Lake Superior Lakewide Management Plan:
1990-2010
Critical Chemical Reduction Milestones
October 23, 2012

Citation: Lake Superior Binational Program. 2012.
Lake Superior Lakewide Management Plan:
1990-2010 Critical Chemical Reduction Milestones.
Prepared by the Superior Work Group – Chemical Committee.
104 pages. Toronto and Chicago.

Acknowledgments

This Lake Superior Lakewide Management Plan (LaMP) critical chemicals milestones document was developed by the Superior Work Group's Chemical Committee of the Lake Superior Binational Program. The following members provided primary writing and editing of this report:

Jim Bailey, EcoSuperior
(807) 624-2140; mercdivertsuperior@yahoo.com
Glynn Gomes, Gomes Consulting Enterprises (for Environment Canada)
(416) 993-7039; glynn@gomesconsulting.com; www.gomesconsulting.com
Cherie Hagen, Wisconsin Department of Natural Resources
715-635-4034; cherie.hagen@wisconsin.gov
Liz LaPlante, U.S. EPA, Great Lakes National Program Office
(312) 353-2694; laplante.elizabeth@.epa.gov
Carri Lohse-Hanson, Minnesota Pollution Control Agency
(651) -757-2535; carri.lohse-hanson@state.mn.us
Michelle McChristie, Ontario Ministry of Environment
(807) 475-1693; michelle.mcchristie@ontario.ca
Sara Moses, Great Lakes Indian Fish and Wildlife Commission
(715) 682-6619 x2109; s.moses@glifwc.org
Matt Preisser, Michigan Department of Environmental Quality
(517) 335-0061; preisserm@michigan.gov
Nancy Stadler-Salt, Environment Canada
(905) 336-6271; nancy.stadler-salt@ec.gc.ca

The Chemical Committee also appreciates contributions from individuals from the federal, state, provincial, and tribal agencies that reviewed the draft report. In particular, the following individuals provided substantial input:

- Carol Andrews and Kim Hand, Barr Engineering
- Netta Benazon, Benazon Environmental Inc.
- Martin Nantel[1], Ken De, Alan Waffle, Daryl McGoldrick, Deb Burniston, Liisa Jantunen, and Anita Wong, Environment Canada
- Tania Havelka and Chip Weseloh, Canadian Wildlife Service
- Erin Johnston and Todd Warner, Keweenaw Bay Indian Community
- Ed Kolodziejski and Naomi Tillison, Bad River Band of the Lake Superior Tribe of Chippewa Indians
- Pat McCann, Minnesota Department of Health
- Joe Graham and John Jereczek[2], Wisconsin Department of Natural Resources
- Amy Thomas, Battelle Memorial Institute
- Melonee Montano and Laura Armagost, Red Cliff Band of Lake Superior Chippewa

[1] Martin Nantel has since moved to Fisheries and Oceans Canada.
[2] John Jereczek has since moved to Minnesota Department of Natural Resources.

- Nancy Schuldt, Fond du Lac Band of Lake Superior Chippewa
- Margaret Watkins, Grand Portage Band of Lake Superior Chippewa
- Alexis Cain, Erin Newman, and Bradley Grams, U.S. EPA Region 5
- Todd Nettesheim, Elizabeth Murphy, and Ted Smith, U.S. EPA, Great Lakes National Program Office
- Mike Ripley, Chippewa Ottawa Resource Authority
- Bill Route, National Park Service

“We need to bring all the people of Lake Superior together. We need to talk to each other about what is happening in our villages and our communities, to share our experiences, our concerns, and our hopes for the future. We need to meet our neighbors and learn from them.”

- Walter Bressette, Anishanabe elder

Lake Superior watershed sign installed by the Minnesota LaMP program.

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Executive Summary

Background. In 1990, the International Joint Commission's (IJC's) Fifth Biennial Report on Great Lakes Water Quality challenged the governments of Canada and the United States to "designate Lake Superior as a demonstration area where no point source discharge of any persistent toxic substance will be permitted." The following year, the *Lake Superior Binational Program to Restore and Protect Lake Superior* (or the *Lake Superior Binational Program* [LBSP]) was announced, providing for a Zero Discharge Demonstration Program (ZDDP) and a "broader program" focusing on ecosystem restoration. (Appendix A1 includes the complete 1991 agreement.) The Lake Superior Lakewide Management Plan (LaMP), a management strategy developed by Lake Superior partners, was developed to implement the ZDDP and ecosystem restoration programs. The LaMP set reduction schedules for the nine ZDDP chemicals:

- Mercury;
- Polychlorinated biphenyls (PCBs);
- Pesticides (including: aldrin/dieldrin, chlordane, DDT/DDE, and toxaphene);
- Dioxin;
- Hexachlorobenzene (HCB); and
- Octachlorostyene (OCS).

Results. This *2010 Critical Chemical Reduction Milestones* report documents progress in reducing the nine ZDDP chemicals between 1990 (baseline) and 2010 and includes discharge and emissions inventories from sources within the Lake Superior Basin (LSB) in 1990, 2000, 2005 and 2010. The program has many successes resulting from the activities, collaborations and commitments of a wide range of actively-engaged state, provincial, tribal, and federal agencies, industries, non-governmental organizations, and citizens. Challenges, however, still remain. Details of these activities since 2005 can be found in Appendix B.

In 2010, discharge and emission inventories for the ZDDP chemicals were updated for the entire LSB. These included an analysis of emissions from a broad range of sources including: mining, fuel combustion, incineration, waste handling, commercial products, and municipal wastewater and solid waste facilities. Details of the inventories are presented in Appendix C.

Notable achievements in reducing discharges and emissions include:

- 80% reduction in mercury discharges and emissions;
- 86% reduction in dioxin discharges and emissions;
- Ongoing safe collection and disposal of PCB-containing materials; and
- Ongoing safe collection and disposal of ZDDP pesticides, including more than 4,800 kg (10,600 pounds) collected between 1992 and 2007.

While the LaMP program is limited in its ability to differentiate the relative effects of in-basin versus out-of-basin sources of contaminants on the Lake Superior ecosystem, levels of ZDDP chemicals in general have declined and concentrations in Lake Superior are often (but not always) lower in Lake Superior air, water, sediment, fish, and wildlife. Some persistent issues under evaluation include:

- A notable exception is mercury in fish, which has begun to trend upwards. Lake Superior also exceeds the other Great Lakes in mercury levels in fish.
- While toxaphene levels in Lake Superior fish remain higher than other Great Lakes fish, a recent study of the trend in lake trout indicates a steady decline since 2000 and possible leveling off starting in 2007.
- Fish consumption advisories in Lake Superior continue for mercury, PCBs, chlordane, dioxin, and toxaphene.
- PCBs, dieldrin, and toxaphene levels in the open waters of Lake Superior exceeded water quality standards in both the 2005 and 2010 milestone reports.
- 8% of newborns in the Lake Superior watershed exceeded the Reference Dose (RfD) for mercury. A seasonal effect was also found, suggesting locally-caught fish is an important source of pregnant women's mercury exposure.

Remaining challenges include inventory development and quantification, identifying further reduction challenges and opportunities and improving the ability to accurately quantify ZDDP chemical sources, such as:

- In-service (or in-use) PCB-containing articles and equipment;
- Unknown stockpiles of banned pesticides;
- HCB estimate(s) for iron sintering; and
- Smaller sources that are known to emit ZDDP chemicals, but are not easily quantified (e.g., land clearing and mobile sources).

Other reduction challenges include:

- Emissions from existing taconite mining and possible new or expanded mining;
- A lack of dioxin reduction progress between 2005 and 2010; and
- Sources that are proportionately more important as other sources have been reduced (e.g., mercury from human cremation).

Achieving the program's 2015 targets and moving toward the 2020 goal of zero discharge and zero emission will be difficult. The Lake Superior partners, however, remain committed to achieving the goals of the Lake Superior Binational Program.

Summary. Emission reductions of critical chemicals have been documented by – and achieved through – the ZDDP. The ZDDP has shown that Great Lakes stakeholders can indeed be successful in reducing sources of toxic chemicals. In summary, 2.1 tonnes (2.3 tons) of mercury

was released from sources in the basin in 1990; this is now reduced to 0.4 tonnes (0.4 tons) in 2010. Dioxin is following a similar trend as mercury but preventable sources still dominate the inventory. 4.6 tonnes (5.0 tons) of ZDDP pesticides was collected from just the Minnesota counties bordering Lake Superior since 1992 and pesticides are also collected in Wisconsin, Michigan, and Ontario. PCB equipment in service or storage is diminishing but disposal rates have not yet leveled off.

Chapter 1. Scope and Background

1.1 LaMP Critical Chemicals and the Zero Discharge Demonstration

As observed in LaMP 2000 Chapter 4, Annex 2 of the 1987 Canada-U.S. Great Lakes Water Quality Agreement (GLWQA) contains a framework for LaMPs to restore beneficial uses and reduce the loadings of critical pollutants (LSBP, 2000). In their 1990 biennial report on the GLWQA, the IJC called for the Parties to establish a Zero Discharge Demonstration Area for Lake Superior.

In response, government agencies in 1991 established *A Binational Program to Restore and Protect the Lake Superior Basin*, also known as the LSBP (see Appendix A). Included in this program are the ZDDP, with a goal of zero discharge and zero emission of nine persistent bioaccumulative and toxic substances (PBTs) and a "Broader Ecosystem Program" that focuses on the non-chemical elements of the Lake Superior ecosystem. The LSBP identifies nine chemicals that are targeted for zero discharge and zero emissions because of their presence in Lake Superior water, fish, or wildlife.

The LaMP prioritizes actions and projects that will help achieve the goals of the ZDDP. The ZDDP chemicals and the other chemicals already designated as critical under the LaMP process are listed in Table 1-1a. They fall into three management categories: zero discharge, lakewide remediation and local remediation. Further information about the LaMP process can be found at www.epa.gov/glnpo/lakesuperior.

Prevention chemicals are either in the "Monitor" category (present but not exceeding "yardsticks") or "Investigate" category (data from Lake Superior are needed to evaluate this chemical); both categories are listed in Table 1-1b. Prevention chemicals are essentially on a "watch list" that requires additional information and follow-up. Only the nine ZDDP chemicals are targeted for zero discharge in the LSBP; the other critical chemicals are subject to virtual elimination per the GLWQA.

Stages 1 and 2 of the chemical portion of the LaMP, which describe the status of pollutants in the Lake Superior ecosystem and set load reduction targets for critical pollutants, respectively, have been completed. Chapter 4 of the LaMP 2000 then proposed remedial measures for these Lake Superior critical pollutants. The 2005 Chemical Milestones report (LSBP, 2006a) identified actions taken toward those remedial measures, estimated the load reductions since 1990, and identified further reduction strategies. This 2010 Chemical Milestones report updates the load reduction estimates from 1990 to 2010, identifies remedial measures taken since 2005, and identifies additional reduction strategies still needed to achieve future milestones.

The load reduction schedule from Stage 2 (Table 1-2) describes four timelines for reductions of mercury, PCBs, dioxin/HCB/OCS and the targeted pesticides. Note that although 2010 is a milestone year for mercury and PCBs only, the report documents progress on all four chemical groups.

Table 1-1a. Existing Critical Chemicals for Lake Superior

Management Category	Chemical	
Zero Discharge	Chlordane DDT and metabolites Dieldrin/aldrin Hexachlorobenzene PCBs	2,3,7,8– Tetrachlorodibenzo-p-dioxin (TCDD) Toxaphene Mercury OCS
Lakewide Remediation	Polycyclic aromatic hydrocarbons (PAHs) (anthracene, benz(a)anthracene, benzo(b)fluoranthene, dinitropyrene, benzo(a)pyrene, pyrene, benzo(g,h,i)perylene, phenanthrene)	Alpha-hexachlorocyclohexane (BHC) Cadmium Heptachlor/heptachlor epoxide TCDD(TEQ)[1] dioxins and furans
Local Remediation	Aluminum Arsenic Chromium Copper Iron	Lead Manganese Nickel Zinc

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

Table 1-1b. Existing Prevention Chemicals for Lake Superior

Management Category	Chemical	
Monitor	1,4-dichlorobenzene 1,2,3,4-tetrachlorobenzene Mirex/photo-mirex	Pentachlorobenzene Pentachlorophenol BHC, gamma congener
Investigate	1,2,4,5-tetrachlorobenzene 3,3-dichlorobenzidine 2-chloroaniline Tributyl tin	BHC, beta and delta congeners Hexachlorobutadiene

Table 1-2. Summary of Reduction Targets for Lake Superior ZDDP

Pollutant	Reduction Schedule (1990 base line)
Mercury	60% reduction by 2000 80% reduction by 2010 100% reduction (zero discharge/zero emission) by 2020 (applies to in-basin sources)
PCBs	Destroy PCBs in service or in storage 33% destruction by 2000 60% destruction by 2005 95% destruction by 2010 100% destruction by 2020
Pesticides **Aldrin/Dieldrin, Chlordane, DDT/DDE, and Toxaphene**	Retrieve and destroy all cancelled pesticides in the basin by the year 2000
Dioxin [1] **HCB** **OCS**	80% reduction by 2005 90% reduction by 2015 100% reduction by 2020

[1] The LSBP lists 2,3,7,8-TCDD (dioxin) for the ZDDP. By convention, dioxin is measured and reported as toxic equivalents (TEQ) of TCDD.

1.2 Progress and Accountability

In the LaMP 2000 Chapter 4, the Chemical Committee identified reduction strategies for different sectors (e.g., mining, forestry, health care, schools, etc.). The 2005 Chemical Milestones report includes additional reduction strategies. Reduction and inventory activities needed to make progress toward the 2010 reduction milestone were identified in Addendum 4C of the 2008 LaMP. Agency reports on progress toward the LaMP activities and strategies identified in these documents between 2005 and 2010 are included in Appendix B. Highlights are summarized below.

Note that the reduction activities in Appendix B are split into three types: 1) LaMP Chemical Reduction Activities, 2) Other Projects Aligned with LaMP Goals, and 3) New Regulations and Policies Aligned with LaMP Goals. While the LaMP program directly implements toxic reduction projects depending on available funding, the LaMP agencies recognize the importance of tracking other programs' projects as well as developments in broader regulations and policies that are aligned with LaMP goals.

1.2.1 LaMP Chemical Reduction Activities

The following highlighted activities are a direct result of the LaMP (i.e., activities that were funded for LaMP implementation and in which workgroup members had an active role):

- Collections were carried out in different parts of the basin, including electronic waste and pharmaceutical collections by the non-profit, faith-based organization, Earth Keepers, in the Upper Peninsula. First time hazardous waste collections also took place in some Ontario communities. Various outreach activities promoted collections and waste diversion on tribal reservations and in Canadian First Nations communities. The Western Lake Superior Sanitary District (WLSSD) continued "Medicine Cabinet Clean-Out Days". Several local governments sponsored mercury product collections.
- Technical data sharing included the first LaMP-hosted Lake Superior conference held since 1990. The 2007 "*Making a Great Lake Superior"* conference included a toxic chemical session facilitated by the LaMP Chemical Committee.
- Other outreach efforts included presentations at tribal events (fisher meetings, tribal open houses and health fairs, powwows), the *Midwest Society of Environmental Toxicology and Chemistry* and the *Eighth International Conference on Mercury as a Global Pollutant* by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) on reducing health risks from eating fish. GLIFWC also regularly publishes articles on healthy fish consumption in its triannual newspaper, the *Mazina'igan,* and distributes Mercury Maps to tribal members illustrating the mercury concentrations in walleye from various lakes.
- Open burning abatement projects included the conclusion of a project that involved three local Minnesota governments and the Minnesota Pollution Control Agency (MPCA). In Ontario, Neebing Township prohibited trash burning. Outreach was conducted on First Nations communities to discourage open burning.

1.2.2 Other Projects Aligned with LaMP Goals

The following highlighted projects were not a direct result of the LaMP but are in alignment with LaMP goals and took place in the LSB:

- Energy conservation and alternative energy projects were carried out by a variety of entities at several levels. For example, a number of buildings recently built or remodeled in the LSB have been certified by the Leadership in Energy and Environmental Design (LEED), including nine college campus projects, two health care clinics, the Resource Management and Tribal Court building on the Fond du Lac reservation, a business, Coast Guard station and a rural electric cooperative building. An additional 33 projects have registered for LEED certification.
    - Minnesota Power has increased wind power development in its portfolio, including Oliver County and Bison wind farms in North Dakota and Taconite Ridge in Minnesota. Several tribes in the Lake Superior basin (Fond du Lac, Bad River, Keweenaw Bay Indian Community, Red Cliff and Grand Portage) have begun evaluating wind power potential on their reservations. The Fond du Lac Band has also installed solar panels on its Ojibwe school.
    - The Greenwich Wind Farm under construction in the Township of Dorion (Ontario). Once complete, it will provide approximately 100 megawatt (MW) of power under optimal operating conditions. This is enough renewable energy to power around 30,000 typical Canadian homes each year.

- The Prince Wind Farm, located northwest of Sault Ste. Marie, was Canada's largest wind farm when it began operation in November 2006. It has 126 wind turbine generators and a combined installed capacity of 189 MW.

- Wastewater treatment plants throughout the basin are being upgraded. Canada and Ontario have announced funding for upgrading Nipigon and Red Rock sewage treatment facilities from primary to secondary treatment. The Town of Nipigon has completed the upgrade of its primary sewage treatment plant to secondary treatment standards and is operational. The Town of Red Rock is currently undertaking an environmental assessment to determine its preferred option to upgrade to secondary treatment standards. These upgrades will help with the delisting of Nipigon Bay as an Area of Concern (AOC) by reducing the amount of municipal wastewater pollution entering the bay. In Michigan, the City of Ishpeming has documented a decrease in mercury discharge after requiring amalgam separators at dental offices. The City of Marquette is upgrading its wastewater treatment plant with activated sludge and new secondary clarifiers. Tribal wastewater projects include extending sewer lines and bringing failing septic systems up to code.
- Household hazardous waste (HHW) and pesticide collections were carried out, including city, county, tribal/First Nations, and regional HHW and waste pesticide collections. The Bad River and Red Cliff Bands carried out programs to eliminate elemental mercury in thermometers and sphygmomanometers at tribal health clinics.
- Sediment projects, including both studies and implementation, have been carried out on both sides of the border. For example, design and federal environmental assessment are underway for the thin-layer cap for contaminated sediment in Peninsula Harbour. Assessment of sediment management options is underway at Thunder Bay North Harbour. In St. Marys River, studies are being done to determine whether deeper, more-contaminated sediments may be exposed during increased flow, ice scour and changes in water level at Bellevue Marine Park. Assessments are being done at two sites downstream of the park to determine what sediment management may be required. Sediment characterization and assessment projects are also underway in the St. Louis River AOC, by Minnesota and Wisconsin, which will facilitate prioritization of areas for remediation and restoration.
- The Keweenaw Bay Indian Community has completed remediation of a brownfield site on its reservation. The Sand Point brownfield site was capped in 2006 and re-vegetated with native flora in 2011.
- Under the Great Lakes Regional Collaboration (GLRC), the Great Lakes states, tribes, and cities worked with the U.S. Environmental Protection Agency (U.S. EPA) to develop two regional strategies to address mercury in the Great Lakes Basin. One strategy focused on mercury in products and the other on atmospheric mercury emissions. The Mercury in Products Phase-down Strategy was developed in 2008 and a Mercury Emissions Reduction Strategy was developed in 2010.
- The Great Lakes Air Deposition Program funded a study that brought together over 170 scientists and managers from around the Great Lakes Basin to compile and evaluate over 100,000 mercury measurements and conduct new modeling and analyses. The *Great*

Lakes Mercury Connections integration report summarizes the technical published documents.

- The MPCA's statewide mercury Total Maximum Daily Load (TMDL) was approved by U.S. EPA in 2007. In 2008, Minnesota stakeholders made recommendations in the Strategy Framework for Implementing Minnesota's Statewide Mercury TMDL. This includes mercury reduction schedules for various sectors.
- In January 2008, the Michigan Department of Environmental Quality (MDEQ) released its Mercury Staff Report, a state-wide strategy to eliminate anthropogenic mercury use and releases in Michigan. As MDEQ implements the report's recommendations, further reductions in mercury loadings to Michigan's environment should result.
- In addition to these reduction projects, the Minnesota Department of Natural Resources Minerals Department has received federal funding through the Great Lakes Restoration Initiative (GLRI) to examine different mercury emission control technologies at taconite plants. This sector is the largest source of mercury emissions in the 2010 LSB inventory.
- A statewide open burning survey was done by Minnesota in 2010. Results show that statewide, rural Minnesotans are burning 12% less than in 2004. In northeastern Minnesota, which includes the LSB, the drop was 18%. In 2005, the Bad River Band of the Lake Superior Tribe of Chippewa Indians initiated a Burn Barrel Buyback Program to reduce open burning on the reservation.

1.2.3 New Regulations and Policies Aligned with LaMP Goals

Some government regulations and policies have been developed since the 2005 Chemical Milestones report that affect releases of the nine chemicals targeted for zero discharge. Those that are most closely aligned with contaminants in the LSB include the following:

- New PCB regulations were published in September 2008 in *Canada Gazette II*. The purpose of these regulations is to minimize the risks posed by the use, storage and release of PCBs by accelerating the elimination of these substances. An amendment was published in *Canada Gazette II* on March 31, 2010.
- On August 24, 2007, Ontario implemented *Ontario Regulation 496/07* that requires cessation of coal use at the remaining four coal-fired plants, including Thunder Bay, by December 31, 2014.
- In December 2011, the U.S. EPA issued the first national standards for mercury pollution from power plants, entitled the *Mercury and Air Toxics Standards (MATS),* pursuant to a 20-year legal requirement to reduce dangerous air toxics. U.S. EPA estimates that these standards will greatly reduce emissions of mercury, arsenic, acid, nickel and cyanide, preventing up to 11,000 premature deaths per year. In Michigan alone, the U.S. EPA estimates that the MATS rules will prevent up to 410 deaths and will result in $1.4 to $3.4 billion of health benefits to Michigan residents in 2016.
- Minnesota's Next Generation Act was passed in 2007. It established a strong renewable energy standard which requires energy companies to provide 25% of power from renewable sources by 2025, appropriated funding for energy projects and research, and

established statewide greenhouse gas reduction goals of 15% by 2015, 30% by 2025, and 80% by 2050.

- In 2008, Wisconsin passed a rule to control mercury emissions from coal-fired power plants. The rule requires a 90% reduction of mercury emissions or acceptance of a 0.0080 pounds mercury per gigawatt (GW)-hr limitation from large coal-fired power plants by January 1, 2015. Large coal-fired power plants also have the option of choosing a multi-pollutant alternative. The multi-pollutant alternative requires the affected power plants to achieve nitrogen oxides (NOx) and sulfur dioxide (SO_2) reductions beyond those currently required by federal and state regulations.
- In 2009, Wisconsin enacted a law that prohibited the sale of a number of products that contain mercury, including thermometers, manometers, thermostats, barometers, hydrometers, toys, jewelry and over-the-counter drugs.
- Since February 2009, the United Nations Environment Programme (UNEP) has been developing a globally legally binding instrument to control mercury pollution (UNEP, 2012; U.S. EPA, 2012).

Chapter 2. Introduction

2.1 Purpose

This Critical Chemical Reduction Milestones report is intended to provide a summary of progress that has been made since 1990 towards reducing the nine chemicals targeted for zero discharge (see Table 1-1). The summary includes inventories of mercury, dioxin and PCBs (to the extent possible), including amounts recovered in collections, amounts estimated to be released and where possible, amounts estimated to be retained in storage, in service and in sediment. The estimated reductions are then compared to the Stage 2 reduction targets (see Table 1-2).

As well as summarizing progress towards the 2010 targets, this report also identifies strategies for making progress toward the reduction targets for 2015. In addition, the report examines the strategies for addressing the other critical and prevention pollutants (see Table 1-1) and emerging contaminants as well as the nine chemicals targeted for zero discharge.

2.2 Methods

The original Lake Superior Binational Agreement (Appendix A) provided guidance on three types of activities that should be pursued as part of the ZDDP. These included pollution prevention, special protection designations and controls and regulations. Over time, the binational partners have refined the original guidance into a set of guiding principles.

2.2.1 Three Actions from the Lake Superior Binational Agreement

Of the three types of actions, the most productive so far for achieving reductions has been pollution prevention (P2). A number of the projects listed in Section 1.2.1 and 1.2.2 are classic examples of P2. Through P2, the "low hanging fruit" has been reduced but the remaining sources are more difficult to reduce. It is the intent of the binational partners to prioritize P2 as the preferred reduction strategy (see Guiding Principles in Appendix A2).

The second type of activity involves the development of special protection designations. Most of the special protection designations mentioned in the agreement have been implemented. The Outstanding International Resource Water (OIRW) designations were adopted by Michigan and Minnesota before LaMP 2000 was released. Wisconsin adopted special protection designations for Lake Superior with administrative rule revisions in 2006. The OIRW designation and Wisconsin's equivalent designation require new or expanded discharges to use best technology in process and treatment. Wisconsin also included greater protections for additional Lake Superior tributaries and certain nearshore areas as part of state Outstanding Resource Waters (ORWs) designations in 2006.

On the Canadian side of the basin, Parks Canada is in the process of establishing the Lake Superior National Marine Conservation Area from Thunder Cape at the tip of Sleeping Giant Provincial Park in the west, to Bottle Point just east of Terrace Bay, and extending south in the lake to the Canada-U.S. border. It will include the waters of Black Bay and Nipigon Bay and cover a total area of 10,850km^2. Once created, it will be the largest freshwater protected area in the world. A Memorandum of Agreement between Canada and Ontario for establishing the conservation area was signed in 2007. In the meantime, Parks Canada continues to work with

First Nations, local communities, various government organizations and local stakeholders to address outstanding issues that will bring the area closer to establishment. The Harmonization Committee was created in October 2010. This committee is made up of various provincial and federal governments with overlapping roles within the Lake Superior National Marine Conservation Area.

The third activity type, controls and regulations, includes a number of regulatory activities that were under development when the Lake Superior Binational Agreement was approved in 1991. Since then, various programs have been implemented and others are under development or consideration. Section 1.2.3 summarizes the most recent regulations and government policies that will have the greatest impact in the basin.

2.2.2 Guiding Principles

In 1997, the Lake Superior Task Force (composed of administrators and senior managers from the various government agencies and partners under the Lake Superior LaMP) crafted a set of guiding principles to clarify the approach used to achieve load reduction targets toward reaching zero discharge. These were subsequently published in the LaMP Stage 2 in 1999. In 2004, these guiding principles were updated and served to guide continuing implementation of the ZDDP (Appendix A2).

Chapter 3. Load Reduction Inventory

Since the 1990 baseline year, releases of the nine designated chemicals have declined in the LSB. Between 1990 and 2000, reductions occurred primarily because of the closures of two mining facilities (White Pine Mine copper smelter in Michigan and Algoma Ore Division iron sintering facility in Ontario). Other reductions occurred because of changes in mercury-bearing products such as paint and batteries, changes in incineration rules, a U.S. EPA-driven Great Lakes-wide phase-out of PCB equipment, and hazardous waste and pesticide collections. Since 2000, additional reductions have occurred, mostly in the industrial, incineration, and product source categories.

3.1 Out-of-Basin Sources

As discussed in the LaMP 2000 (Chapter 4, pages 4-82 to 85), reductions in out-of-basin sources of toxic chemicals are needed to reduce contaminant levels in Lake Superior. While the LaMP program itself cannot drive state, provincial, national and international policy and regulations that affect emissions, it is in the best interests of the LaMP partners to participate in these efforts to reduce toxic chemicals from being imported into the LSB via atmospheric deposition and products. Participation in out-of-basin reduction programs by LaMP partners is reported in Sections 1.2.2 and 1.2.3 and Appendix B

3.2 In-Basin Inventory Methodology

This section describes load reduction estimates for 1990, 2000, 2005 and 2010. Both the Canadian and U.S. inventories have been reviewed and updated for all four time periods. Appendix C shows a more detailed version of each of the two nations' updated mercury and dioxin inventories for the LSB. Whenever possible, actual measurements of discharges and emissions were used for the inventory. Where directly measured data were not available, a variety of estimates were used. These include databases such as the National Pollutant Reduction Inventory in Canada and the National Emissions Inventory in the U.S., estimates derived from emission factors and throughput information from basin facilities (e.g., taconite mercury emissions), and population normalized numbers that are based on other inventories. Readers of this document are encouraged to supply updated inventory estimates for review by the Chemical Committee.

When the U.S. and Canadian inventories were combined, there were some differences in categories used to report, methodologies used, or inventory calculation. These reporting differences may have resulted in categorical and subtotal/total changes between the Chapter 3 and Appendix C tables.

In addition to estimating discharges and emissions of mercury and dioxin, Environment Canada and U.S. EPA attempted to estimate discharges and emissions for HCB. Select sources of HCB were also identified and included in the inventory. These estimates are not considered as complete as the mercury and dioxin inventories, but Section 3.7 presents preliminary estimates. In addition to estimating discharges and emissions, the partners have estimated the amount of mercury, dioxin, and HCB in ash, sludge, contaminated soil, contaminated sediment, disposed materials, recycled materials, and/or mine tailings and waste rock when possible. These tables are summarized in Appendix C.

3.3 Mercury

3.3.1 Mercury Reduction Goals

The reduction goals for mercury discharges and emissions described in LaMP Stage 2 include the following (1990 baseline):

- 60% reduction by 2000
- No formal mercury milestone for 2005
- 80% reduction by 2010
- No formal mercury milestone for 2015
- 100% reduction by 2020

In Section 3.3.2 below, it is estimated that an 80% reduction of mercury emissions and discharges has taken place since 1990, which meets the mercury reduction goal for 2010. In order to meet the 100% reduction goal by 2020, an additional 417 kg/yr of mercury must be reduced from 2010 loads.

3.3.2 Sources of Mercury

The mercury inventory in Table 3-1 includes releases to both air and water for the baseline year, as well as the milestone year of 2000, non-milestone year of 2005, and milestone year of 2010. It should be noted that discharges (i.e., to water) are only a small portion of the releases. In 1990, discharges represented <2% of the total discharges and emissions, but by 2010 discharges dropped to <0.7%. (See Appendix C for detailed estimates of discharges and emissions).

Some changes have been made to the inventory tables since the first version appeared in LaMP 2000. In both the 2005 and 2010 milestone inventory analyses, Environment Canada and U.S. EPA investigated the previous methods and assured consistency with the most recent estimates. Table 3-1 shows the revisions to the mercury inventory among the three reports. In the LaMP 2000, the first estimates of the 1990 baseline discharges and emissions were made, along with estimates for 2000 (but no projections were made for future milestones). In the 2005 Milestones report, the 1990 and 2000 estimates were recalculated and the 2005 estimates were made (again, no projections were made for future milestones). In this 2010 Milestones report, 1990, 2000, and 2005 estimates are recalculated and the 2010 emissions have been calculated. No projections were made for 2015.

Although these three reports show a trend of decreasing estimated mercury emissions, this is attributable to improved database and inventory methods over the years. Hence, this decrease should not be interpreted as a decrease in actual emissions. Unless the background inventory documents for each report are consulted, it is inappropriate to compare estimates between LaMP 2000, the 2005 Milestones report, and this current 2010 Milestones report. For the purposes of trend analysis of sources, the 2010 Milestones report estimates are considered the best estimates available. Previous numbers in the LaMP 2000 and 2005 Milestones report are considered out of date.

Table 3-1. Revisions to Mercury Discharge and Emission Estimates in LaMP 2000, 2005 Milestones Report, and Current 2010 Milestones Report, kg/yr

LaMP Report	1990	2000	2005	2010
LaMP 2000	2444	819	NA	NA
2005 Milestones	2250	700	653	NA
2010 Milestones	2136	617	597	417

NA – Not Applicable

While the inventories have improved, there are still uncertainties and limitations that must be noted. For mercury, the caveats that must be considered include:

- In Canada, a considerable quantity of mercury is estimated to be present in discarded mercury relays and instrumentation and control equipment. A high recycling rate was assigned for mercury relays (60%) and for instruments and control equipment (50%) for the year 2010 based on the work of Cain (2005) and Cain et al. (2007), which is in turn based on U.S.-based practices.
- Other consumer products not in the Canadian inventory include preservatives, reagents, mercury compounds, and other mercury-added products. However, the combined mercury present in these products is small compared to the amount in switches and relays, instrumentation and control, dental amalgam, and the other consumer products examined in this report.
- A systematic process is needed in Canada for identifying and managing mercury-containing equipment in industrial, commercial, and institutional facilities. Information gathered from such a project would assist in providing a more accurate estimate of the fate of mercury in these products once they are discarded.
- The inventory of mercury-containing consumer products being disposed in the LSB (Ontario) needs improvement.
- 2010 National Pollutant Release Inventory (NPRI) data were not available during the preparation of the Canadian inventory; values provided in the inventory were for the year 2008 because 2009 and 2010 data were not available. This should be updated once the 2010 NPRI data are available. The quality of the NPRI data is rated as unknown because the methodology used to estimate the amounts released by the individual reporting facilities is not known.
- There was no information available for mercury emission from soil for the Canadian inventory.

- Mercury emission factors for fireplaces, woodstoves, and wood-burning furnaces/boilers are based on limited studies. In addition, it is important to note that while the quantity of mercury present in discarded products is based on data, with the exception of fluorescent lamps, most of the assumptions regarding the fate of mercury are based on professional judgment, resulting in uncertainty about the actual quantities released to the atmosphere, water, and land. See Benazon Environmental Inc. (2011) for additional details.
- It is also difficult to estimate the impact of local reduction efforts because equipment that contains mercury is not inventoried. For example, a hazardous waste collection of 30 kg of mercury cannot necessarily be subtracted from the total amount of mercury known to be in the basin since that total amount is not known. When possible, the amounts captured by local reduction efforts are captured in Appendix B.
- Data from the 2008 National Emissions Inventory (NEI) were used for the U.S. 2010 estimates because 2010 data were not available.
- When NEI data were not available and the in-basin population was used for U.S. 2010 emission estimates, 2008 population estimates were used since the throughput, including cremation rates and vehicle miles traveled, were also 2008 data.
- The population estimate by the U.S. EPA in this report is more accurate than that of the previous Milestones report because a geographic information systems (GIS)-based analysis limited the analysis this year to only those portions of counties that were within the Lake Superior watershed.
- Very small sources of mercury have been removed from the inventory for simplicity. For example, the NEI estimated 0.0008 kg of mercury from a grocery store in Minnesota and 0.0001 kg from a sand and gravel pit in Michigan. In total, 154 minor sources represented <0.4 kg/yr of mercury.

With these caveats, Table 3-2 shows the mercury emissions and discharges from sources in the LSB while Table 3-3 shows the percent reduction.

Table 3-2. Mercury Releases to Air and Water from Sources in the Lake Superior Basin, kg/yr

Source	1990 (kg/yr)			2000 (kg/yr)			2005 (kg/yr)			2010 (kg/yr)		
	U.S. 1990	Canada 1990	Total 1990	U.S. 2000	Canada 2000	Total 2000	U.S. 2005	Canada 2005	Total 2005	U.S. 2010	Canada 2010	Total 2010
Mining/ Metals Production[1]	852.3	604.4	1456.7	338.3	4.5	342.8	303.2	26.2	329.4	257.1	3.7	260.8
Industrial	26.3	23.4	49.7	13.1	14.7	27.7	16.3	7.8	24.1	4.3	0.1	4.4
Products	213.8	31.4	245.2	6.7	1.8	8.5	4.8	1.6	6.4	3.5	1.0	4.5
Fuel Combustion	134.2	61.0	195.2	131.6	60.0	191.6	167.6	40.0	207.6	108.1	10.7	118.8
Incineration[2]	81.1	12.0	93.1	15.8	4.4	20.2	9.0	3.1	12.1	9.5	3.1	12.6
Waste Handling/ Landfills	38.8	27.5	66.3	10.0	5.0	15.0	8.1	5.0	13.1	6.7	5.0	11.7
Municipal/ Institutional	20.8	9.2	30.0	2.1	9.2	11.3	1.8	3.0	4.8	1.7	3.0	4.7
Total	1367.3	768.9	2136.2	517.6	99.5	617.1	510.7	86.7	597.4	390.9	26.6	417.4

[1] Includes iron sintering at Algoma Steel in Wawa, ON in 1990 and Mesabi Nugget in Hoyt Lakes, MN in 2010.
[2] Includes cremation.

Table 3-3. Percent Reduction of Mercury Releases from 1990 to 2010

Source	Reduction (%) 1990-2000	Reduction (%) 1990-2005	Reduction (%) 1990-2010
Mining/ Metals Production	76%	77%	82%
Industrial	44%	52%	91%
Products	97%	97%	98%
Fuel Combustion	2%	-6%1	39%
Incineration	78%	87%	86%
Waste Handling/ Landfills	77%	80%	82%
Municipal/ Institutional	62%	84%	84%
Total	71%	72%	80%
Stage 2 Reduction Goal	60%	70%	80%

[1] Emissions from the U.S. coal-fired utility sector increased in 2005.
[2] Although the LaMP Stage 2 did not have a mercury reduction goal for 2005, 70% is halfway between the 2000 and 2010 goals.

There have been reductions in discharge and emissions of mercury across all major sources from 1990 to 2010 (Figure 3-1). Large reductions in the mining sector (82%) are due to the closure of the White Pine copper smelter in White Pine, Michigan and the Algoma iron sintering plant in Wawa, Ontario. Industrial releases (primarily Canadian pulp and paper) have decreased by 91% since 1990. Product-related releases (i.e., incineration, products and waste handling/landfills) have clearly undergone significant reductions between 1990 and 2010. Municipal/institutional releases have been reduced by 84%. While the percentage reduction from fuel combustion seems low at 39%, it is in part a result of reductions due to installation of mercury emissions control technology rather than simply a reflection of decreased demand. This emissions control technology represents a significant improvement for the individual facilities that have invested in it.

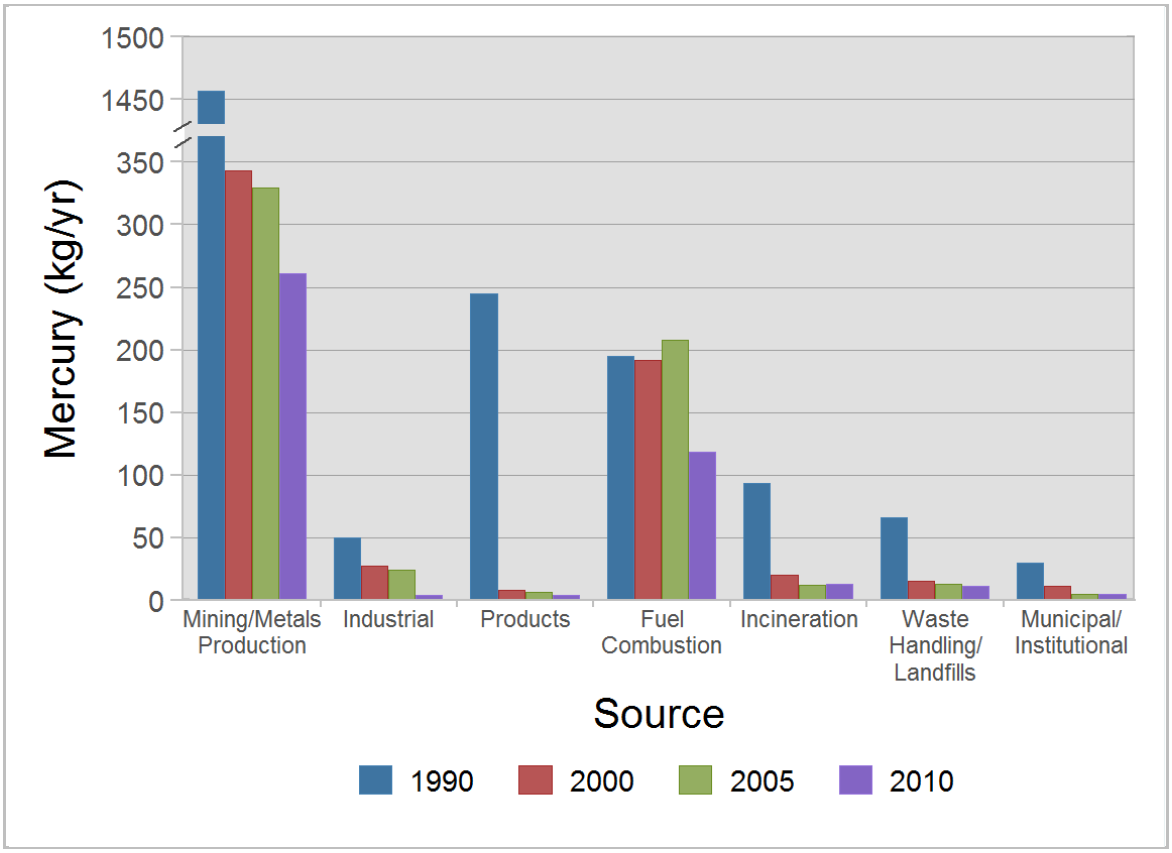
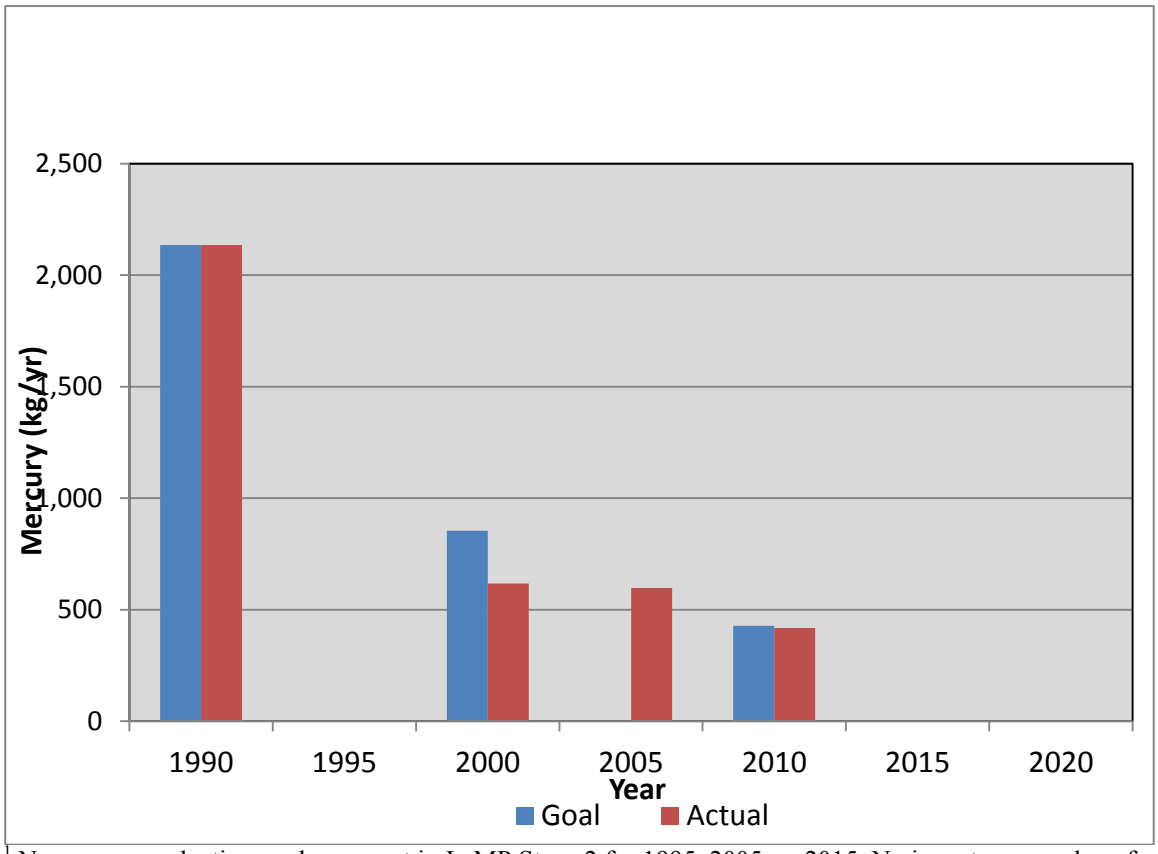


Figure 3-1. Reductions of Mercury Discharges and Emissions from Lake Superior Sectors between 1990 and 2010, kg/yr.

Figure 3-2 shows mercury releases since 1990 compared to the reduction schedule identified in the Stage 2 LaMP. (Note that there were no official Stage 2 LaMP goals for 1995 and 2005.) The trend shows a decrease in releases since 1990. Releases are at or very close to the milestone reduction targets. In 2010, the goal was 427 kg compared to the amount of discharges and emissions estimated for 2010 of 417 kg. An additional 204 kg/yr of mercury must be reduced from 2010 loads to meet the 2015 goal and 417 kg/yr must be reduced to reach the 2020 target of 100% reduction.



[1] No mercury reduction goals were set in LaMP Stage 2 for 1995, 2005, or 2015. No inventory was done for 1995. The goal for 2020 is zero discharge and zero emission.

Figure 3-2. Estimated Mercury Discharges and Emissions from Lake Superior Sources Between 1990 and 2010 Compared to the Stage 2 Load Reduction Goals[1], kg/yr.

The remaining mercury emission sources in the basin in 2010 are shown in Figure 3-3. Mining/metals production represents 63% of the mercury emissions for 2010, and of the 261 kg/yr from mining/metals production, a total of 257 kg/yr is attributed to taconite mining. The next largest source is fuel combustion (28%), which totaled 119 kg/yr, of which 86 kg/yr is from coal-fired utilities. Incineration (including cremation) and waste handling/landfills account for 3% each. Together, institutional/municipal products and industry account for 3% of emissions.

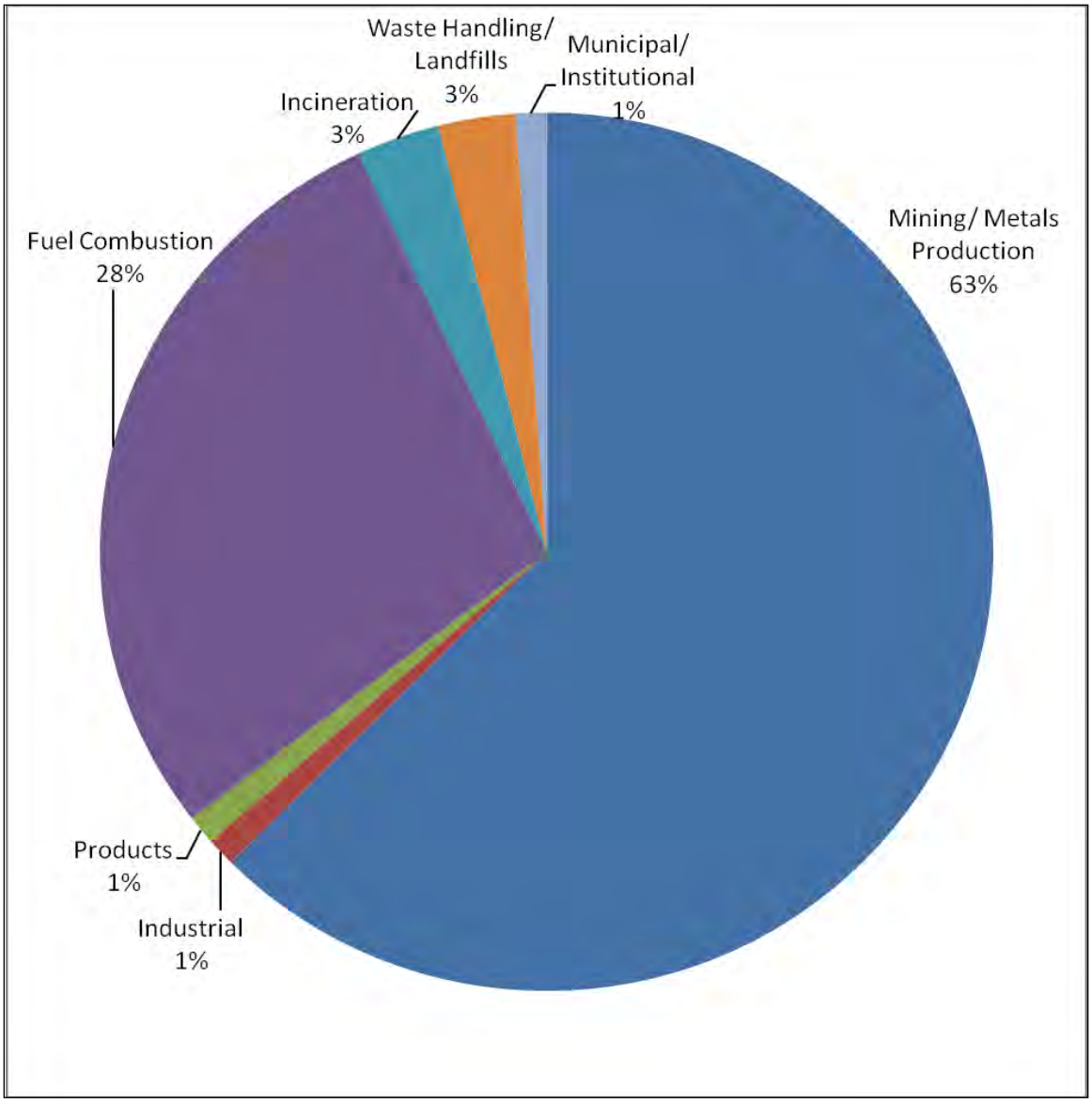


Figure 3-3. Percentage of Mercury Releases from Different Sectors in the Lake Superior Basin, 2010.

3.3.3 2020 Milestone Conclusions

It is possible to anticipate certain mercury reductions and increased releases/emissions from sources in the Lake Superior basin before reaching the 2015 and 2020 milestone years. New facilities or facility expansions may occur before 2015 and may increase the mercury loading.

Fuel Combustion

Figure 3-1 shows a gradual increase in mercury emissions from fuel combustion between 1990 and 2005, but a decline in 2010. This is due to a combination of reduced demand and the installation of mercury emission control equipment at the Presque Isle and Taconite Harbor coal-fired utilities. The utilities that operate these plants are considering whether they will continue to operate in the future. Specifically, the Minnesota Public Utilities Commission (MPUC) required Minnesota Power to conduct a baseload diversification study that looked at closing boilers at the Taconite Harbor and Syl Laskin coal-fired power plants in the Lake Superior watershed (MPUC, 2011). In addition, media reports indicate Wisconsin Energy (which operates the Presque Isle plant) is considering whether the plant might be shut down or converted to natural gas (WE Energies Blog, 2011). In Canada, the Long Term Energy Plan announced by the Government of Ontario in November 2010 stated that Thunder Bay Generating Station will convert from burning coal to burning natural gas, which will virtually eliminate mercury emissions from that site. It is expected that mercury emissions will remain at less than 10 kg/yr until coal combustion ceases in 2014.

According to Table 3-4, the potential reduction for these three largest coal-fired power plants in the basin ranges from <7 kg/yr with just Thunder Bay converting to natural gas, to about 40 kg/yr if all three facilities were either shut down or converted to natural gas. Some of the smaller utility coal-fired power plants are included in Table 3-4 for comparison purposes. Note that the 76 MW Bay Front plant was estimated to emit 13.8 kg of mercury in 2010, while the much larger 625 MW Presque Isle plant was estimated to emit 13.7 kg in 2010, which is much less than in 2005 before the Toxecon® mercury control technology was in place. These smaller plants are becoming more significant as the mercury inventory shrinks and the larger plants improve their pollution control equipment.

Table 3-4. Mercury Emissions from Six[1] Coal-fired Power Plants in the Lake Superior Watershed, 1990-2010

Name	1990 (kg Hg)	2000 (kg Hg)	2005 (kg Hg)	2010 (kg Hg)
Taconite Harbor, MN	0.5	22.6	25.8	28.9
Bay Front, WI	1.5	1.5	13.9	13.8
Presque Isle, MI	68.0	41.7	55.5	13.7
Laskin, MN	2.6	8.1	9.5	7.5
Thunder Bay, ON	57	56	37	7
Hibbard, MN	2.1	0.7	2.7	7.2
Total Mercury, all sectors	2136.6	620.9	635.3	417.4

[1] These six have the highest mercury emissions from coal. There are other coal-fired boilers in the watershed that release less mercury and others that burn a mixture of coal and other fuels.

Although further reductions from coal-fired power plants can be expected, energy agencies also project that energy consumption overall will decrease. For example, trends tracked by the U.S. Energy Information Administration (EIA) suggest that per capita energy use will drop through

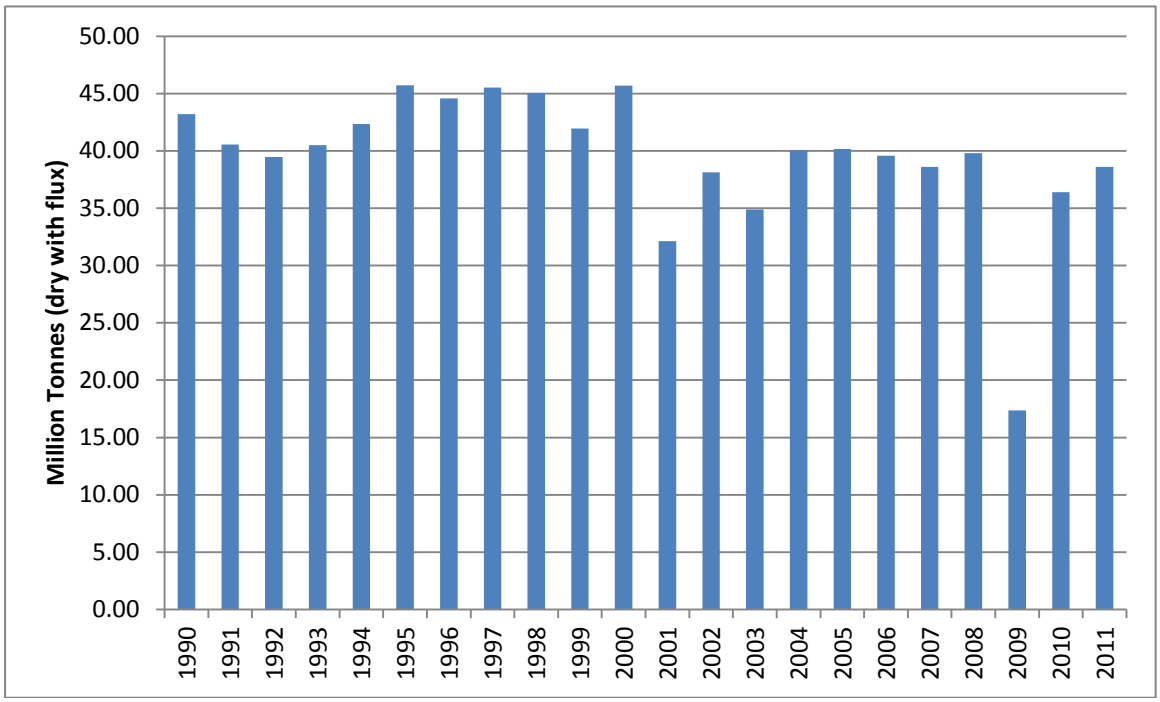
2035 (EIA, 2011). This is coupled with a decline in basin population (i.e., the estimated Canadian population dropped from 247,926 [1990] to 227,108 [2010] while the estimated U.S. population increased from 423,204 to 433,860 in the same period). However, the overall decrease in population may not cause a decrease in emissions since the power plants can sell their excess energy on the grid.

Mining and Metals Production

A variety of projects, including taconite mining, nonferrous mining, scram mining, and a possible refinery expansion have been considered within or near the Lake Superior watershed, although discharge or emission estimates are not possible at this time and some of these new sources may have low mercury emissions.

Sources identified in every milestone inventory have the potential to fluctuate. Because taconite production is such a large source of mercury, and because emissions generally track production, it is important to acknowledge variability in this source (Figure 3-4). For example, the milestone year of 2000 was over 13 M tonnes higher than in 2001. If the 2000 production had been closer to the 2001 production, then the 2005 and 2010 milestones would have shown an increase in mercury emissions from taconite rather than a decrease. Variability in large sources therefore plays an important role in describing progress towards the goal of zero discharge and zero emission.

The status of mercury reductions in the taconite industry is difficult to project at this point. Studies on mercury cycling in taconite plants are ongoing. Taconite plants are currently running at or near capacity and analysts believe demand for taconite pellets, nuggets, and concentrate will remain strong. However, in 2008-2010, the taconite industry was hit by the overall economic recession and plants were idled temporarily in 2009. Production picked up and by 2010 and 2011, levels were only slightly lower than pre-recession production.



Sources: 1990-2009 data from Minnesota Department of Revenue, 2010; 2010 data from Wagstrom, 2011; rough estimate from Myers, 2011

Figure 3-4. Taconite Production in Minnesota, 1990-2011.

For this reason, the overall amount of mercury emitted per tonne of pellets produced may better describe the overall progress made by this industry (Table 3-5). These data suggest some improvement in the rate of mercury emitted from taconite production since 1990. This is probably due to installation of pollution control equipment at the Keewatin Taconite plant in 2005, which dropped mercury emissions at that facility by 28%. The increased ratio in 2005 is due to a higher proportion of pellets from plants with higher emission factors.

Table 3-5. Ratio of Kilograms of Mercury Emitted to Million Tonnes of Taconite Pellets Produced in Minnesota during LaMP Milestone Years

Year	Mercury Emissions (kg)	Pellets (M tonnes)	Ratio
1990	323.9	43.20	7.5
2000	341.8	45.68	7.5
2005	338.1	40.17	8.4
2010	250.4	36.39	6.9

Other Sources and Pathways

Contaminated Sediments. In Canada's portion of the LSB, significant quantities of mercury (~880 kg) are present in contaminated sediments. These are located within two AOCs (Jellicoe Cove, and Thunder Bay Harbour), which are scheduled to be remediated prior to 2020. Also, Santiago (2010) has indicated that limited sediment sampling at Black Bird Creek and Lake "C" has shown possible low level mercury contamination. Additional sediment sampling is underway to further characterize the extent of contamination.

Recycling and Disposal. Large quantities of mercury (2,900 to 5,800 kg) are also present in sludge disposed in drums contained within reinforced concrete vaults at a waste disposal site in Marathon, Ontario. The site is being monitored; however, groundwater sampling results indicate that no mercury is leaching from the waste site.

In addition, many industries in Canadian North Shore towns recycle fluorescent lights. Concern has been raised that preparation of lamps for recycling may result in significant emissions of mercury. For example, the use of a drum top crusher to crush used fluorescent lamps before they are sent for recycling may be a preventable source of mercury emissions. Further investigation is required to identify potential sources of mercury emissions once used fluorescent lamps are collected, stored and transported for recycling.

Cremation. Mercury emissions from cremation have increased due to increased cremation activity and quantity of amalgam in the teeth of deceased. Increases of mercury emissions from cremation are expected to continue over the next 15 years (MPCA, 2008) followed by a gradual decline as less amalgam will be present in the future generations.

Mercury-containing Products:

- Thermometers: There are bans in sale and use of mercury-containing fever thermometers, and mercury-free alternative thermometers are replacing them (Interstate Mercury Education and Reduction Clearinghouse [IMERC], 2008a, Cain, 2005), resulting in corresponding decline in mercury emissions (to ~2015).
- Thermostats: Various states also have restrictions on mercury-containing thermostats, resulting in many companies ceasing manufacture or sale, resulting in an expected gradual decline in emissions over the next decade (to ~2020).
- Switches and Relays: Legislative restrictions of certain mercury-added switches and availability of new non-mercury technologies have contributed to the decline in mercury in switches and relays in 2007 compared to 2004 (IMERC, 2008b), resulting in many companies ceasing manufacture or sale of these products across the U.S. However, because of the long life-spans of switches and relays, a large quantity of mercury is expected to remain in the public realm. North American automakers voluntarily phased out the use of mercury in switches in new motor vehicles at the end of 2002 (Michigan Mercury Switch Study, 2002) and associated mercury emissions are expected to decrease over the next 10 years (to 2020). Voluntary discontinuation of mercury switches by Canadian appliance manufacturers occurred in 1999/2000, but because these products

have long service life, mercury will continue to be found in discarded appliances for the next 20 to 30 years (Association of Municipal Recyclers [AMRC], 2004).

- Measurement and Control Devices: Sales of new measurement and control devices containing mercury have declined considerably in recent years in the U.S. (Wienert, 2009), likely due to product restrictions.
- Button-Cell Batteries: After 2011, mercury emissions from button-cell batteries are expected to decline considerably when battery manufacturers voluntarily produce mercury-free alternatives (from 2010 to 2015). However, embedded mercury button-cell batteries in products manufactured off-shore will likely continue to be consumed in the U.S. and Canada for some time to come.

Special Materials Program. The Canadian Municipal Hazardous and Special Waste (MHSW) Program is designed to collect consumer hazardous and special materials so they can be recycled or disposed of safely. The first phase began in July 2008 and includes nine materials. The second (consolidated) phase began July 1, 2010 and includes 22 materials (including the original nine).The program is expected to substantially increase the quantity of mercury-containing products recycled in the LSB.

As older mercury-containing products are discarded and replaced with non-mercury devices, it is expected that emissions from this source will continue to decline accordingly. Despite the restriction, bans, voluntary phase-out and recycling/waste management activities, some mercury-containing products will still be found in use, storage, or disposal past the 2020 ZDDP target.

3.4 Dioxin

In this inventory, the term dioxins and furans refers to two groups of chemical compounds: the polychlorinated dibenzo-*p*-dioxins and the polychlorinated dibenzofurans. These chemicals are not created intentionally, but can be generated by sub-optimal combustion conditions and incomplete combustion processes. Because of their hydrophobic nature and resistance toward metabolism, dioxins and furans persist and bioaccumulate in the fatty tissues of animals and humans. There are numerous individual compounds, or congeners, associated with each of these chemical groups that exhibit varying degrees of similar “dioxin-like” toxicity. The most widely studied and highly toxic compound is 2,3,7,8-TCDD. Dioxins and furans are usually quantified in terms of total toxicity relative to TCDD expressed as a TEQ, in which a series of toxic equivalency factors (TEFs) are assigned to each of the dioxin-like compounds in a mixture to obtain the relative toxicity with respect to TCDD. Therefore, the TEQ is the amount of TCDD needed to equal the combined toxic effect of all dioxins and furans found in the mixture.

Different TEF schemes have been used to calculate TEQ, including:

- I-TEQ, a scheme adopted by the U.S. EPA in 1989;
- TEQ-$WHO_{94,}$ adopted by the World Health Organization (WHO) in 1994;
- TEQ-WHO_{98}, adopted by WHO in 1998 as an update to the previous one; and
- TEQ-WHO_{05}, adopted by WHO in 2005 as an update to the previous one.

To be consistent with the dioxins and furans inventory prepared by the U.S. EPA (U.S. EPA, 2005), emissions of dioxins and furans are generally reported in g TEQ-WHO98/yr wherever possible. In some instances, however, only I-TEQ data are presented because the TEQ-WHO_{98} equivalents are not available. Yet in other cases (burn barrels and yard waste), dioxin and furan data are available in g TEQ-WHO_{05}/yr. See Appendix C for more details on units used. For example, an emission of 4 g dioxin in a year is reported using the different TEFs as follows:

- 4 g I-TEQ/yr
- 4 gTEQ-WHO_{94}/yr
- 4 gTEQ-WHO98/yr
- 4 gTEQ-WHO_{05}/yr

An examination of the TEF assigned to each congener within the I-TEQ, TEQ-WHO_{98} , and TEQ-WHO_{05} calculation methodologies show that the difference between the three methodologies is generally small and would likely result in similar estimates. It is unclear which would result in a higher estimate as it depends on the concentrations of the individual congeners, which vary by source.

3.4.1 Dioxin Reduction Goals

The reduction goals for dioxin, HCB, and OCS described in LaMP Stage 2 include the following (1990 baseline):

- No formal dioxin milestone for 2000
- 80% reduction by 2005
- No formal dioxin milestone for 2010
- 90% reduction by 2015
- 100% reduction by 2020

In order to meet the 90% reduction goal by 2015, an additional 1.03 TEQ/yr of dioxin must be reduced from 2010 loads. In Section 3.4.2 below, it is estimated that an 86% reduction of dioxin emissions and discharges has taken place since 1990. Due to the similar methods of formation of dioxin, HCB, and OCS, the lack of data concerning discharges and emissions of OCS, and the incompleteness of the HCB inventory, changes in the dioxin inventory will serve as a surrogate for both HCB and OCS inventories. Additional HCB discharge and emission information is presented in Section 3.7, but the percent reduction has not been estimated due to the incomplete inventory.

3.4.2 Sources of Dioxin

The dioxin inventory, listed in Table 3-6, includes releases to air and water for the baseline year, the year 2000, the milestone year of 2005 and the year 2010. It should be noted that similar to mercury, discharges to water are only a small portion of the releases inventoried in Table 3-6.

For example, in both the U.S. and Canada the amount of dioxin discharged to water and soil was <1% of the total releases to air, water, and soil in 2010 (see Appendix C).

Some important changes have been made since the first version of the inventory tables in LaMP 2000. The inventory has been adjusted downward mainly because the U.S. incineration numbers in LaMP 2000 reflected a different unit (g total polychlorinated dibenzo-p-dioxin [PCDD]/ polychlorinated dibenzofuran [PCDF]), although incineration is still the single largest category in the revised inventory for 2010. Also, coal-fired power plants were identified as the largest point sources of dioxin in 2005. However, based on revised data submitted under NPRI and discussions with representatives of the facility, it appears that previous dioxin emission estimates were incorrectly calculated by the Thunder Bay Generating Station (Todd, 2010). Current emissions from this source are documented as 0 g TEQ/yr in the NPRI database. Once these corrections are made, the pattern of incineration being the largest source and fuel combustion being the second largest source is the case for 2000, 2005, and 2010. The 1990 baseline year was dominated by an iron sintering plant, which was shut down before the 2000 milestone year.

While the inventories have improved, uncertainties and limitations still must be noted:

- In Canada, there is considerable uncertainty associated with the emissions estimate from landfill fires and burn barrels due to the lack of accurate data. The frequency and extent of landfill fires in the past is unknown and there is some uncertainty about the percentage of waste burned in rural areas. If more than 5% of annual rural waste is burned in landfill fires, emissions from landfill fires could be an important source of dioxins and furans. Additional information on the quantity of garbage burned is required along with appropriate emission factors.
- No releases were estimated from sediments on the Canadian side of the LSB. Low concentrations of dioxins and furans have been found to be widely dispersed within the watershed in those locations, with higher levels present in Thunder Bay, Peninsula Harbour and at the mouth of the Magpie River, as a result of industrial activity. Limited sediment sampling at Black Bird Creek and Lake "C" has shown contamination with dioxins and furans (Santiago, 2010). Elevated dioxin levels have also been found in sediments of Crawford Creek and floodplain soils within the St. Louis River AOC, below a former wood treatment facility in Superior, Wisconsin. Additional sediment sampling is underway to further characterize the extent of contamination. Insufficient information exists to estimate quantities.
- Due to reporting cycles, neither 2010 NPRI nor NEI data were available so values provided in the inventory were for year 2008. An update is desirable once the 2010 NPRI data are available.
- Information is needed on the extent to which land clearing and brush burning operations exist in the LSB. In the U.S., Lake Superior and national inventories, land clearing activities have a high uncertainty compared to controlled sources. Until the method and LSB-specific activity data improve, land clearing estimates will not be added to the inventory.
- There are potentially significant sources of dioxin emissions which have not been captured in the inventory. For example, the inventory does not include dioxin from

wildfires which may have human or natural origins. Additional information on the use of outdoor wood furnaces in the LSB is required.

