1. INTRODUCTION

Canada is a vast country containing a large portion of the world's fresh water resources. This precious resource is vital to all life sustaining functions, human and ecological. Canadians respect and value this 'Our most precious resource'. Within this framework, Ontario both population based and geographical land mass, is one of the largest provinces in Canada. Ontario geographically is a vast province, bordering the world's largest fresh water body, the Great Lakes However there is still a great deal of ambiguity in regards to how Ontario manages this precious resource. Given the institutional infrastructure currently in place, can Ontario guarantee that the quality and quantity of water available will ensure that ecological and human systems remain healthy?

In the field of water management, a number of approaches are starting to develop that address the whole hydrolic cycle, which focuses on watershed management. Lessons learned in the field of water management over the last decade, provide a framework that begins to clarify how and why the watershed management approach is gaining currency in a wide range of jurisdictions locally and globally. In 1997, the United States Environmental Protection undertook a study examining a review of the watershed management literature. The study identified nine key components of successful watershed management:[1]

1. Political endorsement
2. Enabling legislation and policy direction
3. Co-ordination and a co-ordinating body at the watershed/subwatershed level
4. Sustainable funding
5. A multidisciplinary, integrated approach to water management
6. Clear goals and objectives (related to watershed management)
7. Good data, appropriate technical and analytical skills; and useful decision-support tools
8. Public involvement and partner collaboration
9. Dynamic leadership

Ontario is beginning to approach water management from a watershed basis and incorporate these principles, but given the historical state of Ontario's water resources, is Ontario and Ontarians doing enough? In order to examine this question, this report begins with identifying Ontario's watersheds and attempting to determine the ecological health of them, with particular focus on the Greater Toronto Area (GTA). Sources of water pollution and their effects on human and ecological

[1] Committee on Watershed Management et al., 1999; Hooper, 1999; Born and Genskow, 2000; Born and Genskow, 2001; U.S EPA, 1997 in Muldoon and Mcculloch, 1999

systems will then be considered. In the following section, a brief look at different issues facing watershed management will be examined. At this point, the report turns to a regulatory approach, examing the laws, policies and institutions working on water management in an international, national, provincial and municipal level. The report concludes with a section on avenues for public support, and provides examples of regulatory tools and organizations that can aid people interested in improving Ontario's water sources.

2. ONTARIO'S ECOLOGY AND WATERSHEDS

2.1 WHAT IS A WATERSHED?

As water flows downhill in small to progressively larger streams and rivers, it moves over land and provides water for urban, agricultural, and ecological needs. The watershed community is made up of everyone who lives there plus all other animal and plant life. **The community of humans, plants, and animals depends on the watershed and influence it in some way.** Flowing water carries organic debris and dissolved organic matter that provide food and shelter for aquatic life. At the same time, water may also carry pollutants like motor oil, fertilizers, and pesticides. Numerous activities in a watershed have the potential to degrade water quality. There is no "pure" water in nature; all water is "polluted" to some extent. Even in pristine watersheds where water quality is not affected by humans, "natural" pollutant sources are abundant. These include sediment from stream bank erosion, bacteria and nutrients from wildlife, and chemicals deposited by rainfall. A watershed has four important functions:

1. It stores water of various amounts and for different times;
2. It releases water as runoff;
3. It provides diverse sites for chemical reactions to take place; and

4. It provides habitat for flora and fauna.

The first two functions are physical in nature and are termed *hydrologic* functions (Fig. 2). The last two are the *ecological* functions. Human activities affect all the functions of a watershed.

2.2 WHAT ARE ONTARIO'S WATERSEHDS?

The Ministry of Natural Resources (MNR) identifies three primary watersheds in the province of Ontario. As evident from the map to the right, these include: the Great Lakes, Nelson River and Hudson Bay. These three primary divisions have been divided into 17 secondary divisions. Most secondary divisions are either large river systems or groupings of small coastal streams. Ontario's secondary watershed divisions range in size from 4,000 to 150,000 square kilometers. These secondary divisions are further sub-divided into 144 tertiary divisions ranging in size from 700 to 31,000 square kilometers.[2]

(Source: MNR 2004)

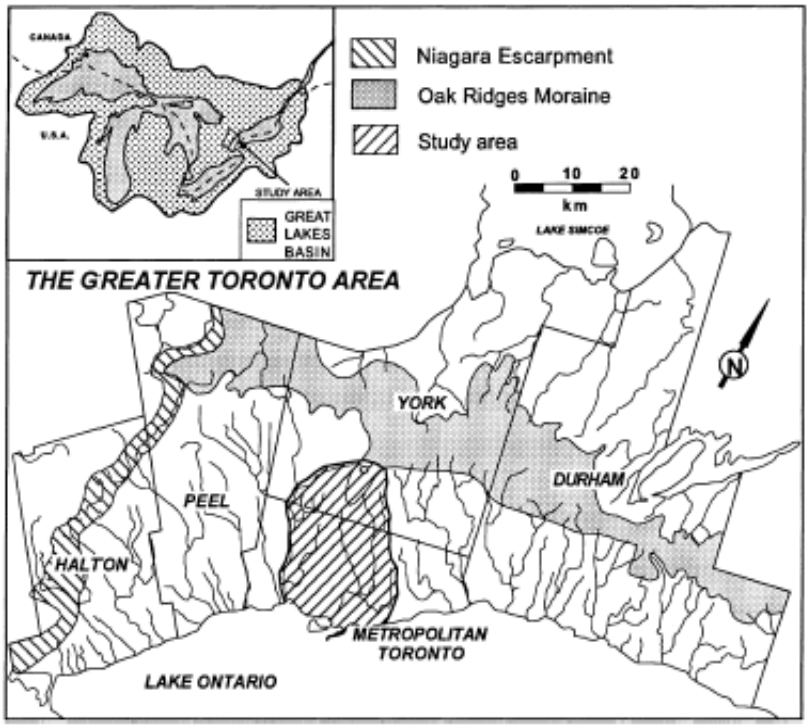
THE OAK RIDGES MORAINE

The Oak Ridges Moraine is a 106 km long ridge of rolling hills and porous soils and gravels from which the headwaters for some 30 rivers in the province originate. The headwaters of the main and east branches of the Humber are located on the moraine. One-quarter of the Humber's total land area is located on the Oak Ridges Moraine. It is also forms the headwaters for over 65 rivers and streams including the Don, Duffins Creek and the Rough, provides critical habitat (wetlands, kettle lakes, kettle bogs and natural and planted forests) for many species. The Moraine also provides a direct source of clean drinking water for more than a quarter of a million people and indirectly for millions more.[3] The Oak Ridges Moraine is currently threatened by developers wanting to extend Toronto's urban sprawl. However, too much development on the Moraine

[2] http://www.mnr.gov.on.ca/MNR/water/watershed.html (downloaded June 12, 2004).
[3] The information regarding Oak Ridges Moraine is compiled from: http://www.oakridgesmoraine.com/ (downloaded July 20th 2004).

means habitat loss for hundreds of plant and animal species. Currently, 30% of the Moraine is still forested; this represents one of Ontario's last remaining 'large' forested areas in southern Ontario. The Moraine is one of the last continuous corridors of green space left in southern Ontario.

There is a strong public movement to protect the Moraine currently underway. A coalition of NGOs and citizens groups has collaborated to put pressure on municipal and Provincial governments to stop development in the area. This coalition consists of Earthroots, S.T.O.R.M. (Save The Oak Ridges Moraine), The Federation of Ontario Naturalists and Save the Rouge Valley System Inc. The campaign was strongly supported by the Greater Toronto Services Board (representing all GTA municipalities), the Don Watershed Council, the Waterfront Generation Trust, the Conservation Authorities Moraine Coalition, 465 scientists and over 100 citizens groups across southern Ontario.[4]



(Source: Howard, 2001)

The health of streams and rivers originating in the moraine depends on the hydrological functions of the moraine. When natural spring-fed sources of water are replaced by urbanized sources of water, rivers and streams are invariably less healthy. The future of the moraine will have a significant impact on the ultimate health of our watersheds and communities.[5]

[4] For further information on the Oak Ridges Moraine see: www.oakridgesmoraine.com or contact one of the mentioned organizations, contact information can be found in Appendix:

[5] http://www.trca.on.ca/water_protection/strategies/humber/#healthy (downloaded June 12, 2004)

PROVINCIALLY DETERMINED WATERSHEDS

The following chart outlines the watersheds identified by both Conservation Ontario and the Ministry of Environment (MOE). As can be there are some discrepancies between the regions identified. Recently, the Provincial government has decided to approach water management from a watershed basis and is implementing The Source Water Protection Act.[6] The MOE has "organize(d) watershed(s) into regions for the purpose of timely and efficient delivery of source water protection plans across Ontario's 36 conservation authorities"[7]

White Paper Proposals	Conservation Ontario Proposals	Lead CA	Comments/Rationale
Essex	Same	Essex	
Lower Thames, Upper Thames, Catfish, Kettle	Lower Thames, Upper Thames, St. Clair	Upper Thames	Lake St. Clair watersheds kept together
St. Clair			Included above
Long Point, Grand	Catfish, Kettle, Long Point, Grand	Grand	Lake Erie watersheds kept together
Ausable Bayfield, Maitland	Same	Ausable Bayfield	
Saugeen, Grey Sauble	same	Saugeen	
Nottawasage, Lake Simcoe	Same	Lake Simcoe	
Niagara, Hamilton	Niagara	Niagara	
Halton, Credit	Halton, Hamilton	Halton	Burlington Bay watersheds kept together/historical working relationship
Toronto	Credit, Toronto, Central Lake Ontario	Toronto	Oak Ridges Moraine and Peel/York/Durham Groundwater Study
Central Lake Ont, Ganaraska	none		Included above and below
Otonabee, Kawartha, Crow, Lower Trent	Otonobee, Kawartha, Crowe, Lower Trent, Ganaraska	Lower Trent	Trent River watershed CAs kept together
Quinte, Cataraqui	Quinte	Quinti	Quinti is already an amalgamation of 3 CAs
	Cataraqui		Options still being

[6] Further information on this Act is provided in Chapter 7: Provincial Laws and Policies
[7] MOE (2004). White Paper on Watershed-based Source Protection Planning, Ministry of Environment (Ontario), pg: 11.

			reviewed
Mississippi Rideau	same	Rideau	
South Nation, Raisin	same	Raisin	
North Bay Mattawa		North Bay Mattawa	Size of Watershed Region requires further discussion
Nickel District		Nickel district	Size of Watershed Region requires further discussion
Sault Ste Marie		Sault Ste. Marie	Size of Watershed Region requires further discussion
Mattagami		Mattagami	Size of Watershed Region requires further discussion
Lakehead		Lakehead	Size of Watershed Region pending further discussion

From reviewing the chart above it becomes obvious that there a number of discrepancies between what the MOE and CO consider to be watershed boundaries.[8] The watersheds that the MOE and CO can agree on included: Essex, Ausuable Bayfield, Maitland, Saugeen, Grey Sauble, Nottawasage, Lake Simcoe, Mississippi and Rideau, South Nation and Raisin. Discrepancies still remain over: Lower & Upper Thames, St. Clair, Cat Fish, Kettle, Long Point, Grand, Niagara, Hamilton, Halton, Credit, Toronto, and Central Lake Ontario. CO has also put forward proposals that still require further discussion, these watersheds included: North Bay and Mattawa, Nickel District, Sault St. Marie, Mattagami, and Lakehead. These inconsistencies are not surprising, as Rhoades (1998) and Guijt and Sidersky (1999) have noted, watersheds rarely coincide with any units of the "social landscape".[9]

Basic facts (including human uses and the ecological state) on a few of the above mentioned watersheds are mentioned below. However, due to the Toronto focus of this Report, greater information and details pertaining to Toronto's watershed are mentioned in the subsequent section of this chapter.

[8] Considering the institutional commitment for watershed management, it is astonishing that watershed boundaries have yet to be determined. It was also unclear to this writer as whether or not the proposed watershed boundaries were based on ecological or geographical functions in comparison to political jurisdictions and economic concerns over implementation of watershed management plans.

[9] Johnson, N., Helle Munk Ravnborg, Olaf Westermann, Kirsten Probst (2001). "User participation in watershed management and research." Water Policy **3**: 510.

NOTTAWASAGE VALLEY WATERSHED[10]

The Nottawasage River is the major drainage basin, with an area of 3,361 km2, and includes 21 municipalities.

Prominent water resources, environmental and recreational features within the Valley include:

1) Niagara Escarpment (designated by UNESCO as a World Biosphere Reserve
2) Oro and Oak Ridges Moraines (major groundwater recharge for potable water aquifers
3) Wasaga Beach (world's longest freshwater beach)
4) Blue Mountain (centre for Ontario's snow ski industry)
5) Minesing Swamp (RAMSAR significant wetland)
6) Best migratory trout and salmon fisheries in Ontario

LAKE SIMCOE WATERSHED[11]

The total land area of Lake Simcoe Watershed is 2,848 km2. There are approximately 15 communities that occupy 3% of the watershed, many of the municipalities obtain their water from and discharge treated sewage effluent to into Lake Simcoe at an average daily flow of 12,500 m3/day. Agricultural and forest areas occupy about 44% and 41% of the watershed respectively. Most of the intensive agricultural activity occurs along the Holland River System in an area known as the Holland Marsh. Wetlands occupy approximately 10% of the watershed. Lake Simcoe is one of the largest freshwater lakes in North America, outside the Great Lakes. The Region generates 160 million dollars to the local economy, but economic losses have occurred since the mid-70s as a result of high phosphorous levels from point and non-point sources. Deterioration in water quality has led to eutrophication, reduced dissolved oxygen and shifts in the fish populations.

GRAND RIVER

The Grand River drains an area of 6965 km2 in southern Ontario and has a population of over 670,000. It originates 20km south of Georgian Bay at an elevation of 526m above sea level and flows over a length of 298km to its mouth on Lake Erie at 355m above sea level. The basin is

[10] Following information paraphrased from: Palmer, R. M., C. Jones and M. Walters (1998). "Environmental Monitoring Initiatives to Sustain Growth in Ontario, Canada." Water Science Technology **38**(11): 113-122.
[11] Following information paraphrased from: Palmer, R. M., C. Jones and M. Walters (1998). "Environmental Monitoring Initiatives to Sustain Growth in Ontario, Canada." Water Science Technology **38**(11): 113-122.

dominated by silt and clay tills overlaying permeable limestone. Broad spectrum of environments along the river valley[12]

MUSKOKA-HALIBURTON

The Muskok-Halburton area is in south-central Ontario, and is largely undeveloped. The local topography is rugged. Ridges, usually 20-100m high are separated by lakes and swampy lowlands. Tills and soils are shallow, but locally thicker class, sand and gravel deposits occur. Regional climate is cool, average of 189 frost-free days per year. Great-Lakes –St. Lawrence Forest Region: mixed deciduous and coniferous forests, dominated by sugar maple. The landscape is forested and nonagricultural. There are several rural municipalities, but seasonal recreation is the dominant human activity. Clear-cut logging was major industry in past, with the last major forest clearing 60-100 years ago.[13]

2.3 TORONTO REGION WATERSHEDS

The Environmental Commissioner's Office (ECO) has determined Toronto as a priority environmental site.[14] This area contains six major watersheds draining into Toronto's waterfront, including Etobicoke and Mimico Creeks, the Humber, Don, and Rouge Rivers, and Highland Creek. Extensive urbanization and continued growth pressures in the area have contributed to significant environmental impacts. The area receives bacterial and nutrient inputs and heavy metal and organic chemical contamination as a result of discharges from combined sewers, storm sewers, and sewage treatment plants. Agricultural non-point sources are a problem in some of the upper watersheds. Due to urbanization, fish and wildlife habitats require extensive rehabilitation and protection. A Remedial Action Plan is currently being implemented, focusing on an extensive range of issues such as sewer and storm-water management.[15]

[12] Rott, E., Hamish Duthie, and Eveline Pipp (1998). "Monitoring organic pollution and eutrophication in the Grand River, Ontario, by means of diatoms." Canadian Journal of Fish and Aquatic Science **55**: 1445
[13] Galloway, G. a. R. P. (2003). Managing Groundwater Resources in the Great Lakes Basin: Securing Our Future Visions and Principles. Toronto, Munk Centre for International Studies, University of Toronto**:** 4
[14] ECO (2004). http://www.eco.on.ca/english/aboutont/priority.htm (downloaded June 14, 2004)
[15] For more information please refer to: http://www.on.ec.gc.ca/water/raps/intro_e.html (downloaded June 14, 2004)

LAKE ONTARIO WATERFRONT[16]

Lake Ontario's Waterfront is highly urbanized, and includes a diversity of land uses including parks, residential, industrial and commercial applications. The Toronto Bay area contains a downtown core that is largely dominated by commercial towers. Outside the core, land use is dominated by light industrial and residential land. The East Bay front and Port Industrial area supports a variety of industrial, infrastructure and commercial activity. A significant amount of area is vacant and underutilized. South of the commercial core is the major transportation corridor that includes the Gardiner Expressway, Lake Shore Boulevard and the railways. Further south is a mix of recreation and residential areas, which include the Harbourfront, the Island Ferry Docks, tour boats, the Waterfront Trail, hotels and stores. Residential use of the area has increased substantially in recent years due to the construction of a number of high-rise apartments and condominiums.

As early as 1850, Toronto's Waterfront was severely polluted with sewage, animal wastes and garbage. Since then, population growth in conjunction with industrial activity has continued to degrade water quality and destroy the aquatic habitat. By 1950, more than 600 hectares of marshland had been filled in, wiping out several sensitive plant and animal species. Widespread chemical use, municipal sewage, industrial effluents, discharge of bilge water from boats, stream alteration, deforestation and other activities have all contributed to the degradation of Toronto's aquatic environment. Ecological diversity throughout the area is low and human recreational uses of the streams, rivers and Lake Ontario is limited by intermittently high levels of pollution.

The degraded condition of the area has prompted the International Joint Commission (IJC)[17] to designate the Toronto Waterfront as an Area of Concern (AoC) in Ontario. The factors contributing to the degraded state of the waterfront are numerous. In addition to contributions from the Great Lakes system, the Waterfront receives discharges from six highly urbanized watersheds (Humber, Don and Rouge Rivers and Etobicoke, Mimico and Highland Creeks). Existing and planned developments in Toronto have the potential to exacerbate the current situation, and as such, there is little evidence to suggest that substantial improvements will occur in the near future.

[16] The information in regards to Lake Ontario's Waterfront is summarized from: Toronto, City. of. (1999). The Toronto Waterfront Scan and Environmental Improvement Strategy Study. Toronto, City of Toronto**:** 1-280.
[17] More information on the IJC and its programs can be found in subsequent Chapters of this report.

DON RIVER

The Don drains from two regions in the GTA, Toronto and York, and incorporates 8 municipalities/communities, including: Toronto, East York, North York, York, Scarborough, Markham, Vaughan, and Richmond Hill. There are two main branches to the Don. German Mills Creek flows into the East don just below Steeles Ave. and Taylor or Massey Creek joins in at the forks near Don Mills. The river drops over 220 meters on its way from the headwaters in Maple to Lake Ontario, 38 km away. The headwaters of the East Don in the City of Vaughan are still undeveloped but are threatened by urban sprawl from Richmond Hill. Many parts of the don in North York still have a predominantly natural character. There is one large dam on the Don – the G. Ross Lord dam at Finch and Dufferin, which was completed in 1973.[18]

The TRCA notes that the Don River is one of Canada's most degraded urban rivers, and over 80% of its 360 km2 land is urbanized and home to over 800,000 people. Once 100% forest, it is now only 7.2% forest cover and the area has lost almost all of its wetlands. The TRCA also notes that the Don faces a number of challenges and key areas which include: combined sewer overflows (CSOs), Mouth of the Don, the West Don Lands and the Don Watershed Council.[19] The work of the Toronto Remedial Action Plan indicates that the Don receives effluent from 30 combined sewers and 872 storm sewers. As a component of contaminated storm water runoff from urban areas, coliform bacteria levels in the Don watershed are persistently elevated.[20] In the spring of 2000, the Toronto Waterfront Revitalization Task Force released their report on the future of Toronto's waterfront: *Gateway to the New Canada, Our Toronto Waterfront*. The report joined a long list of other reports calling for renaturalizing the degraded section of the Don where it flows into Lake Ontario. The West Don Lands is an 80-acre parcel of land located in the east of downtown between the mouth of the Don River and the original ten blocks of the old Town of York. For over 100 years industry thrived in this area; today it is all but gone lying derelict and ultimately can present an amazing opportunity to add to the restoration of the Don. The Don River rejuvenation is supported by a number of community organizations, including the City sponsored program "Bring Back the Don" and other programs through the TRCA.[21]

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[18] The previous information compiled from: Don Today, http://www.ilap.com/wilson/Don/DonNow/Now_Index.html (downloaded August 5, 2004).
[19] TRCA (2004). The Don Watershed. http://www.trca.on.ca/water_protection/strategies/don/#healthy
[20] Toronto, City. of. (1999). The Toronto Waterfront Scan and Environmental Improvement Strategy Study. Toronto, City of Toronto: 3-5.
[21] For more information on "Bring Back the Don" please see: http://www.toronto.ca/don/index.htm and for TRCA programs: http://www.trca.on.ca/water_protection/strategies/don/#regeneration

HUMBER RIVER[22]

The Humber has is headwaters in the Niagara Escarpment and Oak Ridges Moraine. The Humber is 908 km2 in total and drops over 350 meters in elevation before it enters Lake Ontario at Humber Bay. The Humber River spans four regional municipalities (or counties) and 10 local municipalities. It is bounded to the west by Etobicoke Creek, Mimico Creek and Credit River watersheds, and east by the Don and Rouge River watersheds. The land uses in the Humber vary dramatically, including farms, low density residential areas, high density residential, and industrial. The land use is divided between urban or urbanizing, agricultural uses and rural. Some of the most notable natural features of the Humber River Watershed include:

- Oak Ridges Moraine
- Niagara Escarpment
- The Humber Marshes – provincially significant wetland remains an important nesting area for birds such as the Great Blue Heron and American Coot.
- High Park – Toronto largest urban park, containing remnant prairie habitat and over 50 hectares of one of the last Black Oak Savannah habitats in southern Ontario.
- Brook Trout – high quality aquatic habitat in the Humber supports more than 50 species of fish.
- Red-Shouldered Hawk – the presence of the nationally vulnerable Hawk in the watershed is indicative of the Humber's high quality forest and wetland habitats.

The Humber Watershed Alliance produced a "Report Card" in an attempt to determine the health of the watershed. Within the report surface and groundwater, landforms, terrestrial habitat, aquatic habitat and air all examined.[23] Some of the results from the report include:

- Suspended solids are too high for good aquatic habitat about half the time in the Black Creek and Lower Humber
- Data from 1999 suggest conditions have declined in the past 10-15 years
- Phosphorus levels exceed the Provincial Water Quality Objective (PWQO) over half the time
- Nitrate concentrations exceed the Canadian Water Quality Guideline
- Ammonia concentrations exceed PWQO sometimes in the West Humber and Black Creek and may be toxic to aquatic life
- Chloride levels have been rising across the watershed over the last 30 years. The levels may be toxic to aquatic life
- Levels of aluminum, cadmium, copper, iron, lead, silver and zinc exceed PWQO in the Lower Humber
- PCB residues exceed IJC Aquatic Life Guidelines
- Common pesticides and herbicide were detected in the Lower Humber

[22] Information on the Humber River compiled from: http://www.chrs.ca/Rivers/Humber/Humber-F_e.htm
[23] Humber Watershed Alliance. (2003). A Report Card on the Health of the Humber River Watershed. Toronto, Humber Watershed Alliance. http://www.trca.on.ca/water_protection/strategies/humber (downloaded July 29, 2004)

Despites these indicators there is active community involved in the protection of the watershed. The Humber Watershed Alliance is one group that incorporates a number of stakeholders working together. Humber Watershed Alliance was established in 1997, has a membership of 73 people which includes residents, interest groups, business associations, elected representatives from the local and regional municipalities in the watershed, TRCA stag and the Chair of the TRCA.
Regeneration projects include:

- Raymore Park Fishway, Toronto
- Palgrave Mill Pond Rehabilitation Project
- Caledon East Wetland and Boardwalk
- Doctors McLean Park Fishway, Woodbridge
- Granger Greenway Trail, Vaughan
- Bolton Community Action Site

ETOBICOKE & MIMICO CREEKS

Etobicoke Creek is south of the Airport and just to the west of the 427. Within the Toronto Region from the 401 it flows through Centennial Park, Markland Woods, Etobicoke Valley Park, then passes the Toronto Golf Club and through Marie Curtis Park, where it empties into Lake Ontario. Mimico Creek starts from the intersection of the 401 and the 427 the creek flows diagonally to the east. It is located on the east side of the 427. Within Toronto the creek can be found just east of the 427. It meanders through West Deane Park, Central Park then through urban areas. It terminates at Humber Bay Park on Lake Ontario. These are also two of the most highly developed, & degraded watersheds in Toronto area.[24]

Environmental issues include changes in ground and surface water volumes and flows resulting from water contamination, flooding and erosion; lack of storm water control; loss of forests, tributaries and wetlands; impaired condition of flora, fauna and aquatic species; altered landscapes through settlement, urban development and aggregate extraction; degraded air quality; the creation of urban heat islands; and the potential impacts of global climate change.

Social and economic issues pertinent to the Etobicoke and Mimico Creek watersheds include loss of archaeological sites; loss of heritage sites and resources; lack of awareness regarding heritage, cultural diversity and identities; disconnected green open spaces and trail systems; limited angling and wildlife viewing opportunities; anticipated development in the headwaters of Etobicoke Creek;

[24] http://www.out-there.com/ton01riv.htm

development of infill and brownfield sites; agricultural practices; the cost of rehabilitation efforts; lack of sustainable funding sources; and constrained legislation and planning tools. [25]

The TRCA created the Etobicoke and Mimico Creek Task Force, with a mandate to develop an ecosystem based management strategy to help restore Etobicoke and Mimico Creeks. Greening Our Watersheds, was a report that culminated from 2 years of work by this multi-stakeholder task force of planners, biologists, engineers, heritage preservationists, naturalist, municipal elected representatives and watershed residents and outlines a number of improvement and strategies for management of the watershed. The Etobicoke-Mimico Watershed Coalition, established by the TRCA will be accountable for implementation of Greening Our Watersheds. They will do this through the establishment of Community Action Areas and Sites. Members of the Watershed Coalition will include watershed residents, elected representatives, stewardship group representatives, agency representatives, community groups and watershed businesses.

ROUGE RIVER

The Rouge River and its main tributary, Little Rough Creek, flow through an area that remains largely undeveloped – the watershed encompasses about 2,200 hectares within Metropolitan Toronto. Red clay in the river's bank give the water a distinct colour as it flows towards Lake Ontario.[26]

According to the Rouge Park Ecological Survey, the lower Rouge Park ecosystem is home to:[27]

- At least 762 plant species
- 225 bird species
- 55 fish species
- 27 mammal species

The Rouge ecosystem has also been recognize because it is one of 36 critical Carolinian sites remaining in Canada and boasts several provincially significant wetlands and dozens of environmentally sensitive areas. Of particular interest are:

- 6 nationally rare and 92 regionally rare plants
- 5 nationally rare breeding birds
- 2 nationally vulnerable fish, numerous locally rare reptiles, amphibians and mammals.

[25] http://www.trca.on.ca/water_protection/strategies/etobicoke/#key (downloaded June 12, 2004).
[26] City of Toronto. Rouge Beach Park. http://www.city.toronto.on.ca/parks/parks_gardens/rougebeach2.htm
[27] The following information compiled from: http://www.frw.on.ca/

Some community organizations within the watershed include Friends of the Rouge Watershed and Rouge Valley Foundation that host a variety of programs.

HIGHLAND CREEK[28]

The TRCA has called the Highland Creek "the orphan" among Toronto's watersheds. Is over 75 km of watercourses and drains an area of 102 km2. At 85% urbanized, it's the most developed watershed in the TRCA jurisdiction. Since most of the development occurred before storm water management controls were required, its waters are quite degraded. Most areas along the creek have poor aquatic habitat conditions, as a result of poor water quality and high peak flows associated with urban watercourses. A high percentage of the Highland's watercourses have been either buried underground or lined with concrete in order to reduce erosion and prevent flooding. Due to its urban setting it is very susceptible to urban runoff. In addition the loss of natural forest and meadow areas leaves less food and shelter for wildlife to survive and raise their young. Storm water runoff and habitat loss are major factors affecting the health of the Highland Creek watershed.

The altered streams offer little if any aquatic habitat potential. Highland Creek also has over 90 in-stream barriers like dams and weirs, which reduce the ability of fish species to access upstream areas. In addition, there is a lack of quality streamside vegetation (also called riparian vegetation) which negatively affects aquatic habitat. Healthy watercourses have trees and shrubs along their banks to reduce erosion, provide shade for cooling the water and provide cover for spawning fish. Terrestrial habitats have been largely lost, with only 6.2% of the watershed's area covered by forest.

Despite all this degradation, there is much left to be valued in the Highland Creek watershed. The lower reaches of the creek's eastern branch (the Malvern branch), its western branch (Bendale branch) and the main branch flow through lush corridors. The creek's estuary (at its mouth) is, by urban standards, relatively natural and many species of lake fish use the mouth of Highland Creek at various times during their life cycle. The City of Toronto's efforts to place water quality improvement storm water ponds in the upper reaches of the Highland's Centennial Creek tributary are positive first steps toward the long-term revitalization of this entire ecosystem.

[28] Information on the Highland Creek Watershed is compiled from the TRCA: http://www.trca.on.ca/water_protection/strategies/highland/

2.4 ASSESSING THE HEALTH OF AN ECOSYSTEM

The threats to local watersheds are broad and expansive. Issues include changes in ground and surface water volumes and flows resulting from water contamination, flooding and erosion; lack of storm water control; loss of forests, tributaries and wetlands; impaired condition of flora, fauna and aquatic species; altered landscapes through settlement, urban development and aggregate extraction; degraded air quality; the creation of urban heat islands; and the potential impacts of global climate change.[29] In order to ensure the health of Ontario's watersheds, a number of necessary conditions must be met. For example a consistent method of measurements and analysis is needed across the various watersheds, and information of indicators to biodiversity and water quality need to be accessible to the public. This would require a greater breadth and depth of knowledge of local watersheds than is currently available. "Data on the "state of the watershed" are vital to support wise land-use planning decisions, establish specific (and realistic) targets during future sub-watershed studies and to design sustainable growth practices for new development."[30] Hall notes that the "the optimal method for assessing the severity of ecosystem damage is with reference to pre-impact conditions (Smol 1992)…but they are rarely available, especially for lakes in remote regions. As a result, we must rely on indirect sources of information to infer long-term trends in water quality"[31] Unfortunately, environmental monitoring has been effected by recent budget cuts and there is a serious lack of information on the state of Ontario's watersheds and the ecosystems health. The funding crisis has resulted in a number of community organizations, Conservation Ontario, Conservation Authorities and the TRCA to turn to volunteer programs that teach residents how to collect this information. In summary, in order for sustainable watershed management practices to be put into place there needs to be a greater quantity of data on specific watershed indicators and overall ecological health, this has to incorporate as much historical information as is available. The scientific community needs to collaborate to establish a comparable methodology so research in the various watersheds can be easily compared.[32] Finally, there needs to

[29] These sources of contamination will be examined in the subsequent chapter.
[30] Palmer, R. M., C. Jones and M. Walters (1998). "Environmental Monitoring Initiatives to Sustain Growth in Ontario, Canada." Water Science Technology 38(11): 4.
[31] Hall, R. a. J. P. S. (1995). "Paleolimnological assessment of long-term water-quality changes in south-central Ontario lakes affected by cottage development and acidification." Canadian Journal of Fish and Aquatic Science 53: 2
[32] Currently the scientific community attempts to determine the health of an ecosystem by looking at various keystone species, such as amphibians. If these species are unable to thrive than various contaminants and geochemical processes are analyzed. However, there has been no consensus on how to examine the inter-linkages

be more resources devoted to monitoring and reporting. It has been recommended that a publicly accessible database be established so target areas can be more easily identified, and public resources are more efficiently directed to abatement and pollution prevention.

between various species or among species interactions within a predetermined ecological setting, such as a watershed.

3. SOURCES OF WATER POLLUTION

Regional land use decisions have an obvious and direct impact on the types and sources of water pollution within that particular region. Given the broad range of anthropogenic activities currently undergo in Ontario, there a number of sources that contribute to the declining quality of ground and surface water. Activities that contribute pollutants to Ontario's water sources include agriculture, forestry, mining, industrial activity and urban settlements. "It has been recognized for over two decades that different amounts and types of nutrients exported from agricultural, urbanized, and forested landscapes have a direct effect on the quality of downstream rivers and lakes"[33] As Baker has noted, "watersheds draining into Lakes Superior, Michigan, Huron, and Ontario, where forestry is the dominant land use, the dominant land use in Lake Erie's watershed is row crop agriculture. Consequently, the tributaries draining into Lake Erie carry, on average, much larger loads of sediments, nutrients, and pesticides than do the tributaries entering the other Great Lakes.[34] Kolak has noted that there are five major pathways for water contaminants, which include: "1) industrial and municipal discharge, 2) surface runoff and waterways, 3) diagenetic processes in sediments, 4) groundwater and 5) atmospheric depositions."[35] Kolak also cautions, that most studies on water contamination have focused on "critical" contaminants that exhibit toxic effects at very low concentrations, however he shows that loading of 'noncritical' (in his work, copper) contaminants may not pose an immediate hazard, but continued loading to the environment could have significant repercussions when the loading capacity is exceeded.[36] One method of identifying sources of contamination is through the separation of point and non-point sources. Point sources can be defined as: pollution of water from one place in a concentrated manner that is easy to identify. For example, effluent discharge from sewage treatment plants or industrial plants. Non-point sources on the other hand are, Pollution of the water from numerous locations that are hard to identify as point source. For example, agriculture and urban diffuse source runoff.

[33] Crosbie, B. a. P. C.-F. (1999). "Percentage land use in the watershed determines the water and sediment quality of 22 marshes in the Great Lakes basin." Canadian Journal of Fish and Aquatic Science 56: 1781. Others that have reported this include: Beaulac and Reckhow 1982: Pterjohn and Correll 1984; Nelson et al. 1996.
[34] Baker, D. (1993). "The Lake Erie Agroecosystem Program: water quality assessments." Agriculture, Ecosystems and Environment 46: 197
[35] Kolak, J., David Long and Tina M Beals (1998). "Anthropogenic inventories and historical and present accumulation rates of copper in Great Lakes sediments." Applied Geochemistry 13: 59
[36] Kolak, J., David Long and Tina M Beals (1998). "Anthropogenic inventories and historical and present accumulation rates of copper in Great Lakes sediments." Applied Geochemistry 13: 60.

3.1 POINT SOURCES

The immediate image that comes to mind when considering point sources, is an industrial plant releasing it's effluents from a pip directly into the neighboring stream. However, other "important point sources include numerous active and abandoned landfill sites, underground storage tanks, snow dumps and septic systems."[37] Howard notes that within a 700km^2 sub-region of the GTA (his study area), point sources of contamination include 82 open and closed landfills, over 2000 underground storage tanks, 13 snow dumps, 10 coal tar sites and approximately 3000 septic systems[38] Within this report, sources of contamination will be separated into the following sub-categories: industry, landfill sites & storage tanks, septic systems and snow dumps.

INDUSTRY

Nine industrial sectors usually cover the majority toxic water polluters. The nine sectors are petroleum, pulp and paper, metal mining, industrial minerals, metal casting, organic chemical manufacturing, inorganic chemical, iron and steel, and electric power generation.[39] Two industries where there has been considerable research on effluent effects to water quality include the pulp and paper industry and metal mining.

PULP & PAPER

Before the 1970's there were no regulations in place restricting effluents from pulp and paper mills, however no there are regulations in place requiring primary and secondary treatment of effluents. As Sibley notes, "Efforts to reduce environmental impacts resulting from the discharge of pulp mill effluents into aquatic environments have historically been directed toward traditional pollutants such as biochemical oxygen demand, suspended solids, and organic loadings (quoting Owens 1991)…but more recently, increased concern over chlorinated compounds in bleaching effluents."[40] Sibley's research was on Jackfish Bay, on the north of Lake Superior, 225 km east of Thunder Bay. He found that despite the fact that mill effluent was subjected to primary and secondary treatment before being dispelled into Blackbird Creek, the "degradation of bottom

[37] Howard, K. W. F. a. S. L. (2001). "Transport of urban contaminants into Lake Ontario via sub-surface flow." Urban Water 2: 184
[38] Howard, K. W. F. a. S. L. (2001). "Transport of urban contaminants into Lake Ontario via sub-surface flow." Urban Water 2: 185
[39] Municipal/Industrial Strategy for Abatement (MISA). http://www.ene.gov.on.ca/envision/water/misa/index.htm (downloaded May 26, 2004).
[40] Sibley, P., D.G. Dixon and D.R. Barton (2000). "Impact of bleached kraft pulp mill effluent on benthic community structure in relation to environmental factors." Journal of Aquatic Ecosystem Stress and Recovery 7: 229

sediments at Jackfish Bay was clearly evident based on the presence of a distinct pollution gradient… The gradient was comprised primarily of explanatory variables sediment organic matter and sediment from the mill. The spatial distribution was consistent with effluent discharge and sediment deposition patterns. Three impact zones: 1. Primary 300- 1200m from outfall, intermittent exposure to the effluent, and remaining stations.[41] Sibley noted that these pollution gradients were having a direct impact on the sustainability of the local ecology in the Bay.

METAL MINING

There have been numerous studies on how metal mining affects local water resources; two Ontario based studies include work by Aczue and Keller. Azcue's work focused on Moira Lake, which has accumulated large quantities of arsenic and toxic metals since the 1830's, when mining begain in its drainage basin. Azcue also notes that "despite the fact that the mine activities ceased in 1961, leachates from the abandoned mine wastes still deliver large quantities (about 3.5 Mg.y "t) of arsenic to the lake." [42] Keller on the other hand, has noted that emissions of sulphur dioxide from the Sudbury area smelters have affected thousands of lakes within a 17,000 km^2 area around Sudbury, "thankfully they have been on the decline since the 1970's"[43]

TYPES OF POLLUTANTS

As previously noted, the pulp and paper industry has had a tendency to disperse pollutants that effects the biochemical oxygen demand, suspended solids, organic loadings and more recently chlorinated compounds from the bleaching effluents. Metal mining on the other hand, has been found to leach arsenic and toxic metals, and sulphur dioxide. Two other deadly elements that are having a detrimental effect on Ontario's water sources are mercury (Hg) and persistent organic pollutants. A number of studies have found direct point-source industrial emissions of Hg.[44] Scheuhammer, quoting Evans (1986) notes that most researchers now agree that anthropogenic emissions of Hg to the environment have increased substantially relative to natural emissions since the onset of the industrial revolution. Scheuhammer also notes that current Hg deposition exceeds deposition experience prior to 1940 for small lakes in central Ontario. His work show on to show

[41] Sibley, P., D.G. Dixon and D.R. Barton (2000). "Impact of bleached kraft pulp mill effluent on benthic community structure in relation to environmental factors." Journal of Aquatic Ecosystem Stress and Recovery 7: 239
[42] Azcue, J. a. J. N. (1993). "Arsenic forms in Mine-Polluted Sediments of Moira Lake, Ontario." Environment International 19: 405
[43] Keller, W., Peter Dillon, Jocelyne Heneberry, Michael Malette and John Gunn (2001). "Sulphate in Sudbury, Ontario, Canada, Lakes: Recent Trends and Status." Water, Air and Soil Pollution 130: 794
[44] For further information on this see: Scheuhammer notes that Fimreite (1974) and Rimreite and Reynolds (1973).

the dangers of bioaccumulation of Hg in the food chain, noting "in numerous lakes remote from industrial point source inputs of Hg, predatory fish of various species frequently have elevated Hg concentration (in Ontario)"[45] It is obvious that Hg emissions are not declining but in fact increasing, and in combination with the effects of bioaccumulation this can pose a serious threat to the ecological functioning of Ontario's water system, and ultimately jeopardize human health.

The second form of pollutants is persistent organic pollutants (POPs).[46] POPs are organic compounds that resist photolytic, biological and chemical degradation. They include: DDT, PCB, Aldrin, Dieldrin, Endrin, Chlordane, Heptachlor-Hexachlorobenze, dioxins, furans. They have a tendency to bioaccumulate in fatty tissues and are semi-volatile, enabling them to move long distances in the atmosphere before deposition occurs. Although some natural sources of organochlorines are known to exist, most POPs originate almost entirely from anthropogenic sources associated largely with the manufacture, use and disposition of certain organic chemicals. In contrast, HCB, dioxins and furans are formed unintentionally in a wide range of manufacturing and combustion processes. "Investigators have also demonstrated a convincing correlation between environmental concentrations of PCBs and dioxins with reduced viability of larvae in several species of fish. Noteworthy as well is a report suggesting significant reproductive impairment in a number of Great Lakes species described as top level predators dependent on the Great Lakes aquatic food chain. Supporting this is the observation that wildlife, including stranded carcasses of St. Lawrence beluga whales, with reported high incidence of tumors has contained significantly elevated concentrations of PCBs mirex, chlordane and toxaphene. A 100% incidence of thyroid lesions in Coho, pink and Chinook salmon sampled in the Great Lakes over the last two decades has also been reported to be associated with increased body burdens of POPs".[47] Dachs did a case study on Lake Ontario and POPs because it is a mesotrophic lake and has been heavily impacted by PCB inputs. Thus, it provides a good example to study the potential effect of eutrophication on the biogeochemical cycles of POPs. He found that potential inputs and outputs of POPs in aquatic environments are wet and dry deposition, riverine inputs/outputs, air-water exchange, vertical sinking of particle-associated pollutants,

[45] Scheuhammer, A. M. a. J. E. G. (1999). "The bioaccumulation of mercury in aquatic organisms from two similar lakes with differing pH." Ecotoxicology 8: 50

[46] The following information on the properties and effects of POPs is compiled from: Rltter, L., K.R. Solomon and J. Forget. Persistent Organic Pollutants: An Assessment Report. Guelph, Ontario, International Program on Chemical Safety (IPCS)**:** 1-43.

[47] Rltter, L., K.R. Solomon and J. Forget. Persistent Organic Pollutants: An Assessment Report. Guelph, Ontario, International Program on Chemical Safety (IPCS)**:** 11

transformation/degradation, and sediment accumulation and resuspension processes.[48] Both the United States and Canada, have signed a number of international treaties such as the Great Lakes Water Quality Agreement (which will be examined in a subsequent chapter) and more recently the Stockholm Convention on POPs which came into effect May 17, 2004. Contradictory to this apparent will do mitigate the problems of POPs; Dach's work suggests that some policy issues regarding water quality management may be inadequate. First, the control of PCB loadings from tributaries is not a sufficient measure to control water column PCB concentrations since atmospheric inputs dominate the mid and long-term pollution trends. Second, if the efforts to control eutrophication in Lake Ontario succeed, PCB concentrations in phytoplankton and in fish will reach a plateau or perhaps increase. Therefore, water quality management requires a multi-disciplinary approach. Indeed, water pollution issues must be addressed together with atmospheric pollution issues and account for the ecological complexity of the aquatic environment.[49]

SEPTIC SYSTEMS

If sewage system works efficiently, natural processes should deplete contaminants in the effluent to harness levels within a short distance of the leaching bed. "Unfortunately, many septic systems do not perform the function for which they were designed. In some cases, the septic tanks are unable to cope with the volumes and types of waste generated by modern households equipped with dishwashers and washing machines. At other times, geochemical conditions in the soils and sediments fail to provide the degree of natural attenuation necessary to treat the effluent"[50] Howard notes that in his small study area in the GTA there are approximately 5000 septic systems, and these septic systems leach 179 tons of chloride and 253 tons of inorganic nitrogen into various water sources (either directly or permeation into the groundwater). Further details of his study are in the table below: Mass loading from 5000 septic systems.[51]

[48] Dachs, J., Steven Eisenreich and Raymond Hoff (2000). "Influence of Eutrophication on Air-Water Exchange, Vertical Fluxes, and Phytoplankton Concentrations of Persistent Organic Pollutants." Environmental Science Technology 34: 1096

[49] Dachs, J., Steven Eisenreich and Raymond Hoff (2000). "Influence of Eutrophication on Air-Water Exchange, Vertical Fluxes, and Phytoplankton Concentrations of Persistent Organic Pollutants." Environmental Science Technology 34: 1102.

[50] Howard, K. W. F. a. S. L. (2001). "Transport of urban contaminants into Lake Ontario via sub-surface flow." Urban Water 2: 189

[51] Howard, K. W. F. a. S. L. (2001). "Transport of urban contaminants into Lake Ontario via sub-surface flow." Urban Water 2: 189

Table 3
Mass loading from 5000 septic systems

Parameter	Peak concentration (mg/l)	Contaminant mass per system each year (kg)	Total mass loading (t/year)	Total mass loading over 20 years (t)
Chloride	98	0.017542	179.0	3580
Inorganic nitrogen	84	0.012852	153.0	3070
Toluene	0.213	0.078	0.4	7.8
Dichloromethane	0.007	0.0026	0.01	0.26
1,4-dichlorobenzene	0.0033	0.0012	0.01	0.20

It is not only urbanites that are susceptible to water contamination from septic systems. Studies in the Muskoka-Haliburton region of south-central Ontario, infamously known as cottage country, have shown that these remote lakes and their watersheds receive only low to modest levels stresses from anthropogenic sources such as deposition from industrial sources, however Hall's research in the area found that elevated nutrient loading in the area was caused mainly from cottages and their associated septic wastes.[52]

SNOW DUMPS

Table 6
Mass loading from snow dumps (total snow volume estimate -2.7×10^5 m^3)

Parameter	Average peak concentration (mg/l)	Peak mass loading (t)
Chloride	805	218
Sodium	536	145
Copper	23.2	6.3
Lead	21.1	5.7
Arsenic	1.2	0.32

Howard, quoting Johnston (1984) notes that snow ploughed into banks along the roadside accumulates domestic inert particulate matter and a wide range of contaminants such as domestic garbage, road de-icing chemicals, heavy metals (lead, arsenic, cooper), oils and organic matter. …A significant proportion of chemicals accompanying snow to the dump will leach into soils and groundwater beneath the site when the snow eventually melts. Typical contaminants include sodium, chloride, copper, arsenic and lead. (Quoting Pilon & Howard, 1987)[53]. Howard's

[52] Hall, R. a. J. P. S. (1995). "Paleolimnological assessment of long-term water-quality changes in south-central Ontario lakes affected by cottage development and acidification." Canadian Journal of Fish and Aquatic Science 53: 2

[53] Howard, K. W. F. a. S. L. (2001). "Transport of urban contaminants into Lake Ontario via sub-surface flow." Urban Water **2**: 189

results for a 700km^2 area of the GTA are summarized in the table above entitled: Table 6: Mass loading from snow dumps.

