Lake Ontario LaMP 2002

Biennial Report

April 2002

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April 2002

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1.0 Introduction

1.1 Introduction

The Lake Ontario Lakewide Management Plan (LaMP) is a binational effort designed to restore and protect the Lake Ontario ecosystem. It is led by the United States Environmental Protection Agency (USEPA), Environment Canada (EC), the New York State Department of Environmental Conservation (NYSDEC), and the Ontario Ministry of Environment and Energy (OMOE). Building on previous initiatives (the Niagara River Toxics Management Plan and the Lake Ontario Toxics Management Plan), the LaMP provides a framework for coordinating binational actions needed to address lakewide problems.

Lakewide problems (known as beneficial use impairments) that have been identified and are being addressed by the LaMP include:

- restrictions on fish and wildlife consumption;
- degradation of wildlife populations;
- bird or animal deformities or reproductive problems; and
- loss of fish and wildlife habitat.

Evidence suggests that the underlying causes of the first three lakewide problems are polychlorinated biphenyls (PCBs), DDT and its metabolites, mirex, dioxins/furans, dieldrin and mercury. These contaminants (also known as lakewide "critical pollutants") are the focus of LaMP source reduction activities. The critical pollutants are of concern because they are persistent (remaining in the water, sediment and biota for long periods of time) and bioaccumulative (accumulating in organisms to levels that are harmful to human health).

Loss of fish and wildlife habitat is a lakewide impairment caused by artificial lake level management, the introduction of exotic species, and the physical loss, modification, and destruction of habitat, such as deforestation and damming of tributaries.

Through the LaMP, the Four Parties (EC, USEPA, OMOE and NYSDEC), are seeking to restore the lakewide beneficial uses of the lake by reducing the input of critical pollutants and by addressing the biological and physical factors discussed above.

What is a LaMP?

In 1987, the governments of Canada and the United States made a commitment, as part of the Great Lakes Water Quality Agreement, to develop and implement a Lakewide Management Plan (LaMP) for each of the five Great Lakes. The Plans were to "embody a systematic and comprehensive ecosystem approach to restoring and protecting beneficial uses in ... open lake waters" and "serve as an important step toward virtual elimination of persistent toxic substances and toward restoring and maintaining the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem." (IJC, 1987).

The main purpose of LaMPs is to coordinate efforts amongst government agencies to reduce the amounts of contaminants entering the lakes and address causes of lakewide problems.

1.2 Lake Ontario LaMP 2002 Report

The Lake Ontario LaMP 2002 Report is the first in a series of progress reports. The Report provides a summary of actions taken and progress made by the LaMP since the LaMP Stage 1 Report was released in 1998.

The LaMP Stage 1 Report identified the problems existing lakewide in Lake Ontario, and the chemical, physical, and biological causes of these impairments. It also included information on progress made to date, monitoring results, and a three-year binational work plan that identified the activities the LaMP partners would undertake to restore beneficial uses of the Lake. The work plan identified activities to further reduce inputs of critical pollutants to Lake Ontario, reassess beneficial use impairments in open lake waters, manage biological and habitat issues, and develop ecosystem objectives and indicators. The binational work plan has since been revised and updated.

"Lake Ontario LaMP Updates" have been produced which highlight progress. Many of the actions identified in the current work plan have been completed. Other actions have been initiated or are in the planning stage.

This Report provides an in-depth assessment of progress made by the LaMP in:

- the development and adoption of ecosystem indicators (chapter 2);
- the assessment of the status of beneficial use impairments (chapter 3);
- the reduction of levels of critical pollutants in water, sediment and biota (chapter 4); and
- the reduction of inputs of critical pollutants to Lake Ontario (chapter 5).

In addition, the report provides an update on public involvement activities (chapter 6) and outlines next steps (chapter 7).

2.0 Lake Ontario Ecosystem Indicators

2.1 Developing Ecosystem Goals, Objectives and Indicators

After several years of work, the LaMP has adopted ecosystem goals, objectives and indicators that will be used to measure progress in restoring and maintaining the health of the Lake Ontario ecosystem. The selected ecosystem indicators reflect lakewide conditions and are sensitive to a number of stressors. For example, healthy populations of bald eagles and lake trout, both top-level native predators, indicate the presence of suitable habitat, healthy populations of prey organisms, and low levels of environmental contaminants. Healthy populations of eagles and trout also reflect our society's commitment to responsible stewardship in protecting habitat, limiting harvests and reducing levels of contaminants in the environment.

2.2 Ecosystem Goals for Lake Ontario

Work first began on Lake Ontario ecosystem goals, objectives and indicators as part of the Lake Ontario Toxics Management Plan (LOTMP) in the late 1980s. U.S. and Canadian monitoring experts brought together by LOTMP developed ecosystem goals and objectives for the lake. The LaMP has adopted these goals, which provide a vision for the future of Lake Ontario and the role human society should play:

- The Lake Ontario ecosystem should be maintained and, as necessary, restored or enhanced to support self-reproducing and diverse biological communities.

- The presence of contaminants shall not limit uses of fish, wildlife and waters of the Lake Ontario basin by humans, and shall not cause adverse health effects in plants and animals.

- We, as a society, shall recognize our capacity to cause great changes in the ecosystem and we shall conduct our activities with responsible stewardship for the Lake Ontario basin.

2.3 Ecosystem Objectives for Lake Ontario

The LaMP also adopted the LOTMP's five ecosystem objectives that describe the conditions necessary to achieve LaMP ecosystem goals:

- Aquatic Communities: The waters of Lake Ontario shall support diverse and healthy reproducing and self-sustaining communities in dynamic equilibrium, with an emphasis on native species.

- Wildlife: The perpetuation of a healthy, diverse and self-sustaining wildlife community that utilizes the lake habitat and/or food shall be ensured by attaining and sustaining the waters, coastal wetlands, and upland habitats of the Lake Ontario basin in sufficient quantity and quality.

- Human Health: The waters, plants and animals of Lake Ontario shall be free from contaminants and organisms resulting from human activities at levels that affect human health or aesthetic factors, such as tainting, odour and turbidity.

- Habitat: Lake Ontario offshore and nearshore zones surrounding tributary, wetland and upland habitats shall be of sufficient quality and quantity to support ecosystem objectives for the health, productivity and distribution of plants and animals in and adjacent to Lake Ontario.

- Stewardship: Human activities and decisions shall embrace environmental ethics and a commitment to responsible stewardship.

2.4 Ecosystem Indicators for Lake Ontario

Annex 11 of the Great Lakes Water Quality Agreement (GLWQA) describes the surveillance and monitoring activities that the parties will carry out in order to assist in evaluating the attainment of specific water quality objectives listed in Annex 1 of the GLWQA. These activities include the development of ecosystem health indicators for each of the Great Lakes.

Indicators proposed by the LOTMP and the State of the Lakes Ecosystem Conferences (SOLEC) served as a starting point for the LaMP's selection process. SOLEC has provided a forum for Great Lakes monitoring and ecosystem indicator issues. Data collected and reported by U.S. and Canadian monitoring programs were reviewed to identify what types of information, collected on a regular basis, could be used to measure long-term trends. The LaMP used six criteria to select appropriate ecosystem indicators that are:

- well-recognized by monitoring experts;
- supported by historical data available for comparison purposes;
- consistent with SOLEC and LOTMP indicator recommendations;
- easily understood by the general public;
- supported by data available from existing monitoring programs; and
- reflective of general "ecosystem health" on a lakewide scale.

The eleven indicators selected provide a good characterization of ecosystem health across the foodweb. The selected indicators can be divided into three groups:

(1) Critical Pollutant Indicators: which measure concentrations of critical pollutants in water, young of the year fish, herring gull eggs and lake trout, and compare this information against existing guidelines;

(2) Lower Foodweb Indicators: which track the status of nutrients, zooplankton and prey fish (such as alewife and smelt). These indicators reflect the ability of the ecosystem to support higher level organisms (such as lake trout and waterbirds); and

(3) Upper Foodweb Indicators: which monitor the health of herring gull, lake trout, bald eagle, mink and otter populations. These top level predators are dependent on quality habitat and sufficient prey populations, free of problematic contaminant levels.

The indicators were presented at SOLEC, Remedial Action Plan (RAP) meetings, the Finger Lakes-Lake Ontario Watershed Protection Alliance Conference and in the LaMP 2001 Update Report. In general, the indicators have been well received by the public. The LaMP adopted the indicators in 2001.

The process of fine tuning and reporting on these indicators will foster closer working relationships between U.S. and Canadian monitoring programs and will promote better binational coordination. Additional indicators will be considered, as necessary, to help guide LaMP restoration activities. A brief overview of each of the selected indicators is provided below.

2.4.1 Critical Pollutant Indicators

Critical Pollutants in Offshore Waters

Objective: critical pollutants in open waters should not pose a threat to human, animal and aquatic life
Measure: concentration of critical pollutants in offshore waters
Purpose: to measure priority toxic chemicals in offshore waters and to assess the potential impacts of toxic chemicals on human health and the aquatic ecosystem and the progress of contaminant reduction efforts
Target: concentrations of critical pollutants in offshore waters are below standards and criteria designed to protect the health of human, animal and aquatic life

Critical Pollutants in Young-of-the-Year (YoY) Fish

Objective: critical pollutants chemicals should not pose a risk to fish-eating wildlife
Measure: concentration of critical pollutants chemicals in YoY fish
Purpose: to measure persistent toxic chemicals in YoY fish and to evaluate measure potential harm to fish-eating wildlife
Target: concentrations of critical pollutants chemicals in YoY fish are below standards and criteria designed to protect fish-eating wildlife

Critical Pollutants in Herring Gull Eggs

Objective: the health and reproductive success of waterbirds should not be impaired by contaminants present in the aquatic foodweb
Measure: annual concentrations of persistent toxic chemicals in herring gull eggs from colonies
Purpose: to measure critical pollutants in herring gull eggs from colonies that reflect general lakewide conditions and to compare contaminant concentrations to criteria designed to protect waterbirds
Target: contaminant levels in colonial nesting waterbird eggs are similar to those of unaffected reference sites or are below existing standards or criteria designed to protect colonial waterbirds

Critical Pollutants in Lake Trout Tissue

Objective: consumption of fish should not be restricted due to contaminants of human origin
Measure: concentrations of pollutants in edible fish tissue responsible for advisories
Purpose: to measure critical pollutants in fish and to evaluate the potential exposure of humans to these substances through fish consumption
Target: contaminants in fish tissue are below the existing standards and criteria designed to protect human health, as shown by the elimination of fish advisories

2.4.2 Lower Foodweb Indicators

Nutrients in Open Waters

Objective: nutrient levels should be sufficient to support aquatic life without causing persistent water quality problems (such as the depletion of dissolved oxygen in bottom waters, nuisance algal blooms or accumulations, and decreased water clarity)
Measures: total spring phosphorus levels (micrograms per litre), chlorophyll-a, and water clarity
Purpose: to follow trends in open lake nutrients
Target: nutrient levels allow attainment of fishery management objectives without exceeding the GLWQA phosphorus-loading target for Lake Ontario

Zooplankton Populations

Objective: zooplankton populations should be sufficient to support a healthy and diverse fishery
Measures: (1) mean individual size, and (2) biomass
Purpose: to directly measure changes in mean individual size and biomass of zooplankton populations in order to indirectly measure changes in food-web dynamics due to: changes in vertebrate or invertebrate predation, changes in system productivity, the type and intensity of predation, and energy transfer within a system
Targets: zooplankton populations are sufficient to maintain prey and predator fish at levels consistent with existing binational fishery objectives; mean individual size of approximately 0.8 mm is generally considered an optimal size when the water column is sampled with a 153 micron mesh net; specific biomass targets will be developed as the state of knowledge permits

Preyfish

Objective: a diverse array of preyfish populations should be sufficient to support healthy, productive populations of predator fishes
Measures: abundance, age and size distribution of preyfish species (such as deepwater ciscoes, sculpins, lake herring, rainbow smelt and alewives)
Purpose: to directly measure the abundance and diversity of preyfish populations and to indirectly measure the stability of predator species necessary to maintain biological integrity
Target: given the rapid changes that have occurred in the Lake Ontario foodweb, a specific target in terms of average annual biomass cannot be set at this time; a specific target will be set once fishery managers have a better understanding of prey fish dynamics

2.4.3 Upper Foodweb Indicators

Herring Gull

Objective: Lake Ontario should support healthy populations of colonial waterbirds
Measure: total number of active herring gull nests counted per year (with additional species counted, as necessary)
Purpose: to directly measure numbers of breeding gulls on Lake Ontario in order to detect changes in population status that may reflect stresses due to contaminants, disease or insufficient food supply
Target: reproduction and fledging rates of herring gulls are normal (that is, similar to unaffected background areas)

Lake Trout

Objective: lake trout populations should be sustained through natural reproduction
Measures: (1) abundance of naturally produced fish, (2) number of mature females, and (3) number harvested
Purpose: to measure progress and identify obstacles to the successful rehabilitation of naturally reproducing populations of lake trout
Targets: abundance of at least 2.0 mature female lake trout larger than 3,000 grams per standard gillnet; abundance of naturally-produced mature females greater than 0.2 in U.S., and 0.1 in Canadian waters per standard gillnet; harvest not to exceed 30,000 fish per nation; and abundance of naturally produced age 2 fish of at least 26 juveniles from July bottom trawls in U.S. waters and increased over current levels in Canadian waters

Mink and River Otter

Objective: naturally reproducing populations of mink and river otter should be established throughout the Lake Ontario basin
Measure: number of tributaries and wetlands with established mink and river otter populations
Purpose: to evaluate mink and otter populations in the Lake Ontario basin
Target: all suitable habitats have established, healthy and naturally reproducing populations

Bald Eagle

Objective: shoreline and inland bald eagle nesting territories should be established and sustained through natural reproduction throughout the basin
Measures: (1) total number of established bald eagle nesting territories within the Lake Ontario basin, (2) total number of established shoreline nesting territories, and (3) average number of eaglets per nest successfully produced
Purpose: to measure trends in the recovery and reestablishment of bald eagles within the basin
Targets: all suitable habitat for bald eagle nesting is successfully utilized; average basinwide fledging rates per occupied territory are one eaglet per nest or greater; and shoreline nesting territories are defined as those less than seven kilometers from the lake.

2.5 Next Steps

With the adoption of this initial suite of ecosystem indicators, attention now shifts to data collection and synthesis. Fortunately, much of this work is already being done through existing federal, state and provincial Great Lakes water quality, biomonitoring and fisheries programs and organizations, such as the Great Lakes Fishery Commission's Lake Ontario Lake Committee, consisting of New York and Ontario fishery managers.

Additional input from technical experts and the public will be considered over the years to come. Further study will be necessary to define specific targets for zooplankton populations and prey fish. In the meantime, data collection and reporting on basic measures for these populations will provide some measure of how well these components of the ecosystem are faring.

The status of these indicators will be reported on in future LaMP reports and public meetings. The need for any additional indicators will be considered as part of the data collection and reporting process.

2.6 References

Lake Ontario Toxics Management Plan. 1989. A report by the Lake Ontario Toxics Committee. February 1989. Environment Canada, United States Environmental Protection Agency, Ontario Ministry of the Environment and New York State Department of Environmental Protection (Appendix V – Ecosystem Objectives Work Group).

Selection of Indicators for Great Lakes Basin Ecosystem Health. 2000. Version 4, State of the Lakes Ecosystem Conference, Prepared by: Paul Bertram, United States Environmental Protection Agency, GLNPO, 77 West Jackson Blvd., Chicago, IL 60604, USA and Nancy Stadler-Salt, Environment Canada, 867 Lakeshore Rd., Burlington, Ontario, Canada L7R 4A6, March 2000.

Fish Community Objectives for Lake Ontario. 1998. Prepared by: S. Orsatti, R. Lange, T. Stewart, C. Schneider, A. Mathers and M. Daniels. March 1998. Lake Ontario Committee, Great Lakes Fishery Commission.

3.0 Beneficial Use Impairments

3.1 Introduction

The rapid development of the Lake Ontario basin prior to the 1970s was accompanied by habitat loss, over-harvesting of fisheries, and the release of excessive nutrients and toxic pollution that caused major changes in the Lake Ontario ecosystem. The extent of these changes was fully realized in the 1960s and 1970s, when Lake Ontario waters were choked with algae and colonial water birds experienced nearly total reproductive failure due to the presence of high levels of toxic contaminants in the food chain. In 1978, Canada and the United States took action to control inputs of nutrients and persistent toxic contaminants entering the Great Lakes, and in 1987, renewed the Great Lakes Water Quality Agreement (GLWQA) in order to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin ecosystem.

Today, as a result of these actions, levels of toxic contaminants in the Lake Ontario ecosystem have decreased significantly. Colonial waterbird populations have recovered and are reproducing normally. However, bioaccumulative toxics persist in sediment, water and biota at levels of concern for higher order predators (such as bald eagles, snapping turtles, mink, otters and humans).

Polychlorinated biphenyls (PCBs), DDT, mirex, dieldrin, mercury and dioxins/furans have been identified as critical pollutants linked to lakewide impairments in Lake Ontario. In addition to the historical loss of significant habitats, artificial lake level controls were identified as a significant cause of degraded habitats. (Refer to the 1998 "Lakewide Management Plan for Lake Ontario - Stage 1 Report" for a detailed discussion on the evaluation of these lakewide impairments.) Although there have been positive changes related to these impairments, their overall status of "impaired" remains unchanged.

The LaMP recently completed its assessment of the status of benthos and phytoplankton/zooplankton populations. This assessment concluded that benthos and nearshore phytoplankton populations are degraded lakewide with the introduction of exotic species (zebra and quagga mussels) suspected as the underlying cause. Additional study will be needed to determine whether zebra mussels and/or recently introduced predatory zooplankton, such as the spiny water flea, have degraded zooplankton populations (Table 3.1). The LaMP will promote the prevention of future introductions of exotic species by raising awareness of the problem and the need to take action.

The status of benthos and phytoplankton and zooplankton populations, along with recent information on fish and wildlife populations and fish and wildlife habitat are summarized in the following sections.

3.2 Impairment of Beneficial Uses

The LaMP process uses a broad range of ecological factors, in addition to regulatory standards, to identify critical pollutants. The GLWQA defines critical pollutants as "substances that persist at levels that, singly or in synergistic or additive combination, are causing, or are likely to cause, impairment of beneficial uses despite past application of regulatory controls due to

Table 3.1 Lake Ontario Lakewide Beneficial Use Impairments, Impacted Species and Pollutants

Lakewide Impairments	*Impacted Species*	*Lakewide Critical Pollutants and Other Factors*
Restrictions on Fish and Wildlife Consumption	Trout, Salmon, Channel catfish, American eel, Carp, White sucker Walleye, Smallmouth Bass[a] All waterfowl[b] Snapping Turtles[b]	PCBs, Dioxins, Mirex Mercury[a] PCBs, DDT, Mirex[b] PCBs[b]
Degradation of Wildlife Populations	Bald Eagle[c] Mink and Otter[c]	PCBs, Dioxin, DDT PCBs
Bird or Animal Deformities or Reproductive Problems	Bald Eagle[c] Mink and Otter[c]	PCBs, Dioxin, DDT PCBs
Loss of Fish and Wildlife Habitat	A wide range of native fish and wildlife species	Lake Level Management Exotic Species Physical Loss, Modification, and Destruction of Habitat
Degradation of Benthos	*Diporeia* populations[d]	Exotic Species (Zebra Mussels, Quagga Mussels) suspected and other factors to be confirmed
Degradation of Phytoplankton Populations	Nearshore Phytoplankton	Exotic Species (Zebra Mussels, Quagga Mussels) suspected and other factors to be confirmed

[a] Canadian advisories only
[b] U.S. advisories only
[c] Indirect evidence only (based on fish tissue levels)
[d] Dramatic decline in abundance in eastern Lake Ontario and disappearance of the species from large areas of the Lake.

Notes: Dieldrin, although listed as a LaMP critical pollutant, is not associated with an impairment of beneficial use.
"DDT" includes all DDT metabolites; "Dioxin" refers to all dioxins/furans.

their: presence in open lake waters; ability to cause or contribute to a failure to meet Agreement objectives through their recognized threat to human health and aquatic life; or ability to bioaccumulate."

Lake Ontario provides beneficial uses to society for recreational activities such as fishing and swimming, as well as support to agriculture and industry through various other water uses. If the water quality of Lake Ontario is negatively affected, society suffers beneficial use impairments. As defined by the GLWQA, "impairment of beneficial use(s)" is a change in the chemical, physical, or biological integrity of the Great Lakes system sufficient to cause any of the following:

(1) restrictions on fish and wildlife consumption;
(2) tainting of fish and wildlife flavour;
(3) degradation of fish and wildlife populations;
(4) fish tumors or other deformities;
(5) bird or animal deformities or reproductive problems;
(6) degradation of benthos;
(7) restrictions on dredging activities;
(8) eutrophication or undesirable algae;
(9) restrictions on drinking water consumption, or taste and odour problems;
(10) beach closings;
(11) degradation of aesthetics;
(12) added costs to agriculture or industry;
(13) degradation of phytoplankton and zooplankton populations; and/or
(14) loss of fish and wildlife habitat.

The LaMP 1998 report identified four lakewide beneficial use impairments related to persistent toxic substances and habitat loss: (1) restrictions on fish and wildlife consumption; (2) degradation of wildlife populations; (3) bird or animal deformities or reproductive problems; and (4) loss of fish and wildlife habitat. Two new impairments are now being added to the list: 5) degradation of benthos; and 6) degradation of nearshore phytoplankton populations.

3.3 Recent Findings

3.3.1 Benthos

Benthic macroinvertebrates are small insect-like organisms that live in the bottom sediments of the lake and are an important food source for many types of fish. Dramatic changes have occurred within Lake Ontario's benthic community since the 1950s due primarily to significant reductions in nutrient loadings and changes in the numbers and types of fish that feed on benthic organisms. These impacts may have overshadowed any past or present lakewide impacts from toxic contaminants.

