LAKE SUPERIOR LaMP

LAKEWIDE MANAGEMENT PLAN

Lake Superior
Lakewide Management Plan

Stage 3 - Reducing Critical Pollutants

Draft - November 1999

LAKE SUPERIOR
BINATIONAL PROGRAM

Lake Superior Lakewide Management Plan (LaMP)

Stage 3

Reducing Critical Pollutants
Draft
November 1999

Lake Superior Binational Program

Preamble

Dear Great Lakes Stakeholders:

We are very pleased to present the draft chemical portion of the Lake Superior Lakewide Management Plan (LaMP) 2000 document to you today. We are providing this public consultation draft to you in advance of April 2000 so that we can all benefit from your views and input and so that together we can restore and protect the Lake Superior ecosystem.

As you may know, the LaMP process has been underway for a number of years enabling varied public input and participation by the Great Lakes stakeholder community. This careful, methodical process has resulted in a relatively large time gap between the stages of the LaMPs. Because of concerns regarding a prolonged process, the LaMP schedules for Lakes Superior, Michigan, and Erie have been significantly accelerated. Early in 1999, the Great Lakes States' Environmental Directors issued a challenge that all LaMP documents were to be completed by Earth Day 2000. This challenge was accepted at a meeting of senior managers (the Binational Executive Committee [BEC]) from the U.S. Environmental Protection Agency (U.S. EPA), Environment Canada, the Great Lakes states, the Province of Ontario, and some Tribes. A resolution was issued by the BEC that calls for the completion by April 2000 of a "LaMP 2000" document which would reflect the state of the knowledge and progress of the lakewide management plans at that time. The LaMPs would be updated every two years beginning in 2002. LaMP stages will no longer be issued but will be replaced by a single binder containing information relating to problem identification, targets, actions and monitoring for all aspects of the ecosystem.

This document, *Reducing Critical Pollutants*, is the implementation stage of the chemical portion of the Lake Superior LaMP. It is in draft form and is not the final compilation of all reduction strategies relating to zero discharge of the nine critical pollutants for Lake Superior. In the coming months, the document will undergo revision based on internal agency review and your valued participation.

Comments can be forwarded to the contact names below at U.S. EPA or Environment Canada. Public and agency comments received by January 10, 2000 will be considered in the final chemical portion of the Lake Superior LaMP document issued on Earth Day 2000.

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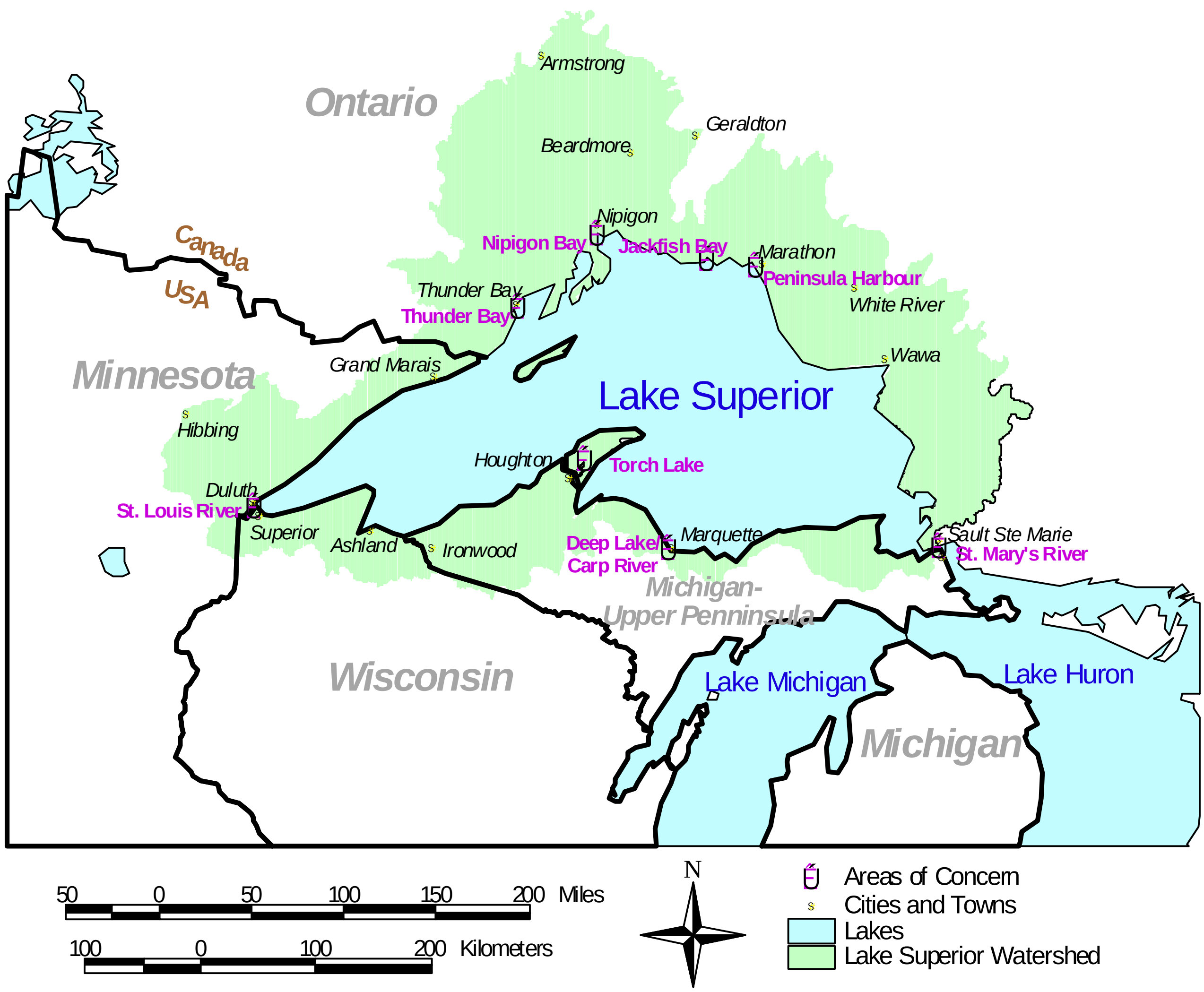
Lake Superior Watershed



Acknowledgments

The strategies and action items proposed in this draft Stage 3 Lakewide Management Plan largely come from work that has gone before, including the Lake Superior Binational Program Pollution Prevention Strategy (1996), and various other strategies developed through the Lake Superior Binational Program member agencies and other organizations. The Superior Work Group Chemical Committee and the Lake Superior Binational Program would like to thank all of those individuals whose work provides the foundation for this plan to protect Lake Superior.

We would also like to thank the Lake Superior Binational Forum for their participation in the development of this draft document.

Finally, we would like to thank Bill Ward, Erin Toelke, Karen Kosky, Stacey Durley, and Julie Mauer from Tetra Tech EM Inc. for their patience and professionalism in completing this document in a timely manner.

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Executive Summary

The Great Lakes Water Quality Agreement (GLWQA) of 1972 committed the United States and Canada (the Parties) to address the water quality problems of the Great Lakes in a coordinated, joint fashion. In 1987, the GLWQA was amended to strengthen and extend the Parties' commitment to protecting the waters of the Great Lakes. Annex 2 of the 1987 amendments contains a framework for the development of Lakewide Management Plans (LaMP) to address critical pollutants and impaired beneficial uses on a lake-wide basis and for Remedial Action Plans (RAP) for specific Areas of Concern (AOC). The LaMPs are intended to identify critical pollutants that affect the beneficial uses of the Lakes and to develop strategies to restore these beneficial uses.

In 1999, the U.S.-Canadian Binational Executive Committee committed to accelerate the LaMP process, publish a complete set of LaMPs for lakes Superior, Michigan, and Erie by the year 2000, and update the LaMPs biennially thereafter.

Pursuant to the 1987 amendments, LaMPs are to be submitted to the International Joint Commission (IJC) at the following four stages, each of which builds upon the work of the previous LaMP.

- The problem has been defined,
- Critical pollutant load reduction schedules have been set,
- Reduction strategies and remedial measures have been selected, and
- Water quality monitoring indicates that the critical pollutants no longer contribute to the impairment of beneficial uses.

The overall management goals of the LaMPs are to restore impaired uses and to achieve environmental criteria and lake ecosystem objectives.

The Binational Program to Restore and Protect the Lake Superior Basin, also known as the Lake Superior Binational Program (LSBP) was established in 1991. Included in this program are a Zero Discharge Demonstration Project, where no point source discharge of any persistent, bioaccumulative, and toxic substance would be permitted, and a broader program that focuses on the non-chemical elements of the Lake Superior ecosystem. 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.

