

Chapter 18: The Township of Mulmur

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18 Township of Mulmur

18.1 Introduction

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

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

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

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

18.2 Drinking Water Systems

The Township of Mulmur operates groundwater-based water supplies in one community and does not have any surface water-based supplies. As shown in Figure 18-1 the groundwater supply is within the South Georgian Bay-Lake Simcoe (SGBLS) Source Protection Region (SPR). This list below also indicates the corresponding lead Source Protection Authority (SPA) for the municipal water supply.

Municipal Groundwater Supply in the Township of Mulmur within the Nottawasaga Valley Source Protection Authority (SPA):

- Mansfield Well Supply with three wells

Sections of the Lisle WHPA (located in the Township of Adjala-Tosorontio) cross over the border into The Township of Mulmur (Table 18-1). Information on this system can be found in the Adjala-Tosorontio chapter (Chapter 8) of this report.

Table 0-1: WHPA that cross into the Township of Mulmur in the SGBLS SPR

Local Municipality that WHPA extends into	Municipality where wellhead is located	Name of Water Supply	Source Protection Region (SPR) & Source Protection Authority (SPA)	Location where entire Assessment can be obtained
Township of Mulmur	Township of Adjala-Tosorontio	Lisle	SGBLS SPR and Nottawasaga Valley SPA	This report (Chapter 8)

18.3 Mansfield Well Supply

The Township of Mulmur is situated in the Nottawasaga Valley Watershed and is approximately 20 km north of the Town of Orangeville. The Mansfield Municipal Water Supply system supplies water to the Village of Mansfield located on the east side of the Township 5 km north of Highway 89. Approximately 151 households are serviced by the system (Township of Mulmur, 2008).

The Mansfield Water Supply System consists of three wells, a pumping station, treatment and storage reservoir. The system is permitted to take water under M~~ECPOE~~ Permit to Take Water (PTTW) No. 6581-BT4KK7 from wells PW1, PW2A and PW3A issued on September 4, 2020.

Well 1 (PW1) was drilled in 1991 and is located on the northern edge of the village of Mansfield. The well is constructed with steel casing and 152 mm diameter telescoping stainless steel wire wound 8-slot screen, 2.1 m in length, set between 31.1 and 33.2 m below ground surface. The screen is located in an unconfined aquifer described as sand with gravel and clay.

Well 2 (PW2A) was drilled in 1981 and is located on the southern edge of the village. The well is constructed with steel casing and 150 mm diameter telescoping stainless steel wire wound 25-slot screen, 1.8 m in length, set between 43.6 and 45.4 m below ground surface. The screen is located in a confined aquifer described as a mix of coarse sand and fine gravel.

~~Well 3 (PW3A) was drilled in 2020 and is located in the north east part of Mansfield and replaces Well PW3A. A 5-inch test hole was constructed on April 27, 2020 using mud rotary drilling technology. The drilling encountered approximately 6m of gravel and sand at the surface, underlain by clayey silt till to a depth of 35m (115ft) which was underlain by layered sand and clayey silt to 61m below ground (200 ft) when the drilling was stopped in the shale bedrock. A continuous wound stainless-steel screen was installed from 52.7m to 60.7m (173 to 199 feet) below ground. Well 3 (PW3) was drilled in 2000 by Gerrits Well Drilling as a 252 mm diameter well with a depth of 56.6 m. The well is constructed with steel casing and 252 mm diameter telescoping stainless steel wire wound 18-slot screen, 3 m in length, set between 55.8 and 56.6 m below ground surface. The screen is located in a confined aquifer described as coarse to medium sand with some silt and clay layering.~~

The screen is located in a confined aquifer described as coarse to medium sand with some silt and clay layering.

The overburden in the Township of Mulmur consists of glacial formations consisting of glacio-lacustrine (glacial lake) sediments, fluvial (river) and glacio-fluvial deposits and ice-deposited drift. The soils in fluvial and glacio-fluvial outwash deposits vary from well-bedded and sorted

sand and gravel in outwash plains and meltwater channels, to irregularly stratified sand and gravel in kame hummocks. The bedrock underlying the Township of Mulmur consists of dolomite, limestone, and shale deposited during the Ordovician and Silurian periods of the Palaeozoic Era.

Most of the wells in the Township are constructed in the overlying overburden or in the limestone and dolomite. The underlying shale formations are generally poor water producers and the water quality in the shale is often noted to be poor.

The water table elevation ranges from greater than 520 metres above sea level (masl) on the west side of the Township to less than 200 masl on the north-eastern part of the Township. The Niagara Escarpment and the bedrock valley systems appear to play an important role in controlling the groundwater movement in the area. In general, the groundwater flow reflects the surface topography and the general direction of groundwater flow is toward the east.

Information presented for the Mansfield section of this Chapter is based on Burnside, 2010b report.

18.3.1 Groundwater Vulnerability Assessment

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

The Groundwater Vulnerability for the Mansfield water supply has been delineated following the process recommended in the Technical Rules. The areas that contribute groundwater to the wells were delineated as WHPA. The Groundwater Vulnerability within the WHPA was assessed and consideration was included to consider the effects of man-made structures that may increase the Vulnerability. The WHPA and the Vulnerability were considered together as per the Technical Rules to determine a Vulnerability Score for the Mansfield wells. Details of the methods for the Vulnerability Analysis are provided in Burnside, 2010b.

18.3.1.1 Well Head Protection Area (WHPA) Delineation

The delineation of Wellhead Protection Areas for the Mansfield wells was completed by R.J. Burnside & Associates using a process of three-dimensional groundwater flow modelling (development by S.S Papadopoulos and Associates, Inc. (SSP&A) in collaboration with Burnside) and reverse particle tracking. The model was developed using MODFLOW and the reverse particle tracking module MODPATH. The model allows for aquifer conditions to be simulated and for the areas contributing to the wells based on time of travel (TOT) to the well to be computed. Calculations of the TOT were completed using the permitted rates of production for the supply wells.

For this study, although the focus is on the Mansfield wells, the model domain was extended to natural surface water divides. As built, the model domain extends 5.5 km west to east and 3.5 km north to south for a total area of 11.71 km². The model boundaries are aligned with the groundwater pathlines inferred from the interpolated water level contours and the locations of streams. A no-flow boundary condition was specified along the western edge of the model. This boundary is aligned along a groundwater pathline inferred from the water level contours. Along the eastern edge of the model, the groundwater discharge is assumed to occur at the streams flowing eastwards. The boundaries of the model are assumed to be sufficiently distant from the water supply wells to not affect the calculations of water levels and pathlines in the immediate vicinity of the wells.

Based on the known hydrostratigraphy, the model domain is divided vertically into two layers. The first model layer represents the overburden layer, and the second layer represents the upper weathered bedrock. For this study, a model grid with variable spacing was designed to provide a relatively fine resolution around the water supply wells. The grid spacing around the wells is 25 m. The spacing is increased to 50 m away from the wells. The model grid contains a total of 20,842 active cells in 116 rows and 157 columns.

Model input data was gathered from a variety of sources including the hydrogeologic data, reports on the construction of the new well and the existing MOE water well record database. The model was calibrated to steady state using water level data from the above sources.

