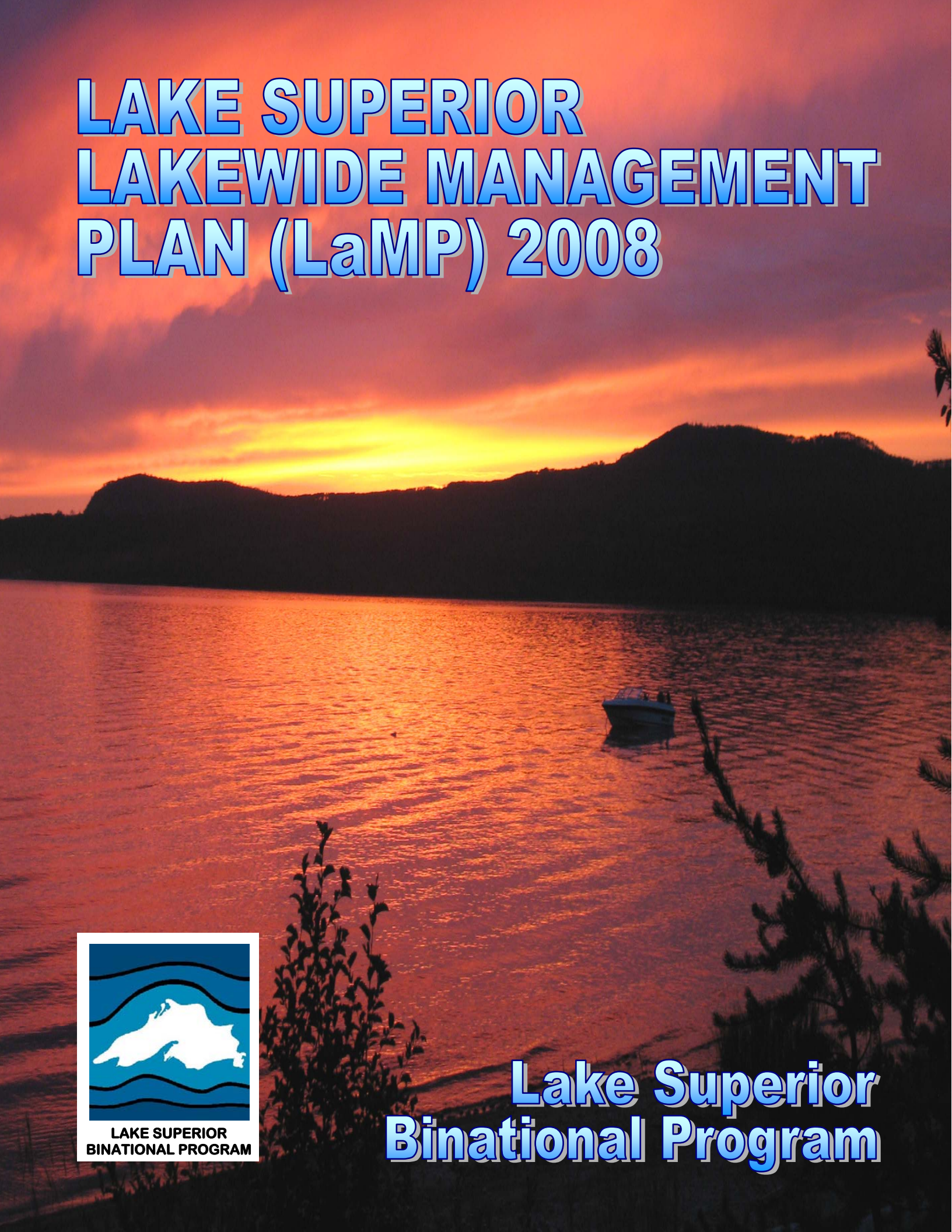
LAKE SUPERIOR LAKEWIDE MANAGEMENT PLAN (LaMP) 2008



LAKE SUPERIOR BINATIONAL PROGRAM

Lake Superior Binational Program

Cover photo: *Cypress Bay on Lake Superior's north shore.* **Photo credit:** *Tim Leblanc, Ontario Ministry of Natural Resources.*

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Lake Superior Lakewide Management Plan (LaMP)

2008

Lake Superior Binational Program

Acknowledgements
Lake Superior Lakewide Management Plan

The Lake Superior Lakewide Management Plan 2008 was prepared by the Binational Program's Superior Work Group with input from various other agencies and organizations including the Lake Superior Binational Forum. We would like to thank the committees of the Superior Work Group for their efforts in completing this document.

Member agencies of the Lake Superior Binational Program are:

1854 Authority
Agency for Toxic Substances and Disease Registry
Bad River Band of Lake Superior Chippewa
Chippewa-Ottawa Resource Authority
Environment Canada
Fisheries and Oceans Canada
Fond du Lac Band of Lake Superior Chippewa
Grand Portage Band of Lake Superior Chippewa
Great Lakes Indian Fish and Wildlife Commission
Health Canada
Keweenaw Bay Indian Community
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Minnesota Department of Natural Resources
Minnesota Department of Health
Minnesota Pollution Control Agency
Ontario Ministry of Natural Resources
Ontario Ministry of the Environment
Parks Canada
Red Cliff Band of Lake Superior Chippewa
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service
U.S. Geological Survey
U.S. National Park Service
Wisconsin Department of Natural Resources

Lake Superior LaMP 2008 Guide to Changes – New files included in LaMP 2008 are **bolded**.

File name	Contents	How to update your LaMP 2006 binder
LS LaMP 2008 Executive Summary	Executive Summary	Replaces LaMP 2006 Executive Summary
LS LaMP 2008 Chapter 1	Introduction and Purpose of the Lake Superior Lakewide Management Plan	Replaces LaMP 2006 Chapter 1
LS LaMP 2008 Chapter 2	Public Outreach and Education	Replaces LaMP 2006 Chapter 2
LS LaMP 2008 Chapter 3	Ecosystem Goals, Indicators, and Monitoring	Replaces LaMP 2006 Chapter 3
LS LaMP 2008 Chapter 4 Update	Lake Superior Critical Pollutants Progress Report	Replaces LaMP 2006 update at beginning of Chapter 4
LS Chapter 4 2000	Lake Superior Critical Pollutants	No change
LS LaMP 2008 Chapter 5 Update	Human Health Information	Replaces LaMP 2006 update at beginning of Chapter 5
LS Chapter 5 2000	Human Health	No change
LS LaMP 2008 Chapter 6 Update	Habitat, Terrestrial Wildlife, and Aquatic Communities Progress Reports	Replaces LaMP 2006 update at beginning of Chapter 6
LS Chapter 6 2006	Status of Aquatic and Terrestrial Communities and Habitat in the Lake Superior Basin	No change
LS LaMP 2008 Chapter 7 Update	Developing Sustainability in the Lake Superior Basin: 2008 Progress Report	Replaces LaMP 2006 update at beginning of Chapter 7
LS Chapter 7 2004	Developing Sustainability in the Lake Superior Basin	No change
LS LaMP 2008 Chapter 8	Collaborative Efforts	Replaces LaMP 2006 Chapter 8
LS LaMP 2008 Chapter 9	Climate Change	New. Insert after LaMP 2008 Chapter 8
LS LaMP 2008 Appendix A	Lake Superior Areas of Concern/Remedial Action Plan Summary Matrix and Fact Sheets	Replaces LaMP 2006 Appendix A

File name	Contents	How to update your LaMP 2006 binder
LS Appendix B 2000	Total Maximum Daily Load (TMDL) Development Strategy for Lake Superior	No change
LS Appendix C 2006	The Lake Superior Zero Discharge Demonstration Program and Relationship to Chemical Contaminants in Lake Superior	No change
LS Appendix D 2006	Mercury Reduction for Lake Superior: *A Mercury Reduction Assistance Project for Lake Superior Region Facilities*	No change
LS LaMP 2008 Appendix E	Proceedings from Making a Great Lake Superior 2007: A Conference Linking Research, Education and Management	New. Insert after Appendix D
LS LaMP 2008 Appendix F	Making A Great Lake Superior Conference 2007 Evaluation Findings	New. Insert after Appendix E
LS glossary 2000	Glossary	No change
LS acronyms 2006	Acronyms and Abbreviations	No change

Contents
Lake Superior Lakewide Management Plan

Note: Appendices B through D are not included in this update – they appear in LaMP 2006.

Executive Summary

View of Copper Harbor, Michigan, at sunset, June 2007.
Photo credit: Roger Eberhardt, Michigan Department of Environmental Quality.

Lake Superior Lakewide Management Plan 2008

Executive Summary

BACKGROUND

Since 1991, as called for in the *Canada-U.S. Great Lakes Water Quality Agreement*, the Lake Superior Lakewide Management Plan (LaMP) has provided an assessment of the state of the Lake Superior ecosystem, including its ecological impairments, emerging issues and their causes, and gaps in knowledge which require further research and monitoring. The LaMP has also identified additional actions required to achieve LaMP goals and targets. The Lake Superior Binational Program partners are continuing to develop and implement the LaMP. As will be documented in this chapter and throughout the entire LaMP 2008 document, the many accomplishments of both the Zero Discharge Demonstration Program (ZDDP) and the Broader Program (the two components of the Binational Program) reinforce the concept of the Lake Superior LaMP as an exemplary model for binational cooperative ecosystem management of the Great Lakes.

Affirmation of the Lake Superior LaMP as a Model for Ecosystem Management

With the release and publication of LaMP 2008, the U.S., Canada, Michigan, Minnesota, Wisconsin, Ontario, Tribal/First Nation and other Binational Program partners renew their commitment to a strong, active, vigorous LaMP document and process, and continue to affirm that the LaMP is uniquely positioned to serve as the most effective ecosystem management model for the Lake Superior basin.

The partners affirm that the Lake Superior LaMP should continue to provide, in partnership with other binational programs, the guiding framework for the management interventions needed to maintain and restore the "physical, chemical and biological" integrity of the lake, as well as the place to define and harmonize agency and partner commitments to those actions.

Furthermore, as the Lake Superior and Great Lakes ecosystems face increasingly serious environmental threats, the LaMP must evolve and adapt to remain the best model to address these challenges. The LaMP will do so through an "adaptive management" approach. Although there are several new Great Lakes basinwide restoration and protection initiatives, we must resist efforts to completely redo the existing successful "governance" structure of the Lake Superior LaMP. We must coordinate priorities but recognize the comparative advantage of the Lake Superior LaMP.

The partners that have created and implemented the LaMP have, among other functions, committed to a process that provides an arena for discussions, recommendations, and decisions among governments; identifies and addresses current high priority issues; facilitates initiation and implementation of joint commitments in a way that minimizes the duplication of effort; identifies funding priorities; pools and leverages resources; documents actions and projects undertaken by Binational Program partners; provides outreach and education on these projects

and the ecosystem status of the Lake; facilitates coordinated research and monitoring; provides opportunities for stakeholder input; and provides a venue for discussion of lake resource issues.

In sum, the governmental partners that have committed to building and sustaining the Binational Program, and thereby the LaMP 2008, reaffirm their support for, and commitment to, the LaMP process and the LaMP document itself.

The Lake Superior Binational Program – Background

The LaMP contains ecosystem goals and targets and funded and proposed (non-funded) actions for restoration and protection of the Lake Superior ecosystem. Actions include commitments by the government partners as well as suggested voluntary actions that could be taken by non-governmental partners. The first LaMP document, published in 2000, identified these actions in six ecosystem themes: critical pollutants, aquatic communities, terrestrial wildlife communities, habitat, human health and sustainability. Since then, each biennial LaMP update has reported accomplishments, status toward goals, challenges and next steps.

LaMP 2008

LaMP 2008 builds on the previous LaMP documents although many of the original LaMP 2000 chapters have been revised, replaced, and updated. The LaMP 2008 chapters contain a 2006-2008 progress report which presents an accomplishment summary of the 1) actions completed or underway to restore/protect the lake, 2) challenges, and 3) next steps.

Highlights of LaMP 2008 include: Public Outreach and Education projects (Chapter 2); new draft Ecosystem Goals and Objectives, including climate change and aquatics goals (Chapter 3); a Chemical Milestones reduction report as well as a Management Strategy for Substances of Emerging Concern (Chapter 4); a draft Aquatic Invasive Species "Complete Prevention Plan" (Chapter 6); Community Sustainability projects (Chapter 7); a chapter on coordination with other Great Lakes programs (Chapter 8), including the Great Lakes Regional Collaboration; a new chapter on Climate Change (Chapter 9); and highlights from the *Making a Great Lake Superior 2007* conference (Chapter 2 Addendum C, Appendix E, and Appendix F). Updates on progress to restore Areas of Concern are contained in Appendix A.

LaMP 2008 is available on a CD-ROM, and is designed to be printed in a loose-leaf format that can be inserted into a three-ringed binder. LaMP 2008 will also be available on the web at www.epa.gov/glnpo.

This LaMP 2008 Report is not intended to be circulated extensively to the public; the agencies plan to produce a separate public-friendly brochure to inform the public on Binational Program activities. Citizens of the basin, as partners and stakeholders in the Binational Program, are strongly encouraged to become actively involved. The Lake Superior Binational Forum can be reached at 1-888-301-LAKE (1-888-301-5253).

ACCOMPLISHMENTS AND NEXT STEPS: HIGHLIGHTS 2006 TO 2008

The Lake Superior Binational Program Partners

The activities below represent some of the accomplishments by the various partners represented on committees of the Lake Superior Binational Program, as well as challenges and next steps. Additional details can be found in the respective chapters of LaMP 2008.

Critical Pollutants

Accomplishments include:

- Production of a Critical Chemical Reduction Milestones report which detailed reductions in critical pollutants from 1990 to 2005. Highlights include:
    - Reduction in mercury releases by 71 percent since 1990;
    - Reduction in dioxin releases by 76-79 percent since 1990;
    - Continuing phase out of PCBs; and
    - Collections of more than 12,700 kg (28,000 pounds) of waste pesticides associated with the zero discharge demonstration program since 1992.
- Collection of over 320 tons of electronic waste comprised of unwanted televisions, computers, and other waste electronics and of over one ton of unwanted medicines in the Upper Peninsula of Michigan. Collection events were sponsored through a US EPA grant to the Earth Keepers, a faith-based environmental organization.
- Implementation of both ongoing and special hazardous waste collection events. Special collections were carried out in the following locations:
    - Thunder Bay region (EcoSuperior ran collections for mercury in schools, household hazardous waste, thermostats, and compact fluorescent bulbs);
    - City of Superior (basinwide mercury reduction project with collections in Two Harbors, Minnesota; Ironwood, Michigan; and three Wisconsin locations);
    - Western Lake Superior Sanitary District (Medicine Cabinet Clean-out Days); and
    - Keweenaw Bay Indian Community (mercury thermostats and compact fluorescent bulbs).
- Continuation of burn barrel/backyard trash burning outreach and education. Bad River Air Quality Department surveys found a 31 percent reduction in the number of burn barrels by the end of 2006. Red Cliff banned burn barrels in 2007.

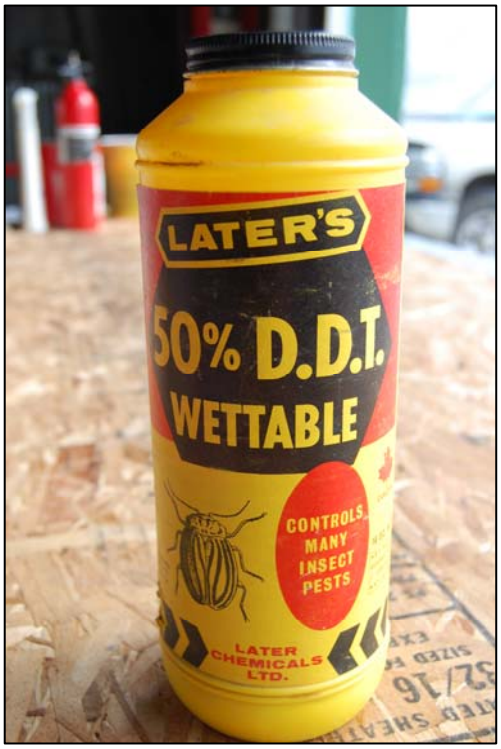


Figure ES-1. Despite being banned decades ago, DDT continues to be received during Lake Superior basin collections. Photo credit: Jim Bailey, EcoSuperior.

- Development of a *Management Strategy for Substances of Emerging Concern* in the Lake Superior basin.
- Planned and moderated the *Toxic Contaminants* session of the October 2007 *Making A Great Lake Superior 2007* conference. Speakers and posters included new and emerging chemical threats; water, sediment, fish and eagle toxics monitoring projects; mercury cycling; atmospheric deposition; pollution prevention; and identifying sources of toxic contaminants. In addition, Chemical Committee members presented Lake Superior posters and papers at the *Eighth International Conference on Mercury as a Global Pollutant*, Midwest Society of Environmental Toxicology and Chemistry (SETAC), SETAC North America, and the *State of the Lakes Ecosystem Conference 2006*.
- Development of a *Chemical Reduction and Inventory Activities* matrix for 2010 Milestone Targets.
- Continuation of work with other organizations to address critical pollutant sources outside the basin. Projects that will boost Lake Superior efforts include the Great Lakes Regional Collaboration's *Mercury in Products Phase-Down Strategy*, Michigan's Mercury Strategy, Minnesota's new law that requires a 90 percent reduction of mercury emissions from the largest coal-fired power plants, Ontario's new waste regulation that requires the producers of household hazardous and special wastes to develop and fund a diversion program, and Wisconsin's development of a new emissions rule for coal-fired power plants.

Next steps include:

- Implementing chemical reduction activities that will help reach the 2010 targets;
- Participating in the realtor/landowner outreach project, which educates realtors and landowners on how to protect Lake Superior, with an emphasis on preventing releases of toxic chemicals by rural landowners; and
- Preparing an inventory of critical chemical releases in 2010 in order to monitor progress against the chemical reduction milestones.

Ecosystem (Habitat, Aquatic Communities, Terrestrial Wildlife)

Accomplishments include:

- Updating and redrafting an Ecosystem Goals and Strategic Objectives document. These draft goals contain Strategic Outcomes, specific Goals and Subgoals that the Lake Superior Work Group has determined are necessary to achieve and protect a diverse, healthy and sustainable Lake Superior ecosystem;
- Addressing the emerging issue of climate change by incorporating mitigation and adaptation strategies in the draft Ecosystem Goals and Strategic Objectives, in Lake Superior Work Group committee workplans and activities and in state LaMP capacity grants;
- Final approval of a National Marine Conservation Area near Thunder Bay, Ontario.
- Development of recommendations for herptile monitoring in the Lake Superior basin in conjunction with a grantee;
- Maintaining and updating the "Important Habitat" map for the Lake Superior basin;

- Maintaining and updating a set of touch-screen kiosks located around the basin that present information about important habitat and projects;
- Maintaining a joint Habitat/Terrestrial Wildlife web site;
- Drafting a "Complete Prevention Plan" for preventing the entry of new aquatic invasive species to Lake Superior; and
- Working with the National Park Service and other agencies to draft a prevention plan for Viral Hemorrhagic Septicemia in Lake Superior.

Next steps include:

- Finalizing the Ecosystem Goals and Strategic Objectives document;
- Working with state and external grants to ensure consistency between climate change goals and adaptation/mitigation strategies;
- Completing the AIS Complete Prevention Plan;
- Working with Parks Canada to ensure the details in the new Lake Superior National Marine Conservation Area management plan support LaMP goals and objectives; and
- Participating in the Upper Great Lakes Study to examine whether the regulation of Lake Superior outflows can be improved to address the evolving needs of the upper Great Lakes.

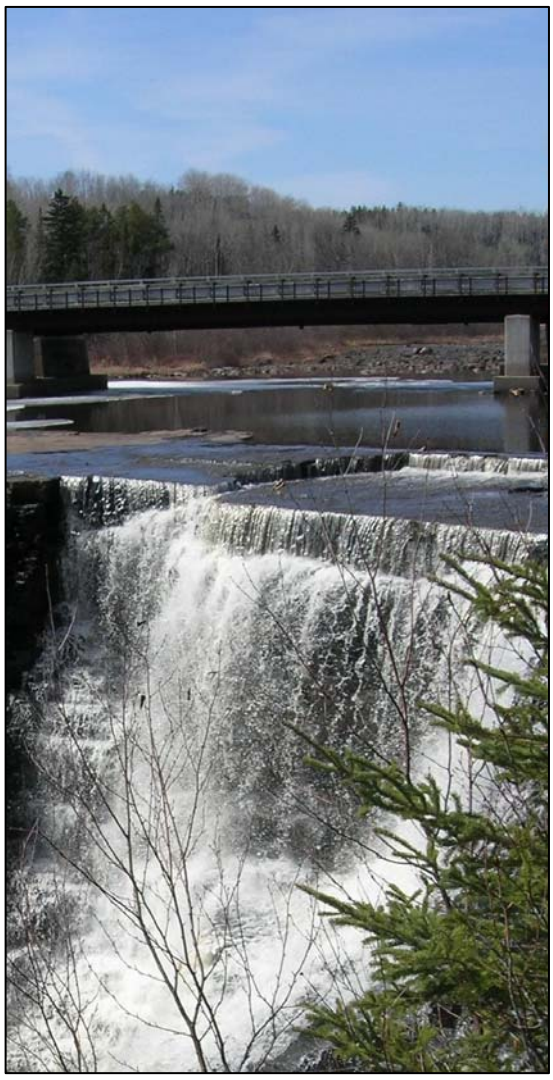


Figure ES-2. Kakabeka Falls, west of Thunder Bay. Photo credit: Melissa Simon, ORISE/US EPA-GLNPO.

Human Health

Accomplishments include:

- Meetings of the Great Lakes states in 2007 to discuss Great Lakes fish consumption advisories, including:
    - The 2007 *National Forum on Contaminants in Fish*, where the Great Lake states discussed fish consumption advisories and the mercury fish consumption protocol.
    - The *State of Lake Michigan Conference 2007*, where the Great Lakes states discussed the use of Decision Support Systems (DSS) to communicate fish consumption advisories.
    - The *Making a Great Lake Superior 2007* conference, where presentations focused on fish consumption advisories in Lake Superior.

- Discussions at the *Making a Great Lake Superior 2007* Human Health Session on beach monitoring, e-coli sources at beaches, and amphibole mineral fiber issues on the Mesabi Range;
- Funding by US EPA of a project to determine whether hair mercury measurement has a long-term effect on an individual's fish consumption habits and reduces their risk of exposure to methylmercury;
- Funding by US EPA of a Lake Superior project entitled "Mercury Levels in Blood from Newborns" to determine if newborns have been exposed to mercury from maternal fish consumption; and
- Continuation of the Great Lakes Public Health Network (GLPHN), led by Health Canada, which has held eleven teleconferences on such issues as transboundary air pollution, health effects of PBDE (flame retardants), children's health and environment, health based air quality index, environmental and occupational causes of cancer and health risks of pesticides.

Next steps include:

- Completion of the above projects and reporting the results;
- Continuation of the outreach/education of the Great Lakes Public Health Network;
- Coordination between Health Canada and the US EPA to establish a Binational Human Health network; and
- Continued outreach/education on Great Lakes fish advisories.

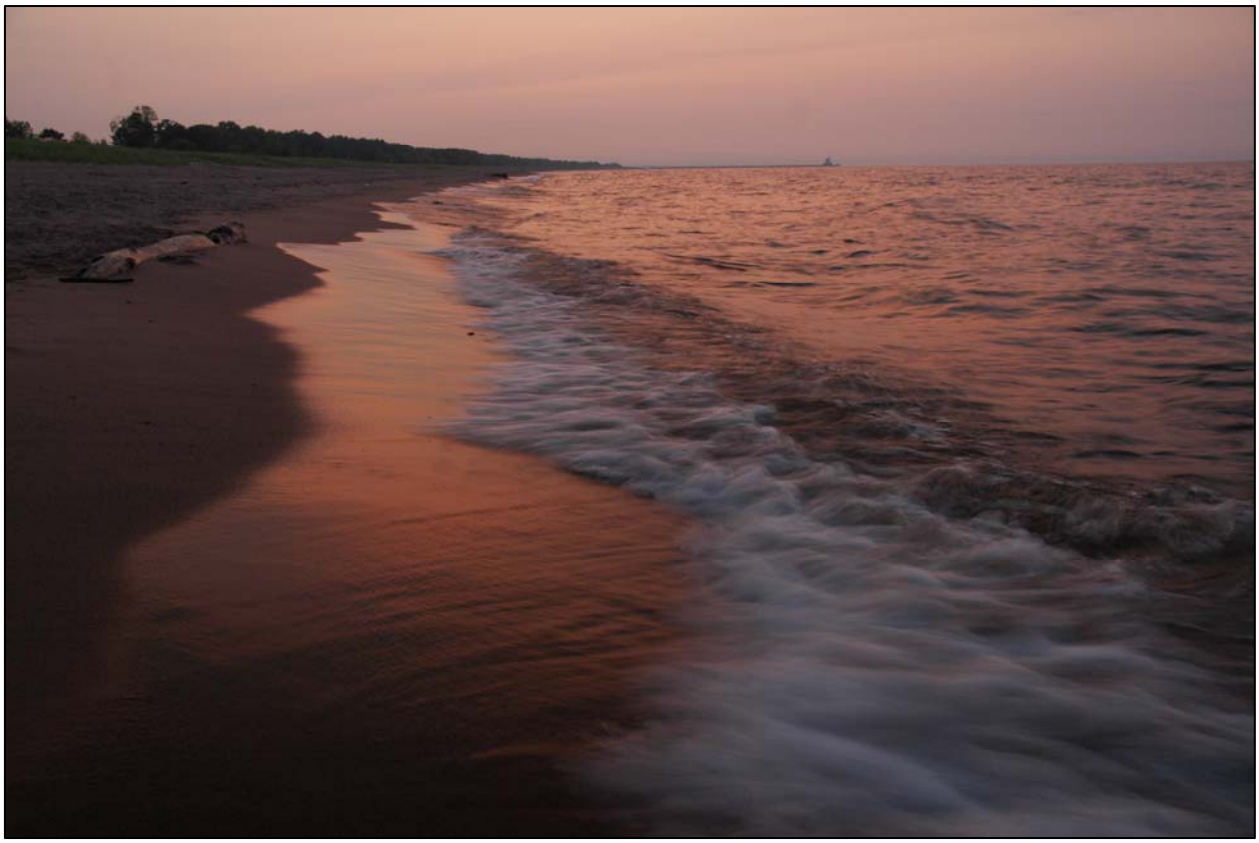


Figure ES-3. Wisconsin Point on Lake Superior at Superior, Wisconsin. Photo Credit: Frank Koshere, Wisconsin Department of Natural Resources.

Sustainability

Accomplishments include:

- Creating groundwork for better informed future activities with the completion of the Canadian portion of the Aboriginal Community Awareness Review and Development Project, which assesses aboriginal attitudes towards environmental issues;
- Cataloging and encouraging sustainability initiatives through the development of the Tracking of Community Sustainability Project;
- Increased awareness and knowledge of sustainability challenges and opportunities facing Lake Superior Binational Program and basin communities by organizing a Sustainability session at the *Making a Great Lake Superior 2007* conference*;* and
- Exploring the effects of mineral mining on Lake Superior's environment and communities through the establishment of the Ad Hoc Mining Committee.

Next steps include:

- Promote the adoption of a sustainable approach to resource management and decision-making throughout the Lake Superior basin.
- Expanding the internal and external network of Lake Superior basin sustainability partners.

Outreach and Education

Accomplishments include:

- Planned and held the *Making a Great Lake Superior 2007* conference that attracted over 450 participants. The conference brought together educators, researchers, federal, state, provincial and tribal managers, the public and scientists for a conference focused on Lake Superior critical issues;
- Engaged students and teachers in Lake Superior environmental action through the creation and dissemination of an interactive web-based curriculum *Connecting the Coast,* which connects people with service projects that support LaMP priorities;
- Continuation of the Pathfinders Program, an outreach/education program targeted to youth and students; and
- Completion and issuance of the Chemical Milestones Fact Sheet, in coordination with the Chemical Committee.

Next steps include:

- Writing of the Lake Superior LaMP 2008 public friendly brochure; and
- Planning for the next Lake Superior conference.

The Lake Superior Binational Forum

The Lake Superior Binational Forum, the citizen's group associated with the government agencies responsible for carrying out the Binational Program, has been key to establishing an effective multi-stakeholder process. The Forum has held many workshops over the years for the purpose of acquiring necessary background information to help develop recommendations and

proposals for sustainable development, human health and reducing the Lake Superior nine critical pollutants. They have also held very successful public input sessions and published many documents on key issues relating to the LaMP.

Accomplishments include:

- Conducted an annual Lake Superior Environmental Stewardship Awards Program that recognizes outstanding sustainable and best management practices in five categories in the U.S. and Canada;
- Developed and promoted an annual Lake Superior Day celebration held on the third Sunday in July around the basin; and
- Held public input sessions on a variety of topics including land use planning and management, invasive species, impacts of pharmaceuticals on water quality, and impacts of the shipping industry on Lake Superior.

Next steps include:

- Seek to involve more youth in Lake Superior leadership activities, with a focus on university and college students;
- Work with the Sustainability Committee to develop a database of key communities that are initiating sustainable projects that protect the lake basin; and
- Identify ways to collaborate with citizen groups in Areas of Concern communities to share resources, staff, and create synergy with their outreach efforts.

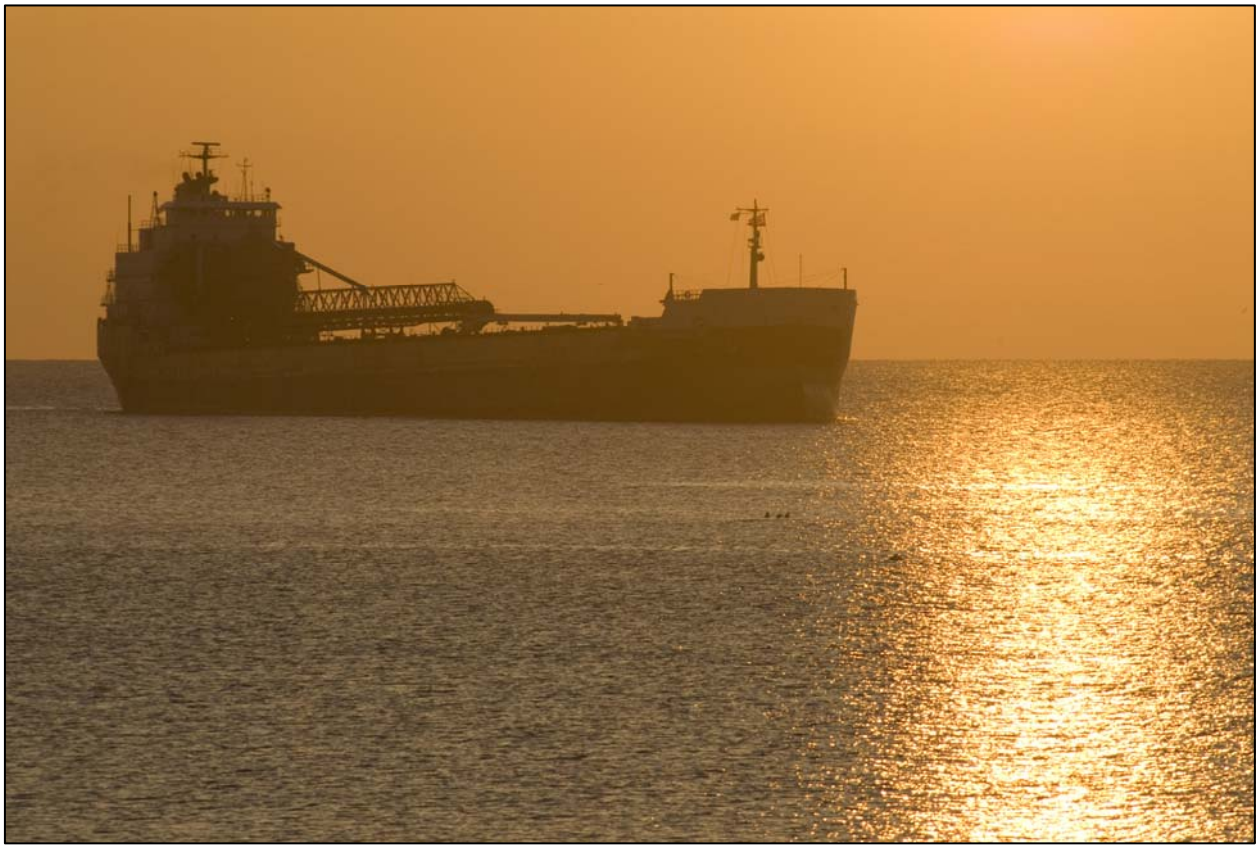


Figure ES-4. Freighter on Lake Superior at sunrise. Photo credit: Brenda Jones, US EPA.

NEXT STEPS AND CHALLENGES OF THE BINATIONAL PROGRAM

In general, the next steps for the Binational Program are to:

- Continue to implement projects and priorities identified in the LaMP;
- Advocate the benefits of toxic chemical reduction activities to decision makers and the public to ensure continued support;
- Implement the management framework for substances of emerging concern;
- Focus project, activities and research on nearshore activities and the connection to water quality;
- Continue communication and outreach activities that will achieve measurable progress toward the Binational Program goals;
- Continue with priority ecosystem monitoring, mapping, research, and restoration efforts;
- Prepare various internal and public reports, including the biennial LaMP updates;
- Build capacity in the Binational Program by recruiting additional partners;
- Continue to coordinate with critical Great Lakes initiatives such as the Great Lakes Regional Collaboration, the Binational Toxics Strategy, AOCs, COA and the Great Lakes Legacy Act; and
- Seek additional funding for LaMP implementation from a wide variety of sources.

Future accomplishments will be dependent upon commitments by governments, NGOs, and individuals to support the science, resource management, and activities that will protect and restore the basin.

Challenges include:

- Addressing new emissions of critical pollutants, especially mercury, from new or expanded mining sources;
- Addressing the emerging issue of climate change;
- Development of capacity and committees (as necessary) to address mining, coordinated monitoring and climate change issues;
- Protecting critical lake and tributary habitats;
- Continuing rehabilitation plans for sturgeon, walleye, lake trout, and brook trout;
- Preventing invasion and transport of non-native species within the basin;
- Ensuring the maintenance of healthy aquatic communities on rivers with hydropower;
- Establishing long-term monitoring programs of biological communities;
- Establishing monitoring programs for invasive species and fish community changes and status;
- Ongoing support and maintenance of the geographic database and projects associated with the Lake Superior Decision Support System;
- Closing information gaps on the status and trends of habitat conditions;
- Developing land use change models;
- Maintaining the capacity of the Lake Superior Binational Program;
- Educating the public on important habitat and ecological resources in the Lake Superior basin by webinars, conferences, workshops, interactive information kiosks and other web-based informational methods; and

- Implementing the recommendations of the Great Lakes Regional Collaboration in coordination with other LaMP priorities.

Figure ES-5. Isle Royale, June 2007. Photo credit: John Marsden, Environment Canada.

Chapter 1

Introduction and Purpose of the Lake Superior Lakewide Management Plan

Isle Royale National Park, Michigan. Photo Credit: Melissa Simon, ORISE/US EPA-GLNPO.

Lake Superior Lakewide Management Plan 2008

Chapter 1 Contents

Chapter 1
Introduction and Purpose of the Lake Superior Lakewide Management Plan

1.0 INTRODUCTION

The Lake Superior basin is one of the most pristine and unique ecosystems in North America. Containing the largest surface area of any freshwater lake in the world, Lake Superior has some of the most breathtaking scenery in the Great Lakes and serves as a backdrop to a wide range of recreational and outdoor activities enjoyed by people from all over the world. Sparsely populated even today, Lake Superior has not experienced the same level of development, urbanization, or pollution as the other Great Lakes. Recognizing this unique and invaluable resource, the federal, state, provincial, and U.S. tribal governments; First Nations; environmental groups; industry; and the public have taken steps to protect this great legacy for generations to come. This shared partnership has served as a model the world over for cooperative binational resource management.

The Great Lakes Water Quality Agreement (GLWQA) between the U.S. and Canada commits the two countries (the Parties) to address the water quality issues of the Great Lakes in a coordinated fashion. Annex 2 of the GLWQA provides a framework for the reduction of critical pollutants as they relate to impaired beneficial uses of open lake waters. In undertaking the Lakewide Management Plans (LaMP), the Parties agree to build upon cooperative efforts with state, tribal, and provincial governments and to ensure that the public is consulted. The Parties, partner agencies, and tribal/First Nations also recognize the need to conduct lakewide adaptive management using an ecosystem approach which addresses human health, habitat, terrestrial wildlife communities, aquatic communities, and sustainability.

1.1 AFFIRMATION OF THE LAKE SUPERIOR LaMP AS A MODEL FOR ECOSYSTEM MANAGEMENT

With the release and publication of LaMP 2008, the U.S., Canada, Michigan, Minnesota, Wisconsin, Ontario, tribal/First Nation and other Binational Program partners renew their commitment to a strong, active, vigorous LaMP document and process, and continue to affirm that the LaMP is uniquely positioned to serve as the most effective ecosystem management model for the Lake Superior basin.

The partners affirm that the Lake Superior LaMP should continue to provide, in partnership with other binational programs, the guiding framework for the management interventions needed to maintain and restore the “physical, chemical and biological” integrity of the lake, as well as the place to define and harmonize agency and partner commitments to those actions.

Furthermore, as the Lake Superior and Great Lakes ecosystems face increasingly serious environmental threats, the LaMP must evolve and adapt to remain the best model to address

these challenges. The LaMP will do so through an "adaptive management" approach. Although there are several new Great Lakes basinwide restoration and protection initiatives, we must resist efforts to completely redo the existing successful "governance" structure of the Lake Superior LaMP. We must coordinate priorities but recognize the comparative advantage of the LaMP.

The partners that have created and implemented the LaMP have, among other functions, committed to a process that provides an arena for discussions, recommendations, and decisions among governments; identifies and addresses current high priority issues; facilitates initiation and implementation of joint commitments in a way that minimizes the duplication of effort; identifies funding priorities; pools and leverages resources; documents actions and projects undertaken by Binational Program partners; provides outreach and education on these projects and the ecosystem status of the Lake; facilitates coordinated research and monitoring; provides opportunities for stakeholder input; and provides a venue for discussion of lake resource issues.

In sum, the governmental partners that have committed to building and sustaining the Binational Program, and thereby the LaMP 2008, reaffirm their support for, and commitment to, both the LaMP process and the LaMP document itself.

1.2 THE LAKE SUPERIOR BINATIONAL PROGRAM

In 1990, the fifth biennial report of the International Joint Commission (IJC) to the U.S. and Canadian governments recommended that Lake Superior be designated as a demonstration area where "no point source discharge of any persistent toxic substance will be permitted." In response, on September 30, 1991, the federal governments of Canada and the U.S., the Province of Ontario, and the States of Michigan, Minnesota, and Wisconsin announced a **Binational Program to Restore and Protect Lake Superior**. Known as the Lake Superior Binational Program (LSBP), the Program identifies two major areas of activity:

- A Zero Discharge Demonstration Project
- The Broader Program

The LSBP also recognizes that public participation is an important part of the program.

The Zero Discharge Demonstration Program (ZDDP) established Lake Superior as a demonstration project to achieve zero discharge and zero emission of nine toxic, persistent, and bioaccumulative chemicals: mercury, total polychlorinated biphenyls (PCBs), dieldrin/aldrin, chlordane, DDT, toxaphene, 2,3,7,8-TCDD (dioxin), hexachlorobenzene (HCB), and octachlorostyrene (OCS). Voluntary pollution prevention is the preferred approach to achieving reduction goals, but enhanced controls and regulations might be necessary to achieve zero discharge.

The Broader Program recognizes that zero discharge of persistent toxic substances alone will not be sufficient to restore and protect Lake Superior. The Broader Program focuses on the coordination needed among the many resource and environmental agencies to protect, restore

and maintain the entire Lake Superior ecosystem, including aquatic and terrestrial communities and habitat.

Public Involvement is critical to the success of the Binational Program. The LSBP highlights the importance of the partnership approach to achieve specified common goals. The Program encourages the commitment of all partners to develop new and innovative approaches to ecosystem management. The citizens of the basin are partners and stakeholders in the Binational Program.

LSBP Organization

Lake Superior Task Force

The Task Force consists of senior Canadian and U.S. federal, provincial, tribal, and state representatives who make management decisions related to Lake Superior. The Task Force serves as a steering committee and is responsible for program direction.

Superior Work Group

The Work Group is comprised of Canadian and U.S. technical experts who represent various agencies and organizations that manage Lake Superior water and other resources. The Work Group reports to the Task Force. The Work Group is comprised of a number of committees, currently including: critical pollutants, habitat, aquatic communities, terrestrial wildlife communities, developing sustainability, and public involvement. These committees address pollution prevention and reduction, habitat issues, aquatic and terrestrial community diversity and sustainability, special designations, ecosystem integrity and monitoring, human use and health issues, and public communication and involvement.

Lake Superior Binational Forum

The Forum is a group of 24 Lake Superior citizen volunteers who make recommendations to the governments, consult with the broader public, and carry out joint LaMP implementation projects. Forum members bring perspectives from a variety of community sectors including business, environmental groups, academia, and industry. The vision statement endorsed in 1992 by the Forum is also a philosophical backdrop for the Binational Program.

A VISION FOR LAKE SUPERIOR

As citizens of Lake Superior, we believe ...

that water is life and the quality of water determines the quality of life.

We seek a Lake Superior watershed ...

that is a clean, safe environment where diverse life forms exist in harmony; where the environment can support and sustain economic development and where the citizens are committed to regional cooperation and personal philosophy of stewardship;

that is free of toxic substances that threaten fish, wildlife and human health; where people can drink the water or eat the fish anywhere in the lake without restrictions;

where wild shorelines and islands are maintained and where development is well planned, visually pleasing, biologically sound, and conducted in an environmentally benign manner;

which recognizes that environmental integrity provides the foundation for a healthy economy and that the ingenuity which results from clean, innovative and preventive management and technology can provide for economic transformation of the region;

where citizens accept the personal responsibility and challenge of pollution prevention in their own lives and lifestyles and are committed to moving from a consumer society to a conserver society; and

where there is greater cooperation, leadership and responsibility among citizens of the basin for defining long-term policies and procedures which will protect the quality and supply of water in Lake Superior for future generations.

We believe that by effectively addressing the issues of multiple resource management in Lake Superior, the world's largest lake can serve as a worldwide model for resource management.

Endorsed by the Lake Superior Binational Forum on January 31, 1992
as an expression of the hearts and minds of all of us.

This vision statement expresses the commitment and desire of members of the Lake Superior community to foster a healthy, clean, and safe Lake Superior ecosystem. It reflects the diverse pathways and mechanisms by which humans and nature interact within land and water ecosystems, and challenges the inhabitants of the Lake Superior watershed to accept personal responsibility for protecting the Lake and the landscape that sustains it. The vision statement specifies broad, powerful objectives for the Lake Superior ecosystem, in plain language.

1.2.1 LaMP Documents Produced To Date

Historically, formal LaMP "stages" were to be submitted to the IJC when a key stage of work was completed, in accordance with the framework outlined in Annex 2 of the 1987 amendments to the GLWQA:

- Stage 1: When problem definition is complete and critical pollutants are identified;
- Stage 2: When chemical load reduction schedules are completed;
- Stage 3: When remedial measures have been selected; and
- Stage 4: When monitoring indicates that the contribution of critical pollutants to impaired beneficial uses has been eliminated.

LaMP Stages 1, 2, and 3 have been completed for the chemical portion of the Lake Superior LaMP.

The Lake Superior Stage 1 LaMP, which was submitted to the IJC in September 1995, used environmental data to identify 22 critical pollutants that: 1) impaired or were likely to impair beneficial uses in the Lake, 2) were likely to affect human health or wildlife because they exceeded chemical yardsticks, or 3) impaired Lake ecosystem objectives. The Stage 1 LaMP summarizes all known data on critical pollutant loadings from point sources throughout the Lake Superior basin.

The Stage 2 LaMP, which was submitted to the IJC in July 1999, sets remediation goals or load reduction schedules for the nine virtual elimination pollutants identified in the Stage 1 LaMP. The Lake Superior Binational Forum stakeholders group submitted pollutant reduction recommendations, which were public and agency reviewed, edited, and formed the basis for the final targets set in the Stage 2 LaMP. In Stage 2, the critical pollutants were placed into management categories that reflect pollutant impacts, tendency to bioaccumulate, and occurrence at toxic levels.

The Stage 3 LaMP requirements under the GLWQA, captured in Chapter 4 of LaMP 2000, select pollutant load reduction strategies and remedial actions with respect to the nine virtual elimination pollutants: mercury, PCBs, dieldrin/aldrin, chlordane, DDT, toxaphene, dioxin, HCB, and OCS.

In addition to staged LaMP reporting on the ZDDP, work proceeded in two areas between 1991 and 1998: habitat and non-regulatory special designations. In the program area of habitat, agencies developed ecological criteria for important Lake Superior habitat, set up a database for habitat sites, prepared a comprehensive GIS-based map of important habitat sites and areas, and examined the impact from major dischargers on habitat. In the program area of sustainability, criteria for non-regulatory special designations were developed.

1.2.2 Ecosystem Components

While the initial focus of the LaMP work was on strategies for reducing the critical pollutants and establishing the ZDDP, as well as a broader program that advanced our understanding of habitat and landscapes, work has been carried out in other areas as well. The partner agencies have developed LaMP documents for a number of ecosystem themes, including aquatic communities, terrestrial wildlife communities, habitat, human health, and developing sustainability. The work in these themes was released for the first time for public comment and review in LaMP 2000.

Adopting an ecosystem approach has initiated a shift from a narrow perspective of managing environmental media (water, air, and soil) or a single resource (e.g., fish or trees) to a broader perspective that focuses on managing human uses and abuses of watersheds or bioregions and that comprehensively addresses all environmental media and resources within the context of a living system. The Lake Superior LaMP is guided by a set of ecosystem objectives and indicators to judge progress. Published as a discussion paper in 1995, the document ***Ecosystem Principles and Objectives, Indicators, and Targets for Lake Superior*** describes extensive ecosystem objectives and sub-objectives. These objectives have been refined and updated (see Chapter 3) since the document's original release and are described in abbreviated form below:

1. General Objective – Human activity in the Lake Superior basin should be consistent with *A Vision for Lake Superior*. Future development of the basin should protect and restore the beneficial uses as described in Annex 2 of the GLWQA.

2. Chemical Contaminants Objective – Levels of persistent, bioaccumulative, and toxic chemicals should not impair beneficial uses of the natural resources of the Lake Superior basin. Levels of chemical contaminants which are persistent, bioaccumulative, and toxic should ultimately be virtually eliminated in the air, water, and sediment in the Lake Superior basin. A zero discharge demonstration program is the primary means for achieving reductions of in-basin sources of contaminants.

3. Aquatic Communities Objective – Lake Superior should sustain diverse, healthy, reproducing and self-regulating aquatic communities closely representative of historical conditions.

4. Terrestrial Wildlife Objective – The Lake Superior ecosystem should support a diverse, healthy, and sustainable wildlife community in the Lake Superior basin.

5. Habitat Objective – To protect, maintain, and restore high-quality habitat sites in the Lake Superior basin and the ecosystem processes that sustain them. Land and water uses should be designed and located compatible with the protective and productive ecosystem functions provided by these natural landscape features.

6. Human Health Objective – The goal of the Lake Superior LaMP Human Health Chapter is to fulfill the human health requirements of the GLWQA, including: defining the threat to

human health and describing the potential adverse human health effects arising from exposure to critical pollutants and other contaminants (including microbial contaminants) found in the Lake Superior basin, addressing current and emerging human health issues of relevance to the LaMP, and identifying implementation strategies currently being undertaken to protect human health and suggesting additional implementation strategies that would enhance the protection of human health.

7. Sustainability Objective – Human use of the Lake Superior ecosystem should be consistent with the highest social and scientific standards for sustainable use, and should not degrade it, nor any adjacent ecosystems. Use of the basin's natural resources should be consistent with their capability to sustain the ecosystem's identity and functions, should not risk the socioeconomic and cultural foundations of any citizens, nor deny any generation the benefits of a healthy, natural Lake Superior ecosystem. The obligation of local communities to determine their future should be incorporated in any polices directed at the management of natural and social resources in the basin.

In the LaMP 2002, it was noted that a comprehensive set of ecosystem targets needed to be developed to guide management actions over the long term. In keeping with the public's recommendation to integrate the habitat, terrestrial wildlife, and aquatic committees, the three committees started work on developing a set of ecosystem goals. These ecosystem goals were developed and distributed for public comment and input, and can now be found, in draft, in Chapter 3. The goals also contain new climate change mitigation and adaptation goals.

Each biennial LaMP incorporates the latest available scientific and technical information into the existing LaMP document. The primary audience for these biennial reports is the Parties and their partners who are charged with lakewide management. This report will also be used to meet reporting requirements to the IJC. A public-friendly LaMP brochure will be released to the public later in 2008.

1.3 LaMP ACCELERATION AND THE LaMP DOCUMENT

1.3.1 What is LaMP 2008?

In May 1999, the Great Lakes States Environmental Directors issued a challenge to the U.S. Environmental Protection Agency (US EPA) that all LaMP documents were to be completed by Earth Day 2000. This challenge was accepted at a meeting of the Binational Executive Committee (BEC), which is composed of senior managers from the US EPA, Environment Canada, the Great Lakes states, the Province of Ontario, and several tribes. A resolution was adopted by the BEC that calls for the completion by April 2000 of a "LaMP 2000" document which would reflect the state of the knowledge and progress of the LaMPs at that time (see Addendum 1A to this chapter).

LaMPs were published in 2000, and progress reports were released biennially after that. Analysis by various LaMP work groups identified a need to refine the LaMP reporting process,

particularly with regard to the time, effort, and resources needed to produce the documents. Greater emphasis needed to be placed on implementation and partnerships to protect each lake basin. To that end, the BEC endorsed an approach to reporting in 2003 that strikes a balance between consistency among LaMPs and individual LaMP needs, while minimizing reporting efforts. LaMP teams endeavor to spend at least 80 percent of their time on LaMP implementation, and a maximum of 20 percent on reporting.

The LaMP document serves several purposes. First, it summarizes the technical research and scientific study of the Lake Superior ecosystem. Second, it represents a framework and road map for guiding and supporting priority actions and/or additional research in the basin. Third, the document presents actual pollution prevention, restoration, and other actions that governments, industries, tribes, and other stakeholders can take to achieve the overall goals and visions of the LaMP. Finally, the document serves as a strategic plan to help achieve sustainability in the basin ecosystem.

LaMP 2008 has several notable sections that should be highlighted. Chapter 3 contains draft ecosystem goals and objectives that the Binational Program and the LaMP have determined are necessary to achieve and protect a diverse, healthy, and sustainable Lake Superior ecosystem. Although a draft version of these goals was originally included in the LaMP 2006, revisions were needed to better organize the goals and to accommodate emerging issues like climate change. In addition, for the first time, goals related to the aquatic ecosystem have been included. These aquatic ecosystem goals were coordinated with the Lake Superior Technical Committee of the Great Lakes Fisheries Commission. They were also distributed for public review and comment to Lake Superior stakeholders.

The Critical Pollutants section, Chapter 4, contains a Management Strategy for Substances of Emerging Concern that describes how the Superior Work Group and committee will address emerging contaminants. In the Habitat Chapter (Chapter 6), a draft Aquatic Invasive Species "Complete Prevention Plan" sets out a strategy on how to prevent additional aquatic invasive species from entering Lake Superior. Information on steps to prevent Viral Hemorrhagic Septicemia (VHS) from entering Lake Superior is also included. An update on the progress of the Great Lakes basinwide restoration effort, the Great Lakes Regional Collaboration, is summarized in Chapter 8. A new chapter on climate change (Chapter 9) details the potential impacts of climate change on the Lake Superior ecosystem, as well as possible mitigation and adaptation actions. Since substantial progress has been made on a number of Lake Superior Areas of Concern (AOCs), including Torch Lake, St. Louis River, Thunder Bay, and Nipigon Bay, we have included narrative AOC progress reports, as well as a summary matrix, in Appendix A of the LaMP. Appendix E contains a summary of proceedings from the highly successful *Making a Great Lake Superior 2007* conference, held in October 2007

1.4 RELATIONSHIP OF THE LaMP TO OTHER INITIATIVES AND EFFORTS

There are many ongoing collaborative efforts between the LaMP and other Great Lakes efforts, one of which, Areas of Concern, is highlighted below. A more comprehensive and detailed description of other collaborative initiatives may be found in Chapter 8.

1.4.1 Remedial Action Plans for Areas of Concern

The GLWQA amendments of 1987 also called for the development of Remedial Action Plans (RAPs) for designated AOCs. The primary goal of the RAPs is to restore impaired "beneficial uses," both ecological and cultural, as identified in Annex 2 of the GLWQA amendments, in degraded areas within the basin. The GLWQA amendments directed the two federal governments to cooperate with state and provincial governments to develop and implement RAPs for each AOC. In the Great Lakes basin, 43 AOCs have been identified by the U.S. and Canadian governments, 26 in U.S. waters, and 17 in Canadian waters (five are shared between the U.S. and Canada on connecting river systems).

Collingwood Harbour and Severn Sound, in Ontario, and Oswego River/Harbor, in New York State, are the first three of these 43 sites to be de-listed. Additionally, Spanish Harbour in Ontario and Presque Isle Bay in Pennsylvania have been designated Areas in Recovery. Other individual beneficial use impairments (BUI) that have been delisted include the removal of the degradation of benthos BUI from the Manistique River, Michigan, AOC (on November 16, 2006); removal of the restrictions on dredging BUI from the Presque Isle Bay, Pennsylvania, AOC (on March 16, 2007); and removal of the fish tumor and other deformities BUI from the Torch Lake, Michigan, AOC (on April 5, 2007).

There are eight AOCs in the Lake Superior basin, four in Canada, three in the U.S., and one shared between the two countries along the St. Marys River. In particular, much progress has been made on the St. Marys River AOC in Ontario and Michigan, and the St. Louis River AOC in Minnesota and Wisconsin, where draft delisting guidelines have been written and are being circulated for public review and input. The guidelines are scheduled for completion by December 2008. Narratives and a matrix summarizing the current status of the Lake Superior RAPs may be found in Appendix A of the LaMP.

The RAPs and LaMPs are similar in that they both use an ecosystem approach to assessing and remediating environmental degradation, consider the 14 BUIs outlined in Annex 2, and rely on a structured public involvement process. RAPs, however, encompass a much smaller geographic area, concentrating on an embayment, a single watershed, or stretch of a river. The main focus of a RAP is on environmental degradation in that specific area, and remediating the BUIs locally. Most of the Lake Superior RAPs have had active local Public Advisory Committees (PACs), with stakeholders in some cases undertaking local remediation projects. In most AOCs, the BUI (e.g., habitat loss) can be related or connected to local activities. On the other hand, some fish advisories are attributable to the lakewide concentrations of persistent, bioaccumulative, and toxic chemicals.

Forging a strong relationship between the LaMPs and the RAPs is important to the success of both efforts. The AOCs can, in many cases, serve as point source discharges to the lake as a whole. Improvements in the AOCs will, therefore, eventually help to improve the entire lake. Much of the expertise about the use impairments and possible remedial efforts reside at the local level; cooperation between the two efforts is essential in order for the LaMPs to remove lakewide impairments.

Due in part to the passage of the U.S. *Great Lakes Legacy Act*, described in Chapter 8, AOCs have taken on added importance and urgency in the U.S. Delisting of the AOCs is a top priority for the U.S. and Canadian governments; increased funding for the Legacy Act will help accelerate the delisting process in the U.S. The main federal funding programs for the RAP program are detailed below.

1.4.2 Great Lakes Action Plan (Canada)

The 2005-2010 Great Lakes Action Plan for Areas of Concern provides $40 million from the Government of Canada toward its commitment to restore, protect, and conserve the Great Lakes.

Improving the ecological integrity of the Great Lakes ecosystem has been, and continues to be, a priority for the Government of Canada. This funding, spread over five years, will continue the environmental restoration of key aquatic areas of concern in Ontario.

The Great Lakes Action Plan program is a coordinated effort of the seven Canadian federal government departments participating in the federal Great Lakes Program: Environment, Fisheries and Oceans, Health, Public Works and Government Services, Agriculture and Agri-Food, Natural Resources, and Transport.

The $40 million is directed towards remediation activities at the 15 remaining AOCs contained either entirely within Canada (10) or joint Canada-U.S. sites on connecting channels (5). These remediation activities are identified in RAPs that have been prepared for each AOC.

Remediation activities which are the responsibility of the federal government, as identified in RAPs, will include:

- Working in partnership with other agencies on fish and wildlife rehabilitation projects;
- Completing contaminated sediment assessment and remediation strategies for relevant AOCs;
- Undertaking engineering and technical studies to identify cost-effective wastewater treatment technologies and approaches that will assist municipalities in securing infrastructure funding; and
- Leading the development and implementation of multi-agency monitoring plans essential to support the design and evaluation of these activities.

Through the Great Lakes Sustainability Fund (GLSF), partners will be engaged to implement projects related to habitat restoration, sediment assessment, and municipal wastewater improvements. GLSF provides financial and technical support to projects that aim to significantly accelerate work to restore the environmental quality of Canada's 15 remaining AOCs. GLSF projects reflect diverse and dedicated partnerships with local and provincial governments, community groups, academia, and industry; projects focus on an extensive range of restoration activities. These include the development and implementation of innovative strategies for improving municipal wastewater treatment, assessment and remediation of contaminated sediment, restoration of fish and wildlife habitat, non-point source pollution control and watershed stewardship, and public outreach activities to promote various tools and

strategies. By completing these federal actions, progress should be made toward the ecological restoration of AOCs.

Federal actions have been completed in Severn Sound and Collingwood Harbour, and ecological restoration has been achieved. These locations have been successfully delisted, or removed from the list of AOCs. Federal actions have been completed in Spanish Harbour, and monitoring of its recovery is underway. Federal actions will be completed in Port Hope under another process.

Added to previous funding, this $40 million budget commitment means more than $300 million of dedicated federal resources have been directed at restoring and protecting the Great Lakes since the first Great Lakes Action Plan was launched in 1989.

1.4.3 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem

On August 16, 2007, Canada and Ontario announced the official signing of the 2007-2010 *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem* (COA). This renews commitment by the governments of Canada and Ontario to work towards restoration, protection, and maintenance of the Great Lakes basin ecosystem.

The COA focuses on cleaning up 15 severely degraded ecosystems in the Great Lakes (AOCs), reducing harmful pollutants, improving water quality, conserving fish and wildlife species and habitats, lessening the threat of aquatic invasive species, and improving land management practices within the Great Lakes basin. The agreement also contains new areas of cooperation such as protecting sources of drinking water, understanding the impacts of climate change, and encouraging sustainable use of land, water, and other natural resources. It ensures that scientific information is available to support remediation and protection efforts and to measure their success for the benefit of the growing number of Canadians dependent upon the lakes, and will contribute to meeting Canada's obligations under the GLWQA, which has recently undergone review by both countries. A new COA beyond 2010 would consider the recommendations and results of that review.

ADDENDUM 1A:

BINATIONAL EXECUTIVE COMMITTEE CONSENSUS POSITION ON THE ROLE OF LaMPS IN THE LAKE RESTORATION PROCESS

Binational Executive Committee Consensus Position on the Role of LAMPS in the Lake Restoration Process

The development and implementation of Lakewide Management Plans (LaMPs) are an essential element of the process to restore and maintain the chemical, physical, and biological integrity of the Great Lakes ecosystem. Through the LaMP process, the Parties, with extensive stakeholder involvement, have been defining the problems, finding solutions, and implementing actions on the Great Lakes for almost a decade. The process has taken much longer and has been more resource-intensive than expected.

In the interest of advancing the rehabilitation of the Great Lakes, the Binational Executive Committee calls on the Parties, States, Provinces, Tribes, First Nations, municipal governments, and the involved public to significantly accelerate the LaMP process. By accelerate, we mean an emphasis on taking action and a streamlined LaMP review and approval process. Each LaMP should include appropriate actions for restoration and protection to bring about actual improvement in the Great Lakes ecosystem. Actions should include commitments by the governments, parties and regulatory programs, as well as suggested and voluntary actions that could be taken by non-governmental partners. BEC endorses the April 2000 date for the publication of "LaMP 2000", with updates every two years.

BEC is committed to ensuring a timely review process and will be vigilant in its oversight.

The BEC respects and supports the role of each Lake Management Committee in determining the actions that can be achieved under each LaMP. BEC expects each Management Committee to reach consensus on those implementation and future actions. Where differences cannot be resolved, BEC is committed to facilitating a decision. BEC recognizes the Four-Party Agreement for Lake Ontario and the uniqueness of the agreed upon binational workplan.

The LaMPs should treat problem identification, selection of remedial and regulatory measures, and implementation as a concurrent, integrated process rather than a sequential one. The LaMPs should embody an ecosystem approach, recognizing the interconnectedness of critical pollutants and the ecosystem. BEC endorses application of the concept of adaptive management to the LaMP process. By that, we adapt an iterative process with periodic refining of the LaMPs which build upon the lessons, successes, information, and public input generated pursuant to previous versions. LaMPs will adjust over time to address the most pertinent issues facing the Lake ecosystems. Each LaMP should be based on the current body of knowledge and should clearly state what we can do based on current data and information. The LaMPs should identify gaps that still exist with respect to research and information and actions to close those gaps.

Adopted by BEC on July 22, 1999.

Chapter 2

Public Outreach and Education

Hartley Nature Center, Duluth, Minnesota.
Photo credit: Carri Lohse-Hanson, Minnesota Pollution Control Agency.

Lake Superior Lakewide Management Plan 2008

Chapter 2 Contents

Chapter 2
Public Outreach and Education

BACKGROUND

The Lake Superior Binational Program has a long history of public involvement in the development of the Lake Superior Lakewide Management Plan (LaMP). In particular, the Lake Superior Binational Forum, the primary public group associated with the agencies responsible for carrying out the Zero Discharge Demonstration Project, has been key to establishing an effective multi-sector stakeholder process. The Forum has held many workshops over the years for the purpose of acquiring necessary background information to help develop recommendations and proposals for reducing the sources of nine critical pollutants to the Lake Superior basin. The Forum has also published many documents on key issues relating to the LaMP.

In addition, a separate Lake Superior Work Group Communications/Public Involvement Committee, comprised of staff from government agencies and their partners, was formed to help expand the network of stakeholders and outreach activities. This Committee has produced documents for the purpose of informing the public about all aspects of the LaMP and the Binational Program.

2.0 ABOUT THIS CHAPTER

All the partners involved in the Lake Superior LaMP (i.e., state, provincial, and federal agencies, Tribes/First Nations, industry, the public, and others) have long been committed to an open, fair, and significant public involvement process. One of the main goals of the Lake Superior Binational Program is, in fact, to promote meaningful public participation and education to ensure that the needs and concerns of the diverse population in the Lake Superior basin are met. This section of the LaMP will briefly describe the efforts that have been made to date on public outreach and involvement initiatives.

2.1 PUBLIC INVOLVEMENT

A major tenet of ecosystem management is the necessity of continuous involvement of the public that is respectful of all viewpoints and stakeholders. Public input and support helps to ensure that the actions recommended in the LaMP are carried out, leading the way to restoring and protecting the lake ecosystem. The key to public support and the program's success is effective communication between the government agencies and the diverse population of the Lake Superior basin.

The LaMP 2008 is presented as a working document, based on existing information. It was the goal of the Binational Executive Committee to provide a *current* foundation for discussion of

Lake Superior efforts, not necessarily a *complete historical one.* The LaMP is modified based on new findings and public input. To that end, public input received on previous LaMP documents has been addressed in LaMP 2008. This is a necessary step if we are to institute adaptive management on an ecosystem scale.

A significant project related to public outreach is the Community Awareness Review and Development (CARD) project carried out in 2004-2005, and extended in Canada from 2006-2007. Thirteen communities and four First Nations were surveyed to determine community priorities and awareness of environmental issues. The results of this project will be used to focus future community outreach efforts and engage communities in implementing projects to achieve LaMP goals. See Chapter 7, Section 7.1.1 for more information on the CARD project.

2.2 PUBLIC OUTREACH/EDUCATION EFFORTS TO DATE

When the Lake Superior Binational Program first began, public involvement activities were carried out primarily by the Binational Forum (see Section 2.2.1 below). As the Program matured, it became apparent that the government agencies and their partners needed their own separate public outreach mechanism. Therefore, a separate group was formed entitled the Communications/Public Involvement Committee. Over the years, the two groups have worked together, complementing each other's efforts to involve the Lake Superior basin population.

2.2.1 Lake Superior Binational Forum

Since 1991, the Lake Superior Binational Forum has served as the public body that provides input to the governments responsible for carrying out the goals of the Binational Program. The purpose of the Forum is to promote participation among government, industry, and environmental stakeholders on the restoration and protection of Lake Superior. The Forum is comprised of Canadian and American stakeholders representing diverse community sectors such as environmental, Tribal/First Nation, industrial, business, health, faith community, and academic interests.

Figure 2-1. The Lake Superior Binational Forum donated three books about Lake Superior to five public libraries around the basin, including the Red Cliff Tribal library in Bayfield, Wisconsin. Red Cliff Librarian Gina LaGrew and two young patrons read books about the lake on special display at the library. Photo credit: Lissa Radke, Northland College.

The Forum has held technical workshops on various topics including mercury reduction,

sustainability indicators, PCBs, pesticides, and land use. These workshops provided necessary background information that led to proposals for chemical phase-out schedules and reduction recommendations. For example, recommendations related to the nine critical pollutants may be found in the Stage 2 Lakewide Management Plan (available at http://www.epa.gov/glnpo/lakesuperior/pubs.html). A more complete list and description of recent Forum activities may be found in Addendum 2A.

The Forum has focused on a series of projects that are conducted jointly with the Lake Superior Work Group. These have included a newspaper insert on critical Lake Superior issues, the CARD project, an annual environmental stewardship awards program, workshops on mercury and household garbage burning, Lake Superior Day, public input sessions, mercury reduction mentoring, and updates to the monitoring metadatabase. Forum activities are reviewed annually during the preparation of a yearly work plan.

2.2.2 Activities of the Communications/Public Involvement Committee

The Communications/Public Involvement Committee (or the Communications Committee) of the Lake Superior Work Group implements provisions of a strategy reflecting the Lake Superior Binational Program's long-term commitment to communications, public involvement, outreach, and education.

The Binational Program has produced various documents and brochures for the purpose of informing and educating the public. These documents include a general informational brochure on the Binational Program, as well as a brief introduction piece for each committee on the Lake Superior Work Group.

Since the LaMP 2006 Report was released, the Communications Committee has produced a highlights brochure and a 2005 Zero Discharge Demonstration Program and Critical Chemical Milestones factsheet. The first, "Lake Superior Lakewide Management Program (LaMP) Highlights 2006", was based on the LaMP 2006 Report and was mailed to Lake Superior stakeholders and distributed at Lake Superior Day events and various meetings around the basin. The second factsheet was based on the Zero Discharge Demonstration Program and Critical Chemical Milestones Report 2005. This was also mailed to Lake Superior stakeholders and distributed at various meetings around the basin.

In addition, the Communications Committee has coordinated more closely with the US EPA Great Lakes National Program Office (GLNPO) Communications Team so that many Lake Superior highlights are reflected in a quarterly activities report that reaches the highest level of US EPA management.

The Binational Program has developed a traveling display as a tool for outreach and education to the general public. This display is used to publicize Lake Superior and the Binational Program at public meetings, seminars, and conferences. The display includes a large photograph of the lake, with space for fact sheets, brochures, and other documents. The display booth is staffed by members of the Binational Program. In addition, a table-top display developed by University of Wisconsin-Extension is in use around the basin.

The Communications Committee has moved the main program web site to a joint Canada-U.S. site (www.binational.net), which is a site devoted to binational programs jointly led by Environment Canada and US EPA. The committee has also been revising the agency Lake Superior Binational Program web sites (www.epa.gov/glnpo/lakesuperior/ and http://www.on.ec.gc.ca/greatlakes/default.asp?lang=En&n=E621AE0A-1), which consist of a home page and supporting pages. This complements the Forum web site, which can be found at www.superiorforum.info.

The Communications Committee continues to participate in joint outreach and education projects with the Forum, such as a Lake Superior Awards program (see Addendum 2A) and Lake Superior Day. Over the past two years, Lake Superior Day has received support from many local governments and non-government organizations around the basin, as well as the following federal and state representatives:

- Rona Ambrose, Minister, Department of the Environment, Government of Canada;
- Stephen Johnson, Administrator, US EPA;
- Jennifer Granholm, Governor of Michigan;
- Tim Pawlenty, Governor of Minnesota; and
- Jim Doyle, Governor of Wisconsin.

A mailing list has been compiled to keep the public informed of new developments in the Lake Superior basin and to provide them with the opportunity to comment. The mailing list includes both U.S. and Canadian government agencies, tribal organizations and First Nations, environmental groups, and other public groups.

Assembling material to inform the public on progress toward restoring and protecting Lake Superior is another role which the committee fulfills. The committee is currently working on collecting success stories for distribution in various newsletters.

As this LaMP 2008 Report is not intended to be circulated extensively to the public, the agencies will produce a separate document, a LaMP 2008 Highlights brochure, to inform the public about activities of the Binational Program.

2.2.3 Lake Superior Pathfinders Program

The Lake Superior Pathfinders program is empowering environmental leadership for its third year!

Pathfinders began in 2002 when educators at the University of Wisconsin-Extension received a grant from the Wisconsin Coastal Management Program (WCMP) to create environmental leadership programs for high school youth and adult audiences. A study group of approximately 12 partner organizations, including Lake Superior Binational Program experts, met over the course of a year to assist with the development of the programs and then conducted pilot versions for both audiences. The youth program was piloted with 38 students in August of 2004, and the adult program was piloted over weekends in September 2004 with 12 participants selected from 59 nominated by UW-Extension educators and partners. In 2005, WCMP provided funding for

the development of a statewide model for the youth program, involving 85 participants (59 from Wisconsin) in three different week-long sessions. Northland College's Sigurd Olson Environmental Institute also became a partner and supplied funds, educators, and in-kind contributions. During the summer 2006 program, 120 students were expected to attend, including 30 Navigators, or returning Pathfinders who focus mostly on service learning. The adult program is still being pursued, but funding is not yet available.

The goals of Pathfinders include assisting participants to learn more about their own leadership styles through the use of tools such as low and high ropes challenge courses, climbing walls, and on-the-water kayak experiences. Educators help participants learn how to better utilize their skills in their communities and to take action on critical lake issues. After attending the program, participants better understand critical Lake Superior issues, as identified by the Binational Program. They more effectively gather, analyze, and evaluate related information, and have the confidence, knowledge, and desire to take action to respond to these issues in a more sustainable way. They recognize their own personal leadership skills and develop a personal "action" plan to complete in their community. When addressing an issue, they understand the Lake Superior basin community and respect different perspectives in seeking a resolution, while networking and forming relationships and partnerships. Participants also gain a sense of place for Lake Superior, as well as insight into the lake's cultural significance and the Anishinabe or Chippewa Tribe's reliance on it as they interact with Tribal elders and educators.

Figure 2-2. Students paddle and plant wild rice. Photo credit: Steve Durocher, Cedar Tree Institute.

The Pathfinders program is currently considering options to implement the program in Michigan, Minnesota, and Ontario in an effort to expand lakewide, creating leaders of critical environmental issues all around Lake Superior.

For more information on this program, please visit www.northland.edu/pathfinders. More information and details on the Pathfinders program may be found in Addendum 2B of this chapter and in Chapter 7.

2.2.4 Landowner and Realtor Outreach Project

The Landowner and Realtor Outreach Pilot Project aims to educate realtors and rural residential property owners about environmental issues. In terms of Lake Superior LaMP initiatives, this project is unique because it is not being implemented consistently basinwide, but is instead being piloted on a jurisdictional basis. Property ownership and real estate regulation usually falls within the jurisdiction of provincial, state, or local governments, and funding opportunities and schedules are at the federal level or lower. Various LaMP partners are already engaged in outreach efforts that address some of the same environmental issues addressed in this project, although these existing efforts target a different audience. The project employs a two-pronged

approach that includes a binder containing both LaMP and locally-specific information, in addition to coordinated outreach activities (home visits, realtor workshops, etc.).

Figure 2-3. The Landowner and Realtor Outreach Pilot Project aims to educate realtors and rural residential property owners about environmental issues. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

For these reasons, the Landowner and Realtor Outreach Pilot Project has adopted an opportunistic, jurisdictionally-specific approach to implementation. This allows implementers to take advantage of existing resources such as funding opportunities, organizational capacity, and ongoing programs. Where gaps exist, knowledge sharing and technology transfer can be done across jurisdictions in order to share information and best practices. Providing jurisdictionally specific information also increases the utility and relevance to landowners and realtors.

Binationally, the project team has prepared a prototype binder organized into the following tabs:

- Introduction to the Lake Superior Watershed
- What Is In This Guide?
- Wells
- Septic Systems
- Waste Disposal
- Energy Conservation
- Wetlands
- Shorelines
- Habitat
- Stormwater
- Landscaping for Wildlife
- Other References
- Appendix

Each tab includes introductory information outlining the issue and its importance to Lake Superior and the LaMP. This is followed by jurisdictionally-specific information provided by local sources relevant to rural homeowners in the Lake Superior basin. This might include information from federal, provincial, or state agencies; local municipal or county governments; and non-government organizations. The introductory information for each tab is currently in a draft stage.

Ontario

In Ontario, an environmental non-government organization called Green Communities Canada is already implementing an outreach program called Well Aware that is targeted at landowners and realtors. The program addresses many of the same environmental issues that are a priority for the Lake Superior LaMP. The program is implemented at the community level through trained Well Aware service providers who conduct home visits and community forums in their community. In the Lake Superior basin, the only Well Aware service provider is a non-government organization called EcoSuperior that serves the Thunder Bay community.

In support of the Landowner and Realtor Outreach Project, the Ontario Ministry of the Environment has provided EcoSuperior with funding to increase the capacity of the existing Well Aware program. Between September 2007 and March 31, 2008, EcoSuperior will be conducting additional home visits, hosting a community forum in Kakabeka Falls, and undertaking research, review, and development of content for three sections of the binder for completion by March 31, 2008: Shorelines, Burning Garbage, and Household Hazardous Waste. The latter two topics correlate with the Waste Disposal tab in the prototype binder.

EcoSuperior has recently completed 54 Well Aware visits in the Thunder Bay area. Additional home visits will resume in the spring when the climate is more reliable. In March 2008, EcoSuperior held a free information and education night on wells and septic systems in Thunder Bay. This location was chosen based on overwhelming interest in a similar Realtor's Forum held there in June 2007.

Both Well Aware and the additional work for this project have been funded by Ontario Ministry of the Environment. Environment Canada provides in-kind support for the project through the involvement of two staff on the project team.

Minnesota, Wisconsin and Michigan

All three states have participated in the Landowner and Realtor Outreach Project. The Minnesota Pollution Control Agency has contacted local governments for input to the concept, and local government landowner guides have been incorporated in the draft Minnesota version of the binder. Wisconsin supports both the concept and their Lake Superior partners in the project.

The Superior Watershed Partnership, based in Michigan, has worked with the Landowner and Realtor Outreach Project team and is seeking to implement the project in all of the Upper Peninsula counties, not just those in the Lake Superior basin.

2.3 MAKING A GREAT LAKE SUPERIOR 2007 CONFERENCE

From October 28 to 31, 2007, the *Making A Great Lake Superior 2007* conference was held at the Duluth Entertainment and Convention Center in Duluth, Minnesota. Sponsored by US EPA GLNPO, Environment Canada, and Minnesota Sea Grant, the purpose of this significant conference, the first of its kind since 1990, was to allow researchers, land and resource managers, educators, and basin residents to participate in interdisciplinary discussions about the status and successes of Lake Superior as well as challenges and critical issues of importance facing Lake Superior.

The conference was co-chaired by Environment Canada and US EPA, with support from the Lake Superior Task Force, the Work Group, and the Binational Forum of the Lake Superior Binational Program. The conference incorporated presentations from individuals, organizations, governments, academics, non-profits, and citizen groups involved in research, educational activities, or management in the Lake Superior watershed. Conference participants included:

For more detailed information about the *Making A Great Lake Superior 2007* conference, please see Addendum 2C or www.seagrant.umn.edu/superior2007/. Please also refer to Appendix E of LaMP 2008.

- Researchers;
- Educators;
- Government agencies;
- Tribes and First Nations;
- Communities;
- Citizen groups;
- Business and industry;
- Students; and
- Local governments.

This conference provided a significant opportunity to raise awareness about, and educate and engage people in, the Lake Superior Binational Program. The conference format included plenary and break-out sessions, a trade show exhibit and poster area, an awards banquet, field trips, and public events on climate change.

Figure 2-4. The *Making a Great Lake Superior 2007* conference in Duluth, Minnesota, included a kite making session (from recycled materials). Photo credit: Elizabeth LaPlante, US EPA.

The conference attracted over 450 binational participants from around the Lake Superior basin and beyond. A special effort was made to include teachers. Thirty-three teachers attended, most of whom received scholarships, with many more on the waiting list. The teachers received continuing education credits for their participation.

The conference included a facilitated session on Education and Outreach. The session was co-chaired by Environment Canada and US EPA.

One of the most significant ways the conference engaged participants in the Binational Program was by adopting an environmental statement to reduce the overall environmental impact of the conference and respect the spirit of the Lake Superior Zero Discharge Demonstration Program. Specifically, the misson statement stated:

> ***Making a Great Lake Superior 2007*** *pledges to reduce the impact to the air, water, and land of the Lake Superior Basin from the transportation, energy demand, and waste created by planning and attending this conference. To this end,* ***Making a Great Lake Superior 2007*** *will reduce the overall impact of the conference and respect the spirit of the Lake Superior Zero Discharge Demonstration Program to eliminate the release of toxic substances in the basin, through a pollution prevention approach to all aspects of the conference including:*
>
> - *Offsetting all unavoidable carbon emissions through the implementation of a carbon neutral strategy;*
> - *Decreasing the amount of waste produced by the conference;*
> - *Reducing energy and water consumption;*
> - *Disposing of waste in an environmentally responsible manner; and*
> - *Eliminating the use of harmful chemicals at the event.*

The venue made significant efforts toward these goals by providing a food service plan that emphasized locally grown, produced, and when possible, organic products. Over 60 percent of all the food products served at the conference were locally produced. Other waste minimization efforts included recyclable products, dishware, food waste minimization, and composting. The conference web site was used to promote group transportation options, disseminate conference information paper-free, and to broadcast web casts for those unable or unwilling to travel. Participants were encouraged to use sustainable transportation to and from the event, and to bring their own name tag. Awards were provided in both of these categories.

Figure 2-5. Members of the Lake Superior Task Force learned about habitat studies on Isle Royale National Park, MI, in June 2007. Photo credit: Roger Eberhardt, Michigan Department of Environmental Quality.

An evaluation survey was conducted by email following the event in order to quantitatively and qualitatively capture participant feedback and to measure satisfaction. The response rate was 70 percent (281 responded of 402 participants). Below is a summary of the results:

- 97 percent rated their conference experience as good or excellent;
- 86 percent have already used or plan to use information from the conference in the future;
- 66 percent rated the Climate Change session as very useful and were interested in having it as a topic at the next conference;
- 85 percent stated the conference was somewhat or very effective at fostering dialogue and information sharing between researchers, educators, and managers;
- 71 percent felt that the green aspects were very important (another 22 percent stated that it was somewhat important);
- 95 percent recommended a Lake Superior conference be held on a regular basis, with over 81 percent stating that they would attend; and
- Networking was an important part of the conference experience, and the event facilitated interactions between researchers, natural resource managers, and educators.

For more detailed conference evaluation results, please refer to Appendix F of LaMP 2008. Conference results are also available at http://www.seagrant.umn.edu/superior2007/.

More information on the conference can be found in Addendum C.

2.4 CONCLUSION

The partners involved in the Lake Superior Binational Program have many ongoing outreach, education, and communication activities. The partners believe that these will meet the objectives of informing and educating the public about the program, involving the public in the decision-making process, and educating and motivating stakeholders into action. These agencies are mindful that involvement by people representing a wide range of interests is essential to the success of the Lake Superior Binational Program. Public input and support will help ensure that actions recommended in the program are carried out, leading the way to restoring and protecting Lake Superior.

ADDENDUM 2A:
LAKE SUPERIOR BINATIONAL FORUM ACCOMPLISHMENTS: 2005-2007

The Lake Superior Binational Forum is a citizen stakeholder group comprised of 24 U.S. and Canadian volunteers working together to provide input and analysis to governments on critical issues. The members also develop strategies to educate the public about how to protect and restore the natural environment of Lake Superior.

During 2005-2007, the Forum accomplished the following milestones:

1. The Forum Participated in the *Making a Great Lake Superior 2007* Conference

The Binational Forum helped organize and conduct the following programs and sessions at the *Making a Great Lake Superior 2007* conference held on October 29-31, 2007, in Duluth at the Duluth Entertainment and Convention Center:

- Members of Planning Committees
  Forum members participated on the Executive, Steering, Sessions, Communications, and Outreach committees since late 2006 to help define the overall agenda, set goals, recruit speakers, plan session content, and develop a communications plan.

- Moderators and Speakers at Special Sessions
  In cooperation with Work Group members, Forum members facilitated or presented at three special topic sessions: watershed stewardship, environmental and economic sustainability, and a facilitated workgroup on education and outreach.

- Kite Making Workshop
  To highlight the main message for Lake Superior Day 2008, several Forum members and volunteers from Northland College (Ashland, Wisconsin) joined Phil Kucera, a kite maker and artist from Ironwood, Michigan, to make kites at the Great Lake Aquarium on the Sunday afternoon before the 2007 conference. The purpose of the workshop was to show how clean energy sources such as the wind contribute to better water quality. Approximately 130 kids and adults made kites at the workshop.

Figure 2-6. Children learned to make kites from recycled materials at the *Making a Great Lake Superior 2007* conference. Photo credit: Elizabeth LaPlante, US EPA.

- Art Gallery
  A Forum member recruited about 25 artists from around the basin whose visual media represented the aesthetic, spiritual, historical, and cultural aspects of the lake through paintings and photographs, sculptures, and movies. Works by the artists were displayed in

an art gallery designed and built for the conference, as was a movie theatre that offered films about the lake.

- Local Elected Officials Lunch
  The Forum often partners with local elected officials during its meetings in host communities around the lake each year. To increase collaboration with these officials, the Forum partnered with the Great Lakes and St. Lawrence Seaway Initiative to host a lunch and informal meeting to share resources and needs. Mayors, town and county board chairs, tribal leaders, and local government department chairs met together on the last day of the conference to learn about lake issues, local concerns and needs, and how to work together in the future.

2. Environmental Stewardship Awards Program

In collaboration with the Lake Superior Work Group (LSWG) in 2004, the Forum initiated an annual Environmental Stewardship Awards Program to recognize outstanding contributions that help restore or protect the basin's natural environment. Recipients in both the U.S. and Canada were selected from five categories for their innovative or ongoing activities: Youth; Adult Individual; Business, Industry, and Community; Organization; and Tribe/First Nation.

The winners in the last two years were:

In the U.S.:

- Youth – Deb Ganz-Brown's and Laurie Schmidt's 2002 6th grade classes, Pattison School, Superior, Wisconsin (2006);
- Adult Individual – Mary Rehwald, Ashland, Wisconsin (2006); a tie with Bob Olsgard, Spooner, Wisconsin, and Jill Jacoby, Duluth, Minnesota (2007);
- Business – Conservation Technologies, Duluth, Minnesota (2006); Septic Pumping, Ashland, Wisconsin (2007);

Figure 2-7. Jill Jacoby holds her award for being named a U.S. winner of the 2007 Lake Superior Binational Program Environmental Stewardship award for outstanding actions taken by an individual to protect Lake Superior. The "beachscape," handmade artwork with sand and driftwood, was created by Washburn, Wisconsin, artist Jim Radtke (left), and presented to Jacoby by U.S. Co-chair of the Lake Superior Binational Forum Bruce Lindgren (right). Photo credit: Lissa Radke, Northland College.

- Industry – A two-way tie between (1) Memorial Medical Center, Ashland, Wisconsin, and (2) Sappi Cloquet LLC, Cloquet, Minnesota (2006); CG Bretting Manufacturing Company, Ashland, Wisconsin (2007); and

- Community/Organization – A three-way tie among (1) Earth Keepers, Upper Peninsula, Michigan; (2) "A View from the Lake," a joint Minnesota Sea Grant and University of Wisconsin-Extension project; and (3) Cities for Climate Protection, Duluth, Minnesota (2006); Lake Superior Streams (2007).

In Canada:

- Youth – Anishnabek of the Gitchi Gami, Thunder Bay, Ontario (2007);

- Adult Individual – Jake VanderWal, Thunder Bay, Ontario (2006); Karin Grundt, Wawa, Ontario (2007);

- Business – First Nations Issues (2006); and

- Community/Organization – Zero Waste Action Team, Thunder Bay, Ontario (2006).

The winners and honorable mention recipients for each year since 2004 can be found on the Forum's web site at www.superiorforum.info.

3. Lake Superior Day

The Forum wanted to elevate the visibility of Lake Superior issues by promoting a celebration of the lake's importance, uniqueness, and beauty. An annual Lake Superior Day is now held throughout the basin on the third Sunday in July.

The purpose of Lake Superior Day is to educate residents about their role as trustees of the lake by encouraging them to make thoughtful behavioural choices that eliminate pollution and foster sustainable lifestyles. Lake Superior Day encourages people to pledge to care for the basin's natural resources and to appreciate the lake's unique ecosystems.

The main messages have been to educate the public about the LaMP and successful implementation of LaMP goals and to promote sustainable activities that reduce impacts on the lake. Target audiences

Figure 2-8. Barbara Kerkove, a junior majoring in graphic design and biology at Northern Michigan University, created this Lake Superior Day logo in 2007 to symbolize the annual event. Kerkove's design was chosen from almost 30 others entered in a design contest held by the university's Art and Design Department.

have included local elected officials, libraries, environmental groups, anglers and recreational boaters, chambers of commerce, and churches.

The Forum developed a web site that describes activities and events that people can organize in their communities. The day is promoted through special buttons, post cards, placemats, flyers, newspaper ads, and press releases. About 45 groups have organized events for these annual celebrations. For example, several churches in the Chequamegon Bay, Wisconsin, area offered 'blessing of the water' services, beach clean ups, special sermons, and potluck meals. A partnership of the Cedar Tree Institute, Superior Watershed Partnership, and area musical groups held a free public concert in Marquette that included a dance, new music composed specially for the event, and a chamber orchestra.

For a list of previous year's events as well as activity ideas, visit the Forum's web site at www.superiorforum.info.

4. Public Input Sessions

One of the Forum's main functions is to serve as a link between the general public and the government agencies that are managing the lake. By holding open meetings in at least four host communities per year and soliciting comments about issues, the Forum can learn what the public wants and needs. The Forum shares this feedback with members of the Lake Superior Binational Program, which uses the feedback to help shape policy regarding lake management strategies.

To enhance this role, in 2004 the Forum initiated a public input session to be held at each of its quarterly meetings. These sessions allow open exchanges between specialists and the public. Time is spent at each session to collect comments from citizens about concerns regarding environmental issues in the Lake Superior basin. The following sessions were held around the lake during 2005-2007:

- February 2005 – Stream restoration in the Upper Peninsula (Marquette, Michigan);
- May 2005 – Impacts of the shipping industry on the lake (Sault Ste. Marie, Ontario);
- September 2005 – Native American/First Nations protection and restoration programs (Grand Portage, Minnesota);
- November 2005 – Citizen Science: Volunteer water quality monitoring opportunities (Thunder Bay, Ontario);
- March 2006 – Mining in the Lake Superior basin: trends and issues (Hibbing, Minnesota);
- May 2006 – Land use in Ontario (Marathon, Ontario);
- September 2006 – Successful Lake Superior protections/restorations in Marquette & the Upper Peninsula (Marquette, Michigan);

- November 2006 – Emerging concerns regarding pharmaceuticals and personal care products in our water (Thunder Bay, Ontario);

- January 2007 – Taking Natural Steps into economic and environmental sustainability (Ashland, Wisconsin);

- May 2007 – Sustainability and impacts of waterfront development (Thunder Bay, Ontario); and

- September 2007 – Sustainability in resource industry: best practices (Wawa, Ontario).

5. The Forum continues to provide input and analysis to governments about LaMP implementation

In addition to holding workshops and public input sessions, the Forum has also written numerous letters to various government representatives about different environmental issues having the potential to negatively impact the Lake Superior ecosystem.

The Forum also worked on two other joint projects with the LSWG: a mercury reduction mentoring program and a monitoring database development project.

Mercury Reduction Mentoring Program

The initial mercury reduction program for Lake Superior was undertaken in Canada between September 2005 and March 2006 as a result of recommendations from a September 2004 joint industry-government-Forum meeting which included providing advice to industry on mercury reduction through industry peers. A contractor, Don Murray, was hired in this capacity.

Of the companies initially contacted by the contractor, three facilities had recently shut down and one was on strike. Of the 15 operating facilities contacted, 10 consented to host a workshop and two were interviewed about the extent of their mercury reduction programs. Seven companies have sent letters to the contractor committing to take part in the mercury reduction program.

Environment Canada will continue to fund this project through 2008.

Objectives for 2007-2008:

1. Fulfill follow-up obligations from the 2005-2006 mercury mentoring project with companies who made commitments to the project;
2. Extend the mercury mentoring project to include facilities that were unwilling/unable to participate in the initial project where possible; and
3. Improve on the workshops and program initiated in the 2005/2006 project by building on the lessons learned from it.

The Forum has played an important role in this joint project with the LSWG by contacting representatives in the industrial and municipal government sectors to invite them to learn how to identify mercury-containing equipment and devices in their facilities, how to dispose of them

safely, and how to purchase mercury-free devices. The Forum is helping to serve as the mentor and motivator to new participants and sectors that have not yet conducted this kind of inventory and replacement process.

