LAKE ONTARIO
LAKEWIDE MANAGEMENT PLAN
STATUS

APRIL 22, 2008

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1

CHAPTER 1 STATE OF LAKE ONTARIO

1.1 Summary 1-1
1.2 Linking Lake Ontario's Ecosystem Goals, Objectives and Indicators 1-1
1.3 Lake Ontario Status 1-1

1.3.1 Critical Pollutant Indicators 1-1
1.3.2 Lower Food Web Indicators 1-5
1.3.3 Upper Food Web Indicators 1-7

1.4 References 1-10

CHAPTER 2 BACKGROUND

2.1 Summary 2-1
2.2 Introduction to Lake Ontario 2-1

2.2.1 Climate 2-2
2.2.2 Physical Characteristics and Lake Processes 2-2
2.2.3 Aquatic Communities 2-3
2.2.4 Demographics and Economy of the Basin 2-7

2.3 LaMP Background 2-8
2.4 LaMP Structure and Processes 2-9
2.5 References 2-11

CHAPTER 3 ECOSYSTEM GOALS, OBJECTIVES, AND INDICATORS

3.1 Summary 3-1
3.2 Development of Lake Ontario Ecosystem Goals and Objectives 3-1

3.2.1 Ecosystem Goals for Lake Ontario 3-1
3.2.2 Ecosystem Objectives for Lake Ontario 3-1

3.3 Ecosystem Indicators 3-2

3.3.1 Critical Pollutant Indicators 3-3
3.3.2 Lower Foodweb Indicators 3-18
3.3.3 Upper Foodweb Indicators 3-22

3.4 Cooperative Monitoring Progress Towards Meeting LaMP Goals and Indicators 3-26
3.5 Major 2003 Cooperative Monitoring Projects 3-27

3.5.1 Lake Ontario Atmospheric Deposition Study (LOADS) 3-28
3.5.2 Lake Ontario Lower Aquatic Foodweb Assessment (LOLA) 3-28
3.5.3 Interagency Laboratory Comparison Study 3-29

3.6 Other Indicator Initiatives 3-30
3.7 Actions and Progress 3-30
3.8 References 3-30

CHAPTER 4 IDENTIFICATION OF BENEFICIAL USE IMPAIRMENT ASSESSMENTS

4.1 Summary 4-1
4.2 Beneficial Use Impairments Defined by the Great Lakes Water Quality Agreement 4-1
4.3 Beneficial Use Impairment Identification Process and Problem Definition 4-1
4.4 Beneficial Use Impairments in Lake Ontario 4-2

4.4.1 Restrictions on Fish and Wildlife Consumption 4-3
4.4.2 "Degradation of Wildlife Populations" and "Bird or Animal Deformities or Reproduction Problems" 4-6
4.4.3 Loss of Fish and Wildlife Habitat 4-9
4.4.4 Degradation of Benthos 4-12
4.4.5 Degradation of Nearshore Phytoplankton Populations 4-13
4.4.6 Degradation of Fish Populations 4-15

4.5 Unimpaired Lakewide Beneficial Uses in Lake Ontario 4-18

4.5.1 Tainting of Fish and Wildlife Flavor 4-18
4.5.2 Fish Tumors 4-19
4.5.3 Restrictions on Dredging Activities 4-19
4.5.4 Eutrophication or Undesirable Algae 4-20
4.5.5 Restrictions on Drinking Water Consumption, or Taste and Odor Problems 4-21
4.5.6 Beach Closings 4-22
4.5.7 Degradation of Aesthetics 4-23
4.5.8 Degradation of Zooplankton 4-24
4.5.9 Added Costs to Agriculture or Industry 4-24

4.6 Actions and Progress 4-24
4.7 References 4-25

CHAPTER 5 HABITAT ASSESSMENT AND RESTORATION

5.1 Summary 5-1
5.2 Habitat Types of the Lake Ontario Basin 5-1

5.2.1 Habitat Zones and Foodwebs 5-1
5.2.2 Nearshore Habitat 5-1
5.2.3 Offshore Habitat 5-2
5.2.4 Nearshore Wetlands 5-2
5.2.5 Tributaries 5-2

5.3 Current Status of Basin Habitat 5-2
5.4 Ongoing Work 5-4

5.4.1 Binational Activities 5-4
5.4.2 U.S. Activities 5-6
5.4.3 Canadian Activities 5-9

5.5 Actions and Progress 5-11
5.6 References 5-11

CHAPTER 6 SOURCES AND LOADS OF CRITICAL POLLUTANTS

6.1 Summary 6-1
6.2 Identifying Lakewide Problems and Critical Pollutants 6-1
6.3 Lake Ontario Sources and Loadings Strategy 6-2
6.4 Identifying Sources and Loadings of Critical Pollutants 6-3
6.4.1 Data Sources and Limitations 6-3
6.4.1.1 Sources Within the Lake Ontario Basin 6-4
6.4.1.2 Sources and Releases Outside the Lake Ontario Basin 6-5
6.4.1.3 Atmospheric Deposition 6-6
6.4.2 Loadings – General 6-6
6.4.3 Loadings of Critical Pollutants 6-9
6.4.3.1 PCBs 6-9
6.4.3.2 DDT and its Metabolites 6-9
6.4.3.3 Mirex 6-9
6.4.3.4 Dioxins and Furans 6-10
6.4.3.5 Mercury 6-11
6.4.3.6 Dieldrin 6-11
6.5 Actions and Progress 6-11
6.5.1 Binational Activities 6-12
6.5.1.1 Niagara River Toxics Management Plan 6-12
6.5.1.2 Lake Ontario Air Deposition Study (LOADS 6-12
6.5.1.3 Great Lakes Binational Toxics Strategy 6-17
6.5.1.4 Lake Ontario Mass Balance Models 6-17
6.5.1.5 Binational Sediment Workshop 6-21
6.5.2 U.S. Activities 6-24
6.5.2.1 Contaminant Trackdown 6-24
6.5.2.2 Government Activities 6-27
6.5.2.3 Pollution Prevention Partnerships 6-31
6.5.3 Canadian Activities 6-32
6.5.3.1 Contaminant Trackdown 6-32
6.5.3.2 Government Activities 6-39
6.5.3.3 Pollution Prevention Partnerships 6-40
6.6 References 6-42

CHAPTER 7 HUMAN HEALTH

7.1 Summary 7-1
7.2 Background 7-1
7.3 Human Health and the Lake Ontario LaMP 7-2
7.4 Human Health Pathways 7-2
7.5 Beneficial Use Impacts 7-3

7.5.1 Fish Consumption Advisories 7-4
7.5.2 Drinking Water 7-6
7.5.3 Bathing Beach (Closings) and Recreation 7-6

7.6 Great Lakes Human Health Network 7-7
7.7 Actions and Progress 7-8
7.8 References 7-8

CHAPTER 8 PARTNERSHIPS

8.1 Summary 8-1
8.2 Binational Partnerships 8-1

8.2.1 Lake Ontario Committee 8-1
8.2.2 Lake Ontario-St. Lawrence Water Level Study 8-2
8.2.3 Cooperative Monitoring 8-3
8.2.4 Remedial Action Plans 8-3

8.3 Public Partnerships 8-4
8.4 Actions and Progress 8-4
8.5 References 8-4

CHAPTER 9 PUBLIC INVOLVEMENT AND COMMUNICATION

9.1 Summary 9-1
9.2 Public Involvement Goals 9-1
9.3 Meeting Public Involvement Goals 9-1

9.3.1 Public Meetings 9-1
9.3.2 Publications 9-1
9.3.3 Websites 9-2
9.3.4 Media Events 9-3
9.3.5 Special Projects 9-3
9.3.6 Speaking Engagements 9-4
9.3.7 LaMP Display 9-4
9.3.8 Information Distribution 9-4

9.4 Information Connections 9-4
9.5 Actions and Progress 9-5
9.6 References 9-5

CHAPTER 10 SIGNIFICANT ONGOING AND EMERGING ISSUES

10.1 Summary 10-1
10.2 Significant Ongoing Issues 10-1

10.2.1 Protection and Restoration of Native Species 10-1
10.2.2 Invasive Species 10-2
10.2.3 Lake Ontario Water Levels 10-6

10.3 Emerging Issues 10-8

10.3.1 Rapid Urbanization of the Canadian Side of Western Lake Ontario 10-8
10.3.2 Emerging Chemicals of Concern 10-9
10.3.3 Other Emerging Chemicals 10-12
10.3.4 Fish and Wildlife Disease 10-12
10.3.5 Type E botulism 10-13
10.3.6 Climate Change 10-14
10.3.7 Harmful Algal Blooms 10-14

10.4 Actions and Progress 10-15
10.5 References 10-19

CHAPTER 11 SUMMARY OF AREA OF CONCERN STATUS

11.1 Summary 11-1
11.2 Background and Current Status 11-1
11.3 Binational Areas of Concern 11-3

11.3.1 Niagara River Area of Concern 11-4

11.3.1.1 Niagara River (U.S. Side) 11-4
11.3.1.2 Niagara River (Canada Side) 11-5

11.3.2 St. Lawrence River Area of Concern 11-7
11.3.2.1 St. Lawrence River at Massena, New York 11-7
11.3.2.2 St. Lawrence River at Cornwall, Ontario 11-8

11.4 U.S. Areas of Concern 11-11

11.4.1 Eighteenmile Creek 11-11
11.4.2 Rochester Embayment 11-12
11.4.3 Oswego River 11-13

11.5 Canada Areas of Concern 11-14

11.5.1 Hamilton Harbour 11-14
11.5.2 Toronto and Region 11-16
11.5.3 Port Hope Harbour 11-18
11.5.4 Bay of Quinte 11-19

11.6 Actions and Progress 11-21
11.7 References 11-21

CHAPTER 12 LAMP WORKPLAN ACTIONS AND PROGRESS

12.1 Summary 12-1

CHAPTER 13 LAMP NEXT STEPS

13.1 Summary 13-1
13.2 Next Steps 13-1
13.3 Research and Monitoring Needs 13-2
13.4 Recommendations 13-2
13.5 References 13-2

TABLES

2.1 Basin Land Use (%) 2-8
2.2 Shoreline Land Use (%) 2-8
3.1 Concentrations of Critical Pollutants (pg/L) compared to NYSDEC ambient water quality guidelines 3-4
4.1 Lake Ontario Lakewide Beneficial Use Impairments, Impacted Species and Pollutants 4-4
6.1 Estimates of Critical Pollutant Loadings to Lake Ontario 6-7
6.2 PCB air concentrations, pg/m^3 and air temperature. Sampled from Ship and from nearby Land based station. Average of three intensive sampling events (April and September 2002 and July 2003) 6-13
6.3 Total PCBs, DDE and Mirex in Lake Ontario Surface Water dissolved phase, ng/L (Average of 3 intensive sampling events: April and Sept. 2002 and July 2003) 6-14
6.4 Concentrations of Total Gaseous Mercury (TGM) and Reactive Gaseous Mercury (RGM) in Air and filtered Total Gaseous Mercury (TGM) and Dissolved Gaseous Mercury (DGM) in the Water Column of Lake Ontario 6-16
6.5 Total Dioxins / Furans air concentrations (pg/m^3) LOADS three intensive sampling periods 6-16
6.5 Phases of Lake Ontario Trackdown Studies 6-34
10.1 Other non native species threatening Lake Ontario ecosystem, their origin, date and location of first sighting, mechanism of introduction into the Great Lakes, and their current or potential impacts. (Dermot and Legner 2002, Mills et al. 1993, Owens et al. 1998, Ricciardi 2001, Witt et al. 1997, and Zaranko et al. 1997) 10-2
10.2 Summary of Actions and Progress 10-16
11.1 Summary of Beneficial Use Impairments for Lake Ontario Lakewide, Nearshore, and Areas of Concern (Based on the 14 IJC Use Impairment Indicators) 11-2
12.1 Lake Ontario Lakewide Management Plan Binational Workplan (2007-2011) 12-2

FIGURES

2.1 Lake Ontario Drainage Basin 2-1
2.2 Sedimentation Basins in Lake Ontario (Thomas, 1983) 2-3
3.1 Dieldrin dissolved phase trends in Niagara River surface water at Niagara-on-the-Lake 1987-2000 3-5
3.2 Contaminants in Young-of-the-Year Fish From Nearshore Areas of New York's Lake Ontario Basin, 1997 3-7
3.3 Contaminant trends in Lake Ontario lake trout 3-8
3.4 PCBs in 65 cm Coho Salmon from Lake Ontario, 1976-2006 3-9
3.5 Mirex in 65 cm Coho Salmon from Lake Ontario, 1976-2006 3-9
3.6 Mercury in 65 cm Coho Salmon from Lake Ontario, 1976-2006 3-9
3.7 Total DDT and metabolites in 65 cm Coho Salmon from Lake Ontario, 1976-2006 3-9
3.8 PCB Trends in Lake Ontario Herring Gull Eggs 3-11
3.9 DDE Trends in Lake Ontario Herring Gull Eggs 3-12
3.10 Dieldrin Trends in Lake Ontario Herring Gull Eggs 3-13
3.11 Mirex Trends in Lake Ontario Herring Gull Eggs 3-14
3.12 2,3,7,8-Dioxin Trends in Lake Ontario Herring Gull Eggs 3-15
3.13 Mercury Trends in Lake Ontario Herring Gull Eggs, Toronto and Snake Island. 3-16
3.14 Hexachorobenzene (HCB) Trends in Lake Ontario Herring Gull Eggs 3-17
3.15 Mean spring total phosphorus concentration in the open waters of Lake Ontario 3-19
3.16 Corrected chlorophyll-a values in 0 – 20 m integrated samples, offshore waters (depth ≥ 100 m) in Lake Ontario, 1974 – 2003 3-19
3.17 Summertime Secchi disc depths in Lake Ontario offshore waters (depth ≥ 100 m) 1966 – 2004 3-20
3.18 Numbers of Gull, Tern and Cormorant Nests on Lake Ontario, 1976 – 1999 3-24
3.19 Otter sightings and harvests in the Lake Ontario basin 1999-2000 3-25
3.20 Number of Occupied Bald Eagle Nesting Territories in the Lake Ontario basin 3-26
4.1 Phytoplankton Densities from Toronto-based Lake Ontario Water Treatment Plant Intakes, 1923-1998 4-14
6.1 Variations in flows and loads of mercury in US Tributaries 6-5
6.2 Total PCB comparison of IADN (1998-2000) and Sterling (2002-2003) 6-14
6.3 PCB air sampling at Sterling for the period April 2002 – March 2003 showing direct relationship between air temperature and amount of PCBs measured 6-14
6.4 Model Confirmation 1998 - 2001 6-20
6.5 Output for Lake Trout PCB Concentrations under Baseline and Other Loading Scenarios 6-20
6.6 Lake Ontario PCB Mass Balance for the Year 2000 6-21
6.7 Ontario Tributary Source Trackdown locations 6-33
10.1 Greenbelt Plan Area 10-9
11.1 Lake Ontario Areas of Concern (AOCs) 11-3

APPENDICES

A Glossary and List of Acronyms
B Lake Ontario Letter of Intent
C LaMP Management Team

PHOTO CREDITS

Cover Bald Eagle – U.S. Environmental Protection Agency (USEPA)
Aerial Shot - Cootes Paradise – Environment Canada (EC)
Salmon - Canadian Department of Fisheries and Oceans (DFO)

Executive Summary – USEPA*

Chapter 1 – DFO
Chapter 2 – EC
Chapter 3 – USEPA*
Chapter 4 – New York State Department of Environmental Conservation (NYSDEC)
Chapter 5 – DFO
Chapter 6 – EC
Chapter 7 – Ontario Ministry of Environment (OMOE)
Chapter 8 – USEPA
Chapter 9 – OMOE
Chapter 10 – USEPA*
Chapter 11 – EC
Chapter 12 – USEPA
Chapter 13 – USEPA

* Photos for the Executive Summary and chapters 3 and 10 are taken from USEPA's web site Visualizing the Great Lakes which contains images from a variety of contributors.

EXECUTIVE SUMMARY (LAMP 2008)

Introduction

This Lake Ontario Lakewide Management Plan Status 2008 is the latest, comprehensive compilation of existing LaMP reports, and replaces the 2006 Status. The document contains new/updated information on the state of Lake Ontario, Lake Ontario LaMP indicators, habitat, and public involvement and communication. The report also provides an update on LaMP workplan actions and progress and next steps. Several of the chapters in this document have been updated and other chapters will be updated at a later date, as new information becomes available.

Background

In 1987, the governments of Canada and the United States made a commitment, as part of the Great Lakes Water Quality Agreement (GLWQA), to develop a Lakewide Management Plan (LaMP) for each of the five Great Lakes.

The Lake Ontario LaMP is a binational, cooperative effort to restore and protect the health of Lake Ontario by reducing chemical pollutants entering the lake and addressing the biological and physical factors impacting the lake.

Building on the Lake Ontario Toxics Management Plan (LOTMP) (1989, 1991, 1993), the Lake Ontario LaMP focuses on:

- Restoring lakewide beneficial use impairments, as defined in the GLWQA (Annex 2) and described in Chapter 4 of this LaMP;
- Virtually eliminating critical pollutants that, due to their toxicity, persistence in the environment and their ability to accumulate in organisms, are likely to contribute to these impairments despite past application of regulatory controls; and
- Improving physical and biological integrity of the waters of Lake Ontario and water dependent resources that have been impaired by human activities.

The Binational Executive Committee (BEC) of the GLWQA passed a resolution in 1999 requiring each Lake to produce an updated Lakewide Management Plan (LaMP) at least once every two years. To facilitate this requirement, the Lake Ontario LaMP is presented in a loose-leaf format with general tabbed sections that can be inserted into a three-ring binder. This format allows the LaMP to be viewed as an evolving document where new material can be easily added and outdated material removed. The date when information was updated is located at the bottom of each page.

LaMP 2008

The LaMP 2008 Status for Lake Ontario has been developed by Region 2 of the US Environmental Protection Agency (USEPA), Environment Canada (EC), the New York State Department of Environmental Conservation (NYSDEC), The Ontario Ministry of the Environment (OMOE), the Ontario Ministry of Natural Resources (OMNR), Fisheries and Oceans Canada (DFO), and the US Fish and Wildlife Service (USF&W). The document incorporates all relevant information/commitments from: the Lake Ontario Toxics Management Plan (1989, 1991, 1993), the Lake Ontario LaMP Stage 1 Report (1998), the Lake Ontario LaMP 2002 Biennial Report, the Lake Ontario LaMP 2004 Status and the Lake Ontario LaMP 2006 Status. In addition, the following chapters of the LaMP have been updated since the Lake Ontario LaMP 2006 Status was released:

- Chapter 1 State of Lake Ontario

- Chapter 3 Ecosystem Goals, Objectives and Indicators
- Chapter 5 Habitat Assessment and Restoration
- Chapter 9 Public Involvement and Communication
- Chapter 11 Summary of Areas of Concern Status
- Chapter 12 LaMP Workplan Actions and Progress
- Chapter 13 LaMP Next Steps
- Appendix C LaMP Management Team
- Appendix D 5-year Binational Workplan for the Lake Ontario LaMP

The primary audience for this document is government agencies and their partners who are involved directly in restoration and protection activities around the Lake. LaMP Status also responds to the reporting requirement to the International Joint Commission under the Great Lakes Water Quality Agreement (GLWQA). *Update* newsletter is prepared annually by the LaMP Agencies to inform the public about developments and progress on LaMP Program activities.

LaMP 2008 Highlights

State of Lake Ontario (Chapter 1)

- The State of Lake Ontario chapter provides a status of the Lake Ontario ecosystem measured against the objectives and indicators of the Lake Ontario Lakewide Management Plan (Chapter 3). The status of contaminated sediment has been provided, which is an indicator under development.

- Lake Ontario's ecosystem can be considered improving in a number of areas while improvements are required in other areas. Progress is being made towards achieving the Lake Ontario LaMP Objectives in critical pollutants. Bald eagle, mink and otter are achieving LaMP Objectives however lower food web indicators and sport fish contaminants indicators are not. Challenges appear to be linked to nearshore nutrient levels, invasive exotic species, and human effects on habitat.

Ecosystem Goals, Objectives, and Indicators (Chapter 3)

- This chapter evaluates the status of the Lake Ontario LaMP's ecosystem indicators based on reports and information provided by government monitoring programs as of the beginning of 2006. The key findings of these studies are presented in each of the indicator assessments.

- This chapter was released March 23, 2007. Figures 3.4 through 3.7 were revised and released April 22, 2008.

- The LaMP has adopted 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.

- The LaMP also adopted the LOTMP's five ecosystem objectives that describe the conditions necessary to achieve LaMP ecosystem goals around the following categories aquatic communities, wildlife, habitat, human health and stewardship.

- The eleven indicators selected provide a good characterization of ecosystem health across the food web. 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 Food web 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 Food web 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.

- Detailed information regarding the objective, purpose, measure, target and status for each indicator is presented in this Chapter. A summary of this information is provided as a State of Lake Ontario report in Chapter 1.

Habitat Assessment and Restoration (Chapter 5)

- This chapter provides an overview of the types of habitat in the Lake Ontario basin, status of the habitat, and the restoration and protection activities that have been completed or are still ongoing in the U.S. and Canada. The material presented is based on information that existed as of December 2007.

- New information about the Binational Biodiversity Conservation Strategy has been added. This is an important new initiative for the LaMP and many partners around the basin. Although it is still in the planning stages, it will be continue to be a priority for planning and implementation in the years to come.

- Ongoing Canadian and U.S. habitat activities have been updated to reflect recent and planned activities.

Public Involvement and Communication (Chapter 9)

- This chapter discusses the Public Involvement and Communication component of the Lake Ontario LaMP. It highlights the goals for public involvement and describes ways in which the LaMP implements these goals. The chapter focuses on the activities that have been conducted over the past ten years and lists contacts for further information.

- In 2006, the LaMP had material available at the SOLEC Conference in Milwaukee and the plan is to participate in a like fashion at SOLEC 2008 to be held in Niagara Falls, Ontario in October.

- On October 24, 2007 the LaMP hosted a joint public meeting with the Niagara River Toxics Management Plan. The meeting was held in Grand Island, New York. The focus of the meeting was progress on the NRTMP, with a brief overview of the work of the LaMP. About 30 members of the general public attended. There were three media outlets present, including the Buffalo News, National Public Radio, and the Niagara Falls Review.

- Building on the theme of stewardship, the Ontario Ministry of the Environment led an initiative to develop a temporary exhibit on the Lake Ontario ecosystem at the Marine Museum of the Great Lakes in Kingston, Ontario. In 2007 Ministry of the Environment reconnected with the Marine Museum to explore the possibility of future partnership in reinstalling the Lake Ontario "Ecogallery". The museum is going to research options and will contact the ministry at a later date.

- 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. Ongoing and planned activities include opportunities to meet with existing groups, forming partnerships locally to assist in LaMP projects and providing information when requested and regularly through the LaMP website and mailings. Stewardship of the Lake will be emphasized at future partnership meetings. The LaMP will continue to inform the public through reporting and public meetings, and will participate in other meetings such as SOLEC and the International Joint Commission (IJC) biennial sessions.

LaMP Workplan Actions and Progress (Chapter 12)

- Seven agencies now work together to implement the Lake Ontario LaMP through an updated binational workplan. This workplan became effective in January 2007 and enhances binational efforts to restore and to protect Lake Ontario and its biological resources. Table 12.1 summarizes the actions and progress made in all the workplan activities.

- The revised workplan now combines the previous short term and long term plans into one document. It accomplishes this by listing activities under the four major work areas and then identifying in separate columns short term (3 year) and longer term (5 year) outputs. An additional column in the workplan reports on the status or assessment of each activity. The short term (3 year) outputs for each activity have been established to be consistent with the commitments of the Canada-Ontario Agreement (COA). The long term (5 year) outputs can also reflect the desired results.

- LaMP Next Steps (Chapter 13)

The LaMP parties will continue their cooperative efforts towards the restoration and protection of Lake Ontario and its ecosystem. The LaMP workplan outlines details of activities by the LaMP parties for the next 5 years. In the upcoming years, special attention will be concentrated on the following activities:

Coordinating binational monitoring efforts and programs to better assess the health of Lake Ontario and its ecosystem.

- Reducing critical pollutant loadings to the Lake.
- Reporting on the status of the LaMP's ecosystem indicators, and adopting new indicators.
- Assessing the current status of the lower food web and the fisheries.
- Re-evaluating the status of the Lake's beneficial use impairments, as needed.
- Developing a binational habitat conservation strategy and actions.
- Conducting public outreach and promoting LaMP partnerships and stewardship of the Lake and its watershed.

The LaMP agencies are looking forward to continuing efforts to improve Lake Ontario and its ecosystem. The updated workplan and relevant documents can be found on the web at www.binational.net.

CHAPTER 1 LAKE ONTARIO STATUS

1.1 Summary

This chapter provides a status of the Lake Ontario ecosystem measured against the objectives and indicators of the Lake Ontario Lakewide Management Plan (Chapter 3). In addition, the status of contaminant in sediment cores has been provided. This is an indicator under development.

1.2 Linking Lake Ontario's Ecosystem Goals, Objectives, and Indicators

The Lake Ontario LaMP adopted ecosystem goals to provide a vision for the future of Lake Ontario. Subsequently, ecosystem objectives and indicators were developed to provide a practical approach for monitoring progress towards achieving the LaMP's ecosystem goals. Ecosystem objectives were identified for aquatic communities, wildlife, human health and stewardship. Eleven indicators, approved in 2001, are designed to track progress towards ecosystem objectives in three categories: critical pollutants, lower food web, and upper food web.

The LaMP's indicators will be reviewed periodically to ensure that they continue to measure the status of the Lake Ontario ecosystem relative to LaMP goals and objectives, and that they are supported by the monitoring agencies. The LaMP work group and management committees are developing new indicators to address elements not yet measured such as habitat, contaminated sediments, and stewardship. As these are developed, they will be available to the Lake Ontario community for review and comment. Once new indicators are finalized, indicator descriptions will be incorporated into Chapter 3 and the indicator status will be reported in Chapter 1.

More detailed information on the development of the LaMPs goals, objectives and indicators can be found in Chapter 3.

1.3 Lake Ontario Status

Overall Lake Ontario's ecosystem is improving. All the critical pollutant indicators, the bald eagle indicator, and the mink and otter indicators are showing progress towards achieving the Lake Ontario LaMP Objectives. Lower food web indicators and the lake trout population indicator are indicating challenges that appear to be linked to nearshore nutrient levels, invasive exotic species, and human affects on habitat.

The discussion presented here is summarized into three categories of indicators: critical pollutants, lower food web and upper food web. An overview of the status of each of these categories is followed by more details on each of their constituent indicators. More detailed information about the status of each of these indicators, including tables, figures, and references, is provided in Chapter 3.

1.3.1 Critical Pollutant Indicators

Critical pollutant indicators measure concentrations of critical pollutants in water, young of the year fish, herring gull eggs, and sport fish (lake trout and coho salmon). A brief status of the critical pollutant indicators is provided here.

Summary: Overall, critical pollutants are continuing to decline in all indicators presented although many are still present at levels above criteria. Fish advisories are still in effect due to PCBs, dioxins, mirex and mercury, however concentrations are declining.

Details: The most recent data available (2004) show concentrations in the open waters of many organic compounds and metals present in only trace amounts, with some below available water quality objectives. PCB and dieldrin levels are declining over the last two decades (Figure 1.1).

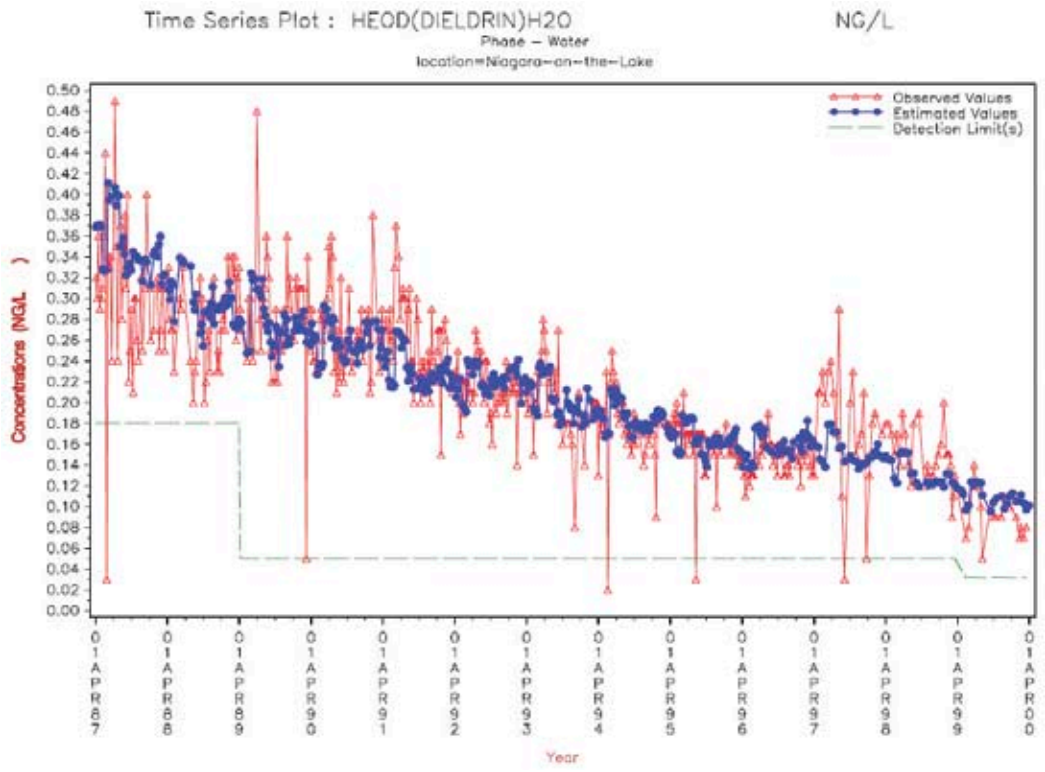


Figure 1.1: Dieldrin dissolved phase trends in Niagara River surface water at Niagara-on-the-Lake 1987-2000.

Contaminant concentrations in young-of-the-year fish from New York State (1997) showed that mercury, dioxin, total DDT and dieldrin concentrations were below their respective criteria at all sampled locations; in fact dieldrin was not detected at any location. However PCBs and mirex were found to exceed their respective criteria at some locations (Figure 1.2). PCB levels in New York Areas of Concern were below the GLWQA 100 ng/g criteria, the fish collected from the Black River, Salmon River and Sodus Bay exceeded it. Mirex was above the GLWQA criteria of "non-detect" at all locations except at the Black River and Sodus Bay. Mirex concentration trends through time were mixed depending on where sampling occurred. Eighteenmile Creek, NY showed no significant change in concentrations, whereas the Oswego River site levels dropped from 2.0 and 4.7 parts per billion in 1984 and 1987 respectively to not detected in 1997. A small increase of 2-4 parts per billion in 1984-1986 changes to 8.5 parts per billion in 1997 at the Salmon River. Five sites (Twelve Mile Creek, Burlington Beach, Bronte Creek, Credit River, and Humber River) along the Ontario shoreline of the lake showed total PCBs and DDT levels declining but still above guidelines. Mirex levels are at or below guidelines (SOLEC 2007).

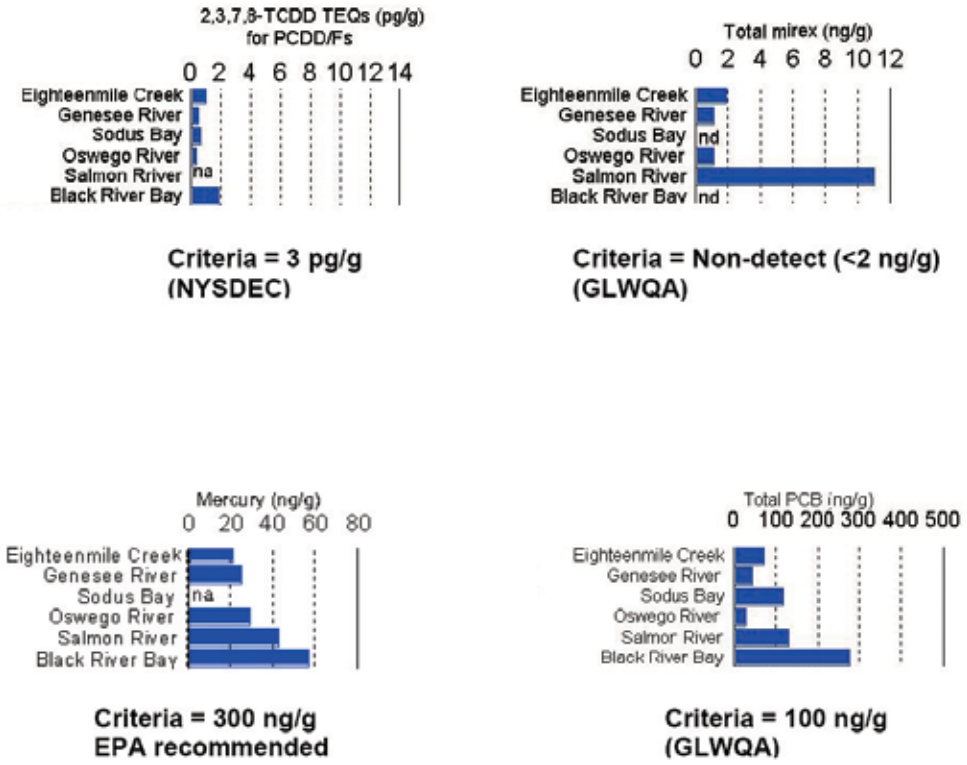


Figure 1.2: Contaminants in Young-of-the-Year Fish from Nearshore Areas of New York's Lake Ontario Basin, 1997.

PCBs, dioxins, mirex and mercury are still responsible for a number of lakewide fish consumption advisories. Overall, the proportion of the piscivorus fish community assessed has experienced a dramatic reduction in contaminant levels since the mid-1970s (Figure 1.3). The U.S. EPA monitoring program shows PCB concentrations have declined from >6 µg/g in 1978 to <2 µg/g in 2000. Annual reports from the Canadian federal fish contaminants program show concentrations of PCBs, DDT and mercury in similarly aged fish have generally declined in most monitored fish species. After a period of consistent decline total PCB levels have remained virtually unchanged since 1998 at a level of 1.27 µg/g. Total DDT concentrations continued a pattern of a steady decline since 1994. Whole fish concentrations of DDT have been consistently less than the Great Lakes Water Quality Agreement objective of 1.0 µg/g since 1995.

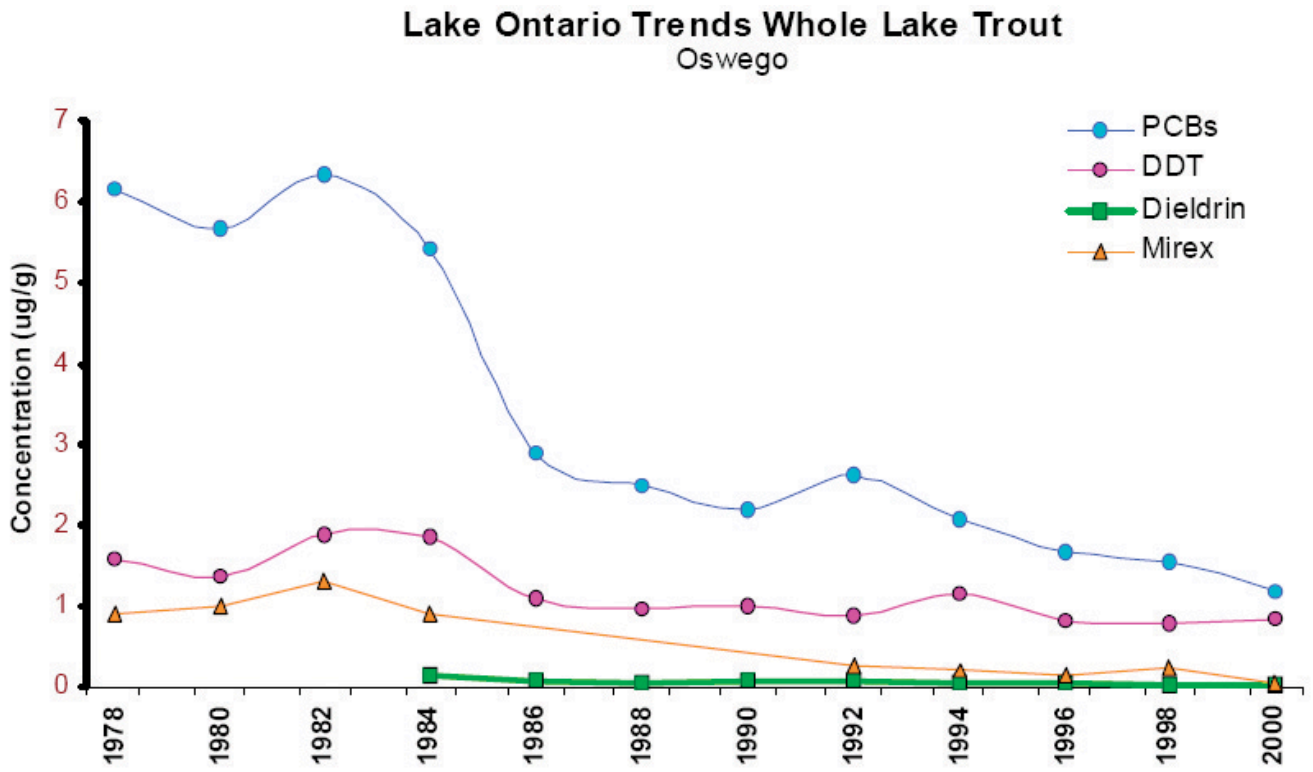


Figure 1.3 Contaminant trends in Lake Ontario lake trout.

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. Over the same time period, concentrations of mirex have decreased from greater than 0.1 ppm to less than 0.05 ppm (Figure 1.5). Similar trends have been observed for mercury and DDT, as can be seen in Figures 1.6 and 1.7, respectively.

Contaminant levels in herring gull eggs have continued to decline since the 1970s when monitoring first began. Change-point regression analysis continues to show that most contaminant levels at most sites (72.4%) are declining as fast as or faster now than they did in the past. This is particularly evident for dieldrin and DDE. The rates of decline have slowed for some compound-site comparisons particularly PCBs and mirex. There has been only one Lake Ontario site where temporal data is available on the emerging chemical PBDE. Results showed concentrations increased dramatically from 1981 through 1999 but appear to have declined slowly since then, possibly due to the manufacturer ceasing production in December 2003 (Figure 1.4).

Temporal trends of legacy and current persistent organic pollutants of concern are reported for a Lake Ontario sediment core from two Lake Ontario stations; one station is located 16 km north of Fort Niagara (near the mouth of the Niagara River) and the other from the offshore of Lake Ontario near its centre. This study aims to assess historical inputs of legacy and current-use persistent compounds into Lake Ontario, examining progress towards virtual elimination of priority pollutants and providing information for setting lake-wide management priorities on chemicals of emerging concern. These studies provide a baseline of information for assessing management of these compounds in Lake Ontario

The offshore site showed trends of legacy contaminants such as polychlorinated biphenyls (PCBs) and dioxins/furans (PCDD/Fs) slowing their rates of declines in recent years after significant reductions, while perfluorinated compounds show considerable increases. Persistent organic pollutants of current concern, such as polybrominated diphenylether (PBDE) concentrations, dominated by BDE-209, peaked in the two

most recent slices. Polychlorinated naphthalenes (PCNs) exhibited a similar trend to PBDEs, peaking only in recent years. The recent peak of PCN concentration is unexplained, and requires further assessment[1].