3.2 NON-POINT SOURCES

Non-point sources of water pollution can be sourced back to three major contributors: agricultural practices, urban development and atmospheric deposition. These sources are not as visually obvious as point source pollutants, but their damage is equivocal to them. Crosbie has noted, "conservation and restoration in the Great Lakes should be focused on controlling non-point-source impacts:"[54]

AGRICULTURE

There is a host of information linking the detrimental effects of agriculture (in it's broadest term, incorporating cash crops, cattle ranching, and domestic food supplies) to declining water quality, for simplicity of this report only a portion of the literature will be examined.[55] As documented in the Environmental Commissioner of Ontario's (ECO) July 2000 special report on intensive farming and groundwater protection and in the ECO 2001/02 Annual Report, pollution from farms is a contributing factor to many of today's ground and surface water contamination problems. Contaminants from agricultural operations can enter surface and/or ground water via runoff from fields, direct deposition by grazing animals, discharge from tile drains, flow through soil and cracks in the bedrock, or improperly sealed or poorly maintained wells. Once contaminated, cleanup of surface water and ground water, in particular, can be expensive and difficult and

Table 8
Mass loading of agricultural chemicals

Parameter	Rural use		Urban use	
	Mass loading tonnes per year	Mass loading over 30 years (t)	Mass loading tonnes per year	Mass loading over 30 years (t)
Inorganic-N	797	23910	106	3180
Chloride	112	3347	0	0

[54] Crosbie, B. a. P. C.-F. (1999). "Percentage land use in the watershed determines the water and sediment quality of 22 marshes in the Great Lakes basin." Canadian Journal of Fish and Aquatic Science 56: 1789

[55] For nutrient dynamics in agricultural watershed and the role of riparian forests see: Peterjohn, W.T., and Correll, D.L. 1984. For an examination of the empirical relationship between land use cover and stream water quality in agricultural areas see: Osborne, L.L., and Wiley, M.J. 1988 and for Nitrogen, phosphorus and organic carbon in streams from agriculture: Nelson, P.N., Cotsaris, E., and Oades, J.M. 1996.

contaminants can persist in ground water for decades.[56] In Part 2 Report for the Walkerton Inquiry, Commissioner O'Connor stated that "agriculture can be a significant source of the contaminants in drinking water" and that, as part of a multi-barrier approach to providing safe drinking water, the source of the water must be protected. In 1992, 1,292 farm wells were tested in Ontario and 14% were found to exceed Canadian Drinking Water Quality Guidelines for nitrate/nitrite. Increased damage to the environment and human health caused by nitrogen have largely resulted from the intensification of farming practices on a declining land base, resulting in an increased need for more rigorous regulations to mitigate damages. The *NMA* and O. Reg. 267/03 are premised on the concept that it is essential to mitigate and prevent damage caused by this kind of nutrient overloading.[57] Nitrogen and/or phosphorus resulting from agricultural practices can increase the amount of dissolved nutrients in surface water causing algal blooms and long-term ecosystem changes. Elevated levels of nitrates/nitrogen, in drinking water can cause a rare, but potentially fatal condition call methaemoglobinemia in babies and has been linked to bladder cancer. Materials containing nutrients may also contain heavy metals such as cadmium, lead and pathogens such as E. coli, Campylobacter, Cryptosporidium and Giardia, hormones and antibiotics and pesticides.[58] Crosbie and Chan provide a study on wetlands "provides direct links among land use impacts (particularly agriculture), water quality impairment, and wetland plant diversity."[59] They found that Metolachlor which is a commonly used herbicide in Ontario has been consistently found in agricultural runoff. Spaling also found that drainage from agricultural land provides "evidence indicat(ing) that changes in water quality at the field level accumulate at the watershed scale, and that drainage alters the area and pattern of wetlands in sub-regional and regional scales."[60] Leon also discovered that agricultural practices in Duffins Creek, contributed nitrogen and phosphorus overloads to the watershed.[61] Finally Howard, in his 700km2 study area of the GTA, found approximately 159 km^2 of his study area is represented by parkland, golf courses or agriculture and receives regular applications of nitrogen,

[56] McRobert, D. (2004). What Makes Nutrient Management So Controversial? London Swine Conference, Environmental Commissioner of Ontario.
[57] McRobert, D. (2004). What Makes Nutrient Management So Controversial?, London Swine Conference, Environmental Commissioner of Ontario
[58] McRobert, D. (2004). What Makes Nutrient Management So Controversial? London Swine Conference, Environmental Commissioner of Ontario.
[59] Crosbie, B. a. P. C.-F. (1999). "Percentage land use in the watershed determines the water and sediment quality of 22 marshes in the Great Lakes basin." Canadian Journal of Fish and Aquatic Science 56: 1791.
[60] Spaling, H. (1995). "Analyzing cumulative environmental effects of agricultural land drainage in Southern Ontario, Canada." Agriculture, Ecosystems and Environment **53**: 290.
[61] Leon, L. F., W.G. Booty, G.S. Bowen, D.C.L. Lam (2004). "Validation of an agricultural non-point source model in a watershed in southern Ontario." Agricultural Water Management **65**: 59-75.

potassium and phosphate fertilizers. A further 460 km2 is urbanized and receives nitrate applied by urban residents for the growth of lawns. Pesticides are also used extensively. He noted that groundwater contamination by leaching of fertilizers is a common problem, and nitrogen mass balance calculations by Gillham (1978) and the National Research Council (1978) have shown that between 25% and 50% of nitrogen applied will be leached into the groundwater. In urban areas, excessive use and heavy watering may lead to heavier losses.[62] His results are summarized in table on the left: Mass loading of agricultural chemicals.

URBAN RUNOFF

With southern Ontario containing the greatest population concentration in Canada, and Toronto the largest Canadian city, it is not surprising that urbanization is greatly increasing. Urbanization can have a variety of negative effects on local waters and watersheds. As Bourbonniere notes that increased urbanization around Lake Ontario has increased the quantity of urban runoff in Lake Ontario.[63] "The sub-surface transport of urban contaminants into Lake Ontario takes place by one of two means: 1) via groundwaters that enter the lake directly along its shoreline, and 2) via groundwaters that discharge to urban streams that subsequently feed into the Lake."[64] Urban runoff can include oil and gas from vehicles, road salts, herbicides and pesticides applied by the public for gardening purposes, residues from washing cars, as well as a host of other substance that are deposited either accidentally or purposefully.[65] It has been illustrated that the "urbanized character of the watershed, has accelerated land runoff from paved roadways and from domestic wastewaters."[66] This can restrict the ability of local watersheds to reabsorb water through the natural hydraulic cycle, as the increased paved area channels the water to storm drains.

STORMWATER

Another source of contaminants originating from urban settlements is from storm-water. Storm-water contains oil and grease residue from vehicles, road salt, pesticides and other pollutants.

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[62] Howard, K. W. F. a. S. L. (2001). "Transport of urban contaminants into Lake Ontario via sub-surface flow." Urban Water **2**: 189

[63] Bourbonniere, R. a. P. A. M. (1996). "Sedimentary Geolipid Records of Historical Changes in the Watersheds and Productivities of Lakes Ontario and Erie." Limnology and Oceanography 41(2): 352-359.

[64] Howard, K. W. F. a. S. L. (2001). "Transport of urban contaminants into Lake Ontario via sub-surface flow." Urban Water 2: 184

[65] For an examination of the major toxicants and the effects of motorway runoff on freshwater ecosystems see: Maltby, L., Boxall, A.B.A., Forrow, D.M., Calow, P., and Betton, C.I. 1995

[66] Bourbonniere, R. a. P. A. M. (1996). "Sedimentary Geolipid Records of Historical Changes in the Watersheds and Productivities of Lakes Ontario and Erie." Limnology and Oceanography 41(2): 357.

Particularly problematic are the older storm sewers which are combined with sanitary sewers and overflow raw sewage during heavy rainfalls.[67] In addition pollutants are also contributed by storm sewers during dry weather, due to illegal sanitary cross connections, excess surface watering (from car washing), and accidental or deliberate spills. Dry weather loadings, while relatively small in comparison to wet weather loadings, contain contaminants such as: bacteria, suspended solids, aluminum, barium and copper.[68] More than 2, 6000 storm sewers discharge storm water into the City of Toronto and 34 of these contain combined sewer overflow (CSO). In areas of Toronto developed after 1975, storm water has been stored in storm water ponds for flood control purposes which indirectly benefits storm water quality through the settling process. Increasingly the City has introduced a range of water conservation programs, downspout disconnection programs, and retrofit activities but there has been insufficient baseline or follow-up data to assess the impact of any particular program on reductions in CSO.[69] An example of a municipal response to this situation is the City of Toronto's Wet Weather Flow Master Plan (for a full discussion on this initiative please see page 80 of this report).

City of Toronto Wet Weather Flow Master Plan

Initiated in 1997, this project is a collaborative effort undertaken to address the prevention, control and reduction of wet weather related water pollution. The Master Plan consists of an integrated plan for initiatives to manage wet weather flows, caused by rain storms and snow melt. In developing the plan, a hierarchy of maximum source control, then conveyance and then end- of – pipe has been adopted. While this initiative is within the jurisdiction of the City of Toronto, partnerships have been developed with other municipalities located in other watersheds (Clean Waters, Clear Solutions 1998).

SALTING

Winters in Ontario can be cold, with a great deal of ice and snow. To mitigate the hazards of driving and walking on this ice,

Table 5
Road salt mass load

Parameter	Tonnes applied annually	Tonnes released annually to groundwater	Total mass loading over 30 year period (t)
Chloride	56 000	30 800	924 000
Sodium	36 000	19 800	594 000

[67] Toronto RAP: Clean Waters, Clear Choices, 1998
[68] Toronto RAP: Clean Waters, Clear Choices, 1998
[69] Toronto RAP: Clean Waters, Clear Choices, 1998

salt is usually applied. As Howard notes, "until recently it has been widely assumed that the vast majority of salt applied during the winter is flushed into storm sewers, streams and lakes by spring rains and snow-melt. However, catchment salt balance studies conducted in eastern parts of Toronto have shown that as little as 45% of the salt applied each year leave the catchment area the remainder entering the sub-surface and passing into the water table. As can be seen from the table *Road salt mass loads*, in a 30 year period this can result in 924,000 tons of chloride and 594,000 tons of sodium leaching into local waters.

ATMOSPHERIC DEPOSITION

A final source of non-point pollutants arise from atmospheric deposition. Kolak, quoting Nriagu (1986) notes that "the high surface area/drainage basin ratios of the Great Lakes, renders this water body susceptible to atmospheric deposition"[70] When most people consider sources of pollution from the atmosphere, the initial thought is to acid rain, which changes the pH balance of water making it acidic. However, Galloway provides evidence from a number of studies focusing on the Sudbury area that concluded water acidity AND metals were a result of acidic precipitation.[71] Hall's results (in addition to Neary et al. 1990) were consistent with the finding of water chemistry monitoring programs, under way since 1979, which have demonstrated a strong correlation between lake water pH declines and sulphate deposition in Central Ontario (Neary et al 1990).[72] Hall quoting Neary (1990) also determined that natural organic acids were not a major a major factor explaining the acidification of the lakes in the region. Despite this decrease in acidity, Snucins research does not have overly optimistic results for the ecological health of the water in the region. Snucins studies Killarney Provincial Park, which is located 40-60km southwest of Sudbury. He found that with current legislated controls on industry, by 2010 approximately 30% of the park will still have critical loads in excedance for sulphur.[73]

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[70] Kolak, J., David Long and Tina M Beals (1998). "Anthropogenic inventories and historical and present accumulation rates of copper in Great Lakes sediments." Applied Geochemistry 13: 69

[71] Galloway, G. a. R. P. (2003). Managing Groundwater Resources in the Great Lakes Basin: Securing Our Future Visions and Principles. Toronto, Munk Centre for International Studies, University of Toronto: 2

[72] Hall, R. a. J. P. S. (1995). "Paleolimnological assessment of long-term water-quality changes in south-central Ontario lakes affected by cottage development and acidification." Canadian Journal of Fish and Aquatic Science 53: 13

[73] Snucins, E., John Gunn, Bill Keller, Sushil Dixit, Atle Hindar and Arne Kenriksen (2001). "Effects of Regional Reductions in Sulphur Deposition on the Chemical and Biological Recovery of Lakes Within Killarney Park, Ontario, Canada." Environmental Monitoring and Assessment 67: 187

4. WATERSHED ISSUES IN ONTARIO

4.1 WATERSHED ISSUES IN ONTARIO

The key watershed issue in Southern Ontario is balancing and maintaining 'watershed health' while simultaneously accommodating growth. Watershed health can be measured and evaluated by assessing the balance between Ontario's economic, social and environmental needs. In considering Ontario's water needs, a water growth management strategy must include: long term planning to determine appropriate land uses that ensure adequate water supplies; the protection of surface water and groundwater quality; water allocations in consideration of long term water supplies and environmental need and the management of growth with consideration for the groundwater system to receive wastewater.

In Ontario, watershed and sub watershed plans are not required to be carried out on behalf of the provincial or local government. Rather, it is a voluntary activity more often than not taken on by either Conservation Authorities (CA's), alone, or, in partnership with a range of stakeholders which may include municipalities or land developers. Given the increasing recognition of the importance of the health of water related resources, Justice O'Connor in Part Two of the Report of the Walkerton Inquiry, has recommended that watershed-based source protection plans be a legislated requirement under the Environmental Protection Act. In an effort to support the development of this recommendation, Conservation Ontario has committed to assist the province in improving information gathering tools and processes to inform the status of watershed and sub watershed planning in Ontario. The fragmentation of water management responsibilities in Ontario presents a challenge to watershed managers and implementing agencies. The lack of clarity in defining roles and responsibilities has resulted in the duplication of efforts, lack of water quality and quantity monitoring and gaps in information, specifically related to groundwater management (Conservation Ontario: The Importance of Watershed Management, 2001).

A Provincial approach to watershed management and planning was introduced in the watershed management guidelines released by the Ontario Ministries of Environment and Energy and Natural Resources in June of 1993. Guidelines provided stakeholders with information on how to carry out watershed and sub watershed planning strategies and how these plans could be integrated into the municipal land use planning process. While providing basic information on the development of watershed strategies, there are no provincial guidelines or generally accepted best

practices for how watershed plans should be implemented, monitored, reported or reviewed. This has resulted in a lack of consistency in watershed management approaches throughout the province, and more importantly a lack of commitment and indeed enforcement in carrying through with the implementation of planned strategies. Without clearly defined and financially supported monitoring and reporting mechanisms, it is difficult for watershed management implementing agencies to gauge progress and constructively plan for their respective watersheds.

In 1996, a provincial evaluation of watershed management was carried out. Watershed management stakeholders were contacted and requested to respond to a questionnaire which would identify all watershed management projects initiated within their watersheds between 1990 and 1995. In many cases, the lead agency was either a municipality or developer but in 81 of the 87 projects reported on, a CA was involved as the lead implementer (Conservation Ontario, Watershed Management in Ontario: Lessons Learned, 2003). The main conclusion of the study was that there was and is a need for the protection of Ontario's natural resources and environmental health. The information gathered, was published in 1997 by the Ministries of Environment and Natural Resources as the "Inventory of Watershed Management Projects in Ontario, 1990 – 1995" (Watershed Management in Ontario: Lessons Learned, 2003). In 2000 as a follow-up to the first report, the MOE and MNR provided funding to Conservation Ontario to update the watershed inventory database (1996 – 2000 survey). This time around, internet based technologies were used in that the report was developed as a map-referenced database that was administered on-line. Watershed management projects were defined as an initiative that integrated multiple resource issues with a water resource emphasis and while one project may represent a full watershed development plan another project may only have identified a sub watershed plan for a proposed development site. While in 1995, 23 of the 38 CA's responded to the survey, in 2000 only 11 of the CA have provided updated information. As a result of the low response rate, the MNR followed- up with CA's through a series of telephone surveys. Once completed, survey analysis determined that there were fewer watershed management projects initiated between 1996 – 2000 than between 1990 – 1995 and that a large majority of projects had been developed in response to urban development and agricultural pressures in the form of rehabilitation or regeneration projects (Watershed Management in Ontario: Lessons Learned, 2003).

To date CA's and municipalities are still referring to the 1993 Provincial Guidelines as this is the most recent report related to watershed management released by the province. In May of 2003, Conservation Ontario released a 'Watershed Management in Ontario Report: Lessons Learned

and Best Practices' in an effort to update the generic framework for watershed management which reflects the changes in practice that have occurred since 1993. The Lessons Learned and Best Practices process takes the province's work one step further by also providing an evaluation framework for measuring progress in watershed management in Ontario (ibid).

Traditionally, the Province's had defined watershed management as dealing with issues of flood and erosion , CA's encourage that a provincial integrated water policy should be developed that moves beyond this narrow understanding of the role of watersheds. CA's require that in additional to developing a provincial policy with greater scope, the province needs to clarify their role in water management. While it has the broadest jurisdiction over water it has not, to date, shown equal levels of leadership and consistency. CA's have recommended that a provincial water policy should develop consistent standards, implementation procedures, regulations and enforcement mechanisms and monitoring systems related to water quality and quantity. A provincial policy should embrace an 'adaptive environmental management' approach which allows policies and programs to be adapted to monitoring and evaluation results and the province should encourage the Federal Government to develop a national framework for water policy and to strengthen agreements with provinces under the Canada Water Act. A Federal Water Policy was tabled in Parliament in 1987, but was not subsequently developed into a national policy. CA's have encouraged that a national policy should clearly define the federal government's role in the design of national standards for water quality and monitoring on a watershed basis (Conservation Ontario: Importance of Watershed Management in Protecting Ontario's Drinking Water Supplies. 2001).

4.2 SOURCE PROTECTION: CASE STUDY, WALKERTON ONTARIO

In May 2000, Walkerton's drinking water system became contaminated with deadly bacteria, primarily *Escherichia coli* O157:H7. Seven people died, and more than 2,300 became ill. The tragedy triggered alarm about the safety of drinking water across the province.

Ontario's rural heartland in shock

May, 2002: Highlights of the Walkerton tainted water inquiry findings

"We have a terrible tragedy here."

With those words, Ontario Premier Mike Harris waded into the Walkerton, Ontario water crisis on Friday, May 26, 2000. He addressed a crowd of reporters and residents in the normally quiet town in the heart of Ontario's rural heartland– a part of the province that normally gears up for a flood of fun seekers at this time of year.

Instead, Walkerton began the transition into the town "where those kids died from E. coli". It's not what anyone wanted, but it was the end result. Reporters from around North America descended on the area, trying to get to the bottom of what's being described as Canada's worst–ever outbreak of E. coli contamination. Seven people died from drinking contaminated water. Hundreds suffered from the symptoms of the disease, not knowing if they too would die.

According to the local medical officer of health, it all could have been prevented. Dr. Murray McQuigge stunned the country with his revelation on CBC Radio on May 25, 2000 that the Walkerton Public Utilities Commission knew there was a problem with the water several days before they told the public.

The impact of discovering that the young and the old in a small Ontario town were dying from drinking town water will reverberate throughout Ontario and the country for years. Premier Harris immediately blamed the former NDP government for loosening water standards. Within a week he had announced his own full–scale public inquiry that will inevitably look at government cuts that have radically changed the daily operations of the Ministry of the Environment.

As time goes by, officials move closer to discovering what went wrong, but it is evident there will be no easy answers. Many players will get their share of the blame.

Water supply far from safe

It could years, before anyone there turns on a tap without wondering if the water is safe.

Imagine what it's like. A bowl of soup must be made from bottled water. Soap and water are used to wash dirty hands, but then bleach is used to make sure the dangerous bacteria are gone. You wonder if it's safe to wash your clothes or your car with tap water. Almost every aspect of your life is altered. And then there are all of the people whose jobs have disappeared. James Skarnikat is a chef at a restaurant and wrote a diary for us. What does the staff do when the restaurant is closed and doesn't know when it will reopen?

And then there is the social impact. Everyone in the community knows someone who has died or was seriously ill. They've all attended the funerals. Their kids' soccer games were cancelled. Parents of players from teams in the neighbourhood were afraid the Walkerton players were infected and could infect their kids with the deadly bacteria. Even some adults were afraid of getting too close to their co–workers. They didn't want to take the chance.

The people of Walkerton also know very well the people who may end up shouldering the blame. It's a small town where everyone knows everyone. Friendships have been severely tested, and some have been destroyed.

Koebel asks for privacy

The manager at the heart of this controversy, Stan Koebel, appealed for privacy.

Koebel was in charge of the Public Utilities Commission. Medical officer of health, Dr. Murray McQuigge, insists the PUC knew the water supply was contaminated, days before the public was informed. At the time Koebel said he was shocked, and it was revealed he was under the care of a doctor. He made one brief

appearance before the hordes of reporters, but his goal was to stay in isolation. His friends, and there are many, said he would never knowingly put people at risk.

The Inquiry

Koebel's name came up many times as an inquiry into Walkerton's water opened in the town in October, 2000, five months after the trouble first came to light.

The inquiry was called to look into how the water was contaminated with the deadly strain of E. coli bacteria.

Early witnesses included a past mayor of Walkerton and the Mayor at the time of the contamination.

Ontario addresses water safety

It didn't take long for a political battle to ensue. On May 29, 2000, a clearly shaken Ontario Environment Minister Dan Newman called a news conference to say changes would be made to ensure that the province's water supply remained safe.

"If there is something positive that can ever come out of an event like this, it is that changes be made to ensure that it doesn't ever happen again," he said at the Ontario legislature.

Economic impact

A 60-page study released in November, 2001 concluded that the Walkerton water tragedy cost at least $64.5 million and an estimated $155 million, if human suffering was factored in. Each household in the town of 5,000 spent about $4,000 on average as a result of the contamination, for a total of $6.9 million. The study weighed in the costs and benefits of providing safe drinking water.

The study also concluded that real estate values in Walkerton fell a total of $1.1-million as a result of the contamination of the water supply. Costs for the town's businesses, for items such as bottled water or disinfecting and replacing equipment, are estimated at $651,422.

Lost revenues from May 1, 2000 to April 30, 2001 were estimated at $2.7 million. The study estimates that it cost more than $9 million to fix the town's water system, while the Ontario government spent about $3.5 million on legal fees and another $1.5 million to supply clean water to institutions.

CBC News (2000) Inside Walkerton, A Water Tragedy

Summary of Recommendations[74]

Seven people died, and more than 2,300 became ill. Some people, particularly children, may endure lasting effects.

- The contaminants, largely *E. coli* O157:H7 and *Campylobacter jejuni*, entered the Walkerton system through Well 5 on or shortly after May 12, 2000.

[74] (Ministry of the Attorney General (2002) Walkerton Commission of Inquiry, Part Two http://www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton/part1/WI_Chapter_01.pdf)

- The primary, if not the only, source of the contamination was manure that had been spread on a farm near Well 5. The owner of this farm followed proper practices and should not be faulted.

- The outbreak would have been prevented by the use of continuous chlorine residual and turbidity monitors at Well 5.

- The failure to use continuous monitors at Well 5 resulted from short-comings in the approvals and inspections programs of the Ministry of the Environment (MOE). The Walkerton Public Utilities Commission (PUC) operators lacked the training and expertise necessary either to identify the vulnerability of Well 5 to surface contamination or to understand the resulting need for continuous chlorine residual and turbidity monitors.

- The scope of the outbreak would very likely have been substantially reduced if the Walkerton Public Utilities Commission operators had measured chlorine residuals at Well 5 daily, as they should have, during the critical period when contamination was entering the system.

- For years, the PUC operators engaged in a host of improper operating practices, including failing to use adequate doses of chlorine, failing to monitor chlorine residuals daily, making false entries about residuals in daily operating records, and misstating the locations at which microbiological samples were taken. The operators knew that these practices were unacceptable and contrary to MOE guidelines and directives.

- The MOE's inspections program should have detected the Walkerton PUC's improper treatment and monitoring practices and ensured that those practices were corrected.

- The PUC commissioners were not aware of the improper treatment and monitoring practices of the PUC operators. However, those who were commissioners in 1998 failed to properly respond to an MOE inspection report that set out significant concerns about water quality and that identified several operating deficiencies at the PUC.

- The provincial government's budget reductions led to the discontinuation of government laboratory testing services for municipalities in 1996. In implementing this decision, the government should have enacted a regulation mandating that testing laboratories immediately and directly

Following the Walkerton water crisis, the provincial government initiated an inquiry which was carried out in two phases – Part One dealt with the "The Events of May 2000 and Related Issues" and Part Two with the development of "A Strategy for Safe Drinking Water". The Walkerton inquiry investigated the existing approaches to water safety, exposing flaws in the system related to fragmented responsibilities shared amongst the various levels of government; unforceable water safety guidelines; downloaded infrastructure costs; and deregulated monitoring programs. It has been argued that the Walkerton tragedy could have been avoided if the MOE had adequately

fulfilled its regulatory and overseeing role and if it pursued a mandatory rather than voluntary pollution abatement program (Cooper, 2003).

The Walkerton experience demonstrated the need for provincial and municipal jurisdictions to adopt '*multi-barrie*r' approaches to protect the quality and quantity of our local water supplies. The multi barrier approach involves a series of measures to protect water from it source through to its point of distribution. Accordingly, the multi barrier approach involves all levels of government and their corresponding responsibilities related to source protection, water treatment, the distribution system and monitoring and response programming. Ensuring that all these barriers are put in place will mean new or revised laws across jurisdictions with clear lines of responsibility and new funding arrangements (Cooper, 2003). Key strategies in addressing water quality and quantity must address the following:

- Protection of source waters from contamination from point and non-point-industrial, municipal, and agricultural sources
- inappropriate developments should be minimized or avoided in ground water recharge/discharge areas, aquifers and headwaters
- and strategies must address the cumulative effects of water taking by multiple users which has been identified as an 'unsustainable situation' (MOE, Report of The Advisory Committee April 2003)

In addition to defining approaches to managing our waters, Part Two of the Walkerton Report recommended that watershed-based source protection plans (SPP), be developed for all watersheds in Ontario and that these plans exist as a sub-set of broader watershed management plans that are currently developed by local municipalities and Ontario's CA's. It was further recommended, that where appropriate these plans be managed by the relevant CA's. In singling out CA's as potential management bodies for the implementation of SPP's, Justice O'Connor referred to their long history in the field of watershed planning and management (Part Two: Report of the Walkerton Inquiry, 2002) It is important to note that source protection planning is one component of the 'multi – barrier' approach to ensuring the safety of drinking water, and it is the first barrier in this system. The second and third avenues for intervention include, processes related to the treatment of water and water distribution. It was also recommended that the watershed –based source protection plans be developed within a 'place-based' framework (Fox and Kinkead, 2004). The "place based approach" assumes the following processes when thinking about source-protection planning: the *triggers* or causes that precipitate watershed studies and/or plans; available funding for the implementation of plans; the willingness of municipalities to participate in plan

development; the degree of land use changes (urban and rural) within a specific watershed; the rehabilitation and regeneration needs of specific watersheds and the number of watersheds that exist within a particular jurisdiction (Watershed Management in Ontario: Lessons Learned, 2003).

The primary role of SPP's, would be to regulate and control levels of water withdrawl and contaminant loading which would be assessed through the use of such tools as water budgets, water quality models and vulnerability mapping exercises. At the provincial level the MOE would use the information gathered in considering applications for Permits to Take Water and for Certificates of Approval on wastewater discharge and other contaminant releases. O'Connor recommended that at the municipal level this information be used to identify susceptible lands where protection measures are needed to ensure public health and safety and that municipal planning, zoning and bylaw decisions be consistent with ensuring the required level of protection (Fox and Kinkead, 2004).Out of the 93 recommendations Justice O'Connor made in Part Two of the Walkerton Report, 22 were related to source protection planning and were designed to protect sources of drinking water from contamination and from threats to sustainability of water (O'Connor 2002 in Fox and Kinkead, 2004). The Walkerton report was the starting point for the development of a draft watershed-based source protection planning framework.

On November 15 2002, an 18 member Advisory Committee on Watershed-based Source Protection Planning was established by the MOE. The committee met over a four month period to build consensus amongst its members and was asked to provide advice to the government to support the development of a framework for watershed-based source protection planning (MOE: Advisory Report on Watershed-Based Source Protection Planning, 2003). The feedback was consistent with Justice O'Connor's recommendations in Part Two Report of the Walkerton Inquiry, and again reiterated the need for source protection planning for Ontario's waters. The Committee defined a watershed as a system that consists of all the lands that drain into a particular body of water and considers watersheds to be the most ecologically practical unit for managing water since impacts are felt on the watershed level rather than at the level of political boundaries, such as municipalities (ibid). Further, watershed based source protection acknowledges that the quality and quantity of ground and surface water is influenced by the integrity of the watershed and by maintaining, restoring and improving the diversity and function of natural features the water resources within a watershed can be enhanced which is the most effective way of protecting our drinking water (ibid). Planning for watershed based source protection identifies areas where threats to drinking water sources exist and then creates controls and land use designations that are viewed as

an appropriate response. Operating at the watershed level allows for whole water resource systems to be considered when threats are being assessed.

One of the 'Framework Fundamentals' of the Advisory Report was that local municipalities and Conservation Authorities will be important players in the realization of watershed –based source protection plans (ibid). The Advisory Committee Report proposes new powers for municipalities who in effect will be the key players in the development and implementation of watershed – bases source protection plans, not only through representation on CA's but through their role in implementing , controlling and influencing land use and land use planning. Municipalities can influence the location of new high risk land uses through restrictions in their Official Plans and can impose conditions of development before issuing permits for new developments through the planning process. However, it must be recognized that the Planning Act (through which the municipality has jurisdiction over local land use planning), applies primarily during the limited period of time when a development is being proposed, through the approvals process and initial construction but it does not allow for long-term monitoring and enforcement of land use planning activities (MOE: Advisory Committee on Source Protection Planning, 2003). The ability of the municipality to regulate pre - existing land use is even more difficult and while some work with landowners and industry on a voluntary basis, municipalities cannot make this type of co operation mandatory (ibid). In response to this situation the Advisory Committee has recommended that the Province commit to working with municipalities to develop new powers and supporting tools that supplement existing powers to manage high risk land use activities in the short, medium and long term.

New responsibilities for Conservation Authorities:

CA's currently receive provincial funding for flood control activities and can collect voluntary levies from municipalities for doing agreed upon work. This means that CA's are not resourced enough to deal with their new roles in leading the development of watershed-based source protection plans and once source protection planning becomes mandatory, CA's will need to have additional funding, to implement activities. New sources of funding could potentially include an additional charge being added as a line item to the municipal tax bill or, funding directly from the province. Again consistent with O'Connor's recommendations, the Advisory Committee has suggested that CA's be given the responsibility for co-coordinating the development of watershed based source protection plans.

In reference to current legislation, the Advisory Committee noted that existing legislative powers are not being used to their fullest extent and recommended that any new legislative provisions should focus on gaps in the current framework. This would best be facilitated by consolidating source water protection provisions under one piece of legislation which may be complemented by the creation of a consolidated set of regulations under the source water protection legislation. This recommendation differs from Justice O'Connor's Report which suggested that source protection be implemented through amendments to the Environmental Protection Act. While differing in their institutional recommendations, both are consistent in recognizing that source protection should be separate from drinking water treatment and distribution for the purpose of legislation. The Legislative basis for source protection planning is found in Recommendation Seven in which the Advisory Committee recommends a stand alone piece of legislation for source water protection be developed that incorporates provisions related to source protection from other legislation so that the legislation will be as clear and comprehensive as possible and this legislation must take precedence over other legislation especially when human health is a concern (MOE: Advisory Committee on Watershed Source Protection Planning, 2003). Based on this recommendation legislation would therefore require that provincial decisions affecting water quality and quantity related to permit taking and certificates of approval must be consistent with this legislation.

In February of 2004 the Government of Ontario released a White Paper on watershed – based source protection planning. The paper proposes a legislative framework for the development and approval of water source protection plans. The overall goal of the plans would be to promote public health by conserving and protecting current and future sources of drinking water. The plans would be developed by a multi-stakeholder Source Protection Planning Committee (SPPC), which would be established by the boards of existing conservation authorities, or in watersheds without a CA, Source Protection Planning Boards created by the province. The SPP Committee would play a coordinating role in planning for source protection plans and final approval will be centralized at the MOE.

The primary role of the proposed SPPC's in each identified planning area, is to get consensus on what sufficient municipal support will mean for the source protection plan for that particular area. There is the need to understand how municipal support will be defined before the plan goes for provincial approval and to coordinate a transparent and local consultation process The

Advisory Committee on Watershed-based Source Protection Planning reports suggests that approximately 16 source protection planning areas should be established in southern Ontario and 8 in Northern Ontario. It further goes on the recommend that planning areas in southern Ontario should be based on tertiary level watersheds and those in Northern Ontario on secondary level watersheds. In all cases, the planning area should be based on the current distribution of CA's in the province and designation of planning areas could also consider the pairing of CA's that already have source protection planning experience with those that don't. The White Paper also invited discussion and feedback on two other important government initiatives: strengthening the rules for the issuance of water-taking permits and requirements related to water bottling companies and other permit holders to pay for the water they use (New White Paper an Important Step for Safe Water and Healthier Ontarians News Release 2004).

The White Paper continues to address water management from a broad watershed system level but as it stands, the approach could potentially contribute to an already over complicated situation related to organizational capacity and administrative overlaps of roles and responsibilities. It also remains unclear how the protection plans will relate to existing municipal planning systems and regulations (Ferrigan, 2004). The necessary legislation needed to implement this policy will be developed once the Advisory Committee on Watershed-based Source Protection Planning reports back to Government. It is expected that legislation pertinent to this process should be enacted by December of this year (ibid). This date corresponds with the lifting of the Governments water taking moratorium which was imposed December 2004 in a response to recommendations to review provincial groundwater supplies.

Since this is the first instance of province wide source protection planning there is a level of uncertainty is estimating its potential costs. The Advisory Committee recommended that the province provide substantial levels of funding for the development of initial source protection plans and similar to the O'Connor Report it also advocates for a permanent funding framework to be put in place drawn from a number of funding sources including those who benefit from and/ or impact water sources. O'Connor also favored a combination of funding mechanisms which may includes increased municipal water rates and specific user fees for water usage.

While there is room for flexibility to respond to local conditions the "key ingredients" in the development of water source protection plans as proposed by Justice O'Connor include:

- Clear objectives and targets
- The development of 'Water budgets' including projected future water needs and related costs
- A contaminants model, including assessment of future pollutant loadings and cumulative impacts
- Maps, based on provincially prescribed definitions and methodology that identify high, low and medium risk areas and sensitive water resources
- Identification of where source protection issues exist
- An implementation plan to manage identified source issues
- A monitoring and reporting plan

(Ministry of the Attorney General "Walkerton Commission of Inquiry, 2002)

4.3 CONSERVATION ONTARIO'S WATERSHED MANAGEMENT FRAMEWORK

In 2001, before the release of the Walkerton Report (but still after the water crisis that occurred there), the provincial government commissioned a report entitled "Managing the Environment: A Review of Best Practices" (Executive Resource Group, 2001) which called upon the province to implement a number of strategic shifts in environmental management. Key recommendations included: embracing a place-based approach to water management which is based on boundaries "that make environmental sense" ; the striking of a balance among the use of regulatory and non-regulatory tools; improvements in the sharing and coordination of jurisdictional responsibility; and the development of an accountable inclusive citizen involvement process (Fox and Kinkead, 2004). In response to the provincial report, under the leadership of Conservation Ontario and/or individual CA's five specific demonstration project were initiated. Provincial oversight was organized by the MNR while the MOE provided seed funding to match CO and CA's financial and in-kind contributions (Fox and Kinkead, 2004). The five project themes included:

- *Watershed Management: Lessons Learned and Best Practices in Planning, Implementation and Monitoring*
- *A Framework for Sustainable Water Allocation and Water Use*
- *Watershed Reporting: Improving Publics Access to Information*
- *Web-based Interactive Communications and Information Sharing*
- *Phosphorus Management and Water Quality: Economic Incentives and Multi-Stakeholder Watershed Management (Conservation Ontario)*

The Watershed Management: Lessons Learned and Best Practices Report, examines the best of current watershed practice through the presentation of three case studies from three different CA's which include the Credit Valley; Grand River and Toronto Region Conservation Authorities. The information in this report provides a general framework for understanding watershed based planning in Ontario.

What is Watershed Management in Ontario?

Watershed management is defined to include the development of watershed plans, the implementation of those plans, monitoring of progress and review of plans. The process of watershed management has four main stages and has traditionally been implemented in a reactive manner in response to external '*triggers*' related to public concerns over local environmental conditions. The four stages of watershed management include: watershed planning; implementation; monitoring and reporting; and review and evaluation (Watershed Management in Ontario: Lessons Learned, 2003). As practiced by Conservation Ontario, there are two additional key elements in the watershed management process which are continuously integrated throughout the four stages of plan development. These elements are the development of *partnerships* with watershed stakeholders and *public involvement*. In the generic watershed management framework, a clear distinction is made between watershed planning, which is a component of watershed management, and watershed management itself (ibid). The distinction is relevant, in that by definition and design, they are effectively two separate processes. Watershed management takes a comprehensive, ecosystems approach to water dealing with all water related natural features, terrestrial resources, fisheries, water linkages and green space planning (MOE: Report of the Advisory Committee, 2003). While watershed planning can be described as a process that 'uses watersheds and sub-watersheds as the biophysical basis for planning and management. It is based on using the hydrologic cycle as the pathway that integrates physical, chemical and biological processes of the basin ecosystem' (MOE, 1997). Successful watershed planning should effectively provide a means for integrating planning for safe and sustainable drinking water supplies with a range of water management objectives (Conservation Ontario). Although Conservation Ontario has provided this generic watershed management framework, it is worthy to note that large variations exist in the province between the size and nature of its watersheds; in the relevant issues and the tools and approaches used in the management process. As a result, there is clear acknowledgement of the 'place based' approach to watershed management which reflects the distinct local environmental, economic and social contexts of the varying regions of Ontario.

Watershed management is not just about managing natural resources, it also includes the management of human and land use activities that affect natural resources. The natural features and functions within a watershed determine the extent to which the natural system can moderate effects of human activities. By virtue of the fact that human activity includes actions by governments, municipalities, industries and landowners, watershed management inherently requires a co-operative effort. An integrated watershed management approach attempts to influence how water is managed at each point of contact: by farmers, landowners, industry, land developers, wastewater managers, municipalities and water supply managers. This approach is based on the concept of 'causality' which identifies the cause and effect relationships of human activities on natural functions that extend across political jurisdictional boundaries.

Watershed management in Ontario is characterized by:

- The concept of a shared responsibility amongst stakeholders and the public for environmental protection and enhancement
- Sharing of plan implementation responsibilities across jurisdictional agencies
- Identifying goals for improvements in environmental performance through the use of the '*Adaptive Environmental Management'* approach
- the "place based" framework which focuses on the use of ecological as opposed to political boundaries
- the use of a broad range of implementation and management tools (regulatory and non-regulatory) to respond to watershed and sub watershed goals and objectives

Conservation Ontario's Watershed Management Process

The generic watershed management process in Ontario is composed of four main stages and can be visually represented with the following diagram:

Figure 1-2: The Watershed Management Process

The notion of 'triggers' features prominently in Ontario's approach to watershed management. The 'trigger', is the result of the introduction of development proposals that may have negative environmental effects, intense urban/rural development activities, large water takings etc. As a result of the traditionally reactive nature of watershed management the concept of 'the trigger' has been adopted into Conservation Ontario's 'Schematic of the Watershed'.

The Watershed Management Process: Stage One

PLANNING:

The deliverable product as a result of stage one is the development of a watershed, sub-watershed or other watershed-based environmental plan (s). The development of a 'plan' is the result of a number of key activities.

a) Scoping: Scoping involves preliminary issue identification and information gap analysis that allows for the development of a work plan and the allocation of resources.

b) Characterizing the System: This stage focuses on filling in data and information gaps identified in the scoping exercise. Collection of information and data is focused on the following components: surface water resources, surface water quality, groundwater resources, stream morphology, terrestrial resources, aquatic resources, and land use and area demographics. Once this information is gathered the next step is to introduce an *integration analysis* by mapping the interrelationships of the 'components'.

c) Setting Goals: At this stage, goals, objectives and working targets are set with involvement from stakeholders and the public.

d) Development of Management Alternatives: Alternative management strategies are developed for future scenarios. These strategies are based on the technical data collected and public and stakeholder input.

e) Evaluating Management Alternatives (MA): MA's are evaluated against a common set of criteria which often include the following: the MA's ability to meet targets, public acceptability, cost, technical feasibility and its impact on future land uses.

f) Selection of MA: With input from the public and stakeholders a suitable MA is selected.

g) Finalizing Targets: Targets are amended in line with the selected MA.

h) Developing Implementation and Monitoring Plans: This plan lists actions to be taken, agencies responsible, timelines and funding sources.

The Watershed Management Process: Stage Two

Implementation: The deliverable in stage two, is the implementation of the program, policies or projects that arise from watershed, sub watershed or other watershed-based environmental plans. The chart below provides a guideline of what an implementation schedule might look like for a specific feature of a watershed plan, in this example the feature highlighted is a Natural Heritage System.

Typical Responsibilities for Implementation of Watershed Strategies

Management Recommendation	Purpose	Responsibilities (Who)	Timing (When)	Other Considerations (How)
Feature: Natural Heritage System (NHS)				
Protect significant stream corridors-main branch and tributaries, protect floodplain, fill line	Protect life and property, develop water quality buffer, provide wetland and stream protection and facilitate engagement	Municipality, CA, landowners and community	Develop and adopt policies immediately implement at draft plan stage	Designate green space, implement flood and fill line regulations, develop interface between wetland and proposed development
Protect woodlots with significant wildlife habitat	Wildlife habitat, landscape ecology and aesthetics	Landowners, municipality, MNR, community groups	Change municipal Official Plans as necessary, EIS at draft plan stage and ongoing management	Designate green space EIS for adjacent developments, SWM, trail and interface between green space and development
Require EIS for development in adjacent lands and /or category two areas	Protect and enhance function of NHS, develop amenity benefit for human residents	CA, Region, City to review developer EIS	Draft plan stage, policy in Official Plans	Refer to specific features and function in strategy

Source: Watershed Management in Ontario: :Lessons Learned and Best Practices, 2003
Note: (SWM: Storm water Management; EIS: Environmental Impact Study; EIR: Environmental Implementation Report)

How are watershed plans implemented?

Watershed Plans can be implemented through a variety of mechanisms and through a range of agencies at the provincial and municipal level. Mechanisms for implementation can be categorized as such: land use planning mechanisms (i.e. Municipal zoning of sensitive areas such as groundwater recharge/discharge areas); through regulation mechanisms (i.e. restrictions on water

takings); land and water stewardship mechanisms (i.e. best management practices and water conservation initiatives), public land securement and infrastructure development and maintenance.

Most watershed plans are characterized by the inclusion of implementation activities which reflect a mix of mechanisms. For example, an activity may focus on a regulatory mechanism such as the use of municipal sewer bylaws which restrict certain pollutants from being discharged with an incentives program which recognizes and awards good corporate citizens. The administrative structure for Stage Two: Implementation is the establishment of an *Implementation Committee*. Members of the Committee must identify the implementation requirements relevant to the specific plan and consider options available. In order to address the multiplicity of issues addressed in watershed or sub watershed plans, an implementation plan typically includes a range of implementation mechanisms. In addition to the traditional land use planning systems a range of other tools can be used to implement watershed plans which include the use of the Aggregate Resources Act (which the Implementation Committee can refer to when commenting on applications for development); the Ontario Water Resources Act (when the Implementation Committee would like to comment on water takings) and working through interest groups and stewardship approaches that engage neighborhoods, business's and institutions.

Typical Evaluation Matrix for Assessing Implementation Mechanisms

Strategy Elements			
Watershed Goals and Objectives	**Land Use Planning**	**Policies/Criteria/Regulation**	**Funding Mechanisms**
To protect, restore and enhance terrestrial and aquatic features and their ecological functions	Natural features protected as constraint lands	▪ New SWM policies developed to enhance water quality ▪ Stream buffers defined in new municipal policies related to development	etc
To protect, restore and enhance water quality in streams	Natural heritage features protecting water quality identified for protection	▪ New SWM policies developed to enhance water quality	etc
To protect and restore natural vegetative canopy along streams and aquatic systems	Stream corridor and buffer identified for protection	▪ Buffers in new policies ▪ Servicing standards that provide stream protection	Etc.

Source: Conservation Ontario, Watershed Management in Ontario: Lessons Learned and Best Practices, 2003

The Watershed Management Process: Stage Three

Watershed Monitoring and Reporting:

This stage assesses whether plan goals, objectives and targets are being met, and periodically communicates results to decision-makers and the public. This stage is characterized by systems that analyze stresses on the watershed, for example, the number of combined sewer overflows, the environmental conditions and institutional responses to the overall health of the watershed in question.

Watershed monitoring is distinct from *environmental monitoring* which has been carried out in Ontario for many decades (Conservation Ontario, Watershed Management in Ontario: Lessons Learned and Best Practices, 2003). Environmental monitoring has been typically implemented in a style whereby multiple agencies collect information for their particular area of interest. While watershed monitoring is still a sub - type of environmental monitoring, it differs in that its approach assesses the watershed ecosystem as a whole and measures *watershed stresses* (pollutant loadings), *environmental conditions* (water quality) and *responses* to the state of the watershed on behalf of government, business and the public. In addition, watershed monitoring incorporates *reporting* to the stakeholders and the public as a component of its overall undertaking (ibid). Watershed monitoring indicators are developed and organized in a framework that reflects the principles used in the development of the overall specific Watershed Plan. Using this approach, the indicators will reflect the specific context and challenges and public preferences to the watershed in question. The most commonly used indicator system amongst CA's is the *"Stress-Condition - Response"* model which is based on the concept that human actions create specific stresses on the environment. The resultant changes in environmental conditions can be measured and therefore serve as an understandable criteria that can be communicated to stakeholders and the public alike. Experience has shown that while monitoring and reporting on environmental stresses and conditions is fairly developed and ingrained in the process, monitoring and reporting on responses or implementation actions is still under - developed in many existing watershed plans (ibid).

Watershed Reporting as a specific activity, has only been developed and used over the last decade. Prior to the introduction and release of "Watershed Report Cards" , CA's in Ontario have struggled with issues of how to report effectively on watershed health. Key lessons learned on watershed reporting include the following: reporting should be tied to watershed goals, objectives

and targets; reporting should be based on solid science with detailed data available to those that may be interested in further investigation and verification and reporting must recognize that different types and frequencies of reporting may be needed for different audiences (ibid.)[75] The diagram below provides a schematic of Stage Three: Watershed Monitoring and Reporting.

Source: Conservation Ontario, Watershed Management in Ontario: Lessons Learned and Best Practices, 2003

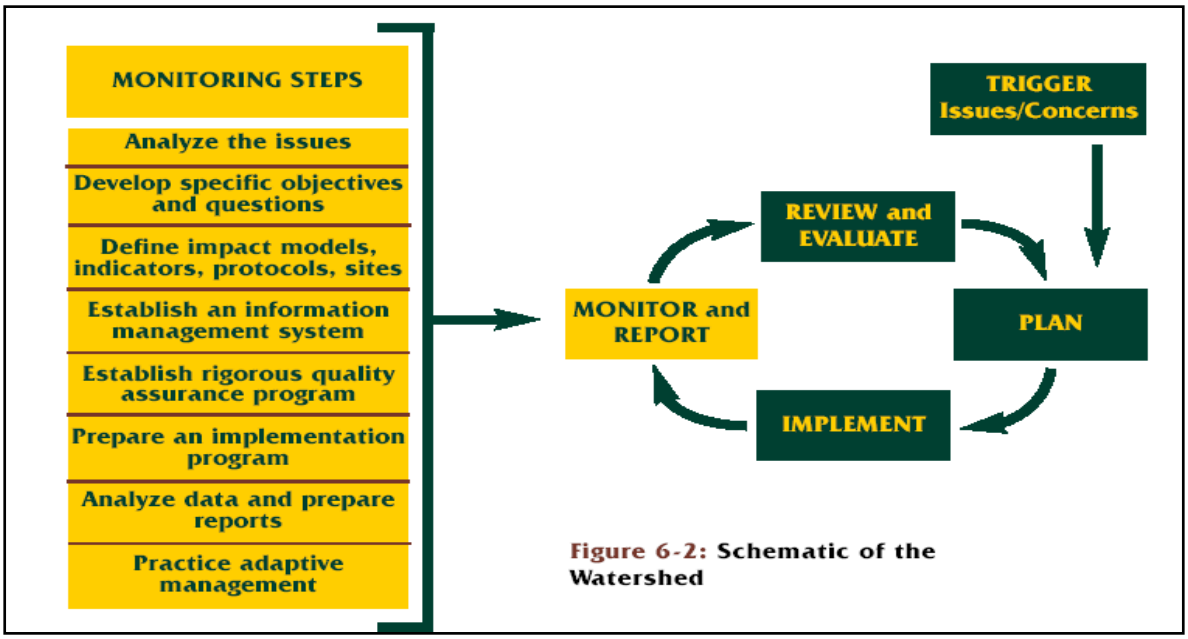

Figure 6-2: Schematic of the Watershed

The Watershed Management Process: Stage Four

Review, Evaluation and Updating:

Activities in this stage include the review of watershed management plans to see if changes are needed in any sub-component. If change has been identified then the alteration of targets and actions is required. The review process should be carried out at a time when the natural system has had sufficient time to respond to management actions taken as a result of implementation activities identified in a watershed or sub watershed plan. Experience has suggested that the timeframe is approximately ten years after the completion of a watershed plan. The review stage is part the *Adaptive Environmental Management (AEM)* approach which is described by Conservation Ontario as an "iterative process which reflects a systems approach to planning, managing and monitoring watershed activities". The overall experience in the watershed management cycle in Ontario, has seen a focus on the planning stage to the detriment of implementation, monitoring and review activities.

[75] For further information on Watershed Progress Report Cards please see Humber River Case Study

In Part Two of the Walkerton Inquiry, Justice O'Connor recommended that drinking water sources be protected by watershed based source protection plans. Conservation Ontario has proposed the watershed management framework in response to this recommendation and through its implementation will support and enable source protection plans to be developed. Watershed management as practiced by Ontario's CA's have been consistent with Ontario's "fundamental shifts" in approaches to environmental management. Contemporary approaches to watershed management can be summarized as follows:[76]

- WM is built on the concept of shared responsibility for environmental protection and enhancement
- Share implementation of plans across jurisdictional agencies
- Strives for continuous improvement in environmental performance through the use of *Adaptive Environmental Management*
- Is "place based" using boundaries that are ecological
- Uses a broad spectrum of tools including regulation, the land use planning process, best management practices, incentives, education and volunteer actions

[76] (Conservation Ontario, Watershed Management in Ontario: Lessons Learned and Best Practices, 2003).

