Appendix A. Assessment Report

The approved Assessment Report: Cataraqui Source Protection Area (June 2011) Report is included on the DVD that is attached to paper copies of the Source Protection Plan, and can be downloaded from http://cleanwatercataraqui.ca/assessmentReport.html.

The content of this appendix consists of the summary from the Assessment Report: Cataraqui Source Protection Area (June 2011). All references made to maps, figures and chapters come from the Assessment Report.

Clean water is vital to all life. For people, clean and plentiful *drinking water* is essential for good health. The province of Ontario recognized the importance of *drinking water* when they established the drinking water source protection program and passed the Clean Water Act, 2006.

The *Assessment Report* represents the completion of a major phase of work in the drinking water source protection program for the Cataraqui Source Protection Area. This report pulls together the findings of 15 technical studies about local sources of *drinking water* and the risks that affect them.

The purpose of the *Assessment Report* is to identify areas where *drinking water* sources are vulnerable to *contamination* or over use and to prioritize *drinking water issues* and *drinking water threats* within those *vulnerable areas*. The document has been prepared in accordance with detailed technical rules prepared by the Ontario Ministry of Environment. The report will help us to prepare a *source protection plan* by 2012.

Participants in the Process

The process that we are following is spelled out in the Ontario Clean Water Act, 2006 and its regulations. It is guided by two bodies — the Cataraqui Source Protection Authority and the Cataraqui Source Protection Committee (SP Authority and SP Committee, respectively).

The SP Authority includes the 17 *members* of the Cataraqui Region Conservation Authority board plus a representative of the Township of Frontenac Islands.

The 16-*member* SP Committee includes representatives from the municipal, economic and community sectors.

Our other stakeholders and partners include municipalities, federal and provincial government agencies, community groups, businesses, residents and visitors.

Cataraqui Source Protection Area

The Cataraqui Source Protection Area is located at the eastern end of Lake Ontario and the upper part of the St. Lawrence River. It includes a portion of the Bay of Quinte, Hay Bay, the southern portion of the Rideau Canal and the Thousand Islands. It contains the 11 municipalities within the Cataraqui Region Conservation Authority jurisdiction plus the municipality of Frontenac Islands (Howe and Wolfe Islands).

The landscape is varied ranging from *Canadian Shield* and numerous lakes in the central area to the agricultural landscape of the *limestone* and clay plains of the south and west. The east contains significant amounts of sand and gravel.

There are 12 major *watersheds*. The two largest ones are the Cataraqui and Gananoque River *watersheds* in the central portion of the area. The western and eastern sections of the Cataraqui Source Protection Area are *drained* by several smaller *streams*.

Surface Water

Surface water quality and quantity vary across the CSPA due to differences in *geology*, land use and development. Data from the Provincial Water Quality Monitoring Network stations, the Lake Partner Program, bacterial beach data from local health units and Cataraqui Region Conservation Authority sampling of *inland lakes* and *streams* was used to assess *surface water* quality. A summary of the findings is provided below:

- chloride, sodium and *conductivity* concentrations are generally increasing, likely due to road salt application
- high levels of *phosphorus* are found throughout the Cataraqui Source Protection Area
- high bacteria levels are found near the Butlers Creek Provincial Water Quality Monitoring Network station and at beaches near the Bath, Gananoque and Brockville *drinking water* intakes.

Water flow patterns are generally very similar across the Cataraqui Source Protection Area with peak flows during the spring *freshet* and minimum flows during August and September. The 39 existing *water control structures* in the Cataraqui Source Protection Area have a significant effect on the flows in their respective watercourses. These include the Cataraqui and Gananoque Rivers, and Millhaven, Highgate, Little Cataraqui, Lyn and Buells creeks.

Groundwater

The Cataraqui Source Protection Area has shallow soils over fractured *bedrock*. This has an influence on groundwater quality and quantity.

Groundwater data in the Cataraqui Source Protection Area is quite limited. However, we do know that there are problems with groundwater quality and quantity.

Data collected through the Provincial Groundwater Monitoring Network and hydrogeological studies produced for proposed developments indicate that there are high levels of *hardness*, iron, manganese, sodium, chloride, fluoride and bacteria in some locations.