In completing the various TOT capture zones for the supply wells PW1, PW2A and PW3A, the operation of the well was assumed to be at the pumping rates in the PTTW; 227 L/min, 182 L/min and 252 L/min, respectively.

The capture zones of all three wells have circular shapes within the limits of the 2-year TOT which indicates primarily radial flow in the immediate vicinity of the wells. Thereafter the zones are fan-shaped extending in the western direction consistent with regional groundwater flow.

The 25-year TOT zones for wells PW1, PW2A and PW3A are approximately 0.16 km², 0.11 km² and 0.14 km², respectively. The WHPAs for the Mansfield Wells are shown in Figure 18a-1.

Further details of the modeling exercise can be found in Burnside, 2010b.

18.3.1.2 WHPA-E /~~WHPA-F~~

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

18.3.1.3 Groundwater Vulnerability

The Groundwater Vulnerability was determined using the Aquifer Vulnerability Index (AVI) method as outlined in the Draft Assessment Report Guidance Module 3 – Appendix 3 (December 2006). This was completed as a separate Geographic Information System (GIS) exercise and did not include the groundwater flow models. The primary datasets used in this support role were the Ministry of Northern Development and Mines Surficial Geology of Southern Ontario and the Ministry of Natural Resources (MNR) Ontario Base Data.

Various interpolation methods were evaluated to determine the best for creating the AVI surface. It was determined that the interpolation produced by the Australian National University's Digital Elevation Model algorithm (ANUDEM) performed the best. Following the interpolation, post processing was performed on the results to produce a vector polygon dataset, and areas less than 5 hectares in size were merged with larger areas. The final AVI surface used for this study is a combination AVI surface - using bedrock wells, supplemental points, and overburden wells greater than 500 m from a bedrock well. This combination AVI surface was created to reflect aquifer vulnerability for the municipal wells. More details on the AVI approach and their limitations are available in Burnside, 2010b.

The Groundwater Vulnerability is shown in Figure 18a-2. The Vulnerability is dominantly Low with Medium Vulnerability surrounding Well PW1. The Vulnerability on the map shows a strong east-west transition with areas northwest of the wells classified as highly vulnerable. This is a result of decreasing overburden thickness with proximity to the Niagara Escarpment. There is a small circular area of Low Vulnerability that occurs in the vicinity of Well PW1 that is thought to be generated due to variations in the local lithology.

18.3.1.4 Transport Pathway Increase

The Technical Rules allows for an increase in vulnerability rating of an aquifer due to the presence of Transport Pathways that may increase the vulnerability of the aquifer by providing

a conduit for contaminants to bypass the natural protection of the aquifer. The Vulnerability Rating can be increased from Medium to High, Low to Medium, or from Low to High in accordance with the potential for artificial Transport Pathways to increase the observed Vulnerability.

Transport pathways are developed where man-made (anthropogenic) features in the aquifer provide a path along which contaminants can migrate to the regional aquifer. The following features were considered as transport pathways within the context of the Burnside, 2010b study:

Subsurface Utilities

Utilities that are constructed in the sub-surface are potential Transport Pathways as they provide a pathway for contaminants to enter into the aquifer below. Utilities that may act as Transport Pathways include storm water trunk sewers and sanitary infrastructure. The depth of excavation for the construction of utilities will determine the risk that the wells pose on the municipal supply aquifer. Storm sewers in the Village were noted; however, since the aquifers used by the municipal supply wells are generally over 30 m deep and are protected by overlying low permeability layers, the risk posed from buried utilities is Low.

Domestic Water Wells

Domestic water wells are the most common man-made preferential pathway in rural areas. Improperly constructed wells can potentially introduce a cumulative impact to drinking water sources especially when the casing deteriorates. Similarly, if the well is no longer in use, improper abandonment also provides a preferential pathway for a contaminant to impact a drinking water source.

A review of water well records from the MOE water well database and a field survey were conducted to identify wells within the WHPAs. The wells were then ranked based on their risk to the supply aquifer. This process is described in detail in Burnside, 2010b. The survey resulted in the identification of 15 water wells within the WHPAs and classified five of the wells as high risk wells.

Water wells are the main Transport Pathway of concern because they present a risk to the municipal supply as they may create a conduit for contaminants to enter the aquifer.

Within the Burnside, 2010b study, an upgrade of Vulnerability based on Transport Pathways was only performed for areas that fell within the WHPAs delineated as part of the study. The locations of transport pathways and increased vulnerability are reflected in the maps of Vulnerability Scores (See Section 18.3.1.5).

18.3.1.5 Vulnerability Score

The WHPA zones for the Mansfield Water Supply, as shown in Figure 18a-1, and the Groundwater Vulnerability as shown in Figure 18a-2, were used to assign a Vulnerability Score by using the matrix from Table 5.3 (Chapter 5: Methods Overview, Section 5.2.4). Figure 18a-3 illustrates the Vulnerability Scores for the Mansfield Water Supply and is used to assess Drinking Water Threats in Section 18.3.3. The Transport Pathways are illustrated as circles with 30 m radius in the WHPAs.

18.3.1.6 Uncertainty Rating

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

The Uncertainty Rating associated with the WHPA A-D delineation was assessed using a qualitative process outlined in Burnside 2010b. As mentioned above, a technical peer review consultant was also used to assess the uncertainty of the WHPA delineation. As a more conservative assessment, the results from the peer review are presented for this section.

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

The Uncertainty Assessment methodology used by Burnside, 2010a, considers the type, quantity and quality of available data, the methods used to determine the Vulnerability Assessment components, and the nature of the groundwater flow system. Using information from the Vulnerability mapping and the Transport Pathway update it is concluded that the uncertainty of the overall Vulnerability Score can be considered to be Low.

18.3.2 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.

As part of the Issues Evaluation, Burnside 2010b assessed whether any contaminants are impacting or have the potential to impact or interfere with Mansfield's drinking water source by a review of available water quality data.

The following parameters were identified as parameters of consideration: hardness, organic nitrogen, sodium and nitrate.

Organic Nitrogen was sampled on two occasions. An organic nitrogen concentration of 0.23 milligrams per liter (mg/L) was present in a sample collected in 2001 from Well PW2A. In 2003, a sample from Well PW1 had a concentration of 0.16 mg/L. This is in exceedance of the Ontario Drinking Water Quality Standards (ODWQS) operational guideline of 0.15 mg/L. Organic nitrogen is calculated as the difference between the Total Kjeldahl Nitrogen (TKN) and ammonia nitrogen. High levels may be generated from septic tank or sewage effluent contamination, which is often associated with odour and chlorine-worsened taste problems. There are no other data points that include organic nitrogen within the data reviewed making it difficult to determine if these values represent isolated occurrences or indicate a trend. Since the organic nitrogen standard is an operational standard and non-health related it is not considered to be an Issue in the context of this report.

A hardness concentration of 285 mg/L was present in a sample collected from Well PW2A in 2001 which exceeds the Operational Guideline (OG) of the ODWQS range of 80 to 100 mg/L. This level is typical of drinking water obtained from an aquifer that is influenced by a carbonate source such as the underlying dolostone bedrock. This level of hardness can be considered to be naturally occurring. Hardness in water is also an aesthetic objective and is typically handled using household water softeners; hardness therefore should not interfere with the use of water from these sources.