5. GREAT LAKES

In the late 1960s, growing public concern about the deterioration of water quality in the Great Lakes stimulated new investment in pollution research, especially the problems of eutrophication and DDT. Governments responded to the concern by controlling and regulating pollutant discharges and assisting with the construction of municipal sewage treatment works. This concern was formalized in the first Great Lakes Water Quality Agreement between Canada and the U.S. in 1972.

Major reductions were made in pollutant discharges in the 1970s. The results were visible. Nuisance conditions occurred less frequently as floating debris and oil slicks began to disappear. Dissolved oxygen levels improved, eliminating odor problems. Many beaches reopened as a result of improved sewage control, and algal mats disappeared as nutrient levels declined. The initiatives of the 1970s showed that improvements could be made and provided several important lessons beyond the cleanup of localized nuisance conditions.

Great Lakes & the Great Lakes Basin

Source: Munk Centre for International Studies (2003)

First, the problem of algal growth in the lakes caused by accelerated eutrophication required a lake-wide approach to measure the amount of the critical nutrient, phosphorus, entering and leaving each lake from all sources and outlets. This approach of calculating a 'mass balance' of the substance was then combined with other research and mathematical modeling to set target loading limits for phosphorus entering the lake (or portions of the lake). The target load is the amount of phosphorus that will not cause excessive algal growth (i.e., an amount that could safely be assimilated by the ecosystem). Other major lessons learned about the system resulted from research on toxic substances, initially the pesticide DDT. Toxic contaminants include persistent organic

chemicals and metals. These substances enter the lakes directly from discharges of sewage and industrial effluents and indirectly from waste sites, diffuse land runoff and atmospheric deposition. As a result of increased research, sampling and surveillance, toxic substances have been found to be a system-wide problem. A number of laws, policies and organizations have been initiated to resolve these transboundary problems.

5.1 POLICES & LAWS

There are two main pieces of international law, between Canada and the United States, that govern the Great Lakes, the Boundary Waters Treaty of 1909 and the Great Lakes Water Quality Agreement (GLWQA) of 1978. For the purposes of this report, only the GLWQA will be reviewed as the majority of water management programs originate from the Agreement.

GREAT LAKES WATER QUALITY AGREEMENT (GLWQA) 1978

The Agreement, first signed in 1972 and renewed in 1978, expresses the commitment of each country to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem and includes a number of objectives and guidelines to achieve these goals. It reaffirms the rights and obligation of Canada and the United States under the Boundary Waters Treaty and has become a major focus of Commission activity.

In 1987, a Protocol was signed amending the 1978 Agreement. The amendments aim to strengthen the programs, practices and technology described in the 1978 Agreement and to increase accountability for their implementation. Timetables are set for implementation of specific programs. The Parties will meet biennially to discuss progress and report periodically to the Commission. New annexes address atmospheric deposition of toxic pollutants, contaminated sediments, groundwater, and non-point sources of pollution. Annexes are also added to incorporate the development and implementation of remedial action plans for Areas of Concern (AoC) and lake wide management plans (LaMP) to control critical pollutants.

The Commission monitors and assesses progress under the Agreement and advises Governments on matters related to the quality of the boundary waters of the Great Lakes system. The Agreement also calls upon the Commission to assist the Governments with joint programs

under the Agreement, and provides for two bi-national boards -- the Great Lakes Water Quality Board and the Great Lakes Science Advisory Board -- to advise the Commission.

THE GREAT LAKES CHARTER

Aside from "hard law" as reflected in Federal and Provincial statutes, "soft law" (not legally binding) instruments also influence in-basin water use and removals. The most important is the Great Lakes Charter, which was signed by the eight Great Lakes governors and two Great Lakes premiers in 1985. The Charter sets out five principles for the management of the waters of the Great Lakes:

1) Integrity of the Great Lakes Basin,
2) Interjurisdictional cooperation,
3) Protection of the waters of the Great Lakes,
4) Prior notice and consultation, and
5) Cooperative programs and practices

The Great Lakes Charter also records a commitment by the signatory States and Provinces to pursue the development and maintenance of a common data base and information regarding the use and management of basin water resources, the establishment of systematic arrangements for the exchange of water data and information, the creation of a Water Resources Management Committee, the development of a Great Lakes Basin Water Resources Management Program, and additional coordinated research efforts to provide improved information for future water planning and management decisions. Although not fully implemented, these commitments point towards the kind of cooperation and coordination that will be required in the future.[77]

There is also a "Vision Statement" that is supplementary to the Great Lakes Charter, entitled Annex 2001. In its six directives, the governors and premiers agreed, among other things, to develop a new set of binding agreements within three years to "protect, conserve, restore, improve and manage use of the Waters and Water-Dependent Natural Resources" of the basin, use a process that allows for ongoing public input, design an information gathering system that will assess available information and existing systems, completely update data on existing water uses, identify needs, provide a better understanding of groundwater, and plan for the

[77] Galloway, G. a. R. P. (2003). Managing Groundwater Resources in the Great Lakes Basin: Securing Our Future Visions and Principles. Toronto, Munk Centre for International Studies, University of Toronto**:** 17

implementation of an ongoing support system. A Water Management Working Group (WMWG) and several subcommittees are coordinating work towards these ends. Simultaneously, the Great Lakes Commission led technical efforts aimed at developing a Decision Support System, relying heavily on funding from the Great Lakes Protection Fund.[78]

CANADIAN & AMERCIAN BI-NATIONAL PROGRAMS

The two countries develop domestic programs in support of the commitments made and they also undertake cooperative joint initiatives such as the Great Lakes Bi-national Toxics Strategy and reporting on the State of the Great Lakes Ecosystem. Other bi-national initiatives include the development of Lake wide Management Plans[79], and investigation of the atmospheric deposition of contaminants into the lakes.[80]

GREAT LAKES BI-NATIONAL TOXICS STRATEGY[81]

- The Great Lakes Bi-National Toxics Strategy is a voluntary program between Canada and the United States. It has four main components which include: 1) Information Gathering, 2) Analyzing current legislation, initiatives and programs which manage or control substances, 3) Identifying cost-effective options to achieve further reductions, and 4) Implementing actions to work toward the goal of virtual elimination. The highlights of the Great Lakes Bi-national Toxics Strategy: An Approach to Virtual Elimination can be summarized as:[82] The strategy recognizes that pollution issues in the Great Lakes do not respect jurisdictional or geographic boundaries and must be addressed in a collaborative fashion. Canada and the U.S. will work with the Province of Ontario, Great Lakes states, Tribes and First Nations, and public and private partners to virtually eliminate persistent toxic substances from the Great Lakes.
- The primary emphasis will be on pollution prevention. The strategy seeks to reduce and virtually eliminate the releases of persistent toxic substances.
- The concept of virtual elimination recognizes that it may not be possible to achieve total elimination of all persistent toxic substances. For example, some substances such as mercury, dioxins and furans may occur naturally and would exist at low levels even without human intervention.

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[78] Galloway, G. a. R. P. (2003). Managing Groundwater Resources in the Great Lakes Basin: Securing Our Future Visions and Principles. Toronto, Munk Centre for International Studies, University of Toronto**:** 19

[79] More information on the Lakewide Management Plans can be found in subsequent sections of this report.

[80] The following information on the Great Lakes Bi-national Program compiled from www.binational.net (downloaded June 9, 2004)

[81] Text box from Council of Great Lakes Industries (CGLI) (2004). The Great Lakes Bi-national Toxics Strategy: A Voluntary Program Related to the Reduction of PBTs Released to the Great Lakes. Seattle Washington. **2004**. http://www.cgli.org/ationalToxicsStrategyBackgr.pdf (downloaded June 9, 2004).

[82] Environment Canada. "Highlights of the Great Lakes Bi-national Toxics Strategy". http://www.ec.gc.ca/press/usa1_b_e.htm (downloaded June 9, 2004)

- The strategy targets a common list of persistent, bioaccumulative and toxic substances, including mirex, toxaphene, PCBs, dioxins and furans.
- In Canada, we have the Toxic Substances Management Policy (TSMP) and have just announced under that policy that 13 toxic substances are targeted for virtual elimination nationally. Twelve of the 13 substances are targeted in the Great Lakes Bi-national Toxics Strategy.
- Specific actions, including measurable reduction targets, are identified on a substance-by-substance basis. The strategy sets quantitative targets and timelines tracking to virtual elimination. For example, by 1997, Canada will report that there is no longer use, generation, or release from Ontario sources that enter the Great Lakes of five bioaccumulative pesticides (chlordane, aldrin/dieldrin, DDT, mirex and toxaphene) and the industrial byproduct or contaminant octachlorostyrene. The United States will confirm that it has met this target by 1998.

Level I Substances
(to be virtually eliminated)
- Aldrin/dieldrin
- Benzo (a) pyrene
- Chlordane
- DDT (and DDD, DDE)

- The strategy presents a straightforward, four-step framework for action including information gathering; analyzing current regulations and programs that manage the substances; identifying cost-effective options to achieve further reductions; and taking action toward the goal of virtual elimination.
- An open, transparent, accountable process will be used to involve the Great Lakes community. The strategy includes provisions for information sharing, and sets out a means to measure and communicate progress.

This Strategy challenges all sectors of society to participate and cooperate to ensure its success. The goal of virtual elimination will be achieved through a variety of programs and actions, but the primary emphasis of this Strategy will be on pollution prevention. The Strategy will also be guided by the principles articulated by the International Joint Commission's (IJC) Virtual Elimination Task Force (VETF) in the *Seventh Biennial Report on Great Lakes Quality*. This Strategy has been developed under the auspices of the Bi-national Executive Committee (BEC), which is charged with coordinating the implementation of the bi-national aspects of the 1987 GLWQA. The BEC is co-chaired by EC and USEPA, and includes members of the Great Lakes states, the Province of Ontario, and other federal departments and agencies in Canada and the United States (U.S.).[83] Canadian Actions and challenges under the Bi-national Strategy are listed in Appendix 5.[84]

[83] EPA (2004). Great Lakes Bi-national Toxics Strategy. **2004**. http://www.epa.gov/glnpo/p2/bns.html#Purpose (downloaded June 12, 2004).
[84] For further information on Canada and the work on the Great Lakes see: www.on.ec.gc.ca/water/greatlakes/inro-e.html

Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA), 1994

All levels of government have shown a commitment to the GLWQA and mitigating the problems within the Great Lakes. The Canadian-Ontario Agreement Respecting the Great Lakes Basin Ecosystem is one example of the various levels of government coming together over this issue. The goal of the program is to restore the vast areas outside AoCs that drain into the Great Lakes and St. Lawrence River, with particular emphasis on agricultural projects, species at risk, and climate change mitigation. The program is to provide major opportunity for the recognition of federal government involvement and contribution throughout the more populated areas of Ontario.

Within Areas of Concern (AoC) identified in the *Great Lakes Water Quality Agreement,* Environment Canada's Great Lakes Sustainability Fund (formerly Great Lakes 2000 Cleanup Fund) provides a funding source to characterize problems and implement remediation/restoration projects. Several Conservation Authorities have very effectively partnered with Environment Canada in numerous AoCs, and have provided leadership in cleanup efforts. However, there is no comparable funding source for areas outside of AoCs. This proposal suggests a framework for a federally supported partnership of investing in environmental restoration and remediation outside AoCs. The goal of the program is to restore the vast areas that drain to the Great Lakes and St. Lawrence basin which are located outside of AoCs, and in so doing restore the health of the Great Lakes themselves.[85]

The federal government is requested to contribute $100 million of new money over five years ($20 million/year) which can be accessed by all Conservation Authorities or other capable service delivery organizations. This equates to a current value of approximately $87 million. Presently, $30 million over five years ($6 million/year) has been allocated for restoration a Presently, $30 million over five years ($6 million/year) has been allocated for restoration and remediation of 16 Areas of Concern through Environment Canada's Great Lakes Sustainability Fund. A fund of $100 million over five years reflects the size and extent of the watersheds that are located outside of the AoCs, and the urgent need to implement programs in these areas. We believe this program would squarely respond to Canada's recent commitment to providing the resources needed to implement

[85] CO (2002). Proposal for a Federally Supported Healthy Great Lakes Program: Executive Summary. Toronto, Conservation Ontario, pg: 3.

the *Canada-Ontario Agreement* and the Lake wide Management Plan annex pursuant to it. The program also addresses the federal Auditor General's statements that the Government remains accountable for implementation of the *Great Lakes Water Quality Agreement* and that it must do more to get the job done.[86] Within Canada, the CAs will be responsible for the central coordination and management of individual Networks, which may be arranged such that several Conservation Authorities collaborate to deliver one regional Network.[87]

5.2 INTERNATIONAL JOINT COMMISSION (IJC)[88]

The Boundary Waters Treaty (1909) established the International Joint Commission and set the basic principles for guiding boundary water relations between Canada and the United States. The purpose of the IJC is to allow the two countries cooperate to manage shared waters wisely and to protect them for the benefit of today's citizens and future generations. The IJC's Mission Statement states:

> "The International Joint Commission prevents and resolves disputes between the United States of America and Canada under the 1909 Boundary Waters Treaty and pursues the common good of both countries as an independent and objective advisor to the two governments. In particular, the Commission rules upon applications for approval of projects affecting boundary or transboundary waters and may regulate the operation of these projects; it assists the two countries in the protection of the transboundary environment, including the implementation of the Great Lakes Water Quality Agreement and the improvement of transboundary air quality; and it alerts the governments to emerging issues along the boundary that may give rise to bilateral disputes"

Many rivers and some of the largest lakes in the world lie along, or flow across, the border between the United States and Canada. The International Joint Commission assists governments in finding solutions to problems in these waters.

The 1909 Boundary Waters Treaty established the Commission, which has six members. Three are appointed by the President of the United States, with the advice and approval of the Senate, and three are appointed by the Governor in Council of Canada, on the advice of the Prime Minister. The Commissioners must follow the Treaty as they try to prevent or resolve disputes. They

[86] CO (2002). Proposal for a Federally Supported Healthy Great Lakes Program: Executive Summary. Toronto, Conservation Ontario, pg: 4
[87] CO (2002). Proposal for a Federally Supported Healthy Great Lakes Program: Executive Summary. Toronto, Conservation Ontario, pg: 4
[88] All of the following information on the structure and function of IJC is taken directly from their web page: http://www.ijc.org/en/home/main_accueil.htm (downloaded June 14, 2004)

must act impartially, in reviewing problems and deciding on issues, rather than representing the views of their respective governments. The Commission has set up more that 20 boards, made up of experts from the United States and Canada, to help it carry out its responsibilities.

COMPETING INTERESTS

These lakes and rivers are used for many purposes. Communities and industries may get fresh water from them, allow waste water to drain into them, or use hydroelectric power generated by the flow of rivers. Farms may use these waters for irrigation. Recreational boats and commercial ships also travel through the inland waters. These differing needs conflict from time to time. In some cases the International Joint Commission plays the role of authorizing uses while protecting competing interests in accordance with rules set out by the two governments in the Treaty. For example, the Commission may be called upon to approve applications for dams or canals in these waters. If it approves a project, the Commission can set conditions limiting water levels and flows, for example to protect shore properties and wetlands and the interests of farmers, shippers and others. After the structure is built, the Commission may continue to play a role in how it is operated.

INVESTIGATING WATER POLLUTION

When asked by governments, the International Joint Commission investigates pollution problems in lakes and rivers along the Canada-United States border. When communities or industries pollute these waters, both countries may suffer. The governments of the United States and Canada can also ask the Commission to monitor situations and to recommend actions.

INVESTIGATING AIR POLLUTION

The United States and Canadian governments have asked the Commission to bring to their attention, or to investigate, air pollution problems in boundary regions. Air pollution can travel thousands of miles and settle on land or in water far away from the source of the pollution. When air pollutants fall on rivers or lakes they can affect the quality of the water. In 1991, the two governments signed the Canada-United States Air Quality Agreement and set up an Air Quality Committee to report every two years on progress. The International Joint Commission has been asked to invite comments on the Committee's reports from individuals and groups and to prepare summaries of the views expressed.

5.3 AVENUES FOR PUBLIC PARTICIPATION

The IJC has a number of opportunities for the public to become involved in its operations and to assist in the protection of the Great Lakes and other boundary waters between the United States and Canada. From an institutional perspective, the IJC holds public meetings every two years to discuss restoration progress, it also sponsors Conferences, meetings and round table discussions which are open to the public, and the Commission Boards that monitor the operation of structures (such as damns) hold 'regular' public meetings.[89]

In relation to education and information provisions, the IJC publishes a number of reports and studies, these include: a) Progress Made, b) Challenges remaining in restoring and protecting boundary waters, and c) a Newsletter every three years, titled "Focus on the International Joint Commission Activities. The IJC web page also host a number of resources, with links to federal and provincial programs and the relevant government agencies both in Canada and the United States, and the Great Lakes Information Network (GLIN).[90] The GLIN provides Great Lakes news, a regional events calendar, a laws and policy reference guide, and links to current job opportunities and funding sources. There is also an image gallery, and a mailing list.[91]

In addition to becoming involved within the institution and accessing the educational resources available online, the IJC offers a number of conferences and public forums that are accessible to the public. The State of Great Lakes Ecosystem Conferences (SOLEC) is one example.[92] The public can easily access background papers, conference overviews and agendas online. Two other options include the Lake Erie and Lake Superior Bi-national Public Forums both of which are open and welcoming to citizen involvement.[93]

[89] It was unclear to this writer what was meant by "regular" meetings. The web page does not provide any calendar of scheduled events or contact information.
[90] The EPA has a Great Lakes Atlas which acts a resource book http://www.epa.gov/glnpo/atlas/index.html
[91] For more information on the GLIN see their web page: http://www.great-lakes.net/
[92] More information about SOLEC and Great Lakes indicators can be found at http://www.epa.gov/glnpo/solec and at http://www.on.ec.gc.ca/solec.
[93] For Contact Information on these Public Forums please refer to Appendix 6.

6. FEDERAL LAWS & POLICY

There are a number of important legislations in Canada that have a bearing on water management in Ontario. Imperative to water management is *The Constitution Act*, which sets out a division of powers between the federal and provincial governments. Other relevant Federal legislation includes the *Canada Water Act* which emphasizes Federal-Provincial cooperation in areas such as river basin planning and flood damage reduction, the *Canadian Environmental Protection Act* which has consolidated many Federal authorities related to environmental quality, the *Fisheries Act* which includes important provisions related to pollution control and habitat protection, the *Canadian Environmental Assessment Act*, and the *International River Improvements Act*, which was intended to regulate domestic interference with the flows of trans-boundary rivers.[94] This report will examine these influential Acts and their bearing upon the protection of Ontario's water resources.

6.1 CONSTITUTIONAL ISSUES

The division of responsibilities for water is complex and often shared. Under *The Constitution Act* , the provinces have the primary responsibility for the management of water resources, which includes both surface and groundwater and are responsible for:

- flow regulation;
- authorization of water use development; and
- Authority to legislate areas of water supply, pollution control, thermal and hydroelectric power development.

Federal responsibilities are in areas that have the potential for significant national economic impact, such as navigation and fisheries. Water on federal lands (e.g., National Parks), in the territories and on the reserves of Canada's aboriginal people's falls under federal jurisdiction. The federal government also has responsibility for boundary and transboundary waters.

Shared federal-provincial responsibilities include:

- inter-provincial water issues;
- agriculture;
- significant national water issues; and
- Health.

[94] Galloway, G. a. R. P. (2003). Managing Groundwater Resources in the Great Lakes Basin: Securing Our Future Visions and Principles. Toronto, Munk Centre for International Studies, University of Toronto**:** 11

Provinces, therefore, have authority to legislate in areas of domestic and industrial water supply, pollution control, non-nuclear thermal and hydroelectric power development, irrigation, and recreation. They have delegated some of this responsibility to local government bodies.

The federal government has proprietary rights regarding federal lands and water in the territories, national parks, and Indian reserves. Parliament has exclusive legislative jurisdiction over commercial navigation, a power that extends over most watercourses of significant size. Parliament also has exclusive legislative jurisdiction over both inland and ocean fisheries, including their protection in river basins. It shares jurisdiction with the provinces in agriculture and health. Parliament also has the residual power to legislate for the peace, order and good government of the country, regulation of trade and commerce, banking, taxation and the public debt, census and statistics, defense and criminal law. Under its declaratory power, Parliament may bring into federal jurisdiction a local work declared to be of general advantage to Canada or to two or more provinces. The federal government is responsible for conducting relations with other countries, an extremely important power in relation to water as so much of Canada's water resources are in boundary water basins.

6.2 CANADA WATER ACT (1970, 1985)

The federal government passed the Canada Water Act in 1970 and created the Department of the Environment in 1971 (which administers the Act), entrusting the Inland Waters Directorate with providing national leadership for freshwater management. Under the Constitution Act (1867), the provinces are "owners" of the water resources and have wide responsibilities in their day-to-day management. The federal government has certain specific responsibilities relating to water, such as fisheries and navigation, as well as exercising certain overall responsibilities such as the conduct of external affairs.

The Canada Water Act provides the framework for cooperation, development, and utilization of Canada's water resources. It contains a number of provisions that govern water quality in general such as:

- Authorizes various federal-provincial arrangements such as joint subcommittees, programs or agreements with respect to water resource management (Part I);

- Regulates discharges of waste into "prescribed water quality management areas" and establishes federal water quality management programs for inter-jurisdictional waters (Part II);
- Establishes advisory committees to assist in the implementation of the Act (section 28); and
- Requires the Minister of the Environment to report annually to Parliament on operations under the Act (section 38).

The Canadian Water Act can be separated into 3 distinct parts, the provisions of which are outlined as follows[95]: Part I, Section 4, provides for the establishment of federal-provincial consultative arrangements for water resource matters. Sections 5, 6, and 8 provide the vehicle for cooperative agreements with the provinces to develop and implement plans for the management of water resources. Section 7 enables the Minister, directly, or in cooperation with any provincial government, institution, or person, to conduct research, collect data, and establish inventories associated with water resources. Part II provides for federal-provincial management agreements where water quality has become a matter of urgent national concern. It permits the joint establishment and use of federal or provincial incorporated agencies to plan and implement approved water quality management programs. The application of alternative cooperative approaches and programs has resulted in Part II never having been used. Part III, which provided for regulating the concentration of nutrients in cleaning agents and water conditioners, was incorporated into the *Canadian Environmental Protection Act* (CEPA) in 1988 and later into Sections 116-119 (Part VII, Division I) of the new *Canadian Environmental Protection Act*, 1999, which came into force March 31, 2000. Also under sections 30 and 31, persons convicted of violating the Canada Water Act face small fines and prohibition orders.

The section of the Canada Water Act that can be most utilized by the public is Section 38, which requires annual reporting. Section 38 of the Revised Statues of Canada (1985) requires that a report on the operations under the Act be laid before Parliament after the end of the fiscal year. The report describes a wide range of federal activities conducted under the authority of the Act, including significant water research, participation in federal-provincial agreements and undertakings and a public information program.[96]

[95] The following information from: CELA (2004). Toronto, Canadian Environmental Law Association. http://www.ecolawinfo.org/WATER%20FAQs/Regulatory%20Context%20for%20Water/CanWatLeg.htm#CanWat_04 (downloaded August 3, 2004)

[96] Environment Canada (2002). Canada Water Act Annual Report 1999-2000. Ottawa, Environment Canada. **2004**. http://www.ec.gc.ca/water/en/info/pubs/ar/e_ar99-00.htm#preface

6.3 CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) 1999

The new Canadian Environmental Protection Act, 1999 is the centre-piece of the federal government's pollution control regime.[97] It is principally administered by Environment Canada, although Health Canada has certain responsibilities in relation to the assessment and regulation of toxic substances. The underlying principles are to ensure pollution prevention, achieve sustainable development, protect biological diversity, exercise caution in cases of scientific uncertainty, adopt an ecosystem approach to environmental management, and virtually eliminate persistent and bioaccumulative toxic substances.

The Canadian Environmental Protection Act, 1999 contains numerous provisions which address water pollution and environmental enforcement, and, as a result, provides some degree of protection for surface waters. For example, the Act:

- Creates a public right to formally apply for an investigation of suspected contraventions of the Canadian Environmental Protection Act (sections 17 to 21);
- Creates a public right to bring a civil "environmental protection action" in respect of contraventions of the Act (sections 22 to 38);
- Creates a civil cause of action for loss or damage resulting from contraventions of the Act (sections 39 and 40);
- Requires pollution prevention plans from companies whose commercial, manufacturing, processing, or other activities, involve toxic substances from Schedule 1 of the Act (Part 4);
- Establishes a regime for identifying, assessing and regulating toxic substances (Part 5);
- Establishes a regime for identifying, assessing and regulating "animate products of biotechnology" (such as genetically modified organisms) (Part 6);
- Regulates nutrients such as phosphates that may adversely affect or degrade aquatic ecosystems (sections 116 to 119);
- Regulates ocean dumping and protects the marine environment from land-based sources of pollution through non-regulatory means (sections 120 to 137);
- Controls Canadian sources of international water pollution through regulations, interim orders or pollution prevention planning (sections 175 to 184);
- Controls transboundary movement of hazardous waste, hazardous recyclable material and prescribed non-hazardous waste for final disposal (sections 185 to 192);
- Requires companies or facilities to prepare emergency plans for toxic substances (Part 8); and

[97] CELA (2004). Toronto, Canadian Environmental Law Association. http://www.ecolawinfo.org/WATER%20FAQs/Regulatory%20Context%20for%20Water/CanWatLeg.htm#CanWat_04 (downloaded August 2, 2004)

- Imposes a duty on corporate officers and directors to take all reasonable care to ensure that the corporation complies with the Act and its regulations, orders and directions (section 280).

A number of water-related regulations have been promulgated under the Canadian Environmental Protection Act with respect to ocean dumping, phosphorus concentrations, pulp and paper effluent, chlorinated dioxins and furans, and pulp and paper mill defoamer and wood chips. The Canadian Environmental Protection Act makes it an offence to contravene the Act or regulations, orders or directions made under the Act (section 272). Persons convicted of contravening the Act face substantial penalties – up to $1 million in fines, jail terms, profit-stripping restoration and restitution orders (sections 272 to 294). In certain circumstances, a person charged with an offence may avoid prosecution by agreeing to undertake prescribed "environmental protection alternative measures" (sections 295 to 297).

CEPA provides a number of environmental rights to Canadian citizens, such as ensuring access to information and the right to an investigation if there is reason to believe a violation has been committed. CEPA contains provisions providing for disclosure of both general and case-specific enforcement information. At the general level, the federal Minister of Environment is required to report annually on the administration and enforcement of the Act. CEPA annual reports provide a national summary of enforcement and compliance efforts. The reports contain statistics on inspections, warnings, directions, prosecutions, and convictions under the various CEPA regulations. They also contain a brief description of enforcement and compliance initiatives. The CEPA Registry contains copies of administrative agreements entered into by the Minister and provincial or territorial governments or an aboriginal people[98] CEPA also provides access to case-specific information. Thus, for example, it allows the public to be informed of deals struck to address situations of non-compliance by providing that the Environmental Registry must contain a copy of every "environmental protection alternative measures" agreement entered into by the Attorney General of Canada and a person who is alleged to have committed an offense under CEPA.[99] CEPA also promotes public involvement in enforcement activities by giving every adult Canadian resident who believes that an offense has been committed under CEPA the right to apply to the Minister for an investigation. The Minister must then investigate all matters he or she

[98] CEC (2003). Public Access to Government-held Environmental Information. Report on North American Law, Policy and Practice. North American Environmental Law and Policy Series. Montreal, Commission for Environmental Cooperation of North America**:** 63

[99] CEC (2003). Public Access to Government-held Environmental Information. Report on North American Law, Policy and Practice. North American Environmental Law and Policy Series. Montreal, Commission for Environmental Cooperation of North America**:** 63

considers necessary to determine the facts relating to the alleged offense. During the investigation, the Minister must report to the applicant every ninety days on the progress of the investigation and actions, if any, the Minister proposes to take. If the investigation is discontinued, the Minister must provide reasons to the applicant.[100]

6.4 FISHERIES ACT (FA)

In the late 19th century, the federal government enacted the *Fisheries Act* (*FA*), one of the most powerful tools available to the federal government to regulate water pollution.[101] The Fisheries Act was first enacted in 1868 and is administered by the Department of Fisheries and Oceans. It is primarily aimed at protecting fish and their habitat. However, the Act contains some strong provisions relating to water pollution, and, therefore, provides some protection for surface water. The Fisheries Act:

- Prohibits the harmful alteration, disruption or destruction of fish habitat (section 35(1));
- Prohibits the deposit of "deleterious substances" into or near waters frequented by fish (section 36(3));
- Enables the passage of regulations in relation to the deposit of waste, pollutants or deleterious substances (sections 36(4), 36(5) and 43), and
- Imposes civil liability for loss or expenses caused by the unlawful deposit of deleterious substances (section 42).

A number of regulations have been made under the Fisheries Act in relation to the liquid effluent from various industrial sectors, including chlor-alkali plants, meat and poultry plants, metal mining facilities, petroleum refiners, potato processing plants, and pulp and paper mills.

The Act protects fish populations and fish habitat from pollution, prohibiting the deposition of harmful substances into fish-bearing waters or watercourses that may eventually enter fish-bearing waters. Harmful substances include suspended solids, fertilizer, manure, fuel, and pesticides. The Act also prohibits "harmful alteration, disruption or destruction&" of fish habitat, defined to include "spawning grounds and nurseries, rearing, food supply and migration areas on which fish depend to carry out their life processes." Work carried out near a fish-bearing watercourse must

[100] CEC (2003). Public Access to Government-held Environmental Information. Report on North American Law, Policy and Practice. North American Environmental Law and Policy Series. Montreal, Commission for Environmental Cooperation of North America: 64

[101] The following information on the Fisheries Act is compiled from, Commission on Environmental Cooperation (2003), Canadian Environmental Law Association (2004), McRobert (2004), and Food and Agriculture Canada (2003).

have the approval of Fisheries and Oceans Canada. Failure to comply with the Act may result in heavy fines or imprisonment.[102] Persons convicted for contravening "fish habitat" and "deleterious substance" provisions face substantial penalties under the Act, such as $1 million fines, jail terms, profit-stripping, license suspensions and restoration orders (sections 40(2), 79.1 and 79.2).[103] However, McRobert has noted that this has historically not been the case with the agriculture sector. Subsection 36(3) of the *FA* prohibits the discharge of deleterious substances (which can harm fish) into water frequented by fish unless the deposits are authorized by regulation. Farm operations are subject to this provision as well as the prohibition of activities that "results in the harmful alteration, disruption or destruction of fish or fish habitat" under the *FA*. However, enforcement against the agricultural sector has been lacking in the past and the Department of Fisheries and Oceans (DFO) or Environment Canada has launched very few prosecutions, although February 2004 reports in *Ontario Farmer* indicate that this might be changing.[104] The FA is also required to publish annual enforcement reports.[105]

6.5 CANADIAN ENVIRONMENTAL ASSESSMENT ACT

The Canadian Environmental Assessment Act (CEAA) first became law in June 1992, with amendments to the act that came into force on October 30, 2003. The purpose of the Act was to establish a federal environmental process. "Whereas the Government of Canada seeks to achieve sustainable development by conserving and enhancing environmental quality and by encouraging and promoting economic development that conserves and enhances environmental quality"[106] The Canadian Environmental Assessment Agency defines an environmental assessment as: "a process to predict the environmental effects of proposed initiatives before they are carried out. This includes identifying possible environmental effects, proposing measures to mitigate adverse effects, and

[102]Agriculture and Food Canada (2003) http://res2.agr.gc.ca/publications/hw/11d1_e.htm (downloaded August 2, 2004)
[103] CELA (2004). Toronto, Canadian Environmental Law Association. http://www.ecolawinfo.org/WATER%20FAQs/Regulatory%20Context%20for%20Water/CanWatLeg.htm#CanWat_04 (downloaded August 2, 2004)
[104] McRobert D. (2004). What Makes Nutrient Management So Controversial? London Swine Conference, Environmental Commissioner of Ontario.
[105] CEC (2003). Public Access to Government-held Environmental Information. Report on North American Law, Policy and Practice. North American Environmental Law and Policy Series. Montreal, Commission for Environmental Cooperation of North America**:** 61
[106] Government of Canada (1992 (2003)).Preamble to: Canadian Environmental Assessment Act.

predicting whether there will be significant adverse environmental effects, even after the mitigation is implemented"[107]

The Act[108]:

- ensures that the environmental effects of projects are carefully reviewed before federal authorities take action in connection with them so that projects do not cause significant adverse environmental effects
- encourages federal authorities to take actions that promote sustainable development
- promotes cooperation and coordinated action between federal and provincial governments on environmental assessments
- promotes communication and coordination between federal authorities and Aboriginal peoples
- ensures that development in Canada or on federal lands does not cause significant adverse environmental effects in areas surrounding the project
- ensures that there is an opportunity for public participation in the environmental assessment process

The Act is based off the principle of sustainable development and is the fundamental objective of the federal environmental assessment process. In administering the Act, federal authorities are obligated to exercise their powers in a manner that protects the environment and human health, and applies the precautionary principle. The Act recognizes the importance of cooperation with other jurisdictions that also may have legal responsibilities to conduct an assessment of the same project.

The Act applies to projects where the Government of Canada has decision-making authority, whether as a proponent, land manager source of funding or regulator. All projects receive an 'appropriate' degree of environmental assessment. The degree depends largely on the scale and complexity of the likely effects of the project. As a result there are four types of assessments: screening (including class screenings), comprehensive study, mediation, and assessments by a review panel. Through a screening, a responsible authority documents the environmental effects of proposed project and determines ways to eliminate or minimize harmful effects through modifications to the project plan. Projects with known effects that can be easily mitigated may be assessed through a class screening. Large-scale and environmentally sensitive projects usually undergo a more intensive assessment called a comprehensive study, which includes mandatory

[107]CEAA (2004) Frequently Asked Question (http://www.ceaa-acee.gc.ca/999/index_e.htm#1 (downloaded August 2, 2004).
[108] The following information regarding the CEAA is taken directly from their web page: Canadian Environmental Assessment Agency (2003). About the Canadian Environmental Assessment Registry. http://www.ceaa.gc.ca/050/about_cear_e.cfm (downloaded August 2, 2004)

opportunities for public participation. The Act established the role of a Federal Environmental Assessment Coordinator for every screening and comprehensive study to assist federal departments and agencies in working together and with other jurisdictions. In carrying out its duties, the Coordinator may establish a federal project committee, set time lines, and determine the timing of public participation activities. Mediation is a process in which the Minister of the Environment appoints an impartial mediator to assess a project and help interested parties resolve issues. Assessments by a review panel appointed by the Minister of the Environment may be required when the environmental effects of a proposed project are uncertain or likely to be significant or when warranted by public concerns. Review panels offer individuals and groups a chance to present information and express their concerns. Follow-up programs are mandatory for projects after a comprehensive study, mediation or review panel. For screenings, the responsible authority must determine if a follow-up program is appropriate under the circumstances.

There are many ways to get involved in federal environmental assessment, through the *Canadian Environmental Assessment Act.* The primary vehicle for public participation is the Canadian Environmental Assessment Registry. The principal federal statue giving the public the right to access environmental information is the CEAA. The CEAA came into force in January 1995 and is administered by the Canadian Environmental Assessment Agency. The Federal Minister of Environment must report annually to Parliament on the activities of the Agency, the administration and implementation of the Act. The report must contain a statistical summary of all environmental assessments conducted or completed under the authority of the Act during that year. "The Preamble of the Act states that the government is committed to facilitating public participation in the environmental assessment of projects and providing access to the information on which environmental assessments are based. The Act requires that a public registry of relevant records be established for each project and prescribes notice and comment procedures aimed at incorporating the concerns of the public into the assessment process."[109] Part II of CEPA entitled "Public Participation," requires the establishment of an Environmental Registry to facilitate access to documents relating to matters under the Act, including notice of any approval granted under the Act. Disclosure of documents on the Registry is subject to the AIA. The Minister is given discretion

[109] CEC (2003). Public Access to Government-held Environmental Information. Report on North American Law, Policy and Practice. North American Environmental Law and Policy Series. Montreal, Commission for Environmental Cooperation of North America**:** 42.

regarding the form of the Registry, how it is to be kept and how access is provided.[110] The Canadian Environmental Assessment Registry provides basic information on federal environmental assessments starting in November 2003. It also contains several search tools to help find information on environmental assessments.[111]

On the registry, one can:

- search using **key words** to easily locate projects
- conduct **advanced searches** using specific criteria, such as by department, province, or drainage region
- find a quick list of all environmental assessments **currently out for public comment**
- view an **interactive map** to see where environmental assessments are occurring in Canada

The Canadian Environmental Assessment Registry will contain additional information for comprehensive studies, review panels, mediations and class screenings. You can also view other documents relating to environmental assessments and obtain these documents by contacting the person listed on each assessment.[112] Given the very limited enforcement powers under CEAA 112 and the absence of offenses and penalties, compliance is secured primarily through education and information mechanisms such as the annual report and public registry system[113]

There are other avenues for public involvement through the CEAA including:

- Take advantage of opportunities to participate in screenings, including reviewing and commenting on screening reports before a final decision is made on the project.
- Examine and comment on a class screening report before the Canadian Environmental Assessment Agency declares it as appropriate means to assess similar projects.
- Review and submit comments during the comprehensive study process. The Minister of the Environment takes public comments into account before determining the future of a project.
- Participate in any public meetings or hearings associated with a review panel.
- Apply for funding to assist your participation or that of your organization in comprehensive studies, mediations and review panels through the Agency's Participant Funding Program.

[110] CEC (2003). Public Access to Government-held Environmental Information. Report on North American Law, Policy and Practice. North American Environmental Law and Policy Series. Montreal, Commission for Environmental Cooperation of North America**:** 44.
[111] You can access the Canadian Environmental Assessment Registry at http://www.ceaa.gc.ca/050/index_e.cfm
[112] Canadian Environmental Assessment Agency (2003). About the Canadian Environmental Assessment Registry. http://www.ceaa.gc.ca/050/about_cear_e.cfm (downloaded August 2, 2004)
[113] CEC (2003). Public Access to Government-held Environmental Information. Report on North American Law, Policy and Practice. North American Environmental Law and Policy Series. Montreal, Commission for Environmental Cooperation of North America**:** 65

6.6 INTERNATIONAL RIVER IMPROVEMENTS ACT

The International River Improvements Act went into force in 1985, between Canada and the United States. The *International River Improvements Act* prohibits the construction, operation or maintenance of certain international river improvements without a valid license. The Act defines an "international river improvement" as a dam, obstruction, canal, reservoir or other work the purpose of effect of which is to increase, decrease or alter the natural flow of water or affect its actual or potential use outside Canada. It applies to waters which flow across the international boundary from Canada into the United States. The Act does not apply to projects constructed under authority of an Act of the Parliament of Canada, situated on boundary waters as defined in the Canada-United States Boundary Waters Treaty (1909), or constructed or operated solely for domestic, sanitary or irrigation purposes or other similar consumptive uses.[114]

[114]Environment Canada (2002) Acts Administered by the Ministry of Environment http://www.ec.gc.ca/EnviroRegs/Eng/SearchDetail.cfm?intAct=1006 (downloaded August 2, 2004)

7. PROVINCIAL LAWS & POLICIES

Within the Province of Ontario, there is not one specific law or Act that deals exclusively with water or watershed management. Instead, regulation is a complex matrix of laws and policies that are suppose to work together to protect the Province's water resources. As McRobert notes, "as a consequence of the events in Walkerton, a plethora of changes to law and policy were initiated, including the enactment in 2002 of the Nutrient Management Act (MNA), the Sustainable Water and Sewage Systems Act, and the Safe Drinking Water Act.[115]

Four Main Legislations that were instituted by the Ontario Government:

1. Safe Drinking Water Act 2002
2. Sustainable Water and Sewage Systems Act
3. Nutrient Management Act
4. Drinking Water Systems Regulation

There is a fifth piece of legislation that is currently under review by the Provincial Cabinet, entitled the Source Water Protection Act. Within this chapter of the report these five integral policies will be reviewed, in conjunction with a number of other programs instituted by not only the Provincial government, but also the Ministry of Environment (MOE), Ministry of Natural Resources (MNR) and the Ministry of Agriculture and Food (OMAF).

7.1 ONTARIO WATER RESOURCES ACT (OWRA)

The *Ontario Water Resources Act* is the primary statute governing the use of water in Ontario. It contains water quality provisions which allow the MOE to protect surface and ground water from pollution and sewage discharges. The OWRA also prohibits "discharges or deposits of material of any kind into a water body or watercourse that may impair water quality."[116] The basic provision is a prohibition on the withdrawal of more than 50,000 liters per day from either a well or surface waters without a permit from the Ministry of the Environment (MOE). Even with respect to smaller volumes, the MOE has the authority to prohibit withdrawals where the taking interferes "with any public interest in any water." The Act confers broad discretion on the MOE to issue, refuse, condition, alter or revoke its approval for water uses, and a similar

[115] McRobert, D. (2004). What Makes Nutrient Management So Controversial? London Swine Conference, Environmental Commissioner of Ontario.
[116] McRobert, D. (2004). What Makes Nutrient Management So Controversial? London Swine Conference, Environmental Commissioner of Ontario.

authority is conferred with respect sewage works. Provincial regulations on water taking were recently amended to require evaluation on an ecosystem basis.[117]

The OWRA also provides for criminal liability, with financial punishment for non-compliance. Section 30(1) states that "Every person who discharges or causes or permits the discharge of any material into any waters that may impair the quality of the water is guilty of an offence."[118] Individuals are liable to a fine of not more than $10,000 for each day the offence continues on a first conviction and $25,000 per day for subsequent convictions plus imprisonment for not more than one year. The fine for corporations is $2,000 -$100,000 per day on first conviction and $4,000-$200,000 per day for subsequent convictions.

The OWRA also legislates municipal water works; the municipal water works provides drinking water for approximately 82% of the population or 8.9 million people.[119] Under the OWRA, which is administered by the MOE, each municipality is responsible for ensuring that water of adequate quality is delivered to the consumer and private owners of water works falling under the OWRA are fully responsible for the Ontario Drinking Water Objectives (ODWOs).

7.2 SAFE DRINKING WATER ACT 2002

In the Part Two Report of the Walkerton Inquiry, Commissioner Dennis O'Connor recommended that the Ontario government enact a Safe Drinking Water Act to deal with matters related to treatment and distribution of drinking water. As articulated by Commissioner O'Connor, the purpose of the Safe Drinking Water Act is to gather in one place all legislation and regulations relating to the treatment and distribution of drinking water.

As recommended by Commissioner O'Connor, the government has passed a Safe Drinking Water Act, which expands on existing policy and practice and introduces new features to protect drinking water in Ontario. The act's purpose is to protect human health through the control and regulation of drinking-water systems and drinking-water testing. The act also provides legislative authority to implement 50 of the 93 recommendations made in Commissioner O'Connor's Part Two Report.

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[117] Galloway, G. a. R. P. (2003). Managing Groundwater Resources in the Great Lakes Basin: Securing Our Future Visions and Principles. Toronto, Munk Centre for International Studies, University of Toronto**:** 12

[118] The following information regarding criminal liability is compiled from: AdmiraltlyLaw.com: Ontario Water Resources Act, http://www.admiraltylaw.com/Pollution%20presentation/sld034.htm

[119] http://www.greenontario.org/strategy/water.html (downloaded July 29, 2004)

The *Ontario Safe Drinking Water Act*, 2002 (hereafter referred to as the *Safe Drinking Water Act*) was enacted in December 2002, in response to recommendations made by Justice O'Connor in his Report of the Walkerton Inquiry, Part 2[120]. In essence, the Act consolidates legislative and regulatory requirements regarding the treatment and distribution of drinking water in Ontario. Before the passage of this Act, drinking water was generally governed by the *Ontario Water Resources Act* as part of the province's overall regime for protecting surface and groundwater. During the 1980s and 1990s, several members of the Ontario Legislature introduced private members' bills to enact specialized safe drinking water legislation. However, none of these private members' bills were enacted into law.

The Act creates, through regulation, legally-binding standards for contaminants in drinking water:

- These standards are intended to protect public health,

The Act makes it mandatory to use licensed and accredited laboratories for drinking water testing:

- The *Safe Drinking Water Act* generally requires laboratories that conduct drinking water tests to be licensed under the Act. The *Safe Drinking Water Act* and the Drinking Water Testing Services Regulation (O. Reg. 248/03) require any laboratory that performs drinking water testing to obtain a license effective October 1, 2003. In addition, the *Safe Drinking Water Act* requires owners and operating authorities of drinking water systems regulated under the Drinking Water Systems Regulation (O. Reg. 170/03) to use a licensed laboratory for drinking water testing;
- In order to obtain a license, laboratories must be accredited for the tests they conduct. Licenses may be issued with conditions, and the Director has the authority to amend the conditions or to revoke or suspend the license if the laboratory is not in compliance with the requirements of the Act;
- Drinking water system owners are also generally prohibited from using water testing services from out-of-province laboratories, unless the laboratories satisfy the eligibility criteria under the Act; and
- There are some limited circumstances where the Director may authorize the use of non-accredited laboratories, such as the existence of geographic constraints or if there is no accredited method for a particular test.

The Act makes it mandatory to report adverse test results where contaminants in drinking water do not meet the drinking water quality standards:

- The Act imposes a duty to report adverse test results to the Ministry of the Environment and to the local Medical Officer of Health. Both the operator and owner and the laboratory must comply with this reporting requirement;

[120] The following information is compiled from the Canadian Environmental Law Association. http://www.cela.ca/faq/cltn_detail.shtml?x=1498#1548 (downloaded August 1, 2004)

- These reports will have to be made in accordance with the requirements established by Ontario Regulation 170/03. This Regulation requires the report to be made in situations such as the violation of a chemical or physical standard or the presence of an indicator of adverse water quality such as E. coli. The reports are to be made immediately -- either in person or by telephone -- and confirmed in writing within 24 hours; and
- Where adverse test results are reportable, the owner of the drinking water system must undertake the appropriate corrective action to address the particular drinking water problem.

All operators of municipal drinking water systems must be trained and certified:

- Drinking water system operators must hold a valid operator's certificate issued under the regulations. For now, existing unexpired licenses issued under O.Reg. 435/93 under the Ontario Water Resources Act are deemed operator's certificates until the successor regulation is in place; and
- The proposed successor regulation, the Certification of Drinking-Water Systems Operators and Water Quality Analysts, sets out the requirements for certification and training. "Grandfathered" operators will be required to be recertified within 1 or 2 years, depending on their responsibilities in the system. Training is defined to include continuing education and on-the-job training. Operators will be recertified every 3 years if they successfully complete a specific number of hours of training. The more responsibility an operator has, the more training will be required.

The Act establishes a licensing regime for drinking water systems:

- All municipal drinking water systems must obtain an approval from the Director of the Ministry of the Environment. The Act sets out timing and content requirements for approval applications, including copies of drinking water works permits, operational plans, and, in some cases, financial plans and permits to take water;
- The Director may refuse an application, or impose terms and conditions upon the approval. The Director may also grant partial or complete relief from regulatory requirements regarding treatment, sampling, testing, or monitoring; and
- In addition, all other regulated drinking water systems (including municipal non-residential systems serving community centers and sports complexes) are required to have a professional engineer certify that the system is in compliance with regulatory requirements. This certification has to be renewed every five years for surface water systems and every 10 years for groundwater systems.

The Act gives broad inspection powers to officers of the Ministry of the Environment, and creates a new position of Chief Inspector who oversees inspections and enforcement:

- Provincial officers may conduct inspections without a warrant or court order in order to determine compliance with the Act or regulations;
- During inspections, provincial officers have a wide range of powers similar to provisions found in other Ontario environmental legislation such as the Ontario Water Resources Act and the Environmental Protection Act. Among other things, these include the authority to enter into or on any part of the natural environment, or any place where a drinking water system is located. They have the authority to take samples, conduct tests, require production of documents, take photographs and videotapes, stop and search vehicles and place locks or fences to secure places;

- If a prescribed deficiency (that is, a violation that poses a drinking water health hazard) is found during an inspection, the provincial officer must conduct a follow-up inspection within a year;
- The Act requires the passage of a "compliance regulation" be made that would set out specific inspection requirements such as the frequency of inspections, the actions required and response time in the event of a deficiency, and the procedures to be followed for investigations and enforcement. To date, a compliance regulation has been proposed, but not passed, by the Ministry of the Environment; and
- The Act also requires the appointment of a Chief Inspector with responsibility for overseeing inspections and enforcement activities under the Act. The Inspector must submit annual reports on inspection and enforcement matters to the Legislature.

