Lake Superior Lakewide Management Plan:
1990-2005
Critical Chemical Reduction Milestones

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"When it was calm, and the sun shone bright, I could sit in my canoe, where the depth was upwards of six fathoms, and plainly see huge piles of stone at the bottom, of different shapes, some of which appeared as if they were hewn. The water at this time was as pure and transparent as air; and my canoe seemed as if it hung suspended in that element. It was impossible to look attentively thorough this limpid medium at the rocks below without finding, before many minutes were elapsed, your head swim, and your eye no longer able to behold the dazzling scene."

Jonathon Carver, 18th century explorer, from B. Littlejohn and W. Drew,
Superior: The Haunted Shore

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Executive Summary

In 1990, the International Joint Commission (IJC) challenged the governments of Canada and the United States to develop a program to virtually eliminate the discharge of nine persistent, bioaccumulative and toxic substances in the Lake Superior Basin. The following year, the Lake Superior Binational Program to Restore and Protect Lake Superior (the Binational Program) was announced, providing for a Zero Discharge Demonstration Program (ZDDP) and a "broader program" focusing on ecosystem restoration. The ZDDP set ambitious reduction schedules for mercury, PCBs, pesticides (aldrin/dieldrin, chlordane, DDT/DDE and Toxaphene), dioxin, hexachlorobenzene (HCB), and octachlorostyrene (OCS). The Lake Superior Lakewide Management Plan (LaMP), a management strategy developed by Lake Superior partners, was developed to implement the ZDDP and the ecosystem restoration program.

While 2005 is a milestone reporting year for dioxin and PCBs, the "Critical Chemical Reduction Milestones" report documents progress across the group of ZDDP chemicals. Included is a detailed examination of the many binational actions between 1990 (the baseline year for the ZDDP) and 2005. The program has had many successes, but many challenges remain. The successes are the result of collaboration and commitment by the wide range of Tribal/First Nation, non-governmental organizations, state, provincial and federal agencies actively engaged in the Lake Superior Binational Program. The involvement of the citizens of the Lake Superior Basin and other stakeholders including the business community and municipalities cannot be overstated. Details of these activities can be found in Appendix B.

In 2005, emission inventories for the ZDDP chemicals were updated for both the U.S. and Canadian portions of the Lake Superior Basin. These included an analysis of emissions from a broad range of sources including mining, fuel combustion, incineration, waste handling, commercial products, sediment and municipal sewage. Details of the inventories are presented in Appendix C.

Notable achievements include a 71% reduction in mercury releases; a 76-79% reduction in dioxin releases; significant reductions of PCBs materials in Ontario and the Lake Superior states; and an ongoing collection and safe disposal of waste pesticides around the basin, with more than 12,700 kg (28,000 pounds) collected between 1992 and 2004 in Minnesota and Wisconsin alone. While the LaMP program is limited in its ability to predict the relative effects of local versus distant sources of contaminants on the Lake Superior ecosystem, most monitored chemicals in Lake Superior biota have declined over time and continue to do so. One notable exception is toxaphene which, for a number of reasons, is not declining.

Identified challenges include improving our ability to accurately quantify existing inventories of ZDDP chemicals, such as in-use PCBs, and further sources of banned pesticides. Additionally, achieving the program's 2010 targets will test our collective abilities. While chapter 5 of this report presents a range of comprehensive strategies to continue moving toward our ZDDP targets, without extraordinary additional reductions, the next set of targets will be very difficult to achieve.

Finally, while the Lake Superior ZDDP has been realizing progress over the past 15 years, the program remains dynamic. The participants recognize the evolving nature of and the interactions between persistent toxic chemicals and the ecosystem. The Lake Superior partners remain committed to achieving the ambitious goal of restoring and protecting the Lake Superior Basin.

Chapter 1. Scope and Background

1.1 LaMP Critical Pollutants 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 Lakewide Management Plans (LaMPs) to restore beneficial uses and reduce the loadings of Critical pollutants. In their 1990 biennial report on the GLWQA, the International Joint Commission (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 Lake Superior Binational Program (LSBP – see Appendix A). Included in this program are a Zero Discharge Demonstration Project (ZDDP), where discharges and emissions of certain persistent bioaccumulative and toxic substance would be virtually eliminated and a broader 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.

While the LaMP process is part of the GLWQA, the LaMP is also serving to carry out the goals and objectives of the Lake Superior Binational Program, including the ZDDP. Further information about the LaMP process can be found at http://www.epa.gov/glnpo/lakesuperior/2006/ls_chapter1_2006.pdf. The nine ZDDP chemicals and the other pollutants already designated Critical as part of the LaMP process are listed in Table 1-1a. They fall into three management categories: zero discharge, lakewide remediation and local remediation.

Prevention pollutants are either in the Monitor category (present but not exceeding yardsticks) or Investigate category (data from Lake Superior are needed to evaluate this chemical) and are listed in Table 1-1b. Prevention pollutants have properties that give them potential to impair the lake but they have been found below harmful levels or have not been monitored in Lake Superior. The intention is to manage the Prevention pollutants to avoid impairments in the future.

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. LaMP 2000 Chapter 4 proposed remedial measures for Lake Superior Critical pollutants. This Lake Superior Critical Chemical Reduction Milestones report identifies actions taken towards those remedial measures, estimates the load reductions since 1990 and identifies further reduction strategies.

The load reduction schedule from Stage 2 (Table 1-2) describes four timelines for mercury, PCBs, dioxin/HCB/OCS and the targeted pesticides. Note that although 2005 is a milestone year for dioxin and PCBs only, the report documents progress on all four chemical groups.

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

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

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

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

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

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

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

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

1.2 LaMP 2000 Progress and Accountability

In the LaMP 2000 Chapter 4, the Chemical Committee identified reduction strategies for sectors. Certain activities within these strategies were considered higher priority. For example, Level 1 activities were highest priority, Level 2 activities were priorities but there was a barrier such as lack of authority or funding and Level 3 activities were not considered priorities at the time. Different agencies selected different activities in LaMP 2000. Agency reports on progress towards the LaMP 2000 activities are included in Appendix B.

1.2.1 LaMP Chemical Reduction Activities

In general, Lake Superior agencies and organizations have succeeded in carrying out a number of the Level 1 activities and also some Level 2 activities. A complete listing of activities since the LaMP 2000 can be found in Appendix B. The following activities are considered highpoints of activities that are a direct result of the LaMP:

- Mercury product reduction projects were carried out in every jurisdiction and varied from auto switch collections; thermostat collections and swaps; thermometer collections and swaps; fluorescent lamp collections; outreach and collections at schools; ongoing basinwide mercury project focused on industry; a

municipal mercury project; and dental amalgam projects at Western Lake Superior Sanitary District (WLSSD), the rest of the Minnesota basin, Superior, Thunder Bay, Ashland and Ishpeming.

- Open burning outreach and reduction projects happened in every jurisdiction. Projects included Bernie the Burn Barrel outreach and materials for local governments developed by WLSSD; EcoSuperior produced and distributed materials and reached out to First Nations; the City of Superior and Douglas County did outreach and Wisconsin Department of Natural Resources (WDNR) produced a Lake Superior-specific video; Minnesota Pollution Control Agency (MPCA) experimented with a rain-barrel-for-a-burn-barrel swap and worked with three counties on open burning abatement county projects; and tribes carried out local open burning abatement projects, including an especially intensive effort by the Bad River Band of Lake Superior Chippewa.
- Lake Superior specific waste collections were carried out, including abandoned waste in Minnesota; first ever household hazardous waste in some Ontario communities; a new household hazardous waste facility in Sault Ste. Marie, Michigan; and a faith based effort by Earthkeepers in Michigan's Upper Peninsula.
- PCB transformers were changed out at three Minnesota utilities in a pilot project to identify suspect transformers, rank them and decommission as many as possible.
- A series of workshops and public input sessions hosted by the Lake Superior Binational Forum examined a variety of critical chemicals and their loads from Lake Superior sources. This included a mercury reduction workshop that lead to a basinwide mercury reduction project, an open burning workshop that triggered additional outreach in Ontario and a public input session on mining.

1.2.2 Other Projects Aligned with LaMP Goals

These are projects that were not a direct result of the LaMP but are in alignment with the LaMP goals, including the following highlights. Funding is needed to maintain and expand these activities.

- Energy conservation and alternative energy projects were carried out by a variety of entities at several levels. For example, Canada adopted a version of EPA's Energy Star program and the One Tonne Challenge was kicked off in Ontario. (Note: the One Tonne Challenge program was discontinued in 2006.) EcoSuperior continued its energy audit program. A number of green buildings were built in the basin, including Hartley Nature Center, Duluth Zoo, Minnesota Power's Millennium Star House, a Northland College project and others. Potential for developing wind energy is being actively investigated in several areas, including testing by tribes and First Nations.
- Wastewater treatment plants throughout the basin are being upgraded and special projects undertaken to reduce mercury in their effluent. For example, the Thunder Bay wastewater treatment plant is being upgraded to a secondary level; Duluth, Superior, Ashland and Ishpeming have programs to install dental amalgam

separators; and Bayfield's new wastewater treatment plant is considered a zero discharge facility by the WDNR.

- Hazardous waste and pesticide collections were carried out, including city, county, tribal/First Nations and regional household hazardous waste and waste pesticides.
- Sediment projects, including both studies and implementation have been carried out on both sides of the border. A U.S. $6.3 million sediment remediation at Newton Creek and Hog Island Inlet in the St. Louis River Area of Concern was one of the first projects carried out that used Great Lakes Legacy Act funding. A CDN $20 million remediation project at Northern Wood Preservers in the Thunder Bay Area of Concern (AOC) resulted in the removal and treatment of 11,000 m^3 of PAH contaminated sediment and the creation of 5 ha (12.4 acres) of fish habitat.
- Open burning surveys were done by Ontario and Minnesota. The surveys provided additional insight into the reasons that people burn, what the rate of burning is and what might make them stop.
- In addition to these reduction projects, there is promising research being done by the Minnesota Department of Natural Resources Minerals Department on mercury cycling at taconite plants. This line of investigation may lead to a technology for reducing mercury emissions from these facilities.

1.2.3 New Regulations and Policies Aligned with LaMP Goals

Some government regulations and policies have been developed since LaMP 2000 that affect releases of the nine chemicals targeted for zero discharge. Those that are most closely aligned with contaminant sources in the Lake Superior basin include the following highlights:

- Ontario Regulation 196/03 requires dentists that place, repair, or remove mercury amalgams to install mercury separators that capture at least 95 percent of mercury particles and prevent discharge to sewers. It is estimated that the compliance rate for Ontario dentists is 99 percent, and the Royal College of Dental Surgeons of Ontario is following up on the 1 percent of remaining cases.
- Mercury product bans that affect the basin include the City of Duluth ban on retail of certain mercury products, installation of certain mercury products and banning elemental mercury in schools. This is regarded as the first of a series of mercury bans at cities nationwide. Other bans have been established in Superior, Ashland and Douglas County. The State of Minnesota added a ban on mercury thermometers to the existing bans on mercury products.
- Both the U.S. federal government and Ontario tightened incinerator regulations after LaMP 2000. These regulations decreased emissions of mercury and dioxin.
- Regulations and laws on mercury from coal fired power plants have been finalized since the LaMP 2000. These include the EPA Clean Air Mercury Rule (CAMR) and coal fired power plant emission laws passed by Minnesota and Wisconsin (although the Wisconsin law was designed to be replaced by the CAMR). Other Great Lakes states are considering regulations that are more stringent than the CAMR.

Chapter 2. Introduction

2.1 Purpose

This Critical Chemical Reduction Milestones report is intended to provide a summary of progress that has been made towards reducing the nine chemicals targeted for zero discharge since 1990. The summary will include 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 will then be compared to the Stage 2 reduction targets (see Table 1-2).

As well as summarizing progress towards the 2005 targets, this report will also identify strategies for making progress towards the reduction targets for 2010. In addition, the report will examine 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 activities, the most fruitful so far has been pollution prevention. A number of the projects listed in section 1.2.1 and 1.2.2 are classic examples of pollution prevention. Through pollution prevention, the easiest reductions have been achieved, and those remaining are more difficult. It is the intent of the binational partners to continue to pursue this method (see Guiding Principles section 2.2.2).

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. The OIRW designation requires new or expanded discharges to use best Technology in Process and Treatment.

In Wisconsin, new rules relating to Lake Superior basin waters to better protect Lake Superior from wastewater pollution were adopted by the Wisconsin Natural Resources Board on April 26, 2006. Under revisions to NR 102 and NR 207, the current designation of Lake Superior tributaries currently classified as Outstanding Resource Waters (ORWs) are expanded to additional levels of protection. These proposals modify the existing

ORW designation for selected tributaries to include a ¼ mile arc within Lake Superior at the mouth of each of those tributaries. In addition, waters within ¼ mile of the islands of the Apostle Islands National Lakeshore would also be classified as ORWs. A third part would prohibit any new or increased discharges of the targeted pollutants to waters of the basin unless the discharge was the result of utilization of best technology in process or control.

Canada is in the process of establishing a 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. An agreement in principle between Canada and Ontario for establishing the conservation area was signed in 2005.

The third type of activity, 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, programs have been implemented and others are under 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 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. The 2004 guiding principles are an update and serve to guide continuing implementation of the ZDDP.

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; 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).

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.

Chapter 3. Load Reduction Inventory

Since the 1990 baseline year, releases of the nine designated ZDDP chemicals declined in the Lake Superior basin. Between 1990 and 2000, reductions primarily occurred 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 USEPA driven Great Lakes-wide phase-out of PCB equipment, and waste 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 in order to reduce the import of toxic chemicals to the Lake Superior basin 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 as well as Appendix B.

3.2 In-Basin Inventory Methodology

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

In addition to estimating discharges and emissions of mercury and dioxin, Environment Canada (EC) and the USEPA attempted to estimate discharges and emissions for hexachlorobenzene. These estimates are not considered as complete as the mercury and dioxin inventories, but section 3.7 presents preliminary conclusions. In addition, the partners have estimated the amount of mercury and dioxin in ash, sludge and contaminated sediment. 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 percent reduction by 2000
- 80 percent reduction by 2010
- 100 percent reduction by 2020

In Section 3.3.2 below, it is estimated that a 71% reduction of mercury emissions and discharges has taken place since 1990. In order to meet the 80% reduction goal by 2010, an additional 200-207 kg/yr of mercury must be reduced from 2005 loads.

3.3.2 Sources of Mercury

The mercury inventory below includes releases to both air and water for the baseline year of 1990 as well as the milestone year of 2000 (Table 3-1). Although 2005 is not a milestone year for mercury, it is possible to extrapolate between the 2000 goal of 60% reduction and the 2010 goal of 80% reduction and conclude that 2005 should be 70% reduction. It should be noted that discharges are only a small portion of the releases inventoried in Table 3-1. In 1990, discharges represented <2% of the total releases and this dropped to <0.6% in 2005 (see Appendix C for detailed estimates).

Some changes have been made to the inventory tables since the first version appeared in LaMP 2000. The revised estimates of releases in 1990 are 194 kg/yr smaller than estimated in LaMP 2000. This revised baseline showed larger estimates in the industrial, incineration and direct product emissions sectors, while the mining, fuel combustion, and landfill and waste handling emissions were estimated to be smaller than the LaMP 2000 inventory. The 2000 inventory was estimated to be 119 kg/yr smaller than LaMP 2000. The changes in the sectors followed the same pattern as 1990. Also, fifteen percent of products sent to landfills were not been added to Table 3-1 as landfill emissions as was done in LaMP 2000. This is because improvements in the inventories have allowed us to better estimate landfill and waste handling emissions.

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

- Mercury emissions from mobile sources are not presented because of new work being done on estimating the emission factors. Initial indications are that the old emission factors greatly overestimated mercury from mobile sources, especially diesel engines.
- The open burning category for mercury emissions from the US may be overestimated. A different method that relies on the USEPA mercury flow model

predicts a lower emission from open burning of trash. Until this is resolved, we will use the higher numbers.

- While Canadian inventory estimates have been refined and improved, a number of areas of uncertainty remain. In particular, 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 estimated based on various data, most of the assumptions regarding the fate of mercury are based on professional judgment rather than on actual experimental data, resulting in some uncertainty about the estimated quantities released to the atmosphere, water, and land. See Benazon 2006 for additional details.
- It is also difficult to estimate the impact of local reduction efforts on the emissions within the basin. This is because the in-service and/or in-storage equipment is not inventoried. For example, a hazardous waste collection that brings in 30 kg of mercury can not necessarily be subtracted from the total amount of mercury known to be in the basin since that total amount is not known. What can be done is to tally the amounts captured by local reduction efforts (see Appendix B).
- Very small sources estimated in the NEI (NEI 2005) 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 although the goal of zero discharge and zero emission applies to them, they are low priority.

With these caveats, Table 3-1 shows the mercury emissions and discharges from sources in the Lake Superior basin and Table 3-2 shows the percent reduction.

Table 3-1. Mercury Releases to Air and Water from Sources in the Lake Superior basin, kg/yr.

Source	US 1990	Canada 1990	Total 1990	US 2000	Canada 2000	Total 2000	US 2005	Canada 2005	Total 2005
Industrial	40.0	23.4	63.4	40.5	14.6	55.1	36.6	9.3	45.9
Mining[1]	852	604	1456	338	5.9	344	303	30.2	333
Fuel Combustion	150	63.9	214	162	62.1	224	187	42.6	229
Incineration	136	7.7	144	26.4	2.2	28.6	14.5	1.5	16.0
Products	208	65.1	273	5.1	14.3	19.4	3.8	5.8	9.6
Waste Handling/ Landfills	38.2	29.0	67.2	9.9	5.3	15.2	8.1	4.0	12.1
Municipal/ Institutional	23.0	9.2	32.2	4.3	9.2	13.5	3.9	<7.5	3.9-11.4
Total	**1447**	**803**	**2250**	**587**	**114**	**700**	**556**	**93-101**	**650-657**

[1] includes iron sintering at Algoma Steel in Wawa, Ontario

Table 3-2. Percent Reduction of Mercury Releases between from 1990-2000 and 1990-2005.

Source	Percent Reduction 1990-2000	Percent Reduction 1990-2005
Industrial	13	28
Mining[1]	76	77
Fuel Combustion	-5	-7
Incineration	80	89
Products	93	96
Waste Handling/ Landfills	77	82
Municipal/ Institutional	58	65-88
Total	**69**	**71**

In order to see which sectors have decreased and at what rates, Figure 3-1 shows the major sectors in 1990, 2000 and 2005. The large reductions in the mining sector are due to the closure of the White Pine copper smelter in White Pine, Michigan and of the Algoma sintering plant in Wawa, Ontario. Product related releases (i.e., incineration, products and waste handling/landfills) have clearly undergone significant reductions between 1990 and 2005.

Figure 3-2 shows the decrease in mercury releases since 1990 compared to the reduction schedule identified in the Stage 2 LaMP. (Note that the 2005 estimated reduction goal of 70% reduction is actually an extrapolation between the 2000 goal of 60% reduction and the 2010 goal of 80% reduction.) The trend shows a decrease in releases since 1990 and loads are at or below the milestone reduction targets. However, it also appears that the trend in decreasing releases is starting to flatten out. To reach the 2010 target of 80% reduction, we need an additional 8% reduction from 1990 levels. This equates to an additional reduction of mercury of 200-207 kg/yr.

In considering the remaining mercury emission sources in the basin, Figure 3-3 shows the relative contribution of the various sectors. Note that mining represents half of the mercury emissions for 2005. Of the 333 kg/yr from mining in 2005, 303 is from the taconite sector. The next largest source is fuel combustion. Of the 229 kg/yr from fuel combustion, 161 kg/yr is from coal fired utilities. The smallest four categories represent the various discharges and emissions associated with products. Collectively, this is still a significant source and projects that encourage proper disposal of mercury bearing products and accelerate their replacement with non-mercury alternatives should continue.

Figure 3-1. Reductions of Mercury Discharges and Emissions from Lake Superior Sectors Between 1990 and 2005, kg/yr.

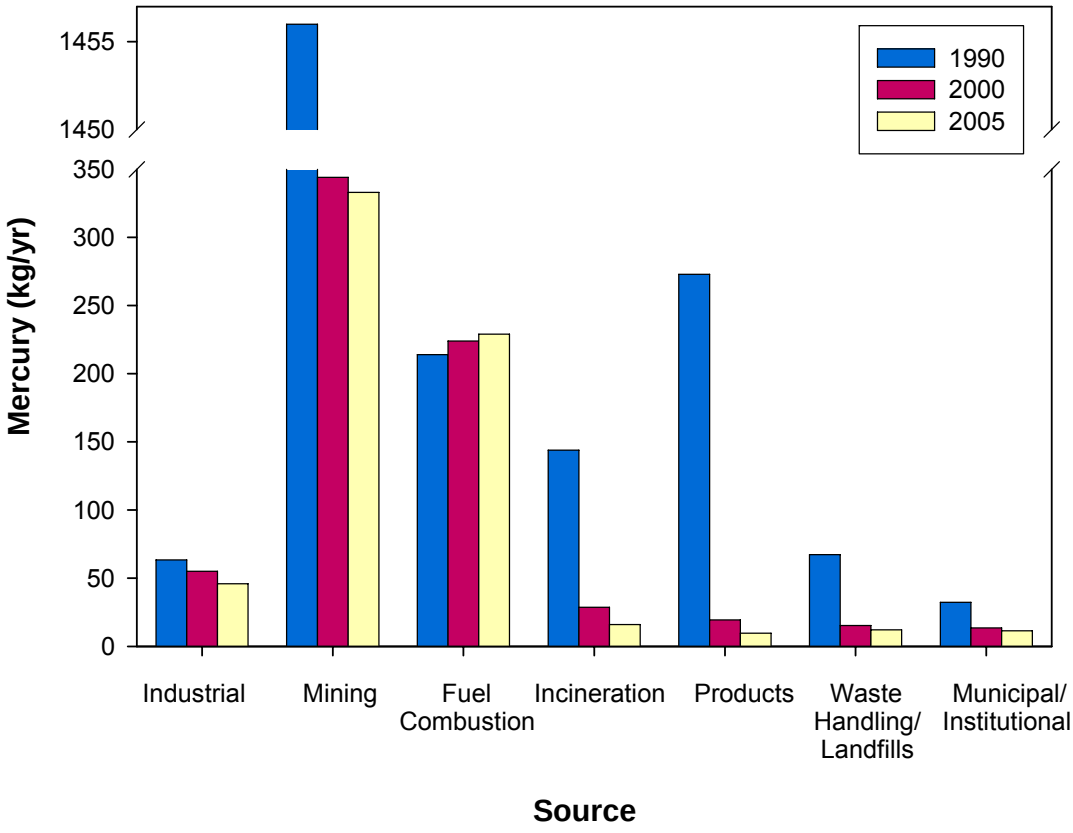


Figure 3-2. Actual Reductions of Mercury Discharges and Emissions from Lake Superior Sources Between 1990 and 2005 Compared to the Stage 2 Load Reduction Goals, kg/yr.

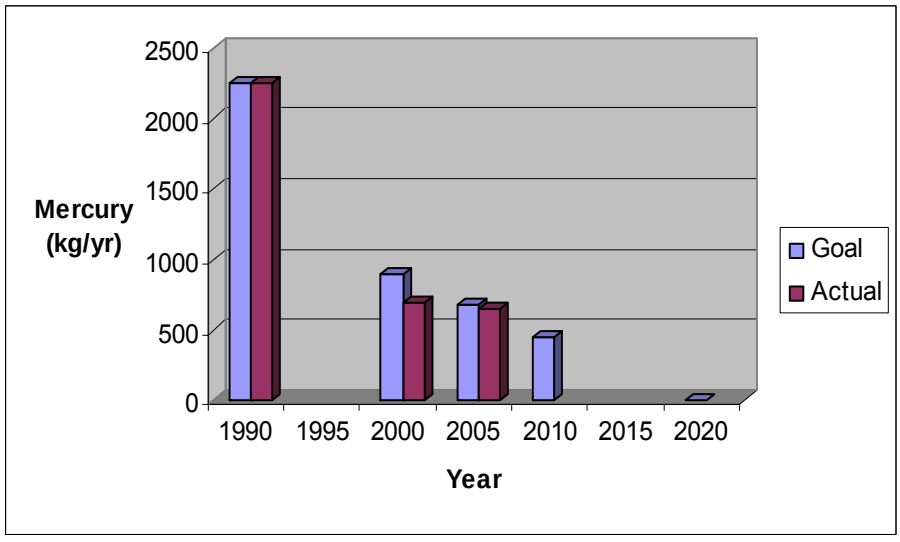
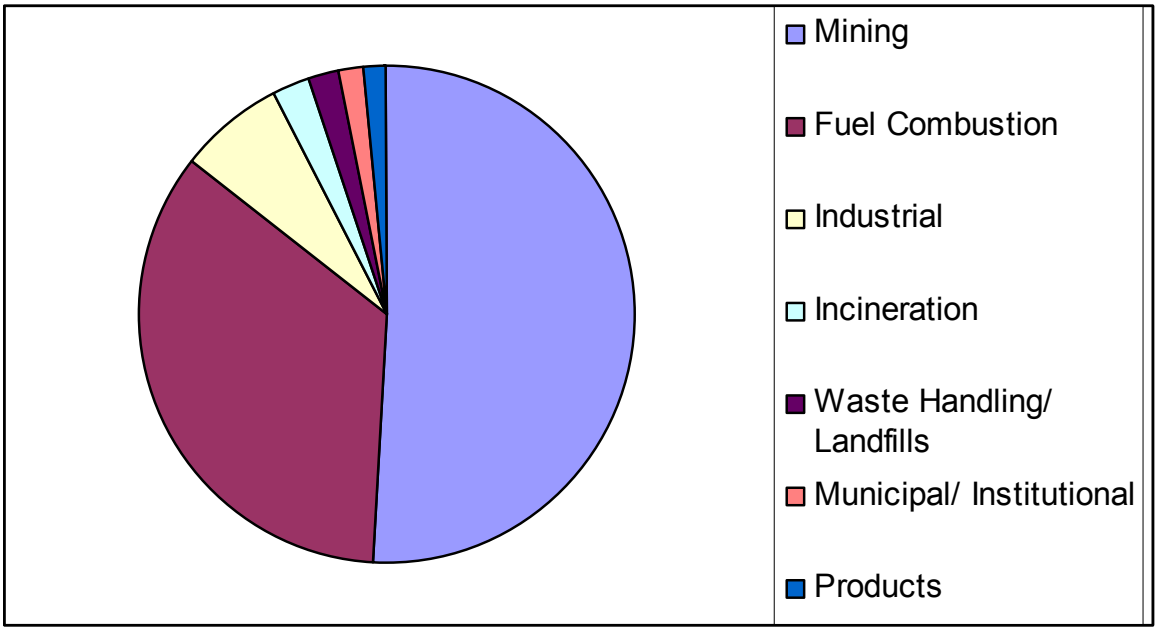


Figure 3-3. Percentage of Mercury Releases from Different Sectors in the Lake Superior Basin, 2005.



3.3.3 2010 Milestone

Before 2010, it is possible to anticipate some further mercury reductions as well as some increased emissions. For example, while Figure 3-1 shows a gradual increase in mercury emissions from fuel combustion between 1990 and 2005, it is likely that emissions from two coal fired power plants in the basin will have a decrease in mercury emissions by 2010. Emissions from Wisconsin Energy's Presque Isle coal fired power plant will decrease due to the installation of mercury control sorbent technology at the end of 2005. Minnesota Power's Taconite Harbor coal fired power plant will be installing pollution control equipment that is expected to achieve 90% reduction in mercury emissions. While there was a possibility that the Ontario Power Generating coal fired power plant in Thunder Bay would be converted from burning coal to burning natural gas, which would reduce mercury emissions, this conversion plan was cancelled in June 2006. OPG's Fossil Business, and Thunder Bay GS in particular, are actively studying mercury reduction technologies to ensure that the corporation could implement such measures should the Province implement mercury reduction legislation. In Wisconsin, the Presque Isle plant emitted 45.7 kg/yr in 2005 and in Minnesota the Taconite Harbor station emitted 31.9 kg/yr. Assuming a 90% reduction at both facilities, a 70 kg/yr reduction is possible by 2010, which is about a third of the 200-207 kg/yr reduction needed to meet the 80% reduction by 2010 reduction goal.

Although we can predict reductions at the two coal fired power plants discussed above, energy agencies project that energy consumption will increase. For example, the US Department of Energy (DOE) estimates energy demand will rise 50% between 2004 and 2030 (see www.eia.doe.gov/oiaf/aeo/pdf/trend_3.pdf). While there may be a decline in

basin population (i.e., the Canadian population dropped 10% between 1990 and 2005 and the US population increased by 2% in the same period) this may not cause a decrease in emissions since the power plants can sell their excess energy on the grid.

In addition, some new or expanded facilities that start before 2010 may be releasing mercury that was not part of the 1990 baseline. A variety of facilities, including new and expanded taconite processing, coal and coke gasification, and nonferrous mining have been proposed within or near the Lake Superior watershed, although discharge or emission estimates are not possible at this time.

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 will remain strong. (see www.nma.org/newsroom/miningweek/miningweekarchive/asp2005/mw020405.asp#story3).

3.4 Dioxin

3.4.1 Dioxin Reduction Goals

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

- 80 percent reduction by 2005
- 90 percent reduction by 2015
- 100 percent reduction by 2020

In order to meet the 90% reduction goal by 2015, an additional 3.13 to 4.01 g I-TEQ/yr of dioxin must be reduced from 2005 loads. In Section 3.4.2 below, it is estimated that a 76% to 79% reduction of dioxin emissions and discharges has taken place since 1990.

3.4.2 Sources of Dioxin

The dioxin inventory, listed in Table 3-3 below, includes releases to both air and water for the baseline year, the year 2000 and the milestone year of 2005. It should be noted that discharges are only a small portion of the releases inventoried in Table 3-3. For example, in the US Appendix C for dioxin, the amount of dioxin in discharges to water was only about 5% of the total releases to air and water.

Some significant changes have been made since the first version of the inventory tables appeared in LaMP 2000. The inventory has been adjusted downward mainly because the US 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.

While the inventories have improved, there are still uncertainties and limitations that must be noted. For dioxin, the following caveats must be added:

- The extent of landfill fires occurring in the Lake Superior basin is unknown. Anecdotal information from Canada suggests that it occurs frequently, yet several Canadian municipalities that were contacted indicated that landfill fires do not occur at their landfill, though legal brush fires are permitted. If more than 5% of annual rural waste generated 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.
- 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.
- In some categories, no evidence was found of changes in practices between the baseline and milestone years, so the dioxin emission estimates remained the same.
- The US and Canada used different methods in estimating dioxin emissions from open burning of trash. The Canadian method assumes that 20-40% of rural residents burn garbage and that none of the urban residents burn garbage. The US method assumes that 31% of basin residents burn. The US method may overcount since the 31% applies to all residents, not just rural. While trash burning by Ontario residents classified as urban would cause an undercount in the Canadian inventory, this is not thought to be prevalent in the Ontario urban population as there are well established garbage collection systems. The percentage used for rural population burning is therefore reasonable for Ontario rural and small city populations. It could be that the surveys highlight the differences in burning practices between the Canadian and US populations. The US method is believed to be representative for the US side since it is based on a telephone survey of northeast Minnesota and northwest Wisconsin residents that did not distinguish between urban and rural.
- The US NEI (NEI 2005) was used as a last resort for some categories since the methodology and reporting may not be entirely consistent between states.
- The dioxin emission factor for White Pine copper smelter from 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.
- The numbers for fuel combustion include estimates of dioxin and furan release from OPG Thunder Bay Generating station. The value used for 1990 and 2000 is calculated from an average of the values for the years 2003-2005. We do not have accurate data before 2003 and there is no reason to expect that a reduction occurred between 1990 and 2003. We have used an average number for these estimates since yearly values are subject to changes in production.

With these caveats, Table 3-3 shows the current understanding of dioxin discharges and emissions from sources in the Lake Superior basin and Table 3-4 shows the percent reduction over time.

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

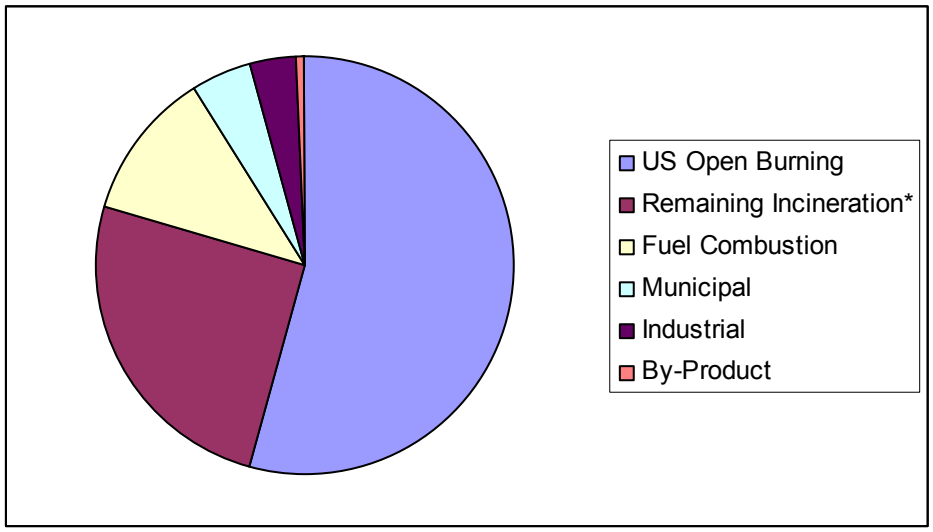
Source	US 1990	Canada 1990	Total 1990	US 2000	Canada 2000	Total 2000	US 2005	Canada 2005	Total 2005
Algoma Steel		19.4	19.4		0	0		0	0
Incineration	5.31-6.11	0.39	5.6-6.5	4.61-5.41	0.39	5.0-5.8	4.41 - 5.21	0.26	4.7 - 5.5
Fuel Combustion	1.30-1.48	0.25	1.55-1.73	0.41-0.59	0.23	0.64-0.82	0.44 - 0.63	0.23	0.67-0.86
Industrial	0.18	0.72	0.90	0.17	0.03	0.20	0.17	0.05	0.22
Municipal	0.26	0.05	0.31	0.26	0.05	0.31	0.26	0.05	0.31
Commercial By-Product	0.04	0.02	0.06	0.04	0.02	0.06	0.02	0.02	0.04
Total	**7.09-8.07**	**20.8**	**27.8-28.9**	**5.49-6.47**	**0.73**	**6.21-7.19**	**5.30-6.29**	**0.61**	**5.91-6.90**

Table 3-4 Percent Reduction of Dioxin Releases between 1990-2000 and 1990-2005.

Source	Percent Reduction 1990-2000	Percent Reduction 1990-2005
Algoma Steel	100	
Incineration	11 - 12	16 - 18
Fuel Combustion	53 - 59	50 - 57
Industrial	78	76
Municipal	0	0
Commercial By-Product	0	33
Total	**75 - 78**	**76 - 79**

The largest single reduction was due to the closing of Algoma Steel's iron sintering plant in Wawa, Ontario, which alone was responsible for about 66% of the dioxin emission reduction between 1990 and 2005. The next largest category is incineration, where the largest subcategory is US open burning of trash. The US Appendix C further breaks out the sources of dioxin emissions, which shows that US open burning is responsible for 3.94 g I-TEQ/yr. This was over half of the dioxin released from sources in the Lake Superior basin in 2005. Figure 3-4 shows the distribution of sources remaining in 2005. (Note that where a range of emissions was estimated, Figure 3-4 uses the high end of the estimate.)

Figure 3-4. Percentage of Dioxin Releases from Different Sectors in the Lake Superior Basin, 2005.



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

3.3.3 2010 Milestone

The 2005 goal of 80% was not reached, although it was quite close (i.e., estimated at 76% to 79% reduction). In order to meet the 90% reduction goal in 2015, in-basin sources must reduce an additional 3.13 to 4.01 g I-TEQ/yr of dioxin. Open burning is a preventable source of dioxin and elimination of open burning by 2015 would achieve the goal if all else remained equal.

Although overall dioxin emissions have been decreasing, there are two subcategories that may increase. Coal combustion could increase in the basin in response to increased energy demand. Also, cremation has increased in both countries since 1990, although this is still a relatively small source. The actual estimates for these subcategories are found in Appendix C. It is not known how the use of mercury control technologies at the Presque Isle and Taconite Harbor coal fired power plants will affect their dioxin emissions.

3.5 PCBs

The original intent of the Stage 2 PCB reduction schedule was to inventory all the PCB equipment, track the equipment disposed and derive the grams of PCBs reduced from the concentration of PCBs and the weight or volume of materials disposed. With this information, it would be possible to estimate the percent reduction over time. As noted in Chapter 4 of LaMP 2006, "The PCB inventory has been a challenge as there is no comprehensive and up-to-date inventory." Without the availability of a complete inventory, it is not possible to estimate PCB reductions over time.

To date, proposals for improving the inventory have not been approved by potential funders, who prefer a more proactive approach to PCB reduction. In the absence of a complete inventory, the Superior Work Group's Chemical Committee has considered what information is actually available for determining priorities and measuring progress. This includes the current PCB management approaches in the Lake Superior jurisdictions (see Appendix D), the information that is available on quantities of PCB materials removed for disposal or storage, and the need for consistency with the Great Lakes Binational Toxics Strategy (GLBTS). Table 3-5 shows the amount of PCB materials decommissioned and put into storage in Ontario from facilities in the basin for selected years. Clearly, significant quantities 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 3-6 shows the amount of PCB materials that have been disposed of in Minnesota from facilities in the basin. The cumulative total PCB waste has been graphed in Figure 3-5 and the equipment categories of ballasts, capacitors and transformers are broken out in Figure 3-6 and two categories of contaminated oil are shown in Figure 3-7(data provided by MPCA). While the cumulative total PCB wastes is still climbing in Figure 3-5, the equipment and oils trends in Figures 3-6 and 3-7 are relatively flat. It appears that materials are still being contaminated by PCBs, but disposal of PCB equipment and the oils in them have reached a plateau. Since PCB equipment is still present in Minnesota distribution systems and other parts of the power stations, this indicates additional effort is needed to move PCB phase-out to a higher level.

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 data base for PCB storage, the Environment Canada data base for PCB disposal and the Minnesota hazardous waste data base for PCB disposal. (Note: funds and regulatory mechanisms are not currently available to separately track the Wisconsin and Michigan PCB disposal records from facilities within the Lake Superior basin. See Appendix D for the PCB management approach in Michigan and Wisconsin.)
2. Examine the storage and disposal categories trends every 5 years (e.g., the weight of high level 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 3-5 to 3-7 are examples of this.
3. In Canada, also show how much of the stored PCBs are destroyed.
4. Compare these trends with provincewide or statewide trends.
5. Measure progress by the cumulative total of PCB materials stored or disposed and by the difference between the in-basin inventory and the provincewide or statewide inventories. PCB reductions should be as great or greater in the Lake Superior basin as the province or state.

Table 3-5. PCB Liquid and Solid Waste in Storage at Provincially Monitored Sites, 1990-2006.

Type of Waste	Year			
	1990[1.]	1995[1.]	1997[1.]	2006[2.]
HL liquid (L)				
Bulk liquid (L)	31407	142809	114385	16389
Amount in transformers (L)	32059	20024	13616	0
Amount in capacitors (L)	21646	384	0	0
Total HL liquid (L)	85112	163217	128001	16389
LL liquid (L)				
Bulk liquid (L)	54871	36212	18629	10057
Amount in transformers (L)	5295	5316	1707	1087
Amount in capacitors (L)	1102	0	0	0
Total LL liquid (L)	61268	41528	20336	11144
HL solid (kg)				
Wt. Of drums of soil and gravel (kg)	118025	49628	25800	0
Wt. Of drums of ballasts (kg)	5225	55570	31737	1200
Wt. Of drums of capacitors (kg)	19413	7040	5759	215
Wt of drums of clothing (kg)	3900	2435	6000	3600
Total HL solid (kg)	146563	114673	69296	5015
LL solid (kg)				
Wt. Of drums of soil and gravel (kg)	128604	133125	118421	0
Wt. Of drums of ballasts (kg)	1150	0	0	200
Wt. Of drums of capacitors[3.] (kg)	20	30	30	
Wt of drums of clothing (kg)	5900	11155	10125	1204
Total LL Solid (kg)	135674	144310	128576	1404
Miscellaneous Waste				
Pallets (kg)	270	270	270	
Transformer carcasses (kg)	150	550	700	168
Empty drums (no. of units)	31	8	7	
Unidentified waste (kg)	2125	330		807

HL= high level, <10,000 pm

LL = low level

Blank = data not available

1. Data obtained from Brigham (1999)

2. Data obtained from MOE (2006)

3. 1 partial drum (weight unknown), 2006

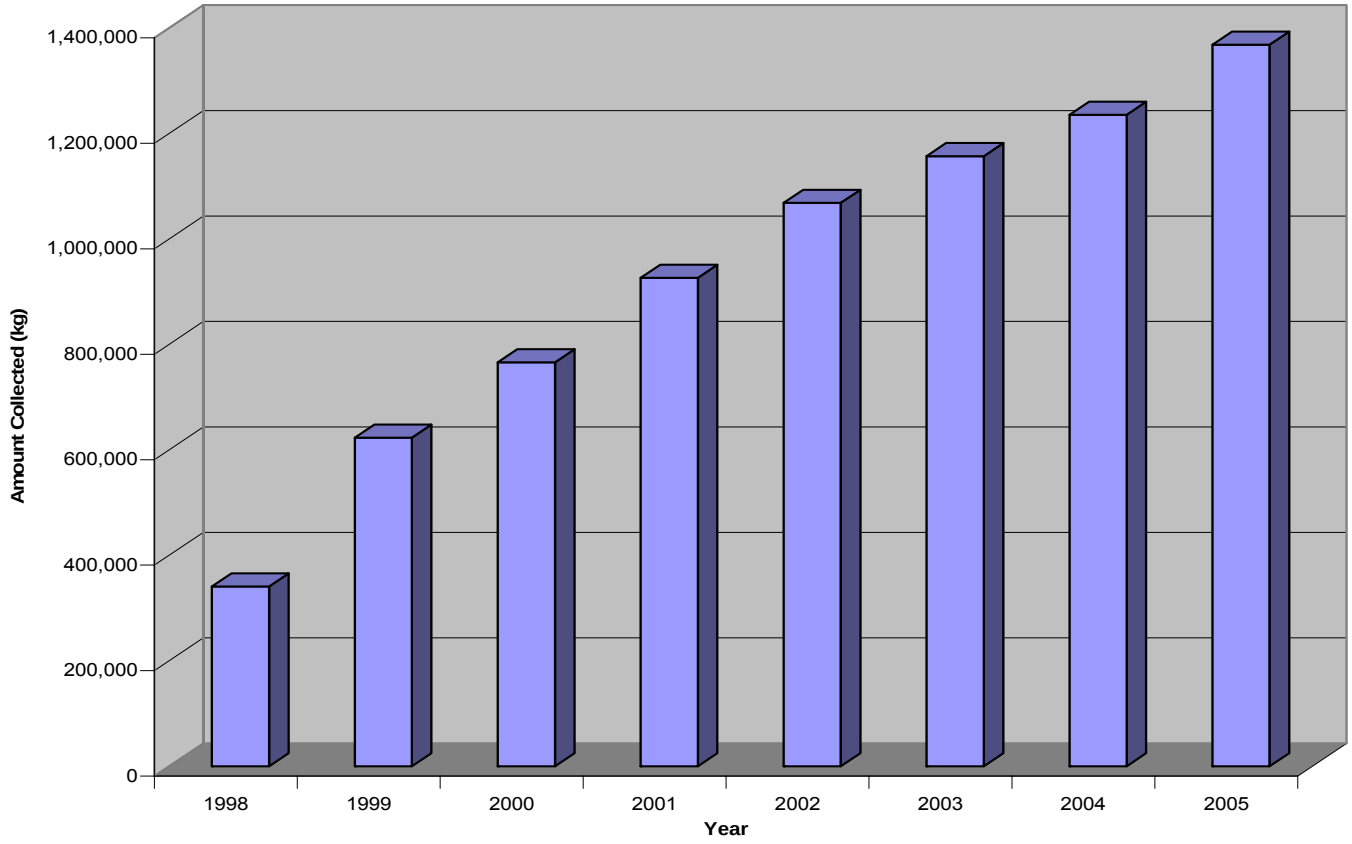
Table 3-6. PCB Liquid and Solid Waste Disposed from Minnesota Lake Superior Basin Facilities, 1998-2005 (kg/yr).

