

Executive Summary

This report is the first step in evaluating *source water* in the Cataraqui Source Protection Area (CSPA). It provides base information for the synthesis of a final *assessment report* which is the foundation of the *source protection plan* for the CSPA.

The CSPA is located at the eastern end of Lake Ontario and the beginning of the St. Lawrence River. It includes a portion of the Bay of Quinte, Hay Bay, the southern half of the Rideau Canal and the Thousand Islands of the St. Lawrence River. It includes 11 municipalities within the Cataraqui Region Conservation Authority (CRCA) jurisdiction plus the municipality of Frontenac Islands (Howe and Wolfe Islands) and about 1,800 smaller islands in the St. Lawrence River (see **Figure 1-2**).

The area is characterized by the exposed bedrock, lakes and woodlands of the *Canadian Shield (Frontenac Axis)* in the central part of the area, and the agricultural landscape of the *limestone* and clay plains to the south and east. Urban development is concentrated along the shoreline of Lake Ontario and the St. Lawrence River.

Stakeholders and Partners

The diversity of the local landscape is reflected in the range of interested stakeholders within our *watersheds*. Our stakeholders and partners include municipalities, federal and provincial government agencies, community groups, businesses, residents, and visitors. In addition to working closely with our municipalities, we also work with local health units and provincial and federal government agencies. A variety of community organizations and individuals representing agriculture, cottagers, industry, the environment and recreation help to round out our stakeholder organizations and represent the various interests in our area.

Geology and Soils

The physical landscape of the CSPA is highly variable, both topographically and geologically. The bedrock geology ranges from the *Precambrian igneous and metamorphic rocks* of the *Canadian Shield* in the central area, to the *Middle Ordovician sedimentary rocks* in the eastern and western portions of the CSPA.

The surficial geology ranges from clay plain and *drumlins* in the west, to exposed bedrock in the central area, to sand, gravel, *till* and exposed rock in the east. A large part of the CSPA is characterized by shallow soil cover over bedrock. The physiography ranges from *limestone* plain to a rolling rock surface with depressions filled with clay or water. Soils vary between clay and *loam*, with some sand and gravel deposits, and some *peat* and *Muck* areas, as well as various combinations of these. The major soil types are Lansdowne and *Napanee Clay*, as well as *Farmington Loam*.

The largest total land cover in the CSPA is woodland at approximately 46 percent, followed by agriculture at approximately 43 percent.

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The topography of the CSPA ranges in elevation from about 74 m GSC (Geodetic Survey of Canada) along the shoreline of Lake Ontario and the St. Lawrence River to about 209 m GSC in the central north portion of the region, near Canoe Lake.

Lakes, Rivers and Streams

There are 12 major *watersheds* in the CSPA. The two main rivers, the Cataraqui and the Gananoque, flow in southerly directions through the central part of the region to Kingston and Gananoque, respectively. The western and eastern sections are drained by several smaller streams.

There are 39 dams and structures currently in operation. These have a significant influence on the hydrology of the CSPA.

Historically, there have been a number of mill dams across the CSPA, dating from as early as the 1700s. In most cases, these structures have been removed. Some of these historic structures have been maintained or re-constructed to form some of the structures we have today.

Groundwater

Generally, the groundwater flow follows the topography, flowing south towards Lake Ontario and the St. Lawrence River.

Three recent groundwater studies have been completed in the CSPA, the United Counties of Leeds and Grenville Groundwater Management Study (Dillon, 2001), the Western Cataraqui Region Groundwater Study (Trow, 2007) and the Frontenac Islands Groundwater and Aquifer Characterization Study (CSPA, 2007). All used the Ontario Ministry of the Environment (MOE) water well database to determine depth to water table, thickness of geological units, as well as groundwater flow direction.

Additional information such as *recharge* areas, *discharge* areas, direction of groundwater flow, material composition, properties and depositional environment of aquifers is yet to be included in this report, but should be available once the on-going groundwater research is completed.