- In some categories, no evidence was found of changes in practices between the one milestone year and the next so the estimate stayed the same.
- The U.S. and Canada used different methods in estimating dioxin emissions from open burning of trash. The Canadian method assumes that: (1) 11% of the total population in northwestern Ontario burn garbage, and (2) 60% of residential waste generated by households was burned in burn barrels. The U.S. inventory assumes that: (1) 19% of basin residents in Michigan and Wisconsin and 16.8% in Minnesota burn garbage, and (2) 43% of waste generated by rural households was burned.
- The difference between states' burning rate is due to a 2010 Minnesota statewide survey which documents a decrease in the rate of burning in northeastern Minnesota since 2006. Since a LaMP open burning abatement project had been carried out in northeast Minnesota in 2006 and 2007, but not elsewhere, it was felt that the new Minnesota rate should not be applied in Michigan and Wisconsin.
- The U.S. NEI (U.S. EPA, 2008) was used as a last resort for some categories since methodologies and reporting may not be nationally consistent.

Table 3-6 shows the current estimates of dioxin discharges and emissions from sources in the LSB. Table 3-7 shows the estimated percent reduction over time.

The largest single reduction was due to the closing of Algoma Steel's iron sintering plant in Wawa, Ontario in 1998, which alone was responsible for about 66% of the dioxin emission reduction between 1990 and 2010. In 2010, the largest source of dioxin is incineration, and most of the incineration emissions are from U.S. unpermitted burning of trash via backyard burning, landfill fires, and small incinerators at businesses. At roughly half the emissions from incineration, fuel combustion was the next largest source in 2010. Perhaps the most striking finding is that there has been little progress in these two largest sources between 2005 and 2010. The percent reductions for both sources are virtually unchanged and their relative size means that the overall percent reduction between 2005 and 2010 is also unchanged.

Figure 3-5 shows dioxin releases since 1990 compared to the reduction schedule identified in the Stage 2 LaMP. (Note that there were no Stage 2 LaMP goals for 1995, 2000, and 2010. The goal of 85% reduction for 2010, which was half-way between the 2005 and 2015 goals, was extrapolated). The trend shows a decrease in releases since 1990. The 2010 estimated releases are just below the milestone reduction target. To reach the 2015 target of 90% reduction, an additional 4% reduction from 1990 levels is needed. Regardless of the TEF schema used to calculate, this equates to an additional reduction of dioxin of about 1 g TEQ/yr. However, to reach the ultimate 2020 target of 100% reduction, an additional 14% reduction from 1990 levels is required. This equates to an additional reduction of dioxin of about 4 g TEQ/yr from 2010.

Figure 3-6 shows the distribution of sources from various sectors remaining in the LSB in 2010. Incineration accounts for 65% of the dioxin emissions for 2010. This includes burn barrel emissions, landfill fires, small incinerators, and Canadian (but not U.S.) open burning. Fuel

combustion accounts for 32% of emissions. The remaining percentage is from commercial byproduct and industrial releases. Municipal/institutional sectors did not contribute to dioxin releases in 2010.

3.4.3 2020 Milestone Conclusions

There was not a LaMP Stage 2 dioxin goal for 2010. However, a goal of 85% was extrapolated, which was halfway between the 2005 (80%) and 2015 (90%) goals. Of the individual sources that currently contribute dioxin emissions, only two – industrial releases and municipal/institutional releases – were successful in achieving the theoretical 85% reduction target; however, these two sources contribute less than 2% of the current emissions total. Additional effort is required to reduce emissions from other sources.

Table 3-6. Dioxin Releases to Air and Water from Sources in the Lake Superior Basin, g TEQ/yr

Source	1990 (g TEQ/yr)			2000 (g TEQ/yr)			2005 (g TEQ/yr)			2010 (g TEQ/yr)		
	U.S. 1990	Canada 1990	Total 1990	U.S. 2000	Canada 2000	Total 2000	U.S. 2005	Canada 2005	Total 2005	U.S. 2010	Canada 2010	Total 2010
Iron Sintering	NA	19.40	19.40	NA	0.00	0.00	NA	0.00	0.00	NA	0.00	0.00
Incineration	6.43	0.80	7.23	3.47	0.66	4.13	2.35	0.29	2.65	2.29	0.30	2.59
Fuel Combustion	1.52	0.25	1.77	0.82	0.22	1.04	1.02	0.23	1.25	1.05	0.19	1.25
Industrial	0.01	0.72	0.73	0.01	0.03	0.04	0.01	0.04	0.05	0.00	0.03	0.03
Commercial By-Product	0.04	0.10	0.14	0.04	0.07	0.11	0.02	0.08	0.10	0.02	0.08	0.10
Municipal/ Institutional	0.0004	0.05	0.0504	0.0004	0.05	0.0504	0.0045	0.00	0.0045	0.0001	0.00	0.0001
Total*	**7.99**	**21.33**	**29.31**	**4.34**	**1.04**	**5.38**	**3.40**	**0.65**	**4.05**	**3.36**	**0.60**	**3.96**

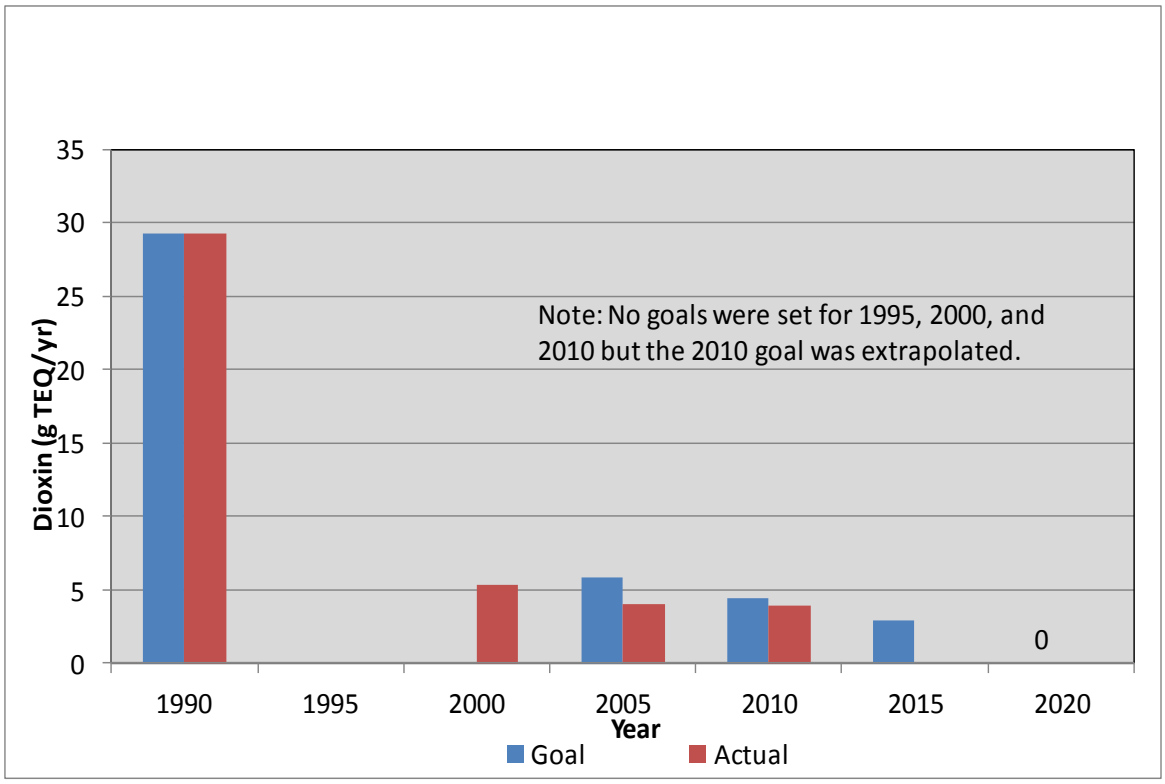
NA = Not Applicable; The Algoma Steel Plant was located in Wawa, Ontario (Canada).

* Totals are estimates only. It is recognized (and discussed in text) that U.S. and Canadian values were generated using different TEFs as indicated by the TEQ. Different dioxin units are used in different databases, sometimes even within categories. For the purposes of tracking percent reduction over time, these unit differences do not influence the analysis. For the U.S., generally facility emission estimates are TEQ-WHO_{98} and mobile and area source emissions use TEQ-WHO_{05}. For Canada, generally coal and wood combustion, industrial emissions, incinerators, cremation, and emissions from products are reported as I-TEQ, petroleum combustion and landfill fires are reported as TEQ-WHO_{98}, and backyard trash and yard waste burning are reported as TEQ-WHO_{05}. More information on TEQs used is provided in Appendix C.

Table 3-7. Percent Reduction of Dioxin Releases from 1990 to 2010

Source	Reduction (%) 1990-2000	Reduction (%) 1990-2005	Reduction (%) 1990-2010
Iron Sintering	100	100	100
Incineration	43	63	64
Fuel Combustion	41	29	29
Industrial	94	93	96
Commercial By-Product	21	28	31
Municipal/ Institutional	0	91	100[1]
Total	**82**	**86**	**86**
Stage 2 Reduction Goal	**na**	**80**	**85[2]**

[1] A small amount of dioxin discharge was estimated for 2010, so technically, the reduction is 99.8%.
[2] Although the LaMP Stage 2 did not have a 2010 dioxin reduction goal, 85% is halfway between the 2005 and 2015 goals.



Total values are expressed g TEQ/yr. These values are estimates generated summing data with I-TEF and TEQ-WHO_x.

Figure 3-5. Estimated Reductions of Dioxin Releases to Air and Water from Lake Superior Sources between 1990 and 2010 Compared to Stage 2 Load Reduction Goals, g TEQ/yr.

Overall, the extrapolated 2010 goal of 85% was barely achieved, with an overall reduction of 86%. This goal was met due to the elimination of the iron sintering sector from the inventory (closure of the Algoma Steel plant). In order to meet the 90% reduction goal in 2015, the remaining in-basin sources must be reduced by an additional 1.03 g TEQ/yr of dioxin. U.S. and Canadian unpermitted burning contributed 2.59 g TEQ to 2010 dioxin releases, and as a preventable source of dioxin, elimination of unpermitted burning by 2015 should be targeted. After incineration, mobile sources were the largest emitters of dioxin in 2010 (i.e., 0.71 g TEQ for gasoline and diesel, on-road and non-road sources). Several national initiatives to improve emissions from cars, trucks, and ships have the potential to decrease dioxin emissions. The possible closure or conversion to natural gas of the largest coal-fired power plants in the basin as discussed in Section 3.3.3 would lead to decreases of dioxin emissions in the range of 0.01 to 0.03 g TEQ.

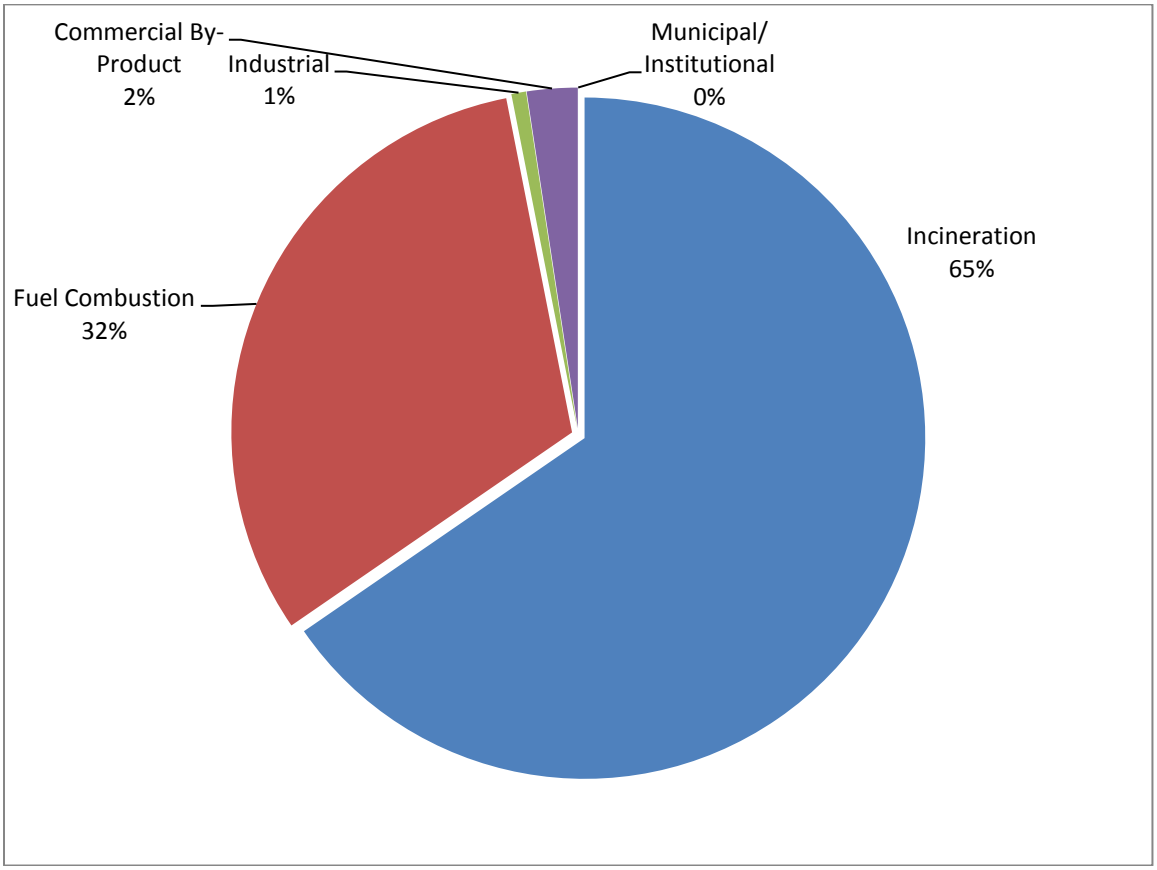


Figure 3-6. Percentage of Dioxin Releases from Different Sectors in the Lake Superior Basin, 2010.

3.5 PCBs

The original intent of the Stage 2 PCB reduction schedule was to inventory all the PCB equipment still in service or use, track its disposal and calculate the grams of PCBs reduced from the concentration of PCBs and the weight or volume of materials disposed. With this information, and respective calculations, it would be possible to estimate the percent reduction

over time. As noted in Chapter 4 of LaMP 2006 (LSBP, 2006), "The PCB inventory has been a challenge as there is no comprehensive and up-to-date inventory." Furthermore, no current inventory - U.S. or Canadian - tracks various smaller pieces of equipment that were exempt from provisions in U.S. and Canadian statutes and regulations or had reduced regulatory requirements, yet still contain PCBs many times at high concentrations (e.g., capacitors, insulators, etc.). Finally, through data collected over the period since the initiation of the Toxic Substances Control Act (TSCA), it is not clear that the initial baselines utilized for current partial inventories account for the actual amount of PCB equipment or PCBs present in U.S. commerce. Without the availability of a complete PCB inventory, and the lack of complete information in the currently available inventories, it is extremely difficult to have a full picture of PCB reductions over time. However, certain pieces of knowledge on the existence of PCB equipment may be ascertained through the data currently available.

To date, proposals for improving the inventory of PCB equipment have not been approved by potential funders, who prefer a more proactive approach to PCB reduction directed toward known sources of PCBs. In the absence of a complete inventory, the LSB Work Group has considered what information is actually available for determining priorities and measuring progress. This information includes: the current PCB management approaches that are used by the LSB jurisdictions (see Appendix D), the information that is available on quantities of PCB materials in existence or removed for disposal or storage, and the need for consistency with the Great Lakes toxics strategies.

Table 3-8 shows the amount of PCB materials decommissioned and put into storage in Ontario from facilities in the basin for selected years. The Ontario inventory covers large equipment that is ≥50 ppm PCBs, but not small equipment or equipment <50 ppm PCBs. Therefore, small high concentration PCB equipment is not counted. Even with these caveats, it is clear that there have been substantial reductions in the quantities stored at provincial sites in the LSB over the last 20 years. Significant quantities of PCB-containing equipment and PCB material have been moved out of storage for disposal since some of the categories are down to zero PCBs in storage in 2006 and other categories have dwindled to low amounts.

Table 3-8. Summary of PCB Waste in Storage at Province of Ontario-Monitored Sites in LSB 1990-2010

Type	Quantity of PCB Waste in Storage (assorted units)				
Year	**1990**	**1995**	**1997**	**2006**	**2010**
HL Liquid (L)	85,112	163,217	128,001	16,389	25,814
LL Liquid (L)	61,268	41,528	20,336	11,144	6,066
HL Solid (tonne)	146	114	69	5.0	1.8
LL Solid (tonne)	136	144	128	1.4	9.8
Misc.[1]	2,576	1,158	977	975	No Data

HL = High Level (>500 ppm); LL = Low Level (<500 ppm)

[1] Miscellaneous includes PCB-contaminated pallets (kg), transformer carcasses (kg), empty drums (no. of units), and unidentified waste (kg).

Environment Canada provided an estimate of the quantity of High Level (HL) liquid in use, totaling 93,528 L, and that 3,695 kg of Low Level (LL) solids and 144 L of LL liquids were sent for destruction.

It is expected that PCB waste will continue to drop on the Canadian side of the LSB in response to the requirements of the 2008 PCB regulations (Environment Canada, 2008) which call for:

- The phase-out of all HL PCBs (over 500 ppm PCBs) and PCBs over 50 ppm in sensitive areas that are currently in use by December 31, 2009.
- The phase out of all equipment between 50 and 500 ppm PCBs that are not in sensitive areas and the phase out of pole top (contaminated mineral oil) transformers and PCB light ballasts by December 31, 2025.
- The destruction of all PCBs that were stored on September 5, 2008 no later than December 31, 2011.
- The phase out of all PCB storage sites at sensitive locations by September 5, 2009.

For the U.S. side of the basin, Table 3-9 shows the amount of PCB materials that have been disposed of from facilities in Minnesota. Unlike other states within the Basin, Minnesota performs TSCA compliance monitoring and enforcement actions for U.S. EPA; additionally, Minnesota considers PCBs in concentrations ≥50 ppm to be a hazardous waste under the Resource Conservation and Recovery Act (RCRA) Subtitle C program, making PCBs a jointly regulated waste under RCRA and TSCA. However, Michigan and Wisconsin do not administer TSCA use programs, nor do they have a state statute equivalent to TSCA. As a result, Minnesota is the only state where it is possible to track disposal of PCBs from facilities located within the LSB. Despite these major distinctions, for simplicity, it is assumed that the actual disposal amounts for large PCB equipment ≥50 ppm PCBs among the three states will be similar as TSCA applies to all of those cases; however, the same may not be true for PCB equipment from sources not tracked explicitly by or regulated under TSCA (<50 ppm PCB equipment, small equipment, etc.), where only Minnesota requires additional waste management actions. In addition, the pathway for disposing of PCB materials will differ since Michigan and Wisconsin generators can dispose of many ≥50 ppm PCB waste streams as solid waste while those same wastes are classified as hazardous waste in Minnesota.

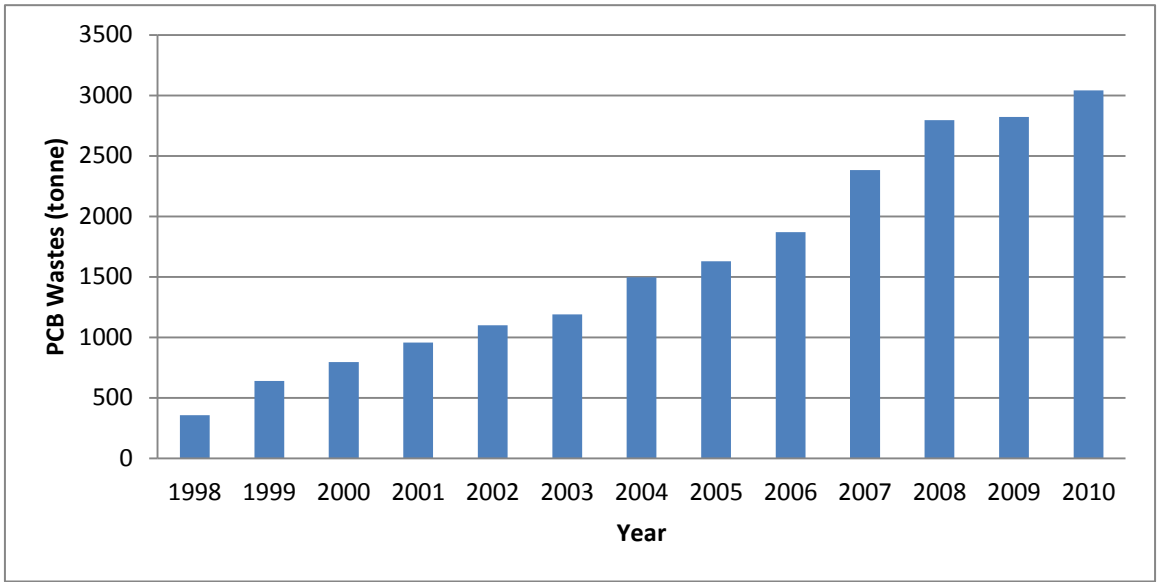
Table 3-9. Summary of All PCB Waste Disposed from Minnesota Lake Superior Facilities, 1998 – 2010 (tonnes/yr)

Type	1998	1999	2000	2001	2002	2003	2004[1]	2005	2006	2007	2008	2009	2010
PCB Waste	356	283	157	160	143	89	2M	133	242	512	414	26	220

[1]The high quantity for 2004 was due to an incident at a recycling facility where a PCB containing item passed through a shredder and resulted in a large amount of contamination (though at low concentrations).

Despite the reporting limitations, over time, the total amount of PCB materials will decrease since the amount of PCB equipment is finite and most PCB equipment is nearing the end of its projected life. The cumulative total PCB waste has been graphed in Figure 3-7, which shows that

the rate of total PCB wastes has not flattened over the years. It is likely that large amounts of equipment in both the U.S. and Canada are approaching the end of their useful service, which will result in further increases in disposal, followed by the anticipated flattening in the cumulative disposal curve.



[1] Due to an incident at a recycling facility in 2004 where a PCB containing item that passed through a shredder contaminated a large amount of low level contaminated material, the material associated with that incident has been removed for graphing purposes. The facility in question was assumed to have disposed of 500,000 pounds (~227,000 kg) of PCB waste instead. In other years, the facility reported 370,000 to 1,000,000 pounds (170,000 to 460,000) but in 2004, it was 4,412,976,000 pounds (~2,000,000,000 kg).

Figure 3-7. Cumulative Total of All PCB Wastes Disposed from Minnesota Facilities in the Lake Superior Basin, 1998 – 2010 (tonnes/yr)[1]

An attempt was made to further analyze trends in different types of PCB materials, including the three categories below. Except for ballasts as noted below, reports of "PCB wastes" were not added to either the low or high level wastes.

- LL waste, which was primarily PCB oil >50 ppm plus solvent rinsate;
- HL waste, which was primarily PCB oil and transformers >500 ppm;
- Ballasts, which include records that specify ballasts were disposed, as well as records of "PCB waste" from schools, medical facilities and appliance and electrical businesses (due to the high probability that the "PCB waste" was actually ballasts).

Table 3-10 shows the amounts of HL waste, LL waste, and ballasts collected since 1998. There may be a leveling off for the LL and HL wastes, although this may simply reflect recent changes in reporting practices (e.g., reporting as "PCB waste"). For ballasts, Figure 3-8 suggests there is no sign of leveling off.

Table 3-10. Low Level PCB, High Level PCB, and Ballasts Disposed from Minnesota LSB Facilities, 1998 – 2010 (tonnes/yr)

Waste	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Low Level	128	113	87	58	76	0	1	0	13	13	0	0	0
High Level	27	13	0	64	2	2	3	8	0	0	0	0	0
Ballasts	4	4	3	4	3	3	3	4	7	7	7	4	7

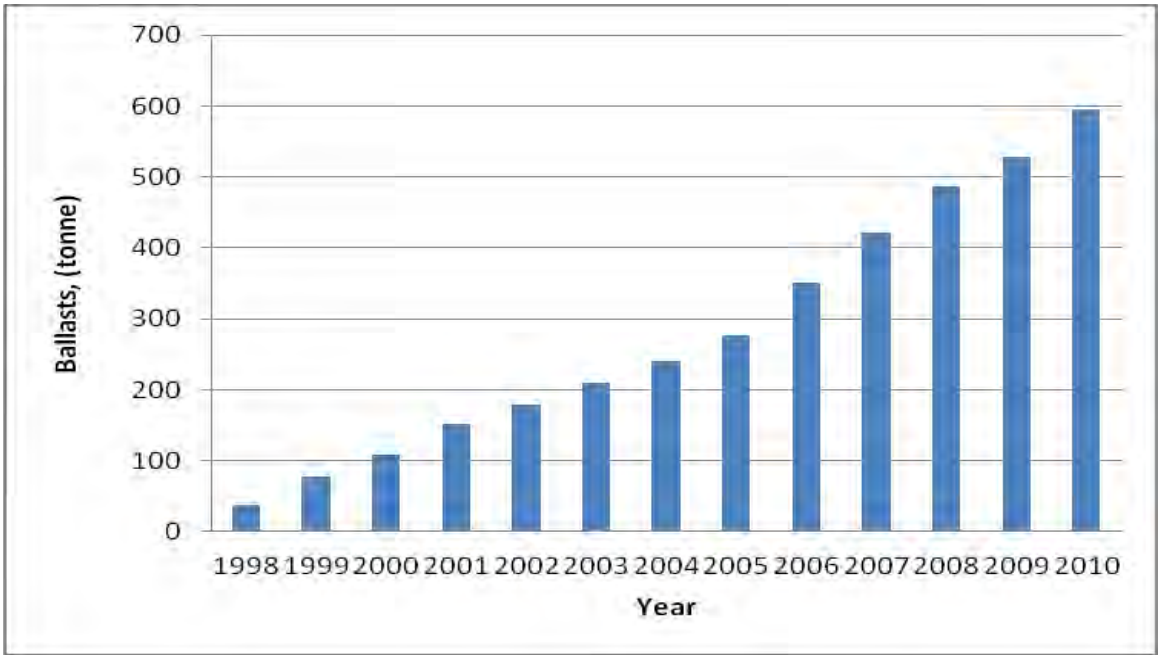


Figure 3-8. Ballasts Disposed from Facilities in the Minnesota Lake Superior Basin, 1998 – 2010 (tonnes/yr).

The ballast trend is of particular interest since it shows that ballasts are still being disposed of in large numbers. Ballasts are still in use in fluorescent lamps in schools, colleges, health care facilities, and workplaces. For example, the Minnesota records show that in 2010, two health care facilities disposed of over 400 kg of PCB wastes, two colleges disposed of 3,000 kg, and five school districts disposed of 27 kg of ballasts or "PCB waste" presumed to be ballasts. There are documented cases of leaking ballasts in U.S. classrooms; exposure to children and pregnant females is a concern.

The Chemical Committee proposes the following alternative method for tracking the Lake Superior PCB inventory and establishing a means of measuring progress:

1. Track 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. In preparing this report, the Ontario and Environment Canada databases have been reviewed and found to be slightly different.

2. Examine the storage and disposal category trends every 5 years (e.g., the weight of HL capacitors stored in Ontario or the weight of PCB oil in Minnesota). Produce figures showing the cumulative total for various categories and the total weight of materials removed or stored. Figures 3-7 and 3-8 are examples of this.[3]
3. In Canada, show how much of the stored PCBs are destroyed.
4. Compare trends with province-wide or state-wide trends.
5. Measure progress by the cumulative total of PCB materials disposed. PCB reductions should be as great or greater in the LSB as the province or state.

In addition to PCBs reported in Minnesota's hazardous waste disposal database, Minnesota records indicate that a spill of oil from PCB transformers was discovered in the LSB in 2007. Three transformers that were improperly stored leaked oil in a storage area. The site was cleaned up and the mining company that was responsible for the transformers was fined. An estimated 75 gallons (284 L) of PCB oil was spilled. Also, two distribution transformers that leaked a total of 6 gallons (23 L) of PCBs were cleaned up in 2006. As these are Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)-based incidents and not allowed events under TSCA, these spills may not be representative of conditions elsewhere in the LSB or nationally. However, PCB release incidents are currently being analyzed by the U.S. TSCA program to better evaluate the issue of "releases as PCB sources" within the Great Lakes Basin.

PCBs may also be discharged and emitted from sources in the basin as part of combustion processes, through inadvertent production in manufacturing processes (such as pigment and dye making), or leaks or illegal discharges to stormwater or wastewater treatment plants/publicly owned treatment works. Although manufacturing processes that are associated with inadvertent PCB production may not be present in the LSB, it is possible that products made from these processes may be used in the LSB. The Superior Work Group (SWG) attempted to calculate discharges and emissions from the U.S. portion of the basin for the first time in this Milestones report. The number was estimated to be 36 kg, mostly from backyard burning, although there is a low confidence in this number.

[3] Regulatory and/or reporting mechanisms are not currently available to separately track the Wisconsin and Michigan PCB disposal records from facilities within the LSB. See Appendix D for the PCB management approach in Michigan and Wisconsin.

3.6 Pesticides

3.6.1 Pesticide Reduction Goals

Use of dichlorodiphenyltrichloroethane (DDT), toxaphene, chlordane and aldrin/dieldrin peaked in the mid 1960s to mid 1970s. All of these pesticides' registrations were cancelled; production is legal, but sale and distribution within the U.S. and Canada is illegal. Cancellations occurred in the 1980s for domestic use in the U.S. and by the 1990s for domestic use in Canada. U.S. companies may still produce and export cancelled pesticides or "trans-ship" pesticides produced in one country and shipped to another. As recently as 2003, the Foundation for Advancement and Scientific Education found evidence of production or trans-shipment of these pesticides by U.S. companies in the Port Import Export Retrieval Service records (Smith et al., 2008).

The LSBP goal was to retrieve and destroy all remaining stockpiles of the cancelled pesticides in the basin by the year 2000. Cancelled pesticides targeted for collection include DDT, dichlorodiphenyldichloroethylene (DDE), aldrin/dieldrin, toxaphene, dicofol (also known as Kelthane), hexachlorobenzene, mercury pesticides, HCB pesticides, 2,4,5-T (Silvex) and other pesticides that have the potential to be contaminated by dioxin or HCB. Although significant quantities have been collected, it is not possible to assure that all stockpiles have been removed. In fact, significant quantities of some cancelled pesticides continued to be collected annually since 2000.

3.6.2 Pesticide Collections

Although U.S. and Canada domestic production has ceased and uses have been cancelled, these pesticides continue to have an environmental presence. Furthermore, it should be noted that toxaphene and other pesticides in Lake Superior mostly originate from regions outside the basin and significant amounts arrive through aerial transport and deposition. Collection programs in the LSB continue to gather these pesticides. Lake Superior strategies for pesticides include continued or expanded collection opportunities coupled with concerted public outreach. This approach has the advantage of collecting not only the pesticides targeted for zero discharge, but the other pesticides that are considered critical chemicals for Lake Superior (i.e., heptachlor and hexachlorocylcohexane [HCH]). The collections carried out in each Lake Superior jurisdiction are described below.

<u>Michigan</u>
In Michigan, the safe and proper disposal of outdated, unused or unwanted pesticides is accomplished primarily through the Michigan Clean Sweep Program, which is administered by the Michigan Department of Agriculture and Rural Development. Participating Clean Sweep sites will accept pesticide products and mercury free of charge from any Michigan resident. Over the past 14 years, nearly 1.7 million pounds (850 tons) of pesticides have been removed from circulation and properly disposed of via permanent collection sites. Currently, there are over a dozen Clean Sweep sites established around the state. The only long-standing collection site solely in the Lake Superior basin is located in Marquette and is operated by the Marquette County Solid Waste Management Authority.

Determining long-term trends in waste pesticide collections in Michigan's Upper Peninsula is difficult because of the limited availability of historical data. In general, pesticide usage has

been considered low in this area of the Lake Superior basin, and few pesticides were collected between 1990 and 1996 (Knorek, 2005). Data from 1996 to 2006 are limited because they are not in electronic form and/or are not readily available. However, approximately 434 kg (955 pounds) of pesticides were collected in Upper Peninsula counties from September 2002 to October 2003, including 15 kg (33 pounds) of DDT (LSBP, 2004).

Beginning in 2003, the State of Michigan began to systematically track collected products by U.S. EPA registration number or active ingredient. Soon thereafter, the state developed a database to better track, monitor and report collection data. In recent years, Michigan has been able to document the collection of tens of thousands of pounds of pesticides from around the state. In 2010, the Marquette collection site alone brought in a total of 3,457 kg (7,622 pounds) of pesticides (formulated product, including unknowns).

Table 3-11a shows the recent collection data specifically for zero discharge pesticides at the Marquette collection site. Amounts are listed as weight of active ingredient, not whole product. Overall, the amounts have been low for these pesticides, possibly indicating their relative scarcity in the region or the fact that they were brought in during earlier collections. It is unclear why DDT-containing products were received in 2010 but not in other years. It is possible that such products were received but without clear labeling. In fact, the Marquette site collects a large quantity of "unknown" pesticides (material without clear formulation information) annually. For example, in 2010 the total unknown submissions (formulated product) weighed approximately 298 kg (658 pounds).

In addition to the Clean Sweep site at Marquette, several other Upper Peninsula counties have organized pesticide collections independent of the Clean Sweep Program. Specifically, both Chippewa County and Mackinac County provided collection opportunities in recent years (Chippewa County joined Clean Sweep in 2011). As shown in Table 3-11b, these sites collected a large quantity of unused pesticides. Product amounts were tracked by net weight. Although breakdowns by active ingredient are not available, it is likely that some of the ZDDP chemicals were received at these collection sites. Unlike Marquette, both Chippewa and Mackinac Counties straddle multiple Great Lakes basins and thus some of the collected stockpiles derive from outside the Lake Superior basin. Overall, the data suggest that demand continues to exist for pesticide collection programs in the Upper Peninsula.

Table 3-11a. Waste Pesticides Collected in Marquette County, Michigan, Fiscal Years 2006 to 2010 (kg)[*]

Pesticide	2006	2007	2008	2009	2010	Total
Chlordane	1.2	NA	0.3	0	0.8	2.3
DDT	0	NA	0	0	3.2	3.2
Dieldrin/ Aldrin	0	NA	0	0	0.9	0.9
Dioxin[†]	0.3	NA	0.2	0.2	0	0.7
Heptachlor	0	NA	0	0	0	0
Mirex	0	NA	0	0	0	0
Toxaphene	0	NA	0	0	0.1	0.1
Total	1.5	NA	0.5	0.2	5.0	7.2

NA = Not Available
* All amounts reported are weight of active ingredient, not formulated product. Data from 2007 were not reported to the state.
[†] The pounds listed are for two pesticides containing dioxin, Silvex and 2,4,5-T.
Source: Michigan Department of Agriculture and Rural Development, 2011

Table 3-11b. Waste Pesticides Collected in Chippewa and Mackinac Counties, Michigan, 2005 to 2010[*] (net weight, kg)

Pesticide	2005	2006	2007	2008	2009	2010	Total
Chippewa – liquids	272	149	101	144	63	43	772
Chippewa – solids	50	143	47	39	24	35	338
Chippewa – aerosols	0	0	0	0	0	0	0
Mackinac – liquids	0	0	92	225	33	36	386
Mackinac – solids	39	0	10	262	152	22	485
Mackinac – aerosols	0	0	6	11	1	4	22
Total	361	292	256	681	273	140	2,003

Source: Drug & Laboratory Disposal, Inc., 2012

Minnesota

The Minnesota Clean Sweep Program began to collect waste pesticides in 1990. Over 2 million kg (4.6 million pounds) of waste pesticides have been collected and documented since the program began. Many of these pesticides were collected during clean sweep collections organized and staffed by the Minnesota Department of Agriculture (MDA). Sources included farms, small businesses, golf courses, nurseries, greenhouses, city and county parks, and road maintenance departments. The first waste pesticide clean sweeps were held in the LSB in 1992.

Since 1996, the WLSSD has had a cooperative agreement with MDA to collect and inventory all pesticides collected from households in Carlton, Cook, Lake, and St. Louis Counties. As part of this agreement, MDA would pay for the disposal of household pesticides collected at the Duluth Regional HHW facility, run by WLSSD, and shipped for disposal.

In 2002, the MDA began clean sweep operations with reduced funding. To address the continuing need for pesticide disposal, MDA worked with county and regional HHW establishments to expand existing partnerships to provide continuous opportunities for businesses and farmers seeking disposal of unwanted pesticides. MDA would pay for disposal of collected pesticides as well as continue to dispose of a predetermined amount of HHW waste pesticides. WLSSD has continued its cooperative agreement with MDA and documents certain pesticides disposed of from the area. Since spring of 2004, WLSSD is a cooperator in a new partnership with MDA that allows WLSSD to collect, store, and ship agricultural/business pesticides for payment by MDA. WLSSD also ships HHW waste pesticides for payment by MDA. To date, MDA has been able to pay for and record all pesticides that WLSSD has collected; however, future collections and payments depend on funding.

The new waste pesticide collection program has dropped the requirement to inventory household pesticides due to the time demand it places on HHW staff. However, partners are still required to record all PBT household pesticides (including dioxin bearing pesticides) that are received for disposal by MDA. MDA also requires participating facilities to document agriculture and business waste pesticides in order to distinguish them from HHW waste pesticides.

Table 3-12 presents data for pesticides targeted for zero discharge in the LSB. The table includes pesticides collected from northeastern Minnesota counties, which are mostly non-agricultural. WLSSD may have collected and disposed of household waste pesticides and even some business waste pesticides prior to 1996; however, these are not included in the table due to the difficulty in retrieving and analyzing paper records prior to 1996. All agriculture special event clean sweep collections held in the Basin are included. Any pesticides shipped by WLSSD for payment by MDA are recorded in MDA's database and thus are included in the tables.

The greatest amount of pesticides was collected from St. Louis County, where WLSSD is located. This may be influenced by how collected pesticides were inventoried. If a pesticide was not identified to a county, then it was listed under St. Louis County. No pesticides were collected from Cook County. During the period 1992-2007, approximately 3,569 kg (7,700 pounds) of DDT was collected. No mirex was collected from these counties from 1992 to 2007.

Wisconsin

The Wisconsin Department of Agriculture, Trade and Consumer Protection supports clean sweeps in Wisconsin counties. The first year that clean sweep grants were awarded in LSB counties was 1992. However, the data for 1992 were not broken down by individual pesticide. No data were reported for LSB counties in the years 1993-1995. In 1995, the Northwest Cleansweep Program was established for the collection and disposal of hazardous wastes in the northwest Wisconsin region. The program, run by the Northwest Wisconsin Regional Planning Commission (NWRPC) with funding from the Wisconsin Department of Agriculture, Trade and Consumer Protection, began agricultural collections in LSB counties in 1996. Table 3-13 presents data on agricultural pesticides collected by the NWRPC (from farmers and agribusinesses) beginning in 1996.

In addition to agricultural clean sweeps, periodic HHW collections have been conducted in northwestern Wisconsin counties. The Environmental Resources Center at the University of Wisconsin-Madison compiles and maintains data on Wisconsin Hazardous Waste Collection Programs, featuring households and very small quantity generator programs, at www.uwex.edu/erc/hazwste.html. The type of pesticide collected is not reported for HHW collections. In 2004, in the four-county LSB area of Wisconsin, no pesticides were collected during HHW collections held in Douglas County (no collections were held in Ashland, Bayfield, or Iron Counties).

While the Minnesota and Wisconsin pesticide collection reporting requirements are similar, it is not possible to combine them due to different periods of record (i.e., 1992-2007 for Minnesota and 1996-2010 for Wisconsin) and areas of coverage. Counties that are outside the Lake Superior basin but are lumped with Lake Superior counties in Minnesota (i.e., Aitkin, Itasca and Koochiching are not in the Lake Superior basin) are much less agricultural than the Wisconsin counties that are lumped with the Lake Superior counties (i.e., Burnett, Eau Claire, Price, Rusk, Sawyer, St. Croix, and Taylor are not in the Lake Superior basin).

Assuming the Minnesota data are the closest fit for the mostly non-agricultural basin, Figure 3-9 shows the rate of collections over time using a cumulative analysis (e.g., the amount of pesticides shown for 2007 is the cumulative amount collected between 1992 and 2007). Figure 3-9 shows that the rate of collection of these particular banned pesticides began to slow starting in 2001. While it is difficult to extrapolate based on a rate change, this suggests that most stockpiles of these banned pesticides have been collected and the current low rate of disposal reflects previously unknown stockpiles that are discovered during property transfer. Because the “break point” between the old and new rates is 2001, it appears that the LaMP Stage 2 goal of collecting all the stockpiles by 2000 was not met, but only missed the goal by one year in Minnesota and quite possibly in the rest of the Lake Superior basin.

Table 3-12. Waste Pesticides Collected in Minnesota Lake Superior Counties[1], 1992-2007 (kg of Product[2])

Pesticide	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
Chlordane	74	23	5	47	90	92	83	64	83	72	4	23	42	20	37	9	767
DDT	451	336	24	51	1403	135	253	267	306	134	32	34	59	40	40	5	3569
Dieldrin/ Aldrin	5	5	0	0	6	1	27	8	4	24	0	0	0	0	0	0	80
Dioxin[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	60	25	33	117
Heptachlor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.454
Mirex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Toxaphene	16	5	0	10	6	5	1	13	1	3	0	0	0	0	0	0	61.23
Total	**547**	**368**	**29**	**108**	**1505**	**234**	**364**	**352**	**394**	**234**	**36**	**58**	**100**	**120**	**104**	**47**	**4597**

[1] Includes data for pesticides collected in Carlton, Cook, Lake, and St. Louis Counties as well as Koochiching, Itasca and Aitkin Counties.
[2] Weight is for the pesticide product, not the active ingredient.
[3] The kilograms listed are for pesticides containing dioxin. These include Silvex, 2,4-D with 2,4,5-T, fenchlorphos, Ronnel, some Weedones, and a few others.
Source: (Kaminski, 2011)

Table 3-13. Waste Pesticides Collected in Wisconsin Northwest Cleansweeps[1], 1996-2010 (kg of Product[2])

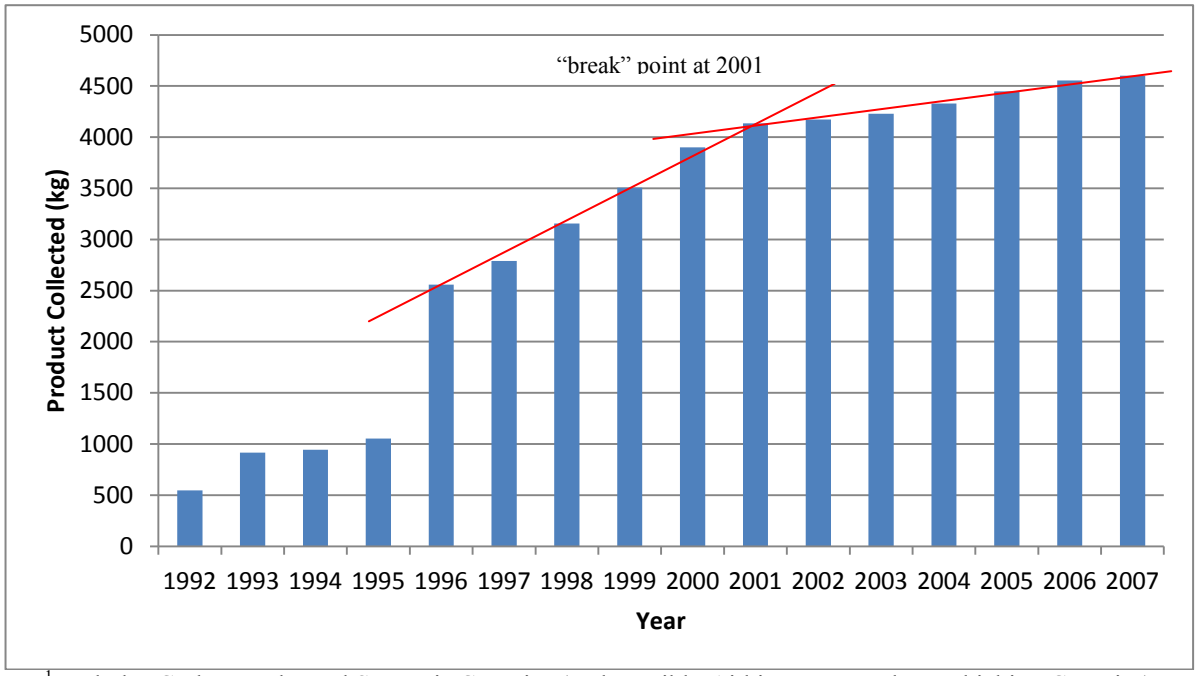
Pesticide	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Chlordane	0	2	0	19	45	0	33	34	1	9	6	25	18	27	26	244
DDD/DDT	36	3	0	61	76	101	30	5	0	8	11	5	8	15	13	372
Dieldrin/ Aldrin	0	4	0	330	6	10	0	0	0	0	0	0	3	14	23	390
Dioxin [3]	375	73	268	588	516	476	422	364	221	345	295	220	179	188	269	4798
Heptachlor	0	0	0	0	0	0	0	4	0	0	0	5	0	0	0	10
Mirex	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Toxaphene	218	0	0	0	0	0	0	0	0	0	0	0	4	0	0	221
Total	**629**	**82**	**267**	**998**	**643**	**587**	**485**	**407**	**223**	**362**	**312**	**255**	**212**	**244**	**331**	**6036**

[1] Includes data for pesticides collected in counties served by the NWRPC as follows:
1996: Ashland, Bayfield, Douglas, Iron; 1997: Ashland, Price, Taylor, Washburn; 1998: Counties served were not specified; 1999: Ashland, Douglas, Eau Claire, Iron, Rusk, Sawyer, St. Croix, Taylor, Washburn
2000: Ashland, Bayfield, Douglas, Iron, Price, Rusk, Sawyer, St. Croix, Taylor, Washburn; 2001-2003: Ashland, Bayfield, Burnett, Douglas, Iron, Price, Rusk, Sawyer, St. Croix, Taylor, Washburn; 2004: Ashland, Bayfield, Burnett, Douglas, Iron, Price, Rusk, Sawyer, Taylor, Washburn; 2005: Ashland, Bayfield, Burnett, Douglas, Price, Rusk, Sawyer, Taylor, Washburn; 2006-2009: Ashland, Bayfield, Burnett, Douglas, Iron, Price, Rusk, Sawyer, Taylor, Washburn; 2010: Ashland, Bayfield, Burnett, Douglas, Price, Rusk, Sawyer, Taylor, Washburn

[2] Weight is for the pesticide product, not the active ingredient.

[3] The pounds listed are for pesticides containing dioxin. These include Silvex, 2,4-D, pentachlorophenol, and 2,4,5-T.

Source: (Johnson, 2012).



[1] Includes Carlton, Lake and St. Louis Counties (and possibly Aitkin, Itasca and Koochiching Counties)

Figure 3-9. Cumulative Amount of Pesticide Products Collected in Northeast Minnesota 1992-2007 (kg)[1].

Ontario

On April 22, 2009, Ontario's Cosmetic Pesticides Ban was implemented under the Pesticides Act and Ontario Regulation 63/09 to prohibit the use of certain pesticides for cosmetic purposes. There are exceptions to the ban for the use of prohibited pesticides, such as agriculture and forestry. There are also exceptions to the ban for golf courses, specialty turf and public works, that require integrated pest management certification of licensed exterminators and the preparation of annual reports on prohibited pesticide use.

Under the ban, the use of biopesticides and certain lower risk pesticides are allowed for cosmetic uses such as on lawns, gardens, parks and school yards, The Ontario government has also provided funding to the Agricultural Adaptation Council to administer a grant program for the research and development of new biopesticides and lower risk pesticides. Information about the ban is available on the ministry website at: www.ontario.ca/pesticideban.

Since 1990, ZDDP pesticides have been removed as waste from the LSB as one of the objectives. Representatives of the Ontario Ministry of the Environment (OMOE) and the Ontario Ministry of Agriculture Food, and Rural Affairs (OMAFRA) were contacted regarding quantities of waste pesticides removed from the LSB over the 1990 to 2010 period. The agencies do not have a central database or inventory that tracks removed waste pesticides and therefore are not able to provide the requested information.[4] OMAFRA, with the support of Croplife, conducted an Ontario Obsolete Pesticides Collection event in 2009 in the Thunder Bay area. A total of 1,027 kg was collected at the Thunder Bay Coop (Brooker, 2010).

The Thunder Bay landfill and hazardous waste carriers operating in the LSB were contacted by the Canadian engineering consultant regarding quantities of pesticides, including those targeted for zero discharge in the LSB, removed from the Basin. Waste pesticides are amalgamated into drums under the OMOE waste classification number and there is no record for quantities of specific pesticides disposed (i.e., wastes are tracked by waste class and not specifically by pesticides that are part of the ZDDP). As summarized in Table 3-14, a total of 1,435 L and 192 kg of pesticides were collected by the Thunder Bay landfill and 160 L by EcoSuperior in 2005 (Benazon Environmental Inc,, 2006). The landfill collected 2,255 L in 2009. Clean Harbors reported that over the period of 2006 to 2009, a total of 479 L plus 6.5, 205 L labpack drums of pesticides were removed. Potter Environmental documented a total of 320 kg collected in 2009. Thus, the total quantities collected over the period of 2005 to 2009 are 1,539 kg, 4,329 L and 6.5, 205 L labpacks.

The cumulative total collected by all agencies since 1990 is not known.

3.6.3 Conclusions

Although the LSB is mostly non-agricultural, some banned pesticides were used for residential, silvicultural, or property management purposes and a large amount of banned pesticides have been collected in or near the basin since 1992. While the LaMP Stage 2 reduction goal was to

[4] Hazardous wastes are tracked by waste classes.

collect all of the pesticides that contained any of the nine ZDDP chemicals by 2000, it is obvious that these pesticides are still present.

It appears that most known pesticide stockpiles have been depleted. Where long-term data sets exist (e.g., Minnesota), the collection rate for these pesticides began to slow by 2001 (Figure 3-9). At the very least, the message is getting out to the communities and these pesticides are being collected for proper disposal. Finding these pesticides and seeing a continuing disposal pattern is a clear indication of the need for waste pesticide collections to continue, even in non-agricultural area.

Table 3-14. Summary of Pesticides Collected from the Ontario Portion of the LSB

Organization	Quantities			
	2005	**2006-2009**	**Total**	**Units**
Thunder Bay Landfill	1435	2255	3690	L
	192	No Data	192	kg
EcoSuperior	160	No Data	160	L
OMAFRA	No Data	1027	1027	kg
Clean Harbors	No Data	479	479	L
	No Data	6.5	6.5	205 L Labpack
Potter Environmental	No Data	320	320	kg
Total kg	**192**	**1347**	**1539**	kg
Total L	**1595**	**2734**	**4329**	L
Total Labpacks,	No data	No data	**6.5**	205 L Labpacks

3.7 Hexachlorobenzene

The HCB inventory is incomplete and is subject to several caveats, as noted below:

- HCB data are missing from the former Algoma Steel sintering plant in Wawa. However, since 19.4 g of dioxin was produced at the sintering facility in 1990 and reports on other iron sintering plants show large quantities of both dioxin and HCB are emitted, HCB was also likely emitted from the Ontario facility.
- Representatives of the Thunder Bay Generating Station have indicated that previous HCB estimates were erroneously calculated by the facility and that the facility is not, and has never been, a source of HCB in the basin. NPRI data from 2003 and onwards have been revised to show zero emissions from this source.
- HCB emissions from coal combustion were not estimated for the U.S. side.
- Canadian emissions for landfill fires are estimated at zero for 2010.
- There are no current medical waste incinerators operating on the Canadian side of the LSB because of Ontario Regulation 323/02, which required that all hospital incinerators

be shut down by the end of 2003. Four operated in 1990: two were shut down in 1994 and the other two were shut down in 2003.

- On the Canadian side, total on-site emissions/releases have declined from 218 g/yr in 1990 to 122 g/yr in 2010—a reduction of 44%, which is well below the 85% interim target reduction. The decrease is mostly associated with reductions in HCB from pulp and paper, as a result of the conversion of the bleaching process to chlorine dioxide in place of elemental chlorine.
- In each of the milestone years, the main sources of HCB on the Canadian side of the LSB are atmospheric emissions from on-site residential waste combustion (burn barrels; 96 g/yr) and leaching from pentachlorophenol-treated poles (16 g/yr). There is considerable uncertainty associated with these estimates because emission factors are based on limited data and because of the uncertainty associated with the activity data (quantity of waste burned in on-site residential waste combustion). Emissions from these sources are not expected to drop significantly over the next five years.
- The largest source in the U.S. HCB inventory was open burning of trash, followed by mobile sources.

Table 3-15 provides a tabular summary of the HCB inventory. Due to the caveats listed above, percent reduction calculations were not made for HCB; trends with the dioxin inventory will continue to serve as a surrogate for HCB trends.

Table 3-15. Hexachlorobenzene Releases to Air and Water from Sources in the Lake Superior Basin, g/yr

Source	1990 (g/yr)			2000 (g/yr)			2005 (g/yr)			2010 (g/yr)		
	U.S. 1990	Canada 1990	Total 1990	U.S. 2000	Canada 2000	Total 2000	U.S. 2005	Canada 2005	Total 2005	U.S. 2010	Canada 2010	Total 2010
Industrial	0.7	68.0	68.7	0.7	2.2	2.9	0.7	0.8	1.5	0.7	1.8	2.5
Fuel Combustion	54.7	10.6	65.3	57.8	10.3	68.1	60.6	10.3	70.9	63.3	7.8	71.1
Incineration	776.3	117.0	893.3	509.8	147.0	656.8	361.2	94.0	455.2	347.3	96.0	443.3
Pentachlorophenol Use	35.9	22.0	57.9	33.5	18.0	51.5	32.5	17.0	49.5	29.2	16.0	45.2
Total	867.7	217.6	1085.3	601.8	177.5	779.3	455.1	122.1	577.2	440.6	121.6	562.2

Chapter 4. Re-evaluation of Critical Chemicals

The LaMP Stage 2 document sets out a process for categorizing and managing pollutants in Lake Superior. The management goals are to restore impaired uses and achieve environmental criteria and lake ecosystem objectives. Based on this process, 23 critical and 14 prevention pollutants were identified (LSBP, 1998a).

Initially, a list of "chemicals of concern" was developed by combining the U.S. Great Lakes Water Quality Guidance (GLI) Bioaccumulative Chemicals of Concern (BCCs) and the list of Tier I and Tier II substances under the Canada-Ontario Agreement (COA). The chemicals of concern were then systematically evaluated, along with other substances identified in the Stage 1 LaMP, following the Management Goal Flow Chart for Lake Superior Critical Chemicals and placed into either the "critical" or "prevention" pollutant categories.

The list of critical pollutants includes substances that require reductions at the source and/or removal from the ecosystem to restore beneficial uses, achieve ecosystem objectives, meet jurisdictional environmental criteria, or are one of the nine substances in the ZDDP. Prevention pollutants have properties that give them the potential to impair the lake ecosystem (e.g., fish consumption advisories, fish and wildlife health impairments, and human health impairments) but they either have been found below harmful levels or they have not been monitored in Lake Superior. The intention is to manage the prevention pollutants to avoid impairments in the future.

To guide the development of load reduction or remedial strategies, critical and prevention pollutants were grouped into management categories. The critical pollutants are subdivided into three management categories, while the prevention pollutants are grouped into one of two management categories. The substances are listed by management category in Table 1-1 and an explanation of the management approaches can be found in Table 4-1.

This chapter provides an overview of the environmental levels of critical pollutants, prevention pollutants, and substances of emerging concern in Lake Superior air, water, sediment, and wildlife. This is followed by a Three-Part Management Strategy for chemicals of emerging concern, and an overview of levels of chemicals of emerging concern in the Lake Superior ecosystem.

Table 4-1. Management Approaches for Lake Superior Critical and Prevention Pollutants

Management Category	Description
Critical Pollutants	**Levels of PBT chemicals should not impair beneficial uses of the natural resources of the LSB. Levels of critical pollutants which are persistent, bioaccumulative and toxic should ultimately be virtually eliminated in the air, water and sediment in the LSB.**[1]
Zero Discharge[2]	As a management approach, virtual elimination from the environment requires that zero discharge or emission is applied to the use, generation, and release of PBT 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.
Lakewide Remediation	These pollutants have less potential to bioaccumulate than those in the zero discharge. 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.
Local Remediation	Local remediation pollutants consist of metals that impact AOCs or other nearshore areas. These are mainly metals that 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 ecosystem, 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.**
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.
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.

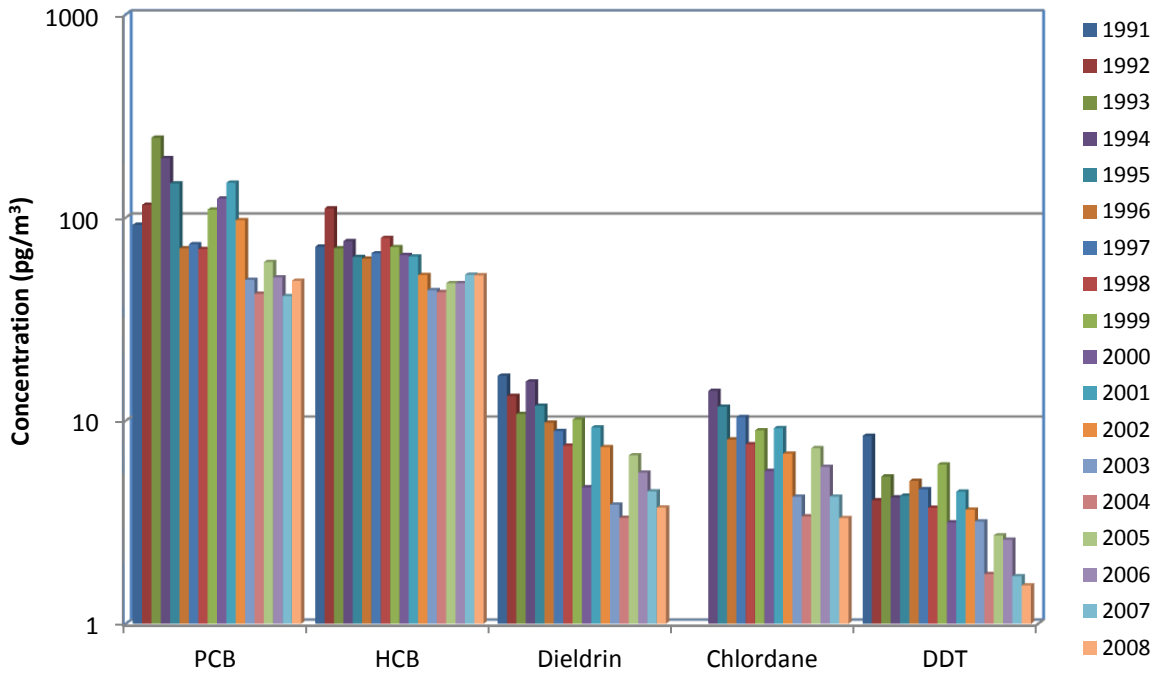
[1] Source: LSBP, 1998b
[2] This category was referred to as Virtual Elimination in the LaMP Stage 2 report.

4.1 Contaminant Levels and Trends Summary

This section provides general information on current levels as well as spatial and temporal trends of certain PBT chemical contaminants in the Lake Superior ecosystem. These contaminants are monitored in a variety of media including air, water, sediments, herring gull eggs, bald eagles and lake trout. Examining contaminant trends across multiple media provides insight into ecosystem-wide trends.

4.1.1 Atmosphere

The Integrated Atmospheric Deposition Network (IADN) has been monitoring levels of persistent organic pollutants (POPs) in the atmosphere at six sites throughout the Great Lakes since 1991. In general, the Lake Superior sampling site at Eagle Harbor has atmospheric POP concentrations among the lowest of the six stations. Most chemicals monitored (including PCBs, HCB, dieldrin, chlordane, and DDT) have decreased over time (IADN, 2008; Venier and Hites, 2010a, b). Figure 4-1 shows the time-trends for five ZDDP chemicals.



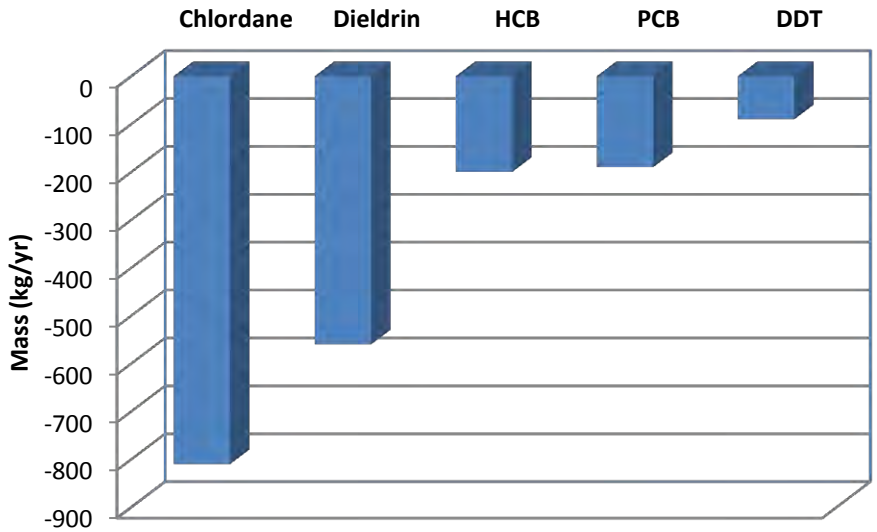
Source: Nettesheim and Craddock, 2011

Figure 4-1. Time Trends for Persistent Organic Pollutants Measured by IADN at Lake Superior's Eagle Harbor Station from 1991-2008.

The declines in atmospheric concentrations of critical pollutants are a result of reduced use or outright bans on these chemicals. Among this suite of chemicals, PCBs have shown the slowest rate of decline, particularly at the remote northern sites on Lakes Superior and Huron. The

relatively small decline in atmospheric PCB concentrations over the last two decades is noteworthy since these chemicals were banned in the U.S. over 30 years ago. The observed trends in Lake Superior may be related to the fact that Lake Superior has colder water temperatures and a larger volume relative to the other Great Lakes (IADN, 2008). The slow decline overall across the Great Lakes Region may also indicate that PCBs in existing industrial/electrical equipment or in storage and disposal facilities may still be slowly leaking into the atmosphere (Venier and Hites, 2010a, b). Given that known quantities of PCB equipment nearing the end of life still exist within the LSB, this is highly likely.

Lakes respond more slowly to chemical use reductions than the atmosphere. Once banned, many pollutants quickly decline in the atmosphere. As a result, the atmosphere becomes a sink for these chemicals as they escape from the lake, rather than a source of contaminants to the lake. This is currently the case for PCBs, dieldrin, chlordane, DDT and HCB, as shown in Figure 4-2. Lake Superior is slowly moving towards a steady state where atmospheric inputs of these chemicals to the lake will equal outputs from the lake.



*Negative numbers indicate that the net flow of a chemical over the course of the year is from the lake into the atmosphere

Source: IADN, 2008

Figure 4-2. Atmospheric Flow (kg/yr) of Persistent Organic Pollutants at the IADN Eagle Harbor Site on Lake Superior in 2005*.

4.1.2 Water

A number of pollutants have decreased in Lake Superior waters over the last three decades. Nevertheless, some chemicals are still present at levels of concern. Of the nine ZDDP critical pollutants, the concentrations of three chemicals (PCBs, dieldrin and toxaphene) continue to exceed certain jurisdictional water quality standards. Table 4-2 shows recent open lake

concentrations of certain critical pollutants relative to water quality yardsticks around the basin. As noted in Section 4.1.1, open lake water concentrations of these pollutants respond more slowly than atmospheric levels to reductions in use. Consequently, critical pollutants currently exceeding water quality guidelines could potentially remain above these thresholds for many years to come.

Table 4-2. Concentrations (ng/L) of Select Critical Pollutants in Lake Superior Open Lake Water Compared to Jurisdictional Water Quality Yardsticks[a,b]

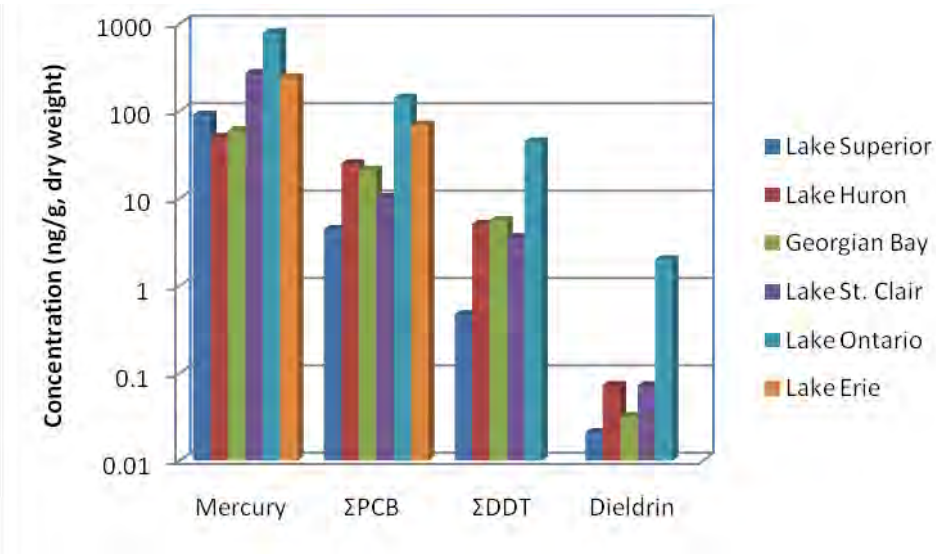
Critical Pollutant	Jurisdictional Water Quality Yardstick (ng/L)				Open Lake Concentration (ng/L)
	Minnesota[c]	Michigan[c]	Wisconsin[c]	Ontario	
PCB	0.0045	0.026	0.003	1.0	**0.043**[e]
HCB	0.074	0.45	0.22	6.5[d]	0.013[e]
Dieldrin	0.0012	0.0065	0.0027	1.0	**0.112**[e]
Chlordane	0.04	0.25	0.12	60	0.013[e]
DDT	0.011	0.011	0.011	3.0[d]	0.005[e]
Mercury	1.3	1.3	1.3	200	0.39[f], 0.21[g]
Toxaphene	0.011	0.068	0.034	8.0	**1.0**[h]

[a] Red values exceed one or more established yardstick value.
[b] The purpose of listing yardsticks is not to compare numbers across jurisdictions, but to provide a reference for comparing water quality results to available yardsticks and determine if exceedances are occurring. Ontario's Provincial Water Quality Objectives (PWQOs) are intended to protect aquatic organisms based on no adverse effects on growth, survival or reproduction. U.S. water quality criteria are based on human health considerations or the protection of wildlife that consumes aquatic organisms and thus tend to be more stringent than PWQOs for substances that bioaccumulate. Thus, the various yardsticks are not directly comparable (Ontario Ministry of the Environment, 1994).
[c] Water quality standards for the Lake Superior states are based on GLI methodologies.
[d] The Ontario PWQO for dieldrin refers to the sum of dieldrin and aldrin and the PWQO for DDT refers to the sum of DDT and its metabolites.
[e] Waltho, 2010; Great Lakes Surveillance Program 2005 data, total PCBs are blank-corrected
[f] Dove *et al.*, 2012; 2008 data
[g] Jeremiason *et al.* 2009; 2006 data
[h] Jantunen, 2011; 2005 data. Note: Toxaphene concentrations in Lake Superior water was reported to be 0.7 ng/L in the 2005 Milestones report. However, these small differences seen between years can be attributed to analytical variability for this difficult to measure chemical mixture.