The Act imposes a statutory standard of care upon managers of municipal drinking water systems (not yet in force):

It states that specified persons must;

- exercise the level of care, diligence and skill in respect of a municipal drinking water system that a reasonably prudent person would be expected to exercise in a similar situation; and
- act honestly, competently and with integrity, with a view to ensuring the protection and safety of the users of the municipal drinking water system.

This standard of care would apply to the owner of the municipal drinking water system, the person who oversees the accredited operating authority or who exercises decision-making authority over the system, or the officers and directors of the corporation that owns the system. Failure to carry out this standard is defined as an offence under the *Safe Drinking Water Act*, and individuals may be convicted of the offence regardless of whether the owner of the system is prosecuted or convicted.

7.3 SUSTAINABLE WATER & SEWAGE SYSTEMS ACT

The *Sustainable Water and Sewage Systems Act, 2002* was enacted in December 2002. It helps ensure clean, safe drinking water for Ontario residents by making it mandatory for municipalities to assess and cost-recover the full amount of water and sewer services. CELA notes that the *Sustainable Water and Sewage Systems Act* requires municipalities to identify and recover the costs necessary to sustain water and sewer services. In particular, municipalities must assess the costs in a full cost report, and then develop a plan to recover the costs.[121]

The implementation of the *Sustainable Water and Sewage Systems Act* will give municipalities an incentive to promote conservation to avoid expanding or constructing new water treatment facilities.

[121] The following information is compiled from CELA: http://62.44.8.131/faq/cltn_detail.shtml?x=1502#1624

Ontario municipalities have been slowly introducing water meters into their communities. As opposed to a flat rate, metering means consumers will pay for the amount of water actually used. This generally leads to conservation when people realize that they will pay less for water if they use less. Some Ontario municipalities have also introduced increasing block rates. This means charging a higher unit price as use rises, which is another incentive for conservation.

The Act will also encourage municipalities to plan for long-term renewal and replacement of drinking water distribution systems. Life cycle financing for these systems will be encouraged. The provincial government has also considered the problem of major rate increases, and incorporated provisions to avoid rate shocks. Under the regulations for the *Sustainable Water and Sewage Systems Act* (which have not yet been released) a cap on municipal rates will likely be established. The Minister, however, will have the discretion to allow municipalities to set higher rates in special circumstances.

7.4 NUTRIENT MANAGEMENT ACT

Ontario's *NMA* and the new general regulation under *NMA* (O. Reg. 267/03) will have an impact on farmers, municipalities and livestock producers. The regulation took effect on September 30, 2003 and is to be phased in over approximately four years. O. Reg. 267/03 contains 122 sections and incorporates four complex and lengthy protocols. However, its current scope is narrow and it applies to a limited number of existing and most new livestock operations. As one observer has noted, the *NMA* and O. Reg. 267/03 "are not integrated with existing environmental, planning or municipal legislation." They are "one more irregular piece of Ontario's jigsaw puzzle of regulation," challenging government regulators, farmers, lawyers and others to make the pieces fit and raising complex issues wherever livestock farming is carried on or nutrients are spread on farmland.[122]

The purpose of the NMA is "to provide for the management of materials containing nutrients in ways that will enhance protection of the natural environment and provide a sustainable future for agricultural operations and rural development."[123] Each agricultural operation will be classified into one of nine categories based on the nature of the operation and on the amount of nutrients generated and received. The agricultural operation would then be required to comply with the regulations specific to its category – intensive farming operations

[122] McRobert, D. (2004). What Makes Nutrient Management So Controversial?, London Swine Conference
[123] McRobert, D. (2004). What Makes Nutrient Management So Controversial?, London Swine Conference

will be expected to comply with more stringent regulation than small, family farms. There are over twenty-six specific subject matters that may be regulated including,

a) Size, capacity, location and construction of buildings that store materials containing nutrients, or house farm animals
b) The amount of materials containing nutrients that may be applied to lands, the quality of the materials, and the type of land to which they may be applied
c) The time and manner in which materials containing nutrients may be applied to lands
d) Preparation, approval and revision of nutrient management plans (NMPs) for agricultural operations, and nutrient management strategies (NMSs) for municipalities and generators of materials containing nutrients
e) Establishment of a registry containing the NMPs and NMSs
f) Collection and chemical analysis of materials containing nutrients

Under the NMA any municipal by-law addressing the same topic as regulation becomes inoperative, thereby establishing uniform province-wide standards. Under the regulatory system that preceded the NMA, MOE required generators of biosolids (e.g. Sewage Treatment Plants, pulp and paper mills), haulers of septage, and managers of sites onto which biosolids are applied to have and follow certificates of approval under the EPA.

McRobert outlines a number of problems with the NMA.[124] One of the sources of controversy has been described as the nutrient management compliance and enforcement maze created by the *NMA*. As reported in the ECO's recent annual report, one of the most contentious issues raised by commenters on Bill 81 related to whether OMAF or MOE should be accountable for ongoing enforcement of the *NMA* and associated regulations. For the most part, agricultural organizations took one of two positions: (a) OMAF should be wholly accountable since the *NMA* is about nutrient management by farm operations and since OMAF has expertise on farms and a positive, co-operative relationship with farmers; or (b) a MOE inspection unit should be seconded to OMAF. Many farm groups stressed that the approach to compliance and enforcement should be positive and cooperative rather than punitive. For the most part, environmental groups recommended that MOE be wholly accountable for enforcement due to its independence and its expertise in enforcement. In his Part 2 Walkerton Inquiry report, Commissioner O'Connor stated that OMAF may not be sufficiently independent to both promote agriculture and enforce the regulations and he recommended that MOE oversee all compliance requirements of the *NMA*.

[124] The following has been paraphrased from: McRobert, D. (2004). What Makes Nutrient Management So Controversial?, London Swine Conference

Up until November 2003, it appeared that compliance and enforcement would be multi-layered. OMAF officers would have been responsible for the first line of enforcement. The MOE would only be called in after multiple violations, repeat offences or refusal to admit an OMAF Agricultural Officer. MOE would also have been called in for spills or other incidents that may have a major impact on human health or the environment.

In theory, this plan sounded reasonable; however, the ECO has found that shared responsibilities and limited government resources in the area of *Fisheries Act* enforcement has sparked jurisdictional turf wars, and can result in "enforcement inertia" and other complications. For this reason, the ECO has argued that it would be logical to assign MOE the lead role in enforcement of the *NMA*.

Section 61 of the *NMA* states that: "A regulation supersedes a by-law of a municipality or a provision in that by-law if the by-law or provision addresses the same subject matter as the regulation." A provision of a by-law that is superseded will be inoperative so long as the regulation is in force. Chief Building Officers (CBOs) will have to decide whether a local by-law has been superseded by *NMA* regulations as explained by one commentator. OMAF has argued that O. Reg. 267/03 will supersede by-laws made under the *Planning Act*. However, this interpretation is open to question; indeed, section 71 of the *Planning Act* states that where there is a conflict between the *Planning Act* authority and other general and special Acts, the *Planning Act* is paramount. Whether O. Reg. 267/03 supersedes a by-law made pursuant to the *Municipal Act* will also require interpretation to determine which provisions of the by-law "address the same subject matter" as *NMA* regulations.

Some legal commentators also argue that unless the legislation is clarified, many of these CBO decisions will be challenged in the courts. For a preview of this kind of litigation, see the *City of Ottawa* v. *City of Ottawa, Chief Building Official, (2003).* This decision grants the appellant city a stay of a decision by the city's own CBO to issue a building permit for a livestock farm, pending an appeal to the Ontario Court of Appeal. In December 2003 a Divisional Court panel upheld a ruling that the CBO had to give the producer a building permit, but did not have to designate his newly acquired dairy farm as a legal non-conforming use. The Divisional Court panel of Justices also determined that the trial judge was correct in concluding that a proper interpretation of the term "other applicable law" in the *Building Code Act* excluded three environmental statutes, the *OWRA*, the *EPA* and the *Fisheries Act*. However, the trial judge

did not comment on the applicability of the *NMA* since the application for the building permit was received before O. Reg. 267/03 came into force.

7.5 WATERSHED-BASED SOURCE PROTECTION PLANNING

Pollution Probe defines source water as untreated water from streams, lakes, or underground aquifers that people use to supply private wells and public drinking systems. Source water comes from either surface water or groundwater. Source water protection is about protecting both the quality and the quantity of these water sources now and into the future.[125] Source protection plans are designed around the functioning of watersheds, with a goal of maintaining the ecological health of the watershed.

In February 2004 and the Provincial government put forward the White Paper on Watershed-Based Source Protection Planning (now will be referred to as the White Paper). As Pollution Probe notes, the White Paper 'describes an approach for the development of a watershed-based source water protection program in the province and it sets out the legislative framework proposed for the planning components of the plans.'[126] The White Paper proposes to[127]:

- an approach for the development of a watershed-based source water protection program, including how stakeholders and the public will be involved at the local level;
- a legislative framework for the development and approval of source water protection plans; and
- ways to enhance Ontario's management of water takings, including improvements to the Ministry of the Environment's water takings program. It also puts forward factors that need to be considered in designing a system of water-taking charges.

The overarching goal would be to protect human health by ensuring that current and future sources of drinking water in Ontario's lakes, rivers and groundwater are kept from potential contamination and depletion. In addition, these plans would help maintain and enhance the ecological, recreational, and commercial values of our water resources.[128]

In watershed regions with more than one conservation authority, a lead conservation authority would be designated for administrative purposes. Lead conservation authorities would

[125] Pollution Probe (2004). The Source Water Protection Primer. Toronto, Pollution Probe**:** 20
[126] Pollution Probe (2004). The Source Water Protection Primer. Toronto, Pollution Probe**: 66**
[127] Province of Ontario (2004) The White Paper on Watershed-based Source Water Protection, http://www.ene.gov.on.ca/envision/water/spp.htm (downloaded June 28, 2004)
[128] The following information regarding the White Paper is compiled from: Province of Ontario (2004) The White Paper on Watershed-based Source Water Protection.

have the following administrative responsibilities: working with the source protection planning board (SPPB) in each watershed to recommend a chair for the Source Protection Planning Committee (SPPC) for the watershed region to the province (see following sub-sections for details on SPPBs and SPPCs); working with the SPPB to establish an SPPC for the watershed region, while also ensuring proper stakeholder representation on the committee; serving as the coordinating body for the technical experts and use of technical and other shared resources; and assisting each SPPB to establish work planning priorities with the SPPC. The SPPBs would be responsible for recommending a lead conservation authority for each region to the province. The Minister would have the authority to designate the lead conservation authority. It is anticipated that the 'lead' would go to the conservation authority within the watershed region with the most experience in, and capacity to coordinate, watershed management. Pg. 16

The primary responsibilities of the SPPB would be to review the work of the Source Protection Planning Committee (SPPC), specifically: reviewing and approving the Terms of Reference for the source water protection planning process based on the legally binding directions provided by the Ministry; ensuring that the source water protection assessment and plan comply with the requirements of the legislation and the provisions of the Terms of Reference, including the provisions governing public participation; working with the SPPC towards achieving supporting resolutions from 100% of municipal councils; and seeking formal documentation of the level of support for a source water protection plan. The SPPB would be required to consider objections to the plan and attempt to resolve outstanding issues, ensuring that objections and the approach taken to attempt to resolve them are documented. Once developed, the SPPB would submit the recommended draft source water protection plan to the Ministry for approval.

Each watershed region would have a multi-stakeholder source protection planning committee (SPPC). The SPPC would coordinate the development of the source water protection plan (or plans) for the watershed region, and ensure plans conform to the source water protection legislation, regulations and associated guidelines. The primary functions of the SPPC would be to: develop terms of reference for the source water protection plan within the watershed; provide direction for the development of the draft source water protection assessment and source water protection plan for each watershed in accordance with the source water protection legislation and regulations; coordinate the collection and analysis of technical data to support the source water protection plan and ensure the best available science is used; establish a watershed sub-committee with representatives of all municipalities in the watershed region as a formal mechanism for ongoing

consultation during development of the source water protection plan; establish, as necessary, sub-committees for other stakeholders; establish and co-ordinate a transparent local consultation process to ensure broad consultation based on minimum requirements set by the Ministry (e.g., SPPC meetings to be advertised and open to the public to the extent possible; draft plans and proposals published and made widely available; inviting the public to provide their comments and input in writing); once completed, submit the draft plan to the SPPB for review; work with the SPPB toward achieving supporting resolutions from 100% of municipal councils; undertake other tasks, perform other duties and meet other requirements as specified in the legislation and regulations; and at key milestones, assess the appropriateness and validity of the approach, the science, and operational / management practices used in plan development. The lead conservation authority would be responsible for establishing the SPPC.

The SPPC would begin development of a source water protection plan (SPP) for the watersheds in its region and coordinate with adjoining areas as appropriate (i.e., where groundwater travels across watershed boundaries). The purpose of the SPP would be to indicate the management actions that are required to protect the quality and quantity of sources of drinking water over the long term. The development of an SPP would entail evaluating management options based on the ranked hazards identified in the source water protection assessment, prioritizing actions and implementing them. The SPP would then be developed in accordance with the legislation and regulations. (Note that the content of the SPP would be outlined in detailed regulations and would be based, in part, on the results of the work of the Technical Experts Committee and the Implementation Committee.)[129]

There would be a number of mechanisms in addition to the SPPC for stakeholders to be involved in the development of their local source water protection plan. This could include participating in working groups established by the SPPC to work on specific aspects or tasks associated with the planning process. The working groups would assist with the technical work and other tasks related to the development of source water protection plans.[130]

The White Paper is a commitment by the Provincial government to implement O'Connor's recommendation from the Walkerton Report. The White paper can also been seen as the Provincial government is attempting to provide accountability and community participation into the

[129] Province of Ontario (2004) The White Paper on Watershed-based Source Water Protection: 23
[130] Province of Ontario (2004) The White Paper on Watershed-based Source Water Protection: 19

governance of watershed management, with the goal of ensuring ecological integrity of Ontario's watersheds.

7.6 OTHER WATER MANAGEMENT POLICIES

There are a myriad of other laws and policy under various Ministries that deal with water quality, pollution prevention and sediment and bacteria control and flooding issues. The following section will give a brief overview of some of these policies.

The White Paper describes a number of recent actions that the provincial government has undertaken to protect water at is source. It states, "On November 14, 2003, acting on the recommendation of the Advisory Committee on Watershed-based Source Protection, the government announced the establishment of two expert source water protection committees: The 21-member Implementation Committee is tasked with providing advice to the government on tools and approaches to implement watershed-based source protection planning. One of the committee's first tasks is to provide advice on new and existing roles and responsibilities of the province, municipalities and conservation authorities to implement source protection plans. The committee is also examining innovative funding mechanisms and incentives. The 16-member Technical Experts Committee is providing advice on an Ontario based threat assessment process. The committee is providing advice on areas including: categorizing threats to water; linking groundwater protection to surface water management; the effects of water-takings on the availability and quality of drinking water; appropriate risk management tools for various levels of threats; and protecting both current and future drinking water sources. On December 18, 2003, the government announced a moratorium on new and expanded water taking permits for products such as bottled water. The moratorium is in effect from December 18, 2003 until December 31, 2004. It ensures that 'permits to take water' will not be issued for new and expanding water bottling operations and certain other commercial takings until new rules are developed. The new rules will be in effect before the moratorium is lifted."[131]

The Provincial government has also created a number of policies that reallocate control of water management to the municipalities. Key statues in Ontario that grant municipalities jurisdiction over environmental and land use matters effecting water include: the *Planning Act*, the *Municipal Act* and the *Building Code Act*. The *Planning Act* gives municipalities the power to

[131] Province of Ontario (2004). White Paper on Watershed-based Source Protection Planning: 3

adopt official plans, zoning by-laws and the obligation to regard the conservation of natural resources when considering subdivision approvals.[132] In 1996, the Planning Act was amended and the provincial government established a new Provincial Policy Statement (PPS) under the Act. The PPS affirms that prime agricultural areas and normal farm practices will be promoted and protected. The 1996 PPS is currently under review and we expect that a revised version of the PPS will be tabled for public consultation in June 2004.[133] In 2001, the Ontario government significantly revised the Municipal Act. The new law, which took effect in January 2003, contains a number of provisions to authorize control over specific environmental matters through the use of by-laws. Examples include by-law powers on tree cutting, the adoption of waste management plans and by-laws to curb noise pollution. However, it did not alter municipal powers with respect to regulating farm operations.

MUNICIPAL INDUSTRY STRATEGY ABATEMENT (MISA)

The Municipal Industrial Strategy Abatement Program (MISA) was established as a result of the Canadian/Ontario Great Lakes Water Quality Agreement. It attempts to reduce toxic pollution, by setting effluent levels and monitoring standards for the nine major toxic polluters. The nine sectors are petroleum, pulp and paper, metal mining, industrial minerals, metal casting, organic chemical manufacturing, inorganic chemicals, iron and steel, and electric power generation. The sector regulations were developed between 1993-1995. The regulations include monitoring and reporting requirement includes:

- For every chemical parameter in the MISA there are two limits (not to be exceeded on any day) and a monthly average
- A required monitoring frequency to demonstrate compliance with the limits
- Every effluent must not be toxic to fish and water fleas
- Each plant must prepare an annual report to be available to the ministry
- Incidents of non-compliance must be reported directly to the ministry followed by a letter.

Each of the Sector's effluent levels are outlined by separate Ontario Regulations

ONTARIO'S WATER RESOURCES INFORMATION PROJECT (WRIP)

Historically, information about Ontario's water has been collected in isolation and access to the data has been very limited. In order surpass this problem the Provicial government initiated the

[132] McRobert, D. (2004). What Makes Nutrient Management So Controversial?, London Swine Conference
[133] McRobert, D. (2004). What Makes Nutrient Management So Controversial?, London Swine Conference

Water Resources Information Project (WRIP) in March 2002. According to the MNR, WRIP's aims are to create:

> "...an integrated, standardized water information program for Ontario as the foundation for effective knowledge-based water management decisions - bringing the right information to people when they need it." -The Provincial Water Information Strategy: Integrating Ontario's Efforts in the New Millennium."[134]

In co-operation with all levels of government and partner agencies, WRIP's goal is to:

a) Ensure that decision-makers and all Ontarians have accessible, high-quality information about water resources
b) Provide the tools and information systems necessary to effectively assess and manage Ontario's water resources
c) Build a credible, province-wide information base that includes data about the quality and quantity of groundwater and surface water
d) Document a framework that will guide the integrated water information program.

Under WRIP, managers have begun documenting the water programs and services delivered by provincial ministries, such as the ministries of the Environment (MOE), Natural Resources (MNR), and Agriculture and Food (OMAF). The business framework established through this initiative - referred to as the water management architecture - will be extended to include these elements of the provincial organization: resources, services, processes, locations, people, organizations, workflow, schedules, policies and business rules; where they are; what they do, and; their relationship to one another. The business framework will then be extended to include the relationships with other government levels and partner agencies that are also involved in addressing provincial priorities. This framework will guide the development of the water resources information program, ensuring that all components and projects for managing water in Ontario are considered and included as part of the overall vision for integrated water management across the province.

ENVIRONMENTAL FARM PLANS (OMAF)

The OMAF and many of its stakeholders (such as the Ontario Federation of Agriculture) have long promoted a voluntary approach to nutrient management, and spent approximately 15 million Federal Green Plan dollars in the early 1990s to support the Environmental Farm Plan Program (EFPP). Since 1993 OMAF has provided technical support to the voluntary EFPP, which encourages farmers to develop Environmental Farm Plans (EFP), including manure management plans. Some excellent work has been done under this program. However, because

[134] Ministry of Natural Resources Homepage: wwwmnr.on.gc.ca

participation in these projects has been voluntary, the off-farm ecological impacts caused by manure management are not emphasized and data collection on EFPs was uneven, and there was no assurance that the program has changed the practices on the majority of farms.[135]

OTHER PROGRAMS:

Provincial Groundwater Monitoring Information System (PGMIS)
This system provides access to information about groundwater levels and other valuable data collected under the Provincial Groundwater Monitoring Network and associated processes for viewing trend analysis data, tabular reporting, etc.

Drinking Water Management and Compliance Information System (DWMCIS)
There's a new regulation in Ontario that governs the inspection of drinking water facilities and every aspect of the reporting of drinking water quality by municipalities. DWMCIS is the information system that makes that new legislation work.

Ontario Flow Assessment Techniques (OFAT)
OFAT is a series of Geographic Information System (GIS)-based tools that employs existing regional hydrological models. It is used to estimate high, low, mean annual or other flow patterns in any watershed in Ontario

[135] McRobert, D. (2004). What Makes Nutrient Management So Controversial?, London Swine

8. MUNICIPAL ARRANGEMENTS

8.1 CONSERVATION AUTHORITIES

The role of municipal government in water resource management is limited. While local land – use planning decisions can have major impacts on local water resources, the province has historically provided little policy direction to municipalities on the protection of surface and groundwater resources (Winfield, 1999). The most important actors, in terms of water resource management at the municipal level, are the Ontario Conservation Authorities.

Co-operative watershed management led by Ontario's Conservation Authorities has a long history in the Province of Ontario. Dating back to the early 1900's, severe water problems associated with flooding, drought and sub-standard water quality in Southern Ontario prompted government action. Increasingly, the province was experiencing water quality issues that were the result of rapid urbanization and accompanying deforestation. These activities were negatively affecting economic growth and development in the region. The Province responded by introducing special legislation enabling eight municipalities to form the Grand River Conservation Commission (Statutes of Ontario C. 55, 1932). The Commission was granted the authority to conduct research studies and projects related to water conservation. The goal of water conservation projects during this time period was to provide for a consistent supply of water for municipal, domestic and manufacturing purposes (Conservation Ontario: The Importance of Watershed Management, 2001). The Grand River Conservation Commission provided a model for water management on a river basin basis, which was replicated provincially with the promulgation of the Conservation Authorities Act of 1946 (Statutes of Ontario, C. 11, 1946). The Conservation Authorities Act, which permitted municipalities in a watershed (or watersheds), to form a Conservation Authority was legislated in response to concerns expressed by Ontario agriculturalists, naturalist's and sportsmen's groups who were concerned with the unhealthy state of Ontario's natural resources. This movement had begun in the early 1930's, with the formation of interest groups such as the Ontario Conservation and Reforestation Association and the Federation of Ontario Naturalists. The Conservation Authorities Act provided a mechanism to conserve the environment and address natural resource management

issues (Conservation Ontario, National Watershed Stewardship Policy Discussion: Ontario Region Case Study, 2003).

CA's are governed by provincial legislation, (the Conservation Authorities Act), and they deliver programs under this legislation on behalf of the federal and provincial governments, local municipalities, and other organizations. The legislation provides the legal mechanism for CA's to conserve and protect watershed resources. CA's have been described as 'local watershed managers' and were established to fulfill the role of 'planning, co-coordinating, and management agencies to facilitate municipal and provincial partnerships and to promote a comprehensive approach to resource management' (Conservation Ontario). CA's were mandated to "further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals" (R.S.O. 1990, C. 27, s.20). Currently, there are 36 Conservation Authorities in the Province of Ontario and these individual Authorities exist under the umbrella of Conservation Ontario.

Conservation Ontario is governed by a Council Board of Members and senior staff that are appointed by each of the 36 Conservation Authorities (CA's) (Fox and Kinkead, 2004). Conservation Ontario is the umbrella body for a network of 36 CA's that exist in Ontario which serve approximately 90% of Ontario's population. The stated objectives of Conservation Ontario are: "to ensure that Ontario's rivers, lakes and streams are properly safeguarded, managed and restored; to protect, manage and restore Ontario's woodlands, wetlands and natural habitat; to develop and maintain programs that will protect life and property from natural hazards such as flooding and erosion; and to provide opportunities for the public to enjoy, learn from and respect Ontario's natural environment" (Conservation Ontario). Conservation Authorities (CA's) are formally defined as "community – based environmental organizations dedicated to conserving, restoring, developing and managing natural resources on a watershed basis". CA's exist to serve the public and Ontario landowners and provide advice to all levels of government on the responsible management of Ontario's waters. Each individual CA's programs and services respond to the unique natural and water management needs of each particular watershed. Their programs also respond to the varying intensities and mixes of land and resource use within a particular jurisdiction. CA's do not exist throughout the whole of Ontario, particularly in large parts of the north. In these areas, the Conservation Authority Act gives watershed municipalities an option to come together to create a CA. CA's are by definition

partnership agencies formed by their constituent municipalities. CA's are a partnership between the Province of Ontario and municipalities and exist to facilitate the management of water and natural resources on a watershed basis. A CA's governing board is comprised of representatives elected by the municipal councils in the particular watershed and the responsibilities of the Board include: setting budgets, policies and key directions of the CA. Powers of the CA include the ability to undertake research, acquire land, raise municipal levies, construct works, control surface water flows, create regulations and prescribe fees and permits (Ivey, 2002). CA's can regulate the use of the lands that they own and enter into agreements with other parties to manage lands that they do not own. CA have a history of working closely with all levels of government to coordinate and implement services that aim to improve water quality, maintain water supply, reduce flood damages, protect natural areas, provide citizen based educational programs and to provide outdoor recreational opportunities. Each of the CA's has developed and continues to work on individual watershed management plans that reflect their differences in climate, geology, drainage area demographics, growth and levels of water usage (Conservation Ontario). Community needs are represented through the active engagement of local youth groups, volunteers and environmental groups through stewardship and educational programming delivered by CA's and the involvement of community groups as partners in specific targeted projects. The work of the CA's is also supported by corporations and businesses that are increasingly recognizing the efforts of local CA's and Conservation Ontario (Conservation Ontario).

Although Ontario has always assumed a watershed approach to water resource management, the understanding of the concept and the scope and sophistication of watershed functions and relationships has matured over the last fifty years. In the 1950's through to the 1970's what was defined as "watershed management" primarily focused on single-issue flood management programs. The scope of watershed management began to develop further in the 1980's and 1990's to a more complex systems approach which was reflected in the development of Master Drainage Plans. Contemporary "watershed management" approaches are defined as integrated, ecosystem based management initiatives with a clear focus on the interrelationships among environmental, social and economic dimensions of growth. Historically, CA's were established to address concerns relating to flood control, surface water quality, soil and water conservation and hydro electric power generation. These concerns have evolved and broadened

over the last four decades as it has become clear that the concept of a watershed approach has presented an opportunity to address a range of resource management issues in an integrated manner (Mitchell in Ivey, 2002). The contemporary approach to watershed management advocated by Conservation Ontario is the understanding that watershed management is a process by which the management of upstream waters is integrally connected to the health of downstream waters. Conservation Ontario (and its associated Conservation Authorities), also work within a framework that recognizes that watershed boundaries transcend political jurisdictions and therefore, conservation work requires an understanding of political and ecosystem management complexities concurrently (Conservation Ontario).

While Ontario's watershed–based CA's have consistently played a role in *surface* water management, over the past five decades they have increasingly assumed greater roles and responsibilities in other aspects related to the water management cycle. While the initial role of the CA was focused on flood control, responsibilities and areas of focus have widened to include issues related to broader watershed and ecosystem management functions and specific programming and research activities include: the protection of ground water recharge/discharge areas, aquifers and headwaters through land purchases, restoration activities of degraded waters and activities related to non-point source pollution, particularly from agricultural sources. (Conservation Ontario). Conservation Ontario's approach to watershed management has been regarded as a leading example of innovative water management systems and has been adopted elsewhere in North America and globally (Fox and Kinkead, 2004). Within the last decade, in Ontario, the watershed has evolved to be regarded as a ecosystem based unit rather than a political unit and with this fundamental shift in approach the watershed now reflects and represents the boundaries for managing human activities (Conservation Ontario, Watershed management in Ontario: Lessons Learned, 2003).

One of the key challenges for local Conservation Authorities, is the ability and means (re: financial and human resources) to build capacity in local water management organizations. In the context of contemporary political trends as expressed in Section One, page eight, which include: deregularization, government downsizing and downloading, local watershed management agencies are increasingly faced with difficulties in delivering the new responsibilities delegated to them by higher levels of government. With amendments to the Conservation Authorities Act in

2000, the role of the Province as a partner in watershed management has been reduced substantially and in effect has increased the responsibilities and roles of local watershed management agencies (R.S.O. 1990, C.27).

While Conservation Authorities in Ontario provide a positive example of a model of cooperative management and protection of water resources by local government their limited mandates and budgetary restraints have prevented them from fulfilling their potential as watershed based ecosystem management agencies (Winfield, 1999). CA's have experienced severe financial constraints since funding from the provincial government has been consistently reduced since 1995 (ibid). In addition to the funding crisis, much of the CA's work has been reactive rather than proactive and as s result it has had a history of 'fixing a problem' rather than preventing the problem from happening in the first instance. At the legislative level, it has been argued that current legislation deters appointments and watershed decision making processes from being made outside of the political process which in effect slows down the process of effectively dealing with the issues at hand (Conservation Ontario: National Watershed Stewardship Policy Discussion: Ontario Region Case Study, 2003).

In conclusion, the key challenges that CA's face includes the following:

- A complex, politicized institutional environment
- Fluctuating senior government support
- Reduced funding
- Issues related to accountability (Ivey, 2002)

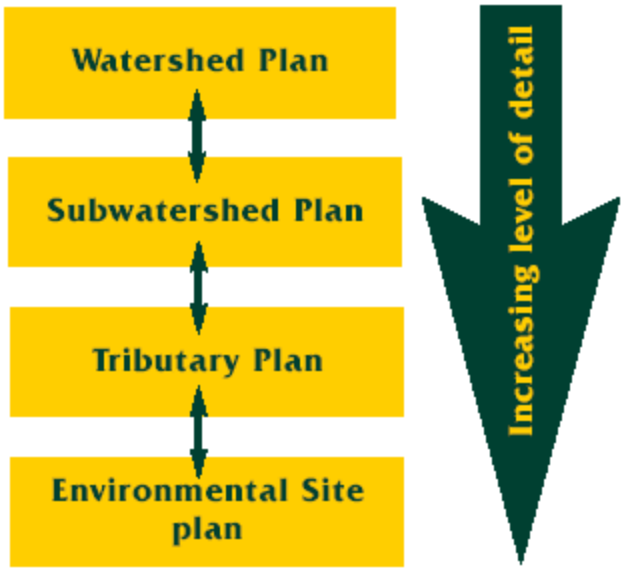
Despite the highly complex and fragmented nature of current water related legislative frameworks, Ontario has developed a strong institutional framework that promotes and enhances a co-operative watershed approach. The structure of Ontario's Conservation Authority's has enabled a range of agencies to respond collectively to watershed issues. CA's have been able to act as facilitators and communicate to various levels of government and communities in regards to watershed management issues. While provincial legislation sets guidelines related to watershed management, the current institutional framework in Ontario allows programming to be locally driven and agencies to be by local people who call on government to form a Conservation Authority.

8.2 NESTED WATERSHED PLANNING WITHIN INDIVIDUAL CA'S

The most efficient way to carry out the process of watershed planning is to; a) develop an overall, comprehensive watershed plan, b) develop sub watershed plans on a priority basis c) develop tributary plans and d) design site specific environmental site plans. This particular 'hierarchy of plans' would ultimately be the most effective and efficient approach to the watershed planning process. Primarily due to financial constraints, many municipalities and CA's only have the capacity to develop sub watershed plans as the starting point and when further technical, human an financial resources become available these plans are eventually integrated into more comprehensive watershed plans.

Watershed plans typically cover a land area that is upwards of 1,000 km2 and correspond to drainage basins of major rivers. They most often include both implementation and monitoring plans, define objectives and targets for the whole watershed and provide watershed-wide policy direction. A typical recommendation found in a watershed plan is the delineation of natural areas to be protected from development which often interfaces with municipal official plan policies. Costs related to development of a watershed plan typically range anywhere from Cdn $ 300,000 to Cdn $ 1 million (Conservation Ontario. Watershed Management in Ontario: Lessons Learned and Best Practices, 2003). Sub watershed plans covers areas within

Figure 3-5: Nested Watershed Planning



(Conservation Ontario. Watershed Management in Ontario: Lessons Learned and Best Practices, 2003)

the range of 50 to 200 km2. At this scale more detail can be found in the plans. In addition to providing direction for Best Management Practices, sub watershed plans also include implementation and monitoring plans tailored to address specific sub watershed issues and local municipal concerns. Recommendations may be incorporated into official plans, secondary plans and local growth management strategies. Costs generally range from Cdn $200,000 to Cdn $500,000 (ibid). Those development proposals that focus on significant land use changes often require Tributary Plans which are also referenced as Environmental Management Plans, Environmental Impact Reports, Environmental Area Plans or Master Environmental Servicing Plans. These plans are carried out on a portion of a sub watershed area which is usually between 2km2 to 10 km2 (ibid). These plans are more specific in that they document environmental resources, establish environmental protection targets and define areas to be protected. These plans are often developed in response to storm water management issues and provide best practice approaches and site location for storm water management facilities. Recommendations resulting from Environmental Management Plans are reflected in municipal secondary plans, Official Plan amendments, conditions of draft plan approvals, and conditions of site plan approvals. Costs generally range from Cdn $ 75,000 to Cdn $ 100,000 (ibid). Environmental Site Plans which provide the finest level of detail are often referred to as Storm water Management Reports (ESWM). These Reports are prepared to meet requirements set out in Draft Plans of Approval and provide details on proposed environmental/storm water management approaches, site servicing and specific landscape features. These plans are often included in the engineering design drawings for draft approved plans of subdivisions and can cost anywhere in the range of Cdn $ 25, 000 to $ 50,000 (ibid).

General Trends in Watershed Management

- More thorough technical analysis in watershed plans
- Increasing use of GIS as an integration tool
- Increased use of water modeling and data management processes
- Engineering approach used to manage water resources in urbanized areas is being replaced by ecosystems approach
- Trends towards watershed monitoring
- Interest in inter-watershed planning where resources cross watershed boundaries i.e.) Oak Ridges Moraine where 9 conservation authorities are collaborating
- Emphasis on protecting the natural environment *system*

Overall in the last decade watershed planning has changed in these ways:

- The development of better tools for the characterization of watersheds
- Increased integration across disciplines
- The inclusion of economic and social factors in watershed planning

8.3 FUNDING AND RESOURCES FOR WATERSHED MANAGEMENT

In Ontario, watershed management activities are undertaken by conservation authorities, municipal governments and the province. Each jurisdiction implements their own watershed related activities but the overall lack of sustainable funding has been a major challenge at all levels. Watershed management expenditures currently exist in two forms: operating and capital costs. Operating costs occur continually and include the operation and maintenance of water management facilities, data collecting and monitoring, administration and enforcement of regulations and policies and the ongoing implementation of watershed plans. Capital costs are reflected in time bound projects which may include the development of watershed plans, the construction of water management facilities and the implementation of remedial projects. Historically, the province of Ontario actively funded both capital and operational watershed based programs. Throughout the last decade, operational costs have been shifted from the provincial to local levels while capital funding has been maintained (albeit at decreased levels) through special projects such as the Toronto and Region Remedial Action Plan. (Conservation Ontario: The Importance of Watershed Management in Protecting Ontario's Drinking Water Supplies, 2001).

In 1987, a Federal Water Policy was developed that stated "the federal government endorses an integrated approach to planning and development of water resources and increasingly, watersheds are becoming the preferred spatial unit for water resource planning." (Government of Canada Federal Water Policy, 1987). Yet, since 1987, federal interests and commitments to watershed management have decreased and accompanying monies available for cooperative agreements have slowly dissipated. As a result, CA's are increasingly relying on funding sources that include; municipal levies based on property assessments, user fees for services provided by the CA (i.e. recreational activities etc.), charitable foundations, provincial

and federal government contracts and other fee-for-service contracts. Prior to 1996, CA's received substantial and stable funding from the province in transfer payments. Throughout the 90's total amounts received were reduced by 80% due to government cutbacks, although increasingly, reinvestments on behalf of the province have been made to a range of CA programming (Conservation Ontario: National Watershed Stewardship Policy Discussion, 2003).

Ontario's conservation authorities are responsible for a broad range of watershed management activities that fall under the general headings of watershed management and monitoring, environmental advisory services, and stewardship. From 1997 to 1999, total expenditures for these activities averaged $5.80 per hectare or $4.50 per person living within the conservation authority jurisdictions. The total cost of watershed management activities undertaken by the conservation authorities is about $59 million per year (2001) (Conservation Ontario, the Importance of Watershed Management in Protecting Ontario's Drinking Water Supplies, 2001). CA's were formed through a partnership between the province and local municipalities. The partnership approach has been a consistent principle in the development of CA programs and projects whereby partnerships are developed that best suit a project and often a 'partnership' becomes on of the conditions of funding. Municipal levies (raised from property taxes), are a major source of funding for CA's therefore an authority's revenues reflect the population of the municipalities contained within their borders. As a result, revenues raised can vary dramatically therefore affects conservation authority capacity, in addition to staffing complements of each CA range from 3 to over 300 (Ivey, 2002). Available sources of funding for watershed management activities include: municipal taxes; provincial and federal revenue sources; development charges; grant programs; private funding; and special charges (i.e. water/sewer rates, sewer use surcharges, storm water utilities) (Watershed Management in Ontario: Lessons Learned and Best Practices, 2003) In some instances certain restrictions on the use funds are imposed. For instance, development charges (which are imposed by local municipalities on new developments), may only be used on development-related capital works initiatives and some grants and private funds are often restricted to use in environmental stewardship programs.

The municipalities manage water supply, wastewater, and storm water systems as well as rural municipal drains and certain shoreline protection programs. From 1995 to 1997, annual municipal expenditures in Ontario on water supply, wastewater, and storm water systems averaged $2.09 billion. This amounts to $273 per person or $660 per household. The overall breakdown of this expenditure is as follows: 51% for water supply, 45% for wastewater services, and 4% for storm sewers (Conservation Ontario, the Importance of Watershed Management in Protecting Ontario's Drinking Water Supplies, 2001).

Provincial ministries enforce environmental protection regulations and sponsor limited watershed management activities directly. These activities are concentrated in the Ministry of the Environment.3 Readily available data describing the operational expenditures of the Provincial Ministry of the Environment allow only a rough estimation of these expenditures on watershed management. Assuming that one half of the expenditures on compliance and resource conservation are associated with water resources, then total expenditures in 1998-1999 and 1999-2000 have been about $50 million per year or about $4.30 per person in the Province. Provincial ministries also help finance municipal and conservation authority activities, but the associated transfer payments are included in the costs reported above for these jurisdictions (ibid).

Watershed planning is an important component of watershed management. The costs for watershed planning are borne by conservation authorities, municipalities and a variety of provincial agencies. The clearest compilation of watershed planning costs is provided in the document, "Inventory of Watershed Management Projects in Ontario, 1990-1995" (Ontario Ministries of Environment and Natural Resources, 1997). This document identifies 84 studies conducted over the five-year period having a total budget of $16.5 million. Allowing for additional studies for which there were no budget figures, the total expenditures on watershed planning were probably in the order of $20 million over 6 years or $3.3 million per year. On a per capita basis, this represents an annual cost of about $0.30 (ibid).

Sources of Revenue for Watershed Management

Estimated revenue sources for watershed management are outlined in Table 4.1. Local taxes and user fees fund 89% of the costs of watershed management or $251 per person while Provincial and Federal funds make up the balance of $31 per person (11%).

Jurisdiction	Total Expenditure per Person	Local Taxes	Local User Fees	Provincial Funding	Federal Funding
Municipalities	$273.00	18%	73%	8%	1%
Conservation Authorities	$4.50	58%	19%	17%	7%
Provincial Programs	$4.50	0%	0%	100%	0%
Total	$282.00	18%	71%	10%	1%

Notes:

1. Municipal user fees are the customer billings and other charges for water and wastewater services.
2. The assessment of revenue sources for the CA is based on revenues measure net of estimated user fee revenues from recreation areas. Local tax revenues for CA represent the municipal levies. User fee revenues include various service charges as well as donations.
3. The assessment of provincial funding does not account for Federal transfer payments.

Source: The Importance of Watershed Management in Protecting Ontario's Drinking Water Supplies

There are great differences in the level of watershed management activity across conservation authorities. Some of this variation is explained by differences in resource management issues that the conservation authorities face and some is explained by funding constraints and a lack of technical resources (e.g., staff, equipment, decision support tools) in some of the conservation authorities. The cost of watershed management for a given watershed is a function of a number of variables and costs are highly dependant on the size of the watershed and its population since this is representative of the intensity of land use and impacts on water (Conservation Ontario, the Importance of Watershed Management in Protecting Ontario's Drinking Water Supplies, 2001).

Under the *Conservation Authorities Act*, the mandate of a CA is to "establish and undertake, in the area over which it has jurisdiction, a program designed to further the conservation, restoration, development and management of natural resources other than gas, oil, coal and minerals". Authorities have the power to undertake research, acquire land, raise municipal levies, construct works, control surface water flows, create regulations, and

prescribe fees and permits. Initially, conservation authority activities focused on the quality and quantity of surface waters in Ontario. Their projects included structural and non-structural approaches to flood protection and low flow augmentation. Construction of reservoirs and dykes, floodplain regulation, and reforestation were early activities [1]. Although conservation authorities now make more use of their broad mandate, the provincial government is presently only funding projects involving core provincial interests, primarily flood management. A recent addition to CA responsibilities is groundwater monitoring, in partnership with the Ontario Ministry of the Environment.

As described above Conservation Authorities partner with local municipalities to conduct watershed and sub watershed studies and plans and since the beginning of the conservation authority program in Ontario, nearly 100 watershed and sub watershed plans have been completed. Additional programs, which many authorities consider core even though they are not funded by the province, include:

- reforestation and sustainable woodlot management,
- watershed strategies and management,
- ecosystem regeneration,
- environmental education and information programming
- land acquisition
- outdoor recreation
- water quality and quantity
- soil conservation
- environmental land use planning
- habitat protection
- agricultural and rural landowner assistance, and
- sensitive wetlands, flood plains, valley lands protection

(Source: University of Guelph)

8.4 THE ROLE OF MUNICIPAL GOVERMENTS

The jurisdictional framework for protecting the environment and managing natural resources in Ontario has evolved over decades and is characterized by fragmentation, overlap in some areas and gaps in others (Conservation Ontario, Watershed Management in Ontario: Lessons Learned, 2003). The Provincial government has the broadest jurisdiction over water and

mechanisms to deal with water issues. In the 1970's and 1980's, Ontario introduced a broad range of water management initiatives, but these were often disjointed and uncoordinated and remain so to this day (McCulloch & Muldoon, 1999). A number of Ministries within the Provincial Government have authority over different areas of water management and even within a single Ministry, a range of departments manage different aspects of water. In short, no single policy or government body oversees the coordination of water management in Ontario. All waters within Ontario's boundaries are not fully within provincial jurisdiction and as a result the Federal, Provincial and municipal governments all have jurisdiction over certain aspects of water management. Federal and Provincial governments have also entered in inter-provincial and international agreements regarding the management of water in defined 'combined jurisdictions' which has exacerbated problems related to the duplication of activities and "gaps in responsibility" (McCulloch & Muldoon, 1999). The Ministry of the Environment (while not the only Ministry at the provincial level involved in water related issues it is one of the most active), enforces legislation, regulations, and policies that apply to the construction and operation of communal water services. In some cases, it approves municipal decisions and plays a role in monitoring performance and enforcing compliance with provincial standards. Municipalities as the owners of water systems are responsible for the delivery of water services. In effect, the province and municipalities share dual responsibilities for the provision of water services. While responsibilities may overlap and cause administrative delays and confusion as to who is ultimately responsible for certain areas of water management, it has been argued by the Walkerton Report that this arrangement offers a tighter, more stringent system in an area that is critical to public health and it acts as a form of 'double protection" in ensuring the delivery of Ontario's water. (Ministry of the Attorney General, Part Two Report of the Walkerton Inquiry, 2002).

Management approaches to water over the last twenty years have focused on the reduction or minimization of adverse impacts on water as opposed to providing 'full protection' of water resources. Water management decisions are made by balancing ecosystem functions of water with other uses in addressing our economic and industrial needs. The overall ad-hoc approach to water management has resulted in a range of reactive policies and programs that are focused on point issues as they reach a crisis stage (McCulloch & Muldoon, 1999). Over the last ten years budget cuts at the provincial level and deregulatory measures have further exacerbated

the random approach to establishing an integrated water policy for Ontario. It has been argued by McCulloch & Muldoon 1999, that an effective water management program should be coordinated among the provincial government's own ministries in partnership with other jurisdictions including municipalities, and that each jurisdiction should be guided by the same policies in making decisions over water management issues.

Local municipalities in Ontario have specific responsibilities for water and related land management practices that have been conferred on them by provincial statutes including the Municipal Act, the Public Utilities Act, Local Improvement Act, and the Planning Act (Ministry of the Attorney General Walkerton Report: Part Two, 2002). In short, local government agencies are responsible for the operation of water works and water systems. Approval is required by the MOE to construct private or municipal water systems and the municipality is responsible for certifying the qualifications of systems staff and establishing operating procedures at their facilities. Water systems in Part Two: Report of the Walkerton Inquiry, are defined as all physical components of a water supply system, including water supply facilities, treatment facilities, storage reservoirs, distribution networks, pumping stations etc. that serve a defined population (ibid). Currently, in Ontario, most local water systems are operated by public utilities commissions, or departments of municipal governments. Due to constrained management and institutional capacities, a number of smaller municipalities have contracted out their water operations to the Ontario Clean Water Agency (OCWA) which is an agency of the Province. Historically, the Province has delivered water services directly to municipalities and this was a function assumed under the 1956 Ontario Water Resources Commission. While the MOE owned and operated approximately 25% of all water and sewage treatment plants in Ontario, recent trends have seen the delivery of water services shifted back to the municipalities. In 1993 the MOE's water treatment division was consolidated in the OCWA which assumed ownership of plants and in 1997, the Water and Sewage Services Improvement Act transferred ownership of these plants back to the municipalities (ibid).

Currently, 82 % of Ontarians receive their drinking water from municipal water systems. Water systems may range from single groundwater supplies to large networks of treatment plans and distribution systems. Approximately 70% of municipal water systems are operated directly by municipalities while 23% are operated under contract with the Ontario Clean Water Agency

(OCWA) and 6% are contracted to private companies and fewer than 1% to another municipality. In addition there are a number of inter municipal agreements consolidating delivery of water services among municipalities (ibid).

8.5 THE CASE OF WATER TAKINGS AND MUNICIPAL LAND USE PLANNING

Water plays a critical role in ecosystem and ecological functions while simultaneously supporting many of our urban and rural social and economic activities. At the local level land use planning is increasingly becoming an important avenue for municipal involvement in surface and groundwater protection. Land use activities clearly influence ground and surface water quality and quantity and local governments are most familiar with those particular activities in their jurisdiction and are often in the best position to apply land use controls (Ivey, 2002). While the Planning Act permits a municipality to control and regulate uses on land through official plans and zoning by – laws the taking of groundwater has historically been the responsibility of the Province and municipalities have lacked the ability to protect water resources from being 'over used' which effectively impacts the quality and quantity of local water supplies. It is on this basis that there is a need for there to be a more effective relationship between land use controls and groundwater protection to ensure that informed land decisions can be made (McDonald and Nethery, 2004).

The Province of Ontario has abundant freshwater sources with over 225,000 lakes, hundreds of rivers and streams and plentiful groundwater aquifers within its provincial boundaries. Ontario borders on four of the five Great Lakes which contain 20% of the world's surface freshwater supply (McCulloch & Muldoon, 1999). Water in Ontario has historically been used on a first-come, first serve basis which has resulted in conflicts among its range of users and the cumulative impacts of water usage have not be analyzed in any comprehensive manner. The competition in usage has often resulted in undermining the ecosystem functions of water. It has been argued by the Environmental Agenda for Ontario Project, that there needs to be political and public commitment guaranteeing the ecosystem function of water. The people of Ontario have the 'dubious distinction of being one of the most intensive users of water in the

world" (ibid) and local shortages have occurred especially in those areas that rely on groundwater. In response to our culture of water use, Ontarians should be thinking about using water 'wisely', and this approach should be evaluated against the following criteria; a) the importance of water use in relation to other uses and b) whether a particular use of water is sustainable over a long period of time (ibid). Decisions regarding uses of water must be made in accordance with a hierarchy of uses and if it can be demonstrated that the use does not interfere with ecosystems functions of water and water quality and quantity (ibid).