At this time, we have limited data on the influence of surface water on groundwater, and vice versa. Base flow surveys have been conducted to identify the extent of groundwater *discharge* to streams. There is very little base flow data across the *watershed*, and this is a significant data gap for the SWP program.

Although most streams in the CSPA are warm water, and many go dry over the summer months, indicating a lack of groundwater contribution, there are identified *cold water systems* (lake and stream) in the CSPA. *Cold water systems* can be an indicator of groundwater contributions. Part of our ongoing research is to identify the *recharge* areas that contribute groundwater to these coldwater systems. Two years of temperature monitoring in area streams has occurred (i.e. 2006 and 2007) and some locations have been identified for further investigation, as they may be cold water sites.

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Vegetation

Wetlands, wooded areas and vegetated buffers can protect drinking water sources by trapping sediments and soils, and by altering or reducing contaminants, nutrients and some pathogens before input to surface and groundwater sources.

The CSPA benefits from a relatively high percentage of wetland cover, especially on the *Frontenac Axis*. The overall percentage of wetland cover, based on our review of provincial data, is about 5.7 percent.

About 46 percent of the land is covered by woodlands, based on our review of provincial data. The actual coverage varies from about 30 percent in the west, to 60 percent or more on the *Frontenac Axis*, and about 50 percent in the east.

Work on the Central Cataraqui Region Natural Heritage Study (CRCA, 2006a) found that the overall percentage of woodland cover appears to be slowly increasing. The Study applies only to the City of Kingston and Loyalist Township; however, similar trends are noted in the balance of the CSPA. This overall increasing trend was observed through examination of landsat images presented in the Landsat Image Analysis for the Cataraqui Region Conservation Authority Final Report (Dendron Resource Surveys Incorporated, 2007).

Fish and Wildlife

Fish populations are often used as an indicator of general water quality and temperature. The CSPA is known for both warm and cold water fisheries, as well as the associated tourism and recreation activities. There are Walleye in Lake Ontario, Muskellunge in the St. Lawrence River, and Lake Trout in the cold water lakes of the interior. There are few cold or cool water streams; however it is known that Willys Brook in the Gananoque River *watershed* supports a population of brook trout. There is a long tradition of recreational fishing in the area, and there are numerous lodges and outfitters to serve this business.

Aquatic macroinvertebrates are an important indicator of ecosystem health. They are a more sensitive indicator of habitat disturbance, such as erosion, or of chemical contamination, than standard chemical monitoring. The CRCA now participates in the Ontario Benthos Biomonitoring Network. To date, aquatic macroinvertebrate monitoring has been conducted in 2003, 2004, 2005 and 2007 at various locations. A majority of the sites were found to be potentially impaired, based on the species that were present.

The needs of humans and other animals often clash when wetlands, marshes, shorelines or forests are cleared for human habitation. The CSPA is home to 13 *endangered* or *threatened* species (according to the Species at Risk Act), as well as three species of *special concern*. Of these, six are *endangered* species — four birds and two plants. The Ministry of Natural Resources (MNR) Natural Heritage Information Centre (NHIC) list includes five additional *endangered* species and 12 *threatened* species or species of concern.

The CSPA has been affected by a variety of invasive species, ranging from plants such as Purple Loosestrife (*Lythrum salicaria* L.); fish such as the Sea Lamprey (*Petromyzon marinus*), Round

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Goby (*Neogobius melanostomus*) and Common Carp (*Cyprinus carpio*); and invertebrates such as the Zebra mussel (*Dreissena polymorpha*).

Population

According to Statistics Canada, the population of the CSPA was about 199,000 in 2001. The majority of people live in the City of Kingston (about 114,000 residents), with the next largest centre of Brockville having about 21,000 residents.

The overall population of the CSPA grew at a rate of about 0.5 percent per year between 1991 and 2001. The greatest increase was experienced in the Township of South Frontenac, while the City of Brockville, the City of Kingston, and the Town of Gananoque experienced the lowest population growth during that time.