4.1.3 Sediments

Contaminant levels in the sediments of Lake Superior are generally among the lowest of the Great Lakes and below guidelines established to protect aquatic life. Environment Canada sampled mercury, PCBs, DDT, and dieldrin in Lake Superior and Lake Huron sediments at 87 stations in 2001-2002 and compared the results to existing sediment data throughout the region

(Gewurtz et al., 2008). Levels of these compounds in Lake Superior sediments were low, often approaching two orders of magnitude below levels previously measured in Lakes Erie and Ontario (Figure 4-3). None of these compounds exceeded the Canadian Sediment Quality Probable Effect Level (PEL; Canadian Council of Ministers of the Environment [CCME], 2002) at any of the 20 sample sites in Lake Superior. Similarly, Li et al. (2009) found that Lake Superior had the lowest sediment PCB concentrations of any of the Great Lakes.



Source: Gewurtz *et al.* 2008

Figure 4-3. Surficial Sediment 75th Percentile Concentrations (ng/g, dry weight) in the Great Lakes Region.

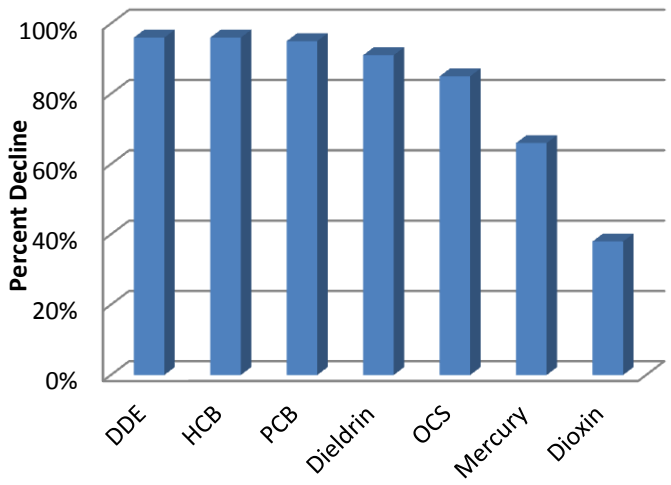
The primary source of contaminants to Lake Superior is atmospheric deposition (Gewurtz et al., 2008). Although dioxin, furan, and PCB congener profiles, measured as part of the Ontario Ministry of the Environment's Great Lakes Nearshore Monitoring and Assessment Program, show that local sources of contamination exist within Lake Superior (e.g., Thunder Bay, Peninsula Harbour, and the mouth of the Magpie and St. Marys Rivers), this is primarily a result of pulp and paper mills and wood preservation plants in the watershed (Shen et al., 2009).

Levels of legacy contaminants in Lake Superior sediments are generally stable or decreasing. Overall, it has been estimated that the total sediment PCB load in the Great Lakes has decreased by >30% from 420 to 300 tonnes (Li et al., 2009). But the reduction in contaminant loading is not uniform across the Great Lakes Basin; PCBs, DDT and mercury have shown little decline in Lake Superior sediments since they were first measured in the 1960s, which is not consistent with decreased releases of these chemicals over the last three decades (Gewurtz et al., 2008). This observation is believed to be due to the especially slow sedimentation rate in Lake Superior, with surficial sediments potentially integrating contaminant inputs over 30 or more years.

4.1.4 Herring Gull Eggs

Herring gulls are an especially useful avian species for monitoring contaminant trends because they are a top predator in the food web and they are permanent, year-round residents of the Great Lakes. Since they rely on both aquatic and terrestrial food sources, they are exposed to PBT chemicals through multiple pathways. Monitoring herring gull eggs provides information on both the level of contaminant exposure in this species and degree of maternal transfer of contaminants to the young.

The Canadian Wildlife Service has been monitoring a number of contaminants since 1974 through its Herring Gull Egg Monitoring Program. The program tests eggs from 15 colony sites including two on Lake Superior, Granite Island and Agawa Rocks. Typically, Lake Superior sites are among the least contaminated of the 15 sites, although mercury was intermediate relative to other Great Lakes colonies (Weseloh et al., 2011). Certain ZDDP chemicals, such as PCBs, DDE, HCB and dieldrin, have shown decreases of greater than 90% at the Lake Superior colony sites since monitoring began (Figure 4-4).



Chemical	Concentration[b]	
	1974/84[c]	2004/07/09[d]
DDE	16.7	0.70
HCB	0.25	0.009
PCB	62.8	3.29
Dieldrin	0.52	0.05
OCS	5.2	0.8
Mercury	0.36	0.11
Dioxin	16.0	9.87

[a] The concentrations reported are the average of the two Lake Superior sites: Agawa Rocks and Granite Island.
[b] All concentrations are reported in µg/g except OCS, which is in ng/g, and dioxin, which is in pg/g. All are reported on a wet weight basis.
[c] Dioxin monitoring began in 1984. All other contaminants have been monitored since 1974.
[d] The most recent data is 2009 for mercury; 2007 for DDE, HCB, PCB, and OCS; and 2004 for dieldrin and dioxin.

Sources: Weseloh and Havelka, 2005 & 2009; Weseloh et al. 2006; Weseloh et al. 2011

Figure 4-4. Percent Decline in Legacy PBT Chemicals in Herring Gull Eggs Collected at Two Lake Superior Sites between 1974/84 and 2004/2007/2009[a].

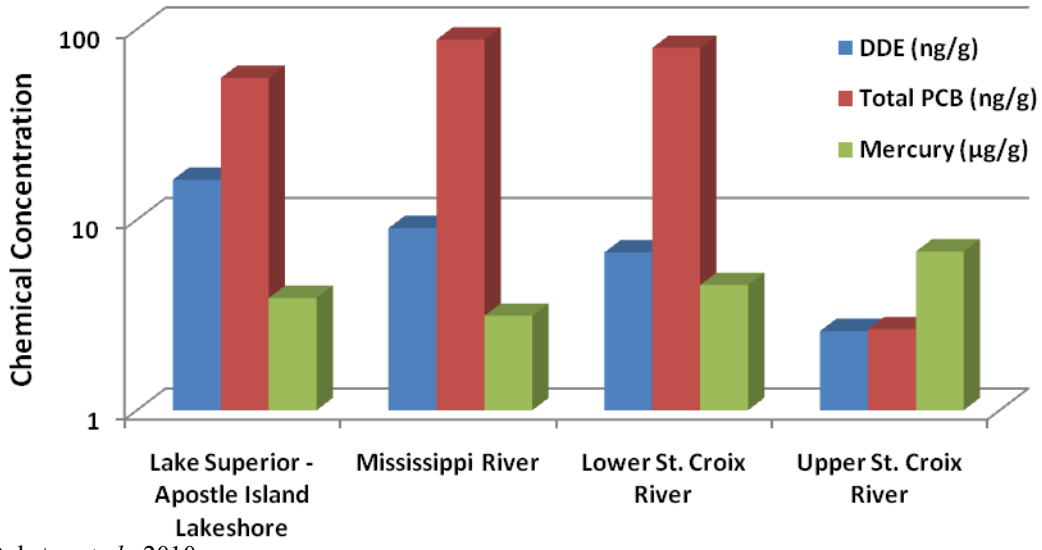
The measured contaminants have decreased 38% to 96% in Lake Superior herring gull eggs since monitoring began in 1974. But the most recent data show that in the last decade (1997-2007) there was no significant decline in most of these legacy contaminants (Weseloh and

Havelka, 2005 & 2009). Many chemical concentrations appear to be at or approaching a plateau in Lake Superior herring gull eggs. For example, Weseloh et al. (2011) found that in all 15 sites tested across the Great Lakes, including the two Lake Superior colonies, there was no significant decline in mercury concentrations in herring gull eggs from 1994-2009.

4.1.5 Bald Eagle Plasma and Feathers

Bald eagles are useful biosentinels of environmental contaminants because they reside at the top of the aquatic food web. In recent years, the U.S National Parks Service (NPS), the Wisconsin Department of Natural Resources (WDNR), and the MDEQ, as well as Clemson and Indiana Universities, have completed studies of bald eagles in the LSB investigating the levels and trends of a variety of contaminants including mercury, PCBs, and DDT.

Although some chemicals are lower in bald eagles nesting near Lake Superior relative to other locations, other contaminants may be higher in the Lake Superior coastal eagle population. For example, in northern Wisconsin, Dykstra et al. (2010) found DDE (a metabolite of DDT) was highest along the Lake Superior shore while mercury and PCBs were greater at certain inland locations south of the LSB (Figure 4-5). In addition, bald eagle nestlings from the Lake Superior shoreline in Wisconsin had feather mercury concentrations greater than in nestlings sampled at Voyageurs National Park (Minnesota), to the west of the LSB (Pittman et al., 2011). MDEQ found that mercury levels in nestlings tested between 2004 and 2008 were higher in the Lake Superior watershed than in the Lake Michigan or Huron watersheds (Weirda et al., 2009).

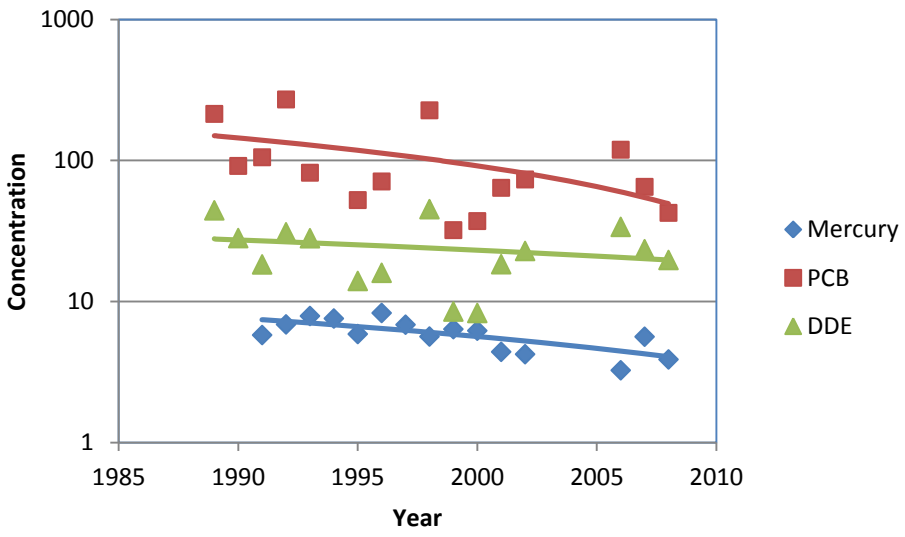


Source: Dykstra *et al.*, 2010

Figure 4-5. DDE and PCBs in Plasma and Mercury in Feathers of Bald Eagle Nestlings along Lake Superior and at Three Inland Sites (2006-2008).

Venier et al. (2010c) found evidence of contaminant "hot spots" along Lake Superior. Several flame retardants, PCBs and organochlorine pesticides were measured in nestling plasma at 15 sites in Michigan near the shores of Lakes Superior, Michigan and Huron. Bald eagles from one Lake Superior site (b-34) had the highest levels of DDTs, PCBs, dieldrin, chlordane and polybrominated diphenyl ethers (PBDEs) of any of the sites studied. Similar trends have also been observed in other piscivorous birds. For example, Evers et al. (2011) noted seven mercury hot spots in loons spread across the Great Lakes Region, including one in the LSB near Marquette in Michigan's Upper Peninsula. A biphasic mercury trend was also noted for this species in northern Wisconsin, with mercury levels decreasing from 1992-2000 but increasing from 2002-2010 (Meyer et al., 2011).

Although contaminants in bald eagles in the Great Lakes Region are below historic levels, there is evidence that certain chemicals may be reaching a plateau or once again increasing in this species. Dykstra et al. (2010) observed decreases in mercury (2.4% per year), DDE (3% per year) and PCBs (4.3% per year) from 1989-2008 in bald eagles nesting on the southern shore of Lake Superior (Figure 4-6). However, the rate of decline of PCBs and DDE over this entire time period was significantly lower than for the time period from 1989-2001 alone, suggesting organochlorine levels in eaglets may be nearing a plateau.



Source: Dykstra *et al.*, 2010

Figure 4-6. Time Trends (1989-2008) of Mercury (µg/g) in Feathers and PCBs (ng/g) and DDE(ng/g) in Plasma of Bald Eagle Nestlings at or Near the Apostle Islands National Lakeshore.

Similarly, MDEQ observed higher mercury levels in nestlings sampled during 2004-2008 than 1999-2003 within four out of 41 Michigan watersheds studied, while the opposite trend occurred

in only one. Eagles in Voyageur National Park, just outside the LSB to the west, also displayed an increasing mercury trend between 2000 and 2010 (Pittman et al., 2011).

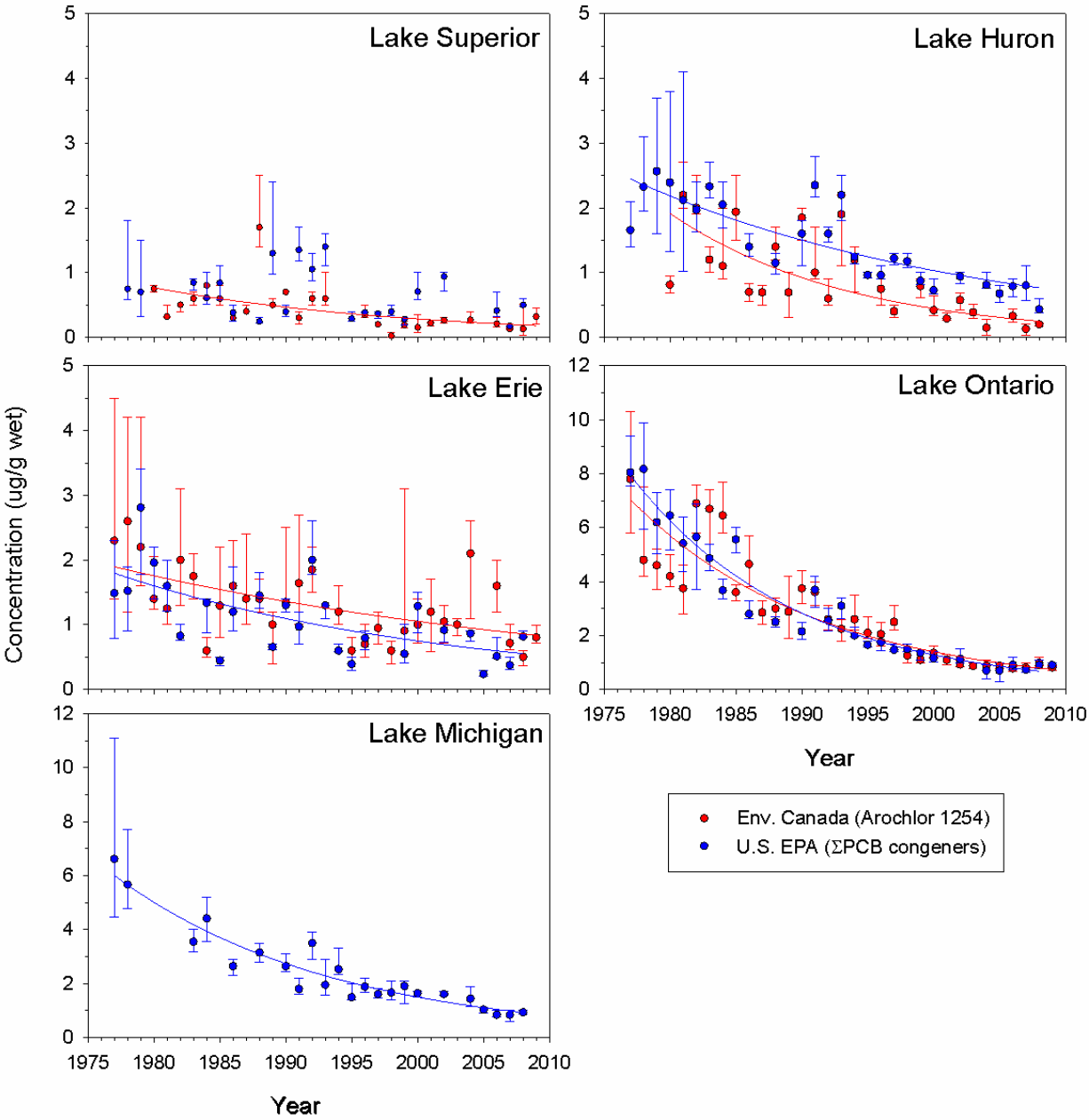
Taken as a whole, bald eagles demonstrate that Lake Superior is not, as is often assumed, always the least contaminated of the Great Lakes and may contain chemical "hot spots" of higher contaminant levels. Legacy PBT chemicals have declined significantly in this species over the last 50 years, but this decline may be reaching a plateau or even reversing in some instances. This is consistent with observations in other piscivorous bird species such as herring gulls (see Section 4.1.4) and common loons.

4.1.6 Whole Lake Trout

A number of programs have been in place since the 1970s to monitor spatial and temporal trends of chemical contaminants in Great Lakes lake trout. According to data collected by the U.S. EPA's Great Lakes Fish Monitoring and Surveillance Program (GLFMSP) and Environment Canada's Fish Contaminants Monitoring and Surveillance Program (FCMSP), whole lake trout from Lake Superior are typically less contaminated than those collected from the other Great Lakes (Carlson and Swackhamer, 2006; Bhavsar et al., 2007; 2008; Carlson et al., 2010). For example, PCBs have declined in top predator fish (lake trout in Lakes Superior, Michigan, Huron and Ontario and walleye in Lake Erie) across the Great Lakes since the two programs began monitoring in the 1970s. Throughout this time period Lake Superior lake trout were consistently lower in PCBs than the fish from the other Great Lakes (Figure 4-7).

The GLFMSP and the FCMSP have observed significant decreases in concentrations of PCBs, DDT, chlordane and dieldrin in whole lake trout over time, as illustrated for Lake Superior in Table 4-3. Similar long-term results have been found for POPs by MDEQ's Fish Contaminant Monitoring Program (FCMP), Environment Canada's Fish Contaminant Monitoring Program, Ontario Ministry of the Environment's Sport Fish Contaminant Monitoring program (SFCMP), and the Chippewa Ottawa Resource Authority (CORA).

In contrast to many POPs, mercury levels in lake trout from Lake Superior are consistently higher than in those from the other Great Lakes (Bhavsar et al., 2010). Similar observations were made for bald eagle feathers, as discussed above. This trend may be due in part to the presence of local industries such as mining, chlor-alkali production and pulp/paper production.



Source: McGoldrick, 2011; Murphy, 2011

Dashed lines show log-linear regression model if annual change is significantly different from zero ($\alpha = 0.05$).

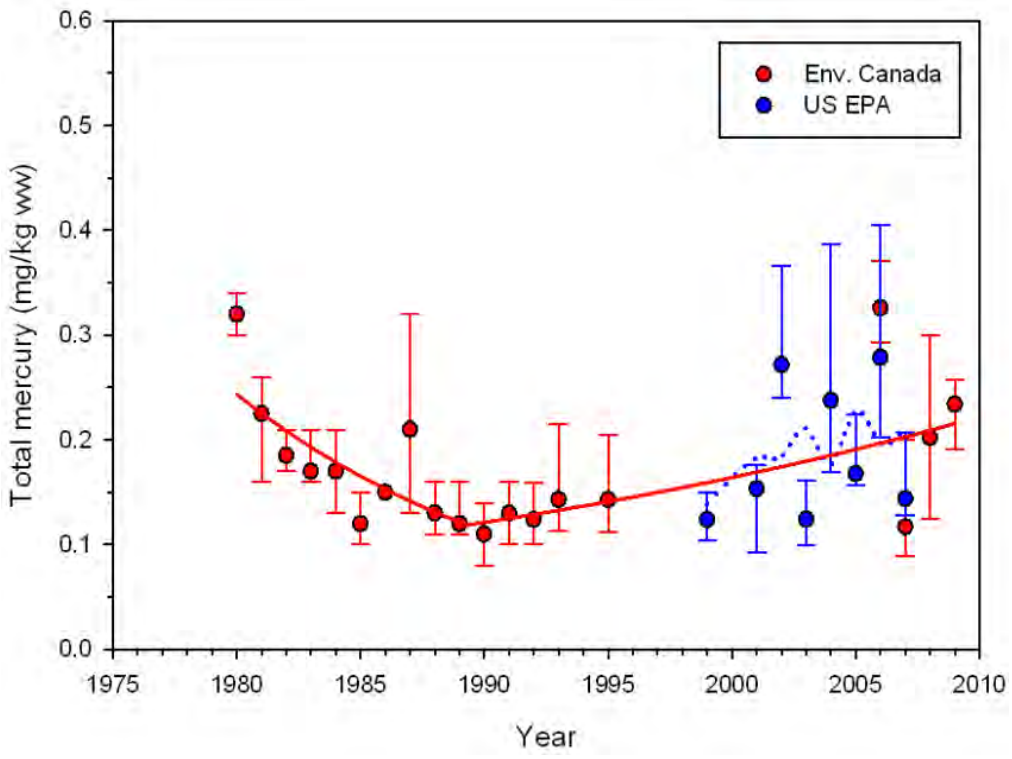
Figure 4-7. Total PCB Concentrations (median & IQR) for Individual (Environment Canada) and Composited (U.S. EPA) Whole Body Lake Trout or Walleye (Lake Erie) Collected from each of the Great Lakes.

Table 4-3. Long-term Rate of Decrease of Contaminants in Whole Lake Superior Lake Trout as Measured by the U.S. EPA and Environment Canada

Contaminant	Trend
Total PCBs	5% long-term annual decline[a]
Total DDT	6.8 % long-term annual decline[b]
Total Chlordane	Consistent decline since EPA ban in 1988. Steady state with no significant increase or decrease[c]
Dieldrin	Consistent decline since monitoring began. Long-term annual decline = 2 – 18%[d]

[a] PCB concentrations remain above the Water Quality Agreement criterion of 0.1 µg/g ww.
[b] DDT concentrations remain below the Water Quality Agreement criterion of 1.0 µg/g ww.
[c] Median chlordane concentration is 0.01 µg/g ww. There is no Water Quality Agreement criterion for this compound.
[d] There is no Water Quality Agreement criterion for this compound.
Sources: McGoldrick, 2011; Murphy, 2011

Certain studies have noted that despite the elevated levels relative to the other Great Lakes, mercury concentrations in Lake Superior lake trout have been declining since the 1970s (Bhavsar et al., 2010). More recent data have revealed that this trend may be reversing. A compilation of mercury data in Lake Superior lake trout collected by the U.S. EPA and Environment Canada (Figure 4-8) indicates that mercury levels began increasing around 1990 (McGoldrick, 2011; Murphy, 2011). This is consistent with another recent study showing a U-shaped mercury trend in Lake Superior lake trout collected near the Apostle Islands (Wisconsin), with a breaking point at 2005 when mercury began to once again increase (Zananski et al., 2011). This pattern has been seen on a broader scale in the Great Lakes Basin and adjacent regions, with mercury in walleye in Ontario lakes and walleye and northern pike in Minnesota lakes shifting to an upward trend in the 1990s (Monson et al. 2011, Monson, 2009).



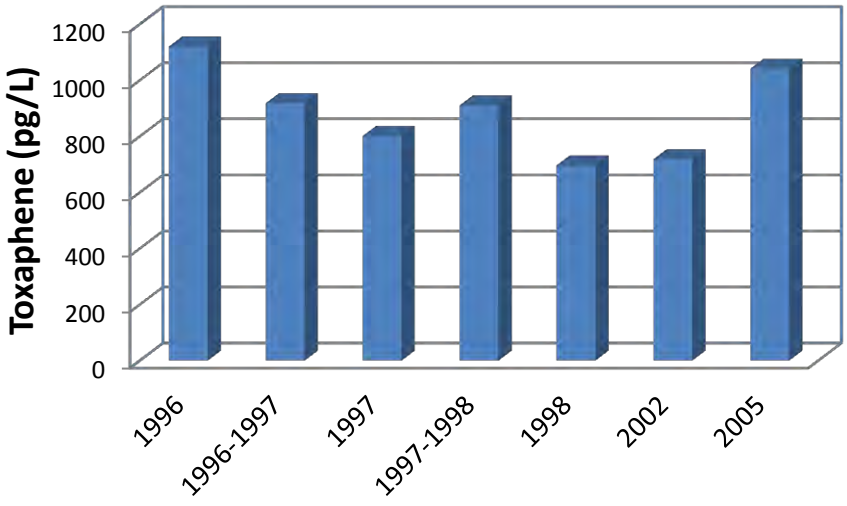
Source: McGoldrick, 2011; Murphy, 2011

Figure 4-8. Temporal Trends of Mercury in Lake Superior Lake Trout Collected by the U.S. EPA and Environment Canada.

4.1.7 Toxaphene

Toxaphene has emerged as a contaminant of great interest in Lake Superior. Although toxaphene is banned in many parts of the world, including the U.S., it can be carried to the Great Lakes region via long-range transport from the southern U.S., where it remains at substantial levels in the environment following years of heavy usage as an insecticide. While most of the ZDDP chemicals tend to be lower in Lake Superior than the other Great Lakes, toxaphene concentrations in the Lake Superior environment and biota often exceed levels found throughout the rest of the Great Lakes region. Decreases in toxaphene concentrations have been observed throughout the Great Lakes in all media following its ban in the mid-1980s.

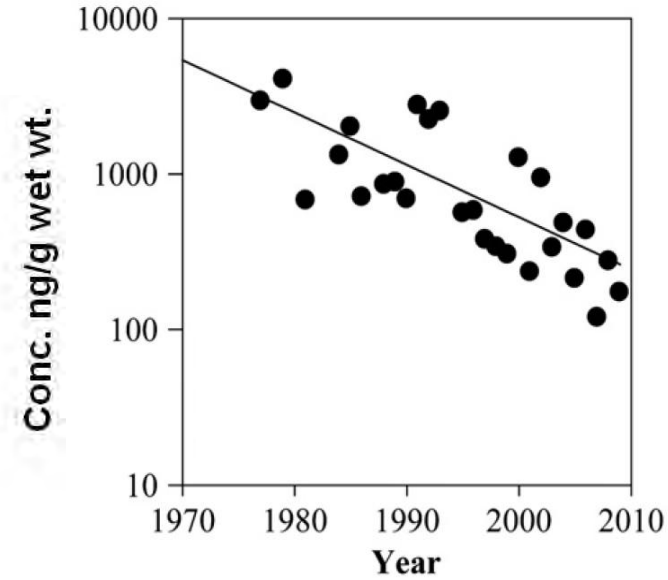
Toxaphene concentrations in the Great Lakes peaked in the late 1970s and early 1980s. Levels have decreased substantially since the mixture was banned in the early 1980s. Recently, the rate of decline of this chemical in Lake Superior waters has slowed substantially. Toxaphene concentrations in Lake Superior water did not change between 1996 and 2005, according to data collected by Environment Canada (Figure 4-9). The small differences seen between years can be attributed to analytical variability for this difficult to measure chemical mixture.



Sources: Jantunen, 2011; Jantunen and Bidleman, 2003; Swackhamer et al,. 1999; James et al., 2001

Figure 4-9. Toxaphene Concentrations in Lake Superior Water (pg/L).

A recent study on toxaphene trends in Great Lakes fish show that concentrations remain the highest in Lake Superior (up to ~480 ng/g) and lowest in Lake Erie (up to ~50 ng/g) (Xia et al., 2012). Concentrations of toxaphene in Lake Superior lake trout continue to exhibit exponential temporal declines (Figure 4-10); however, concentrations appear to level off starting in 2007 (Xia et al., 2012). Continued monitoring of toxaphene in top predator fish in the coming years should confirm whether toxaphene concentrations have reached a steady state in Great Lakes fish.



Source: Xia et al., 2012

Figure 4-10. Total Toxaphene in Lake Superior Lake Trout from 1977-2009.

The presence of higher toxaphene concentrations in Lake Superior relative to the lower Great Lakes has been attributed primarily to the physical properties of the lake (i.e., large volume, long residence time, and cold temperatures; Xia et al., 2011). These factors, in combination with the chemical properties of toxaphene (high vapor pressure, high solubility), cause toxaphene to be released more slowly from Lake Superior than the lower Great Lakes (Carlson and Swackhamer, 2006). Further, food web changes in Lake Superior over time may have had an effect on toxaphene concentrations in top predators such as lake trout by affecting bioaccumulation rates and altering trophic structure.

The toxaphene example demonstrates that despite its remote location and relative lack of industrial development, the Lake Superior ecosystem is susceptible to long-range transport of pollutants. As a result, Lake Superior is not always the "cleanest" of the Great Lakes.

4.1.8 Contaminants of Emerging Concern

Much of the current, basin wide, persistent toxic substance data that are reported focus on legacy chemicals that have been restricted through various forms of legislation but continue to be detected in fish (e.g., PCBs). However, programs in both the U.S. and Canada are making efforts to incorporate the monitoring and surveillance of emerging chemicals into their routine work. Chemicals of interest, also known as chemicals of emerging concern (CECs), are identified through scientific studies (e.g., Howard and Muir, 2010), and general screening of annual samples and also through risk assessments by regulatory bodies. As CECs are identified through this process, they will be reported out through the State of the Lakes Ecosystem Conference (SOLEC), particularly those chemicals with established criteria. Environmental Specimen Banks containing tissue samples are a key component of both the U.S. and Canadian monitoring programs, allowing for retrospective analyses of newly identified chemicals of concern to develop long-term trends in the short term.

Fostering collaboration between U.S. and Canadian monitoring programs for various media will be beneficial, especially in times of fiscal restraint. In 2009, an ad-hoc binational group was formed to bring together government representatives and researchers working on identifying new chemicals in the Great Lakes ecosystem with the objective to facilitate best management practices and sharing of information and resources. The group provides a forum for agencies and researchers to seek and provide information on emerging contaminant surveillance, monitoring, chemical methods development, and provides a place to collaborate on similar chemicals, or classes of chemicals, in different media. Collaboration among research in differing media also provides an excellent opportunity for cost sharing, an accelerated rate of discovery, and a validation of results among the Great Lakes research and monitoring community.

Section 4.2 presents a more detailed discussion of levels and trends of certain emerging contaminants of concern in Lake Superior media.

4.1.9 Fish Consumption Advisories

Despite decreasing critical pollutant concentrations in a variety of media, contaminant concentrations remain high enough to prompt fish consumption advisories both within Lake Superior and for inland lakes within the basin. A number of jurisdictions around Lake Superior, including states, provinces and tribal organizations, provide risk-based advice designed to limit

human exposure to environmental contaminants through fish consumption. These advisories are especially critical for vulnerable consumers, such as children, women who anticipate bearing children, and frequent consumers, such as sport fishermen, Native Americans, and First Nations.

Jurisdictional differences in fish consumption advisory trigger levels and meal size definitions, in combination with regional variations in contaminant concentrations, result in variations among the advisories issued by each jurisdiction. Table 4-4 outlines some examples of 2011-2012 fish consumption advisories impacting the LSB. These are general guidelines. More restrictive guidelines for individual waterbodies with above average contaminant concentrations also exist. Table 4-4 summarizes only the U.S. consumption advisories for illustrative purposes. While sensitive populations (children and women of childbearing age) often have more restrictive guidelines, blanks in Table 4-4 indicate that there is no separate advice for the sensitive populations.

State fish consumption advice can be found at:
http://water.epa.gov/scitech/swguidance/fishshellfish/fishadvisories/general.cfm#tabs-4.
The Canadian guidelines can be found at:
www.ene.gov.on.ca/environment/en/resources/collection/guide_to_eating_ontario_sport_fish/index.htm

The majority of fish advisories are based on levels of mercury, dioxins, furans and PCBs. In general, other contaminants, such as mirex, toxaphene, and chlordane, are no longer consumption-limiting contaminants, although certain restrictions in Lake Superior fish are still based on toxaphene (OMOE, 2011). The pie charts in Figure 4-11 illustrate the percentage of consumption restrictions caused by each of the contaminants in the four Ontario Great Lakes and their connecting channels and inland locations for 2011-2012. In Lake Superior, consumption advisories issued for fatty species by OMOE (OMOE, 2011) were mainly due to levels of dioxins, furans, PCBs and, in some cases, toxaphene or mercury. Restrictions on inland waters, particularly for northern pike and walleye, were primarily due to mercury.

There is insufficient information to decipher whether and to what degree the nutritional benefits of Great Lakes fish may outweigh the risk of contaminant exposure to consumers (Turyk et al., 2011). Fish advisories continue to be based solely on risk, rather than from a risk-benefit standpoint that simultaneously considers the nutritional benefits of eating fish. However, as part of their advisory, all of the Lake Superior states make qualitative statements documenting the benefits of eating fish.

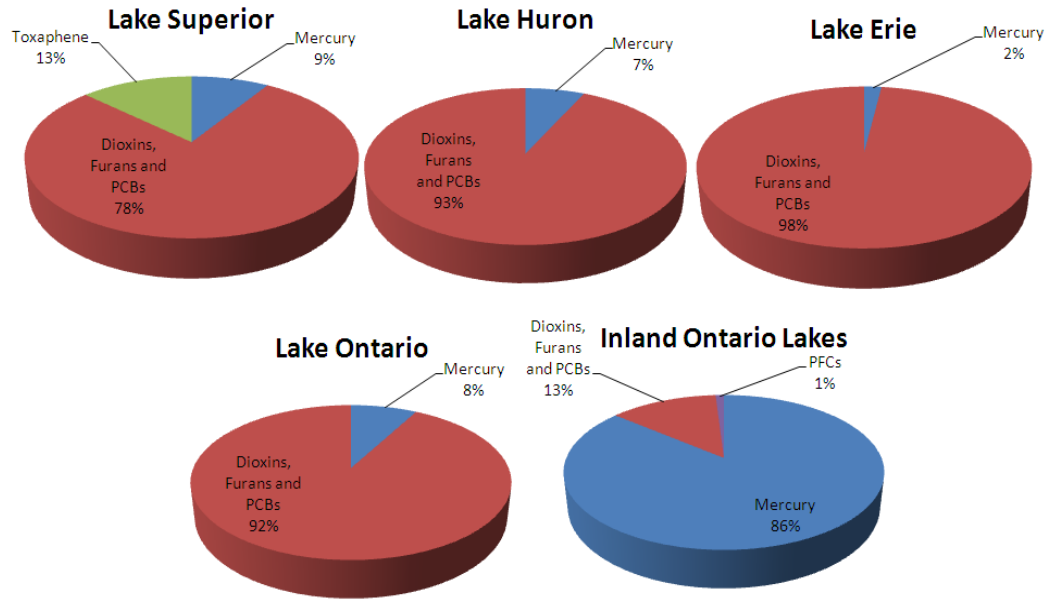
Table 4-4. Select U.S. Fish Consumption Advisories for Lake Superior and Inland Lakes

Agency Issuing Advisory	Waters	Contaminant of Concern	Species	Consumption Advice	
				General Population	Sensitive Population[b]
Wisconsin Department of Natural Resources	Inland Waters of Wisconsin (Exceptions for listed waters, e.g. St. Louis River, not presented here)	Mercury and PCBs	Bluegill, crappie, yellow perch, sunfish, bullhead, trout	Unrestricted	1 meal per week
			Walleye (inland), pike, bass, catfish, and all other species	1 meal per week	1 meal per month
			Muskellunge	1 meal per month	Do not eat
	Lake Superior (PCBs and Mercury are responsible for advice for most species)	Mercury and PCBs	Smelt	Unrestricted	Unrestricted
			Brown trout, Chinook salmon (<30"), chubs, coho, lake herring, lake trout (<22"), lake whitefish, rainbow trout	1 meal per week	1 meal per week
			Chinook salmon (>30"), lake sturgeon (>50"), lake trout (22"-37"), siscowet (<29")	1 meal per month	1 meal per month
			Walleye	1 meal per week	1 meal per month
			Lake Trout (>37")	1 meal per 2 months	1 meal per 2 months
			Siscowet (29"- 36")		
			Siscowet (>36")	Do not eat	Do not eat
Michigan Department of Community Health	Inland Lakes in Michigan (PCB advisories for listed waters, e.g. Torch Lake, not presented here)	Mercury	Crappie (<9"), rock bass (<9"), yellow perch (<9")	Unrestricted	Unrestricted
			Crappie (>9"), largemouth bass, smallmouth bass, muskellunge, northern pike, rock bass (>9"), walleye, yellow perch (>9")	1 meal per week	1 meal per month
	Lake Superior	Mercury	Burbot (<22"), walleye (<22")	Unrestricted	Unrestricted
			Burbot (>22"), walleye (>22")	1 meal per week	1 meal per month
		PCBs	Brown trout, coho salmon, cisco (6-30"), rainbow trout (>26"), suckers, whitefish	Unrestricted	1 meal per week
			Chinook salmon	Unrestricted	1 meal per month
		Mercury, chlordane, PCBs	Lake trout (<26")	Unrestricted	1 meal per week
			Lake trout (26-30")	Unrestricted	1 meal per month
			Lake trout (>30")	1 meal per week	Do not eat
		Chlordane, PCBs, dioxin	Siscowet (14-18")	Unrestricted	1 meal per month
			Siscowet (<18")	Do not eat	Do not eat
Minnesota Department of Health	Inland Lakes of Minnesota	Mercury and/or PCBs	Sunfish, crappie, yellow perch, bullhead	Unrestricted	1 meal per week
			Bass, catfish, walleye (<20"), northern pike (<30") and all other species	1 meal per week	1 meal per month

Table 4-4. Select U.S. Fish Consumption Advisories for Lake Superior and Inland Lakes, Con't.

Agency Issuing Advisory	Waters	Contaminant of Concern	Species	Consumption Advice	
				General Population	General Population
			Walleye (>20"), northern pike (>30"), muskellunge	1 meal per week	Do not eat
	Lake Superior	Mercury and PCBs	Smelt, pink salmon	Unrestricted	-
			Chinook salmon (<30"), coho salmon, lake trout (<23"), rainbow trout, brown trout, lake whitefish, lake herring (cisco)	1 meal per week	-
			Chinook salmon (>30"), lake trout (23-34"), siscowet (<25")	1 meal per month	-
			Lake trout (>34")	1 meal per 2 months	-
			Siscowet (>25")	Do not eat	-

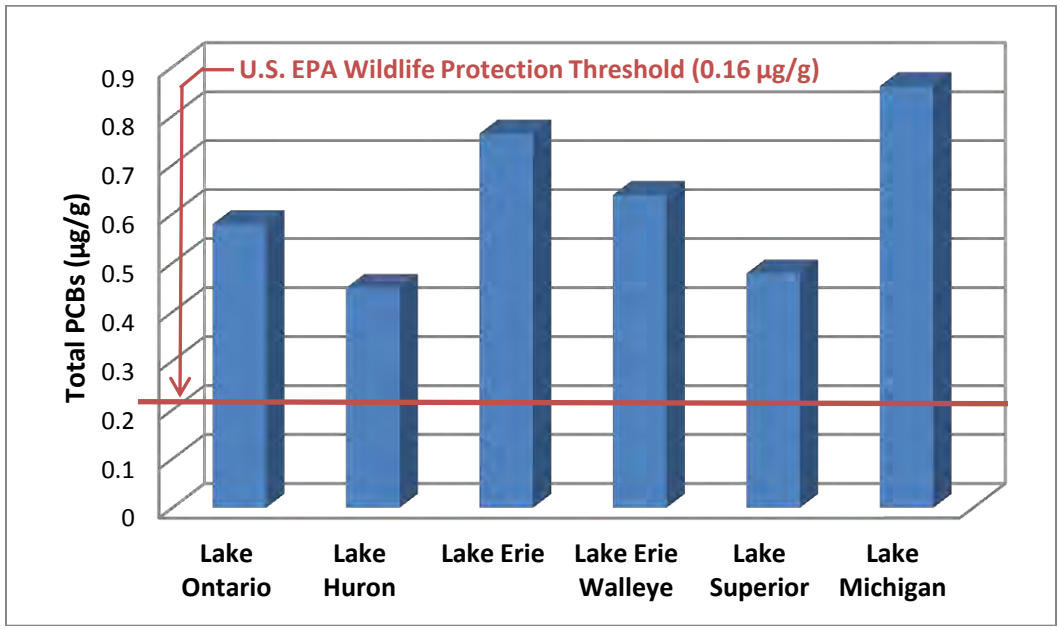
Sources: Wisconsin: WDNR, 2011; Michigan: MDCH, 2011; Minnesota: MDH, 2011a,b



Source: OMOE, 2011

Figure 4-11. Percentage of OMOE Fish Advisories for 2011-2012 Based on Specific Critical Contaminants in the Great Lakes and Inland Lakes of Ontario.

In addition to triggering human fish consumption advisories, chemical concentrations remain high enough to cause negative impacts on wildlife. For example, PCB concentrations measured by the GLFMSP in 2010 exceeded concentrations established by the U.S. EPA to protect the health of fish-dependant wildlife (0.16µg/g) in all five Great Lakes (Figure 4-12). The concentrations exceed the GLWQA PCB concentration objective for whole fish (0.1 µg/g) to an even greater degree.



Source: Murphy, 2011

Figure 4-12. 2010 PCBs in Whole Lake Trout (except Walleye in Lake Erie) Relative to the Established EPA Wildlife Protection Threshold.

Although concentrations of most contaminants are low (as compared to the other Great Lakes) and have decreased over time, they continue to impair the beneficial use goal of unrestricted fish consumption stated in Annex 2 of the GLWQA and may pose a threat to fish-consuming wildlife. Furthermore, because these critical contaminants are declining at slower rates over time, it is likely that their presence will continue to have impacts for future decades.

4.1.10 Human Biomonitoring

A number of large- and small-scale Great Lakes Region human biomonitoring programs have been carried out or are currently underway. Some of the key human biomonitoring studies specific to the LSB or the Great Lakes Basin as a whole that occurred in the last decade are outlined below.

The MDH's Mercury in Newborns in the Lake Superior Basin Study, funded by the U.S. EPA's Great Lakes National Program Office (GLNPO), assessed population-level mercury exposure for

residents of the LSB, with a focus on newborn infants. Residual dried blood spots from 1,465 newborns from Minnesota (*n*=1126), Wisconsin (*n*=139), and Michigan (*n*=200) were collected and analyzed for total mercury by the MDH Public Health Laboratory. The amount of mercury found in the newborn bloodspots is indicative of the mothers' mercury exposure during pregnancy. The blood samples were anonymized; meaning, there was no personally identifying information attached to the blood sample. However, information was retained on the baby's sex, month and year of birth, state of residence, and whether the mother lived in an urban or non-urban area (Minnesota only). Most infants were found to have low or undetected total mercury levels. However, 8% of tested newborns had total mercury levels above the RfD for methylmercury (the highly toxic form of mercury found in fish) set by the U.S. EPA. Other significant findings from the study included:

- No relationships were seen between the level of mercury and the baby's sex or urban/non-urban residence.
- Babies born during the summer months were more likely to have an elevated mercury level. This seasonal effect suggests that increased consumption of locally-caught fish during the warm months is an important source of pregnant women's mercury exposure in this region.
- No Michigan samples were above the U.S. EPA RfD, 3% of the Wisconsin and 10% of the Minnesota samples were above this level. One possible explanation is that Minnesotans have reported eating more locally-caught fish than do people in Wisconsin or Michigan.

As a result of the study, MDH is strengthening outreach and communication efforts to health care providers and others to ensure that the public has information that promotes eating fish low in mercury.

Through the GLRI, the Agency for Toxic Substances and Disease Registry (ATSDR) is undertaking a large-scale human biomonitoring project in the Great Lakes Basin. ATSDR has competitively awarded funds to Minnesota, Michigan, and New York health departments to measure environmental toxicant levels in the blood and urine high risk fish consumers who live in the Great Lakes Basin. The purpose of the study is to determine if there are higher levels of contaminants in those people with greater exposure, such as people who eat Great Lakes fish. This information will guide actions that the state health departments take to protect citizens. Ontario, in collaboration with a federal agency, recently conducted a province-wide survey of fish consumption including for the Great Lakes region. This survey is expected to result in a better understanding of the sport fish consumption pattern on the Canadian side of the Great Lakes.

As part of the ATSDR study, the MDH received funding from the U.S. Centers for Disease Control and Prevention in 2010 for population-based contaminant biomonitoring of 500 American Indian adults within the LSB. MDH is collaborating with the Fond du Lac Band of Lake Superior Chippewa Human Services Division to conduct the study. The three-year project is currently in the planning and preparation stage, with recruitment and enrollment taking place in summer 2012. A broad range of contaminants arising from fish consumption as well as

historical industrial activities in the region will be measured in blood and urine, including heavy metals (mercury, lead, cadmium), PCBs, mirex, HCB, DDT/DDE, toxaphene and 1-hydroxypyrene. Some contaminants of "emerging concern" are also included (bisphenol A, triclosan, perfluorinated compounds [PFCs]) as well as two nutrients associated with fish consumption (omega-3 fatty acids and selenium). American Indians are a population of concern because they may be more likely to eat fish than other subpopulations in the basin. Findings will be used to develop a data-driven public health action plan to reduce exposure to Great Lakes contaminants through targeted interventions.

During 1999-2000, the Effects on Aboriginals of the Great Lakes (EAGLE) Project was conducted by a partnership between the Assembly of First Nations, Health Canada and First Nations in the Great Lakes Basin to examine the effects of contaminants on the health of the Great Lakes Aboriginal population (Davies and Phil, 2001). The objectives of the Contaminants in Human Tissues Program, a major component of the EAGLE Project, were to determine levels of environmental contaminants in the tissues of First Nations people in the Great Lakes Basin, to correlate these levels with freshwater fish and wild game consumption, and to provide information and advice to First Nations people on the levels of environmental contaminants found in their tissues. Contaminants were tested in hair (n=393) and blood (n=528) from 26 First Nations in the Great Lakes Basin and included over 35 PCB congeners, 34 organochlorine compounds (such as toxaphene, DDE/DDT) and mercury. Some key findings included:

- PCBs, DDE and toxaphene (Congener 50) were the most commonly detected contaminants in blood.
- PCB and mercury levels, but not toxaphene or DDE, were higher in males than females. Although males also had higher consumption rates of freshwater fish and wild game, no significant statistical relationship was found between consumption rates and contaminant levels. Consumption of certain species was correlated with specific contaminant levels (e.g., walleye/pickerel and mercury, rainbow trout and PCBs).
- PCB, DDE and toxaphene levels, but not mercury, increased with increasing age-group.
- Levels of mercury in hair of First Nations people in the Canadian Great Lakes Basin suggest levels have decreased since 1970.
- Most participants had serum PCB and hair mercury levels that were below Health Canada's guidelines (where available) and were not associated with any adverse health effects.

The Wisconsin Department of Health Services (WDHS), in collaboration with a variety of researchers, has conducted human biomonitoring to look at contaminant exposure (e.g., PCBs, DDE, mercury) and associations with health outcomes among frequent consumers of Great Lakes fish. In 2004-2005, WDHS carried out a study of methylmercury exposure among 2000 Wisconsin residents (ages 18 to 92) (Knobeloch et al., 2007). Participants provided hair samples for mercury analysis and completed a survey about their fish consumption habits. The U.S. EPA exposure guideline, which equates to a hair mercury concentration of 1 µg/g, was exceeded in 29% of the hair samples provided by men and 13% of those provided by women. Hair mercury levels were positively correlated with both age and the number of monthly fish meals reported. Mercury was on average eight times higher in fish consumers than non-fish consumers. Despite

reporting similar fish consumption rates, men had significantly higher hair mercury levels than women. On average, sportfish consumers had greater hair mercury levels than non-sportfish consumers, with 41% and 29% of men and women, respectively, from this cohort exceeding the 1 µg/g U.S. EPA guideline. It should be noted that this study was carried out statewide, not just within the LSB.

WDHS followed up the 2004-2005 study by advising Wisconsin residents whose hair mercury levels exceeded 1 µg/g to reduce their intake of large, predatory fish (Knobeloch et al., 2011). All study participants were re-contacted in 2008 with the opportunity to fill out a follow-up questionnaire and have their hair mercury levels retested. As a result of the 2005 intervention, residents whose hair mercury levels exceeded 1 µg/g significantly reduced fish intake, with 30% reporting eating smaller or different species of fish. The number of people with hair mercury levels exceeding 1 µg/g fell by over 30%.

The ATSDR Great Lakes Human Health Effects Research Program (GLHHERP), initiated in 1992, is designed to characterize exposure to contaminants via consumption of Great Lakes fish, and to investigate the potential for short- and long-term adverse health effects by providing grants to researchers. The funded research is occurring throughout the Great Lakes Basin, with a number of studies including research within the LSB. Descriptions of the numerous currently funded studies can be obtained through the ATSDR website (http://www.atsdr.cdc.gov/grtlakes/funded-institutions.html).

4.1.11 Summary and Potential Management Implications

- The main source of critical contaminants to Lake Superior is atmospheric deposition, although some local sources exist.
- Long-term monitoring of contaminant concentrations across several media is critical to assessing the health of the Lake Superior ecosystem.
- Concentrations of many legacy PBT contaminants have declined over time, indicating government interventions on the use of these chemicals have been effective.
- The rate of decline of PBT chemical concentrations in various media has slowed, suggesting the system is reaching steady-state in many cases. As a result, further decreases in contaminant concentrations in the region may take many years to become apparent.
- Lake Superior's physical, thermal and biological characteristics make it unique and especially sensitive to retaining PBT contaminants.
- Lake Superior is not always the "cleanest" of the Great Lakes, as is illustrated by examples such as mercury in lake trout, POPs in bald eagle plasma and toxaphene in several biotic and abiotic matrices.
- Many contaminants remain in Lake Superior and surrounding inland waters at concentrations sufficient to trigger fish consumption advisories.
- Because the Lake Superior ecosystem is sensitive to chemical inputs and efficient at retaining environmental contaminants, prevention is critical to its protection.

- The introduction of invasive species to the Lake Superior ecosystem must be stopped. Modifications to the existing food web affect contaminant transport as well as the biology of the lakes.
- To determine current concentrations and establish long-term trends, coordinated physical, chemical and biological monitoring efforts in the Great Lakes must continue under the various binational and domestic programs, such as the Coordinated Science and Monitoring Initiative (CSMI). 2011 was a Lake Superior CSMI year of intensive monitoring. The next CSMI year for Lake Superior is scheduled for 2016.
- Statistical design of monitoring programs and associated analytical methodologies may need to be altered to reflect lower environmental concentrations (i.e., to have greater power to detect small changes in concentrations).
- Analytical method development and chemical risk prioritization are necessary to support detection, monitoring, and regulation of the overwhelming number of emerging contaminants of concern.
- Action is needed beyond the LSB. The ZDDP is critical for the LSB but will have limited impact on PBT chemicals in the Lake Superior environment in the face of long-range transport from regional and global sources.
- There is a need to increase toxicity testing of chemicals of emerging concern in order to support the establishment of appropriate water quality standards, thresholds for the protection of aquatic and fish-consuming wildlife and human fish consumption advisories.
- Advocating for P2, conservation recycling, local and renewable energy sources, and reduced dependence on synthetic chemical substances are ways to ensure a sustainable society and a healthy Lake Superior.

4.2 Chemicals of Emerging Concern

4.2.1 Introduction

The term CEC has come to define the universe of newly detectable chemical substances being discovered in air, water, sediment and wildlife. The term has also come to define chemicals for which a growing body of research points to potential (or "emerging") risks or concerns.

Certain CECs are newly manufactured compounds, only very recently being released into the environment. Others have been in use for longer time periods but have only recently been the target of analysis due to pervious lack of analytical capabilities, restrictive analytical costs, or newly recognized health hazards. Regulations exist for some, but not all, CECs, and the regulations can be quite complex. For example, the manufacture of all PBDEs is banned in Canada and for new uses of octa- and penta-BDE—but not deca-BDE—mixtures in the U.S.; most U.S. work in this arena has been based on industry-led phase-outs. Canada and certain states also further restrict the import, use, and sale of certain PBDE mixtures. In Canada, all commercial, manufacturing, and processing uses of polybrominated biphenyls (PBBs) are banned.

While there are no federal restrictions on PBBs in the U.S., PBBs are no longer known to be produced and placed into the market. The PFC, perfluorooctane sulfonate (PFOS), is included on the list of toxic substances under the Canadian Environmental Protection Act, prohibiting its use, sale and the manufacture. Current uses of PFCs are largely unregulated by the U.S.; however, proposed new uses are prohibited without notice and risk management activities, and long-chain PFC phase-outs are currently underway through a U.S. EPA-industry stewardship and voluntary phase-out project (to be completed in 2015). To note, much like banned pesticides, chemicals with manufacture regulations in the U.S. can still be exported internationally. As a result, a U.S. ban, phase-out or production stoppage has no bearing necessarily on U.S. manufacture for international export(s). Also, manufacturing restrictions do not address chemicals already in commerce, such as articles or products. Such items will be in commerce until the end of the respective product's life.

Improvements in instrumentation and analytical methods, along with reduced sampling and analytical costs, have enabled scientists to detect more substances at lower concentrations than was possible a short time ago. This 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, the difficult human health questions many emerging risks pose, and the challenges in chemical monitoring and surveillance combined with the resources required to investigate and manage a single substance, pose serious research and management challenges.

4.2.2 Three-Part Management Strategy

The Lake Superior LaMP has developed a management strategy for CECs, which can be found in the LaMP 2008 (LSBP, 2008). A summary of the strategy follows:
Three-Part Strategy for Chemicals of Emerging Concern

1. Focus on P2 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.
    - Better utilize and publicize available Emergency Planning and Community Right-to-Know Act (EPCRA) and TSCA data on CECs to inform and improve the quality of P2 efforts.
    - Identify P2 opportunities collaboratively and binationally with stakeholders in the basin or in collaboration with chemistry or toxin reduction 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 P2 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 (see Figure 4-2 in LaMP 2008) to:

   - Identify the five LSBP management categories and the process for assigning substances to each of them (Tables 4-5, 4-6 and 4-7 in LaMP 2008).
   - Identify a discrete list of substances for which monitoring or use data are lacking.
   - Recognize pollutants which are of special concern due to concentrations that exceed yardsticks (the current critical pollutants).
   - Identify, in conjunction with stakeholder input, additional critical pollutants.

3. Report on CECs

   - 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 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.
     - identify sources of substances of emerging concern in the Lake Superior watershed.

4.2.3 Levels of CECs in the Lake Superior Environment

CECs have been detected throughout the Lake Superior ecosystem. Most studies to date have focused on two classes of chemicals: brominated flame retardants, consisting of PBDEs and PBBs and PFCs, consisting of PFOS and perfluorooctanoic acid (PFOA), and a suite of 11 to 12 other PFCs. Pharmaceuticals and personal care products (PPCP) are another important group of chemicals of emerging concern, but there is currently insufficient information on their presence in the Lake Superior ecosystem.

The following is an overview of available information on the levels and trends of these contaminants in a variety of media in the LSB. Since the available information is limited, detailed interpretation of levels and trends data is difficult in many cases and determination of even short-term trends is often not possible.

Air

A major vector for PBDEs to enter the environment is through the atmosphere. PBDEs have been found in all air samples collected by the IADN, including those collected at the remote Eagle Harbor site on Lake Superior. The fact that these compounds were found at Eagle Harbor demonstrates that they are widespread and can be transported in the atmosphere to remote locations (Strandberg et al., 2001). Within the Great Lakes Basin, PBDEs were highest at the urban sampling sites of Chicago and Cleveland and lowest at Eagle Harbor. Spatial trends and levels of PBDEs in the Lake Superior atmosphere are similar to those observed for PCBs.

Temporal trends in air vary by PBDE congener. BDE 47 and 99, components of the commercial penta-BDE product, decreased rapidly between 2003 and 2006, reflecting decreased production of this chemical mixture in North America since 2004. In contrast, BDE 209, a component of the deca-BDE mixture, has not decreased at any IADN sampling site throughout the Great Lakes. This reflects the continued use of this commercial product, which is not yet regulated in the U.S. (Venier and Hites, 2008).

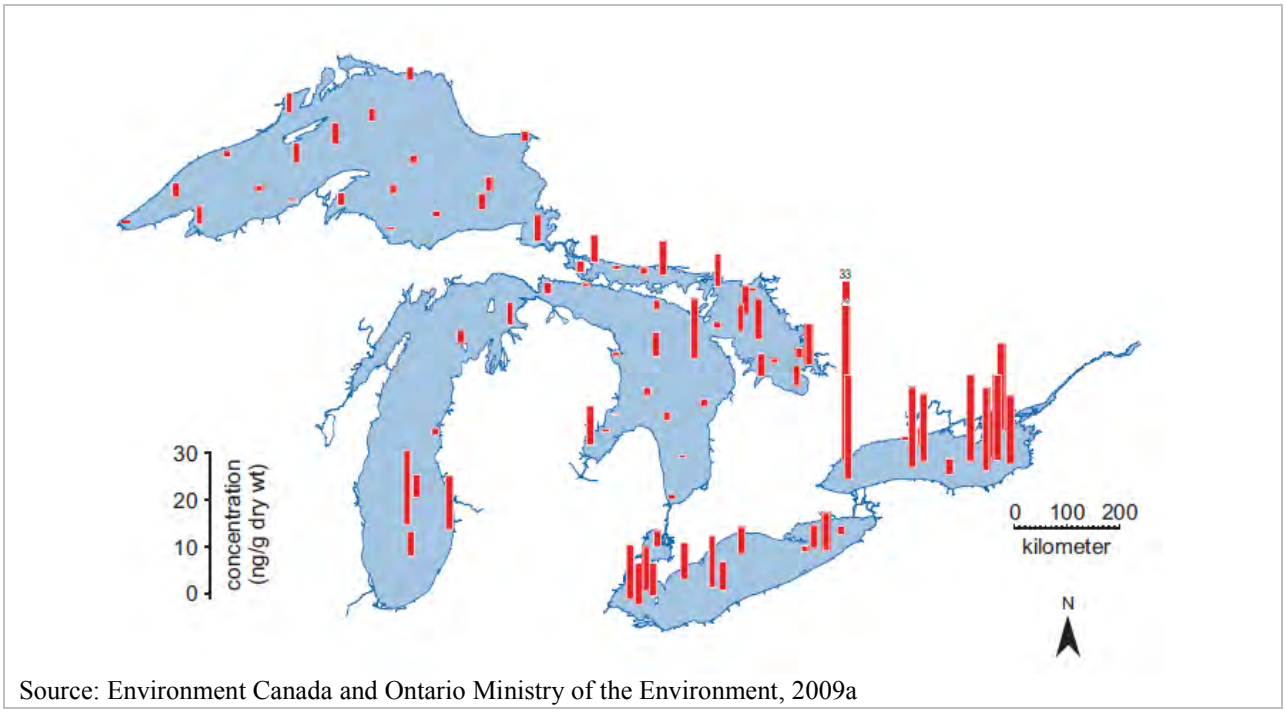
Water

PBDEs released into the atmosphere from manufacturing, landfills, and e-waste recycling facilities condense onto particulates and subsequently enter waterbodies. They may also enter the water directly from waste water treatment facilities (Hale et al., 2008) and as leachate from leaking landfills (Kim et al., 2006).

PFCs have been measured in Lake Superior surface waters. Mean PFOS and PFOA in Lake Superior water samples collected between 2002 and 2005 were lower than the concentrations measured in Lakes Ontario, Huron or Erie (Furdui et al., 2008). Between 2001 and 2005, PFOA concentrations ranged from 0.07 to 1.2 ng/L in Lake Superior surface waters and were generally 1.5- to 2-fold greater than PFOS concentrations (Scott et al., 2010).

Sediment

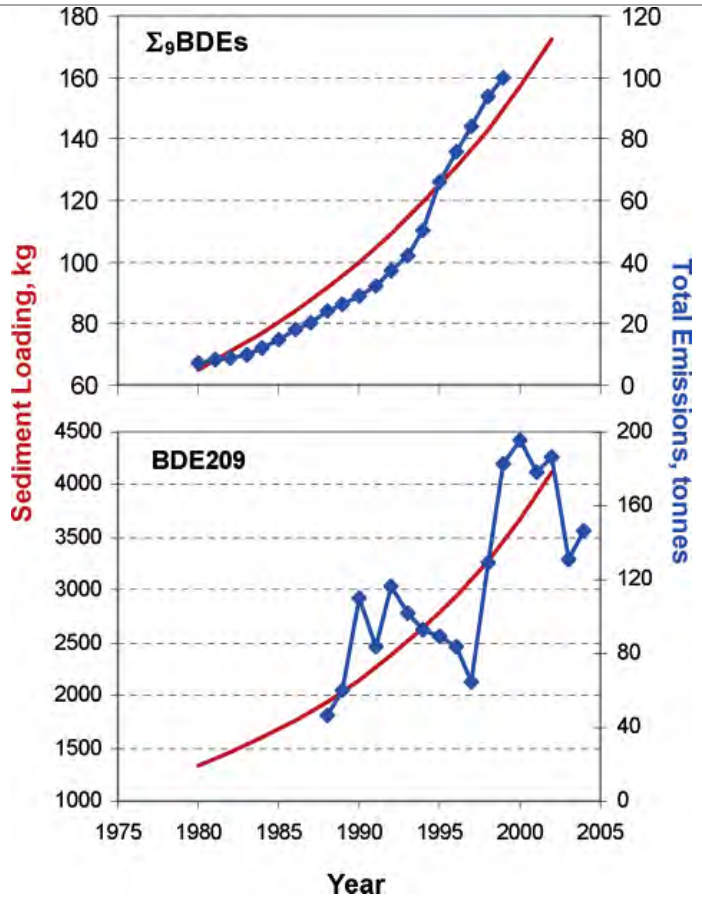
PBDEs were assessed in sediment cores taken from Lake Superior at six locations during 2001 and 2002 (Song et al. 2004). Lake Superior's total PBDE load was estimated to be 2 to 6 metric tons, with a current loading rate of approximately 80 to 160 kg/yr. Despite its large surface area, Lake Superior had the lowest PBDE total and annual load of any of the Great Lakes. Studies by Environment Canada confirm that PBDEs levels in sediments are lowest in Lake Superior relative to the other Great Lakes, as shown in Figure 4-13 (Environment Canada and Ontario Ministry of the Environment, 2009a). This is likely due to patterns of urbanization and long-range airborne transport and the effects of lake characteristics on residence time.



Source: Environment Canada and Ontario Ministry of the Environment, 2009a

Figure 4-13. PBDE Concentrations in Surficial Sediment in Open Water Areas of the Great Lakes.

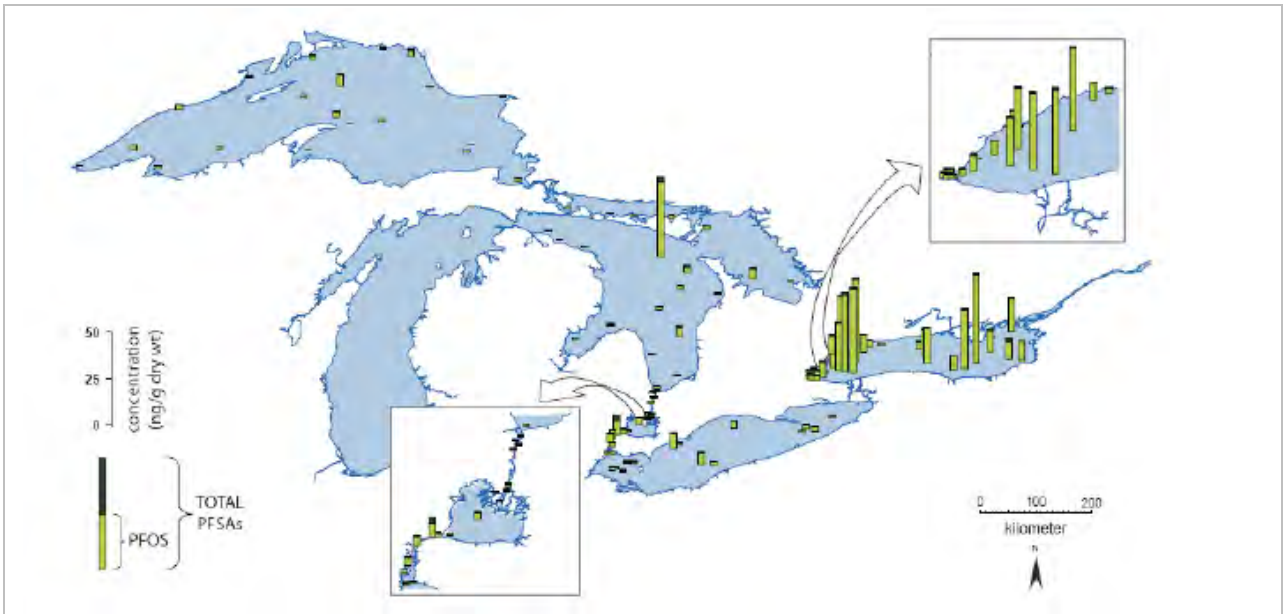
In contrast to PCBs, which showed declining trends or leveling trends, PBDEs increased in Lake Superior sediments in recent years. From the 1970s through 2002, PBDE fluxes into the sediments of all of the Great Lakes have increased exponentially (Li et al., 2006), correlating with PBDE emissions patterns in the Great Lakes Basin (Figure 4-14).