Type of Waste	Year							
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Ballasts	1,134	1,955	376	1,925	962	1,683	116	1,405
Capacitors	1,254	9,593	31,168	2,106	15,885	0	84	19
Contaminated Soil	3,061	3,061	0	0	0	0	0	0
Contaminated Equipment	2,122	6,256	4,455	3,157	14,774	0	0	0
Oil < 500ppm	185,441	93,747	98,549	69,282	84,327	445	0	284
Oil > 500ppm	9,522	22,406	0	0	0	0	0	0
Solids	4,095	940	615	69	363	0	831	272
Transformer Carcasses	111,133	141,647	5,350	82,429	23,875	1,550	3,036	7,620
Wastes	5,562	2,714	2,081	1,329	1,926	84,992	74,361	123,153
Total PCB Wastes	323,325	282,320	142,594	160,296	142,112	88,669	78,428	132,753
Bayside* to TX	0	0	0	0	0	0	45,428	0
Bayside* to WI	0	0	0	0	0	0	2,001,692,243	0
Bayside* to MI	0	0	0	0	0	0	416,863	0

- In 2004, Bayside Recycling accidentally shredded some PCB bearing equipment, which contaminated subsequent materials that passed through the shredder. Waste that was shipped to Texas for disposal was also contaminated with lead. The large amount of waste shipped to Wisconsin was very low level. The remaining contaminated material was sent to Michigan for disposal. None of the contaminated material was recycled. These data are not included in Figure 3-5 because they distort the overall trend.

Source: Franklin 2006.

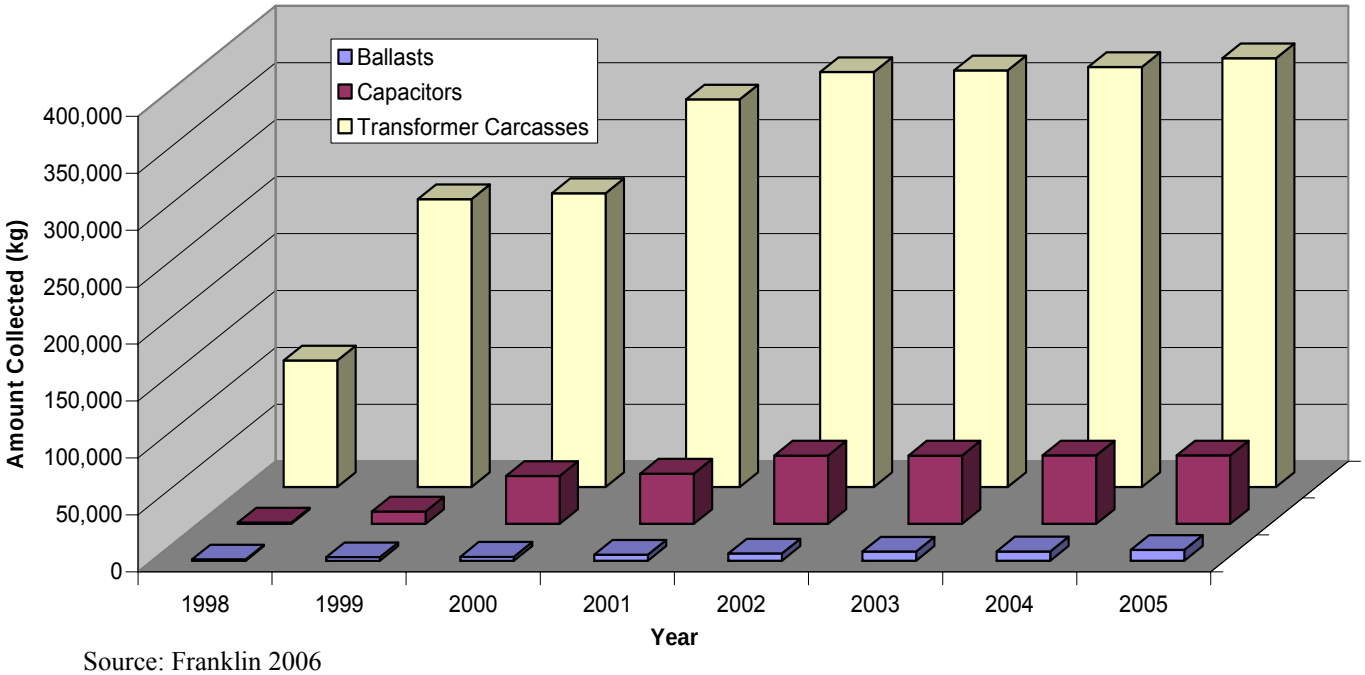
Figure 3-5. Cumulative Total of PCB Wastes Disposed from Minnesota Lake Superior Facilities*, 1998-2005 (kg/yr).



* Does not include Bayside Recycling 2004 shredder incident.

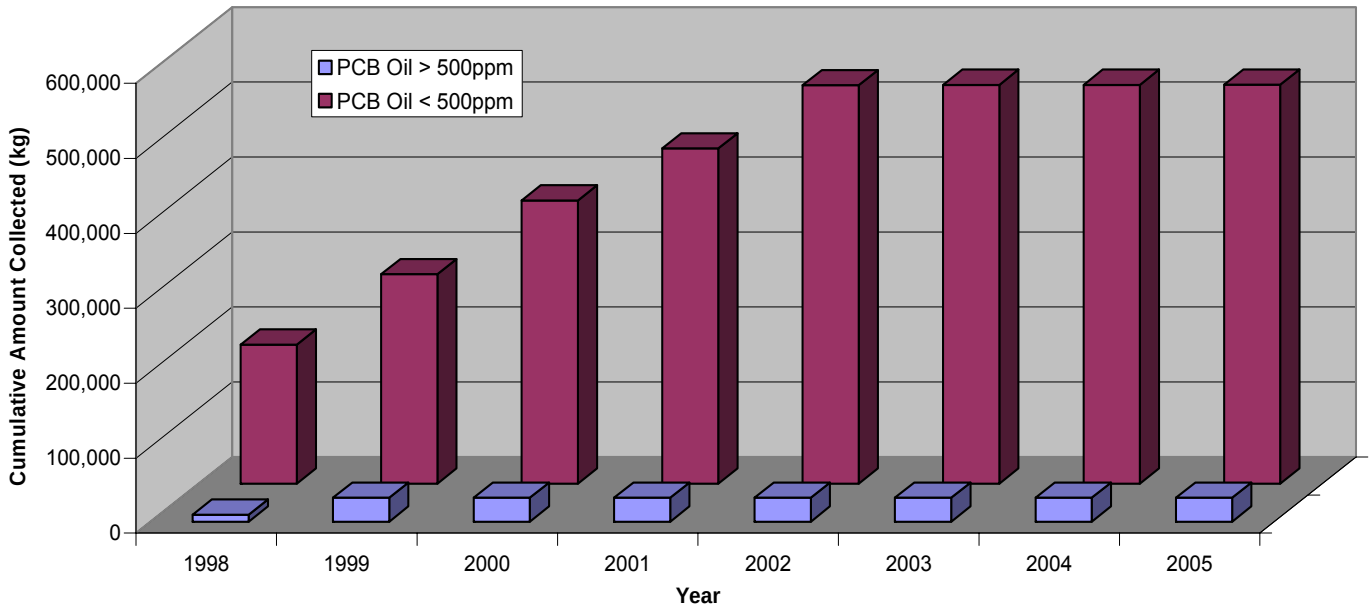
Source: Franklin 2006

Figure 3-6. Cumulative Total of PCB Ballasts, Capacitors and Transformers Disposed from Minnesota Lake Superior Facilities, 1998-2005 (kg/yr).



Source: Franklin 2006

Figure 3-7. Cumulative Total of High and Low Level PCB (<500 ppm) Contaminated Oil Disposed from Minnesota Lake Superior Facilities, 1998-2005 (kg/yr).



Source: Franklin 2006

3.6 Pesticides

3.6.1 Pesticide Reduction Goals

Use of DDT, toxaphene, chlordane and aldrin/dieldrin peaked in the mid 1960s to mid 1970s. All of these pesticides were canceled (production is legal, sale and distribution is illegal in the US) by the 1980s for domestic use in the United States and by the 1990s for domestic use in Canada and have not been produced in the United States for years.

The LSBP goal is to retrieve and destroy all remaining stockpiles of the canceled pesticides including DDT, DDE, aldrin/dieldrin, and toxaphene, as well as dicofol (also known as Kelthane), HCB, mercury pesticides and 2,4,5-T (Silvex) and other pesticides contaminated by dioxin or HCB in the basin by the year 2000. Although significant quantities have been collected it is not possible to assure that all stockpiles have been removed.

3.6.2 Pesticide Collections

Although US and Canada domestic production has ceased and uses have been canceled, these pesticides continue to have an environmental presence. Furthermore it should be noted that toxaphene and other pesticides in Lake Superior mostly originates from regions outside the basin and significant amounts arrive through aerial transport and deposition. In addition, the level of toxaphene in Lake Superior has not shown a general decline over the years like the other pesticides (see section 4.3.4). Collection programs in the Lake Superior basin continue to bring in these pesticides. Lake Superior strategies for pesticides include continued or expanded collection opportunities coupled with concerted public outreach. This strategy 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., BHC and heptachlor). The collections carried out in each Lake Superior jurisdiction are described below.

<u>Michigan</u>

The Michigan Department of Agriculture's Michigan Groundwater Stewardship Program (MDA MGSP), in cooperation with the USEPA, local units of government, and the Michigan Department of Environmental Quality (MDEQ), has established 16 permanent Clean Sweep sites located throughout the state.

Michigan's Clean Sweep pesticide collections originally began in 1987 as a series of one-day collections in specific watersheds. The move to establish permanent Clean Sweep pesticide collection sites began in 1996 when Michigan Department of Agriculture (MDA[1]) obtained USEPA funding to construct five sites throughout the state.

Clean Sweep is made possible by a strong and unique state, federal, local and industry partnership. The MDA[1], through the MGSP and fees from pesticide and fertilizer

registration on specialty and agricultural products, provides funding to support the disposal of pesticides, while the local unit of government/host site provides for staffing, scheduling, site maintenance, promotion, vendor selection, etc. The USEPA has historically provided funding for site construction, and will often provide additional funding for pesticide disposal. During the past ten years, over 1,200,000 pounds or 545 tonnes, of pesticides have been removed from circulation and properly disposed of via the permanent collection sites.

Farmers and individual Michigan residents may drop off potentially harmful pesticides at a Clean Sweep site where they will be collected, packaged for shipping, and disposed of properly and safely. There is no charge for this service.

The Marquette County Solid Waste Authority serves as a collection point for pesticide drop-offs in the Upper Peninsula in the Lake Superior Basin. They collect and store pesticides at an approved site until they have enough to make it worthwhile for them to call a licensed waste hauler. The pesticides are then incinerated at an approved facility. The MDA[1] reimburses the Marquette County Solid Waste Authority for the pesticide disposal cost.

Generally, pesticide usage is low in the Michigan Lake Superior Basin. The Marquette County Solid Waste Authority collects waste from 12 counties in the Upper Peninsula, and few pesticides were collected between 1990 and 1996 (Knorek, 2005). Limited data is available on waste pesticides collected in the Michigan Lake Superior Basin from 1996 to 2004. In 2005, the state developed a database of pesticide collection data beginning with 2004 data. In 2003, Michigan began tracking each product presented for disposal by the USEPA registration number.

The 2004 Lake Superior LaMP reports 434 kg (955 pounds) of pesticides were collected at the Marquette County Solid Waste Authority (i.e., Alger, Baraga, Chippewa, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Ontonagon, and Schoolcraft). 15 kg (33 pounds) was DDT.

From May 2005 to August 2006, the Marquette County Solid Waste Authority collected 362 pounds (164 kg) of active ingredient from waste pesticides. The active ingredient information is based in USEPA Pesticide Product Information System data on products and formulation. Of the waste pesticides collected, 2.65 pounds (1,2 kg) was Chlordane. Additionally, no DDT, toxaphene, mirex, Dieldrin/Aldrin, or Heptachlor was identified during the collections. Although, nearly 70 percent of the product collected came in as unknown.

Minnesota

The Minnesota Clean Sweep Program began to collect waste pesticides in 1990. Over 1.2 million kg (2.8 million pounds) of waste pesticides have been collected and documented since the program began. Many of these pesticides were collected during waste pesticide clean sweep collections organized and staffed by the Minnesota

Department of Agriculture (MDA^2). Some sources of these pesticides were 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 Lake Superior basin in 1992.

Since 1996, the Western Lake Superior Sanitary District (WLSSD) has had a cooperative agreement with MDA^2 to collect and inventory all pesticides collected from households in Carlton, Cook, Lake, and St. Louis Counties. As part of this agreement, MDA^2 would pay for the disposal of household pesticides collected at the Duluth Regional Household Hazardous Waste (HHW) facility, run by WLSSD, and shipped for disposal.

In 2002, the MDA^2 began clean sweep operations with reduced funding. To address the continuing need for pesticide disposal, MDA^2 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^2 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^2 and documents certain pesticides disposed of from the area. Since spring of 2004, WLSSD is a cooperator in a new partnership with MDA^2 that allows WLSSD to collect, store, and ship agricultural/business pesticides for payment by MDA^2. WLSSD also ships HHW waste pesticides for payment by MDA^2. To date, MDA^2 has been able to pay for and record all pesticides that WLSSD has collected; however, there is an allotment that, once reached, WLSSD can cease collecting or pay for disposal themselves.

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 persistent, bioaccumulative, and toxic (PBT) household pesticides, including dioxin bearing pesticides, that are received for disposal by MDA^2. MDA^2 also requires participating facilities to document agriculture and business waste pesticides in order to distinguish them from HHW waste pesticides.

Table 3-7 presents data for pesticides targeted for zero discharge in the Lake Superior Basin. The tables include pesticides collected from counties that make up the Lake Superior Drainage Basin in Minnesota. Three other counties are considered to contribute insignificant land volume to this area. 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^2 are recorded in $MDA's^2$ database and thus are included in the tables. The largest quantity of pesticides were collected from St. Louis County, where WLSSD is located. This may be influenced by the way in which the collected pesticides were inventoried. If a pesticide was not attached to a county during the inventorying, then it was listed under St. Louis County, WLSSD's home county. No pesticides were collected from Cook County. During the period 1992-2004, more pesticides containing dioxin were collected than any other pesticide. Nearly 4,050 kg (9,000 pounds) of pesticides

containing dioxin were collected from the four Minnesota counties during this period. Approximately 3,482 kg (7,700 pounds) of DDT were collected. No mirex was collected from these counties from 1992 to 2004.

Table 3-7. Waste Pesticides Collected in Minnesota Lake Superior Counties*, 1992-2004 (kg).

Pesticide	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Chlordane	74	23	5	47	90	92	83	64	83	72	4	23	42	703
DDT	451	336	24	51	1403	135	253	267	306	134	32	34	59	3483
Dieldrin/ Aldrin	5	5	0	0	6	0	27	8	4	5	0	0	0	59
Dioxin†	0	3	1354	943	440	96	233	213	297	415	5	11	42	4051
Heptachlor	50	0	0	0	1	0	0	0	1	1	0	0	0	53
Mirex	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	61
Total	596	371	1383	1051	1945	328	596	565	692	630	40	69	142	8410

* Includes data for pesticides collected in Carlton, Cook, Lake, and St. Louis Counties. All amounts reported in kilograms.
† The pounds 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: Kaminiski 2005.

Wisconsin

The Wisconsin Department of Agriculture supports collections in Wisconsin counties. The first year that Clean Sweep grants were awarded in Lake Superior Basin counties was 1992. However, the data for 1992 were not broken down by individual pesticide. No data were reported for Lake Superior Basin 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, began agricultural collections in Lake Superior Basin counties in 1996. Table 3-8 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 Lake Superior Basin area of Wisconsin, no pesticides/poisons were collected during HHW collections held in Douglas County (no collections were held in Ashland, Bayfield, or Iron Counties).

Table 3-8. Waste Pesticides Collected in Wisconsin Northwest Cleansweeps*, 1996-2004 (kg).

Pesticide	1996	1997	1998	1999	2000	2001	2002	2003	2004	Total
Chlordane	0	2	0	19	45	0	33	34	1	132
DDD/DDT	36	3	0	61	76	101	30	5	0	311
Dieldrin/Aldrin	0	4	0	331	6	10	0	0	0	351
Dioxin†	376	73	268	589	517	477	423	365	222	3310
Heptachlor	0	0	0	0	0	0	0	4	0	4
Mirex	0	0	0	0	0	0	0	0	0	0
Toxaphene	218	0	0	0	0	0	0	0	0	218
Total	630	81	268	999	643	587	486	406	223	4325

* All amounts reported in kilograms. Includes data for pesticides collected in counties served by the NWRPC as follows:
1996: Ashland, Bayfield, Douglas, and Iron Counties
1997: Ashland, Price, Taylor, and Washburn Counties
1998: (counties served were not specified)
1999: Ashland, Douglas, Eau Claire, Iron, Rusk, Sawyer, St. Croix, Taylor, and Washburn Counties
2000: Ashland, Bayfield, Douglas, Iron, Price, Rusk, Sawyer, St. Croix, Taylor, and Washburn Counties
2001-2003: Ashland, Bayfield, Burnett, Douglas, Iron, Price, Rusk, Sawyer, St. Croix, Taylor, and Washburn Counties
2004: Ashland, Bayfield, Burnett, Douglas, Iron, Price, Rusk, Sawyer, Taylor, and Washburn Counties

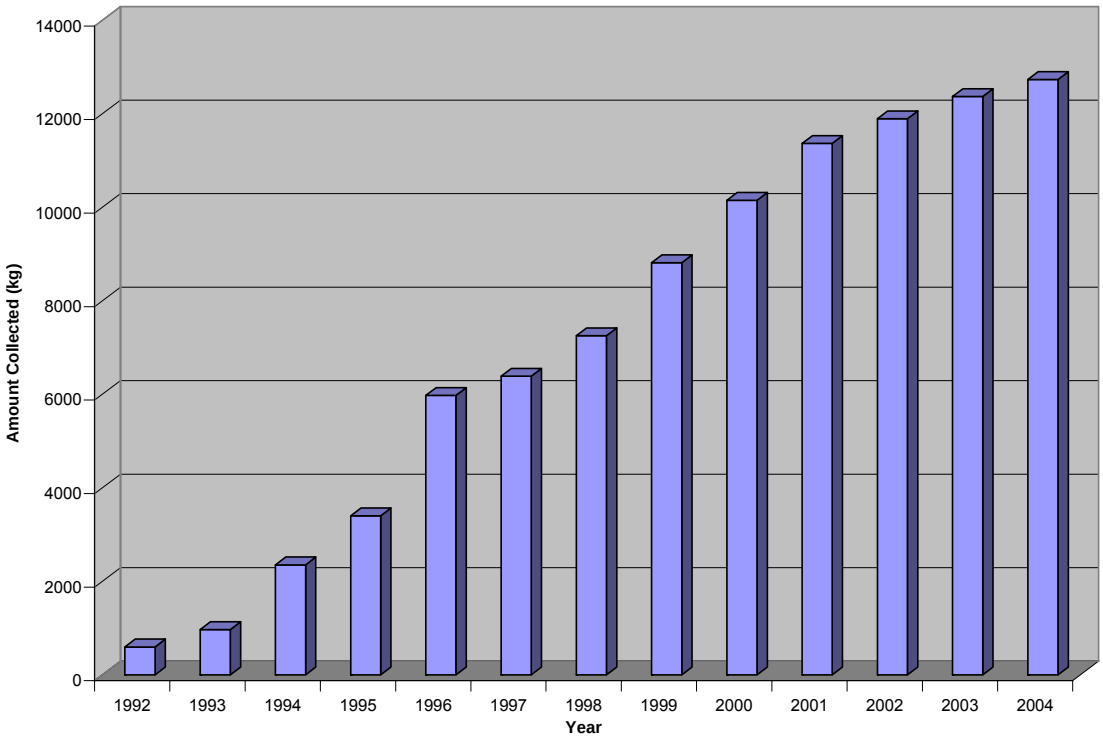
† The pounds listed are for pesticides containing dioxin (Silvex, 2,4-D, pentachlorophenol, and 2,4,5-T).
Source: Springman 2005.

Because of the similarity between the Minnesota and Wisconsin collection programs, it is possible to chart the cumulative total of pesticides from Tables 3-7 and 3-8. Figure 3-8 shows a steady steep rate of pesticides collected over time. The amount collected jumps in 1996 when the Wisconsin program begins. It does appear that the rate of collection of these particular banned pesticides is beginning to slow down starting in 2001.

Ontario

In the early 1980s, Canadian pesticide collections were administered through two Clean Sweep programs. The last Ontario Ministry of Environment (MOE) agricultural waste collection program was conducted in 1991 to 1992. Pesticides have been collected as household hazardous wastes at regional/municipal household hazardous waste depots in Thunder Bay. These depots will continue to collect these substances. In 2002 and 2003, collections in Thunder Bay, Manitouwadge and Marathon took in 599 kg (1,321 pounds) of solid pesticides and another 1,348 litres (350 gallons) of liquid pesticides.

Figure 3-8. Cumulative Amount of Pesticides Collected in Minnesota and Wisconsin Counties in the Lake Superior Basin, 1992-2004 (kg).



3.6.3 Conclusions

Although the Lake Superior basin is mostly non-agricultural, a significant amount of banned pesticides have been collected in or near the basin since 1992. While 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. The good news is that the rate of these pesticides being turned in appears to have dropped since 2001. 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 areas.

3.7 Hexachlorobenzene

The HCB inventory is problematic since it is incomplete. Appendix C contains the limited estimates that have been completed. Based on this limited data, the following conclusions about HCB in-basin sources can be drawn:

- There is limited data available to calculate total emissions from this source. HCB was likely emitted from the former iron sintering facility in Wawa which was operating in 1990 and from on-site residential waste combustion, landfill fires, and medical waste

incinerators but no data are available to confirm this. Remaining conclusions apply only to those sources where HCB emissions were calculated.

- On the Canadian side, emissions to the atmosphere, soil and water (environment) declined from 224 g in 1990 to 34.1 g in 2005, corresponding to a decline of 85%. The decrease is largely associated with reductions in reported HCB emissions from the OPG Thunder Bay generating station which reported a release of 123.9 g in 2000 but has reported zero release of HCB every year since.
- Pulp and paper has also been responsible for significant reductions (about 32% of the total), likely due to the conversion of the bleaching process to chlorine dioxide in place of elemental chlorine.
- Currently, the largest source of HCB on the Canadian side is from the PCP-treated utility poles and railway ties in use (21 g), followed by residential wood combustion (10 g).
- The largest source in the US HCB inventory was open burning of trash, followed by motor vehicles.
- HCB emissions from coal combustion were not estimated for the US side. It is not known how the use of mercury control technologies at the Presque Isle and Taconite Harbor coal fired power plants will affect their HCB emissions.

Chapter 4. Re-evaluation of Critical and Prevention Pollutants

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 in the LaMP Stage 2 (LSBP 1998).

Initially, a list of "chemicals of concern" was developed by combining the U.S. Great Lakes Water Quality Guidance (GLI) Bioaccumulative Chemicals of Concern (BCC) and the list of Tier I and Tier II substances under the Canada-Ontario Agreement (COA) (see Appendix E). 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 (see Figure 4-8) and placed into either the "Critical" or "Prevention" pollutant categories.

The list of Critical pollutants includes substances which 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 Zero Discharge Demonstration Program (ZDDP). Prevention pollutants have properties that give them potential to impair the lake but they have been found below harmful levels or have not been monitored in Lake Superior. The intention is to manage the Prevention pollutants to avoid impairments in the future.

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 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 (below).

This chapter provides an overview of the environmental levels of Critical pollutants, Prevention pollutants and substances of emerging concern in Lake Superior water, sediment and wildlife. This is followed by an overview of the issue of contaminants of emerging concern, a proposed update to the list of Critical and Prevention pollutants, and a proposed watch list for emerging contaminants.

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

Management Category	Pollutant
Critical Pollutants	
Zero Discharge*	As a management approach, virtual elimination from the environment requires that zero discharge or emission is applied to the use, generation, and release of persistent, bioaccumulative, toxic substances originating from human activities. The effect of these chemicals is found both locally and lakewide. Sources may be local or outside of the basin.
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 Areas of Concern (AOCs) or other nearshore areas. These are mainly metals which have both natural sources and sources due to human activity. The management approach is concurrent localized reduction in loads and remediation of hot spots.
Prevention Pollutants	
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.

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

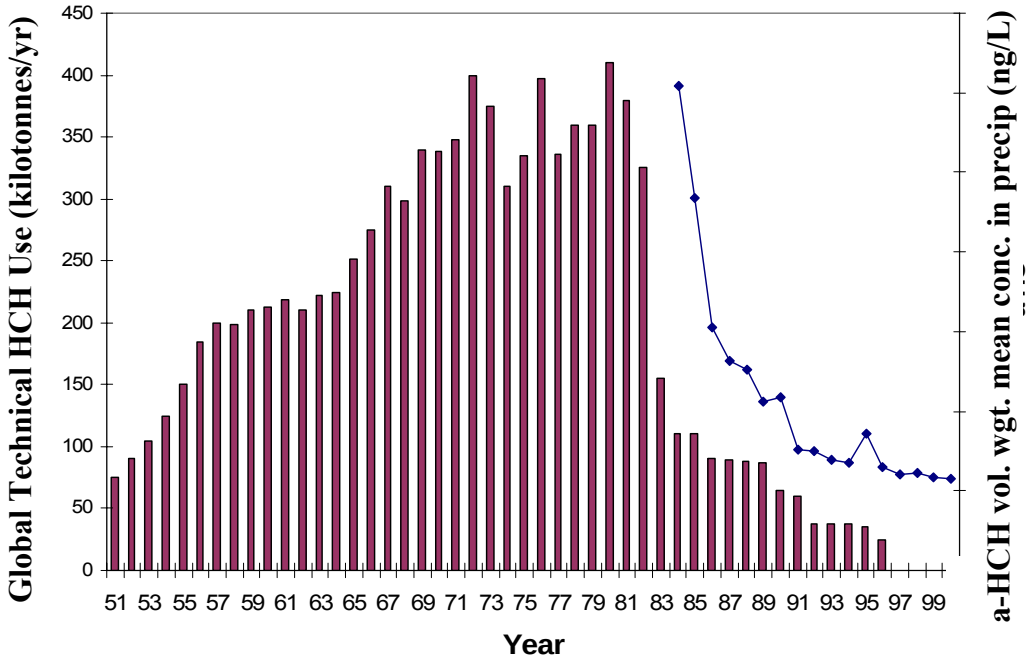
4.1 Contaminant Levels and Trends Summary

The tables and figures in section 4.1 are summarized from a presentation given during the Lake Superior Task Force teleconference meeting on November 9, 2005. The complete presentation can be found in Appendix F. The tables and figures provide general information on temporal trends of persistent, bioaccumulative, and toxic (PBT) chemical contaminants in various media of the Lake Superior ecosystem including air, water, herring gull eggs, and fish. Looking at contaminant trends across various media provides insight into ecosystem-wide trends in contaminants rather than trends in only one medium. At the time of LaMP 2006 publication, chemical contaminant analyses of water, sediment, air, precipitation, lower food web, and fish samples collected during the 2005 Lake Superior Coordinated Monitoring effort, were being completed. When compiled, these data will provide a current snapshot of chemical contaminants in Lake Superior.

4.1.1 Atmosphere

In Figure 4-1, the volume weighted mean concentration of α-HCH in precipitation at the Integrated Atmospheric Deposition Network (IADN) satellite station at Sibley, Ontario, Canada has declined in a pattern following a reduction in the global usage of technical HCH (technical HCH is about 70% α-HCH; Chan *et al.* 2003). These data show a clear environmental response to government intervention in reducing the use of a persistent chemical.

Figure 4-1. Decline of α-hexachlorocyclohexane (α-HCH) in Precipitation at Sleeping Giant Provincial Park, Ontario, Canada Following Global Decline in Usage of Technical HCH.



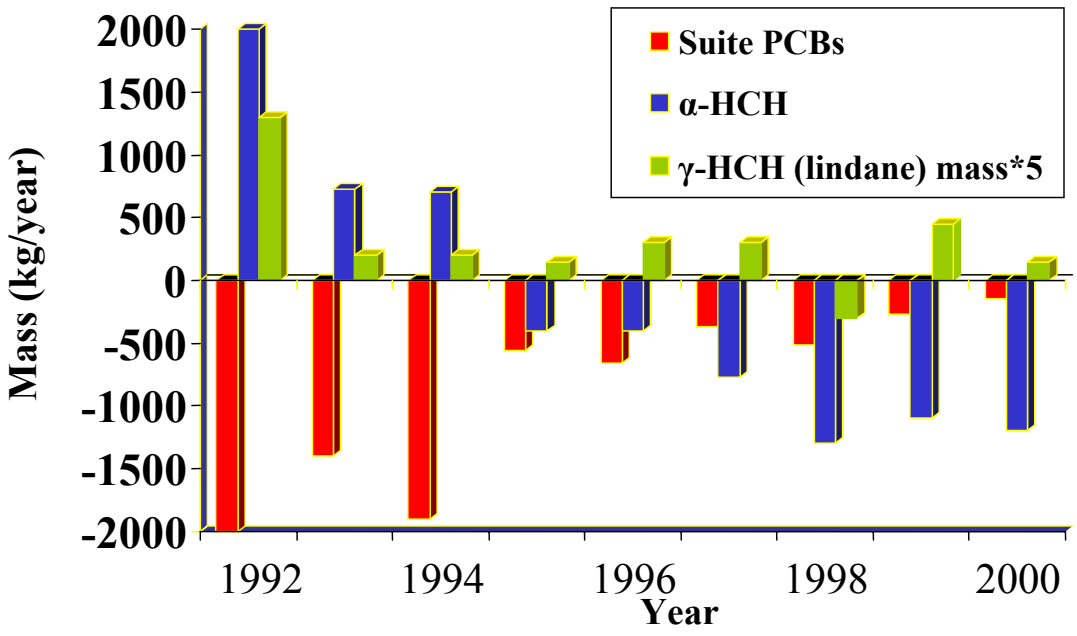
Source: Chan *et al* (2003)

Figure 4-2 shows how a lake responds slower than the atmosphere to reductions in use of a chemical. Negative numbers indicate the net flow of a chemical over the course of a year is from the lake to the atmosphere. Positive numbers indicate net flow from the atmosphere to the lake. Note that lindane flows are multiplied by 5 to compensate for the scale of the graph.

After chemicals such as PCBs and α-HCH were banned, atmospheric concentrations quickly declined and the atmosphere has become a sink rather than a source of these chemicals. Lake Superior continues to be a reservoir for chemicals such as PCBs and α-HCH, but has slowly moved towards steady state where atmospheric inputs to the lake will equal outputs from the lake. Contrast this with γ-HCH (lindane), which is still in use and for which the atmosphere is still largely a source to Lake Superior.

Despite declines in atmospheric concentrations of critical pollutants, the atmosphere continues to be the main source of these pollutants to Lake Superior. Long range transport of pollutants from areas such as the southern Great Lakes and southeastern United States continue to bring pollutants to the lake (Hafner and Hites 2003, Ma, 2005).

Figure 4-2. Atmospheric Flows (kg/year) of a Suite of PCBs, α-HCH, and γ-HCH (Lindane) Over Time at the Eagle Harbor IADN Site.



Source: Blanchard *et al*. 2004

4.1.2 Water

Concentrations of a suite of toxic organic contaminants in water including some of the Lake Superior critical and lakewide remediation pollutants have declined between 1986-87 and 1996-97 (Table 4-2). Nevertheless, of the nine critical pollutants, dieldrin, PCBs and toxaphene concentrations in Lake Superior continue to exceed the most stringent water quality yardsticks. As noted in Section 4.1.1, open lake water concentrations of these pollutants respond slower to reductions in use than atmospheric concentrations. As a result, critical pollutants currently exceeding water quality guidelines are likely to remain above these guidelines for many years.

Table 4-2. Concentrations of Some LaMP Critical Pollutants (ng/L) in Lake Superior Open Lake Water Compared to Water Quality Yardsticks (see note below).

	MN*	MI*	WI*	ON**	Open Lake Concentration
PCBs	0.0045	0.026	0.003	1.0	**0.0705**[1]
HCB	0.074	0.45	0.22	6.5	0.014[2]
Dieldrin	0.0012	0.0065	0.0027	1.0 (+ Aldrin)	**0.126**[2]
Chlordane	0.04	0.25	0.12	60	<0.03[3], 0.0099[4]
DDT	0.011	0.011	0.011	3.0 (∑DDE, DDD, DDT)	0.005[2] (p,p'DDE)
Mercury	1.3	1.3	1.3	200	0.71[5]
Toxaphene	0.011	0.068	0.034	8.0	**0.7**[6]
g-BHC (lindane)	80	25	18	10	0.357

* Water quality based standards for the Lake Superior states are based on GLI methodology.

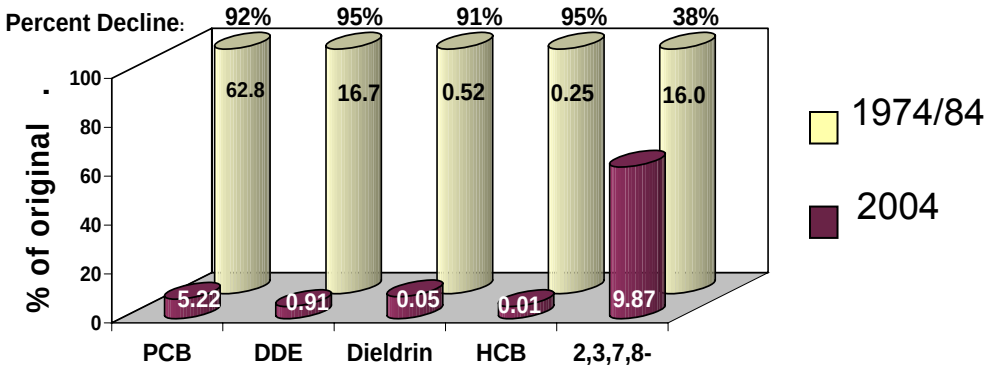
** The purpose of listing available yardsticks from each jurisdiction is not to compare these numbers between jurisdictions, but to provide a reference for comparing water quality results to available yardsticks and determine if exceedences are occurring. For instance, Ontario's Provincial Water Quality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

[1]Warren, 2005 (1996 data), [2]Williams *et al*. 2004 (2001 data), [3] Williams and Kuntz 1999 (1997 data), [4]Jantunen *et al.* in press (1996-1998 data), [5]A. Dove, 2006 (2003 data), [6]Muir *et al*. 2004 (1998 data).

4.1.3 Herring Gull Eggs

The concentrations listed for each chemical or chemical group are the mean of the two Lake Superior monitoring sites which are part of the Canadian Wildlife Service's Herring Gull Egg Monitoring Program (Granite Island and Agawa Rocks). They show a 38% to 95% decrease in concentrations between the initial year of monitoring for the chemical or chemical group and concentrations measured in 2004.

Figure 4-3. Percent Decline in Mean Concentrations of a Set of Chlorinated PBT Chemicals in Herring Gull Eggs Collected from Two Sites on Lake Superior Between 1974 or 1984 and 2004.*



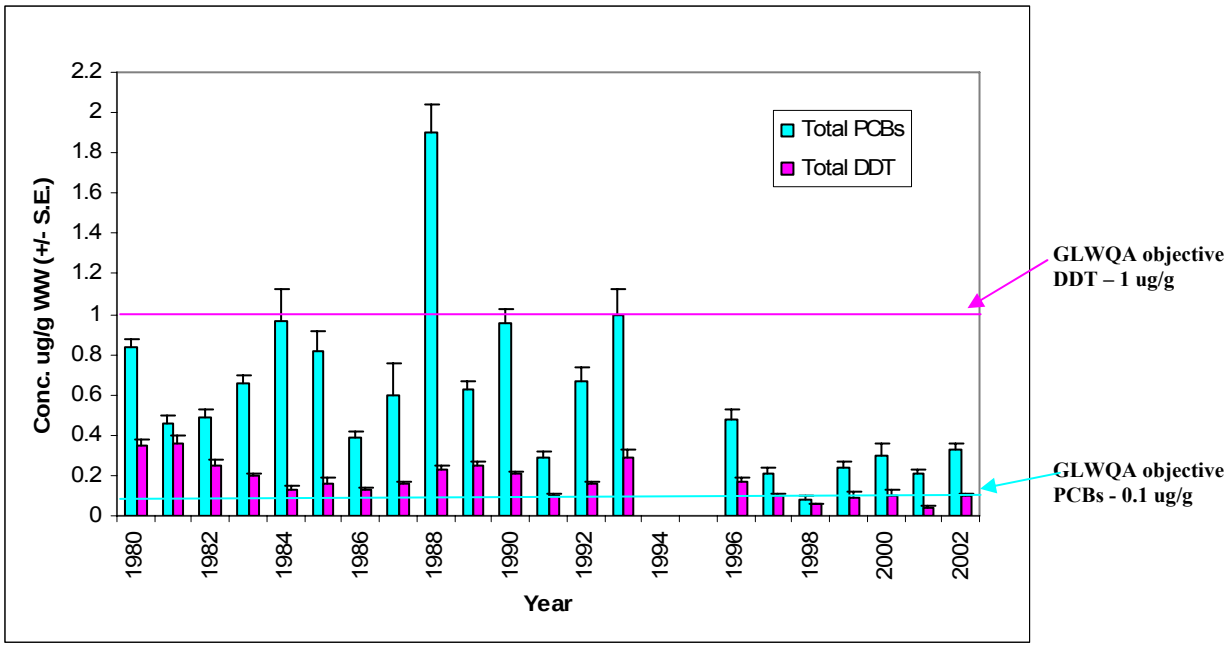
*Dioxin monitoring began in 1984 and all other listed contaminants have been monitored since 1974. Dioxin concentrations are reported in parts per trillion (pg/g) and all other chemicals are reported in parts per million (ug/g).

Source: Weseloh and Havelka, pers. comm..

4.1.4 Whole Lake Trout

Canada's Department of Fisheries and Oceans (DFO) and the USEPA have programs in place to monitor chemical contaminant temporal trends in Great Lakes whole lake trout. Data from both programs show that concentrations of most monitored chemicals in Lake Superior whole lake trout have declined over time (Figure 4-4). While concentrations of some chemicals such as DDT and its metabolites have met the GLWQA fish tissue concentration objectives in whole fish, others such as total PCBs, continue to exceed these objectives.

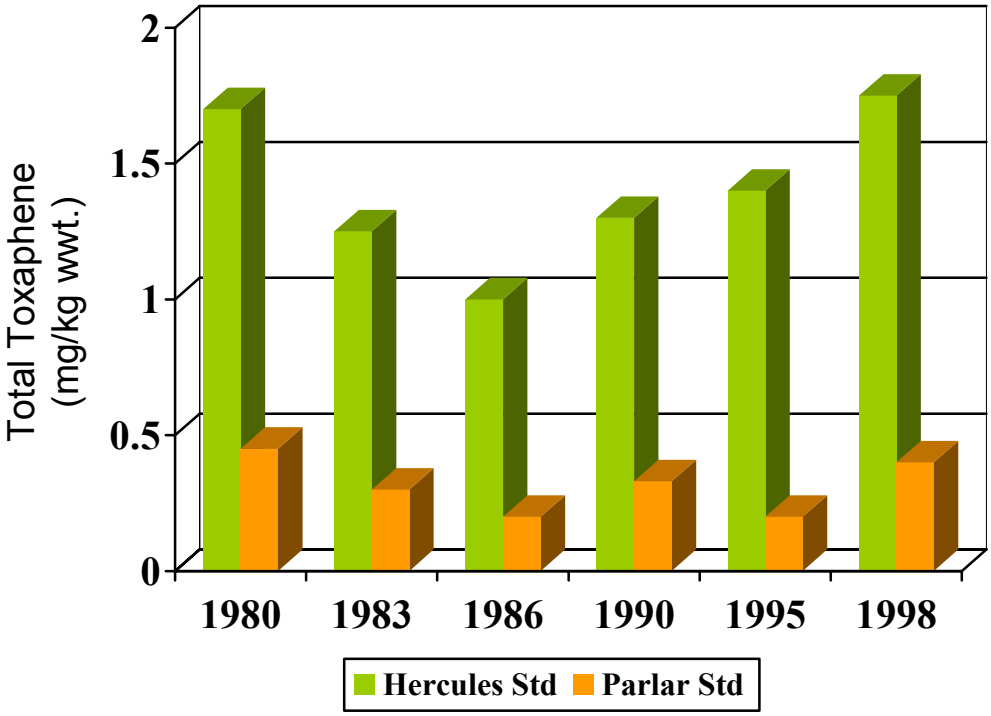
Figure 4-4. Concentrations of Total PCBs and Total DDT in Whole Lake Trout Collected and Analyzed by the Canada's Department of Fisheries and Oceans.



Unlike most other PBT contaminants that have been monitored in Lake Superior whole lake trout, concentrations of toxaphene have not declined over time (Figure 4-5). Toxaphene concentrations in Lake Superior lake trout are generally the highest in the Great Lakes (Luross *et al.* 2002, Swackhamer 2004). Several factors are responsible for toxaphene levels not declining in Lake Superior. First, the chemical properties of toxaphene (relatively high vapor pressure, high solubility) coupled with the lake's size, cold temperatures, and long water retention time, lead to greater persistence of toxaphene. Second, food web changes in Lake Superior over time have had an effect on toxaphene concentrations in top predators such as lake trout.

The example of toxaphene shows that despite its remote location and relative lack of industrial development within the basin, the properties of the Lake Superior ecosystem make it very susceptible to long-range transport of pollutants.

Figure 4-5. Total Toxaphene Concentrations in Whole Lake Superior Lake Trout Over Time Quantified Using Two Different Toxaphene Standards.



