DRINKING WATER SOURCE PROTECTION
Our Actions Matter
CTC Source Protection Region

Toronto and Region SPA Assessment Report

NOTICE OF AMENDMENTS

Currently proposed amendments to this document, made under Ontario Regulation 287/07, Section 34, are summarized in the table below. Page references are to those of the pdf. The proposed amendments to the document are highlighted in yellow.

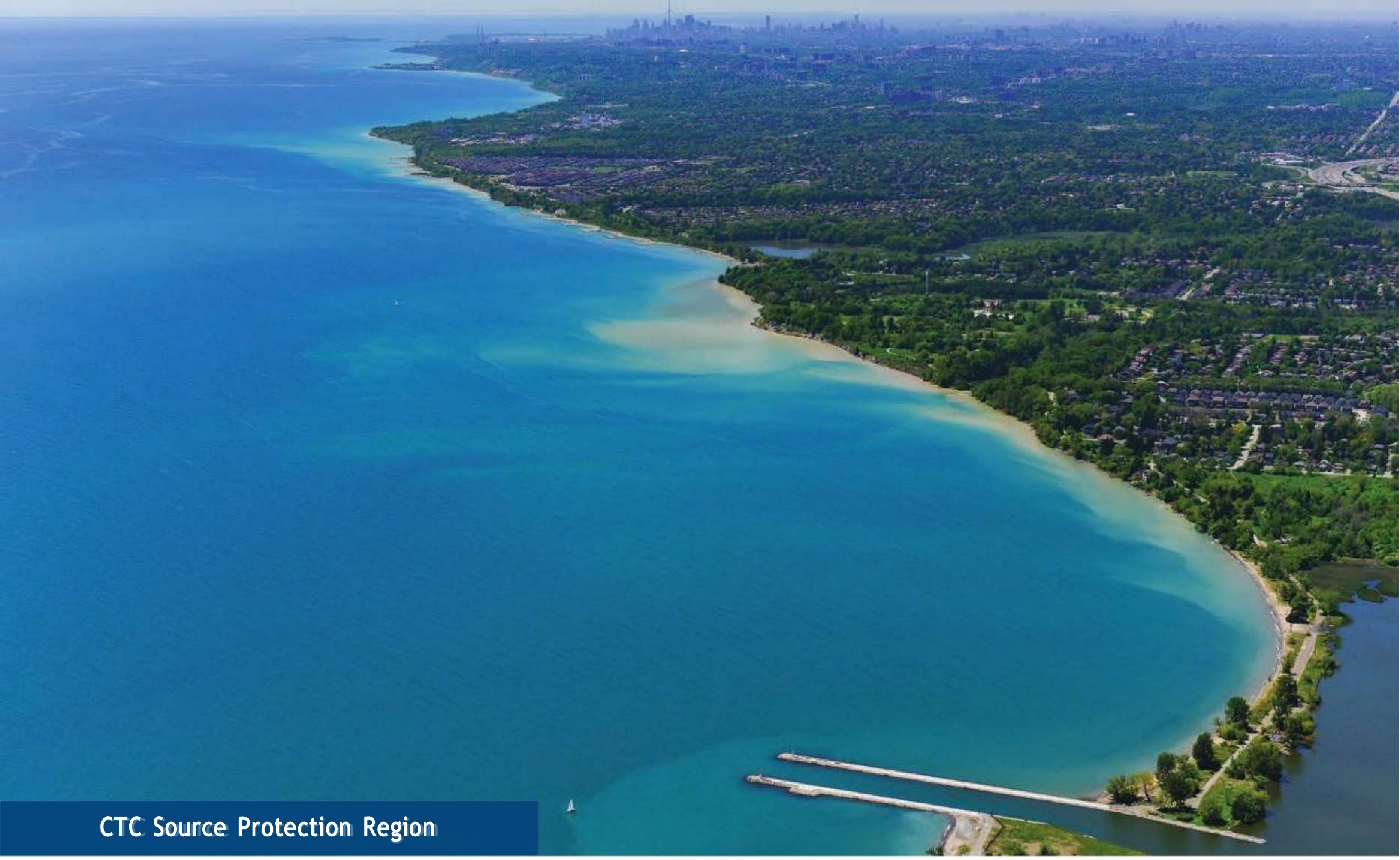
DATE PROPOSED AMENDMENTS POSTED: Monday June 5, 2023

Table: Summary of Anticipated Section 34 Amendments to the Assessment Report for the Toronto and Region Source Protection Area

PDF Page No.	Section or Figure	Brief Description of Anticipated Amendment	Estimated Timing to Submit Proposed Amendment to Ministry of the Environment, Conservation, and Parks
4-5, all pages	Cover page, footers	Update to proposed version number; date of approval and effective dates	September 2023
7	Version Control	Summary of proposed amendment version	September 2023
8	Executive summary	Add version number and Director's Technical Rules documentation	September 2023
10-14	Executive Summary: Figures ES:3, ES:4 and ES:7	Update figures to incorporate new or update WHPA's and IPZ's, and IPZ collector lines	September 2023
15-30	Glossary	Updates to glossary terms	September 2023
31	Introduction	Update text on summary of public consultations	September 2023
33-47	Chapter 2-Watershed Characterization	Update text, maps and tables to reflect: the new production Well PW-7 in Nobiletin; the new deep intake for the Toronto Island system; and the new production Well 6 in Caledon East	September 2023
48	Section 4.1.4	Amendments to text on Transport Pathways methodologies used in technical assessments	September 2023

49-54	Sections 4.2-4.2.2	Updated text and figures on numbers and locations of WHPAs, and transport pathways methodology	September 2023
55-72	Section 4.3	Update text, maps and tables to reflect the new production Well 6 in Caledon East and capacity increases for Palgrave Well 4. Includes updated Wellhead Protection Area (WHPA) delineation, scoring, and mapping as well as updated transport pathways methodology and assessment	September 2023
73-81	Section 4.4	Update text, maps and tables to reflect the new production Well PW-7 in Nobleton. Note that there are no changes to the capture zones or vulnerability scores.	September 2023
82- 92	Section 4.6	Update text, maps and tables to reflect the updated information for the new Toronto Island Intake	September 2023
94-96	Section 5.1.2; Tables 5.1-5.3	Update text and tables to reflect where threats can exist under different version of Director's Technical Rules	September 2023
97	Section 5.5, Table 5.8	Updates number of wells and significant threat and parcel counts in text and table	September 2023
98-117	Section 5.5.1	Update text, maps, and tables to reflect the new production Well 6 in Caledon East and capacity increase for Palgrave Well 4. Includes updated Threats from Managed Lands, Livestock Density and Impervious Surfaces.	September 2023
118-127	Section 5.5.2	Update text, maps, and tables to reflect the new production Well 7 in Nobelton. Includes updated analysis from Managed Lands, Livestock Density and Impervious Surfaces.	September 2023
128- 186	Section 5.7	Update text, maps and tables to reflect the updated information for the new Toronto Island Intake	September 2023

		and threat assessment for the new Ashbridges Bay Outfall	
187	Table 6-1	Update significant threat and parcel counts.	September 2023
189-200	Chapter 7	Update references	September 2023



DRINKING WATER SOURCE PROTECTION
Our Actions Matter
CTC Source Protection Region

~~Approved~~ Proposed Amended Assessment Report: Toronto and Region Source Protection Area

Prepared by: CTC Source Protection Committee
Approved: ~~February 23, 2022~~TBD
Effective Date: ~~March 2, 2022~~TBD
Version ~~5~~6.0 (Proposed June 5, 2023)

DRINKING WATER
SOURCE PROTECTION
Our Actions Matter
CTC Source Protection Region

~~Approved~~ Proposed Amended Assessment Report:

Toronto and Region Source Protection Area

Toronto and Region Conservation Authority

Ontario

This project has received funding support from the Government of Ontario.

Preface

Source Protection Committee Commitment

The CTC Source Protection Committee (SPC) is a multi-stakeholder committee selected to represent municipal, economic, and public interests. The SPC has legislated responsibilities to protect drinking water sources across the CTC Source Protection Region.

The SPC has developed a Source Protection Plan that is currently being implemented by responsible parties, including municipalities, in order to eliminate, reduce, or manage threats to drinking water sources, both now and in the future.

About This Document

This Assessment Report identifies the location and nature of threats to sources of municipal drinking water supplies. These threats include activities that are impacting or could adversely impact drinking water quality or quantity from groundwater and/or surface water sources.

The Toronto and Region Source Protection Authority submitted the original *Proposed Assessment Report* to the Minister of the Environment for approval in December 2010**.** At that time, additional technical work was being carried out, which necessitated updates to the *Proposed Assessment Report*. The *Amended Proposed Assessment Report* was submitted to the Ministry of the Environment on July 29, 2011, and it was subsequently approved on January 18, 2012. An updated Assessment Report was submitted to the Province in December 2014 and approved in July 2015.

Public comments on this Assessment Report were sought in May 2014 for the Tier 3 Water Budget study on the municipal water systems in York Region coinciding with consultation on newly proposed water quantity policies. The public was invited to review the *Updated Approved Assessment Report* online at www.ctcswp.ca. In addition, a public drop-in session was held in collaboration with the South Georgian Bay-Lake Simcoe Source Protection Region in the Town of Whitchurch-Stouffville on May 7, 2014 for those wanting more information. Notice of this comment period was posted online and sent to individuals on the CTC SPC's electronic mailing list. Residents impacted by the Tier 3 Water Budget and quantity policies were also informed by newspaper advertisements in local weekly newspapers of their opportunity to comment. The comments and input received during the public consultation periods were considered by the CTC SPC in finalizing this Assessment Report.

Note 1: The Ministry of Environment, Conservation and Parks has undergone several name changes throughout the years. It was called the Ministry of Environment (MOE) in the early 2000's. In June 2014, the name was changed to the Ministry of the Environment and Climate Change (MOECC). In June 2018, the name was changed yet again, to the Ministry of the Environment, Conservation and Parks (MECP), as it is currently known. In June 2014, the Ministry of Natural Resources (MNR) changed its name to the Ministry of Natural Resources and Forestry (MNRF). In 2021, the Ministry of Natural Resources and Forestry changed its name to Ministry of Northern Development, Mines, Natural Resources and Forestry and in 2022, its name to Ministry of Northern Development, Natural Resources and Forestry. The recent and past names of both Ministries are used within this document.

Version Control

Version	Approval Date	Effective Date	Description of Amendment
1.0	July 24, 2015	December 31, 2015	N/A
2.0	n/a	n/a	Section 51: Review and update for consistency between chapters, as well as with the Credit Valley and Central Lake Ontario Assessment Reports. Section 51: Update wording for Tables of Drinking Water Threats to direct readers to https://swpip.ca/. Date amendment posted: June 5, 2018
3.0	March 11, 2019	March 25, 2019	Section 34: Updated protection areas around Caledon East municipal drinking water system in the Town of Caledon.
4.0	February 23, 2022	March 2, 2022	Section 51: Minor typographical changes. Section 34: Updated protection areas around the Aurora Drinking Water System.
5.0	n/a	n/a	Amendments to the document, made under Ontario Regulation 287/07, Section 51, to correct clerical, grammatical or typographical errors; to make changes referencing a name, title, location, or address that has changed; to incorporate Phase I Director Technical Rule 2017 amendments Date amendment posted: May 20, 2022
6.0	TBD	TBD	Section 51: Minor typographical changes Section 34: Updated protection areas around the Palgrave and Caledon East Drinking Water System. Updated protection areas around Nobleton Drinking Water System. Updated protection areas around Toronto Drinking Water System.

EXECUTIVE SUMMARY

Why should you read this document?

The *Approved Updated Assessment Report: Toronto and Region Source Protection Area* (Assessment Report) has been prepared under the direction of the CTC Source Protection Committee (SPC), one of 19 such committees across Ontario (**Figure ES: 1**). It is a requirement of the *Clean Water Act, 2006* (*CWA*) and Ontario Regulation (O. Reg.) 287/07 as amended by O. Reg. 59/10 and has been developed in accordance with the regulations, the *Technical Rules*: A*ssessment Report* and the *Terms of Reference: Toronto and Region Source Protection Area*, as approved by the Minister of the Environment, Conservation and Parks. Amendments to the Toronto and Region Assessment Report resulting in versions 2.0, 3.0~~, and~~ 4.0 and 5.0 were made using the 2017 Director's Technical Rules and Tables of Drinking Water Threats. Sections of the Assessment Report that were not updated as part of those amendments refer to the 2009 edition of the Director's Technical Rules and Tables of Drinking Water Threats.

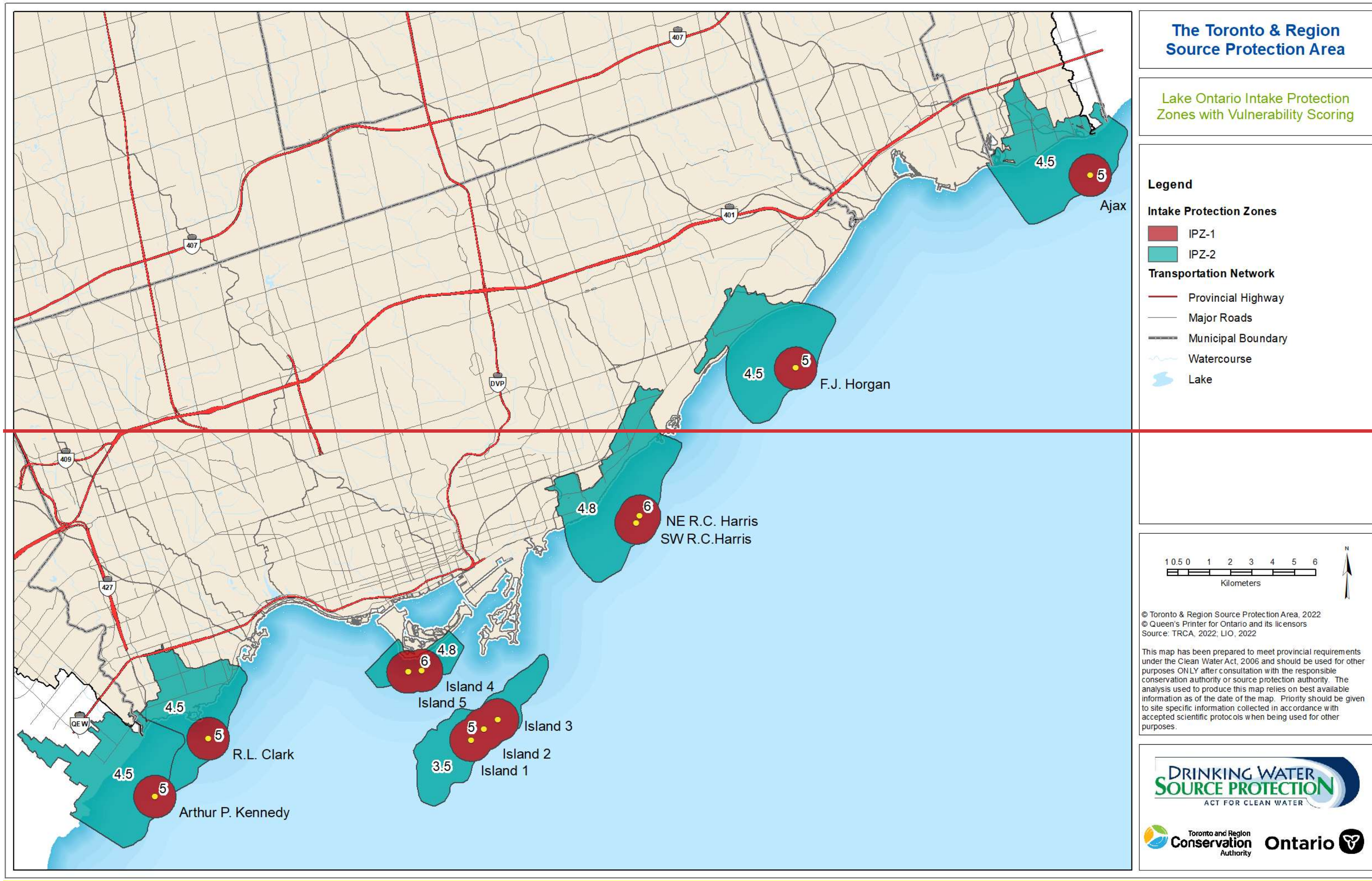
This version 6.0 of the Assessment Report identifies the location and nature of threats to sources of municipal drinking water supplies. These threats include activities that are impacting or could adversely impact drinking water quality or quantity from groundwater and/or surface water sources. New information includes a new vulnerable area, significant water quantity threats based on the recently completed York Tier 3 Water Budget work, additional threats to surface water quality in Lake Ontario, and updated maps.

This Assessment Report identifies the location and nature of potential threats to sources of municipal drinking water. These threats include activities that are adversely impacting, or could impact, drinking water quality or quantity from groundwater and/or surface water sources.

Source protection committees determine threats to drinking water sources by delineating and applying vulnerability scores to different types of vulnerable areas, where they exist, within each source protection area, as discussed in the legislation. These areas are:

- Intake protection zones (IPZs);
- Highly vulnerable aquifers (HVAs);
- Significant groundwater recharge areas (SGRAs);
- Wellhead protection areas (WHPAs);
- Issue contributing areas (ICAs); and
- Water quantity vulnerable areas (WHPA-Q1/Q2).

Detailed information about how these vulnerable areas were delineated and scored can be found in **Chapters 4** (regarding vulnerability) and **Chapter 5** (regarding Intake Protection Zone-3)**.** This Assessment Report identifies and describes, per the *Technical Rules*, each of these types of vulnerable areas within the Toronto and Region Source Protection Area (TRSPA). Below are maps showing the vulnerable areas within the TRSPA. Descriptions, scoring, and documentation on the analyses performed to arrive at these delineations are all contained in the body of this Assessment Report or in the referenced technical appendices.


The Toronto & Region Source Protection Area
Lake Ontario Intake Protection Zones with Vulnerability Scoring
Legend
Intake Protection Zones
IPZ-1
IPZ-2
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
1 0.5 0 1 2 3 4 5 6
Kilometers
N
© Toronto & Region Source Protection Area, 2022
© Queen's Printer for Ontario and its licensors
Source: TRCA, 2022; LIO, 2022
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
Ajax
F.J. Horgan
NE R.C. Harris
SW R.C.Harris
Island 4
Island 5
Island 3
Island 2
Island 1
R.L. Clark
Arthur P. Kennedy
4.5
5
4.8
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3.5
407
401
409
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DVP
QEW

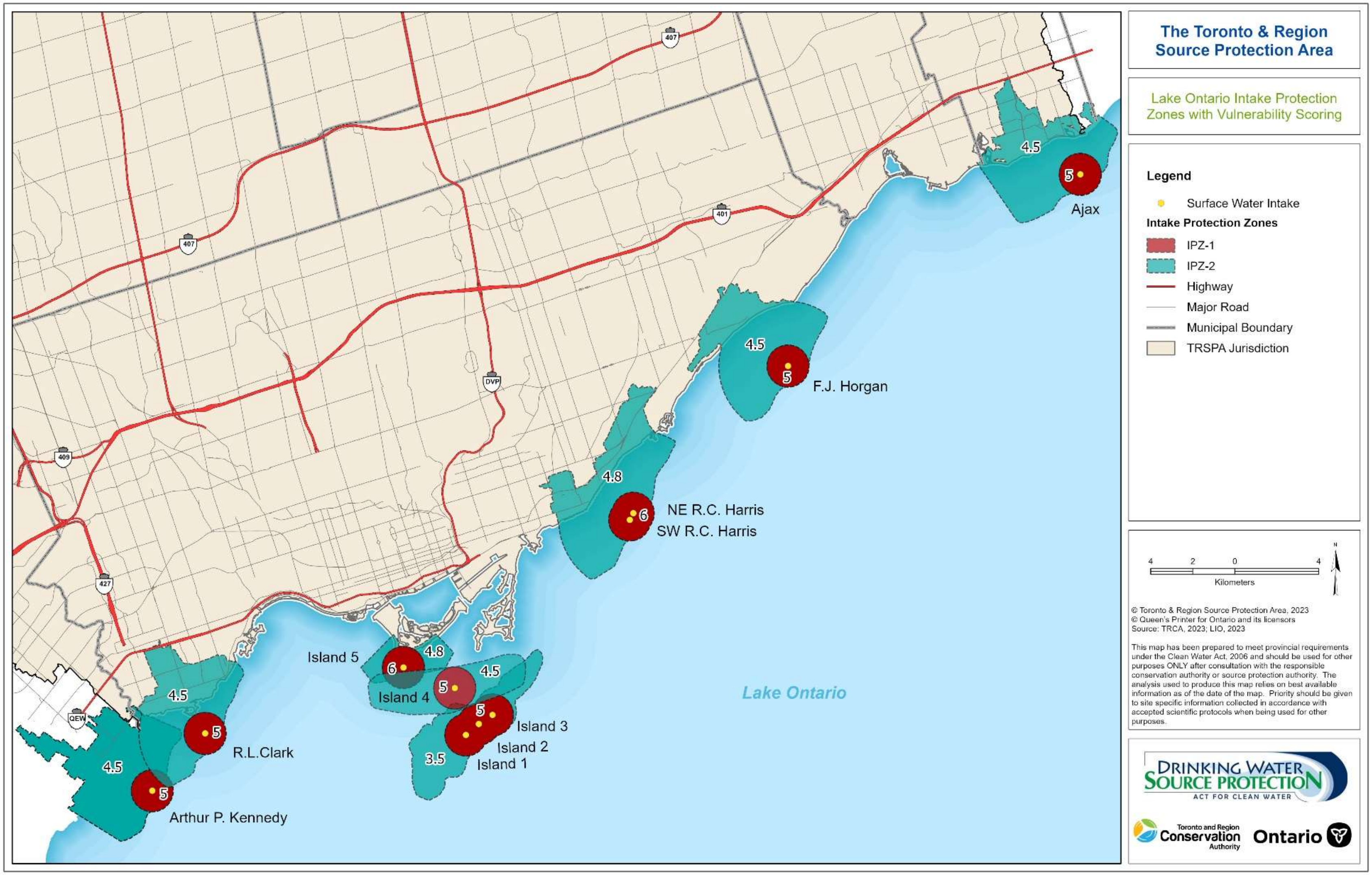
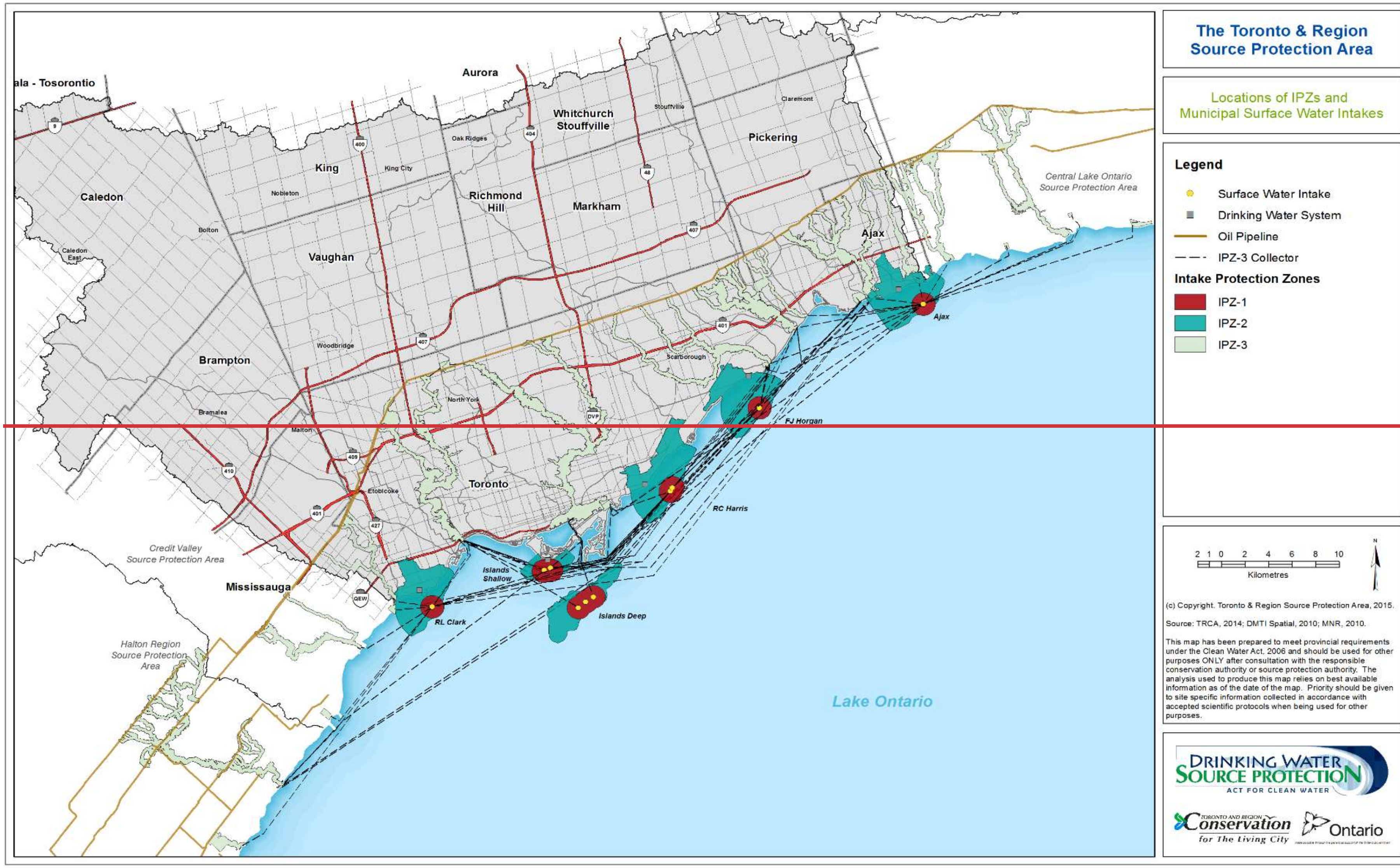


Figure ES: 3: Intake Protection Zones Delineation 1 and 2 with Vulnerability Scoring for TRSPA Water Treatment Plants


The Toronto & Region Source Protection Area
Locations of IPZs and Municipal Surface Water Intakes
Legend
Surface Water Intake
Drinking Water System
Oil Pipeline
IPZ-3 Collector
Intake Protection Zones
IPZ-1
IPZ-2
IPZ-3
Aurora
Whitchurch Stouffville
Pickering
King
Caledon
Richmond Hill
Markham
Vaughan
Ajax
Brampton
Toronto
Mississauga
Central Lake Ontario Source Protection Area
Credit Valley Source Protection Area
Halton Region Source Protection Area
Lake Ontario
RL Clark
Islands Shallow
Islands Deep
RC Harris
FJ Horgan
Kilometres
(c) Copyright. Toronto & Region Source Protection Area, 2015.
Source: TRCA, 2014; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation for The Living City
Ontario

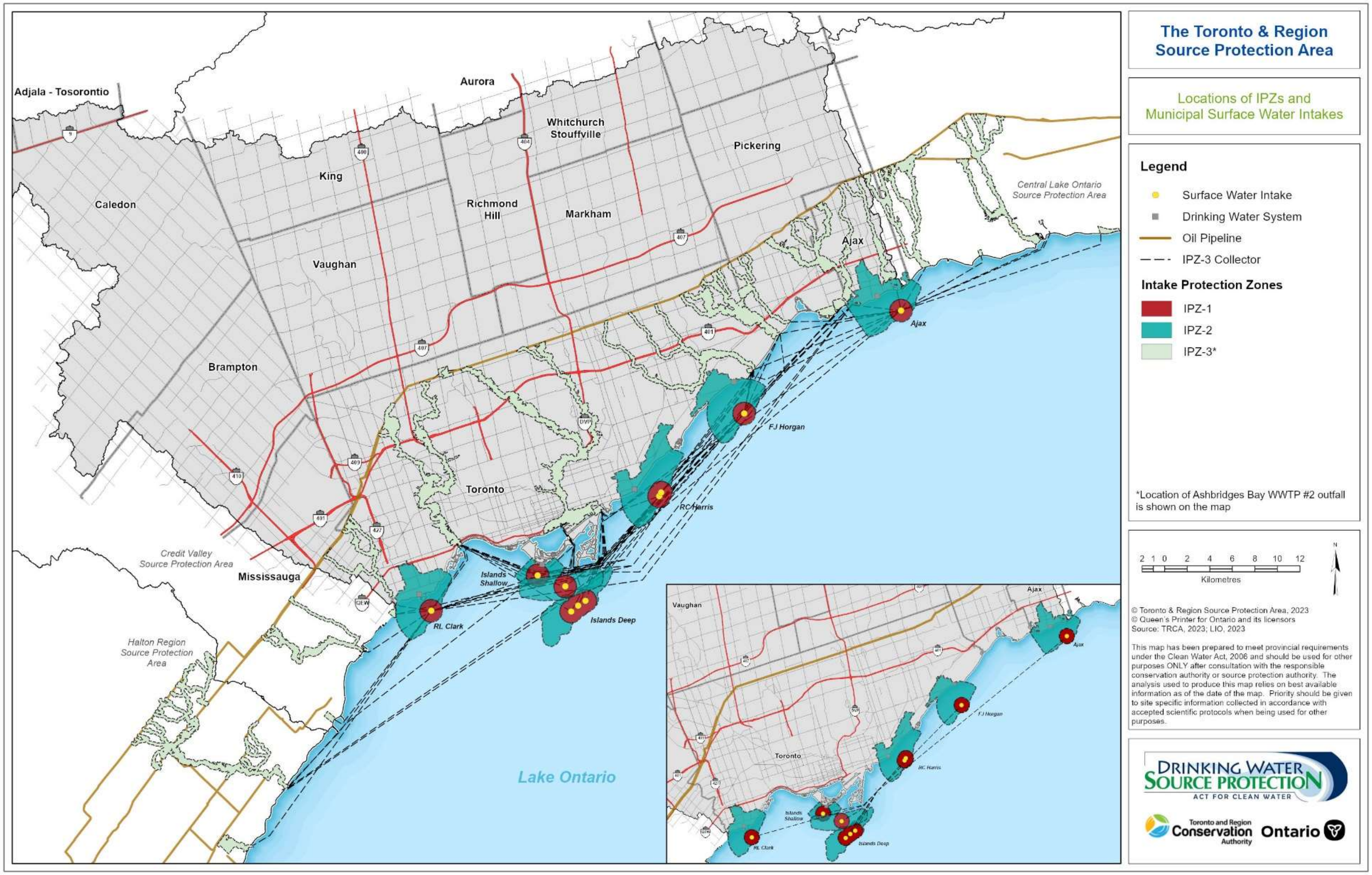
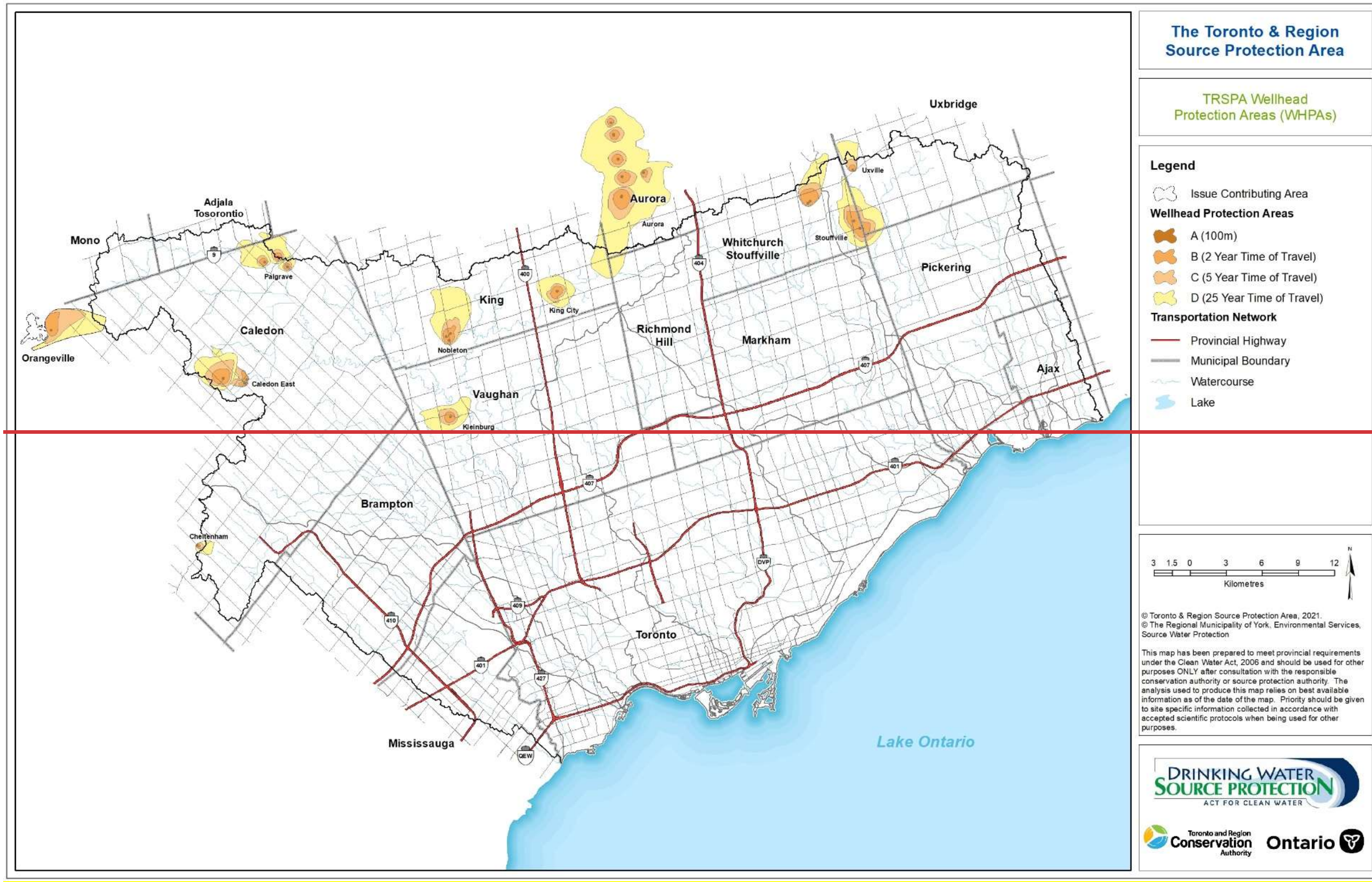


Figure ES: 4: Location of Intake Protection Zones and Municipal Surface Water Intakes


The Toronto & Region
Source Protection Area
TRSPA Wellhead
Protection Areas (WHPAs)
Legend
Issue Contributing Area
Wellhead Protection Areas
A (100m)
B (2 Year Time of Travel)
C (5 Year Time of Travel)
D (25 Year Time of Travel)
Transportation Network
Provincial Highway
Municipal Boundary
Watercourse
Lake
Kilometres
© Toronto & Region Source Protection Area, 2021.
© The Regional Municipality of York, Environmental Services, Source Water Protection
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
Uxbridge
Adjala Tosorontio
Mono
Aurora
Whitchurch Stouffville
Pickering
King
Caledon
Orangeville
Richmond Hill
Markham
Ajax
Vaughan
Brampton
Toronto
Mississauga
Lake Ontario
Palgrave
Nobleton
King City
Caledon East
Kleinburg
Uxville
Stouffville
Cheltenham

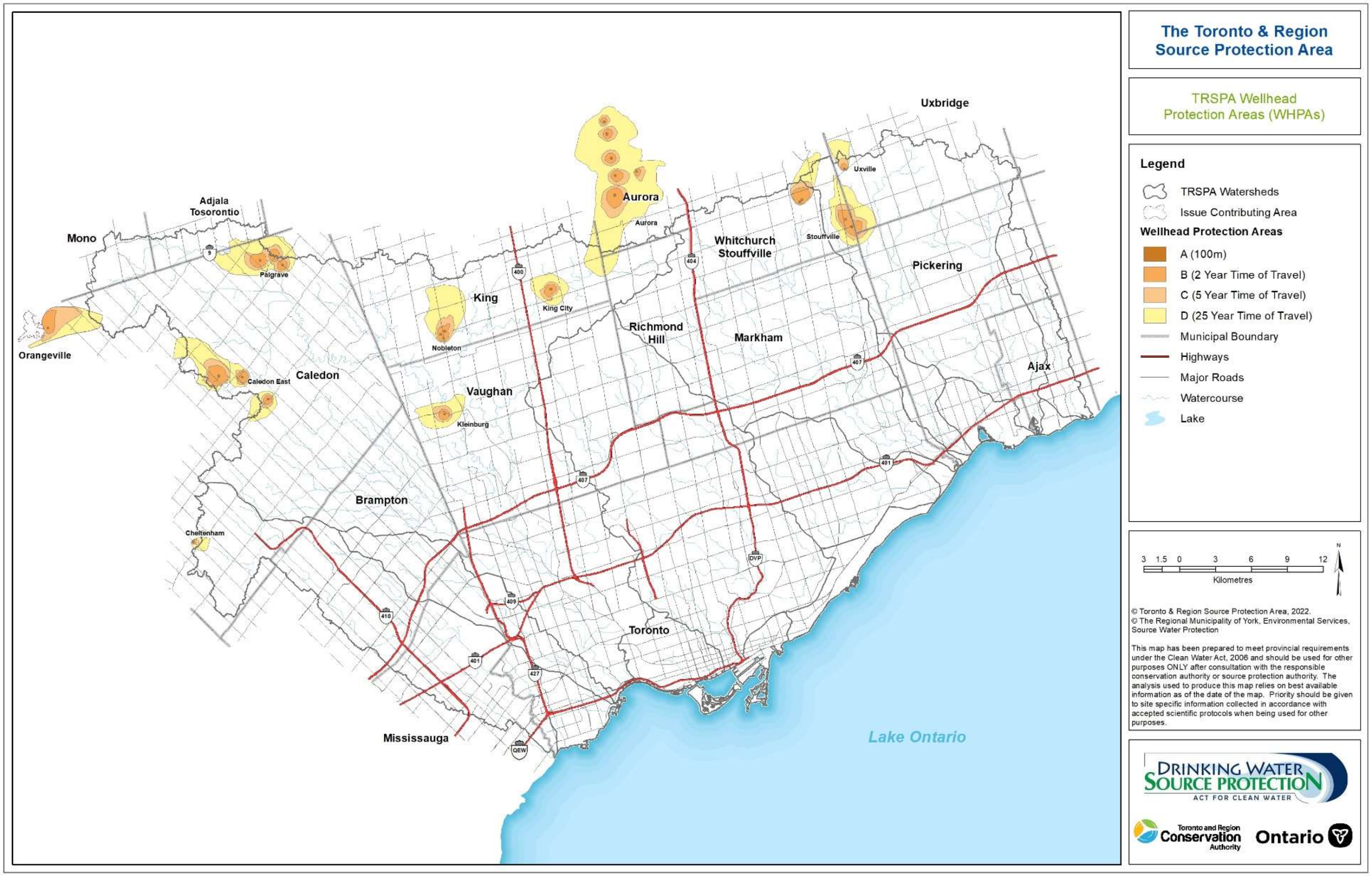


Figure ES: 7: TRSPA Wellhead Protection Areas (WHPA)

Glossary

Below are some terms, scientific and non-scientific, related to Drinking Water Source Protection. Note that some of these terms are derived from draft documents, and as such may be subject to change. They are provided here for information purposes, not as official legal definitions.

Abandoned Well: A well that is deserted because it is dry, contains non-potable water, was discontinued before completion, is not being properly maintained, was constructed poorly, or for which it has been determined that natural gas may pose a hazard.

~~**Abiotic**: Not relating to living things.~~

Activity: One or a series of related processes, natural or anthropogenic that occur within a geographical area and may be related to a particular land use.

~~**Aggregate Risks**: Multiple risks in a municipal water supply protection area that are considered together relative to the overall risk to drinking water sources.~~

~~**Agro-ecosystem**: Any agricultural system, which incorporates a natural community of plants and animals within a particular physical environment, on land where domestic animals are raised or crops grown.~~

~~**Ambient water**: Natural concentration of water quality constituents prior to mixing of either point or non-point source load of contaminants.~~

~~**Aquatic**: Growing or living in water.~~

~~**Aquiclude**: A saturated geologic unit that is incapable of transmitting significant quantities of water under ordinary conditions.~~

Aquifer: ~~An underground area of porous, permeable soil or rock that contains a sufficient amount of water to support a domestic well. Shallow aquifers exist in the overburden, the sedimentary rock and soil above bedrock, whereas bedrock aquifers are found in the bedrock itself, beneath whatever overburden is present.~~ An underground layer of water-bearing sediments (e.g. sand, gravel) or permeable rock from which groundwater can be usefully extracted via a water well

Aquifer Vulnerability Index (AVI): A numerical indicator of an aquifer intrinsic or inherent vulnerability susceptibility to contamination expressed as a function of the thickness and permeability of overlying layers.

Aquitard: The layer of geological material that prevents or inhibits the transmission of water in a confined aquifer.

Artesian: groundwater under sufficient pressure to rise above the top of the aquifer containing it.

~~**Attenuation (Flow)**: Flow that is lessened or weakened or the severity reduced.~~

~~**Average Maximum Water Velocity**: The average highest speed of a surface water body.~~

~~**Bank Stability**: The ability of a stream bank to resist change.~~

Baseflow: ~~The water that flows into a stream through the subsurface.~~The sustained component of flow in a watercourse (I.e. stream, river) which continues even through dry weather periods. It is normally regarded as the sum of groundwater flow and delayed throughflow.

Bedrock: The solid rock underlying unconsolidated surface material.

Bedrock Geology: The study of the solid rock underlying unconsolidated surface material. Also refers to description of bedrock types.

~~**Benthic**: Occurring at the base of bodies of water: lakes, oceans and seas.~~

Benthic Invertebrates: Small aquatic organisms that live in stream sediments and are a good indicator of water quality and stream health.

Biochemical Oxygen Demand (BOD): A measurement used to assess the rate at which water is deoxygenated. High BOD generally corresponds to water containing high amounts of organic pollution.

~~**Bioengineering**: The application of biological science to engineering principles. The use of living or organic plant material to achieve engineering solutions.~~

~~**Biogeochemistry:** The study of the cycles of chemical elements, such as carbon and nitrogen, and their interactions with and incorporation into living things.~~

~~**Biological Diversity**: The variability among organisms and the ecological complexes of which they are a part.~~

~~**Biomass**: The amount of living matter, usually measured per unit area or volume of habitat.~~

~~**Biotic:** Relating to, produced by, or caused by living organisms~~

Bog: A wetland ecosystem characterized by high acidity, low nutrient levels, and accumulation of peat and mosses, chiefly *Sphagnum*. The water table is at or near the surface in spring, and slightly below during the remainder of the year. The bog surface is often raised; if flat or level with the surrounding wetlands, it is virtually isolated from mineral soil waters. Peat is usually formed in situ under closed drainage and oxygen saturation is very low. ~~Bogs are rare across the Toronto and Region Source Protection Area (TRSPA).~~

~~**Broader Landscape**: The watershed or drinking water source protection study area. Applies to regional, rather than local aquifer vulnerability assessments; usually using an indices method of vulnerability assessment.~~

***Campylobacter* Bacteria:** Bacteria commonly found in the intestines of humans and animals. Some types of *Campylobacter* can cause serious illness in humans.

~~**Carbon Sequestration**: Process by which carbon is removed from the environment and held within, for example, a wetland.~~

Catchment: The groundwater and surface water drainage area from which a woodland, wetland, or watercourse derives its water.

Chemical: A substance used in conjunction with, or associated with, a land use activity or a particular entity, and with the potential to adversely affect water quality.

Climate: The average weather conditions of a place or region throughout the seasons.

Cold water: Water with a temperature of approximately 14ºC. This thermal habitat is typically considered ideal for brook and brown trout.

Conceptual Water Budget: A written description of the overall flow system dynamics for each watershed in the Source Protection Area taking into consideration surface water and groundwater features, land cover (e.g., proportion of urban vs. rural uses), human-made structures (e.g., dams, channel diversions, water crossings), and water takings.

~~**Conductivity**: The quality or power of conducting or transmitting.~~

Cone of Influence: For one or more wells that draw water from an aquifer, this is the area within the depression created in the water table or potentiometric surface when the wells are pumped at a rate equivalent to their allocated plus planned quantities of water.

Confined Aquifer: An aquifer that is bounded above, and perhaps below by layers of geological material that do not transmit water readily.

~~**Conservation**: The protection of natural or man-made resources and landscapes for later use.~~

~~**Consumptive Use:** Water use that diminishes the source and is not available for other and future uses.~~

Contaminant: Chemicals and pathogens.

Contaminant of Concern: A chemical or pathogen that is or may become a drinking water threat.

Contamination: The mixing of harmful elements, compounds or microorganisms with surface or groundwater. Contamination can occur naturally (e.g., an aquifer flowing through mineral deposits that contain heavy metals) or through human activity (e.g., sewer water flowing into a river). Nutrients, such as nitrogen and phosphorus, can also cause water contamination when they are present in excessive amounts.

~~**Contiguous**: Having contact with, or touching along a boundary or point.~~

~~**Cumulative (water quality) Effects**: The consequence of multiple threats sources, in space and time, which affect the quality of drinking water sources.~~

~~**Cumulative (water quantity) Effects**: The consequence of multiple threats sources, in space and time, which affect the quantity of drinking water sources.~~

~~**Data Gaps**: The lack of raw information for a specific geological area and/or specific type of information.~~

Decommissioned Wells: ~~Capped, plugged and sealed in compliance with regulatory requirements (O. Reg. 903) established by the Ministry of the Environment and Climate Change.~~ To permanently fill in and seal a well to eliminate the well as a source of water, or as a potential physical hazard and to prevent movement of water within well.

Dense Non-Aqueous Phase Liquids (DNAPLs): a group of chemicals that is insoluble and denser than the water portion of the shallowest aquifer~~water.~~

Designated System: A ~~drinking water system that are included in a terms of reference, pursuant to resolution passed by a municipal council under subsection 8(3) of the proposed *Clean Water Act, 2005*~~ drinking water system that is included in a Terms of Reference for developing source protection plans, pursuant to resolution passed by a municipal council under subsection 8(3) of the *Clean Water Act, 2006* or added by the Minister..

~~**Developed / Developable**: Reference to the useable portion of a parcel of land that meets the regulatory zoning provisions, particularly those pertaining to defining the area of occupation for buildings, structures, facilities and infrastructure.~~

Discharge Area: An area where water leaves the saturated zone across the water table surface.

~~**Drainage Density**: Length of watercourse per unit drainage area.~~

Drainage System (under the Drainage Act): ~~A drain constructed by any means, including works necessary to regulate the water table or water level. This broad definition allows for features to be included in drainage systems to restore wetlands while still protecting the agricultural interests of the private landowners.~~ A drain constructed by any means, including the improving of a natural watercourse, and includes works necessary to regulate the water table or water level within or on any lands or to regulate the level of the waters of a drain, reservoir, lake or pond, and includes a dam, embankment, wall, protective works or any combination thereof. Physically, a municipal drain is simply a drainage system. Under the Drainage Act, municipalities are legislated to maintain and repair drains and to respond to petitions for new drainage systems. Municipal drains are generally watercourses as defined under the Conservation Authorities Act and are therefore regulated by Conservation Authorities.

Drained: A condition in which the level or volume of groundwater or surface water has been reduced or eliminated from an area by artificial means.

Drinking Water Concern: A purported drinking water issue that has not been substantiated by monitoring, or other verification methods. Drinking water concerns will be identified through consultations with the public, stakeholder groups, and technical experts (e.g., water treatment plant operators).

Drinking Water Threat: ~~An existing activity, possible future activity or existing condition that results from a past activity, (a) that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water, or (b) that results in or has the potential to result in the raw water supply of an existing or planned drinking-water system failing to meet any standards prescribed by the regulations respecting the quality or quantity of water, and includes an activity or condition that is prescribed by the regulations as a drinking water threat.~~ An existing activity, possible future activity or existing condition that results from a past activity that adversely affects or has the potential to adversely affect the quality or quantity of any water that is or may be used as a source of drinking water.

Drinking Water Issue: A substantiated condition relating to the quality of quantity of water that interferes or is anticipated to soon interfere with the use of a drinking water source by a municipal residential system or designated system.

Ecological: Relating to the totality or pattern relations between organisms and their environment.

Ecosystem: A natural community of plants and animals within a particular physical environment, which is linked by a flow of materials throughout the non-living (abiotic) as well as the living (biotic) section of the system.

~~**Elevation**: The height of a portion of the Earth's surface in relation to its surroundings.~~

Empirical: Information gained by means of observation, experience, or experiment.

Enhancement: To add to, or to make greater; for example, to add additional water to a wetland, in order to make greater its environmental functionality.

Entity: One or a series of related objects, natural or anthropogenic, that may be related to a specific process. Examples: Storage Tank, Bird Colony, Abandoned Well, Mine Tailing, Natural Radiation Source.

Entrain: To draw in and transport through water.

Episodic: Made up of separate loosely connected episodes.

Erosion: The wearing away of the land by the action of water, wind or glacial ice.

***Escherichia coli* (*E. coli*) and Campylobacteria**: A type of coliform bacteria found in human and animal waste. Their presence in water indicates fecal contamination. A type of coliform bacteria found in human and animal feces. Their presence in surface and groundwater indicates fecal contamination. Some types of *E. coli* can cause serious illness for humans.

Event: Occurrence of an incident (isolated or frequent) with the potential to promote the introduction of a threat into the environment. An event can be intentional, as in the case of licensed discharge or accidental, as in the case of a spill.

Existing Drinking Water Source: The aquifer or surface water body from which municipal residential systems or other designated systems currently obtain their drinking water. This includes the aquifer or surface water body from which back-up wells or intakes for municipal residential systems or other designated systems obtain their drinking water when their current source is unavailable or an emergency occurs.

Exposure: The extent to which a contaminant or pathogen reaches a water resource. Exposure, like a drinking water threat, can be quantified based on the intensity, frequency, duration and scale. The degree of exposure will differ from that of a drinking water threat dependent on the nature of the pathway or barrier between the source (threat) and the target (receptor) and is largely dependent on the vulnerability of the resource.

Extirpated: A species that still exists somewhere in the world, but is no longer found in the study area.

Fen: Fens are peatlands characterized by surface layers of poorly to moderately decomposed peat, often with well-decomposed peat near the base. The waters and peat in fens are less acid than in bogs, and often are relatively nutrient poor and minerotrophic since they receive water through groundwater discharge from adjacent uplands. Fens usually develop in situations of restricted drainage where oxygen saturation is relatively low. Usually very slow internal drainage occurs through seepage down very low gradient slopes, although sheet surface flow may occur during spring melt or periods of heavy precipitation or if a major local or regional aquifer discharges into the wetland. Some fen wetlands develop directly on limestone rock where minerotrophic waters are emerging through constant groundwater discharge. Fens are rare across the Toronto and Region Source Protection Area (TRSPA). Nutrient-rich, peat-forming wetland that receives water from surface water or groundwater flow. They are usually less acidic than bogs.

Flood Pulse: The peak flow during a flooding event.

Floodplain: A plain bordering a river, which has been formed from deposits of sediment carried down the river. When a river rises and overflows its banks, the water spreads over the floodplain. The flat, low-lying area along a stream channel that is subjected to recurrent flooding. It is formed when the stream overflows its channel during times of high flow. When the water recedes, alluvial deposits generally are deposited along the plain bordering the stream.

Flow Regime: The pattern of how water levels change in a stream.

Flow Stability: Determined by measuring the ratio of surface discharge to groundwater discharge on an annual basis.

Fluvial: ~~Relating to a stream or river~~. Process associated with rivers and the deposits and landforms they create.

Forest Cover: The percentage of the watershed that is forested.

Forest Interior: The portion of a woodlot which remains when a 100 metre buffer is removed from the perimeter of the forest (e.g., 100 metres in from the outside edge).

Function: An ecological role for human benefit.

Future Municipal Water Supply Areas: An area corresponding to a wellhead protection area or a surface water intake protection zone, or an aquifer or groundwater area identified for future municipal water supply infrastructure (either a well or a surface water intake pipe).

Geology: The science of the composition, structure and history of the Earth. It thus includes the study of the material of which the Earth is made, the forces which act upon these materials and the resulting structures.

Geomorphology: The scientific study of the origin of land, including riverine and ocean features on the Earth's surface.

Glaciation: The covering of an area or the action on that area, by an ice sheet or by glaciers.

~~**Goals**: High level achievements to aim for with respect to source protection (e.g., to protect drinking water sources). Provides an opportunity to add value statements. Not measurable through numeric means.~~

~~**Gradient**: The rate or regular graded ascent or descent.~~

Granular: Having a texture composed of small particles.

Great Lakes: The five interconnected freshwater lakes located along the border of in Canada and the United States: Lake Ontario, Lake Superior, Lake Huron, Lake Erie, and Lake Michigan.

Great Lakes Connecting Channels: The rivers that connect the Great Lakes (e.g., St. Clair River, St. Lawrence River).

Groundwater: Subsurface water that occurs beneath the water table in soils and geological formations that are fully saturated.

Groundwater Discharge: ~~The function of a wetland to accept subsurface water and hold it for release over long periods of time.~~ An area in which there are upward components of hydraulic head in the aquifer. Groundwater is flowing toward the surface in a discharge area and may escape as a spring, seep, or baseflow; or by evaporation and transpiration.

Groundwater Recharge Area: The area where an aquifer is replenished from (a) natural processes, such as the infiltration of rainfall and snowmelt and the seepage of surface water from lakes, streams and wetlands, (b) from human interventions, such as the use of storm water management systems, and (c) whose recharge rate exceeds a specified threshold.

Groundwater Table: ~~The meeting point between the groundwater and the unsaturated layer above it.~~ The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric. It can be measured by installing shallow wells extending a few metres into the zone of saturation and then measuring the water level in those wells.

Groundwater Under the Direct Influence of Surface Water (GUDI): ~~Groundwater supply sources that have a direct hydrological connection to surface water sources (rivers, streams, ponds, etc.), and are therefore vulnerable to contamination from the surface.~~ Groundwater raw supply obtained from a water well and where there is an interaction between the surface water and groundwater supply that may impact the water quality at the well.

Habitat: The environment of an organism; the place where it is usually found.

Hazard: A contaminant and/or pathogen threat.

Hazard Rating: The numeric value which represents the relative potential for a contaminant of concern to impact drinking water sources at concentrations significant enough to cause human illness.

Headwaters: Area of a watershed where a major river system originates

High Water Mark: The usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. Under the director's technical rules, this term is consistent with the definition of 'ordinary high water mark' as defined by Fisheries and Ocean Canada as described in DFOs Fish Habitat Fact Sheet #T-6.

Highly Vulnerable Aquifer (HVA): An aquifer that can be easily changed or affected by contamination from both human activities and natural processes as a result of (a) its intrinsic susceptibility, as a function of the thickness and permeability of overlaying layers, or (b) by preferential pathways to the aquifer.

Hydraulic Gradient: A measure of the change in groundwater head over a given distance. Maximum flow will normally be in the direction of the maximum fall in head per unit of vertical distance.

Hydric Soil: A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favour the growth and regeneration of hydrophytic vegetation.

Hydrogeology: Hydrogeology is the study of the movement and interactions of groundwater in geological materials.

Hydrologic Cycle: The continuous movement of water on, above, and below the surface of the earth.

Hydrologic Function: The functions of the hydrological cycle that include the occurrence, circulation, distribution, and chemical and physical properties of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere, and water's interaction with the environment including its relation to living things.

Hydrology: The study of the Earth's water, particularly of water on and under the ground before it reaches the ocean or before it evaporates into the air.

Hydro-period: The seasonal pattern of the water level of a wetland that is a hydrologic signature of each wetland type. It defines the rise and fall of a wetland surface and subsurface water.

~~**Hydrophytic Plants:** Vegetation adapted to growing in water or in hydric soils.~~

Imminent Threat to Health: A contaminant of concern that can affect human health in a short period of time.

Index of Biotic Integrity (IBI): Indicator of overall stream health.

Infiltration: ~~The movement of water into soil pores from the ground surface.~~ The downward entry of water through the soil surface into the soil. (MNR Water Resources Glossary)

~~**Inland Lake:** An inland body of standing water, usually fresh water, larger than a pool or pond or a body of water filling a depression in the earth surface.~~

Inland Rivers: A creek, stream, brook and any similar watercourse inland from the Great Lakes that is not a connecting channel between two Great Lakes

~~**Intermittent:** Stopping and beginning again, pausing at intervals. An intermittent stream is a watercourse that does not flow permanently year-round.~~

Intermittent Stream: A watercourse that does not flow permanently year-round.

Intrinsic Vulnerability: The potential for the movement of a contaminant(s) through the subsurface based on the properties of natural geological materials.

~~**Invertebrates:** Animals lacking a spinal column.~~

Impact: Often considered the consequence or effect, the impact should be measurable and based on an agreed set of indicators. In the case of drinking water source protection, the parameters may be an acceptable list of standards which identify maximum raw water levels of contaminants and pathogens of concern. In the case of water quantity, the levels may relate to a minimum annual flow, piezometric head or lake level.

Knowledge Gaps: Lack of referenced materials or expertise to assess certain characteristics of the specific watershed that can be adequately described without tabular or spatial data.

Landform: Defines the physical shape of the landscape and the materials based on how the geologic material was deposited by glaciers.

Land Use: A particular use of space at or near the earth surface with associated activities, substances and events related to the particular land use designation.

~~**Liaising:** Business act to refine logistics around gathering data and information.~~

Local Discharge: Discharge to a watercourse that originates nearby. The water moves through the upper layers of the groundwater system.

Low Flow: The flows that exist in a stream channel in dry conditions.

~~**Macroinvertebrates:** Animals lacking a spinal column that are visible with the unaided eye.~~

Marsh: Wetlands frequently or continually inundated with water, characterized by emergent soft-stemmed vegetation adapted to saturated soil conditions (e.g., cattails).

~~**Meandering:** Bends in the course of a river which continually curves from side to side.~~

Meltwater Channel: The path of drainage and leftover sedimentary deposits usually from the ice margin of an alpine or continental glacier.

Model: An assembly of concepts in the form of mathematical equations or statistical terms that portrays the behaviour of an object, process or natural phenomenon.

Model Calibration: The process for generating information over the life cycle of the project that helps to determine whether a model and its analytical results are of a quality sufficient to serve as the basis of a decision.

Model Evaluation: A comparison of model results with numerical data independently derived from experiments or observations of the environment.

Model Validation: A test of a model with known input and output information that is used to adjust or estimate factors for which data are not available.

Model Verification: The examination (normally performed by the model developers) of the numerical technique in the computer code to ascertain that it truly represents the conceptual model and that there are no inherent numerical problems with obtaining a solution.

Monitoring: Periodic evaluation of a site to determine success in achieving goals.

Moraine: ~~The debris or rock fragments brought down with the movement of a glacier.~~ Marginal glacial deposits (lateral, medial, terminal, ground) of unsorted and stratified material.

Municipal Residential System: All municipal drinking-water systems that serve or are planned to serve a major residential development (i.e., six or more private residencies).

Naturalize: To make a part of the physical environment natural, free from conventional characteristics.

Natural Heritage: The legacy of natural objects and attributes encompassing the countryside and natural environment, including plants and animals.

Naturally Occurring Processes: Processes that occur in nature and that are not the result of human activity. For example, erosion along a stream that provides a source of drinking water or the leaching of naturally occurring metals found in bedrock into groundwater.

Non-Aqueous Phase Liquid (NAPL): ~~A group of chemicals that is insoluble in water, including light and dense NAPLs.~~ An organic liquid that is insoluble in water (hydrophobic), such as oil, gasoline, and other petroleum products.

Non-consumptive Water Use: Water use that does not diminish the source or impair future water use.

Non-Point Source: A source of pollutants from a wide geographic area, such as manure runoff, stream bank erosion, and storm water runoff, which threatens the quality of surface and groundwater sources of drinking water.

~~**Non-Renewable Resources:** A resource that is not capable of being replaced by natural ecological cycles or sound management practices within the timeframe of a human life.~~

Nutrient: Something that nourishes and promotes growth. It is possible to have too many nutrients in an ecosystem, which can result in an unhealthy imbalance or overgrowth of certain species.

Ontario Drinking Water Standards (ODWS): means Ontario Regulation 169/03 (Ontario Drinking Water Quality Standards) made under the *Safe Drinking Water Act*, 2002. Water quality standards through which the Provincial Government of Ontario regulates drinking water quality. Standards contain maximum allowable concentrations (MAC) for major inorganic and organic parameters in water.

Organic Matter: Of, relating to, or derived from living organisms.

Overburden: Unconsolidated geologic material above the bedrock.

Parcel Level: A parcel is a conveyable property, in accordance with the provisions of the Land Titles Act. The parcel is the smallest geographic scale at which risk assessment and risk management are conducted.

Pathogen: A disease-causing organism.

Percolation: The downward movement of water in the ground through porous soil and cracked or loosely-packed rock.

Permeability: The quality of having pores or openings that allow liquids to pass through. The ability of a material to transmit a fluid, a measure of how quickly fluid will flow through the rock or sediment.

Phosphorus: A non-toxic pollutant that is an essential nutrient. In excessive amounts it leads to eutrophication of a water system. Phosphorus accumulates along the entire length of a river from a variety of point and non-point sources.

Physiography: The study or description of landforms.

Planned Drinking Water Source: The drinking water source (i.e., aquifer or surface water body) from which planned municipal residential systems or other planned designated systems are projected to obtain their drinking water from in the future and for which specific wellhead protection areas and surface water intake protection zones have been identified.

Point Source: A source of pollutants from a municipal treatment plant or an industrial facility, often by way of a pipe.

Poorly Drained: Soils that are saturated at or near the surface during a sufficient part of the year such that field crops cannot be grown without drainage.

Precipitation: The deposits of water in either liquid or solid form which reach the Earth from the atmosphere. It includes rain, sleet, snow and hail.

Preferential Pathways: Any structure of land alteration or condition resulting from a naturally occurring process or human activity which would increase the probability of a contaminant reaching a drinking water source.

Productivity: Rate of production, especially of food or solar energy by producer organisms.

Raw Water: Water that is in a drinking-water system or in plumbing that has not been treated in accordance with, (a) the prescribed standards and requirements that apply to the system, or (b) such additional treatment requirements that are imposed by the license or approval for the system.

Raw Water Supply: Water outside a drinking-water system that is a source of water for the system.

Recharge Area: An area where water enters a saturated zone at the water table surface.

Regional Discharge: Water that has traveled deep beneath the ground through the saturated zone and resurfaces at the water table.

Regulated Areas: Those areas for which conservation authorities delineate and restrict land uses by making regulations under subsection 28(1) of the *Conservation Authority Act*. This subsection applies to watercourses, streams, lakes, valleys, flood plains, and wetlands in Ontario. Provincially approved standards and methodologies for delineating Regulated Areas are outlined in draft guidance documents prepared by Conservation Ontario in cooperation with the Ontario Ministry of the Natural Resources (MNR).

~~**Renewable Resources:** Resources capable of being replaced through ecological processes or sound management practices.~~

Reserve Amounts: Minimum flows in streams that are required for the maintenance of the ecology of the ecosystem.

~~**Restoration:** Changing existing function and structure of wetland habitat so that it is similar to historical conditions.~~

Return Period: The frequency in which a flow event in a stream is likely to repeat itself.

Receptor: The exposed target in danger of incurring a potential impact. An example would be any aquifer or surface water body used for drinking water consumption.

Response Factor: Typical factors affecting the response include dilution, rate of discharge, absorption, and degradation of the contaminant or pathogen in question. Because of the nature of the water resource, certain contaminants and pathogens may not have an impact (see definition), great enough to warrant concern or responsive action. The level of impact may not effectively degrade the water resource and therefore would not require a mitigative action.

~~**Riffle/Pool System:** A riverine system that alternates cycles of shallow broken water (riffle) and deeper still water (pool).~~

Riparian Areas: Vegetated areas close to or within a water body that directly or indirectly contribute to fish habitat by providing a variety of functions such as shade, cover, and food production areas.

Risk: The likelihood of a drinking water threat (a) rendering an existing or planned drinking water source impaired, unusable or unsustainable, or (b) compromising the effectiveness of a drinking water treatment process, resulting in the potential for adverse human health effects.

Riverine: Relating to or resembling a river.

Runoff: Water that moves over land rather than being absorbed into the ground. Runoff is greatest after heavy rains or snowmelts, and can pick up and transport contaminants from landfills, farms, sewers, industry and other sources.

Saturated Soil: Soil that is full of moisture.

~~**Scale:** A graduated series or scheme of rank or order.~~

~~**Security of well or intake infrastructure:** An evaluation of structures/measures that are in place or are needed to protect a municipal groundwater supply well or surface water intake from potential contamination from external sources.~~

Sediment: Material deposited by water, wind or glaciers.

Sedimentary Bedrock: Rock formed of mechanical, chemical or organic sediment such as rock formed from sediment transported from elsewhere, by chemical precipitation from solution or from inorganic remains of living organisms.

Semi-Quantitative: Describes an approach or methodology that uses measurable or ranked data, derived from both quantitative and qualitative assessments, to produce numerical values to articulate results.

Sensitivity Analysis: Sensitivity analysis evaluates the effect of changes in input values or assumptions on a model results.

Severity: The degree to which an impact is measured compared to an idealized value of some indicator of concern. In the case of water quality, the severity may relate to degree of measurable exceedance of some contaminant or pathogen. In the case of water quantity, deviation from some measurable indicator (e.g., minimum annual flow, piezometric head or lake level) must also be established.

Significant Hydrologic Features: (a) A permanent or intermittent stream, (b) wetlands, (c) kettle lakes and their surface catchment areas, (d) seepage areas and springs, and (e) aquifers and recharge areas that have been identified as significant by the Ministry of Natural Resources, using evaluation procedures established by that Ministry, as amended from time to time.

Sinkhole: Any depression in the surface of the ground, with or without collapse of the surrounding soil or rock, which provides a means through which surface water can enter the ground and therefore come in contact with groundwater. Sinkholes often allow this contact to occur quite rapidly and do little to filter any contaminants the surface water may contain.

Site-level: The most refined scale at which technical assessment of hydrological and hydrogeological conditions can be conducted. These assessments may contribute to water budgets, vulnerability assessments, and issues evaluation.

Slope: Ground that forms a natural or artificial incline.

Source Protection (Drinking Water Source Protection): ~~Protecting surface water sources such as lakes, rivers and streams, and groundwater sources from contamination or overuse, particularly through the planning process under the *Clean Water Act, 2006.* It is the first step in the multi-barrier approach to protecting drinking water. Other barriers include water testing and monitoring, reliable water treatment and distribution systems and training of water managers and staff. At this time, the emphasis of the project is to identify and address existing or potential threats to municipal water supplies by concentrating on zones immediately surrounding municipal wellheads and surface water intake zones in Lake Huron. See the About Source Protection tab for more details.~~ Protecting surface water sources such as lakes, rivers and streams, and groundwater sources from contamination or overuse, particularly through the planning process under the *Clean Water Act, 2006.* It is the first step in the multi-barrier approach to protecting drinking water.

Source Protection Planning: ~~The creation of local, watershed-based plans for the protection of the quality and quantity of drinking water sources, now and in the future. Plans will be created by local stakeholders on Source Protection Committees (SPCs); this process will be facilitated by conservation authorities, who will ensure that SPCs have the technical knowledge to ensure that plans are science-based. See the About Source Water Protection and Our Project tabs for more details.~~ The creation of local, watershed-based plans for the protection of the quality and quantity of drinking water sources, now and in the future.

~~**Spawn:** To produce or prevent eggs in the reproductive process (particularly in aquatic animals).~~

Spillway: The valley that results when glacial meltwater cuts into the landscape. Spillways are often composed of sand and gravel.

Stratigraphy: Geology that deals with the origin, composition, distribution and succession of layers of the Earth.

Stream: A body of running water flowing on the surface of the Earth.

~~**Substrate:** The base on which an organism lives.~~

Subwatershed: An area that is drained by an individual tributary into the main watercourse of a watershed.

~~**Successional Areas:** Ecosystems undergoing the gradual process of change that results from one community gradually replacing another.~~

Surface Water: Water occurring in lakes, rivers, and streams that may be used as a source of drinking water. As water moves in a cycle (hydrologic cycle), groundwater and surface water interact; this may cause contaminants to move between groundwater and surface water systems.

Surface to Aquifer Advection Time (SAAT): The average time required by a water particle to travel from a point at the surface to the aquifer of concern. The SAAT is approximated by using the vertical component of the advective velocity integrated over the vertical distance and the average porosity.

Surface to Well Advection Time (SWAT): The average time required by a water particle to travel from a point at the ground surface to the well, including both vertical and horizontal movement.

Surface Water Intake Protection Zone (IPZ): The contiguous area of land and water immediately surrounding a surface water intake, which includes:

1) The distance from the intake.
2) The minimum travel time of the water associated with the intake of a municipal residential system or other designated system, based on the minimum response time for the water treatment plant operator to respond to adverse conditions or an emergency. And
3) The remaining watershed area upstream of the minimum travel time area (also referred to as the Total Water Contributing Area) is applicable to inland water courses and inland lakes only.

Surficial Geology: Deals with the study and description of the forms on the outer layer of the Earth.

Swamp: Any wetland dominated by woody plants such as trees and shrubs. This is generally considered as 25% or more cover of trees or tall shrubs. Standing to gently flowing waters occur seasonally or persist for long periods on the surface. Many swamps are characteristically flooded in spring, with dry relict pools apparent later in the season.

Targets: In the context of technical guidance documents, these are detailed goals that are often expressed as numeric goals (e.g., to reduce contaminant X in this aquifer by 10 per cent by 2009).

~~**Ten-year storm wind conditions:** The maximum sustained wind speed coming from a single direction likely to occur once every ten years.~~

Terrestrial: Living on or growing on land.

Thermal Regime: The characteristic behaviour and pattern of temperature.

Till: ~~Tough, unstratified clay loaded with stones originating from finely ground rock particles that were deposited by glacial activity.~~ A term applied to a mixture of unstratified grain sizes ranging from clay to boulders deposited directly by glacial activity.

Time of Travel (TOT): An estimate of the time required for a particle of water to move in the saturated zone from a specific point in an aquifer into the well intake.

Tolerance of a Water Supply System: A measure of the ability to sustain required pumping levels even during exposure events.

Topography: A detailed description or representation of the features, both natural and artificial, or an area. Also, the physical and natural features of an area, and their structural relationships.

Transport Pathway: A man-made or natural feature on the landscape that may promote quicker travel of contaminants to the water bearing rock material, than would otherwise occur in the surrounding landscape. Where transport pathways occur the vulnerability score may be increased.