Recently completed studies have given us a better picture of the potential impacts of the contaminants in Lake Ontario sediment on benthic communities. Sediment samples were collected throughout Lake Ontario in 1997. Pollution-sensitive benthic organisms were then exposed to these sediments under laboratory conditions to evaluate sediment toxicity. Results show that contaminant concentrations in lake bottom sediments pose little to no acute toxic threat to these sensitive test organisms. Additional information will be needed to assess the potential for contaminants to have long-term chronic impacts on these organisms.

Although contaminant-related impacts on benthos are not a concern for the open lake, localized toxic contaminant impacts on benthic organisms have been documented in some Lake Ontario Areas of Concern with elevated levels of sediment contamination. These problems are being addressed through local Remedial Action Plans.

It is clear that the introduction of the zebra mussel in the late 1980s has had a detrimental impact on Lake Ontario benthos. The Quagga mussel, a more recent arrival, is capable of living in colder, deeper waters than the zebra mussel. These mussels filter water to feed on microscopic phytoplankton and other organic material, thereby reducing the amount of food available to other benthic organisms. The filtering action of the mussels has contributed to the dramatic improvements in water clarity. At the same time, populations of important native benthic organisms have generally declined.

Zebra mussels are causing serious lakewide problems in the Lake Ontario ecosystem.
Photo Credit: Centre for Great Lakes & Aquatic Sciences

Prior to the arrival of the zebra mussel, populations of *Diporeia*, a small shrimp-like organism, was the dominant benthic organism in the lake. Typically, a few thousand of these organisms were present in a square meter of lake bottom and provided an important source of food for fish. A decade after the zebra mussel invasion, fewer than ten of these organisms can be found per square meter in waters up to 200 meters deep. This means there is less food to support lake trout, white fish and other fish. Although the mussels are suspected to be the cause of these declines, a clear cause-effect relationship has yet to be established.

Some less important nearshore native benthic species have benefited from the zebra mussel invasion. Populations of some shallow water (less than 10 metres-deep) native benthic organisms that prefer the habitat created by zebra mussel shells and can feed on the mussel's waste products have increased. Nearshore fish, such as perch and smallmouth bass that feed on these organisms, are benefiting from the increase in these benthic populations.

Additional studies of Lake Ontario benthic organisms, phytoplankton, and zooplankton are underway to develop a better understanding of the rapid changes that are occurring in Lake Ontario's foodweb.

3.3.2 Phytoplankton and Zooplankton Populations

Healthy and balanced communities of phytoplankton and zooplankton are essential components of all normal aquatic ecosystems. Without these microscopic plants and animals, there would be no fish in lakes. Lake Ontario phytoplankton and zooplankton data have been collected during the past few decades as part of Canadian and U.S. monitoring programs. Changes in the structure of plankton communities and their relationship to nutrient levels have been examined in nearshore, offshore, and embayment habitats in order to better understand whole-lake processes.

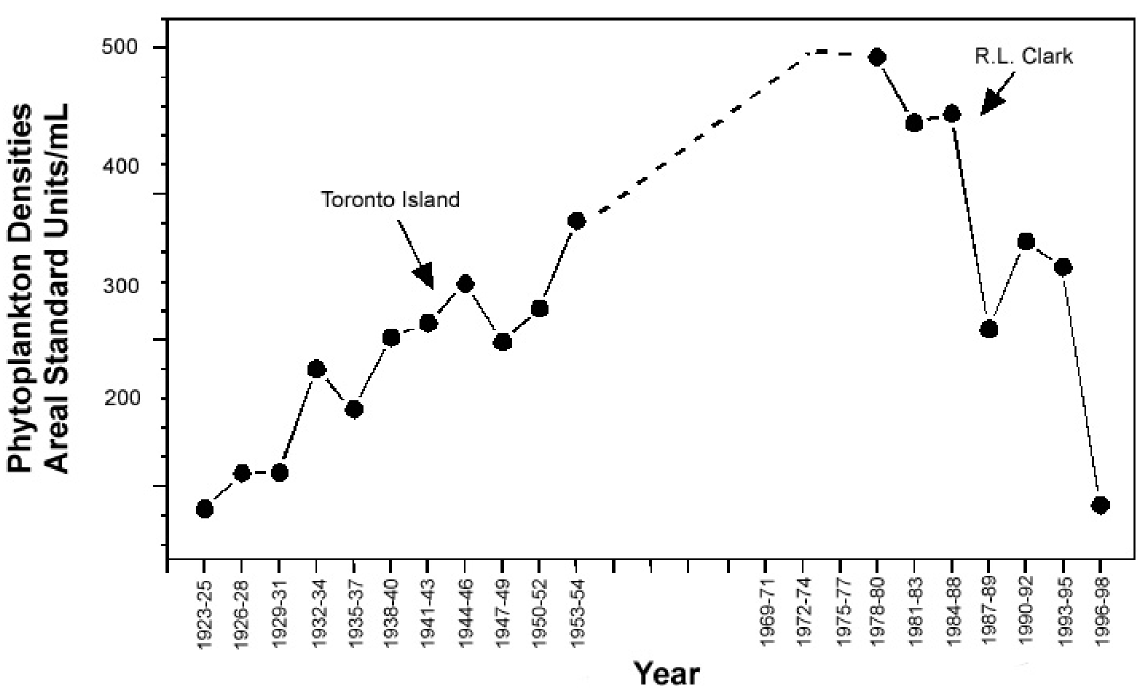
In recent decades in Lake Ontario, these communities have been influenced by reductions in inputs of phosphorus from municipal waste treatment facilities, invasions by exotic species and changes in fish communities. As with the benthic community, these changes may have overshadowed any impacts that contaminants may have had on phytoplankton and zooplankton populations in the past. There is no indication that current levels of contaminants pose a concern for phytoplankton and zooplankton populations. However, through bioaccumulation even low concentrations of contaminants in phytoplankton and zooplankton can pose concerns for higher-level predators such as fish and waterbirds. Today the potential impacts of exotic mussels and predatory zooplankton are believed to pose the greatest threat to these native populations.

Phosphorus and Phytoplankton

The Lake Ontario phytoplankton community is controlled by both nutrient supply, typically measured in terms of total phosphorus, and by the size of zooplankton populations that feed on phytoplankton. During the 1940s to the 1970s excessive discharges of nutrients from agriculture and wastewater discharges resulted in abnormally high Lake Ontario phosphorus levels. The result was an explosion in the growth of phytoplankton and algae creating severe water quality problems. The U.S. and Canada implemented phosphorus controls at wastewater treatment plants beginning in the 1970s and reduced total phosphorus levels in the open lake by 30 percent over a 15-year period. Nearshore waters that had the highest nutrient levels saw declines in phosphorus levels well over 50 percent.

Several long-term studies have documented changes in phytoplankton. Collections of phytoplankton samples from Toronto drinking water intakes provide a historical perspective on long-term trends and their response to changing nutrient levels (Figure 3.1). These collections

Figure 3.1 Phytoplankton Densities from Toronto-based Lake Ontario Water Treatment Plant Intakes, 1923-1998



Source: Nicholls 2000.

show that phytoplankton densities doubled between the 1920s and the 1950s in response to increasing and excessive nutrient levels. Beginning about 20 years ago, this trend was reversed reflecting the success of phosphorus controls which have maintained open lake total phosphorus concentrations at or below a level designed to prevent nuisance growths of algae.

Since the arrival of the zebra mussel, there has been concern that this species could alter the Lake Ontario foodweb in a number of ways. The impacts of the filtering action of zebra mussels on nearshore phytoplankton densities were seen as early as 1992. By 1998, zebra mussel feeding apparently had reduced phytoplankton densities by more than 90 percent in some inshore areas. The composition of phytoplankton communities has also changed, with edible types of algae decreasing and less edible forms increasing.

Normally chlorophyll-a concentrations are directly proportional to nutrient levels. However in some nearshore waters, an apparent "decoupling" of chlorophyll-a and nutrients is being observed where increases in nutrients are not accompanied by expected increases in chlorophyll-a. It is unclear whether this decoupling reflects grazing activity of zebra and quagga mussels or the result of physical processes specific to the nearshore.

Research continues to provide a better understanding of seasonal changes in phytoplankton populations in nearshore and offshore waters and embayments. Studies undertaken in the mid-1990s in Canadian waters found that nearshore spring phytoplankton densities were six to eight-times higher than summer densities at the eastern end of the lake. Offshore stations showed much less difference between spring and summer phytoplankton biomass. Spring phytoplankton density peaks were confined to April and May at eastern Lake Ontario nearshore sampling locations, but often extended into June at western sampling sites, indicating higher nutrient levels related to Niagara River inputs. With continued declines in nutrients entering Lake Ontario via the Niagara River, recent studies now find little difference between eastern and western Lake Ontario nutrient levels.

Zooplankton

The structure and population levels of zooplankton communities are strongly controlled by phytoplankton levels and by the size and distribution of prey fish that feed on them (such as alewife and smelt). Prey fish may have been the most important controlling factor in the 1980s and early 1990s when their populations were much higher than current levels. Declining nutrient levels also played a role. Although the total zooplankton biomass decreased significantly over this period, the composition of the zooplankton community changed very little.

The transport of exotic zooplankton by ocean-going freighters to the Great Lakes remains an on-going threat to Lake Ontario. The spiny water flea was discovered in Lake Ontario in 1985, followed by the zebra mussel in 1989. A decade later in 1998, *Cercopagis* (also known as the fishhook flea, a zooplankton native to Europe) was discovered in Lake Ontario. Both the fishhook flea and the spiny water flea are large zooplankton that feed on smaller native zooplankton. The potential impact that these predatory zooplankton will have on Lake Ontario zooplankton communities is not well understood at this time. In addition, it is anticipated that reductions in phytoplankton densities due to zebra and quagga mussel filtering may result in smaller zooplankton populations.

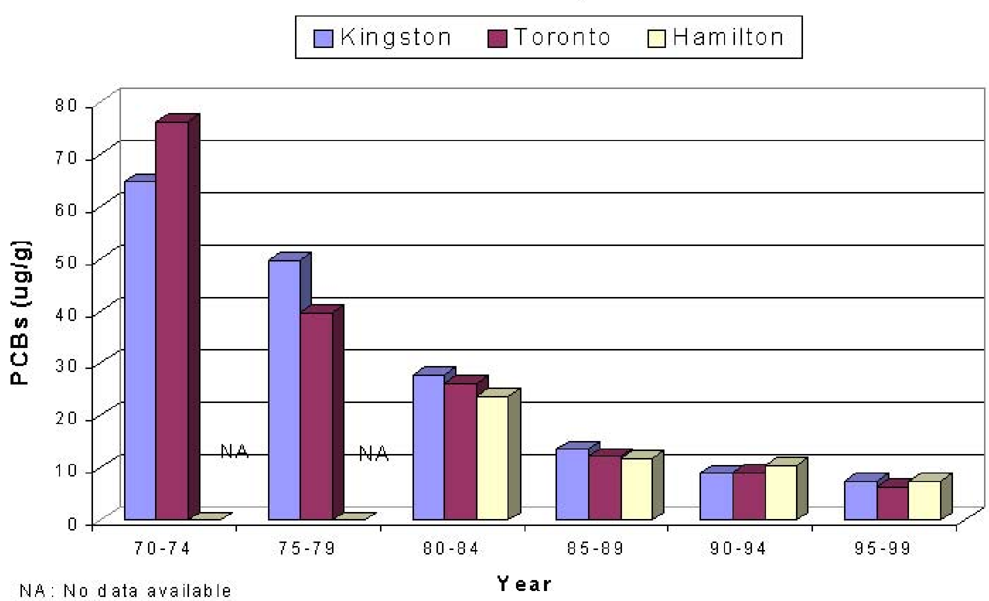
Research continues to better understand seasonal changes in zooplankton populations in nearshore, offshore and embayments. Recent studies in U.S. waters of Lake Ontario indicate that embayments are very productive habitats compared to nearshore and offshore areas. Embayment phosphorus concentrations were nearly twice those in nearshore and three times those in offshore areas. Embayment chlorophyll-a and zooplankton density were higher than both nearshore and offshore habitats. This suggests that embayments may be an important source of food for developing fish.

In contrast to the 1970s when excessive levels of nutrients from Lake Erie were entering Lake Ontario via the Niagara River, today nutrient loadings from upstream lakes have been greatly reduced.

3.3.3 Fish & Wildlife Populations Colonial Water Birds

Lake Ontario is home to hundreds of thousands of colonial nesting water birds. Biologists from the Canadian Wildlife Service, the Ontario Ministry of Natural Resources and the New York State Department of Environmental Conservation recently completed the third Lake Ontario-wide census of nesting colonial water birds, a survey that is conducted approximately once every ten years. The information collected from these surveys, along with the results of other studies carried out over a number of years in the Lake Ontario basin, provide a good indication of improvements to the ecosystem. Surveys have shown that: Caspian tern numbers are increasing; common terns, though their numbers are declining, are adapting to man-made sites in the face of large ring-billed gull populations;

Figure 3.2 PCB Concentrations in Herring Gull Eggs from Lake Ontario Colonies, 1970 - 1999



NA: No data available

Sources: Bishop et *al*. (1992), Pettit et *al*. (1994), Pekarik et *al*. (1998) and D.V. Weseloh (Unpublished).

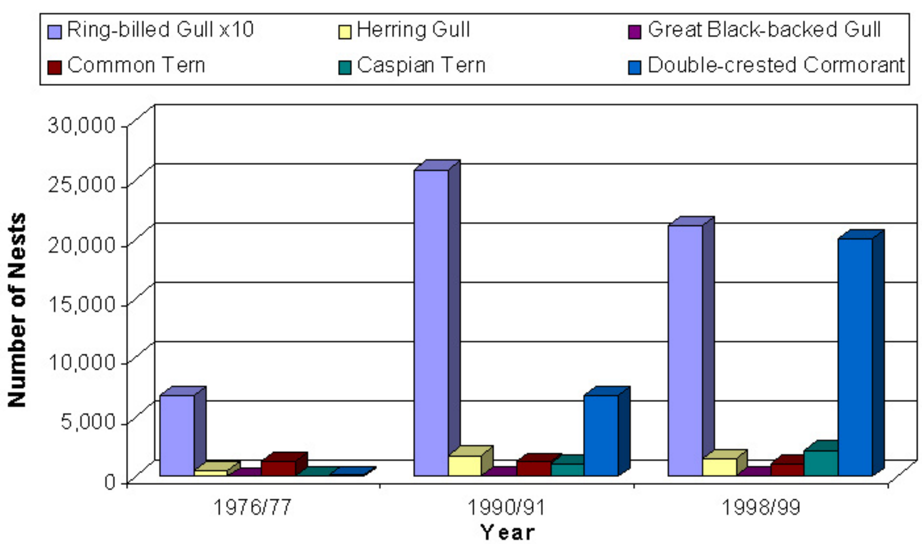
both herring and ring-billed gull populations appear to have leveled off during the last decade; cormorant populations have greatly expanded; and black-backed gulls represent a new nesting species on Lake Ontario.

Caspian tern numbers on Lake Ontario are increasing.
Photo Credit: Don Simonelli

Fish-eating birds, such as gulls, terns, cormorants and night herons, have been used as bio-indicators of contamination on Lake Ontario and throughout the Great Lakes for more than 30 years. The Canadian Wildlife Service monitors contaminant levels, as well as their biological effects, in both the overall population and the individual birds. In the 1970s, fish-eating birds in the Great Lakes, including Lake Ontario, were found to have very high levels of contaminants such as PCBs, DDE and mirex in their eggs. They also exhibited much thinner eggshells than normal, elevated rates of embryonic mortality and deformities, total reproductive failure, and declining population levels. Most of these conditions have improved greatly. Contaminant levels have declined dramatically in eggs of herring gulls (Figure 3.2), Caspian terns and double-crested cormorants. Eggshell thickness has returned to normal or, at least, is not a problem for any of the species. Population levels of several colonial, fish-eating bird species have increased.

Although many of the obvious signs of toxic contamination are no longer apparent, the

Figure 3.3 Number of Gull, Tern and Cormorant Nests on Lake Ontario, 1976-1999



Note: Numbers pertain only to colonies in Canadian waters.
^Ring-billed Gull numbers have been divided by ten for sake of graphical representation.
Data for 1976/77 and 1990/91 from: Blokpoel & Tessier. 1996. "Atlas of colonial waterbirds nesting on the Canadian Great Lakes, 1989-1991. Part 3. Cormorants, gulls and island-nesting terns on the lower Great Lakes system in 1989. Technical Report Series No. 225. Canadian Wildlife Service, Ontario Region".
Data for 1998/99 from: Canadian Wildlife Service, Unpublished.

Canadian Wildlife Service is continuing its research to better understand the potential for more subtle effects of environmental contaminants on fish-eating birds and other wildlife on Lake Ontario. Lake Ontario-wide surveys of colonial waterbirds were conducted in 1976-1977, 1990-1991 and 1998-1999 for six species of colonial water birds: double-crested cormorant, ring-billed gull, herring and great black-backed gulls, and common and Caspian terns (Figure 3.3).

Double-crested cormorants have increased tremendously on Lake Ontario during the last quarter-century. As cormorant populations increased so did public concerns that cormorants were depleting nearshore fish populations and reducing fishing opportunities. In 1977, there was one cormorant colony on Lake Ontario, which contained 96 nests. In 1999, there were over 20,000 nests on 17 colonies. The two largest colonies, each with more than 4,500 cormorant nests, were located in the eastern half of the lake.

NYSDEC completed a detailed diet assessment of Little Galloo cormorants in 1999 that determined, if left unchecked, cormorant predation on smallmouth bass has reduced numbers of smallmouth bass large enough for anglers to legally harvest. In response to this threat to smallmouth bass and other nearshore fish populations, a large scale, sanctioned cormorant control program was initiated on Little Galloo Island in 1999. All cormorant eggs in ground nests were sprayed with non-toxic corn oil to prevent them from hatching and to eliminate any production of young. Reducing the number of cormorants is also desired because of their potential impact on other species of colonial birds with which they nest, especially the black-crowned night heron.

The ring-billed gull is the most numerous colonial waterbird on Lake Ontario and the Great Lakes. During 1998-99, over 200,000 nests were tallied on 18 colonies on Lake Ontario. Between the first two census periods, the population grew by ten percent per year, but between 1990-1991 and 1998-99 it declined by two percent per year. By 1999, ring-billed gulls had also completely abandoned seven colony sites that were active in 1990-1991. Natural habitat change and gull control activities were responsible for some of this decline, but nesting cormorants and great black-backed gulls also may be exerting an influence.

The herring gull is the most widespread colonial waterbird nesting on the Great Lakes. In 1998-99 it nested at 18 different locations on Lake Ontario, with a population of almost 1,500 nests. In 1990-1991, 21 colonies were counted, with about 1,800 nests. In 1976-77 there were 448 nests on 13 colonies. After growing at an average annual rate of 11 percent from 1976-77 to 1990, this population also declined by two percent per year overall between 1990 and 1999.

Of the six species of colonial waterbirds discussed here, the great black-backed gull is the least numerous. During the 1976-77 census, it was not found nesting on Lake Ontario. In 1990, there were 15 nests on three sites and in 1998-99, there were 33 nests on six sites. This large gull, which has only started nesting on Lake Ontario regularly since the early 1980s, may be a serious competitor and predator with some of the other species of colonially nesting birds.

Since 1990, the lakewide population of common terns has declined by 11 percent. However, it is encouraging that the number of nesting sites in Canadian waters increased from 6 to 14 between 1990 and 1998. Most of these sites were located on man-made islands, shoals or “tern rafts”, and two were re-established colonies at sites that had been abandoned. Artificial nest sites seem to be an attractive alternative for this species. Average annual growth rates of Caspian tern populations were 24 percent for 1976-77 to 1990-1991 and eight percent for 1990-1991 to 1997-98. Substantial cormorant colonies do not seem to be having a negative impact on the growth of the Caspian tern colonies with which they are located. For example, on Little Galloo, nests increased from 4,072 to 7,591 during the same period. However, the large black-backed gull may be preying on terns; in 1995, 21 fresh Caspian tern carcasses were found within black-backed gull nesting territories. The results of the recent population surveys are mixed but encouraging; contaminants do not appear to be limiting any of the colonial bird populations.

Lake Trout

Rehabilitation of a naturally-reproducing lake trout population is the focus of a major international effort on Lake Ontario. Enhanced sea lamprey control, stocking the Seneca strain lake trout (which have a higher survival rate), and restrictive harvest regulations have all contributed to lake trout rehabilitation. High abundance of mature lake trout age six and older was achieved in 1986, and was maintained through 1998. Naturally-spawning juvenile lake trout were first detected in 1993, coincident with peak estimated lake trout egg production. The decline in alewife populations, known to prey heavily on lake trout eggs and fry, has likely contributed to the increased survival rate of naturally produced lake trout. Naturally-spawned lake trout have been collected each year since 1993 and, over time, are being collected at older ages. It is anticipated that natural reproduction of lake trout will increase markedly as naturally-spawned lake trout reach sexual maturity and increasingly contribute to the spawning population. Members of the 1993 cohort of naturally-spawned lake trout likely commenced spawning in the fall of 2000. It is encouraging that 25 of the 35 naturally-spawned lake trout collected in 2001 were from the 2000 year class.