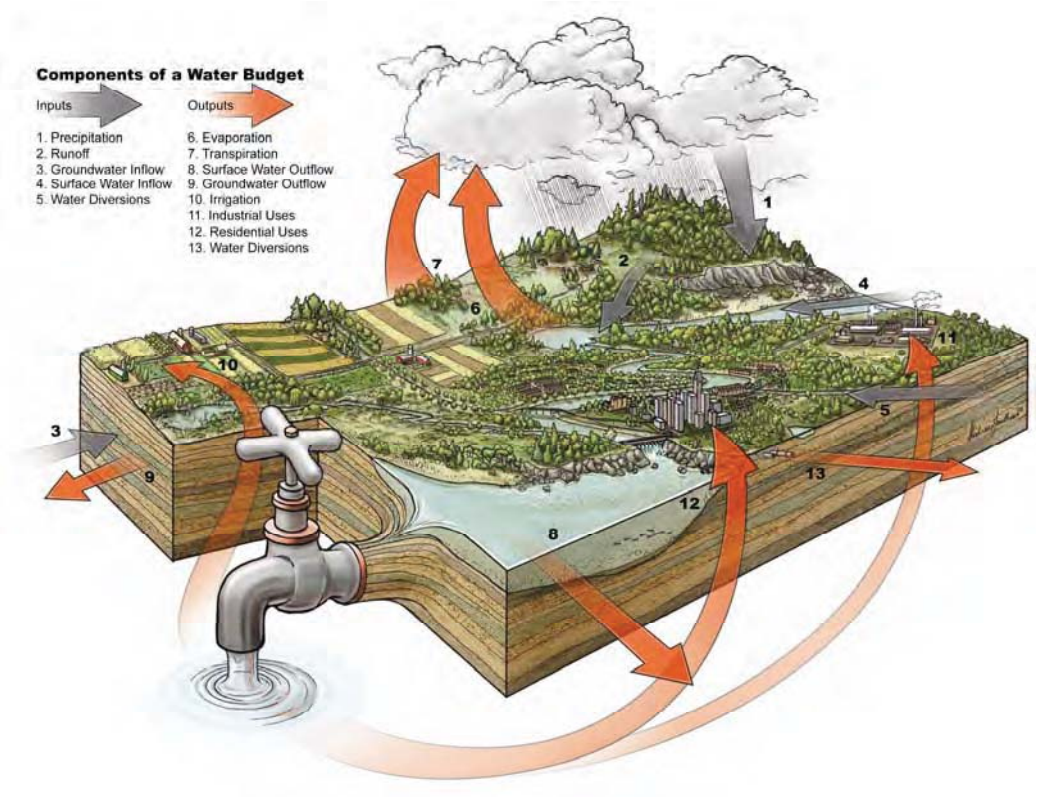
The amount of groundwater in the Cataraqui Source Protection Area is difficult to measure. There are approximately 20,000 private wells and numerous communal wells at campgrounds and trailer parks. In some areas, wells are known to go dry during extended periods of drought.

Water Budget

A *water budget* is very much like a financial budget. It accounts for all the water into and out of a *watershed*, including *surface water* such as lakes, *rivers* and *streams* as well as groundwater (water that is located under the ground). This includes *precipitation*, evaporation, transpiration, *runoff, infiltration, groundwater recharge* and storage in lakes, *wetlands* and *aquifers*.

For the purpose of preparing a *water budget* we answered four questions.

- Where is the water?
- How does the water move?
- What are the stresses on the water and where are they located?
- What are the trends in water levels or water use?



There are four required levels of *water budget* for drinking water source protection. Each level is more detailed than the previous one and can have different outcomes depending on the detail and assumptions of the *model* used. The decision on whether to prepare a higher level *water budget* is based on how much stress there is on water in the area being examined.

The *conceptual water budget* looked at the source protection area as a whole and calculated the *water budget* based on average annual values. The *conceptual water budget* found that the amount of water being used was very low compared to the amount of available water on an average annual basis.

The Tier 1 *water budget* examined 21 *subwatersheds* and calculated the *water budget* based on average monthly values. Looking at *surface water*, four *subwatersheds* had significant stress, six had moderate stress and the balance had low stress. When groundwater was assessed, only one *subwatershed* had significant stress, four had moderate stress and the balance had low stress.

The Tier 2 *water budget* looked in more detail at those areas deemed to have a moderate or significant stress at the Tier 1 stage, which also contain a municipal residential *drinking water*

system. Based on the stress assessment results at the Tier 1 stage, the Lansdowne and Sydenham *drinking water system* areas were selected to move forward to this stage of the *water budget* process. The Tier 2 analysis for Lansdowne found a low stress. Work on the Sydenham *water budget* indicated that a Tier 3 Water Budget needed to be done.

The Tier 3 water budget includes an even more refined approach looking at specific *local areas* where one can consider daily or hourly conditions. It looks at the *exposure, tolerance* and *risk* levels for the *local area* being examined.

For the Sydenham Tier 3 exercise, the storage in Sydenham Lake was considered with the main question being whether the withdrawal amount could or could not be met during regular and drought conditions. The outcome throughout all the simulated scenarios was that the Sydenham Lake never fell below the critical level, and sufficient water supply was expected. Therefore, the Tier 3 findings assign a low *risk* level to the Sydenham *local area.*

Source Water Quality Issue Evaluation and Threat Assessment

The process for assessing *risks* to *source water* quality is prescribed by the Ontario government. Rather than looking at all water everywhere, the source protection initiative in Ontario focuses on specific places where the *source water* is considered to be most vulnerable or sensitive to pollution and/or overuse. These places are called *vulnerable areas*. These *vulnerable areas* are either related to groundwater resources on a broad *scale* or to groundwater and *surface water* around municipal water treatment plants.