Source: Whittle *et al.* 2000

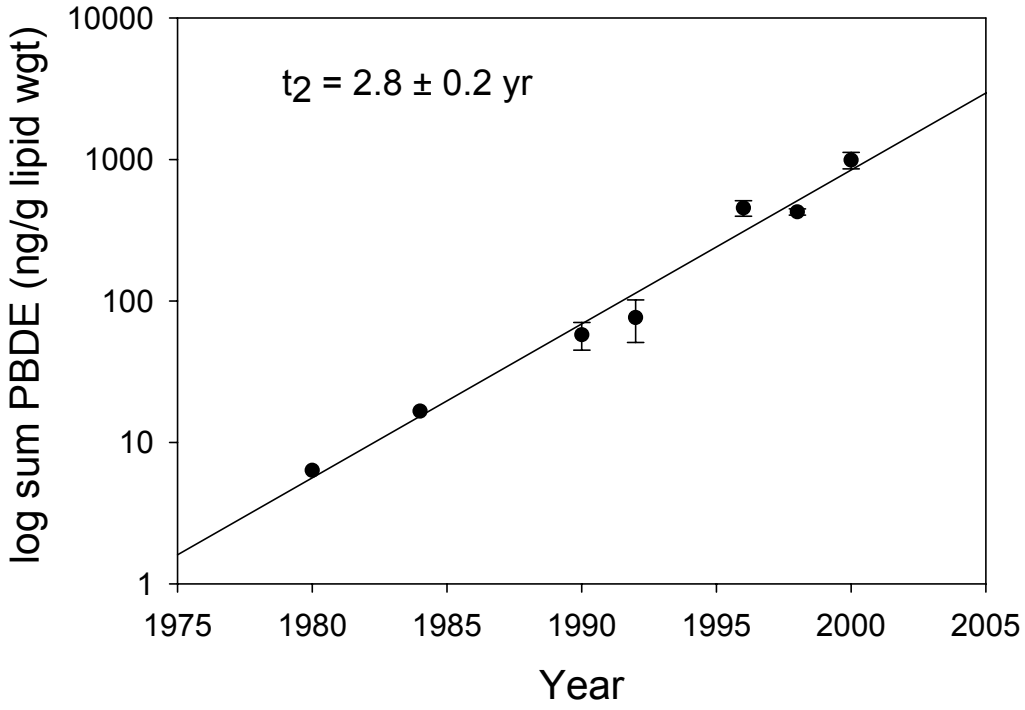
4.1.5 Emerging Contaminants

The term "emerging contaminants" has come to define an emerging awareness of the presence in the environment of many chemicals used in commerce, along with concern over the risk that these chemicals may pose to human and wildlife health. See section 4.2 for a further discussion of this group of chemicals.

Polybrominated Diphenyl Ethers (PBDEs) are a class of flame retardant chemicals that are often labeled as emerging contaminants. While concentrations of PCBs, DDT, and other "legacy" pollutants have been declining in the Lake Superior environment, analysis of archived Lake Superior whole lake trout tissues (Figure 4-6) shows that PBDE concentrations increased exponentially between 1980 and 2000 with a doubling time every 2.5 – 3 years (Zhu and Hites 2004).

Monitoring data for most other classes of emerging contaminants in Lake Superior is currently very limited or non-existent, making an evaluation of their environmental presence and potential effects to the Lake Superior ecosystem difficult at this time.

Figure 4-6. Concentrations of Polybrominated Diphenyl Ethers (PBDEs) in Whole Lake Trout from Lake Superior, 1980-2000.



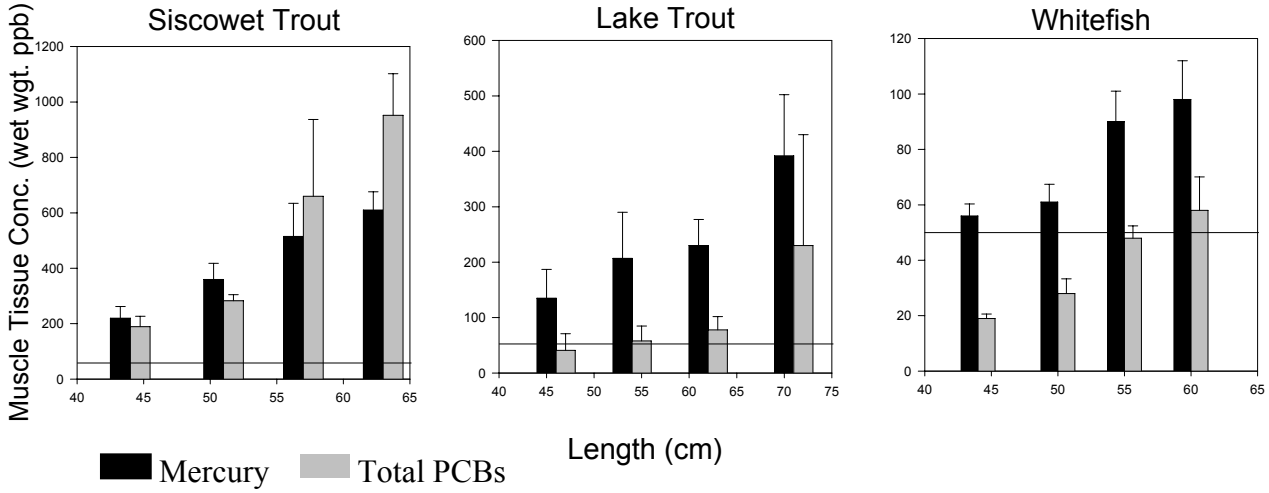
Source: Zhu and Hites. 2004

4.1.6 Human Health

Contaminants measured in fillet tissues of fish provide an estimate of human exposure to these contaminants through fish consumption. Many jurisdictions around Lake Superior, including states and provinces, provide risk-based advice designed to limit exposure to environmental contaminants through fish consumption.

Concentrations of mercury and/or total PCBs in fillet tissues from all sizes of Lake Superior lake trout, siscowet lake trout, and whitefish measured in studies conducted by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) continue to exceed the most restrictive fish consumption advisory trigger levels used by jurisdictions around the lake (Figure 4-7). Other contaminants such as dioxins and furans, chlordane, and toxaphene are also responsible for fish consumption restrictions in some species and sizes of Lake Superior fish. Although concentrations of most contaminants are lowest in Lake Superior fish (compared to the other Great Lakes) and have decreased over time in the Lake Superior environment, they continue to impair the beneficial use goal of unrestricted fish consumption stated in Annex 2 of the GLWQA.

Figure 4-7. Total Mercury and Total PCB Concentrations in Fillet Tissue of Lake Superior Siscowet Trout (*Salvelinus namaycush siscowet*), Lake Trout (*Salvelinus namaycush namaycush*), and Whitefish (*Coregonus clupeaformis*).*



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

Source: GLIFWC data, unpublished

4.1.7 Summary and Potential Management Implications

- In general, concentrations of many legacy PBT contaminants have declined over time. Government intervention has been very effective.
- In most cases, concentrations of PBT chemicals in various media are decreasing at much slower rates or have leveled off over time.
- Lake Superior's physical, thermal, and biological properties make it unique and particularly sensitive to retaining PBT chemicals.
- The atmosphere is the main source of PBTs to the lake; some source regions have been identified.
- Substances of emerging concern such as PBDEs are increasing in fish and sediments in Lake Superior.
- Fish consumption advice is continually changing due to new monitoring data and new information on toxicological interactions of individual contaminants and contaminant mixtures.
- Fish advisories will likely not decline in the foreseeable future because small declines in fish tissue concentrations will not equal significant changes in fish consumption advice.
- Because the Lake Superior ecosystem is sensitive and is efficient at retaining environmental contaminants, prevention is critical to protecting Lake Superior (toxaphene example).

- Stop the introduction of invasive species. Disruption of the food chain affects contaminant transport as well as the biology of the Lakes.
- Coordinated monitoring efforts need to continue as per agreed to rotational schedule. The next Lake Superior monitoring year will be 2011.
- Statistical design of monitoring programs may need to change to reflect lower environmental concentrations; i.e. have greater power to detect changes in concentrations.
- Action is needed beyond the Lake Superior basin. The Zero Discharge Demonstration Project is critical for the Lake Superior basin but will have limited impact on these PBTs in the Lake Superior environment in the face of regional and global sources.
- Many positive recommendations were identified in the work of the Great Lakes Regional Collaboration (GLRC) on the U.S. side. These need to be implemented.
- Advocating for pollution prevention, 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 Emerging Contaminants

The continuing discovery of chemicals used in industrial, agricultural, and personal applications in air, water, sediment, and biota has brought forth a formidable challenge for environmental scientists, managers, and policy makers. The universe of new chemicals being discovered in the environment is often lumped into a collective group referred to as "emerging contaminants". While it has been known for over 20 years that compounds such as pharmaceuticals enter the environment, improvements in instrumentation and analytical methodology for detecting chemical substances in environmental media have brought increased awareness and concern over the presence and potential risk that these chemicals may pose to the health of humans and other organisms in the environment (Daughton 2001, Sanderson et al. 2003, Sanderson et al. 2004).

4.2.1 What Are Emerging Contaminants?

There are approximately 75,000 chemicals currently registered under the *Toxic Substances Control Act* (TSCA) inventory in the U.S. (TSCA 2005). Very few have regulations governing their release to the environment, and very few are the focus of contaminant monitoring programs (Daughton 2001). The term "emerging contaminants" has come to define an emerging awareness of the presence in the environment of many chemicals used in commerce, along with concern over the risk that these chemicals may pose to human and wildlife health.

Emerging contaminants are often grouped according to their typical anthropogenic uses. Examples of these groups include: flame retardants, fluorinated surfactants, personal care products, pharmaceuticals, detergents, plasticizers, antimicrobial agents, current-use pesticides, and others. Many of these compounds are released to the environment from municipal, industrial, and agricultural sources and source pathways (Daughton 2001).

Table 4-3 provides an example list of some emerging contaminant groups, some of the chemicals that fall into those groups, and their general uses. These groups contain chemicals that may differ greatly in their chemical properties and level of understanding with regard to environmental fate and toxicology. Much research is being devoted to developing analytical methods for emerging contaminants, understanding their fate and transport properties in the environment, and determining what ecological and human health effects they may be causing.

Table 4-3. Examples of Common Classes of Emerging Contaminants, Specific Chemicals of Interest in Those Groups, and Their Common Uses.

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

4.2.2 Sources of Emerging Contaminants

Many of the current contaminants of emerging concern are found in the environment in areas close to municipal sewage treatment facilities. Compounds such as pharmaceuticals and personal care products are rinsed down the drain, carried in runoff, or excreted as waste and end up at sewage treatment facilities. These compounds vary

widely in their chemical properties, which affects how readily they are removed or broken down by current sewage treatment techniques. Depending on the chemical, current treatment can remove close to 100 percent of some of these chemicals, while others may only be reduced by less than 10 percent (Mills et al. 2005, Daughton 2001). Removal efficiency will also vary depending on the variety of compounds present and their concentrations in the input wastewater. Regardless of these removals, municipal sewage treatment plants are not designed to specifically remove these compounds, and many are released to the environment. Concentrations in natural surface waters (including oceans) generally range from ppb (μg/L) to ppt (ng/L) (Daughton 2001).

Once in the environment, the fate of these chemicals released from municipal sewage treatment varies widely depending on the chemical structure of the compounds. Thus, the relative ability of a compound to elicit a biological response or cause environmental stress will be related to how biologically active it is, its concentration, its persistence, and how it behaves in a mixture of other similar compounds. For instance, compounds that have an estrogenic mode of action are often expressed in estrogen equivalent concentrations that relate the relative estrogenicity of each compound to the most potent estrogen, 17β-estradiol (Legler 2001). Whole effluent toxicity (WET) and toxicity identification and evaluation (TIE) are two methods that have been developed for evaluating chemical mixtures present in various effluents for their potential toxicity (US EPA 1991a, b and c, US EPA 2000). WET approaches are commonly used to identify the total toxicity of an effluent while TIE approaches are aimed at identifying the individual chemical components that cause toxicity within an effluent (St J. Warne, 2003).

While municipal sewage treatment facilities are a major source for many types of emerging contaminants, many other sources exist. For instance, many compounds used as flame retardants and coatings to repel water, oil, and grease are used ubiquitously and can be found in household and workplace dust. While small releases can occur from industrial manufacturing facilities, most releases occur as volatilization from products the compounds are used in. Other sources of emerging contaminants include veterinary use of antibiotics and hormones in pets, runoff from agricultural activities such as pesticide application, and hormones and antibiotics used in cattle and other animal production.

Chemicals such as polybrominated diphenyl ethers (PBDEs) and perfluorooctane sulfonate (PFOS) were manufactured to resist breakdown, which makes them effective for their designed uses, but also means that they will resist breakdown in the environment. These properties have led to their global distribution through many of the same pathways that have led to global distribution of PCBs and many organochlorine pesticides. PBDEs and PFOS have been shown to bioaccumulate and are toxic to some organisms in laboratory studies (Haglund et al. 1997, McDonald 2002, Boudreau et al. 2003), but their true significance as environmental pollutants is still unclear.

4.2.3 Research

To date, much of the work on emerging contaminants has focused on monitoring for their presence in the environment and developing methods to evaluate their potential toxicity to various organisms. While laboratory toxicity data exists for a large number of chemicals regulated under programs such as TSCA, full risk assessments on the environmental fate and transport, ecotoxicity, persistence, and potential health effects of the universe of chemicals used by society is lacking. In response to this lack of information, Health Canada and Environment Canada have recently completed a systematic review of 23,000 in use chemicals and announced plans to conduct further in-depth assessments into the toxic risk of about 4,000 chemicals currently being used in Canada (Globe and Mail 2006). These efforts highlight the fact that many questions remain about whether emerging contaminants are truly an environmental concern and how they should be managed.

The desired properties of many emerging contaminants which make them effective in regard to the desired uses in society are the same properties that have led to concern when they are found in the environment. Many of these compounds are designed to be biologically active, and the compounds themselves, their breakdown products, or the presence of the compounds in a mixture may cause unintended responses by organisms living in the environment. The theory of endocrine disruption describes how certain chemicals can behave in a similar manner to natural biological hormones, and when those chemicals are present at high enough concentrations in the environment, they can trigger unintended responses by the endocrine system. Examples of these types of responses that have been observed in organisms, particularly below municipal sewage treatment outflows, include reduced reproductive ability, abnormally elevated levels of certain proteins in male fish that are normally found only in females (i.e., vitellogenin), and intersex gonads, such as where female ovary tissue can be found distributed throughout the male testes (Giulio et al. 2004, US EPA 1997, Jobling et al. 2003).

Improving techniques in molecular biology allow researchers to measure responses to chemicals at the sub-cellular level. These techniques provide the possibility of being able to detect environmental stress at extremely low levels of biological organization. One of the big questions that remains unanswered is whether effects that are measured at the sub-cellular level have any relevance at higher levels of biological organization, such as at the population level. This missing link is critical to determining whether many of these compounds, that may cause observable effects to organisms near a point source, are actually causing harm on a greater scale.

Another concern is that these chemicals are not present individually in the environment. Chemicals in a mixture can interact in an additive, synergistic, or antagonistic manner. These types of effects are difficult to measure. While approaches such as WET and TIE offer some answers, prioritization of which anthropogenic chemicals currently in use are of the greatest concern is a growing challenge. These chemicals should be monitored and/or regulated to determine if their presence is a risk to the health of humans and other organisms in the environment. A further discussion on the questions and research gaps

surrounding some emerging contaminants can be found in several places including the US EPA's website at http://www.epa.gov/nerlesd1/chemistry/pharma/needs.htm.

4.2.4 Emerging Contaminants in Lake Superior

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

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

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

Archived lake trout tissue collected between 1980 and 2000 was analyzed for PBDEs and one PBB (#153) (Zhu and Hites 2004). Concentrations of PBB-153, a component of a flame retardant banned in the 1970s, did not show a significant decreasing trend as many other banned chemicals (i.e., PCBs, DDT) have. PBDEs increased exponentially with a doubling time of every 2.5 to 3 years. Similar results were also found in lake trout and/or walleye from the other Great Lakes.

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

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

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

Similarly, total perfluoroalkyl contaminants (sum of perfluorosulfonates and perfluorocarboxylic acids) were lowest in Lake Superior lake trout (mean 13 ng/g) (Furdui et al., 2006b).

4.3 Proposed Management Approaches for Emerging Contaminants

4.3.1 Updating the List of Critical and Prevention Pollutants

Evidence is mounting that chemicals which may be persistent, bioaccumulative and toxic and are not included in the list of Critical and Prevention pollutants are not only present but increasing in the environment in the Great Lakes, including Lake Superior. This diverse group of chemicals has been called "emerging contaminants of concern" (see detailed discussion in section 4.2). In order to stay consistent with the goals of the Lake Superior LaMP, a management strategy for emerging contaminants must be developed.

At the time of this publication, efforts are underway to categorize and prioritize action on some recognized emerging contaminants based on screening and assessment research into potential ecotoxicological effects. For instance, Health Canada and Environment Canada conducted screening risk assessments for several emerging contaminants under the *Canadian Environmental Protection Act* (CEPA) of 1999. These assessments have recommended that PBDEs, chlorinated paraffins, PFOS and certain other fluorinated substances be added to the Schedule 1 list of toxic substances that can be regulated under *CEPA 1999* (Environment Canada 2006). Health Canada and Environment Canada also recently completed a systematic review of 23,000 in use chemicals and announced plans to conduct further in-depth assessments into the toxic risk of about 4,000 chemicals currently being used in Canada (Globe and Mail 2006).

According to the Management Goal Flow Chart for Lake Superior Critical Chemicals (Figure 4-8) new chemicals will only be added to the list of Critical pollutants for Lake Superior when monitoring data shows that one of the yardsticks developed for that chemical has been exceeded. Following the same approach used in the Stage 1 LaMP the Superior Work Group's Chemical Committee proposes to add emerging contaminants which have been detected in Lake Superior or assessed as PBT substances to the list of Lake Superior Prevention pollutants (LSBP 1995). As new contaminants are added to government lists such as COA, GLI, and Schedule 1 of *CEPA 1999* through their risk assessment process, the Chemical Committee has the responsibility to add these contaminants to the Lake Superior list of Prevention pollutants. This is the case with PBDEs, and PFOS which have been proposed for addition to the Canadian toxic substances list: Schedule 1 of *CEPA 1999*. These substances will be included in the Prevention – Monitor management category as they have been detected in Lake Superior. As monitoring data are collected and yardsticks developed for these contaminants, they will subsequently be evaluated following the process outlined in Figure 4-8 for possible inclusion on the Critical pollutants list.

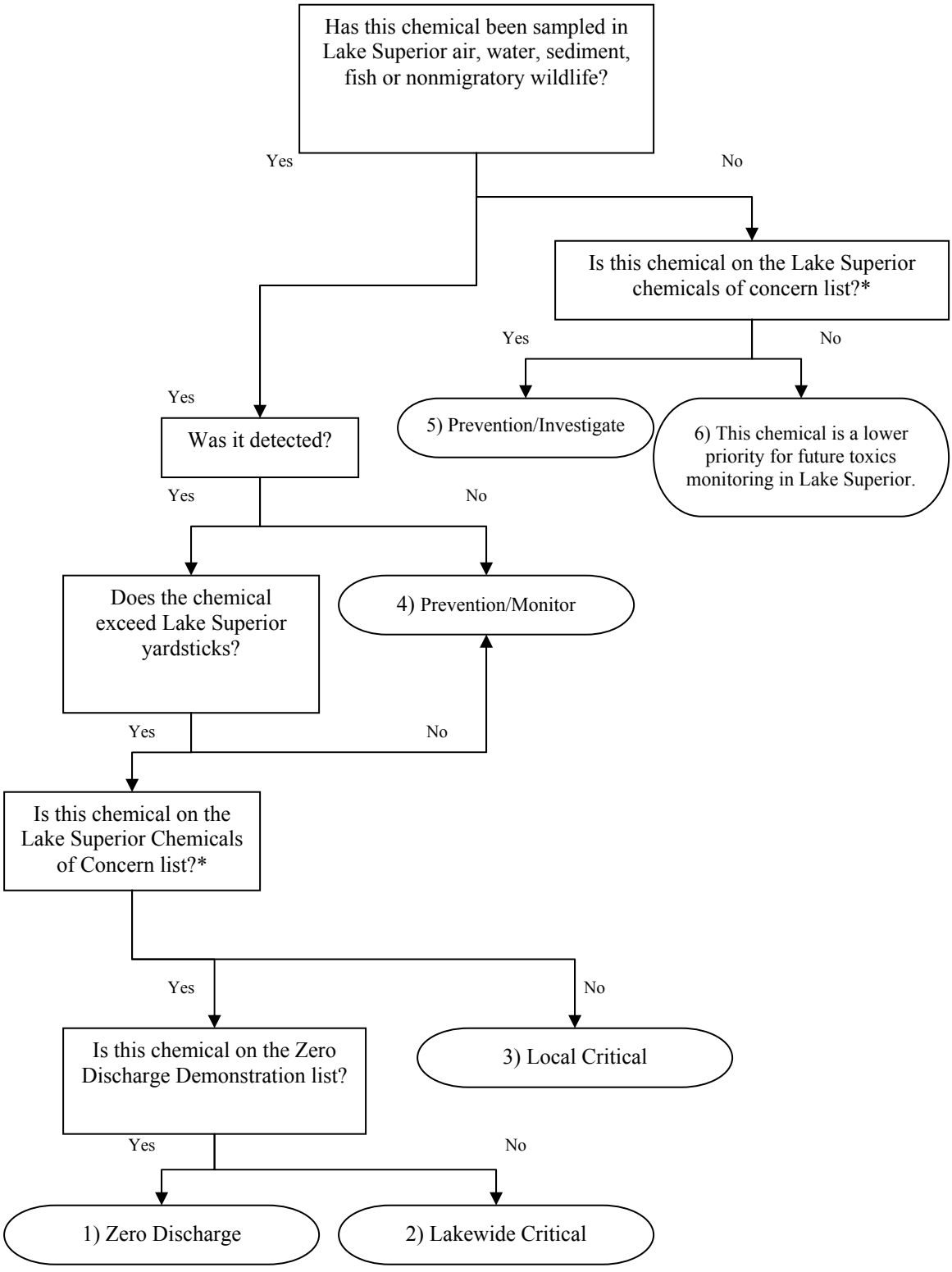
Tables 4-4a and b are the proposed update to Tables 1-1a and b which shows where emerging contaminants would be placed. These tables will be updated as sampling and risk assessment results become available. Until yardsticks are developed for emerging contaminants, they cannot become Critical pollutants. In either category Prevention/Monitor or Prevention/Investigate, the approach to reducing these chemicals is pollution prevention.

4.3.2. A Proposed "Watch List" for New and Emerging Chemicals

The Chemical Committee recognizes that significant time can pass between when a chemical is first found in the environment, is properly evaluated for its risk to ecosystem and human health, and when it may be designated as a pollutant that requires some kind of management response by a given jurisdiction. Because of this time lag and because of the concern over new and "emerging" contaminants that are being detected in many environmental media, the Chemical Committee proposes to create a "Watch List" to be updated with new chemicals that have been detected in the Lake Superior ecosystem and are under evaluation for potential persistent, bioaccumulative and/or toxic effects. As decisions are made by the governments around Lake Superior to regulate or not regulate these chemicals, the management approach by the Chemical Committee will be to evaluate these chemicals according to the process outlined in Figure 4-8 and add to either the Critical or Prevention pollutant lists if appropriate. Prior to these regulatory decisions, the management approach by the Chemical Committee will be to encourage monitoring and pollution prevention in the release of these chemicals.

The initial proposed Watch List contains the list of emerging chemicals on the Environment Canada analyte list for samples collected in various Lake Superior media during a 2005 coordinated monitoring effort, most of which have been recognized by as emerging contaminants of concern by COA or the IJC (Table 4-4a and b). The list would be updated as monitoring results are released.

Figure 4-8. Management Goal Flow Chart for Lake Superior Critical Pollutants.



* See Appendix E

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

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

Table 4-4b. Proposed Revisions to Prevention Pollutants and Management Approaches for Lake Superior

Monitor	1,4-dichlorobenzene 1,2,3,4-tetrachlorobenzene Mirex/photo-mirex	Pentachlorobenzene Pentachlorophenol BHC-gamma congener *PBDEs*[1] *PFOS*[1]
Investigate	1,2,4,5-tetrachlorobenzene 3,3-dichlorobenzidine 2-chloroaniline Tributyl tin	BHC, beta and delta, congeners Hexachlorobutadiene

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

[1] These compounds were recently proposed for addition to the Schedule 1 list of toxic substances that are regulated under CEPA 1999.

Table 4-5. A Proposed Watch List of New and Emerging Chemicals* for the Lake Superior LaMP.

Chemical	Source
Chlorinated paraffins	Proposed for Schedule 1
Decabromodiphenyl ethane	
HBCD (Hexabromocyclododecane)	Emerging (IJC)
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)
Pharmaceuticals	Emerging (IJC, COA)

* Most of these substances currently being sampled for in Lake Superior by Environment Canada as part of a 2005 coordinated monitoring effort.

Source: COA = Canada Ontario Agreement Respecting the Great Lakes Basin Ecosystem; Schedule 1 = emerging chemical proposed for addition to *CEPA 1999* Schedule 1 list of Toxic substances after EC/HC screening assessment; Emerging = recognized by 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.

Chapter 5. Reduction Strategies

5.1 Previous Reduction Strategies

The LaMP 2000 identified 22 reduction strategies (Appendix G). Arranged by chemical, these 22 strategies included a series of reduction activities which are further explained in the LaMP 2000. Of those 198 reduction activities, a portion were selected by the jurisdictions surrounding Lake Superior as high and medium priority activities. The follow-up on these activities can be found in Appendix B.

5.2 Revised Reduction Strategies

The Lake Superior Binational Program partners agreed that the list of reduction activities was not flexible enough to take into account new information on source reduction opportunities. In some cases, the reduction activity was downgraded because of additional information collected after LaMP 2000 that showed the activity was not viable at this time (e.g., not timely or cost effective or market conditions were wrong). In other cases, new opportunities arose that became new reduction activities (e.g., reducing mercury in the shipping industry).

The revised strategies for reducing Lake Superior critical chemicals were developed by Lake Superior partners at a meeting in Madison, Wisconsin in August 2005. The partners acknowledged that some strategies applied to multiple chemicals (see Section 5.2.1) and some strategies were more chemical specific. For the first time, the LaMP also addresses strategies for reducing emerging contaminants. For all the critical chemicals, the LaMP strives for the virtual elimination goal of the GLWQA and the Lake Superior-specific ZDDP goals. In alignment with the concept that zero discharge and zero emission are goals similar to zero defects or zero injuries, the Lake Superior jurisdictions have used a prevention approach in revising these strategies and selecting reduction activities.

5.2.1 Multiple Chemicals

Ecosystem Information: We need information on pollutant levels and their impacts in the Lake Superior basin.

- Monitor Lake Superior people, fish, wildlife, water, sediment and air to track overall trends of ZDDP chemicals as well as other persistent bioaccumulative and toxic pollutants detected in the Lake Superior basin

Pollutant Source Information: To assess progress toward ZDDP goals, and to ascertain where reductions are needed, we need information on sources of ZDDP chemicals in the basin.

- Update the inventory of discharges and emissions as well as use, storage and disposal of products that release any of the ZDDP chemicals
- Track Lake Superior source indicators

- Model sources and fates of the ZDDP chemicals in the Lake Superior basin

Internal Integration: LaMP goals must be integrated into other programs in order to achieve reductions.

- Integrate LaMP objectives into regulatory framework when possible
- Incorporate other programs into the LaMP that target the ZDDP chemicals and focus on pollution prevention and voluntary reductions
- Align state, provincial and federal funding programs with LaMP priorities

Partnerships Outside LSBP Agencies: LaMP agencies need partners who can also bring about reductions in ZDDP chemicals.

- Sustain existing partnerships and seek new ones
- Work with the Lake Superior Binational Forum for outreach and implementation

Education, Outreach and Assistance: The LaMP provides a means of integrating information on sources of ZDDP pollutants and strategies for reductions. An important role of the LaMP is to make this information accessible to residents of the basin and other organizations and citizens to support progress toward zero discharge. Provide outreach and education to multiple audiences

- Provide technical and financial assistance

Contaminated Sediment Management: Legacy sources of ZDDP and other critical pollutants must be managed to prevent bioaccumulation and to restore beneficial uses in the Lake Superior Basin ecosystem.

- Promote contaminated sediment management options at AOCs and other contaminated sites since those sites can be a long-term source of pollutants to the Lake Superior basin ecosystem.

Stormwater Management: Stormwater is a source of critical pollutants to Lake Superior.

- Support stormwater management activities as a way to prevent pollutant loading to Lake Superior.

Consistency: Consistency will lead to smoother, broader and quicker reductions.

- Emphasize consistency within agencies, across the Lake Superior basin and also within Great Lakes programs

Sustainability: The zero discharge goal is closely linked to sustainability.

- Support sustainability initiatives by Lake Superior basin communities
- Promote outreach that describes the connections between lifestyle choices and the ZDDP.
- Support pollution prevention activities, including community based efforts.
- Support community networking around the Lake Superior basin to promote ZDDP activities.

5.2.2 Mercury

Mining: Since half of the estimated in-basin mercury emissions for 2005 were from mining, emissions from this sector are critical to overall emission reductions from sources in the Lake Superior basin.

- Focus on emissions from taconite plants:
    - support research on mercury emission reduction technology
    - public awareness of relative loading of mercury emissions from different sources

    - green chemistry opportunities
    - potential for collaboration with other similar mining operations
- Evaluate mercury emission and discharge potential of new nonferrous mining proposals
- Consider cumulative effects of new or expanded mining facilities with other mercury emissions (i.e., coal fired power plants and boilers as well as mercury emissions from products)

Energy Production: About a third of the estimated mercury reductions for 2005 were from the energy production sector and reductions are needed.

- Track nationwide regulatory developments that affect mercury emissions from energy production
- Provide timely input in the approval process for new electric power generation projects
- Promote energy conservation
- Promote alternative energy

Products: Although mercury in products used in industrial, commercial, educational and residential applications has significantly decreased, opportunities still exist for reductions and it is important to properly manage mercury bearing equipment.

- Emphasize the role of communities in proper handling and disposal of mercury products
- Continue government funding and support of community mercury reduction and education projects
- Explore additional product legislation and bans
- Develop mandatory product recovery/recycling programs
- Continue to reach out to industrial and commercial facilities, including the shipping industry
- Expand provincial and statewide projects using Lake Superior demonstration projects
- Encourage a long-term US and Canadian retirement plan for elemental mercury

Inventory

- Continue to identify additional mercury sources (e.g., induction furnace electrical converter)

5.2.3 PCBs

Inventory: Update use and storage information to the extent possible.

- Inventory in-use PCB containing equipment in the basin.
- Inventory PCB equipment in storage.
- Inventory nonliquid PCB products and PCB contaminated products.
- Prioritize phase-out according to sensitivity of site (i.e., schools and hospitals)

Mentoring: Provide technical assistance to current PCB owners with the identification and phase-out of their PCBs.

- "Enlist" PCB award winners to mentor other companies and municipalities to remove PCBs.

- Extend pilot projects to the rest of the basin (e.g., Minnesota transformer phase-out project or Chicago PCB sweep)

Equipment Collection and Phase-out: Use a variety of methods to reduce PCBs per the Stage 2 reduction schedule.

- Include PCB capacitors in any PCB collection programs.
- Phase-out distribution transformers and transformers near in sensitive sites.
- Identify and phase-out other equipment such as rectifiers and bushings that could contain PCBs.
- Identify and phase-out nonliquid PCBs where possible.

5.2.4 Dioxin, Hexachlorobenzene and Octachlorostyrene

Alternatives to Burning

- Explore potential promotion of composting as alternative to burning
- Pilot pathway intervention opportunities resultant from GLBTS

Waste Reduction

- Pilot waste reduction program in a basin community involving a cost/benefit analysis of current waste disposal costs and what could be saved with an aggressive composting, packaging reduction, working w/local retailers to reduce packaging. Goal is to reduce waste and waste disposal costs – rurally it could reduce burning.
- Pilot an incentive program with a sector of manufacturers to reduce packaging (not necessarily Lake Superior specific)

Public education

- Continue burn barrel education but use only local sponsors

5.2.5 Pesticides

Collections: Meet zero discharge objectives for six ZDDP chemicals as well as reducing other pesticides through collections

- Support and expand clean sweeps and track yields
- Sustained funding for ongoing and special collections
- Inform residents of proper disposal methods and opportunities for disposal

Inventory: Maintain and update the inventory of pesticides removed from the Lake Superior basin

- Work with federal, state and provincial agricultural agencies and other organizations that collect waste pesticides to develop a Lake Superior data base

Alternative Practices: Reduce residents dependence on pesticides

- Promote alternative practices
- Collaboration with other agencies that have responsibilities for pesticide use and disposal

5.2.6 Emerging Contaminants

Acknowledgement: Emerging contaminants are a concern in the Great Lakes and nationally as well as in the Lake Superior basin.

- Recognize that emerging contaminants are a relevant issue for the Lake Superior basin.
- Given the nature of emerging contaminants, education, outreach and awareness activities will focus on prevention.

Reductions: We need to look for opportunities to reduce emerging contaminants.

- In absence of Lake Superior yardsticks, look for pollution prevention opportunities.
- Look for co-benefits in current reduction programs.

Additional information: The Lake Superior LaMP will recommend and (where possible) implement strategies for obtaining additional information on emerging contaminants in the Lake Superior basin.

- Regulatory agencies should establish yardsticks for emerging contaminants.
- Lake Superior monitoring programs should collect baseline information.
- When emerging contaminants are found in Lake Superior and there are opportunities for reductions within Lake Superior basin sources, the LaMP should refer to the GLBTS for consideration, which will convey the need for reductions to the appropriate national programs.
- The LaMP should use ongoing monitoring programs and archived samples to help monitor chemicals of concern.

5.3 Reduction Activities

The Lake Superior partners will still be using the activities identified in LaMP 2000 as a data base for identifying possible reduction projects. They will also continue to report progress such as the summaries found in Appendix B.

The following additional examples of activities were generated in the Madison 2005 meeting:

Mercury

- Promote NEWMOA-like mercury products resolution with jurisdictions in the basin
- Continue community outreach and product collections.
- Share examples of model by-laws and ordinances
- Share examples of existing successful mercury reduction projects
- Expand current basinwide mercury reduction initiative to cover more areas, sectors and products

PCBs

- Confirm status of military PCB equipment in the basin.
- Share suspect transformer serial numbers data base.

Chapter 6. Conclusions

The year 2005 marked the midpoint between the ZDDP baseline year of 1990 and the goal for virtual elimination of the discharge and emission of nine Critical pollutants within the Lake Superior basin set for 2020. The ZDDP has provided a framework to measure progress towards virtual elimination, and this report has described the progress that has been made since 1990 and the challenges that lie ahead.

Many Critical pollutant reduction projects have occurred in all Lake Superior basin sectors since Level 1 and 2 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 pollution prevention. Through pollution prevention, the easiest reductions have been achieved, and those remaining are more difficult. Several special designations and regulations either prior to or since the publishing of LaMP 2000 have or will help to achieve LaMP goals. The impact of some of these on pollutant reductions, such as EPA's CAMR and Canada's designation of the Lake Superior National Marine Conservation Area, are likely to be positive but is unknown at this point. It is clear that much of the loading of Critical pollutants to Lake Superior is coming from out-of-basin sources. The ZDDP has been effective at reducing Critical pollutant loadings within the basin, but further action is needed beyond the basin if virtual elimination is to become a reality.

Tracking Critical pollutant releases 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 in our ability to accurately and properly characterize emissions from diffuse sources such as landfills and products containing Critical pollutants. For all Critical pollutants, 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 Lake Superior basin 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 69% by the year 2000 and 71% by 2005 since the 1990 ZDDP baseline. In order to meet the Stage 2 LaMP 80% reduction goal by 2010, an additional 200-207 kg/yr of mercury must be reduced from 2005 loads. While emissions continued to decline between 2000 and 2005, the rate of decline appears to have slowed. The largest remaining emission sectors for mercury are mining and fuel combustion, which together account for greater than 85% of the mercury emissions within the basin.

For dioxin, it is estimated that dioxin discharges and emissions declined 75-78% by the year 2000 and 76-79% by 2005 since the 1990 ZDDP baseline. In order to meet the 90% reduction goal by 2015, an additional 4.32 to 4.46 g I-TEQ/yr of dioxin must be reduced from 2005 loads. Open burning is a completely preventable source of dioxin and elimination of open burning by 2015 would reach the goal if all else remained equal. Fuel combustion is the second largest source of in-basin dioxin and trends by 2010 are unknown due to changes in control technology at coal fired utilities and demand for electricity.

The hexachlorobenzene (HCB) inventory is problematic since it is incomplete. Where estimates were available on the Canadian side, emissions to the atmosphere, soil and water (environment) declined from 224 g in 1990 to 34.1 g in 2005, corresponding to a decline of 85%. The decrease is largely associated with reductions in reported HCB release from the OPG Thunder Bay generating station which reported a release of 123.9 g in 2000 but has reported zero release of HCB every year since. Pulp and paper has also been responsible for significant reductions (about 32% of the total), likely due to the conversion of the bleaching process to chlorine dioxide in place of elemental chlorine. PCP-treated utility poles and railway ties in use (21 g), followed by residential wood combustion (10 g) were the largest identified HCB sources on the Canadian side. On the US side, the largest sources were open burning of trash, followed by motor vehicles.

Tracking PCB reductions over time has not been possible without the availability of 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 data base 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 Lake Superior basin is mostly non-agricultural, a significant amount of banned pesticides have been collected in or near the basin since 1992. Although the LaMP Stage 2 reduction goal was to collect all of the pesticides that contained any of the nine Zero Discharge Demonstration chemicals by 2000, it is obvious that these pesticides are still present and that collections need to continue, even in non-agricultural areas.

The ZDDP has documented reductions in emissions of some Critical pollutants. However, due to the ubiquitous nature of these pollutants and the fact that most of the loading of these pollutants comes from outside the basin, it is not possible to measure the impact that the ZDDP has had on reducing Critical pollutant concentrations in the environment. However, the ZDDP is providing an example on how emissions that contribute to the global pool of Critical pollutants can be reduced locally.

In general, concentrations of Critical pollutants have also 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 US and Canada to restrict the manufacture and use of PCBs and certain pesticides.

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. 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. Critical pollutants such as toxaphene have not declined in the Lake Superior ecosystem due to the chemical properties of toxaphene and the physical and thermal properties of Lake Superior. Toxaphene 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 chemicals of emerging concern in the Lake Superior ecosystem have led to a significant challenge for lake managers. Substances that are used in our every day lives such as personal care products and pharmaceuticals, along with specific-use chemicals such as PBDEs and fluorinated compounds 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 we have little information on the exposure potential and environmental fate and transport of these "emerging" contaminants, the management challenge lies in deciding which of them should be defined as chemicals of concern and subsequently monitored and/or remediated. Although in the case of PBDEs and PFOS these have been proposed for addition to the CEPA list of toxic substances following screening level risk assessments by EC and HC.

In re-evaluating the Critical and Prevention pollutants for Lake Superior some substances of emerging concern have been proposed for addition to the list of Prevention Pollutants. This was done following the process used in the Management Goal Flow Chart in Chapter 4 (originally from the Stage 2 LaMP). According to this approach, emerging substances which have been shown to be persistent, bioaccumulative and/or toxic through an appropriate risk assessment process can be included in the Prevention-Investigate management category. Emerging substances which have been detected in Lake Superior can be placed in the Prevention-Monitor management category in Figure 4-8. Substances will only be added to the list of Critical pollutants for Lake Superior when monitoring data shows that one of the yardsticks that have been developed for that chemical has been exceeded.

Significant progress towards Critical pollutant reductions has been made. Environmental levels of most substances in biota and environmental media have declined since tracking began. However, possible increases in future industrial activity could increase the release of Critical pollutants in the basin. Understanding that prevention is a more cost effective approach than degradation followed by remediation, the Chemical Committee advocates using pollution prevention measures to limit the release of all Critical and Prevention pollutants to Lake Superior.

References Cited

Battelle. 2005. Personal communication. Estimated discharges and emissions for LaMP milestones report. Battelle, Columbus, Ohio.

Bauduin, N. 2005. Personal communication. Mercury emissions from Wisconsin coal fired power plants. Wisconsin Department of Natural Resources, Madison, Wisconsin.

Benazon Environmental Inc. 2006. Emissions Inventory 2005 for Canadian Portion of the Lake Superior Basin. Lake Superior Binational Program. Final Report. March 30, 2006. 102 pp.

Blanchard, P., C.V. Audette, M.L. Hulting, I. Basu, K.A. Brice, C.H. Chan, H. Dryfhout-Clark, F. Froude, R.A. Hites, and M. Neilson. 2004. Atmospheric Deposition ofToxic Substances to the Great Lakes: IADN Results through 2000. Published by: Environment Canada and the United States Environmental Protection Agency. ISBN: 0-662-37467-3. Public Works and Government Services Canada Catalogue Number: En56-156/2000-1E. US EPA Report Number: 905-R-04-900.

Boudreau, T.M., P.K. Sibley, S.A. Mabury, D.C.G. Muir, K.R. Solomon. 2003. Toxicity of perfluorinated organic acids to selected freshwater organisms under laboratory and field conditions. MS thesis. University of Guelph, Guelph, ON, Canada.

Brigham, D. 1999. Zero Discharge: How far have we come? Prepared for the Chemical Committee of the Lake Superior Work Group, Lake Superior Binational Program.

COA. 1994. Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem. Environment Canada, Toronto, Ontario. www.on.ec.gc.ca/laws/coa/coa94-e.html

CGLI. 2006. 9/11/06 Letter from Dale Phenicie, Council of Great Lakes Industries, to Carri Lohse-Hanson, Minnesota Pollution Control Agency. 10 pp.

Chan, C., D.J. Williams, M.A. Neilson, B. Harrison, and M.L. Archer. 2003. Spatial and Temporal Trends in the Concentrations of Selected Organochlorine Pesticides (OCs) and Polynuclear Aromatic Hydrocarbons (PAHs) in Great Lakes Basin Precipitation, 1986 to 1999. *Journal of Great Lakes Research*. 29(3):448–459.

Daughton, C.G. 2001. "Pharmaceuticals in the Environment: Overarching Issues and Overview," in Pharmaceuticals and Personal Care Products in the Environment: Scientific and Regulatory Issues, Daughton, C.G. and Jones-Lepp, T. (eds.), *Symposium Series 791*; American Chemical Society: Washington, D.C., pp. 2-38.

Dove, A. 2006. Personal communication. Data from Lake Superior 2003 spring surveillance cruise, Environment Canada Surveillance Program, Ecosystem Health Division, Environment Canada, Burlington, Ontario.

Dykstra C.R., M.W. Meyer, P.W. Rasmussen, and D.K. Warnke. 2005. Contaminant Concentrations and Reproductive Rate of Lake Superior Bald Eagles, 1989–2001. *Journal of Great Lakes Research*. 31:227-235.

Energy Information Administration, US DOE (Department of Energy). 2006. Annual Energy Outlook 2006. www.eia.doe.gov/oiaf/aeo/pdf/trend_3.pdf.

Environment Canada. 2006. Assessment of Substances under CEPA 1999. CEPA Environmental Registry. http://www.ec.gc.ca/CEPARegistry/subs_list/assessments.cfm. September 29 2006. Accessed October 16, 2006.

Environment Canada 2006b. Domestic Substances List Categorization and Screening Program. DSL Program, Existing Substances Evaluation, CEPA Registry. http://www.ec.gc.ca/substances/ese/eng/dsl/dslprog.cfm. August 2 2005. Accessed October 16 2006.