The Lake Superior Stage 1 LaMP, which was submitted to the IJC in September 1995, used environmental data to identify 22 critical pollutants that (1) impair or are likely to impair beneficial uses in the Lake, (2) are likely to affect human health or wildlife because they exceed chemical yardsticks, or (3) impair Lake ecosystem objectives. The Stage 1 LaMP summarizes all known data on critical pollutant loadings from point sources throughout the Lake Superior Basin. In addition, the Stage 1 LaMP also identifies "prevention pollutants" that do not yet impair beneficial uses but have the potential to impair the ecosystem because of their persistence, bioaccumulative ability, and toxicity. These pollutants should be "prevented" from impairing beneficial uses by limiting or controlling their input to the system.

The Stage 2 LaMP, which was submitted to the IJC in July 1999, grouped the critical and prevention pollutants into management categories that reflect pollutant impacts, tendency to bioaccumulate, and occurrence at toxic levels. The 22 critical pollutants are subdivided into three categories: (1) virtual elimination pollutants, (2) lake-wide remediation pollutants, and (3) local remediation pollutants. The 12 prevention pollutants are subdivided into two management categories: (1) monitor and (2) investigate. Finally, the Stage 2 LaMP sets remediation goals or load reduction schedules for the 22 critical pollutants identified in the Stage 1 LaMP.

This Stage 3 LaMP addresses load reduction strategies and remedial actions with respect to the 9 virtual elimination pollutants: mercury, polychlorinated biphenyls (PCBs), dieldrin/aldrin, chlordane, dichloro-diphenyl-trichloroethane (DDT), toxaphene, dioxin, hexachlorobenzene (HCB), and octachlorostyrene (OCS). It also identifies longer term needs to reduce inputs of these pollutants. Because the load reduction schedules set in the Stage 2 LaMP extend to the year 2020, the Stage 3 LaMP looks at reduction strategies to be taken within the next 2 to 3 years to meet the interim goals and to keep load reduction schedules on track. This document identifies reduction strategies specifically targeted for the critical chemical pollutants and remedial measures either already committed to by the Parties or deemed necessary to achieve environmental goals. The reduction strategies are targeted at both load reduction and remediation of contaminated sites. In addition, the Stage 3 LaMP identifies monitoring activities necessary to track progress in achieving the reduction schedules and progress toward environmental goals.

The Stage 2 Lake Superior LaMP sets targets for the reduction and virtual elimination of dioxin, mercury, pesticides, and PCBs in the Lake Superior Basin. Most trends have shown significant achievement of the reduction and elimination goals. However, all of these chemicals remain as sources of contamination in the Great Lakes Basin. In addition, because of inconsistent or nonexistent reporting, it is difficult to accurately assess the total reduction of these chemicals. The current situation is summarized below.

- Mercury use and emissions have been significantly reduced in the Lake Superior Basin as a result of ceased production at the White Pine copper smelter in Michigan and the Algoma Ore Division iron sintering facility in Ontario. The mercury content in consumer products has also been reduced by over 80 percent. Although total emissions from mining operations have declined since 1990, mercury emissions from these sources continue.
- The Stage 2 LaMP calls for decommissioning 33 percent of PCBs in the Basin by 2000 and 60 percent by 2005. In the U.S. portion of the Basin, no data are available to accurately assess decommissioning trends. However, 11 major Great Lakes utilities report a decrease of 24,700 PCB-contaminated capacitors owned between the years 1994 and 1998. From 1994 to 1996, U.S. EPA Region 5 disposal facilities received 41 million pounds of PCBs. In 1997, facilities received 153 million pounds of PCBs. From 1994 to 1997, U.S. EPA Region 5 PCB storage facilities received 29 million pounds of PCBs. In Canada, between 1990 and 1997, 68,513 liters of high-level PCB liquid waste; 40,932 liters of low-level PCB liquid waste; 129,712 kg high-level PCB solid materials; and 16,914 kg of low-level PCB solid materials were destroyed at provincially monitored sites in the Lake Superior Basin. An additional 29,212 liters of PCB liquids and 129,867 kg of PCB solids were destroyed at federally monitored sites.
- Closure of medical waste incinerators, other small commercial and industrial incinerators, and the White Pine and Algoma Ore Division facilities, has resulted in a 75 to 95 percent reduction in dioxin emissions in the Basin which meets or exceeds the 2005 and 2010 goals of 60% and 80% dioxin emission reductions, respectively. Although data are lacking to assess HCB and OCS, reductions in those chemicals are likely to follow trends similar to dioxin. Current dioxin emissions are estimated at 113 g toxic equivalency quotient (TEQ)/yr. Additional information should also be collected to assess the impact of household waste burn barrels. These burn barrels are currently estimated to produce approximately 7 g TEQ/yr in the U.S. portion of the Basin.
- The Stage 2 LaMP calls for the retrieval and destruction of all stockpiles of chlordane, DDT, DDE, dicofol, aldrin/dieldrin, hexachlorobenzene (HCB), mercury pesticides, toxaphene, Silvex, and other pesticides contaminated by dioxins or HCB by 2000. Clean sweep programs throughout the Lake Superior Basin have made significant progress in achieving this goal; however, because it is difficult to determine the amount of these agricultural chemicals remaining in stockpiles, it is likely that all stockpiled pesticides targeted in the LaMP will not be accounted for by 2000. From 1990 to 1998, more than 25,000 kg of pesticides have been collected under statewide clean sweep programs in the Lake Superior states. More than 50 percent of the total mass of pesticides collected consisted of DDT. Amounts of canceled pesticides collected have begun to decline with the exception of DDT, which is not declining but appears to have no pattern of collection.

The load reduction strategies discussed in this Stage 3 LaMP are subdivided into multiple sector strategies, sector-specific strategies, and out-of-Basin strategies. In addition to identifying specific reduction strategies, the LaMP also identifies general methods of measuring the effectiveness of the strategies as they are implemented. The multiple sector strategies include (1) voluntary agreements that will fill in the gaps between mandatory reductions and virtual elimination, some of which are already used by Lake Superior Partners; (2) economic incentives, evaluation, and assistance, such as the development and compilation of cost-effectiveness information; (3) other incentives, such as awards and credit for beyond-compliance reductions; (4) purchasing policies of both governments and consumers; (5) product stewardship, such as designing, manufacturing, transporting, retailing, and disposing of products with the intent to minimize environmental impacts; (6) energy conservation, especially where fossil fuels are used; (7) collections of both household and agricultural products; (8) control and reduce pesticides use for agricultural, residential, and other purposes; (9) solid waste management methods to promote the “reduce, reuse, and recycle” concept; and (10) PCB phase-outs, particularly of equipment containing PCBs in electric utilities, industry, and municipal utilities.

Sector-specific strategies consider nine specific sectors, though each identified strategy may not apply equally to all facilities within any given sector. These sectors include (1) demolition, salvage and recycling, particularly involving products containing mercury and PCBs; (2) schools, which can both foster a conserver attitude and become a model of the zero discharge philosophy; (3) small businesses, which generate a substantial quantity of hazardous wastes but may lack the necessary information or tools to implement reduction strategies; (4) mining, including both extraction processes and emissions reductions; (5) health care, including products and equipment used at clinics, hospitals, dental, and veterinary facilities; (6) energy production, particularly fossil fuel burning and PCB equipment; (7) forest products, particularly pulp and paper mills, sawmills, and wood treatment facilities; (8) the public sector through utilizing pollution prevention activities, control and regulatory actions, and special designations; (9) communities and households; and (10) other industry.

Out-of-Basin strategies focus on atmospheric deposition, which is a major source of critical pollutant loadings to Lake Superior. However, the manufacture of products outside the Basin may also result in the release of contaminants into the air, and the products themselves may release chemicals when used and disposed of within the Basin.

Sediment contamination is a major issue for all of the Lake Superior AOCs, though the extent to which these sites serve as continuing sources of contamination to the Lake Superior ecosystem has yet to be determined. However, in order to adopt a holistic approach to restoring beneficial uses to Lake Superior, the Stage 3 LaMP identifies several binational actions to be taken to assist with the remediation of sites where contaminated sediment is impairing beneficial uses.

To adequately and accurately track progress toward virtual elimination of the nine critical pollutants and, therefore, achieve beneficial uses and ecosystem objectives, monitoring strategies must be identified and implemented. Two types of monitoring strategies are put forward for discussion: source monitoring and environmental monitoring. Source monitoring would track virtual elimination pollutant loadings to the Lake Superior ecosystem. Environmental monitoring would track the virtual elimination pollutants in the Lake Superior ecosystem. The Stage 3 LaMP identifies a menu of possible monitoring activities to track progress in meeting overall ecosystem goals.

The Stage 2 LaMP set specific milestones toward the reduction of the critical pollutants in the Lake Superior Basin (see Table ES-1). The Stage 3 LaMP summarizes general requirements to meet the upcoming milestones.