The *vulnerable areas* are defined as:

- *highly vulnerable aquifers* and *significant groundwater recharge areas*. As the Cataraqui Source Protection Area consists of a large percentage of shallow soils and fractured *bedrock*, these types of *vulnerable areas* occupy a substantial proportion of the landscape
- *wellhead protection areas* around a municipal well
- *surface water intake protection zones* around a municipal water intake.

The vulnerability to *contamination* of the lands and waters within each of these areas varies depending on the proximity to the well or intake, the degree of protection from pollution around the well or intake and other factors.

These areas are mapped and assigned vulnerability scores. The scores are between one (low) and ten (high). *Drinking water issues* are evaluated and *drinking water threats* are assessed in each *vulnerable area*. By assessing and ranking *drinking water threats* that could harm the quality of *source water*, local communities can make informed decisions about how to protect their water supplies.

The untreated source water within each *vulnerable area* is evaluated for the presence of *drinking water issues*. These are problems that occur when (selected) *chemicals* or *pathogens* are found in the water at a concentration that deteriorates its use as *source water*, or when it appears that this may occur in the future.

An example of a *drinking water issue* is salt (sodium chloride). It can come from natural sources, but it is also used in water softeners, to melt ice on roads and to sterilize swimming pools.

A *drinking water threat* is an *activity* or a *condition* that has harmed or could harm the quality or quantity of a *drinking water* source. The Ontario Ministry of Environment has prescribed a list of 21 types of *activities.* Source Protection Committees are able to propose the addition of other *activities* that are of special interest in their area. In 2010, the Cataraqui Source Protection Committee received approval by the Ministry to include two additional local *drinking water threats*: the use of conditioning salts in water softeners and the movement of specified substances (chemicals) along corridors such as Highway 401. This report assesses these local and prescribed *drinking water threats* and their *risk* posed to our *source water* within Chapters 5 and 6.

Conditions exist where there is *contamination* of the rock, soil and water from a past *activity.* They may result in *drinking water threats* if they meet certain tests which have been outlined by the province. At this time of this report, there is insufficient data on *conditions* that could result in *drinking water threats* within the Cataraqui Source Protection Area. This information may be available in future editions of the *Assessment Report*.

Groundwater

Groundwater resources in the Cataraqui Source Protection Area are generally characterized by the *geology*. Most people draw their water from wells that are either in *limestone*, *sandstone* or the *Precambrian* rock on the *Canadian Shield*. Water generally flows through small cracks or fractures of less than one millimetre in the rock. The fractures transmit the water from higher to lower levels through a network of cracks that is known as the rock *aquifer*. These rock *aquifers* are generally covered with a thin layer of sand and/or clay soil (also known as *overburden*), but most wells are drilled through to the rock.

Some parts of the Cataraqui Source Protection Area have thicker soil cover, which can act as a protective barrier to groundwater, especially when the soil mainly consists of clay. Areas with less soil cover tend to be highly vulnerable to surface *contamination* as random rock fractures can act as a direct conduit for *contaminants* to reach the groundwater.

Once groundwater is contaminated, it can be very difficult and expensive to clean up and sometimes it cannot be used as a source of potable water. We need to ensure that our groundwater resources can be used in the future.

As part of our area-wide study of groundwater resources, we have concluded that groundwater flow may not be the same as *surface water* flow, especially at deeper levels. For example, a portion of the groundwater flow in the Cataraqui Source Protection Area may flow northwest into the Mississippi-Rideau Source Protection Region through the underlying geological formations.

Highly Vulnerable Aquifers

Sources of groundwater or *aquifers* are considered to be *highly vulnerable aquifers* when there is an insufficient protective layer above the *aquifer*. Because of the complexity of the *geology* in the Cataraqui Source Protection Area, precise mapping of these *aquifers* is difficult. As a result vulnerability scores, which are dependent on the presence and thickness of overlying soil, could vary over very short distances.

A vulnerability assessment was completed using a 2002 amendment to the Ministry of Environment Intrinsic Susceptibility Index protocol. This method was also used by the adjacent

source protection regions, which have similar geology and groundwater characteristics. The findings are described in detail in Chapter 5.

Given the geological complexity of the Cataraqui Source Protection Area, with vulnerable *bedrock aquifers* very close to the surface, a majority of the Cataraqui Source Protection Area should be considered a *highly vulnerable aquifer* for the purpose of source protection planning. The *highly vulnerable aquifer* area is assigned a vulnerability score of six.

Chloride, sodium, nitrate, and microbiological contaminants (total coliform, fecal coliform and *Escherichia coli*) are considered to be *drinking water issues* in the *highly vulnerable aquifer*. The vulnerability scoring of the *aquifer* means that moderate and low-ranked *threats* may exist in that area. In accordance with provincial rules, these *threats* have not been counted for this report.

Significant Groundwater Recharge Areas

An *aquifer* is an area of soil or rock under the ground that has many cracks and spaces and has the ability to store water. Water that seeps into an *aquifer* is called *recharge*. Much of the natural *recharge* of an *aquifer* comes from rain and melting snow. The land area where the rain or snow seeps down into an *aquifer* is called a *recharge area*. *Recharge areas* often have loose or permeable soil, such as sand or gravel, which allows water to seep easily into the ground. Areas with shallow fractured *bedrock* can also be *recharge areas*.