Uncertainty Analysis: Uncertainty analysis investigates the effects of lack of knowledge and other potential sources of error in the model

Uncertainty Score: Uncertainty addresses known gaps in data/information about, or deficiencies in methods of assessment for, threats and/or vulnerability. It reflects the degree of confidence in the semi-quantitative data used to calculate risk.

Unconfined Aquifer: An aquifer whose upper boundary is the water table.

Unsaturated Zone Advection Time (UZAT): Estimated time for water to flow vertically from ground surface through to the water table.

Valley: A long, narrow depression on the Earth surface, usually with a fairly regular downward slope. A river or stream usually flows through it.

Valuation of the Supply: An evaluation of the importance of a particular municipal well or intake to the whole municipal drinking water supply. For example, where there are multiple supplies, value may be smaller, versus a single supply where value may be greater.

~~**Vernal Pools:** Temporary pools of water that are usually devoid of fish, and thus allow the safe development of natal amphibian and insect species.~~

Water Treatment Plant (WTP): A facility that provides municipal drinking water.

Waste Water Treatment Plant (WWTP): A facility that treats sanitary sewage.

Water Well Information System (WWIS): ~~A database of water wells from across Ontario that includes a summary of the characteristics of the well and soil for each well.~~ A Government of Ontario database of water wells installed across Ontario".

Water Balance: Use of a water budget to mitigate changes to the hydrological cycle following urbanization, typically by increasing infiltration and evaporation and decreasing runoff.

Water Budget: The movement of water within the hydrologic cycle can be described through a water budget or water balance. It is a tool that when used properly allows the user to determine the source and quantity of water flowing through a system. From a groundwater perspective the key components of a water budget are: infiltration, contribution to baseflow, deeper groundwater flow outside the study area and groundwater taking.

Water Control Structure: An engineered structure designed to hold back water and mimic a natural water regime that promotes wetland restoration, without affecting adjacent agricultural practices.

Watercourse: An identifiable depression in the ground in which a flow of water regularly or continuously occurs (*Conservation Authorities Act,* Section 28(251), Regulations by the Minister of Natural Resources, May 2006October 2021).

Water Cycle: The continuous movement of water from the oceans to the atmosphere (by evaporation), from the atmosphere to the land by condensation and precipitation, and from the land back to the sea (via stream flow).

Watershed: An area where many sources of surface water drain into the same place. A watershed is the area of land where all of the water that is under it or drains off of it goes into the same place. Its boundaries are defined by ridges of high land.

Water Quality Indicator: An entity that provides information on the condition and quality of water through its life cycle patterns. Water quality can also be determined through non-living sources, like chemical sampling.

Water Table: The surface below which the soil is saturated with water.

Water Wells: A hole in the Earth surface used to obtain water from an aquifer. For a bored well, an earth auger is used to bore a hole to carry earth to the surface. The casing is usually steel, concrete or plastic pipe. Modern dug wells are dug by power equipment and typically are lined with concrete tile. Dug and bored wells have a large diameter and expose a large area to the aquifer. These wells are able to obtain water from less-permeable materials such as very fine sand, silt, or clay. Drilled wells are constructed by either percussion or rotary-drilling machines. Drilled wells that penetrate unconsolidated material require installation of casing and a screen to prevent inflow of sediment and collapse. A flowing, or Artesian, well is completed in a confined aquifer that has a water level higher than the ground surface at the location of the well. This causes water to flow out of the well.

Weathering: The disintegration of the Earth crust by exposure to the atmosphere, most importantly, rain.

Well Capture Zone: The area in the aquifer that will contribute water to a well in a certain time period. Often measured in days and years. Area at the ground surface is also included if the time period chosen is longer then the travel time for water in the aquifer and the groundwater recharge area is incorporated.

Wellhead Protection Area (WHPA): The surface and underground area surrounding a water well or well field that supplies a municipal residential system or other designated system through which contaminants are reasonably likely to move so as to eventually reach the water well or wells.

Wetland: Land that is seasonally or permanently covered by shallow water, as well as land where the water table is close to or at the surface. In either case, the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic plants or water tolerant plants. The four major types of wetlands are swamps, marshes, bogs, and fens. Periodically soaked or wet lands being used for agricultural purposes, which no longer exhibit wetland characteristics, are not considered to be wetlands for the purposes of this definition (*Provincial Policy Statement,* 2005). The four major types of wetlands are swamps, marshes, bogs, and fens.

~~**Wetland Values:** Wetland processes or attributes which are beneficial to society.~~

~~**Woodland:** A treed area that provides environmental and economic benefits to both the private landowner and the public, such as erosion prevention, hydrological and nutrient cycling, clean air and long-term storage of carbon, wildlife habitat, outdoor recreational opportunities, and the sustainable harvest of a wide range of woodland products. Woodlands include treed areas, woodlots, or forested areas and vary in their level of significance at local, regional, and provincial levels (*Provincial Policy Statement,* 2005).~~

Whitchurch-Stouffville Museum. Notices were posted in newspapers and letters were sent to newly affected property owners. In addition, notice was posted on the CTC website and sent to the website subscribers. The comments and input received online during the public consultation period were considered by the CTC SPC and are reflected in this new information contained in this Assessment Report.

Public consultations on more recent amendments to the *Assessment Report: Toronto and Region Source Protection Area*, as described in the Version Control table in the Preface, occur in conjunction with those for the CTC Source Protection Plan. These consultations are described in chapter 5 of the CTC Source Protection Plan.

2.3.1 Municipal Surface Water Sources and Water Treatment Plants (WTPs)

City of Toronto Municipal Residential Systems

The City of Toronto Municipal Residential Water Supply System consists of four water filtration plants, 18 pumping stations, ten major underground storage reservoirs, four elevated storage tanks, and approximately 510 km of trunk watermains and 5,015 km of distribution watermains. The water for the water treatment plants listed below is drawn from intakes that extend up to 5,400 m into Lake Ontario:

- R.L. Clark Water Filtration Plant;
- Island Filtration Plant;
- R.C. Harris Water Filtration Plant; and
- F.J. Horgan Water Filtration Plant.

The plant capacities are provided in **Table 2.6**. As part of the assessment of Lake Ontario supplies completed by Stantec (*2008a*), operator interviews were conducted for each of the four City of Toronto WTPs to identify potential concerns regarding these supplies. The following concerns were noted:

- R.L. Clark WTP: pathogen fluctuations (*E. coli, Cryptosporidium*, and *Giardia*) related to discharge from Humber and GE Booth (formerly Lakeview) Wastewater Treatment Plants (WWTPs), pesticide and herbicide levels, sodium levels related to road de-icing, WWTP bypasses, combined sewer overflow (CSO), urban runoff discharged through storm sewers, and the presence of two nearby marinas;
- Island WTP: no known issues/concerns (active intakes are deep and far offshore);
- R.C. Harris WTP: pathogen fluctuations from Ashbridges Bay WWTP, the nearby presence of Ashbridges Marina and Bluffers Point Marina, storm sewer outfalls, Don River, lake *seiches*, and annual up-welling and *downwelling*; and
- F.J. Horgan WTP: bulk chemical storage and spills from industrial facilities, Canadian National (CN) rail line, and Highland Creek WWTP.

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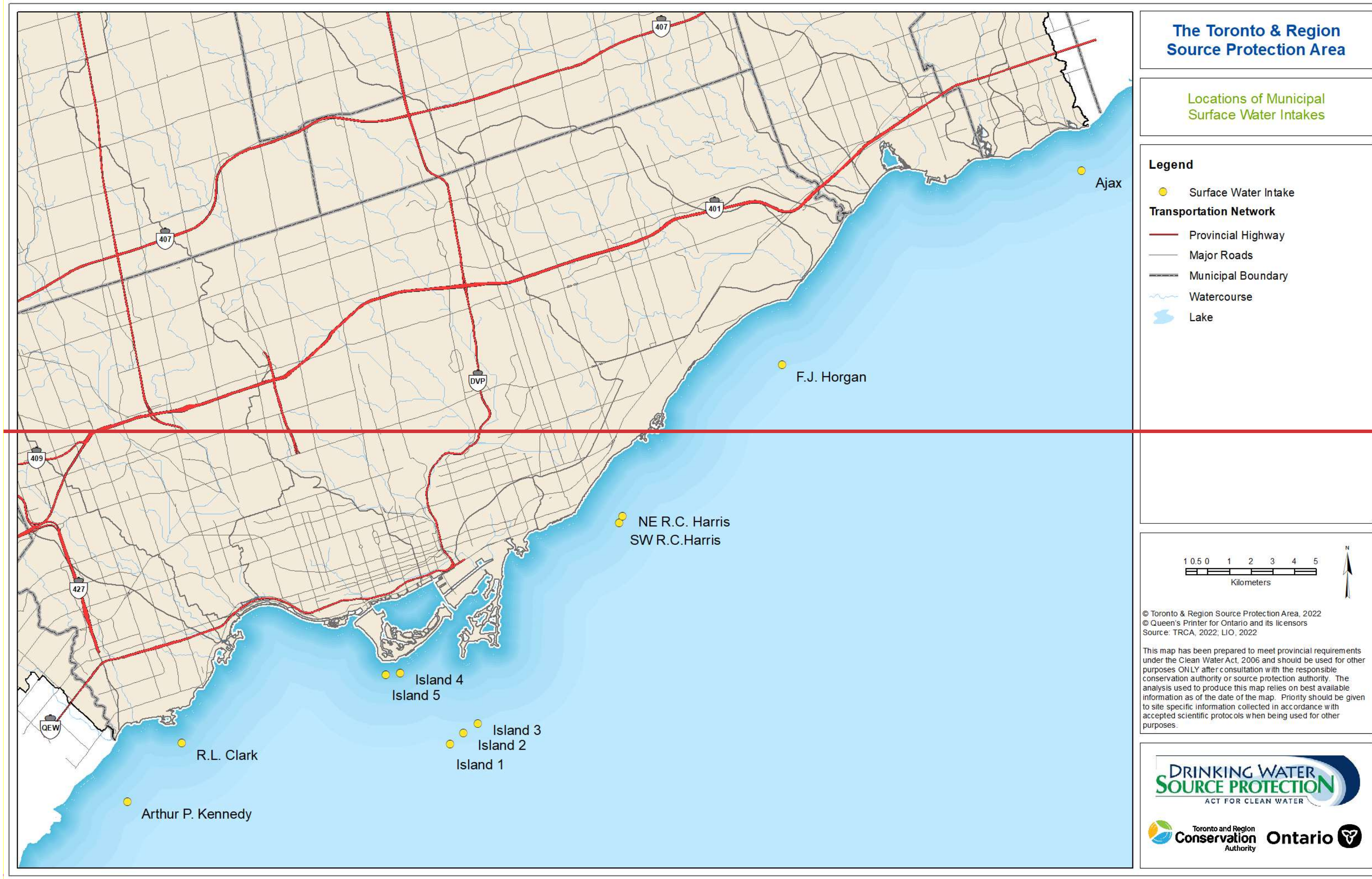
Table 2-6: Lake Ontario Municipal Drinking Water Intakes

Water System	Population Served	Intakes	Intake Depth (m)	Intake Length (m)	Capacity (m^3/day)	Average Monthly Use (m^3/day)	Average Annual Use (m^3)	Comments/Data Sources
R.C. Harris (Toronto)	3,200,000	Northeast	15	2,232	950,000	168,000	61,365,000	All four systems are part of the Toronto water supply system that services approximately 3.2 million residents in the City of Toronto and southern portion of York Region (Data from Toronto Water, 2006; OCWA, 2007; EarthTech, 2001b).
		Southwest	15	2,125				
R.L. Clark (Toronto)		1	11	1,610	615,000	415,000	151,475,000	
F.J. Horgan (Toronto)		1	18	2,925	570,000	359,000	131,035,000	
Island (Toronto)		East	83	4,848	410,000	176,000	62,240,000	
		Middle	83	4,662				
		West	83	4,696				
		Shallow - West	11	828	NOT IN SERVICE FOR MUNCIPAL PURPOSES			
		Shallow - East	70~~17~~	~~690~~3200	251,000	NA	NA	
Ajax (Durham)	188,028	1	18	2,392	163,500	NA	NA	Serves Town of Ajax and City of Pickering (MOE, 2006b) (Most data from Simcoe, 2000; capacity from MOE, 2006a).

Notes:
There is a Region of Peel intake that services TRSPA residents, but it is located in the Credit Valley Source Protection Area.
Intake lengths are all measured from the shoreline
ML = megalitres (1,000,000 Litres)
NA = Not Available


The Toronto & Region Source Protection Area
Locations of Municipal Surface Water Intakes
Legend
Surface Water Intake
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
Ajax
F.J. Horgan
NE R.C. Harris
SW R.C.Harris
Island 4
Island 5
Island 3
Island 2
Island 1
R.L. Clark
Arthur P. Kennedy
407
401
409
427
DVP
QEW
1 0.5 0 1 2 3 4 5
Kilometers
N
© Toronto & Region Source Protection Area, 2022
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Source: TRCA, 2022; LIO, 2022
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation Authority
Ontario

Figure 2.6: Locations of Municipal Surface Water Intakes

Durham Region Municipal Residential Systems

The Durham Region Municipal Residential Systems within the TRSPA consists of the Ajax WTP. This is a surface water treatment facility that supplies water primarily for residents in the Town of Ajax and in the City of Pickering, as well as other residents, as required. *Raw water* is drawn from Lake Ontario through the 2.1 m diameter intake pipe extending 2,500 m into the lake. The treatment plant facility has a rated capacity of 163.5 mL/day (36 MIGD).

As with the City of Toronto systems, part of the assessment of Lake Ontario supplies completed by Stantec (*2009*) included operator interviews for the Durham Region treatment plants to identify potential concerns regarding these supplies. The following concerns were not based on conclusive scientific evidence but on the fact that there are existing activities in the area near Ajax Water Supply System which may have potential impact:

- Taste and odour in late summer/early fall;
- Turbidity from Duffins Creek WWTP;
- Industrial discharges to the nearshore environment;
- Salt runoff from Highway 401; and
- Pickering Nuclear Generating Station (radionuclides greater than background).

2.3.2 Municipal Groundwater Systems

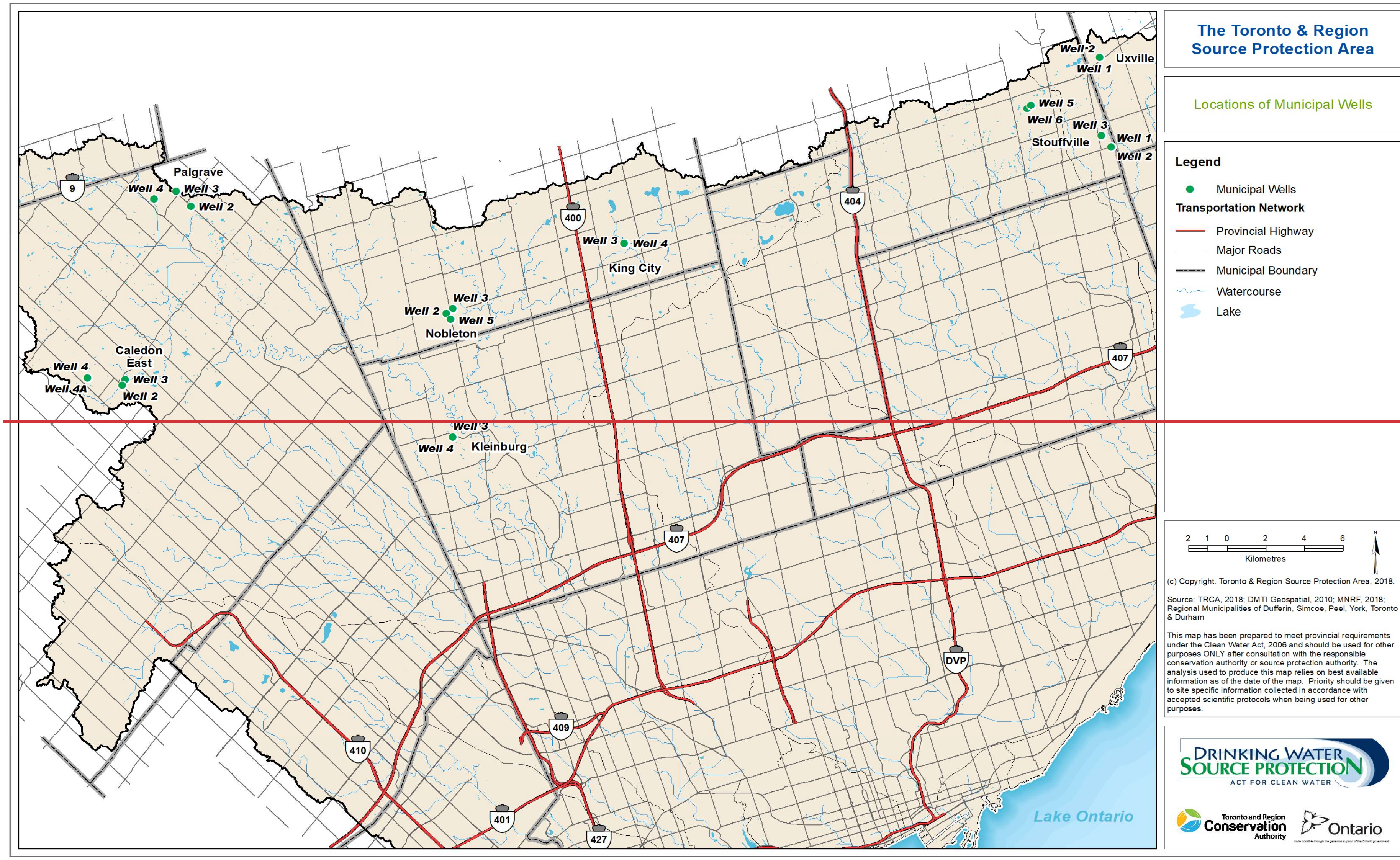
There are five groundwater-based large municipal residential drinking water systems in the TRSPA, as shown in **Figure 2.7**. In the Region of Peel there is one system in Palgrave-Caledon East, and in York Region there are systems in Kleinburg, Nobleton, King City, and Stouffville.

The municipal system in Uxville, although included in **Figure 2.7**, is not considered to be a residential system since it services an industrial park. It was designated for inclusion in this report by a council resolution from the Durham Region. This sixth system is discussed separately under designated municipal drinking water systems.

In addition, there are three groundwater-based large municipal residential drinking water systems in CVC and SGBLS whose WHPAs extend into TRSPA, these being the Region of Peel's Cheltenham system, Orangeville, and the Region of York's Newmarket-Aurora system.

Data regarding the five municipal residential drinking water systems, within TRSPA, and Uxville and their wells are summarized in

Table 2-7~~**Table 2.7**~~. Annual monitoring reports are publicly available from the regions or over the internet (www.peelregion.ca, www.york.ca, and www.region.durham.on.ca). Each of the six systems is characterized below, including treatment and monitoring ~~programs.Data~~programs. Data regarding municipal residential drinking water systems whose WHPAs extend into TRSPA from other Source Protection Areas are outlined in their respective Assessment Reports.


The Toronto & Region Source Protection Area
Locations of Municipal Wells
Legend
Municipal Wells
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
Uxville
Well 2
Well 1
Well 5
Well 6
Well 3
Well 1
Well 2
Stouffville
Palgrave
Well 4
Well 3
Well 2
Well 3
Well 4
King City
Well 3
Well 2
Well 5
Nobleton
Caledon East
Well 4
Well 4A
Well 3
Well 2
Well 3
Well 4
Kleinburg
Lake Ontario
9
400
404
407
409
410
401
427
DVP
2 1 0 2 4 6
Kilometres
N
(c) Copyright. Toronto & Region Source Protection Area, 2018.
Source: TRCA, 2018; DMTI Geospatial, 2010; MNRF, 2018; Regional Municipalities of Dufferin, Simcoe, Peel, York, Toronto & Durham
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

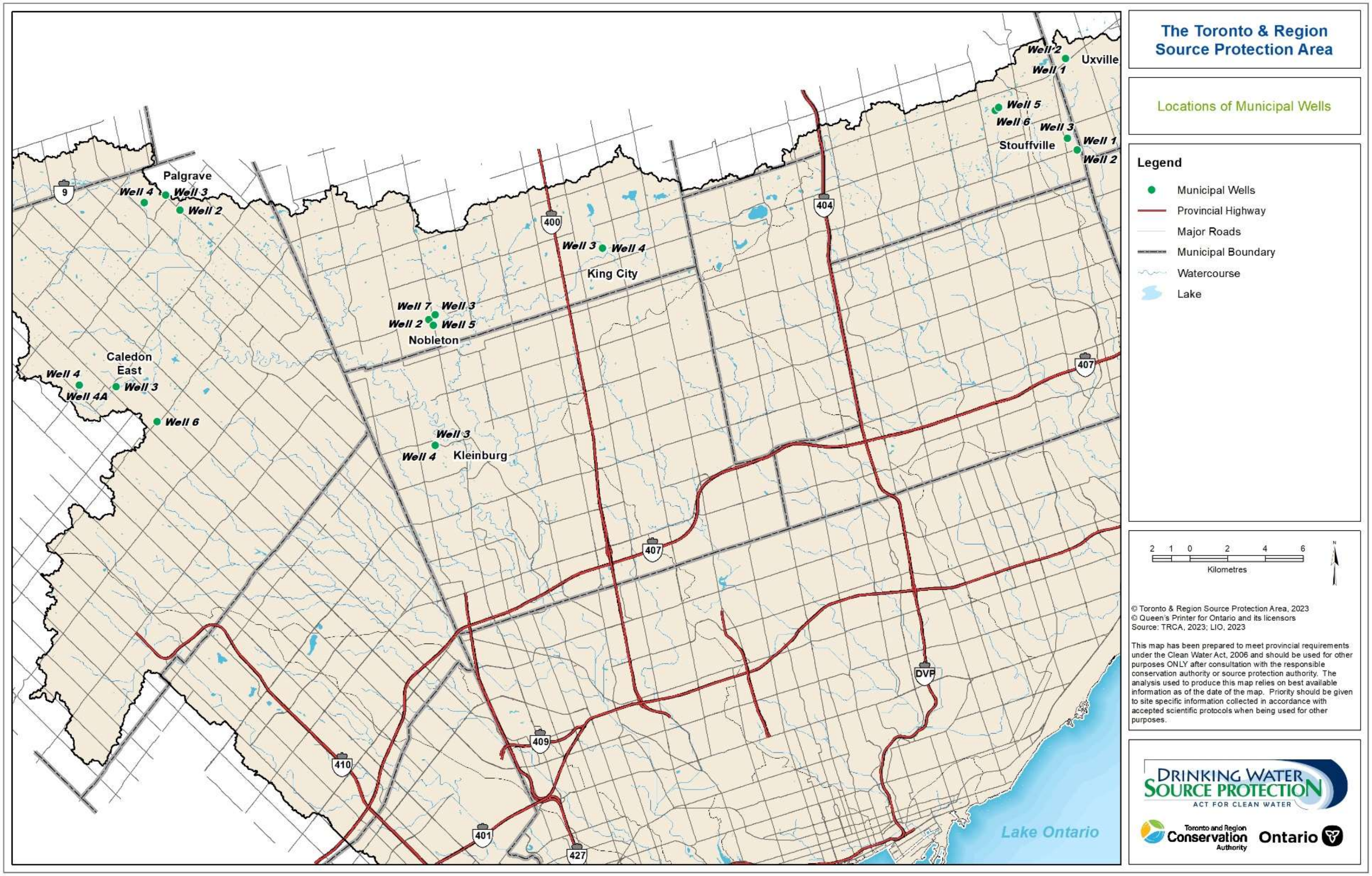


Figure 2.7: Locations of Municipal Wells

Table 2-7: Municipal Groundwater-Based Drinking Water Supply

Water System	Population Served [1]	Well	Well Depth (m)	Aquifer	Capacity (L/s)	Average Monthly Use (m^3)	Average Annual Use	Comments/ Data Sources
Palgrave	~~3,670~~ ~~5,582~~14,000	PAL-2	47	Oak Ridges	30.3	6,2706~~,103~~	~~73,232~~76,285	[1]~~Census Canada, 2001 Region of Peel, 2008a,b~~Region of Peel, 2021
		PAL-3	82	Thorncliffe	68.2~~1~~	21,600~~40,579~~	262,800~~486,944~~	
		PAL-4	91	Thorncliffe	60.6~~30.3~~	7,920~~6,103~~	96,360~~73,232~~	
Caledon East		CE-3	48	Oak Ridges	29.6~~8.1~~	12,780~~3,045~~	155,490~~36,538~~	[1]~~Census Canada, 2001 Region of Peel, 2008c,d~~Region of Peel 2021
		CE-4	57	Thorncliffe	42.0~~45.0~~	23,490~~33,053~~	285,795~~396,632~~	
		CE-4A	58	Thorncliffe	75.0	26,040~~25,100~~	316,820~~304,150~~	
		CE-6	159	Scarborough	50.0	Not yet operation	Not yet operation	
Kleinburg	4,595	KLB-3	77	Scarborough	38.0	30,562	366,750	[1]Census Canada, 2001 York Region, 2008a
		KLB-4	79	Scarborough	60.6			

Water System	Population Served [1]	Well	Well Depth (m)	Aquifer	Capacity (L/s)	Average Monthly Use (m^3)	Average Annual Use	Comments/ Data Sources
Nobleton	3,513	NB-2	112	Scarborough	22.7	6,669	80,034	[1]Census Canada, 2001 York Region, 2008b NB-5 based on useage in 2015 and 2016
		NB-3	94	Thorncliffe and Scarborough	22.7	25,293	303,512	
		NB-5	101	Scarborough	28.9	20,505	205,046	
		NB-7	93	Thorncliffe and Scarborough	28.9	Not yet operational	Not yet operational	
King City	5,600	KC-3	105	Thorncliffe	11.1	18,169	218,028	[1]Census Canada, 2001 York Region, 2008c
		KC-4	105	Thorncliffe	11.0	30,641	367,694	
Whitchurch-Stouffville	27,000	STF-1	102	Thorncliffe	4.8	20,045	240,535	Wells 5 and 6 are under the direct influence of surface water[1] Census Canada, 2001 York Region, 2008d
		STF-2	106	Thorncliffe	5.7	19,688	236,254	
		STF-3	29	Oak Ridges	19.3	46,709	560,509	
		STF-5	15	Oak Ridges	19.0	36,699	440,389	
		STF-6	21	Oak Ridges	15.6	32,678	392,134	
Uxville	NA (non-residential)	Well 1	61	Oak Ridges	22.0	1,008	12,097	[1]Census Canada, 2001 Durham Region, 2008a
		Well 2	61	Oak Ridges		80	964	

Region of Peel Residential Groundwater Systems

Palgrave-Caledon East Drinking Water System

The Palgrave-Caledon East Drinking Water System is groundwater-based. Water is pumped from three municipal wells in Palgrave (PAL):

- PAL-2;
- PAL-3 (outside the TRSPA); and
- PAL-4.

PAL-2 is screened within the lower portion of the Oak Ridges Aquifer Complex. PAL-3 and PAL-4 are ~~screened in~~screened in the Thorncliffe Aquifer that occupies deep bedrock valley systems in the area. PAL-3 is located a few hundred metres north of the TRSPA boundary, in the South Georgian Bay-Lake Simcoe Source Protection Region. It is mentioned in this Assessment Report for completeness, particularly since the WHPA extends into the TRSPA.

The water treatment process consists of iron removal and disinfection. Iron is removed through oxidization by sodium hypochlorite followed by greensand filtration. Sodium hypochlorite (chlorine) is also used for primary and secondary disinfection.

In Caledon East (CE) water is pumped from three municipal wells:

- CE-3;
- CE-4; ~~and~~
- CE-4A;
- CE-6~~.~~

CE-3 is screened in the Oak Ridges Aquifer Complex. Raw water is treated with sodium hypochlorite (chlorine) for primary and secondary disinfection. CE-4 and CE-4A are screened in the Thorncliffe Aquifer Complex. The water treatment process includes iron removal and disinfection. Iron is removed through oxidization by sodium hypochlorite followed by greensand filtration. Sodium hypochlorite (chlorine) is used for primary and secondary disinfection.

York Region Residential Groundwater Systems

Between 2003 and 2009, York Region conducted wellhead protection studies for all their wells within the TRSPA. In addition, in 2007 a comprehensive *Water Quality Characterization and Issues Identification* study was completed for all York Region groundwater supply systems (Genivar, 2007). The results of this latter study showed that the shallow and deep groundwater supplies of York Region consistently meet the Ontario Drinking Water Quality Standards (ODWQS). The shallow groundwater supplies, prior to treatment, are susceptible to influence from anthropogenic (human) activities such as nutrient application and de-icing materials. To proactively monitor changes in the groundwater quality, York Region has several sentry wells (wells used for monitoring water levels and water quality within WHPAs) that form part of the region's groundwater monitoring program. York Region samples raw water quarterly at all municipal water supply wells to test for inorganic compounds. In addition, a selected number of sentry wells are tested once per year and microbial samples are obtained weekly from the treated water supply. York Region has municipal water supplies at Kleinburg, Nobleton, King City, and Whitchurch-Stouffville. Each is outlined in greater detail below.

Kleinburg

York Region operates two production wells servicing Kleinburg (KLB) in the City of Vaughan:

- KLB-3; and
- KLB-4.

The water supply is now provided from two ~~wells, since~~wells, since KLB-2 was decommissioned by York Region in 2013. Water treatment for the Kleinburg wells includes the addition of chlorine for disinfection. Sodium silicate is also added to keep the iron in suspension so it does not precipitate out and stain plumbing fixtures and laundry. Following treatment, water can enter the distribution system from the single well pumphouse.

Nobleton

York Region operates three production wells servicing Nobleton (NB) in the Township of King. The following wells provide the water supply:

- NB-2;
- NB-3; ~~and~~
- NB-5; and
- NB-7~~.~~

Water treatment for the Nobleton wells includes the addition of chlorine for disinfection. Sodium silicate is added to the water following chlorination to reduce the potential for iron to precipitate out and stain plumbing fixtures and laundry in the serviced area. Treated water enters the distribution system from three points: NB-2, NB-3 and NB-5. Currently, one storage tank services the community of Nobleton.

King City

York Region operates the following two production wells servicing King City (KC) in the Township of King:

- KC-3; and
- KC-4.

Water treatment for the King City wells includes the addition of chlorine for disinfection. Sodium silicate is also added to keep the iron in suspension so it does not precipitate out and stain plumbing fixtures and laundry. Following treatment, water enters the distribution system from the two points. There is currently one storage tank servicing the community of King City.

Whitchurch-Stouffville

The water supply in Whitchurch-Stouffville is a blended lake-based and groundwater-based system. The Stouffville (STF) water system includes five production wells servicing the Town of Whitchurch–Stouffville. In 2009, York Region added a connection to provide surface water from the City of Toronto water system (Lake Ontario). Water treatment for the Stouffville wells includes the addition of chlorine for disinfection. Sodium silicate is also added to keep the iron in suspension so it does not precipitate out and stain plumbing fixtures and laundry. Sodium silicate is not added to STF-5 and STF-6 as very low iron levels are present in the shallow groundwater. The groundwater from Stouffville STF-5 and STF-6 receives additional disinfection through an ultraviolet (UV) system, given that the water in these wells is classified as GUDI. Following treatment, water enters the distribution system from three points:

- STF-3 (at the storage tank location);
- STF-5 and STF-6 combined (at the reservoir location); and
- STF-1 and STF-2 combined (at the reservoir location).

There are currently two storage tanks and two reservoirs servicing the community of Stouffville. York Region also operates two booster pumping stations: a small one in Stouffville that supplies water to a number of homes in the Highway 48/Bloomington area, and a second on Tenth Line, near well STF-3.

Designated Municipal Drinking Water Systems (Groundwater)

Uxville Drinking Water Supply

The Uxville well supply system is a groundwater treatment facility operated by the Durham Region that supplies potable water to commercial and industrial consumers in the Uxville Industrial Park development in the Township of Uxbridge. Although it is not a municipal residential system, the Durham Region passed a Council Resolution in 2009 directing TRCA to include it in this ~~Assessmenet~~Assessment Report.

The production well is approved for a capacity of 1,898 m^3/day (0.42 MIGD). A standby well is located at the same site. The treatment process includes chlorination at the main well building. The distribution system delivers the treated water through 2.8 km of watermains and includes a 1,134 m^3 capacity elevated tank for storage and pressure equalization. Sodium hypochlorite is used for disinfection.

Between 2000 and 2004 the Durham Region completed wellhead protection studies for its groundwater-based drinking water systems. Following these studies, the region installed six sentry wells strategically located upgradient of the municipal supply well for monitoring of non-microbiological parameters. The surface water quality in the stormwater management pond located beside the municipal wellhead is also monitored. All measured parameters in Uxbridge and Uxbridge Industrial Park sentry wells were below the applicable ODWQS (Jagger Hims, 2007).

2.3.3 Other Water Use

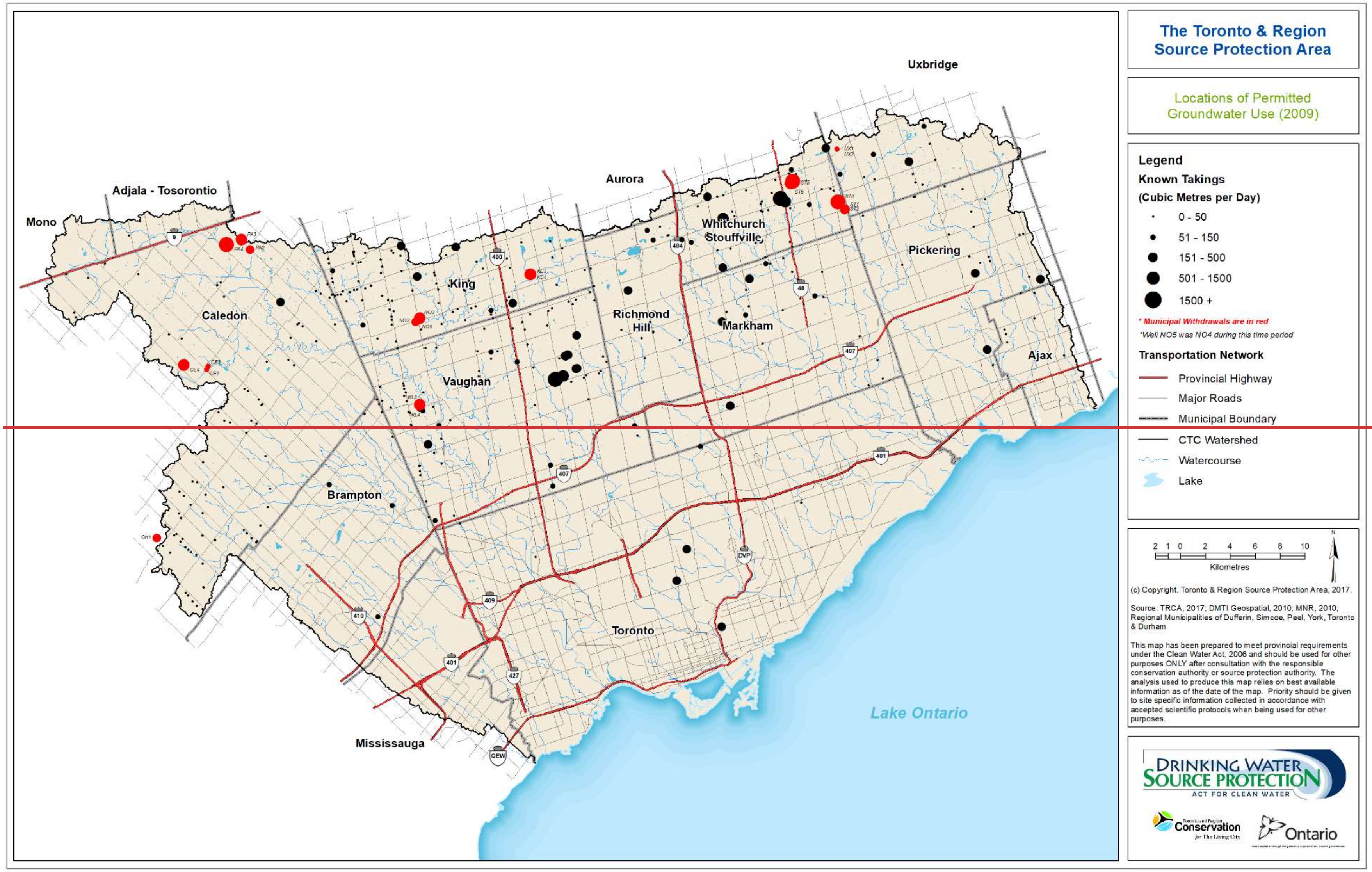
In addition to documenting municipal drinking water supplies, the *Clean Water Act, 2006* (*CWA)* specifies that assessment reports must also map and describe:

- O. Reg. 170/03 systems, including those that provide drinking water or that serve designated or public facilities (such as community centres, campgrounds, churches, schools, and so on). Provincial data show that 159 O. Reg. 170/03 water systems exist in the TRSPA; and
- Private wells, of which there are an estimated 7,964 within the TRSPA.

The locations of the known O. Reg. 170/03 systems across the TRSPA are shown in **Figure 2.8**. The locations of Permits to Take Water (PTTW) for surface water use are shown on **Figure 2.9** and the PTTW locations for groundwater use are shown on **Figure 2.10**. Most people in the TRSPA live in the south, close to Lake Ontario, and receive their drinking water from lake-based intakes. In addition, the lake-based systems now service communities north of Toronto such as Bolton, Richmond Hill, Thornhill, and Markham, which were once serviced by groundwater-based systems.


The Toronto & Region Source Protection Area
Locations of Permitted Surface Water Use (2002-2005)
Legend
Known Takings
(Cubic Metres per Day)
0 - 50
51 - 150
151 - 500
501 - 1500
1500 +
* Municipal Withdrawals are in red
*Well NO5 was NO4 during this time period
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
CTC Watershed
Watercourse
Lake
Kilometres
(c) Copyright. Toronto & Region Source Protection Area, 2017.
Source: TRCA, 2017; DMTI Geospatial, 2010; MNR, 2010; Regional Municipalities of Dufferin, Simcoe, Peel, York, Toronto & Durham
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation
Ontario
Uxbridge
Aurora
Adjala - Tosorontio
Mono
Whitchurch Stouffville
Pickering
King
Caledon
Richmond Hill
Markham
Ajax
Vaughan
Brampton
Toronto
Mississauga
Lake Ontario
F.J. Horgan
R.C. Harris
R.L. Clark
Lakeview
Toronto Islands

Figure 2.9: Locations of Permitted Surface Water Use (2002-2005)


The Toronto & Region Source Protection Area
Locations of Permitted Groundwater Use (2009)
Legend
Known Takings
(Cubic Metres per Day)
0 - 50
51 - 150
151 - 500
501 - 1500
1500 +
* Municipal Withdrawals are in red
*Well NO5 was NO4 during this time period
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
CTC Watershed
Watercourse
Lake
Kilometres
(c) Copyright. Toronto & Region Source Protection Area, 2017.
Source: TRCA, 2017; DMTI Geospatial, 2010; MNR, 2010; Regional Municipalities of Dufferin, Simcoe, Peel, York, Toronto & Durham
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Uxbridge
Mono
Adjala - Tosorontio
Aurora
Whitchurch Stouffville
Pickering
King
Caledon
Richmond Hill
Markham
Ajax
Vaughan
Brampton
Toronto
Mississauga
Lake Ontario

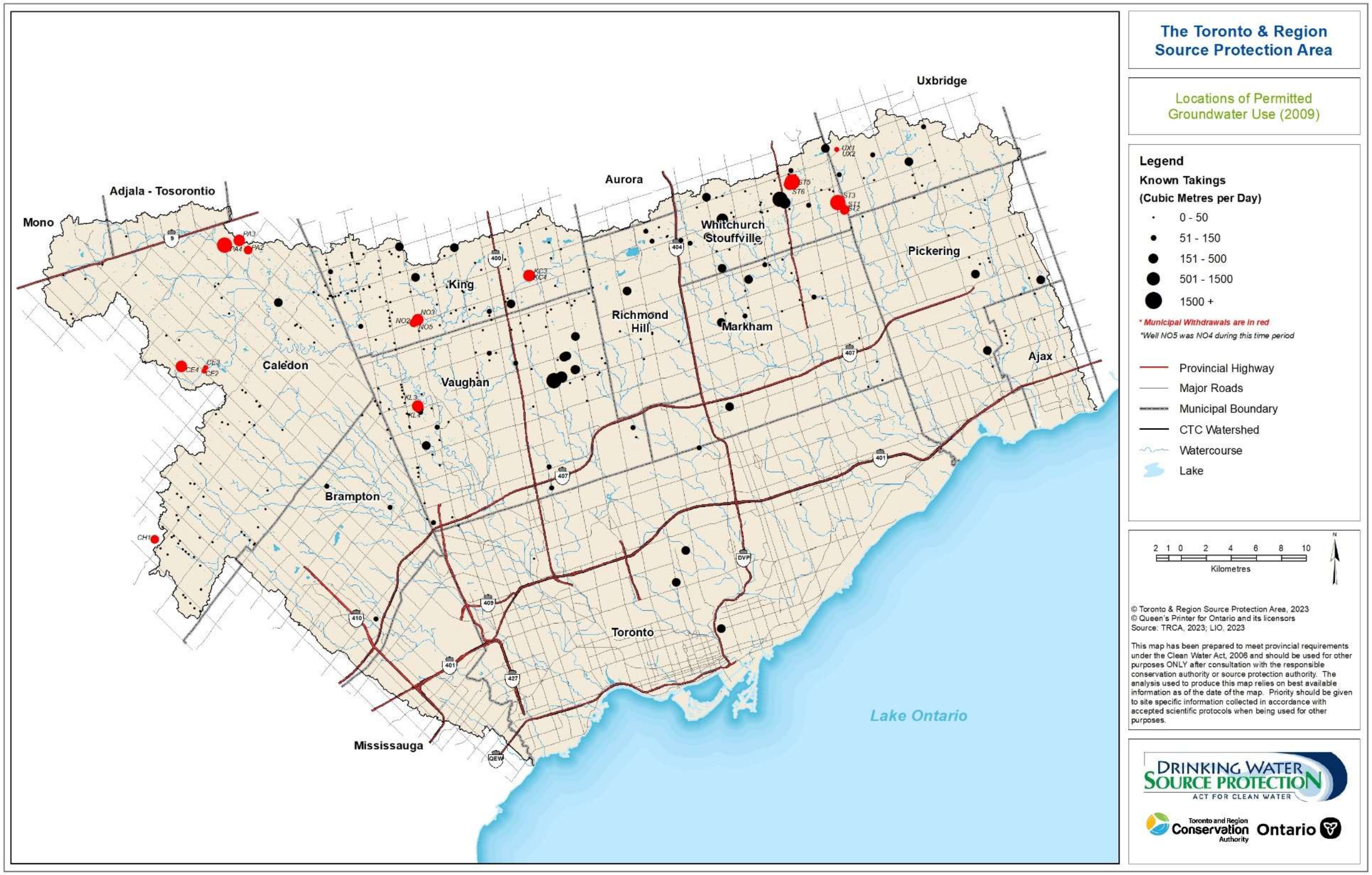


Figure 2.10: Locations of Permitted Groundwater Use (2009)

4.1.4 Transport Pathways

Under the *CWA*, man-made structures such as improperly maintained or abandoned wells, aggregate pits, quarries, and storm water ponds may affect the natural vulnerability in a system and are termed "transport pathways." There are indeed several such structures and features within the TRSPA that could increase the vulnerability of the various aquifers where they circumvent the natural protection that the overlying materials provide. There are private wells that may be improperly maintained or left abandoned, quarries that may remove protective material, and horizontal structures, such as trunk sewers, that may provide a shorter pathway for potential contaminants to travel to drinking water sources.

While the Technical Rules provide a general framework for the assessment of transport pathways, they are not prescriptive on the methodology to be applied in the analyses. Earlier work was completed by various consultants employing differing assumptions, data sources, and methodologies.

To improve upon the consistency and standardization across the CTC SPR, a transport pathway adjustment study was undertaken by the Central Lake Ontario Source Protection Authority and is documented ~~The methodology followed to determine whether a vulnerability score increase is warranted due to transport pathways is described in more detail in~~ **Appendix D3** ~~of this Assessment Report~~.

At present, there are two different transport pathway methodologies being used in the CTC SPR. The Conservation Ontario methodology which is still under development, and the Credit Valley Source Protection Area methodology which has been utilized once since the initial pilot study. The CVSPA methodology is the more conservative of the two methodologies. The CTC SPR Board voted to adopt the Conservation Ontario methodology once finalized as the minimum standard and encourage the application of the CVSPA methodology where possible.

While subsurface utilities, aggregate operations, and water wells were all considered, uncertainties associated with the water well database and the unknown depth of municipal linear infrastructure limited the analysis. The *Technical Rules* indicate that a SPC may conclude that the data available may be insufficient or of too poor quality to justify an increase in vulnerability. Given this, the adjustment study~~that study~~ recommended the consideration of pathways resulting only from aggregate pits and quarries for adjustments to vulnerability scores in WHPAs. ~~Several datasets for pathway features were reviewed in an attempt to assess transport pathways within the CTC Source Protection Region including the TRSPA jurisdiction. Only the data for pits and quarries was accurate enough to adjust the vulnerability to delineate HVAs. This adjustment for pits and quarries was done consistently with the WHPA vulnerability assessments~~.

Over the last decade, the coverage and accuracy of the water well and borehole data, and ~~of~~ infrastructure databases have been improved significantly, primarily through work completed by the Oak Ridges Moraine Groundwater Program, municipalities, and other partner agencies. This has allowed for refinement in the location and depth of potential transport pathways on the landscape, as reflected in more recent work completed for municipalities within the TRSPA.

~~The CTC SPC recommends that additional data be collected on pathways to re-visit the vulnerability assessment in a future iteration of this Assessment Report. The conservatism built into the current assessment provides assurance that vulnerability of aquifers is sufficient at this time. Pits and quarries as transport pathways resulted in a small significant change 0.48% (increase) in the area identified as HVAs.~~

4.1.5 Uncertainty Assessment

Confidence with the aquifer vulnerability mapping (AVI) depends on the density of data, the accuracy and currency of the surface geology mapping, and interpretations and assumptions made in the development of three-dimensional models. Over the last decade, the Oak Ridges Moraine Groundwater ~~Programhas~~Program has made significant advances in its understanding of the hydrogeologic system, adding new high integrity data sources, refining existing data, and developing cutting edge tools and products. As well, there is a relatively high density of data for the area of the CTC watershed region compared to other source protection regions.

The delineation of the SGRA mapping was based on a complex surface water model linked to a complex, three-dimensional groundwater flow model, and both models were calibrated to the satisfaction of external peer reviewers.

Together, these factors result in a high level of confidence in the results of the groundwater vulnerability analyses for the CTC Region. Therefore, the level of uncertainty is considered to be low. The reader is cautioned, however, that there is always a certain level of uncertainty, particularly in studies involving the subsurface, which cannot be observed directly. These studies are also regional in nature; site-specific information should always be used where available to determine local vulnerability. Data (quality and quantity) and knowledge gaps are complex.

Data on uncertainty factors surrounding HVA and SGRA analyses are provided in **Appendix D2.** Specific drinking water threats associated with all HVAs must be identified. Activities that pose a threat to the source water in these zones are listed in the Provincial Tables of Circumstances (*Technical Rules, Tables 10, 11, 17 and 18*) and discussed in **Chapter 5** of this document.

4.2 GROUNDWATER VULNERABILITY – WELLHEAD PROTECTION AREAS (WHPA)

The groundwater-based municipal supplies in the TRSPA are currently delivered through seven active water systems which have a total of 2~~0~~2 wells.

A wellhead is the physical structure of the well above the ground. A wellhead protection area is the area that surrounds the well through which contaminants are reasonably likely to move toward or reach the well. The size of the area is determined by using a computer model that estimates the time it takes groundwater to travel within the aquifer to the well based on rate the water is pumped out of the well, the type of geological materials around the well, and the speed that groundwater travels. Pollutants from a variety of activities can seep into the ground and move toward a well. The following four WHPA have been determined for each groundwater well listed in the *TRSPA Terms of Reference*:

- WHPA-A: the area within 100 m radius of the well - The area where the risk to the well is highest and the greatest care should be taken in handling any potential contaminant.
- WHPA-B: the area where groundwater is estimated to take up to 2 years to reach the well from within the aquifer. This second ring is important to protect from bacteria and viruses from human and animal waste as well as hazardous chemicals.
- WHPA-C: the area where groundwater is estimated to take up to 5 years to reach the well from within the aquifer. Although biological contaminants are less of a concern in the third ring, chemical pollutants remain a concern.

- WHPA-D: the area where groundwater is estimated to take up to 25 years to reach the well from within the aquifer. In this outer ring, the most persistent and hazardous pollutants remain a concern.

~~Two other WHPA (~~WHPA-E ~~and WHPA-F~~) isare delineated to include the area in and around the surface water body that is influencing the groundwater flow ~~a *GUDI well*~~. WHPA-E is delineated the same way as the IPZ-2 for a surface water intake (see **Section 4.6)** from the point of interaction between the aquifer and the surface water body. If the point of interaction is not known, the WHPA-E is delineated from the point of interaction between the aquifer and the surface water body that is nearest to the well. In the TRSPA, Stouffville Wells 5 and 6 have a WHPA-E associated with them~~been classified as GUD~~I. The WHPA-Es' for the Stouffville wells are contained within the WHPA-A and B zones.

~~WHPA-F zones are delineated where an issue has been confirmed for a GUDI well. No WHPA-Fs have been delineated in the TRSPA.~~

Mapping of WHPAs has been completed by consultants working for the respective regional municipalities and then peer reviewed by consultants under the direction of the CTC SPC. The WHPAs have been mapped for all of the following 2~~1~~2~~0~~ municipal wells in the TRSPA watersheds:

- Caledon East (4~~3~~ wells);
- Palgrave (3* wells);
- Nobleton (4~~3~~ wells);
- Kleinburg (2 wells);
- King City (2 wells);
- Whitchurch-Stouffville (5 wells); and
- Uxville (2 wells).

*Palgrave 3 is located within the Nottawasaga Valley Source Protection Area.

The WHPAs have been incorporated by municipalities into the appropriate Official Plans. For all of the above wells the WHPAs, other than the fixed distance WHPA-A, were estimated based on groundwater modelling that determines where and how far groundwater will flow in an aquifer over a period of time, under permitted pumping conditions. The information required to construct a representative groundwater flow model that will calculate time of travel includes:

- Types, thickness, geometry, and interrelationships between geologic layers;
- Hydraulic properties of geologic layers (*porosity*, *permeability*);
- Rate of groundwater recharge; and
- Interaction of groundwater with streams and lake.

The models were developed using the United States Geological Survey (USGS) code referred to as MODFLOW (three-dimensional MODular FLOW modelling system) and MODPATH, a particle-tracking postprocessor model for MODFLOW (Wayne and Harbaugh, 2000). The time of travel associated with WHPA-B through WHPA-D do not necessarily represent a time of travel from the ground surface to the well intake. In many cases, the time of travel associated with WHPA-B through WHPA-D represents the time of travel within the aquifer. The extent of the WHPA is then projected vertically to the ground surface. The WHPA zones determined across the TRSPA are shown together on **Figure 4.5.**

WHPAs A to D were delineated per *Technical Rule 47 (1*) to *(4)* and *Technical Rule 48 (3)*, using three-dimensional flow modelling. This involved the creation of numerical models, as done for the Tier 2 water budget study (see **Chapter 3**). The modelling package used for the analysis varied amongst the municipalities. Most groundwater consultants used the three dimensional MODFLOW modelling system, while others used the Finite element FLOW (FeFLOW) model.

WHPAs A-D for all wells in the TRSPA were delineated through a time of travel assessment, using *backward particle tracking* analysis. Forward particle tracking analysis was used to cross-check the WHPA delineation.

The WHPAs were delineated by pumping each well to *steady state* at rates determined to be the maximum future average annual groundwater demand that can be sustained by the wells. The rates were chosen through consultation with individual municipalities.

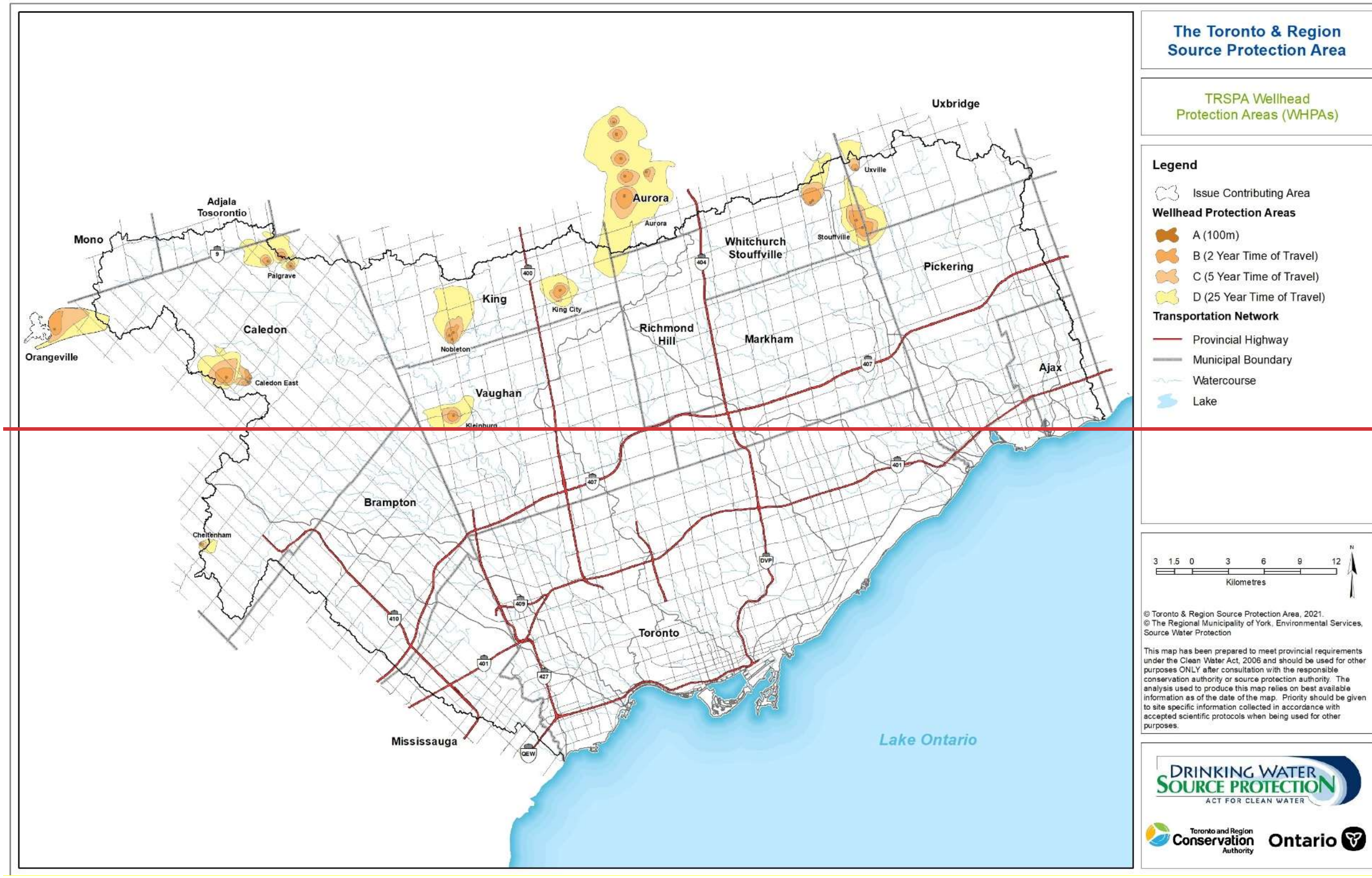
4.2.1 WHPA Vulnerability Assessment

For all TRSPA WHPAs, the score for each grid cell was then converted into a value of high, medium, or low, based on thresholds in the *Technical Rules* provided in **Table 4.2**. If the model suggested that flow from a cell never reached the well, the lowest vulnerability score was applied. The WHPA delineations for all of the TRSPA wellfields are presented in more detail below, along with the associated vulnerability scores, based on the SWAT scoring system shown in **Table 4.2.**

The vulnerability maps for the TRSPA's WHPA zones were all based on complex hydrogeologic models. All were developed using a modified Surface to Well Advection Time (SWAT) approach, except for the Uxville wellfield, which was assessed using the ISI approach to vulnerability. The modified approach assumed a zero time-of-travel in the unsaturated zone, as approved by the MOECC Director (**Appendix D3**) as per the *Technical Rule 38(3)*. The original source of all of the geologic and hydrogeologic data for these models was the Conservation Authorities Moraine Coalition (CAMC) geologic model (Version 3) produced in 2006 (Kassenaar and Wexler, 2006). The underlying data and numeric models were updated to account for more recent wells, water level data, and aquifer tests.

Vulnerability within WHPA-E is also assessed using the *Technical Rules* relevant to the IPZ-2. The range of applicable vulnerability scores within the WHPA-E is shown on **Table 4.3**.

For the wellheads within the Region of Peel, the hydrogeologic understanding had to be expanded to the west, since the boundary of existing CAMC model does not include the wellhead areas for Caledon East and Palgrave. For the wellheads in York Region, the CAMC hydrogeologic understanding was enhanced through intensive investigations conducted by York Region.


The Toronto & Region
Source Protection Area
TRSPA Wellhead
Protection Areas (WHPAs)
Legend
Issue Contributing Area
Wellhead Protection Areas
A (100m)
B (2 Year Time of Travel)
C (5 Year Time of Travel)
D (25 Year Time of Travel)
Transportation Network
Provincial Highway
Municipal Boundary
Watercourse
Lake
3 1.5 0 3 6 9 12
Kilometres
N
© Toronto & Region Source Protection Area, 2021.
© The Regional Municipality of York, Environmental Services, Source Water Protection
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER
SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation Authority
Ontario
Uxbridge
Adjala
Tosorontio
Mono
Palgrave
Aurora
Whitchurch
Stouffville
Uxville
Pickering
King
King City
Orangeville
Caledon
Nobleton
Richmond
Hill
Markham
Caledon East
Vaughan
Ajax
Kleinburg
Brampton
Cheltenham
Toronto
Mississauga
Lake Ontario

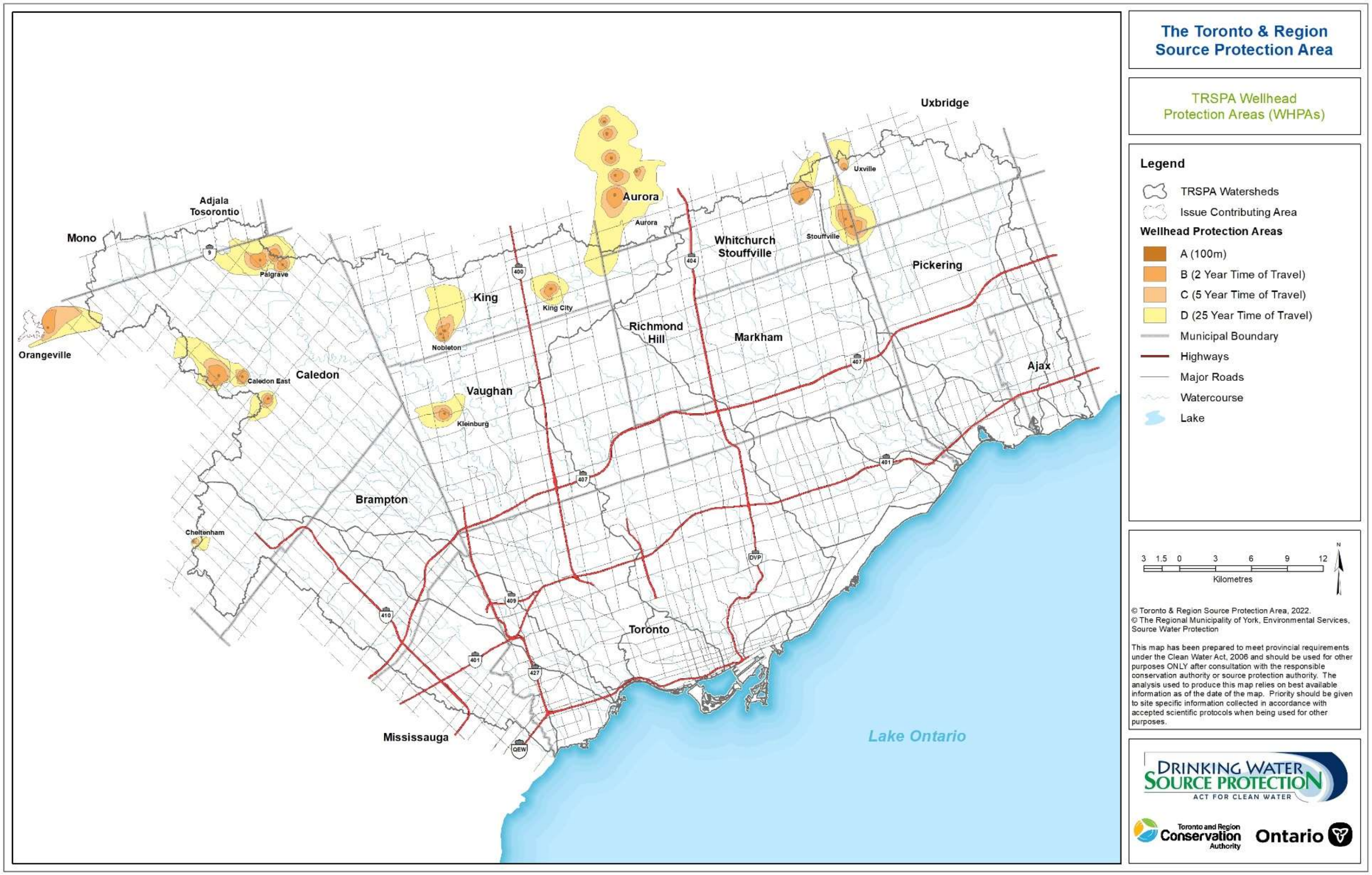


Figure 4.5: TRSPA Wellhead Protection Areas

Table 4.2: Vulnerability Categories and Wellhead Protection Area Vulnerability Scoring

WHPA Zone	Vulnerability Score by SWAT Methodology			Vulnerability Score by (ISI) Methodology		
	Low (>25 years)	Medium (5-25 years)	High (< 5 years)	Low (>80)	Medium (40-80)	High (<40)
Zone A	10	10	10	10	10	10
Zone B	6	8	10	6	8	10
Zone C	2	6	8	4	6	8
Zone D	2	4	6	2	4	6

Table 4.3: Range of Vulnerability Scores in Wellhead Protection Area E

WHPA E	Range of Vulnerability Scores
Inland Lakes	5.6, 6.3, 6.4, 7.0, 7.2, 8.0, 8.1, 9.0
Inland Rivers and Streams	6.3, 7.0, 7.2, 8.0, 8.1, 9.0

4.2.2 Transport Pathways

The *Technical Rules* allow for adjustments to the vulnerability scoring to account for the presence of transport pathways. Examples of potential pathways include subsurface utilities, aggregate operations, and clusters of private water wells. Adjustments to the vulnerability to account for the presence of transport pathways were considered for all WHPAs and were implemented for Caledon East and Palgrave WHPAs. For Caledon East and Palgrave, a vulnerability increase was considered for linear features (i.e. watermains, sanitary sewers, and sewer mains) and vertical features (stormwater management ponds, aggregate extraction areas, and clusters of boreholes) where features lie within a WHPA or an unconfined or semi-confined aquifer. The uncertainty in transport pathways is associated with the quality of GIS data available and the assumptions made. For these reasons, vulnerability increases for geothermal systems, sewage lagoons and pipelines were not identified in either the Caledon East or Palgrave WHPAs in this study.

The identification of transport pathways was undertaken in accordance with a methodology proposed by the CVSPA through a recent technical study undertaken in recent years. Theis methodology is described in the report "Credit Valley Source Protection Area Transport Pathway Assessment" and received endorsement from the CTC SPC in December 2022 until the Conservation Ontario methdology becomes available. The report assesses various features on the landscape within WHPAs and provides recommendations on the criteria to be applied to the analysis of each feature.

Subsurface Utilities

Information on the location of sewers and other subsurface utilities was reviewed. Where a utility was thought to represent a possibility of becoming a transport pathway the vulnerability rating of the underlying aquifer was increased to the next category.

Aggregate Operations

Information on the locations, and status of aggregate operations was reviewed. Aggregate operations may create or enhance a transport pathway to groundwater increasing the vulnerability of the aquifer.

Water Wells

Domestic water wells are the most common transport pathway in rural areas. Improper construction can potentially introduce a cumulative impact to drinking water sources, especially when the casing deteriorates. If the well is no longer in use, improper abandonment also provides a pathway for a contaminant to impact a drinking water source.

A review of the MOECC WWIS was undertaken to identify older, unused domestic wells. However, as many are decades old, it is not known if their status has been updated in the WWIS since being drilled, if they still exist, or if they have been decommissioned. Also, the *Technical Rules* do not provide guidance on how they should be considered. As a result, different consultants have applied a wide range of assumptions and standards in their assessments.

An analysis was applied to assess the effect of clusters of water wells as transport pathways. The methodology that was applied is described in **Appendix D4**. Based on this analysis, the CTC SPC opted against the inclusion of such pathways since the unreliability of the database used and the high uncertainty associated with the analyses were too high to defend in a reasonable manner. The adjustments considered across the TRSPA are discussed by wellfield, below.

4.3 REGION OF PEEL – TOWN OF CALEDON EAST AND PALGRAVE

The communities of Caledon East and Palgrave are located at the headwaters of the Humber River in the TRSPA. The Region of Peel operates one groundwater-based municipal drinking water supply system within the TRSPA. The system includes:

- Caledon East (~~4~~3 wells); and
- Palgrave (3 wells).

Palgrave has one wellhead located north of the TRSPA, but is included because the WHPAs extend into the TRSPA, **Figure 4.5.** An additional system is also located in Cheltenham, where the wellhead is located in the CVSPA, but the WHPA zones extend into the TRSPA. The WHPA zones for a Town of Orangeville well also extend into the TRSPA. The vulnerability analysis, scoring, and threats analysis for the Cheltenham and Orangeville systems are included in the *Updated Assessment Report: CVSPA*.

4.3.1 Geological Setting

Caledon East Well 3 is screened in the Oak Ridges Aquifer Complex, and wells 4 and 4A are screened in the Thorncliffe Aquifer Complex. Caledon East Well 6 is screened in the Scarborough Aquifer Complex. Palgrave Well 2 is screened in the Oak Ridges Aquifer Complex, while Well 3 and Well 4 are screened in the Thorncliffe Aquifer Complex.

4.3.2 Data Sources and Study Methodology

The scoring methodology for all of the Peel well systems was based on the numerical flow model using the Surface-to-Well advection time based on forward particle tracking. Because of uncertainties in modelling groundwater flow in the unsaturated zone, and to ensure that the values were conservative a travel time of “zero” was assumed above the water table.

The original modelling for the Caledon East wellfield was completed by Earthfx Inc. in 2007 and 2008, using a MODFLOW-based groundwater flow model which was discussed in **Chapter 2** of this report (Earthfx, 2007a; Earthfx 2008b). This model, known as the “West Model” was based on a groundwater model developed for the Oak Ridges Moraine by the YPDT groundwater management study team in 2006 and was peer reviewed by AMEC Earth and Environmental in 2009 (AMEC, 2010). WHPA delineations and vulnerability scoring for CE-4A was completed by Matrix Solutions Inc. (Matrix 2018; Matrix 2015).

The original modelling for the Palgrave wellfield was completed by Earthfx Inc. in 2007 and 2008 (Earthfx 2007a; Earthfx, 2008) and was peer reviewed by AMEC Earth and Environmental in 2009 (AMEC, 2010). The model and methodology used were the same as the Caledon East wellfield.

Documents published prior to 2015 have been subject to extensive peer review by a panel of municipal representatives, private consultants, and the TRCA prior to acceptance by the CTC SPC, and inclusion in this *Updated Assessment Report: TRSPA*. Reports prepared after 2015 to amend the Assessment Report to reflect wells being brought on-line were at a minimum reviewed by a qualified professional.

The subsequent modeling for the Caledon East and Palgrave wellfields was completed by Aqua Insight in 20221 using PWRMM21. The PWRMM21 model completes updates to the PWRMM19 model exclusivley in the Palgrave, Caledon East and Caledon Village areas. The groundwater flow model input parameters and boundary conditions present outside these areas are documented by Earthfx and GeoKamp (2020)

The following is a summary of these reports. Technical information on model construction and calibration are summarized in the foundation reports referenced above.

4.3.3 Caledon East WHPA A-D Delineation and Vulnerability Scoring

The groundwater flow rate calculations were based on reverse particle tracking from each well under maximum permitted pumping conditions. Although the wells are not currently pumping at their permitted rates, the flow rates were considered to be a reasonable estimation of potential future water use, given the rapidly growing population in this area. The vulnerability scores were assigned to the respective WHPA zones based on the values in **Table 4.2**. **Figure 4.6** illustrates the WHPA delineations, while **Figure 4.7** provides the vulnerability assessment and **Figure 4.9Figure 4.9** **Figure 4.8** illustrates the final vulnerability scores for all wells in the Caledon East wellfield including impacts of transport pathways.

4.3.4 Palgrave WHPA A-D Delineation and Vulnerability Scoring

The original Palgrave WHPAs were determined concurrently with those for Caledon East, by the same consultantEarthfx with the same numerical model.

The updated Palgrave and Caledon East WHPAs were determined concurrently by a new consultant Aqua Insight with an updated numerical model. The resultant WHPAs are shown on **Figure 4.10Figure 4.10Figure 4.9**, while the vulnerability is shown on **Figure 4.11Figure 4.11Figure 4.10** and the final vulnerability scores, including impact of transport pathways are shown in **Figure 4.13Figure 4.13Figure 4.11**.

4.3.5 Transport Pathways

As part of the original modelling, Although a transport pathway adjustment was considered for the Caledon East wellfield to account for a large diameter sanitary sewer that crosses into the WHPA-A for Well 3, the area was already considered high vulnerability, so no adjustment was made. No transport pathway adjustment was required for the Palgrave wells.

As part of the the updated modelling work (Aqua Insight, 2022) transport pathways were identified in both Caledon East (**Figure 4.8Figure 4.8**) and Palgrave (**Figure 4.12Figure 4.12**).