Franklin, P. 2006. Personal communication. Retrieval of hazardous waste disposal records for facilities in the four Lake Superior basin counties. Minnesota Pollution Control Agency, St. Paul, Minnesota

Furdui, V.I., Crozier, P.W., Reiner, E.J., Mabury, S.A. 2006a. Optimized trace level analysis of perfluorinated acids in the Great Lakes watershed. *Environ. Sci. Technol.*, submitted.

Furdui, V.I., Stock, N., Whittle, D.M., Crozier, P.W., Reiner, E.J., Muir, D.C.G., Mabury, S.A. 2006b. Perfluoroalkyl contaminants in lake trout from the Great Lakes. Presented at the 41st Central Canadian Symposium on Water Quality Research, February 13 &14, 2006, in Burlington, Ontario, Canada.

GLATEI. 2005. Great Lakes Regional Air Toxic Emissions Inventory. www.glc.org/air

GLI. 1995. Great Lakes Water Quality Initiative. US Environmental Protection Agency. www.epa.gov/gliclearinghouse/gli_bkgd.htm

GLBTS. 2004. Great Lakes Binational Toxics Strategy: 2004 Annual Progress Report. http://binational.net/bns/2004/2004glbts_01.pdf

Globe and Mail. 2006. Risk of 4,000 everyday chemicals to be studied From household cleaners to pop bottles, ingredients previously ignored may affect health, scientists say. Byline: Martin Mittelstaedt, IDN: 062570214, Date: September 14 2006, Page: A19.

Granke, Leah. 2005. Personal communication. Throughput and emission factors for Lake Superior LaMP inventory. Michigan Department of Environmental Quality, Lansing, Michigan

Great Lakes Indian Fish and Wildlife Commission (GLIFWC) 1999-2005. Unpublished data.

Haglund P., Zook D.R., Buser H.R., Hu J. 1997. Identification and Quantification of Polybrominated Diphenyl Ethers and Methoxy-Polybrominated Diphenyl Ethers in Baltic Biota. *Environmental Science and Technology*. 31:3281-3287.

Hafner, W. D. and R. A. Hites 2003. Potential Sources of Pesticides, PCBs, and PAHs to the Atmosphere of the Great Lakes. *Environmental Science and Technology*. 37:3764-3773.

International Joint Commission. 1990. Fifth Biennial Report Under the Great Lakes Water Quality Agreement of 1978 to the Governments of the United States and Canada and the State and Provincial Governments of the Great Lakes Basin.

Jantunen, L.M., Helm, P.A., Ridal, J.J., Bidleman, T.F., *In Press*. Air-water gas exchange of organochlorine pesticides in the Great Lakes, including some chiral compounds. *Environmental Pollution*

Jobling, S., D. Casey, T. Rodgers-Gray, J. Oehlmann, U. Schulte-Oehlmann, S. Pawlowski, T. Baunbeck, A.P. Turner, C.R. Tyler. 2003. Comparative responses of mollusks and fish to environmental estrogens and an estrogenic effluent. *Aquatic Toxicology*. 65:205-220.

Jones, B. 2005. Personal communication. Sediment contaminant load at Torch Lake Area of Concern. US Environmental Protection Agency, Chicago, Illinois.

Kaminski, S. 2005. Personal communication. Waste pesticides collected in the Lake Superior counties in Minnesota. Minnesota Department of Agriculture, St. Paul, Minnesota.

Knorek, J. 2005. Personal communication. Waste pesticides collected in the Lake Superior counties in Michigan. Michigan Department of Agriculture, Lansing, Michigan.

Lake Superior Binational Program (LSBP). 1995. Lake Superior LaMP, Lakewide Management Plan, Current Status of Critical Pollutants, Stage 1, Problem Identification. Prepared by the Superior Work Group, Lake Superior Binational Program.

Lake Superior Binational Program 1998. Protecting Lake Superior – Lakewide Management Plan, Stage 2. Load Reduction Targets for Critical Pollutants. Prepared by the Superior Work Group Chemical Committee. Thunder Bay and Chicago. 162 pp.

Lake Superior Binational Program 2000. Lake Superior Lakewide Management Plan (LaMP) 2000. Environment Canada, Toronto. US Environmental Protection Agency, Chicago.

Lake Superior Binational Program 2004. Lake Superior Lakewide Management Plan (LaMP) 2004. Environment Canada, Toronto. US Environmental Protection Agency,

Chicago.

Lake Superior Binational Program 2006. Lake Superior Lakewide Management Plan (LaMP) 2006. Environment Canada, Toronto. US Environmental Protection Agency, Chicago.

Legler, J. 2001. Development and application of in vitro and in vivo reporter gene assays for the assessment of (xeno-)estrogenic compounds in the aquatic environment. PhD thesis. Wageningen University, Utrecht, The Netherlands.

Lohse-Hanson, C. 2006. Personal communication. Estimated discharges and emissions for LaMP milestones report. Minnesota Pollution Control Agency, St. Paul, Minnesota

Luross, J.M., M. Alaee, D.B. Sergeant, C.M. Cannon, D.M. Whittle, K.R. Solomon, and D.C.G. Muir. 2002. Spatial Distribution of Polybrominated Diphenyl Ethers and Polybrominated Biphenyls in Lake Trout from the Laurentian Great Lakes. *Chemosphere.* 46:665-672.

Ma, J., S. Venkatesh, Y. Li, Z. Cao, and S. Daggupaty 2005. Tracking Toxaphene in the North American Great Lakes Basin. 2. A Strong Episodic Long-Range Transport Event. *Environmental Science and Technology*. 39:8132-8141.

Mabury, S.A. 2006b. Perfluoroalkyl contaminants in lake trout from the Great Lakes. Presented at the 41st Central Canadian Symposium on Water Quality Research, February 13 &14, 2006, in Burlington, Ontario, Canada.

McDonald, T.A. 2002. A perspective on the potential health risks of PBDEs. *Chemosphere*. 46(5):745-755.

Mills, M.A., G.D. Sayles, P. McCauley, R, Brenner, E.J. Kleiner. 2005. Wastewater treatment and its management of endocrine disrupting chemicals. Poster given at: United States Environmental Protection Agency Science Forum. Washington, D.C., May 16-18.

Ministry of the Environment of Ontario. 1994. Water Management Policies Guidelines Provincial Water Quality Objectives. http://www.ene.gov.on.ca/envision/gp/3303e.htm.

Ministry of the Environment of Ontario. 2006. Unpublished data.

Ministry of Environment of Ontario. 2006. Internal document: PCB in storage in the Lake Superior watershed. Ontario Ministry of Environment, Thunder Bay, Ontario.

MPCA. 2005. St. Louis River AOC Sediment Management Plan. Prepared by Emmons Oliver Resources, Inc.; Desotelle Consulting PLC; Schoolerman Consulting; and Beaster Consulting for the Minnesota Pollution Control Agency. EPA Grant GL97540401-2.

MPCA. 2006. Draft Minnesota Statewide Mercury Total Maximum Daily Load. Minnesota Pollution Control Agency, St. Paul, Minnesota. www.pca.state.mn.us/publications/wq-iw4-01b.pdf

Muir, D.C.G., D.M. Whittle, D.S. De Vault, C.R. Bronte, H. Karlsson, S. Backus, and C. Teixeira. 2004. Bioaccumulation of Toxaphene Congeners in the Lake Superior Food Web. *Journal Great Lakes Research.* 30:316-340.

National Mining Association. 2005. www.nma.org/newsroom/miningweek/miningweekarchive/asp2005/mw020405.asp#story3.

National Pollutant Release Inventory. 2005. NPRI On-line Data Search. Environment Canada. http://www.ec.gc.ca/pdb/querysite/query_e.cfm

NEI. 2005. National Emissions Inventory. www.epa.gov/ttn/chief/net

Sanderson H., D.J. Johnson, C.J. Wilson, R.A. Brain, and K.R. Solomon. 2003. Probabilistic hazard assessment of environmentally occurring pharmaceuticals toxicity to fish, daphnids and algae by ECOSAR screening. *Toxicology Letters*. 144:383-395.

Sanderson H., R.A. Brain, D.J. Johnson, C.J. Wilson, and K.R. Solomon. 2004. Toxicity classification and evaluation of four pharmaceuticals classes: antibiotics, antineoplastics, cardiovascular, and sex hormones. *Toxicology*. 203:27-40.

Song, W., J.C. Ford, A. Li, W.J. Mills, D. Buckley, and K.J. Rockne. 2004. Polybrominated Diphenyl Ethers in the Sediments of the Great Lakes. 1. Lake Superior. *Environmental Science and Technology*. 38:3286-3293.

Springman, R. 2005. Wisconsin Department of Agriculture. Personal communication.

St J. Warne, M. 2003. A Review of the ecotoxicity of mixtures, approaches to, and recommendations for, their management. In *Proceedings of the Fifth National Workshop on the Assessment of Site Contamination*. National Environment Protection Council Service Corporation. Langley A, Gilbey M and Kennedy B (Eds). pp. 253-276.

Swackhamer, D. L. 2004. Trends in Great Lakes Fish Contaminants. Project report submitted to US EPA Great Lakes National Program Office, Chicago, IL.

Swain, E. 2005. Minnesota Pollution Control Agency. Appendix A: Mercury Emission Inventory for Minnesota from the 2005 Mercury Reduction Progress Report to the Minnesota Legislature. 13 pages. www.pca.state.mn.us/publications/reports/lrp-mercury05-appa.pdf

Taft, W. 2005. Personal communication. Sediment contaminant load at Deer Lake Area of Concern. Michigan Department of Environmental Quality.

TenEyck, M. and D, Brooke. 2005. Estimates of Dioxin Releases in the U.S. Portion of Lake Superior Basin. Lake Superior Research Institute, Superior, Wisconsin. 48 pp.

TSCA. 2005. US EPA (United States Environment Protection Agency) Toxic Substances Control Act. www.epa.gov/region5/defs/html/tsca.htm

Tuominen, Tim. 2005. 1/15/05 letter to Minnesota Pollution Control Agency. Western Lake Superior Sanitary District, Duluth, Minnesota.

Tuominen, Tim. 2006. 7/19/06 email to Carri Lohse-Hanson with the Minnesota Pollution Control Agency. Western Lake Superior Sanitary District, Duluth, Minnesota.

USEPA (United States Environment Protection Agency). 1991a. *Technical support document for water quality-based toxics control.* Office of Water Enforcements and Permits, Washington, DC. EPA/505/2-90-001.

USEPA (United States Environment Protection Agency). 1991b. *Methods for toxicity identification evaluations.* TJ Norberg-King, DA Mount, EJ Durham, GT Ankley, LP Burkhard, JR Amaato, JT Lukasewycz, MK Schubauer-Berigan, L Anderson-Carnahan (Eds), EPA-600/6-91/003.

USEPA (United States Environment Protection Agency). 1991c. *Toxicity identification evaluation: Characterisation of chronically toxic effluents. Phase I.* EPA-600/6-91/005.

USEPA (United States Environment Protection Agency). 1997. Special report on environmental endocrine disruption: An effects assessment and analysis. EPA/630/R-96/012. Risk Assessment Forum, Washington D.C.

USEPA (United States Environment Protection Agency). 2000. Method Guidance and Recommendations for Whole Effluent Toxicity (WET) Testing (40 CFR Part 136). EPA/821/B-00/004.

Warren, G. 2005. USEPA, Great Lakes National Program Office, 1996 data. Personal communication.

Weseloh, D.V. and T. Havelka 2005. Personal communication.

Whittle, D. M. 2005. Personal communication.

Whittle, D.M., Kiriluk, R.M., Carswell, A.A., Keir, M.J., and MacEachen, D.C. 2000. Toxaphene Congeners in the Canadian Great Lakes Basin: Temporal and Spatial Food Web Dynamics. *Chemosphere* 40:1221–1226.

Williams, D.J. and K.W. Kuntz. 1999. Lake Superior Surveillance Program: Spatial Distributions and Temporal Trends of Selected Parameters, with emphasis on 1996-1997 Data. Environment Canada Report #EHD/ECB-OR/99-01/I. 44pp.

Williams, D.J., K.W. Kuntz and V. Richardson. 2004. Lake Superior Surveillance Program: Spatial Distributions and Temporal Trends of Selected Parameters, with emphasis on 2001 Data. Environment Canada Report #EHD/ECB-OR/04-02/I. 50pp.

Zhu, L.Y. and R.A. Hites. 2004. Temporal Trends and Spatial Distributions of Brominated Flame Retardants in Archived Fishes from the Great Lakes. *Environmental Science and Technology*. 38:2779-2784.

List of Acronyms

AHA	American Hospital Association
AOC	Area of Concern (from Great Lakes Water Quality Agreement Annex 2)
APEs	alkylphenol ethoxylates
BAC	benzalkonium chloride
BAF	bioaccumulation factor
BCC	bioaccumulative chemical of concern
BHC	hexachlorocyclohexane (aka, HCH or benzene hexachloride)
BMPs	Best Management Practices
BUI	Beneficial Use Impairment (from Great Lakes Water Quality Agreement Annex 2)
C3	Clean Corporate Citizen
CAC	Citizens Action Committee
CAMR	Clean Air Mercury Rule, US
CARD	Community Awareness Review and Development
CCME	Canadian Council of Ministers of the Environment
CDN	Canadian
CEM	[US] Coastal Environmental Management funding
CEPA	Canadian Environmental Protection Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COA	Canada Ontario Agreement [Respecting the Great Lakes Ecosystem]
CORA	Chippewa Ottawa Resource Authority
CSA	Canadian Standards Association
CWS	Canada-Wide Standard
2,4-D	(2,4-dichlorophenoxy) acetic acid
DDE	dichlorodiphenyldichloroethylene (metabolite of DDT)
DDT	dichloro diphenyl trichloroethane
DEET	diethyltoluamide
DFO	Department of Fisheries and Oceans, Canada
DOE	Department of Energy, US
EC	Environment Canada
ECOS	Environmental Council of the States, US
EIS	Environmental Impact Statement
EPCRA	Emergency Planning and Community Right-to-Know Act, US
EQIP	Environmental Quality Incentive Program
GIS	Geographic Information Systems
GLATEI	Great Lakes Regional Air Toxic Emissions Inventory

GLBTS	Great Lakes Binational Toxics Strategy
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, US
GLWQA	Great Lakes Water Quality Agreement
H2E	Hospitals for a Healthy Environment
HBCD	hexabromocyclododecane
HC	Health Canada
HCB	hexachlorobenzene
HCH	hexachlorocyclohexane (aka, BHC or benzene hexachloride)
HEARRT	Healthcare Environmental Awareness and Resource Recovery Team, Minnesota
HHW	household hazardous waste
HPBA	Hearth, Patio and Barbeque Association
HVAC	heating ventilation and air conditioning
IADN	Integrated Atmospheric Deposition Network
IJC	International Joint Commission
IPM	Integrated Pest Management
KBIC	Keweenaw Bay Indian Community
LaMP	Lakewide Management Plan (from Great Lakes Water Quality Agreement Annex 2)
LSB	Lake Superior Basin
LSBP	Lake Superior Binational Program
MACT	Maximum Acheivable Control Technology, US Clean Air Act
MBP3	Michigan Business Pollution Prevention Partnership
MCL	Maximum Contaminant Limit
MDA[1]	Michigan Department of Agriculture
MDA[2]	Minnesota Department of Agriculture
MDA[3]	Minnesota Dental Association
MDEQ	Michigan Department of Environmental Quality
MDNR	Minnesota Department of Natural Resources
MISA	Municipal and Industrial Strategy for Abatement, Canada
MNR	Ministry of Natural Resources, Ontario
MOE	Ministry of the Environment, Ontario
MOEA	Minnesota Office of Environmental Assistance
MOU	Memorandum of Understanding
MPCA	Minnesota Pollution Control Agency
NEI	National Emissions Inventory, US
NEMO	Non-point Education for Municipal Officials

NEWMOA	Northeast Water Management Officials Association
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System, US Clean Water Act
NPRI	National Pollutant Release Inventory, Canada
NPS	Non Point Source
NRC	Natural Resources Canada
NRCS	Natural Resource Conservation Service, US
NREPA	Natural Resources and Environmental Protection Act
NWF	National Wildlife Federation
NWRPC	Wisconsin Regional Planning Commission
OCS	octachlorostyrene
OFNTSC	Ontario First Nations Technical Services Corporation
OIRW	Outstanding International Resource Water, US
ONRW	Outstanding National Resource Waters, Minnesota
OPG	Ontario Power Generation
ORW	Outstanding Resource Waters, Wisconsin
P2	pollution prevention
P5	Pulp and Paper Pollution Prevention Program, Michigan
PAH	polycyclic aromatic hydrocarbons
PBB	polybrominated biphenyl
PBDE	polybrominated diphenyl ether
PBT	persistent, bioaccumulative and toxic chemical
PCB	polychlorinated biphenyl
PCDD	polychlorinated dioxin
PCDF	polychlorinated furan
PCP	pentachlorophenol
PFCA	perfluorocarboxylate
PFOA	perfluorooctanoic acid
PFOS	perfluoroalkyl sulfonates
PWQO	Provincial Water Quality Objective
RAP	Remedial Action Plan (from Great Lakes Water Quality Agreement Annex 2)
RBC	Reservation Business Committee
SCCP	short chain chlorinated paraffins
SCORE	Select Committee on Recycling and the Environment, Minnesota
SEP	Supplemental Environmental Project, US
SLRCAC	St. Louis River Citizens Action Committee
SOLEC	State of the Lakes Ecosystem Conference
SOP	Strategic Options Process

STORET	Water Quality Storage and Retrival System, US
SWG	Superior Work Group
2,4,5-T	2,4,5-trichlorophenoxy-acetic acid
TAS	Treatment as State
T-BACT	Best Available Control Technology for Toxics
TBBPA	tetrabromobisphenol A
TBGS	Thunder Bay Generating Station
TCDD	total polychlorinated dioxin
TEQ	Toxic Equivalence Quotient
TEQ-WHO_{98}	Toxic Equivalence Quotient - World Health Organization 1998
TIE	toxicity identification and evaluation
TMDL	Total Maximum Daily Load, US
TRI	Toxics Release Inventory, US
TSCA	Toxic Substances Control Act, US
TSP	Total Suspended Particulates
UP	Upper Peninsula, Michigan
US	United States
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
WDNR	Wisconsin Department of Natural Resources
WET	Whole effluent toxicity, US
WLSSD	Western Lake Superior Sanitary District, Minnesota
ZDDP	Zero Discharge Demonstration Project

Appendix A

A Binational Program to Restore and Protect the Lake Superior Basin

September 1991

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.

Appendix B

Reduction Activities in the Lake Superior Basin: 2000-2005

Appendix B.1 Canada Progress Report

Milestones Report
Action Items – EC/MOE Accomplishments – 2000 to 2005

Voluntary Agreements/Programs
Establishment of Depots for HW & HH products
Energy Conservation
Dioxins/Mercury/Incinerators/Burn Barrels
PCBs
Mercury
Curricula & Outreach
Sediments and Remediation
Reporting Criteria and Standards
Assessments and Remediation

LaMP 2000 Action Item No.*	Description	EC or MOE Priority**

Voluntary Agreements/Programs/Actions

1 Establish voluntary agreements to reduce use, discharge or emissions of the nine designated chemicals (EC-1, MOE-1)

3 Continue discussions with seven pulp and paper mills (EC-1, MOE-1)

EcoSuperior leads a voluntary program involving several Thunder Bay and north shore industries to collect fluorescent lights for the recovery and recycling of mercury. Bombardier Transportation was the first company to sign onto the program in 2000 and in the first year, they shipped 1500 tubes for recycling. As of 2005, it now is estimated that 10% of fluorescent bulbs in the LS basin were recycled (Benazon, 2006).

Most auto recyclers on the Canadian side of the Lake Superior basin voluntarily participate in the Switch Out program for the collection of mercury switches from end-of-life automobiles received by their facilities.

A joint Work Group-Forum-Industry mentoring program is being conducted on the Canadian side of the Lake Superior basin in order to audit and inventory elemental mercury at industrial facilities during 2005/2006 (including the 7 pulp mills). The mentor will also assist in assuring best purchasing and management practices, and will provide guidance for the responsible recycling of mercury, where required. Priority locations include sites at which paper mill and mine site closures and decommissioning exercises are planned.

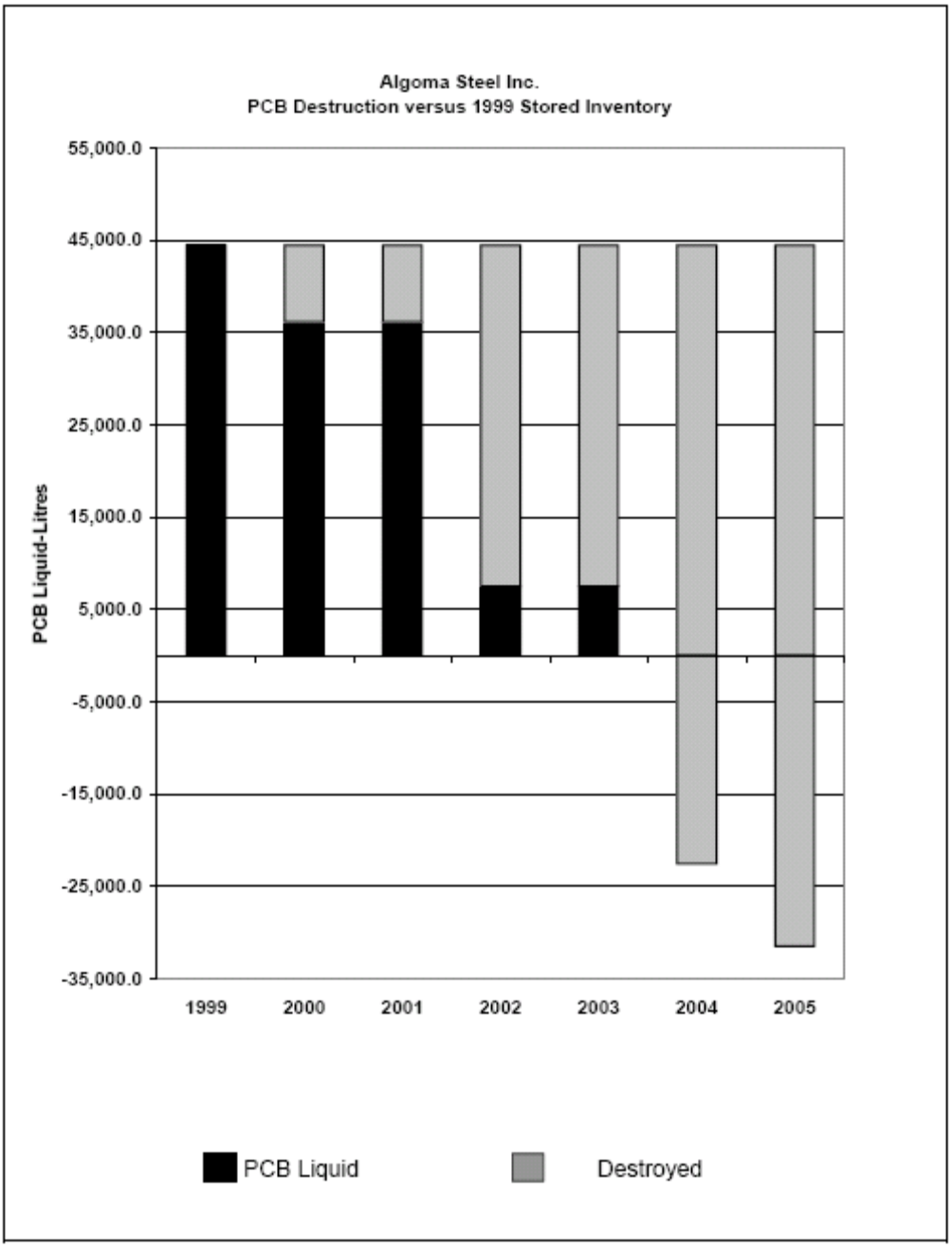
Ontario Power Generation has implemented a voluntary coal, ash and flue gas sampling and analysis program to support development of the Canada Wide Standard for mercury emissions from coal-fired power plants. In addition, OPG Thunder Bay Generating Station is a PCB-free facility, having removed all the on-site PCBs many years ago.

There was an industry-led initiative by manufacturers to reduce the mercury content of fluorescent lighting and it was endorsed by the Canada-Wide Standard Council in 2001. In 1985, there was an average of 48.2 mg of mercury per 4 ft florescent tube, whereas the value in today's lamps is generally less than 5mg. Furthermore, mercury emissions from fluorescent tubes sent to landfills has decreased in the basin from 13 kg in 2000 to 4 kg in 2005 (Benazon, 2006). The CWS for mercury-containing lamps is 70% mercury reduction by 2005 and 80% reduction by 2010 in regards to the average content of mercury in all such lamps sold in Canada, using 1990 as baseline.

Over the last several years, Environment Canada conducted stack tests for dioxins and furans and many other substances of concern at facilities in Ontario which included the Norampac Kraft mill in Red Rock (2002), the pulp mill in Marathon (2003), and the Newmont gold mine at Hemlo (2004), through the Voluntary Stack Testing Program.

PCB reduction commitment letters were sought from three sectors in Ontario – the automotive, iron and steel and utilities sectors. A positive response was received from Algoma Steel in 1999. Algoma Steel voluntarily agreed to eliminate 71,000 kg of stored PCBs by 2005. They seized an immediate opportunity to ship for destruction 13,000 kg of PCB being taken out of service in 2000, one year prior to their original launch date planned for 2001.

Algoma Steel followed through on commitments to the MOE and EC under an Environmental Management Agreement, for the diversion or destruction of contaminants above and beyond their regulatory requirements since the year 2000. They destroyed 121,500 kg of in-storage PCBs by Dec 31, 2005, which is 170% of the inventoried amount present in 1999 (see Table following). Furthermore, they have implemented a mercury recycling program which removed all accumulated mercury inventories by January, 2002, and instituted a mercury lamp and tube recycling program. An estimated 95.5 grams of mercury was recovered from approximately 3,409 flourescent fixtures in 2003. Early in 2005, Algoma acquired its' own in-house equipment to handle and process fluorescent tubes. During that year, Algoma shipped nearly 9.75 kg of mercury from approximately 5,000 fluorescent tubes, 450 high-intensity discharge lamps and 4 retired, mercury ignition tubes.



As part of a basin-wide mercury reduction program led by a contracted "mentor" in 2006, seven companies from various sectors (2 mines, 3 pulp and paper, 1 iron and steel, 1 harbour facility) have agreed to review and plan for the replacement of mercury containing equipment and chemicals that may be contaminated with mercury, as the opportunity arises.

Establish Depots for HW & HHproducts

18 Develop depot and reverse distribution systems for citizens (EC-1, MOE-2)
20 Establish depots for mercury-containing household products (EC-1, MOE-1)
21 Investigate feasibility of redrafting legislation to accommodate product stewardship (MOE-2)
32 Initiate or continue permanent household and agricultural hazardous waste collection depots (EC-2, MOE-2)
51 Municipal source separation programs to divert household hazardous materials (EC-1, MOE-1)
89 Small business utilization of hazardous waste depots (EC-2, MOE-1)

To augment existing municipal household hazardous waste programs in Thunder Bay and Sault Ste. Marie, Environment Canada and MOE partnered with other agencies to fund hazardous waste collection events undertaken by EcoSuperior in the six townships around Thunder Bay, as well as at Red Rock, Nipigon, Schreiber, Marathon, Manitouwadge and Wawa. The goal was to maximize the recycling of toxic compounds (e.g. mercury) and minimize the disposal of hazardous waste through landfilling or incineration. Several tonnes of hazardous waste were diverted from landfill in each community at each event. This included over 20 kg of mercury in total.

EcoSuperior, with support from Environment Canada partnered with the local small business community to divert electronic waste from landfills. Participants were given a subsidy to assist in the recycling and proper disposal of computers and peripherals in order to limit the landfilling of toxic substances, including mercury which is present in electronic waste. A similar program exists in Sault Ste. Marie Ontario for the collection, reusing, recycling and proper disposal of e-waste twice a year by Clean North.

Recycling depots have been set up at heating wholesale supply outlets in Thunder Bay for thermostat recycling. Instead of being landfilled, collected thermostats are sent to Honeywell Inc., for safe retrieval and reuse of mercury.

A "pay-as-you-go" depot for commercial generators of fluorescent lights has been set up in Thunder Bay and is operated by MGM Electric Inc. This depot receives and recycles between 20 and 30 thousand spent tubes per year.

In collaboration with EcoSuperior, the Ontario MOE, pharmacy retailers and distributors; Environment Canada developed and implemented the mercury thermometer “Take Back” pilot project. This project promoted the return of thermometers by the public to participating pharmacies in Thunder Bay, Sault Ste. Marie and all North Shore towns with pharmacies. Mercury was recovered and consumers were encouraged to replace mercury thermometers with mercury-free substitutes.

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. Although the Ontario First Nations Technical Services Corporation submitted a proposal to establish a pilot recycling project for First Nations within the Lake Superior Watershed, this project remains unfunded. There is a still a need for recycling in order to limit the open burning of garbage in the basin.

Energy

22 Promote energy conservation programs (EC-2, MOE-1)
23 Home and industry energy audits (EC-2, MOE-1)
24 Encourage municipal energy councils (EC-2, MOE-1)
114 Alternative energy sources (MOE-2)
167 Reduce reliance on petroleum hydrocarbons for energy production and heating at First Nations (EC-2)

Canada adopted the "Energy Star" system to rate a number of household and office products and inform the public in regard to their energy efficiency in 2003.

The Government of Canada has endowed $550 MM 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. The town of Marathon and Marathon Pulp will use $50,000 from the fund to study the feasibility of a wind farm to augment energy requirements of the surrounding community.

Ontario has set a target for the province to produce five per cent of its electricity from renewable sources by 2007 and ten per cent by 2010. In addition, a new program, the 'Every Kilowatt Counts' campaign, includes rebates for consumers to replace inefficient central air conditioners with new ENERGYSTAR® qualified systems; a province-wide educational and incentive program reaching 4.3 million households, which will provide every Ontarian the basic tools to help the province achieve a Culture of Conservation; and a refrigerator retirement program, targeted at removing old, outdated and inefficient refrigerators.

Dioxins/Mercury/Incinerators/Burn Barrels

47 Insist on highest standards and best available technology for new incinerators (EC-2)

48 Prevent or remove chlorinated or mercury containing material from incinerator feedstocks (EC-2, MOE-1)

127 Reduce dioxin and furan discharges from pulp bleaching process (MOE-1)

EcoSuperior, with support from Environment Canada is providing guidance to seven rural townships in the vicinity of Thunder Bay to promote and increase recycling and the reduction of household garbage burning and the practice of garbage burning at landfills. Initial activities included a presentation to municipal officials and other government agencies on the hazards associated with garbage burning, and qualitative audits of the individual landfills through individual site visits. A follow-up workshop was conducted late in the winter of 2006 and involved presentations for landfill staff, as well as site visits to two landfills, which allowed for the sharing of methods and strategies by the participants in order to best provide effective services.

EC conducted a national landfill study under the Canada-wide Standards process and concluded that, of 928 landfill sites in Northern Ontario, 1-3% of the sites are burning waste that generates total dioxins emissions of 0.5-1.5 grams TEQ/year. The 2005 inventory report for the Canadian side of the basin estimates that total annual dioxin levels of 0.05 g TEQ-WHO_{98} have been produced from landfill fires on a constant basis since 1990 (Benazon, 2006).

A Canada-wide Standard has been endorsed to reduce mercury for coal-fired power plants on a nationwide basis. The Canadian Council of Ministers of the Environment (CCME) have agreed to provincial caps which will produce an overall 65% recapture level of mercury from coal burned in all power plants on a national scale by 2010. In addition, exploratory negotiations are to continue in order to determine the possibility of capturing 80% or more of the mercury from coal burned in power plants by 2018. Ontario's commitment to has committed to the emission of no mercury from coal-fired plants by 2010 was shelved in 2006. To this end, the Atikokan Power Plant wass slated to be closed at the end of 2007 but now will remain open. Although not technically in the LS watershed, emissions from the Atikokan plant could be considered to be in the primary sphere of influence on Lake Superior.

The CCME has agreed to participate in new initiatives to reduce emissions from residential wood burning appliances. Initiatives include: an update of the CSA standards for new wood burning appliances, the development of a national regulation for new, cleaner-burning residential wood heating appliances, the development of a national public education program and the assessment of a national wood stove upgrade or change-out program. These measures would help reduce HCB and B(a)P emissions; while, at the same time, test results have been inconclusive in regard to dioxin reductions.

A partnership of Environment Canada and the Hearth, Patio and Barbeque Association (HPBA) will be conducting a project to measure emissions from conventional woodstoves and verify historical emission factors.

EcoSuperior has been involved in local promotion of the national Burn-It Smart Campaign of NRC and EC to reduce emissions from woodstoves and similar appliances.

The Binational Household Garbage Burning Reduction Strategy was piloted in the Lake Superior basin. It will now serve as a model for other regions of both countries.

The bleached Kraft mills along the north shore are all discharging effluents with significantly decreased levels of dioxins and furans relative to historical values (there was a 90% reduction in levels during the period from 1990 to 2004,).

The portion of the wood preservation industry using pentachlorophenol (includes Northern Wood Preservers) is engaged in a Strategic Options Process (SOP) of CEPA. The Options Process for preservation plants was launched to generate the best possible information and advice through multi-stakeholder consultations to the address dioxin issues and includes the implementation of Best Management Practices.

PCBs

55 PCB "mentors" to assist small facilities (EC-1)
56 Formation of PCB cooperatives (EC-1, MOE-1)
57 Include PCBs in outreach and hazardous waste collections for small businesses (EC-2, MOE-1)
58 Destroying PCBs in use or storage (MOE-1)
59 Training sessions for small PCB owners (EC-1, MOE-1)
60 Monitoring and documentation of PCB-bearing equipment until removal (EC-2, MOE-2)
61 In-basin destruction capability for low level PCBs (EC-1, MOE-1)
125 Remove PCBs in storage at pulp and paper mills (EC-1, MOE-1)

A canvass of seven pulp and paper mills on the north shore of Lake Superior revealed that three mills (Marathon Pulp, Smurfit Stone (closed 2003) and Norampac) are entirely PCB-free and the remaining four are phasing out their in-use and in-storage PCBs. The City of Thunder Bay is also considered PCB-free, and Algoma Steel Inc. in Sault Ste. Marie, Ontario, under its Environmental Management Agreement has already destroyed 83 percent of its PCB inventory. Most facilities have plans in place to replace PCB-containing equipment with PCB-free equipment as it comes out of service.

PCB reduction commitment letters were first mailed to industries throughout the basin in late 1999 and continue to be sent to new industry sectors. Letters are also being sent to facilities on an ongoing basis to determine current inventory levels. As well as targeting major industries, commitment and inventory correspondence began to include school boards and other sensitive sites (food, beverage, hospitals, care facilities, and water treatment industries) in 2002.

EC initiated a PCB Phase-Out Award Program and the City of Thunder Bay was recently recognized by the Great Lakes Binational Toxics Strategy for successfully phasing out

PCB-containing equipment from 60 municipal buildings, plants, arenas and old age homes. There were 44 drums containing over 25 tonnes of high-level PCB wastes which were sent for destruction in 2001 (GLBTS, 2004).
EC planned to conduct a trial facility PCB audit and to prepare a Case Study for small- and medium-sized industries. A document entitled "Scope of Work for a PCB Audit Programme" was planned as part of a mentoring program. The facilities were to be inspected for the presence of PCBs; and an assessment was to be made to assess the costs to replace the equipment and destroy the PCBs, along with the benefits of replacing the equipment (improved efficiency, reduced liability and insurance). This project has not been funded; however, it remains on the agenda as part of any future program.

PCB Mentoring in the Canadian basin of the lake was to include educational outreach to 30 small and medium-sized facilities. This project was never funded, but should be considered in any future initiatives.

Mercury

73 Seek out and dispose of mercury and PCBs on school property (MOE-1)
100 Making facilities "mercury free" and pollution prevention projects (EC-1, MOE-1)
101 Partnerships with dental associations (EC-1, MOE-1)
103 Voluntary agreements with the health care industry to reduce mercury and dioxin (EC-2, MOE-1)
107 Apply results of the 1999 City of Toronto pilot to the Thunder Bay area (EC-2, MOE-2)
108 Regulatory exemption for mercury wastes reclaimed from dental offices (MOE-1)

The MOE is working with EcoSuperior to support educational and communication efforts to reduce mercury levels in secondary schools. The initiative includes a reduction in the use of mercury-containing products, the use of safe and proper collection and recycling methods, as well as encouraging the use of alternatives to mercury products (i.e. digital thermometers and thermostats). In addition, OPG Thunder Bay Generating Station will be involved in sponsoring the Ecosuperior program to identify mercury in schools in 2006/2007.

Environment Canada and MOE worked with stakeholders including the Dental Hygienists Associations, universities and colleges, the City of Toronto and the Royal College of Dental Surgeons of Ontario to prepare a "Standard of Practice for the Profession" guide for the disposal of dental amalgam and mercury wastes. EcoSuperior, with support from MOE, produced a best management practices guide for mercury which was distributed to Canadian Lake Superior basin dentists.

Ontario Regulation 196/03 requires that dentists, who use, repair, or remove mercury amalgams, must install mercury separators that capture at least 95% of mercury particles and prevent discharge to sewers. It is estimated that the compliance rate for Ontario

dentists is 99%, and the Royal College of Dental Surgeons of Ontario is following up on the 1% of remaining cases.

Considering that the compliance rate of Ontario dentist is 99% in regard to implementation of O.R. 196/03, it would appear that the results of 1999 City of Toronto pilot project for the capture and removal of mercury-containing dental amalgam prior to discharge at dental offices has been effectively applied to the Thunder Bay area.

With funding from EC's Great Lakes Sustainability Fund and MOE, EcoSuperior leads a Thermostat Recycling Project and a Fluorescent Light Recycling Program. Conventional fluorescent lamps are also collected from fourteen industries, institutions, and municipalities located in Thunder Bay, Red Rock, Terrace Bay, and Marathon (see Voluntary Agreements Section above for a more detailed description).

The "Switch Out" program to remove mercury switches from end-of-life autos destined for recycling is ongoing on the north shore of Lake Superior. All mercury collected through the Switch Out program, led by EcoSuperior along the north shore and in conjunction with the Clean Air Foundation, is sent to Fluorescent Lamp Recyclers in Ayr, Ontario (also mentioned in Voluntary Agreements Section).

Agreements were signed between Environment Canada and major pharmacy retailers in Ontario to voluntarily remove mercury thermometers from pharmacy shelves. In turn, the public was encouraged to return thermometers to participating pharmacies in the "Take-back" pilot program in the city of Thunder Bay and North Shore communities of Nipigon, Terrace Bay and Marathon, Wawa and Sault Ste. Marie, Ontario.

White goods are now collected at Thunder Bay landfills after freon-gas is removed by a contractor. Also, Lakehead Scrap Metals removes the mercury switches prior to shredding the appliances for metal recovery and recycling.

Curricula & Outreach

38 Increase awareness of the risk of pesticides use (MOE-2)
69 Provide training materials for appliance recyclers and auto salvage operators (EC-2)
79 Supplement and develop new curricula aimed at reducing the nine designated chemicals (EC-1)
141 Expand the Pollution Prevention Demonstration Site Program to include Canadian Federal facilities and First Nations (EC-2)
162 Provide sector-specific pollution prevention outreach (EC-2)

In 2005, an agreement was signed between the Ontario Ministry of the Environment and Health Canada Pest Management Regulatory Agency to coordinate surveillance, outreach, and enforcement activities relating to pesticides. In 2004, pesticide vendors were visited by MOE staff to determine compliance issues and information needs of the vendors. Auditing continued in 2005, resulting in reminder letters outlining the errors

vendors were making regarding the storage and display of pesticide products, as well as resource information that could be supplied to their clients.

In September 2004 the Lake Superior Binational Forum held a government and industry summit titled "Getting to Zero: Mercury Reductions and the Zero Discharge Demonstration Program." Recommendations from the summit were used by a group of participants to develop a basin-wide mercury reduction project. For this project, site visits and workshops were conducted by an Environment Canada contractor to mentor industry in undertaking mercury inventories in their facilities in 2006, with the goal to educate purchasing staff as to responsible purchasing practices and technical staff as to the safe removal and disposal of any recovered mercury (also, see 'joint Work Group-Forum-Industry mentoring project in the 'Voluntary Agreements…..' section above, for a further description).

In partnership with Environment Canada, EcoSuperior conducted programming and outreach to individual Canadians to take energy conservation measures to reduce greenhouse gas emissions. This program was formerly known as the "One-Tonne Challenge".

EC and MOE supported EcoSuperior in the presentation of a garbage-burning reduction campaign. Phase 1 of the campaign was a workshop in 2002 hosted by the Lake Superior Binational Forum entitled *Burning Household Garbage: Impacts and Alternatives* and feedback was received from the public and other agencies on behaviors and alternatives. Phase 2 was a media campaign, outreach to schools, and presentations to community groups and elected politicians. Flyers, bags and tags have been produced for a Parks campaign which began in 2004. Recent feedback has occurred with a request for more bags in 2006 from at least one of the parks, so far.

Outreach regarding landfill operations was provided at First Nations pow wows in 2004. Presentations encouraged recycling, hazardous waste collection and other waste minimization alternatives as well as discouraging open burning at landfills.

EcoSuperior, with the support of Environment Canada and Ontario Ministry of the Environment, conducted two workshops for townships officials and frontline workers involved in landfill operation. The first workshop was in 2005 and the second in 2006. These workshops encouraged recycling, hazardous waste collection, and other waste minimization alternatives. They also discouraged open burning at landfills. (a fuller description found in the Dioxins/… Section).

The Lake Superior Binational Forum sponsored a workshop entitled *Mercury in Our Lives: A Workshop on Mercury reduction for the Lake Superior Community,* in Thunder Bay, during 2003. Workshop subjects included human health issues, the mercury inventory of Lake Superior and activities to reduce mercury in the municipal, industrial and commercial sectors in the basin.

The Lake Superior Binational Program prepared a poster for the 2003 IJC mercury workshop which included a timeline of progress since 1990 and some of the significant events that drove concerns about the effect of mercury on human health.

EC developed the GLBTS PCB Newsletter that is being used to promote PCB elimination. Outreach programs such as the PCB Phase-Out Awards, sector mail-out of PCB information, and voluntary commitment letters, continue to build industry awareness of PCB issues and destruction processes.

First Nations bands from Michipicoten, Ojibways of Pic River, and Fort William participated in the EarthKeepers for Solid Waste Workshop. www.ofntsc.org/ENVIR-Earthkeepers.html

A pilot training course involving EarthKeepers for Fuel Management has been provided to FN in the past. It was composed of four three-day modules providing hands on training on fuel handling, storage and emergency preparedness for potential spills. The pilot course was presented to 5-6 communities (two participants from each community, one Band Administrator or equivalent, one works manager or equivalent). Staff from OFNTSC and Environment Canada developed the curriculum and conducted the training. Outside experts were also brought in to conduct some of the training modules and to do the audits.