- For mercury reduction, voluntary agreements and mercury emission control technologies offer the greatest potential for reduction. By 2010, the 80 percent mercury reduction milestone could be met under the following scenario: If purposeful use of mercury is cut by half, energy and mining sectors must reduce emissions by half to meet the 80 percent reduction goal for the Lake Superior basin.
- To meet the 2005 goal for PCB reduction, the U.S. will need to continue to test, decommission, and destroy PCB-bearing transformers and capacitors. The number of transformers and capacitors that should be decommissioned to meet the 2005 goal cannot be estimated until a better PCB inventory is determined through additional testing. To meet the 2000 and 2005 goals, Canada will need to destroy a total of 155,834 kg and 283,355 kg, respectively.
- The significant, remaining sources of dioxin emissions in the Basin include small industrial and other waste incinerators and backyard burning of household waste in burn barrels. Because most large emission sources are under control, the focus must now be placed on small, disperse sources. As a result, the control strategies applicable to these sources should include public education and outreach coupled with aggressive identification of these sources. Other areas to be pursued on a long-term basis are clean up of contaminated sites and investigation of continuing pentachlorophenol use.
- The strategy for targeted pesticides will center on sustained and expanded collection systems and public outreach. These strategies need to continue beyond the year 2000, which was the original goal

for destroying all remaining stockpiles of canceled pesticides. Improved tracking of the amount and types of agricultural chemicals collected is needed to judge progress.

The Lake Superior Binational Program agencies recognize that remedial actions and load reduction activities have been ongoing and will continue for many years to come. As time passes, new reduction strategies will be developed or become more cost-effective. Therefore, the Parties have adopted an iterative approach to the Stage 3 LaMP. Additional resources will be allocated and additional planning activities undertaken to ensure the development and implementation of further reduction strategies as appropriate until all of the LaMP goals have been met.

Future Stage 3 LaMP documents will identify additional load reduction strategies and remedial actions for the virtual elimination critical pollutants, as well as strategies for other critical pollutants. In addition to the LaMP for critical chemicals, the LSBP agencies are developing LaMPs for other critical ecosystem-related elements, including human health, habitats, terrestrial communities, aquatic communities, and sustainable development.

Table ES-1 Summary of Reduction Goals for Lake Superior Virtual Elimination Pollutants

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

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Introduction

The Lake Superior ecosystem is one of the most unique and fragile ecosystems in North America. The food chain of the lake is simple, the human populations are sparse, and the economy is based on natural resources that require careful conservation. As part of the Great Lakes ecosystem, the Lake Superior watershed is addressed under the Great Lakes Water Quality Agreement (GLWQA). In addition, issues that apply only to the greatest lake, Lake Superior, are also addressed in the Binational Program to Restore and Protect the Lake Superior Basin.

The Binational Program to Restore and Protect the Lake Superior Basin, also known as the Lake Superior Binational Program (LSBP), was established in 1991. Included in this program are a Zero Discharge Demonstration Project, where no point source discharge of any persistent, bioaccumulative, and toxic substance would be permitted, and a broader program that focuses on the non-chemical elements of the Lake Superior ecosystem. While the Lakewide Management Plan (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. 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 schedules for critical pollutants, have been completed. This document will fulfill the GLWQA requirement for Stage 3 of the LaMP process, which is intended to identify remedial measures for Lake Superior critical pollutants.

While Stage 3 is known as the implementation stage, activities to reduce the loads and impacts of critical pollutants have been ongoing and are described briefly in this document in Chapter 1. The additional activities needed to achieve the load reduction schedules from Stage 2 are identified in Chapters 2, 3 and 4. Specifically, Chapter 2 identifies potential reduction actions at sources of the critical pollutants. Chapter 3 describes actions at contaminated sites, and Chapter 4 lists monitoring activities that could be used to track progress toward the goal of zero discharge and zero emissions. Chapter 5 describes the next milestones in those load reduction schedules, and Chapter 6 summarizes the high priority activities which are proposed as commitments by the federal, state and provincial environmental agencies and some tribal organizations surrounding Lake Superior. Public input and comment is requested on these proposed actions.

The implementation activities described in this document are recognized as near-term actions. That is, some of these activities will lead directly to load reductions, while others will prepare the way for more difficult and long-term reductions. The Lake Superior environmental agencies recognize that reduction activities will be needed well into the future. However, it is not possible at this point to identify every action that needs to be taken. As a result, this document describes those activities that the agencies will undertake or encourage others to implement in the next two to three years. The LaMP is intended as a living plan for action that will be updated every two years.

This LaMP for critical pollutants is one chapter in a binder of management plans for the Lake Superior basin ecosystem. In addition to the LaMP for critical pollutants, the LSBP agencies are developing LaMPs for other elements of the ecosystem, including human health, habitat, terrestrial communities, aquatic communities and sustainability. This work is guided by a set of ecosystem objectives, targets, and indicators to judge progress, which was published as a discussion paper in 1995: “Ecosystem Principles and Objectives, Indicators, and Targets for Lake Superior.

To deal with the long-term nature of this program and changes that will occur in the Basin and the lake itself, the LSBP agencies will be updating the LaMP every two years. In the future, additional commitments will be identified, progress will be tracked and additional evaluations of the lake and its critical elements will be presented. Like the Lake Superior ecosystem itself, the LaMP process is evolving and adapting to the needs of the lake and its people.

Chapter 1: Progress Toward Zero Discharge

1.1 Introduction: Progress Under the Binational Program Agreement of 1991

This Stage 3 LaMP for Critical Pollutants builds upon the earlier stages of the Lake Superior LaMP. The 1995 Stage 1 LaMP identified critical pollutants for Lake Superior and documented measured sources contributing loads of the nine zero discharge pollutants to Lake Superior. The 1999 Stage 2 LaMP included estimates for source categories of the nine zero discharge pollutants and established reduction schedules for those pollutants. The Stage 2 LaMP also contained environmental and management goals for the critical pollutants that do not fall into the zero discharge demonstration program. Stage 3 of the LaMP process encompasses the strategies needed to achieve the reduction goals set forth in Stage 2. This is arguably the most difficult and dynamic part of the LaMP process. This Stage 3 LaMP contains strategies aimed primarily at achieving pollutant load reductions over the next few years, while also identifying longer term needs to reduce inputs of the nine zero discharge pollutants. In the future, LaMP updates will be released every two years.

1.2 Load Reductions

1.2.1 Introduction

The Lake Superior Basin is the focus of the Zero Discharge Demonstration Project, which has as its primary goal the virtual elimination of nine persistent, bioaccumulative toxic chemicals. The purpose of this project is to demonstrate that the emission and discharge of these nine chemicals can be virtually eliminated within a defined area. Because the sources of these chemicals are located throughout the world and deposition from the atmosphere to the Basin is significant, the virtual elimination of these nine chemicals from the Basin will require that both Lake Superior Binational Program (LSBP) agencies and citizens support and participate in state, provincial, national, and international efforts to reduce the use and emissions of these persistent bioaccumulative toxic chemicals.

Since the 1990 baseline year, releases of the nine designated chemicals have declined. The reductions have occurred for the following reasons:

1. Reduction efforts by facilities in the Basin: For example, the Western Lake Superior Sanitary District pledged to become a zero discharge facility and succeeded in significantly reducing mercury in treated wastewater and sludge.
2. New competitive technologies have replaced old technologies: For example, most of the pulp and paper mills in the Basin that used elemental chlorine before 1990 are now using 100% chlorine dioxide.
3. Facility closures: For example, due to market conditions and aging facilities, a copper smelter and paper mill in the U.S., and a zinc mine and iron smelter in Canada were closed.
4. National and regional regulations: For example, Canadian dioxin effluent limitations had a role in causing pulp and paper mills in the Lake Superior Basin to switch to chlorine dioxide bleaching; in the U.S., mercury battery legislation passed in Minnesota was the impetus for a nationwide shift to mercury-free battery manufacturing.

This section describes load reduction estimates for 1990 to 1999. More details on the 1990 base line estimates can be found in Stage 2. The 1999 estimates are based in part on a new Canadian document (Brigham 1999). The US and Canadian assumptions behind the 1999 numbers are explained in Appendix A. Data will be available in the coming year to better assess whether the year 2000 milestones have been met.

1.2.2 Mercury

Significant reductions in mercury use and emissions in the Lake Superior Basin have occurred for two principal reasons. First, production at the White Pine Mine copper smelter in Michigan and Algoma Ore Division iron sintering facility in Ontario have ceased, resulting in a significant reduction in mercury air emissions. Second, mercury in products, such as batteries, paints, and fungicides, has been reduced, resulting in over an 80 percent decline in mercury content in commercial products. In contrast, mercury emissions continue at relatively high levels from mining operations and fuel combustion, although the total emissions from these sources combined have declined since 1990. The mercury inventory, listed in Table 1.1 below, includes a variety of releases to air, water, and soil. The reduction estimates are expressed as ongoing releases, for example, mercury emissions resulting from product processes, and potential releases, such as mercury emissions resulting from product disposal. The estimated ongoing releases shown in Table 1.1 include air and water mercury emissions in the Lake Superior Basin. Estimated potential releases listed in Table 1.2 represent the mercury disposed in landfills or applied to land. Appendix A contains references and a detailed summary of estimated mercury releases for U.S. and Canadian portions of the Lake Superior Basin for 1990 and 1999.