To participate jointly in the LSWG's focus on monitoring since 2006, the Forum has been conducting a search of Michigan, Minnesota, and Wisconsin to find all private, corporate, municipal, tribal, and non-profit organizations' natural resource monitoring programs at the local, regional, and state levels. The Forum is developing an inventory of who is monitoring which indicators in what region, and will produce a map of these programs.

Based on this list and map, the Forum will conduct a gap analysis of indicators that are missing and where monitoring is needed. Although the Binational Executive Committee (BEC) has developed a database of state, federal, and provincial monitoring programs, the Forum's focus will be on non-governmental efforts. This joint investigation of who is monitoring what elements in an ecosystem will help produce a comprehensive overview of Lake Superior monitoring efforts.

6. Involving Youth in Leadership Activities

The Forum's Outreach Committee is seeking greater youth involvement in Forum activities. The Forum has organized a model monitoring assessment program to involve college and university students from around the basin, together with their faculty mentors in exploring, evaluating, and expanding the citizen science movement around the basin. Northern Michigan University (NMU) in Marquette has expressed support for this program; Forum members are working with the NMU interdisciplinary Environmental Science Program to develop details and funding sources.

ADDENDUM 2B:
PATHFINDERS PROJECT UPDATE

Lake Superior Pathfinders launches its 4th year of programming with exciting additions!

The Lake Superior Pathfinders program of the Sigurd Olson Environmental Institute at Northland College now offers three distinct residential summer experiences for young people to learn more about Lake Superior. Using the Lake as a living classroom, students learn through experiential, life-changing experiences!

Making Waves is a new program for students in grades 6-9. Partnering with the Conserve School in Land O' Lakes, Wisconsin, and Northland College in Ashland, Wisconsin, the program focuses on aquatics both inland and on Lake Superior, and is designed to assist students in learning about and discovering aquatics. Making Waves also enhances students' knowledge through activities that examine real strategies to sustain healthy lake communities, and by developing skills to become better environmental stewards.

Lake Superior Pathfinders continues to offer an Environmental Leadership and Social Justice program to students in grades 9-12. The Pathfinders program assists participants in learning more about their own leadership styles through such tools as low and high ropes challenge courses, climbing walls, and on-the-water experiences. After attending the program, participants understand critical Lake Superior issues, as identified by the Binational Program.

The Lake Superior Navigators program is designed for those students who have attended Pathfinders, or have exceptional leadership experience in grades 9-12. Participants network with other amazing leaders and develop relationships and build capacity through focused experiential activities, exceptional speakers, and skill sharing. They explore community sustainability and leadership concepts by engaging in community service projects in the Ashland area.

All programs are taught by Northland College professors, professional educators, Sigurd Olson Environmental Institute staff, Chippewa tribal elders and educators, community leaders, and field counselors.

To date, Pathfinders has had 266 participants, and educated over 7800 students through school visits and events. Pathfinders serves as a potential model to be instituted around Lake Superior and the Great Lakes basin.

Information on this program can be found at www.northland.edu/pathfinders.

ADDENDUM 2C: Making a Great Lake Superior

The "Making a Great Lake Superior 2007" Conference started with a bang and smoke, or more precisely, the throb of drumming and an Ojibwe pipe ceremony. Designed to increase collaboration among people and organizations that are invested in Lake Superior's well-being, the conference exceeded organizers' expectations with 450 attendees. "Making a Great Lake Superior," which spanned the last three days of October in Duluth, Minn., attracted scientists, government officials, natural resource managers, educators, the media, and citizens from around Lake Superior.

Polar Explorer Will Steger and Minnesota Governor Tim Pawlenty answer reporters' questions about global warming at a news conference during the "Making a Great Lake Superior 2007" Conference.

"We're incredibly pleased with the momentum this conference generated," said Jesse Schomberg, Minnesota Sea Grant's coastal communities educator, who took a major role in organizing the conference on behalf of the Great Lakes Sea Grant Network and with the help of the U.S. Environmental Protection Agency (Liz LaPlante and Janet Keough), Environment Canada (John Marsden), and others. "The feedback has been terrific. A lot of important, useful, and diverse information about Lake Superior was exchanged."

The conference focused on 12 priorities including human health, invasive species, Areas of Concern, and fisheries. Climate change and the most recent Lake Superior research findings grabbed headlines due to their emphasis during the conference and two media briefings. During one briefing, Minnesota Governor Tim Pawlenty stood beside polar explorer Will Steger to announce their plans to tour the state together talking about global climate change's impacts and advocating for solutions.

In the other briefing, three Lake Superior experts gave reporters sweeping overviews of contaminants, fisheries, and research opportunities before hustling across the hall to deliver a more in-depth address to a full audience of conference attendees. Deb Swackhamer, professor of environmental

Families fly kites made from homemade materials off the deck of the Great Lakes Aquarium in Duluth. The event was one of several free pre-conference opportunities open to the public.

chemistry at the University of Minnesota said, “I’m going to tell a story about the ghosts of contaminants past.” After talking about lingering legacy pollutants like PCBs, DDT, and toxaphene, she said that the impacts of today’s chemicals are harder to see and measure, which makes studying them more challenging.

Mark Ebener, fishery assessment biologist with the Inter-Tribal Fisheries and Assessment Program, told reporters that fish, especially whitefish and lake herring (cisco), are thriving in Lake Superior. He called it a “siscowet lake, not a lean trout lake” despite noting that it probably contains more lake trout now than it did in the 1920s -- the heyday of the trout fishery.

Carl Richards, director of the U.S. Environmental Protection Agency’s Mid-Continent Ecology Division, faced the press to describe how advances in technology, like robotic sensors, have significantly changed the way research is conducted. “We can move beyond educated guesses,” he commented. “The types of questions we can ask have changed, and how we look at questions has changed.”

Several facets of the three-day conference broke the confines of tradition. One was the deliberate effort to mix science, management, policy, and education perspectives. Another was the emphasis put on “greening” the meeting and the venue. Conference organizers sought to reduce the resources required to transport, feed, and inform participants. The Duluth Entertainment and Convention Center staff served local and when possible, organic, food; recycling and composting continued as habit. After calculating the amount of carbon consumed beyond the daily norm for 450 people, the conference organizers intend to purchase 75 tons of carbon credits. The credits will go toward alternative energy projects including a solar array, wind turbines, and methane production from dairy farms and wastewater treatment plants. This $900 offset should push the conference beyond carbon neutral to carbon negative.

Several participants even won awards for their efforts to attend the conference in a sustainable manner.

Small Footprint Award (for farthest sustainable modes of travel)

- John Jereczek, Roller-skied 5 miles
- Julene Boe, Walked 1 block (judges erred thinking “1” meant “1 mile”)
- Matt Hudson, Biked 140 miles round trip

Reuse Award (for inventive reuse of nametags)

- Marnie Chauvin
- Ann McCammon-Soltis
- Gary Gulezian
- Carri Lohse-Hanson

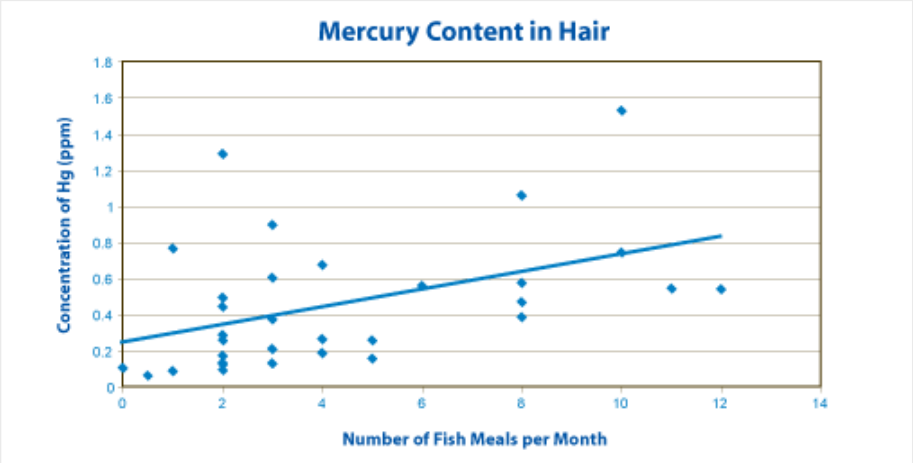
Carri Lohse-Hanson snips a sample of Minnesota Sea Grant Editor Sharon Moen’s hair for mercury testing.

During the ceremony, the Lake Superior Binational

Program also honored Jake Vander Wal from Thunder Bay, Ont., with a Lifetime Achievement Award and acknowledged their Environmental Stewardship Award recipients.

In addition to an art exhibition, vendor booths, poster and oral presentations, and think-tank sessions on topics such as research directions and management issues, 30 conference-goers left with an estimate of their mercury load. In exchange for a chunk of hair and information on the number of fish meals eaten per month, Carri Lohse-Hanson of the Minnesota Pollution Control Agency showed that people who consume more fish tend to have higher concentrations of mercury in their hair, which is consistent with more scientific studies.

The consensus of the presenters and attendees seems to be that people need to remain vigilant about protecting Lake Superior from the consequences of coastal development, invasive species, and climate change.



The Minnesota Pollution Control Agency reports that 30 conference participants, who consumed an average of 4.3 fish meals per month, had an average of 0.45 parts per million (ppm) of mercury in their hair. Although the health threshold for mercury levels is debated, the U.S. EPA sets the bar at 11 ppm.

"I feel that people left the conference with a new energy and new sense of urgency," said Schomberg. "Achieving our regional -- let alone global, environmental, and economic goals -- requires both."

Visit the conference Web site (www.seagrant.umn.edu/superior2007) in the coming months to find out what participants had to say about their experience at the "Making a Great Lake Superior" Conference.

Source: Moen, S. 2007. Making a Great Lake Superior. Minnesota Sea Grant. Available at http://www.seagrant.umn.edu/newsletter/2007/12/making_a_great_lake_superior.html. Reprinted with permission.

Chapter 3

Ecosystem Goals, Indicators and Monitoring

Monitoring boat on the St. Louis River.
Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Lake Superior Lakewide Management Plan 2008

Chapter 3 Contents

Chapter 3
Ecosystem Goals, Indicators and Monitoring

3.0 ABOUT THIS CHAPTER

The Binational Program is committed to the objectives of zero discharge of targeted critical pollutants and to a broader program to restore and protect ecosystem integrity in Lake Superior and its watershed. The Lake Superior vision statement, entitled *A Vision for Lake Superior* (see Chapter 1), expresses this commitment to the Lake Superior ecosystem. The vision statement reflects the diverse pathways and mechanisms by which humans and nature interact within land and water ecosystems, and challenges the inhabitants of the Lake Superior watershed to accept personal responsibility for protecting the Lake and the landscape that sustains it.

3.1 ECOSYSTEM GOALS, SUBGOALS, AND OUTCOMES

Background

The Lake Superior LaMP contains critical pollutant goals, namely the targeted reduction goals for the nine critical pollutants (see Chapters 1 and 4). Until now, the LaMP and the Superior Work Group have not fully developed similar goals and objectives for the broader ecosystem program. In this chapter, draft ecosystem goals and objectives are presented, as a complement to the critical chemicals goals. These draft goals have undergone public review and comment and are scheduled to be finalized in 2008.

A Vision for Lake Superior expresses the desire for, among other things, a watershed where diverse life forms exist in harmony—that is, free of toxic substances that threaten fish, wildlife, and human health, and where wild shorelines and islands are maintained.

The Habitat, Aquatic Communities, and Terrestrial Wildlife Committees, in turn, have put forward a mission to "support intact, diverse, healthy and sustainable ecosystems and the native plant and animal communities that depend upon them." The committees have described the natural processes that must be present and functioning well in order for a healthy ecosystem to exist, as well as a set of principles that guided, and continue to guide, their work in developing these Ecosystem Goals. These components can be found in the consolidated ecosystem chapter of the Lake Superior LaMP, first published in LaMP 2006.

The Strategic Outcomes that the committees have set in order to preserve, protect, and enhance healthy, sustainable ecosystems, are as follows:

1. Diverse and healthy native plant and animal communities exist in the Lake Superior basin.

2. A program is in place to monitor the abundance, distribution, and health of plant and animal populations and communities in the Lake Superior basin.

3. Species at risk or species of concern are recovered if populations are too low, or controlled if populations are too large.

4. No further extirpation of native species occurs in the Lake Superior basin.

5. No new non-native species will be introduced into the Lake Superior basin.

6. Partnerships among natural resources management agencies, environmental agencies, and non-agency stakeholders are strengthened and broadened.

7. Human activities in the Lake Superior basin mitigate the contribution of greenhouse gases to the environment. Ongoing climate change adaptive management strategies are pursued in the Lake Superior basin.

8. An interagency effort to restore and protect critical habitats will be organized and initiated.

9. Management in the Lake Superior basin is organized and implemented at appropriate watershed scales.

Lake Superior Draft Ecosystem Goals

In order to achieve the Strategic Outcomes referenced above, the Habitat, Aquatic Communities, and Terrestrial Wildlife Committees worked together over the past two years to refine and revise a set of ecosystem goals. These goals contain strategic outcomes, specific goals, and subgoals that the committees have determined are necessary to achieve and protect a diverse, healthy, and sustainable Lake Superior ecosystem. Although a version of these goals was originally included in the LaMP 2006, revisions were needed to better organize the goals and to accommodate emerging issues like climate change. A public comment period was held to gather input on the draft goals.

Figure 3-1. Palisade Head from Shovel Point, MN. Photo credit: Carri Lohse-Hanson, Minnesota Pollution Control Agency.

The draft goals that were released for public comment can be found in Table 3-1. Once final, the committees intend to work toward the fulfillment of the goals and use them as a tool to track progress. The committees and the Binational Program anticipate that all agencies and organizations around the lake can use these goals as a guide to achieving the shared *Vision for Lake Superior*.

These goals were also shared and coordinated with the Great Lakes Fisheries Commission's Lake Superior Technical Committee. The Lake Superior Technical Committee's draft aquatics Environmental Objectives were integrated in the Habitat and Wildlife Committee's ecosystem goals. The committees will continue to work together to ensure coordination and achievement of mutual goals.

Table 3-1. Ecosystem Goals

GOAL	SUB-GOAL		OTHER STRATEGIC OUTCOMES ACHIEVED	GOAL TYPE*
Strategic Outcome #1: Diverse, healthy and self-sustaining native plant and animal communities exist in the Lake Superior basin.				
1		Identify and restore native communities where they are degraded.		IG, S
	Subgoal	Inventory and assess impacts to degraded habitats and communities.	2	
	Subgoal	Develop and distribute GIS information on ecosystem types, conditions and trends, including coastal wetlands and riparian acres, and identify where restoration can occur.		
	Subgoal	Develop and put into place a policy that results in zero loss of wetland acres and function.		
	Subgoal	Restore 25% of degraded wetland acres in the Lake Superior basin.		
	Subgoal	Restore or protect 25% of riparian conifer forest acres in the Lake Superior basin.		
2		Identify and protect a system of representative, high quality ecosystems.		IG, S
	Subgoal	Complete comprehensive, systematic biological surveys in the watershed to identify remaining high-quality natural communities.	2, 8	
	Subgoal	Engage landowners as partners in protecting important habitat.		
	Subgoal	Use special designations to protect important habitat on public lands and waters.		
3		Maintain existing genetic diversity and population integrity.		
4		Manage the harvest of plant and animal resources to ensure diverse, healthy, and self-sustaining native plant and animal communities.		
Strategic Outcome #2: A program is in place to monitor the abundance, distribution, and health of plant and animal populations and communities in the Lake Superior basin.				
1		Institute a long-term Lake Superior basinwide program to monitor ecosystem health utilizing standardized methodology.	1, 3	M
	Subgoal	Explore the development of inventory, monitoring, assessment and reporting tool for the basin and how it might be implemented.		
	Subgoal	Develop, test, and implement standardized monitoring protocols, sampling procedures and data handling for ecological indicators to enable Binational Program agencies to report on the status of the basin's ecosystem health.		
		Neotropical Migratory Birds		

GOAL	SUB-GOAL		OTHER STRATEGIC OUTCOMES ACHIEVED	GOAL TYPE*
		Reptiles and Amphibians		
		Soil Invertebrates		
		Medium-Sized Carnivores		
		Fish and aquatic invertebrates		
		Land Use Change		
		Exotic and Invasive Species		
		Rare Resources		
		Culturally Important Resources		
		Over Abundant Species		
		Indicators of Contaminants in the Environment		
		Indicators of Global Climate Change	7	
Strategic Outcome #3: Species at risk or species of concern are recovered if populations are too low, or controlled if populations are too large. **Strategic Outcome #4**: No further extirpation of native species occurs in the Lake Superior basin.				
1		Complete comprehensive, systematic biological surveys in the watershed to identify locations of rare plants and animals.		IG
2		Encourage the development and implementation of species recovery plans for species at risk or species of concern.		P
3		Work with partners to develop a common understanding of native species overabundance, and develop and implement plans to control overabundant species.	6	C
4		Encourage the appropriate use of native species for all projects requiring vegetation restoration.	1	
	Subgoal	Develop sources of native plants and seeds in an ecologically appropriate manner throughout the Lake Superior basin for use in vegetation restoration.		S
	Subgoal	Establish standards of native species propagation and use as well as definitions of seed zones.		
	Subgoal	Develop a list of critical native species that are regionally / habitat specific and ecologically appropriate.		

GOAL	SUB-GOAL		OTHER STRATEGIC OUTCOMES ACHIEVED	GOAL TYPE*
	Subgoal	Educate citizens in the Lake Superior basin about the importance and appropriate use of local native plants in restoration and landscaping projects.		
5		Inventory the extent of exotic, invasive species and implement control measures.		IG
	Subgoal	Complete an inventory and control plan for priority exotic species at the scale of the Lake Superior basin.	6	P
	Subgoal	Encourage all agencies to develop and implement treatment programs for priority species.		S
Strategic Outcome #5: No new non-native species will be introduced into the Lake Superior basin.				
1		Establish and implement best management practices for a range of activities (e.g., forestry, recreation, intra-lake shipping) to prevent the introduction and spread of exotics.	4	P,S
2		Develop a guidance document for agencies' vegetation restoration for projects in the Lake Superior basin.	6	C
Strategic Outcome #6: Partnerships among natural resource management agencies, environmental agencies, and non-agency stakeholders are strengthened and broadened.				
1		Develop information and educational material to assist local land use decision makers in implementing Binational Program goals through land use planning.	9	C
	Subgoal	Have a Binational Program educator on staff to present material to local governments and decision makers highlighting linkages between land use and ecosystem health.		C
2		Support appropriate public and technical fora to provide opportunities for researchers, resource managers and the public to exchange information.	8	C
3		Inform and educate senior decision makers about how their actions move the Lake Superior basin toward "A Vision for Lake Superior."		C
	Subgoal	Develop a communications plan.		
	Subgoal	Implement the communications plan.		
4		Complete a film about Lake Superior.		C
Strategic Outcome #7: Human activities in the Lake Superior basin mitigate the contribution of greenhouse gases to the environment. Ongoing climate change adaptive management strategies are pursued in the Lake Superior basin.				
1		Understand the impacts of climate change and the limits to the ability to predict and model these impacts on specific ecosystems and local regions.		IG

GOAL	SUB-GOAL		OTHER STRATEGIC OUTCOMES ACHIEVED	GOAL TYPE*
	Subgoal	Continue to refine climate change models so as to develop specific predictions for the Lake Superior basin.		
	Subgoal	Develop model projections of changing water levels for Lake Superior.		
	Subgoal	Model impacts on wetlands and other habitat types under future water level regimes for 20 years, 50 years, 75 years, and 100 years in the future.		
	Subgoal	Predict changes to terrestrial and aquatic ecosystems based on climate change predictions.		
	Subgoal	Develop predictions of the impacts of climate change on keystone biota in the lake and the basin as a whole.		
2		Review and revise Conservation and Restoration Plans in the basin as required based on the climate scenarios developed in the goal above.	1	P
3		Help Lake Superior basin stakeholders adapt to climate change impacts.		
	Subgoal	Help stakeholders to adapt to climate change impacts by facilitating assessment of infrastructure vulnerabilities and capacity.		
4		Make Lake Superior a net carbon reduction area that reduces greenhouse gas emissions.		S
	Subgoal	Facilitate basin collaboration on activities to reduce carbon emissions.		
	Subgoal	Encourage governments around the basin to set greenhouse gas emission reduction targets.		
	Subgoal	Encourage U.S. cities to sign onto the US Mayors' Climate Protection Agreement.		
Strategic Outcome #8: An interagency effort to restore and protect important habitat will be organized and initiated. **Strategic Outcome #9**: Management in the Lake Superior basin is organized and implemented at appropriate watershed scales.				
1		Support the development and implementation of ecologically based integrated watershed management plans for priority watersheds within the Lake Superior basin.	1, 2	P, S
	Subgoal	Identify watersheds that have existing watershed plans.		
	Subgoal	Develop a list of watersheds that need a new or revised plan.		
	Subgoal	Prioritize watershed list.		
	Subgoal	Work with local governments/groups to develop watershed plans for 25% of the highest priority watersheds in need of a new or revised plan.		

GOAL	SUB-GOAL		OTHER STRATEGIC OUTCOMES ACHIEVED	GOAL TYPE*
	Subgoal	Work with local governments/groups to develop watershed plans for 50% of the highest priority watersheds in need of a new or revised plan.		
	Subgoal	Work with local government/groups to develop watershed plans for 75% of the highest priority watersheds in need of a new or revised plan.		
	Subgoal	Work with local governments/groups to develop watershed plans for 100% of the highest priority watersheds in need of a new or revised plan.		
2		Develop and maintain a unified, binational GIS database that includes current basinwide data and decision support models needed for watershed management at a scale and in a format that supports Lake Superior basin planning and watershed management.	6	IG, P
	Subgoal	Develop formal agreements for data sharing, participation and support.		
	Subgoal	Establish a mechanism to maintain shareable data once collected.		
Strategic Outcome # 10: Air and water quality are restored and protected and soils are conserved.				
1		Restore and maintain natural hydrologic processes, including groundwater.		
2		Eliminate contaminants at levels that impact plants and animals, including humans.	3	
3		Protect oligotrophic conditions in nearshore and offshore waters and restore and protect water quality in embayments and tributaries.		

*Goal types: P – Planning
M – Monitoring
IG – Information Gathering
S – Stewardship
C – Communications

3.2 INDICATORS AND ASSESSMENT

State of the Great Lakes Reporting

Since 1998, U.S. EPA and Environment Canada have coordinated a biennial assessment of the ecological health of the Great Lakes ecosystem using a consistent set of environmental and human health indicators. The Great Lakes indicator suite has been developed and continues to be refined by experts as part of the *State of the Lakes Ecosystem Conference* (SOLEC) process.

The SOLEC process was established by the governments of Canada and the U.S. in response to requirements of the *Great Lakes Water Quality Agreement* (GLWQA) for regular reporting on progress toward GLWQA goals and objectives. Since the first conference in 1994, SOLEC has evolved into a two-year cycle of data collection, assessment, and reporting on conditions and the major pressures in the Great Lakes basin. The year following each conference, a State of the Great Lakes report is prepared, based on information presented and discussed at the conference and post-conference comments.

Each State of the Great Lakes report presents the compilation, scientific analysis, and interpretation of data about the Great Lakes basin ecosystem. It represents the combined efforts of many scientists and managers in the Great Lakes community representing federal, tribal/First Nations, state, provincial and municipal governments, non-government organizations, industry, academia, and private citizens.

The contents of the State of the Great Lakes reports provide information to decision-makers at all levels and in all sectors of government, private sector, and the public in order to inform policy choices and decision-making, as well as to influence personal choices leading to a healthier Great Lakes basin ecosystem.

The *State of the Great Lakes 2007* provides assessments of 61 of approximately 80 ecosystem indicators and overall assessments of the categories into which the indicators are grouped: Contamination, Human Health, Biotic Communities, Invasive Species, Coastal Zones and Aquatic Habitats, Resource Utilization, Land Use-Land Cover, and Climate Change. Within most of the main categories are sub-categories to further delineate issues or geographic areas.

Authors of the indicator reports assessed the status of ecosystem components in relation to desired conditions or ecosystem objectives, if available. The SOLEC process focuses on basinwide assessments, but in order to make the indicator reports more relevant to lake managers, the authors were asked to assess the indicators on a lake-by-lake basis, where possible. For many indicators, ecosystem objectives, endpoints, or benchmarks have not been established, and for these indicators, complete assessments are difficult to determine. Five status categories were used:

1. **GOOD –** The state of the ecosystem component is presently meeting ecosystem objectives or is otherwise in acceptable condition.
2. **FAIR –** The ecosystem component is currently exhibiting minimally acceptable conditions, but it is not meeting established ecosystem objectives, criteria, or other

characteristics of fully acceptable conditions.

3. **POOR –** The ecosystem component is severely negatively impacted, and it does not display even minimally acceptable conditions.
4. **MIXED –** The ecosystem component displays both good and degraded features.
5. **UNDETERMINED –** Data are not available or are insufficient to assess the status of the ecosystem component.

Four categories were also used to denote current trends of the ecosystem component:

1. **IMPROVING –** Information provided shows the ecosystem component to be changing toward more acceptable conditions.
2. **UNCHANGING –** Information provided shows the ecosystem component to be getting neither better nor worse.
3. **DETERIORATING –** Information provided shows the ecosystem component to be departing from acceptable conditions.
4. **UNDETERMINED –** Data are not available to assess the ecosystem component over time, so no trend can be identified.

Table 3-2 shows the indicators within the Great Lakes suite, organized by categories, with the latest assessment in the columns on the right. Lake Superior assessments are highlighted by a dark, thick border.

Future work between SOLEC organizers and lake managers could see better coordination in the use of indicators. Since each of the Great Lakes is unique, there will be a requirement for lake specific indicators; however, for common basinwide issues, SOLEC can provide leadership and support in indicator development and assessments.

Additional information about SOLEC and the Great Lakes indicators, along with the full indicator reports, are available at www.binational.net.

Table 3-2. State of the Great Lakes 2007 Indicator Assessments

State of the Great Lakes 2007 Indicator Assessments

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
CONTAMINATION						
Nutrients						
111	Phosphorus Concentrations and Loadings — open lake	?	→	?	?	→
	nearshore	?	?	?	?	?
7061	Nutrient Management Plans		2005 Report			
Toxics in Biota						
114	Contaminants in Young-of-the-Year Spottail Shiners	→	?	→	→	→
115	Contaminants in Colonial Nesting Waterbirds	→	→	→	→	→
121	Contaminants in Whole Fish	→	→	→	→	→
124	External Anomaly Prevalence Index for Nearshore Fish	?	?	?	◆	◆
4177	Biologic Markers of Human Exposure to Persistent Chemicals		?			
4201	Contaminants in Sport Fish	→	→	→	→	→
4506	Contaminants in Snapping Turtle Eggs	?	?	?	?	?
8135	Contaminants Affecting Productivity of Bald Eagles	→	2005 Report			
8147	Contaminants Affecting the American Otter	?	2003 Report			
Toxics in Media						
117	Atmospheric Deposition of Toxic Chemicals — PCBs & others		→			
	PAHs & mercury		◆ & →			
118	Toxic Chemical Concentrations in Offshore Waters	?	?	?	?	?
119	Concentrations of Contaminants in Sediment Cores		→ & ?			
4175	Drinking Water Quality		◆			
4202	Air Quality		→			
9000	Acid Rain	→	2005 Report			
Sources and Loadings						
117	Atmospheric Deposition of Toxic Chemicals — PCBs & others		→			
	PAHs & mercury		◆ & →			
4202	Air Quality		→			
7065	Wastewater Treatment and Pollution		Progress Report			
9000	Acid Rain	→	2005 Report			

Status					Trend			
					→	◆	←	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend

State of the Great Lakes 2007 Indicator Assessments

BIOTIC COMMUNITIES

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
Fish						
8	Salmon and Trout	➡	➡	➡	➡	◆
9	Walleye	?	?	◆	◆	◆
17	Preyfish Populations	➡	⬅	⬅	⬅	⬅
93	Lake Trout	➡	⬅	➡	◆	⬅
125	Status of Lake Sturgeon in the Great Lakes	?➡	?➡	?➡	?	➡
4502	Coastal Wetland Fish Community Health	Progress Report				
Birds						
115	Contaminants in Colonial Nesting Waterbirds	➡	➡	➡	➡	➡
4507	Wetland-Dependent Bird Diversity and Abundance	?	⬅	⬅	⬅	⬅
8135	Contaminants Affecting Productivity of Bald Eagles	➡	2005 Report			
Mammals						
8147	Contaminants Affecting the American Otter	?	2003 Report			
Amphibians						
4504	Wetland-Dependent Amphibian Diversity and Abundance	?	◆	⬅	⬅	◆
7103	Groundwater Dependent Plant and Animal Communities		2005 Report			
Invertebrates						
68	Native Freshwater Mussels		2005 Report			
104	Benthos Diversity and Abundance - Aquatic Oligochaete Communities	◆	◆⬅	◆	◆⬅	◆
116	Zooplankton Populations	◆	?	?	?	?
122	*Hexagenia*	?	?	?	⇆	?
123	Abundance of the Benth Amphipod *Diporeia* spp.	◆	⬅	⬅	⬅	⬅
4501	Coastal Wetland Invertebrate Community Health	2005 Progress Report				
Plants						
109	Phytoplankton Populations	?	2003 Report			
4862	Coastal Wetland Plant Community Health	◆	◆	⬅	◆	◆
8500	Forest Lands - Conservation of Biological Diversity	?				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend

State of the Great Lakes 2007 Indicator Assessments

COASTAL ZONES

ID #	Indicator Name	2007 Assessment (Status, Trend) Lake SU	MI	HU	ER	ON
Nearshore Aquatic						
4861	Effect of Water Level Fluctuations	? 2003 Report				
8131	Extent of Hardened Shoreline	⬅ 2001 Report				
Coastal Wetlands						
4501	Coastal Wetland Invertebrate Community Health	2005 Progress Report				
4502	Coastal Wetland Fish Community Health	Progress Report				
4504	Wetland-Dependent Amphibian Diversity and Abundance	?	◆	⬅	⬅	◆
4506	Contaminants in Snapping Turtle Eggs	?	?	?	?	?
4507	Wetland-Dependent Bird Diversity and Abundance	?	⬅	⬅	⬅	⬅
4510	Abundance of the Benth Amphipod *Diporeia* spp.	◆	⬅	⬅	⬅	⬅
4861	Effect of Water Level Fluctuations	? 2003 Report				
4862	Coastal Wetland Plant Community Health	◆	◆	⬅	◆	◆
4863	Land Cover Adjacent to Coastal Wetlands	Progress Report				
Terestrial						
4861	Effect of Water Level Fluctuations	? 2003 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Alvars	? 2001 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Cobble Beaches	⬅ 2005 Report				
8129	Area, Quality and Protection of Special Lakeshore Communities - Islands	?				
8129	Area, Quality and Protection of Special Lakeshore Communities - Sand Dunes	2005 Progress Report				
8131	Extent of Hardened Shoreline	⬅ 2001 Report				

AQUATIC HABITATS

ID #	Indicator Name	2007 Assessment (Status, Trend) Lake SU	MI	HU	ER	ON
Open Lake						
111	Phosphorus Concentrations and Loadings	?	➡	?	?	➡
118	Toxic Chemical Concentrations in Offshore Waters	?	?	?	?	?
119	Concentrations of Contaminants in Sediment Cores	➡ & ?				
8131	Extent of Hardened Shoreline	⬅ 2001 Report				
Groundwater						
7100	Natural Groundwater Quality and Human-Induced Changes	2005 Report				
7101	Groundwater and Land: Use and Intensity	2005 Report				
7102	Base Flow Due to Groundwate Discharge	⬅				
7103	Groundwater Dependent Plant and Animal Communities	2005 Report				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend

State of the Great Lakes 2007 Indicator Assessments

HUMAN HEALTH

ID #	Indicator Name	2007 Assessment (Status, Direction)				
		Lake				
		SU	MI	HU	ER	ON
4175	Drinking Water Quality			◆		
4177	Biological Markers of Human Exposure to Persistent Chemicals					
4200	Beach Advisories, Postings and Closures	?	?	◆?	?	?
4201	Contaminants in Sport Fish	➡	➡	➡	➡	➡
4202	Air Quality			➡		

INVASIVE SPECIES

ID #	Indicator Name	2007 Assessment				
		Lake				
		SU	MI	HU	ER	ON
Aquatic						
18	Sea Lamprey	➡	2005 Report			
9002	Non-Native Species (Aquatic)	◆	⬅	⬅	⬅	⬅
Terrestrial						
9002	Non-Native Species (Terrestrial)		?			

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend

State of the Great Lakes 2007 Indicator Assessments

LAND USE - LAND COVER

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
General						
4863	Land Cover Adjacent to Coastal Wetlands	Progress Report				
7002	Land Cover/Land Conversion	?	?	?	?	?
7054	Ground Surface Hardening	2005 Progress Report				
7101	Groundwater and Land: Use and Intensity		2005 Report			
Forest Lands						
8500	Forest Lands - Conservation of Biological Diversity		?			
8501	Maintenance and Productive Capacity of Forest Ecosystems		?			
8503	Forest Lands-Conservation & Maintenance of Soil & Water	?	?	?	?	?
Agricultural Lands						
7028	Sustainable Agriculture Practices		2005 Report			
7061	Nutrient Management Plans		2005 Report			
7062	Integrated Pest Management		2005 Report			
Urban/Suburban Lands						
7000	Urban Density		?			
7006	Brownfields Redevelopment		➡			
7054	Ground Surface Hardening	2005 Progress Report				
Protected Areas						
8129	Area, Quality and Protection of Special Lakeshore Communities - Alvars	?	2001 Report			
8129	Area, Quality and Protection of Special Lakeshore Communities - Cobble Beaches	⬅	2005 Report			
8129	Area, Quality and Protection of Special Lakeshore Communities - Islands		?			
8129	Area, Quality and Protection of Special Lakeshore Communities - Sand Dunes	2005 Progress Report				
8164	Biodiversity Conservation Sites	Proposed Indicator				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend

State of the Great Lakes 2007 Indicator Assessments

RESOURCE UTILIZATION

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
3514	Commercial/Industrial Eco-Efficency Measures		2003 Report			
7043	Economic Prosperity	?	2003 Report			
7056	Water Withdrawls	◆	2005 Report			
7057	Energy Consumption	?	2005 Report			
7060	Solid Waste Generation		?			
7064	Vehicle Use	⬅				
7065	Wastewater Treatment and Pollution	Progress Report				

CLIMATE CHANGE

ID #	Indicator Name	2007 Assessment (Status, Trend)				
		Lake				
		SU	MI	HU	ER	ON
4858	Ice Duration on the Great Lakes	⬅				

Status					Trend			
					➡	◆	⬅	?
Not Assessed	Good	Fair	Poor	Mixed	Improving	Unchanging	Deteriorating	Undetermined

Note: Progress Reports and some Reports from previous years have no assessment of Status or Trend

3.3 MONITORING PROGRAMS AND INVENTORIES

3.3.1 Cooperative Monitoring of Lake Superior

The Great Lakes Binational Cooperative Monitoring Initiative is above and beyond the routine monitoring programs that agencies normally conduct. It is a binational effort that focuses on one lake each year, with the goal of filling key information gaps as identified through the LaMPs. The program complements and builds on existing monitoring and research projects being conducted on the lake in the same year. Each lake, therefore, goes through a cooperative monitoring cycle every five years.

Figure 3-2. In 2005-2006, Lake Superior was the focus of the Great Lakes Cooperative Monitoring Initiative, a binational effort that targets one lake each year to fill key information gaps, as identified through the LaMPs. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Lake Superior Cooperative Monitoring Programs
In 2005 and 2006, Lake Superior was the focus of the Cooperative Monitoring Initiative, addressing key information needs identified by the Lake Superior Work Group. Numerous agency and academic scientists from both the U.S. and Canada participated by providing input to the design of the programs, and by conducting sampling, laboratory analysis, and data interpretation. Although some of the results of the Cooperative Monitoring Initiative are available (such as the Lower Food Web study results, as presented in Chapter 6) data are still being analyzed and reports prepared.

3.3.2 Inventories of Monitoring Programs

Binational Executive Committee Great Lakes Monitoring Exchange The Great Lakes Binational Executive Committee (BEC) identified the need for a binational, basinwide inventory of monitoring programs, to raise awareness of ongoing activities, promote collaboration, and identify monitoring gaps. The Great Lakes Monitoring Exchange now provides links to nearly 30 monitoring programs that sample in the Lake Superior basin. This inventory contains programs conducted by organizations in Canada and the U.S. The Great Lakes Monitoring Exchange can be found at http://binational.on.ec.gc.ca/bec/intro-e.cfm.

Great Lakes Commission Environmental Monitoring Inventory The Great Lakes Commission web site provides information on a large array of monitoring programs, including monitoring programs for air, water, and landscapes.[1] The Environmental Monitoring Inventory for the Great Lakes contains over 200 records of environmental monitoring programs pertaining

[1] Great Lakes Commission Data and Monitoring web site: www.glc.org/monitoring.

to the Lake Superior basin. Both Canadian and American monitoring programs are included in this inventory.[2]

3.4 DECISION SUPPORT SYSTEMS

3.4.1 Lake Superior Decision Support System

The Lake Superior Decision Support Project was initiated by the Lake Superior Binational Program and designed by scientists at the University of Minnesota's Natural Resources Research Institute (NRRI).[3]

This system offers a variety of online and downloadable maps of the Lake Superior basin and links to a number of GIS resources pertinent to Lake Superior. In 2006, GIS resources for important habitat sites and areas were added to the decision support system.

In 2007, the US EPA Great Lakes National Program Office provided funding to the NRRI to create a system of fine resolution and nested watersheds across the Lake Superior basin, to add data layers that describe environmental and human disturbance gradients (both point and non-point sources) within the watersheds, to provide a tool for using the watershed information in designing monitoring programs and to identify information on reference (least impacted) and degraded watersheds and coastal regions. The project will develop tools to allow users to scale data appropriate to their sampling domain, incorporate stressor information into analyses, and disseminate information through the Lake Superior Decision Support System. At the time of this report, this project is ongoing. Thus far, high resolution elevation data have been assembled for the Lake Superior basin (10 meter resolution for the U.S. and 20 meter for Canada). High resolution hydrologic data are being assembled for both the U.S. and Canadian sides of the Lake Superior basin.

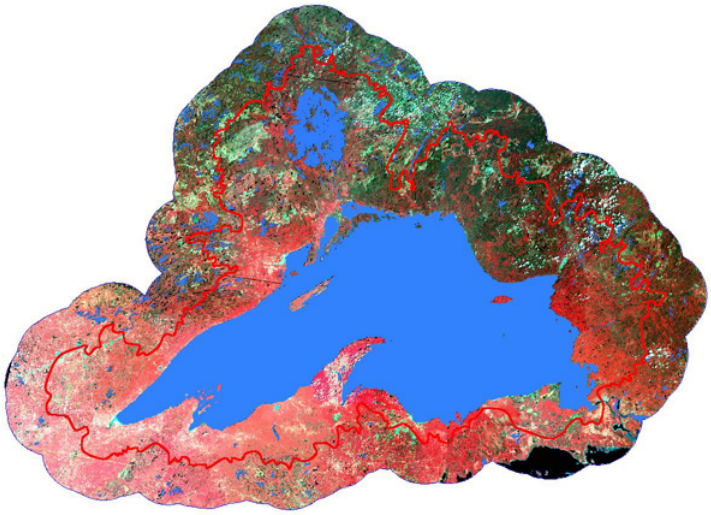


Figure 3-3. The Lake Superior Decision Support Project offers online maps displaying a variety of data, including climate, census, city lights, land use/cover, habitat sites/areas, forest types, Landsat satellite image (at right), and elevation. Photo credit: The Lake Superior Decision Support Project.

[2] Great Lakes Commission Great Lakes Monitoring Inventory and Gap Analysis web site: www.glc.org/monitoring/greatlakes.
[3] Lake Superior Decision Support Project web site: www.nrri.umn.edu/lsgis.

3.4.2 Lakeviews

Progress on the *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem* (COA) "Coordination of Monitoring, Research and Information Management" Annex has led to the development of "Lakeviews," a system of distributed databases linked by web services and mapping technologies that serves as a discovery, access, visualization, and decision support tool for information regarding trends in environmental quality.

"Lakeviews" is designed to provide easy access to environmental information using an interactive mapping tool. The system provides a snapshot of environmental programs. The application employs web services to dynamically pull information from distributed sources created by various government departments and partner organizations. Because of the flexibility offered by this design, the application is highly customizable in terms of form, content, and functionality. With the architecture already in place, the current focus is on content development—helping information custodians and their clients understand what web services are, how to develop them, how to use them, and why they are so beneficial.

Chapter 4

Lake Superior Critical Pollutants Progress Report

Cleaning up the Reserve Mining barrel dump site. Photo credit:
Susan Johnson, Minnesota Pollution Control Agency

Lake Superior Lakewide Management Plan 2008

Chapter 4 Contents

Chapter 4
Lake Superior Critical Pollutants Progress Report

4.0 THE ZERO DISCHARGE DEMONSTRATION PROGRAM

Reducing toxics loadings to Lake Superior is a key component in the effort to achieve a sustainable Lake Superior basin. The LaMP Stage 2 document sets a goal of eliminating discharges and emissions of nine critical pollutants in the Lake Superior basin by 2020, with interim targets in 2000, 2005, 2010, and 2015. The baseline for the reduction targets is 1990. The nine chemicals targeted for zero discharge and zero emission include chlordane, DDT, dieldrin, dioxin, hexachlorobenzene (HCB), mercury, octachlorostyrene (OCS), PCBs, and toxaphene. The Lake Superior Binational Program's Zero Discharge Demonstration Program (ZDDP) is a unique experimental program intended to end the use of these nine critical pollutants in industrial processes or products, and to prevent their release in the Lake Superior basin.

Chapter 4 updates information on concentrations of critical pollutants in Lake Superior, accomplishments in the 2006-2007 period, challenges to accomplishing the 2010 critical pollutant reduction milestones, and provides a strategy for substances of emerging concern. Acronyms for this chapter are included in Addendum 4A.

Why Zero Discharge for Lake Superior?

Among the Great Lakes, Lake Superior provides the best opportunity to achieve zero discharge and zero emission. The governments around Lake Superior announced *A Binational Program to Restore and Protect the Lake Superior Basin* in 1991, with an agreement to work together on the ZDDP and on broader ecosystem issues. The 1991 Agreement stresses voluntary pollution prevention but acknowledges that enhanced mandatory controls may be necessary.

What Progress Has Been Made toward Zero Discharge?

As noted in the LaMP 2006 Critical Pollutants Progress Report, Lake Superior partners were, at the time, preparing a report on progress toward the 2005 milestones. This report was released in October 2006 with a summary fact sheet released in 2007 (presented in Addendum 4B). Reductions of note include:

- Mercury releases have dropped 71 percent since 1990;
- Dioxin releases have dropped 76-79 percent since 1990;
- PCBs continue to be phased-out; and
- More than 12,700 kg (28,000 lbs) of waste pesticides associated with the zero discharge demonstration have been collected since 1992.

4.1 POLLUTANT CONCENTRATIONS IN THE ENVIRONMENT

Enforcement of environmental regulations, changes in industrial development patterns, implementation of pollution prevention projects, and the efforts of individual citizens have significantly reduced pollutant releases to Lake Superior. However, the goal of zero discharge and zero emission is a challenging one with a significant amount of work remaining to be done.

The ZDDP, and other programs, are aimed at reducing toxic chemicals at their sources, resulting in the eventual reduction in the ecosystem. Concentrations of toxic organic contaminants, including the Lake Superior critical and lakewide remediation pollutants such as PCBs and DDT, have declined over time in many commonly-monitored environmental media including fish, water, air, and herring gull eggs. Much of the declines occurred immediately following government action to ban or restrict the use of these "legacy" pollutants in the 1970s and 1980s. Further declines of these chemicals in the Lake Superior environment have been difficult to measure for many reasons, including continued atmospheric inputs of pollutants from distant sources, the unique physical and chemical properties of Lake Superior, food web changes within the lake, and the inherent variability that occurs in measuring environmental contaminants, particularly at low concentrations.

Table 4-1 identifies "yardsticks" for water quality in Lake Superior. These are standards from the four Lake Superior jurisdictions, current as of January 2008. These yardsticks provide a way to monitor the status of Lake Superior critical chemicals in lake water as the ZDDP moves forward toward achieving its goals. Table 4-2 shows concentrations of some persistent bioaccumulative toxic chemicals in Lake Superior water resulting from 2005 US - Canada coordinated monitoring programs. Concentrations of PCBs, HCB, dieldrin, and toxaphene remain above one or more Lake Superior jurisdictional yardstick values.

Some chemicals also exceed yardsticks in other media. For example, mercury, PCBs, dioxin, and some pesticides exceed fish consumption advisory yardsticks in Lake Superior fish. Figure 2 in Addendum 4B demonstrates how mercury, which did not exceed the water quality yardstick in Table 4-1, does exceed the fish consumption yardstick. The figure also shows that PCBs exceed the fish consumption advisory yardstick.

While concentrations of many ZDDP and other legacy pollutants have declined in Lake Superior over time, a new set of chemical threats to the lake and its ecosystem has emerged over the past several years. "Substances of emerging concern" is a term often used to describe a whole suite of chemicals that are used in human society and can be detected in the environment. Awareness of the presence of many of these chemicals and their potential risk to ecosystem and human health is new and evolving rapidly as scientists investigate the scope of the issue.

Table 4-1. Jurisdictional Lake Superior water quality yardsticks for some LaMP critical pollutants (ng/L).

Pollutant	Water Quality Yardsticks (ng/L)[1]			
	MN[2]	MI[2]	WI[2]	ON
PCBs	0.0045	0.026	0.003	1.0
HCB	0.074	0.30	0.22	6.5
Dieldrin	0.0012	0.0065	0.0027	1.0 (+Aldrin)
Chlordane	0.04	0.25	0.12	60
DDT	0.011	0.011	0.011	3.0 (∑DDE, DDD, DDT)
Mercury	1.3	1.3	1.3	200
Toxaphene	0.011	0.068	0.034	8.0
g-BHC (lindane)	80	25	18	10

[1] The purpose of listing available yardsticks from each jurisdiction is not to compare these numbers between jurisdictions, but to provide a reference for comparing water quality results to available yardsticks and determine if exceedences are occurring. For instance, Ontario's Provincial Water Quality Objectives (PWQOs) are intended to protect aquatic organisms based on no adverse effects on growth, reproduction or survival. PWQOs are not developed based on human health considerations or the protection of wildlife that consume aquatic organisms. Hence, Water Quality Criteria developed by U.S. jurisdictions tend to be more stringent than PWQOs for substances that bioaccumulate and, therefore, are not directly comparable (Ontario Ministry of the Environment, 1994).
[2] Water quality based standards for the Lake Superior states are based on the Great Lakes Water Quality Initiative.

Table 4-2. Concentrations (ng/L) of some critical pollutants in Lake Superior open lake water.

Pollutant	Open Lake Concentration (ng/L)[1]
PCBs (Values "Blank-Corrected", total of 132 congeners)	0.059 ± 0.022, n = 14
HCB	0.013 ± 0.001, n = 14
Dieldrin	0.112 ± 0.011, n = 14
Chlordane (cis + trans)	0.009 ± 0.003, n = 13
DDT (p,p'DDE + p,p'DDD+ p,p'DDT+ o,p'DDT)	0.014 ± 0.004, n = 13
Mercury	0.42 ± 0.14, n = 12
Toxaphene	1.014 ± 0.121[2]
g-BHC (lindane)	0.283 ± 0.038, n = 14

[1] Dove, A, Environment Canada. Personal communication (2005 data).
[2] Jantunen L., 2006 (2005 data).

Chemicals such as polybrominated diphenyl ethers (PBDEs) are increasing in fish tissue and sediment in Lake Superior (Figures 4-1a and 4-1b). On a concentration basis, perfluorinated alkyl acids (i.e., PFOS and PFOA) are now the predominant halogenated organic contaminants in Lake Superior waters (Muir, personal communication). Recognizing the importance of this issue, and in the spirit of the pollution prevention approach used by the ZDDP, the Lake Superior Binational Program has developed a strategy for addressing "substances of emerging concern." The strategy folds substances of emerging concern into the LaMP process, creates a mechanism for identifying monitoring and management priorities for these substances, and calls for a pollution prevention management strategy. The strategy is described in detail within Section 4.3.2.

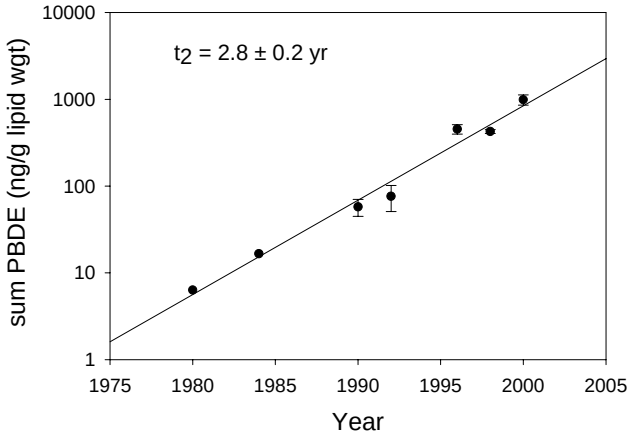


Figure 4-1a. Total PBDE concentrations in Lake Superior whole lake trout (Zhu and Hites 2004).

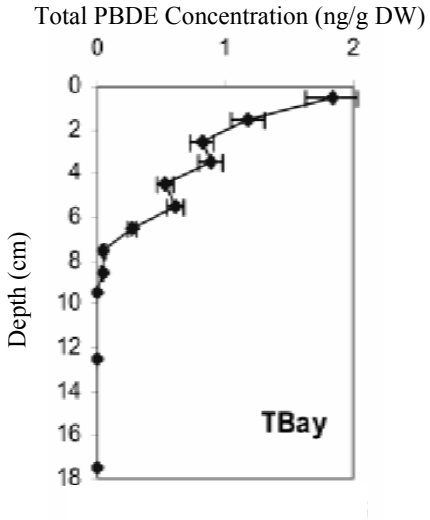


Figure 4-1b. Total PBDE concentrations with depth in a Lake Superior sediment core from near Thunder Bay, Ontario (Song et al. 2004).

4.2 LaMP ACCOMPLISHMENTS 2006 TO 2008

Actions undertaken or completed since the release of the LaMP 2006 report are summarized below. Earlier actions not reported in the 2006 update are also presented.

4.2.1 Chemical Reduction Activities in the Lake Superior Basin

The following descriptions of chemical reduction projects have been implemented in the Lake Superior basin since the LaMP 2006 update. They are either a direct result of the LaMP or are in alignment with LaMP goals. Items in italics are those that have an especially strong connection to the LaMP through funding sources, participation by LaMP staff, projects of the Superior Work Group or Forum Chemical Committees, or previous commitments to the Lake Superior Binational Program's Zero Discharge Demonstration Program.

Collections

- *Under the Earth Keepers Initiative, the Superior Watershed Partnership coordinated events on Earth Day 2006 and 2007 using a grant from US EPA's Great Lakes National Program Office (GLNPO). Besides the 129 congregations in the Earth Keepers Coalition, the initiative includes a number of partners in Michigan's Upper Peninsula, including the Keweenaw Bay Indian Community (KBIC), The Cedar Tree Institute, The Nature Conservancy, Northern Michigan University, and others. In 2006, Earth Keepers sponsored an e-waste collection that brought in 320 tons of unwanted televisions, computers, and other waste electronics. In 2007, the Pharmaceutical Drop-off Day resulted in over a ton of unwanted medications, including $500,000 worth of controlled substances.*
- At the Marquette County Solid Waste Landfill, 28.8 kg of elemental mercury was collected in 2006 and 2007 as part of the county's Household Hazardous Waste (HHW) collection program.
- In 2006, Smurfit Stone Container Corporation in Ontonagon, Michigan, held a mercury thermometer exchange event. More than 100 fever thermometers, 13 lab grade thermometers, and 3 blood pressure units were collected.
- *A program administered by EcoSuperior (a non-profit environmental organization in Thunder Bay, Ontario) that focuses on mercury reduction in schools is now entering its second year. The program includes collection of mercury-containing items and leftover chemicals from science rooms, presentations to students about mercury and use of a Lumex mercury vapor analyzer. Almost every school visited was found to have some mercury on hand. Over 4 kg of mercury was collected between April 2006 and March 2007.*

Figure 4-2. EcoSuperior uses a Lumex instrument to detect sources of mercury vapor at schools. Photo credit: Jim Bailey, EcoSuperior.

- *Fluorescent lamp recycling for the residential sector has been in place in Thunder Bay for several years. This EcoSuperior program has now been expanded to other Lake Superior basin communities including Red Rock, Wawa, Geraldton and Longlac (now formally known as Greenstone). In addition to the Ontario Ministry of the Environment, Ontario Power Generation continues to support this project.*
- *EcoSuperior has been collecting compact fluorescent lamps (CFLs) since the inception of this program and will continue to collect them. Due to the increased public attention being given to disposal issues, EcoSuperior has already begun to expand information on CFL acceptance centers; 5,000 lamps were collected between April 2006 and March 2007.*

- *Although all members of the Ontario Automotive Recyclers Association now participate in the vehicle Mercury Switch Out program, many area recyclers are not members of this association. EcoSuperior is working with the Clean Air Foundation to identify those recyclers who are not Switch Out participants and to encourage them to join.*
- *EcoSuperior continues to promote the Thermostat Recycling program while private sector partners operate the depots. Shipping of collected thermostats is handled and paid for by Honeywell Inc. Operation by private sector partners makes this program sustainable over the long term. Approximately 800 thermostats were collected through this program between April 2006 and March 2007.*
- *EcoSuperior organized HHW collections in the Ontario north shore towns of Nipigon, Red Rock, Schreiber, and Wawa. This initiative was supported by the Ontario Ministry of the Environment, Environment Canada, and participating municipalities. Events were well-publicized with high rates of participation.*

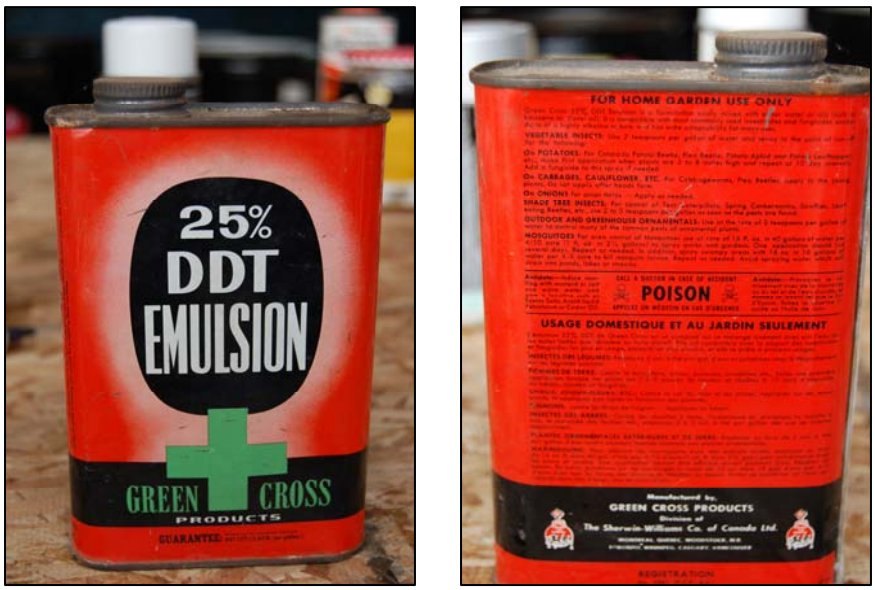


Figure 4-3. Despite being banned decades ago, DDT is still turned in at HHW collections in the Lake Superior basin. As the label on the back of the container directs, DDT was at one time common "for home garden use only." Photo credit: Jim Bailey, EcoSuperior.

- *Mercury reduction programs have been sponsored by the City of Superior including, exchange programs, e-waste, dental amalgam waste separators, and shipping industry assistance. The City of Superior continues to accept mercury at the wastewater treatment facility and recycle it for free for residents. The City also collects fluorescent bulbs at the wastewater treatment plant and at a local hardware store. Murphy Oil pays for the recycling of them.*
- The Northwest Regional Planning Commission (NWRPC) of Wisconsin continues to operate a ten-county hazardous waste collection program for Ashland, Bayfield, Burnett, Douglas, Iron, Price, Rusk, Sawyer, Taylor, and Washburn counties. The program has operated since 1995 and has collected well over one million pounds of hazardous wastes. The program also collects and recycles electronic waste. The program has highlighted the collection of mercury and mercury instruments in several of its operational years. In 2007, dental offices and mercury amalgam waste in the region were highlighted through a U.S. Department of Agriculture (USDA) Rural Development Administration grant. In 2008, residents will be allowed to bring in medications to Saturday collection events in each county.

- Superior has held several electronic-waste collections funded by grants from local businesses and foundations, including Best Buy and the Duluth Area Community Foundation.
- The City of Superior hosts an annual hazardous waste Clean Sweep. In addition industries in town can have a "milk run" sponsored by Northwest Regional Clean Sweep to pick up hazardous waste based on need.
- The Anishinabek of the Gitchi Gami Environmental Programs (AGGEP) has implemented the first curbside recycling at Fort William First Nation (FWFN). This two year curbside recycling pilot project, funded by Environment Canada, EcoAction and the Laidlaw Foundation, commenced in November 2007. Eighty FWFN residences, in a specific section of the community, are included in the pilot. Each home was provided with one year's supply of blue recycling bags; residents in the trial area have been encouraged to participate. The curbside recycling pilot project was developed by AGGEP to engage FWFN citizens in progressive, solid waste management and education and to raise awareness of waste being dumped illegally in the community. After two years of piloting this project AGGEP hopes to expand recycling to other areas of Fort William First Nation.
- *KBIC is currently conducting mercury thermometer exchanges for tribal members. In addition, KBIC is in the process of collecting spent fluorescent light bulbs for proper disposal.*
- Grand Portage, Fond du Lac, Bad River, and Red Cliff either hold annual HHW collection events or offer sites where these materials can be brought for proper disposal. In addition, Fond du Lac runs an e-waste collection program.
- KBIC partnered with the Village of Baraga for an annual spring HHW cleanup event.
- *Western Lake Superior Sanitary District (WLSSD) held the first Medicine Cabinet Clean-Out Event at their hazardous waste center in Duluth with 166 households participating. WLSSD collected 229 lbs of non-controlled medications and 21 lbs of controlled substances, in addition to some miscellaneous drugs and drug waste. The total collection of material was 258 lbs, filling nearly three 55-gallon drums.*
- In Minnesota, ongoing hazardous waste collection programs are found in the Lake Superior basin at WLSSD (both business and household), St. Louis County, Lake County, and Carlton County. Cook County contracts with WLSSD to conduct collections.

Outreach/Education

- *The LaMP Chemical Committee planned and moderated the Toxic Contaminants session of the October 2007 Making A Great Lake Superior 2007 conference. Speakers and posters included new and emerging chemical threats; water, sediment, fish and eagle toxics monitoring projects; mercury cycling, atmospheric deposition; pollution prevention; and identifying sources of toxic contaminants.*
- *The Chemical Committee prepared and updated four posters for use at workshops and conferences in the Lake Superior basin. The four updated posters presented at the Making A Great Lake Superior 2007 conference included Lake Superior 2005 Chemical Milestones: Meeting the Target of Zero Discharge and Zero Emission in the Lake Superior Basin; Proposed Management Strategy for Substances of Emerging Concern in*

the Lake Superior Basin; An Overview of Mercury Reduction Activities in the Lake Superior Basin; and Actions to Prevent Open Burning of Trash in the Lake Superior Watershed.

- Great Lakes Indian Fish and Wildlife Commission (GLIFWC) staff presented information on critical chemicals in Lake Superior fish at Red Cliff and KBIC commercial fishing meetings. Following the presentations, staff drafted an article based on these presentations for GLIFWC's quarterly newspaper, the *Mazina'igan*.
- GLIFWC staff presented papers on *Reducing health risks to the Anishinaabe from methylmercury* at both the annual Midwest Society of Environmental Toxicology and Chemistry (SETAC) Chapter meeting in St. Cloud, Minnesota, and the *Eighth International Conference on Mercury as a Global Pollutant* in Madison, Wisconsin. GLIFWC staff also presented its work on mercury trends in walleye from northern Wisconsin lakes at the 2006 annual SETAC North America meeting in Montreal, Quebec, Canada.
- *GLIFWC presented New and Emerging Chemical Threats to the Lake Superior Ecosystem and Tribal Assessment of PBT Contaminant Concentrations Across Size Ranges of Four Commonly Harvested Lake Superior Fish at the Making a Great Lake Superior 2007 conference. The latter presentation was also given at the 2007 annual SETAC North America meeting in Milwaukee, Wisconsin.*

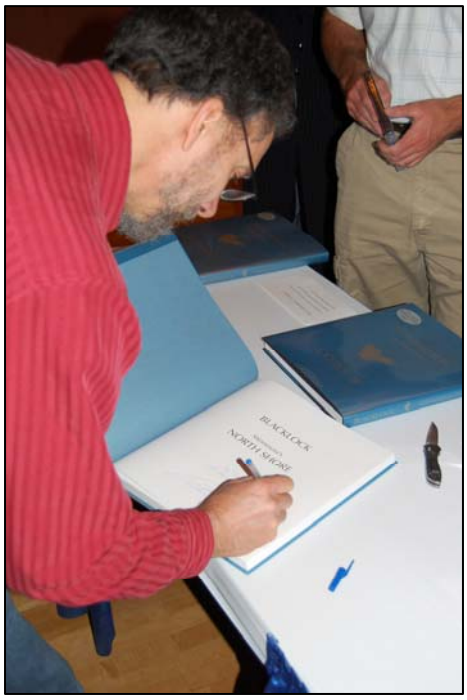


Figure 4-4. The *Making A Great Lake Superior 2007* conference, held in Duluth, Minnesota, in October 2007, was a great success, bringing together a wide range of people, groups, and agencies with an interest in protecting the Lake Superior basin environment. Here, at a session sponsored by the Minnesota Conservancy, Craig Blacklock signs a copy of his latest book of Lake Superior photos entitled, *Minnesota's North Shore*. Photo credit: Jim Bailey, EcoSuperior.

- Grand Portage continues to implement a pesticide use policy on the reservation to help avoid unnecessary and unscrupulous spraying of pesticides.
- The Bad River Air Quality Department initiated a burn barrel buy-back program in the fall of 2005. Based upon windshield surveys of burn barrels located on the reservation and surveys completed by tribal members who burn, this collection contributed to the reduction of approximately 2.5 tons/yr of garbage disposed by backyard burning and a 31 percent reduction of the total burn barrels on the reservation as of the end of 2006. The program is scheduled to continue in future years.
- *EcoSuperior summarized the open burning outreach that has been continued in the Lake Superior basin in Ontario with a view to conducting a follow-up survey to assess the effectiveness of the programs. The summary report is a good reference for what has happened and how to repeat it, but the report exposed some gaps in coverage. It will be used as a reference to develop a survey to assess the impact and effectiveness of outreach to date.*

- *A GLNPO grant to the Minnesota Pollution Control Agency (MPCA) on burn barrel abatement included projects in Carlton and St. Louis Counties that involved displays at county fairs and distribution of open burning materials developed by the counties. In St. Louis County, a billboard campaign continued, alerting stakeholders to the dangers of backyard trash burning. The county also developed an open burning video aimed at fire departments and distributed to fire departments an information kit including the video, plus brochures, a disk with a PowerPoint presentation, and a poster. Cook County used MPCA funding to contract with CLIMB, an education theater organization, to prepare and present open burning abatement mini-dramas in rural schools in all four Lake Superior counties.*
- WLSSD served as the agent for an open burning outreach campaign in northeastern Minnesota counties.

Figure 4-5. A billboard in St. Louis County, Minnesota, warns residents of the unhealthy, unsafe, and illegal nature of open burning. Photo credit: Mary McReynolds, St. Louis County.

- *The MPCA included Lake Superior Binational Program information at their display in the Eighth International Mercury as a Global Pollutant Conference in 2006. Approximately 500 mercury and 50 PCB use trees posters were distributed. The complete set of use trees (i.e., mercury, PCBs, dioxin, HCB, OCS, cadmium, polynuclear aromatic hydrocarbons (PAHs), and pentachlorophenol (PCP)) were also displayed at the Making A Great Lake Superior 2007 conference.*
- *The MPCA provided graphics services, editing, and printing for 25,000 placemats for Lake Superior Day. Placemats included games and trivia to promote a sense of place*

and also listed 12 Ways You Can Protect the Lake Everyday. The placemats were divvied up and mailed to Forum and Superior Work Group members for distribution.

- *The MPCA installed 20 watershed signs on Minnesota state and county roads at the watershed divide to raise awareness about the impact of human activities in the Lake Superior watershed and the physical extent of the watershed.*

Figure 4-6. Twenty watershed signs were installed in the Minnesota portion of the Lake Superior basin by the MPCA. Photo credit: Joel Peterson, MPCA.

- *The MPCA provided keypad polling technology and technical assistance for the Lake Superior session at the State of the Lakes Ecosystem Conference 2006 (SOLEC 2006) and the Toxic Chemical session at the Making A Great Lake Superior 2007 conference.*
- *NWRPC provided burn barrel education through a GLNPO grant that targeted residents of Douglas, Bayfield, Ashland and Iron counties. Three public service announcements were developed and were broadcast on Duluth – Superior television networks. The project also surveyed all municipal elected officials in the four-county region to elicit their answers to questions relating to burn barrel usage and its dangers. A previous GLNPO grant was used to make a 15-minute video/DVD on burn barrel dangers. It was distributed to schools, municipalities, and the Northern Great Lakes Visitors Center for use in their theater.*
- *NWRPC provided solid, hazardous and medical waste audits to nine hospitals in its region in 2007 to help prepare them for future Wisconsin Department of Natural Resources (WDNR) environmental audits, and to introduce them to the "Hospitals for a Healthy Environment" web site, which addresses environmental issues that hospitals are confronted with. The focus was to ensure that hospital wastes are identified properly and handled according to state and federal regulations.*
- *The City of Superior has initiated a florescent light education campaign though local media to promote proper recycling. This was funded by Superior Light and Power.*

- *In 2007, representatives from the City of Superior and WDNR visited six "Tier 1" industrial businesses within the Superior urban area. Each business was located on the shores of Lake Superior or contributed stormwater to the lake via storm sewers or drainage ways. The purpose of the visits was to assess how surface runoff was treated and otherwise managed prior to releasing the runoff offsite. Representatives from the city educated the industries about mercury and collected 20 lbs from Frazer Ship yards.*
- *Education initiatives in the City of Superior included Earth Week tours of the waste water plant, Pollution Prevention week presentations to local government officials, and a poster entitled 'Coming About' on Mercury: The Lake Superior Basin-wide Mercury Reduction Program presented by the City of Superior at the Eighth International Conference on Mercury as a Global Pollutant in 2006.*
- The City of Superior's Environmental Services and Parks and Recreation divisions are creating an outdoor classroom and developing a curriculum that Superior teachers can use to take advantage of the nearby habitat and forest. This project was funded by grants from the Wisconsin Coastal Management Program and Department of Natural Resources. The plan includes developing grade-specific lessons using the Wisconsin K-8 Forestry Field Lesson Guide by LEAF (Learning, Experience and Activities in Forestry).
- The City of Superior received a grant from the Great Lakes Commission for an erosion control awareness project; 100 volunteers have assisted city crews in plantings and restoration in Central Park on Faxon Creek.

Mercury Products

- *As a follow-up to a joint Work Group-Forum-Industry mercury mentoring program conducted on the Canadian side of the Lake Superior basin in 2005/2006, a contractor was hired to extend the program in 2007-2008. The objectives were to follow up with companies who made commitments to the project. Follow-up actions included assessing any changes to practices for managing mercury-containing equipment and to their inventory of mercury-containing equipment. The contractor also offered workshops in 2007-2008 to facilities that were unwilling or unable to participate in the initial project. The contractor was guided by a steering committee of Work Group and Forum members. Final results from this project will be available in the spring of 2008.*
- *On the U.S. side of the basin, the joint Work Group-Forum-Industry project is being implemented by the City of Superior. During 2006-2007, the project focused on three mercury collections. In Two Harbors, Minnesota, 10 lbs of mercury-bearing equipment was collected and 40 thermometers exchanged in five hours. In Ironwood, Michigan, 100 thermometers were exchanged and 35 lbs of elemental mercury were turned in at a seven hour event. In Wisconsin, the project coordinator accompanied WDNR inspections at three facilities and provided information on mercury phase-out.*
- *The MPCA surveyed hardware stores and retailers in the Duluth area in preparation for mercury thermostat outreach. Of the 12 stores checked, three sold mercury thermostats. Stores that had pharmacies as well as hardware departments were checked for mercury thermometers, but none were found to be selling them (this is now illegal in Minnesota). Six stores also sold fluorescent lamps in bulk, and the individual lamps were not labeled as containing mercury.*

- *In an effort to reduce mercury discharge to the wastewater treatment facility and Lake Superior, the Superior Watershed Partnership gave a series of presentations to the Superior District Dental Society to inform area dentists of the extent of the problem and provide assistance to develop and implement a mercury reduction plan utilizing amalgam separators in their dental offices.*
- The Ishpeming, Michigan, wastewater treatment plant has tracked a reduction in mercury discharge since late 2005. In June of 2005, dentists in Ishpeming were notified that Sewer Use Ordinances were changed, requiring installation of 95 percent removal or better devices. Mercury amalgam separators were online by September 2005.
- *The City of Superior received a grant from GLNPO titled "City of Superior Basinwide Mercury Reduction" to work with the shipping industry to increase awareness of mercury and to recycle properly. To date, educational materials have been distributed to the industry through waterfront shipping facilities, and mercury has been recycled from one ship. In addition, a portion of this grant was dedicated to contract with WLSSD and NWRPC to collect mercury in underserved areas.*

Figure 4-7. Mercury reduction efforts have recently involved the shipping industry through education provided at waterfront shipping facilities. Photo credit: Frank Koshere, WDNR.

- The City of Superior is anticipated to sign the Green Tier Charter for Mercury. Superior was instrumental in crafting the Wisconsin state mercury minimization guidance.

Lake Superior Binational Forum Activities

- *The Forum Chemical Committee continues to track progress toward the chemical reduction targets developed by the Forum in 1995 and adopted by Lake Superior agencies in the LaMP Stage 2.*
- *The Forum Chemical Committee provided valuable input into the Critical Chemical Reduction Milestones (LSBP 2006) report which was released on Lake Superior Day 2006 for a 60-day consultation period. The final report was released at SOLEC in October 2006.*

- *The Forum Chemical Committee continued their support and input into the "Basin-Wide Mercury Reduction Project." Committee members recommended that the government continue to fund this work and follow-up on recommendations contained in the March 30, 2006 report compiled by a contractor for Environment Canada.*
- *Committee members reviewed the 2006/2007 Forum work plan project to integrate LaMP goals and facilitate connective networks with Area of Concern (AOC) communities. Forum meeting notices are to be sent out to Remedial Action Plan (RAP) and Public Advisory Committee (PAC) members in those communities where public input sessions are to be held, inviting them to attend and discuss ways in which the Forum can help foster community involvement.*
- *The Committee planned and held a public input session on pharmaceuticals and personal care products (PPCPs) and their impact on the environment. Recommendations resulting from this session, held in Thunder Bay in November 2006, have been forwarded to the governments and various health organizations. The Committee suggested adding to the Forum work plan a joint Superior Work Group/Lake Superior Binational Forum project focusing on how best to conduct education and outreach on the proper disposal of PPCPs.*
- *The Committee provided input to a Superior Work Group proposal on substances of emerging concern in the Lake Superior basin.*
- *Committee members have provided input on the Realtor's Outreach project, initiated by the Superior Work Group (see Chapter 2, Section 2.2.4). This project will inform/improve understanding of realtors, prospective buyers, and current landowners about environmental concerns associated with rural and residential properties in the Lake Superior basin, and to help change their attitudes and approaches to activities and the use of these types of properties.*

Emissions Controls

- Minnesota Power (MP) announced its Arrowhead Regional Emissions Abatement (AREA) project. Additional pollution control equipment will be installed at the Laskin and Taconite Harbor coal-fired power plants. The Taconite Harbor plant is currently being upgraded, and the new mercury control technology, MinPlus, is expected to capture up to 90 percent of the mercury emissions. MP has installed equipment designed to reduce NOx emissions by 66 percent and is exploring the potential to convert the Laskin boiler from coal to biomass.
- Smurfit Stone Container Corporation in Ontonagon, Michigan installed equipment in response to US EPA's Clean Air Act's regulation 40 CFR 63, Subpart DDDDD, National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial and Institutional Boilers and Process Heaters, commonly called the Boiler Maximum Achievable Control Technology (MACT). The Boiler MACT has since been remanded by Federal Court and is no longer in effect. The system controls emissions through more efficient combustion and sorbent injection.
- In 2006, Smurfit Stone Container Corporation committed an investment of more than $4.5 million for pollution control equipment.

- The City of Sault Ste. Marie, Michigan, has adopted a new ordinance that bans outdoor wood burning stoves. Existing units are grandfathered but cannot be replaced. The benefit is a reduction of particulate matter in the atmosphere.

Energy Conservation

- In Duluth, St. Mary's Clinic First Street Building received a Leadership in Energy and Environmental Design (LEED) certification. At 236,000 square feet, it is the largest green health care facility in the country and one of only ten in the nation to receive LEED certification. The project achieved a 25 percent reduction in energy and a 30 percent reduction in water use.
- The non-profit organization Women in Construction completed construction of a house at the Hawk Ridge Estates subdivision in Duluth, Minnesota. The home, which will be on display into 2009, features solar panels and tubes for heating, reuse of wood building material, and kitchen countertops made completely of recycled paper.
- Bad River designated three members to participate in the Chequamegon Bay Area Green Team in 2007 as part of its Renewable Energy and Energy Efficiency Tribal Task Force.
- US EPA Region 5 has developed a climate change framework which emphasizes energy conservation, innovation, and reductions.

Green Energy

- The Brookfield Power Prince Wind Energy Project northeast of Sault Ste. Marie, Ontario, was completed in 2006. The largest wind farm in Canada, it has 126 turbines and is capable of generating 189 megawatts (MW).
- Under the Federation of Canadian Municipalities (FCM) Green Communities Fund, the Town of Marathon and Marathon Pulp Inc. (MPI) have entered into a joint venture to explore and research the potential of a mid-sized (20 to 50 MW) renewable wind energy farm situated along the coast of Lake Superior, within the town limits. Marathon is interested in the project because it would offer its residents increased energy independence and savings, environmental sustainability, improved human health, and the potential for economic development. The project could ultimately eliminate MPI's high fixed hydro cost and make it a more

Figure 4-8. Brookfield Power completed Prince Wind Energy Project in 2006. It is the largest wind farm in Canada. Photo credit: Gary Stewart, OMNR.

competitive operation, while gaining recognition as a leader in the use of sustainable renewable energy technologies. The 12-month on-site wind-monitoring field test will collect real data to demonstrate the project's economic feasibility. A business case and engineering design work will follow. It is estimated that the wind farm could provide an approximate annual reduction of 24,000 to 56,000 tonnes of carbon dioxide, 96 to 224 tonnes of nitrous oxide, and 28 to 64 tonnes of sulphur dioxide per year over the existing generation mix.

- More information about the fund can be found on the FCM Communities web site at http://www.fcm.ca/english/gmf/gmf.html
- A total of 575.18 MW of electrical generation from non-fuel sources has been proposed and are at various stages of approval and development in the Ontario portion of the Lake Superior basin. This includes:
    - Aguasabon River Hydro Power – 10 MW;
    - Coldwell Wind – 200 MW;
    - Provedence Bay/Spring Bay wind – 15 MW;
    - Greenwich Wind near Ouimet Canyon – 200 MW;
    - McGraw Falls Hydro – 2 MW;
    - Gitch Animik Bezhig Hydro – 8.28 MW;
    - Gitchi Amik Nizh Hydro – 9.9 MW;
    - Ventus Energy Lakehead Wind Park – 100 MW;
    - Sault Ste. Marie Solar Photo Volteic – 20 MW;
    - Fort William First Nation Solar Farm Photo Volteic – 10 MW.
- MP added 90 MW of wind energy from the Oliver County Wind Energy Project in North Dakota to its energy portfolio in 2007. MP is also working on the Taconite Ridge wind energy project in Virginia, Minnesota, with a goal of having a system capable of producing 25 MW in 2008.
- Fond du Lac Band has received funding to pursue a biomass gasification unit which will be used at the Fond du Lac Ojibway School to reduce energy needs and costs. This unit will use wood left over from fire reduction work. The order for the unit has been placed with the manufacturer.
- Fond du Lac has installed two anemometers with ongoing data collection. Preliminary results show promise for the use of wind energy on one area of the reservation.
- In response to the need to deal with climate change, the Fond du Lac Environmental Program is developing a strategy for improvements in energy and fuel efficiency within their own program as well as reservation-wide.
- The Bad River Band has collected 3 years worth of anemometer data from three sites on the reservation and is working with a certified meteorologist to analyze their data to assess wind energy alternatives.
- KBIC is currently conducting anemometer studies at their Pequaming Hatchery and is pursuing funding for additional renewable energy projects.
- The Red Cliff Band is exploring the possibility of alternative energy sources on its reservation.
- The J.H. Warden Generating Station in L'Anse, Michigan, is being converted by the new owner, L'Anse Warden Electric Generating Company, from coal to biomass. The intent is to increase from 60 MW of coal burning to 80 MW using biomass in 2008. The

biomass will come in part from waste from the Smurfit-Stone Container paper mill, and steam from the plant will be used by a neighboring mineral ceilings plant.

Figure 4-9. Western coal is brought by train to Superior, Wisconsin, and shipped to electric generating facilities. In 2008, the port shipped 20.8 million tons of coal, mostly to Detroit. Photo credit: Frank Koshere, WDNR.

Monitoring and Reporting

- In 2007, the Ontario Ministry of the Environment carried out an urban stream pesticide monitoring project to determine the quantities of common pesticides entering urban streams. Samples were taken twice a month during the summer in 2007 by the Regional Pesticides Specialists. McVicar's Creek and the McIntyre River were monitored in Thunder Bay. Final results will be available in 2008.
- The National Park Service (NPS) - Great Lakes Inventory and Monitoring Network sampled bald eagle nestlings in 2006 and 2007 along the length of the St. Croix and Namekagon Rivers, a portion of the Mississippi River in downtown Minneapolis/St Paul, and along the south shore of Lake Superior. PCBs and DDT continue to decline from highs in the 1970s, though concentrations are higher in nestlings sampled on Lake Superior and in the Greater Twin Cities area. NPS found active DDT in three of 10 nestlings on Lake Superior but only one of 26 nestlings from inland areas. PBDEs were found in all nestlings sampled, and data suggest a near doubling of the concentrations over the last five years. Mercury was highest in nestlings along the upper portions of the St. Croix and Namekagon Rivers where extensive areas of wetlands likely contribute to the production and availability of mercury.
- Red Cliff is taking the lead in the planning and development process for analysis of a large barrel dump site off the north shore coast of Minnesota. They are working with MPCA, US EPA, the Corps of Engineers and others to determine next steps. They are developing a Strategic Project Implementation Plan and hiring a contractor to help with the analysis and planning.
- GLIFWC completed studies of 37 PBT contaminants (including seven of the nine zero discharge pollutants) in Lake Superior cisco (formerly lake herring). Results from the studies were presented at various forums including meetings of SETAC and the *Making a Great Lake Superior 2007* conference.

- Red Cliff continued a Surface Water Quality Monitoring Program that tests 21 different locations on the reservation for 22 different parameters including mercury, dioxin (2,3,7,8-TCDD), PCBs, toxaphene, and chlordane. Keweenaw Bay, Grand Portage, Fond du Lac, and Bad River currently have in place or are developing similar surface water quality monitoring programs.
- Bad River is monitoring and anticipates close out of another old Underground Storage Tank in 2008.
- Grand Portage collected fish in 2007 for contaminant analysis (i.e., mercury, PCBs, dioxins, etc.) and will be collecting fish again in 2008.
- Fond du Lac plans to collect fish for mercury analysis in the summer of 2008.
- The MPCA purchased a solid sample analyzer for a Lumex portable mercury vapor analyzer. The equipment was used to analyze the mercury content of 40 participants of the *Making A Great Lake Superior 2007* conference in 2007 as part of an outreach project. Additional work is planned to compare the Lumex results to standard cold vapor atomic absorption results. The MPCA and WLSSD also made arrangements for a Lumex training refresher course for users in the Duluth-Superior area in 2006.

Sediment and Soil Remediation

- At the Torch Lake AOC in Michigan, the fish tumor Beneficial Use Impairment (BUI) was delisted from this AOC, leaving the fish advisories and restoration of benthos as the remaining BUIs.

Figure 4-10. The Torch Lake Area of Concern Mason site before and after remediation. Photo credit: Brenda Jones, US EPA.

- In 2007, at the Torch Lake site, US EPA performed an emergency removal of arsenic- and lead-contaminated soils and sediments. The Superfund program performed an area assessment afterward and found that further remedial investigation may be warranted.
- MDEQ, Torch Lake Public Advisory Committee, and US EPA are working together to determine if there is a source of PCBs in the lake that is driving the fish consumption advisory. In August 2007, MDEQ and US EPA, using the *R/V Mudpuppy,* collected sediment samples to locate any potential sources of PCBs in the lake. Results indicate there may be a source of low-level PCBs, but the concentrations were not high enough to

warrant remedial action. MDEQ, Torch Lake PAC, and US EPA are awaiting the results of the 2007 Michigan Department of Natural Resources fish sampling to determine if the fish consumption advisory for PCBs is still appropriate.

- Copper mining wastes ("stamp sands") deposited in Michigan's Keweenaw Peninsula watersheds over 100 years ago result in elevated aqueous copper concentrations, poor aquatic habitat, and impacted aquatic macroinvertebrate populations. Two stamp sand deposits were isolated from the streams by stabilizing the stream banks and capping and revegetating the upland areas; 2.5 acres were stabilized in the Kearsarge Creek watershed in 1998, and 19 acres were stabilized in the Scales Creek watershed in 2005. These remedial actions resulted in major improvements to Kearsarge Creek; instream copper concentrations fell by a factor of 10, and the macroinvertebrate population tripled with sensitive species such as mayflies, caddisflies, and stoneflies returning. Conditions in Scales Creek have also improved, instream copper concentrations deceased slightly, macroinvertebrates increased by 40 percent, and sensitive species doubled.
- St. Marys River – Algoma Steel Inc. (ASI) completed an assessment of PAH-contaminated sediment in its boat slip during 2005, and the dredging of 2630 cubic metres was undertaken in 2006. Sediments were disposed in an ASI landfill waste management facility.
- St. Marys River – Assessments of sediment contamination at the Bellevue Marine Park location were undertaken in 2006, and results are being evaluated to determine the cause of site-specific toxicity and the need for sediment management.
- Peninsula Harbour – Results of assessments of mercury and PCB bioaccumulation and ecological risk have indicated the need for sediment management. Remedial options are currently being assessed in consultation with local stakeholders. A preferred option will be selected in 2008.
- Thunder Bay (North Harbour) – Results of assessments of mercury and PCB bioaccumulation and ecological risk have indicated the need for sediment management. Remedial options are currently being assessed in consultation with local stakeholders. A preferred option will be selected in 2008.
- Wisconsin helped fund and manage a sediment monitoring and evaluation plan to collect sediment chemistry and toxicity data within Wisconsin waters of the St. Louis AOC. The results of the sediment assessment will be reported in 2008.
- WDNR has finished the Hog Island cleanup within the St. Louis River (SLR) AOC and is now working with Douglas County officials in revising and beginning implementation of the Hog Island Restoration Master Plan.
- As part of the federal Superfund process, Northern States Power of Wisconsin (NSPW) has completed a remedial investigation of the Ashland site, as well as an ecological risk assessment of the impacted sediment. Cleanup goals for the sediments were based on this assessment and earlier sediment investigation work. NSPW has submitted a Feasibility Study (FS) assessing cleanup options for the entire site and contaminated sediments. WDNR and US EPA are reviewing the FS and will be commenting back to NSPW shortly. NSPW will then resubmit the FS with changes reflecting the agencies' comments. The Bad River and Red Cliff Bands have also been involved in the Ashland/NSP Coal Tar Site (Superfund) Remedial Investigation, as well the natural resources damage assessment.

- WDNR is awaiting analysis results from sampling of suspected contamination on the Superior Water, Power, and Light site.
- The owners of Koppers' plant, a wood processing facility near Superior, have submitted a remedial design study of onsite contamination to the WDNR. The owners have also begun a field investigation of off-site contamination. Contaminants of concern are PAHs, PCP, and dioxin.
- At the St. Louis River/Interlake/Duluth Tar Site in the St. Louis River AOC in 2006, a 2,000-foot long sheet pile wall was placed around the eastern portion of Stryker Bay, and a cap of sand sandwiching a geo-textile mat was placed within the enclosed area. A rock dike with a clay liner was constructed to cut off Slip 6 from the river. In 2007, a water filtration plant was constructed to treat water from the Contained Aquatic Disposal (CAD) facility. The CAD received contaminated sediments from Stryker Bay and other areas where dredged materials contained PAH levels over 13.7 ppb. Activities slated for 2008 include dredging a small segment of the St. Louis River, removing the sheet pile wall, and capping the remaining area. Restoration activities scheduled for 2009 will focus on dredging around Tallas Island.
- The MPCA will enter into a Memorandum of Agreement with the U.S. Army Corps of Engineers, creating a mechanism for sediment assessment and habitat restoration funding and technical assistance for the Minnesota portion of the lower St. Louis River in 2008.
- The MPCA is partnering with University of Minnesota-Duluth Natural Resource Research Institute and has applied Great Lakes Environmental Indicator (GLEI) data to the St. Louis River AOC to establish reference sites for six near-shore ecotypes identified in the SLR Habitat Plan.
- The MPCA and partners from the Harbor Technical Advisory Committee (HTAC) developed the Erie Pier Management Plan converting the harbor's designated Confined Disposal Facility into a dredge material recycle and recovery area. HTAC is working to market materials to regional stakeholders.
- The MPCA oversaw cleanup of a Silver Bay, Minnesota, dump once used by Reserve Mining Co. to discard 12,500 drums filled with grease, solvents, heavy metals, and other hazardous waste. The three-year cleanup ended in 2007 and cost nearly $13 million. Remaining work includes removal of 3,500 tires weighing about a ton each, monitoring groundwater near the old dump site, and cleaning up a pile of coal ash near Lake Superior.

Figure 4-11. Oily debris from the Reserve Mining barrel dump site in Silver Bay, Minnesota. Photo credit: Susan Johnson, MPCA.

- Remediation work on 16 of the 18 contaminated sites at the U.S. Steel (USS) Superfund site has been completed at a cost of more than $12 million.

The remaining two, with contaminated sediments in waters adjacent to the Wire Mill Pond and the coke-settling basin, are currently undergoing remedial action. USS has also conducted additional land and creek investigations. The MPCA and US EPA staff will carry forward the 2003 report requirements and subsequent remediation work to the 2008 five-year review process this spring.

- In 2006, KBIC completed a cleanup of a tribal property that removed and properly disposed of twenty-six 55-gallon drums that included hazardous waste, and non-hazardous waste.
- KBIC's Sand Point stamp sand brownfields site soil cap/cleanup project was completed in 2006. Capping and revegetating the site will reduce heavy metal sediment loading to Keweenaw Bay by an estimated 340 tons per year.

Solid Waste Management

- Red Cliff Tribal Council formally banned the use of burn barrels on the Red Cliff Reservation in 2007. The Band also drafted a Solid Waste Management Plan, with a goal of final approval in 2008.
- Bad River completed a Solid Waste Management Plan in 2007 and is awaiting final approval.
- Illinois-Indiana Sea Grant (IISG) and US EPA GLNPO collaborated on a project to help communities initiate unwanted-medicine collection programs. The two agencies developed *Disposal of Unwanted Medicine: A Resource for Action in Your Community* in an effort to address the emerging concern that medications are ending up in lakes, rivers, and streams (www.iisgcp.org/unwantedmeds). A resource kit was also created for communities to start take-back programs to collect unwanted medicines. Over 160 resource kits have been distributed, and IISG has held workshops for over 100 local officials. As a result, a number of communities or counties in the Great Lakes region have begun collection programs.
- Over the past two years, US EPA developed a web-based burn barrel toolkit entitled *Learn Not to Burn,* which provides resources for local officials to reduce trash burning in their communities. The toolkit includes individual fact sheets for each state and case studies of efforts to reduce household garbage burning in various communities. The toolkit is available free of charge online, or communities may request CD toolkits via the *Learn Not to Burn* web site at http://www.iisgcp.org/learnnot2burn.

Stormwater

- KBIC is working with the local Resource Conservation and Development office to complete a road crossing and culvert inventory for most or all of nine watersheds on and around the L'Anse Reservation, to identify areas of significant sediment loading and prioritize crossings for mitigation.
- KBIC staff are in the process of obtaining federal inspector credentials for conducting Construction Storm Water Discharge Permit compliance inspections on the reservation.
- The Grand Portage Band received an EQIP grant (USDA Natural Resource Conservation Service Environmental Quality Incentive Program) and installed rain gardens and

conducted stream channel restoration near the Lodge and Casino in an effort to reduce non-point source pollution to Lake Superior.

- Red Cliff is applying for Section 319 base funding to develop a non-point source pollution management plan.
- MDEQ provided funding to implement several Best Management Practices (BMPs) in the Iron River watershed. BMPs included livestock exclusion fencing, alternate watering sources, and livestock crossings. An estimated 270 tons of sediment, 250 tons of phosphorous, and 500 tons of nitrogen were reduced through use of the BMPs.
- The City of Superior is working on their Erosion and Post Construction ordinance. In support of this ordinance, they have delineated storm drainage patterns and stream sheds. They maintain a web site for Superior streams, found at: http://www.ci.superior.wi.us/index.asp?nid=117
- The City of Superior approved its "Stormwater Utility" ordinance. A variable fee will be assessed starting in February 2008 based on the area of imperviousness.
- The City of Superior has a stormwater flood control program aimed at residents who have experienced basement backups. The program provides money for televising laterals (up to $150) and installing sump pumps and/or back flow presenters (100%). Participants have to pay for cleaning and repair of laterals if indicated.