A large lake trout of reproductive age.
Photo Credit: Fisheries and Oceans Canada

Mink and River Otters

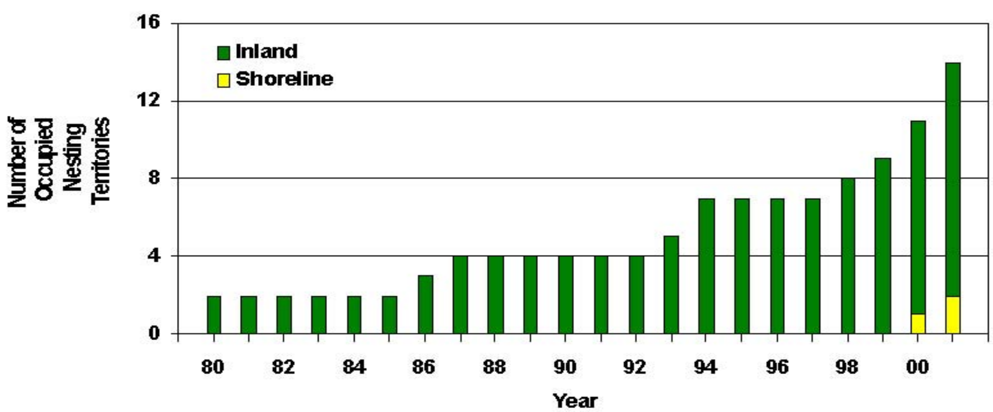
The contamination of fish is one factor that may slow the rate of natural recovery of mink and otter populations. Laboratory studies have suggested that reproduction of these animals may be impaired by the presence of toxic contaminants, such as PCBs and mercury in their diets. Both mink and otter are difficult to study in the wild, which makes reliable population estimates or measures of their reproductive health problematic. Mink and otter are present in many parts of the Lake Ontario basin and trappers legally harvest hundreds each year. Although mink are the primary target, some otters are caught as well. The LaMP will evaluate mink and otter harvest statistics collected across the basin to develop a better understanding of the geographic distribution of these populations. There have been signs of improving populations in recent years. Mink have been identified in the Rochester Embayment area with evidence that natural reproduction is occurring, and river otter are present and reproducing on a number of Lake Ontario tributaries.

Mink have a varied diet, preferring small mammals such as muskrats and rabbits, but they also consume fish and other small aquatic organisms. The river otter's diet changes with the seasons. In the spring and summer, crayfish, frogs and tadpoles are preferred. Otters feed almost entirely on fish during the rest of the year. River otter were found in all major U.S. and Canadian waterways until the 1800s when settlement, unregulated trapping and habitat loss led to their near disappearance in the western half of the Lake Ontario basin. Today, river otter are found along tributaries in the eastern Lake Ontario basin and along the St. Lawrence River. Until recently, they have been largely absent from the central and western parts of the basin, but improved environmental conditions are again favoring the return of the otter. Old farmland is reverting to forest and water quality is much improved. Otters are slowly extending their range westward into the Lake Ontario basin from the Adirondacks and Catskills in eastern New York.

The New York River Otter Project, Inc. is a coalition of industries, nature and educational institutions, conservation and sportsmen's organizations, and individuals working to return river otters to central and western New York State. The ultimate goal was to reintroduce approximately 270 river otters at nine release points across the area. These otters would become the initial breeding stock for that area. Eventually each release area's population would expand and occupy other currently vacant habitat. The first release efforts began in 1995. In 2001, the Project exceeded its goal by successfully reintroducing 279 otters from eastern New York to sites near Lake Ontario and Lake Erie. Project success has also been evaluated through surveys of otter tracks in the snow, individual sight observations and recoveries, and radio telemetry of all otters released at one site. This project's accomplishments should accelerate the natural recovery of river otter populations by several decades.

Studies carried out in New York State compare tissue samples taken from otters before they are released into the area with those of any recovered animals located after their release. Across the

Figure 3.4 Lake Ontario Bald Eagle Population Recovery, 1980-2001



Source: New York State Department of Environmental Conservation, Unpublished data.

lake, scientists from the Ontario Ministries of the Environment and Natural Resources have found that mercury levels in the hair of otters provide a good indicator of mercury in the brains of these animals. High mercury levels can stress the otter's nervous system and cause early mortality. With ongoing research, the use of hair clippings from live trapped and released otters promises to provide an important tool to monitor otter health throughout the Lake Ontario basin.

Bald Eagle

The bald eagle is considered by many to be one of the premier ecological indicators of the Great Lakes. In the 1970s, there were no occupied bald eagle nesting territories in the Lake Ontario basin. Biologists helped to establish two nesting

Bald Eagle
Photo Credit: Jim Flynn, Environment Canada

territories in the basin during the 1980s, through the release of bald eagles captured in Alaska. Since the completion of these reintroduction efforts, the number of occupied bald eagle nesting territories has steadily increased and there are now fourteen established nesting territories in the basin (Figure 3.4). The combined long-term average successful reproduction rates for these nests is greater than one eaglet per nesting attempt. A reproduction rate of at least one eaglet per occupied nesting attempt is necessary to maintain stable bald eagle populations.

Good to excellent bald eagle nesting habitat exists, particularly along the eastern shoreline of the lake. Finally, after four decades, the first Lake Ontario bald eagle shoreline nest was naturally established in 2000 followed by a second in 2001. Both shoreline nests are successfully fledging eaglets suggesting that current contaminant levels in Lake Ontario prey may not pose a barrier to their population recovery along the lakeshore. Additional shoreline nesting territories are expected as their numbers steadily increase. Restoration of occupied shoreline nesting territories will depend, in part, on protecting eagle nesting habitats and preventing human disturbance.

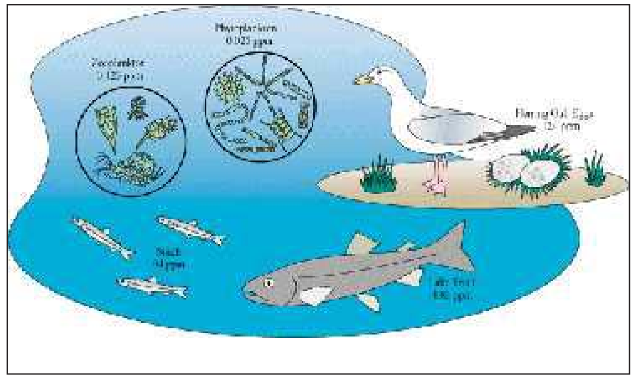
3.3.4 Fish and Wildlife Habitat

Clean water alone cannot restore the Lake Ontario ecosystem. Habitat of sufficient quality and quantity is essential to achieve the restoration and protection of a fully functioning ecosystem. The Lake Ontario LaMP will work with its partners to identify priority lakewide habitat issues and will work to coordinate government and voluntary efforts so that degraded habitat will not limit the restoration of the Lake Ontario ecosystem.

Habitat Zones and Foodwebs

Habitats most important to the health and functioning of the Lake Ontario's aquatic foodweb are: (1) nearshore fish spawning grounds; (2) nearshore wetland and coastal bird and fish nesting and spawning grounds; and (3) tributaries. In turn, the lake can be partitioned into two major overlapping and interacting habitat zones: the nearshore and the offshore. The boundary between these two zones is loosely defined as the 15-metre depth contour.

The feeding relationship among the fish and other organisms within each zone is called a foodweb. All aquatic foodwebs depend on the production of microscopic algae that require adequate light and nutrients to thrive. Algae are fed upon by microscopic zooplankton or by bottom-dwelling benthic organisms (that depend on living and dead material that settles to the bottom). Zooplankton and the benthos provide the link from algae to fish and ensure that material is cycled through the foodweb.



It is necessary to monitor cross sections of the food chain to understand the impacts of chemical, physical and biological changes occurring in the lake. Even low concentrations of pollutants in water can bioaccumulate through the food web to reach levels of concern in fish consumed by humans and wildlife.
Photo Credit: The Great Lakes Atlas- An Environmental Atlas and Resource Book, 3rd Edition.

The Nearshore Habitat

The nearshore zone includes the shallow coastal waters adjacent to shore and all embayments. Within this zone, the degree of wind and wave exposure varies from very shallow protected embayments with little water exchange with the open lake, to exposed coastal areas. Similarly, the degree of nutrient levels and the impact of shoreline development varies widely along the coast. The type of aquatic plants, bottom characteristics, water flow, light and temperature found in nearshore zones determines where fish can find food, avoid predation, or spawn.

The importance of the nearshore zone to Lake Ontario fish communities cannot be over-emphasized. With very few exceptions, most Lake Ontario fish species spend part of their life cycle in the nearshore zone. For many species, the earliest and most critical life stages of egg, larvae and juveniles depend on nearshore habitat. The nearshore resident fish community varies with season, the degree of nutrient enrichment, temperature and available habitat. Dominant fish species spending most of their life cycle in the nearshore include walleye, smallmouth and largemouth bass, freshwater drum, yellow perch, white perch, gizzard shad, various minnows, and several sunfish species.

Offshore Habitat

Temperature is a dominant influence on fish distribution in the offshore zone. The development and expansion of the thermal bar in spring (a band of warm nearshore water), the establishment of the thermocline in mid-summer, and the wind driven mixing and movement of water results in large variations in temperature over depths and regions. Mixing of offshore waters results in more uniform water quality, compared to the nearshore. Most fish species associated with the offshore rely on the nearshore zone or tributaries for spawning and nursery habitat for young.

Nearshore Wetlands

Sixty-eight species of fish use coastal wetlands of Lake Ontario, either as permanent residents or for spawning, nursery or feeding during their lifecycle. The ecosystem and fish and wildlife values associated with wetlands are difficult to quantify systematically. However, protection and rehabilitation of wetlands offers improved habitat for fish and wildlife species. Throughout Lake Ontario, water level regulation is a major stress on remaining wetlands. More variable water levels can lead to greater diversity of wetland plant communities and improve fish and wildlife habitat. Other wetland rehabilitation techniques include planting of aquatic vegetation, creating channels in cattail marshes and local control of water levels through diking.

Since 1960, Lake Ontario's water level has been regulated by a series of dams on the St. Lawrence River. Water levels are determined by the International Joint Commission (IJC) under a formula that seeks to balance a number of interests. Many biologists believe that water level regulation has had serious and lasting impacts on Lake Ontario's natural resources, including fish and wildlife (particularly shorebirds and spawning fish), shoreline habitat and dune barrier systems, and the numerous wetland complexes that line the shoreline. The full range of these impacts, however, has never been documented. The IJC is now in the second year of a five-year U.S. and Canadian study to estimate the impacts that water level regulation has had on shipping, riparian property owners, boating and natural resources.

Tributaries

Recent observations of large numbers of wild chinook salmon and rainbow trout in tributaries have increased the recognition of the potential for greater contribution from wild fish. The main spawning and nursery habitats for approximately one-third of the fish species in the Great Lakes are located within tributaries. The value of most tributaries to Lake Ontario, for migratory trout and salmon spawning and nursery use, has been limited by barriers blocking access, poor water and habitat quality, and unsuitable flow regimes. Stream rehabilitation programs, management of fish passage, and storm water management can improve the spawning and nursery habitat for cold water fish species and increase wild production. Land use practices that better control erosion can reduce run-off of sediments and associated nutrients and contaminants into streams, and act in concert with other water quality control programs.

Current Status of Basin Habitat

It has been estimated that since colonial times about 50 percent of Lake Ontario's original wetlands have been lost. Along intensively urbanized coastlines, 60 to 90 percent of wetlands have been lost. These losses are a result of the multiple effects associated with urban development and human alterations, such as draining wetlands to establish agricultural land, marina construction, dyking, dredging, and disturbances by public utilities. Currently, approximately 80,000 acres of Lake Ontario's wetlands remain. The largest expanses are located in the eastern portion, along the coastline of Presque'ile Provincial Park in Ontario and in Mexico Bay in New York. More than 20 percent of Lake Ontario's wetlands are fully protected in parks, while additional areas are subject to a variety of municipal, state/provincial or federal rules, regulations, acts or programs. Opportunities to protect, restore or replace these valuable habitats need to be explored.

More efforts to create, preserve and restore fish and wildlife habitat are needed in the Lake Ontario basin.
Photo Credit: Bay Area Restoration Council

Several Lake Ontario basin habitat assessments and inventories have been conducted by U.S. and Canadian governments over the last few decades. Given the importance of habitat protection, there is a tremendous amount of activity related to habitat protection and restoration on both sides of the border.

Lake Ontario Water Level Regulation

The artificial control of lake levels affects water level changes in coastal wetlands and dune areas. This can be a threat to the natural ecosystems through the alteration of wetland plant communities and habitat quality. Since 1960, Lake Ontario's water level has been regulated by a series of dams on the St. Lawrence River. Water levels are determined by the International Joint Commission (IJC) under a formula that seeks to balance a number of interests. To better understand the impacts of regulation, the IJC has begun a five-year U.S. and Canadian study to estimate the impacts that regulation has had on shipping, riparian property owners, boating and natural resources.

U.S. Habitat Protection and Restoration Activities

There are many habitat restoration and protection projects currently underway in the U.S. Lake Ontario basin, by both government and private partners. The diversity of projects is illustrated by the following examples:

- A community-based conservation program to protect the wetlands, rivers, streams, and working forests of the Tug Hill Plateau in New York is being carried out by The Nature Conservancy (TNC).

- An evaluation of Lake Sturgeon habitat is underway in the Genessee River, a major tributary to Lake Ontario. The early history of the Genesee River records the existence of giant sturgeon in the lower portions of the river, but sturgeon population has declined over the years. Now there is great interest in restoring the sturgeon to the river.

- A shoreline restoration incentive program is being implemented for Oswego River.

- An education program on shoreline stewardship practices for private landowners has recently begun.

- Protection efforts in the Finger Lakes area are focused especially on the watersheds of the three western Finger Lakes (Hemlock, Canadice, and Honeoye), which remain largely intact and unfragmented. Hemlock Lake and Canadice Lakes are both part of the City of Rochester's water supply system; the city owns 7,200 acres of land within the watershed of the lakes, including their entire shorelines. South of Honeoye Lake lies the Bristol Hills, a relatively intact forest system that stretches east to Naples. This area is the largest documented Appalachian oak-hickory forest in New York. The site also includes a large swamp and wetland complex at the south end of Honeoye Lake. TNC and the Finger Lakes Land Trust are both working to expand protection of the western Finger Lakes by identifying and acquiring important lands and conservation easements in the Bristol Hills, and in the Hemlock, Canadice, and Honeoye watersheds. TNC has protected nearly 1,400 acres in the western Finger Lakes within the last several years. Future strategies will include land acquisition to protect key tracts; land management to restore native forests; and outreach programs to build awareness of the importance of safeguarding watersheds and preventing forest fragmentation.

- The Montezuma wetlands complex, located between Syracuse and Rochester, once comprised more than 40,000 acres of contiguous marshland. Although agricultural activities have drained nearly half of these wetlands, Montezuma is still considered one of the state's premier wetland conservation areas and is one of the most important sites in the state for migratory birds. Every spring and fall, hundreds of thousands of ducks, geese, and shorebirds utilize the complex as a staging area. Both the U.S. Fish & Wildlife Service (USFWS) and the NYSDEC are protecting and restoring wetlands at Montezuma, with a goal of returning the complex to its original size. TNC is working in partnership with both agencies and with Ducks Unlimited to protect key parcels for transfer or donation to NYSDEC or USFWS. Montezuma is a laboratory for invasive species control: USFWS officials are releasing beetles to control purple loosestrife and experimenting with fire and herbicides to control phragmites.

- At Eighteenmile Creek, an ongoing wetlands protection project of the Western New York Land Conservancy, partially funded by the USEPA, is coordinating the towns in the watershed to help design best management practices and zoning ordinances; conduct decision making exercises in each town; produce outreach materials; and prepare criteria for prioritizing acquisition areas and produce a land use/wetland map of the area.

Recent Canadian Habitat Assessment

A recently completed assessment of the status of Canadian habitat in the Lake Ontario basin developed the following findings:

- Nearshore terrestrial habitats in a natural state (such as forests, dunes, beaches and shorecliffs) are in very limited supply and are continuing to decline further. There are many examples of specialized lakeshore natural communities lacking long-term protection. Coastal wetlands have been heavily impacted by historic development activities and remaining wetlands are threatened by habitat alteration, water level controls and sedimentation. The regulation of lake levels since 1960, together with hardening of shoreline areas, have degraded natural shoreline processes (such as erosion and sand transport) affecting the health of nearshore habitats.

- One area of improvement relates to tributary habitats: suspended sediment loadings have declined in most tributaries over the past 26 years. On the other hand, an increasing variability of streamflow is being measured in watersheds associated with intensive agricultural and urban land uses.

- Historic wetland losses have been significant, and the remaining concentrations of wetlands are associated with the Peterborough drumlin field, the edge of the Canadian Shield, and the Niagara Escarpment. Rare vegetation communities also tend to be clustered, but rare species are broadly distributed with a particular concentration in the Niagara area.

- Human population growth is a major stressor, especially in the urban fringe areas of the Greater Toronto Area and the Hamilton to Niagara corridor. Land uses are changing rapidly as a result of urban sprawl. Rural areas are also changing relatively quickly, with the most intensive agricultural practices and the greatest rates of farmland loss in the western parts of the watershed. The number of active farmers is rapidly decreasing, as are the number of farms and total area farmed.

- Protective policies through municipal official plans and habitat areas of provincial interest (such as the Niagara Escarpment and Oak Ridges Moraine) are in place for about half of the regions and counties within the watershed. Private land stewardship programs and property tax incentives have been important factors in encouraging habitat conservation in some areas. Overall, however, the Canadian Lake Ontario watershed is deficient in protected areas that represent the full range of its habitat types.

- A broad mix of government and non-government activity has also taken place to address the rehabilitation of various habitats. Many rehabilitation projects are associated with the four Remedial Action Plans along the Canadian Lake Ontario shore. Wetland, shoreline and stream rehabilitation projects are the most common types, with agricultural programs receiving particular attention. Many rehabilitation projects feature community and volunteer involvement, often with the support of federal or other funding.

3.4 Next Steps

The LaMP will continue to review and re-assess the status of beneficial uses as new information becomes available.

With respect to fish and wildlife habitat the LaMP will work closely with the Great Lakes Fishery Commission's Lake Ontario Committee (LOC), consisting of OMNR and NYSDEC fishery managers and habitat experts, in identifying priority projects, investigations and the development of appropriate aquatic habitat objectives and indicators. The fish community objectives developed by the LOC and related habitat issues and concerns will provide a starting point for the development of LaMP habitat aquatic ecosystem objectives and indicators.

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4.0 Update on Environmental Levels of Critical Pollutants

4.1 Introduction

The Four Parties have implemented programs and undertaken activities, both regulatory and voluntary, that have resulted in measurable improvements lakewide. This chapter provides a summary of the environmental progress that has been made in Lake Ontario, in reducing levels of critical pollutants in water, sediment and lake biota.

4.2 Critical Pollutant Levels in Open Waters

Critical pollutant levels in Lake Ontario have generally declined over the last 20 to 25 years.

With proper treatment, regular monitoring of Lake Ontario water supplies shows that water quality meets public health standards for drinking water supplies. Open lake surveillance monitoring also confirms the high quality of Lake Ontario water.

Nevertheless, critical pollutants are still detected at extremely low concentrations in open waters at levels that exceed the most stringent surface water criteria designed to protect wildlife and humans who consume fish (Table 4.1).

Table 4.1 Critical Pollutant Concentrations in Lake Ontario Open Waters, 1997

	NYS WQS	Measured	
Critical Pollutant	*Standard (pg/L)*	*Concentration(pg/L)*	*Exceeds WQS*
PCBs	1	110	Yes
Dioxins + Furans	0.0006	0.0046	Yes
p,p' - DDE	7	10	Yes
p,p' - DDD	80	13	No
p,p' - DDT	10	2.6	No
Dieldrin	0.6	51	Yes
Mirex	1	R	NA
Dissolved Mercury	700	NS	NA

pg/L = parts per quadrillion
R - Data rejected due to lab problems
NS - Not sampled
NA - Data not available for this time period
NYS WQS - New York State Water Quality Standard for pollutants in open water

Source: Litten & Donlon 1998.

The most recent data available (collected by NYSDEC in 1997) suggest that DDE levels are now slightly above the open water standard, while PCB and dieldrin levels are approximately 100 times higher than their respective standards. Water sampling results from the Niagara River and the St. Lawrence River suggest that mirex and mercury levels also exceed standards in open waters (although information on mirex and mercury was not collected in the 1997 study).

Canadian and U.S. monitoring programs are continually improving sampling and analytical methods with the goal of achieving lower detection limits. The results of U.S. open lake water critical pollutant sampling conducted in 1999 are now being analyzed and will be summarized in future LaMP reports. Environment Canada will be measuring open lake water critical pollutant concentrations in 2003. The LaMP will continue to monitor critical pollutant levels and trends in open waters and report on the results.

4.3 Contaminant Trends in Lake Ontario Sport Fish

The Lake Ontario LaMP has identified a number of critical pollutants that have impaired beneficial uses on a lakewide basis. These persistent contaminants (e.g. PCB, DDT, mirex, dioxin/furans, mercury, dieldrin) tend to bioaccumulate in biological tissue (of fish, animals and humans). Monitoring contaminant levels in tissue, therefore, facilitates the assessment of spatial and temporal trends in water quality and contaminant availability.

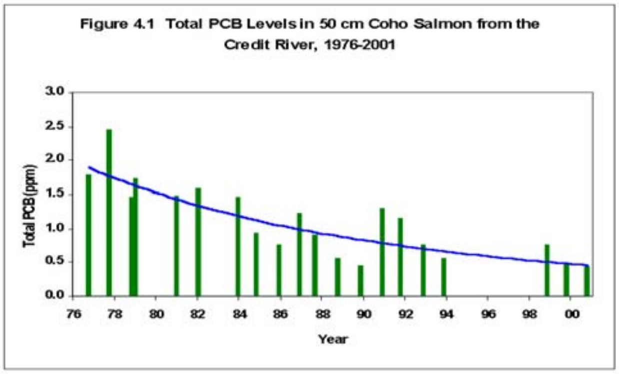
Concentrations of PCBs, DDT and mirex in lake trout tend to be higher in the western basin of Lake Ontario than the eastern basin. This reflects the magnitude of contaminant inputs from the upper lakes and the Niagara River and the industrialized nature of the western end of the lake.