Currently the Ontario Water Resources Act requires that a Permit to Take Water (PTTW) be issued for any ground of surface water taking in excess of 50, 000 liters per day. In assessing the PTTW application, the MOE is required to consider the protection of natural ecosystem functions and the protection of groundwater and surface water sources that may be affected by the water taking. All PTTW proposals are posted on the Environmental Registry for a period of at least 30 days for public comment. After the 30 days the MOE will post a Decision Notice, which indicates whether or not a permit has been granted. Any resident may appeal the decision by serving written notice within 15 days of the decision date. This process does not require direct notification to potentially affected parties which include municipalities and residents that live within a certain proximity to the point of water taking.

The case of water taking in Oro Medonte researched by McDonald and Nethery, 2004, provides an example of the municipalities' inability to control water taking under the current Planning Act approval process which does not explicitly include groundwater protection. In 1994 a water bottling operation, Gold Mountain Springs, obtained a PTTW from the MOE to extract waters on a section of the Oro Moraine which is considered to be a significant recharge area. Gold Mountain Springs, submitted applications to Oro – Medonte requesting official plans and zoning by – law amendments to permit the processing and storage of water on the site. The applicants were refused permission for OP amendments by the Township and in the subsequent appeal filed at the Ontario Municipal Board. In its decision the OMB stated that : " When considering applications under the Planning Act this Board has a positive obligation to examine the environmental and ecological impact of the proposed land use and its associated water taking" and further to this, the Board turned to Section 2.4.1 of the Provincial Policy Statement which states that "the quality and quantity of groundwater and surface water and the

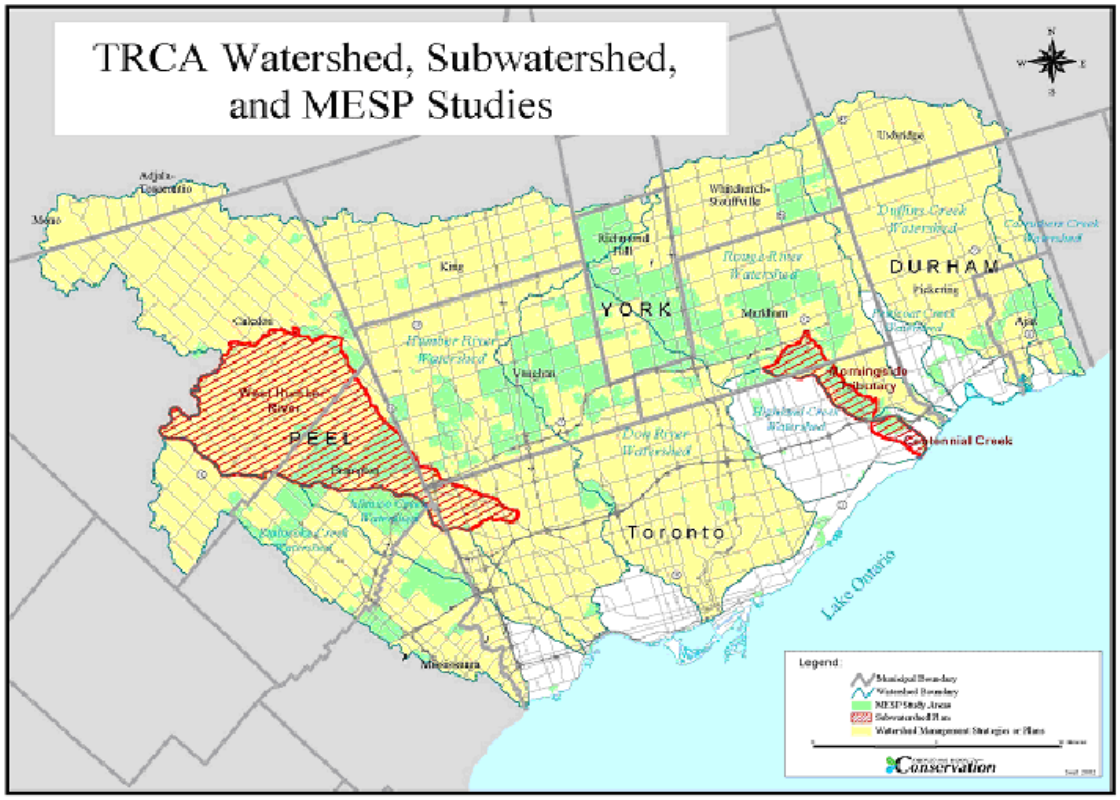
function of sensitive ground water recharge/discharge areas, aquifers and headwaters will be protected or enhanced". Despite the refusal of the applications by the OMB, water continues to be extracted from the site. This situation has lead planners and municipalities to question whether or not water taking should be considered a land use under the Planning Act whereby *both* the use of land and the use of groundwater would be subject to approval processes under the Planning Act. It has been argued (McDonald and Nethery, 2004), that a parallel process pursuant to the Planning Act be established to work in partnership with the OWRA process. An example is the process that is currently in effect for aggregate extraction operations where the MNR has the authority to issue a license to extract pursuant to the Aggregate Resources Act, provided that the lands are appropriately zoned pursuant to the Planning Act (ibid).

While prominent stakeholders such as the Environmental Commissioner of Ontario (ECO), the Association of Municipalities of Ontario (AMO), the Canadian Law Environmental Association (CELA) and Conservation Ontario have consistently lobbied for greater municipal controls over water takings this important issue has not been proposed in recent provincial initiatives, namely the White Paper on Watershed – based Source Protection Planning. While the White Paper does propose reforms to the PTTW system, specifically addressing issues of notification and it's to respond to public concerns; it has not specifically addressed the relationship between land use controls and groundwater protection (ibid).

9: TORONTO

9.1 TORONTO REGION AND CONSERVATION AUTHORITY

Figure 2-3: TRCA Watershed, Subwatershed and MESP Studies



In 1957, the Metropolitan Toronto and Region Conservation Authority was formed which replaced the existence of four smaller authorities. In December of 1997, Amendment Bill 148 was introduced which amended the Conservation Authorities Act, changing the name of Metropolitan Toronto and Region Conservation Authority to Toronto and Region Conservation Authority, reflecting the amalgamation of the former city of Toronto. TRCA's mission is to work with partners to ensure that "The Living City is built upon a natural foundation of healthy rivers and shorelines, green-space and biodiversity, and sustainable communities" (TRCA). TRCA's jurisdiction covers 3,467 square kilometers which includes 2, 506 sq/km of land and 961 sq/km of water-based areas (TRCA). There are nine watersheds within the Toronto Region and six member municipalities which is home to over 3 million people or one – third of

Ontario's population. Member municipalities include: The City of Toronto; Regional Municipalities of Durham, Peel and York; Township of Adjala-Tosorontio and the Town of Mono. Watersheds within the jurisdiction of the TRCA include:

- Humber River, Etobicoke and Mimico Creeks, Don River, Duffins and Carruthers Creeks and Highland Creek, Rouge River and Petticoat Creek

Land uses within the TRCA watersheds vary greatly, from the relatively undeveloped areas such as Duffins Creek to highly urbanized regions such as the Don River which is 80% urbanized. Since its formation, the TRCA has acquired more than 13, 377 hectares of land in the watersheds of the Toronto region, which makes it one of the largest landowners in the GTA (TRCA).

The TRCA is composed of three advisory boards which have been established to provide vision and guidance to its major programs. As with all CA's in Ontario, the TRCA is governed by a Board of Directors, which is composed of elected and appointed municipal officials.

Advisory Board	**Terms of Reference**
Sustainable Communities Board	To initiate, study, report and recommend a comprehensive program for public use and land management of Authority lands and facilities in the region under the jurisdiction of the Authority
Watershed Management Advisory Board	To initiate, report and recommend a comprehensive program of watershed and waterfront management for the region under the jurisdiction of TRCA
Business Excellence Advisory Board	To initiate, study report and recommend a comprehensive program of internal organizational development and corporate policies.

(Source: TRCA)

Since its formation the TRCA has prepared and delivered program for the management of the renewable natural resources within its watersheds. The Authority provides:[136]

- Protection, enhancement, and regeneration of natural resources on a watershed basis
- Sound environmental information and advice to promote good land management practices

[136] For TRCA milestone see Appendix 7.

- Community action on environmental projects
- Outdoor recreation opportunities on 13, 000 hectares of open space, forest lands and Conservation Areas
- Conservation education and heritage programs through outreach programs (TRCA)

The focus of research and watershed planning within the TRCA has been on the development of tributary plans which are also referred to as Master Environmental Servicing Plans (EMPs). It is interesting to note that these plans are primarily funded by the private sector with the TRCA acting as the technical advisor and approval authority. Larger studies (in terms of geographic scope), are referred to as watershed-scale *Component Studies* and *Watershed Plans* which have been used to provide information related to water flow targets, natural heritage targets, habitat targets etc. These plans feed into specific geographically scaled down EMP's. While Watershed Component Studies and Plans are the preferred means of research and planning EMPs have proved to be a more practical tool in providing "Environmental direction for urban development planning." (TRCA). Proliferation in the use of EMPs in the late 1980's and 1990's, was the result of financial and technical support on behalf of the local development industry and the provincial and municipal political regimes of the time. In the late 1980' and 1990's during the period of rapid urban growth in the Greater Toronto Area, many development proposals did not prepare sub watershed because they often took too long to develop and therefore could not be fast tracked into approval. MESP's developed in the 1980's focused on water quantity concerns and were most often carried out through block development in key phases of the sub – division building process. By the early 1990's the MESP scope had broadened to include issues related to water quality, erosion and aquatic and terrestrial habitats. Water -related component studies were required to be extended to the full sub watershed boundary defining the area of development while non-water related components needed only to regard the boundaries of the landowners property (Watershed Management in Ontario: Lessons Learned). Guidance for the development of MESP's was provided by TRCA watershed studies and plans.

The TRCA committed to developing watershed management strategies for each of its nine watersheds in 1989. Within the established two-year time frame, by 1991 a range of watershed studies were completed with varying levels of detail. Budget constraints brought on by the recession of the 1990's accounted for the lack of funding that could be committed to this

endeavor. As a result of the quality of thoroughness in watershed reporting and plan development, TRCA has distinguished between watershed "strategies" and watershed "plans". While both provide strategic direction for protection activities, strategies include detailed modeling and analysis of only a few components of watershed analysis (i.e. the investigation of hydrology and aquatic resources). Strategies are further distinguished from plans by their data gathering methodologies which focus on the gathering of qualitative data and community input. Further technical studies related to strategy documents are considered 'strategy recommendations'. Watershed plans, on the other hand, reflect a data gathering process that involves a quantitative assessment of alternative land use and management scenarios (Watershed Management in Ontario: Lessons Learned). Strategies and plans both provide planning maps and recommended management directions. After the completion of watershed strategies and plans the TRCA prepares a "Watershed Report Card" for the purpose of reporting on watershed health and progress towards stated goals.

Since committing to the development of watershed strategies in 1989, the TRCA has completed strategies for the following watersheds: Don River (1994), Humber River (1997), and Etobicoke and Mimico Creeks (2002) and a watershed plan for the Duffins and Carruthers Creek watersheds (2002). Watershed Report Cards have been completed for Don Watershed (1997 and 2000), and Humber Watershed (2000). Completed Sub watershed plans include: West Humber Sub watershed Study, Morningside Tributary Study and the Centennial Creek Sub watershed Study (TRCA).

The TRCA has also established a Regional Watershed Monitoring Program to fulfill its monitoring and reporting needs at watershed and sub watershed scale. The Regional Watershed Monitoring Network is an ongoing program originally conceived by the Toronto and Region Conservation Authority to develop a comprehensive, integrated and coordinated approach to environmental monitoring in the Toronto region.

The program will fulfill the watershed monitoring and reporting needs of the Toronto Remedial Action Plan (RAP), the TRCA and those of the individual watershed and waterfront councils and alliances while furthering the interests of municipal, provincial and federal partners.

The Network have developed indicators to measure environmental change at the broad watershed and sub watershed levels (known as Tier One monitoring) and will analyze the resulting data to assess the health of the regional environment. The data will then be used by the network partners to help guide environmental management decisions.

The network will focus on six primary areas: aquatic habitat and species and fluvial geomorphology (the physical features and processes of rivers), terrestrial natural heritage, surface water quality, flow and precipitation, ground water and air quality. Multiple indicators will be developed for each of the six areas of the network. These indicators fall into three general categories: condition (the current state of the environment); stress (natural or human-made pressures imposed on the environment); and response (individual or collective management actions to stop or change the pressures). The condition-stress-response indicators are causally linked in a feedback system. This system can highlight potential success stories by illustrating how management actions (responses) can alter stresses on the environment, which in turn improve the general condition (TRCA).

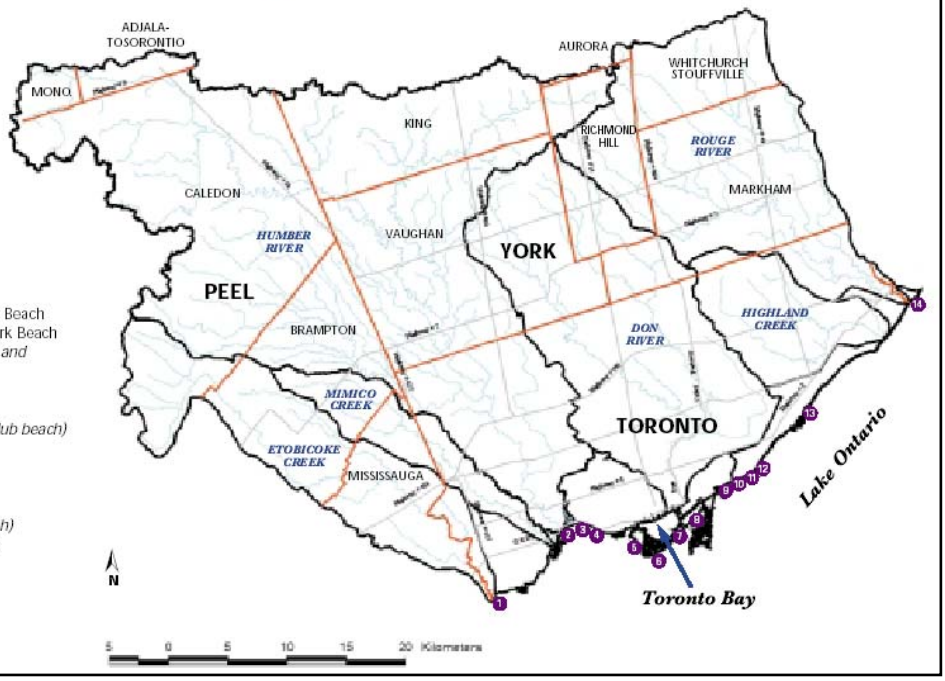
Experience over the years has shown that the TRCA has increasingly developed it scope of activities to include the inclusion of community-based approaches, enhanced technical complexity in the gathering and sharing of information and increased efforts to coordinate watershed planning efforts with municipal planning initiatives.

9.2 THE TORONTO AND REGION REMEDIAL ACTION PLAN (RAP)

In 1972 Canada and the United States signed the first Canada/U.S Great Lakes Water Quality Agreement (GLWQA). The stated purpose of the agreement (revised version signed in 1978), was "to restore and maintain the chemical, physical, and biological integrity of the waters of the Great Lakes Basin ecosystem". In 1987 Canada, the United States and the International Joint Commission (IJC) identified 42 areas of concern (AoC's), including the Toronto region within the Great Lakes Basin ecosystem. The IJC recommended the restoration of the AoC's through the development of a tool known as Remedial Action Plans (WRT, Clean Waters, Clear Choices 1998). The RAP is a process that identifies key goals and strategies in effort' s to

restore the waterfronts, rivers, habitats and waters of identified Areas of Concern (AoC's). The IJC developed 14 criteria to define environmental degradation in the AoC's. The criteria are expressed as 'the impairment of beneficial uses' and the Toronto and Area region currently exceeds eight of these uses with an additional three suspected of being impaired (WRT, Clean Waters, Clear Choices 2001). Impaired uses in the TRA are: restrictions on wildlife and fish consumption; beach closings; eutrophication or undesirable algae; restrictions on dredging activities; degradation of benthos; loss of fish and wildlife habitat; degradation of fish and wildlife populations and degradation of aesthetics (ibid). Under the Great Lakes Water Quality Agreement and the Canada – Ontario Agreement Respecting the Great Lakes, Environment Canada and the Ministry of the Environment have been delegated responsibility for ensuring progress in each AoC within their jurisdiction. In 1996, the two government agencies requested

Figure 2.
Watersheds, municipal jurisdictions, and waterfront beaches in the Toronto and Region RAP area.



List of Beaches:
1. Marie Curtis Park East Beach
2. Sir Casimir Gzowski Park Beach *(formerly Windemere and Ellis Ave. beaches)*
3. Sunnyside Beach
4. Budapest Park Beach *(formerly Boulevard Club beach)*
5. Hanlan's Point Beach
6. Centre Island Beach
7. Ward's Island Beach
8. Clarke Beach Park *(formerly Cherry Beach)*
9. Woodbine Ashbridges Bay Beach
10. Beaches Park
11. Kew Beach
12. Balmy Beach Park
13. Bluffer's Park Beach
14. Rouge Beach

that the Waterfront Regeneration Trust (WRT), and the Toronto Region Conservation Authority (TRCA) act as local coordinators of the Toronto RAP. Although the process had been underway for a period of 10 years, it was not until 1997 that the WRT and the TRCA signed an agreement with the MOE to become coordinators of the RAP for a period of 3 years (1997 – 2000). Key activities to be carried out by the joint implementation agencies include: the annual Clean Waters Summit, the development and release of watershed progress reports, delivery of RAP Awards of

Excellence and the production of an annual newsletter providing information related to community groups activity throughout the relevant watersheds (WRT). The Toronto and Region Area of Concern (AoC) extends from Rouge River in east to the Etobicoke Creek in the west, and includes six major watersheds: Etobicoke Creek, Mimico Creek, Humber River, Don River, Highland Creek and the Rouge River in addition to 45 kilometers of waterfront and Toronto Bay. The area encompasses 210, 600 hectares of urban and agricultural land which supports the activities of approximately 3 million people (RAP: General Information, WRT). The population of the GTA is currently at 4.6 million and expected growth has been projected to reach 6.7 million by 2021 (WRT, Clean Waters, Clear Choices 2001). RAP watersheds located in predominantly urban areas (those north of the City of Toronto); have accommodated rapid urban expansion over the last few decades. Growth has been characterized by low density sprawl accompanied by buildings, roads and other paved surfaces which have eaten up many acres of agricultural and natural lands.

Toronto and region was listed as an AoC due to a number of major environmental issues of concern which were identified. Issues identified include: restrictions on fish and wildlife consumption, beach closings, eutrophication or undesirable algae; restrictions on dredging activities; degradation of benthos; loss of fish & wildlife habitat; degradation of fish & wildlife populations and degradation of aesthetics (RAP, General Information).

The Toronto waterfront is the largest urban centre located on Lake Ontario and is currently under heavy growth pressures which from an environmental perspective, has suffered contaminated runoff, loss of habitat and the degradation of natural landscapes. Lake Ontario is last in the chain of Great Lakes, and as a result the Toronto waterfront is affected by lake wide influences being downstream of the other four Great Lakes and the Niagara River. Of the six watersheds in the TRA AoC each watershed on the AoC list has been designated as impaired for a range of reasons. The watersheds are degraded by many sources of water borne contaminants and deposition from air pollutants. Volumes and pollution loads of storm-water and melting snow from these watersheds create serious impacts in the rivers, streams and waterfront (Clean Waters Report 2001). The overall goal of the RAP process is to establish "a waterfront and watersheds that are fishable, swimmable, drinkable and aesthetically pleasing" (WRT, Clean Waters. Clear Choices, 1999).

The Toronto RAP has assumed an ecosystems approach to guide its vision in achieving the restoration and maintenance of a 'healthy environment'. This approach provides a comprehensive consideration of interactions between air, land, water, and living organisms including humans. It recognizes that although the original designation of the Toronto Area of Concern was focused on the waterfront, the health of the waterfront is closely tied with that of its watersheds, and as a result RAP activities have focused on the entire system (WRT, Clean Waters, Clear Choices, 2001). The Toronto waterfront or Lake Ontario (which is the receiving body of water identified by Canada and the US as an AoC) will only be desisted when local sources of contaminants are eliminated and/or remediate and many of these sources originate in the upstream watersheds.

The IJC recommended a process for the restoration of AoC's through the development and application of Remedial Action Plans. The table below summarizes the overall framework and timeframe identified for restoring beneficial uses (WRT, Clean Waters, Clear Choices Report 1998):

Stages	**Description**	**Status in Toronto and Region**
Stage One: Problem Definition	Identify environmental conditions and the causes of impairments	Stage one report completed in 1989, Environmental Conditions and Problems (1989) 3 impairments noted as requiring further assessment for Toronto
Stage Two: Strategy Development (Planning for Implementation)	Evaluate remedial measures, recommend additional measures, identify agencies for implementation	(1993) Strategies for Restoring Our Waters (1994) Clean Waters, Clear Choices: Recommendations for Action Partial commitments received for implementation
Stage Three (Implementing Actions)	Implementation	1996: A Path to Clean Waters... Actions for Ecosystem Protection and Restoration (3rd Report) 1999: Clean Waters, Clear Choices: 1998 Progress Report. , 1999 Progress Report, 2001 Progress Report
Monitoring Restoration of the Environment		On-going

9.3 IMPLEMENTATION OF THE TORONTO AND AREA REMEDIAL ACTION PLAN

Under the Memorandum of Understanding signed in October 1997 between the WRT, TRCA and MOE, the WRT was given the responsibility of organizing and supporting the RAP Coordinating Committee, the production of annual reports, organizing the Annual RAP Summit, delivering RAP communications materials and providing support to the Toronto Bay Initiative. The TRCA is responsible for coordinating watershed activities such as the Don Council and Humber Alliance, and for the delivery and coordination of monitoring and technical aspects of watershed management activities as defined by the RAP (WRT, Clean Waters, Clear Choices Report 1998). The roles of Environment Canada and the MOE include implementation of federal and provincial recommendations; the provision of expert scientific support; assisting in securing funding from various sources and the provision of overall direction. While EC and the MOE are the agencies responsible for the delivery of RAP they effectively work through the MoU with the TRCA and WRT to facilitate the development and implementation of the TRA RAP. Overall leadership for the implementation of the Toronto and Region RAP is achieved through the four party MoU, between Environment Canada, MOE, WRT and the TRCA. While the WRT and TRCA deliver, coordinate and implement the RAP, EC provides 80% of annual funding support and the MOE provides the balance (WRT Clean Rivers, Clear Choices Report 1999).

In 2002 the WRT completed its five year commitment to the RAP process and currently the TRCA is the principle partner in RAP implementation and advocacy work._TRCA's key role in watershed management is that of advocacy, working with municipalities and community groups to ensure that watershed ecosystems are fully integrated and become mainstreamed into municipal planning initiatives. The RAP Program is part of the TRCA's "Protecting our Waters Program". Key stakeholders involved in on-going development of the RAP include: municipalities, agencies, business and citizens. Municipalities are responsible for responding to aspects of key RAP goals through the facilitation of such activities related to environmental health; storm-water management; contaminant source control; wastewater collection and treatment and municipal planning.

The Toronto RAP is implemented through a range of mechanisms which include: multi-Stakeholder watershed councils as found in Etobicoke-Mimico, Humber and Don Watersheds; Rouge Park Alliance; community groups working on public education, advocacy and restoration activities, inter-regional municipal working groups for storm-water management; programs of the TRCA and the activities of individual municipalities and government agencies of Canada and

Ontario. Under the most recent MoU the TRCA provides the focal point for coordinating activities and public consultation with the following responsibilities: raising public awareness; facilitating forums for exchange and reporting on progress; coordination of RAP communications; focus on RAP implementation activities on an individual watershed basis; provision of technical expertise and organization of cleanup activities (Environment Canada, RAP Implementation). Since its inception progress towards the restoration of the Toronto and Region area has been slow, while the plans and policies recognize what needs to be done implementation often becomes stagnant primarily due to the large number of jurisdictions in the RAP area (WRT, Clean Waters, Clear Choices 1998).[137]

The RAP 1998 Progress Report (Clean Waters, Clear Choices), identified key areas for future efforts and prioritization which included: the management and treatment of run off to prevent further contamination of receiving waters and the use of a range of structural and non-

[137] In 1999 the Regional Municipalities of Peel, York and Durham jointly prepared a discussion paper and recommendations for provincial action and initiated a groundwater management strategy with local conservation authorities. For further information on this initiative please visit http:// www.region.peel.on.ca/pw/water/york-peel/index.htm

structural techniques in the management of TRA watersheds and waterways. In response to these key concerns (amongst a range of others), one of the key activities outlined in the 1998 Progress Report was the need for the development of a monitoring framework for the RAP area. The purpose of a monitoring system was to coordinate various *existing* monitoring programs into one comprehensive framework and to ensure that any monitoring required for delisting is in fact undertake (WRT, Clean Waters, Clear Choices Report 1998). In response to this need the RAP, Great Lakes Quality Board (WQB) and International Joint Commission (IJC) held a workshop on watershed monitoring and management on May 13, 1999. The WQB is principal advisor to the IJC on policy matters relating to the Canada-United States Great Lakes Water Quality Agreement. This public workshop not only supported the RAP process and addressed watershed monitoring as a key theme it also fulfilled a further RAP objective which is to improve public involvement and consultation in watershed strategy development (IJC, 1999). The overall goal of the workshop was to discuss the proposed monitoring framework and to assess the health of watershed ecosystems and their progress towards restoring beneficial uses. The framework was to provide guidance on making watershed management decisions. The key recommendation coming out of the workshop was defined as the need for monitoring data to be linked to watershed stresses/causes based on fact that the goals and results of monitoring should ultimately lead to alternative management actions that positively impact watershed restoration.

Discussion papers for input into the proposed watershed monitoring framework were developed pre conference by 30 local stakeholders including the Don Watershed Regeneration Council and the Humber Watershed Alliance. These groups possess no legal or statutory powers and function as advisory bodies to the TRCA and as liaisons to their respective watershed communities. They are defined by watersheds and not political boundaries therefore advocate for ecosystem based actions and policies at the watershed level (IJC, 1999). Key discussion documents focused on water quality; water quantity; and aquatic habitat and species and consultation workshops were composed of and included input from staff from local and regional municipalities; government and other agencies; academics and interest groups (business, community or other).

The proposed monitoring framework and monitoring requirements were developed within a watershed context and the monitoring indicators selected for the Watershed Monitoring

Network reflect a spectrum stressor factors, environmental effects, and corresponding management responses and activities. Specific monitoring approaches include: biomonitoring; municipal monitoring; and algal community monitoring (IJC, 1999)

Coming out of this workshop the TRCA has taken a lead role in developing the monitoring framework which includes a list of technical indicators in areas of water quality; water quantity; aquatic habitat and species; and groundwater quality. Each indicator has a proposed monitoring protocol and will contribute to reducing the Toronto AoC 'delisting' timeline. TRCA waterfront studies include technical analysis of sediment chemistry; benthos and clam bio monitoring on a project basis; fish sampling; habitat assessments; flow monitoring; snow conditions and precipitation. As part of the Provincial Water Quality Network, in 1999 the TRCA, City of Toronto and MOE began to address the need to resume regular stream water quality monitoring. Since 1996 the MOE had only monitored stream water quality in 2 stations in RAP area, down from 35 in 1995 (ibid).

Ongoing government agency monitoring includes MOE activities such as: reconnaissance surveys; drinking water surveillance programs: intake pipe monitoring; Ontario beach monitoring; fish monitoring; toxic discharge and flow monitoring. Many of these activities are examples of 'bio monitoring' programs. A further example of a bio monitoring program is the Sport Fish Contaminant Study and the Juvenile Fish Monitoring Program which are north carried out by the MOE. They are programs whereby fish are collected from Toronto watersheds and analyzed for contaminants. These bio monitoring programs are part of a "'front line" monitoring because they integrate environmental conditions of watersheds and provide information related to the current state of watersheds (ibid). At the federal level Environment Canada is active in administering the water survey of Canada and tracking of suspended sediment loadings and precipitation.

At the municipal level the City of Toronto Works Department is involved in monitoring through Toronto Lake and stream monitoring programs and municipal intake compliance monitoring. Municipal monitoring varies between municipalities in the Toronto RAP region and they cover a large range of activities which include: forms of traditional monitoring which focus on suitability for a specific use (i.e. beach closings, water supply); catching polluters (e.g.

sewer out-fall monitoring) and performance monitoring (i.e. treatment plants, storm-water management systems). Municipal monitoring assists municipalities in making decisions about the use of land for housing; transportation; recreation and natural area development. The key challenge at the municipal level is to reach a balance between the use of traditional monitoring (grab samples) and long term monitoring which is grounded in an integrative approach to water management.

In the RAP Clean Waters, Clear Choices Report (2001), six areas of priority are outlined. The combination of these actions will increase the chances of the TRA being removed from the AoC list:

- **Wet Weather Flow Management**: Uncontrolled flows of polluted storm-water and combined sewer overflow are the most significant cause of degradation of the Toronto waterfront and its watersheds. The implementation of the City of Toronto's Wet Weather Flow Management Master Plan has been identified as a necessary action. This recommendation goes on to state that upstream municipalities should also implement complementary actions i.e.) programs to retrofit storm-water quantity control ponds and all municipalities need programs to ensure that storm-water management in new developments and redevelopments throughout the watersheds accomplish best results.

- **Pollution Prevention**: Key actions include the reduction in use of hazardous chemicals; the elimination of cross connections between the sanitary and storm water systems; prevention of toxic spills; improvement and enforcement of sewer by laws and storm-water policies; and the application of best management practices for municipal infrastructure. Partners include: City of Toronto; federal and provincial governments; TRCA; private sector; public; , NGO's; municipalities; industry; MOE; landowners; universities/colleges; Ontario Centre for Environmental Technology Advancement and Environment Canada.

- **Habitat Restoration:** This priority action area should focus on the restoration of waterfront and waterfront habitat through initiatives that support improved water quality and water flow patterns which will facilitate linkages between waterfront and upstream/lake wide habitat. At the watershed level the TRCA is preparing a comprehensive Natural Heritage Strategy which will be used as a tool for monitoring regional ecosystem health and restoration decisions. Partners include: TRCA; DFO, MNR; EC; municipalities; MMA; MNR; Ontario Streams and community groups.

- **Smart Growth:** The focus of RAP is on remedial action to restore degraded environments. With ongoing population growth could result in gains made in restoration efforts but new development also offers new opportunities for proactive approaches to environmental protection and management. This approach is reflected in the province's current Smart Growth strategy which promotes actions that support

sustainable urban development and expansion. Partners include: TRCA, municipalities, NGO's, EC, MOE, residents, WRT, Waterfront Revitalization Corporation.

- **Education and Monitoring:** Stakeholders should focus on priority action related to education and monitoring which includes the delivery of increased activities to engage citizens and businesses in lot-level water management; water conservation;

- Reduction and proper disposal of household and garden chemicals; and improved shoreline and habitat management. Partners include: all levels of government; watershed groups; WRT; NGO's and the TRCA (WRT, Clean Waters Clear Choices Report, 2001)

As reported at the November 2000, 3rd Annual Clean Waters Summit, stakeholders had identified a significant paradigm shift in approaches to urban water management since the inception of its work. Progressive positive change in approaches to urban water management could be described in the following manner:

Command and control by upper levels of government ------ local involvement in decision-making

Focus on chemical condition of water → inclusion of physical & biological dimensions

Impact mitigation → functional restoration

Focus on engineering solutions → recognition of the need to integrate non-structural solutions, for maximum effectiveness and to manage costs

End of pipe control → systems control

Simplistic flow control → comprehensive, watershed –based approaches that integrate water quantity, quality, public health, habitats, shoreline protection, recreation opportunities etc.

Why it can't be done → how can we do it?

(Clean Waters, Clear Choices. Toronto and Region Remedial Action Plan Bulletin. March 2001)

Over the past five years key RAP activities have included:

- the development of a watershed based framework for RAP coordination and public involvement

- the integration of RAP objectives into related initiatives such as City of Toronto Environmental Plan; Waterfront Part 2 Plan; Wet Weather Flow Management Master Plan and the York Region Environment Report Card
- the development of an integrated monitoring framework
- four Clean Water Summits
- the development of a comprehensive natural heritage strategy
- the completion of watershed strategies for the Don and Humber Rivers and Etobicoke and Mimico Creeks (Environment Canada, RAP Accomplishments)

THE CITY OF TORONTO'S RESPONSE TO RAP

At the City of Toronto all aspects of water production, transmission and distribution, wastewater collection and treatment, and storm water collection, transmission, treatment are the responsibility of Water and Wastewater Services which is found within the Department of Works and Emergency Services.[138] The City of Toronto manages the watersheds within its boundaries by implementing a range of pollution controls, one of which is the control of the impact of its sewer systems on the terrestrial and aquatic environments. Municipal councils are also empowered by provincial legislation to enact bylaws to control and/or prohibit industrial wastewater discharges into their sewer systems. This action may be taken if it does not conflict with any other existing applicable provincial legislation. The City of Toronto has exercised this right through the implementation of two important projects that have been developed in response to key recommendations provided for by the RAP, the experience of Conservation Ontario and the TRCA and recommendations coming out of the Walkerton Report. The case study project's are: the *Wet Weather Flow Management Master Plan* and the *City of Toronto's Water Efficiency Plan.*

Wet weather flow discharges from combined sewer overflows and storm sewers are largely responsible for the degraded water quality conditions in area surface waters in the Toronto Region. Wet weather flow is runoff that is generated when it rains or snow. In large cities such as Toronto, little water can be filtered into the ground (due to the high levels of concrete), and as a result storm-water runs off roads, parking lots and other paved areas,

[138] For full details on all services provided please visit the City of Toronto, Water Services web site at http://www.toronto.ca/water/index.htm.

emptying into streams rivers and Lake Ontario. Runoff is a major source of water pollution due to the fact that as it travels it 'picks up' oil, grease, metals, salt and pesticides. In older parts of the city the problem is further compounded by the fact that sewers carry both sanitary sewage and storm-water or combined sewer overflow (CSO). During rainstorms, the toxic content load of runoff is extremely high and this why there is a distinction made between 'wet' and 'dry' weather flows. The negative effects that storm-water runoff has on our water supply has resulted in RAP promoting better management of storm-water in the Toronto AoC (RAP Background).

The chemical makeup of wet weather flow is highly variable and generally at its highest during the first rains when the water washes the accumulated contaminants from roads, parking lots and rooftops, and greatest toxicity in storm-water and CSO is associated with winter road maintenance oils, metals and road salt dry weather flows contain high levels of some pollutants primarily from illegal sanitary cross connections and spills (Clean Waters, Clear Choices 2001) the Toronto Bay exceeds provincial water quality objectives for phosphorous, cooper and lead despite reductions in these pollutant (40, 50 and 75 % respectively) over the last two decades (Boyd et al, 2000 in Clean Waters, Clear Choices)

The City of Toronto covers 625 square km and has 2600 sewer outlets, of which 70 empty directly into Lake Ontario, and 10,000 km of underground sewer pipes, including storm sewers, combined sewer overflow (CSO) sanitary sewers and large trunks. Prior to amalgamation (1997), Metro Toronto and the former municipalities initiated a master planning process to deal with '***wet weather flow on a watershed basis'*** WWFMMP (WRT, Clean Waters, Clear Choices Bulletin 2001). The WWFMMP goal is "to reduce, and ultimately eliminate the adverse effects of the wet weather flow on the built and natural environment in a timely and sustainable manner, and to achieve a measurable improvement in ecosystem health of the watersheds" (WRT, Toronto and Region RAP Update, 2000). The WWFMMP is the result of three years of consultation and work on behalf of city residents, City staff and government agencies. The plan was developed on a watershed basis and provides an approach for the elimination of combined sewer overflows (CSOs) and the control of storm-water discharges in Toronto.

Only one of the six RAP watersheds in the city is wholly contained within city limits and as a result the development of the Wet Weather Master Plan included consultation with

upstream municipalities and agencies (TRCA) , who are responsible for storm-water management in the portion of watersheds outside city limits. The plan is consistent with the source protection approach advocated by both Conservation Ontario and the MOE.

The City of Toronto's Wet Weather Flow Management Master Plan (WWFMMP) provides a blueprint for remediation and management of storm-water and combined sewer overflows, which is a significant contribution to restoring beneficial uses for the Toronto RAP. The plan is based on a watershed approach and use's water modeling to evaluate alternative strategies to improve wet weather flows. The plan emphasizes natural systems, and gives priority to source control (dealing with rain and snow where it falls), followed "by end-of –pipe" treatment. Complementary activities to improve dry weather water quality include: the disconnection of illegal connections to sanitary sewers to the storm sewer system and the development of a storm-water policy.

The Master Plan addresses physical and water quality impacts from wet weather flows and contains thirteen objectives which are grouped into four categories:

- **water quality**
- **water quantity**
- **natural areas and wildlife**
- **sewer systems**

An implementation plan has been developed which identifies projects to be implemented over a 25 year timeframe (City of Toronto). The implementation Plan addresses the City of Toronto's overall *Environmental Plan* objectives for water quality and advances the improvement objectives of the Toronto and Region RAP. Implementation began in 2003 and is expected to span a period of 100 years. Achievable mid term targets have been incorporated into a 25 year plan, and carry an estimated cost of 40 $ million per year with an additional 1 $ billion needed total capital improvement and maintenance costs over 25 year period (City of Toronto Water and Wastewater Services Annual Report, 2002).

The WWFMMP process has been divided into a number of stages to help establish approaches, acceptance and a coherent work plan:

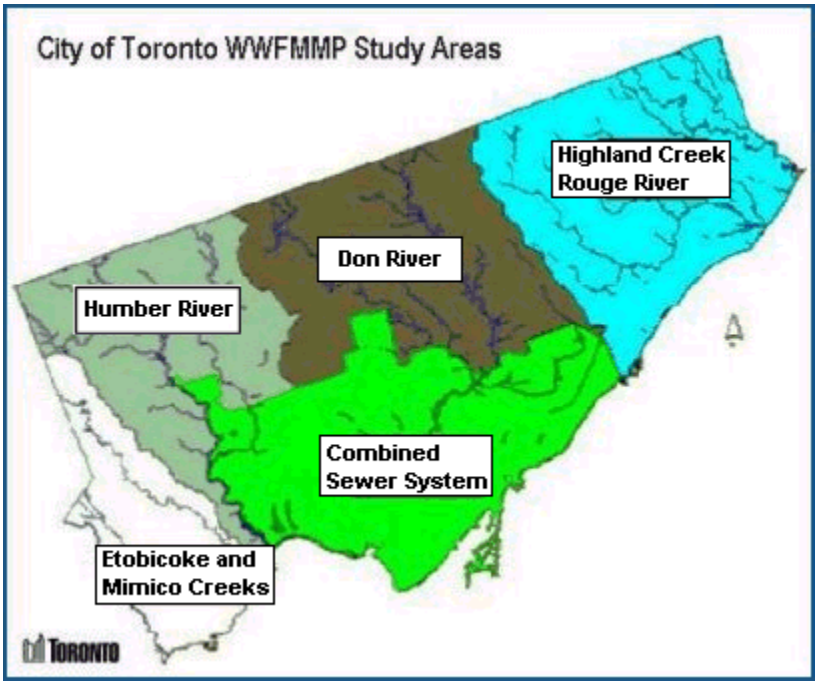
Stage One: Development of Approaches to Waste Water

- Treat rainwater as a resource
- The use of a hierarchical pollution prevention approach, considering solutions at source and at end – of pipe
- Avoid an overly technical approach to storm-water management, and understand the differences between Greenfield storm-water management and Toronto's situation as an urbanized centre which would more likely need to concentrate on retrofitting initiatives

Stage Two (which is currently underway as of 2000) includes:

- Stage Two consists of data collection and target setting whereby the Master Plan process will culminate with the development of a Wet Weather Flow Management Strategy for the City. It will include by-laws, policies, projects, programs, a monitoring plan, an implementation plan and funding mechanisms

The aim of Step 2 of the Master Plan is to develop a Wet Weather Flow Management Strategy for the City of Toronto. The city has been divided into five study areas (see map, below). Four of these generally conform to the boundaries of those portions of the major watersheds that lie within the City (Mimico and Etobicoke Creeks, the Humber River, the Don River, and the Rouge River and Highland Creek).



The fifth study area includes all the parts of Toronto in which there are still combined sewers. This includes much of the former municipalities of Toronto, York and East York and the southwestern part of Scarborough. Data is also being collected on the entire watersheds.[139]

Stage Three: Implementation

During a RAP Roundtable Discussion that took place in 2000, many participants expressed concern over three key themes related to storm-water management programming.

[139] For full details please visit the City of Toronto web site at http://www.toronto.ca/wes/techservices/involved/wws/wwfmmp/planning.htm

First, is the lack of leadership assumed by either the City of Toronto, upstream municipalities or the Province? It was determined that successful restoration of water quality required "big, bold steps" by leaders that were willing to effectively deal with the issue through promoting greater institutional integration and establishing clear policies and regulations. Second, is the need for more effective education and communications campaigns. Outreach activities need to provide clear, tangible demonstrations of storm-water management techniques that clearly indicate the results that people can expect. Third, is the need to establish 'incentive/disincentive' mechanisms in efforts to secure the commitment and participation in wet weather flow management programming. This approach may include financial incentive such as tax credits for source control improvements; subsidies for rain barrels and other lot level equipment; tax benefits for retrofits; financial disincentives such as a fee for the amount of paved surfaces on a property; a financial penalty for property owners that do not disconnect their downspouts or awards programs for best management practices (WRT, Toronto and Region RAP Update, 2000).

9.5 TORONTO'S 'WATER POLLUTION SOLUTION PROGRAM'

Toronto's Water Pollution Solution Program is a long-term plan to protect the environment and sustain healthy rivers, streams and other water bodies. It is about reducing the adverse effects of wet weather flow, which is runoff generated when it rains or snows. (Think of runoff as storm-water.)

The City of Toronto's Sewer Use By–Law: A Pollution Prevention P2 Approach

A P2 approach to addressing pollution improves water quality by reducing or eliminating the creation of pollutants or waste at the source. The City of Toronto is one of the first municipalities in Canada to incorporate pollution prevention planning requirements into the sewer by- law. On this lead it is expected that additional municipalities in the province will soon

implement P2 reporting as part of their efforts to reduce toxic effluent loadings to their treatment plants (Pinchin Environmental, 2001).

In July 2000, Toronto City Council passed a Sewer Use by – law which went through six formal drafts over a period of six years (WRT, Clean Waters and Clear Choices, July 2000). The final by – law contains limits for discharges and sets a high standard for environmental protection. Individual businesses in certain sectors will be required to report on their discharges, and if they are above set limits they will be required to report on how they are planning on reducing or eliminating unacceptable levels of waste. In comparison to the previous Sewer Use By–law the new By–law has a more comprehensive list of subject pollutants for sanitary and combined sewer discharges. Industries and business operating in the City of Toronto must meet the requirements of the new by–law 457 – 2000. Failure to comply with requirements of the by – law can lead to enforcement action including fines and charges (Pinchin Environmental, 2001).

CIELAP's submission to Toronto's new sewer by–law stated that "Toronto's proposed sewer use by–law is an important initiative with implications well beyond the City of Toronto". The by–law has been stronger than proposals advanced by the provincial Ministry of the Environment which have also indicated that it will not be finalizing any of its provincial working proposals on the development of comprehensive sewer by laws (CIELAP, April 2000).

***Managing Water Demand*: Developing a Water Efficiency Plan**

The idea of 'managing water demand' is a relatively new concept but becoming increasingly important. The City of Toronto has addressed this issue and has included 'managing water demand' in part of its water management planning process. The approach is outlined in the City's *Water Efficiency Plan (WEP)*. The Plan points to ways to reduce water use and identifies capital costs and water volume savings through a variety of mechanisms. On average, each Toronto resident use 253 liters of water per day and, with population of 2.6 million residents this amount is equivalent to flushing the toilet 77 million times a day (City of Toronto, 2002). Specific 'Plan' initiatives will address cost effective methods in supplying a growing demand for water in an attempt to control infrastructure expansion. To avoid infrastructure expansion of the water supply system, the City will attempt to reduce its peak day demands for water and therefore must reduce its wastewater flows. For these reasons the Water Efficiency plan will

address measures that reduce peak day demands, wastewater flows or both (City of Toronto, Water Efficiency Plan). Specific programs addressing the issue of water efficiency include: the Toilet Replacement Program and the Residential Washer Cash Incentive Program. The Toilet Replacement Program provides a service for Toronto residents to replace older model toilet's with new water efficient models. The City of Toronto is offering residents living in detached houses, semis, duplexes (including buildings with up to six units), individual condo units, and townhouses a $60 or $75 cash incentive to replace a high water use toilet with a City-selected water efficient model. Toronto's Wash 'n' Save is similar in that the program offers qualified participants a $60 cash back for the purchase of City-selected, high-efficiency clothes washers.[140] water volume savings through a variety of mechanisms. On average, each Toronto resident use 253 liters of water per day and, with population of 2.6 million residents this amount is equivalent to flushing the toilet 77 million times a day (City of Toronto, 2002). Specific 'Plan' initiatives will address cost effective methods in supplying a growing demand for water in an attempt to control infrastructure expansion. To avoid infrastructure expansion of the water supply system, the City will attempt to reduce its peak day demands for water and therefore must reduce its wastewater flows. For these reasons the Water Efficiency plan will address measures that reduce peak day demands, wastewater flows or both (City of Toronto, Water Efficiency Plan).

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[140] For further information on these programs please visit http://www.toronto.ca/watereff/flush/index.htm.
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10. AVENUES FOR CITIZEN INVOLVEMENT

10.1 ENVIRONMENTAL BILL OF RIGHTS

In Ontario, the Environmental Bill of Rights (EBR) is the most comprehensive resource for citizens and non-governmental organizations. The EBR was established in 1993, it establishes a minimum set of rights to the citizenry in regards to environmental protection. The EBR (and the Environmental Registry [ER or Registry]), includes information about proposed legislation, a forum for public input into the policy development process. In summary the EBR and Registry provide for public participation, government accountability, have established an independent government watchdog through the Environmental Commissioner's Office, provides avenues for the public to request an investigation or review of proposed environmental law violations, as well as improving access to the courts and ensuring employer reprisals.

HISTORY

The EBR represents a consistent, minimum set of rights and powers that must be accorded all members of the public if they, collectively or as individuals, are to contribute to government efforts to protect the environment.[142] To ensure that such public rights are respected, the Act also prescribes the minimum rules government ministries must follow in actions, including the implementation of the legislation under their control that may have a significant impact on the environment.

In the early 1970's, a growing number of concerned environmental groups had recognized the need for a comprehensive code of individual rights to complement and support the province's environmental laws. In 1990, the government launched public consultations on the need for and the possible contents of an Environmental Bill of Rights. Following these preliminary discussions, a multi-stakeholder committee, the Environmental Bill of Rights Task

[142] The following information regarding the EBR is taken directly from the Government of Ontario's web page: Ontario (2002). General Information on the Environmental Bill of Rights and Environmental Registry. Toronto. **2004**. http://www.ene.gov.on.ca/envision/env_reg/ebr/english/ebr_info/introduction.htm (downloaded June 12, 2004)

Force, was struck in September of 1991 to assist in the development and drafting of a proposed bill. The Task Force released its draft report for public review and comment in July of 1992.

"An Act respecting environmental rights in Ontario" , 1993 (or the Environmental Bill of Rights (EBR) as it has come to be known) was given first reading on May 31, 1993, and its third and final reading on December 14,1993. It was proclaimed into law by the Minister of Environment and Energy, the Honorable C.J. (Bud) Wildman, on February 15, 1994.

PURPOSE

The purpose of the EBR as described in Section 2 of the legislation, the means to:

- Protect, conserve and, where reasonable, restore the integrity of the environment;
- Provide for the sustainability of the environment;
- Protect the right to a healthful environment.

The legislation has been designed to:

- Prevent, reduce and eliminate the use, generation and release of pollutants that are an unreasonable threat to the integrity of the environment;
- Protect and conserve biological, ecological and genetic diversity;
- Protect, conserve and encourage the wise management of our natural resources, including plant life, animal life and ecological systems;
- Identify, protect and conserve ecologically sensitive areas or processes

The goals of the EBR establish the framework for the legislation. It is important that they are clearly and accurately described because the represent the intention of the law. Each ministry subject to the EBR has to create Statements of Environmental Values (SEV) and explain how the EBR will be considered in any decision it makes that might significantly affect the environment. The purpose statements also assist in the implementation of the Act. Courts also look at the purpose statements of a piece of legislation when deciding how to interpret its provisions.

In order to fulfill its goals the EBR provides:

- The means by which residents may participate in the making of environmentally significant decisions by the Government of Ontario;
- Increased accountability of the Government for its environmental decision-making;
- Increased access to the courts by residents for the protection of the environment;
- Enhanced protection for employees who take action in respect of environmental harm.