Figure 4-12. In Superior, Wisconsin, a *Neighbors Helping Neighbors to Become Stormwater Stewards* project focused on training community leaders to promote environmental stewardship in their local neighborhood Photo credit: Frank Koshere, WDNR.

- The Wisconsin Education board provided a grant to the City of Superior for a *Neighbors Helping Neighbors to Become Stormwater Stewards.* The project focused on training community leaders in the Billings park area to promote environmental stewardship in their local neighborhood.
- Superior hosted a very popular workshop on snow and ice. The workshops helped to minimize the use of salt and deicing chemicals. This was sponsored by the MPCA for Twin Ports residents.

Wastewater Infrastructure

- The City of Marquette is upgrading their wastewater treatment facility with activated sludge and new secondary clarifiers.

- Bad River completed the second phase of a long-term, five-phase project, with the ultimate goal of bringing all failing septic systems up to code. The Tribe established a Private On-site Wastewater Treatment Systems (POWTS) Inspector position to assist Tribal members with POWTS and to provide education/outreach on septic systems.
- Grand Portage added a new sewer line to its West Village housing development and a new line for the central village sewer that replaces several septic systems.
- KBIC is nearing completion of construction of sewer and water line extensions to serve lake front properties along the east shore of Keweenaw Bay.
- KBIC, in conjunction the Village of Baraga, completed repair of approximately 9,000 linear feet of wastewater service lines and upgraded associated existing sewage lagoons.
- Red Cliff removed an obsolete wet well to prevent the potential risk of discharging sewage to a Lake Superior tributary.

4.2.2 New Regulations and Policies Aligned with LaMP Goals

In addition to the activities described above, some government regulations and policies have taken place since the LaMP 2006 update that target releases of the nine chemicals slated for zero discharge or are expected to provide co-benefits for those nine chemicals. Those that are most closely aligned with contaminant sources in the Lake Superior basin include the following:

Air Quality

- Minnesota passed a law requiring 90 percent reduction of mercury emissions from the three largest coal-fired power plants in the state. The bill also requires installation of continuous emission monitoring and allows companies to offset reductions at the three largest plants by reducing mercury emissions in other plants.
- In 2006, Michigan Governor Granholm directed the MDEQ to pursue a rule under Michigan's *Clean Air Act* to reduce mercury emissions from electric utilities by 90 percent by 2015. A stakeholder workgroup is currently developing rules to comply with the Governor's directive.
- In 2007, the MDEQ was granted $100,000 to perform an innovative wood stove change-out and outreach program. MDEQ will create a unique partnership with HPBA and Michigan United Conservation Clubs (MUCC). This partnership will create a campaign to educate Michigan citizens about the benefits of upgrading to cleaner burning technologies for hearth appliances, and an incentive program to achieve a goal of replacing 500 uncertified wood-burning stoves. The MDEQ's role will be to administer the grant, monitor progress toward meeting the goal, and evaluate the outcomes. The MUCC's role will be to create and administer the educational campaign and administer the incentive program. The HPBA will supply the incentives (with assistance from grant funds) and document change-outs.
- The use of Outdoor Wood-fired Boilers (OWBs) is increasing, with about 500,000 expected to be in place nationwide by 2010, primarily in the Northeast and Midwest, including the Great Lakes area. Although US EPA is not adopting regulations to address OWBs, it has taken the following steps: (1) completed development of a test method specific to OWBs; and (2) entered into an agreement with major OWB manufacturers, based on a previous voluntary incentive program. As a result of this agreement,

beginning in April 2007, wood boiler manufacturers are offering for sale at least one model of wood boiler that will emit 70 percent less emissions, with further reductions in subsequent years. In addition, a model rule has been developed for states and local agencies that will include emission limits, zoning, stack height, operation and maintenance, labels, and notices to buyers.

- The Ontario government implemented the Industry Emission Reduction Plan, which establishes new emissions caps for industrial pollution sources in Ontario starting in 2006; the caps become more strict in 2007, 2010, and 2015.
- Under *Regulation 419/05*, the Air Pollution Regulation – Local Air Quality, in 2007, Ontario reviewed and updated the limits for 15 substances based on improved scientific information, updated research on associated health risks and new air dispersion models to provide greater protection of public health and the environment. The standards for these substances will be used primarily to assess and manage local impacts from industries on surrounding neighborhoods and communities. The complete regulation and emissions standards are available in schedules 2, 3, and 4 on this web site: http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_050419_e.htm.
- On August 24, 2007, Ontario implemented *Regulation 496/07,* which requires the cessation of coal use at all four currently operating coal-fired generating stations (Atikokan, Lambton, Nanticoke, and Thunder Bay) by December 31, 2014.
- Ontario anticipates finalizing its mercury emission reduction plan for coal-fired power plants once the Ontario Power Authority's Integrated Power System Plan is reviewed by the Ontario Energy Board.
- The Ontario Ministry of the Environment is in the process of amending the Certificates of Approval for electric arc furnaces to include the dioxin/furan CWS limits, which will come into effect on December 31, 2006 (phase 1), and December 31, 2010 (phase 2).
- Ontario continues to implement the Canada-wide Standards (CWS) for mercury and dioxins/furans from municipal waste, sewage sludge, hazardous waste, and medical waste incinerators.
- The *Canada-wide Standard for Mercury Emissions from Coal-Fired Electric Power Generation Plants* commits the provinces to reduce mercury emissions from coal-fired power plants by 60 percent nationally by 2010.
- A partnership of Environment Canada and the Hearth, Patio and Barbeque Association (HPBA) has conducted a study to measure emissions from conventional woodstoves and verify historical emission factors. The study results are published in the *16th Annual International Emission Inventory Conference* proceedings, available at http://www.epa.gov/ttn/chief/conference/ei16/session5/victor.pdf.

Energy

- Legislation to implement Minnesota Governor Pawlenty's *Next Generation Energy Initiative* was passed in 2007.
    - *25x25 Renewable Electricity Requirements* established the Nation's strongest renewable energy standard, which requires energy companies to provide 25 percent of power from renewable sources by 2025.
    - *Next Generation BioEnergy and BioFuels* appropriates over $35 million for energy projects and research including bioenergy, biomass electricity, biofuels,

plug-in hybrid technologies, renewable hydrogen and solar technology projects; energy research, including funding for the University of Minnesota Initiative for Renewable Energy and the Environment; and funding to double the number of E85 stations in Minnesota from the nation-leading 300 stations to 600 stations.

- *Next Generation Energy Act of 2007* effectively doubles the amount of energy saved by Minnesota's utilities and sets a goal of 1,000 Energy Star Buildings in Minnesota by 2010 and provides adequate funding to achieve the goal. It also expands and strengthens Minnesota's commitment to the development of locally-owned renewable energy projects. It also propels Minnesota along with California in leading the way towards reducing greenhouse gas (GHG) emissions. The bill establishes statewide GHG reduction goals of 15 percent by 2015, 30 percent by 2025, and 80 percent by 2050. The bill also endorses a Minnesota Climate Change Advisory Group (www.mnclimatechange.us).

Co-Benefits: Greenhouse Gas and Mercury Reductions

Reductions in greenhouse gases may have co-benefits with reductions in mercury emissions. Energy conservation is an especially good example of an activity that has co-benefits. Some greenhouse gas control technologies may shift mercury from one pathway to another, for example, from a release to air to a release to a solid waste byproduct. Such a shift may require reconsideration of waste disposal practices.

- Using a grant from the MPCA, a collaboration including the Builders Association of the Twin Cities, the Minnesota chapter of the National Association of the Remodeling Industry, and the Minneapolis-based Green Institute created a Minnesota GreenStar certification program. The program developed a new set of standards aimed at increasing durability, energy efficiency, and indoor air quality. Training for builders and remodelers is mandatory, and projects will require inspection and performance testing at various stages by third-party raters, including the Center for Energy and the Environment and the Neighborhood Energy Connection (www.mngreenstar.org).
- Ontario is extending the retail sales tax credit for installing wind, micro hydro-electric, and geothermal energy systems installed in residential premises up to January 1, 2010.

Great Lakes

- In February, the MDEQ released a comprehensive strategy to eliminate the use and release of mercury to Michigan's environment. The MDEQ's Mercury Strategy Staff Report contains specific recommendations and a comprehensive approach to controlling mercury, including environmental monitoring, inventory development, collaborations and partnerships, education and outreach, and regulatory controls. It also provides an overview of the mercury problem, identifies current sources that contribute to mercury releases, and identifies various methods for reducing and eliminating the sources. It outlines Michigan's rules, regulations, policies, and monitoring activities for mercury, and chronicles various actions undertaken thus far to prevent the use and release of mercury.

- Under a grant from US EPA, EMA Research & Information Center, subcontractor to the Tellus Institute, developed a spreadsheet tool to determine and compare the costs of phasing out PCB transformers against the costs of continued use. The tool was developed with the input of industry representatives and was based on actual case study information. The software was demonstrated to the Great Lakes Binational Toxics Strategy (BTS) PCB Workgroup in 2006. Some of the major cost drivers and considerations included the transformer age, size, type, and rating; the fluid volume and PCB concentration; the location and accessibility of the equipment; spill containment and fire prevention; equipment reliability and importance; and regulatory compliance. The software specifically enables a firm to conduct an itemized financial assessment for the scenarios of keeping, removing, and retrofilling a PCB transformer, including such factors as net present value and payback, depreciation, taxes, inflation, and discounting. US EPA is currently evaluating the spreadsheet tool and will work with other industry representatives to conduct additional trial case studies on the use of the tool.
- A study of PCB emissions from in-service PCB transformers conducted by Dr. William J. Mills of the University of Illinois was submitted to US EPA. Dr. Mills collected samples of ambient air around operating PCB Askarel transformers in January and October 2004. The study showed that PCB levels in rooms with transformers were at least 1 order of magnitude higher than outside background PCB concentrations collected on-site, and higher still than a background PCB concentration collected off-site. The draft report was discussed with the BTS PCB Workgroup in 2006. The workgroup concluded that additional information specific to any potential source of PCBs at the facility would be needed to fully understand the relative contribution loading of PCB transformers. The other potential sources could include past spills, paint, caulk, or other PCB-containing equipment.
- A risk-based decision-making framework for contaminated sediments was completed under the 2002-2007 *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem* (COA). The Ontario Ministry of the Environment is integrating the document with existing guidance to produce "*Guidelines for Identifying, Assessing and Managing Contaminated Sediments in Ontario: An Integrated Approach.*" Pending final internal review, the guidance will be applied throughout the province.
- In 2007, a workgroup of state, tribal, and city staff developed a basin-wide Great Lakes mercury product stewardship strategy to fulfill the Great Lakes Regional Collaboration Strategy recommendation to phase down mercury in products and waste. The Draft *Mercury in Products Phase-Down Strategy* is posted at http://www.glrc.us/initiatives/toxics/drafthgphasedownstrategy.html.

Products

- In Michigan, three acts were passed in 2006 to restrict sales of certain mercury-bearing products.
    - *Public Act 492 of 2006* banned the sale of thermostats that contain mercury or a mercury compound beginning January 1, 2009. It does not apply if the thermostat is a replacement for an existing thermostat containing mercury or a mercury compound that is a component of an "appliance." The term "appliance" is

precisely defined in *Public Act 494*. Thermostats that regulate home heating and cooling do not meet the definition of "appliances."
    - *Public Act 493 of 2006* prohibits the sale of mercury-added blood pressure devices by January 1, 2008, and their "use" by January 1, 2009, with two exceptions: in home use and calibration of mercury-free devices in health care facilities, if deemed warranted.
    - *Public Act 494 of 2006* bans the sale of esophageal dilators, bougie tubes, and gastrointestinal tubes that contain mercury or mercury compounds beginning January 1, 2009.
- Minnesota passed two new laws regarding mercury in products. Both expanded existing mercury legislation. The first in May 2007 phased out the sale of more mercury-containing products (including switches, thermostats, medical devices, and sensors), required recycling of compact fluorescent lamps, set a goal to remove mercury from all pre-K through 12 schools within two and a half years, and strengthened public outreach and collection programs for products still in use. The other bans the sale of cosmetics which are manufactured using mercury.
- The National Vehicle Mercury Switch Recovery Program (NVMSRP) was established by an August 2006 agreement among vehicle manufacturers, steelmakers, vehicle dismantlers, auto shredders, brokers, the environmental community, state representatives, and US EPA. Under this program, vehicle manufacturers, auto dismantlers, and steelmakers promote a voluntary program that facilitates and provides incentives for removal of mercury switches from automobiles at the end of life. NVMSRP met its first-year goals of enlisting all U.S. states to take part in the program, and of developing a way to measure progress toward the goal of collecting at least 80 percent of available mercury switches in future years.
- In 2006, thermostat manufacturers increased collections through the Thermostat Recycling Corporation (TRC), which seeks to improve recovery of mercury-containing thermostats for recycling. The TRC enables wholesalers and contractors across the country to collect and ship mercury thermostats without charge to an industry facility for disassembly and recycling. In 2006, the TRC recovered nearly 113,600 thermostats and thereby removed 1,080 lbs of mercury from the solid waste stream. These figures represent a 29 percent increase in thermostat collections and a 32 percent increase in recovered mercury from 2005. The number of mercury thermostats coming out of service has been estimated at more than 2 million annually. Mercury thermostats that are not managed by the TRC or by HHW programs are either discarded in the trash or as part of construction and demolition waste.
- The American Dental Association has added the use of dental amalgam separators to the list of *Best Management Practices for Amalgam Waste* that it recommends dentists follow.
- The Ontario Ministry of the Environment is moving to ban the cosmetic use of pesticides. New use restrictions are being planned as part of an overall toxic substance reduction strategy. The government has committed to introduce legislation in the spring of 2008.

Pesticide Use in the Great Lakes States

The use of and exposure to lawn chemicals and herbicides and pesticides have been linked to human, aquatic, and ecosystem health effects. Pesticides run-off is also contributing to the Gulf of Mexico dead zone and to deleterious effects in aquatic life and the ecosystem. In alignment with Great Lakes Regional Collaboration recommendations on the reduction of pesticides to the Great Lakes, US EPA GLNPO issued a grant to a non-profit organization, "Safer Pest Control Project", to conduct a workshop entitled "Natural Lawn Care." The grant was matched by the Boeing Corporation and helped support a two-day workshop in Chicago in February 2008 to help cities, municipalities, park and school districts, churches, and turf care professionals learn natural and organic lawn care methods and techniques. More information can be found at www.spcpweb.org/yards.

Solid and Hazardous Waste

- On December 11, 2006, the Minister of the Environment filed Ontario Regulation 542/06 under the *Waste Diversion Act* (WDA). The regulation identifies wastes that fall within the municipal hazardous or special wastes class (MHSW). On February 19th, the Minister of the Environment approved a MHSW program submitted by Waste Diversion Ontario (WDO). The program requires the producers of household hazardous and special wastes to develop and fund a diversion program for specific materials. The regulation focuses on the following key areas: recycling, alternative fuels, and emerging waste technologies. Following approval, the plan is scheduled to be implemented in phases beginning July 1, 2008.
    - WDO will work with brand owners to look at financial or other incentives to reuse and recycle these materials, to increase the amount of materials collected, to promote best practices and encourage innovative diversion techniques, and to develop an education program.
    - Phase one materials will be paints, solvents, oil filters, pressurized containers, fertilizers, pesticides, antifreeze, and single-use dry cell batteries.
    - WDO will be submitting a plan for Phase two materials July 1, 2009. Phase two materials include: fluorescent lights, pharmaceuticals, aerosol containers, fire extinguishers, syringes rechargeable batteries, thermostats, thermometers, or other measuring devices containing mercury. More information may be obtained at http://www.wdo.ca/files/domain4116/Revised%20Final%20MHSW%20Plan%20Nov%2026%2007.pdf.
- The MDEQ released a stakeholder-driven update to the Michigan Solid Waste Policy in 2007. The Policy provides a framework to guide Michigan citizens, businesses, government agencies, institutions, universities, and political leaders in making smart choices for managing Michigan's solid wastes by viewing it as a resource in a global economy. The policy uses the three principles of sustainability: economic vitality, ecological integrity, and improved quality of life to guide solid waste management decisions.

Water Quality

- Minnesota's statewide mercury Total Maximum Daily Load (TMDL) was approved by US EPA in 2007. This TMDL seeks a 93 percent reduction in mercury emissions from the state using mercury levels in fish from northeastern Minnesota as an endpoint. The process has moved into the second phase, in which a mercury TMDL stakeholder group is developing an implementation plan (http://www.mn-ei.org/policy/hgtmdlindex.html).
- Four members of a partnership of northeastern Minnesota businesses, WLSSD, and environmentalists have joined the Minnesota statewide stakeholder process for implementing the statewide mercury TMDL. Once this group makes its recommendations, the information gathered from the process will be taken back to the St. Louis River TMDL Partnership.
- In Ontario, the *Clean Water Act* received Royal Assent on October 19, 2006, and addresses the recommendations from the Walkerton Inquiry which pertain to the protection of drinking water sources. Justice O'Connor's report recommends that: "Drinking water sources should be protected by developing watershed-based source protection plans. Source protection plans should be required for all watersheds in Ontario" (D.R. O'Connor 2002). The report also recommends that "The Ministry of the Environment should ensure that draft source protection plans are prepared through an inclusive process of local consultation. Where appropriate, this process should be managed by Conservation Authorities" (D.R. O'Connor 2002).
- The province passed the *Clean Water Act* in October 2006. The Act will better protect the quantity and quality of water in aquifers, rivers, and lakes, including the Great Lakes by:
    a. Requiring communities to look at the existing and potential threats to their water and set out and implement the actions necessary to reduce or eliminate significant threats.
    b. Requiring communities to take action to prevent threats from becoming significant.
    c. Requiring public participation on every local source protection plan. This means everyone in the community gets a chance to contribute to the planning process.
    d. Requiring that all plans and actions are based on sound science.
- Source Protection Plans are being implemented on Lake Superior by the Lakehead Region Conservation Authority and the Sault Ste. Marie Region Conservation Authority. More information may be obtained on the Conservation Ontario web site: http://conservation-ontario.on.ca/source_protection/CWAFundEarlyActions.htm.

Figure 4-13. Lake Superior water – frozen and unfrozen. Photo credit: Chris Zadak, MPCA.

4.3 Challenges

4.3.1 Overall Challenges

Most of the challenges summarized in the LaMP 2006 update remain today. These include:

1. Chemical inventories must be up-to-date and as accurate as possible. The PCB inventory has been a challenge, as there is no comprehensive and up-to-date inventory.
2. Outreach and coordination internally and externally are essential and must be strengthened.
3. More easily achieved reductions have been accomplished, and the remaining sources will be more difficult to reduce.
4. Out-of-basin sources continue to be a major source of deposition to the Lake Superior watershed.

The *Critical Chemical Reduction Milestones* report (LSBP 2006) provides additional detail on these challenges. The Milestones report also warns of the potential for critical pollutant increases due to projected increases in energy demand and proposed new emission sources. New developments since the release of the Milestones report include three new mines that have received permits to discharge in the Lake Superior basin and other proposed mines and a coal gasification plant that are in the planning stages. All three permitted mines are likely to begin operations before the 2010 mercury reduction milestone.

- The Kennecott Eagle Project in Michigan is expected to yield 112 million to 135 million kg of nickel and about 90 million kg of copper. Mercury emissions are estimated to be quite small at <0.1 kg/yr.
- The Minnesota Steel project in Minnesota would both mine taconite and produce steel slabs. An estimated 35 kg/year of mercury would be emitted from this facility.
- Mesabi Nugget, also in Minnesota, is a new kind of taconite processing plant with an estimated mercury emission of 35 kg/yr.

Burning Garbage

Although no large open burning surveys were done in the Lake Superior basin in 2006 or 2007, anecdotal evidence points to the continuing practice of burning garbage. In the 2006-2007 period, regional newspapers reported several wildfires that were started by burn barrels, a burning dump truck load that had to be dumped on the road and hosed down by firefighters, and an accidental landfill fire. One of the wildfires killed the elderly man who started the fire.

Photo credit: US EPA

Also, US Steel recently announced their intent to expand the Keewatin taconite mine in Minnesota. If the project is completed, about 22 kg/year of mercury would be released from the additional ore being mined.

These new and expanded emission sources, particularly of mercury, present the most significant challenge to Binational Program agencies as the 2010 reduction milestone goals rapidly approach. In response to a Task Force request, the Chemical Committee prepared a list of broad potential actions that could be taken by Binational Program agencies to help meet the 2010 reduction milestones given the challenges posed by these new emission sources. The agencies responded by committing to various specific actions underneath those recommendations. Addendum 4C describes these specific actions in detail.

4.3.2 Substances of Emerging Concern

The Problem

The phrase "substances of emerging concern" has come to define the universe of newly detectable chemical substances being discovered in air, water, sediment, and wildlife. Improvements in instrumentation and analytical methods enable scientists to detect more substances at lower concentrations than was possible a short time ago. This improved detection ability brings with it an emerging concern over the risk these substances may pose to human and ecosystem health and a formidable challenge for environmental scientists, managers, and policy makers. The sheer number of potential substances for investigation combined with the resources required to investigate and manage a single substance pose a significant research and management challenge.

For the purposes of management in the Lake Superior basin, substances of emerging concern are those substances whose presence in the environment may pose a risk to human and/or ecosystem health. While this definition could include thousands of substances, the focus of the management strategy will be limited to those substances that have been identified, categorized, or prioritized by appropriate technical, research, or management authorities. Table 4-3 lists some examples of substances of emerging concern.

Figure 4-14. Shovel Point trail, MN. Photo credit: Carri Lohse-Hanson, MPCA.

Table 4-3. Examples of common classes of substances of emerging concern, specific chemicals of interest in those groups, and their common uses.

CHEMICAL GROUP	EXAMPLES OF CHEMICAL USES
Flame Retardants • Polybrominated diphenyl ethers (PBDEs) • Polybrominated biphenyls (PBBs) • Tetrabromobisphenol A (TBBPA)	Retard flammability of plastics, foams, polymers, wiring insulation
Fluorinated Surfactants • Perfluorooctane sulfonate (PFOS) • Perfluorooctanoic acid (PFOA)	Fire fighting foams; water, oil, soil, and grease repellents on surfaces such as carpets, fabrics, and upholstery; surfactants in chrome plating operations
Personal Care Products • Triclosan • Benzalkonium chloride (BAC) • Synthetic musk fragrances	Anti-microbial soaps, perfumes, disinfectants, shampoos, etc.
Pharmaceuticals • Steroids • Hormones – estrogens and androgens • Caffeine • Cotinine	Over the counter, prescription, veterinary drugs
Detergents • Alkylphenol ethoxylates (APEs)	Industrial and institutional cleaning, metal finishing, textiles
Plasticizers • Phthalates	Added to plastic formulations to change rigidity
Current-use Pesticides • N,N-diethyltoluamide (DEET) • Dachtal • Chlorothalonil • Pyrethroid pesticides	Insect repellants, fungicides, insecticides, herbicides
Short Chain Chlorinated Paraffins (SCCP)	Mainly used in extreme pressure lubricants in the metal processing industry

Source: LSBP 2006.

Is There Evidence That Substances of Emerging Concern Are Present in the Lake Superior Basin?

Emerging contaminants have been detected in the Lake Superior ecosystem. Most studies to date have focused on brominated flame retardants (PBDEs and polybrominated biphenyls [PBBs]) as well as perfluorinated chemicals (PFOS and perfluorooctanoic acid [PFOA]). The following is an overview of some of these studies.

PBDEs have been detected in air at the Lake Superior Integrated Atmospheric Deposition Network (IADN) station at Eagle Harbor, Michigan (Strandberg et al. 2001). Concentrations of PBDEs were similar in air above all the Great Lakes and showed a strong urban signal from Chicago. Similar spatial results have also been found for PCBs.

Two classes of brominated flame retardants (total PBDEs and total PBBs) were measured in composites of six-year-old lake trout captured in 1997 from all the Great Lakes except Lake Michigan (Lake Michigan samples were not measured) (Luross et al. 2002). Lake Superior lake trout had the second highest PBDE concentrations (mean of 56 ppb) and the lowest PBB concentrations (mean of 0.25 ppb).

Archived lake trout tissue collected between 1980 and 2000 was analyzed for PBDEs and one PBB (#153) (Zhu and Hites 2004). Concentrations of PBB-153, a component of a flame retardant banned in the 1970s, did not show a significant decreasing trend as many other banned chemicals have (i.e., PCBs, DDT). PBDEs increased exponentially with a doubling time of every 3 to 4 years (Figure 4-1a). Similar results were also found in lake trout and/or walleye from the other Great Lakes.

Total PBDEs were detected at a mean concentration of 7.9 ppb in bald eagle nestling blood plasma samples collected from the Wisconsin shores of Lake Superior in 2000-2001 (Dykstra et al. 2005). This compared to a mean total PCB concentration of 51.5 ppb and a mean DDE concentration of 13.4 ppb also in samples from 2000-2001 (Dykstra et al. 2005).

Sediment cores from six off-shore locations in Lake Superior were analyzed for ten PBDE congeners by Song et al. 2004 (Figure 4-1b). In general, and in contrast to concentrations of PCBs in the same samples, PBDE concentrations were increasing significantly in recent years. The authors estimated an annual PBDE loading rate for Lake Superior at 80-160 kg/year.

Perfluorinated chemicals have been reported for surface waters and in lake trout from Lake Superior (Furdui et al. 2006a; Furdui et al. 2006b). Mean PFOS and PFOA concentrations of less than 1 ng/L were lowest in Lake Superior compared to Lakes Ontario, Erie, and Huron (Furdui et al. 2006a). In lake trout, the mean PFOS concentration was 5 ng/g and again was lowest for lake trout from the five Great Lakes. Similarly, total perfluoroalkyl contaminants (sum of perfluorosulfonates and perfluorocarboxylic acids) were lowest in Lake Superior lake trout (mean 13 ng/g) (Furdui et al. 2006b).

What Does the Management Strategy for Substances of Emerging Concern in the Lake Superior Basin Provide?

The Lake Superior LaMP has identified the importance of substances of emerging concern within the context of "restoring and protecting the Lake Superior Basin." The main goal of the strategy for emerging substances is to prevent the future designation of additional critical pollutants. The issue presents a vast challenge for which a management strategy will help to clarify and facilitate the inclusion of substances of emerging concern in the LaMP process. It provides a means to develop monitoring priorities for these substances in an organized and systematic way, encourages pollution prevention activities, funding, and reporting of those activities in the LaMP updates. For example, collections of unused pharmaceuticals or electronics by groups with US EPA support have been previously reported in the LaMP, even though they did not target any of the current critical or prevention pollutants. Finally, a management strategy for substances of emerging concern will help emphasize pollution

prevention as the preferred management approach for both critical pollutants and substances of emerging concern in the Lake Superior basin.

Management Strategy for Substances of Emerging Concern in the Lake Superior Basin

Overview

The Chemical Committee of the Lake Superior Workgroup has developed a three-part management strategy for substances of emerging concern in the Lake Superior basin: 1) Pollution prevention will be the focus and guiding principle for the management effort, 2) Substances of emerging concern will be added to the critical and prevention pollutant management categories, after appropriate public and technical consultation, using the decision path set out by the Revised Management Goal Flow Chart (Figure 4-15), and 3) Substances of emerging concern will become a new reporting section in the biennial LaMP updates.

Three-Part Strategy

1. Focus on pollution prevention projects in order to:

    - Look for co-benefits in current reduction programs. Substances of emerging concern may be produced through processes that generate some of the current critical or prevention pollutants.
    - Identify pollution prevention opportunities with stakeholders in the basin or in collaboration with the BTS or other programs that focus on preventing or reducing release of a specific substance, a class of substances, specific uses, sectors, modes of action, or endpoints.
    - Use pollution prevention as the preferred management approach for all chemicals of concern including critical pollutants and substances of emerging concern. There will be no discrete list of substances for pollution prevention activities.

2. Use the Revised Management Goal Flow Chart (Figure 4-15) to:

    - Identify the five LSBP management categories and the process for assigning substances to each of them (Tables 4-4, 4-5, and 4-6).
    - Identify a discrete list of substances for which monitoring or use data is lacking.
    - Recognize pollutants that are of special concern due to concentrations which exceed yardsticks (the current critical pollutants).
    - Identify, in conjunction with stakeholder input, additional critical pollutants.

3. Report on substances of emerging concern:

    - Adding a new section to the critical pollutants chapter of the LaMP to report on substances of emerging concern will:
        - Highlight monitoring needs and the state of science in the Lake Superior basin;
        - Provide a record of relevant pollution prevention activities;

- Create awareness about outreach activities for these substances;
- Provide a forum for tracking reductions;
- Promote investigation of alternatives to these substances; and
- Identify sources of substances of emerging concern in the Lake Superior watershed.

Conclusion

In the LaMP 2000 report, the Chemical Committee identified reduction strategies to address each of the Zero Discharge critical pollutants. These were updated in the Milestones Report (LSBP 2006). The Committee also devoted a section of the Milestones Report to introducing the issue of substances of emerging concern as an important management consideration for the Lake Superior LaMP. The LaMP has a responsibility to evaluate chemical substances that may pose a risk to the human and ecological health of the Lake Superior basin. Creating a management strategy for these substances will help to prevent the potential designation of new critical pollutants. Creating a section for regular reporting in this area will enable tracking of substance release and reduction inventories. It will also help to promote the development and use of sustainable chemical management practices. As more information about the risks from substances of emerging concern becomes available, tolerable background levels will be established. These will be used to develop "yardsticks" for management in the Lake Superior LaMP. The LaMP will then be in a good position to refine specific strategies that may be needed to prevent or reduce concentrations of substances of emerging concern from reaching critical levels.

Table 4-4. Existing critical pollutants for Lake Superior.

MANAGEMENT CATEGORY	CRITICAL POLLUTANTS	
1. Zero Discharge*	Chlordane DDT and metabolites Dieldrin/aldrin Hexachlorobenzene PCBs	2,3,7,8 –TCDD dioxin Toxaphene Mercury Octachlorostyrene (OCS)
2. Lakewide Remediation	PAHs (anthracene, benz(a)anthracene, benzo(b)fluoranthene, clinitropyrene, benzo(a)pyrene, perylene, benzo(g,h,i)perylene, phenanthrene)	Alpha-BHC Cadmium Heptachlor/heptachlor epoxide TCDD(TEQ)[a] dioxins and furans
3. Local Remediation	Aluminum Arsenic Chromium Copper Iron	Lead Manganese Nickel Zinc

[a] TEQ = Toxicity Equivalent

Table 4-5. Existing prevention pollutants for Lake Superior.

MANAGEMENT CATEGORY	PREVENTION POLLUTANTS	
4. Monitor	1,4-dichlorobenzene	Pentachlorobenzene
	1,2,3,4-tetrachlorobenzene	Pentachlorophenol
	Mirex/photo-mirex	BHC, gamma congener
5. Investigate	1,2,4,5-tetrachlorobenzene	BHC, beta and delta congeners
	3,3-dichlorobenzidine	
	2-chloroaniline	Hexachlorobutadiene
	Tributyl tin	

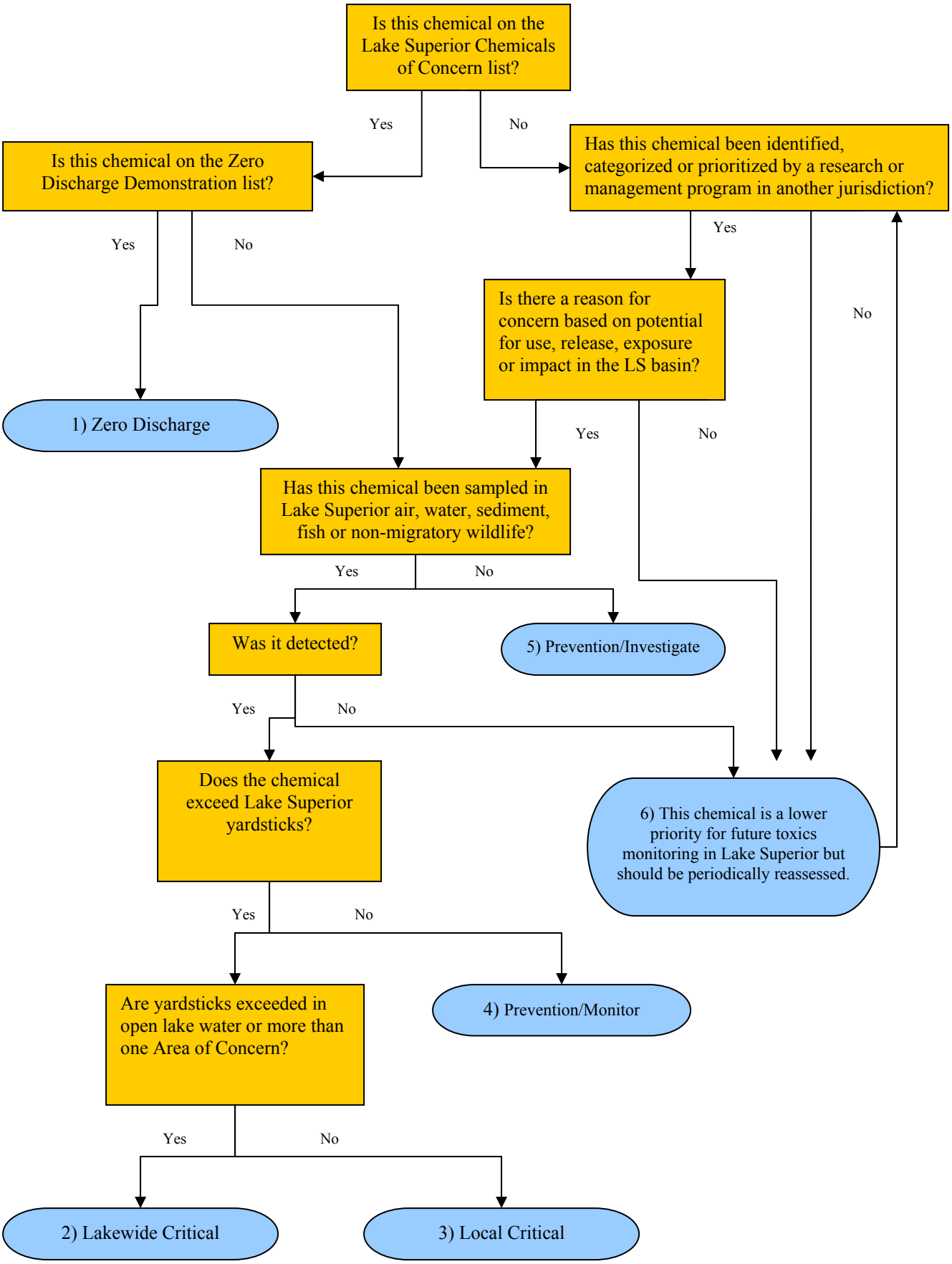
Table 4-6. Explanation of management categories.

MANAGEMENT CATEGORY	DESCRIPTION
Critical Pollutants	Levels of persistent, bioaccumulative toxic chemicals should not impair beneficial uses of the natural resources of the Lake Superior basin. Levels of critical pollutants which are persistent, bioaccumulative and toxic should ultimately be virtually eliminated in the air, water and sediment in the Lake Superior basin.†
1. Zero Discharge*	As a management approach, virtual elimination from the environment requires that zero discharge or emission is applied to the use, generation, and release of persistent, bioaccumulative and toxic substances originating from human activities. The effect of these chemicals is found both locally and lakewide. Sources may be local or outside of the basin.
2. Lakewide Remediation	These pollutants have less potential to bioaccumulate than those in the zero discharge category. Some of the lakewide remediation pollutants are responsible for nearshore problems in multiple locations, and some exceed criteria in open lake waters. The management approach for these pollutants is to coordinate lakewide reductions in loadings.
3. Local Remediation	Local remediation pollutants consist of metals that impact AOCs or other nearshore areas. These are mainly metals which have both natural sources and sources due to human activity. The management approach is concurrent localized reduction in loads and remediation of hot spots.
Prevention Pollutants	Prevention pollutants have properties that give them potential to impair the lake, but they have been found below harmful levels or have not been monitored in Lake Superior. The intention is to manage the prevention pollutants to avoid impairments in the future.
4. Monitor	Although these pollutants have not been found at harmful levels in the Lake Superior ecosystem, the ecosystem should be monitored to confirm the continued absence at levels of concern for these pollutants.
5. Investigate	Substances in this category have been identified as being of concern by Lake Superior programs such as GLI or COA. Because these pollutants were not sampled in previous surveys, they should be sampled for in the future.

* This category was previously referred to as Virtual Elimination in the LaMP Stage 2 report.

† Lake Superior Binational Program. 1998. Ecosystem principles and objectives, indicators and targets for Lake Superior (revision date). Lake Superior Work Group of the Lake Superior Binational Program, Thunder Bay, Ontario. 110 p.

Figure 4-15. Revised management goal flow chart for Lake Superior critical chemicals (Replaces Figure B-1 in the LaMP Stage 2, 1999).



Explanation of Decision Points for Figure 4-15:

Is this chemical on the Lake Superior Chemicals of Concern list?

The Lake Superior Chemicals of Concern list is a list of chemicals derived by combining the U.S. Great Lakes Water Quality Initiative (GLI) bioaccumulative chemicals of concern (BCCs - as originally discussed in the Lake Superior LaMP Stage 2, Appendix B) and the list of Tier I and Tier II substances that form the baseline commitment under COA. The Lake Superior Chemicals of Concern are listed in Tables 4-4 and 4-5.

Is this chemical on the Zero Discharge Demonstration list?

The goal of the ZDDP is to achieve zero discharge and zero emission of certain designated persistent bioaccumulative toxic substances in the Lake Superior basin. In 1999, the Lake Superior Binational Program mapped out a two-decade reduction plan for the "Nasty Nine" pollutants. The plan identified targets for staged reductions of these pollutants, with 1990 as the baseline year and 2020 as the year where virtual elimination will be achieved.

Has this chemical been identified, categorized or prioritized by a research or management program in another jurisdiction?

Examples of a research or management program in which chemicals may be identified, categorized, or prioritized include: Annex 1 Supplement of the Great Lakes Water Quality Agreement, Environment Canada's CEPA Schedule 1 or Chemical Management Plan, BTS, US EPA Toxic Substances Control Act (TSCA), US EPA High Production Volume (HPV) program, or otherwise identified by an International Joint Commission, Commission for Environmental Cooperation, Health Canada, or US EPA program, COA, BTS, European list, or other respected international list.

Is there a reason for concern based on potential for use, release, exposure or impact in the LS basin?

Consider whether there is potential for Lake Superior basin effects based on current or historic use, release, or exposure data in the basin. Consider whether there is evidence of significant impact in another geographic location with the same sources and use patterns as the Lake Superior basin, or that effects would be significant by the time it was able to be measured through monitoring in the basin.

Has this chemical been sampled in Lake Superior air, water, sediment, fish or non-migratory wildlife?

Consider whether the substance has been the subject of a thorough and scientific sampling campaign by a qualified body or individual.

Does the chemical exceed Lake Superior yardsticks?

To identify substances which are "likely to impair" the ecosystem, the most stringent water, sediment, and biota criteria, standards, or guidelines (not including those for drinking water) of the jurisdictions in the basin will be used as the standard for concentrations of concern in Lake Superior. They are described as yardsticks so as not to imply any action but to strictly define critical pollutants. Substances for which no yardsticks exist will need to be re-evaluated should yardsticks be developed by Lake Superior agencies, but for all substances this is a dynamic process, where new information will cause a substance to be moved to a new category.

Are yardsticks exceeded in open lake water or more than one Area of Concern?

"A beneficial use is considered impaired on a lake-wide basis only if it is found in a minimum of two AOCs or one open-lake site."[1]

4.4 NEXT STEPS

In addition to chemical reduction projects that LaMP Chemical Committee members will track and coordinate in their own jurisdictions, the Committee will concentrate on a variety of projects through 2010. A description of the activities that Lake Superior partners will be undertaking to reduce and inventory the nine designated zero discharge and zero emission chemicals is included in Addendum 4B.

At this point, the following projects are anticipated for the Chemical Committee:

- Implement the activities described in Addendum 4B;
- Participate in the realtor/landowner outreach project with an emphasis on preventing releases of toxic chemicals by rural landowners;
- Prepare a LaMP update in 2010; and
- Estimate inventory releases in 2010 in order to monitor progress under the Stage 2 LaMP reduction milestones.

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[1] Source: Lake Superior Stage 1 LaMP, Section 2.1, page 17.

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ADDENDUM 4A: CHAPTER 4 ACRONYMS

AGGEP	Anishinabek of the Gitchi Gami Environmental Programs
AOC	Area of Concern
APEs	alkylphenol ethoxylates
AREA	Arrowhead Regional Emissions Abatement
BAC	benzalkonium chloride
BCCs	bioaccumulative chemicals of concern
BHC	benzene hexachloride
BMPs	Best Management Practices
BTS	Great Lakes Binational Toxics Strategy
BUI	Beneficial Use Impairment
CAD	Contained Aquatic Disposal
CEC	Commission for Environmental Cooperation
CEPA	Canadian Environmental Protection Act
CFLs	compact fluorescent lamps
COA	Canada-Ontario Agreement Respecting the Great Lakes System
CWS	Canada-wide Standards
DDT	dichlorodiphenyltrichloroethane
DEET	N,N-diethyltoluamide
DW	dry weight
EC	Environment Canada
e-waste	electronic waste
FCM	Federation of Canadian Municipalities
FS	Feasibility Study
FWFN	Fort William First Nation
GHG	greenhouse gas
GLEI	Great Lakes Environmental Indicator
GLI	Great Lakes Water Quality Initiative
GLIFWC	Great Lakes Indian Fish and Wildlife Commission
GLNPO	Great Lakes National Program Office
GLWQA	Great Lakes Water Quality Agreement
HC	Health Canada
HCB	hexachlorobenzene
HPBA	Hearth, Patio, and Barbeque Association
HPV	High Production Volume
HTAC	Harbor Technical Advisory Committee
IADN	Integrated Atmospheric Deposition Network
IISG	Illinois-Indiana Sea Grant
IJC	International Joint Commission
KBIC	Keweenaw Bay Indian Community
LaMP	Lakewide Management Plan
LEAF	Learning, Experience and Activities in Forestry
LEED	Leadership in Energy and Environmental Design
LSBP	Lake Superior Binational Program
MACT	Maximum Achievable Control Technology
MDEQ	Michigan Department of Environmental Quality
MHSW	municipal hazardous or special wastes class
MI	Michigan
MN	Minnesota
MOE	Ontario Ministry of Environment
MP	Minnesota Power
MPCA	Minnesota Pollution Control Agency
MPI	Marathon Pulp Inc.
MUCC	Michigan United Conservation Clubs
MW	megawatt
NOx	nitrogen oxides
NPS	National Park Service
NSPW	Northern States Power of Wisconsin
NVMSRP	National Vehicle Mercury Switch Recovery Program
NWRPC	Northwest Regional Planning Commission
OCS	octachlorostyrene
ON	Ontario
OWBs	Outdoor Wood-fired Boilers
PAH	polycyclic aromatic hydrocarbon
PBBs	polybrominated biphenyls
PBDE	polybrominated diphenyl ether
PBT	Persistent Bioaccumulative Toxic chemical
PCBs	polychlorinated biphenyls
PCP	pentachlorophenol

PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonate
POWTS	Private On-site Wastewater Treatment Systems
PPCPs	pharmaceuticals and personal care products
PWQOs	Provincial Water Quality Objectives
SCCP	short chain chlorinated paraffins
SETAC	Society of Environmental Toxicology and Chemistry
SOLEC	State of the Lakes Ecosystem Conference
TBBPA	tetrabromobisphenol A
TCDD	tetrachlorodibenzodioxin
TEQ	toxicity equivalent

TMDL	Total Maximum Daily Load
TRC	Thermostat Recycling Corporation
TSCA	Toxic Substances Control Act
USDA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency
USS	U.S. Steel
WDNR	Wisconsin Department of Natural Resources
WDO	Waste Diversion Ontario
WI	Wisconsin
ZDDP	Zero Discharge Demonstration Program

ADDENDUM 4B: LAKE SUPERIOR ZERO DISCHARGE DEMONSTRATION PROGRAM AND CRITICAL CHEMICAL REDUCTION MILESTONES

LAKE SUPERIOR BINATIONAL PROGRAM

Contents

Photo: Matt Hudson, Great Lakes Indian Fish and Wildlife Commission.

What is the Lake Superior Zero Discharge Demonstration Program?

The goal of the Zero Discharge Demonstration Program (ZDDP) is to achieve zero release of certain designated persistent bioaccumulative toxic substances in the Lake Superior basin. In 1990, the International Joint Commission challenged the governments of Canada and the United States to develop a program to virtually eliminate a group of "The Nine" persistent, bioaccumulative and toxic pollutants. The governments responded to this challenge by creating the Lake Superior "Binational Program to Restore and Protect the Lake Superior Basin." This program guides the Zero Discharge Demonstration Program (ZDDP) targeted at The Nine pollutants. The Lake Superior Binational Program is administered by federal, provincial, state and tribal agencies through the Superior Work Group and Task Force with the assistance of a public involvement and outreach group known as the Lake Superior Binational Forum. The Lake Superior Lakewide Management Plan (LaMP) was developed by the Lake Superior Binational Program as a management strategy for Lake Superior and currently guides the implementation of the ZDDP.

The Nine pollutants are mercury, PCBs, dioxin, hexachlorobenzene, octachlorostyrene and 4 pesticides - dieldrin, chlordane, DDT and toxaphene. The ZDDP targets only Lake Superior basin sources of The Nine. While out-of-basin sources may contribute significantly to the presence of these substances in the lake, these are beyond the ability of the Lake Superior Binational Program to directly influence. These out of basin sources make it difficult to be sure of the effect of local toxic reductions on environmental concentrations in Lake Superior. Despite this, the ZDDP is an important step in taking local action to "clean up our own backyard" with respect to The Nine and other pollutants of concern. As its name implies, the ZDDP is also a model that demonstrates the progress and benefits of multi-sector cooperation to address a global problem.

LAKE SUPERIOR LaMP ZERO DISCHARGE DEMONSTRATION PROGRAM

In 1999, the Lake Superior Binational Program mapped out a two-decade release reduction plan for The Nine pollutants. The plan identified targets for staged reductions of these pollutants, with 1990 as the baseline year and 2020 as the year where virtual elimination will be achieved. Table 1 shows the reduction schedules and targets set out in the release reduction plan.

Table 1 - Summary of Release Reduction Targets for Lake Superior ZDDP

	Summary of Release Reduction Targets for Lake Superior ZDDP				
Pollutant	2000	2005	2010	2015	2020
Mercury	60%		80%		100%
PCBs	33%	60%	95%		100%
Pesticides[2]	100%				
Dioxin[1], HCB, OCS		80%		90%	100%

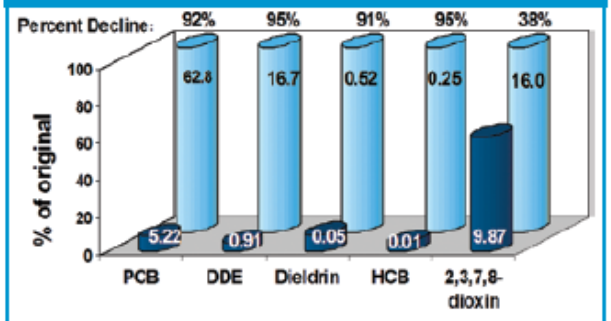
[1] The Binational Program lists 2,3,7,8-TCDD (dioxin) for the Zero Discharge Demonstration Program. By convention, dioxin is measured and reported as toxic equivalents (TEQ).

[2] The 4 pesticides included in the ZDDP are Dieldrin, Chlordane, DDT and Toxaphene.

Fate of The Nine Pollutants in the Lake Superior Ecosystem

In general, the presence of The Nine pollutants has declined in the Lake Superior ecosystem over the past 30 years. Figure 1 shows an example of this decline, using concentrations of several chlorinated substances found in Lake Superior herring gull eggs over the time period that the Canadian Wildlife Service has been measuring them regularly. However, the rate of environmental decline of these pollutants has slowed in recent years. In addition, The Nine continue to impair lake use locally and lake-wide in the form of fish consumption advisories and loss of fish and wildlife habitat, among others. For example, PCBs, mercury, dioxin and some pesticides remain above levels that limit consumption of fish from Lake Superior. Figure 2 shows total mercury and total PCB concentrations in fillet tissue compared to fish length for some species of Lake Superior fish.

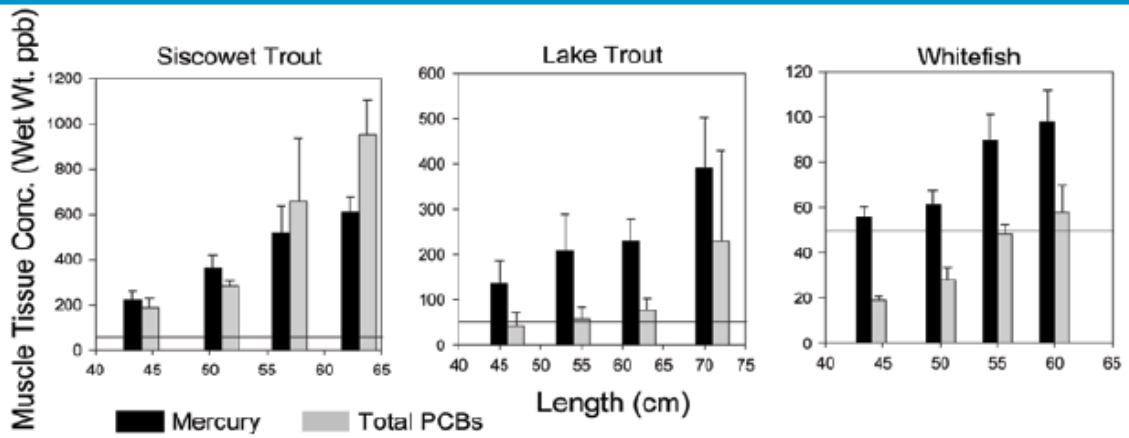
Figure 1 - Percent Decline in Mean Concentrations of a Set of Chlorinated PBT Chemicals in Herring Gull Eggs Collected from Two Sites on Lake Superior Between 1974 or 1984 and 2004.*



Source: Weseloh and Havelka, Environment Canada.

*Dioxin monitoring began in 1984 and all other listed contaminants have been monitored since 1974. Dioxin concentrations are reported in parts per trillion (pg/g) and all other pollutants are reported in parts per million (µg/g).

Figure 2 - Total Mercury and Total PCB Concentrations in Fillet Tissue of Lake Superior Siscowet Trout (*Salvelinus namaycush siscowet*), Lake Trout (*Salvelinus namaycush namaycush*), and Whitefish (*Coregonus clupeaformis*).**



Source: Great Lakes Indian Fish and Wildlife Commission 1999-2005, unpublished data.

**Lines represent the most restrictive fish tissue concentrations (50 ppb) for total mercury and PCBs currently used by one or more jurisdictions around Lake Superior to trigger fish consumption advice and limits on the consumption of fish.

ZERO DISCHARGE AT WORK

Tracking the Release of The Nine Pollutants

In the Lake Superior basin, the year 2005 marked the midpoint between the ZDDP baseline year of 1990 and the 2020 goal for virtual elimination of The Nine pollutants. The 2005 Chemical Reduction Milestones Report details the release reduction successes achieved since 1990 and identifies the challenges that lie ahead for reaching the next reduction target in 2010. The successes are the result of collaboration and commitment by the wide range of stakeholders including business and industry, non-governmental organizations, and municipal, state, tribal, First Nation, provincial and federal agencies actively engaged in the Lake Superior Binational Program. The importance of the involvement of the citizens of the Lake Superior basin cannot be overstated.

A seed disinfectant containing mercury. Credit Minnesota Department of Agriculture

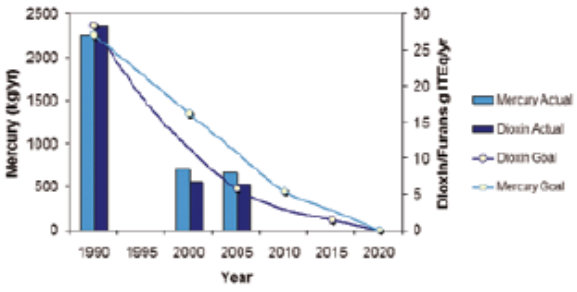
LAKE SUPERIOR LaMP ZERO DISCHARGE DEMONSTRATION PROGRAM

In 2005, emission inventories for The Nine pollutants were updated for both the United States and Canadian portions of the Lake Superior basin. These inventories allow the Lake Superior Binational Program to calculate the change in release of The Nine pollutants since 1990. Figure 3 shows actual release along with the release reduction targets for mercury and dioxin in the Lake Superior basin over the timeframe of the program.

Notable achievements include:

- 71% reduction in mercury releases basin-wide;
- 76-79% reduction in dioxin releases basin-wide;
- Significant reductions of PCB materials basin-wide;
- The ongoing collection and safe disposal of waste pesticides around the basin, with more than 12,700 kg (28,000 pounds) collected between 1992 and 2004 in Minnesota and Wisconsin alone.

Figure 3 - Actual release and release reduction targets for mercury and dioxin in Lake Superior Basin from 1990 to 2020



Top 12 Ways You Can Protect Lake Superior Everyday

- Create an energy efficient home.
- Install water saving devices.
- Never burn garbage.
- Try to reduce, reuse, recycle and repair.
- Take household hazardous materials to hazardous waste collections.
- Never pour oil or other used liquids into a storm drain.
- Put your lawn on a chemical-free diet.
- Inspect your boat and trailer and remove any plants and animals before leaving a boat access.
- Landscape with plants that are native to the region.
- Plant trees to capture carbon dioxide and prevent erosion.
- Use a rain barrel for gardening and washing the car.
- And most importantly, love Lake Superior!

A Lake Superior tributary. Credit: Ron Leonetti.

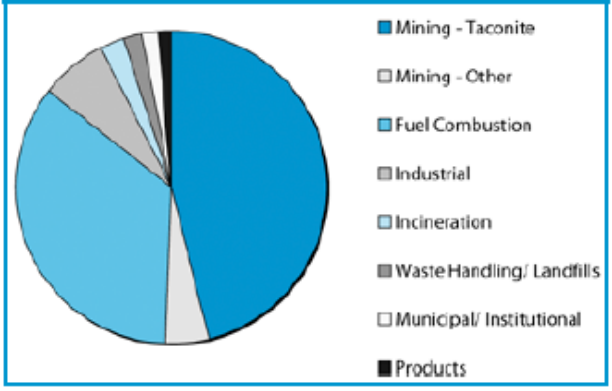
ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestone for Mercury

In a year 2000 report it was estimated that mercury discharges and emissions declined 69% in the Lake Superior basin between 1990 and 2000. By 2005, the total reduction since 1990 had increased to 71%. The greatest reduction as a result of the ZDDP was a 96% reduction in the release of mercury from products. The largest overall reductions have been due to the closures of the White Pine copper smelter in Michigan and the Algoma sintering plant in Wawa, Ontario, which were not related to the ZDDP.

In order to meet the next mercury reduction milestone of 80% by 2010, 2005 loads must be reduced by an additional 200-207 kg/yr. While emissions continued to decline between 2000 and 2005, the rate of decline appears to have slowed (see Figure 3). The largest remaining sectors for mercury emissions are mining and fuel combustion, which together account for greater than 85% of the mercury emissions within the basin. Figure 4 shows the main sources of mercury in 2005. Currently, taconite mines in the Minnesota portion of the basin are the largest single sector for mercury emissions.

Figure 4 - Relative contribution of Mercury Releases from Different Sectors in the Lake Superior Basin, 2005.



Above: Jamie Harvey uses a Lumex unit to test for mercury at an industrial site. Credit: D. Hansen, Minnesota Pollution Control Agency.

Below: Stream fishing in the fall. Mercury levels in certain fish caught in the Lake Superior basin remain high enough to cause fish consumption restrictions. Credit: Michigan Travel Bureau.

LAKE SUPERIOR LaMP ZERO DISCHARGE DEMONSTRATION PROGRAM

ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestones for Dioxin, Hexachlorobenzene and Octachlorostyrene

Dioxin

Release of dioxin is estimated to have declined 75-78% between the ZDDP baseline year of 1990 and year 2000. However, the bulk of these reductions were due to the closure of the Algoma sintering plant, an event which was not related to the ZDDP. Little change, if any, has occurred in dioxin releases since 2000, with current estimates of total release reduction since 1990 at 76-79%. Currently residential open burning of garbage is the largest source of dioxin on both sides of the border. Fuel combustion is the second largest source of in-basin dioxin. Projected trends for dioxin emission from 2005-2010 are unknown due to changing control technology at coal-fired utilities and demand for electricity. Figure 5 shows the contribution of various sectors to dioxin release.

In order to meet the 90% reduction goal by 2015, an additional 4.32 to 4.46 g I-TEQ/yr of dioxin must be reduced from the 2005 load; this can be seen in Figure 3 above. Open burning is a completely preventable source of dioxin, and if all other sources remain unchanged, elimination of open burning by 2015 would achieve the 90% reduction goal.

Hexachlorobenzene

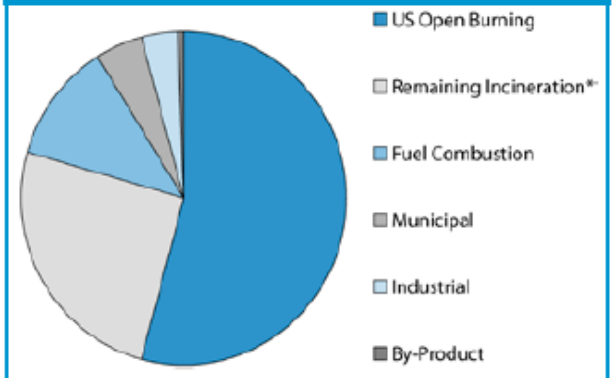
Completion of the hexachlorobenzene (HCB) inventory has been challenging. Utility poles and in-use railway ties treated with PCP, were the largest identified HCB sources on the Canadian side, this was followed by residential wood combustion. On the US side, the largest sources were open burning of trash, followed by motor vehicles. Since 1990, the pulp and paper industry has been responsible for significant reductions in release of HCB (about 32% of the total) because of their conversion of the bleaching process to chlorine dioxide in place of elemental chlorine.

Billboard near Floodwood, MN discourages people from burning garbage, the largest source of dioxin in the Lake Superior basin. Credit: Mary McReynolds, St. Louis County Solid Waste Department.

Octachlorostyrene

Environmental monitoring data in the Great Lakes have shown a decline in levels of octachlorostyrene (OCS) and no large source of OCS is believed to exist within the Lake Superior basin. However, since OCS may form under similar conditions as dioxin and HCB, LSBP may get better information about the release of OCS in the basin by improving the basin inventories for dioxin and HCB.

Figure 5 - Contribution of Dioxin Releases from Different Sectors in the Lake Superior Basin, 2005.



*Remaining Incineration includes Canadian open burning, Canadian landfill fires and U.S. small incinerators.

ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestones for PCBs

Tracking PCB reductions over time has not been possible because data on in-use PCBs in the Lake Superior basin are not available or difficult to access. As an alternative, the LSBP has proposed to track PCB disposal and storage via the Ontario database for PCB storage, the Environment Canada database for PCB disposal and the Minnesota hazardous waste database for PCB disposal. To date the resources have not been available to assess the Wisconsin and Michigan PCB disposal records from facilities in the Lakes Superior Basin in the same way. Storage, disposal, and/or destruction of PCB capacitors, transformers and oil will be analyzed every 5 years for trends and cumulative progress.

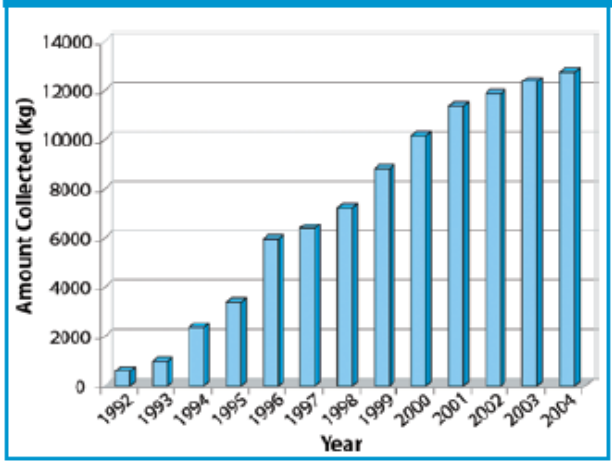
A PCB transformer. Photo Credit: Scott Bohling, Minnesota Pollution Control Agency.

ZERO DISCHARGE POLLUTANTS

2005 Reduction Milestones for Pesticides: Dieldrin, Chlordane, DDT and Toxaphene

Although the Lake Superior basin is mostly non-agricultural, a significant amount of banned pesticides have been collected in or near the basin since 1992. Although the initial reduction goal was to collect all remaining stores of these pesticides by 2000, it is obvious that these pesticides are still present in the basin and that collections need to continue, even in non-agricultural areas. Figure 6 shows the amounts of pesticides of interest (i.e. those targeted by the ZDDP and those that may be contaminated by dioxin) that have been collected in Minnesota and Wisconsin counties in the Lake Superior basin.

Figure 6 - Cumulative Amount of Pesticides Collected in Minnesota and Wisconsin Counties in the Lake Superior Basin, 1992-2004 (kg).



LAKE SUPERIOR LaMP ZERO DISCHARGE DEMONSTRATION PROGRAM

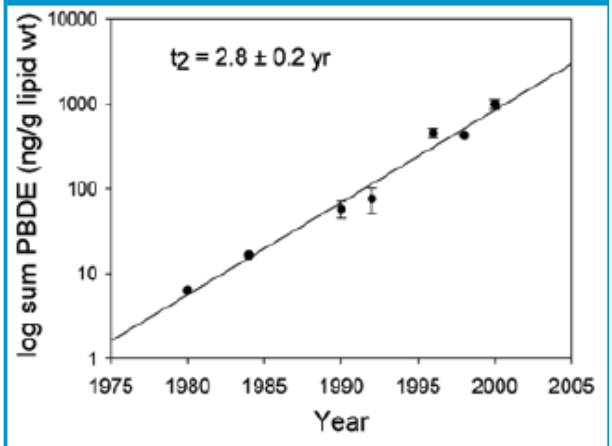
The Future of the Lake Superior Zero Discharge Demonstration Program

Identified challenges include improving our ability to accurately quantify inventories of The Nine pollutants, such as PCBs, and banned pesticides. Chapter 5 of the full report presents a range of comprehensive strategies to encourage progress towards ZDDP targets. Current trends, particularly increasing mining operations and energy use within the basin, provide a challenge for all partners in the Lake Superior Binational Program to meet the next set of reduction targets.

Recent discoveries of chemicals of emerging concern in the Lake Superior ecosystem also pose a new challenge for the ZDDP. Chemicals of emerging concern include many substances that have common, everyday uses and are being detected in water, fish, and sediments. The potential ecosystem impacts of these chemicals are largely unknown. Polybrominated diphenyl ethers (PBDEs) are one example group of chemicals of emerging concern that has been increasing in Lake Superior lake trout (Figure 5). PBDEs are commonly used as flame retardants in products such as furniture and computers. Other groups of chemicals of emerging concern include pharmaceuticals, personal care products and household pesticides. As a first step in addressing these chemicals, a watch-list has been proposed for those that have been detected in Lake Superior and are under evaluation for potential persistent, bioaccumulative and/or toxic effects. As more becomes known, management strategies will be developed by the Lake Superior Binational Program. In the meantime, the Binational Program will encourage monitoring and pollution prevention of these chemicals.

Although significant pollutant reductions have been made over the past 15 years, predicted future increases in industrial activity, energy demand and increased human population may result in corresponding increases in the release of toxic pollutants in the basin. Since pollution prevention is more cost-effective than degradation followed by restoration, it is preferable to limit the release of toxic pollutants to Lake Superior. Recognizing the evolving nature of the interactions between persistent toxic chemicals and the ecosystem, the Lake Superior Binational Program remains committed to achieving the goals of the ZDDP as part of the larger goal to restore and maintain the health of the Lake Superior basin ecosystem.

Figure 7: Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Whole Lake Trout from Lake Superior, 1980-2000. Source: Zhu and Hites 2004.



For More Information:

For more information about the Zero Discharge Demonstration Program, please view the Lake Superior Binational Program website at www.binational.net. As the Program has many partners, additional reports and documents relevant to the Program may be found on Partner Agency Sites. Links to those sites can also be found on binational.net or contact:

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ADDENDUM 4C: CHEMICAL REDUCTION AND INVENTORY ACTIVITIES FOR 2010 LAKE SUPERIOR MILESTONE

ID	Jurisdiction	Chemical (primary)	Chemical (secondary)	Action	R/I[1]	2005 Load of Primary Chemical[2]	2005 % of Primary Chemical[3]
Overall Reductions							
1	All	Mercury		Develop policy or regulation that caps mercury emissions so that new or expanded sources would be allowed only if overall emissions did not increase.	R	653	100%
	MI	The Michigan Department of Environmental Quality (MDEQ) has released a comprehensive strategy to eliminate the use and release of mercury to Michigan's environment. The MDEQ's Mercury Strategy Staff Report contains specific recommendations and a comprehensive approach to controlling mercury, including environmental monitoring, inventory development, collaborations and partnerships, information and outreach, and regulatory controls. It also provides an overview of the mercury problem, identifies current sources that contribute to mercury releases, and identifies various methods for reducing and eliminating the sources. It also outlines Michigan's rules, regulations, policies, and monitoring activities for mercury, and chronicles various actions undertaken thus far to prevent the use and release of mercury.						
	MN	The Minnesota statewide mercury Total Maximum Daily Load (TMDL) is the best program for attempting to implement this action. The TMDL calls for a 93% reduction of mercury emissions from all Minnesota sources. The Minnesota LaMP program will seek opportunities for information sharing and input into the TMDL implementation process. The implementation phase is currently being scoped out by a stakeholder group: www.mn-ei.org/policy/hgtmdlindex.html.					
	WI	The Wisconsin Department of Natural Resources (WDNR) is proposing revisions to the state's air mercury rule in response to three separate but related actions. They include promulgation of the federal Clean Air Mercury Rule (CAMR) in May 2005, a directive from Governor Doyle in August 2006 to further reduce mercury emissions, and a January 2007 Citizens' Petition requesting revision to Chapter NR 446 (state mercury rule).					
	ON	Ontario continues to follow the *Canada Wide Standard for Mercury Emissions from Coal Fired Generating Stations,* which commits the province to reducing mercury emissions from coal-fired generating stations by 60% nationally by 2010. On August 27, 2007, Ontario implemented *Regulation 496/07* that requires cessation of coal use at the remaining four coal-fired plants, including Thunder Bay, by 2014.					
2	All	Pesticides		Encourage, support, assist, and provide funding for collections.	R	unknown	100%
	EC	EC has funded Household Hazardous Waste collections in the Lake Superior basin. These collections have yielded a quantity of pesticides. EC will continue to work with its partners and pursue funding opportunities in the future.					
	US EPA	The U.S. Environmental Protection Agency (US EPA) will consult with states on pesticides collections; will continue to provide outreach/education on both legacy and current use pesticides. Will continue to support workshops and trainings to educate public, municipalities, schools, and park districts on reducing use of and alternatives to pesticides.					
	MI	The MDEQ will consult with the MI Department of Agriculture on pesticide collections.					

ID	Jurisdiction	Chemical (primary)	Chemical (secondary)	Action	R/I[1]	2005 Load of Primary Chemical[2]	2005 % of Primary Chemical[3]
	MN	The Minnesota Pollution Control Agency (MPCA) will consult with Minnesota Department of Agriculture, counties, and Western Lake Superior Sanitary District (WLSSD) on how they are doing under the new waste pesticide funding regime.					
	WI	Support mercury/toxics/pesticides/e-waste/clean sweeps. Support efforts that make hazardous waste collections more affordable in rural areas such as Northwest Wisconsin Regional Planning Commission's mobile clean sweep program for households, farmers, and small businesses.					
	ON	Ontario has provided financial support for EcoSuperior to undertake a collection and education program in Canadian Lake Superior basin communities. Some communities have gone on to carry out subsequent collections, at their own expense. Ontario will introduce draft legislation to ban the cosmetic use of pesticides in urban areas in the spring of 2008.					
3	All	PCBs		Encourage, support, assist, and provide incentives for phase-out.	R		100%
	EC	EC has proposed revisions to the existing *Chlorobiphenyl Regulations* and the *Storage of PCB Material Regulations of the Canadian Environmental Protection Act 1999* (CEPA 1999) that would set specific dates for the complete destruction of all PCBs in service and in storage.					
	US EPA	US EPA encourages, supports, assists, and provides incentives for PCB phase-out where possible. Will work with MN, WI, and MI as well as the BTS program, to explore state PCB utility reductions.					
	MI	MDEQ encourages, supports, assists, and provides incentives for PCB phase-out where possible.					
	MN	The LaMP program will work with Toxic Substances Control Act (TSCA) staff to follow-up on progress on Minnesota Power's 1994 phase-down plan. We are especially interested in an update on PCB equipment at the Arrowhead Terminal.					
	WI	Through the Green Tier program, WDNR collaborates with businesses to ensure proper management and phase-out of PCBs by providing technical assistance with PCB management and phase-out.					
4	All	All		Work with other programs to improve LaMP inventory	I		100%
	EC	EC will continue to work with our partners to improve the LaMP inventory.					
	US EPA	Will work through the LaMP chemical committee to provide support on updated emission factors as needed.					
	MI	MDEQ works with other programs and agencies to improve the LaMP inventory.					
	MN	This action is already incorporated in the LaMP coordinator's workplan. Work will include seeking updated emission factors and throughputs as well as compiling hazardous waste and pesticide collection data.					
	WI	This action is already incorporated in the LaMP coordinator's workplan. Work will include seeking updated emission factors and throughputs as well as compiling hazardous waste and pesticide data.					
5	All	Dioxin	Mercury	Encourage, support, assist, and provide funding for open burning abatement programs.	R	4.2	65%
	EC	EC will continue to support public education on open burning education and work with its partners to support open burning abatement programs.					
	US EPA	US EPA will continue to support open burning abatement actions, programs, and projects, in coordination with the BTS and Sea Grant outreach. Such support may include staff, technical, and financial resources.					

ID	Jurisdiction	Chemical (primary)	Chemical (secondary)	Action	R/I[1]	2005 Load of Primary Chemical[2]	2005 % of Primary Chemical[3]
	MI	In Michigan, the practice of open burning may be regulated at both the state and local level. At the state level, open burning is regulated under Parts 55, 115, and 515 of the *Natural Resources and Environmental Protection Act, Public Act 451 of 1994*, as amended, and associated administrative rules. There are two state agencies responsible for administering these open burning regulations: MDEQ and Michigan Department of Natural Resources; however, these regulations may be enforced by local units of government. The MDEQ has also developed a document for local officials which is a "Model Open and Outdoor Burning Ordinance." This publication is designed to help local officials craft their own burning ordinance. The ordinance provides options to be more restrictive than the state regulations if they choose. Another outreach tool MDEQ has developed is a burn barrel display. MDEQ has also developed instructions for making a display.					
	MN	The MPCA will use a federal grant extension to carry out an outreach project that involves radio spots, magazine advertising, and written materials. The open burning abatement message is also included in the landowner-realtor outreach project that the MPCA is seeking funding to implement.					
	WI	Support programs for burn barrel reduction, one of the most preventable sources of dioxin and other PBT release to the atmosphere. WDNR will look to expand its education partner base through the involvement of WDNR's forestry concern over burn barrels as a cause of forest fires. WDNR will continue to investigate burn barrel outreach projects through partners such as the Waste Management Program. The WDNR will also encourage adoption of burn barrel ordinances by local units of government.					
	U.S. Tribes	Lake Superior Tribes will continue to conduct open burning outreach, education, and abatement programs, along with continuing household hazardous waste and other collections to provide alternatives to open burning of garbage.					
6	All	Dioxin		Work on common backyard burning inventory method.	I	4.2	65%
	EC	EC will continue to support and work with its partners to improve the backyard burning inventory, including working toward a common method.					
	US EPA	US EPA will work with MPCA and EC staff to clarify the original methods and work toward a common method.					
	MI	Assist LaMP partners is finding a common method.					
	MN	Per Minnesota's commitment to Action 4, the LaMP coordinator will work with MPCA, US EPA, and EC staff to clarify the original methods and work toward a common method.					
	WI	Wisconsin will continue to work with the Binational Program toward a common method.					
7	All	Mercury	Dioxin	Encourage, support, assist, and provide funding for energy conservation programs.	R	229	35%
	EC	EC will ensure that existing federal programs (such as Natural Resource Canada's ecoENERGY Efficiency Initiative and the ecoENERGY Retrofit program) are promoted through existing communications channels. Environment Canada will also work with its partners to support other energy conservation programs.					
	US EPA	US EPA Region 5 recently released a climate change framework that calls for energy conservation, reduction, and outreach on alternatives. US EPA will work with states, businesses, and municipalities to help reduce energy usage to mitigate the effects of climate change. US EPA has recently provided support to MPCA and the Will Steger Foundation to pursue climate change mitigation/greenhouse gas reductions and will partner with them to implement on-the-ground actions.					

ID	Jurisdiction	Chemical (primary)	Chemical (secondary)	Action	R/I[1]	2005 Load of Primary Chemical[2]	2005 % of Primary Chemical[3]
	MI	The MDEQ has partnered with the Department of Labor and Economic Growth Energy Office, Michigan Public Services Commission and Department of Transportation to identify various energy efficiency and energy conservation programs and resources available to the public, private business, and municipal government.					
	MN	Minnesota recently passed laws that set goals for renewable energy and energy conservation as part of the state's contribution towards reducing the impact of climate change. It is likely that mercury reduction co-benefits will result. The LaMP program will seek opportunities to pilot projects in the Lake Superior watershed. In addition, Minnesota's Governor Tim Pawlenty is the 2008 chair of the National Governors Association and plans to focus the organization on clean energy.					
	WI	In November 2007, Governor Jim Doyle signed the historic Midwest Governors Association Energy Security and Climate Stewardship Platform and the Midwestern Greenhouse Gas Accord to work on a regional strategy to achieve energy security and reduce greenhouse gas emissions. Governor Doyle and Governor Pawlenty [Minnesota] met in early January to discuss the next steps that Minnesota and Wisconsin will take to make the Midwest a renewable energy leader. Governor Doyle has proposed a Governor's Office of Energy Independence and proposed $40 million in his budget for renewable energy like solar, wind, hydrogen, biodiesel, and ethanol.					
	U.S. Tribes	Lake Superior Tribes will continue to actively pursue alternative energy sources and seek to maximize energy efficiency.					
	ON	Ontario, through the Ontario Power Authority, will continue the Every Kilowatt Counts initiative. Consumer incentives are available for purchasing energy efficient appliances, cycling down air conditioners during periods of high demand, and free pick up and disposal of old refrigerators. Commercial and industrial users are eligible for the Electricity Retrofit Incentive Program and the Load Management Program.					
8	All	Mercury		Encourage, support, assist, and provide funding for collections and product alternatives.	R	45.3	7%
	EC	EC will continue to work with its partners to support Household Hazardous Waste collections.					
	US EPA	US EPA is provided financial support to cities, non-profit groups, and other entities for continued hazardous and e-waste collections as well as unwanted medicine collections.					
	MI	See Michigan's Solid Waste Policy, action #13					
	MN	While messages about mercury products are included in the realtor/landowner outreach project that the MPCA is seeking funding to implement, the agency will not actively seek projects specifically for the basin since products are a relatively small portion of the inventory, and infrastructure and outreach in the basin are already well established.					
	WI	Adopt the Great Lakes Regional Collaboration's *Mercury in Products Phase Down Strategy* as Wisconsin's guideline for reducing mercury in products. Continue to work with the City of Superior mercury reduction initiatives. Continue to support and seek ways to expand mercury initiatives to other communities in the basin.					
Fuel Combustion							
9	MI	Mercury		Support Wisconsin Energy's Presque Isle mercury control technology.	R	45.7	7%
		Michigan supports reduction of mercury emissions from coal-fired powered plants.					

ID	Jurisdiction	Chemical (primary)	Chemical (secondary)	Action	R/I[1]	2005 Load of Primary Chemical[2]	2005 % of Primary Chemical[3]
10	ON	Mercury		Support efforts to explore viability of a low mercury emissions process at the Thunder Bay Generating Station; encourage public education and informed discussion.	R	37	6%
11	MN	Mercury		Support Minnesota Power's Taconite Harbor mercury control technology.	R	31.9	5%
		The MPCA will approach Minnesota Power and MDEQ to participate in an informal group to examine mercury cycling at the two facilities in the Lake Superior basin that have mercury control technology or are installing it (i.e., the Presque Isle coal-fired power plant in Marquette and Minnesota Power's Taconite Harbor facility).					
Trash Burning							
12	MN	Dioxin	Mercury	Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.	R	1.76	27%
		Solid waste infrastructure in the northeastern Minnesota is already fairly well established, but the MPCA will seek opportunities for improvement through the Northeast Waste Advisory Council (NEWAC) and the Solid Waste Officers of the Northeast Region (SWONERs).					
13	MI	Dioxin	Mercury	Encourage, support, assist, and provide funding for solid waste infrastructure in rural areas.	R	1.59	25%
		The MDEQ released a stakeholder-driven update to the Michigan Solid Waste Policy in 2007. The Policy provides a framework to guide Michigan citizens, businesses, government agencies, institutions, universities, and political leaders in making smart choices for managing Michigan's solid wastes by viewing it as a resource in a global economy. The Policy uses the three principles of sustainability: economic vitality, ecological integrity, and improved quality of life to guide solid waste management decisions.					
14	WI	Dioxin	Mercury	Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.	R	0.59	9%
15	All U.S.	Dioxin	Mercury	Work with US EPA to improve estimate of emissions from landfill fires.	I	unknown	unknown
	US EPA	US EPA will continue to work with experts on landfill emission factors and throughput measurements. We will continue to seek information on wildfire emissions. We will support states' efforts in this endeavor.					
	MI	MDEQ will work with partners to estimate emissions from landfill fires where appropriate.					
	MN	Per Minnesota's commitment to Action 4, the MPCA will work with experts on landfill emission factors and throughput measurements. We will also seek additional information on wildfire emissions.					
	WI	WDNR will cooperate with MPCA and US EPA experts on landfill emission factors and throughput measurements.					
16	ON	Dioxin	Mercury	Encourage, support, assist, and provide funding for solid waste infrastructure in rural areas	R	0.21	3%

ID	Jurisdiction	Chemical (primary)	Chemical (secondary)	Action	R/I[1]	2005 Load of Primary Chemical[2]	2005 % of Primary Chemical[3]
		Ontario continues to improve collection of Municipal Household and Special Wastes (MHSW). A plan has been developed by Waste Diversion Ontario and submitted to the Minister of the Environment that would improve access to hazardous waste collection. Under this program the costs of recovering and disposing of MHSW will be borne by industry. Wastes such as paints, solvents, oil filters and containers, single-use batteries, antifreeze, pressurized containers, fertilizers, and pesticides will be included in the program. Early objectives will be to increase the number of collection events and to expand collections to areas without existing service.					
17	ON	Dioxin	Mercury	Work with landfill owners and operators to decrease landfill fires.	R	0.05	1%
Mining							
18	MN	Mercury		Incorporate reductions in mercury from taconite into statewide mercury TMDL that are also part of the LaMP inventory.	R	303	46%
		Given the size of this source in the mercury inventory, the Minnesota LaMP program will seek opportunities for LaMP reductions through other agency programs. The best fit will be the mercury TMDL as mentioned in Item 1. The 93% statewide TMDL reduction cannot be met without reductions from the mining sector.					
19	US EPA	Mercury		Evaluate mercury as part of taconite residual risk	I	303	46%
		US EPA will continue to pursue this through the BTS.					
20	MI & WI	Mercury		Develop estimate of mercury that would be released from proposed mine projects	I	unknown	unknown
	MI	MDEQ will work with other programs and agencies to estimate mercury releases from proposed mine projects.					
	WI	Currently no mining is proposed in Wisconsin; however, there is speculation of mining interests. In the event of a mining proposal, the state will promote the reformation of the State Mining Team.					
Pesticide Inventory							
21	MI	Pesticides		Analyze waste pesticide collections to make consistent with rest of U.S. inventory	I	unknown	unknown
		MDEQ will work with the Michigan Department of Agriculture to analyze waste pesticides collected and will use consistent reporting where possible.					
PCB Inventory							
22	ON	PCBs		Develop cumulative tracking of inventory from 1990	I	unknown	100% of Canadian PCBs
23	EC	PCBs		Assist Ontario with cumulative tracking	I	unknown	100% of Canadian PCBs

ID	Jurisdiction	Chemical (primary)	Chemical (secondary)	Action	R/I[1]	2005 Load of Primary Chemical[2]	2005 % of Primary Chemical[3]
24	MN	PCBs		Develop cumulative tracking of inventory from 1990	I	unknown	unknown
		Because of state TSCA delegation, the MPCA has direct access to records, but computerized records only go back to 1998. LaMP staff will work with the hazardous waste database staff to see if a student worker can compile 1990 to 1997 PCB records. The agency will work with Ontario, EC, and US EPA to keep methods as consistent as possible.					
25	WI	PCBs		Report to extent possible on PCBs disposed since 1990	I	unknown	unknown
26	MI	PCBs		Report to extent possible on PCBs disposed since 1990	I	unknown	unknown
		Report to extent possible on PCBs disposed since 1990					
27	US EPA	PCBs		Assist WI and MI with cumulative tracking	I	unknown	100% of U.S. PCBs
		US EPA will continue to support WI and MI with cumulative tracking of PCB disposal to the extent possible.					

[1] R = Reduction or I = Inventory.
[2] The estimated load from the 2005 milestones inventory that can be associated with the action is reported as kg/yr except for dioxin, which is g I-TEQ/yr.
[3] The fraction of the 2005 milestones inventory estimated load that can be associated with the action is reported as percent. For example, in Action 9, 45.7 kg/yr is associated with the Presque Isle coal-fired power plant, and this is 7% of the 2005 milestone inventory. Some actions can be associated with 100% of the inventory.

Chapter 5

Human Health Information

Children at the beach.
Photo Credit: Elizabeth LaPlante, US EPA.

Lake Superior Lakewide Management Plan 2008

Chapter 5 Contents

Chapter 5
Human Health Information

5.0 INTRODUCTION

The Lake Superior Lakewide Management Plan (LaMP) seeks to restore and protect the beneficial uses of Lake Superior, including safe beaches, clean drinking water, and healthy fish and wildlife populations. Awareness of the underlying causes of these beneficial use restrictions from chemical and microbial contaminants and the associated health consequences will allow public health agencies to develop societal responses protective of public health.

These beneficial uses include "Swimmability," "Fishability," and "Drinkability." Swimmability means that all beaches are open and available for public swimming. Fishability means that all fish are safe for human consumption. Drinkability means that treated drinking water is safe for human consumption.

Figure 5-1. The LaMP seeks to restore and protect the beneficial uses of the Great Lakes, such as safe beaches. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Chemical and microbial pollutants enter the human body through three major routes: ingestion (water, food, soil), inhalation (airborne), and dermal contact (skin exposure). Within the scope of the LaMP update, exposure to pollutants through water contact will be highlighted. The major areas of health concern directly related to Great Lakes water quality are pollutant exposure from ingestion of contaminated fish, incidental ingestion of water while swimming along beaches, and ingestion of contaminated water.

5.1 LAMP 2006-2008 ACCOMPLISHMENTS AND ACTIVITIES

5.1.1 Great Lakes Public Health Network

In May 2002, the Great Lakes Binational Executive Committee (BEC) endorsed a recommendation to establish a Great Lakes Human Health Network as a forum or mechanism to discuss human health issues directly related to Great Lakes water quality. The U.S. and Canada then proceeded to develop their own domestic networks, to be joined together once established,

to form the binational forum endorsed by BEC. Both countries have proceeded with different approaches based on their different institutional structures and capacities.

In Canada, Health Canada has led the development of the Canadian network. Under the *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem* (COA), Health Canada committed to undertake this work. The 2002 COA commitment 3.4.2 stated "Establish and facilitate the work for a Public Health Network in the Great Lakes Basin." The current 2007 COA commitment 3.2.a states "Support and facilitate the activities of environmental public health networks in the Great Lakes Basin."

The Canadian network, called the Great Lakes Public Health Network (GLPHN), was formally established on November 16, 2005. It took three years to establish the network, which involved working closely with the Ontario Ministry of Health and Long Term Care (not signatories of COA) to build trust and a grassroots development process for the GLPHN through the 37 Ontario Public Health Units and their respective Medical Officers of Health.

Today, the GLPHN consists of 183 voluntary representatives of governments and their agencies, including Ontario Public Health Units. The network assists in the provision of members' respective environmental health programs and facilitates participation in other related networks by:

- Exchanging high-quality, peer-reviewed human health information related to drinking water and recreational water quality, fish consumption, air quality, sediment, soil, and other ecosystem issues in the Great Lakes basin, in support of the Great Lakes Water Quality Agreement and in turn, COA;
- Identifying and documenting health issues related to chemical and biological contaminants in the ecosystem and establishing priorities of concern, and to bring these priorities back to their respective organizations and to the attention of the COA management committees;
- Communicating human health information and advice (technical, policy, or other) related to the ecosystem of the Great Lakes basin among federal and provincial governments and their agencies, and local health units, that are mandated to protect public health in the Ontario Great Lakes basin to stakeholders (including the public) through member organizations, as required; and
- Creating a forum for discussion to support the coordination of public health and environmental management decisions regarding health matters related to water, air, and soil quality in the basin ecosystem.

The GLPHN is primarily designed to facilitate information sharing of environmental health issues between federal and provincial governments and Ontario Public Health Units. Members are able to use the information in their respective organizations and relay it to the communities they serve. The network facilitates better coordination and communication among governments, researchers, health officers, and the Great Lakes community on health issues related to the ecosystem of the basin.

A Steering Committee was formed on September 22, 2005, consisting of representatives from Environment Canada, Ontario Ministry of Environment, and seven representatives from the Public Health Units around the Great Lakes. The committee is co-chaired by Health Canada and Ontario Ministry of Health and Long Term Care. Secretariat support is provided by Health Canada Safe Environments Programme B Ontario Region (SEP-ONR.). The Steering Committee approved the GLPHN Terms of Reference, which are currently under its biennial review; review considerations include such topics as broadening membership, binational re-structuring, and expanding information-sharing mechanisms. The Steering Committee meets four times a year to provide direction and set priorities for the GLPHN, the committee meets as needed to establish working groups to address specific issues or projects.

Eleven teleconferences have been held to date on topics that have included transboundary air pollution, health effects of PBDEs (flame retardants), children's health and environment, health-based air quality index, environmental and occupational causes of cancer, health risks of pesticides and best practices to reduce exposure, bluegreen algae and microtoxins, climate change, wood smoke, radon, pharmaceuticals, and mercury in fish.

Currently the GLPHN Steering Committee is considering alternative methods of information-sharing such as web site portals, listservs, and workshops. The success of the GLPHN over the last two years has been the caliber of its speakers and material packages that members receive on each teleconference topic. Medical doctors that join the call are able to earn Continuing Medical Education credits.

The approach taken by Canada in establishing the GLPHN has been to create a network that meets the environmental health information needs of the public health users. Care was taken to ensure that users of the network had a hand in creating and maintaining it, thereby valuing it. Years of establishing trust and developing a system that meets the needs of the user have resulted in a highly valued network that public health units depend on for credible and reliable environmental health information in a format that is not overbearing or inaccessible.

Health Canada is working together with US EPA to establish ways to join each country's respective networks to establish a binational network. The GLPHN has expressed strong interest in this collaboration and wants to work toward developing the Binational Network in 2008.

5.1.2 Children's Health Activities

Children are different from adults and may be more vulnerable to environmental exposures. Consider that:

- Children's neurological, immunological, digestive, and other bodily systems are still developing and are more easily harmed;
- Children eat more food, drink more fluids, and breathe more air than adults in proportion to their body mass—their food, fluids, and air therefore must be safe; and
- Children's behavior patterns—such as crawling and placing objects in their mouths—often result in greater exposure to environmental contaminants.

US EPA has forged partnerships and taken increasingly more steps to protect children's health from the variety of contaminants and pollutants that may affect them in the air they breathe, the water they drink, and the food that they eat. US EPA directs its efforts toward ensuring that children's homes and schools are healthy and safe places where they can live and learn. The goal is to ensure that state, local, and tribal governments; communities; school districts; and caregivers in the Great Lakes region understand the relationship between the environment and the health of children and will take action to improve the health of children by reducing risks and exposures to environmental hazards where they live and learn.

More information on children's environmental health can be found at www.epa.gov/children.

Toxicity and Exposure Assessment for Children's Health (TEACH)[1] contains information pertaining to scientific literature in the field of children's environmental health for 18 chemicals or chemical groups of concern to children, which may potentially impact children's health. The goal of the TEACH project is to complement existing children's health information resources by providing a listing and summary of scientific literature applicable to children's health risks due to chemical exposure.

Green Cleaning in Schools Act. Many schools and states are recognizing the vulnerabilities of children to toxic substance exposures, including those in cleaning agents, and have taken innovative steps to reduce this exposure. One such innovative program is the "Green Cleaning in Schools." Illinois and New York became the first two states in the country to require that all elementary and secondary schools purchase only environmentally-sensitive cleaning supplies. More information can be found at www.ilga.gov/legislation/publicacts/fulltext.asp?Name=095-0084 and www.healthyschoolscampaign.org/campaign/green_clean_act_2007.