Due to the surrounding land uses, sodium, chloride and nitrate were identified as parameters of concern since they are typically associated to road salt and agricultural activities. Sodium concentrations were plotted and indicate that there is an increasing trend however the levels will not exceed ODWQS in the next 50 years. There is only one sample date for which chloride was measured. The concentration measure was 12 mg/L and was collected in 2001. This is well below the ODWQS. Since there are no other data points no trend analysis can be performed for this parameter. Nitrate concentrations were plotted and concentrations ranged from 0 to

4.6 mg/L; however, no increasing trend can be interpreted from the data. It can be concluded that sodium and nitrate are not water quality Issues.

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

18.3.3 Drinking Water Threats Evaluation

An assessment of Drinking Water Threats for the Mansfield water supply was completed in accordance with the detailed methodology presented in Burnside 2010b. 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 Mansfield 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
- an enumeration of Drinking Water Threats

18.3.3.1 List of Drinking Water Threats – Activities

The list of Prescribed Drinking Water Threats considered in the assessment for the Mansfield drinking water supply is provided in Chapter 5, section 5. 5.1.

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

18.3.3.2 List of Drinking Water Threats – Conditions

The following information sources were consulted to identify existing Conditions that could affect the Mansfield Well Supply:

- Ecolog Environmental Risk Information Services Ltd Search. Databases used include:
 - Record of Site Condition
 - MOE Spills Database and Occurrence Reporting Information System
- Files from the MOE district offices for review called Data Hound Files

More details and on these sources can be found in Burnside 2010b.

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

18.3.3.3 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 ~~table of Drinking Water Threats~~ Technical Rules threat circumstances can be used to correlate activities that are or would be Drinking Water Threats with the Vulnerability Scores. 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 ~~circumstances tables~~ can be found at ~~the~~ <https://threats.swpip.ca/https://swpip.ca/>. Source Water Protection Information Portal. Government of Ontario's Drinking Water Threats and Circumstances.

18.3.3.3.1 Pathogen Parameters

The ~~MECP table of Drinking Water Threats~~ Technical Rules Key Table on Figure 18a-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 Mansfield Well Supply (Figure 18a-4). Activities that are or would be Significant Drinking Water Threats for pathogens can be observed within the areas where the Vulnerability Score is 10. Pathogens can also only be a Significant, Moderate or Low Threat within WHPA-A and WHPA-B.

18.3.3.3.2 Chemical Parameters

The ~~MECP table of Drinking Water Threats~~ Technical Rules Key Table on Figure 18a-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 Mansfield Well Supply (Figure 18a-5). 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.

18.3.3.3 DNAPL (Dense Non-Aqueous Phase Liquids) Chemical Parameters

Figure 18a-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 Mansfield Well Supply. [The MECP table of Drinking Water Threats-Technical Rules](#) [The Key Table on Figure 18a-6](#) can be used to identify the circumstances in which these Activities would be Significant or Moderate Drinking Water Threats.

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

Further to Section 18.3.3.2 no Conditions have been confirmed within the WHPA for the Mansfield Well Supply.

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

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

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

Figure 18a-3 illustrates the Vulnerability Score maps for Mansfield well supply that can be used to determine where a Condition is or would be a Significant, Moderate or Low Threat to Drinking Water.

18.3.3.5 Enumerating Drinking Water Threats

18.3.3.4.1 18.3.3.5.1 Enumerating Significant Drinking Water Threats – Methods

Identification and enumeration of Significant Drinking Water Threats related to Issues and Conditions have been described in Section 18.3.2 and 18.3.3.2, respectively. This section describes the identification and enumeration of Significant Drinking Water Threat Activities. Identification of Activities requires determining where they are located in terms of vulnerable areas and their associated Risk Score based on the type of Activity. Detailed methodology can be found in Burnside, 2010b. Additional refinement of the Significant Drinking Water Threats enumeration was completed using the methodology outlined in Chapter 5 (Section 5.5.6.4) of this Assessment Report.

In order to classify activities in the study area the various databases and sources outlined in Section 18.3.3.2 were reviewed and information on site activities was compiled. The circumstances under which Activities are considered Threats and the classification of those Threats are contained in the ~~Table of Drinking Water Threats~~ Technical Rules provided by the MOE (MOE 2008b).

An automated process was developed to search the Table and provide an indication of the hazard and risk score for each identified activity. The automated process generates a project database that houses information on the threat and also includes the various component scores that are included in the final determination of risk category. The risk category in the automated process is calculated using processes described by the MOE in their document Threats EBR Lookups (MOE, 2009d) and is identical to that used by the ~~Tables of Drinking Water Threats~~ Technical Rules. As a quality control mechanism, the calculated risk categories were verified by manual searches of the ~~MOE Tables of Drinking Water Threats~~ Technical Rules to ensure that the automated calculations were correct for Threats categorized as Significant. In order to ensure consistency in the approach for assumptions regarding various activities and the methodology for the evaluations of Threats a consensus was arrived at among all consultants conducting work within the SGBLS Source Protection Region (SGBLS, 2010).

Once a Hazard Rating is assigned to an identified parcel based on the MOE tables, then a Risk Score can be assigned. The Risk Score is calculated by multiplying the Vulnerability Score as defined by the Vulnerability component of the study (Section 18.3.1.5) with the Hazard Rating

which provides a score out of 100. Risk Score is classified as Significant when the score is greater than 80.

Two unique 'polygon' Threats were assigned to each WHPA with a Vulnerability Score of 10 in accordance with the common methodology developed by SGBLS (SGBLS, 2010). For the Threat 'sewage system or sewage works – sanitary sewers and related pipes', where present, one Threat was assigned to each WHPA to account for the potential Threat that could exist related to the sanitary network. One Threat was assigned to represent the entire network since detailed information regarding distribution and conveyance capacities was not readily available within some study areas. The second polygon Threat assigned was related to domestic fuel storage (i.e. Fuel Storage) which may be on a property as a primary source of heating fuel. One fuel storage Threat was assigned to each WHPA where there was a high probability that natural gas was not available in the area.

Some Threats such as the Application of Agricultural Source Material to Land have Circumstances based on datasets that are on a scale larger than individual properties. These Circumstances included percent Managed Lands, Livestock Density and Impervious Surfaces. Therefore, additional calculations were required to determine these Circumstances for each WHPA. The percent Managed Lands and Livestock Density calculations were completed for this project using a methodology developed in consultation with the SGBLS Source Protection Region and was based on the MOE Technical Bulletin for Managed Land and Livestock Density Calculations (MOE, ~~November~~September 2009). Managed Lands, Livestock Density and Impervious Surfaces are discussed in more detail below.

~~18.3.3.4.1~~ ~~118.3.3.5.1.1~~ **Managed Lands**

Managed Land is land to which nutrients (Agriculture Source Material (ASM), commercial fertilizer, Non-Agricultural Source Material (NASM)) are applied. Managed Lands is broken into two subsets; agricultural managed lands and non-agricultural managed lands. Agricultural Managed Lands include areas of crop land, fallow and pasture land that may receive nutrients. Non-agricultural Managed Lands includes golf courses, sports fields and residential lawns and other built up grassed areas that may receive nutrients (primarily commercial fertilizers).