The Technical Rules (MECP, 2021) require a discussion of the uncertainty related to the WHPA delineation, vulnerability mapping, transport pathway location and the assignment of vulnerability scores within the WHPAs. As the same methodologies applied in all areas, the uncertainty assigned to all WHPAs, and vulnerability scores is the same and is summarized below.

Therefore, as part of the updated modelling,

Vvulnerability category rating values and the vulnerability scores are dependent on the presence of transport pathways. In this assessment, the vulnerability associated with private or public landfills and closed aggregate extraction areas was increased from Low to Moderate or Moderate to High when the feature lies within a WHPA of an unconfined or semi-confined aquifer. As such, the vulnerability rating was uniformly increased by one level in the presence of these features.

4.3.6 Uncertainty Assessment

WHPAs A-D for the Region of Peel wells were delineated through the use of complex numerical models based on the best available hydrogeologic data. These studies benefited from the most recent enhancement of the conceptual, hydrostratigraphic and numerical models of the area, and represent the most recent refinements in the numerical modelling for headwaters area of the Humber Watershed.

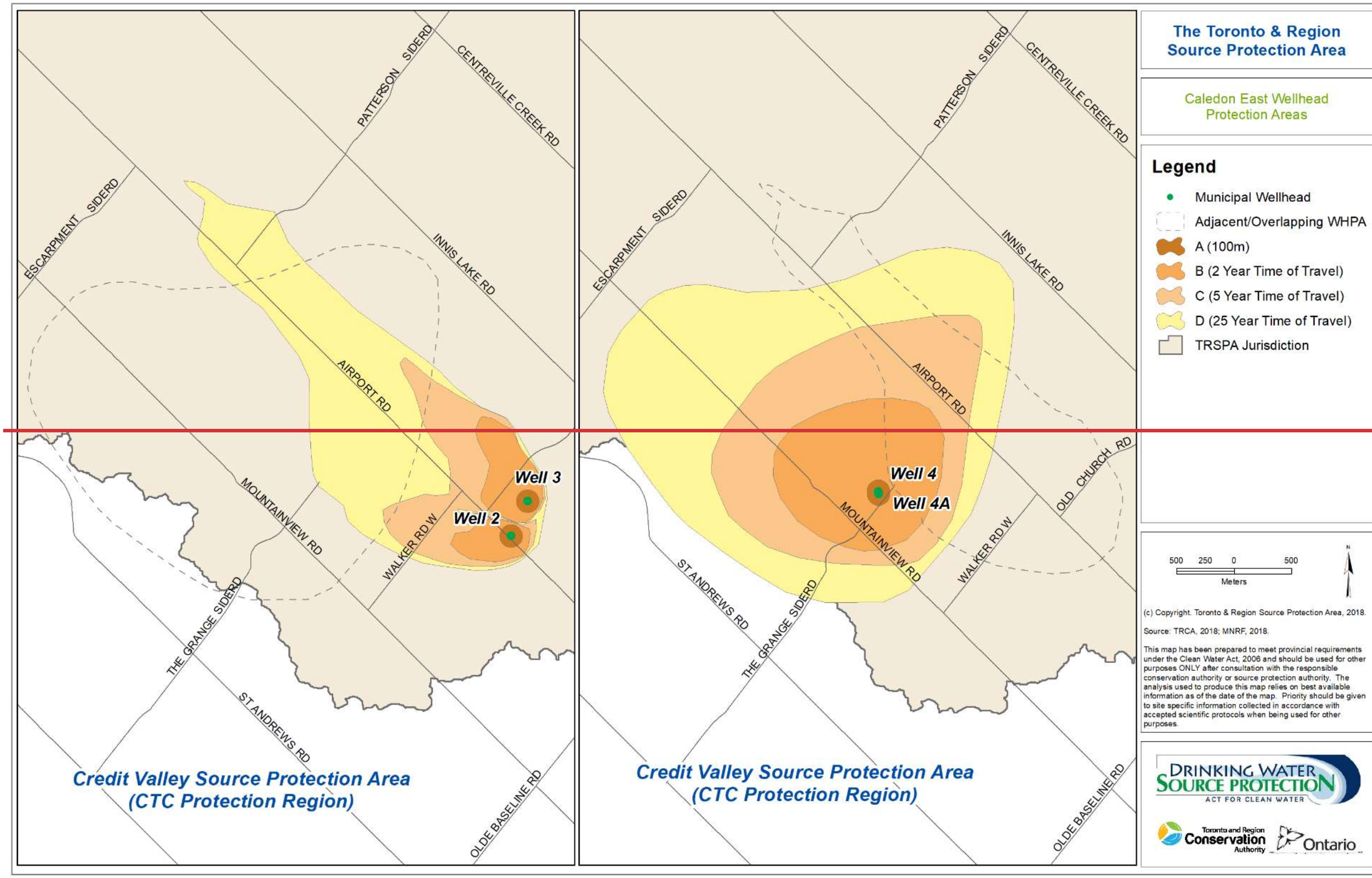
The dimensions and vulnerability scoring of WHPA-A, are set within the *Technical Rules*. With the other WHPAs, however, there is an intrinsic level of uncertainty in the analysis, given the complexity of the study area and the limited data available in some areas. The vulnerability assessment also has a certain level of uncertainty associated with it.

Uncertainty associated with Peel's wellfield assessments is found in **Table 4.4**, and further discussed in **Appendix D**. The uncertainty is summarized as follows:

- The WHPAs were delineated with a regional scale model with good calibration. A sensitivity analysis was completed to account for variation in model parameters. The uncertainty in the WHPAs is low.
- Considering the variability in the density of the data used to create the AVI mapping and that the well database has inherent uncertainty, the vulnerability mapping of the area is considered to have high uncertainty.

Table 4.4: Uncertainty Assessments - Region of Peel

Well	Uncertainty Type	Level of Uncertainty				
		WHPA-A	WHPA-B	WHPA-C	WHPA-D	WHPA-E
Caledon East	Delineation of WHPA	Low	Low	Low	Low	n/a
	Vulnerability Score	Low	Low	Low	Low	n/a
	Overall – Vulnerability Scores	**Low**	**Low**	**Low**	**Low**	**n/a**
Palgrave	Delineation of WHPA	Low	Low	Low	Low	n/a
	Vulnerability Score	Low	Low	Low	Low	n/a
	Overall – Vulnerability Scores	**Low**	**Low**	**Low**	**Low**	**n/a**


The Toronto & Region Source Protection Area
Caledon East Wellhead Protection Areas
Legend
Municipal Wellhead
Adjacent/Overlapping WHPA
A (100m)
B (2 Year Time of Travel)
C (5 Year Time of Travel)
D (25 Year Time of Travel)
TRSPA Jurisdiction
Well 2
Well 3
Well 4
Well 4A
PATTERSON SIDERD
CENTREVILLE CREEK RD
ESCARPMENT SIDERD
INNIS LAKE RD
AIRPORT RD
MOUNTAINVIEW RD
WALKER RD W
OLD CHURCH RD
THE GRANGE SIDERD
ST ANDREWS RD
OLDE BASELINE RD
Credit Valley Source Protection Area (CTC Protection Region)
500 250 0 500
Meters
N
(c) Copyright. Toronto & Region Source Protection Area, 2018.
Source: TRCA, 2018; MNRF, 2018.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation Authority
Ontario

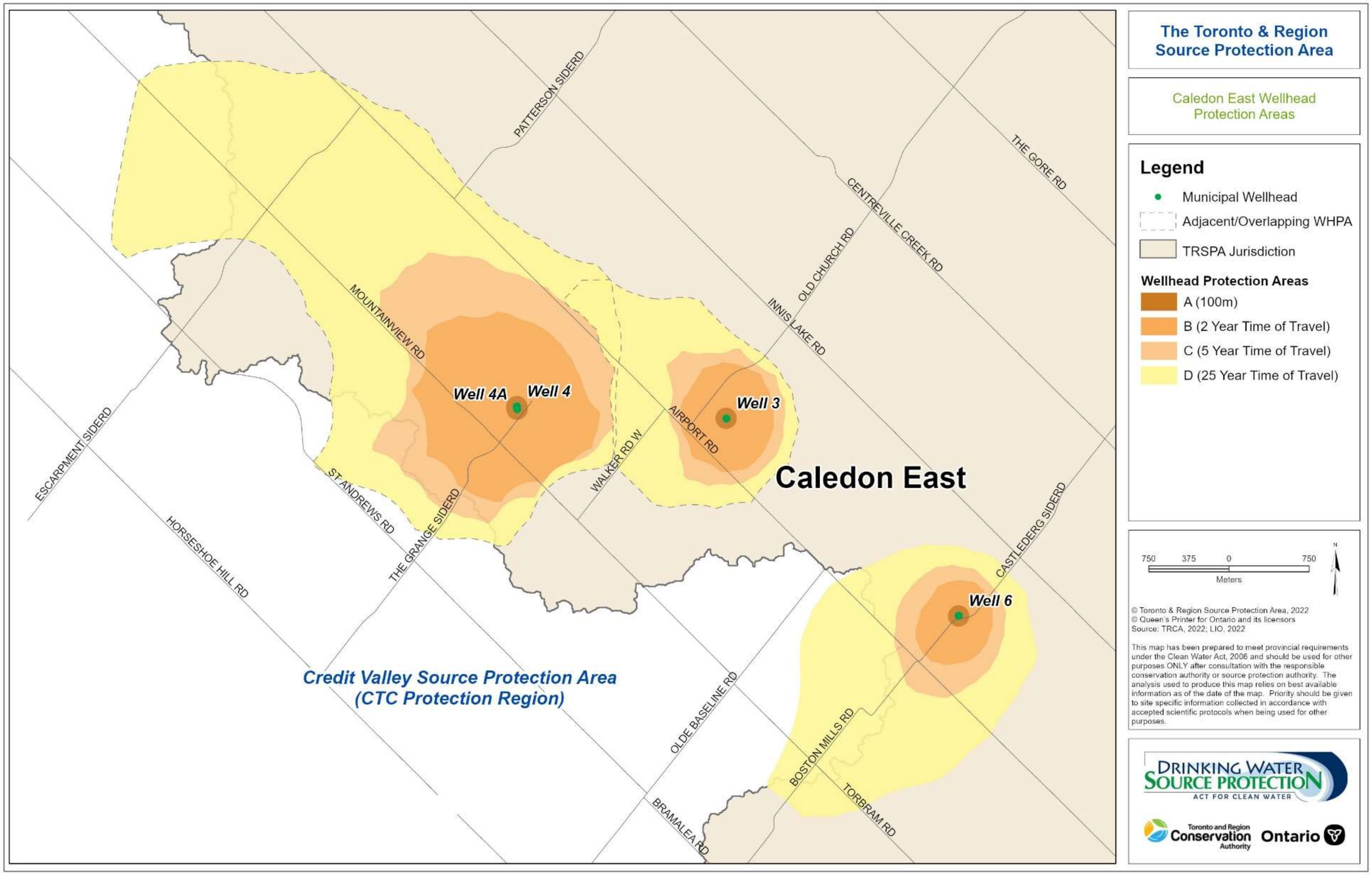
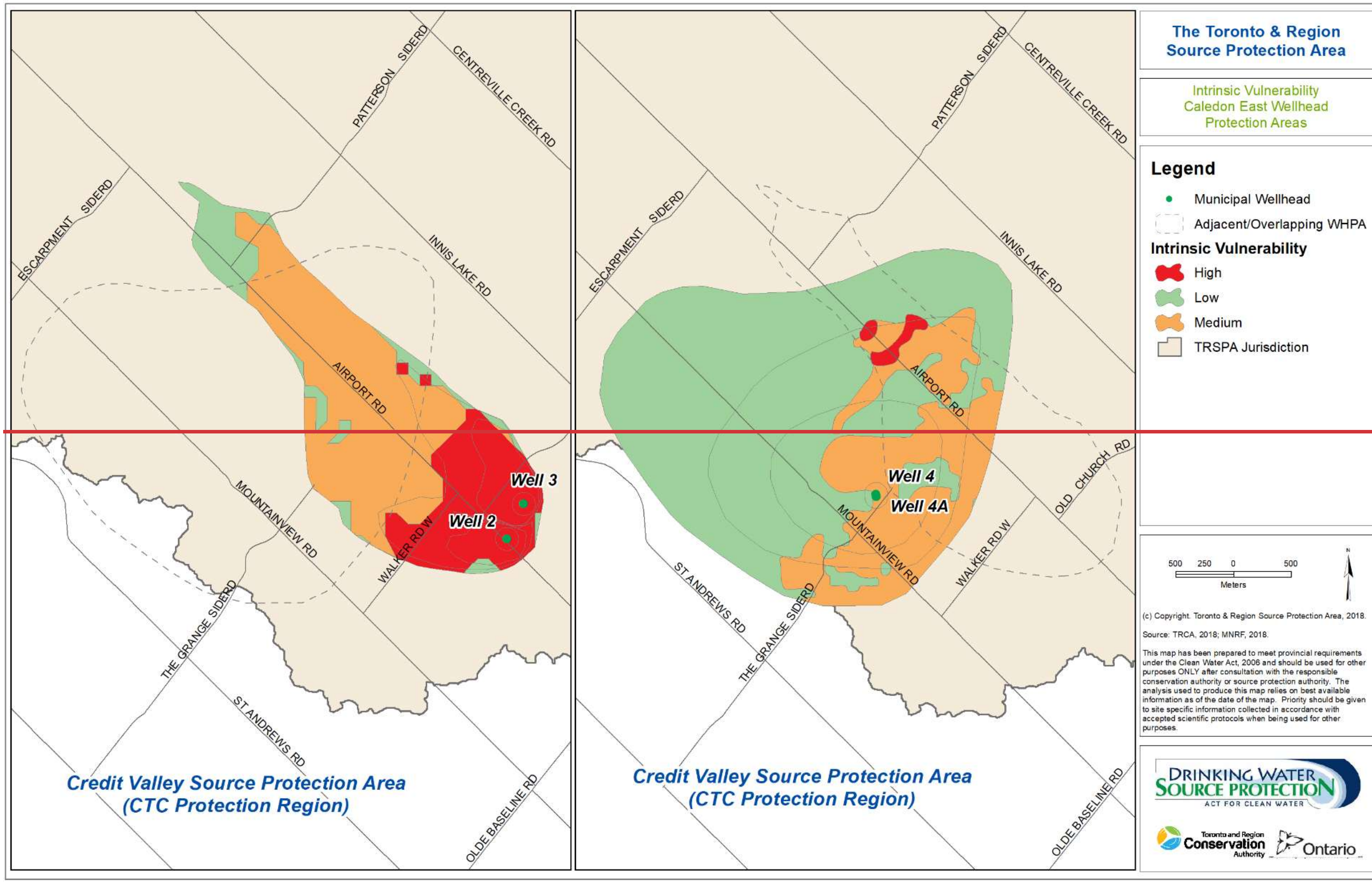


Figure 4.6: Caledon East Wellhead Protection Areas


The Toronto & Region Source Protection Area
Intrinsic Vulnerability Caledon East Wellhead Protection Areas
Legend
Municipal Wellhead
Adjacent/Overlapping WHPA
Intrinsic Vulnerability
High
Low
Medium
TRSPA Jurisdiction
Well 3
Well 2
Well 4
Well 4A
PATTERSON SIDERD
CENTREVILLE CREEK RD
ESCARPMENT SIDERD
INNIS LAKE RD
AIRPORT RD
MOUNTAINVIEW RD
WALKER RD W
OLD CHURCH RD
ST ANDREWS RD
THE GRANGE SIDERD
OLDE BASELINE RD
Credit Valley Source Protection Area (CTC Protection Region)
500 250 0 500
Meters
(c) Copyright. Toronto & Region Source Protection Area, 2018.
Source: TRCA, 2018; MNRF, 2018.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation Authority
Ontario

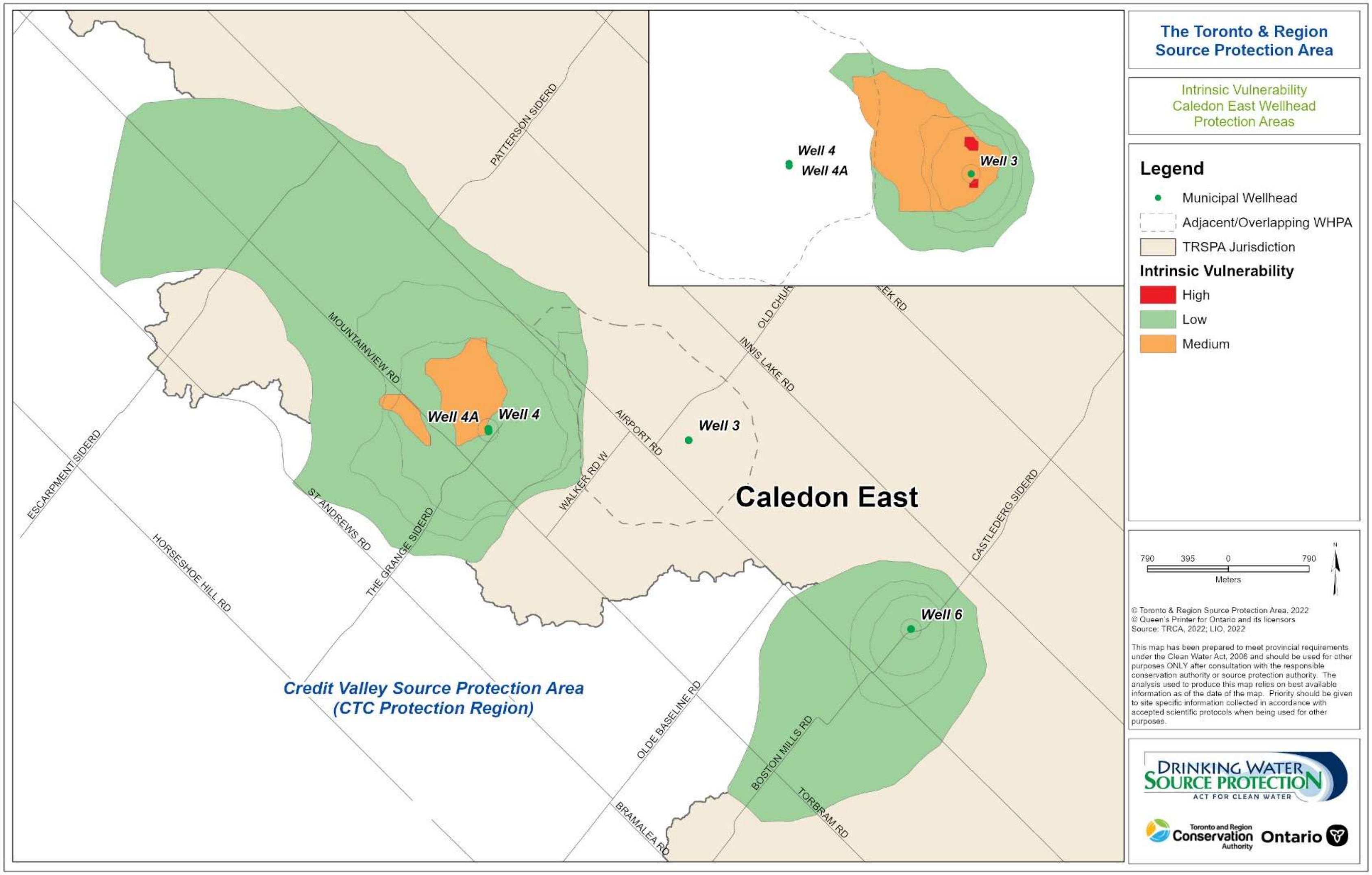
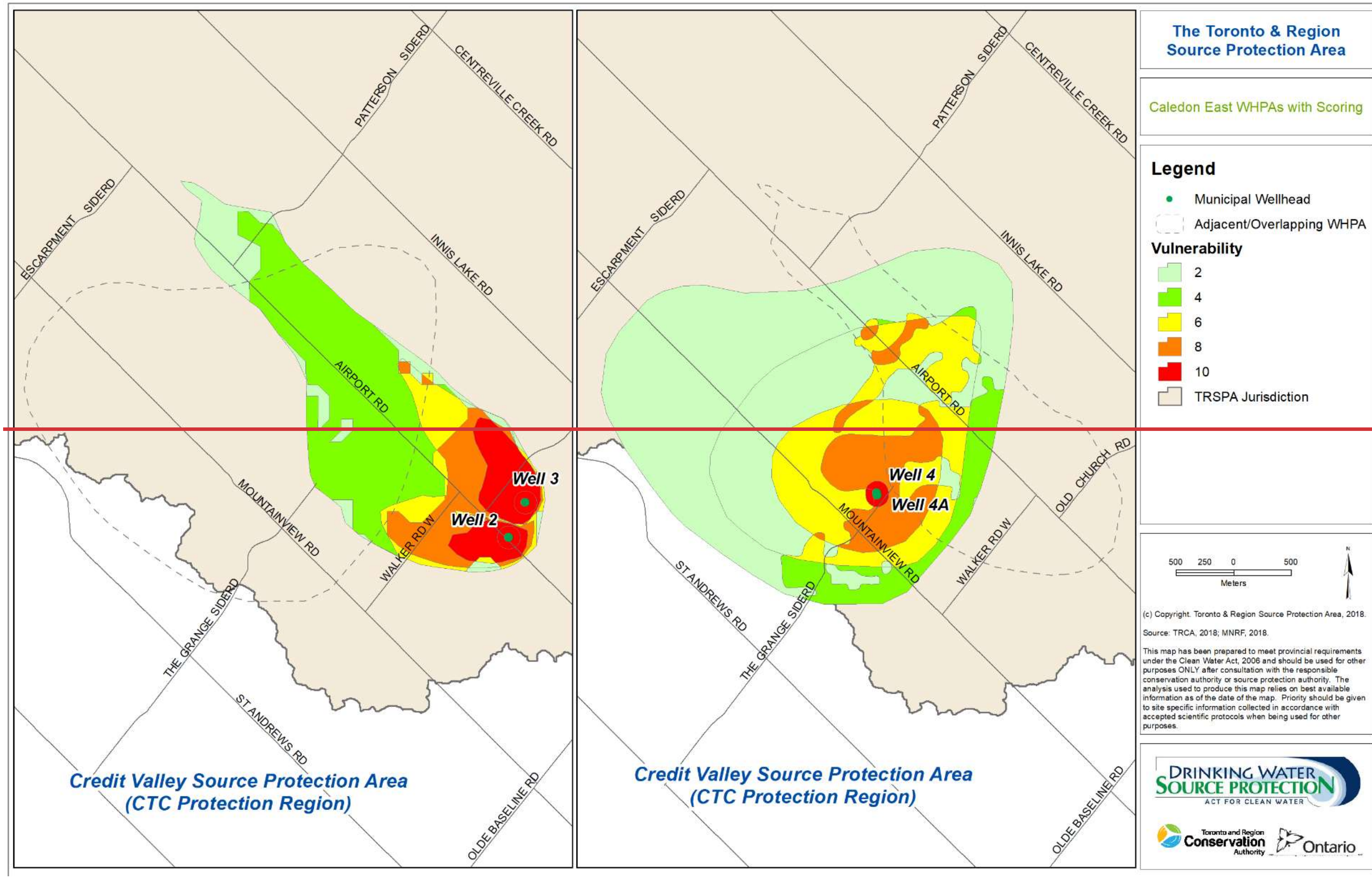


Figure 4.7: Intrinsic Vulnerability - Caledon East Wellhead Protection Area


The Toronto & Region Source Protection Area
Caledon East WHPAs with Scoring
Legend
Municipal Wellhead
Adjacent/Overlapping WHPA
Vulnerability
2
4
6
8
10
TRSPA Jurisdiction
500 250 0 500
Meters
(c) Copyright. Toronto & Region Source Protection Area, 2018.
Source: TRCA, 2018; MNRF, 2018.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation Authority
Ontario
Well 3
Well 2
Well 4
Well 4A
PATTERSON SIDERD
CENTREVILLE CREEK RD
ESCARPMENT SIDERD
INNIS LAKE RD
AIRPORT RD
MOUNTAINVIEW RD
WALKER RD W
OLD CHURCH RD
ST ANDREWS RD
THE GRANGE SIDERD
OLDE BASELINE RD
Credit Valley Source Protection Area
(CTC Protection Region)

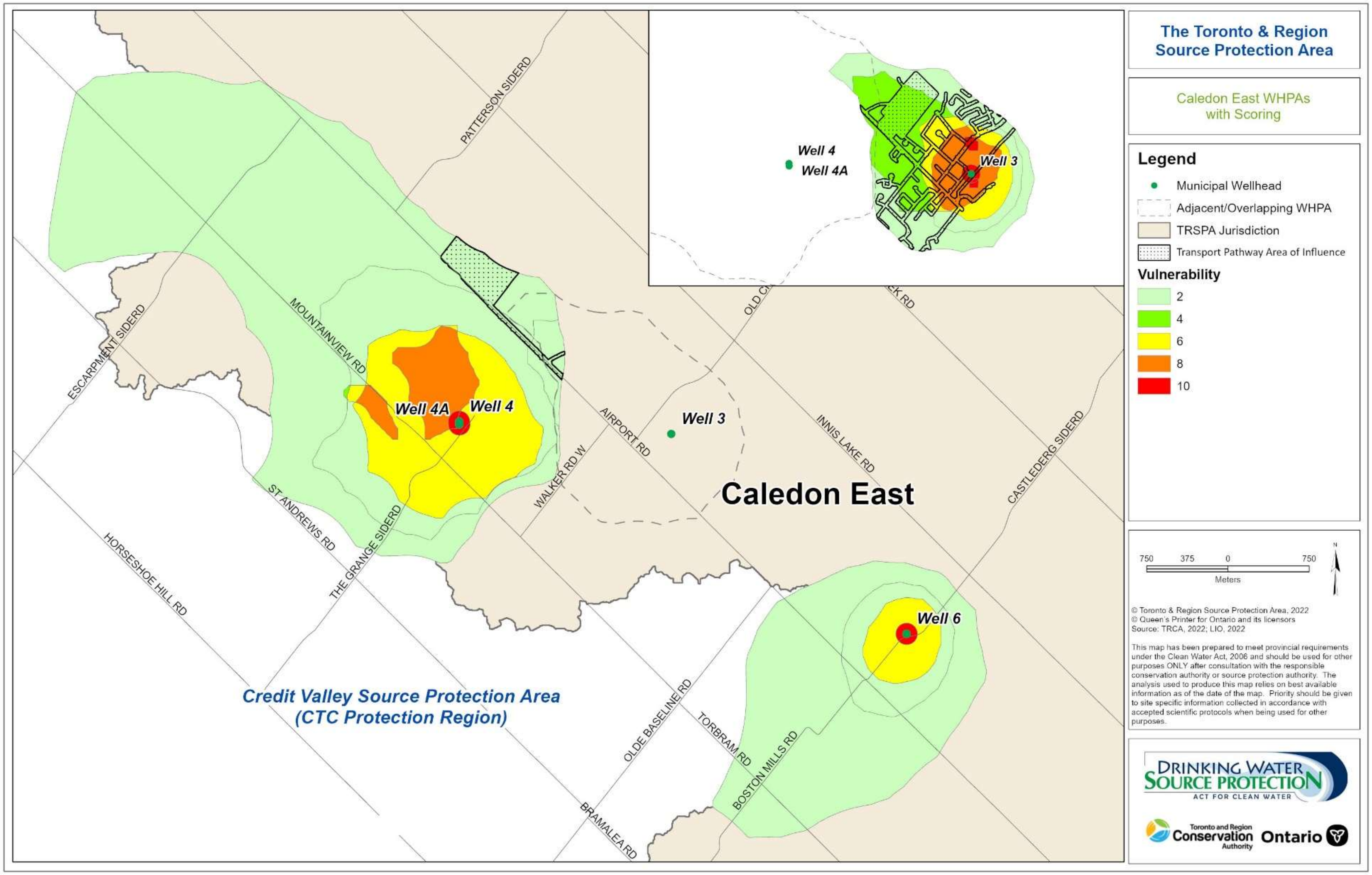


Figure 4.8: Caledon East Wellhead Protection Areas with Scoring

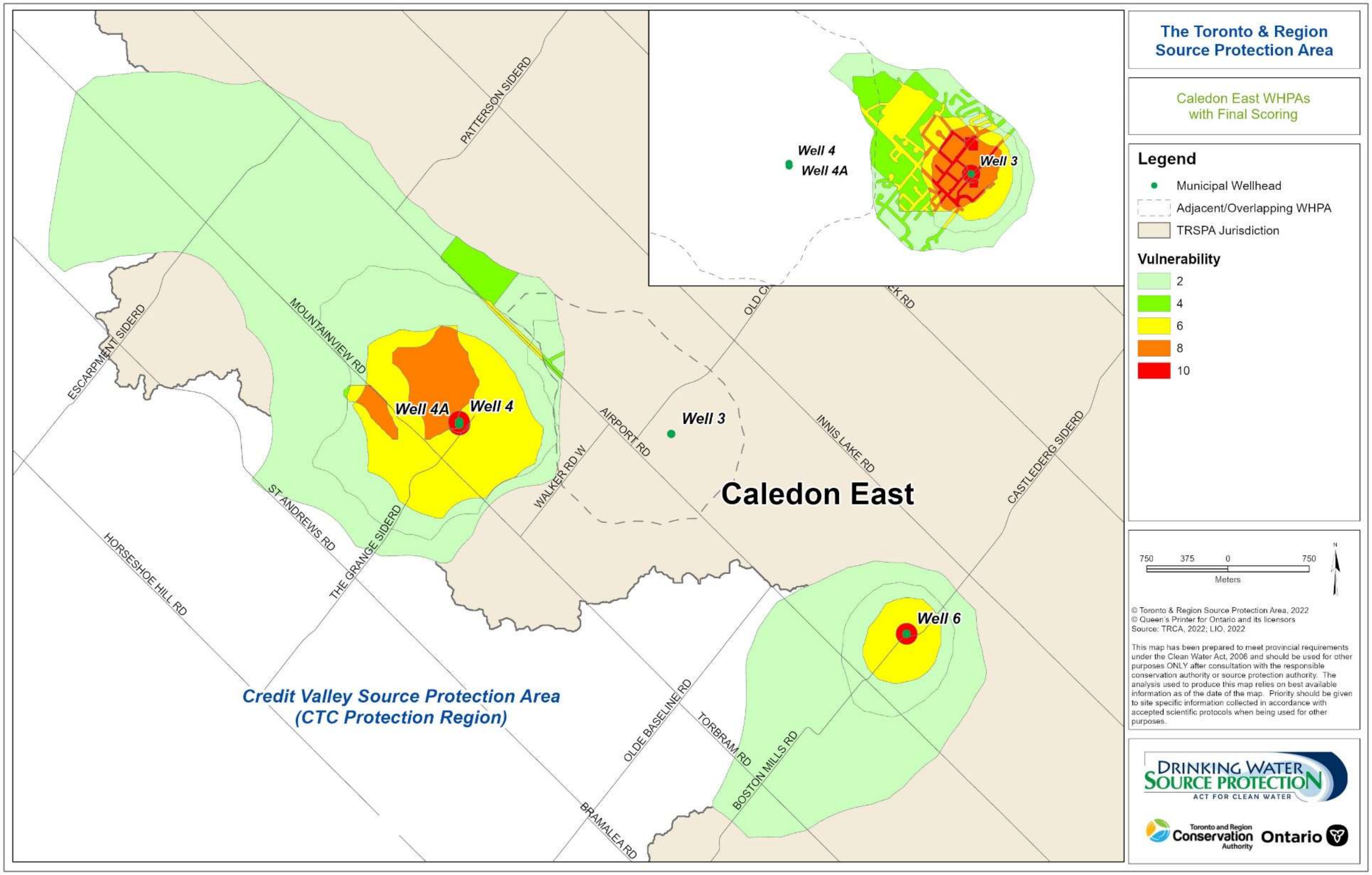
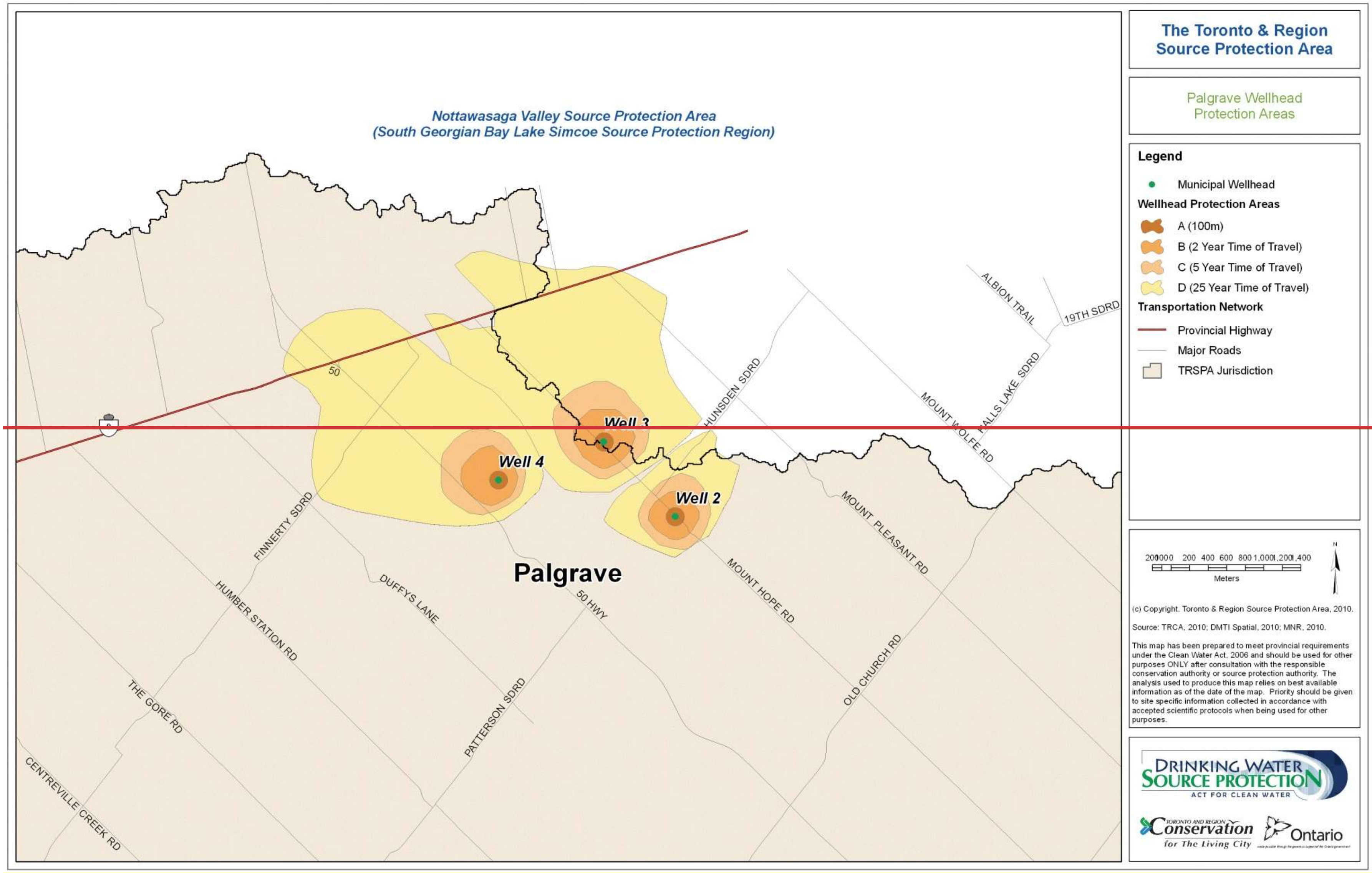


Figure 4.9: Caledon East Wellhead Protection Areas with Final Scoring including Transport Pathways


The Toronto & Region Source Protection Area
Palgrave Wellhead Protection Areas
Legend
Municipal Wellhead
Wellhead Protection Areas
A (100m)
B (2 Year Time of Travel)
C (5 Year Time of Travel)
D (25 Year Time of Travel)
Transportation Network
Provincial Highway
Major Roads
TRSPA Jurisdiction
Meters
(c) Copyright. Toronto & Region Source Protection Area, 2010.
Source: TRCA, 2010; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
Nottawasaga Valley Source Protection Area
(South Georgian Bay Lake Simcoe Source Protection Region)
Well 2
Well 3
Well 4
Palgrave
50
ALBION TRAIL
19TH SDRD
HUNSDEN SDRD
MOUNT WOLFE RD
FALLS LAKE SDRD
MOUNT PLEASANT RD
MOUNT HOPE RD
FINNERTY SDRD
DUFFYS LANE
50 HWY
HUMBER STATION RD
THE GORE RD
PATTERSON SDRD
OLD CHURCH RD
CENTREVILLE CREEK RD
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation for The Living City
Ontario

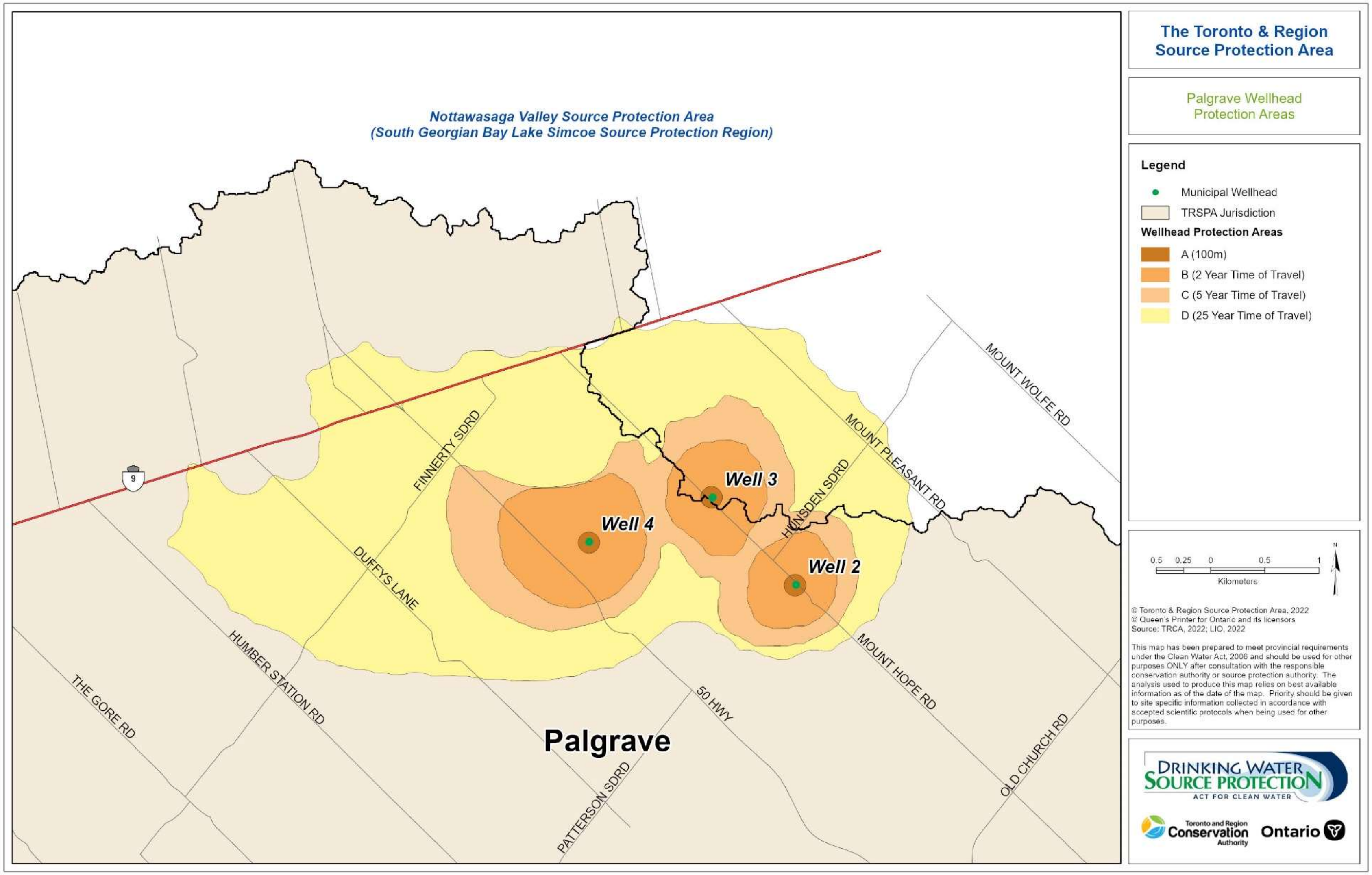
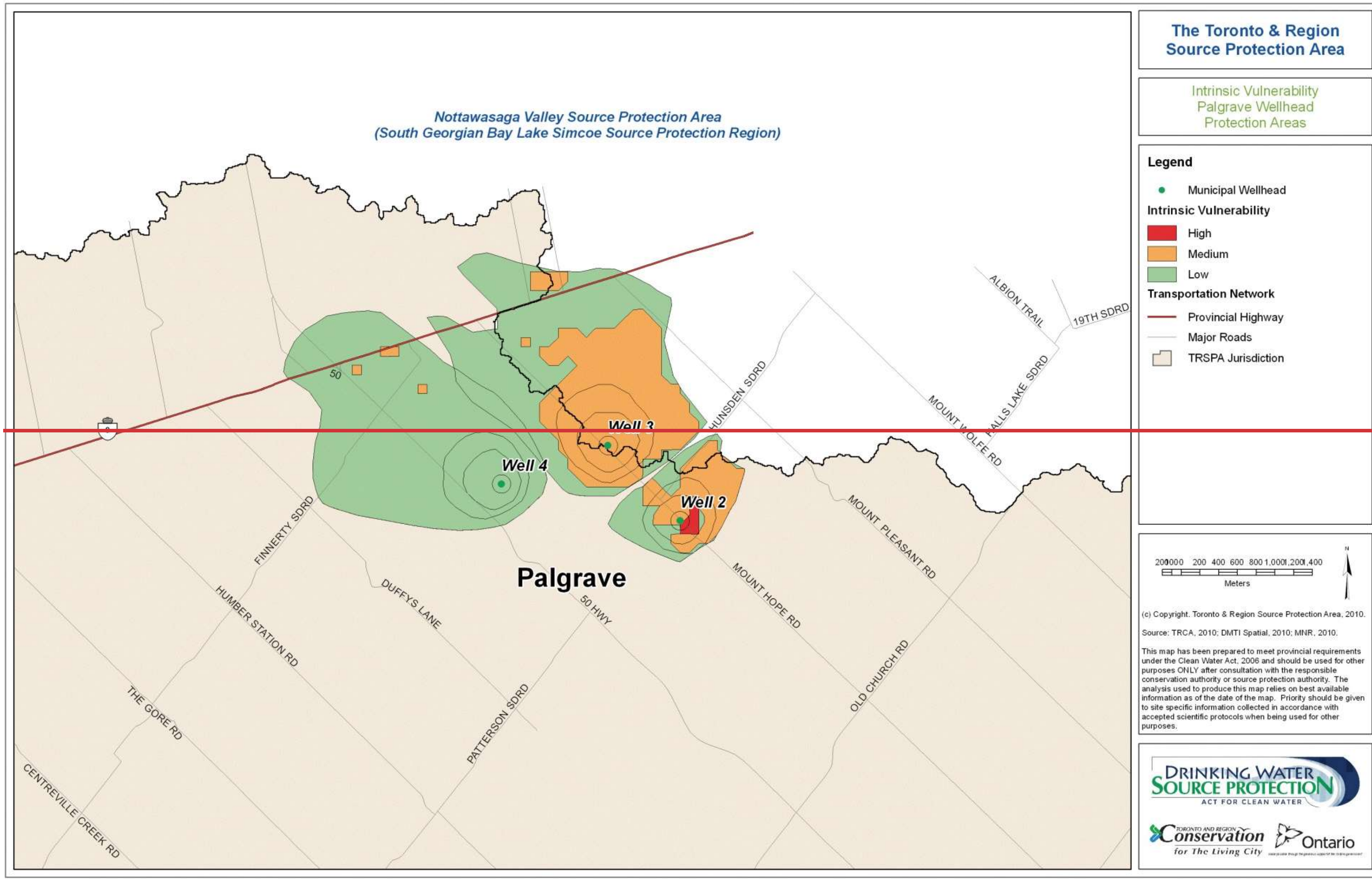


Figure 4.10~~10109~~: Palgrave Wellhead Protection Areas


The Toronto & Region Source Protection Area
Intrinsic Vulnerability Palgrave Wellhead Protection Areas
Nottawasaga Valley Source Protection Area
(South Georgian Bay Lake Simcoe Source Protection Region)
Well 2
Well 3
Well 4
Palgrave
50
FINNERTY SDRD
HUMBER STATION RD
DUFFYS LANE
50 HWY
MOUNT HOPE RD
MOUNT PLEASANT RD
OLD CHURCH RD
PATTERSON SDRD
THE GORE RD
CENTREVILLE CREEK RD
HUNSDEN SDRD
MOUNT WOLFE RD
FALLS LAKE SDRD
ALBION TRAIL
19TH SDRD
Legend
Municipal Wellhead
Intrinsic Vulnerability
High
Medium
Low
Transportation Network
Provincial Highway
Major Roads
TRSPA Jurisdiction
200 0 200 400 600 800 1,000 1,200 1,400
Meters
N
(c) Copyright. Toronto & Region Source Protection Area, 2010.
Source: TRCA, 2010; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation for The Living City
Ontario

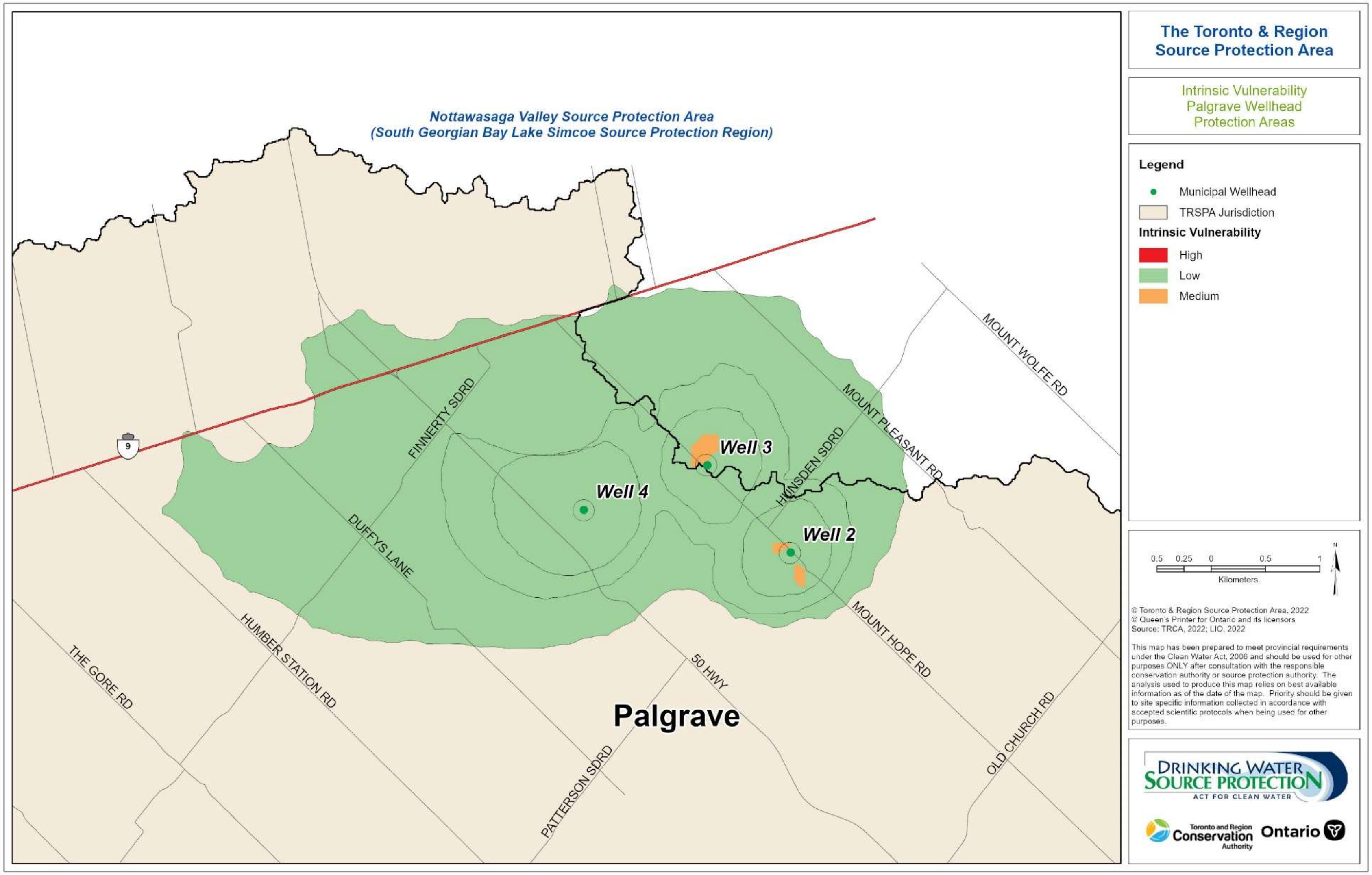
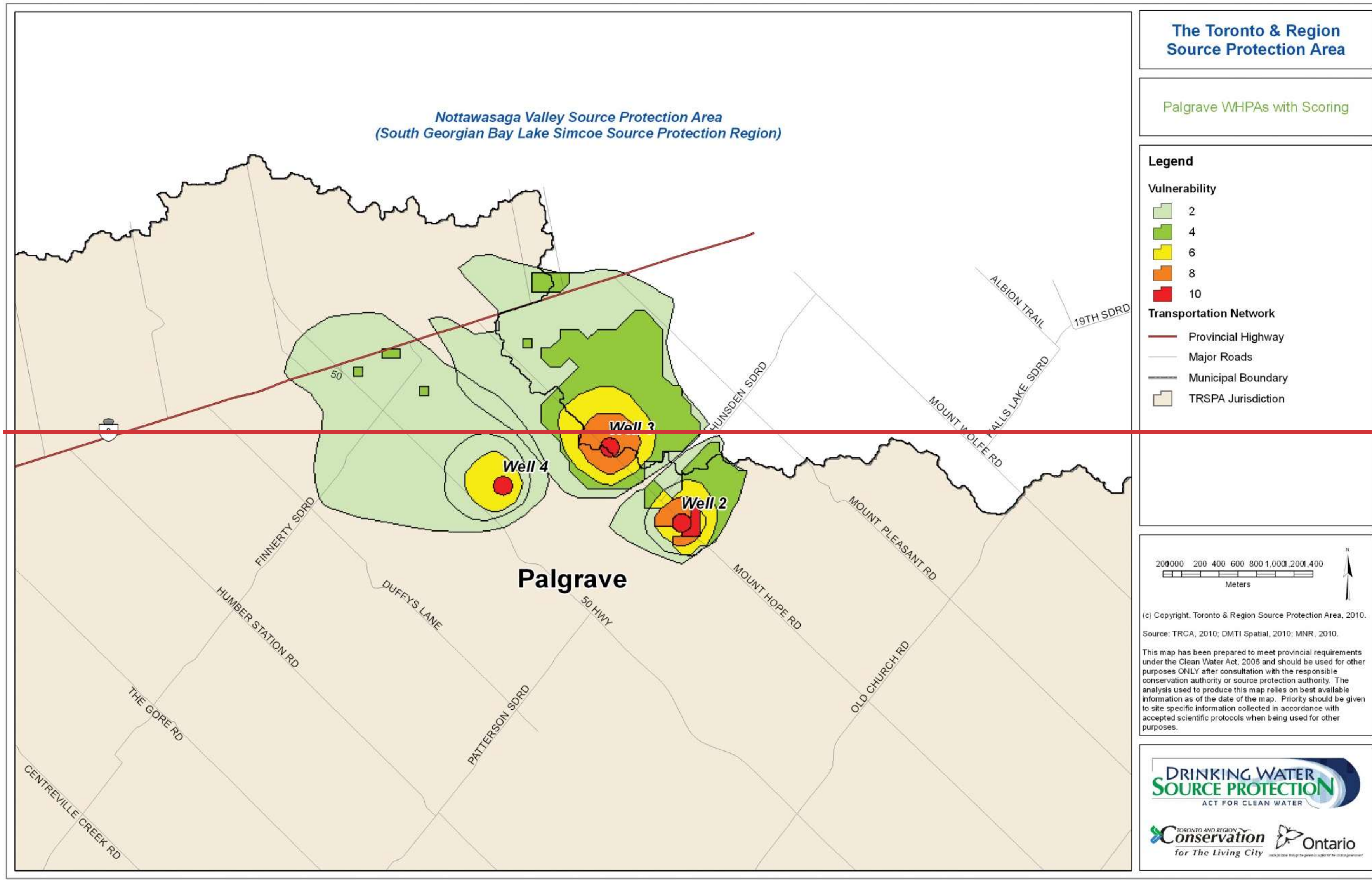


Figure 4.111110: Intrinsic Vulnerability Palgrave Wellhead Protection Area


The Toronto & Region Source Protection Area
Palgrave WHPAs with Scoring
Legend
Vulnerability
2
4
6
8
10
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
TRSPA Jurisdiction
Nottawasaga Valley Source Protection Area
(South Georgian Bay Lake Simcoe Source Protection Region)
Well 2
Well 3
Well 4
Palgrave
50
FINNERTY SDRD
HUMBER STATION RD
DUFFYS LANE
50 HWY
PATTERSON SDRD
THE GORE RD
CENTREVILLE CREEK RD
MOUNT HOPE RD
MOUNT PLEASANT RD
OLD CHURCH RD
MOUNT WOLFE RD
FALLS LAKE SDRD
ALBION TRAIL
19TH SDRD
HUNSDEN SDRD
Meters
(c) Copyright. Toronto & Region Source Protection Area, 2010.
Source: TRCA, 2010; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation for The Living City
Ontario

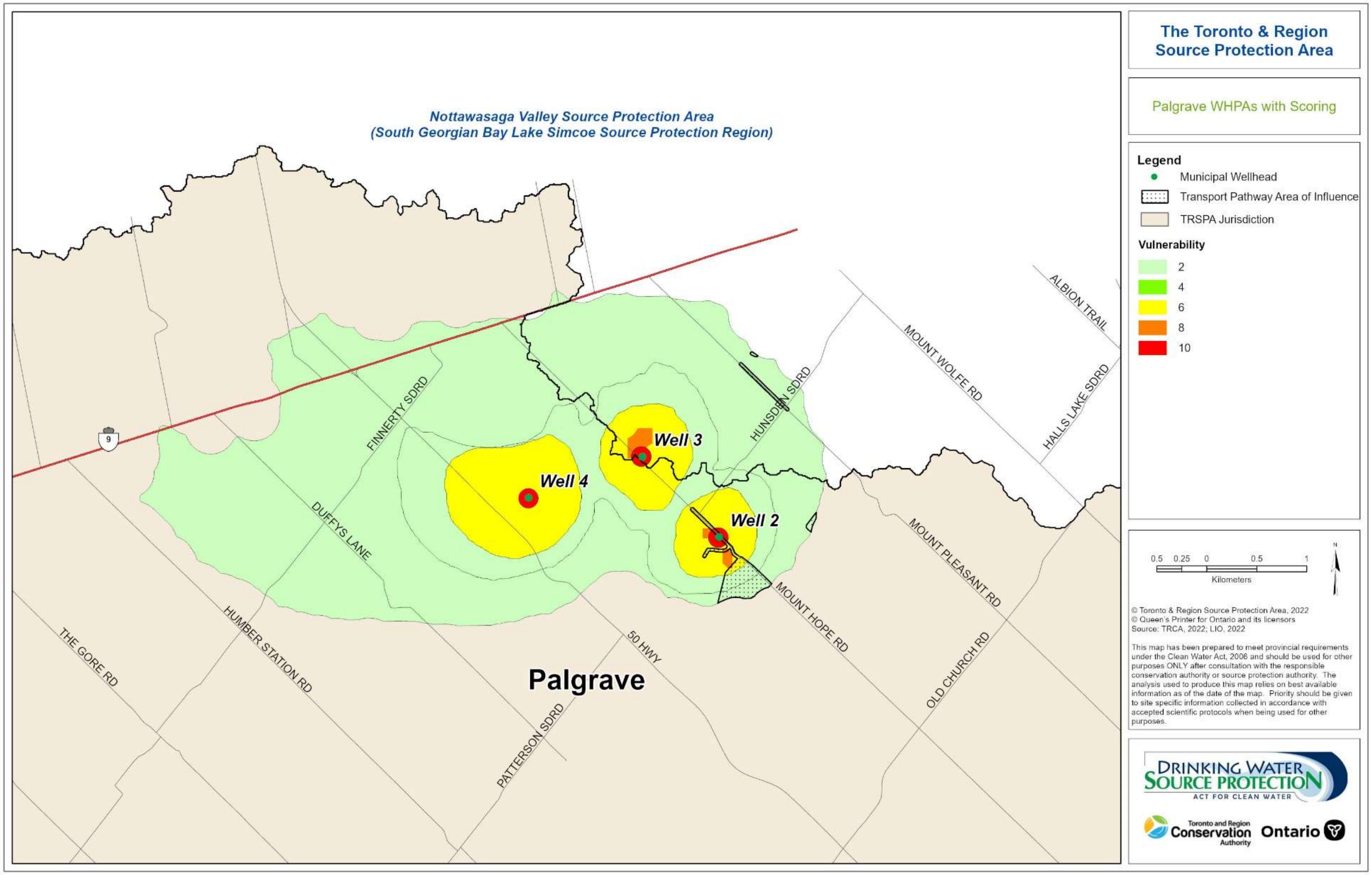


Figure 4.121211: Palgrave Wellhead Protection Areas with Scoring

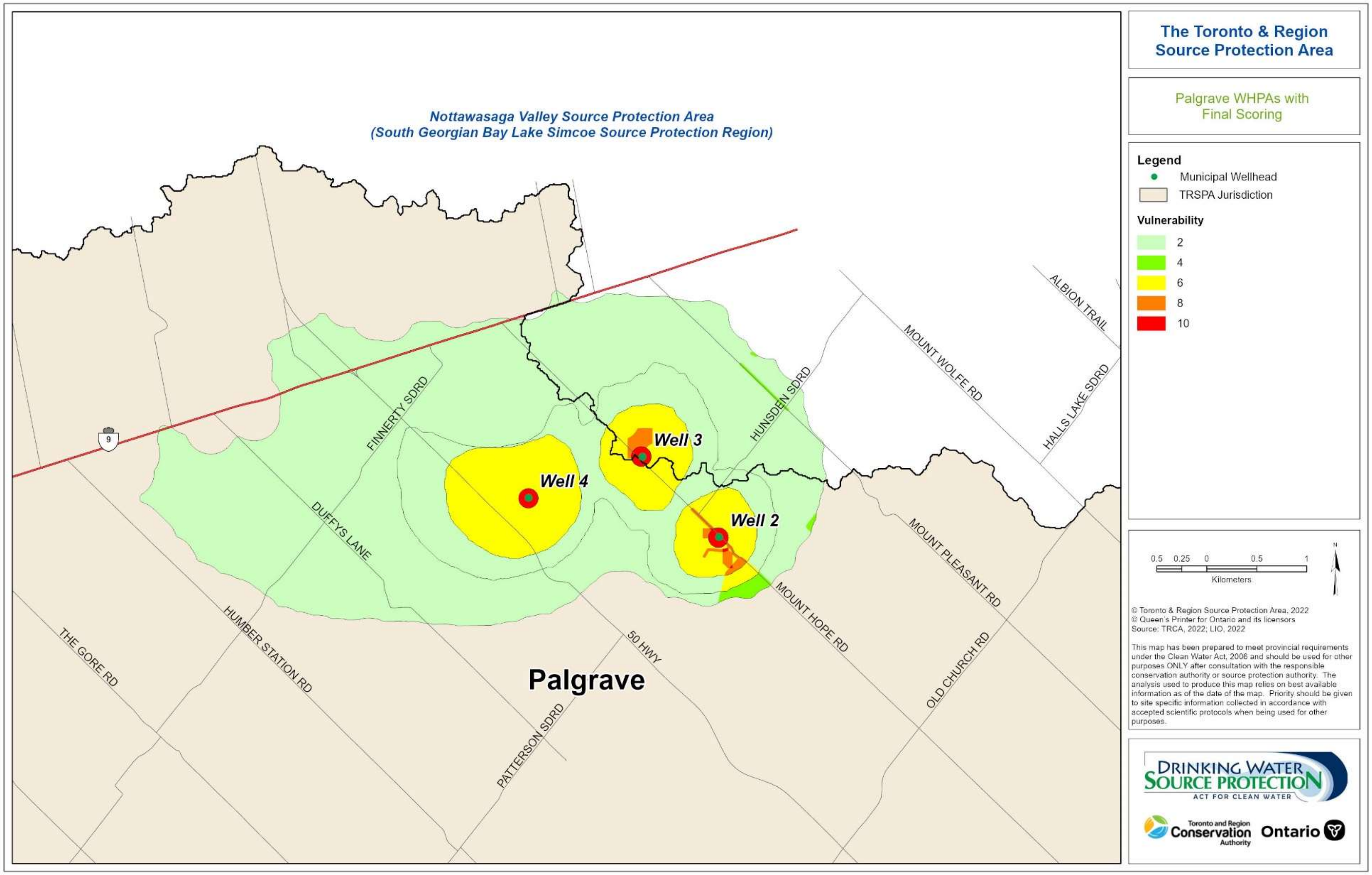


Figure 4.13: Palgrave Wellhead Protection Areas with Final Scoring including Transport Pathways

4.4 YORK REGION – TOWNS OF NOBLETON, KLEINBURG, KING, AND WHITCHURCH-STOUFFVILLE

4.4.1 Geological Setting

York Region operates four groundwater-based municipal drinking water supplies within the TRSPA. These systems include:

- Nobleton (~~4~~3 wells);
- Kleinburg (2 wells);
- King City (2 wells); and
- Whitchurch-Stouffville (5 wells).

These systems are located in the headwaters of the Humber River System, with the exception of Whitchurch-Stouffville, which is in the headwaters of both the Rouge River and Duffins Creek watersheds. All of the wells are screened in the overburden, with depths ranging up to 100 m below grade. Further details on the setting for each wellfield are provided below.

The wells for York Region's Aurora-Newmarket wellfield are located in the South Georgian Bay – Lake Simcoe Source ~~Proteciton~~Protection Region, outside of the Toronto and Region Source ~~Proteciton~~Protection Area. However, the wellhead protection area for Aurora well 7 extends into TRSPA and is shown on **Figure 4.5**. The part of the wellhead protection area that extends into TRSPA has a vulnerability score of 2 (low).

4.4.2 Data Sources and Study Methodology

The vulnerability scoring methodology for all four systems was based on a complex numerical groundwater flow model using the Surface-to-Well advection time with forward particle tracking. Because of uncertainties in modelling groundwater flow in the unsaturated zone, and to ensure that the values were conservative a travel time of "zero" was assumed above the water table, as approved by the MOECC Director (letter in **Appendix D3**) under *Technical Rule 38(3).* Therefore, the numerical method applied was sufficiently conservative that transport pathway adjustment was not required.

The groundwater modelling was completed by Earthfx Inc. in 2009 using a MODFLOW-based groundwater flow model (Earthfx, 2009b). The model was based on a groundwater model, the Core Model, developed for the Oak Ridges Moraine by the YPDT study team in 2006 (Kassenaar and Wexler, 2006), and peer reviewed by Conestoga Rovers and Associates in 2010 (CRA, 2010). Technical information on model construction and calibration are summarized in the foundation reports referenced above. Foundational documents have been subject to extensive peer review by a panel of municipal representatives, private consultants, and the TRCA prior to acceptance by the CTC SPC, and inclusion in this Assessment Report. The following is a summary of these reports.

WHPAs A-D were delineated through particle tracking analysis, pumping each well to steady state at rates determined with the town to be the maximum future average annual groundwater demand that can be sustained by the wells.

4.4.3 Nobleton WHPA Delineation and Vulnerability Scoring

The Regional Municipality of York operates four~~three~~ wells in Nobleton that are screened in the Scarborough Formation or Aquifer and are permitted for producing about 3,500 m^3 of water per day. The groundwater flow calculations were based on reverse particle tracking from each well under maximum permitted pumping conditions. Alternative scenarios with single well pumping at the maximum wellfield rate were also conducted to ensure that the capture zones would include these variations. Although the wells are not currently pumping at their permitted rates, the flow rates were considered to be a reasonable estimation of potential future water use, given the rapidly growing population in this area. Based on professional judgment by York Region staff, with the concurrence of the peer reviewers, no transport pathway adjustments were made for these wells. The resultant WHPA map is shown on **Figure 4.142**, while the vulnerability is shown on **Figure 4.153.** The vulnerability scores for the all three wells in the Nobleton wellfield is shown on **Figure 4.164**.

The vulnerability scoring was completed using the same methodology as for the Region of Peel municipal water systems described above.

4.4.4 Kleinburg WHPA Delineation and Vulnerability Scoring

The Regional Municipality of York operates two wells in Kleinburg, with an average yield close to 1,000 m^3 of water per day. All of the water is drawn from the Scarborough Aquifer (Marshall, Macklin, Monaghan, 2006).

Modelling was completed by Earthfx Inc. in 2009 using a MODFLOW-based groundwater flow model (Earthfx, 2009). This model was based on the YPDT groundwater flow model discussed above and was peer reviewed by Conestoga Rovers and Associates in 2010 (CRA, 2010).

The groundwater time of travel (TOT) calculations were based on reverse particle tracking from each well under maximum permitted pumping conditions. Alternative scenarios with single well pumping at the maximum wellfield rate were also conducted to ensure that the capture zones would include these variations. Although the wells are not currently pumping at their permitted rates, the flow rates were considered to be a reasonable estimation of potential future water use, given the rapidly growing population in this area.

No transport pathway adjustments were made for these wells. The resultant WHPA map is shown on **Figure 4.175**, while the vulnerability is shown on **Figure 4.18Figure 4.18Figure 4.16**. The vulnerability scores is shown on **Figure 4.197**.

4.4.5 King City WHPA Delineation and Vulnerability Scoring

King City currently has two operating wells that produce about 2,000 m^3 of water per day. Both of these wells are screened in the Thorncliffe Aquifer (Marshall Macklin Monaghan Limited, 2006). The modelling work was completed by Earthfx Inc. in 2009 using a MODFLOW-based groundwater flow model (Earthfx, 2009). This model was based on the YPDT groundwater flow model discussed above and was peer reviewed by Conestoga Rovers and Associates in 2010 (CRA, 2010).

The groundwater TOT calculations were based on reverse particle tracking from each well under maximum permitted pumping conditions. Alternative scenarios with single well pumping at the maximum wellfield rate were also conducted to ensure that the capture zones would include these variations. Although the wells are not currently pumping at their permitted rates, the flow rates were considered to be a reasonable estimation of potential future water use, given the rapidly growing population in this area.

No transport pathway adjustments were made for these wells. The resultant WHPA map is shown on **Figure 4.1208**, while the vulnerability is shown on **Figure 4.2119** and the final vulnerability scores for the King City wellfield are shown on **Figure 4.220**.

4.4.6 Whitchurch-Stouffville WHPA Delineation and Vulnerability Scoring

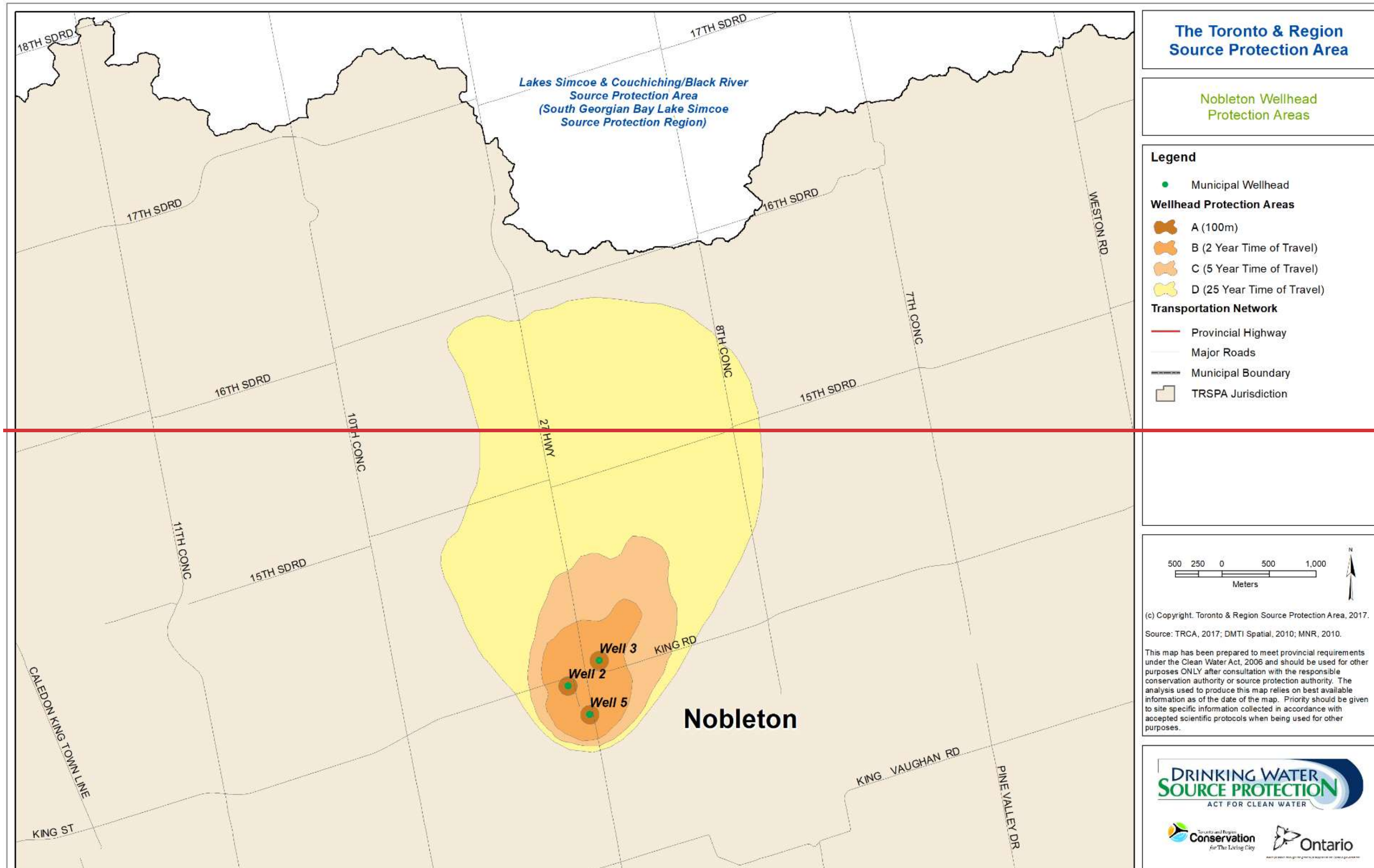
Data provided by the Regional Municipality of York showed that the average annual groundwater taking from the five Stouffville wells presently totals over 5,500 m^3 of water per day (Marshall MacklinMonaghan Limited, 2006). Stouffville groundwater withdrawals are from the Oak Ridges Aquifer (Wells 3, 5, and 6) and the Thorncliffe Aquifer (Wells 1 and 2).