The Ontario Ministry of Finance population projections (2004-2031) anticipate overall growth in Ontario of about 1.2 percent over the first decade (2004-2014), 1.0 percent during the second decade (2015-2024), and 0.8 percent for the balance of the period (2025-2031).

Combining knowledge from the City of Kingston Urban Growth Strategy (J.L. Richards & Associates Ltd.) with Statistics Canada data, it is known that approximately 86,000 residents live outside of the City of Kingston in the CSPA. According to Ministry of Finance projections, the population outside the City of Kingston can be expected to grow by about 17.8 percent. The City of Kingston is expected to grow from 114,000 to 155,000 by 2031 — an increase of 41,000. This would see the CSPA as a whole with a population of approximately 256,000 in 2031, which is an increase of 57,000 from 2001.

Land Use

Land use impacts water in many ways. Depending on the activity on the land, the subsequent change in the water may be severe or it may be less noticeable. Careful planning can help to reduce the impacts of land use on sources of water.

All of the municipalities in the CSPA have official plans directing where future development is to occur. Most also include policies for protection of wetlands, shorelines and other sensitive areas, as well as providing for stormwater management in urban areas.

Although all land uses have a potential impact on water, brownfields, landfills and resource extraction such as mining, pits, quarries, and oil and gas, are of particular concern.

Nearly all older urban areas have some brownfield sites, but only the City of Kingston has prepared a study and a plan for sites in the municipalities.

In the CSPA we have identified 31 active landfill sites, 16 closed sites, eight junkyards, and one incinerator. Additional closed sites may be identified in the future.

Mining is not a major land use in the CSPA, with only one active mine, extracting graphite near Desert Lake and one woolastonite mine currently under development near Seeley's Bay. Pits and quarries are a more common land use in the area. There are 55 active, 158 inactive, and 69 abandoned pits in this area, while quarries include 47 active, nine inactive, and 167 abandoned.

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The materials being extracted include *limestone*, *dolostone*, and *sandstone*, as well as surficial materials including sand and gravel.

Transportation is a potential concern for the protection of *source water*. Spills can occur when substances are being transported. Road salt, from storage and applications, as well as spills of various cargo, can find their way into watercourses. The density of the transportation network can affect the environmental health of an area, creating barriers for wildlife and affecting streams and rivers where they cross.

The CSPA falls within the major east-west transportation corridor between Toronto and Montreal, with connections to Ottawa to the northeast and the United States to the south. The main Canadian National Rail line and Highway 401 follow the north shore of Lake Ontario and the St. Lawrence River. The St. Lawrence Seaway is a major water transportation route, providing shipping along the Great Lakes to the Atlantic Ocean. Recreational boating is also a popular pursuit on the Rideau Canal, Lake Ontario, the St. Lawrence River and the numerous lakes in the northern part of the area.

Municipal sewage treatment is provided for the town of Amherstview, the village of Bath, the village of Odessa (all three in Loyalist Township), the City of Brockville, the Town of Gananoque, the City of Kingston, and the village of Lansdowne (Township of Leeds and the Thousand Islands). Corrections Canada also operates sewage treatment facilities at various locations. The balance of the area relies mainly on septic systems for sewage treatment.

Agriculture is found in all areas of the CSPA, including the *Canadian Shield*. A majority of the agricultural land is found close to Lake Ontario and the St. Lawrence River. At the southwest end of the region, where the temperature is moderated by Lake Ontario, there are specialty farms with apple orchards and berry patches. Agriculture is the primary land use on Amherst Island and the Township of Frontenac Islands. The key agricultural products in the CSPA are dairy products; fruits and vegetables; grain, including corn; hay; poultry and eggs; beef and beef products.

Recreational activities in the CSPA include boating, hunting, fishing, hiking, outdoor activities, and a host of other activities with a range of potential environmental impacts.