STRUCTURE

Government of Ontario retains primary responsibility for environmental protection, however the EBR provides residents with formal rights to play a more effective role. As previously mentioned, it does so by providing for public participation, improving government accountability, establishment of the Environmental Commissioner, providing a process for requesting an investigation, improving public access to the Courts, and providing protection to employees who report unlawful environmental practices by their employer. The EBR subjects certain Ministries and Policies/Acts to the Environmental Rights outlined in the EBR[143]. The government agency that provides information to the public and works with the Ministries subject to the EBR is the Environmental Commissioner's Office (ECO).

ENVIRONMENTAL COMMISSIONER

The Environmental Commissioner is an officer of the Ontario Legislative Assembly and reports to the Legislature. The roles of the Environmental Commission are broad and expansive. The Commissioner reviews applications for review and investigation and directs them to the appropriate ministries.

Contact the Environmental Commissioner in order to:

- ask questions on how to use the provisions of the EBR:
- get copies of the forms needed to apply for a review or investigation, or use your other EBR rights;
- forward your applications for a review or investigation;
- provide suggestions on how to improve the operation of the EBR;
- provide your views on how any particular part of the EBR is working, whether ministries are complying with their requirements under the EBR, or
- any other matter related to the EBR

http://www.eco.on.ca/

1. The operation of the ***whistle blower*** provisions of Act.

2. The Commissioner serves as an ***auditor*** by reviewing:
   - The implementation of the EBR and compliance by ministries with its requirements;
   - The use of the Environmental Registry;
   - The exercise of discretion by ministers under the Act;
   - Recourse to appeal decisions on Class I and II instruments;
   - The receipt, handling and disposition of applications for review or investigation;
   - Ministry plans and priorities for conducting reviews of policies, regulations and instruments;
   - The use of the, right of action, its defenses and the public nuisance provisions of the Act

[143] For detailed information about what Ministries, and their subsequent Acts and Policies that are subject to the EBR refer to Appendix 8.

3. The Commissioner serves as an ***educator*** by:

- Assisting ministries to develop their Statement of Environmental Values and use them in decision making (upon request);
- Assisting ministries with education programs (upon request);
- Providing educational programs about the Act to the public;

4. Providing ***advice and assistance*** to members of the ***public*** who wish to participate in decision-making processes facilitated under the Act.

5. The Commissioner keeps the ***government accountable*** by:

- Submitting to the Legislature every year a report describing the work undertaken by the Commissioner (these reports are available on the Environmental Commissioner's website);
- Reporting to the Legislature at any time on any manner that cannot wait until the annual report is submitted.

The Environmental Commissioner of Ontario (ECO) has an expansive resource center online as well as at their office in downtown Toronto. The web page includes information about the EBR and ECO, as well as Ontario (with priority environmental sites), links to the environmental Registry, Publications & Forms, News Releases, as well as a host of other resources. The office also provides a number of services, including: access to the Environmental Registry, Environmental media clippings, limited photocopying, research assistance, referrals to other agencies, and specialized bibliographies. The Resource Centre is open to the public Monday to Friday, 9:30-5. It is highly recommended that you call ahead to ensure the librarian will be available.

RIGHTS OUTLINED IN THE EBR

The EBR provides the public with a number of formal opportunities to become involved in the governmental decision-making process, and a right to participate in and contribute to decisions that will have a significant effect on the environment. These rights can be described in terms of: the public's right to a healthful environment; increased public participation in decision-making by government; improved public access to the courts; increased government accountability for its environmental decisions; and protection from reprisal for reporting environmental situations in the workplace. The EBR recognizes that Ontario residents must have the tools necessary to protect their right to a healthful environment. To further this end, the EBR outlines a number of important legal rights and opportunities. It prescribes in law,

a clear, uniform and publicly accessible system of decision-making that provides both an opportunity for better decisions and a promise of greater government accountability. Finally, it establishes an Environmental Registry as a tool for public notification and interaction.

ENVIRONMENTAL REGISTRY

The EBR states that the provincial government must give notice of all proposed polices, Acts, regulations, and instrument that are deemed to be environmentally significant. The primary mechanism for notification is the publicly accessible Environmental Registry.[144] The Environmental Registry was created in 1994 as a Bulletin Board System to provide residents of Ontario access to environmentally significant decisions the Government of Ontario was contemplating. Whenever a proposal is subject to the public participation requirements of the EBR it is posted on the Registry for a minimum of 30, longer pending on how environmentally significant the proposal may be.[145] To ensure that the Registry is consistent, standardized information is made available in a timely manner. The Registry provides:

- general information on the EBR and its regulations
- Statements of Environmental Values for prescribed ministries
- notice of proposals and decisions on environmentally significant Acts, policies, regulations and instruments
- appeals and their decisions on instruments
- relevant court actions, lawsuits and their decisions
- EBR contacts in each prescribed ministry
- links to related Acts and Regulations
- links to related websites
- For each proposal, the following minimum information must be placed on the Registry by the originating ministry
- brief summary of proposal (full text not required)
- ways the public can participate in the decision
- the timing for public participation
- where and when the public can view written information on the proposal or a hype link to the information
- an address where comments on the proposal can be submitted

[144] To access the Environmental Registry refer to: http://www.ene.gov.on.ca/envision/env_reg/ebr/english/

[145] The EBR established a procedure for determining the time length that proposal will be open to public comments, factors effecting the time can include the complexity of matters involved, the level of public interest, the period of time the public may require to make an informed comment, and any other factors the Minister may consider important.

The Registry not only ensures the right to notify the public of proposed legislation that will have an effect on the environment, but it also provides for public involvement in the policy development process, by ensuring the right to comment. During the notice period of proposed legislation, the public has a right to submit comments on any proposal and the Minister in charge has an obligation to consider all the comments received and communicate how those comments affected their decision. The EBR creates three duties for governments to respond to proposal suggestions: Members of the public not only have the right to comment, but also the right to have their comments considered. A minister must take every reasonable step to ensure that all the comments relevant to the proposal, received through the public participation process, are duly considered. A minister must give notice of a decision as soon as reasonably possible after it has been made. The notice of decision is to be placed on the Environmental Registry, as well as any other information deemed appropriate by the minister. The notice of decision must include a brief explanation of the effect, if any, public participation had on the decision.

OTHER RIGHTS

As previously mentioned, one of the rights established under the EBR is the right for a requesting an investigation proposed violations of provincial environmental law. Any two persons who are residents in Ontario can apply for an investigation if they believe that an Act, regulation or instrument subject to the EBR has been contravened.[146] The two applicants must fill out the application and then submit it to the Commissioner. Within 10 days of receiving the application the Environmental Commissioner must refer it to the mister responsible for the administration of the statue, after which receipt of the application will be acknowledged by the Environmental Commissioner. The minister must investigate all matters to the extent considered necessary. However, the minister does not have to investigate if: the application is frivolous or vexatious, the alleged contravention is not serious enough to warrant an investigation, the alleged contravention is not likely to harm the environment or there is already an ongoing investigation or completed investigation. If the minister decides not to investigate, notice of the decision, with a brief statement of the reasons, must be given to the applicants, any person alleged in the application to have been involved and the Environmental Commissioner.

[146] A copy of the Application for Review is available through the Office of the Environmental Commissioner or via a link at http://www.ene.gov.on.ca/envision/env_reg/ebr/english/ebr_info/Requesting_a_investigation.htm.

The EBR also improves access to the courts. First, the EBR provides a right to request an investigation which, if warranted, may result in the ministry conducting the investigation and bringing forward a court action on your behalf. This makes government more responsive to citizens concerns. Second, the EBR creates a new right to sue. Under the Act, the public has access to the court where a public resource has been harmed or imminently could be harmed by someone who is not acting within the environmental laws and when the government has not taken action. Third, the EBR removes the public nuisance barrier to court access. No longer will those who suffer harm be denied access to the courts simply because their injury is similar to that borne by others.

Finally, the EBR provides the right to protection from employer reprisals. The EBR enhances worker protection from reprisal by expanding existing "whistle blower" protection to a larger number of workers and to all statutes designated under the Act. The EBR also provides protection for employees who may be harassed or disciplined as a result of their participation in activities under the EBR.

10.2 NATIONAL POLLUTANT RELEASE INVENTORY

A tremendous information resource for citizens and NGO's in Canada is the National Pollutant Release Inventory. In Canada, the National Pollutant Release Inventory (NPRI) is the only legislated, nation-wide, publicly accessible pollutant inventory. There were 268 substances listed in the NPRI for the 2000 reporting year; 55 substances are designated toxic by the Canadian Environmental Protection Act. The National Pollutant Release Inventory has been published annually since the program's inception in 1992.[147]

WHAT IS THE NPRI?

The National Pollutant Release Inventory (NPRI) provides Canadians with access to information on the releases and transfers of key pollutants in their communities. The NPRI is a major starting point for identifying and monitoring sources of pollution in Canada. It is an important consideration in managing risks to the environment and human health as well as in

[147] To view the National Pollutant Release Inventory web site go to: www.ec.gc.ca/pdb/npri

monitoring indicators for the quality of our air, land, and water. It is also emerging as an indicator for corporate environmental performance.

Established in 1992 and legislated under the Canadian Environmental Protection Act, 1999 (CEPA 1999), the NPRI program is delivered by Environment Canada (EC) and requires companies to report information on releases and transfers of pollutants to EC on an annual basis. Environment Canada makes the information available to Canadians in an annual public report, and maintains a detailed inventory that can be accessed and searched through an on-line database.

Public access to the NPRI motivates industry to prevent and reduce pollutant releases. It helps the Government of Canada track progress in pollution prevention, evaluate releases and transfers of substances of concern, identify and take action on environmental priorities, and implement policy initiatives and risk management measures.

Only facilities that meet established reporting criteria are required to report to the NPRI. Pollutants from mobile sources such as trucks and cars, households, facilities that release pollutants on a smaller scale and certain sector activities, such as agriculture and education and some mining activities, are not included in the NPRI but are reported under a separate program.

ON-LINE DATA SEARCH

There are three basic search facilities accessible from the website.[148] The first is a substance search, which allows the user to search based on a particular substance covered by the NPRI[149], facility, year type of industries and location. Secondly, is a geographical search where the user can sort by city, province, NPRI number, Facility name, releases, and disposals & recycling locations. Finally, the third search is via particular industries, this search allows for on-site releases, disposals (off-site and on-site) and off-site recycling. There is also information on the particular Facilities, such as contact information, parent companies, geographical coordinates, standards and industrial classification, any pollution-prevention plans undertaken,

[148] The following information is from exploring the various links accessible from the NPRI homepage: www.ec.gc.ca/pdb/npri.
[149] For a complete list of substances covered under the NPRI refer to Appendix

other environmental programs, as well as comments and historical substance reports. The NPRI also has an interactive on-line mapping tool, however the user will need to into install a program called the AutoDesk Map Guide, but the webpage provides a direct link to download the program. The NPRI web page also provides a variety of links such as links and background information on other domestic and international programs, substance-specific content for Mercury, Dioxins & Furans, Hexachlorobenzene, and Polycyclic Aromatic Hydrocarbons. The NPRI web page includes helpful links to a variety of environmental and health organizations such as:

- Priority Substance Assessment Program: A program where Health Canada assess the risks to human, environment and non-human organisms' health from environmental exposure to various substances,
- Agency for Toxic Substances and Disease Registry (ATSDR): An agency of the US Department of Health and Human Service that serves the public by using the best science, taking responsive public health actions and providing trusted health information to prevent harmful exposures and diseases related to toxic substances.
- Toxicological Profile Information Sheet: ATSDR produces "toxicological profiles" for hazardous substances. Profiles are developed from a priority list of 275 substances
- Environmental Defense Scorecard: Scorecard provides detailed information on more the 6,900 chemicals, including all the chemicals used in large amounts in the states.
- Integrated Risk Information System (IRIS): IRIS is an electronic database containing information on human health effects that may result from exposure to various chemicals in the environment.

PROPOSED CHANGES TO THE NPRI PROGRAM

In an attempt to increase greater harmonization with the NPRI and Ontario's Airborne Contaminant Discharge monitoring and reporting program, the NPRI Multi-Stakeholder Work Group was established.[150] As a result of the working group and the report that was produced, a number of changes were made to the NPRI. This included reporting of additional substances such as thallium, PCBs, and a modified list of dioxins, furans and hexachlorobenzene (HCB).[151]

[150] For information on the differences between the NPRI and Ontario's Regulation 127 see: "A Comprehensive Review of the Differences between the NPRI and O. Reg 127/01": http://www.ec.gc.ca/pdb/npri/ResponseECandMOE/EXECUTIVESUMMARY_e.cfm and "Response Statement to the Report": http://www.ec.gc.ca/pdb/npri/ResponseECandMOE/ResponseStatementApril17-03_e.cfm

[151] For specific requirements refer to:
Thallium: http://www.ec.gc.ca/pdb/npri/documents/Thallium2003_e.pdf
PCBs: http://www.ec.gc.ca/pdb/npri/documents/PCB_e.pdf
Dioxins, Furans & HCBs: http://www.ec.gc.ca/pdb/npri/documents/Dioxins_furans_HCB2003_e.pdf

Dioxins and furans are reported together, and include the 17 most toxic dioxins and furans. On June 6, 2002, the Metal Mining Effluent Regulations (MMER) was registered under the Fisheries Act. The MMER applies to all Canadian metal mines with an effluent flow rate in excess of 50 cubic meters per day that were in commercial operation, under development or reopened after the day the Regulations were registered.[152] The MMER requires metal mines to report on the present of a number of substances in the mine effluent. There are a number of proposed changes currently under examination in relation to mining and their reporting standards, the full examination of this topic is too vast for this report, for further information on this topic please refer to NPRI web page and the subsequent links to mining.

10. 3 NAFTA and the NAAEC

The North American Agreement on Environmental Cooperation (NAAEC) is one of two side agreements to NAFTA (North American Free Trade Agreement), between Canada, Mexico and the United States. The NAAEC was developed to support the environmental provisions of NAFTA by establishing a level playing field with a view to avoid trade distortions and promoting environmental cooperation.

Key objectives of the NAAEC are to promote sustainable development, encourage pollution prevention policies and practices and enhancing compliance with environmental laws and regulations. The NAAEC also promotes transparency and public participation in the development and improvement of environmental laws and policies.

The NAAEC requires that each Party ensure its laws provide for high levels of environmental protection without lowering standards to attract investment. Each Party agrees to effectively enforce its environmental laws through the use of inspectors, monitoring compliance and pursuing the necessary legal means to seek appropriate remedies for violations. Each Party must also provide a report on the state of its environment, develop environmental emergency preparedness measures, promote environmental education, research and

[152] For a review of the mining exemptions: http://www.ec.gc.ca/pdb/npri/documents/Mining2003_e.pdf

development, assess environmental impacts and promote the use of economic instruments. Parties may also appoint National Advisory Committees composed of private sector representatives to assist in implementing the Agreement domestically.

COMMISSION FOR ENVIRONMENTAL COOPERATION

The NAAEC established the Commission for Environmental Cooperation (CEC) to oversee implementation of the agreement and monitor the abilities of the Parties to meet the obligations. The CEC is a forum for cooperation to achieve a wide range of objectives identified in the NAAEC and discuss environmental issues of a mutual concern. The CEC also has a quasi-judicial role in ***reviewing submissions from the public on enforcement matters*** and in supporting an arbitral panel process to resolve disputes between the Parties on specific trade-related issues associated with failure to effectively enforce environmental laws and regulations.

The CEC consists of a Council of Ministers, a Secretariat headed by an Executive Director and a Joint Public Advisory Committee (JPAC). The Council is comprised of Environment Ministers from each of the parties and is the governing body of the CEC. The Council oversees and develops recommendations on the implementation and elaboration of the NAAEC. It is responsible for directing the Secretariat, conducting cooperative work program and developing recommendations to address key environmental issues and addressing any questions that may arise between the Parties regarding the application of the NAAEC.

The Secretariat, which is headed by an Executive Director, is comprised of a professional staff drawn equitable from each of the three countries. The CEC Secretariat is located in Montreal, Quebec. The Secretariat provides technical, administrative and operational support to the Council and to any committees and groups established by the Council. The Secretariat is also responsible for management of the submissions on enforcement matters process. Any person or non-governmental organization may make submissions to the Secretariat asserting a Party's failure to effectively enforce its environmental laws. Consideration of such submissions may result in a decision by the Council to direct the Secretariat to develop a factual record.

The **Joint Public Advisory Committee (JPAC) is** comprised of 15 citizens, 5 from each country, representing a broad range of interests. The JPAC creates the bridge for public participation in the activities of the CEC through public sessions held in each of the countries. The JPAC also provides advice to the Council on any matter within the scope of the NAAEC including the Coca's annual program and budget. In addition, it may provide relevant technical, scientific and other information to the Secretariat. The JPAC meets during the regular session of Council as well as three additional times annually.

ENVRIONMENTAL RIGHTS UNDER THE NAAEC

The NAAEC establishes a legal framework for outlining a protocol that national governments are to follow for making information on the state of the environment and guaranteeing enforcement of national environmental law, thus ensuring a minimal level of environmental rights for the citizens of North America.[153] Article 2 outlines Parties general commitments as:

> Article 2.1 a) "States are obligated to prepare and make publicly available reports on the state of the environment".
>
> Article 2-3: "Each Party **SHALL CONSIDER** prohibiting the export to the territories of the other Parties of a pesticide or toxic substance whose use is prohibited within the Party's territory. When a Party adopts a measure prohibiting or severely restricting the use of a pesticide or toxic substance in its territory, it shall notify the other Parties of the measure, either directly or through an international organization."

Article 3 continues to note that environmental protection should retain priority and that countries should continue to progress in this area:

> "Each Party SHALL ensures that its laws and regulations provide for high levels of environmental protection and shall strive to continue to improve those laws and regulations."

Article 4, if fully adopted by national governments, would provide the greatest establishment of environmental rights. Article 4-2 states that each Party shall:

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[153] The following information regarding the NAAEC is taken directly from the Agreement: (1993). North American Agreement on Environmental Cooperation. http://www.cec.org/pubs_info_resources/law_treat_agree/naaec/index.cfm?varlan=english (downloaded July 12, 2004).

> "4-2a) publish in advance any such measure that it proposes to adopt
> 4-2b) provide interested persons and Parties a reasonable opportunity to comment on such proposed measures."

The implication of this would be something akin to Ontario's Environmental Bill of Rights, where proposed legislation is put forward in a public forum, with a minimum amount of time and established guidelines for submitting comments on the proposed legislation. Unfortunately, at the current moment in time none of the Parties have such a forum established at the federal level. Articles 5, 6, and 7 outline similar rights that the EBR has in accordance with access to courts such as: government enforcement actions, private access to remedies (if environmental laws and regulations are violated), and procedural guarantees. These Articles were included with the "aim of achieving high levels of environmental protection and compliance with its (National) environmental laws and regulations".[154]

ARTICLE 14 & 15

Article 14 and 15 – Citizens Submissions on Enforcement Matters - provide the public with the greatest avenue for participation in the enforcement of national environmental laws. In order to improve accountability and ensure that national governments are enforcing national environmental the procedures under these two Articles allow individual or non-governmental organizations to make submissions to the CEC on alleged environmental law violations. Any non-governmental organization or person established or residing in the territory of a Party to the Agreement may make a submission. The NAAEC Council adopted revisions to the process during 1999 Annual Session. Bringing the Facts to Light clearly and concisely outlines the procedures for making a submission as follows[155]:

1. File submission with the Secretariat
2. If not acceptable revise & resubmit, if Secretariat acknowledges the submission
3. Requests response from the Party
4. Response from the Party & Secretariat decides whether developing a factual record is warranted
5. Notification to Council
6. Decision by Council on whether a factual record is warranted

[154] Article 5-1 NAAEC (1993)
http://www.cec.org/pubs_info_resources/law_treat_agree/naaec/index.cfm?varlan=english
[155] CEC (2000). Bringing the Facts to Light: A Guide to Article 14 and 15 of the North American Agreement on Environmental Cooperation. Montreal, Quebec, Commission for Environmental Cooperation**:** pgs 76.

7. Secretariat Prepares draft factual record, which it submits to the Council
8. Parties comment on Factual Record
9. Secretariat prepares draft factual record, which it submits to the Council
10. Two-thirds vote by the Council on making the final factual record publicly available
11. If yes, publication of the final factual record

The Secretariat has a registry to provide information so any organization, person or JPAC can follow status of any given submission. The Secretariat also maintains a file on each submission, with all documents available electronically on their web site.

OTHER RESOURCES

In 1995, the CEC created the North American Fund for Environmental Cooperation (NAFEC), to sponsor community-based projects in Canada, Mexico and the United States that promote the goals and objective of the CEC.[156] The NAFEC supports projects that:

- Are community-based (involve a clearly defined community of stakeholders who participate in the design and implementation of the project
- Respond to a specific issue of problem and lead to concrete results
- Reflect cooperative and equitable partnerships between or among organizations different sectors and/or countries within North America
- Meet the objectives of the CEC (by complementing the current CEC program)
- Strengthen and build the capacities of local people, organizations and institutions
- Emphasize sustainability: link environmental, social and economic issues; and
- Leverage additional support, but are unlikely to obtain full funding from other sources

For more information on how to apply and how proposals are evaluated please refer to the NAFEC webpage.

In addition to the providing a legal framework for citizens to ensure that their national governments are enforcing their domestic environmental law, and funding for community-based

[156]CEC (2004). Grants for Environmental Cooperation. Montreal. **2004**: http://www.cec.org/grants/about/index.cfm?varlan=english (downloaded July 12, 2004)

projects, the CEC web page can act as a resource center for those concerned about the environment. It contains:

- A database on Transboundary Agreement
- Summary of Environmental Law in North America, which is searchable by country. Some of the issues covered include:
    a) Introduction to the Legal System (including a hierarchy of domestic law, per country)
    b) Institutional Framework for Environmental Protection
    c) Constitutional Provisions
    d) General Environmental law & Policies
    e) Environmental Information
    f) Public Participation
    g) Environmental Impact Assessment
    h) Protection and Management of Water Resources
    i) Protection of the Oceans and Coastal Areas
    j) Chemical Substances and Products
    k) Private Land Use Planning and Management
    l) Environmental Management of Public Lands

10.4 COMMUNITY INVOLVEMENT IN THE TORONTO AND REGION: REMEDIAL ACTION PLAN (R AP) PROCESS

A Public Advisory Committee (PAC) was established early in the RAP process. Its role is to provide support and advice to the RAP Team and Technical Committee. It serves important functions in terms of defining problems and developing recommendations for restoration. RAP public participation also takes place through the RAP Annual Summit and some through the organization efforts of former PAC members who meet as a group and act as an independent 'watchdog' in the implementation of RAP activities (WRT, Clean Waters, Clear Choices, 1998). By 1995, when a number of local watershed groups had been established, it had become clear that mobilization of citizens was on a watershed and sub-watershed scale and not at the AoC level. This very important fact was acknowledged in the RAP MoU whereby participation and citizen involvement was officially recognized as occurring through watershed groups. The 1991 RAP Report 'Strategies for Restoring Our Waters' , identified four river based citizen groups: the Black Creek Project; Save the Rouge Valley System; the Task Force to Bring Back the Don and Action to Restore a Clean Humber. As of 2001, there are at least 28 groups participating in a range of activities, including habitat restoration, lobbying, public education, and publicity events such as the Toronto Bay Initiative's annual big summer splash, the Paddle down the Don

and Children's' Water Festivals, to name just a few (WRT, Clean Waters, Healthy Habitats, 2001).

Currently TRCA provides the focal point for RAP coordinating activities and public consultation with the following responsibilities: raising public awareness; facilitating forums for exchange and reporting on progress; coordination of RAP communications; focus on RAP implementation activities on an individual watershed basis; provision of technical expertise and organization of cleanup activities (Environment Canada, RAP Implementation). The RAP initiative is found within TRCA's 'Protecting our Water' programming area.[157] Listed below are participants that contribute to the RAP program:

- Environment Canada
- Fisheries and Oceans Canada
- Great Lakes Sustainability Fund
- Ontario Ministry of Natural Resources
- Ontario Ministry of the Environment
- Ontario Ministry of Agriculture and Rural Affairs
- Municipalities of Toronto, Ajax, Pickering, Markham, Richmond Hill, Vaughan, King, Caledon, Peel and Brampton.
- Toronto Bay Initiative
- Toronto Harbour Commission
- Waterfront Regeneration Trust
- Don Regeneration Council
- The Humber Alliance
- The Rouge Park Alliance
- Duffins and Carruthers Task Force
- Etobicoke and Mimico Watershed Council
- Ryerson University
- University of Toronto
- York University
- Seneca College (Environment Canada)

The Toronto and Region RAP process is implemented by multi-stakeholder groups in most of the watersheds. Although each watershed group is at a different stage in its work, a review of their most recent publications gives a clear sense of the priority actions in each watershed, and the common themes among them.

[157] http://www.trca.on.ca/water_protection/remedial/#partners.

Municipalities, TRCA and a number of NGOs undertake a variety of initiatives intended to raise awareness of storm water quantity/quality, habitat and wildlife issues and to encourage behavior change towards water conservation, lot level management, pollution prevention and habitat stewardship. Nevertheless, the general public still has a minimal understanding of these issues, limited knowledge about ways they can reduce their personal contributions to the problems, and little motivation to change their behaviors. There is also an important relationship between individual and government actions. Waterfront residents are more willing to take individual action if they can see leadership from their governments. And they are more willing to support government programs if they understand the role of improved environmental conditions in encouraging economic vitality and providing a high quality of life. As a result public education and awareness has been identified as a key 'project' that must be included in RAP public outreach activities (WRT, Clean Waters, Healthy Habitats, 2001 pp 39).

Milestone watershed publications.

	Etobicoke/ Mimico	Humber	Don	Highland	Rouge
Draft Fish Management Plan	1998	1998	1997	1998	1992
State of the Watershed Report	1998	1994	1992	1999	—
Watershed Strategy	2001	1997	1994	Strategic direction is provided in the State of the Watershed Report	Rouge Park Management Plan 1994 and Rouge North Management Plan 2001
Report Card 1	—	2000	—	—	—
Report Card 2	—	—	2000	—	—

(WRT, Clean Waters, Healthy Habitats, 2001)

10.5 TORONTO AND REGION CONSERVATION AUTHORITY

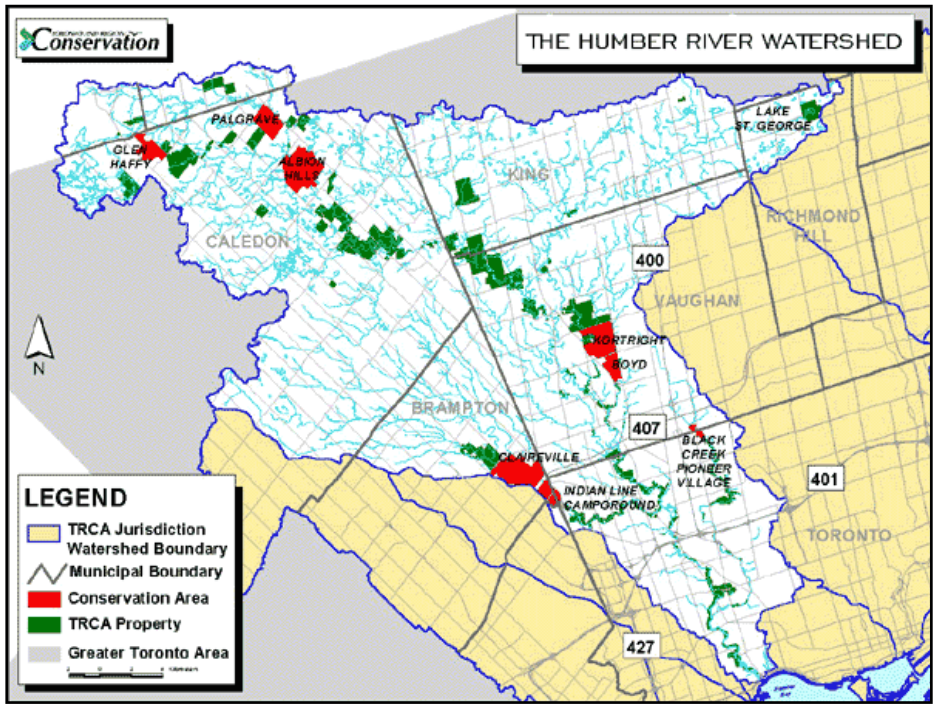
"Toronto and Region Conservation Authority acts as a catalyst for positive change, providing technical expertise and working with volunteer groups to improve the health of watersheds. We also consult with community members about their expectations for the watershed. In its advocate role for watersheds, Toronto and Region Conservation works with municipalities to ensure that our watershed ecosystems become as important in community planning as the road, sewer, and water supply systems" (TRCA)

A number of 'watershed councils' councils have been established by the TRCA to assist in the development and implementation of local watershed strategies. These groups possess no legal or statutory powers and function as advisory bodies to the TRCA and as liaison to their respective watershed communities. They are defined by watersheds and not political boundaries therefore advocate for ecosystem based actions and policies at the watershed level. The three watershed case studies (Humber Watershed, Duffins and Carruthers Creek and Highland Creek) will provide some insight as to how citizen's groups organize at the community level and are involved in watershed management and how the TRCA as an institution is actively engaging Toronto Area citizens through education and outreach activities. Case studies have been selectively chosen to illustrate the ecological, social and environmental differences that exist within the Toronto region.

Case Study One: Humber Watershed

Humber Watershed Profile

The Humber Watershed has its headwaters in the Niagara Escarpment and the hills of the Oak Ridges Moraine and is comprised of five sub–watersheds. The Humber River itself flows through the most densely populated



areas of Canada (TRCA). Forty six percent of the Humber's land area is used for agricultural purposes and the history of poor agricultural practices on its lands has had negative impacts related to the quality and quantity of its ground and surface waters. Since the Humber area was settled, it has lost 80% of its wetlands, and more than 80% of its forest cover and the current state of its health is severely threatened by the loss of its natural areas.

Community Involvement and Accomplishments: Humber Watershed Alliance

In 1994 the TRCA established the Humber Watershed Taskforce which was compromised of citizens; elected officials; agency and special interest group representatives. The Taskforce produced an action strategy known as the 'Legacy and Call to Action'. The Humber Watershed Management Strategy "Legacy, A Strategy for a Healthy Humber", published in the spring of 1997, included 30 objectives for the management of the watershed, one of which was the creation of a Humber Watershed Alliance to facilitate the implementation of the 'Legacy'. The Alliance was established by the TRCA by the end of 1997 and its membership of 73 people includes residents; interest groups; business associations; elected representatives from the local and regional municipalities in the watershed; agency staff and the Chair of the TRCA (TRCA). The Watershed Alliance was formed on the basis of one of the fundamental principle supporting the work of the TRCA which is related to that of community empowerment. Under the TRCA's approach the watershed community itself, becomes the driving force in protecting the watershed (TRCA). Major accomplishments of the Alliance first established in 1997 include:

- the release of the first Humber Report Card
- Designation of the Humber as a Canadian Heritage River in 1999 due to its large human heritage characteristics and recreational value. The river encompasses 269 archeological sites and 799 listed or designated historical buildings, cemeteries and mill sites.
- The facilitation of more than 20 community events to celebrate stewardship and provide an environmental education forum
- Development of a Humber Discovery Walk

In 2000 the Humber Watershed Alliance produced a "Report Card on the Health of the Humber River Watershed". The report card assessed the health of the watershed using 28 indicators. Indicators are grouped into four categories which aim to adapt a holistic approach to watershed management. The categories are: environment; society; economy and 'getting it done'.

While the health of the Humber Watershed varies considerably depending on the location being evaluated and the indicator being used, in 2000 the Humber Watershed was given an overall score of 'C' which is defined as a "fair grade". There was a wide range of grades and at the two extremes the watershed was rated "A" for outdoor education and "F" for storm-water management. The report card set targets for 5, 15, and 20 years from now and has proposed a range of methods for reaching their goals (TRCA). Upon release of the 2003 Humber Watershed Progress Report, the Watershed Alliance identified major progress towards targets set in 2000 for 2005 (TRCA).

Humber Watershed sub watershed: The Black Creek Conservation Project

The Black Creek Conservation Project is a community based non-profit organization that works towards restoring the Black Creek. The Black Creek is a degraded stream in immediate need of aid. It is a major source of bacterial and chemical pollutants to the Humber River, which in turn pollutes the Toronto waterfront. The Black Creek watershed is the smallest of the five sub-watersheds of the Humber River, with a drainage area of approximately 66 square kilometers (TRCA, 1997). The creek arises within the City of Vaughan and flows southwards (roughly following Jane Street), before emptying into the Humber River at the Lambton Golf Course in Toronto, just south of Eglington Avenue. Concern for the Black Creek finally began back in 1982 when, in response to increasing degradation, the Black Creek Conservation Project of Toronto was established. The "Black Creek Project" is a community-based, charitable, environmental organization situated in the City of Toronto. It works in close cooperation with the Toronto and Region Conservation Authority, as well as federal, provincial and municipal funders and partners in an effort to restore the ecological health and functioning of the Black Creek ecosystem. Over the past 20 years, the Black Creek Project has completed numerous restoration and naturalization projects throughout the watershed (TRCA). The Black Creek Project works closely with schools, community groups, multicultural groups and individuals. Some of the programs offered include community based environmental restoration projects, public outreach and awareness campaigns, and outdoor education workshops.

2000 to 2002: "Clean the Creek" Program

Over the last two years, the Black Creek Project has carried out a total of 122 community outreach events and activities under the "Clean the Creek" program.[158] Actions have included:

- the planting of 2,746 native trees and shrubs and 1,700 aquatic and wet meadow plants within the watershed
- 25 clean-up events which filled over a dozen dumpsters with garbage and litter pulled from the creek and parklands
- completion of a comprehensive water quality assessment of the creek (temperature, invertebrate communities, fish, amphibians, bio-monitoring, water chemistry)
- business and community outreach to address the issue of stolen shopping carts being dumped into the creek
- the development of a Regeneration Strategy for the Black Creek Project to prioritize our restoration activities
- conducting numerous watershed tours, educational tours and events
- working to address issues pertinent to the watershed such as; storm-water contamination, road salt impacts, snow dump impacts

2002 to 2004: "Partnerships in Restoration" Program

For the next three years, the Black Creek Project will be developing a new program to assist schools and community groups in implementing a set of programs which combines the education curriculum with environmental restoration.[159].

Case Study Two: Highland Creek

[158] For further information please see: http://www.trca.on.ca/water_protection/strategies/humber/

[159] For further information on the work of the Black Creek Conservation Project please see: http://www.trca.on.ca/water_protection/strategies/humber/default.asp?load=black_creek

Highland Creek

Storm-water runoff and habitat loss are the major factors affecting the health of the Highland Creek watershed and it is often referred to the "the orphan" among Toronto's watersheds. It's area is 85% urbanized and it is the most developed watershed in the TRCA's jurisdiction and because most of the development occurred before storm-water management controls like ponds were required, its waters are highly degraded (TRCA). In addition, a high percentage of the Highland's watercourses have been either buried underground or lined with concrete baskets in efforts to reduce erosion an prevent flooding and such altered streams offer limited aquatic habitat potential or riparian vegetation.

Community Involvement and Achievements

Highland Creek is the only TRCA river watershed for which a community Task Force has *not* been established to direct the development of a watershed strategy and the establishment of a Highland Task Force is a major goal of the TRCA (TRCA). In the absence of a 'task force' the Highland Creek Watershed Steering Committee was established in May 2003 as part of the Highland Creek Environmental Stewardship Program and this group meets several times per year. The Committee is made up of 21 people and includes: TRCA staff; residents residing in the Highland Creek area and City of Toronto staff members. The main goal of the Committee is to works towards greater collaboration on initiatives taking place in the watershed and to involve more community residents in environmental stewardship activities.[160]

Key features of the Highland Creek:

[160] For further information please see: http://www.trca.on.ca/water_protection/strategies/highland/

- One of the smaller watersheds in the Toronto and region area known for its habitat and wildlife. The creek received increased profile in late 90's with the development of a trail linked to the waterfront.
- The Friends of Highland Creek group has undertaken a number of restoration projects in partnership with City of Toronto and TRCA.
- It is the most developed watershed in the TRCA jurisdiction and its stream in highly altered
- It is the only TRCA river watershed for which a community taskforce has not been developed

The role of the local municipality in public awareness and local watershed projects

'The City of Toronto is working on a new program called "Jump In" to solve water pollution that outlines several objectives that focus on improving the *quality* of storm-water in the watershed, while also reducing the *quantity* of storm-water runoff into the creek. These include:

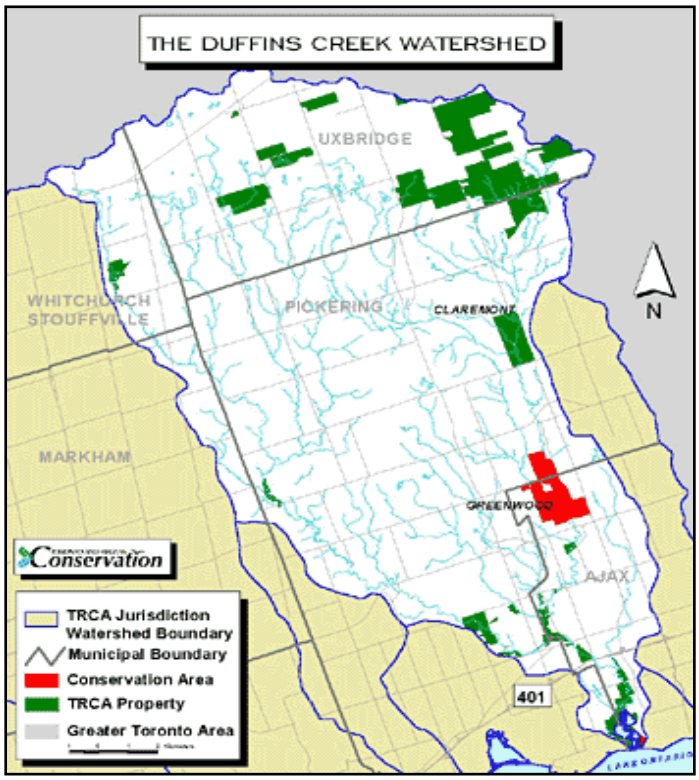
- improving the quality and aesthetics of surface water
- protecting, restoring and enhancing natural areas
- Preventing pollution at the source to help eliminate toxic contaminants in ground and surface waters.

Through public information seminars, citizens can learn how to prevent and reduce pollution on individual home and commercial properties. At the public sessions information about environmentally friendly lawn and garden care, and how to participate in the City of Toronto's **Downspout Disconnect Program** is made available.[161] The goal of the program is to disconnect downspouts linked directly to the storm-water system in 40 % of the households in Highland Creek. By taking this step, residents will be helping to provide a clear and direct benefit to the health of the creek - a reduction of 30 - 40 % of the total storm-water flow (TRCA).

Duffins and Carruthers Creek Watersheds

[161] For more information on Toronto's Downspout Disconnect Program see: http://www.city.toronto.on.ca/watereff/downspout.htm

The Duffins Creek and Carruthers Creek Watershed's are among the healthiest in the Greater Toronto Area. Together they cover 323 square kilometers of land. Duffins Marsh provides one of the healthiest coastal marshes in the Toronto area and is noteworthy for its wildlife and aquatic habitats and both watersheds boast excellent water quality (TRCA).



The TRCA is committed to developing a watershed management strategy for Duffins and Carruthers Creeks and in this effort formed a Technical Advisory Committee (TAC) in 1999. The TAC consisted of TRCA staff and scientists and experts in watershed modeling techniques. The TAC has released two separate 'State of the Watershed Reports' one for Duffins Creek and one for Carruthers Creek. These reports provided the basis for the Task Force members to organize and prepare the release of a Watershed Management Strategy.

In 2000 two separate community Task Forces were established to address the two watersheds individually. The Task Forces were comprised of watershed residents; elected officials; and representatives from government agencies and environmental groups. The role of each Task Force was to develop a watershed management plan to provide direction for future land use planning decisions and management of the watersheds. The Duffins and Carruthers Watershed Plans responded to the growing urban economy and expanding urban boundaries of the region. These particular watershed plans differ from both the Humber and Highland Creek Plans in that, they provide a framework for future land use on relatively undeveloped land as opposed to dealing with the outcomes of intense urbanization that has already occurred in the other two watershed regions.

Note the differences in key watershed issues that are of concern in Duffins and Carruthers Creek relative to the Humber and Highland Creek:[162]

- Keeping the watershed health while accommodating growth
- Promoting tourism in the watersheds and protecting the resources upon which the public use is based
- Conserving the natural environmental and biodiversity

A watershed plan for Duffins and Carruthers Creek was completed in August 2003. The project was a three year effort involving local and regional municipal governments, watershed residents and non-government agencies (TRCA). Currently the TRCA is in the process of developing and Terms of Reference for a new watershed Task Force Committee who will work on the implementation of the watershed plan.

A Snapshot of watershed Priorities in Five of the TRCA's Watersheds[163]

Watershed Priorities

The **Etobicoke-Mimico Watersheds** Task Force is about to publish its strategy Greening Our Watersheds. The draft strategy's five priority actions are to improve water management, promote sustainable urban growth, secure green open spaces, expand environmental education, and protect and restore natural habitats.

The 2000 **Humber River Watershed** Report Card, prepared by the Humber Watershed Alliance, concluded that most aspects of the watershed were in fair or poor health, that the system was under significant stress, and that development pressures pose the threat of increased stress. The Alliance recommends priority be given to stormwater ponds/controls, riparian reforestation, wetland creation, river barrier mitigation, and community involvement/education.

The 2000 **Don Watershed** Report Card, prepared by the Don Watershed Council, is titled A Time for Bold Steps to emphasize the fact that, while there has been considerable progress in re-creating habitats (130 regeneration projects between 1997 and 1999 alone), they are mostly small scale projects like tree-plantings and wildflower gardens. The bold steps that are now required will deal with the most destructive forces in the river – wide fluctuations in the flow regime, massive amounts of stormwater pollution and sediments, and CSOs. The priority actions are therefore to complete and implement the Wet Weather Flow Plan in Toronto and undertake similar actions in the upstream municipalities.

A State of the Watershed Report was published for the **Highland Creek Watershed** in 1999. This will provide a sound basis for preparation of an integrated strategy, when considered in conjunction with TRCA's natural heritage inventory, draft fisheries management plan and the City of Toronto's Wet Weather Flow Plan.

The **Rouge River Watershed** does not have a single coordinated group working on the entire watershed. However the Rouge Park Alliance, while responsible primarily for the Rouge Park, also provides leadership for a watershed perspective. The Rouge Park's General Manager acts as TRCA's watershed specialist for the Rouge catchment area. The Rouge Park Management Plan (1994) and the Rouge North Management Plan (2001) include an emphasis on ecological planning principles in a broader, watershed context.

10.5

[162] For further information on Duffins and Carruthers Creek please see http://www.trca.on.ca/water_protection/strategies/duffins/

[163] Waterfront Regeneration Trust "Clean Waters Healthy Habitats Progress Report" 2001

THE CITY OF TORONTO: OPPORTUNITIES FOR PUBLIC INVOLVEMENT IN WATERSHED RELATED ACTIVITIES

The Wet Weather Flow Management Master Plan (WWFMP)

A WWFMP Steering Committee was created to provide advice to the Commissioner of Works and Emergency Services throughout the development of the Master Plan. The Committee included councilors and representatives from the community, key agencies and City staff. Steering Committee members were selected through a collaborative process that brought representatives of key stakeholder groups to the table. A sample of members includes representatives from: the Waterfront Regeneration Trust; City of Toronto Works and Emergency Services - Technical Services; Citizens for a Safe Environment; Remedial Action Plan Public Advisory Committee and the MOE: Standards Development Branch. Steering Committee meetings were open to the public The Wet Weather Flow Management Master Plan Steering Committee has completed its mandate and is no longer active.

Wastewater Treatment

Toronto's Works and Emergency Services Department operates four filtration plants; three spread along the lakeshore and one located on Toronto Island. All wastewater treatment plants are part of a community's landscape. For instance in the Humber Bay Treatment Plant neighborhood, one of the ways the City and neighborhood stay in touch is through the Neighborhood Liaison Committee (NLC). This group provides input on issues related to the treatment plant that affect the community and helps the City keep citizens informed about what's happening there.[164] The City also publishes a community newsletter called The Humber Resource which deals with current and local topics related to the plant.[165] Another way to keep in touch is through public meetings on proposed changes to the site, such as the odor study, which is currently underway.[166]

[164] For information on the NLC please see:
http://www.city.toronto.on.ca/water/wastewater_treatment/treatment_plants/humber/nlc.htm
[165] The Humber Resource:
http://www.city.toronto.on.ca/water/wastewater_treatment/treatment_plants/humber/newsletter.htm
[166] For further information on the odor study please see:
http://www.city.toronto.on.ca/water/wastewater_treatment/treatment_plants/humber/index.htm

APPENDIX 1: EVALUATION OF WATERSHED MANAGEMENT IN ONTARIO

TABLE 5-1: AN EVALUATION OF WATERSHED MANAGEMENT IN THE ONTARIO CONTEXT

Components of Successful Watershed Management	Advantages	Ontario Context Strengths and Weaknesses	Rating
Political Endorsement	Gives political support for a watershed approach through legislation, policy statements, agreements, guidelines, and shared-funding for research, decision-support tools and infrastructure.	There is little political support for watershed management, although policies in the Federal Water Policy and the 1993 provincial Watershed Planning documents support the watershed approach. Funding support of watershed management has been reduced at the provincial and municipal levels. Current funding is ad hoc and provided on a project-by-project basis.	
Enabling Legislation	Provides the framework for administrative procedures, partnership building, and legitimacy of certain actions.	Ontario has enabling legislation for establishing a watershed approach throughout Ontario, with the exception of the northern part of the province. Through the Conservation Authorities Act, 38 Conservation Authorities exist with the prime purpose to conserve, restore, develop and manage natural resources on a watershed basis. Other federal and provincial legislation can be used in support of watershed management (e.g., Federal Fisheries Act; Ontario Water Resources Act; Environmental Protection Act; Planning Act; Public Utilities Act, Municipal Act).	
Co-ordination and a Co-ordinating Body at the Watershed /Subwatershed Level	Builds trust and goodwill, continuity, a knowledge of context and local conditions, reduces the problems of power-sharing and duplication, matches the scale of the problem, and provides opportunities for sharing or pooling limited resources.	Where Conservation Authorities exist, and where support from other government agencies and water users is sufficient, they have co-ordinated the activities of watershed municipalities with respect to local watershed issues. Conservation Authorities have a long and successful history of partnership building and on-the-ground results. Partners have included municipalities, federal and provincial agencies, First Nations, other conservation authorities, business, educational institutions, landowners and community groups.	
Sustainable Funding	Provides continuity, long-term commitment, competency, capacity, and implementation of projects.	Lack of adequate and sustainable funding for watershed management has been a major challenge in Ontario at all government levels.	
A Multi-Disciplinary, Integrated Approach	Identifies resource functions/processes, cause-effect relations and linkages among watershed components (rivers, wetlands, groundwater, atmosphere, floodplains, upland areas).	The ability of various agencies and organizations to provide staff and expertise for watershed management varies substantially. Many of the larger conservation authorities and municipalities have a multidisciplinary team of professionals and technicians to support watershed management. Others have limited capacity. Some share staff and technical resources to undertake specific aspects of watershed management.	

Table 5-1. An Evaluation of Watershed Management in the Ontario Context (continued)

Components of Successful Watershed Management	Advantages	Ontario Context Strengths and Weaknesses	Rating
Clear Goals and Objectives	Defines the scope and focus for defining issues and problems and finding solutions.	Watershed plans that have been completed across the province to date, have a clear statement of goals and objectives	
Good Data, Appropriate Technical and Analytical Skills, and Useful Decision-Support Tools	Provides a strong base from which appropriate decisions can be made; encourages useful science moving away from analysis towards synthesis.	Available resource data from federal and provincial sources is either not as accessible as required or maintained to the extent needed. Conservation Authorities have differing capacities to obtain good reliable data, interpret the data, and build useful decision-making tools. There are opportunities to share professional and technical expertise and to apply decision-support tools and models developed for one watershed to others.	
Public Involvement	Builds trust, consensus; leverages effort; and ensures implementation and change will occur at the local level.	Public input and involvement has been a key component of watershed planning and management in Ontario for the past twenty years.	
Partner Collaboration		Partner collaboration (or having all the implementers involved) is essential but has not always been part of the watershed management process and is not required by legislation. This can detract from the credibility of watershed management.	
Shared Action Plans and a Range of Incentives to Undertake Action	Includes education, information, opportunity to participate in planning, opportunity to participate in "hands-on" action, applause and celebration, cost-sharing incentives, public-private partnerships, and finally, surcharges, regulation and enforcement.	Watershed management processes which have fostered the broadest degree of participation, including the federal and provincial agencies, have been successful in identifying a range of practical options and developing actions plan which result in on-the-ground actions. This is because the implementers have been involved in the process from the onset (e.g. Grand River Basin Watershed Management Plan).	
A Continuum of Proactive Planning, Monitoring, and Updating	Ensures flexibility and adaptability in dealing with changing environmental, social, and economic issues.	Watershed management must be a continuous planning process in order to be effective in the long-term and to respond to change. Often incentives and funding for monitoring, evaluating and updating is very limited. Federal and provincial agencies are withdrawing from funding monitoring networks. The link between planning and implementation (e.g. through official plans, MOE regulations) is often inconsistent or weak.	
Dynamic leadership	Helps advance efforts, increase involvement and lend legitimacy and credibility to the process.	There are few outstanding champions for watershed management at the federal, provincial or watershed levels. (Notable for her leadership in British Columbia is Honourable Iona Campagnolo, Chair, Fraser Basin Council).	