Sediments and Remediation

126 Clean up of mercury-contaminated sediments in Peninsula Harbour (EC-2, MOE-2)

128 Assessment of existing wood preservation facilities and voluntary programs (EC-1)

194 Initiate necessary sediment remediation measures at AOCs (EC-1, MOE-1)

A partnership of government and industry took remedial measures to complete the cleanup of the Northern Wood Preservers site In Thunder Bay Harbour. The project involved the dredging of 13,000 m^3 creosote-contaminated sediment from the harbour for treatment off-site. An additional 21,000 m^3 contaminated sediment were contained within the confines of a rockfill berm and capped with clean fill. The source of creosote was isolated using a steel-sheet pile wall. Monitoring programs are now underway to assess that the barrier and groundwater control system's effectiveness in preventing the remaining on-shore contaminants from moving toward Lake Superior. Studies in 2004 and beyond will document changes in fish habitat and assess natural recovery of low impacted sediment remaining outside of the rock-filled berm.

Federal and provincial officials are in the process of assessing scientific studies and will consider management options for the three Areas of Concern. In the Peninsula Harbour AOC, the agencies are working with Marathon Pulp Inc. to implement an ecological risk assessment related to contaminated sediment. In the Thunder Bay AOC, studies are underway in the north harbour to complete the sediment assessment and determine an appropriate sediment management strategy. In the St. Marys AOC, a sediment management strategy is being developed for the Bellevue Marine Park area.

MOE, with the assistance of Environment Canada, deployed suspended sediment traps upstream of the Bellevue Marine Park in the St. Marys River AOC in 2005. The purpose of this study was to determine the characteristics of the sediments depositing over the contaminated area, and to input this information into a sediment management plan.

Reporting Criteria/Standards Setting

187 Lower reporting limits on persistent, bioaccumulative, toxic chemicals under TRI and NPRI and for PCBs under TSCA (EC-1)

144 Coordinate critical pollutants reduction strategies with TMDL reductions or limits under Ontario's Certificate of Approval process (MOE-1)

152 Regulations to require monitoring and reporting emissions from industrial and commercial emission sources (MOE-1)

Ontario Regulation 323/02 was enacted in 2002 and requires that all hospital incinerators in the province must close by December 6th, 2003. Hospital incinerators were the largest emissions source of dioxins and the forth largest emissions source of mercury in the Ontario (Dioxins & Furans CWS Status Report, Oct 2004, pg 7).

A Canada-wide Standard has been endorsed to reduce mercury emissions from coal-fired power plants (mentioned in the Dioxin… Section).

A CWS has been endorsed to reduce mercury and dioxin emissions from non-hazardous (municipal) waste incinerators.

In regard to dental amalgam, a Canada-wide Standard was set in 2001 in order to reduce the release of mercury from dental practices by 95 percent by 2005, using 2000 as the base year.

As of 2005, EC is planning to revise the current federal regulations for PCBs so that the latest requirements regarding their use and storage will be consolidated into one regulation. Some of the new requirements for consideration include a stepwise progression of timelines for retirement of PCB-containing equipment based on their PCB concentration levels. In that regard, all equipment containing 500 mg/kg of PCBs or greater would be the first equipment to be retired with an end-of-use date planned for Dec 31st, 2009. Other significant revisions will be the imposition of strict phase-out and destruction dates for certain categories of PCBs. In regard to the destruction of PCBs in storage, EC proposes that all PCB-containing solutions of greater than or equal to 50 mg/kg be destroyed by Dec 31st, 2009; and all other PCB solutions to be destroyed in as little as one year after the regulation comes into force (see What's New for further details at – www.ec.gc.ca/PCB/).

For the reporting year 2000, Environment Canada added dioxins and furans and hexachlorobenzene to the NPRI list of substances to be reported annually by industry and institutions. Reporting threshold limits for other contaminants such as mercury, were also

lowered during the same reporting period. For instance, all companies that use mercury at their facility at levels of equal to or greater than 5 kg/yr, must now report all occurrences (releases, disposal, recycling) of mercury omitted from their facility on an annual basis, even if that value is zero.

A new provincial air pollution regulation [Ontario Regulation 419/05: Air Pollution – Local Air Quality] came into effect on November 30, 2005. The regulation includes: setting new and updated air standards for 40 harmful pollutants; updating air dispersion models; and implementing a new approach to set and implement air standards more quickly.

Assessments and Remediation

168 Support First Nations on contaminated site assessment and remediation (EC-1)

176 Pursue the Great Lakes Binational Toxics Strategy for mercury, PCBs, dioxins, HCB, OCS, and pesticides (EC-1)

Temporal and spatial trends of mercury in fish from Lake Superior are continually being evaluated by Environment Canada and the MOE/MNR through their Sport Fish Eatability Program.

Environment Canada has conducted stack tests for all COA contaminants, including dioxins for two Kraft mill boilers in the basin (Norampac and Marathon) and crematoria and waste incinerators in other locations. Test results were made available for updating the Lake Superior dioxin inventory, in 2005.

The IJC's 10th Biennial Report on Great Lakes Water Quality recommended that mercury be added to the list of substances measured in the Integrated Atmospheric Deposition Network (IADN). In 2001, equipment was purchased and installed at the two IADN Canadian Master stations (Point Petre and Burnt Island) to measure gaseous and particulate mercury, as well as mercury in precipitation.

Footnotes:

* see Figure 4-1 entitled, *Action Summary. Lake Superior Critical Pollutants,* Chapter 4, "Lake Superior 2000 LaMP Report

** Level 1 commitments are actions currently supported or planned to be supported by agencies and member organizations within the next two to three years with funds and/or personnel. In some cases, the initial stages of those activities ranked at this level may already have been completed by some of the agencies or partner organizations such as municipalities. Level 2 commitments are actions that require additional resources or policy decisions in order to be accomplished or supported. In some cases these actions are as important as those in rank (1) to achieve zero discharge.

References:

Benazon, Netta (2006). Canadian Emissions Inventory 2005, Lake Superior Basin, Benazon Environmental, Guelph, Ontario.

Appendix B.2 United States Environmental Protection Agency Progress Report

The table below indicates which activities the EPA chose as part of the LaMP 2000. Some of these activities were Level 1, which indicates a high level of interest and the others were Level 2, which indicates there was a known barrier to overcome, such as lack of funding or authority or the need for a lead from other agencies.

A summary of USEPA projects and actions relating to these LaMP 2000 activities is included in the table. The table includes those projects which were LaMP commitments but may have been accomplished through other initiatives and efforts, such as the Binational Toxics Strategy, other LaMPs, etc. A more complete description of the activities identified as Level 1 or Level 2 in the LaMP 2000 can be found in Section 4.2 of that document.

LaMP 2000[1]	Description	LaMP Chemicals
LEVEL 1		
1	**Voluntary agreements**	Nine critical pollutants
The USEPA, primarily through the Binational Toxics Strategy, has used voluntary agreements to reduce the use and release of the nine critical pollutants. One example is the Chlorine Institute's commitment (under the BTS) to reduce mercury use by 50% by 2005; as of 2005, they had reduced mercury by 91%. USEPA also initiated a chlor-alkali mercury monitoring program at a chlor-alkali plant to monitor reductions. The American Hospital Association, working with the EPA, has reduced significantly reduced mercury and dioxins use and release working through hospitals and other health facilities. Mercury inventories at Indiana steel mills are complete and the project tech transferred to other steel mills in the basin. EPA has funded the Great Lakes Navy Dental Institute to research, and produce outreach materials on, best management practices for dental offices. The EPA has funded many pesticides and hazardous waste clean sweeps over the years to address continuing sources of banned or cancelled pesticides.		
2	**Establish voluntary agreements to reduce the use or release of PCBs**	PCBs
Through the Binational Toxics Strategy, the USEPA sent out commitment letters to companies to reduce/replace PCBs and PCBs-containing equipment. Specific companies were targeted, primarily owners of transformers and capacitors. Council of Great Lakes industries outreached to trade associations, through a GLNPO grant. EPA collected and posted photographs of PCB-containing equipment on the web site to assist potential owners.		
5	**Direct or indirect financial assistance**	mercury, pesticides, dioxin
USEPA, through CEM and now GLNPO grant funds, has supported state, tribal and non-profit efforts to reduce mercury, dioxins and pesticides. GLNPO grant money to the states has particularly enabled MN, for example, to: provide assistance to electric cooperatives and municipal utilities to phase-out PCB transformers; to undertake open burning abatement projects; to implement municipal mercury reduction projects and to implement an abandoned waste collections projects. USEPA has also provided funding to Wisconsin to develop burn barrel outreach kits, brochures and videos, to the St Louis River CAC for habitat planning and restoration projects, to GLIFWC for various fish contaminants work, fish consumption outreach, and to CORA and other Tribes for mercury exchange programs, burn barrel reduction and other efforts.		

18	**Develop depot and reverse distribution systems for citizens**	mercury, pesticides
USEPA has provided a great deal of funding for mercury and pesticides clean sweeps and take back programs, primarily through funding to states and tribes. EPA has funded many state and tribal pesticides clean sweep programs, mercury manometers replacement programs, auto switches removal programs, thermometer exchanges, amalgam separator programs. A recent grant from EPA to the Earth Keeper group enabled this faith based group to hold several hazardous, mercury, pesticides and e-waste collection programs.		
22	**Promote energy conservation programs**	mercury
EPA, along with the Department of Energy, has promoted its Energy Star program to encourage the use of energy-efficient products.		
32	**Initiate or continue permanent household and agricultural hazardous waste collection depots**	Mercury, pesticides
EPA continues to fund household hazardous waste and pesticides clean sweeps, through its grants to states and non-profit organizations such as the Earth Keeper group. GLNPO has also funded the mercury basin-wide reduction project, with a focus on shipping, and a mercury basinwide reduction project in conjunction with GLRC recommendations.		
35	**Complete the PCB and Mercury Clean Sweep pilot project and recycle PCB-free oil**	PCBs and mercury
The PCB [Used Oil] Clean Sweep Program was studied to determine the feasibility of the program by identifying potential participants and determining if these sources of PCB-containing used oil would participate in a clean up program. The Cook County PCB and Mercury Clean Sweep conducted a survey, the results of which demonstrated a lack of awareness of PCBs among potential generators of used oil and wastewater. Survey results also show that generators of small quantities of waste have little motivation for using a program that may "save them money" when there is little cost and no real business-related consequences for throwing PCB- and mercury-containing waste in the trash.		
38	**Increase awareness of the risk of pesticide use**	pesticides
USEPA has continued to do outreach and education on the risks of pesticides use through its Region 5 Pesticides Division. The official EPA policy of Integrated Pest Management (IPM) has been outreached through the healthy schools, children's health and other pollution prevention efforts. Additional targeted efforts for schools, park districts, and golf courses are now underway. GLNPO has increased its coordination with Region Pesticides office to jointly fund and implement priority projects. EPA is also partnering with several non-profit groups to spread the word about IPM, reduced pesticide use, natural landscaping and other similar efforts.		
49	**Burn barrel outreach and ordinances**	dioxin
EPA has funded numerous burn barrel outreach and education efforts. This includes funding to Wisconsin, MPCA, GLIFWC, the Earth Keeper group, for such projects as burn barrel kits, videos, posters and outreach materials. Funding has also been given to other states, tribes, non profits and environmental groups to hold seminars and training sessions, develop outreach materials and to "tech transfer" work to under-served areas of the basin.		
55	**PCB "mentors" to assist small facilities"**	PCBs
Considering using the results of the MPCA PCB project to encourage or "mentor" other states and facilities.		
57	**Include PCBs in outreach and hazardous waste collections for small businesses**	PCBs
Helped fund MPCA's utility phase-down program. The objective of the Lake Superior Zero Discharge Demonstration is to assist owners of small quantities of PCBs to remove contaminated pole-mounted transformers in the Lake Superior watershed. This project and the voluntary actions of Minnesota Pollution Control Agency and several utility companies resulted in the replacement in 64 percent of the transformers identified.		
58	**Destroying PCB in use or storage**	PCBs
No additional progress on the US side.		
62	Encourage testing for PCBs	PCBs

EPA is publicizing MPCA's Utility PCB testing and removal project for potential "tech transfer" to other areas of the Lake Superior basin. .		
63	**Removal of PCB-bearing equipment in lieu of fines**	PCBs
No additional progress on US side.		
65	**Endorsement of PCB reduction goals by power generators**	PCBs
No progress.		
66	**Formalize the PCB Phase-down Program pilot project**	PCBs
A scoping study and economic analysis on the voluntary phase-out of PCBs were done as part of the USEPAs consideration of developing a more formal national voluntary PCB phase-out program. Many of the 2,400 entities registered in the PCB Transformer Database in 2000 have since had their PCB transformers removed. Additionally, the USEPA has begun to seek the voluntary phase-out of PCB electrical equipment. The finalization and actual implementation of a national US EPA program is expected in 2006.		
67	**Identify federally owned PCBs**	PCBs
In April, 2004 the USEPA identified 26 of 433 PCB storage sites as federally owned. PCBs were included on the last list of chemicals to be considered for reduction under a U.S. Executive Order on Greening the Government. The USEPA will outreach to Federal facilities regarding the order, and will share information on how to identify and dispose of PCB equipment.		
73	**Seek and destroy mercury and PCBs in schools**	mercury, PCBs
USEPA funded development of mercury reduction curricula and materials through the University of Wisconsin extension, and distributed these materials through the Binational Toxics Strategy. EPA/GLNPO provided money to states to help with "mercury-free" school projects. GLNPO helped fund Clancy, the mercury sniffing dog and has been working with EPA's children's health coordinator to spread "healthy schools" across the Lake Superior basin. EPA's healthy school web site is: www.epa.gov/schools.		
75	**Develop and distribute information on mercury reduction at schools through the Binational Toxics Strategy**	mercury
GLNPO has provided funding through its pollution prevention grants on outreach and education to schools to help with mercury reduction/education.		
76	**Basin-wide coordination of citizen and school monitoring programs**	mercury
Through the Great Lakes Regional Collaboration, increased effort is being made to address and coordinate the many school mercury efforts. GLNPO is working with the Region 5 Children's Health programs to better coordinate these programs.		
87	**Information on compliance with revisions to Underground Injection Control Regulations**	mercury
N/A		
100	**Hospital P2 projects – Making facilities "mercury free" and pollution prevention projects**	mercury
See #103 and 104, below. EPA partnered with the American Hospital Association to implement a Mercury Virtual Elimination Plan.		
103	**Voluntary agreements with the health care industry to reduce mercury and dioxin**	mercury and dioxin
EPA partnered with Hospitals for a Healthy Environment to virtually eliminate mercury use and release from their facilities (see #104 below). EPA gave a grant to Earth Keepers to outreach and educate dentists in the U.P about dental amalgam separators. As an addition to the original grant, EPA has given Earth Keepers a grant to outreach to health facilities, hospitals and other health care providers on the reduction of mercury and dioxins.		
104	**Voluntary Agreement with the American Hospital Association**	mercury
The Hospitals for a Healthy Environment (H2E) group produced a Mercury Virtual Elimination Plan for hospitals under the AHA-EPA MOU. EPA worked with state and local governments to provide technical assistance to hospitals. EPA also worked with the NWF on their "mercury free pledge", with over 650		

hospitals signing up. Current status: H2E has 1,204 Partners representing 7,473 facilities.		
116	**Determination on regulation of mercury emissions from electric utilities**	mercury
In December 2000, EPA made a determination that the mercury emissions from coal-fired electric utilities were having an adverse affect on the environment and that the emissions should be controlled. Subsequently, EPA decided to control these emissions through a cap-and-trade program rather than through a maximum available technology regulation. The Clean Air Mercury Rule, finalized in 2005, requires states to submit plans that will collectively reduce mercury emissions at least 21 percent by 2010 and 69 percent by 2018. States may choose to participate in a national emissions trading program or choose to control mercury emissions in another way, as long as mercury emissions are reduced at least as much as the federal regulations require.		
117	**Funds to support mercury research in a number of priority areas**	mercury
GLNPO has funded many mercury research efforts, including those in the chloralkali sector,.for mercury dental amalgam reduction and controlling mercury in dental wastewater.		
118	**Workshops on reduction of mercury-containing devices at utilities**	mercury
No workshop funded but GLNPO has given grant funds to outreach/educate in general on reduction of mercury-containing materials and products.		
137	**Developing of a mercury-reduction plant at a manufacturing plant**	mercury
Synopsis of mercury-reduction project written up for Lake Michigan LaMP 2000-02.		
145	**Technical and regulatory assistance on how to identify and address Class V wells that may endanger groundwater**	mercury
N/A		
146	**Priority review to priority Class V wells within source water protection areas**	mercury
N/A		
151	**Identify opportunities to reduce storage, use, or release of mercury and PCBs**	mercury
Many of these opportunities have been identified through the BTS's mercury and PCBs reduction strategies.		
162	**Provide sector-specific pollution prevention outreach**	
Many ongoing efforts including the Lake Superior mercury reduction project in the shipping industry, the mercury/dioxins efforts in the hospital/healthcare/dental sectors, the mercury reduction at steel mills, the auto switches mercury reduction project, the wood-burning stove industry, and the electric utilities sector.		
164	**Partnerships between the Hearth Products Association for wood stove change-out program**	HCB
EPA has been working with the Hearth Products Association over the years on wood stove change-out programs. In 2000, there were pilot programs in Traverse City, MI and Green Bay, WI. The change-out program was expended to 12 states in 2001. EPA has helped develop outreach materials on best management practices. Also developed were a media outreach package, website fact sheets and labeling program promoting EPA-certified stoves and clean/safe wood burning practices. Burn it smart workshops held in 2 US cities. One to three wood additional stove change-out pilot programs are being considered, as is a "green stoves" labeling program.		
176	**Pursue the Great Lakes Binational Toxics Strategy for mercury, PCBs, dioxins, HCB, OCS, and pesticides**	mercury, PCBs, dioxins, HCB, OCS, and pesticides
Close and regular contact with BTS staff to ensure coordination with BTS reduction strategies. Two SWG members are also BTS members. Over the years, the BTS and the LaMP have coordinated and consolidated GLNPO funding to address the joint highest priority reduction projects.		
178	**Require emissions limits on pollutants for all operating medical waste incinerators**	Dioxins and mercury
The USEPA has imposed emissions limits on pollutants for all operating medical waste incinerators, leading		

to a 95 percent reduction in dioxin and mercury emissions.		
187	**Lower reporting limits on persistent, bioaccumulative, toxic chemicals under TRI and NPRI and for PCBs under TSCA.**	
EPA is proposing higher reporting limits for toxic chemicals under TRI.		
191	**Permanently retire U.S. Government stockpile of mercury and other sources of elemental mercury**	mercury
The Department of Defense Conducted a thorough Environmental Impact Assessment and decided to suspend sales of the mercury stockpile for at least 40 years, and to consolidate its mercury holdings at a single facility. The US Department of Defense suspended sales of mercury from its mercury stockpile in 1994, in response to concerns from the USEPA. There are currently 4,436 metric tons of mercury safely stored in three secure locations in the United States. The Defense National Stockpile Center is currently preparing an Environmental Impact Statement (EIS) because the stockpiled mercury has been declared excess to national defense needs. The **Mercury Management EIS** will help identify alternatives for the management of the mercury and analyze potential impacts. At this time, a decision has been made to consolidate the three mercury storage locations at one site in Nevada.		
195	**Complete remedies for Torch Lake and St. Louis River**	PCBs, mercury
USEPA has increased funding to the states to address the Lake Superior AOCs. In 2005-6, MDEQ and EPA made significant progress toward delisting the remaining Torch Lake BUIs; an ongoing PCB source still needs to be addressed. EPA has funded the St. Louis River Citizens Action Committee (CAC) over the years to develop a habitat delisting plan. In 2005-06, EPA increased funding to the CAC, MDEQ and WDNR to write a "roadmap toward delisting" the St. Louis River AOC, proposed a long-term plan for delisting the AOC, develop BUI delisting targets by 2008 and to begin work on high priority projects. A proposed MPCA workplan submitted to EPA envisioned a 20-year delisting process.		
LEVEL 2		
19	**Encourage dialogue on import of mercury-bearing products and nationwide labeling of mercury-bearing products**	mercury
USEPA has encouraged dialogue on product labeling through funding of the Northeast Waste Management Officials Association (NEWMOA)		
47	**Insist on highest standards and best available technology for new incinerators**	
71	**Training sessions for demolition contractors**	
[1] Numbers correspond to number assigned in the LaMP.		

Appendix B.3 Michigan Department of Environmental Quality Progress Report

Action #: LaMP 2000[1]	Action Description	
LEVEL 1		
1	**Voluntary agreements**	
Michigan has various voluntary stewardship programs such as the Michigan Chapter of Hospitals for a Healthy Environment (H2E), Michigan's Clean Corporate Citizen (C3) Program, Michigan Business Pollution Prevention Partnership (MBP3), Michigan Pulp and Paper Pollution Prevention (P5) Program, Michigan Turf Grass Program, Michigan Clean Marina's Program, and several others where mercury reduction goals play a significant role in their overall initiatives. As just one example, Mercury Minimization Plans were set as an industry wide goal for all P5 partners during 2004. The 10 participating paper mills, which account for approximately 70% of Michigan's paper production, have committed to perform system-wide mercury audits or inventories and pledged to eliminate mercury-containing devices as they are retired or taken out of service. In early 2005, it is thought that all of the existing P5 membership (ten mills) will have self certified that their mercury minimization plans are in place. New members joining the P5 Program in the future will be expected to do the same.		
5	**Direct or indirect financial assistance**	
The Michigan department of Environmental Quality provides a number of non-regulatory assistance and information programs which emphasize pollution prevention (P2) to help the citizens and businesses of Michigan make informed decisions and take actions that conserve resources and prevent pollution and waste. The goal of the Michigan Pollution Prevention Research Grant Program is to further the state's P2 efforts by encouraging the development and diffusion of innovative P2 technologies to benefit Michigan businesses and the environment. See http://michigan.gov/deq/0,1607,7-135-3307_3515_28903-85382--,00.html.		
13	**Internal purchasing policy**	
It is the clear intent of the State agencies to avoid purchasing products that contain mercury whenever possible. Vendor shall offer mercury-free products when available. Should mercury-free alternatives not exist, as presently is the case with fluorescent lamps, bidders shall offer the lowest mercury content available. See: http://connect.michigan.gov/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/DMB/Aquisition%2520Services/Statewide%2520Purchasing/Templates/ITB%2520Template.doc		
19	**Import and labeling of mercury bearing products**	
The Environmental Council of the States has a policy on Hg bearing products. See ECOS.org . Additionally, vendor shall disclose whenever products contain added mercury by indicating whether or not a product contains mercury and if so, attach and explanation that includes the amount or concentration of mercury and justification as to why that particular product is being proposed. Vendor shall ensure that mercury added products containing mercury in excess of 1 gram or 250 pm, shall be labeled "contains mercury".		
22	**Promote energy conservation programs**	
The Department of Environmental Quality has partnered with the Department of Labor and Economic Growth Energy Office, Michigan Public Services Commission and Department of Transportation to identify various energy efficiency and energy conservation programs and resources available to the public, private business and municipal government. Energy efficiency plays an important role in pollution prevention and environmental sustainability in Michigan. For more information, see http://www.michigan.gov/deq/0,1607,7-135-3585_27504---,00.html and http://www.michigan.gov/cis/0,1607,7-154-25676---,00.html.The Michigan Energy Demonstration Centers are non-profits who received start-up funding from the MI Energy Office to provide energy related assistance to residential customers. For more information, see		

http://www.warmtraining.org/medc/ or visit www.northernoptions.org for the Marquette location. See also http://www.michigan.gov/deq/0,1607,7-135-3585_4127_24843---,00.html and http://www.michigan.gov/documents/bewinterwise_138994_7.htm for information on "green buildings" concepts and energy conservation, respectively.		
23	**Home and industry energy audits**	
See # 22 above.		
32	**Collections (household hazardous waste, pesticides, elemental mercury, etc.)**	
In 2005, 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. For clean sweeps, see #33.		
48	**Prevent or remove chlorinated or mercury containing material from incinerator feed sticks**	
There are currently no incinerators present in the basin. The last one closed in 1999.		
49	**Burn barrel outreach and ordinances**	
In Michigan, the practice of open burning may be regulated at both the state and local level. At the state level, open burning is regulated under Parts 55, 115, and 515 of The Natural Resources and Environmental Protection Act, Public Act 451 of 1994, as amended, and associated administrative rules. There are two state agencies responsible for administering these open burning regulations: The Department of Environmental Quality (DEQ) and the Department of Natural Resources (DNR); however, these regulations may be enforced by local units of government. The DEQ has also developed a document for local officials which is a "Model Open and Outdoor Burning Ordinance." This publication is designed to help local officials craft their own burning ordinance. The ordinance provides options to be more restrictive than the state regulations if they choose. Another outreach tool DEQ has developed is a burn barrel display. DEQ has also developed instructions for making a display of your own. For more information, see http://www.michigan.gov/deq/0,1607,7-135-3310-65250--,00.html.		
50	**Evaluate adoption of law prohibiting disposal of mercury-bearing waste**	
In the 2005 Michigan legislative session, there were 26 bills introduced to the House and Senate, all of which relate to mercury. Ten of the bills cover various aspects which constitute mercury disposal bans). Other mercury reduction bills cover sales bans, phase outs and use bans which may also require labeling and state notification.		
63	**Removal of PCB-bearing equipment in lieu of fines**	
N/A		
69	**Recycler and auto salvage training**	
The Alliance of Automobile Manufacturers has joined with the Michigan Department of Environmental Quality to launch a landmark statewide mercury switch collection program for end-of-life vehicles. The purpose of the program is to collect and recycle mercury-containing switches found in old automobiles to ensure they are safely removed before vehicles are shredded, crushed, or smelted; preventing the mercury from being released to the environment. For more information on pollution prevention programs, see http://www.michigan.gov/deq/0,1607,7-135-3585-115473--,00.html.		
73	**Seek and destroy mercury and PCBs in schools**	
Public Act 375 of 2000 requires that schools no longer purchase, store, or use any mercury or mercury-containing instruments as of 2004. For more information, see http://mi.gov/deq/0,1607,7-135-3585_4127_4175-11693--,00.html.		

100	**Hospital P2 projects**	
See M2P2 final report at http://www.michigan.gov/deq/0,1607,7-135-3585_4127_4175-14172--,00.html and hcwh.org. For information on Hospitals for a Healthy Environment (H2E) Technology Demonstration Project, see http://www.michigan.gov/deq/0,1607,+7-135-3585-101603--,00.html.		
101	**Partner with dental associations**	
The Superior District Dental Society (Marquette, MI) working with the Central Lake Superior Watershed Partnership and the Marquette Wastewater Treatment Plant, passed a resolution to voluntarily install mercury amalgam separators. The Dental Society represents 58 dental offices in Marquette and Alger County.		
103	**Voluntary agreements with the health care industry to reduce mercury and dioxin**	
The goal of the H2E Technology Demonstration Project is to encourage greater adoption of innovative P2 technologies and practices among healthcare providers. See http://www.michigan.gov/deq/0,1607,+7-135-3585_4129_4173-101603--,00.html. Additionally, in the voluntary agreement described in the Memorandum of Understanding between the American Hospital Association and the U.S. Environmental Protection Agency (1998), virtual elimination of mercury in hospitals was called for by 2005 and set goals of total waste volume reduction by 50% by 2010. Several prominent hospitals in the Upper Peninsula, including Marquette General, have adopted these goals.		
148	**Require toxic reduction plans in new or re-issued NPDES permits**	
See Mercury Permitting Strategy on DEQ website http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-11384--,00.html.		
149	**Include appropriate limits for persistent, bioaccumulative, toxic substances in air emission permits**	
Michigan utilizes its base regulatory programs to reduce mercury released from point sources through the air permitting process. Any new or modified source of mercury emissions must go through a Best Available Control Technology for Toxics review. Each source is required to demonstrate the maximum degree of mercury emission reduction reasonably achievable taking into account energy, environmental, economic impacts, and other costs. Sources of mercury emissions must also go through a health-based screening review that uses modeling of source emissions to predict the ambient impact of a toxic chemical. Predicted ambient impacts can be no greater than health-based screening levels. Typically, these screening levels only consider exposure from direct inhalation. Because the primary concern for mercury is from indirect exposure pathways (i.e., consumption of fish), the health-based inhalation screening level of 0.3 micrograms per cubic meter (µg/m3) (with a 24-hour averaging time) was withdrawn and emissions of mercury are evaluated on a case-by-case basis. Therefore, mercury emission limits for new and modified sources are primarily set on a case-by-case basis. See http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-mercury-report.pdf.		
150	**Pollution prevention components in enforcement settlements**	
The Marquette Regional Solid Waste Authority purchased a Lumex Mercury Vapor analyzer as a SEP settlement for county health departments to be used in spill response and prevention.		
151	**Identify opportunities to reduce storage, use, or release of mercury and PCBs**	
For information on the MDEQ's Universal Waste guidance document, see http://www.deq.state.mi.us/documents/deq-ead-tas-univwaste.pdf.		

162	**Provide sector-specific pollution prevention outreach**	
For information on pollution prevention in Michigan, see http://www.michigan.gov/deq/0,1607,7-135-3585---,00.html.		
176	**Pursue Binational Toxics Reduction Strategy goals**	
LaMP activities were consistent with BTS reduction goals and Michigan participation is on-going.		
LEVEL 2		
4	**Evaluate economic incentives to promote reductions**	
DEQ offers a variety of voluntary partnership programs to encourage businesses to pursue pollution prevention. These partnerships provide business sectors a forum for sharing technologies and strategies that when adopted, save money by reducing energy costs, water use, chemical use and the generation of hazardous, toxic or solid wastes. In addition to the financial benefits, businesses and organizations that participate in these partnerships receive public recognition and improve corporate relations. For more information, see http://www.michigan.gov/deq/0,1607,7-135-3585_4129---,00.html.		
18	**Develop depot and reverse distribution systems for citizens**	
N/A		
33	**Assist in conducting industrial clean sweeps and use economy of scale for collections and shipments of hazardous waste**	
See http://www.michigan.gov/deq/0,1607,7-125-1568_2383_2406---,00.html for information on clean sweep programs in Michigan.		
34	**Initiate and continue periodic abandoned "white goods" collections**	
55	**Encourage PCB mentors**	
N/A		
57	**Include PCBs in outreach and hazardous waste collections for small businesses**	
The Small Business P2 Loan Program (P2 Loan Program) provides loans of up to $300,000 at an interest rate of 5% or less to existing independently owned businesses with 500 or fewer full time employees. Projects that qualify for P2 loan funding include those that either eliminate or reduce waste at the business location (source reduction), result in environmentally sound reuse and recycling for the loan applicant's generated wastes, or conserve energy or water on-site. For more information, see http://www.michigan.gov/deq/0,1607,7-135-3307_3515_4144---,00.html.		
58	**Encourage destroying PCBs**	
N/A		
62	**Testing of transformers and capacitors to identify remaining PCBs**	
Accomplished through regulation of PCB containing equipment		
65	**Endorsements of PCB reduction goals by power generators**	
N/A		

71	**Training sessions for demolition contractors**	
In 2004, a workshop was held called *Handling Hazardous Building Components: How to Stay Safe and Be Environmentally Friendly*. The goal of the workshop was to provide public and private sector customers in the building ownership/operation, construction, renovation, repair and regulatory sectors with an overview of the federal and state health, safety and environmental compliance requirements regarding building maintenance, renovation, and demolition activities. Attendees were supplied with a set of tools, best management practices, and an opportunity to learn about a variety of pollution prevention or alternative resources through direct instruction or by way of discussions with vendor personnel or other participating organizations. The workshop was a success with almost 200 attendees.		
147	**Bans on non-essential uses of the nine persistent, bioaccumulative, toxic substances targeted for zero discharge**	
See above, # 50		
191	**Retire federal mercury stockpile**	
Participation on the Environmental Council of the States which recently renewed resolution No. 96-2 on Hg. See ECOS.org		

Appendix B.4 Minnesota Pollution Control Agency Progress Report

The table below indicates which activities the MPCA chose as part of the LaMP 2000. Some of these activities were Level 1, which indicates a high level of interest and the others were Level 2, which indicates there was a known barrier to overcome, such as lack of funding or authority or the need for a lead from other agencies.

A summary of Minnesota projects and actions relating to these 40 LaMP 2000 activities is included in the table. The table also reports on progress made by other Lake Superior partners in Minnesota, such as the Western Lake Superior Sanitary District and others. A more complete description of the activities identified as Level 1 or Level 2 in the LaMP 2000 can be found in Section 4.2 of that document.

LaMP 2000[1]	Description	LaMP Chemicals
LEVEL 1		
1	**Voluntary agreements**	mercury, PCBs, dioxin
The eight facilities in the Lake Superior basin that did mercury reduction voluntary agreements with the MPCA have eliminated approximately 5,000 pounds of mercury since 1990. Three of the facilitys' case studies are summarized in the *Mercury Reduction for Lake Superior* brochure and all the facilitys' Voluntary Mercury Reduction Progress Reports can be found at http://www.pca.state.mn.us/air/mercury.html#reports .		
5	**Direct or indirect financial assistance**	mercury, pesticides, dioxin
Directly as a result of the LaMP, the MPCA has used $150,000 of state and federal funding to provide assistance to electric cooperatives and municipal utilities to phase-out PCB transformers; $65,000 of state and federal money for open burning abatement projects (see #49 above); $24,000 municipal mercury reduction projects; and $10,000 for abandoned waste collections. We've also provided $15,000 of state money to the SLRCAC and $10K to Northern Initiatives for the CARD project. We also purchased rain barrels and digital thermostats for residents to swap for burn barrels and mercury thermostats; thermostat bins to supply at no cost to contractors; and amalgam separators to supply at no cost to dental offices.		
22	**Promote energy conservation programs**	mercury
Minnesota energy conservation projects since the LaMP 2000 include Minnesota Power's Millennium Star house (www.mnpower.com/energyhome), the Duluth Zoo (www.nmnrenewables.org/zoo/index.shtml) and Hartley Nature Center (www.nmnrenewables.org/HNC/index.shtml) energy efficiency projects and a Lake Superior Stewardship award given to a Minnesota firm that has designed energy efficient facilities in northeastern Minnesota and northwestern Wisconsin (http://www.lhbcorp.com/awards_citations/index.php?sect_rank=2&story_id=37).		
49	**Burn barrel outreach and ordinances**	dioxin
Open burning abatement projects implemented by the MPCA, a city and three of the four Lake Superior counties include a burn-barrel-for-a-rain barrel exchange; various forms of outreach including brochures, bookmarks and county fair displays; promotion of composting instead of burning; development of a video for fire suppression officials (still in progress); and a theatrical presentation to elementary schools.		
WLSSD held the *Open Burning: Preventable Pollution* workshop for local government officials in 2005 (http://www.wlssd.com/Open_Burning/Tools_for_Reducing.htm).		
56	**Encourage PCB cooperatives**	PCBs
The MPCA is wrapping up the final results of a project that replaced 450 transformers suspected to contain PCBs at 3 utilities in the basin. We expect the database that results from the project has the potential to be useful nationwide.		

62	**Encourage testing for PCBs**	PCBs
Per #56 above, the decommissioned transformers were tested. We are still compiling the test results.		
69	**Recycler and auto salvage training**	PCBs
The State of Minnesota is working with Minnesota Waste Wise to remove mercury switches from end-of-life vehicles (www.mnchamber.com/about/ww_mercuryrecovery.cfm).		
71	**Demolition contractor training**	PCBs
The MPCA participated in demolition contractor workshops (i.e., *Remodeling Lake Superior: A Contractor's Workshop*) hosted by the City of Superior in 2001.		
73	**Seek and destroy mercury and PCBs in schools**	mercury, PCBs
Minnesota's Mercury Free Zone was just starting up during the development of LaMP 2000. Since then, this Lake Superior originated program has spread statewide. As of March 2005, half a ton (1000 pounds) of mercury has been safely removed from MN schools; 490 out of the 1,800 MN middle and high schools have signed the mercury free pledge; Clancy (mercury detecting dog) and his human coworkers have assessed 149 schools for mercury contamination; and they have also educated at least 15,498 students, teachers and school facility about the dangers of mercury and how to properly manage mercury waste (www.pca.state.mn.us/programs/mercury-free/index.html .		
For PCBs, see #64 below.		
93	**Investigate wet scrubbers**	mercury
An inventory of scrubbers by the MPCA was attempted, but is not considered comprehensive. More recently, the Minnesota DNR has investigated the role for scrubbers at taconite plants and the possibility of capturing mercury from the scrubber dust.		
U.S. Steel Keewatin plant will be installing a new wet scrubber.		
96	**Separate pyrite fraction from coal at taconite facilities**	mercury
As it turned out, the facility in question was not interested in trying this.		
100	**Hospital P2 projects**	mercury
MOEA formed the Healthcare Environmental Awareness and Resource Recovery Team (HEARRT) which addresses sustainability, waste reduction, proper disposal of wastes and alternative products and methods for the health care sector. MOEA also held statewide *Hospitals for a Healthy Environment* workshops in 2001.		
101	**Partner with dental associations**	mercury
The MPCA worked with WLSSD and the northeast chapter of the Minnesota Dental Association (MDA^3) to survey dentists and distribute free waste amalgam separators in the basin. Between WLSSD and the MPCA, we have "saturated the market" of dentists in the basin who are willing to voluntarily use a separator. We have also tested mercury levels in the air in two dental clinics in the basin at their request. In addition, the MDA^3 implemented a statewide mercury amalgam separator project and 1,100 dental offices staewide pledged to install separators (http://www.mndental.org/professionals/amalgam_recovery/).		
144	**Coordinate with TMDL and ON Certificate of Approval**	mercury
The St. Louis River Mercury TMDL Partnership Board put together an innovative project "menu" for additional mercury reduction projects that should be done in the Minnesota portion of the basin (http://www.barr.com/PDFs/Papers/SLRP/SLRP%20mercury.pdf).		
The MPCA LaMP coordinator assisted with review and public outreach for the statewide mercury TMDL (http://www.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html).		
The MPCA listed portions of the lower St. Louis River as needing TMDLs for some of the LaMP critical chemicals, including PCBs, dieldrin, DDT, dioxin and toxaphene for exceedences in the water column in addition to previous listing for mercury (www.pca.state.mn.us/publications/wq-iw1-03.xls).		

148	**Add Toxic Reduction Plans to water permits**	mercury
Completed for all the major municipal dischargers.		
156	**Consider ONRW when reviewing water quality rules**	mercury, PCBs, pesticides, dioxin
Minnesota's GLI Rule (i.e., MN Rules Ch. 7052) has not been reopened since LaMP 2000.		
199	**Coordinate monitoring strategy**	mercury, PCBs, pesticides, dioxin
MPCA has participated in but not led basinwide monitoring discussions. Our major interest has been to champion the need to monitor source indicators. MDH has continued cooperating on fish tissue sampling and assisted GLIFWC with a compilation of monitoring data.		
LEVEL 2		
13	**Internal purchasing policy**	mercury, PCBs
MPCA has begun to compile existing state and MPCA purchasing policies.		
19	**Import and labeling of mercury bearing products**	mercury
No changes made to existing Minnesota laws that require labeling.		
24	**Municipal energy councils**	mercury
No action taken.		
25	**Demand Side Management line-charge with utility deregulation**	mercury
Minnesota did not pursue utility deregulation.		
32	**Collections (HHW, pesticides, elemental mercury, etc.)**	mercury, pesticides
Besides the ongoing local haz waste collections, the Dept. of Ag has continued funding pesticide collections. The MPCA has done some collections in the form of the abandoned waste project, thermostat swaps, and the barrel-for-a-barrel project.		
55	**Encourage PCB mentors**	PCBs
The MPCA discussed a collective PCB reduction effort or coordinating a PCB reduction effort through a single provider such as Minnesota Power, but was advised that smaller utilities preferred to handle the project within their own system. Minnesota Power does provide some support, however, in their role as a transfer point for some decommissioned PCB equipment from their customers and some other utilities.		
58	**Encourage destroying PCBs**	PCBs
See #56 above		
64	**Government assistance for testing and removal of PCBs at municipalities, schools, hospitals and small business**	PCBs
After review of a 1997 of potential PCB transformer and capacitor owners, a decision was made to not pursue this action due to the lack of candidates.		
77	**Use mercury sniffing dog in schools**	mercury
see #73 above		
94	**Assist taconite and electric utilities with mercury reduction technologies**	mercury
The state participated in a study to understand mercury cycling in taconite plants. A Minnesota DNR minerals Division report entitled *On the Distribution of Mercury in Taconite Scrubber Systems* was submitted to EPA and other funders in 2003. Studies are continuing.		
95	**Convert from coal to low mercury energy at industrial utilities (e.g., taconite)**	mercury
While some taconite company representatives expressed interest in natural gas, changing market conditions for natural gas made conversion infeasible.		
114	**Alternative energy**	mercury
Fond du Lac and Grand Portage Reservations have done some preliminary work on alternative energy potential on their reservations. Also see #22 above.		

119	**Convert from coal to low mercury energy at utilities**	mercury
No conversions were achieved, but a coal gasification project has been proposed in and near the Lake Superior basin.		
Minnesota Power has participated in studies on mercury control technologies at their Laskin plant (Lake Superior basin) and Clay-Boswell (Mississippi River basin)		
147	**Bans on non-essential uses of the nine**	mercury
Two Minnesota mercury product bans affected the basin since 2000. The City of Duluth undertook a ban on fever thermometers which was later expanded to include other types of mercury bearing equipment. The State of Minnesota also banned mercury thermometers.		
149	**Limit toxics in air permits and lower emissions threshold for MACT**	mercury, PCBs, dioxin, HCB, OCS
The MPCA agreed with EPA on a normal MACT schedule for the taconite industry.		
176	**Pursue Binational Toxics Reduction Strategy goals**	mercury, PCBs, pesticides, dioxin
LaMP activities were consistent with BTS reduction goals. BTS partners assisted with some of the Minnesota projects and the MPCA shared information with the BTS. LaMP projects were also featured along with BTS activities in the GLNPO Significant Activities Report.		
179	**Lower mercury limits for sludge and med waste incinerators**	mercury
No new action taken in Minnesota.		
180	**Change RCRA to prevent burning mercury waste**	mercury
No new action taken in Minnesota.		
187	**Lower federal reporting limits**	mercury, PCBs, dioxin
See Appendix B.2		
188	**Nationwide product stewardship**	mercury
Minnesota is implementing an auto switch collection effort as part of Minnesota Waste Wise (http://www.moea.state.mn.us/publications/mn-switchreport-may2005.pdf)		
189	**Provide incentives to utilities to control mercury and invest in alternative energy**	mercury
Minnesota has an aggressive ethanol program that has spread since 2000 and now includes three gas stations in Duluth that offer E85 (http://www.mda.state.mn.us/ethanol/about.htm). The state also passed a law requiring 90% reduction of mercury emissions at the state's largest coal fired power plants (http://www.governor.state.mn.us/mediacenter/pressreleases/PROD007500.html). In addition, Minnesota Power is voluntarily installing mercury control equipment at the Taconite Harbor coal fired power plant, which is in the Lake Superior basin.		
190	**Tighten pesticide shipping laws**	pesticides
No action on state's part. Requires federal lead.		
191	**Retire federal mercury stockpile**	mercury
The U.S. government completed an environmental review of potential stockpile management options and chose to consolidate 4,890 tons of mercury from four storage sites to one site (www.epa.gov/fedrgstr/EPA-IMPACT/2004/April/Day-30/i9726.htm).		
194	**Remediate sediment**	mercury, PCBs, pesticides, dioxin
The MPCA agreed to a cleanup plan for Stryker Bay (http://www.pca.state.mn.us/publications/reports/slridt-soudecision.pdf) and completed a sediment management plan for the St. Louis River Area of Concern.		
[1] Numbers correspond to number assigned in the LaMP.		