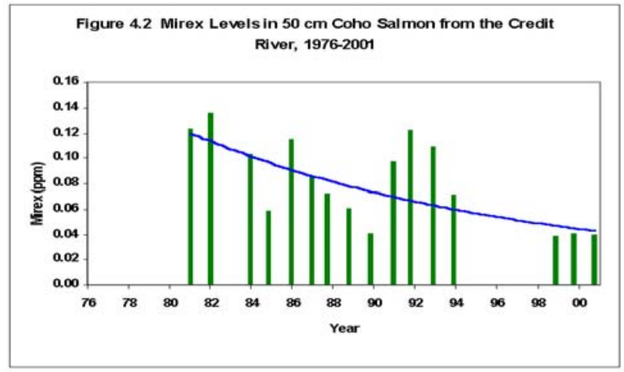
Fish Consumption Advisories

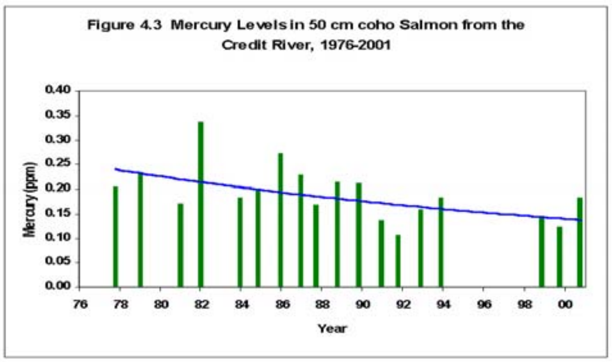
Both the Province of Ontario and New York State issue fish consumption advisories for fish caught in Lake Ontario waters. In general, the consumption advisories are based on contaminant levels in different species and ages of fish, taking into account that contaminant levels are generally higher in older, larger fish. While there are some differences in the fish tissue monitoring methodologies used by the two governments, both jurisdictions agree that PCBs, dioxin, DDT, and mirex are responsible for lakewide fish consumption advisories. The LaMP is coordinating binational efforts to control and reduce inputs of these contaminants to the lake.

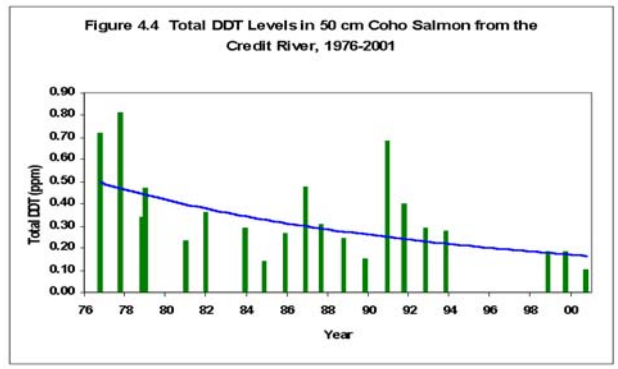
Ontario anglers should refer to the Guide to Eating Ontario Sport Fish, published every two years by the Ministry of Natural Resources and the Ontario Ministry of the Environment, for size and species-specific consumption advice. www.ene.gov.on.ca

U.S. anglers should refer to New York State Department of Health's Chemicals in Sportfish and Game, which includes specific and general advisories for Lake Ontario. www.health.state.ny.us/nysdoh/environ/fish.htm









Source: Ontario Ministry of the Environment (A. Todd, A. Hayton), Unpublished data.

Overall, the fish community has experienced a dramatic reduction in contaminant levels since the mid-1970s. Long-term trends in contaminant concentrations are illustrated using data collected by the Ontario Ministry of Environment (OMOE) for 50-centimetre coho salmon from the Credit River spawning run (Figures 4.1 to 4.4). Coho salmon data are well suited to analysis of trends over time since they spend most of their time in the Lake and different individuals of similar age return to the same location each year to spawn. In the mid-1990s, coho salmon stocks in the Credit River were low and no samples were obtained. Concentrations of total PCB, mirex, mercury, and total DDT in Credit River coho salmon have been decreasing steadily since monitoring commenced in the late-1970s. Total PCB concentrations have decreased from greater than 1.5 ppm in late-1970s to approximately 0.5 ppm in 2000 (Figure 4.1). Over the same time period, concentrations of mirex have decreased from greater than 0.1 ppm to less than 0.05 ppm (Figure 4.2). Similar trends have been observed for mercury and DDT, as can be seen in Figures 4.3 and 4.4, respectively.

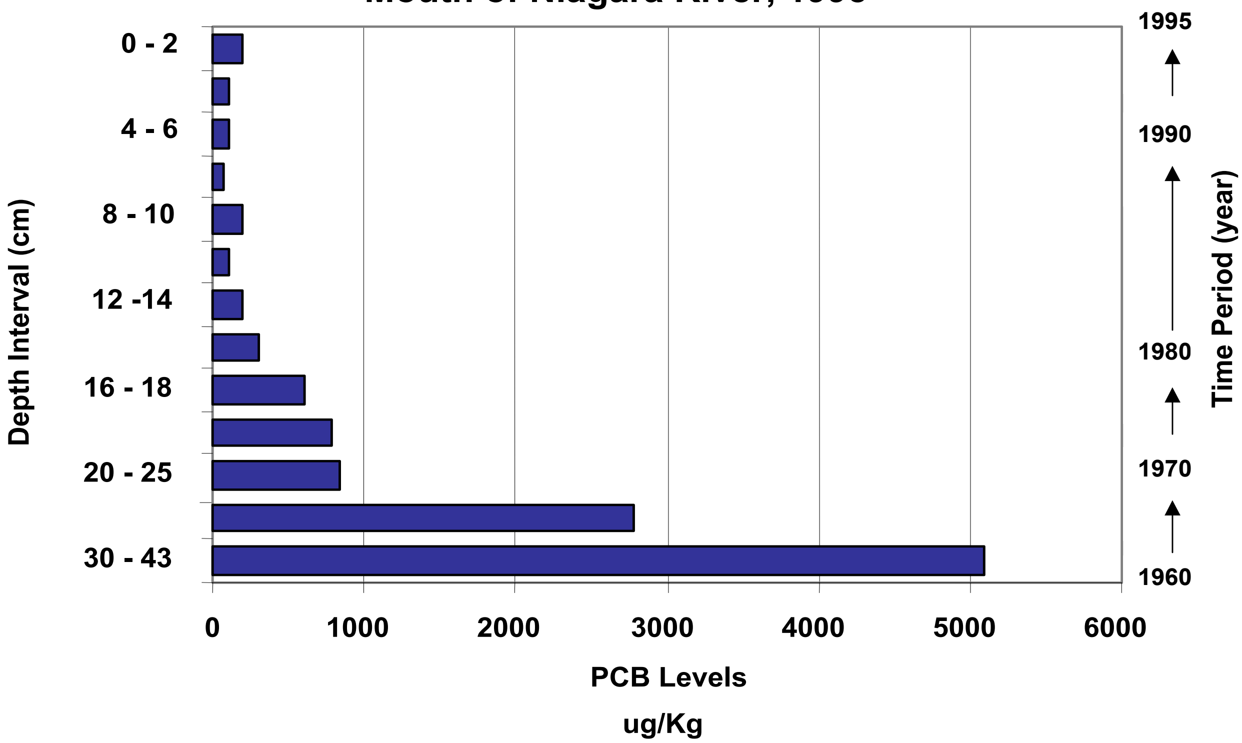
4.4 Contaminant Trends in Sediments

Sediment core samples provide another means of evaluating contaminant trends over time. Since many toxic pollutants are transported through the water attached to suspended sediments, analysis of sediment samples taken from different depths below the lake bottom show how the concentrations of chemicals have changed over time. A cooperative U.S. – Canadian investigation collected sediment cores from the bottom of Lake Ontario at the mouth of the Niagara River to better understand long term trends in contaminant loadings to the lake. The results (Figure 4.5) show that the input of toxic chemicals associated with suspended sediment from the river has declined, most significantly between 1960 and 1980. The surface concentrations of all priority chemicals, except PCBs, in these core samples are now less than OMOE's lowest effect level or LEL (that is, the level at which a toxic contaminant can be expected to affect some benthic organisms).

In 1998, Environment Canada's National Water Research Institute (NWRI) repeated a survey of Lake Ontario bottom sediments, using the same locations that were sampled by NWRI in 1968. The purpose of the study was to determine any changes in the spatial (geographic) distribution of contaminants. A total of 80 stations were sampled, throughout the Lake Ontario basin. The samples were analyzed for metals, PCBs, pesticides, dioxins/furans, polyaromatic hydrocarbons, total organic carbon, grain size and toxicity. In addition, samples at each location were sieved, the benthic organisms in each sample were identified and counted, and the sediments were tested for overall toxicity. Acoustic sediment surveys were undertaken at the same time, and repeated in 2000 (using a system called Roxann) to update bottom sediment substrate maps. This information will be used by the LaMP to better understand aquatic habitats and the rate and scale of changing sediment patterns through time as a result of lakebed erosion and sedimentation. Data are still being processed and analyzed.

In 1997, scientists from the USEPA, NOAA and the New York State Department of Environmental Conservation undertook a comprehensive study of sediment quality in Lake Ontario using a random sample design. The purpose of the study

Figure 4.5 Total PCB Levels in a Sediment Core from Mouth of Niagara River, 1995



NOTE: Total PCB congener analyses of sediments from the mouth of the Niagara River, taken at various depths below the lake bottom, show that levels of this contaminant decreased significantly.

Source: NYSDEC 1996.

was to assess sediment quality in the lake as a whole by: establishing a baseline of data for chemicals of concern against which future trends could be measured; determining the biological quality of the sediments; and identifying any specific relationships between levels of chemical contamination and benthic community structure. Survey results are still being analyzed, however, some preliminary findings include:

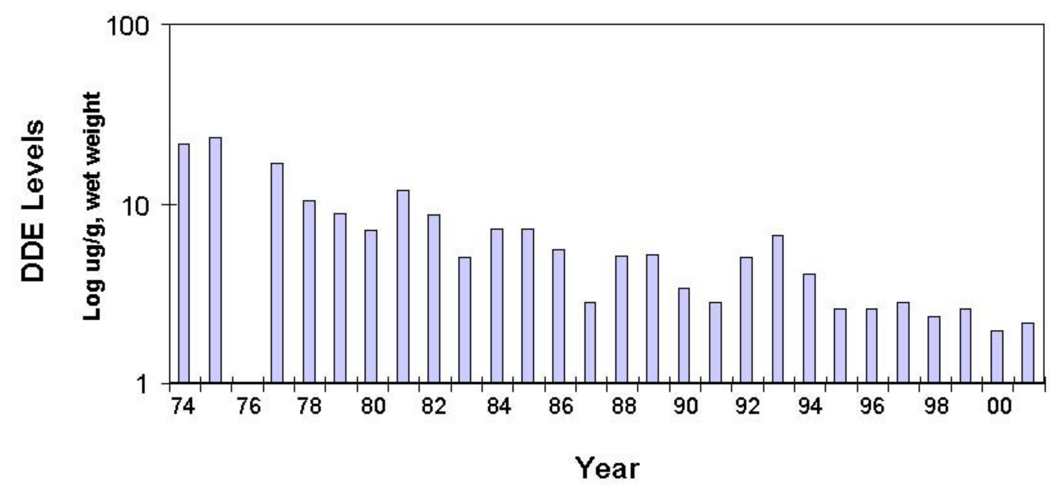
- 100 percent of the sediments were found to be not acutely toxic;
- approximately 60 percent of the surface sediments in Lake Ontario exceeded the mercury LEL guideline;
- only 5 percent of the sediments exceeded the dieldrin LEL guideline;
- 30 percent of the sediments exceeded the mirex LEL guideline; and
- only 20 percent of the sediments exceeded the DDT LEL guideline.

The LaMP intends to pool the results and data from these two comprehensive investigations, as well as data from ongoing nearshore sediment surveys to get a better understanding of the nature and significance of sediment sources of critical pollutants to Lake Ontario.

4.5 Contaminant Trends in Herring Gull Eggs

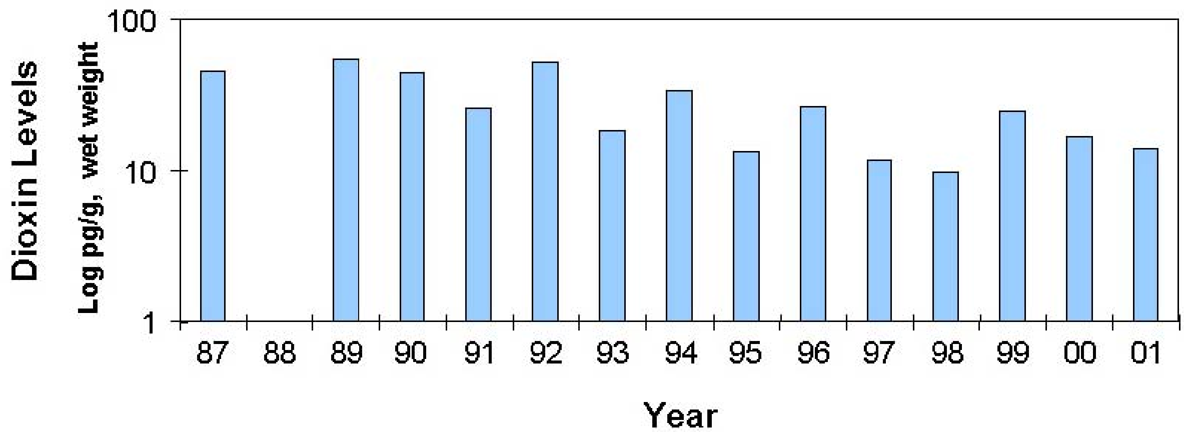
The direct correlation of load reduction activities and ecosystem improvements is further illustrated in the reduced levels of contaminants in herring gull eggs. In Lake Ontario, herring gull egg samples have been collected annually since the mid-1970s at Kingston Harbour (Snake Island) and Toronto Harbour (in Tommy Thompson Park). Trends in concentrations of the following five compounds were examined: DDE, mirex, PCBs, dioxin (2,3,7,8 TCDD) and mercury.

Figure 4.6 DDE Levels in Herring Gull Eggs from Kingston Harbour, 1974-2001



Source: Bishop et *al*., 1992; Pettit et *al*., 1994; Canadian Wildlife Service, Unpublished data.

Figure 4.7 Dioxin Levels in Herring Gulls Eggs from Toronto Harbour, 1987-2001



Source: Bishop et *al.*, 1992; Pettit et *al.*, 1994; Canadian Wildlife Service, Unpublished data.

Note: data for dioxin extend from 1987-2001 and those for mercury have been collected only sporadically. For mirex and PCBs, data extend from 1974-2001.

Levels of contaminants in herring gull eggs have decreased dramatically from the mid 1970s to the late 1980s. Concentrations of DDE (Figure 4.6) and PCBs continue to decrease at both sites. This is also true for dioxin levels at Toronto Harbour (Figure 4.7). However, the decline in dioxin levels at Kingston Harbour and in mirex levels at both Kingston Harbour and Toronto Harbour has been slower in recent years.

Overall, these results are encouraging; they suggest that the food base for the herring gull in Lake Ontario is becoming less contaminated.

4.6 Cooperative Monitoring

Although the LaMP's primary focus is the development of strategies and actions designed to restore impaired lakewide uses, effective monitoring is required to track progress in achieving its goals. Whenever possible, the LaMP promotes cooperative U.S.-Canadian monitoring efforts in Lake Ontario's open waters, nearshore areas and tributaries. Increased communication and coordination of existing programs is encouraged. The LaMP's cooperative monitoring approach has three components: (1) promoting increased communication and coordination among monitoring programs; (2) developing special monitoring projects to answer specific LaMP-related questions; and (3) building on existing monitoring initiatives.

The LaMP will be working over the next few years to better coordinate U.S and Canadian monitoring related to LaMP beneficial uses and ecosystem indicator data needs. The LaMP's information needs can be classified into four general categories:

- evaluating the status of beneficial use impairments;
- monitoring environmental levels of critical pollutants;
- measuring progress through the use of ecosystem indicators; and
- providing input to mass balance modeling.

Existing U.S. and Canadian monitoring programs meet most of the LaMP's beneficial use and ecosystem indicator monitoring needs. The findings of these programs are highlighted in LaMP reports and will be used in reporting on selected ecosystem indicators. The LaMP is now working to promote and encourage existing U.S. and Canadian programs to coordinate their efforts, and where possible, expand their efforts as needed to develop a more complete lakewide assessment of current conditions. The LaMP will support these efforts by identifying available equipment, boats and other resources that can support these activities.

Some LaMP information needs may require special investigations that go beyond routine monitoring programs. For example, the LaMP agencies are initiating a study to compare critical pollutant water sampling methods used by U.S. and Canada. This will help determine the comparability of U.S. and Canadian sampling results.

Lake Ontario fishery researchers have a well-developed binational approach to monitoring and reporting through the efforts of the Great Lakes Fishery Commission's binational Lake Ontario

Water quality is monitored to ensure that nutrient levels are sufficient to support aquatic life and are not causing unsightly algal blooms.
Photo Credit: Environment Canada

Committee. NYSDEC and OMNR conduct joint hydro-acoustic surveys at key times of the year to evaluate the status of alewife and smelt populations. Binational investigations of eel populations are also being conducted. The findings of these studies, as well as other individual agency studies (such as warm water fish population monitoring and lake trout restoration) are presented at annual Lake Committee meetings. The Lake Ontario Technical Committee (LOTC) of U.S. and Canadian fishery researchers maintains close contact through an informal network that allows them to efficiently address monitoring issues.

Monitoring programs are often subject to equipment, staffing, budgetary and/or weather events all of which can derail sampling plans. Similar to the LOTC, the LaMP is developing an informal network of contacts involved in monitoring critical pollutants in water, sediment and biota that may be able to assist each other when problems arise. Increased communication will also lead to a better understanding of each other's sampling methods and recognition of opportunities to collaborate. Binational reporting on LaMP ecosystem indicators will further promote communication between various monitoring programs.

4.7 Emerging Chemicals of Concern

In addition to pursuing the elimination of critical pollutant inputs, the LaMP tracks information on other bioaccumulative contaminants that may potentially cause lakewide impairments. Polybrominated diphenyl ethers (PBDEs) are a class of bioaccumulative chemicals that have been widely used over the last two decades as flame retardant in textiles, polyurethane foam, acrylonitrile butadiene styrene plastic (ABS) and electrical components. These materials can contain between 5 to 30 percent PBDE by weight. PBDEs are used in many types of electrical equipment, such as computers and televisions, and in building materials greatly reducing fire risks. Unfortunately, PBDEs are also highly mobile in the environment and are now recognized as a globally persistent organic pollutant found even in the marine foodweb of remote Arctic regions. Environmental sampling in Lake Ontario has also shown that PBDE concentrations in fish and wildlife tissue have been increasing in recent years.

A number of actions are underway that will help evaluate the potential risk PBDE may pose to fish, wildlife and human health. There are currently no water quality or fish tissue criteria for PBDEs. Studies have been initiated by both federal governments to assess the potential effects of PBDE on human health. Environmental sampling by Canadian and U.S. investigators of Lake Ontario water, fish and gulls eggs is developing a more complete picture of PBDEs in the Lake Ontario foodweb. A major study being conducted by Environment Canada researchers will provide a preliminary mass balance assessment of all inputs of PBDEs to Lake Ontario, as well as concentrations in tissues throughout the foodweb.

The LaMP will continue to be on the alert and will evaluate any other new bioaccumulative contaminants that may potentially cause lakewide impairments.

4.8 Next Steps

The LaMP will continue to monitor levels of critical pollutants in water, sediment and biota and report on the findings.

4.9 References

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Litten, S. and Donlon, J. 1998. Enhanced toxics sampling for trace organic chemicals in Lake Ontario. April 1998. Bureau of Watershed Assessment and Research, Division of Water, New York State Department of Environmental Conservation. Albany, New York. 12233-3508.

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Pettit, K., C. Bishop, D.V. Weseloh, and R. Norstrom. 1994. An Atlas of Contaminants in Eggs of Fish-Eating Colonial Birds of the Great Lakes (1989-1992) Vol. I. Can. Wild. Serv. Tech. Rep. No. 193.

5.0 Sources and Loadings of Critical Pollutants

5.1 Introduction

This chapter provides an update on the inputs (both sources and loadings) of critical pollutants to Lake Ontario, based on the latest available data. Polychlorinated biphenyls (PCBs), DDT and its metabolites, mirex, dioxins/furans, mercury and dieldrin have been identified as critical pollutants impairing lakewide beneficial uses for Lake Ontario. These contaminants can enter Lake Ontario via a number of routes, including rivers, precipitation, point sources (e.g. sewage treatment plants, industrial facilities, waste sites) and non-point sources (e.g. stormwater, agricultural runoff). The levels of contaminants are also constantly changing in response to many known and unknown factors. As a result, loading data are often limited and rely on numerous assumptions.

The focus of the LaMP's contaminant reduction efforts is to identify those opportunities within the Lake Ontario basin where critical pollutant sources can be further controlled. Areas with concentrations of population and industry, such as the greater metropolitan area of Toronto-Hamilton and Rochester, are obvious locations to be included in the LaMP's review of potential opportunities. Being the last in the chain of the Great Lakes, Lake Ontario receives a large percent of its known contaminant loadings from upstream lakes. To restore Lake Ontario's beneficial uses, contaminant reduction activities need to be implemented through upstream LaMP and RAP efforts.

5.2 Data Sources and Limitations

Previous attempts to develop loading estimates of critical pollutants entering the lake identified a number of data gaps including: (1) insufficient data to estimate critical pollutant loadings for many tributaries; (2) limited data on atmospheric loadings of critical pollutants throughout the basin; and (3) the amount of critical pollutants being effectively removed from the system due to burial in the deep basins of the lake.