Environmental Health Issues during Pregnancy Awards. US EPA recently awarded more than $500,000 in federal grant funds to educate healthcare providers and women of child-bearing age on environmental health risks. The EPA grants focus on environmental health issues that include exposure to mercury, lead, environmental tobacco smoke, chemicals, pesticides, drinking water contaminants, and indoor and outdoor air contaminants. Much peer-reviewed research has documented the relationship between a mother's environment and the health of her developing fetus. Various behaviors and experiences are associated with adverse health outcomes for both the mother and infant. These experiences can occur before, during, and after pregnancy.

An award was given to the Michigan Inter-Tribal Council, Sault St. Marie, Michigan, to deliver the message of the environmental risks of tobacco smoke, mercury, lead, and drinking water contaminants directly to Native American women of child-bearing age. The project includes two phases:

- Provide outreach and education on environmental health issues to pregnant women and healthcare providers; and
- Evaluate the effectiveness of the outreach and education to both audiences.

[1] US EPA Toxicity and Exposure Assessment for Children's Health (TEACH) web site: www.epa.gov/teach.

More information can be found at http://yosemite.epa.gov/ochp/ochpweb.nsf/content/prenatalgrants.htm.

Natural Lawn Care Workshop

Many peer-reviewed research studies have linked pesticide exposures to a variety of adverse human, aquatic, and ecosystem effects. To reduce pesticide use, exposure, and run off, the US EPA Great Lakes National Program Office (GLNPO) awarded a grant to a non-profit organization, Safer Pest Control Project, to hold a Natural Lawn Care workshop. The sold-out workshop was held in Chicago on February 20-21, 2008, and educated lawn care professionals, schools, cities, park districts, nurseries, and businesses on how to reduce reliance on lawn pesticides and chemicals. The workshop taught the fundamentals of organic and natural lawn care in addition to providing information on the possible human and ecosystem health risks of pesticides. The workshop was consistent with both the Lake Superior LaMP pollution prevention goals and the pesticides/non-point source reduction goals of the Great Lakes Regional Collaboration. A similar workshop will be held in the Lake Superior basin and will provide valuable information to cities and towns, including cities and towns in Ontario where they have banned the cosmetic use of pesticides. Information on the workshop, including access to summary materials, can be found at www.spcpweb.org/yards/.

Safer Pest Control Project Executive Director Rachel Rosenberg speaks at the Natural Lawn Care Workshop held in Chicago, February 2008. Photo credit: Mark DeMeulenaere.

5.1.3 Beaches Safe to Swim

Background. The Great Lakes Water Quality Agreement calls for recreational waters to be substantially free from bacteria, fungi, and viruses.[2] These microbial organisms of fecal origin have the potential to cause relatively mild illnesses (e.g., gastroenteritis) to more serious illnesses (e.g., hepatitis, typhoid fever) from a single exposure.

Lake Superior's myriad recreational activities do present risks for contamination to occur (i.e., swimming, water-skiing, sail-boarding, and wading). Apart from the risks of accidental injuries,

[2] International Joint Commission. 1994. Revised Great Lakes Water Quality Agreement of 1978 as Amended by Protocol Signed November 18, 1987. Reprint February 1994.

the major human health concern for Lake Superior recreational waters is microbial contamination by bacteria, viruses, and protozoa.[3,4]

To improve water quality testing at the beach and to help beach managers better inform the public when there are water quality problems, Congress passed the *Beaches Environmental Assessment and Coastal Health* (BEACH) Act in October 2000. One of the provisions of the BEACH Act authorizes US EPA to award grants to eligible states, tribes, and territories to develop and implement beach monitoring and public notification programs at coastal beaches, including the Great Lakes.

Progress on Developing and Implementing Beach Monitoring and Notification Plans. Since passage of the BEACH Act, approximately $11.7 million in BEACH grants have been issued to Great Lakes states to implement beach programs, which has resulted in a significant increase in the number of monitoring and notification programs at Great Lakes beaches. All of the Lake Superior states have beach monitoring and public notification programs in place at most of their coastal beaches and at all of their high-priority coastal beaches.

During the years 2004 to 2006, the States of Michigan, Wisconsin, and Minnesota significantly expanded the number of beaches reported within each state (Table 5-1) and the number of bacterial samples analyzed.[5] As a consequence, the number of Lake Superior beaches monitored increased from 11 in 2000 to 305 in 2006. The additional resources available from the Beach Act resulted in more frequent monitoring at beaches where problems were detected. Sampling frequency was increased from once a month to a sampling frequency of one to two times per week. However, many Lake Superior beaches are not monitored unless the public reports a problem. Monitoring resources expended at beaches where no bacterial pollution sources exist and pristine conditions are found would not be a wise use of these resources.

However, beach managers have directed their monitoring resources to priority beaches to protect the public. The beaches selected for more frequent monitoring are the beaches where contamination problems have been detected and risk to human health requires more information. Thus, the increase in postings during the years 2004 to 2006 at some Lake Superior beaches resulted when samples were directed to areas where known problems existed.

Table 5-1. Number of Great Lakes beaches reported per state

State	Number of Beaches 2000-2002		Number of Beaches 2004-2006	
	Average	Minimum - Maximum	Average	Minimum - Maximum
Michigan	137	125-157	577	337-971
Minnesota	3	1-5	79	79-79
Wisconsin	45	39-54	192	192-192

[3] Health Canada. 1998. Summary: State of Knowledge Report on Environmental Contaminants and Human Health in the Great Lakes Basin. Great Lakes Health Effects Program, Ottawa, Canada.
[4] World Health Organization. 1998. Guidelines for safe recreational water environments: Coastal and fresh-water.
[5] Rockwell, Wirick, and Kovatch, 2006. Bacteria, beaches and swimmable waters: has bacterial contamination increased? MWWD-IEMES Antalya, November 6-10.

During 2006, 97 percent of Lake Superior beaches were open more than 95 percent of the time in the U.S. This meets the key objective of the *2002 U.S. Great Lakes Strategy* goal: "By 2010, 90% of monitored, high priority Great Lakes beaches will meet bacteria standards more than 95% of the swimming season." Figure 5-2 shows the percentage of Lake Superior beaches with postings from 1998 to 2006. The red and yellow segments, representing greater than 5 percent of beaches with postings, range from 3 to 10 percent of each year's total number of beaches.

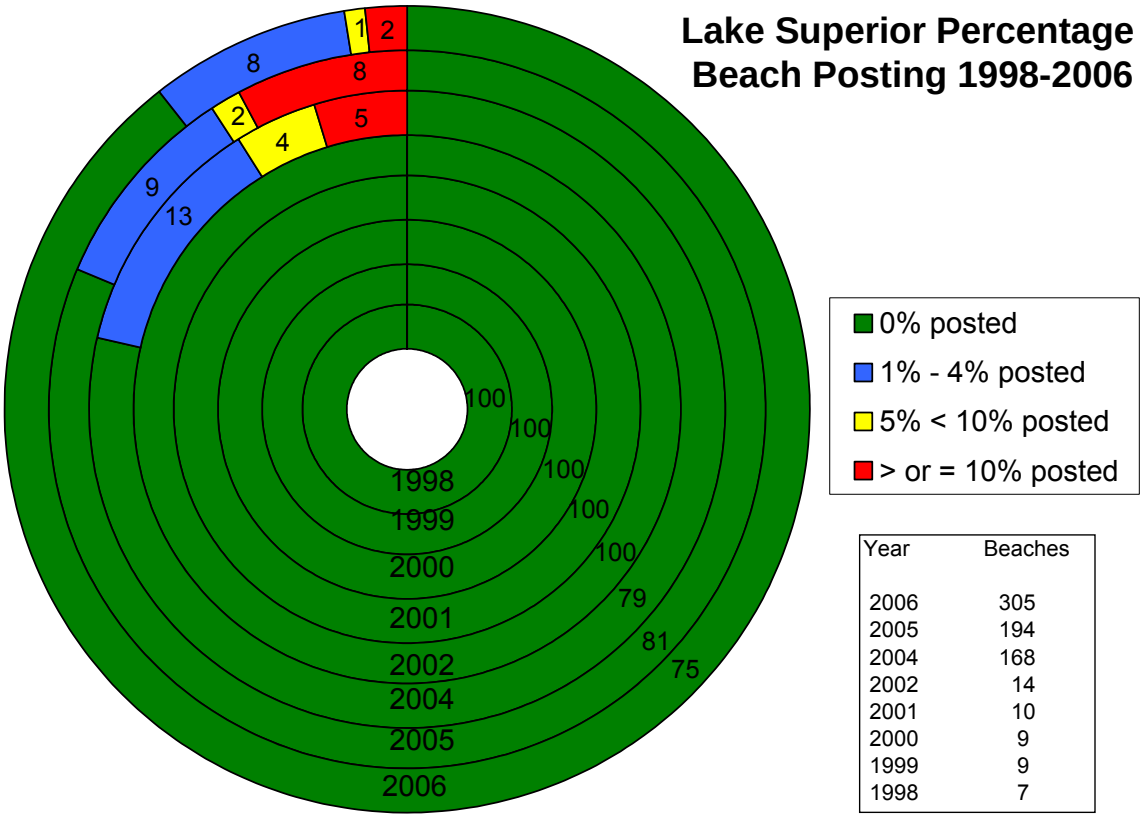


Figure 5-2. Lake Superior Percentage Beach Posting 1998-2006.

Beach program summaries for Michigan, Minnesota, and Wisconsin are presented below.

Michigan's Beach Program. The Michigan Department of Environmental Quality (MDEQ) has received a total of $1,708,572 in BEACH Act funding since 2002 to support beach monitoring and notification programs. Along Lake Superior:

- There are 115 public Michigan beaches in 9 counties, 21 of which are monitored; and
- An estimated $33,414 (an estimated 12 percent of BEACH Act funds for 2007) was distributed to monitor 21 beaches in 7 counties on Lake Superior in 2007.

The monitoring of beaches in Michigan is voluntary and is conducted by local health departments, which are required to notify various entities of the test results within 36 hours, and

may petition the Circuit Court for an injunction ordering the owners of a beach to close the beach. The MDEQ provides Clean Michigan Initiative-Clean Water Fund (CMI-CWF) and BEACH Act grants to local health departments to aid in the implementation or enhancement of their beach monitoring programs. The CMI-CWF and BEACH Act grants are designed to fund proposals that determine and report levels of *E. coli* in the swimming areas of public beaches. The objectives of MDEQ's beach program are to:

- Assist local health departments to implement and strengthen beach monitoring programs;
- Determine whether waters of the state are safe for total body contact recreation;
- Create and maintain a statewide database;
- Compile data to determine overall water quality; and
- Evaluate the effectiveness of MDEQ programs in attaining water quality standards for pathogen indicators.

Local health departments request an average of $380,000 of BEACH Act funds per year from the MDEQ for local beach monitoring programs for approximately 200 high-priority beaches. The BEACH Act allocation for Michigan provides funding to support monitoring once per week at 80 beaches for part of the summer and 100 beaches for most of the summer. In 1998, only 20 counties monitored their beaches. Since the MDEQ has been providing grants for beach monitoring, the number of counties with a beach monitoring program has risen steadily: 24 counties monitored at least one of their beaches in 2000, 36 counties monitored in 2001, 26 counties monitored in 2002, and 38 counties monitored in 2003, 53 in 2004, and 52 in 2005.

In 2006, monitoring was conducted at 207 Great Lakes public beaches in 37 counties in Michigan. Out of 2,422 daily samples collected, 85 (3.5 percent) exceeded Michigan's water quality standards for *E. coli*. The exceedances were reported from 50 beaches (24 percent of monitored Great Lakes beaches), 41 of which reported beach closures or advisories (52 incidents lasting a total of 333 days).

All beach monitoring data are reported to and evaluated by the MDEQ. The MDEQ incorporates beach monitoring data into other water pollution prevention programs to encourage strategic improvements in water quality. Michigan's Beach Monitoring web site immediately provides current and historical test results for *E. coli* and beach closings/advisories as they are reported from health departments for all public beaches in Michigan.[6] All public beaches are required to post a sign indicating whether the beach is monitored and where the results can be found.[7]

Minnesota's Beach Program. The Minnesota Pollution Control Agency (MPCA) administers Minnesota's Beach Monitoring Program. The purpose of the program is to implement a consistent coastal beach water monitoring program to reduce the risk of beach users' exposure to disease-causing microorganisms in water. Approximately 58 miles of public beaches and a total of 79 coastal beaches were identified along Lake Superior. Selected beaches along Lake Superior are monitored in accordance with BEACH Act requirements with prompt notification to the public whenever bacteria levels exceed US EPA-established standards.

[6] Michigan's Beach Monitoring web site: www.michigan.gov/deq/1,1607,7-135-3313_3686_3730---CI,00.html.
[7] Michigan House Bill 4719 (Act 507). 2001. Available at: www.deq.state.mi.us/beach/public/default.aspx.

The state has received $1,488,365 in BEACH Act grants since 2001 to develop and implement beach monitoring and notification programs. A Beach Team comprised of state and local-level environmental and public health officials, and other interested parties, was formed to design MPCA's Beach Program. A standard sampling protocol was developed, and standard advisory signs were designed based on feedback from Beach Team members and public meetings held in coastal communities. The 2007 beach season was the fifth full season that a consistently implemented beach-monitoring program was conducted in the coastal area of Minnesota. Other facts about the 2007 beach season include:

- There were 913 monitoring visits during the 2007 beach season;
- 39 sites were monitored once a week from May to October for both *E. coli* and fecal coliform;
- 66 of the samples collected exceeded the water quality limit of 235 cfu/100 mL for *E. coli*;
- 33 advisories were posted during the monitoring season;
- Two of the monitored beaches were under advisory for most of July and August; and
- 93 percent of Minnesota's Lake Superior beaches met bacteria standards more than 95 percent of the time.

MPCA has improved many aspects of its public notification process. The state has developed an exceptional interactive and informative web site that summarizes key information about beach advisories and closings.[8] This site also provides information on beach logistics, amenities, and local weather. E-mail notices are automatically sent to interested parties. A local phone message is continually updated with the latest advisories (218-725-7724).

Figure 5-3. Minnesota's Beach Monitoring Program provides prompt notification to the public whenever bacteria levels exceed US EPA-established standards. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Minnesota Success Stories and Current Research Projects. The principal success of MPCA's Beach Monitoring Program is the continued public awareness the advisories bring to ongoing

[8] Minnesota Lake Superior Beach Monitoring Program web site: www.MNBeaches.org.

water pollution issues. Since the MPCA started monitoring 35 beaches in 2002 (39 since 2005), the level of awareness of bacterial pollution of recreational waters in the region, as well as in the state, has risen dramatically. The understanding that wastewater overflows and by-passes can have an effect on beach water quality, even a short-lived one, has led to the demand for solutions to the inflow and infiltration problems in the region. Residents and tourists are starting to realize that bacteria problems can occur in any part of the Lake Superior basin, but that they occur with more frequency in the most urban areas and during storm events. Residents and visitors are picking up after their dogs on a more regular basis. They continue to be vocal about sewage overflows and demand that they be corrected. The coastal cities are installing large holding tanks, backup generators, and home sump pumps to slow and/or stop storm-related sewage overflows.

At all 39 monitored Lake Superior beaches, potential sources of pollution either on the beach or nearby have been identified. These sources include stormwater discharges or streams with stormwater discharges into them. The City of Duluth and the Western Lake Superior Sanitary District (WLSSD) have conducted dye testing in the sewer lines and stormwater pipe tanks to eliminate them as potential sources of bacteria at the New Duluth Boat Club (DBC) site on Park Point. They have also conducted a limited amount of spatial testing to determine if there is one specific point of discharge.

The University of Minnesota – Duluth, in collaboration with WLSSD and the MPCA's Lake Superior Beach Program, received a grant from Sea Grant to research DNA fingerprinting at two of the more polluted beaches, including the New DBC Beach. The project, entitled "Beach sand and sediments are temporal sinks and sources of Escherichia coli in Lake Superior," will investigate sources of *E. coli* bacteria contributing to beach closures in the Duluth-Superior Harbor. This study investigated potential sources of *E. coli* contaminating DBC Beach by using DNA fingerprinting. Over 3,600 *E. coli* strains were obtained from 55 lake water, 25 sediment, and 135 sand samples taken from five transects at the DBC Beach at 11 different times during the summer through fall months of 2004 and 2005. Potential sources of *E. coli* at this beach were determined by using a known-source DNA fingerprint library containing unique *E. coli* isolates from wildlife, waterfowl, and treated wastewater obtained near Duluth. Amounts of *E. coli* in the samples were enumerated by membrane filtration counting, and the presence of potentially pathogenic *E. coli* was determined. *E. coli* counts in all samples increased during the summer and early fall (July to

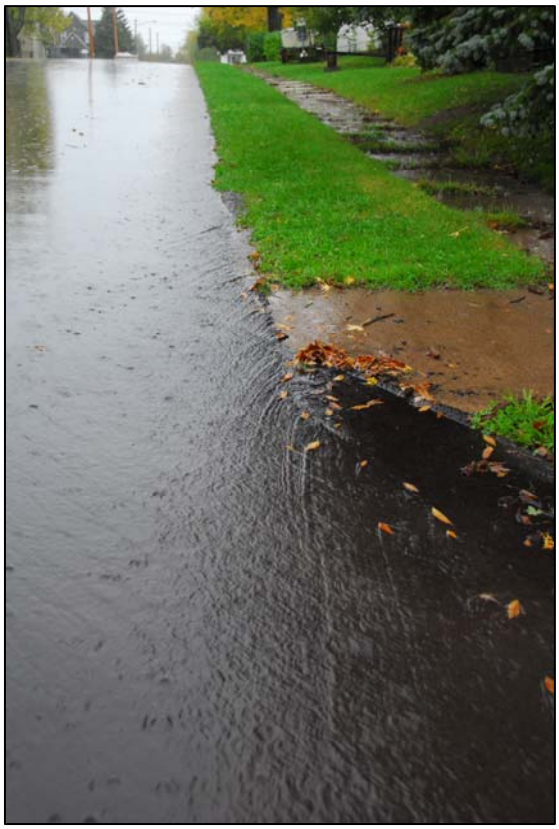


Figure 5-4. Stormwater runoff was identified as one of the primary sources of bacteria at Lakewalk Beach in Minnesota. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

September). While *E. coli* in spring samples originated mainly from treated wastewater effluent, the percentage of *E. coli* from waterfowl increased from summer to fall. DNA fingerprint analyses indicated that some *E. coli* strains may be naturalized, and autochthonous members of the microbial community in the beach sand and sediments were examined. However, results indicated that <1 percent of the *E. coli* strains at the DBC Beach were potentially pathogenic. These results also suggest that wave action may influence the early colonization and homogeneous distribution of *E. coli* in beach sand and the subsequent release of sand or sediment-borne *E. coli* into lake water. Taken together, these results indicate that sand and sediment serve as temporal sources and sinks of human and waterfowl-derived *E. coli* that contribute to beach closures.

Source identification work is also being conducted by MPCA, which received a grant from US EPA to pilot a beach sanitary survey tool to identify pollution sources at two Great Lakes beaches: Lakewalk Beach and New DBC Beach. At the New DBC Beach, the primary source of bacteria was suspected to be the waterfowl population that lives and travels through the area. At Lakewalk Beach, stormwater runoff and sanitary sewer overflow were identified as the primary sources of bacteria.

Wisconsin's Beach Program. The Wisconsin Department of Natural Resources (WDNR) operates Wisconsin's Beach Monitoring and Notification Program. Since 2001, WDNR has received $1,460,130 in BEACH Act grants to develop and implement monitoring and notification programs at beaches along Lake Michigan and Lake Superior. Passage of the BEACH Act has enabled WDNR to substantially increase the number of beaches it monitors. Along the Lake Superior shoreline, Ashland, Bayfield, Douglas, and Iron Counties have 15.35 miles of beaches. Among these counties, 40 beaches are monitored.

To design its state beach monitoring and notification program, the WDNR formed a workgroup composed of state-level environmental and public health officials, local health departments, and academic researchers. Using GPS technologies, 192 beaches were identified along Lake Michigan and Lake Superior. Additional GPS data layers were added to include the location of all wastewater treatment plant outfalls along with their proximity to the beaches. Additional information was collected for each beach, evaluating the potential for impacts from stormwater runoff, bather and

Figure 5-5. Many beaches on Lake Superior are monitored to ensure that water quality conditions are safe for swimming. Photo credit: Frank Koshere, WDNR.

waterfowl loads, and the location of outfalls and farms. This information was used to rank and classify beaches as high, medium, or low priority. These rankings indicate how often the beaches should be monitored to ensure that water quality conditions are safe for swimming.

The WDNR's public notification and risk communication measures were developed in collaboration with the workgroup and other stakeholders, including the public. These efforts included development of signs at beaches to give notice to the public that the coastal recreational waters are not meeting, or are not expected to meet, water quality standards. These signs, which are also in Spanish and Hmong, were designed based on feedback from a beach user survey and public meetings held around the state.

Other products that were developed include: an automatic e-mail service to which the public can subscribe to receive daily updates on beach conditions; a statewide informational brochure, approximately 100,000 copies of which were distributed at local beaches, parks, and health departments; a statewide Beach Health web page (www.wibeaches.us) for collecting monitoring and advisory data and reporting up-to-date as well as historical conditions at all Wisconsin coastal beaches; and an internal web site for local health departments to report their daily advisory and monitoring data in the format required for US EPA reporting at the end of the beach season.

Current Research Projects. The BEACH Act funding was inadequate for a comprehensive monitoring program, so other funding was sought. Several groups have been brought together to create a comprehensive monitoring and source-tracking program. The groups include: local health departments, Northland College, the University of Wisconsin-Oshkosh, and the Lake Superior Alliance. The following objectives have been completed by this collaboration:

- Investigation of high levels of *E. coli* with additional spatial sampling to assist in identifying the source of contamination. This includes investigation of tributaries, outfalls, and other inputs to Lake Superior in proximity to the beaches. This included vertical and horizontal sampling at several beach locations.
- Recovery of *E. coli* isolates from a variety of sources so that a database could be constructed to help determine the source of *E. coli* recovered from beach water samples. Over 2,000 *E. coli* isolates have been recovered from sources such as dogs, cattle, sheep, deer, gulls, geese, human sources, and from the beaches (beach water) under study.
- Investigated the implications of sampling at different water depths – 12, 24, 36, and 48 inches.
- Utilized genetic fingerprinting techniques (rep PCR), antibiotic resistance patterns, and spatial sampling to determine the source of beach water *E. coli* isolates.
- Conducted watershed investigations at select locations to determine impacts on beach water quality.
- Worked with local health officials to mitigate any source of *E. coli*; and beach contamination so that beaches can remain open and public health is protected.
- In 2007, the WDNR received funding from US EPA to conduct sanitary surveys at 18 Wisconsin Great Lakes beaches, including seven along Lake Superior. The project has allowed researchers to identify sources of microbial contamination at numerous

beaches around Wisconsin and initiate the process of planning for mitigation of some of the sources.

Many other successes have resulted from the beach program in northern Wisconsin:

- A State of Wisconsin Certified Lab was set up in an area that had no previous capability for beach testing. This lab also allows other local health departments and citizens to have samples collected and analyzed when they believe there is a problem with either a beach or another location in the area.
- Utilizing the Wisconsin Beach Monitoring and Notification Program as an example, the State of Wisconsin Health and Hygiene Laboratory and the WDNR have teamed up to provide a similar service for high-use inland beaches located at many Wisconsin State Parks. Up-to-date information is also provided on the Wisconsin Beach Health web site.[9]
- Testing Lake Superior's public beaches has spurred counties to test their local inland beaches as well. Vilas and Oneida Counties in northern Wisconsin modeled their inland beach programs after the Wisconsin Coastal Beach Program and sampled 16 beaches in the summer of 2005.
- Twenty-seven Lake Superior beaches now have baseline *E. coli* data, and beach management decisions can be based on good scientific data.
- The use of genetic testing, antibiotic resistance patterns, and spatial sampling has identified several likely sources of *E. coli.*
- Having identified potential sources of contamination, the process of source mitigation can begin.
- There have been several public meetings at several locations in the Lake Superior region to bring all interested parties together to discuss water quality and beach "health" issues.

Figure 5-6. The BEACH Act has helped to protect public health at local beaches in Wisconsin. Photo credit: Frank Koshere, WDNR.

The BEACH Act has established a foundation in an economically disadvantaged area so that it can acquire high-quality scientific data, protect public health at local beaches, help local officials acquire data to respond to questions from citizens regarding beach water quality and help mitigate any issues that may pose a risk to human health.

[9] Wisconsin Beach Health web site: www.wibeaches.us.

Accomplishments Related to Communication to the Public. Because it has been shown that people who engage in recreational water sports have a higher incidence of symptomatic illnesses, it has become increasingly more important to make the public aware of the potential health hazards that are associated with recreational waters. Recent progress has been made on the national and local levels to provide the public with useful tools that can provide needed information regarding the use of recreational waters. At the national level, the following public communication tools are available:

BEACH Watch.[10] This web site contains information about US EPA's BEACH Program, including grants, US EPA's reference and technical documents including US EPA's *Before You Go to the Beach* brochure, upcoming meetings and events, conference proceedings, and links to local beach programs. The web site also provides access to BEACON (Beach Advisory and Closing On-line Notification), US EPA's national beach water quality database.

Annual Great Lakes Beach Association (GLBA) Conference.[11] The GLBA is comprised of members from U.S. states, Environment Canada, local environmental and public health agencies, and several universities and non-governmental organizations (NGOs). The GLBA's mission is the pursuit of healthy beach water conditions in the Great Lakes area. Since 2001, the GLBA has held beach conferences annually to bring together beach managers, scientists, and agency officials to exchange information on improving recreational water quality. The next conference is planned for September 2008, in northwest Indiana.

BEACHNET.[12] BEACHNET is an email discussion list that seeks to facilitate communication among people interested in the improvement of recreational beach water quality in the Great Lakes basin. The listserv is sponsored by the GLBA and is hosted by the Great Lakes Information Network (GLIN). Both the GLBA and the listserv are open to anyone interested in improving beach water quality, understanding bacterial contamination, developing better ways to detect and monitor pollution, or monitoring and assuring beach visitors' health. There are currently several hundred subscribers to BEACHNET.

BeachCast.[13] This web site provides Great Lakes beach goers with access to information on Great Lakes beach conditions, including health advisories, water temperature, wave heights, monitoring data, and more. BeachCast is a service of the Great Lakes Commission and its GLIN.

5.1.4 Fish Consumption Advisory Programs Outreach Efforts and Meetings

The Great Lakes states met in 2007 to discuss fish consumption advisories across the Great Lakes basin:

[10] US EPA BEACH Watch web site: www.epa.gov/OST/beaches.
[11] Great Lakes Beach Association web site: www.great-lakes.net/glba/.
[12] BEACHNET Discussion web site: http://www.great-lakes.net/glba/beachnet.html.
[13] Great Lakes Commission BeachCast web site: http://www.glc.org/announce/03/07beachcast.html.

- As part of the 2007 *National Forum on Contaminants in Fish* – Great Lakes Basin Break-out Session, held in Portland, Maine, in July 2007, the Great Lake states met for a two-day session to discuss fish consumption advisories, the mercury fish consumption protocol, and the development and implementation of a basinwide fish consumption message.

- During the *Lake Michigan: State of the Lake 2007* Conference on October 2-3, 2007, the Great Lakes Environmental and Molecular Science Center (GLEAMS) brought the Great Lakes states together to discuss the potential for using Decision Support Systems (DSS) to communicate fish consumption advisories by making greater use of tools such as online mapping applications and new genomics tools. The second day of the meeting focused on having fish consumption experts discuss their communication outreach plans.

- During the *Making a Great Lake Superior 2007* conference, three presentations focused on contaminants in fish, including an overview of fish consumption advisory topics, a presentation on tribal assessment of PBT contaminant concentrations in four commonly harvested Lake Superior fish, and a presentation on fish advisory outreach to vulnerable populations in the Upper Peninsula of Michigan. Following these presentations, there was good discussion on promoting consumption of low-contaminant fish species.
    - The Lake Superior Human Health Session also included presentations on a variety of topics, including: beach monitoring, identifying seasonal sources of *E. coli* at beaches, amphibole mineral fiber issues on the Mesabi Range, and rip currents. Further information and the Human Health Conference abstracts can be found at www.seagrant.umn.edu/superior2007.

5.1.5 Research Projects in the Great Lakes

New Projects

***Advisory Awareness among Volunteers in a 2004 Mercury Exposure Study*.** This project with the Wisconsin Department of Health and Family Services will help determine whether hair mercury measurement has a long-term effect on an individual's fish consumption habits and reduces their risk of exposure to methylmercury.

In 2004, two thousand and thirty-one Wisconsin volunteers completed a fish consumption questionnaire and provided hair for mercury analysis. Each volunteer received a result letter that provided individualized fish consumption advice.

In order to evaluate the effectiveness of the 2004 project as an educational tool, the State of Wisconsin plans to conduct a follow-up survey of these individuals and invite them to have their hair re-analyzed for mercury. All data from the surveys and laboratory hair analyses will be entered into an electronic database and merged with 2004 records for each participant in the follow-up study.

***Mercury Levels in Blood from Newborns from the Lake Superior Basin*.** US EPA GLNPO has funded a project to measure levels of mercury in the blood of newborns from the Lake Superior

basin to determine if newborns have been exposed to mercury from maternal fish consumption. The project will help characterize this population's exposure to mercury and assist health departments in targeting health protective outreach and advice on fish consumption.

This project is proposed to prospectively measure levels of mercury in the blood of newborns from the Lake Superior basin. People are exposed to mercury through consumption of fish. Measuring mercury exposure in newborns within the Lake Superior basin will help characterize this population's exposure to mercury. The data collected will assist public health departments in targeting health protective outreach and advice on fish consumption, which is the major source of methylmercury exposure. Public health agencies will also use these data to provide primary care providers with direction on targeting subpopulations for services (such as screening questions and blood tests) similar to the services that have been used for lead poisoning prevention.

Ongoing Projects

Great Lakes Sportfish Consumption Advisory Consortium – Outreach Toolkit. The Great Lakes Sportfish Consumption Advisory Consortium is in the process of developing a basinwide outreach toolkit, including printing educational materials related to mercury-contaminated fish. This toolkit will include several educational and outreach components focusing on the following groups: children, Area of Concern (AOC) residents, healthcare professionals, and restaurant and culinary school professionals. Each component of the toolkit will be implemented and evaluated for its effectiveness. The toolkit will be available for all of the states to use and implement. The consortium would like to expand and improve the most successful components of the toolkit.

Figure 5-7. A Great Lakes basinwide outreach toolkit that includes educational materials related to mercury-contaminated fish will focus on children, among other targeted groups. Photo credit: Frank Koshere, WDNR.

5.1.6 Opportunities for Future Collaboration – Healthcare Professionals

According to experts in the field of fish consumption advice, healthcare professionals are the primary and most trusted source of information regarding fish consumption advisories. At the present, there is limited environmental health training in the healthcare community, inconsistent evaluation of environmental health by healthcare accreditation boards, and no uniform approach used by healthcare professionals to assess whether patients are aware of the benefits and risks of eating fish.

The Great Lakes states and US EPA are interested in working with the healthcare professional sector (associations of physicians, nurses, and midwives) to evaluate opportunities to improve effective communication of fish consumption benefits and risks to patients, especially those patients who are most susceptible to the risks of exposure from contaminants in fish (women of child-bearing age and children).

5.1.7 Pollution Prevention

IL-IN Sea Grant Unwanted Medicine Disposal Community Toolkit. In the U.S., the use of prescription medicine increases every year. Often when prescriptions expire or are no longer needed, they are flushed or discarded. However, pharmaceuticals can pass through sewage plants and contaminate waterways.

With funding from US EPA GLNPO, Illinois-Indiana Sea Grant created a toolkit entitled *Disposal of Unwanted Medicines: A Resource for Action in Your Community.*[14] Over 160 resource kits have been distributed, and Sea Grant has held workshops for over 100 local officials. As a result, a number of communities or counties in the Great Lakes region have begun collection programs.

The collection of resources in the toolkit is intended for waste management officials and others who are interested in addressing the problem of unwanted medicines in the environment. A panel of expert reviewers, including solid waste managers, pharmaceutical and personal care product researchers, pharmacists, doctors, and communication specialists, reviewed this resource kit, and their comments and suggestions were incorporated into the final version.

Illinois-Indiana Sea Grant focuses on collection events for the public as a partial solution to the problem on unwanted medicines in the environment. To assist event organizers, the kit provides a set of case studies and sample educational materials along with the Northeast Recycling Council's step-by-step advice for running a collection. Background information on the science behind the issue and a bibliography of news stories and articles from scientific journals are also featured.

Illinois-Indiana Sea Grant continues to post updated materials to the toolkit web site in an effort to provide users with the most current content available on this issue.

EarthKeepers Pharmaceutical and Personal Care Products Collection Event. In 2007, US EPA Headquarters and GLNPO funded an Earth Day Pharmaceutical and personal care product collection event in the Upper Peninsula of Michigan. Held by EarthKeepers, an environmental faith-based organization, the one-day event collected over one ton of unwanted medicines and personal care products, including a number of illegal, controlled drugs.

Prescription medication and over-the-counter medicines were collected across a 400-mile area at about two dozen free drop-off sites across northern Michigan during this third annual EarthKeeper Clean Sweep on Earth Day 2007. Volunteers collected tens of thousands of drugs,

[14] IL-IN Sea Grant. *Disposal of Unwanted Medicines: A Resource for Action in Your Community*. Available at http://www.iisgcp.org/unwantedmeds/.

pills, and personal care products, and pulled off what US EPA called "the largest geographical pharmaceutical collection in U.S. history." The collections prevented these medicines from being released into rivers, tributaries, lakes, and other waterways where they have been shown to cause harm to aquatic and ecosystem health. Recent nationwide studies found that 80 percent of rivers sampled tested positive for a range of pharmaceuticals, including antibiotics, birth control hormones, antidepressants, veterinary drugs, and other medications.

5.1.8 Pharmaceuticals and Personal Care Products in the Canadian Environment

A national workshop called "Pharmaceuticals and Personal Care Products (PPCP) in the Canadian Environment: Research and Policy Directions" took place March 5th to 7th, 2007, in Niagara-on-the-Lake, Ontario. This workshop assessed the current state of Canada's research on PPCPs in the environment in government, academia, and industry sectors. Invited speakers provided overviews on environmental exposure and monitoring, effects of PPCPs on aquatic ecosystems, alternatives for reduction of human and environmental exposure to PPCPs, risk assessment process and needs, international, industry activities, provincial, and municipal activities. A principal focus of the workshop was setting priorities for research, monitoring, and regulation of PPCPs. A workshop report was produced and can be found at: http://www.nwri.ca/ppcp-ppsp/i-cover-e.html. The report also provides an overview of policy and management issues.

5.2 CHALLENGES

Although there continues to be a decline in fish contaminant levels, this decline has slowed in recent years and at levels still high enough to warrant fish consumption advisories. In addition, new pathogens and viruses have appeared in the Great Lakes with the potential to cause ecosystem harm. Chemicals of emerging concern, personal care products, and pharmaceuticals are coming under increased scrutiny for their presence in the Great Lakes and potential to cause harm to aquatics, and human and ecosystem health.

5.2.1 Fish Contaminant Levels in Lake Superior

US EPA GLNPO collects data under the Great Lakes Fish Monitoring Program (GLFMP). This program annually collects and composites 15 salmon filets into three composites in the small, medium, and large size categories from a variety of sites on each of the Great Lakes. Figures 5-8 through 5-13 below represent general contaminant trends in Great Lakes sport fish. Data shown in the figures reflect the changing nature of the Sport Fish Fillet Monitoring piece of the fish monitoring program. Sites have been continuously added and removed over the life of the program, and samples themselves have varied from year to year according to collection, location, and size. For that reason, only general trends can be gathered from these data.

Without remediation of contaminated sediments or restriction of contaminated atmospheric deposition, fish tissue concentrations will continue to warrant fish consumption advisories. US EPA does not issue fish consumption advice—the Great Lakes states and tribes are responsible for this task. However, concentrations measured in GLFMP sport fish can be compared to

categories in the *Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory*.[15] Table 5-2 presents PCB, mercury, and chlordane consumption limits for sensitive populations created for the *Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory*.

Current concentrations of total PCBs in Lake Superior coho and chinook salmon fillets fall into the one meal per month consumption advice categories (see Figures 5-8 and 5-11). Total PCBs are a summation of all PCB congeners analyzed.

No DDT protocols exist to compare Lake Superior coho and chinook salmon fillet concentrations (see Figures 5-9 and 5-12).

Current concentrations of total chlordane in Lake Superior coho and chinook salmon fillets fall into the unlimited consumption category of the draft chlordane addendum to the protocol (see Figures 5-10 and 5-13). Total chlordane is a summation of *cis* and *trans* chlordane, *cis* and *trans* nonachlor, and oxychlordane.

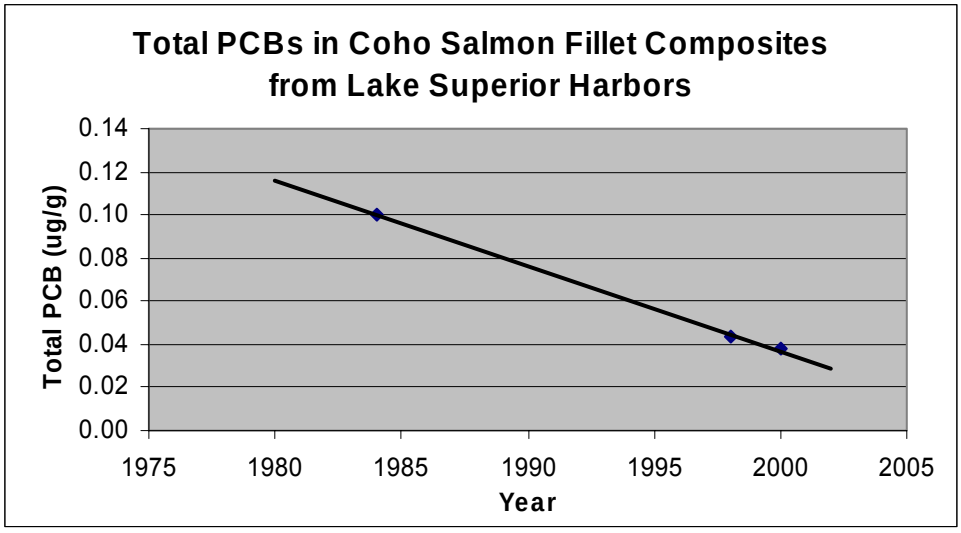


Figure 5-8. Total PCBs in Coho Salmon Fillet Composites from Lake Superior Harbors[16]

[15] Great Lakes Sport Fish Advisory Task Force. The PCB Protocol is available at http://fn.cfs.purdue.edu/anglingindiana/HealthRisks/TaskForce.pdf (1993). The Mercury Protocol is available at http://dhfs.wisconsin.gov/eh/Fish/FishFS/2007Hg_Add_Final_05_07.pdf (2007).

[16] Source: US EPA Great Lakes National Program Office – Great Lakes Fish Monitoring Program, 2008.

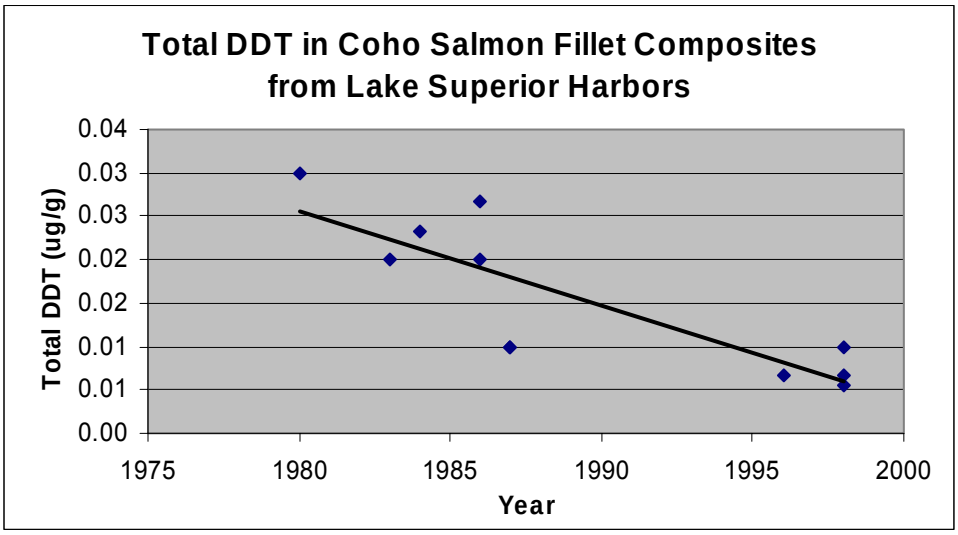


Figure 5-9. Total DDT in Coho Salmon Fillet Composites from Lake Superior Harbors[17]

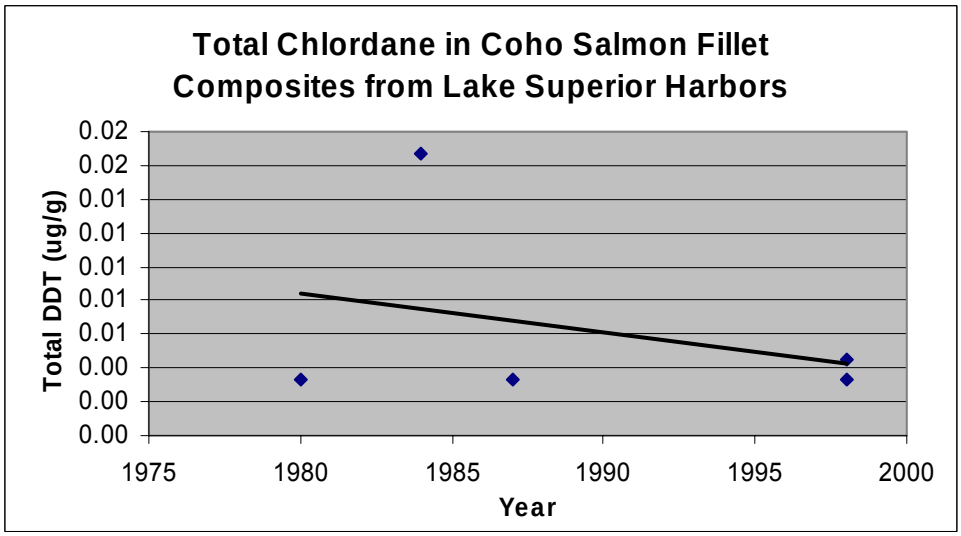


Figure 5-10. Total Chlordane in Coho Salmon Fillet Composites from Lake Superior Harbors[18]

[17] Source: US EPA Great Lakes National Program Office – Great Lakes Fish Monitoring Program, 2008.
[18] Source: US EPA Great Lakes National Program Office – Great Lakes Fish Monitoring Program, 2008.

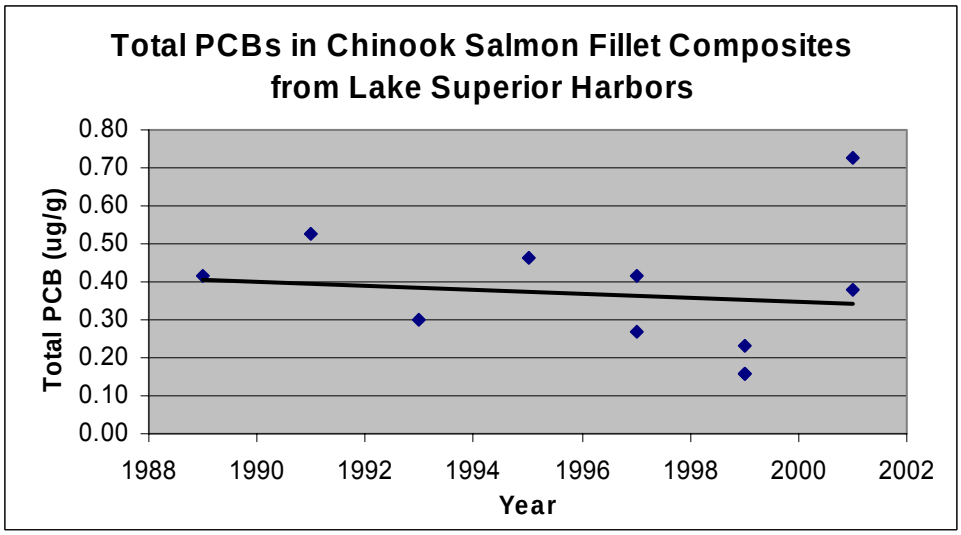


Figure 5-11. Total PCBs in Chinook Salmon Fillet Composites from Lake Superior Harbors[19]

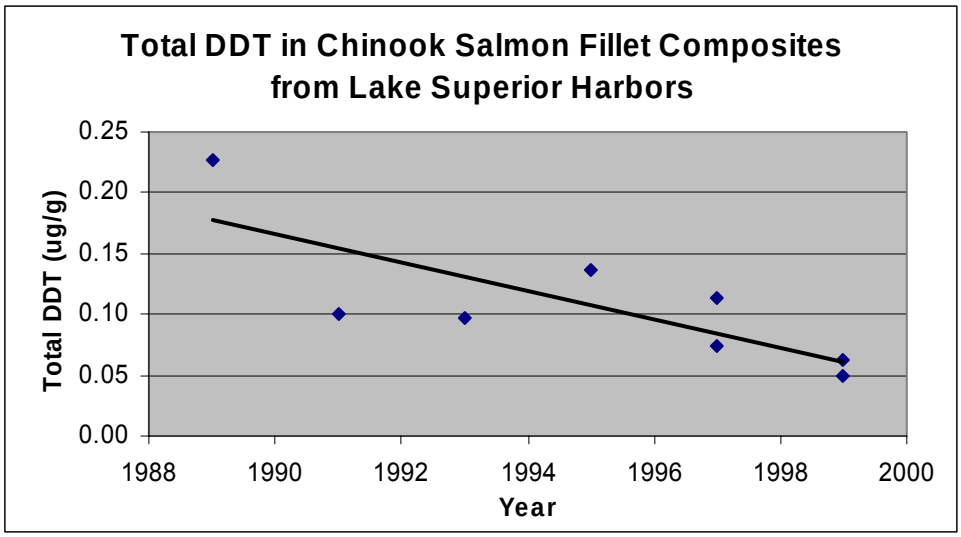


Figure 5-12. Total DDT in Chinook Salmon Fillet Composites from Lake Superior Harbors[20]

[19] Source: US EPA Great Lakes National Program Office – Great Lakes Fish Monitoring Program, 2008.
[20] Source: US EPA Great Lakes National Program Office – Great Lakes Fish Monitoring Program, 2008.

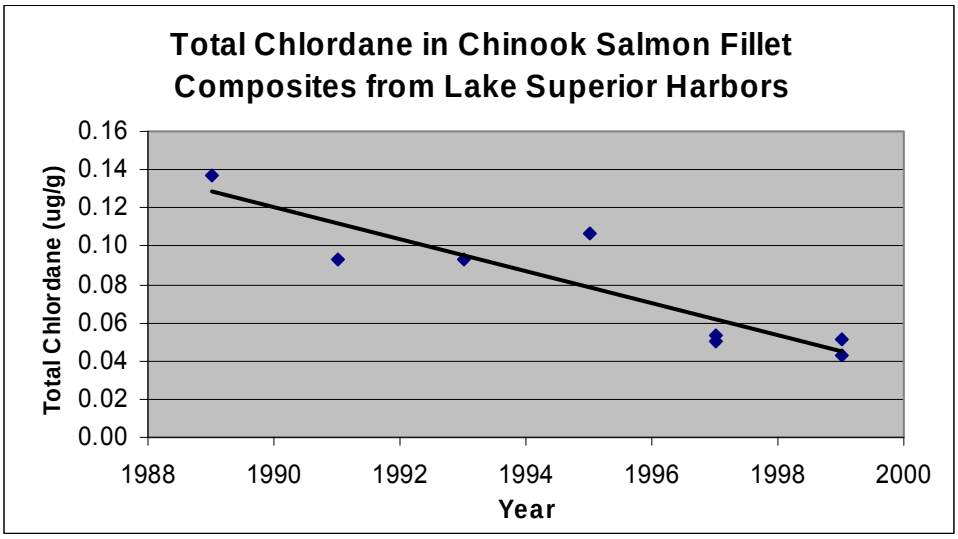


Figure 5-13. Total Chlordane in Chinook Salmon Fillet Composites from Lake Superior Harbors[21]

Table 5-2. Consumption limits for sensitive populations created for the *Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory***

	Consumption Advice		
Consumption Advice Groups*	Concentration of PCBs (ppm)	Concentration of Mercury (ppm)*	Concentration of Chlordane (ppm)**
Unrestricted Consumption	0 – 0.05	0 ≤ 0.05	0 – 0.15
2 meals/ week		> 0.05 ≤ 0.11	
1 meal/ week	0.06 – 0.2	>0.11 ≤ 0.22	0.16 – 0.65
1 meal/ month	0.21 – 1.0	>.22 ≤ 0.95	0.66 – 2.82
6 meals/ year	1.1 – 1.9		2.82 – 5.62
Do not eat	>1.9	>0.95	>5.62

*Women of childbearing age and children under age 15.
**The chlordane protocol is draft.

[21] Source: US EPA Great Lakes National Program Office – Great Lakes Fish Monitoring Program, 2008.

5.3 HUMAN HEALTH AND CHEMICAL RISKS

5.3.1 Process by which US EPA Evaluates Chemicals for Human Risk

US EPA utilizes the Integrated Risk Information System (IRIS) to evaluate the health effects of individual substances. IRIS provides hazard identification and dose-response assessment information. The information in IRIS can be used in combination with exposure information to characterize the public health risks of a given substance in a given situation. These risk characterizations can form the basis for risk-based decision-making, regulatory activities, and other risk management decisions designed to characterize and protect public health.

US EPA's process for developing IRIS assessments consists of: (1) an annual Federal Register announcement of US EPA's IRIS agenda and call for scientific information from the public on the selected substances, (2) a search of the current literature, (3) development of a draft Toxicological Review (other support document) and IRIS Summary, (4) internal peer consultation, (5) Agency Review, (6) Interagency Review, (7) external peer review and public comment, (8) final Agency Review, Interagency Review, and US EPA Office of Research and Development management approval, and (9) posting on the IRIS database.

For more information on the chemicals currently being evaluated by IRIS, go to http://cfpub.epa.gov/ncea/iris/index.cfm.

5.3.2 Sources of Exposure to PBDEs

Although the use of flame retardants saves lives and property, there have been unintended consequences of the use of polybrominated diphenyl ethers (PBDEs). There is growing evidence that PBDEs persist in the environment and accumulate in living organisms, as well as toxicological testing that indicates these chemicals may cause liver toxicity, thyroid toxicity, and neurodevelopmental toxicity. Environmental monitoring programs in Europe, Asia, North America, and the Arctic have found traces of several PBDEs in human breast milk, fish, aquatic birds, and elsewhere in the environment. Particular congeners, tetra- to hexabrominated diphenyl ethers, are the forms most frequently detected in wildlife and humans.

The mechanisms or pathways through which PBDEs get into the environment and humans are not known yet, but could include releases from manufacturing or processing of the chemicals into products like plastics or textiles, aging and wear of the end consumer products, and direct exposure during use (e.g., from furniture). Some research has evaluated PBDE levels in market basket foods.[22] This research suggests that dietary exposure does not account for the high body burdens that have been observed in people. The latest research suggests that household dust and air from the indoor environment may play a significant role in PBDE body burden levels.[23]

[22] Schecter A, Päpke O, Harris TR, Tung KC, Musumba A , Olson J, and Birnbaum L. 2006. Polybrominated Diphenyl Ether (PBDE) Levels in an Expanded Market Basket Survey of U.S. Food and Estimated PBDE Dietary Intake by Age and Sex. Environmental Health Perspectives, Volume 114, Number 10.
[23] US EPA.Office of Pollution Prevention and Toxics, Polybrominated diphenylethers (PBDEs) web site: http://www.epa.gov/oppt/pbde/.

5.4 IS THERE A HUMAN HEALTH RISK?

5.4.1 Viral Hemorrhagic Septicemia

Viral Hemorrhagic Septicemia (VHS) virus is a serious fresh and saltwater fish pathogen that is increasingly observed in the Great Lakes region of the U.S. and Canada.[24] VHS virus is a rhabdovirus that affects fish of all size and age ranges but does not pose any threat to human health. VHS cannot infect humans if they eat fish that have the pathogen.[25]

VHS, known for its damaging effects in Europe and the Pacific Northwest, was first detected in the Great Lakes in 2005 and was later confirmed in fish captured in 2003. Since its arrival, VHS has caused widespread mortality of fish in the lower Great Lakes, affecting thousands, perhaps hundreds of thousands of fish in a single event. VHS has proven to be broadly pathogenic in the Great Lakes, affecting dozens of fish species across several families. Recent genetic work indicates that Great Lakes VHS isolates are most closely related to isolates from the Atlantic seaboard of North America, and that the introduction of VHS to the Great Lakes likely occurred within the past 5-10 years. Despite the rapid spread of VHS through the lower Great Lakes, VHS has not yet been reported from Lake Superior or its watershed.

In 2007, the U.S. National Park Service prohibited all ballast water from being released in the boundaries of Isle Royale National Park to prevent possible VHS contamination of its waters. The National Park Service, in conjunction with other state and federal agencies, has drafted a VHS prevention, containment, and response plan. For more information, please see: www.dec.ny.gov/animals/25328.html or www.aphis.usda.gov/publications/animal_health/content/printable_version/sa_vhsfo_vs.pdf.

5.4.2 Botulism

Type E botulism poisoning of fish and wildlife has recently increased in the Great Lakes with the most recent example in Michigan near the Sleeping Bear Dunes National Lakeshore. Many people are concerned not only of the ecological impacts of this type of botulism but also of the human health impacts.

In the past, a few Type E botulism cases were reported in humans. However, this was due to improperly prepared smoked or cooked fish, and these cases were rare. Most media reports of botulism issues in humans are from Type A and B botulism. These types of botulism occur in food as a result of improperly canned or jarred food. Cooking food to proper temperatures will destroy bacteria, including botulism.

[24] U.S. Department of Agriculture Animal and Plant Health Inspection Service. 2007. Stakeholders Announcement: USDA Amends Viral Hemorrhagic Septicemia-Susceptible Species List. Available at: http://www.aphis.usda.gov/publications/animal_health/content/printable_version/sa_vhsfo_vs.pdf.
[25] New York State Department of Environmental Conservation website: http://www.dec.ny.gov/animals/25328.html.

When fishing or hunting water fowl in the Great Lakes, it is important to choose healthy fish and to discard fish or waterfowl that are sick or act abnormally. Improper cooking may not destroy the botulism Type E toxin.

5.5 NEXT STEPS

Challenges and next steps related to improving human health include:

- Continue to implement actions outlined in the Great Lakes Regional Collaboration's Coastal Health Strategy;
- Continue to improve beach monitoring and public notification;
- Promote measures that will reduce or eliminate pollution sources at Great Lakes beaches;
- Develop and disseminate a standardized sanitary survey tool to identify contamination sources at Great Lakes beaches;
- Continue pharmaceutical outreach and education to collect unwanted medications;
- Continue pollution prevention actions to prevent chemicals of emerging concern from entering waterways;
- Disseminate information and training tools on the use of forecast models at Great Lakes beaches; and
- Work with the International Joint Commission to evaluate standardization of criteria for posting beaches in the U.S. and Canada.

5.6 INFORMATION

Web links listed below provide reference material for information cited in beach LaMP updates. In addition, a collection of useful resources (journal articles, publications, published abstracts, and technical reports) has been compiled for future use.

Lake Superior States' Beach Web Pages

Michigan: www.michigan.gov/deq/1,1607,7-135-3313_3686_3730---C1,00.html
Minnesota: www.pca.state.mn.us/water/beaches/
Wisconsin: www.dnr.state.wi.us/org/water/wm/wqs/beaches/

Great Lakes Sea Grant

Great Lakes Sea Grant Network: http://www.greatlakesseagrant.org/
Michigan Sea Grant: http://www.seagrant.umich.edu/
Minnesota Sea Grant: http://www.seagrant.umn.edu/
Wisconsin Sea Grant: http://www.seagrant.wisc.edu/

US EPA

US EPA's BEACH Watch home page, including links to the BEACH Act, the *National Beach Guidance and Required Performance Criteria for Grants*, US EPA's national beach water quality database, and technical and reference documents:
http://www.epa.gov/waterscience/beaches/

US EPA Great Lakes National Program Office: http://www.epa.gov/glnpo/

US EPA's *Report to Congress: Impacts and Control of CSOs and SSOs* (delivered August 26, 2004): http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm

Great Lakes Monitoring – The Swimmability Index:
http://www.epa.gov/glnpo/glindicators/water/beachb.html

Great Lakes Strategy 2002 – A Plan for the New Millennium:
http://www.epa.gov/grtlakes/gls/gls04.html

BEACON – Beach Advisory and Closing On-line Notification:
http://oaspub.epa.gov/beacon/beacon_national_page.main

Other Web Sites

Alliance for the Great Lakes Citizen's Center for Beach Health:
http://www.greatlakes.org/conservation/beach_health_index.asp

Great Lakes Water Institute – Bacterial Genetics Research Lab:
http://www.uwm.edu/Dept/GLWI/ecoli/

Great Lakes Beach Association: http://www.great-lakes.net/glba/

Great Lakes Information Network (GLIN): http://www.great-lakes.net/

Beaches in the Great Lakes Region: http://www.great-lakes.net/tourism/rec/beach.html#new

Center for Disease Control - Healthy Swimming: http://www.cdc.gov/healthyswimming/

Great Lakes BeachCast – Great Lakes Beach Information (many links from this site):
http://www.great-lakes.net/beachcast/nr_moreinfo.html

Great Lakes Research Consortium: http://www.esf.edu/glrc/

NOAA Great Lakes Environmental Research Laboratory (GLERL)
Center of Excellence for Great Lakes and Human Health:
http://www.glerl.noaa.gov/res/Centers/HumanHealth/

USGS Great Lakes Science Center: http://www.glsc.usgs.gov/

Great Lakes Commission: http://www.glc.org/

International Joint Commission: http://www.ijc.org/

Council of Great Lakes Research Managers – Great Lakes-St. Lawrence Research Inventory: http://ri.ijc.org

Great Lakes Protection Fund: http://www.glpf.org/

International Association for Great Lakes Research: http://www.iaglr.org/

Lake Superior Duluth Streams: www.DuluthStreams.org

Wisconsin Beach Health Web site: www.wibeaches.us

Chapter 6

Habitat, Terrestrial Wildlife, and Aquatic Communities Progress Reports

Wild rice at Kakagon Slough. Photo credit: Janet Keough, US EPA.

Lake Superior Lakewide Management Plan 2008

Chapter 6 Contents

Chapter 6
Habitat, Terrestrial Wildlife, and Aquatic Communities Progress Reports

6.0 ABOUT THE CHAPTER

The Habitat, Aquatic Communities, and Terrestrial Wildlife Committees of the Binational Program have cooperated to compile this chapter of the LaMP 2008. This chapter highlights actions taken to restore and protect fish, wildlife, and their habitats in the Lake Superior basin since the release of the LaMP 2006 Report. These committees are part of a historic and unique collaborative endeavor by Lake Superior resource managers to protect, maintain, and restore aquatic and terrestrial wildlife and high-quality habitat sites in Lake Superior basin and the ecological processes that sustain them. The committees are comprised of technical personnel from federal, state, provincial, and tribal natural resource agencies.

Over the past two years, the three committees have worked together to refine and revise a set of "Ecosystem Goals" that contain Strategic Outcomes, specific Goals, and Subgoals that the committees have determined are necessary to achieve and protect a diverse, healthy, and sustainable Lake Superior ecosystem. Although a version of these goals was originally included in the LaMP 2006, revisions were needed to better organize the goals and to accommodate emerging issues like climate change (see sidebar). In addition, the goals were expanded to include issues related to the aquatic ecosystem. A public comment period was held to gather input on the draft goals. The Ecosystem Goals are scheduled to be finalized in 2008.

Draft Ecosystem Goals Acknowledge the Need to Plan for Climate Change

During the recent revision of the Ecosystem Goals (see adjacent text), it became clear that unless agencies understand and plan for predicted climate change, a great deal of money and time could be spent on projects with little likelihood of success. In addition, the committees recognized that the Lake Superior basin should do its part to try and reduce emissions of greenhouse gases. These realizations prompted the development of four goals related to climate change under the umbrella of a Strategic Outcome that states **"Human activities in the Lake Superior basin mitigate the contribution of greenhouse gases to the environment. Ongoing climate change adaptive management strategies are pursued in the Lake Superior basin."** The four goals are to: 1) understand the impacts of climate change and the limits to the ability to predict and model these impacts on specific ecosystems and local regions, 2) review and revise Conservation and Restoration Plans in the basin as required based on the climate scenarios developed in the goal above, 3) help the Lake Superior Basin stakeholders adapt to climate change impacts, and 4) make Lake Superior a net carbon reduction area that reduces greenhouse gas emissions.

The draft goals that were released for public comment can be found in Chapter 3 of this LaMP (see Section 3.1). Once final, the committees intend to work toward the fulfillment of the goals and subgoals, and plan to use the goals as a tool to track progress. The committees and the Binational Program as a whole hope that, when final, all agencies and organizations around the Lake can use these goals as a guide to achieve our shared vision for Lake Superior.

6.1 ACCOMPLISHMENTS/PROGRESS

The following chapter recognizes many accomplishments over the past two years; however, readers should note that these are not all of the actions that have been taken to restore and protect the basin. The committees are tracking projects completed in furtherance of the LaMP; these represent a sample of projects initiated and/or completed in the past two years. The format of this chapter contains sections discussing broad, watershed-scale projects, updates on native and non-native species efforts, and outreach and education initiatives (see Chapter 2 for additional outreach efforts).

6.1.1 Watershed Initiatives/Protection/Restoration

This section presents updates on initiatives to protect or restore the ecological health of the Lake Superior watershed.

Important Habitat in the Lake Superior Basin. The Lake Superior Binational Program emphasizes protective measures for fish, plant, and other wildlife habitat over costly restoration once damage has occurred. Nonetheless, restoration is critical in areas where ecological functions are impaired. In 1991, the governments of Michigan, Minnesota, Wisconsin, and Ontario agreed to identify critical habitats and continue habitat reclamation projects already under way to restore fisheries, wildlife, and wetlands in the basin. As a result, the Habitat Committee produced a map showing important habitat in the Lake Superior basin and the ecological features of each site. In 2006, the map was revised to include additional information about the sites already listed, and to identify other important habitat areas within the Lake Superior basin. Copies of the map are available—simply contact one of the Habitat Committee co-chairs listed at the end of this chapter.

Canadian Watercourse Stewardship Project Update. Benthic macro-invertebrates are indicator species that respond to ecosystem changes faster than other members of the aquatic community. Trends and changes in aquatic invertebrate populations and community structure can serve as indicators of short-term, action-required stresses that may ultimately influence the aquatic community of Lake Superior. These organisms are the focus of the Watercourse Stewardship Project, a joint endeavour between the Superior Work Group and the Binational Forum. The benthic community composition in a number of Lake Superior tributary streams that are considered to be “healthy” is being compared to that found at selected sites in areas that are believed to be impaired in order to determine the biological health of these waterways. The stewardship component of this project involves public education and the creation of a “Citizen’s Guide to Monitoring Water Quality” that allows the general public to sample stream communities and determine local water quality conditions. Bug Trading Cards were also produced to encourage youth to take an interest in the region’s waterways and the organisms that live in them.

Monitoring Forest Management Impacts on the Headwaters of Lake Superior Migratory Brook Trout Rivers – Lake Superior’s Forest Fish. Planned forest management activities within Lake Superior tributaries that support coaster brook trout have raised concerns about the

potential impacts of changes in flow regimes and stream temperature. Increases in peak flow and stream temperatures, as well as alterations to groundwater inputs, that may result from forest management activities have the potential to alter in-stream habitat structure and thermal regimes and adversely affect the spawning and rearing habitat that is critical to brook trout. Researchers with Ontario's Centre for Northern Forest Ecosystem Research in Thunder Bay are evaluating forest landscape characteristics (e.g., geology, forest type, topography) and have established monitoring reaches to measure stream flow, temperature, and biological characteristics (e.g., water chemistry, aquatic invertebrates, fish communities) in Lake Superior watershed streams catchments. The study uses a before/after, control/impact design to evaluate the influence of different levels of watershed timber harvest on stream flows, water temperature, and biological characteristics of small streams that contribute directly and indirectly to brook trout habitat. The study will help quantify the risks posed by forest management activities to brook trout habitat and will provide recommendations to mitigate risks during forest management planning.

Hog Island and Newton Creek Habitat Master Plan. The Hog Island and Newton Creek Ecological Restoration Master Plan provides a blueprint for the restoration of natural communities and ecosystem processes for Newton Creek, the Hog Island Inlet, and Hog Island in Superior, Wisconsin. Historically, this area has been contaminated by industrial discharges and a former municipal combined sewer overflow. From 1997 to 2005, multiple partners remediated the contaminated sediments in Newton Creek and Hog Island Inlet. Through a process of stakeholder engagement and collaboration, the Ecological Restoration Master Plan intends to build upon the success of these remediation efforts by proposing a guiding vision as well as specific goals, objectives, and actions that will help to restore terrestrial, riparian, wetlands, and aquatic habitats; increase ecosystem biodiversity and resilience; and reduce threats to the natural communities in the area. The plan also intends to increase environmental awareness, community enjoyment, and economic vitality through passive recreational, educational, and stewardship opportunities. Because the area is part of the St. Louis River Area of Concern (AOC), the restoration of Hog Island, Hog Island Inlet, and Newton Creek is a critical link in a much larger process to preserve the Great Lakes.

Watershed Plans Spreading Across Michigan's Upper Peninsula. Since 2006, several more watershed plans have been approved by the Michigan Department of Environmental Quality (MDEQ) including the Sault Ste. Marie Watershed Plan and the Salmon Trout River Watershed Plan. Watershed plans in Michigan are approved by the MDEQ as meeting requirements under either Section 319 of the Clean Water Act or for accessing state funding through the Clean Michigan Initiative (CMI). Encouragement of watershed plan development throughout the Lake Superior basin is one of the objectives of the Habitat Committee. Each of the watershed plans shares the objectives of promoting coordinated and collaborative actions amongst stakeholders and providing guidance for implementation of actions that will reduce existing water quality impacts and provide a basis for protection from future impacts. The following watershed plans have been approved by MDEQ in the Lake Superior basin:

- Whetstone Brook and Orianna Creek Watersheds – City of Marquette;
- Chocolay River Watershed – Marquette County;
- Munising Bay Watershed – City of Munising and Alger County;
- Lower Dead River Watershed – City of Marquette;

- Trap Rock River Watershed – Keweenaw and Houghton Counties;
- Otter River Watershed – Houghton, Baraga and Ontonagon Counties;
- Sault Ste. Marie Watershed – City of Sault Ste. Marie; and
- Salmon Trout River – Marquette County.

Figure 6-1. Watershed management plans lead to restoration actions. The Whetstone and Orianna Creek Watershed Management Plan for Marquette, Michigan, identified this old abandoned culvert on the Orianna Creek as causing erosion and sedimentation to the stream, as well as being a barrier to fish passage. Photo credit: Superior Watershed Partnership.

Figure 6-2. In 2007, a grant from US EPA Great Lakes National Program Office allowed the Superior Watershed Partnership, Upper Peninsula Resource Conservation and Development Council, and Michigan Waterfowl Association to remove the culvert and stabilize the banks of Orianna Creek. Photo credit: Superior Watershed Partnership.

Field Evaluation of Water Crossings in the Lake Superior Basin. Roads and water crossings constructed during forest management operations are widely considered to pose a significant risk to fish and fish habitat. The Ontario Ministry of Natural Resources (OMNR) and the Canada Department of Fisheries and Oceans (DFO) have jointly developed *The Protocol for the Review of Water Crossings Proposed Through the Forest Management Planning Process.* The protocol includes a "Risk Evaluation Procedure" to evaluate the potential risk posed by planned water crossings. The goal of this study is to conduct a field-based evaluation of water crossings installed following the review and risk evaluation to determine the effectiveness of the protocol at mitigating risk. The field survey will focus on Lake Superior tributary river systems, some of which are used by migratory fishes in Lake Superior, including coaster brook trout. These systems are particularly sensitive to habitat fragmentation resulting from improperly constructed crossings. The project will develop an efficient field monitoring protocol, quantify risk factors associated with water crossings, and contribute to the validation and revision of the review protocol.

Habitat Manipulation Study Attempts to Improve Habitat for Brook Trout. The lack of quality spawning and early fry stage rearing habitat is severely limiting brook trout population abundance on the Little Sioux River. Rehabilitation of Lake Superior brook trout is a top

priority of Wisconsin's Lake Superior Basin Brook Trout Management Plan, the Lake Superior Fisheries Management Plan, and the Lake Superior LaMP.

A graduate student from the University of Minnesota-Duluth is conducting a habitat improvement project on the Little Sioux River that will re-expose natural habitat features critical to brook trout that are buried under excessive sand. The objectives of this project are to measure changes in physical habitat, invertebrates, and fisheries before and after a habitat improvement project. Sand movement will be restored and critical spawning features re-exposed by manually removing the footprints of old beaver dams, small woody debris, and overhanging speckled alder.

Michipicoten River Hydroacoustic Assessment of Fish Passage Relative to Regulated Flows. Lake Superior fish access up the Michipicoten River is limited by a hydroelectric power development several kilometres up river from the lake. Excellent spawning habitat exists below the dam; however, these areas are subject to dewatering and flushing on a regular basis as the hydro facility holds or releases water. The OMNR is presently undertaking acoustic enumeration of both spring and fall spawning runs in relation to flow over a three-year period. The findings will highlight the effects on native species and ecosystem function. This information will be used to support decision-making in the river management planning process.

The Paradise Island Nature Reserve. The Thunder Bay Field Naturalists Club, a non-profit organization, purchased Paradise Island, which is located in the Lake Superior National Marine Conservation Area and the Lake Superior Archipelago on the south side of St. Ignace Island, south of Nipigon. The island is about 28 hectares (60 acres) and is exposed to the open waters of Lake Superior. Paradise Island is recognized by the OMNR as an Area of Natural and Scientific Interest (ANSI) because of its extensive raised cobble beaches, unusual stunted windswept vegetation, and arctic disjunct plants. The majority of the island was privately owned and slated for cottage development. The Thunder Bay Field Naturalists have added this property to its 385 hectares (950 acres) of ecologically-significant land holdings in the region. This project was supported by the Greenlands Program, an OMNR-Nature Conservancy of Canada initiative. Additional support for this purchase was provided by two Canadian conservancy organizations: the EJLB Foundation and the McLean Foundation.

Nipigon River Land Acquisition: Gapen's Pool

Gapen's Pool. Photo credit: OMNR.

Brook trout have very specific habitat needs, requiring sites with substantial groundwater springs for successful spawning and incubation. While such locations are relatively rare in Lake Superior, there are three known spawning sites on the lower Nipigon River, attracting lake-dwelling brook trout from across Nipigon Bay and beyond. The major spawning area is in Gapen's Pool, where massive springs fed by groundwater create perfect opportunities for spawning. This area is currently in a relatively undisturbed condition, although much of the surrounding landscape is developed. In the LaMP 2006, the protection of Gapen's Pool was identified as a "Next Step" that needed to occur in order to protect critical lake and tributary habitat.

The property adjacent to this critical spawning area consists of 24 hectares (60 acres) of vacant land positioned along the east bank of the Nipigon River south of Lake Helen and is the major recharge area for groundwater discharging into the northeast corner of Gapen's Pool. In March 2007, Trout Unlimited Canada successfully purchased this property with the support of the OMNR and its partner the Lake Superior Advisory Committee, Parks Canada, Trout Unlimited U.S., and through the generous donations of individuals, corporations, and foundations. A conservation plan will be developed to protect and conserve the critical functions that this property provides to brook trout in the Nipigon River specifically, and to the restoration efforts in Lake Superior.

Graphic depiction of Nipigon River area. Photo credit: OMNR.

Great Lakes Environmental Indicators (GLEI) Project Update. The US EPA funded a five-year major competitive research grant (2001-2006) to the University of Minnesota-Duluth to develop a new generation of environmental indicators for coastal regions of the U.S. Great Lakes. The project focused on the coastal and nearshore zone for the entire U.S. portion of the Great Lakes from Lake Ontario to Lake Superior. The project included over 27 scientists in a consortium of 10 universities and was a cooperative agreement with US EPA's Mid-Continent Ecology (MED) Division in Duluth.

The final report for the project was completed in the spring of 2006, and a special issue of the *Journal of Great Lakes Research* [Vol. 33 (Special Issue 3), 2007] that primarily focuses on results from the GLEI effort will be released in 2008. A full copy of the report can be found at the following website: http://glei.nrri.umn.edu/default/documents/GLEI_final_VersionVIII.pdf

Overall, the GLEI effort measured eight major responses, each with different sampling methodologies and sample size requirements. These indicators included populations of amphibians, birds, diatoms, fish, macroinvertebrates, and wetland plant communities. In addition, contamination due to polycyclic aromatic hydrocarbons (PAHs) and land cover in the U.S. Lake Superior basin was characterized. Field sampling was completed with a random stratified design that incorporated over 200 stressor variables among six major categories: agriculture, atmospheric deposition, land cover-land use, human population densities, point source pollution, and shoreline modification. Field sampling was completed primarily in 2002 and 2003, while the landscape characterization was completed for 1992 and compared with the characterization for 2001 to determine land use change. The number of sites sampled in the Lake Superior coastal region for the various components were the following: 110 sites for birds, 12 sites for PAH contamination, 40 sites for diatoms, 32 sites for fish and macroinvertebrates, and 25 sites for wetland vegetation. In addition, US EPA-MED sampled more than 15 sites as well as extensive regions of the nearshore zone in the western portion of Lake Superior.

The results indicated that agriculture and population density had major influences on the indicator responses for all of the components studied. Strong signals in birds, diatoms, fish, and macroinvertebrates were observed in areas where either agriculture was predominant in the landscape or where human population densities were greatest. Considerable variation in responses was exemplified at different spatial scales and many at surprisingly large scales. PAH contamination was found in several of the major areas of industrial activity such as in the St. Louis River of Minnesota and Wisconsin. Land use change in the Lake Superior basin was not as extensive as found in the southern and eastern portions of the U.S. Great Lakes basin; however, there was some conversion of forested areas to urbanized, residential, or ex-urbanization areas within the basin. In general, the Lake Superior basin and nearshore areas, as indicated from the biological responses measured, were in relatively good condition compared to many portions of the southern and eastern U.S. Great Lakes coast. However, many wetland and high-energy shores had conditions that were approaching the highly degraded regions of the southern and eastern U.S. Great Lakes areas. These data provide some of the most extensive and comprehensive sampling ever completed for a substantial portion of the U.S. Lake Superior coastal region. These data also provide a solid baseline that will allow comparisons to be made with future changes in coastal resources, and will potentially provide a mechanism to track further degradation or improvements in health of the coastal region of Lake Superior.

The special issue of the *Journal of Great Lakes Research* referenced above will include 22 peer-reviewed papers. These papers are listed in the reference section at the end of this chapter.

Great Lakes Wetlands and Habitat Initiative. The Great Lakes Regional Collaboration's (GLRC) December 2005 *Strategy to Protect and Restore the Great Lakes* identifies habitat and wetlands degradation as a key threat and provides recommendations for protection and restoration. The GLRC's Wetlands and Habitat Initiative is working to address these recommendations. As a first step, the initiative is focused on protecting and restoring 200,000 acres of wetlands in the Great Lakes basin. Efforts to date include:

- Establishment of a Steering Committee with members from federal agencies; state, local, and tribal governments; and non-governmental organizations (NGOs) to help guide the initiative.
- Development of a habitat project and funding database to link projects with funding sources for restoration projects.
- Request for data in order to provide an estimate of the number of wetland acres protected, restored and improved by federal agencies and their partners since the release of the December 2005 GLRC Strategy.
- Production of a report that describes progress, the habitat project and funding database, key issues, and next steps. The report is under final review for release to the public.

Whittlesey Creek National Wildlife Refuge Update. The Whittlesey Creek National Wildlife Refuge was established along Lake Superior near Ashland, Wisconsin, in 1999 by the U.S. Fish and Wildlife Service (USFWS). Whittlesey Creek is a small refuge with a big impact on the lake and local communities. Acquisition includes the coastal wetland at the head of Chequamegon Bay, three tributary streams, and their floodplains. Habitats were altered since early European settlement by logging, farming, road and railroad building, and stream dredging. Native brook trout were almost extirpated from the Whittlesey Creek watershed. The USFWS has been acquiring lands, restoring habitats, and rehabilitating brook trout populations over the past eight years.

Figure 6-3. White pine planted in Whittlesey creek refuge. Photo credit: Darienne McNamara, USFWS.

During 2006 and 2007, activities at the refuge included projects in four areas. First, almost 5,000 trees were planted in the floodplains of Whittlesey Creek and Little Whittlesey Creek, where land had been cleared and farmed in the late 1800s and early 1900s. Second, a stream restoration project involved replacing a culvert that was a barrier to fish within the refuge with one that is now passable for fish and other aquatic life. The project opened four miles of stream to fish passage above the former barrier, providing important habitat for brook trout. Third, 10 acres of wetland in the refuge was

hydrologically restored in 2006. This restoration allowed sheet-flow on the floodplain and created several shallow pools for migratory birds. Native sedges, grasses, and forbs were planted on about two acres of the site in 2007. Finally, the USFWS and Wisconsin Department of Natural Resources (WDNR) are conducting an experiment to examine whether a self-sustaining migratory brook trout population can be established in Whittlesey Creek by stocking, enacting protective regulations, and improving habitat improvement. The stocking component involves paired stocking of multiple life stages of two Isle Royale strains with known lake-dwelling life history.

These activities advance goals and objectives that are part of the Refuge's Habitat Management Plan and the Brook Trout Plan for Wisconsin's Lake Superior basin. In addition, they advance the restoration of an important habitat site as identified on the Binational Program's map of important habitat conditions in the Lake Superior basin.

Fond du Lac Band of Lake Superior Chippewa is Restoring an Important On-Reservation Watershed. The Fond du Lac Resource Management Division (RMD) is engaged in a comprehensive hydrologic study and restoration activities in the Stoney Brook watershed, which encompasses over half of the reservation at 59,248 acres. Its headwaters include the reservation's premier wild rice lakes, designated as "Outstanding Reservation Resource Waters" in the Band's federally-approved Water Quality Standards. The Stoney Brook watershed was extensively ditched under judicial order in the early 1900s to drain wetlands and open up acreage for crop agriculture, which was generally unsuccessful. The substantial hydromodification of this ditch system persists and has resulted in detrimental fluctuating water levels in the wild rice lakes, significant stream and riparian habitat impairment, and disconnected wetlands throughout the watershed.

Recent activities in the watershed include:

- The development of a continuous hydrologic model using extensive field data;
- The development of a comprehensive Stoney Brook Watershed Management Plan that will incorporate management objectives including water level management in wild rice lakes, identifying stream and ditch reaches for habitat restoration, improving wetland function and forest management, and providing a road map for future implementation projects; and
- The construction of control structures to assist in water level management of wild rice lakes, and use of mechanical cutters and harvesters to remove several hundred acres of aquatic plants that have succeeded in the areas that once supported wild rice. Coupled with aggressive re-seeding efforts, these management activities will help restore much of the lost wild rice resource within the reservation.

Watershed Health Initiative Aimed at Reducing Runoff. Many groups throughout the Lake Superior basin are taking a keen interest in their watershed. A group of government, nonprofit, industry representatives, and citizens called the Wisconsin Lake Superior Basin Partner Team developed a watershed health initiative aimed at slowing the flow of water runoff from the land in the Lake Superior basin. Land use changes over the last century have increased the volumes and rate that water runs off the land, resulting in flooding, erosion, and sedimentation in streams.

As a result, Lake Superior tributaries in Wisconsin have changed shape and character and carry a heavy load of sand and sediment.

Figure 6-4. Ashland County (Wisconsin) Land Conservation Committee Chairman George Mika discusses agriculture's role in the Marengo River Watershed at an information meeting.
Photo credit: S. Schultz, Stable Solutions LLC.

The Partner Team obtained funding from the Great Lakes Commission and U.S. Forest Service to develop guidance for hydrologic assessment as the first step in watershed planning. The group applied the U.S. Forest Service and U.S. Department of Interior "Framework for Analyzing the Hydrologic Condition of Watersheds" to the Marengo River watershed as a test case. Based on that experience, the group developed a guide adapted to the unique needs of the Lake Superior basin. The guide provides a step-by-step process that describes how to assemble a review team, find mapping information, find information for Lake Superior basin watersheds, and how to evaluate watershed features. The hydrologic condition assessment identifies the most important factors or activities that affect the timing, volume, and velocity of water runoff. The guide and the Marengo River Watershed Test Case were completed in 2007. Partner Team members will present the guide to groups interested in watershed planning. The guide and Marengo test case documents are available from the University of Wisconsin-Extension Lake Superior Basin Educator and at http://basineducation.uwex.edu/lakesuperior/watershedmgmt.htm.

Figure 6-5. Silver Creek culvert failure in 2003. Photo credit: S. Schultz, Stable Solutions LLC.

6.1.1.1 Special Designations

National Marine Conservation Area Established on Lake Superior. In October 2007, the Government of Canada announced the creation of the country's newest National Marine Conservation Area (NMCA). More than 10,000 square kilometres of Lake Superior, including the lakebed, islands, and north shorelands within the NMCA boundaries, make up the largest freshwater marine protected area in the world. NMCAs are part of the Parks Canada family of protected areas. They consist of protected zones and cooperatively managed multiple-use areas where activities such as commercial fishing and shipping continue. Dumping, mining, oil and gas exploration and extraction are prohibited within the park boundaries.

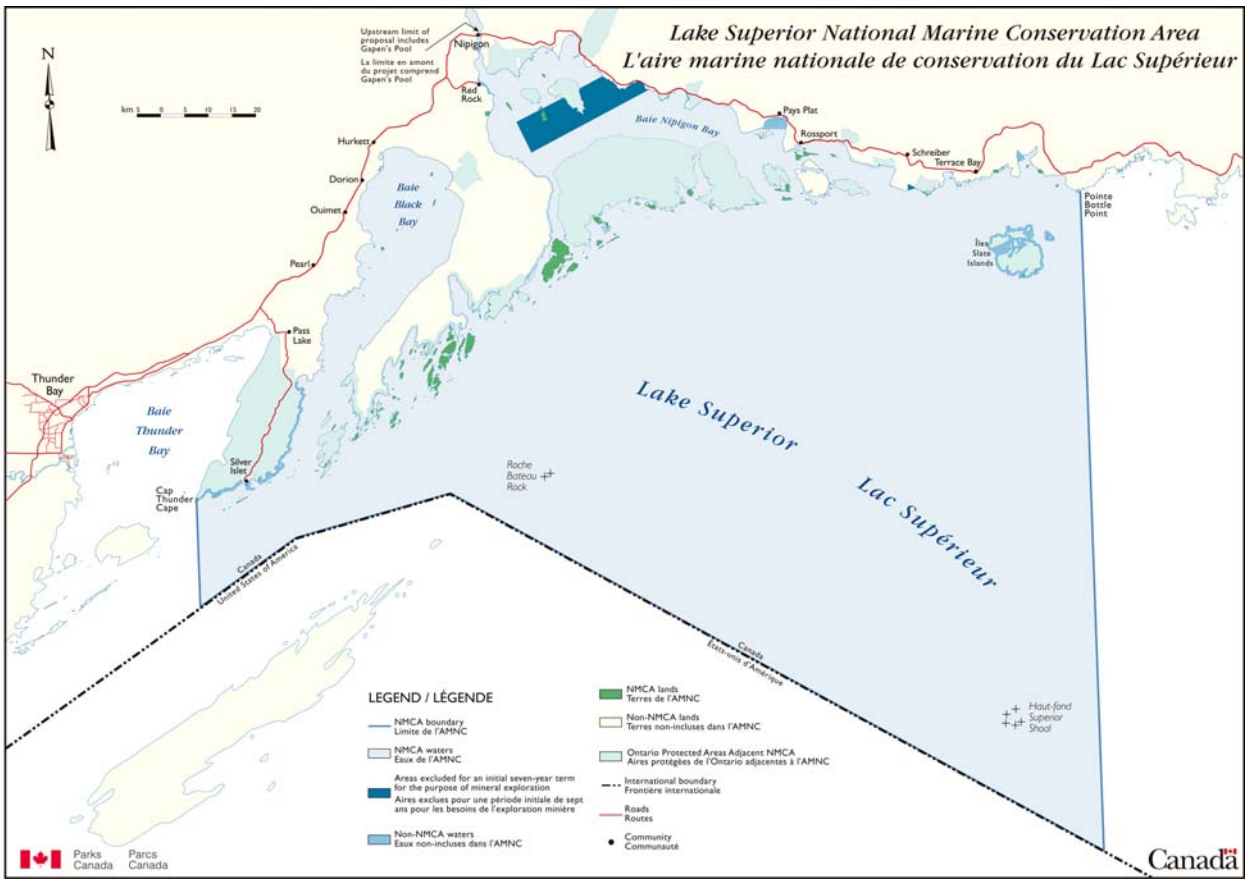


Figure 6-6. The National Marine Conservation Area in Lake Superior, established by the Government of Canada in 2007, represents the largest freshwater marine protected area in the world. Photo credit: Parks Canada.

Outstanding Resource Water Protection in Wisconsin. New rules relating to Lake Superior basin waters to better protect Lake Superior from wastewater pollution were adopted by the Wisconsin Natural Resources Board on April 26, 2006. The new rules will create a consistent approach across Minnesota, Michigan, and Wisconsin in implementing the Governors' agreement to manage Lake Superior as a zero discharge demonstration zone. Under revisions to Wisconsin's administrative code, the designation of Lake Superior tributaries currently classified as Outstanding Resource Waters (ORW) is expanded to trigger additional levels of protection. These proposals modify the existing ORW designation for selected tributaries to include a one-quarter-mile arc within Lake Superior at the mouth of each of those tributaries. In addition, waters within one-quarter mile of the islands of the Apostle Islands National Lakeshore would also be classified as ORW. A third part would prohibit any new or increased discharges of the targeted pollutants to waters of the basin unless the discharge was the result of utilization of best technology in process or control.

NERR Site Selection Process Underway in Wisconsin. The National Estuarine Research Reserve (NERR) System is a nationwide network of protected coastal estuaries that are designated and supported through the National Oceanic and Atmospheric Administration (NOAA). The NERR program integrates research, outreach, and stewardship activities related to estuary resources, including Great Lakes freshwater estuaries. NERR sites represent a formal

partnership between federal and state governments, but they also often include a variety of other partners and resources. There is local, statewide, and national interest in designating a Wisconsin Lake Superior NERR site, which would represent only the second freshwater estuary site in the nationwide NERR system.

In September of 2006, Wisconsin initiated the process of selecting a Lake Superior site to nominate for NERR designation. The process built upon previous and ongoing grassroots efforts to raise awareness and appreciation of Lake Superior's freshwater estuaries. The University of Wisconsin-Extension, Wisconsin Department of Administration-Coastal Management Program, and WDNR are leading this process for the State of Wisconsin. Representatives from over 25 organizations assisted by participating in two project teams. The process evaluated 35 sites located on Lake Superior's southern shore for their suitability as a NERR site, and evaluation criteria were used to narrow the list of potential sites to three options. Community input was then gathered regarding the remaining candidate NERR sites. In early 2008, state agency representatives will use the gathered information to recommend a Lake Superior site to Wisconsin's governor for nomination to NOAA as a Wisconsin NERR site.

National Forests Consider Special Designations. All four national forests within the Lake Superior basin (Hiawatha, Ottawa, Chequamegon-Nicolet, and Superior) have had forest plan revisions since 2004. These plans help address many of the LaMP watershed, habitat, terrestrial wildlife, and fisheries issues, and all are available online through http://www.fs.fed.us/r9/. Research Natural Areas (RNA's) are part of a national network of natural areas designated in perpetuity for research and education and/or to maintain biological diversity on National Forest Service lands. RNA's are designed for non-manipulative research, observation, and study. The National Forest Service has identified 69 candidate RNA's (forestwide data—not all are in the Lake Superior basin). These will be evaluated further for possible designation as RNA's.

Salmon Trout Designated as "Endangered River." In their 2006 report *America's Most Endangered Rivers*, the conservation group American Rivers has designated the Salmon Trout River in the Upper Peninsula of Michigan as the fourth most endangered river in the U.S. This is not a formal governmental designation but a local designation by a private group.

A proposed nickel/copper sulfide mine will be constructed directly beneath the river, if mining permits are approved. The Salmon Trout River flows into Lake Superior west of Marquette, Michigan, and has the only known remaining breeding population of coaster brook trout on the southern shore of Lake Superior. Significant efforts to restore and enhance this brook trout population are ongoing, and a Management Plan was recently approved for the watershed.

According to the American Rivers report, "The threat of contamination from acid mine drainage is a concern in any sulfide mining operation, and the proposed Eagle Mine project is no exception. Because the ore body is located directly under the river, and the mining site will be directly adjacent to this, any acid mine drainage that occurs would have a direct impact on river and groundwater quality. Such contamination in the river could bring serious harm to water quality — potentially contaminating the drinking water supply, and seriously harming the natural habitat of the unique native species. Even minute quantities of these toxins are deadly to juvenile coaster brook trout."

6.1.2 Native Species Rehabilitation/Protection

The following section describes progress in efforts to rehabilitate or protect native species in the Lake Superior basin.

Herptile Work Update. As discussed in the LaMP 2006, reptiles and amphibians have been identified as a critical group of species to be monitored by the State of the Lake Ecosystem Conference (SOLEC) and the LaMP 2000, as they are sensitive to human-caused perturbations and chemical contaminants, and many species are in decline worldwide. Dr. Steve Hecnar (Lakehead University, Ontario), and Dr. Gary Casper (Great Lakes Ecological Services and Casper Consulting) have developed and field-tested a basinwide amphibian and reptile monitoring program during 2006 and 2007. Representative sampling sites on both the Canadian (Thunder Bay and Lake Superior Provincial Park) and U.S. (Pictured Rocks National Lakeshore, Michigan, and Moquah Barrens, Wisconsin) portions of the Lake Superior basin were sampled. Project components include monitoring site selection, intensive multi-species surveys, database and data repository development, and statistical analyses. Statistical analyses will utilize a proportion of area occupied (PAO) model that is capable of incorporating data from existing monitoring programs for basinwide analysis.