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 ~~Part XII of the Technical Rules (December 2021)~~, ~~the Table of Drinking Water Threats~~. Managed Lands were identified and the Managed Lands proportions were

determined for the Dufferin County WHPA as outlined in Burnside, 2010a-c. [The calculation of Managed Lands was updated to reflect the methodology in the most recent technical bulletin \(November, 2009\).](#) The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 18.3.3.5.2).

Figure 18a-7 illustrates the distribution of Managed Lands within the delineated WHPA zones for the Mansfield Supply.

18.3.3.4.1.2 18.3.3.5.1.2 Livestock Density

Livestock Density is calculated to provide a measure of the potential for generating, storing and land applying ASM as a source of nutrients within a defined area. The livestock density is expressed as Nutrient Units per Acre. It is determined by dividing the Nutrient Units generated in each area by the number of acres of agricultural managed land in the area where agricultural source material is applied.

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 [Part XII of the Technical Rules \(December 2021\)](#). ~~the Table of Drinking Water Threats.~~ The Livestock Density was determined for the Dufferin County WHPAs as outlined in Burnside, 2010a-c. The results from this analysis were used in the enumeration of Significant Drinking Water Threats (Section 18.3.3.5.2). Figure 18a-8 illustrates the distribution of Livestock Density within the delineated WHPA zones for the Mansfield Supply.

18.3.3.4.1.3 18.3.3.5.1.3 Impervious Surfaces

Impervious Surfaces are defined in the Technical Rules as areas that receive road salt application and include roads and parking lots. The areas were determined using road mapping from the National Road Network (Natural Resources Canada) and satellite air photography to identify large parking lots and paved areas. Using a 1 km x 1 km grid centered over each vulnerability area, the percentage of impermeable surfaces within each square kilometre was calculated. For further details on the methods used to assess impervious surfaces for the Dufferin County WHPAs see Burnside, 2010a-c. [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.](#)

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 ~~Part XII of the Technical Rules (December 2021), the Table of Drinking Water Threats. The Impervious Surfaces are used in the identification of threat activities associated with the application of winter de-icing agents (salt).~~

Figure 18a-9 illustrates the distribution of Impervious Surface within the delineated WHPA zones for the Mansfield Supply.

~~18.3.3.4.~~ **18.3.3.5.2 Enumerating Significant Drinking Water Threats – Results**

As discussed above, there are no Significant Threats associated with Conditions or Drinking Water Issues.

Table 18-2 documents the enumeration of existing and potential activities that are considered to be Significant Drinking Water Threats within the WHPAs for the Mansfield Water Supply.

A total of forty-seven (47) Activities have been identified that are considered to be potential Significant Drinking Water Threats in association with thirty-three (33) land parcels. The identified activities include residential and agricultural land uses. Twenty-four (24) parcels were identified as having potential significant threat activities relating to residential land use via the use of private individual sewage disposal systems. Other identified activities relate to application of commercial fertilizer to land eleven (11), application of Agricultural Source Material to land two (2), application of pesticides to land two (2), handling and storage of commercial fertilizer one (1), and handling and storage of pesticide one (1). Three (3) Significant Threats (one per WHPA) have also been included to represent the potential for subsurface storage of fuel for home heating purposes within the area where the Vulnerability Score is ten (10). Three (3) additional parcels were also identified as potential Significant Threats related to handling and storage of fuel.

Table 0-2: Number of Significant Drinking Water Threats for the Mansfield Village Well Supply, Enumeration of Significant Threats (Wellhead Protected Area)

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	24
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	11
9	The handling and storage of commercial fertilizer to land	1
10	The application of pesticide to land	12
11	The handling and storage of pesticide	1
12	The application of road salt	0
13	The handling and storage of road salt	0

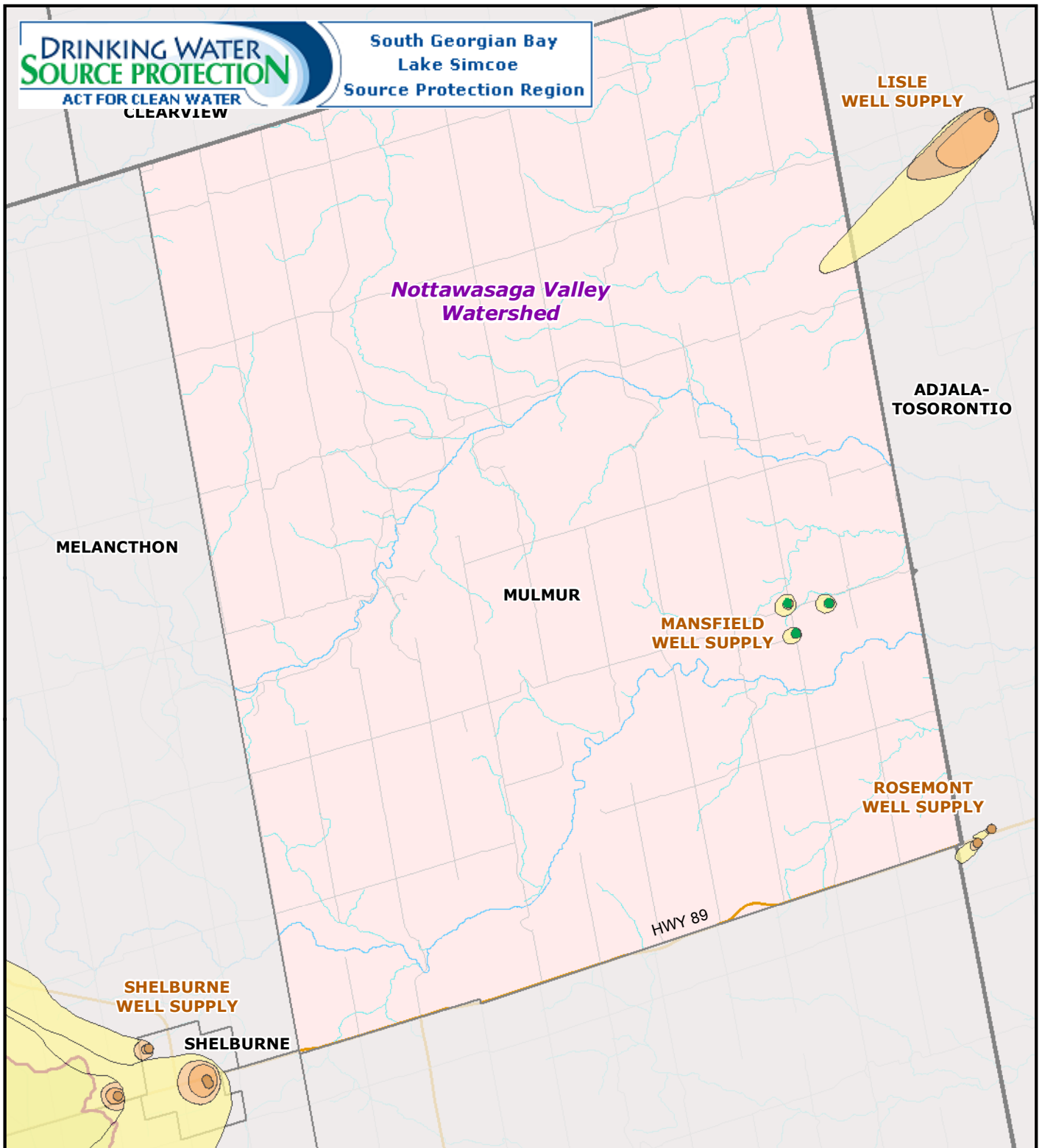
Threat Number	Threat	Significant Threat Counts Number of Threats
14	The storage of snow	0
15	The handling and storage of fuel	6
16	The handling and storage of dense non-aqueous phase liquid	0
17	The handling and storage of an organic solvent	0
18	The management of runoff that contains chemicals used 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
<u>22</u>	<u>The establishment and operation of a liquid hydrocarbon pipeline. O. Reg. 385/08, s. 3; O. Reg. 206/18, s. 1.</u>	0
-	Total Number	467* significant threats (on 33 properties)

