 40% - 80%
- ≥ 80%

NOTES

1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

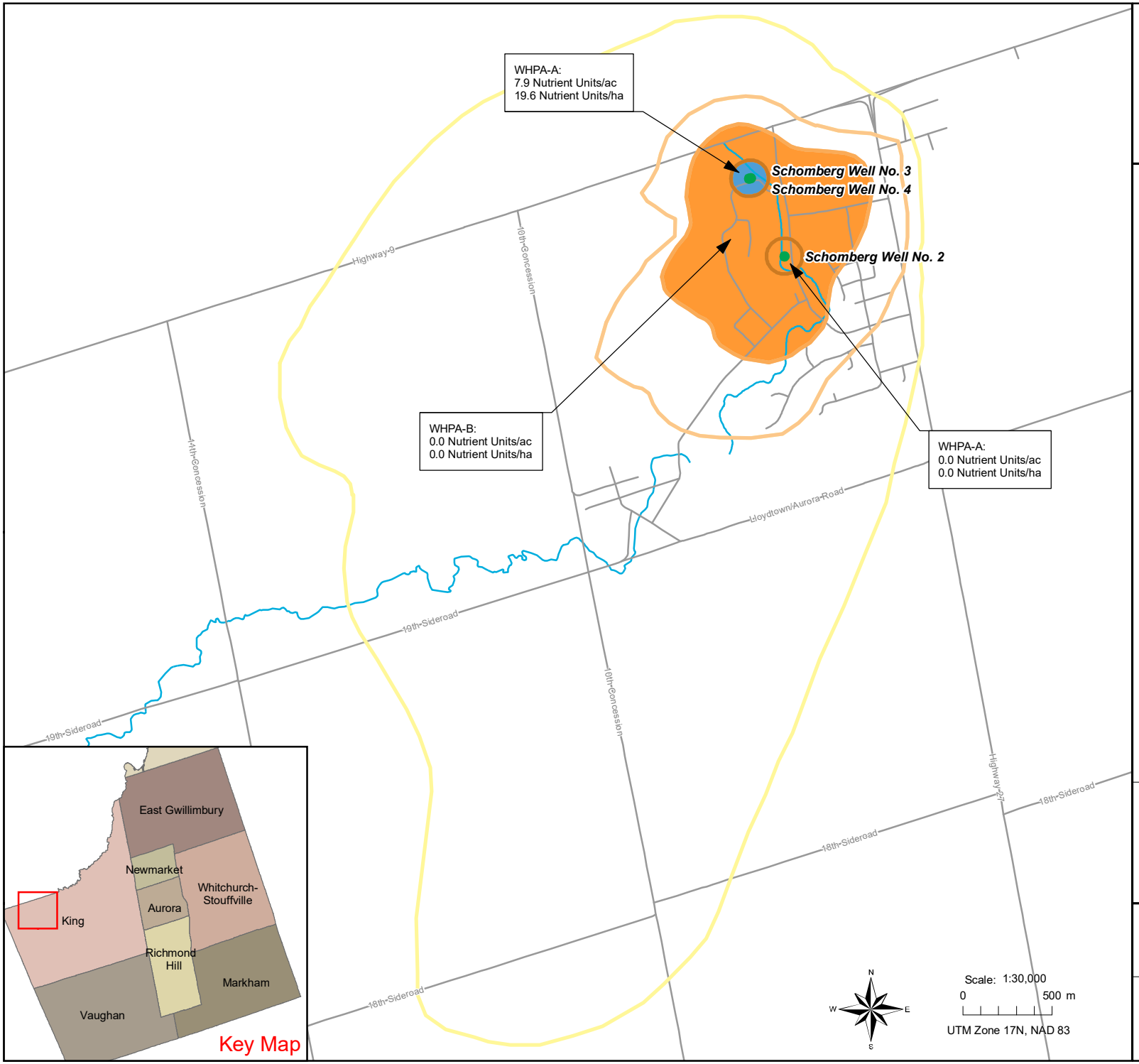
Stantec

Ontario

13f-7

This map was produced for York Region by Stantec for purposes of completing the Assessment Report under the Clean Water Act. 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.

Livestock Density - Schomberg



- Municipal Well Type 1
- Roads
- Watercourse

Wellhead Protection Areas

- WHPA-A
- WHPA-B
- WHPA-C
- WHPA-D

Nutrient Units / Acre

- ≤ 0.5
- >0.5 - 1.0
- ≥ 1.0

NOTES

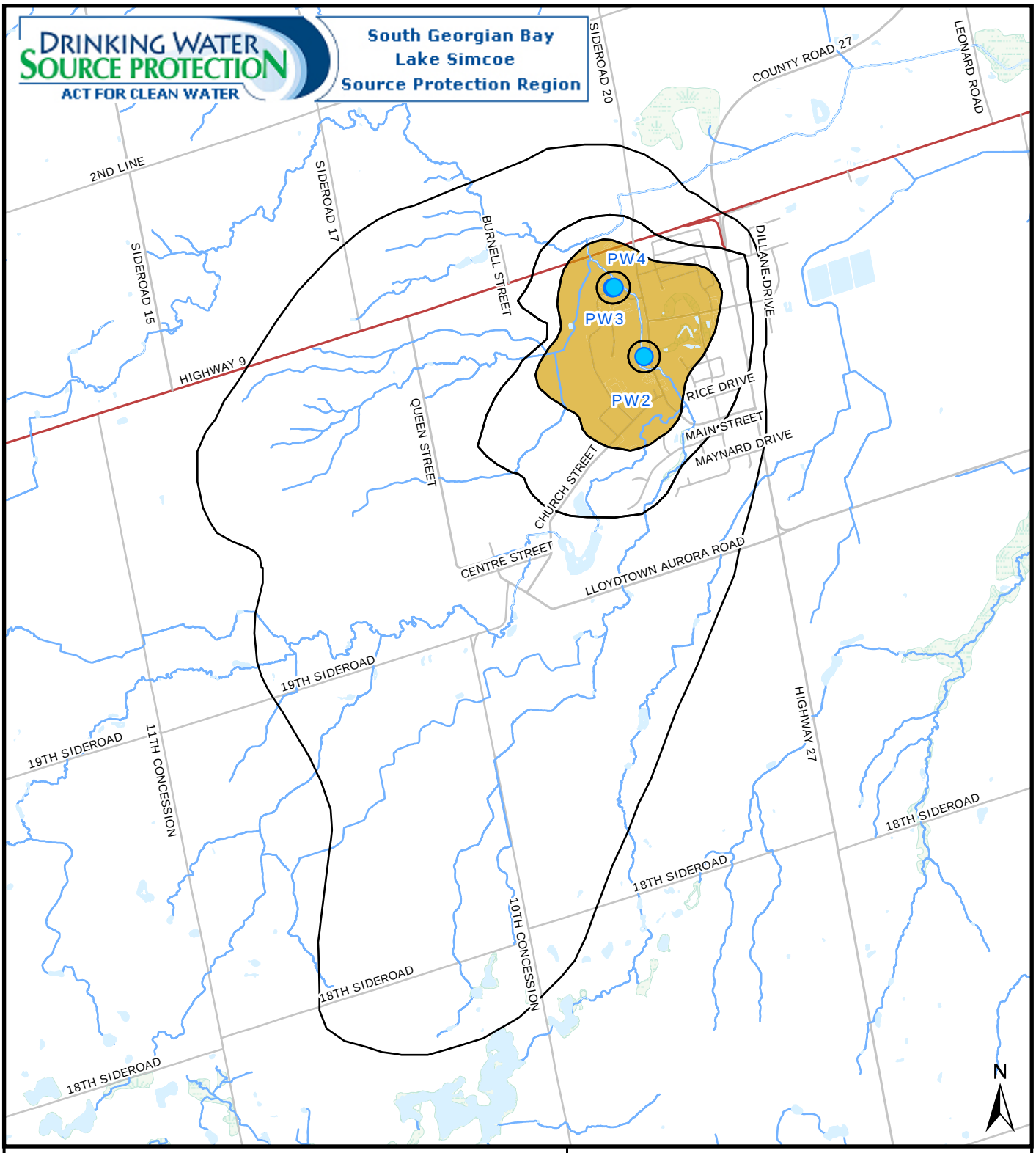
1. Please refer to Section 2.0 of the Assessment Report for summary of prescribed threat categories.

Created By: R. Freymond
S. Stroszka-Li
Project #: 122510019
Date: June 2010

Stantec

Ontario

13f-8



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Schomberg WHPA

Created by: LSRCA, 2025-08-05

Scale 1:35,000

0 300 600 1,200 m

UTM Zone 17N, NAD83

Ontario

Figure 13f-9

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

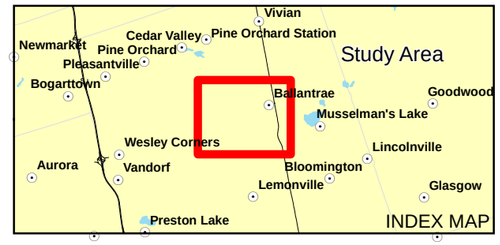
N

Well 1
Well 2
Well 3
Well 4
Ballantrae

CRANBORN CHASE
WOODLOT CRT
LOGGERS TRAIL
BALLANTRAE RD
GEORGE PIPHER LANE
ROBERT GRAY RD
GREENAN RD
GRAYFIELD DR
LEGENDARY TRAIL
LONG STAN
GEORGE
ARNIES CHANCE
PLAYER PL
MCMULLEN DR
PETTET RD
TRANMER RD
AURORA RD
ELLIOT ST
TAMARAC DR
JASMINE CRES
FELCHER BLVD
LAKESHORE RD
TREEVIEW AVE
BROOKDALE CRT
IROQUOIS DR
GREENVALLEY CIR
FORESTVIEW TRAIL
HERON TRAIL
MCCOWAN RD
SANDY LANE
HIGHWAY 48
JESSE THOMPSON RD
LOBRAICO LANE
KENNEDY RD
VANDORF SIDE RD

LEGEND

- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- WHPA-A (100 m)
- WHPA-B (2yr Time of Travel)
- WHPA-C (5yr Time of Travel)
- WHPA-C1 (10yr Time of Travel)
- WHPA-D (25yr Time of Travel)
- Waterbody
- Wetland



REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

PROJECT
REGIONAL MUNICIPALITY OF YORK

TITLE
BALLANTRAE WHPA DELINEATION

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	22 Jan. 2013	Figure 13g-1	
GIS	ME	22 Jan. 2013		
CHECK	GP	22 Jan. 2013		
REVIEW				

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure2_BallantraeWHPADelineation.mxd

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

N

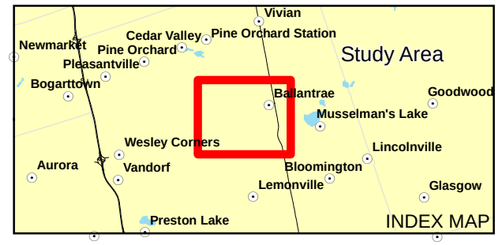
Well 3
Well 4
Well 2
Well 1
HIGHWAY 48

LEGEND

- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- Waterbody
- Wetland
- Wellhead Protection Area (WHPA)

WWAT Vulnerability

- Low (> 25 years)
- Medium (5-25 years)
- High (< 5 years)



REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

PROJECT
REGIONAL MUNICIPALITY OF YORK

TITLE
BALLANTRAE INITIAL AQUIFER VULNERABILITY

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	22 Jan. 2013	**Figure 13g-2**	
GIS	ME	22 Jan. 2013		
CHECK	GP	22 Jan. 2013		
REVIEW				

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure3_BallantraeWwatVulnerability.mxd

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

N

Well 3
Well 4
Ballantrae
Well 2
Well 1
HIGHWAY 48

LEGEND

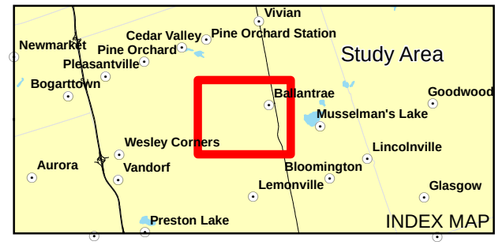
- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- Waterbody
- Wetland

Wellhead Protection Area (WHPA)

- WHPA-A (100 m)
- WHPA-B (2 Year Time of Travel)
- WHPA-C (5 Year Time of Travel)
- WHPA-D (25 year Time of Travel)

Intrinsic Vulnerability Scoring

- WHPA Vulnerability Scoring - 10 (high)
- WHPA Vulnerability Scoring - 8
- WHPA Vulnerability Scoring - 6
- WHPA Vulnerability Scoring - 4
- WHPA Vulnerability Scoring - 2 (low)



REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

PROJECT
REGIONAL MUNICIPALITY OF YORK

TITLE
BALLANTRAE VULNERABILITY SCORES

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	22 Jan. 2013	**Figure 13g-3**	
GIS	ME	22 Jan. 2013		
CHECK	GP	22 Jan. 2013		
REVIEW				

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure4_BallantraeIntrinsicVulnerabilityScoring.mxd

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

Well 1 I
Well 2 I
Well 3 I
Well 4

HIGHWAY 48

N

LEGEND

- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- Waterbody
- Wetland

Pathogens

Vulnerability Score	Provincial Table Number (Table Name) Significant	Moderate	Low
10 (red)	12 (PW10S)	13 (PW10M)	-
8 (orange)	-	14 (PW8M)	15 (PW8L)
6 (yellow)	-	-	16 (PW6L)

REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

PROJECT
REGIONAL MUNICIPALITY OF YORK

TITLE
BALLANTRAE AREAS FOR SIGNIFICANT, MODERATE AND LOW DRINKING WATER THREATS: PATHOGENS

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	16 Nov. 2012		
GIS	ME	6 Dec. 2012		
CHECK	GP	6 Dec. 2012		
REVIEW				

Figure 13g-4

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure9_Ballantrae_AreasForSignificantModerateAndLowDrinkingWaterThreats_Pathogens.mxd

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

Well 1
Well 2
Well 3
Well 4
HIGHWAY 48

N

LEGEND

- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- Waterbody
- Wetland

Chemicals

Vulnerability Score	Provincial Table Number (Table Name)		
	Significant	Moderate	Low
10 (red)	1 (CW10S)	3 (CW10M)	6 (CW10L)
8 (orange)	2 (CW8S)	4 (CW8M)	7 (CW8L)
6 (yellow)	-	5 (CW6M)	8 (CW6L)

REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

PROJECT
REGIONAL MUNICIPALITY OF YORK

TITLE
BALLANTRAE AREAS FOR SIGNIFICANT, MODERATE AND LOW DRINKING WATER THREATS: CHEMICALS

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	16 Nov. 2012		
GIS	ME	6 Dec. 2012		
CHECK	GP	6 Dec. 2012		
REVIEW				

Figure 13g-5

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure8_Ballantrae_AreasForSignificantModerateAndLowDrinkingWaterThreats_Chemicals.mxd

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

N

Well 3
Well 4
Well 2
Well 1

HIGHWAY 48

LEGEND

- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- Waterbody
- Wetland

Vulnerability Score	DNAPLs Provincial Table Number (Table Name) Significant	Moderate	Low
WHPA A, B, C (<5 year TOT) (beige)	9 (DWAS)	-	-
6 (within WHPA D) (yellow)	-	10 (DW6M)	11 (DW6L)

REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

PROJECT
REGIONAL MUNICIPALITY OF YORK

TITLE
BALLANTRAE AREAS FOR SIGNIFICANT, MODERATE AND LOW DRINKING WATER THREATS: DNAPLS

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	16 Nov. 2012	Figure 13g-6	
GIS	ME	6 Dec. 2012		
CHECK	GP	6 Dec. 2012		
REVIEW				