The core taken near offshore of Fort Niagara showed reduced loadings to this area for all contaminants analyzed in the top 2 cm of the core. Only four of eight metals examined have guidance values which were found at concentrations greater than respective Toxic Equivalent Concentration (TEC) levels and total PCB was below the TEC. The trend indicates that since 1964 significant reductions have taken place for the conventional pollutants measured in this study[2].

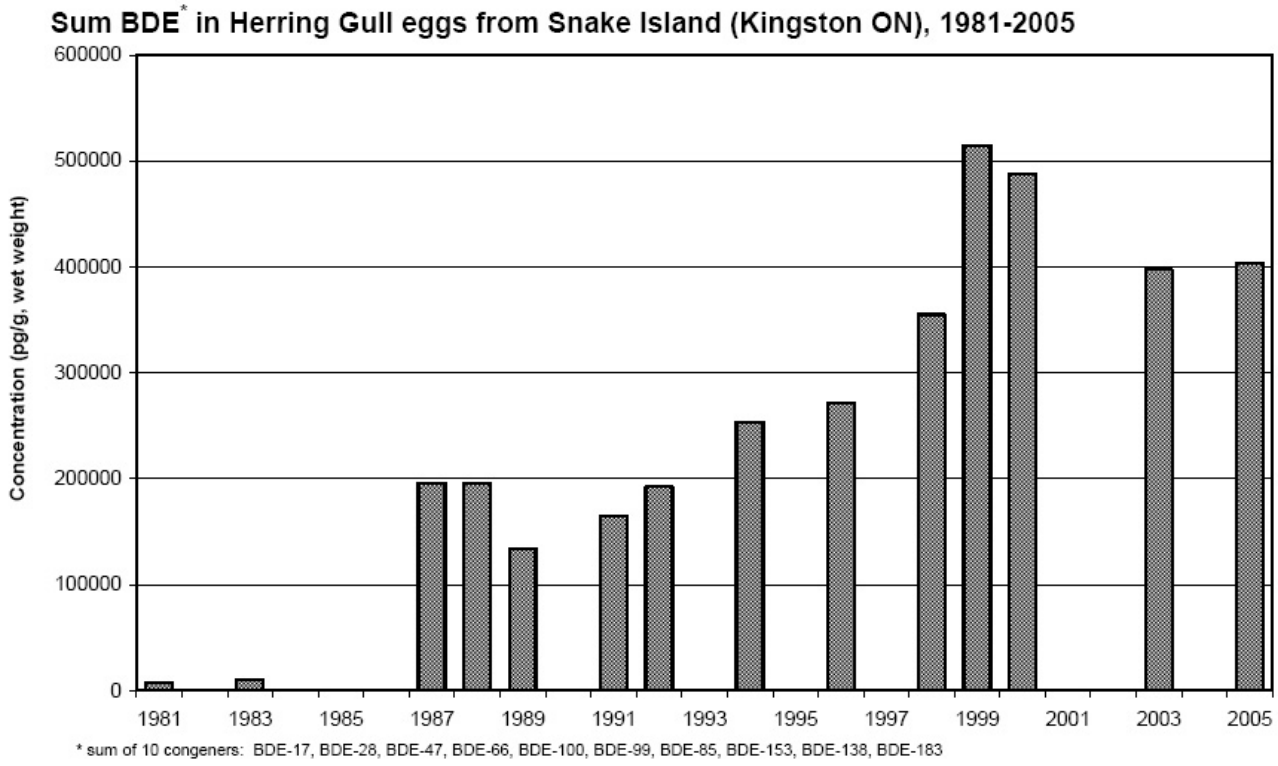


Figure 1.4 Polybrominated Diphenyl Ether (PBDE) Trends in Lake Ontario Herring Gull Eggs. Totals reflect the sum of 10 congeners: PBDE-17, PBDE-28, PBDE-47, PBDE-66, PBDE-100, PBDE-99, PBDE-85, PBDE-153, PBDE-138 and PBDE-183.

1.3.2 Lower Food Web Indicators

Lower food web indicators track the status of nutrients in open waters (total phosphorus, chlorophyll a, and secchi disc depth), zooplankton populations (mean individual size and biomass), and prey fish populations (abundance, age and size distribution of deepwater ciscoes, sculpin, lake herring, rainbow smelt and alewife). They reflect the ability of the ecosystem to support higher level organisms (such as lake trout and waterbirds).

Summary: In Lake Ontario the offshore waters have changed from a mesotrophic system towards an oligotrophic system. This has come at a time when demands for a salmonid sport fishery have increased, non-native species such as the alewife have exhibited highly variable population dynamics, oligotrophic fish stocks are recovering, and exotics such as the zebra mussel, quagga mussel and currently the predatory zooplankton, such as *Bythotrephes cederstromi* and *Cercopagis pengoi*, have become established and may be impacting food web dynamics. Complicating the lower food web is the reoccurrence of nearshore algal blooms, resulting in problems such as beach closures, drinking water quality concerns, and added costs to industry. The sources of these problems are uncertain. This will be the focus of an intensive binational monitoring effort in 2008.

Details: In response to binational phosphorus control programs, open lake phosphorus concentrations declined from a peak of about 25 µg/L in 1971 to the 10 µg/L concentration recommended to achieve the GLWQA target load to the lake by the mid 1980s. Offshore phosphorus levels continued to decline through the 1990s and are now at approximately 5 – 7 µg/L (Fig 1.5). However, nearshore areas are now suffering from increased occurrences of the filamentous algae *Cladophora* similar to the 1970s. Chlorophyll data from Environment Canada's Surveillance Program showed the trophic status of Lake Ontario has changed from a mesotrophic system in the 1970s and is now bordering on oligotrophic. Monitoring will assist in determining if this trend is continuing.

Water clarity, as measured by secchi disc depth, has increased dramatically in Lake Ontario over time (Figure 1.6). Some of the improvements occurred concurrently with improved phosphorus discharge controls and the accompanying decline in nuisance algal biomass. However, the most dramatic changes in offshore waters have been apparent since about 1989, indicating that water clarity has increased due to influences other than phosphorus discharge controls.

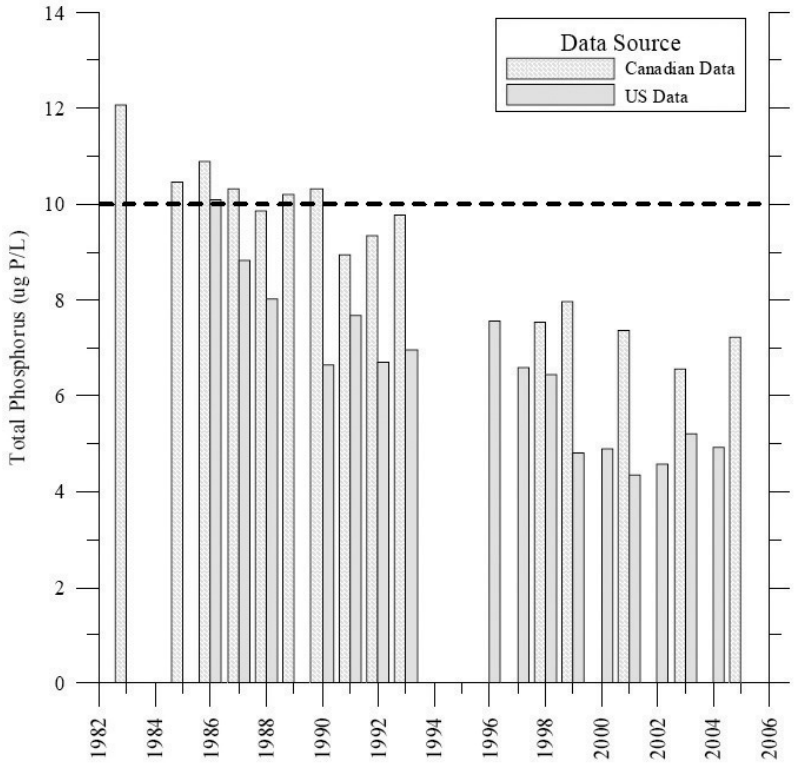


Figure 1.5 Mean spring total phosphorus concentration in the open waters of Lake Ontario. (Dashed line represents concentration recommended to achieve GLWQA target loads)

Mean zooplankton length can be used as an indicator of the balance between plankton eating fish and fish predators. Offshore crustacean zooplankton body size had a mean of 0.74 mm, close to the 0.8 mm target. Future Status reports will provide more information on this indicator.

The prognosis is poor for Lake Ontario alewife and rainbow smelt populations, the non-native mainstays of the offshore food web for most pelagic predators. Both species have been affected by changes in the food web and declines in productivity in the open lake. Alewife abundance has been declining during recent years, but a stronger 2005 year-class suggests a small rebound may occur. Smelt abundance continues to decline to record low levels. The recent invading round goby continues to increase in abundance and to expand its range into the offshore in association with quagga mussels. Gobies continue to increase in importance as diet items for fish like lake trout. Slimy sculpin populations have declined for all size categories except the largest during

recent years, but this observation may be affected by changes in sampling gear. Specific indicators for prey fish populations are needed, but the rapid pattern of change has defied efforts to define future abundance targets.

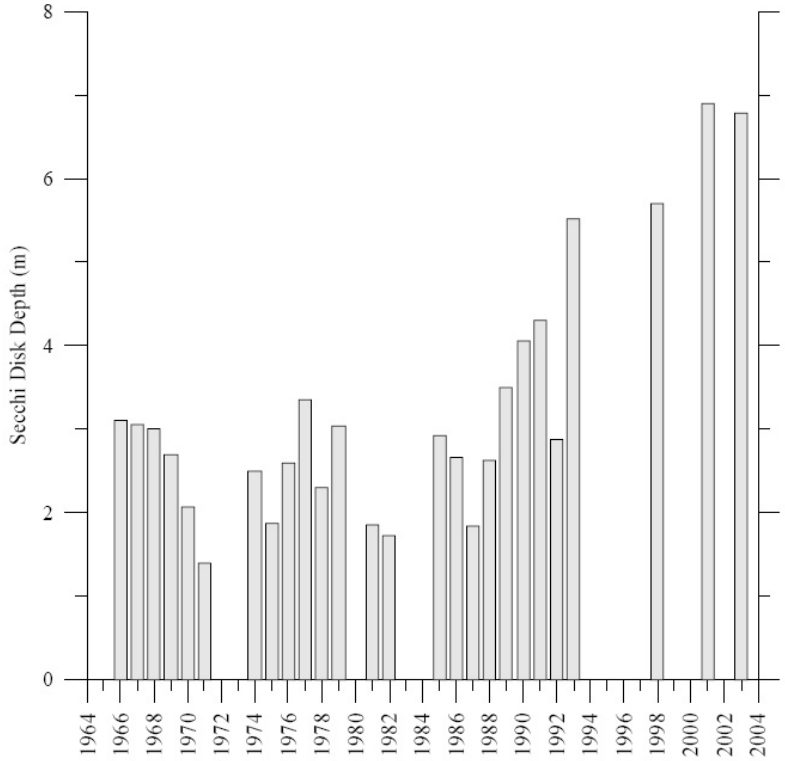


Figure 1.6: Summertime Secchi disc depths in Lake Ontario offshore waters (depth ≥ 100 m) 1966 – 2004.

Reductions in non-native alewife and smelt may have positive effects on other native species in the lake. The number of deepwater sculpin caught in trawls has continued to increase during recent years, from 1 fish caught during 2004 to 16 fish observed during 2006. Prior to 1998, the last documented record of a deepwater sculpin being captured in U.S. waters of Lake Ontario was over 50 years ago. Future monitoring will determine if a recovery of deepwater sculpin is occurring. Assessments suggest that lake herring abundances may be increasing. Currently sampling has not found any deepwater cisco in Lake Ontario; plans are underway for the re-introduction of this critical element of the offshore food web.

1.3.3 Upper Food Web Indicators

Upper food web indicators monitor the health of lake trout, herring gull, bald eagle, mink and otter populations. These top level predators are dependent on quality habitat and sufficient prey populations, free of problematic contaminant levels.

Summary: Restoration of naturally reproducing population of lake trout is the focus of a major international effort in Lake Ontario coordinated by the Lake Ontario Committee of the Great Lakes Fisheries Commission. While natural reproduction of lake trout is occurring, their abundance is well below target and adult numbers of adult fish are declining. Only one of the five lake trout restoration targets were met during the most recent sampling period 2006. The numbers of fish stocked has declined and the survival of stocked young fish continues to be low. New strategies to improve this restoration effort are being developed. Changes to the offshore food web may be having effects on this effort. The Lake Ontario Committee is revising the Lake Trout Rehabilitation Plan to include new strategies for restoration and revised indicators of success. The Lake Ontario LaMP will review this document and consider how the current LaMP objectives and indicator targets may need to be adjusted.

Contaminants do not appear to be limiting herring gull or other colonial bird populations. Double-crested cormorant populations are expanding. Herring gull populations are stable but may be in flux possibly due to nesting competition with double-crested cormorants. Great black-back gulls are in decline having suffered severely from a botulism outbreak in 2005. Mink are located throughout the basin and their populations are stable. River otter, found around the eastern end of Lake Ontario, in central Ontario and along the St. Lawrence River, are now moving into western and central New York as more and more abandoned agricultural land returns to natural conditions. The number of bald eagle nesting territories within the Lake Ontario basin continues to increase. During 2007 there were two additional shoreline nests established for a total of 3. The 2004 fledging rate was above the one eaglet per nest target.

Details: Only one of the five lake trout restoration targets were met during the most recent sampling period 2006. Harvest by the fisheries on the lake remains below the target level for restoring the population. The rate of wounding by sea lampreys on lake trout, a measure of mortality caused by this parasite, is much lower than pre-1985 levels, but has increased during recent surveys to more than the target level, suggesting that the low host density is affecting wounding rates. Despite low harvest rates, and until recently, low sea lamprey attack rates, the abundance of adult lake trout, including mature females, is below targets and declining. Reduced numbers of lake trout stocked into the lake, especially since 2004, are contributing to the decline in abundance. Stocked fish are not surviving as well as they did in the past as evidenced by very low catches of young lake trout in assessment programs in recent years. Small numbers of naturally produced lake trout have been produced from 1993 to 2004, but the number of these wild juveniles caught in trawls is below target. A final and key indicator of the success of restoration will be an abundance of wild adult lake trout, but the assessment captures of wild adults remain rare and well below the target.

Lake Ontario is home to nearly 1,000,000 colonially nesting waterbirds. Biologists from the Canadian Wildlife Service, the Ontario Ministry of Natural Resources and the New York State Department of Environmental Conservation have completed three Lake Ontario-wide census of nesting colonial water birds, a survey that is conducted approximately once every 10 years. Although herring gulls are the selected LaMP waterbird indicator, this section also includes information on species of colonial waterbirds in order to provide additional information on waterbird issues. Lake Ontario-wide surveys were conducted in 1976-1977, 1990-1991 and 1998-1999 for six species of colonial water birds: double-crested cormorant, ring-billed gull, herring gull, great black-backed gulls, common tern and Caspian tern. Selected species are monitored more frequently; their recent numbers are discussed and updated below.

Herring Gull - The herring gull is the most widespread colonial waterbird nesting on the Great Lakes[26]. As a native non-migratory species that relies heavily on aquatic prey organisms, the herring gull serves as an excellent indicator species. From 1976/77 to 1990, the number of nests (breeding pairs) of Herring Gulls on Lake Ontario increased from 522 to nearly 1800, a 242% increase. The number of nesting sites increased from 14 to 21. However, more recently, from 1990 to 2003, the number of breeding pairs decreased to approximately 1400 (when adjusted for uncensused sites), a decline of approximately 22%. Declines in the numbers of breeding Herring Gulls have been most noticeable at sites where cormorants also nest. However, a cause and effect relationship has yet to be established.

Double-crested Cormorant – From 1977 to 1999 the Lake Ontario population of breeding cormorants increased from 96 pairs to over 20,000. In response to this increase and the cormorant's potential impacts to vegetation and co-occurring tree/shrub-nesting species, management actions were begun on Little Galloo Island (NY) in 1999 and at Presqu'ile Provincial Park (ON) in 2003. These actions appear to have stabilized the number of nesting cormorants in the eastern basin of Lake Ontario (at approximately 9,000 pairs) and decreased it in the central basin to just over 5,000 (Figure 1.7). However, the number of nesting pairs in Lake Ontario's western basin is now the greatest (9,000+ pairs) and appears to be still growing. Cormorants are reproducing very well.

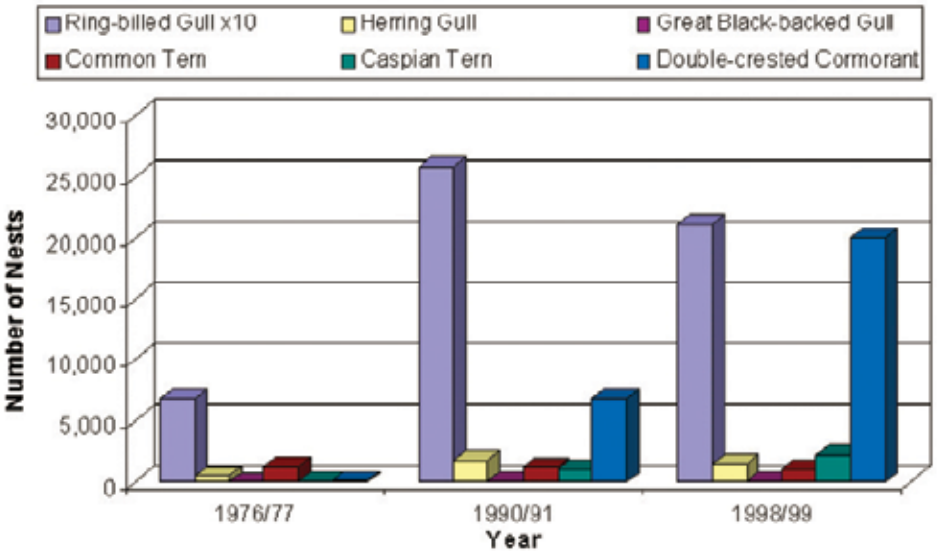


Figure 1.7: Numbers of Gull, Tern and Cormorant Nests on Lake Ontario, 1976 – 1999

Great Black-backed Gull - Of the gulls and terns which commonly nest on Lake Ontario, the great black-backed gull is the least numerous. During the 1976-77 census, it was not found nesting anywhere on Lake Ontario. In 1990, a total of 15 nests were found on 3 sites and by 2004 this number had grown to 40 pairs. However, there was a severe botulism-induced die-off of various colonial waterbirds in Lake Ontario in the summer-fall of 2004 and several Lake Ontario-banded black-backed gulls were found dead. In the spring of 2005, the breeding numbers had declined to only 12 pairs.

Mink and river otter are making a comeback in the Lake Ontario basin. Their populations were severely reduced in the 1800s due to habitat loss, water pollution and excessive trapping. Prior to these changes the river otter had the largest geographic range of any North American mammal. A review of trapping data showed that more than 5,000 mink were trapped during the 1999-2000, harvest season. Although otter trapping is illegal in a large portion of the basin, over 1,200 otter were trapped in the remaining areas in the 1999-2000 seasons (Fig. 1.8). There were also a number of otter sightings in the portion of the Lake Ontario basin that is closed to otter trapping. The harvest counts found in the trapping records represent only a small percentage of the total populations of mink and otter in the Lake Ontario basin. This provides good evidence that significant numbers of these animals are present in the basin.

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 active bald eagle nesting territories in the Lake Ontario basin. Two eagle nesting territories were artificially established in the basin during the 1980s through the introduction of adult eagles captured in Alaska. Since that time the number of nesting territories has steadily increased. There are now 23 established nesting territories in the basin. The 2004 average successful reproduction rates for these nests was ~1.5 eaglets per nesting attempt. A minimum reproduction rate of 1.0 eaglet per occupied nesting territory is generally believed to be necessary to maintain stable bald eagle populations.

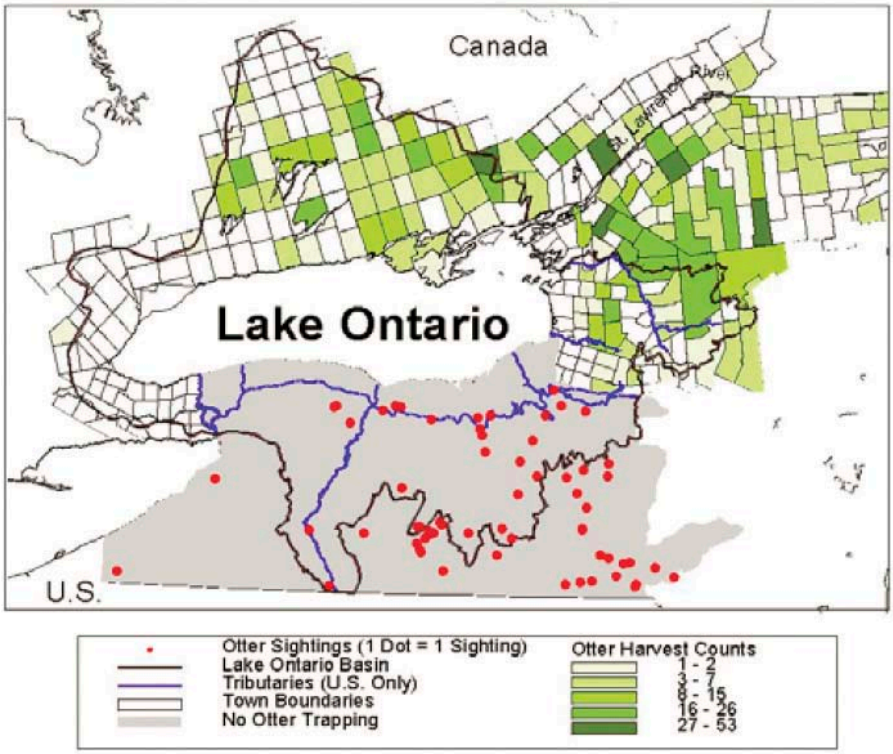


Figure 1.8: Otter sightings and harvests in the Lake Ontario basin 1999-2000.

Although good to excellent bald eagle nesting habitat exists along the eastern shoreline of the lake, there were no shoreline or island nests until recently. In 2000 the first shoreline nesting territory was established and has successfully fledged each year since. Two additional nests were established during 2007 for a new total of 3 shoreline nesting territories. The result of successful nests and reproduction rates has been 18 young eagles fledged from known shoreline territories since 2000. More eagles are expected to occupy shoreline nesting sites as their numbers steadily increase. Human disturbance has slowed the return of eagles to the shoreline. Restoration of shoreline nesting territories will depend in part on protection of eagle nesting habitats and preventing further human disturbance. As well as nesting habitat, Lake Ontario provides considerable overwintering habitat with increasing numbers of eagles being observed during the winter in the eastern basin and the Thousand Islands.

1.4 References:

1 Crozier, Patrick, Rocsana, Lega, Terry Kolic, Karen Macpherson, Sarah Gewurtz, Li Shen1, Paul Helm, Eric Reiner, Ian Brindle, Chris Marvin. Temporal Trends of Legacy and Emerging Persistent Organic Pollutants in a Sediment Core from Lake Ontario. Poster Session, SETAC Conference 2006.

2 New York State Department of Environmental Conservation, 2007. Results from core collected in Lake Ontario, April 2007. NYS Department of Environmental Conservation. Division of Water. October 2007, 42 pages.

3 SOLEC, 2007. State of the Lakes Great Lakes 2007 (Draft). State of the Lakes Ecosystem Conference (SOLEC). June 2007. 534 pages.

CHAPTER 3 ECOSYSTEM GOALS, OBJECTIVES AND INDICATORS

3.1 Summary

This chapter evaluates the status of the Lake Ontario LaMP's ecosystem indicators based on reports and information provided by government monitoring programs as of the beginning of 2006. The key findings of these studies are presented in each of the indicator assessments. The reader should refer to original source reports for complete findings as well as details on monitoring techniques.

3.2 Development of Lake Ontario Ecosystem Goals and Objectives

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

3.2.1 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.

3.2.2 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.

3.3 Ecosystem Indicators

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 food web. 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 Food web 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 Food web 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, 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 fosters closer working relationships between U.S. and Canadian monitoring programs and will promote better binational coordination. Additional indicators, measures and/or targets will be considered, as necessary, to help guide LaMP restoration activities. The status of each indicator based on recent monitoring information is provided below. Some proposed improvements to indicator reporting are also discussed.

3.3.1 Critical Pollutant Indicators

Critical pollutant indicators measure concentrations of critical pollutants in water, young of the year (YoY) fish, herring gull eggs and lake trout, and compare this information against existing guidelines.

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

Status: Environment Canada (EC) operates the only long-term Lake Ontario surface water contaminant monitoring program and will serve as the primary source of information to evaluate this indicator. Information from other special surface water investigations will also be considered as new information becomes available. EC has developed a new measurement technique and has invested in the construction of an ultra-clean laboratory in order to measure trace concentrations of pollutants in the surface waters of the Great Lakes. In 2004, a pilot project to measure organic contaminants in the surface waters in the western portion of Lake Ontario was initiated; full coverage of the lake was obtained in 2005. The 2005 data are not yet available, but the 2004 data show that concentrations of many organic compounds and metals are present in only trace amounts, and some are below available water quality objectives (Table 3.1). Concentrations of most critical pollutants (PCBs and mercury concentrations using comparable measurement techniques were not available prior to 2004) were similar in 2001 and 2004. Sampling and analytical problems have made it difficult to develop reliable estimates of dioxins and furans for offshore surface waters.

Some differences with earlier measurements in 1999, 2001, 2002 and 2003[1, 36, 37] are noted in these recent data. However, these apparent differences are not considered to be great, especially considering the generally low values obtained in these studies. In addition, differences in methods, volumes of waters sampled, and time of year, could result in differing values. Seasonal changes in water concentrations, in particular, may contribute to the differences between studies. Contaminant concentrations may be higher early in the season, when low temperatures and winter ice cover may limit volatilization of contaminants from the water to the atmosphere.

Collectively, the data for Lake Ontario offshore surface waters indicate that PCB levels are up to 140 times higher, and dieldrin up to 245 times higher than the most stringent ambient water quality guidelines designed to protect humans who consume fish (Table 3.1).

Table 3.1 Concentrations of critical pollutants (pg/L) compared to NYSDEC ambient water quality guidelines.

Critical Pollutant	Fall 1999[1]	Spring 2001[2]	Average of 2002 & 2003[3]	Spring 2004[4]	Most Stringent NYSDEC Ambient Water Quality Guideline	Basis Code[5]
Dieldrin	3 - 6	176		147	0.6	H (FC)
p,p'-DDE	0 - 2	19	4	14	7	H (FC)
p,p'-DDD	1 - 3	31		21	80	H (FC)
p,p'-DDT	0.54- 0.95	<43		<43	10	H (FC)
Total DDT	3 - 6	<43		<43	11	W
Photomirex	<0.02 – 0.3	<40		<40	No guideline	-
Mirex	0.15 – 0.30	<14		<14	1	H (FC)
Total PCB	26 – 46	NA	93	144	1	H (FC)
Dissolved Mercury (ng/L)	NA	NA	0.16 – 0.30	0.62[6]	0.7	H (FC)

Notes:

1) organic contaminant values are whole-water concentrations from NYSDEC, autumn 1999, using large volume samples (>400 L), filters and resin

2) values are dissolved concentration MLE (maximum likelihood estimates) from Environment Canada, spring 2001, offshore locations, using large volume samples (50 L), ship-based Goulden extraction.

3) organic contaminant values are average values for three large volume (~400 L) XAD resin and filter sampling events collected as part of the Clarkson University LOADs project.

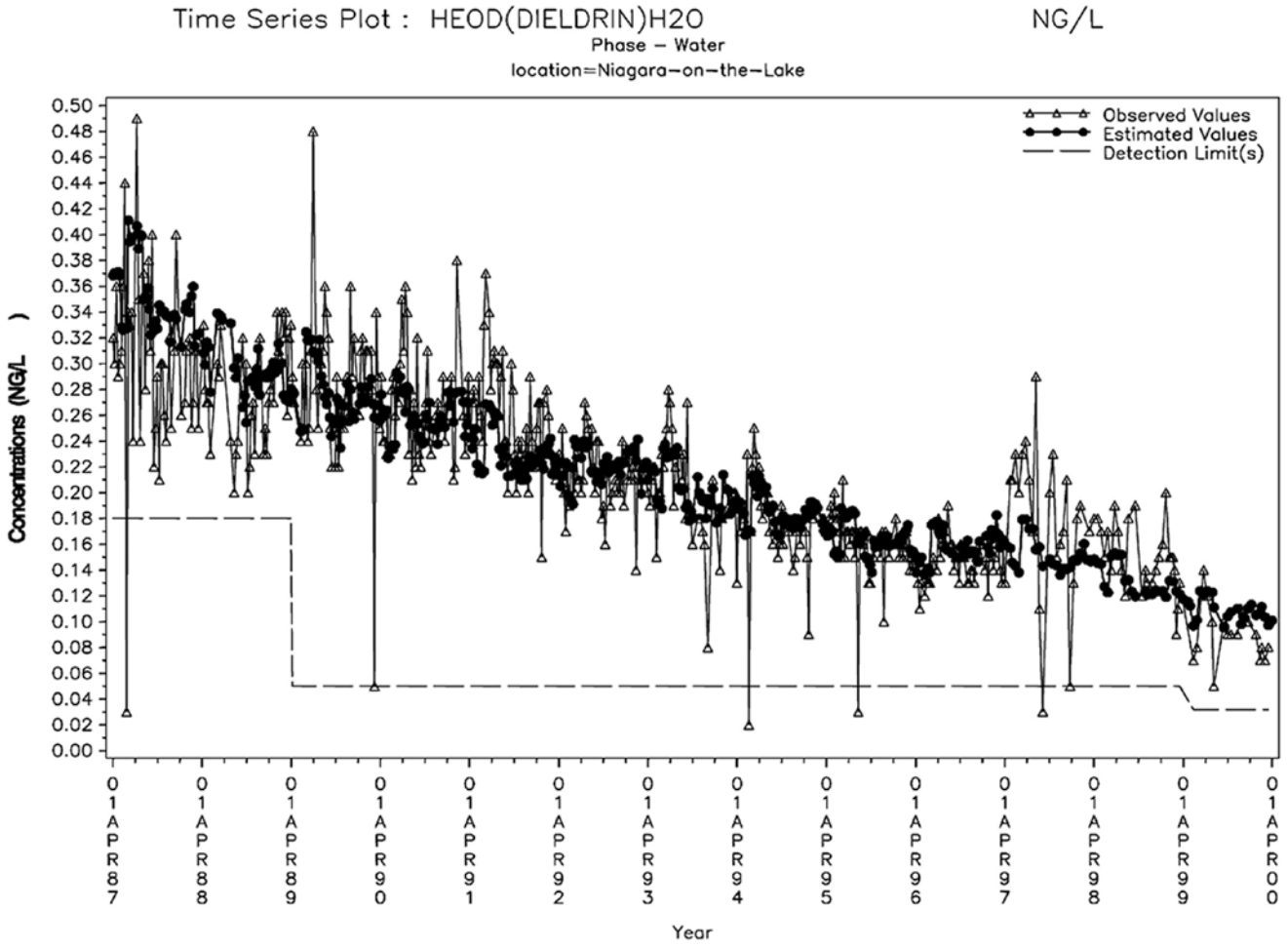
4) values are dissolved concentration MLE (maximum likelihood estimates) from Environment Canada, spring 2004, using 16 L samples, Goulden extraction in clean lab. Data are from offshore locations in the western portion of Lake Ontario only. PCB values are corrected for laboratory blanks.

5) NYSDEC Value Basis Codes: H (FC) = Human Health Fish Consumption; W = Wildlife Protection

6) This particular result is for "total" mercury and therefore reflects a maximum potential value for dissolved mercury; since the total (dissolved plus particulate) is less than the dissolved NYSDEC criteria, the criteria is met.

The Niagara River Upstream-Downstream and the Wolfe Island St Lawrence River monitoring programs provide additional information on historical trends of some contaminants at sites entering and leaving Lake Ontario[2, 3]. For example, these programs show that concentrations of PCBs on suspended sediments and dissolved concentrations of dieldrin in Niagara River water entering Lake Ontario have been declining over the last two decades (Fig 3.1).

Figure 3.1 Dieldrin dissolved phase trends in Niagara River surface water at Niagara-on-the-Lake 1987-2000.



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

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

Status: YoY fish PCB and mirex levels remain a concern at some locations.

New York State 1997 YoY fish sampling results[4] showed that PCBs and mirex exceed criteria designed to protect fish-eating wildlife at some locations (Figure 3.2). PCB levels in YoY fish collected from the Black River, Salmon River and Sodus Bay exceeded the GLWQA 100 ng/g criteria. PCB levels in YoY fish collected from U.S. AOCs were below the 100 ng/g criteria. Mirex was above the GLWQA criteria of "non-detect" at all locations except at the Black River and Sodus Bay. Mercury, dioxin, total DDT and dieldrin

YoY concentrations were below their respective criteria. Dieldrin was not detected at any location.

Mirex was at 2 ppb in YoY fish from Eighteenmile Creek and showed no change by 1997 but at the Oswego River site, the 1984 and 1987 means of 2.0 and 4.7 ppb decreased to less than detection in 1997. The mean mirex level of 8.5 ppb for Salmon River YoY fish represents a relatively small increase over means of 2 to 4 ppb measured in YoY fish from 1984-1986. Photomirex, a degradation product of mirex, was detected at low levels (mean = 3.7 ppb wet weight) in YoY fish only from the Salmon River. Low levels were last detected in young fish from the Salmon River, Oswego River and Black River Bay in 1984.

The results of more recent NYSDEC and OMOE studies will be reported here in future updates.

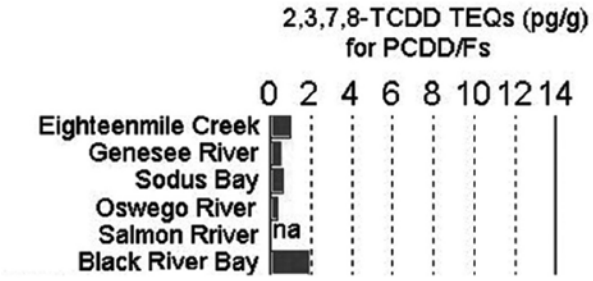
Critical Pollutants in Fish Tissue

Objective: consumption of fish should not be restricted due to contaminants of human origin
Measure: concentrations of pollutants in fish 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

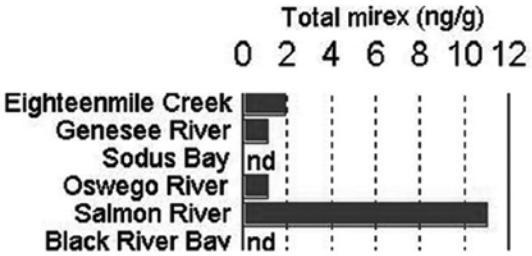
Status: PCBs, dioxins, mirex and mercury are still responsible for a number of lakewide fish consumption advisories.

Overall, the fish community has experienced a dramatic reduction in contaminant levels since the mid-1970s. One source of fish contaminant trend information is the U.S. EPA GLNPO fish contaminant monitoring program[5] (Fig. 3.3). Each year NYSDEC and USGS work together to provide EPA with lake trout for analysis. PCB concentrations have declined from >6 µg/g in 1978 to <2 µg/g in 2000. Trends are becoming increasingly more difficult to detect in the short term, controlling processes have half-lives on the order of a decade or two.

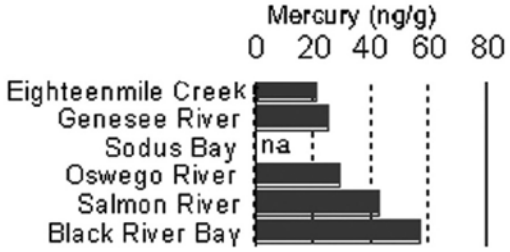
Figure 3.2 Contaminants in Young-of-the-Year Fish From Nearshore Areas of New York's Lake Ontario Basin, 1997[4].



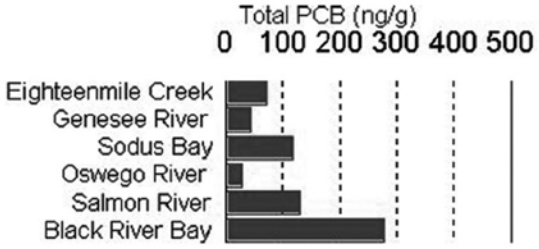
Criteria = 3 pg/g (NYSDEC)



Criteria = Non-detect (<2 ng/g) (GLWQA)

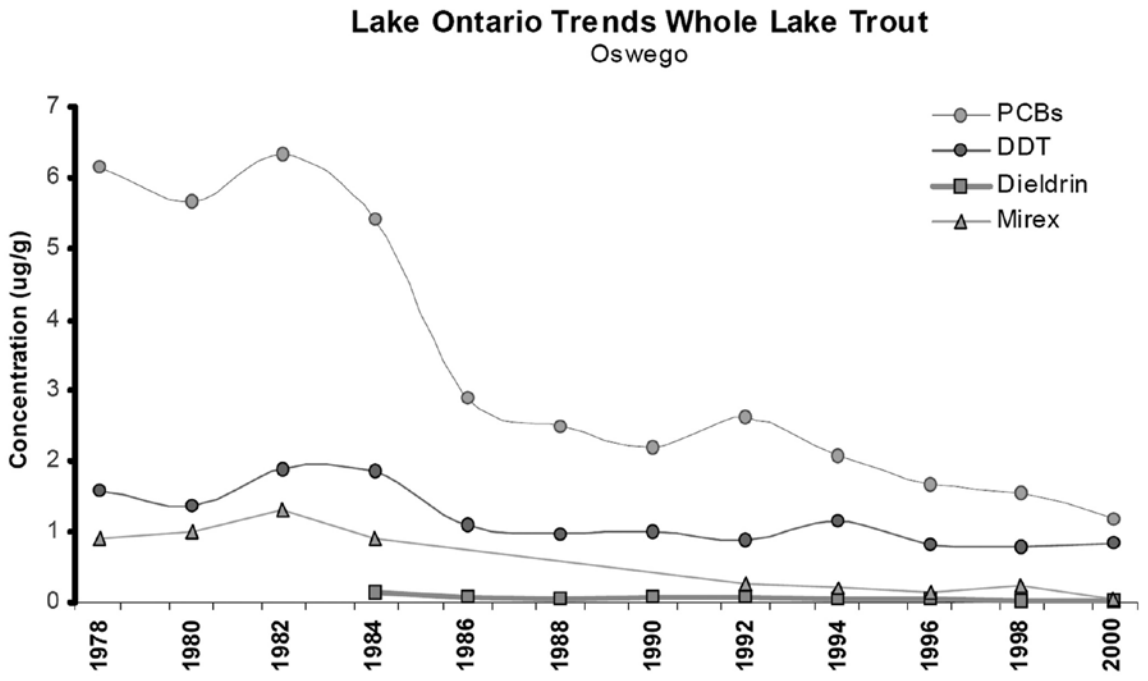


Criteria = 300 ng/g EPA recommended



Criteria = 100 ng/g (GLWQA)

Figure 3.3 Contaminant trends in Lake Ontario lake trout[5].