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Notes for the table above:

1. The number of parcels identified will typically be less than the number of significant threats as multiple threats can be observed per parcel
2. *23 verified existing Threats and 24 potential Threats that require further investigation



- Municipal Supply Well in Township of Mulmur
- 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)
- SWP Watershed Region
- Upper Tier Municipality
- Lower Tier Municipality

**Drinking Water System
Vulnerable Areas in
Township of Mulmur**

Created by: LSRCA
Date: 2011-04-01



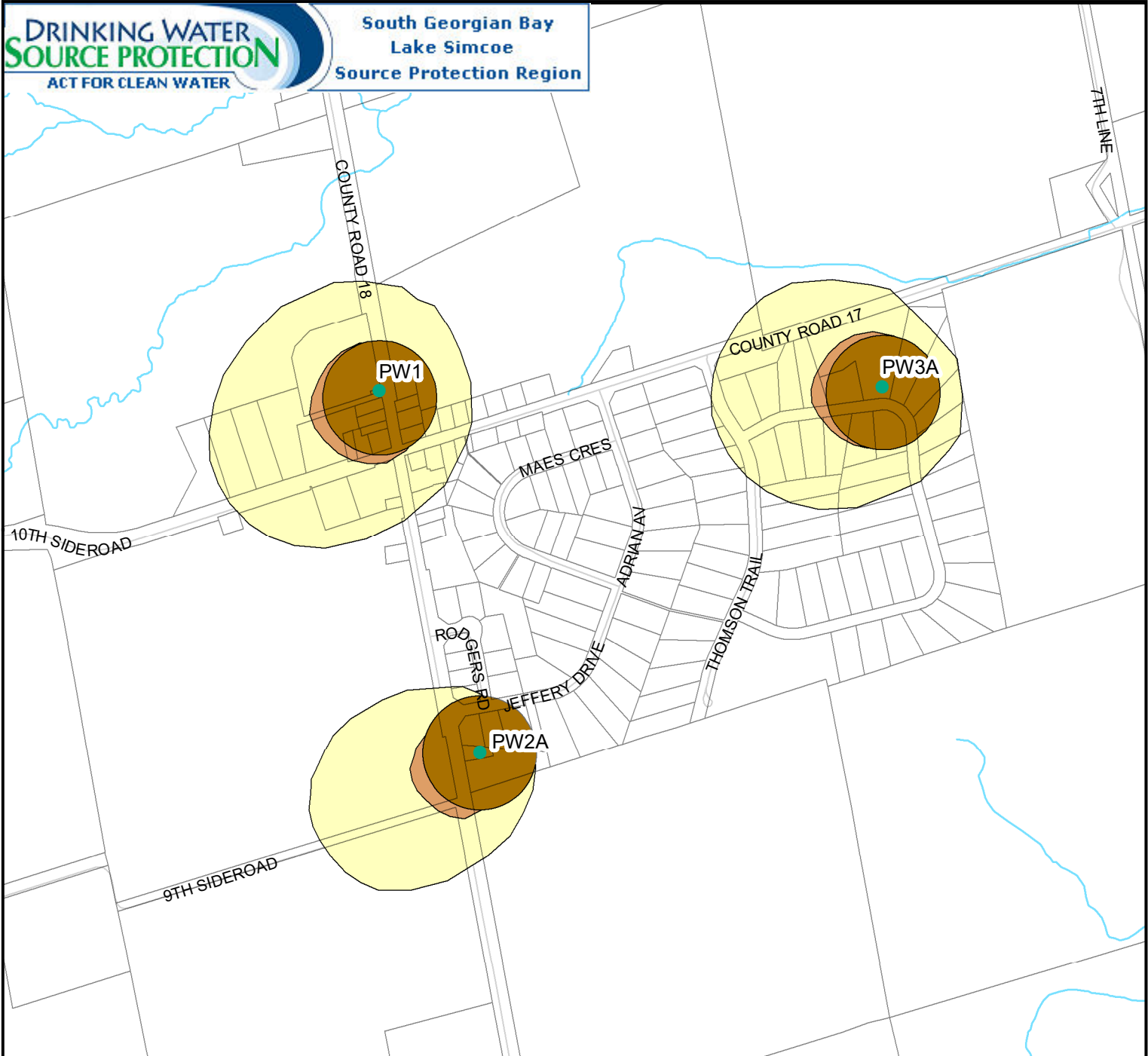
Scale: 1:120,000
0 1 2 3km
UTM Zone 17N, NAD83