Modelling was completed by Earthfx Inc. in 2009 using a MODFLOW-based groundwater flow model (Earthfx, 2009). This model was based on the YPDT groundwater flow model discussed above and was peer reviewed by Conestoga Rovers and Associates in 2010 (CRA, 2010). The groundwater TOT calculations were based on reverse particle tracking from each well under maximum permitted pumping conditions. The resultant WHPA map is shown on **Figure 4.231**, while the mapping of vulnerability is shown on **Figure 4.242**. The final map showing the vulnerability scores for the Whitchurch-Stouffville wellfield is shown on **Figure 4.253**.

4.4.7 Uncertainty Assessment

The dimensions of WHPA-A and the vulnerability scoring are set within the *Technical Rules* (. Delineating WHPAAP-B, C, and D includes an intrinsic level of uncertainty in the analysis given the complexity of the study area and data gaps in certain instances. The vulnerability scoring also has a certain level of uncertainty associated with it. The overall uncertainty associated with York Region's wellfield assessments is found in **Table 4.5**, and further discussed in **Appendix D**. The uncertainty can be summarized as follows:

- The WHPAs were delineated with a sub-regional scale model and had good calibration. A sensitivity analysis was completed to account for variation in model parameters. The uncertainty in the WHPAs is low.
- The surface-to-well advection time was undertaken in a conservative manner, and therefore, the vulnerability scoring is considered to have low uncertainty.


The Toronto & Region
Source Protection Area
Nobleton Wellhead
Protection Areas
Legend
Municipal Wellhead
Wellhead Protection Areas
A (100m)
B (2 Year Time of Travel)
C (5 Year Time of Travel)
D (25 Year Time of Travel)
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
TRSPA Jurisdiction
Lakes Simcoe & Couchiching/Black River
Source Protection Area
(South Georgian Bay Lake Simcoe
Source Protection Region)
18TH SDRD
17TH SDRD
16TH SDRD
15TH SDRD
11TH CONC
10TH CONC
27 HWY
8TH CONC
7TH CONC
WESTON RD
KING RD
KING VAUGHAN RD
KING ST
CALEDON KING TOWN LINE
PINE VALLEY DR
Well 3
Well 2
Well 5
Nobleton
500 250 0 500 1,000
Meters
N
(c) Copyright. Toronto & Region Source Protection Area, 2017.
Source: TRCA, 2017; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
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SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation
Ontario

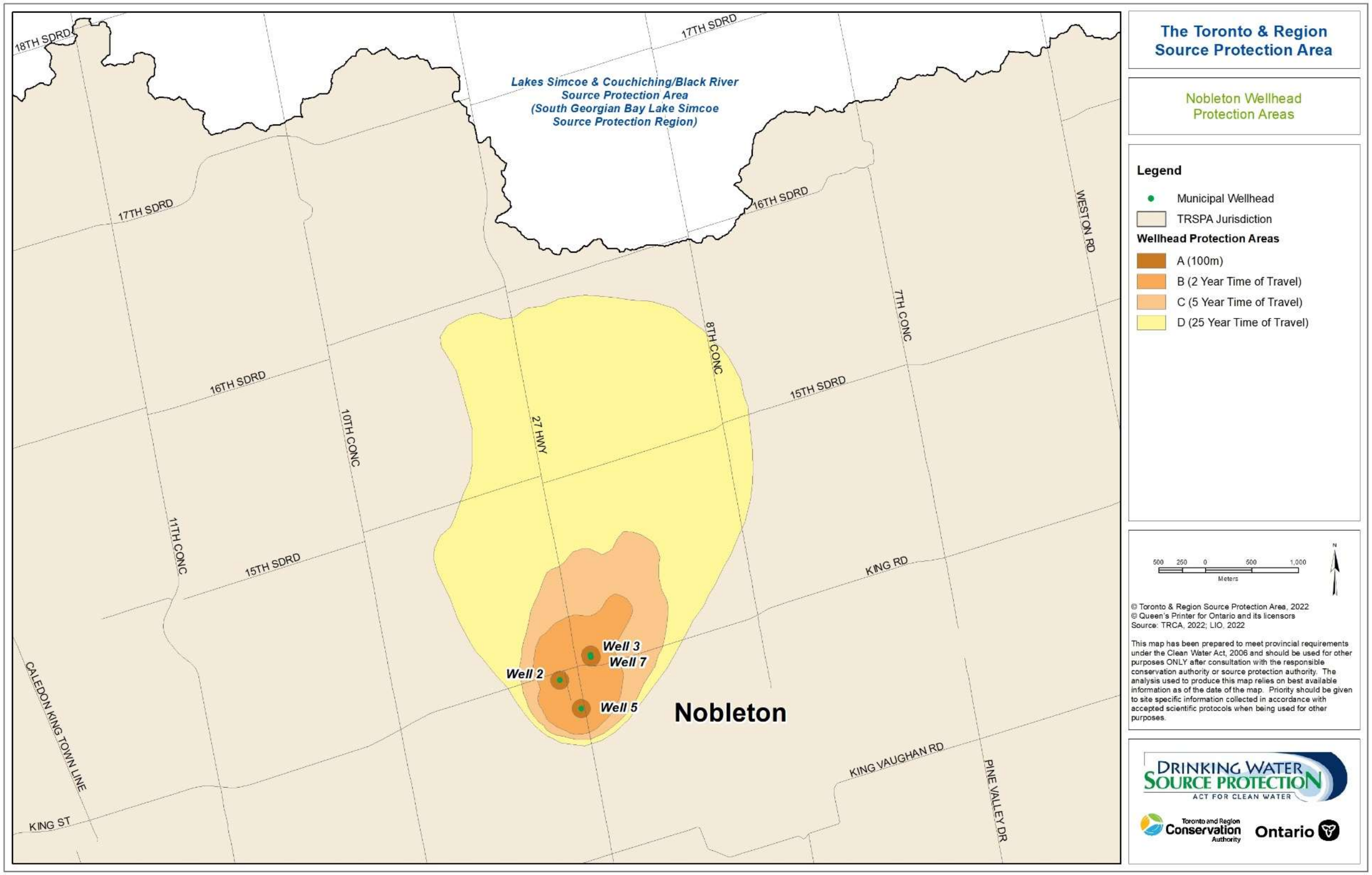
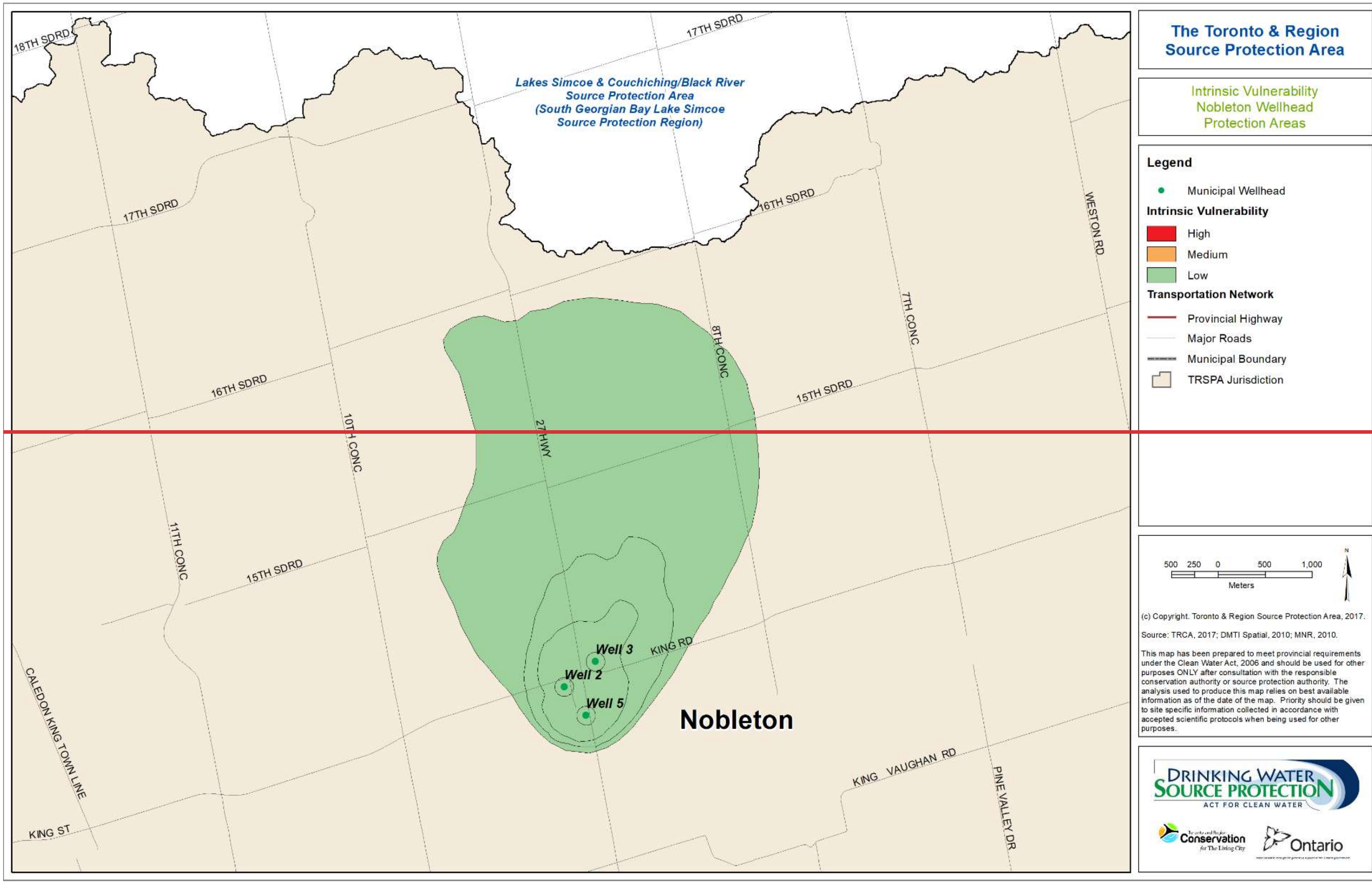


Figure 4.141412: Nobleton Wellhead Protection Areas


The Toronto & Region Source Protection Area
Intrinsic Vulnerability Nobleton Wellhead Protection Areas
Legend
Municipal Wellhead
Intrinsic Vulnerability
High
Medium
Low
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
TRSPA Jurisdiction
500 250 0 500 1,000
Meters
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Lakes Simcoe & Couchiching/Black River Source Protection Area (South Georgian Bay Lake Simcoe Source Protection Region)
Nobleton
Well 3
Well 2
Well 5
18TH SDRD
17TH SDRD
16TH SDRD
15TH SDRD
KING RD
KING VAUGHAN RD
KING ST
CALEDON KING TOWN LINE
11TH CONC
10TH CONC
27 HWY
8TH CONC
7TH CONC
WESTON RD
PINE VALLEY DR
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation for The Living City
Ontario

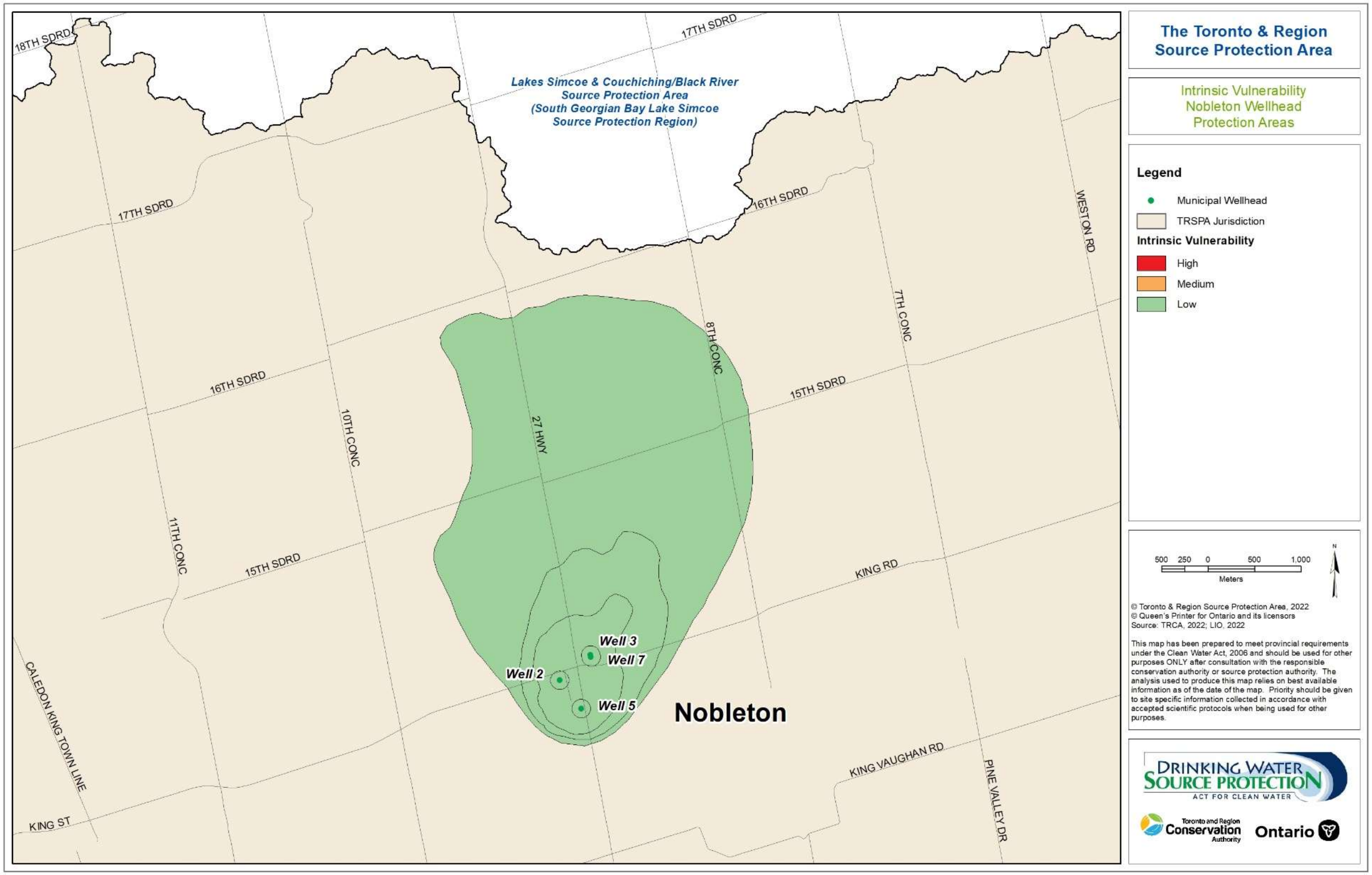
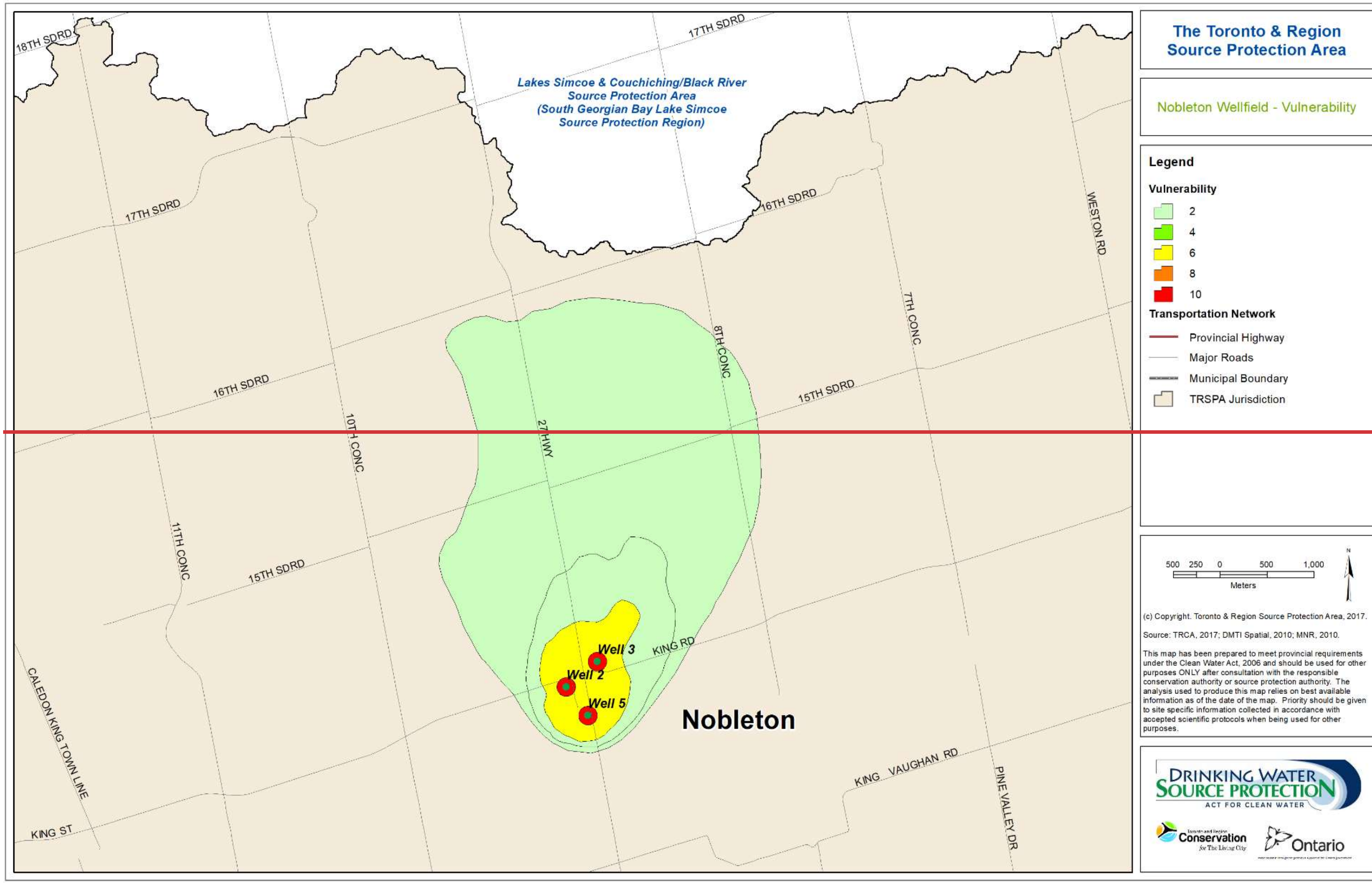


Figure 4.~~15~~15~~13~~: Intrinsic Vulnerability Nobleton Wellhead Protection Area


The Toronto & Region Source Protection Area
Nobleton Wellfield - Vulnerability
Legend
Vulnerability
2
4
6
8
10
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
TRSPA Jurisdiction
Lakes Simcoe & Couchiching/Black River Source Protection Area (South Georgian Bay Lake Simcoe Source Protection Region)
Nobleton
Well 3
Well 2
Well 5
18TH SDRD
17TH SDRD
16TH SDRD
15TH SDRD
KING RD
KING VAUGHAN RD
KING ST
27 HWY
10TH CONC
11TH CONC
8TH CONC
7TH CONC
WESTON RD
PINE VALLEY DR
CALEDON KING TOWN LINE
500 250 0 500 1,000
Meters
(c) Copyright. Toronto & Region Source Protection Area, 2017.
Source: TRCA, 2017; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
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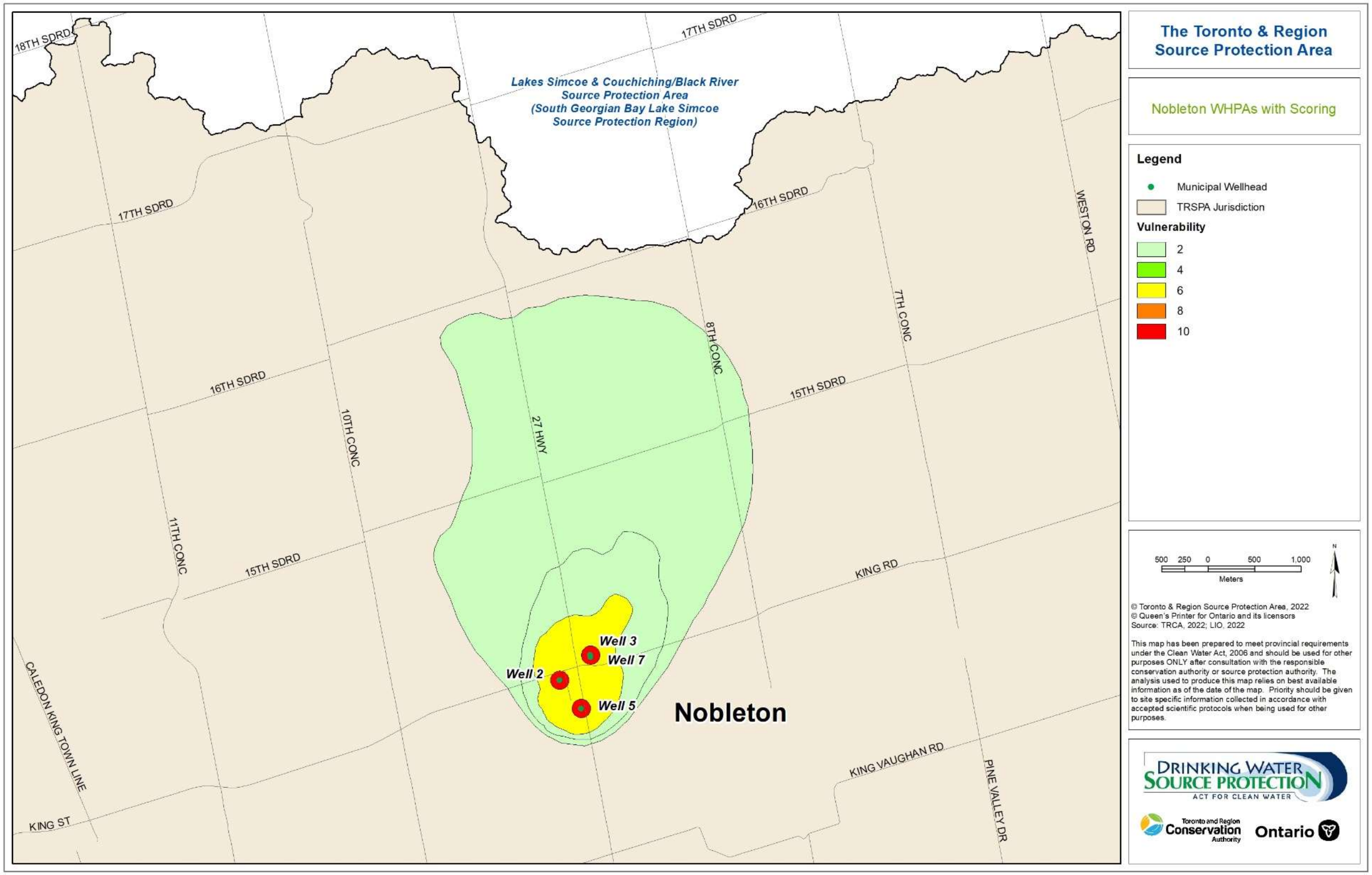


Figure 4.~~16~~1614: Nobleton Wellhead Protection Areas with Scoring

The model results show that near-shore current patterns are strongly correlated to wind directions, which are primarily westerly and easterly. Particularly at the western end of Lake Ontario the current patterns within the lake are three-dimensional. While surface water is moving in one direction, the currents near the bottom move in the reverse direction, which can also cause upwelling of bottom water to the surface, and downwelling of surface water to lower depths. Downwelling can bring surface contaminants down to the depth where the intakes are located.

Summary – IPZ-2 Delineation

Table 4.7 summarizes the information on the IPZ-2s for intakes in the TRSPA. A description of IPZs for the Arthur P Kennedy (formerly Lakeview) Water Treatment Plant, located in the CVSPA has also been included, because it extends into the TRSPA. For a full discussion of the Arthur P Kennedy (formerly Lakeview) Water Treatment Plant, please consult the *Approved Updated Assessment Report: CVSPA.*

Mapping of IPZs and vulnerability scores for the TRSPA are shown on **Figure 4.297** (R.L. Clark), **Figure 4.3028** (Toronto Island), **Figure 4.3129** (R.C. Harris), **Figure 4.320** (F.J. Horgan), and **Figure 4.331** (Ajax).

The IPZ-3 delineations are provided in **Chapter 5**, with a summary of the methodology in **Appendix E6**.

4.6.2 Vulnerability Scoring for IPZs

Once water quality IPZs are delineated, scientific calculations, along with professional experience, are used to determine how vulnerable each IPZ is to contamination. This vulnerability score (V) is essentially qualitative and derived from the formula provided in *Technical Rules*:

$$V = Vf_z \times Vf_s$$

The zone vulnerability factors (Vf_z) are assigned to each IPZ according to its susceptibility to becoming contaminated. Zone vulnerability factors depend on varying circumstances, such as the surrounding environmental conditions, the percentage of the area that is land, and how water flows through the area. As indicated earlier, transport pathways (conduits by which potential contaminants might enter the IPZ) are also considered. Natural pathways such as small channels, gullies, or fractured rock that create an opening for contaminants may also increase vulnerability.

Each intake is assigned a source vulnerability factor (Vf_s) between 0.5 and 0.7. This score depends on factors such as the type of intake, the depth and length of the intake, and the number of past incidents of exceeding the water quality guidance/standards. Water quality and trends are summarized in **Chapter 2**. Also, information about intake depth and intake distance from shoreline is shown in **Table 2.6**.

The formula does not consider specific contaminants, their respective properties, or their behaviours. The vulnerability score (V) and assigned Vf_z and Vf_s scores, do not have units. Additional discussion on the vulnerability scoring for lake-based intakes is provided in **Appendix E6.**

The vulnerability score for each intake is assigned a score based on the following criteria:

- Low vulnerability (V≤5);
- Moderate vulnerability (5<V≤6); and
- High vulnerability (V>6).

IPZ-3s related to the Type A intakes (Great Lakes) in the study area have been delineated and are reported in **Chapter 5** of this Assessment Report.
Once the IPZs have been delineated, the assignment of a vulnerability score is derived from the equation given in Part VIII of the *Technical Rules*, which provides for a possible range of scores.

Table 4.7: Extent of IPZ-2 in the Toronto and Region Source Protection Area

SPA/SPR	WTP	In-Lake Extent	Upland Extent
CVSPA/CTC	Arthur P. Kennedy (formerly Lakeview)	Extends approximately 3.2 km northeast and 2.9 km southwest of the intake. Particle tracking indicates that the IPZ does not touch the shoreline.	The IPZ-2 was extended to the shoreline and upland to encompass stormshed boundaries, and the following Etobicoke Creek watercourse that contributes to the source water intake area.
TRSPA/CTC	R.L. Clark	The IPZ-2 extends approximately 3.6 km northeast and 3 km southwest of the intake. Particle tracking indicates that the IPZ-2 extends to the shore between the TRSPA boundary and Humber Bay Park.	Extends to the west and east of the decommissioned Lakeview Generating Station, and as far north as the QEW.
	Toronto Island (Shallow)	The IPZ-2 ~~is a complex polygon that~~ extends approximately 1.5 km northwest and 1.8~~2.5~~ km northeast of the~~each~~ intake. The total length of the IPZ-2 zone is about 3.8~~4.5~~ km, and covers about 2.3~~3~~ km of the shoreline of Toronto Islands. Both the IPZ-1 and 2 extend to and include the northern shoreline of the Toronto Islands.	The northern extent of IPZ-2 has an administratively set limit of 120 m as the landward extent along this section of shoreline of Toronto Island. The 120 m extent on-shore is approximately ~~3~~2.3 km in length. No sewer-sheds or tributaries exist on the affected portion of Toronto Island.
	Toronto Island (Deep)	The IPZ-2 extends approximately ~~6~~ 9 km along the lakeshore. The IPZ-2 is not connected to the shore, indicating that contaminants are unlikely to be transported to the intake from shore within the 2-hr time-of-travel.	Because the IPZ-2 from the deep Island intakes do not reach even the shore of Toronto Island, there is no upland extent for these IPZ-2 zones.
	R.C. Harris	Currents in this area are predominantly parallel to shore and the in-water IPZ-2 extends approximately 4.5 km northeast and 3.6 km southwest of the intake. It is estimated that the IPZ-2 for the northeast intake would extend approximately 360 m further to the northeast. The particle tracking indicates that the IPZ-2 does not extend to shore, potentially significantly reducing the threats within the 2-hr time-of-travel	The western extent of the IPZ-2, when projected onto the shore, intersects the shoreline at Ashbridges Bay Park. The IPZ-2 then follows Woodbine Avenue north just past the Danforth. It extends east to Kingston Road. From that point, the IPZ-2 winds through to Cliffcrest Drive. From the end of Cliffcrest Drive the IPZ-2 follows the shoreline at a distance of 120 m until Bluffers Park where it connects to the shoreline.
	F.J. Horgan	Currents in this area are predominantly parallel to shore and the in-water IPZ-2 extends approximately 3.3 km in either direction from the intake. The particle tracking indicates that the IPZ-2 does not extend to shore, potentially significantly reducing the threats within the 2-hr time-of-travel.	The IPZ-2 intersects the shoreline near Bellamy Road, and extends north towards Kingston Road. It cuts northeast past Guildwood Parkway to Galloway Road, then extends north towards Lawrence Avenue, then northeasterly to Highland Creek, then follows the creek to its mouth in Lake Ontario.

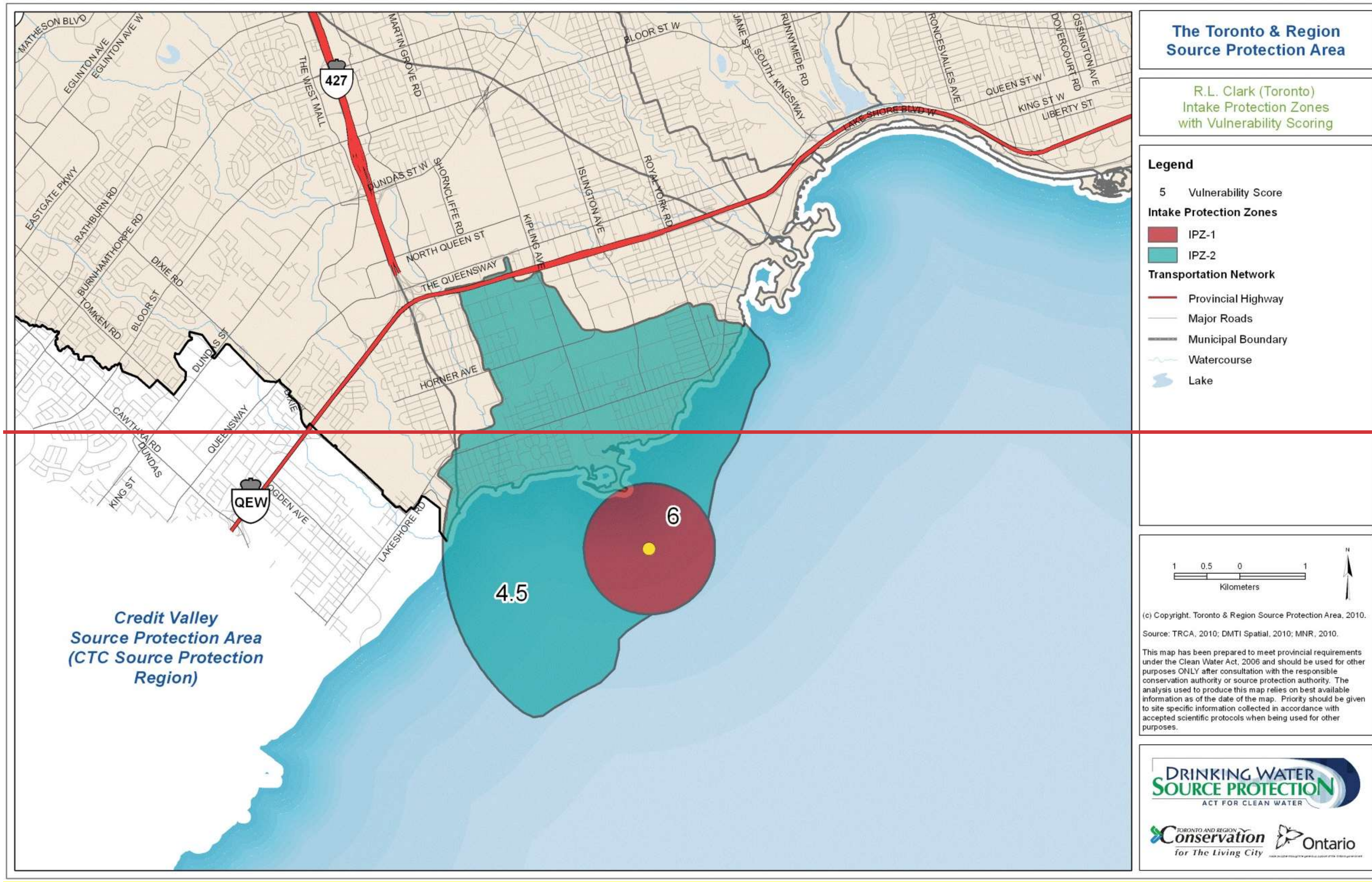
SPA/SPR	WTP	In-Lake Extent	Upland Extent
	Ajax	The in-lake IPZ-2 extends approximately 3 km northeast of the intake and 3.5 km southwest of the intake. The particle tracking indicates that the IPZ-2 extends approximately 500 m from shore, but does not extend to the shoreline.	Ajax WTP IPZ-2 extended to include Duffins Creek WPCP and its outfall on the zones western boundary. Western boundary extended to include the Pickering Ontario Power Generating Station, recognizing the potential risk in the event of a spill. The eastern boundary extends to the western borders of Cranberry Marsh. The IPZ-2 extends upstream in Duffins Creek and Carruthers Creek conservatively to ensure inclusion of major transportation corridors. The zones most northerly boundary is Hwy 401 and the Canadian National (CN) rail line. On either side of both streams a 120 m buffer zone was also included in the IPZ-2.

Table 4.8: Vulnerability Scores and Uncertainty, for Intake Protection Zone-1s and Intake Protection Zone-2s of Lake Ontario Intakes

Municipality	Intake Location	IPZ	Vulnerability			Uncertainty Level Rating		
			Area Vulnerability Factor	Source Vulnerability Factor	Vulnerability Score	IPZ Delineation	Vulnerability Score	Combined
Region of Peel	Arthur P Kennedy (formerly Lakeview)	IPZ-1	10	0.5	5.0	Low	Low	Low
		IPZ-2	9	0.5	4.5	High	Low	High
City of Toronto	R.L. Clark WTP	IPZ-1	10	0.5	5.0	Low	Low	Low
		IPZ-2	9	0.5	4.5	High	Low	High
	Island WTP (Deep Intakes)	IPZ-1	10	0.5	5.0	Low	Low	Low
		IPZ-2	7	0.5	3.5	Low	Low	Low
	Island WTP (Shallow Intakes)	IPZ-1	10	0.6	6.0	Low	Low	Low
		IPZ-2	8	0.6	4.8	High	Low	High
	R.C. Harris WTP	IPZ-1	10	0.6	6.0	Low	Low	Low
		IPZ-2	8	0.6	4.8	High	Low	High
	F.J. Horgan WTP	IPZ-1	10	0.5	5.0	Low	Low	Low
		IPZ-2	9	0.5	4.5	High	Low	High

Municipality	Intake Location	IPZ	Vulnerability			Uncertainty Level Rating		
			Area Vulnerability Factor	Source Vulnerability Factor	Vulnerability Score	IPZ Delineation	Vulnerability Score	Combined
Durham Region	Ajax WTP	IPZ-1	10	0.5	5.0	Low	Low	Low
		IPZ-2	9	0.5	4.5	High	Low	High

WTP = Water Treatment Plant


The Toronto & Region
Source Protection Area
R.L. Clark (Toronto)
Intake Protection Zones
with Vulnerability Scoring
Legend
5 Vulnerability Score
Intake Protection Zones
IPZ-1
IPZ-2
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
6
4.5
Credit Valley
Source Protection Area
(CTC Source Protection
Region)
427
QEW
BLOOR ST W
DUNDAS ST W
NORTH QUEEN ST
THE QUEENSWAY
HORNER AVE
LAKE SHORE BLVD W
QUEEN ST W
KING ST W
LIBERTY ST
MATHESON BLVD
EGLINTON AVE
EGLINTON AVE W
EASTGATE PKWY
RATHBURN RD
BURNHAMTHORPE RD
DIXIE RD
TOMKEN RD
BLOOR ST
DUNDAS ST
CAWTHRA RD
DUNDAS
KING ST
QUEENSWAY
DIXIE
OGDEN AVE
LAKESHORE RD
THE WEST MALL
MARTIN GROVE RD
SHORNCLIFFE RD
KIPLING AVE
ISLINGTON AVE
ROYAL YORK RD
JANE ST
SOUTH KINGSWAY
RUNNYMEDE RD
RONCESVALLES AVE
DOVERCOURT RD
OSSINGTON AVE
1 0.5 0 1
Kilometers
N
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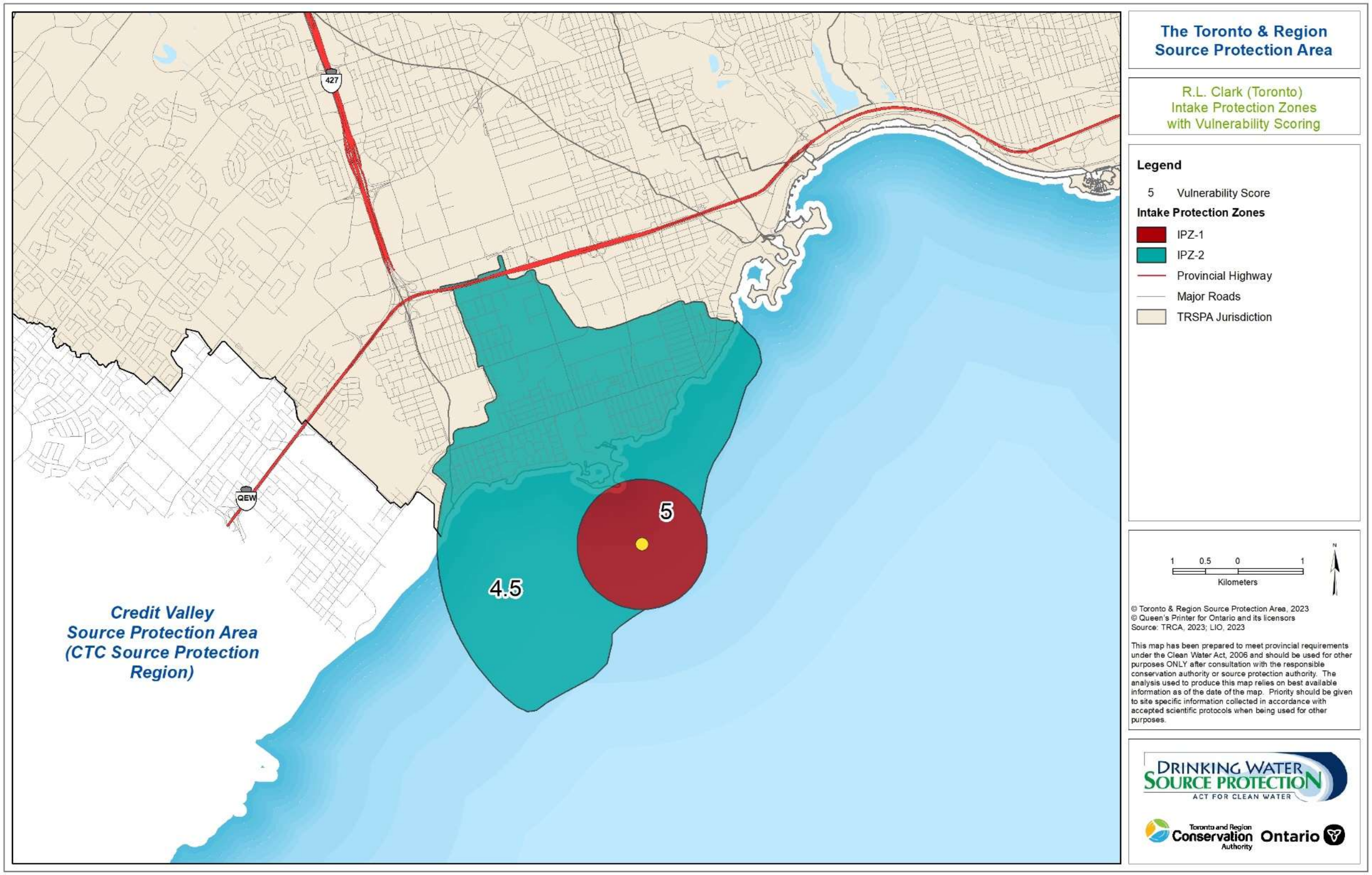

Figure 4.292927: R.L. Clark (Toronto) Intake Protection Zones with Vulnerability Scoring


The Toronto & Region Source Protection Area
Toronto Islands (Toronto) Intake Protection Zones with Vulnerability Scoring
Legend
5 Vulnerability Score
Intake Protection Zones
IPZ-1
IPZ-2
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
6
4.8
5
3.5
KEELE ST
BLOOR ST W
RUNNYMEDE RD
RONCESVALLES AVE
DUFFERIN ST
DUNDAS ST W
GERRARD ST W
UNIVERSITY AVE
SIMCOE ST
SPADINA AVE
BATHURST ST
YONGE ST
SHUTER ST
PARLIAMENT ST
QUEEN ST E
RIVER ST
PAPE AVE
LAKE SHORE BLVD E
QUEEN ST W
ADELAIDE ST W
KING ST W
FRONT ST W
FRONT ST E
QUEENS QUAY E
QUEENS QUAY W
CHERRY ST
THE QUEENSWAY
LIBERTY ST
JAMESON AVE
LAKE SHORE BLVD W
BAYVIEW AVE
1 0.5 0 1
Kilometers
N
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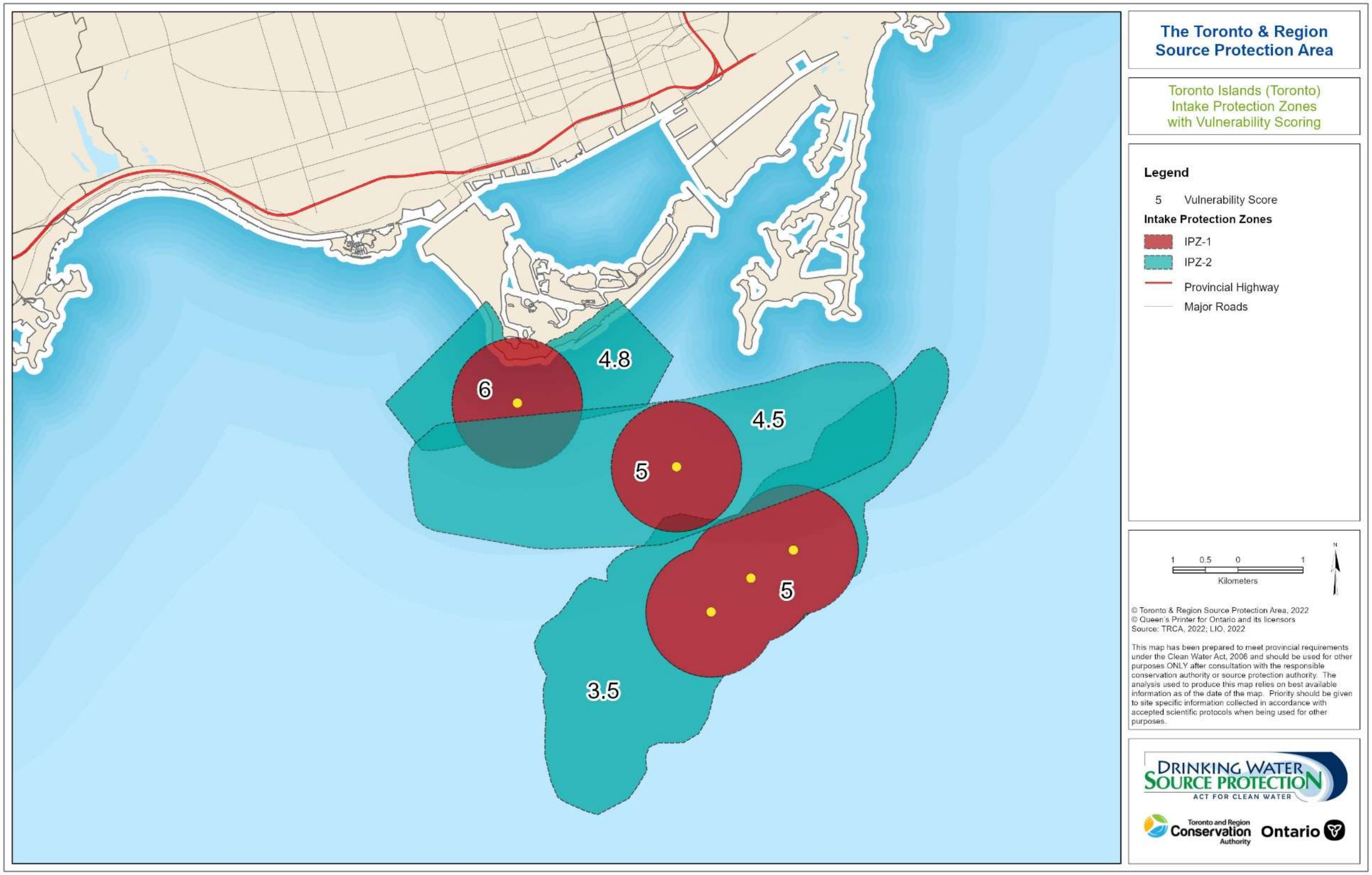


Figure 4.303028: Toronto Islands (Toronto) Intake Protection Zones with Vulnerability Scoring

R.L. Clark

The R.L. Clark water treatment plant (WTP) is located in a highly urbanized area between the Etobicoke Creek and Mimico Creek outlets into Lake Ontario. As was mentioned in **Section 2.3.1**, the intake for this facility extends 1.6 km offshore at a depth of about 11 m. The vulnerability score for lake-based intakes is based upon the zone vulnerability factor (Vf_z). This factor does not consider the nature of a contaminant, but rather the ability of a contaminant to reach the source water body – in this case, Lake Ontario. The IPZ-2 delineation based on modelling came near to the shore, and to be consistent with other intakes within the Lake Ontario Collaborative, was projected onto shore as shown in **Figure 4.297**. The IPZ-1 for the Clark WTP was assigned a Vf_z of 10 in accordance with *Rule 88*, which states that all IPZ-1s shall be assigned an area vulnerability factor of 10.

The *Technical Rules* require that IPZ-2s shall be assigned an area vulnerability factor not less than 7 and not more than 9 (*Rule 89*) based on both natural and anthropogenic influences. The natural characteristics that were considered by the Lake Ontario Collaborative in determining the Vf_z within the IPZ-2 included the slope of the upland environment and the discharges from both Etobicoke and Mimico creeks. Surface water runoff may transport sediment, salt, oil and other contaminants into either of these creeks or directly into Lake Ontario.

The area surrounding the R.L. Clark WTP is highly urbanized, which has resulted in large quantities of storm and surface water runoff. Anthropogenic pathways in the IPZ-2 include large surface runoff volumes from urban areas and transportation routes, and discharges from storm sewers and CSOs. Transportation routes to consider in this area include: Lakeshore Boulevard West, QEW/Gardiner Expressway, Browns Line, Kipling Avenue, Islington Avenue, and Royal York Road, as well as various residential roads located within the IPZ-2 area. Additional sites of concern located within the IPZ-2 include the decommissioned Lakeview Generating Station, and the railway switching yards.

Given these conditions, the natural and anthropogenic characteristics of the area around the intake provide for the discharge of contaminants into the lake. The Vf_z is assigned a high rating of 9 based on these findings.

The second component of the overall vulnerability score for surface water intakes is the source vulnerability factor (Vf_s). This factor varies from 0.5 to 0.7 for Great Lakes (Type A) intakes, with 0.7 being the highest vulnerability. The MOECC guidelines for the Design of Water Treatment Works (MOE, 1982) prescribes a minimum submergence of 3 m with a preference of 10 m or deeper. Overall, it was determined that this WTP has an area vulnerability similar to the other four plants in the Toronto drinking water system (Stantec, 2008a). With the general drift of the lake, from east to west, the other three plants can be used as indicators for this plant to prepare and make adjustments if necessary. As a result of these factors, the R.L. Clark WTP was given a Vf_s score of 0.5 (Stantec, 2008a). The net vulnerability scores assigned for the R.L. Clark IPZ-1 and IPZ-2 are 5.0 and 4.5, respectively.

Toronto Island (Shallow):

The Island WTP surface water supply currently operates with three (3) deep lake raw water intake pipes and two (2) inactive shallow intake pipes. The new moderate depth lake intake is now being constructed via the modification and extension of one of the Island WTP's inactive shallow intake pipes.

The shallow island intake #5 extends 1,800 m into Lake Ontario, and the modified and extended shallow intake #4 extends 3,200 m into Lake Ontario, 70 m below the water surface. The purpose of the modification and extension of the original shallow intake #4 is primarily to increase the capacity of the original Deep Lake Water Cooling system, owned and operated by Enwave Energy Corporation, to meet the growing demand for cooling in Toronto's downtown core.

However, use of the fourth intake is designed to provide Toronto Water with additional flexibility and redundancy but is not anticipated to be a routine operational decision. For example, if any of the existing three deep intakes need to be shut down to rehabilitation operations, the fourth intake would be used as the substitute water supply source.

~~Although the Toronto Island shallow intakes are not in active use,~~ Given shallow intakes #4 and #5~~they~~ are being maintained as a backup water source,~~. Therefore,~~ vulnerability zones were calculated and scored for these two intakes. The IPZ-1s for these shallow intakes were assigned a Vf_z of 10 in accordance with *Rule 88*.

The natural characteristics that were considered by the Lake Ontario Collaborative in determining the Vf_z within the IPZ-2 included the slope of the upland environment and discharges from the Don River. Surface water runoff may transport sediment, salt, oil and other contaminants into the Don River, the Toronto Harbour, or directly into Lake Ontario.
The land mass associated with the IPZ-2 projection is a portion of the Toronto Islands which are not urbanized. The land area is mainly parkland, with some cottages located to the eastern end, whose drainage generally flows to the Inner Harbour. As such, the area vulnerability score is projected to be less than that for the other intakes.

The shallow Toronto Island IPZ-2 is adjacent to the Toronto Harbour, which was included on the International Joint Commission's list of 42 Areas of Concern for the Great Lakes in 1987. The area surrounding the harbour is highly urbanized, but the only hydrological pathways by which contaminants can be transported to the IPZ-2 area is through the Inner Harbour, which are addressed through the IPZ-3 analysis. Anthropogenic pathways outside the IPZ-2 area include large volumes of storm and surface water runoff from urban areas (which originates mainly from the Don River) and transportation routes. Transportation routes to consider in this area include: Lakeshore Boulevard and the Gardiner Expressway. Additional sites of concern located near~~within~~ the IPZ-2 include the decommissioned Queens Quay incinerator, and the port area in general.

Because of the natural and anthropogenic characteristics of the area around the intake, and the large anthropogenic characteristics of the area beyond the IPZ-2, which discharge contaminants into the lake, the Vf_z is assigned a rating of 8.

The second component of the overall vulnerability score for surface water intakes is the source vulnerability factor (Vf_s). This factor varies from 0.5 to 0.7 for Great Lakes (Type A) intakes, with 0.7 being the highest vulnerability. Overall, it was determined that this WTP is one of the most sensitive of the four plants in the Toronto drinking water system. As a result of these factors, the shallow intakes of the Toronto Island WTP were given a Vf_s score of 0.6. The vulnerability scores for the shallow Island intakes IPZ-1 and IPZ-2 are 6.0 and 4.8, respectively.

Toronto Island (Deep)

The IPZ-1s for the three deep intakes associated with the Toronto Island WTP were assigned a Vf_z of 10 in accordance with *Rule 88*. The natural characteristics of the upland environment, and anthropogenic pathways within the study area were determined not to influence the deep Island WTP intakes, and therefore, the Toronto Island WTP IPZ-2 Vf_z was determined to be 7 (low) (Stantec, 2008a).

The deep island intakes extend 5,400 m into Lake Ontario, 83 m below the water surface. The depth of these intakes was established based on physical limnological input from the National Research Institute, which indicated that this depth should provide a constant temperature for cooling purposes. Operators described the raw water entering the plant as good with virtually no variation in characteristics. Operators also indicated that the intakes were isolated from shoreline influences. Slight temperature changes do occur as a result of seasonal upwelling and downwelling associated with normalization of lake water densities and subsequent turnover, which typically occurs in the fall, and occasionally spring seasons.

Annual reports for the last two years do not indicate exceedances for any of the testing parameters. Because there are no significant concerns regarding the source vulnerability for these three intakes, the Vf_s for all three deep intakes was assessed to be 0.5 (low). The resultant vulnerability score for the IPZ-1 and IPZ-2 are 5.0 and 3.5 respectively, as shown on **Figure 4.3028,** represents the minimum value for all intakes in the Great Lakes because of the depth and off-shore distance of these intakes.

5.0 DRINKING WATER THREATS ASSESSMENT

5.1 OVERVIEW

5.1.1 Threats to Drinking Water Quantity

The Technical Rules outline the legislated content for assessment reports across Ontario. The Technical Rules report was posted on the MOECC's website in December 2008 and further amended in November 2009. The 2017 version of the document can be found at: https://www.ontario.ca/page/2017-technical-rules-under-clean-water-act. Amendments to the Central Lake Ontario Source Protection Area Assessment Report resulting in version 2 were made using the 2017 Director's Technical Rules and Tables of Drinking Water Threats. Sections of the Assessment Report that were not updated as part of those amendments refer to the 2009 edition of the Director's Technical Rules and Tables of Drinking Water Threats.

The *Technical Rules* require that a Water Quantity Risk Assessment be completed for municipal drinking water supplies if they are considered *stressed* according to the water budget calculations described in **Chapter 3** of this Assessment Report. In the Toronto and Region Source Protection Area (TRSPA), municipal water supplies are sourced from groundwater and from Lake Ontario (**Chapter 2**). Stresses to water quantity have been identified with part of the Toronto and Region Conservation (TRCA) watersheds through the York Tier 3 Water Budget process (**Chapter 3**).

Note that the *Technical Rules* exempt Great Lakes sources from the water quantity threat assessment process.

Conceptual and Tier 1 Water Budgets were completed for the TRSPA study area, as per *Technical Rules (19–24)*. The screening results calculated groundwater and/or surface water *stresses* in 21 *subwatersheds,* but the only additional work necessary under the *Clean Water Act, 2006* (*CWA)* was a Tier 3 Water Budget for the Whitchurch–Stouffville and Uxville drinking water supplies, as discussed in **Chapter 3.** Under other programs within the conservation authority and municipalities, additional work is planned to examine the potential effects to the ecosystem in the other stressed subwatersheds. The CTC Source Protection Committee (SPC) has recommended to the conservation authority and municipality that additional work to assess the potential stresses to the ecosystem in these watersheds should be undertaken.

5.1.2 Threats to Drinking Water Quality

It should be noted that the site-specific verification of threats was not conducted as part of this study. Therefore, it is possible that threats identified in this document do not actually exist, and it is also possible that a non-documented threat exists that has not been enumerated. However, if a significant threat has been enumerated but does not exist, policies in a Source Protection Plan would not apply. Conversely, if a significant threat has not been enumerated but does exist, such policies would apply. A key implementation activity will be to confirm the existence of significant drinking water threats at the site scale.

In the Water Quality Risk Assessment process, the hazard rating and the vulnerability score are multiplied to produce a risk score. In place of having to complete these calculations for all threats*, Part XI (Rule 118)* of the *Technical Rules* under the CWA allows reference to activities in the Table of Drinking Water Threats that may pose a potential threat to the quality and/or quantity of drinking water within each vulnerable area. The size and complexity of the Table of Drinking Water Threats precludes efficient reference and analysis. Therefore, in March, 2010, the Ministry of the Environment and Climate Change (MOECC) developed a series of 76 Provincial Tables of Circumstances each of which lists every circumstance that make an activity a low, moderate, or significant drinking water threat, as per the 2009 Director's Technical Rules. The Director's Technical Rules have been subsequently updated three times in 2013, 2017 and 2021. The Tables of Drinking Water Threats and Circumstances for three subsequent updates can be viewed in the Provinces Source Water Protection Threat Tool, http://swpip.ca ~~The Provincial Tables of Circumstances that apply in the TRSPA are listed in **5.1** summaries Vulnerability Areas and Scores Tables of Drinking Water Threats and Circmstances~~ .

~~The identification of threats to municipal drinking water sourced from Lake Ontario follows a different process, using event based modelling as described in **Section**~~ **5.7.6**~~.~~

No issues or conditions were identified in the TRSPA, as per *Rules (114) and (115)* (issues) and *Rule (126)* (conditions), although a small part of the issue contributing area (chloride) for Orangeville Well 10 extends into the northwest corner of the TRSPA.

Tables 5.1a, 5.1b, and 5.1c summarize where significant, moderate or low water quality threats can occur based on Vulnerable Area and Vulnerability Score under each of four versions of the Director's Technical Rules (2009, 2013, 2017, and 2021). For additional information, refer to Section 5.2 Threats Assessment Methodology for further information on Table 5.1a, to Section 5.7.6 Threats from Activities in Intake Protection Zones for Table 5.1b, and Section 5.4 Groundwater Quality Threats in Highly Vulnerable Aquifers for Table 5.1c.

Table 5.1a: Identification of Drinking Water Quality Threats in WHPA-A/B/C/D using~~Provincial Tables of Circumstances (2010)~~ 2009, 2013, 2017 and 2021 Director's Technical Rules

Threat Type	Vulnerable Area and Score	Threat Classification Level			
		Significant	Moderate		Low
		2009 / 2013 / 2017 / 2021 DTR's	2009 / 2013 / 2017 DTR's	2021 DTR's	2009 / 2013 / 2017 / 2021 DTR's
Chemicals	WHPA-A/B (VS = 10)	✓	✓	✓	✓
	WHPA-B/C (VS = 8)	✓	✓	✓	✓
	WHPA-B/C/D (VS = 6)		✓	✓	✓
Handling / Storage of DNAPLs	WHPA-A/B/C (VS = Any Score)	✓			
	WHPA-D (VS = 6)		✓		✓
Pathogens	WHPA-A/B (VS = 10)	✓	✓	✓	
	WHPA-B (VS = 8)		✓	✓	✓
	WHPA-B (VS = 6)				✓

DTR's refers to Director's Technical Rules
VS = Vulnerability Score

Table 5.2: Identification of Drinking Water Quality Threats in WHPA-E and IPZ's using 2009, 2013, 2017 and 2021 Director's Technical Rules

Threat Type	Vulnerable Area and Score	Threat Classification Level				
		Significant		Moderate	Low	
		2009 / 2013 / 2017 DTR's	2021 DTR's	2009 / 2013 / 2017 / 2021 DTR's	2009 / 2013 / 2017 DTR's	2021 DTR's
Chemicals	IPZ/WHPA-E (VS = 9)	✓	✓	✓	✓	✓
	IPZ/WHPA-E (VS = 8 to 8.1)	✓	✓	✓	✓	✓
	IPZ/WHPA-E (VS = 6 to 7.2)			✓	✓	✓
	IPZ/WHPA-E (VS = 4.2 to 5.6)				✓	✓
Handling / Storage of DNAPLs	IPZ/WHPA-E (VS = 9)		✓	✓		
	IPZ/WHPA-E (VS = 7 to 8.1)			✓	✓	✓
	IPZ/WHPA-E (VS = 4.8 to 6.4)				✓	✓
	IPZ/WHPA-E (VS = 4.5)					✓
Pathogens	IPZ/WHPA-E (VS = 9)	✓	✓	✓	✓	✓
	IPZ/WHPA-E (VS = 8 to 8.1)	✓	✓	✓	✓	✓
	IPZ/WHPA-E (VS = 6 to 7.2)			✓	✓	✓
	IPZ/WHPA-E (VS = 4.2 to 5.6)				✓	✓

DTR's refers to Director's Technical Rules
VS = Vulnerability Score
Note: Currently there are IPZ vulnerability scores of 3.5 to 6 within TRSPA.

Table 5.3c: Identification of Drinking Water Quality Threats in HVA's using 2009, 2013, 2017 and 2021 Director's Technical Rules

Threat Type	Vulnerable Area and Score	Threat Classification Level			
		Significant	Moderate		Low
		2009 / 2013 /2017 / 2021 DTR's	2009 / 2013 / 2017 DTR's	2021 DTR's	2009 / 2013 /2017 / 2021 DTR's
Chemicals	HVA (VS = 6)		✓	✓	✓
Handling / Storage of DNAPLs	HVA (VS = 6)		✓		✓

Pathogens	HVA (VS = 6)				

DTR's refers to Director's Technical Rules
VS = Vulnerability Score

Threat Type	Vulnerability Area	Vulnerability Score	Table of Circumstances Name and Reference Code		
			Significant	Moderate	Low
Chemical*	WHPA-A,B,C,D	10	Table 1: CW10S	Table 3: CW10M	Table 6: CW10L
		8	Table 2: CW8S	Table 4: CW8M	Table 7: CW8L
		6	n/a	Table 5: CW6M	Table 8: CW6L
	WHPA-E, IPZ	7.2	n/a	Table 27: CIPZWE7.2M	Table 35: CIPZWE7.2L
		6.0	n/a	Table 75: CIPZWEM6	Table 76: CIPZWEL6
		5.4	n/a	n/a	Table 40: CIPZWE5.4L
		5.0	n/a	n/a	Table 74: CIPZWEL5
		4.8	n/a	n/a	Table 42: CIPZWE4.8L
		4.5	n/a	n/a	Table 43: CIPZWE4.5L
	SGRA, HVA	6	n/a	Table 17: CSGRAHVA6M	Table 18: CSGRAHVA6L
DNAPL	WHPA-A,B,C	all	Table 9: DWAS	n/a	n/a
	WHPA-D, SGRA, HVA	6	n/a	Table 10: DW6M	Table 11: DW6L
Pathogen	WHPA-A,B	10	Table 12: PW10S	Table 13: PW10M	n/a
		8	n/a	Table 14: PW8M	Table 15: PW8L
		6	n/a	n/a	Table 16: PW6L
	WHPA-E, IPZ	7.2	n/a	Table 53: PIPZWE7.2M	Table 62: PIPZWE7.2L
		6.0	n/a	Table 57: PIPZ6M	Table 66: PIPZ6L
		5.4	n/a	n/a	Table 68: PIPZWE5.4L
		5.0	n/a	n/a	Table 69: PIPZ5L
		4.8	n/a	n/a	Table 71: PIPZWE4.8
		4.5	n/a	n/a	Table 72: PIPZWE4.5L

***Notes:** Only Tables of Circumstances that apply within the TRSPA are included*
n/a: does not apply
** In some Tables of Circumstances, both chemicals and DNAPLs are listed*
Current information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

5.2 THREATS ASSESSMENT METHODOLOGY

Under the *CWA*, a "prescribed threat" (hereafter referred to as "threat") is defined as "an activity or condition that adversely affects or has the potential to adversely affect the quality or quantity of any

5.5 GROUNDWATER QUALITY THREATS IN WELLHEAD PROTECTION AREAS (WHPA)

The threats assessment and inventories within the WHPAs were completed by consultants retained respectively by the regional municipalities of Peel (**Appendix E3**), York (**Appendix E4**), and Durham (**Appendix E5**). ~~Table 5.6~~ Table 5.8 summarizes the significant threats identified in the WHPAs across the TRSPA, and the following sections provide details organized by well field. No issues were identified in any wellhead protection area in the TRSPA. Issues pertaining municipal residential drinking water systems whose WHPAs extend into TRSPA are outlined in the Assessment Report for their respective SPAs. **Appendices E3, E4,** and **E5** contains additional information on the approach and mapping products.

Table 5.8: Summary of Significant Drinking Water Threats to Groundwater Quality for the Toronto and Region Source Protection Area

Region	Well(s)	Significant Drinking Water Threats	Total # of Parcels with Significant Drinking Water Threats
Region of Peel	Caledon East 3	29~~4~~ ~~3~~	20~~3~~ ~~2~~
	Caledon East 4 & 4A		
	Caledon East 6		
	Palgrave 2	9~~1~~ ~~2~~ ~~1~~	9~~1~~ ~~2~~ ~~1~~
	Palgrave 3		
	Palgrave 4		
York Region	Kleinburg 3	34*	14*
	Kleinburg 4		
	Nobleton 2	138	74
	Nobleton 3		
	Nobleton 5		
	Nobleton 7		
	King City 2	19	10
	King City 3		
	Whitchurch–Stouffville 2	243	80
	Whitchurch–Stouffville 3		
	Whitchurch–Stouffville 5		
	Whitchurch–Stouffville 6		
Durham Region	Uxville 1 and 2	17	8
	Total**	**489~~62~~**	**205~~195~~**

Note threat counts NOT adjusted for the removal of Kleinberg Well 2. Threats verification underway by York Region staff.

***Note threat counts NOT adjusted for the Orangeville ICA extending into TRSPA, as no significant threats were identified there beyond what is stated in the Credit Valley SPA Assessment Report.*

5.5.1 Drinking Water Threats - Region of Peel

Caledon East - Threats and Issues

Caledon East Well 3 is located off of Airport Road in the centre of the Village of Caledon East, while Caledon East 4 and 4A are located across from a park in a residential area. The WHPAs for Caledon East 3 intersect and extend northwest along Airport Road. Land uses within the WHPAs include commercial, residential, agricultural, and recreation.

The threats inventory for Caledon East wells 3 and 4 was conducted by R.J. Burnside and Associates (Burnside, 2010), and by Matrix Solutions Inc. for Well 4A (Matrix, 2018). For Caledon East 6, a desktop threats was completed in 2022. The summary of potential threats identified for this well field is provided in ~~Table 5.7~~**Table 5.9**. No significant managed lands threats were identified for this area. No conditions or issues were identified for this water system. The areas where the threats are or would be low, moderate, and significant for chemicals, DNAPLs, and pathogens are shown on **Figure 5.8**, **Figure 5.9**, and **Figure 5.10**, respectively.

Table 5.9: Significant Threats Identified in Caledon East

Activity (or Threat Type)	Threats			
	Sig.	Mod.	Low	Total
1. The establishment, operation, or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act* (*EPA*)	0			
2. The establishment, operation, or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage	7~~0~~			
3. The application of agricultural source material to land	1~~0~~			
4. The storage of agricultural source material	1~~0~~			
5. The management of agricultural source material	0			
6. The application of non-agricultural source material (NASM) to land	1~~0~~			
7. The handling and storage of non-agricultural source material NASM	1~~0~~			
8. The application of commercial fertilizer to land	1~~0~~			
9. The handling and storage of commercial fertilizer	1~~0~~			
10. The application of pesticide to land	1~~0~~			
11. The handling and storage of pesticide	1~~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	5~~2~~			
16. The handling and storage of a dense non-aqueous phase liquid	8~~4~~			
17. The handling and storage of an organic solvent	0~~1~~			
18. The management of runoff that contains chemicals used in the de-icing of aircraft	0			
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body	0			
20. An activity that reduces the recharge of an aquifer	0			

Activity (or Threat Type)	Threats			
	Sig.	Mod.	Low	Total
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard	1~~0~~			
22. The establishment and operation of a liquid hydrocarbon pipeline.	0			
Total Threats	29~~7~~			
Total Parcels	20~~5~~			

**Note in 2018, well 4A was brought on-line, at this time low and moderate drinking water threats were not re-evaluated, and so the enumeration of moderate and low threats were removed from this summary.*

Managed Lands

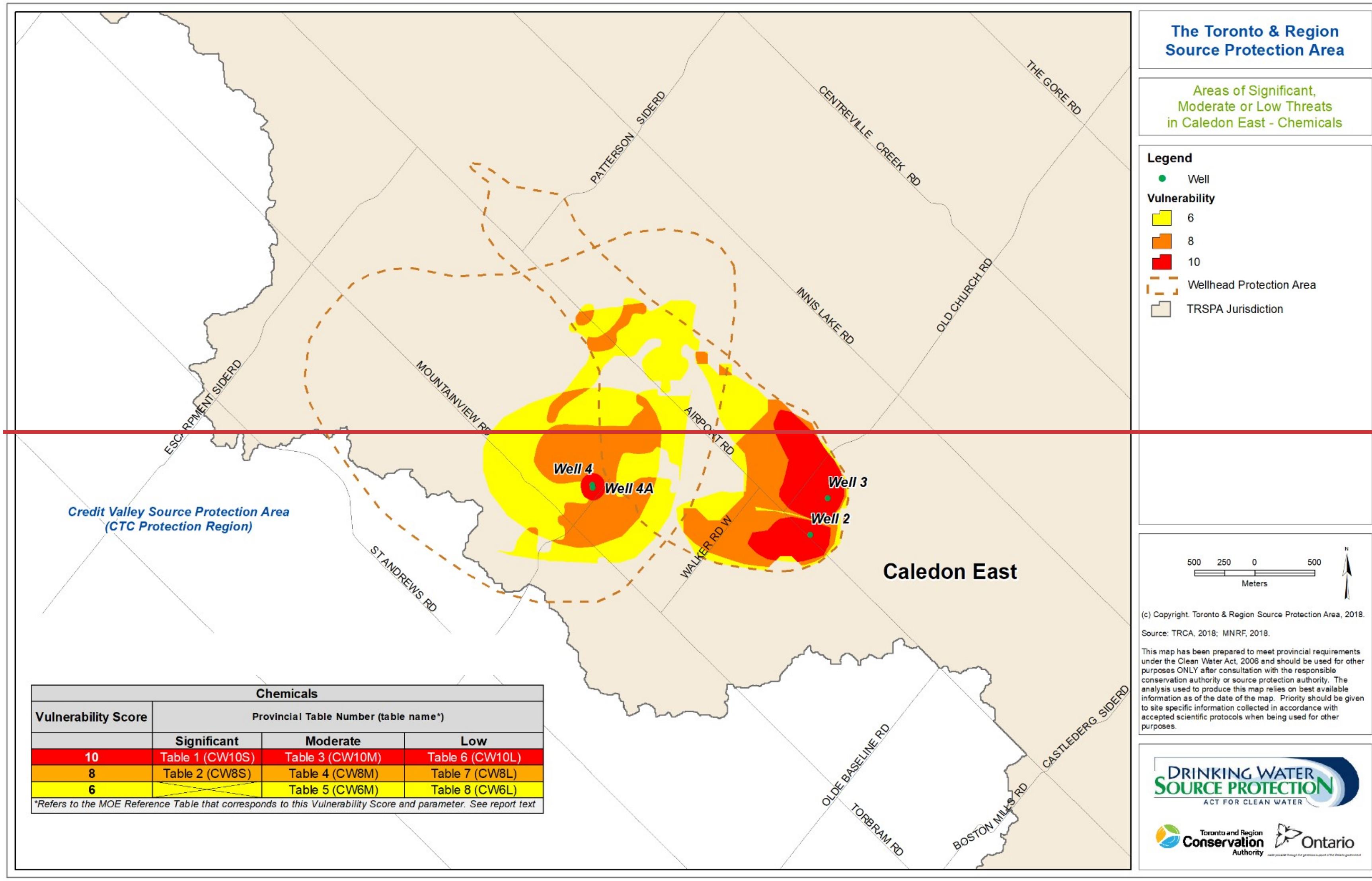
A review of the maps of percent managed lands reveals that the WHPAs in Caledon East have less than 80% managed lands and moderate to low potential for nutrient application as a cause for concern (Error! Reference source not found.).