Source: Li et al., 2006

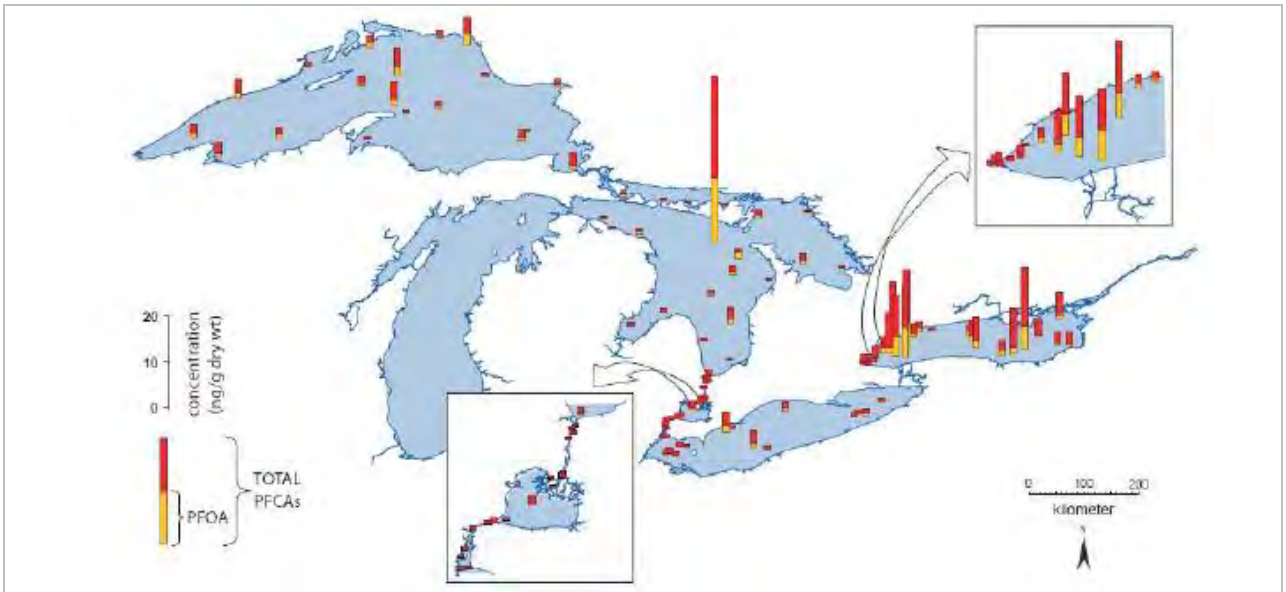
Figure 4-14. Sediment Loading and Emissions of Total PBDEs (excluding BDE 209) and BDE 209 for the Entire Great Lakes Basin.

Environment Canada and Ontario Ministry of the Environment (2009b) also measured levels of perfluorosulfonates (PFSAs), including PFOS, and perfluorocarboxylates (PFCAs), including PFOA, in surficial sediments in open waters of the Great Lakes (Figures 4-15 and 4-16, respectively). As was seen with PBDEs, both PFSAs and PFCAs were highest in the more urbanized and industrialized lower Great Lakes and lower in Lakes Superior and Huron.



Source: Environment Canada and Ontario Ministry of the Environment, 2009b

Figure 4-15. Total Perfluorosulfonates (PFSAs) and Perfluorooctane Sulfonate (PFOS) Concentrations in Surficial Sediments in Open Water Areas of the Great Lakes (excluding Lake Michigan).



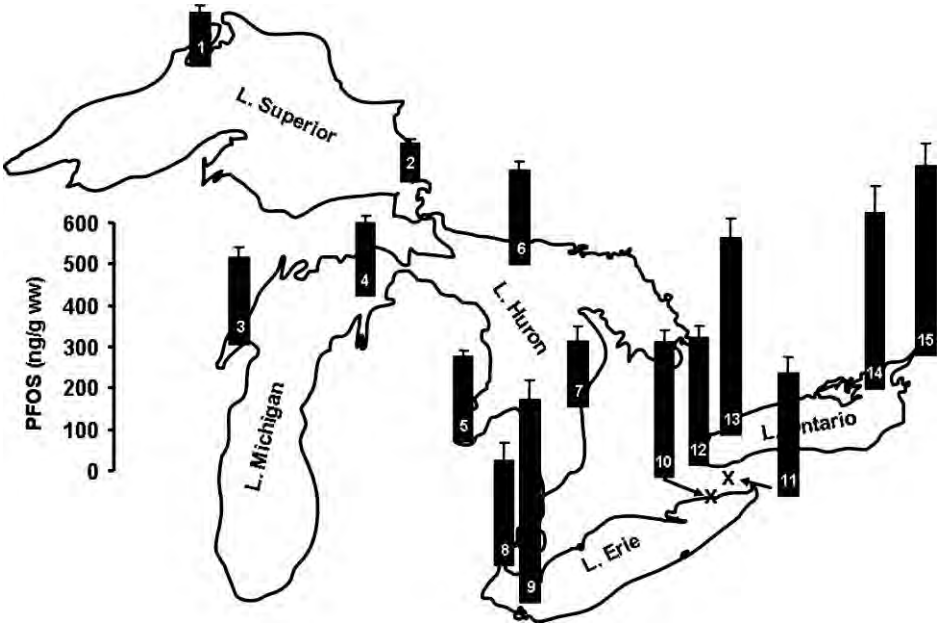
Source: Environment Canada and Ontario Ministry of the Environment, 2009b

Figure 4-16. Total Perfluorocarboxylates (PFCAs) and Perfluorooctanoic Acid (PFOA) Concentrations in Surficial Sediments in Open Water Areas of the Great Lakes (excluding Lake Michigan).

Herring Gull Eggs

Lower brominated PBDE congeners have stabilized or declined in herring gull eggs across the Great Lakes. These compounds increased from 1982 to 2000, but showed no significant increase between 2000 and 2006. In contrast, higher brominated congeners, especially BDE 209, appear to be increasing in recent years (Gauthier et al., 2008). This is similar to the patterns that have been observed in air samples collected by IADN (Vernier and Hites, 2008) and reflects the fact that lower molecular weight PBDE mixtures (e.g., penta- and octa-BDE) have been phased out or banned in most industrialized countries, while higher molecular weight mixtures (e.g., deca-BDE) are still in production. This is another example of environmental media responding to anthropogenic use patterns, as has been seen for a number of legacy POPs.

PFCs have also been quantified in Great Lakes herring gull eggs collected in 2007. Of the 15 colonies tested, PFOS concentrations were lowest at the two Lake Superior sites and generally increased from the northwest to the southeast across the Great Lakes (Figure 4-17; Gebbink et al., 2009).



Source: Gebbink et al., 2009

Figure 4-17. Mean PFOS Concentrations (ng/g) in Herring Gull Eggs Collected in 2007 from 15 Colonies in the Laurentian Great Lakes.

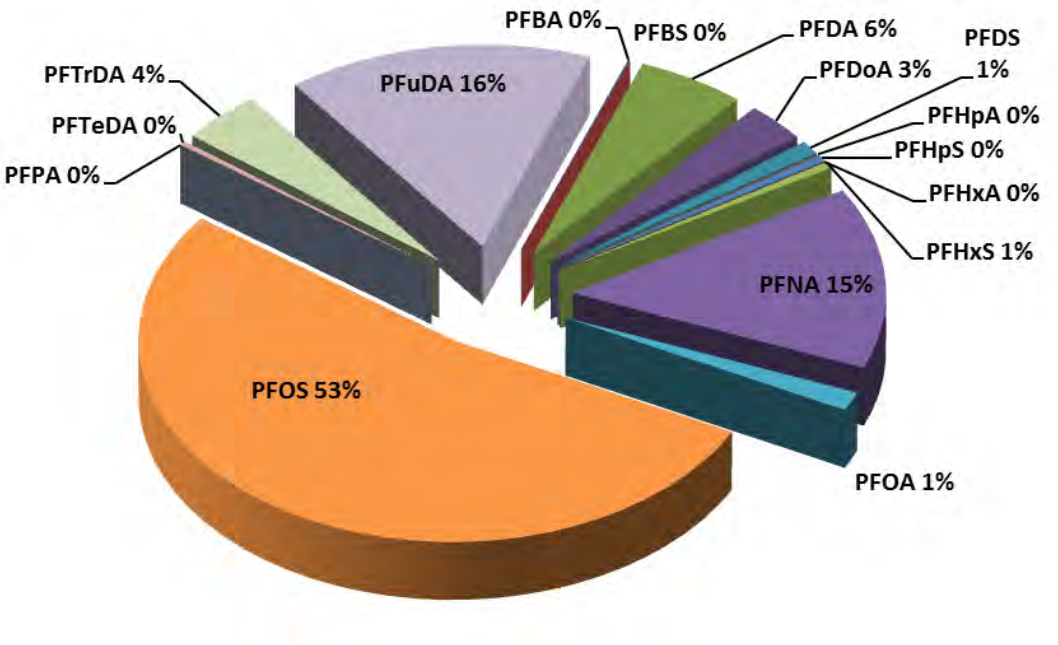
Bald Eagles

Total PBDEs were detected at a geometric mean concentration of 7.9 ng/g in five bald eagle nestling blood plasma samples collected from the Wisconsin shores of Lake Superior in 2000-2001 (Dykstra et al., 2005). A more recent study found mean PBDE levels in eaglet plasma

collected in 2005 ranging from 0.35 to 29.3 ng/g (arithmetic mean) at three Lake Superior sites (Venier et al., 2010c). These values represented both the highest and lowest values obtained among 15 sites throughout the basins of Lakes Superior, Huron and Michigan, although the mean of the three Lake Superior samples (11.3 ng/g) is similar to that found by Dykstra et al. (2005).

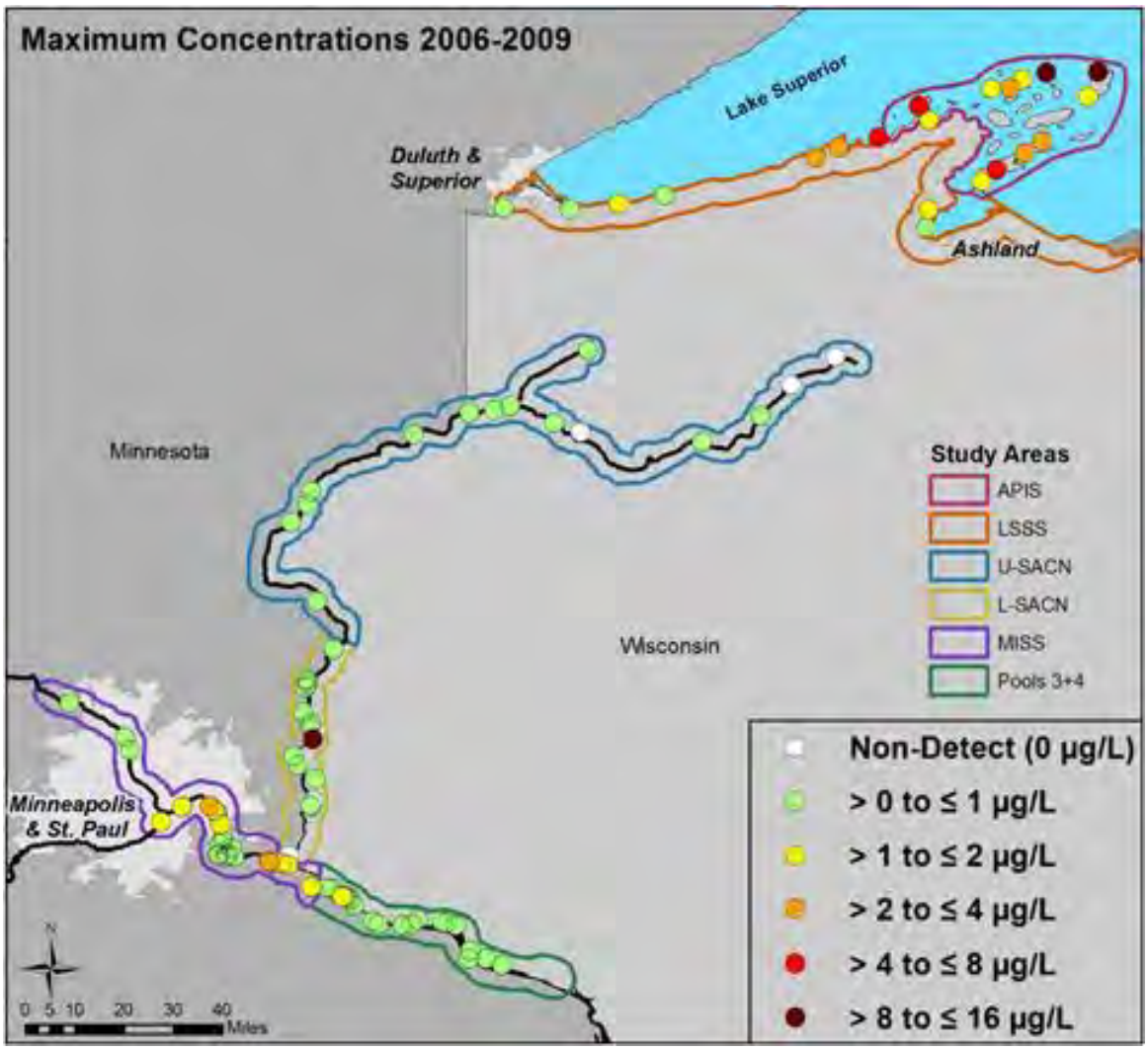
One of the largest studies of emerging contaminants in bald eagles is an ongoing monitoring program by the U.S. NPS Great Lakes Inventory and Monitoring Network. The most recent data published by NPS includes a four-year period from 2006 through 2009, when 154 nestlings were sampled for nine PBDE congeners and 16 PFCs, including PFOS and PFOA (Route et al., 2011). PBDEs and PFCs were found in all nestlings sampled. Geometric mean levels of PBDEs in Lake Superior nestlings ranged from 18 µg/L to 6.47 µg /L over the four years. Lake Superior eagles had significantly higher levels of PBDE congeners #99, #100, #153, and #154 than eagles sampled in some inland study areas. More recent unpublished data show penta- and octa-PBDEs increased through about 2006 in Lake Superior eagles and have steadily declined through 2011 (Route, 2011).

By volume, Route et al. (2011) found PFOS made up 53% of the PFC load in eaglets sampled on Lake Superior followed by PFuDA (16%), PFNA (15%), and PFDA (6%) (Figure 4-18). The remaining PFCs each made up <5% of the total. PFOA, a PFC of considerable concern globally, made up 1% of the PFC load in Lake Superior eagles. However, compared to inland study areas, PFOA was significantly higher in eaglets on Lake Superior, and were particularly high on outer islands of the Apostle Islands (Figure 4-19). The exact reason for this pattern of distribution needs more investigation. NPS is continuing to collect samples to further investigate these trends.



Source: Route et al., 2011

Figure 4-18. Percent by Volume of 16 Different PFC Analytes in Bald Eagle Nestling Plasma Sampled on the Wisconsin Shore of Lake Superior in 2008 and 2009.



Source: Route et al., 2011

Figure 4-19. Maximum Concentrations of PFOA Found in Plasma of Bald Eagle Nestlings in Six Study Areas in the Upper Midwest, 2006-2009.

Lake Trout

The production and use of three popular commercial formulations of PBDE have or are being voluntarily phased out by industry in North America. The phase out of the more toxic penta- and octa-BDE compounds started in 2004 and, by 2012, the use of deca-BDE formulations will also cease. In a national survey of PBDE concentrations in top predator fish from lakes across Canada, the highest concentrations were observed in fish from the Great Lakes and >95% of the PBDE compounds in the fish were tetra-, penta-, or hexa-BDEs (Gewurtz et al., 2011). Federal Environmental Quality Guidelines (FEQG) have been developed by Environment Canada for these three homologue groups which are meant to provide targets for acceptable environmental quality, assess the significance of observed concentrations, and to measure the success of risk management activities. The FEQGs to protect wildlife consumers of fish for tetra-, penta- and hexa-BDEs are 88, 1.0, and 420 ng/g ww, respectively.

Routine monitoring of PBDEs in whole top predator fish from the Great Lakes combined with retrospective analyses of archived samples by the U.S. EPA (Zhu and Hites, 2004) and Environment Canada have provided a complete picture of PBDE contamination in Great Lakes fish from 1977 to the present day. Concentrations of PBDEs in lake trout and walleye rose continuously through to the early 2000s then began to decline for penta-BDE. PBDE concentrations in Lakes Superior and Erie appear to be declining as the slopes of the regressions are all negative; however, the slopes are not significantly different from zero at $\alpha = 0.05$ with a power of 80%. The majority of tetra-BDE and all hexa-BDE concentrations reported for lake trout and walleye in 2009 from all the Great Lakes are below Environment Canada's FEQGs; however, all measured penta-BDE concentrations are well above the FEQG of 1.0 ng/g ww.

Two classes of brominated flame retardants, PBDEs and PBBs, were measured in composite samples of lake trout collected in 1997 from Lakes Superior, Erie, Huron, and Ontario (Luross et al., 2002). The study found that concentrations of PBBs were lowest in Lake Superior, but PBDEs were second highest in Lake Superior lake trout, lower only than Lake Ontario. A similar ranking of PBDE concentrations among lake trout from the Great Lakes was observed by the U.S. EPA Great Lakes Fish Monitoring and Surveillance Program (Carlson and Swackhamer, 2006).

PFCs were also measured in lake trout from the Great Lakes collected in 2001. Mean PFOS concentrations in fish were lowest in Lake Superior (5 ng/g) and were nearly 25-fold lower than lake trout from Lake Erie (121 ng/g), which had the highest fish tissue concentrations (Furdui et al., 2007).

Humans

Levels of major PBDE congeners in serum were assessed in a cohort of Great Lakes residents in 1994-1995 and again in the same individuals in 2001-2003 and 2004-2005 (Turyk et al., 2010). Total PBDEs increased 69% in serum over this time frame. Unlike many contaminants (e.g., mercury, PCBs, DDT, toxaphene), PBDE levels were not associated with the consumption of Great Lakes sport fish. Relative concentrations of individual PBDE congeners also shifted over time, potentially due to differences in persistence of the congeners or to changes in exposure associated with the phase out of the penta-BDE, but not deca-BDE, commercial product.

Chapter 5. Reduction Strategies

5.1 Previous Reduction Strategies

Critical chemical reduction strategies exist in several previous LaMP documents and can be summarized as follows:

- The **1991 Lake Superior Binational Agreement** (Appendix A.1) identified three approaches to zero discharge and zero emission, including special designations, P2, and controls and regulations. The agreement included some very specific strategies, many of which have been implemented.
- During development of the **LaMP Stage 2** load reduction schedules released in 1999, the Lake Superior Task Force developed the first set of guiding principles for targeting reductions of critical chemicals, which were revised and updated in the 2005 Milestones report (Appendix A.2)
- The **LaMP 2000** report was the first document to compare the 1990 baseline to a milestone year. The document also identified 22 reduction strategies and government agencies committed to activities within the strategies at either high or medium priority. This report is available for downloading at http://www.epa.gov/greatlakes/lakesuperior/index.html.
- The **2005 Milestones report** (available at the U.S. EPA website above) revised the strategies and, for the first time, actions to reduce CECs were discussed.
- **LaMP 2008** (also available at the U.S. EPA website above) identified 27 additional reduction and inventory activities in its Addendum 4C. In some cases, activities were specific to certain jurisdictions. The Appendix B reports in this 2010 milestones document use the same framework as Addendum 4C. LaMP 2008 also includes a *Three-Part Strategy for Chemicals of Emerging Concern* (see Section 4.2 of this report).

For this 2010 milestones document, chemical inventory and/or reduction strategies are provided below: in Section 5.2, recommendations are from the Canadian and U.S. contractors who updated the discharge and emission inventories; in Section 5.3, strategies were derived from the Appendix B reports for all jurisdictions and Chapter 3. The following strategies are not intended to replace the strategies identified in previous LaMP documents, but to augment them.

5.2 Inventory Improvement – Suggestions from Canadian and U.S. Consultant Reports

5.2.1 Canada

Mercury

- The recycling rate and fate of an estimated 44 kg Hg/yr from discarded mercury relays and 33 kg/yr from instrumentation and control equipment in industrial and commercial facilities is unknown. A systematic process for monitoring the waste stream for mercury-containing equipment used by industrial, commercial, and institutional facilities in the LSB is needed. Environment Canada should consider reinstituting the Mercury Recovery Program initiated in 2005 to assess whether mercury-containing equipment is being put into landfills and how to increase reuse and recycling. The information gathered in

undertaking such a project will assist in providing a more accurate estimate of the fate of mercury in these products once they are discarded.

- Although the majority of mercury from consumer products has been accounted for in this inventory, Environment Canada may wish to estimate mercury releases from pharmaceuticals, reagents, and miscellaneous electronics such as pressure transducers, films, scanning electrodes and other products used in the LSB and include them in the inventory.
- Environment Canada should consider contacting waste service providers and agencies that collect mercury containing consumer products in the LSB on a yearly basis to get information on the total waste collected, and quantities of mercury-containing products, pesticides, and PCBs. This will ensure that a more accurate record of such wastes is documented. Alternatively, or in addition, Environment Canada could consider contacting Stewardship Ontario to obtain further information on hazardous and special waste collected and removed yearly from the Basin by the existing municipalities of the LSB.
- Environment Canada should consider contacting representatives responsible for the Federal Contaminated Sites Inventory and the Ontario Ministry of the Environment to obtain more specific information about contaminated sites in the LSB.

Dioxin

- Environment Canada should consider updating the industrial emission data obtained from NPRI once the 2010 NPRI data are available.
- Environment Canada should consider gathering information on the extent to which land clearing and brush burning operations exist in the LSB. If quantities of wood burned become available, existing forest fire emission factors could be used to estimate dioxin and furan emissions from this source.
- Outdoor wood furnaces is a recently identified potential source of dioxins and furans (and possibly HCB) emissions. A survey was conducted in the Province of Ontario to better understand the prevalence of such units in Ontario. Some of the municipalities in the LSB were included in the survey but the data have not yet been made public. Additional information on the extent to which this activity is practiced in the LSB and the content and quantity of the material burned is needed.
- Environment Canada should consider obtaining the results of additional sediment sampling that has been conducted recently in Black Bird Creek System when they become available over the next few months.

Pesticides

- Environment Canada may wish to contact the Thunder Bay Landfill, waste service providers operating in the LSB, and OMAFRA on a yearly basis to request information on quantities of amalgamated pesticides waste collected. This will ensure that a more accurate record of such wastes is documented in the future.

Small and Medium Facilities

- Emissions from larger industrial facilities meeting the NPRI reporting threshold requirements have been included in the emissions inventory. These are known as point sources. However, emissions from facilities that emit substances below reporting thresholds, such as small and medium enterprises (also known as area sources), are not reported or documented. This is a data gap. Environment Canada should develop methods for identifying and estimate ZDDP substances emitted from this source.

5.2.2 United States

- Move the year in which the inventory is prepared back at least one year, preferably two, so that actual data for that year are more readily available.
- Add "structural" (building) fires as a source of emissions; NEI has some data available but not for the chemicals of concern. This would seem a likely source of mercury and especially dioxins, PCBs and HCBs as products of incomplete combustion when chlorine-containing materials are burned, especially in poor combustion conditions.
- For significant sources that tend to vary from year to year (e.g., taconite processing), consider including average releases/year for past 5 years.
- Information needs to be acquired on HCBs from pesticides and past use as a fungicide in seed covering.
- Obtain more information regarding the PCB report program ("permit compliance system") and data added to the inventory in 2010 to ensure data are interpreted correctly.

5.3 Inventory and Reduction Strategies from Chapter 3 and Appendix B

The following inventory and reduction activities were gleaned from the evaluation of progress towards zero discharge and zero emission in Chapter 3 and the 2010 Appendix B tables. These activities are presented as recommendations to the agencies that implement the LSBP. In the following, "LaMP agencies" refers to the various federal, state, provincial, and tribal agencies that participate in the LaMP and which develop policy and implement programs to protect the environment and public health, both through regulations and by promoting voluntary actions. It is recommended that the Lake Superior Binational Task Force consider which of these activities will be implemented by their agencies. Additionally, it is recognized that some reduction strategies may be best carried out by LaMP agency partners, including local governments, non-governmental organizations, and industry.

5.3.1 Mercury

General

- LaMP agencies should increase the level of public education on mercury toxicity; pathways into fish, wildlife, and humans; and how they can help remove it from the basin.

Mining

- Chemical Committee members should participate in or track the various mining-related work groups, committees, partnerships and forums that take place around the Lake Superior basin, such as the Lake Superior LaMP's Mining Committee, to educate themselves about mining in the basin, to provide input to decision-makers on the basin-wide chemical programs and inventories (i.e., historical and current levels and trends), and to participate in discussions about best mining practices.
- The Chemical Committee, in coordination with other SWG committees and agencies, should track the opening of new mines, expansion of existing mines, reopening of closed mines, and closure of existing mines for inventory purposes so that in 2015, a list will be ready for inventory research.
- LaMP agencies should support activities that seek to reduce mercury emissions from mining through research activities, voluntary reductions, and/or enforcing controls and regulations.

Wastewater Treatment and Water Permitting

- LaMP agencies and partners, including municipalities, should investigate opportunities to remove mercury from the wastewater stream, including through both voluntary and regulatory means (e.g., local ordinances). They should build off existing success stories from around the basin, such as WLSSD, Thunder Bay, Superior, Bayfield, Marquette, and Ishpeming where wastewater treatment plant innovations and toxics reductions have been accomplished.

Utilities

- Canadian LaMP agencies should track the impact of Ontario Regulation 496/07 on mercury emissions from the Thunder Bay Generating Station.
- U.S. LaMP agencies should track the impact of the Mercury and Air Toxics Standards rule on mercury and dioxin emissions from coal-fired power plants in the basin, especially Presque Isle in Marquette, Bay Front in Wisconsin, and Taconite Harbor and Laskin in Minnesota.

Cremation

- Mercury emissions from cremation have increased due to increased cremation activity and quantity of amalgam in the teeth of deceased. Increases of mercury emissions from cremation are expected to continue over the next 15 years (MPCA, 2008) followed by a gradual decline as less amalgam will be present in future generations. LaMP agencies should track mercury emissions from crematoriums, and investigate opportunities to reduce emissions (e.g., removal of mercury fillings, crematoria emission controls, or non-cremation alternatives such as alkaline hydrolysis).

Products

- The Chemical Committee should work with agency hazardous waste disposal programs to characterize the different jurisdictions' policies or rules on fluorescent lamp drum-top crushers and identify points of agreement as well as differences. A consistent policy

across the LSB is desirable to ensure that drum- top crushers used in lamp recycling do not release mercury to the atmosphere.

- The LaMP agencies should work with various jurisdictions and partners to promote wide-spread bans, restrictions, and voluntary phase-out of mercury-containing products with households, schools, municipalities, and businesses. Regulatory bans, restrictions and voluntary phase-outs of mercury in various products, combined with availability of mercury-free products, are resulting in many companies ceasing to manufacture or sell mercury-containing products, and corresponding declines in mercury emissions. However, because of varying service lives of products, varying quantities of the mercury-containing products will continue to be used (and/or appear in discarded products) even as these products are being replaced. As older mercury-containing products are discarded and replaced with non-mercury devices, it is expected that emissions from this source will continue to decline accordingly. Despite the restrictions, bans, voluntary phase-out and recycling/waste management activities, some mercury-containing products will still be found in use, storage, or being disposed past the 2020 ZDDP target.
- The Chemical Committee and the Canadian LaMP agencies should work with Stewardship Ontario to help promote the MHSW Program.The Canadian MHSW Program is designed to collect consumer hazardous and special materials so they can be recycled or disposed of safely. The first phase began in July 2008 and included nine materials. The second (consolidated) phase began July 1, 2010 and includes 22 materials (including the original nine).The program is expected to substantially increase the quantity of mercury-containing products recycled in the Canadian portion of the LSB.

5.3.2 Dioxins

- LaMP agencies and local governments should continue to support open burning abatement programs. For example, LaMP agencies should coordinate a basinwide survey of rural residents concerning the amount, frequency, and type of material burned.
- The Chemical Committee should consult with agency solid waste managers to determine the extent that accidental or unplanned landfill fires occur and how they contribute to regional chemical inputs. This includes gaining a better understanding of how they are reported in the different jurisdictions and what steps agencies can take to reduce the frequency and intensity of fires.
- The Chemical Committee should also consult with agency solid waste managers concerning leachate recirculation in landfills located in the Lake Superior watershed to improve understanding of the benefits of recirculation and the potential to convert existing landfills, if appropriate.
- The Chemical Committee should seek expert assistance in interpreting the U.S. land clearing estimate and work with Canadian partners to assure a consistent method.
- The Chemical Committee should seek expert assistance in tracking developments in mobile sources as regulations that affect 2010-2015 emissions from on-road and off-road sources.

- The Chemical Committee should consult with agency inspectors to develop a set of assumptions to apply to the small incinerator emissions since they have remained unchanged in the inventory since 1990 due to a lack of knowledge about trends in this mostly illegal source.
- LaMP agencies should increase the level of public education on dioxins, their toxicity; pathways into fish, wildlife, and humans; and how they can help remove them from the basin.

5.3.3 PCBs

- LaMP agencies and partners should continue to remediate locations of historical PCB contamination, including sediments at designated AOCs.
- The Chemical Committee should continue to track disposal and storage via the Ontario database for PCB storage, the Environment Canada database for PCB disposal and the Minnesota hazardous waste database, and U.S. EPA PCB records for PCB storage and disposal.
- The Chemical Committee should examine the storage and disposal categories trends every 5 years, and produce figures showing the various categories and the total weight of articles and materials removed or stored. As part of this examination, the Chemical Committee should pay particular attention to PCB article/equipment end-of-life considerations, the limits of PCB waste data, and how trends could affect PCB articles and equipment more broadly than current inventories allow.
- The Chemical Committee should identify and show the quantity of the stored PCBs that are destroyed in Canada.
- To the extent possible, progress should be measured by the cumulative total of PCB articles and equipment stored and disposed based on available PCB waste data.
- LaMP agencies and partners should increase the level of public education on PCBs, their toxicity; pathways into fish, wildlife, and humans; and how they can help remove them from the basin.

5.3.4 Pesticides

- LaMP agencies should continue to support existing pesticide collection programs, such as clean sweeps, and should consider expanding collections to additional geographic areas.
- Chemical Committee members should document which agency and local government entities collect and track the types and amounts of pesticides disposed. This includes identifying contacts and requesting their input on LaMP documents that discuss pesticides prior to the 2015 milestone data call.
- LaMP agencies and local governments should consider adopting policies or resolutions using the 2009 *Ontario Pesticides Act: Cosmetic Pesticide Ban Regulations.*

- LaMP agencies and partners should increase the level of public education on pesticides, including their safe and appropriate usage; their toxicity; pathways into fish, wildlife, and humans; and how they can help remove old or unused pesticides from the basin.

5.3.5 CECs

- The Chemical Committee should seek expert assistance in interpreting the 2011 Coordinated Science and Monitoring Initiative data on levels of chemicals of emerging concern in the Lake Superior environment.
- The Chemicals Committee should seek expert assistance in better linking CECs to products, processes and sectors so that voluntary pollution prevention and source reduction projects can be implemented by state, local, tribal and industry partners.
- The Chemicals Committee should work to make chemical substance and risk information on CECs more easily accessible to state, local, tribal, industry and non-governmental organization (NGO) partners, to enhance local CEC efforts that support the LaMP.
- The Chemical Committee should compile information on the type and status of different pharmaceutical collections in the basin, including the *Yellow Jugs Old Drugs* program in Michigan, *Medicine Cabinet Clean Out Day* in Minnesota, the *Take Your Medicine… Back to Your Pharmacy* program in Ontario, the U.S. Drug Enforcement Administration's *Prescription Drug Take-Back* initiative, and other efforts to locate and properly dispose of unwanted medication. Following the information gathering, the Committee should look for opportunities to "twin" successful projects across the basin.
- LaMP agencies should develop policies or programs that assist nursing homes and other health care facilities in proper disposal of unwanted medication.
- LaMP agencies should increase the level of public education on new and emerging chemicals; their potential toxicity; pathways into fish, wildlife, and humans; and how they can help remove them from the basin.

5.3.6 HCB

- Canadian LaMP agencies or their inventory consultant should seek a means to approximate the HCB emissions from the Algoma iron sintering plant in 1990 for baseline inventory purposes so that a percent reduction for HCB for basin sources can be estimated.

5.3.7 Other Inventory and Reduction Strategies

- LaMP agencies should conduct long-term monitoring of contaminant concentrations across several media since it is critical to assessing the health of the Lake Superior ecosystem. This should include the continuation of coordinated monitoring efforts. For example, the Coordinated Science and Monitoring Initiative is a binational, Great Lakes-wide effort between federal and state agencies and other partners designed to address the major priorities for each of the lakes. Comprehensive field monitoring is rotated between the each of the Great Lakes in successive years. For Lake Superior, the year of intensive monitoring just occurred in 2011. In the years approaching 2016, the next year of focused

sampling for Lake Superior, LaMP agencies and partners should carefully consider contaminant monitoring needs (e.g., biota, sediments, etc.) as they plan for future monitoring activities. Statistical design of monitoring programs and associated analytical methodologies may need to be altered to have greater power to detect small changes in concentrations.

- LaMP agencies should recognize that because the Lake Superior ecosystem is sensitive to chemical inputs and efficient at retaining environmental contaminants, prevention is critical to its protection.
- LaMP agencies and partners should continue to identify and support various energy efficiency and energy conservation programs (e.g., Leadership in Leadership in Energy and Environmental Design) and provide resources to the public, private businesses, and municipal governments.
- LaMP agencies should promote activities that halt or slow down invasive species, pursuant to the Lake Superior Aquatics Invasives Species Complete Prevention Plan. The invasion of foreign species to the Lake Superior ecosystem must be stopped. Modifications to the existing food web affect contaminant transport as well as the biology of the lake.
- LaMP agencies should recognize that action is needed beyond the LSB. The ZDDP is critical for the LSB but will have limited impact on PBT chemicals in the Lake Superior environment in the face of long-range transport from regional and global sources. LaMP agencies should continue to track and, where possible, participate in out-of-basin chemical reduction activities.
- U.S. LaMP agencies should work with state TMDL programs to reduce ZDDP chemicals statewide and in specific waterbodies that require TMDLs for ZDDP chemicals, including mercury in the St. Louis River. Several states are implementing or developing state-wide TMDLs, including Minnesota (for mercury) and Michigan (for both PCBs and mercury).
- LaMP agencies should increase the level of public education on contaminants. There are many success stories that could be used as examples of how regulations, combined with changes in industry and public behaviors, have helped clean up the Great Lakes. Witness the success of the bald eagle from near extinction to a growing population due largely to taking DDT off the market. The many programs discussed in this document rely on voluntary participation from industry, small municipalities, and the public. A successful public education program is needed to meet the goal of zero discharge and zero emission.

Chapter 6. Conclusions

1990-2000 Retrospective

When the governments and stakeholders contemplated LaMP critical pollutant reduction schedules in the early 1990s, the goal of virtual zero discharge and zero emission was set for 2020, a quarter of a century into the future. With the completion of this 2010 Milestones report, less than one decade remains to meet the 2020 goal. The data provided in this report illustrates many successes – yet more needs to be done. Using the mercury and dioxin examples, reaching the reductions achieved so far (80% and 86%, respectively), may prove to be easier than reducing the remaining 15 to 20% needed to achieve zero discharge and zero emission.

Between 1990 and 2000 many industries in the LSB made changes to their production processes to reduce critical pollutants. The pulp and paper industry, for example, changed to chlorine dioxide and extended oxygen delignification, reducing dioxin to undetectable levels. Two mining operations that released large amounts of mercury and dioxin but were no longer profitable shut down. Permitted processes such as medical waste and sewage sludge incineration were stopped as standards became more difficult to meet and alternatives became more attractive. Manufacturers stopped adding mercury to products, due to a combination of voluntary and regulatory actions. States passed special designations such as the Outstanding International Resource Water. The Great Lakes Water Quality Initiative set tough and consistent water quality standards for BCCs.

In the decade following 2000, Canadian wastewater treatment plants made the transition from advanced primary treatment to secondary treatment and beyond. Provincial and state regulations caused coal-fired power plants operators to investigate and use lower mercury fuels and install mercury control equipment. Local open burning abatement programs increased the pressure to find alternatives to burning. Across the basin, as more residents had access to hazardous waste collections, stockpiles of mercury-containing products and old banned pesticides have dwindled to the point where the remaining stockpiles may be identified primarily during estate preparation. Local utilities took advantage of assistance programs to change-out transformers suspected of containing PCBs. Due to a U.S. EPA Maximum Achievable Control Technology requirement, the most polluting furnaces in the taconite industry were retrofitted with new technology that reduced particulates and had the co-benefit of reducing mercury. A scram mining operation emerged that made use of existing taconite tailings instead of expanded mining. States developed or started development of statewide TMDLs for mercury and PCBs.

Many critical pollutant reduction projects have occurred in all LSB sectors since reduction activities were identified in LaMP 2000. Many of these activities were a direct result of the LaMP, while others were closely aligned with LaMP goals. To this point, the most fruitful of the pollutant reduction methods identified in the Lake Superior binational agreement has been P2. Through P2, the easiest reductions have been achieved; those remaining are more difficult.

2000 to the Present

A majority of the loading of critical pollutants to Lake Superior is coming from out-of-basin sources. LaMP agencies have been effective at reducing critical pollutant loadings within the basin, but further action is needed beyond the basin if virtual elimination in the ecosystem is to become a reality.

Tracking critical pollutant emissions has been more straightforward for pollutants such as mercury and dioxins than for pollutants such as PCBs and pesticides. The amount of direct emission measurements and the quality of emission factors and emission estimates has improved since the publication of LaMP 2000. Despite the improvement, many gaps still exist to accurately and properly characterize emissions from diffuse sources such as landfills, mobile sources, and products containing these chemicals. For all critical chemicals, it is still difficult to estimate the impact of local reduction efforts, such as pesticide clean sweeps, on emissions within the basin. This is because in-service or in-storage equipment and products are not inventoried.

Despite estimates and knowledge gaps that exist within the LSB emissions inventory, reasonable and scientifically valid estimates about critical pollutant reductions within the basin have been made. For instance, it is estimated that mercury discharges and emissions declined 72% by the year 2005 and 80% by the year 2010 (compared to the 1990 baseline). In order to meet the Stage 2 LaMP goal of zero discharge and zero emission by 2020, an additional 417 kg/yr must be reduced. (In order to meet the extrapolated 90% reduction goal by 2015, an additional 204 kg/yr of mercury must be reduced from 2010 loads.) According to the inventory data, the largest remaining emission sources for mercury are mining and fuel combustion (mostly from coal), which together account for 91% of the current mercury emissions within the basin, although mercury from mining emissions is more than twice that from fuel combustion in the LSB. Data from 2010 indicate that mercury emissions from mining have dropped 21% from 2005 levels and fuel combustion has dropped by 43%.

For dioxin, it is estimated that dioxin discharges and emissions declined 82% by the year 2000 and 86% by 2005 compared to the 1990 ZDDP baseline. According to the inventory data, the dioxin decline remains at 86% in 2010. In order to meet the 90% reduction goal by 2015, roughly 1 g TEQ/yr of dioxin must be reduced from 2010 loads. Open burning is a completely preventable source of dioxin and elimination of open burning by 2015 would exceed the goal if all else remained equal. Fuel combustion (mostly from mobile sources) is the second largest source of in-basin dioxin and trends by 2015 are difficult to predict due to changes in pollution control for mobile sources such as diesel engines.

The HCB inventory is problematic since it is incomplete. For the first time since the inventory effort began, the Canadian and U.S. inventories were combined. The largest sources in 2010 were incineration and vehicles. It is not possible to estimate the overall reduction of HCB because an estimate is not available for the largest source identified in 1990 (i.e., the iron sintering plant), although it is likely to be similar to the dioxin reduction of 85% by 2010.

Tracking PCB reductions over time has not been possible without a complete inventory. As an alternative, the Chemical Committee has proposed to track disposal and storage via the Ontario database for PCB storage, the Environment Canada database for PCB disposal and the Minnesota hazardous waste database and U.S. EPA PCB databases for PCB disposal. Storage, disposal, and/or destruction of PCB capacitors and oil will be analyzed every 5 years for trends and cumulative progress. Reductions within the basin should be greater than or equal to state or province-wide trends.

Although the LSB is mostly non-agricultural, a significant amount of banned pesticides have been collected in or near the basin since 1992. Although the LaMP Stage 2 reduction goal was to collect all of the pesticides that contained any of the nine ZDDP chemicals by 2000, it is obvious that these pesticides are still present and that collections need to continue. The positive news is that the rate of disposal of these pesticides has stabilized or declined since 2001. Anecdotal evidence from collections indicate that the banned pesticides coming into the programs are from sources that were recently discovered, usually as part of preparing for an estate sale or other property transfer. The largest known stockpiles appear to have been disposed already.

In each of the milestone years, the LaMP agencies and consultants inventoried a variety of sources, searching for the best data each time to continually update and improve the inventories. However, the program has reached the point that some remaining conservative assumptions about certain discharges and emissions in the inventory are unusable as we continue to track progress towards zero. For example, the inventory estimate for U.S. small incinerators was assumed to be 0.6 g/yr TEQ dioxin in 1990, 2000, 2005 and 2010 since we had no direct evidence of change. This conservative assumption is not critical when the amount is low compared to the rest of the inventory, but in 1990, small incinerators were just 2% of the inventory compared to 15% of the inventory in 2010. LaMP agencies will need to invest in some additional inventory research in order to make more accurate emission estimates in 2015 and 2020.

In general, concentrations of critical pollutants have declined in various compartments of the Lake Superior ecosystem including air, water, sediment, herring gull eggs, and fish. These declines have occurred following government intervention in both the U.S. and Canada to restrict and/or ban the manufacture and use of PCBs and certain pesticides in the 1970s and 1980s; however, declines of most of these banned pollutants have occurred at a much slower rate in recent years due to continued atmospheric inputs. Critical pollutants continue to impair beneficial uses set forth in the GLWQA both locally and lakewide. Concentrations of PCBs, mercury, and other critical pollutants remain above levels that limit consumption of fish from Lake Superior. PCBs, toxaphene, and dieldrin in Lake Superior water remain above the most sensitive water quality yardsticks used by Lake Superior jurisdictions to evaluate water quality. A relatively recent finding is that levels of mercury in Lake Superior fish are slightly higher than in the other Great Lakes. In addition, some Great Lakes fish data indicate an upward trend in fish mercury levels. The elevated level of mercury provides an example of how, despite its remote location and relative lack of industrial development, Lake Superior's unique properties make it particularly susceptible to pollutant inputs.

Recent discoveries of many CECs in the Lake Superior ecosystem have led to an important challenge for lake managers. Chemicals that are used in our everyday lives, such as personal care products and pharmaceuticals, along with specific-use chemicals, such as PBDEs and PFCs, are being detected in various compartments of the Lake Superior ecosystem. Some of these, such as PBDEs, are increasing in concentration in fish and sediments. Because little is known on the potential toxicity and environmental fate and transport of many of these CECs, the management challenge lies in deciding which of them should be defined as chemicals of concern and subsequently monitored and/or remediated. The Chemical Committee advocates using the precautionary approach through pollution prevention measures to limit their release to Lake Superior, along with the understanding that prevention is a more cost effective approach than degradation followed by remediation.

The Path Forward

The ZDDP has documented reductions in emissions of critical chemicals. While it is tempting to point out that the sources within the LSB are small compared to atmospheric deposition from out-of-basin sources, as a demonstration, this program has succeeded and can actually document its success. By proving that people living around Lake Superior have succeeded in reducing sources of toxic chemicals, the ZDDP shows that this can happen elsewhere.

To put the accomplishments of Lake Superior's people into perspective, it is estimated that 2.1 tonnes (2.3 tons) of mercury was released from sources in the basin in 1990 but is down to 0.4 tonnes (0.4 tons) in 2010. Eliminating more than a tonne and a half of mercury is a resounding success -- but the work is not finished. The remaining 0.4 tonnes is still a lot of mercury. Dioxin is following a similar trend as mercury but preventable sources still dominate the inventory. 4.6 tonnes (5 tons) of banned pesticides were collected from just one state since 1992. Ongoing pesticide collections are continuing in Ontario and the other states as well. Stockpiles of PCBs are diminishing but by no means eliminated since the trend has not even flattened.

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List of Acronyms

AMRC	Association of Municipal Recyclers
AOC	Area of Concern (from Great Lakes Water Quality Agreement Annex 2)
ATSDR	Agency for Toxic Substances and Disease Registry
BCC	bioaccumulative chemical of concern
BHC	hexachlorocyclohexane (aka, HCH or benzene hexachloride)
CCME	Canadian Council of Ministers of the Environment
CEC	chemical of emerging concern
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COA	Canada-Ontario Agreement [Respecting the Great Lakes Ecosystem]
CORA	Chippewa Ottawa Resource Authority
CSMI	Coordinated Science and Monitoring Initiative
DDE	dichlorodiphenyldichloroethylene (metabolite of DDT)
DDT	dichloro diphenyl trichloroethane
EAGLE	Effects on Aboriginals of the Great Lakes
EIA	Energy Information Administration
EPCRA	Emergency Planning and Community Right-to-Know Act, U.S.
FCMP	Fish Contaminant Monitoring Program
FCMSP	Fish Contaminants Monitoring and Surveillance Program
FEQG	Federal Environmental Quality Guideline
GIS	Geographic Information Systems
GLFMSP	Great Lakes Fish Monitoring and Surveillance Program
GLHHERP	Great Lakes Human Health Effects research Program
GLI	Great Lakes [Water Quality] Initiative
GLIFWC	Great Lakes Indian Fish and Wildlife Commission
GLNPO	Great Lakes National Program Office
GLRC	Great Lakes Regional Collaboration, U.S.
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
HCB	hexachlorobenzene
HCH	hexachlorocyclohexane (aka, BHC or benzene hexachloride)
HHW	household hazardous waste
HL	High level

IADN	Integrated Atmospheric Deposition Network
IJC	International Joint Commission
IMERC	Interstate Mercury Education and Reduction Clearinghouse
LaMP	Lakewide Management Plan (from Great Lakes Water Quality Agreement Annex 2)
LEED	Leadership in Energy and Environmental Design
LL	Low level
LSB	Lake Superior Basin
LSBP	Lake Superior Binational Program
MATS	Mercury and Air Toxics Standards
MDA	Minnesota Department of Agriculture
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDH	Minnesota Department of Health
MHSW	Municipal Hazardous and Special Waste
MPCA	Minnesota Pollution Control Agency
MPUC	Minnesota Public Utilities Commission
MW	megawatt
NEI	National Emissions Inventory, U.S.
NPRI	National Pollutant Release Inventory, Canada
NPS	National Parks Service
NWRPC	Northwest Wisconsin Regional Planning Commission
OCS	Octachlorostyrene
OIRW	Outstanding International Resource Water, U.S.
OMAFRA	Ontario Ministry of Agriculture Food, and Rural Affairs
OMOE	Ontario Ministry of the Environment
ORW	Outstanding Resource Waters, Wisconsin
P2	pollution prevention
PAH	polycyclic aromatic hydrocarbons
PBB	polybrominated biphenyl
PBDE	polybrominated diphenyl ether
PBT	persistent, bioaccumulative and toxic chemical
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzo-p-dioxin
PCDF	polychlorinated dibenzofuran

PEL	probable effect level
PFC	perfluorinated compound
PFCA	perfluorocarboxylate
PFOA	perfluorooctanoic acid
PFOS	perfluoroalkyl sulfonates
PFSA	perfluorosulfonate
POP	persistent organic pollutant
PPCP	pharmaceuticals and personal care products
PWQO	Provincial Water Quality Objective
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
SFCMP	Sport Fish Contaminant Monitoring Program
SOLEC	State of the Lakes Ecosystem Conference
SWG	Superior Work Group
2,4,5-T	2,4,5-trichlorophenoxy-acetic acid
TCDD	total polychlorinated dioxin
TEF	toxic equivalency factor
TEQ	Toxic Equivalence Quotient
TMDL	Total Maximum Daily Load, U.S.
TSCA	Toxic Substances Control Act, U.S.
UNEP	United Nations Environment Programme
U.S. EPA	United States Environmental Protection Agency
WDHS	Wisconsin Department of Health Services
WDNR	Wisconsin Department of Natural Resources
WHO	World Health Organization
WLSSD	Western Lake Superior Sanitary District, Minnesota
ww	wet weight
ZDDP	Zero Discharge Demonstration Program

Lake Superior Lakewide Management Plan: 1990-2010 Critical Chemical Reduction Milestones

Appendix A - Lake Superior Binational Program Background Documentation

Appendix B - Reduction Activities in the Lake Superior Basin: 2005-2010

Appendix C - In-Basin Chemical Source Inventories: 2005-2010

Appendix D - PCB Management in Lake Superior Jurisdictions

Appendix E – Combined COA/GLI List of P,B,T Chemicals of Concern

October 23, 2012

Appendix A

Lake Superior Binational Program Background Documentation

A.1 A Binational Program to Restore and Protect the Lake Superior Basin
(September 1991)

A.2 Zero Discharge Demonstration Program Guiding Principles
(August, 2004)

A.1 A Bi-National Program to Restore and Protect the Lake Superior Basin

Introduction

In its Fifth Biennial Report on Great Lakes Water Quality, the International Joint Commission (IJC) recommended that "the Parties designate Lake Superior as a demonstration area where no point source discharge of any persistent toxic chemical will be permitted." This document identifies the responses of the federal governments of the United States and Canada, the States of Minnesota, Wisconsin and Michigan and the Province of Ontario (the governments) to this recommendation.

Lake Superior has not experienced the intense development, urbanization and pollution characteristics of the lower lakes and has remained relatively pristine. To protect the high quality waters of the Lake Superior Basin, and to restore beneficial uses where they have been degraded, the United States and Canadian environmental protection programs will be expanded, coordinated and accelerated. This effort includes two major areas of activity: (A) a zero discharge demonstration program devoted to the goal of achieving zero discharge or emission of certain designated persistent bioaccumulative toxic substances, which may degrade the ecosystem of the Lake Superior Basin, and (B) a broader program of identifying impairments and restoring and protecting the Lake Superior Basin ecosystem.

A Taskforce of senior managers from resource management and environmental protection agencies from the governments is proposing the following approach to those areas of activity identified above. The ultimate goal of these activities is to restore and maintain the integrity of the Lake Superior ecosystem through prevention, control and restoration programs. In developing this action plan the Taskforce is consulting not only government entities, but also the public through a stakeholder advisory forum. Because of the significant diversity in philosophy, approach, statutory underpinnings and program maturity, the Taskforce identified parallel action plans for the portion of the basin in the United States and the portion in Canada. The actions identified as short term are expected to occur within the next three years. However, when actions are to occur over the longer term, over the next three to five years, they have been so identified. Wherever possible the governments have identified uniform activities in directing programs to meet the common goal, and remain committed to coordinating an effective and equitable basinwide program.

The governments will ensure that their respective regulatory programs are compatible with the attainment of the goal and fair to dischargers on both sides of the basin. Furthermore, the governments will ensure a regular reporting on the progress of the plan through semi-annual meetings of the Parties to the Great Lakes Water Quality Agreement.

The challenge to designate Lake Superior as a "demonstration area where no point source discharge of any persistent toxic substance will be permitted," is accepted. Following the process described in this document, the governments will use existing authorities, and seek expanded authorities, to pursue the goal of zero discharge.

At the same time, the development and implementation of Remedial Action Plans (RAPs) will continue, existing regulatory programs will be fully implemented, and new initiatives to identify Lakewide impairments, responsible source and corrective measures will be initiated. Public participation will be an important part of this program.

The Lake Superior Zero Discharge Demonstration Program

GOAL: To achieve zero discharge and zero emission of certain designated persistent bioaccumulative toxic substances, which may degrade the ecosystem of the Lake Superior Basin.

This goal will be pursued through actions taken in three areas. The waters in the Lake basin will be designated as meriting special protection and antidegradation requirements. Reduction in existing loadings will be secured both through voluntary pollution prevention activities and enhanced control and regulatory efforts. Each area is described in detail below.

1. Pollution Prevention

Policy: To eliminate or further reduce persistent bioaccumulative toxic substances at their sources, the governments agree to develop and implement pollution prevention approaches. The prevention of pollution is the preferred approach to environmental protection. When preventing pollution is not feasible, the remaining waste management options (in priority order) are reuse, recycling, treatment and disposal. Disposal or other release to air, water or land should occur only as a last resort, and when there are no prudent and feasible alternatives.

Status: The United States Environmental Protection Agency (USEPA) has identified Lake Superior as a focal point of the Great Lakes Pollution Prevention Action Plan announced in April of 1991. Most state programs or proposals are in the planning stages and have been developed using guidance from USEPA. Pollution Prevention activities can fall into many categories, but the present discussion is limited to include voluntary elimination/reduction programs and technical assistance activities.

Canada has identified Lake Superior as a priority area for implementation of its recently announced Great Lakes-St. Lawrence Pollution Prevention Initiative. The Ontario Ministry of the Environment is willing to participate with the federal governments in programs directed at the protection of Lake Superior, and, will seek reductions of persistent toxic substances from all industrial operations in the Great Lakes, initially with a focus on Lake Superior.

Bi-National Action Plan
Action: The United States and Canada have funded a bi-national dialogue in pollution prevention, focused on Lake Superior. A Lake Superior Stakeholders Advisory Committee will facilitate a process to develop a strategy to reduce current emissions of toxic substances and eliminate future sources. A Lake Superior Stakeholder Advisory Committee will consider what stakeholders can do to achieve immediate and near term reductions in toxic loadings and to clearly define the barriers to toxics reduction. The Lake Superior stakeholders will participate in the Pollution Prevention Symposium in Traverse City, Michigan in conjunction with the IJC Biennial Meeting.

Action: The United States and Canada will encourage the twinning of two major municipalities in the Lake Superior Basin to enhance citizen dialogue and to exchange ideas and practices respecting pollution prevention strategies.

United States Action Plan

Action: The States and USEPA will develop and implement education programs and technical assistance activities to promote pollution prevention leading to the elimination or reduced use of toxics materials. A joint project, the Lake Superior Partnership, is being undertaken by the State of Minnesota and the Western Lake Superior Sanitary District in Duluth to conduct multi-media compliance inspections and identify pollution prevention opportunities. A training program for individuals involved in Remedial Action Planning will also be developed, with special attention to the St. Louis River Area of Concern.

Action: USEPA will seek voluntary reduction of the release and off-site transfer of toxic materials from major corporations. Collectively the activities are known as the "33/50" program. Using 1990 as a baseline, USEPA is seeking thirty-three percent reductions by 1992 and fifty percent reductions by 1995.

Canadian Action Plan

Action: Canada and Ontario will develop pollution prevention strategies for all sectors in the basin through consultation with governments, industry, municipalities, business and individuals. Funds will be directed toward assisting stakeholders with the development of sectoral toxic chemical reduction plans, as well as demonstration projects involving pollution prevention technologies and educational programs. The polluter pays principle will apply to implementation of these plans.

Action: Environment Canada, Ontario Ministry of Environment and Domtar, a large Canadian corporation, will shortly investigate the feasibility of introducing a chlorine-free bleaching process to the mill at Red Rock, Ontario, through an initial bench scale study to be completed by 1992.

Action: The Conservation Council of Ontario is developing a program to improve the effectiveness of community involvement in solving environmental problems.

The program builds on existing consultation processes and community based plans to develop and publicize a list of priority issues. Each participating community will also identify specific targets, the actions it wishes to undertake, and the support required to facilitate public and community involvement.

Communities in the Lake Superior Basin will be particularly encouraged to participate in this exercise, and financial assistance will be provided to assist in the development of plans.

2. Special Protection Designations

Policy: Because of the unique character of the Lake Superior resource, the governments in the United States portion of the basin will seek to implement a "toxic freeze strategy". Under this strategy the governments will designate all US Lake Superior Basin waters as a special resource, apply enhanced antidegradation approaches which require best technology for any proposed new or increased discharge of certain designated persistent bioaccumulative toxic substances into those waters, and designate certain portions of the Lake basin as areas where no new or increased point source discharges of these pollutants will be permitted.

Canada and Ontario also recognize the unique character and pristine nature of Lake Superior. The governments, in order to maintain this ecosystem, intend to be as diligent as possible regarding the approval of any new or expanded industrial or municipal facility. The governments will encourage non-polluting industries to establish in the Lake Superior Basin.

Status: Each State has an existing process for antidegradation evaluation. These processes will be standardized through the Great Lakes Water Quality Initiative, and will include enhanced requirements for Lake Superior.

The Canada Water Act is the legislative tool available to designate Lake Superior as a special Water Quality Management Area pursuant to a federal-provincial agreement.

United States Action Plan

Action: By written agreement, the Governors commit to initiate appropriate state procedures to designate all waters of the Lake Superior Basin as Outstanding International Resource Waters (OIRW). Under the OIRW designation, the increased discharge of certain designated persistent bioaccumulative toxic substances will not be allowed without an adequate antidegradation demonstration which includes the installation of the best technology in process and treatment. The States will develop the procedure for the antidegradation demonstration under the Great Lakes Water Quality Initiative.

Action: By written agreement, the Governors commit to initiate appropriate State procedures to designate certain special areas of the Lake Superior Basin as Outstanding National Resource Waters (ONRW). The purpose of this ONRW designation is to prohibit the new or increased discharges of certain designated persistent bioaccumulative toxic substances by point sources in these areas, including respective buffer zones and transition areas as defined by the states. Examples of areas to be considered for such designation include:

National Parks, Lakeshores and Refuges, and
State Parks, Recreational Areas and Refuges.

The States will develop procedures under the Great Lakes Water Quality Initiative for state implementation for the ONRW designation.

Action: The States and USEPA will evaluate the possibility of pursuing and/or supporting other special designations of areas in the Lake Superior Basin. Examples of these other designations include: the United Nations Biosphere Reserve Program and the International World Heritage Program.

Canadian Action Plan

Action: Canada and Ontario are presently reviewing the Canada-Ontario Agreement Respecting Great Lakes Water Quality. As part of this review process the two governments will pursue a federal-provincial designation respecting Lake Superior under the Canada Water Act. The public will be involved in this review.

3. Controls and Regulations

Policy: In the United States, it is a national goal that the discharge of pollutants be eliminated. To ensure continued progress toward this goal, point source controls will be improved as a result of upgraded technology based requirements and revised Lake Superior Water Quality Standards designed to provide consistent protection of water quality in the basin. Best Management Practices will be required where nonpoint sources are significantly impairing water quality. Air emissions will be required to meet enhanced emission standards and other control measures as necessary to protect the Lake.

Canada and Ontario have agreed to adopt the goal of virtual elimination of persistent toxics substances from the ecosystem. They also agree to apply the philosophy of zero discharge of persistent toxic substances to the ecosystem.

Status: The United States has adopted technology-based effluent requirements for fifty-one categories of industrial dischargers and municipal sewage treatment works. The states have adopted Water Quality Standards for Lake Superior and its tributaries. These requirements are applied through state issued National Pollutant Discharge Elimination System (NPDES) permits for those facilities which discharge directly into surface waters and through pretreatment standards for industries which discharge into sanitary sewer systems.

At present, both the technology based requirements and the water quality standards are undergoing review and updating. A rulemaking involving multiple statutes is underway for the Pulp, Paper and Paperboard industry and will result in decreased releases to the environment. Water Quality Standards and related implementing procedures are being updated through the Great Lakes Water Quality Initiative, a joint state-USEPA effort to ensure that standards are adequately protective and consistently applied to dischargers.

The Clean Air Act requires the assessment of the role and relative importance of atmospheric deposition of hazardous air pollutants on the Great Lakes. By 1995, USEPA is to promulgate any necessary emission standards or control measures. The design of the needed monitoring program is underway, and an air research "master station" has been established on the Keewanaw Peninsula.

The Lakewide Management Planning process described in the following section will be used to coordinate these activities.

Ontario is currently preparing new and revised regulations to reduce and eliminate point sources of persistent toxic substances. Ontario will be incorporating the philosophies of pollution prevention, multi-media considerations, and zero discharge of persistent toxic substances in the preparation of the regulations.

Bi-National Action Plan

Action: The governments will undertake the development of common water quality standards and implementing procedures for the Lake Superior Basin. This effort will establish common interim water quality goals as progress is made toward the elimination of discharges of persistent, bioaccumulative toxic substances, and build on the Great Lakes Water Quality Initiative.

Action: The governments will pursue expanding bans of persistent bioaccumulative toxic substances, and/or the establishment of sunset restrictions for these substances as necessary.

Action: The governments will complete an inventory of toxic air emissions and an assessment of toxic air deposition in the Lake Superior Basin.

United States Action Plan

Short-term Strategy

Action: The States and USEPA will continue enforcing existing standards through air and NPDES permits and pretreatment requirements. Facilities will continue to meet either technology, air quality or water quality based effluent limits or face enforcement actions.

Action: The States will require analysis for certain designated persistent, bioaccumulative toxic substances in stormwater discharges from municipalities with populations greater than five thousand. Stormwater permits and best management practices will be required for municipal and industrial stormwater discharges that significantly impair water quality.

Action: The States will require toxics reduction plans in each new or reissued NPDES permit for point sources discharging to Lake Superior or its tributaries which have effluent limitations for toxic pollutants that are below levels reliably measured by present analytical methods. The plans will examine process modification and use alternative substances to eliminate or reduce the discharge of these pollutants and ensure progress toward the goal of zero discharge. Examples include on-site recycling, product substitution and use of closed loop systems.

Action: The States and USEPA will include pollution prevention components in enforcement settlements as appropriate. Such components can include comprehensive environmental audits, product substitution, and elimination or reuse of process wastes.

Action: The States, with the concurrence of USEPA, will designate the following as persistent, bioaccumulative substances of immediate concern for Lake Superior and its tributaries, as per the Great Lakes Water Quality Initiative: 2,3,7,8-TCDD; octachlorostyrene; hexachlorobenzene; chlordane; DDT, DDE and other metabolites; dieldrin; toxaphene; PCB's; and mercury. Contaminants known to cause fish and wildlife consumption advisories or impacts or accumulate to unacceptable levels in sediments will be considered by the Governors for designation in the future. New chemicals may be added following assessments of environmental effects and impacts and after public review and comment. These compounds will be the focus of the zero discharge demonstration project and form the basis for discussions with the Canadian governments.

Action: USEPA will adopt guidance and the states will revise/adopt water quality standards and enhanced antidegradation procedures in accordance with the Great Lakes Water Quality Initiative.

Action: USEPA is revising the technology based requirements for direct and indirect dischargers. A "cluster" of regulations under multiple environmental laws is being developed for the Pulp, Paper and Paperboard industry to maximize environmental benefit. The "cluster" rulemaking is an integrated regulatory framework in which all regulations affecting the industry are considered together to identify prevention opportunities and develop a comprehensive environmental solution, consistent with the ecosystem approach under the Great Lakes Water Quality Agreement (GLWQA).

Action: The States will issue permits to implement revised standards and requirements.

Action: The USEPA will propose Sediment Quality Criteria for use in identifying contaminated sediments. These criteria will identify sediment quality that is protective of aquatic life, and establish a process for deriving criteria protective of other beneficial uses.

Action: USEPA will develop emission standards based on Maximum Achievable Control Technology under the requirements of the reauthorized Clean Air Act. In the interim, the states will require the Best Available Control Technology for toxic compounds emitted by air sources as agreed in the Great Lakes States' Air Permitting Agreement.

Long-term Strategy

Action: The States and USEPA will initiate sediment remediation measures at AOC's and other impaired sites known to contribute persistent, bioaccumulative substances to the Lake Superior ecosystem.

Action: USEPA will develop emission standards and other control measures as might be necessary to control the emission of hazardous air pollutants in the Great Lakes basin.

Action: The states and USEPA will include appropriate limits for persistent bioaccumulative toxic substances in air emission permits to eliminate or further reduce the deposition of these substances in the Lake Superior Basin.

Canadian Action Plan

Action: Canada will release a pulp and paper regulatory reform package that will set stringent controls on Biochemical Oxygen Demand, Total Suspended Solids and acute toxicity as well as prevent the formation of dioxin and furans. Under the Canadian Environmental Protection Act (CEPA), Canada is reviewing the adequacy of existing regulations with a view to possibly strengthening them, or the need for additional regulations.

Action: Canada has established a priority substances list under CEPA that will be expanded and revised in 1994. Control options will be evaluated for substances that are found to be toxic and recommended control measures will be developed and implemented.

Action: Environmental effects monitoring programs will be required to assess the adequacy of control measures.

Action: The Great Lakes Cleanup Fund is supporting technology development and a demonstration program on pulp and paper effluents. The first priority of this program is directed towards the removal and treatment of chlorinated organic contaminants in effluents, particularly from bleached kraft mills.

Action: Under Ontario's Municipal and Industrial Strategy for Abatement (MISA), regulations are being developed to virtually eliminate persistent toxic substances from industrial effluents.

Action: In addition to the above, Ontario, in rescoping its MISA program, will feature zero discharge and pollution prevention principles, beyond the requirements for acute toxicity elimination and Best Available Technology. Ontario will be preparing a list of persistent toxic substances whose discharge will be banned.

Action: Bottom sediments adjacent to the Northern Wood Preservers site in Thunder Bay are highly contaminated with PAHs, PCPs and possibly dioxins from current and historical runoff from the facility. Pending the completion of an Environment Canada assessment of sediment contamination, a technology demonstration for removal of contaminated materials will be conducted under the Cleanup Fund in 1992. A tandem project will also be undertaken to demonstrate sediment treatment technology to render the dredgate harmless.

Action: Ontario is committed to ensuring an adequate level of treatment for all municipal wastewater discharges to Lake Superior. Thunder Bay is undertaking a phased upgrade of its sewage treatment plant, to progress to secondary treatment by 1995. Provincial support is being provided to individual phases of this upgrade.

Action: Canada and Ontario are working to ensure a complementary approach to regulation of industrial discharges is achieved.

Action: Ontario is currently reviewing its control programs respecting air quality with the aim of strengthening regulations to further reduce emissions of persistent toxics and other contaminants.

Action: Ontario is developing new sediment quality guidelines which set numerical objectives for the protection of aquatic life and outline procedures for the management of contaminated sediments. Release for public consultation is expected by the end of this year.

The Broader Program to Restore and Protect the Lake Superior Ecosystem

Policy: As progress is made toward the goal of zero discharge and emissions from sources of persistent, bioaccumulative toxic substances, the governments will undertake an integrated, ecosystem based program to protect and restore the Lake Superior Basin. This program will include a systematic evaluation of chemical-induced environmental impairments in the basin and the identification of measures to ameliorate those impacts. This broader program also includes an inventory of existing habitat, activities to protect those resources, with special emphasis on the habitats required by threatened or endangered species, and activities to restore/reclaim impaired areas.