Canada has maintained a long-term, basin wide monitoring program that measures whole body concentrations of contaminants in lake trout and/or walleye [6]. The Canada Department of Fisheries and Oceans (DFO) had maintained this program for more than 25 years. This program was recently transferred to Environment Canada. Annual reports document contaminant burdens in similarly aged fish (4^+ - 6^+ range). Since the late 1970s, concentrations of historically regulated contaminants such as PCBs, DDT and Hg have generally declined in most monitored fish species. After a period of consistent decline total PCB levels have remained virtually unchanged since 1998. Over the past 6 years mean PCB levels were 1.27 µg/g which represent about 44% of the 1997 concentration. Total DDT concentrations continued a pattern of a steady decline since 1994. Whole fish concentrations have been consistently less than the Agreement Objective of 1.0 µg/g since 1995.

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 [7]. 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 3.4). Over the same time period, concentrations of mirex have decreased from greater than 0.1 ppm to less than 0.05 ppm (Figure 3.5). Similar trends have been observed for mercury and DDT, as can be seen in Figures 3.6 and 3.7, respectively.

Both U.S. and Canadian fish tissue monitoring programs have been expanded to include some of the more recently recognized bioaccumulative contaminants such as polybrominated diphenyl ethers (PBDE). Future reporting on this indicator will include information on mercury levels in walleye. The identification of mercury as a lakewide critical pollutant is based on walleye advisories. Mercury is not a cause of lake trout or salmon consumption advisories.

Figure 3.4 PCBs in 65 cm Coho Salmon from Lake Ontario, 1976-2006.

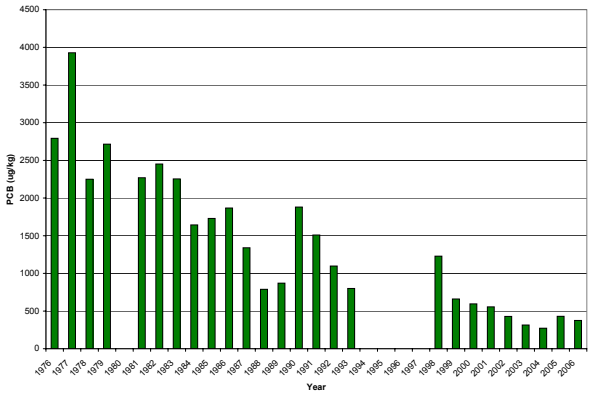


Figure 3.5 Mirex in 65 cm Coho Salmon from Lake Ontario, 1976-2006.

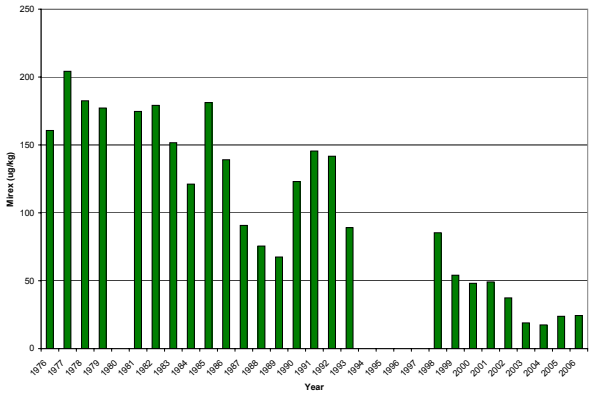


Figure 3.6 Mercury in 65 cm Coho Salmon from Lake Ontario, 1976-2006.

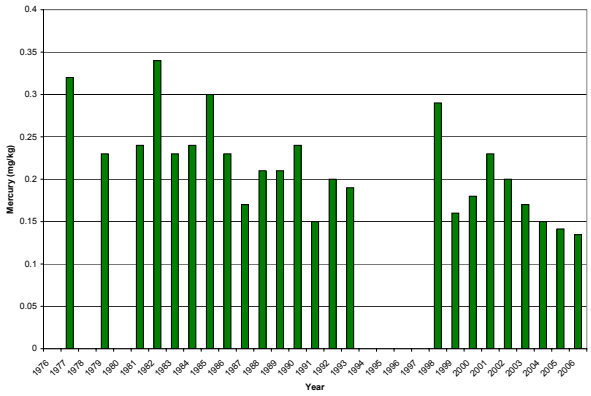
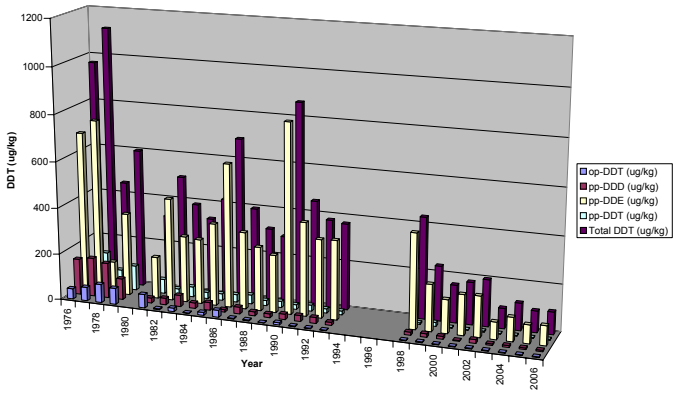


Figure 3.7 Total DDT and metabolites in 65 cm Coho Salmon from Lake Ontario, 1976-2006.



Critical Pollutants in Herring Gull Eggs

Objective: the health and reproductive success of waterbirds should not be impaired by contaminants present in the aquatic food web
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

Status: Critical pollutant concentrations in gull eggs are continuing to decrease.

The herring gull is the most widespread colonial waterbird nesting on the Great Lakes. As a native, non-migratory species that relies heavily on aquatic prey organisms, the herring gull provides an excellent indicator species. The Canadian Wildlife Service's herring gull egg contaminant monitoring program has provided an excellent means to track environmental trends in persistent toxic chemicals[8-12, 26-28].

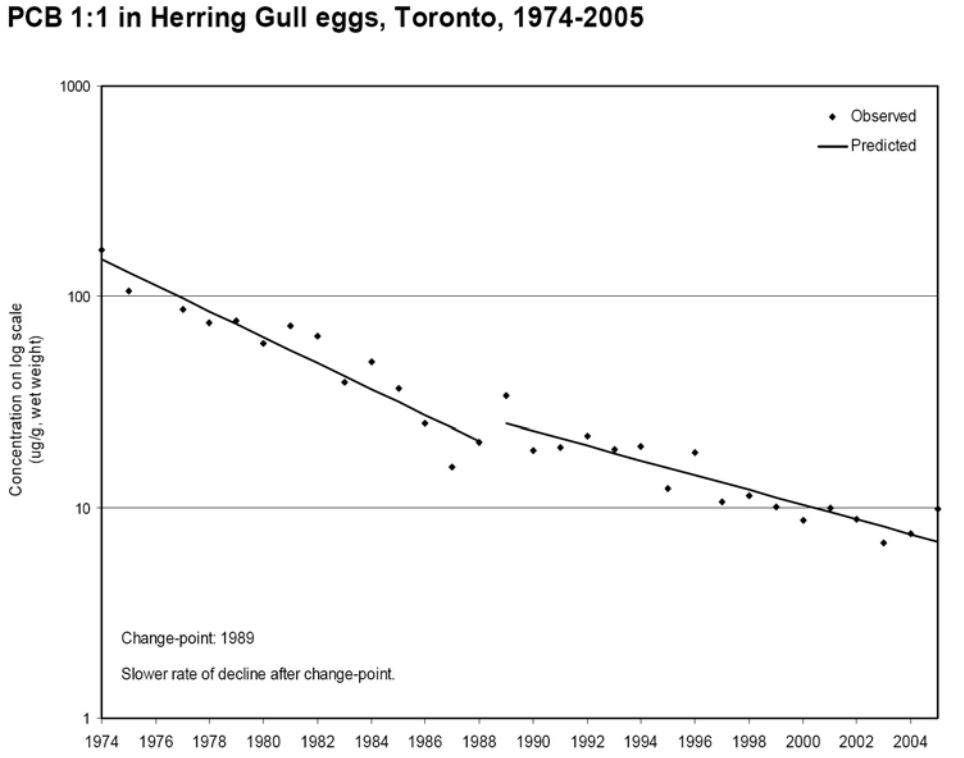
The long-term decline in concentrations of critical pollutants in eggs of Great Lakes and Lake Ontario herring gulls is well documented. Rates of decline of several organochlorine contaminants in herring gull eggs from the 1970s through the 1990s are available[8-12, 26- 28]. More recent changes in Lake Ontario herring gull egg concentrations for the critical pollutants DDE, dieldrin, mirex, PCBs, and Hg (2000-2005) and TCDD and TCDF (2000-2003), are as follows: DDE has declined 67.6 – 82.8%, dieldrin: 58.4 – 84.2%, mirex: 68.7 – 82.8%, PCBs: -12.6 – 41.8%, Hg: 36.0 – 38.0%, 2378-TCDD: -55.0 – 9.3%, 2378-TCDF: 12.7 – 93.1%30 . Trends for critical pollutants in gull eggs are illustrated in Figures 3.8 – 3.13. Similar decreases have been seen in other pollutants such as hexachlorobenzene (HCB) (Figure 3.14).

Data for PBDEs in herring gull eggs from the only Lake Ontario site where temporal data are available are shown in Figure 3.15. Concentrations increased dramatically from 1981 through 1999 but appear to have declined slowly since then[29, 30].

Future work on this indicator could include the development of specific target concentrations for critical pollutants in gull eggs. Although many of the obvious signs of toxic contamination are no longer apparent, the 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.

Since the 1970s, the levels of most chlorinated hydrocarbons have decreased significantly at the majority of colonies on the Great Lakes. Change-point regression analysis continues to show that most contaminant levels at most sites (72.4%) are declining as fast as or faster now than they did in the past. This is particularly evident for dieldrin and DDE. The rates of decline have slowed for some compound-site comparisons particularly PCBs and mirex.

Figure 3.8 PCB Trends in Lake Ontario Herring Gull Eggs. "PCB 1:1" indicates that total PCBs have been quantified assuming a one to one ratio of PCB aroclors 1254 and 1260. Note that the vertical scale is logarithmic.



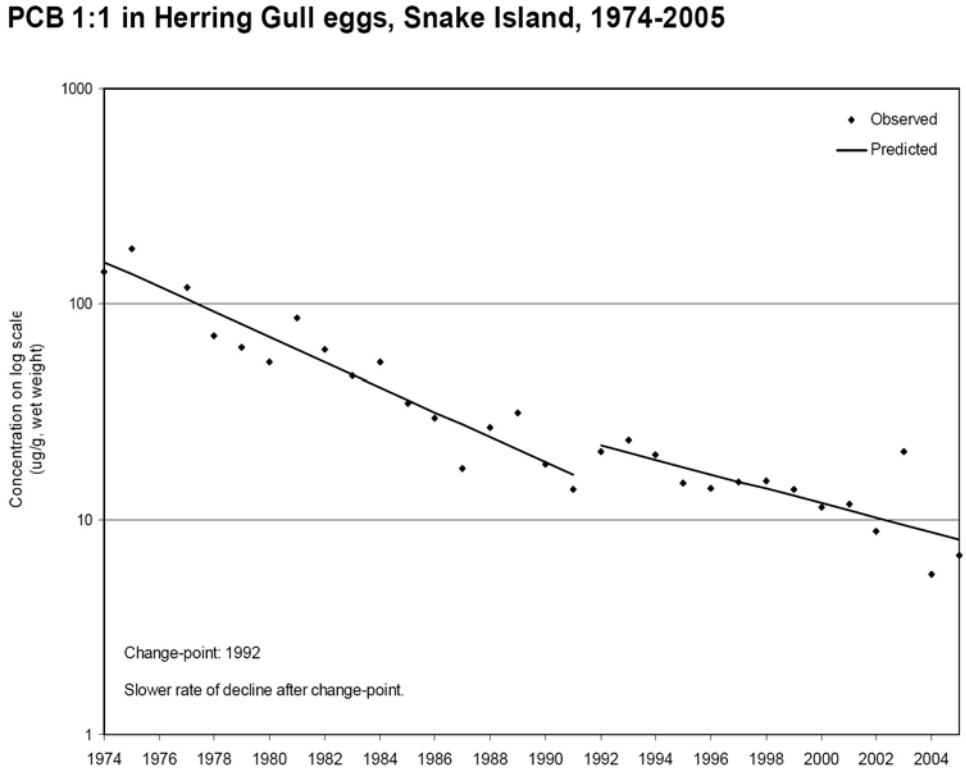


Figure 3.9 DDE Trends in Lake Ontario Herring Gull Eggs.

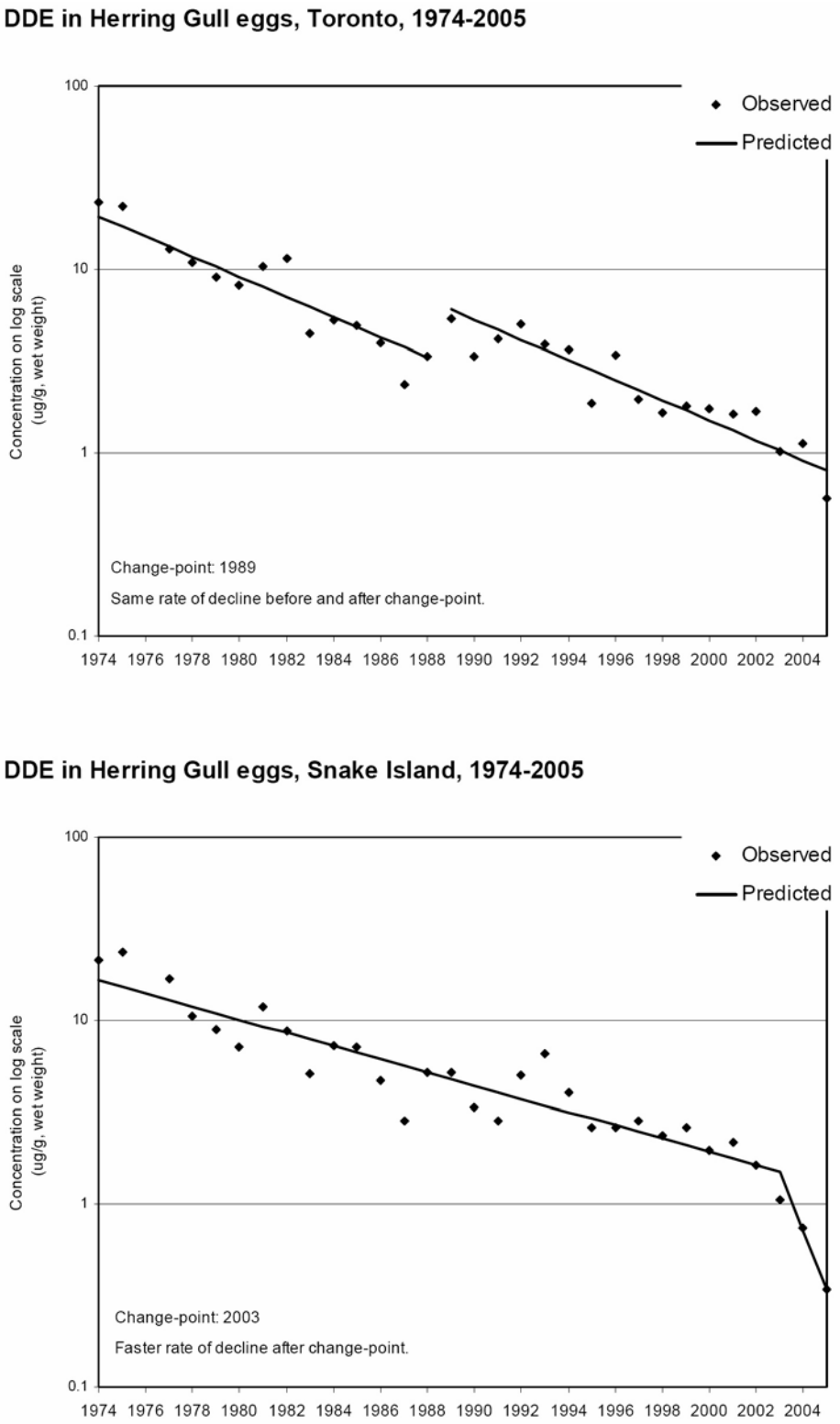
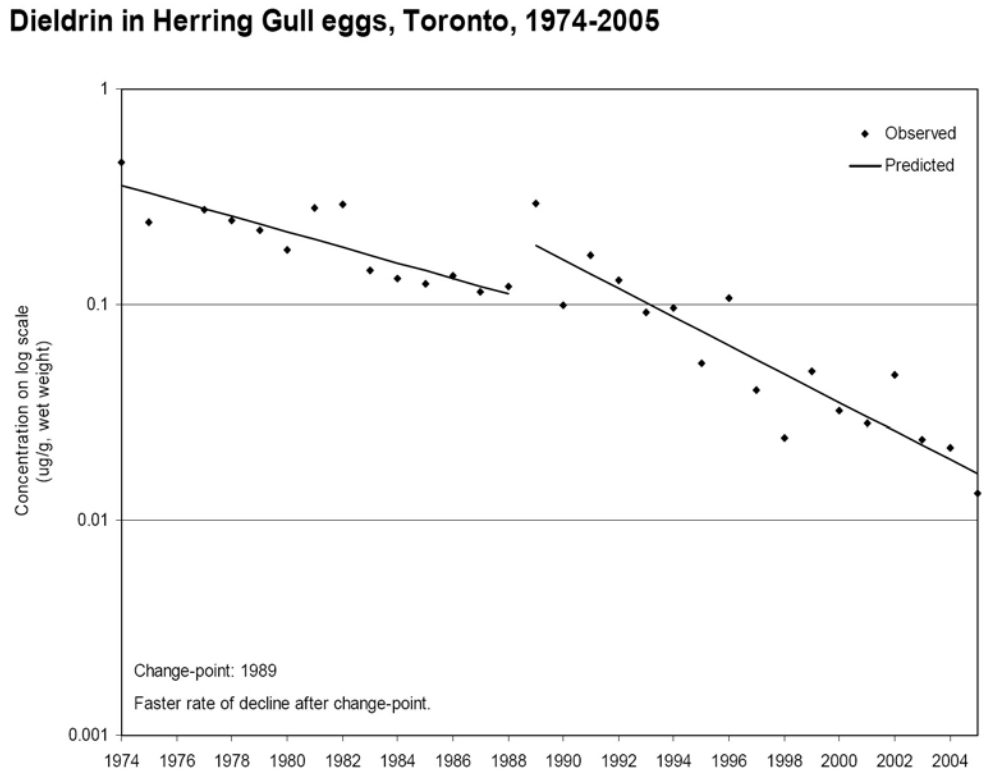


Figure 3.10 Dieldrin Trends in Lake Ontario Herring Gull Eggs.



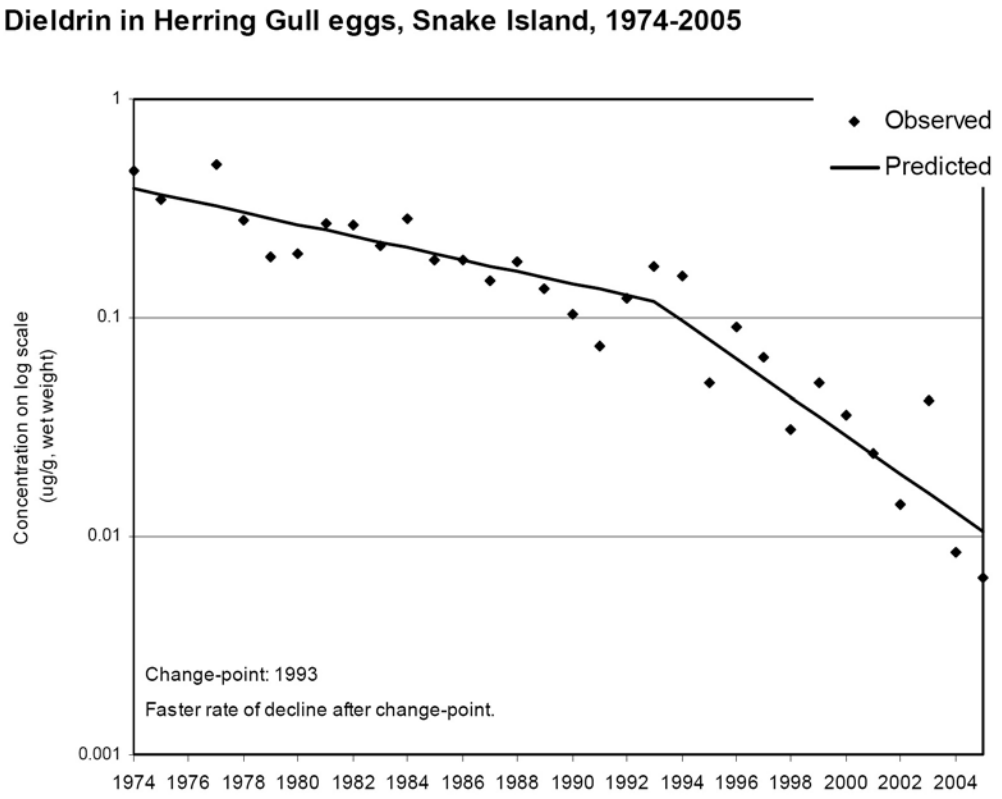
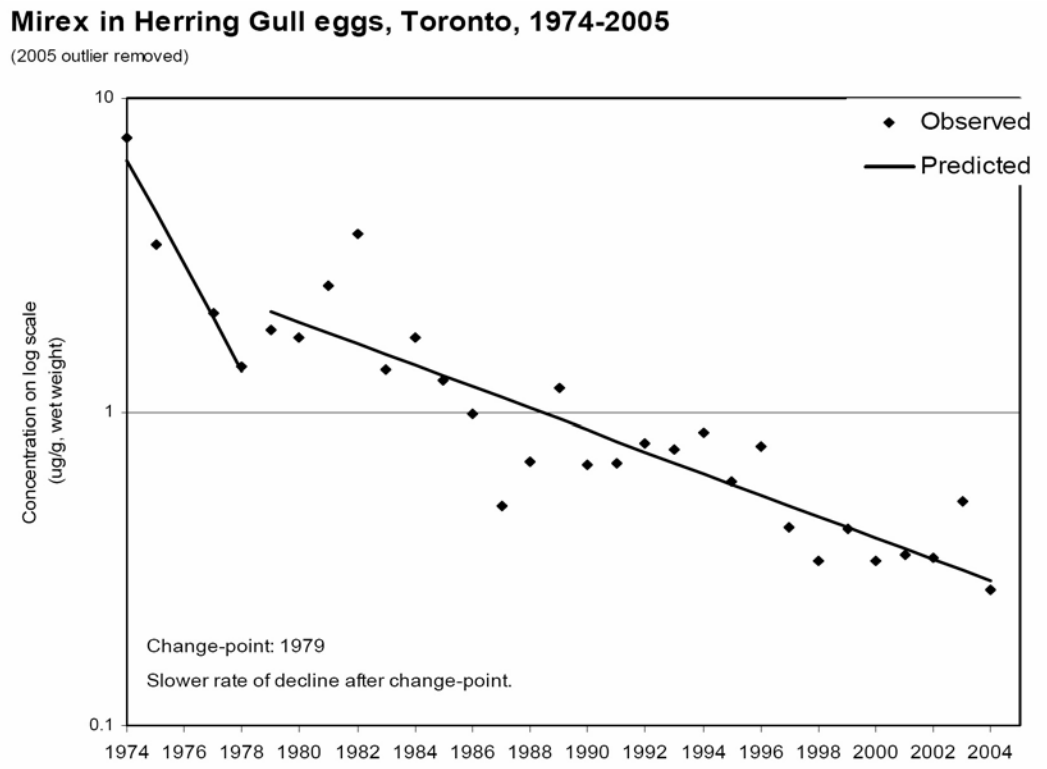


Figure 3.11 Mirex Trends in Lake Ontario Herring Gull Eggs.



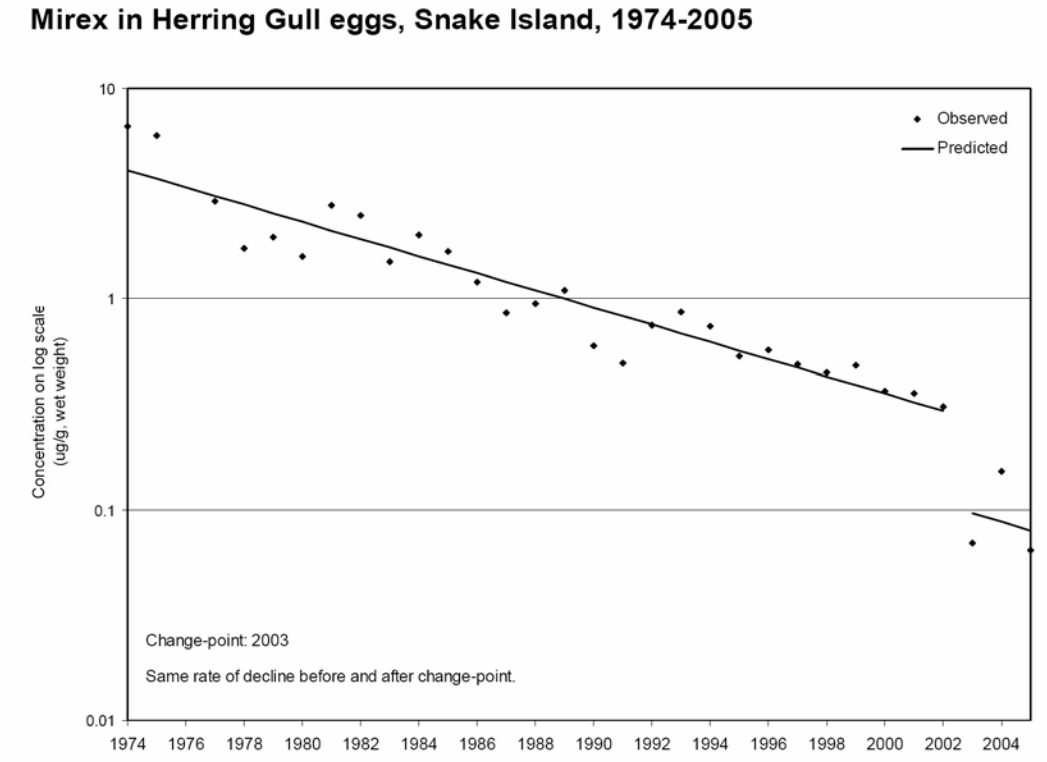
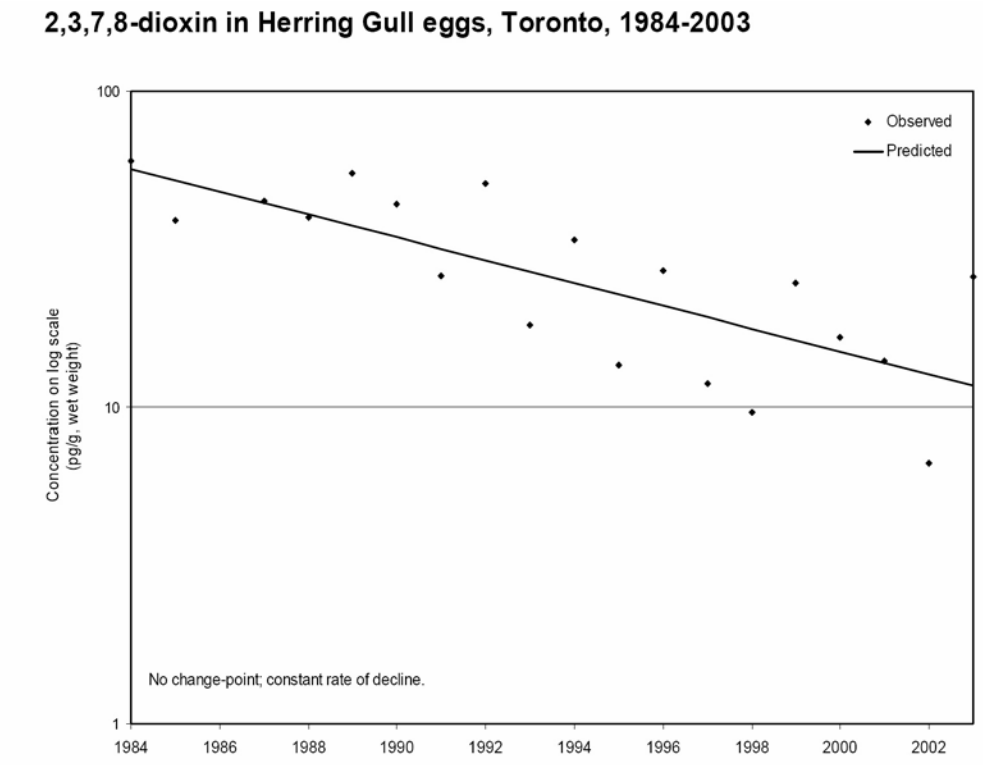


Figure 3.12 2,3,7,8-Dioxin Trends in Lake Ontario Herring Gull Eggs. Note that the vertical scale is logarithmic.



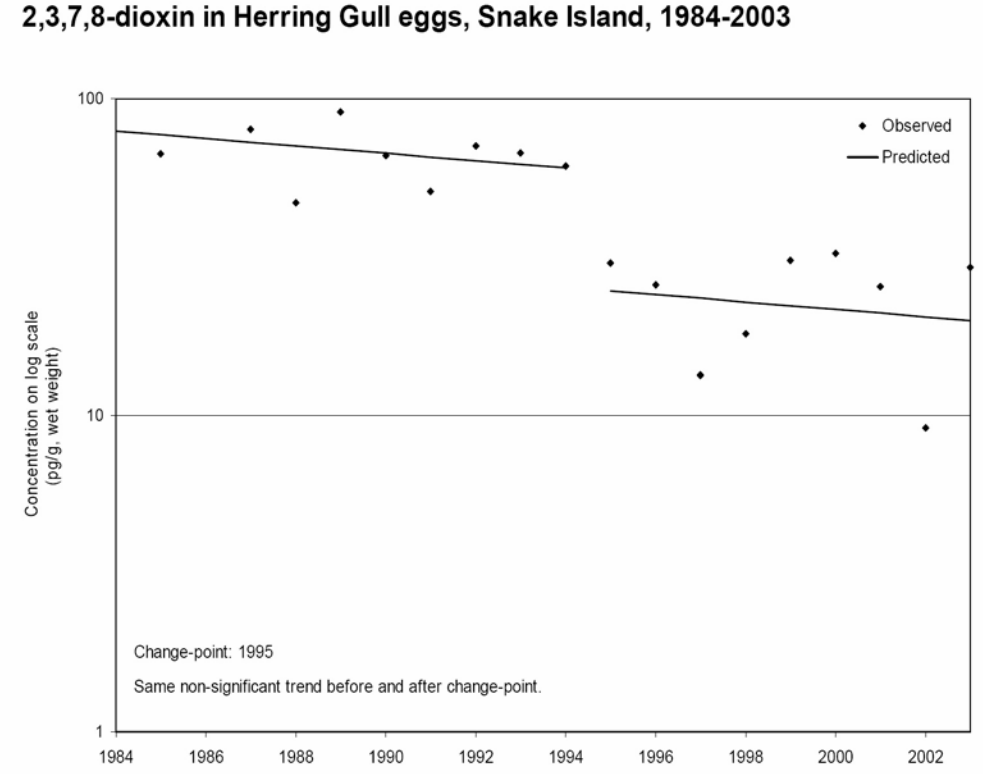


Figure 3.13 Mercury Trends in Lake Ontario Herring Gull Eggs, Toronto & Snake Island. Note that the vertical scale is logarithmic.

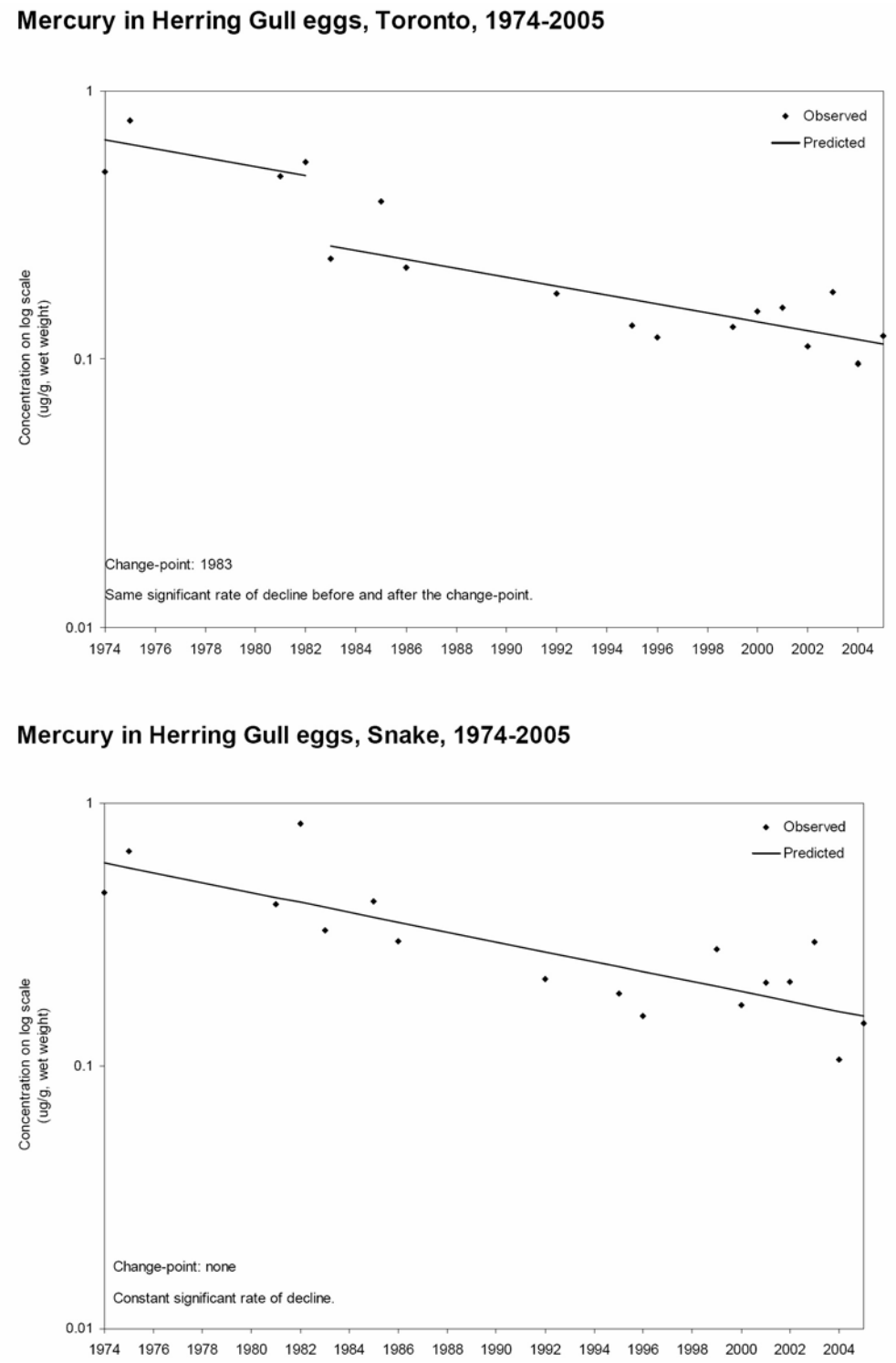
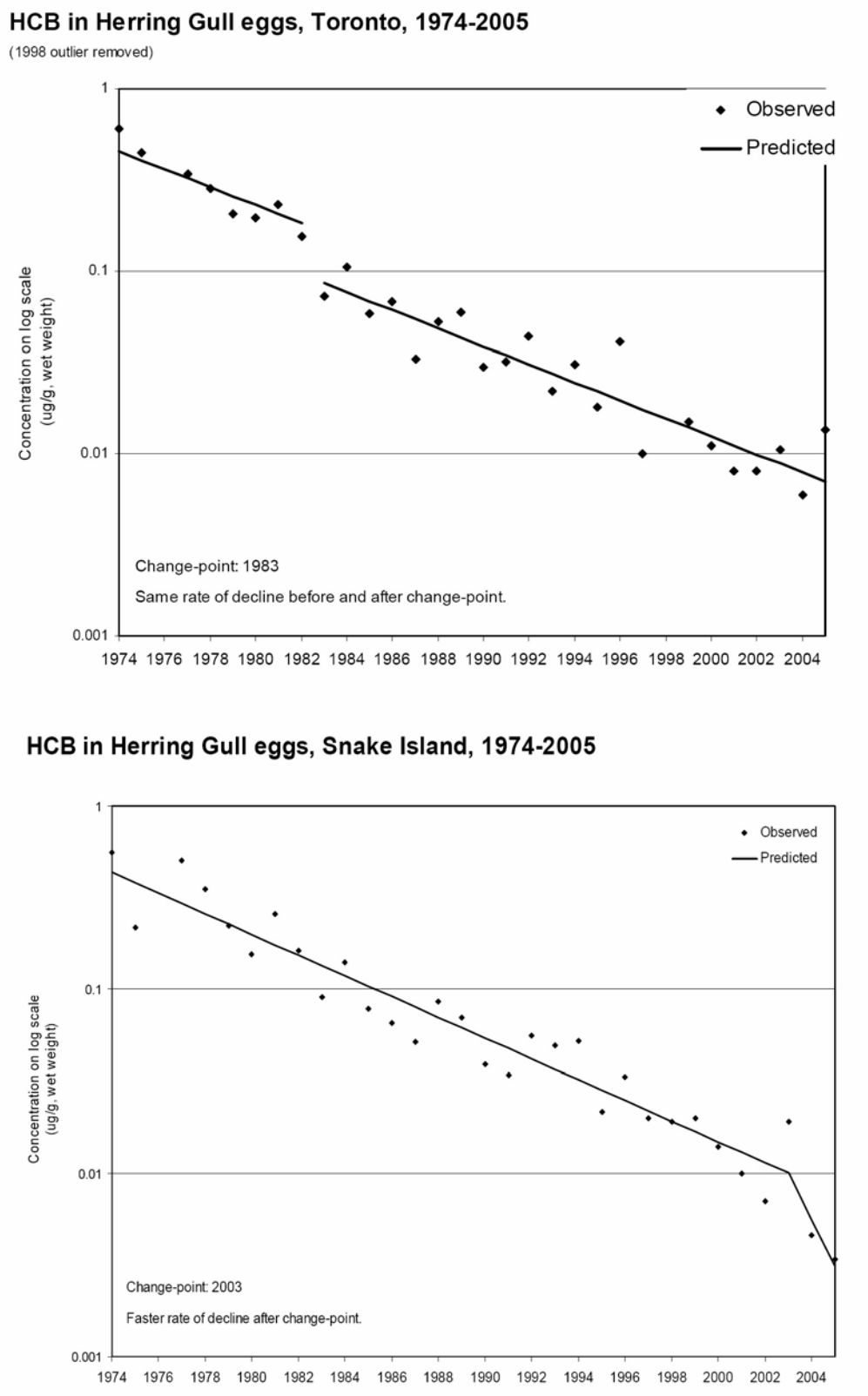


Figure 3.14 Hexachorobenzene (HCB) Trends in Lake Ontario Herring Gull Eggs. Note that the vertical scale is logarithmic.