A *recharge area* is considered significant when there is a relatively high rate of *infiltration* of water from the surface into the ground within that area. *Recharge* helps to maintain the water level in the *aquifers* that are used for *drinking water*.

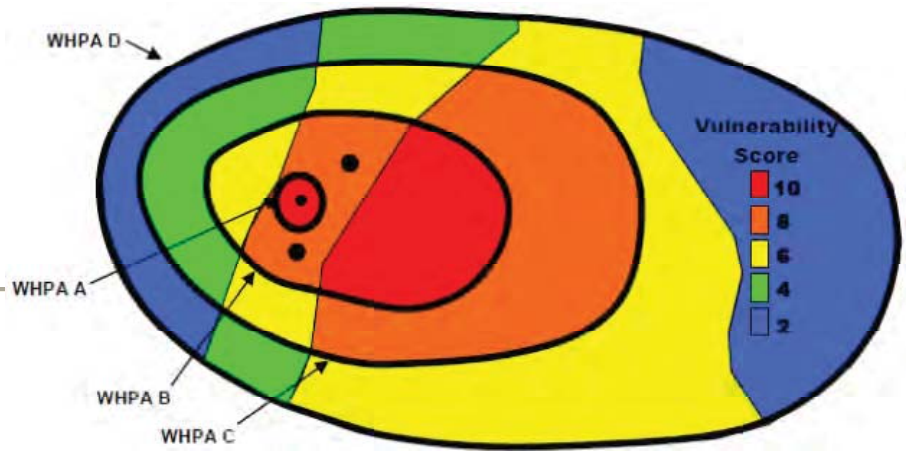
Identification of *significant groundwater recharge areas* in the Cataraqui Source Protection Area is challenging. *Bedrock* comprises the main *aquifer* in the region. Flow within this *aquifer* is through multiple complex fractures. The irregular *topography* in the *Canadian Shield* appears to produce locally controlled flow systems rather than *watershed scale recharge* and *discharge areas*.

A method prescribed by the province of Ontario has been used to identify and map the *significant groundwater recharge areas*. Because of the complex flow characteristics in the *watershed*, the mapped *significant groundwater recharge areas* should be confirmed in the future through field work and analyses. The *significant groundwater recharge areas* are assigned a vulnerability score of six, four or two.

Chloride, sodium, nitrate, and microbiological contaminants (total coliform, fecal coliform and *Escherichia coli*) are considered to be *drinking water issues* in the *significant groundwater recharge areas*. The vulnerability scoring of these areas means that moderate and low-ranked *threats* may exist in them. In accordance with provincial rules, these *threats* have not been counted for this report.

Wellhead Protection Areas

A wellhead is the physical structure of the well above the ground. A *wellhead protection area* is the area around the



wellhead where land uses and *activities* have the potential to affect the quality of water that flows into the well.

A *wellhead protection area* is delineated by mapping the *geology* and groundwater levels surrounding the wellhead and using this information to create a mathematical *model*. This *model* is used to predict the speed at which the groundwater is flowing toward the well and from which direction, depending on the pumping rate at the municipal well supply. Using the mathematical *model*, a series of areas are delineated based on the time it would take groundwater and a *contaminant* to reach the wellhead. They are as follows:

- *wellhead protection area* 'A' is a 100 metre radius around the wellhead
- *wellhead protection area* 'B' is the area within which the *time of travel* to the well is less than or equal to two years, but excluding *wellhead protection area* 'A'
- *wellhead protection area* 'C' is the area within which the *time of travel* to the well is less than or equal to five years, but greater than two years
- *wellhead protection area* 'D' is the area within which the *time of travel* to the well is less than or equal to twenty-five years, but greater than five years
- *wellhead protection areas* 'E' and 'F' are mapped to account for situations where the groundwater is under the direct influence of *surface water*; *wellhead protection area* 'F' is intended to capture additional areas that contain the source of a *drinking water issue* in the untreated water.

The vulnerability of the *aquifer* to *contamination* can be assessed within these areas. The Ministry of Environment has an established method for scoring vulnerability. Simply put, the more vulnerable the *aquifer* and the closer proximity to the well, the higher the vulnerability score.

To produce a vulnerability score, the first step is to determine how easily *contaminants* can enter the *aquifer*. Scores are assigned as low, medium or high for specific locations.

The next step is to determine if human *activity* in the *wellhead protection area* has altered the landscape making it easier for *contaminants* to reach the *aquifer*. These alterations are called *transport pathways*. *Transport pathways* can be ditches, other wells, pipelines or other man-made features.

Once the vulnerability of the *aquifer* has been finalized, the last step is to combine it with the *wellhead protection area* zones to determine the final vulnerability scores for the *wellhead protection area*. Possible scores are two, four, six, eight and ten.

The Cataraqui Source Protection Area contains three municipal wells:

- Cana Well Supply, City of Kingston
- Lansdowne Well Supply, Township of Leeds and the Thousand Islands
- Miller Manor Apartments Well Supply, Township of Front of Yonge.