Table 1.1 Ongoing Release: Mercury to Air and Water from Sources in the Lake Superior Basin, 1990 and 1999 (kg/year)

Source	US 1990[a]	Canada 1990[a]	Total 1990[a]	US 1999[b]	Canada 1999[b]	Total Remaining 1999	Percent Reduction
Industrial	11	23	34	11	20	31	8.8%
Mining	912	604	1516	385	0.4	385.4	74.6%
Fuel Combustion	137	126	263	193	122	315	+19.8%
Incineration	85	1	86	14	1	15	82.6%
Products	150	41	191	1[c]	34[c]	35	81.7%
Municipal	61	53	114	40	53[d]	93	18.4%
Re-emission (15% of Table 1.2 total)	146	55	201	34	15	49	75.6%
Total	1502	903	2405	705	244	949	60.5%

[a] Stage 2 LaMP mercury release estimates (LSBP 1999).

[b] See Appendix A for assumptions and references for 1999 ongoing mercury release estimates.

[c] Comprehensive data for mercury air emission estimates for thermometers, thermostats, light switches, and pigments are not available for the U.S., and mercury air emission reduction percentages for these products and other instruments in Canada could not be estimated. As a result, the product emission estimates for the U.S. and Canada are not comparable.

[d] This estimate does not include reductions from household hazardous waste collections in Ontario.

Table 1.2 Potential Release: Mercury to Landfills and Soils from Sources in the Lake Superior Basin, 1990 and 1999 (kg/year)

Source	US 1990	Canada 1990	Total 1990	US 1999	Canada 1999	Total Remaining 1999	Percent Reduction
Dry Cell Batteries	851	300	1151	85	30	115	90.0%
Other Products	117	73	190	74	61	135	28.9%
Medical/Dental	6		6	6		6	0.0%
Ash [a]		10	10		10	10	0.0%
Sludge [b]	4	2	6	61	2	63	+1,050%
Total	972	385	1350	226	103	329	75.6%

[a] An estimate for U.S. potential release from ash is not available.

[b] Sludge is applied to land and landfilled. This estimate includes the estimate for materials previously being incinerated in small incinerators (48 kg/yr), the sludge from the WLSSD that is applied to land, and 10 percent of the mercury in total commercial/municipal effluent. This does not include sludge burned at WLSSD, which is included under Incineration in Table 1.1.

Overall, mercury releases have declined from most sources in the Basin. However, the estimate of mercury releases from fuel combustion increased, most likely because of a revised estimate method and increased population and per capita consumption of electricity. The increase in the estimate of mercury releases from total sludge in Table 1.1 is because of the development of a new process technology at the Western Lake Superior Sanitary District (WLSSD) in Minnesota scheduled for completion in 2001. During the interim, half of the sludge generated is being applied to land while the other half is being incinerated at WLSSD. Once the new process is in place, sludge will no longer be incinerated and the overall volume of sludge generated will be reduced. In addition, the estimated emissions from small incinerators were added to the estimate of mercury in sludge because most small incinerators in the basin have closed since 1990.

In addition, the potential release estimates for mercury-containing products such as thermometers, thermostats, and dental products, may be lower than indicated in Table 1.2 due to state and community mercury-reduction activities in the Basin that may be difficult to quantify at the Basin level. For example, the Thermostat Recycling Corporation collected a total of about 9,660 mercury-switch thermostats in Michigan, Minnesota, and Wisconsin in 1998, diverting about 77 pounds of mercury from the municipal waste stream in those states (Erdheim, 1999). The states and province have also developed mercury pollution prevention and reduction strategy programs, such as community clean sweeps and developing outreach materials.

At the 5th International Conference on Mercury as a Global Pollutant in 1999, two researchers independently estimated that 15 percent of mercury disposed in landfills is re-emitted through volatilization (Andrews and Swain, 1999, and Kindbom and Munthe, 1999). Therefore, 15 percent of the potential release mercury sources in Table 1.2 is re-emitted and is added to the ongoing release category (see Table 1.1). The estimated total mercury releases of 2,405 kg/year in 1990 and 949 kg/year in 1999, demonstrate a 60.5 percent reduction. This estimate meets the year 2000 LaMP milestone of 60 percent reduction, however, other factors such as taconite production will have an effect on the final year 2000 release estimates.

1.2.3 PCBs

The LaMP reduction goals call for 100 percent destruction of PCBs in the Lake Superior basin by the year 2020. The main concern with PCB reductions within the Lake Superior Basin is not their ongoing release, since PCBs are rarely found in permitted discharges and emissions. The PCB reduction goals for Lake Superior are aimed at preventing future release by destruction of PCBs in use and storage. The goals also address clean up and destruction of PCB contaminated soils and sediment, where accessible. Regionally, PCB volatilization from past releases and eventual atmospheric deposition is a significant pathway for PCBs to Lake Superior.

1.2.3.1 PCB Reporting Status

The total PCB inventory for the entire Lake Superior Basin is difficult to assess because of the differences between U.S. and Canadian reporting requirements. Canada requires facilities to report PCBs by weight of contaminated equipment and materials, whereas the U.S. requires facilities to report numbers of equipment containing PCBs, primarily transformers and capacitors. While the current Canadian inventory is superior due to provincial and federal reporting requirements, recent changes to the U.S. Toxic Substances Control Act (TSCA) will improve reporting on high-level PCB equipment. Under the new TSCA reporting requirements, owners of transformers containing greater than 500 ppm PCBs must register with the U.S. EPA.

The individual U.S. states are also beginning to compile more detailed inventories of PCB use. For example, the Minnesota Pollution Control Agency (MPCA) has recently completed a survey of PCB containing equipment used by Minnesota industries, utilities, schools, and municipalities. Michigan similarly has an ongoing Critical Materials Register that requires facilities to track PCBs. These new data and initiatives will improve the U.S. portion of the Lake Superior PCB inventory.

1.2.3.2 Current Use

Table 1.3 lists the quantities of PCBs estimated to be in use in both the U.S. and Canadian portions of the Basin in 1990, the baseline year for the LaMP goals, and in 1999. The 1990 baseline data for both U.S. and Canada are taken from the Stage 2 LaMP Report (LSBP 1999). The current U.S. data are limited. As a result, several assumptions were made to estimate the amount of PCBs in use in the Basin. Specifically, data from MPCA's PCB inventory survey was analyzed and applied, on a per-capita basis, to the U.S. portion of the Lake Superior Basin (see Appendix A).

Table 1.3 Estimated PCB Use in the U.S. and Canada

	United States	Canada

Source	Transformers > 500 ppm In Use (kg)[a] 1990	Transformers > 500 ppm In Use (kg)[b] 1999	Transformers < 500 ppm and All Capacitors In Use (kg)[a] 1990	Transformers < 500 ppm and All Capacitors In Use (kg)[c] 1999	In Use (kg)[d] 1990	In Use (kg)[e] 1997	In Storage (kg)[d] 1990	In Storage (kg)[e] 1997
Industrial	637,346	798,988	N/A	6,667	194,830	181,674	134,200	386,563
Utilities	26,618	384			11,300		57,880	
Municipal					14,815		4,360	
Commercial					32,700		22,140	
Total	663,964	799,372	N/A	6,667	253,645	181,674	218,580	386,563

[a] Pure PCBs (LSBP 1999).

[b] U.S. EPA TSCA database of facilities in the Lake Superior Basin with transformers containing PCB-laden material at concentrations greater than 500 ppm. (Increase due to ongoing inspection and discovery process and/or reporting untested equipment)

[c] Estimates based on MPCA's PCB Inventory Survey, 1999, extrapolated to Michigan and Wisconsin using population-based projections (see Appendix A) (Beadey 1999).

[d] PCB contaminated materials and fluids (LSBP 1999).

[e] PCB contaminated materials and fluids (Brigham 1999).

The number of U.S. PCB transformers identified in the U.S. basin increased from 1990 to 1999 because more pieces of equipment are discovered as the equipment owners inspect and test their equipment or report equipment that has not yet been tested. There is no registration requirement for capacitors, however EPA estimated that in all of Region 5 (most of the Great Lakes region), a total of 29,700 PCB-containing capacitors were still in use as of December 1998 (EPA 1999). The major utilities in the Great Lakes Basin estimate that from 1994 to 1998, they had already removed 27% of their PCB-contaminated equipment (EPA and Environment Canada 1998a).