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure10_Ballantrae_AreasForSignificantModerateAndLowDrinkingWaterThreats_DNAPLS.mxd

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

WHPA-B:
56.9% (20.83 ha) Managed Lands
1.3% Ag Lands
55.6% Non-Ag Lands

WHPA-C:
58.4% (22.98 ha) Managed Lands
2.4% Ag Lands
56.0% Non-Ag Lands

WHPA-C:
12.9% (10.28 ha) Managed Lands
5.4% Ag Lands
7.5% Non-Ag Lands

WHPA-A:
41.9% (1.31 ha) Managed Lands
0.0% Ag Lands
41.9% Non-Ag Lands

WHPA-A:
17.3% (0.62 ha) Managed Lands
0.2% Ag Lands
17.1% Non-Ag Lands

WHPA-B:
13.3% (7.70 ha) Managed Lands
4.7% Ag Lands
8.6% Non-Ag Lands

Well 1
Well 2
Well 3
Well 4

HIGHWAY 48

N

LEGEND

- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- Waterbody
- Wetland

Wellhead Protection Area (WHPA)

- WHPA-A (100 m)
- WHPA-B (2 Year Time of Travel)
- WHPA-C (5 Year Time of Travel)
- WHPA-D (25 year Time of Travel)

Percent Total Managed Land

- ≤ 40%
- > 40% - < 80%
- ≥ 80%

REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region

PROJECT
REGIONAL MUNICIPALITY OF YORK

TITLE
BALLANTRAE MANAGED LANDS

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067		SCALE AS SHOWN	REV. 0.0
DESIGN	ME	16 Nov. 2012	
GIS	ME	16 Nov. 2012	
CHECK	GP	16 Nov. 2012	
REVIEW			

Figure 13g-7

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure5_Ballantrae_ManagedLand.mxd

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay Lake Simcoe Source Protection Region

633000 634000 635000 636000 637000

4878000 4877000 4876000 4875000

Well 1
Well 2
Well 3
Well 4

HIGHWAY 48

N

LEGEND

- Municipal Well Type I
- Watercourse
- Watercourse, Intermittent
- Waterbody
- Wetland

Wellhead Protection Area (WHPA)

- WHPA-A (100 m)
- WHPA-B (2 Year Time of Travel)
- WHPA-C (5 Year Time of Travel)
- WHPA-D (25 year Time of Travel)

Nutrient Units/Acre

- ≤ 0.5
- > 0.5 - < 1.0
- ≥ 1.0

REFERENCE

Base Data - MNR LIO, obtained 2009
Produced by Golder Associates Ltd under licence from
Ontario Ministry of Natural Resources, © Queens Printer 2012
Projection: Transverse Mercator Datum: NAD83 Coordinate System: UTM Zone 17

300 150 0 300 600 900
SCALE 1:15,000 METRES

PROJECT
REGIONAL MUNICIPALITY OF YORK

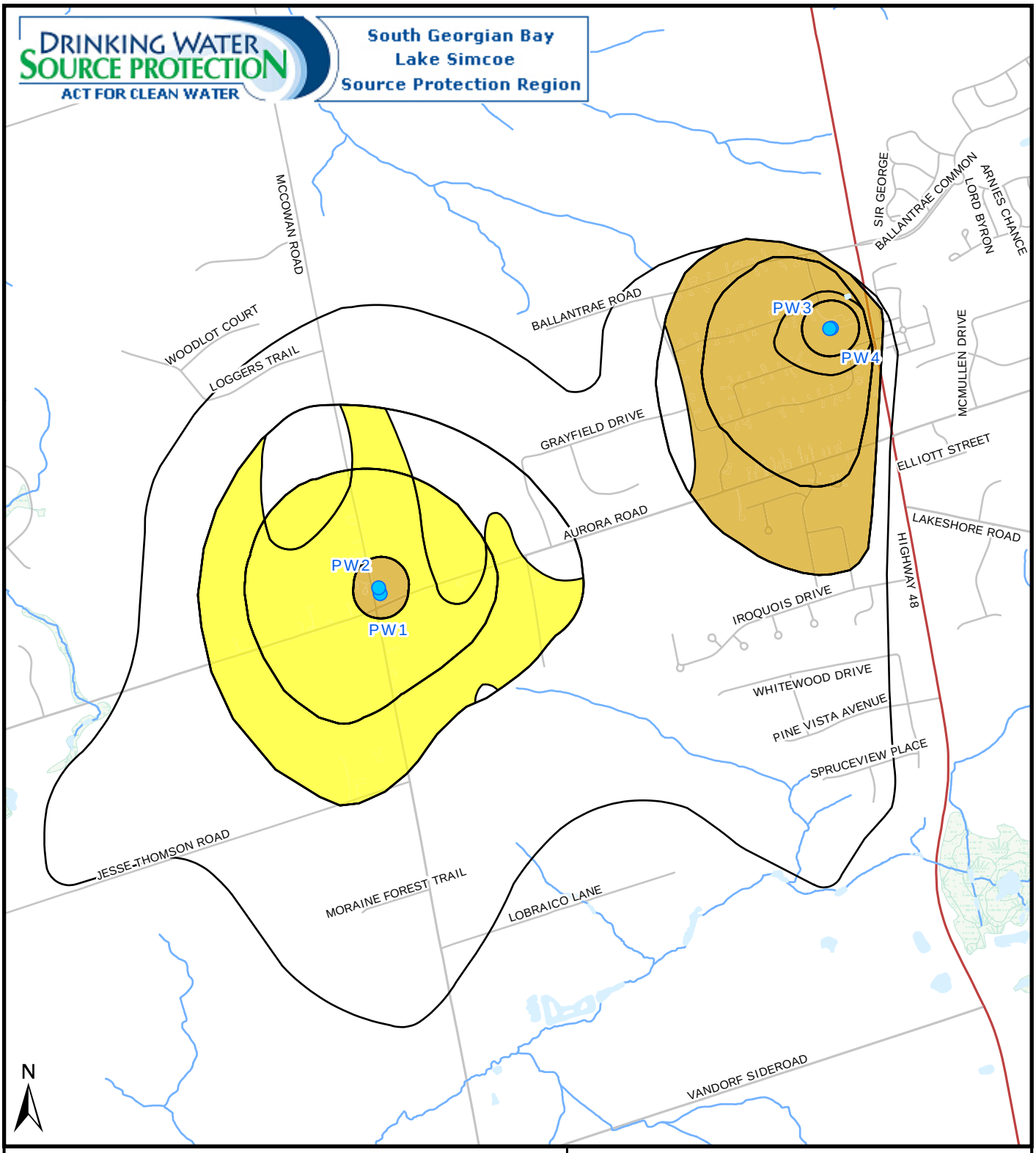
TITLE
BALLANTRAE LIVESTOCK DENSITY

Golder Associates
Mississauga, Ontario

PROJECT NO. 11-1170-0067			SCALE AS SHOWN	REV. 0.0
DESIGN	ME	16 Nov. 2012		
GIS	ME	16 Nov. 2012		
CHECK	GP	16 Nov. 2012		
REVIEW				

Figure 13g-8

G:\Projects\2011\11-1170-0067_Ballantrae\GIS\MXDs\Reporting\Final\Figure6_Ballantrae_LivestockDensity.mxd



Well

Impervious Surfaces in WHPA

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

Impervious Surfaces - Ballantrae WHPA

Created by: LSRCA, 2025-08-05

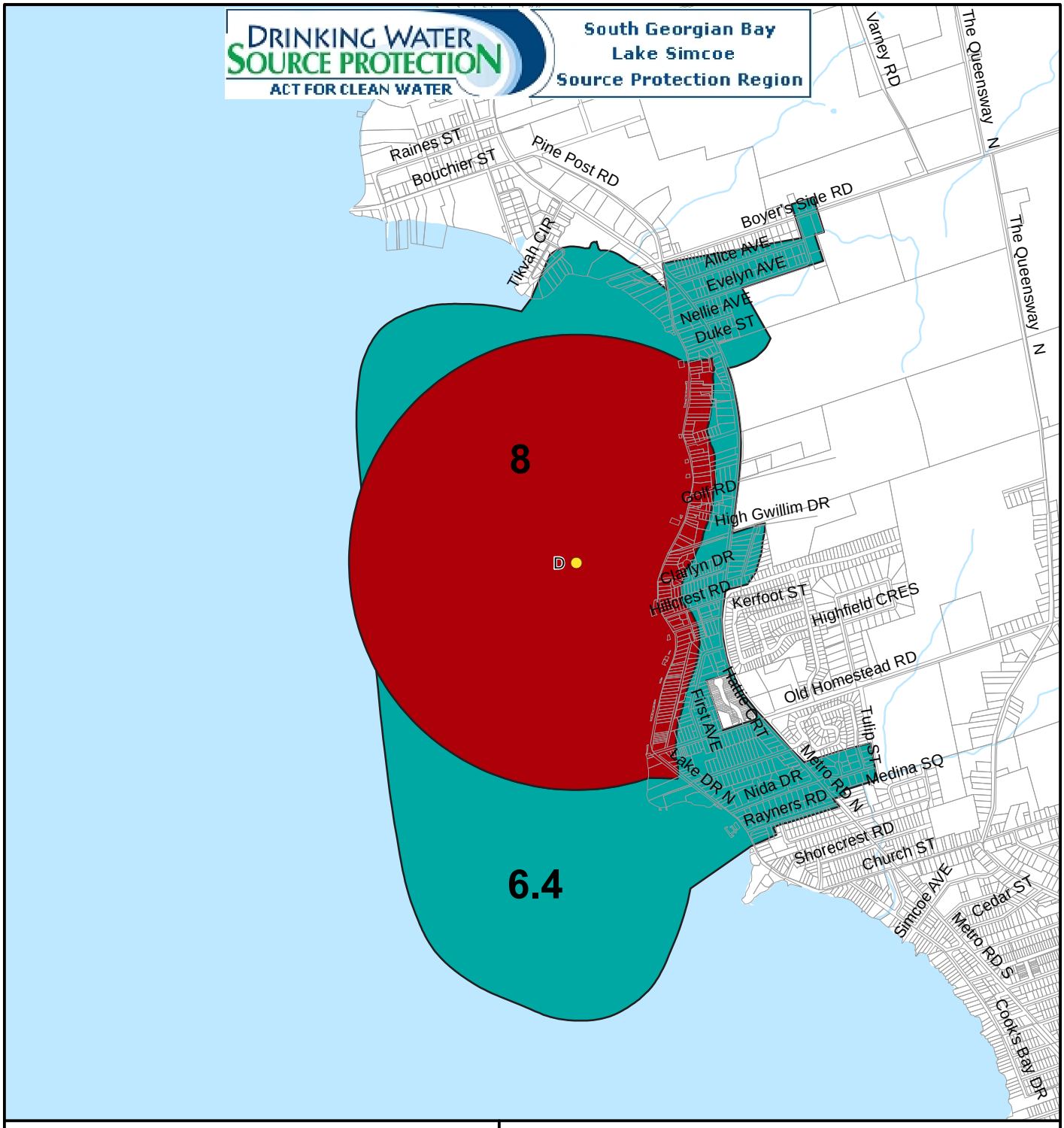
Scale 1:20,000

0 175 350 700 m

UTM Zone 17N, NAD83

Ontario

Figure 13g-9



Legend

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

INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - KESWICK WTP, YORK REGION

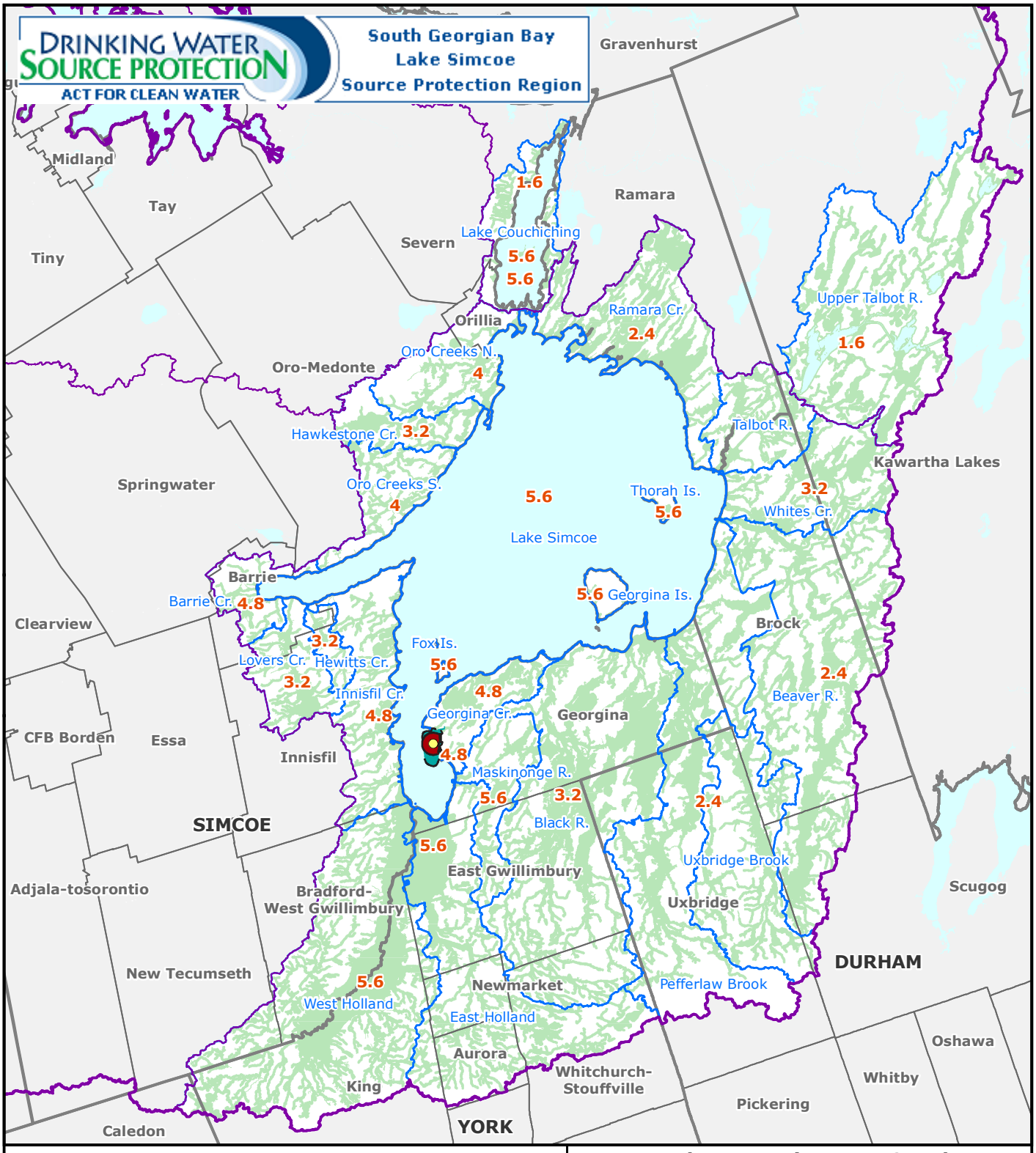
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

DATE: JUNE 2010	SCALE: 1:25000
PROJECT: 0-071948.12	FILE. NO.:0-07194812F8.1-1

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

GENIVAR Ontario

FIGURE 13h-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
Keswick, York Region