Livestock Density

A review of the livestock density maps revealed that most of the supply well WHPAs have livestock densities less than 1.0 NU/acre and therefore in the medium or low range (Error! Reference source not found.).

Impervious Surfaces

Error! Reference source not found. illustrates the relative threat level for road salt application for roads within the vulnerable areas based on their percent impervious surfaces and vulnerability scores. Based on the Table of Drinking Water Threats, all roads within the Caledon East WHPAs were ranked with a moderate or low threat levels for road salt application. Despite the moderate or low rating, it should be noted that the presence of these impermeable surfaces and their associated salt applications present an opportunity for chloride and sodium to impact the underlying aquifer. The Region of Peel has implemented a salt management plan which includes soil management strategies in salt vulnerable areas (Ecoplans, 2006a) and salt management strategies for parking lots and private lands (Ecoplans, 2006b).



Chemicals			
Vulnerability Score	Provincial Table Number (table name*)		
	Significant	Moderate	Low
10	Table 1 (CW10S)	Table 3 (CW10M)	Table 6 (CW10L)
8	Table 2 (CW8S)	Table 4 (CW8M)	Table 7 (CW8L)
6		Table 5 (CW6M)	Table 8 (CW6L)

*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text

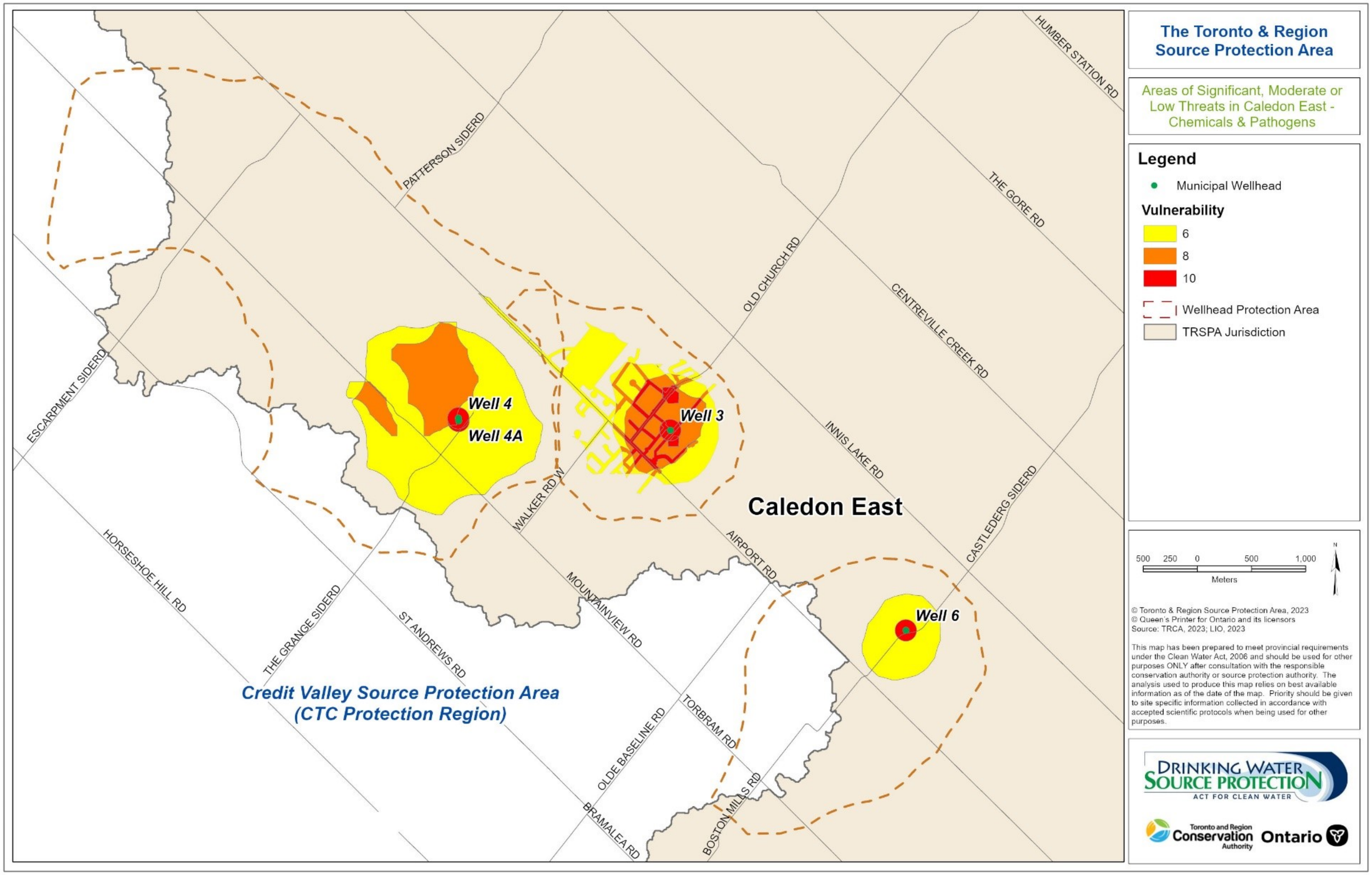
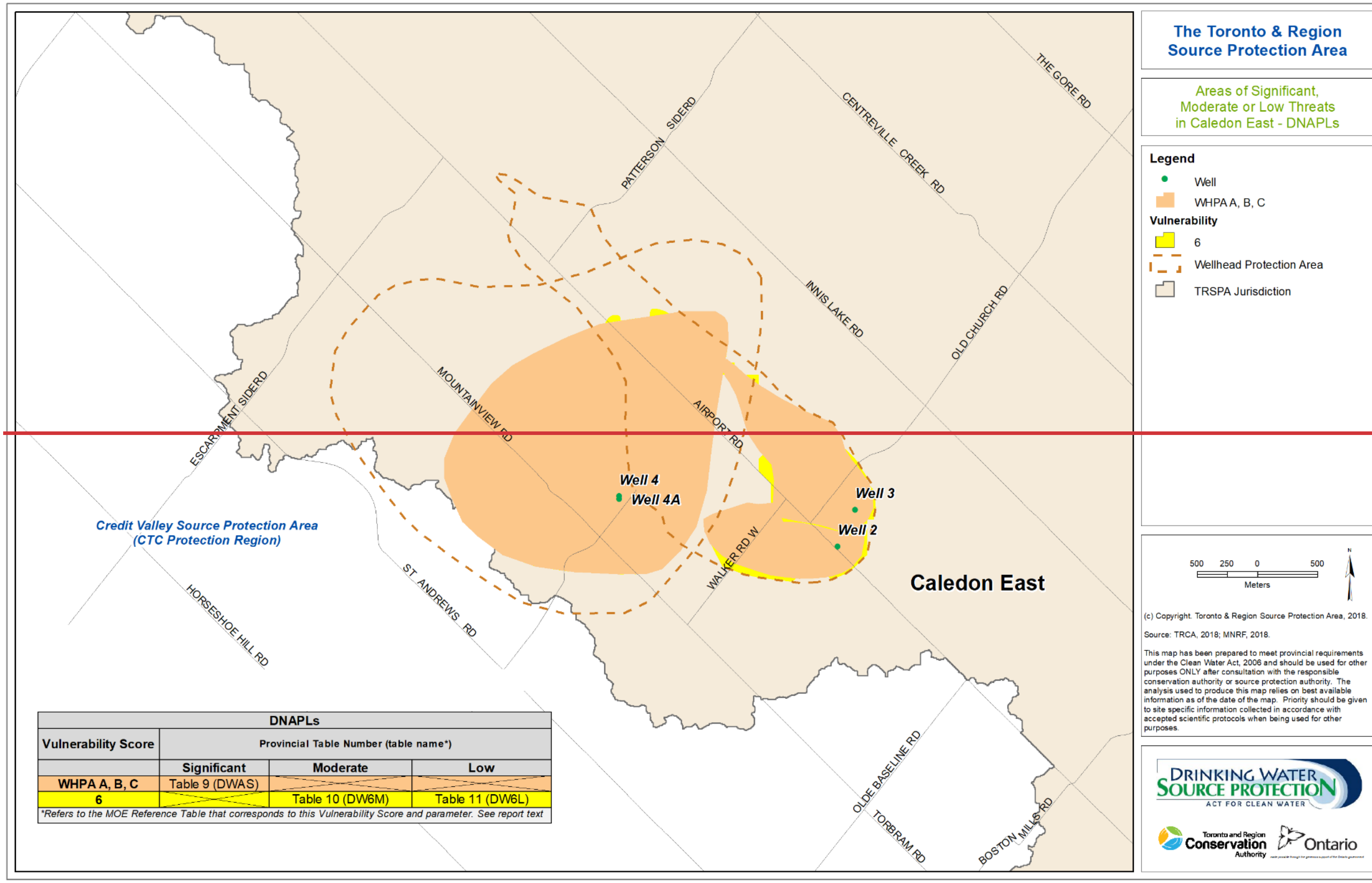


Figure 5.5: Areas of Significant, Moderate and Low Threats in Caledon East – Chemicals and Pathogens

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/



DNAPLs			
Vulnerability Score	Provincial Table Number (table name*)		
	Significant	Moderate	Low
WHPA A, B, C	Table 9 (DWAS)		
6		Table 10 (DW6M)	Table 11 (DW6L)

*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text

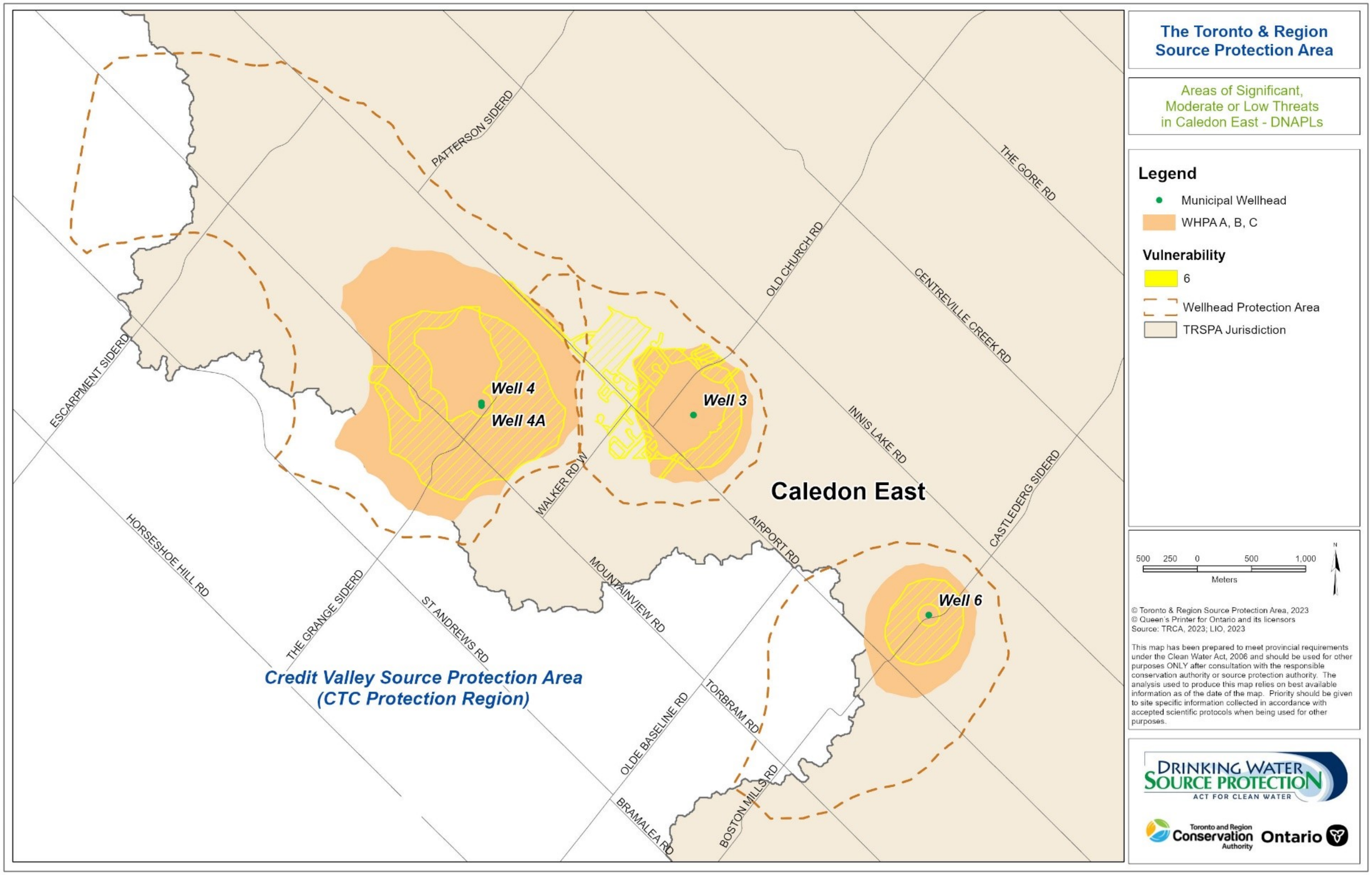
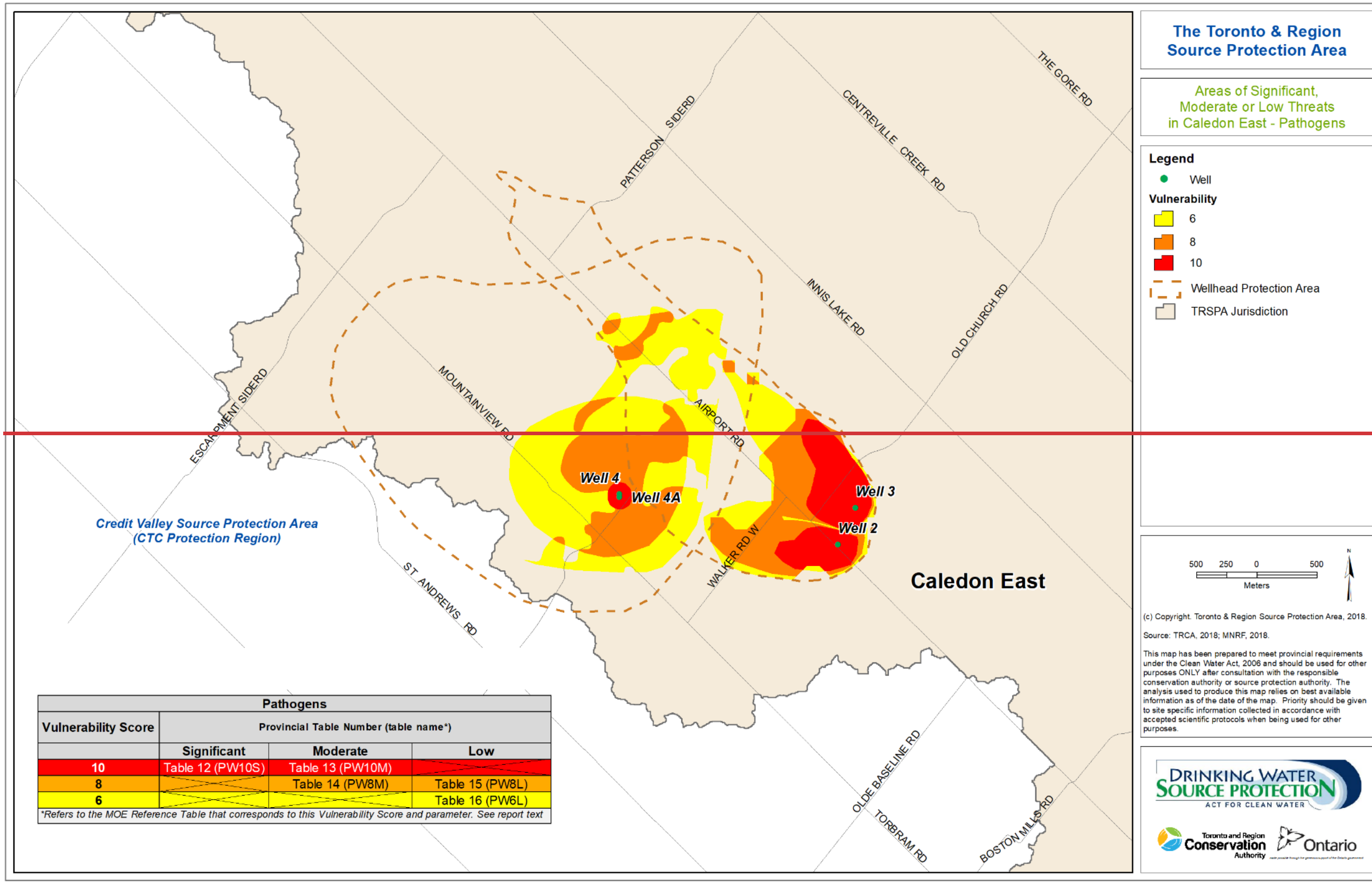


Figure 5.6: Areas of Significant, Moderate and Low Threats in Caledon East - DNAPLs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/



Pathogens			
Vulnerability Score	Provincial Table Number (table name*)		
	Significant	Moderate	Low
10	Table 12 (PW10S)	Table 13 (PW10M)	
8		Table 14 (PW8M)	Table 15 (PW8L)
6			Table 16 (PW6L)

*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text

~~Figure 5.7: Areas of Significant, Moderate and Low Threats in Caledon East – Pathogens~~

~~*The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/*~~

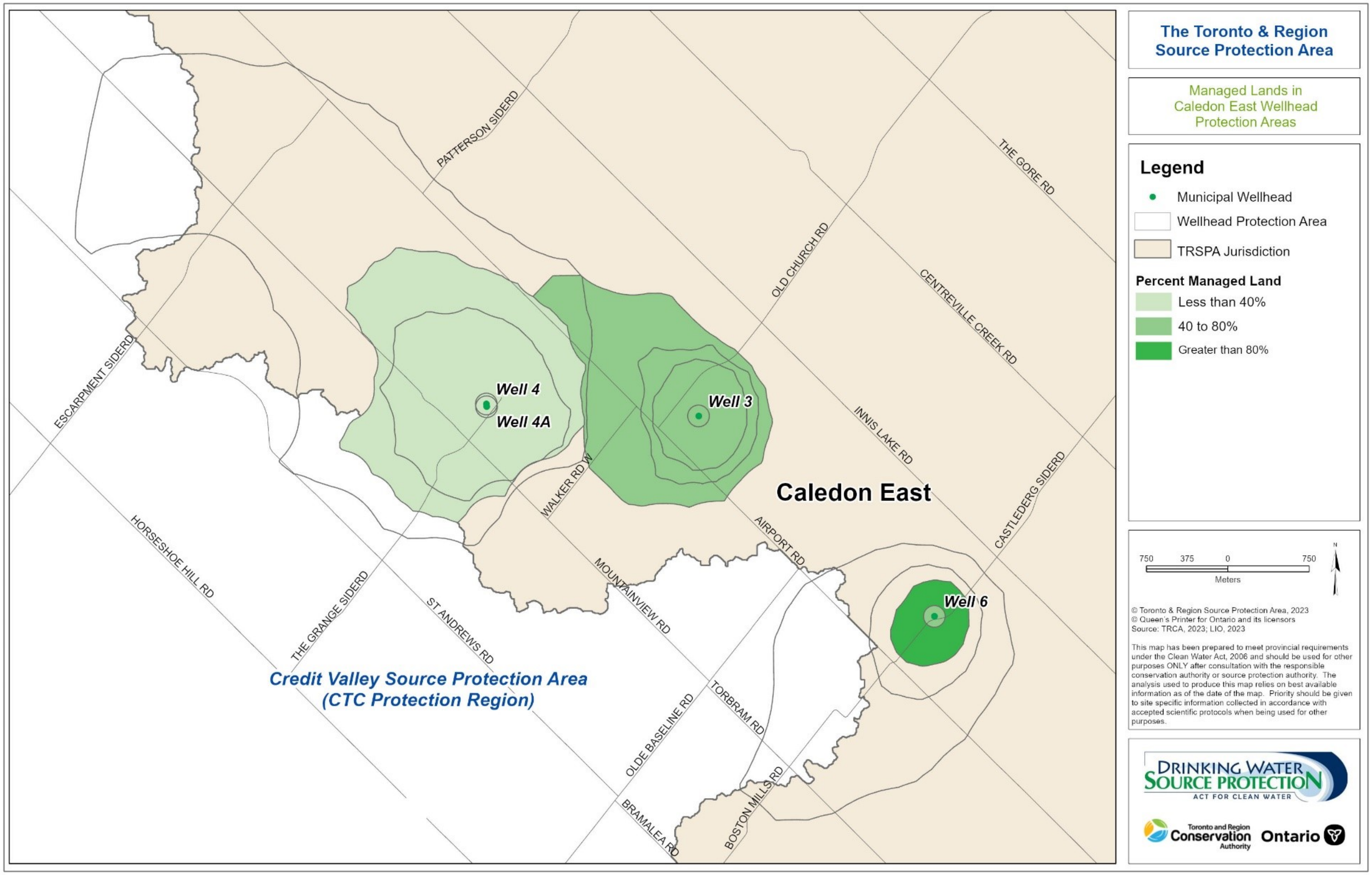


Figure 5.7 Managed Lands in Caledon East WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

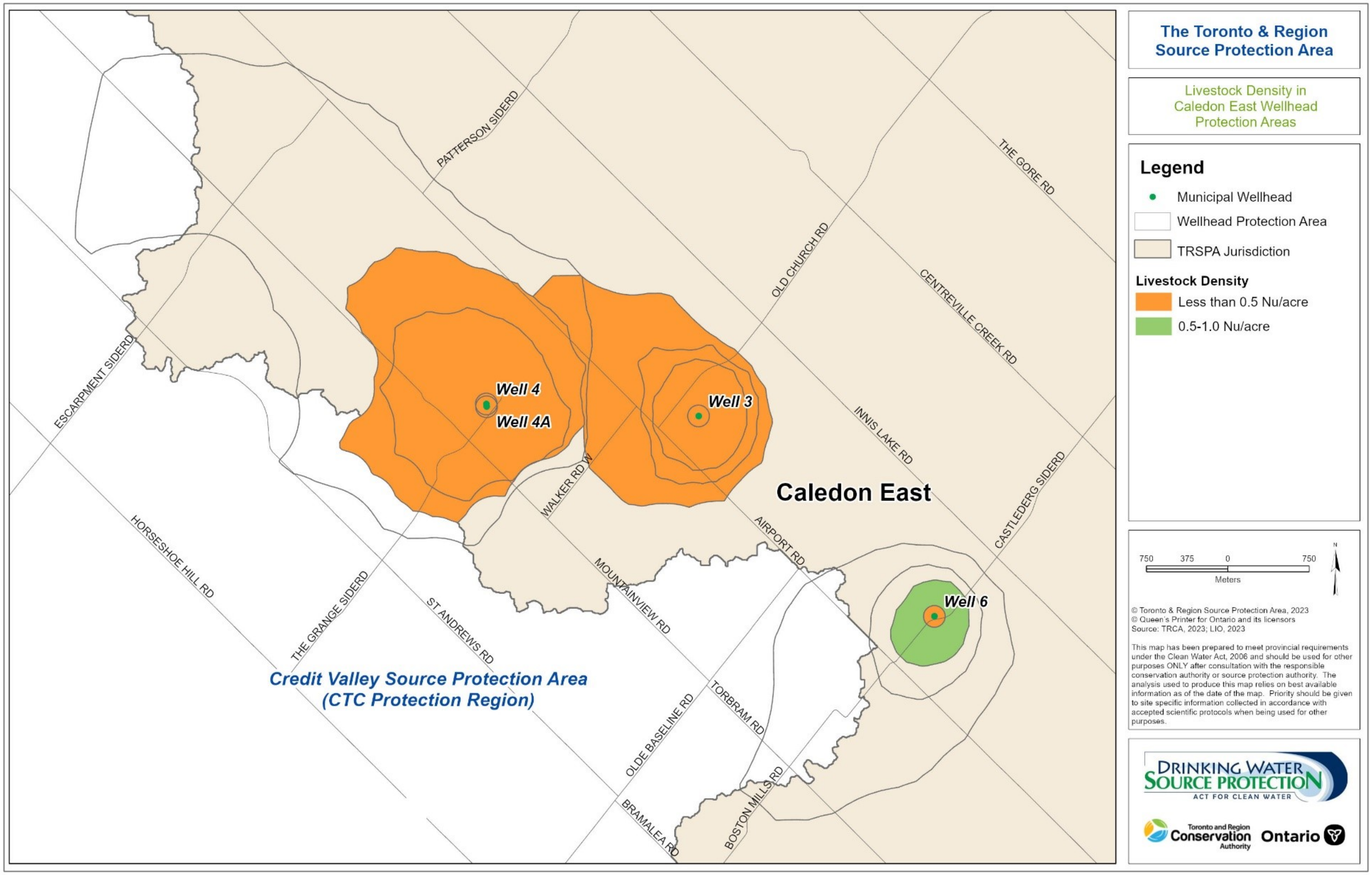


Figure5.8 Livestock Density in Caledon East WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

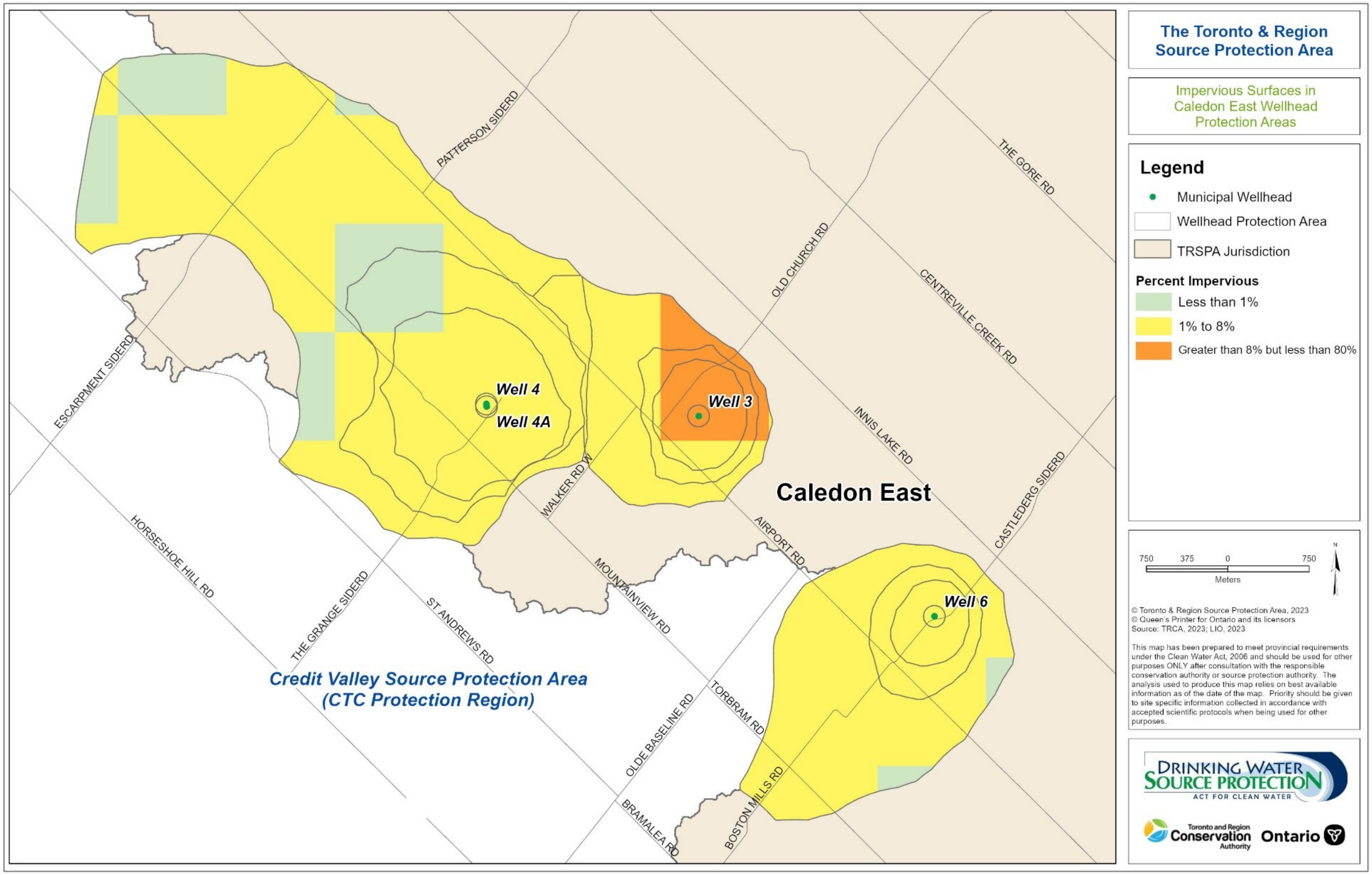


Figure 5.9 Impervious Surfaces in Caledon East WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

Palgrave - Threats and Issues

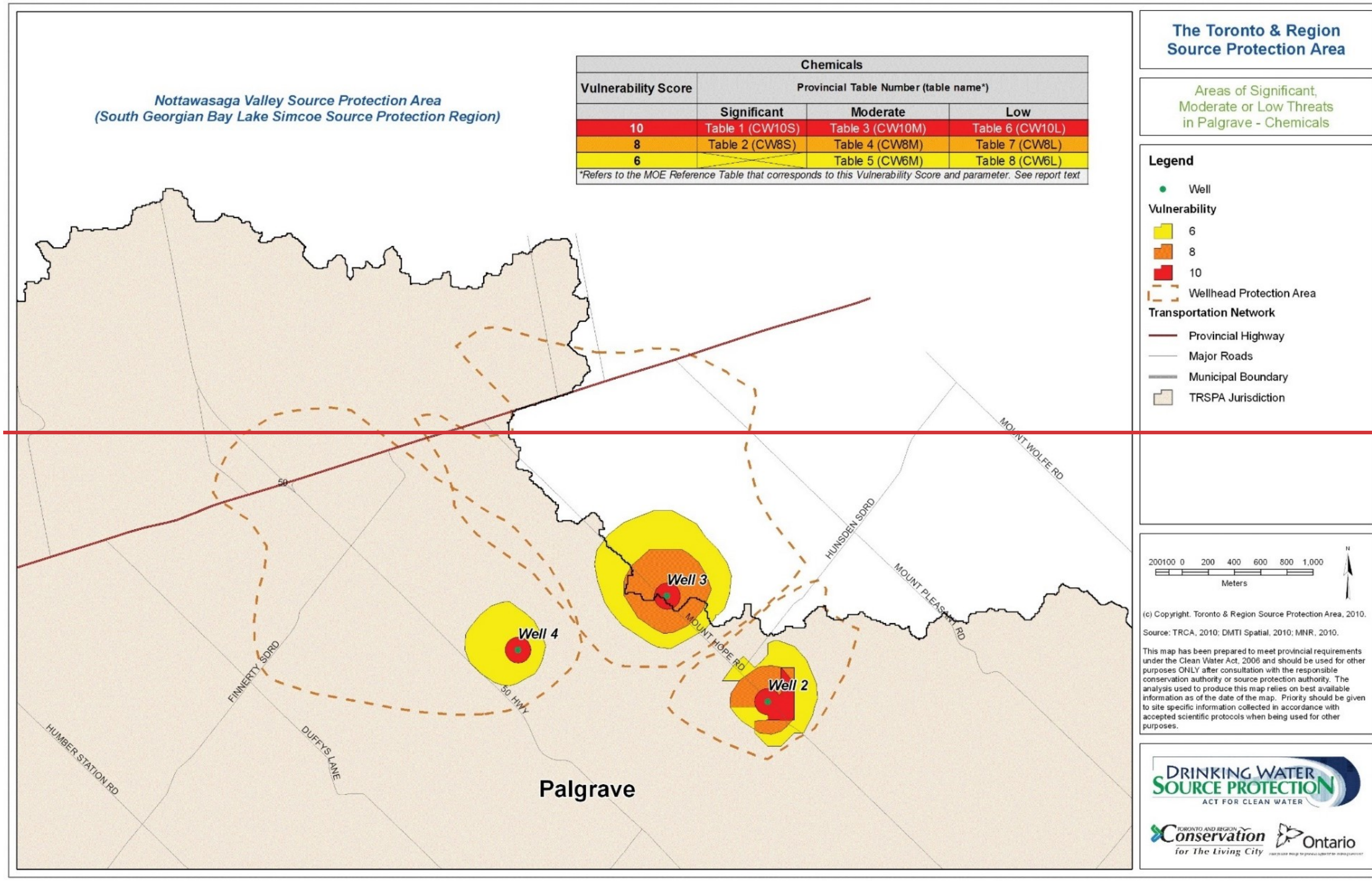
The WHPAs of the Palgrave wells cover land north of the Village of Palgrave up to Highway 9. Palgrave well 2 is located on Mount Hope Road beside a large wetland area, Palgrave well 3 is located beside a baseball field on Mount Hope Road, and Palgrave well 4 is located on a wooded property east of County Road 50. Land uses within the Palgrave WHPAs include natural and open space, agricultural, and residential. No conditions or issues were identified for this water system.

The threats inventory for Palgrave was conducted by R.J. Burnside and Associates (Burnside, 2010). The summary of potential low, moderate, and significant threats for this well field is tabulated in **Table 5.108.** No significant managed lands threats were identified for this area. No conditions or issues were identified for this water system. The areas where the threats are or would be low, moderate, and significant for chemicals, DNAPLs, and pathogens are shown on **Figure 5.11, Figure 5.12,** and **Figure 5.13**, respectively.

Table 5.10: Threats Identified in Palgrave

Activity (or Threat Type)	Threats			
	Sig.	Mod.	Low	Total
1. The establishment, operation, or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act* (*EPA*)	0	0	0	**0**
2. The establishment, operation, or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage	5~~0~~	25	36	**61**
3. The application of agricultural source material to land	0	0	2	**2**
4. The storage of agricultural source material	0	2	0	**2**
5. The management of agricultural source material	0	0	0	**0**
6. The application of non-agricultural source material (NASM) to land	0	1	2	**3**
7. The handling and storage of non-agricultural source material NASM	0	0	0	**0**
8. The application of commercial fertilizer to land	0	3	2	**5**
9. The handling and storage of commercial fertilizer	0	1	1	**2**
10. The application of pesticide to land	0	1	1	**2**
11. The handling and storage of pesticide	0	1	1	**2**
12. The application of road salt	0	0	0	**0**
13. The handling and storage of road salt	0	0	0	**0**
14. The storage of snow	0	0	0	**0**
15. The handling and storage of fuel	3~~4~~	9	4	**17**
16. The handling and storage of a dense non-aqueous phase liquid	1~~0~~	0	0	**0**
17. The handling and storage of an organic solvent	0	0	0	**0**
18. The management of runoff that contains chemicals used in the de-icing of aircraft	0	0	0	**0**
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body	0	0	0	**0**
20. An activity that reduces the recharge of an aquifer	0	0	0	**0**
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard	0	2	0	**2**
22. The establishment and operation of a liquid hydrocarbon pipeline.				
Total Threats	**~~4~~9**	**45**	**49**	**98**
Total Parcels	**9~~4~~**	**35**	**40**	**79**

Notes: Sig. = Significant; Mod. = Moderate


The Toronto & Region Source Protection Area
Areas of Significant, Moderate or Low Threats in Palgrave - Chemicals
Chemicals
Vulnerability Score
Provincial Table Number (table name*)
Significant
Moderate
Low
10
Table 1 (CW10S)
Table 3 (CW10M)
Table 6 (CW10L)
8
Table 2 (CW8S)
Table 4 (CW8M)
Table 7 (CW8L)
6
Table 5 (CW6M)
Table 8 (CW6L)
*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text
Nottawasaga Valley Source Protection Area
(South Georgian Bay Lake Simcoe Source Protection Region)
Well 2
Well 3
Well 4
Palgrave
MOUNT WOLFE RD
HUNSDEN SDRD
MOUNT PLEASANT RD
MOUNT HOPE RD
FINNERTY SDRD
50 HWY
DUFFYS LANE
HUMBER STATION RD
50
Legend
Well
Vulnerability
6
8
10
Wellhead Protection Area
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
TRSPA Jurisdiction
200100 0 200 400 600 800 1,000
Meters
N
(c) Copyright. Toronto & Region Source Protection Area, 2010.
Source: TRCA, 2010; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation for The Living City
Ontario

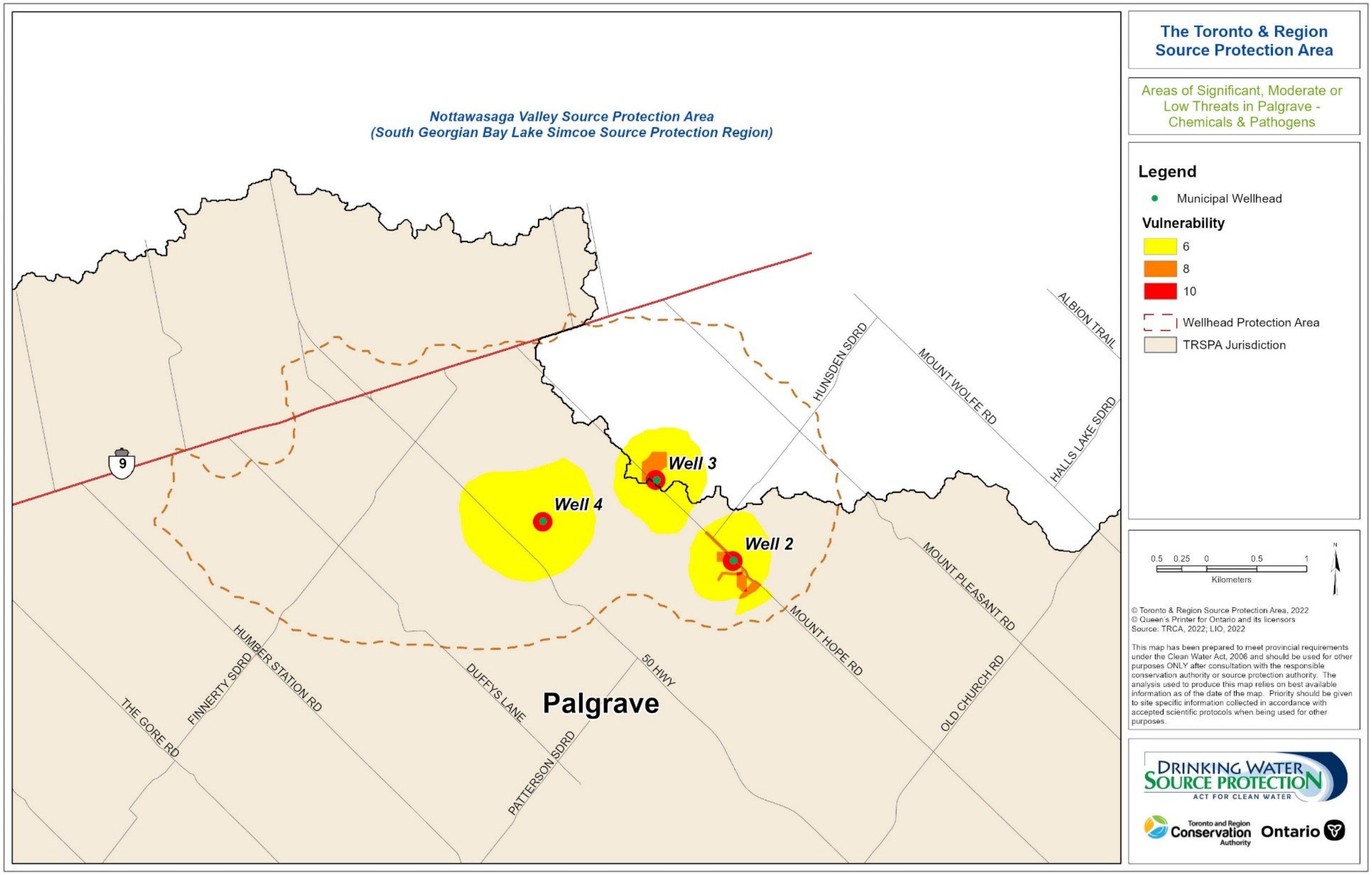
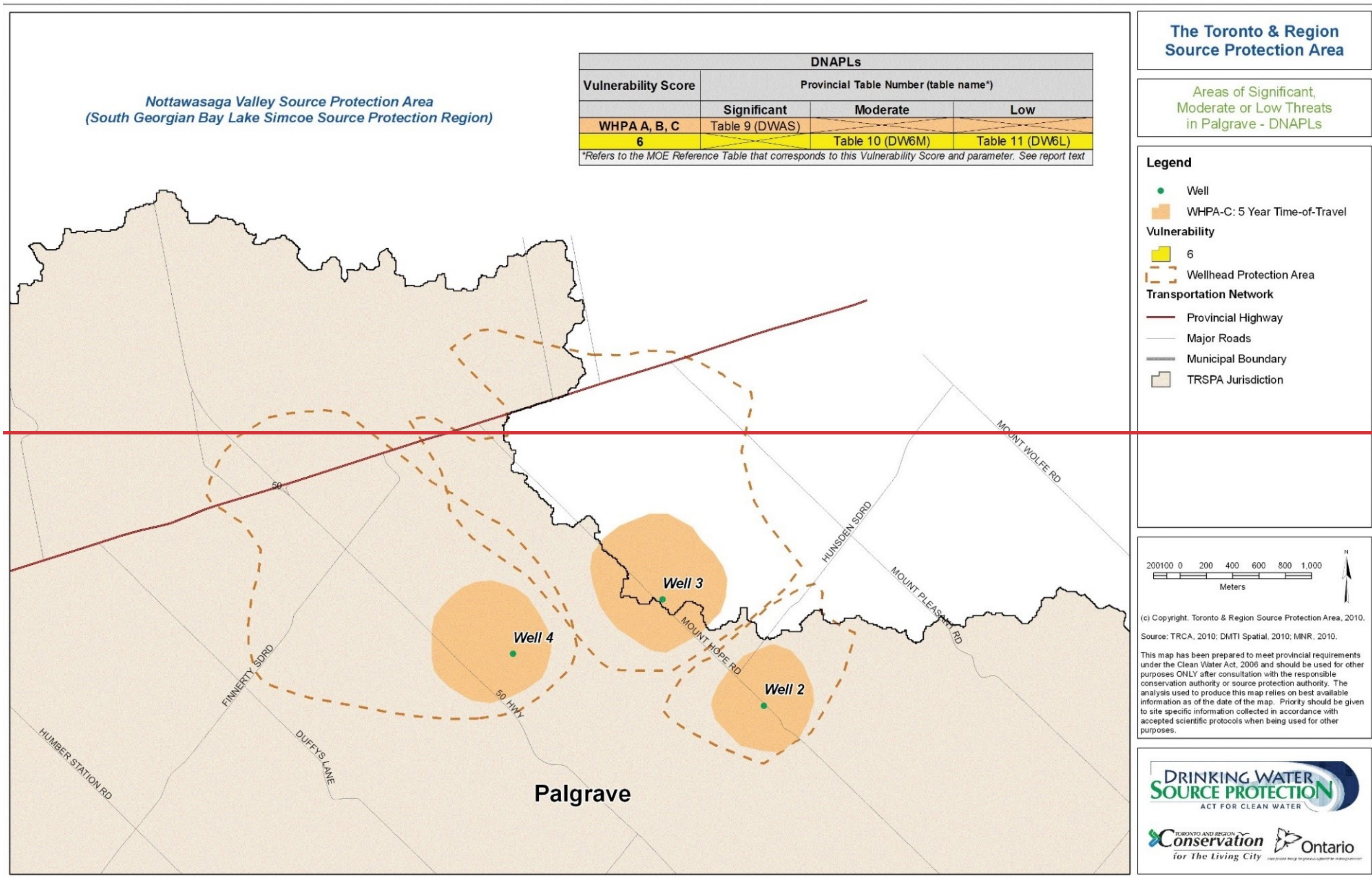


Figure 5.10: Areas of Significant, Moderate and Low Threats in Palgrave ~~-~~ – Chemicals and Pathogens

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/


The Toronto & Region Source Protection Area
Areas of Significant, Moderate or Low Threats in Palgrave - DNAPLs
DNAPLs
Vulnerability Score
Provincial Table Number (table name*)
Significant
Moderate
Low
WHPA A, B, C
Table 9 (DWAS)
6
Table 10 (DW6M)
Table 11 (DW6L)
*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text
Nottawasaga Valley Source Protection Area
(South Georgian Bay Lake Simcoe Source Protection Region)
Well 2
Well 3
Well 4
Palgrave
MOUNT WOLFE RD
HUNSDEN SDRD
MOUNT PLEASANT RD
MOUNT HOPE RD
FINNERTY SDRD
DUFFYS LANE
HUMBER STATION RD
50 HWY
50
Legend
Well
WHPA-C: 5 Year Time-of-Travel
Vulnerability
6
Wellhead Protection Area
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
TRSPA Jurisdiction
200100 0 200 400 600 800 1,000
Meters
N
(c) Copyright. Toronto & Region Source Protection Area, 2010.
Source: TRCA, 2010; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.

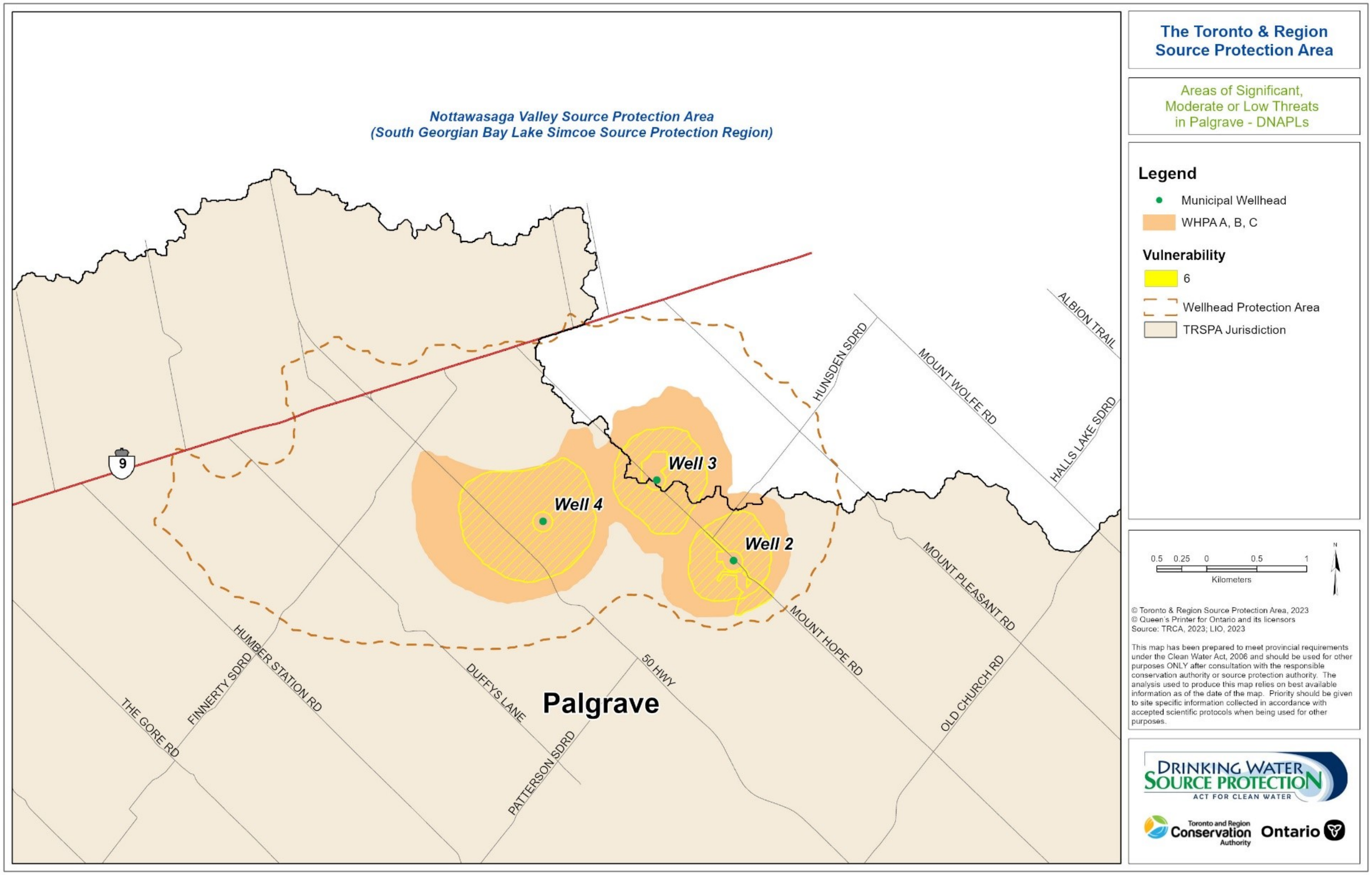
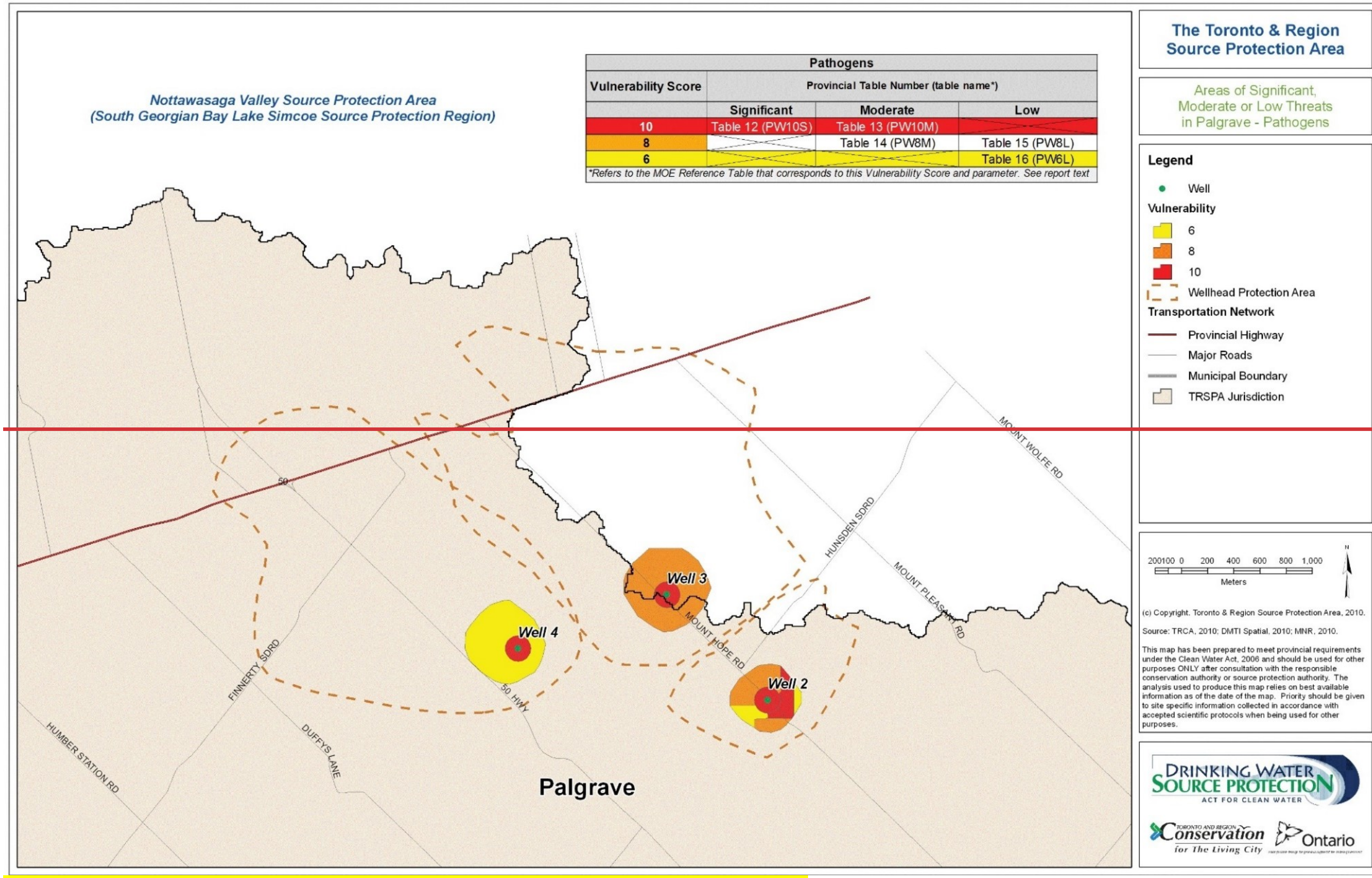


Figure 5.11: Areas of Significant, Moderate and Low Threats in Palgrave - DNAPLs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/



~~Figure 5.10: Areas of Significant, Moderate and Low Threats in Palgrave - Pathogens~~

~~*The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/*~~

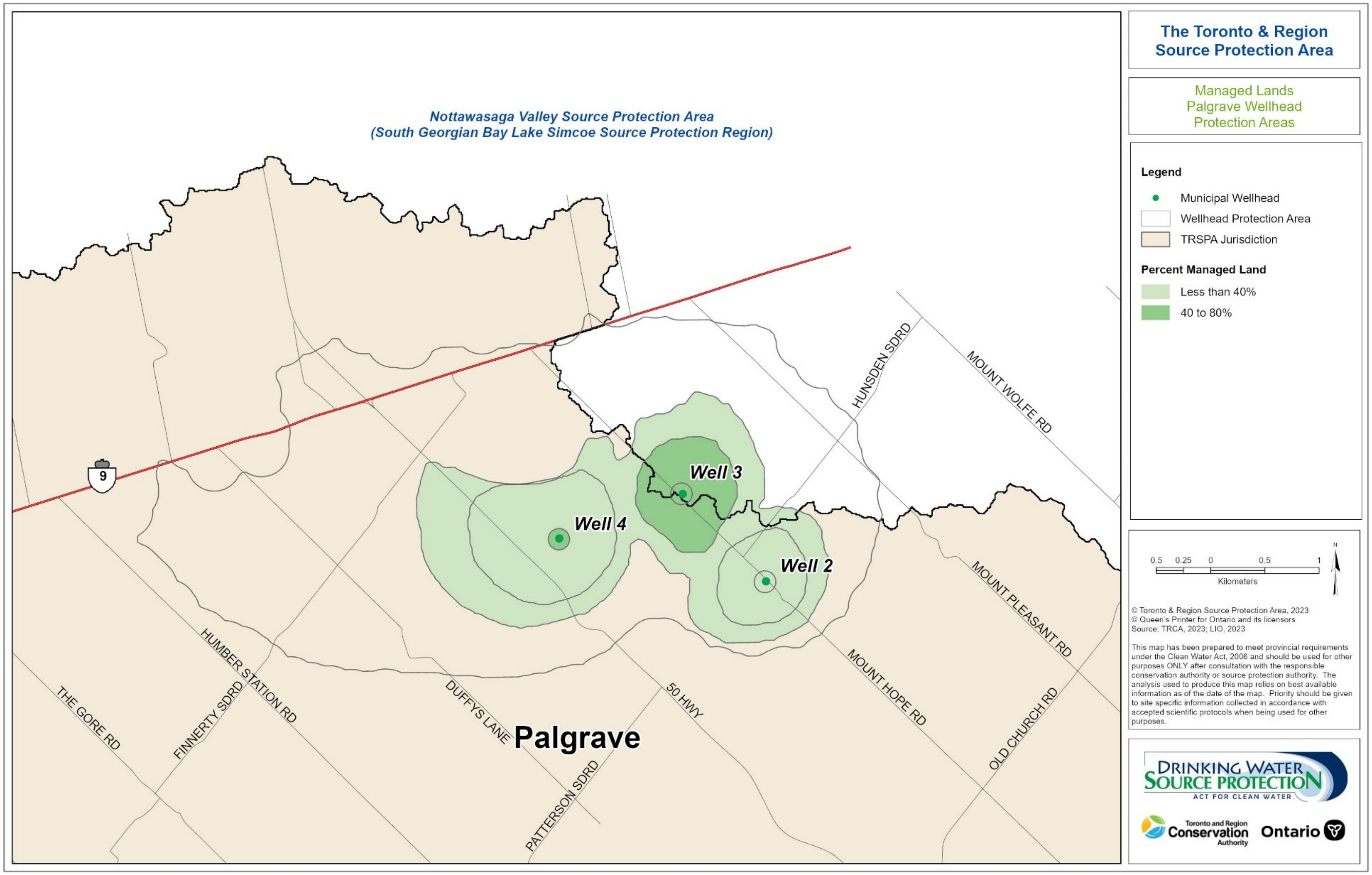


Figure 5.12 Managed Lands in Palgrave WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

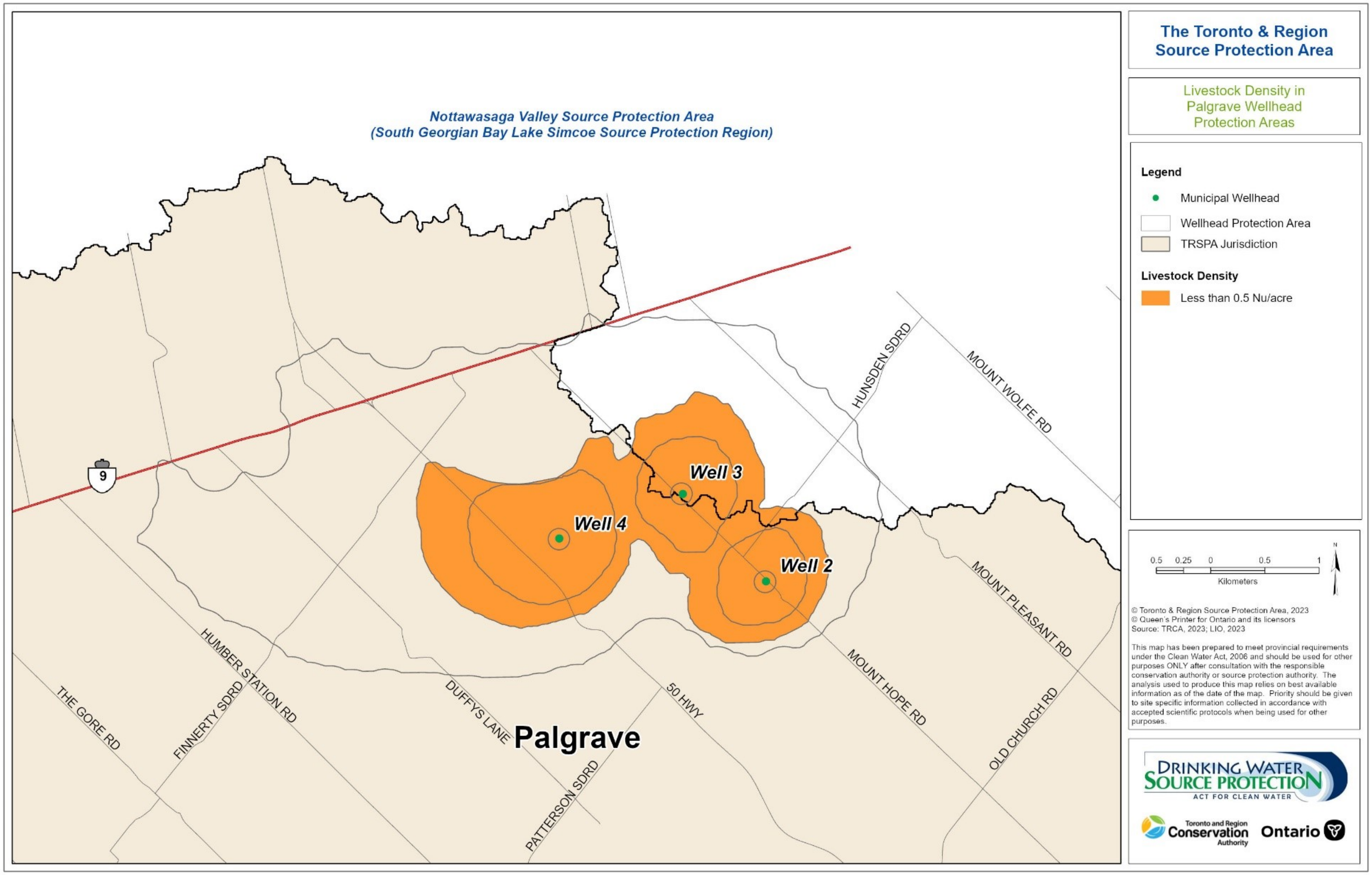


Figure 5.13 Livestock Density in Palgrave WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

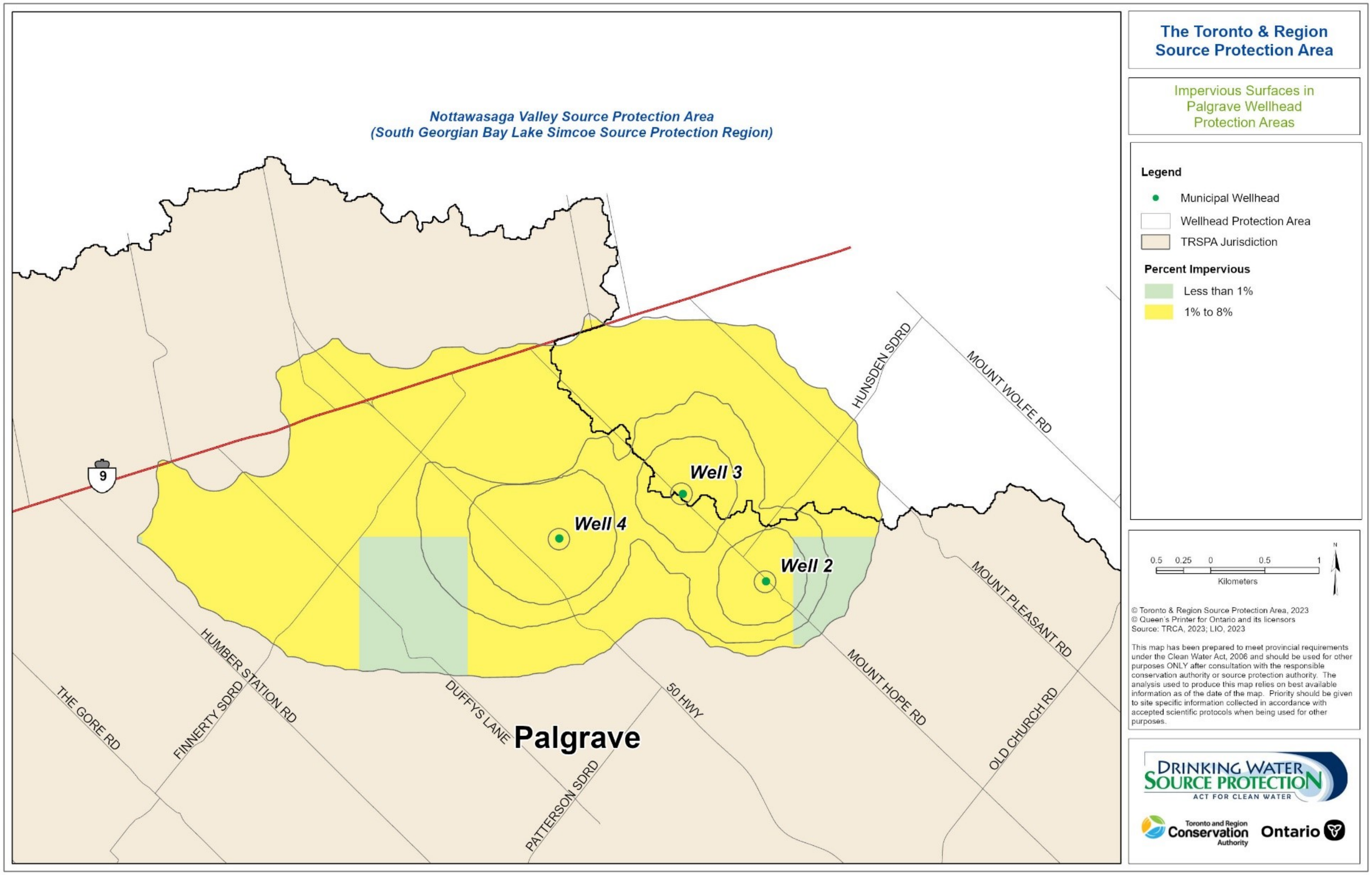


Figure 5.14 Impervious Surfaces in Palgrave WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

Nobleton - Threats and Issues

The three wells in Nobleton are located near the intersection of Regional Road #27 (formerly Highway 27) and King Road. The WHPA zones extend northward to just south of the 16th Side Road, and therefore encompass most of the community. Land uses include a mix of commercial and residential, with agricultural to the north of the village.

During the threats assessment process, the difficulty of enumerating domestic fuel storage threats (home heating oil) was identified by the consultants. *The Accord (*see **Appendix E2**) specified applying a single threat count for handling and storage of fuel in each WHPA vulnerable area, unless there was a high probability that natural gas was the primary source of heating fuel. However, the CTC SPC Working Group opted to diverge from this aspect of *The Accord*, requesting that a threat count for handling and storage of fuel oil be assigned to each individual property, unless it could be shown that the property is not using fuel oil.

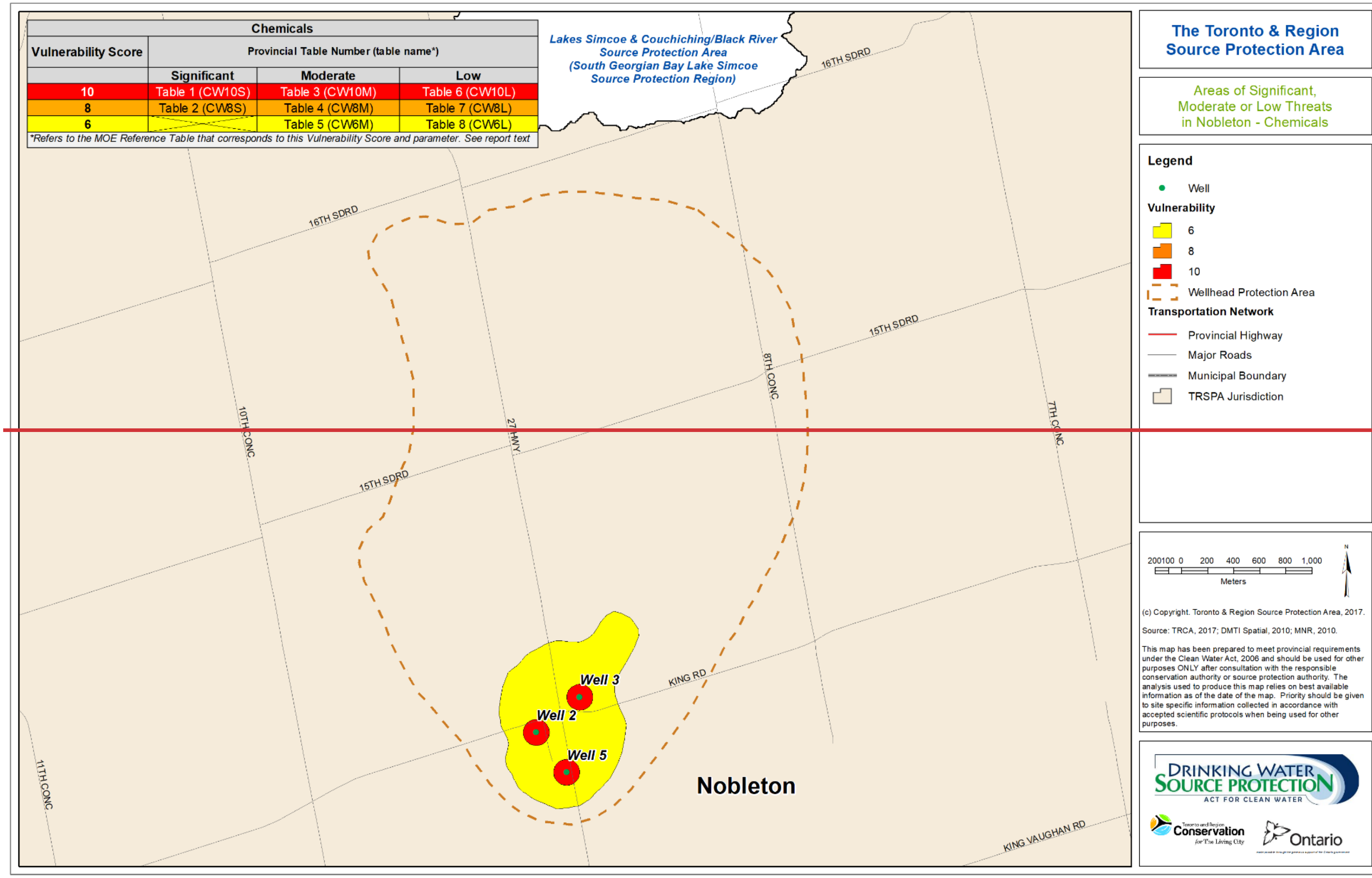
For the York Region WHPAs within TRSPA, it was assumed that unserviced private lots (i.e., those parcels with private septic systems) have fuel oil tanks. Therefore, the numbers from Threat Activity 2 (the establishment, operation, or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage) as identified by Stantec were added to ~~Threat Activity~~Threat Activity 15 (the handling and storage of fuel).