1.2.3.3 PCB Reduction Goals and Progress

The Stage 2 Lake Superior LaMP calls for decommissioning 33% of the PCBs in the Basin by 2000 and 60% by 2005. In the U.S. portion of the Lake Superior Basin, no data are available to accurately assess decommissioning trends. However, 11 major Great Lakes utilities report a decrease of 24,700 PCB contaminated capacitors owned between the years 1994 and 1998 (EPA 1999). From 1991 until its completion, 173,952 kg of PCBs will be decommissioned solely due to the ongoing closure of the Copper Range mine (Tetra Tech, Inc. 1996).

In 1990, EPA began tracking the removal and disposal of PCBs, under the Notification and Manifesting Rule. This Rule tracks PCB waste disposal volumes but not the source of the waste. From 1994-1996, Region 5 disposal facilities received 41 million pounds of PCBs; in 1997, these facilities received 153 million pounds of PCBs due to the opening of a new PCB disposal facility in Michigan (EPA 1999). From 1994-1997, Region 5 PCB storage facilities received 29 million pounds of PCBs (EPA 1999).

Under the U.S. TSCA requirements, PCB disposal and storage has also been tracked. The disposal and storage of PCBs has continued steadily over the past ten years, as illustrated in Tables 1.4 and 1.5.

Table 1.4 PCBs Received at Commercial Disposal Facilities in the U.S. (EPA 1999)

Year	PCBs (millions of pounds)
1990	122
1991	40
1992	52
1993	59
1994	43
1995	45

1996	35
1997	153

Table 1.5 PCBs Received at Commercial Storage Facilities in the U.S. (EPA 1999)

Year	PCBs (millions of pounds)
1990	41
1991	86
1992	18
1993	19
1994	21
1995	30
1996	44
1997	20

In Canada, seven companies reported a total of 157,977 liters of high level PCB liquid in use in 1997 (Brigham 1999). In 1997, 128,001 liters of high level PCB liquid, 20,336 liters of low level liquid, 69,296 kg high level solid PCB materials and 128,576 kg low level solid PCB materials remained in storage at provincially monitored sites. An additional 8,842 liters of PCB liquids and 7,935 kg PCB solids remained in storage at federally monitored sites at the end of 1997 (Brigham 1999).
Canada continues to maintain an inventory of PCB equipment and materials that are in use or storage or that have been destroyed (Brigham 1999). Tables 1.6 and 1.7 summarize the amount of high level and low level solid and liquid PCB waste destroyed between 1990 to 1997 at provincially monitored sites. Zero percent reduction means for that time period there was no decrease in that waste category.

Table 1.6 Solid PCB Waste Destroyed at Provincially Monitored Sites in Ontario (kilograms) (Brigham 1999)

Year	Type of Waste	Amount (>10,000 ppm)	Percent Reduction	Amount (<10,000ppm)	Percent Reduction
1990-1997	Drums of soil/gravel	92,225	78.1	14,704	11
1995-1997	Drums of ballasts	23,833	42.8	1,150	100
1990-1997	Drums of capacitors	13,654	70	30	0
1995-1997	Drums of clothing	no decrease	0	1,030	9

Table 1.7 Liquid PCB Waste Destroyed at Provincially Monitored Sites in Ontario (litres) (Brigham 1999)

Year	Type of Waste	Amount (>10,000 ppm)	Percent Reduction	Amount (<10,000ppm)	Percent Reduction
1990-1995	Bulk liquid	0	0	18,659	34
1995-1997	Bulk liquid	28,424	20	17,583	48.5
1990-1997	Liquid in transformers	18,443	57	3,588	68
1995-1997	Liquid in capacitors	21,646	100	1,102	100

1.2.4 Dioxin

The term "dioxin" represents a class of halogenated aromatic hydrocarbon compounds including polychlorinated dibenzodioxins and dibenzofurans. (Tetra Tech Inc. 1996). There are a total of 210 possible congeners of dioxin, depending on the location and substitution of chlorine in the molecule . Those congeners with chlorine substitution in the 2,3,7, and 8 positions on the molecule are generally thought to be responsible for the greatest degree of toxicity associated with dioxin (EPA 1998b).

In humans, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) has been shown to cause chloracne and liver damage. Based upon animal studies, dioxin is also a suspected carcinogen and is thought to be toxic to the immune system and may have detrimental reproductive and developmental effects (EPA 1995). Because of the high degree of toxicity associated with the 2,3,7,8-TCDD congener, the relative toxicity of other dioxin and furan congeners are assessed in terms of a toxicity equivalency factor (TEF), with 2,3,7,8-TCDD having a TEF value of 1.0. Throughout this document, concentrations of dioxins and furans are presented as a toxic equivalence quotient (TEQ). TEQs are determined by summing the products obtained from multiplying concentrations in grams (g) of individual dioxin-like compounds produced by a source by the corresponding TEF value for each compound (EPA 1996).

Unlike mercury and PCBs, there are no deliberate uses for dioxin. It occurs purely as a by-product in processes such as combustion and chlorination. In the context of the Lake Superior load reduction schedules, the "dioxin" that is targeted is 2,3,7,8-tetrachloro-dibenzo-p-dioxin because of the high degree of toxicity associated with that specific compound. Furthermore, most research completed to date has focused primarily on identifying sources of the 2,3,7,8-TCDD congener, rather than other forms of dioxins and furans. Nonetheless, to ensure that all potential dioxin congeners are addressed under the LaMP, and because many data are reported as TEQ, the parameter that is being tracked under the load reduction schedule is the TEQ.

In 1990, most of the dioxin produced in the Lake Superior Basin was released to the atmosphere (about 400-2,430 g TEQ/year) (see Table 1.8). Roughly 128 g TEQ/year was disposed in soils and landfills, 46 g TEQ were in PCB equipment, 31 g TEQ were estimated to be in contaminated sediment, and only 1.6 g TEQ/year were released into water. Most of the dioxin released to the atmosphere (370-2,400 g TEQ/year) was produced by small incinerators used at apartment buildings, nursing homes, schools, grocery stores and other small sources.

Since the 1990 base line estimates were completed, virtually all of these small, inefficient incinerators have been phased out, resulting in a very large reduction in dioxin air emissions. In addition, a significant reduction of about 22 g TEQ dioxin/year resulted from the closure of the Algoma Ore Division iron sintering plant in Wawa, Ontario and the White Pine Mine smelter in Northern Michigan. Closure of all medical waste incinerators in the U.S. portion of the Basin and all but three of the medical waste incinerators in the Canadian portion since 1990 has also resulted in a significant reduction in dioxin emissions within the Lake Superior basin. A summary of Lake Superior Basin dioxin emissions from 1990 through 1999 is presented in the table below.

Table 1.8 Summary of Lake Superior Basin Dioxin Emission Estimates 1990 to 1999

	U.S.[a]		**Canada**[a]		**Total**	
Source	1990	1999	1990	1999	1990	1999
Industrial	1.5×10^{-7} - 0.7	0 - 0.3	23.88	2.08		
Fuel Combustion	3.43	0.93	1.04	1.04		
Incineration	369 - 2,408	90.2	0.13	0.07		
Municipal/ Residential	N/A	N/A	0.05	0.05		
Commercial Products	N/A	N/A	0.27	0.27		
TOTAL	374 - 2,413	91.1 - 91.4	25.4	3.5	399.4 - 2438.4	94.6 – 94.9

[a] Canada figures in g TCDD/yr; U.S. figures in g TEQ-TCDD/yr.
N/A estimates not available.

Although many dioxin sources are now under control in the Basin, "backyard burning" by U.S. households and small businesses continues. It is believed that "rural burning" also occurs in Canada. No firm estimate can be made yet for the release of dioxin TEQs from these burn barrels, but preliminary calculations indicate that household waste burned in burn barrels can be a significant source of dioxin compounds. An initial estimate of the impact of household waste combustion in the U.S. is described in Appendix A.3.1 and included in Table 1.8. Since the burn barrel estimates are incomplete and the range of the dioxin emitted from small incinerators is so wide, an estimate of progress made towards zero discharge is problematic. However, setting aside the unknown burn barrel contribution yields an approximately 75 to 95 percent reduction in dioxin emissions resulting from the closure of medical waste and other small incinerators and the White Pine and Algoma facilities. The assumptions built into these estimates are explained in Appendix A.3.

1.2.4.1 Hexachlorobenzene

Data are too sketchy to confidently predict the change in hexachlorobenzene (HCB) releases in the Lake Superior Basin since 1990. What little data are available suggest that some of the major sources of dioxin, such as incineration, are also sources of HCB. Until more and better monitoring data and emission factors are available, dioxin trends will substitute for HCB trends.

1.2.4.2 Octachlorostyrene

Even less is known about octachlorostyrene (OCS) than hexachlorobenzene. However, the literature again suggests that some sources of dioxin are the same as for OCS. Until better data are available, dioxin trends will substitute for OCS trends.