A portion of the Westport's *wellhead protection area* (a limited extent of *wellhead protection area* 'D') is also located in the Cataraqui Source Protection Area. The well itself is located within the adjacent Mississippi-Rideau Source Protection Region.

Cana Well Supply

Cana is a small residential community located in the Kingston Mills area. It was established as a cooperative development in the early 1950s. Utilities Kingston operates a well, a Water Treatment Plant and a sewage treatment plant that serve 32 households in the community.

The *wellhead protection area* has been mapped and includes *wellhead protection areas* 'A' to 'E' (see **Map 5-12**). The sewage treatment plant, private residences, industrial areas, natural areas and transportation corridors are located within the *wellhead protection area*.

Vulnerability mapping has also been completed. Using the results of this mapping, vulnerability scores were calculated for all of the areas. The scores range from six to ten (see **Map 5-14**).

Drinking water issues of total coliform and *Escherichia coli*, chloride and sodium were found in untreated water for this system. Further study is needed to determine the source.

An assessment of *threats* was conducted within the *wellhead protection area* around this water treatment plant. For existing *activities*, we found 23 locations with significant *threats*, 44 with moderate *threats* and nine with low-ranked *threats*. This represents a total of 76 enumerated parcels and 95 individual *threats*.

Lansdowne Well Supply

The village of Lansdowne has two wells that supply its water. The wells and water treatment facility are operated by the Ontario Clean Water Agency.

The *wellhead protection area* has been mapped and includes *wellhead protection areas* 'A' to 'D' (see **Map 5-20**). Vulnerability scoring is shown in **Map 5-22**. The scores range from six to ten.

Total coliform and *Escherichia coli* are considered to be *drinking water issues* in the untreated water for this system. Further study is needed to determine the source.

An assessment of *threats* was conducted within the *wellhead protection area* around this water treatment plant. For existing *activities*, we found 64 locations with significant *threats*, 106 with moderate *threats* and 41 with low-ranked *threats*. This represents a total of 211 enumerated parcels and represents 254 individual *threats*.

Miller Manor Apartments Well Supply

Located in the village of Mallorytown, Miller Manor Apartments is a 17-unit apartment building operated by the United Counties of Leeds and Grenville. Its water is supplied by a well and treatment system operated by A.J.'s Water Treatment.

The *wellhead protection area* has been mapped and includes *wellhead protection areas* 'A' to 'D' (see **Map 5-28**). Private residences, commercial areas, a school, natural/undeveloped areas, transportation corridors, recreational and agricultural areas are located within the *wellhead protection area*.

Vulnerability mapping has also been completed (see **Map 5-30**). The scores range from four to ten.

Total coliform, *Escherichia coli*, chloride, sodium and nitrate are all considered to be *drinking water issues* in the untreated water for this system. Further study is needed to determine the source.

An assessment of *threats* was conducted within the *wellhead protection area* around this water treatment plant. For existing *activities,* we found 20 locations with significant *threats,* 22 with moderate *threats* and 79 with low-ranked *threats*. This represents a total of 121 enumerated parcels and represents 185 individual *threats*.

Westport Well Supply

Westport is located within the adjacent Mississippi-Rideau Source Protection Region. Two wells supply about 650 people with *drinking water*. It is being included in this *Assessment Report* because a small part of the *wellhead protection area* extends into the Cataraqui Source Protection Area.
The *wellhead protection area* has been mapped and includes *wellhead protection areas* 'A' to 'D' (see **Map 5-36**). Part of *wellhead protection area* 'D' (about 0.5 kilometres of the total length) is located within the Cataraqui Source Protection Area.

Vulnerability mapping has also been completed (see **Map 5-38**). The vulnerability score in *wellhead protection area* 'D' are two and four.

An assessment of *threats* was conducted within the portion of this *wellhead protection area* that falls within the Cataraqui Source Protection Area. For existing *activities,* we found no locations with significant *threats,* none with moderate *threats* and one with a low-ranked *threat.*

For additional information about the Westport *wellhead protection area,* please refer to the *Assessment Report* for the Mississippi-Rideau Source Protection Region.

Surface Water Sources

The larger urban communities within the Cataraqui Source Protection Area rely on *surface water* for their *municipal drinking water systems*. The communities of Brockville, Gananoque, Kingston, Amherstview, Odessa, Bath, Napanee and Sandhurst Shores all get their *drinking water* from Lake Ontario or the St. Lawrence River. The village of Sydenham gets its *drinking water* from Sydenham Lake.

Intake Protection Zones

The purpose of an *intake protection zone* is to delineate a potentially *vulnerable area* around a municipal *surface water* intake. According to Ministry of Environment Technical Rules each intake may be surrounded by three zones — *intake protection zones* 1, 2 and 3.