Created by: LSRCA
Date: 2010-10-20

GENIVAR

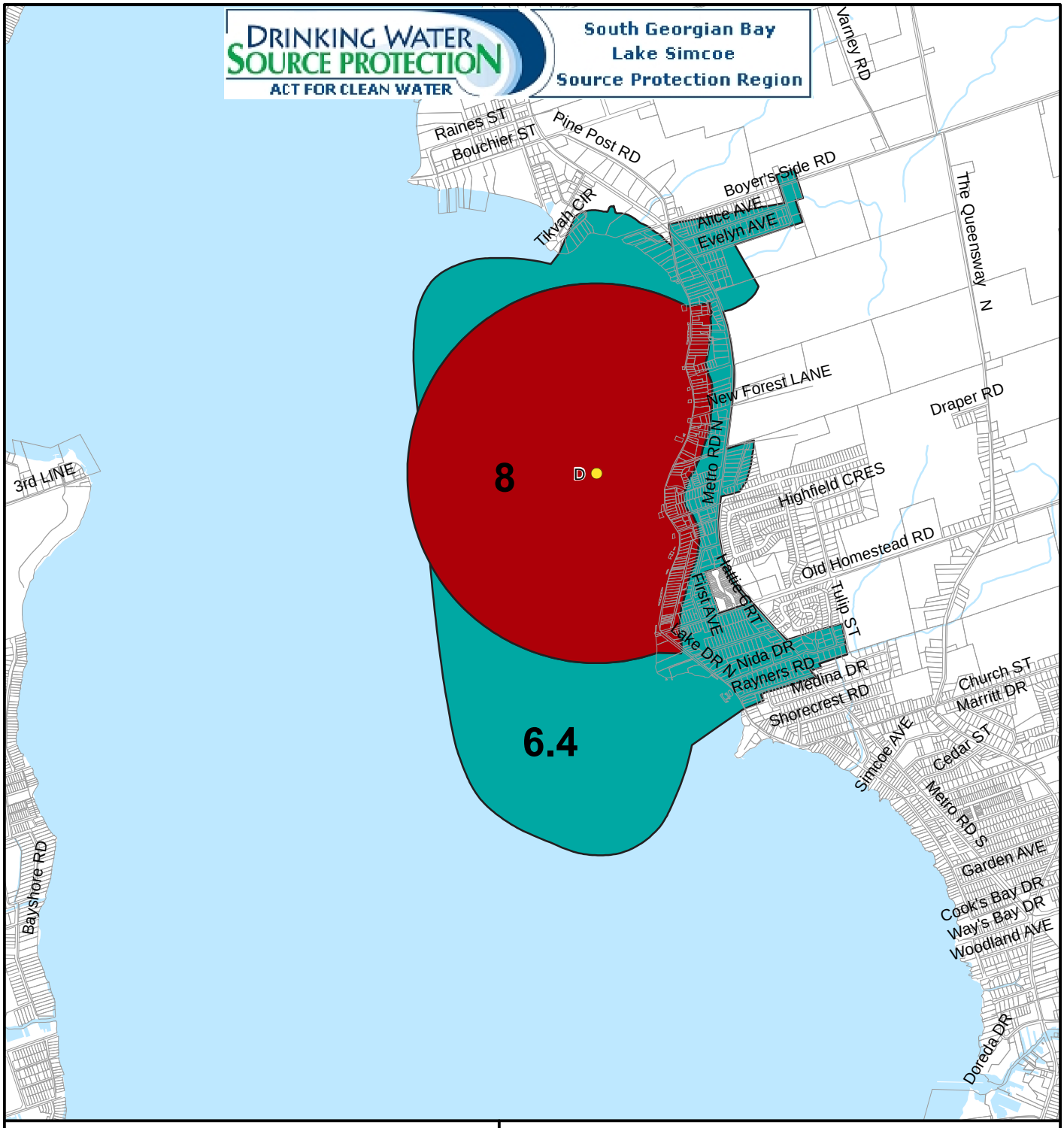
Scale: 1:500,000 0 2 4 6 8 10km

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 13h-2



Legend

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

N W E S

400 200 0 400 Metres

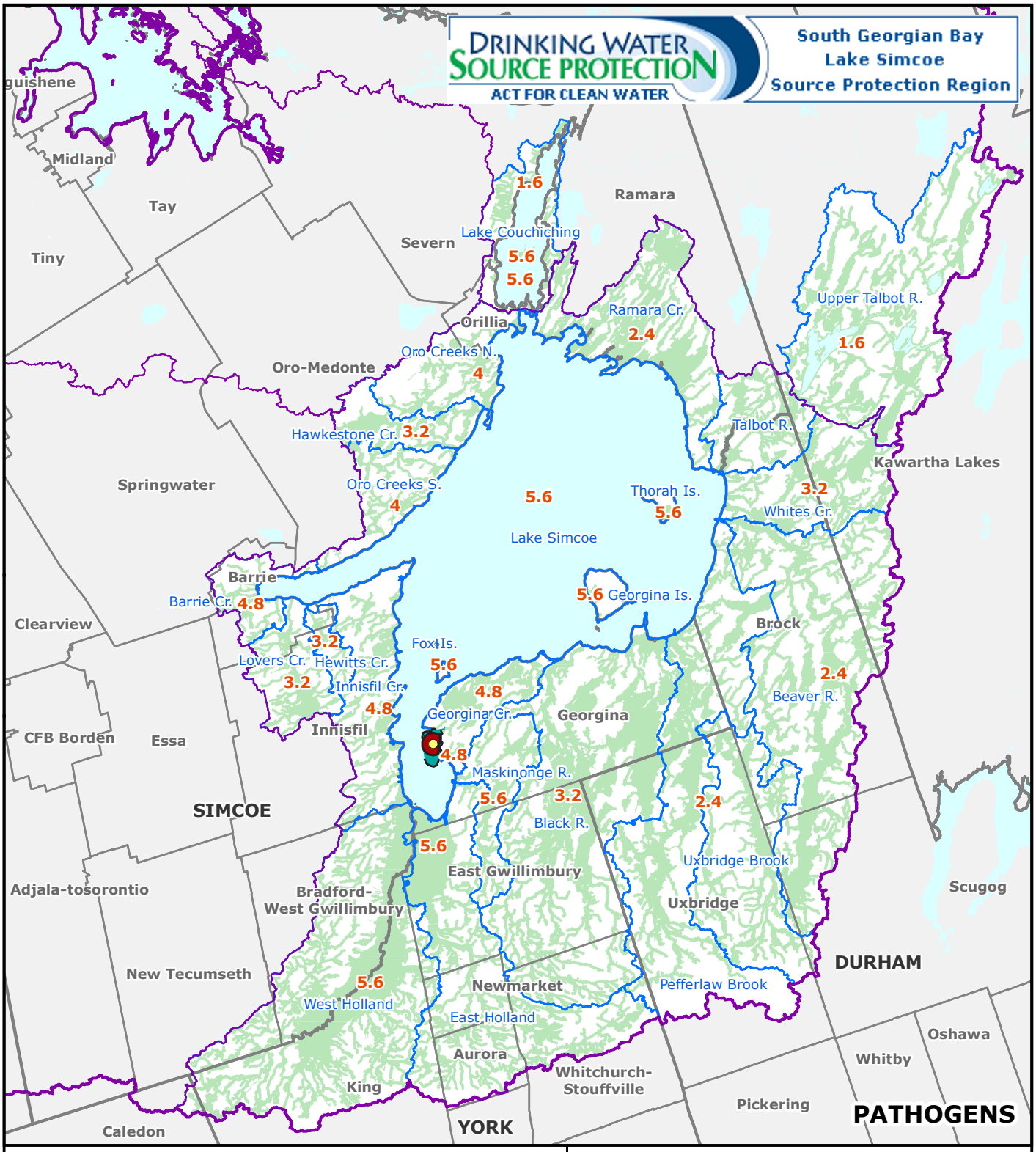
AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - KESWICK WTP

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: 1:30000
PROJECT: 0-071948.12	FILE. NO.:0-07194812F8.1-2

GENIVAR Ontario

FIGURE 13h-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
Keswick, York Region

Created by: LSRCA
Date: 2010-10-20

GENIVAR

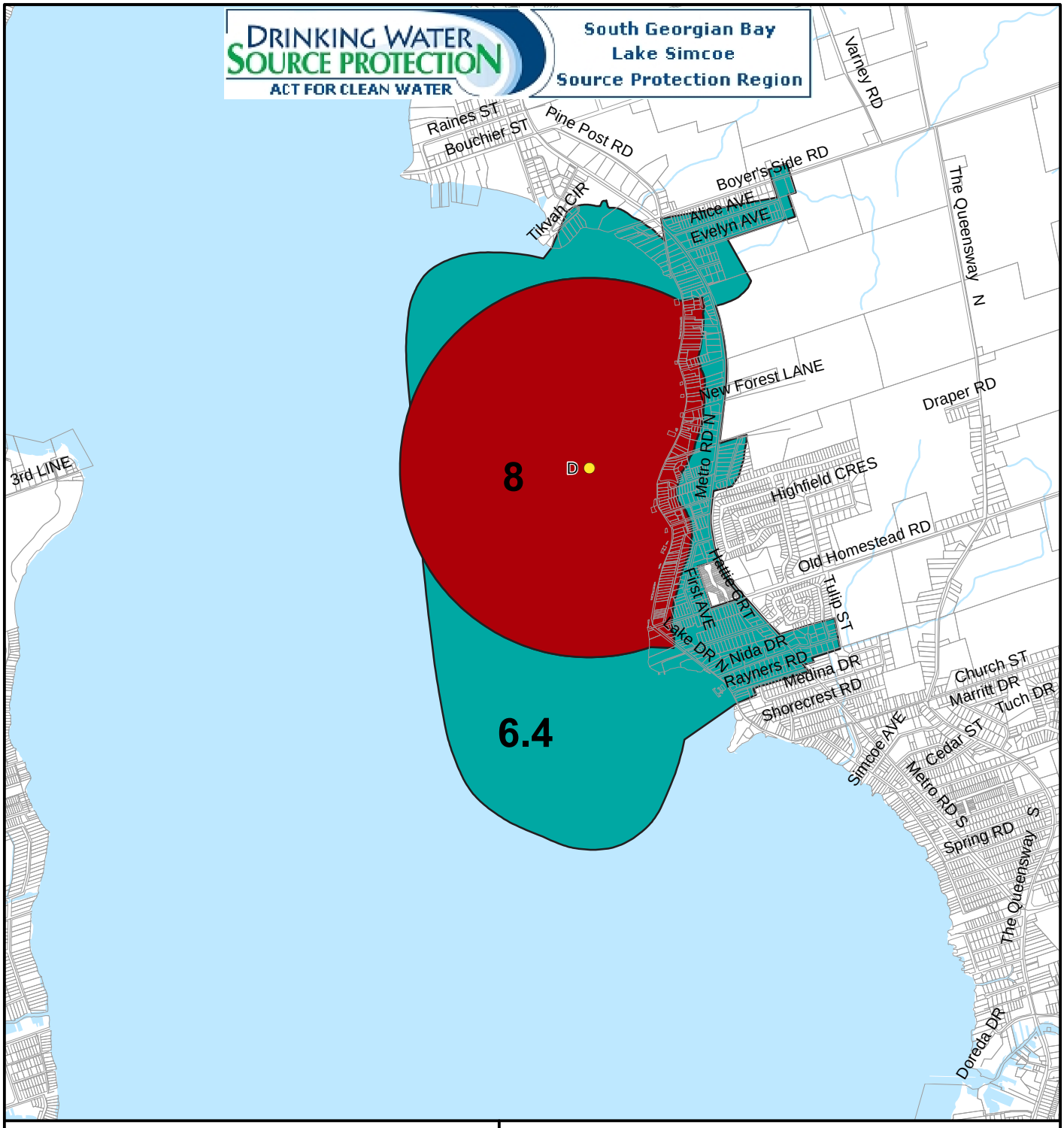
Scale: 1:500,000 0 2 4 6 8 10km

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 13h-4



Legend

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

N / W / E / S

400 200 0 400 Metres

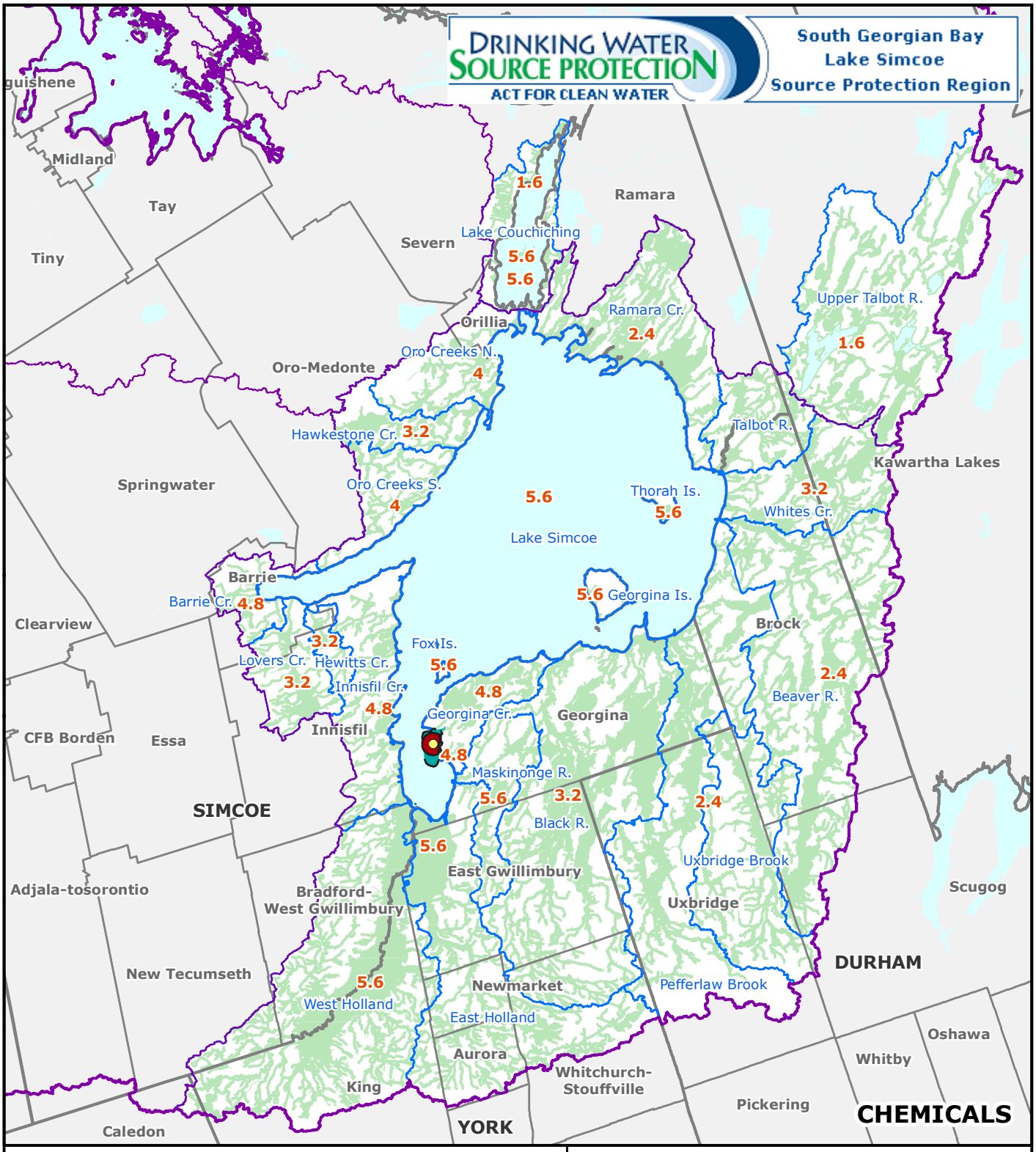
AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - KESWICK WTP