Activities that take place on or near water bodies and watercourses have potential impact on *source water*. Activities involving motorized vehicles, outboard motors, or mechanical devices also have a higher potential for *source water* impacts. Emissions and spills from motors, disruption of soil from all terrain vehicles and mountain bikes, and even erosion and compaction of soil from hiking activities should all be carefully managed and controlled to lessen the impact on the environment and on water sources.

The CSPA contains a diversity of natural areas that are fairly well represented in number and protected at the national, provincial and regional levels. In terms of area, only slightly more than three percent of this area is protected.

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Water Uses and Values

In addition to providing drinking water, our lakes, water bodies, and aquifers are vital supports for the local ecology and economy.

Drinking water in the CSPA is obtained from a variety of sources. Communities and individuals along Lake Ontario and the St. Lawrence River (as well as around inland lakes), which represents about 80 percent of the population in the CSPA, draw from the surface water. Most inland communities draw from groundwater aquifers, mainly through private wells, and there are three municipal residential groundwater supplies.

The CSPA includes nine municipal residential surface water intakes. One intake is located on an inland lake, while six intakes are located along the shoreline of Lake Ontario and two are located along the St. Lawrence River. Corrections Canada has an intake on the Cataraqui River at the Pittsburgh Institution at Joyceville.

Many residents in unserviced portions of the region draw their water directly from Lake Ontario, the St. Lawrence River, or an inland lake or watercourse. There is little knowledge of the number of residences serviced in this manner, the distribution of such intakes, or the extent of water treatment that is used.

In rural settings, particularly in campground areas or trailer parks, water is supplied by a communal well. These wells typically provide water resources for hundreds of individuals. Communal wells are at this time only known to be in trailer parks and campgrounds. The number and location of trailer parks in the CSPA is not known at this time.

Most of the residents in the rural portions of the CSPA obtain their drinking water from private wells. There are approximately 20,000 domestic wells in the CSPA. This includes residents living in most of the villages and hamlets. Private wells in some parts of the CSPA are known to run dry during extended periods of drought.

According to Permit to Take Water (PTTW) data from the Ministry of Environment, the largest volume of water taken in the CSPA is for industrial cooling from Lake Ontario and the St. Lawrence River. When inland water supplies are considered the largest volume of water used is that associated with commercial facilities, followed by municipal, industrial and *dewatering* uses.

Agriculture is an important part of the local economy and culture. Agricultural products take two forms: animal and plant. There is limited crop irrigation in the CSPA; therefore agricultural water use relates to animal products. Unlike cooling water at industrial facilities the water drawn for agricultural uses is consumed (or used up) in the process.

A majority of the industrial water use in the area occurs along the north shore of Lake Ontario. Notable water users include the Ontario Power Generation plant in Napanee, the Lafarge Canada Inc. and Koch Industries Inc. facilities in Loyalist Township, and the Invista Canada Inc. operation in Kingston.

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Water Quality

Water quality data for surface and groundwater in the CSPA comes from a variety of sources including.

Surface Water

Although long-term water quality data is sparse throughout the CSPA the Provincial Water Quality Monitoring Network (PWQMN) dataset included sufficient information to analyze several parameters, as well as to perform trend analysis. Key findings were that the chloride levels are generally increasing; likely associated with road maintenance practices. Total phosphorous levels were found to be high at all monitoring stations, but generally decreasing. Also, the Butlers Creek monitoring station displays consistently elevated chloride levels.

Through analysis of Lake Partner Program data it was found that most of the monitored lakes within the CSPA are either meso-trophic or eutrophic. Of the two study areas with the majority of the lakes (i.e. Cataraqi River and Gananoque River) the Gananoque River Study Area is the most nutrient enriched.