In Nobleton, most homes appear to be serviced with natural gas and municipal water/ wastewater, although some are on private wastewater disposal systems. The threats inventory for Nobleton was conducted by Stantec (2010). The threats inventory for Nobleton was conducted by Stantec (2010). The maps showing the areas of low, moderate, and significant threats for chemicals, DNAPLs, and pathogens are shown on **Figure 5.17**, **Figure 5.18** and **Figure 5.19**, respectively. The summary of potential significant, moderate, and low threats is tabulated in **Table 5.12~~0~~**. No conditions or issues were identified for this water system.

Table 5.12: Threats Identified in Nobleton

Activity (or Threat Type)	Threats			
	Sig.	Mod.	Low	Total
1. The establishment, operation, or maintenance of a waste disposal site within the meaning of Part V of the *Environmental Protection Act* (*EPA*)	0	4	0	**4**
2. The establishment, operation, or maintenance of a system that collects, stores, transmits, treats, or disposes of sewage	59	0	356	**415**
3. The application of agricultural source material to land	1	0	1	**2**
4. The storage of agricultural source material	0	0	0	**0**
5. The management of agricultural source material	0	0	0	**0**
6. The application of non-agricultural source material (NASM) to land	0	0	0	**0**
7. The handling and storage of non-agricultural source material NASM	0	0	0	**0**
8. The application of commercial fertilizer to land	0	1	1	**2**
9. The handling and storage of commercial fertilizer	0	0	1	**1**
10. The application of pesticide to land	1	0	1	**2**
11. The handling and storage of pesticide	0	0	1	**1**
12. The application of road salt	0	2	2	**4**
13. The handling and storage of road salt	0	0	0	**0**
14. The storage of snow	0	0	0	**0**
15. The handling and storage of fuel	60	0	371	**431**
16. The handling and storage of a dense non-aqueous phase liquid	17	0	0	**17**
17. The handling and storage of an organic solvent	0	0	3	**3**
18. The management of runoff that contains chemicals used in the de-icing of aircraft	0	0	0	**0**
19. An activity that takes water from an aquifer or a surface water body without returning the water taken to the same aquifer or surface water body	0	0	0	**0**
20. An activity that reduces the recharge of an aquifer	0	0	0	**0**
21. The use of land as livestock grazing or pasturing land, an outdoor confinement area, or a farm-animal yard	0	0	0	**0**
Total Threats	**138**	**7**	**737**	**882**
Total Parcels	**74**	**7**	**359**	**440**

Notes:
Sig. = Significant; Mod. = Moderate
NA means Not Available



Vulnerability Score	Chemicals – Provincial Table Number (table name*)		
	Significant	Moderate	Low
10	Table 1 (CW10S)	Table 3 (CW10M)	Table 6 (CW10L)
8	Table 2 (CW8S)	Table 4 (CW8M)	Table 7 (CW8L)
6		Table 5 (CW6M)	Table 8 (CW6L)

*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text

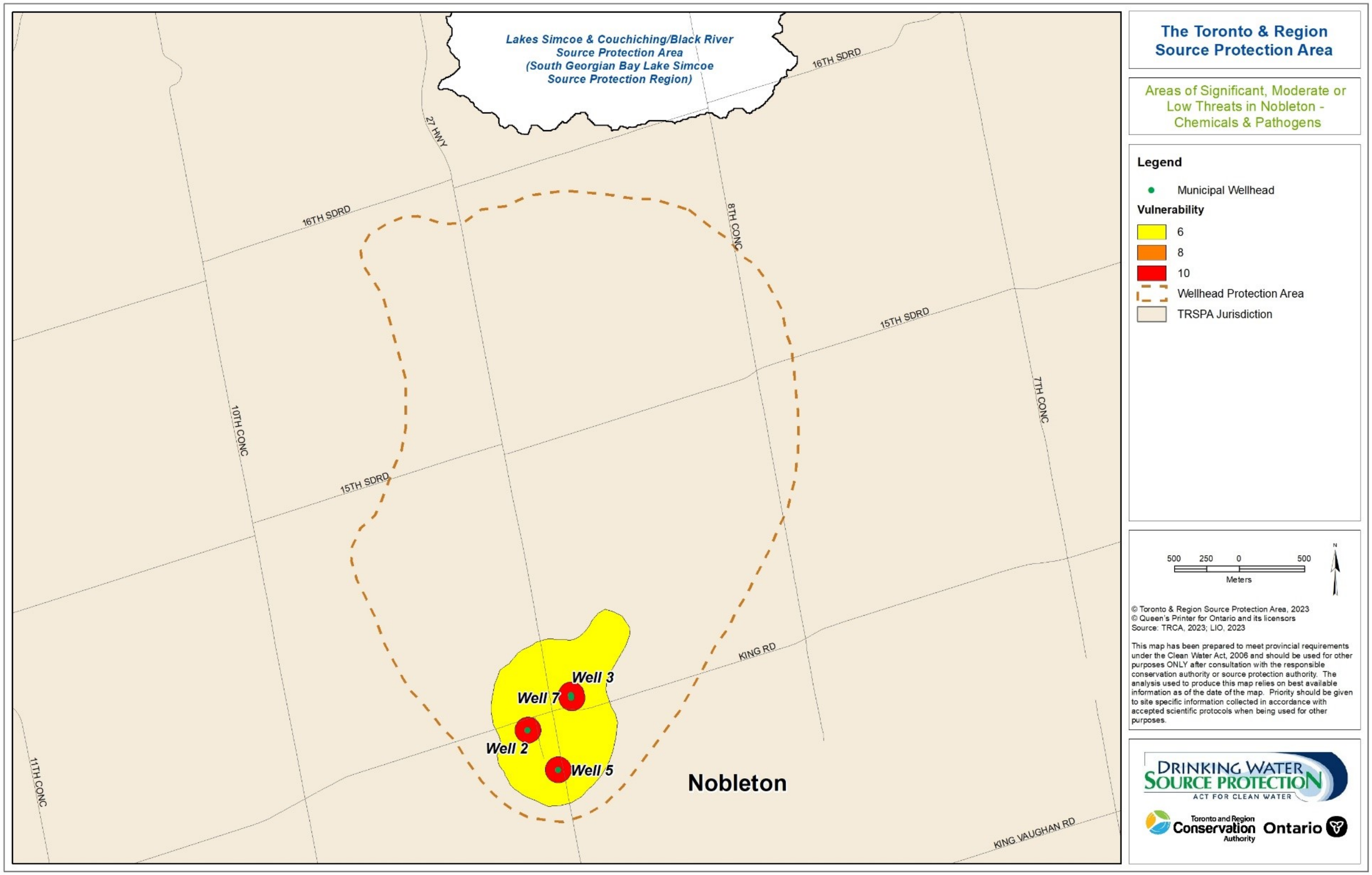
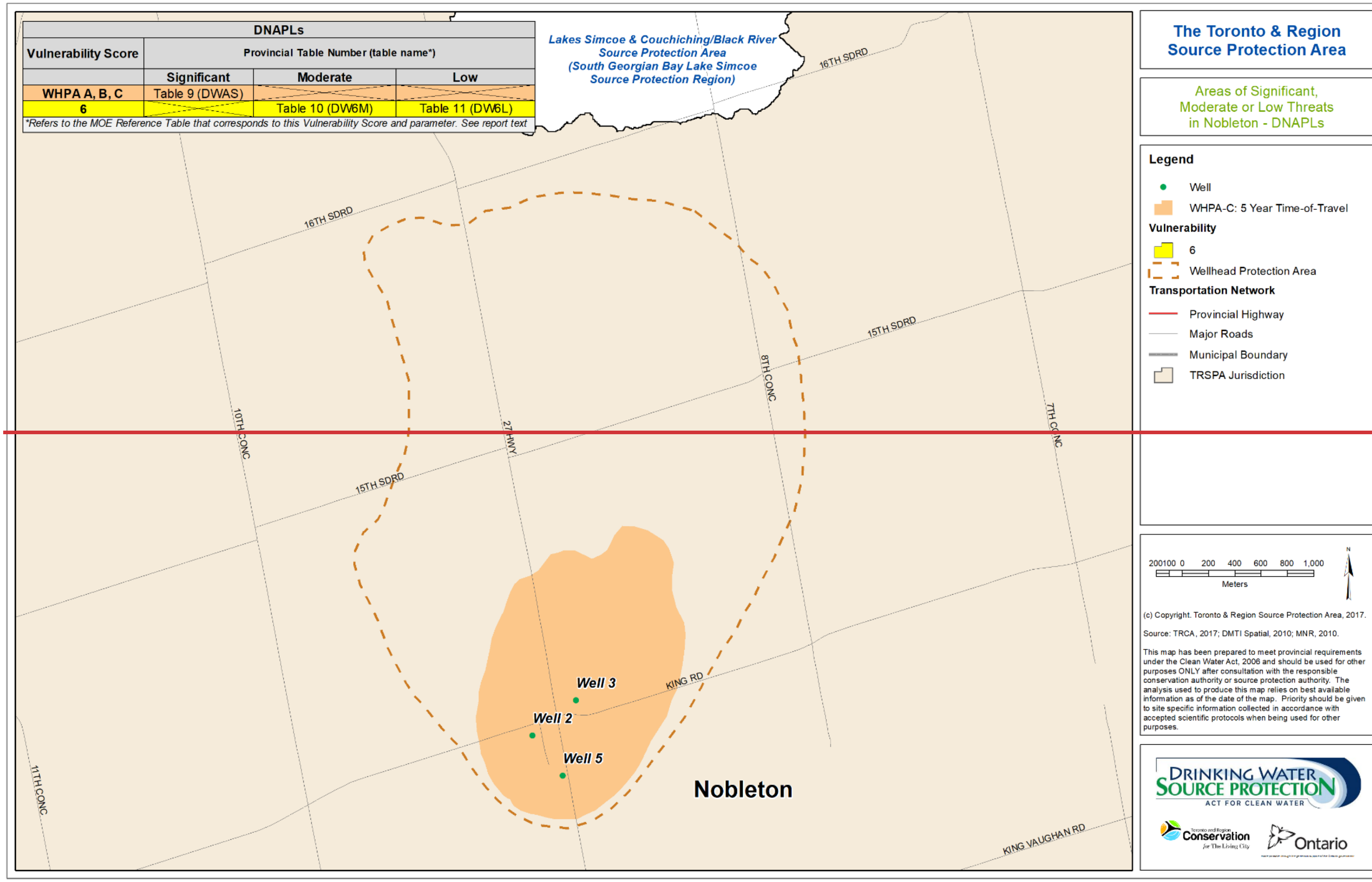


Figure 5.18: Areas of Significant, Moderate and Low Threats in Nobleton – Chemicals and Pathogens

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

DNAPLs			
Vulnerability Score	Provincial Table Number (table name*)		
	Significant	Moderate	Low
WHPA A, B, C	Table 9 (DWAS)		
6		Table 10 (DW6M)	Table 11 (DW6L)

*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text



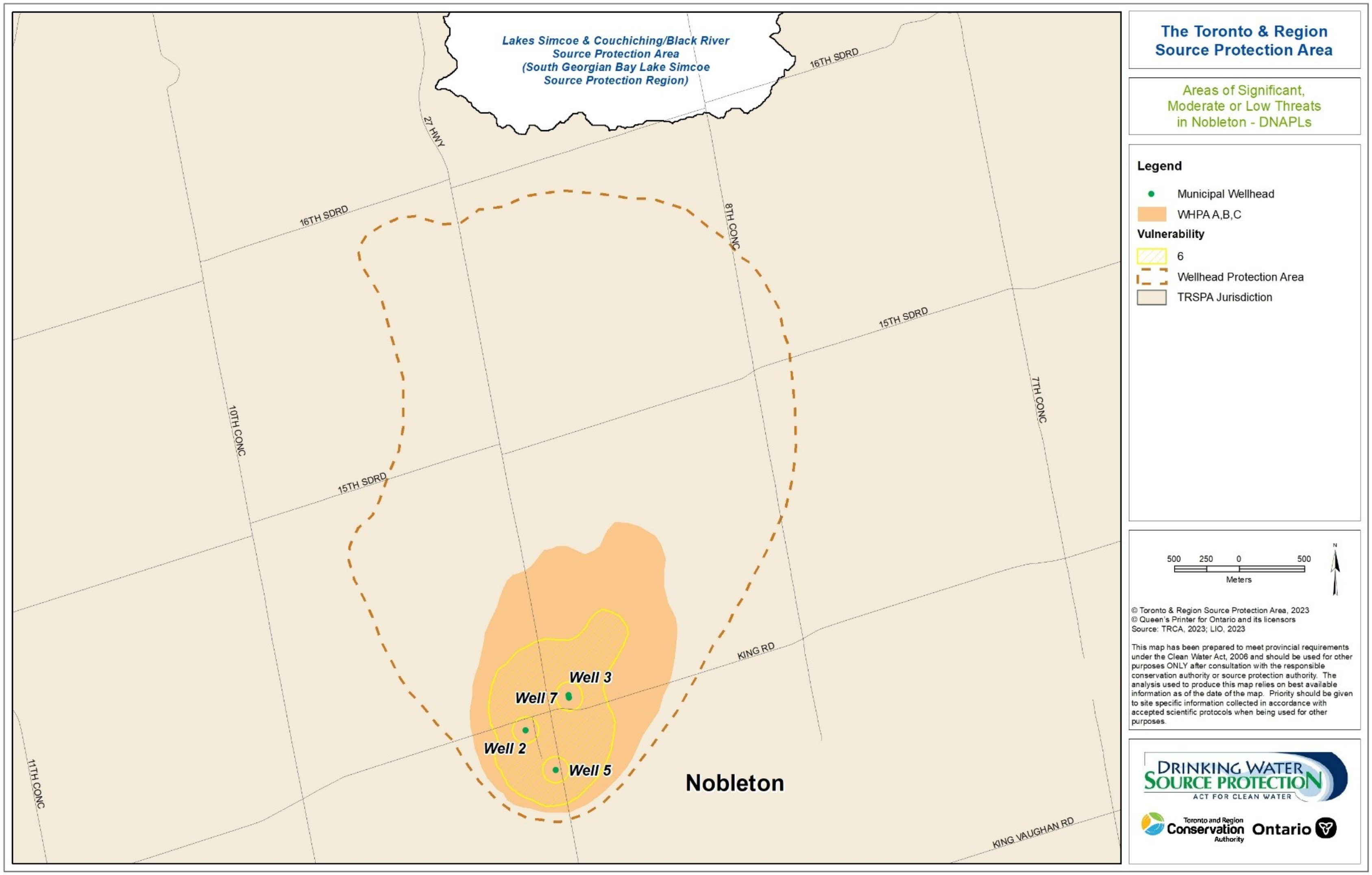
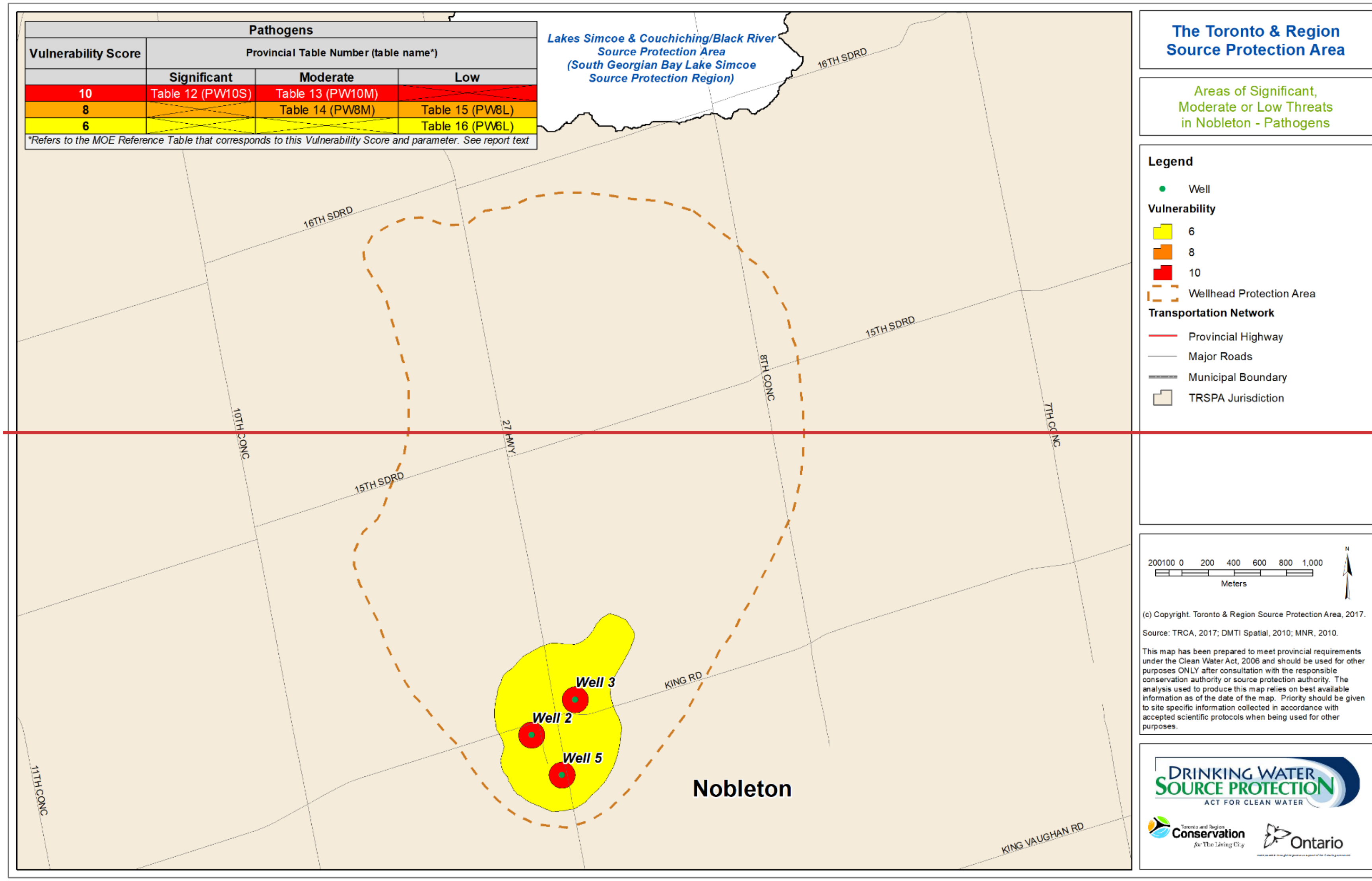


Figure 5.19: Areas of Significant, Moderate and Low Threats in Nobleton - DNAPLs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/



~~**Figure 5.16: Areas of Significant, Moderate and Low Threats in Nobleton – Pathogens**~~

~~*The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/*~~

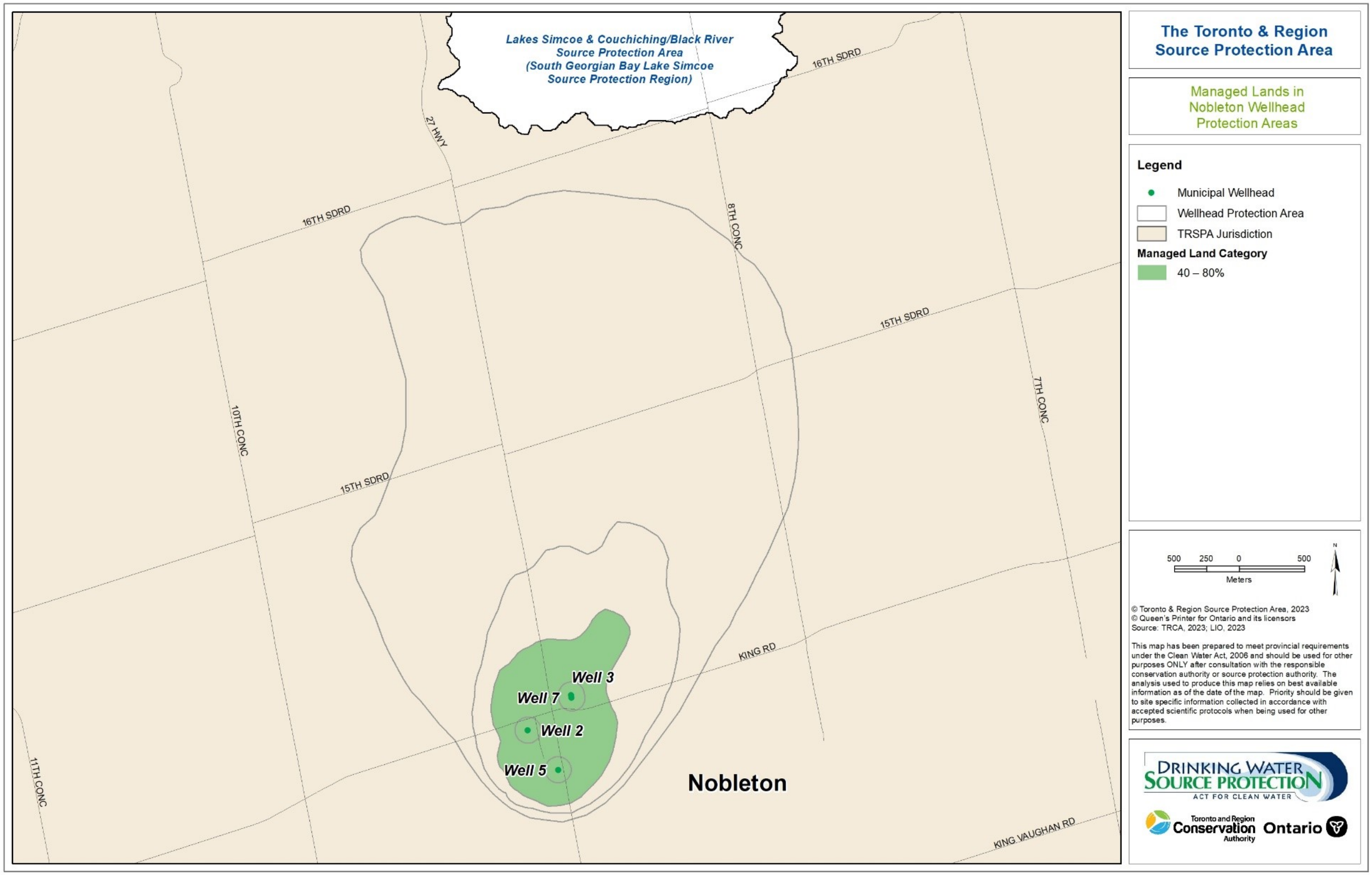


Figure 5.20 Managed Lands in Nobleton WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

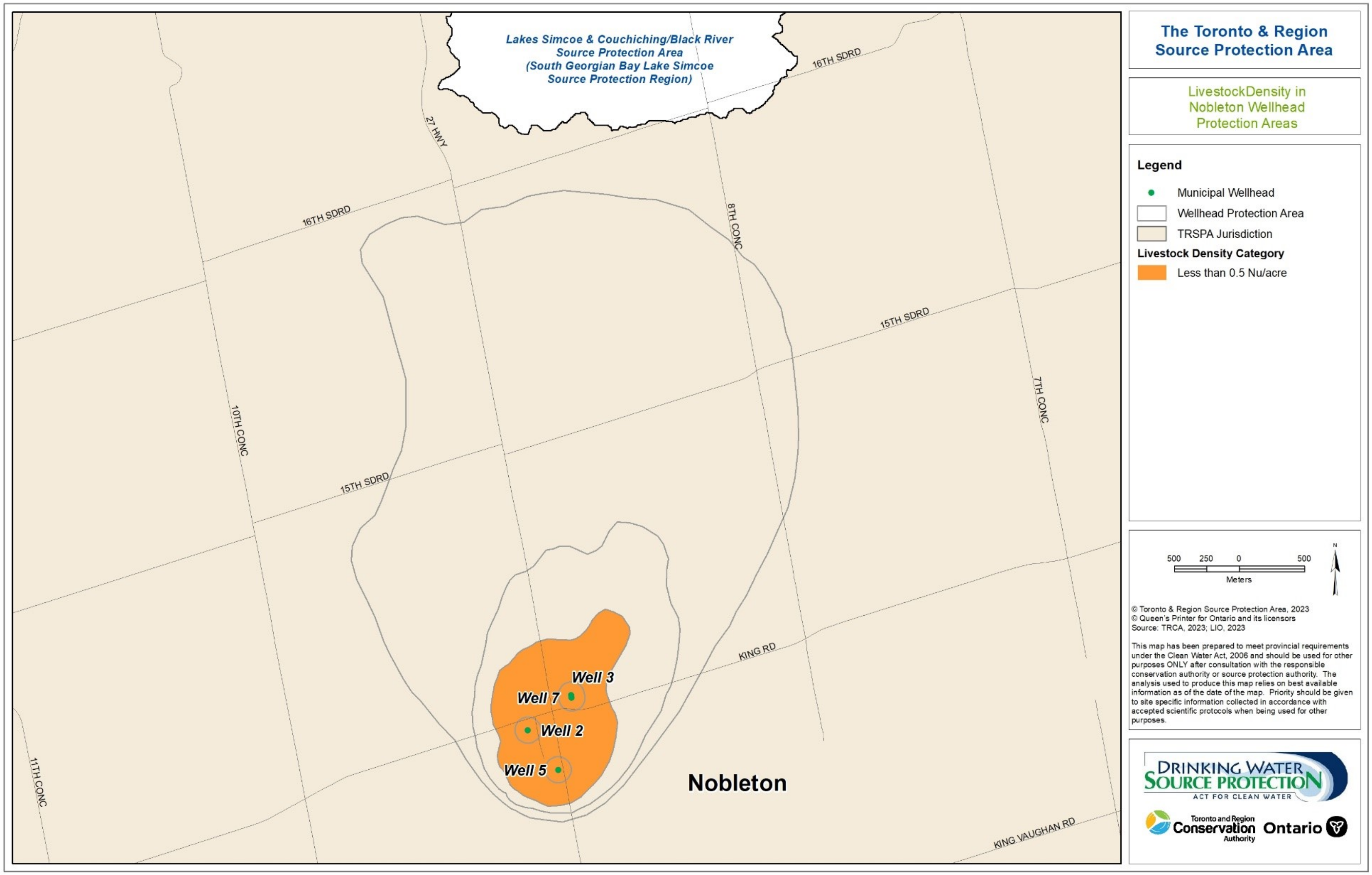


Figure 5.21 Livestock Density in Nobleton WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

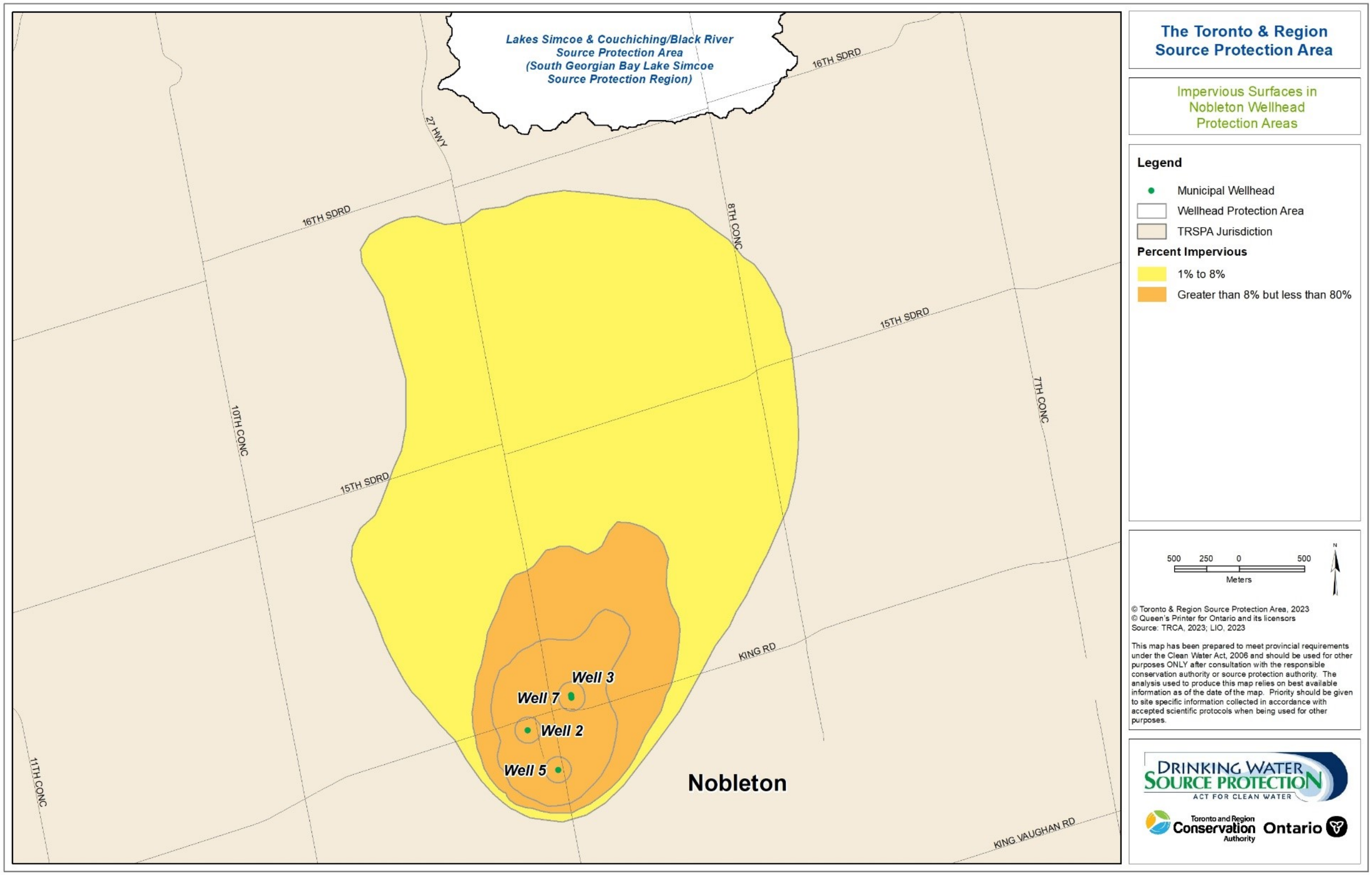


Figure 5.22 impervious Surfaces in Nobleton WHPAs

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

5.6 SURFACE WATER QUANTITY THREATS

There are no inland surface water intakes in the TRSPA. The only surface water intakes are located in Lake Ontario. Since the *Technical Rules* exclude consideration of water quantity stress in the Great Lakes, no surface water quantity threats have been identified in TRSPA.

5.7 SURFACE WATER QUALITY THREATS

Technical Rules (118), (125), and (*126)* require that significant municipal drinking water threats be listed and described in the vulnerable areas around surface water intakes (IPZ-1 and IPZ-2s), including those in Lake Ontario. A description of the approach used in vulnerability assessment for IPZs is presented in **Chapter 4.** It should be noted that all of the activities listed in the provincial threats tables are land based, and do not apply in Lake Ontario. There are no threat activities included which occur only within the lake itself, such as those related to shipping.

5.7.1 Threats from Conditions and Issues in Intake Protection Zones (IPZ-1s and 2s)

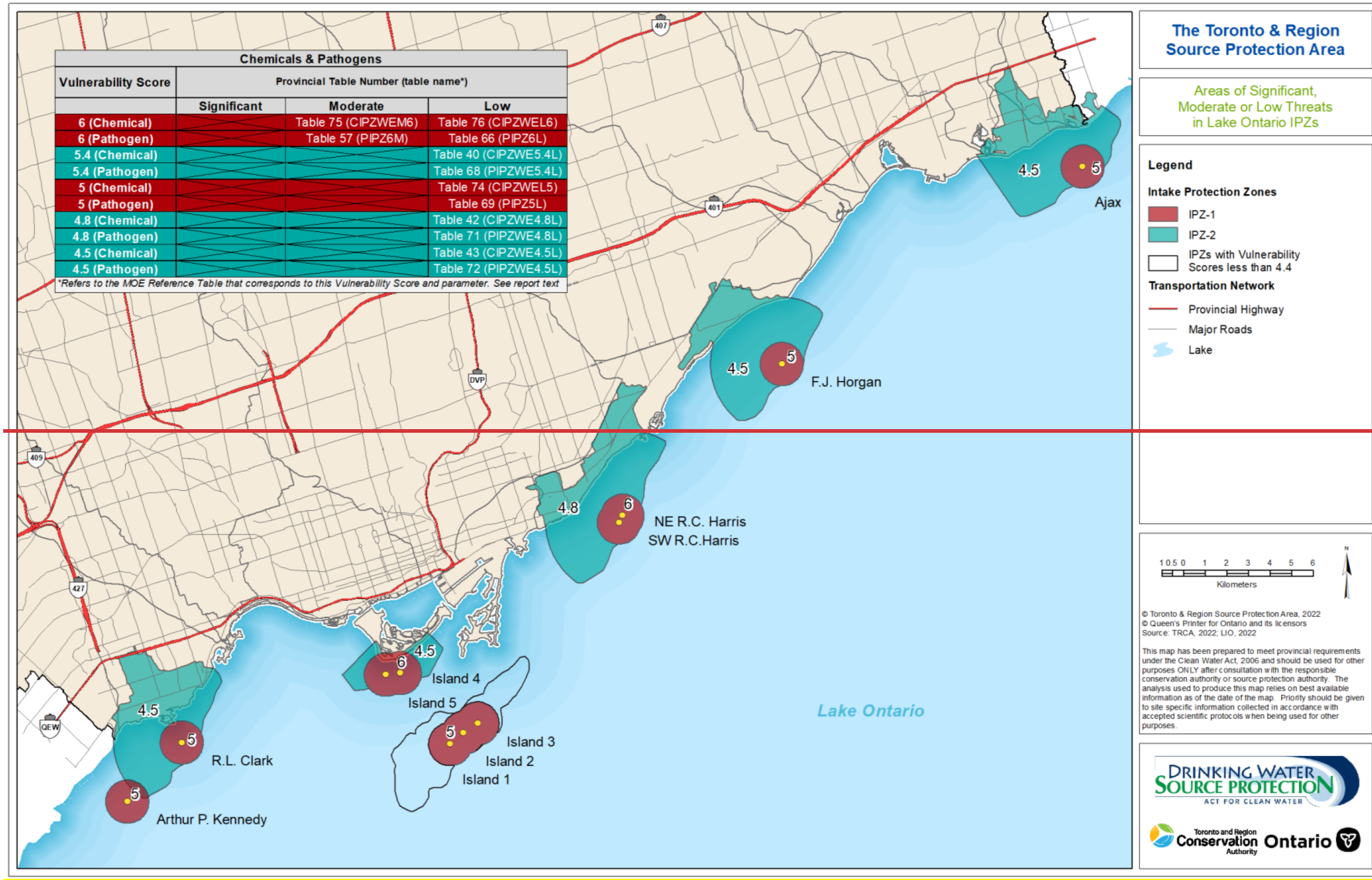
No conditions or issues with respect to municipal drinking water quality have been identified for any of the lake based municipal water supplies within the TRSPA. However, staff from the regional municipalities of Peel, York, Durham, and the City of Toronto will continue to monitor the municipal raw water quality in accordance with the *Safe Drinking Water Act (2002)* as to ensure that no issues occur in the future without immediate corrective action.

5.7.2 Threats from Activities in Intake Protection Zones (IPZ-1s and 2s)

The six TRSPA Lake Ontario intakes (including two for the Toronto Island facility, which has both shallow and deep intakes) have vulnerability scores of either 5 (Ajax, Toronto Island—deep, and F.J. Horgan), or 6 (R.C. Harris, R.L. Clark, and Toronto Island—shallow). There are a number of circumstances where an activity could pose a low risk to the intakes where it exists, according to the Provincial Tables of Circumstances. **Figure 5.32** and **Table 5.164** show the count of potential activities that pose threats in vulnerable IPZ-1.

Table 5.16: List of Possible Activities that are Threats in Intake Protection Zone-1s

Threat Category	Number of Possible Activities/Conditions with Threat Risk Classification			Total
	Significant	Moderate	Low	
Vulnerability Score = 5 (Ajax, F.J. Horgan, and Toronto Island—deep intakes)				
Pathogens	0	0	13	13
Chemical (including DNAPLs)	0	0	558	558
Total	**0**	**0**	**571**	**571**
Vulnerability Score = 6 (R.C. Harris, R.L. Clark, and Toronto Island—shallow intakes)				
Pathogens	0	12	15	27
Chemical (including DNAPLs)	0	13	1,193	1,206
Total	**0**	**25**	**1,208**	**1,233**



Chemicals & Pathogens			
Vulnerability Score	Provincial Table Number (table name*)		
	Significant	Moderate	Low
6 (Chemical)		Table 75 (CIPZWEM6)	Table 76 (CIPZWEL6)
6 (Pathogen)		Table 57 (PIPZ6M)	Table 66 (PIPZ6L)
5.4 (Chemical)			Table 40 (CIPZWE5.4L)
5.4 (Pathogen)			Table 68 (PIPZWE5.4L)
5 (Chemical)			Table 74 (CIPZWEL5)
5 (Pathogen)			Table 69 (PIPZ5L)
4.8 (Chemical)			Table 42 (CIPZWE4.8L)
4.8 (Pathogen)			Table 71 (PIPZWE4.8L)
4.5 (Chemical)			Table 43 (CIPZWE4.5L)
4.5 (Pathogen)			Table 72 (PIPZWE4.5L)

*Refers to the MOE Reference Table that corresponds to this Vulnerability Score and parameter. See report text

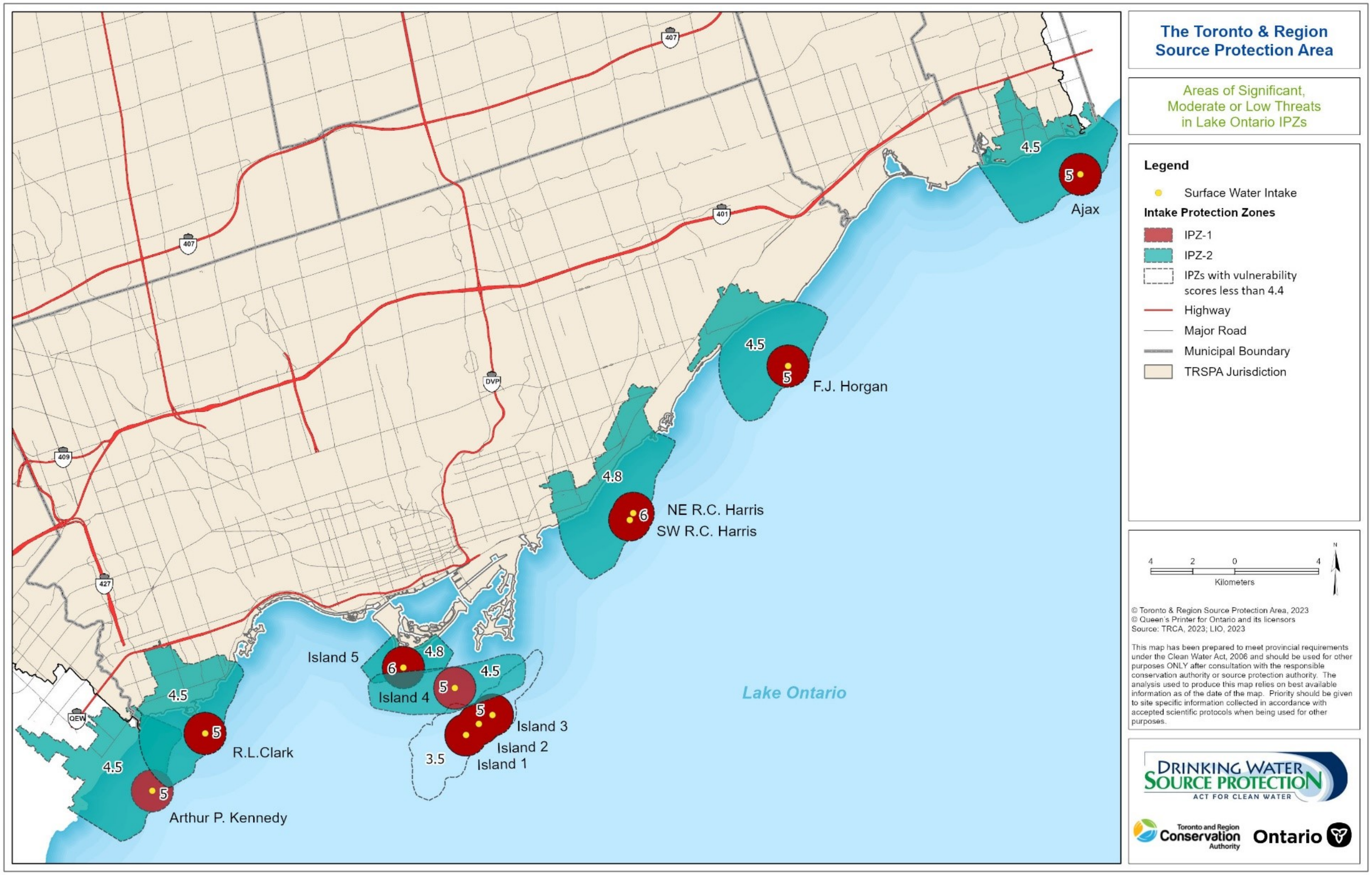


Figure 5.32: Areas of Significant, Moderate and Low Threats in Lake Ontario in IPZ-1s and 2s

The information that appears in the Provincial Tables of Circumstances can be generated by searching the Source Water Protection Threats Tool, accessible via http://swpip.ca/

All of the TRSPA IPZ-1, with the exception of the shallow Toronto Island Intakes (which cover part of the land area of the Toronto Islands), are fully within Lake Ontario. None of the potential activities, therefore, pose any level of threat within the IPZ-1s, which are the most vulnerable areas around the intakes. Where the IPZ-1 for the Toronto Island Treatment Plant extends onto the shore (approximately 150 m), some activities are considered low-level threats. Tables 41 (CIPZWE4.9L), 44 (CIPZWE4.2L), 69 (PIPZ5L), and 73 (PIPZWE4.2L) of the Provincial Tables of Circumstances apply to these areas.

In an IPZ-2 with a vulnerability score greater than 4 (e.g., R.L. Clark, R.C. Harris, F.J. Horgan, and Toronto Island—shallow intakes), a number of possible activities pose a low risk to the intakes, according to the following Provincial Tables of Circumstances:

- Table 43 (CIPZWE4.5L);
- Table 42 (CIPZWE4.8L);
- Table 40 (CIPZWE5.4L);
- Table 72 (PIPZWE4.5L);
- Table 71 (PIPZWE4.8L); and
- Table 68 (PIPZWE5.4L).

The numbers of low threats for these intakes are summarized in **Table 5.175**. For IPZ-2 areas with a vulnerability score of 4 or less (e.g., Toronto Island-deep intakes), no activities listed pose even a low level of risk to the intakes, according to the Provincial Tables of Circumstances.

Table 5.17: Summary of Threats, Intake Protection Zone-2s

Threat Category	Number of Possible Activities/Conditions with Threat Risk Classification			Total
	Significant	Moderate	Low	
Vulnerability Score = 4.8 (R.C. Harris)				
Pathogens	0	0	13	13
Chemical (including DNAPLs)	0	0	436	436
Total	**0**	**0**	**449**	**499**
Vulnerability Score = 4.5 (Ajax, Arthur P Kennedy, F.J. Horgan, R.L. Clark, Toronto Island Shallow)				
Pathogens	0	0	13	13
Chemical (including DNAPLs)	0	0	239	239
Total	**0**	**0**	**252**	**252**

5.7.3 Threats from Managed Lands in Intake Protection Zones (IPZ-1s and 2s)

The vulnerability of the area is considered in the Provincial Tables of Circumstances along with the low, moderate or high score for nutrient application in the managed lands analyses to determine the level of threat to drinking water. If an IPZ-1 or IPZ-2 extends onto land and has a vulnerability score higher than 4.4, the managed lands must be mapped as a threat to municipal drinking water sources as a surrogate in the determination of risk associated with the application of nutrients to the land. In the TRSPA, all of the IPZ-2s have a low risk score associated with the application of nutrients due to managed land activities (see **Table 5.168** and **Figure 5.30**). There are a mix of land uses along the Lake Ontario waterfront in the TRSPA, ranging from urban residential, employment areas, quarries, marinas and ports, parks, agriculture, and coastal wetlands. There are no agricultural activities within the IPZ-2 land areas in the TRSPA.

Table 5.18: Managed Lands (%) in Intake Protection Zones

Managed (%) in IPZs	Risk Score	% of Total IPZs Managed Lands	Threat
< 40	Low	70.9	Low
40–80	Moderate	29.1	
> 80	High	0	

5.7.4 Threats from Estimated Livestock Density in Intake Protection Zones (IPZ-1s and 2s)

The land area within this IPZ is urban parkland and there is no livestock activity within this vulnerable area, as shown on **Figure 5.31**.

5.7.5 Threats for Impervious Surfaces in Intake Protection Zones (IPZ-1s and 2s)

The impervious surfaces were calculated based on the land area only. IPZ-2s within the TRSPA were mapped according to *Technical Rule 16 (11).* The *Technical Rules* require that only those areas in an IPZ-2 with impervious surfaces greater than 8% be mapped. Areas with less than 8% impervious surfaces are not mapped (see **Table 5.197**). The vast majority of the land portion of IPZ-2s falls within the 8%–80% range. This is a direct result of the land uses and transportation network along TRSPA's Lake Ontario waterfront.

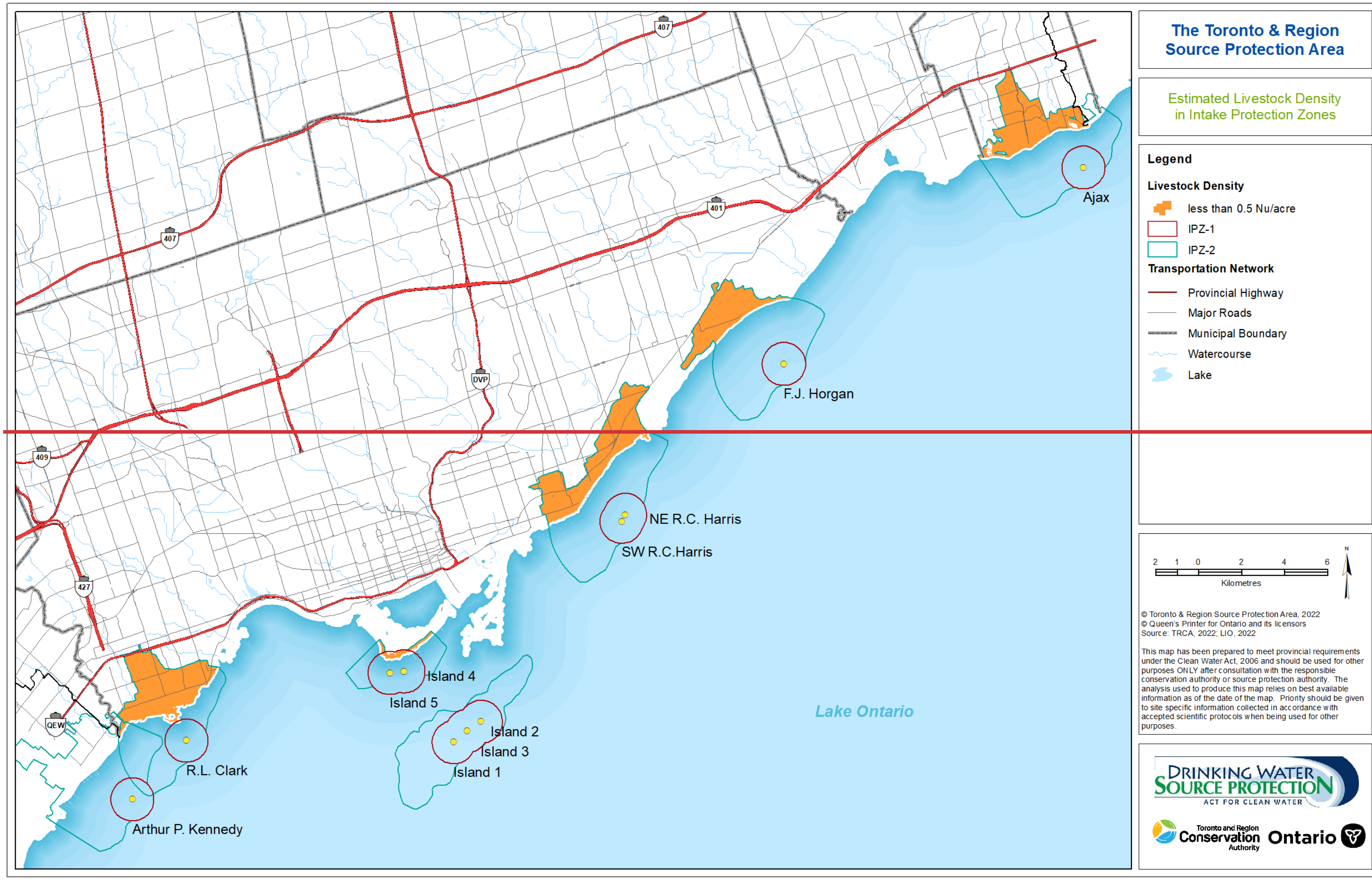
Table 5.19: Impervious Surfaces in Intake Protection Zones

Impervious Surfaces (%) in IPZs	% of Total IPZs	Threat
not more than 1	1.7	No Threat
more than 1; not more than 8	10.0	Low
more than 8; not more than 80	88.3	
80 or more	0.0	

Generally, in IPZ-2s in the study area, areas with less than 8% imperviousness are associated with lakefront parks, conservation areas, and provincially significant coastal wetlands. For example, in these areas, the road network is limited, as is development (see **Figure 5.32**). Where agricultural facilities were found within vulnerable SGRAs and HVAs of the TRSPA, the building footprint of any structure within those facilities must be digitized to calculate the area occupied by the structure.


The Toronto & Region Source Protection Area
Managed Lands in Intake Protection Zones
Legend
Percent Managed Land
Less than 40%
40 to 80%
IPZ-1
IPZ-2
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
Ajax
F.J. Horgan
NE R.C. Harris
SW R.C.Harris
Island 4
Island 5
Island 2
Island 3
Island 1
R.L. Clark
Arthur P. Kennedy
Lake Ontario
407
401
409
427
DVP
QEW
2 1 0 2 4 6
Kilometres
N
© Toronto & Region Source Protection Area, 2022
© Queen's Printer for Ontario and its licensors
Source: TRCA, 2022; LIO, 2022
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Toronto and Region Conservation Authority
Ontario

Figure 5.33: Managed Lands in Intake Protection Zones


The Toronto & Region Source Protection Area
Estimated Livestock Density in Intake Protection Zones
Legend
Livestock Density
less than 0.5 Nu/acre
IPZ-1
IPZ-2
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
Kilometres
Ajax
F.J. Horgan
NE R.C. Harris
SW R.C.Harris
Island 4
Island 5
Island 2
Island 3
Island 1
R.L. Clark
Arthur P. Kennedy
Lake Ontario
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Source: TRCA, 2022; LIO, 2022
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
Drinking Water Source Protection
Act for Clean Water
Toronto and Region Conservation Authority
Ontario

Figure 5.34: Estimated Livestock Density in Intake Protection Zones

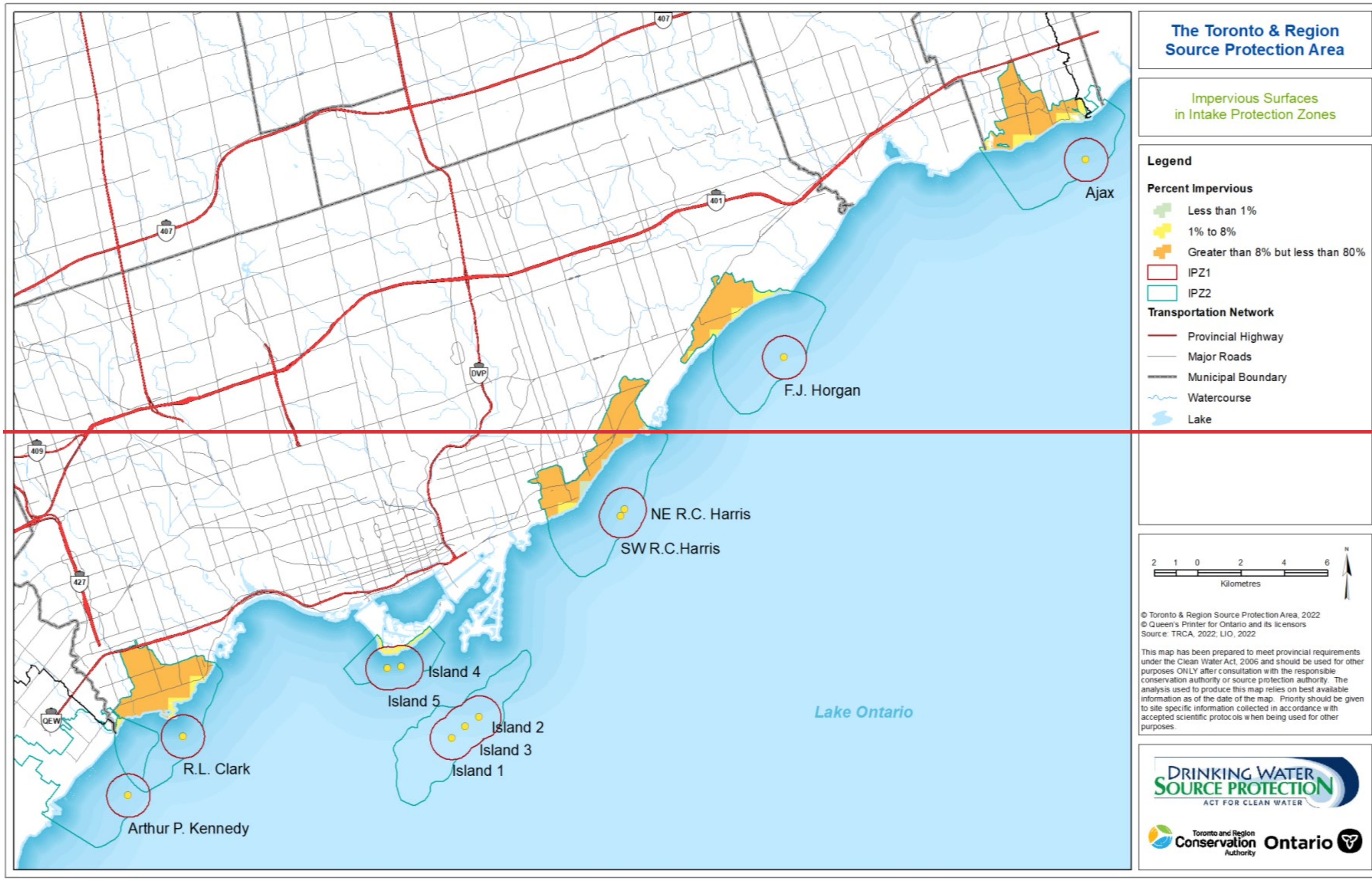

The Toronto & Region Source Protection Area
Impervious Surfaces in Intake Protection Zones
Legend
Percent Impervious
Less than 1%
1% to 8%
Greater than 8% but less than 80%
IPZ1
IPZ2
Transportation Network
Provincial Highway
Major Roads
Municipal Boundary
Watercourse
Lake
2 1 0 2 4 6
Kilometres
N
© Toronto & Region Source Protection Area, 2022
© Queen's Printer for Ontario and its licensors
Source: TRCA, 2022; LIO, 2022
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
Ajax
F.J. Horgan
NE R.C. Harris
SW R.C.Harris
Island 4
Island 5
Island 2
Island 3
Island 1
R.L. Clark
Arthur P. Kennedy
Lake Ontario
407
401
409
427
DVP
QEW

Figure 5.35: Impervious Surface in Intake Protection Zones

5.7.6 Threats from Activities in Intake Protection Zones

The *Technical* ~~*Rules* stipulate~~*Rules* stipulate that event-based modelling can be used to identify whether spills from existing facilities, such as bulk petroleum storage facilities, wastewater treatment plants (WWTP), and industrial chemical facilities, are significant threats to nearby water treatment plant (WTP) intakes.

A number of spill scenarios were modelled as part of the Lake Ontario Collaborative (LOC) project to determine if certain land-based activities could pose a potential drinking water threat to these intakes. Any scenario that identifies conditions under which a contaminant could exceed a *threshold* in the raw water is identified as a significant drinking water threat.

The Technical ~~*Rules* require~~Rules require an IPZ-3 is to be delineated if modelling demonstrates that contaminants may be transported to an intake and result in deterioration of the raw water quality of a drinking water supply. The key *Technical Rules* and the MOECC's Technical Bulletin: *Delineation of Intake Protection Zone-3 Using Event Based Approach (EBA)*, dated July 2009 describes the process for delineating IPZ-3. These are described below:

- *Rule (68)*: If … modelling or other methods demonstrate that contaminants ... may be transported to a Type A intake … an area known as IPZ-3 shall be delineated;
- *Rule (69)*: the area delineated shall not exceed the area that may contribute water during or as a result of an extreme event;
- *Rule (130)*: An activity is or would be a significant drinking water threat in an IPZ if modelling demonstrates that a release of a chemical parameter or pathogen would be transported to the intake and result in deterioration of the water as a drinking water source;
- Guidance from the MOECC identified that *Rule (68)* prescribes that an IPZ-3 must be delineated if a spill may result in deterioration of the water supply; and
- The intent of *Rules (68)* and (*130)* was to identify the location and type of activity of concern and based on an understanding of that type of activity, contaminants of concern, and potential spill volume. This was referred to as an Events Based Approach which may be used to determine whether or not an IPZ-3 should be delineated.

Modelling Approach

The LOC developed a list of existing land use activities near and along the shoreline of Lake Ontario that were of concern if a spill from each location were to occur. The spill characteristics for each modelling scenario (volume, release mechanism, release rate, concentration, and other variables) were determined by the LOC modelling team with input from industry and municipal representatives.

Where concentrations predicted at an intake exceeded the threshold, the land use activity was identified as a significant threat and an IPZ-3 was delineated to identify the contaminant travel path to the intake.

If spill scenario modelling results indicate that a spill/release from an existing facility has the potential to impact a WTP (basically reach an intake) at a level that a WTP needs to shut down, then that facility is automatically identified as a significant drinking water threat activity. There is no limitation based on the time-of-travel within the event based modelling methodology.

A list of proposed spill scenario simulations for existing facilities was developed in concurrence with municipal partners, source protection committees, and MOECC. The following criteria were used:

- The location and possible materials released under normal operation and spill scenarios;
- Conditions under which contaminants could reach drinking water intakes;

- Predicted concentration of key parameters at the intakes; and
- Evaluation of historical raw water analyses at drinking water plants to assess whether there are observed elevations of parameters that may be linked to storm events or past spill or weather conditions.

Based on the criteria above, the following list of preliminary scenarios was modelled:

- Disinfection failure at each Lake Ontario WWTP to evaluate the potential effects to nearby WTPs;
- Release of *E. coli* from an industrial processing facility into the Credit River;
- Combined Sewer Overflow (CSO) release in the City of Toronto to evaluate the potential effects to the Toronto WTPs;
- Sanitary Trunk Sewer (STS) breaks within some Toronto area tributaries;
- Spill of gasoline/refined product from large pipelines located under major tributaries to Lake Ontario (e.g., Credit River, Humber River, etc.);
- Release of gasoline from a bulk petroleum fuel storage and handling facilities in the Keele/Finch area of Toronto and in the Mississauga – Oakville area; and
- Discharge of tritium from nuclear plants at Pickering or Darlington.

The identification of significant threats did not consider any regulated risk management requirements. Current risk management measures and the adequacy of existing regulatory requirements will be considered in the development of the source protection plan. Source protection plans are required to reduce or eliminate threats to drinking water.

The spill scenarios that were modelled for the Lake Ontario intakes are summarized in **Table 5.20**, below, and described in the text following the table. The selected LOC spill scenarios are based on "real" events that have occurred in the past and, as such, are not representative of extreme events. For example, the pipeline spill scenario events used for the LOC is based on the Enbridge pipeline rupture event that occurred near Kalamazoo, Michigan during the summer of 2010. Details regarding the spill scenario characteristics and how the model (MIKE-3) was calibrated and validated are provided in **Appendix E6**. MIKE-3 model uses the full three-dimensional representation of water motion. It simulates the seasonal temperature conditions and summer stratification that affects the circulations patterns in Lake Ontario, which is required for accurate predictions of water currents.

Table 5.21 presents all of the scenarios that were modelled for the CTC Source Protection Region while **Table 5.22** shows all of the modelled scenarios that result in significant drinking water threats to the TRSPA intakes, as well as spill scenarios located in TRSPA that result in significant drinking water threats in adjacent source protection areas. Further details are provided in **Appendix E6**.

Table 5.20: Lake Ontario Intake Model Spill Scenarios

Lake Ontario Intake Model Spill Scenario Details			Contaminant of Concern
Type	Location	Volume and Duration of Spill	
Disinfection Failure at WWTP	Mid-Halton WWTP SW-Halton WWTP SE-Halton WWTP Clarkson WWTP GE Booth (formerly Lakeview) WWTP Humber WWTP Ashbridges Bay WWTP1* Ashbridges Bay WWTP2* Highland Creek WWTP Duffins Creek WWTP Wellington WWTP Corbett Creek WWTP Harmony Creek WWTP Courtice WWTP Port Darlington WWTP	Disinfection failure at the plant, leading to a release of *E. coli* at a level of 5,000,000/100mL for a two-day period between April and August	*E. coli*
Sanitary Trunk Sewer (STS) Breaks	Sanitary trunk sewer breaks from pipes located within 120 meters or regulated limit of the main tributaries along the Toronto Waterfront (Etobicoke Creek, Humber River, Don River, Highland Creek) up to and including the location of the first lateral sewer connection upriver from the mouth	Actual density of *E. coli* (1,000,000 CU/100ml) measured downstream of the Aug. 19, 2005 event in Highland Creek was used to model impact. Simulated spills to each of the other tributaries assumed release of 50% of their design flow at an *E. coli* density of 5,000,000 CFU/100mL to each tributary, all simulated for 24 hour spill duration	*E. coli*
Combined Sewer Overflow Spill	Toronto Inner Harbour	Continuous simulation of actual conditions from April 1, 2007 to Oct 31, 2008.	*E. coli*
Lagoon Spill	Industrial Processing Facility on the Credit River	52,800 $m^{3,}$ with *E. coli* concentration at 5,000,000/100mL, 24 hour duration	*E. coli*
Petroleum (gasoline) Pipeline Break	16 Mile Creek Joshua Creek Credit River Etobicoke Creek Humber River Don River Highland Creek Rouge River Petticoat Creek Duffins Creek Carruthers Creek Lynde Creek Oshawa Creek Bowmanville Creek Wilmot Creek Graham Creek	2,700 m^3 of fuel, 6 hour duration	Benzene

Lake Ontario Intake Model Spill Scenario Details			Contaminant of Concern
Type	Location	Volume and Duration of Spill	
	Ganaraska River		
	Cobourg Creek		
Bulk Petroleum (gasoline) Release	Bulk petroleum storage and handling facilities in Oakville and North York	260,000 litre benzene spill under easterly and westerly wind conditions, 6 hour duration Three, 15-minute spills, volume ranging from 200 to 1000 litres of benzene under a variety of meteorological conditions	Benzene
Tritium Release	Pickering Nuclear Facility	2900 kg of tritiated water discharged over a period of 6 hours at a concentration of 7.9 $x10^{11}$ Bq/L (e.g., the estimated total amount of tritium activity released was $2.3x10^{15}$ Bq)	Tritium
Tritium Release	Darlington Nuclear Facility	2900 kg of tritiated water discharged over a period of 6 hours at a concentration of 7.9 $x10^{11}$ Bq/L (e.g., the estimated total amount of tritium activity released was $2.3x10^{15}$ Bq)	Tritium

* New outfall modelled to select intakes only (from Toronto Background Brief 2022)

Wastewater Treatment Plant Disinfection Failure

Modelling scenarios were undertaken to determine if disinfection failures at wastewater treatment plants would cause deterioration of the quality of raw water for drinking water purposes for the TRSPA WTPs. The modelled parameter of concern for these scenarios was *E. coli* and the recreational standard for *E. coli* of 100 CFU/100 ml was used as the threshold to assess deterioration of the quality of water. Normally the measured *E.* coli levels in the raw water in the vicinity of these intakes is less than 1 CFU/100 ml. The simulation date for this modelling was April 25 to August 31, 2008, using wind data from the Pearson Airport. Note that these conditions were not extreme event conditions, but daily conditions that occurred within the simulation period window. Each WWTP was simulated at the Certificate of Approval flow rate, and *E. coli* levels within the discharge were set constant at 5,000,000 CFU/100 ml. The decay of *E. coli* was taken into consideration for the modelling. The Lake Ontario version of MIKE-3 was used to model the contaminant pathway within Lake Ontario and determine the concentrations of the contaminant at the intakes.

The City is undertaking a major infrastructure upgrade to create a new Ashbridges Bay outfall with increased capacity and greater diffusion capability further from the lakeshore (note that the current intake will be maintained for emergency use). The existing outfall was assessed as not being a significant drinking water threat through the initial Lake Ontario lake-wide modelling work for the 2015 Assessment Report; updated modelling was required for the new Island intake, and existing and new ABTP outfall, as described below. A focused lake modelling was conducted for this new ABTP outfall and the City of Toronto Island Water Treatment Plant potable water intakes. Because the focused modelling study results indicate that E.Coli densities from the new ABTP outfall for the Island Intakes are similar to those for the existing ABTP outfall, no changes are required at other Lake Ontario intakes. This modelling has demonstrated that both the new and existing Ashbridges Bay outfalls are a significant drinking water threat to New Intake #4.

Sanitary Trunk Sewer Breaks

A series of scenarios were modelled to determine if simultaneous trunk sewer breaks near Lake Ontario across the Toronto shoreline would cause deterioration of the quality of water at the TRSPA intakes. Although there are trunk sewers near Lake Ontario in other municipalities within the CTC that may be threats, these have not been assessed to date.

Four trunk sewer break locations were modelled during this exercise. The sewer breaks were considered to occur where the trunk sewer was located within the tributary valley out to the greater of the regulated limit or 120 metres of the top of bank and between the WWTP up river to the first lateral connection to the trunk sewer. Within this area, the maximum amount of waste water would be present in the pipe and the time of travel to the lake would be less than two hours. Trunk sewer flow was estimated at about 50% of the design flow of each WWTP.

The Highland Creek sewer break was modelled based on measurements taken during an actual event (August 2005). Water quality was sampled downstream of the actual break, where mixing with Highland Creek itself had already diluted the sewage effluent. In the other three cases the breaks in the other streams (Etobicoke Creek, Humber River and Don River) were modelled by adding sewer flows to the tributary flows at the river mouths to account for dilution that would occur before the sewage reached Lake Ontario. The simulation assumed the ambient level of *E. coli* was 1000 CFU/100 ml in each tributary. During the trunk sewer break in Highland Creek, the measured level downstream was 1,000,000 CFU/100mL. In the other cases it was assumed that the level of *E. coli* in the raw, undiluted sewage was 5,000,000 CFU/100 ml prior to dilution with the tributary. This level is consistent with regularly observed levels in raw sewage. The ambient lake conditions were assumed to have zero CFU and first order decay of *E. coli* was applied. The first order decay means that the bacterial population (*E. coli* in this case), is estimated to reduce at a constant rate over time. The time is the modelled travel time to the intake.

Combined Sewer Overflow Spill

A number of combined sewers flow into the Toronto Inner Harbour. The modelling for this scenario comprised a continuous simulation of actual conditions between April 1, 2007 to October 31, 2008. The 2007 data were used to calibrate the model and the 2008 data were used to assess the impacts to the drinking water intakes.

Lagoon Spill

A lagoon spill from an industrial processing facility on the Credit River was modelled to determine the effects of a release of 52,800$m^{3,}$ of water containing *E. coli* at a concentration at 5,000,000/100mL over a 24 hour period.

Petroleum Pipeline Breaks

Modelling scenarios were undertaken to determine if gasoline containing benzene spilled from an oil pipeline rupture as it crosses the Credit River, Humber River, Don River, Highland Creek, Rouge River or Duffins Creek would reach any of the TRSPA intakes and cause deterioration of the quality of raw water. The modelled parameter of concern for these scenarios was benzene and the raw water quality threshold used for assessing the threat from benzene was the ODWS (0.005 mg/l).

The pipeline flow was based on the daily average flow rate of 0.125 cubic metres of fuel per second (m^3/s), with a spill duration of 6-hours. Therefore the spill volume was 2,700 m^3 of fuel (at 1% benzene, for a benzene volume of 27 m^3). The pipeline flow was mixed with the river flow and it was assumed that the benzene in the gasoline would fully mix in the river water. The temperature in the tributaries was set at 20˚C, as was the gasoline temperature in the pipeline. The daily flow volumes in the rivers were obtained from the Canada Water Survey database, and the flow rates in the rivers were simulated by conservation authority staff using in-house HEC-RAS models. Similar to the modelling scenarios described above, the MIKE-3 model was used to simulate the contaminant pathway within Lake Ontario and the concentrations at the intakes.

As shown in **Table 5.20**, petroleum pipeline break scenarios were not previously simulated for Joshua and Etobicoke Creeks in the Assessment ~~Report, but~~Report but were identified as significant drinking water threats because they are located between two other tributaries where significant threats were simulated and identified.

In 2013, the CTC Source Protection Region had the consultant run the simulation for these creeks using the same models, but less conservative assumptions applied to the petroleum pipeline break scenarios previously executed. Despite these assumptions, the modelled spill of the pipeline still resulted in a Significant Drinking Water Threat.

In 2019, in response to increased demand for lake-water cooling of downtown office towers, a private entity, ENWAVE, is retrofitting one of the former shallow intakes for the Toronto Island Water Treatment Plant. The addition of IPZ 1 and 2 for the new fourth intake, and the deletion of the existing IPZ 1,2, and 3 for the east shallow intake will be incorporated into the new intake. The City of Toronto had a consultant undertake focused modelling that incorporated technical results form IPZ evaluations related to the new fourth intake and for an anticipated new future location of the Ashbridges Bay Treatment Plant outfall that would affect all intakes. The modelling indicated that the new and existing Ashbridges Bay outfalls are a significant drinking water threat to the New Intake #4.

The modelled concentrations of benzene at the shallow Toronto Island intakes from a pipeline spill to the Humber River was 1 mg/L, and to the Don R was 0.4 mg/L. The modelled concentrations of benzene at the deep Toronto Island intakes from a pipeline spill to the Humber River was 0.01 mg/L, and to the Don R was 0.01 mg/L. As the new Toronto Island intake is physically located at an intermediate distance and depth between the shallow and deep intakes, a petroleum pipeline spill to either the Don River or the Humber River is also a significant threat to the new Island intake.