Status: A Lakewide Management Planning (LaMP) process will be initiated in 1992 to provide a framework for all of the discharge and/or emission control programs impacting the Lake basin and to set the stage for the submission of a Lakewide Management Plan. Information on the state of the Lake will be assembled. Such information will include an inventory of impairments, identification of pollutants believed to be responsible for those impairments, identification of sources, and identification of action items to reduce the contribution of pollutants to the system. Work will also begin on identification of ecosystem objectives and monitoring strategies to support the LaMP process. The monitoring strategy will include an improved international air

toxic monitoring network and modeling to identify major local and distant sources impacting the basin. Consistent with the Clean Air Act, control strategies for these sources will be devised and implementation will be initiated. A critical component of the LaMP process is the identification and implementation of fast-track actions that can immediately be undertaken. It is expected that this process will include all of the activities identified in the Zero Discharge Demonstration Program above. This process will be an inclusive effort, involving not only the public, but federal (bi-national), state, and provincial environmental protection and resource management agencies.

Discussions have begun between the environmental protection and resource management agencies in the basin so that the quantity and quality of fish and wildlife habitat are appropriately protected. In 1989, Canada announced a five year Great Lakes Action Plan. This plan, which has been extended, more than doubled the resources devoted to work on the Lakes, and included for the first time a Health Effects program and a Cleanup Fund.

Action: The United States will implement its 5-year strategy to coordinate efforts in the basin. This Strategy includes all of the major actions on the Great Lakes by Great Lakes States and federal agencies.

Action: The governments will continue to support and where possible accelerate the development and implementation of Remedial Action Plans. This effort provides a mechanism for focusing the prevention, control and remediation tools available to all levels of government in the basin and will contribute to the reduction of risks to human health and the environment.

Action: The governments will inventory habitats in the basin.

Action: The governments will continue the habitat reclamation projects currently underway to restore fisheries and wetlands in Areas of Concern, and in the United States portion of the basin, other impacted areas, where appropriate.

Action: The governments will coordinate their lakewide planning process with fisheries management agencies through the Great Lakes Fisheries Commission.

Action: The governments will use existing authorities to review the impacts of hydroelectric power generation in the basin on habitat and water quality, and propose mitigative measures to ensure those impacts are minimized and/or mitigated.

Action: The governments will develop a coordinated monitoring program to identify problems and measure successes of programs. Appropriate environmental indicators of progress, programmatic measures, measurement methods and databases will be developed.

Implementation

The Lakewide Management Planning process will ultimately be used to monitor progress with the commitments identified in the Zero Discharge Demonstration Program. A LaMP management committee will be convened no later than early 1992. In the interim, the Taskforce

which produced this document will track commitments and report on progress through the semi-annual meetings of the Parties to the Great Lakes Water Quality Agreement. The Taskforce will continue to seek public involvement through the Stakeholders Advisory Forum.

Activities identified in The Broader Program to Restore and Protect the Lake Superior Ecosystem will be monitored through the 5-Year Strategies and subsequent annual workplans developed by the governments.

A.2. Zero Discharge Demonstration Program

Guiding Principles

Preamble

The 1991 *Binational Program to Restore and Protect the Lake Superior Basin* is the guiding document for the Lake Superior Binational Program. In this document governments accepted the IJC challenge to designate Lake Superior as a demonstration area where no point source discharge of any persistent toxic substance will be permitted. The goal of the Lake Superior Zero Discharge Demonstration Program is "to achieve zero discharge and zero emission of certain persistent bioaccumulative toxic substances, which may degrade the ecosystem of the Lake Superior basin". This goal is to be pursued through 1) special designation protection of the waters and antidegradation requirements, 2) reduction of existing loads through voluntary pollution prevention activities, and 3) enhanced control and regulatory efforts.

In 1997 the Lake Superior Task Force crafted a set of guiding principles to clarify the approach used to achieve load reduction targets on the way to reaching zero discharge. These were subsequently published in the LaMP in 1999. The 2004 guiding principles are an update and serve to guide continuing implementation of the zero discharge demonstration.

1. Strive for Zero
The Lake Superior Binational Program (LSBP) agencies commit to strive for zero discharge and zero emission of designated critical pollutants. Activities that go beyond regulatory compliance and internalize best management practices leading to zero waste will be encouraged.

2. Targets Are Applied Basinwide
The reduction schedules are planning targets reported in the LaMP for the entire basin and are not schedules for specific facilities, sectors, jurisdictions or sources.

3. Staged Reductions
The endpoint of the load reduction schedules is zero discharge following staged reductions. Progress is measured by comparing the 1990 baseline inventory to updated source inventories developed for milestone years. For some sources, progress will be difficult to quantify and qualitative descriptions of progress will also be needed.

4. New or Expanded Sources
New or expanded sources will be incorporated into the source inventories. The LSBP will engage proponents of new or expanded facilities in order to minimize potential increased discharges and emissions over current loads.

5. Advocacy
LSBP will advocate the goal of zero discharge and seek appropriate opportunities with agencies, partners and facilities.

6. Load Reduction Strategies

a) Pollution Prevention
Pollution prevention is the preferred generic approach to reducing persistent bioaccumulative toxic chemicals. Under a P2 approach, reductions will be achieved with a variety of strategies, including but not limited to the following: source reduction; eco-efficiency[1]; life cycle management; material substitution; closed loop technologies; education and awareness programs; developing markets for industrial by-products; incentives to reduce; recycling; collections and sweeps; new technologies for waste treatment; new technologies for destruction of persistent bioaccumulative toxic chemicals; and contaminated site remediation.

b) Regulations
Although pollution prevention is preferred, it may be appropriate for agencies to apply a regulatory approach to achieve LaMP load reduction targets.

7. LaMP Critical Pollutant Sources
The LaMP load reduction targets address all current and proposed in-basin sources of designated critical pollutants. Out-of-basin sources add a significant load to Lake Superior and need to be addressed. The LSBP agencies will advocate and work with other initiatives and jurisdictions outside the basin to deal with transboundary air emissions to better protect the Lake Superior basin.

8. In-basin Solutions
Wherever possible and practical, the reduction of pollutants should not be based on their removal from the Lake Superior basin to other basins (transfers). In-basin solutions are preferred.

9. Sustainable Economy
LaMP strategies that go beyond regulatory control requirements should not create social or economic situations that regionally disadvantage the residents of the Lake Superior basin. Actions taken to fulfill the load reduction schedules must be consistent with a sustainable economy.

10. Collaboration
Meeting the load reduction targets published in the LaMP goes beyond the agencies directly involved. The objectives of the LaMP will not be reached without the active involvement of many others (municipalities, other agencies, organizations, businesses and individuals).

[1] "The delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impact and resource intensity throughout the life cycle, to a level at least in line with the earth's estimated carrying capacity." (World Business Council for Sustainable Development)

11. Outreach and Education

The LSBP agencies will engage the Lake Superior basin stakeholders in the zero discharge demonstration. Businesses, communities and individuals will be presented with the challenge of accepting responsibility for the watershed of Lake Superior.

12. Lake Superior Binational Program

The LSBP is an integrated program addressing critical pollutants, human health, sustainability, habitat, aquatic and terrestrial communities, and communications. The approach described in the LaMP chemical chapter supports and is integrated with the other chapters of the LaMP.

Approved by Lake Superior Task Force
August, 2004

Appendix B

Reduction Activities in the Lake Superior Basin: 2005-2010

B.1.1 Federal: Canada

B.1.2 Ontario

B.1.3 Canada First Nations and Métis

B.2.1 U.S. Federal Agencies

B.2.2 Michigan

B.2.3 Minnesota

B.2.4 Wisconsin

B.2.5 U.S. Tribal (Bad River)

B.2.6 U.S. Tribal (Fond du Lac)

B.2.7 U.S. Tribal (Grand Portage)

B.2.8 U.S. Tribal (Keweenaw Bay Indian Community)

B.2.9 U.S. Tribal (Red Cliff)

B.3.1 Lake Superior Binational Forum

B.3.2 Other Binational Programs

The information in Appendix B identifies which approaches (e.g., voluntary agreement, programs, and actions) have been implemented to deal with the reduction strategies described in Chapter 5, and reports on accomplishments achieved to date to support these approaches.

The following tables detail chemicals of concern, reduction actions or accomplishments associated with reductions, and notes whether each activity supports reduction or inventory of chemicals. The actions or accomplishments deal with:

- Overall Reductions;
- Fuel Combustion;
- Landfills, Trash Burning and Incineration;
- Metals and Mining;
- Pesticide Inventory;
- PCB Inventory;
- Emerging Chemicals;
- Clean-up and Remediation;
- Outreach/Communications;
- Monitoring; and,
- Wastewater Treatment.

Also, the tables describe whether each activity is associated with:

- A Direct Result of the LaMP;
- Other Projects Aligned with LaMP Goals;
- Regulations, Policies or Other Instruments Aligned with LaMP Goals;
- A reduction;
- An inventory; or,
- Outreach.

Appendix B is organized into the following subsections:

- B.1 Canada Progress Report;
    - B.1.1 Federal: Canada;
    - B.1.2 Ontario;

    - B.1.3 Canada First Nations and Métis;
- B.2 United States Environmental Protection Agency Progress Report;
    - B.2.1 U.S. Federal Agencies;
    - B.2.2 Michigan;
    - B.2.3 Minnesota;
    - B.2.4 Wisconsin;
    - B.2.5 U.S. Tribal (Bad River);
    - B.2.6 U.S. Tribal (Fond du Lac);
    - B.2.7 U.S. Tribal (Grand Portage);
    - B.2.8 U.S. Tribal (Keweenaw Bay Indian Community);
    - B.2.9 U.S. Tribal (Red Cliff);
- Appendix B.3 Binational Progress Report;
    - B.3.1 Lake Superior Binational Forum; and,
    - B.3.2: Other Binational Programs.

Information sources for Appendix B include:

- The 2006 LaMP (LSBP, 2006);
- 2008 LaMP (LSBP, 2008);
- Great Lakes Binational Toxics Strategy: 2008-2009 Biennial Progress Report (GLBTS, 2010);
- Representatives from Environment Canada, Ontario Ministry of the Environment, and EcoSuperior;
- Representatives from U.S. EPA; States of Michigan, Minnesota, and Wisconsin; and Bad River, Fond du Lac, Grand Portage, Keweenaw Bay Indian Community, and Red Cliff bands; and
- Lake Superior Binational Forum

The ID column identifies consistent actions/accomplishment categories among the various tables. For example, ID 2, refers to "Encourage, support, assist, and provide funding for collections/diversions." ID numbers beginning with 2010 (e.g., 2010-1) represent new categories added in this report and not identified previously.

Appendix B.1 Canada Progress Report

B.1.1 Federal: Canada

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• Environment Canada will continue to work with its partners and pursue funding opportunities in the future.	• Reduction • Direct Result of the LaMP
3	***Encourage, support, assist, and provide incentives for phase-out.***		
	PCBs	• Environment Canada 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. Final PCB regulations were published in September 2008 in *Canada Gazette II*. The purpose of these regulations is to minimize the risks posed by the use, storage and release of PCBs by accelerating the elimination of these substances. An amendment was published in *Canada Gazette II* on March 31, 2010. Since the PCB regulations have come into force approximately 15 million kg of solids and 4 million L of liquids, containing PCBs in varying concentrations have been sent to destruction facilities within Ontario.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
	Other Chemicals	• Canada prohibited the manufacture of all PBDEs in Canada and the use, sale, import of tetra-, penta- and hexaBDE in July 2008).	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
4	***Work with other programs to improve LaMP inventory.***		
	Multiple Chemicals	• Environment Canada will continue to work with our partners to improve the LaMP inventory.	• Inventory • Other Projects Aligned

ID	Chemical(s)	Actions/Accomplishments	Notes
		• Environment Canada's Integrated Atmospheric Deposition Network continues to monitor toxic pollutant deposition to the Great Lakes Basin. Polybrominated diphenyl ethers (PBDEs) have recently been added to the list of monitored analytes. (See http://www.ec.gc.ca/rs-mn/default.asp?lang=En&n=BFE9D3A3-1 for more information.)	with LaMP Goals
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		
	Dioxin, Mercury, and PCBs	• Environment Canada will continue to support public education on open burning education and work with its partners to support open burning abatement programs. Environment Canada has published a public brochure in 2010, *What Goes Up Must Come Down*, to discourage open burning of garbage. It also has a new website on open burning. (See http://www.ec.gc.ca/gdd-mw/default.asp?lang=En&n=684B44DD-1; Environment Canada, 2010.)	• Reduction • Other Projects Aligned with LaMP Goals
6	***Work on common backyard burning inventory method.***		
	Dioxin	• Environment Canada will continue to support and work with its partners to improve the backyard burning inventory, including working toward a common method.	• Inventory • Other Projects Aligned with LaMP Goals
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• Environment Canada 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. EcoSuperior delivers the "Energuide For Houses" (ecoENERGY Retrofit) program in Thunder Bay for Natural Resources Canada. This program advises homeowners on how to economically improve home energy efficiency and reduce emissions as part of Canada's climate change solution. Several hundred homes in Thunder Bay have been evaluated through this program. Retrofits that reduce energy consumption have been completed on many of these homes.	• Reduction • Other Projects Aligned with LaMP Goals
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		

ID	Chemical(s)	Actions/Accomplishments	Notes
	Mercury	• Environment Canada will continue to work with its partners to support Household Hazardous Waste collections.	• Reduction • Other Projects Aligned with LaMP Goals
		• In December 2006, Environment Canada proposed (under the *Canadian Environmental Protection Act*, 1999) requirements for pollution prevention plans (for vehicle manufacturers and steel mills) for mercury releases from mercury switches in end-of-life vehicles processed by steel mills. Pollution prevention plans are required to be prepared by 2008. Algoma Steel is located in the Lake Superior Basin and it can potentially process some scrap steel in its steelmaking process. There are no vehicle manufacturers in the Lake Superior Basin. • Also in December 2006, Environment Canada posted a draft Risk Management Strategy for products containing mercury for management of environmental effects of this mercury. Environment Canada plans to publish a proposed regulation on mercury-containing products for public comment in the winter of 2011. The objective is to reduce mercury releases to the environment from products to the lowest possible level by prohibiting or limiting the mercury content in products. • In April 2009, Environment Canada posted a Proposed P2 Notice in *Canada Gazette Part I*. This required that best management plans (BMPs) be prepared by dental facilities for mercury releases from dental amalgam waste. The Final Notice was published in Canada Gazette Part 1 in May 2010. The Pollution prevention had to have been prepared by August 2010 and implemented by November 2010. The majority of the dental offices in Ontario have not only installed the amalgam separators, but also implemented all the BMPs for the proper management and disposal of the contact amalgam waste, non-contact amalgam waste, and the elemental mercury.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP
	Develop instruments to protect watersheds, air quality and the environment.		
2010-1	**Multiple Chemicals**	• In December 2006, the Government of Canada launched the Chemicals Management Plan (CMP) with a funding commitment over four years of $300 million. The plan assesses	• Reduction

ID	Chemical(s)	Actions/Accomplishments	Notes
		risks associated with substances to ensure proper management. In 2007, the Chemical Management Plan's Challenge initiative collects information on properties and use of high priority substances in order to facilitate decisions on the best management approach to protect Canadians and the environment. The CMP was recently renewed for another 5 years.	• Regulations, Policies or Other Instruments Aligned with LaMP Goals
Fuel Combustion			
2010-2	***Encourage, support, assist and provide funding to reduce emissions from wood burning.***		
	Dioxin and Mercury	• Natural Resources Canada's *Burn It Smart!* campaign (involving all levels of government, ENGOs, national partners and industry) held workshops in First Nations communities, Ontario communities and two United States border communities in 2005 and 2006. *Natural Resources Canada dropped support for this campaign as of March 2007. Environment Canada took over education component in 2007; however, this campaign is not active at this time. Also noted in the Canada First Nations and Métis table.*	• Reduction • Other Projects Aligned with LaMP Goals
		• Environment Canada (Great Lakes Binational Toxics Strategy workgroup) conducted tests on artificial logs to determine HCB and benzo(a)pyrene emissions in 2005. • Environment Canada conducted an EPA-certified wood stove study on two appliances in 2009, comparing emission factors from similar stoves under real-world conditions to literature values. • A partnership of Environment Canada and the Hearth, Patio and Barbeque Association of Canada (HPBAC) conducted a project to measure emissions from conventional woodstoves and verify historical emission factors (2006). Results were presented in 2007 at the 16th Annual Emission Inventory conference in Raleigh, North Carolina. Emission data from the study included PAH, efficiencies, particulate matter and some metals. However, there were no specific results for dioxins, mercury or HCB. The emission factors were reasonably close to previous figures.. • Environment Canada also partnered with HPBAC to gather information on outdoor wood boiler use in Ontario and Eastern Canada. The result of the survey showed that none of	• Inventory • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		the HPBAC members sold outdoor wood boilers. However, Environment Canada conducted another survey in 2007 with local fire departments in Ontario and eastern Canada. In Ontario, the response rate was over 40% to the survey and it was identified that there were over 3,000 outdoor boilers in operation, in Quebec a similar response rate identified over 4,500 outdoor wood boilers.	
Pesticide Inventory			
2010-3	***Characterize pesticide emissions.***		
	HCB	• In 2006, Great Lakes Binational Toxics Strategy workgroup worked with CropLife Canada and Pest Management Regulatory Agency to improve estimates of quantity of HCB released from pesticide application in Canada.	• Inventory • Other Projects Aligned with LaMP Goals
PCB Inventory			
23	***Assist Ontario with cumulative tracking.***		
	PCBs	• Assist Ontario with cumulative tracking. No further information is available.	• Inventory • Other Projects Aligned with LaMP Goals
24	***Develop cumulative tracking of inventory from 1990.***		
	PCBs	• As part of the Binational Toxics Strategy, Environment Canada (Ontario Region) continues to update its PCB inventory by canvassing facilities throughout Ontario, with the goal of being able to more accurately state the percentage reductions. The GLBTS PCB Workgroup should further examine the overall PCB equipment inventory program and spearhead improvements in the database. This should be completed in order to ensure that adequate PCB capacitor and transformer inventories exist, and that they can be easily accessed on a lake-by-lake basis. This improved Great Lakes inventory will allow for a	• Inventory • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		better assessment of reductions to meet challenge goals in the Lake Superior Basin. For stored PCB >500 ppm, Ontario has met the goal of 90% reduction. For in-use PCB >500 ppm, Ontario has achieved approximately 89% reduction as compared to the 90% target. The reductions are estimated based on the reports submitted under the federal PCB Regulations as of December 2009. The PCB equipment inventory can also be tracked under the PCB Regulations. However, the inventory is not easily accessed on a lake-by-lake basis.	
Clean-up and Remediation			
	Contaminated Sediment Remediation		
2010-4	**Multiple Chemicals**	• St. Marys River: Although the assessment of surficial sediments in Bellevue Marine Park indicated that management action is not required, current studies are underway to determine whether deeper, more contaminated sediments might be exposed by increased flow, ice scour and changes in water level. In addition, biological and chemical assessments are underway to determine if sediment management is required at two sites located downstream of Bellevue Marine Park. • Peninsula Harbour – The design and federal environmental assessment of the thin-layer cap for contaminated sediment is underway; construction will begin in the spring/summer of 2012, provided that any ongoing sources of PCBs are controlled, the environmental assessment is completed and funding is in place. • Thunder Bay North Harbour – The assessment of sediment management options is underway; pilot studies and stakeholder involvement will be completed prior to determining the preferred option.	• Reduction • Other Projects Aligned with LaMP Goals

B.1.2 Ontario

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
1	***Develop policy or regulation that caps mercury emissions so that new or expanded sources would be allowed only if overall emissions did not increase.***		
	Mercury	• 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 24, 2007, Ontario implemented *Ontario Regulation 496/07* that requires cessation of coal use at the remaining four coal-fired plants, including Thunder Bay, by December 31, 2014.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides and Mercury	• Environment Canada has funded Household Hazardous Waste collections in the Lake Superior basin (e.g., by EcoSuperior, a non-profit environmental organization in Thunder Bay, Ontario), along with Ontario Ministry of the Environment and local municipalities. These collections have yielded a quantity of pesticides.	• Reduction • Direct Result of the LaMP
	Pesticides and Mercury	• Ontario has provided financial support for EcoSuperior to undertake a (pesticides) collection and education program in Canadian Lake Superior basin communities. Some communities have gone on to carry out subsequent collections at their own expense. • CleanFARMs Obsolete Pesticide Collection Campaign: Industry collected and disposed of 117,000 kg of obsolete pesticides in 2009 in Ontario. The initiative was done in cooperation with various organizations (AGCare, Ontario Ministry of Agriculture, Food and Rural Affairs, Ontario Farm Animal Council, Canadian Animal Health Institute, Ontario Veterinary Medical Association and Ontario Agri Business Association). See http://www.cleanfarms.ca/collectioncampaign/ for more details.	• Reduction • Other Projects Aligned with LaMP Goals
	Pesticides and Mercury	• On December 11, 2006, the Ontario Ministry 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	• Reduction • Regulations, Policies or Other Instruments Aligned

ID	Chemical(s)	Actions/Accomplishments	Notes
		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. The plan was scheduled to be implemented in phases beginning July 1, 2008: o 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. o Phase one materials will be paints, solvents, oil filters, pressurized containers, fertilizers, pesticides, antifreeze, and single-use dry cell batteries. o WDO submitted a plan for Phase two materials on 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. o The Government of Ontario sought public input on its approach to divert waste from landfills. The deadline for input was January 11, 2010 (OMOE, 2009).	with LaMP Goals
	Dioxin, Pesticides and Mercury	• In October 2009, Ontario Ministry of the Environment produced a report, *From Waste to Worth: The Role of Waste Diversion in the Green Economy*, resulting from public consultation. The report proposed an approach to divert more waste from landfills by placing the onus on manufactures/ importers to recycle their products and packaging, providing a wider range of material for Ontarians to recycle; providing incentives and banning of certain materials from landfill; and proposals. The ministry of the Environment conducted additional consultations on the report.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
3	***Encourage, support, assist, and provide incentives for phase-out.***		
	PCBs	• The LaMP 2006 report noted, "Various commitments have been made in the *Canada-Ontario Agreement* regarding the destruction of PCB material currently in storage. Ontario has set a goal to destroy all PCBs in storage by 2008." Update: Environment Canada has noted that for stored PCB >500 ppm, Ontario has achieved 90% reduction. See entry in the federal table above (Develop cumulative tracking of inventory from 1990.) for more information on PCB tracking.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
4	***Work with other programs to improve LaMP inventory.***		
	Multiple Chemicals	• In 2005, Ontario Ministry of the Environment conducted a recovery study in the Kaministiquia River (which flows into the Thunder Bay Harbour). Sediment and water samples were collected and analyzed for contaminants such as metals, PAHs, PCBs, pesticides, and nutrients. Benthos samples were also collected for identification and enumeration. Overall, environmental conditions in the lower Kaministiquia River have improved. The results do not indicate any significant contaminant issues, other than metals which may be naturally occurring • Ontario Ministry of the Environment collected sediment, water, and benthos in Lake George and Little Lake George in 2005. These two lakes are located within the St. Marys River Area of Concern. Sediment and water were analyzed for contaminants such as metals, PAHs, TPHs, oils and greases, and nutrients. Toxicity tests, using benthic invertebrates, were conducted using the collected sediment. • Ontario Ministry of the Environment, with the assistance of Environment Canada, deployed suspended sediment traps upstream of the Bellevue Marine Park in the St. Marys River Area of Concern in 2005. The purpose of this study was to determine the quality of the sediments depositing over the contaminated area, and to input this information into a sediment management plan.	• Inventory • Other Projects Aligned with LaMP Goals
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		
	Dioxin and	• In addition to the outreach featuring Bernie the Burn Barrel (see Binational Programs below this table), EcoSuperior is building on the burning garbage by-law adopted by	• Reduction

ID	Chemical(s)	Actions/Accomplishments	Notes
	Mercury	Neebing Township (Municipality of Neebing, 2009) to encourage other area townships to ban the open burning of garbage. EcoSuperior collaborated with the Ontario Ministry of the Environment, the Lake Superior Binational Forum and the Thunder Bay District Health Unit to provide scheduled presentations on open burning to at least four township councils. EcoSuperior developed and delivered a template for a by-law that prohibits open burning of garbage, and requested a vote by council. EcoSuperior is aiming for at least one township with adopting a new by-law on the issue. As a gesture of appreciation for the participating townships, EcoSuperior provided signage for the landfill site reminding users of the provincial regulations against burning garbage. These activities are ongoing.	• Direct Result of the LaMP
		• The Canadian Centre for Pollution Prevention's Great Lakes Burn Barrel Website services promotes reduced residential trash burning in the Great Lakes Basin (with support from Environment Canada).	• Reduction • Other Projects Aligned with LaMP Goals
		• Environics Research Group conducted a Northern Ontario survey on open burning in 2010 for EcoSuperior (Environics, 2010). The survey followed up on a similar survey conducted in 2001. 41% of residents surveyed reported hearing messages or being aware of a campaign to stop burning garbage, and 83% believe burning garbage is not a common practice. But the percentage of residents who report burning their own garbage has not changed significantly since the 2001 survey. Outreach campaigns have been re-launched in 2010 with an emphasis on encouraging municipalities to adopt by-laws prohibiting the burning of garbage.	• Inventory • Other Projects Aligned with LaMP Goals
		• On August 12, 2009, the Township of Neebing, south of Thunder Bay, Ontario, passed a bylaw that prohibits the burning of garbage and other noxious materials. This proactive bylaw protects the health of their citizens and the environment by prohibiting the burning of materials such as tires, plastics, construction waste, and painted and treated wood.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP

ID	Chemical(s)	Actions/Accomplishments	Notes
7	***Encourage, support, assist, and provide funding for energy conservation or renewable energy programs.***		
	Mercury and Dioxin	• EcoSuperior, in partnership with Thunder Bay Hydro, provided rebates for the purchase of Energy Star rated appliances, as well as education to homeowners about energy conservation. This program was extremely well subscribed. • EcoSuperior, in partnership with Environment Canada, conducted programming and outreach as part of the Canadian "One-Tonne Challenge." This program asked individual Canadians to take energy conservation measures sufficient to reduce greenhouse gas emissions by one tonne. The One-Tonne Challenge program has been discontinued. • The Federation of Canadian Municipalities announced a $50,000 Green Municipal Fund grant awarded to the town of Marathon to explore the feasibility of developing, constructing, and commissioning a mid-sized (20 to 50 MW) wind energy farm on the shores of Lake Superior. The field study involves the Town of Marathon and Marathon Pulp. Commissioning of the wind energy facility could provide a reduction of up to 56,000 tonnes of CO_2, 224 tonnes of NO_3, and 64 tonnes of SO_2, annually. Update: Marathon Pulp is bankrupt, but this has no effect on the project since the partners are the Town of Marathon, Tembec Inc. and Kruger Inc. The wind farm was not built. The project is on hold until Ontario Power Authority and Ontario Ministry of the Energy sort out details associated with the Feed-In Tariff Program and the transmission capacity. In order to handle the greater capacity, the transmission lines need an upgrade from 110 kV to 215 kV. • There have been wind power proposals in Algoma (Canada). A wind farm has been built and is in operation (since 2006) just outside of Sault Ste Marie - http://www.brookfieldpower.com/_Global/5/documents/relatedlinks/730.pdf.	• Reduction • Other Projects Aligned with LaMP Goals
		• 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	• Reduction • Regulations, Policies or Other Instruments Aligned

ID	Chemical(s)	Actions/Accomplishments	Notes
		Electricity Retrofit Incentive Program and the Load Management Program. • The Government of Ontario made a commitment to implement a Renewable Energy Policy with the goal to have 5% (1,350 megawatts) of all generating capacity to come from renewable energy sources by 2007 and 10% (2,700 megawatts) renewable energy by 2010. Update: Ontario passed the *Green Energy Act*, and related amendments to other legislation, on May 14, 2009. The act aims to expand Ontario's renewable energy production • *Ontario Regulation 232/98* (*Landfilling Sites*) under the Ontario Environmental Protection Act requires the collection of landfill gas for new or expanding landfill sites larger than three million cubic metres or 2.5 million tonnes. The Thunder Bay landfill is licensed eight million cubic metres, and the facility is currently burning off methane gas and obtaining credits. In September 2010, Thunder Bay Hydro opened the Mapleward Renewable Generating Station, which will remove more than 263 million cubic feet of methane gas from the environment and instead use it to produce enough power to light 3,000 homes annually in Thunder Bay. • Thunder Bay's 2009 Annual Report for wastewater treatment reported that the City's Water Pollution Control Plant produces methane gas during its anaerobic digestion process. While some of this gas is partially re-circulated in the digesters to provide mixing, excess methane gas is used for fuel for four plant boilers, to provide heat for the digestion process and for plant buildings (City of Thunder Bay, 2010).	with LaMP Goals
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• The six townships around the Thunder Bay conducted a hazardous waste collection event in 2006 with Environment Canada and other partner funding. The goal is to maximize the recycling of toxic compounds (e.g., mercury) and to minimize the disposal of hazardous waste through incineration. • EcoSuperior, with support from Environment Canada and through a partnership with local small businesses, conducted an incentive program to divert electronic waste from a	• Reduction • Direct Result of the LaMP

ID	Chemical(s)	Actions/Accomplishments	Notes
		landfill. Participants were given a subsidy when they submitted computers and other electronic waste for recycling and proper disposal. In 2009 and 2010, EcoSuperior in partnership with Pack Pros Plus, a licensed collector, conducted E-waste collections at Intercity Shopping Centre as part of Waste Reduction Week. More than 30 tonnes of E-waste was recycled thru these initiatives, part of the Ontario Electronics Stewardship program. Electronic waste contains many toxic substances, including mercury, and recycling is environmentally preferable to landfilling. • A program administered by EcoSuperior (primarily funded by Environment Canada's Great Lakes Sustainability Fund) 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. • Fluorescent lamp recycling for the residential sector has been in place in Thunder Bay for several years. EcoSuperior has been collecting compact fluorescent lamps (CFLs) since the inception of this program and will continue to collect them. Five-thousand lamps were collected between April 2006 and March 2007. 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). Support for this project is provided by Environment Canada, Ontario Ministry of the Environment, and Ontario Power Generation. • Many industries in North Shore towns also recycle fluorescent lights. MGM Electric Inc. in Thunder Bay operates a "pay-as-you go" depot for fluorescent, incandescent, and high-intensity discharge (HID) lamps and collects from commercial, industrial and general public sectors. This depot collects approximately 100,000 lamps per year and sends them to a certified recycler for processing (Chadwick, 2011). • The Ontario Ministry of the Environment is working with partners to develop: fluorescent	

ID	Chemical(s)	Actions/Accomplishments	Notes
		lamp recycling pilots aimed at municipalities and schools; a pilot program for recycling mercury thermostats; and a mercury clean sweep event for schools. • 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. The thermostat program operates with support from Environment Canada, Ontario Ministry of the Environment, and Honeywell Inc. • Environment Canada has funded Household Hazardous Waste collections in the Lake Superior basin (e.g., by EcoSuperior), along with Ontario Ministry of the Environment and local municipalities. Typically, a few items containing mercury (e.g., fever thermometers, thermostats, etc.) are collected during these events. • 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. • All members of the Ontario Automotive Recyclers Association now participate in the vehicle Mercury Switch Out program; but, many area recyclers are not members of this association. EcoSuperior worked with the Clean Air Foundation to identify those recyclers who are not Switch Out participants and to encourage them to join. Canadian Steel Producers Association and Canadian Vehicle Manufacturers' Association fund and support this national program in partnership with the Automotive Recyclers of Canada and the Canadian Association of Recycling Industries. (See www.switchout.ca for more	

ID	Chemical(s)	Actions/Accomplishments	Notes
		information). • In 2005/2006 a joint Work Group-Forum-Industry mentoring program was conducted on the Canadian side of the Lake Superior Basin in order to audit and inventory elemental mercury at industrial facilities. The mentor also assisted in assuring best purchasing and management practices, and provided guidance for the responsible recycling of mercury, where required. Site visits and workshops were conducted, and priority locations involved any future paper mill and mine site closures and decommissioning exercises.	
		• In September 2007, the Clean Air Foundation partnered with 850 heating and cooling contractors in Ontario to collect thermostats containing mercury and to encourage the use of programmable thermostats. The program was called "Switch the 'Stat." • In 2008, the Recycling Council of Ontario instituted a Fluorescent Lamp Stewardship program (Take Back the Light) to recycle the lamps from institutional, commercial, and industrial sectors.	• Reduction • Other Projects Aligned with LaMP Goals
		• *Ontario Amalgam Waste Disposal Regulation 196/03* requires dentists that place, repair, or remove mercury amalgams to install mercury separators that capture at least 95% of mercury particles and prevent discharge to sewers. 100% of Ontario dentists have installed amalgam separators before October 2008. • July 2010, Ontario Ministry of the Environment's consolidated Municipal Hazardous or Special Waste (MHSW) Program Plan includes residential and business stream wastes, including mercury-containing wastes (e.g., thermostats, mercury switches, measuring devices, fluorescent bulbs).	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
2010-5	***Develop regulations to reduce use of pesticides.***		
	Pesticides	• On April 22, 2009, Ontario's Cosmetic Pesticides Ban was implemented under the *Pesticides Act* and *Ontario Regulation 63/09*, to prohibit the use of certain pesticides for cosmetic purposes. There are exceptions to the ban for the use of prohibited pesticides, such as agriculture and forestry. There are also exceptions to the ban for golf courses,	• Reduction • Regulations, Policies or Other Instruments Aligned

ID	Chemical(s)	Actions/Accomplishments	Notes
		specialty turf and public works, that require integrated pest management certification of licensed exterminators and the preparation of annual reports on prohibited pesticide use. Under the ban, the use of biopesticides and certain lower risk pesticides are allowed for cosmetic uses such as on lawns, gardens, parks and school yards, The Ontario government has also provided funding to the Agricultural Adaptation Council to administer a grant program for the research and development of new biopesticides and lower risk pesticides. Information about the ban is available on the ministry web site at: www.ontario.ca/pesticideban.	with LaMP Goals
2010-1	***Develop instruments to protect watersheds, air quality and the environment.***		
	Multiple Chemicals	• The *Clean Water Act* (October 2006) was passed to better protect the quantity and quality of water in aquifers, rivers, and lakes, including the Great Lakes by: o 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. o Requiring communities to take action to prevent threats from becoming significant. o Requiring public participation on every local source protection plan. This means everyone in the community gets a chance to contribute to the planning process. o Requiring that all plans and actions are based on sound science. • *Ontario Regulation 419/05: Air Pollution – Local Air Quality*, came into effect on November 30, 2005. Ontario's Local Air Quality Regulation is the main tool used by the Ministry of the Environment to regulate air contaminants released by industrial facilities in order to protect local communities. The regulation recognizes environmental performance and focuses action to improve performance, where required, through both science-based air standards and technology-based (site-specific and sector-based technical standards) standards. Since 2005, 68 new/updated science-based air standards have been introduced. The complete regulation and list of air standards may be viewed at:	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_050419_e.htm. • 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. • Canadian Municipalities initiated the Green Municipal Fund to increase environmental quality. The Government of Canada has endowed $550 million to the Federation of Canadian Municipalities to establish and manage the Green Municipal Fund. The fund supports funding partnerships of municipalities with the public and private sector to undertake projects which increase air, water, and soil quality and climate protection. • Ontario facilities in manufacturing and minerals processing sectors that report are reporting emissions to NPRI, must track, report and develop plans to reduce toxic substances they use, create or release. The first reports (for 2010) are due by June 1, 2011 and summaries of the toxic reduction plans are due by December 31, 2011. The Government of Ontario has also committed funding to assist facilities to comply with the *Toxics Reduction Act*.	
Fuel Combustion			
10	***Support efforts to explore viability of a low mercury emissions process at the Thunder Bay Generating Station; encourage public education and informed discussion.***		
	Mercury	• Support efforts to explore viability of a low mercury emissions process at the Thunder Bay Generating Station; encourage public education and informed discussion.	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
Landfills, Trash Burning and Incineration			
12		***Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.***	
	Dioxin and Mercury	• EcoSuperior, with the support of Environment Canada and Ontario Ministry of the Environment, conducted a workshop on March 2, 2005 for townships, First Nations, and government officials involved in landfill operation. This workshop encouraged recycling, hazardous waste collection, and other waste minimization alternatives as well as discouraged open burning at landfills. EcoSuperior also conducted outreach to residents of rural communities around Thunder Bay, as well as to residents of the Canadian North Shore of Lake Superior. Activities included a workshop and multi-media campaign targeted at townships, parks, and First Nations communities. *These workshops are also reported in the First Nations and Métis table.* • EcoSuperior, with support from Environment Canada, conducted a workshop for landfill attendants in March 2006. • EcoSuperior has provided guidance to seven rural townships in the vicinity of Thunder Bay to promote and increase recycling, and to reduce the practices of burning household garbage and garbage burning at landfills. Activities have included: a presentation to municipal officials on the hazards associated with garbage burning; qualitative audits of the individual landfills; and a follow-up training presentation for landfi*ll staff in the late winter of 2006.*	• Reduction • Direct Result of the LaMP
		• 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.	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
17	***Work with landfill owners and operators to decrease landfill fires.***		
	Dioxin and Mercury	• EcoSuperior conducts outreach to work with landfill owners and operators to prevent landfill fires. Landfill fires are currently a rare occurrence.	• Reduction • Other Projects Aligned with LaMP Goals
2010-6	***Reduce emissions from waste incineration.***		
	Dioxin	• 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.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
2010-7	***Regulate disposal of hazardous wastes.***		
	Multiple Chemicals	• In Ontario, *Ontario Regulation 461/05: Land Disposal Restrictions Regulation* prohibits the land disposal of untreated hazardous wastes, as well as requires that wastes meet specific treatment standards. These treatment standards will significantly reduce the harmful components in the waste, or minimize the ability of the hazardous components to enter the environment once they have been disposed. The new rules will also apply to approximately 85,000 tonnes of hazardous wastes imported from the United States and other provinces for land disposal in Ontario.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
Pesticide Inventory			
2010-8	***Analyze pesticide compliance and use issues.***		
	Pesticides	• In 2007, the Ontario Ministry of the Environment (Standards Development Branch) 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. The results for Thunder Bay did not find pesticides (other than some creosote in one sample). In 2008/2009 pesticide concentrations were monitored in ten Ontario streams. Results show a significant decrease (by approximately 80%) in concentrations of three pesticides commonly used in	• Inventory • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		lawn care products since the ban came into effect.	
		• In 2005, a Memorandum-of-Understanding (MOU) was signed between the Ontario Ministry of the Environment's Operations Division and Health Canada's Pest Management Regulatory Agency to share information and collaborate where possible on their respective pesticide compliance promotion programs. The ministry manages its approach to pesticide compliance and enforcement through education and outreach, inspections, site visits, response to incidents, voluntary abatement, orders, tickets and prosecutions. The ministry uses a risk-based approach when determining how to respond to issues of non-compliance. Each year, the ministry conducts several hundred pesticides inspections across all pesticide industry sectors (e.g. vendors, lawn care, structural, agricultural, etc.). The details and summaries of compliance rates are available through the local Ministry of the Environment Office. There were multiple outreach and education initiatives to promote awareness and assess compliance with the Cosmetic Pesticide Ban in 2009, 2010 ad 2011. .	• Inventory • Regulations, Policies or Other Instruments Aligned with LaMP Goals
		Emerging Chemicals	
2010-9	***Reduce releases to pharmaceuticals to the environment.***		
	Pharmaceuticals	• In 2009, Environment Canada collaborated with Ontario Ministry of the Environment, Health Canada and EcoSuperior to conduct a pilot program on the safe disposal of unused and expired pharmaceutical products in Thunder Bay and other Lake Superior basin communities. The program promoted existing pharmaceutical take-back programs, re-enforcing the message, "Take Your Medicine… Back to Your Pharmacy". Outreach included displays and public events and presentations to community groups, seniors and the general public. The program continued in 2010, and EcoSuperior is planning another collection in 2011. Pharmacists participating in the outreach campaign, and collecting unused and expired	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		medicine returned by the public, demonstrated that they disposed of returned products in accordance with the Ontario Ministry of the Environment *Ontario Regulation 347: General – Waste Management* at their own costs. This pilot project is an example of a pollution prevention activity that helps support the Lake Superior Lakewide Management Plan Management Strategy for Substances of Emerging Concern (http://www.epa.gov/glnpo/lamp/ls_2008/ls_2008_4.pdf p. 34 of 61). It also supports Environment Canada and Health Canada's commitment (2-2.3e) under Annex 2 of the Canada-Ontario Agreement, and is also aligned with Canada's Chemical Management Plan. In 2010, EcoSuperior produced two reports describing: o Expansion of their educational and outreach campaigns to seniors, companion pet owners, equine community; o Efforts to expand the pilot program from Thunder Bay to other Lake Superior basin communities; and o Their tracking of pharmaceutical (and other) returns. *See the First Nations and Métis table for information on how the pilot program was tailored to the Aboriginal communities of the Lake Superior Basin.*	
Wastewater Treatment			
	Wastewater Treatment Plants/Systems		
2010-10	**Multiple Chemicals**	The Town of Nipigon has completed the upgrade of its primary sewage treatment plant to secondary treatment standards and it is operational. The Town of Red Rock is currently undertaking an Environmental Assessment to determine its preferred option to upgrade its sewage treatment facilities. Upgrades to the facilities will reduce the amount of municipal wastewater pollution that is released into Nipigon Bay, which is an Area of Concern requiring clean-up under the U.S.-Canada Great Lakes Water Quality Agreement. The project will help ensure Nipigon Bay is no longer listed as an Area of Concern	• Reduction • Other Projects Aligned with LaMP Goals
Clean-up and Remediation			

ID	Chemical(s)	Actions/Accomplishments	Notes
	Contaminated Sediment Remediation		
2010-4	**Multiple Chemicals**	• 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 integrated the document with existing guidance to produce "*Guidelines for Identifying, Assessing and Managing Contaminated Sediments in Ontario: An Integrated Approach.*" The guideline was applied throughout the province. The guideline was published in May 2008 and is available here: http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079844.pdf.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

B.1.3 Canada First Nations and Métis

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
7		***Encourage, support, assist, and provide funding for energy conservation or renewable energy programs.***	
	Mercury and Dioxin	• Renewable Energy projects constructed in the Lake Superior Basin include a partnership of private investors and Pic River First Nation of White River (near Marathon) that built the 23 megawatt run of the river Umbata Falls Hydroelectric project. Pic River First Nation has also constructed other green energy projects: Wawatay Generating Station (13. 5 MW, run of the river); and, Twin Falls (5 MW, run of the river). • Pic River First Nation hosted the November 6th, 2010 regular meeting of the Lake Superior Binational Forum. A representative of Pic River First Nation gave a presentation to Forum members on sustainable economic activities undertaken by the band. This presentation mainly centered on the hydro-electric project developed by the band. This presentation is available on the Lake Superior Binational Forum's website at: http://www.superiorforum.org/forum/viewtopic.php?f=144&t=1341&sid=527d4bb1208a42556f84742df434f6c2 • Red Rock First Nation near Nipigon is currently co-operating with several other organizations, including Ontario Power Generation, to plan a hydro-electric project for the Little Jackfish River at the North end of Lake Nipigon	• Reduction • Other Projects Aligned with LaMP Goals
Fuel Combustion			
2010-2		***Encourage, support, assist and provide funding to reduce emissions from wood burning.***	
	Dioxin and Mercury	• Natural Resources Canada's *Burn It Smart!* campaign (involving all levels of government, ENGOs, national partners and industry) held workshops in First Nations communities, Ontario communities and two United States border communities in 2005 and 2006. *Natural Resources Canada dropped support for this campaign as of March 2007. Environment Canada took over education component in 2007; however, this campaign is not active at this time. Also noted in the Federal: Canada table.*	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
Landfills, Trash Burning and Incineration			
12		***Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.***	
	Dioxin and Mercury	• EcoSuperior, with the support of Environment Canada and Ontario Ministry of the Environment, conducted a workshop on March 2, 2005 for townships, First Nations, and government officials involved in landfill operation. This workshop encouraged recycling, hazardous waste collection, and other waste minimization alternatives as well as discouraged open burning at landfills. EcoSuperior also conducted outreach to residents of rural communities around Thunder Bay, as well as to residents of the Canadian North Shore of Lake Superior. Activities included a workshop and multi-media campaign targeted at townships, parks, and First Nations communities. *These workshops are also reported in the Ontario table.* • EcoSuperior has presented displays discouraging open burning at pow-wows in the communities of Pays Plat, Pic River, and Rocky Bay). • Pic River First Nation, Rocky Bay First Nation, and Pays Plat First Nation hosted a LaMP display at summer pow-wows. This display focused on the negative impacts of burning garbage. A survey on the prevalence of garbage burning was filled in by visitors to the display. • Fort William First Nation (FWFN) through co-operation with Anishinabek of the Gitchi Gami Environmental Programs has implemented the initiatives which implemented both outreach and practical programs aimed at improved environmental quality at Fort William First Nation near Thunder Bay. Some of the initiatives undertaken by the Anishinabek of the Gitchi Gamicommunity based organization include: o Community recycling program (2007 and 2008) o Household hazardous waste collection (2008)	• Reduction • Direct Result of the LaMP

ID	Chemical(s)	Actions/Accomplishments	Notes
		○ Audit of illegal dump sites on the FWFN reserve (2007) • A campaign to promote awareness of the hazards related to open burning was conducted with First Nations along the north shore of Lake Superior. Display booths, promotional materials, and presentations were available at a series of aboriginal conferences during 2004-2005. It was determined that the best method for transferring information is through community events such as pow-wows, annual gatherings, and community feasts, and by publishing articles in local/First Nation publications. It was also determined that, in order for First Nations to move towards eliminating the practice of burning domestic garbage, additional and continued support is essential to establish a permanent recycling infrastructure. Presently, there are a limited number of First Nations that have available infrastructure to recycle or even for overall waste management. Support is needed in the form of long term financial commitments, capacity building, and education. The communities which committed to implementing a recycling project are Pic River First Nation, Pays Plat First Nation, Lake Helen (Red Rock) First Nation, and Biinjitiwaabik Zaaging Anishinaabek (Rocky Bay) First Nation. Ontario First Nations Technical Services Corporation prepared a proposal to establish a pilot recycling project for First Nations within the Lake Superior Watershed. The program is dealing with jurisdictional and policy issues prior to funding decisions and initiation of a recycling program.	
Emerging Chemicals			
	Reduce releases to pharmaceuticals to the environment.		
2010-9	**Pharmaceuticals**	• In 2009, Environment Canada collaborated with Ontario Ministry of the Environment, Health Canada and EcoSuperior to conduct a pilot program on the safe disposal of unused and expired pharmaceutical products in Thunder Bay and other Lake Superior basin communities. Posters and flyers were translated to Ojibway (the language of the Aboriginal communities of the Lake Superior basin), with the message: "Take Your Medicine… Back to Your Pharmacy or Nursing Station." These posters and flyers were distributed to 11 Aboriginal communities. In 2010, EcoSuperior produced two reports describing how the program expanded. *See entry in the Ontario table for more details.*	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
Additional Outreach/Communications			
2010-11	***Provide information about toxics chemicals and the Lake Superior basin to the public and stakeholders.***		
	Multiple Chemicals	• Pic River First Nation had extremely strong, vocal representation at a Lake Superior Binational Forum public input session held in Marathon on November 5th, 2010. This public input session dealt with the Peninsula Harbour Area of Concern and a mining proposal being put forward for the Marathon area by Marathon PGM Inc. • Representatives of the Red Rock band have attended Canadian sessions hosted by the Lake Superior Binational Forum.	• Reduction • Other Projects Aligned with LaMP Goals

Appendix B.2 United States Environmental Protection Agency Progress Report

B.2.1 U.S. Federal Agencies

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
1	***Develop policy or regulation that caps mercury emissions so that new or expanded sources would be allowed only if overall emissions did not increase.***		
	Mercury	• The Great Lakes Mercury Emission Reduction Strategy, sponsored by the Great Lakes Regional Collaboration (GLRC), was finalized in October 2010. The GLRC is a regional, effort developed by the Great Lakes states, tribes, and cities in cooperation with the relevant federal agencies. The Strategy contains recommendations for reducing mercury emissions in the Great Lakes. These recommendations address issues related to fossil fuel electric power generation; industrial, commercial, and institutional boilers; the mercury cell chlor-alkali industry; metals production; products and processes that deliberately use mercury; Portland cement production facilities; waste incinerators; cross-cutting strategies to address all mercury emission sources; and methods environmental agencies could take to track progress on implementation. In total, the Strategy outlines thirty-four (34) recommendations. The goal of the Strategy is to reduce mercury emissions within the Great Lakes states and to develop mercury reduction approaches that might serve as an example in other jurisdictions. This effort is meant to 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 cost-effective reductions can be achieved. • The Federal government has imposed restrictions on the export of mercury that will impact chlor-alkali plants that close or convert to membrane technology, freeing up mercury for sale. The Toxic Substances Control Act, as revised by the Mercury Export Ban Act of 2008, prohibits commercial export of mercury from the United States starting in 2013. Moreover, the Mercury Export Ban Act requires the Department of Energy to designate a facility for long-term mercury storage and to accept unwanted elemental	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		mercury from the public at that facility, for a fee that reflects "the pro rata cost of long-term management and storage of elemental mercury delivered to the facility." Therefore, starting in 2013, when a chlor-alkali facility closes, the mercury freed up cannot be sold to overseas markets. Chlor-alkali companies will be able either to sell the mercury for domestic use, or pay a fee to have the Department of Energy store it. • US EPA is encouraging mercury collections and product alternatives by providing financial support to cities, non-profit groups, and other entities for continued hazardous and e-waste collections as well as unwanted medicine collections. • 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 promoted a voluntary program that facilitated and provided 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 February 2008, the NVMSRP collected its millionth mercury-containing automotive switch, which represents more than 1 ton of mercury that has been removed from the environment. A record of NVMSRP progress to date can be found here. • The Great Lakes Commission, funded by the U.S. EPA, sponsored a scientific synthesis of information on mercury in air, water, fish, and wildlife through its Great Lakes Air Deposition (GLAD) program. In project entitled, "Integrating Multimedia Measurements of Mercury in the Great Lakes Region," over 170 scientists and managers worked together within the Great Lakes Basin to compile and evaluate over 100,000 mercury measurements and have conducted new modeling and analyses. The synthesis resulted in the report *Great Lakes Mercury Connections: The Extent and Effects of Mercury Pollution in the Great Lakes Region*, released in October 2011. The synthesis, a collaboration of	

ID	Chemical(s)	Actions/Accomplishments	Notes
		Biodiversity Research Institute, the Great Lakes Commission, and the University of Wisconsin-La Crosse, discusses why mercury pollution is a problem, what risks does it pose, where are mercury levels highest, and how mercury contamination is changing over time in the Great Lakes Region. Key mercury policy connections in the Great Lakes Region and beyond are also discussed.	
3	***Encourage, support, assist, and provide incentives for phase-out.***		
	PCBs	• The US is pursuing rulemaking action under the Toxic Substances Control Act (TSCA). In the Spring and Summer of 2010, US EPA requested comments on an Advanced Notice of Proposed Rulemaking (ANPRM) that seeks to further reduce and/or eliminate use authorizations for PCBs currently allowed under TSCA regulations. • US EPA is working with state and local partners to address PCB contamination in pre-1978 industrial building products, such as caulk, paint, and light ballasts. • US EPA encourages, supports, assists, and provides incentives for PCB phase-out where possible. They will work with MN, WI, and MI as well as the Binational Toxics Strategy (BTS) program, to explore state PCB utility reductions. • 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	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		currently evaluating the spreadsheet tool and will work with other industry representatives to conduct additional trial case studies on the use of the tool.	
4	***Work with other programs to improve LaMP inventory.***		
	All	• In order to improve the LaMP inventory, US EPA work through the LaMP chemical committee to provide support on updated emission factors as needed.	• Inventory • Direct Result of the LaMP
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		
	Dioxin, Mercury, and PCBs	• US EPA will continue to support open burning abatement actions, programs, and projects, in coordination with the Binational Toxics Strategy and Sea Grant outreach. Such support may include staff, technical, and financial resources. • 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.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
6	***Work on common backyard burning inventory method.***		
	Dioxin	• US EPA will work with MPCA and EC staff to clarify the original backyard burning inventory methods and work toward a common backyard burning inventory method.	• Inventory • Direct Result of the LaMP
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• 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	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		partner with them to implement on-the-ground actions.	
Fuel Combustion			
10	***Emissions Controls/Reductions***		
	Multiple PBT Chemicals	• USEPA is developing "Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces, and New Residential Masonry Heaters" that will address new Outdoor Wood-fired Boilers (OWBs). The standards are expected to be proposed in the Federal Register in summer 2012. The rule development follows previous action on OWBs: (1) development of a test method specific to OWBs; and (2) agreement with major OWB manufacturers to offer 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. • USEPA Region 5 supports the change out of residential wood-burning appliances through Supplemental Environmental Projects (SEPs)	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
Landfills, Trash Burning and Incineration			
11	***Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.***		
	Dioxin and Mercury	• US EPA will continue to work with experts on landfill emission factors and throughput measurements. They will continue to seek information on wildfire emissions, and will support states' efforts in this endeavor.	• Reduction • Other Projects Aligned with LaMP Goals
Metals and Mining			
16	***Assess Mining Impacts***		
	Multiple Chemicals	• USEPA headquarters and USEPA Region 5 have formed mining workgroups who meet regularly to discuss the potential impacts of mining activities on the environment.	• Reduction • Other Projects Aligned

ID	Chemical(s)	Actions/Accomplishments	Notes
			with LaMP Goals
18	***Incorporate reductions in mercury from taconite into statewide mercury TMDL that are also part of the LaMP inventory.***		
	Mercury	• US EPA will continue to pursue evaluating mercury as part of taconite residual risk through the Binational Toxics Strategy.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
PCB Inventory			
20	***Develop cumulative tracking of inventory from 1990.***		
	PCBs	• US EPA will continue to support WI and MI with cumulative tracking of PCB disposal to the extent possible.	• Inventory • Direct Result of the LaMP
Wastewater Treatment			
2010-10	***Wastewater Treatment Plants/Systems***		
	Mercury	• USEPA Region 5 is conducting an evaluation of currently available technologies for removing mercury from wastewater to determine the level of mercury removal that is currently achievable and affordable for a large group of dischargers, and whether new technologies exist to remove mercury from wastewater at the nanogram per liter level.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

B.2.2 Michigan

Several State of Michigan departments changed names, and in one case were temporarily merged, since the beginning of the reporting time period in 2005. For ease of discussion, current (2011) state department names are used for the following: Michigan Department of Environmental Quality, Michigan Department of Natural Resources, and Michigan Department of Agriculture and Rural Development.

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
	Develop policy or regulation that caps mercury emissions so that new or expanded sources would be allowed only if overall emissions did not increase.		
1	**Mercury**	• The Michigan Department of Environmental Quality (MDEQ) updated its mercury permitting strategy and multiple discharger variance for National Pollutant Discharge Elimination System permits issued during fiscal years 2005-2009. The updates to the mercury permitting strategy include lowering the Level Currently Achievable (LCA) from 30 nanograms per liter (ng/L) to 10 ng/L and adding the option for reduced monitoring for facilities that average less than 5 ng/L of mercury in their discharge over a 12-month period. The revised strategy will further the goal of attaining the mercury water quality standard of 1.3 ng/L through the reduced LCA and continued implementation of pollutant minimization plans. In the Michigan portion of the Lake Superior basin, all facilities are or will shortly be required to meet strict limits using U.S. Environmental Protection Agency (EPA) approved sampling protocols and methods. • In January 2006, the Director of the MDEQ charged a team of staff from the air, water, pollution prevention and remediation programs with developing a state-wide strategy to eliminate anthropogenic mercury use and releases in Michigan. After public input, the MDEQ Mercury Strategy Workgroup (MSWG) released the report entitled, MDEQ Mercury Strategy Staff Report in January 2008. The desired outcome is to reduce the concern for the consumption of fish with methyl mercury, to eliminate exposure to elemental mercury from spills and to avoid impacting neighboring states and Canada from mercury transport and deposition. This comprehensive mercury report provides 67	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		specific recommendations, including the workgroup's top ten priority actions, such as: continuing to create a reliable inventory; reducing releases from coal-fired power plants and cement plants; and developing a regional mercury emissions reduction strategy. The MDEQ is currently focused on implementing the top ten identified priorities. The 2005 mercury emissions inventory has been completed by MDEQ. • The MDEQ developed new air pollution control rules addressing mercury emissions from coal-fired electric generating units (EGUs) to meet the requirements of Governor Jennifer M. Granholm's directive to reduce mercury emissions 90% by 2015 from coal-fired EGUs. The rules went into effect October 16, 2009. The final rules to control mercury emissions from EGUs can be viewed at http://www.michigan.gov/deqair. • In 2009, MDEQ Air Quality Division staff developed a permit template that requires special conditions for operation of a drum crusher in the facilities' Permit to Install. MDEQ staff developed a fact sheet and distributed the information to all known fluorescent lamp manufacturers and distributors of drum top crushers. • In 2010, the MDEQ began planning for the development of a statewide Total Maximum Daily Load (TMDL) for inland lakes, rivers and streams impaired by atmospheric deposition of mercury. Mercury is largely responsible for fish consumption impairments and the impairments to indigenous aquatic life and wildlife designated uses in thousands of acres and miles of Michigan's inland lakes and streams. TMDL development is required for impaired waters included on Michigan's Clean Water Act Section 303(d) list. Michigan's mercury TMDL will follow a regional model similar to the approaches used by the Minnesota Pollution Control Agency (MPCA) Statewide Mercury TMDL and the Northeast Regional Mercury TMDL. TMDLs characterize current water quality, identify point and nonpoint sources, estimate current mercury loads from these sources, and describe the mercury load reductions necessary to achieve Michigan's applicable water quality standards to assure all designated uses are achieved. In early 2011, the U.S. Environmental Protection Agency awarded the state a grant under the Great Lakes Restoration Initiative to develop the state-wide mercury TMDL. The project will	

ID	Chemical(s)	Actions/Accomplishments	Notes
		commence during the summer of 2011 and is scheduled to be completed in 2013.	
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• The Michigan Clean Sweep Program helps protect the state's natural resources and prevent agriculture pollution by ensuring the safe and proper disposal of outdated, unused or unwanted pesticides in Michigan. Clean Sweep is made possible by a strong and unique state, federal, local, and industry partnership. There have been a number of Clean Sweep sites established around the state, including a site in the Upper Peninsula run by the Marquette County Solid Waste Management Authority. Since 2006, the Marquette collection has brought in over 18,000 pounds of unwanted pesticides (whole formulated product), including many Zero Discharge Demonstration Program chemicals and thousands of pounds of products of unknown composition. • The Superior Watershed Partnership and Land Trust coordinated the Earth Keepers initiative, a unique coalition of faith communities (125 congregations/churches) in Michigan's Upper Peninsula that have taken action to protect human health and the environment including the watersheds of three Great Lakes (Lakes Superior, Michigan, and Huron). Over the years, the Earth Keepers has coordinated popular collections for pesticides, electronic wastes and other materials. For example, the e-waste collection has brought in over 300 tons of computers, monitors, TVs, and other electronics from twenty-seven sites across the Upper Peninsula. Recent events include: • On Earth Day, April 23, 2005, a Clean Sweep event was held in Michigan's Upper Peninsula as part of the Earth Keeper Initiative. Sponsored by nine faith communities, two environmental groups, the Keweenaw Bay Indian Community, and Michigan Governor Jennifer Granholm's office of Faith-Based Initiatives, the event was an unprecedented success. A total of 45.7 tons of wastes and toxic materials were collected, including pesticides, mercury (including over 40 pounds of raw mercury), oil-based paints and thinners, car batteries, anti-freeze, and harsh cleaners. The hazardous wastes were distributed to the Delta County and Marquette County hazardous waste processing	• Reduction • Direct Result of the LaMP

ID	Chemical(s)	Actions/Accomplishments	Notes
		facilities. The Delta County facility received more hazardous waste in the Earth Keeper event (25.5 tons) than in the previous seven years, and the Marquette facility received (20.2 tons) more than it normally does in an entire year! • During 2006, the Superior Watershed Partnership and its Earth Keepers partners focused again on community-based efforts to reduce toxins in the Upper Peninsula of Michigan. The project included three main objectives: 1) Replicate the successful 2005 Clean Sweep event at 27 sites (2 new sites were added) across the Upper Peninsula, 2) Work with the Keweenaw Bay Indian Community to implement a mercury reduction program for tribal members and facilities, and 3) Work with the Marquette municipal wastewater treatment facility and local dentist offices to reduce mercury contamination to the municipal wastewater treatment system and Lake Superior.	
3	***Encourage, support, assist, and provide incentives for phase-out.***		
	PCBs	• MDEQ encourages, supports, assists and provides incentives for phase-out where possible. • Michigan is developing a state-wide TMDL for PCBs. See below under "PCB Inventory."	• Reduction • Other Projects Aligned with LaMP Goals
4	***Work with other programs to improve LaMP inventory.***		•
	All	• MDEQ continues to work with Lake Superior basin governments to improve the LaMP inventory. The MDEQ, Office of the Great Lakes coordinates the reporting and other activities for several State of Michigan departments, divisions, and programs.	• Inventory • Direct Result of the LaMP
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		•
	Dioxin, Mercury, and PCBs	• In Michigan, the practice of open burning is currently regulated at both the state and local level. At the state level, open burning is regulated under various statutes and administrative rules, including Parts 55, 115, and 515 of the Natural Resources and Environmental Protection Act, Public Act 451 of 1994, as amended, and associated	• Reduction • Regulations, Policies or Other Instruments Aligned

ID	Chemical(s)	Actions/Accomplishments	Notes
		administrative rules. Two state agencies, the MDEQ and the Michigan Department of Natural Resources (MDNR), are responsible for administering these open burning regulations, however these regulations may be enforced by local units of government. • In 2008, the MDEQ began the process of amending the existing open burning regulations. A stakeholder workgroup was assembled in May 2009 that included both internal and external stakeholders. In May 2010, public hearings and informational sessions were held in Marquette, Lansing, and Gaylord. The open burning amendments were later withdrawn. Presently, MDEQ is working with the legislature to amend the state statute. For additional information, visit the MDEQ's Open Burning website. • At the local level, a number of local communities throughout the State of Michigan have already taken independent action to ban or otherwise regulate open burning. For example, the City of Ishpeming prohibits open burning within the city limits with a few exceptions, such as small backyard fire pits and ceremonial events. • The MDEQ has developed numerous guidance documents and outreach tools related to open burning, all of which are available on its Open Burning website. Materials developed during the 2005-2010 time period include: o *Burning Household Waste* (2005) – this brochure identifies the pollutants that are released from household burn barrels and the implications for human health and the environment; it also articulates the alternatives to burning household waste (reduce – resuse – recycle – disposal). o *Burn barrel display* (2006) – The MDEQ's burn barrel display has been displayed at numerous events throughout the state. MDEQ also created instructions for making your own display. o *Open Burning Regulations in Michigan* (2006, revised 2009) – this brochure outlines the various federal, state, and local regulations pertaining to general open burning as well as the burning of trash, grass clippings and leaves, brush	with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		and trees, building materials, buildings, campfires, and beekeeping equipment. o *Model Ordinance for Outdoor and Open Burning* (2006, revised January 2011) – this publication is designed to help local officials craft their own burning ordinance. The ordinance provides options for local governments to be more restrictive than the state regulations if they choose.	
6	***Work on common backyard burning inventory method.***		
	Dioxin	• MDEQ investigates backyard burning and assists LaMP partners in finding a common method where possible.	• Inventory • Direct Result of the LaMP
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• The MDEQ has partnered with the Michigan Energy Office, Michigan Public Service Commission, Michigan Department of Transportation and others to identify various energy efficiency and energy conservation programs and make resources available to the public, private businesses, and municipal governments. • The Michigan Energy Office has a number of specific programs aimed at energy efficiency, including the Michigan Biomass Energy Program, Clean Cities Program, Green Lodging Program, Green Venues Program, and the Rebuild Michigan Program. • A number of buildings recently built or remodeled in the Lake Superior Basin have been certified by the Leadership in Leadership in Energy and Environmental Design (LEED). In Michigan, these include three buildings at Northern Michigan University in Marquette and a U.S. Coast Guard boat house station. Through the end of 2010, an additional four Michigan-based projects had registered for LEED certification. • Local governments across the Lake Superior basin are starting to focus resources on addressing sustainability and energy consumption. For example, the City of Marquette,	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		Michigan formed the Sustainability Community Ad Hoc Committee in 2008. • The Superior Watershed Partnership (SWP) is distributing nearly 100,000 compact fluorescent light bulbs (CFLs) to households across the Upper Peninsula. As a part of this 3 year project funded by the Michigan Public Service Commission, the SWP is giving away free CFLs to households through churches, tribes, local units of government, and community service organizations. • The Alger Energy Savers program is a collaboration of the Pictured Rocks National Lakeshore and Superior Watershed Partnership and Land Trust with funding provided by the Great Lakes Restoration Initiative. Alger Energy Savers offers a wide range of technical and financial assistance to area homeowners with special emphasis on the two gateway communities of Munising and Grand Marais, which serve as entries to the National Park.	
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• In 2006, three public acts were passed in Michigan restricting the sale of certain mercury-bearing products: ○ *Public Act 492 of 2006* banned the sale of most thermostats that contain mercury or a mercury compound beginning January 1, 2009. ○ *Public Act 493 of 2006* prohibits the sale of most mercury-added blood pressure devices by January 1, 2008, and their "use" by January 1, 2009. ○ *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. • In 2008, three additional mercury-related public acts were passed in Michigan: ○ *Public Act 193 of 2008* requires the department and all state agencies shall, whenever	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		possible, avoid purchasing products containing mercury or mercury compounds if products that do not contain mercury or mercury compounds are available and those products are cost effective as determined by the department. ○ *Public Act 394 of 2008* established a manufacturer electronic device takeback program to promote electronic waste recycling. By April 1, 2010, all retailers, including internet, catalog, manufacturer direct, and in-state retailers, can only sell new computers and televisions manufactured by manufacturers registered with the state. The manufacturer registration must include specific details on the manufacturer's e-waste takeback program, which must be free and convenient for consumers. In the first year of the program (2010), manufacturers reported collecting a total of 3,392 tons of electronic waste. ○ *Public Act 503 of 2008* requires that on or before December 31, 2013, dentists shall install or have installed and use on each wastewater drain in the dentist's office that is used to discharge dental amalgam, a separator that has an efficiency of 95% or greater as determined through testing in accordance with standards published by the international organization for standardization in ISO 11143. • MDEQ staff contributed to several major initiatives of the Great Lakes Regional Collaboration Strategy to Restore and Protect the Great Lakes, including the "Mercury in Products Phase-Down Strategy" (2008) and the "Great Lakes Mercury Emission Reduction Strategy" (2010). Michigan, along with the other Great Lakes states, is currently working on implementing these strategies. • The Michigan Mercury Switch/Sweep (M2S2) Program is a collaborative partnership between the MDEQ and the Alliance of Automobile Manufacturers. The program's goal is to remove mercury switches from at least 80 percent of all end-of-life vehicles processed in Michigan annually. • The Michigan Clean Sweep Program site in Marquette, operated by the Marquette County Solid Waste Management Authority, collects mercury as well as pesticides. In some	

ID	Chemical(s)	Actions/Accomplishments	Notes
		years, hundreds of mercury-bearing products are collected, including thermometers, thermostats, blood pressure cuffs, and electrical switches. During the 2005 to 2010 time period, the site received a total of 519 individual items plus 44 pounds of bulk liquid mercury, totaling approximately 85 pounds of mercury recovered from the environment. • In addition to Marquette, all of the Upper Peninsula counties maintain recycling and household hazardous waste collection programs. These programs vary from county to county, but several accept mercury. For more information, see www.michigan.gov/deqrecycling. • The MDEQ awarded a grant to the North Star Academy in Marquette for mercury collection and disposal in 2005-2006. • The Copper Country Intermediate School District, which serves schools in Baraga, Houghton and Keweenaw Counties in Michigan's Upper Peninsula, received a 2006-2007 state grant for a project entitled "Implementing and Modeling Proper Chemical Use in Rural Communities." The project had two primary goals: 1) create a comprehensive chemical inventory for each district; and 2) ensure proper chemical storage, hygiene and handling, and the use of less toxic or non-toxic alternatives when possible. Activities accomplished under the grant included multiple teacher training workshops and a chemical waste pickup through Michigan Technological University. Mercury was one of the chemicals of concern. • 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. • The City of Sault Ste. Marie held auto switches collections from 2008 to 2010. In 2008, the city reported collecting 378 switches, removing 0.83 pounds of elemental mercury from the waste stream. A portion of the collection area resides within the Lake Superior basin.	