1.2.5 Pesticides

The LaMP reduction goal for pesticides is to retrieve and destroy all stockpiles by 2000. The pesticides being targeted are chlordane, DDT, DDE, dicofol (also known as Kelthane), aldrin/dieldrin, hexachlorobenzene, mercury pesticides, toxaphene, Silvex, and other pesticides contaminated by dioxin or hexachlorobenzene. Collection of these pesticides is likely to have side benefits as other pesticides, including two other critical chemicals that are pesticides (hexachlorocyclohexane and heptachlor), are collected at the same time. Minnesota, Wisconsin, Michigan and Ontario have collected significant amounts of these substances through collection programs in the Lake Superior basin. Unfortunately, the data from these collections are inconsistent, and not always reported by specific pesticide. Stores of these substances apparently still remain in the Lake Superior Basin, and as a result, it is not possible to determine that all the stockpiled pesticides will be accounted for by 2000. For example, pesticides may be held by farmers or become orphaned when farm property is sold. Collections should continue in to the future.

Table 1.9 shows that aldrin, chlordane, and DDT have been collected in large amounts in the Lake Superior states from 1990 to 1998. More than 50 percent of the total pounds of pesticides collected was DDT (EPA and Environment Canada 1998b). The amount of canceled pesticides collected has begun to decline with the exception of DDT. Although DDT collections do not appear to be declining, they also have remained steady over the period (EPA 1999).

In the early 1980s, Canadian pesticide collections were administered through two clean sweep programs. The last Ontario Ministry of Environment and Energy (OMEE) 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.

Table 1.9 Clean Sweep Collections Of Pesticides In The Lake Superior States (U.S. Programs)

State	Dates of Collection	Substances Collected - pounds					
		Aldrin/ Dieldrin	Chlordane	DDT	Silvex	Toxaphene	Total Pesticide
Michigan[a]	1995	147	25	193	Not estimated	0	365
Minnesota[b]	1992 – 1998	74	535	4,959	6,000	83	11,651
Wisconsin[c]	1996-1998	0	36	97	28	480	641
Total (each substance)		221	596	5,249	6,028	563	12,657

[a] Compiled by Michigan Department of Agriculture. The Lake Superior counties collect about 9 percent of the total substances collected in the state. The substances collected in the Michigan Lake Superior counties were calculated as 9 percent of the total for each substance collected.

[b] Compiled by Minnesota Department of Agriculture Waste Pesticide Collection Program. Data include all Lake Superior counties' waste pesticide collections.

[c] Compiled by Wisconsin Department of Agriculture, Trade, and Consumer Protection for 1996. Compiled from collection event summaries from the Northwest Regional Planning Commission for 1997 and 1998.

Chapter 2:
Reduction Strategies

2.1 Introduction

The purpose of the Lake Superior Stage 3 LaMP is to identify strategies that will reduce critical pollutants in accordance with Stage 2 load reduction schedules, with the ultimate goal being the virtual elimination of critical pollutant inputs to the environment. There are several broad categories of strategies, including Contaminated Sites Strategies (Chapter 3) and Monitoring Strategies (Chapter 4). This chapter covers strategies aimed primarily to reduce loads from sources within the Lake Superior Basin. They are grouped into the following sections: Multiple Sector Strategies, Sector Specific Strategies, and Out-of-Basin Strategies. The latter identifies actions that could be taken on a broader scale to protect Lake Superior from airborne contaminants.

These draft strategies are presented for public comment. Some are proposed as commitments to be undertaken in the next two to three years by government agencies working on the Lake Superior Binational Program. The proposed commitments are summarized in Chapter 6. This chapter presents actions which are proposed as agency commitments, as well as actions which have been discussed through the Binational Program, but are not proposed as commitments at this time. These actions are included and denoted under the heading "future possibilities." Some of these are important if load reduction goals in 2005 and 2010 are to be met.

The government agencies working on the Binational Program are proposing various actions to pursue in the coming two to three years. Strategies listed in this chapter are denoted as draft commitments by the following acronyms.

EC	Environment Canada (EC)
EPA	United States Environmental Protection Agency – Region V (USEPA)
MI	Michigan Department of Environmental Quality (MDEQ)
MN	Minnesota Pollution Control Agency (MPCA)
ON	Ontario Ministry of Environment (OMOE)
WI	Wisconsin Department of Natural Resources (WDNR)
GL	Tribal (Placeholder pending tribal review).

Lake Superior Binational Program agencies are indicated in the text as LSBP agencies. Some of these strategies can be pursued with existing resources, although many would require additional resources in order to be accomplished. In this chapter, strategies that are not accompanied by agency acronyms in the listing are included for future reference but are not proposed as commitments at this time.

2.2 Multiple Sector Strategies

2.2.1 Introduction

Some reduction strategies are applicable to nearly all sectors of society (industry, business, government, and communities). For example, energy conservation can be applied to every sector. Similarly, the same pollution control technology may be used by different sectors, and the same government programs may apply to a variety of sectors. The following reduction strategies are recognized for their broad applicability to multiple sectors.

2.2.2 Voluntary Agreements

Regulatory measures provide only part of the reductions needed to meet the zero discharge and zero emission challenge. Voluntary agreements to reduce discharges and emissions beyond the legally required limits are needed to fill the gap between mandatory reductions and virtual elimination (e.g., zero release). The voluntary agreement approach is already being used in several LSBP agencies and it is proposed that this effort be emphasized in the Lake Superior Binational Program. The success of voluntary agreements could be evaluated in three ways: 1) the reduction in releases of mercury, dioxin, HCB and OCS beyond the compliance limits; 2) the amount of PCBs decommissioned from a voluntary agreement facility; or 3) the number of facilities that participate in a voluntary agreement.

Binational Action:

- (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. (EC, EPA, MI, MN, ON, WI)

Canadian Action:

- (2) Environment Canada and the Ontario Ministry of Environment have met with the seven pulp and paper mills on the Canadian north shore of Lake Superior and are planning additional meetings to review the status of each mill regarding its environmental impact relative to mills in other jurisdictions. These discussions may lead to agreements to implement voluntary programs in each mill that will reduce emissions and discharges beyond regulatory requirements. (EC, ON)

2.2.3 Economic Incentives, Evaluation and Assistance

There can be an economic cost associated with zero discharge and zero emission. Some sources will be easier and cheaper to reduce while others will be more difficult and expensive. Developing and compiling information on the cost effectiveness would be beneficial in choosing reduction activities because the most cost-effective reductions should be implemented first. In addition, the governments should consider what economic incentives could be used to encourage reductions and how to provide sector- specific support and guidance to sources that have significant releases, but lack the resources to implement reductions. Progress on these economic strategies could be measured in a variety of ways. Some examples of measurement could be: 1) cost effectiveness information compiled for the strategies in this Stage 3; 2) quantity of the nine designated chemicals that are avoided through implementation of strategies; or 3) number and size of loans or grants in some jurisdictions for programs that reduce the nine designated chemicals.

US Actions:

- (3) U.S. LSBP agencies will evaluate a variety of economic incentives or disincentives to promote verifiable or innovative reductions. Possible incentives include early reduction credits, tax relief, low-interest loans, grants, rebates and bounties for achievers. Possible disincentives include fees, taxes or caps on mercury-bearing products or uncontrolled sources of any of the nine designated chemicals. (MI)
- (4) U.S. LSBP agencies will provide indirect or direct financial support to businesses, organizations and local governments for pollution prevention projects. Possible projects include clean sweeps, bounties on mercury products or burn barrels, mercury swaps for alternative products, education, purchasing policies, energy conservation, water conservation, pay-as-you-throw trash disposal fees and others. (EPA, MI, MN, WI)

Future possibilities:

- (5) Compile a running list of the cost effectiveness of the reduction strategies. Sources of information pertaining to cost effectiveness include the Minnesota Mercury Initiative Strategies Report, the Canadian Pollution Prevention Centre in Sarnia, the Lake Superior Energy Efficiency report (Wisconsin Energy Conservation Corporation 1998), and facility-specific environmental review documents.
- (6) Investigate the establishment of a fund to assist in reduction, remediation, treatment, disposal and safe storage of the nine designated chemicals. The source of the funding could be from both the public and private sectors.
- (7) Undertake an assessment of the utility of various economic instruments for the municipal and industrial sectors of the Lake Superior watershed.
- (8) Continue to explore alternative financing arrangements for environmental protection and restoration (e.g. revolving loan funds).
- (9) In Canada, investigate the feasibility of a program to waive the federal GST or Provincial sales tax on environmentally friendly products.

2.2.4 Other Incentives

While economic incentives are important, there are other types of incentives that should be used in the Zero Discharge Demonstration Project. Examples of other incentives include awards and credit for beyond-compliance reductions. Possible measures of success for this strategy could include the total pounds of pollution avoided during a given year, or the number of facilities each year that meet established criteria.