The mapping of these zones depends on the location of the intake. There are four different types of intakes:

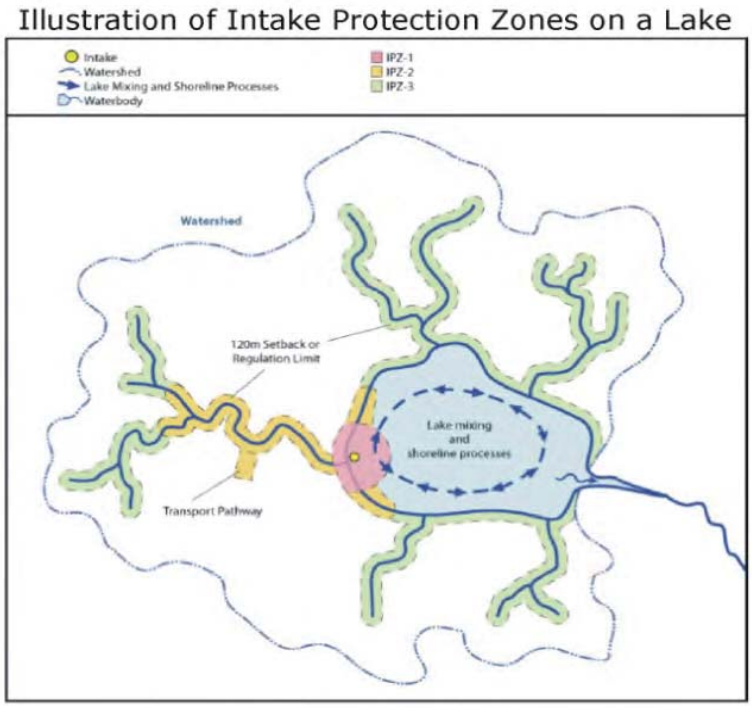
- Type 'A' – Great Lakes (example: Lake Ontario)
- Type 'B' – *Connecting Channel* (example: St. Lawrence River)
- Type 'C' – Rivers (not affected by a dam)
- Type 'D' – Other.

The Cataraqui Source Protection Area has Type 'A', 'B' and 'D' intakes. There are no Type 'C' intakes in the Cataraqui Source Protection Area.

Intake protection zone 1 is a set area, generally a one-kilometre radius around the intake.

Intake protection zone 2 is defined by the movement of water and is sized to encompass a two-hour *time of travel* for a *contaminant* to reach the intake.

Intake protection zone 3 is an area of special interest. For the Type 'A' and 'B' intakes, it is the area in which *contaminants* could reach the intake during and after a large storm. For Type 'D' intakes, it is defined based on the lakes and *streams* that contribute water to the intake.



Lake Ontario-St. Lawrence River Intakes

There are eight municipal intakes along the Lake Ontario and St. Lawrence River shoreline in the Cataraqui Source Protection Area. They are:

- Brockville
- James W. King – Gananoque
- Kingston Central
- Point Pleasant – Kingston
- Fairfield – Amherstview and Odessa
- Bath
- A.L. Dafoe – Napanee
- Sandhurst Shores.

While the A.L. Dafoe intake is located in the Cataraqui Source Protection Area, the community it serves (Napanee) is actually located in the adjacent Quinte Source Protection Region.

The *intake protection zone* for the Picton intake, also located in the Quinte Source Protection Region, extends into the Cataraqui Source Protection Area.

The eight municipal intakes listed above were all part of a technical study conducted by the Centre for Water and the Environment at Queen's University. This study *modeled* winds, water currents and weather patterns to delineate *intake protection zones* for each of these intakes. These are shown in **Maps 6-1** to **6-58**.

Vulnerability scoring for each of the eight intakes was also undertaken as part of this study. The calculation of this scoring is laid out in the Ministry of Environment technical rules.

Brockville

The Brockville water treatment plant is operated by the City of Brockville. It serves 22,000 residents of Brockville and 1,000 residents of the Township of Elizabethtown-Kitley. The intake pipe is located in the St. Lawrence River (see **Maps 6-1** and **6-2**).

Vulnerability scores help us to measure how vulnerable the *drinking water* source is to *contamination* (see **Map 6-3**). The vulnerability scores are nine for *intake protection zone* 1 and 8.1 for *intake protection zone* 2. This means that the water is very susceptible to *contamination*.

Escherichia coli is considered to be a *drinking water issue* in the untreated water for this system. Further study is needed to determine the source.

An assessment of *threats* was conducted within the *intake protection zone* 1 and 2 around this water treatment plant. For existing *activities,* we found three locations with significant *threats,* 293 with moderate *threats* and eight with low-ranked *threats*. This represents a total of 304 parcels with 356 individual *threats*.

James W. King (Gananoque)

The James W. King WTP is operated by the Town of Gananoque. It serves 5,200 residents of Gananoque. The intake pipe is located in the St. Lawrence River (see **Map 6-9**).

The vulnerability scores are nine for *intake protection zone* 1 and 8.1 for *intake protection zone* 2 (see **Map 6-10**). This means that the water is very susceptible to *contamination.*

There are no substances considered to be a *drinking water issue* in the untreated water for this system.