Table 5.1 presents an update of the four major categories of critical pollutant loading estimates based on the latest available data: (1) loadings from sources outside the Lake Ontario basin; (2) loadings from sources inside the Lake Ontario basin; (3) atmospheric loadings; and (4) releases from Lake Ontario to the St. Lawrence River and volatilization (evaporation) to the atmosphere. The data come from a number of information sources and monitoring programs that use different criteria, methods, and loading calculation methods.

Long-term water quality monitoring programs are conducted by Environment Canada at Fort Erie, Niagara-on-the-Lake (at both ends of the Niagara River) and at Wolfe Island at the head of the St. Lawrence River. These programs use similar sampling and analytical methods and the loading calculation methodologies have been agreed to by the Four Parties. The data provides a good estimate of the critical pollutant loadings that originate from upstream Great Lakes basins, those that originate in the Niagara River basin, and the amounts of critical pollutants that leave Lake Ontario via the St. Lawrence River.

Estimates of atmospheric loadings of critical pollutants to Lake Ontario were developed by the Integrated Atmospheric Deposition Network (IADN) for PCBs, DDT and dieldrin. The IADN

Table 5.1 Estimates of Critical Pollutant Loadings to Lake Ontario

Note: Loadings in this table are only ESTIMATES. The data are drawn from a number of different sources and monitoring programs which use different criteria, methods, and loading calculation methodologies. As a result, these estimates contain a significant degree of uncertainty and should only be considered as general indications of the relative significance of loadings from various sources.

	Loadings from Sources Upstream of the Lake Ontario Basin (Kg/yr)			Loadings from Water Discharges Within the Lake Ontario Basin (Kg/yr)				Atmospheric Loadings (Kg/yr)	Amounts Leaving Lake Ontario (Kg/yr)			Net Change (Kg/yr)
	Other Great Lakes	Niagara River Basin	Total	Point and Non-Point Via Tributaries	Direct Point Source Discharges		Total		Via St. Lawrence River	Volatilization to Atmosphere	Total	
					U.S.	Can.						
PCBs	155	25	180	97	1.6	ND	98.6	32	364.5	230	594	-283.4
Total DDT	42.7	-12.75 see footnote	29.93	16	1.7	ND	17.7	13.2	1.06	NA	NA	NA
Mirex	0.000	1.095	1.095	0.9	ND	ND	0.9	ND	NA	NA	NA	NA
Dieldrin	29.57	2.185	31.76	5.0	0.15	ND	5.2	4.2	39.7	220	260	-218.84
Dioxins/ Furans	ND	ND	ND	NQ	<.0001	NQ	NQ	0.005	ND	NA	NA	NA
Mercury	839.5	-73.0 see footnote	766.5	37.0	3.51	86.2	127	133	ND	NA	NA	NA

NA - no information available ND - not detected/not measurable NQ - present but not quantified

Sources:

Niagara River and Upstream Great Lakes

Williams, D. J. et al., 2000. The Niagara River Upstream/Downstream Program, 1986/87 – 1996/97. Report and Appendices. Ecosystem Health Division, Environment Canada – Ontario Region. Loadings calculated based on latest available data. Values are for 1996/97. Values for Niagara River Basin estimated based on measured results at Niagara-On-The-Lake (total) minus Fort Erie (other Great Lakes). For total DDT results suggest that the Fort Erie site is subject to contamination by a source upstream and close to the Fort Erie station (Environment Canada, unpublished data). Mercury results should be used with caution as all samples were below the detection limit (Environment Canada, unpublished data).

Tributaries

Litten, S., 1996. Trackdown of Chemical Contaminants to Lake Ontario from New York State Tributaries. Bureau of Watershed Assessment and Research, Division of Water, NYSDEC, Albany, N.Y. 12233-3502.

Boyd, D., and H. Biberhofer, 1999. Large Volume Sampling at Six Lake Ontario Tributaries During 1997 and 1998: Project Synopsis and Summary of Selected Results.

Boyd, 1999. Assessment of Six tributary Discharges to the Toronto Area Waterfront. Volume 1: Project Synopsis and Selected Results. Report prepared for the Toronto and Region RAP.

Point Sources

Litten, 1997. NYSDEC

New York State SPDES program.

Khettry, R., 1999. Draft Report on the Sewage Treatment Plant Monitoring Studies Conducted in 1997 and 1998 in Support of the Canada-Ontario Agreement. Prepared for Environment Canada and the Ontario Ministry of the Environment.

Ministry of the Environment MISA data.

Atmospheric

National Atmospheric Deposition Program, Mercury Deposition Network. Data from website:http://nadp.sws.uiuc.edu/mdn/. Data for two closest stations (Dorset, Ontario and Tioga County, Rennsylvania) were averaged for 1997 and 1998 to obtain a value of 7.0ug/m^2 for mercury deposition to Lake Ontario. The mercury loading was then calculated based on lake area of 19,000 km^2

Galarneau et al., 2000. Atmospheric Deposition of Toxic Substances to the Great Lakes: IADN Results to 1996, U.S./ Canada IADN Scientific Steering Committee. Values for PCBs, DDTs and Dieldrin are means for 1995 and 1996. Volatilization losses for DDT compounds could not be calculated for 1995-96 due to lack of water chemistry data.

Eisenreich, S.J., and W.M.J. Strachan, 1992. Estimating Atmospheric Deposition of Toxic Substances to the Great Lakes- An Update, Proceeding of a workshop held at the Canada Centre for Inland Waters, Burlington, Ontario. Value of 5.2g/yr for TCDD wet deposition only (does not contain dry deposition or air-water exchange values).

St. Lawrence River

Merriman, J., 1998. Trace Organic Contaminants in the St. Lawrence River at Wolfe Island. Report No. EHD 98-02/I. Loadings calculated based on latest published data 1994-1995.

network for Lake Ontario consists of a master station at Point Petre (near the eastern end of Lake Ontario), and a satellite station located in Burlington, Ontario (at the west end of the lake). A similar network, the National Atmospheric Deposition Program, Mercury Deposition Network, is the source of information for atmospheric mercury deposition. The dioxin estimates are based on data provided from numerous agencies at a Canada/U.S. binational workshop in 1992. Estimates for the amounts of critical pollutants volatilizing to the atmosphere are also provided where available. In general, estimating atmospheric deposition is difficult, and these estimates contain a significant degree of uncertainty.

The amounts of critical pollutants entering Lake Ontario via Lake Ontario basin tributaries were estimated based on the best available information. Because critical pollutants entering tributaries may originate from a number of sources or activities (such as point sources, atmospheric deposition onto the watershed, contaminated industrial sites, landfills, historic use of pesticides, storm drainage, combined sewer overflows, etc), pollutant levels can be highly variable. In general, there is insufficient data to accurately estimate critical pollutant loadings to Lake Ontario from tributaries. As a result, quantitative and qualitative monitoring techniques, as well as biological monitoring results, were used to estimate loadings, or the relative presence or absence of critical pollutants within each tributary watershed (see Table 5.2). The loading estimates provided should be considered qualitative and approximate, as sampling in most cases was not event-based (during a storm).

Estimates of loadings of critical pollutants from direct point source dischargers are limited by a lack of data and confounded by jurisdictional differences. New York State requires dischargers whose wastewater is known or suspected to contain significant levels of critical pollutants to monitor for these contaminants. There is no current data on Ontario point sources since no Ontario industrial point source discharges the critical pollutants in sufficient quantities to require regulation under the province's MISA (Municipal/Industrial Strategy for Abatement) Program.

This assessment does not include information on combined sewer overflows (CSOs), stormwater and other non-point sources that discharge directly to the lake, nor is there an assessment of the contribution to the loadings from in-place sediments and air emissions within the basin.

As a result, the loading numbers in Table 5.1 are only estimates. The data are drawn from a number of different sources and monitoring programs that use different criteria, approaches, and loading calculation methodologies. Some of these estimates are also based on data collected in different years and under a variety of conditions. As a result, these estimates contain a significant degree of uncertainty and should only be considered as general indications of the relative significance of loadings from various sources.

5.3 Estimated Loadings of Critical Pollutants

Polychlorinated Biphenyls (PCBs)

Levels of polychlorinated biphenyls in the environment have decreased in response to the banning and phasing out of the various uses of PCBs. Analysis of the most recent data available indicates that most of the estimated PCB loadings to Lake Ontario originate outside the Lake Ontario basin (see Table 5.2). Data suggest that upstream sources are responsible for approximately 60 percent of the inputs, while sources within the basin contribute 30 percent (most of which enters

Table 5.2 Estimates of Critical Pollutants Entering Lake Ontario Via Major Tributaries from Atmospheric, Point and Non-point sources

Source	Average flow (1000m^3 per day)	PCBs (Kg/Yr)	Total DDT (Kg/Yr)	Dioxins/ Furans (g/Yr)	Dieldrin (Kg/Yr)	Mirex (Kg/Yr)	Mercury (kg/yr)
Burlington Canal	NA	2.8(1) Y(8, 10)	Y(8)	Y(8)	Y(10)	ND Y(8)	NA
Cataraqui River	444	Y(12)	ND(12)	NA	ND(12)	ND(12)	NA
Credit River	567	Y(8, 12)	Y(8, 12)	NA	ND(12)	0.004(11) Y(8, 12)	0.0044(11)
Don River	425	1.0(3) Y(12)	0.5(3)	Y(10)	0.1(3)	ND(12)	ND(12)
Duffins Creek	292	Y(8, 12)	Y(8)	NA	ND(12)	ND(12)	ND(12)
Etobicoke Creek	193	0.6(3)	0.0367(3)	NA	0.016(3)	NA	NA
Humber River	798	1.7(3) Y(8, 12)	0.4(3)	NA	0.1(3)	Y(8)	Y(8, 12)
Napanee River	723	NA	NA	Y(7)	NA	NA	NA
Oakville Creek	166	Y(8)	Y(8)	NA	NA	NA	NA
Trent River	17,107	Y(4, 12)	ND(12)	Y(7, 10)	ND(12)	ND(12)	ND(12)
Twelve Mile Creek	15,466	Y(8, 12)	Y(8)	Y(7)	ND(12)	ND(8, 12)	0.0045(11)
Welland Ship Canal	2,246	Y(8, 12)	Y(8)	Y(7)	ND(12)	Y(8)	NA
Atmospheric (2)		32	13.2	0.005	4.2	NA	133
Upstream (9) • Niagara River • Other Great Lakes	492,000	25 155	-12.75 42.7	NA NA	2.185 29.57	1.095 0.000	-73.0 839.5
Black River	10,129	52.2(5)	0.02(5)	Y(7)	1.1(5)	Y(5)	10.40(5)
Eighteen mile creek	240	7.3(5)	0.01(5)	Y(5)	0.1(5)	Y(5)	0.47(5)
Genesee River	6,868	14.2(5)	0.03(5)	Y(5)	1.7(5)	0.03(5)	12.20(5)
Irondequoit Creek	269	0.003(5)	0.002(5)	Y(5)	0.002(5)	NA	0.26(5)
Johnson Creek	308	Y(6)	Y(6)	Y(6)	NA	NA	NA
Oak Orchard Creek	822	Y(5)	Y(5)	Y(5)	Y(5)	Y(5)	0.53(5)
Oswego River	16,340	17.1	1.5	Y(5)	1.2(5)	0.9(5)	13.11(5)
Sandy Creek	220	1.01(5)	NA	NA	NA	NA	0.03(5)
Wine Creek	20	0.001(5)	ND(5)	NA	ND(5)	NA	0.02(5)

NA- no information available
Y- Detected in qualitative monitoring
ND- Not detected

Sources:
1- Fox et Al, 1996
2- Hoff et al, 1998
3- D'Andrea and Anderton, 1996
4- Poulton, 1990
5- Litten, 1996
6- Estabrooks et al, 1994
7- MOE, MISA, 1994
8- MOE Spottail Shiner data
9- Niagara River Upstream/ Downstream Program, 1997-1999
10- Canviro consultants, 1988
11- Boyd and Biberhofer, 1999
12-Unpublished Water Data, MOE, 2002

the lake via tributaries). Atmospheric loadings contribute the remainder of the estimated loadings directly to the lake surface. When the loss of PCBs from the lake basin via volatilization and the St. Lawrence River is considered, it appears that the total amount of PCBs within Lake Ontario is decreasing.

DDT and its Metabolites

Agricultural use of the pesticide DDT was been banned in North America after it was found that DDT and its breakdown products were causing widespread reproductive failures in eagles and other wildlife species. Although it is still being used in other parts of the world, levels of DDT in the North American environment have decreased significantly and species that were once negatively affected, such as cormorants, have recovered.

Approximately half of the DDT that enters Lake Ontario comes from upstream sources. Atmospheric deposition and tributary sources contribute to the remainder. Although use of DDT has been banned, monitoring indicates that there may be local sources in some tributaries. As expected, DDT levels in point source discharges are negligible. Previous estimates indicate that the amount of DDT leaving the lake (primarily through volatilization) may be greater than the amount coming in.

Mirex

Mirex was used in the Lake Ontario basin primarily as a flame retardant in manufacturing and electrical applications. Use and production of mirex is now banned in North America. Most of the mirex that enters Lake Ontario originates in the Niagara River basin. During the 1970s, a manufacturer discharged large quantities of mirex-contaminated wastewater to the Niagara River, resulting in widespread contamination of Lake Ontario sediment and fish. Two facilities located on the Oswego and Credit Rivers, which used mirex in the 1970s, have been extensively investigated as there were concerns regarding known or potential mirex releases to these rivers. A review of current information, including mirex levels in resident fish, indicates the Oswego and Credit Rivers are not significant sources of mirex to the lake. No reliable estimates of atmospheric deposition or volatilization of mirex are available.

Dieldrin

Use and production of the pesticide dieldrin has now been banned in North America. Based on information collected by Environment Canada, dieldrin concentrations in water have declined from 0.33 ppt in 1986 to 0.14 ppt in 1998. Most of the dieldrin that enters the lake comes from upstream sources (80%). Dieldrin inputs from sources within the Lake Ontario basin and from atmospheric deposition are low. When the rate of loss of dieldrin in Lake Ontario due to volatilization and via the St. Lawrence River is factored in, it appears that the amount of dieldrin in the lake is decreasing.

Dioxins and Furans

Dioxins and furans are a group of chemical by-products that are produced by a variety of chemical and combustion processes, including internal combustion engines, incinerators, forest fires and wood and waste burning. Studies have shown that some wildlife species are extremely sensitive to the toxic effects of these contaminants. As a result, steps have been taken to control and limit those processes that produce high levels of dioxins and furans, resulting in a significant decrease in environmental levels of these chemicals over the last two decades.

Dioxins and furans exist at very low levels in the environment and, as a result, are difficult and costly to detect and accurately quantify. Dioxins and furans continue to be released through a wide variety of combustion processes such as cement kilns and steels mills. Historically chemical manufacturing sources in the Niagara River Basin were significant sources of these contaminants to Lake Ontario. These sources have been effectively controlled, although some low-level releases from these sites will occur for years to come. Sediment samples from the mouth of the Niagara River show that dioxin levels have decreased by more than 90 percent since control actions were implemented in the 1970s. Although the Niagara River upstream-downstream program did not detect dioxins and furans in Niagara River water, information from other media (mussels, spottail shiners) suggest that there are some low-level releases of dioxins and furans occurring along the Niagara River. Using the same types of qualitative water and biological sampling methods, dioxins and furans have also been detected in some Lake Ontario tributaries and harbours. Air emissions are recognized as an important source of these contaminants to the environment, however, no reliable estimates of atmospheric deposition or volatilization of dioxins/furans are available. As a result there is insufficient information to draw any conclusions on the relative significance of the various loading pathways.

Mercury

Mercury is a naturally-occurring metal, which is found in small amounts in most soils and rocks. Mercury is used in thermometers, medical and dental products, batteries and in the production of various synthetic materials, such as urethane foam. Estimates of mercury loadings to Lake Ontario should be viewed as preliminary. Mercury that enters Lake Ontario comes from upstream sources (approximately 75 percent), direct point source dischargers (10 percent), inputs from tributaries (5 percent) and atmospheric deposition (10 percent). Given the special difficulties with measuring low levels of mercury in the environment, there are no estimations of how much mercury leaves Lake Ontario via the St. Lawrence River or through volatilization.

5.4 Significance of Estimated Loadings of Critical Pollutants

Strategies to reduce or eliminate inputs of critical pollutants need to be based on an understanding of the production, use and disposal of these chemicals in order that their sources can be controlled. An understanding of the various physical and chemical pathways by which these contaminants move through the ecosystem is also necessary in order to determine the appropriate control strategy and predict the time needed to restore impairments.

The Niagara River is the largest tributary to Lake Ontario, providing over 83 percent of all the tributary water that flows into the lake. Along with the contribution of water, the Niagara River also contributes contaminants to Lake Ontario originating from the waters of the other Great Lakes and from sources along the river. Since 1986, significant reductions in the concentrations and loadings of critical pollutants, in most cases greater than 60 percent, have been measured in the Niagara River. The reductions are due to, in part, the effectiveness of remedial activities at Niagara River sources in reducing chemical inputs to the river. The river is becoming less polluted; however the rate of improvement has slowed, because the majority of pollutants now come from upstream sources outside of the Niagara River Basin.

Based on the limited loadings data available, it appears that the most significant source of critical pollutants to Lake Ontario now comes from outside the Lake Ontario basin. Upstream sources are responsible for most of the PCBs, DDT (and its metabolites) and dieldrin that enter the lake. Most of the mirex entering Lake Ontario comes from the Niagara River basin. Atmospheric deposition and tributary inputs are the other main sources of critical pollutants.

Restoring beneficial uses in Lake Ontario will depend, in part, on the successful implementation of LaMPs and RAPs upstream, as well as other Great Lakes programs (such as the Canada-Ontario Agreement, the U.S. Great Lakes Strategy, and the Great Lakes Binational Toxics Strategy), and other national, binational and global initiatives that address persistent toxics reductions. The LaMP will continue to address in-basin sources of critical pollutants.

The loading estimates also indicate that the volume of some contaminants leaving the lake, such as PCBs, DDT and dieldrin, may be greater than the amount entering Lake Ontario. One explanation for this may be that contaminants are slowly being released from sediments in the Lake Ontario system. Volatilization may be another significant process by which critical pollutants are leaving the Lake Ontario system.

5.5 Progress to Date

5.5.1 Binational Activities

Critical Pollutant Sources and Loadings Reduction Strategy

The Four Parties have developed and agreed to a cooperative, binational approach for reducing critical pollutant loadings to Lake Ontario. Working closely with regulatory programs, local governments, industry and individuals, the Four Parties continue to address known and potential sources of critical pollutants throughout the Lake Ontario basin.

Due to the scale and complexity of pollutant sources within the basin, the Four Parties agreed that a load reduction schedule based on a percent reduction target is not practical. Instead, the Parties are taking a focused and strategic approach to identify, assess and mitigate sources of critical pollutants through regulatory or voluntary measures. Such an approach may go beyond existing programs to address significant sources identified by the LaMP as a binational priority.

The LaMP critical pollutant reduction strategy has three main elements: (1) data/information synthesis; (2) coordination with regulatory actions; and (3) promoting voluntary actions. These three components are described below:

- Data/Information Synthesis: Information on the concentrations, sources, loadings and pathways of critical pollutants are being evaluated, with the aim of identifying source reduction actions. The actions could include, for example, watershed evaluations, further monitoring, and source reduction activities.

- Coordination with Regulatory Actions: The LaMP is identifying and highlighting specific remedial and other regulatory program efforts underway that are contributing to LaMP pollutant reduction goals that LaMP strategies can build upon. Regulatory programs are also being kept apprised of any information relevant to their enforcement interests or monitoring requirements, so that regulatory tools can be applied as appropriate to address specific LaMP priority sources.

- Voluntary Actions: The LaMP is promoting voluntary efforts to reduce inputs of critical pollutants by: encouraging community and local government pollution prevention programs (such as pesticide "clean sweeps" and mercury equipment/thermometer collections); communicating and highlighting the LaMP goals and objectives and the importance of voluntary efforts (through success stories); and encouraging accelerated product phase-outs, pollutant minimization plans or other actions by industry or local governments.

The U.S. and Canada are using compatible approaches to source reduction strategies in order to best utilize current initiatives, historic actions and individual human and information sources. The U.S. has evaluated critical pollutant information and related actions in all watersheds within its portion of the basin. Canada has focused on actions within priority watersheds, based on available ambient monitoring information and emissions data from industrial, municipal and other non-point source discharges (such as combined sewer overflows/stormwater, waste sites). Local strategies will be developed to address identified sources of critical pollutants in these watersheds.

Great Lakes Binational Toxics Strategy

In 1997, Canada and the United States agreed to work toward the virtual elimination of persistent toxic substances in the Great Lakes by signing the Great Lakes Binational Toxics Strategy (BTS). Since 1998, Environment Canada, the United States Environmental Protection Agency and Great Lakes basin stakeholders have been working toward the virtual elimination of strategic substances, (which includes all the Lake Ontario LaMP critical pollutants within Tier 1 substances). The Strategy establishes reduction challenges for the Tier 1 substances in the timeframe 1997 to 2006.

Pollution prevention, regulatory initiatives and remediation activities on critical pollutants on a sector and chemical basis are coordinated through the Great Lakes Binational Toxics Strategy. Under the Strategy, governments and industry work cooperatively to identify sources of these critical pollutants, and to develop and implement the actions needed to move closer to the ultimate goal of virtual elimination. More information and Strategy progress highlights are available on-line at www.binational.net/bns.

The work of the Great Lakes BTS and the Lake Ontario LaMP is mutually beneficial. The BTS promotes voluntary initiatives and cooperative efforts to achieve reductions of critical pollutants in the Great Lakes basin. The LaMP uses regulatory and voluntary initiatives, in addition to source "trackdown" activities to achieve reductions in the level of critical pollutants from in-basin sources.