Binational Action:

- (10) In cooperation with the Lake Superior Binational Forum, LSBP agencies will establish a Lake Superior steward project. A special effort will be made to identify suppliers of products that are free of mercury, dioxin, and HCB. (EC, EPA, MI, ON, WI)

Future possibility:

- (11) Acknowledge credit for beyond-compliance reductions, in order to provide an incentive for Basin facilities to voluntarily reduce the use and emissions of the nine critical pollutants. The purpose of these credits is to avoid penalizing facilities that have already achieved reductions before nation-wide reduction programs are established.

2.2.5 Purchasing Policies

Much of the effort to reduce the nine designated chemicals will take place at the chemical's point source. However, the role of consumers should not be underestimated. Consumer purchases can influence the production and use of the nine designated chemicals. The governments themselves are significant consumers and government purchasing policies can set an example. Measuring progress towards this strategy could be determining the number of entities that develop purchasing policies on a before-and-after comparison of purchases. Also, calculations of quantities of critical pollutants avoided due to product switching could be estimated.

U.S. Action:

- (12) U.S. LSBP agencies will evaluate and begin the development of purchasing policies to eliminate use of products that might include mercury equipment or PCB equipment (e.g., boilers, buildings, vehicles, electrical equipment and laboratory equipment). Policies will also examine phase-out of existing mercury or PCB containing items. (MN, MI)

Canadian Action:

- (13) Canadian LSBP agencies will work with pulp and paper mills to develop purchasing policies that require the certification of feedstock materials and confirm that levels of the nine critical pollutants are extremely low (concentration to be determined). (EC)

Future possibilities:

- (14) LSBP agencies will introduce process chlorine-free paper products whenever possible in their communication.
- (15) Encourage facilities that use feedstock chemicals such as caustic soda, potassium hydroxide, sodium hypochlorite, sulfuric acid, chlorinated solvents, pesticides, analytic reagents or preservatives to develop purchasing policies to avoid purchasing chemicals that contain mercury, dioxin or hexachlorobenzene, even in trace amounts. Facilities would develop strategies to purchase products proven to be free of the nine critical pollutants. The nine critical pollutants should not be used or discharged in the manufacture of purchased products. Chemical suppliers who provide clean chemical products could get an award through the proposed Lake Superior steward program.
- (16) Contract to print Lake Superior Binational Program documents with printers who participate in the Great Printers Project.

2.2.6 Product Stewardship

Product stewardship includes designing, manufacturing, transporting, retailing and disposal of products with the intent to minimize the impact of products to the environment. A variety of product stewardship programs are already in use by manufacturers. At this time these programs focus on the waste management portion of the product life cycle. For example, Honeywell Corporation in Minnesota has a reverse distribution system where owners of mercury bearing Honeywell thermostats can return them to the company for mercury recycling. Other possible product stewardship strategies include disposal depots maintained by manufacturers and labeling of products that contain critical pollutants. Of the nine designated chemicals, this strategy will be most applicable to mercury because of its many different uses. Possible measures of success for product stewardship include the number of companies labeling mercury bearing products used in the Lake Superior Basin, the weight of products brought into depots or returned through a reverse distribution system.

Binational Action:

- (17) LSBP agencies will work with manufacturers within and outside the Lake Superior Basin to develop depots and reverse distribution systems for citizens. Possible products to include in this strategy include batteries, paints, fluorescent lamps, thermostats, pressure-testing equipment, dental amalgam, laboratory reagents and others. (EPA, EC, MI, ON)

U.S. Action:

- (18) U.S. LSBP agencies will encourage a nationwide dialogue on the import of mercury bearing products. Nationwide labeling of mercury products will also be encouraged. (EPA, MN, MI)

Canadian Actions:

- (19) Canadian LSBP agencies will assist in establishing depots for old mercury containing thermometers, fluorescent tubes and other products for households. (EC, ON)

- (20) The province of Ontario will investigate the feasibility of redrafting existing legislation to accommodate product stewardship strategies involving waste disposal. (ON)

2.2.7 Energy Conservation

Burning fossil fuels, particularly coal, to produce energy releases mercury and dioxin into the atmosphere. Fuel combustion is the second largest source of mercury emissions within the Lake Superior Basin, but it is a relatively small source of dioxin. Control technologies are not currently available to substantially reduce mercury emissions from this source. Energy conservation would decrease the demand for energy, lower the amount of fuel burned, and thus reduce mercury emission. An additional significant benefit of this strategy is that it provides economic savings for the participants.

However, since energy is not necessarily used where it is produced, a decrease in energy used in the Basin will not automatically result in decreased emissions. The Lake Superior utilities will still be able to sell their energy to other customers outside the Basin. Despite this drawback, energy conservation in the Basin is still valuable as a demonstration to be emulated outside the region.

The area of energy conservation and demand side management has been explored through the Lake Superior Energy Efficiency Work Group (Wisconsin Energy Conservation Group 1998). Energy conservation is also recommended in the Lake Superior Binational Program P2 Strategy (1996). A variety of other programs deal exclusively with the use of energy conservation to lower bills and promote environmentally friendly homes and businesses. One such program is the U.S. EPA Energy Star program. Several organizations in the Lake Superior Basin are current participants in this program.

Water efficiency can also affect energy conservation. Work in the U.S. and Canada has shown that water conservation programs can have a beneficial impact on wastewater treatment plant performance. Water conservation can lead to increased performance and efficiency of treatment plants and decreased energy use, leading to reduction in operation and maintenance costs.

Measures of progress for energy conservation could include: 1) tracking trends in per capita electrical consumption in the Basin compared to other regions; 2) the number of businesses enrolled in programs such as Energy Star; and 3) the ratio of fluorescent lamps to incandescent lamps sold in the Basin. This type of information can often be translated into amount of energy saved, dollars saved and amount of mercury emissions that were prevented.

Binational Actions:

- (21) LSBP agencies will promote energy conservation programs (e.g. on the U.S. side: EPA Energy Star Program) within the Lake Superior Basin, agencies will especially urge the publicly-owned facilities, schools and universities in the Lake Superior Basin to participate in energy conservation programs. The agencies will also work with the utilities operating in the Basin to coordinate government and utility energy conservation programs. (EC, EPA, MI, MN, ON, WI)
- (22) LSBP agencies will encourage home and industry energy audits. (EC, MI, ON)
- (23) LSBP agencies will encourage municipal energy councils such as the Thunder Bay 2002 and the Duluth Citizen's Energy Council. (EC, MN, ON)

U.S. Action:

- (24) As part of utility deregulation, the state of Minnesota will consider establishment of a mandatory "line charge" for demand side management energy efficiency projects. (MN).

Future possibilities:

- (25) Encourage large electrical consumers (facilities) to use federal and provincial energy audit programs.
- (26) Encourage utilities to conduct special promotions of their energy conservation programs within the Lake Superior Basin.
- (27) Encourage re-lamping with fluorescent lamps and the proper disposal and recycling of old lamps. In addition, the governments will emphasize the proper identification and disposal of PCB ballasts on old fluorescent lamps.
- (28) Encourage consumer upgrades to energy-efficient programmable electronic thermostats combined with proper disposal of old mercury thermostats.
- (29) Encourage utilities to send mercury awareness and energy conservation information to consumers with monthly utility bills.

2.2.8 Collections

Many household and agricultural products contain mercury and/or other LSBP defined critical pollutants which could be eventually released to the environment. Within the Lake Superior Basin, collection of household and agricultural products that contain mercury or other critical pollutants should be reasonably available to all Basin residents. In addition, the Stage 2 LaMP reduction goals for pesticides are based on the operation of agricultural product collections. Most collections are publicly-funded programs to collect household and agricultural hazardous waste and recycle or dispose of it properly.

In 1998, the City of Superior, Wisconsin Toxic Reduction Committee evaluated the availability and effectiveness of household hazardous waste and agricultural pesticide collection programs in the Lake Superior Basin. This work is summarized below. Collection programs in the Lake Superior Basin face challenges of funding and efficiency in serving a largely rural and scattered population. Generally single-event collections are the most expensive. Mobile collection programs have been found to be more cost-effective in some parts of the Lake Superior Basin, such as in Wisconsin where a program is operated by the Northwest Wisconsin Regional Planning Commission. Permanent collection facilities operate in some of the larger population centers of the Basin. Some areas of the Basin are under-served.

In Michigan, Minnesota, and Wisconsin, household hazardous waste collection programs are usually coordinated in some way by county government. In both Minnesota and Wisconsin, all Lake Superior Basin counties have ongoing collection programs. In Duluth, Minnesota there is also a permanent collection program operated by Western Lake Superior Sanitary District. Except for Marquette County, Michigan's Lake Superior counties do not have on-going collection programs. The upper peninsula of Michigan has two permanent collection locations in Marquette and Escanaba. Canadian residents of the Lake Superior Basin experience a lesser availability of household hazardous waste collection programs. In Canada, two clean sweeps were attempted in the early 1980s for recently banned organochlorine pesticides. They were found to be an inefficient way to collect these materials and the initiative was replaced with permanent household hazardous waste depots operating seasonally in Thunder Bay. Thunder Bay is the only Canadian municipality within the Basin that has an ongoing collection program.