While data analysis is still underway, preliminary results suggest that detection probabilities vary among species, sites, sampling sessions, and methods. Most species expected at sampling sites were detected, and it is believed that some highly effective sampling techniques have been documented. The final report is due in the spring of 2008.

Results should be applicable throughout the Lake Superior basin for use in amphibian and reptile habitat protection and restoration. The ability will be established to monitor up to 21 species and determine trends in species occupancy. The ability to detect species declines or increases will have direct bearing on both aquatic and terrestrial habitat management for these species within the basin's forests, grasslands, wetlands, lakes, and streams.

Mapping of Important Fish Habitat. Efforts continue to develop a relationship between habitat quantity and quality and fish production in Lake Superior (LaMP 2006). Our knowledge of what substrates are present (sand, clay, gravel, cobble), in what surficial quantity, at what depth, and exactly where they are relative to other substrates or bottom features is slowly increasing.

Since 2006, several new substrate mapping projects were completed that target habitat for native lake sturgeon, brook trout, walleye, and lake trout in nearshore waters and tributary sites. Recent projects include Buffalo Reef (see next article below), Gull Island, and Sand Cut shoals in Wisconsin waters. Between 2005 and 2007, seventeen lentic areas encompassing 1,718 hectares have been mapped, and a total of 196 hectares have been treated for sea lamprey larvae. Future developments include the incorporation of remote-sensing data to improve the classification of sea lamprey habitats.

Wave Energy and Water Currents Move Stamp Sands Toward Buffalo Reef. Mining wastes, such as the stamp sands (the crushed ore from copper mining), leach concentrations of metals in water that have been found above toxicity thresholds for many animal and plant

species. Mining wastes have been identified in the Lake Superior LaMP 2000 as a principal stress to aquatic habitat in Lake Superior.[1]

The Gay Peninsula, located along the eastern shore of the Keweenaw Peninsula immediately south of the town of Gay, Michigan (and its copper smelter), is composed almost entirely of stamp sands. Tribal fish harvesters have become increasingly concerned about the movement of stamp sands and effects that the deposits may have on Buffalo Reef, an important spawning reef for lake trout and lake whitefish located south of the Gay Peninsula. The impairment of this reef could lead to a decline in important species and impact the tribal population that depends on this resource. Buffalo Reef is an important spawning area in Lake Superior (Goodyear et al. 1982).

The lakebed was classified into seven categories, and four of those were acoustically distinct types of sand substrate. As indicated in the Canadian National Water Research Institute's (NWRI's) report, the acoustic classification method was not able to distinguish areas of stamp sand from areas of native sands. This may be due to mixing of sands that has occurred since the stamp sands were deposited. Further work should be done to ascertain whether a clear boundary exists between native sands and stamp sands. A visual inspection of samples collected in the field by the NWRI indicates that the area of sands immediately north of Buffalo Reef appears to be stamp sands regardless of its acoustic signature. Field staff also observed transport and mixing of sands due to wave action. Therefore, despite the uncertainty regarding the precise nature of the sands, it is reasonable to assume that stamp sands continue to be transported from the areas immediately surrounding the Town of Gay into areas of Lake Superior immediately north of Buffalo Reef.

Differences between Deep and Shallow Forms of Lake Trout. Deepwater forms of lake trout, abundant in Lake Superior, were once present in Lakes Michigan and Huron. The effort to restore self-sustaining populations of lake trout to the Great Lakes has been ongoing for over 50 years. These efforts have focused nearly exclusively on the lean (shallow-water) form and have been successful only in Lake Superior. Researchers have estimated that approximately 50 percent of the volume of Lakes Michigan, Huron, and Ontario are unpopulated due to lost deepwater forms of fish, including lake trout (Eshenroder and Burnham-Curtis 1999). This estimate reinforces the idea that rehabilitation of lake trout in the Great Lakes will not be complete until a diversity of body forms is restored (Krueger and Ihssen 1995; Eshenroder and Krueger 2002).

Rehabilitation of deepwater lake trout will require a scientific basis for understanding deepwater forms and how they differ from those found in shallow water. In 2006 and 2007, researchers from the Great Lakes Fishery Commission (GLFC), USFWS, and National Park Service (NPS) sampled all forms of lake trout around Isle Royale, Michigan. The GLFC research team will examine phenotypic and genetic diversity of lake trout in the Isle Royale region of Lake Superior and compare that with fish from Great Slave Lake, Great Bear Lake, Lake Mistassini, and the Klondike Reef area of Lake Superior. This work will help determine whether lake trout morphs in Lake Superior and Great Slave Lake represent biologically discrete groups or a continuum of body shapes. The relation of body shape to body size, lake, depth at capture, and diet will also be determined.

[1] Lake Superior LaMP 2000, pp. 8-10.

Figure 6-7. Siscowet have a high fat content, unlike nearshore lean lake trout. Photo credit: Michigan Department of Natural Resources, Marquette, Michigan.

Siscowet Surplus Production Dynamics. Fisheries management agencies around Lake Superior are jointly assessing siscowet (a deepwater lake water variety) populations to gain a broader understanding of their ecological role in Lake Superior. Information on relative abundance, food habits, and age and size composition are needed. These fish have a high fat content (unlike nearshore lean lake trout), and interest has been expressed in developing a siscowet commercial fishery to harvest them for their omega-3 oil content. In anticipation of a new fishery, agencies are working to determine the annual sustainable yield of siscowet that could be expected. It is from this type of information that interested parties will determine whether rendering siscowet for their oil is economically feasible.

Important Prey Fish in Lake Superior - Learning About Cisco Survival at Various Life Stages. The two largest remaining lake herring or cisco commercial fisheries on the Great Lakes are supported by the Thunder Bay and Black Bay, Lake Superior, stocks. Lake herring are also an integral component of the Lake Superior pelagic fish community and a forage base for top predator fish species in Lake Superior. The sustainability of these fisheries relies on controlling the harvest in relation to the size of the populations. With support from the OMNR, the United States Geological Survey-Biological Resources Division (USGS) research ship the *Kiyi* is conducting fall acoustic surveys in these waters. These surveys, to estimate the abundance of pre-spawning cisco, in conjunction with commercial monitoring of the harvest, will provide biomass estimates of the spawning stocks and, ultimately, exploitation rates.

Figure 6-8. Acoustic surveys are being conducted in Lake Superior to determine the sustainability of cisco commercial fisheries. Photo credit: USGS.

Wolf Delisted in Upper Great Lakes. The U.S. removed the western Great Lakes population of gray wolves from the federal list of threatened and endangered species in 2007. The action was taken by the USFWS in recognition of the success of gray wolf recovery efforts under the Endangered Species Act.

Gray wolves were previously listed as endangered in the lower 48 states, except in Minnesota, where they were listed as threatened. The USFWS's removal of the gray wolf from the endangered and threatened species list applied only to the Western Great Lakes Distinct Population Segment (DPS), which includes all the areas currently occupied by wolf packs in

Minnesota, Michigan, and Wisconsin, as well as areas in these states in which wolf packs may become established in the future. A portion of this population is found in the Lake Superior basin.

When the wolf was first listed as endangered in the 1970s, only a few hundred wolves remained in Minnesota. Recovery criteria outlined in the Eastern Timber Wolf Recovery Plan include the assured survival of the gray wolf in Minnesota and a population of 100 or more wolves in Wisconsin and Michigan for a minimum of five consecutive years. The recovery plan identified 1,250 to 1,400 as a population goal for Minnesota. The region's late winter gray wolf population now numbers approximately 4,000 and occupies portions of Wisconsin, Michigan, and Minnesota. Wolf numbers in the three states have exceeded the numerical recovery criteria established in the species' recovery plan.

The Michigan, Minnesota, and Wisconsin Departments of Natural Resources (DNRs) have developed plans to guide future wolf management actions. Protection of wolves, control of problem animals, consideration of hunting and trapping, as well as maintenance of the long-term health of the wolf population will be governed by the appropriate state or tribe.

Figure 6-9. In 2007, the western Great Lakes population of gray wolves was removed from the federal list of threatened and endangered species. Photo credit: National Park Service.

Once a species is removed from Endangered Species Act protection, there are several safeguards to help ensure it continues to thrive, including a mandatory five-year monitoring period. The USFWS also has the ability to immediately relist a species on an emergency basis, if monitoring or other data show that is necessary.

Who's Eating Whom in the Western Arm of Lake Superior. Lake Superior's fish community continues to change due to recovering lake trout populations, naturalization of introduced salmonids, declines in rainbow smelt populations, and fluctuating cisco year classes. One recently completed study used bioenergetics modeling of predator fish in the western arm of Lake Superior, including Minnesota and Wisconsin waters, to provide a comprehensive picture of community dynamics. Simulations of consumption by predators in 2000 and 2004 revealed current trends, and enabled comparisons to previous studies in the late 1980s and early 1990s. Modeling results were completed in 2007 for nearshore and offshore areas, for three ecoregions representing geographically distinct areas, and for Minnesota and Wisconsin waters within the western arm. Results indicate that the western arm of Lake Superior is at or near carrying capacity for predators. Lean lake trout are responsible for most consumption of rainbow smelt and coregonines, while the deepwater form of lake trout known as siscowet ranks second in

predatory consumption. Although individual Chinook salmon consumed more prey fish per unit time than did any other species, they along with other potadromous species played minor roles in total consumption. Because most predators in the western arm are wild fish, and survival of stocked predators has declined dramatically, managers no longer have the ability to control prey populations through stocking. Periodic hydroacoustic assessments of forage fish populations, predator diet monitoring, and bioenergetics analyses of predator consumption are warranted to track predator-prey dynamics, provide data for management of the fisheries, and quantify the allocation of prey species for the commercial fishery in the western arm of Lake Superior.

Efforts to Monitor and Report on the Status of Shortjaw Cisco in Lake Superior. The shortjaw cisco is one of four forms of deepwater ciscoes known in Lake Superior and is designated as threatened across Canada. Since the 1800s, ciscoes have been extensively fished commercially in the Great Lakes. Shortjaw cisco were preferred due to their large size and relative ease of capture. Overexploitation, invasive species, and habitat impairment have been responsible for the dramatic decline of this once abundant species. Little is known about the biology of this species, and the setting of recovery targets, critical habitat, and allowable harm all hinge on knowledge of biology, taxonomy, and population parameters such as population size, growth, and mortality. Initial investigations on Lake Superior have determined that shortjaw cisco are sparsely distributed and occur at historically low densities. For the past two years, OMNR and DFO have partnered in sampling efforts to determine the distribution, abundance, and life history of this species. This work will contribute to recovery planning for this species.

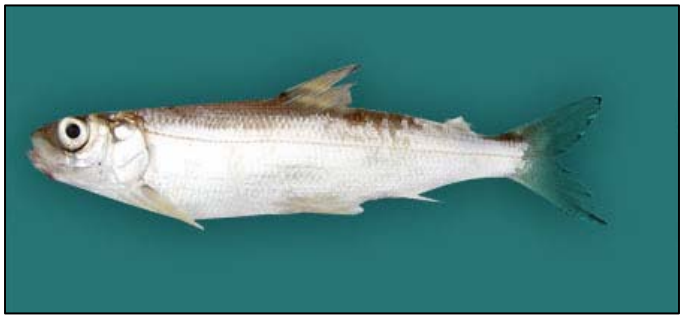


Figure 6-10. Shortjaw cisco. Photo credit: K. Schmitt, OMNR.

Coaster Brook Trout Subject of Federal Review. On March 20, 2008, the USFWS announced in the Federal Register the 90-day finding on a petition to list the U.S. population of coaster brook trout (*Salvelinus fontinalis*) as endangered. The USFWS found that the petition contained substantial scientific or commercial information indicating that listing the U.S. population of coaster brook trout may be warranted. With the publication of the notice, the USFWS began a status review of the coaster brook trout. At the conclusion of the status review, the USFWS will issue a 12-month finding on the petition. To ensure that the status review of the coaster brook trout is comprehensive, the USFWS is soliciting scientific and commercial information regarding the coaster brook trout throughout its range. More information is available at http://www.fws.gov/midwest/eco_serv/soc/fish/cobr/index.html.

Factors Limiting Brook Trout Abundance Examined. Factors limiting brook trout abundance in tributary streams along the Wisconsin shore of Lake Superior are not well defined but are important for developing strategies to rehabilitate the fishery for migratory coaster brook trout. Salmonid abundance in 38 stream reaches within 22 streams in 12 watersheds was measured to evaluate associations between salmonid abundance and stream habitat. Brook trout are more abundant in headwaters but are present in downstream reaches. Although brook trout abundance differs between upstream and downstream reaches, size structure appears similar. The downstream reaches differ in some of the habitat variables measured (flow, depth, width) but are also warmer. Both the brook trout distribution and the assemblage composition suggest that brook trout distributions are influenced by temperature. Brown trout abundance is not different between stream reaches, nor is coho abundance, and no consistent relation between abundance of brook trout and other salmonids was observed. Based on this observation and the explanatory power of the temperature and community data, we would not recommend pursuing competition studies. The most meaningful approach to brook trout conservation in these systems is to protect the groundwater and vegetation that maintain cold water.

On the Brook Trout Restoration Trail

Around Lake Superior, agencies and research continue to address knowledge gaps related to rehabilitation/restoration needs of brook trout in Lake Superior and its tributary streams. In Nipigon Bay, Ontario, and at Pictured Rocks National Lakeshore, Michigan, researchers with OMNR, DFO Canada, and Northern Michigan University are engaged in a multi-year tagging and stationary fish logging station study to investigate what causes some brook trout to remain in their native streams for life, while others leave the streams to inhabit the Lake Superior environment. The projects are also attempting to identify at what stage some young brook trout leave their native streams and what environmental conditions might trigger their emigration.

Cross stream antennas at the logging station record movement of fish tagged with internal transponders. Photo credit: OMNR.

Lake Superior Shoreline Waters Surveyed for Coasters. Tribal and federal agencies involved with coaster brook trout rehabilitation and stocking conducted surveys of coasters along over 100 km of shoreline waters in Lake Superior in 2006 and 2007. Coaster surveys occurred along the Grand Portage Indian Reservation in Minnesota; Red Cliff Reservation and Chequamegon Bay, Wisconsin; Keweenaw and Huron Bays, and Isle Royale, Michigan.

Walleye Rehabilitation and the Black Sturgeon River Dam. Restoration efforts for walleye in Black Bay have progressed from that reported in the LaMP 2006 report. Recent work has led to the conclusion that the construction of the Black Sturgeon Dam in the 1960s was the primary cause for the collapse and subsequent failure of the population to recover due to loss of access to spawning habitat. Radio tracking by OMNR and DFO has demonstrated that both walleye and

lampreys are present at the base of the dam in the spring. The dam benefits the Lake Superior ecosystem as a barrier to sea lamprey spawning but also prevents recovery of walleye by denying access to historic spawning areas. With this conflict revealed, work has begun with the Great Lakes Fishery Commission barrier task team to develop options for fish passage at the Black Sturgeon Dam. The OMNR and its agency and public partners are approaching the process with a number of objectives: (1) restore the natural ecological function of the Black Sturgeon River, (2) re-establish historical migration routes for native fish species (e.g., walleye, lake sturgeon), and (3) limit movement of non-native species (sea lamprey, Pacific salmon) into the Black Sturgeon watershed.

Figure 6-11. The Black Sturgeon Dam blocks walleye access to historic spawning areas, preventing walleye recovery in Black Bay. Photo credit: OMNR.

Walleye Rehabilitation in the Lower Nipigon River and Nipigon Bay. Restoration efforts of walleye in the Nipigon River system have been underway for many decades via transfer stocking of adults, zero harvest regulations, and habitat rehabilitation. With indications that walleye stocks may be responding, OMNR has undertaken a synthesis of all the data collected to date to determine the population trajectory. Moving forward, the historic walleye spawning area in the river is being assessed for its present condition and potential for future use by spawning fish. This area is thought to comprise the main spawning areas for the Nipigon Bay walleye population. A trap netting and telemetry study in partnership with the Red Rock Indian Band and Ontario Power Generation is also underway to determine the status of walleye in Nipigon Bay and identify important habitat.

Levels of Persistent Toxics in Nestling Bald Eagles in Lake Superior and in Adjacent Inland Waters. In 2006, the U.S. NPS's Great Lakes Inventory and Monitoring Network (GLKN) began long-term monitoring of persistent, bioaccumulative toxics (PBTs) using bald eagle nestlings as sentinels. Sampling was conducted at Apostle Islands National Lakeshore, St. Croix National Scenic Riverway, and Mississippi National River and Recreation Area in 2006 and 2007. Blood and feather samples were collected and analysis performed for PCBs, DDT (including breakdown products DDE and DDD), mercury, lead, and three emerging contaminants (PBDE, PFOS, and PFOA). The latter three contaminants are widely used as flame retardants (PBDE) and water/stain repellents (PFOS and PFOA) and have come under increasing scientific and regulatory scrutiny.

Preliminary results of the 2006 data indicate that, when compared to the past work of others, PCBs and DDE concentrations in Lake Superior eaglets continue to decline from highs in the 1970s. However, active DDT was found in three of ten nestlings sampled on Lake Superior, but only one of 26 nestlings from inland areas. Mercury concentrations were lowest in nestlings from Lake Superior and the Greater Twin Cities and highest in nestlings along the upper portions of the St. Croix and Namekagon Rivers where extensive wetlands likely contribute to its

production and availability. Lead concentrations were highest in nestlings from the Twin Cities but were generally low elsewhere. Patterns of occurrence for PBDEs mirrored those of PCBs, highlighting the similarity in transfer pathways and the persistence of the two chemical groups. PBDEs were found in all nestlings sampled, and the data suggest a near doubling of the concentrations in nestlings along the south shore of Lake Superior over the last five years. Levels of PFOS were highest in the Greater Twin Cities, followed by the Lake Superior nests, and levels were lowest in the upper St. Croix and Namekagon River system.

The GLKN plans to sample the three parks on a two-years-on and two-years-off basis. The next sampling is planned for 2010 and 2011.

White River Fish Passage Concern. Two extensive log jams are present in the White River, Wisconsin, as a result of poor logging practices and an emergency release of water from a dam malfunction. These log jams may prevent lake sturgeon passage upstream to historic spawning habitat. In 2006, the USFWS and Bad River Band of Lake Superior Chippewa began a two-year project to determine whether lake sturgeon are able to swim upstream past the log jams during spring flows regulated by the dam.

Lake sturgeon adults were captured, tagged, and released in the lower river, downstream of the log jams. Sampling was also conducted upstream of the log jams to determine if tagged lake sturgeon could move past the log jams. A second means to determine if spawning run fish were able to access upstream spawning habitat was to capture larval sturgeon during their downstream drift, which occurs shortly after hatching.

Adult spawning run lake sturgeons were captured each year in the lower river downstream of the log jams. Flow in 2006 was about 150 cubic feet per second (cfs) below the long-term average, which ranged from about 300 to 500 cfs during the spawning period. Only a single lake sturgeon was captured upstream of the log jam, and no larval sturgeon were encountered. In 2007, flow was again low and averaged about 200 cfs during the spawning period. However, seven adults were captured upstream of the log jams, and successful reproduction was confirmed by the capture of a larval lake sturgeon.

Figure 6-12. Larval lake sturgeon. Photo credit: USFWS Ashland, Wisconsin.

2006 Great Lakes Lake Sturgeon Coordination Meeting. In November 2006, the third Great Lakes Lake Sturgeon Coordination Meeting was held in Sault Ste. Marie, Michigan. The purpose of these meetings is to provide a forum to foster communication and exchange of information relating to the study, management, and restoration of lake sturgeon in the Great Lakes basin, to address priority research and assessment needs, and to address selected emerging issues. Over 120 individuals attended the meeting, representing more than 40 different entities

including state, tribal/First Nation, federal and provincial governments, academic, private, and other NGOs.

As with previous meetings, the 2006 Coordination Meeting addressed several focus areas and emerging topics. The four focus areas covered were habitat use and juvenile ecology, genetics and management implications, streamside rearing, and assessment technologies. The emerging issue theme addressed sturgeon legal issues such as illegal harvest, increased market interest for caviar as world sturgeon stocks decline, and the proposed listing of the lake sturgeon as an endangered or threatened species in parts of Canada.

Streamside Lake Sturgeon Culture for the Ontonagon River. Lake sturgeon were once abundant in the Ontonagon River, Michigan, but adults were not recovered during several survey attempts in the 1980-1990s by the Michigan DNR and USFWS. Stocking began in 1998 and continued until 2004 from eggs collected from a local, wild fish stock but reared in a traditional hatchery. To increase the likelihood for imprinting, which takes place in very newly hatched fish, a streamside rearing facility that utilizes water from the Ontonagon River was established. In 2007, young lake sturgeon were raised from approximately 85,000 eggs taken from a population in a nearby river. Eggs were fertilized, incubated, and hatched. Approximately 1,000 young were successfully reared to 6 inches in length and were released into the Ontonagon River in the fall of 2007. Streamside rearing will again take place in 2008 at the facility, and some individual fish remaining from the 2007 effort will be tracked using radio telemetry.

Assessment of Lake Sturgeon Stocking and Rehabilitation Progress. Assessments of the rehabilitation stocking effort in the Ontonagon River have been limited in scope and conducted primarily in the river. To evaluate stocking progress and to describe the status of lake sturgeon in Lake Superior near the Ontonagon River, the USFWS, Keweenaw Bay Indian Community, Michigan DNR, and Great Lakes Indian Fish and Wildlife Commission initiated a pilot project to assess juvenile lake sturgeon. The project utilized the fall walleye index netting (FWIN) protocol developed in Ontario (Morgan 2002).

Prior to being stocked, a microscopic coded wire tag is inserted in the snout of each fish. During surveys, each juvenile lake sturgeon captured is checked for the presence of a coded wire tag to determine if it is a stocked or naturally produced fish. In 2006 and 2007, ninety-seven juvenile lake sturgeon ranging from 401 mm to 986 mm were captured. Coded wire tags were detected in 84 fish, positively identifying them as stocked fish. In addition, a thumb-nail-size piece of tissue was collected from the fins of all fish without a coded wire tag. Fin clips will be genetically analyzed to determine the parental stock of these fish. The sturgeon captured were tagged and released. If these fish are captured during future Lake Superior survey work, agencies will obtain data on the growth and movement of these fish.

Flow Manipulation Study for Lake Sturgeon Rehabilitation. On the Kaministiquia River in Thunder Bay, OMNR and Ontario Power Generation continue to partner in a detailed radio telemetry study aimed at documenting the migratory response of spawning lake sturgeon to controlled flow conditions over Kakabeka Falls. The movement of adult sturgeon up to the historic spawning area at the falls is being monitored and is followed by a detailed larval drift netting assessment to document spawning success under the different annual spring flow

conditions set out by the study plan. Work also continues to monitor the movements of radio-tagged adult sturgeon on the Black Sturgeon River via remote data loggers. These fish are also barred from accessing historic spawning areas by the Black Sturgeon Dam. In Nipigon Bay, preliminary investigations on the Gravel River are underway to determine if reproduction is occurring (drift netting for larvae).

Figure 6-13. OMNR and Ontario Power Generation are partnering in a flow manipulation study for lake sturgeon rehabilitation. Photo credit: OMNR.

6.1.2.1 Lower Trophic Level Research and Monitoring

LaMP 2006 reported on multi-agency cooperative efforts to sample the lower trophic levels of the Lake Superior food web.[2] Sampling and analysis of previously collected data continued in 2006 and 2007 by researchers from Environment Canada, DFO, OMNR, University of Minnesota-Duluth, Michigan Technological University, University of Wisconsin-Superior, WDNR, US EPA Great Lakes National Program Office and Mid-Continent Ecology Division, and USGS. Objectives are to assess the density and biomass of lower trophic level invertebrates, as well as spatial and temporal variations in nearshore and offshore areas of Lake Superior. Organisms comprising the lower trophic levels include phytoplankton, zooplankton, *Mysis* (tiny free-swimming crustaceans), and *Diporeia* (tiny bottom-dwelling amphipods) across the lake. A summary of the activities, progress, and select findings of these agencies are described below. Numerous publications and reports will be generated by this research.

[2] LaMP 2006. Chapter 6, pp. 13-16. Available at: http://www.epa.gov/glnpo/lakesuperior/.

Zooplankton

As described in detail in LaMP 2006, the offshore summer crustacean communities in Lake Superior are dominated by calanoid copepods, particularly the large, deep-living species *Limnocalanus macrurus* and *Leptodiaptomus sicilis*. Cladocerans make up a relatively small proportion of summer biomass, with the cladoceran community dominated by the large non-daphnid species *Holopedium gibberum*, a taxon typically associated with oligotrophic (cold, low nutrient) waters. Both total biomass levels and community composition have remained relatively consistent over the last decade.

Diporeia

Researchers have documented dramatic declines in *Diporeia* abundance and distribution in the lower Great Lakes. This has generated concerns that fish, particularly lake whitefish that rely heavily on these organisms for food, will be affected. In Lake Superior, *Diporeia* are most abundant in waters less than 100 m and tend to increase with depth from inshore to offshore (Figure 6-14). Within this depth zone, densities have remained relatively stable over time (Figure 6-15). At most sites deeper than 100 m, *Diporeia* densities have shown an overall downward trend during the monitoring period, although there has also been substantial variation.

One project, sponsored by the Michigan Great Lakes Protection Fund, has resulted in a description of the natural history of Lake Superior *Diporeia*, including nutrition (lipid content, gut fullness) and production (length-weight relationships, production to biomass ratios and year class structure). Progress has also been made in relating the distribution of amphipods to the deposition of organic carbon in Lake Superior and to the primary production in nearshore regions.

Scientists used the results of their *Diporeia* studies to develop a depth-based sampling scheme with coverage across Lake Superior. This design includes nearly 50 sites including many that have been monitored for up to 10 years.

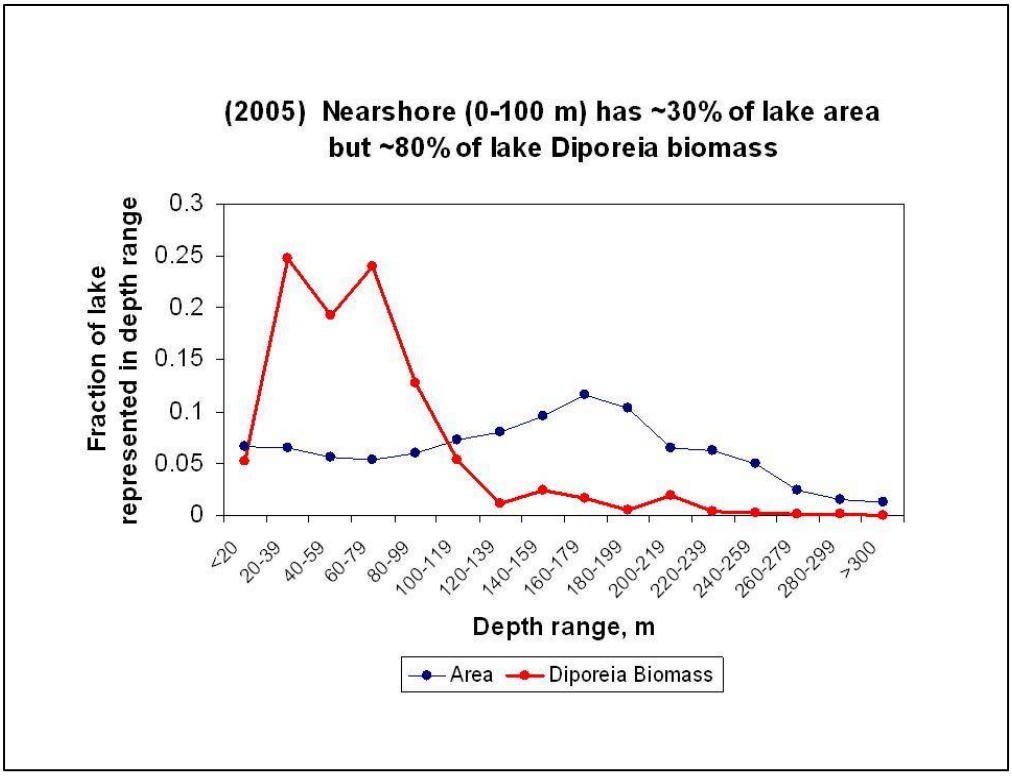


Figure 6-14. Abundance of Diporeia in Lake Superior at varying depths. Source: US EPA.

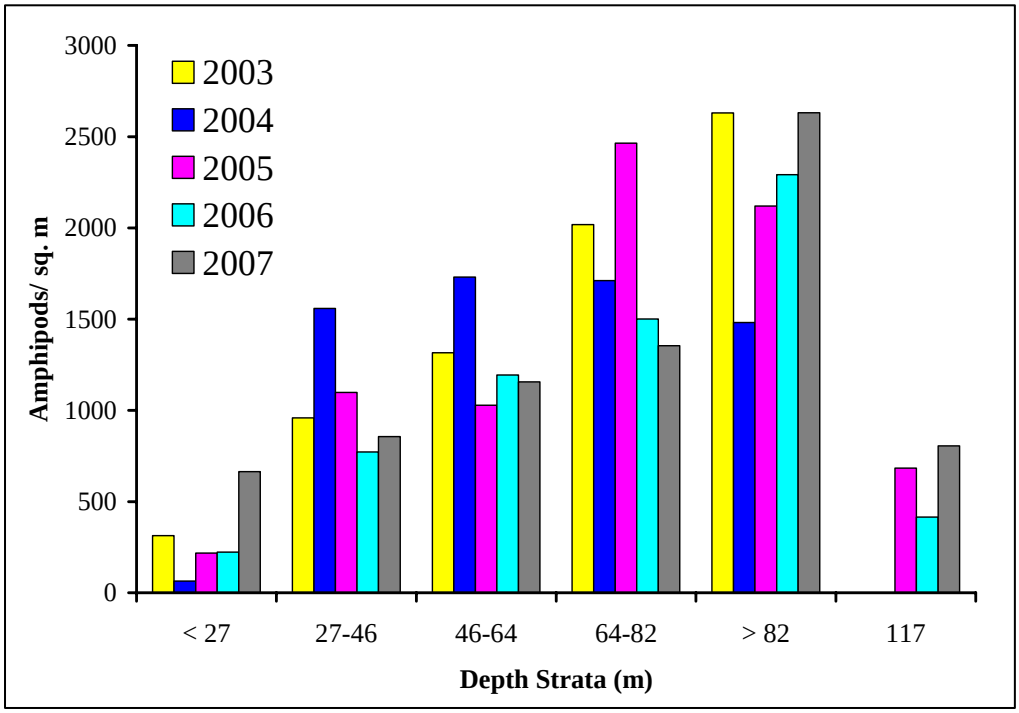


Figure 6-15. Diporeia abundance related to depth strata in Wisconsin waters of Lake Superior. Source: Steve Schram, WDNR.

Mysis

Mysis, commonly known as the opossum shrimp, is the largest invertebrate in Lake Superior. It occupies primarily hypolimnetic waters and has a simple lifecycle of approximately 2 years in Lake Superior. *Mysis* exhibits diel vertical migration, migrating up in the water column at dusk and descending to deeper water at dawn. *Mysis* eat detritus, phytoplankton, zooplankton, and benthos and are an important prey item for most species of fish at one life-stage or another.

Mysis were sampled during spring, summer, and fall in 2005. In 2006, a subset of sites from 2005 was sampled in each of the three seasons; while a number of new sites were sampled once during summer. The total number of sampling events in 2005 was 60, with 10, 18, and 32 stations visited in spring, summer, and fall. Slightly more stations were sampled in offshore waters than in nearshore waters, with the demarcation at 80 m. In 2006, fewer sites were sampled, but these will provide information on inter-annual variability.

Figure 6-16. *Mysis* were sampled in offshore and nearshore Lake Superior waters in both 2005 and 2006 to assess variations on density with depth. Photo credit: USGS.

Mysis density on a per-square-meter basis was greater in offshore than in nearshore waters across all three seasons (Figure 6-17). Mean density ranged from about 140 to 165 individuals/m^2 in offshore waters. Mean density in nearshore waters was about 30 individuals/m^2 in spring and fall but was higher in summer at about 80/m^2. The higher estimate in summer was due to one station with density estimates around 285/m^2. Mean density at each station increased with depth, similar to findings from other Great Lakes. A comparison of density estimates in Lake Superior compared to the other Great Lakes both historically and today is shown in Figures 6-18 and 6-19.

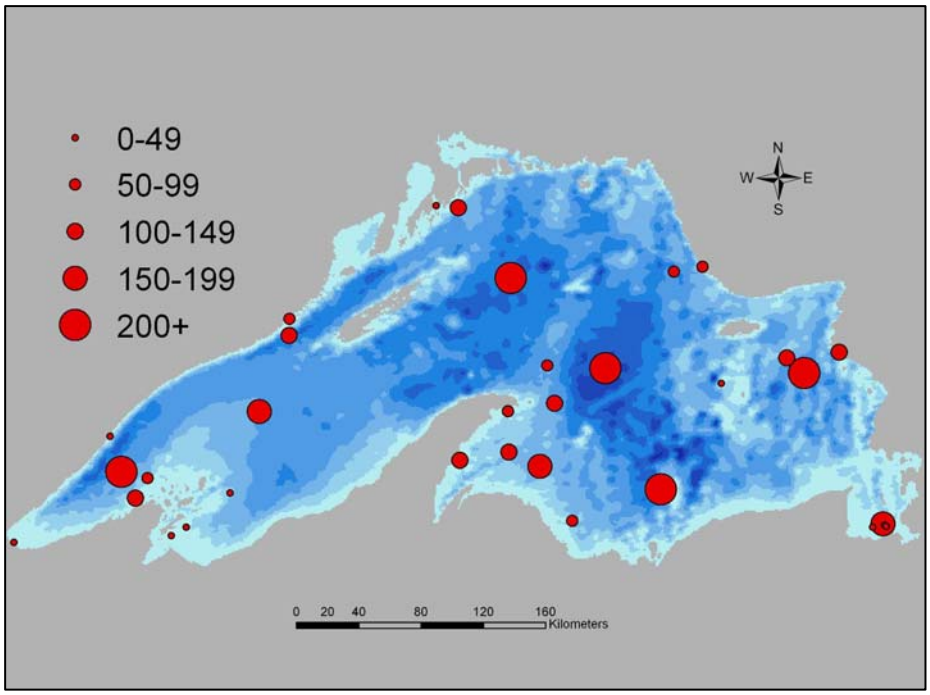


Figure 6-17. Mean density averaged among seasons for each station in 2005. Circle size is representative of *Mysis* density, with blue water showing bathymetry. Source: USGS.

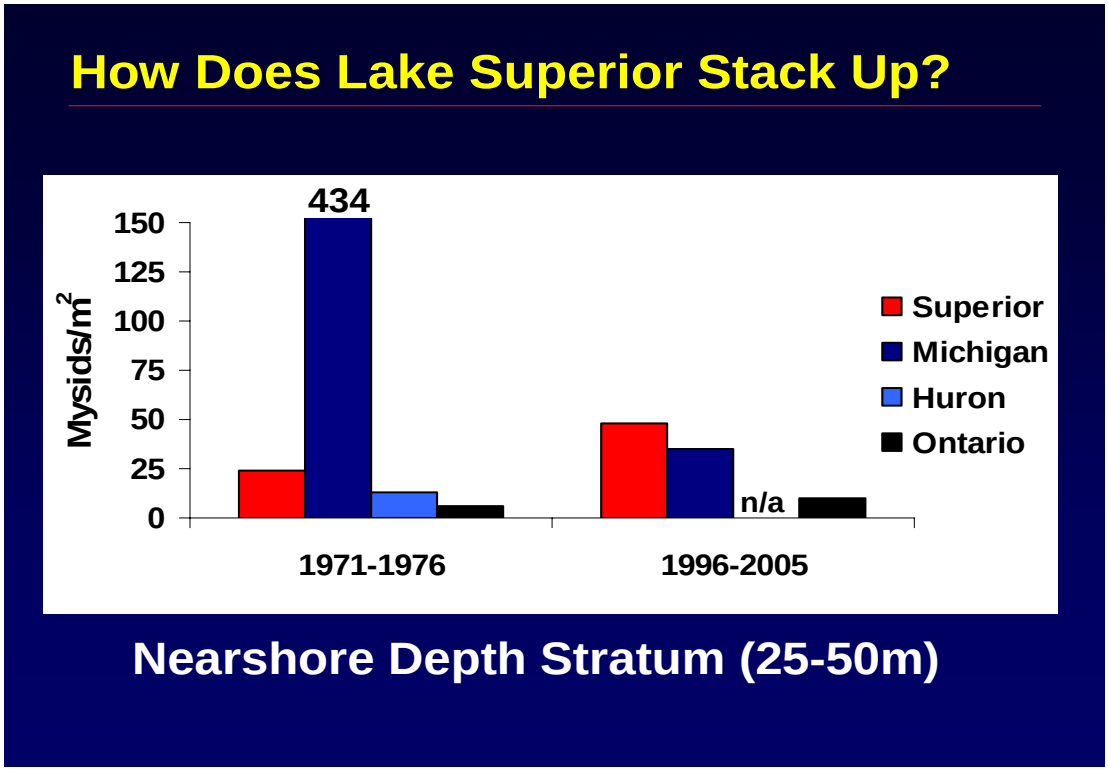


Figure 6-18. *Mysis* density in the Great Lakes at nearshore depths, 1971-1976 and 1996-2005. Source: USGS and US EPA.

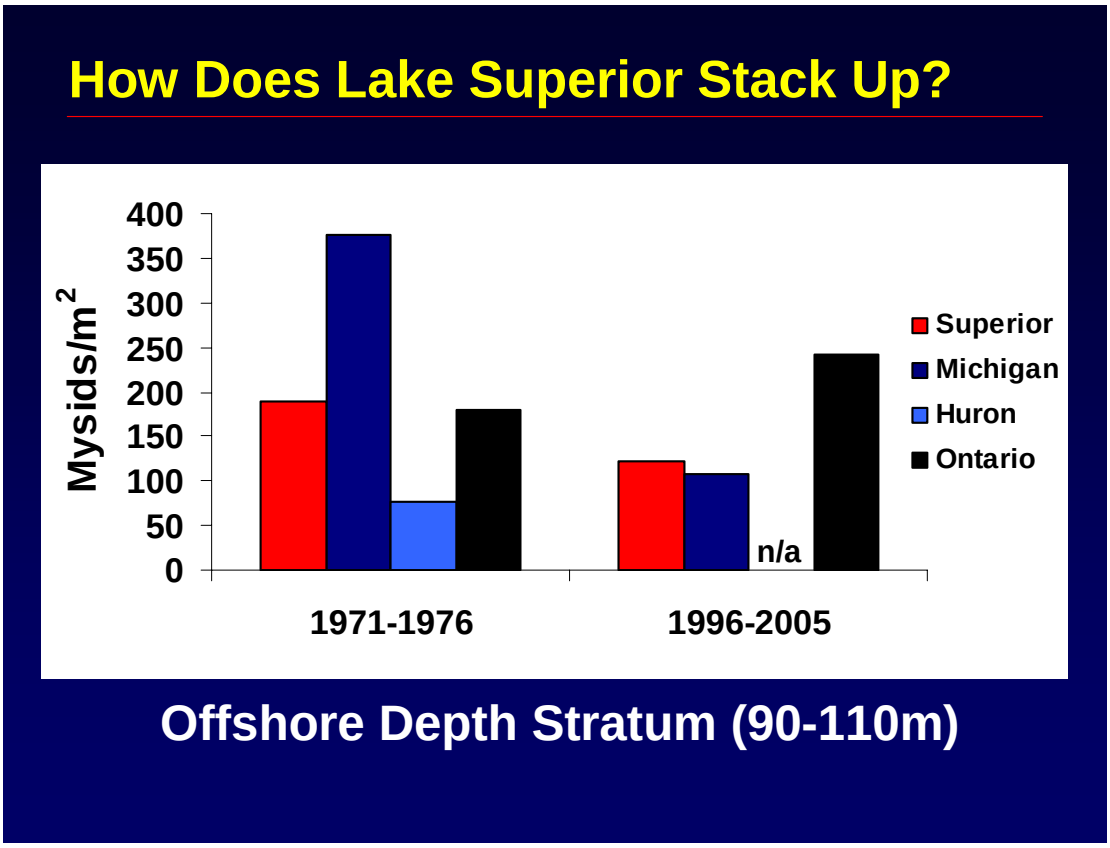


Figure 6-19. *Mysis* density in the Great Lakes at offshore depths, 1971-1976 and 1996-2005. Source: USGS and US EPA.

Putting the Pieces Together in Lake Superior. Lower trophic level samples collected in 2005 and 2006 are part of a larger study that also involves fish. These data will be used to examine food web relations in both nearshore and offshore waters, with particular emphasis on the importance of *Mysis* and *Diporeia* to the entire fish community. To understand Lake Superior dynamics, and to manage the fisheries as effectively as possible, it is important to integrate "top-down" (focus on fisheries) and "bottom-up" (focus on the physical/chemical environment, and the lower trophic levels) approaches, since abiotic and physical features provide the hydrologic and geochemical context in which all biologic interactions occur. One method of achieving this integration is through the use of ecological models, which are capable of integrating across multiple trophic levels and provide a statistically testable means for ecosystem assessment.

An upcoming study will use biomass size spectrum modeling to examine variability in trophic transfer resulting from differing food chain lengths, nearshore versus offshore environments, and anthropogenic development along the Lake Superior shoreline. In addition to the biomass size spectrum modeling, a detailed diet analysis of the gut contents of the predominant planktivorous and piscivorous fish species in the lake will be conducted. Overall, this research will provide comprehensive information on diet preferences in economically valuable fish communities, the identification of functional groups in the Lake Superior ecosystem, new information for fisheries

modeling, and multiple evaluations of the similarities and differences between the nearshore and offshore communities in this large lake.

The detailed diet analysis of the offshore communities will provide insight into the food preferences of the offshore community and allow comparisons of prey consumption with trawl and hydroacoustic estimates of prey availability, and thus identification of whether prey availability might be limiting offshore populations. Diet analyses of the nearshore food webs will provide a more comprehensive understanding of nearshore diet preferences, and findings can be extrapolated to apply to the other Great Lakes, indicating a set of reference conditions for some of the threatened or extirpated native species in the other Great Lakes (e.g., lake trout, all sculpin species, and siscowets lake trout).

One of the most significant findings to date is that 90 percent of all kiyi (deepwater chub) stomachs contained solely *Mysis*, as opposed to cisco (lake herring), which contained a mixture of zooplankton species. This result shows a potentially important difference in food sources in the two most abundant prey fish species in the lake.

6.1.3 Nuisance Species Developments/Efforts

Emerald Ash Borer (EAB) Update. This insect was introduced into North America sometime in the 1990s. It was first reported killing ash (genus *Fraxinus)* trees in the Detroit and Windsor areas in 2002. It continues to spread, and infestations have been found in the eastern Upper Peninsula and throughout lower Michigan, Ohio, northern Indiana, northern Illinois, Maryland, and recently in Pennsylvania and Toronto, Ontario (Figure 6-20).

Within the Upper Peninsula, EAB was first detected at Brimley State Park in Chippewa County in September 2005 and more recently was found at Straits State Park in Mackinac County in November 2007. Quarantines are in place prohibiting the transport of ash wood from either county. At Brimley State Park, all ash trees greater than one inch in diameter were removed within a half mile of the detection site. As yet, no additional EAB have been detected within this area. At Straits State Park, officials are determining the extent of the infestation before prescribing control or eradication strategies. To date, over two thousand trap trees have been established throughout the Upper Peninsula to facilitate EAB detection.

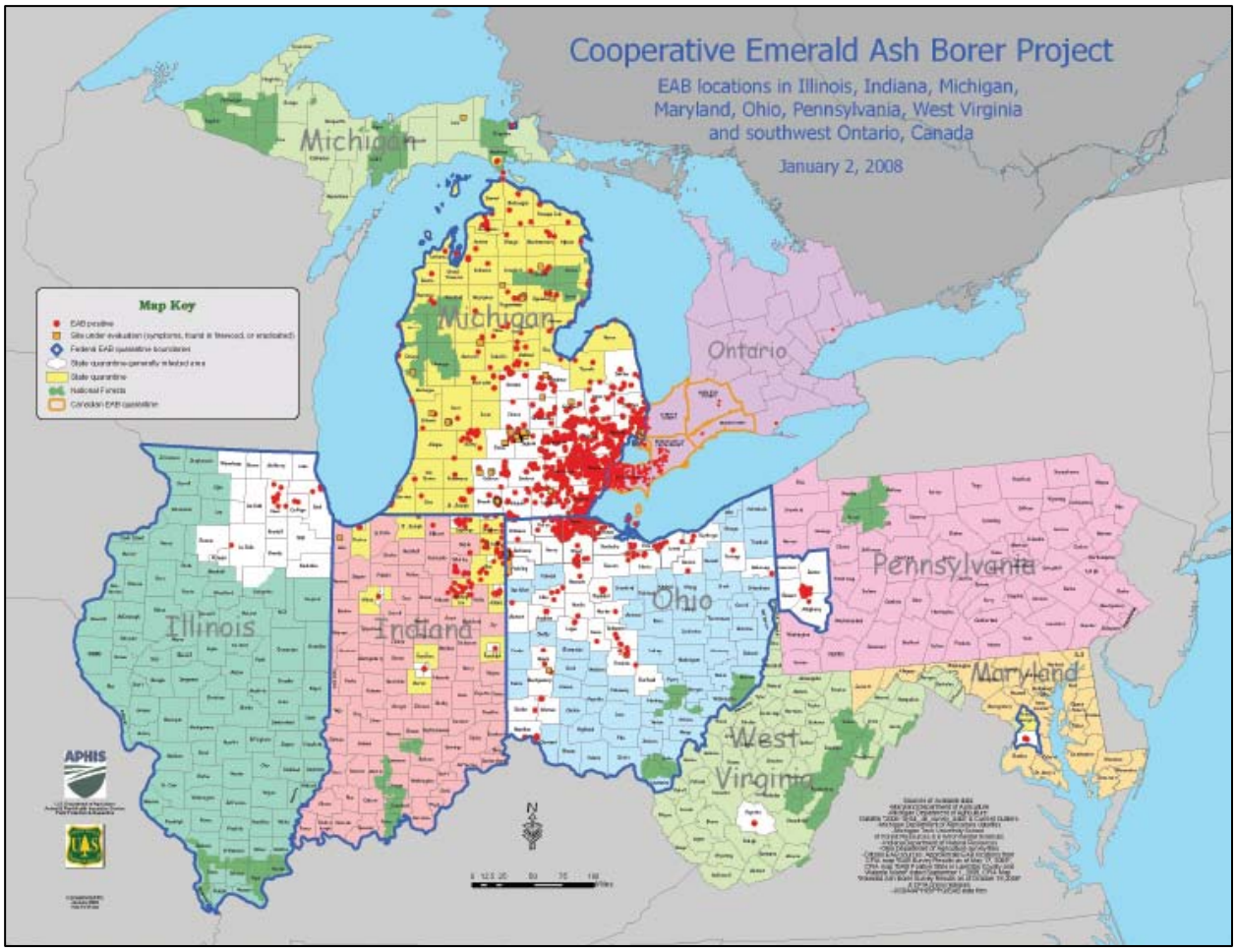


Figure 6-20. The Emerald Ask Borer continues to spread, with infestations in the eastern Upper Peninsula and throughout lower Michigan, Ohio, northern Indiana, northern Illinois, Maryland, Pennsylvania, and Ontario. Source: U.S. Department of Agriculture.

Invasive Free Zone Update. The goal of this long-term project, initiated in 2005, is to create an invasive free zone (IFZ) by eradicating invasive plants and restoring wildlife habitat on the Whittlesey Creek National Wildlife Refuge, associated private lands, and adjacent U.S. Forest Service property at the Northern Great Lakes Visitor Center (720 acres total). The project applies a systematic approach to control invasive species and restore wildlife habitat on a landscape scale. The first phase involved mapping to determine the extent of invasive species within the project boundary. In 2006, the focus shifted to treatment, and the restoration of infested areas began in 2007. After two years of refining mapping and treatment methods, project staff wrote a long-term management plan that can be found online at www.fws.gov/midwest/WhittleseyCreek/.

Another document developed as part of this project is the Invasive Free Zone Guidebook. It provides a resource for those who would like to establish an IFZ elsewhere and provides information to allow any interested agency, organization, or individual to create a new IFZ based on the original demonstration project. The guidebook can be found at

http://www.fws.gov/midwest/WhittleseyCreek/documents/IFZGuidebook.pdf. In addition to the guidebook, project staff are available to provide technical assistance. The Eastern Region of the U.S. Forest Service (a member of the Binational Program) has issued a challenge to national forests to create new IFZs, and other agencies are showing interest as well. Project staff hope to leverage existing support to continue the IFZ project and ultimately expand the existing boundaries of the IFZ to eradicate invasive species on a larger scale.

Figure 6-21. Members of the 2007 Youth Conservation Corps and IFZ staff at the Chequamegon Bay Invasive Free Zone. Photo credit: USFWS.

VHS - New Aquatic Invasive Species Cause for Concern in Great Lakes. Viral Hemorrhagic Septicemia (VHS) is a deadly fish virus that has been recently detected in lower Great Lakes freshwater fish. It has NOT yet (as of March 2008) been found in Lake Superior. VHS can infect a wide range of fish species and has been the cause of large fish kills in other parts of the Great Lakes. The VHS found within the Great Lakes is closely related to the VHS strain detected within Atlantic and eastern Gulf of St. Lawrence waters. VHS is considered an invasive species (not native to the Great Lakes), but scientists are not sure how it arrived. It may have come in with migrating fish from the Atlantic Coast, it may have hitch-hiked in ballast water from ships, or it may have been introduced by infected fish being imported, stocked, or used for bait. Other potential ways of spreading the virus are recreational boating/angling or waterfowl movements.

We now know that VHS was the cause of Great Lakes fish kills as early as 2003. This virus was diagnosed for the first time in the Great Lakes as the cause of large fish kills in Lake Huron, Lake St. Clair, Lake Erie, Lake Ontario, and the St. Lawrence River in 2005 and 2006.

Thousands of muskies, walleye, lake whitefish, freshwater drum (sheepshead), yellow perch, gizzard shad, redhorse, and round gobies died. Many chinook, white bass, emerald shiners, smallmouth bass, bluegill, black crappie, burbot, and northern pike were diseased but did not die in large numbers. This is the first time a virus has affected so many different fish species from so many fish families in the Great Lakes. VHS has no impact on human health.

Figure 6-22. While VHS has no impact on human health, the virus can kill infected fish. Photo credit: Dr. Jim Winton, USGS.

VHS is transmitted when infected fish shed the virus in their urine and reproductive fluids. VHS particles in the water infect gill tissue first, and then move to the internal organs and the blood vessels. The blood vessels become weak, causing hemorrhages in the internal organs, muscle, and skin. Fish can also be infected when they eat an infected fish. Fish that survive the infection will develop antibodies to the virus. Antibodies will protect the fish against new VHS infections for some time. However, the concentration of antibodies in the fish will drop over time, and the fish may **start shedding virus** again. This may create a cycle of fish kills that occurs on a regular basis.

Lake Superior features unique fishery resources, and several tribal entities, state agencies, and national parks are charged with their management and protection. In the fall of 2007, the NPS organized a meeting in conjunction with the *Making a Great Lake Superior 2007* conference in Duluth, Minnesota, to discuss the VHS threat and potential prevention and response strategies. In January 2008, a workshop was held at US EPA's Great Lakes National Program Office in Chicago that included representatives of the NPS, Grand Portage Band, and other tribal, federal, state, and academic entities to draft a VHS prevention, containment, and response plan.

The plan is focused on (1) preventing contamination of the waters of the four units of the National Park System located in the Lake Superior basin and the Grand Portage Indian Reservation, (2) detecting the introduction of VHS, and (3) responding to VHS detection and outbreaks. The plan will assist park and tribal managers, staff, and cooperators in assessing the risk of VHS introduction and, subsequently, planning and implementing the appropriate levels of prevention and monitoring actions for their area based upon that risk. The plan also provides a framework for response. The plan includes an analysis of the risks posed by the various pathways, or vectors, for transmission of the virus; a listing of known measures to prevent or contain the virus; an overall plan for the prevention of or response to the virus in the four National Park System units and the Grand Portage Indian Reservation and recommendations for enhancing cooperation with tribes, agencies, and other organizations. Emergency recommendations for the parks and the Grand Portage Band include an outreach campaign; boat decontamination; restrictions on the use of bait; and ensuring that agency operations and practices do not spread the virus, including agency-controlled vessel ballast water. The plan can

be viewed at http://www.nps.gov/piro/naturescience/upload/VHS%20Plan%20-%20Final%202008Mar14.pdf.

How Can You Help?

- Drain all water from your boat, motor, bilge, live wells, trailer, containers, bait buckets, coolers, and fishing equipment before leaving the lake or shoreline.
- Clean and disinfect all recreational equipment with a 10 percent household bleach/water solution. Chlorine is known to kill VHS.
- Do not move live or dead fish (including unused minnows), fish eggs, or fish parts between waters. All fish must be dead before leaving the landing or shoreline. Ice your catch, and discard your minnows in secure trash.
- Do not use minnows unless they were purchased from a certified bait dealer.
- Do not release live fish into wild waters (i.e., unused bait minnows, exotic ornamental fish).
- Remove all visible plants, animals, and mud from your boat and trailer before leaving shoreline.
- Know and follow state, tribal, and federal regulations on VHS prevention actions.

Aquatic Invasive Species
Complete Prevention Plan Under Development

Background and Purpose

Lake Superior has been the focus of special protection and restoration initiatives for many years in recognition of its unique status among freshwater lakes in the world. Its ecosystem and economy have been severely impacted by aquatic invasive species and it remains at serious risk for introduction of new aquatic species through a number of open pathways those species use to enter the lake. To address this risk, the Lake Superior Workgroup initiated development of a prevention plan for aquatic invasive species in 2006. The purpose of the plan is to develop a Lake Superior Aquatic Invasive Species Complete Prevention Plan to close pathways for new invasions based primarily on:

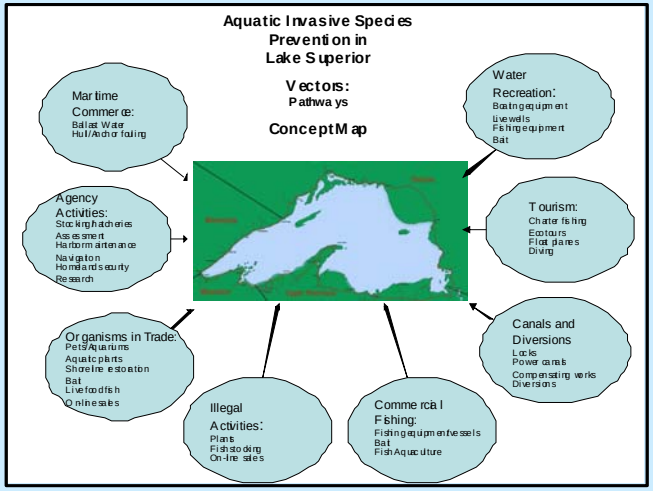
- The U.S. Great Lakes Regional Collaboration AIS prevention recommendations
- U.S. and Canadian federal prevention programs and regulations
- State and Provincial prevention programs and regulations
- Lake Superior Lakewide Management Plan
- Other key available documents and information

The prevention plan will include:

- A focus on prevention of new species introductions to Lake Superior
- Closure of pathways used by aquatic invasive species
- Coordination of programs and actions between the U.S. and Canada
- Monitoring/rapid response capacity for new invasions

Progress

The project originated with the Habitat and Aquatic Communities Committees of the Lake Superior Workgroup in 2006. A Project Team was established in 2007 and a concept map for identifying vectors and the associated pathways by which aquatic invasive species enter Lake Superior was drafted. The draft concept map with the outline of vectors/pathways is at the end of this chapter. The concept map and plan outline was presented at the Making a Great Lake Superior conference in October, 2007 and ideas for stakeholder input to the plan were solicited. A draft plan is now under development. For an outline of upcoming actions with regard to the development of the plan, see Section 6.2.4.



Current Status of Sea Lampreys. The estimated abundance (with 95 percent confidence interval) of spawning-phase sea lampreys in Lake Superior in 2007 was 65,500 (51,300-97,400) (Figure 6-23). Spawning-phase sea lamprey abundance has been 94,000 on average since 2000, which is equivalent to the average population found in Lake Superior in the early 1980s. Although this is approximately 10 percent of pre-control spawning-phase sea lamprey abundance, it remains above the estimated target levels of 35,000 spawners required to achieve the fish community objective of 5 marks per 100 fish. Wounding rates also continue to show an upward trend since 2000.

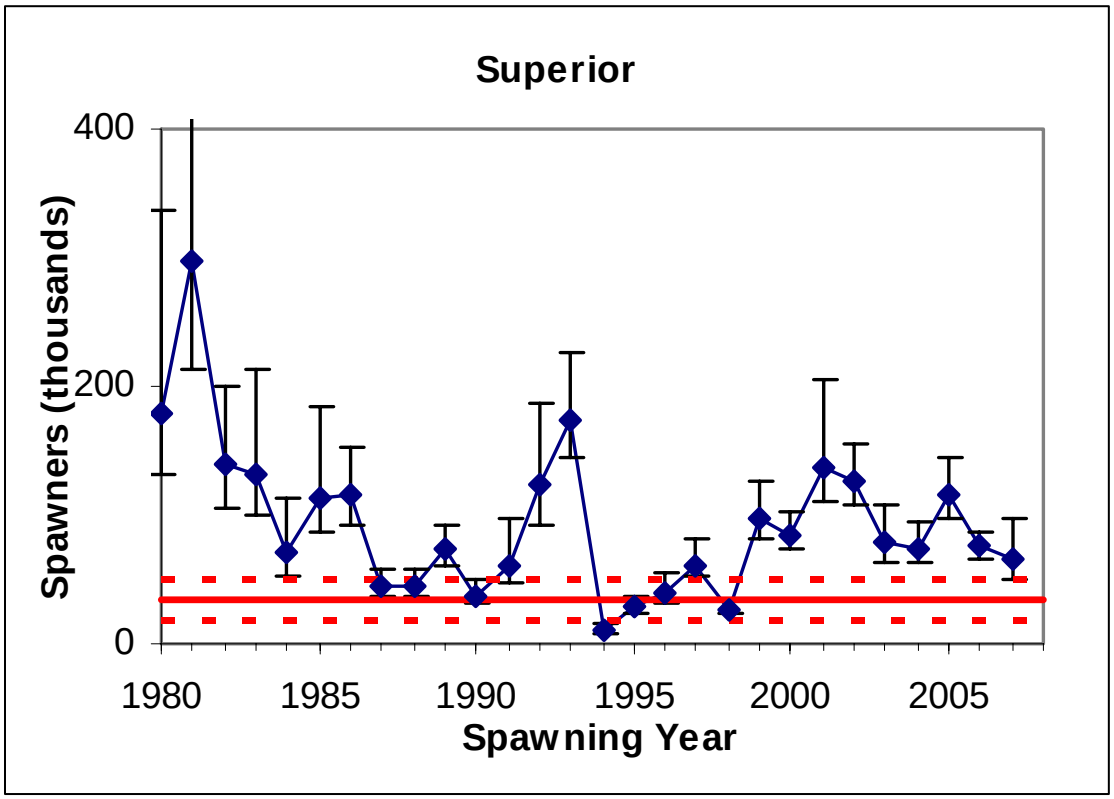


Figure 6-23. Abundance of spawning-phase sea lampreys with 95 percent confidence intervals from 1980 to 2007. The solid red line represents the suppression target of 35,000 spawning-phase sea lampreys; the dashed red lines are the 95 percent confidence intervals for the target. Source: DFO-Sea Lamprey Control.

To date, sea lampreys have been collected from 137 of the 1,915 tributaries to Lake Superior. Of these, 52 receive regular treatment on a 3- to 5-year cycle, and an additional 19 have been treated at least once in the last 10 years. Barriers are in place in 15 tributaries and block access to spawning and nursery habitats, reducing sea lamprey production from these rivers.

During 2006 and 2007, a total of 62 treatments took place, comprised of 53 streams and 9 lentic areas (shallow nearshore waters at tributary mouths). This increased control effort compares to an average of 18 streams and one lentic area treated annually during the period 2000 to 2005. The effects of the increased treatment effort should be observed beginning in 2008.

Assessment of larval sea lamprey populations in support of control has remained constant since 2000 at approximately 105 streams per year. However, since 2004, greater effort has been expended in evaluating streams immediately following treatment to detect populations of sea lampreys that may have survived the lampricide application. If significant survival is suspected, the stream may be prioritized for re-treatment within the same year or one year later.

Assessment of spawning-phase populations continues in 19 tributaries to Lake Superior. Mark-recapture estimates of abundance within these tributaries are used within multiple regression models, along with other stream-specific biotic and abiotic factors, to estimate lakewide abundance of spawning-phase sea lampreys (Figure 6-23). This estimate is the primary method used to evaluate the long-term effectiveness of the sea lamprey management program in Lake Superior.

Nearshore Fish Community Assessment and Aquatic Invasive Species Monitoring. Nearshore embayments represent some of the habitat most heavily impacted by human activity in Lake Superior. In eastern Lake Superior, Batchawana Bay and Goulais Bay are areas with high shoreline development associated with both cottages and year-round homes. A three-year project is underway in these locations to monitor the health of the fish community and detect the appearance of aquatic invasive species (AIS). AIS represent a significant threat to the health of fish communities in the Great Lakes, including Lake Superior. Early detection of AIS and assessing their extent will provide valuable information for research and planning strategies to mitigate their impacts on native fish communities.

Rainbow Smelt - A Bottleneck to Native Fish Recovery?

Researchers from Michigan State University joined the USGS and OMNR in 2006 to assess impediments to ciscoe larval survival to age 1. Researchers were particularly interested in the impact of the non-native, predatory rainbow smelt. It was felt that, despite their small size, rainbow smelt may impose a big effect on the survival of newly hatched native cisco. Field investigations of this relationship demonstrated that individual rainbow smelt consumed very few larval cisco. However, because of the sheer abundance of rainbow smelt, it was estimated that rainbow smelt predation may have a profound effect on larval cisco survival and recruitment into the population. This knowledge of impacts in Lake Superior is important in planning for restoration in other areas of the lake and in the lower Great Lakes where smelt are also abundant. Finding means of releasing cisco from probable bottlenecks, like that imposed by rainbow smelt predation, could aid in cisco recovery in the Great Lakes.

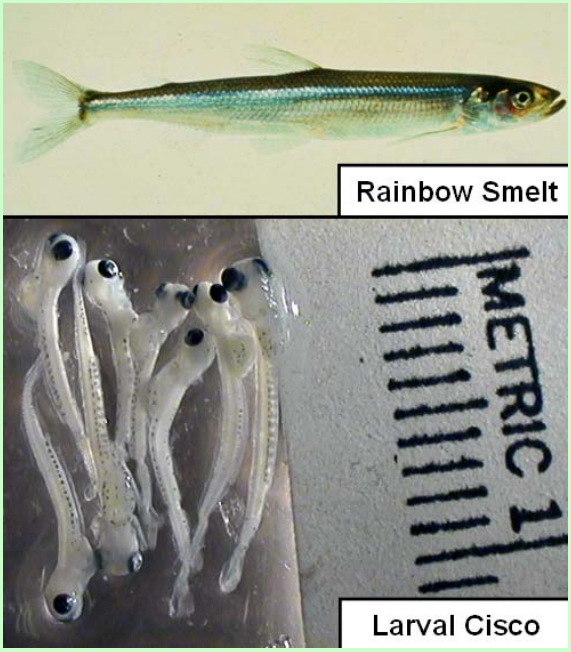


Photo credit: Great Lakes Fishery Commission.

Tracking AIS along the South Shore of Lake Superior. The USFWS Ashland, Wisconsin, fishery office conducted ruffe and other AIS surveillance with bottom trawl, trap, and fyke net surveys at 18 locations along the south shore of Lake Superior in the spring and fall of 2006 and 2007. This survey has been conducted since 1998, as called for in the Ruffe Control Plan. Other AIS species collected and monitored during these surveys include round goby, white perch, three-spine stickleback, and common carp. Additionally, information and outreach are provided to boaters, anglers, harbor masters, elementary schools, and sport fishing organizations.

Surveys are conducted on the periphery of the ruffe range and eastward where ruffe have not yet been detected to search for new infestations. In 2006, the ruffe range expanded eastward 226 km from Marquette, Michigan, to Whitefish Bay, Michigan. Ruffe were detected by USFWS field crew in Grand Marais, Michigan, and by anglers in Little Lake Harbor and Tahquamenon River. Anglers familiar with outreach materials contacted state and federal fishery offices, and specimens were identified as ruffe. No range expansion was detected in 2007. In Lake Superior, the ruffe range currently spans the entire south shore from the Duluth-Superior Harbor, Minnesota/Wisconsin, to Whitefish Bay, Michigan; and along the north shore from the Duluth-Superior Harbor to Thunder Bay, Ontario.

Preventing the Spread of AIS from Bait Buckets and Aquaculture. The potential exists for AIS to spread to uninfested waters through the transport of wild harvested baitfish and aquacultured fish. Baitfish and aquaculture industries are diverse and complex, as are their risks of spreading AIS. To deal effectively and fairly with this potential vector, it is important to characterize the industry according to its risks of spreading AIS. One approach to this problem is to apply the Hazard Analysis and Critical Control Point (HACCP) concept similar to that used by the seafood industry to minimize seafood consumption health risks. The HACCP approach concentrates on the points in the process that are critical to the safety of the product, minimizes risks, and stresses communication between regulators and the industry.

To address the potential for AIS, including some fish pathogens and parasites—often referred to as biological pollution—to spread to uninfested waters through: 1) the movement of equipment (i.e., boats, trailers, nets, waders, water collection devices, etc.) used by federal, state, tribal, and private resource researchers, managers, consultants, and enforcement personnel; and 2) the transfer of baitfish and fish raised for stocking into public and private waters, the Great Lakes Network Sea Grant offices conducted outreach and educational activities from 2004 to 2007.

Twenty-seven AIS-HACCP workshops were conducted within the Great Lakes basin, and approximately 540 individuals participated from state, federal, and tribal resource management agencies, private aquaculture, wild baitfish harvest, environmental consultants, public fish hatcheries, extension education, law enforcement, environmental consultants, and researchers. Workshops were designed with the “train the trainer” approach in mind. The AIS-HACCP video *From Net to Sale* was duplicated, and 1000 copies were allocated to project personnel for use and distribution in their training workshops. Twenty-one percent of workshop respondents to the survey reported conducting over 100 additional workshops reaching approximately 2000 individuals.

Michigan's Ballast Water Control Permit. Under its new ballast water control permit to regulate AIS discharge, the Michigan Department of Environmental Quality issued 92 permits to individual ocean-going ships in 2007. These represented 37 different companies. All ocean-going ships must obtain a permit from MDEQ for port operations and either not discharge ballast water or treat the ballast water before discharge with an approved treatment technology. All permits issued in 2007 were for no discharge of ballast water; no ships installed approved treatment to allow discharge. None of the permitted ships conducted port operations in Michigan's Lake Superior ports.

6.1.4 Education/Outreach Initiatives

The following section discusses initiatives related to outreach and education efforts.

Connecting The Coast – A New Service Learning Web Site Empowering Students to Solve Lake Superior Issues. Complex environmental issues face the Lake Superior region, its communities, and citizens. A new service learning web-based curriculum, called "Connecting the Coast" (CTC), challenges students to help solve these issues.

CTC is targeted to high school students, as future Lake Superior community leaders. It guides students through an investigation of research compiled by the Lake Superior Binational Program on critical environmental issues as identified in the Lake Superior LaMP.

The CTC curriculum uses a "systems" approach, stressing the interaction of social, economic, and natural resource forces in an investigation of critical issues. The CTC moves students from discovery to action as they design their own projects that result in personal or community change to address a critical issue. The curriculum incorporates reflection as a way students can examine the outcomes of their service learning experience through self-directed evaluation and sharing.

The CTC web site (http://connectingthecoast.uwex.edu) includes hundreds of photos, interactive links, references, and fun activities students can use to explore issues, project ideas, and ways to reflect on their experience. Historic and cultural viewpoints are integrated into the curriculum to broaden perspectives on each issue. (See also Chapter 8, section 8.1 of LaMP 2008.)

Two Outreach Videos on Invasive Species Produced. The Great Lakes Indian Fish and Wildlife Commission received funding from state and federal agencies to produce two episodes of the television program *Discover Wisconsin*. One episode focused on AIS and featured a variety of lake user groups including fishermen, resort owners, tribal members, and scuba divers. It highlighted the fact that AIS affect nearly everyone, and everyone shares the responsibility to prevent their spread. The cooperative efforts of various government agencies, tribes, and non-governmental groups were also highlighted. The episode aired in June of 2006 and will be rebroadcast twice.

The other episode focused on terrestrial invasives and featured a variety of user groups impacted by terrestrial invasive species including private woodland owners and tribal members. A variety of cooperative efforts around the State of Wisconsin were featured to shed light on current

education outreach and control efforts. The episode aired in June of 2007 and will be rebroadcast twice.

Lake Superior Education and Outreach Programs Get Basin Students and Residents on the Water. Lake Superior Research Institute (LSRI) and University of Wisconsin-Extension (UW-Extension) Partnership at University of Wisconsin-Superior (UW-Superior) have developed a partnership over the past 10 years to develop and implement watershed education programs in the basin. A number of programs have been implemented with the support of a network of educators in the region, as well as external grant funds. Several of the programs utilize the UW-Superior research vessel, the *LL Smith, Jr.*, to provide on-the-water programs for a variety of audiences that include citizens, children in grades K through 12, college students, and teachers. A program that targets local government officials, *A View From the Lake*, was developed through a partnership with Minnesota Sea Grant and is an extension of a Lake Superior Non-point Education for Municipal Officials (NEMO) program. This initiative has brought information on the connection between land use and water quality to communities at eight ports in western Lake Superior and reaches over 400 people per season. In addition to *A View From the Lake* program, other groups that use the vessel each season include ten to twelve 5th grade classes for their Lake Superior unit, Elderhostel programs, teacher training, and university programs. Approximately 900-1,100 people participate in programs on the lake each year.

Other programs at UW-Superior include a citizen stream volunteer monitoring program, teacher training and assistance with Lake Superior-based curriculum development, coastal wetland research, and assistance to local planning committees who want to incorporate protection of water resources into their comprehensive plan. A watershed education resource center that loans a variety of sampling equipment as well as microscopes and other resources is maintained on campus. As a result of these programs, citizen volunteers are monitoring 15 streams in the Lake Superior basin (Wisconsin and Minnesota), the school district of Superior has incorporated Lake Superior-based units into the 6th and 7th grade curricula, staff are working with Douglas County, Wisconsin, on their comprehensive plan, and three coastal wetlands are being monitored by researchers, students, and volunteers in order to evaluate the health of these estuaries.

Managing Woodlands in the Clay Plain of Lake Superior. There are nearly 3 million acres of forest land along Wisconsin's Great Lakes coasts. As resource managers, loggers, and landowners have become familiar with the basic concepts and principles of forestry, including the implementation of Forestry Best Management Practices (BMPs) for Water Quality, they are asking more sophisticated questions on forest management that reflect regional or site specific concerns. In order to address management questions that are specific to the Lake Superior watershed, the WDNR Division of Forestry compiled forest management recommendations for lands in Lake Superior's red clay region and for lands with trout streams draining to Lake Superior.

Managing Woodlands for Wisconsin's Coastal Trout Streams (WDNR, PUB-FR-386 2007) provides an overview of trout ecology and how the health of trout streams can be impacted by the condition of forests. Considerations for landowners on how to control runoff and

sedimentation and protect trout streams during forest management activities are included in the guide.

Managing Woodlands on Lake Superior's Red Clay Plain (WDNR, PUB-FR-385 2007) describes the high potential for erosion and the unstable slopes common along Lake Superior's southern shore. Information is provided on how landowners can conduct sustainable forestry activities by slowing the flow of water runoff.

Technical reports, table-top displays, and information and training workbooks were also created as part of this grant project. The technical reports contain much more detailed information and are intended for someone with a background in forestry, fisheries, or soils. The displays are available for use at conferences, fairs, workshops, or other events. Information and training workbooks contain all of the materials discussed above for each subject area, along with full-day and hour-long PowerPoint presentations.

6.2 CHALLENGES AND NEXT STEPS

The Habitat, Terrestrial Wildlife, and Aquatic Communities Committees have identified a number of challenges as we move forward in the implementation of the LaMP for Lake Superior. In general, all committees will continue to encourage projects by partner agencies and governments that further the objectives of the LaMP. All the agency partners are acting within their areas of jurisdiction with the good of the Lake Superior basin in mind. Many of the committees' and partners' accomplishments are highlighted in this report. The committees will remain focused on forwarding the message, "complete all projects with the big lake in mind."

The committees have identified five broad action areas: Information Gathering, Monitoring, Communication, Planning, and Stewardship. Taking effective actions in these areas can be said to represent the overall challenges to achieving a sustainable Lake Superior ecosystem that is a global model for resource management.

More specifically, active and continuous *information gathering* is required to help us understand and piece together the intricacies of the complex relationship between living organisms and their physical environment. *Monitoring* may take many forms and is ultimately designed to direct management activities and policy development. Monitoring of population trends (change, stability), or research-oriented monitoring to gain an understanding of the cause and effect of specific actions on species or habitats, or why a project was a success or failure, will provide sign posts to improve future management within the lake basin. Together, these actions will provide insight and knowledge that can be communicated to governments, policy makers, planners, managers, and citizens of the basin. This will enable informed and effective *communication* about the links between land and resource use and ecosystem health with industry, business, landowners, and the public. Moving toward actively *planning* at a basinwide scale will assist in addressing the gaps in, and impediments to, sustainable resource management of land and water resources, help speak to the needs of today, and prepare us for future challenges. Finally, addressing *stewardship* needs will help foster the development of a healthy basin ecosystem that is resilient to perturbations from human activities and provides a broad

range of sustainable benefits to its citizens. This category of active stewardship actions includes those "on-the-ground" activities that most directly impact the ecosystems that make up the basin.

The challenge of protecting and preserving Lake Superior and its basin require a long-term approach by governments, industry, NGOs, and individuals. In 2006, the committees noted a number of significant needs that, if successfully addressed, would make important contributions to the LaMP goals related to the Lake Superior ecosystem and, ultimately, human health. While these needs remain, progress has been made on many of them.

The committees and partner agencies have identified a number of steps that will help us begin to meet the needs and challenges described above, over the next two years. Future accomplishments continue to be dependent upon commitments by governments and other organizations, including individuals, to support the science, resource management, and legislative activities that will protect and restore the basin. During the 2008-2010 reporting period, the committees will continue to support, resource, and seek funds and partners for presently occurring projects and issues, new projects, and emerging issues.

6.2.1 Information Gathering

- ***Challenge: Provide ongoing support and maintenance of geographic information.***

Next Steps: This information is essential to the effective implementation of the LaMP, as it provides natural resource information to decision makers. One of the databases associated with the Lake Superior Decision Support System contains information on important habitat conditions in the Lake Superior basin. An updated version of the database and the corresponding important habitat conditions map is available from the following web site: http://www.nrri.umn.edu/lsgis/index.htm. The important habitat sites database has also been included in the newly created Great Lakes Basin GIS-Decision Support System produced by the Institute for Fisheries Research at the University of Michigan-Ann Arbor. Long-term maintenance of the Lake Superior GIS databases is still required. This will assist the Habitat Committee in meeting an ongoing challenge to fill information gaps on the status and trends of habitat conditions in the Lake Superior basin and develop management recommendations to protect and restore important habitat sites.

In another effort related to gathering geographic information, the Superior Work Group recently formed an Ad Hoc Mining Committee. The committee is working to develop a GIS-based tool which would be useful to decision-makers and may help to avoid damage to environmentally sensitive areas identified through the Binational Program's Important Habitat mapping effort. The Province of Ontario already publishes information in map form, locating geology and current mine workings. The Ad Hoc Mining Committee has discussed the need to find funding to compile and extend that information to the U.S. side of the basin in the coming year. For additional information on the Ad Hoc Mining Committee, see Chapter 7, section 7.1.8.

6.2.2 Monitoring

- ***Challenge: Put in place biological, community-based monitoring programs on which to base species status and trends reports.***

Next Steps: Using the GLEI project results as a baseline, continue to collect data that will allow comparisons to be made with future changes in coastal resources and provide a mechanism to track further degradation or improvements in health of the coastal region of Lake Superior.

6.2.3 Communication

- ***Challenge: Educate the public on important habitat and ecological resources in the Lake Superior basin by expanding the use of interactive information kiosks.***

Next Steps: The Habitat Committee will continue to maintain the current kiosk network and update information in the databases that support the kiosks.

- ***Challenge: Develop communication tools to present information, issues, and solutions related to the Lake Superior basin ecosystem.***

Next Steps: Continue to promote the Connecting the Coast curriculum by presenting information about its availability and use to high school and state science teachers.

Next Steps: The Habitat and Terrestrial Wildlife Committees will maintain and update their joint web site. In addition, the committees will work with the Communications Committee as appropriate to develop communication tools.

6.2.4 Planning

- ***Challenge: Develop ecologically based integrated management plans for all watersheds within the Lake Superior basin.***

Next Steps: The Superior Watershed Partnership is teaming with the Nature Conservancy to develop a watershed management plan for the Two-Hearted River in Luce County. The Two-Hearted River watershed is considered one of the most pristine wilderness watersheds on the south shore of Lake Superior. The river is a cold water trout fishery that has been designated a Michigan Natural River (Part 305, P.A. 451) and an Outstanding State Resource Water. The watershed itself is listed as an important habitat site by the Habitat Committee and contains Beavertown Lakes, McMahon Lake, and Swamp Lakes, which are also listed because of globally rare plant communities. In 2007, the Nature Conservancy completed a riparian analysis of the watershed using GIS maps and verification by field visits. The overarching goal of this analysis was to identify the functional riparian area of the Two-Hearted River system and to assess its sensitivity to further development and forest management activities based on the characteristics. The results of the analysis are being used to develop the watershed management plan and eventually, to assist Luce County in revising zoning ordinances to better protect the river.

Figure 6-24. The Two-Hearted River in Michigan's Upper Peninsula was a favorite fishing spot of author Ernest Hemingway and had a prominent place in his "Nick Adams" stories. Photo credit: Superior Watershed Partnership.

- ***Challenge: Address preventative measures related to aquatic species transport in ballast water in Lake Superior.***

Aquatic Invasive Species Complete Prevention Plan – Next Steps. There remains much to be done to protect Lake Superior from new introductions of AIS from around the world and from within the Great Lakes. Development of a complete prevention plan is proposed as a timely tool to integrate and augment all the disparate pieces of regulation and education to accomplish that protection. Canada and the U.S. share this responsibility and the Lake Superior LaMP process is uniquely positioned to establish this protection. The LaMP is the primary delivery tool for a number of binational processes dedicated to protecting the lake and also for implementing many recommendations of the U.S. Great Lakes Regional Collaboration.

When completed, the draft plan will be reviewed by the Superior Work Group, and a stakeholder comment process will be initiated. Following stakeholder input, the draft will be reviewed by the Lake Superior Task Force, and final review and approval steps will be determined.

Minnesota Pollution Control Agency Ballast Water Permit Development - Next Steps. The Minnesota Pollution Control Agency (MPCA) continues to promote additional federal efforts to control the ship-mediated spread of AIS. Given the uncertain timeline for federal action, the

MPCA is moving forward with the development of a general National Pollutant Discharge Elimination System / State Disposal System (NPDES/SDS) permit for ballast water. The permit is initially planned to cover ballast water discharges from commercial vessels on Minnesota waters of Lake Superior and associated harbors. The permit could include best management practices, monitoring requirements, specific discharge performance standards, and other requirements—all of which will combine to assure protection of Minnesota waters from AIS. A final permit is expected to be available by September 30, 2008.

- ***Challenge: Plan for sustainable land, shoreline, and water development.***

Upper Great Lakes Study Underway. The International Joint Commission appointed the International Upper Great Lakes Study Board in February 2007 to examine whether the regulation of Lake Superior outflows can be improved to address the evolving needs of the upper Great Lakes. The study area includes Lakes Superior, Michigan, Huron, and Erie, and their interconnecting channels (St. Marys River, St. Clair River, Lake St. Clair, Detroit River, and Niagara River), up to Niagara Falls.

Major topics for investigation include determining the factors that affect water levels and flows, developing and testing potential new regulation plans, and assessing the impacts of these potential plans on the ecosystem and human interests. Staff from the WDNR Office of the Great Lakes will co-chair the Ecosystem Technical Work Group.

Physical changes in the St. Clair River will be investigated early in the study as one factor that might be affecting water levels and flows. Depending on the nature and extent of the physical changes, and their potential impact on water levels and flows, the study may also explore potential remediation options.

- ***Challenge: Ensure the maintenance of healthy aquatic communities on rivers with, and those identified for, hydro power development.***

Next Steps: OMNR is working with Ontario Power Generation on a long-term study to determine the impacts of fluctuating water flows and levels on sturgeon populations in the Kaministiquia River in Thunder Bay.

- ***Challenge: Maintain continued support for LaMP projects in order to accomplish LaMP goals by continuing efforts by the LaMP to ensure governments keep the LaMP in the top priority of their funding targets.***

Next Steps: 1) Communicate to senior-level managers in the Canadian federal and Ontario provincial government the importance of the Canada-Ontario Agreement as a funding mechanism to achieve LaMP objectives; 2) List the important U.S. funding sources and means to keep LaMP priorities at the top of grant lists.

6.2.5 Active Stewardship

- ***Challenge: Protect critical lake and tributary habitats.***

Next Steps in Ontario: 1) Ontario will continue to work with Parks Canada to ensure the details in the new Lake Superior National Marine Conservation Area management plan support LaMP goals and objectives.

- ***Challenge: Cooperate with Great Lakes Regional Collaboration's Wetlands and Habitat Initiative to restore and enhance important Lake Superior upland, wetland, riparian, and tributary habitats.***

Next Steps for U.S.: Assist the U.S. Interagency Task Force in utilizing Lake Superior important habitats in setting priorities for the Wetlands and Habitat Initiative. Work with the Wetlands and Habitat Initiative to link GLRC goals with Lake Superior habitat actions and needs.

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Krueger, C.C. and P.E. Ihssen. 1995. Review of genetics of lake trout in the Great Lakes: history, molecular genetics, physiography, strain comparisons, and restoration management. J. Great Lakes Res. 21 (Supple. 1):348-363.

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The following is a list of the 22 peer-reviewed papers that will appear in the *Journal of Great Lakes Research* (JGLR) in early 2008. Papers focused exclusively on Lake Superior are highlighted in bold; however, most of the papers include data and analysis of indicators for Lake Superior.

JGLR Special Issue (Vol. 33, Special Issue 3): Coastal Indicators

1. Niemi, G.J., Kelly, J.R., and Danz, N.P. 2007. Foreword: Environmental indicators for the coastal region of the North American Great Lakes: Introduction and prospectus. *J. Great Lakes Res*. 33 (Special Issue 3).
2. Bhagat, Y., Ciborowski, J.J.H., Johnson, L.B., Uzarski, D.G., Burton, T.M., Timmermans, S.T.A., and Cooper, M.J. 2007. Testing a fish index of biotic integrity for responses to different stressors in Great Lakes coastal wetlands. *J. Great Lakes Res*. 33 (Special Issue 3).
3. Brady, V.J., Ciborowski, J.J.H., Johnson, L.B., Danz, N.P., Holland, J.D., Breneman, D.H., and Gathman, J.P. 2007. Optimizing fishing time: one vs. two-night fyke net sets in Great Lakes coastal systems. *J. Great Lakes Res*. 33 (Special Issue 3).
4. Brazner**,** J.C., Danz,' N.P., Trebitz, A.S., Niemi, G.J., Regal, R.R., Hollenhorst, T.P., Host, G.E., Reavie, E.D., Brown, T.N., Hanowski, J.M., Johnston, C.A., Johnson, L.B., Howe, R.W., and Ciborowski, J.J.H. 2007. Responsiveness of Great Lakes wetland indicators to human disturbances at multiple spatial scales: a multi-assemblage assessment. *J. Great Lakes Res*. 33 (Special Issue 3).
5. Croft, M., and Chow-Fraser, P. 2007. Development of the wetland macrophyte index to detect degree of water-quality impairment in Great Lakes coastal marshes. *J. Great Lakes Res*. 33 (Special Issue).
6. Frieswyk, C.B., Johnston, C.A., and Zedler, J.B. 2007. Identifying and characterizing dominant plants as an indicator of community condition. *J. Great Lakes Res*. 33 (Special Issue 3).
7. **Grandmaison, D.D., and Niemi, G.J. 2007. Local and landscape influence on red-winged blackbird (*Agelaius Phoeniceus*) nest success in Great Lakes coastal wetlands. *J. Great Lakes Res*. 33 (Special Issue 3).**
8. Hanowski, J.M., Danz, N.P. Howe, R.W., Regal, R.R., and Niemi, G.J. 2007. Considerations for monitoring breeding birds in Great Lakes coastal wetlands. *J. Great Lakes Res*. 33 (Special Issue 3).
9. Hollenhorst, T.P., Brown, T.N., Johnson, L.B., Ciborowski, J.J.H., and Host, G.E. 2007. Methods for generating multi-scale watershed delineations for indicator development in Great Lake Coastal ecosystems. *J. Great Lakes Res*. 33 (Special Issue 3).
10. Howe, R.W., Regal, R.R., Hanowski, J.M., Niemi, G.J., Danz, N.P., and Smith, C.R. 2007. An index of ecological condition based on bird assemblages in Great Lakes coastal wetlands. *J. Great Lakes Res*. 33 (Special Issue 3).
11. Johnston, C.A., Watson, T., and Wolter, P.T. 2007. Sixty-three years of land alteration in Erie Township. *J. Great Lakes Res*. 33 (Special Issue 3).
12. Johnston, C.A., Bedford, B., Bourdaghs, M., Brown, T.N., Frieswyk, C., Tulbure, M., Vaccaro, L., and Zedler, J.B. 2007. Plant species indicators of physical environment in Great Lakes coastal wetlands. *J. Great Lakes Res*. 33 (Special Issue 3).
13. Kang, M., Ciborowski, J.J.H., and Johnson, L.B. 2007. The influence of anthropogenic disturbance and environmental suitability on the distribution of the nonindigenous amphipod *Echinogammarus ischnus* at Laurential Great Lakes coastal margins. *J. Great Lakes Res*. 33 (Special Issue 3).
14. Kireta, A.R., Reavie, E.D., Danz, N.P., Axler, R.P., Sgro, G.V., Kingston, J.C., Brown, T.N., and Hollenhorst, T.P. 2007. Coastal geomorphic and lake variability in the

Laurentian Great Lakes: implications for a diatom-based monitoring tool. *J. Great Lakes Res*. 33 (Special Issue 3).

15. **Miller, C., Niemi, G.J., Hanowski, J.M., and Regal, R.R. 2007. Breeding bird communities across an upland disturbance gradient in the western Lake Superior region. *J. Great Lakes Res*. 33 (Special Issue 3).**
16. **Peterson, A.C., and Niemi, G.J. 2007. Evaluation of the Ohio Rapid Assessment Method for wetlands in the western Great Lakes: an analysis using bird communities. *J. Great Lakes Res*. 33 (Special Issue 3).**
17. Peterson, G.S., Sierszen, M.E., Yurista, P.M., and Kelly, J.R. 2007. Stable nitrogen isotopes of plankton and benthos reflect a landscape-level influence on Great Lakes coastal ecosystems. *J. Great Lakes Res*. 33 (Special Issue 3).
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Chapter 7

Developing Sustainability in the Lake Superior Basin: 2008 Progress Report

Ice ridge mirage at sunset. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Lake Superior Lakewide Management Plan 2008

Chapter 7 Contents

Chapter 7
Developing Sustainability in the Lake Superior Basin

7.0 INTRODUCTION

Through its Lakewide Management Plan (LaMP), the Lake Superior Binational Program (LSBP) is seeking, promoting, and implementing sustainable development approaches that work toward a restorative Vision for Lake Superior—approaches that will ensure the sustainability, or the capacity for continuance into the long-term future, of the basin's natural and human systems and institutions.

This chapter update:

- Reviews sustainability initiatives and activities conducted by the Sustainability Committee between April 1, 2006, and March 31, 2008;
- Highlights some of the challenges; and
- Ties current initiatives and challenges to future initiatives for sustainability in the Lake Superior basin.

7.1 SELECTED ACTIVITIES

The projects highlighted below represent a sample of sustainability activities recently pursued by the committee, as well as independent community-based initiatives that complement Superior Work Group efforts regarding regional sustainability.

7.1.1 Aboriginal Community Awareness Review and Development

One significant success is the completion of the Aboriginal Community Awareness Review and Development Project (CARD) in the Canadian portion of the Lake Superior basin. The goal of the project was to better understand the attitudes and awareness of basin residents regarding local sustainability and environmental issues. Thirteen non-Aboriginal communities in both the U.S. and Canada were surveyed in 2005, and since then the Sustainability Committee has surveyed the Canadian Aboriginal communities of Fort William, Pays Plat, Biinjitiwabik Zaaging Anishnabek (Rocky Bay), and Pic River First Nations. Results of the Aboriginal CARD survey indicated that environmental issues ranked behind the top priorities of housing, employment, health, and education. However, most communities ranked water among their top three most important environmental issues. They expressed high levels of concern regarding the impact of industrial activities, tourism, and other development on traditional activities, habitat and wildlife, burial grounds, sacred sites, artifacts, and medicinal and traditional plants. They also identified the lack of recycling opportunities and the burning of garbage as concerns. Future initiatives targeted at Canadian Aboriginal communities will have to include multiple, diverse community benefits; take a holistic approach to addressing environmental, social, and cultural issues using water and land use as priority areas for action; and more personally engage the communities.