APPENDIX 2: KEY ELEMENTS OF SUCCESS

Figure 4-1 Key Elements of Success in Watershed Management

ASPECT	FACTORS FOR SUCCESS
Watershed / Subwatershed Planning	Tailor planning process to particular watershed Develop clear Terms of Reference that define process, roles and responsibilities Build understanding and support of Steering Committee Collect baseline data up front Effectively characterize the system by integrating information from each discipline Use GIS to communicate data, information and recommendations Set clear, understandable goals, objectives and targets Consider a range of alternatives Have expertise and decision support tools for evaluating alternatives
Implementing Watershed Plans	Identify clear, discrete actions and responsibilities Ensure clear accountability of deliverables Ensure "buy in" from key partners from the beginning Gain support of municipal politicians and staff Include actions at different scales (i.e., watershed, subwatershed, site and individual actions) Set "do-able" short term milestones as well as longer-term targets
Monitoring and Reporting	Celebrate success Report on a regular basis Involve the public in developing monitoring plans, monitoring and reporting Link monitoring to watershed goals, objectives and targets.
Periodic Review of Plans	Update at 10 year intervals to reflect changes in environmental conditions, stressors, and public preferences
Partnership Approaches	Involve key partners from the beginning of the process in Steering Committee and others (i.e., Technical Committees) Seek strong leadership fat the political and staff level from key partners Forge strong links to other programs and processes to maximize the use of information Use consensus-based approaches to develop a shared vision Adopt a philosophy of collaboration in planning and implementation
Public Involvement	Involve the public in determining the study objectives, goals and selection of the preferred plan Be inclusive, open and unbiased Aim to create "local ambassadors" - public participants in the process who can educate, motivate and serve as watchdogs in their own neighbourhoods Find a strong, enthusiastic and respected citizen to chair the project Steering Committee
Communication	Use effective visual tools such as GIS mapping and photos Develop reports that are engaging, easy to read and appealing Consider the needs of users (e.g., make Implementation Plans stand-alone documents) Celebrate successes
Institutional Aspects	Have strong coordination at the local level (e.g., in the CA) Have watershed managers develop watershed/subwatershed plans Set an ambitious schedule and keep to it Find dedicated staff to develop the watershed/subwatershed plan

APPENDIX 3: TRENDS IN WATERSHED MANAGEMENT

Figure 4-3 Trends in Watershed Management

ASPECT	FACTORS FOR SUCCESS
Watershed Planning	There has been an increase in subwatershed planning in rural areas More comprehensive technical analysis is being carried out in watershed and subwatershed plans GIS is increasingly being used as an integrative and communications tool The engineering approach to managing water resources in urban areas is being replaced with an ecosystem approach There has been increased use of modelling and data management Many plans and programs (such as fisheries, forestry and monitoring plans) are being developed on a watershed basis There is increased interest in inter-watershed planning There has been an increased emphasis on understanding and protecting the natural environment system, rather than its component parts There has been a philosophical shift with an emphasis on prevention rather than clean up
Implementation of Plans	Diverse mechanism are being used to implement watershed and subwatershed plans, including education Conservation authorities are playing a greater role in source protection of drinking water, by commenting in the land use planning process Conservation authorities are increasing providing upfront subwatershed data and information for use in municipal land use planning processes
Monitoring and Reporting	The trend is towards incorporating monitoring into all subwatershed plans The use of tools such as Watershed Report Cards allow the public to easily understand environmental conditions, progress made, and where effort still needs to be spent
Periodic Review of Plans	Many conservation authorities are beginning to focus on review of older watershed and subwatershed plans Many conservation authorities have adopted the concept of adaptive environmental management
Partnership Approaches	Developing close ties with staff at member municipalities has allowed CAs to provide advice on land use changes, infrastructure choices, etc. Developing ties with universities had allowed some CAs to address emerging issues and keep pace with the evolving science of watershed management
Public Involvement	Many CAs are embracing new tools and approaches to better involve the public in watershed planning and management
Institutional Aspects	There has been increased integration of watershed and subwatershed plans into the official plan process Many CAs have recruited technical experts is fields such as hydrology and hydrogeology in order to carry out watershed planning and management Many CAs have been able to reduce the high costs of watershed planning through: establishing watershed-wide databases, taking a stronger role in project management, using multiple specialists rather than a single consultant to carry out plans, and carrying out some components of studies in-house

APPENDIX 4: TRCA MILESTONES

1957 The Metropolitan Toronto and Region Conservation Authority inaugural held February 20, 1957 in the North York Council Chambers with its objectives being:

- good land use, leading to farm planning
- control of flood damage by flood plain acquisition and construction of necessary dams and channel works
- pollution control
- reforestation of marginal and sub marginal land
- the establishment of conservation areas and historic sites
- the undertaking of a broad program of conservation information and education leading to effective land and water use

1959 Completion of the Plan for Flood Control and Water Conservation

- Agreement with Metropolitan Parks Department for their management of all Authority lands within Toronto, excepting Black Creek Conservation Area (later named Black Creek Pioneer Village)
- Carruthers Creek added to MTRCA area of jurisdiction

1960 Forestry agreement established with the Ministry of Natural Resources for long term management of reforested MTRCA lands by the Ministry

1961 Approval of the $38 million Plan for Flood Control and Water Conservation to be funded by the Authority ($13 m), the Province ($16 m) and the Government of Canada ($9 m)

- Adoption of the Master Plan for the Acquisition of Flood Plain and Conservation Land identifying those lands suitable for acquisition
- Adoption of The Plan of Ancillary Conservation Measures detailing how the Authority would provide for reforestation, wildlife habitat improvement and the development of public recreational facilities on the lands it acquired

1963 Adoption of regulations for Fill, Construction and Alteration to Waterways

- Adoption of the report on Pollution Control and Recreation in The Toronto Region identifying contributing factors to poor water quality and recommending policies to maintain high quality in order to retain recreational uses along watercourses

1966 Adoption of the Streambank Erosion Control Program to carry out remedial works upstream of proposed reservoirs on both Authority and private lands to improve fish habitat and reduce siltation of future reservoirs

1970 Designation of the Authority, by the Minister of the Environment, as the implementing agency for the Metropolitan Planning area's 1967 Waterfront Plan, excepting the lands within the central harbour area, and extending the Authority's area of jurisdiction into Lake Ontario

1972 Adoption of a 10 Year Waterfront Plan and a series of implementing projects

1972 Adoption of a Policy for Erosion Control and Bank Stabilization in Toronto

1977 Adoption of the first Erosion Control and Bank Stabilization Projects in Durham, Peel and York

1980 Adoption of a Watershed Plan, with ten component programs, resulting from the comprehensive review and consolidation of its policies, programs and projects. The ten programs are: Flood Control, Erosion and Sediment Control, Land Acquisition, Stormwater Management, Conservation Land Management, Shoreline Management, Lake Ontario Waterfront Development, Watershed Recreation, Heritage Conservation and Community Relations

1986 Review and revision of the Watershed Plan based on five years of implementation

1989 Adoption of the Greenspace Strategy as an extension and complement to the Watershed Plan

1992 Circulation of the Review of Public Use of Authority Lands and the draft Valley and Stream Corridor Management Program

1993 Completion of the review for the extension of the Authority's Fill Regulation mapping project

1994 Adoption of the Valley and Stream Corridor Management Program

- Completion of "Forty Steps to a New Don", the report and recommendations of the Don Watershed Task Force
- Initiation of the preparation of a Humber River Watershed Strategy and the establishment of a Humber Watershed Task Force

1995 We adopted the Strategy for Public Use of Conservation Authority Lands. The Province delegated to the Authority its responsibilities for erosion and slope instability

- The Authority endorsed the report and recommendations of the Humber Watershed Task Force

1996 Official opening of Colonel Samuel Smith Park

- Ground-breaking for Etobicoke Motel Strip Park
- Opened Duffins Creek Bridge along the Waterfront Trail

1997 The Authority celebrated its 40th anniversary

- The Authority developed a Three Year Business Plan 1997 - 1999. This plan outlined what services the Authority would provide over the three year period and how it would meet the funding targets set by its partners. The Plan also set revenue targets for the Conservation Areas, Black Creek Pioneer Village, the Kortright Centre and various other Authority programs
- Metropolitan Toronto and the Regions of Peel, York and Durham supported the Business Plan and with this support the Authority has been able to continue to deliver its programs and to find new and innovative approaches to revenue generation

- The Conservation Foundation of Greater Toronto was also restructured to meet the ever-increasing fund raising needs of the Authority. To support the increased fund raising requirements, a new Marketing and Development Division was formed reporting to the Finance and Business Development Advisory Board
- Official opening of the Don Valley Brick Works

1998 Humber Bay Shores Community Waterfront Park completed

- Establishment of the Frenchman's Bay Rehabilitation Project

1999 Designation of the Humber as a Canadian Heritage River

- *State of the Watershed Report: Highland Creek Watershed* completed
- Opening of the William Alexander Dempsey EcoPark
- Completion of site remediation efforts for the Arsenal Lands watershed
- New wetland habitat at Spadina Quay created
- Provincial addition of 660 hectares of land to the Rouge Park (North) and transfer of ownership to the TRCA. All provincial lands within Rouge Park South (709 hectares) transferred to the TRCA
- Etobicoke and Mimico Creek Watersheds Task Forces established
- Boyd Conservation Field Centre celebrates its 25th anniversary as an outdoor education centre
- Completion of the Living Machine waste water treatment building at the Kortright Centre for Conservation

2000 Formation of the Conservation Authorities Moraine Coalition in partnership with eight other Conservation Authorities on the Oak Ridges Moraine

- First Humber Report Card issued
- List of fauna "species of concern" completed for the Toronto region
- Purchase of the 30.5 hectare Baker Sugarbush
- Black Creek Pioneer Village celebrates its 40th anniversary
- Official Launch of the Living City campaign by the Conservation Foundation

2001 *Riverprize* awarded to the Humber River from the Riverfestival held in Brisbane, Australia

- Official opening of the Granger Greenway in Kleinburg

2002 Supported Source Protection Planning

- Released major watershed strategies for Etobicoke and Mimico Creeks, and the Duffins and Carruthers Creeks
- Helped secure funding for waterfront parks, namely Port Union and Mimico Waterfront Linear Park
- Began two major Lower Don River Environmental Assessments
- Supported Oak Ridges Moraine Conservation Plan implementation
- Secured 180 hectares of Environmentally Sensitive Land

- Planted over 160, 000 native trees and shrubs
- Completed a State of the Terrestrial Ecosystem report
- Launched the Volunteer Natural Heritage Monitoring program
- Worked with communities on 25 community action sites
- Adapted UNESCO teaching programs for a sustainable future
- Expanded Nature Outreach Programs

2003 Federation of Canadian Municipalities approved funding to install a breathing wall at TRCA Head Office.

- TRCA addressed several species changes in the GTA such as the presence of West Nile Virus in mosquitoes and the invasion of Asian Longhorned Beetles and Grass Carp
- Participated in the first Canadian Rivers Day, June 8, 2003
- Black Creek Pioneer Village launched Sensational Sounds of Summer, a series of weekend cultural music events
- First annual Heart Lake Dragon Boat Festival was held at Heart Lake Conservation Area

APPENDIX 5: CANADIAN ACTIONS AND CHALLENGES UNDER THE BINATIONAL TOXIC STRATEGY

Environment Canada and United States Environmental Protection Agency have encapsulated Canada's current actions and the challenges faced under the Binational Program as:

1. Report by 1997, that there is no longer use, generation or release from Ontario sources that enter the Great Lakes of five bioaccumulative pesticides (chlordane, aldrin/dieldrin, DDT, mirex, and toxaphene), and of the industrial byproduct/contaminant octachlorostyrene. If ongoing, long-range sources of these substances from outside of Canada are confirmed, work within international frameworks to reduce or phase out releases of these substances

- EC and USEPA will continue to support Great Lakes watershed "clean sweeps," which receive unwanted and hazardous agricultural chemicals for appropriate disposal. These programs have previously received sizeable quantities of these pesticides.

- EC and USEPA will undertake actions to verify that these five pesticides are no longer used or released in the Great Lakes watershed, based on the weight of evidence from use and environmental monitoring data. EC will also undertake actions to verify no commercial production, use or importation of these five pesticides in the Great Lakes watershed, based on the weight of evidence from use and environmental monitoring data. In the U.S., it is recognized that there may be continued legal use of some of these cancelled pesticides; the goal is to encourage decreased use of these products. In addition, alternative methods of disposal are encouraged.

- EC and USEPA will verify that octachlorostyrene (OCS) is no longer deliberately released to the Great Lakes watershed; efforts to eliminate OCS formation as a byproduct will be promoted.

- If ongoing local sources of toxaphene in Lakes Superior and Michigan are confirmed, undertake appropriate actions to seek reductions. If ongoing long-range sources of toxaphene are confirmed, work within international frameworks to reduce or phase out releases of the substance.
    - Assess and pursue recommendations from the joint U.S.-Canada technical workshop on toxaphene in the Great Lakes, held in Spring 1996.

    - EC and USEPA will develop and implement a joint monitoring plan through the LaMP monitoring committee to track toxaphene levels in Lake Superior. Monitoring of toxaphene in Lake Michigan and the high Arctic will be integrated with Lake Superior monitoring to track reductions in this class of pollutant.
- Registration of chlordane, aldrin/dieldrin, DDT and toxaphene was voluntarily discontinued by the registrants. Mirex was never registered as a pest control product in Canada.

- The federal Pest Management Regulatory Agency (PMRA) is working with stakeholders on risk reduction strategies and to support the implementation and use of sustainable pest management strategies such as integrated pest management. Partners in these initiatives include provincial governments, both regulatory and extension programs, pesticide manufacturers, researchers, federal government departments, grower and trade associations, and environmental groups.

2. Seek by 2000, a 90 percent reduction in use, generation, or release of alkyl-lead consistent with the 1994 COA.

- Provincial monitoring programs indicate a 96 percent decline in atmospheric lead levels to date.

- It is estimated that releases of alkyl-lead (1,000 kg/yr) in Ontario are almost entirely from aviation fuel. Minor generation through industrial or mining processes utilizing lead is possible and will be investigated. Elimination of alkyl-lead in aviation fuel will be investigated in partnership with responsible sources.

3. Seek by 2000, a 90 percent reduction of high-level PCBs (>1 percent PCBs) that were once, or are currently, in service and accelerate destruction of stored high-level PCB wastes which have the potential to enter the Great Lakes Basin, consistent with the 1994 COA.

- Over 40 percent of Ontario's high-level PCBs have been decommissioned. Continued efforts to decommission the remaining PCBs to meet the 90 percent target will be pursued in conjunction with owners and interested stakeholders, with a goal of "one-stop decommissioning and destruction" where possible.

- The target for PCB destruction applies to the 18,614 tonnes of high-level PCB wastes now in storage; 1300 tonnes have been destroyed as of December 1995. Demonstrations of new technologies for PCB destruction are being undertaken, in partnership with PCB owners across Ontario. Consolidation of small quantities for destruction, and decontamination to reduce storage/destruction volumes, is being considered.

- New federal regulations, effective February 1997, permit Canadian PCB wastes to be exported to the U.S. for destruction under strict environmental controls. These new controls will expedite the elimination of existing Canadian PCB wastes presently in storage.

- Significant progress is being made by the federal government on the decommissioning and destruction of federally-owned PCBs in the Great Lakes watershed. Over 50 percent of federally-owned PCBs have been decommissioned and destroyed. Work continues by

federal government departments on the decommissioning and destruction of their remaining inventories.

4. Seek by 2000, a 90 percent reduction in the release of mercury, or where warranted the use of mercury, from polluting sources resulting from human activity in the Great Lakes Basin. This target is considered as an interim reduction target and, in consultation with stakeholders in the Great Lakes Basin, will be revised if warranted, following completion of the 1997 COA review of mercury use, generation, and release from Ontario sources.

Through the Lake Superior Binational Program, Canada and the U.S., along with Ontario, Michigan, Minnesota and Wisconsin, have begun implementing a zero discharge demonstration project for mercury. A use-source tree for mercury was developed, and emission estimates generated. Strategies for reducing mercury emissions to "zero" are being developed in consultation with the Lake Superior Binational Forum. The Forum has provided recommendations to the governments consisting of a timeline for achieving zero discharge of mercury.

- It has been estimated that between 2,700 and 3,450 kg of mercury are released to the atmosphere in Ontario annually from anthropogenic sources, while up to 2,500 kg are released to the waters of the Great Lakes Basin annually. Through an analysis of mercury uses and sources, significant sources of mercury have been identified and prioritized. These sources will be encouraged to develop strategies to reduce their releases by 90 percent from a baseline year of 1988 through adoption of pollution prevention measures.

- In partnership with Pollution Probe, Canada and Ontario have identified potential industrial partners to participate in a unique three-way initiative to reduce or eliminate mercury in industrial or commercial applications. Coordination of this effort with U.S. partners is being considered, and the findings and approaches are being shared with the U.S. Virtual Elimination Pilot Project.

- Activities by companies to date have resulted in significant reductions in mercury content in batteries (60 - 90 percent), fluorescent lamps (44 percent) and switches, while further reductions are planned, such as 70 percent by fluorescent lamp manufacturers by 2000. One impact of past mercury usage is that landfill emissions may be a source of mercury releases in the Great Lakes Basin, but the quantities released and possible control mechanisms need further consideration.

- In applying the analytical framework in addressing mercury, relevant information from research projects undertaken by Environment Canada, Natural Resources Canada, and other agencies will be considered.

- Canada will work with the U.S. and Mexico in implementing the North American Regional Action Plan for Mercury and will incorporate mercury reduction targets in its partnerships with commercial and industrial sectors in Ontario.

5. Seek by 2000, a 90 percent reduction in releases of dioxins, furans, HCB, and B(a)P, from sources resulting from human activity in the Great Lakes Basin, consistent with the 1994 COA. Actions will focus on the 2,3,7,8 substitute congeners of dioxins and furans in a manner consistent with the TSMP.

Significant progress has been made in meeting this challenge under the COA and related activities such as the ARET program. This trend will be further promoted in partnerships focusing on priority sources of these pollutants. Implementation of the federal government's TSMP will facilitate additional cooperative actions in these and other sectors, consistent with the mandates of the different federal departments.

- Preliminary Ontario release estimates for B(a)P, HCB, dioxins and furans suggest more than 90 percent of the releases are direct atmospheric releases. A substantial natural emission of B(a)P may also be present from forest fires, complicating analysis of environmental trends in this contaminant. This analysis has identified and prioritized sources of these pollutants for subsequent development of reduction strategies.

- Through ARET, participating companies have reported reductions in emissions of HCB of 80 percent and of dioxins and furans of 98 - 99 percent. Through pollution prevention, participating companies reported 4,300 tonnes of hydrocarbon emissions and 16,000 tonnes of other waste emissions reduced. Participation and reporting of reductions undertaken voluntarily is growing in the Canadian portion of the Great Lakes Basin, signalling a trend away from controls and treatment toward eliminating use and generation.

- Both Canada and Ontario have promulgated stringent effluent requirements for the pulp and paper sector and pulp mills have invested heavily in the past five years to achieve compliance with the regulations. Canada and Ontario will confirm in 1997 that all mills using chlorine-based bleaching are in full compliance with the "non-measurable" effluent concentration requirements and have virtually eliminated dioxins and furans from their effluent.

- Dioxins, furans, and HCB have been assessed and declared toxic under the Canadian Environmental Protection Act. HCB and the 2,3,7,8 substituted congeners of dioxins and furans are proposed for management on a national level under Track I (virtual elimination) of the TSMP. A federal/provincial task force is being established to evaluate control options for dioxins and furans and a multistakeholder group will also be established soon to develop options for HCB. Similarly, control options for polycyclic aromatic hydrocarbons (PAHs) including B(a)P are being developed for the major source sectors such as iron and steel and wood preservation.

- Registration of HCB as a fungicidal seed treatment has been discontinued in Canada since 1976, and uses of HCB as a pesticide are considered illegal under the Pest Control Products Act.

- In lifting its ban on new municipal waste incinerators, Ontario has adopted emissions limits at least as stringent as the MACT standards adopted in the U.S.

6. Promote pollution prevention and the sound management of Level II substances, to reduce levels in the environment of those substances nominated jointly by both countries, and to conform with the laws and policies of each country, including pollution prevention, with respect to those substances nominated by only one country. Increase knowledge on sources and environmental levels of these substances.

In Canada, the federal government will manage Level II substances consistent with federal legislation, the TSMP and COA.

- EC and USEPA will investigate levels of these contaminants in the Great Lakes where appropriate and, where possible, gather additional information on resulting impacts to the ecosystem.

- EC and USEPA will also continue to inventory emissions of selected substances and model their loading to the Great Lakes.

- EC will develop information on the occurrence, fate and effects of organometal compounds (including tributyl tin).

- EC will also upgrade and improve public access to an existing import/export information database concerning imports/exports of hazardous waste.

7. Assess atmospheric inputs of Strategy substances to the Great Lakes. The aim of this effort is to evaluate and report jointly on the contribution and significance of long-range transport of Strategy substances from world-wide sources. If ongoing long-range sources are confirmed, work within international frameworks to reduce releases of such substances.

- EC and USEPA will, as a priority, coordinate efforts to identify sources of atmospheric pollutants in order to better define and coordinate emission control programs.

- EC and USEPA will maintain atmospheric deposition monitoring stations to detect deposition and transport of Strategy substances.

- EC and USEPA will continue research on the atmospheric science of toxic pollutants to refine and improve existing source, receptor and deposition models, fundamental to impact assessment. They will also improve integration of existing air toxic monitoring networks and data management systems to track deposition of contaminants within the Great Lakes.

- EC and USEPA will conduct an assessment of the long-range transport of persistent toxic substances from world-wide sources.

- By 1999, Canada will complete inventories of 10 selected air pollution sources to support assessment of the environmental impacts of air toxics. In addition, by 2001, EC will demonstrate alternative processes to lessen emissions from 5 predominant sources.

8. Complete or be well advanced in remediation of priority sites with contaminated bottom sediments in the Great Lakes Basin by 2006.

- Document the evaluation and assessment of 250 innovative technologies developed under the auspices of the Great Lakes 2000 Cleanup Fund for the safe handling and treatment of contaminated sediments.

- Promote, on a pilot basis, the application and use of a computerized, searchable and user-friendly Sediment Technology Directory (SEDTEC) of 250 technologies for the handling and treatment of sediments, soils, and sludges.

- Describe effects and appropriate remediation measures, working to ensure cleanup of priority contaminated sediments such as in Thunder Bay, Sault Ste. Marie, Hamilton Harbour, and Port Hope.

- Develop long-term approaches to remediate intermediate contamination such as in Jackfish Bay, Metro Toronto, and Cornwall.

9. EC and USEPA will encourage and support voluntary programs by industries to reduce the generation, use, or release of targeted contaminants.

- Continue or establish partnerships with key Great Lakes industries (e.g., automotive, printing) to foster "cleaner, cheaper, smarter" ways of preventing or reducing pollution. Examples include Project XL and ISO 14000.

- Pollution prevention programs will be promoted and encouraged at targeted industrial facilities discharging to the Great Lakes using a variety of ongoing efforts, including within Canada, the Pollution Prevention Pledge Program for Ontario and ARET. Within the U.S., the Common Sense Initiative and other programs will support this action.

APPENDIX 6: GREAT LAKES & IJC CONTACT INFORMATION

GREAT LAKES

International Joint Commission

CANADIAN CONTACTS

Herb Gray – Chair
Robert Gourd – Commissioner
Jack P Blaney – Commissioner

Canadian Head office staff (Ottawa)
http://www.ijc.org/en/background/staff_person_ott.htm
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22nd Floor
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100 Ouellette Avenue
8th Floor
Windsor, ON N9A 6T3
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Fax: 519-257-6740
Contact: Jennifer Day - dayj@windsor.ijc.org

Conferences

SOLEC – State of Great Lakes Ecosystems Conferences

Information about SOLEC and Great Lakes indicators: http://www.epa.gov/glnpo/solec and http://www.on.ec.gc.ca/solec.
Access to background papers, conference overviews & agendas:
www.on.ec.gc.ca/solec/intro.html
To register or for more information: SOLEC@ec.gc.ca

Public Forums

Lake Erie LAMP Bi-national Public Forum

http://erieforum.org/

The Lake Erie Forum is a cooperative bi-national organization of diverse stakeholders whose objective is to restore, protect, and utilize Lake Erie waters to achieve maximum sustainable social and economic benefits by promoting: ecosystem health, diversity and stewardship; recognition and protection of unique environmental areas, such as wetlands, wilderness, open space; the enhancement and maintenance of public access to the lake and shoreline; the protection of indigenous species and their habitats; shoreline and lake uses which encourage a healthy economy and environment and are in the public interest; and meaningful opportunity for public participation in decisions that affect the lake.

The Lake Superior Bi-national Public Forum

http://www.superiorforum.info/

The Lake Superior Bi-national Forum is the public advisory body for the Lake Superior Bi-national Program. It consists of 24 volunteer members from various sectors including small business, environmental organizations, industry, Native American, First Nations and academia. Its purpose is to advise governments about critical issues relating to Lake Superior such as discharge of toxic substances, pollution prevention and restoration efforts. The members of this body are also responsible for developing creative new strategies for eliminating pollutants and contributing towards the foundations of a new economy.

APPENDIX 7: MINISTRIES & POLICIES SUBJECT TO THE EBR

MINISTRIES SUBJECT TO ENVIRONMENTAL BILL OF RIGHTS			
Subject to requests for Review under the EBR	Required to develop Statement of Environmental Values	Required to Post Notice on the Environmental Registry	Required to post notice on Environmental Registry of classified instruments
Ministry of Agriculture, Food and Rural Affairs	Ministry of Agriculture, Food and Rural Affairs	Ministry of Agriculture, Food and Rural Affairs	
Ministry of Consumer and Commercial Relations	Ministry of Consumer and Commercial Relations	Ministry of Consumer and Commercial Relations	Ministry of Consumer and Commercial Relations
	Ministry of Citizenship, Culture and Recreation	Ministry of Citizenship, Culture and Recreation	
	Ministry of Economic Development, Trade and Tourism	Ministry of Economic Development, Trade and Tourism	
Ministry of Energy, Science and Technology	Ministry of Energy, Science and Technology	Ministry of Energy, Science and Technology	
Ministry of the Environment	Ministry of the Environment	Ministry of the Environment	Ministry of the Environment
	Ministry of Health	Ministry of Health	
	Ministry of Labour	Ministry of Labour	
	Management Board Secretariat	Management Board Secretariat	
Ministry of Municipal Affairs and Housing	Ministry of Municipal Affairs and Housing	Ministry of Municipal Affairs and Housing	Ministry of Municipal Affairs and Housing
Ministry of Natural Resources	Ministry of Natural Resources	Ministry of Natural Resources	Ministry of Natural Resources
Ministry of Northern Development and Mines. O. Reg. 179/98, s.2	Ministry of Northern Development and Mines	Ministry of Northern Development and Mines	Ministry of Northern Development and Mines. O. Reg. 179/98, s.2
	Ministry of Transportation.	Ministry of Transportation.	

*See Ontario Regulation 73/94 for more specific exceptions

ACTS AND POLICIES SUBJECT TO EBR

Following Acts subject to requests for Investigation under EBR	Required to post notice on ER for environmentally significant regulations made under them
Aggregate Resources Act	Aggregate Resources Act
Conservation Authorities Act	Conservation Authorities Act
Crown Forest Sustainability Act, 1994	Crown Forest Sustainability Act, 1994
Endangered Species Act	Endangered Species Act
Energy Efficiency Act	Energy Efficiency Act
Environmental Assessment Act	Environmental Assessment Act
Environmental Protection Act	Environmental Protection Act
Fisheries Act (Canada)	Environmental Bill of Rights, 1993
Game and Fish Act	Game and Fish Act
Gasoline Handling Act	Gasoline Handling Act
Lakes and Rivers Improvement Act	Lakes and Rivers Improvement Act
Mining Act	Mining Act
Oil, Gas and Salt Resources Act	Oil, Gas and Salt Resources Act
Ontario Water Resources Act	Ontario Water Resources Act
Pesticides Act	Pesticides Act
Provincial Parks Act	Provincial Parks Act
Public Lands Act	Public Lands Act
Waste Management Act	Waste Management Act, 1992. Reg. 179/98
Niagara Escarpment Planning and Development Act	Planning Act

APPENDIX 8: SUBSTANCES COVERED UNDER THE NPRI FOR 2002

PART 1A SUBSTANCES

Name	CAS No.[1]	Name	CAS No.[1]
Acetaldehyde	75-07-0	Carbon tetrachloride	56-23-5
Acetonitrile	75-05-8	Catechol	120-80-9
Acetophenone	98-86-2	CFC-11	75-69-4
Acrolein	107-02-8	CFC-12	75-71-8
Acrylamide	79-06-1	CFC-13	75-72-9
Acrylic acid [2]	79-10-7	CFC-114	76-14-2
Acrylonitrile	107-13-1	CFC-115	76-15-3
Alkanes, C_{6-18}, chloro	68920-70-7	Chlorendic acid	115-28-6
Alkanes, C_{10-13}, chloro	85535-84-8	Chlorine	7782-50-5
Allyl alcohol	107-18-6	Chlorine dioxide	10049-04-4
Allyl chloride	107-05-1	Chloroacetic acid [2]	79-11-8
Aluminum [3]	7429-90-5	Chlorobenzene	108-90-7
Aluminum oxide [4]	1344-28-1	Chloroethane	75-00-3
Ammonia (total) [5]	*	Chloroform	67-66-3
Aniline [2]	62-53-3	Chloromethane	74-87-3
Anthracene	120-12-7	3-Chloro-2-methyl-1-propene	563-47-3
Antimony [6]	*	3-Chloropropionitrile	542-76-7
Asbestos [7]	1332-21-4	Chromium [8]	*
Benzene	71-43-2	Cobalt [6]	*
Benzoyl chloride	98-88-4	Copper [6]	*
Benzoyl peroxide	94-36-0	Cresol [2,9]	1319-77-3
Benzyl chloride	100-44-7	Crotonaldehyde	4170-30-3
Biphenyl	92-52-4	Cumene	98-82-8
Bis(2-ethylhexyl) adipate	103-23-1	Cumene hydroperoxide	80-15-9
Bis(2-ethylhexyl) phthalate	117-81-7	Cyanides [10]	*
Boron trifluoride	7637-07-2	Cyclohexane	110-82-7
Bromine	7726-95-6	Cyclohexanol	108-93-0
1-Bromo-2-chloroethane	107-04-0	Decabromodiphenyl oxide	1163-19-5
Bromomethane	74-83-9	2,4-Diaminotoluene [2]	95-80-7
1,3-Butadiene	106-99-0	2,6-Di-*t*-butyl-4-methylphenol	128-37-0
2-Butoxyethanol	111-76-2	Dibutyl phthalate	84-74-2
Butyl acrylate	141-32-2	*o*-Dichlorobenzene	95-50-1
i-Butyl alcohol	78-83-1	*p*-Dichlorobenzene	106-46-7
n-Butyl alcohol	71-36-3	3,3'-Dichlorobenzidine dihydrochloride	612-83-9
sec-Butyl alcohol	78-92-2	1,2-Dichloroethane	107-06-2
tert-Butyl alcohol	75-65-0	Dichloromethane	75-09-2
Butyl benzyl phthalate	85-68-7	2,4-Dichlorophenol [2]	120-83-2
1,2-Butylene oxide	106-88-7	1,2-Dichloropropane	78-87-5
Butyraldehyde	123-72-8	Dicyclopentadiene	77-73-6
C.I. Acid Green 3	4680-78-8	Diethanolamine [2]	111-42-2
C.I. Basic Green 4	569-64-2	Diethyl phthalate	84-66-2
C.I. Basic Red 1	989-38-8	Diethyl sulphate	64-67-5
C.I. Direct Blue 218	28407-37-6	Dimethylamine	124-40-3
C.I. Disperse Yellow 3	2832-40-8	N,N-Dimethylaniline [2]	121-69-7
C.I. Food Red 15	81-88-9	N,N-Dimethylformamide	68-12-2
C.I. Solvent Orange 7	3118-97-6	Dimethyl phenol	1300-71-6
C.I. Solvent Yellow 14	842-07-9	Dimethyl phthalate	131-11-3
Calcium cyanamide	156-62-7	Dimethyl sulphate	77-78-1
Calcium fluoride	7789-75-5	4,6-Dinitro-*o*-cresol [2]	534-52-1
Carbon disulphide	75-15-0	2,4-Dinitrotoluene	121-14-2

Name	CAS No.[1]
2,6-Dinitrotoluene	606-20-2
Dinitrotoluene [11]	25321-14-6
Di-*n*-octyl phthalate	117-84-0
1,4-Dioxane	123-91-1
Diphenylamine	122-39-4
Epichlorohydrin	106-89-8
2-Ethoxyethanol	110-80-5
2-Ethoxyethyl acetate	111-15-9
Ethoxynonyl benzene	28679-13-2
Ethyl acrylate	140-88-5
Ethylbenzene	100-41-4
Ethyl chloroformate	541-41-3
Ethylene	74-85-1
Ethylene glycol	107-21-1
Ethylene oxide	75-21-8
Ethylene thiourea	96-45-7
Fluorine	7782-41-4
Formaldehyde	50-00-0
Formic acid	64-18-6
Halon 1211	353-59-3
Halon 1301	75-63-8
HCFC-22	75-45-6
HCFC-122 and all isomers [12]	41834-16-6
HCFC-123 and all isomers [13]	34077-87-7
HCFC 124 and all isomers [14]	63938-10-3
HCFC-141b	1717-00-6
HCFC-142b	75-68-3
Hexachlorocyclopentadiene	77-47-4
Hexachloroethane	67-72-1
Hexachlorophene	70-30-4
n-Hexane	110-54-3
Hydrazine [2]	302-01-2
Hydrochloric acid	7647-01-0
Hydrogen cyanide	74-90-8
Hydrogen fluoride	7664-39-3
Hydrogen sulphide	7783-06-4
Hydroquinone [2]	123-31-9
Iron pentacarbonyl	13463-40-6
Isobutyraldehyde	78-84-2
Isophorone diisocyanate	4098-71-9
Isoprene	78-79-5
Isopropyl alcohol	67-63-0
p,p'-Isopropylidenediphenol	80-05-7
Isosafrole	120-58-1
Lithium carbonate	554-13-2
Maleic anhydride	108-31-6
Manganese [6]	*
2-Mercaptobenzothiazole	149-30-4
Methanol	67-56-1
2-Methoxyethanol	109-86-4
2-Methoxyethyl acetate	110-49-6
Methyl acrylate	96-33-3
Methyl *tert*-butyl ether	1634-04-4
p,p'-Methylene*bis*(2-chloroaniline)	101-14-4
1,1-Methylene*bis*(4-isocyanatocyclohexane)	5124-30-1
Methylene*bis*(phenylisocyanate)	101-68-8
p,p'-Methylenedianiline	101-77-9
Methyl ethyl ketone	78-93-3
Methyl iodide	74-88-4
Methyl isobutyl ketone	108-10-1
Methyl methacrylate	80-62-6
N-Methylolacrylamide	924-42-5
2-Methylpyridine	109-06-8
N-Methyl-2-pyrrolidone	872-50-4
Michler's ketone [2]	90-94-8
Molybdenum trioxide	1313-27-5
Naphthalene	91-20-3
Nickel [6]	*
Nitrate ion [15]	*
Nitric acid	7697-37-2
Nitrilotriacetic acid [2]	139-13-9
p-Nitroaniline	100-01-6
Nitrobenzene	98-95-3
Nitroglycerin	55-63-0
p-Nitrophenol [2]	100-02-7
2-Nitropropane	79-46-9
N-Nitrosodiphenylamine	86-30-6
Nonylphenol	104-40-5
Nonylphenol hepta(oxyethylene) ethanol	27177-05-5
Nonylphenol, industrial	84852-15-3
Nonylphenol nona(oxyethylene) ethanol	27177-08-8
n-Nonylphenol [11]	25154-52-3
Nonylphenol polyethylene glycol ether	9016-45-9
p-Nonylphenol polyethylene glycol ether	26027-38-3
Nonylphenoxy ethanol	27986-36-3
2-(*p*-Nonylphenoxy) ethanol	104-35-8
2-(2-(*p*-Nonylphenoxy)ethoxy) ethanol	20427-84-3
2-(2-(2-(2-(*p*-Nonylphenoxy) ethoxy)ethoxy)ethoxy) ethanol	7311-27-5
4-*tert*-octylphenol	140-66-9
Oxirane, methyl-, polymer with oxirane, mono(nonylphenyl)ether	37251-69-7
Paraldehyde	123-63-7
Pentachloroethane	76-01-7
Peracetic acid [2]	79-21-0
Phenol [2]	108-95-2
p-Phenylenediamine [2]	106-50-3
o-Phenylphenol [2]	90-43-7
Phosgene	75-44-5
Phosphorus [16]	7723-14-0
Phthalic anhydride	85-44-9
Polymeric diphenylmethane diisocyanate	9016-87-9
Potassium bromate	7758-01-2
Propargyl alcohol	107-19-7
Propionaldehyde	123-38-6
Propylene	115-07-1
Propylene oxide	75-56-9
Pyridine [2]	110-86-1
Quinoline [2]	91-22-5
p-Quinone	106-51-4
Safrole	94-59-7
Selenium [6]	*
Silver [6]	*
Sodium fluoride	7681-49-4
Sodium nitrite	7632-00-0
Styrene	100-42-5
Styrene oxide	96-09-3
Sulphur hexafluoride	2551-62-4

Name	CAS No.[1]	Name	CAS No.[1]
Sulphuric acid	7664-93-9	1,1,2-Trichloroethane	79-00-5
1,1,1,2-Tetrachloroethane	630-20-6	Trichloroethylene	79-01-6
1,1,2,2-Tetrachloroethane	79-34-5	Triethylamine	121-44-8
Tetrachloroethylene	127-18-4	1,2,4-Trimethylbenzene	95-63-6
Tetracycline hydrochloride	64-75-5	2,2,4-Trimethylhexamethylene diisocyanate	16938-22-0
Thiourea	62-56-6	2,4,4-Trimethylhexamethylene diisocyanate	15646-96-5
Thorium dioxide	1314-20-1	Vanadium [17]	7440-62-2
Titanium tetrachloride	7550-45-0	Vinyl acetate	108-05-4
Toluene	108-88-3	Vinyl chloride	75-01-4
Toluene-2,4-diisocyanate	584-84-9	Vinylidene chloride	75-35-4
Toluene-2,6-diisocyanate	91-08-7	Xylene [18]	1330-20-7
Toluenediisocyanate [11]	26471-62-5	Zinc [6]	*
1,2,4-Trichlorobenzene	120-82-1		

* No single CAS number applies to this NPRI listing.
1 CAS Registry Number denotes the Chemical Abstracts Service Registry Number, as appropriate.
2 "and its salts" – The CAS number corresponds to the weak acid or base. However, the substance includes the salts of these weak acids and bases. When calculating the weight of these substances and their salts, use the molecular weight of the acid or base, not the total weight of the salt.
3 "fume or dust"
4 "fibrous forms"
5 "Ammonia (total)" means the total of both of ammonia (NH_3 – CAS No. 7664-41-7) and the ammonium ion (NH_4^+) in solution.
6 "and its compounds"
7 "friable form"
8 "and its compounds" except hexavalent chromium compounds
9 "all isomers" including, but not limited to, the individual isomers of cresol: *m*-cresol (CAS No. 108-39-4), *o*-cresol (CAS No. 95-48-7) and *p*-cresol (CAS No. 106-44-5)
10 "ionic"
11 "mixed isomers"
12 "all isomers" including, but not limited to, HCFC-122 (CAS No. 354-21-2).
13 "all isomers" including, but not limited to, HCFC-123 (CAS No. 306-83-2) and HCFC 123a (CAS No. 90454-18-5).
14 "all isomers" including, but not limited to, HCFC 124 (CAS No. 2837-89-0), and HCFC 124a (CAS No. 354-25-6).
15 "in solution at a pH of 6.0 or greater"
16 "yellow or white"
17 "(except when in an alloy) and its compounds"
18 "all isomers" including, but not limited to, the individual isomers of xylene: *m*-xylene (CAS No. 108-38-3), *o*-xylene (CAS No. 95-47-6) and *p*-xylene (CAS No. 106-42-3).

PART 1B SUBSTANCES

Name	CAS No.[1]	Name	CAS No.[1]
Mercury [6]	*	**Hexavalent chromium compounds**	*
Cadmium[6]	*	**Lead**[19,20]	*
Arsenic [6]	*	**Tetraethyl lead**	**78-00-2**

19 "and its compounds" except tetraethyl lead
20 Does not include lead (and its compounds) contained in stainless steel, brass or bronze alloys

PART 2 SUBSTANCES

Name	CAS No.[1]	Name	CAS No.[1]
Benzo(a)anthracene	56-55-3	Dibenzo(a,h)anthracene	53-70-3
Benzo(a)phenanthrene	218-01-9	Dibenzo(a,i)pyrene	189-55-9
Benzo(a)pyrene	50-32-8	7H-Dibenzo(c,g)carbazole	194-59-2
Benzo(b)fluoranthene	205-99-2	Fluoranthene	206-44-0
Benzo(e)pyrene	192-97-2	Indeno(1,2,3-c,d)pyrene	193-39-5
Benzo(g,h,i)perylene	191-24-2	Perylene	198-55-0
Benzo(j)fluoranthene	205-82-3	Phenanthrene	85-01-8
Benzo(k)fluoranthene	207-08-9	Pyrene	129-00-0
Dibenz(a,j)acridine	224-42-0		

PART 3 SUBSTANCES

Name	CAS No.[1]	Name	CAS No.[1]
Hexachlorobenzene	118-74-1	Polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans [21]	*

21 This class of substances is restricted to the following congeners:
2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (1746-01-6);
1,2,3,7,8-Pentachlorodibenzo-*p*-dioxin (40321-76-4);
1,2,3,4,7,8-Hexachlorodibenzo-*p*-dioxin (39227-28-6);
1,2,3,7,8,9-Hexachlorodibenzo-*p*-dioxin (19408-74-3);
1,2,3,6,7,8-Hexachlorodibenzo-*p*-dioxin (57653-85-7);
1,2,3,4,6,7,8-Heptachlorodibenzo-*p*-dioxin (35822-46-9);
Octachlorodibenzo-*p*-dioxin (3268-87-9);
2,3,7,8-Tetrachlorodibenzofuran (51207-31-9);
2,3,4,7,8-Pentachlorodibenzofuran (57117-31-4);
1,2,3,7,8-Pentachlorodibenzofuran (57117-41-6);
1,2,3,4,7,8-Hexachlorodibenzofuran (70648-26-9);
1,2,3,7,8,9-Hexachlorodibenzofuran (72918-21-9);
1,2,3,6,7,8-Hexachlorodibenzofuran (57117-44-9);
2,3,4,6,7,8-Hexachlorodibenzofuran (60851-34-5);
1,2,3,4,6,7,8-Heptachlorodibenzofuran (67562-39-4);
1,2,3,4,7,8,9-Heptachlorodibenzofuran (55673-89-7); and
Octachlorodibenzofuran (39001-02-0).

PART 4 SUBSTANCES

Name	CAS No.[1]	Name	CAS No.[1]
Carbon monoxide	630-08-0	Sulphur dioxide	7446-09-5
Oxides of nitrogen (expressed as NO_2)	11104-93-1	Total particulate matter[24]	*
$PM_{2.5}$ [22]	*	Volatile organic compounds[25]	*
PM_{10} [23]	*		

22 means any particulate matter with a diameter less than or equal to 2.5 microns.
23 means any particulate matter with a diameter less than or equal to 10 microns.
24 means any particulate matter with a diameter less than 100 microns.
25 Refer to Appendix 3 of *Supplementary Guide for Reporting Criteria Air Contaminants (CACs)* to the National Pollutant Release Inventory for definition of VOCs.

APPENDIX 10: PUBLIC ACCESS CONTACT INFORMATION

Environmental Commissioner of Ontario http://www.eco.on.ca/

The ECO Resource Centre Catalogue is now available on-line. For more information, please contact the librarian by e-mail at resource.centre@eco.on.ca.

Collection

Ontario government publications, Federal government reports, International governmental and non-governmental publications, Corporate and government annual reports, Environmental legislation and policy literature, Environmental periodicals and reference works, Environmental management literature, Major works on a wide range of environmental issues. To access the publication & forms go to: http://www.eco.on.ca/english/publicat/index.htm

Location, Hours of Operation, Phone and Fax Numbers

The Resource Centre is located at:
1075 Bay Street, Suite 605
Toronto, Ontario M5S 2B1

Phone: (416) 325-0363
Fax: (416) 325-3370

The Resource Centre is open to the public Monday to Friday, from 9:30 a.m. to 5 p.m. We recommend you call ahead to ensure that our librarian will be available to help you.

National and Regional NPRI Offices http://www.ec.gc.ca/pdb/npri/

National Office

National Pollutant Release Inventory
Environment Canada
9th Floor, Place Vincent Massey
351 St. Joseph Blvd.
Gatineau, QC
K1A 0H3
Tel: (819) 953-1656
Fax: (819) 994-3266

Ontario

National Pollutant Release Inventory
Environment Canada
4905 Dufferin Street, 2nd Floor
Downsview, ON
M3H 5T4
Tel: (416) 739-5955
Fax: (416) 739-4326
E-mail: NPRI_ONTARIO@ec.gc.ca

NPRI Software Help Desk

E-mail: nprihelpdesk@ec.gc.ca
Tel: (819) 994-1672
1-877-877-8375

NAFTA: Commission for Environmental Cooperation www.cec.org

CEC Secretariat
Submissions on Enforcement Matters Unit
Commission for Environmental Cooperation
393, rue St-Jacques Ouest,
Bureau 200
Montréal (Québec) H2Y 1N9
Tel.: (514) 350-4300
Fax: (514) 350-4314

CEC Secretariat – Mexico Liaison Office
Progreso No. 3
Viveros de Coyoacan
04110 México, D.F. México
Tel.: (525) 659-5021
Fax: (525) 659-5023

E-mail: info@ccemtl.org
Registry and Public Files:
http://www.cec.org and click on "Citizen Submissions on Enforcement Matters"

GREAT LAKES

International Joint Commission

CANADIAN CONTACTS

Herb Gray – Chair
Robert Gourd – Commissioner
Jack P Blaney – Commissioner

Canadian Head office staff (Ottawa)
http://www.ijc.org/en/background/staff_person_ott.htm
234 Laurier Ave West
22nd Floor
Ottawa, ON K1P 6K6
Tel (6130 995-2984
Fax; 613-993-5583
Contact Fabien Lengelle:
lengellef@ottawa.ijc.org
Regional Office (Windsor)
http://www.ijc.org/en/background/staff_person_wind.htm
100 Ouellette Avenue
8th Floor
Windsor, ON N9A 6T3
Tel: 519-257-6733
Fax: 519-257-6740
Contact: Jennifer Day - dayj@windsor.ijc.org

Conferences

SOLEC – State of Great Lakes Ecosystems Conferences

Information about SOLEC and Great Lakes indicators: http://www.epa.gov/glnpo/solec and http://www.on.ec.gc.ca/solec.
Access to background papers, conference overviews & agendas: www.on.ec.gc.ca/solec/intro.html
To register or for more information: SOLEC@ec.gc.ca

Public Forums

Lake Erie LAMP Bi-national Public Forum http://erieforum.org/

The Lake Erie Forum is a cooperative bi-national organization of diverse stakeholders whose objective is to restore, protect, and utilize Lake Erie waters to achieve maximum sustainable social and economic benefits by promoting: ecosystem health, diversity and stewardship; recognition and protection of unique environmental areas, such as wetlands, wilderness, open space; the enhancement and maintenance of public access to the lake and shoreline; the protection of indigenous species and their habitats; shoreline and lake uses which encourage a healthy economy and environment and are in the public interest; and meaningful opportunity for public participation in decisions that affect the lake.