An assessment of *threats* was conducted within the *intake protection zone* 1 and 2 around this water treatment plant. For existing *activities,* we found one location with significant *threats,* 166 with moderate *threats* and 12 with low-ranked *threats*. This represents a total of 179 parcels and 229 individual *threats*.

City of Kingston

The City of Kingston is served by two *drinking water* treatment plants, one in the central part of the city (Beverley Street) and one in the western part (Point Pleasant). Both plants draw their water from Lake Ontario (see **Maps 6-16** and **6-23**).

The Kingston Central plant serves a population of 80,000 while the Point Pleasant plant serves 44,000 people.

The vulnerability scores for both plants are six for *intake protection zone* 1, which is considered moderate. For *intake protection zone* 2, the Kingston Central plant scores 4.8 while the Point Pleasant plant scores 4.2 (see **Maps 6-17** and **6-24**). This means that the water is somewhat susceptible to *contamination.*

There are no substances considered to be a *drinking water issue* in the untreated water for these systems.

An assessment of *threats* was conducted within the *intake protection zone* 1 and 2 around these water treatment plants. For existing *activities* around Kingston Central, we found no locations with significant *threats,* one location with a moderate *threat* and 101 locations with low ranked *threats*. This represents a total of 102 parcels and 115 individual *threats*.

A count of *activities* around Point Pleasant found no significant or moderate *threats*. However, there are ten parcels with low-ranked *threats,* representing 14 individual *threats*.

Loyalist Township

Loyalist Township has two *drinking water* treatment plants. The Fairfield plant (**Map 6-30**) is located in Amherstview and serves 8,620 people in Amherstview, Odessa, Harewood and Brooklands. The Bath plant (**Map 6-37**) serves 1,800 residents in the community of Bath and 550 inmates in the Millhaven and Bath Institutions. Both of the plants draw their water from Lake Ontario.

The vulnerability scores for both plants are seven for *intake protection zone* 1 and 6.3 for *intake protection zone* 2 (see **Maps 6-31** and **6-38**). This means that the water is susceptible to *contamination*.

Total coliform is considered to be a *drinking water issue* in the untreated water for the Fairfield plant. Organic nitrogen and *Escherichia coli* are considered to be *drinking water issues* in the untreated water for the Bath water treatment plant.

An assessment of *threats* was conducted within the *intake protection zone* 1 and 2 around these water treatment plants. For existing *activities,* we found no parcels with significant *threats* at either the Fairfield or Bath *intake protection zones.* Existing *activities* around the Fairfield *intake protection zone* included seven moderate *threats* and 173 low-ranked *threats*. This represents a total of 180 parcels with 220 individual *threats*.

The Bath *intake protection zone threat* activities result in 34 moderate *threats* and 82 low-ranked *threats,* representing a total of 116 parcels and 309 individual *threat* counts.

Town of Greater Napanee

The Town of Greater Napanee has two *drinking water* treatment intakes in the Cataraqui Source Protection Area. The A.L. Dafoe intake serves 10,000 people in the town of Napanee, which is located in the Quinte Source Protection Region (see **Map 6-44**). The Sandhurst Shores water treatment plant serves 230 residents in the Sandhurst Shores subdivision (see **Map 6-51**). Both of the plants draw their water from Lake Ontario.

The vulnerability scores for both plants are seven for *intake protection zone* 1 and 5.6 for *intake protection zone* 2 (see **Maps 6-45** and **6-52**). This means that the water is susceptible to *contamination*.

There are no substances considered to be a *drinking water issue* in the untreated water for either water treatment plant.

An assessment of *threats* was conducted within the *intake protection zone* 1 and 2 around these water treatment plants. For existing *activities* around the A. L. Dafoe plant and the Sandhurst Shores facility, we found no parcels with significant *threats*. Existing activities around the A.L. Dafoe *intake protection zone* included six locations with moderate *threats* and 21 locations with low-ranked *threats*. This represents 27 parcels and 67 individual *threat* counts.

For moderate and low *threats* around the Sandhurst Shores *intake protection zone*, we found seven moderate *threats* and 179 parcels with low-ranked *threats*. This represents 186 parcels and 345 individual *threat* counts.

Picton

The Picton water treatment plant intake is located in the Quinte Source Protection Region. The *intake protection zone* 3b for the plant is partially located within the Cataraqui Source Protection Area. The intake is located in the Bay of Quinte, part of Lake Ontario (see **Map 6-59**).

The vulnerability score for the portion of *intake protection zone* 3 that falls within the Cataraqui (*intake protection zone* 3b) is six (see **Map 6-60**). This means that the water is susceptible to *contamination*.

An assessment of *threats* was conducted within the portion of the Picton *intake protection zone* 3b that falls within the Cataraqui Source Protection Area. For existing *activities*, we found no locations with significant *threats*, 13 with moderate *threats* and 32 with low-ranked *threats*. This represents 45 parcels and 173 individual threat counts.

For additional information about the Picton Intake, please refer to the *Assessment Report* for the Quinte Source Protection Region.

Sydenham

There is only one inland *municipal drinking water system* intake in the Cataraqui Source Protection Area. It serves 940 residents in the village of Sydenham in the Township of South Frontenac. The intake is located in Sydenham Lake.