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



Figure 18-1



Legend

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



**WELLHEAD PROTECTION AREAS-
MANSFIELD WELL SUPPLY, MULMUR**

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

Created by: NVCA
Date: 2022-03



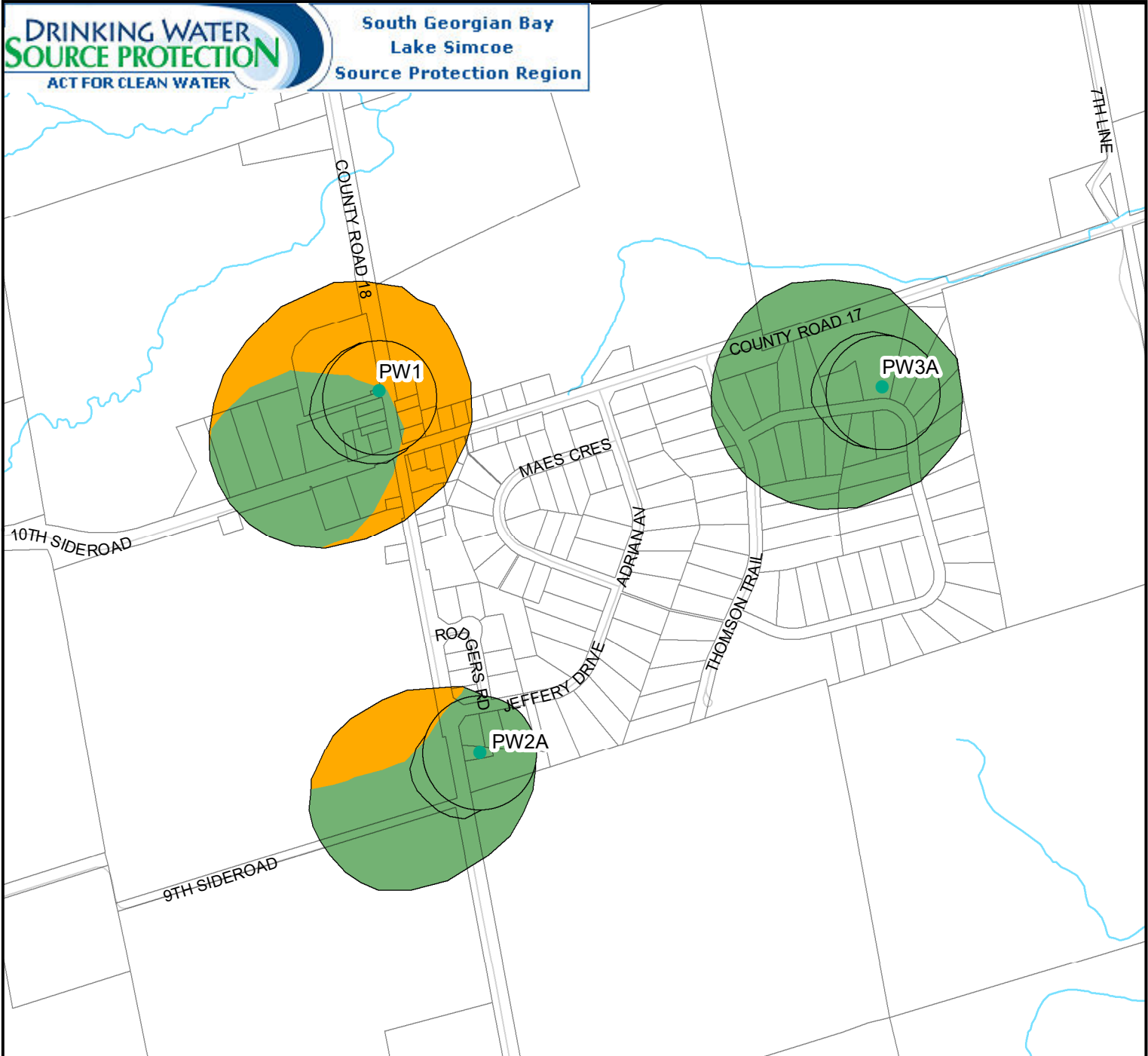
Scale: 1:10,000

UTM Zone 17N, NAD83

Ontario

Figure 18a-1

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.



Legend

● MUNICIPAL WELL LOCATION

Aquifer Vulnerability Index

- High
- Medium
- Low



**GROUNDWATER VULNERABILITY-
MANSFIELD WELL SUPPLY, MULMUR**

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

Created by: NVCA
Date: 2022-03



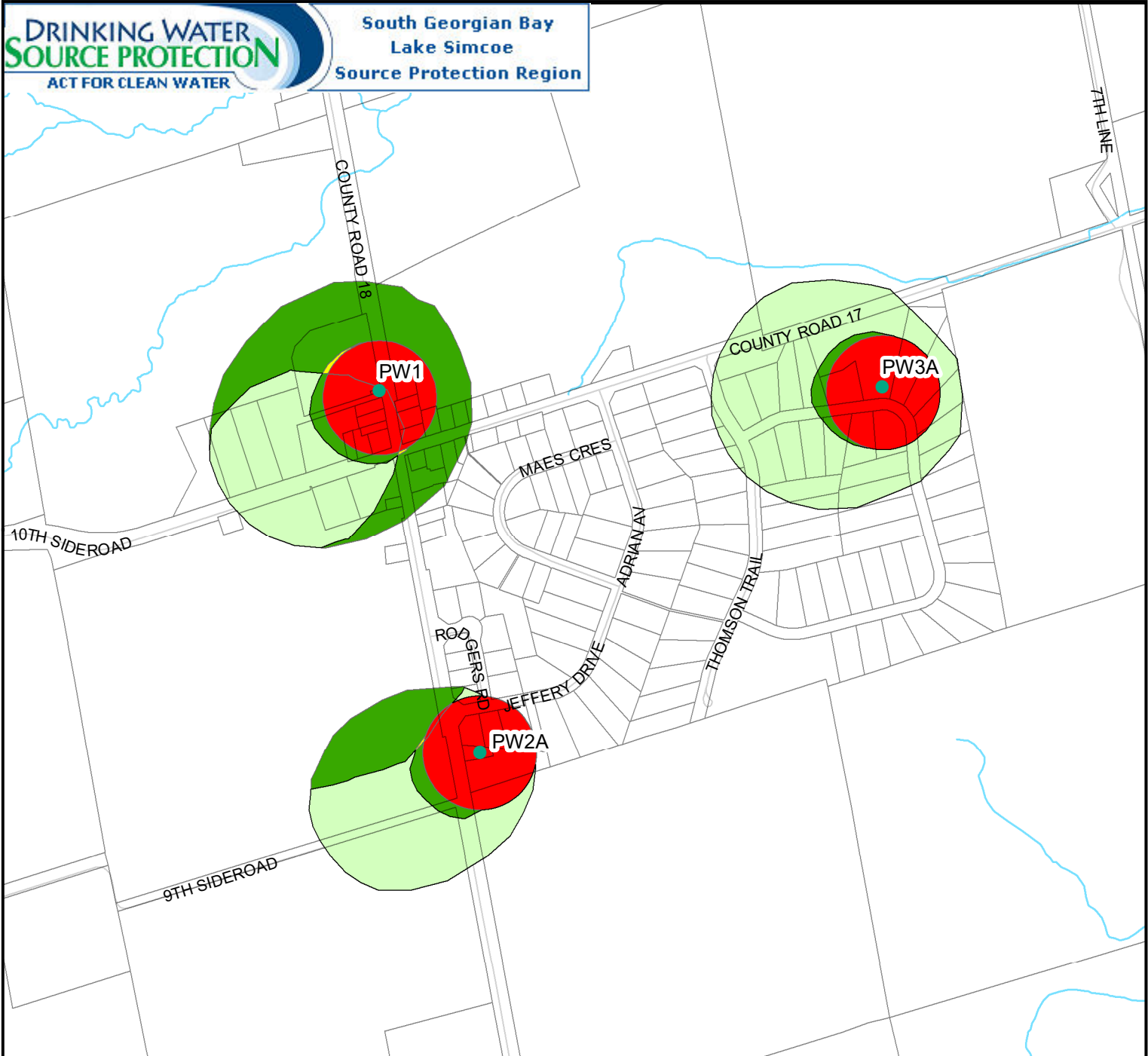
Ontario

Scale: 1:10,000

UTM Zone 17N, NAD83

Figure 18a-2

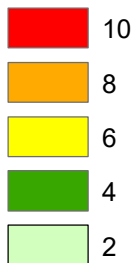
This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose of completing the South Georgian Bay Lake Simcoe Assessment Report. Base data have been compiled from various sources, under data sharing agreements. While every effort has been made to accurately depict the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



Legend

● MUNICIPAL WELL LOCATION

Vulnerability Score



**VULNERABILITY SCORES-
MANSFIELD WELL SUPPLY, MULMUR**

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

Created by: NVCA
Date: 2022-03



Ontario

Scale: 1:10,000

UTM Zone 17N, NAD83

Figure 18a-3

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.



