Chapter 8 - Topics for Additional Research

8.1 Summary of Data Gaps

This *Assessment Report* represents our use of the best available information at this time. Research for the report was constrained by *data gaps* that are described in detail by **Appendix 'K-1'**. *Data gaps* exist where it was not possible to fulfil a requirement of the Technical Rules: Assessment Report (MOE, 2009) (see **Appendix 'L-1'**) in this edition of the report. They can be sorted into three general categories:

- topics for which data may exist but are not currently accessible
- topics for which there are no existing data, and where data will likely need to be collected by others
- topics for which there are no existing data, but data could be collected in the future by the Cataraqui Region Conservation Authority (CRCA) and its partners in eastern Ontario.

The Cataraqui Source Protection Committee and CRCA will work with the Province of Ontario to fill as many of the gaps as possible over the coming years. In the interim, the Committee will be mindful of the precautionary approach when addressing topics for which there is uncertainty.

8.2 Anticipated Improvements for Subsequent Assessment Reports

The science of *drinking water* source protection will continue to improve over time. There will be opportunities in subsequent versions of this report to improve the volume and certainty of the findings. The following sections and **Appendix 'K-2'** describe potential improvements related to the collection and analysis of data, within the existing scope of the Technical Rules.

8.2.1 Water Budget

In some cases, there were not enough data to fully account for some variables of the *water budget*. More data particularly for *precipitation*, *evapotranspiration* and groundwater water levels would improve the *water budget* results. These data would also be helpful for identifying and mapping *significant groundwater recharge areas* (SGRA), *highly vulnerable aquifers* (HVA) and *wellhead protection areas* (WHPA).

8.2.2 Significant Groundwater Recharge Areas & Highly Vulnerable Aquifers

A majority of the improvements for SGRA delineations would come through field work. It would include confirmation of *recharge* and *discharge areas*. This could be done through a variety of methods. It could encompass taking specific location samples with a soil auger to confirm the surficial materials within the SGRAs that are identified in Chapter 5. Similar information could be used to confirm *highly vulnerable aquifers*, as the depth of the material is an important input for making that designation.

An additional possibility that appears to provide worthwhile results for *groundwater discharge* is radon testing of the water. Work along these lines has been conducted by researchers at Queen's University in the Tay River *watershed* (Gleeson et al., 2009) in the Mississippi-Rideau Source Protection Region. Some work has also been conducted by CRCA staff in conjunction with Queen's researchers at a few locations in the CSPA. This method of *discharge* testing appears to be a reasonable option for field *validation* of *groundwater discharge* in *streams*, and could be used to pinpoint specific *discharge* locations.

There is a challenge with one of the most important data sets used for both SGRA and HVA mapping, the Water Well Information System (WWIS). The precise geographic location of some of the wells in this database is known to be uncertain, and there are inconsistencies in the descriptions of the soil and rock materials in the well logs.

Both of these aspects could be improved over time. If there is a requirement to update the location of the well whenever work is done on the well (for example; pump maintenance), this could be added to the database to provide much better location information of all wells across the province. A pilot project in the Quinte Conservation area (XCG Consultants Ltd., 2003) made this recommendation, and estimated that if this practice were adopted, within ten years all active wells in the province would have updated location information. The remaining wells lacking updated information could then be inventoried; as they may be unused, or have long ago been abandoned or decommissioned.

With respect to the well log material, this problem might never be completely solved. However, guidelines could be established for the material descriptions used by well drillers, and training could be made available on the appearance and behaviour of particular materials. In addition, down-hole video footage of selected wells could be helpful to confirm the soils, rock, and fractures that they pass through.

8.2.3 Wellhead Protection Areas

The WHPA delineation work completed as part of the *drinking water* source protection initiative, and prior to it, has some of the same constraints as the regional-*scale* groundwater research, including the challenges associated with the WWIS data.

Specifically, more work on the soil depth, and the soil make-up in the vicinity of the WHPA will help with *recharge* estimates, and with the assessment of potential vulnerability. Two of the most important parts of a WHPA *model* are the *permeability* and *transmissivity* estimates. These can be estimated using multiple pumping/packer tests on the *monitoring* wells of the area. The variability of these values, especially in fractured *bedrock*, can make a substantial difference to the overall *model*, and the area the water comes from to supply the wells.