ID	Chemical(s)	Actions/Accomplishments	Notes
		• In 2010, MDEQ received an EPA Great Lakes Restoration Initiative grant of approximately $850,000 to implement portions of the MDEQ Mercury Strategy Staff Report, including: assistance to dentists to comply with Act 503 (installation of separators at dental offices); education and outreach to various sectors, including schools and first responders; and focused efforts on various mercury-containing products including automobile switches, thermostats and white goods.	
2010-1	***Develop instruments to protect watersheds, air quality and the environment.***		
	Multiple PBT Chemicals	• The MDEQ's Nonpoint Source Program coordinates the development of watershed management plans, which serve as guides for communities to protect and improve water quality. Statewide, more than one hundred and fifty plans have been developed at the local level utilizing MDEQ grants through the federal Clean Water Act as well as the state's Clean Michigan Initiative. In the Lake Superior basin, watershed management plans have been approved numerous watersheds, including the Chocolay River, Eagle River, Huron Creek, Lower Dead River, Munising Bay, Otter River, Salmon Trout River, Trap Rock River, and the Two Hearted River. • The State of Michigan has encouraged and assisted with the development of numerous voluntary stewardship partnerships with mercury reduction goals, including the following: ○ Michigan Chapter of Hospitals for a Healthy Environment; ○ Michigan's Clean Corporate Citizen Program; ○ Michigan Business Pollution Prevention Partnership; ○ Michigan Pulp and Paper Pollution Prevention Program; ○ Michigan Turf Grass Program; and ○ Michigan Clean Marina's Program.	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		• The MDEQ participates in numerous public/private partnerships that benefit air and water quality. For example, the Michigan Natural Shoreline Partnership (MNSP) seeks to improve water quality by promoting natural shoreline landscaping. This is accomplished through professional training and certification programs, education, research, and policy development.	
Fuel Combustion			
2010-2	***Encourage, support, assist and provide funding to reduce emissions from wood burning.***		
	Dioxin and Mercury	• In 2007, the MDEQ was granted $100,000 to perform an innovative wood stove changeout and outreach program in partnership with the Hearth, Patio & Barbeque Association and Michigan United Conservation Clubs. This partnership created 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. Through this project, a total of 529 units were exchanged resulting in a 30% improvement in particulate emissions from those 529 wood stoves.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
10	**Emissions Controls/Reductions**		
	Multiple PBT Chemicals	• The City of Sault Ste. Marie, Michigan, has adopted a new ordinance that bans outdoor wood burning stoves in the city. Existing units are grandfathered but cannot be replaced. The benefit is a reduction of particulate matter in the atmosphere. The code of ordinances for the City of Sault St. Marie, Codified through Ordinance No. 519-10, enacted June 21, 2010 is available here. • 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	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		efficient combustion and sorbent injection. Overall, the Smurfit Stone Container Corporation had committed an investment of more than $4.5 million for pollution control equipment, however the Smurfit facility in Michigan closed in 2010. • The L'Anse Warden Electric Company (formerly the J.H. Warden Generating Station) in L'Anse, Michigan, was built in 1959 and historically burned pulverized coal, natural gas, or #2 fuel oil. In 2007-2008, the facility was converted to biomass and was approved to burn alternative materials such as wood waste, chipped railroad ties, tire derived fuel, paper sludge, and mill ash from the nearby Smurfit-Stone Container paper mill. However, the mill has since closed and mill ash and sludge were removed from the facility's fuel portfolio. Steam from the plant is used by a neighboring mineral ceilings plant. While the move away from conventional coal has resulted in a decrease in certain pollutants (e.g., mercury), the burning of other fuels, such as tire derived fuel, releases other toxins into the environment, including dioxins and furans. Overall, the facility has been in compliance with all emission limits.	
Landfills, Trash Burning and Incineration			
	Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.		
12 **13** **14**	**Dioxin and Mercury**	• In 2005, the Marquette County Solid Waste Management Authority removed over 75,000 pounds of toxic/hazardous material from the waste stream. These materials included household hazardous waste such as mercury, volatile organic compounds, and poisons. • In 2005, the Marquette County Solid Waste Management Authority updated the landfill to run as a bioreactor, allowing the system to facilitate the treatment of waste. Part of this update was a cost reduction of leachate treatment from $0.06 to $0.003 per gallon discharged. This savings allows the Authority to invest in new technology and better controls. ○ Improvements include treatment of liquid wastes on-site and the break down and treatment of resilient toxic materials. Paint waste and metals are biologically treated and stabilized. The total control of batch treatment facilitates effective remediation of	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		toxic/reactive materials found in the solid waste stream. Because the system relies on treatment instead of dilution, the materials don't end up in the Lake. ○ The upgrade to the landfill also reduced the volume and increased the life of the facility. The organic portion of Marquette County's solid waste was reduced in volume by approximately 50 percent. • 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. The Solid Waste Policy embodies the consensus agreement of stakeholders on the Solid Waste Policy Advisory Committee, a group made up of representatives from local governments, the environmental community, and the solid waste and recycling industries.	
Metals and Mining			
	Legacy mining remediation		
2010-12	**Multiple Chemicals**	• In Michigan's Keweenaw Peninsula, copper mining wastes ("stamp sands") deposited in watersheds over 100 years ago still persist and 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. In the Kearsarge Creek watershed, 2.5 acres were stabilized in 1998; as a result, instream copper concentrations fell by a factor of 10, and the macroinvertebrate population tripled with sensitive species such as mayflies, caddisflies, and stoneflies returning. In the Scales Creek watershed, 19 acres were stabilized in 2005; post-remediation studies show that instream copper concentrations deceased slightly, macroinvertebrates increased by 40 percent, and sensitive species	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		doubled. • The City of Ishpeming is working with Cliffs Natural Resources and the MDEQ to remove Partridge Creek from the Cliffs Shaft Mine. Plans include enhancement and day-lighting portions of the creek and structural stabilization of the storm sewer system. Partridge Creek was diverted into the mine in 1973 to allow for stormwater control and to mitigate deteriorating stormwater infrastructure. Waters emerging from the mine carry a significant load of mercury, which is the remaining controllable source to Deer Lake. This project should lead to the delisting of the Deer Lake Area of Concern. In 2010, the City of Ishpeming was awarded a $2 million Great Lakes Restoration Initiative grant to support the Phase I of the of the Partridge Creek diversion.	
Pesticide Inventory			
21	***Analyze waste pesticide collections to make consistent with rest of United States inventory.***		
	Pesticides	• Pesticide collections in Michigan are organized by the Michigan Clean Sweep Program, run by the Department of Agriculture & Rural Development. The Marquette County Solid Waste Management Authority runs the only permanent Clean Sweep site in Michigan's portion of the Lake Superior basin. Over the 2005-2010 time period, many of the "Nasty Nine" pesticides were collected, including chlordane, DDT, dieldrin/aldrin, dioxin, and toxaphene. Unfortunately, a direct comparison of the Michigan data to the Minnesota and Wisconsin inventories is difficult for a number of reasons. For more information, please see Section 3 of this report.	• Inventory
2010-13	***Support and encourage integrated pest management.***		
	Pesticides	• Researchers in Michigan continue to study potential biological control agents for controlling spotted and diffuse knapweed. In 2010, the MDNR contracted the release and monitoring of *Larinus minutus*, a knapweed flower weevil, and *Cyphocleonus achates*, a knapweed root weevil, at five sites on state lands in Schoolcraft (Upper Peninsula), Missaukee, Crawford, Montcalm and Jackson counties. The sites will be restored with	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		native plants. If the insects prove successful in controlling the invasive weeds, they could offer a viable alternative to herbicide control.	
PCB Inventory			
2010-14	***Total Maximum Daily Load (TMDL)***		
	PCBs	• In 2008, a TMDL for PCBs was developed by MDEQ for the Pere Marquette River watershed in the Lake Michigan basin. No TMDLs were developed for PCBs in the Lake Superior watershed from 2005 to 2010. However, in 2010, the MDEQ began planning for the development of a statewide TMDL for inland lakes, rivers and streams impaired by PCBs and mercury. Both PCBs and mercury are responsible for impairments to indigenous aquatic life and designated uses such as fish consumption in thousands of acres and miles of Michigan's inland lakes and streams. TMDL development is required for impaired waters included on Michigan's Clean Water Act Section 303(d) list. Michigan's statewide PCB TMDL will follow a regional model similar to the approaches used by the Minnesota Pollution Control Agency (MPCA) Statewide Mercury TMDL and the Northeast Regional Mercury TMDL. In early 2011, the U.S. Environmental Protection Agency awarded the state a grant under the Great Lakes Restoration Initiative to develop the state-wide PCB and mercury TMDL. The project will commence during the summer of 2011 and is scheduled to be completed in 2013.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
Emerging Chemicals			
2010-9	***Reduce releases to pharmaceuticals to the environment.***		
	Pharmaceuticals	• The Michigan Clean Sweep Program recently added pharmaceuticals to the list of items that Clean Sweep sites can collect. Livestock producers, animal rescue organizations and zoos are encouraged to bring in expired or unused medications for animals as well as for humans. Due to varying county policies, not all Clean Sweep are able to take in pharmaceuticals. In some cases, these collections are held as separate special events. At present (2011), the Clean Sweep site in Marquette does not routinely accept pharmaceuticals. Continued collection of pharmaceuticals by the Clean Sweep Program	• Reduction

ID	Chemical(s)	Actions/Accomplishments	Notes
		may be dependent upon funding.	
2010-15	***Encourage, support, assist, and provide funding for emerging chemical programs.***		
	Multiple Emerging Chemicals	• In 2005, the MDEQ funded a study through the Clean Michigan Initiative – Clean Water Fund to characterize the occurrence and fate of a 22 compound target list of pharmaceuticals and personal care products (PPCPs) and endocrine disrupting compounds (EDCs) at various locations within the City of Ann Arbor, City of Grand Rapids, and City of Monroe water use cycles. The final report was produced in September 2006. Results of this study showed a reduction in the concentrations of certain compounds based on samples collected before and after source water and wastewater treatment processes. The data indicated some variability in the removal of PPCPs and EDCs in water and wastewater systems, depending on the treatment process. Additionally, characterization of occurrence and concentration of analytes in source water supplies was similar in the three Michigan communities.	• Inventory • Other Projects Aligned with LaMP Goals
Additional Outreach/Communications			
2010-11	***Provide information about toxics chemicals and the Lake Superior basin to the public and stakeholders.***		
	Multiple Emerging Chemicals	• In 2007, the MDEQ created a document titled "A Remedy for Residential Drug Disposal" to provide assistance to everyday citizens about household drug disposal. In 2010, in cooperation with Michigan Sea Grant and Illinois-Indiana Sea Grant, it prepared another drug disposal guidance document, titled "Prescription for Clean Water: Guide for the Safe Disposal of Unused Medications." The pamphlet provides follow-up links to relevant governmental and private organization websites and documents. These and other materials are available for downloading from the MDEQ's Household Hazardous Waste website.	• Outreach • Other Projects Aligned with LaMP Goals
	Multiple Chemicals	• The Michigan Business Pollution Prevention Partnership (MBP3) continued to make strides through 2010. MBP3 is a voluntary environmental stewardship program developed in 1997 jointly by the business community and the MDEQ. This diverse partnership consists of Michigan businesses, municipalities, institutions, organizations and	• Outreach • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		associations (both private and public) that seek the advancement of pollution prevention principles. Through adopting these principles, MBP3 members can reduce or eliminate hazardous discharges or emissions to our environment while increasing operational efficiencies and lowering costs. Source reduction is the key to developing sustainable environments; however, reuse and recycling are key ingredients to successful source reduction. Over the years, MBP3 partners have reported recycling batteries, waste oils, paints/solvents, electrical components, antifreeze, ballasts, mercury, and other harmful contaminants. MDEQ is responsible for providing pollution prevention assistance, recognizing participants, and reporting on the program's progress. Several MBP3 partner organizations are located within the Lake Superior basin. • In 2006, the Michigan Green Chemistry Program was created by Executive Directive Number 2006-6. The Green Chemistry Program has responsibility for promoting and coordinating state green chemistry activities such as research, development, and demonstration, education, and technology transfer activities in Michigan. The objective is to foster use and development of new chemicals and chemical products that reduce or eliminate the use or generation of hazardous substances while producing high quality products through safe and efficient manufacturing products. The MDEQ has been given primary responsibility for implementing the Green Chemistry Program and convening a Green Chemistry Roundtable.	
	Mercury	• In 2008, the MDEQ's MSWG created a single comprehensive webpage to serve as a central clearinghouse for mercury information, including pollution prevention, remediation, and specific topics related to air, water, and solid waste. To highlight the information and improve ease of access, a clickable "MERCURY" icon was created on the department's front page (http://www.michigan.gov/deq) to take users directly to the mercury page. • MDEQ staff worked with the Great Lakes Commission on the creation of a regional mercury monitoring workgroup with the objective of improving communication and coordination of mercury monitoring activities throughout the Great Lakes basin. This	• Outreach • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		effort resulted in a 2007 report titled, "Mercury Deposition Monitoring in the Great Lakes States: Current Activities and Future Directions" assembled by the Great Lakes' States Mercury Deposition Discussion Group. This report is being used to guide future work on atmospheric mercury monitoring in the Great Lakes basin and the recommendations have been incorporated in the MDEQ Mercury Strategy Staff Report. • In order to highlight Michigan's activities and perspectives, MDEQ staff gave mercury-related presentations and chaired sessions at numerous conferences, workshops, and other events during the 2005 to 2010 time period. Some of these events occurred within the Lake Superior basin, for example the Upper Peninsula Environmental Health Association Annual Training Conference in Marquette in 2006. • MDEQ has created a number of outreach publications focusing on mercury, including: ○ "Mercury – Dispose of it Safely!" – Staff worked in partnership with the Greater Grand Rapids Children's Environmental Health Initiative to develop a brochure on mercury awareness and proper disposal of mercury-containing items. ○ "Fluorescent Light Drum-Top Bulb Crushers" – In 2009, MDEQ staff developed a fact sheet which was distributed to all known fluorescent lamp manufacturers and distributors of drum top crushers.	
Clean-up and Remediation			
2010-4	***Contaminated Sediment Remediation***		
	Multiple Chemicals	• The construction completion date for the Torch Lake Superfund Sites was September 23, 2005. The remedial action recommended under the Torch Lake Superfund Record of Decision for the Superfund Sites included capping the exposed upland stampsands with 6 inches of sandy loam and re-vegetating. Natural attenuation was selected for Torch Lake proper. About half of the Superfund Sites were located within the Torch Lake AOC. The completed remedial actions help prevent additional copper and other heavy metal loadings to the lake by wind or water erosion from stamp sands, and	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		additional loadings of other by-products from historical mining and milling processes. • In 2007, the US EPA Superfund Emergency Removal Branch (SFERB) performed an emergency removal of arsenic, PCB, and lead-contaminated soils and sediments at Torch Lake. The SFERB performed an area assessment afterward and recommended further remedial investigation for source identification and potential removal. The comprehensive source identification has not taken place and US EPA Superfund now considers this site's work complete. • At the Torch Lake AOC in Michigan, the fish tumor Beneficial Use Impairment (BUI) was removed in 2007, leaving two remaining BUIs: restrictions on fish and wildlife consumption and restoration of benthos. • Also at Torch Lake, sediment investigations performed by researchers from MDEQ and Michigan State University indicate that the slime clays (wastes resulting from the copper mining, milling, smelting, processing, and reclamation processes) remain in place. These slime clays are heavily contaminated with heavy metals including very high levels of copper, cadmium, chromium, mercury, and others. These slime clays are covered by a thin layer of sediments comprised of silts, sands, and organic debris and range from 2 to 10 centimeters deep. It is understood that this thin layer has formed since the mining operation ceased in 1968. Sediment investigations for the MDEQ performed by Michigan Technological University (MTU) indicate that the sediments are more contaminated at the sediment water interface than at depth. MTU conducted studies which found that the no action, natural attenuation sedimentation rate is estimated to be 850 years, without the confounding increasing contamination. • In 2007, the MDEQ produced a biennial remedial action plan update for Torch Lake AOC. • Contaminated sediment characterization work has continued in the St. Marys River AOC. In 2007, the MDEQ produced a biennial remedial action plan update for the Michigan portion of the AOC.	

ID	Chemical(s)	Actions/Accomplishments	Notes
	PCBs	• The MDEQ, Torch Lake Public Advisory Committee (PAC), 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. The MDNR has been conducting fish sampling to assist with the assessment of fish consumption advisory for PCBs and mercury.	• Reduction • Other Projects Aligned with LaMP Goals
Wastewater Treatment			
2010-10	***Wastewater Treatment Plants/Systems***		
	Mercury	• In June of 2005, dentists in Ishpeming, Michigan were notified of changes to the sewer use ordinances, requiring installation of 95 percent removal or better devices. Mercury amalgam separators were online by September 2005. The Ishpeming wastewater treatment plant has tracked a reduction in mercury discharge since late 2005. • In 2006, the Superior District Dental Association (based in Marquette, Michigan), working with the Central Lake Superior Watershed Partnership and the Marquette Wastewater Treatment Plant, passed a resolution for its members to voluntarily install mercury amalgam separators. Over 30 dentist offices in the Marquette area did so. Once the mercury is separated out it can then be properly disposed of at the local hazardous waste recycling facility. As a result of this action, the Marquette Waste Water Treatment Plant has seen a 19 percent (Fall 2008) reduction in mercury in the effluent going to Lake Superior.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
	Multiple Chemicals	• The City of Marquette is upgrading their wastewater treatment facility with activated sludge and new secondary clarifiers.	• Reduction • Other Projects Aligned with LaMP Goals

B.2.3 Minnesota

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
1	***Develop policy or regulation that caps mercury emissions so that new or expanded sources would be allowed only if overall emissions did not increase.***		
	Mercury	• The Minnesota Mercury Emissions Reduction Act of 2006 took into account the unique situation that existed in the state, including wet scrubbers operating at a number of large coal-fired power plants in the state and use of western coal, which has a lower mercury concentration that is more difficult to capture. When fully implemented in 2014, the act will result in a 90 percent reduction of emissions from six generating units at Minnesota's three largest coal-fired power plants. • Minnesota's statewide Total Maximum Daily Load (TMDL) for mercury was approved by the U.S. Environmental Protection Agency in March 2007. The next step was development of recommendations on the main elements of the Mercury TMDL Implementation Plan by a stakeholders group. Their 2008 recommendations are in the *Strategy Framework for Implementing Minnesota's Statewide Mercury TMDL*. • Between Minnesota, Wisconsin, and Fond du Lac Indian Reservation, St. Louis River jurisdictions have identified impairments for a number of toxic pollutants in the St. Louis River including mercury (fish & water), PCBs (fish & water), dioxin, DDT, dieldrin, toxaphene, lead, and PAHs. EPA hired a federal contractor to assist the stakeholders with the project. The consultant drafted a TMDL scoping options report in 2011, which is under consideration by stakeholders.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• Northeastern counties and WLSSD continued to work with the Minnesota Department of Agriculture waste pesticide collection program.	• Reduction • Regulations, Policies or Other Instruments Aligned

ID	Chemical(s)	Actions/Accomplishments	Notes
			with LaMP Goals
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		
	Dioxin, Mercury, and PCBs	• The MPCA carried out an Open Burning Abatement in the Minnesota Portion of the Lake Superior Basin project with cooperation from local governments. Projects included the following: • In Carlton and St. Louis Counties, solid waste departments made displays at county fairs and distributed open burning materials developed by the counties. In St. Louis County, a billboard campaign continued, alerting stakeholders to the dangers of backyard trash burning. They also developed an open burning video aimed at fire departments and distributed an information kit including the video, plus brochures, a disk with a power point presentation and a poster to fire departments. 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, eventually reaching 6,913 students. • The MPCA implemented a barrel-for-a-barrel swap in which the agency purchased 100 rain barrels and exchanged them for burn barrels in Duluth and Two Harbors. • The MPCA and WLSSD distributed a series of radio messages in the Iron Range and WLSSD service area.	• Reduction • Direct Result of the LaMP
	Dioxin	• The MPCA added the following goal to its strategic plan: "By July 1, 2008, reduce emission of dioxins and furans from open burning (e.g., burn barrels and wood-burning stoves) sources by 50 percent from 2002 levels." The agency's draft *Minnesota Solid Waste Policy Report* for 2007 proposes a target of "No open burning of farm or household garbage after 2010."	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• The non-profit organization Women in Construction completed a house at the Hawk Ridge Estates subdivision in Duluth, Minnesota in 2008. The home features solar panels and tubes for heating, reuse of wood building material and kitchen countertops made completely of recycled paper. • Between 2006 and 2010, nine building projects were LEED certified in the Minnesota portion of the Lake Superior basin, including college campus, health care, grocery store, and rural electric cooperative headquarters buildings. • 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).	• Reduction • Other Projects Aligned with LaMP Goals
		• Minnesota Power has carried out the following renewable energy generation projects: ○ In December of 2006, Minnesota Power began purchasing all the energy generated from the new 50-MW Oliver Wind I Energy Center built by NextEra Resources near Center, N.D. In 2007, Minnesota Power entered into a second 25-year wind power purchase agreement with NextEra. A 48-MW facility was built adjacent to the initial Oliver County wind farm, and the new generators began commercial operation in November of 2007. ○ Taconite Ridge, a 25 MW wind farm near Virginia, Minn. became operational in June of 2008. Built by Minnesota Power on property owned by the company's largest power customer, U.S. Steel, Taconite Ridge was the first commercial wind energy facility in	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		northern Minnesota. ○ Construction began in 2010 on the 76-MW Bison Wind I Energy Center near New Salem, N.D. Bison I represents the first wave of Minnesota Power-constructed wind farms that will be built in south central North Dakota and linked to Minnesota, by way of a 465-mile direct current (DC) transmission line. ALLETE finalized an agreement Jan. 1, 2010 to purchase a 250-kilovolt DC line between Center, N.D. and Hermantown, Minn. (near ALLETE headquarters in Duluth) and phase out a long-term contract to buy coal-generated electricity now transmitted over the line. • The Next Generation Initiative was passed in 2007: ○ ***25x'25 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.	

ID	Chemical(s)	Actions/Accomplishments	Notes
8		***Encourage, support, assist, and provide funding for collections and product alternatives.***	
	Mercury	• 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 also had pharmacies as well as hardware departments were checked for mercury thermostats 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. • WLSSD assisted the City of Superior with a Mercury Reduction project by collecting mercury in underserved areas. • In the 2006-2007 time period, one of three mercury collections in the basin was sponsored by industry in Two Harbors. 10 pounds of mercury bearing equipment was collected and 40 thermometers exchanged in five hours.	• Reduction • Direct Result of the LaMP
		• Minnesota has passed new legislation 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), requires recycling of compact fluorescent lamps, sets 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.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
Fuel Combustion			
11		***Support Minnesota Power's Taconite Harbor mercury control technology.***	
	Mercury	• Minnesota Power submitted the Arrowhead Regional Emission Abatement (AREA) Project to the Minnesota Public Utilities Commission in October 2005. Minnesota Power planned to install Mobotec multipollutant control technology on each of the three 75 MW coal-fired units at the Taconite Harbor plant. The MPCA completed its review of the AREA in 2006, and found that the project will reduce emissions of sulfur dioxide, nitrogen oxides and mercury from these power plants. When combined with the plans to upgrade pollution control technology at the Syl Laskin plant (also in the Lake Superior basin),	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		mercury would be reduced 72%.	
Landfills, Trash Burning and Incineration			
12	***Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.***		
	Dioxin and Mercury	• 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.	• Reduction • Other Projects Aligned with LaMP Goals
15	***Work with US EPA to improve estimate of emissions from landfill fires.***		
	Dioxin and Mercury	• The MPCA Lake Superior Binational Program coordinator worked with the Environment Canada and U.S. EPA contractors to update the 2010 discharge and emissions inventory.	• Inventory • Direct Result of the LaMP
Metals and Mining			
18	***Incorporate reductions in mercury from taconite into statewide mercury TMDL that are also part of the LaMP inventory.***		
	Mercury	• The Minnesota Department of Natural Resources' (DNR) Division of Lands and Minerals received GLRI, industry, and state funding to research controlling atmospheric mercury emissions from taconite processing plants. Evaluations include injection of brominated sorbents into flue gas, upstream from wet scrubbers, as well as post-scrubber fixed carbon and baghouse methods. Activated carbon will also be added directly to the taconite pellet bed in the beginning of the taconite processing stream, as a means to oxidize mercury in process gases.	• Reduction • Other Projects Aligned with LaMP Goals
Pesticide Inventory			
2010-3	***Characterize pesticide emissions.***		
	Pesticides	• The MN Department of Agriculture and WLSSD were consulted concerning pesticide collection records between 2005 and 2010. Recordkeeping was available through 2007.	• Inventory • Direct Result of the LaMP

ID	Chemical(s)	Actions/Accomplishments	Notes
PCB Inventory			
2010-16	***Spills Database***		
	PCBs	• MPCA spills database for northeastern Minnesota indicates that between 2006 and 2010, 751 gallons of transformer fluid leaked and was cleaned up. 81 gallons of this was PCB oil. Most of the PCB oil (75 gallons) came from improperly stored industrial transformers. The remainder was from 2 small distribution transformers. During this time, several mercury spills also occurred, including a broken manometer and several switches.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
Emerging Chemicals			
2010-9	***Reduce releases to pharmaceuticals to the environment.***		
	Pharmaceuticals	• Western Lake Superior Sanitary District (WLSSD) kicked off their first *Medicine Cabinet Clean-Out Day* at their hazardous waste center in Duluth in 2007. 271 pounds of unwanted medication were collected and the District has periodically held other collections.	• Reduction • Other Projects Aligned with LaMP Goals
Additional Outreach/Communications			
2010-11	***Provide information about toxics chemicals and the Lake Superior basin to the public and stakeholders.***		
	Multiple PBT Chemicals	• 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, hexachlorobenzene, octachlorostyene, cadmium, PAHs and PCP) were also displayed at the *Making A Great Lake Superior* 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 in 2007-2009. • The MPCA installed 20 watershed signs at Minnesota state and county roads at the watershed divide in 2007 to raise awareness about the impact of human activities in the	• Outreach • Direct Result of the LaMP

ID	Chemical(s)	Actions/Accomplishments	Notes
		Lake Superior watershed and physical extent of the watershed. • The MPCA purchased a solid sample analyzer for a Lumex portable mercury vapor analyzer. The equipment was used to analyze mercury content of 40 participants of the *Making A Great Lake Superior* conference in 2007 as part of an outreach project. The MPCA provided keypad polling technology and technical assistance for the Lake Superior session at the *State of the Lakes Ecosystem Conference* and the Toxic Chemical session at the *Making A Great Lake Superior* conference.	
2010-17	***Surveys***		
	Dioxin and Mercury	• The Minnesota Office of Environmental Assistance carried out a statewide survey of rural open burning practices in 2010. Residents of Northeastern Minnesota turned out to be better informed of the problems associated with open burning and had a lower rate of trash burning (17 percent) than the state as a whole (33 percent). Further information is available at http://www.pca.state.mn.us/index.php/view-document.html?gid=14316.	• Reduction • Other Projects Aligned with LaMP Goals
Clean-up and Remediation			
2010-4	***Contaminated Sediment Remediation***		
	Multiple PBT Chemicals	• 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 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. Activities slated for 2008 include dredging a small segment of the St. Louis. Removing the sheet pile wall and capping the remaining area. 2009 and 2010 restoration activities focused on dredging around Tallas Island. The clean-up was finished in 2010.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
2010-18	***Dredge Materials Management***		
	Multiple PBT Chemicals	• 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.	• Reduction • Other Projects Aligned with LaMP Goals
2010-19	***Contaminated Site Clean-up***		
	Multiple PBT Chemicals	• 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 clean-up 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.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

B.2.4 Wisconsin

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
1	***Develop policy or regulation that caps mercury emissions so that new or expanded sources would be allowed only if overall emissions did not increase.***		
	Mercury	• Wisconsin's mercury rule was revised in 2008. The rule requires a 90% reduction of mercury emissions or acceptance of a 0.0080 pounds Hg per GW-hr limitation from large coal-fired power plants by January 1, 2015. Large coal-fired power plants also have the option of choosing a multi-pollutant alternative. The multi-pollutant alternative requires the affected power plants to achieve nitrogen oxides (NOx) and sulfur dioxide (SO_2) reductions beyond those currently required by federal and state regulations. Under the multi-pollutant approach, an additional six years is allowed to achieve the 90% mercury emission reduction standard with interim reductions required. • Gov. Doyle signed the law in October 2009. It prohibits the sale of a number of products that contain mercury, including thermometers, manometers, thermostats, barometers, hydrometers, toys, jewelry and over-the-counter drugs. Starting in January 2012, schools can no longer store mercury anywhere in their buildings and must remove all traces of mercury from science labs, equipment and machinery, excluding thermostats or other ventilation infrastructure.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
		• 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.	• Reduction • Direct result of LaMP
3	***Encourage, support, assist, and provide incentives for phase-out.***		
	PCBs	• Through the Green Tier program, WI DNR collaborates with businesses to ensure proper management and phase out of PCBs by providing technical assistance with PCB management and phase out.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
4	***Work with other programs to improve LaMP inventory.***		
	All	• Wisconsin supports mercury/toxics/PESTCIDES/E-WASTE/clean sweeps. Support efforts that make hazardous waste collections more affordable in rural areas such as Northwest Wisconsin Regional Planning Commission mobile clean sweep program for households, farmers, and small businesses.	• Inventory • A Direct Result of the LaMP
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		
	Dioxin, Mercury, and PCBs	• Support programs for burn barrel reduction, one of the most preventable sources of dioxin and other PBT release to the atmosphere. Wisconsin DNR will look to expand its education partner base through the involvement of DNR's forestry concern over burn barrels as a cause of forest fires. We will continue to investigate burn barrel outreach projects through partners such as the Waste Management Program. The DNR will also encourage adoption of burn barrel ordinances by local units of government.	• Reduction • A Direct Result of the LaMP
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• Wisconsin has a mercury switch recycling service that is free to auto salvage operators. An auto recycling trade association is assuming responsibility for continuing the program as government funding expires.	• Other Projects Aligned with LaMP Goals
		• The City of Superior, Wisconsin, received US EPA funding for 2005-6 to carry out the U.S.-side technical assistance for the basin-wide mercury reduction project. The grant focused on the shipping industry with peer-to-peer mentoring available.	• A Direct Result of the LaMP
		• In 2007 Wisconsin concluded a project to collect mercury-filled manometers that were used to measure vacuum pressure in dairy cow milking systems. Approximately 400 pounds of mercury were removed from Wisconsin's dairy farms. Grant money from the Great Lakes National Program Office (GLNPO) and the Great Lakes Protection Fund funded the project. The reimbursement incentive encouraged dealers to seek out dairy farmers and convince them to install a reliable non-mercury gauges. DNR partnered with the University of Wisconsin and the Department of Agriculture, Trade and Consumer Protection to increase project credibility, locate mercury-filled manometers, and reduce	• Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		manometer collection costs.	
Fuel Combustion			
9	***Support mercury control technology.***		
	Mercury	• Coal fired powerplant in Ashland is in the process of switching from burning coal to wood waste and biomass. Coal usage reduced from 70,000 to 13,000 tons per year. Burned 253,548 tons of waste wood in 2009.	• Reduction
Emerging Chemicals			
2010-15	***Encourage, support, assist, and provide funding for emerging chemical programs***		
	Multiple Emerging Chemicals	• Northwest Regional Planning Commission received funding through GLRI to support community CLEAN SWEEPS including un-used/out-dated Pharmaceuticals USGS 2010 sampling for emerging chemicals of concern in the St.Louis River AOC, including water and sediment samples in the vicinity of WWTPs in MN and WI.(data not yet available)	• Reduction • Other Projects Aligned with LaMP Goals •
Additional Outreach/Communications			
2010-11	***Provide information about toxics chemicals and the Lake Superior basin to the public and stakeholders***		
	Multiple PBT Chemicals	• Education on the importance of stormwater controls to protect the western Lake Superior Basin is carried out cooperatively between the University of Wisconsin Extension, WDNR, Superior, Wisconsin, Duluth, Minnesota, South St. Louis County Soil Conservation District, and Minnesota Sea Grant. This includes the "View from the Lake" program conducted aboard the UW-Superior education vessel, the *L.L. Smith*, throughout the summer.	• A Direct Result of the LaMP
Clean-up and Remediation			
2010-4	***Contaminated Sediment Remediation***		
	Multiple Chemicals	• The Wisconsin Coastal Management Program phase IV of the contaminated sediment GIS database for the St. Louis River AOC. The project, completed in 2006, represents a partnership between states and the St. Louis River Citizens Action Committee, and will	• Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		allow mapping of contaminant concentrations throughout the AOC. The states are also working with other partners to add more recent sediment characterization results to this database. • In 2005, Wisconsin DNR completed a $6.3 million sediment remediation at Newton Creek and Hog Island Inlet in the St. Louis River Area of Concern. This was one of the first projects carried out using Great Lakes Legacy Act funding. In this final phase, 60,520 tons of petroleum contaminated sediment was removed from Hog Island Inlet and Newton Creek in addition to sediment already removed from upstream segments of the creek during previous clean-up efforts. • In 2007 sediment characterization of the City of Superior waterfront and harbor was conducted with the assistance of Great Lake Legacy Act funding. • In 2010 Great Lakes Legacy Act funding was used for further sediment characterization in the City of Superior, specifically in Howards Bay. • Ashland/Northern States Power Lakefront Site: WDNR supports US EPA in its lead role on this Superfund site, which includes 10 acres of PAH-contaminated sediments in Chequamegon Bay. Record of Decision on cleanup approved September 2010.	
2010-19	***Contaminated Site Clean-up***		
	Multiple Chemicals	• Support and Fund sediment clean up in the St Louis River Area of Concern.	• Other Projects Aligned with LaMP Goals

B.2.5 U.S. Tribal (Bad River)

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• Bad River maintains a waste transfer station for the collection and disposal of household hazardous wastes. • Bad River participated in the Clean Sweep hazardous waste collection program in the fall of 2010. • Planning is underway for a hazardous waste disposal site proposed for the recycling center on the reservation.	• Reduction • Other Projects Aligned with LaMP Goals
	Multiple Chemicals	• Conducts annual spring cleanup that includes collection and disposal of white goods. • Junk cars and associated chemicals removed from the Reservation in 2003. The final report was issued in 2005 and accounts for 222 vehicles, 150 gallons of motor oil and 100 gallons of anti-freeze removed.	• Reduction • Other Projects Aligned with LaMP Goals
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		
	Dioxin, Mercury, and PCBs	• In fall 2005, Bad River Air Quality Department initiated a "Burn Barrel Buy Back Program". Based on windshield surveys of burn barrels located on the Reservation and surveys conducted with tribal members who burn, this collection contributed to the reduction of approximately 2.5 tons/yr of pollution generated from backyard burning and a 31% reduction in the total number of burn barrels on the Reservation as of the end of 2006. The program grant is complete, but the project continues at a reduced capacity. The last barrel purchased was in 2009.	• Reduction • Direct Result of the LaMP
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		

ID	Chemical(s)	Actions/Accomplishments	Notes
	Mercury and Dioxin	• Collected three years of anemometer data from three sites on the Reservation to assess the possibility of wind energy alternatives. They are currently working with a certified meteorologist to analyze their data to assess wind energy alternatives. • In 2007, Bad River designated three members of its Renewable Energy and Energy Efficiency Task Force to participate in the Chequamegon Bay Area Green Team.	• Reduction • Other Projects Aligned with LaMP Goals
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• See 2, above. • 94% of elemental mercury has been eliminated from the Bad River health clinic. All mercury thermometers have been disposed of and the clinic is in the process of changing from mercury sphygmanometers to digital ones. The clinic was targeted be 100% mercury free by 2010. It is currently being determined whether this goal was met.	• Reduction • Other Projects Aligned with LaMP Goals
Landfills, Trash Burning and Incineration			
12 13 14	***Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.***		
	Dioxin and Mercury	• Completed a Solid Waste Management Plan in 2007. The plan has been approved and implemented.	• Reduction • Other Projects Aligned with LaMP Goals
Wastewater Treatment			
2010-10	***Wastewater Treatment Plants/Systems***		
	Multiple Chemicals	• Completed first two phases of a long-term 5 tier project, with the ultimate goal of bringing all failing septic systems up to code. Inspection and diagnosis of 146 septic systems and 69 septic tank systems within the boundaries of the Bad River reservation were completed. The Tribe established and filled a Private On-site Wastewater Treatment Systems (POWTS) Inspector position to assist Tribal members with POWTS and to provide education/outreach on septic systems. Tiers 1 and 3 are complete. Implementation of tiers	• Reduction • Other Activities

ID	Chemical(s)	Actions/Accomplishments	Notes
		2, 4 and 5 will continue in 2011. • Conducted an annual flyover using hyperspectral, thermal and straight photography for a non-point source pollution assessment with a special focus on failed septic systems.	
Clean-Up and Remediation			
2010-19	***Contaminated Site Clean-up***		
	Multiple Chemicals	• Continued involvement in the Ashland/NSP Coal Tar Site (Superfund) Remedial Investigation, as well as the natural resources damage assessment. WDNR supports US EPA in its lead role on the Superfund site, which includes 10 acres of PAH-contaminated sediments in Chequamegon Bay.	• Reduction • Other Projects Aligned with LaMP Goals
Monitoring			
2010-20	***Environmental Media Monitoring***		
	Multiple Chemicals	• Developed a Surface Water Quality Monitoring Program. • Collected one year worth of total and methyl mercury wet precipitation deposition data (2004-2005) and performed two gaseous mercury assessment (July-Sept 2008 and Apr-July 2009). The data is being used to begin to characterize the extent of the mercury problem on the Reservation, supplement data from tribal fish assessments for methylation rates, and assess deposition changes over a short period of time. • Completed 4 year baseline monitoring of TSP, PM_{10} and secondary analysis of the TSP filters for heavy metals including mercury. This sampling was conducted from 2001-2005. $PM_{2.5}$ sampling began in 2002 and still continues. In addition, ozone monitoring has been in place since 2004. The samples being collected will allow for the establishment of baseline assessment and preliminary trend analysis.	• Inventory • Other Projects Aligned with LaMP Goals

B.2.6 U.S. Tribal (Fond du Lac)

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
1	***Develop policy or regulation that caps mercury emissions so that new or expanded sources would be allowed only if overall emissions did not increase.***		
	Mercury	• Beginning a TMDL effort for the St. Louis River, in partnership with EPA R5, MPCA, WDNR; the Fond du Lac reach of the river is impaired for mercury in fish tissue, while further downstream in the AOC, there are multiple beneficial use impairments that will be addressed	• Reduction • Other Projects Aligned with LaMP Goals
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• Continued recycling, household hazardous waste collection, solid waste, electronic waste and white goods programs. Cleanup crews collect items such as appliances for people who are unable to bring in these items themselves.	• Reduction • Other Projects Aligned with LaMP Goals
5	***Encourage, support, assist, and provide funding for open burning abatement programs.***		
	Dioxin, Mercury, and PCBs	• Burn barrels prohibited in Solid Waste Ordinance (2003); community response and other solid waste management opportunities have diminished this problem on the reservation.	• Reduction • Other Projects Aligned with LaMP Goals
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• Installed solar voltaic panels on the Ojibwe School, supplementing power needs. • Working with Rural Renewable Energy Alliance to install additional solar air heating systems as broadly as possible (2 home systems were installed in a pilot project). • Anemometer data was collected for three years, evaluating the possibility of generating wind energy on the Reservation. Results show promise for the use of wind energy at one area of the Reservation. Seeking funding for installing a turbine at Duff Road site. • In response to the need to deal with climate change, the Fond du Lac Environmental Program developed a Strategic Energy Plan for improvements in energy and fuel efficiency within their own program as well as reservation-wide. • The Fond du Lac Reservation Business Committee ratified the Kyoto Protocol, adopting a goal of 20% renewable energy use by 2020.	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		• Developed reservation fleet inventory, and calculated fuel use and costs; will use this data to develop a green fleet and purchasing program. • Energy audits were completed on all commercial buildings on the reservation, and we are converting all lighting to LED's as opportunities and funding allow. • Community outreach and education efforts target climate change impacts and potential mitigation strategies. • Researching a biomass cogeneration/wood pellet manufacturing facility to provide wood fuel. • The new Resource Management Division and Tribal Court building opened in June 2010, eligible for LEED certification at the gold level. This low-impact design building includes a small green roof, rain garden, energy and water efficient features, and a newly-installed solar photovoltaic array that produces, at times, excess energy to the regional grid.	
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• See also 2, above. • Continued implementation of e-waste collection program. • Member of the National Partnership for Environmental Priorities; goal of recycling one pound of mercury per year.	• Reduction • Other Projects Aligned with LaMP Goals
2010-1	**Develop instruments to protect watersheds, air quality and the environment.**		
	Multiple Chemicals	• Numerical nutrient and biological criteria are in development for water quality standards.	• Reduction • Other Projects Aligned with LaMP Goals
Wastewater Treatment			
2010-10	***Wastewater Treatment Plants/Systems***		
	Multiple Chemicals	• Continuing to plan a cooperative tribal/nontribal wastewater management project for Big Lake. An independent sanitary district was created in 2006, and final engineering designs are underway, while the Big Lake Area Sanitary District applies for federal funding through USDA-Rural Development, and from other sources.	• Reduction • Other Activities
Monitoring			
2010-20	***Environmental Media Monitoring***		
	Multiple	• Ongoing ground and water stream monitoring in connection with Black Bear Golf Course	• Reduction

ID	Chemical(s)	Actions/Accomplishments	Notes
	Chemicals	(pesticides, herbicides, nutrients in ground and surface water, biological indicators in Otter Creek). Nine years of monitoring data show that no turf maintenance chemicals are migrating to the shallow groundwater or Otter Creek. • Continued monitoring reservation lakes and streams in support of tribal water quality standards and protection programs; updated monitoring strategy to reflect a 'mature' tribal water quality program (beyond baseline, establishing status and trends). • Continued monitoring for acid deposition, mercury and methyl mercury deposition, ozone, dioxin, NOx, and PM 2.5. • Collected fish for mercury analysis in the summer of 2008, as follow-up to initial fish tissue data collected in 2001; observed similar mercury concentrations as previous study.	• Other Projects Aligned with LaMP Goals

B.2.7 U.S. Tribal (Grand Portage)

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• Grand Portage continues to offer sites for proper disposal of household hazardous waste.	• Reduction • Other Projects Aligned with LaMP Goals
	Multiple Chemicals	• Continues a program for the removal and proper disposal of white goods/appliances, junk vehicles, tires and e-waste at least once per year. Collection totals to date include 125 white goods, 400 tires, 14 vehicles and 40 e-waste units (TVs, computers, etc.).	• Reduction • Direct Result of the LaMP
3	***Encourage, support, assist, and provide incentives for phase-out.***		
	PCBs	• Grand Portage continues to implement a Pesticide Use Policy on the Reservation to help reduce and avoid unnecessary and unscrupulous spraying. The reservation has received a 401 conditional certification under the EPA Pesticide General Permit.	• Reduction • Other Projects Aligned with LaMP Goals
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• Pursuing grants to set up a large wind turbine as a result of previous anemometer studies that supported the possibility of wind energy development on the Reservation.	• Reduction • Other Projects Aligned with LaMP Goals
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• See also 2, above. • A number of wall thermostats have been collected during the semi-annual HHW collection events. • Conducted its first Business Hazardous Waste Removal during the summer of 2005. 46 fluorescent light bulbs were collected and recycled. These collections have continued and are now held multiple times each year.	• Reduction • Direct Result of the LaMP
2010-1	***Develop instruments to protect watersheds, air quality and the environment.***		
	Multiple Chemicals	• Received an EQIP grant (U.S. Dept. of Agriculture, Natural resource Conservation Service, Environmental Quality Incentive Program) in 2006 to create 5 rain gardens and conduct stream channel restoration near the Lodge and Casino. This is the beginning of numerous	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		activities to reduce non-point source pollution in this area. This grant has been completed and was shown to be very successful.	
		• Grand Portage water quality standards were approved by the US EPA on November 30, 2005. These standards are the same or more restrictive than the State of Minnesota's standards. The standards have been implemented and new criteria were added during the first triennial review, which was completed in 2010.	• Reduction • Regulations, Policies or Other Instruments Aligned with LaMP Goals
Wastewater Treatment			
2010	***Wastewater Treatment Plants/Systems***		
	Multiple Chemicals	• Completed a project extending sewer lines to connect approximately 40 homes and office buildings along the Lake Superior shoreline. There are plans to hook up more homes and businesses in the future. • 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.	• Reduction • Other Projects Aligned with LaMP Goals
Monitoring			
2010-20	***Environmental Media Monitoring***		
	Multiple Chemicals	• Continued to maintain a surface water monitoring program.	• Reduction • Other Projects Aligned with LaMP Goals

B.2.8 U.S. Tribal (Keweenaw Bay Indian Community)

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• In 2006, KBIC completed a clean-up of a Tribal property that removed and properly disposed of twenty-six 55-gallon drums that included both hazardous and non-hazardous waste. • Under the Michigan Earth Keeper Initiative, KBIC co-sponsored Upper Peninsula wide "clean sweep" events in 2005, 2006 and 2007 for hazardous household waste (HHW) collection. In 2005, 45.7 tons of HHW were collected, including lead-acid batteries, pesticides, herbicides, mercury and more. In 2006, 320 tons of e-waste were brought in, including 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. • In 2008, KBIC partnered with Superior Watershed Partnership to hold a HHW collection event. 620 pounds of HHW, 23 pounds of pharmaceutical waste, and 1 container of controlled substances were collected. • In 2009, KBIC held its own HHW collection event. 2186 pounds of HHW were collected.	• Reduction • Direct Result of the LaMP
	Multiple Chemicals	• Prior to 2009, KBIC co-sponsored an annual Spring Cleanup Event with the Village of Baraga that collected white goods. Since 2009, KBIC has conducted its own Spring Cleanup of bulky waste and white goods for KBIC tribal members through curbside collection.	• Reduction • Other Projects Aligned with LaMP Goals
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• In 2008, KBIC is completed 20 meter wind anemometer studies through the DOE Tribal Anemometer Loan Program at their Pequaming Hatchery. A similar wind study (20 meter anemometer) is currently ongoing at the Zebra Buffalo Fields site. • The KBIC Economic Developer is currently administering a grant from the DOE for a wind feasibility study. The study involves placing two 60 meter MET (anemometer) towers at two locations (Industrial Park and Buffalo Fields) for 12 months. Towers have	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		not yet been installed. • In 2008, KBIC distributed Green Checklists for tribal members, which outlined steps for energy conservation. Checklists were provided by Superior Watershed Partnerships.	
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• See also 2, above. • Ongoing effort to replace old light bulbs with fluorescent bulbs and collect spent fluorescent light bulbs for proper disposal. In 2009 and 2010, KBIC distributed 200 boxes of CFL light bulbs provided by the Superior Watershed partnership. • Received funding to provide a mercury thermometer exchange for Tribal members in 2006. The exchange was advertised, but no mercury thermometers were received. • Provided digital thermometers to KBIC Medical Clinic.	• Reduction • Other Projects Aligned with LaMP Goals
Landfills, Trash Burning and Incineration			
12 13 14	***Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.***		
	Dioxin and Mercury	• Tribal Council approved the KBIC Solid Waste Management Plan (fall of 2005) which includes actions to divert household hazardous material from landfills and burn barrels. The Tribe is currently working on securing funding for the implementation of this plan. • Received $500,000 in 2009 from Indian Health Services (HIS) through the Tribal Solid Waste management Assistance program for the construction of a solid waste transfer station, the option identified in the Solid Waste Management Plan. The transfer station will be located in the KBIC Industrial Park. Design engineering of the transfer station is underway.	• Reduction • Other Projects Aligned with LaMP Goals
Metals and Mining			
2010-21	***[new Action]***		
	Multiple Chemicals	• From 2002-2006, KBIC collaborated with several other agencies to clean up the 71 acre Sand Point Brownfield site, which was contaminated with heavy metals (copper, lead, mercury, cadmium, arsenic) as a result of historical copper mining activities. Activities included re-grading of stamp sands, reconfiguration of drainages, lining of drainage ways with rocks, installing a 6-10 inch soil cap on approximately 34 acres and planting of vegetation to stabilize the soil cap. These efforts will reduce erosion and loading of stamp	• Reduction • Other Projects Aligned with LaMP Goals

ID	Chemical(s)	Actions/Accomplishments	Notes
		sands into Keweenaw Bay by an estimated 340 tons annually. • KBIC has also undertaken on-reservation remediation planning and implementation activities to address historical copper mining impacts associated with process waste materials, or stamp sands. • During the 2005-2010 period, KBIC also participated in a mine permit application review and comment, as well as public outreach and education related to the first sulfide mining operation in Michigan permitted under new state laws (Kennecott Eagle Project). • KBIC has served on the Lake Superior Workgroup Mining Committee.	
Wastewater Treatment			
2010-10	***Wastewater Treatment Plants/Systems***		
	Multiple Chemicals	• KBIC began construction of sewer and water line extensions in spring 2006 to serve lake front properties along the east shore of Keweenaw Bay. The project is nearing completion. • KBIC, in conjunction with the Village of Baraga, completed repair of approximately 9,000 linear feet of wastewater service lines and upgraded associated existing sewage lagoons. • KBIC staff obtained federal inspector credentials for conducting Construction Stormwater Discharge Permit compliance inspections on the Reservation. Grant funding was secured in 2006. The KBIC water quality specialist and water resources technician received full credentials in 2008. KBIC has performed some compliance work on the reservation with the new hospital that is being constructed. This has now become a semi-permanent program for the water quality specialist and the project is still ongoing.	• Reduction • Other Activities
Clean-Up and Remediation			
2010-19	***Contaminated Site Clean-up***		
	Multiple Chemicals	• Seven illegal dumps within the Reservation were cleaned up in 2005 and 2006. • KBIC's Sand Point stamp sand brownfield site was capped in 2006. A small (<3 acres) section that was not capped in 2006 due to lack of funding will be capped in 2011. Beginning in the spring of 2011, the entire site will be planted with native flora to enhance the area for wildlife and aesthetics. Capping and re-vegetating the site also will reduce heavy metal sediment load entering Keweenaw Bay from the property.	• Reduction • Other Projects Aligned with LaMP Goals
Monitoring			
2010-	***Environmental Media Monitoring***		

ID	Chemical(s)	Actions/Accomplishments	Notes
20	**Multiple Chemicals**	• In 2005, KBIC completed a surface water quality monitoring program to collects baseline data from Reservation waters and from Keweenaw Bay in Lake Superior. Data collection and monitoring (2-year cycle) is currently ongoing. Low level metals testing has been conducted at 24 stations in collaboration with the USGS and the Silver River Watershed from 2005-2008. A comprehensive report was published in 2010. • KBIC is worked with the local Resource Conservation and Development Office to complete a road crossing and culvert inventory for all nine watersheds on and around the L'Anse Reservation, to identify areas of significant sediment loading and prioritize crossings for mitigation. The inventory was completed in 2008 with finding from NRCS.	• Monitoring • Other Projects Aligned with LaMP Goals

B.2.9 U.S. Tribal (Red Cliff)

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
2	***Encourage, support, assist, and provide funding for collections/diversions.***		
	Pesticides	• Red Cliff maintains a recycling and waste transfer station and participates in annual "Clean Sweep" hazardous waste collection events in conjunction with Bayfield County.	• Reduction • Other Projects Aligned with LaMP Goals
3	***Encourage, support, assist, and provide incentives for phase-out.***		
	PCBs	• Red Cliff Tribal Council formally banned the use of burn barrels on the reservation in 2007.	• Reduction • Other Projects Aligned with LaMP Goals
7	***Encourage, support, assist, and provide funding for energy conservation or alternative energy programs.***		
	Mercury and Dioxin	• Red Cliff is currently exploring the possibility of alternative energy sources on its reservation. A wind energy assessment that was completed in 1996 is currently being reviewed to determine the feasibility of using wind energy on the reservation. Red Cliff is applying for funding through the U.S. Department of Energy to assess additional alternative energy resources for the Tribe, particularly geothermal.	• Reduction • Other Projects Aligned with LaMP Goals
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• Also see 2, above. • The Red Cliff health clinic has removed all mercury thermometers and sphygmomanometers and maintains a mercury thermometer exchange program. • The Red Cliff Dental Clinic continues implementation of program which installs trap filters to collect and recycle mercury associated with the use of mercury dental fillings.	• Reduction • Other Projects Aligned with LaMP Goals
2010-1	***Develop instruments to protect watersheds, air quality and the environment.***		
	Multiple Chemicals	• Red Cliff has received Section 319 base funding to develop a non-point source pollution management plan. A position has been created and is currently filled with a half-time (20 hours per week) staff person whose main focus is development of a Red Cliff Watershed Management Plan.	• Reduction • Other Projects Aligned with LaMP Goals
Landfills, Trash Burning and Incineration			

ID	Chemical(s)	Actions/Accomplishments	Notes
12 13 14	***Encourage, support, assist, and provide funding to improve solid waste infrastructure in rural areas.***		
	Dioxin and Mercury	• The Red Cliff Band drafted a Solid Waste Management Plan was approved in 2009 and is now being implemented.	• Reduction • Other Projects Aligned with LaMP Goals
2010-10	***Wastewater Treatment Plants/Systems***		
	Multiple Chemicals	• Red Cliff removed an obsolete wet well to prevent the potential risk of discharging sewage to a Lake Superior tributary.	• Reduction • Other Projects Aligned with LaMP Goals
Clean-Up and Remediation			
2010-19	***Contaminated Site Clean-up***		
	Multiple Chemicals	• Red Cliff is the lead executing agency 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, USACE and others to determine the environmental/civil risks in regard to proper clean-up implementation. They are currently working with a contractor to resolve these issues and move forward with the project. • Red Cliff maintains continued involvement in the Ashland/NSP Coal Tar Site (Superfund) Remedial Investigation, as well as the natural resources damage assessment. WDNR supports US EPA in its lead role on the Superfund site, which includes 10 acres of PAH-contaminated sediments in Chequamegon Bay. Red Cliff is currently working with WDNR to form a citizen advisory group for the site.	• Reduction • Other Projects Aligned with LaMP Goals
Monitoring			
2010-20	***Environmental Media Monitoring***		
	Multiple Chemicals	• Red Cliff continues to implement a Surface Water Quality Monitoring Program that tests 8 different locations on the Reservation for 5 different parameters including *E. coli*, total phosphorus, nitrate, total Keldahl nitrogen, and total nitrogen.	• Inventory

Appendix B.3. Binational Progress Report

B.3.1 Lake Superior Binational Forum

ID	Chemical(s)	Actions/Accomplishments	Notes
Overall Reductions			
4	***Work with other programs to improve LaMP inventory.***		
	All	• 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 the State of the Lakes Ecosystem Conference (SOLEC) in October 2006.	• Inventory • Direct Result of the LaMP
8	***Encourage, support, assist, and provide funding for collections and product alternatives.***		
	Mercury	• 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 the contractor for Environment Canada.	• Reduction • Direct Result of the LaMP
Emerging Chemicals			
2010-9	***Reduce releases to pharmaceuticals to the environment.***		
	Pharmaceuticals	• 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 (SWG) proposal on substances of emerging concern in the LS basin.	• Reduction • Direct Result of the LaMP
Clean-up and Remediation			

ID	Chemical(s)	Actions/Accomplishments	Notes
2010-4		***Contaminated Sediment Remediation***	
	Multiple Chemicals	• Committee members reviewed the 2006/2007 Forum work plan project to integrate LaMP goals and facilitate connective networks with Area of Concern communities. Forum meeting notices are to be sent out to Remedial Action Plan/Public Advisory Committee 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.	• Outreach • Direct Result of the LaMP
Outreach/Communications			
2010-11		***Provide information about toxics chemicals and the Lake Superior basin to the public and stakeholders.***	
	Multiple Chemicals	• Committee members have provided input on the Realtor's Outreach project, initiated by the Superior Work Group. 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 use of these types of properties.	• Outreach • Direct Result of the LaMP

Appendix B.3.2. Other Binational Programs

- In February 2004, the Lake Superior Binational Forum sent letters to local and regional schools, colleges and universities regarding mercury reduction and asking for input on how these institutions handle mercury usage and disposal and what challenges they face with respect to mercury use and disposal. A subcommittee of the Lake Superior Binational Forum Chemical Committee was formed to work with a contractor on the mercury reduction project for the Lake Superior Basin to assist with peer-to-peer mentoring, industry visits, and moving the project forward. Other activities of the Binational Forum Chemical Committee between 2004 and 2006 included:
  - Working with Lake Superior Work Group to ban mercury thermometers in small communities, e.g. Manitouwadge, Ontario;
  - Providing input to the Lake Superior Work Group on their inventory of critical pollutant emission sources, and on chemical strategies;
  - Providing input to Ontario Ministry of the Environment regarding the White Paper on Watershed-based Source Protection Planning and the Draft Ontario Source Protection Act.
  - Developing a process for adding emerging chemicals of concern to the current list of critical pollutants.

- The Canadian and United States LaMP Forum brings awareness of the hazards of burning garbage through the use of multi-media display called Bernie the Burn Barrel. These four-foot tall displays recite key messages about the hazard of burning to children and adults alike. United States and Canadian Bernie replicae will travel to Forum meetings, Lake Superior Day events, community events, libraries, and other strategic locations with educational materials to inform basin residents about the dangers and alternatives to burning garbage. A "Burn Barrel Outreach Media Kit" includes posters, brochures, factsheets, a bookmark and clip art developed by the Western Lake Superior Sanitary District (WLSSD), Duluth, Minnesota, Environment Canada, and others. This interactive display are suitable for adults and younger audiences at a variety of venues.

- 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.

- 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.

- Great Lakes Binational Toxics Strategy workgroup worked in 2005 with Council of Great Lakes Industries, pesticide industry, and the Pest Management Regulatory Agency (Health Canada) to identify quantity of HCB released from pesticide application.

- The Great Lakes Binational Toxics Strategy workgroup partnered with Puget Sound Clean Air Agency (USA) on further emissions testing on wax fire logs and regular cordwood. Environment Canada finalized a report on artificial log testing with Puget Sound Clean Air Agency in 2006.

- Environment Canada developed a DVD with three videos (*Advanced Technology Woodstove, Firewood Preparation*, and *Woodstove Operation*). The DVD is distributed to woodstove exchange program participants in both Canada and the U.S.

Appendix C

In-Basin Chemical Source Inventories:

2005-2010

In-Basin Chemical Source Inventories

In LaMP 2000, the U.S. and Canada strove to make the inventory tables as similar as possible. This masked some of the unique features of the inventories so in this report, the inventory for each side of the Lake Superior Basin is presented separately. An important feature in the Canadian inventory is the Rating column in which the Canadian consultant, Netta Benazon, ranked the estimates based on a method used in the EPA draft dioxin reassessment. The Benazon 2011 report goes into greater detail for each estimate and includes a number of conclusions and data gap recommendations that will be useful for improving the inventories in the future.

An important feature of the U.S. inventory is the "Source of Data" column for each estimate, which was not done in LaMP 2006. While the U.S. does not have a report that is exactly comparable to Benazon 2006, a series of spreadsheets with the calculations is available from Carri Lohse-Hanson at the Minnesota Pollution Control Agency. Where the methods used to make estimates for this report different significantly from the LaMP 2000 methods, there is additional documentation in this appendix.

C.1 Canadian Chemical Emissions Inventory

Introduction

In 1991, the Lake Superior Binational Program (LSBP) was established for Lake Superior to restore and protect the basin. The LSBP has a number of ecosystem objectives for the lake in addition to a Zero Discharge Demonstration Program (ZDDP) which has as its primary goal the elimination of the discharge and emissions of nine persistent, bio-accumulative toxic chemicals by 2020. These include dioxin, mercury, hexachlorobenzene (HCB), octachlorostyrene (OCS), polychlorinated biphenyls (PCBs), and pesticides, including aldrin/dieldrin, chlordane, DDT, and toxaphene.

Information was gathered wherever possible on the nine identified persistent toxic chemicals. Because numerous mercury and dioxins and furans sources exist in the Lake Superior Basin (LSB), the focus was on these chemicals. A few sources of HCB were also identified and included in the inventory. Progress on the collection, storage, and destruction of PCBs, pesticides, and mercury-containing wastes was also documented, where information was available.

The following categories of sources were investigated:

- Industrial facilities;
- Fuel combustion;
- Incineration;
- Prescribed burning
- Municipal solid waste;

- Municipal wastewater treatment;
- Commercial products;
- Contaminated soil, sediments and sludge;
- Recycling of hazardous and special waste; and
- PCBs: in use, stored, removed/destroyed.

An emissions inventory was prepared for the year 2010. In addition, revisions to the 1990, 2000, and 2005 inventories were made, where appropriate, and presented in this document so that trends in emission reductions since 1990 can be assessed.

To complete the emissions inventory, a comprehensive scientific literature search was conducted, and numerous agencies were contacted for information. Revisions were made to the LSB population estimate. To calculate emissions from industrial point sources, the National Pollutant Release Inventory (NPRI) was queried; for area sources, updated emission factors and activity data were identified, as necessary, and calculations were performed to arrive at a best estimate. Care was taken to assign quality ratings to each estimate to account for the uncertainties within the data used to arrive at the final values.

In addition, agencies and organizations associated with waste recycling and disposal were contacted for information on wastes containing mercury, pesticides, and PCB collected yearly from the LSB.

Summary tables providing annual emissions for each source category for mercury, dioxins and furans, and HCB for the years 1990, 2000, 2005, and 2010 are provided in Tables C.3.1, C.3.2, and C.3.3. More details for each of these tables are provided in tables C.3.1a and C.3.1b, C.3.2a and C.3.2b, and C.3.3a and C.3.3b, respectively. The emission estimates presented in this section include releases to the atmosphere, water, and land as well as off-site transfers for disposal or recycling where applicable. Table C.3.4 summarizes the quantity of PCB waste in storage at provincially monitored sites in LSB.

Mercury

As presented in Table C.3.1, on-site releases of mercury, including atmospheric, water, and land, have decreased from 769 kg/y in 1990 to 27 kg/y in 2010—a reduction of 96% over this period and well above the targeted 80%. Releases to surface water have declined by 89% from 18 kg in 1990 to 2 kg in 2010.

The largest source, by far, of atmospheric emissions in 1990 was the Algoma iron sintering facility in Wawa which emitted 600 kg/y. This facility was shut down in 1998.

Excluding the Algoma facility, emissions/releases in 1990, 2000, 2005, and 2010 amounted to 169, 100, 87, and 27, respectively, or a reduction of 84%.

Apart from the Algoma facility, the largest reductions of mercury emissions/releases (in kg) has been from consumer and commercial products containing mercury, particularly

mercury content in fluorescent lamps, and batteries, dental amalgam, paint and fungicides. A reduction from 65 to 5 kg or 94% has been achieved since 1990 from this source category.

The next largest mass reduction has been from fuel consumption, from 61 to 11 kg/y, largely due to reduced emissions from the Thunder Bay Generating Station (from 57 kg/y in 1990 to about 7 kg/y in 2010), which is now only operating as a peak electricity generating plant.

Considerable reductions in on-site releases have also been achieved in pulp and paper (from 22 to 0 kg/y) and from wastewater treatment plants (from 9.2 to 3 kg/y) during the 1990 to 2010 period.

Mercury emissions from mining are similar now to quantities emitted in 1990 (i.e. about 4 kg/y), though emissions were higher in the years 2000 and 2005. The recent reductions from these facilities can be partly attributed to plant closures.

New NPRI reporting requirements published on December 5, 2009, under the authority of section 46 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999), stipulate that mining facilities must report to NPRI, not only quantities of NPRI substances released to the environment from the mine, but also the quantities of NPRI substances contained in the waste rock and tailings disposed of at the mine or transferred off site for disposal for the years 2006 to 2008 and onwards. The quantity reported for the year 2009 is 2,216 kg.

Currently, the largest mercury emission/release sources are mining (4 kg/y), the Thunder Bay Generating Station (about 7 kg/y), and commercial and consumer products (about 5 kg/y).

Contributions from combustion of residential wood combustion, refined petroleum products, natural gas as well as from on-site residential waste combustion, and landfill fires are smaller in comparison to other sources (i.e. < 2 kg/y each).

Mercury emissions reductions from residential wood combustion, refined petroleum products, and natural gas have been small (i.e. < 25%) over the 1990 to 2010 period; reductions from on-site residential waste combustion (burn barrels) and landfill fires have been greater due to the decreased presence of mercury in disposed consumer products and increased awareness about the environmental impacts of burning waste.

The estimates for mercury releases from waste water treatment plants in the LSB for the years 2005 and 2010 have been revised based on the results of a recent study (not yet published) on 48 waste water treatment plants in Ontario. The estimates include releases from urban run-off as many of the plants have combined sewers. A reduction of 67% has been achieved since 1990 likely as a result of the decreased mercury content in consumer products.