Legend

● MUNICIPAL WELL LOCATION

Vulnerability Score

- 10
- 8
- 6

150 75 0 150 Meters



AREAS WHERE PATHOGENS ARE OR WOULD BE SIGNIFICANT, MODERATE OR LOW THREATS- MANSFIELD WELL SUPPLY, MULMUR

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

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

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

Created by: NVCA
Date: 2022-03

Scale: 1:10,000

UTM Zone 17N, NAD83



Ontario

Figure 18a-4



Legend

● MUNICIPAL WELL LOCATION

Vulnerability Score

- 10
- 8
- 6

150 75 0 150 Meters



AREAS WHERE CHEMICALS ARE OR WOULD BE SIGNIFICANT, MODERATE OR LOW THREATS- MANSFIELD WELL SUPPLY, MULMUR

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

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

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

Created by: NVCA
Date: 2022-03

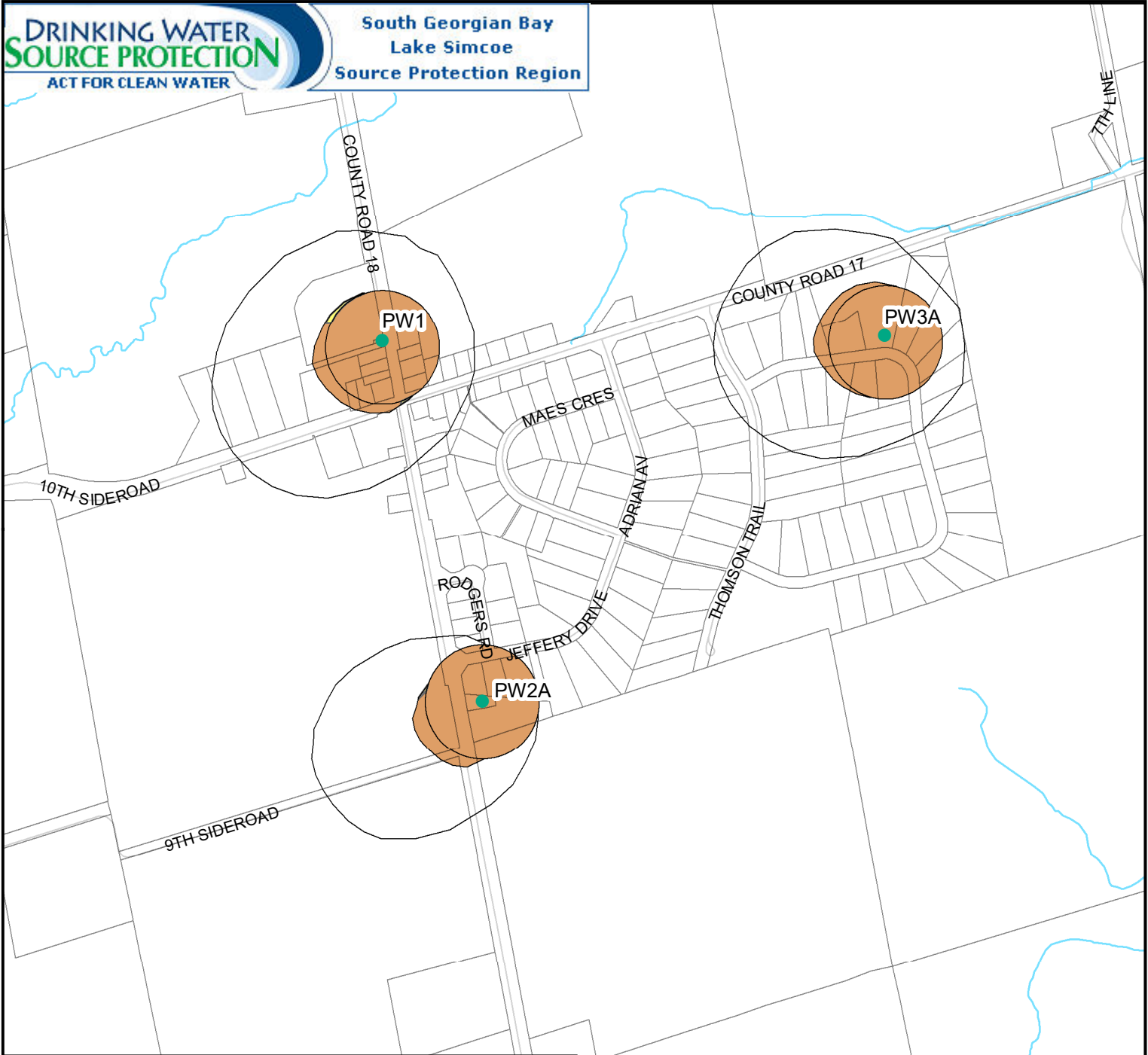
Scale: 1:10,000

UTM Zone 17N, NAD83



Ontario

Figure 18a-5



Legend

- MUNICIPAL WELL LOCATION
 - WHPA-C: 5-YEAR TIME-OF-TRAVEL
- VulnerabilityScore**
- 6



100 50 0 100 Meters

**AREAS WHERE DNAPLS ARE OR WOULD BE SIGNIFICANT, MODERATE, OR LOW THREATS-
MANSFIELD WELL SUPPLY, MULMUR**

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

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

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

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Date: 2022-03

Scale: 1:10,000

UTM Zone 17N, NAD83



Ontario

Figure 18a-6

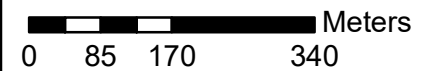
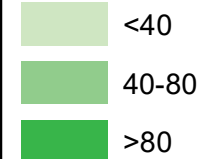
**Managed Lands -
Township of Mulmur
Mansfield
(Well 1, 2 & 3)**