Having longer term records of the water level in wells (Provincial Groundwater Monitoring Network, supply, and *monitoring*), and how they change with time, and with c*limate* (*precipitation* events, season) will make a substantial difference in how the WHPA *model* is prepared, and the results.

Similar to the SGRAs and HVAs, the location of *recharge areas* is also very important to the WHPA *model*. Improvements to our knowledge of those areas would therefore also benefit the WHPAs.

8.2.4 Intake Protection Zones

The delineation of *intake protection zones* (IPZ) would also benefit from additional data and further research. For recommendations related to IPZ 3 on Lake Ontario and the St. Lawrence River, see Section 8.2.5.2 below.

Having extensive field data over a long period of record improves the accuracy of the *models* that are used to delineate IPZ. For the work on eastern Lake Ontario and the upper St. Lawrence River in Chapter 6, two years of field data were used. These data were used to extrapolate to a range of field conditions; greater certainty would be achieved with additional data. A more detailed *model* would also help to refine the IPZ delineations, but the existing *model* used the maximum available computing power.

Further field *monitoring* with respect to *discharge* locations (concentrations, flow rate) and *raw water* intakes (concentrations) would allow further work to try to connect *drinking water issues* to specific locations, allowing the confirmation of significant *drinking water threats*.

Long term water current and wind *monitoring* would also provide WTP operators with real time information during a spill event, and how vulnerable their intakes are to *contamination*.

Transport pathways were estimated using mapping of pipe, *stream* and ditch locations. In the future, more complete pipe data (particularly diameter and *slope*) could be used to more accurately calculate the extent of *transport pathways*, as it can be used to estimate flow velocity in the pipes. The same type of information could be used for *streams* and ditches to estimate how far up a *stream* a *transport pathway* should be considered, given the time for a spill to travel to the intake.

In addition to the field data, additional consideration of the time between a spill occurring and it being reported could be included in future IPZ work. Consideration for the storage time in the system (hours or days of water available), and the time needed to fill that storage, would be useful for the emergency management coordinators at each municipality. This knowledge would aid in the response time and for determining what steps should be taken if a spill were to occur near an intake, and whether the intake would need to be shut off.

The existing IPZ work on the Lake Ontario and St. Lawrence River intakes in the CSPA was based on field data collected during ice free situations. The findings therefore do not fully address the ice cover situations, which occur in most years. The researchers at Queen's University who completed the IPZ *modeling* for these intakes are working on a modified method that accounts for ice cover. Once it is ready, additional IPZ work could be conducted for the Cataraqui intakes. It is expected that the delineated IPZs (under ice cover) might be smaller than those delineated in ice free situations, and also that they may extend in different geographic directions.

8.2.5 Source Water Quality Issues and Threats

8.2.5.1 Additional Research on Issues

There currently is minimal information on *raw water* quality at the water treatment plants. *Raw water* testing is only required a few times a year, and the samples are only analysed for a short list of parameters. Additional testing, with more frequent scheduled testing throughout the year, and extra sampling sites would allow for more complete *raw water* analyses. Sampling the *raw water* at the intake, prior to chlorination, would also help to identify bacterial/*pathogenic drinking water issues*.

As discussed in Chapters 5 and 6, efforts to target sources of a *contaminant* contributing to a *drinking water issue* would be aided with up-*gradient* and upstream sampling for *contaminant* concentrations (this could lead to the delineation of *issue contributing areas*).

With respect to *watershed*-wide water quality information, the *monitoring* and analysis of groundwater quality has been relatively inactive over the past decade. A sampling program, with emphasis on identified *vulnerable areas*, would assist in the identification of *drinking water issues* on the landscape. This sampling program could include water quality sampling at private wells or the establishment of *monitoring* wells for water quality analysis.

8.2.5.2 Additional Research on Threats

Conditions

As noted in Chapter 4, further research on *conditions* is warranted. The lack of available data to demonstrate where *contamination* has actually occurred (and has not been cleaned up) has prevented the identification of *conditions* in this report.