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: 1:30000
PROJECT: 0-071948.12	FILE. NO.:0-07194812F8.1-3

GENIVAR Ontario

FIGURE 13h-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
Keswick, York Region

Created by: LSRCA
Date: 2010-10-20

GENIVAR

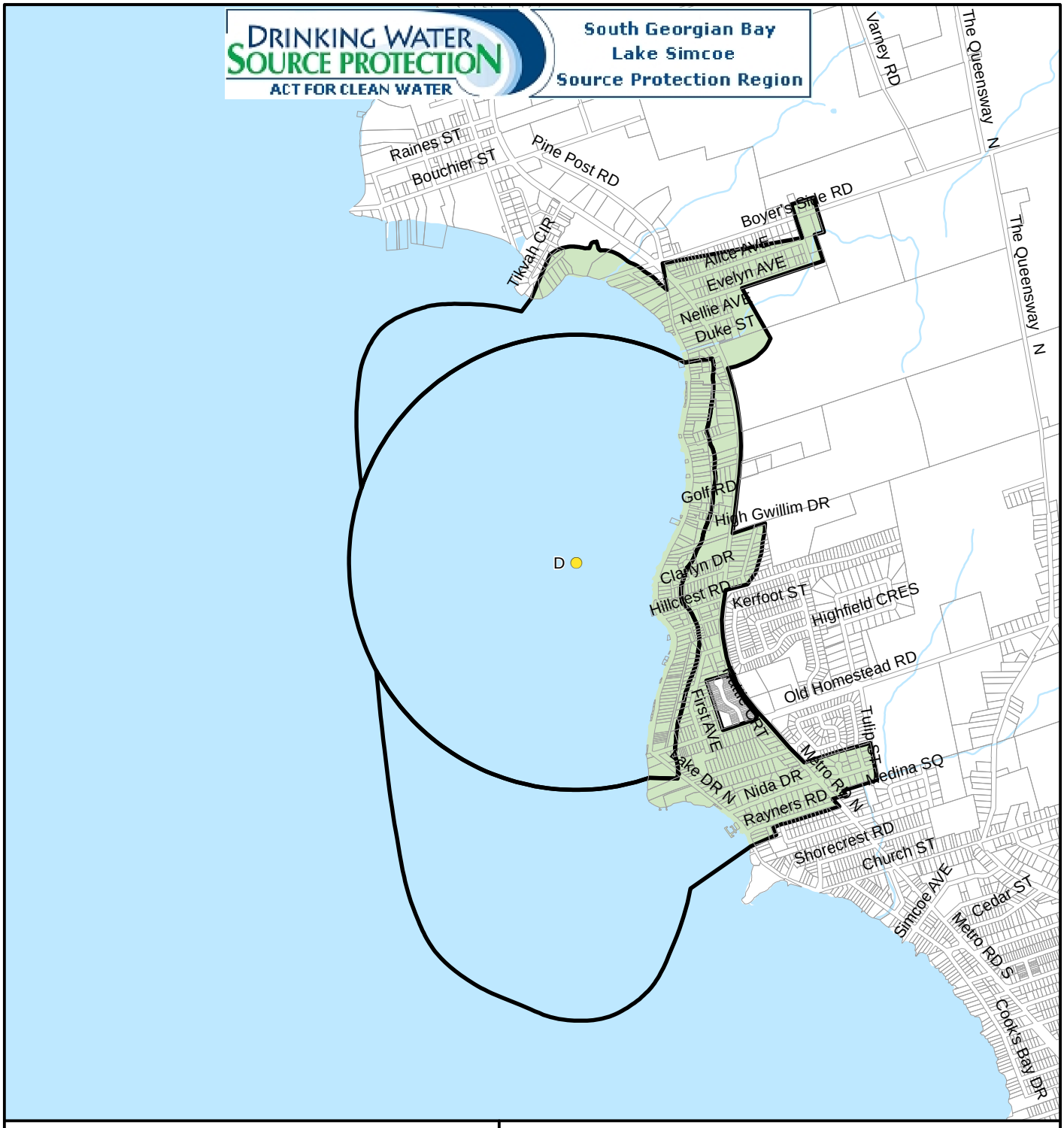
Scale: 1:500,000 0 2 4 6 8 10km

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 13h-6



Legend

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

N W E S

310 155 0 310 Metres

MANAGED LANDS - KESWICK WTP

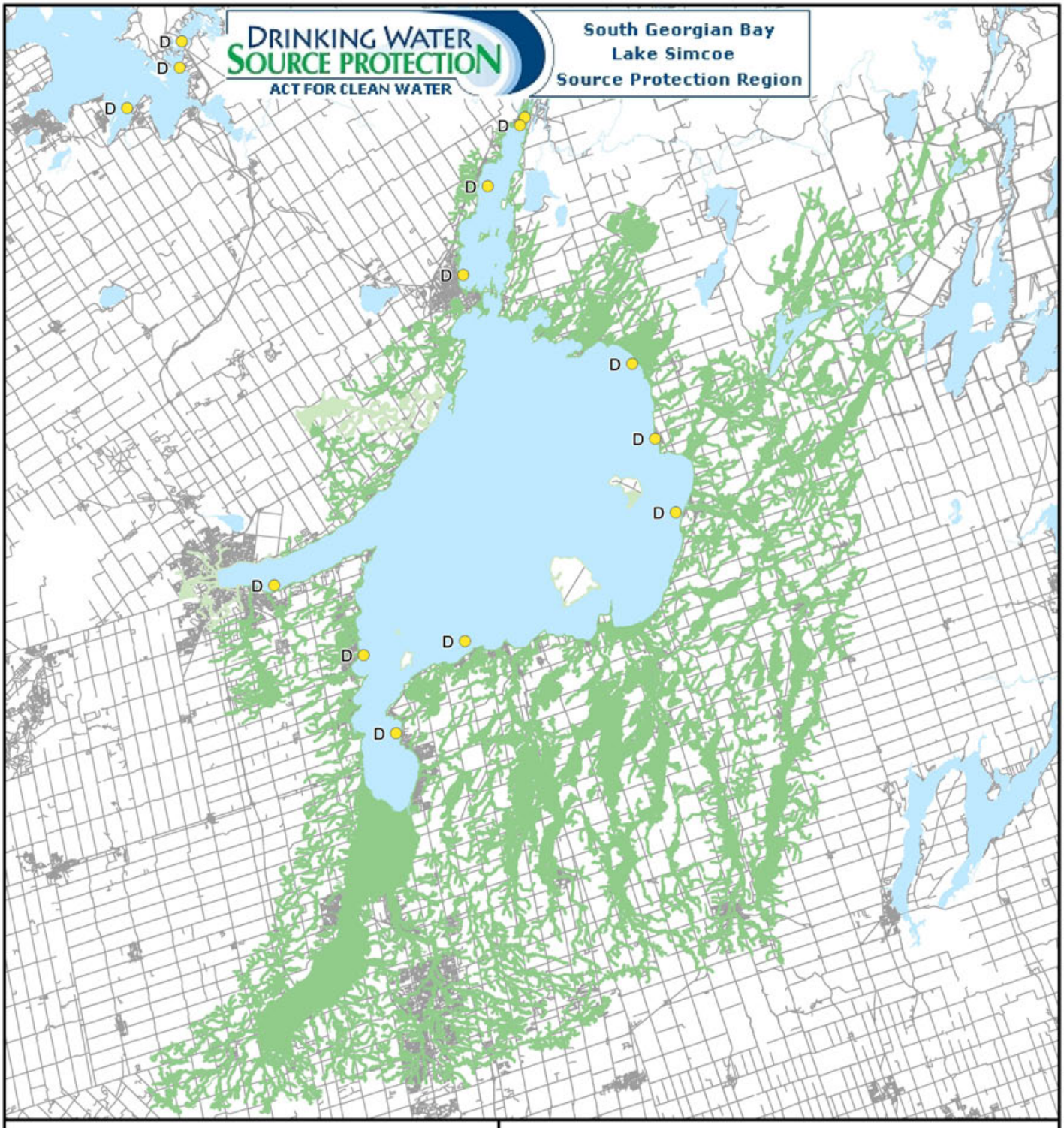
The Managed Land proportion proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010 | SCALE: 1:25000

PROJECT: 0-071948.12 | FILE. NO.:0-07194812F8.1-4

GENIVAR Ontario

FIGURE 13h-7



Legend

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

N W E S

5,300 2,650 0 5,300 Metres

MANAGED LANDS - INTAKE PROTECTION ZONE 3

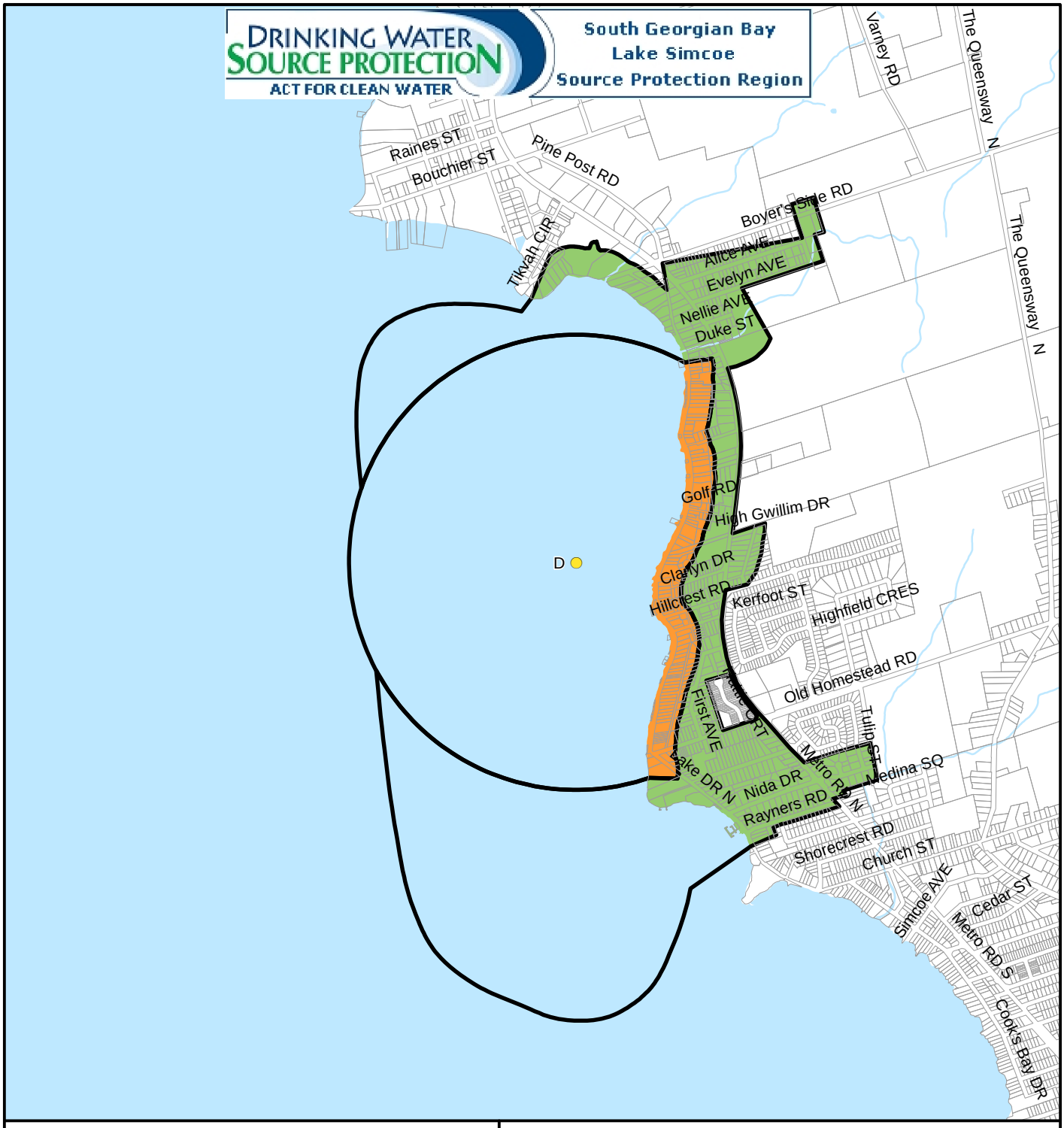
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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

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

GENIVAR Ontario

FIGURE 13h-8



Legend

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

N W E S

310 155 0 310 Metres

LIVESTOCK DENSITY - KESWICK WTP

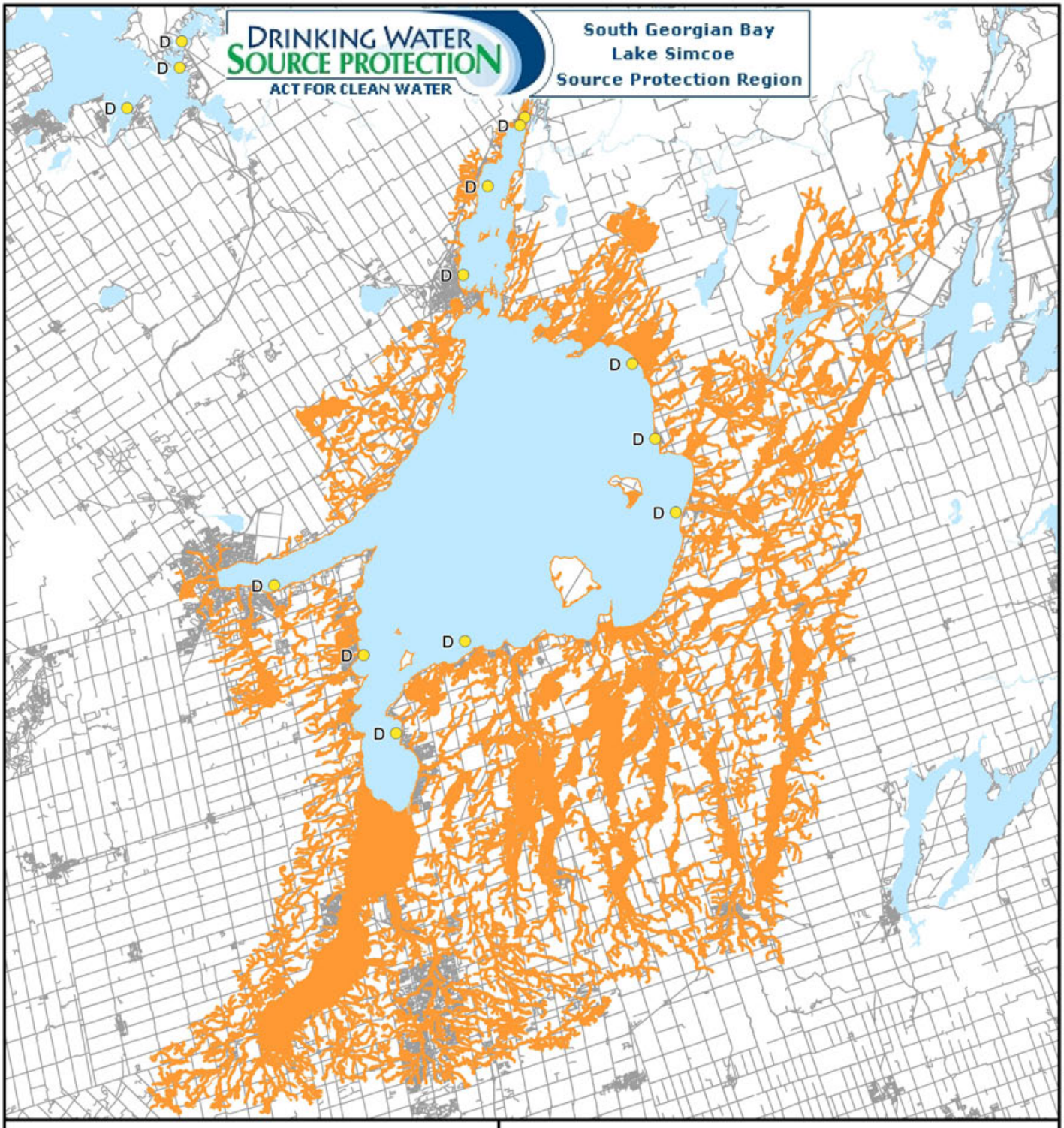
The Livestock Density proportion is illustrated for the parts of IPZ 1 and 2 where the vulnerability score is greater than 4.1.