Intake protection zones 1, 2 and 3 have been delineated and are shown on **Map 6-66**. *Intake protection zone* 1 has a vulnerability score of nine. *Intake protection zone* 2 has a vulnerability score of 8.1. *Intake protection zone* 3a is scored 6.3. The higher the score, the more vulnerable the area is to *contamination*.

Dissolved organic carbon is considered to be a *drinking water issue* in the untreated water for the plant.

An assessment of *threats* was conducted within the *intake protection zones* 1, 2 and 3 around this water treatment plant. For existing *activities*, we found three locations with significant *threats*, 168 with moderate *threats* and five with low-ranked *threats*. This represents 176 parcels and 309 individual *threat* counts.

Potential Impacts from Climate Change

Climate change has potential implications for both water quantity and quality. It is clear that our c*limate* is changing, but which aspects of our c*limate*, how much they may change in the future and what impacts this may have in the Cataraqui Source Protection Area is unknown.

Climate change impacts occur on a regional *scale*. The current research looks at areas as large as eastern Ontario, eastern Canada or the northeastern United States. This research suggests that for our area we can expect an increase in temperature, more winter *precipitation* which may be in the form of rain or snow, small increases in *runoff* and more frequent heavy *precipitation* events. These changes could have the following *impacts*:

- more *evapotranspiration* due to higher temperatures and less *runoff* to *streams* and *recharge* to groundwater
- more *precipitation* falling as rain rather than snow
- more frequent heavy *precipitation* may cause more flooding and *erosion*.

Impacts on water quantity could include less water available in lakes and *wetlands* and consequently less supply for *drinking water*. This could lead to lower lake levels in the summer causing problems for recreational boating and swimming as well as commercial shipping.

Less water recharging into the ground could result in lower groundwater levels, dry wells and even dry *streams* and lakes.

There could also be *impacts* on water quality. Warmer winters could allow for more pests and invasive species. Warmer weather could also lead to more algae, requiring increased treatment at water treatment plants. Cyanobacteria (blue-green algae) are of special concern. Higher temperatures, more sunny days, and increased *nutrient runoff* into *surface waters* have the potential to increase the toxic blooms of these algae. However, other *climate* change factors may cancel out the effect of these conditions on the growth of cyanobacteria.

Lower streamflows and water levels in lakes may mean an increased concentration in the amount of *contaminants* in *surface water*. More intense storms could also result in more *contaminants* being washed into *surface water*.

Climate change may also mean changes to the *vulnerable area* definitions around municipal intakes and wells.

For *wellhead protection areas*, more *precipitation* may mean more *contaminants* flowing into the area via *transport pathways*, which will increase the vulnerability of these areas. Drier conditions and less *recharge* may mean lower overall flow rates, resulting in larger *wellhead protection areas*.

For *intake protection zones*, more frequent storms could mean increased vulnerability due to more *contaminants* being washed into the water. It could also mean increased streamflow, which could increase the size of some *intake protection zones*.

Warmer temperatures may result in lower water levels, exposing some intakes to the surface and surface *impacts*. A shorter ice cover period may make additional *activities* such as a longer shipping season a possibility, increasing the possibility of more spills.

Water *conservation* measures, increased *monitoring*, more research, protecting *recharge areas* and reducing greenhouse gas emissions are all measures that can be used to reduce *impacts* of or adapt to climate change.

Topics for Additional Research

In preparing background studies for the *Assessment Report* a number of *data gaps* and topics for additional research were noted. The Cataraqui Source Protection Committee and CRCA will work with the province of Ontario to fill as many of these *data gaps* as possible over the coming years. In the interim, the Committee will consider these *data gaps* and other topics and take a precautionary approach when addressing topics where there is uncertainty.

The additional research will allow for the continuous improvement of the report. Some of the key topics for work over the longer term include:

- The collection of additional data particularly for *precipitation*, *evapotranspiration* and groundwater water levels. These data would improve the certainty of our findings related to *water budgets*, *significant groundwater recharge areas*, *highly vulnerable aquifers* and *wellhead protection areas*.
- Further research on the complex *geology* and *hydrogeology* of the Cataraqui Source Protection Area. Most of the current research relies on water well records which may be inaccurate. Where there are few wells, there are very little usable data. There are opportunities to improve the reliability of future records.
- The collection of additional data in Lake Ontario and the St. Lawrence River would capture a wider range of actual wind conditions, waves, and water currents in different years. This would improve the accuracy of the *intake protection zones* on the lake and *river*.
- Research on the extent of *intake protection zones* during the winter season (ice cover) would advance our understanding of how *contaminants* move in the water throughout the year.
- Further research on *conditions* is warranted. There is a lack of available data to demonstrate where *contamination* has actually occurred and similarly, where *contamination* has been cleaned up. These limitations have prevented the identification of *conditions* in this report.

Key Findings

A summary of the key findings of the *Assessment Report* is provided in Chapter 9. It includes an overall summary of the *drinking water issues* and *drinking water threats* found in all of the *vulnerable areas*.