Emissions from cremation have increased by 40% due to increased quantity of amalgam in the teeth of deceased and a general increase in cremation activity. Increases are expected to continue over the next decade and a half followed by a gradual decline as less amalgam will be present in the next generation of the deceased.

Recovery of mercury from discarded consumer products has increased in the LSB from 48 to 64 kg/y—an increase of 33% over the period of 1990 to 2010. The highest calculated recycling rates are for fluorescent lamps, estimated to be 24%, and for end-of-life vehicle switches, estimated to be 60%. A considerable quantity of mercury is estimated to be present in discarded displacement and reed relays and instrumentation and control equipment, amounting to 44 and 33 kg/y, respectively. A high recycling rate was assigned for displacement and reed relays (60%) and for instruments and control (50%) for the year 2010 based on the work of Cain (2005, 2007) which is in turn based on U.S.-based practices. However, the actual recycling rate and fate of mercury from these products in the LSB is not known.

Other potential mercury-containing consumer products that have not been included in the inventory are formulated mercury-added products, including preservatives (i.e. thimerosal, used as an antibacterial agent in vaccines and other pharmaceuticals) and reagents and mercury compounds (i.e. mercuric chloride, mercuric nitrate, and others used in leather tanning processes, electroplating and laboratory applications). In addition, there are a number of miscellaneous mercury added products including pressure transducers, films, transceivers, and scanning electrodes). The combined mercury present in these products is small compared to that in switches and relays, instrumentation and control, dental amalgam, and the other consumer products examined in this report.

Recycling of fluorescent lamps, automobile switches, and thermostats takes place in the LSB through EcoSuperior environmental programs, Summerhill Impact, municipalities, and independent operators.

Significant quantities of mercury (approximately 880 kg) are present in contaminated sediments in the LSB. These are located within two Areas-of Concern (Jellicoe Cove, and Thunder Bay Harbour), which are scheduled to be remediated prior to 2020.

Large quantities of mercury (2,900 to 5,800 kg) are also present in sludge disposed in drums contained within reinforced concrete vaults at the waste disposal site in Marathon, Ontario. The site is being monitored and groundwater sampling results indicate that no mercury is leaching from the waste site.

Table C.3.1. Summary of Mercury Emissions/Releases in the LSB

Mercury: Onsite Releases[e] (kg/y)						
Source	**Year**				**Reduction**	**Targeted Reductions (2010)**
	1990	**2000**	**2005**	**2010**		
Industrial	628	19.1	34.0	3.8	99%	80%
Fuel Combustion	61	60	40	11	82%	80%
Waste Incineration	10.5	2.5	1.1	1.0	90%	80%
Municipal Solid Waste	27.5	5.0	5.0	5.0		
WWTP	9.2	9.2	3.0	3.0	67%	80%
Cremation	1.5	1.9	2.0	2.1	-40%	80%
Consumer & Commercial Products[2]	31.4	1.8	1.6	1.0	97%	80%
Total	**769**	**100**	**87**	**27**	**96%**	80%
Sediment[6]	880	880	880	880	0%	80%
Soil[5]						80%
Mercury: Disposed/Recycled (kg/y)[3]						
Disposed[7]	536	250	93	88	83%	80%
Recovered[4]	48	54	380	64	-33%	
Mine Tailings and Waste rock				2216		

[1] Includes emissions/releases to the atmosphere and water.
[2] Includes emissions/releases from automobile switches, household appliances, paint, and fungicides as these are not accounted for in emissions/releases from municipal solid waste or WWTP.
[3] Includes mercury in disposed or recycled waste.
[4] Based on reported NPRI industrial recovery and on calculated quantities from consumer products (Table 4-6b).
[5] Information not available.
[6] Approximate mass in sediments.
[7] On-site plus off-site
WWTP = wastewater treatment plant
Blank = data not available

Table C.3.1.b. Summary of Mercury Emissions/Releases, Lake Superior Basin

Source Category	1990 Emissions (kg)			2000 Emissions (kg)			2005 Emissions (kg)			2010 Emissions (kg) j			Rating
	Atm	Water	Total	Atm	Water	Total	Atm	Water	Total	Atm	Water	Total	
Industrial													
Pulp and Paper	10.9	10.9	21.8	11.5	3.1	14.6	4.4	3.1	7.8	0		0	U
Mining	4.0	0.4	4.4	4.4	0.1	4.5	26.0	0.2	26.2	3.5	0.3	3.7	U
Asphalt Manufacturing Facilities	0.06		0.06	0.06		0.06	0.06		0.06	0.06		0.06	L
Wood Preservation													
Iron Sintering	600		600										L
Metal Finishing		1.5	1.5										U
Photoprocessing	0.0004	0.003	0.0034										U
Subtotal Industrial	**615**	**12.8**	**627.8**	**16.0**	**3.2**	**19.1**	**30.4**	**3.3**	**34.0**	**3.6**	**0.3**	**3.8**	**U**
Fuel Combustion													
Coal													
Utilities[k]	57		57	56		56	37		37	3.7		3.7	U
Residential/Commercial/ Industrial[a]													
Wood													
Residential Wood Combustion	1.5		1.5	1.5		1.5	1.5		1.5	1.3		1.3	P
Commercial/Industrial[b]													
Petroleum													
Refined Petroleum Products	1.0		1.0	1.0		1.0	1.0		1.0	0.9		0.9	L
Natural Gas	1.9		1.9	1.7		1.7	1.5		1.5	1.5		1.5	L
Subtotal Fuel Combustion	**61**		**61**	**60**		**60**	**40**		**40**	**10.7**		**10.7**	
Waste Incineration (Method 1)													
Rural On-site Residential Waste Combustion	9.0		9.0	2.1		2.1	1.1		1.1	1.0		1.0	U
Landfill Fires	0.8		0.8	0.03		0.03	0		0	0		0	U
Hazardous and Municipal Waste Combustion[c]													
Small Incinerators[d]													

Source Category	1990 Emissions (kg)			2000 Emissions (kg)			2005 Emissions (kg)			2010 Emissions (kg) j			Rating
	Atm	Water	Total	Atm	Water	Total	Atm	Water	Total	Atm	Water	Total	
Industrial													
Medical Waste Incineration[e]	0.8		0.8	0.4		0.4	0		0				U
Subtotal Waste Incineration	**10.5**		**10.5**	**2.5**		**2.5**	**1.1**		**1.1**	**1.0**		**1.0**	**U**
Municipal Solid Waste Handling and Disposal (Method)	**27.5**		**27.5**	**5.0**		**5.0**	**5**		**5**	**5**		**5**	**U**
Waste Water Treatment (Method 1)													
Land Application of Sludge[1]													
Wastewater Treatment Plants	4.6	3.9	8.5	4.6	3.9	8.5	1.5	1.5	3.0	1.5	1.5	3.0	U
Runoff		0.7	0.7		0.7	0.7							U
Subtotal Waste WaterTreatment	**4.6**	**4.6**	**9.2**	**4.6**	**4.6**	**9.2**	**1.5**	**1.5**	**3.0**	**1.5**	**1.5**	**3.0**	**U**
Cremation	**1.5**		**1.5**	**1.9**		**1.9**	**2.0**		**2.0**	**2.1**		**2.1**	**M**
Consumer Products (Method 2)													
Fluorescent Lamps	2.4	0.01	2.4	2.3	0.01	2.4	0.7	0.00	0.7	0.5	0.00	0.5	M
Thermometers	3.1	0.01	3.1	0.2	0.01	0.2	0.1	0.01	0.1	0.1	0.00	0.1	P
Batteries	7.7		7.7	0.1		0.1	0.1		0.1	0.1		0.1	P
Thermostats	0.4	0.01	0.4	0.3	0.01	0.4	0.3	0.01	0.3	0.2	0.01	0.3	P
AutomobileSwitches	0.4	0.00	0.4	0.9		0.9	0.5		0.5	0.2		0.2	P
Household Appliance Switches	0.9		0.9	0.9		0.9	1.1		1.1	0.8		0.8	P
Displacement and reed relays	1.1	0.04	1.1	1.0	0.04	1.0	0.7	0.03	0.7	0.7	0.02	0.7	P
Measurement and Control Devices	2.5	0.2	2.7	0.6	0.04	0.7	0.5	0.04	0.5	0.4	0.03	0.5	P
Dental Amalgam	13.5	2.5	16.0	7.4	1.2	8.6	3.3	0.6	3.9	1.7	0.1	1.8	P
Pigments													U
Paint	21.2	0.1	21.3	0		0	0		0	0		0	M
Fungicidies	8	0.8	8.8	0		0	0		0	0		0	P

Source Category	1990 Emissions (kg)			2000 Emissions (kg)			2005 Emissions (kg)			2010 Emissions (kg) j			Rating
	Atm	Water	Total	Atm	Water	Total	Atm	Water	Total	Atm	Water	Total	
Industrial													
Pharmaceuticals	0.01		0.01	0.01		0.01	0.01		0.01	0.01		0.01	P
Subtotal Consumer Products	**61.2**	**3.7**	**64.9**	**13.8**	**1.3**	**15.1**	**7.2**	**0.7**	**7.9**	**4.8**	**0.2**	**4.9**	
Total (Includes Method 1 Estimates) [g]	**751**	**18**	**769**	**92**	**8**	**100**	**82**	**5**	**87**	**25**	**2**	**27**	

Blank indicates information not available.
Rating = data quality; H=high; M=moderate; L=low; P=preliminary; U=unknown.
[a] No coal burning is believed to take place in the LSB other than the Thunder Bay Generating Station.
[b] Emissions from wood burning in industrial facilities is assumed to be reported under NPRI.
[c] No incineration of municipal solid waste, hazardous waste, or sewage sludge has taken place on the Canadian side of the LSB over the period of 1990 to 2005.
[d] Does not take place on the Canadian side of the LSB.
[e] No medical waste incinerators currently operate on the Canadian side of the LSB due to Ontario Regulation 323/02 requiring that all hospital incinerators be shut down by the end of 2003.
Four operated in 1990. Two were shut down in 1994 and the other two were shut down in 2003.
[f] Land application of biosolids does not take place on the Canadian side of the LSB nor has it taken place in the past.
[g] Two methods were used to estimate mercury emissions from consumer products. The first method (Method 1) uses assumptions on quantities of municipal solid waste and sewage water generated, the mercury concentration in the waste and sewage water, and some assumptions as to the fate of the mercury during waste and sewage water handling, transfer, and disposal. The second method (Method 2) examines individual products, the number of units discarded, their mercury content, and makes assumptions about the fate of mercury in the process of discarding these products. To avoid double counting, the total includes Method 1 estimates and excludes Method 2 estimates except for estimates from household appliances, automobile switches and paints and fungicides, which are included because it is assumed that the majority of emissions are to the atmosphere during scrap metal recycling (automobile switches) or during application (paint and fungicides) and are therefore not accounted for in mercury content in municipal solid waste which is the basis for the Method 1 estimate. The totals do not include estimates for mine tailings and waste rock or estimates from sediments. The recovery estimates includes estimates from method 2 as estimates for recovery were not available using Method 1.
[j] Data is from 2008 NPRI database.
[k] The 2010 value for atmospheric emissions is from Todd (2010) and is considered to be preliminary.

Table C.3.1b. Summary of Mercury Disposed/Recycled, Lake Superior Basin

Source Category	1990 Disposal/Recovery (kg)				2000 Disposal/Recovery (kg)				2005 Disposal/Recovery (kg)				2010 Disposal/Recovery (kg)				Rating
	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	
	On-site	Off-site			On-site	Off-site			On-site	Off-site			On-site	Off-site			
Industrial																	
Pulp and Paper					4.9	22.6		0	0.3	1.6		115					U
Mining					0	115			0	1.2		195.5					U
Mine Tailings and Waste Rock													2216			95	
Asphalt Manufacturing Facilities																	L
Wood Preservation																	
Iron Sintering																	L
Metal Finishing																	U
Photoprocessing																	U
Subtotal Industrial					**4.9**	**137.6**		**0**	**0.3**	**2.8**		**311**	**2216**			**95**	**U**
Fuel Combustion																	
Coal																	
Utilities		10			1.0	0		1	0.7			0.5	0.2				U
Residential/Commercial/ Industrial[a]																	
Wood																	
Residential Wood Combustion																	P
Commercial/Industrial[b]																	
Petroleum																	
Refined Petroleum Products																	L
Natural Gas																	L
Subtotal Fuel Combustion		**10**			**1**	**0**		**1**	**0.7**			**0.5**	**0.2**				
Waste Incineration																	
Rural On-site Residential Waste Combustion	9.0				2.1				1.1				1.0				U
Landfill Fires																	U
Hazardous and Municipal																	

Source Category	1990 Disposal/Recovery (kg)				2000 Disposal/Recovery (kg)				2005 Disposal/Recovery (kg)				2010 Disposal/Recovery (kg)				Rating
	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	
	On-site	Off-site			On-site	Off-site			On-site	Off-site			On-site	Off-site			
Industrial																	
Waste Combustion[c]																	
Small Incinerators[d]																	
Medical Waste Incineration[e]		0.02								0							U
Subtotal Waste Incineration	**9**	**0.02**			**2.1**				**1.1**	**0.0**			**1.0**				**U**
MunicipalSolid Waste Handlingand Disposal		**507**				**101**				**86**				**85**			**U**
Waste Water Treatment																	
Land Application of Sludge[f]																	
Wastewater Treatment Plants		2.1				2.1				0.7				0.7			U
Runoff																	U
Subtotal Waste Water Treatment		**2.1**				**2.1**				**0.7**				**0.7**			**U**
Cremation																	**M**
Consumer Products																	
Fluorescent Lamps		14.2		0.0		14.0		0.0		4.1		0.7		3.2		1.2	M
Thermometers		11.5		0.0		1.3		0.6		0.8		0.3		0.6		0.2	P
Batteries		292.0		0.0		3.4		0.0		4.3				4.3			P
Thermostats		14.3		0.0		12.1		0.0		9.3		0.8		8.5		0.3	P
Automobile Switches		0.3	0.5	0.0		0.8	1.2	0.0		0.4	0.6	1.0		0.2	0.3	1.0	P
Household Appliance Switches		0.8	1.3	0.0		0.7	1.2	0.0		0.9	1.4	0.0		0.6	1.0	0.0	P
Displacement and reed relays		47.2		15.9		37.6		22.0		20.5		30.9		17.7		26.6	P
Measurement and Control Devices		96.7		10.7		24.1		16.0		18.4		18.3		16.4		16.4	P
Dental Amalgam		56.9		21.8		31.2		13.9		22.5		17.0		17.0		18.7	P
Pigments		5.6				5.6				0.0				0.0			U
Paint						0.0				0.0				0.0			M
Fungicidies		7.2				0.0				0.0				0.0			P
Pharmaceuticals		0.1				0.1				0.1				0.1			P

Source Category	1990 Disposal/Recovery (kg)				2000 Disposal/Recovery (kg)				2005 Disposal/Recovery (kg)				2010 Disposal/Recovery (kg)				Rating
	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	Land Disposal		EAF	Recovery	
	On-site	Off-site			On-site	Off-site			On-site	Off-site			On-site	Off-site			
Industrial																	
Subtotal Consumer Products		**546.8**	**1.8**	**48.4**		**130.8**	**2.4**	**52.5**		**81.2**	**2.0**	**68.9**		**68.7**	**1.3**	**64.4**	
Sediments[g]	880				880				880				880				L
Sludge[h]																	M
Total[i]	**9**	**527**	**2**	**48**	**8**	**242**	**2**	**54**	**2**	**91**	**2**	**380**	**1**	**87**	**1**	**64**	

Blank indicates information not available. Rating = data quality; H=high; M=moderate; L=low; P=preliminary; U=unknown.

[a] No coal burning is believed to take place in the LSB other than the Thunder Bay Generating Station.

[b] Emissions from wood burning in industrial facilities is assumed to be reported under NPRI.

[c] No incineration of municipal solid waste, hazardous waste, or sewage sludge has taken place on the Canadian side of the LSB over the period of 1990 to 2005.

[d] Does not take place on the Canadian side of the LSB.

[e] No medical waste incinerators currently operate on the Canadian side of the LSB due to Ontario Regulation 323/02 requiring that all hospital incinerators be shutdown by the end of 2003. Four operated in 1990: two were shut down in 1994 and the other two were shutdown in 2003.

[f] Land application of biosolids does not take place on the Canadian side of the LSB nor has it taken place in the past.

[g] Includes sediments from Thunder Bay Harbour and Jellicoe Cove.

[h] The contaminated sludge contains 2,900 to 5,800 kg of mercury and is contained on-site in drums and concrete vaults and a groundwater monitoring program is in place to confirm that leaching of mercury is not occurring.

[i] Two methods were used to estimate mercury emissions from consumer products. The first method (Method 1) uses assumptions on quantities of municipal solid waste and sewage water generated, the mercury concentration in the waste and sewage water, and some assumptions as to the fate of the mercury during waste and sewage water handling, transfer, and disposal. The second method (Method 2) examines individual products, the number of units discarded, their mercury content, and makes assumptions about the fate of mercury in the process of discarding these products. To avoid double counting, the total includes Method 1 estimates and excludes Method 2 estimates except for estimates from household appliances, automobile switches and paints and fungicides, which are included because it is assumed that the majority of emissions are to the atmosphere during scrap metal recycling (automobile switches) or during application (paint and fungicides) and are therefore not accounted for in mercury content in municipal solid waste which is the basis for the Method 1 estimate. The totals do not include estimates for mine tailings and waste rock or estimates from sediments. The recovery estimates includes estimates from method 2 as estimates for recovery were not available using Method 1.

[j] Data is from 2008 NPRI database.

Dioxins and furans

As presented in Table C.3.2, dioxins and furans on-site releases have dropped by over 97% since 1990. The elevated value of 21g TEQ/y in 1990 was largely associated with atmospheric emissions amounting to 19.4 g TEQ/y from the iron sintering plant in Algoma (Canada). This plant was shut down in 1998 and is no longer a source of emissions. Other dioxins and furans contributions associated with the 1990 value that are not currently sources of emissions in the LSB are discharges to water from pulp and paper effluent, emissions from medical waste incineration, and emissions/releases from the Northern Wood Preservers creosote/PCP treatment operations. Discharges to water (and atmospheric emissions) from pulp and paper mills declined considerably in 2000, likely as a result of the conversion of the pulp and paper bleaching process from chlorine to chlorine dioxide due to the Pulp and Paper Regulations. Four medical waste incinerators were operating in the LSB and all were shut down by 2003. The Northern Wood Preservers creosote/PCP treatment operations were shut down in 2003.

Dioxins and furans in disposed and recycled waste has also fallen by over 99% largely as a result of plant shut-downs and the conversion of the pulp and paper process to chlorine dioxide.

Table C.3.2. Summary of Dioxins and Furans Emissions/Releases in the LSB

Dioxins and Furans: Onsite Releases[1, 3] (g TEQ/y)[3]						
Source	**Year**				**Reduction**	**Targeted Reductions (2010)**
	1990	**2000**	**2005**	**2010**		
Industrial	20.12	0.032	0.039	0.026	99.9%	85%[2]
Fuel Combustion	0.3	0.2	0.2	0.2	33%	85%[2]
Waste Incineration	0.8	0.7	0.3	0.3	63%	85%[2]
Prescribed Burns	0.001	0.001	0.001	0.001	0%	
WWTP	0.05	0.05			100%	85%[2]
Cremation	0.0003	0.0003	0.0003	0.0003	0%	85%[2]
Consumer & Commercial Products	0.10	0.09	0.08	0.08	20%	85%[2]
Total	**21.3**	**1.1**	**0.6**	**0.6**	**97%**	**85%[2]**
Sediments[5]						
Soil[6]	31.38	6	6	6	81%	85%[2]
Dioxins and Furans: Disposed/Recycled (g TEQ/y)[3 4]						
Disposed	107	94	0.01	0.01	100%	85%[2]
Recycled	0.003	0.003	0	0	100%	85%[2]

[1] Includes emissions/releases to the atmosphere, water, and soil.
[2] Interim milestone, halfway between the 80% milestone for 2005 and 90% for 2015.
[3] Some of the data were available in g I-TEQ/y; others in g TEQ-WHO_{98}/y or g TEQ-WHO_{05}
[4] Includes dioxins and furans in disposed or recycled waste.
[5] Low concentrations of dioxins and furans have been found to be widely dispersed within the watershed of the Canadian portion of the LSB with higher levels present in Thunder Bay, Peninsula Harbour, and at the mouth of the Magpie River as a result of industrial activity. Insufficient information exists to estimate quantities.
[6] Units are in g/y and TEQ equivalent is unavailable. Estimate is for contaminated soil and sediments at the Northern Wood Preservers site, which was remediated in 2002.
WWTP = wastewater treatment plant
Blank = data not available

Total dioxins and furans releases to the environment estimated for the year 2010 amount to approximately 0.6 g TEQ/y and are mostly from fuel combustion and burn barrels. There is considerable uncertainty associated with the emissions estimate from landfill fires and burn barrels due to the lack of accurate activity data. The frequency and extent of landfill fires in the past is unknown and there is some uncertainty about the percentage of waste burned by those burning waste in rural areas.

The Thunder Bay Generating Station was identified as the largest current source of dioxins and furans in the LSB in the 2005 LSB Emissions Inventory Report. However, based on revised data submitted under NPRI and discussions with representatives of the facility, it appears that previous dioxins and furans emission estimates were incorrectly calculated by the facility (Todd, 2010). Current emissions from this source are documented as 0 g I-TEQ/y in the NPRI database.

Limited sediment sampling at Black Bird Creek and Lake "C" has shown possible contamination with dioxins and furans, petroleum hydrocarbons and low level mercury (Santiago, 2010). Additional sediment sampling is underway to further characterize the extent of contamination.

Table C.3.2a. Summary of Dioxins and Furans On-Site Emissions/Releases, Lake Superior Basin

Source Category	1990 Emissions (g ITEQ)				2000 Emissions (g ITEQ)				2005 Emissions (g ITEQ)				2010 Emissions (g ITEQ)[g]				Units	Rating
	On-site Releases				On-site Releases				On-site Releases				On-site Releases					
	Atm	Water	Soil	Total	Atm	Water	Soil	Total	Atm	Water	Soil	Total	Atm	Water	Soil	Total		
Industrial																		
Pulp and Paper	0.1	0.47		0.57	0.022	0.01		0.032	0.037	0.002		0.039	**0.026**			**0.026**	I-TEQ	U
Mining																	I-TEQ	
Asphalt Manufacturing	0.00034			0.00034	0.00034			0.00034	0.00034			0.00034	0.00034			0.00034		P
Wood Preserving	0.147	0.0013		0.1483	0			0									I-TEQ	U
Iron Sintering [a]	19.4			19.4	0			0	0			0	0			0	I-TEQ	U
Subtotal Industrial	**19.6**	**0.47**		**20.12**	**0.022**	0.01		**0.032**	**0.037**	0.002		**0.039**	**0.026**			**0.026**		**U**
Fuel Combustion																		
Coal																		
Utitlities	0.021			0.021	0.021			0.021	0.021			0.021	0			0	I-TEQ	U
Residential/ Commercial/ Industrial[b]																		
Wood																		
Residential Wood Combustion	0.089			0.089	0.086			0.086	0.086			0.086	0.07			0.07	I-TEQ	L
Commercial/Industrial[c]																		
Petroleum																		
MotorVehicle Fuel (Diesel)	0.12			0.12	0.10			0.10	0.114			0.114	0.113			0.113	TEQ-WHO98	L
Motor Vehicle Fuel (Gasoline)	0.00436			0.00436	0.0039			0.0039	0.0039			0.0039	0.0037			0.0037	TEQ-WHO98	L
Fuel Oil	0.017			0.017	0.009			0.009	0.009			0.009	0.006			0.006	TEQ-WHO98	L
Subtotal Petroleum	**0.141**			**0.141**	**0.113**			**0.113**	**0.127**			**0.127**	**0.123**			**0.123**	TEQ-WHO98	L
Natural Gas																	g/y	U
Subtotal Fuel Combustion	**0.3**			**0.3**	**0.2**			**0.2**	**0.2**			**0.2**	**0.2**			**0.2**		**U**
Waste Incineration																		
Rural On-site Residential Waste Combustion	0.31			0.31	0.42			0.42	0.27			0.27	0.28			0.28	TEQ-WHO05	L
Landfill Fires	0.34			0.34	0.09			0.09	0			0	0			0	TEQ-	U

Source Category	1990 Emissions (g ITEQ)				2000 Emissions (g ITEQ)				2005 Emissions (g ITEQ)				2010 Emissions (g ITEQ)[g]				Units	Rating
	On-site Releases				On-site Releases				On-site Releases				On-site Releases					
	Atm	Water	Soil	Total	Atm	Water	Soil	Total	Atm	Water	Soil	Total	Atm	Water	Soil	Total		
																	WHO98	
Yard Waste	0.023			0.023	0.022			0.022	0.022			0.022	0.022			0.022	TEQ-WHO05	U
Incineration of Hazardous and Municipal Waste[d]																		
Small Incinerators[e]																		
Medical Incinerators f	0.13			0.13	0.13			0.13	0			0					I-TEQ	L
Subtotal Waste Incineration	**0.8**			**0.8**	**0.7**			**0.7**	**0.3**			**0.3**	**0.3**			**0.3**	TEQ-WHO98	**L**
Prescribed Burns	0.001			0.001	0.001			0.001	0.001			0.001	0.001			0.001	I-TEQ	U
WasteWaterTreatment Plants	0.01	0.04		0.05	0.01	0.04		0.05									I-TEQ	U
Cremation	0.0003			0.0003	0.0003			0.0003	0.0003			0.0003	0.0003			0.0003	I-TEQ	L
Commercial Products																		
PCP Use	0.02		0.08	0.10	0.02		0.07	0.09	0.01		0.07	0.08	0.01		0.07	0.08	I-TEQ	P
Subtotal Consumer Products	**0.02**		**0.08**	**0.10**	**0.02**		**0.07**	**0.07**	**0.01**		**0.07**	**0.08**	**0.01**		**0.07**	**0.08**		
Total[i]	**20.7**	**0.5**	**0.1**	**21.3**	**0.9**	**0.1**	**0.1**	**1.0**	**0.6**	**0.0**	**0.1**	**0.6**	**0.5**	**0.0**	**0.1**	**0.6**		

Blank indicates information not available.

Rating = data quality; H=high; M=moderate; L=low; P=preliminary; U=unknown.

[a] The LaMP (2000) value was 21.8 in g/y and was replaced with 19.4g I-TEQ as reported in (1).

[b] No residential, commercial or industrial coal burning is known to take place on the Canadian side of the LSB other than at the Thunder Bay Generating Station.

[c] Emissions from wood burning in industrial facilities is assumed to be reported under NPRI.

[d] No incineration of municipal solid waste, hazardous waste, or sewage sludge has taken place on the Canadian side of the LSB over the period of 1990 to 2005.

[e] Does not take place on the Canadian side of the LSB.

f No medical waste incinerators currently operate on the Canadian side of the LSB due to Ontario Regulation 323/02 requiring that all hospital incinerators be shut down by the end of 2003. Four operated in 1990: two were shut down in 1994 and the other two were shut down in 2003.

[g] Data is from 2008 NPRI database.

References (1) Environment Canada (2001)

Table C.3.2b. Summary of Dioxins and Furans Disposed/Recycled, Lake Superior Basin

Source Category	1990 Disposed Recovered (g TEQ/y)		2000 Disposed Recovered (g TEQ/y)			2005 Disposed Recovered (g TEQ/y)			2010 Disposed Recovered (g TEQ/y)			Units	Rating
	Disposal	Recovery Transfer	Disposal		Recovery Transfer	Disposal		Recovery Transfer	Disposal		Recovery Transfer		
			On-site	Off-site		On-site	Off-site		On-site	Off-site			
Industrial													
Pulp and Paper	13.18		0	0	0	0	0	0				I-TEQ	U
Mining								0				I-TEQ	
Asphalt Manufacturing													P
Wood Preserving	0.15		0	0.037	0							I-TEQ	U
Iron Sintering												I-TEQ	U
Subtotal Industrial	**13.33**		**0**	**0.037**	**0**	**0.000**	**0.000**	**0.000**					**U**
Fuel Combustion													
Coal													
Utitlities	0.002	0.003		0.002	0.003	0		0	0			I-TEQ	U
Residential/Commercial/Industrial[b]													
Wood													
Residential Wood Combustion												I-TEQ	L
Commercial/Industrial[c]													
Petroleum													
Motor Vehicle Fuel (Diesel)												TEQ-WHO98	L
Motor Vehicle Fuel (Gasoline)												TEQ-WHO98	L
Fuel Oil												TEQ-WHO98	L
Subtotal Petroleum												TEQ-WHO98	L
Natural Gas												g/y	U
Subtotal Fuel Combustion	**0.0**	**0.003**			**0.003**	**0**		**0.000**					**U**
Waste Incineration													
Rural On-site Residential Waste Combustion												TEQ-WHO98	L
Landfill Fires												TEQ-WHO98	U
Incineration of Hazardous and													

Source Category	1990 Disposed Recovered (g TEQ/y)		2000 Disposed Recovered (g TEQ/y)			2005 Disposed Recovered (g TEQ/y)			2010 Disposed Recovered (g TEQ/y)			Units	Rating
	Disposal	Recovery Transfer	Disposal		Recovery Transfer	Disposal		Recovery Transfer	Disposal		Recovery Transfer		
			On-site	Off-site		On-site	Off-site		On-site	Off-site			
Industrial													
Municipal Waste[d]													
Small Incinerators[e]													
Medical Incinerators f	94			94			0					I-TEQ	L
Subtotal Waste Incineration	**94**			**94**			**0**					I-TEQ	**L**
Waste Water Treatment Plants							**0.01**			**0.01**		I-TEQ	**U**
Cremation												I-TEQ	**L**
Commercial Products													
PCP Use												I-TEQ	P
Subtotal Consumer Products	**0.00**		**0.00**			**0.00**	`		**0.00**	**0.00**			
Sediments[g]													
Soil[h]	31.38		6			6			6				
Total[i]	**107**	**0.003**	**0**	**94**	**0.003**	**0**	**0.01**	**0.000**	**0.000**	**0.010**			

Blank indicates information not available. Rating = data quality; H=high; M=moderate; L=low; P=preliminary; U=unknown.

[b] No residential, commercial or industrial coal burning is known to take place on the Canadian side of the LSB other than at the Thunder Bay Generating Station.

[c] Emissions from wood burning in industrial facilities is assumed to be reported under NPRI.

[d] No incineration of municipal solid waste, hazardous waste, or sewage sludge has taken place on the Canadian side of the LSB over the period of 1990 to 2005.

[e] Does not take place on the Canadian side of the LSB.

[f] No medical waste incinerators currently operate on the Canadian side of the LSB due to Ontario Regulation 323/02 requiring that all hospital incinerators be shut down by the end of 2003. Four operated in 1990: two were shut down in 1994 and the other two were shut down in 2003.

[g] There is insufficient information to calculate quantity of dioxins and furans in LSB sediments.

[h] Values are in g/y. TEQ equivalent is not available. Value is not included in total inventory numbers.

[i] Total excludes dioxins and furans in soil and sediments and in-use or stored PCBs.

[j] Data is from 2008 NPRI database.

References

(1) Environment Canada (2001)

HCB

There are limited sources and data available to calculate total emissions for HCB in the Lake Superior Basin.

In the 2005 LSB Emissions Inventory Report, the Thunder Bay Generating Station was identified as the largest HCB source in the LSB based on NPRI data. However, representatives of the facility have indicated that previous HCB estimates were erroneously calculated by the facility and that the facility is not, and has never been, a source of HCB in the basin. NPRI data from 2003 and onwards have been revised to show zero emissions from this source.

HCB on-site emissions/releases have declined from 217 g/y in 1990 to 122 g/y in 2010—a reduction of 44% which is well below the 85% interim target reduction. The decrease is mostly associated with reductions in HCB from pulp and paper, likely due to the conversion of the bleaching process to chlorine dioxide in place of elemental chlorine.

Currently, the main sources of HCB are atmospheric emissions from on-site residential waste combustion (burn barrels) and leaching from PCP treated poles. There is considerable uncertainty associated with these estimates. Emissions from these sources are not expected to drop significantly over the next five years.

Table C.3.3. Summary of HCB emissions/releases in the LSB

HCB: Onsite Releases[1] (g/y)						
Source	**Year**				**Reduction**	**Targeted Reductions (2010)**
	1990	**2000**	**2005**	**2010**		
Industrial	68	2.2	0.8	1.8	97%	85%[2]
Fuel Combustion	10.6	10.3	10.3	7.8	26%	85%[2]
Waste Incineration	117	147	94	96	18%	85%[2]
WWTP						85%[2]
Cremation						85%[2]
Consumer & Commercial Products (PCP)	22	18	17	16	27%	85%[2]
Total[2]	**217**	**178**	**122**	**122**	**44%**	**85%[2]**
Sediments[4]						85%[2]
Soil						85%[2]
HCB: Disposed/Recycled (kg/y)[3]						
Disposed	9	0.5			100%	85%[2]
Recycled						85%[2]

[1] Includes emissions/releases to the atmosphere, water, and land.
[2] Interim milestone, halfway between the 80% milestone for 2005 and 90% for 2015
[3] Includes HCB in disposed or recycled waste.
[4] Information not available.
WWTP = waste water treatment plant
Blank = data not available

Table C.3.3a. Summary of On-Site HCB Emissions/Releases, Lake Superior Basin

Source Category	1990 Emissions (g/y)				2000 Emissions (g/y)				2005 Emissions (g/y)				2010 Emissions (g/y)				Rating
	Atm	Water	Soil	Total	Atm	Water	Soil	Total	Atm	Water	Soil	Total	Atm	Water	Soil	Total	
Industrial																	
Pulp and Paper	65.1			65.1	2.16			2.16	0.82			0.82	1.8			1.8	U
Wood Preservation	2.8	0.006		2.8	0.004			0.004	0			0					U
Iron Sintering																	
Subtotal Industrial	**68**	**0.006**		**68**	**2.2**			**2.2**	**0.8**			**0.8**	**1.8**			**1.8**	**U**
Fuel Combustion																	
Coal																	
Utitlities [a]	0			0	0			0	0			0	0			0	U
Wood																	
Residential Wood Combustion	10.6			10.6	10.3			10.3	10.3			10.3	7.8			7.8	L
Subtotal Fuel Combustion	**10.6**			**10.6**	**10.3**			**10.3**	**10.3**			**10.3**	**7.8**			**7.8**	**U**
Waste Incineration																	
Rural On-site Garbage Combustion	108			108	145			145	94			94	96			96	L
Landfill Fires	9			9	2.4			2.4	0			0	0			0	L
Hazardous and Municipal Waste[b]																	
Small Incinerators[c]																	
Medical Incinerators[d]																	
Subtotal Waste Incineration	**117**			**117**	**147.4**			**147.4**	**94.0**			**94.0**	**96**			**96**	
Commercial Products																	
PCPUse	20.42		1.25	21.67	17.28		1.05	18.33	16.38		0.97	17.35	15.26		0.91	16.17	P
Subtotal Consumer Products	**20**		**1.3**	**22**	**17**		**1**	**18**	**16**		**1**	**17**	**15**		**0.9**	**16**	**P**
Total	**216**	**0**	**1.3**	**217**	**177**		**1**	**178**	**122**		**1**	**122**	**121**		**0.9**	**122**	

Blank indicates information not available. Rating = data quality; H=high; M=moderate; L=low; P=preliminary; U=unknown.

[a] 1990 values were not available; therefore, 2000 values were assumed for the year 1990.

[b] No incineration of municipal solid waste, hazardous waste, or sewage sludge has taken place on the Canadian side of the LSB over the period of 1990 to 2005.

[c] Does not take place on the Canadian side of the LSB.

[d] No medical waste incinerators currently operate on the Canadian side of the LSB due to Ontario Regulation 323/02 requiring that all hospital incinerators be shut down by the end of 2003. Four operated in 1990: two were shut down in 1994 and the other two were shut down in 2003.

Table C.3.3b. Summary of On-Site HCB Emissions/Releases, Lake Superior Basin

Source Category	1990 Disposed Released (g/y)		2000 Disposed Released (g/y)			2005 Disposed Released (g/y)			2010 Disposed Released (g/y)			Rating
	Land	Recovery Transfer	Land Disposal		Recovery Transfer	Land		Recovery Transfer	Land		Recovery Transfer	
			On-site	Off-site		On-site	Off-site		On-site	Off-site		
Industrial												
PulpandPaper			0	0	0	0	0	0	0	0	0	U
Wood Preservation	9		0	0.537	0	0	0	0	0	0	0	U
Iron Sintering												
Subtotal Industrial	**9**		**0**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**U**
Fuel Combustion												
Coal												
Utitlities												U
Wood												
Residential Wood Combustion												L
Subtotal Fuel Combustion						**0.0**		**0.0**	**0.0**		**0.0**	**U**
Waste Incineration												
Rural On-site Garbage Combustion												L
Landfill Fires												L
Hazardous and Municipal Waste[b]												
Small Incinerators[c]												
Medical Incinerators[d]												
Subtotal Waste Incineration												
Commercial Products												
PCP Use												P
Subtotal Consumer Products												**P**
Total	**9**		**0**	**0.5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Blank indicates information not available. Rating = data quality; H=high; M=moderate; L=low; P=preliminary; U=unknown.

[b] No incineration of municipal solid waste, hazardous waste, or sewage sludge has taken place on the Canadian side of the LSB over the period of 1990 to 2005.

[c] Does not take place on the Canadian side of the LSB.

[d] No medical waste incinerators currently operate on the Canadian side of the LSB due to Ontario Regulation 323/02 requiring that all hospital incinerators be shut down by the end of 2003. Four operated in 1990: two were shut down in 1994 and the other two were shut down in 2003.

PCBs

There are 11 active provincial PCB storage sites in the LSB reported by the Ontario Ministry of the Environment.

According to the provincial data obtained for the years 1990, 1995, 1997, 2006, and 2010, High Level liquid PCBs declined by 84% from peak levels in 1995. Low Level liquid PCBs declined by 90% from peak levels. High Level solid PCB waste dropped by 99% and Low Level solid PCB waste by 93% from peak levels. Miscellaneous PCBs declined by 62%.

There is a discrepancy between the information obtained from the Ontario Ministry of the Environment (OMOE) and Environment Canada on the number of PCB storage sites and the quantities of PCBs stored. The OMOE data indicates there are 11 sites in the LSB containing approximately 32,000 L of liquid PCBs, whereas the Environment Canada reports that there are four sites containing approximately 1,300 L of liquid PCBs.

Table C.4.4. Summary of PCB Waste in Storage at Provincially Monitored Sites in LSB 1990-2010

Type	Quantity of PCB Waste in Storage						Targeted Reduction (%)[1]
Year	1990	1995	1997	2006	2010	Reduction (%)	
HL Liquid (L)	85112	163217	128001	16389	25814	84	95
LL Liquid (L)	61268	41528	20336	11144	6066	90	95
HL Solid (kg)	146563	114673	69296	5015	1759	99	95
LL Solid (kg)	135674	144310	128576	1404	9787	93	95
Misc.[2]	2576	1158	977	975	No data	62	95

HL = High Level (> 500 ppm).
LL = Low Level (<500 ppm).
[1] Reduction targets are 33% in 2000, 60% in 2005, 95% in 2010, 98% in 2015 (extrapolated), and 100% in 2020.
[2] Miscellaneous includes PCB contaminated pallets, transformer carcasses, empty drums, and unidentified waste.

It is expected that PCB waste will continue to drop in response to the requirements of the 2008 PCB regulations (Canadian PCB Regulations, SOR/2008-273, September 5, 2008) which call for:

- The phase-out of all High Level PCBs (over 500 ppm) and PCBs over 50 ppm in sensitive areas that are currently in use by December 31, 2009.
- The phase out of all equipment between 50 and 500 ppm that are not in sensitive areas and the phase out of pole top (contaminated mineral oil) transformers and PCB light ballasts by December 31, 2025.

- The destruction of all PCBs that were stored on September 5th, 2008 no later than December 31, 2011.
- The phase out of all PCB storage sites at sensitive locations by September 5th, 2009.

Waste Pesticides

The Thunder Bay landfill and hazardous waste carriers operating in the LSB were contacted regarding quantities of pesticides, including those targeted for zero discharge in the LSB. It was learned that waste pesticides are amalgamated into drums under the Ontario Ministry of the Environment waste classification number and there is no record for quantities of specific pesticides disposed. Quantities collected over the period of 2005 to 2009 amount to 1,539 kg, 4,329 L and 6.5, 205 L labpacks.

Emissions from Small and Medium Facilities

Emissions from larger industrial facilities meeting the NPRI reporting threshold requirements have been included in the emissions inventory. These are known as point sources. However, emissions from facilities that emit substances below reporting thresholds, such as small and medium enterprises (also known as area sources), are not reported or documented. This is a data gap.

Information on Ontario's Toxics Reduction Act, 2009 and the resulting Ontario's Toxics Reduction Strategy was investigated to determine if this initiative will serve to address the gap. It was learned that the same reporting requirements as those specified under NPRI are applicable. Therefore, the regulation does not address small- to medium-sized facilities. However, the regulation does require reporting facilities to track and quantify toxic substances (including dioxins and furans, mercury and HCB) that they use, create and/or release, to develop plans to reduce the use and creation of these substances, and to make summaries of their plans available to the public. Much of the information collected through the reporting requirements of the act and regulations will be made available to the public.

Recommendations to Address Data Gaps

To address data gaps in the dioxins and furans, mercury, and HCB inventories, the following recommendations apply:

Mercury

- When data become available, contact the Thunder Bay Generating Station to confirm the 7 kg mercury emission estimate for the year 2009.
- A systematic process for identifying and managing mercury-containing equipment found in industrial, commercial, and institutional facilities in the LSB is required. Reintroduce the Mercury Recovery Program that was initiated in 2005 to assess the

extent to which such mercury-containing equipment are currently being diverted from the landfill and to increase the diversion rate further. Information gathered from such a project will assist in providing a more accurate estimate of the fate of mercury in these products once they are discarded.

- Although the majority of mercury from consumer products has been accounted for in this inventory, estimate mercury releases from pharmaceuticals, reagents, and miscellaneous electronics such as pressure transducers, films, scanning electrodes and other products used in the LSB and include them in the inventory.
- Contact waste service providers and agencies that collect mercury containing consumer products in the LSB on a yearly basis to request total waste collected, including quantities of mercury-containing products, pesticides, and PCBs. This will ensure that a more accurate record of such wastes is documented. Alternatively, or in addition, consider contacting Stewardship Ontario to obtain further information on hazardous and special waste collected and removed yearly from the Basin by the existing municipalities of the LSB.
- Contact representatives responsible for the Federal Contaminated Sites Inventory and the Ontario Ministry of the Environment to obtain more specific information about contaminated sites in the LSB.
- Update the industrial emission data obtained from NPRI once the 2010 NPRI data are available. Values provided in the inventory are for the year 2009 as 2010 data were unavailable.

Dioxins and furans

- Update the industrial emission data obtained from NPRI once the 2010 NPRI data are available. Values provided in the inventory are for the year 2008 as 2009 and 2010 data were unavailable.
- Conduct additional outreach to further educate rural residents on the environmental impacts associated with the practice of waste burning.
- Gather information on the extent to which land clearing and brush burning operations exist in the LSB. If quantities of wood burned become available, existing forest fire emission factors could be used to estimate dioxin and furan emissions from this source.
- Outdoor wood furnaces is a recently identified potential source of dioxins and furans (and possibly HCB) emissions. A survey was conducted in the Province of Ontario to better understand the prevalence of such units in Ontario. Some of the municipalities in the LSB were included in the survey but the data has not yet been made public. Additional information on the extent to which this activity is practiced in the LSB and the content and quantity of the material burned is required.
- Obtain the results of additional sediment sampling that has been conducted recently in Black Bird Creek System when they become available.

Hexachlorobenzene

- Update the industrial emission data obtained from NPRI once the 2010 NPRI data are available. Values provided in the inventory (e.g., releases for pulp and paper facilities) are based on 2008 as 2009 and 2010 data were unavailable.

Waste Pesticides

- Contact the Thunder Bay Landfill, waste service providers operating in the LSB, and Ontario Ministry of Agriculture, Food and Rural Affairs on a yearly basis to request information on quantities of amalgamated pesticides waste collected. This will ensure that a more accurate record of such wastes is documented in the future.

Emissions from Small and Medium Facilities

- Emissions from larger industrial facilities (point sources) meeting the NPRI reporting threshold requirements have been included in the emissions inventory. A data gap exists for emissions from facilities that emit substances below NPRI reporting thresholds, such as small and medium enterprises (i.e., area sources). Consider developing a methodology to identify and estimate ZDDP substances emitted from these sources.

C.2 U.S. Chemical Source Inventory

Mercury

The following basic assumptions apply to the mercury inventory:

- The preferred method for estimating releases from sources in the basin is measured stack emissions from Lake Superior facilities. The second preferred method is to apply appropriate emission factors to facility-specific throughput data. Typically, these types of data are obtained from state or federal data sources. Data from the third preferred method are derived using emissions and discharges and applying the population ratio (i.e., the population of the basin divided by the population represented by the original load estimate). This method was most commonly used for product related categories.
- The National Emissions Inventory (NEI) and Toxics Release Inventory (TRI) is comparable across states.
- When data are not available for all time periods in the inventory, data from one of the other years is substituted since it is better to error on the exact amount than to leave a blank that counts as a zero when categories are totaled.
- Very small sources from the NEI have been removed from the inventory for ease of use. These 153 sources collectively represent <0.3 kg/yr of mercury. They were removed with the understanding that the goal of zero discharge and zero emission applies to them, but for purposes of understanding the most significant sources in the inventory, they are low priority.

The major revisions to the mercury inventory include the following:

- Coal emissions: The 1990 baseline for utilities has improved since it is based on facility specific estimates rather than proportioned by population. Also, industrial coal fired boilers were better represented in this version of the inventory.

- Fuel Transmission/Distribution: These numbers are high due to high NEI estimates from three gas transmission stations in Michigan. This source will be further examined.
- Backyard Burning: The Battelle method uses assumptions that 31% of the U.S. residents burn trash and that they burn the amount reported by Minnesota counties in the SCORE report as being burned or buried and the mercury content of trash is the same was what Ed Swain estimated for the Minnesota mercury inventory. This may be an overcount since it is higher than the number obtained by applying a population ratio to Ed Swain's Minnesota mercury inventory, which relies on an EPA flow model. For the Lake Superior inventory, the Battelle method will be used since it is more conservative, the assumptions are reasonable and basin-specific and there is a need to keep the assumptions the same for the dioxin inventory.
- Discharges (Table C.2.2): These estimates are considered placeholders since they overcount Other Municipal wastewater treatment plants and undercount other industrial discharges that are not Taconite, Pulp and Paper or Petroleum Refining. Other than the WLSSD numbers, all these estimates are considered placeholders until better estimates can be obtained.
- Sludge and Ash: This is a new category for the LaMP inventory and the estimates are considered to be placeholders. In the Sludge subcategory, other types of landspreading activities are undercounted. Also, the Other Municipal (i.e., other than WLSSD) estimate is considered a placeholder until better estimates can be obtained. For the Ash subcategory, ash that is landfilled is undercounted. However, landfilled ash also represents a doublecount with landfill emissions.
- Sediment: These estimates were obtained from state and federal agencies for three Areas of Concern and for the first time are reported in the Lake Superior LaMP. Note that the units are in kilograms, not kilograms per year.

Table C.2.1 Summary of U.S. Mercury Air Emissions For 1990, 2000, 2005, 2010 By Source/Use Category (kg/yr). DRAFT

Source/Use Category	Inventory Year:				Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010	
Industrial Processes - Mining					
Copper	529.7	0.0	0.0	0.0	Granke 1990-2005
Taconite	323.9	341.8	338.1	275.0	Swain 1990-2010; NEI 2002/2005 (1990-2010)
Industrial Processes - Mining (Total)	853.6	341.8	338.1	275.0	
Fuel Combustion					
Commercial/ Institutional/ Municipal - All Fuels	2.4	2.4	1.4	1.4	NEI 1999/2002 (1990, 2000); NEI 2005 (2005, 2010)
Misc. Industrial - Fossil Fuel	3.4	3.4	3.4	3.4	NEI 2008 (1990-2010)
Mobile Non-Road	0.4	0.4	0.4	0.4	NEI 2008 (1990-2010)
Mobile On-Road	0.0	0.0	0.0	0.0	Barr Engineering 1990-2010
Pulp and Paper - Biomass	0.4	0.4	0.5	0.5	NEI 1999, 2002, 2005 (1990-2010)
Pulp and Paper - Coal	8.7	8.7	10.1	10.2	Granke 1990-2005; NEI 2005 (2010)
Pulp and Paper - Petroleum	0.0	0.0	0.1	0.1	NEI 1999/2002 (1990, 2000); NEI 2005 (2005, 2010)
Pulp and Paper - Wood	3.4	3.4	2.3	2.1	Finke 2000-2010
Residential - All Fuels	19.3	21.2	15.5	4.6	Barr Engineering 1990-2010 - NEI Derived
Utilities - Coal	88.0	85.6	129.9	68.9	Swain 1990-2010; TRI 2000-2010; NEI 1990-2010; MI Utilities Report 1990-2000; Granke 1990; LaMP 2000 (1990); Baudhuin 1990-2005; Patterson 2010

Utilities - Coal/ Biomass	3.0	2.6	3.4	6.8	KaraKash 2000-2010
Utilities - Coal/ Biomass/ NG	3.9	3.4	3.2	4.8	Ganoe 1990-2010
Fuel Combustion (Total)	133.0	131.6	170.3	103.1	
Industrial Processes - Other Than Mining					
Forest Products	19.7	5.9	10.9	0.1	NEI 1999/2002/2005 (1990-2010); TRI 2000/2005 (2000-2005)
Fuel Transmission/Distribution	0.4	0.4	0.7	0.7	NEI 1999/2002 (1990-2010)
Misc. Industrial	2.9	2.9	2.9	2.5	NEI 1999/2002/2005 (1990-2010); Glatei 1999 (1990-2010); TRI 2008 (1990-2010)
Petroleum Refining	1.9	2.4	0.2	0.8	LaMP 2000 (1990); NEI 1999 (2000); NEI 2002 (2005); TRI 2009 (2010)
Industrial Processes - Other Than Mining (Total)	24.8	11.6	14.7	4.1	
Incineration					
Backyard Burning	25.9	3.7	2.4	2.1	Barr Engineering 1990-2010
Cremation	2.6	5.7	6.5	7.2	Barr Engineering 1990-2010
Landfill Fires	0.0	0.0	0.0	0.0	Barr Engineering 1990-2010
Sewage Sludge	21.3	5.0	0.0	0.0	Tuominen 1990-2010
Small Incinerators	8.5	1.4	0.2	0.2	Battelle (1990, 2000); NEI 2005 (2005, 2010)
Waste (Medical)	22.7	0.0	0.0	0.0	LaMP 2000 (1990-2005)
Incineration (Total)	81.1	15.8	9.0	9.5	
Waste Handling and Landfills					
Landfill Volatilization	0.3	0.1	0.1	0.1	Barr Engineering - derived from Swain (1990-2010)
Solid Waste Handling	36.1	8.0	7.1	5.8	Barr Engineering - derived from Swain (1990-2010)
Spills and Dumping	2.5	2.0	1.0	0.8	Barr Engineering - derived from Swain (1990-2010)
Waste Handling and Landfills (Total)	38.8	10.0	8.1	6.7	

Product Volatilization					
Dental Preparations	4.6	3.9	3.3	2.1	Barr Engineering - derived from Swain (1990-2010)
Fluorescent Lamp Breakage	12.2	1.3	0.6	0.6	Barr Engineering - derived from Swain (1990-2010)
Fungicides	66.6	0.0	0.0	0.0	Barr Engineering - derived from Swain (1990-2010)
General Lab Use	2.0	0.9	0.4	0.3	Barr Engineering - derived from Swain (1990-2010)
Paint & Misc. Dissipative Use	127.8	0.0	0.0	0.0	Barr Engineering - derived from Swain (1990-2010)
Mineral Products	0.6	0.6	0.5	0.5	Barr Engineering - derived from Swain (1990-2010)
Product Volatilization (Total)	213.8	6.7	4.8	3.5	

Table C.2.2 Summary of U.S. Mercury Water Discharges For 1990, 2000, 2005, 2010 By Source/Use Category (kg/yr).

Source/Use Category	Inventory Year:				Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010	
Water Discharges					
WLSSD	19.2	0.5	0.2	0.0	Tuominen 1990-2010
Forest Products	1.5	1.5	1.5	0.2	Barr Engineering 1990-2010; TRI 2005 (2005)
Mining - Taconite	0.3	0.3	0.3	0.3	Barr Engineering 1990-2010
Other WWTPs	1.6	1.6	1.6	1.6	Barr Engineering 1990-2010
Water Discharges (Total)	22.6	3.9	3.6	2.2	

Table C.2.3 Summary of U.S. Mercury Sludge/Ash Discharges For 1990, 2000, 2005, 2010 By Source/Use Category (kg/yr).

Source/Use Category	Inventory Year:				Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010	
Sludge/Ash Discharges					
Forest Products	1.1	1.1	1.8	0.5	Finke 2000-2010
WLSSD	0.0	0.9	2.6	1.7	Barr Engineering (derived from Tuominen) 1990-2010
Other WWTPs	7.9	8.1	8.0	8.0	Barr Engineering 1990-2010
Sludge/Ash Discharges (Total)	9.0	10.1	12.5	10.3	

Table C.2.4 Summary of U.S. Mercury in Contaminated Sediment For 1990, 2000, 2005, 2010 By Source/Use Category (kg/yr).

Source/Use Category	Inventory Year:				Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010	
Contaminated Sediment					
Deer Lake AOC*	na	na	na	2877.3	Taft
St. Louis River AOC	na	na	na	12536.4	MPCA
Torch Lake AOC**	na	na	na	0.0	Jones
Contaminated Sediment (Total)	na	na	na	15413.6	

* The total mercury mass in the Deer Lake Impoundment is estimated as approximately 6330 pounds (2877 kg) spread over 1048 acres within 3,087,000 cubic yards of sediment. This estimate is based upon 317 ponar and core samples taken in 1998 and 2000. This estimated mercury mass was reported in the May 2002 Focused Feasibility Study conducted by Earth Tech using the GLNPO and MDEQ data.

** The volume of contaminated sediments in Torch Lake was not obtainable to calculate the mass of mercury present.

Dioxin

The following basic assumptions apply to the dioxin inventory:

- The preferred method for estimating releases from sources in the basin is measured stack emissions from Lake Superior facilities. The second preferred method is to apply appropriate emission factors to facility-specific throughput data. Typically, these types of data are obtained from state or federal data sources. Data from the third preferred method are derived using emissions and discharges and applying the population ratio (i.e., the population of the basin divided by the population represented by the original load estimate). This method was used for the small incinerators and PCP use categories.
- Because of concerns about compatibility between states, data from the National Emissions Inventory (NEI) were not used when another method of estimating emissions was possible.
- The Toxics Release Inventory (TRI) was not used because of its unusual units (i.e., TM17 instead of I-TEQ).
- When data are not available for all three time periods in the inventory, data from one of the other years is substituted since it is better to error on the exact amount than to leave a blank that counts as a zero when categories are totaled.

The major revisions to the dioxin inventory include the following:

- Incineration: The inventory has been adjusted downward because the U.S. incineration numbers in LaMP 2000 reflected a different unit (total PCDD/PCDF), although incineration is still the single largest category in the revised inventory for 2005.
- Small Incinerators: The method for this category was revised based on the rate of illegal burning at Minnesota businesses that were inspected for hazardous waste compliance and the amount of cardboard generated but not recycled in Wisconsin. Since cardboard is only a portion of the trash burned at small incinerators, a safety factor of 5 was applied, resulting in a range of 0.2 to 1 g I-TEQ/yr.
- White Pine Copper Smelter: The dioxin emission factor used in LaMP 2000 was inappropriate since it applied to secondary copper smelting rather than primary copper smelting. The estimate for the smelter in LaMP 2000 has been dropped from this version of the inventory.
- Residential Wood Heating: This category was revised downwards from LaMP 2000. This was due to the use of state-specific information on use of wood for residential heating and an improved emission factor.
- Pentachlorophenol Use: This category was also revised downwards from LaMP 2006. This was due to using the new PCP use methodology in Benazon (2006) and applying the U.S.:Canada in-basin population ratios.
- Sediment: These estimates were obtained from state agencies for the St. Louis River Areas of Concern and for the first time are reported in the Lake Superior LaMP. Note that the units are in grams I-TEQ, not grams per year

Table C.2.5 Summary of U.S. Dioxin Air Emissions For 1990, 2000, 2005, 2010 By Source/Use Category (g TEQ/yr).

Source/Use Category	Inventory Year:				TEQ Scheme	Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010		
Incineration						
Backyard Burning	1.688	1.297	0.884	0.844	WHO-2005	Barr Engineering 1990-2010
Cremation	0.000	0.001	0.001	0.001	WHO-98	Barr Engineering 1990-2010
Landfill Fires	2.047	1.382	0.868	0.841	Unknown	Barr Engineering 1990-2010
Land Clearing Activities	9.408	9.408	9.408	9.408	WHO-2005	NEI 2008 (1990-2010)
Sewage Sludge	0.190	0.190	0.000	0.000	WHO-98	LaMP 2000 (1990-2000)
Small Incinerators	0.600	0.600	0.600	0.600	Unknown	LSRI Report - 1999 & 2005 Data (1990-2010)
Waste (Medical)	1.900	0.000	0.000	0.000	Unknown	Lohse-Hanson (1990-2010)
Incineration (Total)	**15.833**	**12.878**	**11.761**	**11.694**		
Fuel Combustion						
Mobile Non-Road	0.235	0.235	0.235	0.235	WHO-2005	NEI 2008 (1990-2010)
Mobile On-Road	0.937	0.312	0.337	0.360	WHO-98/ I-TEQ	Barr Engineering 1990-2010
Pulp and Paper - All Fuels	0.014	0.014	0.194	0.194	WHO-98	NEI 2005 (1990-2010); Finke (2000-2010)
Residential - All Fuels	0.135	0.091	0.107	0.097	WHO-2005	Barr Engineering 1990-2010 - NEI Derived
Utilities - Coal	0.183	0.163	0.133	0.047	WHO-98	NEI 2005 (1990-2010); Barr Engineering - TRI 2009 Derived (2000-2010)
Utilities - Coal/ Biomass	0.004	0.004	0.005	0.063	WHO-2005	Barr Engineering - Derived From KaraKash (2000-2010)
Utilities - Coal/ Biomass/ NG	0.006	0.005	0.005	0.058	WHO-2005	Barr Engineering - Derived From Ganoe

						(2000-2010)
Fuel Combustion (Total)	**1.515**	**0.824**	**1.016**	**1.054**		
Industrial Processes						
Forest Products	0.006	0.006	0.006	0.000	Unknown	Barr Engineering - TRI 2009 derived (1990-2005); Stone Container was closed in 2010.
Misc. Industrial	0.001	0.001	0.001	0.001	WHO-98	NEI 2005 (1990-2010)
Industrial Processes (Total)	**0.007**	**0.007**	**0.007**	**0.001**		
Product Volatilization						
Pentachlorophenol Use	0.035	0.039	0.020	0.019	Unknown	Lohse-Hanson - Derived From Benazon (1990-2010)
Product Volatilization (Total)	**0.035**	**0.039**	**0.020**	**0.019**		
Total Air Emissions	**17.390**	**13.748**	**12.804**	**12.769**		
Total Air Emissions (Not Including Land Clearing Activities)	**7.982**	**4.340**	**3.396**	**3.361**		

Table C.2.6 Summary of U.S. Dioxin Water Discharges For 1990, 2000, 2005, 2010 By Source/Use Category (g TEQ/yr).

Source/Use Category	Inventory Year:				TEQ Scheme	Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010		
Water Discharges						
WLSSD	0.000	0.000	0.005	0.000	Unknown	Tuominen (1990-2010)
Forest Products	0.003	0.002	0.002	0.002	Unknown	LaMP 2000 - 1990 data (1990-2010)
Total Water Discharges	**0.003**	**0.002**	**0.006**	**0.002**		

Table C.2.7 Summary of U.S. Dioxin Released to Soil and Stored in Sediment For 1990, 2000, 2005, 2010 By Source/Use Category (g TEQ/yr).

Source/Use Category	Inventory Year: 1990	2000	2005	2010	TEQ Scheme	Source of Data & Applicable Inventory Year(s)
Soil/Sediment Discharges						
Pentachlorophenol use	0.141	0.136	0.139	0.134	Unknown	Lohse-Hanson - Derived From Benazon (1990-2010)
Forest Products	0.019	0.019	0.012	0.002	Unknown	Finke 2000-2010; Barr Enigineering - TRI 2009 Derived
WLSSD	0.000	0.003	0.051	0.029	WHO-98	Barr Engineering (derived from Tuominen) 1990-2010
Other WWTPs	0.014	0.014	0.000	0.000	Unknown	LaMP 2000 - 1990 data (1990-2000); 2005 data (2005-2010)
Total Soil/Sediment Discharges	**0.174**	**0.172**	**0.203**	**0.165**		
Contaminated Sediment						
Crawford Creek Basin AOC*	na	na	na	0.003	Unknown	LaMP 2000
St. Louis River AOC*	na	na	na	989.010	Unknown	MPCA
Total Contaminated Sediment	**0.000**	**0.000**	**0.000**	**989.013**		

* grams rather than grams per year

Table C.2.8 Summary of U.S. Hexachlorobenzene Air Emissions For 1990, 2000, 2005, 2010 By Source/Use Category (g/yr).

Source/Use Category	Inventory Year:				Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010	
Industrial Processes - Mining					
Copper	1900.00	0.00	0.00	0.00	LaMP 2000 (1990 Data)
Industrial Processes - Mining (Total)	**1900.00**	**0.00**	**0.00**	**0.00**	
Fuel Combustion					
Mobile Non-Road	22.98	22.98	22.98	22.98	NEI 2008 (1990-2010)
Mobile On-Road	31.75	34.79	37.60	40.36	Barr Engineering 1990-2010
Fuel Combustion (Total)	**54.73**	**57.78**	**60.58**	**63.34**	
Industrial Processes - Other Than Mining					
Misc. Industrial	0.71	0.71	0.71	0.71	NEI 1999 (1990-2010)
Industrial Processes - Other Than Mining (Total)	**0.71**	**0.71**	**0.71**	**0.71**	
Incineration					
Backyard Burning	552.31	415.78	271.52	257.60	Barr Engineering 1990-2010
Sewage Sludge	4.32	4.32	0.00	0.00	Barr Engineering - Derived From Tuominen (1990-2010)
Small Incinerators	89.72	89.72	89.72	89.72	Batelle (1990-2005 Data)
Waste (Medical)	130.00	0.00	0.00	0.00	LaMP 2000 (1990 Data)
Incineration (Total)	**776.35**	**509.82**	**361.24**	**347.32**	

Product Volatilization					
Pentachlorophenol use	35.89	33.47	32.53	29.19	Lohse-Hanson - Derived From Benazon (1990-2010)
Product Volatilization (Total)	**35.89**	**33.47**	**32.53**	**29.19**	
Total Air Emissions	**2767.68**	**601.78**	**455.07**	**440.56**	

Table C.2.9 Summary of U.S. Hexachlorobenzene Released to Soil and Stored in Sediment For 1990, 2000, 2005, 2010 By Source/Use Category (g/yr).

Source/Use Category	Inventory Year:				Source of Data & Applicable Inventory Year(s)
	1990	2000	2005	2010	
Soil/Sediment Discharges					
Pentachlorophenol use	2.20	2.03	1.93	1.74	Lohse-Hanson - Derived From Benazon (1990-2010)
Total Soil/Sediment Discharges	**2.20**	**2.03**	**1.93**	**1.74**	

Appendix D

PCB Management in Lake Superior Jurisdictions

D.1 PCB Management in Ontario

PCBs are a group of stable, heat resistant chemical compounds used, prior to 1980, in power transformers, capacitors and other electrical equipment, and hydraulic fluids. In the early 1970s, scientific evidence showed that PCBs are toxic, persistent and bioaccumulative and represent a serious hazard to human health and the environment. Consequently, the use of PCBs was banned and regulations were put in place to control the handling, storage, import and export, packaging and labeling, treatment and destruction of waste PCBs. In addition, Canada entered into several agreements on the proper management of PCBs and on their end-of-use and destruction within specified time limits.

2007 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem

- PCBs are Tier 1 pollutants and, as such, are targeted for virtual elimination;
- Amend PCB regulations to include limits to PCBs storage and timelines for use of PCBs.

New Canada PCB Regulations

- Environment Canada proposed revisions to the existing Canadian *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. Final PCB regulations were published in September 2008 in Canada Gazette II. (An amendment was published in Canada Gazette II on March 31, 2010.)
- The purpose of these regulations is to minimize the risks posed by the use, storage and release of PCBs by accelerating the elimination of these substances. The regulations:
    - Set deadlines for ending the use and storage of PCBs consistent with Canada's obligations and international agreements;
    - Achieve accelerated destruction and PCB Phase-out;
    - Achieve mandatory reporting and labeling; and,
    - Consolidate the previous PCB Regulations and the Storage of PCB Material Regulations (now repealed) into one regulation (De, 2009).
- The requirements of the regulations include:
    - The phase-out of all High Level PCBs (over 500 ppm) and PCBs over 50 ppm in sensitive areas that are currently in use by December 31, 2009;
    - The phase out of all equipment between 50 and 500 ppm that are not in sensitive areas and the phase out of pole top (contaminated mineral oil) transformers and PCB light ballasts by December 31, 2025;

    - The destruction of all PCBs that were stored on September 5, 2008 no later than December 31, 2011;
    - Maximum of one year storage at a transfer site;
    - Maximum of two years storage at a destruction site;
    - The phase out of all PCB storage sites at sensitive locations (such as water treatment plants, schools, care facilities) by September 5, 2009;
    - Label on all PCB equipment containing 50 ppm or more PCBs, other than light ballasts;
    - Label on the exterior of PCB storage sites; and,
    - Annual reporting using on-line reporting system (De, 2009).[2]
- Since the PCB regulations have come into force approximately 15 million kg of solids and 4 million L of liquids, containing PCBs in varying concentrations have been sent to destruction facilities within Ontario.