Figure 7-1. Water was ranked among communities' top three most important environmental issues in the Aboriginal CARD survey. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

The information found in the Aboriginal CARD, like the information gathered as part of the two non-Aboriginal CARD projects conducted in 2005 in Canadian and American municipalities, towns, and cities, is meant to inform and influence the design and implementation of future Superior Work Group initiatives.

7.1.2 TRAcking of Community Sustainability

The **TRA**cking of **C**ommunity **S**ustainability (TRACS) project is a joint initiative between the Lake Superior Binational Forum (the Forum) and the Sustainability Committee. The Forum is compiling community-based sustainability initiatives in five target communities around the lake, including: Ashland area in Wisconsin; Duluth, Minnesota; Marquette, Michigan; Thunder Bay, Ontario; and Wawa, Ontario. The TRACS inventory will assist the LSBP in determining the extent to which LaMP goals and objectives are met and, ultimately, whether Lake Superior residents are moving towards, or away from, sustainability.

In addition to allowing for the tracking of overall sustainability efforts in the Lake Superior basin, the TRACS project:

- Acts as a corporate memory for the Superior Work Group and the Forum's sustainability efforts;
- Assists the Superior Work Group and the Forum in communicating sustainability initiatives and contacts to interested organizations and citizens around the basin;

- Cultivates awareness of the benefits of sustainable living among citizens, organizations, and communities;
- Catalyzes civic action toward sustainability;
- Promotes partnerships for sustainability;
- Serves as a repository of success stories available to the media;
- Demonstrates how various initiatives can function within and in parallel to the regulatory system; and
- Forms the basis for future "Keepers of Sustainability" Map series (see Section 7.3, Next Steps).

To date, the Sustainability Committee has defined criteria for identifying appropriate actions and programs, and data has begun to be entered into the TRACS database. The database will be completed in 2008.

7.1.3 Sustainability Session at the Lake Superior Conference

In collaboration with the Forum, the Sustainability Committee shepherded a one-day sustainability session at the *Making a Great Lake Superior 2007* conference held in Duluth, Minnesota, in October 2007. Titled *Sustainability: A Superior Paradigm for Reframing Knowledge* (SPaRK), the session achieved the following outcomes:

- Increased awareness and knowledge of sustainability challenges and opportunities facing Lake Superior and basin communities. Some identified needs include:
    - Marked improvement and creativity in the arts of citizenship and governance. In other words, sustainability requires effective institutions of governance and a well-informed, democratically engaged citizenry.
    - More accurate models and descriptions to describe the human enterprise in relation to the earth.
    - Enhanced awareness and education for sustainability. This means a society which not only understands its place within larger cycles and trends, but one with the education and skills appropriate to make sustainable living a reality.
    - To learn how to recognize and solve divergent problems, or problems that cannot be solved by logic and method alone.
- Broadened understanding of plans and ideas to track community and basin sustainability.
    - Awareness that any sustainability approach should consider adopting a systems approach to sustainable development.
- Enhanced awareness and understanding of proven and effective approaches to successfully move communities toward sustainability.
    - The next wave of community economic development will, hopefully, have sustainability as its ultimate goal, and will be driven by sustainable development and systems thinking. It will employ a number of strategies, including eco-municipalities, localization, ecosystem services valuation, sustainable agriculture and local food systems, sustainable tourism, and eco-industrial developments.

7.1.4 Toward A Sustainable Community: A Toolkit for Local Government

In conjunction with "1000 Friends of Wisconsin" and with the help of "Focus on Energy," the University of Wisconsin Extension faculty (educators and specialists agents) in Madison, Stevens Point, Superior, Ashland, Barron, and Shawano County co-authored *Toward A Sustainable Community: A Toolkit for Local Government.* The purpose of this toolkit is to provide ideas and descriptions of specific actions that a local government can take to transform itself into a model of sustainable practices. These practices can result in cost savings and increased employment, and can enhance environmental quality and community well-being. The message of this toolkit is simple: local governments can lead by example. The toolkit is intended to address only the internal workings of local government. Specifically, it addresses sustainable approaches to energy, building, transportation, purchasing, investment, and hiring. It provides practical tools for making these functions of local government more supportive of long-term human and environmental health and well-being. It provides strategies that can be implemented through traditional means of policy development, fiscal administration, local government programs, and education.

The toolkit was distributed to all 72 University of Wisconsin Extension county educators (agents). Presentations were also given to different associations, for example the Wisconsin Chapter of the American Planning Association.

The toolkit is available at www.shwec.uwm.edu/sustk, and the live links in the document are available on the University of Wisconsin Extension, Solid and Hazardous Waste Education Center (SHWEC) web site as well, under publications.

7.1.5 Lake Superior Stewardship/Leadership School Project

The Sigurd Olson Environmental Institute at Northland College and the University of Wisconsin Extension, with help from the Otto Bremer Foundation, operates the Lake Superior Pathfinders program. This experiential learning program aims to develop local leadership skills among adults and youth in the context of Lake Superior basin issues, using sustainability as the overarching theme and a web-based curriculum that supports the needs of the Binational Program.

Figure 7-2. Kayaking in the rain. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Through the Pathfinders program, students in grades 9-12 build leadership skills and confidence on low and high ropes courses and climbing towers, immerse themselves in the Lake Superior environment, explore estuaries, kayak to sea caves, and investigate the lake's critical issues from social, environmental, and

economic perspectives. They help haul fish nets and fish aboard the *Wolverine II*, a commercial fishing boat that trolls around the Apostle Islands, as well as interact with Chippewa tribal elders and educators as they share their culture along the lake and in sacred fishing and ricing waters.

Through the Lake Superior Navigators, students in grades 9-12 students learn about the role research plays in Lake Superior by conducting research with the USGS Lake Superior Biological Station crew aboard the *Kiyi*, a 107 ft research vessel. They explore community sustainability and challenge leadership concepts by engaging in service learning projects in the Ashland area. Past projects have included working with Habitat for Humanity, gardening for a local domestic abuse shelter, creating a Lake Superior mural, and designing and airing a local radio show about critical Lake Superior issues.

Figure 7-3. Wading in the Amnicon River, Douglas County, Wisconsin. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Meanwhile, students in grades 6-9 become better environmental stewards by immersing themselves in the intriguing world of life in wetlands, marshes, ponds, and lakes through the Making Waves program. They explore unique lake environments, including Lake Superior's, each day through hands-on experiments and outdoor endeavors. Making Waves connects their experiences through activities that examine real strategies to sustain healthy lake communities. Students sleep under the stars on the shores of Lake Superior, meet new and exciting people, and wade the shallows of the wetlands.

A medium-term goal is to expand the Wisconsin Pathfinders program to other jurisdictions of the Lake Superior basin. For more information, please see Chapter 2 or visit www.northland.edu/pathfinders.

7.1.6 Aboriginal/Tribal Cooperation

The Sustainability Committee supports environmental management/sustainability capacity for and between Tribes and First Nations through the building of relationships, sharing of information, and exploration of opportunities for Tribal/First Nations collaboration.

Completion of the Aboriginal CARD project represents an important first step toward developing sustainability in First Nations communities. The building of relationships, increased collaboration, and transfer of environmental skills and knowledge among the Grand Portage Reservation, Fond Du Lac Reservation, and the Anishinabek of the Gichi Gami, a citizen-based

environmental organization from Fort William First Nation, also represent a small but significant development.

Grand Portage Environmental staff have been working with Grand Portage Education and Information Technology staff (from Fort William) who are fluent in Ojibwe mowin to translate information for signs and a web page that are being designed to notify residents and visitors about the beach water quality in Grand Portage. Students from Grand Portage are designing the signs and developing the wording for the web page. A goal of this partnership is to develop a bilingual format for both the web page and signs to ensure that Grand Portage youth will see their work in both languages.

7.1.7 Ad Hoc Monitoring Committee

In August 2006, a Lake Superior Monitoring and Decision White Paper explored options for ensuring that Lake Superior waters and watershed monitoring and research efforts are coordinated, integrated, readily available, and consistent with LaMP priorities and goals. In the fall of 2006, Terms of Reference for an Ad Hoc Monitoring Committee were drafted. The original purpose of the committee is stated below:

> To be a "champion" for monitoring, assessment and reporting the status and trends of Lake Superior ecosystems and integrating information on stressors, socioeconomic factors, climate change, and other drivers with ecosystem information. This committee will coordinate with existing standing committees to cross-walk interests in monitoring and reporting on various aspects of the Lake Superior basin ecosystem.

The acquisition and integration of socio-economic data to ecosystem data will remain the Sustainability Committee's primary interest in this committee.

7.1.8 Ad Hoc Mining Committee

For the past number of years Sustainability Committee members have expressed an interest and concern in the increased level of exploration and mining activity witnessed throughout the Lake Superior basin. Sustainability Committee members have been involved, for example, in numerous environmental assessments, permit applications reviews, and toxics reduction efforts. In June 2006, a memorandum to the Superior Work Group by the Chippewa-Ottawa Resource Authority suggested that the ability of the LSBP and basin resource agencies to quickly link ecologically sensitive data to old, current, or potential ore bodies would protect critical habitat in the Lake Superior basin by enabling decision-makers to make wise decisions.

At the April 2007 meeting of the Superior Work Group held at Old Fort William Historical Park in Thunder Bay, Ontario, an Ad Hoc Mining Committee was charged with exploring proactive options to educate the public, agencies, and mineral exploration companies in general on the importance of protecting environmentally sensitive habitats. The Sustainability Committee decided that further discussion related to mining in the Lake Superior basin would best be addressed as part of the Ad Hoc Mining Committee.

The Ad Hoc Mining Committee held several conference calls during 2007, the last of which was well attended by representatives of the United States Geological Survey and Ontario Ministry of Northern Development and Mines. There is consensus that a GIS-based tool would be useful to decision-makers and may help to avoid damage to environmentally sensitive areas identified through the LSBP. The Province of Ontario already publishes information in map form, locating geology and current mine workings. The Ad Hoc Mining Committee has discussed the need to find funding to compile and extend that information to the U.S. side of the basin in the coming year. For additional details on the Ad Hoc Mining Committee, see Chapter 6, Section 6.2.1.

Figure 7-4. Hemlock needles surround an oak leaf in Lake Superior waters. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

7.2 CHALLENGES

There are many sustainability challenges facing the Superior Work Group. Much work remains to be done to effectively protect and restore the Lake Superior ecosystem as well as to support the process of developing sustainability in the basin.

7.2.1 Building Capacity

Additional members, including their skill sets, are necessary to the committee's operations. For example, economic development councils/corporations can become real partners in demonstrating sustainability in the basin.

7.2.2 Adapting to a Fluid Political Landscape

Efforts to promote sustainability must deal with the constantly changing social and political landscapes within and outside the Lake Superior basin. Seizing upon opportunities in this landscape will be critical to success; for example, an economic recovery program could be the platform for sustainable jobs.

7.2.3 Defining, Promoting, and Implementing Sustainability

Sharing the concept of sustainability across the Lake Superior basin, and incorporating it into management decision-making by basin stakeholders, as well as increasing the number and diversity of stakeholders involved in sustainability discussions, remain significant challenges for the Sustainability Committee and the Binational Program.

The development and incorporation of sustainability principles into the daily decision-making processes and operations of organizations throughout the basin is progressing. This is illustrated, for example, by the emerging U.S. south shore eco-municipality movement (see Alliance for Sustainability box), the City of Thunder Bay's adoption of Environmental Principles to guide its corporate decisions impacting the environment, its development of a Community Environmental Action Plan through EarthWise Thunder Bay (see EarthWise Thunder Bay box), and the development of toolkits that provide local governments with ideas and descriptions of specific actions that they can take to transform themselves into models of sustainable practices.[1]

Figure 7-5. Lake Superior wave. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

[1] The toolkit is available at www.shwec.uwm.edu/sustk.

Alliance for Sustainability – Sustainable Chequamegon Initiative

The Alliance for Sustainability (AFS) continued to strengthen and build support for its Sustainable Chequamegon Initiative (SCI) along the south shore of Lake Superior in Wisconsin. The SCI is the result of the efforts of many local residents who have embraced the principles of sustainability and see a bright future for the communities in which they live. AFS drafted an ambitious strategic plan in 2006 with support from many local community members. The plan outlines AFS' goals, objectives, and actions for achieving its sustainability vision. The plan gives AFS a strong document to help guide its activities over the next five years as it strives to develop a model for rural sustainable development. In addition to adopting a strategic plan, some of the many accomplishments of the SCI over the past two years include:

- The City of Bayfield and the Town of Bayfield joined the Cities of Ashland and Washburn in adopting eco-municipality resolutions based on the Natural Step framework. The resolutions commit the governments to implement practices of sustainable community development whenever possible in their planning, policy making, and municipal practices.
- AFS hired a full-time staff person to coordinate its efforts in the Chequamegon Bay region, and the City of Ashland donated space at its Vaughn Public Library for AFS to have an office.
- AFS received a three-year grant from the Bremer Foundation to start a Green Team Network of Early Adopters of Sustainability. The Network provides local businesses, schools, industries, tribes, governments, and institutions a time and a place to develop and implement action plans to become more energy efficient. It provides a way to connect these entities to each other and to services available to them to reduce their carbon footprints and ultimately improve their bottom lines. The Network began in 2007 with 10 members, and as of early 2008, it includes 17 businesses, municipalities, institutions, and local governments.
- AFS conducted "Campaign Sustain" during the summer of 2007 with donations from several foundations, individuals and businesses. The theme of the project was "what one household can do." Four interns knocked on over 4,000 doors in six local communities, handing out compact fluorescent lightbulbs (CFLs) to any resident who unscrewed and handed over their most frequently used incandescent bulb. They also handed out free bus passes, rebate coupons for additional CFLs, and refrigerator magnets with 10 tips to save money by reducing energy usage. The impact of Campaign Sustain was estimated at a $7200 savings to local residents through reduced energy demand, 40 tons of coal saved, and a reduction of 960,000 kilowatt hours of electricity demand per year.
- AFS is sponsoring a Wisconsin Sustainable Business Conference in April 2008 in Ashland, WI.

Alliance for Sustainability presentation (left) and member discussions (right). Photo credit: Alliance for Sustainability.

EarthWise Thunder Bay

EarthWise Thunder Bay (www.earthwisethunderbay.com) began in the summer of 2004, when the City of Thunder Bay committed to develop a Community Environmental Action Plan (CEAP) to promote a sustainable, healthy environmental community. The CEAP supports a number of resolutions already passed by City Council with the end goal of reducing greenhouse gas (GHG) emissions within the City of Thunder Bay.

The first step toward a sustainable community was the development of an Environmental Policy, which was developed in 2005 through the collaboration of community partners, citizens, and the EarthWise Steering Committee. This Environmental Policy established a foundation of 10 Environmental Principles that offer general guidance for corporate decisions affecting the environment, including: energy conservation; meeting applicable environmental legislation and regulations; using the best available technology economically feasible; re-use and recycling of resources; communicating with stakeholders; supporting environmental education; participating in community initiatives; community environmental action planning; applying the precautionary principle; and strengthening green procurement commitments. The policy requires the city to produce, on an annual basis, an Environmental Progress Report highlighting its progress towards sustainability.

In February 2008, in conjunction with the City of Thunder Bay and ICLEI Energy Services (IES), EarthWise completed its GHG emissions inventory and forecast for the city's operations and for the Thunder Bay community as a whole. EarthWise will integrate this report into its planning for the CEAP, and will present both to the City Council in 2008.

Currently, EarthWise is looking for public input and involvement in a number of working groups—each of which are focusing on specific issue sections of the CEAP. The CEAP will be instrumental in delivering a healthy biophysical and socioeconomic environment to the citizens of Thunder Bay and in creating a more comprehensive, systems-oriented framework for municipal operations.

7.3 NEXT STEPS

In conjunction with the Superior Work Group, the Sustainability Committee will be discussing a more comprehensive sustainability framework for the next major LaMP review and revision.

7.3.1 Encouraging Societal Involvement in LaMP

To promote a systemic approach to change in the basin, the LSBP must reach out to businesses, industries, municipalities, educational institutions, not-for-profit organizations, and youth. We will encourage the creation of physical and/or virtual spaces for residents to assemble (videoconferencing, webinars, mini Lake Superior learning events, social virtual networks such as Facebook or My Space, etc.) are other ideas that should be explored by the Superior Work Group and the Forum.

Figure 7-6. Top of Shovel Point. Photo credit: Carri Lohse-Hanson, Minnesota Pollution Control Agency.

7.3.2 Draft LSBP Green Meeting Strategy

To reduce impacts to the air, water, and land of the Lake Superior basin from the transportation, energy demand, and waste created by planning and attending face-to-face meetings of the LSBP, the Sustainability Committee and the *Making a Great Lake Superior 2007* Green Team (http://www.seagrant.umn.edu/superior2007/statement/) plan to draft a Green Meeting Strategy. The intent is that organizers of Forum, Superior Work Group, and Task Force meetings will make every effort to reduce the footprints of each event as per the Green Meeting Strategy. Tools and templates will be developed collaboratively to help implement the strategy.

7.3.3 TRAcking of Community Sustainability Plus

In collaboration with the Forum, the Sustainability Committee will continue adding community-based sustainability initiatives throughout the basin to the TRACS database. The TRAcking of Community Sustainability Plus (TRACS+) inventory will be an ongoing initiative to assist the LSBP in determining the extent to which LaMP goals and objectives are met and, ultimately, whether Lake Superior residents are moving towards, or away from, sustainability. Potential use of the WiserEarth community directory and networking forum (www.wiserearth.org) to map and network non-governmental organizations (NGOs) and individuals addressing sustainability issues should be investigated.

7.3.4 Keepers of Sustainability Map Series

Using the TRACS database as a starting point, a "Keepers of Sustainability Map Series" for the Lake Superior basin could be created. It would include, for example, sectoral maps (institutional, educational, business/commercial, etc.) which depict the location and contact information of basin organizations working on sustainability initiatives. Another option would be to create one map only, with different icons representing different sectors. The main purpose of the Map Series would be to inform citizens of the positive events occurring in the basin, as well as to facilitate networking and information exchange. The creation of an online version should be explored as well. Lastly, this project should be coordinated with another idea discussed by the Superior Work Group—watershed fact sheets that provide basin residents with basic information about the place they live.

7.3.5 Landowner and Realtor Outreach Project

In collaboration with the Superior Work Group, Well Aware, EcoSuperior, Green Communities Canada, and the Lake Superior Partnership, the Sustainability Committee is contributing to the development of education and outreach materials for realtors and homeowners. The materials are aimed at improving realtors' and homeowners' understanding of environmental concerns related to rural, residential properties. It is hoped that, through the project deliverables—which include a Lake Superior Best Management Practices (BMP) manual, professional and community outreach sessions, and home visits—the target audience will begin to change its attitudes and approaches to activities, as well as the use of these types of properties.

Figure 7-7. Outreach and education materials are being developed to help improve realtors' and homeowners' understanding of environmental concerns related to rural, residential properties. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Due to property ownership and real estate regulation that usually falls within the jurisdiction of provincial, state, or local governments; uncoordinated funding opportunities at all levels of governments; and varying local and regional organizational capacities and programs, this unique project is being implemented differently across the basin's various jurisdictions. However, cross-jurisdictional knowledge transfer and collaboration occur when appropriate.

To date, the binational project team has prepared the common elements of the BMP manual. In the spring of 2008, all jurisdictions will be researching, reviewing, and developing content and artwork for their portion of the BMP manual. Completion of the manual is targeted for the summer of 2008. In Ontario, EcoSuperior conducted 54 Well Aware visits in the Thunder Bay area in the summer of 2007. EcoSuperior is also planning a Community Forum in Kakabeka Falls to promote proper management of rural properties. In all jurisdictions, further work on the development, printing, and distribution of the BMP manual, as well as promotional events such as community fora, will depend on the availability of funds.

The design of this project was influenced by the CARD Project that the Sustainability Committee conducted in 2005. The LaMP Chemical Committee has also contributed to the landowner and realtor outreach project (see Chapter 2, section 2.2.4 and Chapter 4).

7.3.6 Aboriginal/Tribal Cooperation

Grand Portage Reservation, Fond Du Lac Reservation, Fort William First Nation, and the Anishinabek of the Gichi Gami, a citizen-based environmental organization based on Fort William First Nation, hope to build on their growing relationship and will seek to pursue collaborative activities.

7.3.7 Climate Change Action at Fond du Lac Reservation

The Fond du Lac Reservation has recently convened a climate change work group comprised of Resource Management Division staff. This group is gathering information about reservation-wide and building-specific energy efficiency, fleet fuel efficiency, and other opportunities to reduce carbon emissions.

Figure 7-8. Fond du Lac Reservation is considering ways to reduce carbon emissions and mitigate the effects of climate change on tribal resources. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Fond du Lac has also invested in research on renewable energy, primarily wind and biofuels, and plans to install a biomass generator in 2009. The tribal council passed a resolution in 2007 signing on to the Kyoto protocols and will seek to reduce GHG emissions 25 percent by 2020. The climate change work group will bring recommendations to the tribal council on purchasing policies, energy efficiency improvements, and other tools for reaching the reduction goals. The work group will continue to reach out to the tribal community to solicit residents' concerns and ideas for mitigating the effects of climate change on tribal resources.

7.3.8 Sustainability Resource Mobilization

The Sustainability Committee will endeavor to stabilize and expand its membership, and will be looking for additional partners both within and outside the LSBP. This should make it easier to leverage a variety of resources, thus helping develop and implement sustainability initiatives. Particular focus will include recruiting university expertise as well as economic development councils/corporations to demonstrate sustainable economies.

7.3.9 Baseline Sustainability Indicators – Phase 2

The Sustainability Committee will analyze previously conducted CARD projects to look for common themes to be pursued. Using the resources mobilized in the above action, the committee will build a work plan and project sets to address what we have learned.

Lifelong Ecological Consciousness Community Learning Program

As ecological systems are continually being degraded, humanity is facing very serious challenges. Solutions exist, but they are complex and often muddled by a great deal of misinformation, myth, and ignorance about ecological systems. The Lifelong Ecological Consciousness Community Learning Program (LECCLP), a program of the Forum for Ecological Education and Action (www.feea.ca) based at Thunder Bay's Lakehead University, assists citizens in becoming ecologically literate and ecologically conscious. By building the knowledge and skills they need to make ecological changes in their own behaviors and those of their family, and by empowering them to influence broader community systems through action and leadership committed to sustainable policies and practices, LECCLP protects and preserves life for future generations.

LECCLP consists of a four-part course in which citizens develop the skills of anticipatory learning, self-directed learning, co-learning, and life-cycle systems-based thinking. The inaugural *Part 1: Introduction to Ecological Literacy* was successfully completed from May to June 2007 and in November 2007. The next course is scheduled to begin May 1, 2008. *Part 2: Extending Our Ecological Literacy* is scheduled to begin April 16, 2008. *Part 3: Ecological Location-based Systems Learning* was completed in November 2007. *Part 4: Ecological Leadership* is slated for either September 2008 or the spring of 2009.

Chapter 8

Collaborative Efforts

Duluth Harbor skyline at night. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Lake Superior Lakewide Management Plan 2008

Chapter 8 Contents

Chapter 8
Collaborative Efforts

8.0 INTRODUCTION

Chapter 1 describes the relationship of the LaMP to other initiatives and efforts, including the Areas of Concern (AOC)/Remedial Action Plan program.

In this chapter, other collaborative efforts will be elaborated on and described.

8.1 CONNECTING THE COAST CURRICULUM

"Connecting the Coast" is a unique, interactive web-based curriculum based on the information, research, critical issues, and priorities of the Lake Superior Lakewide Management Plan (LaMP). The curriculum uses LaMP-critical priorities to engage students in connecting learning to action through self-directed service learning projects. The objective is to positively affect the stewardship of the Lake Superior ecosystem.

Connecting the Coast uses a systems approach to understanding environmental issues while applying a service-learning curriculum that engages learners to: 1) investigate critical environmental issues impacting Lake Superior; 2) create a service learning project to apply what has been discovered through investigation to a self-initiated service learning project that will result in making personal or community change to positively address critical issues; 3) act to complete the service learning experience; and 4) reflect on the outcomes of the service learning experience through student-directed examination. The curriculum involves high school students, as citizens and future Lake Superior community leaders, applying a service-learning curriculum to address the most important Lake Superior Binational Program issues. Students will act as "learner-doers" and will become the catalysts for personal and community change. The Connecting the Coast web site is accessible to anyone interested in learning more about Lake Superior stewardship and environmental issues specific to and within their community.

The issues addressed as curriculum elements are focused on those identified in the LaMP including: 1) building a sustainable Lake Superior environment; 2) reducing critical Lake Superior pollutants; 3) restoring critical habitats and native species; 4) controlling invasives; and 5) understanding the relationship between the Lake Superior ecosystem and human health.

Further information on Connecting the Coast can be found in Chapter 6, section 6.1.4. The web site for the curriculum is http://connectingthecoast.uwex.edu/.

8.2 GREAT LAKES LEGACY ACT (U.S.)

Contaminated sediments at the bottom of rivers and lakes are a significant problem in the Great Lakes basin. For decades, industrial sources contributed substantial amounts of harmful

pollutants to the Great Lakes, including organic molecules like polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) oil and grease, and heavy metals like mercury and cadmium. Recent improvements in controlling these discharges have greatly reduced the amount of contaminants being released into the environment, but high levels of contamination still remain in the sediment as a "legacy" of the historical contamination. These contaminants continue to enter the food chain where they can cause adverse effects to human health and the environment.

To help address the contaminated sediment problem, the *Great Lakes Legacy Act* (GLLA) was enacted in 2002, and funding for the program began in 2004. The Act authorized $270 million in funding over five years,[1] to assist with the remediation of contaminated sediment in the 31 designated U.S. AOCs. The goal of the US EPA Great Lakes National Program Office, which administers the GLLA, is to identify all eligible remediation projects within the 31 U.S. AOCs and develop remediation projects for these sites. GLLA remediation projects must lie within a U.S. AOC and may be funded up to $50 million per year. Priority is given to:

- Remedial action for contaminated sediment;
- Projects identified in a Remedial Action Plan;
- Projects that will use an innovative approach that may provide greater environmental benefits, or equivalent environmental benefits at a reduced cost; and
- Projects that can begin within a year of funding.

Table 8-1 lists GLLA remediation projects completed or substantially completed as of December 7, 2007. The cumulative volume of sediment remediated in the U.S. since 1997 is depicted in Figure 8-1. The map on the following page (Figure 8-2) illustrates the progress and achievements made in sediment remediation activities in the Great Lakes during 2006. Both Figure 8-1 and Figure 8-2 include quantitative estimates as reported by project managers. Data collection and reporting efforts are described in the *Great Lakes Sediment Remediation Project Summary Support, Quality Assurance Project Plan*.[2] Detailed project information is available upon request from project managers.

[1] To date, $91.5 million has been appropriated over 4 years as follows: $9.9 million in FY2004, $22.3 million in FY2005, $29.3 million in FY2006, and $30 million in FY2007.

[2] US EPA. (2006). *Quality Assurance Project Plan for Great Lakes Sediment Remediation Project Summary Support.* Unpublished GLNPO document available from Mary Beth G. Ross (ross.marybeth@epa.gov).

Table 8-1. GLLA remediation projects completed or substantially completed as of Dec. 7, 2007.

Project	Action	Total Cost ($Million)	Cubic Yards Removed	Major Contaminants	Pounds of Contaminants Removed
Black Lagoon	Removal/Residual Cover	$8.7	115,000	PCBs, Mercury, Oil & Grease	338,000
Hog Island	Removal	$5.7	46,000	PAHs, Lead	7,500
Ruddiman Creek	Removal/Residual Cover	$14.2	90,000	PCBs, Lead, Chromium	333,000
Tannery Bay*	Removal	$8.0	41,000	Mercury, Chromium	882,000
Ashtabula*	Removal/Residual Cover	$60.0	496,000	PCBs	25,000

* Costs for Ashtabula and Tannery Bay are estimates, as are the cubic yards and pounds removed for Ashtabula.

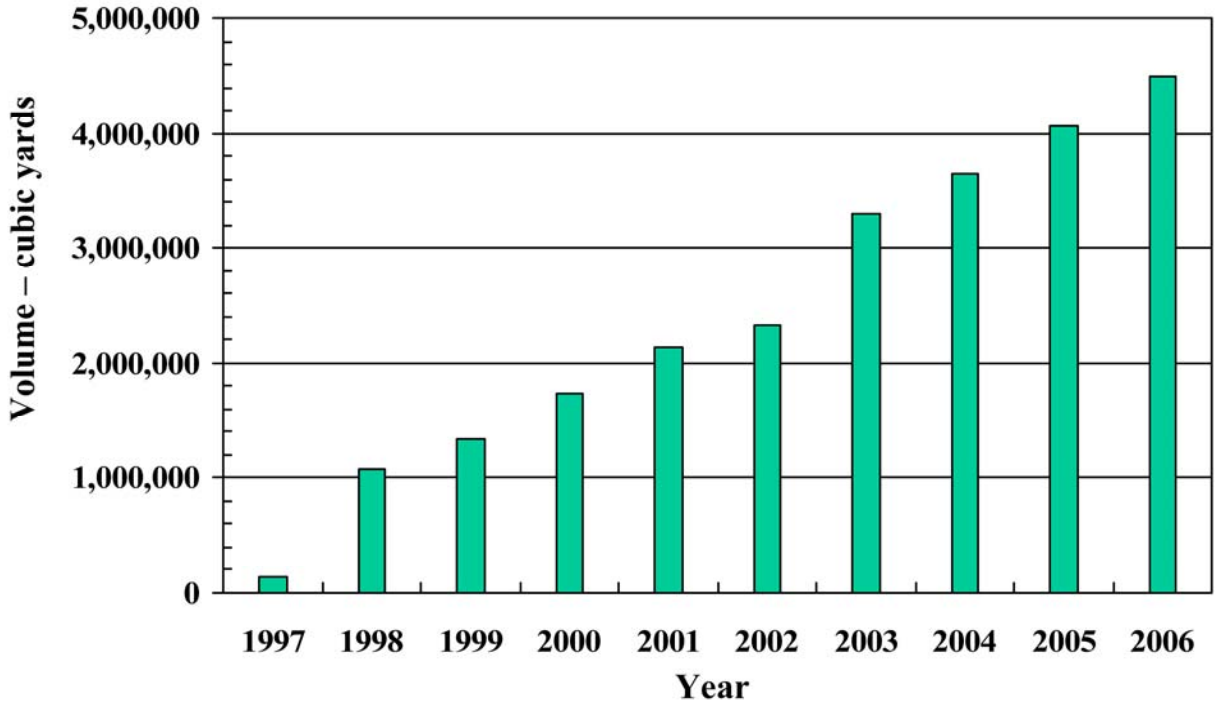

Figure 8-1. Cumulative volume of sediment remediated in the U.S. since 1997. Source: US EPA Great Lakes National Program Office

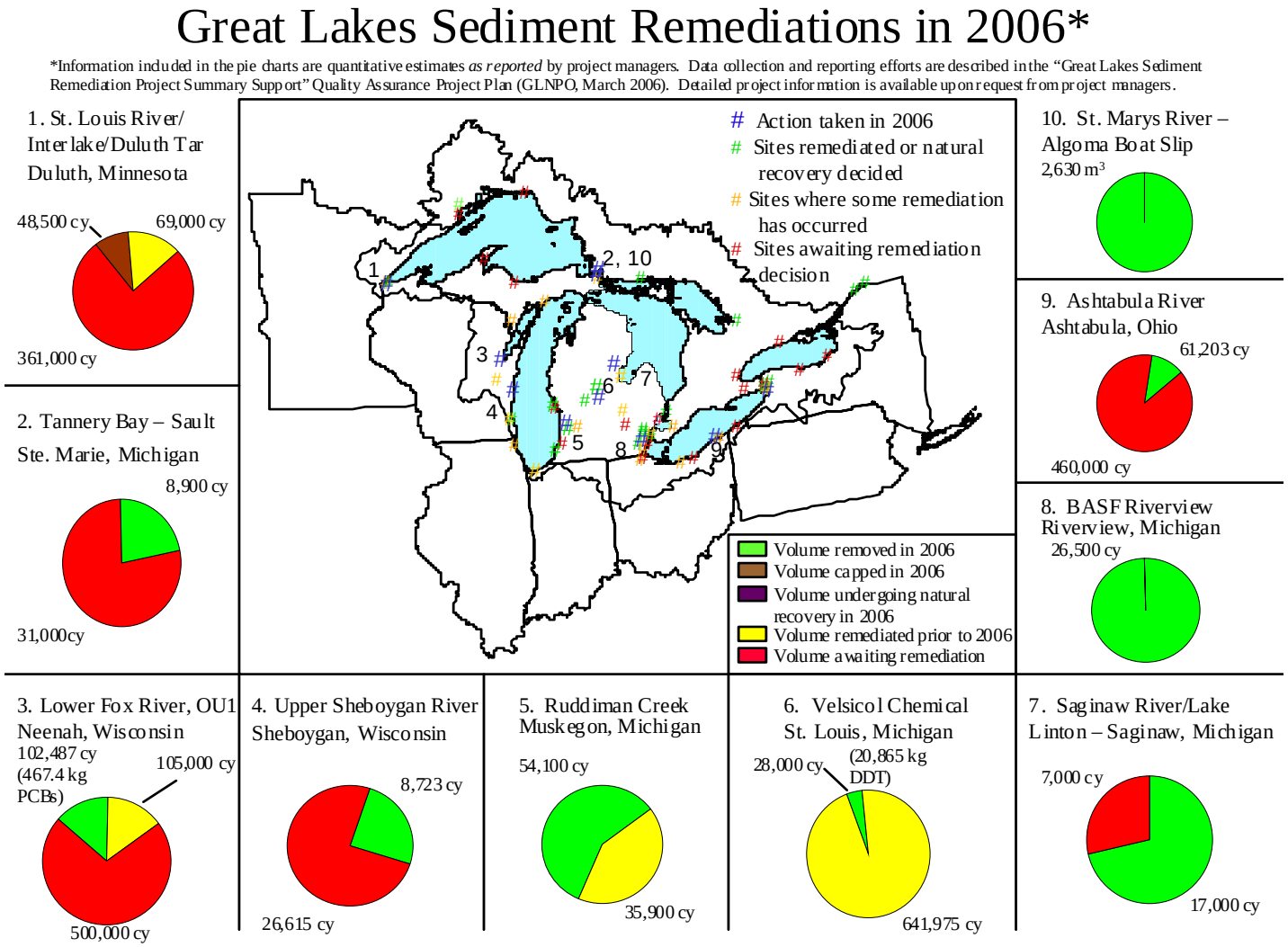

Figure 8-2. Progress in U.S. sediment remediation in the Great Lakes during 2006. Source: US EPA Great Lakes National Program Office

(OU = Operable Unit; cy = cubic yards; m^3 = cubic meters)

8.3 DECISION-MAKING FRAMEWORK FOR CONTAMINATED SEDIMENTS IN ONTARIO

A risk-based decision-making framework for contaminated sediments was completed under the 2002-2007 *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem* (COA) and placed on the Province of Ontario Environmental Registry for a public comment period (November 21, 2006, to January 20, 2007). The Ontario Ministry of Environment (MOE) is integrating the document with existing guidance to produce "Guidelines for Identifying, Assessing and Managing Contaminated Sediments in Ontario: An Integrated Approach". Pending final internal MOE review, the guidance will be applied throughout the province.

The COA framework is being applied to evaluate the need for management actions in a number of the project sites in the Areas of Concern.

8.4 GREAT LAKES REGIONAL COLLABORATION

In May 2004, President Bush signed Executive Order 13340 to create a cabinet-level interagency task force and to call for a "regional collaboration of national significance." After extensive discussions, the federal Great Lakes Interagency Task Force (IATF), the Council of Great Lakes Governors, the Great Lakes Cities Initiative, Great Lakes tribes, and the Great Lakes Congressional Task Force moved to convene a group now known as the Great Lakes Regional Collaboration (GLRC or Collaboration).

The Collaboration includes the US EPA-led federal agency task force, the Great Lakes states, local communities, tribes, non-governmental organizations, and other interests in the Great Lakes region. In December 2005, the Collaboration released recommendations for the following areas: aquatic invasive species, habitat conservation and species management, near-shore waters and coastal areas, areas of concern, non-point sources, toxic pollutants, sound information base and representative indicators, and sustainability. The full set of recommendations can be found in the *Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes.*[3] The GLRC has encouraged and supported the initiation of several projects to restore and protect the Great Lakes basin, including the Lake Superior ecosystem. Actions taken to date to implement these recommendations are presented below.

Federal Great Lakes Interagency Task Force Near-Term Actions

On December 12, 2005, US EPA Administrator Stephen Johnson announced a federal commitment to further the recommendations contained in the *Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes* through implementation of a series of near-term actions. The list included 48 specific actions consisting of one or more activities to be accomplished. The IATF is making progress both in terms of implementing projects to restore and protect the Great Lakes and in improving coordination and communication among the Task Force members. Highlights of progress include:

[3] Great Lakes Regional Collaboration. 2005. Strategy to Restore and Protect the Great Lakes. Available at http://www.glrc.us/strategy.html.

- Twelve of the 48 original near-terms actions are completed; three have been moved to long-term status; the other 33 are on track.
- US EPA, working with state and local partners, has developed a standardized beach sanitary survey form for state and local governments to use in assessing their beaches. US EPA is supporting implementation pilots using the new survey.
- The U.S. Fish and Wildlife Service has listed the Asian Silver Carp, Largescale Silver Carp, and Black Carp as injurious under the Lacey Act.
- In its fiscal year 2008 budget, the National Oceanic and Atmospheric Administration (NOAA) requested funding to establish habitat restoration partnerships focused on Areas of Concern in the Great Lakes, and to create a special NOAA Office on Great Lakes Habitat Restoration that would provide a focal point for all of NOAA's restoration efforts in the Great Lakes.
- Twenty-two environmental restoration projects around the Great Lakes, including the Lake Superior basin, are being funded this year under the Great Lakes Watershed Restoration Grant program. The program is providing $1.1 million in federal money and leveraging an additional $1.9 million in contributions by non-federal partners. Partner agencies are US EPA, U.S. Fish and Wildlife Service, NOAA, Forest Service, and the Natural Resources Conservation Service.
- US EPA has completed five Legacy Act projects (four remediation/one monitor and evaluate), and has six additional projects underway (all monitor and evaluate).
- The IATF's Regional Working Group has been meeting weekly for over a year to oversee implementation of the list of near-term actions, as well as other provisions of the President's Executive Order on the Great Lakes. The meetings have also become an important forum to share information about new programs/initiatives and funding opportunities among members.
- The IATF created the Wetlands Subcommittee and the Aquatic Invasive Species Rapid Response Subcommittee to improve interagency coordination on two high-priority areas for the Great Lakes. Both subcommittees are also bringing in non-federal partners through joint projects in cooperation with the GLRC.

Figure 8-3. Bark Bay wetlands. Photo credit: Janet Keough, US EPA.

Great Lakes Regional Collaboration Strategy – Collaboration Efforts

The Collaboration partners have begun a series of joint initiatives to address issues in the GLRC Strategy, including invasive species, toxic reductions, habitat protection and restoration, and clean beaches. These initiatives are described below.

Aquatic Invasive Species

Aquatic Invasive Species Rapid Response Initiative

While preventing the introduction of aquatic invasive species (AIS) is the first line of defense against invasions, even the best prevention efforts may not stop all AIS introductions. In 2007, the GLRC Executive Committee endorsed the formation of an Aquatic Invasive Species Rapid Response Initiative to increase the likelihood that invasions will be addressed successfully through early detection and rapid response efforts, while populations are still localized and can be contained and eradicated. In the summer of 2007, a Communication Protocol was developed at the direction of the GLRC Executive Committee, and Points of Contact were identified by participating GLRC agencies. In December 2007, a compendium of the Points of Contact and Communication Protocol was finalized and distributed to GLRC agencies. GLRC agencies are now developing plans for a mock exercise to test the Communication Protocol in early summer 2008.

Great Lakes Clean Boat Initiative

GLRC partners and the media will promote a "Great Lakes Clean Boat Day" early in the 2008 boating season. This effort will celebrate recreational boating in the Great Lakes and promote practices which will reduce the spread of aquatic invasive species. The Great Lakes are one of the top recreational boating destinations in the nation. Nearly 4.3 million boats are registered in the eight Great Lakes states—with approximately $16 billion spent on boats and boating activities in a single year, directly supporting 107,000 jobs. Outreach efforts to this user group can help ensure a healthy Great Lakes ecosystem, as well as help support a strong and sustainable recreational economy. Agencies are compiling educational material over the winter of 2008. At the same time, the Great Lakes states are determining the preferred day or days for holding "Great Lakes Clean Boat Day."

Figure 8-4. Bayfield, Wisconsin, Madeline Island Ferry leaves the dock. Photo credit: Frank Koshere, WDNR.

Toxic Pollutants

Toxic Pollutants Initiative

The Toxic Pollutants Initiative sets forth a series of near-term activities undertaken by members of the Collaboration to reduce or virtually eliminate persistent toxic substances such as mercury and PCBs in the basin, as well as prevent new toxic threats to the basin through pollution prevention and enhanced surveillance, protect public health through education and outreach, and work with international forums to address sources outside the basin. Initiative activities include:

1. **Mercury Phase-down Strategy –** In 2007, a workgroup of state, tribal, and city staff developed a basinwide Great Lakes mercury product stewardship strategy to fulfill the GLRC Strategy recommendation to phase down mercury in products and waste. The draft *Mercury in Products Phase-Down Strategy* is posted at http://www.glrc.us/initiatives/toxics/drafthgphasedownstrategy.html.

2. **Burn Barrel Education and Outreach Campaign –** US EPA and Great Lakes states, tribes, and cities are jointly developing an education and outreach program to address open burning across the Great Lakes basin. Targeted at local and tribal waste management officials, this project provides information on infrastructure and alternatives to burning in communities, as well as tools to strengthen burning ordinances and support greater compliance with current regulations. This program is being presented at meetings in all Great Lakes states.

3. **Pharmaceutical and Electronic Waste Disposal Education and Outreach –** US EPA, Great Lakes states, tribes, and cities are developing an education and outreach effort to address pharmaceutical and electronic wastes in the Great Lakes basin. This effort, targeting waste management officials, provides information about disposal and recycling policies and options. Illinois/Indiana Sea Grant, Great Lakes states, and US EPA staff have presented information to local solid waste management officials and others on pharmaceutical waste at numerous conferences throughout the basin.

4. **Great Lakes Sport Fish Consortium Project –** The Great Lakes Sport Fish Consortium, the Wisconsin Department of Health and Family Services, and representatives of Great Lakes states and tribes finalized the *Protocol for Mercury-based Fish Consumption Advice: An addendum to the 1993 Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory*, with funding from US EPA. Basinwide fish consumption outreach materials related to mercury will be produced by the end of 2008.

Mercury Emission Reduction Initiative

In 2007, the GLRC decided, under its Toxic Pollutants Initiative, to develop a strategy for reducing mercury emissions across the Great Lakes region. This effort should produce institutionalized activities to sustain mercury emissions reduction from new and existing sources whose mercury emissions have not been regulated, and from sources where regulations have been implemented but additional reductions are technically feasible and economically reasonable. Examples of potential sources include manufacturing processes that produce

mercury emissions, and the disposal of mercury-containing products. A strategy will be drafted in 2008, including an evaluation of the major sources of mercury deposition in the Great Lakes region, identification of priority sectors, and reduction approaches.

Habitat/Species

Habitat/Wetlands Initiative

The GLRC Strategy outlined the problems associated with habitat loss and degradation and provided recommendations for protecting and restoring Great Lakes habitat. To address the strategy's key habitat and wetland issues, the Collaboration launched a Wetlands Initiative with two near-term goals: 1) a wetlands challenge to federal and non-federal partners to protect and restore 200,000 acres of wetlands in the Great Lakes basin; and 2) improving coordination of federal wetlands management programs.

Figure 8-5. A Habitat/Wetlands Initiative will seek to address the key problems identified in the GLRC Strategy. Photo Credit: Steve Durocher, Cedar Tree Institute.

At the same time, the U.S. Army Corps of Engineers launched a $1 million Great Lakes Habitat Initiative that builds upon the recommendations of the GLRC Strategy. The initiative will help partners advance habitat and wetland restoration projects by connecting partners with the information and resources they need to make projects happen. This effort includes developing a database and detailed inventory of potential habitat and wetlands restoration projects.

The two initiatives share similar goals and have been merged into one overarching Habitat/Wetlands Initiative, focusing initially on coordination to accomplish the wetlands challenge to federal and non-federal partners to protect and restore 200,000 acres in the Great Lakes basin.

Beach Project Initiative

The GLRC identified coastal health as a challenge, recognizing the significance of beaches to the economic well-being, health, and quality of life of the region's citizens. Because contamination leading to beach advisories continues to be a concern in the basin, the GLRC called for the identification of sources of contamination and remediation. Several federal, state, local, and tribal partners who work together with the Great Lakes Beach Association are creating and improving the use of sanitary surveys and beach forecasting models. The GLRC will increase this cooperation by supporting and encouraging the use of sanitary surveys and predictive modeling. Ultimately, the GLRC hopes to recognize and integrate sanitary survey tools and predictive modeling as a coastal health initiative to enhance the health of beaches along the Great Lakes to promote recreational activity and reduce risk to human health. In 2008, the partners are developing outreach materials for distribution and utilization of the sanitary survey tools and predictive models.

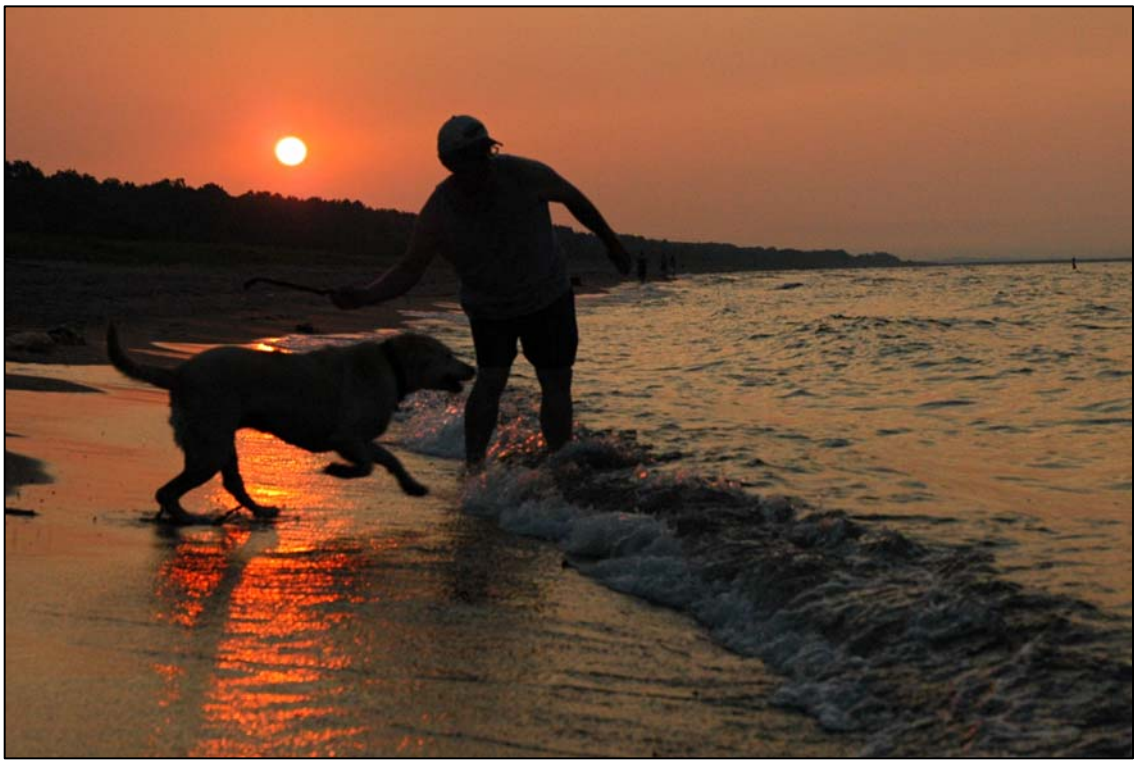

Figure 8-6. A man plays catch with his dog at Wisconsin Point on Lake Superior. Photo credit: Frank Koshere, WDNR.

Great Lakes Watershed Restoration Grant Program

For the past three years, the Great Lakes Watershed Restoration Grant Program (Program) has funded projects to develop and implement local watershed plans that: address water quality and living resources in Great Lakes watersheds; help restore critical sand dune, wetland, forest, and stream habitats for fish and wildlife; and control invasive plant species. In response to a September 1, 2007, request for proposals, 54 proposals were received and are now being reviewed by Program partners. Decisions on grant awards will be announced in late March 2008.

Funding for the Program has come from five federal agencies: US EPA, U.S. Fish and Wildlife Service, Forest Service, NOAA, and Natural Resource Conservation Service. For the last three years, the five agencies have contributed discretionary money for the Program through agreements with the National Fish and Wildlife Foundation (NFWF). NFWF coordinates the Program, including issuing yearly requests for proposals, conducting proposal reviews, and administrating grants.

In fiscal year 2006, 14 projects were funded with $827,000 in federal funds and more than $1.3 million in non-federal contributions. In fiscal year 2007, 22 projects were funded with $1.1 million in federal funds and more than $1.8 million in non-federal contributions from partners. This year, more than $1 million in federal funds will be available. In addition, NFWF has

secured funding in the amount of $700,000 for each of the next three years from ArcelorMittal Steel to supplement the Program.

Figure 8-7. Boaters explore Huron Island National Wildlife Refuge. Photo credit: Frank Koshere, WDNR.

8.5 CANADA-ONTARIO AGREEMENT RESPECTING THE GREAT LAKES BASIN ECOSYSTEM

On August 16, 2007, Canada and Ontario announced the official signing of the 2007-2010 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA). This renews a commitment by the governments of Canada and Ontario to work towards restoration, protection, and maintenance of the Great Lakes basin ecosystem.

The COA includes collaborative actions between six federal and three provincial agencies focused on achieving specific results towards the agreement's long-term vision of a healthy, prosperous, and sustainable Great Lakes ecosystem. It contains over 180 commitments that are supported by hundreds of individual projects. The agreement focuses on cleaning up 15 severely degraded ecosystems in the Great Lakes (Areas of Concern), reducing harmful pollutants, improving water quality, conserving fish and wildlife species and habitats, lessening the threat of aquatic invasive species, and improving land management practices within the Great Lakes basin. The COA also contains new areas of cooperation such as protecting sources of drinking

water, understanding the impacts of climate change, and encouraging sustainable use of land, water, and other natural resources. It ensures that scientific information is available to support remediation and protection efforts and to measure their success for the benefit of the growing number of Canadians dependent upon the lakes. The COA will also contribute to meeting Canada's obligations under the Canada-U.S. *Great Lakes Water Quality Agreement*, which has recently undergone review by both countries. A new COA beyond 2010 would consider the recommendations and results of that review.

Annex 3 of COA focuses on Lake and Basin Sustainability. The approach for Annex 3 is to continue to work via binational lakewide and basinwide programs to respond to the interrelated and cumulative challenges facing the long-term prosperity of the Great Lakes. There are six goals in Annex 3:

1. Encourage and enhance Great Lakes sustainability;
2. Improve water quality in each Great Lake by making progress on virtual elimination of persistent bioaccumulative toxic substances and the reduction of harmful pollutants;
3. Conserve and protect aquatic ecosystems, species and genetic diversity;
4. Reduce the threat of aquatic invasive species in the Great Lakes Areas of Special Focus;
5. Understand the impact of climate change on the Great Lakes ecosystem; and
6. Develop and implement locally-created, science-based source protection plans to identify and mitigate risks to drinking water sources in the basin.

8.6 GREAT LAKES BINATIONAL TOXICS STRATEGY

The Great Lakes Binational Toxics Strategy (GLBTS or Strategy) marked its 10-year anniversary in May 2007. Over the past 10 years, the governments of Canada and the U.S., along with stakeholders from industry, academia, state/provincial and local governments, Tribes, First Nations, and environmental and community groups, have worked together toward the achievement of the Strategy's challenge goals for 12 Level 1 persistent toxic substances. Of the Strategy's 17 challenge goals that were established in 1997, 12 have been achieved and one more is expected in the near future; significant progress has been made toward the remaining four challenge goals.

While the substance-specific workgroups for mercury, PCBs, dioxins/furans, and hexachlorobenzene (HCB) and benzo(a)pyrene (B(a)P) continued to work toward meeting their challenge goals, the highlight of 2007 for the GLBTS Integration Workgroup was a series of 10-year anniversary events held in Chicago in May. The events began with a Stakeholder Forum followed by an evening reception and dinner. A GLBTS Future Focus Workshop to consider broadening the GLBTS to address emerging chemical threats to the Great Lakes basin was also held in conjunction with the 10-year anniversary events.

Considering stakeholders' ideas about future directions for the GLBTS, including emerging substances of interest in the Great Lakes, US EPA and Environment Canada proposed a new path forward for the GLBTS that aligns with work being undertaken by other existing Great Lakes programs, such as the *Great Lakes Water Quality Agreement*, and is consistent with domestic and international chemical management programs, including the *Canada-Ontario Agreement Respecting the Great Lakes Basin*, Canada's Chemicals Management Plan, U.S. High Production Volume program, and the tri-lateral U.S./Canada/Mexico Security and Prosperity Partnership.

Figure 8-8. In May 2007, the GLBTS marked its 10-year anniversary with a series of events in Chicago, Illinois. Photo credit: Kelly Phillips, Environment Canada.

The new path forward for the GLBTS includes the creation of two new groups focused on emerging substances and their associated sectors: a new Substance Group and Sector Group. The Substance Group will focus on information gathering and integration of data on potential toxic substances in the Great Lakes basin. The Sector Group will review information on industrial sectors within the basin and explore potential opportunities for the GLBTS process to enhance the environmental management activities of select industries. These groups will work together to identify potential opportunities for action that may be accomplished through the GLBTS.

Chapter 9

Climate Change and its Impact on the Lake Superior Basin

Ice caves at Meyers Beach, Bayfield, Wisconsin. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

Lake Superior Lakewide Management Plan 2008

Chapter 9 Contents

Chapter 9
Climate Change and its Impact on the Lake Superior Basin

9.0 BACKGROUND

The United Nations recently released the Intergovernmental Panel on Climate Change's (IPCC) *Fourth Assessment Report Climate Change 2007* (or Synthesis Report). This report summarizes the most important findings, which include:

1. Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and a rising global average sea level.

2. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.
    a. In terrestrial ecosystems, earlier timing of spring events and poleward shifts in plant and animal ranges are with *very high confidence* linked to recent warming. In some marine and freshwater systems, shifts in ranges and changes in algal, plankton, and fish abundance are with *high confidence* associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation.

3. Global greenhouse gas (GHG) emissions due to human activities have grown since pre-industrial times, with an increase of 70 percent between 1970 and 2004.
    a. Changes in atmospheric concentrations of GHGs and aerosols, land-cover, and solar radiation have altered the energy balance of the climate system.
    b. Global atmospheric concentrations of CO_2, methane (CH_4), and nitrous oxide (N_2O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years.

4. Most of the observed increase in globally-averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations. It is *likely* that there has been significant warming from anthropogenic sources over the past 50 years averaged over each continent (except Antarctica).

9.1 OBSERVED AND ANTICIPATED EFFECTS ON THE GREAT LAKES BASIN ECOSYSTEM

The effects of a changing climate are now and continuing to be experienced in the Great Lakes and the Lake Superior basin over the next century. In a report prepared for the International Joint Commission (IJC) by the Great Lakes Water Quality Board in 2003, Environment Canada

and US EPA scientists extensively detailed documented and anticipated effects to the Great Lakes ecosystem due to climate change. The Union of Concerned Scientists also issued a report detailing similar changes. These include the following:

- Winters are getting shorter;
- Annual average temperatures are growing warmer, in fact increases are projected to be anywhere from 2°C to almost 4°C (Kling et al. 2003);
- Extreme heat events are occurring more frequently;
- The duration of lake ice cover is decreasing as air and water temperatures rise; and
- Heavy precipitation events, both rain and snow, are becoming more common.

In addition, anticipated changes include the following:

- Future lake levels are expected to decline as winter ice coverage decreases;
- Declines in the duration of winter ice cover are expected to continue;
- Earlier ice breakup and earlier peaks in spring runoff will change the timing of stream flows;
- The distributions of fish and other organisms in lakes and streams will change. Coldwater species such as lake trout, brook trout, and white fish are likely to decline in the southern parts of the Great Lakes region, while warm water species are likely to expand northward;
- Invasions by non-native species will likely be more common, increasing the stress on native plant and animal populations;
- Lower water levels coupled with warmer water temperatures may accelerate the accumulation of mercury in the aquatic food chain;
- Increased incidence of extreme events such as severe storms and floods;
- More forest fires will result from hotter and drier conditions; and
- Increases in the number and severity of summertime pollution episodes.

Figure 9-1. One of the expected effects of climate change is more frequent invasions of non-native species such as this Eurasian water milfoil. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

In short, the Great Lakes basin is already seeing significant impacts associated with global warming, and scenarios project far greater warming in the 21st century. Both adaptation and mitigation activities are necessary to begin to address climate change impacts.

9.2 ACTIVITIES

The Lake Superior LaMP is beginning to address the potential problems and effects of climate change on the basin, through outreach and education, mitigation activities, and adaptation projects. Some of these activities are detailed below.

9.2.1 LAMP ACTIVITIES

Climate change was a primary focus of the *Making a Great Lake Superior 2007* conference, held in Duluth, Minnesota, on October 29-31, 2007. Both a plenary session and a focused breakout session on climate change were included, with presentations by members of the United Nations IPCC (see text box on page 9-5).

Goals to address the issue of climate change have been incorporated into the revised LaMP Ecosystem Goals, including climate change mitigation and adaptation actions.

A US EPA grant to the Minnesota Pollution Control Agency and the Will Steger Foundation will focus on climate change outreach/education and adaptation and mitigation actions, consistent with the LaMP climate change Ecosystem Goals.

9.2.2 OTHER ACTIVITIES

The following are Lake Superior and Great Lakes basin activities related to climate change that support LaMP goals.

- The towns of Ashland and Washburn, Wisconsin, passed Eco-Municipality Designation Resolutions calling for reducing dependence on fossil fuels, the primary contributor to GHG emissions and ozone depletion.[1]
- The Town of Bayfield unanimously passed a resolution on October 16, 2006, to follow the Natural Step framework and join Washburn and Ashland as eco-municipalities.
- The Sustainable Chequamegon Initiative, a project of the Alliance for Sustainability, has drafted a *Sustainable Chequamegon Initiative Strategic Plan for 2006-2011* that incorporates the Natural Step framework and climate change mitigation actions and activities.
- Apostle Islands National Lakeshore is educating the public on climate change as well as pursuing carbon mitigation strategies. The National Park Service provides a comprehensive list of climate change talking

Figure 9-2. Apostle Islands National Lakeshore is educating the public on climate change and is pursuing carbon mitigation strategies. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

[1] North American EcoMunicipality Network Update. 2007. Available at www.1kfriends.org/documents/NAEco-MunicipalityNetworkUpdateforTNSIMeeting-January2007.pdf.

points and a brochure detailing the anticipated effects on the Great Lakes region. Apostle Islands National Lakeshore has also established a sustainability policy and a list of best management practices for climate change mitigation and adaptation. The park also participates in the national Climate Friendly Parks program.[2]

- Researchers at the Large Lakes Observatory at the University of Minnesota at Duluth spoke at the *Making a Great Lake Superior 2007* conference on the effects of temperature change on the lake. They have concluded that Lake Superior is responding more quickly to climate change than previously expected and that the surface water temperatures of Lake Superior are rising rapidly while annual ice coverage of the lake is simultaneously declining. The study looked at air temperatures, ice cover, and water temperature data collected at buoy sites since 1906.[3]

Figure 9-3. Research indicates that annual ice coverage on Lake Superior is declining.
Photo Credit: Frank Koshere, Wisconsin Department of Natural Resources.

- Minnesota, under the leadership of Governor Tim Pawlenty, has been a leader in pursuing reductions in GHG emissions. The Governor recently proposed, and the legislature passed, an energy plan that puts Minnesota squarely at the front of states leading the way toward increasing energy efficiency, expanding community-based energy development, and establishing a statewide goal to reduce GHG emissions. The Plan also requires Minnesota's electric utilities to provide 25 percent renewable electricity by 2025.

[2] National Park Service Climate Change and Sustainability website. Available at http://www.nps.gov/apis/naturescience/climate-change-and-sustainability.htm.
[3] Austin, J. 2007. Rapid warming of Lake Superior. Available at http://www.d.umn.edu/~jaustin/ICE.html.

Making a Great Lake Superior 2007 Conference

The main message from the climate change experts at the Lake Superior conference could be summarized as:

Solutions to climate change are available to us, and the time to act is now.

This message was delivered by both elected officials and US EPA and Environment Canada climate change experts among the 500 people who participated in the Lake Superior conference in Duluth in October of 2007. Minnesota Governor Tim Pawlenty voiced his commitment to pursuing climate change actions, citing the creation of his own Climate Change Advisory Group as an example. Top officials from the US EPA and Environment Canada joined a keynote panel to detail the global causes and local effects of a changing climate on the environment. Dr. Joel Scheraga (US EPA) and Dr. Linda Mortsch (Environment Canada), both members of the 2007 Nobel Prize-winning Intergovernmental Panel on Climate Change, joined Environment Canada climatologist David Phillips in demonstrating that unprecedented weather conditions, such as extreme storm events and droughts, are expected and that communities must adapt their infrastructure to endure. Their message was backed by a full day of presentations and dialogue among scientists, natural resource managers, outreach specialists, and government officials.

Mitigation and adaptation actions were cited as the most important strategies by the keynote panel. Following the panel, participants had the chance to learn how the global phenomenon of a changing climate is expected to affect the Lake Superior ecosystem. During the climate change breakout session, presentations from university researchers from Minnesota, Wisconsin, and Ontario shared information with a captivated audience on the warming of surface waters, the decrease of ice coverage, and the decline in amphibian communities. Managers from the National Park Service and the City of Thunder Bay spoke to the ongoing challenges caused by changing ecological conditions and their methods of promoting sustainability as a means of mitigating the problem. After hearing the experts, plans for mitigation and adaptation actions varied, yet one component was agreed upon: the timeline for action is today.

Dr. Joel Scherega and Dr. Linda Mortsch discuss climate change at the *Making a Great Lake Superior 2007* conference. Photo credit: Elizabeth LaPlante, US EPA.

- Environment Canada and Ontario Ministry of Natural Resources have contributed to a publication released by Natural Resources Canada called *Coastal Zone and Climate Change on the Great Lakes*.[4] The report details on a lake-by-lake basis expected climate change variables, impacts, and adaptation strategies based upon a series of community-based workshops held in the Great Lakes basin, plus the review of scientific, peer-reviewed literature, scientific assessment of changes in climatic variables (e.g., temperature and precipitation) and evaluation of GCM (global climate models) climate change scenario data. The impacts to the coastal region of Lake Superior are expected to be less than those associated with the other Great Lakes. This is because of the low level of human settlement in the Ontario portion of the Lake Superior basin and the great size and depth of the lake, which will moderate warming trends. Monitoring these impacts and the adaptation strategies are key to moving forward with the LaMP.
- In 2003, the Water Quality Board issued a report to the International Joint Commission on the projected effects of climate change on the Great Lakes basin and recommended management strategies.[5]
- Lake Superior Work Group members participated in the "Pileus Project," coordinated by Michigan State University (MSU) and US EPA's Office of Research and Development. This project provides useful climate information to assist decision makers. The current focus is on two leading industries in the Great Lakes region: agriculture and tourism. Through the use of climate models and participatory workshops, Pileus seeks to: provide a better understanding of historical climate trends, variability, and their past impacts on people and industry; evaluate how future climate trends and variability may impact people and industry, using newly developed, climate-related models; and create an economic framework which explicitly incorporates climate into the decision-making process. Stakeholders and researchers from the Pileus Project are building on each other's experiences, pooling expertise, and expanding knowledge about climate impacts on industry. The core research team is located at MSU and consists of scientists from diverse disciplines. For more information about the Pileus Project, see http://pileus.msu.edu.
- US EPA Region 5 recently released its climate change strategy, entitled *USEPA Region 5 Framework for Addressing Climate Change and Clean Energy* (presented in Addendum 9A to this chapter).[6] The framework focuses on:
  - Changing how our energy is produced;
  - Changing how our energy is used;
  - Changing how materials, products, and waste are managed; and
  - Integrating climate change considerations into US EPA operations and core programs.

[4] Coastal Zone and Climate Change on the Great Lakes. 2006. Available at http://adaptation.nrcan.gc.ca/projdb/pdf/85a_e.pdf.

[5] Climate Change and Water Quality in the Great Lakes Basin; Report of the Great Lakes Water Quality Board to the International Joint Commission, ISBN 1-894280-42-3. 2003. Available at http://www.ijc.org/php/publications/html/climate/index.html.

[6] US EPA Region 5 Framework for Addressing Climate Change and Clean Energy. 2008. Available at http://www.epa.gov/region5/aboutr5/index.htm.

- Annex 3 (Lake and Basin Sustainability) of the *Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem* (COA) addresses ecosystem sustainability, including climate change. It is agreed that climate change will affect the Great Lakes basin ecosystem. Understanding the impacts of climate change on the Great Lakes basin ecosystem in support of the development of adaptation strategies is one goal of COA. Over the next three years, Canada and Ontario will work together to develop a comprehensive management framework that considers the full range of impacts that can be expected for the Great Lakes basin from present and future climatic changes. The framework will incorporate four elements:
    1. Identifying and projecting changes to climate and ecosystems:
    2. Assessing impacts and vulnerabilities;
    3. Adapting to change; and
    4. Learning from impacts and adaptation research internationally and domestically.

  In order to achieve the goal of understanding the impacts of climate change on the Great Lakes basin ecosystem in support of the development of adaptation strategies, two results have been identified. Canada and Ontario have made commitments in order to achieve these results.

  Result 1: The impacts of climate change on ecosystem composition, structure, and function, including biodiversity (organisms and their habitat), water quality and quantity, human health and safety (including access to clean drinking water), social well-being and economic prosperity are understood in support of the development of adaptation strategies. Canada and Ontario commitments:

  a) Support the development of evidence, indicators, and model projections of climate and ecosystem change in the Great Lakes basin;

  b) Increase understanding of the impacts on and vulnerabilities of the Great Lakes, including biodiversity, natural resources, water assets, human health and safety, the economy and infrastructure in support of the development of adaptation strategies; and

  c) Facilitate linkages to climate change science, impacts, adaptation, and policy work of international, national, provincial and municipal governments, non-governmental organizations, industry, and academia.

  Result 2: The capacity of Great Lakes communities to adapt to a changing climate is increased. Canada commitment:

  a) Provide information to decision-makers and the public on scientific studies of atmospheric hazards and regional atmospheric change impacts.

  Ontario commitment:

  b) Continue working with other agencies and organizations to help communities around the Great Lakes ensure that foundation work is begun on managing the impacts of climate change.
- As of February 2008, four of the larger cities in the Lake Superior basin, Marquette, Ashland, Superior, and Duluth, had signed on to the U.S. Mayors' Climate Protection Agreement. Under the Agreement, participating cities commit to take the following three actions:

  - Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies to urban forest restoration projects to public information campaigns;
  - Urge their state governments, and the federal government, to enact policies and programs to meet or beat the GHG emission reduction target suggested for the U.S. in the Kyoto Protocol—a 7 percent reduction from 1990 levels by 2012; and
  - Urge the U.S. Congress to pass bipartisan GHG reduction legislation, which would establish a national emission trading system.

- The *National Summit on Coping with Climate Change* took place on May 8-10, 2007, in Ann Arbor, Michigan, and included participants from the Binational Program. The summit brought together leading scientists and scholars with key decision makers in a structured discussion that addressed the options available to institutions, firms, and societies in the U.S. for adapting and responding to climate change. The summit focused on four specific sectors that represent illustrative examples of the social, economic, environmental, and natural resource issues that need to be addressed. The chosen areas of focus were public health, the energy industry, water quality, and fisheries. The summit then turned its attention to general models for how different kinds of organizations, within these sectors and more generally, can put into place structures or processes that help them to anticipate and adapt to near- and long-term change.[7]
- The National Governor's Association (NGA), chaired by Governor Tim Pawlenty of Minnesota, has developed a publication entitled *Securing a Clean Energy Future: A Call to Action*, which outlines a strategy for reducing dependence on oil and reducing emissions of GHGs.[8]
- In October 2006, Canada announced *The Action Plan to Reduce Greenhouse Gases and Air Pollution* – including the intention to regulate GHGs that cause climate change. *The Action Plan to Reduce Greenhouse Gases and Air Pollution* will:
  - Impose mandatory targets on industry to achieve a goal of an absolute reduction of 150 megatonnes in GHG emissions by 2020;
  - Impose targets on industry so that air pollution from industry is cut in half by 2015;
  - Regulate the fuel efficiency of cars and light duty trucks, beginning with the 2011 model year; and
  - Strengthen energy efficiency standards for a number of energy-using products, including light bulbs.

  As part of the action plan, the Regulatory Framework for Air Emissions presents mandatory and enforceable reductions in emissions of GHGs and air pollutants from industrial sectors and other sources. This regulatory system will place Canada on the path to achieving sustained absolute reductions in industrial GHG emissions.

  More information about The Regulatory Framework for Air Emissions can be found in Addendum 9B to this chapter and at: http://www.ecoaction.gc.ca/turning-virage/index-eng.cfm.

[7] Background papers and other information about the summit are available on the internet at http://www.snre.umich.edu/climate_change/sector_papers.
[8] Securing a Clean Energy Future: A Call to Action. 2008. Available at http://www.subnet.nga.org/ci/scef/.

9.3 OUTREACH

- Minnesota Sea Grant provides education and outreach on climate change through its award-winning program "View From the Lake." Since 2004, this program has brought over 1,800 people from 150 communities out onto Lake Superior to see their community from the water and discuss issues related to protecting local natural resources and Lake Superior. The program takes place on the University of Wisconsin's *L.L. Smith, Jr.* Research Vessel and sails to eight ports in Minnesota and Wisconsin, bringing local government officials, residents, teachers, and others out to learn about the newest research on climate change, water quality, and a variety of other issues. The program gives the public options and resources for taking action in their community and at their own homes.[9]
- EarthWise Thunder Bay is a partnership between the City of Thunder Bay and a network of volunteers who have agreed to work together on the issues of climate change and community sustainability.[10] The main priority of EarthWise is to create a Community Environmental Action Plan. In March 2003, the City of Thunder Bay unanimously passed a resolution to participate in the Partners for Climate Protection (PCP) program. With this resolution, Thunder Bay made a commitment to work towards reducing GHG emissions in municipal operations by 20 percent below 1990 levels, and at least 6 percent throughout the municipal area, joining a network of more than 150 Canadian municipal governments who have committed to taking action on climate change by reducing GHG emissions. The mission of EarthWise Thunder Bay is to focus the energy, involvement, and collective wisdom of the community to secure the environmental health of our region, and thereby improve the social and economic well-being of future generations.

9.4 CHALLENGES

The issue of climate change raises many challenges, which the Binational Program must seek to address, including:

- Communicating climate change information (especially climate change information specific to the Lake Superior basin), impacts, and priority actions from the scientific community to decision/ policymakers and the broader public;
- Preparing for potentially dramatic changes in the Lake Superior climate—and the ability of the Binational Program to help Lake Superior stakeholders adapt to these changes;

Figure 9-4. Lake Superior stakeholders will need to adapt to potential climate change impacts, such as more frequent and severe storm events. Photo credit: Frank Koshere, Wisconsin Department of Natural Resources.

[9] Minnesota Sea Grant. A View From the Lake program website: http://www.seagrant.umn.edu/vfl/.
[10] EarthWise Thunder Bay website: www.earthwisethunderbay.com.

- Assisting Lake Superior stakeholders in both understanding and mitigating the potential impacts of climate change; and
- Obtaining sufficient resources to help stakeholders adapt to climate change impacts, such as more frequent and severe storm events.

9.5 NEXT STEPS

Next steps for the Lake Superior Binational Program and Work Group include the following:

- Determine climate change adaptation and mitigation actions and projects that can be undertaken by the LaMP and the Binational Program, and seek support as feasible;
- Incorporate these climate change mitigation and adaptation actions into Lake Superior Binational Program and Work Group workplans, grants, and priorities;
- Distribute important reports such as the "Climate Change and Water Quality in the Great Lakes Basin" paper, written by the Great Lakes Water Quality Board to the IJC, to Lake Superior stakeholders;
- Collate all Lake Superior-related climate change research and studies for use by the Lake Superior Binational Program and stakeholders; and
- Coordinate with state, provincial, regional, and federal climate change strategies, frameworks, and priorities as much as possible.

Figure 9-5. Next steps include determining mitigation actions for climate change impacts, such as anticipated declines in future lake levels. Photo credit: John Marsden, Environment Canada.

9.6 REFERENCES

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ADDENDUM 9A:

U.S. EPA Region 5 Framework for Addressing Climate Change and Clean Energy

U. S. Environmental Protection Agency Region 5 recognizes the need to address climate change and reduce greenhouse gas emissions in our six states. Climate models predict increased variability in precipitation, with longer droughts and larger storms, boosting the need for water conservation and prevention of sewer overflows. With our public and private partners, we will evaluate our programs and policies for opportunities to address the effects of climate change on the environment and to promote energy efficiency, clean energy, cleaner transportation practices and sustainable development. Many governments and organizations in the region are working to reduce greenhouse gas emissions. Region 5 will use its leadership role to add value to these efforts by focusing on:

- **Changing how our energy is produced**
- **Changing how our energy is used**
- **Changing how materials, products and waste are managed**
- **Integrating climate change considerations into Agency operations and core programs**

We will engage and promote environmental stewardship among key stakeholders in Region 5 including the public; federal, state, tribal and local governments; and electric power utilities and other large companies.

Changing How Our Energy Is Produced

One-third of greenhouse gas emissions in the U.S. come from electric power generation. Seventy percent of the region's electricity is generated from coal, which produces more greenhouse gas emissions per kilowatt produced than other fossil fuels. We will:

- Challenge electric utilities in the region to reduce their greenhouse gas emissions through measures such as increased renewable energy production and energy efficiency programs to decrease costs to households and businesses
- Encourage governments and corporations to purchase renewable energy through EPA's Green Power Partnership
- Promote the use of combined heat and power systems, focusing initially on wastewater treatment plants, ethanol facilities and large hotels and casinos
- Collaborate with Region 5 states to promote combined heat and power and energy efficiency through state regulations

Changing How Our Energy Is Used

Electricity and fuel use in homes, commercial buildings and industries result in 62 percent of U.S. greenhouse gas emissions (17, 17, and 28 percent, respectively). Transportation contributes much of the rest—28 percent. We will:

- Provide information to the public to help them green their homes, schools, workplaces and cars through measures such as energy conservation, recycling and fuel-efficient transportation

- Reduce energy use in communities by:
  - Recruiting local governments to take the ENERGY STAR Challenge and assisting them in improving energy efficiency in government, residential and commercial buildings in their communities
  - Promoting green building and sustainable development on the state, local and developer level to address the engineering and market barriers that limit such development
  - Training wastewater and drinking water utilities to conduct energy audits at their facilities to reduce energy use and encourage on-site energy production

- Call on large companies in Region 5 to join the Climate Leaders and Performance Track programs; Climate Leaders works with companies to inventory their greenhouse gas emissions, develop a plan to reduce those emissions and set a public reduction goal

- Recruit new partners to the SmartWay Transport Partnership, a voluntary program that reduces greenhouse gas emissions from the freight industry

- Work with other federal agencies, states and industry to expand the use of agricultural waste digesters through innovative permitting and funding mechanisms

Changing How Materials, Products and Waste Are Managed

Reducing waste and increasing recycling and reuse of materials saves energy and reduces greenhouse gas emissions by avoiding effects associated with resource extraction and waste disposal. We will:

- Promote reduction of municipal, industrial and construction waste in the region

- Recruit governments and companies to become partners in the WasteWise program; WasteWise works with Region 5's partners to reduce nonhazardous waste through measures such as use of recycled materials

- Collaborate with large public venues such as stadiums and convention centers to make them Green Venues, using practices such as energy efficient heating and cooling systems, increased recycling, use of local food in concessions, and environmental outreach to the millions of people who visit these venues

Integrating Climate Change Considerations into Agency Operations and Core Programs
We will:

- Seek to include greenhouse gas reductions in Supplemental Environmental Projects that result from enforcement settlements within Region 5 and incorporate climate change considerations into reviews of Environmental Impact Statements

- Educate our employees so they can reduce their carbon footprint at home, at work and in their communities; for example, we will encourage employees to switch to compact fluorescent lamps (CFLs) and recruit organizations in their community to become Change-a-Light Pledge Drivers

- Review and revise policies to improve environmental performance of Region 5 operations in areas such as energy efficiency, use of alternative fuels, reduction of paper use and fleet fuel economy

ADDENDUM 9B: CANADA'S REGULATORY FRAMEWORK FOR AIR EMISSIONS

In October 2006, Canada's new government made clear its intention to regulate greenhouse gases that cause climate change, as well as air pollutants that cause smog and acid rain.

The Regulatory Framework for Air Emissions is one of the main features of our ambitious agenda to tackle climate change and clean up the air we breathe. Consistent with the polluter-pays principle, our Regulatory Framework includes strong short-term regulatory targets to reduce air emissions from major industries, including the following sectors:

- electricity produced by combustion,
- oil and gas,
- forest products,
- smelting and refining,
- iron and steel,
- cement, lime, and chemicals production,
- some mining sectors.

Action on Greenhouse Gases

Industry accounts for about half of Canada's greenhouse gas emissions that cause climate change. The Government is mandating the reduction of industrial greenhouse gas emissions through the introduction of a robust regulatory regime that includes access to domestic emissions trading, the Kyoto Protocol's Clean Development Mechanism and a technology fund.

This regulatory system will place Canada on the path to achieving sustained absolute reductions in industrial greenhouse gas emissions. More specifically, it will ensure that as early as 2010 total greenhouse gases stop rising, and that by 2020 we achieve absolute reductions of 150 megatonnes compared to this year's levels.

Action on Air Pollutants

About half of Canada's air pollution is produced by industry. The Regulatory Framework for Air Emissions sets overall national fixed emissions caps for air pollutants. This will lead to reductions in air pollutant emissions that cause smog and acid rain by up to 55% as early as 2012 compared to 2006 levels. These targets will specify the maximum level of pollutant that can be emitted from a given sector in a given year.

Regulations will place caps on total emissions of four acid rain and smog -causing air pollutants:

- Nitrogen oxides (NOx),
- Sulphur oxides (SOx),
- Volatile organic compounds (VOCs), and
- Particulate matter (PM).

Sector specific caps on these and other pollutants, such as mercury, will also be included.

Other Emission Reduction Initiatives

In addition to measures to reduce air emissions from industry, the Government is committed to addressing emissions from transportation, strengthening energy efficiency standards for a number of energy-using products, and for the first time, the Government has recognized the urgent need to take action to improve indoor air quality and committed to implement measures to do so.

Cooperation with Provinces and Territories

We will continue to work in partnership with provinces and territories to promote approaches that avoid unnecessary duplication of effort so that we get the maximum amount of environmental benefits with the least amount of administrative and cost burden for industry.

Benefits & Costs

These actions will reduce the impact of greenhouse gases and air pollution on the environment and the health of Canadians. These regulations will have real, tangible health and environmental benefits for everyone, as well as positive economic effects. The estimated benefits as of 2015 from the reduced risk of death and illness associated with our air quality improvements are over $6 billion annually.

The Government's regulatory approach will promote investment in technology and innovation in Canada, yielding long-term economic benefits from enhanced productivity, improved energy efficiency, greater competitiveness, more opportunity to sell Canadian environmental products and know-how abroad and more jobs for Canadians.

A reduction in air emissions will also raise the productivity of some sectors. For example, reduced pollution is expected to lead to an increase in production of up to $150 million for key agricultural crops. Other industries will also benefit, including tourism, forestry and in-land fishing.

The health benefits will include reductions in the number of premature deaths related to air pollution, strokes, heart attacks, hospital admissions and emergency room visits, cases of child acute bronchitis, and the number of days where asthma symptoms occur. There will be many environmental benefits as well, including improved conditions for nature and wildlife.
Strong actions inevitably come at a cost, and those costs will be borne, at least in part, by individual Canadians and their families. The costs associated with this initiative are real but manageable. This can include increased prices for consumer products such as vehicles, natural gas, electricity, and household appliances.

Appendix A:

Lake Superior Areas of Concern/ Remedial Action Plan Summary Matrix and Fact Sheets

Waterfall on the Cypress River, Ontario.
Photo Credit: Tim Leblanc, Ontario Ministry of Natural Resources.

Lake Superior Lakewide Management Plan 2008

Appendix A Contents

Appendix A
Lake Superior Areas of Concern/Remedial Action Plan Summary Matrix and Fact Sheets

A.0 INTRODUCTION

As noted in Chapter 1, Section 1.3.1, entitled Remedial Action Plans for Areas of Concern, the Remedial Action Plans (RAPs) and LaMPs are similar in that they both: use an ecosystem approach to assessing and remediating environmental degradation, consider the 14 beneficial use impairments outlined in Annex 2 of the Great Lakes Water Quality Agreement, and rely on a structured public involvement process. Forging a strong relationship between the LaMPs and the RAPs is important to the success of both efforts. The Areas of Concern (AOCs) can, in many cases, serve as point source discharges to the lake as a whole. Improvements in the AOCs will, therefore, eventually help to improve the entire lake. Much of the expertise related to the use impairments and possible remedial efforts resides at the local level; cooperation between the two efforts is essential in order for the LaMPs to remove lakewide impairments. Information on the progress of RAPs for the eight AOCs in Lake Superior is presented in both a summary matrix and individual AOC information sheets in this Appendix.

A.1 AREAS OF CONCERN SUMMARY MATRIX

AOC Name	Primary Contaminants	Geographic Area	Stressors	Beneficial Use Impairments	Funding Programs and Partners	Clean-Up Actions Completed	Key Activity Needed	Barriers	Next Steps
St Marys River Michigan/ Ontario	▪ PAHs ▪ Oil and grease ▪ Bacteria	▪ From the head of the river at Whitefish Bay (Point Iroquois - Gros Cap), downstream through the St. Joseph Channel to Humburg Point on the Ontario side, and to the straits of Detour on the Michigan side.	▪ Combined sewer overflows/storm sewer overflows ▪ Loss of wetlands ▪ Point and nonpoint source pollution ▪ Wastewater discharges ▪ Urban/industrial development ▪ Navigational structures ▪ Contaminated sediment	▪ Fish and wildlife consumption restrictions ▪ Fish and wildlife degradation ▪ Fish tumors or other deformities ▪ Degradation of benthos ▪ Dredging activities restrictions ▪ Eutrophication or undesirable algae ▪ Beach closings ▪ Aesthetics degradation ▪ Loss of fish and wildlife habitat ▪ Bird or animal deformities or reproductive problems (Michigan only)	▪ Superfund ▪ Clean Water Act ▪ Navigational dredging ▪ Canada Ontario Infrastructure Program ▪ Great Lakes Sustainability Fund ▪ Canada-Ontario Agreement ▪ Great Lakes Legacy Act ▪ EC Sediment Fund	▪ Upgrade East End STP to secondary treatment ▪ Tannery Bay Clean Up: Legacy Act project - mercury and chromium contaminated sediment. Shoreline restoration and reseeding	▪ Complete contaminated sediment assessment ▪ Monitor key fish and wildlife populations ▪ Continued water quality monitoring ▪ Beneficial Use Impairment restoration criteria	▪ Resource limitations	▪ Monitoring to confirm restoration at cleaned contaminated sediment sites. ▪ Development and implementation of sediment management plan ▪ Update delisting criteria (underway in MI) ▪ Development of a F&W Restoration Plan for Michigan's portion of the AOC (underway in MI)
Deer Lake Michigan	▪ Mercury ▪ Historic Nutrient Loadings	▪ Approximately 1,000-acre impoundment in central Marquette County, Michigan. The AOC includes Carp Creek, Deer Lake, and the Carp River downstream 20 miles to Lake Superior at Marquette.	▪ Contaminated sediments from waste materials associated with historic iron, gold and silver mining practices	▪ Fish consumption restrictions ▪ Eutrophication ▪ Degradation of eagle populations	▪ Michigan DEQ Water Bureau ▪ CCIC ▪ Federal ▪ City of Ishpeming	▪ Sewer separation; primary treatment plants replaced by advanced secondary wastewater treatment ▪ Deer Lake was drawn down and refilled to allow methylation of mercury from exposed sediments	▪ Identify and restore beneficial uses of the Carp River watershed ▪ Source Control- Remove ~30% of mercury loadings to Deer Lake by reducing or eliminating Partridge Creek's flow through Cliffs Mine Shaft via Ishpeming's storm sewers to Carp Creek ▪ Complete removal	▪ Sediment remediation ▪ Michigan DEQ Water Bureau completed negotiations with PRP in Nov. 2006. Consent Judgment available from Sharon Baker at MDEQ (Bakers9@michigan.gov) ▪ Resource limitations ▪ Fish Tissue	▪ Sediment remediation ▪ Complete analysis of beneficial use impairments ▪ Have begun Delisting Determination Document using state developed delisting guidance to determine which BUIs are eligible for delisting. ▪ Complete BUI removals ▪ Remove the

AOC Name	Primary Contaminants	Geographic Area	Stressors	Beneficial Use Impairments	Funding Programs and Partners	Clean-Up Actions Completed	Key Activity Needed	Barriers	Next Steps
							process for Reproduction and Eutrophication BUIs. ▪ Further fish tissue analysis to document current status of Fish Consumption BUI. We suspect that this BUI might also be close to removal.	analysis ▪ Monitoring of the remedial action ▪ City of Ishpeming needs to determine which option they wish to pursue related to meeting their agreement with CCIC, and funding for this option needs to be found.	mercury source for the identified mercury loadings.
Torch Lake Michigan	▪ Copper ▪ Mercury ▪ Arsenic ▪ Lead ▪ Chromium ▪ Heavy metals	▪ Torch Lake and immediate environs.	▪ Contaminated sediments from mine tailings associated with historic copper mining and milling practices ▪ Upland mine tailings deposits from historic copper mining activities which have been deposited into area lakes and streams	▪ Fish and wildlife consumption restrictions ▪ Degradation of benthos ▪ Fish Tumors BUI has been removed	▪ Superfund ▪ MDEQ, AOC and District ▪ GLNPO	▪ Superfund - recommended remedial actions in 1992 and 1994 RODS have been completed – coverage of exposed mine tailings and stamp sands ▪ In 2007, EPA Superfund completed emergency removals of arsenic, lead, and PCB contaminated soils and sediments at the Village of Lake Linden Recreation Park beach and marina areas, which were of immediate risk to human and environmental health. These actions resulted in the EPA Superfund - RB performing	▪ Identification of potential PCB source related to fish consumption advisories ▪ EPA and MDEQ performed sediment sampling to determine if there was a discrete PCB source. Data showed PCB concentrations in sediments below actionable levels. The levels did follow the same trends as earlier sampling with SPMDs and sediment sampling, which indicated higher levels near the Hubbell/Tamarack City area.	▪ PCB source remediation, if necessary ▪ Cannot begin removal documents for remaining BUIs until Superfund determines if they will perform further remedial actions	▪ Have reviewed the status of the Fish Consumption BUI and degraded Benthos BUI and are awaiting further analysis of data or determination of additional actions by Superfund ▪ Have removed the Fish Tumor BUI

AOC Name	Primary Contaminants	Geographic Area	Stressors	Beneficial Use Impairments	Funding Programs and Partners	Clean-Up Actions Completed	Key Activity Needed	Barriers	Next Steps
						further analysis around Torch Lake. This work identified additional areas that may need further remedial investigations or remedial actions.	▪ In 2007, MDEQ and MDNR sampled fish as part of the Fish Contaminant Monitoring Program. Results are expected in April 2008. The fish residue results will determine whether the BUI can be delisted or if further work is needed.		
St. Louis River Minnesota/ Wisconsin	▪ PAHs ▪ Mercury ▪ Suspended sediment ▪ PCBs ▪ Other metals ▪ Oil and grease ▪ Pathogens ▪ Nutrients ▪ DDT ▪ Dieldren ▪ Dioxin 2378 TCDD ▪ Toxaphene ▪ *E. Coli* ▪ PCP	▪ St. Louis Bay, the Nemaji River basin and the St. Louis River basin to Cloquet, MN, including urban areas of Duluth, MN, and Superior, WI – extending 10 miles into Lake Superior	▪ Contaminated sediments ▪ Abandoned hazardous waste sites ▪ Poorly designed or leaky landfills ▪ Industrial discharges and chemical spills ▪ Infiltration and inflow ▪ Point and nonpoint sources ▪ Municipal and industrial runoff ▪ Turbidity ▪ Sedimentation ▪ Exotics ▪ Loss of habitat/wetland fills ▪ Sediment runoff, particularly from urban or construction	▪ Fish and wildlife consumption restrictions ▪ Fish and wildlife degradation ▪ Fish tumors or other deformities ▪ Degradation of benthos ▪ Dredging activities restrictions ▪ Excess loadings of nutrients and sediment to Lake Superior ▪ Beach closings ▪ Aesthetics degradation ▪ Loss of fish and wildlife habitat	▪ Superfund ▪ Navigational dredging ▪ GLNPO ▪ States ▪ Great Lakes Legacy Act ▪ Cities ▪ WI and MN Coastal Management ▪ Great Lakes Commission ▪ Other miscellaneous grant funding sources ▪ USACE Detroit (WRDA) ▪ Fond du Lac Tribe ▪ SLR Citizens Action Committee	▪ Wastewater treatment ▪ Sediment contamination studies to identify hotspots ▪ Evaluation of cleanup options at two Superfund sites ▪ Contaminated sediment database ▪ Habitat Management Plan ▪ Key habitat area acquisition ▪ Newton Creek/Hog Island Cleanup ▪ Grassy Point Wetland Restoration project ▪ Stryker Bay Remediation – Phase III ▪ Hog Island Restoration Plan	▪ Assessment of fish and wildlife health (body burden and health implications) ▪ Assessment of nonpoint sources of pollution to AOC and stormwater controls ▪ AOC specific wetlands protection and restoration program ▪ Selective clean up of contaminated sediments ▪ Cost-benefit analyses of clean up and habitat restoration alternatives ▪ Control of vessel discharges (ballast	▪ Lack of dedicated resources for projects and staffing ▪ Lack of funding source to manage sediment contamination issues on an AOC-wide, bi-state basis ▪ Greater financial support from the federal government is needed ▪ Lack of cost estimates for protection, restoration, or clean up activities ▪ Lack of long term horizon - policies	▪ Contaminated site remediation ▪ Mercury reduction ▪ Water quality protection ▪ Habitat restoration and protection ▪ Stormwater and infiltration and inflow control ▪ Update AOC-wide contaminated sediment strategy ▪ Develop “delisting roadmap” to identify ultimate goals and steps needed ▪ Outreach and education campaign ▪ Prioritize remediation, habitat restoration and protection strategies

AOC Name	Primary Contaminants	Geographic Area	Stressors	Beneficial Use Impairments	Funding Programs and Partners	Clean-Up Actions Completed	Key Activity Needed	Barriers	Next Steps
			sources ▪ Transportation sources and dredging ▪ Sewage overflows ▪ Forest fragmentation ▪ Riparian development ▪ Exotics/Invasives			Completed ▪ Near Shore reference ecotypes identified – NRRI GLEI ▪ Wastewater treatment-Surge tank Installation (SSO) ▪ Remedial design of Kopper's Wood Processing complete ▪ Sampling completed at Superior Water, Power and Light site ▪ Habitat Management Plan implementation	and bilge water) ▪ Updating of RAP documents – delisting goal development ▪ Reduction of invasive species ▪ Develop monitoring strategies ▪ Write PBT Contaminant TMDL by 2011 ▪ Establish SLR AOC-Wide Delisting Targets by end of 2008	and funding ▪ Organizations focused on short term ▪ Difficulty in maintaining public support over the long term ▪ Atmospheric deposition uncontrollable	▪ Secure long-term funding at federal and state levels
Thunder Bay Ontario	▪ Mercury	▪ About 28 km along the shoreline and up to 9 km offshore, including the watershed	▪ Contaminated sediments ▪ Industrial and municipal effluent ▪ Industrial development	▪ Fish and wildlife consumption restrictions ▪ Fish and wildlife degradation ▪ Degradation of benthos ▪ Dredging activities restrictions ▪ Beach closings ▪ Aesthetics degradation ▪ Phytoplankton and zooplankton pops. degradation ▪ Loss of fish and wildlife habitat	▪ Great Lakes Sustainability Fund ▪ Canada Ontario Infrastructure Programs ▪ Canada-Ontario Agreement (MOE) ▪ EC Sediment Fund	▪ Secondary treatment installed for a number of pulp and paper mills ▪ Clean up and rehabilitation of contaminated sediment at Northern Wood site ▪ Various habitat creation and enhancement projects ▪ Chippewa Beach restoration ▪ STP upgraded to secondary treatment	▪ Monitor fish and wildlife populations to confirm progress (e.g. Kam River sturgeon)	▪ Resource limitations	▪ Complete sediment assessment at north end of harbour to determine preferred management option ▪ Update delisting criteria ▪ Draft monitoring plan
Nipigon Bay Ontario	▪ None	▪ A large portion of Nipigon Bay and the Nipigon River downstream of Alexander Dam.	▪ Water level and flow fluctuations ▪ Wastewater discharges	▪ Fish and wildlife degradation ▪ Eutrophication or undesirable algae ▪ Loss of fish and	▪ Great Lakes Sustainability Fund ▪ Canada Ontario Infrastructure Programs	▪ Created water management plan for Nipigon River to regulate hydroelectric facilities' water use to	▪ Upgrade primary STP in Nipigon (planning completed) ▪ Monitor fish and	▪ Resource limitations	▪ Assist community to obtain funding and/or undertake STP upgrade ▪ Update delisting

AOC Name	Primary Contaminants	Geographic Area	Stressors	Beneficial Use Impairments	Funding Programs and Partners	Clean-Up Actions Completed	Key Activity Needed	Barriers	Next Steps
		Two communities are located in the vicinity of the Bay: Red Rock (population: 1,300) and Nipigon (population: 1,900).		wildlife habitat	▪ Canada-Ontario Agreement	help restore brook trout ▪ Various habitat restoration projects ▪ Secondary treatment installed at Norampac	wildlife populations to confirm progress (coaster brook trout)		criteria ▪ Draft monitoring plan ▪ Area in Recovery Report
Jackfish Bay Ontario	▪ Solids (i.e. wood fiber) ▪ Dioxin	▪ The 14 km reach of Blackbird Creek between Terrace Bay Pulp Inc. pulp mill and Jackfish Bay, including Lake A, Moberly Lake and Jackfish Bay itself.	▪ Industrial discharge ▪ Contaminated sediments	▪ Fish and wildlife consumption restrictions ▪ Fish and wildlife degradation ▪ Fish tumors or other deformities ▪ Bird or animal deformities or reproductive problems ▪ Aesthetics degradation ▪ Loss of fish and wildlife habitat	▪ Great Lakes Sustainability Fund ▪ Canada-Ontario Agreement ▪ National Sciences and Engineering Research Council of Canada (NSERC)	▪ Effluent quality from paper mill improved ▪ Chlorine dioxide bleaching plant upgraded resulting in lower AOX levels	▪ Assess status of natural recovery	▪ Time for natural recovery ▪ Best available technology needs to be utilized at all times	▪ Continued natural recovery and monitoring ▪ Update sediment monitoring data ▪ Update delisting criteria ▪ Update long term monitoring plan ▪ Area in Recovery Report
Peninsula Harbour Ontario	▪ Mercury ▪ PCB	▪ Peninsula Harbour proper, and a portion of open Lake Superior immediately south of the peninsula.	▪ Contaminated sediments	▪ Fish and wildlife consumption restrictions ▪ Fish and wildlife degradation ▪ Degradation of benthos ▪ Dredging activities restrictions ▪ Loss of fish and wildlife habitat	▪ Great Lakes Sustainability Fund ▪ Canada-Ontario Agreement (MOE) ▪ Marathon Pulp Inc. ▪ EC Sediment Fund	▪ Pulp kraft mill installed secondary treatment for effluent; discharge moved out of AOC ▪ Ecological risk assessment completed	▪ Update Ecological Risk Assessment and complete Sediment Management Options assessment		▪ Update delisting criteria ▪ Create long term monitoring plan ▪ Detailed design for sediment strategy

A.2 AREAS OF CONCERN FACT SHEETS

A.2.1 Canadian Fact Sheets

A.2.1.A Thunder Bay

Thunder Bay Area of Concern

General Information

Where?