Legend

● Well Locations

Percent Managed Lands



Created by: NVCA
Date: 2020-08-25

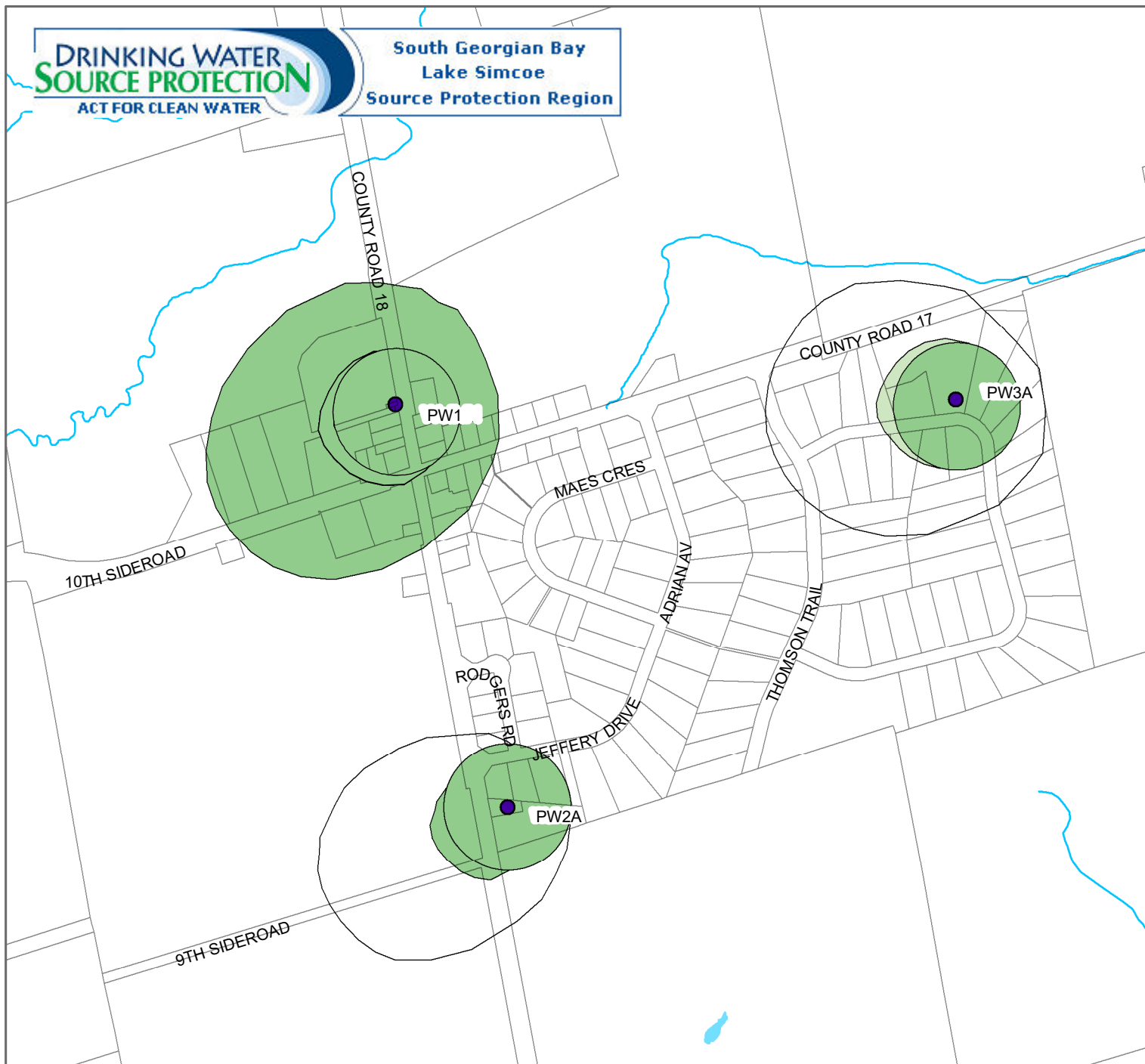
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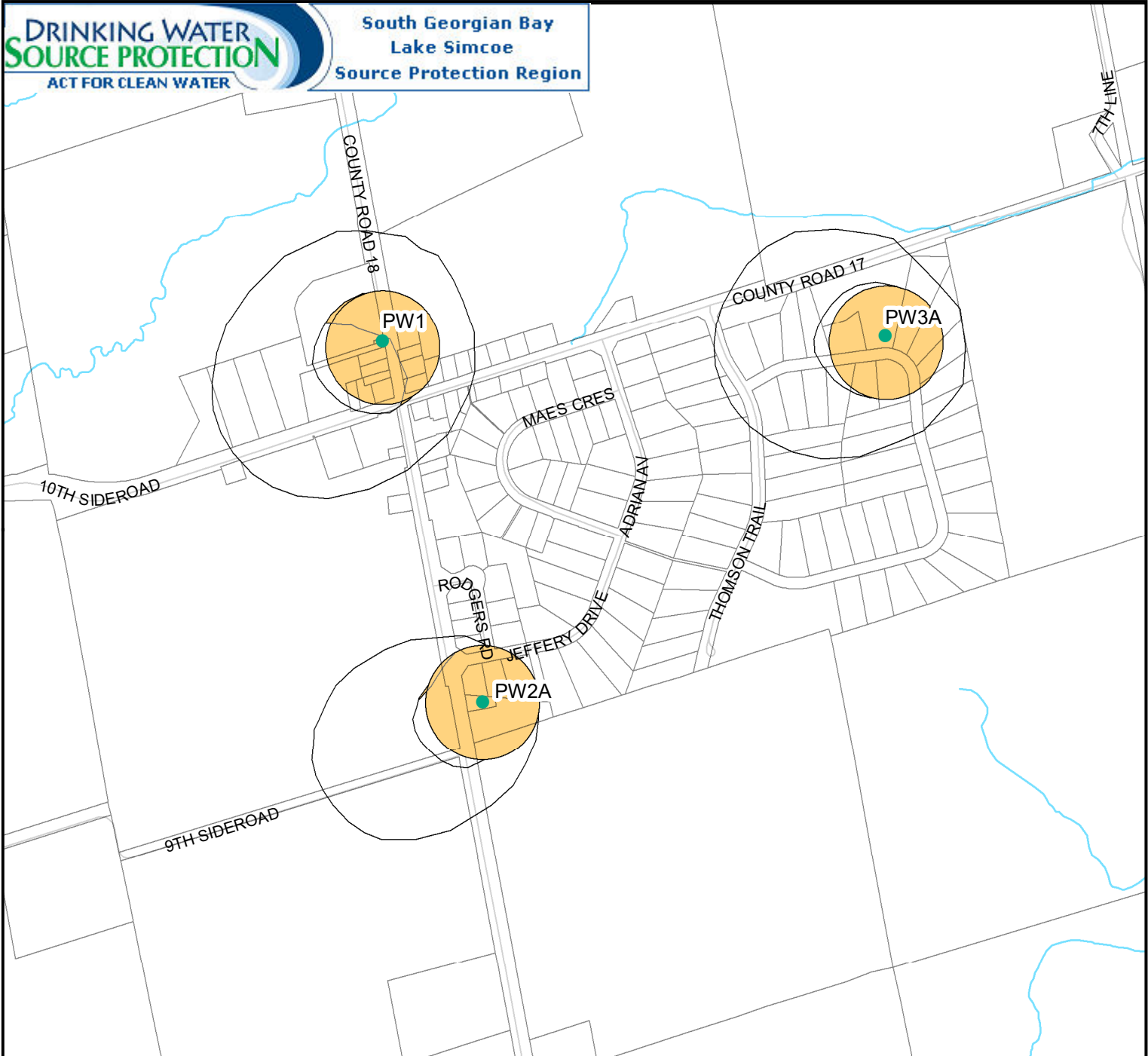
UTM Zone 17N, NAD83



Ontario  **Figure 18a-7**

This map was originally created for the Nottawasaga Valley Conservation Authority Water Budget Model - Geological/Hydrostratigraphic Model Development June 2009, for the purposes of completing the South Georgian Bay Lake Simcoe Assessment reports. While every effort has been made to accurately depict the base data, errors may exist.





Legend

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



**LIVESTOCK DENSITY-
MANSFIELD WELL SUPPLY, MULMUR**

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

Created by: NVCA
Date: 2022-03

Scale: 1:10,000

UTM Zone 17N, NAD83



Ontario

Figure 18a-8

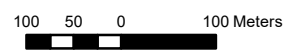
The Livestock Density proportion is illustrated for the parts of WHPA A-D where the vulnerability score is greater than 6.

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.



Legend

- Municipal Well Location
- <1%
- =1 - <6%
- =6 - <8%
- =8 - <30%
- =>30%



IMPERVIOUS SURFACES - MANSFIELD

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

The Impervious Surfaces proportion is illustrated where the vulnerability score is greater than 6.

This map was produced for the South Georgian Bay Lake Simcoe Protection Region for the purpose 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.

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Date: 2025-09

Scale: 1:8,000

UTM Zone 17N, NAD83



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Figure 18a-9