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6.0 SUMMARY, CONCLUSIONS, AND NEXT STEPS

6.1 SUMMARY AND CONCLUSIONS

The *Clean Water Act, 2006 (CWA)* and regulations aim to protect drinking water supplies in Ontario. The Act requires that we assess risks to all drinking water sources by completing an assessment report. This *Assessment Report: Toronto and Region Source Protection Area (TRSPA*) describes the physical features and water resources within the TRSPA jurisdiction. Using approved provincial methodologies, it delineates vulnerable areas and assesses specific activities on the landscape within these vulnerable areas as potential drinking water threats. The municipal drinking water systems comprise the primary focus of this assessment, but it also provides a description of the physical features and water resources within the TRSPA jurisdiction. The analysis follows the *Technical Rules* prescribed by the Province.

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 various chapters in this Assessment Report have been completed to meet provincial requirements in the determination of any potential risk to drinking water supplies. Based on these discussions, the status and sustainability of drinking water can be determined, as required under the *CWA, 2006*. The vulnerable areas and threats identified in this Assessment Report will be the focus of the source protection plan policies.

Municipal drinking water systems within the TRSPA are primarily surface water based, with Lake Ontario as the source. Surface water quality issues in the streams and rivers across the TRSPA have been correlated to the amount of urbanization. The *Lake Ontario Collaborative Intakes Protection Zone Studies* (Stantec 2008a; Stantec 2008b) assessed raw water quality data from the municipal intakes in Lake Ontario that serve as the drinking water source for all municipal supplies in TRSPA. In general, the source water for the TRSPA Lake Ontario drinking water systems was of good quality. In the northern portion of the TRSPA groundwater continues to be used as a municipal drinking water source.

The analyses of the Watershed Characterization component of this Assessment Report revealed some increasing trends in levels of contaminants in the shallow groundwater system that support private wells in the study area and are associated with the application of road salt. Groundwater quality across the TRSPA is generally good, with naturally elevated iron, manganese, and hardness in the deeper groundwater.

Surface water quality in the streams discharging into Lake Ontario show some elevated levels of chlorides, phosphorus, copper, and nitrates as compared against ecosystem and aquatic life standards (*Canadian Water Quality Guidelines*). These contaminants are thought to be associated with the impact of urbanization and agricultural activities. With the exception of chlorides, which are still below the provincial standards, the other parameters showed decreasing or no trend. The surface water in these streams is not used as a drinking water supply.

Daily loads illustrate that a few large precipitation events occur each year that transport a significant proportion of the load to the lake. It is during these periods that watershed influences will likely be

observed at drinking water intakes in Lake Ontario. When and where spikes of turbidity occur at the intakes will depend upon physical mixing and transport functions of the nearshore zone. Lake wide modelling studies, undertaken as part of IPZ-3 studies can be of assistance in interpretation of what constitutes important local watershed runoff events. Of course, extreme storm can occur at any time including during the summer months.

Urban lands are estimated to include 97% of the entire population within the TRSPA. While the vast majority of the population will continue to be serviced by Lake Ontario based water supply systems, municipal groundwater wells will continue to provide water to towns and villages in the Oak Ridges Moraine and Greenbelt areas. With an estimated 3.8 million residents living in TRSPA watershed in 2006, and close to 50% growth forecast by 2031, it is anticipated there will be increased urbanization and pollutant loadings which will require ongoing monitoring and possible risk mitigation measures.

The Water Budget analysis in this Assessment Report assessed potential water quantity stress in both surface water (not including Lake Ontario) and groundwater. Groundwater supplies in TRSPA are used as a source of drinking water for both municipal and private wells and to support ecosystem functions. The surface water in streams in the study area is important for supporting the ecosystem and is also used for irrigation, agricultural, industrial, and other non-drinking water purposes.

Based on the Tier 2 Water Budget analysis the TRSPA has determined that five subwatersheds were found to have moderate or significant groundwater stress levels and seventeen subwatersheds have moderate or significant surface water stress levels during summer months. Of these potentially stressed watersheds only two are associated with a municipal drinking water source and have been assessed at the Tier 3 Water Budget level. The Tier 3 Water Budget analysis has now been incorporated into this Assessment Report (see **Chapter 3.9** and the summary below). All other catchments in the study area have low stress levels for both groundwater and surface water.

Vulnerability was assessed and scored in the following vulnerable areas in TRSPA - Highly Vulnerable Aquifers (HVAs), Wellhead Protection Areas (WHPAs), and Intake Protection Zones (IPZs) following the *Technical Rules*. The IPZs (IPZ-1s and IPZ-2s) were all ranked as having low vulnerability. The resulting HVA and SGRA analyses reflect the presence of many shallow aquifers that are naturally vulnerable. The vulnerability in the WHPAs was found to be highest in close proximity to municipal wellheads, decreasing with distance from the wellheads.