The Thunder Bay Area of Concern (AOC) extends approximately 28 kilometres (17 miles) along the shoreline of Lake Superior and up to 9 kilometres (5.5 miles) offshore from the City of Thunder Bay. The Thunder Bay watershed is drained by the Kaministiquia River system and a number of smaller rivers and creeks.

Why was this area listed?

Major environmental issues of concern (or beneficial use impairments) in the area included:

- fish consumption restrictions
- negative pressures on fish populations
- degradation of phytoplankton and zooplankton populations
- degradation of benthos
- dredging restrictions
- loss of species abundance and diversity
- reduced recreational opportunities
- decline in aesthetic values
- loss of fish and wildlife habitat

What is being done? How is it being done?

In order to improve the environmental conditions noted above, a Remedial Action Plan (RAP) has been developed for Thunder Bay. The Thunder Bay RAP is a partnership between the federal and provincial governments. Public involvement and participation in the RAP to date has been coordinated by a Public Advisory Committee (PAC) which represents a variety of interests in the Thunder Bay community (e.g. private citizens, academia, industry, labour, recreational groups and property owners). The PAC has provided public input and advice throughout the RAP process, in addition to endorsing both the Stage 1 and 2 documents.

This plan involves the following steps:

- defining the problem (Stage 1 – completed in 1991)
- planning for implementation (Stage 2a – completed in 2004)
- implementing the actions (Stage 2 – underway)
- monitoring the restoration of the environment and eventual delisting (Stage 3)

The Stage 2 Report contains a list of recommended remedial actions to restore the above environmental conditions. It was developed through the RAP process, which included consultation with the public. Many of the actions have already been implemented.

HIGHLIGHT of the RAP

Contaminated sediments are recognized as significant contributors to impaired water quality in the Great Lakes. Thunder Bay Harbour sediment contamination from polycyclic aromatic hydrocarbons (PAHs), chlorophenols, dioxins and furans around Northern Wood Preservers (NWP) contributed to the International Joint Commission 's (IJC) identification of the Harbour as an AOC. A biological assessment study was conducted to establish site specific clean up criteria. Based on measured biological effects related to PAHs, three cleanup zones were identified corresponding to areas of acute toxicity, chronic toxicity and no measurable toxicity.

Abitibi Consolidated Inc., Northern Wood Preservers Inc., Canadian National Railway Co., Environment Canada and the Ontario Ministry of the Environment worked together to remediate the area around the Northern Wood Preservers site. The project, referred to as the Northern Wood Preservers Alternative Remediation Concept (NOWPARC), was a plan to isolate the contaminant source, clean-up the contaminated sediment, and enhance fish habitat. Extensive public consultation was undertaken to ensure public acceptance of the plan.

The primary components of the project have been completed. These improvements in the "integrity" of the local ecosystem were:

- A 1,000 meter long rockfill containment berm to contain a portion of the contaminated sediment
- Environmental dredging to remove 11,000 m^3 (14,400 yd^3) of contaminated sediment from the Harbour
- Thermal treatment and off site disposal of 17,000 tonnes (18,700 tons) of contaminated sediment
- A Waterloo steel wall and environmental clay barrier were constructed around the NWP pier to prevent the movement of on-site contaminants back into the harbour
- A buffer zone of clean fill within the containment berm
- Stormwater controls to collect drainage and channel it through a settling pond prior to discharge into Thunder Bay Harbour
- 48,000 m^2 (approximately 12 acres) of fish habitat were created as compensation for the infilling activities
- A groundwater treatment plant to treat contaminated groundwater that accumulates behind the clay barrier

NOWPARC was a significant project for the RAP. As such, it contributes to the objectives of the Lake Superior Binational Program's Lakewide Management Plan (LaMP), which includes the Zero Discharge Demonstration Program.

Through this project, the areas of highest sediment contamination were removed and treated, and additional fish habitat was created. Project implementation, including public consultation, took seven years to complete at a cost of $20 million (CDN), forging linkages between the economy, the environment, and the community. Now that implementation is complete, the site has been decommissioned and a post-remediation monitoring plan is in place. To demonstrate adequate monitoring of effectiveness, the focus has now shifted to long-term monitoring of the isolation barriers, natural recovery of sediments outside the berm and fish habitat development.

This is a major achievement in the restoration and remediation of this once highly contaminated sediment site. This project, in concert with other RAP initiatives, will help to improve water quality and sediment conditions in the Harbour, and will provide a more hospitable environment for plants, animals, and people.

RAP Development/History

The Thunder Bay Remedial Action Plan (RAP) was developed by Environment Canada and the Ontario Ministry of the Environment, with support from the general public.

The RAP adopted an ecosystem approach to address environmental problems which incorporated land, water, air, plants, animals and ultimately people. Therefore, the cooperation and involvement of other federal and provincial government agencies has been key to the RAP progress.

Members of the public, including individuals and organizations, participated in the RAP process as members of the PAC. The PAC provided a forum for community stakeholders and included private citizens, academia, industry, labour, recreational groups and property owners.

The Thunder Bay RAP was developed to identify use impairments, define specific goals for the region and describe appropriate remedial and regulatory measures to rehabilitate the AOC. Incorporating the needs identified by the PAC will ensure that the plan responds to the community needs and enjoys a high level of public support and implementation.

RAP Status

Strategies to address beneficial use impairments have been designed to increase aquatic and terrestrial habitat, enhance recreational opportunities, and to improve the aesthetic value of the Harbour and its tributaries. The highest profile remediation project has been the NOWPARC project. A post-remediation monitoring plan is being implemented to evaluate the success of the project and to track the progress of natural recovery over time.

Many water quality issues have been addressed as a result of process changes and improved effluent treatment at local pulp and paper mills. Secondary treatment and 100 percent chlorine dioxide substitution at the Bowater pulp and paper mill have resulted in dramatic improvements in effluent quality. Likewise, the installation of secondary treatment at Abitibi Consolidated has resulted in the effluent being non-toxic since 1999. These improvements are expected to enhance sediment and water quality conditions and encourage the return of healthy biotic communities.

Various fish and wildlife habitat rehabilitation projects have been completed along the waterfront and on tributary streams. These have included improving walleye spawning habitat, restoring habitat diversity along floodways, creating nearshore nursery habitat and wetland sites, alleviating water quality barriers to fish migration, and enhancing habitat diversity within dredged navigation channels. These efforts will increase the extent of productive aquatic and terrestrial habitat by rehabilitating and protecting wetland and riparian environments.

The involvement of the public and their commitment to both rehabilitation and continued vigilance of the ecosystem are important to the success of the Thunder Bay RAP. Community involvement in the Thunder Bay RAP has been evident in such projects as organized cleanups of the Thunder Bay waterfront and participation in Lake Superior Day celebrations and waterfront development workshops. The PAC played a lead role in this process, making the public aware of progress towards the final goal of a healthy, balanced ecosystem and the ways in which this can be accomplished.

RAP Implementation

The Thunder Bay RAP Stage 2 Report contains a complete list of recommended remedial actions for the AOC, many of which are in progress or completed. A monitoring strategy will be developed to measure progress towards delisting. With the support of federal and provincial governments and the community, the remaining recommended actions will be completed and the monitoring strategy will be implemented.

Although total mercury in surficial sediment (0-3 cm or 0-1 in) in the area adjacent to Cascades Fine Paper Inc. is lower than that observed in the early 1970's, results of the 2004 Environment Canada sediment assessment indicated that some sediment is toxic, although the causes do not appear solely related to mercury, and that benthic communities are altered compared to reference. Methyl mercury is transferred from sediment to benthic invertebrates, and under generally "intermediate and maximum" exposure and trophic transfer scenarios methyl mercury could bioaccumulate in receptors to levels that are not protective of adverse effects at some of the sites. These sediment studies agree with the conclusions from the Environmental Effects Monitoring program for the Cascades Fine Paper mill that the sediment is toxic and the benthic community is impaired in the vicinity of the mill outlet. A primary zone of contamination has been delineated and sediment management options have been screened. Capping and dredging are being carried forward as possible remediation options. Geotechnical studies and wind/wave effect studies are currently being conducted to determine the feasibility of capping the sediment in this zone. If capping is not feasible, the data from these studies will be used to assess the feasibility of dredging. This information is critical to the identification of any appropriate remedial actions to address contaminated sediment in the AOC.

Sediment at a site in the centre of the inner Thunder Bay Harbour, informally referred to as the Cascades Triangle, was found to be toxic to benthic organisms. Because chemicals of concern were not found to be elevated in this sediment, studies are currently underway to determine the cause of the toxicity.

A strategy has been implemented to address beach closures at Chippewa Beach, and as a result of this, the number of closures has been considerably reduced.

There is a commitment to ensure the gains realized through RAP implementation are maintained and progress towards restoration and ultimate delisting of Thunder Bay as an AOC continues.

RAP Accomplishments

Many projects have built on the notable successes in the Thunder Bay AOC. Several fish and wildlife habitat rehabilitation projects have been completed in wetlands, riverine shorelines, along the Thunder Bay waterfront, and within the river mouths draining into Thunder Bay. Contaminated sediments have been removed at the Northern Wood Preservers site and have undergone treatment and disposal. In 2005, the City of Thunder Bay, with assistance from the Canada Strategic Infrastructure Fund, completed construction of the Secondary Sewage Treatment facility at the Water Pollution Control Plant. In addition to secondary sewage treatment, the new facility includes nitrification to eliminate ammonia from the wastewater.

RAP Participants

Cooperation is critical to the RAP process. Undertaking environmental restoration requires a large amount of local knowledge, scientific expertise, and hard work. One agency or group cannot undertake such a large task on their own, without the help of others. Listed below are participants that contribute to the RAP program.

- City of Thunder Bay
- Environment Canada
- Fisheries and Oceans Canada
- Great Lakes Sustainability Fund
- Lakehead Region Conservation Authority
- Lakehead University
- Ontario Ministry of Natural Resources
- Ontario Ministry of the Environment
- Public Advisory Committee

A.2.1.B Nipigon Bay

Nipigon Bay Area of Concern

General Information

Where?

The Nipigon Bay Area of Concern (AOC) is in the most northerly area of Lake Superior. The AOC encompasses a large portion of Nipigon Bay and, the largest tributary to Lake Superior, the Nipigon River.

Why was this area listed?

When listed in the late 1980s, the major environmental issues of concern (or beneficial use impairments) in the area included:

- degradation of fish and wildlife populations - particularly the loss of walleye and yellow perch fisheries and decline in the brook trout and lake trout stocks
- degradation of benthos (bottom dwelling organisms)
- restrictions on dredging activities
- undesirable algal growth on substrates in the lower Nipigon River
- degradation of aesthetics on the waterfront
- loss of fish and wildlife habitat in the Nipigon River
- water level fluctuations from the generation of electricity continue to affect streambank erosion and sediment load

What is being done? How is it being done?

In order to improve the environmental conditions noted above, a Remedial Action Plan (RAP) was developed for the Nipigon Bay Area of Concern (AOC). Implementation of the Nipigon Bay RAP is being achieved through a partnership between the Government of Canada and the Province of Ontario, with support from a Public Advisory Committee (PAC). Many linkages and alliances have been developed as part of the RAP process between the RAP team and various other groups in the community including recreational groups, industry, municipalities and citizens.

This plan, which was initiated in 1987, involves the following three stages:

1. defining and documenting the problem (Stage 1 Report completed in 1991)
2. developing and documenting a strategy of action to rehabilitate and protect the ecosystem (Stage 2 Report completed in 1995)
3. implementing the strategy of remedial and preventive actions and monitoring and confirming the eventual restoration of the impaired beneficial uses (Stage 3)

Thirty-five recommended remedial actions to restore the above environmental conditions were selected through the RAP process, which includes consultation with the public. Most actions have already been implemented.

HIGHLIGHTS of the RAP

Since 1990, the Government of Canada's Great Lakes Sustainability Fund has made significant contributions towards restoring environmental impairments in the Nipigon Bay AOC. A number of projects have been completed to enhance fish and wildlife communities and to rehabilitate degraded aquatic and terrestrial habitat. Logs and debris were removed from historic spawning areas in the lower Nipigon River. The clean up of a former wetland site has resulted in natural regeneration of wetland features. A fish-stocking program was used to increase adult spawning potential in Nipigon Bay with more than 12,000 adult fish stocked over 3 years. A community-based effort was used to clean up and restore habitat in and around a once productive and aesthetic brook trout stream. These efforts are a step towards enhancing fish and wildlife populations in the AOC.

RAP Development/History

Early in the RAP process, the PAC evaluated and identified environmental impairments and developed a list of objectives for the remediation of the area. These objectives were incorporated into the Stage One document: *Environmental Conditions and Problem Definition*. An Options Discussion Paper then developed a list of remedial measures to address the identified environmental problems, carefully weighing each option and identifying preferences. The discussion paper went out for public comment, to assist in the selection of a preferred course of action.

The Stage Two document, *Remedial Strategies for Ecosystem Restoration*, used the selected options to outline stakeholder commitment and implementation timetables necessary to restore impaired beneficial uses.

PAC involvement in the Nipigon Bay RAP has been extensive and integral to the success of the process. The combination of local knowledge and community-based goals with scientific data and expertise has resulted in a pragmatic and defensible strategy to rehabilitate the environmental impairments in the AOC ecosystem.

RAP Status

Most recommended specific remedial actions have been implemented in Nipigon Bay. The Town of Nipigon has undertaken an environmental study report which identifies options for upgrading its primary municipal wastewater treatment plant and has been successful in obtaining funding under phase one of the Canada-Ontario Municipal Rural Infrastructure Fund (COMRIF). Similarly, the Township of Red Rock completed a class environmental assessment for its wastewater treatment plant and has applied for funding in the next phase of COMRIF. Full implementation is contingent on funding availability.

RAP Implementation

Most of the recommended remedial actions have been completed, but until the municipal point source discharges have been addressed, Nipigon Bay will continue to be an Area of Concern. Upgrading the Nipigon and Red Rock Wastewater Treatment Plants is a key recommended action in the Stage 2 Report. Once this action has been implemented, the AOC will be able to move ahead to the formal delisting procedures of Stage Three.

On April 25, 2005, the Government of Canada, the Government of Ontario and the Township of Nipigon announced funding to upgrade the Nipigon sewage treatment plant. The governments of Canada and Ontario will each invest up to $1.9 million (CDN) in the project. The Township of Nipigon will contribute the balance of the total eligible project cost of up to $4 million (CDN). The Government of Canada's contribution is contingent on the successful completion of an environmental assessment of the proposed project under the Canadian Environmental Assessment Act. This investment, made under the first phase of the Canada-Ontario Municipal Rural Infrastructure Fund (COMRIF), will improve the quality of life for local residents. Work includes designing and constructing a rotating biological contractor secondary treatment system and a six-month sludge storage capacity lagoon. Additional funding is required and is being sought to implement this upgrade.

The township of Red Rock has submitted a application for funding in the second phase of COMRIF and is prepared to proceed with the upgrade of their treatment plant if the application is successful.

Once this infrastructure project has been completed, the status of the environmental impairments will be reviewed in order to determine if the delisting targets have been met. Some of this review has already been completed. For example, scientists at Environment Canada have completed an assessment of sediment and bottom-dwelling organisms in the AOC. The results of all these assessments will form the basis of the Stage 3 delisting process.

RAP Accomplishments

The Nipigon River Water Management Plan was established, through public involvement, to reduce the impacts of the operation of hydroelectric dams on the Lake Nipigon/Nipigon River watershed and particularly on the Nipigon River fishery. The plan was in response to water level fluctuations that resulted in the exposure of brook trout spawning beds and affected the groundwater supply critical to the survival of brook trout embryos. The plan expands on an interim agreement between the Ministry of Natural Resources and Ontario Power Generation to maintain minimum flows. These actions directed at brook trout will benefit other fish, wildlife, and benthic populations in the ecosystem with a more natural cycle of river flow.

Notable successes have included the development of a bioengineered marina at Red Rock that features armour stone breakwalls that incorporate public access and fish and wildlife habitat; the Nipigon River Water Management Plan has provided a workable solution to water use conflicts arising from regulated flows; and improvements to brook trout habitat at Clearwater Creek.

There is a commitment to ensure the gains realized to date are maintained and progress towards restoration and ultimate delisting of Nipigon Bay as an AOC continues.

RAP Participants

Cooperation is critical to the RAP process. Undertaking environmental restoration requires a large amount of local knowledge, scientific expertise and hard work. One agency or group cannot undertake such a large task on their own, without the help of others. Listed below are participants that contribute to the RAP program.

- Canada-Ontario Municipal Rural Infrastructure Fund (COMRIF)
- Domtar Packaging
- Environment Canada
- Ministry of Northern Development and Mines
- Ontario Hydro
- Ontario Ministry of Education
- Ontario Ministry of Natural Resources
- Ontario Ministry of the Environment
- Public Advisory Committee
- Township of Nipigon
- Township of Red Rock

A.2.1.C Jackfish Bay

Jackfish Bay Area of Concern

General Information

Where?

The Jackfish Bay Area of Concern (AOC) is located on the north shore of Lake Superior approximately 250 kilometres (155 miles) northeast of Thunder Bay. The AOC consists of a 14-kilometre (9 mile) stretch of Blackbird Creek between Terrace Bay Pulp Inc. (formerly Kimberly–Clark) pulp mill and Jackfish Bay, and includes Lake "A", Moberly Lake, and Jackfish Bay. The town of Terrace Bay is the closest community.

Why was this area listed?

Major environmental concerns (or beneficial use impairments) in the area included:

- restrictions on fish consumption
- degradation of fish populations and fish habitat
- fish tumours and other deformities
- degraded aesthetics
- condition of the sediments and the aquatic communities which utilize them

What is being done? How is it being done?

In order to improve the environmental conditions noted above, a Remedial Action Plan (RAP) has been developed for Jackfish Bay. The Jackfish Bay RAP was developed through a partnership between the Government of Canada and the Province of Ontario, with support from the Jackfish Bay Public Advisory Committee (PAC). Many linkages and alliances have been developed as part of the RAP process between the RAP team and various other groups in the community including private citizens, recreational groups, industry and municipalities.

This plan, which was initiated in 1988, involves the following three stages, each of which, when completed, results in a corresponding report:

1. defining the problem (Stage 1 Report completed in 1991)
2. developing a strategy of action to rehabilitate and protect ecosystem quality (Stage 2 RAP Report completed in 1997)
3. implementing the strategy of remedial and preventive actions (i.e., the RAP), and monitoring and confirming the eventual restoration of the impaired beneficial uses (Stage 3 Report)

In order to determine the actions required for remediation of the AOC, both the identification of the beneficial use impairments and the water use goals, developed by the PAC, were utilized. A number of potential solutions were developed and assessed. Natural recovery, where the ecosystem is allowed to recover on its own, was selected as the preferred strategy in the Stage 2 RAP report.

This was decided due in large part to achievement of higher standards of effluent quality at the Terrace Bay Pulp mill resulting from improved treatment of effluent and changes in mill processes between 1987 and 1997. Acceptance of this plan is based on the fact that recovery is already occurring in many areas.

RAP Development/History

The Jackfish Bay Remedial Action Plan (RAP) was developed by Environment Canada and the Ontario Ministry of the Environment between 1988 and 1997, with support from the general public.

The RAP adopted an ecosystem approach to environmental problems that incorporated land, water, air, plants, animals and ultimately people. Therefore, the cooperation and involvement of many other federal and provincial government agencies has been key to RAP progress.

The general public (both individuals and organizations) participated in the RAP process as members of the PAC, providing a forum for the spectrum of interests existing within a community. The Jackfish Bay PAC encompassed the interests of private citizens, industry, labour, tourism operators and property owners.

Within the Stage One document, beneficial use impairments and objectives for the remediation of the AOC were identified. Upon completion, federal and provincial agencies and the International Joint Commission reviewed the document. An Options Discussion Paper then presented a list of remedial measures to address the identified environmental problems, carefully weighing each option and identifying preferences.

The Stage Two document was completed in 1997. This document recommends a "natural recovery" plan to address most of the impaired beneficial uses in the Area of Concern.

The natural recovery plan does not require the removal of contaminated sediment from the environment. This plan relies on natural processes to bury contaminants in the sediment, effectively isolating them from the water column and food web.

Essential to the natural recovery plan is the maintenance of higher standards of effluent quality by the Terrace Bay Pulp mill, and continued monitoring of the effects of contaminated sediments on the ecosystem. In this way, progressive changes in the ecosystem can be evaluated, and delisting of the AOC can occur at the earliest opportunity.

RAP Status

Additional remediation actions for the Jackfish Bay RAP are not feasible or recommended at this time, and it is recognized that the environmental recovery within the AOC will take some time.

Assessment of the recovery will continue to take place through long-term monitoring. The agencies propose to recognize the Jackfish Bay AOC as an Area in Recovery which will require a detailed long-term monitoring plan that will track the environmental recovery of the AOC. This decision is strongly supported by technical analysis and follows the direction given by PAC in the Stage 2 report.

Environment Canada (EC) revisited the area in September 2007 as part of a sediment/benthos recovery study, and it will be determined if additional toxicity work is required. Ontario Ministry of Natural Resources will be conducting a sport fish collection in the AOC (along with other Lake Superior AOCs). A full EC Benthic Assessment of Sediment (BEAST) assessment will be repeated in 2008. Cycle 4 (April 2007) Environmental Effects Monitoring results are being reviewed. A short- and long-term monitoring strategy to assess water quality, sediment quality, benthos, fish, and other biological indicators (i.e., wildlife) will be developed.

RAP Implementation

Ongoing monitoring and reporting are needed to evaluate the progress of natural recovery. It is recommended that changes in sediment and benthos be evaluated at least once every ten years. Environmental impacts of the pulp and paper industry are evaluated every four years to determine the effectiveness of mitigative measures. Contaminant levels in sport fish are evaluated at least every five years until consumption advisories can be removed. Sediment contamination and aquatic communities in Moberly Lake require regular evaluation to assess progress towards recovery.

Environment Canada and the Ontario Ministry of the Environment and the Ontario Ministry of Natural Resources cooperate to lead implementation actions.

RAP Accomplishments

Contaminant levels in effluent and receiving waters have decreased since the installation of secondary treatment and changes in mill processes to chlorine dioxide bleaching. Mill effluent presently tested has significantly reduced biological effects and is characterized as non-acutely toxic. Previously, Lake A was clogged with extensive accumulation of organic material. Ten years ago effluent flow was diverted away from the lake, recovery has occurred and the lake is now a productive wetland.

RAP Participants

Cooperation is critical to the RAP process. Undertaking environmental restoration requires a large amount of local knowledge, scientific expertise and hard work. One agency or group cannot undertake such a large task on their own, without the help of others. Listed below are participants that contribute to the RAP program.

- Environment Canada
- Great Lakes Sustainability Fund
- Municipality of Terrace Bay
- Ontario Ministry of Natural Resources
- Ontario Ministry of the Environment
- Public Advisory Committee
- Terrace Bay Pulp Inc. (formerly Kimberly-Clark)

A.2.1.D Peninsula Harbour

Peninsula Harbour Area of Concern

General Information

Where?

Peninsula Harbour is located on the northeastern shore of Lake Superior midway between Sault Ste. Marie and Thunder Bay. The Area of Concern (AOC) extends approximately four kilometres (2.5 miles) from the Peninsula into Lake Superior.

Why was this area listed?

Major environmental issues of concern (or beneficial use impairments) in the area included:

- fish consumption advisories due to high levels of toxic contaminants
- degraded fish communities
- fish habitat destruction
- degraded lake bottom communities
- dredging restrictions due to contamination of the bottom sediments

The environmental impairments in Peninsula Harbour result, almost exclusively, from the presence of a substantial area of mercury contaminated sediments. This sediment contamination is particularly severe in Jellico Cove and is the result of historic discharges from the James River-Marathon chlor-alkali plant which closed in 1977. Other contaminants such as PCBs, as well as wood fibre, are found in the sediments, and are also of concern, although a lower priority compared to the mercury.

What is being done? How is it being done?

In order to improve the environmental conditions noted above, a Remedial Action Plan (RAP) is being developed for Peninsula Harbour. The Peninsula Harbour RAP is a partnership between the federal and provincial governments with cooperation from a Public Advisory Committee (PAC). Linkages and alliances have been made between the RAP team and various other groups in the community, including environmental groups, recreational groups, industry and municipalities.

This plan, which was initiated in 1987, involves the following steps:

- defining the problems (Stage 1 – completed in 1991)
- identifying and planning the required remedial actions (Stage 2 draft completed)
- implementing the actions (Stage 2)
- monitoring the restoration of the environment and eventual delisting (Stage 3)

Currently, the RAP is planning for implementation, and a list of remedial actions is being developed to address the environmental problems in the AOC. The most important of these problems is the mercury-contaminated sediment in Jellicoe Cove.

In 2007, an ecological risk assessment (ERA) was conducted and potential risks to four types of receptors were evaluated: benthic invertebrates (sediment dwelling organisms), fish, piscivorous (fish-eating) birds, and piscivorous mammals. Human health risks were also identified in 2007.

A list of potentially feasible remediation options to solve this problem were previously identified in the draft Stage 2 report, but in 2007, a draft Sediment Management Options Assessment report has identified the following options for future consideration:

1. Removal and capping of the contaminated sediments
2. Capping of contaminated sediments
3. A combination of the above

When the preferred sediment management option has been identified, the RAP for Peninsula Harbour will be published in the final RAP Stage 2 Report. This report will guide the restoration and monitoring efforts until Peninsula Harbour is no longer considered an AOC.

RAP Development/History

The Peninsula Harbour Remedial Action Plan (RAP) is being developed by Environment Canada and the Ontario Ministry of the Environment, with support from Fisheries and Oceans Canada, Ontario Ministry of Natural Resources, and the general public.

The RAP adopted an ecosystem approach to environmental problems that incorporates land, water, air, plants, animals and ultimately people. Therefore, the cooperation and involvement of other federal and provincial government agencies has been key to RAP progress.

The general public (both individuals and organizations) participated in the RAP process as members of the PAC, providing a forum for the spectrum of interests existing within a community. The Peninsula Harbour PAC encompassed the interests of environmental groups, recreational groups, industry and municipalities.

The Stage One RAP Report provided a definition and detailed description of the environmental problems with the AOC and identified the beneficial use impairments for the Harbour. The PAC evaluated the use impairments and developed specific water use goals and objectives designed to assist in the restoration and protection of the AOC. These goals provided community-based guidelines for the remediation of impairments in Peninsula Harbour.

The Stage One document was reviewed by federal and provincial agencies and was submitted to the International Joint Commission (IJC) in 1991. The IJC concluded that there was sufficient information to proceed with Stage Two.

When completed, the Stage Two RAP Report will present the remedial options to address the environmental problems within the Harbour. In the report, each option will be evaluated and the preferred course of action for the AOC will be identified.

RAP Status

Remedial strategies for Peninsula Harbour focus on the shallow water areas of the Harbour, while leaving remediation of the deeper areas to natural sedimentation processes. Recent studies have confirmed the severity of the mercury contamination problem. A 2002 biomagnification study completed by Environment Canada concluded that there was biotic uptake of mercury from the sediments, and an Ontario Ministry of the Environment sport fish collection in 2002 found elevated PCB and mercury levels in white suckers.

Currently, a detailed ecological risk assessment (ERA) is being updated to address mercury-contaminated sediment in the vicinity of Jellicoe Cove. The ERA has shown that current mercury levels may reduce reproductive success in longnose suckers and other bottom feeding species, although other fish species do not appear to be adversely affected by current levels of mercury or PCBs. Current concentrations of mercury in fish may reduce reproductive success in individual osprey and other piscivorous raptors foraging primarily within Jellicoe Cove, but any adverse effects on osprey or other piscivorous raptors are unlikely to have population-level consequences. Current concentrations of PCBs in fish may reduce reproductive success in mink and other piscivorous mammals foraging within Jellicoe Cove, the rest of Peninsula Harbour, or both areas in any proportion.

Human health risks were identified in 2007. Adult sport anglers who target lake trout are not predicted to be at risk from methylmercury in fish tissue but may be adversely affected by PCBs in fish. Adult subsistence anglers who consume longnose sucker, lake trout, and lake whitefish are predicted to be at risk from methylmercury in fish tissue if they derive 100% of the fish they consume from the AOC. Subsistence anglers may be adversely affected by PCBs in fish even if as little as 5% of the fish they consume is derived from the AOC.

Remediating sediments in the area of highest contamination may prevent further migration of nearshore mercury to offshore areas. For this reason, a sediment management strategy is being developed. The assessment and management of contaminated sediment is an intensive process. All participants will continue to work together to ensure that an acceptable outcome is achieved.

Additional work has been completed to analyze results from 2003 field work on sport fish, caged clams, and sediment sampling conducted by Ontario Ministry of the Environment. Additional sediment studies of core chemistry and sediment stability have been carried out by the National Water Research Institute of Environment Canada.

RAP Accomplishments

The former chlor-alkali plant, which operated adjacent to the pulp mill from 1952 to 1977, was the main source of mercury contamination to the Harbour. Mercury-contaminated material has since been removed from the plant itself and safely deposited at the facility's own mercury disposal site. Effluent from the Marathon kraft pulp mill is now treated to remove organic pollutants. Process improvements at the mill in 1991 greatly reduced organic enrichment of the AOC. The mill was recognized for this pollution prevention approach in 1995 with an award from the Lake Superior Binational Program. In that same year, the mill constructed a secondary treatment basin (Aerated Stabilization Basin) to further improve effluent quality.

RAP Participants

Cooperation is critical to the RAP process. Undertaking environmental restoration requires a large amount of local knowledge, scientific expertise and hard work. One agency or group cannot undertake such a large task on their own, without the help of others. Listed below are the participants that have contributed to the RAP program.

- Environment Canada
- Great Lakes Sustainability Fund
- Marathon Pulp Inc.
- Ontario Ministry of Natural Resources
- Ontario Ministry of the Environment
- Public Advisory Committee
- Town of Marathon

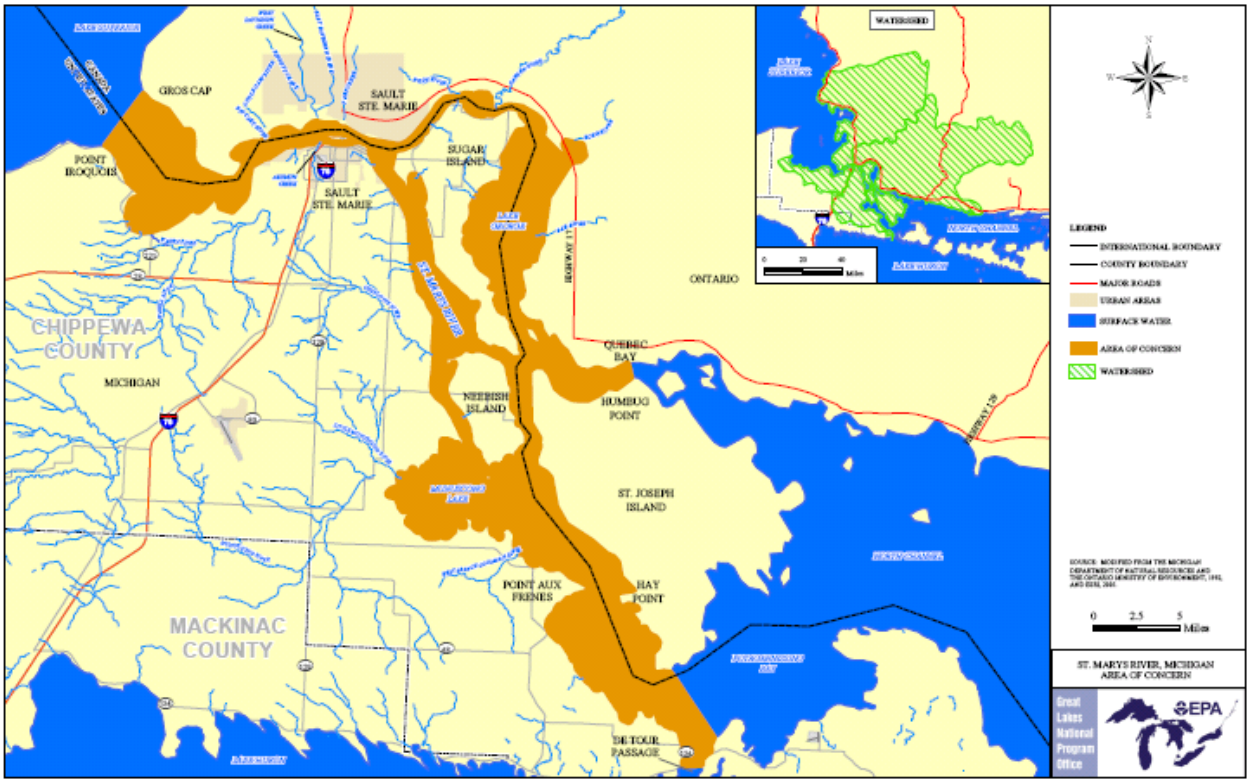
A.2.1.E St. Marys River

St. Marys River Area of Concern

General Information

Where?

The St. Marys River is the 112 kilometre (70 mile) connecting channel from Lake Superior to Lake Huron. The Area of Concern (AOC) boundary includes the entire river which extends from Whitefish Bay between Point Iroquois, Michigan and Gros Cap, Ontario; east and downstream between Quebec Bay and Humbug Point, Ontario in the St. Joseph Channel; between the Michigan side of the river and St. Joseph Island, downstream to the De Tour Passage, Michigan.



Why was this area listed?

Major environmental issues of concern (or beneficial use impairments) in the area included:

- restrictions on fish and wildlife consumption
- unhealthy fish and wildlife populations
- fish tumours and other deformities
- unhealthy populations of bottom-dwelling organisms

- restrictions on dredging
- undesirable algae due to excess nutrients in the water
- beach closures
- poor aesthetics
- loss of fish and wildlife habitat
- bird or animal deformities or reproductive problems (michigan)

What is being done? How is it being done?

In order to improve the environmental conditions noted above, a Remedial Action Plan (RAP) process was initiated for the St. Marys River. The St. Marys River RAP is a partnership between Canadian and U.S. federal governments, provincial (Ontario) and state (Michigan) governments, with cooperation from the local Binational Public Advisory Council (BPAC).

The Remedial Action Planning process, which was initiated in 1988, involves the following three stages:

- defining the problem (Stage 1, completed in 1992)
- determining what remedial actions are needed to rectify the impairments (Stage 2a, completed in 2003)
- implementing the actions (Stage 2)
- monitoring the restoration of the environment and eventual delisting of the AOC (Stage 3)

The final Stage 2a RAP report was released in 2003. More than 60 recommended actions, including a number of restoration and protection measures already completed or in progress, were included in the report. A technical annex to the Stage 2a document has not been developed. The annex, once complete, will identify priorities for action, responsibilities, and a timeline for RAP accomplishments.

HIGHLIGHT of the RAP

The Cannelton Industries site is a former tannery located adjacent to Tannery Bay on the south shore of the St. Marys River, upstream from the city of Sault Ste. Marie, Michigan. Remedial investigation in the 1990's at the tannery site and bay indicated that sediments and wetland areas contained organic material contaminated with chromium and mercury. As a result, these areas were designated as a U.S. Environmental Protection Agency (US EPA) Superfund site under the Comprehensive Environmental Response, Compensation and Liability Act. The remedial action plan for the bay area called for natural recovery, allowing clean silt from St. Marys River to gradually cover the contaminated sediment. All remedial work under the Superfund program was completed in 1999. Remedial work completed included the excavation of 33,000 tons (of tannery waste materials and contaminated soils to off-site solid waste disposal facilities), construction of surface drainage works, a shoreline berm to prevent erosion, and seeding and mulching to revegetate the site. Environmental monitoring was to be performed indefinitely to monitor the natural recovery process.

However, after purchasing the tannery site, Phelps Dodge Corporation along with the city of Sault Ste. Marie, the BPAC, and the State of Michigan, expressed a preference for sediment removal instead of waiting for natural recovery. An application was submitted in 2004, and subsequently accepted for Great Lakes Legacy Act funding. In September 2006, US EPA, Michigan Department of Environmental Quality (MDEQ), and Phelps Dodge Corporation began a project to dredge approximately 40,000 cubic yards (30,600 ^{m3}) of contaminated sediment from the bay and soil from two small mercury-impacted wetland areas. Dredging was completed in 2007 and eliminated approximately 500,000 pounds (227,000 kg) of chromium and 25 pounds (11 kg) of mercury from the St. Marys River.

Significant improvements to the Sault Ste. Marie, Ontario, East End Wastewater Treatment Plant were completed in support of the St. Marys River RAP in 2006. These improvements were completed at a cost of $73 million (CDN), with over $21 million (CDN) provided by the Government of Canada and $25.8 million (CDN) from the Government of Ontario. The upgraded plant has state-of-the-art wastewater treatment technology, and it is expected that significant improvements at the plant will result in improvements to water quality in the St. Marys River.

In response to concern from residents about beach closings and water quality in the Sugar Island area in the summer of 2006, the RAP team agencies partnered with representatives from local, tribal, state/provincial, and federal agencies in Canada and the U.S. to form the Sugar Island Monitoring Work Group (SIMWG) in 2007. The agencies involved in the SIMWG include: Algoma Public Health, Chippewa County Health Department, Ontario Ministry of Environment (OMOE), MDEQ, EC, Health Canada, US EPA, Bay Mills Indian Community, and Sault Ste. Marie Tribe of Chippewa Indians (Sault Tribe). The purpose of the SIMWG was to develop and carry out a coordinated monitoring plan for the St. Marys River along the north shore of Sugar Island. The workgroup's task was to conduct water quality monitoring, characterize the severity of water quality impairment, and identify potential sources of bacteria and floating solids.

The SIMWG worked with the RAP team to hold the Sugar Island and Lake George Channel Symposium on May 15, 2007, at the Cisler Center, Lake Superior State University (LSSU) in Sault Ste. Marie, Michigan. The purpose of the symposium was to provide the public with information about water quality impairments observed in 2006 on the north shore of Sugar Island and in the Lake George Channel, and to discuss the coordinated monitoring and event response procedures planned by the SIMWG for 2007.

After over 17 weeks of monitoring in 2007, the SIMWG ceased monitoring operations in October for the winter (though regulatory monitoring continues year-round). In total, over 800 samples were collected. The group is now in the process of preparing a report and developing recommendations for 2008.

RAP Development/History

Since the AOC includes an international waterway, the St. Marys River RAP requires a cooperative effort between Canadian and U.S. governments. EC, US EPA, OMOE, and MDEQ have worked in partnership to further clarify areas of joint leadership and responsibility.

The cooperation and involvement of the four agencies, along with the Ontario Ministry of Natural Resources (OMNR), Department of Fisheries and Oceans Canada (DFO), and Michigan Department of Natural Resources (MDNR), has been fundamental to the St. Marys River RAP program.

The BPAC was formed in 1988 to provide informed and continuous public participation in the St. Marys River RAP. The citizen-based group represents interests from both Ontario and Michigan. Members work with and advise RAP participants on key aspects of the planning process. Members have included representatives from industry, academia, First Nations, and elected officials. It is important to acknowledge the contributions of the BPAC, which has played a crucial role in the development of the RAP during its 10-year history. These accomplishments include:

- identification of impairments and conditions
- development of water use goals
- identification of remediation needs and options
- assessment of community programs and projects
- development of use goals and general delisting criteria
- establishment of BPAC office and library

The 1992 Stage 1 RAP report described the environmental conditions and identified the use impairments in the AOC. The Stage 2 RAP report was completed in 2003. There were a number of workshops within the Stage 2 process of the RAP, to ensure there was broad based public involvement. These workshops were the basis for developing the strategic plans and water use goals outlined in the RAP for restoring the impaired beneficial uses of the AOC.

RAP Status

The four agency managers have recently made some important decisions for the three upper connecting channel AOCs, including the St. Marys River, regarding development and application of specific, measurable criteria for removing Beneficial Use Impairments (BUIs). As outlined in the Stage 2 RAP, the four agencies and the BPAC developed water use goals and general criteria for removing BUIs for the entire AOC. The next step is to take those general criteria and from them determine specific, measurable criteria that can be applied to relevant remedial actions in both the U.S. and Canadian waters. The process is guided by the Four Agency Letter of Commitment (1998) and the Compendium of Positions Papers (revised in 2007).

In the spring of 2007, the BPAC received a PAC support grant from the MDEQ to develop the fish and wildlife restoration criteria and Restoration Plan. The project is expected to be completed by the end of June 2008. In addition to the fish and wildlife BUIs, the MDEQ is offering the BPAC the opportunity to review the Michigan's statewide criteria outlined in the MDEQ's Guidance for Delisting Michigan's Great Lakes Areas of Concern document for the other eight BUIs listed for the AOC, and either accept the statewide criteria or develop local criteria. The BPAC is currently in the process of comparing criteria outlined in the Stage 2 RAP with the statewide criteria. Determination of the final suite of criteria for Michigan's portion of the AOC is also expected to be complete by the end of June 2008. Binational consultation will occur throughout the entire process. The MDEQ will proceed with approving BUI removal criteria for the St. Marys River AOC, as it has with other Michigan AOCs, by the end of 2008.

The bottom sediments of the river including the Algoma Steel boat slip are contaminated. Algoma Steel removed 3,200 cubic metres (4,200 cubic yards) of contaminated sediment in 2006 and had plans to remove residual contamination in 2007.

Bellevue Marine Park is the first depositional zone downstream from the major industries located in Sault Ste. Marie, and as a result, there is significant contamination of the existing sediment. Elevated levels of contaminants such as PAHs and TPHs have caused impairment of benthic communities and residual toxicity. In 1995, the chemical characteristics of sediment in Bellevue Marine Park were investigated by the OMOE. In 2005, OMOE/EC deployed sediment traps, and samples were sent for analyses. At sampling sites in George Lake and Little Lake George, OMOE found chironomids, mayflies, and clams, indicating there is a healthy benthic environment. Further sediment assessment is required.

RAP Implementation

On April 17, 1998, EC, US EPA, OMOE, and the MDEQ signed a Four Agency Letter of Commitment. The Letter outlined agency roles and responsibilities during implementation of the RAPs for the St. Clair River, Detroit River, and St. Marys River binational AOCs.

The Agencies have worked in partnership to further clarify areas of joint leadership and responsibility. A Compendium of Position Papers has been written and describes how the agencies work together to provide leadership for the RAPs, by involving the public, monitoring and reporting on progress, with the ultimate goal of delisting the AOC. The Compendium was signed on February 2, 2000, and was revised in 2007.

A RAP Coordinator for the St. Marys River has been hired in support of the current Canada-Ontario Agreement (COA) commitments (2007-2010). The RAP coordinator will assist in implementing the St. Marys River RAP, and will provide leadership on consultation with community participants. This position is funded by OMOE through COA and is the result of a unique partnership between the Sault Ste. Marie Region Conservation Authority, OMOE, and EC.

Implementation of the actions recommended in the Stage 2 Report have not all proceeded at the same pace. Some actions are still in the early stages, while others are either complete or have been ongoing for some time.

The following are examples of the projects currently being implemented by various stakeholders:

- Process improvements, water treatment improvements and air quality monitoring at Algoma Steel
- Improvements to water treatment and air emissions at St. Marys Paper
- Land-based investigations and remedial actions are ongoing at the site of a decommissioned manufactured gas plant downstream of the Sault Edison power plant beside MCM Marine. Consumers Energy has removed a total of 11,503 tons (10 435 tonnes) of contaminated soil and 7,519 tons (6 821 tonnes) of contaminated sediment from the site. Following removal, the upland areas, shoreline, and nearshore river bottom were stabilized and improved. The need for removal of additional river-based sediments is currently being investigated.
- The Sault Ste. Marie Area Watershed Management Plan (Michigan) has been approved by the MDEQ. A steering committee meeting was held in late 2007 to prioritize tasks and implement the plan. Many restoration and protection recommendations from the Stage 2a RAP related to Sault, Michigan, were incorporated into the Sault Ste. Marie Area Watershed Management Plan along with many more, detailed recommendations to improve water quality and habitat for the St. Marys River. In the near future, partners including BPAC, LSSU, the City of Sault Ste. Marie, and others will be seeking funding to implement the recommendations of the watershed plan.
- Since 2004, LSSU has been involved in a three-year project to determine the ecosystem health of the St. Marys River. The LSSU researchers are investigating coastal marshes to determine the status of habitat and the wildlife by collecting biological, sediment, and water samples and performing various types of chemical analyses. All field studies have been completed and indices of biotic integrity are being developed. Further refinement and development of biotic and chemical integrity models is ongoing. A final report is to be submitted to the USEPA in the summer of 2008.
- Bellevue Marina Sediment Management Strategy completed.
- The St. Marys River Fishery Task Group's St. Marys River Fisheries Assessment Plan outlines assessments and knowledge needs for the river to address stakeholder identified issues and concerns. In response, Task Group members from Ontario and Michigan have partnered to conduct sport fish harvest, fish population and annual young of the year walleye surveys on the river since 1999. Other assessment and monitoring projects are conducted individually by agencies in support of agency specific programs. Projects completed since the 2006 LaMP Update are highlighted below. Reports published by the Task Group may be viewed at http://www.glfc.org/lakecom/lhc/lhchome.php#pub
    - In 2005 and 2007, OMNR and MIDNR carried out an angler caught sport fish harvest survey of the lower St. Marys River.
    - Annual "young of the year" walleye electrofishing surveys to look at annual recruitment and stocking survival are conducted by members of the St. Marys River Fisheries Task Group which include OMNR and DFO. Established survey sites are covered each year along the east side of Lake George by OMNR and DFO. New sites in the St. Joseph Channel were surveyed in 2007 in an attempt to discover critical habitat locations for young of the year walleye.
    - The Task Group conducted a fish population gillnet survey in 2006. The survey covered 42 sites from Whiskai Bay in the upper river to Potagannissing Bay in the lower river. Ten of these sites were in Ontario waters. The report has been drafted and will be posted on the Great Lakes Fishery Commission web site when complete.
    - The United States Fish and Wildlife Service (USFWS) conducts annual exotic species trawls in the river. In 2006 and 2007, the USFWS trawled the Algoma Steel slip in the upper river and the shipping channel to Purvis Marine dock in the lower river specifically looking for the invasive fish Eurasian ruffe, which is slowly expanding its range eastward along the south shore of Lake Superior.
    - In 2006 and 2007, OMNR conducted a spring rainbow trout creel survey in the St. Marys River.

- In 2007, a short-duration lake herring creel survey was conducted in Potagannissing Bay by the OMNR. Tissue was also collected and sent to OMOE for contaminant analysis.
- LSSU conducted Atlantic salmon spawning success surveys in the St. Marys Rapids in 2007.

RAP Accomplishments

Although implementation of some remedial actions is just beginning, important steps forward have already been made in the St. Marys River AOC. A great deal of monitoring in the St. Marys River has occurred over the last 20 years, primarily in response to the St. Marys River being designated as an AOC. These activities are described in more detail in the 1992 and 2003 RAP documents. Examples of projects that have been completed since the 2006 LaMP Update are highlighted below.

- East End Wastewater Treatment plant was upgraded to secondary treatment, and the outfall pipe was relocated to deeper water.
- Cannelton Industries site dredging was completed in 2007 and eliminated approximately 500,000 pounds (227,000 kg) of chromium and 25 pounds (11 kg) of mercury from the St. Marys River.

RAP Participants

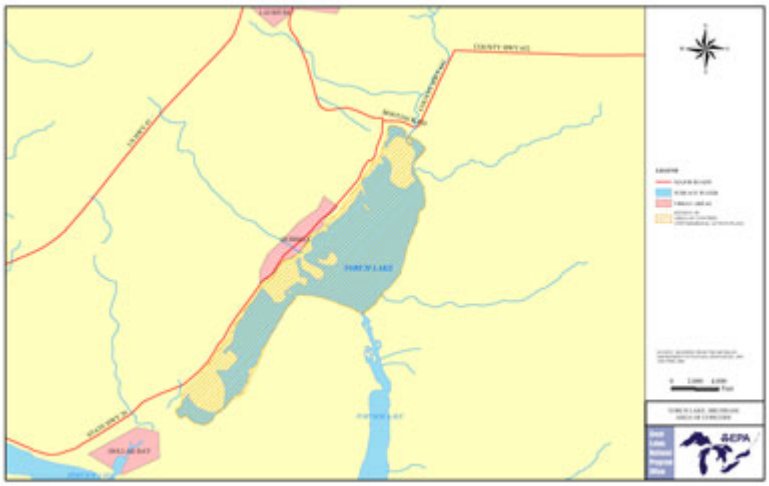
Cooperation is critical to the RAP process. Undertaking environmental restoration requires a large amount of local knowledge, scientific expertise and hard work. One agency or group cannot undertake such a large task on their own, without the help of others. Listed below are participants that contribute to the RAP program.

- Algoma Steel
- Anishinaabeg Joint Commission
- Bay Mills Indian Community
- Binational Public Advisory Council
- Chippewa Ottawa Resource Authority
- City of Sault Ste. Marie, Michigan
- City of Sault Ste. Marie, Ontario
- Environment Canada
- Fisheries and Oceans Canada
- Great Lakes Sustainability Fund
- Health Canada
- Lake Superior State University
- Local First Nations and Native American communities
- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources
- Ontario Ministry of the Environment
- Ontario Ministry of Natural Resources
- Sault Ste. Marie Region Conservation Authority
- Sault Ste. Marie Tribe of Chippewa Indians
- St. Marys Paper

A.2.2 U.S. Fact Sheets

A.2.2.A Torch Lake

Torch Lake Area of Concern



Torch Lake AOC Boundary Map
(click on map to view in separate window)
Torch Lake shape file

Background

Torch Lake became an Area of Concern (AOC) due to fish tumors of unknown origin which resulted in fish consumption advisories. The 1987 RAP document identified three Beneficial Use Impairments (BUIs) for the Torch Lake AOC. Fish Tumors; Degraded Benthos; Fish Consumption Advisories.

The Torch Lake Area of Concern is located on the Keweenaw Peninsula within Houghton County on the northwestern shore of Michigan's Upper Peninsula and on Lake Superior's southern shore. The region is locally known as the Copper Country. Deposits of native (elemental) copper are found in the Portage Lakes Lava Series, a long narrow bedrock formation which extends from the tip of the Keweenaw Peninsula southwest to the Michigan-Wisconsin border covering a distance of over one hundred miles.

Mason Stamp Sand Parcel of Torch Lake AOC after remediation

Copper-bearing ore on the Keweenaw Peninsula contains copper in its native or natural metallic form. For this reason, it has been a source of copper for people for thousands of years. More recently, it is the waste products from the industrial milling, smelting, and leaching operations of the mined copper bearing ore that have created the present environmental concern. These industrial processes began during the 1840s and continued for more than a century until all mining and related operations ceased in 1968. Those processes left stamp sands and slags deposited either on the surface of the surrounding landscape or in adjacent lakes and streams. Portions of the surficial materials eroded into nearby waterbodies.

Mason Stamp Sand Parcel of Torch Lake AOC before remediation

It is estimated that more than 10.5 billion pounds of copper were produced in the Copper Country between the mid-1840s and 1968. Half of this output was processed at sites scattered across the Copper Country landscape. The remainder was processed along the western shoreline of Torch Lake, a 2,700 acre body of water in Houghton County. About 200 million tons of copper ore tailings were deposited in Torch Lake, displacing about 20 percent of the lake's original volume (MDNR 1987).

The Torch Lake Area of Concern Boundary was described in the 1987 Torch Lake Remedial Action Plan (RAP) document "…..Torch Lake and its immediate environs." Immediate environs can be described as those areas along the shore of Torch Lake proper where wastes from the production of copper contributed directly to the contaminate loadings of Torch Lake. These areas had stamp sands and water quenched slags dumped on the shore and into the lake during the copper production process. The AOC boundary was formally agreed to by the Torch Lake Public Advisory Council (TLPAC), US EPA and the Michigan Department of Environmental Quality in 2005.

Beneficial Use Impairments

The 1987 RAP document identified three Beneficial Use Impairments (BUIs) for the Torch Lake AOC:

- Fish Tumors
- Degraded Benthos
- Fish Consumption Advisories

Torch Lake Beneficial Use Impairments

- Restrictions on fish and wildlife consumption
- Fish tumors or other deformities
- Degradation of benthos

Delisting Criteria/Restoration Targets

The Torch Lake AOC Public Advisory Council has requested that the State of Michigan begin the AOC delisting process for their AOC. A technical committee was developed comprised of staff from state and federal agencies and the PAC. The technical committee determined to use delisting criteria based on the recently released Guidance for Delisting Michigan's Great Lakes Areas of Concern document, released January 2006.

RAP/BUI Development and Status

- **2008 Report** – Torch Lake Sediments Report: A Sediment Chemistry Survey of Torch Lake, Houghton County Michigan. August 7, 8, and 9, 2007. Report # MI/DEQ/WB-08/011*.
- **2006** – PCB Study Using Semipermeable Membrane Devices in Torch Lake, Houghton County. MI/DEQ/WB-06/034*.
- **August 2001** – Torch Lake AOC RAP Update completed*.
- **1987** – Michigan Department of Natural Resources Remedial Action Plan for the Torch Lake Area of Concern completed.

* MDEQ reports available by contacting Sharon Baker MDEQ, Water Bureau at 517-335-3310 or Bakers9@michigan.gov.

RAP Implementation

The 1987 Torch Lake RAP suggested the following actions to enhance the recovery of Torch Lake:

- Promote revegetation of tailings to minimize erosion of the particulates associated with the mine tailings by wind and water into the lake;
- Continue the upgrade of local wastewater treatment facilities; and
- Institute sauger/walleye restocking.

Remedial Actions

The Torch Lake AOC included four of 14 Superfund Areas that were divided into operable units (OU). Two of three OUs, i.e. OU 1 and OU2, as designated under the two Superfund Record of Decisions, were applicable to the Torch Lake AOC. These were:

- OU 1 - includes the stamp sands, water quenched slags and other mining wastes deposited along the Torch Lake shoreline.
- OU 2 - includes ground water, surface water and submerged stamp sands and sediments in Torch Lake, Portage Lake, the Keweenaw Waterway/Portage Ship Canal, the Lake Superior Shoreline from south of the North Entry to Freda/Red Ridge, Boston Pond and Calumet Lake.

Mason Stamp Sand Parcel of Torch Lake AOC after Superfund remediation. Note dredge and smelter leftover from the copper mining days.

The selected remedy for OU 1 was to cover with soil and seed down to prevent erosional actions by wind and water. Remedial actions for the Torch Lake Superfund Site were completed by September 2005. Some parcels have already been deleted from the National Priorities List (NPL). Once all parcels are deleted, the state will assume Operation and Maintenance of the areas, including long-term monitoring of all OUs. Under the ROD for OU 2, natural attenuation was the selected remedy for the lakes. OU 2 has been deleted from the NPL.

Hubbell/Tamarack City Stamp Sand Parcel of Torch Lake AOC during remediation (left)
Hubbell/Tamarack City Stamp Sand Parcel of Torch Lake AOC after remediation (right)

Current Projects and Outlook

- Delisting Determination Document under development.
- In 2007, the Fish Tumor BUI was deleted from this AOC.
- Ongoing investigations by MDEQ and US EPA, working in consultation with the PAC, to determine if there is a source of PCBs in the lake that is driving the fish consumption advisory.
- In August 2007, US EPA performed an emergency removal of arsenic-, lead-, and PCB-contaminated soils and sediments above direct-contact criteria established to be protective of human health.
- In late 2007, the US EPA Superfund program performed an Area Assessment and found that further remedial investigation may be warranted.[1]
- In August 2007, MDEQ and the US EPA *R/V Mudpuppy* collected sediment samples to locate any potential sources of PCBs in the lake. Results indicate there may be a source of low level PCBs, but the concentrations were not high enough to warrant remedial action.[2]
- Currently, MDEQ, Torch Lake PAC, and US EPA are awaiting the results of the 2007 MDEQ Fish Contaminant Monitoring Program fish tissue sampling to determine if the Fish Consumption BUI for PCBs is still appropriate.

RAP-Related Publications

- **2007** – Summary Report for the Torch Lake Area Assessment, Torch Lake NPL Site and Surrounding Areas, Keweenaw Peninsula, Michigan.
- **2005** – NPL Fact Sheets for Michigan: Torch lake, US EPA Region 5

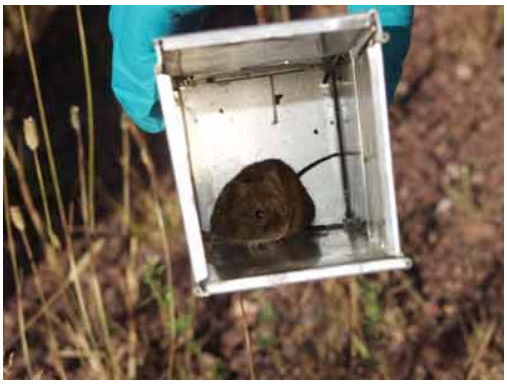
[1] 2008-Summary Report for the Torch Lake Area Assessment, Torch Lake NPL Site and Surrounding Areas, Keweenaw Peninsula, Michigan. Report prepared by the US EPA Emergency Response Branch upon request of US EPA Remedial Branch.
[2] Torch Lake Sediments Report: A Sediment Chemistry Survey of Torch Lake, Houghton County Michigan. August 7, 8, and 9, 2007. Report # MI/DEQ/WB-08/011.

- **2001** – Baseline Study Report: Torch Lake Superfund Site, Houghton County, Michigan, US EPA-Superfund.
- **1996** – A Mining Legacy: Torch Lake and Area of Concern (18-minute video), Houghton/Keweenaw Soil and Water Conservation District.
- **1994** – Declaration for the Record of Decision for Operable Unit II, Houghton County, Michigan, US EPA.
- **1992** – Declaration for the Record of Decision for Operable Units I & III, Houghton County, Michigan, US EPA.

Community/Local RAP Group Involvement

Public election of the members of the Torch Lake Public Advisory Council (TLPAC) took place in the spring of 1997. In less than one year the group adopted its by-laws, mission statement, goals and objectives, and incorporated as a tax-exempt, nonprofit Michigan corporation. It has received contributions from local governments, businesses, environmental groups, and private individuals to help defray logistical expenses. In addition, TLAPAC has been awarded over $24,000 from agency grants and private foundations.

Currently, there are seven schools within the AOC that have instituted Adopt-A-Stream projects. The Keweenaw Waterway Trail Association, in cooperation with local and state agencies, has developed a series of low-impact boating campsites along the waterway.



Wildlife abounds on the newly vegetated stamp sands of Torch Lake AOC. Small mammal survey results show wildlife is quite abundant on newly revegetated stamp sands compared to unremediated stamp sands where we did not find any wildlife at all.

Partners and Stakeholders

- Adams Township
- Calumet Township
- Chassell Township
- City of Hancock
- City of Houghton
- Elm River Township
- Franklin Township
- Hancock Township
- Houghton Co. Natural Resources Conservation Service
- Houghton County Board of Commissioners
- Keweenaw Bay Indians, Band of Chippewa
- Keweenaw National Historical Park
- Lake Linden Village
- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources

- Michigan Statewide Public Advisory Council
- Michigan Technological University, Center for Science and Environmental Outreach
- Osceola Township
- Portage Township
- Quincy Township
- Schoolcraft Township
- Stanton Township
- Torch Lake Public Advisory Council
- Torch Lake Township
- US EPA - Great Lakes National Program Office
- US EPA - Superfund

Torch Lake AOC Contacts

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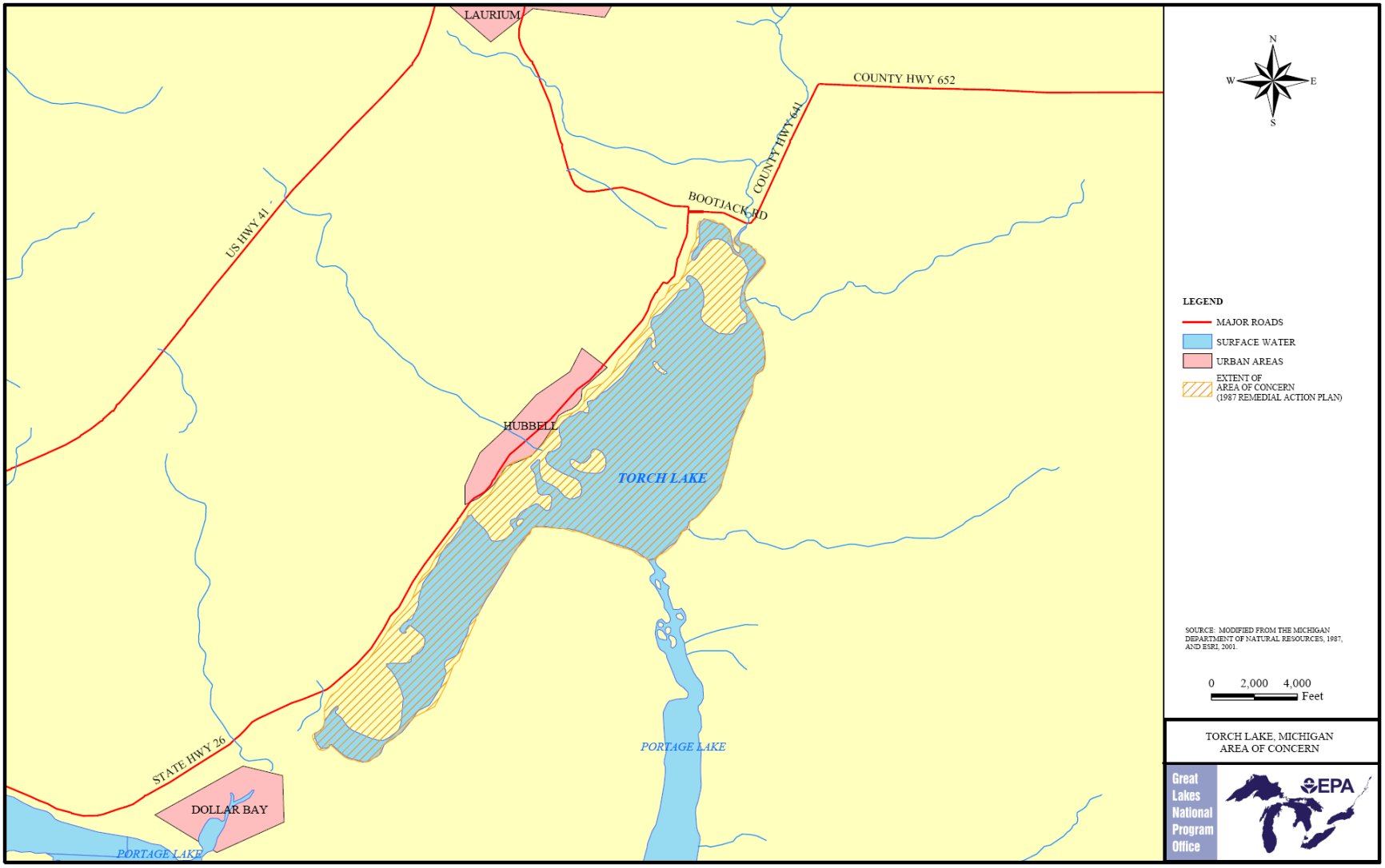
LAURIUM
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COUNTY HWY 641
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TORCH LAKE
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SURFACE WATER
URBAN AREAS
EXTENT OF AREA OF CONCERN (1987 REMEDIAL ACTION PLAN)
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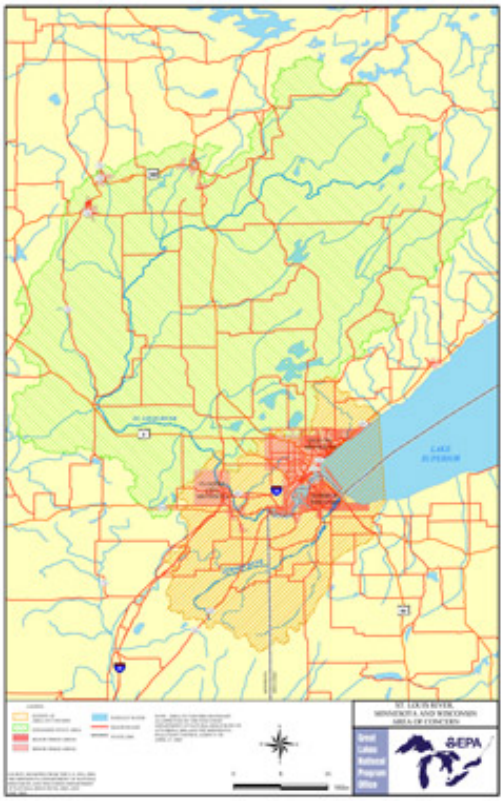
AREA OF CONCERN
Great Lakes National Program Office
EPA

A.2.2.B St. Louis River

St. Louis River Area of Concern



St. Louis River AOC Boundary Map
(click on map to view in separate window)
St. Louis River shape file

Background

The St. Louis River, the largest U.S. tributary to Lake Superior, drains 3,634 square miles, entering the southwestern corner of the lake between Duluth, Minnesota and Superior, Wisconsin. The river flows 179 miles through three distinct areas: coarse soils, glacial till and outwash deposits at its headwaters; a deep, narrow gorge at Jay Cooke State Park; and red clay deposits in its lower reaches. As it approaches Duluth and Superior, the river takes on the characteristics of a 12,000 acre freshwater estuary. The upper estuary has some wilderness-like areas, while the lower estuary is characterized by urban development, an industrial harbor and a major port. The lower estuary includes St. Louis Bay, Superior Bay, Allouez Bay, Kimball's Bay, Pokegama Bay, Howards Bay and the lower Nemadji River.

The St. Louis River System Area of Concern (AOC) is the area being addressed by the St. Louis River System Remedial Action Plan (RAP). While system-wide in its approach, the St. Louis River AOC focuses primarily on the lower 39 river miles and the entire 360 square mile Nemadji River watershed. The Nemadji River is split almost equally between Minnesota and Wisconsin and discharges into the Duluth-Superior Harbor near the natural outlet of the St. Louis River.

The RAP began in 1989 as a collaborative effort between the Minnesota Pollution Control Agency (MPCA) and the Wisconsin Department of Natural Resources (WDNR). At that time, the agencies created a Citizens Advisory Committee (CAC). In 1997, with agency assistance, the CAC opened its doors as an independent nonprofit organization known as the Citizens Action Committee. Many of the original citizen and agency partners are still active in the RAP and CAC.

Beneficial Use Impairments

The RAP process determined that nine of 14 identified beneficial uses were impaired. Some impairments were associated with the physical loss and degradation of habitat, with an estimated 7,700 acres of wetland and open water habitat altered or destroyed since settlement. Other problems were related more to pollution and toxicity. For years, the river smelled bad from industrial discharges. That changed in 1978, when the Western Lake Superior Sanitary District (WLSSD) wastewater treatment plant began operation. Nevertheless, pollution continues to come from sources such as contaminated sediments, abandoned hazardous waste sites, poorly designed or leaky landfills, airborne deposition, industrial discharges, chemical spills, improperly sewered wastes, and surface runoff.

St. Louis River Beneficial Use Impairments

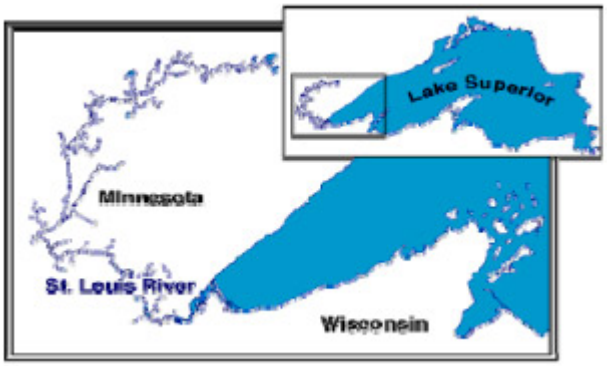
- Restrictions on fish and wildlife consumption
  - *Tainting of fish and wildlife flavor (unclear)*
- Degradation of fish and wildlife populations
- Fish tumors or other deformities
  - *Bird or animal deformities or reproduction problems (unclear)*
- Degradation of benthos
- Restrictions on dredging activities
- Excessive Loading of Sediment and Nutrients
  - *Restrictions on drinking water consumption, or taste and odor problems*
- Beach closings
- Degradation of aesthetics
  - *Added costs to agriculture or industry*
  - *Degradation of phytoplankton and zooplankton populations*
- Loss of fish and wildlife habitat

For further information and details on all of the BUIs, see a corresponding St. Louis River Beneficial Use Impairments document, the Restoration Goals for Beneficial Use Impairments SLRCAC web page, and the Remedial Action Plan (RAP) documents listed in the RAP Development and Status section below.

Delisting Criteria/Restoration Targets

In 2004, the SLRCAC proposed restoration goals for many of the impaired uses through a citizen process and submitted them to the WDNR and the MPCA. The Wisconsin Proposed Delisting Targets were published in October 2007. The proposed targets for each of the BUIs within the St. Louis River AOC provide a good starting point for the SLRCAC, in partnership with the WDNR and MPCA, to move forward with the public comment process (scheduled for Summer 2008) and complete a "delisting roadmap". AOC-wide delisting targets will be finalized by the end of 2008. The targets will serve as the roadmap for actions to lead to delisting the AOC.

The SLRCAC was awarded a grant through the WDNR to facilitate work on the delisting implementation strategies for the St. Louis River AOC. During this project, SLRCAC will coordinate information exchange between federal, state, tribal agencies, and local governments. SLRCAC will guide public participation in the implementation strategies development process. In brief, the SLRCAC will craft, facilitate public and agency review, publish, post on web sites, and distribute the delisting implementation strategies for the St. Louis River AOC.



RAP Development and Status

A progress report containing the CAC's 43 Stage Two recommendations was published in 1995. Implementation began immediately and continues today. Some recommended actions are well underway or completed, such as: (1) land acquisition, with 34,000 acres bordering the river permanently protected by purchase or donation, (2) connection of Fond du Lac, MN, responsible for a high percentage of failing septic systems, to the WLSSD, (3) programs to reduce sewage bypasses by keeping stormwater out of sanitary sewer systems, (4) completion of a habitat plan for the lower St. Louis River, and (5) implementation of a three-phase sediment strategy to reduce impairments associated with sediment contamination.

The Stage One document was published and reviewed in 1992. The IJC gave the RAP high marks for broadening the geographic scope of the AOC and expanding the definition of the use impairments in order to fully encompass local environmental concerns.

Significant RAP Milestones

- **2007** – Working with harbor partners, WDNR released proposed Delisting Targets.
- **2004** – The SLRCAC proposed restoration goals for many of the impaired uses through a citizen process and submitted them to the WDNR and the MPCA.
- **2002** – Lower St. Louis River Habitat Plan completed. The CAC worked with several partners from city, county, state, and federal agencies and entities on this document.
- **1999** – The CAC received funding to implement the habitat plan recommendation.
- **1996** – St. Louis River Citizens Action Committee formed.
- **1995** – RAP Recommendation Implementation Status document drafted.
- **1995** – St. Louis River System RAP Progress Report completed.
- **1992** – The St. Louis River System RAP Stage One document completed.

RAP Implementation

Recent Progress and Achievements

Erie Pier Management Plan: The Harbor Technical Advisory Committee completed the Erie Pier Management Plan, converting the designated Confined Disposal Facility (CDF) into a dredge material recovery and recycle area. A subcommittee is currently developing marketing strategies for the use of materials in regional projects such as mining reclamation, landfill daily cover, and road construction (www.dsmic.org\dredge).

Hog Island Great Lakes Legacy Act Project Completed: November 28, 2005, marked the completion of the Great Lakes Legacy Act sediment cleanup at Hog Island in Superior, Wisconsin. US EPA Great Lakes National Program Office (GLNPO) Director Gary Gulezian joined Wisconsin Governor Jim Doyle and 85 residents, local officials, and legislative aids to celebrate this event. The $6.3 million project removed nearly 55,000 tons of petroleum-contaminated sediment from Newton Creek and parts of Hog Island Inlet.

Hog Island Inlet. Because of past pollution, the inlet has not been safe for swimming or fishing.

Cleanup of this Great Lakes Legacy Act site, a joint project of GLNPO and WDNR, began in July 2005, and the sediment cleanup portion was completed in November 2005. The banks of the creek and inlet were landscaped to prevent erosion. The result will be a healthier habitat for fish and other aquatic life, and the inlet will be safe for recreation.

Approximately $4.1 million of the funds to pay for this project were provided by the Great Lakes Legacy Act. The act authorizes $270 million over a five-year period to clean up contaminated sediment in Great Lakes Areas of Concern. The State of Wisconsin and other parties are providing 35 percent of the project's cost, or about $2.2 million. These are nonfederal matching funds required by the Legacy Act.

Close-up view of the contaminated sediments being removed from Hog Island Inlet.

Remediation of Contaminated Sediments: Surveys conducted in recent years have provided a great deal of useful information about local sediment contamination.

At the St. Louis River/Interlake/Duluth Tar Site in the St. Louis River AOC in 2006, a 2,000-foot long sheet pile wall was placed around the eastern portion of Stryker Bay, and a cap of sand sandwiching a geo-textile mat was placed within the enclosed area. A rock dike with a clay liner was constructed to cut-off Slip 6 from the river. In 2007, a water filtration plant was constructed to treat water from the Contained Aquatic Disposal (CAD) facility. The CAD received contaminated sediments from Stryker Bay and other areas where the dredging of materials containing PAH levels over 13.7 ppb had occurred. Activities slated for 2008 include dredging a small segment of the St. Louis River, removing the sheet pile wall, and capping the remaining area. Restoration activities scheduled for 2009 will focus on dredging around Tallas Island (www.slridt.com).

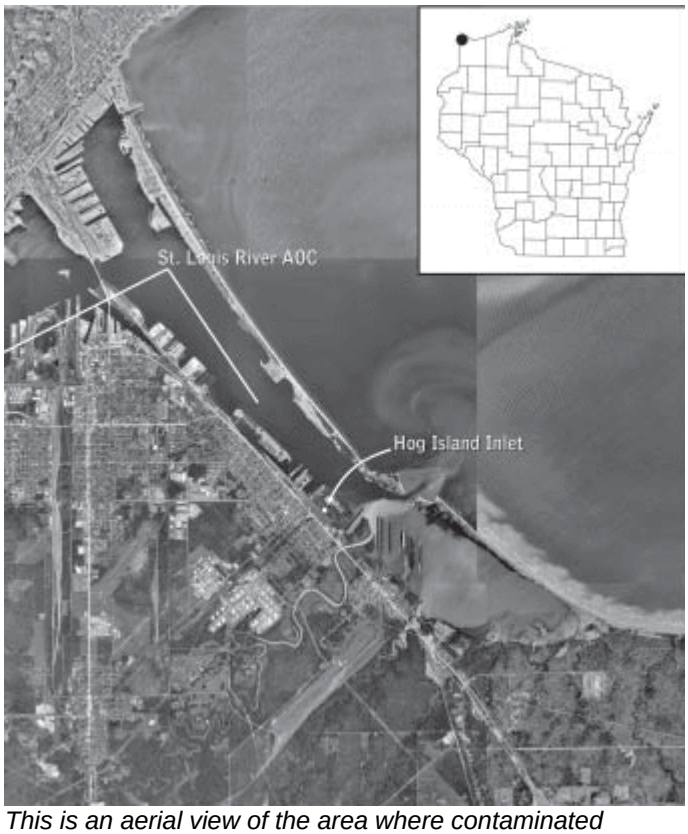
In Minnesota, clean ups are underway at the two state Superfund sites on the river (USX and Interlake). Each site has a community work group.

In Wisconsin, WDNR and Murphy Oil are working together to clean up the Newton Creek System, which includes Hog Island Inlet. This is a staged clean-up process that began with Murphy Oil building a new waste water treatment plant. In Fall 1997, Murphy Oil began cleaning up the headwaters of Newton Creek.

Pollution Prevention:
The RAP helped Oliver, Wisconsin, solve its wastewater treatment problems. Oliver and the Western Lake Superior Sanitary District (WLSSD) in Duluth agreed to lay a pipe under the river and treat Oliver's waste at WLSSD.

Water quality continues to improve, due to pollution prevention efforts, better pre-treatment programs and new stormwater management activities, including efforts to control storm-related "inflow and infiltration," which has caused sewage bypasses in Duluth, with untreated sewage flowing directly into Lake Superior.

MPCA, WDNR, and WLSSD are encouraging pollution prevention in outreach programs aimed at citizens and businesses.



This is an aerial view of the area where contaminated sediment and soil were removed from Newton Creek and Hog Island Inlet.

Habitat Protection and Improvement:
In 2002, the Lower St. Louis River Habitat Plan was completed. The CAC worked with several partners from city, county, state, and federal agencies and entities on this document. The Plan is being used to protect and restore the river. The plan classifies specific areas of the entire estuary into habitat types and recommends what actions are needed to restore, protect or enhance the river. The Plan has been embraced by all levels of government and by other groups and organizations. Most recently it was a basis for the part of the remediation of a Superfund site cleanup located in the river at Stryker Bay on the Minnesota side of the river. Recommendations in the Habitat Plan were also used in the Great Lakes Legacy Act contaminated sediment cleanup site on the Wisconsin side, Hog Island Inlet. (See above.)

Through a grant from US EPA GLNPO, the University of Minnesota - Natural Resources Research Institute applied Great Lakes Environmental Indicator data to the AOC to establish ecotype reference sites for six near-shore ecotypes identified in the St. Louis River Habitat Plan. These reference sites were then field-truthed, and vegetative assessments were performed.

GLNPO led a design process for a restoration master plan at Hog Island. A multi-agency, stakeholder-driven collaborative effort defined specific measures for restoring ecological processes and key habitats within Hog Island and Newton Creek, providing a template for how restorations can occur throughout the Great Lakes watershed.

The RAP was instrumental in the creation of WDNR's St. Louis River Streambank Protection Project, upstream of Oliver, which purchased 6,900 acres, including shorelands bordering five miles along the St. Louis River and 13 miles along the Red River and its main tributaries. The project includes most of the Red River watershed, which is characterized by steep slopes and highly erodible red clay soils.

The St. Louis River Board developed an even larger protection project along the St. Louis, Cloquet, and Whiteface River (all in the St. Louis River watershed). Some 22,000 acres were acquired and transferred to the Minnesota Department of Natural Resources.

Bio-control is being used on purple loosestrife infestations in wetlands on both the Minnesota and Wisconsin sides of the lower estuary.

Current Projects and Outlook

See Priority Action Items in the St. Louis River AOC for a look at current projects and what the RAP partners hope to accomplish in the near future.

RAP-Related Publications

- Wisconsin Proposed Delisting Targets, Short Elliot Henderson for Wisconsin Department of Natural Resources, October 2007.
- Hog Island and Newton Creek – Draft Ecological Restoration Master Plan, Biohabitats for Environmental Protection Agency (GLNPO) and Douglas County, WI, April 2007.
- St. Louis River AOC Sediment Quality Management Plan, Emmons and Oliver Resources, Inc. for MN Pollution Control Agency, September 2005.
- Natural & Cultural History of the Lower St. Louis River: On-the-Water Guide for Canoeists, Kayakers & Boaters. St. Louis River Citizens Action Committee, August 2001.
- Historic Reconstruction of Property Ownership and Land Uses along the Lower St. Louis River. St. Louis River Citizens Action Committee, October 1999.
- Lake Superior/Duluth-Superior Harbor Toxics Loading Study. Minnesota Pollution Control Agency, September, 1999.
- Issue Paper Concerning Wet Weather Flow Issues: Sanitary Sewer Overflows Developed For the WLSSD Effluent Quality Master Plan Project. Western Lake Superior Sanitary District, 1999.
- Wisconsin's Lake Superior Coastal Wetlands Evaluation: A Report to the Great Lakes National Program Office, US EPA. Wisconsin DNR PUB ER-09599, 1999.
- Lake Superior Basin Water Quality Management Plan. Wisconsin DNR PUBL-WT-278-99-REV, March 1999.
- Lake Superior Lakewide Management Plan 2000. Lake Superior Binational Program, April 2000.
- Erosion and Sedimentation in the Nemadji River Basin. Natural Resources Conservation Service and U.S. Forest Service, 1998.
- Newton Creek System Sediment Contamination Site Characterization Report. Wisconsin Department of Natural Resources, December 1995.

More information on these publications can be obtained by contacting the individuals listed in the St. Louis River AOC Contacts section below.

Community/Local RAP Group Involvement

The St. Louis River Citizens Action Committee, or SLRCAC, consists of people of all ages and walks of life who work together to improve the St. Louis River. The independent nonprofit organization incorporated as a 501(c)(3) organization in 1996 to encourage implementation of the RAP and restoration of the AOC. The SLRCAC has a successful track record of bringing parties together to implement projects and facilitate multi-jurisdictional strategies for the AOC. A prime example is the Lower St. Louis River Habitat Plan (2002) developed by the SLRCAC with federal, state, tribal, and local resource management professionals and citizens. This plan is used extensively by the resource management agencies and local communities.

The St. Louis River System RAP has been recognized since its inception for its high level of citizen participation and community involvement. Hundreds of individuals, representing a broad cross-section of the community, have worked together to identify problems, develop and/or implement recommendations and

encourage environmental stewardship. They have provided crucial support for the RAP process and helped to improve the health of the St. Louis River ecosystem.

Just as the St. Louis River and estuary are important components of the Lake Superior basin ecosystem, the RAP activities are important to the Lake Superior Binational Program and the Lakewide Management Plan. RAP actions, from contaminated sediment cleanup to habitat protection, pollution prevention, and community involvement are all important to meet the Lake Superior basin goals.

Public Outreach and Education:
River Watch Program in Minnesota and Water Watch Program in Wisconsin have involved numerous area teachers and school children in hands-on, field-oriented, water-quality education and monitoring. These efforts have also included a spring River Congress, annual stormdrain stenciling and several art/science collaborations.

The RAP helped get signs posted to warn recreational users about contaminated sediments at Stryker Bay in Duluth and at Hog Island Inlet in Superior.

The SLRCAC has organized clean ups at the Connors Point Recreation Area and Wisconsin Point in Superior as well as Grassy Point and Erie Pier in Duluth.

The sign at the entrance to the Newton Creek/Hog Island Inlet Great Lakes Legacy Act Cleanup.