5.5.2 Remedial Action Plans (RAPs)

The International Joint Commission has identified seven "Areas of Concern" in Lake Ontario based on their potential to be significant sources of critical pollutants to the lake. These are: Eighteenmile Creek, Rochester Embayment, and Oswego River in New York State; and Hamilton Harbour, Toronto and Region, Port Hope and Bay of Quinte in Ontario. RAPs concentrate on identifying and addressing local environmental problems. The successful implementation of RAPs in these AOCs is a key component of the overall LaMP strategy.

All New York RAPs have completed and certified to USEPA, as part of the State's 1997 Water Quality Plan, their problem definition and action plan reports. RAP Remedial Advisory Committees continue to meet on a regular basis to focus efforts on the implementation of priority remedial measures and provide periodic status reports. Funding opportunities in New York State provide stakeholders a means to implement selected projects. Such support may include financing from the New York State 1996 Clean Water/Clean Air Environmental Bond Act, the NYS Environmental Protection Fund, the Great Lakes Protection Fund, and USEPA/other federal grant agencies.

Similarly, the Ontario RAPs have all completed their problem definition and action plan reports, and implementation is on-going through various funding sources. A summary of progress on the Lake Ontario RAPs is presented in Appendix C.

The RAP process is a continuing and iterative process that: identifies environmental problems (beneficial uses), as well as the pollutants causing the problems and their sources; recommends remedial activities to restore beneficial uses; conducts and influences remedial activities to achieve an ecosystem approach; and documents progress towards the restoration and protection of beneficial uses in the AOCs.

5.5.3 United States Activities

New York's Water Comprehensive Assessment Strategy

NYSDEC's Comprehensive Assessment Strategy uses watersheds as the basic organizing unit in developing water pollution control strategies. Five-year cycles of monitoring and problem identification, leading to the development of management and restoration activities are initiated in 2 or 3 of New York's 14 major watershed units each year. Once completed, the cycles begin again. Assessment of the Seneca-Oneida-Oswego and the Genesee River watersheds began in 2001 and 2002 respectively.

Watershed assessments developed through this strategy are used to update New York's Priority Waterbodies List which summarizes water quality information and identifies priority problems in rivers and lakes across the state. These assessments also provide a starting point for the development of Watershed Restoration and Protection Action Strategies (WRAPS). WRAPS involve all appropriate agencies and stakeholders to focus grant monies, technical assistance, regulatory efforts and other resources to address identified priority water quality and natural resource needs of a watershed. Information developed by the LaMP's contaminant trackdown efforts directly supports the development of WRAPS for Lake Ontario watersheds.

USEPA and NYSDEC are currently working together on the development of a watershed-based, pollutant management tool known as a "total maximum daily load" (TMDL). The Clean Water Act requires that TMDLs, which identify point and nonpoint sources of a pollutant, be developed for impaired waters such as Lake Ontario. The TMDL also identifies reductions in point and nonpoint loadings necessary to restore impairments. Presently, USEPA and NYSDEC are collecting and analyzing data, and refining a water quality modeling tool that will support the development of a TMDL. The schedule for TMDL development will be made available to the public through LaMP documents such as the Update and Biennial Report.

Contaminant Trackdown Activities

An understanding of significant sources of critical pollutants is essential to effectively control and minimize critical pollutant inputs. Information on potential critical pollutant sources and related problems has been synthesized and used to plan environmental sampling needed to identify and confirm suspected pollutant sources.

Trackdown sampling involves sampling water in local sewer systems for contaminents such as PCBs.
Photo Credit: USEPA

Since 1993, NYSDEC and USEPA have conducted a wide variety of environmental investigations across the Lake Ontario basin, evaluating critical pollutant concentrations in water, sediment and biological samples (Table 5.3). Much of this sampling has been guided by reviews of existing information and recommendations provided by other environmental programs. For example, inactive hazardous waste sites in the basin were ranked based on their potential risk to nearby surface waters. Surface waters adjacent to sites with the highest potential were sampled to identify any sites requiring additional attention. Similar approaches have been used to evaluate potential areas of sediment contamination, contaminants in surface water discharges, fish tissue contamination and the effectiveness of remedial actions.

Other types of contaminant trackdown activities include sampling the Lake Ontario basin sewage treatment plant (STP) wastewaters using state-of-the-art technology capable of achieving extremely low (parts per quadrillion) detection limits for

Table 5.3 Summary of New York Lake Ontario Contaminant Trackdown Investigations, 1993 – 1999

Year	Investigation
1993	• Tributary surface water concentrations and loadings
1994	• Oswego River sediment study • Eighteenmile Creek/Olcott Harbor sediment study • Basinwide inactive waste site study • Basinwide wastewater and surface water study
1995	• Dioxin/Furans in tributary water, sediment and fish
1996	• Eastern Lake Ontario basin tributary sediment study • Expanded young-of-the-year fish sampling • Significant sewage treatment discharges
1998	• Contaminant trackdown sampling at selected sites
1999	• Follow-up trackdown sampling at selected sites

Source: New York State Department of Environmental Conservation

PCBs, pesticides and dioxins. These projects included participation by STP operators, local governments, NYSDEC and USEPA. Wastewater samples were also collected at strategic points within the sewer collection system in an effort to identify where the majority of critical pollutants originate within these systems. This information assisted sewage treatment plants in the Lockport and West Carthage in qualifying for more than two million dollars of New York's Environmental Bond Act funding to upgrade their treatment systems to improve the quality of their wastewater.

Although there is more to do, the work over the last decade has developed a good picture of the location and extent of critical pollutant sources and problems in the US portion of the basin. Key highlights of investigation results and critical pollutant control actions completed or underway in each of New York's Lake Ontario basin watersheds are summarized in Appendix A to this report. For more complete information on specific investigation results, refer to the list of references at the end of Appendix A.

The LaMP will work to: 1) continue to promote and encourage pesticide and household hazardous waste collection through established agency programs; 2) coordinate LaMP efforts with Great Lakes Binational Toxics Strategy activities to achieve critical pollutant related objectives; 3) improve knowledge of critical pollutant concentrations and loadings through atmospheric deposition, US tributary and Niagara River studies; and 4) continue support of contaminant trackdown activities to assist regulatory programs.

5.5.4 Canadian Activities

New Province of Ontario Initiatives

Obsolete Pesticide Collection Program

In 2000, CropLife Canada initiated a two-year province-wide collection program for obsolete pesticides from the agricultural and commercial sectors. The program was developed with funding from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), Ontario Healthy Futures for Ontario Agriculture Program, and with assistance from the Ontario Ministry of the Environment.

The program has collected thousands of litres/kilograms of outdated, unusable, or unregistered pesticides from agricultural and commercial pesticide users in the Lake Ontario Basin. A licensed contractor was hired to dispose of the pesticides at approved facilities in Quebec and Alberta.

New Ontario Air Regulation

On May 1, 2001, the Ontario Ministry of the Environment implemented a regulation that requires the mandatory monitoring and reporting of 358 airborne pollutants from all industrial sectors. Critical pollutants identified by the Lake Ontario LaMP (PCBs, dioxin/furans and mercury) are included.

The application of O. Reg. 127/01 to various facilities is being phased in. Phase I requires electricity generation facilities and facilities with large source emissions, including iron and steel manufacturers and petroleum refineries, to monitor and report emissions in accordance with the regulation. Phase II began January 1, 2002, and covers facilities with small source emissions, including food manufacturers and bulk dry-cleaning facilities.

New Ontario Hazardous Waste Plan

In December 2001, the Ontario Ministry of the Environment announced the following hazardous waste initiatives and laws to increase public accountability and protect human health:

- phase out the existing Ontario hospital incinerators, a major source of mercury emissions and one of the province's largest emitters of dioxins and furans;
- set requirements for the handling, transportation and treatment of biomedical waste;
- require the destruction of PCBs currently in storage at sites throughout Ontario (as part of the phase-out schedule, all PCBs currently stored at sensitive sites, such as schools and hospitals, will be eliminated within one year of the regulation becoming law); and
- as of January 1, 2002, hazardous waste generators will be required to pay for the Ministry's cost of managing hazardous and liquid industrial waste in the province.

Data Synthesis

As part of Environment Canada's commitment to the Lake Ontario LaMP to reduce toxic discharges to the lake, a study was undertaken to update loading estimates on the Canadian side of the lake. Estimates of pollutant loadings were made for tributary streams, air and water point source discharges, atmospheric deposition, and for combined sewer overflow and storm discharge events. In addition, the study summarized the available sediment data. The estimated loadings are a compilation based on the best available information and provide general indications of the relative significance of loadings from various sources to the lake.

The report confirmed that upstream sources are responsible for most of the loadings of critical pollutants to Lake Ontario and that atmospheric deposition is the next largest pollutant source to the lake. Other major findings are that:

- PCB concentrations in most of the major tributaries to Lake Ontario, on the Canadian side, are above the Provincial Water Quality Objectives (PWQOs);
- stormwater runoff may be a significant source of PCB loadings to the lake; and
- municipal inputs (from sewage treatment plant effluents, combined sewer overflows and stormwater discharges) may contribute significant loadings of mercury to the lake, although concentrations are generally below PWQOs.

Tributary Source Trackdown

Studies have shown that concentrations of PCBs in some Lake Ontario tributaries exceed the Provincial Water Quality Objective of 1.0 ng/L. The

Tracking down pollutants in rivers and streams is an important component of the Lake Ontario research.
Photo Credit: Ontario Ministry of the Environment

Ontario Ministry of the Environment (OMOE) and Environment Canada are jointly applying a "trackdown" strategy with the overall goal of determining whether the observed PCB concentrations (and ultimately other priority pollutants) in major tributaries to the Great Lakes can be attributed to locally controllable sources, or whether they reflect recycled contaminants from diffuse historical sources.

Three tributaries of Lake Ontario were selected for the pilot project: Twelve Mile Creek, Etobicoke Creek and the Cataraqui River. Each tributary has previously exhibited some indication of elevated PCB levels in water, sediment or biological tissue relative to background conditions. Upstream/downstream differences in total PCB concentrations in each of these tributaries are in the process of being quantified using water, sediment and juvenile fish data, and/or by quantifying differences in mussel (*Elliptio complanata*) tissue PCB concentrations and congener patterns from selected points throughout each watershed.

The preliminary results of these trackdown activities are presented in Appendix B.

5.6 Next Steps

Future efforts will continue to focus on the restoration of beneficial uses. Contaminant trackdown activities will continue to provide a better understanding of critical pollutant sources. The information gained from these activities will help focus remediation and pollution prevention efforts that ultimately will reduce the amount of critical pollutants entering the lake.

Restoring beneficial uses in Lake Ontario will also depend on the success of other Great Lakes programs, such as the Great Lakes Binational Toxics Strategy, the Canada-Ontario Agreement and the U.S. Great Lakes Strategy. It is only through coordinated and focused initiatives such as these that the effect of critical pollutants can be eliminated and beneficial uses can be restored.

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6.0 Public Involvement and Communications

6.1 Public Involvement Strategy

The goals of the public involvement program, as set out in the Lake Ontario LaMP Stage 1 Report, are to: (1) increase public understanding and awareness of Lake Ontario LaMP planning and activities; (2) provide opportunities for meaningful public consultation; (3) promote environmental stewardship actions; and (4) build partnerships with others who are working to preserve and protect Lake Ontario.

Giving presentations about Lake Ontario is just one of the important aspects of public involvement.
Photo Credit: Ontario Ministry of the Environment

The Lake Ontario LaMP provides a variety of opportunities for people to keep informed about the LaMP projects and progress, and to provide their input and ideas. Information and public participation are encouraged at three levels of interest or involvement:

- The LaMP reaches out to individuals and groups that are already involved and working to conserve and restore Lake Ontario by attending their meetings and mailing information to these groups or their members.
- The LaMP maintains a mailing network of some 1,800 Canadian and American contacts and responds to requests for input and comments on Lake Ontario LaMP documents.
- The LaMP provides information to the general public through the media, the LaMP website and public meetings. Individuals can add their names to the LaMP mailing list for more regular contact.

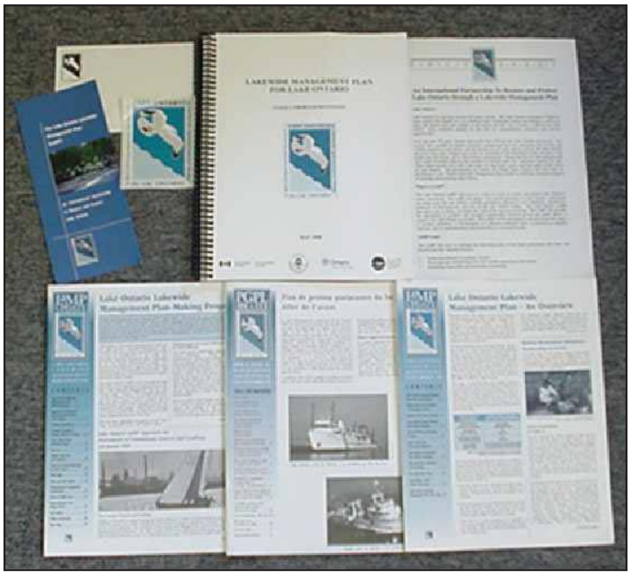
6.2 Update on Activities

Since the release of the LaMP Stage 1 Report, the LaMP has been updating the mailing list and looking at additional ways to reach the public. An annual public meeting is held to provide updates on the Lake Ontario LaMP and Niagara River Toxics Management Plan (NRTMP). The meeting location alternates between Niagara Falls, Ontario, and Niagara Falls, New York.

In 1998, the Four Parties created a binational Lake Ontario LaMP web site, accessible from either the Great Lakes Information Network at www.epa.gov/glnpo/lakeont or the Great Lakes Information Management Resource at www.on.ec.gc.ca/glimr/lakes/ontario. The site includes information on Lake Ontario and the LaMP, and provides access to LaMP publications. An on-line "postcard" has been added for those who want to join the mailing list.

In 1999, the LaMP produced a brochure describing the LaMP and encouraging public participation. That same year, the first of the Lake Ontario LaMP Updates was released, providing information on projects and progress in an informative newsletter style. The Updates were mailed to contacts on the mailing list, distributed at the annual Lake Ontario LaMP/NRTMP public meeting, and posted on the website. Editions were also distributed in 2000 and 2001. The next issue of the Update is scheduled for 2003.

For copies of the LaMP publications, visit the LaMP websites or contact the LaMP addresses at the end of this report.



Lake Ontario LaMP Publications include the Stage 1 Report and annual updates.
Photo Credit: Environment Canada

6.3 Next Steps

The annual public meeting, mailing list and distribution of reports and Updates will be ongoing activities. The LaMP will also maintain and enhance the website, update LaMP materials and displays for use at meetings and conferences, and continue to build links with other groups and individuals in Ontario and New York State.

In an effort to strengthen the connection between LaMPs and RAPs, the concept of a formal Lakewide Advisory Network, proposed in the LaMP Stage 1 Report, has evolved into a strategy that calls for ongoing dialogue with the RAPs and other stakeholders involved in Lake Ontario remediation work. LaMP agencies are seeking out new partnerships and will keep these stakeholders informed about LaMP activities, work cooperatively on outreach activities and invite them to get involved in the LaMP.

In addition, each of the Four Parties to the LaMP will continue to promote public awareness, involvement and partnerships with the LaMP through their agency-specific program activities and grants.

For more information, contact the LaMP at the addresses provided on the back of this report.

7.0 Next Steps

The earlier stages of the LaMP have clearly defined the major problems facing the lake. Future efforts will focus on the restoration of identified beneficial uses, the primary purpose of the LaMP. The development of the LaMP Sources and Loadings Strategy provides an overall approach of how critical pollutant sources will be identified and addressed. The adoption of indicators to meet ecosystem goals and objectives lays out well-defined endpoints for the LaMP's restoration efforts, and a commitment to coordinated monitoring will build even stronger binational relationships necessary to achieve these ambitious goals.

Work will continue to restore beneficial use impairments through the LaMPs Sources and Loadings Reduction Strategy. Contaminant trackdown activities are underway which will provide a more accurate understanding of critical pollutant sources. The development of remedial and pollution prevention actions will continue to reduce critical pollutant loadings to the lake. Future LaMP reports will summarize the findings of these ongoing activities and highlight the status of critical pollutant control actions.

Now that the LaMP has adopted a suite of ecosystem indicators, future work will focus on the collection and synthesis information needed to report on the status of these indicators as part of future LaMP and SOLEC activities. The data collection and interpretation process will foster increased communication and coordination between U.S. and Canadian environmental programs. Environmental program staff will work to fine tune some of the less well-defined targets, such as those for prey fish populations.

Coordination of binational monitoring efforts, particularly those related to the LaMP's ecosystem indicators, will be a special area of emphasis in future years. Planning is underway to evaluate the comparability of U.S. and Canadian surface water sampling methods used to measure levels of persistent toxic substances. LaMP staff are working to identify ways for U.S. and other Canadian program efforts to coordinate with the Ontario Ministry of the Environment's planned intensive Lake Ontario monitoring in 2003 in order to provide a more extensive and binational assessment of lakewide conditions. Ideally, these efforts will lead to long-term binational cooperative monitoring efforts. Aside from developing a better understanding of the status of the Lake Ontario ecosystem, better coordination of monitoring efforts promises to provide real savings in terms of staff time and financial resources.

Providing the public with a sound understanding of the complex problems facing the lake is the first step in gaining public support and participation in achieving the LaMP's goals. In the future, we will be examining new ways to improve the level of participation – primarily by enhancing linkages to existing groups and looking for means of achieving similar objectives so that benefits will be gained by all parties.

Photo Credit: Environment Canada

Appendix A: U.S. Contaminant Trackdown Activities

A.1 Lake Ontario Western Watershed

A.1.1 Description

The western watershed of Lake Ontario includes the tributaries entering the Lake between the Niagara and Genesee Rivers. The area covers about 893 square miles of rolling plains. Agriculture is a major part of the economy. The population is concentrated near a few villages, the City of Lockport and suburban areas west of Rochester. A number of industries are concentrated in the vicinity of Lockport. The Barge Canal crosses the watershed, intersecting several tributaries and augmenting their flows during the canal's navigation season. The source of Barge Canal water can be as much as 90 percent Niagara River water with most of the remaining water coming from Tonawanda and Ellicott Creeks. The major tributaries in this watershed unit, listed from west to east, are: Eighteenmile Creek, Johnson Creek, Oak Orchard Creek, Sandy Creek and Salmon Creek. Eighteenmile Creek's Olcott Harbor is an AOC.

A.1.2 Water Quality Issues

Critical pollutant water quality concerns in this watershed are limited primarily to the Eighteenmile Creek drainage area. The main critical pollutants of concern are PCBs and dioxins/furans. The Eighteenmile Creek RAP is directing a wide range of remedial and monitoring activities to address contaminant sources impacting Olcott Harbor. The RAP's combined problem definition and action strategy report (Stage 1 and Stage 2) was completed in August 1997. A June 2001 update report documented: the continuing investigation and assessment of creek sediments and possible sources of critical pollutants; remediation of inactive hazardous waste sites; reduction of combined sewer overflows (CSOs); and surveillance activities.

Contaminated sediments in areas adjacent to historically industrialized sections of the Barge Canal are periodically washed into Eighteenmile Creek and accumulate behind dams. Other potential contaminant sources are suspected to be located along the Creek. Contaminant trackdown activities indicate that one or more PCB sources may be impacting City of Lockport treated wastewaters, which contribute more than 50 percent of the total flow of the creek during dry weather conditions.

A.1.3 Contaminant Trackdown Activities

Barge Canal and Eighteenmile Creek Sediments — Levels of dioxin/furans in Barge Canal sediments and related tributaries were highest near the City of Lockport downtown area. The creek flows beneath the canal near the center of the city. The periodic de-watering of the canal during the non-navigational season flushes contaminated sediments into the creek where they are trapped behind the Newfane Dam (where some of the highest levels of sediment dioxins and furans are found). Other Eighteenmile Creek contaminant trackdown efforts utilizing sediment and water samples identified the Flintkote Site (Williams Street Island), an undocumented waste dump located in the bed of the creek, as a potential PCB source. A preliminary site investigation has been completed.

Lockport Sewage Collection System — Three phases of wastewater sampling focused on identifying sources of PCBs and other contaminants to the Lockport wastewater collection system by sampling wastewaters at key points in the sewer collection system.

Slater Creek — The 1996 sampling of young-of-the-year (YOY) fish measured relatively high concentrations of PCBs in Slater Creek fish, compared to other Lake Ontario sampling locations. Follow-up sediment and water sampling was conducted in 1998 and 1999 at several points along the creek in an attempt to identify any PCB sources. Hexane-filled passive samplers were used to evaluate creek water quality over a two-week period that included rainstorms that would mobilize contaminants in sediments or other uncontrolled sources. Water and sediment sampling showed that PCB concentrations in sediment and water to be low with no evidence of significant inputs of PCBs to the creek. Dieldrin was found to be slightly elevated in YOY, water and sediment samples. The source of dieldrin may be historical use of this pesticide in orchards located in the headwaters of Slater Creek. A more complete analysis of follow-up sampling results will be completed this year. Contaminant sampling of resident creek fish targeted by anglers is recommended.

A.1.4 Progress to Date and Actions Underway

City of Lockport — City of Lockport sewer system improvement projects, funded by the New York State Clean Water/Clean Air Bond Act, are underway to reduce combined sewer overflows (CSOs). New sanitary sewers have been installed in the northeast part of the city and separated from storm sewers. New storm sewers are being constructed in the west-central part of the city to separate storm water from the CSO. A new clarifier is being constructed at the Lockport wastewater treatment plant (WTP). These improvements should result in a reduction of storm water overflows and provide increased capacity to treat wet weather flows from CSOs.

The results of contaminant trackdown activities in the City of Lockport sewer collection system are being evaluated and will be summarized in future reports.

Eighteenmile Creek — Remedial investigations being conducted at four inactive hazardous waste sites within the Eighteenmile Creek watershed are associated with LaMP critical pollutants: AKZO Chemical, Guterl Steel-Landfill, Guterl Steel-Plant Site and, Flintkote Property. All these investigations should be completed in 2003.