Transport pathway analyses were undertaken within the WHPAs only and assessed whether there were subsurface utilities or if any parts of quarries and pits were present that extend below the water table. Where any of these transport pathways were known to exist, the vulnerability of the part of the area where the pathway was present was increased by one level (e.g., low to moderate). If the vulnerability of that part of the area was already high, no increase was required.

Vulnerability is considered together with provincial hazard scores outlined in the Provincial Tables of Circumstances (November 2009) for the various activities and their associated chemicals and pathogens to determine a risk score. Using both the natural vulnerability and hazard scores, potential drinking water threats are ranked as significant, moderate, or low in each one of the vulnerable areas (HVAs, WHPAs, and IPZs). Significant threats must be addressed in the Source Protection Plan and moderate and low threats may be addressed.

The results of the TRSPA HVA and SGRA vulnerability analyses reflect the presence of many shallow aquifers that are naturally vulnerable. There are a number of private domestic wells that use these shallow aquifers as a source of drinking water. WHPAs were delineated and assigned a vulnerability score for each of the 20 municipal drinking water wells within TRSPA. Detailed maps of the WHPA

vulnerability scoring can be found in **Figure 4-6** to **Figure 4-26** of this Assessment Report. IPZs (IPZ-1s and IPZ-2s) for the study area were all ranked as having low vulnerability.

A threat is defined as an activity or condition 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 and includes an activity or condition that is prescribed by the Province through the *Technical Rules.* The methodology outlined in the *Technical Rules* directs what types of activities can be considered potential threats. The Provincial Tables of Circumstances (November 2009) assigns the level of drinking water threat to a specific circumstance. The circumstance includes the specific characteristic of the prescribed drinking water threat activity, the type of vulnerable area, and its vulnerability score. There was minimal field-truthing of the threat activities identified during the threats' assessment. Such consideration is intended to become part of the process informing the development of the Source Protection Plan policies and implementation.

In addition to identifying potential drinking water threat activities, existing water quality problems or increasing trends that suggest a future water quality problem must be evaluated – and may be labeled as "issues". The requirements to identify an issue are set out in *Technical Rules* 114 - 117. According to *Technical Rule 114.1* (a & b), issues may exist only in vulnerable areas associated with a municipal drinking water system.

The analyses identified no significant drinking water conditions, issues or threats related to quality of water in the HVAs or SGRAs.

With respect to drinking water supplies sourced from Lake Ontario, event based modelling studies undertaken in the vulnerable area surrounding Lake Ontario Intakes, resulted in the identification of 19 unique significant drinking water quality threats to the five intakes located in the TRSPA.

In addition to identifying potential drinking water threat activities, existing water quality problems, or increasing trends that suggest a future water quality problem are issues that must be evaluated. The requirements to identify an issue are set out in *Technical Rule 114 – 117a.* According to T*echnical Rule 114.1* (a & b), issues may exist only in vulnerable areas associated with a municipal drinking water system. No issues or conditions were identified at any municipal drinking water system in TRSPA.

Under the *Technical Rules*, water quantity threats are associated with municipal groundwater and inland surface water systems. These threats were defined and assessed through the York Tier 3 Water Budget process described in **Chapter 3.9**. The Great Lakes, including Lake Ontario, which supplies most of the drinking water within the TRSPA, are exempt from this water quantity threat assessment and there are no riverine surface water intakes within the TRSPA.

Based on the results of the Tier 3 Water Budget, the following moderate existing drinking water quantity threats were identified:

- 15 municipal wells;
- 62 permitted, non-municipal wells; and
- 5506 non-permitted wells.

The risk assessment indicates that the York Tier 3 Local Area is classified at a moderate risk level because increases in pumping to meet allocated demand (amount allowed and required to meet current and planned growth under the current Permits To Take Water) are predicted to create a greater than 1 m incremental drawdown in other permitted wells and under provincially significant wetlands. Therefore, existing consumptive water uses and recharge reduction within the TRSPA portion of the WHPA

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	2
	Palgrave 2	1	1
	Palgrave 3	2	2
	Palgrave 4	1	1
York Region	Kleinburg 3	34*	14*
	Kleinburg 4		
	Nobleton 2	138	74
	Nobleton 3		
	Nobleton 5		
	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.

A number of spill scenarios were modelled as part of the Lake Ontario Collaborative 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 scenarios considered included:

- Disinfection failure at each Lake Ontario waste water treatment plant to evaluate the potential effects to nearby water treatment plants;
- Release of *E. coli* from an industrial processing facility into the Credit River;
- Combined sewer overflow release in the City of Toronto (this did not impact any TRSPA intakes);
- Sanitary Trunk Sewer breaks within Toronto area creeks;
- 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 at facilities in the Oakville area and in the Keele/Finch Area of Toronto; and
- Discharge of tritium from nuclear generating facilities at Pickering and Darlington. This did not impact any TRSPA intakes.