DATE: JUNE 2010 | SCALE: 1:25000

PROJECT: 0-071948.12 | FILE. NO.:0-07194812F8.1-5

GENIVAR Ontario

FIGURE 13h-9



Legend

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

N W E S

5,300 2,650 0 5,300 Metres

LIVESTOCK DENSITY - INTAKE PROTECTION ZONE 3

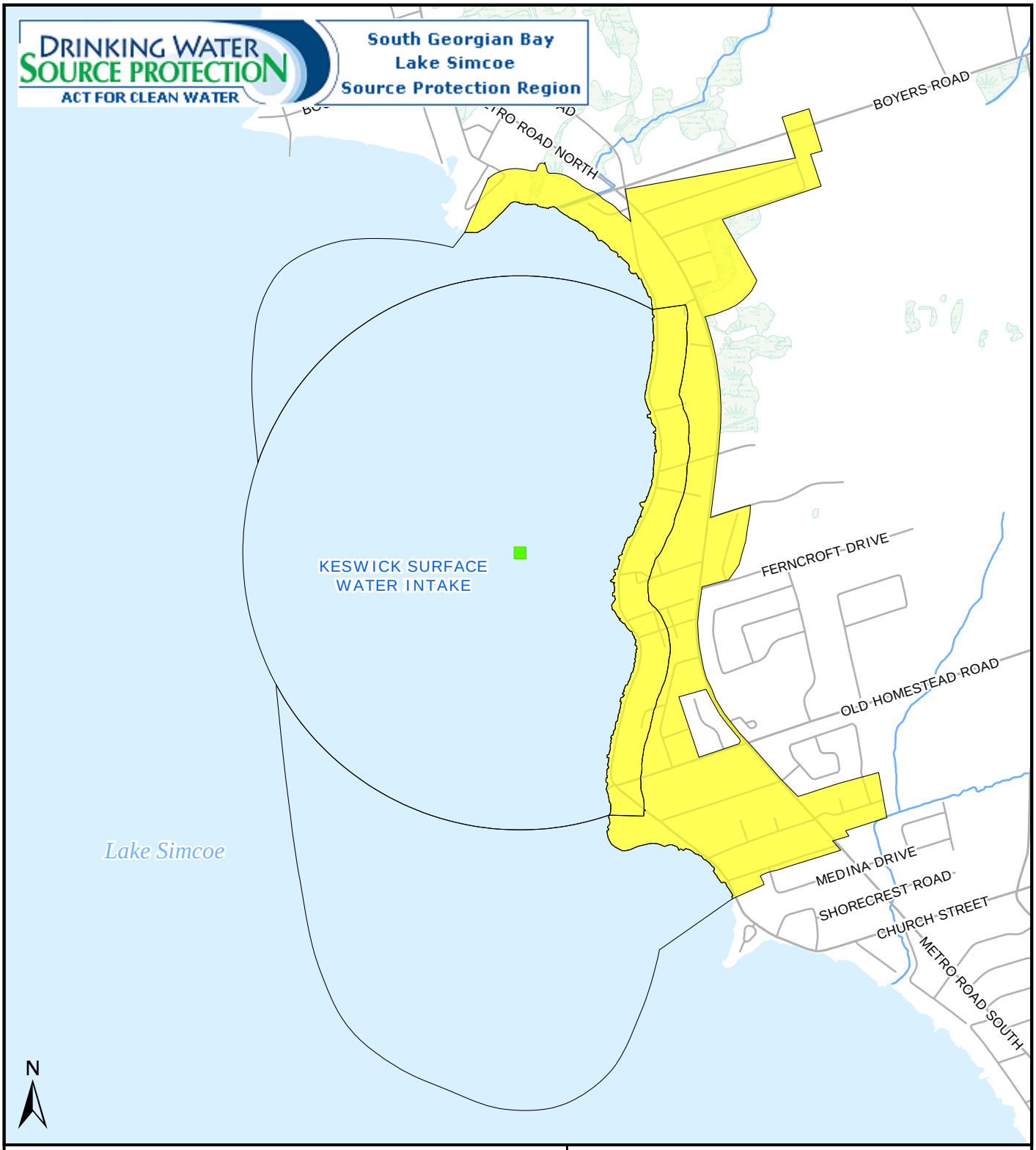
ASSESSMENT OF DRINKING WATER THREATS
SELECTED MUNICIPAL GROUNDWATER SUPPLIES
South Georgian Bay Lake Simcoe
Source Protection Region

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

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

GENIVAR Ontario

FIGURE 13h-10



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

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

Impervious Surfaces - Keswick Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

Scale 1:20,000

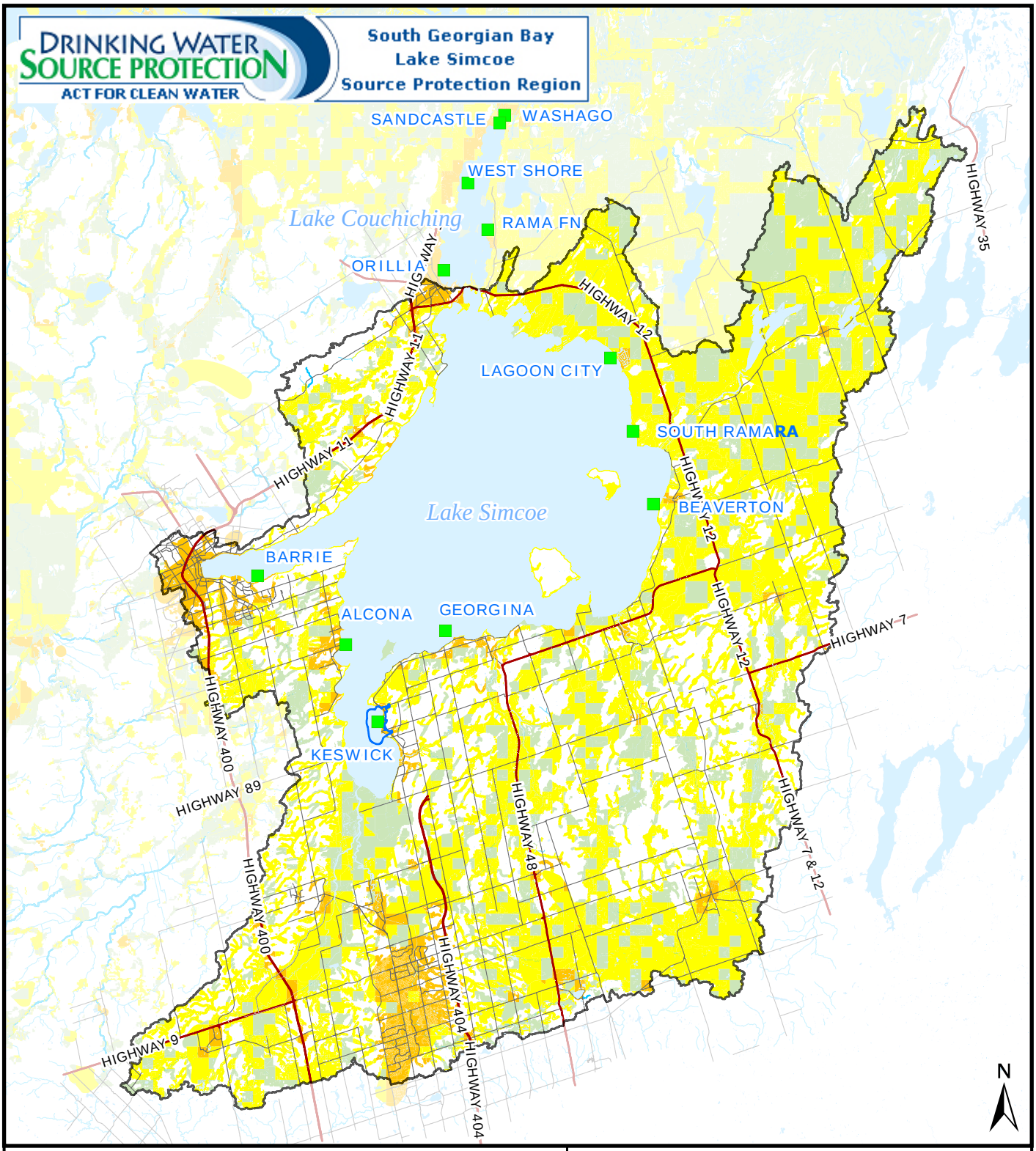
0 0.15 0.3 0.6 km

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 13h-11



Surface Water Intake

Impervious Surfaces in IPZ 3

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

Impervious Surfaces - Keswick Intake Protection Zone 3

Created by: LSRCA, 2025-08-05

Scale 1:500,000

0 5 10 15 20km

UTM Zone 17N, NAD83

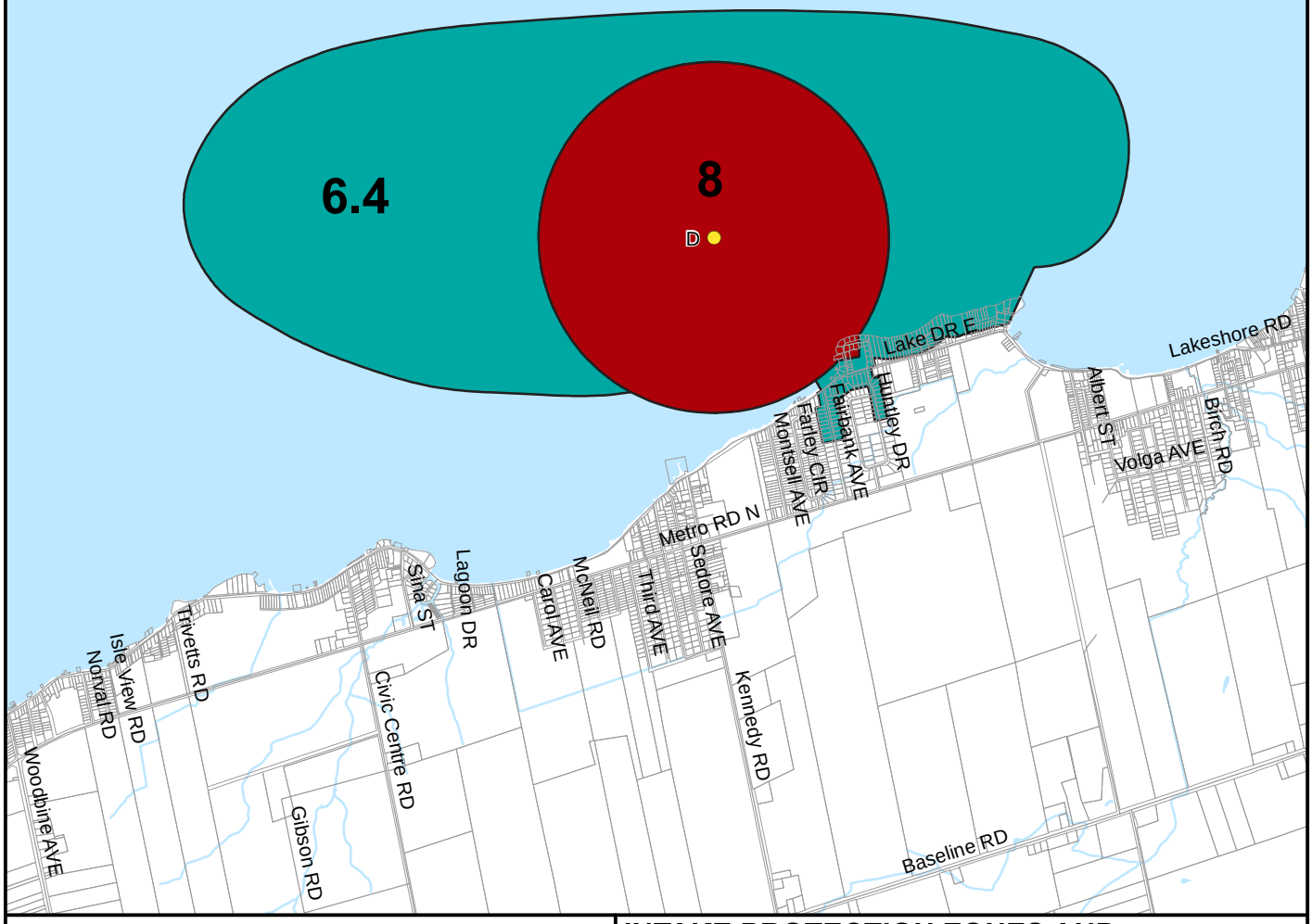
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data,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

Ontario

Figure 13h-12

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Legend

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

N W E S

490 245 0 490 Metres

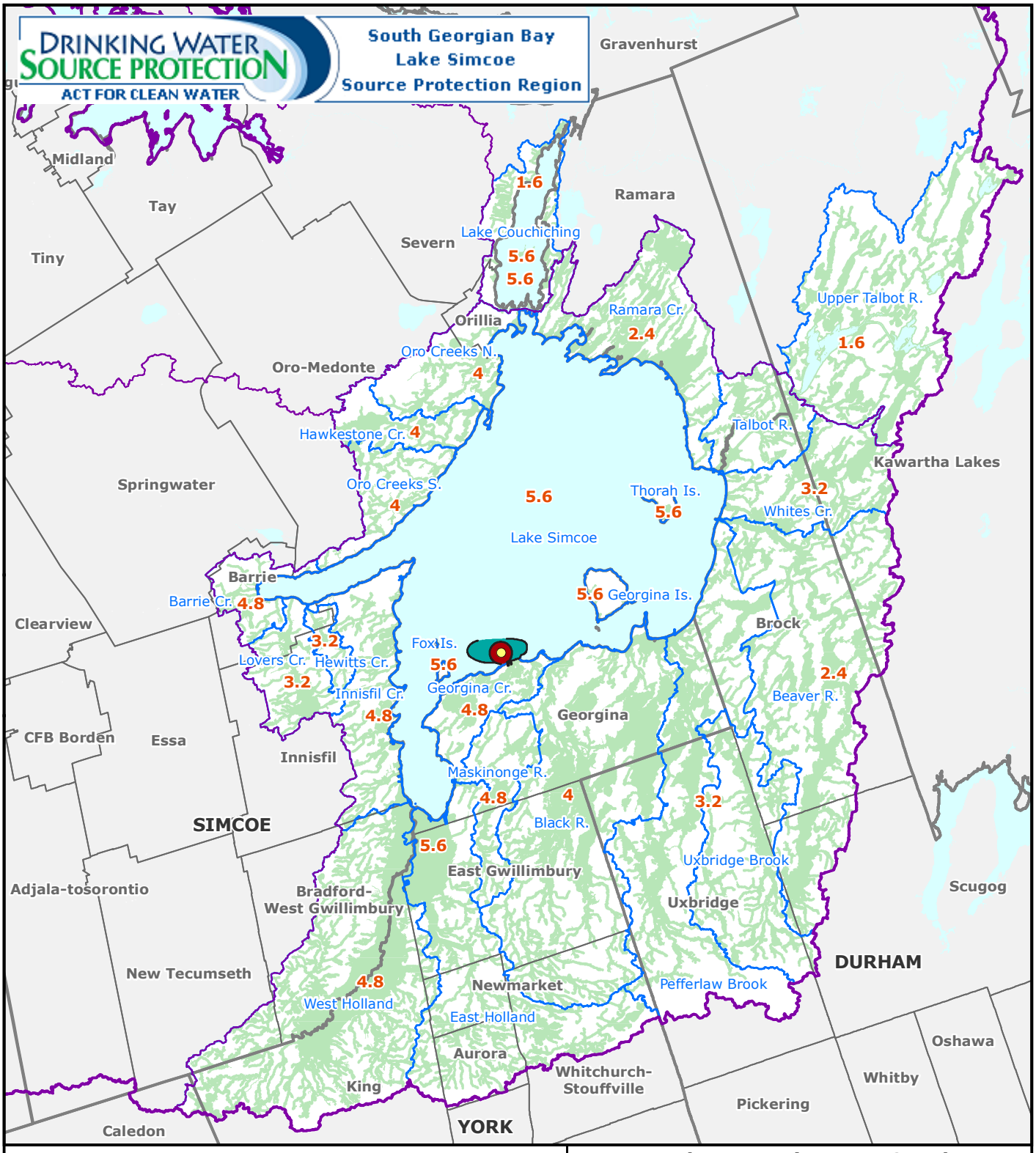
INTAKE PROTECTION ZONES AND VULNERABILITY SCORES - GEORGINA WTP, YORK REGION

DATE: JUNE 2010	SCALE: 1:40000
PROJECT: 0-071948.12	FILE. NO.:0-07194812F8.2-1

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 13i-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
Georgina, York Region