Barge Canal and Eighteenmile Creek Sediments — USEPA is developing tests and criteria to allow remedial action decisions to be made relative to the likely impacts of Barge Canal and Eighteenmile Creek contaminated sediments.

Brockport Creek — Investigations are underway at Brockport Creek, located in the eastern part of the watershed, to evaluate PCB contamination potentially related to the former GE Black & Decker and 3M/Dynacolor facilities. Storm water from these facilities flows into a tributary to this creek. GE and 3M/Dynacolor will evaluate potential PCB contamination impacts on fish and wildlife in Brockport Creek and provide a report to NYSDEC.

SUNY Brockport is studying the plankton community to establish the status of the RAP's plankton use impairment indicator. The study should be completed this fall.

A.2 Genesee River Watershed

A.2.1 Description

The Genesee River watershed has its headwaters in Pennsylvania and flows north (approximately 157 miles) across the width of the western arm of New York State to Lake Ontario. It collects water from 52 tributaries and six lakes on the way to Lake Ontario. The watershed includes the four most westernmost Finger Lakes: Conesus, Hemlock, Canadice, and Honeoye. The mouth of the Genesee River is approximately 75 miles east of the mouth of the Niagara River and six miles north of the City of Rochester. The Genesee River sub-basin consists of 2,400 square miles in New York and is inhabited by approximately 400,000 persons. A major portion of this population resides in the Rochester metropolitan area, which also contains much of the industrial and commercial activity in the U.S. portion of the Lake Ontario basin. The river is used for hydroelectric power generation, industrial and municipal wastewater discharge, limited commercial shipping, and recreation. The rest of the sub-basin is lightly populated and primarily rural-agricultural with small population centers.

A.2.2 Water Quality Issues

Given the high concentration of population, industry and manufacturing in the greater Rochester metropolitan area, the primary critical pollutants of interest are PCBs and mercury. The Monroe County sewage treatment plant serving the Greater Rochester metropolitan is the largest direct U.S. discharger of treated wastewaters to Lake Ontario. Canadice Lake, one of the Finger Lakes, has fish consumption advisories in effect due to PCBs (although levels have significantly decreased in recent years). The Monroe County Department of Health (MCDH) is the lead agency in implementing the RAP. Oversight committees plan, implement and track progress. The Rochester Embayment AOC is located at the mouth of the Genesee River and forms an indentation of the Monroe County shoreline between Bogus Point in the Town of Greece and Nine Mile Point in the Town of Webster. The southern boundary includes approximately 6 miles of the Genesee River that is influenced by lake level fluctuations, from the river's mouth to the Lower Falls. A status report update document was published in March 2001. The RAP is currently focusing on: lawn care education, pollution prevention for auto recyclers, maximizing phosphorus removal at small wastewater treatment plants, creation of a water quality education collaborative organization, and establishment of a phosphorus loading goal. Activities completed or underway, that contribute to RAP implementation goals, include: three watershed planning projects; point and non-point source pollution abatement projects; extensive CSO abatement; mercury pollution prevention projects including two outstanding publications; monitoring activities; and, educational efforts. Considerable progress has been made in establishing delisting criteria and monitoring needs to address impaired uses.

A.2.3 Contaminant Trackdown Studies

Monroe County's Sewer Collection System — A cooperative federal, state and county contaminant trackdown project was carried out in Monroe County's Frank E. Van Lare Water Pollution Control Facility's (WPCF's) sewer collection system, which serves the greater the Rochester metropolitan area. Concentrations of PCBs and pesticides were measured at key points within the sewers to help identify which sections of the city had wastewaters with higher than average contaminant concentrations. One section of the western metropolitan area of Rochester was identified as having wastewaters with PCB concentrations ten times higher than other locations. The Delphi automobile parts manufacturing facility was confirmed as one PCB source in the western metropolitan area contributing to these elevated concentrations of PCBs. Delphi is remediating a groundwater PCB contamination problem and discharges treated groundwater to the sewer system.

Taylor Instruments — Wastewater sampling in the sewers down gradient of Taylor Instruments, a former mercury thermometer manufacturer in the Rochester metropolitan area, confirmed that this site was a source of mercury to the Monroe County sewer collection system.

Hospital and Dental Clinic Wastewaters — Sampling of wastewaters from hospital and dental clinics demonstrated that high levels of mercury were present in these wastewaters. This information supported the development of voluntary mercury phase out and prevention efforts at these facilities.

A.2.4 Progress to Date and Actions Underway

Mercury Pollution Prevention — CDH has implemented a mercury pollution prevention program for hospitals and dental offices in coordination with the University of Rochester's Strong Memorial Hospital and the Eastman Dental Center.

PCB Wastewater Monitoring — Monroe County's WPCF staff added PCB wastewater monitoring requirements and criteria to the wastewater permit for the Delphi facility. Problems with Delphi's PCB groundwater treatment system have been resolved and it is currently in compliance with permit requirements. Federal, state and county staff will evaluate the findings of the full Monroe County WPCF trackdown report, to be completed this year, and determine if additional activities are warranted.

Household Hazardous Waste Collection — Monroe County has established a permanent household hazardous waste collection facility in coordination with several cooperate sponsors such as Kodak, Agway and Walmart. This program includes mobile collection efforts and accepts wastes from certain small quantity waste generators and other counties.

Finger Lakes — The recent Finger Lakes Water Quality Report found some of the highest levels of PCBs concentrations in Conesus Lake sediments. Environmental information relating to Conesus Lake will be reviewed to determine if additional monitoring is required.

Taylor Instruments — In 2000, Combustion Engineering completed excavation of mercury-contaminated soil at the site under a Voluntary Cleanup Agreement with the NYSDEC. All mercury discharges to the combined sewers were eliminated on Ames Street leaving only surface runoff going to the sewers on Hague Street. There is also an extensive dual phase vapor extraction system in two areas of the site to address significant VOC contamination.

Clean Sweep Program — The Solid Waste Committee for Genesee, Livingston, Oswego and Wyoming Counties (GLOW) completed a four-year clean sweep program which netted more than 24,000 pounds of pesticides including more than 2,000 pounds of persistent bioaccumulative toxic chemicals including DDT.

A.3 Lake Ontario Central Watershed

A.3.1 Description

The Lake Ontario Central Watershed extends from the mouth of the Genesee River to the mouth of the Oswego River. There are several minor tributaries to Lake Ontario in this major watershed unit including: Ninemile Creek, Wolcott Creek, and Irondequoit Creek. Irondequoit Bay, Sodus Bay, Port Bay and Little Sodus Bay are along the watershed's Lake Ontario coastline. The Barge Canal runs through the western part of the watershed and crosses Irondequoit Creek. The watershed is heavily agricultural with large orchards along the lakeshore. Population centers are located in Sodus, Wolcott and Webster, a suburb of Rochester.

A.3.2 Water Quality Issues

There are no major critical pollutant issues of concern in this watershed (with the exception of carp PCB and mirex fish consumption advisories in Irondequoit Bay). Irondequoit Bay, located in the eastern part of the greater Rochester metropolitan, is addressed as a part of the Rochester RAP.

A.3.3 Contaminant Trackdown Activities

Sodus Bay and Creek — Poor management of pesticides at the Sodus Fruit Farm led to contamination of on-site soils and buildings. Sampling at the site detected DDT, DDD and DDE in surface soil. Located on Sodus Point, next to Sodus Bay, contaminated runoff from this site has the potential to directly impact the lake. Earlier lakewide investigations of dioxin sediment contamination had detected relatively high levels of dioxin offshore of Sodus Point. Analysis of Sodus Bay sediment samples did not find problematic concentrations of pesticides or dioxins. YOY fish samples collected from Sodus Creek showed total DDT levels exceeded criteria designed to protect fish-consuming wildlife. The source of the total DDT appears to be historical use, as less than one percent consisted of the parent product DDT.

A.3.4 Progress to Date and Actions Underway

Sodus Creek — Available information and sampling results will be reviewed to determine need for follow-up actions.

A.4 Seneca-Oneida-Oswego River Watershed

A.4.1 Description

The Seneca-Oneida-Oswego watershed contains all of New York's larger Finger Lakes: Canandaigua, Keuka, Seneca, Cayuga, Owasco, Skaneateles, Otisco, Onondaga and Oneida. The combined surface area of these nine major lakes is over 208 square miles and represents about four percent of the total watershed area. The watershed drains approximately 5,000 square miles and has a population of about one million. It is divided into seven smaller watershed units: Lower Seneca-Oswego Rivers, Onondaga Lake, Oneida Lake, Clyde River, Upper Seneca River/Finger Lakes, Owasco Creek and Skaneateles Creek. Two-thirds of the population is concentrated in the industrial-commercial Syracuse metropolitan area in the eastern portion of the watershed. The remainder of the watershed is primarily rural and agricultural with several small population centers.

A.4.2 Water Quality Issues

Three of the Finger Lakes (Keuka, Canandaigua and Canadice) have fish consumption advisories in effect for large lake trout (PCBs in Canandaigua and Canadice, and DDT in Keuka). Skaneateles Creek, downstream of the Skaneateles Lake Outlet, has advisories in effect for large brown trout due to PCBs.

Onondaga Lake, located in the Syracuse metropolitan area, was listed on the National Priorities List in 1994. Fish consumption advisories are in place due to mercury. The lake sediments are contaminated with many chemicals (including mercury, other heavy metals and various PAHs) and are being addressed through the federal Superfund program.

Except for Onondaga Lake, all of these lakes have some form of dam or other control structure that retards their flow into down-gradient tributaries. Contamination problems within these lakes are not believed to have a major impact on down-gradient tributaries because a good portion of these contaminants adsorb to, and are deposited with sediments within these lakes.

The Oswego Harbor RAP reports provide a detailed summary of the Lower Oswego River environmental issues. A 1996 update report established a format to identify remedial strategies and track progress. Recent RAP-related studies included additional Oswego River water quality and sediment investigations and, a fish pathology study. The results of a 1998 two-day technical workshop, that evaluated study results and assessed use impairment impacts and needs, is summarized in a 1999 report. Delisting criteria for the AOC were developed, based on USEPA guidance and a delisting strategy proposal, was drafted by NYSDEC and the Remedial Advisory Committee. Important elements of the RAP remedial activities include: the federal relicensing of the Oswego River power dams to include modifications needed to restore aquatic habitat below the dams; results of ongoing fish flesh studies involving Lake Ontario and the Oswego River area; and upstream inactive hazardous waste site remediation, including the results of further upstream contaminated river sediment study and evaluation.

A.4.3 Contaminant Trackdown Activities

Oswego River — A detailed assessment of sediment contamination in the Oswego Harbor, Oswego River and the Seneca River was carried out in 1994 in response to data needs identified in the Oswego RAP Stage II report. One particular area of interest was the status of historical releases of mirex to the Oswego River from an inactive hazardous waste site. Information on benthic community structure richness, biological impairment and sediment toxicity, as well as sediment contaminant levels, was collected at key points along the river and depositional areas behind dams. With the exception of Oswego River's Battle Island area, sediment contaminant levels were found to be low, with little to no evidence of toxicity to benthos. Based on these findings, a more detailed sediment evaluation was conducted in the Battle Island area.

Armstrong World Industries — The inactive hazardous waste site, Armstrong World Industries, near Battle Island, is known to have released mirex and other contaminants to the river before this site was remediated. The study found some small lenses of mirex contamination remain buried in river sediments adjacent to and immediately downstream of the waste site. A follow-up study conducted in 2000 developed detailed information on sediment contamination in the immediate vicinity of the Armstrong World Industries site.

Levels of mirex in Oswego Harbor young-of-the-year fish and Oswego River resident fish are similar to other parts of the Lake Ontario basin, suggesting that remaining contaminated sediments may not be a major concern.

Skaneateles Creek — The discovery of elevated PCB concentrations in Skaneateles Creek brown trout triggered a series of contaminant trackdown efforts that collected water, macro-invertebrate and fish tissue samples along the creek in order to isolate the PCB source or sources. Skaneateles Lake flows into the Seneca River via Skaneateles Creek. These investigations identified the former Stauffer Chemical facility, an inactive hazardous waste site located directly on the creek, as a source of PCBs

Keuka Lake — Contaminant trackdown investigations were conducted in 1997, 1998 and 1999 in an attempt to identify the source of DDT responsible for Keuka Lake DDT fish consumption advisories. Soil, sediment and water samples were collected at key locations around the lake. Results indicated that Brandy Bay Creek is a very low level source of DDT. A former disposal area located along this tributary is one potential source. Historical sources may no longer be significant given the steady decline of DDT in Keuka Lake fish. Only two of fifty-three fish collected and analyzed in 1997 exceeded the FDA limit of 2.0 ppm total DDT.

A.4.4 Progress to Date and Actions Underway

Stauffer Chemical — The company has undertaken a number of remedial actions in order to comply with NYSDEC requirements to control PCB releases from the site.

Onondaga Lake — Since 1994, a number of activities have taken place, which will enable New York and USEPA to reduce the ongoing hazardous substance pollution into the Lake. Over 70 companies in the Lake watershed were queried regarding their past and present waste management and disposal practices. From this information and other information gathered by the NYSDEC, eight sites were determined to be on going contributors of pollution to the lake. Investigations to determine the nature and extent of this pollution are ongoing at five of the sites. Two of the sites are nearing the remedial design and construction phase, and the eighth site, a dredged spoil area, has been remediated through removal of PCB hot spots and capping of the remaining material. In addition, investigations are on going (or will be shortly) at 15 other sites in the area that may have the potential for contaminating the lake or its tributaries. Detailed reports of water quality monitoring of Onondaga Lake tributaries and dischargers, as well as the physical, biological and chemical status of the Lake's surface water, are provided on an annual basis.

Finger Lakes — A major water quality study of the Finger Lakes was completed in 2001 providing a comparative assessment of water quality trends within this important set of Lakes. The use of dated sediment core samples show that DDT surficial sediment concentrations have markedly decreased over the last few decades. Surficial sediment DDT concentrations in some lakes remain above sediment quality "threshold effect level" guidance values.

Oswego River Battle Island Contaminated Sediment — The recently completed evaluation of contaminated sediment in the area of the former Armstrong World Industry waste site will be forwarded to NYSDEC remedial action staff for their evaluation to determine if remedial actions are warranted.

Oswego River RAPS — A final draft delisting document will be developed in 2002. No critical

Document review will include a planned public comment and involvement session.

A.5 Lake Ontario Eastern Watershed

A.5.1 Description

The Lake Ontario Eastern Watershed includes all land areas drained by the tributaries to the Lake from the mouth of the Oswego River to Tibbets Point. The Black River Watershed in Jefferson County splits this watershed unit into two parts. The northern part of the sub-basin has a rather flat terrain with a thin cover of soil and outcroppings of bedrock. The southern part has swampy ponds and estuaries with an inland plain suited for agricultural use. This southern part also includes the hilly slopes of the Tug Hill Plateau, the highest lands in the basin. The total area of the sub-basin is approximately 1,300 square miles.

The population is centered near small incorporated villages or cities, with the remainder of the population scattered among unincorporated communities or on farms in the area. Industrial areas are present in the Oswego-Fulton area and the Villages of Pulaski, Parish and Mexico. Agriculture is generally devoted to dairy farming and crops for its support.

A.5.2 Water Quality Issues

Given the relatively small population centers and limited industry in this watershed, critical pollutant water quality concerns are limited to reducing PCB discharges to Lake Ontario from Alcan, an aluminum manufacturing facility, and finding the source of relatively elevated levels of PCBs in Wine Creek fish and surface water. The ponds and wetlands related to Alcan's wastewater and storm water discharge system became contaminated through past use of PCB hydraulic fluids in aluminum processing equipment.

A.5.3 Contaminant Trackdown Activities

Wine and White Creeks — Wine Creek enters Lake Ontario approximately two miles east of the mouth of the Oswego River. White Creek flows into Wine Creek approximately one mile upstream of the lake. Two potential sources of PCBs are the Pollution Abatement Services inactive hazardous waste disposal site, located at the junction of Wine and White Creeks, and the Niagara Mohawk Fire Training Area located on White Creek. The fire training facility is required to monitor PCBs in its storm water. An abandoned landfill is also located upstream of the fire training facility. Contaminant trackdown water sampling showed that the majority of PCBs enter Wine Creek from White Creek sources. Preliminary results indicate that continuing PCB sources exist at both the PAS and Niagara Mohawk facilities although the significance of these releases will require further evaluation.

A.5.4 Progress to Date and Actions Underway

Alcan Industrial Discharges — Alcan is nearing completion of a new cooling water treatment and recirculation system. This new system is expected to improve the quality of Alcan's wastewater discharges and reduce the volume of wastewater discharges to Lake Ontario volume by approximately 90 percent, from 10 MGD to <1 MGD. Much of the site's storm water will also be treated before being discharged into newly constructed sedimentation basins. These actions are expected to reduce the loading of PCBs to the Lake and will facilitate remediation of the ponds/wetlands.

Eastern Watershed Major Tributaries — Sediment samples were collected from the Chaumont River, Sandy Creek, South Sandy Creek, Salmon River and Wine Creek were analyzed for persistent toxic contaminants and used to conduct toxicity tests.

White Creek Contaminant Trackdown — The final contaminant trackdown report will be finalized and forwarded to hazardous waste site remediation staff for consideration. The need for any additional monitoring will be assessed.

A.6 Black River Watershed

A.6.1 Description

The Black River basin encompasses 2,285 square miles. Among its significant water resource features are the Black River, Fulton Chain of Lakes, Stillwater Reservoir, Perch Lake, Black River Bay, the Chaumont River, and Chaumont Bay. The Black River headwaters begin in Hamilton County in the Adirondack Region. The Black River flows west through the Black River Valley, over a series of waterfalls through the City of Watertown, dropping another 500 feet to the Black River Bay in Lake Ontario. Watertown is the major metropolitan area within the watershed. The basin is mostly forested, dotted with many small lakes.

A.6.2 Water Quality Issues

PCBs are the main critical pollutant of interest in the Black River watershed. Estimates show that in the mid 1990s the Black River was the largest US source of PCB loadings to Lake Ontario from tributary surface waters. Contaminant trackdown efforts have identified PCB sources in the vicinity of the towns of Carthage and Watertown. Remedial actions, improved treatment and other actions have reduced inputs of PCBs to the Black River from these sources. Monitoring efforts are continuing to help evaluate the success of these actions and possibly identify any other yet unrecognized PCB sources.

Past use of DDT in the upper parts of the watershed have contaminated fish and sediment in the Fulton Chain of Lakes, which are tributaries to the Black River. Contaminant trackdown efforts have identified areas of elevated concentrations of DDT in sediments that may warrant remedial actions. Mercury fish consumption advisories have been issued for splake in Stillwater Reservoir.

A.6.3 Contaminant Trackdown Activities

Black River PCB Trackdown — Surface water samples were collected at key points to evaluate PCB inputs from smaller tributaries and from communities with concentrations of paper mills and hydroelectric plants. River surface water PCB concentrations were highest below the Village of Carthage, suggesting a localized PCB source.

Carthage/West Carthage Municipal Sewage Treatment Plant — The treatment plant's effluent was sampled in 1997 as part of an evaluation of sewage treatment plants in the Great Lakes basin using low level detection methods. Of four Lake Ontario basin sewage treatment plants sampled, the Carthage WPCF had the highest concentrations of PCB and DDT indicating the presence of contaminant sources within its wastewater collection area. Consistent with these observations, NYSDEC sediment studies found some of the highest levels of PCBs and total DDT in sediments below the WPCF outfall. Wastewater samples collected within the sewer collection system showed that two large paper mills contributed approximately 90 percent of the PCB loadings over the two-week sampling period. PCB contaminated wastewaters from these mills may be related, in part, to historical paper recycling activities when PCBs were used in inks and carbonless copy paper. A second round of wastewater sampling, following improvements and changes in mill operations, found significantly lower PCB wastewater concentrations.

Black River Sediment Sampling — Sediment cores and surficial sediment samples were collected at more than 40 sites on the Black River, its major and minor tributaries, and other tributaries discharging directly into the eastern Lake Ontario drainage basin. Sediment samples were evaluated for heavy metals, PCBs, chlorinated pesticides, PAHs, and dioxins and furans. Toxicity and bioaccumulation tests were performed using surficial sediment samples collected for chemical analyses. A bioassessment of the study area using benthic organisms was also conducted. Some of the key findings include: extremely high DDT concentrations in the sediments from the Fulton Chain of Lakes (the highest concentration measured was 14,300 ppb in the Gray Lake Outlet, a small tributary to the channel connecting Old Forge Pond with First Lake; high DDT concentrations (990 ppb) in sediment cores taken from Fourth Lake; and elevated dioxin and furan concentrations (2,3,7,8 TEQ = 65 ppt) at the Delano Island site that warrant additional investigation to evaluate the spatial extent of contamination.

Kelsey Creek — Water, sediment and biota sampling conducted in Kelsey and Oily Creeks confirmed that PCB and other contaminant releases were occurring from the inactive hazardous waste disposal site, New York Air Brake.

A.6.4 Progress to Date and Actions Underway

Carthage WPCF System Upgrade — New York State's Environmental Bond Act grant awarded one million dollars to this WPCF, in part, to assist the LaMP in meeting its pollutant reduction goals. Improvements include new metering, flow control systems, skimmers, sludge controls and other equipment. In addition to these improvements, the quality of wastewater entering the WPCF from two large paper mills has improved due to the removal of paper making equipment and flow reductions at the former Ft. James Corp. Mill, and improved pretreatment suspended solids removal and flow reductions at the Climax Mill. Suspended solids entering the WPCF from the Climax Mill have been significantly reduced. NYSDEC is reviewing contaminant trackdown data collected to date to determine if additional monitoring requirements or the development of a pollutant minimization plan need to be added to the WPCF's permit in order to address persistent toxic substances detected in its effluent. Phase 2 of the WPCF upgrade is underway. At the same time, the riverside villages of Herring, Great Bend, Black River and the Town of LeRay are being connected to the WPCF, which will reduce contaminants, nutrients and bacteria inputs to the River due to improper or failing septic systems.