3.3.2 Lower Foodweb Indicators

Lower food web indicators track the status of nutrients, zooplankton and prey fish (such as alewife and smelt). They reflect the ability of the ecosystem to support higher level organisms (such as lake trout and waterbirds). In Lake Ontario phosphorus levels have declined over the past 20 years, but this event has come at a time when demands for a salmonid sport fishery have increased, non-native species such as the alewife have exhibited highly variable population dynamics, pelagic zooplankton production has declined, oligotrophic fish stocks are recovering, and exotics such as the zebra mussel, quagga mussel and currently the predatory zooplankton *Cercopagis pengoi* have proliferated [13, 14, 15].

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.

Status: Concentration recommended to achieve the GLWQA target load for the lake has been met.

In response to binational phosphorus control programs, open lake phosphorus concentrations declined from a peak of about 25 μg/L in 1971 to the 10 μg/L concentration recommended to achieve the GLWQA target load to the lake by the mid 1980s [15, 16, 17]. Offshore phosphorus levels continued to decline through the 1990s and are now at approximately 5 – 7 μg/L (Fig 3.16) [16, 17].

Chlorophyll data from Environment Canada's Surveillance Program show that the trophic status of Lake Ontario has changed from a mesotrophic system in the 1970s and is now bordering on oligotrophy[18] (Figure 3.17). Monitoring in the summer of 2006 and beyond will assist in determining if this trend is continuing.

Water clarity, as measured by Secchi disc depth, has increased dramatically in Lake Ontario over time (Figure 3.18) [19]. Some of the improvement occurred concurrently with improved phosphorus discharge controls and the accompanying decline in nuisance algal biomass. However, the most dramatic changes in offshore waters have been apparent since about 1989, indicating that water clarity has increased due to the influence of zebra and quagga mussels filtering particles (including algae) from the water column.

Figure 3.15 Mean spring total phosphorus concentration in the open waters of Lake Ontario. Dashed line represents concentration recommended to achieve GLWQA target loads.

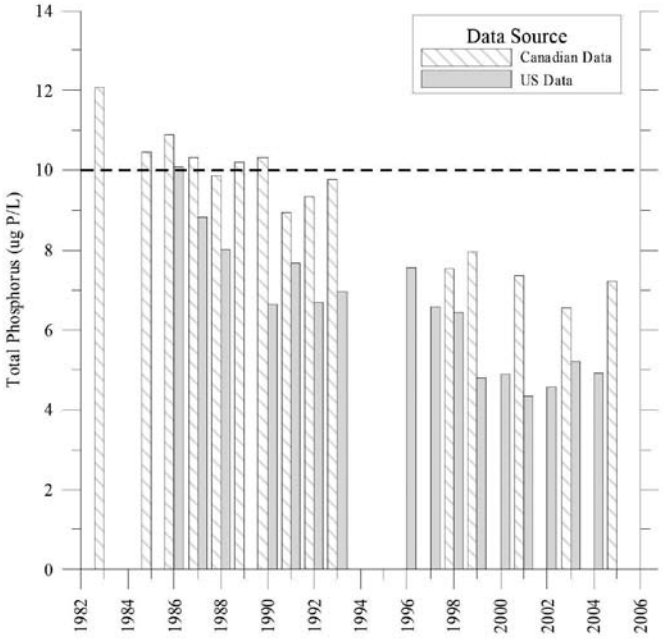


Figure 3.16 Corrected chlorophyll-a values in 0 – 20 m integrated samples, offshore waters (depth ≥ 100 m) in Lake Ontario, 1974 – 2003.

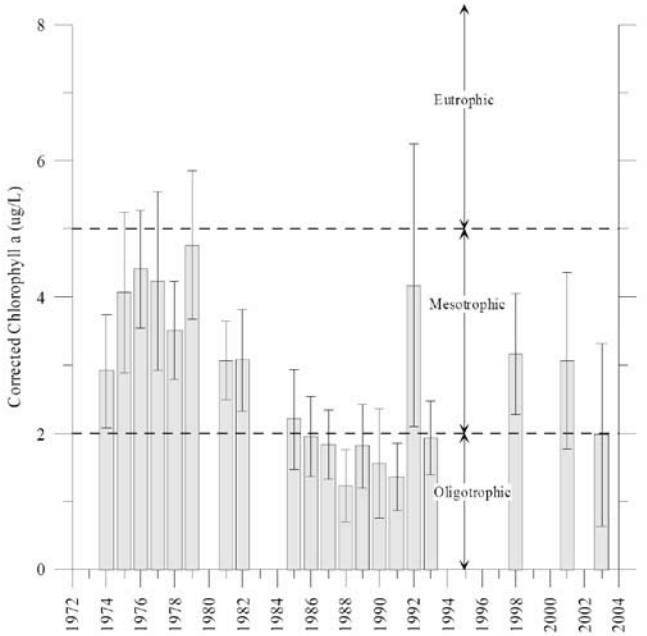
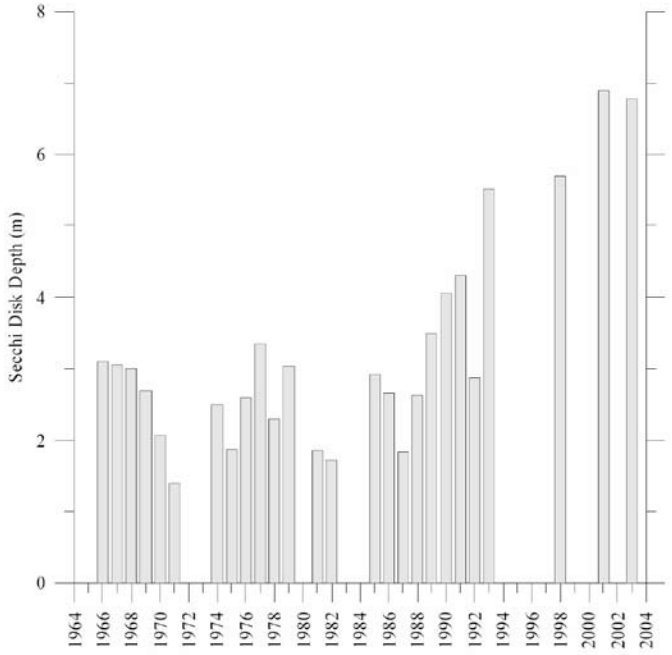


Figure 3.17 Summertime Secchi disc depths in Lake Ontario offshore waters (depth ≥ 100 m) 1966 – 2004.



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 millimeters (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

Status: 2004 mean offshore zooplankton body size was close to the target.

Mean zooplankton length can be used as an indicator of the balance between plankton eating fish and fish predators. Given the dependence of Lake Ontario adult alewife on zooplankton for food, the mean body size of offshore crustacean zooplankton of 0.74 mm, close to the 0.8 mm target, indicates that populations of predator fish are successfully controlling prey fish populations [20]. Mean body sizes much less than 0.8 mm, on the other hand, would indicate that there are insufficient numbers of predator fish to control prey fish populations [21].

Prey Fish

Objective: a diverse array of prey fish populations should be sufficient to support healthy, productive populations of predator fishes
Measures: abundance, age and size distribution of prey fish species (such as deepwater ciscoes, sculpins, lake herring, rainbow smelt and alewives)
Purpose: to directly measure the abundance and diversity of prey fish 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 food web, 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

Status: The prognosis is poor for Lake Ontario alewife and rainbow smelt populations, the mainstays of the offshore food web for most pelagic predators. This indicator may need to be updated as round gobies have expanded their range well into the offshore in association with quagga mussels and these fish are gaining importance as diet items for fish like lake trout.

The following overview of the status of Lake Ontario prey fish is based on the collaborative work of New York State, Ontario Ministry of Natural Resources and the U.S. Geological Survey [22]:

Alewife - The process of food web disruption, mediated by exotic species, may well have eroded lower trophic level support for the Lake Ontario alewife population to below that of the early 1990s. With the carrying capacity of the lake reduced, the alewife population at a low level and made up of a high proportion of fish ≥ age 5 (44%), and environmental conditions unfavorable for production of age-1 alewives, measures of adult alewife abundance are anticipated to be at, or below, 2004 levels through 2006.

Rainbow Smelt - The mean weight of rainbow smelt caught during the June 2004 survey decreased to 2.4 g (0.08 oz) from 3.9 g (0.14 oz) in June 2003, because yearling rainbow smelt (the youngest age group in the catch) dominated the catch in 2004. In 2005, the number of yearlings caught declined significantly perhaps signaling a return to alternating strong and weak year classes. The paucity of large rainbow smelt during 1989-2005 was most likely due to heavy predation and, more recently, several consecutive weak year classes. In all likelihood, any rise in rainbow smelt abundance will be short lived without a relaxation of predation pressure.

Slimy sculpin - Assessment of slimy sculpin was done with a modified trawl in 2005. When compared with 2003 results, the number per trawl declined except for the largest size group (130 mm). Distribution of these fish remained similar across recent sampling years. However, the change in gear type in 2005, warrants some caution in interpretation at least until a few more years are added to the data set.

Deepwater Sculpin - During the alewife assessment in April 2004, one deepwater sculpin was caught and released and in 2005, 17 of various sizes were caught but young small sculpin represented 7 of these fish. Prior to 1998, the last documented record of a deepwater sculpin being captured in U.S. waters of Lake Ontario was over 50 years ago. Although 2005 is only a single year of sampling, these numbers have created some excitement among agencies. In Canadian waters, 1 small deep water sculpin was caught.

Round Goby – This non-native species has been caught in US waters off of Olcott since 2002. This is not surprising as it has been found in near shore waters since about 1998 in the Bay of Quinte. However, it has spread to 130 m deep in just 3 years from 0 in 2002 to 69 per 10 minute trawl in 2005. This species is fast becoming an important diet item for lake trout35 and many other fish species.

Restoring Deepwater Cisco -Historically Lake Ontario's fishery was dominated by benthic fish such as the deepwater Cisco. These fisheries were lost at the turn of the century and this ecological niche has remained vacant ever since. The Lake Ontario Committee of the GLFC has initiated process to reintroduce deep water Cisco to Lake Ontario using existing stocks from Lake Superior. The Chippewa Ottawa Resource Authority has assisted the Lake Ontario Committee in collecting Lake Superior Cisco brood stock and rearing eggs/fry at their facilities. As well, young Ciscoes were transported and are being raised at the U.S. Geological Survey's Northern Appalachian Research Laboratory in Wellsboro, PA in order to create a captive brood stock to support restoration efforts and to conduct disease testing. Concerns over introducing EED (Epizootic Epitheliotrophic Disease) virus to Lake Ontario from Lake Superior will require extensive stress testing of juvenile fish prior to stocking, which could hamper restoration efforts.

3.3.3 Upper Foodweb Indicators

Upper food web indicators 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.

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 4,000 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. In addition, to reduce mortality, lamprey wounding should be no more than 2.0 A1 wounds per 100 lake trout over 433 mm.

Status: In 2005, only 2 of the 5 targets were met; the abundance of naturally produced lake trout is well below its target and adult numbers of both wild and stocked fish are declining.

The rehabilitation of lake trout populations is the focus of a major international effort in Lake Ontario. Coordinated through the Lake Ontario Committee of the Great Lakes Fishery Commission, representatives from New York State Department of Environmental Conservation (NYSDEC), United States Geological Survey (USGS), United States Fish and Wildlife Service (USFWS) and Ontario Ministry of Natural Resources (OMNR) developed the Joint Plan for Rehabilitation of Lake Trout in Lake Ontario[23, 24], identifying a goal, interim objectives, and strategies. The following assessment is based on their most recent progress reports [25, 34].

2005 data showed that the target of a harvest rate of less than 30,000 in each of Canadian and US waters was met. Lake trout harvest continued to decline in 2005 in both countries and is likely due in part to increased angling effort directed at Chinook salmon and declining numbers of lake trout particularly in eastern Lake Ontario. The rate of wounding by sea lampreys on lake trout caught in gill nets increased to more than the target level. This change in wounding rates may be attributable to either increased lamprey abundance or decreased lake trout density.

In 2005, no naturally produced lake trout yearlings were caught showing a break in the 11 consecutive years of wild yearlings. The number of wild age-2 fish also declined dramatically and the condition of adult lake trout also declined to an all time low.

It appears that changes in the offshore ecosystem have rendered the current lake trout restoration strategy ineffective. Accordingly, NYSDEC and OMNR are currently revising the Lake Ontario lake trout management plan. In addition to new restoration strategies/tactics, new indices for assessing performance may also be developed. For example, the establishment of dense lake bottom populations of quagga mussels has forced lake trout monitoring programs to change their bottom trawling methods. These changes will require the lake trout indicator measures and targets to be adjusted to better fit current monitoring programs. The Lake Ontario LaMP will review this document and consider how the current LaMP objectives reflect this new plan.

Herring Gull Populations

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)

Status: Mixed but encouraging. Contaminants do not appear to be limiting herring gull or other colonial bird populations.

Lake Ontario is home to nearly 1,000,000 colonially nesting water birds[26,31]. Biologists from the Canadian Wildlife Service, the Ontario Ministry of Natural Resources and the New York State Department of Environmental Conservation have completed 3 Lake Ontario-wide census of nesting colonial water birds, a survey that is conducted approximately once every 10 years. Although herring gulls are the selected LaMP waterbird indicator, this section also includes information on species of colonial waterbirds in order to provide additional information on waterbird issues. Lake Ontario-wide surveys were conducted in 1976-1977, 1990-1991 and 1998-1999 for 6 species of colonial water birds: double-crested cormorant, ring-billed gull, herring gull, great black-backed gulls, common tern and Caspian tern.[26, 31] Selected species are monitored more frequently; their recent numbers are discussed and updated below.

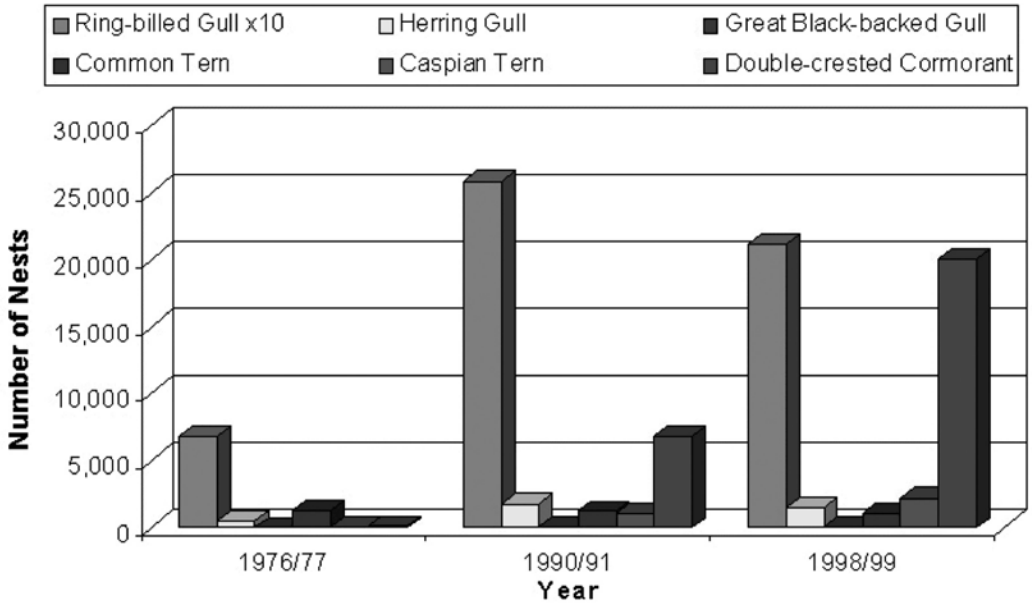
Herring Gull - The herring gull is the most widespread colonial waterbird nesting on the Great Lakes[26]. As a native non-migratory species that relies heavily on aquatic prey organisms, the herring gull serves as an excellent indicator species. From 1976/77 to 1990, the number of nests (=breeding pairs) of Herring Gulls on Lake Ontario increased from 522 to nearly 1800, a 242% increase. The number of nesting sites increased from 14 to 21. However, more recently, from 1990 to 2003, the number of breeding pairs decreased to approximately 1400 (when adjusted for uncensused sites), a decline of approximately 22%[26,31]. Declines in the numbers of breeding Herring Gulls have been most noticeable at sites where cormorants also nest. However, a cause and effect relationship has yet to be established.

Double-crested Cormorant – From 1977 to 1999 the Lake Ontario population of breeding cormorants increased from 96 pairs to over 20,000. In response to this increase and the cormorant's potential impacts to vegetation and co-occurring tree/shrub-nesting species, management actions were begun on Little Galloo Island (NY) in 1999 and at Presqu'Ile Provincial Park (ON) in 2003. These actions appear to have stabilized the number of nesting cormorants in the eastern basin of Lake Ontario (at approximately 9,000 pairs) and decreased it in the central basin to just over 5,000 26,31 (Fig. 3.21). However, the number of nesting pairs in Lake Ontario's western basin is now the greatest (9,000+ pairs) and appears to be still growing. Cormorants are reproducing very well.

Great black-backed Gull - Of the gulls and terns which commonly nest on Lake Ontario, the great black-backed gull is the least numerous. During the 1976-77 census, it was not found nesting anywhere on Lake Ontario. In 1990, a total of 15 nests were found on 3 sites and by 2004 this number had grown to 40 pairs. However, there was a severe botulism-induced die-off of various colonial waterbirds in Lake Ontario in the summer-fall of 2004 and several Lake Ontario-banded black-backed gulls were found dead. In the spring of 2005, the breeding numbers had declined to only 12 pairs.

The next Canadian Wildlife Service (CWS) Lake Ontario colonial waterbird population survey is planned for 2008.

Figure 3.18 Numbers of Gull, Tern and Cormorant Nests on Lake Ontario, 1976 – 1999.



Mink and River Otter

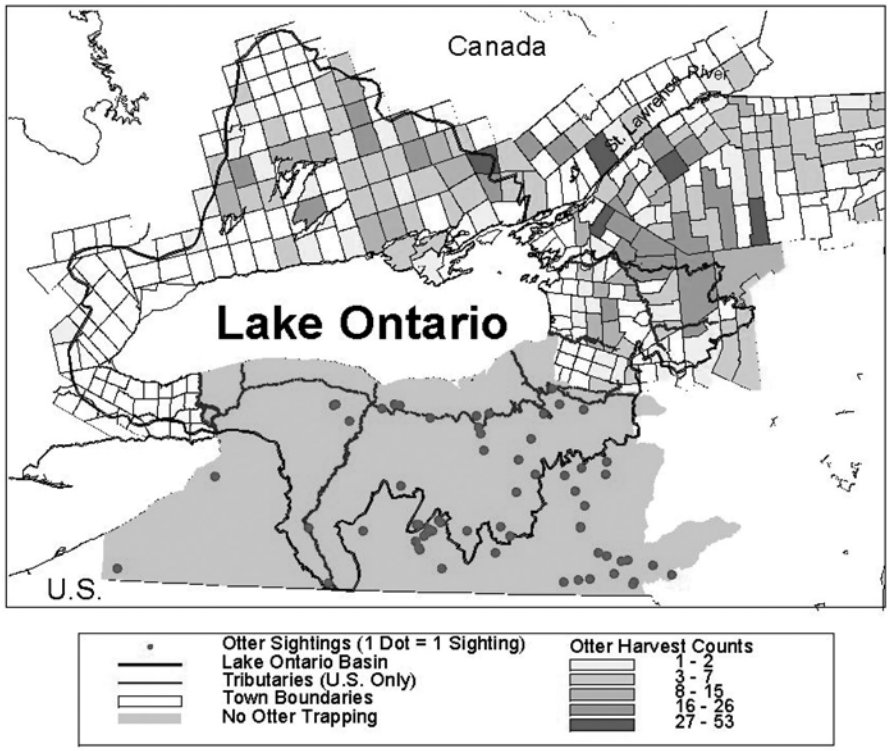
Objective: naturally reproducing populations of mink and river otter should be established throughout the Lake Ontario basin
Measure: number of tributaries and wetlands with established mink and river otter populations
Purpose: to evaluate mink and otter populations in the Lake Ontario basin
Target: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

Status: Sizeable populations of naturally reproducing mink and otter are present in the basin.

Mink and river otter are making a comeback in the Lake Ontario basin. Their populations were severely reduced in the 1800s due to habitat loss, water pollution and excessive trapping. Prior to these changes the river otter had the largest geographic range of any North American mammal. A review of trapping data showed that more than 5000 mink were trapped during the 1999-2000, harvest season. Although otter trapping is illegal in a large portion of the basin, over 1,200 otter were trapped in the remaining areas in the 1999-2000 season (Fig. 3.22). There were also a number of otter sightings in the portion of the Lake Ontario basin that is closed to otter trapping. The harvest counts found in the trapping records represent only a small percentage of the total populations of mink and otter in the Lake Ontario basin. This provides good evidence that significant numbers of these animals are present in the basin [32].

Mink are located throughout the basin and their populations are stable. River otter, found around the eastern end of Lake Ontario, in central Ontario and along the St. Lawrence River, are now moving into western and central New York as more and more abandoned agricultural land returns to natural conditions. Their expansion has been aided by initiatives like the New York River Otter project that released nearly 300 river otters at several locations in central and western New York.

Figure 3.19 Otter sightings and harvests in the Lake Ontario basin 1999-2000.



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 (defined as those less than 7 kilometers from the lake), 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 1 eaglet per nest or greater.

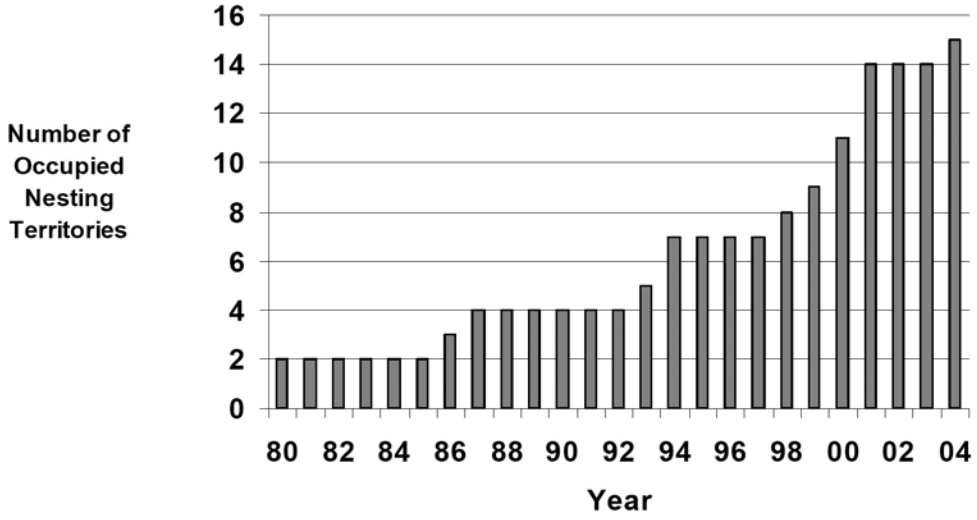
Status: The number of bald eagle nesting territories within the Lake Ontario basin continues to increase and the 2004 fledging rate was above the 1 eaglet per nest target.

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 active Bald Eagle nesting territories in the Lake Ontario basin. Two eagle nesting territories were artificially established in the basin during the 1980s through the introduction of adult eagles captured in Alaska. Since that time the number of nesting territories has steadily increased. There are now 15 established nesting territories in the basin including 1 shoreline nest[33] (Fig. 3.23). The 2004 average successful reproduction rates for these nests was ~1.5 eaglets per nesting attempt. A minimum reproduction rate of 1.0 eaglet per occupied nesting territory is generally believed to be necessary to maintain stable Bald Eagle populations.

Although good to excellent bald eagle nesting habitat exists along the eastern shoreline of the lake, there were until quite recently no shoreline or island nests. Then in 2000 the first shoreline nesting territory was established and has fledged 1 to 2 eaglets each year since. More eagles are expected to occupy shoreline nesting sites as their numbers steadily increase. Human disturbance has slowed the return of eagles to the shoreline. A few years ago a young hunter shot and killed the female of a Bald Eagle pair engaged in nest building behavior along the lake

shore west of Oswego, New York. Restoration of shoreline nesting territories will depend in part on protection of eagle nesting habitats and preventing further human disturbance. A binational eagle working group is developing specific eagle habitat conservation goals and objectives to be included in future reporting on this indicator.

Figure 3.20 Number of Occupied Bald Eagle Nesting Territories in the Lake Ontario basin.



3.4 Cooperative Monitoring Progress Towards Meeting LaMP Goals and Indicators

Having adopted ecosystem indicators, the LaMP has shifted attention 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.

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 are encouraged. The LaMP's cooperative monitoring approach has 3 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 is working 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 4 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. Additional information regarding U.S. and Canadian tributary monitoring and sediment sampling is provided in Chapter 6.

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 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 Ontario 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 impacted by equipment failure, staffing and budgetary cuts, and/or severe 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.

Much of the monitoring done in Lake Ontario would not be possible without the support of U.S. and Canadian research vessels. Cooperative monitoring projects in 2003 were supported by:

- ***Lake Guardian*** (180 ft / 54 m)
  U.S. EPA Great Lakes National Program Office
- ***Limnos*** (148 ft / 45 m)
  Canadian Coast Guard
- ***Great Lakes Guardian*** (45 ft / 14 m)
  Ontario Ministry of the Environment
- ***Lake Explorer*** (82 ft / 25 m)
  U.S. EPA Office of Research & Development

3.5 Cooperative Monitoring Projects

The Lake Ontario Lakewide Management Plan has coordinated a number of binational cooperative monitoring efforts to improve our understanding of the Lake Ontario ecosystem. In addition to promoting projects that address key LaMP information needs, emphasis has been placed on improving communication and data sharing between US and Canadian monitoring programs. Often the hardest part of this type of work is pulling together key researchers to interpret the data and to effectively communicate the "big picture" to stakeholders. This type of coordination and data synthesis takes time and effort and the LaMP is committed to making this happen.

In promoting cooperative monitoring the LaMP has broadened its base of partners to help support and strengthen existing efforts. For example, the LaMP's partnership with the Great Lakes Fishery Commission (GLFC) has brought together water quality and fishery managers. The LaMP and the GLFC have identified common information needs that helped guide the development of this year's projects. This may be the first step in developing a long-term binational strategy for Lake Ontario that meets the needs of both water quality and fishery managers.

Three major binational cooperative monitoring projects are summarized in the following sections.

3.5.1 Lake Ontario Atmospheric Deposition Study (LOADS)

Understanding Sources of Atmospheric Contaminants

Atmospheric deposition is one of the important sources of critical pollutants entering Lake Ontario. This project is developing a more detailed understanding of atmospheric deposition processes within the Lake Ontario basin. The results of this study will support the development of contaminant loading mass balance models that are being used to predict how changes in contaminant loadings will impact contaminant levels in fish tissue.

The partners involved in this study include:

Clarkson University
Environment Canada
EC Meteorological Services Canada
New York State Department of Environmental Conservation
Ontario Ministry of the Environment
U.S. EPA Region 2
U.S. EPA Region 5
U.S. EPA Great Lakes National Program Office
U.S. EPA Office of Research & Development
Fredonia College
State University of New York, Oswego
University of Michigan

PCBs, pesticides, dioxins/furans and mercury were measured in air and wet and dry precipitations samples collected from sampling platforms on land and on the lake. Lake water samples were also being collected during 3 cruises. This work will give the LaMP a better understanding of how contaminants enter and leave the lake via atmospheric processes.

Some of the major questions being addressed by this study include:

- How important are the amounts of contaminants entering the lake via atmospheric deposition compared to other sources, such as upstream lakes and in-basin tributaries?
- Does the nature of atmospheric contaminant deposition differ between land and lake sampling locations?
- How significant are urban sources of atmospheric contamination?

Some of the data from the study is now available and summarized in Chapter 6 of this LaMP Status Report.

3.5.2 Lake Ontario Lower Aquatic Food web Assessment (LOLA)

Understanding Changes in a Post-Zebra Mussel Food web

This project developed a better understanding of the changes that are occurring in Lake Ontario's lower aquatic food web and its ability to support fish populations. The introduction of exotic species such as zebra & quagga mussels has changed the way nutrients are cycled through Lake Ontario's food web impacting the productivity of fisheries and threatening efforts to restore naturally reproducing populations of native fish. The effects of recently introduced exotic zooplankton which may also negatively impact native zooplankton communities is not well understood. The LaMP recently listed 2 new lakewide impairments, degraded benthos and degraded nearshore phytoplankton, probably related to the disruption of the food web by zebra and quagga mussels. The LaMP and the GLFC both agree that the need for better information on the lower food web is a high priority.

Partners involved in this project included:

Great Lakes Fishery Commission
National Oceanic & Atmospheric Administration
Cornell University
U.S. EPA Great Lakes National Program Office
U.S. EPA Office of Research & Development, Duluth
University of Toronto
State Univ. of New York, Environmental Sciences & Forestry
Lake Ontario LaMP Parties (EC, EPA R2, OMOE, OMNR, DFO, NYSDEC, USFWS)

4 sampling cruises (April, August, September & October) were conducted with the assistance of U.S. EPA's vessel Lake Guardian and the Canadian Coast Guard's vessel Limnos. Approximately 30 stations per cruise were sampled along 4 north-south transects. Nutrient, phytoplankton, zooplankton, mysid (a type of freshwater shrimp) and benthic samples were collected in order to characterize the status of Lake Ontario's lower food web. The use of optical plankton counters, a new remote sensing technology, was also explored as a tool to collect information on the status of zooplankton communities. Data interpretation and report writing is being coordinated among U.S. and Canadian partners. Pre-zebra mussel lower aquatic food web surveys conducted in the 1980s will provided a historical point of comparison for these results.

Some of the questions that were addressed include:

- What types of organisms make-up the lower aquatic food web?
- Have exotic species had negative impacts on native benthic organisms and zooplankton?
- Can the lower aquatic food web continue to support existing recreational and sport fisheries?

The project's findings and recommendations are being used to guide the development of better coordination between US and Canadian monitoring programs. The final report is available on U.S. EPA GLNPO's website.

3.5.3 Interagency Laboratory Comparison Study

Understanding Differences in Analytical & Sampling Methods

Accurately measuring extremely low (i.e. parts per trillion) concentrations of critical pollutants is very difficult. The use of different sampling methods and laboratory techniques may provide different results for the same sample due to slight differences in the ability of various methods to capture and measure contaminants. This project was designed to give the LaMP a better understanding of how well the analytical results produced by U.S. and Canadian monitoring programs compare with each other and will allow the LaMP agencies to combine their data sets with confidence to better characterize the lakewide environmental conditions.

Partners involved in this project include:

Environment Canada
U.S. EPA Region 2
Ontario Ministry of the Environment
New York State Department of Environmental Conservation

Samples containing PCBs, pesticides and PAHs were carefully prepared in the lab and split 4 ways and analyzed by laboratories that perform analytical work for the LaMP. The results are now being carefully reviewed to identify any data comparability issues. Later stages of this study will include the collection and analysis of actual field samples at Niagara-on-the-Lake.

Some of the major questions to be addressed through this study include:

- How well do analytical results produced by U.S. and Canadian laboratories compare?
- Does the use of different sampling methods produce similar results?

3.6 Other Indicator Initiatives

Work is on-going to develop habitat indicators. In particular the Great Lakes Wetlands Consortium is involved in a number of studies that will hopefully lead to the development of a set of wetland habitat indicators. The use of walleye or other selected nearshore fish species indicators may also be considered as part of future LaMP indicator development work.

3.7 Actions and Progress

This 2006 Chapter update is the first time that the LaMP is reporting out on the status of its selected ecosystem indicators. Given the rapid rate of unanticipated changes occurring in response to the disruption of the lower aquatic food web by non-native invasive species, the relevance of these selected indicators and targets will need to be periodically re-evaluated. The development and use of the LaMP's ecosystem indicators has helped to demonstrate the need to maintain strong Lake Ontario monitoring programs. The status of these indicators will continue to be reported on in future LaMP reports and public meetings.

3.8 References

1. Luckey, F. & S. Litten, Bioaccumulative Contaminants in Lake Ontario Surface Water, 1999. 2005, U.S. Environmental Protection Agency, Region 2, 290 Broadway, NY, NY 10007. 39 pgs.

2. Williams, D.J. and M. L. O'Shea. Niagara River Toxics Management (NRTMP) Progress Report and Work Plan, June 2003. 45 pgs.

3. Great Lakes Binational Toxics Strategy Report, 2005

4. Preddice, T.L., S.J. Jackling, L.C. Skinner. Contaminants in Young-of-the-year Fish from Near-shore Areas of New York's Great Lakes Basin, 1997. December 2001. Bureau of Habitat, Division of Fish, Wildlife and Marine Resources, New York State Department of Environmental Conservation, Albany, NY.

5. US EPA Great Lakes National Program Lake Trout Contaminant Long Term Monitoring Program

6. Whittle, D.M., M.J. Keir, J. F. Gorrie & E. Murphy. 2004. State of the Lakes Indicators Report: SOLEC Indicator #121 - Contaminants in Whole Fish pp 128-138. http://www.solecregistration.ca/en/reports/default.asp

7. Ontario Ministry of the Environment Sportfish Monitoring Program

8. Jermyn-Gee, K., C. Pekarik, T. Havelka, G. Barrett and D.V. Weseloh. 2005. An atlas of contaminants in eggs of fish-eating colonial birds of the Great Lakes (1998-2001). Vols I and II. Canadian Wildlife Service Technical Report No. 417. Ontario Region, Downsview, Ontario.

9. Pekarik, C., D.V. Weseloh, G.C. Barrett, M. Simon, C.A. Bishop, and K.E. Pettit. 1998a. An atlas of contaminants in the eggs of fish-eating colonial birds of the Great Lakes (1993-1997): Volume I Accounts by Location. Canadian Wildlife Service. 321:pp.1 Technical Report Series.

10. Pekarik, C., D.V. Weseloh, G.C. Barrett, M. Simon, C.A. Bishop, and K.E. Pettit. 1998b. An atlas of contaminants in the eggs of fish-eating colonial birds of the Great Lakes (1993-1997): Volume II Accounts by Chemical. Canadian Wildlife Service. 322:pp.1 Technical Report Series.

11. Bishop, C.A., D.V. Weseloh, N.M. Burgess, J. Struger, R.J. Norstrom, R. Turle and K.A. Logan. 1992a. An atlas of contaminants in eggs of fish-eating colonial birds of the Great Lakes (1970-1988). Volume I. Accounts by species and locations. Technical Report Series No. 152, Canadian Wildlife Service, Ontario Region.

12. Bishop, C.A., D.V. Weseloh, N.M. Burgess, J. Struger, R.J.Norstrom, R. Turle and K.A. Logan. 1992b. An atlas of contaminants in eggs of fish-eating colonial birds of the Great Lakes (1970-1988). Volume II. Accounts by chemical. Technical Report Series No. 153, Canadian Wildlife Service, Ontario Region.

13. Christie, W.J., K.A. Scott, P.G. Sly, and R.H. Stus. 1987. Recent changes in the aquatic food web of eastern Lake Ontario. Can. J. Fish. Aquat. Sci. 44 (Suppl. 2):37-52.

14. EPA. 1993. Lake Ontario: An ecosystem in transition. Report of the Lake Ontario pelagic community health indicator committee. U.S. Environmental Protection Agency. Contract No. 68-W9-0003. 65p.

15. Stevens, R.J.J. and M.A. Neilson. 1987. Response of Lake Ontario to reductions in phosphorus load, 1967-82, Can. J. Fish Aquat. Sci. 44:2059-2068.

16. Dove, A. Personal communication. Environment Canada Surveillance Program data for Lake Ontario, yearly average spring total phosphorus levels, Ecosystem Health Division, Environment Canada.

17. Warren, G. Personal communication. Environmental Protection Agency data for Lake Ontario, yearly average spring total phosphorus levels, Great Lakes National Program Office, U.S. Environmental Protection Agency.

18. Dove, A. Personal communication. Environment Canada Surveillance Program data for Lake Ontario, yearly average summer corrected chlorophyll a concentrations (samples integrated from surface to 20 m depth), Ecosystem Health Division, Environment Canada.

19. Dove, A. Personal communication. Environment Canada Surveillance Program data for Lake Ontario, yearly average summer Secchi disc depth measurements, Ecosystem Health Division, Environment Canada.

20. E. L. Mills, J. P. Gillette, C. E. Hoffman, L.G. Rudstam, R. McCullough, D. Bishop, W. Pearsall, S. LaPan, B.Trometer, B. Lantry, R. O'Gorman, T. Schaner. 2005. 2004 Status of the Lake Ontario Ecosystem: A Biomonitoring Approach. In, 2004 Annual Report, Bureau of Fisheries, Lake Ontario Unit and St. Lawrence Unit to the Great Lakes Fishery Commission's Lake Ontario Committee, March 2005.

21. Rand, P. S., D. J. Stewart, B. F. Lantry, L. G. Rudstam, O. E. Johannsson, A. P. Goyke, S. B. Brandt, R. O'Gorman, and G. W. Eck. 1995. Effect of lake-wide planktivory by the pelagic community in Lakes Michigan and Ontario. Can. J. Fish. Aquat. Sci. 52: 1546-1563

22. R. O'Gorman, R. W. Owens, S. E. Prindle, J. V. Adams, T. Schaner. 2005. STATUS OF MAJOR PREY FISH STOCKS IN THE U.S. WATERS OF LAKE ONTARIO, 2004. In, 2004 Annual Report, Bureau of Fisheries, Lake Ontario Unit and St. Lawrence Unit to the Great Lakes Fishery Commission's Lake Ontario Committee, March 2005.

23. Schneider, C.P., D.P. Kolenosky, and D.B. Goldthwaite. 1983. A joint plan for the rehabilitation of lake trout in Lake Ontario. The Lake Trout Subcommittee of the Lake Ontario Committee, Great Lakes Fishery Commission. 50 pp.

24. Schneider, C.P., T. Schaner, S. Orsatti, S. Lary, D. Busch. 1997 Draft. A management strategy for Lake Ontario lake trout. Final draft, August 1997.

25. New York State Department of Environmental Conservation. 2006. 2005 Annual Report, Bureau of Fisheries, Lake Ontario Unit and St. Lawrence Unit to the Great Lakes Fishery Commission's Lake Ontario Committee, March 2006. .

26. Weseloh, D.V.C., R. Joos, C. Pekarik, J. Farquhar, J.L. Shutt, T. Havelka, I. Mazzocchi, G. Barrett, R. McCollough, R.L. Miller and A. Mathers. 2003. Long-term monitoring of Lake Ontario's nearly 1 million colonial waterbirds: Egg contaminants and breeding populations. In: Munawar, M. (ed.). State of Lake Ontario – Past, Present and Future. Ecovision World Monograph Series. Backhuys Publishers, Leiden, The Netherlands.