Appendix B.5 Wisconsin Department of Natural Resources Progress Report

This table below provides details on the actions taken in Wisconsin as part of the Department's commitments to the Chemical Strategies in LaMP 2000. The level of which the Department originally committed to is identified in the second column. Actions without commitment levels were taken in support of the strategies and in addition to the original committed actions. The commitment number is included at the end of the narrative. This table provides a progress report on activities taken by the Department and other Lake Superior Partners.

Mercury		
Strategy 1 - Encourage voluntary reductions of the use, discharge and emission of mercury.		**At the end of 2004, the city of Superior, Wisconsin completed a three-year Wisconsin Great Lakes Protection Fund project for community-based mercury reduction. Over 400 pounds of elemental mercury, over 10,000 fluorescent bulbs, and thousands of mercury devices have been collected and recycled. Because of the city's outreach, all dentists in the city have installed mercury amalgam separators. In September, 2004 the city of Superior received the National Pollution Prevention Roundtable's Most Valuable P2 Award for its outstanding educational outreach programs. http://www.ci.superior.wi.us/publicwks/wastewater/p2index.htm**
		Murphy Oil USA and the city of Superior, Wisconsin worked in partnership with funding from USEPA GLNPO to develop a mercury and PCB inventory at the refinery and develop a pollution prevention guidebook: "Prescription for Mercury and PCB Elimination, Mercury and PCB Reduction Guidance for Oil Refineries." http://www.ci.superior.wi.us/publicwks/wastewater/p2index.htm
		In September 2004 the Lake Superior Binational Forum held a government and industry summit titled "Getting to Zero: Mercury Reductions and the Zero Discharge Demonstration Program." Recommendations from the summit were used by a group of participants to develop a basin-wide mercury reduction project during the fall of 2004.
		In 2005, Wisconsin and Minnesota scoping projects determined opportunities for mercury reduction in Lake Superior basin industries, particularly in the shipping industry. Forum industry members agreed to serve as peer mentors for a basin-wide mercury reduction project. WDNR and the city of Superior, with input from the chemical committee and forum, developed a 12-page brochure to market the basin-wide mercury reduction and mentoring program for basin industries.
		The City of Superior, Wisconsin received USEPA funding for 2005/2006 to carry out the U.S.-side technical assistance for the basin-wide mercury reduction project.

		Wisconsin has a state-wide program for voluntary agreements with industry to conduct pollution prevention. To date, no formal agreements have been established with facilities within the Lake Superior basin. However, Wisconsin sponsors and supports community-based pollution prevention initiatives in the basin, which have the participation of many local businesses. The goal of these programs is voluntary reduction in the use, discharge and emission of mercury and the other critical pollutants.
		In Wisconsin, the City of Superior set up a fluorescent bulb recycling program where local hardware stores provide collection facilities and local industries (Murphy Oil USA and Superior Water Light and Power) provide funds for bulb recycling
		In Wisconsin, Wisconsin Indianhead Technical College and the City of Superior sponsored an auto switch-the-switch event. Approximately 60 cars were checked by the students from the mechanical program and 38 mercury switches were replaced. The Cities of Superior and Ashland set up a program with auto dealers to replace mercury switches in vehicles before they leave the lots. The auto dealers display posters and flyers advertising their participation.
		The Murphy Oil refinery and City of Superior received EPA GLNPO funding to develop a plan to eliminate the use of mercury and PCB containing equipment at the refinery. The project includes development of a purchasing policy and project outreach that can be used by other industrial facilities.
		Abandoned waste collections were carried out by recreational groups in Wisconsin and Minnesota. White goods can contain mercury switches and PCB ballasts or capacitors
	1	**No official voluntary agreements were established in the Wisconsin Lake Superior basin during 2000-2005. Wisconsin has a new "Green Tier" program to encourage voluntary agreements with industry to encourage activity that surpasses regulatory requirements in exchange for some measure of flexibility. (1)**
Strategy 2 - Develop incentives to reduce mercury.	**1**	**Wisconsin provides financial support for mercury source reduction and pollution prevention projects in the basin. In 2001, the state provided $150,000 to support pollution prevention projects in the Wisconsin Lake Superior basin. (5)**
	1	**WDNR is working with the state Public Service Commission to evaluate clean coal technologies that would have environmental benefits over traditional coal plants. (5)**

Strategy 4 - Mercury Strategy 4: Mercury-bearing products must be reduced in order to halve the amount of mercury in products by 2010.		**In 2000, members of the Wisconsin Lake Superior Public Advisory Team worked with members of the Wisconsin legislature to develop legislation requiring a deposit on the sale of mercury-containing products. The funds would be used for collection programs. To date, this legislative effort has not been successful. (36)**
		In 2001, the Northwest Wisconsin Regional Planning Commission received state funding for small business hazardous waste "milk run" collections, which allows local business to use economy of scale to achieve cost effective collection of mercury and other hazardous waste.
		In Wisconsin's part of the basin, collections for hazardous waste from households, small businesses, and agricultural operations is conducted through a mobile collection program operated by Northwest Wisconsin Regional Planning Commission. In 2002, the program expanded to provide "milk run" collections for small businesses to make proper disposal of hazardous waste more affordable in this rural area. The community based pollution prevention projects in the basin, including the Northwest Wisconsin Mercury Free Schools, utilize this collection program.
Strategy 5 - Proper identification, collection and disposal of mercury-bearing products in the basin.	**1**	**Wisconsin provides funding and support for Northwest Wisconsin Clean Sweep mobile collection program for household, agricultural, and small business hazardous waste. In 2001, a special outreach project was funded to focus on the collection of mercury containing products. (32).**
		Wisconsin provides continuing support for community based pollution prevention programs with a special emphasis on mercury. Collaborative projects include: pollution prevention workshops and projects with hospitals, clinics, dentists. (100) Sector-specific outreach workshops have been sponsored for municipalities, health care, HVAC, demolition, and electrical contractors. (162) City of Superior and WDNR work together to promote upgrades to energy efficient thermostats and proper disposal/recycling of mercury containing thermostats. This includes a state-wide recognition program for participating contractors. (27) The City of Superior and the Superior Toxics Reduction Committee are working with auto dealers to replace mercury switches in cars with non-mercury alternatives. They are instituting a recognition program for mercury-free auto dealers. A new Wisconsin federally-funded project is working with the salvage industry state-wide to remove mercury switches from autos prior to crushing. (69)
		In 2000-2001, several partners, including City of Superior, Northwest Clean Sweep and WDNR conducted an outreach, collection, education, and recognition program called, "Mercury Shake-Down, Northwest Wisconsin Mercury Free Schools." This project will continue into 2001-2002. (73) (81).

		Northwest Wisconsin Regional Planning Commission conducts two annual clean sweep events in each Lake Superior county. In 2004, they completed a special project funded by the Wisconsin Great Lakes Protection Fund to conduct "milk run" collections. This cost-effective hazardous waste collection project was utilized by rural schools districts, government facilities, tribes, and small businesses.
	1	**The City of Superior offered Dental Office Best Management Practices workshops to all Douglas County dentists. City of Superior and City of Ashland pollution prevention project staff have now visited most of the dental offices in the basin in Wisconsin to present training in best management practices. (100) (101) (162)**
	1	**The Northwest Wisconsin Mercury Free Schools program has reached 85 schools. City of Superior staff presents programs to all age school groups. Schools pledge to remove mercury products and elemental mercury. The program includes technical assistance and facility audits. Northwest Wisconsin Regional Planning Commission collects the mercury devices and other hazardous waste. Thousands of mercury items and hundreds of pounds of mercury have been collected through this program. (73)**
Strategy 6 - New laws and regulations may be the most fair way of reducing releases.		**In 2001, both the City of Superior and Douglas County, Wisconsin, passed ordinances banning the sale of mercury thermometers.**
		Increased water protection for Lake Superior – New rules relating to Lake Superior basin waters better protect Lake Superior from wastewater pollution. Under revisions to NR 102 and NR 207, the current designation of Lake Superior tributaries currently classified as Outstanding Resource Waters, are expanded to triggering additional levels of protection. These proposals modify the existing ORW designation for selected tributaries to include a ¼ mile arc within Lake Superior at the mouth of each of those tributaries. In addition, waters within one-quarter mile of the islands of the Apostle Islands National Lakeshore would also be classified as Outstanding Resource Waters A third part would prohibit any new or increased discharges of the targeted pollutants to waters of the basin unless the discharge was the result of utilization of best technology in process or control.
		In late 2002 Ashland, Wisconsin passed an ordinance banning the sale of products containing over 50 mg of mercury (with the exception of dental amalgam). The ban does not apply to fluorescent lights since they contain less than 50 mg mercury. Ashland's ordinance also requires mercury containing devices to be removed from buildings prior to demolition. Superior, WI banned fluorescent lights from landfills in 2002. The City and Douglas County had banned the sale of mercury thermometers in 2001.
	1	**Wisconsin drafted regulations to reduce mercury air emissions from utilities and other large sources in the state. The effort began in 2000 with petitions by citizens and environmental organizations. After considerable work with the public and industry, the Wisconsin DNR Board adopted mercury emission regulations in 2003.**

		Initially the regulatory package did not receive endorsement by the Wisconsin legislature and hence was not enacted. Although the rule-making was controversial, the rationale recognized the severity of the mercury problem state-wide and recognized a state regulatory role in addition to potential federal actions. Wisconsin passed state regulations in 2004 to reduce mercury emissions from utilities by 75% by 2015, these regulations were superseded by the 2005 federal rule. (181)
		In 2005, EPA issued the first-ever federal rule to permanently cap and reduce mercury emissions from coal-fired power plants. This rule makes the United States the first country in the world to regulate mercury emissions from coal-fired power plants. The Clean Air Mercury Rule will build on EPA's Clean Air Interstate Rule to significantly reduce emissions from coal-fired power plants -- the largest remaining sources of mercury emissions in the country. When fully implemented, these rules will reduce utility emissions of mercury from 48 tons a year to 15 tons, a reduction of nearly 70 percent.
Strategy 7 - Remediation of mercury contaminated sediments.		**The Town of Delta in Bayfield County, Wisconsin received a Wisconsin Great Lakes Protection Fund grant to investigate mercury levels in soil at their abandoned town dump. The Town also hired a contractor to develop an erosion control plan at the site, which sits on a tributary to Lake Superior.**
PCBs		
Strategy 1 - Encourage voluntary reductions of the use and storage of PCBs.		**Because of the inadequacy of the U.S. PCB database in the Lake Superior basin, it is not possible to describe a numeric goal for the mass of PCBs that should be destroyed in Wisconsin. Wisconsin regulatory authority and program involvement with PCBs is limited. The EPA retains authority in most cases.**
		Household and small business hazardous waste collection program and outreach includes information about PCB containing materials and equipment. The contractor workshops in January 2001, included an emphasis on PCB containing equipment. (57).
Strategy 2 - Untested equipment must be tested and the inventory must be kept current.		

Strategy 3 - Decommissioning, removal and destruction of PCBs.		**Decommissioning and removal of PCB containing equipment is part of the suite of possible actions that would be considered as Supplemental Environmental Projects as part of enforcement cases where appropriate (63).**
Strategy 4 - Governments to undertake PCB training programs.	**1**	**WDNR staff helped plan and conduct training 2001 training workshops for contractors, dealing with PCBs and other critical pollutants. (71)**
PESTICIDES		
Strategy 1 - Collection of remaining stockpiles of banned pesticides.	**1**	**Wisconsin provides funding and support for Northwest Wisconsin Clean Sweep mobile collection program for household, agricultural, and small business hazardous waste. This includes collection for pesticides. (32, 5, 33)**
	1	**Successful business collection programs of hazardous waste include Western Lake Superior Sanitary District's clean shop program and Northwest Wisconsin Regional Planning Commission's very small quantity generator collection program. (33)**
Strategy 2 - Engage other programs that deal with banned pesticides		
Strategy 3 - Educate residents about the use of pesticides.		**Citizen education is conducted through the community-based pollution prevention programs in the Wisconsin portion of the Lake Superior basin. A combination of state and federal funding has supported these programs. As of 2001, community based programs are underway in Superior, Ashland, and among the Red Cliff Band of Lake Superior Chippewa.**
Dioxin, HCB, and OCS		
Strategy 1 -		**Northwest Wisconsin Regional Planning Commission produced a video for open burning outreach with an**

Encourage voluntary reductions of the discharge and emission of dioxin/HCB/OCS.		**emphasis on protecting Lake Superior.**
		Wisconsin Environmental Decade and Wisconsin Department of Natural Resources (WDNR) produced the Air Defenders: The Quest for Clean Air, an educational program about open burning, air quality and asthma for children 10 years and older. The kit includes a CD of an interactive education game, posters, brochures, a WDNR video called Give Burn Barrels the Boot and a CD with music lyrics for songs such as The Burn Barrel Blues.
		Superior, Wisconsin continues burn barrel outreach activities and Northwest Wisconsin Regional Planning Commission is developing a burn barrel education video for local officials.
		University of Wisconsin Lake Superior Research Institute has a project funded by U.S. EPA GLNPO to update the dioxin inventory for the Lake Superior basin.
		Lake Superior Research Institute at University of Wisconsin, Superior, completed a USEPA funded project to evaluate priority sources and quality assurance information for dioxin emissions on the U.S. side of the basin.
		Air Defenders is an interdisciplinary, multi media educational program and publicly available website (www.airdefenders.org) for students 10 years of age and up. It was developed by the State of Wisconsin in response to concerns related to household trash burning. Air Defenders is designed to help health officials and other community educators, as well as teachers, create hands on classroom lessons for students about the dangers of burning trash. The Air Defenders kit has received national attention from US EPA for its focus on open burning. In 2004, Wisconsin Department of Natural Resources received a Great Lakes National Program Office (GLNPO) to generalize the kit contents and produce and distribute 5,000 additional kits in the GLNPO area. These kits were provided to the various state and provincial environmental agencies in late 2005
		Wisconsin supports voluntary agreements and participates in pollution prevention work with the health care industry to reduce the use of mercury and the formation of dioxin (1, 103)
	1	**LSBP agencies will work with facilities in the Lake Superior basin to establish voluntary agreements to reduce the use, discharge or emissions of the nine designated chemicals in order to meet the goals stated in the stage 2 LaMP reduction schedule. (1)**
	1	**LSBP agencies will support and promote implementation of voluntary agreements with the health care industry to reduce use of mercury and formation of dioxin. (103)**
Strategy 2 - Develop incentives to reduce	**1**	**Wisconsin worked with the Hearth Products Association and provided state funds for a wood stove upgrade incentive program in the Lake Superior and Lake Michigan basin in 2000-2001. This program provides**

dioxin/HCB/OCS.		**incentives for consumers to replace older, less-efficient wood burning stoves with new more efficient wood stoves reducing air emissions. (164) (5)**
Strategy 3 - Pollution prevention is the preferred approach to inhibit the formation of dioxin/HCB/OCS in incineration.	**1**	**WI participates in regional cooperative work on burn barrel education. In addition, a statewide television public service announcement was produced and aired in 2001. In 2001, WI awarded a grant to the Northwest Wisconsin Regional Planning Commission to develop a video for town and county government officials in the WI L. Superior basin on state regulations and local ordinance options, as well as health and environmental effects of backyard garbage burning. (49)**
Strategy 4 - There is a continuing role for the pulp and paper industry to play in dioxin reductions.		**There are no more pulp and paper facilities in the WI L. Superior basin. However, the wood products industry participates in pollution prevention work. In addition, the Wisconsin Paper Council participates in the Wisconsin Public Advisory Team, a stakeholders group established to advise WI on implementation of the L. Superior Binational Program**
Strategy 5 - Identify sources of dioxin/HCB/OCS.		
Strategies That Apply to Multiple Pollutants		
Strategy 1 - Lake Superior goals must be taken into account by other programs.		**The WI Coastal Management Program is funding phase IV of the contaminated sediment GIS database for the St. Louis River AOC. The project represents a partnership between states and the St. Louis River Citizens Action Committee and will allow mapping of contaminant concentrations throughout the AOC.**
		Lake Superior would be better protected from wastewater pollution under 2005 proposed rule changes that would expand the current state designation of Lake Superior tributaries currently classified as Outstanding Resource Waters, a designation triggering additional levels of protection. In addition, waters within one-quarter mile of the islands of the Apostle Islands National Lakeshore would also be classified as Outstanding Resource Waters. New or increased discharges in the Lake Superior basin containing zero discharge pollutants would also be required to use best technology.
		Wisconsin Department of Natural Resources produced a 16-page Lake Superior article for the Wisconsin Natural Resources magazine.
		Wisconsin agencies and individuals developed and produced poster displays on Lake Superior issues and

		goals including mercury and burn barrels. The posters were used at county fair displays during the summer of 2002 and are placed in several locations including the Northern Great Lakes Visitor Center
		In 1998, WDNR established the Wisconsin Public Advisory Team, a stakeholders group with the purpose of advising the state on implementation of the L. Superior Binational Program. This group has worked on several issues, including project funding, mercury reduction, and special designations for Lake Superior. This group helped set priorities for the first year of the WI Lake Superior Protection Fund grants in 2000-2001.
		In November, Governor Doyle celebrated the completion of a 10-year, $6.3 million Great Lakes Legacy Act cleanup project at Newton Creek and Lake Superior's Hog Island Inlet in Douglas County. The cleanup began in 1996 after an earlier study revealed unhealthy levels of oil, grease, and heavy metals such as zinc and chromium in creek and inlet sediment. Since then, approximately 50,000 cubic yards of petroleum-contaminated soils and sediments have been removed from the 1.5-mile creek and 17-acre inlet. Of the $6.3 million dollar cost, about $4.1 million was provided by the Great Lakes Legacy Act administered by the U.S. Environmental Protection Agency. This is only the second such project under the act, which Congress authorized in 2002 to address contaminated sediment problems in the Great Lakes. The Hog Island Inlet clean up took place because of a partnership among local citizens, city, county, state, and federal agencies.
		The Bayfield, Wisconsin area saw the January 2005 groundbreaking for its new regional wastewater treatment plant, described as a "zero discharge" facility because it is designed to perform at a level significantly exceeding state and federal standards. Local funding was supplemented by state and federal grants to pursue the "zero discharge facility" goal. The plant will use an innovative filtering technology in addition to conventional treatment and will use energy saving and other green design elements on-site.
	1	**The EPA and EC will lead efforts to develop a coordinated monitoring strategy for the Lake Superior basin. All of the LSBP agencies will assist in the development of the monitoring strategy and seek resources for implementation. The monitoring strategy will be peer reviewed and presented in LaMP 2002. (199)**
	1	**Researchers from the University of Wisconsin in LaCrosse and Madison as well as Lake Superior University in Michigan examined the distribution and fluxes of total and methyl mercury (about 0.5 ng/L) in the open waters of Lake Superior. (182)**
	2	**The Department continues to participate in the Great Lakes Regional Air Toxics Emissions Inventory to compile a database of point, area, and mobile source emissions for the Great Lakes region. (183)**

Strategy 2 - Sites contaminated by the nine designated chemicals must be identified and cleaned up.	**2**	**One of the first two U.S. Great Lakes Legacy Act projects was completed in November 2005 at Newton Creek and the Hog Island Inlet in Superior, Wisconsin in the St. Louis River Area of Concern. The $6.3 million project removed just over 60,000 tons of sediments contaminated predominantly with PAHs and lead. The Legacy Act project was the final step in the cleanup of 3-mile-long Newton Creek and Hog Island Inlet. Murphy Oil Co. in Superior, cleaned up the upper reaches of Newton Creek in the mid-1990s and Wisconsin Department of Natural Resources cleaned up the middle stretches in 2003. The project's connection to LaMP and RAP goals was instrumental in acquiring state and federal funding. (194)**
		WDNR is working with partners to characterize and pursue resources for clean up at the Ashland coal tar site.
		WDNR supports USEPA in its lead role on this Superfund site which includes of PAH-contaminated sediments in Chequamegon Bay.
		The WI Coastal Management Program is funding phase IV of the contaminated sediment GIS database for the St. Louis River AOC. The project represents a partnership between states and the St. Louis River Citizens Action Committee and will allow mapping of contaminant concentrations throughout the AOC.
Strategy 3 - Pollution prevention is the preferred approach to achieving the goal of zero discharge.		**Public information campaigns funded under the Wisconsin Lake Superior Protection Fund will emphasize pollution prevention**
	2	**Murphy Oil USA and the city of Superior, Wisconsin worked in partnership with funding from USEPA GLNPO to develop a mercury and PCB inventory at the refinery and develop a pollution prevention guidebook: "Prescription for Mercury and PCB Elimination, Mercury and PCB Reduction Guidance for Oil Refineries." http://www.ci.superior.wi.us/publicwks/wastewater/p2index.htm (138)**
Strategy 4 - Lake Superior communities must be supported in their pursuit of the zero discharge demonstration	**1,2**	**WI supports community-based pollution prevention efforts in Superior, Ashland, and Red Cliff. Coordination is funded by a state grant. Most of the pollution prevention projects in the WI L. Superior basin are conducted through these community-efforts. The communities also work with the Western Lake Superior Sanitary District, Thunder Bay, and Marquette (88). The community-based pollution prevention projects do extensive work with the schools, including curriculum training (79). A state grant is also funding a school education project in Superior, where a school will "twin" with a school in Thunder Bay as they pursue their mercury and L. Superior project (80). A state grant is also funding continuation of the Lake Superior water watch citizen monitoring**

program and encouraged to share their expertise to help others protect the Lake.		**program in Wisconsin schools (76).**

Appendix B.6. U.S. Tribal Progress Report

Bad River Updates to LaMP 2000 Commitments

LaMP 2000 Comtmnt. Number	Comtmnt. Level	Project Description	Actions Taken to Meet Commitment
5	1	Provide financial support for pollution prevention projects	Completed the first phase of a long-term 5 phase project, with the ultimate goal of bringing all failing septic systems up to code.
13	1	Develop purchasing policies to eliminate mercury or PCB equipment	
22	1	Promote energy conservation programs	Passed a resolution (August 2005) approving a Renewable Energy and Energy Efficiency Tribal Task Force.
23	1	Home and industry energy audits	
32	1	Initiate or continue permanent household and agricultural hazardous waste collection depots	Maintain a waste transfer station for collection and disposal of these wastes
33	2	Assist in conducting industrial clean sweeps and use economy of scale for collections and shipments of hazardous waste	
34	1	Initiate and continue periodic abandoned “white goods” collections	Conduct annual spring cleanup which includes collection and disposal of white goods.
49	1	Burn barrel outreach and local ordinances	1. Burn barrel ordinance adopted 2. The Bad River Air Quality Department conducted a Burn Barrel Buy Back Program in the

			fall of 2005.
57	1	Include PCBs in outreach and hazardous waste collections for small businesses	
58	2	Destroying PCBs in use or storage	
63	2	Removal of PCB-bearing equipment in lieu of fines	
64	2	Testing and removal of PCB-bearing equipment outreach	
71	2	Training sessions for demolition contractors	
73	2	Seek out and dispose of mercury and PCBs on school property	
76	2	Basin-wide coordination of citizen and school monitoring programs	
88	1	Funding for toxic reduction activities and networking	Conducted a project in 2003 to remove 220 junk cars on the reservation. Fluids and mercury switches were removed before cars were removed and recycled
100	1	Making facilities "mercury free" and pollution prevention projects	Ninety-four percent of elemental mercury has been eliminated from the BR health clinic. All mercury thermometers have been disposed of and the clinic is in the process of changing from mercury sphygmomanometers to digital ones. The clinic should be 100% mercury free by the year 2010.
101	2	Partnerships with dental associations	
103	1	Voluntary agreements with the health care industry to reduce mercury and dioxins	See #100
114	1	Alternative energy sources	Collecting anemometer data to assess wind energy alternatives (study will be complete by end of 2006).
147	2	Bans on non-essential uses of the nine persistent, bioaccumulative, toxic substances targeted for zero	

		discharge	
148	2	Require toxic reduction plans in new or reissued NPDES permits	Conducted an annual flyover using hyperspectral, thermal and straight photography for a non-point source pollution assessment with special focus on failed septic systems.
162	1	Provide sector-specific pollution prevention outreach	See #49
184	1	Pursue reductions of mercury, dioxin and hexachlorobenzene through source reduction elimination/segregation at medical waste incinerators	
187	1	Lower reporting limits on persistent, bioaccumulative, toxic chemicals under TRI and NPRI and for PCBs under TSCA	

Other projects aligned with LaMP goals:

Monitoring:

- Bad River has completed a four year baseline of monitoring of TSP, PM 10 and secondary analysis of the TSP filters for 8 heavy metals, including mercury. This sampling was conducted from 2001-2005. They continue to sample for PM 2.5 which began in 2002.
- Collected one year worth of total and methyl mercury in wet precipitation 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.
- Closed out one old Underground Storage Tank (UST) in October 2005. Another is still being monitored and they anticipate close out in June 2006.
- Conducted an assessment of water, sediment and wild rice plant grains for residuals of the chemical treatment used for invasive species.

Regulations:

- Submitted a "Final" draft to USEPA Region 5, for treatment in a manner as a state (TAS), under the Clean Water Act.

- Obtained TAS under the Clean Air Act in February 2005 allowing the Tribe to comment on air pollution permits issued within 50-miles of the Reservation.

Sediment Remediation:

- Involved in the Ashland/NSP Coal Tar Site (Superfund) Remedial Investigation, as well the natural resources damage assessment.

Fond du Lac Updates to LaMP 2000 Commitments

LaMP 2000 Comtmnt. Number	Comtmnt. Level	Project Description	Actions Taken to Meet Commitment
26	1	Incorporating energy conservation into new structures	1. Received funding (2005) to pursue a biomass gasification unit which will be used at the Fond du Lac Ojibway School to reduce energy needs and costs. This unit will use wood left over from fire reduction work. Air monitoring of this unit will take place by the Fond du Lac air program. Also looking into solar voltaic panels for the school. 2. Collecting anemometer data for the possibility of generating wind energy on the reservation.
32	1	Initiate or continue permanent household and agricultural hazardous waste collection depots	Ongoing recycling, HHW collection, solid waste and white goods program.
34	1	Initiate and continue periodic abandoned “white goods” collections	See #32
49	1	Burn barrel outreach and local ordinances	Initiated a burn barrel outreach effort.
76	1	Basin-wide coordination of citizen and school monitoring programs	

105	1	Mercury thermometer swap program	Conducted a mercury thermometer exchange with reservation homes and businesses in 2001. Approximately 2000 non-mercury thermometers were distributed and approximately 125 mercury thermometers were collected as part of this effort.
144	1	Coordinate critical pollutants reduction strategies with TMDL reductions or limits under Ontario's Certificate of Approval process	1. Completed two biennial tribal 305(b) reports on beneficial use attainment/impairment for reservation lakes and streams. 2. Source Water Assessment and Protection Plan completed and approved by EPA. 3. Ground Water Protection Plan was completed. 4. Tribal Non-point Source Assessment Report completed. 5. Multi-agency work group assembled to review BMPs and other NPS management tools for developing NPS Management Plan. 6. Developed a NEMO (Non-point Education for Municipal Officials) presentation to this work group. 7. Completed tribal Non-point Source Management Program, and successfully applied for Treatment as a State to administer tribal program. 7. Completed a Ground Water Vulnerability Assessment developed under an EPA Pesticides grant.
165	1	Public awareness campaign for community toxic reduction activities	Educational outreach efforts within schools and in the community have informed Band members about the problems associated with hazardous waste. A new recycling/hazardous waste building provides a place to bring these items. Clean up crews pick up things such as appliances for people who can't bring them in themselves.

Other projects aligned with LaMP goals:

Regulations:

- U.S. Environmental Protection Agency Region 5 has recognized the Fond du Lac Band of Lake Superior Chippewa as the first tribe in the region to be granted authority to administer parts of the Clean Air Act.
- Designated five reservation waterbodies, specifically wild rice lakes, as Outstanding Reservation Resource Waters.

- Solid Waste Management Ordinance was approved by RBC in spring 2004.
- Numerical nutrient and biological criteria in development for water quality standards.

Monitoring:

- Continue to monitor for acid deposition, mercury and methylmercury deposition, ozone, dioxin, NOx, PM 2.5.
- Continue to monitor reservation lakes and streams in support of tribal water quality standards and protection program.
- Ongoing ground water and stream monitoring in connection with Black Bear Golf Course (pesticides, herbicides, nutrients in ground and surface water; biological indicators in Otter Creek); provided comprehensive report to US Army Corps of Engineers in spring 2005.
- Cooperative St. Louis River monitoring project with the MN DNR, 1854 Authority, Fond du Lac Resource Management Division included water column mercury concentrations and associated water chemistry parameters, and fish tissue analysis for updating fish consumption advisories.
- Fond du Lac is sponsoring an EPA Region 5 initiative to provide technical and financial support for tribes to enter water quality monitoring data into STORET

Other:

- Continuing to plan a cooperative wastewater management project for Big Lake; memorandum of understanding between Fond du Lac Band and Perch Lake Township to create an independent sanitary district to fund and construct a small community wastewater system.

Grand Portage Updates to LaMP 2000 Commitments

LaMP 2000 Comtmnt. Number	Comtmnt. Level	Project Description	Actions Taken to Meet Committment
27	1	Encourage upgrades to energy-efficient thermostats	Conducted a thermostat swap

		– 1	
34	1	Initiate and continue periodic abandoned "white goods" collections - 1	Conducted a white-goods/appliances removal for proper disposal in the fall of 2002 (121 units), fall of 2004 (130 units), and fall of 2005 (48 units). Plan to continue to do these collections at least once/year.
105	1	Mercury thermometer swap program - 1	Mercury thermometer swaps have occurred periodically since the spring of 2000.
114	2	Alternative energy sources - 2	Pursuing grants to set up a large wind turbine as results from their anemometer studies were favorable for the possibility of wind energy development.

Other Projects Aligned with LaMP Goals

Regulations and Policies:

- Completed the process of writing an Nonpoint Source Assessment Report (August 2004), a Nonpoint Source Management Program (December 2004), and obtaining Treatment as a State (TAS) status from EPA (January 2005).
- Grand Portage water quality standards were approved by EPA on November 30, 2005. These standards are the same or more restrictive than the State of Minnesota.
- Continue to implement a Pesticide Use Policy on the Reservation to help avoid unnecessary and unscrupulous spraying.

Other Hazardous Waste Collections:

- Conducted a Business Hazardous waste removal during the summer 2005 where 46 fluorescent light bulbs were collected and recycled. Grand Portage expects the amount of waste removed to increase as they continue to conduct these removals.

Non-point Source Pollution:

- Will receive an EQIP grant (U.S. Dept. of Ag., 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 activities to reduce non-point source pollution in this area.
- Have been complying with the NPDES Stormwater rules at construction sites.

Wastewater Infrastructure:

- Completed a project extending sewer lines to connect 30 more homes along the Lake Superior shoreline in the spring of 2004. There are plans to hook up more homes and businesses in the future.

Monitoring:

- Maintain a surface water monitoring program.

Keweenaw Bay Indian Community Updates to LaMP 2000 Commitments

LaMP 2000 Comtmnt. Number	Comtmnt. Level	Project Description	Actions Taken to Meet Commitment
14	1	Introduce process chlorine-free paper products	
28	1	Re-lamping with fluorescent lamps	Ongoing effort
32	1	Initiate or continue permanent household and agricultural hazardous waste collection depots	1. Co-sponsored an Upper Peninsula wide "clean sweep" event in 2005 for household hazardous waste which collected 45.7 tons of household hazardous waste including lead-acid batteries, pesticides, herbicides, mercury and more. 2. Under partnership arrangement, will sponsor additional clean sweep events in 2006 and 2007.
34	1	Initiate and continue periodic abandoned "white goods" collections	See #32 2. Cleaning up a number of illegal dumps within the Reservation (2005 and 2006).
100	1	Making facilities "mercury free" and pollution prevention projects	1. Received funding to provide mercury thermometer exchange for Tribal members in 2006.

			2. Co-sponsor an annual Spring Cleanup event with the Village of Baraga that collects white goods.
163	1	Source separation program to divert household hazardous material from landfills and burn barrels	Tribal Council approved the KBIC Solid Waste Management Plan in Fall of 2005, which includes actions to meet this goal. Currently working on securing funding for implementation of the plan. Unknown timeline.

Other Projects Aligned with LaMP Goals

Monitoring:

- KBIC maintains a surface water quality monitoring program that collects baseline data from Reservation waters and from Keweenaw Bay in Lake Superior.

Wastewater Infrastructure:

- KBIC will begin construction of sewer and water line extensions in spring 2006 to serve lake front properties along the east shore of Keweenaw Bay.

Soil/Sediment Remediation:

- KBIC's Sand Point stamp sand brownfields site soil cap/clean up project is scheduled to start in the spring of 2006. Capping and re-vegetating the site will reduce heavy metal sediment load entering Keweenaw Bay from the property.

Alternative Energy:

- KBIC is currently pursuing funds to conduct anemometer studies at their Pequaming Hatchery.

Red Cliff Updates to LaMP 2000 Commitments

LaMP 2000 Comtmnt. Number	Comtmnt. Level	Project Description	Actions Taken to Meet Commitment
14	1	Introduce process chlorine-free paper products	
32	1	Initiate or continue permanent household and agricultural hazardous waste collection depots	Maintain a recycling and waste transfer station. Participate in annual hazardous waste collection events in conjunction with Bayfield County.
33	1	Assist in conducting industrial clean sweeps and use economy of scale for collections and shipments of hazardous waste	See #32
34	1	Initiate and continue periodic abandoned "white goods" collections	
78	1	Green school programs	
106	1	Discontinue sending mercury thermometers home with new mothers and use non-mercury thermometers	1. Red Cliff hired a mercury elimination coordinator in 2003-2004 who carried out projects including testing tribal buildings for mercury vapor with a Lumex, exchanged mercury thermometers and thermostats with digital models, provided information to the community about mercury at health fairs and on a local radio program. 2. The health clinic at Red Cliff has removed all mercury thermometers and sphygmomanometers and maintains a mercury

			thermometer exchange program. 3. The dental office at Red Cliff installed an amalgam trap.
120	2	Conversion from coal burning to natural gas for utilities; householders develop an energy conservation ethic	
165	1	Public awareness campaign for community toxic reduction activities	The mercury elimination coordinator provided mercury education at area schools, regular radio programs on mercury issues, and other educational activities including a community workshop for education on mercury issues in June 2003.
166	2	Recognition program for wastewater treatment plants that implement the Blueprint for Zero Discharge	

Other Projects Aligned with LaMP Goals

Monitoring:

- Continued a Surface Water Quality Monitoring Program that tests 21 different locations on the reservation for 22 different parameters including mercury, dioxin 2,3,7,8-TCDD, PCBs, toxaphene, and chlordane.

Burn Barrel Outreach:

- Conducted a Burn Barrel Elimination Program in which community members pledged to give up their burn barrels. The barrels were picked up for free and participants were provided a free $20 pack of garbage bags per household. Over 100 burn barrels were collected as part of this effort.

Sediment Remediation:

- Involved in the Ashland/NSP Coal Tar Site (Superfund) Remedial Investigation, as well the natural resources damage assessment.

Appendix C

In-Basin Chemical Source Inventories: 1990-2005

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 Ranking column in which the Canadian consultant, Netta Benazon, ranked the estimates based on a method used in the EPA draft dioxin reassessment. The Benazon 2006 report goes into greater detail for each estimate and includes a number of conclusions and gata 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

As part of the requirements of the Lake Superior Lakewide Management Plan (LaMP), an emissions inventory has been completed for dioxins and furans, mercury, and hexachlorobenzene (HCB) for the year 2005. In addition, revisions to the 1990 and 2000 inventories were made, where appropriate, and presented (Benazon, 2006) so that trends in emission reductions since 1990 can be assessed.

To complete the emissions inventory, numerous reference sources were consulted and a comprehensive scientific literature search was conducted. For some sources, particularly for industrial sources, the National Pollutant Release Inventory (NPRI) was queried; for others, appropriate emission factors and activity data were sought and calculations 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.

The annualized emissions inventories for dioxins and furans, mercury, and HCB for the years 1990, 2000, and 2005 are summarized in Tables C.3.1, C.3.2, and C.3.3.

Dioxins and furans

As noted in Table C.3.1, dioxins and furans emissions to the environment totaled about 0.8 g TEQ in 2005, down from 21 g TEQ in 1990—a reduction of over 95%. The substantial decrease has been largely due to the conversion of the pulp and paper bleaching process from elemental chlorine to chlorine dioxide, the closure of the Algoma

Steel sintering facility in Wawa, the cessation of PCP treatment operations at Northern Wood Preservers, and the shut-down of all four medical waste incinerators.

Currently, the largest single source of dioxins and furans in the Lake Superior Basin (LSB) is residential waste combustion (0.21 g TEQ-WHO_{98}) followed by petroleum combustion (0.1 g TEQ-WHO_{98}). Emissions from other industrial sources as well as from residential wood combustion and landfill fires are much lower (approximately 0.05 g I-TEQ each). The frequency and extent of landfill fires in the LSB is unknown. Should it prove to be considerably greater than estimated in this report, it could be an important source of dioxins and furans in the LSB.

Insufficient information exists to assess the extent of dioxins and furans contamination in the sediments within the LSB. Dioxins and furans have not been identified as chemicals of concern in the Thunder Bay or Peninsula Harbour Areas of Concern. However, limited historical testing conducted at Black Bird Creek and Lake "C" near Terrace Bay has shown evidence of dioxins and furans contamination.

Table C.3.1. Summary of Dioxin and Furan Emissions, Lake Superior Basin

Source Category	1990 Emissions (g ITEQ)						2000 Emissions (g ITEQ)							2005 Emissions (g ITEQ)							Units	Rating
	On-site Releases				Disposal	Recovery	On-site				Disposal		Recovery	On-site Releases				Disposal		Recovery		
	Atm	Water	Soil	Total		Transfer	Atm	Water	Soil	Total	On-site	Off-site	Transfer	Atm	Water	Soil	Total	On-site	Off-site	Transfer		
Industrial																						
Pulp and Paper	0.1	0.47		0.57	13.18		0.032			0.032	0	0	0	0.051			0.051	0	0	0	I-TEQ	U
Mining																				0	I-TEQ	
Asphalt Manufacturing	0.0003			3E-04			3E-04			3E-04				3E-04			0.0003					P
Wood Preserving	0.147	0.0013		0.148	0.15		0			0	0	0.037	0	0			0	0	0	0	I-TEQ	U
Iron Sintering[a]	19.4			19.4			0			0				0			0				I-TEQ	U
Subtotal Industrial	**19.6**	**0.5**		**20.1**	**13**		**0.03**			**0.03**	**0**	**0.04**	**0**	**0.05**			**0.05**	**0**	**0**	**0**		**U**
Fuel Combustion																						
Coal																						
Utitlities	0.0248			0.025	0.001		0.025			0.025	0.083	0	0.092	0.021			0.0214	0	0.001	0.003	I-TEQ	U
Residential/Commercial/Industrial[b]																						
Wood																						
Residential Wood Combustion	0.056			0.056			0.049			0.049				0.049			0.049				I-TEQ	L
Commercial/Industrial[c]																						
Petroleum																						
Motor Vehicle Fuel (Diesel)	0.087			0.087			0.079			0.079				0.090			0.090				$TEQ\text{-}WHO_{98}$	L
Motor Vehicle Fuel (Gasoline)	0.0039			0.004			0.0036			0.0036				0.0036			0.0036				$TEQ\text{-}WHO_{98}$	L
Fuel Oil	0.030			0.030			0.020			0.020				0.020			0.020				$TEQ\text{-}WHO_{98}$	L
Subtotal Petroleum	**0.121**			**0.121**			**0.103**			**0.103**				**0.114**			**0.114**				$TEQ\text{-}WHO_{98}$	L
Natural Gas	0.050			0.050			0.05			0.05				0.05			0.05				g/y	U
Subtotal Fuel Combustion	**0.3**			**0.3**	**0.0**		**0.2**			**0.2**				**0.2**			**0.2**	**0**	**0.0**	**0.0**		**U**
Waste Incineration																						
Rural On-site Residential Waste Combustion	0.21			0.21			0.21			0.21				0.21			0.21				$TEQ\text{-}WHO_{98}$	L
Landfill Fires	0.05			0.05			0.05			0.05				0.05			0.05				$TEQ\text{-}WHO_{98}$	U
Incineration of Hazardous and Municipal Waste[d]																						
Small Incinerators[e]																						
Medical Incinerators[f]	0.13			0.13	94		0.13			0.13		94		0			0		0		I-TEQ	L
Subtotal Waste Incineration	**0.4**			**0.4**	**94**		**0.4**			**0.4**		**94**		**0.3**			**0.3**		**0**		I-TEQ	**L**
Waste Water Treatment Plants	**0.01**	**0.04**		**0.05**			**0.01**	**0.04**		**0.05**				**0.01**	**0.04**		**0.05**				I-TEQ	**U**
Cremation	**0.0004**			**4E-04**			**5E-04**			**5E-04**				**6E-04**			**0.0006**				I-TEQ	**M**
Commercial Products																						
PCP Use	0.02		0.08	0.1			0.017		0.066	0.083				0.015		0.062	0.077				I-TEQ	P
PCB Spills[g]				0.003	70					0.003	70						0.003	70			I-TEQ	U
Subtotal Consumer Products	**0.02**		**0.08**	**0.1**	**70**		**0.02**		**0.07**	**0.07**	**70**			**0.02**		**0.06**	**0.08**	**70**	`			
Sediments[h]																						
Soil[i]			31.38						6							6					g/y	P
Total[j]	**21**	**0.5**	**0.1**	**21**	**107**		**0.9**	**0.0**	**0.07**	**1**	**0**	**94**	**0.0**	**0.8**	**0.0**	**0.1**	**0.9**	**0**	**0.0**	**0.0**		

Blank indicates information not available.

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

Notes

[a] The LaMP (2000) value was 21.8 in g/y and was replaced with 19.4 g 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 facilties is assumed to be reported under NPRI.

[d] No incineration of municpal 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] The 70 g I-TEQ listed under disposal is for dioxins and furans in stored or in-use PCBs and is not included in the total inventory numbers.

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

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

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

References

(1) Environment Canada (2001)

Mercury

As presented in Table C.3.2, mercury emissions to the atmosphere have declined from 743 kg in 1990 to 89 kg in 2005. In addition, releases to water have dropped from 16 to 0.2 kg over this period. Mercury in disposed waste decreased from 549 kg in 1990 to 84 kg in 2005. In total, mercury emissions to the environment totaled 89 kg in 2005, down from 759 in 1990 —a reduction of 88%.

The largest source of mercury over the period of 1990 to 2005 was the Algoma Steel iron sintering facility in Wawa. In 1990, atmospheric emissions from this facility (600 kg) were four times higher than those from all other sources combined (143 kg). Currently, the highest atmospheric emissions sources are the TBGS (37 kg), mining (30 kg), and pulp and paper (9 kg). Wood, petroleum and natural gas combustion are moderate sources of mercury, totaling 6 kg. Emissions have not changed much since 1990 as consumption has not changed significantly. On-site residential combustion (0.5kg), landfill fires (0.12 kg), and cremation (0.8 kg) present much smaller sources of mercury emissions to the atmosphere compared to others.

As mentioned above, the TBGS may implement mercury reduction measures should the Province implement mercury reduction legislation.. In addition, one mining facility is being shut down this year (2006). The combined reduction in mercury emissions to the atmosphere would amount to 46 kg or 52% of current levels, bringing total emissions down to 43 kg. When compared to 1990, this would amount to a 94% reduction.