The raw water quality at municipal residential surface water intakes was generally found to be good with elevated colour, temperature and hardness common to the intakes in Lake Ontario and the St. Lawrence River. Lake turn-over and high temperatures were also found to have negative impacts on the drinking water (i.e. clogged filter media in the treatment facilities and higher instances of Taste and Odour {TO} bacteria). The intake located on Sydenham Lake is new, July 2006, and limited sampling to date has found that dissolved organic carbon, colour and hardness are evident. Also a limited sampling program throughout Sydenham Lake in 2007 and 2008 found that total phosphorous, nitrate, aluminum, iron and tungsten frequently exceeded Provincial Water Quality Objectives (PWQO).

Health Unit bacterial beach count and limited PWQMN data was analyzed to characterize the surface water microbiology within the CSPA. It was found that the Butlers Creek PWQMN station had consistently elevated levels of *Escherichia coliform* (*E. coli*) and that three drinking water treatment plant intakes (i.e. Bath Drinking Water Treatment Plant, James W. Kingston Water Treatment Plant and Brockville Drinking Water Treatment) are located in close proximity to beaches with relatively high levels of *E. coli*.

Groundwater

It was found that natural groundwater in all aquifers is relatively young in age. It is important to note that all considered groundwater quality data in this report is based on background conditions (i.e. not from known contaminated sites) and that aquifer type is the primary determinant of groundwater quality in the CSPA.

Four rounds of testing have been conducted under the Provincial Groundwater Monitoring Network (PGMN) for the seven wells across the CSPA. Continued annual hydrogeochemical monitoring at the seven PGMN wells will provide long-term results and the ability to recognize trends in the groundwater chemistry at these sites. Combined with other data sources, such as

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groundwater studies and subdivision reports, PGMN data can provide a more comprehensive and useful hydrogeochemical data source for the CRCA.

The raw water from five municipal/communal supply wells in the CSPA was considered since data from MOE was provided for them. All were found to exceed the Ontario Drinking Water Standards (ODWS) for *E. coli* and Total Coliforms (TC) at least once.

Across the *watershed*, of the 90 wells sampled, *E. coli* was detected in 13 wells (or 14 percent) and TC exceeded the safe level in 36 of 168 wells sampled (or 21 percent).

There are significant data gaps with respect to groundwater quality within the CRCA. Though considerable hydrogeochemical data exists for wells within the CRCA, the data is neither well-organized nor comprehensive. Steps must be initiated to produce well-organized and comprehensive groundwater quality results for the CRCA.

Additional information from the local Public Health Units, or from landfill monitoring programs or other hydrogeological investigations, may be available for use in identifying the general groundwater quality across the CSPA.

Vulnerable Areas

There are four types of *vulnerable areas* defined within Ontario's *source water* protection program:

- Surface water *Intake Protection Zones* (IPZs);
- Groundwater *Wellhead Protection Areas* (WHPAs);
- *Highly Vulnerable Aquifers* (HVAs); and
- *Significant Groundwater Recharge Areas* (SGRAs).

The IPZs and WHPAs are associated with existing or planned municipal residential drinking water systems, whereas the HVAs and SGRAs are naturally occurring areas that have been identified through research on groundwater resources.

Each type of *vulnerable area* is present in the CSPA, although there is only limited information at this time about planned municipal residential drinking water systems.

There are nine surface intakes for municipal residential drinking water systems in the CSPA, which together serve almost 155,000 people:

1. the Town of Greater Napanee (Sandhurst Shores);
2. the Town of Greater Napanee (main intake);
3. Loyalist Township (Fairfield);
4. Loyalist Township (Bath);
5. the City of Kingston (Kingston West);
6. the City of Kingston (Beverly Street);

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7. the Town of Gananoque;
8. the City of Brockville; and
9. the community of Sydenham.

The intake in the Town of Greater Napanee is located in the CSPA but services residents of the Quinte *Watershed* Region. The intakes at Napanee, Loyalist Township, and the City of Kingston all use Lake Ontario as a source. The facilities at Gananoque and Brockville draw from the St. Lawrence River. A relatively new municipal residential intake is operating in the Township of South Frontenac at the village of Sydenham. This new intake draws from Sydenham Lake in the Millhaven Creek *watershed*.