27. Blokpoel & Tessier. An Atlas of colonial waterbirds nesting on the Great Lakes 1991. Part 3. Cormorants, gulls and nesting terns on the lower Great Lakes system. Technical Report Series 225. Canadian Wildlife Service, Ontario Region.

28. Pekarik, C. and D.V. Weseloh. 1998. Organochlorine contaminants in Herring Gull eggs from the Great Lakes, 1974-1995: change-point regression analysis and short-term regression. Environ. Monit. Assess. 53: 77-115.

29. CWS, unpublished data.

30. Norstrom, R.J., M. Simon, J. Moisey, B. Wakeford, D.V.C. Weseloh. 2002. Geographic distribution (2000) and temporal trends (1981-2000) of brominated diphenyl ethers in Great Lakes Herring Gull eggs. Environmental Science and Technology 36:4783-4789.

31. Morris, R.D. and D.V. Weseloh and J.L. Shutt. 2003. Distribution and abundance of Herring Gull (*Larus argentatus*) pairs nesting on the North American Great Lakes. J Great Lakes Res. 29(3): 400-426.)

32. Bouvier, E. 2003. Mink and Otter as Ecosystem Indicators for the Lake Ontario LaMP, report prepared for U.S. Environmental Protection Agency, Communities & Ecosystems Protection Branch, Freshwater Protection Section, 290 Broadway, NY, NY.

33. Nye, P., 2004. New York State Bald Eagle Report 2004. Endangered Species Unit, Division of Fish,Wildlife & Marine Resources, New York State Department of Environmental Conservation. 625 Broadway, Albany, New York, 12233-4754. 26 pg.

34. Ontario Ministry of Natural Resources. 2006. Lake Ontario Fish Communities and Fisheries: 2005 Annual Report of the Lake Ontario Management Unit. Ontario Ministry of Natural Resources. Picton, Ontario, Canada.73 p.

35. Dietrich, J. P., B. J. Morrison and J. A. Hoyle. 2006. Alternative Ecological Pathways in the Eastern Lake Ontario Food Web — Round Goby in the Diet of Lake Trout. Journal of Great Lakes Research 32(2): in press.

36. Pagano, J., 2005. Personal Communication to U.S. EPA Region 2 on status of Clarkson University LOADs project.

37. Holsen, T. 2005, Personal Communication to U.S. EPA Region 2 on status of Clarkson University's LOADs project.

CHAPTER 5 HABITAT ASSESSMENT AND RESTORATION

5.1 Summary

This chapter provides an overview of the types of habitat in the Lake Ontario basin, status of the habitat, and the restoration and protection activities that have been completed or are still ongoing in the U.S. and Canada. The material presented is based on information that existed as of December 2007.

5.2 Habitat Types of the Lake Ontario Basin

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.

5.2.1 Habitat Zones and Foodwebs

Habitats that are critical to the health and functioning of 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 benthos (bottom-dwelling 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 sustain the cycle of material through the foodweb.

5.2.2 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, nutrient levels and the impact of shoreline development vary widely in this zone. 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.

The invasion of the zebra and quagga mussels has caused significant long-term ecosystem disruptions to the nearshore zone of Lake Ontario and the other Great Lakes. These mussels have re-engineered the flow of nutrients in the lake causing a "nearshore shunt" where nutrients are concentrated close to the shore. The result has been increases in growth of the nuisance algae, *Cladophora*, and other water quality effects. The longer term effects of these changes on fish habitat have yet to be fully realized.

5.2.3 Offshore Habitat

Temperature has 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. The mixing of offshore waters results in more uniform water quality when compared to the nearshore. Many fish species associated with the offshore rely on the nearshore zone or tributaries for spawning and nursery habitat for young.

5.2.4 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. Low water levels are thought to have lead to dominance by cattails and reduced diversity of other plant species. 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, excluding carp, 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 IJC has completed a five-year binational study of the effects of water level control on shipping, riparian property owners, boating and the environment. The IJC is currently evaluating the recommendations of the study and several possible new plans for water level control, including a plan that would increase water level variation and benefit wetlands, fish and wildlife habitat. The IJC is continuing government and public consultation before a new plan is selected.

5.2.5 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 to the Lake's aquatic ecosystem. 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 fish 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.

5.3 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. In areas of intense coastline urbanization, 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, diking, 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 Presqu'ile Bay and the Bay of Quinte in Ontario and 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.

Several Lake Ontario basin habitat assessments and inventories have been conducted by U.S. and Canadian governments over the last few decades.

On the U.S. side, the 24,720-square mile portion of the Lake Ontario basin, from the St. Lawrence River and including the Niagara River corridor, is diverse in fish and wildlife habitat. Along the shoreline are sand beaches, sand dunes, and wetlands including fens and coastal marshes, significant habitats for shorebirds, raptors, passerines, and waterfowl. Black terns and common terns nest and forage in the marshes. Sprinkled at the eastern end of the lake, alvars, which are areas of flat limestone bedrock where soils have been scraped away by ice, wind, and water, are habitats for grasses, wildflowers, mosses, lichens, stunted trees, and specialized birds and invertebrates. Upland are forests of oak, ash, white cedar, and hickory.

Habitats have been altered by physical, chemical, and biological changes. Sand transport mechanisms needed to nourish sand beaches, dunes, and coastal wetlands have been disrupted. Shoreline development has impacted terrestrial and aquatic habitats. Urban and agricultural runoff continue to impact tributary and nearshore habitats. Non-indigenous invasive species are replacing native species in both terrestrial and aquatic habitats. The reduced variation in lake levels under the current regulation regime has had a profound impact on shoreline habitats.

The current status of fish and wildlife habitats that takes into account natural resource values and threats is incomplete. Efforts are now underway to assess particular habitats by a number of agencies and organizations. The U.S. Fish and Wildlife Service is continuing to update endangered species, wetland inventory, and aquatic habitat information and inventories. New York State habitat status has been updated in New York State's Comprehensive Wildlife Conservation Strategy which identifies the species in greatest need of conservation, and also includes a full array of wildlife and related issues. The strategy identifies the species in greatest need of conservation; compiles information about those species and their habitats, threats to the species, population trends, conservation goals and objectives and recommends and prioritizes conservation actions. Regional bird conservation mapping being undertaken by Vermont University will help to characterize habitat used by songbird migrants. A binational biodiversity blueprint for the Great Lakes ecoregion has been completed and released by a team of partners including the Ontario Ministry of Natural Resources, Nature Conservancy of Canada and The Nature Conservancy. This blueprint provides guidance conservation action, and reflects the contributions of 200 other agencies and partner organizations throughout the basin. Local watersheds and partnerships, such as the Ontario Dunes Coalition, are conducting assessments of local natural resources and threats.

On the Canadian side, an assessment of the status of Canadian habitat in the Lake Ontario basin in the year 2000 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 (RAPs) 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.

5.4 Ongoing Work

Many habitat restoration and protection projects are underway in the Lake Ontario basin. The following information provides some highlights of the projects supported, in part, by federal, provincial, and state agencies as well as various county, conservation authority, municipal, and private organizations.

Over the last two decades, governmental regulations protecting lake-connected wetlands, shorelines, and littoral zones have significantly reduced the rate of loss of these valuable habitats. More attention is now being given to identifying the opportunities to restore and replace degraded or lost habitats.

5.4.1 Binational Activities

Binational Biodiversity Conservation Strategy for Lake Ontario

Lake Ontario is an ecosystem at a crossroads. On one hand, the lake still harbors significant biodiversity in its native fish, thriving populations of migratory birds, extensive coastal wetlands, and magnificent barrier beaches and dunes. On the other hand, it is threatened by hydrological alteration, nutrient enrichment, and continued invasive species introductions, which have vastly altered the food web.

The LaMP, in collaboration with 25 agencies, universities, and non-profit organizations in the U.S. and Canada is developing a binational roadmap to protect and restore Lake Ontario's biological diversity. This process, which is being facilitated by The Nature Conservancy and Nature Conservancy of Canada, will integrate the natural resource information and habitat priorities of Ontario and New York into a binational action agenda for Lake Ontario as a single ecosystem.

The end result will be a scientifically grounded, common vision of priority strategies that partner organizations can pursue. The process involves selecting important conservation targets, ranking threats to them, and then comparing the recommended strategies to the present actions of public and private partners. This process will enable us to identify gaps in conservation efforts that need to be filled through binational collaboration.

Three workshops have been held thus far, and the collaborators have made progress in many important areas.

During the first phase, a binational basin-wide dataset of species-at-risk, exemplary, threatened natural communities, and protected areas was assembled. Then, conservation targets were identified. Conservation targets are important species, natural communities, or ecological systems that serve as the focus for conservation analysis and planning. Eight ecosystem-level targets were selected for analysis and discussion:

- Open water ecosystems–the pelagic zone of the lake;
- The ecosystem of the lake's bottom in permanently cold waters;
- The nearshore waters that support submerged aquatic plants, and the fish, amphibians, and dabbling ducks that depend on these aquatic habitats;
- Coastal wetland ecosystems of the lake;
- Native fish, including lake trout, Atlantic salmon, lake sturgeon, American eel, and northern pike;
- Coastal terrestrial habitats, such as beaches, dunes, and eroding bluffs;
- Islands that serve as nesting habitat for birds such as the common tern; and
- Tributaries, estuaries, and connecting channels, including major inlet and outlet rivers of the lake.

Finally, the threats that endanger the conservation targets were identified and ranked. The top ranked threats included dams and barriers on tributaries; current aquatic invasive animals; future aquatic invasive animals; and incompatible residential and commercial development.

Other highly ranked threats included pollution from industrial, agricultural, and non-point sources; hydrologic alteration from water level regulation; and climate change.

The next steps will include a more detailed mapping analysis of the threats so that watersheds for conservation action can be prioritized. One major task will be to make the strategies as geographically specific and action-oriented as possible. Questions that need to be answered include:

- Which watersheds most need forested buffers around tributaries to reduce sediment run-off and restore natural flows?
- Which dams are blocking access to important habitat and can be removed or the effects mitigated with minimal environmental and economic impacts?

A second major task will be the identification of a suite of indicators to measure the success of conservation strategies and the status of threats. The objective will be to match the key attributes of the targets (i.e., the density of *Diporeia*, a native shrimp-like animal, as an indication of the status of the benthos) with the existing and future monitoring programs of natural resource organizations in the two countries. A "gap analysis" will compare the monitoring needs with existing monitoring efforts.

By engaging a binational network of partners in developing this action agenda, this project will enhance collaboration and integration of efforts toward achieving the habitat restoration goals of the LaMP.

Great Lakes Fishery Commission's Lake Ontario Committee

Fish population restoration activities are managed jointly by the natural resource agencies with jurisdiction for Lake Ontario and are coordinated through the Great Lakes Fishery Commission's Lake Ontario Committee. The Lake Ontario Committee includes agencies with primary responsibility for managing the fisheries: the Ontario Ministry of Natural Resources (MNR); and the New York State Department of Environmental Conservation (NYSDEC). The Lake Ontario Committee works closely with the federal agencies: the Canadian Department of Fisheries and Oceans (DFO), the U.S. Fish and Wildlife Service (USF&WS), and the U.S. Geological Survey (USGS). As prescribed in the Joint Strategic Plan for Great Lakes Fisheries Management, the Lake Ontario Committee has defined Fish Community Objectives for Lake Ontario. These Objectives

were developed following extensive expert and public consultation. The objectives define desired states for the fish communities of the nearshore zone, the offshore pelagic and the offshore benthic zones. The objectives sought to balance the demands of fishers within the constraints of the food web and in the context of changes to the Lake Ontario ecosystem. The Fish Community Objectives are being reviewed and updated this year.

The Fish Community Objectives do not have specific objectives for aquatic habitat. They do include long term directions for management actions such as fish stocking, commercial and recreational fisheries regulation, sea lamprey control, and habitat protection and rehabilitation. Habitat restoration and improvements in connectivity have been identified as key objectives in binational management plans being developed for restoration of Atlantic salmon, lake sturgeon, American eel and lake trout. Rather than define new environmental objectives that prescribe the habitat requirements for fish, the Lake Ontario Committee plans to use the Lake Ontario LaMP's Ecosystem Objectives (see Chapter 3 of the Lake Ontario LaMP Status Report) to define these habitat requirements.

Binational Marsh Monitoring Program

The binational Marsh Monitoring Program utilizes citizen volunteers to monitor coastal wetlands and their amphibian and marsh bird populations. It is a long-term monitoring program that coordinates the skills, interests and stewardship of hundreds of citizens across the Great Lakes basin to help understand, monitor and conserve the region's wetlands and their amphibian and bird inhabitants. Each spring, volunteers following a standard sampling procedure conduct surveys of marsh bird and amphibian populations and habitat in their local wetlands. To date, amphibians, marsh birds, or both have been surveyed on over 500 routes in the Great Lakes basin. This work has been done by more than 300 volunteers, contributing over 6000 hours of their collective time. Information gathered through the monitoring program will help guide the management and remediation of marshes in the Lake Ontario basin by serving the following objectives:

- monitor populations of marsh birds and amphibians over time on a variety of spatial scales;
- investigate habitat associations of marsh birds and amphibians;
- contribute to the assessment of Great Lakes Areas of Concern (AOCs) and other wetland conservation initiatives with respect to marsh bird and amphibian communities; and,
- increase awareness of marsh bird, amphibian and wetland conservation issues through volunteer participation and communication to the public, scientists and regulators.

5.4.2 U.S. Activities

Several New York State habitat restoration and protection projects are being conducted through the cooperative efforts of county, city, local, and private organizations as well as state and federal agencies. The New York State Open Space Conservation Plan provides a statewide process to identify and acquire undeveloped habitats. The state works in partnership with local governments, non-profit conservation organizations, and private landowners to establish and achieve land conservation goals. Funding for the program is provided by the state's Environmental Protection Fund and, where possible, leveraged by federal and other sources of funding. Ongoing habitat acquisition programs include: Salmon River Corridor, Northern Montezuma Wetlands, Genessee Greenway, and Eastern Lake Ontario shoreline.

The USEPA's Great Lakes National Program Office provides funding for a variety of Great Lakes habitat restoration projects. Projects have included, but are not limited to: wetland creation in the Lower Genessee River/Irondequoit Bay; barrier beach and wetlands habitat restoration on the Lake's shoreline; public education; creation of wildlife nesting habitat and exotic vegetation control at Deer Creek Marsh Wildlife Management Area; protection and restoration of Sandy Pond Peninsula and supporting efforts to protect and restore the bald eagle in the Lake Ontario basin.

There are many habitat restoration and protection projects currently underway in the U.S. Lake Ontario basin, by both government and private partners. While the list is very extensive, here are some examples of the type of work being done:

- A community-based conservation program to protect the wetlands, rivers, streams, and working forests of the Tug Hill region in New York has led to protection of over 45,000 acres within the 150,000 acre Tug Hill core forest. Combined efforts of New York State's Department of Environmental Conservation (NYDEC), Department of State, Tug Hill Commission, a timber investor, Tug Hill Tomorrow Land Trust, and The Nature Conservancy (TNC) have protected a large timber company tract, preserved a portion of the 45,000 acres as a conservation area, provided public access, and ensured sustainable forestry on a major portion of the land.

- Lake Sturgeon projects are ongoing. In the St. Lawrence River, New York Power Authority is investigating the creation of sturgeon spawning beds at the Iroquois Dam. USGS and the State University of New York College of Environmental Sciences and Forestry are currently doing a feasibility study on the viability of reintroducing Lake Sturgeon as a top benthic predator. The early history of the Genesee River, a major tributary to Lake Ontario, 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. An evaluation of lake sturgeon habitat by USGS and USFWS in the Genessee River has been completed. The final report verifies that the river provides good lake sturgeon juvenile habitat and the stocked juvenile lake sturgeon are successfully using the available nursery habitat. USGS plans to continue annual monitoring of the stocked lake sturgeon.

- 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 over 3,500 acres in the western Finger Lakes since 2000. 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. These two agencies are working in partnership with TNC, Ducks Unlimited, Audubon New York, and Friends of the Montezuma Wetlands Complex in protecting and restoring key parcels, and making Montezuma more accessible to the public. Montezuma is a laboratory for invasive species control, where 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. Portions of the streambank have been physically re-established and re-vegetated to reduce erosion and instream sedimentation from man-made disturbances.

- A coordinated Dune Steward Program for the beaches and dunes of eastern Lake Ontario is underway with funding from the DEC and support from New York Sea Grant, Oswego County, the Ontario Dune Coalition and The Nature Conservancy. This program has been extended to include stewards on the Salmon River corridor, and its focuses include restoration of beach and dune habitats, sensitive public access and engagement of the local community in conservation.

- Stewards have also worked with The Friends of Sandy Pond Beach, NY State Parks, DEC, private landowners, and TNC to restore about five acres of degraded dunes on four protected sites and two private sites with the rare native Champlain beachgrass. With advice and support from the U.S. Department of Agriculture, NY Natural Heritage Program, and the University of Vermont, The Friends expanded that effort with native material cultured by local farmers to supply local needs.

- Other efforts include development of an interactive dune education website, developed by NY Sea Grant and local school districts.

- The Dune Steward Program began in the Sandy Pond Beach Natural Area, where the DEC, the local community of Sandy Creek, and several NGO partners including TNC, the Ontario Dune Coalition, the Friends of Sandy Pond Beach have worked together to conserve highly significant dune and wetland habitats. Sandy Pond Beach Natural Area is part of the 17-mile beach-dune-lagoon ecosystem of the eastern shoreline of Lake Ontario, where 6,500 acres of land are protected in one state part, three DEC wildlife management areas, and three TNC preserves.

- The St. Lawrence-Eastern Lake Ontario PRISM (Partnership for Regional Invasive Species Management) is actively engaged in controlling the spread of swallowwort and other invasive species in the eastern Lake Ontario region. This PRISM is one of several such partnerships in place in New York under the auspices of the statewide Invasive Species Task Force.

- A partnership between the US Army Corps of Engineers and The Nature Conservancy, with further support from New York's Environmental Protection Fund, has investigated the dynamics of sand movement and coastal processes shaping the eastern Lake Ontario shoreline. This project contributed to the International Joint Commission's five-year study to develop a new regulation plan for Lake Ontario and the St. Lawrence River.

Great Lakes Regional Collaboration Habitat and Wetlands Initiative

The Great Lakes Regional Collaboration's December 2005 Strategy to Restore and Protect the Great Lakes committed to implement several near term actions that would address key habitat and wetland issues. These near term actions include a wetlands challenge to federal and non-federal partners to achieve a goal of protecting and restoring 200,000 acres of wetlands in the Great Lakes basin, improving coordination of Federal wetlands management programs, streamlining the wetland restoration permitting process and updating the national Wetlands Inventory.

At the same time, the U.S. Army Corps of Engineers initiated a 2 year, $1 million project to develop a Great Lakes Habitat Initiative (GLHI) that builds upon the habitat recommendations of the Great Lakes Regional Collaboration's December 2005 Strategy.

Moving toward implementation, the two initiatives share similar goals and are being merged into one overarching Habitat Initiative. The initial focus of the newly merged Habitat Initiative will be on accomplishing the wetlands challenge to protect and restore 200,000 acres in the Great Lakes basin.

A stakeholder forum that brings together partners will identify restoration projects, identify ways to implement restoration projects, explore ways to develop partnerships and overcome hurdles to project implementation. Databases are being developed which will include: information on more than 150 governmental and nongovernmental programs for funding habitat projects (Funding Programs Inventory); and over 200 potential, site-specific habitat projects entered by federal and non-Federal partners (Restoration Projects Database). Monitoring and tracking progress towards the 200,000 wetland restoration goal will also be done.

Since December 2005, an estimated 65,000 acres of wetlands have been protected, improved or restored by federal agencies working with partners.

5.4.3 Canadian Activities

The 2007 to 2010 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA) is the federal-provincial agreement, signed August, 2007, that supports the restoration and protection of the Great Lakes Basin Ecosystem. The Agreement between the governments of Canada and Ontario outlines how the two governments will cooperate and coordinate their efforts to restore, protect and conserve the Great Lakes basin ecosystem. It builds on the actions taken through previous agreements, and focuses priorities for future actions. The Agreement also contributes to meeting Canada's obligations under the Canada-United States Great Lakes Water Quality Agreement.

Key actions identified in the 2007 to 2010 COA agreement related to the restoration of Lake Ontario habitat include:

- Restoring and protecting fish and wildlife habitats and populations in the Hamilton Harbour, Toronto and Bay of Quinte Areas of Concern (AOC)
- Stewardship work with landowners, community groups and non-government organizations to protect, restore and promote sustainable use of land, water and aquatic resources throughout the Great Lakes Basin.
- Protecting and rehabilitating habitats, including coastal wetlands and Great Lakes Rivers.
- Protecting and restoring heritage fish and wildlife species such as Atlantic salmon, American eel, bald eagle, lake trout and lake sturgeon
- Lessening the threat of aquatic invasive species.
- Applying the new science to understanding the expected impact of climate change on Great Lakes waters, ecosystems and benefits.
- Applying new science to the understanding of habitat restoration activities.

In the Hamilton Harbour AOC, Fish and Wildlife restoration activities continue both in the Harbour and the watershed - with the key focus the restoration of the Cootes Paradise Marsh. Development of a Phosphorus model has provided a tool for the management of Cootes Paradise. The City of Hamilton and Municipality of Halton have developed a Natural Heritage Strategy. Fish and Wildlife Habitat Restoration Program has enhanced 340 ha of habitat at 6 sites in the Harbour. The RAP restoration target is 372 ha of habitat restored

at 9 sites within the AOC. Ongoing COA projects will mitigate the effects of low head weirs, establishing riparian buffers, improve instream habitat and reduce impacts of on-line ponds in tributaries to the Harbour.

Aquatic riparian habitat and conservation is addressed in the Toronto AOC through implementation of the Toronto and Region Conservation Authority's Toronto Waterfront Aquatic Habitat Restoration Strategy. In addition, the removal of barriers along the Rouge River from Lake Ontario to Major Mackenzie Drive for the passage of native fish species has been completed. Fisheries Management Plans have been developed for most of the AOC's watersheds. Work is underway to mitigated 10 barriers to fish movement in the upper Humber and Rouge River systems. In addition, work is underway to rehabilitate 10 hectares of wetlands in the headwaters of the Rouge and Humber watersheds and 2 hectares of coastal wetlands in the Rouge Marshes. An evaluation of the effectiveness of habitat rehabilitation along the Toronto waterfront will guide future restoration projects in the Great Lakes including Lake Ontario.

In the Bay of Quinte AOC, a Fish Habitat management plan and Natural Heritage studies have been completed for all coastal municipalities as well as Mohawk Tyendinaga Territory. A wildlife impairment strategy and a Fisheries Management Plan will be complete by March 2007. These plans will guide future restoration activities in the AOC. The Salmon River and Wilton Creek habitat stewardship projects has implemented over 50 stewardship plans with landowners to increase riparian vegetation and wildlife habitat around wetlands and stream banks.

Many lake wide restoration, conservation and protection projects are being implemented during this COA agreement. U.S. EPA and COA funded the development of a biodiversity conservation strategy for Lake Ontario and its watershed. This initiative brought all of the agencies and NGOs from both sides of the lake together to develop a consensus on biodiversity targets, threats and actions needed for biodiversity conservation in the Lake Ontario watershed. After the completion of this report, Ontario will be building on the strategy by developing a more detailed place-based action plan that will prioritized and guide conservation actions for the Canadian side of Lake Ontario.

Specific habitat conservation projects underway on the Canadian side include work to restore/protect habitat for native populations of Atlantic salmon, American eel, bald eagle and Lake Trout. Examples of these projects include:

- Improvements to steam habitats for Atlantic salmon such as mitigation of barriers to fish passage in the Credit River, tree planting and stream bank stabilization in Cobourg Brook and Duffin's Creek.
- Identification of barriers to eel and other fish species migration throughout the Lake Ontario watershed
- Identification and protection of high priority bald eagle nesting sites and establishment of eagle nesting platforms.

Canada's Great Lakes Wetlands Conservation Action Plan (GLWCAP) focuses on the conservation of coastal wetlands, developed a priority acquisition list for coastal wetland sites along the lower Great Lakes (Great Lakes Wetlands Conservation Action Plan, 1995a). Specific actions and priority areas for protection and rehabilitation were also identified along the entire Canadian shore of Lake Ontario (Great Lakes Wetlands Conservation Action Plan, 1995b). The GLWCAP is being implemented through a cooperative partnership between governments and non-governmental organizations in Canada. Wetland evaluations have been updated for coastal wetlands all along the Canadian shoreline of Lake Ontario. To promote protection of wetland resources these data are being tracked in the Natural Resources Values Inventory System and the Great Lakes Coastal Evaluated Wetlands Database. Analysis of these databases will provide updated estimates of wetland loss/gain across southern Ontario. Wetland creation and rehabilitation projects have been undertaken across the Canadian shoreline including Martindale Pond, Cootes Paradise, Stoney Creek, several sites along the Toronto waterfront (Ashbridges Bay, Bluffers Park, Chyester Springs, Colonel Sam Smith Park, Humber River Marsh, Highland Creek Wetland Complex, Keffer Marsh, Mimico Creek, Rouge River Marsh, Toronto Islands), Oshawa Second Marsh, Sawguin Creek Marsh, Little Cataraqui Marsh, Butternut Creek Swamp and Bayfield Bay Marsh.

Lake Ontario's aquatic biodiversity is at risk from aquatic invasive species (AIS). Currently, there are 185 AIS found in the Great Lakes causing problems such as food web disruptions, disease introduction, habitat alterations and declines in native diversity. Preventing the introduction of AIS is key to protecting aquatic resources, and one tool being used is risk assessment. Fisheries and Oceans Canada's Centre of Expertise for Aquatic Risk Assessment (CEARA) has developed tools to predict and assess the biological risk of potential AIS. By informing policy makers of future potential invaders and the vectors on which they may arrive, the opportunity to prevent their introduction is provided. Risk assessments have been completed for the Asian carps and northern snakehead, and work is ongoing to assess the risk associated with Chinese mitten crab and *Hemimysis anomala*. It is also important to monitor the distribution and spread of AIS and this work is being done for *H. anomala* by Canadian and American agencies. Research into the inter-lake movement of aquatic species as a pathway for secondary spread of AIS is also being studied. Results from this will be used to provide science advice on ballast treatment technologies for the Great Lakes shipping fleet.

5.5 Actions and Progress

The information contained in this chapter has been compiled based on documents produced up to December 2007. The LaMP process is a dynamic one and therefore the status will change as progress is made. This chapter will be updated in future LaMP reports as appropriate.

5.6 References

Busch, D.N., M. Lazaration, M. Smith, and M. Scharf. 1993. Inventory of Lake Ontario Aquatic Habitat Information. USF&WS, Lower Great Lakes Fishery Resources Office, Amherst New York, January 1993.

Ditman, D. E. and E.C. Zollweg. 2006. Assessment of habitat use by experimentally stocked juvenile lake sturgeon. Submitted to US EPA, GLNPO office.

Environment Canada, Ontario Region and the Federation of Ontario Naturalists. 182 pp. Hough Woodland Naylor Dance. 1995. Restoring Natural Habitats. Waterfront Regeneration Trust, Ontario.

Great Lakes Wetlands Conservation Action Plan. 1995a. Great Lakes Wetlands Land Securement Workshop. Final Report.

Great Lakes Wetlands Conservation Action Plan. 1995b. Priority Rehabilitation and Creation Sites for the Lower Great Lakes Including a Selected Site Registry for Coastal Wetlands of the Lower Great Lakes.

Hecky, R.E., R.E.H. Smith, D.R. Barton, S. J. Guilford, W.D. Taylor, M.N. Charlton, and T.Howell, 2004. The Nearshore phosphorus shunt: a consequence of ecosystem engineering by dreiseenids in the Laurentian Great Lakes. Can.J.Fish.Aquat.Sci. 61:1285-1293.

Lantry, B.F., T.H. Eckert, R. O'Gorman, and R.W. Owens, 2001. Lake trout rehabilitation in Lake Ontario, 2000. In NYSDEC 2000 Annual Report of the Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.

Luste, T. And M. Paley. 1996. A Guide to Great Lakes Shoreline Approvals in Ontario. Waterfront Regeneration Trust, Ontario.

Reid, R. 2001. Fish and Wildlife Habitat Status and Trends in the Canadian Watershed of Lake Ontario. Technical Report Series No. 364, Environment Canada, Canadian Wildlife Service- Ontario Region.

Schneider, C.P., D. P. Kolenosky, and D.B. Goldthwaite. 1983. A joint plan for the rehabilitation of lake trout in Lake Ontario. The Lake Trout Subcommittee of the Lake Ontario Committee, Great Lakes Fishery Commission. 50 p.

Stewart, T. J., R.E. Lange, S.D. Orsatti, C.P. Schneider, A. Mathers, and M.E. Daniels. 1999. Fish-community Objectives for Lake Ontario. Great Lakes Fishery Commission Spec. Pub. 99-1. 56 p.

Waterfront Regeneration Trust. 1995. Lake Ontario Greenway Strategy. Waterfront Regeneration Trust, Ontario.

Waterfront Regeneration Trust. Natural Heritage Workgroup. 1995. A Natural Heritage Strategy for the Lake Ontario Greenway. Waterfront Regeneration Trust, Ontario.

Waterfront Regeneration Trust. Shoreline Management Workgroup. 1996. Shore Management Opportunities for the Lake Ontario Greenway. Waterfront Regeneration Trust, Ontario.

Whillans, T.H., R.C. Smardon, and D. Busch. 1992. Status of Lake Ontario Wetlands, a working paper published by the Great Lakes Research Consortium, 24 Bray Hall, SUNY College of Environmental Science and Forestry, Syracuse, NY 13210.

CHAPTER 9 PUBLIC INVOLVEMENT AND COMMUNICATION

9.1 Summary

This chapter discusses the Public Involvement and Communication component of the Lake Ontario LaMP. It highlights the goals for public involvement and describes ways in which the LaMP implements these goals. The chapter focuses on the activities that have been conducted over the past ten years and lists contacts for further information.

9.2 Public Involvement Goals

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 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.

9.3 Meeting Public Involvement Goals

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. Public information and participation are encouraged. The LaMP provides information to the general public through the media, publications, the LaMP websites, and public meetings. Individuals can add their names to the LaMP mailing list for more regular contact.

The LaMP continues to reach out to many organizations each year, using displays and brochures to showcase its basin-wide activities. Public Involvement and Outreach activities constantly evolve based on the LaMP implementation activities going on around the lake. We hope that the outreach improvements presented here, enhance our efforts to reach out and we look forward to future changes and improvements.

The LaMP uses a variety of methods for communicating with and engaging the public. Some actions and initiatives are joint efforts; others are conducted by individual members.

9.3.1 Public Meetings

Beginning in 1996, the Lake Ontario LaMP held annual public meetings in conjunction with the Niagara River Toxics Management Plan to provide an update on activities throughout the year. These meetings alternated from Ontario to New York.

In 2004 the LaMP adopted a new two-phase approach for conducting public meetings. This new approach calls for a LaMP Overview meeting every three years, held in conjunction with the Niagara River Toxics Management Plan, to present a comprehensive overview of LaMP activities and status of the lake ecosystem's health. These meetings will continue to be held alternately in Ontario and New York.

The second phase includes theme-specific public meetings held in locations around the Lake Ontario basin. These meetings are held in an effort to reach a broader audience and involve more people in the protection and restoration of Lake Ontario. Each meeting not only provides an opportunity to report on specific activities focused on a particular theme, but allows the LaMP to engage the public in a dialogue about specific topics of interest (e.g., watershed stewardship, non-point source pollution control, and coastal wetland protection).

9.3.2 Publications

The Lake Ontario LaMP keeps partner agencies and the public informed through two key publications: (1) the biennial Status, and (2) the annual Update. A number of historical publications are also available for reference.

Stage 1 Report: The Stage 1 Report was released in May 1998 to meet the requirement under Annex 2 of the binational Great Lakes Water Quality Agreement (GLWQA) to report to the International Joint Commission (IJC) in stages. The first stage was described as the "Problem Definition" phase. A draft report was released in 1997 for public comment. The consultation period included Open Houses in both Canada and the United States, where agency staff made presentations and were available to answer questions. After adjustments were made to the report, based on input from the public, the report was transmitted to the IJC.

Biennial Report: The biennial report, also required under Annex 2 of the GLWQA, provides detailed information on the LaMP including: background, beneficial use impairments, sources, and loadings of critical pollutants, and ecosystem goals, objectives and indicators. In addition, it reviews habitat restoration, human health considerations, and emerging issues. The full five-year LaMP workplan is included in this document.

The LaMP reporting schedule is mandated by the Great Lakes Binational Executive Committee (BEC), which is the group of senior government representatives to the GLWQA. In June 1999, the BEC implemented a new biennial reporting process and cycle for the LaMPs. The intent was to accelerate time frames, to emphasize action over planning and to streamline the review and approval process for the LaMPs. The date for the biennial release of the LaMP reports was set by the BEC and linked to Earth Week. The first progress report for the Lake Ontario LaMP was released April 2002.

Beginning in 2004, the BEC requested that all LaMPs use a "virtual binder" format for reporting all technical and workplan information. The Lake Ontario LaMP adopted the new format and changed the title of the report to LaMP Status {year}.

The LaMP Status 2004 amalgamated existing information from previous LaMP reports, and provides some updates to longer-term, on-going activities. The new format used the Stage 1 report of 1998 as its base, along with other reports which were prepared up to 2003.

The new binder is considered a living document for partner-agency use, and will be updated regularly and submitted to the International Joint Commission every two years. Copies of the LaMP Status 2004 were distributed to agency partners and the IJC on Earth Day, April 22, 2004.

Highlights Brochure: In 2002, the LaMP produced a brochure as a companion to the biennial report. The format was discontinued when the format of the biennial report changed.

Brochure: The LaMP brochure is a full colour tri-fold publication, produced in 1999 as a way of providing a general description of the Plan and to encourage public participation.

Updates: The Lake Ontario LaMP Update is a newsletter-style publication that provides highlights on each year's activities to the public. The first Update was released in 1999, providing information on projects and progress. Update was mailed to contacts on the mailing list, distributed at the annual Lake Ontario LaMP/ NRTMP public meeting, and posted on the website. Updates were produced semi-annually in years when the biennial report was not produced (2001, and 2003). The LaMP decided to issue Updates annually, beginning in 2003, when the format of the biennial report changed, and the Highlights brochure was discontinued,

9.3.3 Websites

In 1998, the Four Parties created a binational Lake Ontario LaMP website, accessible from either the US Environmental Protection Agency's website or from Environment Canada's site. Since then, the site has been moved to a binational site - a collaborative website which includes information on programs that are binational in nature. The LaMP 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. The site can be accessed at www.binational.net.

LaMP reports continue to be available through the US Environmental Protection Agency's Great Lakes Information Network at www.epa.gov/glnpo/lakeont. Both of these websites can also be accessed from the LaMP page on the Ontario Ministry of the Environment's website: www.ene.gov.on.ca .

9.3.4 Media events

There were no media events in 2004/ 2005. EPA prepared and disseminated a media advisory to the Western New York news media inviting them to attend and cover the joint Niagara River/Lake Ontario LaMP public meeting at Grand Island, NY on Wednesday October 24, 2007. Mike Desmond WNED - AM (NPR) Radio-Buffalo, NY; Aaron Besecker - Buffalo News and Daniel Miner with the Niagara Gazette attended and covered the meeting for their respective media outlets.

9.3.5 Special projects

a. Stewardship Poster

From time to time individual LaMP partners identify their own particular communications needs and work alone or with other partner agencies to develop communications products and initiatives.

In 2003, the LaMP enhanced its focus on stewardship, encouraging people to be responsible for actions that might have an effect on the health of the lake. To support that goal, on the Canadian side of the basin, the governments of Canada and Ontario produced a Lake Ontario poster targeted toward Grade 7 and 8 students and teachers.

The front of the poster boasts an attractive graphic of the Canadian side of the Lake Ontario basin. The back of the poster features nine panels with tips on how students (and their families) can take action to help protect the lake: in the home, in the yard, at the cottage, on the farm, on the street, and in the community. The poster provides a list of websites for more information on environmental protection.

The posters were distributed to all 1,500 schools and 400 libraries on the Canadian side of the basin with the intention that teachers could use these resources in their lesson plans. The poster can be found on Environment Canada's website www.on.ec.gc.ca/pollution/fpd/fsheets/intro-e.html (English); www.on.ec.gc.ca/pollution/fpd/fsheets/intro-f.html (French).

b. Ecogallery

Building on the theme of stewardship, the Ontario Ministry of the Environment led an initiative to develop a temporary exhibit on the Lake Ontario ecosystem at the Marine Museum of the Great Lakes in Kingston, Ontario. The exhibit was created through an innovative partnership between the Ministry of the Environment, the Marine Museum, and the Community Foundation of Greater Kingston, and with the cooperation of Environment Canada. The two-year exhibit, opened Earth Day, April 22, 2004.

The displays review the environmental history of Lake Ontario, outline the Lake Ontario LaMP, and promote individual actions in protecting the environment. While the exhibit appeals to a broad audience, the primary focus is on young people, and includes a strong interactive component. This exhibit represents a unique, creative partnership between the LaMP and local community groups that are committed to environmental education and stewardship.

In 2007 Ministry of the Environment reconnected with the Marine Museum to explore the possibility of future partnership in reinstalling the Lake Ontario "Ecogallery". The museum is going to research options and will contact the ministry at a later date.

c. Enlightening Educators on LaMPs

In 2002-2003, the New York Sea Grant developed a series of training kits for educators in coastal communities bordering both Lake Erie and Lake Ontario. Referred to as "Enlightening Educators on LaMPs," the project provides information about the problems facing the Great Lakes. The goal is to help increase educator awareness of what students can do to help restore the ecological health of the ecosystem, and support the priorities of the LaMP. The project involved multiple educational outreach activities including the development of a Lake Erie and Lake Ontario LaMP educational compendium; a CD-ROM presentation on LaMPs for teachers; and a series of training workshops for teachers, non-formal educators, and stakeholders. The package incorporated Lake Ontario LaMP public information materials.

9.3.6 Speaking Engagements

The LaMP reaches out to individuals and groups that are already involved and working to conserve and restore Lake Ontario, either by attending their meetings, or inviting them to speak at LaMP meetings, or by mailing information to these groups or their members.

9.3.7 LaMP Display

The LaMP has two displays, a 10-foot "pop-up" and a smaller table-top display unit. The display is used at symposiums, fairs, forums and other events throughout the Lake Ontario basin as a means of informing the public about the LaMP.

USEPA has the current LO displays: a 10' pop-up display as well as a table top version which are housed at its Western New York Public Information Office in Buffalo, NY.

The displays were used at the following activities during the past two-years:

- Lake Ontario Ordnance Works Restoration Advisory Board Open House at the
- Lewiston, NY Senior Center on October 18, 2006. 400 Stakeholders inspected the tabletop display.
- US Fish and Wildlife Service Fishing Derby/Environmental Field Day, Niagara Falls, NY - Hyde Park Saturday, June 2, 2007. Two thousand stakeholders inspected the tabletop display
- Niagara River/Lake Ontario LaMP Public Meeting - Grand Island Holiday Inn resort and Conference Center October 24, 2007. Eighty stakeholders inspected the 10' popup display

9.3.8 Information Distribution

The LaMP maintains a mailing network and responds to requests for input and comments on Lake Ontario LaMP documents.