Substantial mercury reductions have been achieved in consumer products: from 65 kg emitted to the atmosphere and water in 1990 to 6 kg in 2005, corresponding to a decline of over 90%. Mercury deposited in landfills from consumer products totaled 538 kg in 1990 and 72 kg in 2005. The reductions are associated with increased recycling and much lower mercury content in consumer products.

Recycling/recovery of mercury has increased in the LSB from 46 kg in 1990 to 69 kg in 2005—an increase of 50% since 1990. Approximately 10% of lamps, batteries, thermostats and 30% to 40% of automobile switches are recycled in the LSB. Additional information is needed to assess the recycling rate achieved by industry for displacement and reed relays and measurement and control devices.

An estimated 1,600 kg of mercury are believed to lie in sediments within two Areas of Concern: Thunder Bay Harbour and Jellicoe Cove in Peninsula Harbour. Efforts are underway to further characterize these sites and develop remediation plans. Substantial quantities of mercury are also present in sludge at a disposal site near Marathon, Ontario. The sludge is contained in drums located in concrete vaults and a groundwater monitoring program is in place to ensure that mercury is not leaching from the waste site.

Table C.3.2. Summary of Mercury Emissions, Lake Superior Basin

Source Category	1990 Emissions (kg)							2000 Emissions (kg)							2005 Emissions (kg)							Rating
	Atm	Water	Total	Land Disposal		EAF	Recovery	Atm	Water	Total	Land Disposal		EAF	Recovery	Atm	Water	Total	Land Disposal		EAF	Recovery	
				Onsite	Offsite						On-site	Off-site						On-site	Off-site			
Industrial																						
Pulp and Paper	10.9	10.9	21.8					14.5		14.5	4.89	22.6		0	9.2		9.2	0.33	11.17		115	U
Mining	4	0.4	4.4					5.9		5.9	0	115			30.2		30.2	0	0		200	U
Asphalt Manufacturing Facilities	0.063		0.063					0.063		0.063					0.063		0.063					L
Wood Preservation																						
Iron Sintering	600		600																			L
Metal Finishing		1.53	1.53																			U
Photoprocessing	0.0004	0.003	0.0034																			U
Subtotal Industrial	**615**	**13**	**628**					**20**		**20**	**5**	**138**		**0**	**39**		**39**	**0**	**11**		**315**	**U**
Fuel Combustion																						
Coal																						
Utilities	57		57		10			56		56	1.0	0		1	37		37	0.1	0.2		0.718	U
Residential/Commercial/Industrial[a]																						
Wood																						
Residential Wood Combustion	1.66		1.66					1.46		1.46					1.46		1.46					P
Commercial/Industrial[b]																						
Petroleum																						
Refined Petroleum Products	3.43		3.43					3.11		3.11					3.24		3.24					L
Natural Gas	1.85		1.85					1.56		1.56					1.41		1.41					L
Subtotal Fuel Combustion	**64**		**64**		**10**			**62**		**62**	**1**	**0**		**1**	**43**		**43**	**0.1**	**0.2**		**0.7**	
Waste Incineration																						
Rural On-site Residential Waste Combustion	5.1		5.1		5.1			0.8		0.8		0.8			0.5		0.5		0.5			U
Landfill Fires	1.15		1.15					0.18		0.18					0.12		0.12					U
Hazardous and Municipal Waste Combustion[c]																						
Small Incinerators[d]																						
Medical Waste Incineration[e]	0.77		0.77		0.02			0.41		0.41					0		0		0			U
Subtotal Waste Incineration	**7**		**7**		**5.12**			**1.4**		**1.4**					**0.6**		**0.6**		**0.5**			**U**
Waste Handling and Landfills	**29**		**29**		**540**			**5**		**5**		**98**			**4**		**4**		**70**			**U**
Waste Water Treatment																						
Land Application of Sludge[f]																						
Wastewater Treatment Plants	4.63	3.89	8.52		2.08			4.63	3.89	8.52		2.08				<7.5	<7.5		2.4			U
Runoff		0.7	0.7						0.7	0.7						0.7	0.7					U
Subtotal Waste Water Treatment	**5**	**5**	**9**		**2**			**5**	**5**	**9**		**2**				**<7.5**	**<7.5**		**2**			**U**
Cremation	**0.7**		**0.7**		**0.2**			**0.8**		**0.8**		**0.3**			**0.8**		**0.8**		**0.3**			**M**
Consumer Products																						
Fluorescent Lamps	2.6	0.01	2.61		15.52		0	2.23	0.01	2.24		13.3		0	0.67	0	0.67		4.02		0.52	M
Thermometers	2.99	0.01	3		11.08		0	0.15	0.01	0.16		1.21		0.55	0.08	0	0.08		0.62		0.22	P
Batteries	7.7		7.7		292		0	0.1		0.1		3.2		0	0.1		0.1		3.6		0.4	P
Thermostats	0.38	0.01	0.39		13.82		0	0.31	0.01	0.32		11.31		0	0.23	0.01	0.24		8.22		1.15	P
Automobile Switches	0.41	0.00	0.41		0.34	0.54	0	0.86		0.86		0.71	1.14	0	0.45		0.45		0.37	0.59	0.94	P
Household Appliance Switches	1.03		1.03		0.85	1.36	0	0.85		0.85		0.7	1.12	0	0.75		0.75		0.62	1.00	0	P
Displacement and reed relays	1.00	0.04	1.04		44.1		14.9	0.90	0.04	0.94		35.2		20.6	0.7	0.03	0.73		19.2		28.9	P
Measurement and Control Devices	3.22	0.18	3.40		92.72		10.36	0.76	0.04	0.8		22.34		14.98	0.61	0.03	0.64		16.95		17.02	P
Dental Amalgam	13	2.4	15.4		55		21	6.9	1.1	8.00		29.1		13.2	2	0.1	2.1		18.3		20.1	P
Pigments					5.6							5.6							0			U
Paint	21.2	0.12	21.32					0		0		0			0		0		0			M
Fungicidies	8	0.8	8.8		7.2			0		0		0			0		0		0			P
Pharmaceuticals	0.01		0.01		0.05			0.01		0.01		0.05			0.01		0.01		0.05			P
Subtotal Consumer Products	**62**	**4**	**65**		**538**	**2**	**46**	**13**	**1**	**14**		**123**	**2**	**49**	**6**	**0**	**6**		**72**	**2**	**69**	
Sediments[g]				1600							1600							1600				L
Sludge[h]																						M
Total[i]	**743**	**16**	**759**		**549**	**2**	**46**	**97**	**1.2**	**98**		**260**	**2**	**50**	**89**	**0.2**	**89**		**84**	**2**	**385**	

Blank indicates information not available.

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

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

Notes

[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 facilties is assumed to be reported under NPRI.

[c] No incineration of municpal 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 sludge 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] To avoid double counting, total excludes estimates from Waste Handling and Landfills, On-site Residential Waste Combustion, and Waste Water Treatment Plants which are already accounted for in the Consumer Products estimates.

HCB

There is limited data available to assess hexachlorobenzene (HCB) emissions in the LSB. HCB was likely emitted from the former iron sintering facility in Wawa which shut down in 1998, from on-site residential combustion, landfill fires, and medical waste incinerators but no data is available to estimate quantities.

For remaining sources, as shown in table C.3.3, HCB emissions to atmosphere, soil and water (environment) declined from 224g in 1990 to 121 g in 2005, corresponding to a 46% drop. The decrease is largely associated with reductions in the pulp and paper sector, likely related to the conversion of the bleaching process from elemental chlorine to chlorine dioxide.

The largest current source of HCB is PCP-treated utility poles and railway ties (16 g), and residential wood combustion (10 g). This represents an 85 % reduction from 1990 levels.

PCBs

Efforts have been underway in Ontario over the last 15 years to phase out, store and destroy or dispose of PCB waste. Liquid and solid PCB waste in storage at provincially monitored storage sites in the LSB has declined by about 80% to 100% over the last 15 years. The percent reduction varies depending on the waste category.

Table C.3.3. Summary of HCB Emissions, Lake Superior Basin

Source Category	1990 Emissions (g)						2000 Emissions (g)							2005 Emissions (g)							Rating
	Atm	Water	Soil	Total	Land	Recovery Transfer	Atm	Water	Soil	Total	Land Disposal On-site	Land Disposal Off-site	Recovery Transfer	Atm	Water	Soil	Total	Land On-site	Land Off-site	Recovery Transfer	
Industrial																					
Pulp and Paper	65.1			65.1			2.16			2.16	0	0	0	3.09			3.09	0	0	0	U
Wood Preservation	2.8	0.006		2.8	9		0.004			0.004	0	0.537	0	0			0	0	0	0	U
Iron Sintering																					
Subtotal Industrial	**68**	**0.006**		**68**	**9**		**2.2**			**2.2**	**0**	**0.5**	**0**	**3.1**			**3.1**	**0**	**0**	**0**	**U**
Fuel Combustion																					
Coal																					
Utilities[a]	123.9			123.9	1.92	2.1	123.9			123.9	1.92	0	2.145	91.9			91.9	2.064	4.816	16.4	U
Wood																					
Residential Wood Combustion	11.7			11.7			10.3			10.3				10.3			10.3				L
Subtotal Fuel Combustion	**136**			**136**			**134**			**134**	**1.9**	**0.0**	**2.1**	**102**			**102**	**2**	**5**	**16**	
Waste Incineration																					
Rural On-site Garbage Combustion																					
Landfill Fires																					
Hazardous and Municipal Waste[b]																					
Small Incinerators[c]																					
Medical Incinerators[d]																					
Subtotal Waste Incineration																					
Commercial Products																					
PCP Use	19.75		1.21	20.96			16.12		0.99	17.11				15.26		0.92	16.18				P
Subtotal Consumer Products	**20**		**1.2**	**21**			**16**		**1**	**17**				**15**		**1**	**16**				**L**
Total	**223**		**1**	**224**			**152**		**1**	**153**	**2**	**1**	**2**	**121**		**1**	**121**	**2**	**5**	**16**	

Blank indicates information not available

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

Notes

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

[b] No incineration of municpal 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.

Recommendations to Address Data Gaps

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

- Conduct a study to assess the frequency and extent of rural landfill fires and evaluate emissions from this source;
- Further increase the recycling rate of discarded mercury-containing products;
- Develop a better understanding of the quantity and fate of mercury in thermostats, displacement and reed relays, and in measurement and control devices located in institutional, commercial, transportation systems (e.g. ships), and industrial facilities within the LSB;
- Evaluate the total quantity of PCBs removed from the LSB since 1990 and the amount currently in use;
- Evaluate the extent of contaminated sediments in Black Bird Creek and Lake "C" downstream from the pulp and paper mill in Terrace Bay;
- Assess the extent of mercury releases to the environment from contaminated sediments in the Thunder Bay Harbour and Jellicoe Cove Areas of Concern and corresponding environmental impact;
- Consider asking facilities that have reported emissions to provide the methodology used to estimate NPRI data in order to allow for a better assessment of data quality;
- Consider a harmonization of methods for NPRI data estimations between industries in order to better determine relative contaminant sources; and
- Consult newly released scientific publications periodically to gather information on the impacts on the local environment associated with past use of mercury-based products at golf course complexes and on releases of dioxin-like PCBs from PCB spills and other sources.

CONCLUSIONS AND RECOMMENDATIONS

The following general conclusions can be made:

- Several revisions were made to the 1990 and 2000 inventory provided in the LaMP (2000) report either because the quality of the data used in arriving at the estimates was unknown, the methodology used to arrive at the values was unclear, or the emission factors and data used were dated.
- Asphalt manufacturing does not appear to be a large source of mercury or dioxins and furans emissions in the LSB, though additional testing may be required to confirm this finding.
- The Thunder Bay Generating Station (TBGS)—a coal-fired utility plant—has been a substantial source of mercury and dioxins and furans in the LSB. Possible Provincial legislation to require mercury reduction technologies would result in considerable emission reductions in the LSB if completed.
- There is no residential, commercial or industrial coal combustion on the Canadian side of the LSB other than the TBGS.

- There is currently no incineration of municipal solid, hazardous, and medical waste or sewage sludge on the Canadian side of the LSB. With the exception of medical waste and on-site residential waste combustion, incineration has not been undertaken in the LSB over the period of 1990 to 2005.
- The quality of most of the estimates completed for this report is rated as Unknown, Preliminary or Low. For many of these sources emissions testing is difficult to conduct requiring the use of numerous assumptions to generate the estimates.
- The Northern Wood Preservers site in Thunder Bay was remediated in 2003. A total of 7,150 dry tonnes of sediment contaminated with benzo(a)pyrene and other PAHs were removed and treated off-site. In addition, a clay barrier wall was installed on the property to prevent leaching of contaminants into Lake Superior. Regular monitoring is being conducted.
- Liquid and solid PCB waste in storage at provincially monitored storage sites in the LSB has declined by about 80% to 100% over the last 15 years.

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 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.
- 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 or Leah Granke's Michigan method, 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 emissions (kg/yr).

Source/Use Category	1990	2000	2005	Source of Data
Mining				
Copper	529.7	0	0	Granke 2005
Iron	322.3	338.0	302.9	Swain 2005
Mining Total	**852.0**	**338.0**	**302.9**	
Fuel Combustion				
Utilities - coal	95.9	106.8	124.4	Granke 2005; Bauduin 2005; Swain 2005
Industrial boilers - coal	38.5	41.0	47.2	Granke 2005; Swain 2005; NEI 2005
Institutional/Commercial	2.8	2.8	2.8	Granke, 2005; NEI 2005
Residential	12.9	11.7	12.1	Granke 2005; NEI 2005; Battelle 2005
Fuel Combustion Total	**150.1**	**162.3**	**186.5**	
Industrial				
Lumber and Wood Products	0.1	0.1	0.5	NEI 2005; GLATEI 2005
Petroleum Refining	1.9	2.4	0.2	LaMP 2000; NEI 2005
Fuel Transmission/Distribution	25.2	25.2	23.0	NEI 2005
Pulp and Paper	10.8	10.8	10.8	NEI 2005
Misc. Industrial	0.2	0.2	0.2	NEI 2005
Industrial Total	**38.2**	**38.7**	**34.8**	
Incineration				
Cremation	1.2	2.5	2.9	Battelle 2005
Medical Waste	22.7	0.0	0	LaMP 2000
Backyard Burning*	82.6	17.5	11.6	Battelle 2005
Small Incinerators	8.5	1.4	0	Battelle 2005
Sewage Sludge	21.3	5.0	0	Tuominen 2005
Incineration Total	**136.3**	**26.4**	**14.5**	
Waste Handling and Landfills				
Solid Waste Handling	35.5	7.9	7.1	Lohse-Hanson 2006 (derived from Swain 2005)
Landfill Volatilization	0.3	0.1	0.05	Lohse-Hanson 2006 (derived from Swain 2005)
Spills and Dumping	2.4	1.9	0.9	Lohse-Hanson 2006 (derived from Swain 2005)
Waste Handling and Landfills	**38.2**	**9.9**	**8.1**	
Product Volatilization				
Paint	125.7	0	0	Lohse-Hanson 2006 (derived from Swain 2005)
Fungicides	65.6	0.04	0	Lohse-Hanson 2006 (derived from Swain 2005)
Fluorescent Lamp Breakage	12.0	1.3	0.6	Lohse-Hanson 2006 (derived from Swain 2005)
Dental Preparations	4.5	3.8	3.2	Lohse-Hanson 2006 (derived from Swain 2005)
General Lab Use	1.9	0.9	0.4	Lohse-Hanson 2006 (derived from Swain 2005)
Product Volatilization Total	**207.8**	**5.1**	**3.8**	

Municipal/Institutional				
Correctional Facility	2.1	2.1	2.1	NEI 2005
Schools	0.07	0.07	0.06	NEI 2005
Municipal/Institutional Total	**2.2**	**2.2**	**2.2**	
Total Emissions	**1425**	**583**	**553**	

* Baseline may be be a significant overcount. Normalizing from either Swain or Granke predicts a lower number. The Battelle method was chosen because it is more conservative and for the need for consistency with dioxin inventory.

Table C.2.2 Summary of U.S. mercury discharges (kg/yr).

Source/Use Category	1990	2000	2005	Source of Data
Discharges				
WLSSD	19.2	0.5	0.1	Tuominen 2005
Other Municipal	1.6	1.6	1.6	Lohse-Hanson 2006 (derived from MPCA 2006)
Taconite	0.3	0.3	0.3	Lohse-Hanson 2006 (derived from MPCA 2006)
Pulp and Paper	1.5	1.5	1.5	Lohse-Hanson 2006 (derived from MPCA 2006)
Petroleum Refining	0.0006	0.0006	0.0006	LaMP 2000
Total Discharges	**22.6**	**3.9**	**3.5**	

Table C.2.3 Summary of U.S. mercury disposed in sludge and ash (kg/yr).

Source/Use Category	1990	2000	2005	Source of Data
Sludge				
WLSSD	0	2.27	4.49	Tuominen 2005
Other Municipal	16	16	16	Lohse-Hanson 2006 (derived from Tuominen 2002 and MPCA 2006)
Ash				
WLSSD	0.59	2.27	0	Tuominen 2005

Table C.2.4 Summary of U.S. mercury in contaminated sediment (kg).

Source/Use Category	Quantity (kg)	Source of Data
Sediment		
St. Louis River AOC	12536.36	MPCA 2005
Torch Lake AOC*		Jones 2005
Deer Lake AOC**	2877.27	Taft 2005

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

** 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.

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 dioxin emissions (g I-TEQ/yr)

Source/Use Category	1990	2000	2005	Source of Data
Incineration				
Cremation	0.0004	0.0009	0.0011	Battelle 2005
Medical	1.90	0	0	Lohse-Hanson 2006
Backyard barrel burning of refuse	3.02	3.96	3.94	Battelle 2005
Small incinerators	0.2 – 1.0	0.2 – 1.0	0.2 – 1.0	TenEyck and Brooke 2005
WLSSD sewage sludge incinerator	0.19	0.19	0	LaMP 2000
Incineration Total	**5.31 – 6.11**	**4.61 – 5.41**	**4.41 – 5.21**	
Fuel Combustion				
Coal	0.32 to 0.50	0.32 to 0.50	0.34 to 0.53	Lohse-Hanson 2006
Petroleum Combustion	0.964	0.085	0.088	Battelle 2005
Residential Wood Heating	0.0176	0.0085	0.0073	Battelle 2005
Fuel Combustion Total	**1.30 – 1.48**	**0.41 – 0.59**	**0.44 – 0.63**	
Industrial				
Lumber and Wood Products	0.02	0.02	0.02	NEI 2005
Petroleum refining	0.0074	0.0074	0.0074	NEI 2005
Pulp and paper	0.14	0.14	0.14	NEI 2005
Industrial Total	**0.17**	**0.17**	**0.17**	
Total Emissions	**6.78 – 7.76**	**5.19 – 6.17**	**5.02 – 6.01**	

Table C.2.6 Summary of dioxin discharges (g I-TEQ/yr)

Source/Use Category	1990	2000	2005	Source of Data
Discharges				
WLSSD	0.01	0.01	0.01	Tuominen 2006
Forest Products	0 – 0.006	0 – 0.003	0 – 0.003	LaMP 2000
Murphy Oil Refinery	0.000015	0	0	TenEyck and Brooke 2005
Pentachlorophenol use	0.04	0.04	0.02	Lohse-Hanson, 2006 (derived from Benazon)
Total Discharges	**0.31**	**0.30**	**0.28**	

Table C.2.7 Summary of dioxin released to soils and stored in sediments (g I-TEQ/yr)

Source/Use Category	1990	2000	2005	Source of Data
Soils				
WLSSD sludge			500	Tuominen 2006
PCB spills	0.0006	0.0006	0.0006	LaMP 2000
Pentachlorophenol use	0.14	0.12	0.12	Lohse-Hanson, 2006 (derived from Benazon)
Sediment				
St. Louis River AOC*			989	MPCA 2005
Koppers Inc.*	0.0029			LaMP 2000

* grams rather than grams per year

Hexachlorobenzene

The HCB inventory is limited. The table below reflects estimates made by Battelle for the USEPA.

Source/Use Category	1990 Emissions (g/year)		1999/2000 Emissions (g/year)		2002 Emissions (g/year)		Source of Data
	Water	Air	Water	Air	Water	Air	
Municipal Solid Waste							
Backyard barrel burning of refuse[1]		1385.76		1816.87		1809.88	Battelle (1990, 2000 & 2002 data)
MI:		571.2		738.49		729.91	Battelle (1990, 2000 & 2002 data)
MN:		615.42		810.70		810.35	Battelle (1990, 2000 & 2002 data)
WI:		199.14		267.68		269.62	Battelle (1990, 2000 & 2002 data)
Land application of sewage sludge							
Wastewater Treatment Plants[2]		0					2000 Lake Superior LaMP (1990 data)
Municipal Solid Waste Total	0	1385.76	0	1816.87	0	1809.88	
Fuel Combustion							
Coal		8.1					2000 Lake Superior LaMP (1990 data)
Wood		7.4					2000 Lake Superior LaMP (1990 data)
Motor vehicles[3]							
Diesel fuel		185.62		208.14		215.75	
MI:		75.26		78.65		81.72	Battelle (1990, 2000 & 2002 data)
MN:		81.14		95.21		99	Battelle (1990, 2000 & 2002 data)
WI:		29.22		34.28		35.03	Battelle (1990, 2000 & 2002 data)
Leaded gasoline		7.69		0		0	
MI:		3.12					Battelle (1990, 2000 & 2002 data)
MN:		3.36					Battelle (1990, 2000 & 2002 data)
WI:		1.21					Battelle (1990, 2000 & 2002 data)

Source/Use Category	1990 Emissions (g/year)		1999/2000 Emissions (g/year)		2002 Emissions (g/year)		Source of Data
Unleaded gasoline		0.21		0.24		0.24	
MI:		0.09		0.09		0.09	Battelle (1990, 2000 & 2002 data)
MN:		0.09		0.11		0.11	Battelle (1990, 2000 & 2002 data)
WI:		0.03		0.04		0.04	Battelle (1990, 2000 & 2002 data)
Residential wood combustion		231.29		103.82		88.57	Battelle (1990, 2000 & 2002 data)
Fuel Combustion Total	0	440.31	0	312.20	0	304.56	
Incineration							
Medical waste[4]		130.00		0		0	2000 Lake Superior LaMP (1990 data)
Small incinerators[5]				89.72		89.72	Battelle (2000 & 2002 data)
WLSSD[6]		1900.00		0		0	2000 Lake Superior LaMP (1990 data)
Incineration Total	0	2030.00	0	89.72	0	89.72	
Industrial							
Chemical manufacturing[7]				0.71			1999 NEI
MI:				0.23			1999 NEI
MN:				0.48			1999 NEI
WI:							1999 NEI
Pesticide application		60		60.30		0.03	2000 Lake Superior LaMP (1990 data); 1999 NEI; 2002 NEI
MI:		40		39.75			2000 Lake Superior LaMP (1990 data); 1999 NEI; 2002 NEI
MN:		10		4.69			2000 Lake Superior LaMP (1990 data); 1999 NEI; 2002 NEI
WI:		10		15.86		0.03	2000 Lake Superior LaMP (1990 data); 1999 NEI; 2002 NEI
Industrial Total	0	60.00	0	61.01	0	0.03	

Source/Use Category	1990 Emissions (g/year)		1999/2000 Emissions (g/year)		2002 Emissions (g/year)		Source of Data
Mining							
Copper range		1900.00		0		0	2000 Lake Superior LaMP (1990 data)
Taconite pelletizing							
Mining Total	0	1900.00	0	0	0	0	
Total	-	5,816.07	-	2,279.80	-	2,204.19	

Notes:

No facilities reporting HCB releases to TRI are located in the US counties of the Lake Superior Basin.

No facility (point source) emissions are included in the Great Lakes Regional Air Toxic Emissions Inventory.

No emission factors for HCB from taconite pelletizing or sewage sludge application were found.

[1] The 1999 NEI and 2002 NEI provide alternate estimates of 927.53 g/yr and 956.99 g/yr, respectively.

[2] A source of HCB at wastewater treatment plants may be the use of ferric/ferrous chloride containing trace HCB. A study of Canadian POTWs showed no detectable HCB in effluent samples (Khettry and EC, 2000)

[3] The 1990 motor vehicle emissions differ from the 2000 Lake Superior LaMP 1990 data. Use of leaded fuel in motor vehicles for highway use was prohibited as of Dec. 31, 1995. Thus, emissions from combustion of leaded gasoline are considered m

[4] As of 1999, all medical incinerators in the US Lake Superior Basin have been closed.

[5] The same methodology used to calculate dioxin emissions from small incinerators was used to calculate HCB emissions: 2,545,299 kg of cardboard burned * 3.53E-05 g HCB/kg

[6] As of 2000, the WLSSD incinerator has been closed.

[7] Reported as "Miscellaneous organic chemical processes" (no facility names given).

Appendix D

PCB Management in Lake Superior Jurisdictions

D.1 PCB Management in Ontario

Canadian Accomplishments:

- In Ontario as of April 2005, an estimated 89% of high level PCBs in storage have been destroyed (about 2741 tonnes remaining) since 1993. Likely to meet 90% challenge by 2006.
- Approximately 70% reduction of high level PCBs in service (about 3000 net tonnes remaining). For PCBs that are still in service, it is unlikely that the 90% reduction target will be met.
- Less than 400 sites (both federal and private) are remaining, down from 1529 in 1993.

BTS PCB Management Assessment December 2005:

Although the Canadian challenge goal of a 90 percent reduction of high-level PCBs in storage (>1 percent PCBs or 10,000 ppm, 1993 baseline) has been achieved based on the information available as of December 2004, Canada is still working to meet its in-service challenge goal of a 90 percent reduction of high-level PCBs (>1 percent PCB or 10,000 ppm) by 2006. However, as described below, some data gaps exist regarding PCBs still in-service. Environment Canada continues to update its inventory information annually.

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 retrofilling 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).

According to the Ontario Ministry of the Environment's latest PCB Inventory reports (2006) for 12 storage sites in the Lake Superior Basin, there have been significant reductions from 1990 levels: high level liquids – 90%; high level solids – 97%; low level liquid – 82%; low level solids – 99%.

Regarding PCBs in in-service equipment, as of December 2004, there were approximately 3,086 tonnes of high-level PCBs in use/service in Canada that need to be targeted for phase out. This is a reduction of approximately 63% since 1989. The priority sectors in Ontario that still have a considerable amount of high-level PCBs in use include utilities, iron/steel, pulp and paper, school/care facility/food processing (sensitive areas), governments, and mining/smelting. 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.

To accelerate the end use and the destruction of PCBs and minimize releases to the environment, Environment Canada is revising its PCB Regulations under the Canadian Environmental Protection Act. Environment Canada is considering the following regulated phase-out of use and end of storage deadlines:

- Phase-out of most high-level (>500 ppm) PCBs in-service by the end of 2009;
- Phase-out of low-level (50-500 ppm) PCB "pad-mounted" transformers by end of 2014;

- Phase-out of low-level PCB "pole-top" transformers, PCB light ballasts and specific PCB equipment at electrical generation, transmission and distribution facilities by 2025; and,
- Destruction of all PCBs in storage when the amendments come into force by the end of 2009 and the allowance of PCBs removed from service to be transferred to storage for only one year.

Other Canada-Ontario PCB Initiatives:

Proposed Revisions to the Canadian *Chlorobiphenyls Regulations* and the *Storage of PCB Material Regulations* under CEPA.

- Proposed changes will include specific deadlines for ending the use of PCBs and destroying PCBs in storage. The proposed revisions will also introduce new labeling requirements and provisions for reporting the destruction of PCBs in storage and reporting the destruction of the remaining PCBs in use. The earliest proposal for action involves the end of use of all PCB equipment containing levels in excess of 500 mg/kg by December 31, 2009.

2002 Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem

- goal of virtual elimination of high-level PCBs;
- replace the current federal Chlorobiphenyls Regulations to require the phase out of PCBs in service in accordance with the requirements and deadlines to be established under the new regulations;
- introduce PCB storage time deadlines through amendments to the federal Storage of PCB Material Regulations;
- replace the current PCB Waste Export Regulations, 1996 to harmonize controls on PCB waste imports and exports and to allow for better control and tracking of wastes with 2-50 ppm PCBs; and,
- use regulatory or other measures to destroy all PCBs in storage by 2008.

Improving the Great Lakes PCB Inventory

- As part of the Binational Toxics Strategy, the US EPA is currently compiling PCB disposal information for 2004 and updating the PCB transformer registrations. Upon completion of the update, the US EPA will re-evaluate data gaps within the inventory. Environment Canada, Ontario Region is currently working to update its inventory by canvassing facilities throughout Ontario, with the ultimate goal of being able to more accurately state the percentage reductions to be achieved by 2006. 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 better assessment of reductions to meet challenge goals in the Lake Superior Basin.

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 the Emergency Planning and Community Right-to-Know Act (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 state programs where applicable and appropriate.

The Michigan Department of Environmental Quality's (MDEQ) Water Bureau 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.

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.

The MDEQ Groundwater Permits Unit of the Water Bureau 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.

The MDEQ-Waste and Hazardous Materials 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.

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.

The MDEQ Remediation and Redevelopment 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

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 1;
Deca (Decabromodiphenyl ether)	Schedule 1; Emerging (IJC, COA)
Decabromodiphenyl ethane	
HBCD (Hexabromocyclododecane)	Emerging (IJC)
PBDEs (polybrominated diphenyl ethers)	Schedule 1; 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 1; 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

The Lake Superior Zero Discharge Demonstration Program and Relationship to Chemical Contaminants in Lake Superior

LAKE SUPERIOR BINATIONAL PROGRAM

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

September 1991

LAKE SUPERIOR BINATIONAL 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."

- Mercury
- PCBs
- Dioxin
- Hexachlorobenzene
- Octachlorostyrene

- DDT
- Chlordane
- Toxaphene
- Dieldrin

Lake Superior Zero Discharge Demonstration Program

- Major focus of Superior Work Group Chemical Committee
- LaMP Stage 1(1995): evaluated problem
- LaMP Stage 2 (1999): Set reduction schedules
  - Zero Discharge by 2020 with interim milestones
- LaMP 2000 (Stage 3 for Chemical LaMP)
  - Strategies and actions

The Lake Superior Zero Discharge Demonstration Program

- Scope: sources **within** the Lake Superior basin
- Reduction schedules are "action goals" rather than goals for levels in the environment
- "Demonstration" is important component of Zero Discharge in Lake Superior Basin
- Local sources are only one component of chemical loadings to Lake Superior
- We do not have information to predict changes in chemical concentrations in the Lake Superior ecosystem based on reductions from local sources

Mercury Loadings to Lake Superior compared to mercury sources within the basin.

Rolfus et al. (2003) loading estimates

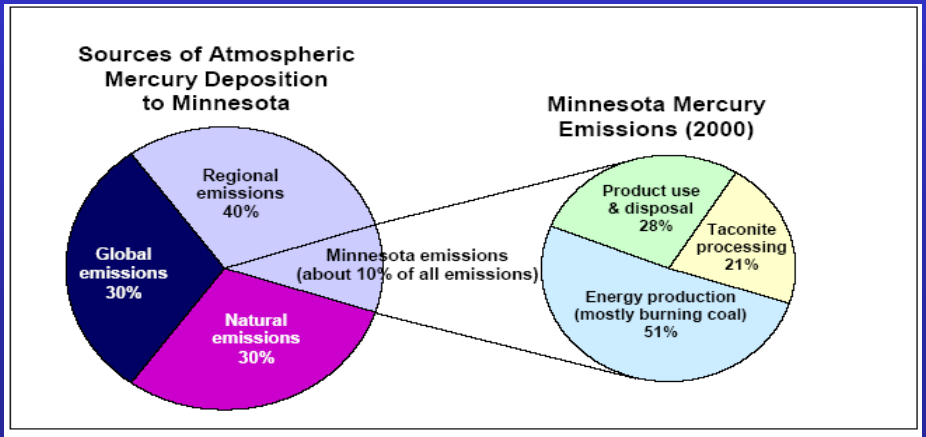
•740 kg/yr atmosphere to lake

280 kg/yr via tributaries (includes atmosphere and watershed)

LaMP 2000 estimates "in-basin" emission of 819 kg/yr

Distant and Local Sources of Mercury Deposition

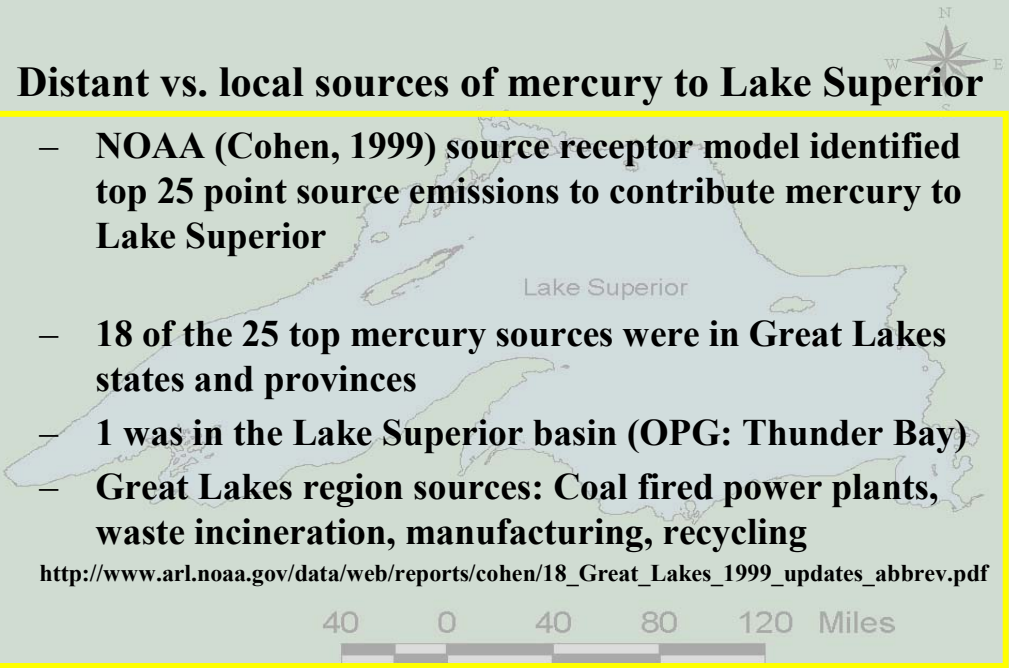
Minnesota Example similar for Lake Superior (Swain, 2005)



Distant vs. local sources of mercury to Lake Superior

- **NOAA (Cohen, 1999) source receptor model identified top 25 point source emissions to contribute mercury to Lake Superior**
- **18 of the 25 top mercury sources were in Great Lakes states and provinces**
- **1 was in the Lake Superior basin (OPG: Thunder Bay)**
- **Great Lakes region sources: Coal fired power plants, waste incineration, manufacturing, recycling**

http://www.arl.noaa.gov/data/web/reports/cohen/18_Great_Lakes_1999_updates_abbrev.pdf



Summary

- Chemical concentrations in the Lake ecosystem are a function of local and distant pollutant sources as well as environmental processes in the Lake Superior basin.
- There is not enough information to judge the results of the zero discharge demonstration program on the environment. The demonstration program is based on innovative strategies for pollutant reductions.
- Estimates of sources in the basin are judged against the reduction goals to report progress on the zero discharge demonstration

Acknowledgements

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- K. Groetsch, MI Dept. of Community Health

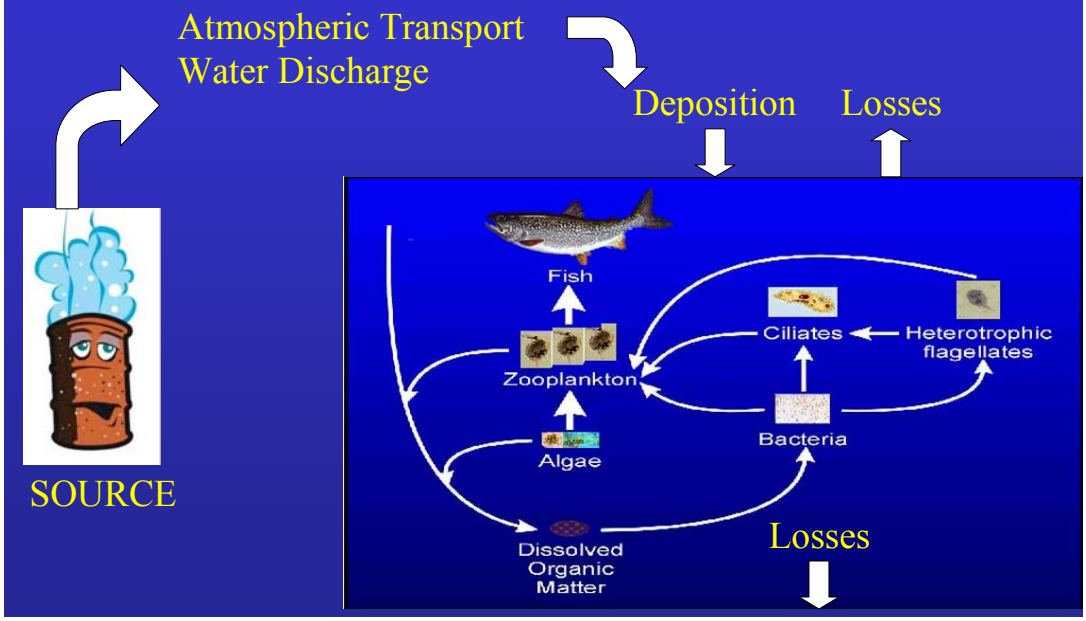
FOCUS OF PRESENTATION

- Task Force request on status of chemical contaminants in Lake Superior ecosystem.
- Provide potential management implications related to these data
- Contaminant concentrations in various media, trends, relation to available yardsticks, transport mechanisms, new concerns.
- Focus on Persistent, Bioaccumulative, and Toxic (PBT) chemicals
  - Great Lakes long term trend monitoring programs
  - Peer-reviewed literature
  - Monitoring data across media allows temporal comparisons

PBT Chemicals of Interest

- **Lake Superior Zero Discharge Chemicals**
  - Polychlorinated Biphenyls (PCBs)
  - Toxaphene
  - Mercury
  - Dioxins
  - Chlordane
  - Dieldrin
  - DDT
  - Hexachlorobenzene (HCB)
  - Octachlorostyrene
- **Other PBTs**
  - **α-HCH (banned)**
  - **γ-HCH (lindane – in use)**
- **Some Chemicals of "Emerging Concern"**
  - Polybrominated diphenyl ethers (PBDE)
  - Polybrominated biphenyls (PBB)

PBT Contaminant Fate and Transport

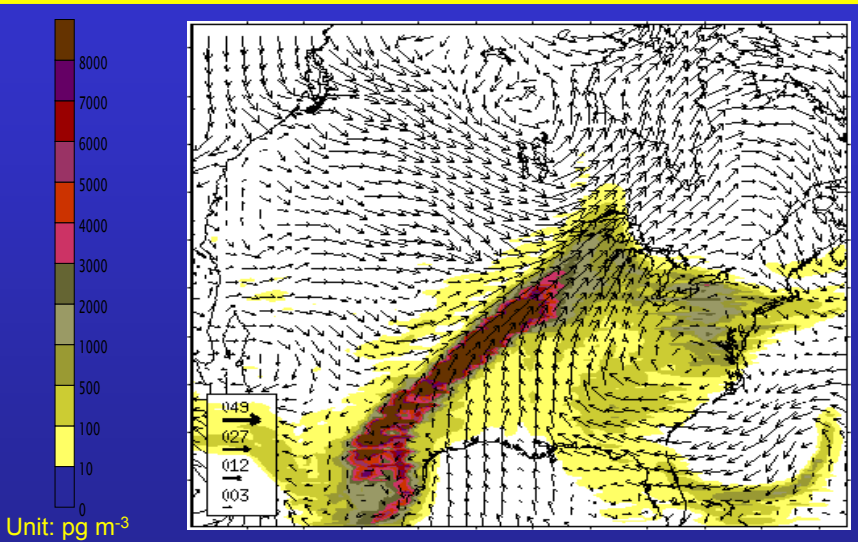


Lake Superior Ecosystem's Unique Characteristics that Impact Chemical Accumulation

- Size
- Pristine relative to other GL
- Smallest watershed SA to lake SA ratio of the GL (1.6 – all other lakes above 2.0)
- Factors affecting chemical retention
  - Long water retention time (~160 years)
  - Cold water temperatures
  - Large surface area
  - Slow particulate settling
  - Complicated food web

ATMOSPHERE

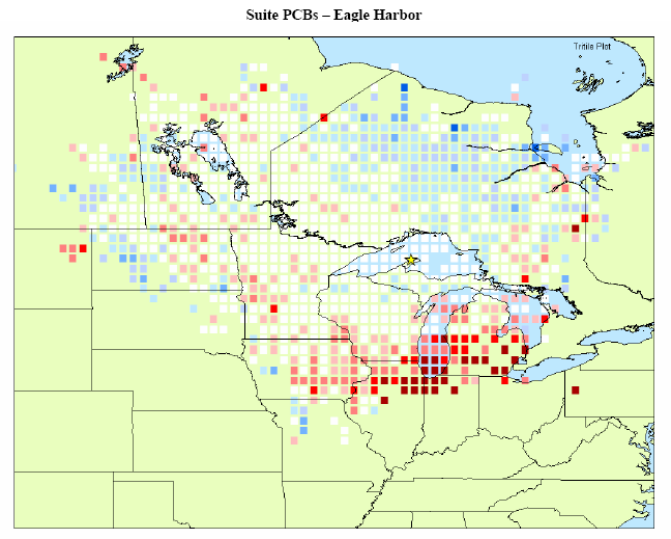
Episodic Transport May Play Important Role in PBT Deposition



Modeled daily air concentration on Sept. 10, 2000; vector winds (m s^{-1}) at 1200m

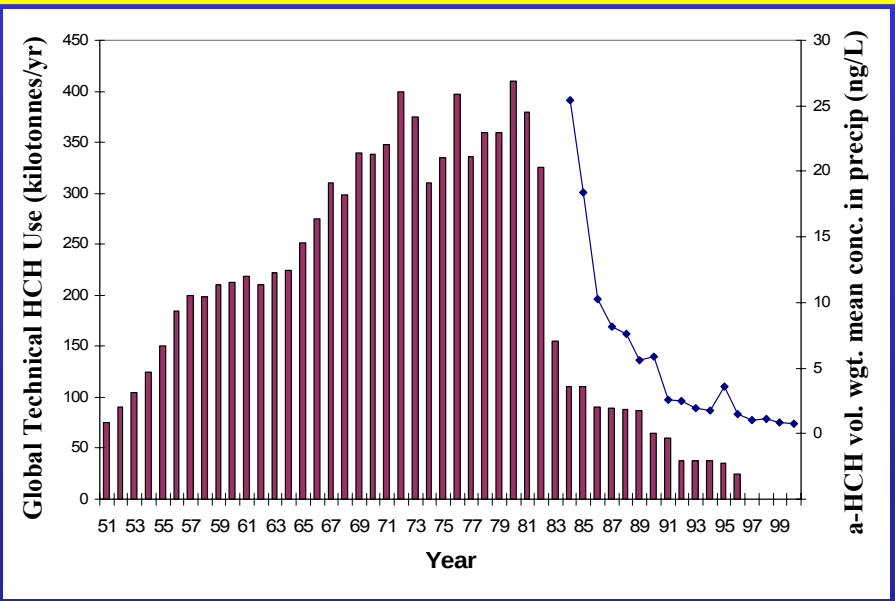
Source: Presentation by Venkatesh and Ma at the GLBTS meeting in Chicago September 15, 2005

PCB Sources to Lake Superior Show Strong Urban Signal



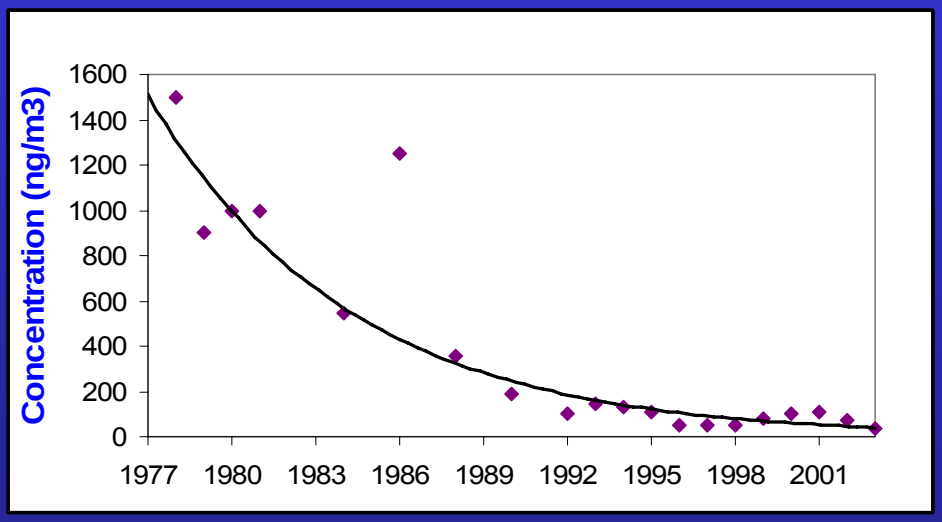
Source: IADN, M. Hulting, USEPA

Decline of α-HCH in Precipitation at Sibley Following Global Decline in Usage



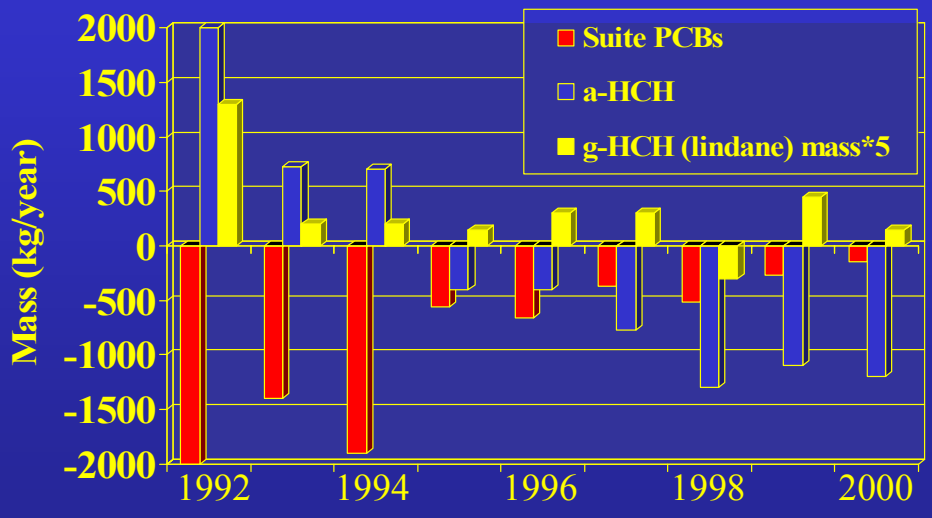
DATA SOURCE: A. Li 1999, C.H. Chan, Environment Canada

Gas Phase PCBs at Eagle Harbor– Exponential Decline Over Time



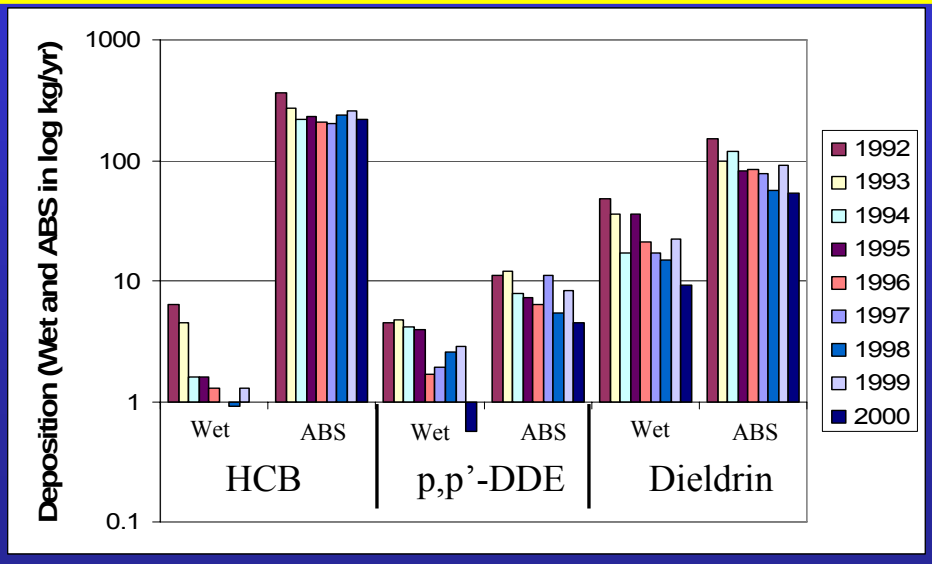
Source: M. Hulting, USEPA – Pre-1990 data from literature, Post-1990 is IADN data

In General: Banned chemicals – net transfer from lake; In-use chemicals – net deposition



•DATA SOURCE: Blanchard *et al.* 2004, Atmospheric Deposition of Toxic Substances to the Great Lakes: IADN Results through 2000.