The Lake Superior Bi-national Public Forum
http://www.superiorforum.info/

The Lake Superior Bi-national Forum is the public advisory body for the Lake Superior Bi-national Program. It consists of 24 volunteer members from various sectors including small business, environmental organizations, industry, Native American, First Nations and academia. Its purpose is to advise governments about critical issues relating to Lake Superior such as discharge of toxic substances, pollution prevention and restoration efforts. The members of this body are also responsible for developing creative new strategies for eliminating pollutants and contributing towards the foundations of a new economy.

APPENDIX 10: PUBLIC ORGANIZATIONS & NGO's

ENVIRONMENTAL GROUPS & ORGANIZATIONS

Canadian Association of Physicians for the Environment	http://www.cape.ca/
Canadian Centre for Pollution Prevention (C2P2)	http://www.c2p2online.com/
Canadian Environmental Law Association (CELA)	http://www.cela.ca/
Canadian Institute for Environmental Law and Policy (CIELAP)	http://www.cielap.org/
Canadian Parks and Wilderness Society (CPAWS)	http://www.cpaws.org/
Center for Clean Products and Clean Technologies	http://eerc.ra.utk.edu/ccpct/index.html
Citizens Environmental Alliance	http://www.citizensenvironmentalliance.org/
Coming Clean	http://www.comeclean.org/
Detroit River Canadian Cleanup Committee	http://www.drccc.info/
Earth Justice	http://www.earthjustice.org/
Public Concern Temiskaming	http://www.publicconcern.org/
Environmental Working Group	http://www.ewg.org/
Evergreen Foundation	http://www.evergreen.ca/
Global Action Center	http://www.globalaction.org/do/Home
Green Roofs for Healthy Cities	http://www.peck.ca/grhcc/main.htm
Greenpeace Canada	http://www.greenpeace.ca/
International Institute for Sustainable Development (IISD)	http://www.iisd.org/
Little River Enhancement Group	http://www.lilreg.com/
National Wildlife Federation	http://www.nwf.org/
Native Forest Network	http://www.nativeforest.org/
Natural Resources Defense Council	http://www.nrdc.org/
Ontario Clean Air Alliance (OCAA)	http://www.cleanair.web.ca/
Ontario Environment Network (OEN)	http://www.oen.ca/
Ontario Nature	http://www.ontarionature.org/index.php3
Ontario Stewarship	www.ontariostewardship.org/
Pollution Probe	www.pollutionprobe.ca/
The Sustainability Network	http://sustain.web.ca/
Toronto Environmental Alliance	http://www.torontoenvironment.org/
Tree Canada Foundation	http://www.treecanada.ca/
Wild Canada	http://www.wildcanada.net/
Wildlands League	http://www.wildlandsleague.org
World Wildlife Fund Canada	http://www.wwfcanada.org/
Earthroots	http://www.earthroots.org/
S.T.O.R.M	http://www.stormco.org/
Federation of Ontario Naturalists	www.ontarionature.org/educate
Friends of the Rouge Watershed	http://www.frw.on.ca/
Wetland Habitat Fund	www.wetlandfund.com/

ENVIRONMENTAL EDUCATION & INFORMATION

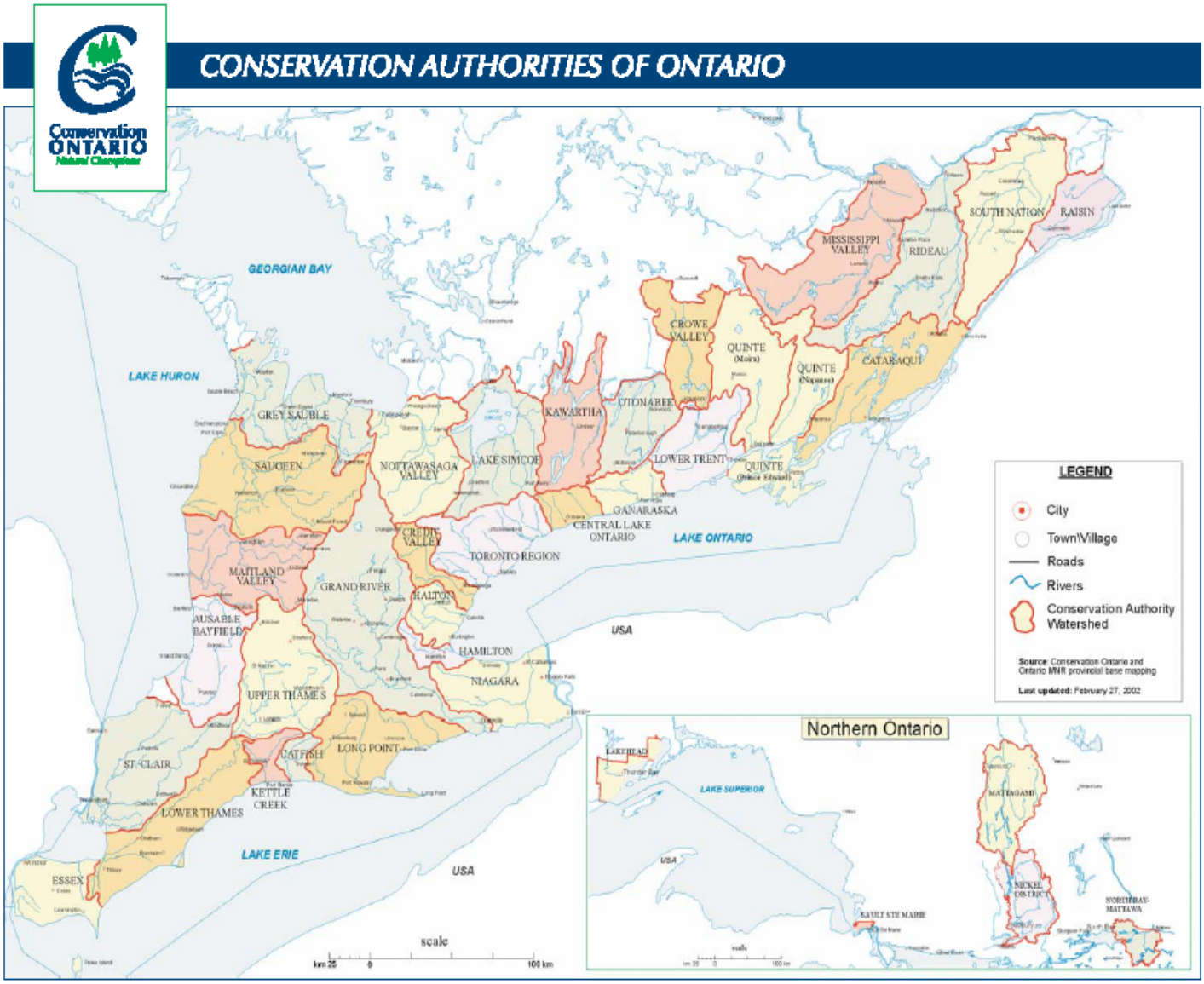
Alternatives Journal	http://www.alternativesjournal.ca/
Canadian Centre for Occupational Health and Safety (CCOHS)	http://www.ccohs.ca/
Climate Change Solutions	http://www.climatechangesolutions.com/

E Magazine	http://www.emagazine.com/
Earth Times	http://www.earthtimes.org/
Ecocycle Newsletter	http://www.ec.gc.ca/ecocycle/
Elements Environmental Magazine	http://www.elements.nb.ca/
Environmental Data Interactive Exchange (Edie)	http://www.edie.net/
Environmental Protection Magazine	http://www.eponline.com/
Global Information Network on Chemicals (GINC)	http://www.nihs.go.jp/GINC/
Go for Green	http://www.goforgreen.ca/
Green Roofs	http://www.greenroofs.com/
Great Lakes Information Network (GLIN)	http://www.great-lakes.net/
Green Ontario	http://www.greenontario.org/
Green Teacher	http://www.greenteacher.com/
Nuclear Information and Resource Service (NIRS)	http://www.nirs.org/
PBS: Trade Secrets	http://www.pbs.org/tradesecrets/
Planet Ark	http://www.planetark.org/
Second Nature - Education for Sustainability	http://www.secondnature.org/

ENVIRONMENTAL MISCELLANEOUS

Canadian Centre for Policy Alternatives	http://www.policyalternatives.ca/
Corporate Watch	http://www.corpwatch.org/
Council of Canadians	http://www.canadians.org/
Eco-Portal	http://www.eco-portal.com/
EcologyFund	http://www.ecologyfund.com/ecology/_ecology.html
Great Lakes Radio Consortium	http://www.glrc.org/
Green Fire Productions (media & communications)	http://www.greenmedia.org/
The Rainforest Site	http://www.therainforestsite.com

APPENDIX 11: CONSERVATION AUTHORITIES MAP & CONTACT INFORMATION



CONSERVATION ONTARIO

CONSERVATION AUTHORITIES OF ONTARIO

120 BAYVIEW PARKWAY, BOX 11
NEWMARKET, ON L3Y 4W3
TEL: 905-895-0716
FAX: 905-895-0751
info@conservation-ontario.on.ca
www.conservation-ontario.on.ca

Conservation Authority	Address	Telephone	Fax	E-mail	Website
Ausable Bayfield Conservation Authority	71108 Morrison Line, RR 3, Exeter, ON N0M 1S5	519-235-2610 1-888-286-2610	519-235-1963	info@abca.on.ca	www.abca.on.ca
Cataraqui Region Conservation Authority	Box 160, 1641 Perth Road, Glenburnie, ON K0H 1S0	613-546-4228	613-547-6474	crca@cataraquiregion.on.ca	www.cataraquiregion.on.ca
Catfish Creek Conservation Authority	RR 5, Aylmer, ON N5H 2R4	519-773-9037	519-765-1489	ccca@execulink.com	www.execulink.com/~ccca/
Central Lake Ontario Conservation	100 Whiting Avenue, Oshawa, ON L1H 3T3	905-579-0411	905-579-0994	mail@cloca.com	www.cloca.com
Conservation Halton	2596 Britannia Road West, RR 2, Milton, ON L9T 2X6	905-336-1158	905-336-7014	admin@hrca.on.ca	www.conservationhalton.on.ca
Credit Valley Conservation	1255 Old Derry Road, Mississauga, ON L5N 6R4	905-670-1615 1-800-668-5557	905-670-2210	cvc@creditvalleycons.com	www.creditvalleycons.com
Crowe Valley Conservation	70 Hughes Lane, Box 416, Marmora, ON K0K 2M0	613-472-3137	613-472-5516	info@crowevalley.com	www.crowevalley.com
Essex Region Conservation Authority	360 Fairview Avenue West, Essex, ON N8M 1Y6	519-776-5209	519-776-8688	admin@erca.org	www.erca.org
Ganaraska Region Conservation Authority	P.O. Box 328, Port Hope, ON L1A 3W4	905-885-8173	905-885-9824	info@grca.on.ca	www.grca.on.ca
Grand River Conservation Authority	400 Clyde Road, Box 729, Cambridge, ON N1R 5W6	519-621-2761	519-621-4844	grca@grandriver.ca	www.grandriver.ca
Grey Sauble Conservation Authority	RR 4, Owen Sound, ON N4K 5N6	519-376-3076	519-371-0437	admin@greysauble.on.ca	www.greysauble.on.ca
Hamilton Conservation Authority	838 Mineral Springs Rd, Box 7099, Ancaster, ON L9G 3L3	905-525-2181	905-648-4622	nature@conservationhamilton.ca	www.hamrca.on.ca
Kawartha Conservation	277 Kenrei Park Road, RR 1, Lindsay, ON K9V 4R1	705-328-2271	705-328-2286	geninfo@kawarthaconservation.com	www.kawarthaconservation.com
Kettle Creek Conservation Authority	44015 Ferguson Line, R. R. 8, St. Thomas, ON N5P 3T3	519-631-1270	519-631-5026	kryan@kettlecreekconservation.on.ca	www.kettlecreekconservation.on.ca
Lakehead Region Conservation Authority	Box 10427, 130 Conservation Rd, Thunder Bay, ON P7B 6T8	807-344-5857	807-345-9156	lakeca@tbaytel.net	www.lakeheadca.com
Lake Simcoe Region Conservation Authority	Box 282, 120 Bayview Parkway, Newmarket, ON L3Y 4X1	905-895-1281	905-853-5881	info@lsrca.on.ca	www.lsrca.on.ca
Long Point Region Conservation Authority	RR 3, Simcoe, ON N3Y 4K2	519-428-4623	519-428-1520	conservation@lprca.on.ca	www.lprca.on.ca
Lower Thames Valley Conservation Authority	100 Thames Street, Chatham, ON N7L 2Y8	519-354-7310	519-352-3435	ltvca@MNSi.net	www.lowerthames-conservation.on.ca
Lower Trent Conservation	441 Front Street, Trenton, ON K8V 6C1	613-394-4829	613-394-5226	information@ltc.on.ca	www.ltc.on.ca
Maitland Valley Conservation Authority	Box 127, 69 Marietta Street, Wroxeter, ON N0G 2X0	519-335-3557	519-335-3516	maitland@mvca.on.ca	www.mvca.on.ca
Mattagami Region Conservation Authority	100 Lakeshore Road, Timmins, ON P4N 8R5	705-360-1392	705-360-1394	mrca@city.timmins.on.ca	www.city.timmins.on.ca/MunicipalMrca.htm
Mississippi Valley Conservation	Box 268, Lanark, ON K0G 1K0	613-259-2421	613-259-3468	info@mvc.on.ca	www.mvc.on.ca
Niagara Peninsula Conservation Authority	250 Thorold Road West, 3rd Floor, Welland, ON L3C 3W2	905-788-3135	905-788-1121	npca@conservation-niagara.on.ca	www.conservation-niagara.on.ca
Nickel District Conservation Authority	Tom Davies Square, 200 Brady Street, Sudbury, ON P3E 5K3	705-674-5249	705-674-7939	ndca@city.greatersudbury.on.ca	www.ndca.com
North Bay-Mattawa Conservation Authority	701 Oak Street East, North Bay, ON P1B 9T1	705-474-5420	705-474-9793	nbmca@nbmca.on.ca	www.nbmca.on.ca
Nottawasaga Valley Conservation Authority	8195 8th Line, Utopia, ON L0M 1T0	705-424-1479	705-424-2115	admin@nvca.on.ca	www.nvca.on.ca
Otonabee Conservation	250 Milroy Drive, Peterborough, ON K9H 7M9	705-745-5791	705-745-7488	otonabeeca@otonabee.com	www.otonabee.com
Quinte Conservation	R.R. #2 2061 Old, Hwy 2, Belleville, ON K8N 4Z2	613-968-3434	613-968-8240	quinteca@quinteconservation.ca	www.pec.on.ca/conservation/
Raisin Region Conservation Authority	P.O. Box 429, 18045 County Road 2, Cornwall, ON K6H 5T2	613-938-3611	613-938-3221	info@rrca.on.ca	www.rrca.on.ca
Rideau Valley Conservation Authority	Box 599, 1128 Mill Street, Manotick, ON K4M 1A5	613-692-3571	613-692-0831	postmaster@rideauvalley.on.ca	www.rideauvalley.on.ca
Saugeen Conservation	RR 1, Hanover, ON N4N 3B8	519-364-1255	519-364-6990	publicinfo@svca.on.ca	www.svca.on.ca
Sault Ste Marie Region Conservation Authority	1100 Fifth Line East, RR 2, Sault Ste Marie, ON P6A 6K7	705-946-8530	705-946-8533	nature@ssmrca.ca	www.ssmrca.ca
South Nation Conservation	Box 69, 15 Union Street, Berwick, ON K0C 1G0	613-984-2948	613-984-2872	info@nation.on.ca	www.nation.on.ca
St. Clair Region Conservation Authority	205 Mill Pond Crescent, Strathroy, ON N7G 3P9	519-245-3710	519-245-3348	stclair@scrca.on.ca	www.scrca.on.ca
Toronto and Region Conservation Authority	5 Shoreham Drive, Downsview, ON M3N 1S4	416-661-6600	416-661-6898	info@trca.on.ca	www.trca.on.ca
Upper Thames River Conservation Authority	1424 Clarke Road, London, ON N5V 5B9	519-451-2800	519-451-1188	infoline@thamesriver.on.ca	www.thamesriver.on.ca

ACRONYMS

AEM	Adaptive Environmental Management
AMO	Association of Municipalities of Ontario
AoC	Area of Concern
ATSDR	Agency for Toxic Substances and Disease Registry (under the US Department of Health)
BIA	Biodiversity Investment Area
BMP(s)	Best Management Practices
BOD	Biological Oxygen Demand
BU	Beneficial Use
BUI	Beneficial Use Impairment
CA	Conservation Authority
CAPMoN	Canadian Air and Precipitation Monitoring Network
CBO	Chief Building Officiers
Cd	Cadmium
CEAA	Canadian Environmental Assessment Act
CEC	Commission for Environmental Cooperation
CELA	Canadian Environmental Law Association
CEPA	Canadian Environmental Protection Act
CIELAP	Canadian Institute for Environmental Law and Policy
CO	Conservation Ontario
CO	Carbon monoxide
COA	Canadian-Ontario Agreement Respecting the Great Lakes Basin Ecosystem
Cs	Cesium
CSO	Combined Sewer Overflow
CWS	Canadian Wildlife Service
DELT	Deformities, Eroded fins, Lesions and Tumors
DDE	Metabolite of DDT
DDT	Dichlorodiphenyltrichloroethane
DFO	Department of Fisheries and Oceans Canada
DWMCIS	Drinking Water Management and Compliance Information System
EBR	Environmental Bill of Rights
EC	Environment Canada
EC	Environmental Commission
ECO	Environmental Commissioner's Office of Ontario
EFP	Environmental Farm Plans
EFPP	Environmental Farm Plan Program
EMP(s)	Environmental Servicing Plans
ENGO	Environmental Non-governmental Organization
EPA	Environmental Protection Act
F2	2nd generation: offspring from successful mating

FCGO	Fish Community Goals and Objectives
FERC	Federal Energy Regulatory Commission (U.S.)
FFG	Functional Feeding Groups
FTE	Full Time Equivalent (with respect to number of employees)
GIS	Geographic Information System
GLFC	Great Lakes Fishery Commission
GLWQA	Great Lakes Water Quality Agreement, as amended by Protocol signed November 18, 1987
Ha	Hectare; 10,000 square meters; 2.47 acres
HCB	Hexachlorobenzene
Hg	Mercury
IADN	International Atmospheric Deposition Network
IBI	Index of Biotic Integrity
IJC	International Joint Commission
IRIS	Integrated Risk Information System
IUCN	International Union for the Conservation of Nature
JPAC	Joint Public Advisory Committee
LaMP	Lake-wide Management Plan
LRTAP	Long-Range Transport of Atmospheric Pollutants
MAB	Man and the Biosphere. Initiated by UNESCO to address problems relating to conservation of resources, resources systems, and human settlement development.
MESP(s)	Master Environmental Servicing Plans
MISA	Municipal Industry Strategy for Abatement
MMAH	Ministry of Municipal Affairs and Housing
MMER	Metal Mining Effluent Regulations
MMP	Marsh Monitoring Program
MNR	Ministry of Natural Resources
MOE	Ministry of Environment
MoU	Memory of Understanding
NAAEC	North American Agreement on Environmental Cooperation
NAFEC	North American Fund for Environmental Cooperation
NAFTA	North American Free Trade Agreement
NDDN	National Dry Deposition Network (U.S. Park Service)
NGO	Non-governmental Organization
NLC	Neighborhood Liaison Committee
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOx	Nitrogen Oxides (nitrous, nitric)
NPRI	National Pollutant Release Inventory
NPS	Non-point Source

O3	Ozone
OCWA	Ontario Clean Water Agency
ODWO	Ontario Drinking Water Objectives
OFAT	Ontario Flow Assessment Techniques
Ohio	EPA Ohio Environmental Protection Agency
OMAF	Ontario Ministry of Agriculture and Food
OMB	Ontario Municipal Board
OMOE	Ontario Ministry of the Environment
OWRA	Ontario Water Resources Act
PAC	Public Advisory Committee
PAH	Polynuclear aromatic hydrocarbons
Pb	lead
PBT	Persistent, Bioaccumulative, and Toxic chemicals
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated dibenzo dioxins
PCDF	Polychlorinated dibenzo furans
PGMIS	Provincial Groundwater Monitoring Information System
POPs	Persistent Organic Pollutants
PPS	Provincial Policy Statement
PTS	Persistent Toxic Substance
PTTW	Permit to take Water
PUC	Public Utility Commission
PWQO	Provincial Water Quality Objective
RAMSAR	The Convention on Wetlands, signed in RAMSAR, Iran in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
RAP	Remedial Action Plan
SEV	Statements of Environmental Values
SO2	Sulfur dioxide
SO4	
SOLEC	State of the Lakes Ecosystem Conference
SP	Suspended Particulates
SPP(s)	Source Protection Plans
spp.	Species
SPPB	Source Protection Planning Board
SPPC(s)	Source Protection Plan Committee
Sr	Strontium
TRA	Toronto Regional Area
TRCA	Toronto Regional Conservation Authority
TRS	Total Reduced Sulfur
UNESCO	United Nations Educational, Scientific and Cultural Organization

USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
WMWG	Water Management Working Group
WQB	Water Quality Board
WRIP	Water Resources Information Project
WRT	Waterfront Regeneration Trust
WWFMMP	Wet Weather Flow Master Plan

GLOSSARY

accepted engineering principles
Those current coastal and hydraulic engineering principles, methods and procedures that would be judged by a peer group of qualified engineers (by virtue of their training and experience), as being reasonable for the scale and type of project being considered, the sensitivity of the location, and the potential threats to life and property.

accepted geotechnical principles
Those current geotechnical engineering principles, methods and procedures that would be judged by a peer group of qualified engineers (by virtue of their training and experience), as being reasonable for the scale and type of project being considered, the sensitivity of the location, and the potential threats to life and property.

accepted scientific principles
Those current principles, methods and procedures, which are used and applied in disciplines such as geology, geomorphology, hydrology, botany and zoology, and would be judged by a peer group of qualified specialists and practitioners (by virtue of their training and experience), as being reasonable for the scale and type of project being considered, the sensitivity of the location, and the potential threats to life and property.

address
Those standards and procedures intended to alleviate or reduce the impacts associated with flooding, erosion and other water related hazards which are used and applied in current coastal and hydraulic engineering, geotechnical and scientific practices.

adverse environmental impacts
Those physical, biological and environmental changes which are of long-term duration, where the rate of recovery is low, where there is a high potential for direct and/or indirect effects and/or where the areas is considered to be critical habitat or of critical significance to the protection, management and enhancement of the shoreline ecosystem.

aquifer
A water-bearing layer (or several layers) of rock or sediment capable of yielding supplies of water; typically is unconsolidated deposits or sandstone, limestone or granite; and can be classified as confined or unconfined.

Area of Concern (AoC)
In 1985, the International Joint Commission (IJC)'s Great Lakes Water Quality Board identified 43 Areas of Concern (AoCs) around the Great Lakes where ecosystem degradation was particularly pronounced.

artesian aquifer
An aquifer that contains water under pressure results in a hydrostatic head which stands above the local water table or above the ground level. For artesian conditions to exist, an aquifer must be overlain by a confining material and receive a supply of water.

artesian well
A well whose water is supplied by a artesian aquifer .

average annual recession rate
Refers to the average annual linear landward retreat of a shoreline or river bank.

bankfull discharge
The formative flow of water that characterizes the morphology (shape) of a fluvial channel. In a single channel stream, bankfull is the discharge which just fills the channel without flowing onto the floodplain.

baseflow
That portion of streamflow derived from groundwater storage to surface streams .

bedrockbedrock
A general term for any consolidated rock.

Beneficial use (BU)
Those human and non-human activities which are dependant on the chemical, physical and biological integrity of the waters of the Great Lakes system.

best management practices (BMPs)
Structural, non-structural and managerial techniques that are recognized to be the most effective and practical means to control non-point source pollutants yet are compatible with the productive use of the resource to which they are applied. BMPs are used in both urban and agricultural areas.

biodegradation
Decomposition of a substance into more elementary compounds by the action of micro-organisms such as bacteria.

biosphere
All living organisms (plant and animal life).

biotransformation
Conversion of a substance into other compounds by organisms; includes biodegradation .

bluff (Great Lakes-St. Lawrence River system and large inland lakes)
Those sections of the shoreline formed in non-cohesive or cohesive sediments where the land rises steeply away from the water such that the elevation of the top of the slope above the base or toe of the slope is greater than two metres and the average slope angle exceeds 1:3 (=18 degrees).

bored well
A well drilled with a large truck-mounted boring auger, usually 12 inches or more in diameter and seldom deeper than 100 feet.

Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA): Canada and Ontario have entered into an agreement in 1994 to renew and strengthen federal-provincial

planning, cooperation and coordination in implementing actions to restore and protect the ecosystem, to prevent and control pollution into the ecosystem, and to conserve species, populations and habitats in the Great Lakes Basin Ecosystem. Implementation of this agreement contributes substantially to meeting Canada's obligations under the 1987 GLWQA.

capillary forces
The forces between water molecules and the clay (or any soil particle) surfaces. Capillary flow refers to water that moves in response to differences in capillary forces. It includes all water between Soil Moisture Tension = 0 and air dry.

channel configuration
The type or morphology of a river or stream channel as determined by the interaction of a number of channel related factors, including width, depth, shape, slope and pattern.

cliff (Great Lakes-St. Lawrence River system and large inland lakes)
Those sections of the shoreline normally formed in bedrock where the land rises steeply away from the water such that the elevation of the top of the slope above the base or toe of the slope is greater than two metres and the average slope angle exceeds 1:3 (=18 degrees).

condensation
The process by which water vapour is cooled to the liquid phase.

confined aquifer
An aquifer in which ground water is confined under pressure which is significantly greater than atmospheric pressure; and whose upper, and perhaps lower, boundary is defined by a layer of natural material that does not transmit water readily. See artesian aquifer .

confining layer
Geological material through which significant quantities of water move at a very slow rate; located below unconfined aquifers , above and below confined aquifers . Also known as a confining bed.

consumptive use
Refers to the portion of water withdrawn or withheld from the Great Lakes Basin and assumed to be lost or otherwise not returned to the Basin due to evaporation, incorporation into products, or other processes.

critical flood depth and velocity
A maximum depth and velocity of flooding water in a floodplain such that further increases in depth and/or velocity may result in threats to life and property damage.

critical loading
The amount of deposition from a particular substance (e.g. sulphur) that can occur while maintaining water quality conditions adequate for sensitive species survival.

discharge
The flow of surface water in a stream or canal, or the outflow of groundwater to a well, ditch or spring .

diversions
Refers to the transfer of water from the Great Lakes Basin into another watershed, or from the watershed of one of the Great Lakes into that of another.

drainage basin
The area of land, surrounded by divides, that provides runoff to a fluvial network that converges to a single channel or lake at the outlet.

drainage water
Water which has been collected by a gravity drainage or dewatering system.

drainage well
A pumped well in order to lower the water table; a vertical shaft to a permeable substratum into which surface and subsurface drainage is channelled.

drilled well
A well usually 10 inches or less in diameter, drilled with a drilling rig and cased with steel or plastic pipe. Drilled wells can be of varying depth.

drought
Drought is a complex term that has various definitions, depending on individual perceptions. For the purposes of low water management, drought is defined as weather and low water conditions characterized by one or more of the following:

-below normal precipitation for an extended period of time (for instance three months or more), potentially combined with high rates of evaporation that result in lower lake levels, streamflows or baseflow, or reduced soil moisture or groundwater storage
-streamflows at the minimum required to sustain aquatic life while only meeting high priority demands for water, water wells becoming dry, surface water in storage allocated to maintain minimum streamflows
-socio-economic effects occurring on individual properties and extending to larger areas of a watershed or beyond.
As larger areas are affected and as low water and precipitation conditions worsen, the effects usually become more severe

dug well
A large diameter well dug by hand or by an auguring machine, usually old and often cased by concrete or hand-laid bricks.

dynamic balance or nature
A system that is continuously altering itself to adjust to constant changes of its component parts.

What is an ecosystem?
An ecosystem is a biological community of interacting organisms and their physical environment.

effective precipitation

The part of precipitation which produces runoff ; a weighted average of current and past precipitation correlating with runoff. It is also that part of the precipitation falling on an irrigated area which is effective in meeting the requirements of consumptive use.

effluent
The discharge of a pollutant in a liquid form, often from a pipe into a stream or river .

environmentally sound
Refers to those principles, methods and procedures involved in addressing the protection, management and enhancement of the ecosystem which are used in disciplines such as geology, geomorphology, hydrology, botany and zoology and applied in the valid study of shoreline and fluvial processes, vegetation, wildlife and aquatic habitat resource management.

erosion
The wearing away of the land surface by running water, wind, ice or other geological agents, including such processes as gravitational creep. Geological erosion is natural occurring erosion over long periods of time.

eutrophication
The natural or artificial process of nutrient enrichment whereby a waterbody becomes filled with aquatic plants and low oxygen content. The low oxygen level is detrimental to fish.

evaporation
The process by which liquid water is transferred into the atmosphere.

evapotranspiration
The combined loss of water to the atmosphere from land and water surfaces by evaporation and from plants by transpiration .

factor of safety
The ratio of resistance or strength of a material or structure to the applied load. In geotechnical engineering, it refers to the ratio of the available shear strength to shear stress on the critical failure surface.

field capacity
The capacity of soil to hold water at atmospheric pressure. It is measured by soil scientists as the ratio of the weight of water retained by the soil to the weight of the dry soil.

flood
A flood is an overflow or inundation that comes from a river or other body of water and causes or threatens damage. It can be any relatively high streamflow overtopping the natural or artificial banks in any reach of a stream . It is also a relatively high flow as measured by either gauge height or discharge quantity.

floodplain
A strip of relatively level land bordering a stream or river . It is built of sediment carried by the stream and dropped when the water has flooded the area. It is called a water floodplain if it is

overflowed in times of high water, or a fossil floodplain if it is beyond the reach of the highest flood .

flow
The rate of water discharged from a source, given in volume with respect to time.

flow regime
Refers to the basin's flow magnitude and duration given a particular precipitation event (amount and intensity) and also the frequency of the events. Given the temporal component of frequency, a basin's flow regime would encompass baseflow, low magnitude (high frequency events) and high magnitude (low frequency events).

fractures
Cracks in bedrock that may result in high permeability values .

gauging station
The site on a stream , lake or canal where hydrologic data is collected.

GIS (geographic information system)
A map-based database management system which uses a spatial reference system for analysis and mapping purposes.

great lakes basin
Refers to the watershed of the Great Lakes and the St. Lawrence River upstream from Trois Rivieres, Quebec. The GLWQA defines the Great Lakes Basin as: all of the streams, rivers, lakes and other bodies of water that are within the drainage basin of the St. Lawrence River at or upstream from the point at which this river becomes the international boundary between Canada and the U.S...

great lakes basin water resources
Refers to the Great Lakes and all other bodies of water (streams, rivers, lakes, connecting channels, tributary groundwater) within the Great Lakes Basin.

Great Lakes Water Quality Agreement of 1978 (GLWQA), as amended by Protocol signed November 18, 1987: An agreement between the U.S. and Canada to restore and maintain the chemical, physical, and biological integrity of the water of the Great Lakes Basin Ecosystem.

grey water
Domestic wastewater other than that containing human excrete, such as sink drainage, washing machine discharge or bath water.

groundwater
Water occurring in the zone of saturation in an aquifer or soil.

groundwater recharge
The inflow to a groundwater reservoir.

groundwater reservoir

An aquifer or aquifer system in which groundwater is stored. The water may be placed in the aquifer by artificial or natural means.

groundwater storage
The storage of water in groundwater reservoirs .

hardness
A characteristic of water caused by various salts, calcium, magnesium and iron (e.g. bicarbonates, sulfates, chlorides and nitrates).

herbicide
Chemicals used to kill undesirable vegetation.

high magnitude
An event that is of great importance in terms of its impacts

humification
The soil forming process that transforms plant tissues into organic matter, on or in soil.

hydraulic flow
The flow of water in a channel as determined by such variables as velocity, discharge, channel roughness and shear stress.

hydrogeologic conditions
Conditions stemming from the interaction of groundwater and the surrounding soil and rock.

hydrogeologist
A person who works and studies with groundwater .

hydrogeology
The geology of groundwater , with particular emphasis on the chemistry and movement of water.

hydrogeologic cycle
The circulation of water in and on the earth and through the earth's atmosphere through evaporation, condensation, precipitation, runoff, groundwater storage and seepage, and re-evaporation into the atmosphere.

hydrology
The study of the occurrence, distribution and circulation of the natural waters of the earth.

hydropower
Power produced by falling water.

hydrosphere
Water held in oceans, river, lakes, glaciers, groundwater, plants, animals, soil and air.

impervious
A term denoting the resistance to penetration by water or plant roots.

impoundment
A body of water, such as a pond, confined by a dam, dyke, floodgate or other barrier. It is used to collect and store water for future use or treatment.

indicator graph
Plot of monthly values of streamflow or precipitation vs. time at a station that has been designated as an indicator of conditions in that geographical location.

infiltration
The downward entry of water through the soil surface into the soil.

infiltration capacity
The maximum rate at which a given soil in a given condition can absorb rain as it falls.

infiltration rate
The quantity of water that enters the soil surface in a specified time interval. Often expressed in volume of water per unit of soil surface area per unit of time (eg. cm/hr).

International Joint Commission (IJC)
The IJC was established under the Boundary Waters Treaty between Canada and the United States, in 1909. There are six Commissioners three from each country. The Commissioners act impartially, reviewing problems and deciding on issues regarding shared waters.

irrigation
The controlled application of water for agricultural purposes through man-made systems to supply water requirements not satisfied by rainfall .

karst formations
Karst formations are limestone regions where underground drainage has formed cavities and passages that cave in, causing craters on the surface. The name comes from the Karst, a limestone region along the northern Adriatic coast in the former Yugoslavia.

lagoon
Water impoundment in which organic wastes are stored or stabilized, or both.

lakeward
A perspective from the land towards the lake or river.

landward
A perspective from the lake or river towards the land.

largest amplitude meander
The meander with the largest measured amplitude in a meandering reach. Amplitude is measured mid-channel to mid-channel and is the horizontal distance perpendicular to the longitudinal axis between two bends in the fluvial system.

leachate

Liquids that have percolated through a soil and that carry substances in solution or suspension.

leaching
The downward transport of dissolved or suspended minerals, fertilizers and other substances by water passing through a soil or other permeable material.

life cycle: Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to the final disposal.

littoral cell
A self-contained shoreline sediment system that has no movement of sediment across its boundaries. The alongshore limits are defined by natural formations or artificial barriers where the net sediment movement changes direction or becomes zero.

low plain (Great Lakes-St. Lawrence River system and large inland lakes)
Those sections of the shoreline formed in non-cohesive or cohesive sediments where the land rises gently away from the water.

meandering system
A dynamic system where semi-circular curves or bends develop in a fluvial system resulting from erosion of a sediment on the outer-bank and deposition of sediment on the inner-bank of the curves or bends. Erosion and deposition processes are themselves dynamic in response to channel configuration, hydraulic flow and sediment yield.

meteorology
The science of the atmosphere; the study of atmospheric phenomena.

minimum streamflow
The specific amount of water reserved to support aquatic life, to minimize pollution, or for recreation. It is subject to the priority system and does not affect water rights established prior to its institution.

moisture
Water diffused in the atmosphere or the ground.

natural flow
The rate of water movement past a specified point on a natural stream . The flow comes from a drainage area in which there has been no stream diversion caused by storage, import, export, return flow, or change in consumptive use caused by man-controlled modifications to land use. Natural flow rarely occurs in a developed area.

nitrate (NO3)
An important plant nutrient and type of inorganic fertilizer (most highly oxidized phase in the nitrogen cycle). In water, the major sources of nitrates are septic tanks, feed lots and fertilizers.

nitrite (NO2)
Product in the first step of the two-step process of conversion of ammonium (NH4) to nitrate (NO3) .

non-point source pollution
Pollution of the water from numerous locations that are hard to identify as point source. For example, agriculture and urban diffuse source runoff.

organic compounds
Natural or synthetic substances based on carbon.

outflow
Flow released from a pond or reservoir, or lakes.

over-withdrawal
Withdrawal of groundwater over a period of time that exceeds the recharge rate of the supply aquifer .

percolation
The state of water movement in the soil or aquifer ; that is, water that moves through the soil at a depth below the root zone .

permeability
The voids in a soil or aquifer media that allows passage of water through the media at a measured rate.

persistent Toxic Substances: Those substances which have a long half-life in the environment. Substances identified in the Strategy have been nominated from multiple selection processes. It is recognized that there are different definitions of persistence which are used in the various U.S. and Canadian domestic programs.

pH
A numerical measure of acidity, or hydrogen ion activity used to express acidity or alkalinity. Neutral value is pH 7.0, values below pH 7.0 are acid, and above pH 7.0 are alkaline.

piping
The internal erosion and carrying away of fine material from within a soil as the result of a flow of water. It refers to the pipe-shaped discharge channel left by erosion which starts at the point of exit of a flow line which exits on the ground surface; typically beneath embankments or on slopes where perched groundwater may seep out.

pockmarked topography
Refers to a Karst landscape where the land surface has the general appearance of being scarred and pitted (surface depressions, craters, etc.)

point-source pollution
Pollution of water from one place in a concentrated manner that is easy to identify. For example, effluent discharge from sewage treatment plants or industrial plants.

pollution plume
An area of a stream or aquifer containing degraded water resulting from migration of a pollutant.

porosity
The percentage of space in the soil or aquifer mass not occupied by solids with respect to the total volume of mass.

potable water
Water that is fit to drink.

ppm (parts per million)
A common basis for reporting water analysis. One ppm equals one unit of measurement per million units of the same measurement.

precipitation
Moisture falling from the atmosphere in the form of rain, snow, sleet or hail.

precipitation indicators
Precipitation is the most important and convenient indicator. Reviewing the precipitation data and comparing it to trends will warn of an impending water shortage. Two precipitation indicators are used:

Percent of average = 100 x total monthly precipitation / total average precipitation for those months. Average precipitation for the month is calculated by summing the monthly precipitation amounts for each year they were recorded at that station and dividing by the total number of years. The percent of average will be calculated for each month and indicators will be determined for the previous 18 months (long term) and the previous three months (seasonal). Under a Level I condition or higher, the previous month (short-term) will also be used, with weekly updates. If a watershed is under a Level I or Level II condition, MNR will add up the number of consecutive readings that register no rain (less than 7.6mm).

precipitation indicator graph
Each month the actual and average monthly precipitation in millimetres (mm), are plotted for the previous 18 months. One plot shows the monthly total amounts and the other plots show the accumulated monthly totals, month by month over the 18 month period. Currently, true indicators are not used but data from selected Environment Canada Synoptic stations across south-central Ontario is plotted.

principal aquifer
The **aquifer** in a given area that is the important economic source of water to wells for drinking, irrigation, etc.

quality assurance
The procedural and operational framework used by modellers to assure technically and scientifically adequate execution of the tasks included in the study to assure that all analysis is reproducible and defensible.

rain guage
Any instrument used for recording and measuring time, distribution and the amount of rainfall.

rainfall
The quantity of water that falls as rain only.

reach (river and streams)
Refers to a length of channel over which the channel characteristics are stable or similar. All geomorphological features and types of aquatic habitat should be proportionately represented in the section of the river or stream being assessed, and at least two of each of the major features of the section should be represented.

recharge zone
The area of land, including caves, sinkholes, faults, fractures and other permeable features, that allows water to replenish an aquifer. This process occurs naturally when rainfall filters down through the soil or rock into an aquifer.

release: A release is any introduction of a toxic chemical to the environment as a result of human activity. This includes emissions to the air; discharges from point and non-point sources to bodies of water; introductions to land, including spills or leaks from waste piles, contained disposal into underground injection wells, or other sources.

resulting from human activity: Any and all sources resulting from human activity, including but not limited to releases from industrial or energy-producing processes, land filling or other actions.

reservoir
A pond, lake, tank or basin (natural or human made) where water is collected and used for storage. Large bodies of groundwater are called a groundwater reservoir or aquifer; water behind a dam is also called a reservoir of water.

retrogressive failure
An unstable slope condition whereby an initial small slip in slope material results in subsequent successive segments of the slope to continue to fail, or slide, in a short period of time.

river
A natural stream of water of considerable volume.

river and stream system
A system that includes all watercourses, rivers, streams and small inland lakes (lakes with a surface area of less than 100 square kilometres) that have a measurable and predictable response to a single runoff event.

river basin
A term used to disignate the area drained by a river and its tributaries.

root zone
The depth of soil penetrated by crop roots.

runoff
The flow of water from the land to oceans or interior basins by overland flow and stream channels.

salt water intrusion
The process by which an aquifer is over-drafted, creating a flow imbalance within an area that results in salt water encroaching into the fresh water supply.

saturation
The soil in which all pore spaces are filled with groundwater .

sediment
Transported and deposited particles derived from rocks, soil or biological material. Sediment is also referred to as the layer of soil, sand and minerals at the bottom of surface water, such as streams, lakes and rivers.

seepage
The appearance and disappearance of water at the ground surface. Seepage designates the type of movement of water in saturated material. It is different from percolation, which is the predominant type of movement of water in unsaturated material.

shoreline sediment compartment
A shoreline sediment system which encompasses two littoral cells supplying depositional material to a common sink zone.

snowfall
The amount of snow, hail, sleet or other precipitation occurring in solid form which reaches the earth's surface. It may be expressed in depth in inches after it falls, or in terms of inches or millimetres in depth of the equivalent amount of water.

snowpack
The winter accumulation of snow on the ground surface.

soil moisture
Water diffused in the soil and remaining as a measurable quantity, as the volume of water divided by the total volume.

soil moisture storage
Water diffused in the soil. It is found in the upper part of the zone of aeration from which water is discharged by transpiration from plants or by soil evaporation .

spring
A place where groundwater naturally comes to the surface, resulting from the water table meeting the land surface.

spring runnoff
Snow melting in the spring causes water bodies to rise. This, in streams and rivers, is called "spring runoff".

storm

A change in the ordinary conditions of the atmosphere, which may include any or all meteorological disturbances such as wind, rain, snow, hail or thunder.

stream
A general term for a body of flowing water. In hydrology, the term is generally applied to the water flowing in a natural channel as distinct from a canal. More generally, it is applied to the water flowing in any channel, natural or artificial.

Some types of streams are: 1. Ephemeral: A stream which flows only in direct response to precipitation , and whose channel is at all times above the water table . 2. Intermittent or seasonal: A stream which flows only at certain times of the year when it receives water from spring (s) or rainfall , or from surface sources such as melting snow. 3. Perennial: A stream which flows continuously. 4. Gaining: A stream or reach of a stream that receives water from the zone of saturation. 5. Insulated: A stream or reach of a stream that neither contributes water to the zone of saturation nor receives water from it.

streamflow
The discharge that occurs in a natural channel. The term streamflow is more general than runoff, as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

stream flow indicators
Gauges in streams measure streamflow and are used to provide indicators to show there is enough streamflow in the river to meet the basic needs of the ecosystem and to show that water is available for other uses such as recreation, hydropower generation or irrigation. One streamflow indicator will be used, percentage of lowest average summer month flow. The average monthly flow for July, August and September for the streamflow station is determined and the lowest of these 3 values is the lowest average summer month flow. Monthly flow for each stream-gauge station will be compared with the lowest average summer month flow for the station to determine the streamflow indicator

streamflow indicator graph
Each month the average flow in cubic meters per second (m3/sec) for that month is plotted on a 1 year graph. The maximum, minimum, and mean flows for each month for that station and monthly average flows at that station for 1997 are also plotted on that graph for comparison.

Mean flow - the mean daily flow for the month indicated, for the period of record at that indicator station. Maximum flow - the maximum mean daily flow ever recorded for the month. Minimum flow - the minimum mean daily flow ever recorded for the month

surface water
Water found over the land surface in stream (s), ponds or marshes.

Three Levels of Low Water Conditions
The Level I condition is the first indication of a potential water supply problem. Level II indicates a potentially serious problem. Level III indicates the failure of the water supply to meet the demand, resulting in progressively more severe and widespread socio-economic effects.

time lag
The time required for processes and control systems to respond to a signal or to reach a desired level. (Also referrred to as lag time.)

topography
The arrangement of hills and valleys in a geographic area.

toxic
A substance which is poisonous to an organism.

toxic pollutants
Materials contaminating the environment that cause death, disease, birth defects in organisms tht ingest or absorb them.

toxic substance
A chemical or mixture that may represent an unreasonable risk of injury to health or the environment. (2003: MNR). "Any substance which can cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological or reproductive malfunctions or physical deformities in any organism or its offspring, or which can become poisonous after concentration in the food chain or in combination with other substances." (1987: GLWQA)

toxicant
A harmful substance or agent that may injure an exposed organism.

toxicity
The quality or degree of being poisonous or harmful to plant, animal or human life.

transpiration
The process by which water vapour escapes from the living plant, principally the leaves, and enters the atmosphere.

turbidity
A measure of water cloudiness caused by suspended solids.

unconfined aquifer
An aquifer whose upper boundary is the water table .

vaporization
The change of a substance from a liquid or solid state to a gaseous state.

washoff
Storm water runoff at surface level.

water balance
The accounting of water input and output and change in storage of the various components of the hydrologic cycle .

water budgets

A summation of input, output, and net changes to a particular water resources system over a fixed period of time.

water pollution
Industrial and institutional waste, and other harmful or objectionable material in sufficient quantities to result in a measurable degradation of the water quality.

water quality
A term used to describe the chemical, physical and biological characteristics of water with respect to its suitability for a particular use.

water supply
Any quantity of available water.

water table
The water level of an unconfined aquifer , below which the pore spaces are generally saturated.

water table aquifer
An aquifer whose upper boundary is the water table ; also known as an unconfined aquifer .

water table well
A well whose water is supplied by a water table or unconfined aquifer .

watercourses
Depressions formed by runoff moving over the surface of the earth; any natural course that carries water.

watershed
All land and water within the confines of a drainage basin.
Area of land that catches rain and snow and drains or seeps into a marsh, stream, river, lake or groundwater. Homes, farms, cottages, forests, small towns, big cities and more can make up watersheds. Some cross municipal, provincial and even international borders. They come in all shapes and sizes and can vary from millions of acres, like the land that drains into the Great Lakes, to a few acres that drain into a pond.
A watershed is defined as a geographic area bounded by topographic features and height of land that drains waters to a shared destination. Every waterway (stream, tributary, ect.) has an associated watershed; and smaller watersheds join together to become larger watersheds. Watersheds are the preferred geographic unit to undertake environmental planning and stewardship delivery.

What is a watershed?
A watershed is the entire area of land whose water, sediments, and dissolved materials (nutrients and contaminants) drains into a lake, river, stream, creek or estuary. Its boundary can be located on the ground by connecting al the highest points of the area around the receiving body of water. It is not man- made, and it does not relate to political boundaries.

Watershed management - in its simplest terms means managing wisely upstream so that downstream remains natural and healthy. The Conservation Ontario model has received worldwide recognition over its 50+ year history and the watershed is now recognized as one of the premier natural ecosystem units on which to manage resources.

Watershed Stewardship - the responsible care of our natural resources and wildlife on a watershed basis - is essential to balancing human economic needs against the needs of our natural environment.

well yield
The withdrawal rate of water from a given well.

wetland
An area (including swamp, marsh, bog, prairie pothole, or similar area) having a predominance of hydric soils that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support and that under normal circumstances supports the anaerobic condition that supports the growth and regeneration of hydrophytic vegetation.

withdrawal
Refers to removal or taking of water from surface water bodies or groundwater sources.

yield
The quantity of water expressed either as a continuous rate of flow (cubic feet per second, etc.) or as a volume per unit of time. It can be controlled for a given use, or uses, from surface water or groundwater sources in a watershed .

zone of saturation
The space below the water table in which all the interstices (pore space) are filled with water. Water in the zone of saturation is called groundwater .

100-year monthly mean lake level (Great Lakes-St. Lawrence River system and large inland lakes)
The monthly mean lake level having a total probability of being equalled or exceeded during any year of one per cent. Monthly mean level refers to the average water level occurring during a month computed from a series of readings in each month.

100-year wind setup (Great Lakes-St. Lawrence River system and large inland lakes)
The wind setup having a total probablility of being equalled or exceeded during any year of one per cent. Wind setup refers to the vertical rise above the normal static water level on the leeward side of a body of water caused by wind stresses on the surface of the water.

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