Partners and Stakeholders

- 1854 Authority(www.1854authority.org)
- Arrowhead Regional Development Commission (www.ardc.org)
- City of Duluth, MN (http://www.ci.duluth.mn.us)
- City of Superior, WI (www.ci.superior.wi.us)
- Fond du Lac Tribe (www.fdlrez.com)
- Harbor Technical Advisory Committee
- Lake Superior Binational Program
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- Minnesota Sea Grant
- River Watch Project
- River Quest
- St. Louis River Citizens Action Committee
- The Nature Conservancy
- U.S. Army Corps of Engineers
- US EPA
- U.S. Fish and Wildlife Service
- Western Lake Superior Sanitary District (www.wlssd.com)
- Wisconsin Department of Natural Resources
- Wisconsin Sea Grant

St. Louis River AOC Contacts

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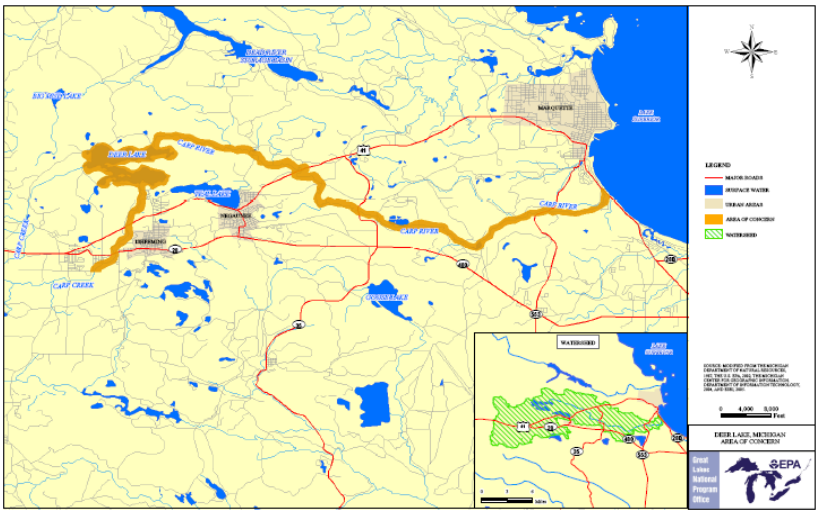
A.2.2.C Deer Lake

Deer Lake Area of Concern



Deer Lake AOC Boundary Map

Background

Deer Lake is an approximately 1,000-acre impoundment in central Marquette County near Ishpeming, Michigan. The Area of Concern (AOC) boundary is considered to be Carp Creek from the discharge point of the old Ishpeming Township A Wastewater Treatment Plant, flowing downstream to the south basin of Deer Lake and includes Deer Lake and the Carp River flowing downstream through the dam from the north basin of Deer Lake about 20 miles to Lake Superior near Marquette. International Joint Commission, Environmental Protection Agency, and Michigan Department of Environmental Quality guidance materials describe that AOCs should be considered on a watershed basis. In most AOCs the watershed is considered a potential source area to that AOC. Contaminant sources to Beneficial Use Impairments (BUIs) that are identified within the watershed, even if not located within the defined AOC boundaries, would be given every consideration for remedial actions, when meeting all federal and state guidance.

Early fall in South Basin looking toward the narrows.

In 1981 fish in Deer Lake were discovered to have concentrations of mercury that exceeded the 1.5 mg/kg "ban on total consumption" by the Michigan Department of Community Health (MDCH). Mercury concentrations in Deer Lake fish also exceeded the mercury levels found in fish from similar lakes at that time.

There were two known industrial sources of mercury to the Deer Lake AOC. The first industrial use of mercury occurred in the 1880s in the northwestern portion of the Deer Lake AOC watershed by the Ropes Gold and Silver Company. Liquid (elemental) mercury was used in an amalgamation process to recover gold from ore between 1882 and 1897 at a location west of the north basin of Deer Lake. Mine tailings were submerged as successive dams were built.

The second industrial use of mercury occurred in the Carp Creek watershed. Mercury salts were used in iron ore assays in laboratories of The Cleveland-Cliffs Iron Company (CCIC). Mercury-containing wastewater from the CCIC laboratories was discharged to the City of Ishpeming wastewater treatment system between 1929 and 1981. During that time the City wastewater treatment plant discharged primary-treated municipal wastewater into Carp Creek which then flows into the south basin of Deer Lake.

Sunset view of the South Basin of Deer Lake looking toward the narrows.

From 1929 to 1963 all wastewater generated in the City of Ishpeming and Ishpeming Township was discharged without treatment through combined sanitary and storm sewers into Carp Creek. From 1964 to 1985 three Primary Treatment Plants treated municipal wastewater before it was discharged into Carp Creek. In 1970 these primary treatment systems were determined to be inadequate by the State Water Resources Commission. The combined sewers were separated into sanitary sewers and storm sewers by 1985. An Enhanced Secondary Wastewater Treatment Plant replaced the three Primary treatment plants in April 1986. The new wastewater treatment system significantly decreased nutrient loadings into Deer Lake; for example, phosphorus loading decreased by 86 percent.

Beneficial Use Impairments

Three beneficial use impairments (BUIs) have been identified for the Deer Lake AOC. These include:

Deer Lake Beneficial Use Impairments

- Restrictions on fish and wildlife consumption
- Bird or animal deformities or reproduction problems
- Eutrophication or undesirable algae

Restrictions on Fish and Wildlife Consumption

Some fish sampled from Deer Lake contain mercury concentrations that exceed the 1.5 mg/kg “do not consume” threshold that has been established by the MDCH. Currently, there is a possession ban for all fish from Deer Lake. There is no fish consumption advisory for brook trout in Carp Creek and the Carp River, however, consumption of other species in these streams is not advised. There are no consumption advisories for wildlife in the Deer Lake AOC.

The matrix below shows the history of the Deer Lake, Carp Creek, and Carp River Fish Consumption Advisories. These advisories are all based on methylmercury found in fish tissue. Please review the Michigan Department of Community Health website at http://www.michigan.gov/mdch/1,1607,7-132-2944_5327-13110--,00.html before consuming fish from Michigan waters.

YEAR	Deer Lake	Carp Creek	Carp River
1981	No Consumption	No Advisory Issued	No Advisory Issued
1982 – 1995	No Consumption of Any Species		
1996 – 2000	No Consumption	Brook Trout Unrestricted / All Other Species-No Consumption	
2001 – 2006	No Consumption	• Brook Trout-Restricted • All Other Species-No Consumption	• Brook Trout-No Restrictions • Northern Pike-Restricted • All Others Species-No Consumption
2007	No Consumption	• Brook Trout & White Sucker-Restricted • All Other Species-No Consumption	• Brook Trout & White Sucker-No Restrictions • Northern Pike-Restricted • All Other Species-No Consumption

Bird or Animal Deformities of Reproductive Problems

Bald eagles maintained a nest at Deer Lake between 1963 and 1980, but did not successfully rear young during that time. Eagles were documented to be reproducing successfully again beginning in 1998.

Eutrophication or Undesirable Algae

Deer Lake was characterized as eutrophic (nutrient-rich) by the U.S. Environmental Protection Agency (US EPA) during a national lake survey in 1972. A 1974-75 study by Northern Michigan University concluded that Deer Lake was hypereutrophic (excessively nutrient-rich). Dissolved oxygen (DO) concentrations have been used to assess and monitor the trophic (nutrient) status of the AOC.

Delisting Criteria/Restoration Targets

The Deer Lake AOC Public Advisory Council has requested that the State of Michigan and the US EPA begin the delisting process for the AOC. An AOC Technical Committee was developed comprised of staff from state and federal agencies and the PAC's technical committee. The technical committee determined to use delisting criteria based on the January 2006 Guidance for Delisting Michigan's Great Lakes Areas of Concern document to understand the current status of the BUIs identified for this AOC. This investigation has resulted in the development of BUI Removal documents for the Eutrophication and Reproduction BUIs (currently in the review process outlined in the Guidance). The technical committee is still conducting investigations related to the Fish Consumption BUI.

RAP Development and Status

A Remedial Action Plan (RAP) for Deer Lake Area of Concern was published by the MDEQ in 1987. The Deer Lake RAP Update is currently in draft form and will be used as the basis for the Deer Lake Delisting Determination Document.

Significant RAP Milestones

As described in the original 1987 RAP, several restoration milestones were achieved prior to the AOC listing process. In addition, many more milestones have been achieved since the RAP was published. The 2008 Deer Lake AOC RAP Update will outline all of the remedial actions and milestones implemented in this AOC since the 1987 Deer Lake RAP (currently in MDEQ Review Process).

A loon swimming during Autumn; from Fred Minnich's Wildlife Survey conducted July 2004-June 2005.

Significant recent activities include:

- **2007** – MDEQ and the PAC Technical Committee completed an assessment of the Eutrophication or Undesirable Algae BUI and concluded that the Deer Lake AOC had recovered from hypereutrophication through processes put in place prior to the 1989 RAP document. The PAC Technical Committee recommended that the Eutrophication or Undesirable Algae BUI be removed based on the states Delisting Guidance criteria (MDEQ, 2006a)
- **2007** – MDEQ and the PAC Technical Committee completed an assessment of the Bird or Animal Deformities or Reproduction Problems BUI, which was directly related to former perceived causes of the bald eagle reproductive failures. The committee concluded that the Deer Lake AOC eagle population had been effected by historic DDT, and these sources had either been controlled through regulatory actions by the federal government or the sources were outside of the basin or not under the direct control of the state. The PAC Technical Committee recommended that the Bird or Animal Deformities or Reproduction Problems BUI be removed based on the states Delisting Guidance criteria.
- **2006** – Amendments to the Consent Judgment (CJ) for Deer Lake between CCIC and the state were completed, which set management, monitoring, and other criteria for Deer Lake. This CJ is available from the MDEQ-Water Bureau.
- **2005 & 2006** – Winter monitoring by MDEQ (2005) and CCIC (2006) showed additional improvements in dissolved oxygen (ELM, 2005). Dissolved oxygen concentrations were sufficient to support fish growth and survival to a depth of 25 feet.
- **2005** – Manolopoulos and Hurley, University of Wisconsin, data showed that chlorophyll a concentrations in the reservoir had decreased significantly since 1972. Data showed that the sediments were still heavily contaminated with total mercury and methylmercury. It was also observed that the lake still stratifies in both basins.

RAP Implementation

Recent Progress and Achievements

- **2007** – MDEQ and the PAC Technical Committee completed an assessment of the Eutrophication or Undesirable Algae BUI and concluded that the Deer Lake AOC had recovered from hypereutrophication through processes put in place prior to the 1989 RAP document. The PAC Technical Committee recommended that the Eutrophication or Undesirable Algae BUI be removed based on the states Delisting Guidance criteria (MDEQ, 2006a)
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- **2006** – The AOC Technical Committee was developed with representatives from the Michigan Department of Environmental Quality, Michigan Department of Natural Resources, the Deer Lake PAC, and US EPA to investigate BUI status and potential for delisting individual BUIs or the entire AOC.
- **2005** – The Deer Lake PAC requested that the State of Michigan and US EPA begin the AOC delisting process for the AOC based on the 2006 MDEQ Guidance for Delisting Michigan's Great Lakes Areas of Concern.

Eaglet in tree near nest on Deer Lake North Basin, hatched and fledged 2004; from Fred Minnich's Wildlife Survey.

Mink on Rocky shore; from Fred Minnich's Wildlife Survey.

Current Projects and Outlook

The Technical Committee has reviewed the status of the BUIs for the AOC as part of the request by the PAC to delist this AOC. The criteria used for this status assessment was based on the Guidance for Delisting Michigan's Great Lakes Areas of Concern. Based on this review, the committee has begun the documentation to remove the Reproduction BUI based on bald eagle productivity and the Eutrophication BUI. This review determined that the development of a Delisting Determination Document cannot move forward at this time until known sources of contamination driving the fish consumption BUI are controlled. Monitoring is required by CCIC under the Consent Judgment. Ongoing projects include:

- Ongoing investigations by MDEQ and US EPA, working in consultation with the PAC, to determine status of the fish consumption advisory. Activities include proposed fish tissue monitoring for 2008.
- Ongoing facilitations by MDEQ and US EPA to aid CCIC and the City of Ishpeming to resolve mercury loadings to Cliffs Shaft Mine via Partridge Creek and the city's stormwaters. After Partridge Creek exits the mine, it becomes a tributary to Carp Creek and contributes greater than 20 percent of the mercury load to Deer Lake.

RAP-Related Publications

- **2008** – MDEQ Deer Lake AOC 2008 RAP Update is currently in the MDEQ review process.
- **2006** – Amended Consent Judgment (CJ) completed between Cleveland Cliffs Iron Company and the state. CJ and related materials and fact sheets are available by contacting MDEQ-Water Bureau, Sharon Baker at 517-335-3310 or BakerS@michigan.gov.

- **2006** – Guidance for Delisting Michigan's Great Lakes Areas of Concern.
- **2002** – Draft RAP update developed by PAC, work continues on this document.
- **1999** – Updated AOC brochure produced.
- **1987** – Remedial Action Plan for Deer Lake Area of Concern completed.

Community/Local RAP Group Involvement

A Public Advisory Council (PAC) was formed for the Deer Lake AOC in 1997. The formation of the PAC was a very positive step, with strong community support from a large stakeholder base. The PAC has 21 voting members, plus three non-voting state agency representatives who serve in an advisory capacity. PAC membership represents a broad cross-section of interests, including:

- City of Ishpeming
- Cleveland-Cliffs Iron Company
- Education
- Environmental Organizations
- Fishing (2 members)
- Human Health Resources
- Lakeshore Residents (4 members)
- Local Businesses (2 members)
- Marquette County
  - Board of Commissioners
  - Drain Commissioner
  - Road Commission
- Native Americans
- Recreation
- Township of Ishpeming
- Wastewater Treatment
- Watershed residents at large

Additional Outreach Projects

- Yearly water quality monitoring provided by the PAC.
- Local community and PAC members continue monitoring Carp Creek to control beaver populations to maintain the coldwater fisheries by removal of beaver dams. PAC supplied waders to support these efforts.
- Ongoing volunteer stream bank, lakeshore, public access site, and island cleanup projects.
- Water quality signage related to fish consumption advisories maintained by PAC.
- Fish spawning bed established by PAC pass-through grant.

Partners and Stakeholders

- Deer Lake Public Advisory Council
- Michigan Department of Community Health
- Michigan Department of Environmental Quality
- Michigan Department of Natural Resources
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency, Great Lakes National Program Office

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Appendix E

Proceedings from Making a Great Lake Superior 2007: A Conference Linking Research, Education and Management

For the final presentation of the *Making a Great Lake Superior 2007* conference, John Austin of the Brookings Institute spoke about the economic benefits of restoring the Great Lakes basin.
Photo credit: Elizabeth LaPlante, US EPA.

Lake Superior Lakewide Management Plan 2008

Proceedings from Making a Great Lake Superior 2007: A Conference Linking Research, Education and Management

October 29-31, 2007
Duluth, MN

Summary

Planning for the *Making a Great Lake Superior 2007* Conference began in 2006, with the goal of bringing all the partners—researchers, educators, and managers—working on Lake Superior issues together to discuss the critical issues facing the lake. A workgroup was formed to help with the brainstorming, decision-making, and preparations for the event. Workgroup members included members of the Lake Superior Work Group, Task Force, Binational Program, Binational Forum and representatives from the Sea Grant Programs in Minnesota, Wisconsin, and Michigan. Minnesota Sea Grant led the conference preparations and functioned as the event planner. An Executive Committee, consisting of mayors, managers, industry officials and others involved with education, research, and management in Lake Superior, was established to help guide the workgroup. Various sub-committees were formed around particular issues such as communication and "green" conferencing.

Conference Goals

The overall conference goal was to work toward better integration of research, education, and management around Lake Superior so as to address those issues most critical to the lake. Issues selected included Areas of Concern, sustainability, toxic pollutants, non-point source pollution, water levels, watershed stewardship, human health, invasive species, habitat, fisheries, climate change and information management. Efforts were made to have equal numbers of talks on management, research, and education within each topic and to have balanced attendance at the conference from each of these audiences. To further the goal of integration, the main objective was to promote discussions on:

- Integrating research results into effective protection and restoration of Lake Superior;
- How management approaches and projects reflect priorities;
- The information needs of land and resource managers, and how this information could best be provided;
- The role of educators in ensuring that accurate information about Lake Superior is reaching the right audiences in the right way; and
- The role of citizen groups in protecting Lake Superior.

Several steps were taken to help achieve these objectives: ensure balance in the presentations between research, education, and management; schedule 30 minute breaks, an evening reception, and a banquet to allow for greater networking time during the conference; and schedule 90 minute workgroup sessions for researchers, educators, outreach staff, and managers to discuss issues, new ideas, and priorities within their group. Pre- and post-conference events were offered to attendees.

Topic Development

A team of "topic shepherds" was identified for each of the 12 main topics addressed at the conference. The topic shepherds, selected from experts in the field, were given the task of developing a plan for their session to include discussions on education, management, and research, while covering the most important and current issues under that topic. Topic shepherds were also responsible for encouraging other experts to present, recommending the abstracts to be accepted for their session, and organizing the talks within the session. Overall, the session presentations were balanced nearly equally between research (30 abstracts accepted), education (29 abstracts accepted), and management (34 abstracts accepted).

Attendee Characteristics

Over 440 people attended all or part of the conference, representing 72 communities in Canada and the U.S. Most participants were from Minnesota (187), Wisconsin (112), and Ontario (64), but with significant numbers from Michigan (28) and Illinois (17), and others from 10 additional states. Conference attendees were fairly equally distributed between land or resource managers (33%), educators (24%), and researchers (19%), with fewer local elected officials, non-profit organization representatives, consultants, and others. Attendees came from a variety of organizations, including universities (22%), federal and state/provincial governments (20% and 15%, respectively), non-profits and non-governmental organizations (9%), local governments (8%), K-12 educational institutions (7%), commercial/business/industry (6%), and tribes (5%), with 8% not listing an affiliation.

Getting the Word Out

Advertising and marketing of the conference was largely limited to electronic means. A conference website was developed and updated with new information as needed. The website also included an e-mail sign-up for conference updates, which grew to 198 contacts. Existing listservs, such as the Great Lakes Information Network (GLIN), and the e-mail networks of everyone involved in conference planning were used to spread the word about the call for abstracts, registration, and other conference information. Many participating organizations also included conference announcements in their newsletters and/or on their websites. No paid advertising was used. Nearly half of evaluation respondents indicated that they heard about the conference through electronic means, with another 36% hearing about the event through personal communications with another individual. Residents, educators, and researchers were slightly more likely to have heard about the event through electronic means, while land managers were evenly split between electronic and personal communication.

Public Involvement

Knowing that this event would be targeted toward those who have a professional interest in Lake Superior, some activities for the general public were scheduled to provide the public with opportunities to learn about the lake. Several events that were open to both conference attendees and interested members of the public were organized. For example, a kite-making workshop at the Great Lakes Aquarium was organized on the afternoon of October 28, 2007. This was led by

students and staff from Northland College. That same evening, collaborations with the non-profit organization Fresh Energy helped to bring polar explorer Will Steger to Duluth for an evening seminar on global warming. Mr. Steger was joined by several other speakers, including Dr. Lucinda Johnson from the Natural Resources Research Institute (University of Minnesota Duluth), who also co-chaired the climate change session at the conference. Monday evening (October 29, 2007), photographer Craig Blacklock gave a public presentation, using some of his newest art and video of Lake Superior, and spoke about the need for conservation along the coast. During the entire conference, an art room was open for public and participant use, featuring Lake Superior-themed art from over 24 regional artists, and screenings of 10 Lake Superior-related videos. All events were well-attended, with approximately 200 participants attending the global warming seminar.

Green Conference

From the beginning, it was agreed upon that the event would have the smallest impact on the environment possible. The conference environmental statement included aspects of waste management, using locally-grown and/or produced foods, and making the event carbon-neutral through minimizing energy requirements and purchasing offsets. This "green" approach affected many conference decisions, including the hotel chosen, menus, printing and advertising, and the conference venue.

The conference was held at the Duluth Entertainment and Convention Center (DECC), a leader in environmental stewardship. All food waste from the event was composted, everything that could be recycled was recycled, bulk containers were used in place of single-serving disposable packages for such things as sugar, cream, cream cheese, butter, fruit juice, and yogurt, and all surplus food from the meals and breaks was donated to the local food bank. The DECC sought out new suppliers for many food items served at the conference, in an attempt to use as many locally-grown or produced products as possible. In the end, of 84 menu items, 62 (74%) were locally grown or produced (within MN or WI). Of the 22 items (26%) that were not local, half were certified organic.

Carbon emissions from the event were estimated at 75 tons, covering travel of participants, materials used and produced for the conference, and energy required for food production. (Considering that locally-grown and produced foods were used as much as possible, it is expected that this number may be an overestimate but significant research is required to confirm this). Offsets totaling 75 tons are being purchased from Native Energy to build wind energy projects. As an additional carbon offset, but also to replace trees used for paper used at and in preparation for the conference, 300 trees and fencing for tree protection are also being purchased for the Flute Reed Partnership, a local watershed group in Hovland, MN, to plant in the spring of 2008.

Other steps were taken to reduce the overall impact of the conference. The hotel was chosen based on its distance to the conference center, the fact that it was connected directly to the DECC through the skywalk system in case of unfavourable weather, and because it had shuttles to and from the local airport. Bags and folders were not provided to participants, but publications of interest were available for those who were interested. A book of abstracts or list of attendees

were not printed for the event, but were made available online instead, along with the presentations. Attempts were made to organize carpools, and chartered buses, but these drew little interest. Prizes were offered for those who traveled the farthest distance under their own power, which led to bikers, walkers, carpoolers, roller skiers, and "scooterers". Participants were asked to bring their own nametags to the event, with additional prizes given to the most interesting nametags. Materials were made available onsite for those who forgot to bring a nametag.

Plenary Session Day One: Setting the Stage (October 29, 2007)

Each day of the conference began in plenary session, with day one setting the background for discussing the most the critical issues facing the lake. After a welcome from Duluth's Mayor Herb Bergson, U.S. EPA Region 5 Regional Administrator Mary Gade charged the participants to find ways to "protect, preserve, and maintain this international treasure," while working together across boundaries. The opening keynote speaker, G. Tracy Mehan III, the former U.S. EPA Assistant Administrator for Water and former director of Michigan's Office of the Great Lakes, spoke of the need to find new ways to address problems by looking for new partnerships across disciplines. He also advocated pursuing technical and social innovation so as to adapt to and mitigate a changing environment. He concluded with the thought that mitigating and adapting to climate change will require resilience in communities and technical, economic, and social improvisation to meet the challenges that arise.

Mr. Mehan's talk was followed by a panel offering perspectives on past and future states of Lake Superior. Mark Ebener, from the Inter-Tribal Fisheries and Assessment Program (Chippewa/Ottawa Resource Authority), described how the Lake Superior fishery has changed over time, while relating the effects of new species on the ecosystem. He also described how stormwater runoff has had, and continues to have, a big impact on the ecosystem. Dr. Deborah Swackhamer, with the University of Minnesota's Institute on the Environment, described the legacy of toxic contaminants in Lake Superior and how Lake Superior is different than the other Great Lakes. She described how our understanding of the lakes has changed over time, and the growing concern over many contaminants of emerging concern, such as fire retardants, pharmaceuticals, plasticizers, and personal care products. Dr. Swackhamer message concluded with the hope that we will learn from our past and carefully evaluate new chemicals before they are released into the environment. Dr. Carl Richards, from the U.S. EPA Mid-Continent Ecology Division, wrapped up the session with a discussion about the ongoing work to assess how the Lake Superior ecosystem is functioning and predictions about how it will change in the future. He also raised questions about whether the right things are being measured in the right way, and whether there is infrastructure in place to share this information effectively.

Day One Concurrent Sessions

Geographic Information Systems, Great Lakes Observing System, and Information Management

Tom Kralidis, with Environment Canada, kicked off the GIS session with a discussion of how the Open GIS Consortium (OGC) has changed how governments and other organizations use

spatial data. The session delved into internet applications and web feature service, online spatial data, and interactivity, with examples including the COASTAL GIS and Lake Superior GIS Projects, the Lake Superior Circle Tour, COASTWATCH, and GLIFWC-MAPS.ORG. Critical needs identified include addressing long-term funding and management, and acquiring new data across the basin. Extension education and outreach using GIS data, and making data more readily available for use by the public and decision-makers were discussed as key opportunities that should be pursued.

Sustainability

The Sustainability Session began with a discussion on a paradigm shift in economic development that is driven by sustainability. This "Fourth Wave" offers a new lens through which individuals and public, private, and non-profit organizations can look through during their decision-making processes. Measuring sustainability was featured during the session as well, with Martin Nantel of Environment Canada discussing the Binational Program's Sustainability Framework, and Sarah Brace (Puget Sound Partnership) describing how Puget Sound uses ecosystem indicators to describe "What is Happening?", "How Does This Affect Me?", and "What Can I Do?". Speakers also described several local initiatives and opportunities for sustainable development, such as the Sustainable Chequamegon Initiative, focusing on creating a sustainable regional community. The importance of moving toward a sustainable future was a common theme throughout the session, with serious ramifications to our environment, economy, and social institutions if this isn't considered.

Non-Point Source Pollution/Stormwater Runoff

Presentations in this session were varied and included nitrate levels in Lake Superior, interactive real-time water quality data visualization, regional stormwater education partnerships, managing woodlands, constructing rain gardens, sand beach dune protection and restoration, and watershed management. Each presentation related directly to how Lake Superior lands are being used, how this use is affecting Lake Superior, and what can be done to reduce these impacts, either on private lands or in the communities. Best Management Practices (BMPs) are vital to reducing these impacts, but they must work on clay and shallow bedrock soils (which requires effective assessment and monitoring of these BMPs), and they must be maintained (which requires funding). Education, in particular hands-on approaches, can be very effective at helping youth and the public understand how they can help protect Lake Superior. Watershed approaches, as employed by the Regional Stormwater Protection Team and used in the Marengo River Watershed Test Case, can be effective from both educational and management perspectives.

Toxic Pollutants

As highlighted in the plenary session, toxic contaminants continue to pose threats to humans, wildlife, aquatic species and other organisms in the Lake Superior basin. Contaminants of emerging concern, endocrine disruptors, and mercury were highlighted in this session, as well as monitoring, reduction strategies, and community activities to deal with these and other contaminants. Some good news was reported: the levels of substances of emerging concern, while increasing in Lake Superior, are lower than in the other Great Lakes, and community level

activities to improve access to recycling and proper disposal of household hazardous wastes are occurring in many communities. Difficult challenges still exist, however, with little community ability and activity to deal with toxic contaminants in the numerous small communities all around the basin. Important new research shows that effluent effects on reproduction in Lake Superior fish are similar to the effects of fish exposed to high levels of female hormones, i.e., reproductive and developmental problems.

Fisheries and Aquatic Ecology

Given that there are entire conferences focusing on the Lake Superior fishery, this session focused on key elements of the ecosystem, and some of the major efforts occurring around the lake to manage, monitor, and rehabilitate the fishery. Dr. Mary Balcer (UW-Superior) started the session by discussing Lake Superior's lower trophic levels, the organisms that provide the major source of food to support fish populations in the lake. While other Great Lakes are experiencing dramatic declines in these organisms, Lake Superior's populations have remained relatively stable, potentially due to the inability of zebra or quagga mussels to thrive in the deepwater portions of the lake. The nearshore zone of the lake was discussed in detail as well, a critical part of the lake which comprises less than 18% of the area but is a critical area of productivity and which has been the focus of most commercial and recreational fishing pressure. This area is recovering from past food web perturbations and moving toward a more natural state, but the existence of invasive species will likely prevent full recovery. States, tribes, and federal governments are active in fisheries work on Lake Superior, with significant efforts to rehabilitate brook trout, walleye and lake sturgeon populations. Key legislation such as the *Canadian Species At Risk Act,* which protects rare or endangered species in Lake Superior, such as the kiyi, shortjaw cisco, blackfin cisco, deepwater sculpin, and lake sturgeon, has been passed, and significant work has occurred on engaging the public in making fisheries management decisions.

Water Levels and Withdrawals

During 2007, Lake Superior reached all-time record low-water levels. Speakers in this session shed light on historical lake levels, how water levels are managed in the lake, and impacts of low water levels to wetlands and shipping, in particular. Since 1921, outflows of Lake Superior have been completely regulated by the international Lake Superior Board of Control. Current targets are aimed at keeping Lake Superior and Lakes Huron and Michigan within historic ranges, while preventing Lake Superior from rising above, or falling below, certain limits. Full control of Lake Superior water levels is not possible, however, since runoff, precipitation, and evaporation cannot be controlled or accurately predicted. Climate change scenarios generally predict lower water levels throughout the Great Lakes (though uncertainty exists); dredging cost estimates to maintain shipping channels at these predicted levels range from $75 to $125 million, but specific limits exist on dredging depths, and other infrastructure and dredge spoil issues remain. Dr. Richard Stewart (University of Wisconsin-Superior) outlined these issues, and how the Great Lakes shipping community can adjust to these changes. Wetlands are also affected by even small lake level changes, but Doug Wilcox (U.S. Geological Survey) presented information showing how coastal wetlands along Lake Superior have adapted to fluctuating water levels, and even require fluctuations to maintain a diverse range of habitats that can support numerous species of fish and wildlife. In concluding this session, William Werrick described the recently

commenced International Upper Great Lakes Study, as initiated by the International Join Commission, to "investigate improvements to the regulation of the outflow of Lake Superior given the impacts regulation may have on water levels, flows, and consequently affected resources throughout the upper Great Lakes system." The final report is expected in 2012.

Plenary Session Day Two: Climate Change in Lake Superior (October 30, 2007)

From stormwater to human health, each and every topic discussed at the conference was affected to some extent by climate change. This session was organized to help participants understand the effects of climate change on the Lake Superior ecosystem from a broad perspective. More detailed discussions were saved for the climate change concurrent session following the morning plenary. Dave Phillips of Environment Canada described the changes being seen from a meteorological perspective, and discussed the social issues about the perception of and adaptation to climate change. Mr. Phillips ended with a call for action to reduce carbon emissions and adapt to a changing climate, while maintaining a message of hope that what needs to be done can be done. Linda Mortsch of Environment Canada described the latest results from the United Nation's International Panel on Climate Change (IPCC), and what climate change means for the Lake Superior basin. According to the IPCC, "warming of the climate system is unequivocal…" and requires a balanced response, including mitigation to reduce emissions and adaptation to respond to the impacts to infrastructure and ecosystems. Impacts in the Great Lakes basin, predicted and observed, include warmer air temperatures, more precipitation, less snowpack, more intense rain events, greater evaporation, warmer water temperatures, changes in thermocline development, and reduced winter ice cover, among others. Past climate is no longer a reliable guide to the future, according to Ms. Mortsch; climate change information needs to be mainstreamed into planning and decision-making. Dr. Joel Scheraga of the US EPA focused on the necessary adaptations to climate change. He also focused on the need for cities, municipalities and others to incorporate climate change into planning and decision-making, and to take adaptation actions now. US EPA is currently undertaking a major assessment of the impacts of climate change on the nation's water quality.

Day 2 Concurrent Sessions

Areas of Concern

Lake Superior has eight Remedial Action Plan (RAP) Areas of Concern (AOCs): three in the U.S. – St. Louis River shared by Minnesota and Wisconsin, and Torch Lake and Deer Lake in Michigan; four in Canada (Ontario) – Thunder Bay, Nipigon Bay, Jackfish Bay, and Peninsula Harbour; and one binational AOC – the St. Marys River. The AOCs are in different phases of planning, assessment, and implementation of remedial actions. This session emphasized four common priority themes across the AOCs: contaminated sediment; habitat degradation; community engagement; and delisting criteria/beneficial use impairment (BUI) assessment. Speakers presented on contaminated sediment assessment and management issues/processes; fish and wildlife habitat assessment and restoration; community engagement processes, including both Public Advisory Committee/Council perspectives and those of other stakeholders; and delisting criteria/BUI assessment processes. Case studies highlighted the Thunder Bay, St. Marys River, and St. Louis River AOCs' public involvement and participation.

Watershed Stewardship

Watersheds provide a geographically-defined, ecologically-based unit for managing water quality and associated natural resources. In addition, watersheds are a logical unit for addressing many types of human activities and impacts. Speakers in this session described their educational programs to help landowners, local officials, students, and teachers understand watersheds and how they function, and help them make decisions to protect water resources. Dr. Ron Sundell (Northern Michigan University) focused on the importance of communication between researchers, educators, and resource managers around the lake, and he proposed developing a collaborative strategy to link the various institutions around Lake Superior, in an attempt to foster greater dialogue and communication.

Human Health

The Human Health session included beach monitoring and sources of *E. coli*, amphibole mineral fiber issues, fish consumption advisories, and rip currents. Some highlights include the benefits of eating whitefish from Lake Superior, given their relatively low level of contaminants and high amounts of beneficial omega-3 fatty acids, and the information shared on how to identify, avoid, and escape rip currents. One particularly interesting proposal was the development of a cisco and whitefish fishery, which would benefit the tribes and provide a healthy alternative fish source to the market. The challenge of communicating health risks without resulting in a complete avoidance of the behavior was a critical point of discussion—fish consumption, swimming with the possibility of rip currents or *E. coli* all present as risks to the "user," even though the risks are low. There is a need to ensure that messages are presented accurately, so that citizens take the appropriate steps to minimize risks, but don't become so overly fearful that they avoid fish consumption or swimming altogether.

Habitat Conservation and Species Management

This topic area included a wide variety of presentations relating to terrestrial and aquatic plants, animals, and their habitats. The session addressed issues relating to status and trends, along with associated inventory and monitoring efforts and needs, research and management results and case studies, and educating students, the public, and decision-makers about habitat and species to ensure that decisions now and in the future are informed by knowledge about these issues. Three key messages regarding public-private partnerships emerged from the session: government cannot do it all alone; landowners need to be in the information loop so they understand what's going on and their permission must be sought for any actions that affect their properties; and local officials must be made aware of activities in their communities. Educational needs include a desire to make presentation materials such as those used during this session available for educators, and the value in having researchers come to classrooms to describe their research to students.

Invasive Species

Presentations focused on the history, ecology, economic impacts, and control of invasive species in Lake Superior. In the lake, 31 plants, 25 fish, 22 invertebrates, and 9 diseases have been discovered that are not native, with 55% of invasive species being introduced unintentionally. Invasive species have been introduced in a variety of ways: 36% in ballast water, 22% through cultivation, and 14% were stocked. Unfortunately, the rate of introduction has been steadily increasing in the past 30 years, from 0.7 per year to 1.8 per year. Sea lamprey and smelt are the two most significant invasive species in Lake Superior, but others are causing ecological harm as well. New technologies are helping with control; pheromones are being explored for use in controlling sea lampreys. The economic cost of invasive species in Lake Superior is significant. Speakers listed public education as a priority, with the suggestion that education is more important than regulations in controlling invasive species introductions. Suggested management implications included using climate change information in new aquatic invasive species policies, and addressing all mechanisms of introduction.

Climate Change

The first half of this session described specific impacts of climate change in the region, followed by presentations addressing adaptation and mitigation efforts. Ice cover on inland lakes has decreased in past decades as winter temperatures have increased; earlier ice breakup and later ice-on dates have been documented on lakes around the region. Water temperatures in Lake Superior have also warmed in the past decades, and this trend was shown to be closely linked to ice cover on the lake. Phytoplankton and amphibian populations may also see changes under warmer climates. Darryl Matson described the City of Thunder Bay's efforts to mitigate climate change through energy reduction, energy conservation, and recycling. Al Douglas described how communities can assess their vulnerability to climate change and develop adaptation plans, and Cindy Hagley (University of Minnesota Sea Grant Program) described *A View From the Lake*, an educational program that focuses on climate change, discussing how the message can be shaped to help participants understand the importance of both mitigation and adaptation.

Facilitated Workgroups Results

At the conclusion of the concurrent sessions, 90-minute workgroup sessions were held for each of the conference's target audiences: researchers, land or resource managers, outreach and public education, and K-12 educators. Each session was designed to build off of the information presented at the conference up to that point, and to give each of these separate audiences a chance to discuss the important pieces they had picked up, and share any needs, gaps, or opportunities that they see.

Plenary Session Day Three: Next Steps, Sustainable Communities and Economics (October 31, 2007)

The final day commenced with leaders from each facilitated workgroup sharing the main points of their discussions the prior day. David Ullrich, Executive Director of the Great Lakes and St. Lawrence Cities Initiative, talked about his work with Great Lakes cities' mayors to protect and restore the Great Lakes. He then introduced a panel of local government representatives from the Cities of Duluth, Bayfield, Superior, and Thunder Bay, and Fond du Lac Band of Lake Superior Chippewa. Each speaker shared thoughts on how their community is attempting to work towards sustainability and protect Lake Superior. It is clear that each community recognized the importance of protecting Lake Superior, and each has taken important steps to this end.

Figure E-1. David Ullrich, Executive Director of the Great Lakes and St. Lawrence Cities Initiative welcoming Lake Superior mayors, tribes and local elected officials at the MAGLS conference. Photo credit: Elizabeth LaPlante, US EPA.

John Austin, of the Brookings Institute, provided the final presentation, discussing the economic future of the Great Lakes. According to Mr. Austin, The Great Lakes region has unique attributes that really matter in today's economy: an educated population, transportation infrastructure, fresh water, and natural attributes that are amazingly valuable in today's economy. Being on the water is one of the engines of today's economy: people want to be near water. Waterfronts, transit and transport, historic buildings, urban streets, and civic and cultural institutions are all amenities that young professionals want in the places they live; our older industrial cities have (or can have) all of these. Economic analysis of the Great Lakes region found that if the main parts of the Great Lakes Regional Collaboration (GLRC) Strategy were accomplished, including fixing sewer overflows, protecting wetlands, and cleaning up all AOCs, at a current cost of $26 billion, the economic benefit would be $80-100 billion for the region. Mr. Austin recommends the following blueprint for renewing the Great Lakes region: growing the talent our nation needs to compete in the world, fund the research and development to create new, clean, and sustainable technologies, sustainably develop the "freshwater coast" by following up on the GLRC, developing the infrastructure such as transit and urban housing needed for this renewal, fuel the binational Great Lakes economy, initiate universal pensions and health care, and provide workforce training and encourage labor adaptability.

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Appendix F

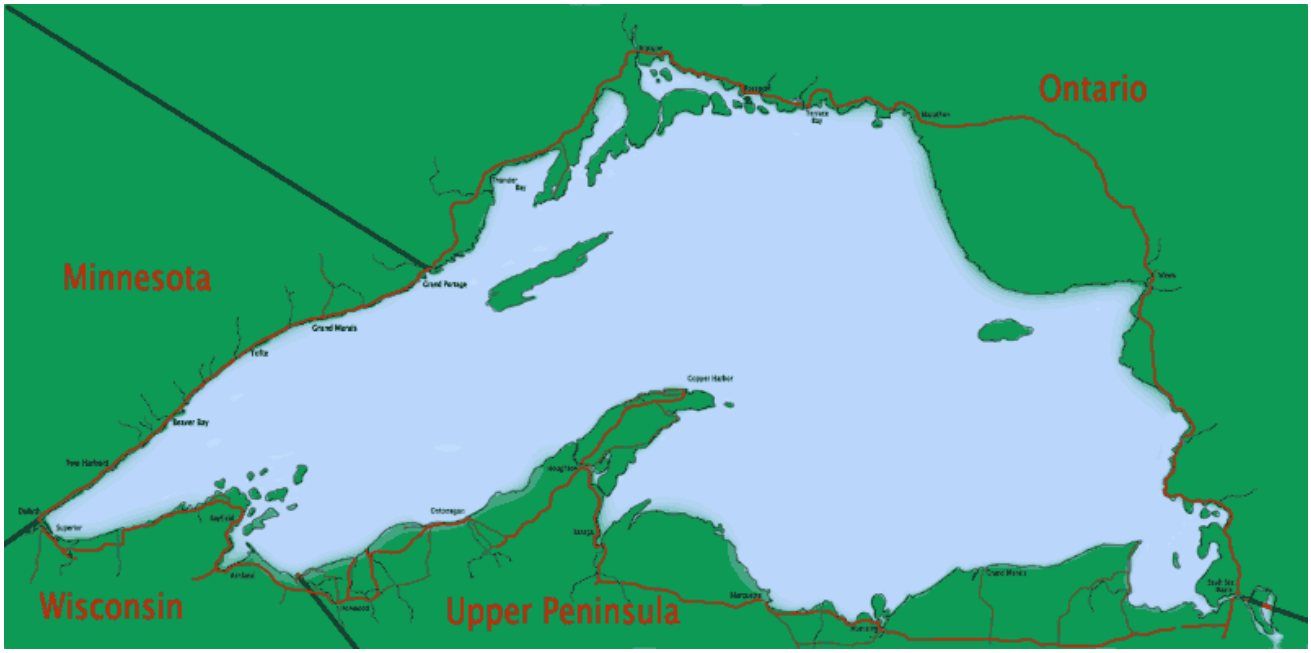
Making A Great Lake Superior Conference 2007 Evaluation Findings

Polar Explorer Will Steger and Minnesota Governor Tim Pawlenty
at a news conference during the *Making a Great Lake Superior 2007* conference.
Photo credit: Dave Ballard, UMD.

Lake Superior Lakewide Management Plan 2008

Making A Great Lake Superior Conference 2007

Evaluation Findings



February 6, 2008

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SUMMARY OF OUTCOMES

Making A Great Lake Superior Conference was held in Duluth, Minnesota, from October 29 through October 31, 2007, with 444 registered participants. Four hundred and two (402) with valid email addresses were invited to complete an electronic survey and 70% (281) did so. This represents a robust response rate. Data analysis supports the following outcomes.

Increased Knowledge of Lake Related Issues

Many survey respondents said that their knowledge about Lake Superior issues increased "somewhat" (55%) or "a lot" (32%) as a result of attending the conference. Those with "low" or "very low" prior knowledge tended to say that their knowledge increased "a lot".

Large Numbers Used or Anticipated Using Information

Eighty-six percent said that they had already used or foresaw using information from the conference. Some examples of use, based on comments, were collaboration with contacts made, using information when teaching, and for media and publications.

Mixture of Lake Researchers, Educators, and Managers Attended

A third of the respondents were from a government or private land or resource management position. Educators made up about a quarter and almost 20% were lake related researchers.

High Levels of Networking

Almost 60% reported that they networked at least 5 times or more at the conference, and approximately a third networked 3 or 4 times. Networking was defined as "informal sharing of information usually requiring you to initiate the sharing and may result in valuable on-going contacts." In addition, during breaks, between sessions, lunch, and on their own time, high percentages of individuals talked with an individual having a different affiliation.

Effectively Fostered Dialog and Information Sharing

Fifty-nine percent felt the conference was "somewhat effective" in fostering dialog and information sharing between the three targeted groups (researchers, natural resource managers and educators) and 26% said the conference was "very effective".

Green Principles Successfully Demonstrated

Almost 75% of participants were "very aware" of the conference's green design. A similar portion said that the conference's steps to minimize its environmental impact were "very important". A small percentage (9%) reported what they considered problems resulting from the green design (lack of abstracts, nametags, bike racks, or cups and a confusing waste/recycling system).

Additional Conferences Wanted

A strong majority (95%) said that the conference should be held on a regular basis and about half favored a biennial conference. A strong majority (81%) said they would attend future conferences on Lake Superior.

High Levels of Satisfaction

Ninety-seven percent (97%) rated their experiences at the conference as either "excellent" or "good", indicating high levels of satisfaction with the conference.

INTRODUCTION

Making A Great Lake Superior Conference held in Duluth, Minnesota from October 29 through October 31, 2007 attracted 444 registered participants. Conference organizers were the U.S. Environmental Protection Agency, Environment Canada, University of Minnesota Sea Grant Program, and the Lake Superior Binational Program. Numerous other agencies and organizations sponsored and helped plan the conference. The University of Wisconsin Extension's Environmental Resources Center, Madison, Wisconsin conducted the evaluation.

Preceding this introduction is a summary of outcomes. Next is a short methods section, followed by findings according to survey question categories. A summary and observations section concludes the report. Appendix A shows categorized comments. Since the evaluation charge was to only collect data and report findings, the report does not reach conclusions. However, a few observations about the conference are presented.

METHODS

The Environmental Resources Center (ERC) undertook the evaluation in support of a staff member, Nancy Larson, University of Wisconsin Extension Lake Superior Basin Educator. She was involved in planning and conducting the conference and requested assistance. Conference organizers provided extensive input as the survey was developed. In keeping with the "green" principles of the conference, the Web was used for survey implementation. The conference was conducted to minimize impacts on the environment and limiting paper use was important.

ERC administered the survey with the assistance of Jesse Schomberg, Conference Co Chair and Mary Lucas, UW-Extension Information Process Consultant. Jake Blasczyk, ERC Evaluation Specialist and his assistant Sue Vang analyzed the data. Neither Jake nor Sue was involved in planning or conducting the conference.

There were 444 conference participants and 402 participants with valid email addresses were asked to complete an electronic survey. The response rate was 70% (281/402) with 63% of all conference participants (281/444) providing data.

The high response rate and the resulting robust nature of the data are likely due to a combination of three factors: 1) survey procedures, 2) characteristics of participants, and 3) overall positive reactions to the conference. Survey procedures followed Dillman's (2007) recommendations, as well as recommended online survey procedures (Ritter and Sue, 2007). Before having access to the Web survey, respondents received an e-mail announcing the survey and explaining its importance. During administration, those not responding received two reminders. These procedures influenced response rate.

Survey responses, especially written comments, suggested that respondents were committed to learning about Lake Superior issues, as well as concerned about the Lake itself. In addition, overwhelming numbers of respondents reacted positively to the conference. These two factors likely also influenced the high survey response rate.

Survey data was entered and analyzed using the statistical software, SPSS. Various tables and graphs from the survey data were created and examined for central tendencies. Trends in frequencies were determined. Through a combination of inductive (Thomas, June 2006) and deductive reasoning, inferences were made which eventually became findings.

Some cross tabulation analyses were also conducted. For example, survey question 5 was analyzed against question 6 to determine if prior knowledge affected how much increased knowledge occurred after the conference.

Written responses and comments were entered and coded in Microsoft Word, then sorted using Excel. Some were coded and counted more than once because they reflected multiple themes.

FINDINGS

The robust data and analysis resulted in six categories of findings (listed A-F below).

A. Characteristics of Participants (Questions 21, 23-24, 5)

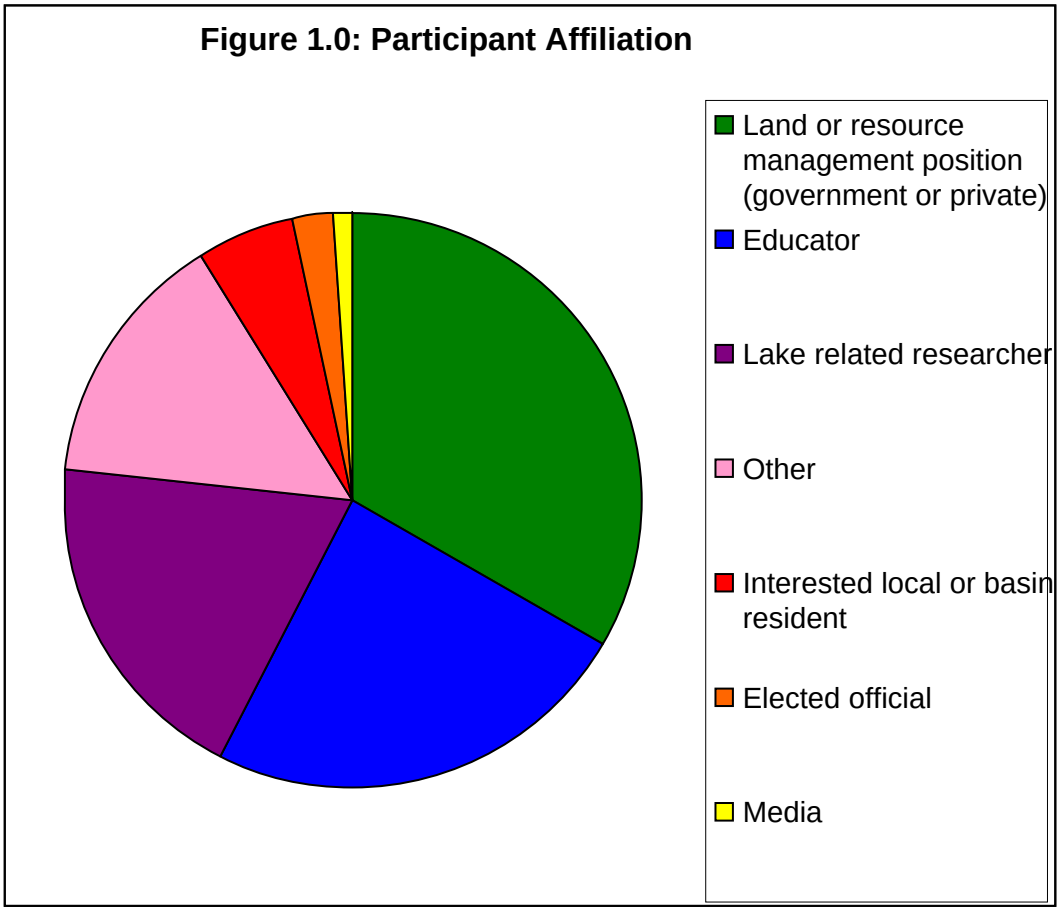
Four findings about characteristics of participants are listed below. More details follow.

- Researchers, educators, and managers represented.
- Many learned about the conference electronically.
- About a third never attended a Great Lakes related conference or workshop within the last two years.
- Many had a high level of knowledge about Lake Superior issues prior to the conference.

1. Researchers, Educators, and Managers Represented.

As Figure 1.0 shows, more respondents (33% or 93 of 281) had a land or resource management position, either government or private. Educators made up almost a quarter (24% or 67) of the respondents and 19% (53) classified themselves as lake related researchers. Less than 6% each were interested residents, elected officials, media representatives, non-profit organization employees, consultants, public sector employees, and students.

Figure 1.0: Participant Affiliation



2. Many Learned About the Conference Electronically.

Nearly half (45% or 125 out of 281) learned about the conference electronically, either through email or the website. Another 36% or 100 heard about it through personal communications with an individual. Other ways were meeting announcements (5%), newsletters (1%), invitations to

the conference (1%), workgroups (1%), and through work (1%). Two percent each reported learning about the conference because they were on a planning committee, the Binational Forum, or because they were an organizer or involved agency/program for the conference.

Cross tabulation analyses revealed that over half of educators, local residents, and lake researchers learned about the conference electronically. Land managers were split almost evenly between talking with an individual (40%) and through the internet (39%).

3. About a Third Had Not Attended a Great Lakes Related Conference or Workshop Within the Last Two Years.

About a third of respondents (35% or 99 of 281) had not attended other conferences or workshops on the Great Lakes in the last two years. A fourth (25% or 71 participants) attended more than three Great Lakes related conferences or workshops in the past two years. The remainder attended related conferences/workshops once (18%), twice (14%), or three times (7%) in the last two years.

Land managers (24%) and lake researchers (19%) were less likely to have attended conferences 5 or more times, compared to interested residents (56%) and educators (49%).

4. Many Reported High Knowledge of Lake Superior Issues Prior to Conference.

Respondents reported high levels of knowledge about Lake Superior issues prior to the conference. Over two thirds reported “high” (53% or 149 of 281 participants) or “very high” (15% or 43 of 281) knowledge. Meanwhile 26% (74 participants) reported “neither high nor low” knowledge. A small portion (4%) reported “low” or “very low” knowledge. Local or basin residents were split between reporting “neither high nor low” knowledge (44%) or “high” knowledge (44%), while most lake researchers (66%), land or resource managers (55%), and educators (51%) reported “high” knowledge.

B. Outcomes: Knowledge and Use of Information (Questions 6, 7)

Outcomes included increased knowledge and plans to use information gleaned at the conference. Specifically:

1. Most Experienced an Increase in Knowledge.

After attending the conference, respondents reported increases in knowledge of Lake Superior issues. Most (55% or 155 of 281) reported that their knowledge increased “somewhat”. About one-third (32% or 90) reported increasing their knowledge “a lot”. Eleven percent (11%) increased their knowledge of Lake Superior issues “a little” or “not at all”.

2. Most Plan to Use or Have Already Used Conference Information.

Eighty-six percent (238 of 276) have either already used or plan to use the information in the future. Participants have already used or plan to use contacts made during the conference (42 comments), share information with others (37 comments), or use the information to teach classes or educate the public (34 comments). Fifteen comments each indicated that use of information was work related, involved climate change information, and meant now having good background information, as well as increased understanding of Lake Superior issues. More educators (99%) and land managers (90%) said that they were likely to use the information compared to lake researchers (75%) and local residents (67%).

C. Reactions to the Conference and its Events (Questions 2-4, 17-20, 30)

Nine findings are presented below. Respondents felt positive about the conference, rated it as being “excellent” or “good”, and experienced few problems from its green design. Fifty-three respondents (19%) experienced difficulties due to the number of sessions, their length, and scheduling of sessions. These issues did not affect their positive reactions to the conference.

Many respondents reported memorable conference events; the plenary sessions were frequently mentioned, especially the one on climate change. This plenary session also received a high rating on a four point usefulness scale. Breakout sessions on climate change, water/lake levels, invasive species, and toxics were often listed as very effective sessions. Percentages considering breakout sessions as very ineffective were relatively low.

Two less well attended activities were field trips and facilitated workgroups. About 14% of respondents participated in the field trips with many rating them as "very useful". About a third of respondents attended the facilitated workgroups and approximately equal numbers rated these as "very useful" and "somewhat useful".

Attendance at the facilitated workgroups was skewed towards educators with more of them participating compared to lake researchers and land or resource managers. Otherwise, the mix of educators, lake researchers, and land or resource managers attending other events appeared more balanced.

1. High Ratings for Conference.

Just over half (55% or 154 of 281) of the respondents selected "excellent" to rate their conference experiences, while 42% (118) rated them as "good". The remaining 3% (8) selected "fair". Nobody selected "poor". Fewer (38%) lake researchers selected "excellent", compared to 75% of local/basin residents, 60% of educators and 55% of land/resource managers.

2. Two Thirds Recalled a Memorable Scheduled Event with Climate Change Plenary Mentioned Often. This Plenary Also Rated High on a Usefulness Scale.

Almost two thirds of the respondents (62% or 165 of 265) recalled a memorable event. Many cited the Tuesday plenary session on climate change and specifically mentioned the keynote speaker, Dave Phillips.

Tuesday's plenary also received high ratings on usefulness. Sixty-six percent (158 of 238) rated it as "very useful", compared to 46% (71 of 153) who rated the Wednesday keynote as "very useful". Sixty-four percent (131 out of 206) found the Monday keynote "somewhat useful" and 56% (89 of 158) rated the Wednesday plenary similarly.

Other memorable events included the climate change lunch panel featuring Governor Tim Pawlenty and Will Steger (29 comments), John Austin's Wednesday speech (13 comments), the tours and field trips (12 comments), the luncheon with teachers and scientists (10 comments), and climate change topics and breakout sessions (10 comments). Also mentioned were the Sunday night activities, the banquet/presentation, the mayor panel, and the opening ceremony.

3. Almost Half Recalled an Effective Breakout Session.

A little less than half (46%, 120 of 259) of respondents recalled a breakout session which they considered to be very effective at increasing their knowledge of Lake Superior issues. The five most frequently mentioned sessions were on climate change (17 comments), water levels and withdrawals (15 comments), lake levels (8 comments), aquatic invasive species (7 comments), and toxic pollutants (7 comments).

4. A Few Recalled an Ineffective Breakout Session.

Ten percent (25 of 259) recalled a breakout session which they considered as very ineffective in increasing their knowledge about issues regarding Lake Superior. The five most commonly listed sessions for ineffectiveness were facilitated workgroups (4 comments), sustainability and aquatic invasive species (3 comments each), and water levels and managing woodlands on red clay plains (2 comments each).

5. Generally All Conference Elements Rated High On Usefulness of Information—Another Indicator of Positive Reactions to the Conference.

As Table 1.0 shows more respondents rated elements of the conference as being "very useful" or "somewhat useful" rather than "not very useful" or "not useful at all". The trend across the scale of usefulness shows positive reactions to the various elements of the conference.

TABLE 1: Usefulness of Conference Elements (Percentage of Respondents)

	"Very Useful"	"Somewhat Useful"	"Not Very Useful"	"Not Useful At All"
Element				
Field Trips to Local Areas of Interest (N=62)	60%	24%	16%	0%
Global Climate Change Panel (N=217)	47%	44%	8%	1%
Concurrent Breakout Sessions Attended (N=246)	41%	55%	4%	0%
Panel: Perspectives on Past and Future States of Lake Superior (N=186)	32%	60%	7%	1%
Lake Superior Art and Video (N=211)	31%	52%	13%	4%
Panel-Sustainable Communities: Local Governments Help Protect and Restore the Lake (N=152)	30%	57%	13%	1%
Facilitated Workgroups on Education, Management, and Research (N=148)	26%	41%	21%	12%
Poster Session (N=222)	19%	59%	19%	4%

6. Low Participation on Field Trips While Being Rated as "Very Useful".

While attendance on field trips was relatively low (62 participants), most who participated considered them to be "very useful" as indicated in Table 1.0. All local/basin residents attending the field trips found them "very useful", compared to 58% of educators and 50% each of lake researchers and land managers.

7. Low Attendance at Facilitated Workgroups With About Two-Thirds Saying That These Were "Somewhat Useful".

About a third of respondents participated in facilitated workgroups. Sixty-seven percent (67%) considered them to some extent useful with the remainder indicating workgroups were "not very useful" or "not useful at all". More residents (50%) and educators (41%) found the facilitated workgroups "very useful", compared to 14% of land managers and 11% of lake researchers.

8. Attendance at Facilitated Work Groups Skewed Towards Educators. Otherwise Attendance of Educators, Lake Researchers, and Land or Resource Managers at Other Events Was More Balanced.

Attendance according to group affiliation reflecting four major groups (see Table 2) showed a relatively balanced distribution of the four groups at each event, except at the facilitated workgroups. Attendance at workgroups was skewed toward educators with 81% of educators responding to the survey attending compared to 37% of lake researchers, 49% of land managers, and 53% of local or basin residents (see Table 2.0).

TABLE 2: Attendances of Events According to Group Affiliation

Affiliation	Panel: Perspectives on Past & Future States of Lake Superior	Global Climate Change Panel	Concurrent Breakout Sessions	Poster Session	Facilitated Workgroups	Panel- Sustainable Communities: Local Governments	Field Trips
Educator (any type)	71%	89%	97%	73%	81%	65%	19%
Local or basin resident	80%	73%	81%	73%	53%	60%	20%
Lake related researcher	80%	92%	82%	96%	37%	38%	16%
Land or resource manager	80%	82%	96%	93%	49%	55%	23%

9. Few Difficulties Reported.

Most participants (81% or 225 of 278) reported no difficulties or problems negatively affecting their conference participation. The 19% (53 participants) who experienced difficulties listed issues with attending different sessions in different strands. Twenty six comments specifically addressed the fact that the three different strands had sessions which did not start or end at the same time, so moving between strands was difficult. Other cited issues were moderators not keeping sessions on time, and communication problems with organizers prior to the conference.

The comments below illustrate some of the common concerns about concurrent sessions.

- "There were too many concurrent sessions. I missed some talks that I really wanted to hear because I couldn't be in two places at once."
- "The timing of the separate sessions was so far off that I ended up missing talks that I wanted to attend, or interrupt in the middle of someone's talk, thinking I was on time for the brief break between talks."
- "Sessions weren't all clearly organized around a single topic, so to hear speakers on a topic I'm interested in, I shifted from concurrent to concurrent session."
- "Staggered talk schedules and monitors who didn't stick to time schedules made it difficult to move from session to session."

D. <u>Networking and Communications Between Targeted Groups (Questions 8-12, 22)</u>

Conference organizers valued networking between participants and dialog or sharing of information between lake researchers, educators and land/resource managers. The majority of survey respondents agreed that these facets were important, with 58% reporting that they networked 5 or more times during the conference. About a quarter said that their contact network increased as a result of the conference. Fifty-nine percent rated the conference as "somewhat effective" in fostering dialog and information sharing between lake researchers, educators, and land/resource managers, compared to 26% saying the conference was "very effective".

High percentages of lake researchers, land/resource managers, and educators talked with another participant having a different affiliation during breaks, lunches, between sessions, and on their own times. This indicated a fair amount of inter-group communication.

1. One Half Said That Networking at Conference Was "Very Important".

Most respondents (51% or 144 of 281) felt that networking at the conference was "very important". Thirty-six percent (102 participants) found networking to be "somewhat important"; while 10% (29 participants) said it was "neither important nor unimportant". One percent (3) felt that networking was "somewhat unimportant".

Lake related researchers were less likely (33%) to rate networking as "very important", compared to interested residents (56%), land managers (56%), and educators (54%).

2. Most Participants Networked 5 Times or More.

Respondents networked with others from around the Lake Superior basin. Exactly 58% (163 out of 281) of survey respondents networked 5 times or more. Over 27% (77) networked 3 or 4 times, while 12% (34) networked 1 or 2 times. Four participants did not network at all. The majority of each affiliation networked at least 5 times, ranging from 47% of lake related researchers to 69% of interested residents and 100% of elected officials and media.

3. A Fourth Increased Their Contact Network "A Lot".

A quarter of the respondents (26%, 72 of 281) reported that the conference increased their network "a lot" compared to 50% or 139 who said that their network of contacts increased "somewhat". Exactly 21% (59) reported "a little" increase in their network, and 4% (10 participants) stated that their network did not increase at all.

4. The Conference's Emphasis on Dialog and Information Between Researchers, Managers, & Educators Was Important to Most Respondents.

Fifty-nine percent (167 of 281) felt it was "very important" to dialog between researchers, managers, and educators, compared to 30% (85) feeling that this was "somewhat important". Roughly 8% (21) felt that the dialog was "neither important nor unimportant", and 1% each felt it was "somewhat unimportant" or "very unimportant".

Fewer lake researchers (45%) felt dialog and sharing between the conference's targeted groups was "very important". Meanwhile, 73% of the educators felt that the emphasis was "very important", compared to 67% of land managers and 63% of local and basin residents.

5. A Slight Majority Rated the Conference as "Somewhat Effective" in Fostering Dialog and Sharing.

Fifty-nine percent (167 of 281) rated the conference as "somewhat effective" in fostering dialog and information sharing between the three targeted groups, compared to 26% (72) that said the conference was "very effective". Nine percent of all participants (24) felt that the conference was "neither effective nor ineffective" in this aspect, while 5% (14) felt that it was "somewhat ineffective". According to cross tabulation analyses more local residents (44%) and educators (39%) said that the conference was "very effective" compared to lake researchers (23%) and land managers (22%).

6. High Percentages Talked to Others With a Different Affiliation Indicating a Fair Amount of Inter-group Communications.

The survey probed for who respondents talked with during breaks, lunch, between sessions or on their own time to learn the extent of inter-group communications. As shown in Table 3.0 a fair amount occurred during informal time blocks. For example, 75% of the educators talked to a lake researcher and 79% of land or resource managers talked to an educator. Fewer local or basin residents compared to other groups talked with lake researchers, yet nearly 60% did.

TABLE 3: Inter-group Communication According to Affiliation

	Affiliation			
	Educator	***Interested local or basin resident***	***Lake related researcher***	***Land/ resource manager***
Percentage Who Talked to Lake Researchers	75%	58%	96%	84%
Percentage Who Talked to Land or Resource Managers	73%	85%	90%	98%
Percentage Who Talked to Educators	92%	71%	74%	79%

E. Opinions and Effects of the Green Design (Survey Questions 13-16)

Nearly three quarters of respondents were "very aware" that the conference aimed to minimize its environmental impact. About the same number felt that the green design was "very important". The green design did not cause problems for an overwhelming majority of respondents. Respondents selected composting, minimizing paper usage, and using local food as the three green-related steps which should be included in future conferences.

1. Almost Two Thirds Very Aware of Conference's Green Design.

A majority (72% or 203 of 281) were "very aware" that the conference was designed to minimize its environmental impact compared to 9% (26) that were "aware" of this fact, while 16% (45) were "somewhat aware". Four were "unaware" that it was a "green" conference.

2. Most Felt That Conference's Green Design Was Important.

Seventy-one percent (200 of 281) felt that a green conference was "very important" and 22% (62) felt that it was "somewhat important". Only 5% (15) felt that minimizing the conference's environmental impact was "neither important nor unimportant", and less than one percent felt it was "very unimportant".

According to cross tabulation analyses, less than half of all lake related researchers (45%) felt the green design was "very important", compared to 84% of land or resource managers, 79% of educators, and 63% of interested residents.

3. Few Problems Resulting From Minimizing Conference's Environmental Impact.

The conference's green design included encouraging participants to bike, reuse their old nametags from past conferences, and bring their own reusable mugs. These efforts did not cause problems for most participants. Nine percent (26 out of 279 participants) reported problems. Of these 26 participants, the five most common issues were with the lack of abstracts (9 comments), lack of nametags (7 comments), the waste and recycling system (3 comments), lack of cups (3 comments), and lack of bike racks (2 comments).

4. Repeat Composting, Minimizing Paper, and Using Local Food at Future Conferences.

Respondents were asked which steps should be taken to make future conferences green. The top three selected were: compost waste foods and disposable cups, etc. (89% or 249 of 281), minimize paper usage (88% or 248), and use locally grown/produced food (87% or 243). Reusing name tags (71% or 200) and carpooling (61% or 171) were also selected. Purchasing CO2 offset credits was the least selected action, which 36% (102) of respondents chose.

F. Interest in Future Conferences (Survey Questions 25-29)

Interest in future Lake Superior conferences was high with an overwhelming majority favoring a regularly scheduled conference. Many would likely attend. Slightly more than half favored a conference every two years while a third favored a conference every three years. Suggested improvements focused on scheduling of breakout sessions and more diversity. Respondents seemed satisfied with topics already covered while offering a few additional suggestions.

1. Most Would Attend Future Conferences.

Eighty-one percent (226 of 278 respondents) would attend future conferences on Lake Superior. Eighteen percent (51) were unsure, and one would not attend. High majorities of lake researchers (74%), educators (88%), land or resource managers (82%) and local/basin residents (81%) would attend a future conference.

2. Almost All Want Conference Held on Regular Basis.

Almost all respondents (95%, 260 out of 275) said that a Lake Superior Conference should be held regularly. High percentages of local residents (87%), lake researchers (90%), land or resource managers (98%) and educators (97%) agreed.

3. One Half Chose Biennial Conferences and a Third Chose Triennial Conferences.

A little over half (52%, 146 of 281) choose a conference every 2 years, while over a third (35%, 98 participants) recommended one every 3 years. A small percentage (11%, or 32) favored a conference every 5 years. More lake related researchers tended to want longer gaps between conferences; 49% suggested one every 3 years, and 19% suggested one every 5 years.

4. Suggestions on Improvements Focused on Scheduling Sessions and Diversity.

Suggestions for improving the conference focused mostly on the scheduling of the breakout sessions (65 comments) and diversifying the conference in a multitude of ways (29 comments). Participants had a difficult time moving between strands for different sessions and attending all the sessions that interested them. Some suggestions for scheduling were: 1) include breaks in between sessions to allow for travel to other rooms, 2) provide longer sessions, 3) focus on fewer topics, 4) provide fewer sessions, 5) keep all sessions in the different strands on the same start/end times, 6) keep sessions on time and on track, and 7) have some repeat sessions.

Suggestions with diversification themes included more interaction between researchers, managers, and educators, mixing up the audiences and session teams, and including more participation from aboriginal communities, schools, industries, and the general public.

The following comments show the types of problems participants had with the scheduling.

- “Fewer topics with longer presentations would allow for a more detailed discussion of issues.”
- “Having each track follow the same schedule so a person could attend breakout sessions from multiple tracks.”
- “Coordinate sessions better, especially to keep speakers within their allotted time.”
- “Too many concurrent session, unable to attend some talks.”
- “Make it easier to move from strand to strand...maybe a five minute break after every other session?”
- “Provide more time between sessions to network, not running individuals from the same groups at the same time in different tracts.”

Other suggestions included providing more time for networking (11 comments), improving the poster session (10 comments) and a few advertising and food suggestions.

5. Satisfied With Covered Topics With a Few Suggestions: Climate Change, Diversity, and Connection With Land.

Most respondents were satisfied with the topics covered at the conference. The top six recommendations for future topics were: diversifying the presenters and participants to include Native Americans, teachers, EPA, etc. (17 comments), climate change information (16 comments), more on the lake ecosystem and estuarine ecology (10 comments), predictions of sustainability and changes (7 comments), education, and toxics (4 comments each). A few mentioned community involvement, economics, land use, politics, and spirituality.

SUMMARY AND OBSERVATIONS

This report presented findings of a Web survey completed by 70% of 402 participants with valid email addresses who attended the *Make A Great Lake Superior 2007* conference. This means that 63% of all participants (281/444) provided data. Developed in collaboration with organizers, the survey ascertained outcomes while probing for reactions to the conference, including how information would be used. Results included eight outcomes and six categories of findings.

Outcomes

Outcomes identified were:

- Increased knowledge of lake related issues.
- Large numbers used or anticipated using information gained.
- Mixture of lake researchers, educators, and land or resource managers attended.
- High levels of networking.
- Effectively fostered dialog and information sharing.
- Green principles successfully demonstrated.
- Additional conferences wanted.
- High levels of satisfaction.

Findings

Findings fall into six categories**.**

1. Characteristics of Respondents

Data showed that researchers, educators, and managers were represented at the conference. Many learned about the conference electronically and about a third had not attended a Great Lakes related conference during the last two years. Many reported a high level of knowledge about Lake Superior issues prior to conference.

2. Outcomes: Knowledge and Use of Information

Two important and frequently reported outcomes were increased knowledge and plans to use information gleaned at the conference.

3. Reactions to the Conference and its Events

Analysis resulted in nine findings regarding reactions to the conference and its events. Generally, survey respondents felt positive about the conference, rated it as being “excellent” or “good” and experienced few problems from its green design. Fifty-three respondents (19%) reported experiencing difficulties mostly due to the high number of sessions, length of sessions, and scheduling of sessions; however this did not negatively impact overall reactions to the conference.

Many respondents recalled and reported memorable events at the conference. The plenary sessions were frequently mentioned, especially the climate change plenary which also received a high rating on a four point scale. Very effective breakout sessions as listed by respondents included climate change, water/lake levels, invasive species, and toxics. Percentages recalling very ineffective breakout sessions were relatively low.

Field trips and facilitated workgroups were two less frequently attended activities. About 14% of survey respondents participated in the field trips and many felt they were "very useful". About a third of the respondents attended the facilitated workgroups and approximately equal numbers rated these as either "very useful" or "somewhat useful".

More educators compared to lake researchers and land or resource managers attended the facilitated workgroups. At other events, the mix of educators, lake researchers, and land or resource managers was more evenly balanced.

4. Networking and Communications Between Targeted Groups

Conference planners and organizers valued networking between participants as well as dialog and sharing of information between lake researchers, educators and land and resource managers. The majority of respondents agreed that these facets were indeed important, with 58% reporting that they networked 5 or more times during the conference. About a quarter said that their contact network increased as a result of the conference. Fifty-nine percent rated the conference as "somewhat effective" in fostering dialog and information sharing between lake researchers, educators, and land or resource managers compared to 26% saying the conference was "very effective".

During breaks, lunches, between sessions, and on their own times, high percentages of lake researchers, land or resource managers, and educators talked with another participant having a different affiliation. This indicated a fair amount of inter-group communication.

5. Opinions and Effects of the Green Design

Nearly three quarters of the survey respondents were "very aware" that the conference was designed to minimize its environmental impact. About the same number felt that the green design was "very important". The green design did not cause problems for an overwhelming majority of respondents. Respondents selected composting, minimizing paper usage, and using local food as the three green-related steps that should be included in future conferences.

6. Interest in Future Conferences

Interest in future conferences about Lake Superior was high with an overwhelming majority favoring a regularly scheduled conference which they would likely attend. Slightly more than half of the respondents favored a biennial conference while a third favored a conference every three years. Suggested improvements focused on scheduling of breakout sessions and more diversity. Respondents seemed satisfied with topics already covered while making a few suggestions.

Observations

This report resulted in the following observations. First, conference participants reacted positively to the conference. When asked to rate their conference experiences on a four point scale from "excellent" to "poor", most selected "excellent" or "good". In addition, measures of usefulness of information gained from various conference elements showed that an overwhelming majority of participants considered the entire conference to be highly useful. Analysis of comments also showed positive reactions to the conference.

Second, conference planners desired dialog and information sharing between groups of different affiliations, especially between lake researchers, educators, and land or resource managers. A fair amount of inter-group dialog and sharing seemed to occur. During breaks,

lunch, between sessions or on their own time, large numbers of conference participants reported talking about Lake Superior issues with a conference participant of a different affiliation.

Third, the conference appeared to have an adequate combination of lake researchers, educators, and land or resource managers, although the number of researchers attending was slightly lower. Having a well represented mixture of participants was another aim of conference planners. About 33% of survey respondents had a government or private land or resource management position compared to 25% being educators and 19% (53 participants) as lake related researchers.

Also noteworthy is that approximately one third of the survey respondents had not attended a Lake Superior related conference or workshop in the last two years. This suggests that the conference attracted those who do not attend Great Lakes conferences frequently and probably first timers or a new audience as well.

Fifth among the noteworthy outcomes is knowledge gained. Many participants reported having a high level of knowledge about Lake Superior issues prior to the conference. Yet these participants along with others with lower levels of knowledge reported that the conference increased their knowledge about Lake Superior issues, and for many the increase in knowledge was “a lot”.

Sixth, most respondents favor another Lake Superior focused conference. Many want a biennial conference. Suggestions for improvement included better scheduling of concurrent breakout sessions.

Finally, conferences organizers are to be commended for a conference that was relatively problem free, while successfully minimizing its impact on the environment. The conference was specifically designed to be “green”. To borrow the familiar adage: organizers and planners successfully “walked their talk”. An overwhelming majority of participants recognized efforts to minimize environmental impact and considered these efforts as being important.

APPENDIX A

The following appendix provides summarized tables of the comments from open ended questions. The survey had a total of 11 questions with possible open ended responses (Questions 3, 4, 7, 15, 19, 20, 21, 23, 28, 29, and 30). Comments were analyzed for trends; some had multiple themes and thus were coded more than once. Italicized comments in the tables below indicate responses that may not be directly related to the question, e.g. a criticism on the conference in response to a question asking for memorable events.

Difficulties or Problems Experienced (Question 3)	
Category	***# of Comments***
Scheduling of sessions not good (inconsistent start/stop times, too many sessions at same time, etc.)	26
Sessions should stay on schedule	12
Communication problems with organizers prior to conference, poor advertising, registration problems	5
Moderator should keep sessions on time or have consistent introductions	4
Wanted abstracts; presenter/scheduling related problems	3 each
Full day agendas too much; improve poster sessions; topics too scattered/general; minor teacher related complaint	2 each
Many individuals focused on own goals; change date; hearing problems; IT problems; temperature problems; Monday lunch panel not good; didn't like foreign aspect of opening ceremony	1 each
Felt that attending sessions from different strands was doable	*1*
General kudos/no problems	*1*

Memorable Scheduled Event (Question 4)	
Category	***# of Comments***
Tuesday Plenary session on climate change	35
Governor Tim Pawlenty, Will Steger, and/or climate change lunch panel	29
David Phillips	24
John Austin (having him speak earlier, not at the end)	13
Tours and field trips (fisheries, stormwater, boat, rain garden)	12
Luncheon with teachers; climate change topics/breakout sessions	10 each
Opening ceremony and speakers, prayer ceremony	8
Banquet dinner and/or presentation	7
Mayor panel, sustainability	6
Sunday night activities (Fresh Energy, Will Steger)	6
Lake levels	4
Green aspect of conference; Tracy Mehan; inclusion of teachers	3 each
Craig Blacklock; mining; poster session	2 each
Art exhibit; ballast panel; closing speakers; Dave Ullrich; exotic species; GIS; Monday session on Great Lakes; Jerry Hembd; John Robinson; Jesse Schomberg; Mindy Granley; VHS; state of lake session; "practical" session; rip currents; shipping impacts; Todd Thompson; USGS	1 each
General comment on good keynote speakers, sessions, topics	*28*
Conference should include more industry, business, general public	*2*
People were able to sneak in to banquet by modifying their name tags	*1*
Not enough time	*1*
Complaints on keynote speaker; opening ceremony; Robert Caldwell	*1 each*

Conference Information To Be Used (Question 7)	
Category	***# of Comments***
Making contacts, for information and future collaborations	42
Sharing information	37
Teaching	34
Media and publications (presentations, articles, websites, papers, radio/media, videos, posters, and handouts)	25
Climate change; increased background knowledge; work purposes	15 each
Management purposes; plans/strategies/future initiatives	9 each
Discussions	8
Project ideas (including for science fairs)	6
Aquatic invasive species; community involvement; local projects; personal life changes	4 each
Economic benefits; grants/funding; ice data; monitoring purposes; research; stormwater treatment; water level; youth symposium	3 each
Model for other conferences; case building; fish data; GIS information; lake stewardship; shipping industry information	2 each
Areas of concern; coalition development; discharge issues; freshwater unit; human health issues; VHS, updating LaMP; fish population dynamics modeling; oil refineries/pipeline; new resources; furthering studies; references in talks; State of the Lakes Ecosystem Conference; sustainability; wastewater treatment of chemicals of concern	1 each
Abstracts wanted; don't know	*1 each*

Green Efforts of Conference Which Caused Problems (Question 15)	
Category	***# of Comments***
Wanted abstracts	9
Name tags didn't work, were inaccurate, did not know about the name tags prior to conference, or allowed people to sneak into banquet	7
Didn't know to bring own cup; recycling/waste system hard to find	3 each
More bike racks; wanted handouts; food (allergies or lack of salads)	2 each
Contact list wanted; not enough green measures; hotel did not encourage reuse; bad keynote speaker; lights left on during presentation; nothing new learned; participant list wanted; more time wanted; wanted other conferences to be green	1 each
None	*4*
Food (positive comment)	*3*
Good kitchen staff (found lost mug)	*1*

Effective Breakout Session (Question 19)	
Category	***# of Comments***
Climate change	17
Water levels and withdrawals (Doug Wilcox)	15
Lake levels (Jay Austin)	8
Aquatic invasive species (Doug Jensen); toxic pollutants	7 each
Areas of concern; fisheries strand; Jay Austin	5 each
Ballast water; GIS sessions; Habitat Conservation and Species Management; human health session; ice session (Jay Austin); lake levels (Todd Thompson); teacher luncheon	4 each
Mary Balcer; reserve mining; sustainability; VHS session; watershed stewardship	3 each
Jim Meeker; NPS pollution; endocrine disruptors (Peter Sorenson); rip tides (Robert Caldwell); Monday/Tuesday evening education sessions; Susan O'Halloran	2 each
Biohabitat presentation; biology workshops; Bob Krumenaker; dredging; Jeff Gunderson; Jerry Hempd; K12 education session; Lake Superior streams; Binational program; mining; rain gardens/field days; rip tides; Thunder Bay presentation; water quality issues	1 each
General kudos, none	*6*
Wanted more time to attend other sessions or GIS	*3*
Research not new, too much emphasis on research	*1*

Ineffective Breakout Session (Question 20)	
Category	***# of Comments***
Facilitated workgroups (be more interdisciplinary, or have better facilitation)	4
Aquatic invasive species; sustainability (too much theory, poor attendance/moderation)	3 each
Managing woodlands on red clay plains (Kristin Shy); water levels; networking sessions too short or unnecessary	2 each
Climate change (not enough perspectives, too focused & repetitive); facilitator's attitude; talk on fish on east/west coats; GLFWC talk; sessions with computer use or confusing graphs; John Gulliver; Karen Rodriguez; Binational forum breakout on public outreach; Marilyn Katz; research workgroup; rain gardens; Robert Hedy; breakout sessions too focused on show & tell instead of action; toxic pollutants	1 each

Other Types of Conference Participants (Question 21)	
Category	***# of Comments***
Non-profit; student	7 each
Government or EPA	5
Municipal	4
Consultant; industry	3 each
Policy & education/community organizing	2
Planning; organizational interest; stakeholder advisor to governments; LTWC staff; Binational Forum participant; researcher/educator/resident; conference speaker; fisheries biologist; tribe-affiliated	1 each

Other Method of Learning About Conference (Question 23)	
Category	***# of Comments***
Planning committee member	6
Binational forum member; organizer/partner	5 each
Superior Work Group member	4
Invited to attend/speak; club/association; workplace	3 each
Magazine; Cindy Hagley told director	1 each

Suggestions to Improve the Conference Attended (Question 28)	
Category	***# of Comments***
Scheduling of sessions (keep sessions on time, breaks between workshops, poor timing, longer sessions, fewer sessions, same start/end times for sessions between strands)	65
Be more diverse (diversifying sessions/audience/partners, use vocabulary that non-scientists can understand, collaborating with more groups)	29
More networking time, free time after lunch	11
Poster session improvement suggestions	10
Food complaint	7
More advertising and information available prior to or during conference	6
Lunch/dinner speakers/activities unwanted or too long	5
Have abstracts; change/reduce keynote speakers; keep focus of conference on sharing knowledge/LaMP/participants/nonpolitical aspects	4 each
Advertise art/poster room; diversify facilitated workgroups (less on LaMP); change focus from research; mix tours into schedule/agenda	3 each
Too much information; shorten banquet presentation; dim lights during presentations; have smaller and more frequent conferences with fewer topics; include teacher-friendly ideas and supplies; have better trained volunteers; action-based facilitated discussions; use comment boards/session highlights	2 each
Add workshops to agenda; more on areas of concern; keep building open until very end; change date; have scientific debate; reduce price of conference; include interaction with keynotes; get better kick-off speaker; change location; session on Lake Superior basics of science; more on land use change; more discussion groups; shorten/cut out mayor panel; don't reuse name tags; change power point presentations to shows; better communication between presenters and organizers; registration table by door; session details outside rooms; replace sustainability with regional/community initiatives; add terrestrial component; have annual webcast/ teleconference updates; include daily debriefing workshop	1 each
General/none	*27*
Good job on green efforts	*2*

Recommended Topics for Future Conferences (Question 29)	
Category	***# of Comments***
Be more diverse (tribes, EPA, DNA, east side, public)	17
More on climate change, better balance on climate change emphasis	16
More on lake ecosystem/earth science, estuarine ecology	10
Predictions of future conditions, impact quantification, population growth, how systems are changing, sustainability	7
Educational impacts/programs/partnerships; toxics	4 each
Community involvement; economics; fisheries/fishing; land use changes; mining; look at other areas (entire basin, offshore waters, middle of lake)	3 each
Aquatic invasive species; local regulations/grassroot efforts; lake levels, management/NATL legislative issues; politics of water management, results/success on BMPs; spirituality; updates on trends and progress	2 each
Air pollution; agency reporting/goal meeting; animal populations; liked drum ceremony; funding; changes at grassroots level; green tools for public education; human history; information booths too expensive; success stories in implementing indicators; in situ technologies; controlling erosion; change location; celebrate Lake Superior Day; fewer topics; river/stream protection; stop all day meetings; pollutants of concern; plenary on education of critical issues; call for papers and abstracts; updates through newsletter/journal; societal response to problems; social dimension; shipping environmentally-friendly; state of lake session for lay people; stormwater and sedimentation; survey results; sewage; not enough time for topics; water diversions; work group in morning with afternoon sessions for solutions	1 each
General kudos/none	*23*
Don't know	*1*

Additional Comments (Question 30)	
Category	***# of Comments***
General kudos on organizers, green efforts, interdisciplinary efforts, location/venue, food, sessions, art room, tours, speakers, etc.	100
Nothing	11
Scholarship gratitude/kudos	7
Include Native Americans, local government, industry, students	5
Information overload, keep presenters on time, reduce concurrent meetings	5
Interdisciplinary aspect made conference too technical, how to find all players?	2
Need future direction and actions, keep momentum up	2
Reduce focus on climate change; change location; less politicians; include diet specification option in registration; nothing new learned; include session highlights on other works	1 each

APPENDIX B

Below is the text for the Web survey. Format reflected the Web software program.

Making a Great Lake Superior Conference

Thank you for completing this survey about your reactions to the *Making A Great Lake Superior* Conference. We greatly appreciate you taking time to do so. Your feedback is very important to planning future activities and to evaluating the conference.

The survey takes no more than ten minutes to complete. Please note that you must now complete the entire survey. You can not stop and log-in later to complete it. Please check one response unless otherwise directed as well as provide any requested information.

If you have any questions please contact Jake Blasczyk, Conference Evaluator, at 608.890.0718 or jblasczy@wisc.edu.

Your e-mail address _____

Your e-mail address is needed so we know you completed the survey. It will be removed before data analysis.

1. Overall how would you rate your experiences at the conference?
   - ○ Excellent
   - ○ Good
   - ○ Fair
   - ○ Poor
2. Did you experience any difficulties or problems that negatively affected your conference participation?
   - ○ No
   - ○ Yes, please identify the difficulty or problem
3. Was there any one scheduled event that now stands out as being particularly memorable?
   - **O** No
   - **O** Yes, please identify the event and explain why it was memorable.
4. Before the conference, how would you describe your level of knowledgeable about the issues facing Lake Superior?
   - ○ Very high
   - ○ High
   - ○ Neither high nor low
   - ○ Low
   - ○ Very low
5. As a result of attending the conference, how much would you say your knowledge of issues facing Lake Superior increased?
   - ○ A lot
   - ○ Somewhat
   - ○ A little
   - ○ Not at all

6. Have you already or do you foresee using any conference information in the near future? If yes, what are one or two ways you have already or might use the information in the future?
   - O No
   - O Yes, here's how:_____

7. How important or unimportant was networking at the conference for you? Networking is informal sharing of information usually requiring you to initiate the sharing and may result in valuable on-going contacts.
   - O Very Important
   - O Somewhat important
   - O Neither important or unimportant
   - O Somewhat unimportant
   - O Very unimportant

8. About how many times during the conference did you network with others from around the basin?

5 or more	3 or 4	1 or 2	Not at all	Can Not Recall
O	O	O	O	O

9. How much did the conference expand your network of individuals that could now be contacted?
   - O A lot
   - O Somewhat
   - O A little
   - O Not at all

10. How important or unimportant to you was the conference's emphasis on dialog and information sharing between researchers, natural resource managers and educators?
   - O Very important
   - O Somewhat important
   - O Neither important or unimportant
   - O Somewhat unimportant
   - O Very unimportant

11. How effective or ineffective was the conference in fostering dialog and information sharing between researchers, natural resource managers and educators?
   - O Very effective
   - O Somewhat effective
   - O Effective
   - O Neither effective or ineffective
   - O Ineffective
   - O Somewhat ineffective
   - O Very ineffective

12. How aware or unaware were you that the conference was designed to minimize its environmental impact (i.e. a “green conference)?

- O Very aware
- O Somewhat aware
- O Aware
- O Unaware
- O Somewhat unaware
- O Very unaware

13. How important or unimportant was it for you that the conference took steps to minimize its environmental impact?

- O Very important
- O Somewhat important
- O Neither important or unimportant
- O Somewhat unimportant
- O Very unimportant

14. Did efforts to minimize the conference’s environmental impact create any problems for your conference participation? If yes, please explain

- O No
- O Yes, please explain

15. Which, if any, of the following steps for reducing the conference’s environmental impact would you definitely like to see at future conferences?

- O Organizing carpools
- O Using locally grown/produced food
- O Encouraging re-used nametags
- O Minimize paper usage
- O Compost waste foods and disposable cups, etc.
- O Purchase CO^2 offset credits
- O None of the above

16. How useful were each of these keynotes and plenary sessions?

Keynote and Plenary	Did Not Attend	Can't Recall	Not at all	Not Very	Somewhat	Very
Monday Keynote – "Resilience: Managing the Greatest Lake in the Face of Changes and Uncertainty	O	O	O	O	O	O
Tuesday Plenary – "Climate change in Lake Superior"	O	O	O	O	O	O
Wednesday Plenary – "What Have We Learned & Next Steps"	O	O	O	O	O	O
Wednesday Keynote – Economic Future of the Great Lakes"	O	O	O	O	O	O

17. How useful were each of these other conference elements for you?

Elements	Did Not Attend	Can't Recall	Not at all	Not Very	Somewhat	Very
Panel: Perspectives on Past and Future States of Lake Superior	O	O	O	O	O	O
Global Climate Change Panel	O	O	O	O	O	O
Concurrent Breakout Sessions	O	O	O	O	O	O
Poster Session	O	O	O	O	O	O
Facilitated workgroups on education, management and research	O	O	O	O	O	O
Sustainable Communities: Local Governments Help Protect and Restore the Lake	O	O	O	O	O	O
Field trips to local areas of interest	O	O	O	O	O	O
Lake Superior art and video	O	O	O	O	O	O

18. Did you recall attending a breakout session that you thought was **very effective** in increasing your knowledge about Lake Superior issues?

O No

O Yes, Please identify this **very effective** breakout session

A.

19. Did you recall attending a breakout session that you thought was **very ineffective** in increasing your knowledge about Lake Superior issues?

- O No
- O Yes, Please identify this **very ineffective** session

  A.

20. Which **one** of the following best describes you as a conference participant?

Lake related researcher	Land or resource management position (government or private)	Elected official	Educator (any type)	Interested local or basin resident	Media	Other
O	O	O	O	O	O	O

21. During breaks, lunch, between sessions or on your own time did you talk about Lake Superior issues with a conference participant who was a lake researcher?

- O No
- O Yes
- O Can't recall

22. During breaks, lunch, between sessions or on your own time did you talk about Lake Superior issues with a conference participant who was a land or resource manager?

- O No
- O Yes
- O Can't recall

23. During breaks, lunch, between sessions or on your own time did you talk about Lake Superior issues with a conference participant who was an educator?

- O No
- O Yes
- O Can't recall

24. Not counting the October conference, how many other conferences and workshops about Great Lakes issues have you attended in the last two years?

- ○ None
- ○ One
- ○ Two
- ○ Three
- ○ More than three

25. Which **one** of the following was the primary way you learned about the conference?

- O Personal communications with an individual
- O Newsletter
- O Electronic (e-mail, Web site)
- O Announcement at another meeting
- O Newspaper
- O Other (Please identify)

26. Do you have any suggestions for improving the Lake Superior conference you attended? If yes, please list below.

27. Would you recommend that a Lake Superior Conference be held on a regular basis? If so, how frequently?

- ○ No
- ○ Yes

28. How often should a Lake Superior Conference be offered?

- ○ Every two years
- ○ Every three years
- ○ Every five years

29. Would you attend future conferences focusing on Lake Superior?

- ○ No
- ○ Maybe
- ○ Yes

30. Do you have recommendations about topics for any future conferences? If yes please list below.

31. Is there anything else you want to tell us about the conference and its usefulness to you? If yes, please do so below.

Thank You for Providing This Valuable Information.

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