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 describes the physical features and water resources within the CLOSPA 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 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, we can determine the status and sustainability of drinking water, as required under the *CWA, 2006.* The identified vulnerable areas and risks are the focus of the source protection plan policies.

It should be noted that all municipal drinking water supplies for the CLOSPA jurisdiction come from Lake Ontario. The *Lake Ontario Collaborative Intakes Protection Zone Studies (2009),* provided us with raw water quality data from the municipal intakes in Lake Ontario that serve as the drinking water source for all municipal supplies in CLOSPA. In general, the Lake Ontario source water for the CLOSPA water treatment plants was of high quality. The operators reported the source as excellent, relatively predictable, and easy to work with, and that raw water quality fluctuations were the result of seasonal, weather-driven events. It should be noted that each of the water treatment plants (WTPs) located in CLOSPA uses a variety of water treatment methods to ensure that raw water from Lake Ontario is potable and aesthetically acceptable.

The analyses of the Watershed Characterization component of this Assessment Report revealed some increasing trends in drinking water quality parameters in shallow groundwater supplies that support private wells in the study area (increases in sodium and chloride associated with the application of road salt or natural geologic formation). Shallow wells are naturally vulnerable to impacts from land-use activities. Water well construction guidelines under *Ontario Regulation 903* (Water Wells) should be strictly adhered to.

Surface water quality is also generally good with some elevated levels in phosphorous, nitrates and copper (decreasing or no trend), and increasing trends observed with chlorides. Chloride levels while increasing are below ecosystem-based standards. Nitrate, phosphorus, and copper levels are often above the standards and are likely associated with nutrient application in agricultural and non-agricultural lands for nitrate and phosphorus and historical industrial land use for copper.

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 interpreting what constitutes important local watershed runoff events.

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 CLOSPA are used as a source of drinking water for private wells (5% of the population in the study area) 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 and other non-drinking water purposes.

Based on the Tier 2 Water Budget analysis the CLOSPA has determined that Lynde and Darlington creek watersheds were found to have moderate groundwater stress levels, and the Lynde, Goodman, Oshawa, Darlington, and Soper Creek watersheds have significant surface water stress levels during summer months. All other catchments in the study area have low-stress levels for both groundwater and surface water. Given that these stresses are not associated with municipal drinking water supplies, which are the focus of the *CWA, 2006* additional investigation and management will take place under the conservation authority's watershed protection programs. Since the *Technical Rules* exclude consideration of the Great Lakes in water budget stress assessment, Lake Ontario was not included in the water budget studies. The findings of the York Region Tier 3 study, completed in 2014 for stressed watersheds where municipal wells are located outside of CLOSPA, identified a very small WHPA Q1/Q2 area within CLOSPA has been included in this Assessment Report.

The vulnerability was assessed and scored in all vulnerable areas in CLOSPA – Highly Vulnerable Aquifers (HVAs) and Intake Protection Zones (IPZ-1s and IPZ-2s), following the *Technical Rules.* There are no Well Head Protection Areas (WHPAs) within the CLOSPA jurisdiction. The delineation of SGRAs located in the WHPA-Q1/Q2 vulnerable area were updated in this Assessment Report as a result of the York Tier 3 water budget analysis.

Vulnerability is considered together with provincial hazard scores outlined in the Provincial Tables of Circumstances 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 HVAs, IPZ-1s and IPZ-2s.

Significant threats must be addressed in the source protection plan and moderate and low threats may be addressed.

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 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 threat 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 must be evaluated and may be labelled 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 *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 *Technical Rules* (Provincial Tables of Circumstances). If and where these activities exist, they may constitute a moderate or low risk to drinking water supplies.

HVAs are areas susceptible to contamination moving from the surface into the groundwater. In the CLOSPA jurisdiction, there are large areas covered by saturated sand deposits that support many shallow wells. These aquifers are considered vulnerable to contamination that may cause deterioration of the water quality in water wells that use this source. Areas of high vulnerability are those with a score of 6 per the *Technical Rules.* The features associated with the transport pathways were assessed for vulnerability adjustment. Pits and quarries were the only pathways with sufficient data to justify vulnerability adjustment. Incidentally, shallow wells that are most vulnerable to water quality impacts are also vulnerable to water quantity impacts during periods of drought. Deeper aquifers that are thicker, and/or have a dense protective layer such as a till overlying them, are generally less vulnerable. Where these aquifers are closer to the surface (closer to the Lake Ontario shoreline) or are exposed such as in river valleys like the Enniskillen Valley they are more vulnerable.

The vulnerability of the HVAs was assessed using the Aquifer Vulnerability Index (AVI) method. The vulnerability in the affected areas was increased by one level. Where this resulted in a change from a vulnerability score of 4 to 6, the zone was defined as a HVA. Although minimum water well construction standards are set up in O. Reg. 903 under the *Ontario Water Resources Act, 1990*, extra caution should be taken when constructing wells in vulnerable aquifer areas.

There are no significant drinking water quality threats from activities, conditions, or issues in the CLOSPA HVAs

SGRAs are areas where the highest volume of recharge to the aquifers occurs and are delineated as part of the water budget process SGRAs are important water quantity areas—replenishing the aquifers that serve as a source of drinking water (including both municipal and other drinking water uses, such as private wells.