Construction of the new outfall has been initiated, with an anticipated completion date of late 2024 / early 2025.

Bulk Petroleum Storage and Handling Spills

Two modelling scenarios were undertaken to determine if the release of gasoline containing benzene from bulk petroleum storage and handling facilities in Oakville and North York would reach water treatment plant intakes and cause deterioration of the quality of raw water. The first scenario was based on the release of 26 million litres (volume of a large fuel storage tank) of gasoline containing 1% benzene over a period of 6 hours. The resulting release was the equivalent to 260,000 litres of benzene.

The second scenario simulated three small (mini tank) spills of 15 minute duration from a ship unloading at the Oakville pier. These spills of 20,000, 50,000, and 100,000 litres of gasoline are estimated to contain 200, 500, and 1,000 litres of benzene.

The spill scenarios were simulated using the Lake Ontario version of MIKE-3 using easterly and westerly wind events as described above. The modelled parameter of concern for these scenarios was benzene and the raw water quality threshold for benzene is 0.005 mg/l - the Ontario Drinking Water Standard (ODWS). The simulation period for the modelling was between April 15 and July 7, 2006. The wind direction and velocity data were obtained from various sources, including Pearson Airport. These represent daily conditions (i.e., not extreme events) that occurred within the chosen simulation period.

Tritium Release

Model scenarios were undertaken to determine if the release of tritium in water from the Pickering or Darlington nuclear power plants would cause deterioration to the quality of raw water for the intakes located in Lake Ontario. The modeled parameter of concern was tritium and the threshold used was the ODWS for tritium (7000 Bq/L). The model also simulated a threshold of 20 Bq/L.

The value of 20 Bq/L has been recommended by the Minister of the Environment and Climate Change's Ontario Drinking Water Advisory Council as a revised drinking water standard based on a running annual average.

The scenario was based on a 1992 spill event when heavy water leaked into the cooling water stream. This resulted in the release of 2,900 kg of tritiated water at concentration of 7.9 x 10^{11} Bq/L. The modelled duration of the spill event was 6-hours, as if it were released May 17, 2006 during a period of easterly currents. This was not an extreme weather period. Similar to the modelling scenarios described above, the MIKE-3 model was used to simulate the contaminant pathway within Lake Ontario and the concentrations at the intakes.

Modelling Results

The modelling runs produced concentration plumes that cover the areas where the contaminant travels during the time period based on weather conditions used in the model run. The extent of the contaminant plume is based on the hydrodynamic conditions in the lake. The model runs identified the extent of the area where contamination is above the threshold level. This area encompasses not only the area to the intake but also beyond. In some cases, the area is quite extensive. Contaminant plumes may also move to and past an intake and then back again, especially where the contaminant concentration persists above the threshold for up to several weeks. The currents in the near shore area in the lake are complex and not one-directional. Further details regarding these points are included in **Appendix E6**.

The Lake Ontario modelling identified 19 locations of significant drinking water quality threats for Lake Ontario intakes within the TRSPA. The Source Protection Plan for CTC SPR must have policies to address the significant drinking water threat activities that are located within the source protection area (SPA).

In addition, TRSPA has identified significant drinking water threat activities located outside of the TRSPA. These activities, although not enumerated in this Assessment Report, affect water treatment plants located in TRSPA, and must be addressed through source protection plan policies developed in adjacent source protection areas. TRSPA staff has brought this information to the attention of the source protection staff of the neighbouring source protection areas to ensure that policies are developed for them.

The modelling results for the event-based modelling are summarized below. **Table 5.2119** outlines the results where the model scenarios predict that an activity will be a significant drinking water threat, including:

- Threats located within the TRSPA that are a significant threat to intakes located within the TRSPA (nineteen unique threats to five intakes); and
- Threats located outside of the TRSPA that are a significant threat to intakes located within the TRSPA (fifteen unique threats to five intakes).

Table 5.2119 shows all of the modelled spills scenarios that result in significant drinking water threats to the TRSPA intakes, as well as spill scenarios located in TRSPA that result in significant drinking water threats in adjacent Source Protection Areas.

Table 5.21: Modelling Results of Significant Drinking Water Threats to Lake Ontario Intakes

SPR/SPA	Intake Affected	Spill Scenario	Activity Location	Parameter of Concern	Water Quality Threshold	Concentration at the Intake (benzene - mg/L; *E. coli* - CFU/100mL)	Significant Threat
Halton-Hamilton/ Halton SPA	Oakville	Ashbridges Bay WWTP disinfection failure	IPZ-3 TRSPA	*E. coli*	100 CFU/ 100 mL	108	Yes
		Etobicoke Creek STS break				144	Yes
CTC/ CVSPA	Lorne Park	Humber River WWTP disinfection failure	IPZ-3 TRSPA	*E. coli*	100 CFU/ 100 mL	734	Yes
		Ashbridges Bay WWTP disinfection failure				756	Yes
		Etobicoke Creek STS break				367	Yes
		North York Petroleum Storage Spill via Humber River	IPZ-3 TRSPA	Benzene	0.005 mg/L	0.078	Yes
		Etobicoke Creek pipeline break				*	Yes
		Humber River pipeline break				0.15	Yes
		Don River pipeline break				0.014	Yes
		Highland Creek pipeline break				0.01	Yes
		Rouge River pipeline break				0.008	Yes
		Duffins Creek pipeline break				0.009	Yes
	Arthur P. Kennedy (formerly Lakeview)	Humber River WWTP disinfection failure	IPZ-3 TRSPA	*E. coli*	100 CFU/ 100 mL	2,906	Yes
		Ashbridges Bay WWTP disinfection failure				780	Yes
		Etobicoke Creek STS break				183	Yes
		Humber River STS break				109	Yes
		Etobicoke Creek pipeline break	IPZ-3 TRSPA	Benzene	0.005 mg/L	*	Yes
		Humber River pipeline break				0.30	Yes

SPR/SPA	Intake Affected	Spill Scenario	Activity Location	Parameter of Concern	Water Quality Threshold	Concentration at the Intake (benzene - mg/L; *E. coli* - CFU/100mL)	Significant Threat
CTC/ CVSPA	Arthur P. Kennedy (formerly Lakeview)	Don River pipeline break	IPZ-3 TRSPA	Benzene	0.005 mg/L	0.023	Yes
		Highland Creek pipeline break				0.12	Yes
		Rouge River pipeline break				0.009	Yes
		Duffins Creek pipeline break				0.011	Yes
		North York Petroleum Storage Spill via Humber River				0.32	Yes
CTC/ TRSPA	R.L. Clark	Clarkson WWTP disinfection failure	IPZ-3 CVSPA	*E. coli*	100 CFU/ 100 mL	1400	Yes
		GE Booth WWTP disinfection failure	IPZ-3 CVSPA			55600	Yes
		Humber River WWTP disinfection failure	IPZ-3 TRSPA			11688	Yes
		Ashbridges Bay WWTP disinfection failure	IPZ-3 TRSPA			2671	Yes
		Etobicoke Creek STS break	IPZ-3 TRSPA			1013	Yes
		Humber River STS break	IPZ-3 TRSPA			343	Yes
		16 Mile Creek pipeline break	IPZ-3 HHSPA	Benzene	0.005 mg/L	0.19	
		Credit River pipeline break	IPZ-3 CVSPA			0.15	Yes
		Etobicoke Creek pipeline break	IPZ-3 TRSPA			*	Yes
		Humber River pipeline break				0.79	Yes
		Don River pipeline break				0.035	Yes
		Highland Creek pipeline break				0.013	Yes
		Rouge River pipeline break				0.01	Yes
		Duffins Creek pipeline break				0.011	Yes
		Bulk storage spill, Oakville facility				0.014	Yes

SPR/SPA	Intake Affected	Spill Scenario	Activity Location	Parameter of Concern	Water Quality Threshold	Concentration at the Intake (benzene - mg/L; *E. coli* - CFU/100mL)	Significant Threat
CTC/ TRSPA (Cont'd)	R.L. Clark (cont'd)	North York Petroleum Storage Spill via Humber River	IPZ-3 TRSPA	Benzene	0.005 mg/L	0.55	Yes
	Toronto Island (Shallow)	Ashbridges Bay WWTP1 disinfection failure	IPZ-3 TRSPA	*E. coli*	100 CFU/ 100 mL	775	Yes
		16 Mile Creek pipeline break	IPZ-3 CVSPA	Benzene	0.005 mg/L	0.008	Yes
		Humber River pipeline break	IPZ-3 TRSPA			0.40	Yes
		Don River Pipeline break				1.0	Yes
		Highland Creek pipeline break				0.015	Yes
		Rouge River pipeline break				0.014	Yes
		Duffins Creek pipeline break				0.015	Yes
	Toronto Island (Deep)	Ashbridges Bay WWTP1 disinfection failure	IPZ-3 TRSPA	IPZ-3 TRSPA	100 CFU/ 100 mL	211	Yes
		Ashbridges Bay WWTP2 disinfection failure	IPZ-3 TRSPA	IPZ-3 TRSPA	100 CFU/ 100 mL	234	Yes
		Humber River pipeline break	IPZ-3 TRSPA	Benzene	0.005 mg/L	0.01	Yes

SPR/SPA	Intake Affected	Spill Scenario	Activity Location	Parameter of Concern	Water Quality Threshold	Concentration at the Intake (benzene - mg/L; *E. coli* - CFU/100mL)	Significant Threat
		Don River Pipeline break				0.01	Yes
		North York Petroleum Storage Spill via Humber River				0.015	Yes
		North York Petroleum Storage Spill via Don River				0.009	Yes
	R.C. Harris	GE Booth WWTP disinfection failure	IPZ-3 CVSPA	*E. coli*	100 CFU/ 100 mL	110	Yes
		Humber River WWTP disinfection failure	IPZ-3 TRSPA			216	Yes
		Highland Creek WWTP disinfection failure				1, 308	Yes
		Ashbridges Bay WWTP1 disinfection failure				4,911	Yes
		Ashbridges Bay WWTP2 disinfection failure				35,601	Yes
		Duffins Creek WWTP disinfection failure				450	Yes
		Don River STS break				127	Yes
CTC/ TRSPA (Cont'd)	R.C. Harris (Cont'd)	16 Mile Creek pipeline break	IPZ-3 HHSPA	Benzene	0.005 mg/L	0.005	Yes
		Humber River pipeline break	IPZ-3 TRSPA			0.101	Yes
		Don River pipeline break				0.31	Yes
		Highland Creek pipeline break				0.088	Yes
		Rouge River pipeline break				0.045	Yes
		Duffins Creek pipeline break				0.047	Yes

SPR/SPA	Intake Affected	Spill Scenario	Activity Location	Parameter of Concern	Water Quality Threshold	Concentration at the Intake (benzene - mg/L; *E. coli* - CFU/100mL)	Significant Threat
		North York Petroleum Storage Spill via Humber River				0.0055	Yes
		North York Petroleum Storage Spill via Don River				0.059	Yes
	F.J. Horgan	Humber River WWTP disinfection failure	IPZ-3 TRSPA	*E. coli*	100 CFU/ 100 mL	100	Yes
		Highland Creek WWTP disinfection failure	IPZ-3 TRSPA			10,471	Yes
		Ashbridges Bay WWTP disinfection failure	IPZ-3 TRSPA			1,373	Yes
		Duffins Creek WWTP disinfection failure	IPZ-3 TRSPA			2,470	Yes
		Highland Creek STS Break	IPZ-3 TRSPA			288	Yes
		16 Mile pipeline break	IPZ-3 HHSPA	Benzene	0.005 mg/L	0.005	Yes
		Humber River pipeline break	IPZ-3 TRSPA			0.065	Yes
		Don River Pipeline Break	IPZ-3 TRSPA			0.25	Yes
		Highland Creek pipeline break	IPZ-3 TRSPA			0.29	Yes
		Rouge River pipeline break	IPZ-3 TRSPA			0.27	Yes
		Duffins Creek pipeline break	IPZ-3 TRSPA			0.075	Yes
		North York Petroleum Storage Spill via Don River	IPZ-3 TRSPA			0.038	Yes
CTC/ TRSPA (Cont'd)	Ajax	Highland Creek WWTP disinfection failure	IPZ-3 TRSPA	*E. coli*	100 CFU/ 100 mL	1225	Yes
		Ashbridges Bay WWTP disinfection failure	IPZ-3 TRSPA			423	Yes
		Duffins WWTP disinfection failure	IPZ-3 TRSPA			7,320	Yes

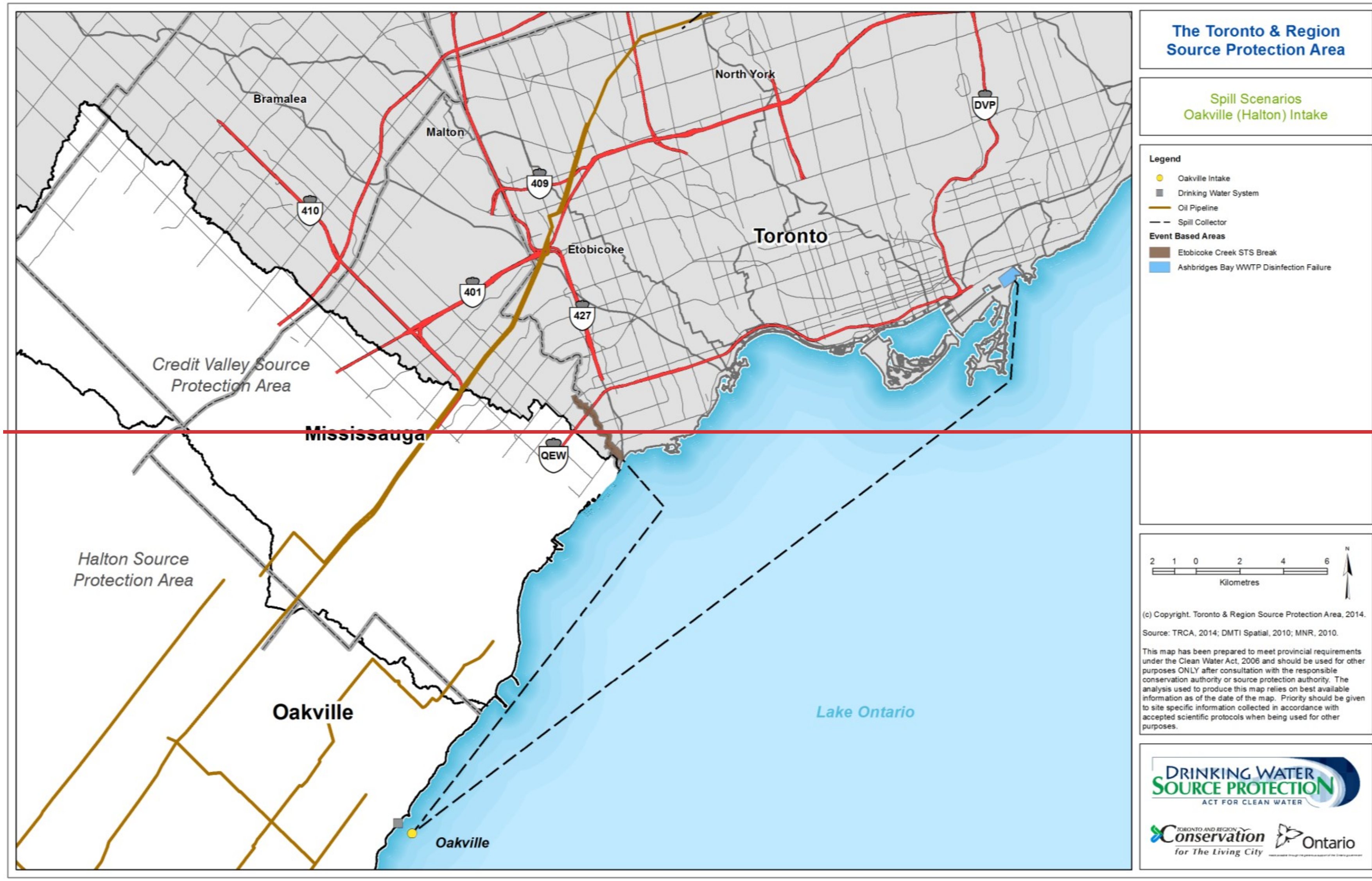
SPR/SPA	Intake Affected	Spill Scenario	Activity Location	Parameter of Concern	Water Quality Threshold	Concentration at the Intake (benzene - mg/L; *E. coli* - CFU/100mL)	Significant Threat
		Corbett Creek WWTP disinfection failure	IPZ-3 CLOSPA			479	Yes
		Harmony Creek WWTP disinfection failure	IPZ-3 CLOSPA			210	Yes
		Courtice WWTP disinfection failure	IPZ-3 CLOSPA			353	Yes
		Don River Pipeline Break	IPZ-3 TRSPA	Benzene	0.005 mg/L	0.01	Yes
		Highland Creek pipeline break	IPZ-3 TRSPA			0.01	Yes
		Rouge River pipeline break	IPZ-3 TRSPA			0.011	Yes
		Petticoat Creek pipeline break	IPZ-3 TRSPA			*	Yes
		Duffins Creek pipeline break	IPZ-3 TRSPA			0.061	Yes
		Carruthers Creek pipeline break	IPZ-3 TRSPA			*	Yes
		Lynde Creek pipeline break	IPZ-3 CLOSPA			*	Yes
		Oshawa Creek pipeline break	IPZ-3 CLOSPA			0.14	Yes

SPR/SPA	Intake Affected	Spill Scenario	Activity Location	Parameter of Concern	Water Quality Threshold	Concentration at the Intake (benzene - mg/L; *E. coli* - CFU/100mL)	Significant Threat
CTC/ CLOSPA	Whitby	Highland Creek WWTP disinfection failure	IPZ-3 TRSPA	*E. coli*	100 CFU/ 100 mL	1064	Yes
		Ashbridges Bay WWTP disinfection failure	IPZ-3 TRSPA			422	Yes
		Duffins Creek WWTP disinfection failure	IPZ-3 TRSPA			6480	Yes
		Highland Creek pipeline break	IPZ-3 TRSPA	Benzene	0.005 mg/L	0.008	Yes
		Rouge River pipeline break				0.006	Yes
		Petticoat Creek pipeline break				*	Yes
		Duffins Creek pipeline break				0.011	Yes
		Carruthers Creek pipeline break				*	Yes
		Pickering Nuclear wastewater release	IPZ-3 TRSPA	Tritium	7000 Bq/L	12,000 Bq/L	Yes
	Oshawa	Pickering Nuclear wastewater release	IPZ-3 TRSPA	Tritium	7000 Bq/L	20,000 Bq/L	Yes

Note:

* Due to time constraints, the in-lake portion of this scenario was not run. However, this tributary lies between two other modelled tributaries which had significant threats from the same activity

The following maps highlight the location of the threat activities, with a "connector" line that highlights the shortest path to the affected intake. Note that the paths shown are not representative of any particular date or current direction. Each scenario is shown in a different colour to best represent the variety and extent of the potential threats. See **Figure 5.36** through **Figure 5.45** for the spills scenarios where there are threat activities located within TRSPA or municipal intakes located in TRSPA are affected by threat activities located within other source protection areas.


The Toronto & Region Source Protection Area
Spill Scenarios
Oakville (Halton) Intake
Legend
Oakville Intake
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
Etobicoke Creek STS Break
Ashbridges Bay WWTP Disinfection Failure
Kilometres
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Bramalea
Malton
North York
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Etobicoke
Credit Valley Source Protection Area
Mississauga
Halton Source Protection Area
Oakville
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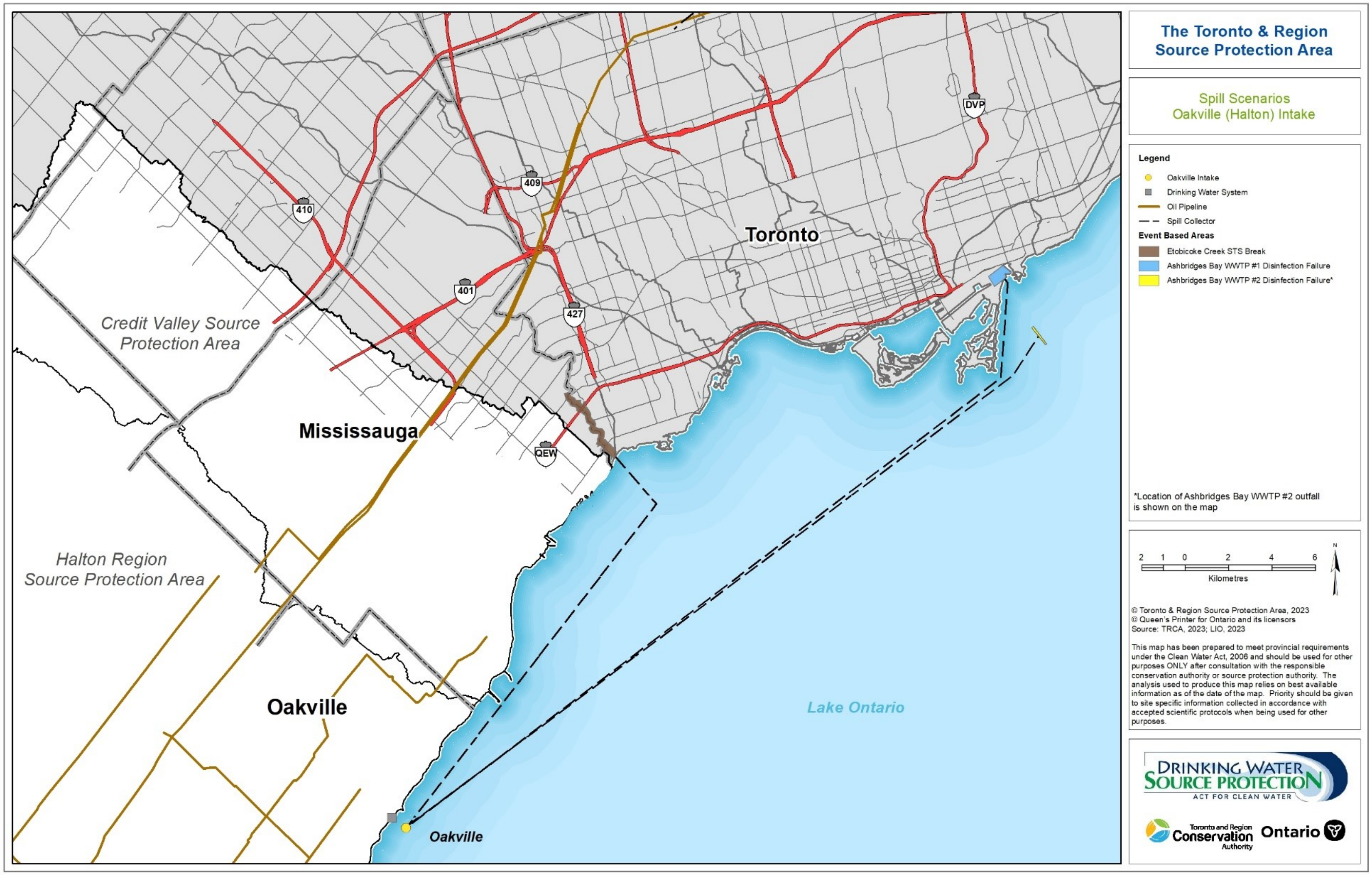
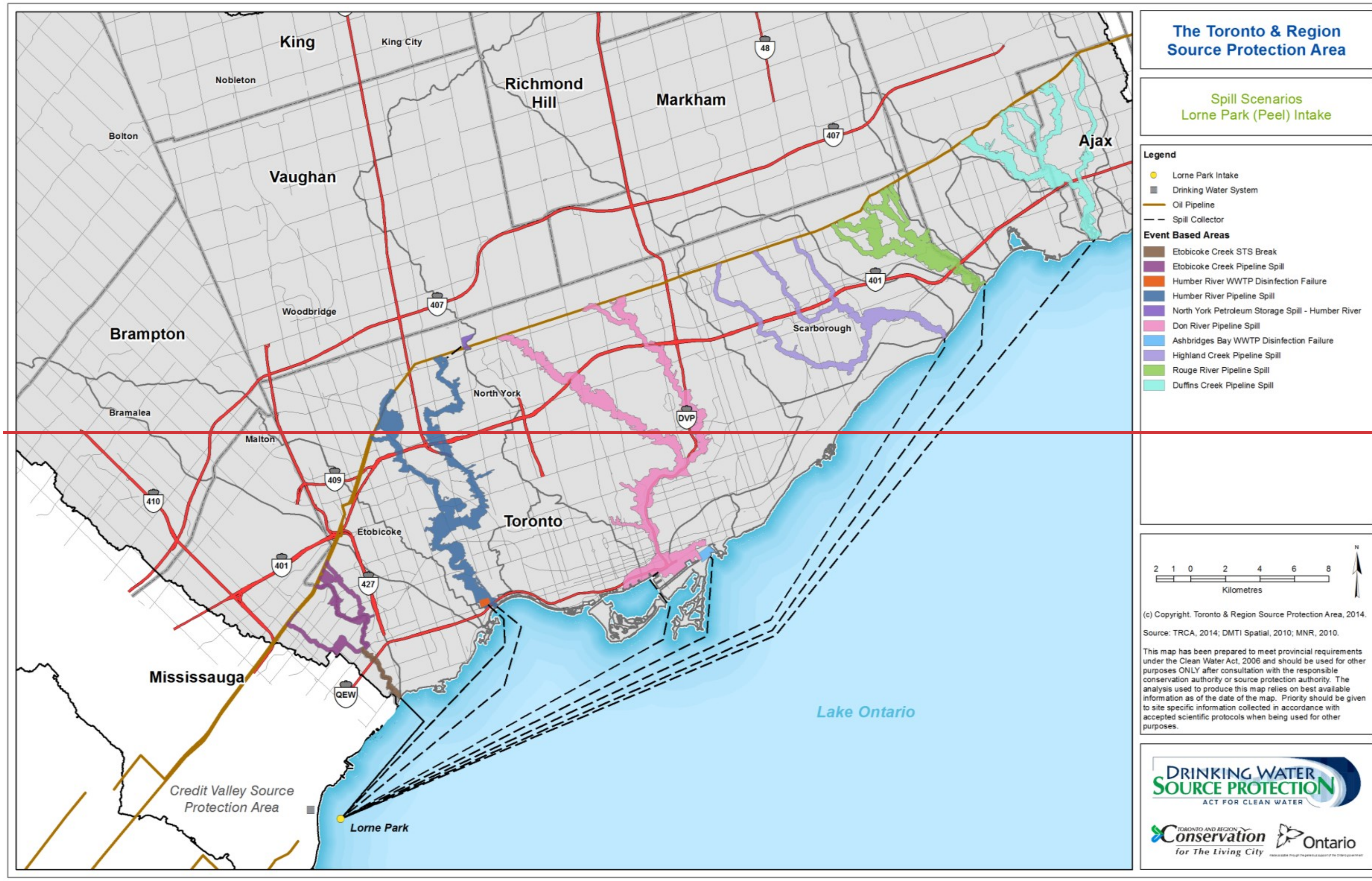


Figure 5.36: Spill Scenarios - Oakville (Halton) Intake


The Toronto & Region Source Protection Area
Spill Scenarios
Lorne Park (Peel) Intake
Legend
Lorne Park Intake
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
Etobicoke Creek STS Break
Etobicoke Creek Pipeline Spill
Humber River WWTP Disinfection Failure
Humber River Pipeline Spill
North York Petroleum Storage Spill - Humber River
Don River Pipeline Spill
Ashbridges Bay WWTP Disinfection Failure
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Duffins Creek Pipeline Spill
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North York
Scarborough
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Malton
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Toronto
Mississauga
Lake Ontario
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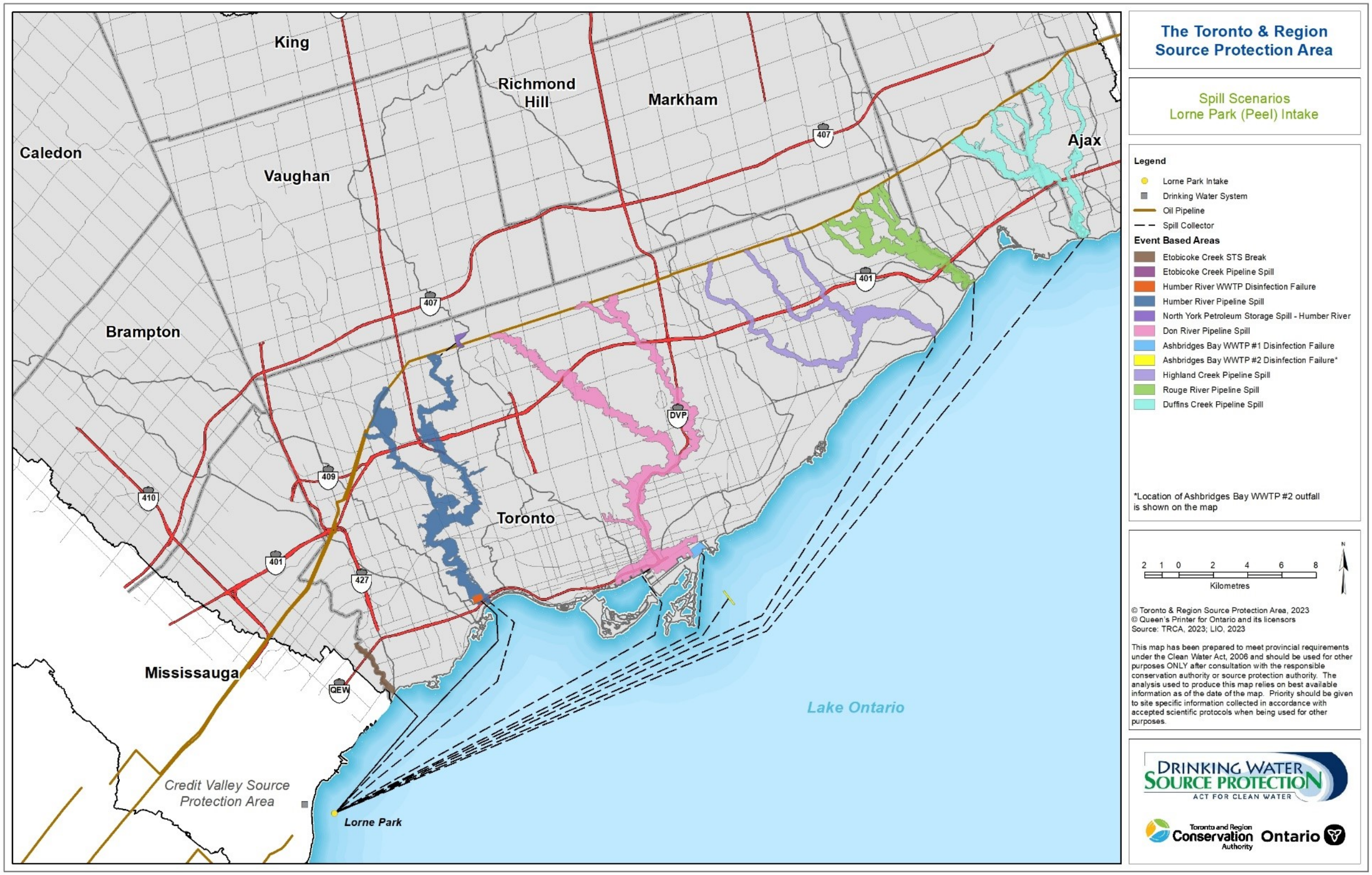
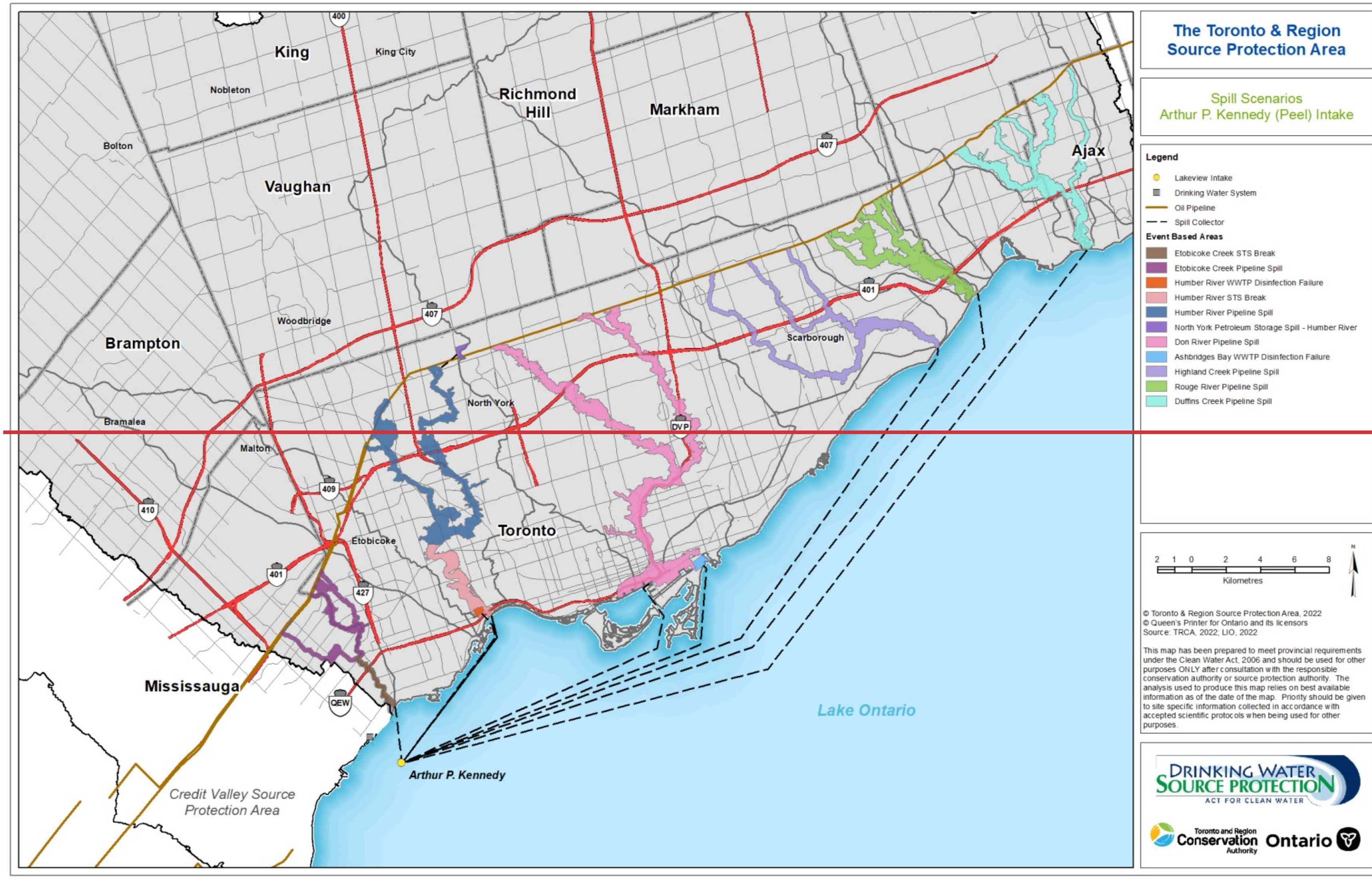


Figure 5.37: Spill Scenarios - Lorne Park (Peel) Intake


The Toronto & Region Source Protection Area
Spill Scenarios
Arthur P. Kennedy (Peel) Intake
Legend
Lakeview Intake
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
Etobicoke Creek STS Break
Etobicoke Creek Pipeline Spill
Humber River WWTP Disinfection Failure
Humber River STS Break
Humber River Pipeline Spill
North York Petroleum Storage Spill - Humber River
Don River Pipeline Spill
Ashbridges Bay WWTP Disinfection Failure
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Duffins Creek Pipeline Spill
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Scarborough
Etobicoke
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Lake Ontario
Arthur P. Kennedy
Credit Valley Source Protection Area
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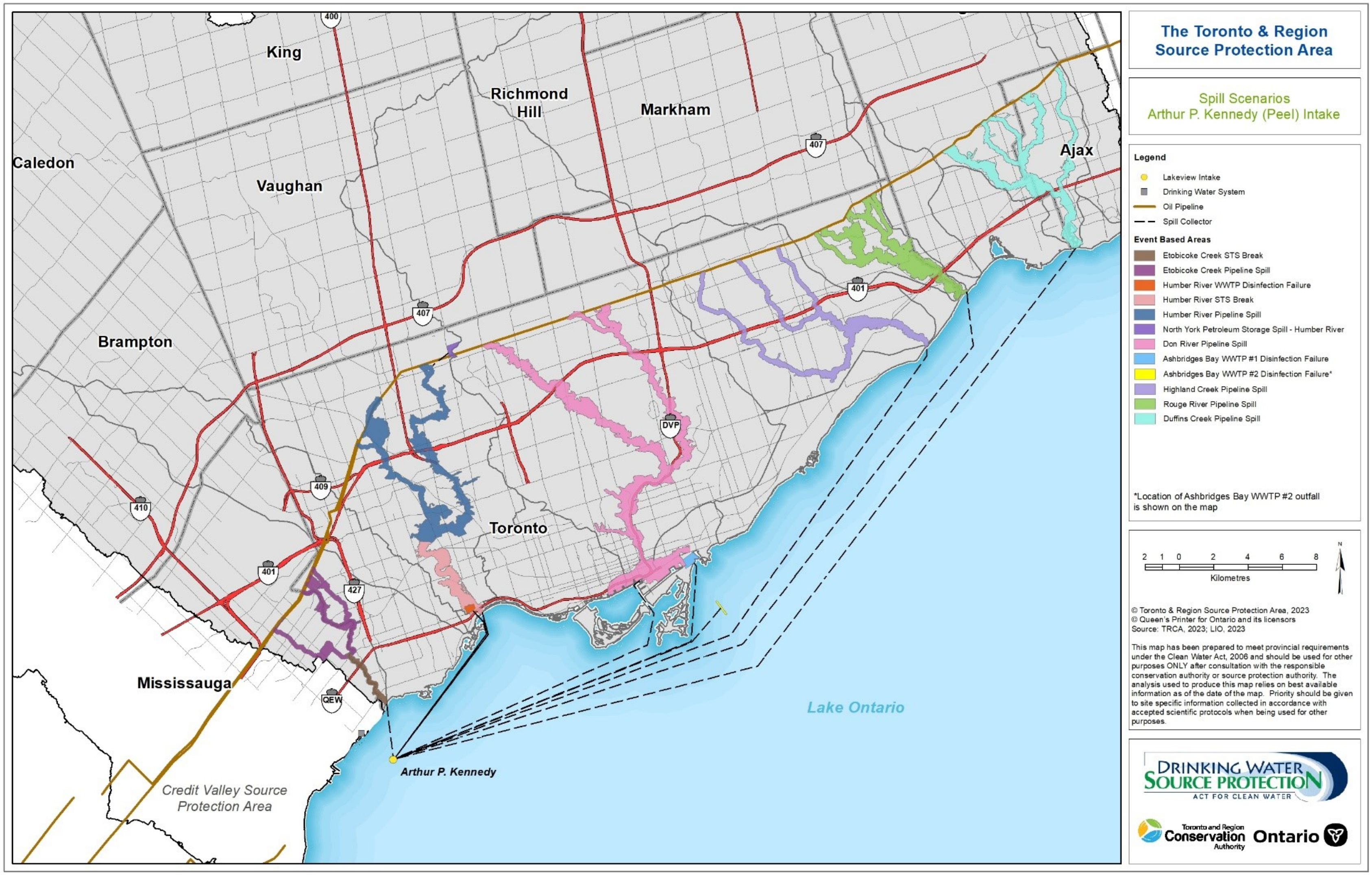
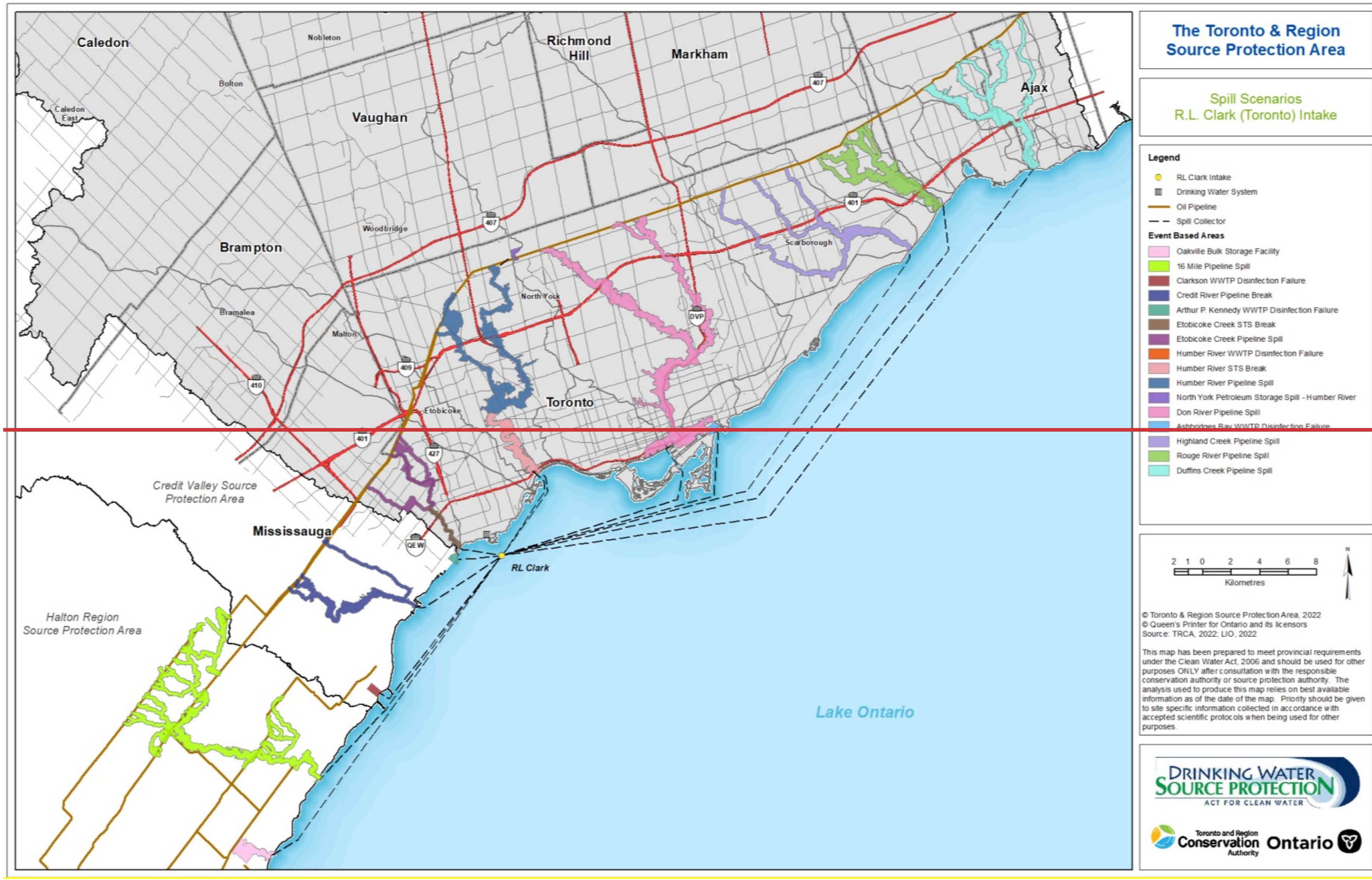


Figure 5.38: Spill Scenarios - Arthur P. Kennedy (Peel) Intake


The Toronto & Region Source Protection Area
Spill Scenarios
R.L. Clark (Toronto) Intake
Legend
RL Clark Intake
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
Oakville Bulk Storage Facility
16 Mile Pipeline Spill
Clarkson WWTP Disinfection Failure
Credit River Pipeline Break
Arthur P. Kennedy WWTP Disinfection Failure
Etobicoke Creek STS Break
Etobicoke Creek Pipeline Spill
Humber River WWTP Disinfection Failure
Humber River STS Break
Humber River Pipeline Spill
North York Petroleum Storage Spill - Humber River
Don River Pipeline Spill
Ashbridges Bay WWTP Disinfection Failure
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Duffins Creek Pipeline Spill
2 1 0 2 4 6 8
Kilometres
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Caledon
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Brampton
Bramalea
Malton
North York
Scarborough
Toronto
Etobicoke
Credit Valley Source Protection Area
Mississauga
Halton Region Source Protection Area
RL Clark
Lake Ontario
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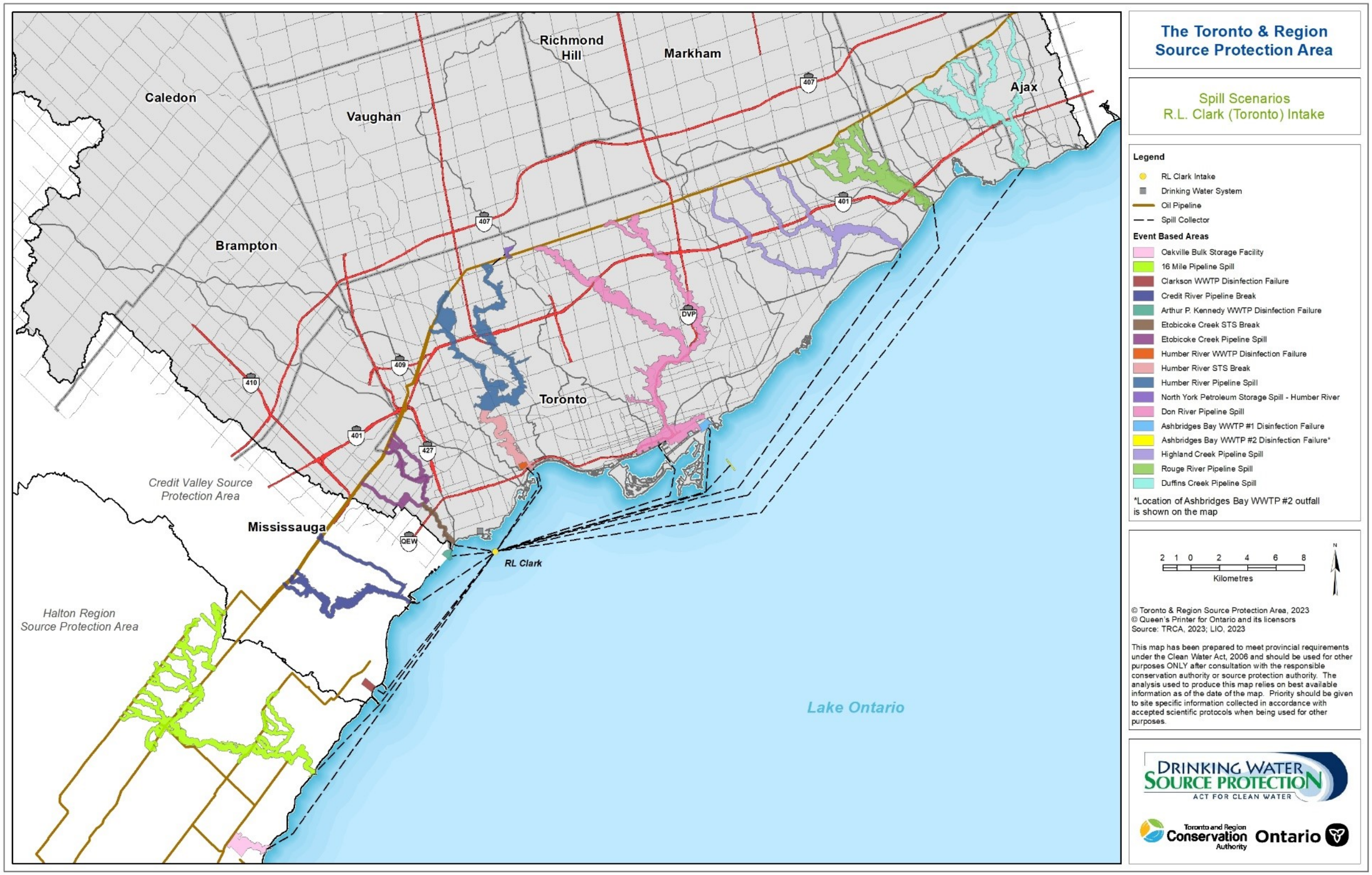
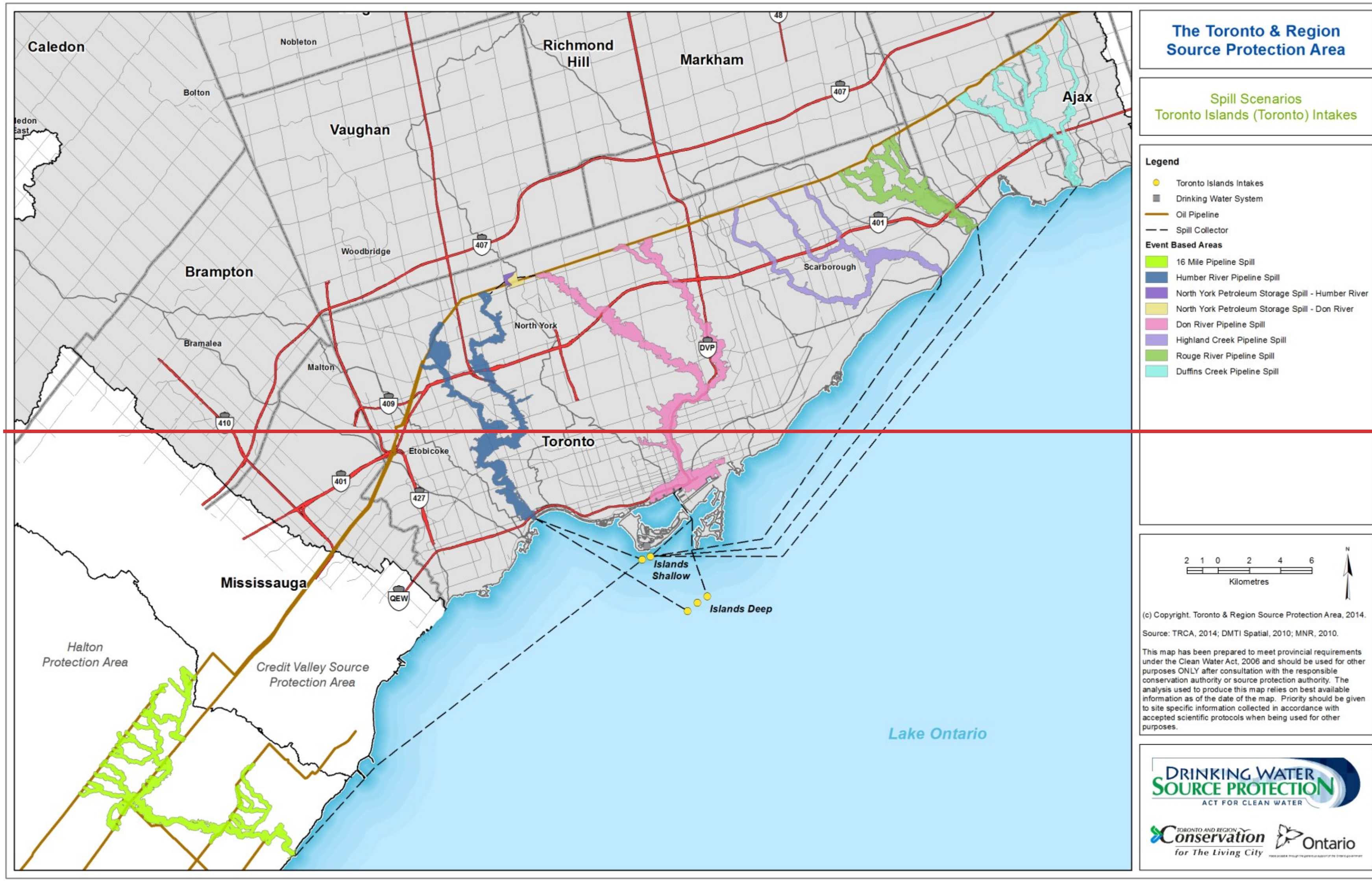


Figure 5.39: Spill Scenarios – R. L. Clark (Toronto) Intake


The Toronto & Region Source Protection Area
Spill Scenarios
Toronto Islands (Toronto) Intakes
Legend
Toronto Islands Intakes
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
16 Mile Pipeline Spill
Humber River Pipeline Spill
North York Petroleum Storage Spill - Humber River
North York Petroleum Storage Spill - Don River
Don River Pipeline Spill
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Duffins Creek Pipeline Spill
Kilometres
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DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation for The Living City
Ontario
Caledon
Nobleton
Richmond Hill
Markham
Bolton
Vaughan
Ajax
Woodbridge
Brampton
Scarborough
North York
Bramalea
Malton
Toronto
Etobicoke
Mississauga
Islands Shallow
Islands Deep
Halton Protection Area
Credit Valley Source Protection Area
Lake Ontario

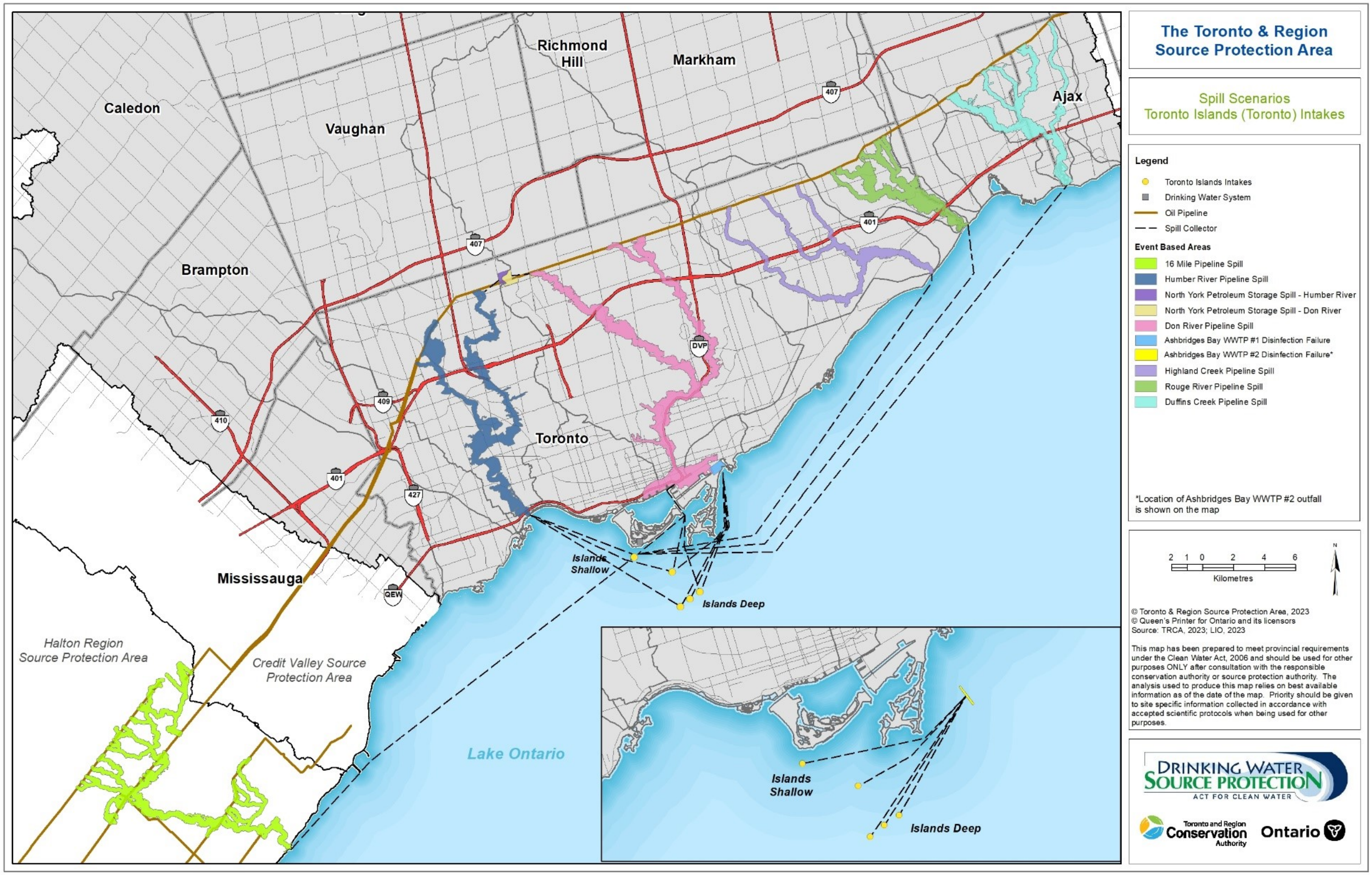
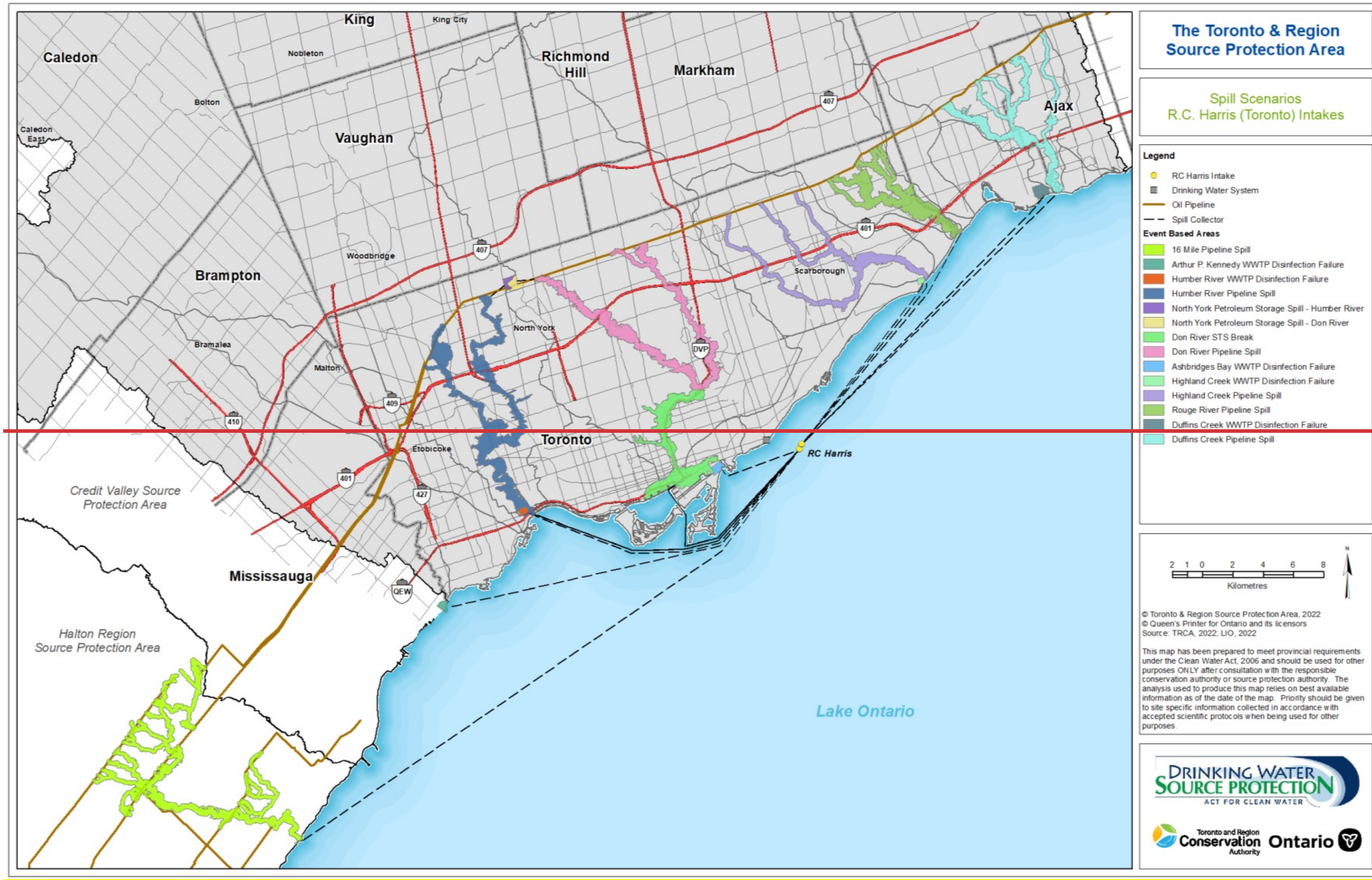


Figure 5.40: Spill Scenarios - Toronto Island (Toronto) Intakes


The Toronto & Region Source Protection Area
Spill Scenarios
R.C. Harris (Toronto) Intakes
Legend
RC Harris Intake
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
16 Mile Pipeline Spill
Arthur P. Kennedy WWTP Disinfection Failure
Humber River WWTP Disinfection Failure
Humber River Pipeline Spill
North York Petroleum Storage Spill - Humber River
North York Petroleum Storage Spill - Don River
Don River STS Break
Don River Pipeline Spill
Ashbridges Bay WWTP Disinfection Failure
Highland Creek WWTP Disinfection Failure
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Duffins Creek WWTP Disinfection Failure
Duffins Creek Pipeline Spill
Kilometres
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King
King City
Caledon
Nobleton
Richmond Hill
Markham
Bolton
Caledon East
Vaughan
Ajax
Woodbridge
Brampton
North York
Scarborough
Bramalea
Malton
Toronto
RC Harris
Etobicoke
Credit Valley Source Protection Area
Mississauga
Halton Region Source Protection Area
Lake Ontario

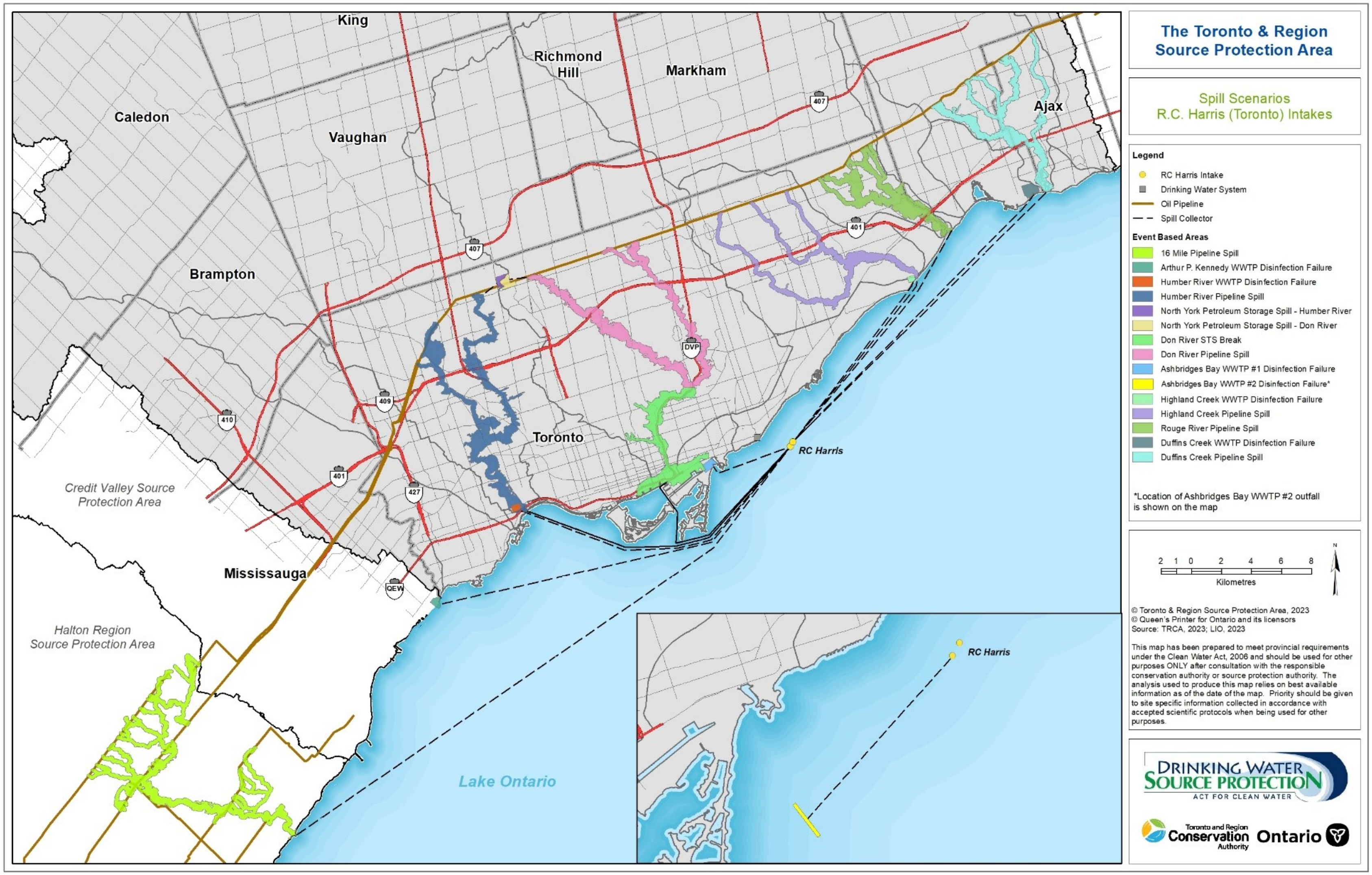
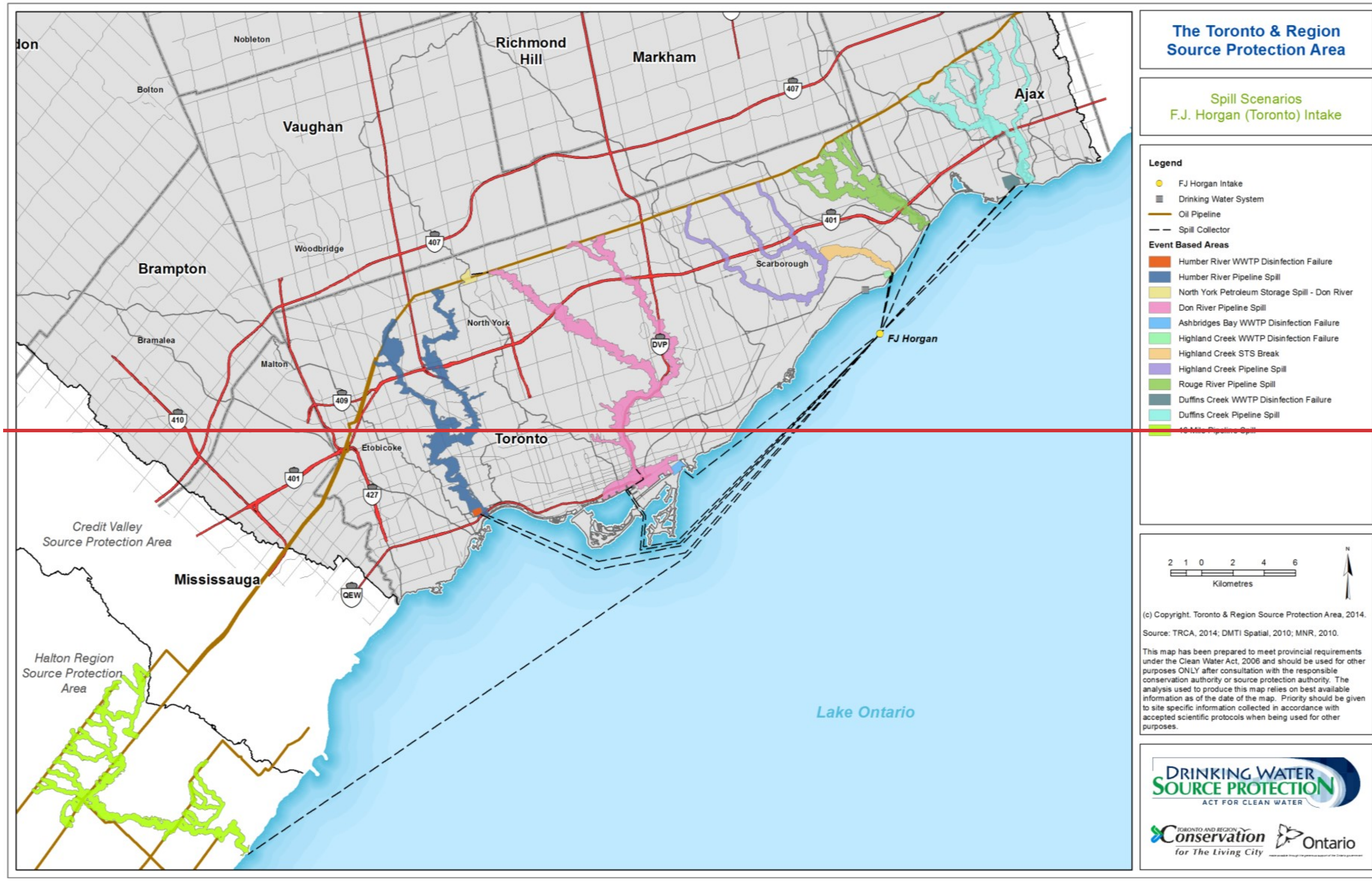


Figure 5.41: Spill Scenarios – R. C. Harris (Toronto) Intakes


The Toronto & Region Source Protection Area
Spill Scenarios
F.J. Horgan (Toronto) Intake
Legend
FJ Horgan Intake
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
Humber River WWTP Disinfection Failure
Humber River Pipeline Spill
North York Petroleum Storage Spill - Don River
Don River Pipeline Spill
Ashbridges Bay WWTP Disinfection Failure
Highland Creek WWTP Disinfection Failure
Highland Creek STS Break
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Duffins Creek WWTP Disinfection Failure
Duffins Creek Pipeline Spill
16 Mile Pipeline Spill
Richmond Hill
Markham
Nobleton
Bolton
Vaughan
Ajax
Woodbridge
Brampton
Scarborough
North York
Bramalea
Malton
FJ Horgan
Etobicoke
Toronto
Credit Valley Source Protection Area
Mississauga
Halton Region Source Protection Area
Lake Ontario
Kilometres
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DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation for The Living City
Ontario