There are three categories of IPZs. The IPZ-1 is a one-kilometre circle around the intake if it is located in one of the Great Lakes. The IPZ-2 is the area where water can reach the intake in a specified time, two hours was used in the CTC. According to the MOECC *Technical Rules*, there can be no significant threats in an IPZ-1 or IPZ-2 if it is located in one of the Great Lakes, e.g., Lake Ontario. An IPZ-3 is delineated if modelling demonstrates that spills from a specific activity that is located outside IPZ-1 and IPZ-2 may be transported to an intake and result in a deterioration of the water quality at an intake. Since the vulnerability scores of IPZ-1 and IPZ-2 are not high enough to identify significant threats; the modelling approach can also be used for activities within IPZ-1 and IPZ-2 to determine if spills from a specific activity within these zones may reach the intake and result in deterioration of the water quality at an intake. If modelling in IPZ-1, IPZ-2 or IPZ-3 demonstrates this deterioration, the modelled threats are deemed to be significant drinking water threats under the provincial rules. The modelling results are also used to delineate event based areas within IPZs where modelled activities are deemed significant.

The selected Lake Ontario Collaborative spill scenarios were based on “real” events that have occurred in the past and were not based on extreme weather condition events at the time of the spill. The IPZ-3 for each threat activity was delineated by drawing a line from the location of the threat activity on shore where the contaminant is released to the affected intake along the shortest path within the area where concentrations were modelled to exceed the threshold for that contaminant.

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 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 Source Protection Region must have policies to address these significant drinking water threats that are located within the source protection area.

In addition, TRSPA has identified significant drinking water threats located outside of the TRSPA. These activities, although not enumerated in this 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 will bring this information to the attention of the source protection staff of the neighbouring source protection areas to ensure that policies are developed for them.

Although total annual runoff is projected to decrease as a result of future climate change, river and stream flows are expected to increase during the winter and decrease significantly during the summer, when demand is highest. Overall, Lake Ontario water levels are generally expected to decline slightly.

In general, communities dependent on surface water systems other than the Great Lakes will become increasingly susceptible to more frequent water shortages. However, the ability to access water in the Great Lakes through deepwater intakes reduces the water supply's vulnerability to drought, as do the interconnected water treatment and distribution systems, which allow sharing between plants during shortages.

TRCA staff is actively engaging consultants to minimize the effects of urbanization and climate change on the hydrology and hydrogeology across the TRSPA. Such work includes pilot projects for a wide variety of innovative stormwater management practices, including rainwater harvesting, green roofs, infiltration enhancements (e.g., pervious pavement, infiltration galleries).

6.2 DATA GAPS AND UNCERTAINTY

Overall, the information available at the time of writing was sufficient to characterize, delineate, and analyze vulnerability and threats. However, it is recognized that data and knowledge gaps do exist and should be addressed in order to enhance the value of the available data and the accuracy of conclusions being drawn from them. These gaps have been identified in **Table 6.2**.

In developing policies to address these significant threats, the CTC Source Protection Committee (SPC) and other SPCs in the Lake Ontario Collaborative must take into consideration the dynamic nature of the nearshore water quality in Lake Ontario. As shown in the modelled scenarios, contaminants released in one source protection area can travel to intakes throughout that area and beyond.

Additional work on assessing other spill scenarios and conditions is needed. The analyses done to date, while providing valuable and robust results, do not provide a complete identification of potential threats. What has been achieved is the calibration and validation of a model which can be used to assess nearshore impacts from the Region of Niagara in the west to Prince Edward County in the east. Peer review is underway on the model calibration and validation process but could not be completed within the time frame for this report. The peer review results will be considered when future updates of this Assessment Report are undertaken

Furthermore, there is the need to be able to do real-time modelling when a spill or other potential threat circumstance arise in order to predict where the contamination may travel and the expected peak concentrations and duration. This will provide municipal water treatment plant operators with the information needed to respond and determine their treatment options, including whether to stop taking water from the intake during the spill.

Further work is required to characterize the potential threats posed by water-borne pathogens other than *E. coli.* Preliminary work to identify the quantity and distribution of pathogens such as *Cryptosporidium* and *Giardia* was not sufficient to characterize the situation and identify where land-based activities are introducing these contaminants into the nearshore. However, based on the results of the *E. coli* scenarios, further work is required to identify the extent and sources of other pathogens to

assess whether a threat exists in the source water. There has also not been an adequate analysis of the threats posed by algae such as Microcystins or algal mats which can block water intakes.