Environment Canada maintains a mailing list of over 500 Canadian stakeholders who have a personal or professional interest in the Lake Ontario LaMP. A similar list of 1100 American stakeholders is maintained by U.S. Environmental Protection Agency. These lists are updated regularly, and new members are added either through the Contact Us page on Binational.Net or by the contact people.

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.

9.4 Information Connections

If you would like to receive information regarding the Lake Ontario LaMP, please contact one of the names below.

In Canada:
Mrs. Pamela Finlayson
Environment Canada
4905 Dufferin St.
Toronto ON M3H 5T4
Phone: (416) 739-5996
Fax: (416) 739-4804
Email: pamela.finlayson@ec.gc.ca

In the United States:
Mr. Mike Basile
US Environmental Protection Agency
Western New York Public Information Office
186 Exchange St.
Buffalo NY 14204
Phone: (716) 551-4410
Fax: (716) 551-4416
E-mail: Basile.Michael@epa.gov

9.5 Actions and Progress

On October 24, 2007 the LaMP hosted a joint public meeting with the Niagara River Toxics Management Plan. The meeting was held in Grand Island, New York. The focus of the meeting was progress on the NRTMP, with a brief overview of the work of the LaMP. About 30 members of the general public attended. There were three media outlets present, including the Buffalo News, National Public Radio, and the Niagara Falls Review.

In June 2005 the LaMP hosted a public information session at the Marine Museum of the Great Lakes in Kingston, Ontario. The meeting was timed to coincide with the International Joint Commission's (IJC) Biennial Meeting. The theme topic of the meeting was stewardship. A presentation on the LaMP was followed by presentations from the {Canadian} Centre for Sustainable Watersheds and the {New York} Finger Lakes - Lake Ontario Watershed Protection Alliance to share their approaches to stewardship. An opportunity for public discussion followed the presentations. The LaMP will plan future public meetings for other areas around the basin.

The LaMP continues to pursue the goal of participating at other agencies' meetings and conferences. In 2004, the LaMP had material available at the SOLEC Conference in Toronto. The LaMP continues to pursue the goal of participating at other agencies' meetings and conferences. In 2006, the LaMP had material available at the SOLEC Conference in Milwaukee and the plan is to participate in a like fashion at SOLEC 2008 to be held in Niagara Falls, Ontario in October.

The LaMP also regularly participates at the International Joint Commission Biennial Meeting. In June 2005, materials were made available in the display area at Queen's University in Kingston, Ontario. The LaMP will continue to explore opportunities to participate in relevant meetings and events around the Lake Ontario basin, including IJC Biennial Meetings, SOLEC, etc.

The LaMP will continue to seek opportunities to partner with other organizations around the Lake Ontario basin in order to share information and expand its outreach activities.

9.6 References

No references were identified for inclusion in this section.

CHAPTER 11 SUMMARY OF AREA OF CONCERN STATUS

11.1 Summary

There are nine Areas of Concern (AOCs) identified around Lake Ontario. Two of these AOCs are binational and are located at the inlet (Niagara River) and outlet (St. Lawrence River). For each AOC, a Remedial Action Plan (RAP) has been developed and is being implemented. The table lists the status of the fourteen use impairment indicators developed by the International Joint Commission (IJC) to assess beneficial uses in the Areas of Concern. This chapter provides a summary of progress as of January 2008.

11.2 Background and Current Status

Use impairment indicators have been applied in the Lake Ontario Lakewide Management Plan to assess lakewide beneficial uses. In addition to lakewide impairments, the AOCs served to identify problems found in localized nearshore areas, embayments, and tributaries watersheds. This is not surprising as industrial and municipal contamination can become concentrated at the mouths of rivers or harbors. Remedial Action Plans (RAPs) serve as the primary mechanism for addressing these localized contaminant problems and other issues unrelated to lakewide impairments. Table 11-1 summarizes the status of these beneficial use impairment (BUI) indicators for the Lake Ontario LaMP and AOCs.

Each AOC is required to develop and implement a Remedial Action Plan (RAP) in accordance with the 1987 amendments to the Great Lakes Water Quality Agreement, signed by the federal governments of the United States and Canada. The federal governments, in cooperation with state and provincial governments, committed to developing and implementing RAPs in 43 Areas of Concern (AOCs). The RAP process strives to identify environmental problems (beneficial use impairments); identify pollutants and other causes of the problems; identify the sources of the pollutants; recommend and implement remedial activities to restore the beneficial uses and document progress towards restoration. The ultimate goal, therefore, is to restore the area's beneficial uses and delist the AOC. This chapter provides a summary of the status of each AOC associated with the Lake Ontario LaMP.

On July 25, 2006, the Oswego River, New York Area of Concern was formally delisted. This celebration of success completes a rigorous process to assure that beneficial uses are restored and protected in an AOC and means that the AOC designation no longer applies. The delisting of the Oswego River AOC has set the stage for achieving progress in addressing all of Lake Ontario's nine AOCs. Figure 11.1 shows the location of the nine AOCs around Lake Ontario. The two binational AOCs (the Niagara River and St. Lawrence River at Cornwall and Massena) actually have separate Canadian and U.S. Remedial Action Plans. In New York, the other AOCs are Eighteenmile Creek and Rochester Embayment. And in Ontario, Canada the other AOCs are Hamilton Harbour, Toronto and Region, Port Hope Harbour, and the Bay of Quinte.

The current focus on applying resources to resolve the BUIs in all of the AOCs along with implementation of remedial measures that further nearshore protection and restoration initiatives, will contribute to overall improvements in the Lake Ontario ecosystem. On varying magnitudes, each of the Lake Ontario RAPs as well as the Lakewide Management Plan (LaMP) employ the fundamental principles of applying an ecosystem approach and conducting public involvement in implementing remedial activities.

Table 11.1 Summary of Beneficial Use Impairments for Lake Ontario Lakewide, Nearshore, and Areas of Concern
(Based on the 14 IJC Use Impairment Indicators)

Use Impairment Indicator	Lakewide Lake Ontario	Niagara River (U.S.)	Niagara River (Canada)	St. Lawrence at Massena+ (U.S.)	St. Lawrence at Cornwall (Canada)	Eighteenmile Creek	Rochester Embayment	Oswego River	Hamilton Harbour	Toronto & Region	Port Hope Harbour	Bay of Quinte
1. Restrictions on Fish and Wildlife Consumption	I	I	I (fish; not wildlife?)	I	I	I	I	O	I	I		I
2. Tainting of Fish and Wildlife Flavor							?		?			
3. Degradation of Fish and Wildlife Populations	I	?	I	?	I	?	I	O	I	I		I
4. Fish tumors or Other Deformities		I		?	?	?	?		I	?		?
5. Bird/Animal Deformities or Reproductive Problems	I	?	?	?		?	I		I	?		
6. Degradation of Benthos	I	I	I	?		I	I		I	I		I
7. Restrictions on Dredging Activities		I				I	?		I	I	I	I
8. Eutrophication or Undesirable Algae			I		I		I	R	I	I		I
9. Drinking Water Restrictions or Taste and Odor Problems				?			I*		?			I*
10. Beach Closings			I		I		I		I	I		I
11. Degradation of Aesthetics							I		I	I		I
12. Added Costs to Agriculture or Industry							I		I			
13. Degradation of Phytoplankton and Zooplankton Populations	I		?	?	?		I		I	?		I
14. Loss of Fish and Wildlife Habitat	I	I	I	I	I		I	R	I	I		I

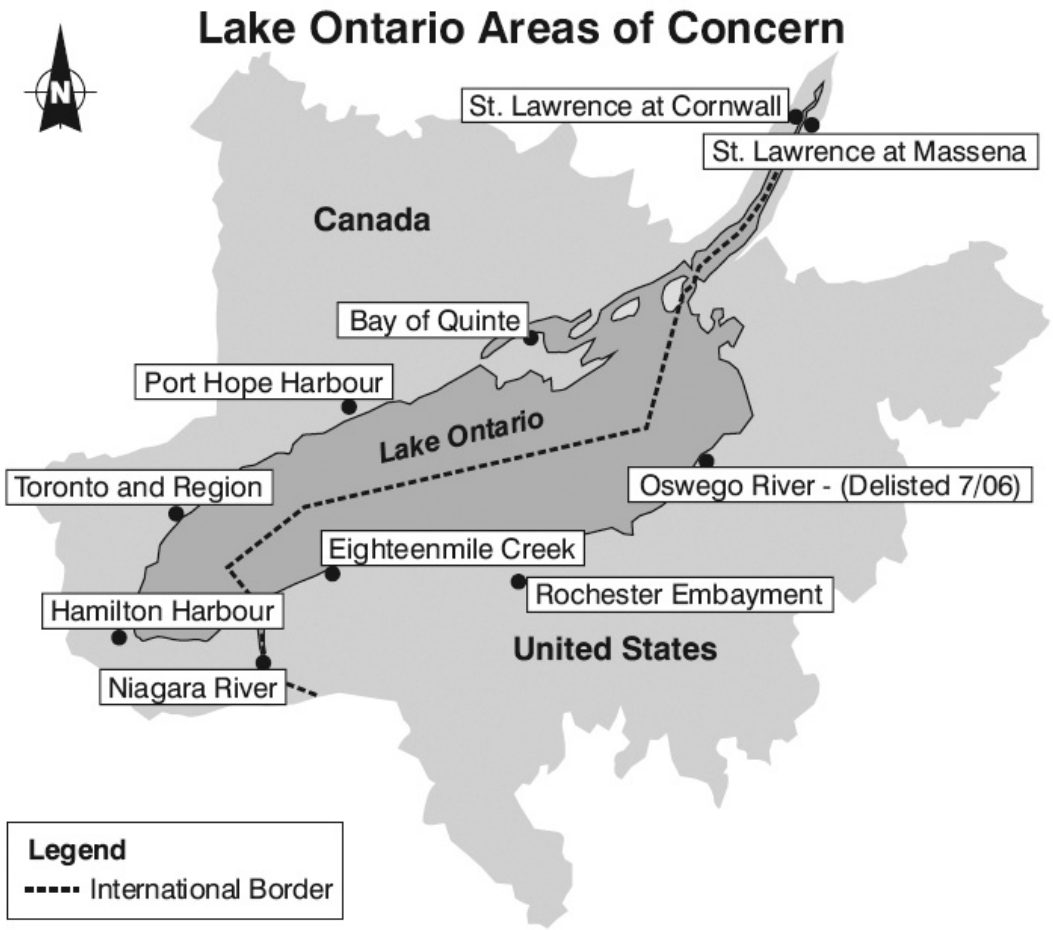
See key next page

Key: Use Impairment Status for Table 11.1

I	=	Impaired
R	=	Beneficial Use Restored
O	=	Resolution by Other Responsibility
?	=	Further Assessment Needed
(Blank)	=	Not Impaired

Key: Other Notations for Table 11.1

I*	=	Taste and Odor Problems unless otherwise not marked for indicator #9 only
I-	=	Lower Genesee River Impaired; Rochester Embayment Needs further study
+	=	"Transboundary Impacts" is an added indicator in this RAP



11.3 Binational Areas of Concern

Canada and the United States have agreed to independently develop Remedial Action Plans for the Binational AOCs within a broader context of intergovernmental cooperation. Separate RAP documents have been developed and are being implemented for the two binational AOCs: the Niagara River, and; the St. Lawrence River at Massena, New York and Cornwall Ontario. Joint participation on technical and public participation activities is part of this RAP Process for these shared waterbodies.

11.3.1 Niagara River Area of Concern

The Niagara River flows 60 kilometres from Lake Erie to Lake Ontario. Downstream from Niagara Falls the river flows for a 15 kilometre stretch through a gorge 100 metres deep and 1 kilometre wide. The binational AOC extends the entire length of the Niagara River and includes the Welland River drainage basin on the Canadian side. The Niagara River passes through heavily industrialized areas, residential and parkland interspersed with remnant natural areas, and drains extensive farmland on the Canadian side. the AOC borders Erie and Niagara counties in western New York, and extends from Smokes Creek near the southern end of the Buffalo Harbor, north to the mouth of the Niagara River at Lake Ontario.

Past municipal and industrial discharges and waste disposal sites have been sources of contaminants to the Niagara River. A long history of development has also changed the original shoreline along much of the river, affecting fish and wildlife habitat. More than half of the flow of the river is diverted for electric power generation on both sides of the river. The gorge and cliff face are habitat for some of the highest concentrations of rare plant species in Ontario. The Niagara River annually supports one of the largest and most diverse concentrations of gulls in the world.

Joint participation includes the Niagara River Toxics Management Plan (NRTMP), the Important Bird Area Program and the International Board of Control.

The International Joint Commission has completed the RAP Status Assessment for the Niagara River Area of Concern. The findings and recommendations report notes significant progress in documentation for the Niagara River under the Niagara River Toxics Management Plan. This NRTMP plan identifies challenges and opportunities for the binational community to accomplish RAP goals under the Great Lakes Water Quality Agreement. The October 2007 Public Meeting on the NRTMP documented significant reductions in contaminates to the river as well as significant progress in hazardous waste site remediation (in New York, 21 of 26 major sites are completed).

Environment Canada and MOE are responsible for the delivery of the Canadian RAP. USEPA Region 2 and NYSDEC deliver the US portion of the RAP. Both RAPs were established in 1989. Summaries of the Remedial Actions plans follow.

11.3.1.1 Niagara River (U.S. Side)

Background: A representative group of Niagara River stakeholders was appointed by NYSDEC as an advisory committee to help develop the RAP. The committee members and NYSDEC direct RAP development. Goals were established, a workplan was developed, responsibilities were defined to complete the RAP document. This RAP document effectively combines the Stage 1 and Stage 2 RAP elements and was completed in September 1994. A Status Report for the Niagara River RAP that updates remedial actions was published in June 2000. The RAP addresses use impairments, sources, and existing remediation programs, and recommends future remedial strategies. A multiple subcommittee approach was utilized to address the complexities of implementation. A technical subcommittee was formed to develop ways to quantify concerns and to communicate progress to address the impaired uses. A public outreach subcommittee was created to develop a binational strategy to address the many issues involved with achieving sustainable development, and an International Advisory Committee was established to foster binational cooperation.

Impairments: The Remedial Action Plan (RAP) identifies five BUIs based on the fourteen possible International Joint Commission (IJC) impairments. Two other use impairments are listed that will require further investigation to determine the extent of their existence. The major BUI is restrictions on fish and wildlife consumption, primarily due to PCB and dioxin contamination. Mirex and chlordane also are chemicals of concern contributing to the consumption restriction use impairment. These restrictions are part of a lakewide advisory for Lake Ontario. Based on the presence of contaminated sediment pockets at certain tributary mouths and nearshore areas, the sediments were evaluated as contributing to a degradation of benthos use impairment at these areas.

Existing restriction on open lake disposal of contaminated sediments from the Niagara River cause the AOC to have a dredging restrictions use. In the upper Niagara River, fish tumors have been reported and the loss of fish and wildlife habitat due to human activities has been dramatic. Degradation of fish and wildlife populations and the presence of bird or animal deformities or reproductive problems will require further investigations.

RAP Structure: Most recently, combined efforts of local organizations and citizens [e.g. the Buffalo Niagara Riverkeepers (BNR)] have been advising and assisting NYSDEC on the Niagara River RAP implementation. This RAP committee, when fully active, involves local government, academia, public and economic interest groups, and private stakeholders. The RAP process involves various components: periodic progress status reports with remedial strategy identification; regular Remedial Advisory Committee (RAC) meetings; project and plan reviews as part of ongoing activities; monitoring and tracking progress; and, public participation coordinated through the RAC. In the Niagara River RAP, priority activities and strategies address: stream water. quality; inactive hazardous waste site remediation; contaminated river sediments; point source control programs; fish and wildlife habitat improvements; and, enhanced environmental monitoring activities. The committee is to be "reenergized" in 2008.

RAP Status and Progress: A Niagara River RAP public information video was completed by the RAC members. This accomplishment of a video by the RAC was based on earlier international cooperation in the development of a slide show. The RAP continues to benefit from New York's Environmental Protection Fund as well as other agency funding sources, such as Bond Act funding of a $1 million habitat restoration project for Strawberry Island. A full day RAP workshop was conducted in July 2006 to start the process of updating and evaluating progress towards meeting goals.

RAP Outlook on the U.S. Side: 2008 presents opportunities for the Niagara River RAP in receiving federal funding for the AOC to revitalize its RAC to address the BUIs. Implementation of the Niagara River RAP is to be a continual improvement process that commits to periodic updates and improvements as knowledge of the use impairments, sources and the effectiveness of remedial measures increases. Remedial actions will be evaluated and coordinated as to their impacts on restoration of beneficial uses. Within the AOC and watershed, a number of studies and assessments will continue to be priorities. These address fish and wildlife consumption restrictions, habitat evaluation, sediment investigation, and contaminant trackdown. Restoring and maintaining an improved quality of life in the ecosystem of the Niagara River and its watershed is the goal. With federal funding in 2008, NYSDEC is to address the BUIs as steps are taken to establish the framework for delisting of the AOC. For additional information see the USEPA website at: http://www.epa.gov/glnpo/aoc/niagara.html.

11.3.1.2 Niagara River (Canada Side)

Background: Much of the impact to the river is from the U.S. side, specifically from past industrial management practices. Efforts on the US side are addressing these issues. Most of the environmental issues on the Canadian side of the river are associated with non-point sources within the rural watersheds of the Niagara-Welland River watershed. Former industrial activities have resulted in contaminated sediment in the Welland River (remediated) and Lyons Creek (strategy under development). Pesticide use, nutrient runoff, wetland and habitat loss, riparian zone impacts and the health of fisheries all remain concerns.

Impairments: There are seven BUIs in the Canadian portion of the AOC. These include restrictions on fish consumption, degradation of fish populations, bird or animal deformities and reproductive problems, degradation of benthos, eutrophication, beach closings, and loss of fish and wildlife habitat. The status of the following four impairments requires further assessment: restrictions on wildlife consumption, degradation of wildlife populations, fish tumours and deformities, degradation of phyto/zooplankton populations. Taste and odor problems persist in drinking water; however, this impairment is not due to local sources.

RAP Structure: Through an agreement signed in 1999, the Niagara Peninsula Conservation Authority (NPCA) has assumed responsibility for coordinating the implementation of the RAP and has developed an Implementation Annex that provides a practical strategy for doing this.

RAP Status and Progress: A rural watershed heritage strategy is being implemented for the Welland River. Actions have included the planting of more than 96,000 trees, rehabilitation of 10.5 hectares of wetland habitat, the installation of over 18 kilometres of fencing to protect riparian habitat adjacent to watercourses and the reduction of phosphorus entering local watercourses by more than 1,500 kilograms per year. By 2002, 135 projects were completed. To date, these activities have increased forest cover on 90 hectares of land, restored 21 kilometres of riparian habitat and seven hectares of wetlands. The NPCA has also been actively involved with local landowners since 1994 to improve water quality in streams. Nutrient and bacterial loadings have been reduced through livestock fencing and manure storage projects. Through a grant program, the NPCA will provide incentives to local landowners within the Niagara-Welland basin in order to foster best management practices for agriculture, create habitat and protect ecologically sensitive land.

Urban stormwater and combined sewer overflows (CSOs) are also being addressed. In the City of Niagara Falls, 4300 urban homeowners were asked to disconnect their roof downspouts. The City also continues to actively promote water conservation through a newly developed corporate water conservation strategy and is now proceeding with full scale implementation of innovative technology for High Rate Treatment of combined sewer overflows. Another large scale initiative is an ongoing program to separate domestic and storm sewers to reduce combined sewer overflow events. Fort Erie and Welland have also initiated projects intended to reduce combined sewer overflows.

The extensive loss of fish and wildlife habitat in the AOC is being addressed by the NPCA and the Niagara Restoration Council. Habitat restoration is ongoing and significant progress has been made towards meeting delisting criteria. The Niagara River corridor was named as a binationally Important Bird Area (IBA) in 1996. A conservation plan for this IBA is being developed through a coalition of interested groups. The Niagara Restoration Council is undertaking a project to remove all barriers to fish passage in the watersheds within the Niagara River Canadian AOC. In 2001, all barriers to fish passage were identified, mapped and classified by type and size. It is anticipated that the majority of barriers will be removed or mitigated by 2005, thus making hundreds of kilometres of upstream fish habitat available to spawning fish.

Progress has also been made in addressing contaminated sediments. Based on the contaminated sediments sites identified in the Stage 2 Niagara River RAP report, the NPCA has submitted a management proposal for all known sites. In 1995, approximately 10,000 cubic metres (13,080 cubic yards) of contaminated sediments were remediated in a section of the Welland River adjacent to Atlas Specialty Steels. Since the sediments were remediated, biological sampling indicates that this section of the river is recovering as anticipated. A sediment management strategy is being developed for Lyons Creek.

Very substantial progress has also been made jointly with the U.S., especially in reducing inputs of toxic chemicals. Monitoring results in the Niagara River show that the concentrations for most of the 18 priority toxics targeted by the NRTMP have been significantly reduced, in many cases by more than 50 percent. On the Canadian side, monitoring results for point sources between 1986 and 1995 showed loading reductions of 99 percent for the 18 chemicals of concern.

RAP Outlook: Full implementation of remedial actions in the Niagara River AOC will require many years, and is contingent on federal, provincial and/or municipal funding availability, and in some cases private sector involvement. MOE has lead responsibility for the RAP and Environment Canada and the Niagara Peninsula Conservation Authority will continue to work in partnership as they move towards delisting. Remediation of CSO discharges is essential to complete RAP implementation and several large infrastructure needs have been identified. Infrastructure costs are estimated at CDN$26M for high

rate treatment of combined sewer overflows for the cities of Niagara Falls and Welland. Developing and implementing a contaminated sediment strategy for Lyons Creek will also require significant funding.

11.3.2 St. Lawrence River Area of Concern

The St. Lawrence River drains the Great Lakes and is among the largest rivers in the world. The AOC is an 80 kilometre stretch of the river that extends upstream from the Village of Massena through the Moses-Saunders power dam at Cornwall, Ontario, downstream to the eastern outlet of Lake St. Francis in Quebec. This AOC is a complex jurisdictional area involving Canada, the United States, Ontario, Quebec, New York State and Mohawks of Akwesasne interests. To divide the work in manageable parts, separate RAPs were developed for the Canadian (Cornwall) and U.S. (Massena) sides of the St. Lawrence River starting in 1988. Multi-national components of the AOC from New York, Ontario, and the St. Regis Mohawk Tribe continue to present opportunities for international cooperation. To the credit and progress of the RAP, examples of this cooperation include stakeholder representation at RAP meetings, preparation of a joint Problem Statement, joint monitoring workshop and information table in 1994, annual St. Lawrence River Ecosystem Conference (primarily Canadian sponsored), and a working relationship to share information from international research and regional area studies.

11.3.2.1 St. Lawrence River at Massena, New York

Background: NYSDEC began development of the St. Lawrence River at Massena RAP in1988. This process is assisted by the Massena Remedial Advisory Committee (RAC) which consists of members from industry, local government, environmental groups, sporting interests, academia, and business. The Stage 1 report was completed in 1990 and identifies use impairments, their causes, and sources. The Stage 2 report was completed in 1991 and includes the development of remedial strategies to: restore water quality and beneficial uses of the tributary rivers and the St. Lawrence River; to eliminate adverse impacts from sources of pollutants at major local hazardous waste sites and other sources within the Area of Concern. A comprehensive RAP Update document was published in April 1995 that consolidated the Stage 1 and 2 documents and established a format to identify remedial strategies and track progress. The most recent Status Report was completed in October 2006.

Impairments: The waters and river bottoms of the AOC are impacted to various degrees by industrial pollution sources, Lake Ontario, municipal treatment facilities, atmospheric deposition, nonpoint pollution from the watershed, and physical disturbances as a result of the power dam and seaway construction.

The Stage 1 RAP identified industry as a major source of contaminants to the AOC. Stage 1 also confirmed two BUIs (fish consumption advisories and loss of fish habitat) and identified five other BUIs that will require further evaluation. A “transboundary impacts” BUI indicator was added to the standard fourteen BUI indicators that were originally developed by the International Joint Commission’s (IJC) as listing and delisting guidance for the indicators. Assessment of threats and restoration of beneficial uses are needed to complete RAP implementation for the AOC.

RAP Structure: Because of the international aspect of this RAP, an evaluation of the possible transboundary effects associated with the downstream interests and jurisdictions (Canada, Ontario, Quebec, and the St. Regis Mohawk Tribe) are an important consideration for this “binational connecting channel Area of Concern”. The Mohawks have received grant funding to implement an erosion and nonpoint source pollution protection project and study fish population and impacts. As New York State has taken the lead to address the Massena area BUIs, the Canadian jurisdictions have taken responsibility for RAP implementation concerning the Ontario and Quebec side of the river. The Mohawks at Akwesasne contribute to both of these RAP processes.

RAP Status and Progress: Priority actions include: completing the land-based and contaminated river sediment remediation (nearing completion), conducting further investigations (as determined necessary), and reassessing BUI status in light of remedial progress and available study results and information (this is the current focus). The most recent RAP Status Report was published in October 2006 and identifies

the remedial progress, includes delisting criteria, and links available information to the relevant BUI indicators for the AOC. Significant progress has been made with land-based remediation at the ALCOA (west), Reynolds Metals (now ALCOA east), and General Motors industrial sites, as well as with the contaminated sediment removal in the St. Lawrence River at General Motors and ALCOA east. Remedial alternatives are under consideration to address contaminated sediment at the Grasse River site. Some alternatives may provide for treating contaminated sediments in place as well as removal from the site.

RAP Outlook on the U.S. Side: International cooperation continues to benefit the RAP process for the St. Lawrence River AOC. Funding opportunities exist to assist the Great Rivers Institute (GRI) at Clarkson, RAP Coordination by NYSDEC, and research projects to meet the needs to address assessment of the BUI indicators. The International Joint Commission completed its RAP Status Assessment of the Area of Concern in May 2003. The document notes the accomplishments in the AOC and makes recommendations to further address BUIs including contaminated sediments. The Massena RAC has focused on the identification of endpoints and then taking the necessary steps to complete the BUI assessment. A technical sub-committee has been formed to facilitate the focus on the indicators and report to the larger RAP committee. Most land and river based remedial measures have been completed (except for the Grasse River tributary which is totally in New York) thus setting the stage for monitoring data collection, review, and assessment. Participants in the RAP process can identify that a "Binational Area of Recovery" designation for the AOC is a near-term possibility. For additional information see the USEPA website at: http://www.epa.gov/glnpo/aoc/stlawrence.html.

11.3.2.2 St. Lawrence River at Cornwall, Ontario

Background: The Cornwall waterfront has been the site of industrial activities for more than 100 years. Although many of the contaminant sources have been eliminated, historical inputs have continued to impact the aquatic environment as contaminated sediment and organisms transfer and cycle mercury and other metals. Local contaminant sources included direct industrial and municipal discharges, and diffuse sources such as urban stormwater and agricultural runoff. (All industrial releases of effluent directly to the St. Lawrence River have ceased). Contaminants also enter the AOC from upstream, from the Great Lakes via Lake Ontario and from air deposition. Land use practices, shipping and the extensive shoreline and water flow alteration that resulted from the construction of the St. Lawrence Seaway continue to alter the natural ecosystem.

Impairments: The following seven BUIs have been identified for the Canadian portion of the AOC:

- Restrictions on fish consumption
- Degradation of fish and wildlife populations
- Degradation of benthos
- Restrictions on dredging activities
- Eutrophication or undesirable algae
- Beach closings/water contact sports
- Loss of fish and wildlife habitat

Three more BUIs - fish tumours and other deformities, bird and other animal deformities, and degradation of plankton populations - are listed as "possibly impaired" and require further assessment work to confirm their status. Table 11.1 provides an up-to-date summary on the status of these additional impairments, as well as the BUIs originally identified within the St. Lawrence River (Cornwall) AOC.

RAP Structure: There are 64 RAP recommendations for improving the aquatic environmental conditions in the AOC, most of which have been implemented or are in progress. The St. Lawrence River Restoration Council provides the local lead for RAP implementation. The group has members from Environment Canada, the Ontario Ministry of the Environment, the Ontario Ministry of Natural Resources, the Mohawk Council of Akwesasne, local municipalities, environmental groups, the Raisin Region Conservation Authority (RRCA) and other groups.

RAP Status and Progress: Significant progress has been made on implementing the RAP and the focus is now on completing priority actions for delisting this AOC by 2010. An update to the 1997 Stage II report has been prepared for the St. Lawrence River (Cornwall) AOC and provides a summary of efforts to focus the RAP towards achieving ecosystem recovery, revisions to delisting criteria and updates the status of BUIs. Highlights of progress to restore beneficial uses are:

Lake St. Francis Tributary Restoration

This highly successful tributary restoration program has been ongoing for 11 years, and is run by the Raisin Region Conservation Authority with support from the Federal, Provincial governments and farm and land owners. Since 1994, the program has achieved the following gains in implementation of beneficial land management practices (BMPs) and habitat and nonpoint source pollution reduction (current to March, 2006):

- 258,228 trees planted in riparian areas
- 40,068 m^2 (9.9 acres) of grassed buffer zones along watercourses
- 60,708 m (66,391 yards) of cattle exclusion fencing, restricting 9,457 cattle from watercourses
- Provision of 52 alternate watering sources for cattle
- 56 manure storage upgrades
- 31 milkhouse washwater projects
- 9,857 acres converted to conservation tillage
- 4 projects to divert clean water around manure storage or other areas
- 47 wellhead protection projects
- 11 abandoned or unused wells plugged
- 13 erosion control projects
- 14 septic system upgrades

This program is ongoing and future actions include applying the Agricultural Non-point Source (AgNPS) model to target important areas for attention.

Cornwall Sediment Strategy

Environment Canada and the Ontario Ministry of the Environment, in partnership with local municipalities, the Mohawks of Akwesasne, industry and environmental groups, developed a strategy for managing contaminated sediment in three zones along the Cornwall waterfront. After five years of working collaboratively through detailed science review and conducting additional technical studies to fill gaps and to evaluate sediment management options, the Cornwall Sediment Strategy was finalized. This strategy states:

- Contaminated sediments should be left in place. As they currently exist, the historically contaminated sediments in the three zones (1,2 and 3) along the Cornwall waterfront are stable and covered with a cleaner layer of sediment and therefore do not pose a significant ecological risk.

- Implement effective Administrative Controls to protect the sediments from being disturbed. This ensures the natural cap is maintained and allows continued deposition of cleaner sediment particles which will further cover and isolate the deeper more contaminated material.

- Implement a comprehensive ongoing monitoring program of environmental conditions and sediment stability to ensure conditions continue to improve.

- This decision is supported by extensive and detailed scientific study, input from local community representatives and input from nationally and internationally recognized experts in mercury research and ecological assessment of contaminated sediment.

Lake St. Francis Fish Habitat Management Plan

A Fish Habitat Management Plan for Lake St. Francis was completed in March 2006 by the Raisin Region Conservation Authority and MNR. It summarizes known critical and sensitive fish habitat areas and degraded fish habitat areas, prioritizes issues of concern and identifies opportunities for habitat enhancement and restoration. The document was prepared in concert with a Fisheries Management Plan that addresses fish population issues for the area. Prepared by the MNR Lake Ontario Management Unit, the Fish Habitat Management Plan includes direction for the enhancement of Walleye spawning/nursery habitats, creation of Walleye resting habitats, shoreline revegetation and erosion protection programs and wetland securement.

Fish Management Plan

MNR developed a Fisheries Management Plan (FMP) in 2005-06 for the Ontario portion of Lake St. Francis, including the Ontario portion of the St. Lawrence River downstream of the Moses-Saunders Dam. The purpose of the plan is to guide the management of fisheries resources for a period of five years (2005-2011), after which it will be revisited and revised if necessary on a five-year cycle. The plan was developed in consultation with a range of stakeholders including First Nations, federal and provincial government agencies, non-government organizations, and the general public. The plan includes strategies for implementation and monitoring along with a set of Fish Community Objectives (FCOs). FCOs are targets for a healthy fish community, and monitoring data can be compared against them to ensure that fisheries management is maintaining fisheries resources.

Other Progress

Since 1990, the Government of Canada's Great Lakes Sustainability Fund has provided over $4.1 million towards 30 restoration projects in the AOC. These projects support activities to reduce pollution from rural non-point sources; improve habitat for aquatic and terrestrial species; manage contaminated sediment; provide outreach and education to local stakeholders and landowners; manage municipal wastewaters (including sewage, combined sewer overflow and stormwater); and incorporate natural heritage protection components into municipal Official Plans.

This funding has, in turn, been used to leverage partnership contributions of more than CDN$13M from a variety of partners including municipalities, conservation authorities, educational organizations, provincial agencies, NGOs, industry, and local farm/landowners and volunteers. These contributions take the form of cash, in-kind materials and service, and/or volunteer labour.

Municipal Wastewater Issues - Candidate projects include: 1) facilitating upgrades of smaller, downstream sewage treatment plants by providing technical assistance or assistance in obtaining infrastructure financing; 2) the completion of pollution prevention and control plans to manage stormwater and combined sewer overflows for communities within the AOC; 3) assisting small and rural communities in the AOC address issues of potential water contamination caused by inadequate septic systems. In 2005, the City of Cornwall completed an Environmental Assessment for the upgrade of their sewage treatment plant from primary to secondary treatment. A subsequent application for Federal and Provincial Infrastructure funding (COMRIF) was not successful. The Federal, Provincial and municipal governments have had further discussions regarding funding for the upgrade however, to date, no progress has been made on finalizing plans for this important project.

RAP Outlook: The goal is to complete all priority actions required for delisting this AOC by 2010. To achieve this goal, an aggressive workplan has been developed and is being implemented to complete all non-point source and habitat projects. A dedicated effort to implement mechanisms that will maintain environmental quality is critical. Municipal infrastructure upgrades required to address the management of sewage and wastewater in some communities within the AOC are being pursued. When RAP implementation actions have been successfully completed, it will be imperative to monitor ecosystem recovery. This may be one AOC which becomes an Area in Recovery while the environment needs time to respond to the positive actions that have taken place.

Outstanding issues in the St. Lawrence AOC include: assessing the status of zooplankton and phytoplankton populations; the restoration and protection of fish and wildlife habitat; a review of sources and levels of bacterial pollution in waters used for body contact recreation.

11.4 U.S. Areas of Concern

11.4.1 Eighteenmile Creek

Background: The Eighteenmile Creek Area of Concern (AOC) is located in the town of Newfane, Niagara County, in western New York State. The creek flows from the south and discharges into Lake Ontario, about 18 miles east of the mouth of the Niagara River, through Olcott Harbor. The AOC includes Olcott Harbor at the mouth of the creek on Lake Ontario and extends upstream to the farthest point at which backwater conditions exist during Lake Ontario's highest monthly average lake level. This point is just downstream of the Burt Dam located about two miles upstream from the harbor in the Hamlet of Burt.

Development of the Eighteenmile Creek RAP was initiated in March 1994. A combined final Stage 1 and Stage 2 RAP document was completed and published in August 1997 by NYSDEC in cooperation with the Eighteenmile Creek Remedial Advisory Committee. A RAP Report card has also been published and is available on the site. It provides information on RAP implementation and indicator status, successes and improvements, current status, trends, and steps needed for restoration of the Area of Concern.

Impairments: Past industrial and municipal waste disposal practices have contributed to BUIs in Eighteenmile Creek. Fish consumption restrictions exist because of PCBs and dioxins found in fish flesh; however, these are closely linked to Lake Ontario and are not unique to the AOC. PCBs and metals in sediments have contributed to degradation of benthos. Contaminated sediments cause restriction of dredging to exist. Bird and animal health is likely impaired by the PCBs, dioxins, DDT and its metabolites, and dieldrin found in fish flesh. PCB and metal contamination prevents open lake disposal of dredged sediment material. Additional investigations are to be conducted to assess the status of fish and wildlife populations and the presence of fish tumors or other deformities.

RAP Structure: In January 2005, EPA awarded the Niagara County Soil and Water Conservation District (NCSWCD) grant funding for RAP coordination over a five year period. RAP management and outreach efforts continue to include conducting committee meetings, workshops, public information outings, and field trips. NCSWCD has established a website to assist in communication on the Area of Concern at: www.eighteenmilerap.com.

RAP Status and Progress: Niagara County SWCD completed a RAP Status Report in December 2006. The previous 2001 report was completed by NYSDEC and the RAP committee. An investigative study of the plankton community was conducted by SUNY at Brockport under an EPA grant, and the results establish that the plankton populations BUI is not impaired. The New York State Environmental Bond Act has provided funding to address the City of Lockport's municipal wastewater and combined sewer overflows. All significant CSO correction work has been accomplished, and remaining CSO mitigation work is under engineering evaluation for project needs. NYSDEC and the Niagara County Department of Health have initiated a comprehensive trackdown sampling project to locate and identify sources of various contaminants in the area of the Flintkote Plant Site. This upstream area is linked as a contaminant source area that is emitting various concentrations of PCBs, mercury and lead into Eighteenmile Creek.

RAP Outlook: RAP activities are now focused on the evaluation of the BUI indicators and establishing delisting criteria to assist in this process. At the same time, continued investigation and assessment of creek sediments and water quality to determine the need to address upstream sediments is a priority. The AOC boundary can be extended upstream to address sources causing impairments in the AOC; hence, the evaluation of PCB and other contaminants sources in the watershed along with continued remediation of inactive hazardous waste sites is also a focus. Planning efforts are underway to develop a Comprehensive Watershed Management

Plan in conjunction with the U.S. Army Corps of Engineers. From this plan, project components to address habitat restoration to benefit the AOC are to be identified. Such projects provide for streambank stability, sediment assessment, best management practices, and community outreach. A separate New York State Department of State grant will develop and implement a monitoring plan to document restoration activities. For additional information see the USEPA website at: http://www.epa.gov/glnpo/aoc/eighteenmile.html.

11.4.2 Rochester Embayment

Background: The Rochester Embayment formed by the indentation of the Monroe County (New York) shoreline between Bogus Point in the town of Parma and Nine Mile Point in the town of Webster, both in Monroe County. The northern boundary of the embayment is delineated by the straight line between these two points. The southern boundary includes approximately 9.6 km (6 miles) of the Genesee River that is influenced by lake levels, from the river's mouth to the Lower Falls. The drainage area of the embayment is more than 7,770 km2 (3,000 sq. mi.) in area. This area consists of the entire Genesee River Basin and parts of two other drainage basins: the easternmost area of the Lake Ontario West Basin and the westernmost area of the Lake Ontario Central Basin.

The Stage 1 document was completed in August 1993. Starting in October 2003, the Monroe County Department of Health received EPA funding for RAP management and coordination. The focus is on research, priority project implementation, and delisting considerations. Ongoing initiatives include: Monroe County's source trackdown, CSO mitigation and abatement, and funded studies of local aquatic conditions. Monroe County has developed RAP related projects and seeks funding to address gaps and needs for watershed improvements including nonpoint sources, habitat restoration and watershed openspace.

Impairments: Twelve of the fourteen BUIs were identified in the Area of Concern. The Stage 2 RAP report was completed and published in September 1997. The Area of Concern includes a 35 sq.mi. (91 km^2) portion of Lake Ontario and a six mile reach of the lower Genesee River. RAP remedial measures address lawn care practices, wetland education, 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.