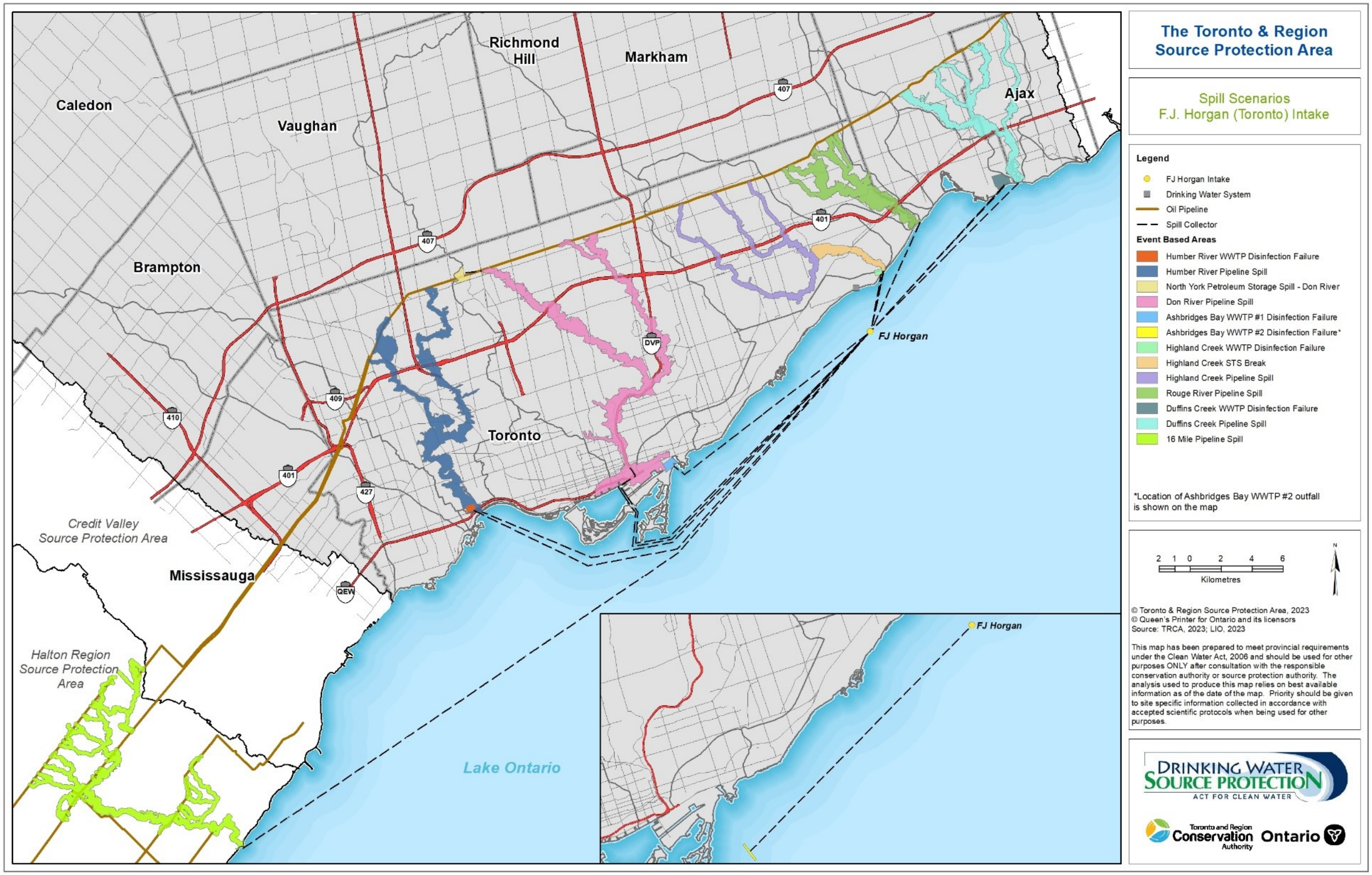
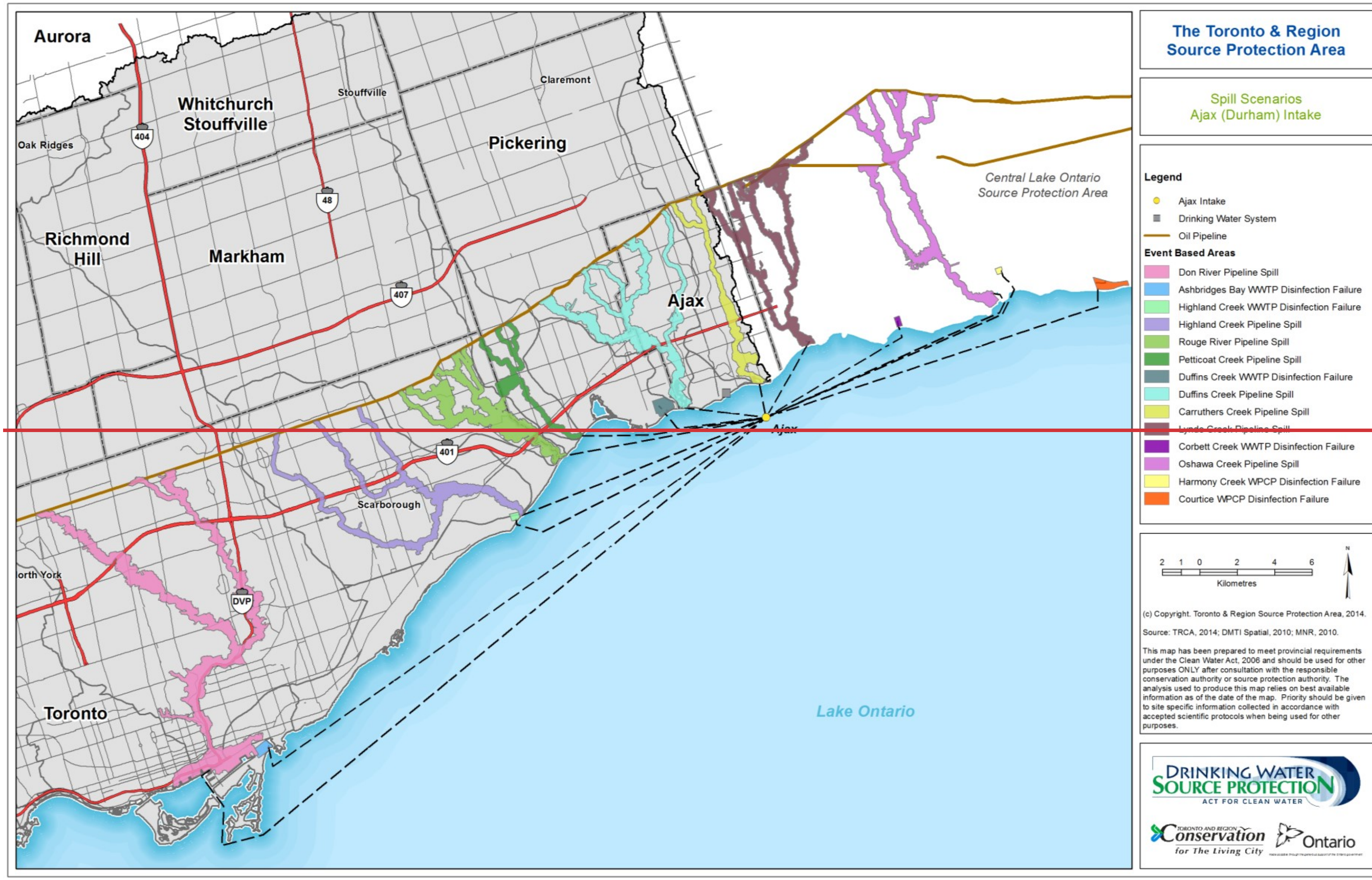


Figure 5.42: Spill Scenarios – F. J. Horgan (Toronto) Intake


The Toronto & Region Source Protection Area
Spill Scenarios
Ajax (Durham) Intake
Legend
Ajax Intake
Drinking Water System
Oil Pipeline
Event Based Areas
Don River Pipeline Spill
Ashbridges Bay WWTP Disinfection Failure
Highland Creek WWTP Disinfection Failure
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Petticoat Creek Pipeline Spill
Duffins Creek WWTP Disinfection Failure
Duffins Creek Pipeline Spill
Carruthers Creek Pipeline Spill
Lynde Creek Pipeline Spill
Corbett Creek WWTP Disinfection Failure
Oshawa Creek Pipeline Spill
Harmony Creek WPCP Disinfection Failure
Courtice WPCP Disinfection Failure
2 1 0 2 4 6
Kilometres
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Aurora
Whitchurch Stouffville
Stouffville
Claremont
Pickering
Oak Ridges
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Richmond Hill
Markham
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Central Lake Ontario Source Protection Area
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orth York
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Toronto
Lake Ontario

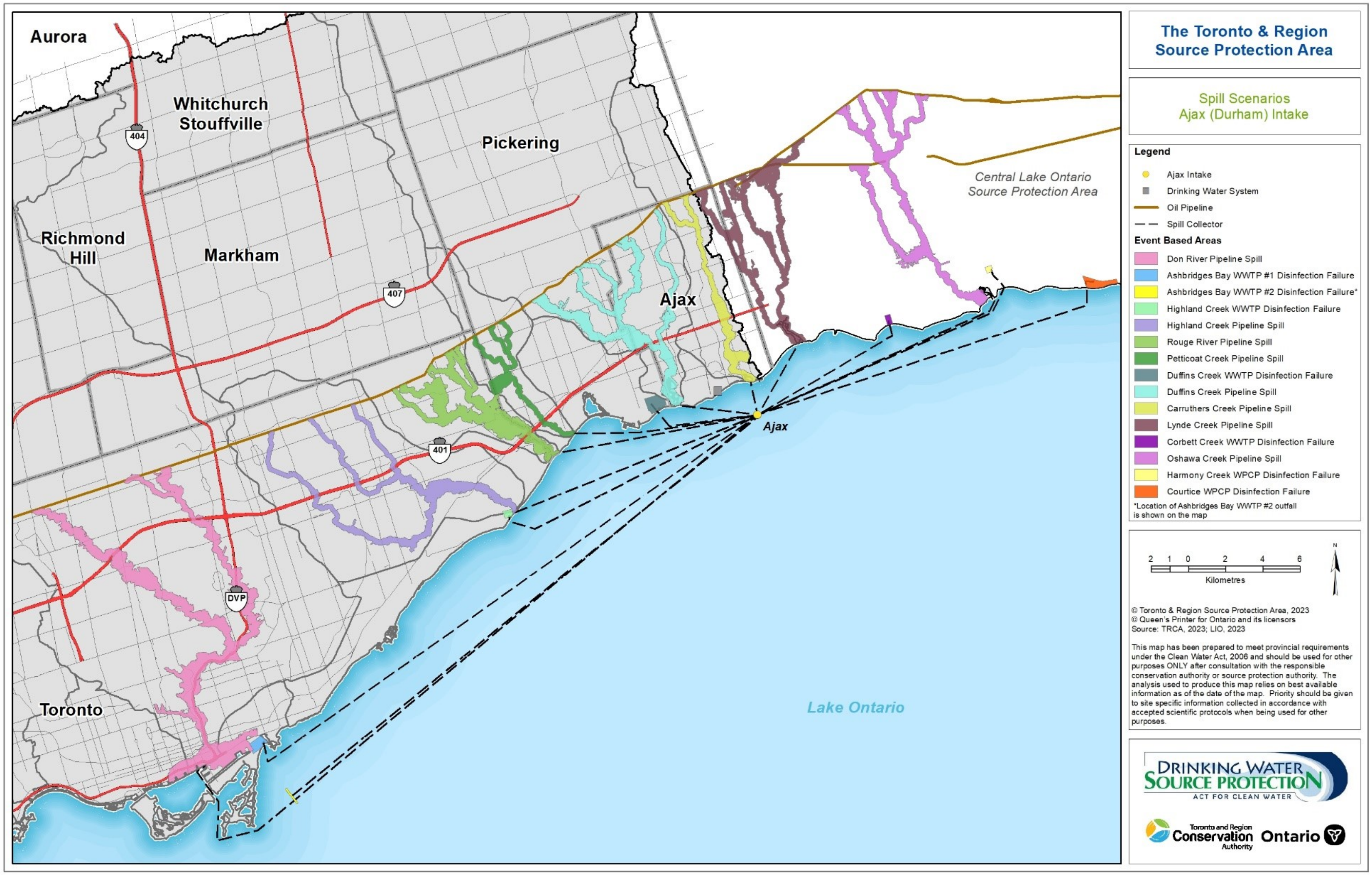
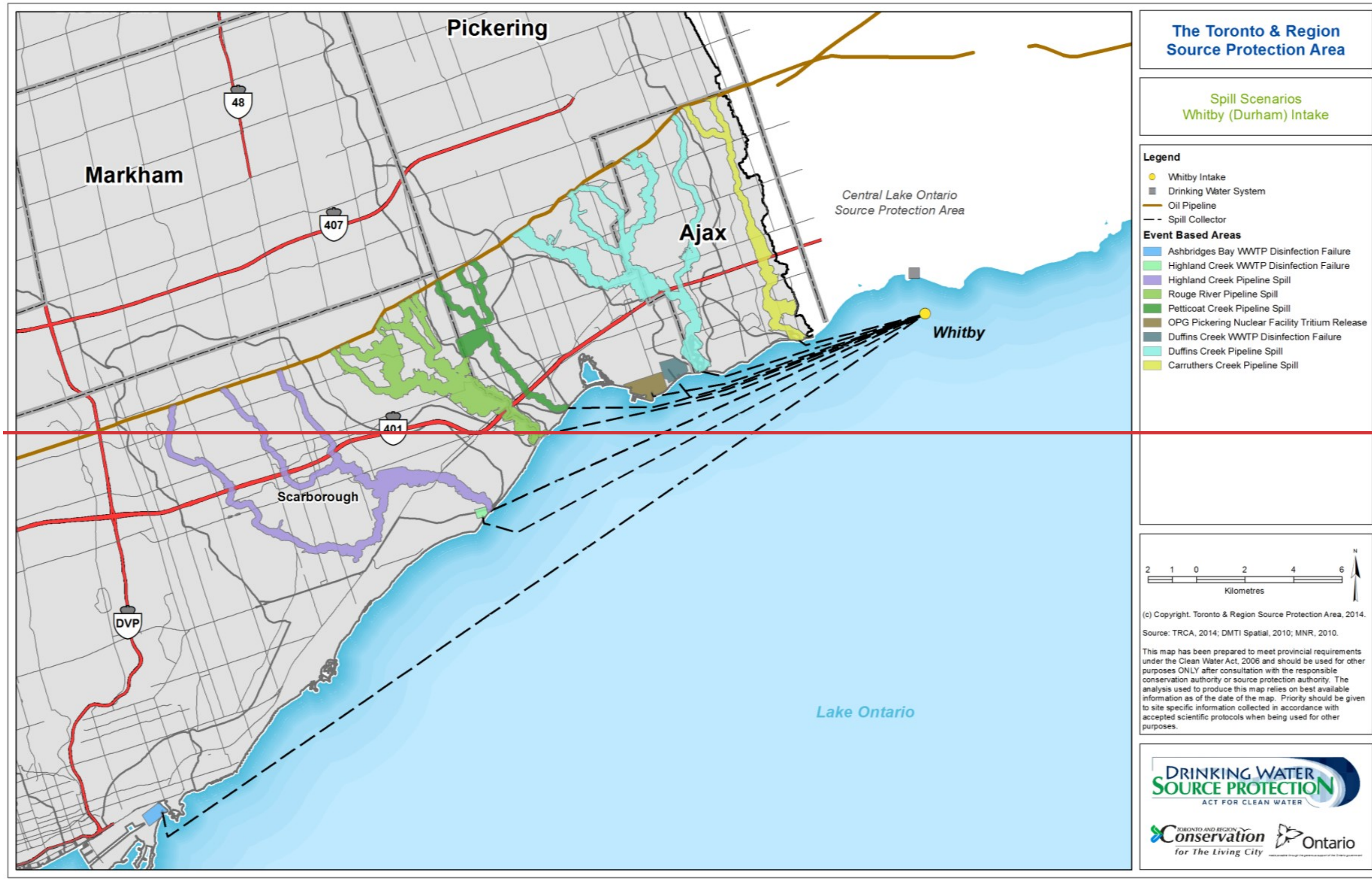


Figure 5.43: Spill Scenarios - Ajax (Durham) Intake


The Toronto & Region Source Protection Area
Spill Scenarios
Whitby (Durham) Intake
Legend
Whitby Intake
Drinking Water System
Oil Pipeline
Spill Collector
Event Based Areas
Ashbridges Bay WWTP Disinfection Failure
Highland Creek WWTP Disinfection Failure
Highland Creek Pipeline Spill
Rouge River Pipeline Spill
Petticoat Creek Pipeline Spill
OPG Pickering Nuclear Facility Tritium Release
Duffins Creek WWTP Disinfection Failure
Duffins Creek Pipeline Spill
Carruthers Creek Pipeline Spill
Pickering
Markham
Ajax
Scarborough
Whitby
Central Lake Ontario Source Protection Area
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Kilometres
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Drinking Water Source Protection
Act for Clean Water
Conservation for The Living City
Ontario

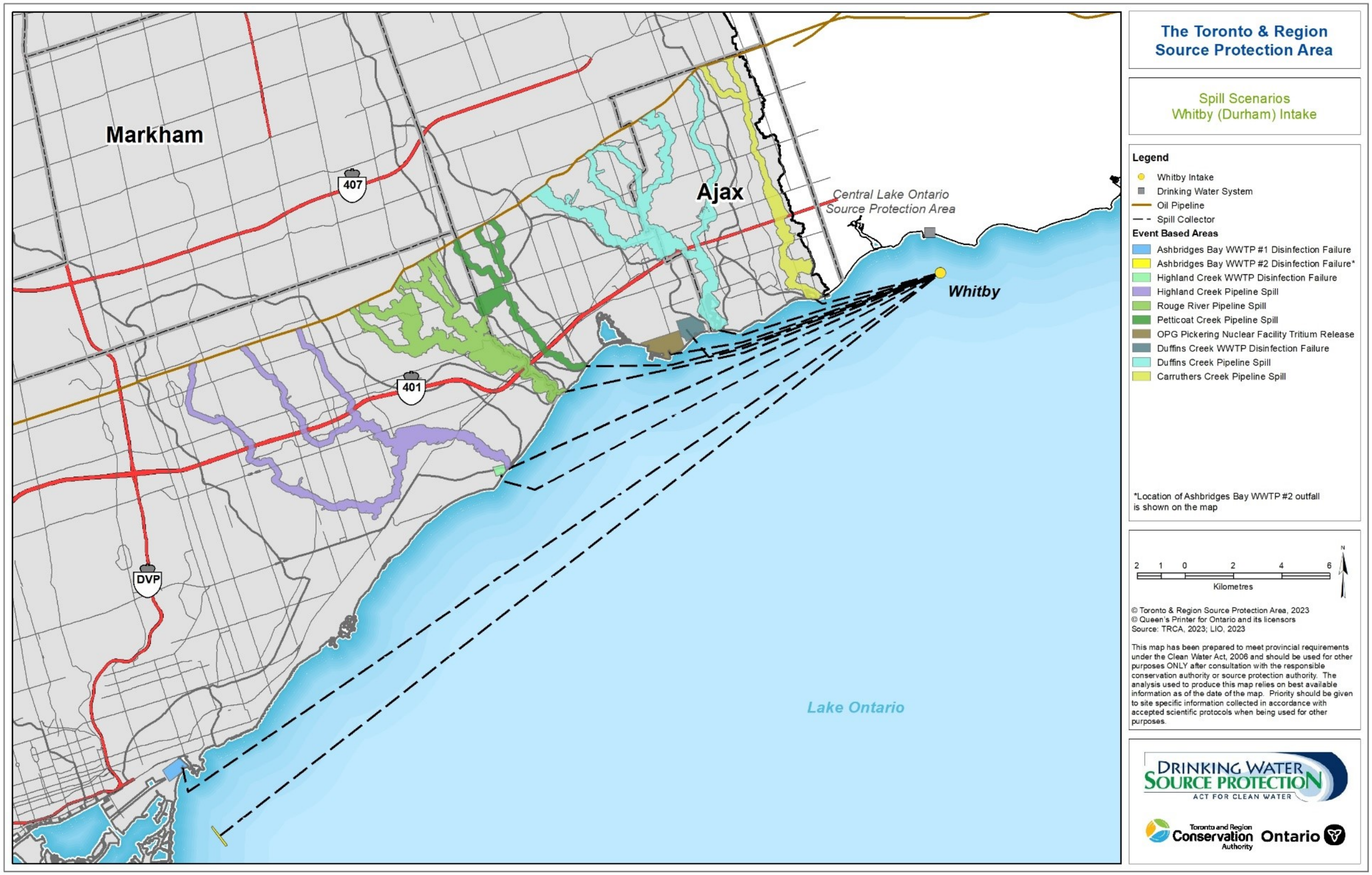


Figure 5.44: Spill Scenarios - Whitby (Durham) Intake

Figure 5.45: Spill Scenario - Oshawa (Durham) Intake

Significant Threats Enumeration

Table 5.22 provides the number of significant drinking threats located in TRSPA, extracted from the information found in **Table 5.2119**. Note that **Table 5.2119** includes multiple references to a single significant drinking water threat location. There are 19 significant threat locations within the TRSPA (note that a threat may affect more than one intake and that some of the affected intakes are outside the TRSPA).

The Source Protection Plan for CTC SPR must have policies to address these significant drinking water threats that are located within the source protection area. In additionaddition, TRSPA has identified significant drinking water threats from activities located outside the TRSPA. These activities affect water treatment plants located in TRSPA that must be addressed through source protection plan policies developed in adjacent source protection areas, where the threat activities are located. These locations are documented in **Table 5.2119**, but are not enumerated as part of the TRSPA threat inventory, since they are located outside of the TRSPA. TRSPA staff has brought this information to the attention of the source protection staff of the neighbouring source protection areas to ensure that policies are developed for them.

Table 5.22: Significant Threats for the TRSPA WTPs

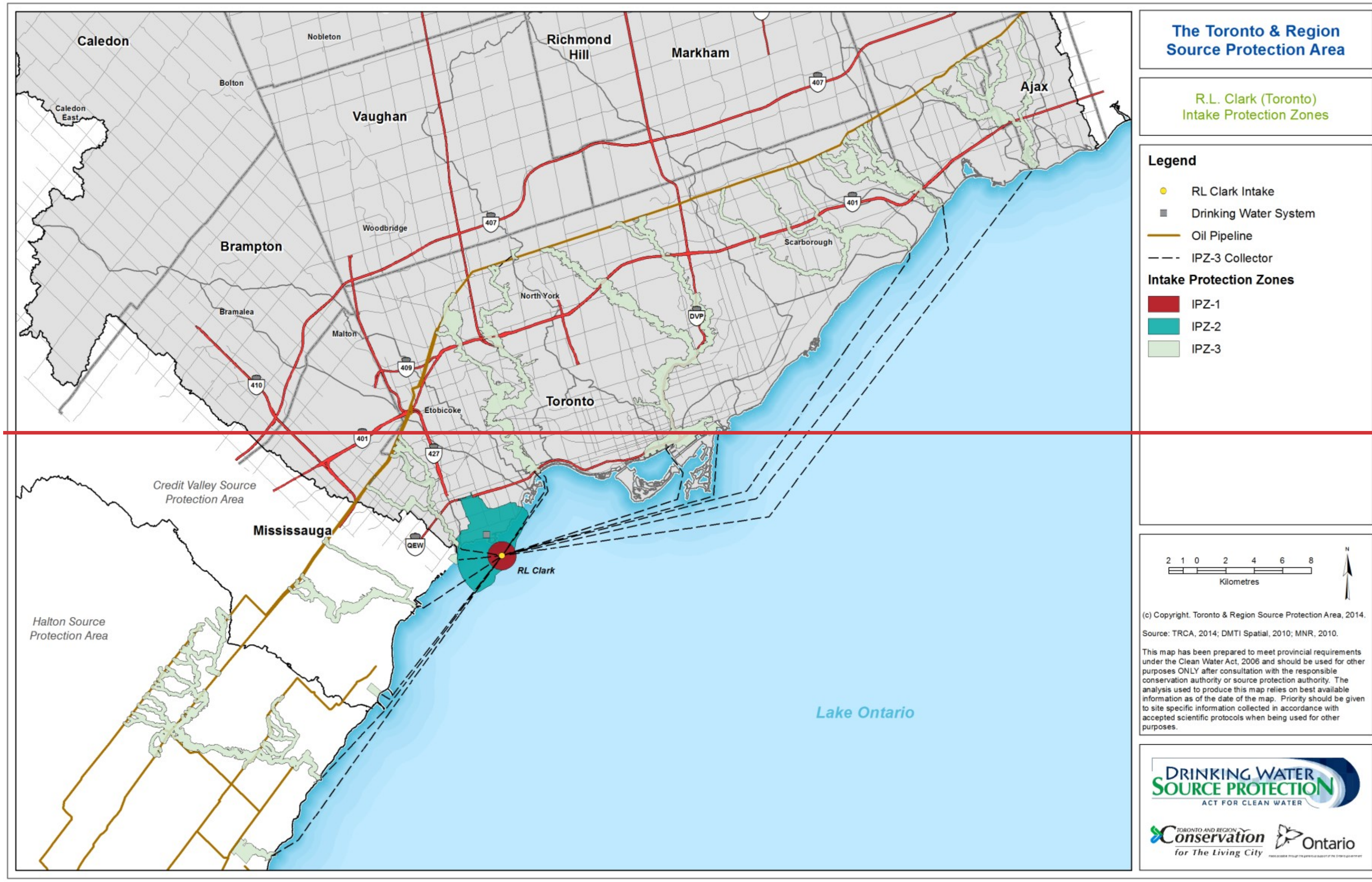
Number of Significant Threat Locations in TRSPA		
Threat Locations	**Parameter of Concern**	**WTP Affected (includes Intakes outside the TRSPA)**
Ashbridges Bay WWTP disinfection failure	*E. coli*	Ajax, R.L. Clark, R.C. Harris, F.J. Horgan, Arthur P. ~~KennedyLorne~~Kennedy, Island Lakes (Deep and Shallow), Lorne Park, Oakville, Whitby
Carruthers Creek pipeline break	benzene	Ajax, Whitby, Oshawa, Whitby
Don River pipeline break	benzene	R.L. Clark, R.C. Harris, F.J. Horgan, Arthur P. Kennedy, Lorne Park, Toronto Island (Shallow and Deep), Ajax
Don River STS break	*E. coli*	R.C. Harris
Duffins Creek pipeline break	benzene	Ajax, R.C. Harris, F.J. Horgan, Arthur P. Kennedy, Lorne Park, Whitby, R.L. Clark, Toronto Island (shallow)
Duffins Creek WWTP disinfection failure	*E. coli*	Ajax, R.C. Harris, F.J. Horgan Whitby
Etobicoke Creek STS break	*E. coli*	R.L. Clark, Arthur P. Kennedy, Lorne Park, Oakville
Etobicoke Creek pipeline break	benzene	R.L. Clark, Arthur P. Kennedy, Lorne Park
GE Booth (formerly Lakeview)	E. coli	R.L. Clark, R.C. Harris
Highland Creek pipeline break	benzene	Ajax, R.C. Harris, F.J. Horgan, Arthur P. Kennedy, Lorne Park, Whitby, R.L. Clark, Toronto Island (shallow)
Highland Creek STS Break	*E. coli*	F.J. Horgan
Highland Creek WWTP disinfection failure	*E. coli*	Ajax, R.C. Harris, F.J. Horgan, Whitby
Humber River pipeline break	benzene	R.L. Clark, R.C. Harris, Arthur P. Kennedy, Lorne Park, Toronto Island (Shallow and Deep), F.J. Horgan
Humber River STS break	*E. coli*	R.L. Clark, Arthur P. Kennedy
Humber River WWTP disinfection failure	*E. coli*	R.L. Clark, R.C. Harris, F.J. Horgan, Arthur P. Kennedy, Lorne Park
North York Petroleum Storage Spill via Don River	benzene	R.C. Harris, F.J. Horgan, Toronto Island (Deep)
North York Petroleum Storage Spill via Humber River	benzene	R.L. Clark, R.C. Harris, Arthur P. Kennedy, Lorne Park, Toronto Island (Deep)
Petticoat Creek pipeline break	benzene	Ajax, Whitby
Rouge River pipeline break	benzene	Ajax, R.C. Harris, F.J. Horgan, Arthur P. Kennedy, Lorne Park, Whitby, R.L. Clark, Toronto Island (shallow)
Pickering Nuclear wastewater release	tritium	Oshawa, Whitby
Number of Significant Threat Locations	**19**	

Note: The actual pipeline break location at each watercourse is the land use activity that is identified as the significant threat.

IPZ-3 Delineation

As discussed above, an IPZ-3 is delineated where modelling demonstrates that a contaminant released during an event may be transported to the intake resulting in an unacceptable deterioration in the quality of water rendering it unsuitable as a source of drinking water. The modeled results outlined in **Table 5.21~~19~~** show where spill events would lead to concentrations of contaminants at the respective intakes in TRSPA that exceed the selected thresholds. Therefore an IPZ-3 must be delineated for each of these scenarios, where the Significant Drinking Water Threat (SDWT) activity is located outside IPZ-1 or IPZ-2. Where the spill scenario was within IPZ-1 or IPZ-2, no IPZ-3 was delineated for that related activity. The Director's Rule (68) guides the delineation of IPZ-3s, which requires that setbacks from tributaries where the modelled contaminant could travel to reach Lake Ontario be determined based on the greater of the area of land measured from the high water mark (not exceed 120 metres) or the Conservation Authority regulation limit. The term 'high water mark' under the Director's Technical Rules is consistent with the definition of 'ordinary high water mark' as defined by DFO-Fact Sheet T-6, Fisheries and Ocean Canada, as the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. The measured high water mark is based on the CGVD28 (Canadian Geographic Vertical Datum) converted from the IGLD (International Great Lakes Datum 1985). The high water mark was delineated and setback extended from this datum.

Once a contaminant is modelled to reach an intake, an Event Based Area (EBA) within the IPZ-1, 2 or 3 was delineated using the required setbacks from the point of its release in the tributary to a point representing the maximum landward extent of the IPZ-2. The EBA is the spatial component of the IPZ-1, 2 or 3 required for database and policy application purposes. A dashed line is also drawn from the point of entry at the lake to the affected intake. This line is termed the "spill collector" and represents the shortest transport path between the shoreline and the affected intakes. An IPZ-3 that falls in the lake such as with a spill at a WWTP is represented by a spill collector dashed line only. The following maps (**Figure 5.46** to **Figure 5.50**) show the (IPZ-1, IPZ-2 and IPZ-3) for each of the municipal intakes located within TRSPA. The delineation of the STS break IPZ-3s and associated Event Based Areas (EBAs) were revised in 2015. A technical addendum discussion these revisions is presented in **Appendix E 6.3.3**.


The Toronto & Region Source Protection Area
R.L. Clark (Toronto) Intake Protection Zones
Legend
RL Clark Intake
Drinking Water System
Oil Pipeline
IPZ-3 Collector
Intake Protection Zones
IPZ-1
IPZ-2
IPZ-3
Kilometres
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Nobleton
Richmond Hill
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Ajax
Bolton
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Vaughan
Woodbridge
Brampton
Scarborough
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Malton
Etobicoke
Toronto
Credit Valley Source Protection Area
Mississauga
RL Clark
Halton Source Protection Area
Lake Ontario

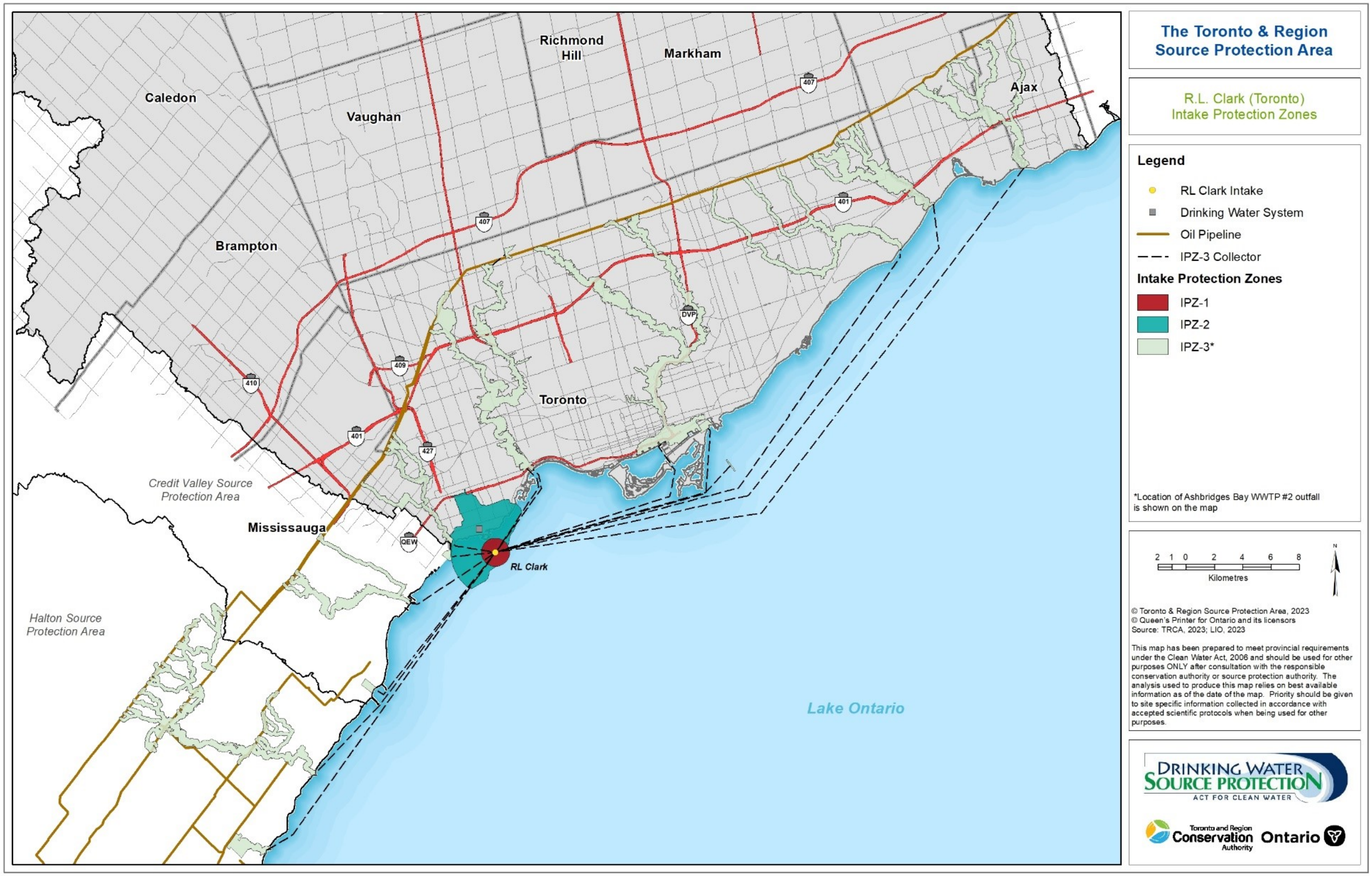
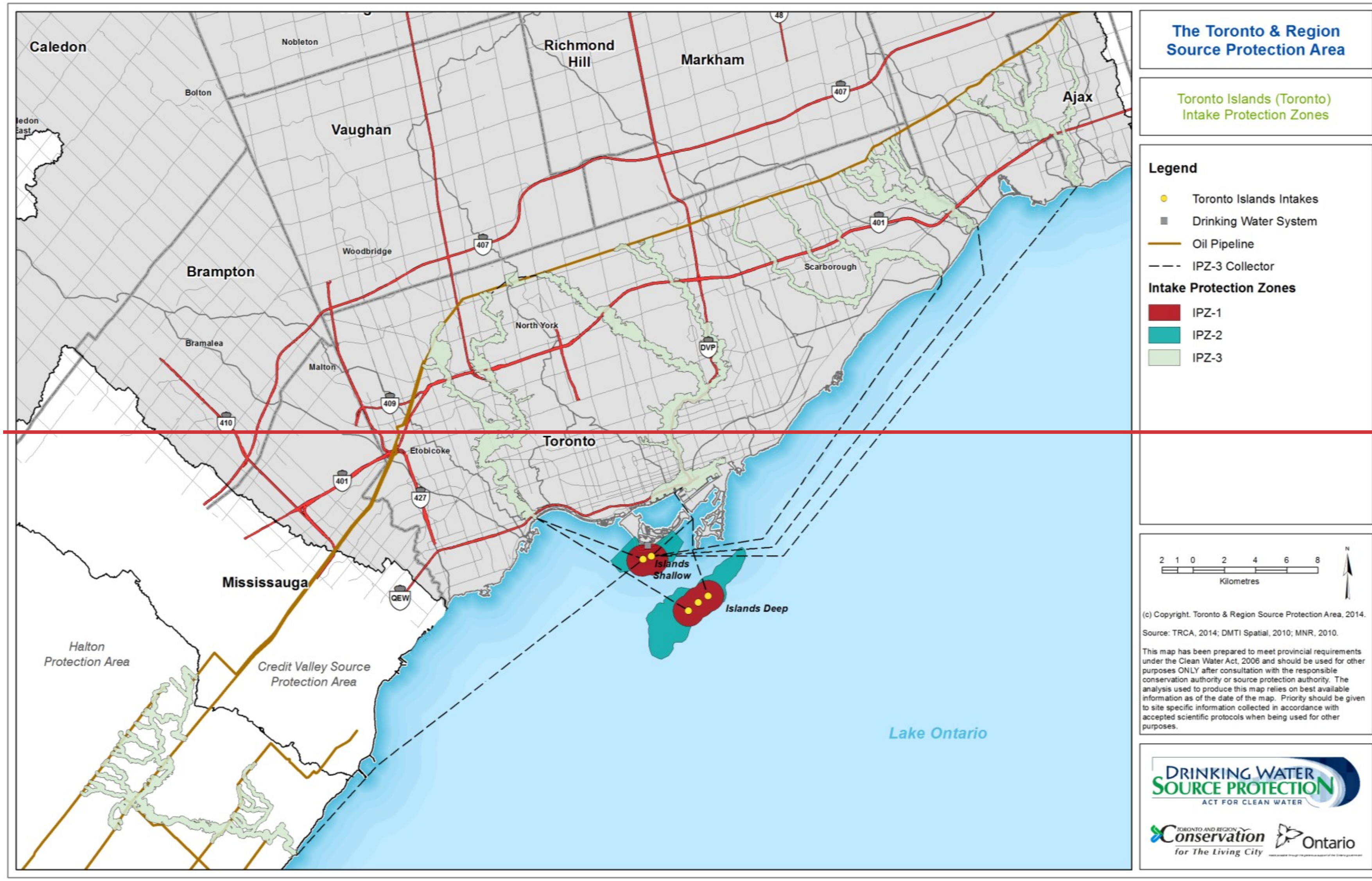


Figure 5.46: R. L. Clark (Toronto) Intake Protection Zones


The Toronto & Region Source Protection Area
Toronto Islands (Toronto) Intake Protection Zones
Legend
Toronto Islands Intakes
Drinking Water System
Oil Pipeline
IPZ-3 Collector
Intake Protection Zones
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IPZ-2
IPZ-3
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Markham
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Bolton
Vaughan
Woodbridge
Brampton
Scarborough
North York
Bramalea
Malton
Toronto
Etobicoke
Mississauga
Islands Shallow
Islands Deep
Halton Protection Area
Credit Valley Source Protection Area
Lake Ontario
Kilometres
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Source: TRCA, 2014; DMTI Spatial, 2010; MNR, 2010.
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DRINKING WATER SOURCE PROTECTION
ACT FOR CLEAN WATER
Conservation for The Living City
Ontario

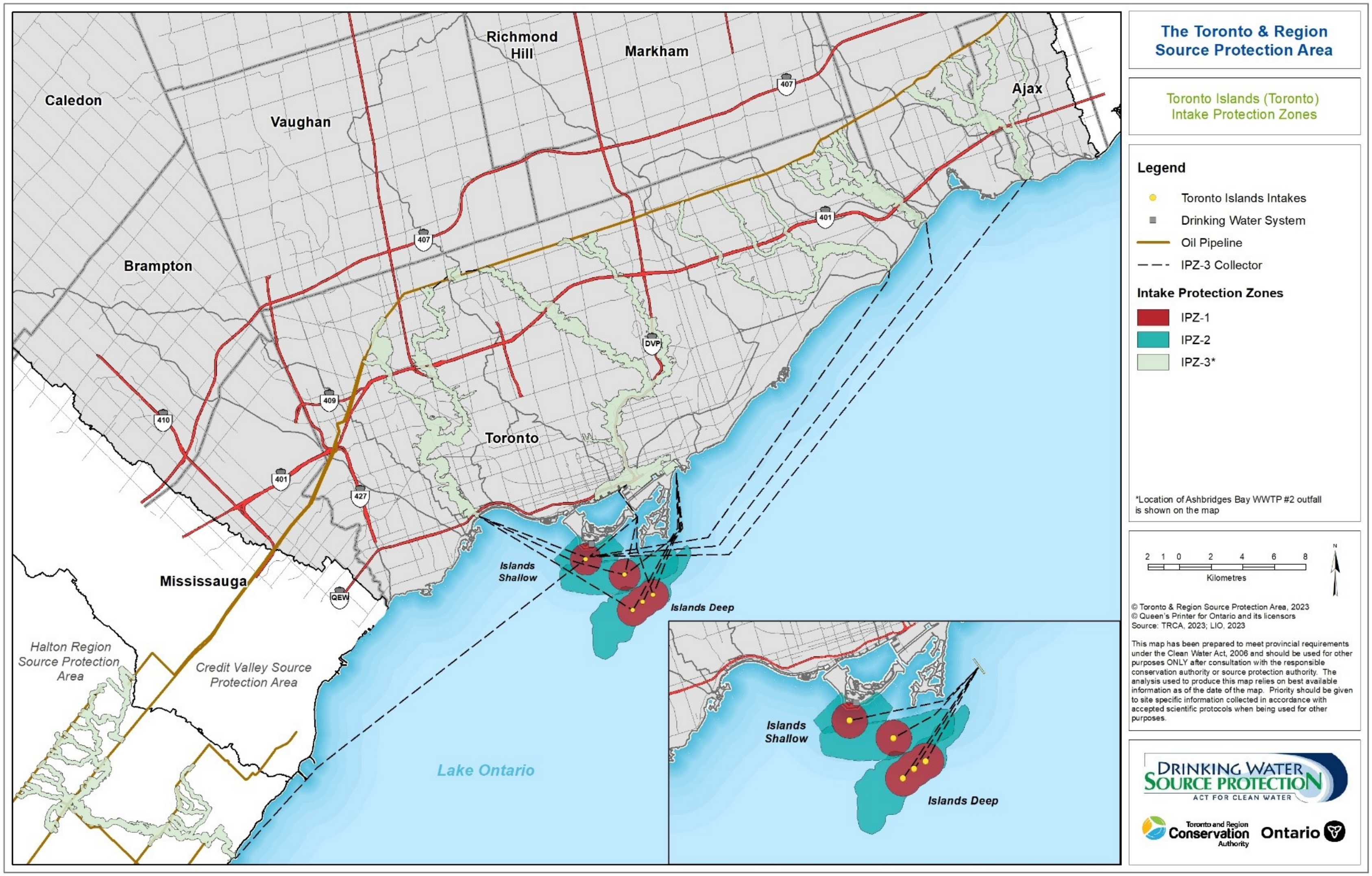
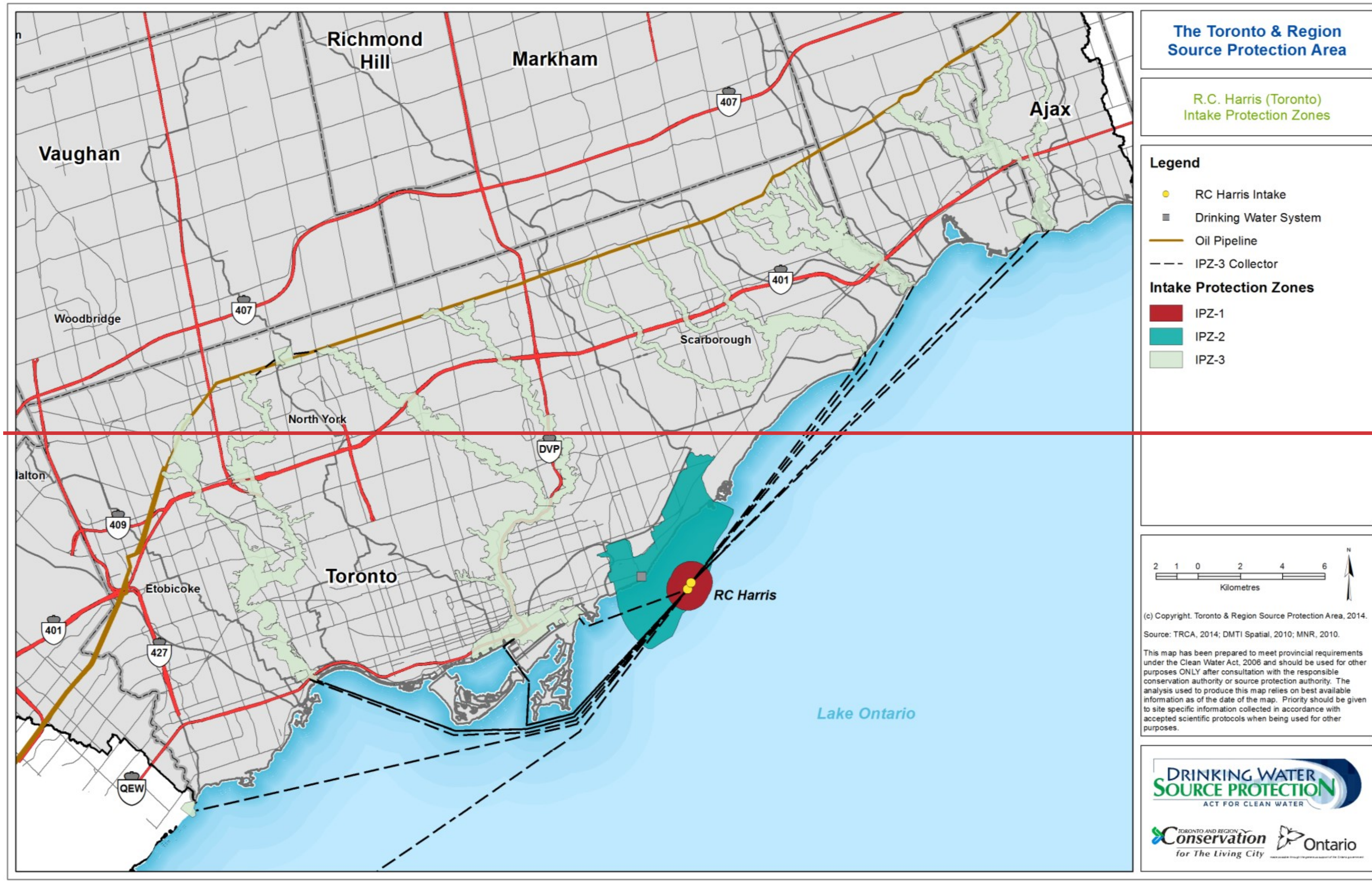


Figure 5.47: Toronto Islands (Toronto) Intake Protection Zones


Richmond Hill
Markham
Vaughan
Ajax
Woodbridge
Scarborough
North York
Toronto
Etobicoke
RC Harris
Lake Ontario
407
401
409
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DVP
QEW
The Toronto & Region Source Protection Area
R.C. Harris (Toronto) Intake Protection Zones
Legend
RC Harris Intake
Drinking Water System
Oil Pipeline
IPZ-3 Collector
Intake Protection Zones
IPZ-1
IPZ-2
IPZ-3
2 1 0 2 4 6
Kilometres
N
(c) Copyright. Toronto & Region Source Protection Area, 2014.
Source: TRCA, 2014; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER SOURCE PROTECTION
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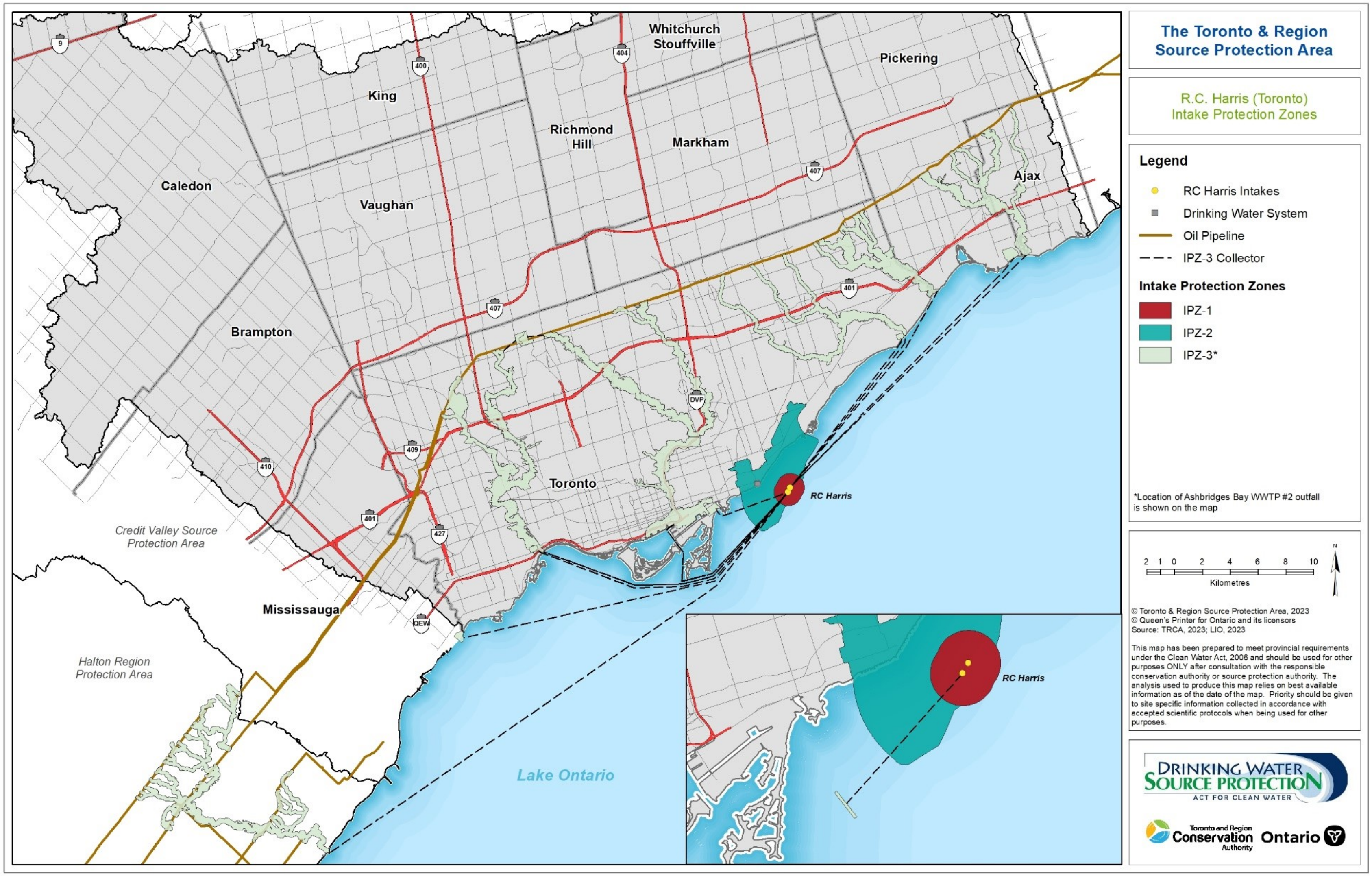
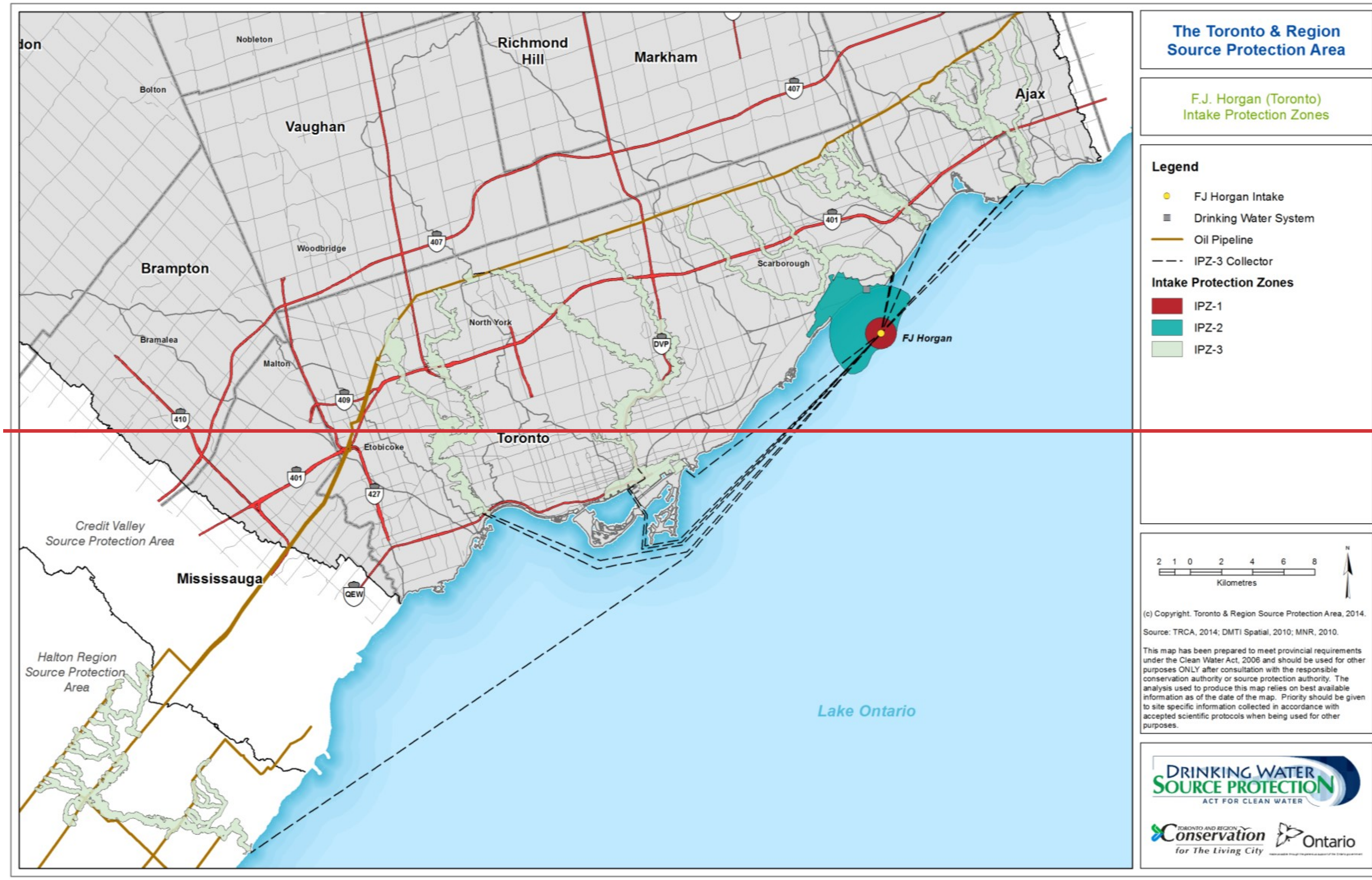


Figure 5.48: R. C. Harris (Toronto) Intake Protection Zones


The Toronto & Region Source Protection Area
F.J. Horgan (Toronto) Intake Protection Zones
Legend
FJ Horgan Intake
Drinking Water System
Oil Pipeline
IPZ-3 Collector
Intake Protection Zones
IPZ-1
IPZ-2
IPZ-3
2 1 0 2 4 6 8
Kilometres
N
(c) Copyright. Toronto & Region Source Protection Area, 2014.
Source: TRCA, 2014; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
Nobleton
Bolton
Richmond Hill
Markham
Ajax
Vaughan
Woodbridge
Brampton
Scarborough
North York
Bramalea
Malton
FJ Horgan
Etobicoke
Toronto
Credit Valley Source Protection Area
Mississauga
Halton Region Source Protection Area
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407
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DVP
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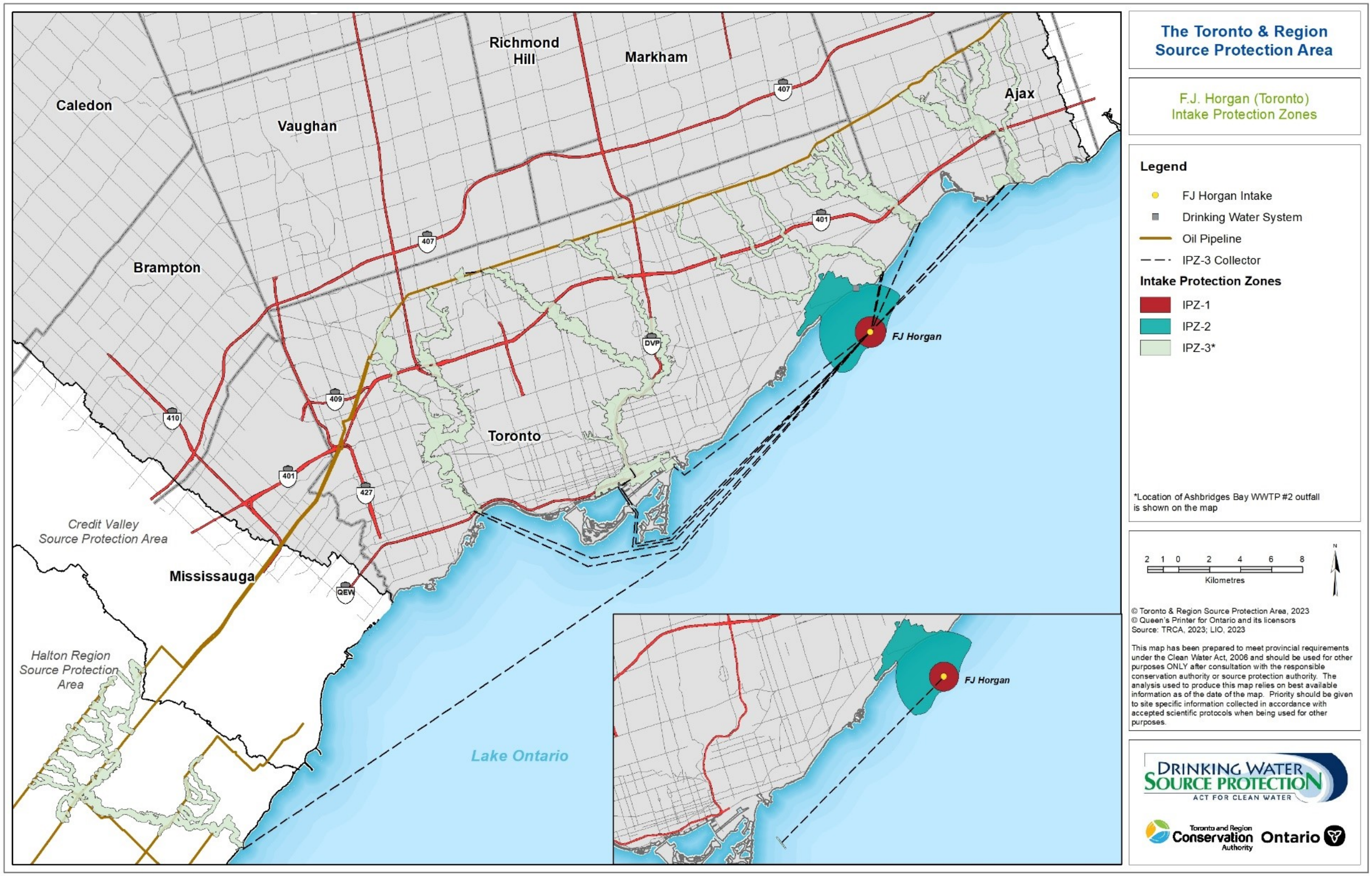
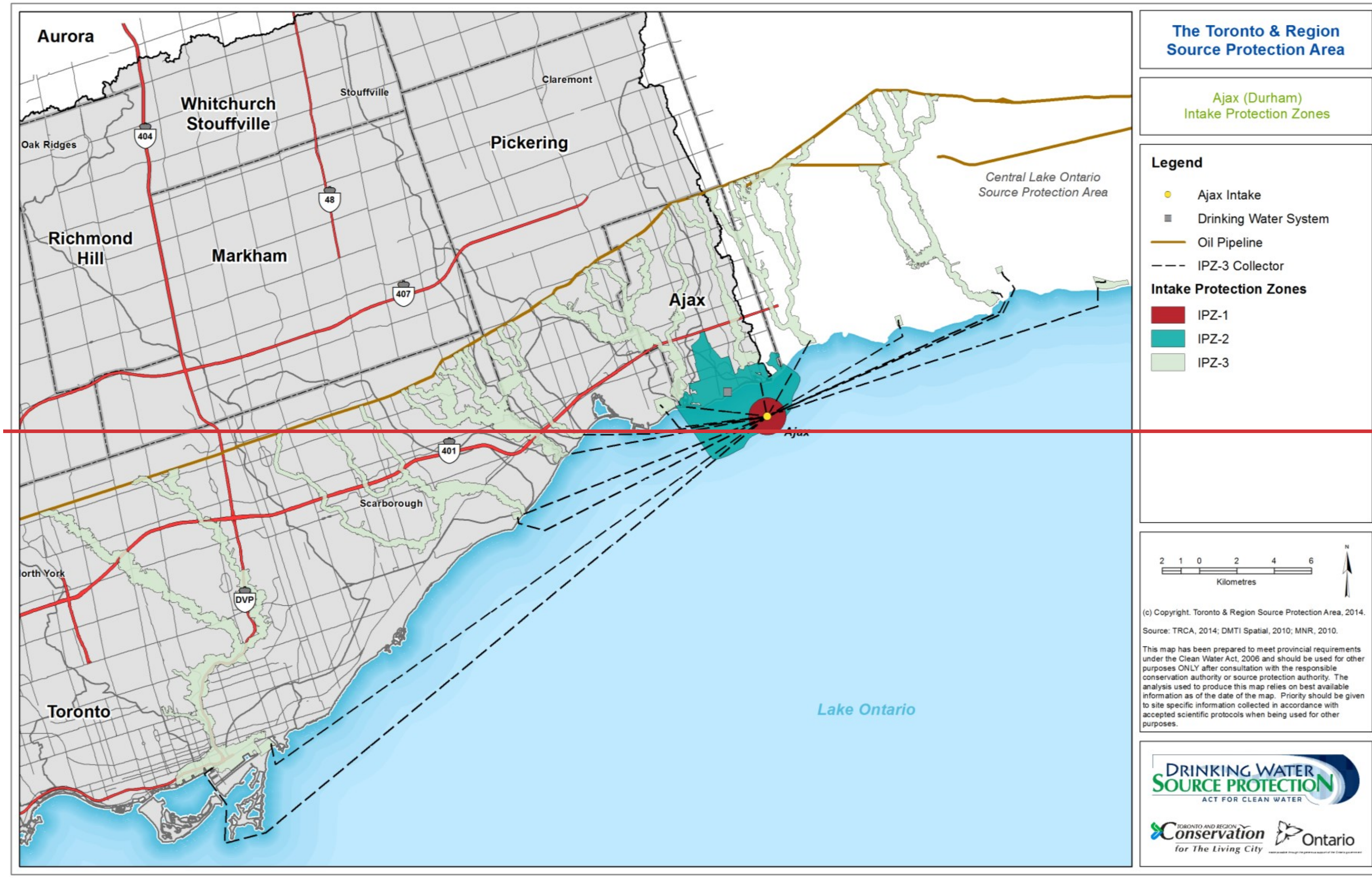


Figure 5.49: F. J. Horgan (Toronto) Intake Protection Zones


The Toronto & Region
Source Protection Area
Ajax (Durham)
Intake Protection Zones
Legend
Ajax Intake
Drinking Water System
Oil Pipeline
IPZ-3 Collector
Intake Protection Zones
IPZ-1
IPZ-2
IPZ-3
Aurora
Whitchurch
Stouffville
Stouffville
Claremont
Pickering
Oak Ridges
Richmond
Hill
Markham
Ajax
Central Lake Ontario
Source Protection Area
Scarborough
North York
Toronto
Lake Ontario
404
48
407
401
DVP
2 1 0 2 4 6
Kilometres
N
(c) Copyright. Toronto & Region Source Protection Area, 2014.
Source: TRCA, 2014; DMTI Spatial, 2010; MNR, 2010.
This map has been prepared to meet provincial requirements under the Clean Water Act, 2006 and should be used for other purposes ONLY after consultation with the responsible conservation authority or source protection authority. The analysis used to produce this map relies on best available information as of the date of the map. Priority should be given to site specific information collected in accordance with accepted scientific protocols when being used for other purposes.
DRINKING WATER
SOURCE PROTECTION
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Ontario

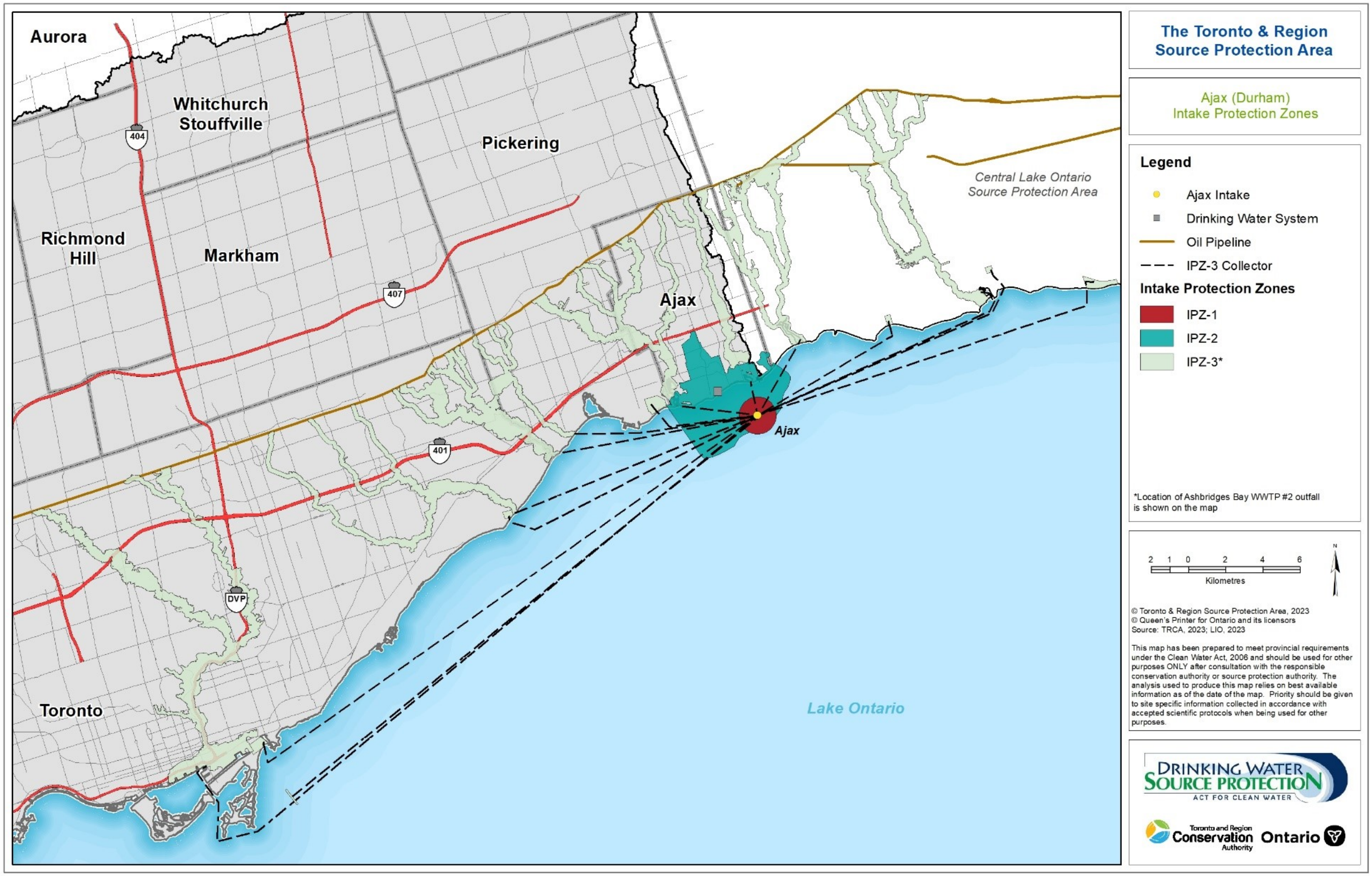

Figure 5.50: Ajax (Durham) Intake Protection Zones

Q1/WHPA Q2 (**Figure ES: 7**) are considered moderate drinking water quantity threats, while future consumptive water uses, and recharge reduction would be significant drinking water quantity threats. The tolerance of the Local Area is classified as high. The uncertainty in the risk classification is low and the uncertainty in tolerance assignment is also low.

The numerical modelling indicates that cross-watershed groundwater flows are significant; suggesting that water management policies must include the broader areas surrounding the stressed watersheds. Water demand in the study area is varied, complex and there is considerable uncertainty in many of the permitted and non-permitted uses. Continued efforts to quantify and monitor actual water use is essential.

A total of 462 significant groundwater quality threats have been identified around municipal wellheads in the TRSPA. They were located on 195 parcels of land as shown in **Table 6.1** below.

Table 6-1: Summary of Significant Drinking Water Threats to Groundwater Quality for the Toronto and Region Source Protection Area

Region	Well(s)	Significant Drinking Water Threats	Total # of Parcels with Significant Drinking Water Threats
Region of Peel	Caledon East 3	~~4~~	~~3~~
	Caledon East 4 & 4A	~~3~~29	~~2~~20
	Palgrave 2	~~1~~	~~1~~
	Palgrave 3	~~2~~	~~2~~
	Palgrave 4	~~1~~9	~~1~~9
York Region	Kleinburg 3	34*	14*
	Kleinburg 4		
	Nobleton 2	138	74
	Nobleton 3		
	Nobleton 5		
	Nobleton 7		
	King City 2	19	10
	King City 3		
	Whitchurch–Stouffville 2	243	80
	Whitchurch–Stouffville 3		
	Whitchurch–Stouffville 5		
	Whitchurch–Stouffville 6		
Durham Region	Uxville 1 and 2	17	8
	Total	**462**	**195**

**Note threat counts NOT adjusted for the removal of Kleinberg Well # 2. Threats verification was completed by York Region staff and numbers will be updated in future assessment reports.*

The *Technical Rules* require only a reference to what circumstances would be moderate and low potential threats. There is no requirement to count or locate where these circumstances exist or are planned. A link to a list of potential moderate and low level threats based on the provincial matrices has been included in this report per the requirements in the Provincial Tables of Threats and associated Circumstances. If and where these activities exist, they may constitute a moderate or low risk to drinking water supplies.

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