Great Lakes Binational Toxics Strategy PCB Workgroup

The following information is summarized from the *Great Lakes Binational Toxics Strategy 2008-2009 Biennial Progress Report* (GLBTS, 2010). Progress has been made on both Canadian and United States sides of the border. Ontario has achieved substantial reductions in High Level PCBs (>10,000 ppm) in storage, as well as PCBs in service or in use in equipment (see Great Lakes PCB Inventory below). PCBs in storage and in-use will continue to drop in response to the requirements of the new Canadian PCB regulations (described above). The PCB Workgroup continues to be involved in reduction opportunities and outreach activities, and is working to meet Canada-Ontario Agreement goals. The PCB Workgroup plans to prioritize recommendations from the 2006 Management Assessment for PCBs. The 2008-2009 Biennial Progress Report outlines these recommendations:

- *"Continue existing Level 1 programs that:*
    - *Promote decommissioning of PCBs in use/ service (PCB equipment and small and large capacitors containing > 50 ppm PCBs).*
    - *Identify and control releases from storage and disposal facilities.*
- *Promote compliance activities for mandatory phase-out of PCBs in service as required by new Canadian PCB regulations.*
- *Continue data gathering and assessment to determine additional PCB sources and to plan for future resource commitments.*
- *Prioritize PCB inventory update and source emission studies.*
- *These recommendations have been reviewed and accepted by the PCB Workgroup. The workgroup plans to address the following recommendations:*
- *Review the literature annually for new information on PCB sources and new or updated data on PCB levels and trends in the Great Lakes.*

[2] For more information, see the full text of the PCB regulations here, http://www.canlii.org/en/ca/laws/regu/sor-2008-273/latest/sor-2008-273.html and an overview of the PCB regulations here, http://www.ec.gc.ca/bpc-pcb/default.asp?lang=en&n=E794BDF1-1 (accessed February 2011).

- *Prepare annual summary reports on the literature reviews but consider that, even though more information may be published, specific information on PCB releases from some sources are still poorly documented (e.g., contaminated sites, dispersive PCB sources).”*

Great Lakes PCB Inventory

The Canada-Ontario Agreement (COA) and the Great Lakes Binational Toxics Strategy (GLBTS) have called for the virtual elimination of High Level PCBs currently in use or storage. Consequently, over the last ten years, they have made significant progress in reducing the amount in storage.

- For stored PCB >500 ppm, Ontario has met the goal of 90% reduction. For in-use PCB > 500 ppm, Ontario has achieved approximately 89% reduction as compared to the 90% target. The baseline year is 1993 for Canada. The reductions are estimated based on the reports submitted under the federal PCB Regulations as of December 2009. The PCB equipment inventory can also be tracked under the PCB Regulations. However, the inventory is not easily accessed on a lake-by-lake basis.
- According to the GLBTS June 2008 Update (GLBTS, 2008) and GLBTS Biennial Report (GLBTS, 2009), a 90% reduction of High Level PCBs (Askarel >1%, 10,000 ppm) in storage has been achieved within the Ontario Great Lakes Basin (compared to 1993). In addition, a 70% reduction in High Level PCBs in service has been achieved since 1989. Also, since 1990, the number of PCB storage sites in the Great Lakes Basin has decreased from 1,529 to less than 400. GLBTS (2009) estimates that there are still approximately 2,771 tonnes of High Level PCBs in use and that efforts are being made to meet a 90% reduction goal for High Level PCBs in use. These efforts include:
    - Continue to decommission PCBs in use/service;
    - Promote compliance activities for mandatory phase-out of PCBs in service as required by the new Canadian PCB regulation; and
    - Continue data gathering and assessment to identify additional PCB sources.
- According to the provincial data for storage obtained for the years 1990, 1995, 1997, 2006, and 2010, High Level Liquid PCBs declined by 84% from peak levels in 1995. Low Level liquid PCBs declined by 90% from peak levels. High Level solid PCB waste dropped by 99% and Low Level solid PCB waste by 93% from peak levels. Miscellaneous PCBs declined by 62%.
- Environment Canada also provided an estimate of the quantity of High Level liquid in use in the Lake Superior Basin, totaling 93,528 L, and that 3,695 of Low Level solids and 144 L of Low Level liquids were sent for destruction.
- As noted, there have been substantial reductions in the quantities stored at provincial sites in the Lake Superior Basin over the last 20 years, ranging from 62% to 99% depending on the category of waste. High Level liquid PCBs declined by 84% from peak levels in 1995 and Low Level liquid PCBs

declined by 90%. High Level solid PCB waste dropped by 99% from peak levels % Low Level solid PCB waste decreased by 93% . Miscellaneous PCBs declined by 62%.

PCBs are both moving into storage sites from service and moving out of storage to destruction. Newer facilities (mostly private) and technologies are now available in Ontario for PCB decontamination and destruction, in addition to the Alberta Swan Hills incinerator. Beyond incineration, available technologies include, for example, decontamination and retrofitting of PCB transformers, solvent cleaning of contaminated metals and transformers, chemical destruction of high- and low-level PCB liquids, decontamination and desorption of PCB soils, ballast recycling, and other PCB equipment recycling and decontamination of PCB mineral oil (<500ppm).

The facilities in the Lake Superior Basin have plans in place to replace PCB in-service equipment with PCB-free equipment as it comes out of service.

D.2 U.S. PCB Regulations in the Lake Superior Basin

EPA

PCBs are regulated under the Toxic Substances Control Act (TSCA) of 1976, which was enacted by Congress to give EPA the ability to track the 75,000 industrial chemicals currently produced or imported into the United States. EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard. EPA can ban the manufacture and import of those chemicals that pose an unreasonable risk.

Concern over the toxicity and persistence (chemical stability) in the environment of Polychlorinated Biphenyls (PCBs) led Congress in 1976 to enact Section 6(e) of the Toxic Substances Control Act (TSCA) that included among other things, prohibitions on the manufacture, processing, and distribution in commerce of PCBs. Thus, TSCA legislated true "cradle to grave" (i.e., from manufacture to disposal) management of PCBs in the United States.

Also, EPA has mechanisms in place to track the thousands of new chemicals that industry develops each year with either unknown or dangerous characteristics. EPA then can control these chemicals as necessary to protect human health and the environment. TSCA supplements other Federal statutes, including the Clean Air Act and the Toxic Release Inventory under EPCRA.

http://www.epa.gov/region5/defs/html/tsca.htm

Michigan

Polychlorinated biphenyls (PCBs) are mixtures of synthetic organic chemicals which, due to their toxicity and persistence in the environment, are regulated under Federal law and Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as

amended (NREPA). PCBs are primarily regulated by the United States Environmental Protection Agency (EPA) under the Toxic Substances Control Act (TSCA). TSCA regulates the manufacturing, processing, distribution in commerce, marking, storage and disposal of PCBs. Provisions of NREPA related to management of PCBs were largely preempted by TSCA. Although TSCA is a non-delegable authority, Michigan operated a PCB program under a TSCA Cooperative Agreement until the late 1980's. The program conducted compliance inspections of sites that were using or had historically used PCBs. Michigan no longer has a separate PCB program and instead integrates PCB clean-up and regulation into other Michigan Department of Environmental Quality (MDEQ) programs where applicable and appropriate, as noted below.

Water Resources Division

The MDEQ, Water Resources Division (WRD) has established procedures for calculating water quality values to protect human health and wildlife for PCBs under the Administrative Rules of Part 31, Water Resources Protection, of NREPA (Part 4, Toxic Substances, R 323.1057). Michigan has also established a process for calculating effluent limits for PCBs under Part 31 (Part 8, Water Quality-based Effluent Limit Development, R 323.1209). The Part 5 Administrative Rules to Part 31 regulate the storage and spillage of oils and polluting materials, including PCBs, and set forth requirements for storage and spill reporting.

According to Section 303(d) of the federal Clean Water Act and the EPA's Water Quality Planning and Management Regulations (Title 40 of the Code of Federal Regulations, Part 130), states are required to develop a Total Maximum Daily Load (TMDL) for water bodies that are not meeting water quality standards. The TMDL process establishes the allowable loadings of a pollutant to a water body based on the relationship between pollutant sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reduction necessary from point and/or nonpoint sources to maintain and/or restore the quality of their water resources. In 2008, the MDEQ developed a TMDL for PCBs for a watershed in the Lake Michigan basin (Pere Marquette River). In 2010, Michigan began planning for the development of a statewide TMDL for PCBs which would address inland lakes, rivers and streams impaired by atmospheric deposition and diffuse sources of PCBs. This statewide PCB TMDL is scheduled to be completed in 2012.

The MDEQ, WRD also administers the groundwater discharge permit program in Michigan under Part 22, Groundwater Quality Administrative Rules, of Part 31 of NREPA. This program requires facilities proposing to discharge waste or wastewater to the ground or groundwater to obtain a discharge permit under the Part 22 Rules. A permittee may not discharge any substance to the waters of the state (including groundwaters of the state) that may become injurious to the protected uses of those waters. There are a specific set of discharge standards that must be met in effluent and/or groundwater. The groundwater discharge standards are developed based on the human drinking water exposure pathway. The Part 22 groundwater discharge standard for PCBs is 0.5 parts per billion, and represents the Federal Maximum Contaminant Limit (MCL)

adopted as the Michigan drinking water standard pursuant to Section 5 of 1976 PA 399, MCL 325.1005.

Air Quality Division

The MDEQ, Air Quality Division regulates sources that emit PCBs into the atmosphere under the Air Toxics Rules for new or modified sources. The source must apply the best available control technology for toxics (T-BACT) for PCBs. After the application of T-BACT, the emissions of PCBs cannot result in a maximum ambient concentration that exceeds the applicable health based screening level (Part 55, Air Pollution Control, of NREPA, R 336.1225). For certain sources such as hazardous waste incinerators or municipal waste combustors, a multi-pathway risk assessment may also be required.

Resource Management Division

The MDEQ, Resource Management Division requires management and disposal of PCBs in accordance with Part 111, Hazardous Waste Management, and Part 115, Solid Waste Management, of NREPA. Part 111 Corrective Action requirements for PCBs are dependant upon the applicability of TSCA. When applicable, all TSCA requirements must be met in coordination with EPA to fulfill corrective action obligations. If a PCB-containing item is not regulated by TSCA and is being discarded, then that item is subject to waste characterization to determine whether or not it is a hazardous waste and subject to regulation under Part 111.

PCB containing items, other than liquids, not regulated by TSCA or Part 111 of NREPA, are solid wastes under Part 115. TSCA exempt wastes must be disposed of at a type II landfill licensed under Part 115 or equivalent facility in another state. Part 115 bans disposal of used oil in municipal incinerators. Therefore, oil containing PCBs found in, or removed from, electrical equipment is prohibited from disposal in this manner in Michigan. Generators of PCB waste exempt from TSCA must confirm that the type II landfill accepts PCB waste prior to disposal, as some landfills may prohibit receipt of PCB's regardless of PCB concentrations.

In addition, liquids containing PCBs in any concentration are regulated under Part 121, Liquid Industrial Waste, of NREPA, and must be manifested during transportation. A generator must use the manifest form required by the state in which the storage or disposal facility is located. PCB waste in concentrations of 100 parts per million or greater is regulated pursuant to Part 147, PCB Compounds, of NREPA. Michigan Administrative Code, R 299.3316, requires that a manifest accompany all shipments in Michigan of PCB or PCB-contaminated materials intended for disposal.

Remediation Division

The MDEQ, Remediation Division administers programs that facilitate the cleanup and redevelopment of contaminated sites statewide, providing for a cleaner, healthier and more productive environment. Clean-up programs continue to place a high priority on

sites were PCBs are a substance of concern. Response activity for the remediation of PCBs in Michigan is conducted under Part 201, Environmental Remediation, of NREPA. Cleanup standards and processes under Part 201 are also applied for conducting remediation under Michigan's Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program. Part 201 provides cleanup standards for PCBs based on protection of human health, welfare, and the environment. Standards are available for protection of various media (soil, groundwater, surface water) and for multiple exposure pathways. Part 201 is partially preempted by TSCA in that Part 201 does not allow for response activity in addition to that which is subject to and complies with TSCA when addressing sites of PCB contamination (Part 201, Section 324.20120a(12)). Therefore, Part 201 cleanup requirements (including applicable cleanup standards) for PCBs are dependant upon the applicability of TSCA.

Minnesota

The use, storage and disposal of equipment containing PCBs are regulated by both state and federal rules, depending upon the concentration of PCBs present. The U.S. Environmental Protection Agency (EPA), under the Toxic Substances Control Act (TSCA), regulates the use, storage and disposal of PCBs with concentrations of 50 parts per million or more (≥50 ppm). The Minnesota Pollution Control Agency (MPCA) regulates the disposal of PCBs with concentrations of ≥50 ppm when they become wastes under the hazardous waste requirements. Wastes with concentrations of PCBs less than 50 ppm are not regulated by the state or federal government as PCB waste, however, regulations do apply to the burning of used oils.

In 2004, Minnesota passed a law (Minn. Stat. §116.07, subd. 26) that changed the way PCB waste is regulated in the state. The law eliminated regulatory redundancies and provided a financial incentive for companies to voluntarily eliminate in-service electric equipment containing PCBs. Under the 2004 law, generators of PCB wastes no longer are subject to certain state rules; however, they are still subject to state hazardous waste requirements for licensing, fees, and proper disposal. Changes in Minnesota law do not alter the requirements or applicability of federal PCB regulations.

In Minnesota, generators of PCB waste must obtain an annual Hazardous Waste License. Licenses and associated annual fees are based on the quantity of hazardous waste generated at a facility. Generators that dispose of or retrofill oil-filled electrical equipment before the end of its service life are now eligible for a waiver to exempt the PCB hazardous wastes generated as a result of such disposal or retrofilling from counting toward the generator's annual fees. These generators may apply to the MPCA to enter into a PCB Phaseout Agreement. The Phase-out Agreement must be approved by the MPCA before the removal work and the generator must annually document its compliance with the Phase-out Agreement.

[Remember: the 2004 Minnesota law did not change the application or requirements of the federal PCB requirements. Federal requirements are discussed in fact sheets available on the MPCA Web site http://www.pca.state.mn.us/waste/pubs/business.html.

Generators may also contact the EPA's TSCA Hotline at 202-554-1404 with questions on federal requirements.]

Wisconsin

PCBs in concentrations equal to or greater than 50 ppm are regulated by the federal Toxic Substances Control Act (TSCA). PCB contaminated materials are regulated in Wisconsin under ch. NR 157, Wis. Adm. Code. Wisconsin has water quality standards to protect human health and wildlife for PCBs and guidelines for setting associated effluent limits. There are groundwater standards for PCBs in Wisconsin laws for Groundwater Protection and in Safe Drinking Water law. PCBs are regulated as hazardous air pollutants under Wisconsin's Air Management Program. Wisconsin's Pre-Demolition Environmental Checklist includes information on PCBs.

Appendix E

Combined COA/GLI List of P,B,T Chemicals of Concern **Chemical**	**Source**[1]
Aldrin/Dieldrin	COA Tier 1
Alpha-BHC	GLI
Beta and delta-BHC	GLI
Gamma-BHC	GLI
BHCs (hexachlorocyclohexanes)	COA Tier 2
Cadmium	COA Tier 2
Chlordane	COA Tier 1; GLI
2-chloroaniline (4,4-methylenbis)	COA Tier 2
DDT	COA Tier 1; GLI
DDT and metabolites	GLI
1,4-dichlorobenzene	COA Tier 2
3,3-dichlorobenzidine	COA Tier 2
Hexachlorobenzene	COA Tier 1; GLI
Hexachlorobutadiene (hexachloro-1,3-butadiene)	GLI
Alkyl Lead	COA Tier 1
Mercury	COA Tier 1; GLI
Mirex/photo-mirex	Mirex COA Tier 1, GLI; Photomirex GLI
Octachlorostyrene (OCS)	COA Tier 1; GLI
PAHs (anthracene, benz(a)anthracene, benzo(b)fluoranthene, clinitropyrene, benzo(a)pyrene, perylene, benzo(g,h,i), perylene, phenanthrene)	COA Tier 2
PCBs	COA Tier 1; GLI
PCDDs (polychlorinated dioxins)	COA Tier 1
PCDFs (polychlorinated furans)	COA Tier 1
2,3,7,8-TCDD	GLI
Pentachlorobenzene	GLI
Pentachlorophenol	COA Tier 2
1,2,3,4-tetrachlorobenzene	GLI
1,2,4,5-tetrachlorobenzene	GLI
Toxaphene	COA Tier 1; GLI
Tributyl tin	GLI
Chlorinated paraffins	Schedule I
Deca (decabromodiphenyl ether)	Schedule I; Emerging (IJC, COA)
HBCD (hexabromocyclododecane)	Emerging (IJC)
PBDEs (polybrominated diphenyl ethers)	Schedule I; Emerging (IJC, COA)
Personal care product additives, including polycyclic musks, nitro musks, and triclosan	Emerging (IJC)
PFCAs (Perfluorocarboxylates), C6, C10	Emerging (IJC, COA)
PFCAs (Perfluorocarboxylates), C9-C15	Emerging (IJC, COA)
PFOA (Perfluorooctanoic acid)	Emerging (IJC, COA)
PFOS (perfluoroalkyl sulfonates)	Schedule I; Emerging (IJC, COA)
Pharmaceuticals	Emerging (IJC, COA)

[1] COA = Canada Ontario Agreement Respecting the Great Lakes System; GLI = Great Lakes Water Quality Initiative bioaccumulative chemical of concern; Schedule 1 = emerging chemical proposed for

addition to CEPA 1999 Schedule 1 list of Toxic substances after EC/HC screening assessment; Emerging = recognized by various groups such as COA (COA 2002-2003 Biennial Progress Report) or the IJC (Priorities 2003-2005: Priorities and Progress under the Great Lakes Water Quality Agreement report to the IJC) as a substance of emerging concern in the Great Lakes.

[2] Heptachlor was on the draft list of GLI BCCs, but was dropped because of experimental methods used to determine the bioaccumulation factor (BAF). It is still a priority for Lake Superior, however, because potential exists for a high BAF and because it exceeded the lakewide yardstick for water quality.

Appendix F

Contaminants Levels and Trends

(Note: Appendix F is contained in a separate file due to its size.)

Appendix F

Contaminants Levels and Trends

CURRENT LEVELS AND TEMPORAL TRENDS OF LEGACY CONTAMINANTS AND EMERGING CHEMICALS OF CONCERN IN THE LAKE SUPERIOR ECOSYSTEM

Sara Moses
Great Lakes Indian Fish and Wildlife Commission

Matt Hudson
Bad River Watershed Association

June 2, 2011

International Association of Great Lakes Research
Duluth, MN

Acknowledgements

- Lake Superior Workgroup and Chemical Committee
  - Especially Carri Lohse-Hanson
- Unpublished data provided by:
  - Michelle Craddock & Todd Nettesheim (EPA/IADN)
  - Elizabeth Murphy (EPA/GLFMP)
  - Chip Wesloh & Tania Havelka (CWS/EC)

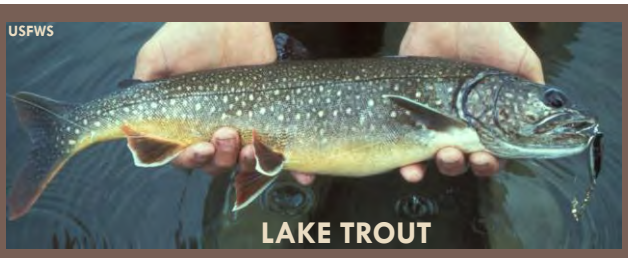
Lake Superior Binational Program

Zero Discharge Demonstration Project

Devoted to the goal of achieving zero discharge or emission of certain designated persistent bioaccumulative toxic substances, which may degrade the ecosystem of the Lake Superior Basin.

Lake Superior Lakewide Management Plan: 1990-2005
Critical Chemical Reduction Milestones

Long-Term Monitoring

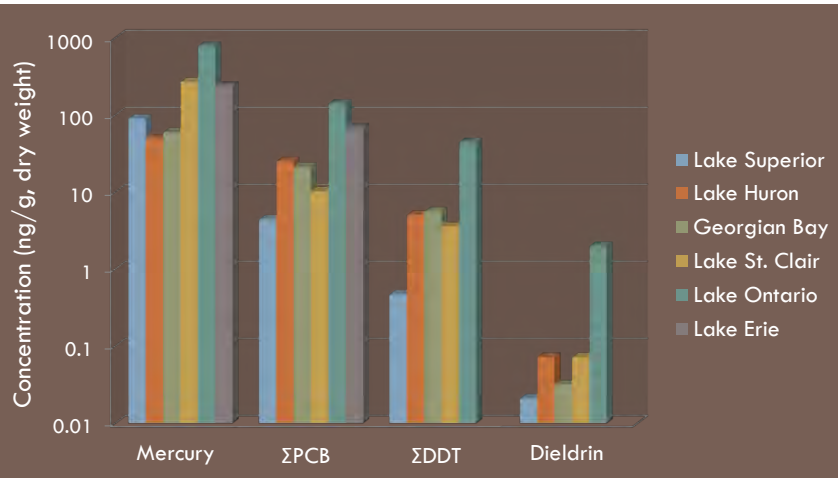


Overview

- Lake Superior is often the "cleanest" of the Great Lakes …
- …But not always.
- Certain chemicals continue to exceed levels of concern.
- Many legacy contaminants are declining in response to regulatory actions…
- …But there are emerging contaminants of concern on the rise.

Lake Superior is often the "cleanest" of the Great Lakes

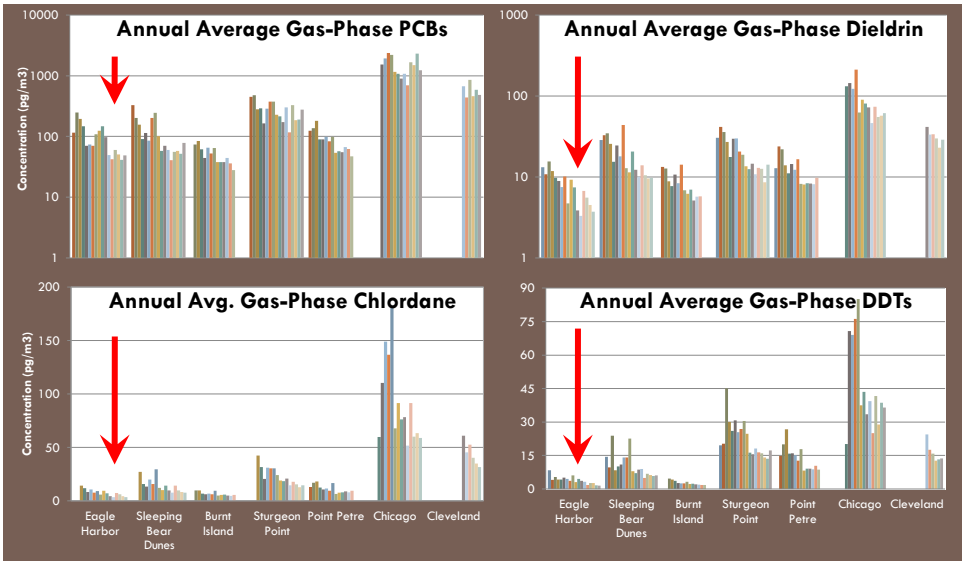
Surficial Sediment 75th Percentile Concentrations (ng/g) in the Great Lakes



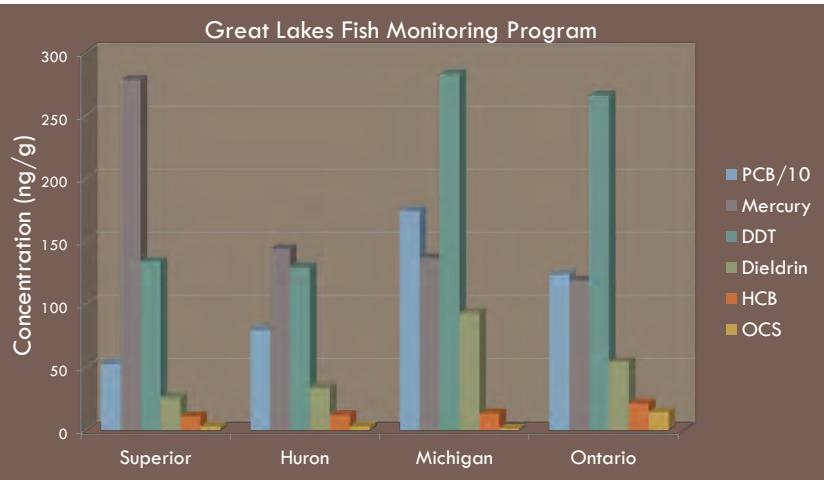
Data from: Gewurtz *et al.* 2008. Spatial distribution of legacy contaminants in sediments of Lakes Huron and Superior. *Journal of Great Lakes Research*. 34:153-168.

Integrated Atmospheric Deposition Network (IADN): 1991-2008

EPA: Nettesheim & Craddock



Legacy Contaminant Concentrations in Lake Trout from the Great Lakes, 1999-2000



Data from: Carlson and Swackhamer. 2006. Results of the U.S. Great Lakes Fish Monitoring Program and effects of lake processes on bioaccumulative contaminant concentrations. *Journal of Great Lakes Research*. 32:370-85.

- **Colder** temperatures
- **Larger** lake volume
- **Local** pollution sources

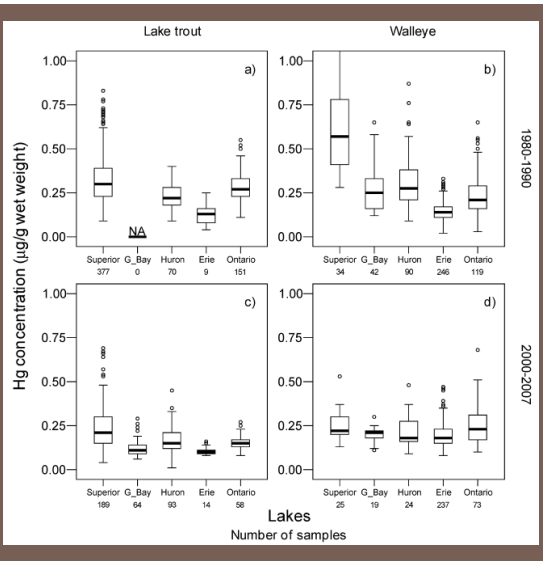
Lake Superior is <u>NOT ALWAYS</u> the "cleanest" of the Great Lakes

Contaminants (ng/g) in Bald Eagle Plasma at Three Lake Superior Sites Relative to the Great Lakes Average

	Site b-26	Site b-34	Site b-46	Great Lakes Average
ΣPBDE	4.4	29.3	0.35	5.7 ± 1.9
ΣPCB	ND	254	ND	73.8 ± 23.3
ΣDDT	ND	73.1	ND	24.3 ± 5.9
Chlordane	ND	9.85	ND	6.8 ± 1.1
Dieldrin	ND	7.27	ND	4.4 ± 0.6

Data from: Venier *et al.* 2010. Flame retardants and organochlorine pollutants in bald eagle plasma from the Great Lakes region. *Chemosphere*. 80:1234-1240.

Mercury in Lake Trout and Walleye from the Great Lakes, 1980-2007



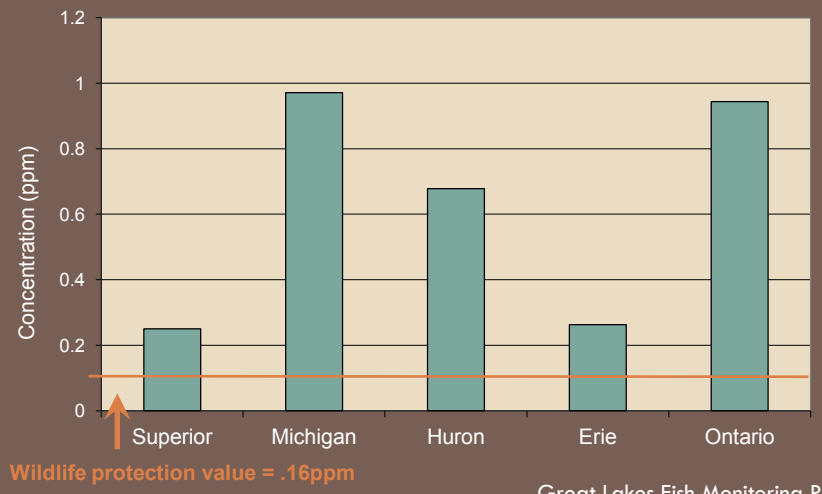
Bhavsar *et al.* 2010. Changes in mercury levels in Great Lakes fish between 1970s and 2007. *Environmental Science and Technology*. 44:3273-3279.

Certain chemicals continue to exceed levels of concern

Concentrations of Select Critical Pollutants in Lake Superior Open Water Compared to Jurisdictional Water Quality Yardsticks

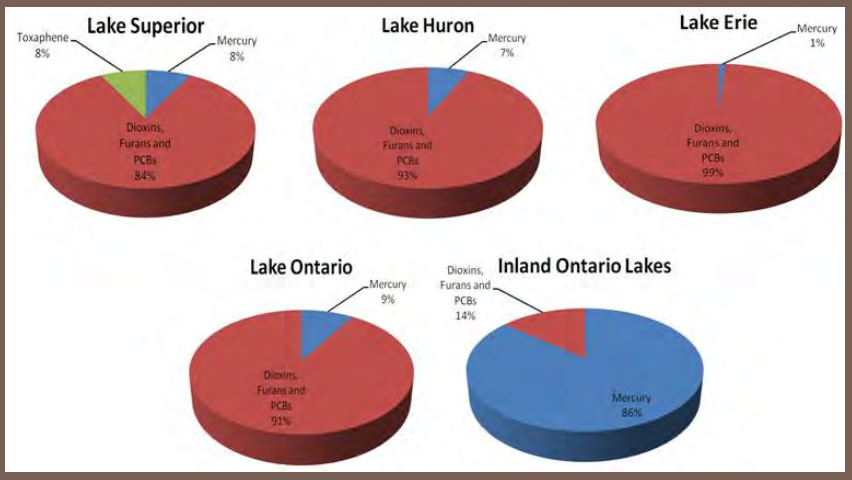
	Jurisdictional Water Quality Yardstick (ng/L)				Open Lake Concentration (ng/L)
	Minnesota	Michigan	Wisconsin	Ontario	
PCB	0.0045	0.026	0.003	1.0	**0.0705**
HCB	0.074	0.45	0.22	6.5	0.013
Dieldrin	0.0012	0.0065	0.0027	1.0	**0.112**
Chlordane	0.04	0.25	0.12	60	0.013
DDT	0.011	0.011	0.011	3.0	0.005
Mercury	1.3	1.3	1.3	200	0.41, 0.21
Toxaphene	0.011	0.068	0.034	8.0	**1.0**

2005 PCB Levels in Whole Lake Trout (except Walleye in Lake Erie) Relative to the Established EPA Wildlife Protection Threshold

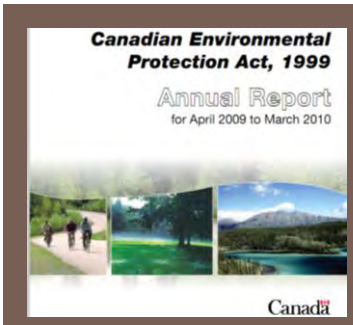


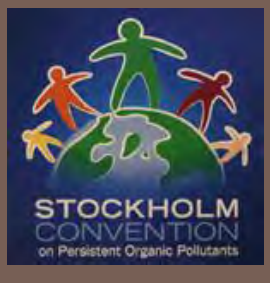
Great Lakes Fish Monitoring Program
EPA: Elizabeth Murphy

Percentage of Fish Advisories Based on Specific Critical Contaminants in the Great Lakes and Inland Lakes of Ontario



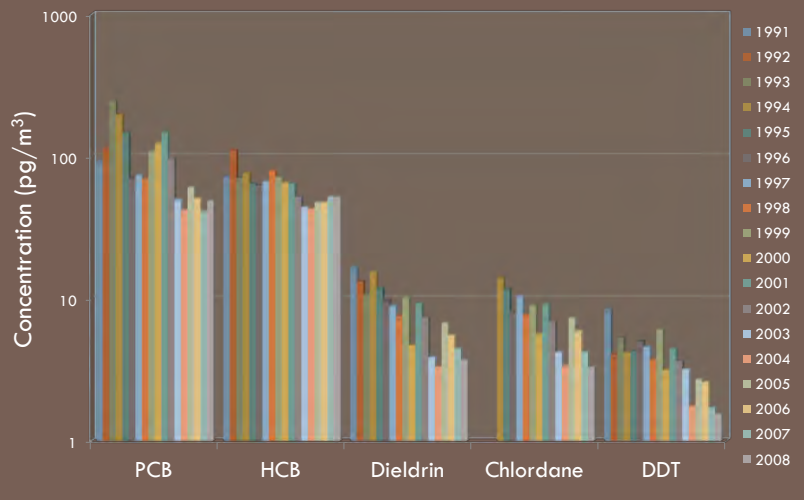
Data from: Ontario Ministry of the Environment. 2011. Guide to Eating Ontario Sportfish:2011-2012. Toronto, Ontario.





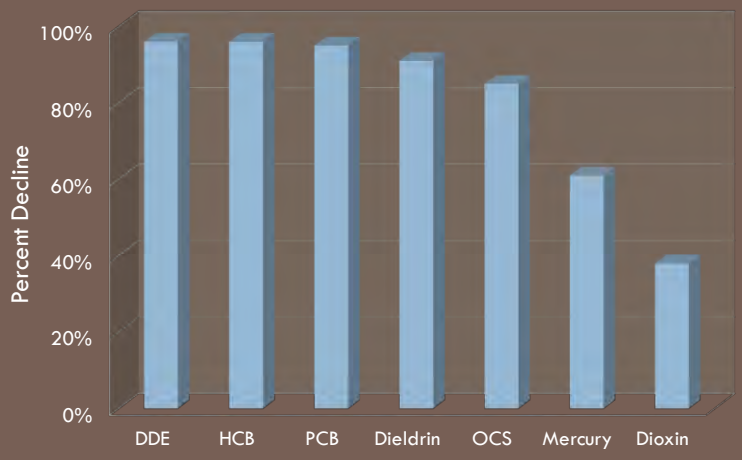
Many legacy contaminants are declining in response to regulatory actions

Time Trends for Persistent Organic Pollutants Measured by IADN at Lake Superior's Eagle Harbor Station, 1991-2008

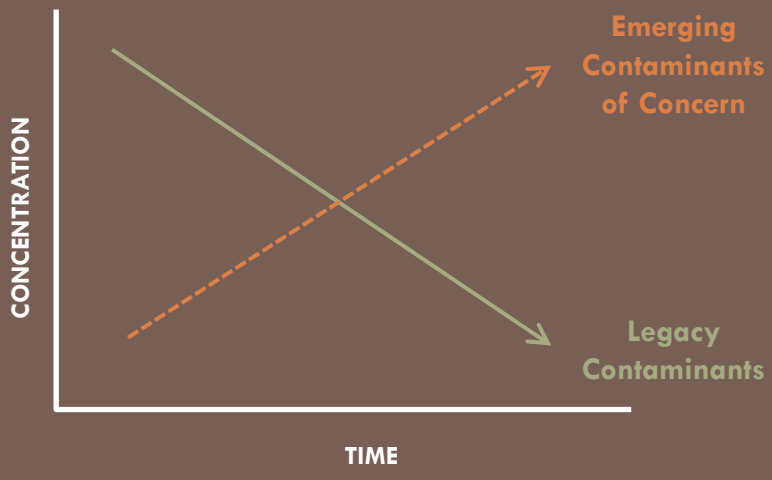


EPA: Nettesheim & Craddock

Percent Decline in Legacy PBT Chemicals in Herring Gull Eggs Collected at Two Lake Superior Sites Between 1974/84 and 2004/7

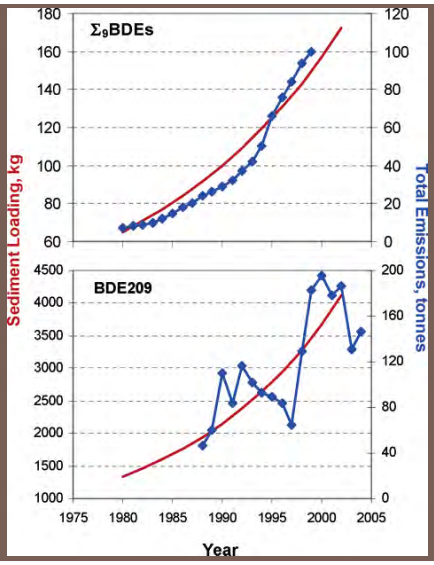


Canadian Wildlife Service: Wesloh & Havelka



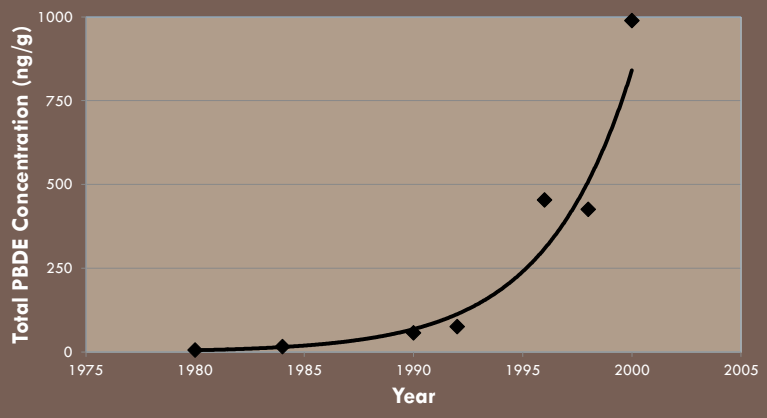
Levels of certain emerging contaminants of concern are increasing

Sediment Loading and Emissions of Total PBDEs (excluding BDE 209) and BDE 209 for the Entire Great Lakes Basin



Li *et al*. 2006. Polybrominated diphenyl ethers in sediments of the Great Lakes: 4. Inluencing factors, trends, and implications. *Environmental Science and Technology*. 40:7528-7534.

Total PBDE Concentrations in Lake Trout from Lake Superior (Apostle Islands), 1980-2000



Data from: Zhu and Hites. 2004. Temporal trends and spatial distributions of brominated flame retardants in archived fishes from the Great Lakes. *Environmental Science and Technology*. 38:2779-84.

Recap

- Lake Superior is often the "cleanest" of the Great Lakes …
- …But not always.
- Certain chemicals continue to exceed levels of concern.
- Many legacy contaminants are declining in response to regulatory actions…
- …But there are emerging contaminants of concern on the rise.

QUESTIONS?

Presented at: Ecology of Lake Superior Conference, Duluth, MN (May 3-5, 2010)

Acknowledgements

- Lake Superior Workgroup, esp. Chemical Committee members!
- T. Nettesheim, B. Murphy, J. Adams, US EPA, GLNPO
- M. Simcik, University of Minnesota
- D. V. Weseloh, R. Letcher, Canadian Wildlife Service
- S. Backus, J. Waltho, L. Jantunen, D. McGoldrick, C. Marvin, Environment Canada
- S. Bhavsar, Ontario Ministry of the Environment
- C. Schrank, WI Dept. of Natural Resources
- P. McCann, MN Dept. of Health
- K. Groetsch, MI Dept. of Community Health

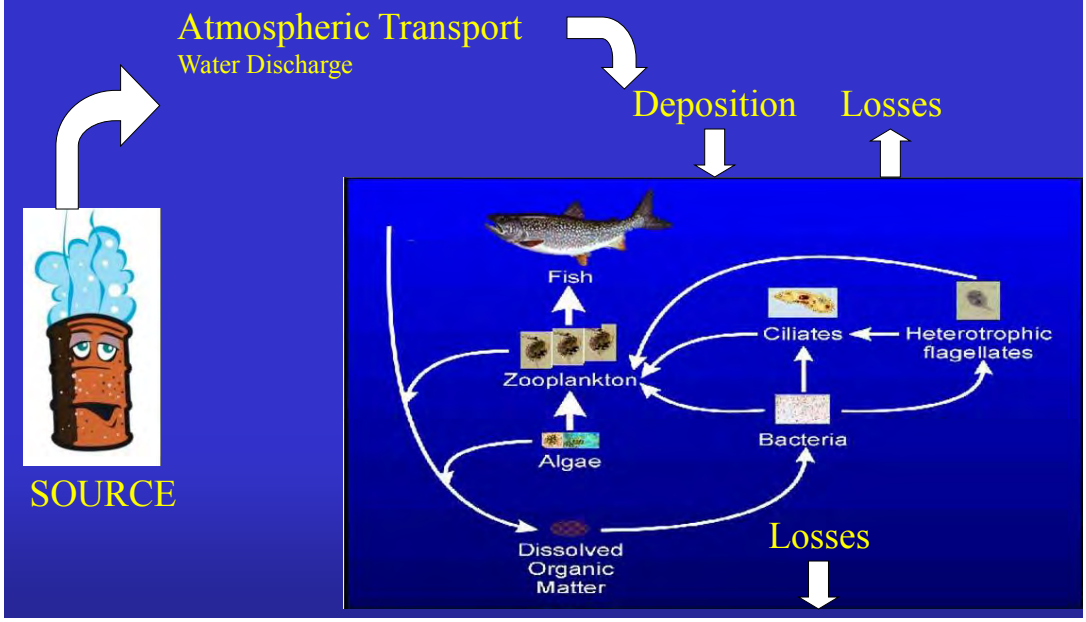
FOCUS OF PRESENTATION

- GLWQA requires LaMPs to identify and reduce critical chemicals in each Great Lake.
- Lake Superior LaMP Zero Discharge Demonstration Program – Milestone Year 2010.
- Is the Lake Superior ecosystem responding to anthropogenic chemical management actions?
- Focus on "legacy" and newer chemicals of concern.
  - Great Lakes long term trend monitoring programs
  - Peer-reviewed literature
  - Monitoring data across media allows temporal comparisons

Some Chemicals of Interest

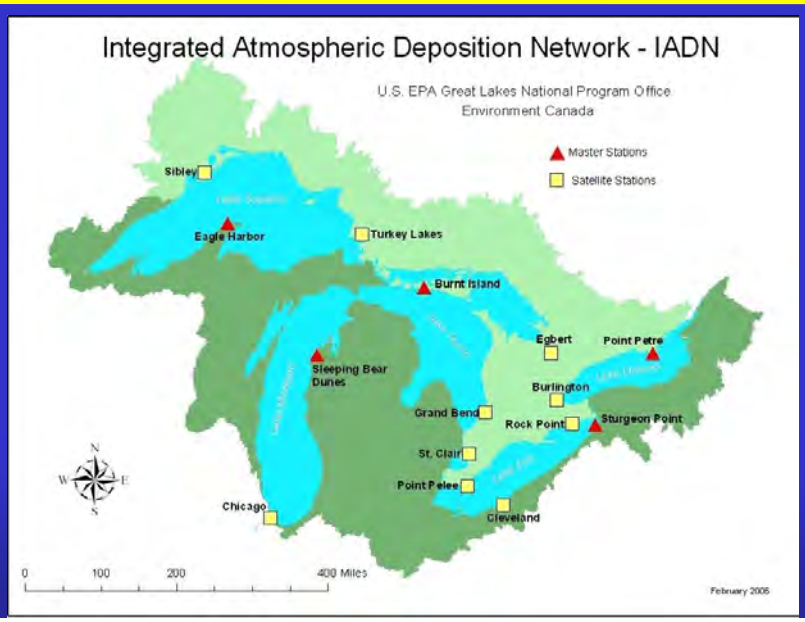
- **Lake Superior Zero Discharge Chemicals**
  - Polychlorinated Biphenyls (PCBs)
  - Hexachlorobenzene (HCB)
  - Octachlorostyrene
  - Toxaphene
  - Mercury
  - Dioxins
  - Chlordane
  - Dieldrin
  - DDT
- **Some Chemicals of "Emerging Concern"**
  - Polybrominated diphenyl ethers (PBDE)
  - Perfluorinated compounds (PFCs)

PBT Contaminant Fate and Transport

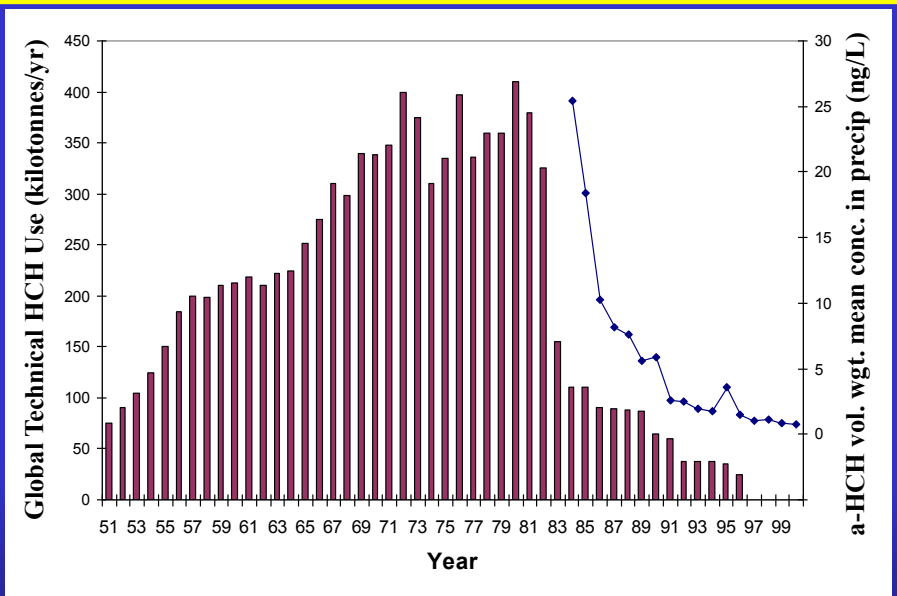


ATMOSPHERE

IADN

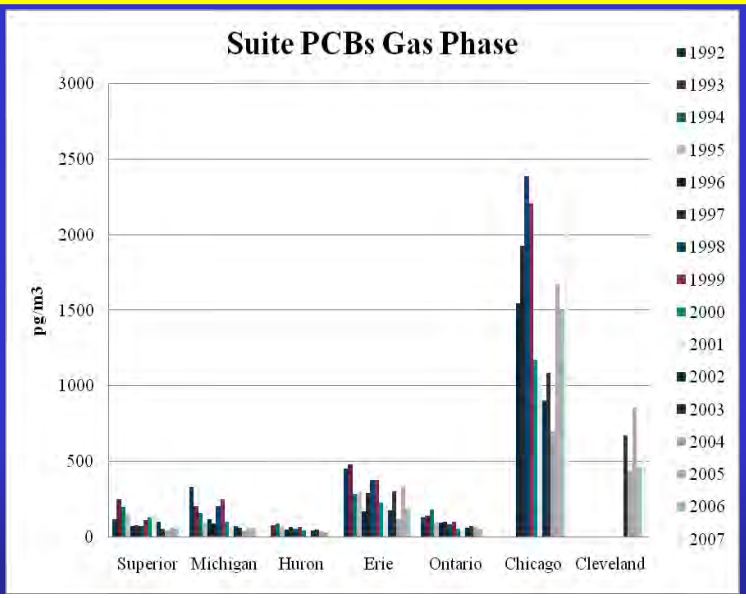


Decline of α-HCH in Precipitation at Sibley Following Global Decline in Usage



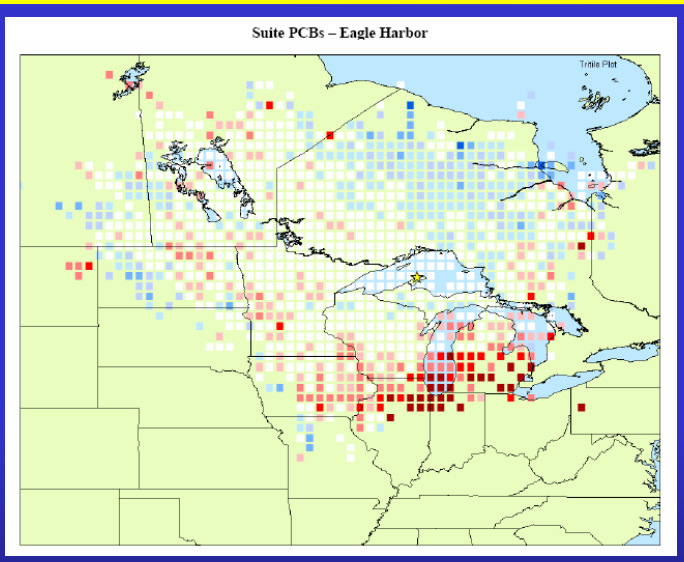
DATA SOURCE: A. Li 1999, C.H. Chan, Environment Canada

Annual Avg. Gas Phase PCBs – Decline at Master Stations, Urban Signal



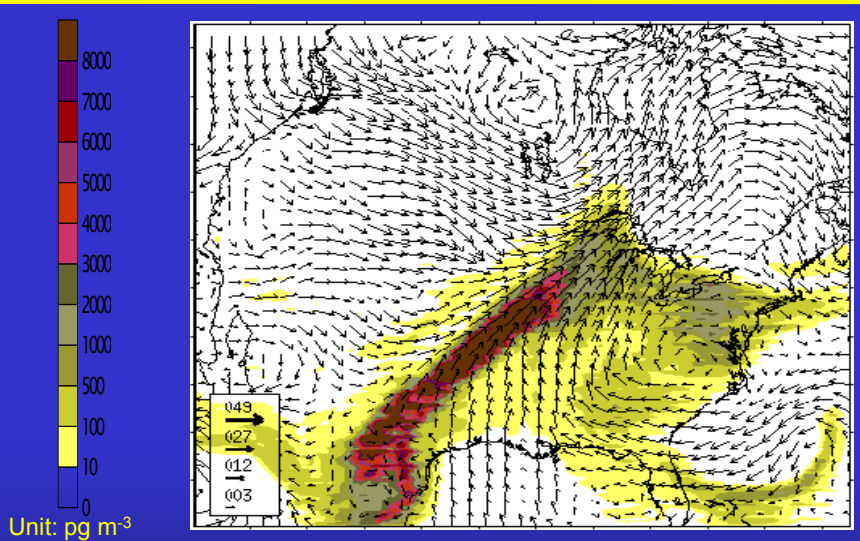
Source: IADN, T. Nettesheim, US EPA

PCB Sources to Lake Superior Show Strong Urban Signal



Source: IADN, M. Hulting, USEPA

Episodic Transport May Play Important Role in Chemical Deposition



Modeled daily air concentration on Sept. 10, 2000; vector winds (m s^{-1}) at 1200m

Source: Presentation by Venkatesh and Ma at the GLBTS meeting in Chicago September 15, 2005

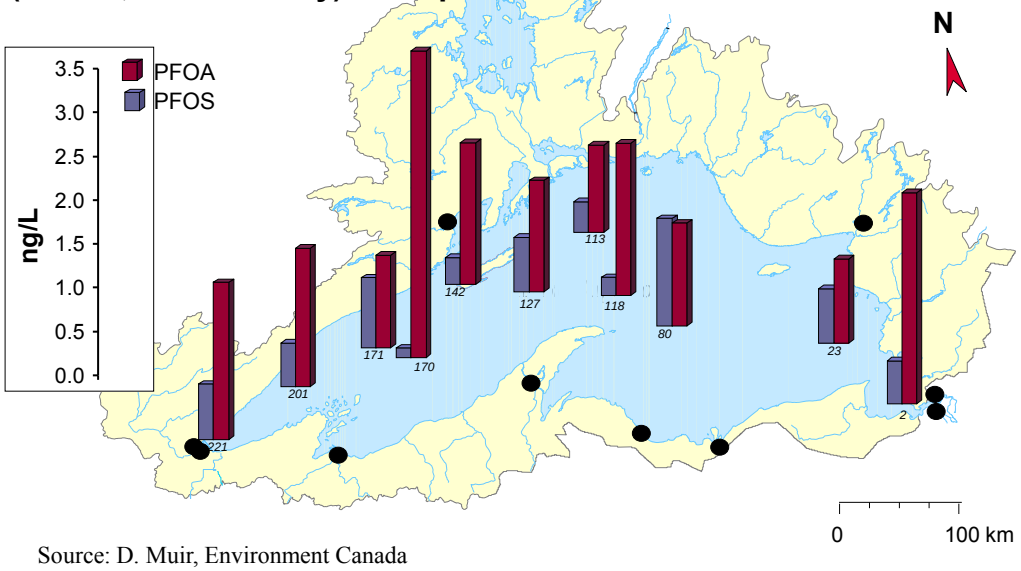
WATER

Some Recent Open-water Contaminant Data Exceeds Most Protective Yardsticks (all data in ng/L)

	MN	MI	WI	ON	Open Lake Conc.
PCBs	0.0045	0.026	0.003	1.0	0.0705[1]
HCB	0.074	0.45	0.22	6.5	0.013[2]
Dieldrin	0.0012	0.0065	0.0027	1.0 (+Aldrin)	0.112[2]
Chlordane	0.04	0.25	0.12	60	0.013[2] (cis + trans chlordane)
DDT	0.011	0.011	0.011	3.0	0.005[2] (p,p'DDE)
Mercury	1.3	1.3	1.3	200	0.41[2], 0.21[3]
Toxaphene	0.011	0.068	0.034	8.0	1.0[4]
g-BHC (lindane)	80	25	18	10	0.310[2]

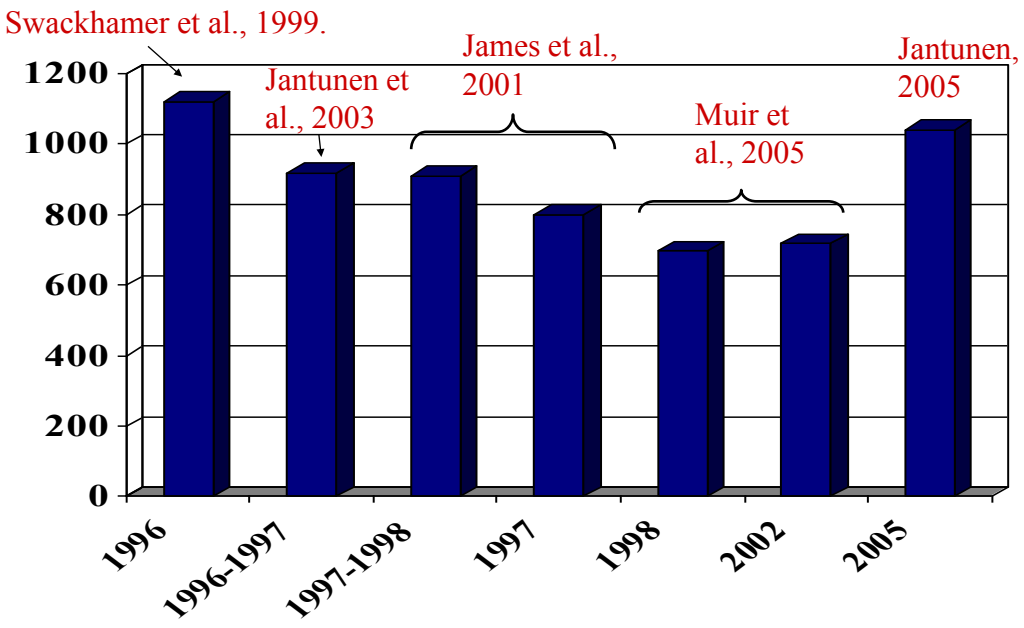
[1]Warren, US EPA, 1996 data [2]Environment Canada, 2005 data [3]Jeremiason *et al.* 2009 , 2006 data [4]Jantunen , pers. comm., unpublished 2005 data

Spatial trends of total PFCAs and PFSAs in Lake Superior surface waters, 2005. No significant differences between sites near MWTPs (Duluth, Thunder Bay) and open lake sites



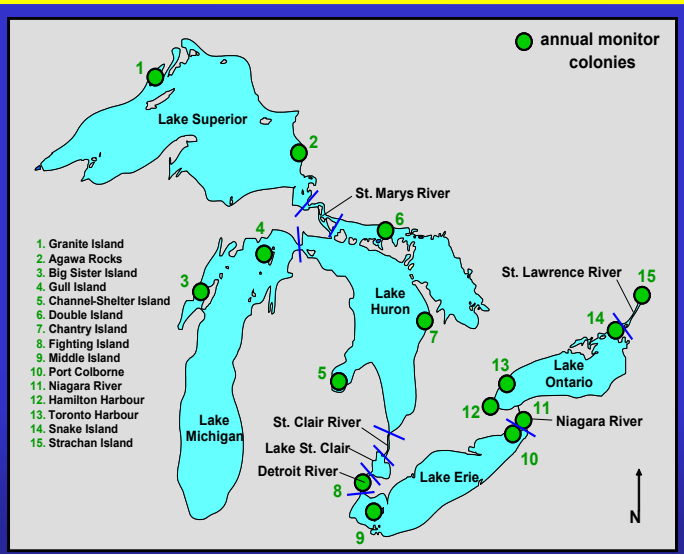
Source: D. Muir, Environment Canada

ΣToxaphene in Lake Superior water, pg/L

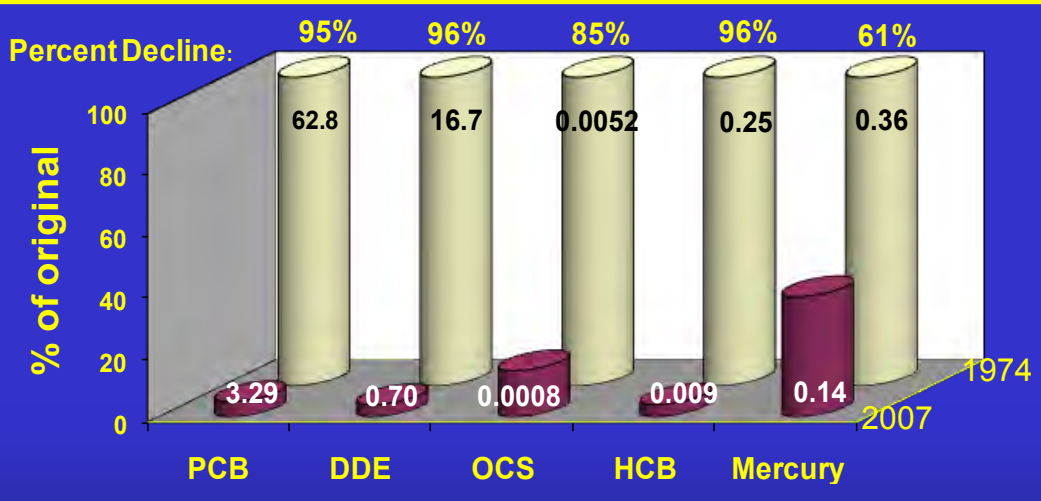


HERRING GULL EGGS

Canadian Wildlife Service – Herring Gull Egg Monitoring Program

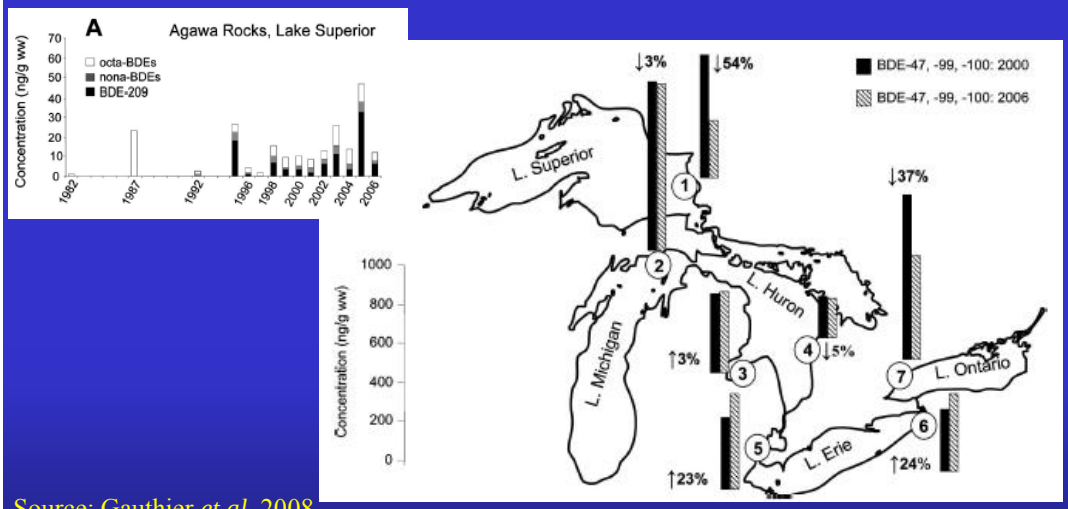


Legacy PBT Declines: Herring Gull Eggs, Lake Superior, 1974-2007



Values are means (ug/g wet wt.) for two sites on Lake Superior.
DATA SOURCE: Environment Canada, Canadian Wildlife Service Weseloh *et al.*

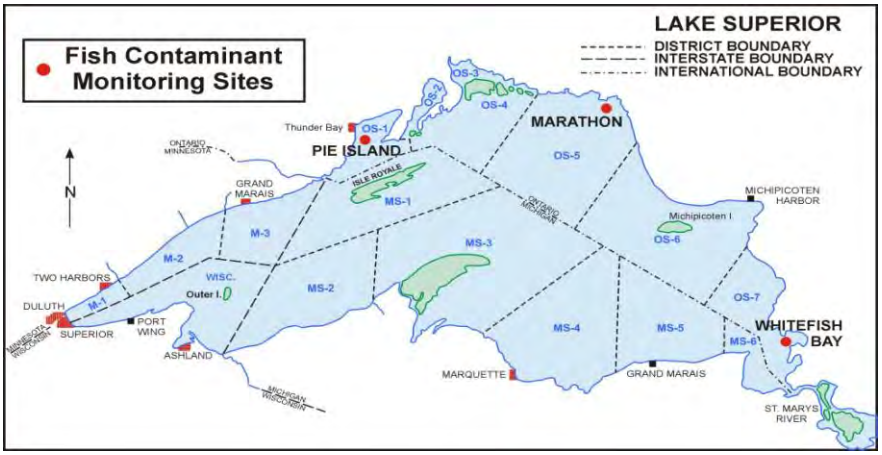
Lower weight PBDEs stabilizing or declining, higher weight may be increasing



Source: Gauthier *et al.* 2008

WHOLE FISH AND FILLETS OF LAKE TROUT

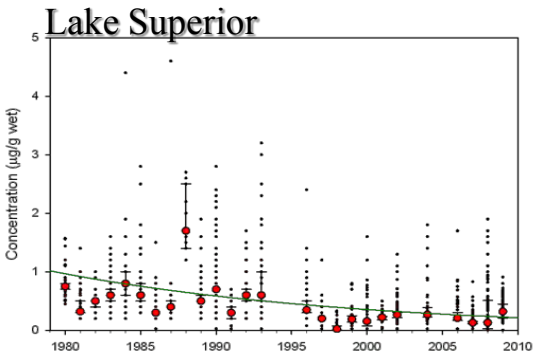
Environment Canada's Fish Contaminants Monitoring and Surveillance Program



Environment Canada Environnement Canada

Canada

ΣPCBs in lake trout - ages 4 to 6



- Over the entire time period there has been a decline of -5.4% per year ($p<0.05$; $r^2 = 0.35$)
- In 2009 – median PCB levels were 0.32 µg/g

year	% fish below (0.1 ug/g)
2007	47%
2008	43%
2009	2%

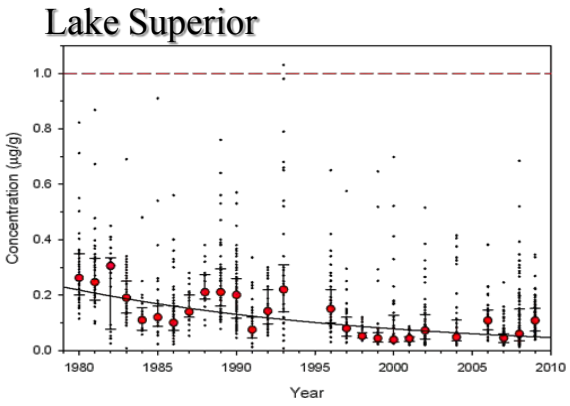
- GLWQA Objective:
  - 0.1 µg/g ww for the protection of birds and animals which consume fish

Environment Canada Environnement Canada

Canada

ΣDDT & metabolites

lake trout - ages 4 to 6



- Over the entire time period there has been a decline of -5.1% per year ($p<0.05$; $r^2 = 0.53$)
- In 2009 – median DDT levels were 0.11 µg/g
- All fish had DDT levels below the GLWQA objective (red dashed line)

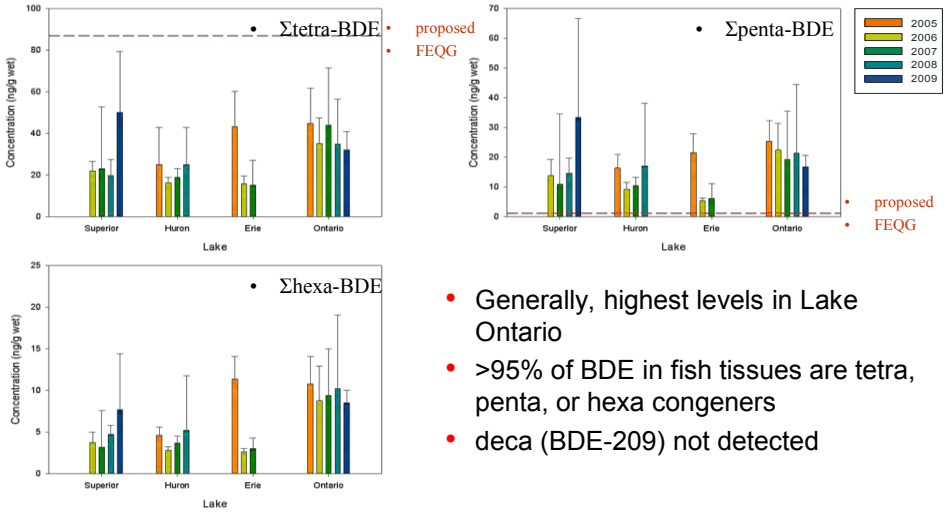
- GLWQA Objective:
  - 1.0 µg/g ww for the protection of birds and animals which consume fish

Environment Canada Environnement Canada

Canada

PBDE's – Canadian Great Lakes

- lake trout – whole body homogenates



- Generally, highest levels in Lake Ontario
- >95% of BDE in fish tissues are tetra, penta, or hexa congeners
- deca (BDE-209) not detected

Environment Canada Environnement Canada

Canada

Summary

- Historical declines of many legacy PBT contaminants in LS have slowed or leveled off.
  - Management implication: Water and fish tissue exceedences likely to continue for foreseeable future.
- In general, environment responds to phase-outs and bans of these pollutants (legacy and evidence for newer PBTs). LS unique.
- Atmosphere is main source of PBTs to the lake.
  - Complex story – invasive species, global use patterns, climate change, analytical capabilities, understanding of toxicity.

Summary

- More current-use chemicals being found in GL ecosystem.
  - Will continue to challenge scientists, managers, and decision-makers.
- Guidelines for some substances of emerging concern are under development, particularly by the Canadian federal govt. Stay tuned.
- Monitoring programs must continue to support these efforts.