Created by: LSRCA
Date: 2010-10-20

GENIVAR

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

UTM Zone 17N, NAD83

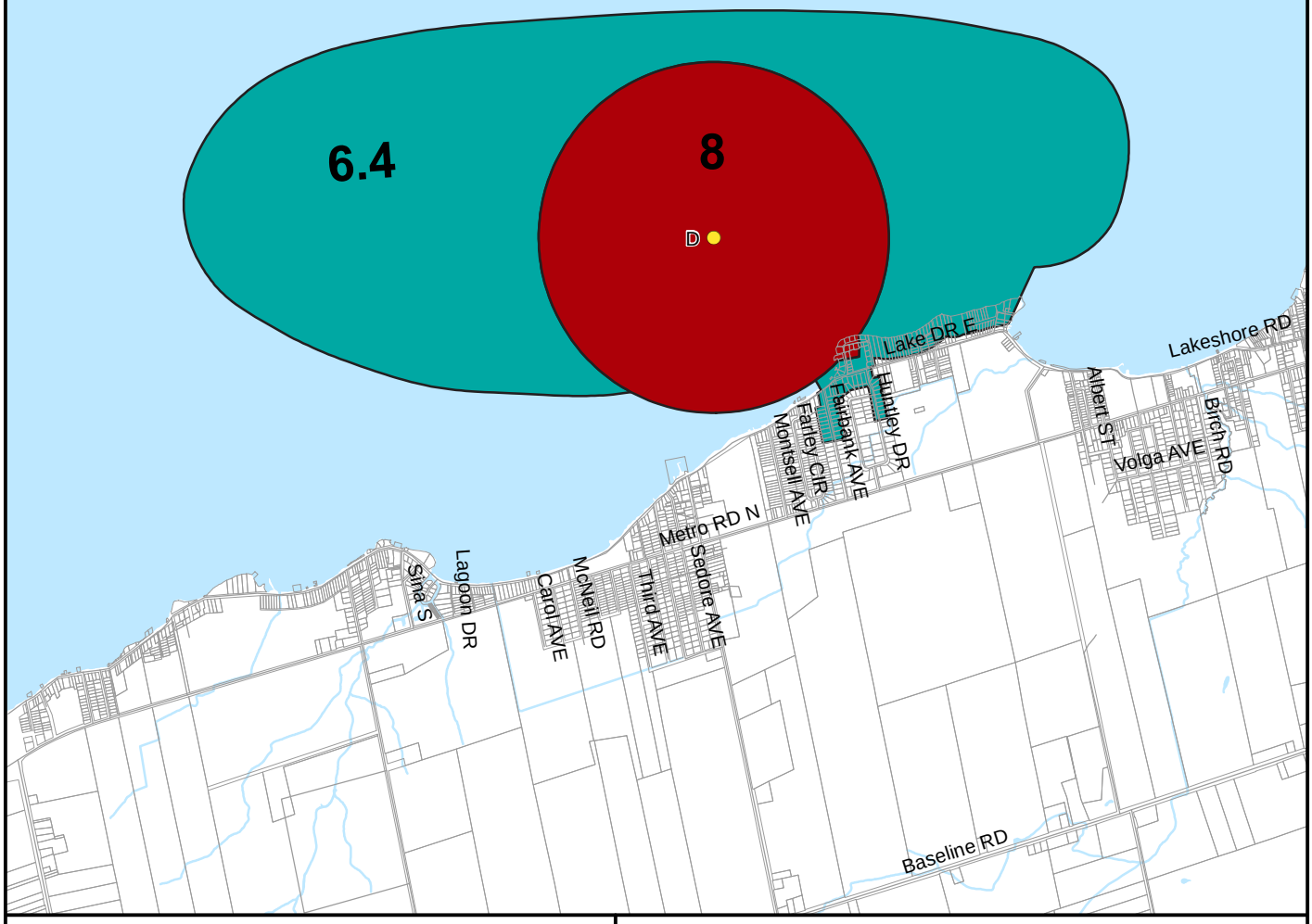
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data,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

Ontario

Figure 13i-2

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Legend

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

N W E S

500 250 0 500 Metres

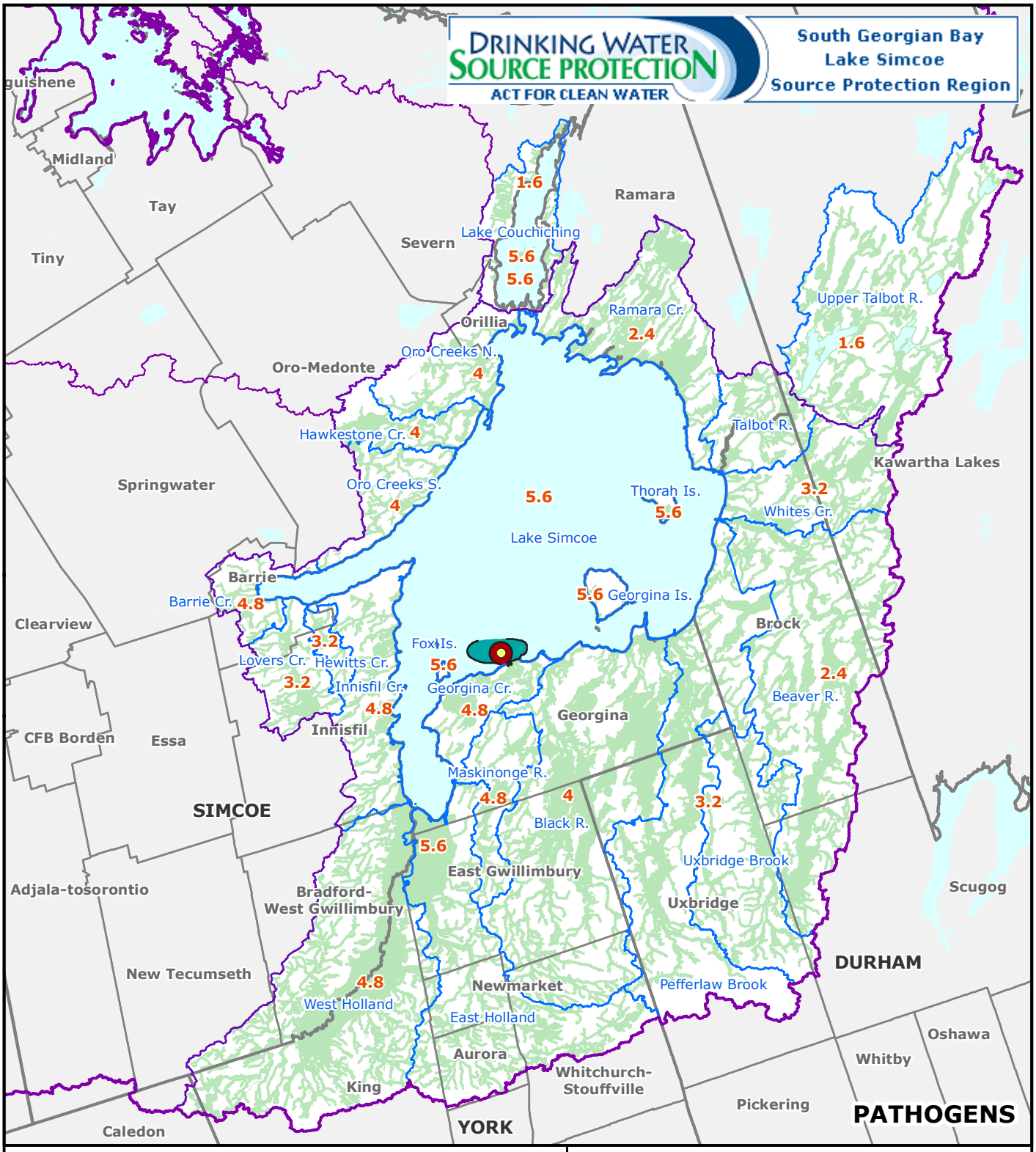
AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - GEORGINA WTP

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	S CA0E00
PROJECT: 0-071948.12	FILE. NO.:0-07194812F8.2-3

GENIVAR Ontario

FIGURE 13i-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
Georgina, York Region

Created by: LSRCA
Date: 2010-10-20

GENIVAR

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

UTM Zone 17N, NAD83

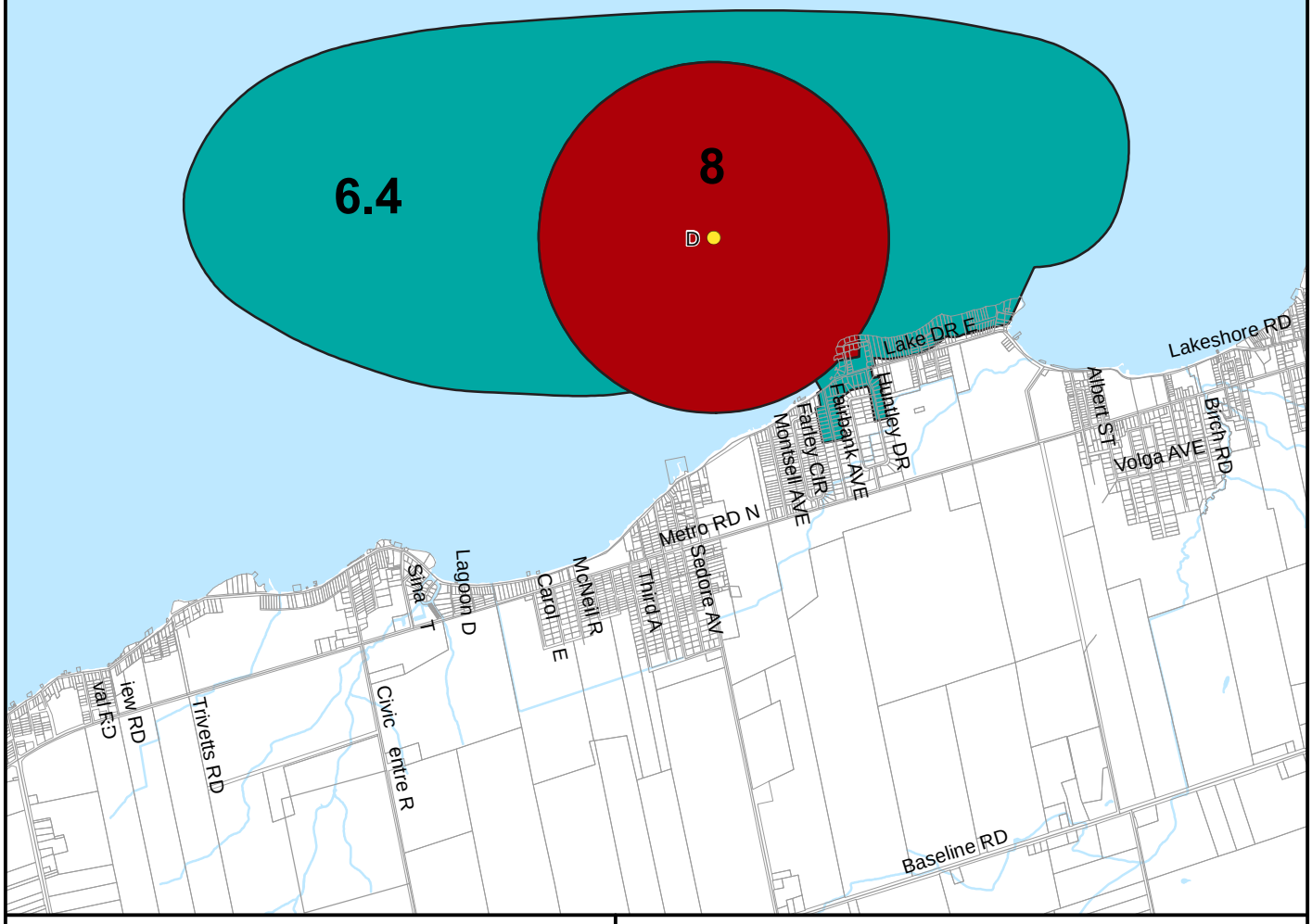
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data,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