There are no significant drinking water quality threats from activities, conditions, or issues identified in the CLOSPA SGRAs. Subsequent to a Tier 3 Water Budget study conducted for York Region, the SGRAs for CLOSPA were re-calculated and re-mapped with the Tier 3 area now fully considered an SGRA.

There are eleven existing moderate drinking water quantity threats located within CLOSPA related to municipal drinking water supply wells outside CLOPSA as identified in the York Tier 3 water budget analysis. Lake Ontario is the only municipal source of drinking water in CLOSPA and Lake Ontario is not included in the water budget studies per the *Technical Rules.*

There are eight significant drinking water quality threats from activities identified for the Lake Ontario intakes located within CLOSPA. All municipal drinking water supplies in CLOSPA come from Lake Ontario**.**

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 WTPs;
- Release of *E coli* from an industrial processing facility into the Credit River (this does not impact any CLOSPA intake);
- Combined sewer overflow release in the City of Toronto to evaluate the potential effects to the Toronto WTPs (this does not impact any CLOSPA intake);
- Sanitary trunk sewer break within the Toronto creeks (this does not impact any CLOSPA intake);

- 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 facility in the Keele/Finch area of Toronto (this does not impact any CLOSPA intake) and in the Mississauga - Oakville area (this does not impact any CLOSPA intake); and
- Discharge of tritium from nuclear-generating plants at Pickering or Darlington.

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 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 Lake Ontario modelling identified eight locations of significant drinking water quality threats for Lake Ontario intakes within the CLOSPA. 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, CLOSPA has identified significant drinking water threats to the Lake Ontario intakes that supply CLOSPA's drinking water located outside of the CLOSPA. These activities, although not enumerated in this report, affect water treatment plants located in CLOSPA, and must be addressed through source protection plan policies developed in adjacent source protection areas. CLOSPA staff has brought this information to the attention of the SWP staff of the neighbouring source protection areas to ensure that policies are developed for them.

There are no significant drinking water quality threats from, conditions, or issues identified in this Assessment Report in any of the delineated vulnerable areas (WHPAs, HVAs, or IPZ1s, IPZ2s and IPZ3s).

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.

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 arises 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 microcystin 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 CLOSPA 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 of 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 assessment is low. For delineation, vulnerability, and scoring of the three vulnerable areas, the uncertainty level is high due to the limited data needed to calibrate the model suites.

For the IPZ-3 studies, pipeline spill scenarios were not completed for each tributary where the oil pipeline crosses. In order to assess the potential threat, additional hydraulic modelling work was done by CLOSPA staff using HEC-RAS software to determine if it would be reasonable to include other creeks not modelled in the oil pipeline break scenario in delineating an IPZ-3. Watercourses that were not included in the original pipeline rupture scenarios were reviewed to determine if similar contaminant transport characteristics were apparent. Where the oil pipeline crossed these additional watercourses, and they were located between other modelled tributaries and a particular intake, it was assumed that these watercourses may be delineated as an IPZ-3 for that intake. This greatly reduced the amount of hydrodynamic modelling required.

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 some time 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 in to water management programs serve to improve analyses and reduce uncertainty. Future editions of this 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 CLOSPA jurisdiction is moderate to high.

York Tier 3 Water Budget Uncertainty

A York Region Tier 3 study completed in 2014 for stressed watersheds where municipal wells are located outside CLOPSA identified a small area in CLOSPA that is within the delineated WHPA Q1/Q2 vulnerable area as discussed in this Assessment Report.

It is estimated that there is a low uncertainty in the assignment of the moderate risk level to the vulnerable area for the following reasons:

1. The factors contributing to uncertainty indicated a low underlying uncertainty for the risk assignment.
2. The moderate risk level is due in part to the potential significant impact on baseflow, provincially significant wetlands and other permitted water takings. Although there is only limited baseflow discharge measurements in the area and limited data on wetland stage, the areas affected are relatively distant from the municipal wells and impacts are likely to be less significant than those simulated under steady-state conditions.
3. Another important factor to consider is that the 2010-2011 municipal water takings represent a reduced taking compared to historic conditions. Total pumping was closer to maximum permitted takings in the 2007 to 2009 period, for example.

There is low uncertainty in the assignment of high tolerance to the local area. The high tolerance is due to the metres of additional drawdown in most wells, the integrated nature of the York municipal supply system, and the fact that a water supply pipeline from Lake Ontario is also available to meet municipal needs.

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 CLOSPA. 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 eleven significant drinking water quantity threats to municipal wells outside of CLOSPA, and eight significant drinking water quality threats to CLOSPA Lake Ontario intakes 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, implementing bodies are required to prepare annual reports to the source protection authority on the actions taken to

implement the significant threat policies directed to them. Thereafter, the source protection authority is required to prepare an annual public report that is submitted to the Minister of the Environment and Climate Change summarizing all 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 become a part of the approved plans, and therefore will also be updated to reflect new or revised data and knowledge as part of the revision process.