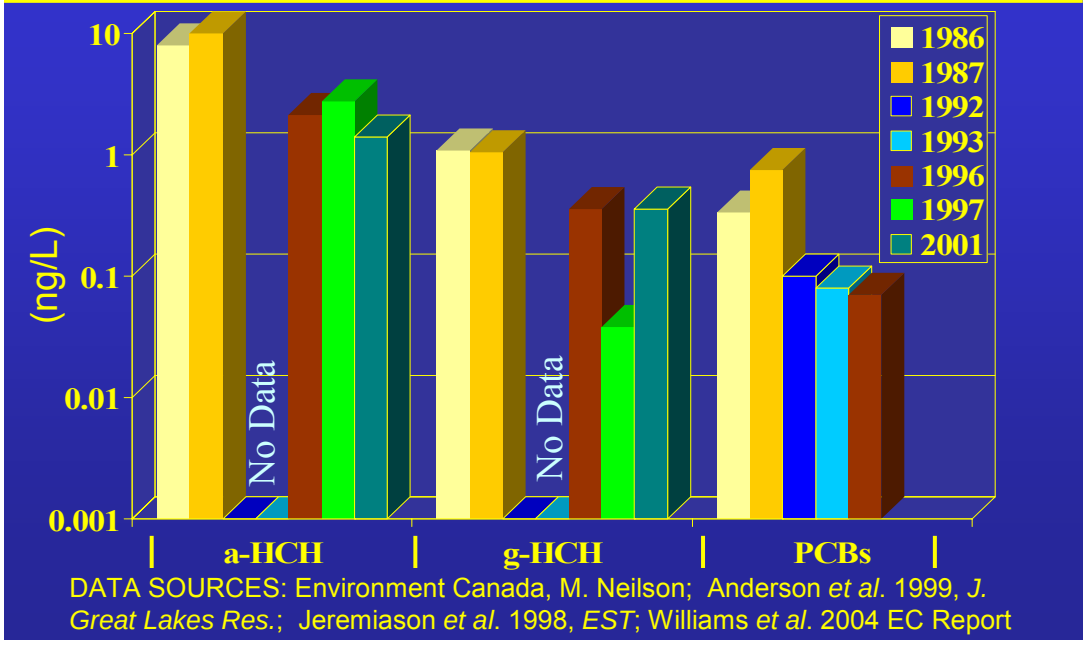
Atmospheric Loadings are Decreasing at Eagle Harbor



DATA SOURCE: IADN Blanchard *et al.* 2004

WATER

Lake Superior Water Concentrations



DATA SOURCES: Environment Canada, M. Neilson; Anderson *et al.* 1999, *J. Great Lakes Res.*; Jeremiason *et al.* 1998, *EST*; Williams *et al.* 2004 EC Report

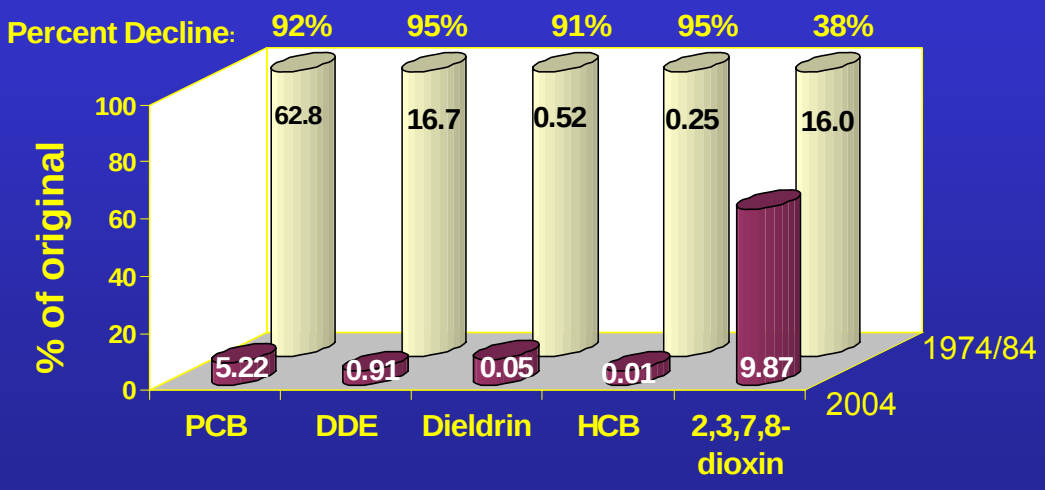
Some Recent Open-water Contaminant Data Exceeds Most Protective Yardsticks (all data in ng/L)

	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	0.014[2]
Dieldrin	0.0012	0.0065	0.0027	1.0 (+Aldrin)	0.126[2]
Chlordane	0.04	0.25	0.12	60	<0.03[3], 0.0099[4]
DDT	0.011	0.011	0.011	3.0	0.005[2] (p,p'DDE)
Mercury	1.3	1.3	1.3	200	0.71[5]
Toxaphene	0.011	0.068	0.034	8.0	0.7[6], 0.6[7]
g-BHC (lindane)	80	25	18	10	0.357

[1]Warren, US EPA, 1996 data [2]Williams *et al.*, EC, 2001 data [3]Williams *et al.*, EC, 1997 data [4]Jantunen, EC, 1996-1998 data [5]Dove, EC, 2003 data [6]Muir *et al.* 2004, 1998 data [7]Swackhamer, UofMN, 1998 data

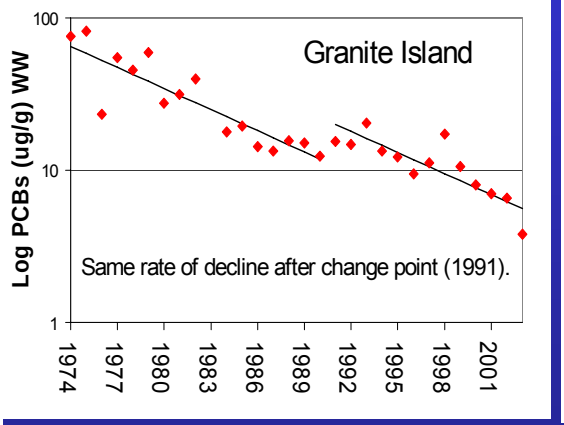
CONCENTRATIONS IN HERRING GULL EGGS AND WHOLE LAKE TROUT

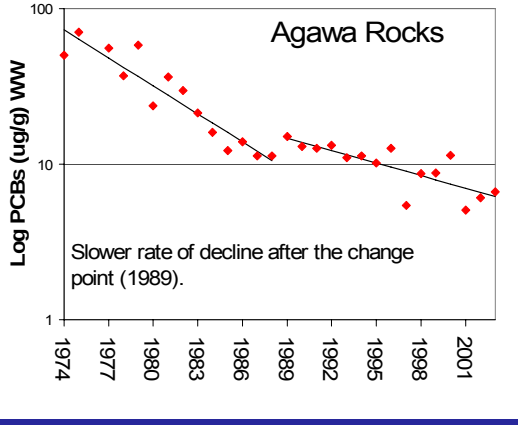
Herring Gull Eggs - Lake Superior, 1974-2004



Values are means for two sites on Lake Superior.
DATA SOURCES: Environment Canada, D.V. Weseloh

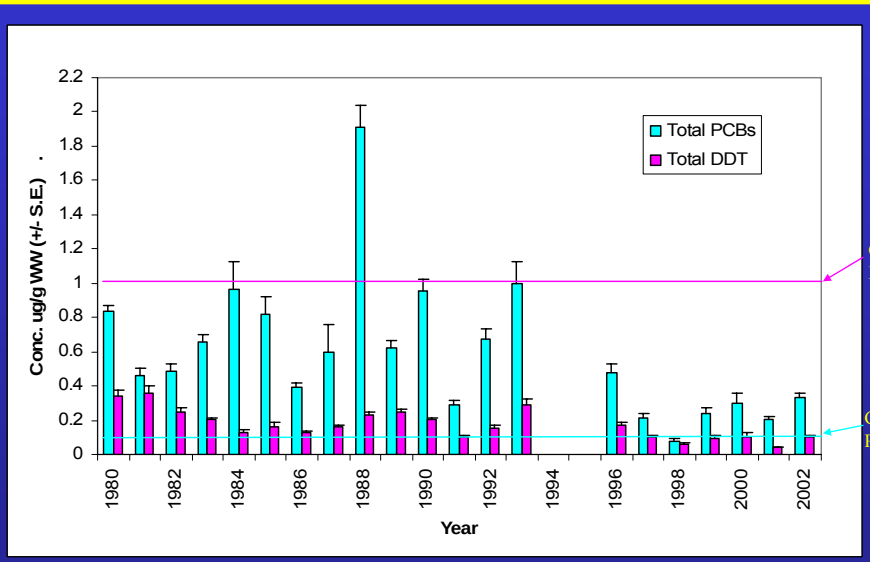
PCBs in Herring Gull eggs show decline in Lake Superior, 1974-2003.





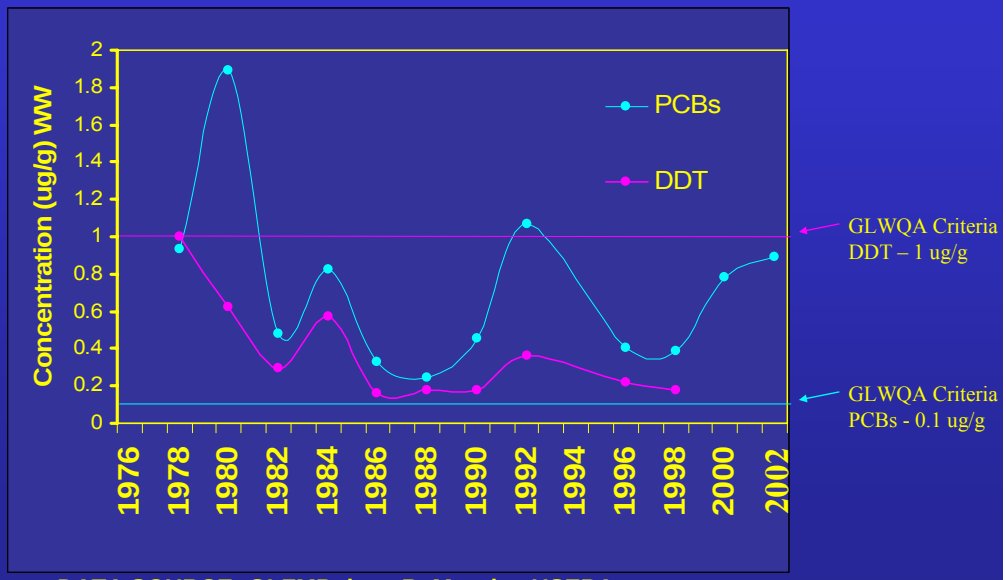
DATA SOURCES: Environment Canada, D.V. Weseloh

Lake Superior Lake Trout – DFO: ∑ DDT below GLWQA Criteria, ∑ PCBs still above



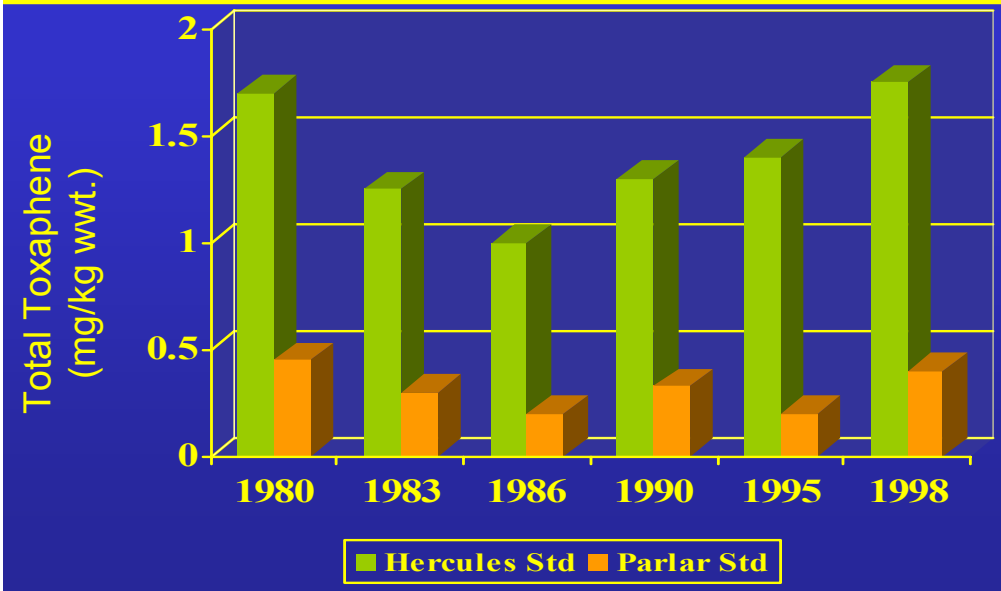
DATA SOURCE: GLFCSP data, M. Whittle, DFO

Lake Superior Lake Trout – EPA: ∑ DDT below GLWQA Criteria, ∑ PCBs still above



DATA SOURCE: GLFMP data, B. Murphy, USEPA

Toxaphene has not Declined in Whole Lake Trout

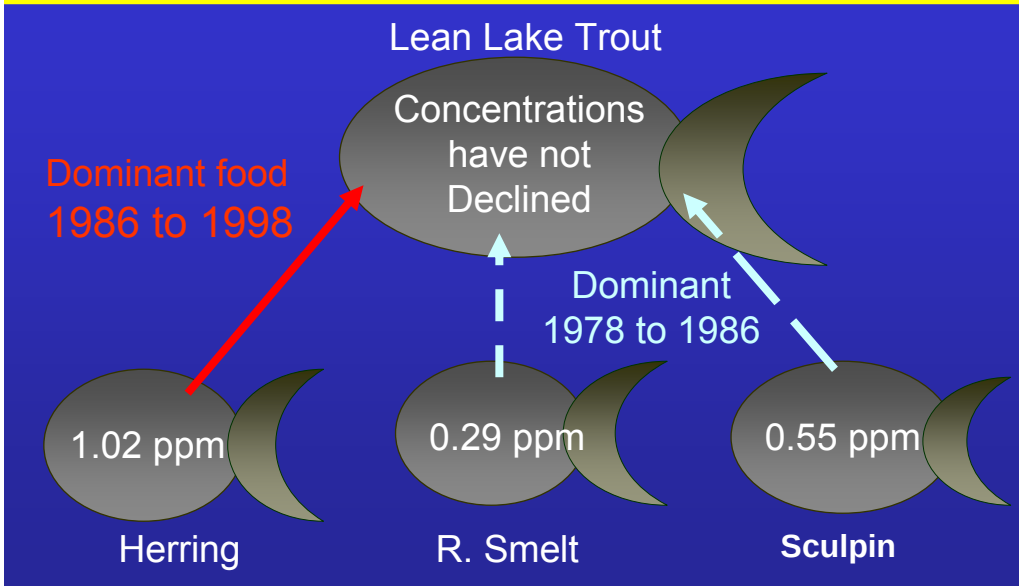


DATA SOURCE: Whittle et al., *Chemosphere (40) 2000.*

Why has Toxaphene not Declined in Lake Superior Fish?

- Combination of:
  - Physicochemical properties of toxaphene
  - Physical, chemical, and biological properties of Lake Superior
  - Food web changes

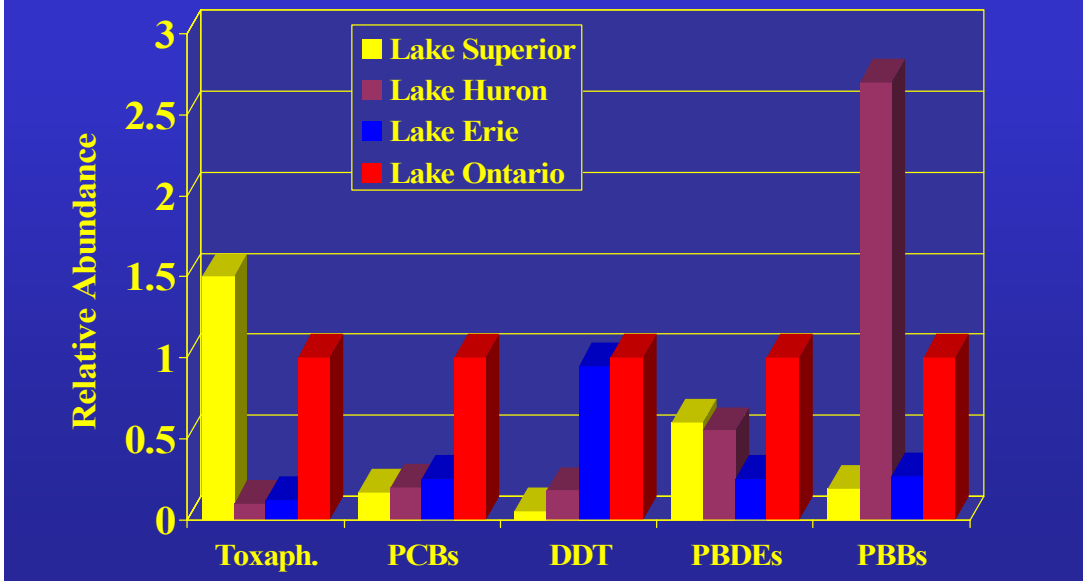
Food Web Structure Impact on Toxaphene



DATA SOURCE: Adapted from M. Whittle et al. , *Chemosphere (40) 2000.*

COMPARISONS BETWEEN THE GREAT LAKES

Lean Lake Trout: Relative to Lake Ontario



DATA SOURCE: Luross et al. 2002, *Chemosphere* (46)

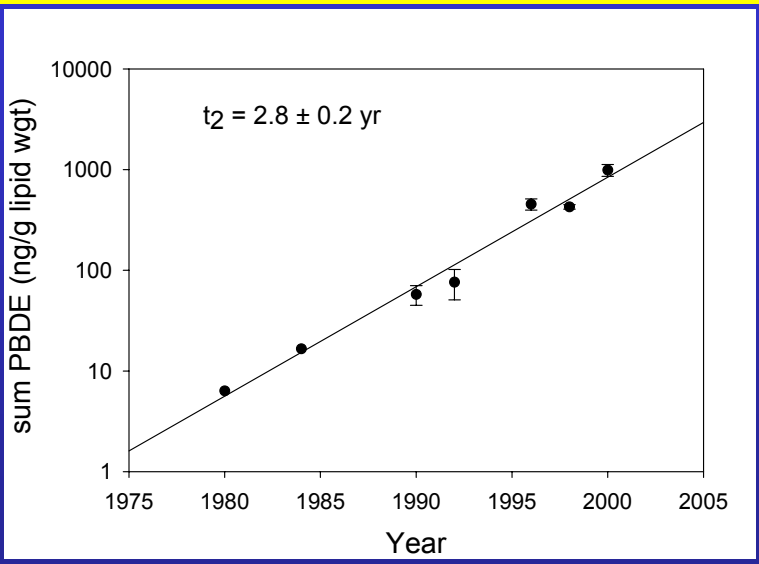
Herring gull egg sites from Lake Superior are among the least contaminated in the Great Lakes

Colony	Mean weighted rank
* Channel-Shelter I. (LH)	1.22
* Strachan I. (SLR)	5.19
Gull I. (LM)	5.28
* Fighting I. (DR)	5.81
Snake I. (LO)	5.82
* Hamilton Hrbr. (LO)	6.21
Middle I. (LE)	6.64
* Toronto Hrbr. (LO)	7.38
Big Sister I. (LM)	7.50
Granite I. (LS)	**9.31**
* Niagara River	9.85
^ Double I. (LH)	11.26
Agawa Rocks (LS)	**12.02**
Chantry I. (LH)	12.73
^ Port Colborne (LE)	13.78

Source: Weseloh *et al.* In press.

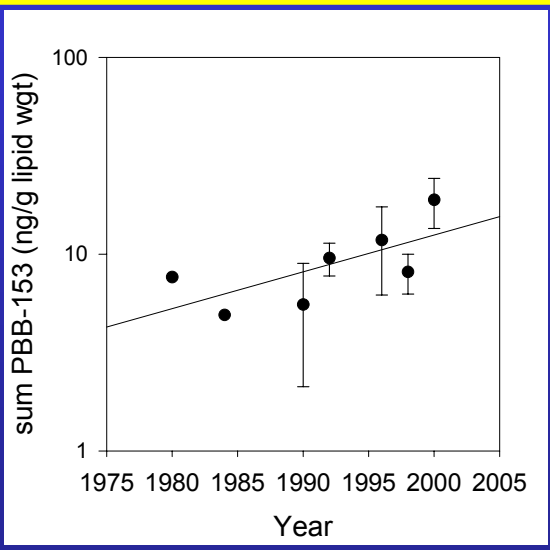
EMERGING CONTAMINANTS OF CONCERN

PBDE concentrations in Lake Superior whole lake trout increasing exponentially



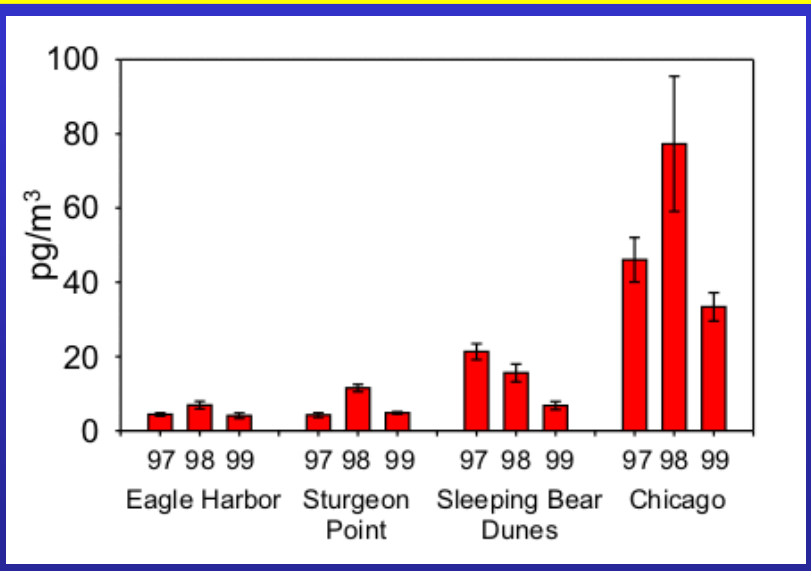
Source: Zhu and Hites, *ES&T* (38) 2004.

PBB-153 banned in 1976, has not declined in Lake Superior whole lake trout



Source: Zhu and Hites, *ES&T* (38) 2004.

Strong Urban Signal from PBDEs in Air



Source: Strandberg *et al*. *ES&T* (35) 2001.

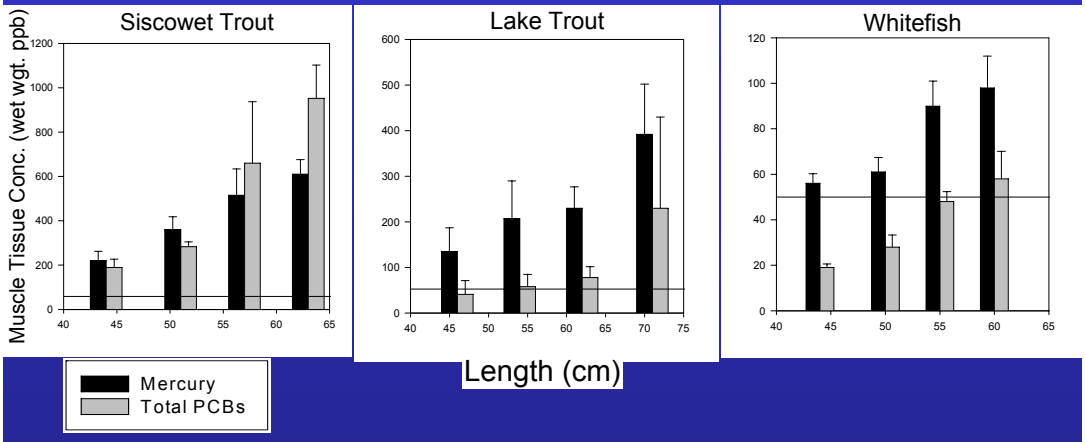
HUMAN HEALTH

Sport Fish Consumption Trigger Concentrations (ppb)– Sensitive Population

Jurisdiction	Total PCBs		Mercury		Toxaphene		Dioxin-like chemicals	
	Trigger	DNE	Trigger	DNE	Trigger	DNE	Trigger	DNE
Wisconsin	50	>1900	50	>1000	-	-	10	BPJ
Minnesota	50	>1900	50	>1000	-	-	-	-
Michigan	50	>1900	500	>1500	5000	-	10	BPJ
Ontario	153	>305	260	>520	235	>469	1.62	>3.24

Sources: P. McCann, MN Dept. Health; C. Schrank, WI BFMHP; J. Bohr, MI DEQ; A. Hayton ON MOE

Fillet Concentrations of Mercury and PCBs Compared to Fish Consumption Trigger Levels



Source: GLIFWC data, unpublished

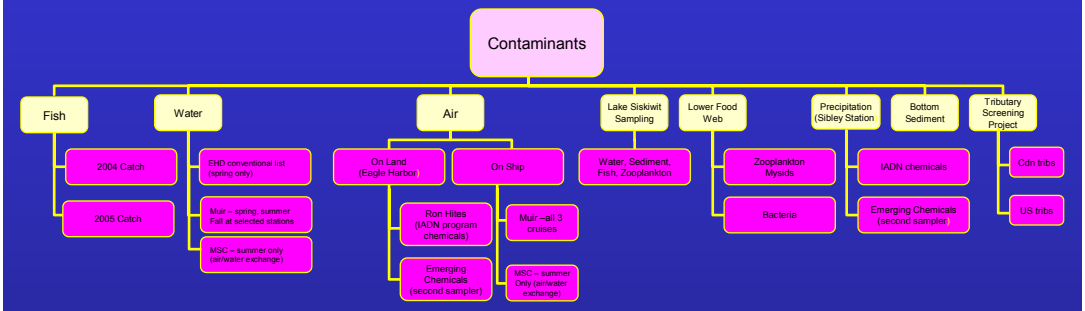
Human Health

- **Presence of chemicals does NOT = negative health effects**
  - Significant exposure is required
  - Human exposure data are very limited.
- **Exposure Pathways.**
  - Air & Water: NOT a direct concern for PBTs
  - Food: Major exposure pathway, particularly fish consumption.

Human Health

- **Fish advisories will likely not decline in the foreseeable future.**
  - Small declines in fish concentrations will not = significant changes in fish consumption advice.
  - New information on toxicity could result in more advisories.
  - Emerging contaminants may become part of advisories.
  - Exposure reduction – Clear, consistent advice

Lake Superior Coordinated Monitoring Chemical Sampling Efforts - 2005



Source: M. Neilson, V. Richardson, Environment Canada

Summary

- In general, concentrations of many legacy PBT contaminants have declined over time – government intervention has been very effective.
- In most cases, concentrations in various media are decreasing at much slower rates or have leveled off over time
- Lake Superior's physical, thermal, and biological properties make it unique and particularly sensitive to retaining PBT chemicals.

Summary

- Atmosphere is main source of PBTs to the lake – some source regions have been identified.
- New chemicals of concern such as PBDEs are increasing in fish and sediments in Lake Superior.
- Fish consumption advice is continually changing due to new monitoring data and new information on toxicological interactions of individual contaminants and contaminant mixtures.

Future Management Actions

- Lake Superior is sensitive! Prevention and preservation critical (toxaphene example).
- Stop introduction of invasives - it affects contaminant transport as well as biology of the Lakes.
- 2005-2006 Coordinated monitoring effort is a great start! Needs to continue as per agreed to rotational schedule - next LS monitoring year will be 2011.
- Statistical design of monitoring programs may need to change to reflect lower environmental concentrations – i.e. have greater power to detect changes in conc.

Future Management Actions

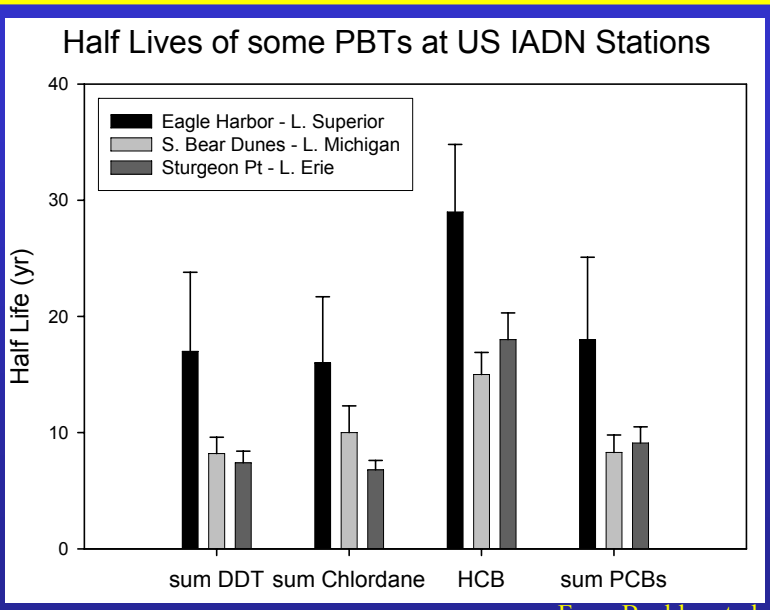
- Tie contaminant reduction outreach efforts to issues identified in the CARD study.
- Action needed beyond the basin! ZDDP critical for the basin but will have limited impact on PBTs in the LS environment in the face of regional and global sources.
- Many positive recommendations identified in the work of the Great Lakes Regional Collaboration on the U.S. side. These need to be implemented.
- How can we learn from our past mistakes? Advocating for pollution prevention, 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.

THANK YOU!

QUESTIONS??

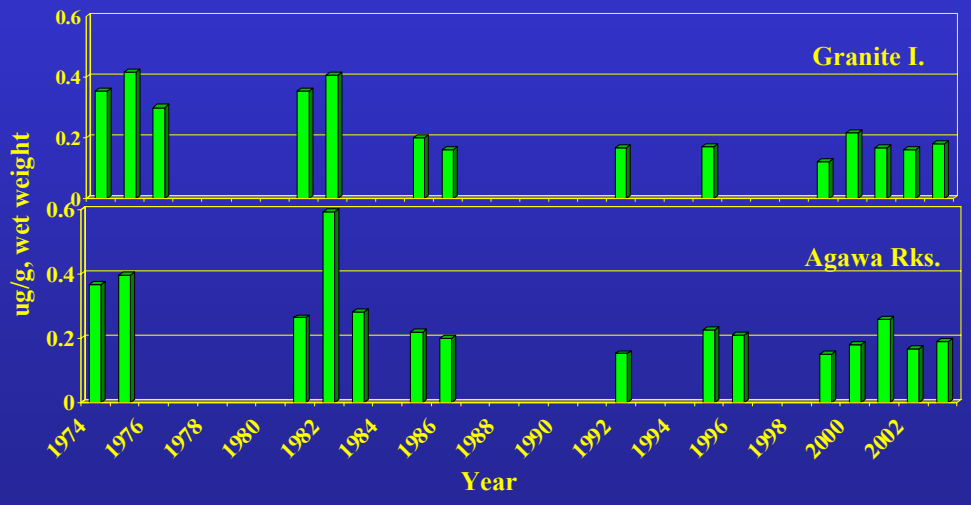
Additional Slides that may be of interest…

Lake Superior Retains Chemicals Longer



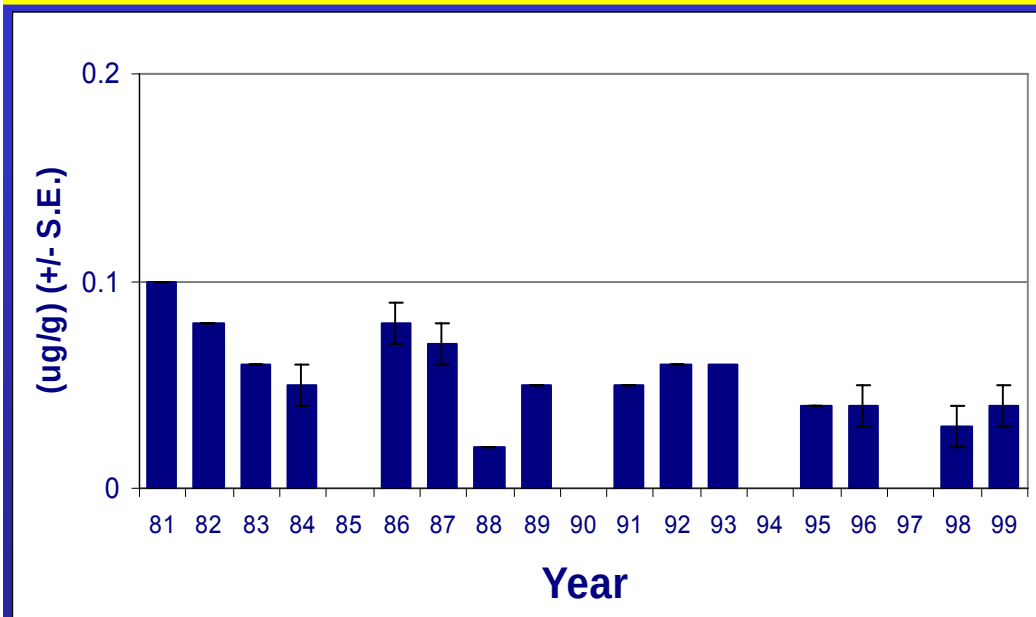
From Buehler et al. *ES&T*, 2004

Mercury in Herring Gull eggs - Lake Superior, 1974-2003.



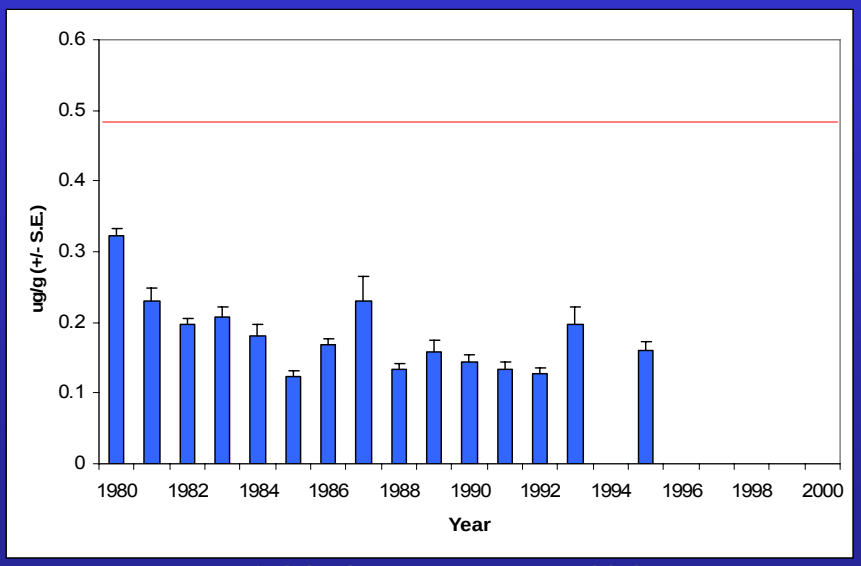
DATA SOURCES: Environment Canada, D.V. Weseloh

Total Mercury in Smelt



DATA SOURCE: Dept of Fisheries & Oceans, M. Whittle

Total Hg Levels in Lake Superior Lake Trout (ug/g +/- S.E. wet weight, whole fish) Ages 4-6



DATA SOURCE: Dept of Fisheries & Oceans, M. Whittle

Appendix G

Previous Reduction Strategies from LaMP 2000

Previous Reduction Strategies from LaMP 2000

MERCURY

Mercury Strategy 1:	Encourage voluntary reductions of the use, discharge and emission of mercury.
Mercury Strategy 2:	Develop incentives to reduce mercury use.
Mercury Strategy 3:	The mining and electric utility sectors must reduce mercury by half in order to meet the 2010 milestone.
Mercury Strategy 4:	Mercury-bearing products must be reduced in order to halve the amount of mercury in products by 2010.
Mercury Strategy 5:	Proper identification, collection and disposal of mercury-bearing products in the basin.
Mercury Strategy 6:	Regulations, compliance, and enforcement.
Mercury Strategy 7:	Remediation of mercury contaminated sediments.

PCBs

PCBs Strategy 1:	Encourage voluntary reductions of the use and storage of PCBs.
PCBs Strategy 2:	Untested equipment must be tested and the inventory must be kept current.
PCBs Strategy 3:	Decommissioning, removal and destruction of PCBs.
PCBs Strategy 4:	Government agencies to undertake PCB training programs.

PESTICIDES

Pesticides Strategy 1:	Collection of remaining stockpiles of banned pesticides.
Pesticides Strategy 2:	Engage other programs that deal with banned pesticides.
Pesticides Strategy 3:	Educate residents about the use of pesticides.

DIOXIN, HCB, OCS

Dioxin Strategy 1:	Encourage voluntary reductions of the discharge and emission of dioxin/HCB/OCS.
Dioxin Strategy 2:	Develop incentives to reduce dioxin/HCB/OCS.
Dioxin Strategy 3:	Pollution prevention is the preferred approach to inhibit the formation of dioxin/HCB/OCS in incineration.
Dioxin Strategy 4:	There is a continuing role for the pulp and paper industry to play in dioxin reductions.
Dioxin Strategy 5:	Identify sources of dioxin/HCB/OCS.

STRATEGIES THAT APPLY TO MULTIPLE POLLUTANTS

General Strategy 1:	Lake Superior goals must be taken into account by other programs.
General Strategy 2:	Sites contaminated by the nine designated chemicals must be identified and cleaned up.
General Strategy 3:	Pollution prevention is the preferred approach to achieving the goal of zero discharge.
General Strategy 4:	Lake Superior communities must be supported in their pursuit of the zero discharge demonstration program and encouraged to share their expertise to help others protect the lake.