Ontario

Figure 13i-4

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Legend

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

N W E S

500 250 0 500 Metres

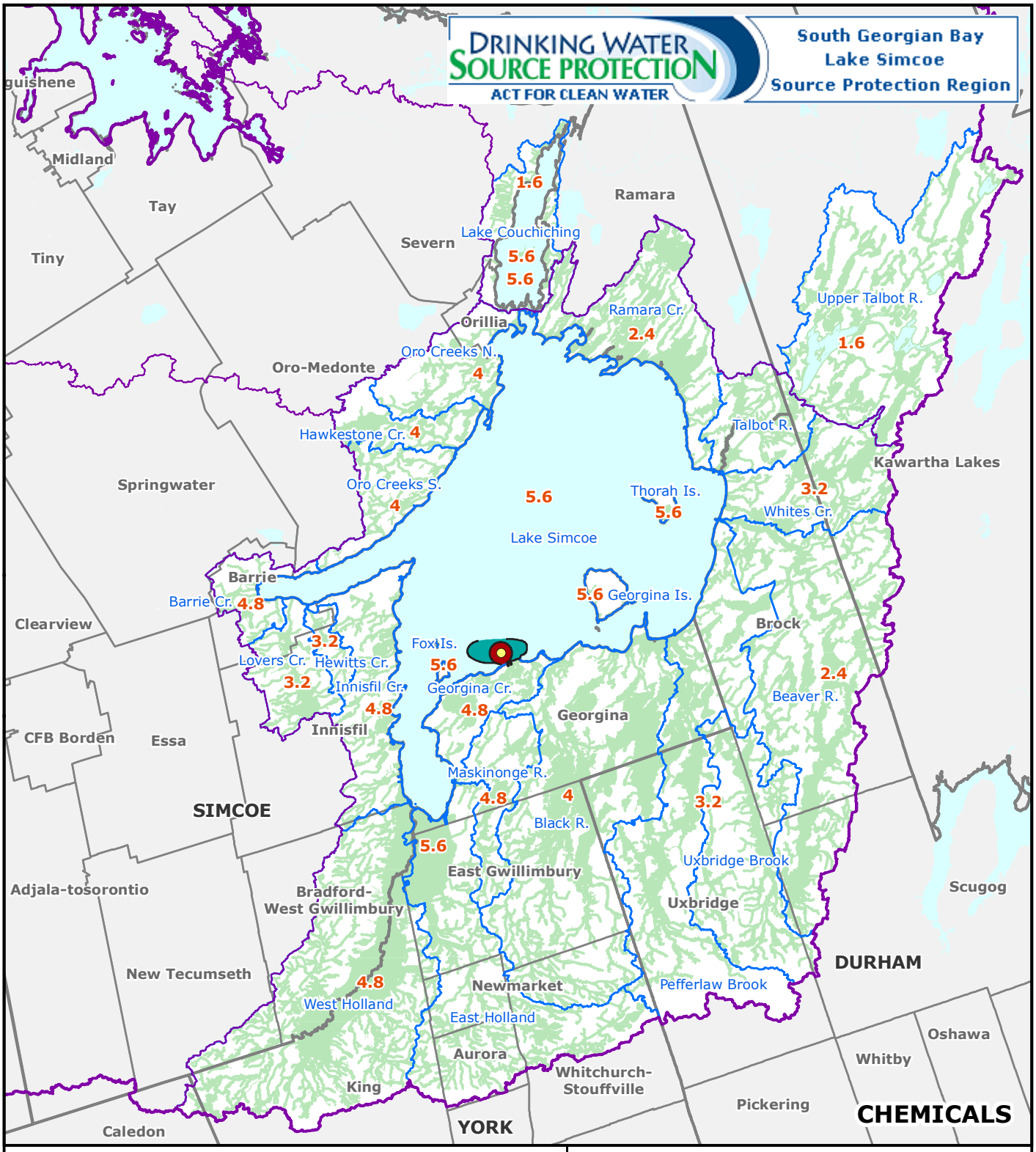
AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS - GEORGINA WTP

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	S CA00
PROJECT: 0-071948.12	FILE. NO.:0-07194812F8.2-2

GENIVAR Ontario

FIGURE 13i-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 Georgina, York Region

Created by: LSRCA
Date: 2010-10-20

GENIVAR

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

UTM Zone 17N, NAD83

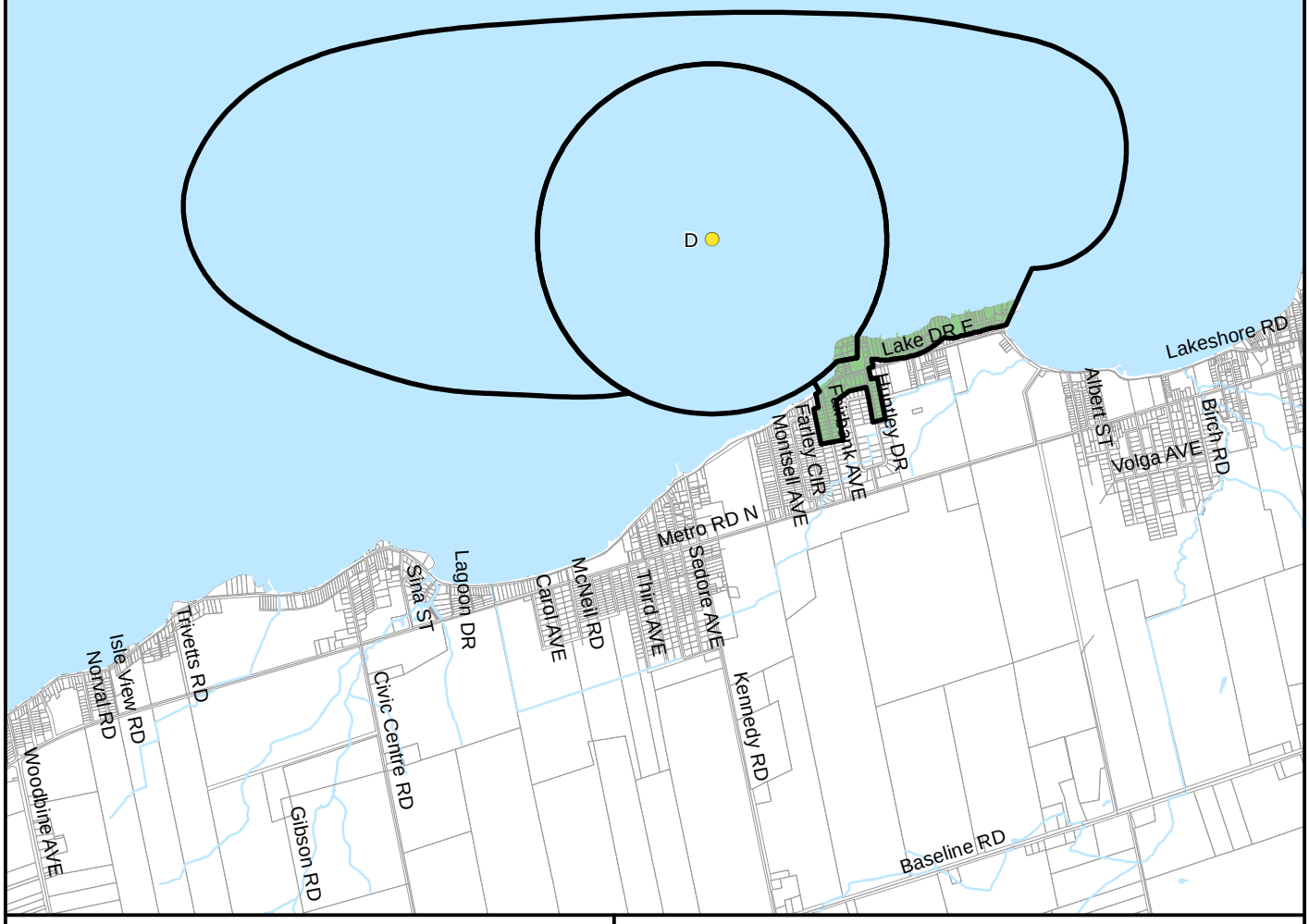
This map was produced by the Lake Simcoe Region Conservation Authority, lead agency of the South Georgian Bay Lake Simcoe Region Source Protection Region. Base data have been compiled from various sources, under data sharing agreements.
While every effort has been made to accurately depict the base data,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

Ontario

Figure 13i-6

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Legend

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

N
W E
S

500 250 0 500 Metres

MANAGED LANDS - GEORGINA WTP

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

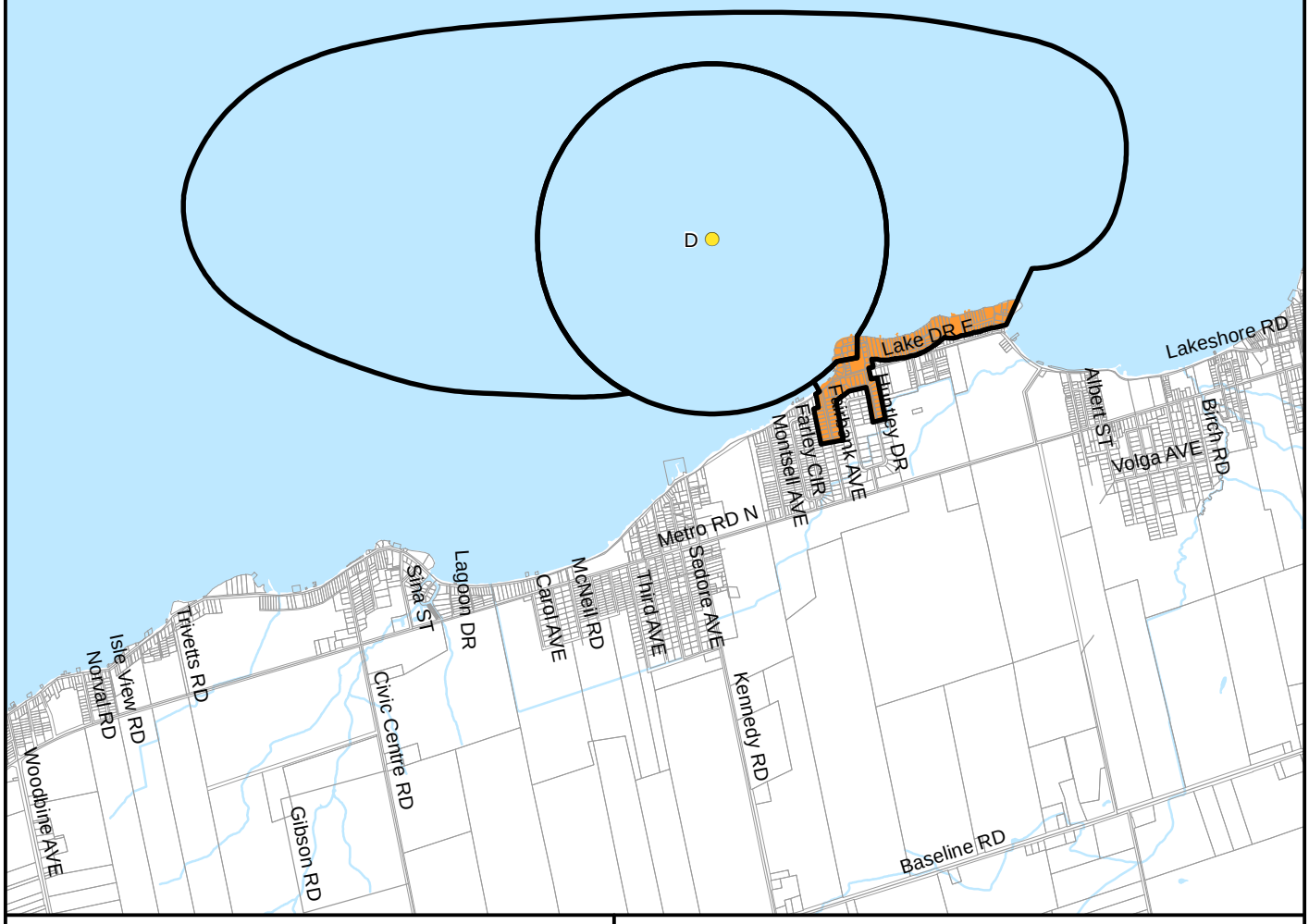
DATE: JUNE 2010	SCALE: 1:40000
PROJECT: 0-071948.12	FILE. NO.:0-07194812F8.2-4

GENIVAR Ontario

FIGURE 13i-7

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



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

500 250 0 500 Metres

LIVESTOCK DENSITY - GEORGINA WTP

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: 1:40000

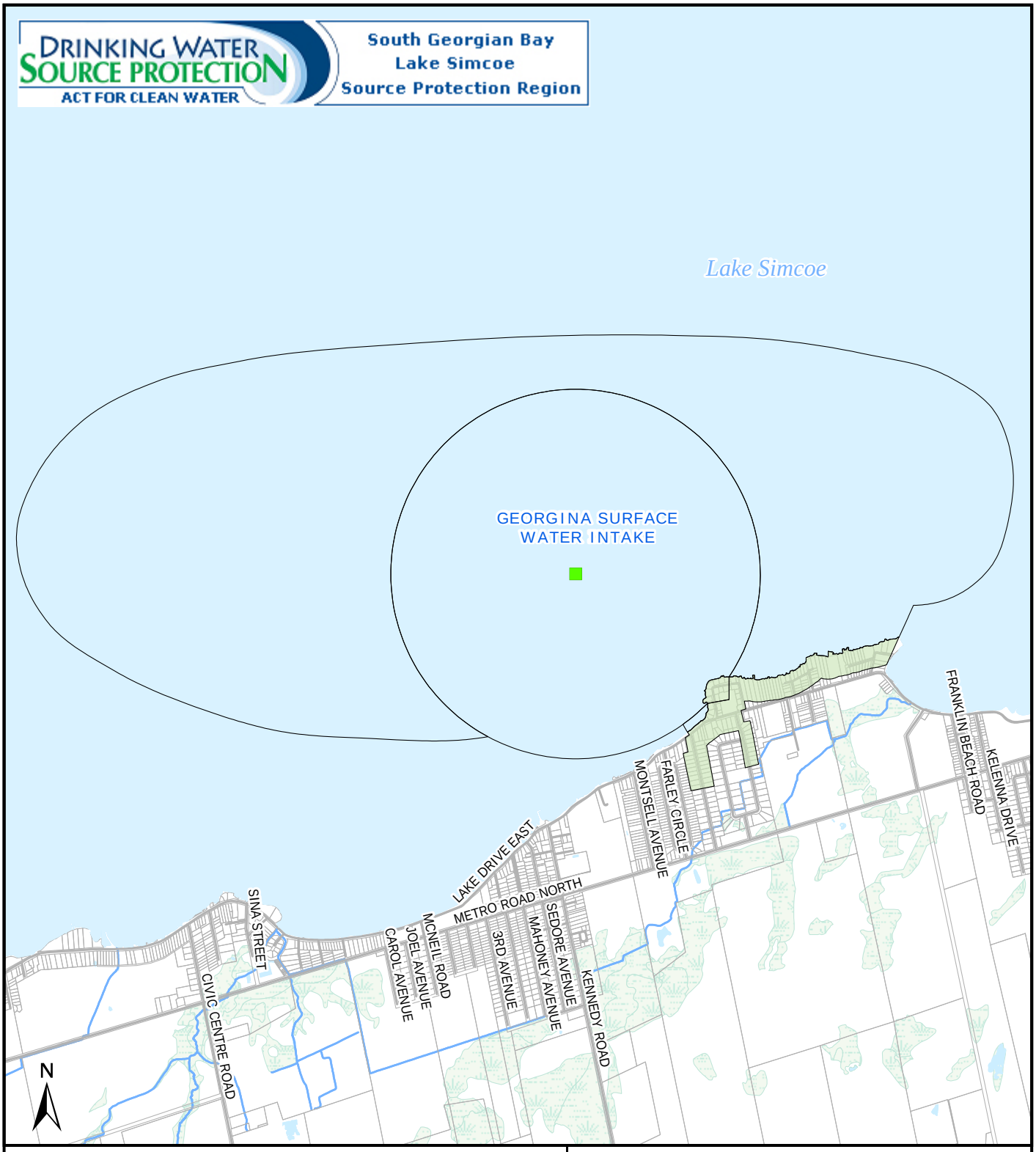
PROJECT: 0-071948.12 | FILE. NO.:0-07194812F8.2-5