Kelsey and Oily Creeks — The New York Air Brake (NYAB) facility, located near Kelsey and Oily Creeks (tributaries to the Black River), operated a foundry, machine shop and hydraulics testing facility. Liquid waste disposal, including PCB wastes, occurred frequently up to the mid 1970s. Waste discharges to Kelsey Creek via the Oily Creek were the main cause of creek environmental impacts. Contaminated creek sediments were removed and on-site contamination controlled. Follow-up contaminant trackdown sampling shows that PCB concentrations in creek surface waters decreased significantly following completion of remedial efforts.

Better definition of Black River PCB sediment contamination at Carthage — NYSDEC will collect additional sediment samples in 2002 to better define the extent and temporal trends of PCB contamination. Funding is being provided by a grant from USEPA GLNPO. A report is anticipated in 2003.

Evaluation of Gray Lake DDT sediment contamination — The elevated levels of DDT sediment contamination at Gray Lake have been well documented. This information will be provided to remedial program staff for their evaluation and assessment of any actions that may be warranted to prevent the migration of DDT contamination from entering the downstream Fulton Chain of Lakes.

Evaluate/promote Pesticide Clean Sweep Collections — Historically, DDT was widely used in the Black River watershed to control black flies and mosquitoes. Pesticide clean sweeps have been conducted in Jefferson County but not in Herkimer and Hamilton Counties, which have the lakes with DDT fish consumption advisories. DDT was often used in the form of briquettes that were placed in the headwaters of streams and creeks and would slowly dissolve over time. The observation of relatively high environmental levels suggests that relatively fresh sources of DDT may still exist. Clean sweep efforts could include outreach to local and county sanitation departments, fishing and hunting clubs and community organizations that may have employed DDT in the past and may still have existing stocks.

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Evaluation of Toxic Contaminants in West Carthage/Carthage Municipal Wastewaters. September 2001. F. Luckey. Western Watershed Protection Section, Bureau of Watershed Protection, Division of Water, New York State Department of Environmental Protection.

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Appendix B: Canadian Tributary Trackdown Activities

B.1 Twelve Mile Creek

B.1.1 Description

Twelve Mile Creek was the first of the pilot projects to be studied. The creek has a relatively small watershed and more than 95 percent of the water entering the creek is Lake Erie water diverted through the Welland Canal. Sampling by the OMOE and Environment Canada in 1997/1998 indicated elevated total PCB concentrations in the water (from 2.4-12.3 ng/L) at the mouth of the creek. Evidence for local sources has been highlighted by results from biomonitoring in 1997, which showed that PCB concentrations in juvenile fish (spottail shiner) collected from the mouth of the creek were significantly higher than those observed from a nearby Lake Ontario beach.

B.1.2 Project Status Summary

Fieldwork for the PCB trackdown started during the summer of 2000; sediment and water samples were collected at upstream and downstream sites of Twelve Mile Creek, including Lake Gibson. Mussels were deployed in the creek upstream of the confluence with Lake Gibson, downstream of Lake Gibson (in the vicinity of two outfalls discharging into the creek), at the power dam (Martindale Pond), and at a combined sewer outflow drainage ditch downstream of the power dam. Young-of-the-year fish were collected from the upstream location, Lake Gibson and the downstream location (Martindale Pond). Caged mussels were also deployed at three sites along the Old Welland Canal: above and below a pulp and paper mill, and downstream close to the confluence with Twelve Mile Creek.

PCBs were bioavailable to the mussels at all of the sample locations. The concentration of bioavailable PCBs increased in Twelve Mile Creek with increasing distance downstream of Lake Gibson and the confluence with the Old Welland Canal. PCB concentration in the mussel tissue was highest at an outfall used jointly by GM and the municipality of St Catharines. PCB tissue concentrations were similar between the upstream and downstream stations in the Old Welland Canal; however, congener pattern analysis suggests that there may be additional sources of PCBs entering the Old Welland Canal. The congener patterns observed in the Old Welland Canal were different from those observed in the mussels deployed at the first municipal outfall by the GM plant, which had the highest PCB tissue concentrations. Downstream congener patterns from Martindale pond suggest a mixture of the Old Welland Canal and GM/municipal congener patterns. Although these preliminary biomonitoring results have succeeded in identifying potential sources of PCBs to Twelve Mile Creek, they are not sufficient to quantify their significance. Follow-up investigation of these areas is planned in order to determine whether these differences reflect significant local sources or are attributable to diffuse urban runoff.

Young-of-the-year fish from Martindale Pond indicated an increase in PCB tissue concentrations compared to the upstream locations in Twelve Mile Creek and Lake Gibson. Interestingly, when the fish were normalized on a lipid weight basis, the PCB concentrations were similar to those in the mussels. Although sediment PCB concentrations were not elevated at locations sampled in Martindale Pond (i.e., less than

0.2 ppm), they were elevated compared to concentrations observed at the upstream station on the southern side of Lake Gibson (i.e., less than 0.04 ppm). This reinforces the findings with the juvenile fish and confirms previous observations that biota in the lower river have a greater exposure to PCBs than those higher up the system. Once again, however, follow-up work based on further analysis of these results will be required to determine the existence of any significant local sources.

Summary reports of the mussel biomonitoring and large volume water sampling are currently being completed, and will contain recommendations for further monitoring. Additional sediment has been collected by Environment Canada from: Lake Gibson; various locations along the Old Welland Canal; the Welland Canal, upstream of Lake Gibson; Twelve Mile Creek, upstream of Lake Gibson; and Martindale pond. As part of a study by Ontario Power Generation, YOY fish will be collected from Lake Gibson.

B.2 Etobicoke Creek

B.2.1 Description

Etobicoke Creek watershed has three main branches: the Main Branch, Little Etobicoke Creek, and Spring Creek. The watershed is primarily urban, with large areas devoted to single uses including business parks, industrial areas (about 24 percent of the total drainage area) and institutions, such as Pearson Airport. Historical water quality data, collected as part of an assessment of six tributaries that discharge into the Toronto area waterfront (OMOE, 1999), indicated that PCB levels associated with wet weather events were elevated at the creek mouth. Other data available for Etobicoke Creek include PCB tissue concentrations in young-of-the-year fish for the period 1980-2000.

B.2.2 Project Status Summary

Field work for the PCB trackdown started during the summer of 2001. A total of 11 sampling locations along Etobicoke Creek were initially sampled, the majority of which were located at the mouths of the major tributaries into the main branch of the creek. The trackdown project included biomonitoring (fish and mussels), sediment collection, and large volume water samples integrated over a ten-week period.

Environment Canada collected surficial sediment samples in July from the 11 sites selected for the study.

Juvenile fish were collected from 9 of the 11 sites and caged mussels deployed at the locations where no fish were observed, as well as at the upstream and downstream locations. As a result of the initial sediment screening, additional caged mussels were deployed at the mouths of two minor tributaries entering the main creek in the areas of elevated PCB levels.

Environment Canada undertook a more intensive sediment sampling regime in September 2001. Sediment was collected from all the fish and mussel locations, as well as at strategic locations south of Pearson Airport. The data are yet to be analyzed.

B.3 Cataraqui River

B.3.1 Description

The findings of a 1994 OMOE study, indicating severely PCB contaminated sediments in the Kingston inner harbour on the Cataraqui River, have been confirmed by more recent studies (Cross, 1999; OMOE, 2000). A former landfill site located on Belle Island has been identified as being a significant historical source of PCBs. Additional sources to the river have been suggested, and include former scrap yards, brownfield sites and existing industries.

Field sampling started in the summer of 2001 and, in an effort to maximize resources and produce the most comprehensive results, the OMOE/Environment Canada project team took a co-operative partnership approach to the trackdown project with other agencies that share an interest in the Cataraqui River. These included the City of Kingston, Kingston Environmental Advisory Forum (KEAF), the Royal Military College (RMC) and Queen's University.

B.3.2 Project Status Summary

Previous studies indicated that PCB contamination in the sediments of the Cataraqui River was greatest on the west side of the river, where urban growth and industrialization historically occurred. As a result of these findings, the trackdown study focused on the west side of the river, and included: biomonitoring (using caged mussels); large volume water samples integrated over a ten-week period and collected directly from the municipal sewer pipes; and sediment cores.

Arrangements were made with the City to collect water samples directly from the municipal sewer pipes twice a week for the ten-week period. The final samples were split; one litre of the sample was sent to an external laboratory by the City for total PCB analysis, while the remainder of the water is being processed by the OMOE laboratory for congener analysis. The external laboratory uses a method detection limit of 50 ng/L. At this level, no PCBs were detected.

Caged mussels were deployed at the mouth of six municipal sewers discharging into the west side of the river. An additional four caged mussel experiments were deployed in other areas of concern and at an upstream reference location.

Sediment cores were collected in July 2001 by Kingston OMOE District staff from 6 storm sewers on the west side of the river, and 26 cores were collected from south west side of the landfill, in an attempt to spatially quantify PCB levels in this area. The cores were analyzed by Environment Canada for total PCBs. Elevated PCB levels were observed in the area immediately south of the landfill. Combined sewers discharge into the southwest corner of the landfill and an old tannery site located adjacent to the landfill on the south side of the creek. Further sediment samples were collected upon retrieval of the caged mussels from all of the caged mussel locations, as well as from three other discharge locations. More intensive sediment sampling in the area immediately south of the landfill and adjacent to the old tannery property was also carried out by Environment Canada. The data are being analyzed.

B.4 References

Cross, K., 1999. An investigation of organochlorines in freshwater sediment: a case study of Belle Island. B.Sc. Honours thesis, Queen's University, Kingston Ontario.

OMOE, 1994. Unpublished sediment quality data. Ontario Ministry of the Environment.

OMOE, 1999. Large volume sampling at six Lake Ontario Tributaries During 1997 and 1998: Project synapses and summary of selected results. Ontario Ministry of the Environment, ISBN 0-7778-9257-X.

OMOE, 2000. Unpublished sediment quality data. Ontario Ministry of the Environment, 22-NOV-01

Appendix C: Remedial Action Plan Updates

Eighteenmile Creek

A combined Stage 1 and Stage 2 RAP document was completed and published in August 1997. Currently the RAP is focused on continuing the investigation and assessment of creek sediments; evaluating possible sources of PCBs and other contaminants in the watershed; remediating inactive hazardous waste sites; correcting combined sewer overflows (CSOs); and, continuing surveillance activities. Implementation activities include: continued trackdown sampling for PCBs; assessment and remedial considerations for sediment sites such as the Barge Canal at Lockport and the William Street Island; an evaluation of potential pollutant sources within the sewer system in the City of Lockport; and, continued fish flesh analyses for contamination. An investigative study of the plankton community was conducted by SUNY Brockport to establish the status of the plankton use impairment indicator. Results are soon to be published. A status report update document was completed in June 2001.

Rochester Embayment

Monroe County Department of Health takes the lead role in implementing the RAP. Current RAP activities include lawn care and wetland education, a new water quality education collaborative organization, pollution prevention for auto recyclers and dentists, volunteer stream and wetland monitoring programs, advancement of phosphorus removal at small wastewater treatment facilities, and a streambank erosion assessment program. Two watershed planning projects have been completed and three more are underway. A Monroe County Stormwater Coalition was formed to plan for compliance with Federal Phase II Stormwater Regulations. Completed activities include several point and nonpoint source pollution abatement projects, extensive combined sewer overflow abatement, and a mercury pollution prevention project. Publications include manuals for hospital mercury pollution prevention, auto recyclers, volunteer stream monitoring, and volunteer wetland monitoring; biannual newsletter; two watershed plans; a watershed developers packet; and, a report on a water quality opinion survey. Oversight committees developed delisting criteria and monitoring methods for use impairments. Grants have been received for hyperspectral imaging of algae beds along the Lake Ontario shoreline, a study of the benthic health of the Rochester Embayment, and further development of monitoring methods for toxic-related use impairments. RAP update documents include publication of a RAP Addendum in 1999 and a recently completed Status Report document in March 2001.

Oswego River

A comprehensive RAP Update document was published in December 1996 that established a format to identify remedial strategies and track progress. Because of the RAP, additional water quality and sediment investigations, as well as a fish pathology study were performed in the Oswego River. A two-day technical workshop was conducted in June 1998 to evaluate study results and assess use impairment impacts and needs. A Workshop Summary and RAP Update report was published in May 1999 that documents workshop proceedings, study results, and RAP implementation strategies. Delisting criteria for the AOC have been developed based on USEPA guidance. A Stage 3 RAP delisting proposal has been drafted by NYSDEC and the Remedial Advisory Committee. Important elements of the RAP remedial activities include: the federal relicensing of the Oswego River power dams and the restoration of habitat through hydrologic modification; results of ongoing fish flesh studies involving Lake Ontario and the Oswego River area; and, upstream inactive hazardous waste site remediation including the results of further upstream contaminated river sediment study and evaluation. A final draft delisting proposal document is planned for 2002. Review of the delisting proposal will involve comments by IJC, USEPA, technical peer groups, and the public. A more formal public comment and involvement session is planned prior to completing the document and seeking endorsement.

Hamilton Harbour

Stakeholder Task Groups, know as the Remedial Action Plan (RAP) Forum, completed a (ten year) review of the RAP recommendations. This will allow the updating of the RAP Stage 2 Report in 2002. The local Bay Area Restoration Council, initiated a program to increase public awareness of the RAP and the Stage 2 update. The update will identify seven program areas: Water Quality and Bacteria, Urbanization and Land Management, Toxic Substances and Sediment Remediation, Fish and Wildlife, Public Access and Aesthetics, Education and Public Information, and Research and Monitoring. At the same time, the Bay Area Implementation Team (BAIT) initiated preparation of a strategic plan to implement the updated recommendations identified by the Stakeholder Forum. The BAIT report "Implementation Actions" defines which agencies will complete tasks identified in the updated RAP recommendations, costs and timelines. Two project areas continue as priorities for remediation: the Randle Reef contaminated sediment clean-up project, now proceeding through planning and design with a newly formed stakeholder Project Advisory Group and the upgrade of the City of Hamilton's wastewater treatment and combined sewer system. The City of Hamilton completed studies on combined sewer upgrades and wastewater treatment plant wet weather flow enhancements as part of its ongoing development of a long-term strategic water quality plan. The RAP for Hamilton Harbour has identified the need to double the pace of wastewater treatment upgrades in order to meet final remediation water quality targets by 2015.

Toronto and Region

The Toronto and Region RAP recently completed an in-depth assessment of progress. Beach water quality has been significantly improved at the Eastern Beaches, and will be improved at the Western Beaches with the completion of a combined sewer/stormwater detention tunnel in 2002. Twenty hectares of new waterfront habitats have provided for increases in the variety and biomass of fish. Lake-wide pollutants such as DDT have decreased, and there are now better controls on spills and industrial inputs to the sewers. However, overall most of the root causes of degradation are still in place and it will likely take decades to restore ecosystem health. Uncontrolled flows of polluted stormwater and combined sewer overflows remain as the most significant causes of degradation of Toronto's waterfront and watersheds. Implementation of the City's Wet Weather Flow Management Master Plan (due to be completed in 2002) will be essential to restore clean waters in the Toronto Area of Concern. Habitat improvements continue along the waterfront and in the watersheds, with emphasis on rivermouth wetlands; areas where land use changes are occurring (Toronto Portlands, West Donlands); removal of barriers in the rivers and creeks; and restoration of shoreline/riparian cover. Although the focus of the RAP is on remedial action to restore degraded environments, increased emphasis is also being placed on pollution prevention (for example, improving and enforcing sewer use by-laws and stormwater policies, applying best management practices, reducing use of hazardous chemicals, smart growth).

Port Hope

Environment Canada has responsibility for RAP coordination for the Port Hope Harbour RAP, however the RAP process has been on hold until the establishment of a low-level radioactive waste facility. The Low-Level Radioactive Waste Management Office (LLRWO) is seeking the necessary approvals for development of such a facility within the Port Hope community and the long-term management of the wastes from the harbour and throughout the Port Hope area. The project proposed by the LLRWMO, acting as a proponent of the Government of Canada, is subject to the Canadian Environmental Assessment Act, and Environment Canada is a recognized federal authority under the federal environmental assessment process.

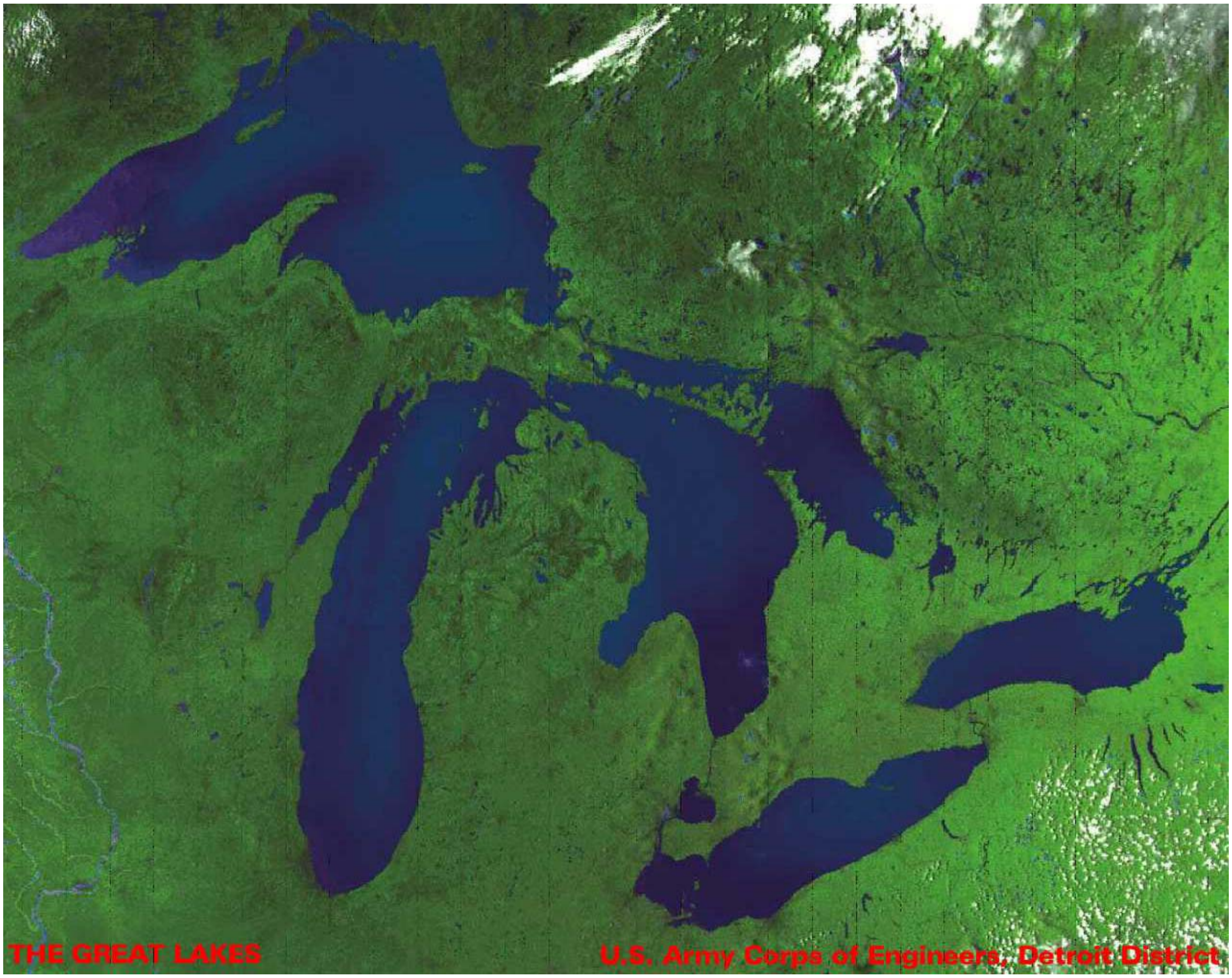
Currently, Environment Canada is working to ensure that all criteria and commitments under the GLWQA and the RAP process are met through discussions with the LLRWMO and the federal environmental assessment process. It is expected that all commitments will be met through this alternative process.

Bay of Quinte

Substantial progress toward delisting the Bay of Quinte Area of Concern has been made. Over 27,000 hectares of farmland have been converted from conventional to conservation tillage, and phosphorus inputs from rural sources have been lowered at source by more that 16,000 kilograms annually. At sewage treatment plants bordering directly on the Bay of Quinte, phosphorus loads have been reduced from 50 kg/day in 1986 to less than 25 kg/day in 1997 with cost savings of $1.75 million resulting from sewage treatment plant optimization for four facilities within the watershed. Within the Bay of Quinte, phosphorus concentrations are approaching the Bay of Quinte RAP target of 30-40 g/L. Water clarity is improving and the algal blooms are less severe. Direct discharges of industrial wastes have been substantially lowered. Beach closings occur less frequently. Over 50 kilometres of shoreline have been planted with native trees, shrubs and grasses to reduce erosion and improve habitats. Three hundred and fifty-four hectares of wetlands has been rehabilitated and protection of an additional 482 hectares of wetland.

Project Quinte scientists are advancing the knowledge for the Bay on fisheries habitat requirements, nutrient and energy transfer and impacts of exotic species. A comprehensive assessment on the health of benthic communities and sediment quality is underway.

The successes realized in the Bay of Quinte are due to the efforts of hundreds of private individuals, local organizations, numerous stakeholders and all levels government. There is a growing sense of stewardship, which holds promise of sustainability of the improvements made to date and for the future recovery of the Bay of Quinte.



For More Information

Check out the Lake Ontario LaMP 2002 Report on the Internet at www.on.ec.gc.ca/glimr/lakes/ontario/ or www.epa.gov/lakeont/

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