RAP Structure: The Monroe County Water Quality Management Advisory Committee (WQMAC) and its subcommittees provide advice and oversight on general water quality, public participation, and RAP implementation activities. Further, the Monroe County Water Quality Coordinating Committee (WQCC), continues to provide guidance contributing to RAP progress.

RAP Status and Progress: Watershed planning projects are in various phases of implementation. A Stormwater Coalition was formed to plan for compliance with new stormwater regulations. Completed projects 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; a biannual newsletter; two watershed plans; a watershed developer's packet; and a report on a water quality opinion survey.

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 BUIs. To address algae and nutrients, Monroe County sponsored a "Lake Ontario Algae Cause and Solution Workshop" in 2002 and later participated in a conference entitled "New York's North Coast: A Troubled Coastline". These activities led to the formation of the Lake Ontario Coastal Initiative, which is a public/private, grassroots, regional partnership. The mission of the Lake Ontario Coastal Initiative (LOCI), encompassing all of New York State's North Coast stakeholders from the Niagara River to the St. Lawrence River, is to enlist and retain broad public commitment for remediation, restoration, protection, conservation and sustainable use of the coastal region. This mission is to be accomplished by securing funds and resources to achieve scientific understanding, educate citizens, and implement locally

supported priorities, programs and projects as identified through LOCI's Action Agenda, released in 2006 and available on this website For addition information on LOCI see their website at: http://ceinfo.org/loci/

RAP Outlook: Delisting criteria and monitoring methods for BUIs have been developed. Remedial Advisory Committee members have prepared a detailed summary of the status of each of the BUI indicators showing the delisting criteria and information available that will be very useful in addressing the BUIs. RAP reporting was updated in a report in 2001 and in an Addendum report at the end of 2002. Currently, an Addendum update is in preparation. A Water Education Collaborative exists to coordinate all public participation activities regarding water quality in the County. The US Army Corps of Engineers has proposed funding assistance for a sediment transport study led by SUNY at Geneseo. Because an extensive watershed plan has also been incorporated into the RAP process, the stakeholders now have to focus on the lower Genesee River and Embayment area to evaluate conditions, identify useful monitoring data/needs, and conduct an assessment of the beneficial uses.

The Rochester Embayment Remedial Action Plan Oversight Committee has summarized data on BUI remediation and identified monitoring that still needs to be undertaken to determine if delisting can occur. The committee also has plans to undertake monitoring that remains to be accomplished in the lower Genesee River AOC. As part of recent activities to solicit input on both new remedial measures and possible changes in priorities from what were included in earlier listings, the RAP Committee has updated its matrix of existing data and data gaps. Plans for the next year are to review current information and reach consensus on delisting for the BUI indicators where delisting criteria have been met. The RAP Oversight Committee will also be looking for opportunities to complete data gaps, especially for the two BUIs rated as unknown in the Stage I report. These are tainting of fish flavor and incidence of fish and wildlife tumors or deformities. For additional information see the USEPA website at: http://www.glc.org/raptest/rochester

11.4.3 Oswego River - (AOC Delisted July, 2006)

Background: The delisted Oswego River/Harbor Area of Concern (AOC) is located on the southeastern shore of Lake Ontario and is centered in the City of Oswego, New York. The AOC includes the harbor area and the lower segment of the Oswego River up to the Varick power dam. The harbor itself is characterized as a multiple-use resource and over 1.2 million people live in the drainage basin. The Oswego River watershed includes the Finger Lakes, industries, municipalities, and extensive areas of farmland and forest that expand an area of over 5,100 square miles. The Oswego River is second only to the Niagara River in size as a tributary to Lake Ontario. The Oswego River RAP process began in 1987, and the Stage 1 document was completed in 1990. The impairments were originally linked to Lake Ontario and upstream sources. The Stage 2 RAP, completed in 1991, identified remedial strategy activities necessary to restore water quality in the lower river and harbor and to eliminate adverse impacts to Lake Ontario from sources of pollutants carried by the Oswego River.

Impairments: Historically, upstream pollutants are known to have traveled through the river and harbor and impacted the Lake Ontario ecosystem, and ultimately led to the Area of Concern designation. For the Oswego RAP, impairments for fish consumption, fish habitat and populations, and eutrophication and algae were identified.

RAP Structure: The advisory committee consisted of a multi-stakeholder group included persons from industry, environmental organizations, government agencies, academia, and private interests.

Delisted: On July 25, 2006, the Oswego River, New York Area of Concern became the first AOC from among the 31 United States AOCs identified in the Great Lakes Water Quality Agreement to be delisted. As a result of much hard work and cooperation (among stakeholders, New York State DEC, USEPA, and IJC), the lower Oswego River and Harbor is once again the crown jewel of the City of Oswego! Through coordinated efforts, the City of Oswego has revitalized the downtown area, the harbor Port Authority has made many improvements, boating and fishing interests have grown, and water access and water quality have improved tremendously.

Through public participation, investigative studies, expert involvement and assessment efforts, the indicators and BUI for the Oswego AOC were addressed and resolved through: pollution reduction activities to reduce point and non-point water discharges; watershed actions to address best management practices and pollution sources; and local agency river corridor enhancement activities. Consistent with U.S. Policy Committee's Delisting Principles and Guidelines, the larger Lake Ontario Lakewide Management Plan responded to the fish consumption advisories; the FERC relicensing of the power dam responded to the fish habitat and population recovery; and eutrophication, algae, and weed characteristics have improved to the point where they are no longer impaired and are managed as nuisance conditions where they occur in isolated areas. Watershed restoration and protection activities, as well as Lake Ontario initiatives, all contribute to the desired results.

There is a true success story behind the preparation of the Stage 3 document and delisting of the Oswego River Area of Concern. By representing stakeholder interests, the RAP Remedial Advisory Committee (RAC) has determined, influenced, and observed the implementation of many supportive activities in the Oswego watershed and accomplished the community's recognition of the importance of this area as a natural resource, thereby encouraging others to act responsibly to restore and protect the environment and the beneficial uses of the AOC. In addition to the implementation of remedial activities, accomplishments for the RAC include: a number of investigative studies and report review activities, the FERC power dam license provisions which fully respond to the needs identified in the Fisheries Enhancement Plan for the Oswego River, significant waterfront revitalization by the City of Oswego, and the benefit of locally-funded environmental enhancement projects. Recreational interests have also been protected and improved through the oversight of responsible agencies.

The RAC effectively applied a wide variety of strategies including the ecosystem approach to address the problems. As a result, the status of each BUI Indicators was resolved and an understanding was achieved that a significant impairment and/or threat to the AOC environment does not exist. The conclusion was that the lower Oswego River and harbor area no longer warrant the AOC designation. NYSDEC, USEPA, and other agencies will continue to use the existing suite of environmental laws and regulatory instruments to implement, monitor and enforce programs that protect the environment in and around the area. The presence of local area environmental groups, concerned citizens, and the agencies' purview provide a vigilance that assures beneficial uses will remain intact and that the riverine system will not revert back to an impaired status.

For more on this delisted AOC see the USEPA website at: http://www.epa.gov/glnpo/aoc/oswego.html.

11.5 Canadian Areas of Concern

11.5.1 Hamilton Harbour

Background: Hamilton Harbour is a 2,150 hectare (5,313 acres) embayment located at the western tip of Lake Ontario. The AOC includes the harbour, Cootes Paradise wetland and open water, and the surrounding watershed drained by three main tributaries: Grindstone Creek; Red Hill Creek; and Spencer Creek, covering a total of 50,000 hectares (123,552 acres). The urban population, which includes Hamilton, Burlington, Stoney Creek, Dundas and Ancaster, is growing rapidly and now is approaching 700,000.

The ecosystem of the harbour reflects its natural conditions (a small water body with a long retention time), a high volume of sewage treatment plant discharges, large scale industrial activities and extensive land use changes. The water and sediments are contaminated by metals, pesticides, PCBs, and PAHs. The sediments of Randle Reef and industrial boat slips are highly contaminated with PAHs and have an adverse effect on the local ecosystem. In addition, the shoreline has been radically transformed with 75 percent of wetlands eliminated and 25 percent of the harbour filled in. Habitat for fish and wildlife is greatly reduced and resident species are exposed to toxic contaminants. The water quality of the harbour continues to be characterized by poor water clarity, low oxygen levels, high nutrient levels and high bacterial levels.

Impairments: Hamilton Harbour AOC has twelve BUIs: restrictions on fish consumption; degradation of fish and wildlife populations; fish tumours; animal (snapping turtle) deformities; degradation of benthos; restrictions on dredging activities; eutrophication and undesirable algae; beach closures; degradation of aesthetics; added costs to agriculture and industry; degradation of phyto/zooplankton populations; and the loss of fish and wildlife habitat.

RAP Structure: In 1991, stakeholders organized into two distinct groups: the Bay Area Restoration Council (BARC) and the Bay Area Implementation Team (BAIT). BARC maintains a balanced voice for all stakeholders of the harbour, performs a watchdog role by monitoring RAP progress, and keeps the public informed. The BAIT is composed of the major implementors of the RAP. The RAP Office has recently completed a RAP Stage 2 Update that provides the current status of the RAP and identifies recommendations from the public. The Update was reviewed by the public, approved by the governments and sent to the IJC in 2003.

RAP Status and Progress: Very positive, visible progress has been made in restoring fish and wildlife habitat. Work at six sites has resulted in: restoration of 340 hectares (840 acres) of habitat; secured habitat for 670 nesting pairs of Caspian and common terns; considerable shoreline rehabilitation; the return of amphibians and reptiles at Cootes Paradise, and increased diversity of native plants and waterfowl partially due to a successful program of carp exclusion. Furthermore, as a result of the Hamilton Harbour Watershed Stewardship Project, over 6500 hectares (16,062 acres) of land have been protected since 1994 through verbal stewardship agreements in the Spencer and Grindstone Creek watersheds including 120 kilometres (75 miles) of riparian habitat and 2900 hectares (7166 acres) of significant wetland and upland habitat.

Sediment remediation remains one of the priorities for Environment Canada in this AOC. Efforts will continue on Randle Reef and the Dofasco boat slip to clean up known sediment hotspots. Environment Canada is working with other government and industrial partners on the Randle Reef Sediment Remediation Project to dredge and contain approximately 500,000 cubic metres (653,975 cubic yards) of contaminated sediment from Hamilton Harbour.

Progress has also been made on improving water quality by reducing the phosphorus, chlorophyll and bacteria levels in the harbour. Reduction of bacterial contamination was achieved by the installation of CSO tanks which store and channel excess storm and sanitary sewage to the Woodward Wastewater Treatment Plant. Further reductions have resulted from low-cost optimization techniques introduced at Halton's Skyway Wastewater Treatment Plant. As a result of these improvements, two beaches were opened in 1993 after a 50-year long swimming prohibition in Hamilton Harbour.

Another notable achievement of the RAP has been the substantial increase in public access to the shoreline and watershed. The Hamilton Harbour Waterfront Trail was opened in 2000 and has increased access to the shoreline to 21 percent. This is a considerable achievement considering that there was essentially no public access to the harbour when the RAP began.

Fisheries and Oceans Canada has implemented monitoring and research programs to assess the status of lower trophic level beneficial uses, the offshore fish community, macrophytes and nearshore fish habitat. This information will guide the evaluation of restoration actions but is also essential for the development of an ECOPATH ecosystem model that is currently under development. These projects have been put in place to guide management decisions on any further habitat restoration initiatives, to assess the effectiveness of remediation actions and understand how invasive species are impacting the food web.

RAP Outlook: The Hamilton Harbour AOC cannot be delisted in the short-term since many of the issues affecting the harbour require significant capital costs and 10-15 years or longer to complete. The total funding required between now and 2015 to achieve delisting of the AOC has been estimated at CDN$650M. This includes $543M for upgrades to Hamilton and Halton's Waste Water Treatment Plants and the Hamilton CSOs to meet RAP water quality targets. The other major capital cost is to remediate PAH contaminated sediments in the area of Randle Reef estimated at $31M. Smaller capital costs are: $9M for City of Hamilton water metering: $9M

for further creation and maintenance of fish and wildlife habitat: and an additional $10M for recreational trail development of and enhancement of lands recently transferred from the Port Authority to the City of Hamilton.

11.5.2 Toronto and Region

Background: The Toronto and Region AOC extends from the Rouge River in the east to the Etobicoke Creek in the west and includes six tributary watersheds which drain into Lake Ontario: Etobicoke Creek, Mimico Creek, Humber River, Don River, Highland Creek and Rouge River. The drainage basin of these watersheds covers 2 000 km^2 (772 mi^2), and over 54 percent of the AOC is considered urbanized and roughly 13% of the area is urbanizing. The AOC includes the City of Toronto and portions of 11 other municipal jurisdictions within the neighbouring Regions of Peel and York. Over 3.4 million people live in the AOC ; approximately 30% of Ontario's population. The population of the Greater Toronto Area (GTA), an area slightly larger than the AOC, is expected to increase by 55.8% (between 1996 -2031).

Over the years, urban growth in the AOC has resulted in extensive physical restructuring of the shorelines, watersheds and landscapes. Through this process, wetlands, forests, fish and wildlife habitat have been lost. Most of the stormwater in the city is discharged into rivers, creeks and ultimately Lake Ontario. The discharge contains high levels of bacteria and nutrients, heavy metals and organic chemical contamination, and this remains the single biggest cause of a degraded aquatic environment. In addition, the many industries of the region discharge into municipal sewage systems which are not designed to remove chemical contaminants. Aging infrastructure and relic systems such as Combined Sewer Overflows (CSOs) continue to impair water quality in the region. Agricultural non-point sources of sediments, nutrients and pesticides contribute to the pollutant loads measured at the river mouths.

Impairments: The RAP has designated the following eight BUIs as impaired: fish consumption restrictions, degraded fish and wildlife populations, degradation of benthos, restrictions on dredging, elevated nutrient levels, beach closures, degradation of aesthetics, and habitat loss. Studies to determine the status of fish tumours, and bird deformities or reproductive problems have been completed and the science indicates that the status of these BUIs is improving. Assessment of the degradation of phyto/zooplankton populations is still required.

RAP Structure: The Toronto and Region RAP Team has representation from TRCA, provincial and federal governments. TRCA is the lead agency for the coordination of the RAP and for many projects which are key to make progress in the Toronto and Region RAP. However, the RAP Team recognizes that its municipal and local partners have a critical role in implementing many of the projects necessary restore environmental conditions. The RAP team continues to provide support (financial and human resources) to the watershed alliances and councils in order to ensure a watershed perspective is adopted and actions are considered and implemented at a watershed level. The RAP program is one of many initiatives in Toronto and Region at work to improve environmental conditions; as this is no small task, it will take the efforts of many to make improvements.

RAP Status and Progress: While certain environmental conditions are improving; there remains much work to do and much room for continual improvement. Many of the water quality parameters have remained fairly constant over the last few years, which is significant and positive in light of the continual development in the Region. However, the effects of development are most apparent during wet weather flows when the rivers and creeks are overwhelmed with stormwater runoff. Pollution loading to the rivers, creeks and Lake Ontario significantly increase during rain and snow melt events. Contaminants such as chlorides are rapidly increasing as new roads are built and other areas are developed.

A significant but subtle success for the Toronto and Region RAP has been the operation of the Regional Watershed Monitoring Network (RWMN) – which provides critical assessments of the beneficial use impairments. In conjunction with the leveraged RAP support, the RWMN relies on all of the Regional Partners to supports its operation.

Sustainable Technologies Evaluation Program (STEP) has been one of this RAP's key deliverables. Determining new and innovative means of dealing with stormwater is necessary in this Region, as traditional stormwater pond management will not be enough to protect water quality, much less to bring about the restoration of the beneficial use impairments. For more information regarding STEP, visit www.sustainabletechnologies.ca.

Under its Wet Weather Flow Management Master Plan (WWFMMP), the City of Toronto is working on significant projects that will ultimately bring about major improvements to the waterfront. A substantial amount of work is required prior to projects being put in-the-ground (i.e. Environmental Assessment). The City of Toronto currently has six major projects underway or being prepared for the EA process – including the Don and Waterfront Interceptor Trunk Capacity and CSO Control project (a project anticipated to cost CDN$500M). Other municipalities in the RAP jurisdiction have completed assessments of how best to retrofit their stormwater facilities and they are now in the process of implementation.

Another significant achievement for the Toronto and Region RAP was the completion of the Terrestrial Natural Heritage System Strategy (TNHSS). The TNHSS provides the framework to identify priority areas of habitat that will go beyond isolated patches of green space and will provide a functioning system that meet the requirements for species survival and aims to improve natural cover in the Region. The RAP will continue to support the adoption of the TNHSS into municipal Official Plans.

An essential component of the Toronto and Region RAP is the development of integrated watershed plans. These plans are necessary to ensure the systemic, long-term changes which are necessary to improve and protect environmental conditions. Watershed modeling forecasts the dismal state of water quality and ecosystem function if current planning techniques and designs are continued. The RAP has supported the development of integrated watershed plans; plans for the Rouge and Humber Rivers are now being finalized, the plan for the Don River is under development and background work for the Etobicoke-Mimico plan is being completed. Without comprehensive planning and systemic changes to development practices and design, the RAP will not be able to improve the status of beneficial use impairments.

Other promising signs of progress include: removal of stream barriers connecting Lake Ontario to the middle portions of Rouge and Humber Rivers for native species of fish that are able to jump, over 680,000 shrubs, plants and trees have been planted in the Region in the last five years, MNR has supported the creation of over 72 ha (178 acres) of wetlands in the last five years, and Toronto now has six beaches with the international Blue Flag accreditation.

Fisheries and Oceans Canada is undertaking research in cooperation with Toronto and Region CA and the University of Toronto to assess the effectiveness of habitat restoration and compensation measures that are planned. A combination of field work and modeling is being used to assess their effectiveness at reaching BUI goals and targets identified for the system. Both fish and fish habitat have been identified as impaired BUIs in the Toronto Region.

RAP Outlook: Implementation of the Toronto and Region RAP will be a decades-long undertaking. The RAP Team is working on a proposed path forward that will ensure all priority actions are taken and required plans for implementation are in place within the next 10 – 12 years. Many of the projects necessary for this RAP are large-scale and require substantial planning and financial investments in order to move forward; as a result they take a number of years before the work can be actualized. For example, a project such as the Revitalization of the Mouth of the Don River, which will naturalize the shoreline for fish and wildlife habitat, provide flood protection, reclaim land for wildlife habitats and recreational uses and enhance pedestrian and bicycle paths linking the Don River valley and the waterfront, are complex, significant and make up critical pieces of this RAP.

Similarly, the City of Toronto's WWFMMP has a 100-year timeframe for implementation and is anticipated to cost CDN$1 billion over the first 25 year period of the plan. The implementation of WWFMMP is key to protecting water quality along Toronto's waterfront.

A lot of progress has been made in the largest urban AOC, also one of the fast growing areas in North America, but the scale of the issues needs to be recognized when considering delisting. Urban development and population growth will continue to impact Toronto and Region for many years and the RAP and its partners are focused on preventing further degradation to environmental conditions.

11.5.3 Port Hope Harbour

Background: Port Hope Harbour is located at the mouth of the Ganaraska River on the north shore of Lake Ontario, and 100 kilometres east of Toronto. The Town of Port Hope is located north of the Harbour. The AOC includes the harbour area and extends 300 metres (328 yards) from the lower Ganaraska River to the confluence area bounded by breakwalls.

Radioactive wastes were generated at a refinery (Eldorado Nuclear Limited) in Port Hope beginning in 1933. Low level radioactive wastes were initially stockpiled or disposed of in ravines and vacant lots in Port Hope during the 1930s. During the 1940s and 50s low level radioactive wastes were also placed in waste management facilities in two municipalities just outside of Port Hope. There is an estimated total of 1 to 1.5 million cubic metres (1.3 to 2 million cubic yards) of low-level radioactive waste and contaminated soils in the Port Hope area. The immediate health and safety risks have been assessed as minimal.

Within the harbour, most of the contaminant input occurred between 1933 and 1953 resulting from operations and waste management practices of the Eldorado refinery. Process wastes were stored at the site and it is likely that surface runoff was the route of contamination for the harbour. An estimated

85,000-90,000 cubic metres (111,175 to 117,715 cubic yards) of sediment containing low-level radioactive material is located within the turning basin and west slip of the harbour. Contaminants include uranium and thorium series radionuclides, heavy metals and PCBs.

In recent years, leaching of radioactive wastes and overflows at drainage ponds has occurred during heavy rains and has resulted in contamination entering the groundwater and Lake Ontario.

Impairments: Port Hope was initially designated as an AOC due to restrictions placed on dredging activities. There have been no other BUIs identified.

RAP Structure: Previously, Environment Canada was responsible for coordination of the Port Hope RAP. However, remediation of Port Hope Harbour is now following a different process, with progress dependant upon the selection and approval of an appropriate waste facility. Natural Resources Canada is working in cooperation with Environment Canada to develop the remediation of the Port Hope AOC for the larger low-level radioactive waste clean up in the Port Hope area.

In 1982, the federal government created the Low-Level Radioactive Waste Management Office (LLRWMO) to assume the responsibility of managing historic wastes in Port Hope and elsewhere in Canada. The office in Port Hope has assisted the RAP in developing costs estimates for cleanup, handling public information requests and offers assistance to residents to assess and remediate their properties. The LLRWMO has been designated by Natural Resources Canada as the proponent of the Port Hope Area Initiative.

RAP Status and Progress: In March 2001, the Government of Canada (represented by Natural Resources Canada) and the three communities of the Town of Port Hope, the Township of Port Hope and the Municipality of Clarington, entered into a legal agreement for the clean up and long term management of local historic low-level radioactive wastes, including wastes found within Port Hope Harbour. The legal agreement is based on community-developed concepts for the local, long-term management of the wastes.

With the signing of the legal agreement, the Government of Canada began a 10 year, CDN$260 million dollar plan called The Port Hope Area Initiative, to develop and implement a long-term solution. Since that time, the Town of Port Hope and the Township of Port Hope have been amalgamated into one community, the Municipality of Port Hope.

Implementation of the legal agreement for the Port Hope clean-up is now underway. The Low-Level Radioactive Waste Management Office (LLRWMO) is seeking the necessary approvals for development of management facilities for the long-term management of the wastes from the Port Hope area, including those found within Port Hope Harbour.

RAP Outlook: Natural Resources Canada is the lead for the clean-up of all historic radioactive wastes found within the local municipalities, including those within Port Hope Harbour, and will work with Environment Canada to ensure that the requirements of the RAP are met. The development of low- level radioactive waste facilities require licenses from the Canadian Nuclear Safety Commission and are subject to the Canadian Environmental Assessment Act.

In March 2007, the Government of Canada approved the Port Hope Project Environmental Assessment. The approval immediately set in motion the licensing process – the next step leading to the cleanup and long-term management of the historic low-level radioactive waste in Port Hope. The Low-Level Radioactive Waste Management Office is preparing licensing documents for submission to the Canadian Nuclear Safety Commission. The Commission will then hold hearings on the Project, expected to take place in mid 2008. The final decision on the project is expected later that year. An additional five years will be required for the physical clean up and emplacement of wastes in newly constructed long-term management facilities.

11.5.4 Bay of Quinte

Background: The Bay of Quinte is a narrow z-shaped inlet of Lake Ontario which is about 100 kilometres (62 miles) in length. It is located on the north shore of Lake Ontario's eastern basin, 135 kilometres (84 miles) east of Toronto and 40 kilometres (25 miles) west of Kingston. The Trent, Moira, Salmon and Napanee Rivers are the major tributaries to the Bay. The drainage area to the Bay of Quinte covers 17,250 square kilometers (6660 square miles), which is the largest drainage basin in Southern Ontario. Parks Canada manages the Trent-Severn Waterway, of which the Trent River is a part. Four First Nations are also located within the drainage basin.

The Bay of Quinte is a unique ecosystem within the Lake Ontario basin. Shallow, and flushed up to 10 times per year, in some respects the Bay behaves like a riverine estuary. The Bay has historically supported a large sports fishery based primarily on walleye. The majority of anglers participating in this fishery come from outside of the Quinte area and the fishery makes a substantial contribution to the local economy. In recent years the ecosystem of the Bay has been greatly influenced by invasive species, such as the zebra mussel, which, by ingesting plankton, have diverted this food source from fish species. Further, the aquatic environment has been altered by decreased nutrient loadings, all of which have reduced the area's capacity to produce walleye. The shoreline of the Bay contains 22 coastal, some of which are under pressure from urban development in the cities of Belleville, Trenton and the Towns of Napanee, Picton and Deseronto.

Impairments: A high level of nutrient enrichment and destruction of fish and wildlife habitat are considered to be linked to the majority of the BUIs that exist in the Bay of Quinte. In particular, the upper reaches of the Bay of Quinte are shallow and susceptible to local nutrient inputs from sewage treatment plants and runoff from urban and agricultural lands.

The Remedial Action Plan for the Bay identifies 10 BUIs that result from 4 main issues: i) excessive nutrients, ii) habitat loss (particularly coastal wetlands), iii) contaminated sediment from historical mining and industrial activities, and iv) bacterial contamination from sewage treatment plants, stormwater discharge and agricultural runoff (which lead to beach closures).

In addition, the incidence of fish tumours and other deformities is an issue which requires further assessment. In 2005, a histopathological tissue analysis of brown bullhead specimens from the Bay of Quinte was initiated. It is anticipated that the results of this analysis will provide a determination of the status "fish tumours and other deformities" BUI.

RAP Structure: In 1997, a Restoration Council, with membership from Federal and Provincial Government agencies (EC, MOE, DFO, MNR, OMAFRA), the local conservation authorities (Lower Trent Region and Quinte), the Mohawks of the Tyendinaga Territory, Department of National Defense and the local environmental group, Quinte Watershed Cleanup was formed to oversee the implementation of the 80 recommendations from the Stage 2 Report.

The Quinte Watershed Cleanup is a local community based group that works to promote the restoration and protection of the Bay of Quinte. This organization originated from a public advisory committee that was set up in 1988 to advise the Provincial and Federal Government during the development of the RAP.

In 2000, a major public consultation was undertaken to establish restoration targets for the Bay of Quinte. The public was supportive of the proposed delisting targets which formed the basis for a Five Year Action Plan.

RAP Status and Progress: Substantial progress toward delisting the Bay of Quinte Area of Concern has been made. Key achievements in the implementation of the Bay of Quinte RAP include:

- a 50% reduction in phosphorus loads from sewage treatment plants since 1990;
- a reduction of 16,500 kilograms (36,376 lbs) of phosphorus annually into streams draining to the Bay of Quinte;
- over 50 kilometres (31 miles) of shoreline have been planted with native trees, shrubs and grasses to reduce erosion and improve habitats;
- the rehabilitation of 354 hectares (875 acres) and protection of a further 482 hectares (1191 acres) of wetland; and
- Over 27,000 hectares (66,718 acres) of farmland have been converted from conventional to conservation tillage.

Through sewage treatment optimization for four facilities bordering directly on the Bay of Quinte, phosphorous loads have been reduced from 50 kg/day in 1986 to less than 25 kg/day in 1997. Within the Bay of Quinte, phosphorous concentrations are approaching the RAP target of 30-40 µg/L. Furthermore, water clarity is improving and the algal blooms are less severe. Direct discharges of industrial wastes have been substantially lowered, and beach closings occur on a less frequent basis.

A phosphorus budget and simulation model were developed by Fisheries and oceans Canada as a tool to guide development of a phosphorus management plan, evaluate future loading scenarios, assess the consequences of reduced tributary flow due to climate change and evaluate the role zebra mussels play in phosphorus recycling.

An ECOPATH ecosystem model was developed by Fisheries and Oceans Canada, Ontario Ministry of natural Resources and Cornell University to evaluate the impact of invasive species and guide fisheries management decisions.

Fish habitat classification and modeling projects are currently underway to assess delisting status and guide further refinement of the fish habitat management plan.

Project Quinte, a long term cooperative research and monitoring project between fisheries and oceans, OMNR and OME has been in place for over 30 years. This program has served as the backbone for evaluating the impairment status of all the biological BUIs and is the key component to both determining whether this RAP can be delisted and ongoing assessment under Stage 3 of the RAP.

A draft Fisheries Management Plan for the Bay of Quinte has been developed and it is expected to be finalized early in 2008.

RAP Outlook: In September 2006, the Restoration Council adopted a 2006 - 2010 Workplan which is to address the remaining remedial actions identified in the Stage 2 RAP. Upon completion of all the remedial actions the Bay of Quinte will move from an Area of Concern to and Area in Recovery.

A component of the work plan is the development of a phosphorus loading model that will assist the Restoration Council in determining and implementing a phosphorus management strategy for the Bay. The phosphorus management strategy may include recommendations for changes to municipal phosphorus loading "caps".

Detailed delisting criteria for fish and wildlife communities and habitats have been developed. Additional habitat conservation and protection measures may be required based on existing natural heritage strategies and the fish habitat management plan.

11.6 Actions and Progress

The information contained in this chapter has been compiled based on past documents and was updated as of December 2003. The RAP process is a dynamic one and therefore the status will change as progress is made. This chapter will be updated in future LaMP reports as appropriate.

11.7 References

Environment Canada, Remedial Action Plan Web site: http://www.on.ec.gc.ca/water/raps/

Government of Canada, Canada's RAP Progress Report 2003, Restoration Programs Division, Environmental Conservation Branch, Environment Canada-Ontario Region, 2003.

Great Lakes National Program Office (GLNPO) Web site: http://www.epa.gov/glnpo/aoc/

CHAPTER 12 LAMP WORKPLAN ACTIONS AND PROGRESS

12.1 Summary

Seven agencies now work together to implement the Lake Ontario LaMP through an updated binational workplan. This workplan became effective in January 2007 and enhances binational efforts to restore and to protect Lake Ontario and its biological resources. The workplan now identifies agency activities according to four major work areas:

- Chemical Contamination and Monitoring;
- Physical and Biological Impacts and Environmental Assessments;
- Public Outreach, Consultation, Reporting, and Communicating Actions; and
- Other Action Initiatives (e.g. the nearshore and climate change).

The workplan is a fundamental component in the LaMP process to direct limited resources, identify priorities, and maintain progress towards achieving the goals and objectives. The revised workplan now combines the previous short term and long term plans into one document. It accomplishes this by listing activities under the four major work areas and then identifying, in separate columns, short term (3 year) and longer term (5 year) outputs.

An additional column in the workplan reports on the status or assessment of each activity. The short term (3 year) outputs for each activity have been established to be consistent with the commitments of the Canada-Ontario Agreement (COA). The long term (5 year) outputs also reflect the desired results.

New activities identified under the expanded four major work areas include: fish populations, additional ecosystem indicators where appropriate, the Binational Biodiversity Conservation Strategy, agency and plan links, water levels, nearshore areas, climate change, and research. The activity listings address many topics including outreach and stewardship. However, in the near term special attention is to be concentrated on the following activities:

- Conducting Lake Ontario Intensive Cooperative Monitoring during 2008,
- Continuing reduction of critical pollutant loadings to Lake Ontario,
- Reporting on ecosystem indicator status and invasive species efforts,
- Evaluating sediment and tributary samplings,
- Broadening partnerships to implement habitat conservation strategies,
- Conducting public outreach to benefit the stakeholders and LaMP,
- Incorporating nearshore plans into LaMP planning,
- Continuing to assess impact of climate change on Lake Ontario.

Note: This workplan now includes the 5 year plan activities and therefore Appendix D (previously containing a standalone 5-year workplan) is to be deleted from the Status Report binder document in 2008.

Lake Ontario Lakewide Management Plan
Binational Workplan (2007-2011)

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
1. Update **Ecosystem Indicators**: make progress on additional indicators and define pollutant reduction targets.	2007 –Agency sign-off for Chapter 3 addressing Ecosystem Indicators has been accomplished and wording now incorporated into LaMP binder.	The LaMP addresses eleven Ecosystem Indicators Chapter 3 contains current information and will be reviewed for updating in the Status Report 2010.	• Adopt indicators as appropriate; develop data and target level goals for indicators; • Report on progress; use trend data. • To update in 2010
2. Update **Critical Pollutant List & Status**:	2008-09 - Consider listing/delisting chemicals; and, relationship to BTS	Sources & Loadings of critical pollutants updated in Status Report 2006	• Assure critical pollution prevention strategies are sound. • Present data for better public understanding. • Continue to assess environmental impact(s).
3. Evaluate **Sediment Core** data:	2007 – collect two sediment core samples (one from the Lake Ontario central basin & one from the Niagara River bar). 2008 – Review workshop strategies, recommendations, and need for further sediment core/assessment and costs.	Funded coring conducted in 2007 at the Niagara Bar and in deepwater deposition zone (Rochester Basin); Analyses and reporting are underway.	Determinations to be consistent with the SOLEC indicators and a long-term binational monitoring plan. LaMP to evaluate sediment core data as a new LaMP indicator of contaminants. Focus will be on surficial sediments and trends.
4. Update **Cooperative Monitoring** activities:	2007 – Two Cooperative Monitoring Workshops have been held which involved agency staff and academic scientists/modellers/ researchers. 2007 - Publish workshop report including issue papers and recommendations 2008 – conduct Lake Ontario Cooperative Monitoring 2009 – Analyses of Lake Ontario Data	March 27-28, 2007 conducted Chemical workshop Oct 23-24 2006 conducted Biological workshop Five main areas of Assessment: • Offshore • Nearshore/shoreside • Lower Foodweb • Lake trout • New Technologies	LaMP parties to continue data analyses; publish synthesis reports; facilitate long term approach to binational monitoring strategy. Continue Cooperative Monitoring Years on a five year cycle for identification of improved understanding of ecosystem processes for Lake Ontario. Propose a State of Lake Ontario Conference/ Workshop to present results of Cooperative Monitoring

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• Coordinate **Side-by-Side** analytical comparisons among participating LaMP parties.	2007 to 2008 – Party participants to evaluate data from Phase IV. 2008 – Participants to prepare summary of data & submit a report to the LaMP on the comparability of results. (summary reports from 2005 are pending) Due to good preliminary results, the Side-by-Side analysis has been incorporated into Cooperative Monitoring implementation.	The Side-by-Side comparisons have verified a consistency and confidence level in data to proceed with and focus on the next phase of cooperative monitoring.	LaMP to facilitate coordination amongst the Parties concerning the practical application of the comparability evaluation.
• Coordinate **Atmospheric Deposition** study.	2008 –calculate loads of dioxins and PCBs to Lake, based on sampling.	Reported on mercury load calculations and other findings and incorporated into LaMP Status Report 2006.	LaMP to prepare synthesis report and define the impact of Atmospheric Deposition on the lake.
Lake Ontario **Toxic Surveys** - chemicals monitoring surveys.	2007 – Ontario sediment cores and sample analyses. 2007 to 2009 – MOE to conduct Lake Ontario Urban Interface - pathways of legacy and emerging chemicals. 2008 – EC-three open lake surveys 2008 – OMOE - nearshore survey 2008 – OMOE to conduct Lake Ontario - Intensive Chemical Monitoring Passive Monitoring Array (emerging chemicals) nearshore/offshore and intake zones 2008 – report on Niagara River Mussel BioMonitoring		OMOE & EC continue data analyses. LaMP to prepare synthesis report. Examples: YOY, fish tissue, Gull eggs

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
5. **CDN – Canadian Source Monitoring & Assessment**: • Report on priority watersheds to include status information; remedial measures; monitoring; recommendations for further action.	2007-08- EC to do further confirmation & follow-up sampling. EC to report on follow-up work (areas with PEL exceedances) with recommendations for further action. EC/OMOE to prioritize areas and develop workplan for follow-up work/trackdown strategies. EC/OMOE to prepare final report with recommendations for PEL exceedances.	MOE to work with partners to continue to implement the Provincial Monitoring Network within Lake Ontario tributaries and provide information to LaMP partners Tributary loadings are being estimated using existing data by the Lake Ontario Consortium Study under Source Water Protection	Address issues arising from collated data.
5. **US – United States Source Monitoring & Assessment**	2007 to 2009 - EPA Tributaries Sampling for critical pollutants, analyze samples and prepare report.	New data will be incorporated into Chapter 6 of the Lake Ontario Status Report 2010.	Focus on chemical presence and environmental impacts to determine trackdown priorities and necessity of remedial measures