The analysis undertaken does not address any threats due to cumulative releases of contaminants under non-spill situations to Lake Ontario water quality. The quality of the water at drinking water intakes within the TRSPA is generally very good based on the information provided by municipal plant operators. As discussed in **Chapter 5.8,** water quality in Lake Ontario may be affected by changes in climate. As the population the Lake Ontario basin continues to grow, there will likely be more water taken for drinking water along with more discharge of municipal sewage and possibly more industrial use of water and industrial discharges. Lake Ontario is the single most important source of drinking water for the people of Ontario.

The *Technical Rules* require a discussion of uncertainty associated with all technical components of the assessment report. In this Assessment Report the uncertainty level for the watershed characterization is low. For delineation, vulnerability, and scoring of the four vulnerable areas, the uncertainty level ranges from low to high due to limited data available to calibrate the model suites. Ongoing studies and continuous improvement built into water management programs serve to improve analyses and reduce uncertainty. Future editions of the TRSPA Assessment Report will reflect such improvements. Because of the combined uncertainties of delineation, vulnerability, and scoring and the lack of land-use data, the uncertainty level for threats assessment in the TRSPA jurisdiction is moderate to high.

For the IPZ-3 studies, pipeline spill scenarios were not completed for each tributary where the oil pipeline crosses. The actual location of travel of a contaminant will depend on the prevailing weather conditions at the time along with the characteristics of the spill and the contaminant which is released. The modelling work done to date does not reflect all of the conditions that might exist nor do the scenarios systematically assess the full array of potential threat activities.

The model assumed that each contaminant did not undergo any transformation during the time period for the model run. This assumption is reasonable in the case of tritium but will likely overestimate the concentrations of benzene over time which may evaporate or be chemically changed. *E. coli* are living organisms naturally found in the intestines of humans and warm-blooded animals and will die sometime after they have been released into the environment. The rate that *E. coli* will die is dependent on time, environmental conditions such as temperature, whether they are shielded by being attached to suspended particles or exposed to disinfecting chemicals. In general terms, *E. coli* survives for about 4-12 weeks in water at a temperature of 15-18°C. Normally waste water treatment plants disinfect the sewage prior to discharge to reduce the concentrations of pathogens, although this is not possible during a disinfection failure event.

Ongoing studies and continuous improvement built into water management programs serve to improve analyses and reduce uncertainty. Future editions of the Assessment Report will reflect such improvements. Because of the combined uncertainties of delineation, vulnerability, and scoring and the lack of land-use data, the uncertainty level for potential threats in the TRSPA jurisdiction is moderate to high.

Table 6-2: Approved Updated Assessment Report Data and Knowledge Gaps

Identified Data and Knowledge Gaps			
Knowledge Gaps			
Need to develop methodology and tools to provide analysis of spills response, which will involve all pathways, including overland flow, stream travel, and groundwater flow, including the unsaturated zone transport Need more detailed consideration of potential transport pathways Need more detailed scrutiny of SGRAs as they relate to drinking water systems Need more detailed scrutiny of HVAs, specifically shallow aquifer deposits			
Threats, Conditions, and Issues			
Component	**Data Set Name or Source**	**Data Gap Problem**	**Comment**
Threats in WHPAs	Significant threats	Lack of field verification	Additional field verification to further reduce inaccuracy
Knowledge Gaps			
Need updated ecological land classification and MPAC data Additional field verification to confirm land use activities Uncertainty regarding the number of animals and types of animals that a farm unit may hold			

6.3 NEXT STEPS

The CTC SPC has used the findings of this Assessment Report, to develop a source protection plan to address the significant drinking water threats identified in TRSPA. In developing the plan, the SPC consulted broadly within the source protection area and with various sectors and neighbouring source protection regions. Per the requirements of Section 19 (1) of the *CWA, 2006*, that updates be included prior to the approval of the source protection plan, this Assessment Report represents updates completed since the submission of the proposed CTC Source Protection Plan in 2012. The *Amended Proposed Source Protection Plan* was submitted for approval in conjunction with the submission of the updated Assessment Report and contains policies to address the additional significant drinking water threats that have been identified.

The SPC must develop policies in its source protection plan to address the 20 significant drinking water quality threats from activities to Lake Ontario intakes (located within the TRSPA jurisdiction), 462 significant drinking water quality threats, and 392 significant drinking water quantity threats to groundwater identified in this Assessment Report. The SPC may choose to develop policies in the source protection plan that address activities that are moderate or low drinking water threats.

Following approval of the source protection plan the source protection authority is required to prepare an annual public report that is submitted to the Minister of the Environment and Climate Change reporting on the implementation of the source Protection plan policies.

Additionally, per Section 36 (1) of the *CWA, 2006* the Minister will set the timeline for the revision of the source protection plan. The assessment reports serve as background documents for the plans, and therefore will also be updated to reflect new or revised data and knowledge as part of the revision process.