The occurrence of locations that might reasonably be expected to include *conditions* has been investigated by the Cataraqui Region Conservation Authority on a preliminary basis. The following data sets were reviewed: Occurrence Reporting and Information System, National Analysis of Trends in Emergencies System, National Environmental Emergencies System, National Pollutant Release Inventory, Contaminated Sites on Federal Land, and Ontario Spills databases. Historical atlases, municipal insurance plans and maps were also reviewed.

An extensive list of locations of interest was prepared in 2009; it covered each *intake protection zone* and *wellhead protection area*. Numerous historic *activities* were documented for which no specific locations were recorded.

A scoping analysis was later completed in 2010 on the portions of the list for those zones and areas where the vulnerability score was eight or greater, thereby resulting in identified *conditions* being potentially significant *drinking water threats.* The relevant vulnerable areas are the *intake protection zones* (1 and 2) for Brockville, James W. King (Gananoque) and Sydenham, and the *wellhead protection areas* for Cana, Lansdowne and the Miller Manor.

The scoping analysis removed those locations from the original list where it was unlikely that the past *activity* was associated with one or more of the tests in Technical Rule 126 or an identified *drinking water issue* within the vulnerable area. About 450 locations of interest remain on the list for the relevant *vulnerable areas*.

Future research on this topic could include:

- Research in collaboration with the Ontario Ministry of the Environment on spills that have occurred in the *vulnerable areas*
- Consultation with one or more experts in *contaminated* sites, who would review the locations of interest and advise on the probability and potential volume and extent of *contamination*
- Additional scoping of those portions of the list that relate to moderate or low *drinking water threats*
- Application of the event-based (IPZ 3) approach to *threat* enumeration to locations of interest along the Lake Ontario and St. Lawrence River shorelines. This work would assess whether or not an *extreme event* outlined in the IPZ 3 *modeling* would result in *contaminants* from locations with a *condition* moving into the *intake protection zones* and deteriorating the *raw water* quality at the intake.

It is anticipated that sampling would be required to determine if past *activities* did in fact result in *conditions* that meet the criteria in Technical Rule 126, which generally describe certain quantities or volumes of *contamination* necessary for a *condition* to occur. Depending on the location and past *activity*, sampling data could come from existing brownfield *monitoring* programs or may require targeted sampling.

Event-Based (IPZ 3) Approach

As discussed in Chapter 6, a map of consolidated *intake protection zone* 3 was prepared for the eight municipal residential *drinking water system* intakes that draw water from either Lake Ontario or the St. Lawrence River within the CSPA. Further to this delineation, additional work relating to specific *discharge* locations and intakes was undertaken by the Cataraqui Region Conservation Authority in 2010 (CRCA, 2011) (see **Appendix 'L-11b'**).

Consideration was given to looking at various *discharge* scenarios (concentration, volume, etc.), and whether they may create a significant *drinking water threat* at the intakes. However, very few data for the *discharge* points were available for this work, resulting in a high level of uncertainty.

At this time, the information available to reliably identify significant *threats* to the intakes using the event-based approach is not available. However, further water quality *monitoring* at the intakes is recommended, and *monitoring* of selected *discharge* points (flow, concentration, etc.) should be considered. A further analysis based on these additional data would allow *discharge* points to be confirmed or disregarded as *threats*.

As more information is required in the identification of significant *threats* along the intakes, similarly, more information and modelling is required of the effect of large industry. As discussed in Chapter 6, there are several industrial facilities along the shoreline of Lake Ontario and the St. Lawrence River, many in very close proximity to the municipal intakes. As the intakes provide the source of our raw drinking water, more research and *modelling* is warranted to determine the effect, if any, by the *activities* of these large industries.

8.2.6 Imagery Analysis/Mapping

This *Assessment Report* uses Digital Raster Acquisition Project for the East (DRAPE) imagery from 2008. However, no comprehensive analyses of the imagery have been completed to date. For the purposes of Technical Rule 16 (mapping of managed lands and impervious surfaces) (MOE, 2009) in particular, *land cover* classification/analysis of the imagery would provide better estimates of impervious surface, and would improve estimates of managed lands.