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
6. **CDN – Canadian Source Trackdown**: • PCB trackdown at 12 Mile Creek, Cataraqui River & Etobicoke Creek. • Mouth of the Trent River (Bay of Quinte watershed) – High levels of Dioxins/Furans have been located in the sediment at the mouth of the Trent River. • Pringle Creek/ Whitby Harbour – OMOE identified elevated levels of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans in sediment and biota.	12 Mile Creek – On-going follow-up being conducted. Voluntary sampling being conducted by the City of St. Catharines. Etobicoke Creek – **2007** continue with Etobicoke Creek PCB Trackdown to isolate PCB sources and work with/ support local MOE District actions, as needed, to abate source(s) of PCBs Cataraqui River – **2007** Re-assessment phase: conduct monitoring to assess remedial measures (dredging) undertaken and report on post clean-up assessment • **2007** ecological risk assessment initiated in spring. Draft report expected in Fall 2007 • **2007** ecological risk assessment to be completed. Final report on findings in 2008	Continue with 12 Mile Creek/ L. Gibson PCB Trackdown work to isolate source(s) Scientists to work with/support local MOE District actions, as needed, to abate source(s) of PCBs Trent River Mouth The Preliminary Human Health Risk Assessment Report, prepared in July 2006 for the Trent River Mouth Steering Committee, concluded that there is no additional health risk for people using the Trent River mouth area for swimming. The OMOE identified a former wood preserving site as an ongoing source of dioxins and furans to the river and is actively working with the company to determine the extent of the contamination and to find solutions to reduce and/or control the contamination. The Ecological Risk Assessment report concludes that there is no justification for removal of the sediment and recommends to: • require further contaminant source control; • delineate further contaminated sediment deposition in the western Bay of Quinte; and • update/ initiate an ecological risk assessment and/or a sediment management assessment in the future should source control be unsuccessful.	Continue work on 12 Mile Creek & Cataraqui River. OMOE to complete report on 12 Mile Creek; determine & implement remedial action plans for 12 Mile Creek, Etobicoke Creek and Cataraqui River if and where required. • Plan additional trackdown work within identified priority watershed areas if warranted. • OMOE is currently carrying out further studies to assess remedial options.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
6. **US – United States Source Trackdown**:	2007 – Genesee River - Monroe County to conduct next phase study of PCBs in Rochester's westside Interceptor System. 2007 to 2008 – Buffalo River - Sediment Remediation Feasibility Study to be conducted on the lower River; the initial phase of Legacy Act funding has been awarded by EPA.	Ongoing	LaMP to incorporate results of trackdown activities and progress in remediating / controlling contaminant sources in future LaMP reports. NYSDEC to follow-up on additional monitoring and remedial actions where indicated. Conduct monitoring, assess data, and report on source trackdown activities and implementation projects, as needed.
7. **Chemical Contamination Reduction Strategies** :			
• **Regulatory** actions and pollution prevention	2007 to 2009 – LaMP to facilitate & coordinate transfer of information from LaMP Parties to appropriate enforcement, regulatory & remedial action branches of their agencies 2007 to 2009 – LaMP to report new regulatory actions & progress of LaMP agencies.	Ongoing	LaMP to liaise with enforcement branch of LaMP agencies & track regulatory actions in the Lake Ontario basin.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **Voluntary** actions and pollution prevention	2007 to 2009 – Clean Sweep – Ontario Waste Agricultural Pesticides Collection Program to offer Ontario farmers safe, free disposal of outdated, de-registered, unwanted pesticides. 2007 to 2009 – Monroe County, NY to implement a mercury educational and sampling effort funded by EPA.	LaMP to coordinate with Binational Toxics Strategy and agencies' hazardous waste minimization & pollution prevention programs to encourage action on sources polluting Lake Ontario. LaMP to identify existing grants & programs; develop a strategy for promotion of pollution prevention programs. LaMP to facilitate partnerships between stakeholder groups for promoting pollution prevention.	LaMP will work to bring together our partners with agency programs that deliver Binational Toxics Strategy's programs. LaMP to continue to promote pollution prevention strategies and programs through partnerships. LaMP to report on future pesticide clean sweeps in LaMP *Update*. Continue mercury educational effort in Monroe County, NY; LaMP to report on results of activities.
• **Mass Balance Model** for PCB load reduction activities.	2007 to 2009 – EPA to integrate new data from cooperative monitoring into the mass balance model for PCBs. Extend model to include the Niagara River and mercury and applicability for other critical pollutants.		1) The LOTOX3 mass balance model (which includes the Niagara River), when utilized in conjunction with other regulatory tools, will be applied to improve the assessment and responses to Lake loadings 2) LOTOX models have applications to TMDL considerations. 3) Apply the LOTOX3 model to assist management decisions on when fish can be eaten and also influence the research on pathways and exposure.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
1. Update **Ecosystem Indicators** and consider additional indicators and targets for physical and biological objectives as information becomes available:	2007 – Chapter 3, Ecosystem Indicators, was updated and incorporated into the Lake Ontario LaMP Status Report.	The LaMP addresses eleven Ecosystem Indicators. Chapter 3 contains current information and will be reviewed for updating in the Status Report 2010.	LaMP to identify & assemble information on additional indicators; adopt as appropriate.
• **Mink and Otter** indicator	The research and impact assessment on the mink /otter indicator has been completed. Monitoring is ongoing and new information will be incorporated into the indicator reporting as it is available.	To update as information is provided.	Researchers to continue the collection & analysis of harvest statistics on mink/otter and report on status and update as appropriate.
• **Bald Eagle** indicator	2007 – Final report to be distributed to agency staff & potential partners such as local planning boards. 2008 – Phase 2 Bald Eagle report now underway - to encourage partnerships to conserve & restore identified bald eagle habitat areas & to develop new nesting sites.	Ongoing	LaMP to review status of bald eagle habitat efforts.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **Fish** indicators	2007 – Lake trout restoration plan is in the process of being updated by LOC. 2008 – LOC State of the Lake Report to provide measures of fish indicators. 2008 – Intensive monitoring year to provide improved lake-wide measures of lake trout status. 2008 – LOC to update Fish Community Objectives including objectives and indicators for nearshore, offshore pelagic, and offshore benthic fish communities. 2008/09 – LOC to adopt restoration plans for lake trout, lake sturgeon, and deepwater cisco, 2008/09 – Atlantic salmon restoration to be advanced with research and implementation of restoration actions. 2009 – American eel restoration to be advanced with research and implementation of restoration actions	Use LOC Fish Community Objectives as LaMP fish indicators	OMNR, NYDEC, USGS, USFWS, and DFO work through LOC to advance Fish Community Objectives and refine indicators for prey fish diversity and community health. OMNR, NYDEC, USGS, USFWS, and DFO work through LOC, to develop a new indicator for the fish community connected to the nearshore. Comprehensive management strategy for Lake Ontario, St. Lawrence River and Atlantic Coast (OMNR) OMNR to report on effectiveness of restoration actions to restore American eel populations in Lake Ontario.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **Coastal Wetlands** Indicator	• Work with Great Lakes Coastal Wetlands Consortium to develop implementation plan for proposed wetland indicators. • Identify outputs and assess if that program activities are appropriate and viable to support the indicator.	Work underway, pilot protocols tested in Durham Region and Bay of Quinte Discussions also underway with IJC as part of adaptive management approach to proposed changes in water level regulation	Begin monitoring and reporting on coastal wetlands indicator.
• **Physical Integrity**	• 2008- Develop white paper indicator proposal on land use, imperviousness, urbanization and trends. • 2008- Identify possible indicator and assess if program activities are appropriate and viable to support the indicator. • 2009- LaMP to adopt indicator.	LaMP in planning steps of developing a white paper on possible indicator. Imperviousness maps being prepared by NCC/TNC as part of the Binational Biodiversity Conservation Strategy.	Begin monitoring and reporting on a physical integrity indicator.
2. Assessment of LaMP Beneficial Use Indicators:	See Beneficial Use Impairment bullet items directly below for consumption advisories, and degradations of benthos, plankton, and fish populations:		

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **Contaminants in fish** (consumption advisories)	LaMP to review current status and trends and report. Activities include: 2007 – MOE/MNR & NYDEC/ NYSDOH maintain/publish sport fish consumption advisories 2008 – MOE/MNR to collect and analyse for chemical contaminants in juvenile fish and y-o-y fish in support of binational intensive chemical monitoring of Lake Ontario 2008 – Gather fish tissue information, integrate and perform trend analyses leading to indicator assessment. 2008 – LOC State of the Lake report provides summary of status and trends in contaminants in fish. 2009 – Produce analytical report of preliminary findings.	Agencies continue contaminant analysis and assessment for input to consumption advisories including: • EPA annual monitoring of lake trout at North Hamlin/Oswego for Lake Ontario chemicals of concern. • Collect & analyze salmonid eggs/ fillet muscle tissue from Salmon River Altmar Fish Hatchery for PCBs, organochlorine pesticides (OCs) & polybrominated diethyl ethers (PBDEs). • OMOE/OMNR to continue program to sample sportsfish in Lake Ontario and sportsfish and Young-of-the-year at Areas of Concern, and analyze for contaminants.	EPA to continue annual fish monitoring for priority critical pollutants and emerging chemicals in whole fish. OMOE to continue annual fish monitoring for priority critical pollutants. LaMP to recommend management & regulatory policy efforts, if needed. The goal of the indicator is to eliminate the consumption advisories which represent environmental impacts in the fish The LOC report provides an overall assessment. LaMP to identify data gaps and make recommendations as appropriate. 2010 – Produce LOC final report; incorporate BTS findings and recommendations. 2010 – Synthesis and Report on Progress regarding agencies findings; identify additional needs; report on trends.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• Degradation of **Benthos, Phytoplankton, Zooplankton**	• 2008 Ontario - Lower Aquatic Food-web Whole Lake Assessment (MOE Near-shore Survey Assessment). LaMP working under the Cooperative Monitoring Initiative (CMI). • 2009 Complete data analyses of Lake Ontario Lower Aquatic Foodweb Assessment (LOLA). • 2009 LaMP to prepare LOLA synthesis report with recommendations for future actions.	• LaMP to better define indicators for lower food web. • MOE to conduct Pickering shoreline cladophera project • 2003 LOLA report was completed with information presented at workshop and articles published. • Physiological indicators of Mysid health and growth are being developed.	

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• Degradation of **Fish populations**	2008 – LOC State of the Lake Report provides fish community indicators and measures of status of lake-wide fish populations. Includes status of fish populations in nearshore, offshore pelagic, and offshore benthic areas of the lake. Data derived from assessments of sport and commercial fisheries, and fishery independent assessments in the lake and tributaries. Surveys carried out by OMNR, NYDEC, USFWS, DFO, USGS, and other partners. 2008 – Use LOC State of the Lake Report to evaluate status of this impaired use indicator. 2008 – Intensive monitoring year provides improved lake-wide measures of lake trout status. 2008 – LOC updates Fish Community Objectives including objectives and indicators for nearshore, offshore pelagic, and offshore benthic fish communities. 2008/9 – LOC adopts restoration plans for lake trout, lake sturgeon, American eel, and deepwater cisco.	LOC continues to coordinated lake-wide assessments of fisheries carried out by NYDEC, OMNR, USGS, USFWS, DFO and other partners. Results incorporated in LOC annual reports and State of the Lake reports. Cooperative Monitoring year provides opportunity for expanded fish community assessment including lake-wide lake trout assessment. NYSDEC Creel Survey to be carried out to obtain information on # of fish caught by species & other information in 28 Lake Ontario tributaries. Data will improve understanding & management of the fishery. USFWS to continue assessment of Niagara River lake sturgeon population.	Continue to use LOC Fish Community Objectives and State of the Lake Report to evaluate beneficial use impairment and consistency. Track annual report and encourage decision making to address impairment causes and better accomplish and define the fish community objectives (to address loss of native species, restoration and recovery planning) OMNR, NYDEC, USGS and partners advance research and development of approaches to introducing deepwater ciscoes in Lake Ontario.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• Degradation of **Fish populations** continued	2008/9 – Atlantic salmon restoration is advanced with research and implementation of restoration actions included research into thiamase and food web interference with restoration success. 2007/2008 – LOC advances plans to restore offshore food web with reintroduction of deepwater cisco. LaMP supports pursuit of resources for these restoration efforts. 2007/08 – DFO conducting research into the role of thiaminase in the diet of Atlantic Salmon as an impediment to restoration initiative. 2007/08 – DFO conducting research on how the shift in diet during the development of Lake Trout and Chinook Salmon contributes to thiaminase deficiency and impacts on reproductive success. 2007/08 – 2010 – DFO funding a project to establish a conceptual framework and development of a Watershed-based Fish Passage Decision Tool for Science and Management Applications in DFO. OMNR is a partner in this project.		Provide scientific advice on impediments to native species restoration. Provide scientific advice on role of changing diet and alewife on thiaminase deficiency in to both native and introduced salmonids. This work will serve in developing an assessment tool to help resource and habitat managers identify and prioritize dam development projects that will restore eel's free passage to quality rearing habitats. Barrier and stream network data used for eel can be applied to any diadromous or catadromous fish species (e.g. sturgeon and salmon).

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
3. **Assessment of other LaMP Indicators and impairment concerns**:			
• **Binational Biodiversity (Habitat) Conservation Strategy**:	2007/2008 – EPA funded TNC to complete binational GIS data base of species & ecological systems; LaMP agencies to begin working with TNC on developing binational habitat strategy. 2008 – Report on progress of Binational Biodiversity (Habitat) Conservation Strategy and relationship to LaMP workplan.	Workshop to discuss strategies held Dec. 2007.	LaMP partners to review binational strategy and develop implementation plans.
• **Canadian Habitat Strategy Implementation**: Assessment and Watershed Management.	Canada LaMP partners to identify & promote watershed management strategies in conjunction with Conservation Authorities (CAs) and other agencies. 2008-09 – Check with the Ontario Conservation Authorities (CAs) on the status of Lake Ontario watershed plans 2008-09 – Report on integrated watershed plans being prepared by CAs address source water protection plans. 2008-09 – Report on natural heritage strategies being prepared by CAs are identified and incorporated into official municipal plans	MOE to initiate Source Water Protection Planning through engagement of Conservation Authorities, municipalities and other partner organizations and groups within Canadian portion of Lake Ontario basin MOE to ensure LaMP partners are kept appraised of progress on these watershed plans.	Canadian LaMP partners to establish partnerships between stakeholders to assist municipalities with the implementation of watershed management strategies.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **US Habitat Strategy Implementation**	2007- EPA funded New York Rivers United project to begin a review of opportunities to restore upstream passage along Lake Ontario tributaries. 2007-2008 Binational habitat conservation strategy to be developed.	New York Rivers United completed its review of priority dams and selected several for further review. Projects were started on 2 dams. NYSDEC Comprehensive Wildlife Conservation Strategy completed; with this, the focus is on species in greatest need of conservation & management needs & strategies. Binational Habitat Conservation Strategy nearing completion; implementation plans will take place after strategies are agreed upon.	New York Rivers United project to begin the second phase of review. The results will be reviewed by US LaMP partners to determine next steps. US LaMP partners will promote implementation of identified binational habitat priorities.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **Water quality surveys and Biomonitoring** (for routine and ongoing Lake Ontario monitoring and assessment)	2007/2008 – NYSDEC, USFWS & Cornell University cooperative monitoring. Conduct annual monitoring of phosphorus, chlorophyll a & zooplankton in NY waters. Results to be reported annually in NYSDEC Lake Ontario Unit, the St. Lawrence Unit Annual Report to the Lake Ontario Committee, & the LaMP. 2007/2008 – EPA to monitor Lake Ontario Spring & Summer at open lake stations each year. 2008 – EC to conduct open lake water quality surveys. 2007/08 – DFO Annual fall assessment of mysid and *Diporeia*. 2008 – Lake Ontario Binational Cooperative Monitoring Year – collaboration of many agencies to sample lake water & biota and assess the state of the lake.	Ongoing 2008 Lake Ontario Monitoring Year is in the planning stages.	Continue NYSDEC, USFWS & Cornell University annual cooperative monitoring of phosphorus, chlorophyll a and zooplankton in NY waters. Results to be reported annually in NYSDEC Lake Ontario Unit, the St. Lawrence Unit Annual Report to the Lake Ontario Committee, & the LaMP. EPA to continue annual open lake water quality monitoring. Agencies will determine future cooperative actions.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **Other** – Work with Great Lakes Fishery Commission's Lake Ontario Committee to identify priority projects & investigations; develop common indicators.	2008 – Provide input to Lake Ontario Committee (LOC) revised Fish Community Objectives for Lake Ontario. 2008 – LaMP to work with LOC to use Fish Community Objectives and State of the Lake report to update the status of beneficial use impairments for fish populations. 2008/09 – LOC works with the LaMP to use LaMP ecosystem objectives to develop environmental objectives to support the Fish Community Objectives.	Ongoing	Continue to partner, share information with Great Lakes Fishery Commission and the Lake Ontario Committee.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
4. **Invasive species**	2007 – Review results of the LOLA project 2007/2008 – USFWS to continue annual survey for Ruffe in Genesee River. 2007/2008 – USFWS, DFO and MNR to conduct surveys for distribution of New Zealand mudsnails and *Hemimysis*. 2007/08. DFO AIS monitoring to conduct *Hemimysis anomala* survey in many Great Lakes locations including Lake Ontario. 2007/08 – DFO Centre of Expertise for Aquatic Risk Assessment (CEARA) and OMNR to conduct biological synopsis and risk assessment for *Hemimysis anomala*. 2007/08 – DFO, Transport Canada and CAISN conducting ballast water monitoring to determine if ballast water exchange/flushing procedures provide sufficient protection against AIS, or whether it will be necessary to implement more stringent regulations for ballast water management. 2007/08 – DFO conducting research to quantify the risk associated with inter-lake movement of commercial ships as a pathway for the secondary spread of aquatic invasive species (AIS). Results will determine whether or not requirement of ballast treatment technologies should be implemented for the Great Lakes' shipping fleet.	2006 LaMP Status Report (Chapter 4) addresses the update on information and research on invasive species and recommends appropriate management options and strategies Results may be reported at GLFC annual meetings. Results may be reported at GLFC annual meetings. Risk assessments are published as formal science advice within DFO Results will be published as reports or peer-reviewed science papers.	Share LOLA findings with agencies charged with AIS management. All LaMP parties to continue to liase with appropriate agencies in working on the management & prevention of new AIS. USFWS will continue work on distribution, abundance and impacts of various AIS and newly introduced species AIS monitoring program to continue but species and pathways may vary annually. Risk assessments will be conducted for DFO national priorities. May include Lake Ontario depending on priority setting in the CEARA workplan Protection of Lake Ontario from the risk of introduction of AIS through 100% compliance on exchange regulations or the implementation of additional control strategies. Protection of all the Great Lakes from the risk of spread of AIS throughout the basin from the Great lakes shipping fleet.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
5. **Emerging Issues**:	2007 – LaMP to facilitate & promote collection of information on emerging issues. 2007 – LaMP to assess available information & research and recommend appropriate management options & strategies where necessary. 2008 – US LaMP partners to determine interaction with Great Lakes Regional Collaboration strategy.	LaMP needs to identify what are the emerging issues (new and on-going) and develop action plans to address them.	LaMP to continue building awareness of emerging issues in the basin.
1. **Partnerships**	2007 to 2009 – LaMP to continue to seek out partnerships for public involvement opportunities; provide LaMP information, display, public outreach materials; continue partnership with the IJC water levels study.	Attended the "Annual Fish & Wildlife Festival and Youth Fishing Contest," June 2, 2007 – Hyde Park, Niagara Falls, NY. The goal of this event is to educate the public about ongoing conservation and environmental activities in the Lower Great Lakes basin.	Promote & pursue the concept of establishing additional locations for LaMP displays at various existing museums, or other venues, on both the Canadian side and US side of the Lake Ontario basin. LaMP to work with other agencies as appropriate.
2. **Stewardship**	2007 to 2009 – LaMP to develop a strategy for more proactive promotion of stewardship; identify community-based actions & partnerships. Continued partnership with the Marine Museum in Kingston, to maintain EcoGallery featuring the LaMP.		LaMP helps local groups to implement "grass-root efforts" that make a difference on the ground and achieve LaMP needs. Provide expertise; develop capacity. Establish understanding of the LaMP, funding resources, and value added.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
3. **Reporting**:	*LaMP Update* annually 2008 – biennial *LaMP Status Report* in 2008 to highlight 20 years of progress of the LaMP/LOTMP and these chapter updates: • State of the Lake • Habitat • PIC • AOCs • Next Steps • Workplan • Appendix C • Appendix D	*LaMP Update* 2007 mailed to mailing list September 2007 Planning for *LaMP Status Report* 2008 taking place	Publish *LaMP Status Report* every two years; and Publish *LaMP Update* annually.
4. **Binational Public Meetings**:	Joint Lake Ontario LaMP and Niagara River Toxics Management Plan (NRTMP) meeting to be held in Grand Island, NY.	Public meeting held October 24; (Joint management meetings conducted October 23-25, 2007).	Convene binational public meetings to assure LaMP understanding and public support.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
5. **Outreach**:	LaMP to review update of display; produce other materials as needed and required to facilitate public awareness and appreciation for LaMP activities and goals. Communicate "what is happening on Lake Ontario" both to the stakeholders and to senior management. Address new and evolving issues and establish connection of citizens to the lake. Demonstrate benefits and accomplishments from resources applied to LaMP. Update & maintain Lake Ontario LaMP website, and active mailing list. Encourage other Great Lakes and non-governmental organizations to add links from their websites to the Lake Ontario LaMP website.	Publications posted on binational.net and agency websites	LaMP materials communicate Vision and Goal for Lake Ontario and involve stakeholders to experience ongoing activities for restoration. Accomplish Lake Ontario message communication. LaMP to continue to update websites and the network of involved and interested groups and individuals.
6. **SOLEC/IJC Meetings**:	Participate in IJC Great Lakes Conference & Biennial Meeting (2007 and 2009) and SOLEC in 2008. Prepare briefing materials and other input to support the SOLEC process.	LaMP MC members present at IJC meeting 2007.	Participate in alternating biennial meetings of SOLEC (even years) and IJC Conferences (odd years). Ensure that SOLEC biennial meetings accurately reflect current LaMP assessments and trends.

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
1. **Internal Government Coordination**:	Identify and communicate actions to accomplish LaMP goals	LaMP to continue to promote information & data transfer.	LaMP to make linkages with other programs conducted by own agencies to influence and contribute. Make updates and other outreach material available internally.
• **Agency Coordination and Plan Links** (e.g. AOCs, Fisheries, Habitat, wetlands, etc.)	Identify connections and activities contributing to LaMP objectives. Influence other programs to accomplish LaMP objectives. Build on Canada-Ontario Agreement (COA) Workplan. Identify program alignment(s) for agencies to address LaMP objectives.	Ongoing	Assure that coordination of agency programs address information and restoration needs for the LaMP. LaMP to make connections with other LaMPs and AOCs to share on issues of common concern.
• **Links to other LaMPs**:	Identify common goals and issues. Work with other LaMPs to accomplish Lake Ontario LaMP objectives. Dialogue / coordinate thru BEC and SOLEC mechanisms.	Ongoing	Address invasive species and ballast water impacts; take specific action; bring task group recommendations forward. Share informaton to address: • upstream sources • out of basin stressors • common areas of collaboration • technology transfer

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
• **Water Levels Control** – Establish value added linkages to International Joint Commission's water levels study.	2007-08 – LaMP to integrate new technical data & information into LaMP reports, where applicable. 2007-08 – LaMP to review Lake Ontario /St. Lawrence River water levels control study. 2007-08 – determine LaMP role, monitoring needs, and regulation adoption strategy.	LaMP is participating in ongoing study reviews.	LaMP partners to follow the effects of any water levels control changes & develop adaptive management recommendations where feasible.
2. **External Coordination**:	Communicate and coordinate goals and projects with interested parties outside the LaMP.	Ongoing	Interested parties outside of the LaMP are aware of LaMP goals and projects.
• **Information and data transfer**:	LaMP to submit data for inclusion into other databases, such as the IJC database. LaMP to promote information exchange and the availability of data for the public and stakeholders.	Ongoing	LaMP to continue to promote information & data transfer.
• **Facilitate Project Implementation**	Identify and support partner initiatives to achieve LaMP goals.	Ongoing	Initiatives identified and supported.
3. **Nearshore Plans/ Projects**: address environmental impacts	Determine how to address environmental impacts and incorporate nearshore plans and nearshore organizations into the LaMP workplanning	Ongoing	Assess implementation activities to benefit the nearshore

ACTIVITY	2007-2009 Outputs	Status - Assessment	Desired 2011 Outputs
4. **Human Health Issues**:	LaMP partners to liaise with the Binational and Canadian Great Lakes Public Health Networks, and/or Human Health agencies, to gather/exchange information on current & emerging human health issues of relevance to the LaMP. LaMP partners to identify actions & address current & emerging human health issues of relevance to the LaMP & make that information available to the public. • MOE/MNR to collect and analyse chemical contaminants in sport fish from Lake Ontario. Use these data to update MOE/MNR "Guide to Eating Ontario Sport Fish." • NYSDEC to collect and analyze sport fish for updating the New York State Department of Health "Chemicals in Sportfish and Game" health advisories.	LaMP continues to maintain connection with the Binational Great Lakes Human Health Network, the Canadian Great Lakes Public Health Networks, and Human Health agencies. LaMP continues to work with Network to gather/exchange information pertaining to human health. LaMP agencies continue to provide the public with advice on the safe consumption of Lake Ontario fish.	LaMP to continue awareness of human health concerns in the basin and connection with Binational Human Health Network. US and Canadian LaMP agencies to continue to provide updated information to the public on the safe consumption of Lake Ontario fish. LaMP partners, in association with human health organizations, the binational Great Lakes Human Health Network and the Canadian Great Lakes Public Health Network, will continue to promote human & ecosystem health within the Lake Ontario basin & will disseminate information on the human health impacts of environmental contaminants.
5. **Climate Change**:	Continue to assess the impact of climate change on Lake Ontario.	Ongoing	Assess impact of climate change on Lake Ontario water levels, species, and the lake basin.
6. **Research and Monitoring**:	Identify and support LaMP priorities for research and monitoring.	Ongoing	Accomplish needed research and monitoring for the Lake Ontario basin.

CHAPTER 13 LAMP NEXT STEPS

13.1 Summary

The LaMP parties will continue their cooperative efforts towards the restoration and protection of Lake Ontario and its ecosystem. The LaMP workplan outlines details of activities by the LaMP parties for the next 5 years. In the upcoming years, special attention will be concentrated on the following activities:

- Coordinating binational monitoring efforts and programs to better assess the health of Lake Ontario and its ecosystem.
- Reducing critical pollutant loadings to the Lake.
- Reporting on the status of the LaMP's ecosystem indicators, and adopting new indicators.
- Assessing the current status of the lower food web and the fisheries.
- Re-evaluating the status of the Lake's beneficial use impairments, as needed.
- Developing a binational habitat conservation strategy and actions.
- Conducting public outreach and promoting LaMP partnerships and stewardship of the Lake and its watershed.

The updated workplan and relevant documents can be viewed on the website at www.binational.net.

13.2 Next Steps

The parties of the LaMP will continue efforts to restore and protect Lake Ontario and its biological resources. The LaMP workplan directs and determines progress towards achieving this goal. An updated LaMP workplan became effective in January 2007 and is based on a 5-year schedule. Some of the activities that the LaMP is pursuing are described below.

Contaminant trackdown efforts in the US and Canada will continue so that contaminant sources can be identified and addressed.

Coordination of binational monitoring efforts, particularly those related to the LaMP's ecosystem indicators, has proven to be valuable for the LaMP, and will continue to be a special area of emphasis for future years. Planning is underway to continue the data analysis from the major binational monitoring efforts, to disseminate this information and evaluate the management implications and follow-up that will evolve from these efforts. A focused effort is the 2008 Lake Ontario Binational Monitoring planned for the lake.

Further assessment of the Lake is planned including the possible development of new indicators, e.g. habitat including physical integrity, coastal wetlands; stewardship and sediment.

The Lake Ontario LaMP has leaped ahead in binational cooperative projects and sharing in recent years. We plan to continue and expand our collaborative efforts in the areas of bald eagle conservation and restoration and monitoring sediment contaminants.

A binational effort is underway to enhance habitat management. This will result in a binational data base and strategy and actions for conservation. The coordinated work will draw information from the Canadian habitat assessment, New York State's Comprehensive Wildlife Conservation Strategy, and other relevant habitat documents.

The LaMP is interacting with the International Joint Committee on its study of a possible change in water level control by the Lake Ontario-St. Lawrence River Water Control Board, and the adaptive management actions that will be needed to monitor and mitigate any potential adverse impacts.

Since the ecosystem is constantly evolving, the LaMP will continue to re-evaluate the Lake's beneficial use impairments as new information becomes available to update their current status.

The LaMP will continue to be vigilant on issues such as: the protection and restoration of native species (i.e., Lake trout, American eel); the prevention of introduction of new non-native species; the continuing colonization of the lake by non-native species such as zebra/quagga mussels, fishhook/spiny waterfleas, and round gobies; the effects of rapid urbanization of the western end of Lake Ontario; emerging chemicals of concern such as PBDEs and flame retardants; fish and wildlife diseases; harmful algal blooms and climate change.

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. Ongoing and planned activities include opportunities to meet with existing groups, forming partnerships locally to assist in LaMP projects and providing information when requested and regularly through the LaMP website and mailings. Stewardship of the Lake will be emphasized at future partnership meetings and member agency programs. We will continue to inform the public through reporting and public meetings, and will participate in other meetings such as SOLEC and the International Joint Commission (IJC) biennial sessions.

Outreach materials that are developed for the public by either U.S. or Canadian agencies will be used in the Lake Ontario basin on both sides of the border whenever possible, to increase awareness of the pollution prevention opportunities in the ecosystem that we have in common.

We are looking forward to this next phase of progress for Lake Ontario and its ecosystem. The updated workplan and relevant documents can be found on the web at www.binational.net, and in Chapter 12 of this document.

13.3 Research and Monitoring Needs

The Lake Ontario Lower Food Web Assessment project was the start of binational cooperative projects to assess the status of the changing lower food web. A major binational cooperative monitoring effort is planned for Lake Ontario in 2008.

The presence of new emerging chemicals in fish and the sediment has begun. A binational sediment core sampling project took core samples in the lake which are being analyzed. The extent of emerging chemicals in the samples will provide direction for future management actions.

13.4 Recommendations

The further reduction of critical pollutants is of primary importance to the LaMP. We recommend that federal, state, local governments, and partner agencies and organizations be encouraged to participate in developing and funding future actions of either a voluntary or a regulatory nature, to track down sources and reduce pollutants.

The binational biodiversity conservation strategy effort is identifying major threats and geographic areas to be protected, and strategies will be identified for future actions. Once the strategy is finalized, we recommend that targeted restoration or protection projects be selected, as well as the process of establishing funding, resources and partners to carry out these projects.

Finally, the synergy that develops from linkages with other Great Lakes strategies that have common goals and objectives, such as pollutant reduction and habitat conservation, should be encouraged.

13.5 References

Lake Ontario 5-Year Workplan, Lake Ontario LaMP Status Report 2008, Chapter 12

APPENDIX C LAMP MANAGEMENT TEAM

Lake Ontario Coordination Committee

Alan J. Steinberg, Regional Administrator, USEPA, Region 2
Jim Vollmershausen, Regional Director General, Ontario Region, EC
Alexander Grannis, Commissioner, NYSDEC
Michael J. Williams, Assistant Deputy Minister, Operations Division, MOE

Lake Ontario Management Committee

Mario Del Vicario, Chief, Watershed Management Branch, USEPA Region 2
Sandra George, A/ Manager, Great Lakes and Lakewide Management, EC
Richard Raeburn-Gibson, Assistant Director, Eastern Region Operations Division, MOE
Don Zelazny, Great Lakes Programs Coordinator, NYSDEC Region 9
Rob MacGregor, Manager for Lake Ontario, St. Lawrence River and Lake St. Francis, OMNR
Scott Millard, Division Manager, Great Lakes Laboratory for Fisheries
& Aquatic Sciences, Fisheries & Oceans Canada
Kofi Fynn-Aikins, Chief, Lower Great Lakes Fishery Resources Office, USFWS

Technical Workgroup

Barbara Belasco
DEPP-WMB
USEPA Region 2
290 Broadway
New York, New York, 10007
phone: (212) 637-3848
fax: (212) 637-3889
e-mail: belasco.barbara@epa.gov
website: http://www.epa.gov/glnpo/ontario.html

Jennifer Vincent
A/Lake Ontario & Lake Erie LaMP Coordinator
Great Lakes and Lakewide Management
Strategic Integration and Partnerships Division
Environment Canada
867 Lakeshore Road
Burlington, ON
L7R 4A6
Phone: (905)336-4477
e-mail: jenn.vincent@ec.gc.ca

Robert Townsend, P.E.
NYSDEC, Division of Water
625 Broadway
Albany, NY 12233-3502
phone: (518) 402-8284
fax: (518) 402-9029
e-mail: retownse@gw.dec.state.ny.us
website: www.dec.state.ny.us/website/dow

Betsy Trometer
US Fish and Wildlife Service
Lower Great Lakes Fishery Resources Office
405 N. French Rd. Suite 120A
Amherst, NY 14228
phone: (716) 691-5456 ext. 22
fax: (716) 691-6154
e-mail: betsy_trometer@fws.gov

Gavin Christie
Ontario Ministry of Natural Resources
Lake Ontario Management Unit
Glenora Fisheries Station
41 Fish Hatchery Lane, R.R.#4,
Picton, Ontario K0K 2T0
Phone: 613-476-3147
Fax: 613-476-7131
email: gavin.christie@ontario.ca

Conrad de Barros
MOE Regional Office
Eastern Region
1259 Gardiners Road, Unit 3
Kingston, Ontario K7P 3J6
phone: (613) 540-6858
fax: (613) 548-6908
e-mail: conrad.debarros@ontario.ca

Public Information Workgroup

Pamela Finlayson
Environment Canada
4905 Dufferin St.
Toronto ON M3H 5T4
phone: (416) 739-5996
fax: (416) 739-4804
email: pamela.finlayson@ec.gc.ca

Michael Basile
U.S. Environmental Protection Agency
Public Information Office
186 Exchange Street
Buffalo, New York 14204
phone: (716) 551-4410
e-mail: basile.michael@epa.gov

Heather Hawthorne
MOE Regional Office
Eastern Region
1259 Gardiners Road, Unit 3
Kingston, Ontario K7P 3J6
phone: 613-548-6927
email: heather.hawthorne@ontario.ca

Don Zelazny
NYSEC - Region 9
270 Michigan Avenue
Buffalo, New York 14202
phone: (716) 851-7000
email: dezelazn@gw.dec.state.ny.us

United States Repository

U.S. Environmental Protection Agency
Public Information Office
186 Exchange Street
Buffalo, New York 14204
phone: (716) 551-4410

Canadian Repositories

Environment Canada
Library Services Section
Canada Centre for Inland Waters
867 Lakeshore Road
Burlington, Ontario L7R 4A6
phone: (905) 336-4982

Environment Canada
Library Services
4905 Dufferin Street
Downsview, Ontario M3H 5T4
phone: (416) 739-5702

Agency Offices

United States Environmental Protection Agency

US Environmental Protection Agency
Region 2
290 Broadway
New York NY 10007
phone: (212) 637-3660

Environment Canada

Environment Canada
4905 Dufferin Street
Downsview, Ontario M3H 5T4
phone: (416) 739-4809 (General Inquiries)

Environment Canada
867 Lakeshore Road
Burlington, Ontario L7R 4A6
phone: (416) 739-4809 (General Inquiries)

New York State Department of Environmental Conservation Regional Offices

NYSDEC - Region 6
317 Washington Street
Watertown, New York 13601
phone: (315) 785-2239

NYSDEC - Region 7
615 Erie Blvd. West
Syracuse, New York 13204-2400
phone: (315) 428-4497

NYSDEC - Region 8
6274 East Avon-Lima Road
Avon, New York 14414
phone: (716) 226-2466

NYSEC - Region 9
270 Michigan Avenue
Buffalo, New York 14202
phone: (716) 851-7000

Ontario Ministry of the Environment Offices

MOE Regional Office
Central Region
8th Floor, 5775 Yonge St.
North York, Ontario M2M 4J1
phone: (800) 810-8248

MOE Regional Office
Eastern Region
1529 Gardiners Road, Unit 3
Kingston, Ontario K7P 3J6
phone: (613) 549-4000

MOE Regional Office
West Central Region
119 King Street West
Hamilton, Ontario L8N 3Z9
phone: (800) 668-4557

Ontario Ministry of Natural Resources Offices

Ontario Ministry of Natural Resources
Lake Ontario Management Unit
300 Water Street, 5th Flr. North Tower,
Peterborough, Ontario K9J 8M5
phone: (705) 755-2001 (General Inquiries)

Ontario Ministry of Natural Resources
Lake Ontario Management Unit
41 Hatchery Lane, RR#4
Picton, Ontario K0K 2T0
phone: (613) 476-3255

Department of Fisheries and Oceans

Department of Fisheries and Oceans
Great Lakes Laboratory for Fisheries & Aquatic Sciences
867 Lakeshore Road
Burlington, Ontario
Canada, L7R 4A6
phone: (905) 336-4702

US Fish and Wildlife Service Offices

US Fish and Wildlife Service
Lower Great Lakes Fishery Resources Office
405 N. French Rd. Suite 120A
Amherst, NY 14228
phone: (716) 691-5456

US Fish and Wildlife Service
Ecological Services
New York Field Office
3817 Luker Rd.
Cortland, NY 13045
phone: (607) 753-9334

Remedial Action Plan Contacts

Hamilton Harbour RAP
John Hall, RAP Coordinator
Canada Centre for Inland Waters
867 Lakeshore Road
P.O. Box 5050
Burlington, Ontario L7R 4A6
phone: (905) 336-6465
e-mail: john.hall@ec.gc.ca

Bay of Quinte RAP
Jeffrey Borisko, RAP Coordinator
Bay of Quinte Restoration Council
c/o Lower Trent Conservation
441 Front Street
Trenton, Ontario K8V 6C1
phone: (613) 394-4829 Ext.213
e-mail: implementation@bqrap.ca

Toronto and Region RAP
Kelly Montgomery, RAP Project Manager
c/o Toronto and Region Conservation Authority
5 Shoreham Drive,
Toronto, Ontario M3N 1S4
phone: (416) 661-6600 Ext. 5576
e-mail: kmontergomery@trca.on.ca

Eighteenmile Creek RAP
Victor F. DiGiacomo
R.A.P. Coordinator
Niagara County Soil & Water
Conservation District
4487 Lake Avenue
Lockport, NY 14094
phone (716) 434-4949
fax: (716) 434-4985
Victor.digiacomo@ny.nacdnet.net
And RAP Coordination, Division of Water
New York State DEC
270 Michigan Avenue
Buffalo, New York 14203-2999
phone: (716) 851-7000

Port Hope RAP
Environment Canada,
Environmental Conservation Branch
4905 Dufferin Ave.
Toronto, Ontario M4T 1M2
phone: (416) 739-5836

Niagara River RAP (Canada)
Jocelyn Baker
c/o Niagara Peninsula Conservation Authority
250 Thorold Road West, 3rd Floor
Welland, Ontario L3C 3W2
phone: (905) 788-3135
e-mail: jbaker@conservation-niagara.on.ca

St. Lawrence River RAP (Canada)
Katherine Beehler, RAP Coordinator
c/o Raisin Region Conservation
18045 County Road 2
P.O. Box 429
Cornwall, Ontario K6H 5T2
phone: (613) 938-3611
e-mail: Katherine.beehler@rrca.on.ca

Rochester Embayment RAP
Monroe County Department of Health
Charles Knauf, Environmental Health Project Analyst
Monroe County Health Department
111 Westfall Road Room 976
Rochester, NY 14692
cknauf@monroecounty.gov
phone: (585) 274-8440
fax: (585) 274-6098

St. Lawrence River at Massena AOC
Ron McDougall, Chairperson
General Motors Powertrain
Route 37 East, PO Box 460
Massena, NY 13662
phone: (315) 764-0271 or (315) 764-2293
also Steve Litwhiler, Citizen Participation Specialist
NYSDEC, Region 6 Office
State Office Building
Watertown, NY 13601
phone: (315) 785-2252

Governmental Remedial Action Plan Contacts

Robert Townsend, NYSDEC, Division of Water
625 Broadway, Albany, NY 12233-3502
phone: (518) 402-8284
e-mail: retownse@gw.dec.state.ny.us

Barbara Belasco, USEPA Region 2
290 Broadway, NY, NY 10007
phone: (212) 637-3848
e-mail: Belasco.Barbara@epa.gov
(Rochester, Eighteenmile Creek, St. Lawrence River Massena RAPs)

Fred Luckey, USEPA Region 2
290 Broadway, NY, NY 10007
phone: (212) 637-3853
e-mail: Luckey.Frederick@epa.gov
also NYSDEC, Division of Water, Region 9
c/o Regional Water Manager, Gerald Palumbo
270 Michigan Ave, NYSDEC Region 9
Buffalo, NY 14203-2999
phone: (716) 851-7070
(Niagara River, Buffalo River RAPs)

Sandra Kok
Great Lakes Areas of Concern
Strategic Integration and Partnerships Division
Environment Canada
867 Lakeshore Road
Burlington, Ontario L7R 4A6
Phone: (905) 336-6281
Sandra.kok@ec.gc.ca
(Niagara River RAP)

Conrad de Barros
MOE Regional Office
Eastern Region
1259 Gardiners Road, Unit 3
Kingston, Ontario K7P 3J6
phone: 613-540-6858
fax: 613-548-6908
e-mail: conrad.debarros@ontario.ca
(St. Lawrence River Cornwall, Bay of Quinte, Port Hope RAPs)

Rimi Kalinauskas
Great Lakes Areas of Concern
Strategic Integration and Partnerships Division
Environment Canada
4905 Dufferin Street
Downsview, Ontario M3H 5T4
phone: (416) 739-5836
e-mail: Rimi.Kalinauskas@ec.gc.ca
(Hamilton Harbour, Toronto, Bay of Quinte, Port Hope RAPs)