GENIVAR Ontario

FIGURE 13i-8

DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER

South Georgian Bay
Lake Simcoe
Source Protection Region



Surface Water Intake

Impervious Surfaces in IPZ 1 & 2

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

Impervious Surfaces - Georgina Intake Protection Zone 1 & 2

Created by: LSRCA, 2025-08-05

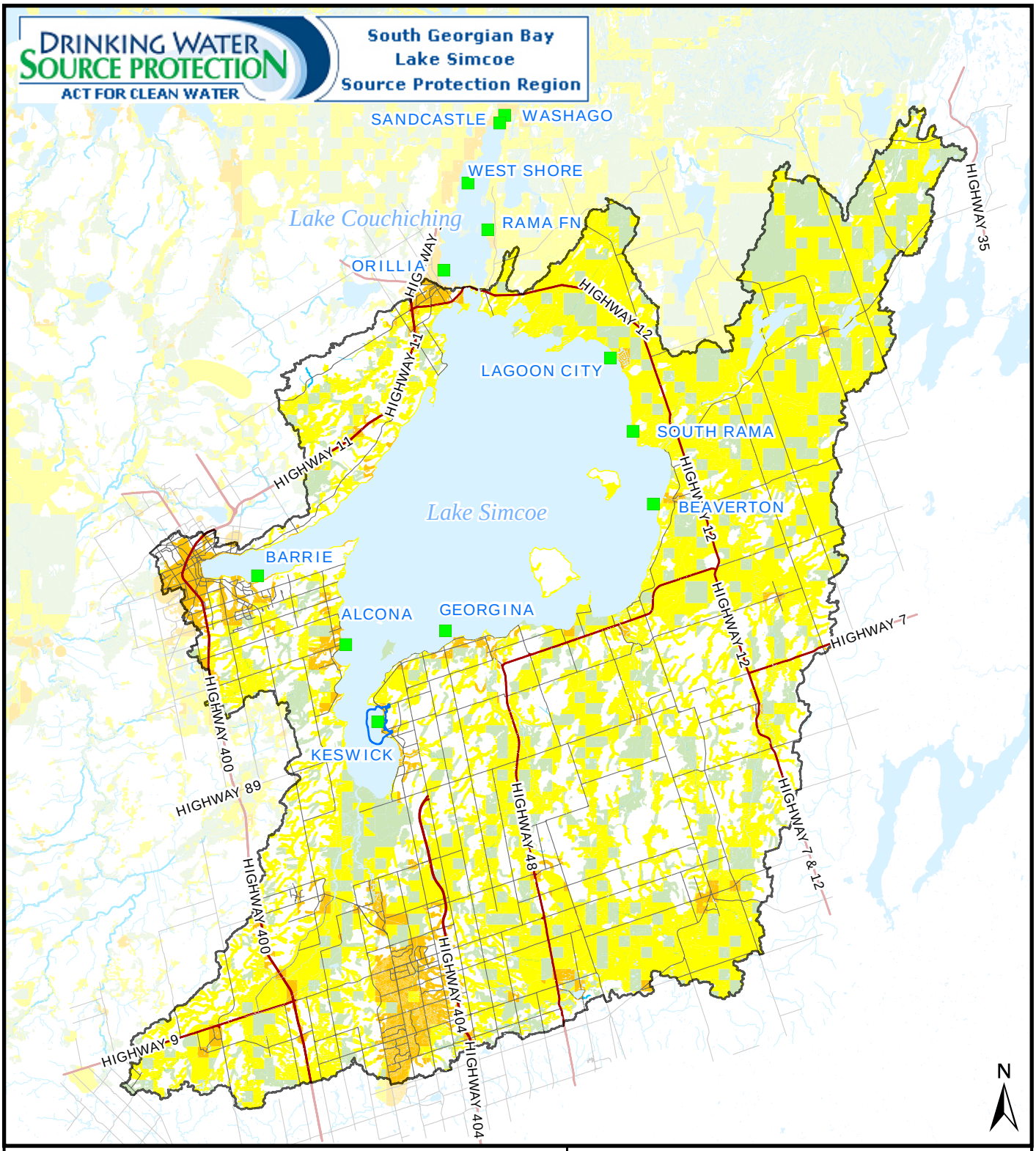
Scale 1:30,000

0 0.25 0.5 1 km

UTM Zone 17N, NAD83

Ontario

Figure 13i-9



Surface Water Intake

Impervious Surfaces in IPZ 3

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

Impervious Surfaces - **Georgina** Intake Protection Zone 3

Created by: LSRCA, 2025-08-05

Scale 1:500,000

0 5 10 15 20km

UTM Zone 17N, NAD83

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

Ontario

Figure 13**i**-12

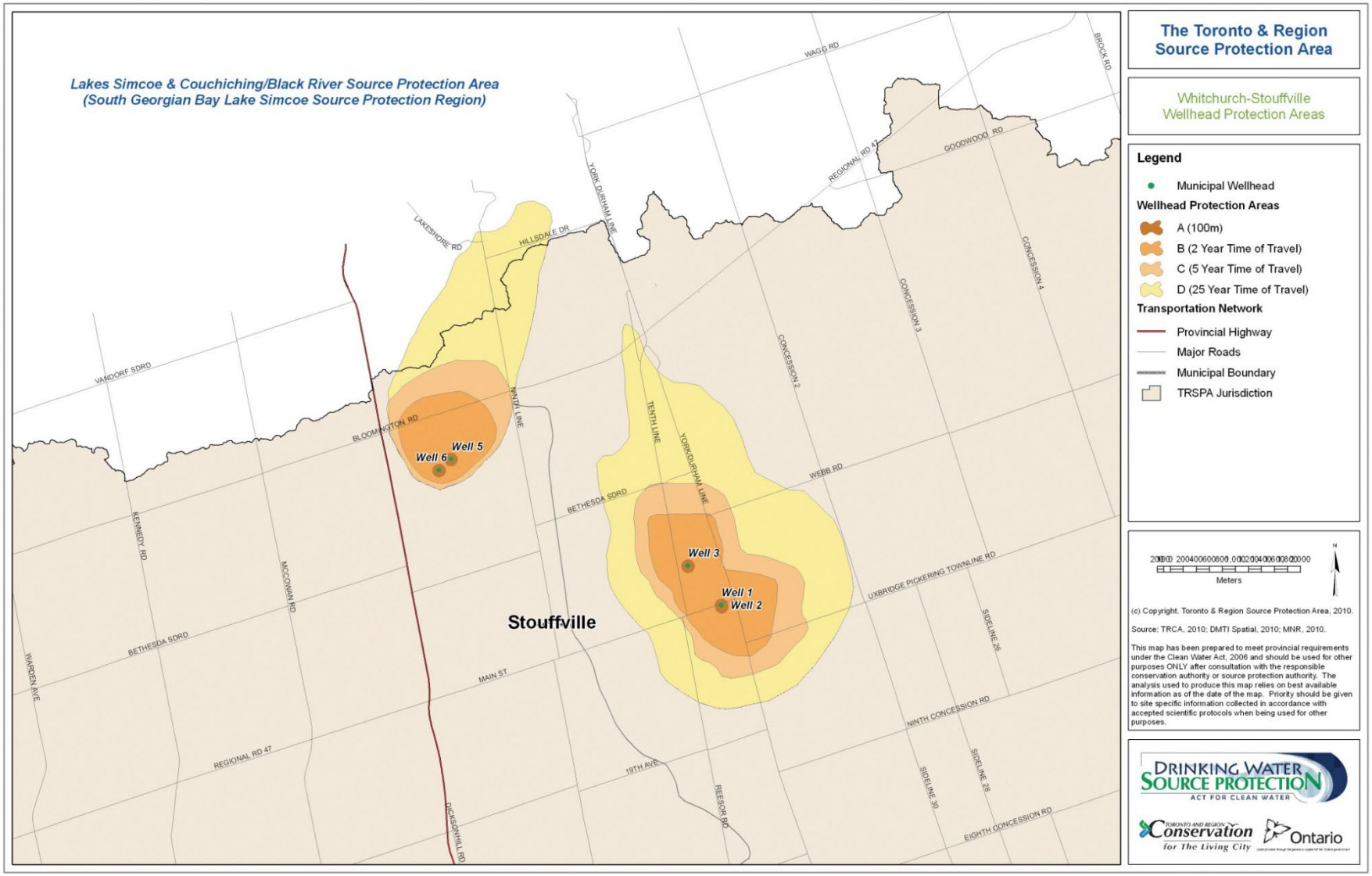


Figure 13j-1: Whitchurch-Stouffville Wellhead Protection Areas

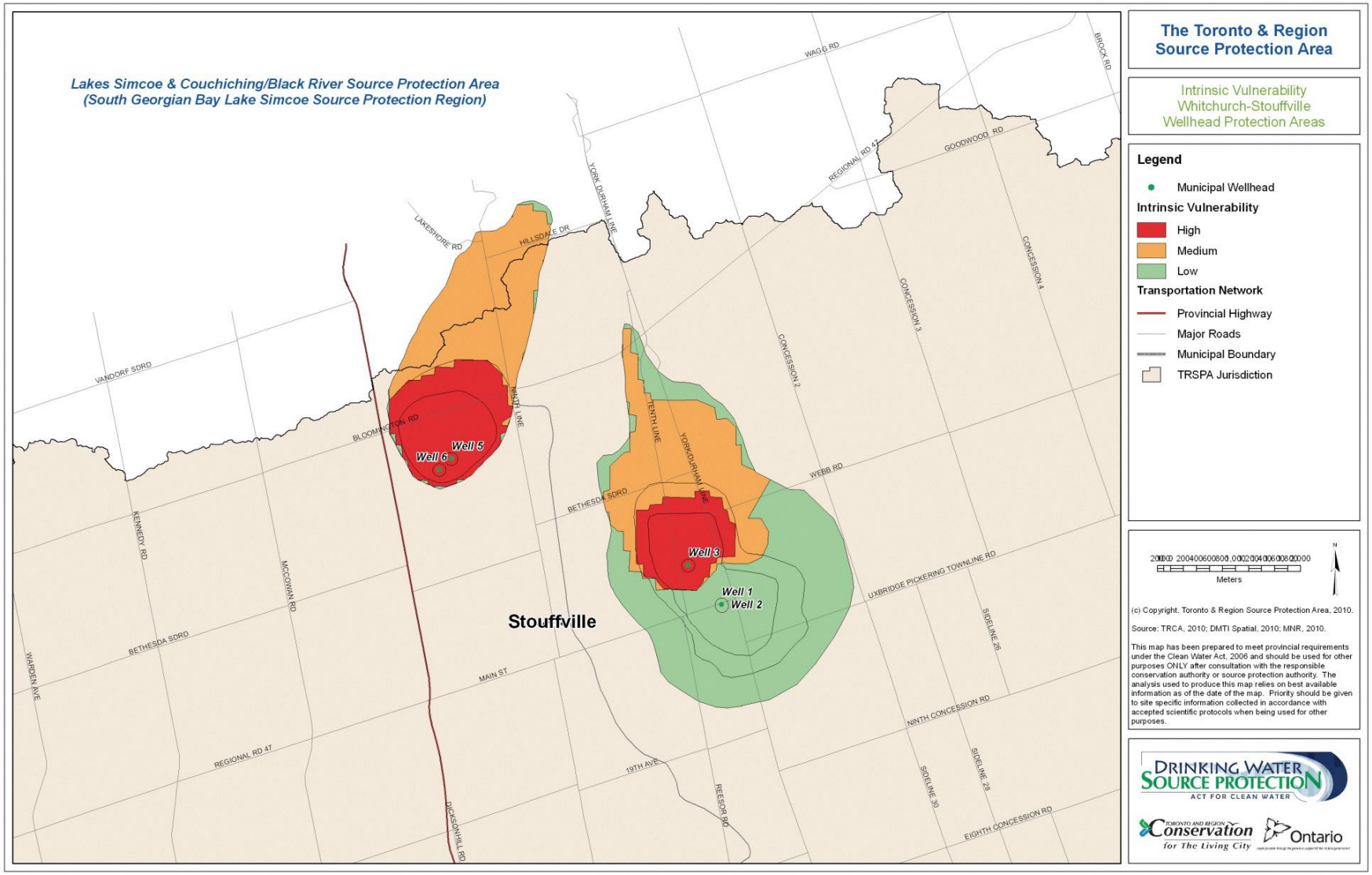


Figure 13j-2: Intrinsic Vulnerability Whitchurch-Stouffville Wellhead Protection Area

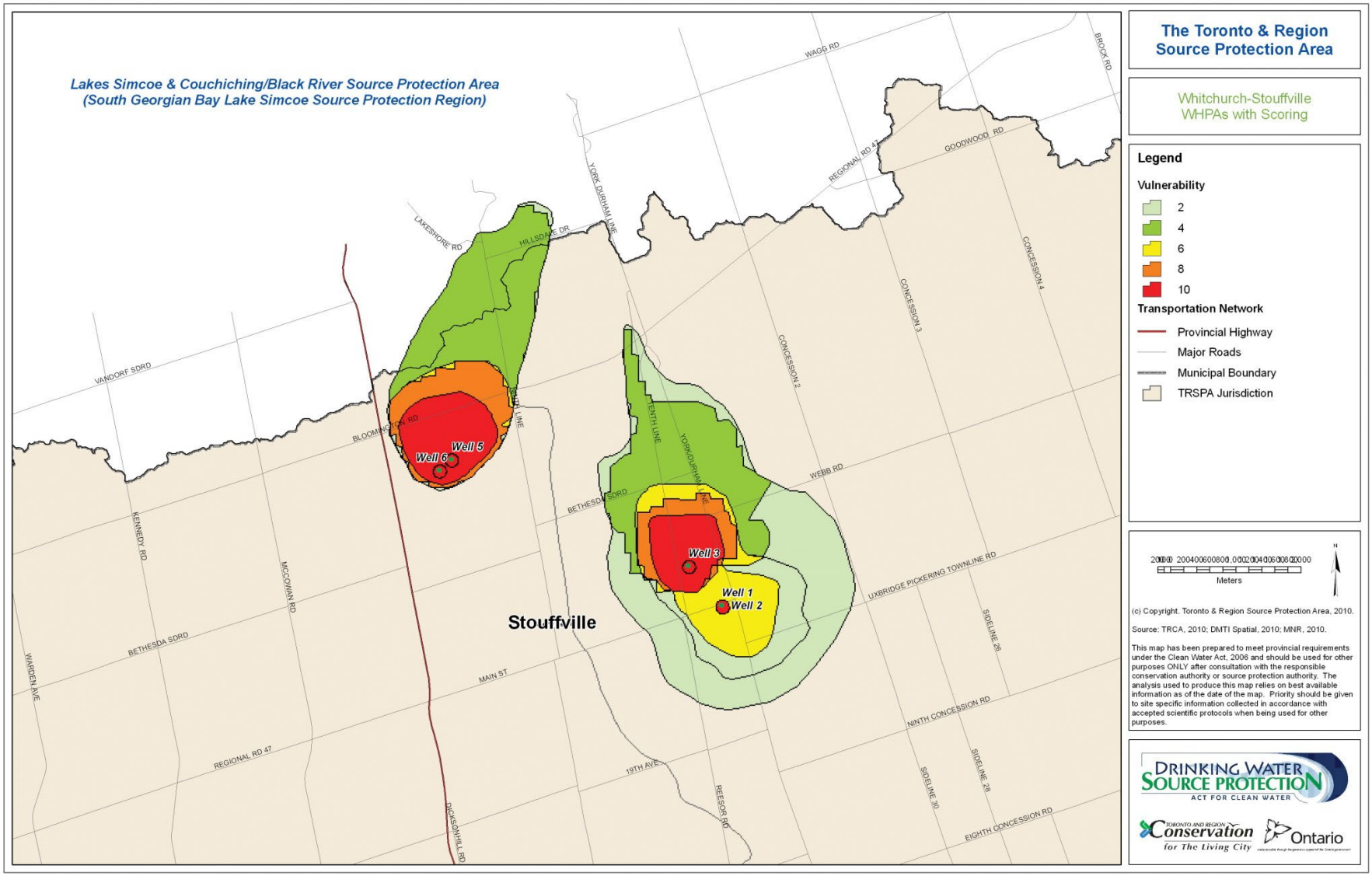


Figure 13j-3: Whitchurch-Stouffville Wellhead Protection Areas with Scoring