A WHPA includes the land area that provides *recharge* to a well. The WHPA is divided into capture zones that are based on the expected amount of time for water on the surface to infiltrate into the ground and eventually reach the well. This is called the time of travel (TOT). Capture zones are normally defined for areas that represent the 2, 5, 10, and 25 year TOT.

Methods for delineating capture zones range from a simple approach such as establishing an arbitrary fixed distance to more complex methods such as analytical and numerical groundwater flow models.

There are three municipal residential drinking water systems that utilize groundwater in the CSPA. These are the Cana Subdivision in the City of Kingston, Miller Manor in the Township of Front of Yonge, and the village of Lansdowne in the Township of Leeds and the Thousand Islands. At the time of writing, only preliminary WHPAs have been identified for Cana and Lansdowne; additional research is ongoing at Lansdowne and will likely take place for the Miller Manor well supply.

Two recent regional groundwater studies provide information on the HVAs in the CSPA. These are the United Counties of Leeds and Grenville Groundwater Management Study (Dillon Consulting Ltd., 2001) and the Western Cataraqui Region Groundwater Study (Trow Associates Ltd., 2007). The studies provide information on the HVAs in the SPA, but they used different methods to address this topic. As a result, the data from the two studies is not comparable. This will be addressed through the preparation of a Groundwater Vulnerability Analysis Report for the Cataraqui area in 2008.

Basic information about groundwater *recharge* areas was also provided in the regional groundwater studies. The studies suggest that much of the CSPA is subject to *recharge*, particularly in areas with fractured *limestone* bedrock. Groundwater *recharge* will also be considered by the Groundwater Vulnerability Analysis Report.

The CSPA contains about 18 small communities that may eventually need to be serviced by a municipal residential drinking water system. These include communities such as Athens, Lyn, Glenburnie and Morven. This will depend on the condition of existing private wells/septic systems and on future development in these communities.

Threats and Issues

A *threat* is a land use, activity or condition (past, present or planned) that may adversely affect the quality and/or quantity of a drinking water source. *Threats* to both groundwater and surface water are present throughout the CSPA and are in the process of being inventoried. *Threats* of concern involve contaminants (both chemical and pathogen) and the possibility of their release into sources of drinking water; through direct introduction, landscape activities, or storage. Examples of *threats* include sewage treatment plant effluent, by-passes, and industrial effluents (direct introduction); stormwater management systems, snow storage, cemeteries, landfills, and the application of road salt, septage, biosolids, manure, fertilizer or pesticide/herbicide (landscape activities); and storage of fuels/hydrocarbons, dense non-aqueous phase liquids, organic solvents, pesticides, fertilizers and manure (potential contaminants). The *threat* inventory has been commenced with field surveys of the CSPA and interviews with municipal staff and local historians. A pattern of positive correlation between population densities (cities, towns and hamlets) and *threats* is already evident.

An *issue* is the negative effect that a land use or activity that is known to have had, or to be currently having on a drinking water source. *Issues* are identified where concentrations of contaminants have exceeded or are approaching water quality standards or guidelines (e.g. ODWS or the PWQO), and/or where the quantity of water has been affected. An *issue* can either be caused by a single event or over a prolonged period of time. Various reports and analysis of PWQMN, Lake Partner Program, and PGMN data were reviewed in order to produce a preliminary list of *issues*.

Issues in the CSPA include (but are not limited to) elevated levels of metals (aluminum and copper), nutrients (phosphorus and all forms of nitrogen), chloride, sodium, and fecal coliform/bacteria. Contamination *issues* have also been identified including the presence of hydrocarbons, organic solvents and pesticides.

Work towards *threats* and *issues* is ongoing as a stand alone document detailing *Threats* Inventory and *Issues* Evaluation is anticipated to be published in the Fall of 2008 and is an central part of the *Assessment Report* and the *Source Water* Protection Plan.