Usage statistics from ongoing programs indicate that collection events are well attended and that participation has increased from year to year. In addition, local government officials report that they receive many inquiries for proper household hazardous waste disposal in areas where collections are not available.

Agricultural "clean sweeps" are an important element of these collections. Surprising volumes of DDT, chlordane, and toxaphene have been collected at events in the U.S. portion of the Basin, even though it is not an agriculture-intensive area.

In 1995, Northwest Regional Planning Commission, a local planning organization, developed a mobile household and agricultural hazardous waste collection program. It is funded by a combination of state and local monies, user fees, and pesticide assessment fees. In 1999, an EPA grant provided additional funds for outreach and expansion activities. The goal of this outreach was to educate people on how their personal actions affect the Lake Superior ecosystem. Preliminary indications are that the expanded outreach has doubled participation in the program.

In the late 1990s several tribes (Bad River Band, Fond Du Lac Band, Keweenaw Bay Indian Community, Grand Portage Band) have conducted collections in communities in and around reservation lands. A strong advertising and educational campaign prior to initiating a collection was found to be a valuable tool. Some tribes offered a limited pick-up service for individuals (e.g. elders) unable to leave their home to deliver material. Household hazardous waste collections implemented by tribes have been funded by a combination of federal and tribal government funding.

A broad indication of success for collection programs is whether collection opportunities are reasonably available to most Basin residents. Success of individual programs can be monitored using collection quantities and number of households using the service.

Binational Action:

- (30) LSBP agencies will seek funding to initiate or continue permanent household and agricultural (e.g. pesticides) hazardous waste (HAHW) collection depots in the largest Lake Superior Basin cities. Furthermore, U.S. LSBP agencies will seek funding to initiate and continue periodic or mobile collections for the more remote locations within the Lake Superior Basin. Collections will not be limited to pesticides but will include a focus on mercury containing products (e.g. thermometers, abandoned appliances). U.S. LSBP agencies will seek funding to initiate and continue Lake Superior Basin HAHW education programs that will include information about how individuals can practice home environmental stewardship; how to identify HAHW and properly dispose of HAHW, and how this protects the Lake Superior basin. (EC, EPA, MI, MN, ON, WI)

U.S. Action:

- (31) U.S. LSBP agencies will assist industries and business in the basin to conduct industrial clean sweeps and use economy of scale for collections and shipments of hazardous waste. Examples of successful business collection programs include Western Lake Superior Sanitary District's clean shop program and Northwest Regional Planning Commission's very small quantity generator collection program. (MI).
- (32) U.S. LSBP agencies will seek funding to initiate and continue periodic abandoned "white goods" collections. (MI)

Future possibility:

- (33) Investigate the use of a surcharge or assessment at the wholesale or retail level on mercury-containing consumer items to fund collection programs.

2.2.9 Pesticide Use

In the United States, the pesticides designated for the Lake Superior zero discharge demonstration program (aldrin/dieldrin, chlordane, DDT and toxaphene) have been canceled (i.e., production is legal, sale and distribution is illegal, but application/use of designated pesticides purchased prior to cancellation is legal). In addition, these designated pesticides, with the exception of chlordane, have not been in production in the U.S. for many years. In 1997, the only remaining U.S. manufacturer of chlordane announced that their production would cease.

In Canada, federal registration for production of aldrin/dieldrin and chlordane has been discontinued in 1990 with the whole and retail sale of end-use products being permissible until 1995. Federal registration for DDT was discontinued in 1985 with permissible use until 1990. The use of toxaphene was suspended in 1980 with retail sale permitted until 1985. Provincially these pesticides have been banned.

While both countries have ceased production, sale and distribution of these pesticides, these pesticides continue to have an environmental presence. Their continued presence in the environment can be attributed to the pesticides' persistence in the environment and the large amounts of these pesticides that were used during the 1960's and 1970's. Furthermore, pesticide collection activities in the Basin have found that these canceled pesticides are still in the possession of some individuals. Global and residual regional usage will continue to contribute to the atmospheric deposition of these pesticides in the Lake Superior Basin. Current contamination levels of the designated pesticides remain a concern as reflected by water concentrations that exceed national water quality standards, sediment concentrations that exceed sediment guidelines, and fish consumption advisories.

Although approximately 75% of the usage of registered pesticides (which can contain, as a contaminant, small amounts of dioxin or hexachlorobenzene) is for agricultural purposes, non-agricultural uses of pesticides also impact the Basin. Pesticides are universally applied to urban landscaping, residential and commercial property, golf courses, university property and governmental property. The information regarding land-usage and pesticide application is complicated by the fact that research does not suggest a precise relationship between the amount of pesticides applied and the environmental fate of these pesticides.

A broad approach to the virtual elimination of the designated pesticides would combine community education, outreach, cooperation, promotion of clean sweeps, and information regarding available alternatives with respect to the targeted pesticides. Measures of progress could include the amount of pesticides collected, the number of people participating in collections, and the use of pesticide educational materials.

Binational Actions:

- (30) LSBP agencies will seek funding to initiate or continue permanent household and agricultural (e.g. pesticides) hazardous waste (HAHW) collection depots in the largest Lake Superior Basin cities. Furthermore, U.S. LSBP agencies will seek funding to initiate and continue periodic or mobile collections for the more remote locations within the Lake Superior Basin. Collections will not be limited to pesticides but will include a focus on mercury containing products (e.g. thermometers, abandoned appliances). U.S. LSBP agencies will seek funding to initiate and continue Lake Superior Basin HAHW education programs that will include information about how individuals can practice home environmental stewardship; how to identify HAHW and properly dispose of HAHW, and how this protects the Lake Superior basin. (EC, EPA, MI, MN, ON, WI)
- (34) LSBP agencies will pursue urban outreach initiative that increases awareness of the risk of using pesticides. (EPA, ON)

Future possibilities:

- (35) Work with the USDA to promote the environmental benefits of the agricultural use of low risk pesticides in protecting the soil and water.
- (36) Distribute information from the EPA's Pesticide Environmental Stewardship Program including:
    1. Acceleration of the registration of low risk pesticides, the use of naturally-occurring biologically produced pesticides and the use of plants genetically engineered with resistance to pests are also viable options.
    2. Annual grants to researchers to develop low risk pesticides or to reduce the use of pesticides
    3. Urban initiative that increases awareness, through outreach, of the risk of pesticide use. (EPA, ON)
- (37) Address continued international production and usage of these pesticides through existing global/international initiatives.
- (38) Continue communication and encourage reporting between the LSBP and the Binational Toxics Strategy on the issue of the long-range transport of pesticides.
- (39) Confirm that pesticides of concern are no longer used in the Basin and eliminate any illegal uses.
- (40) Develop snow mold disposal projects for golf course greens keepers.
- (41) Assist municipalities in improving pretreatment programs to detect and help eliminate trace sources of mercury, PCBs, and pesticide releases discharging into sewerage systems.
- (42) Encourage dialogue with sectors using chlorinated pesticides regarding the practice of burning vegetative residues.

2.2.10 Solid Waste Management

Proper solid waste (garbage) management can decrease release of zero discharge chemicals like dioxin and mercury. Mercury containing products disposed with other solid waste has a high potential of being released into the environment either by vaporization, leaching, or incineration. Solid waste incineration is also a source of dioxin. According to the Stage 2 LaMP, small inefficient waste incinerators were estimated to be a major source of dioxin to the atmosphere. Examples of these incinerators include those used in grocery stores, apartment buildings, and schools. Since 1990, restrictions on air emissions have precluded the legal operation of most inefficient incinerators in the Lake Superior Basin. Backyard garbage burn barrels are another source that is estimated to be a major contributor of dioxin to the atmosphere. Burn barrels may be a particularly important dioxin source in the primarily rural Lake Superior Basin. Burn barrel use has been curtailed in some areas through public education and local ordinances. Compliance depends on the availability of inexpensive and convenient alternatives. Enforcement depends on local desires. Public education is an important step.

The solid waste management philosophy of "reduce, reuse, recycle," serves to help accomplish the pollutant load reduction targets for Lake Superior. Progress on the Lake Superior goals related to solid waste management could be judged in the following ways: 1) the number of local units of government with burn barrel ordinances, 2) estimates of actual burn barrel use; 3) availability of recycling programs to Basin residents, and 4) the amount of mercury-containing waste disposed in landfills.

Binational Actions:

- (43) LSBP agencies will insist on the highest standards and best available technology for new incinerators. (EC, EPA)
- (44) LSBP agencies will evaluate programs to prevent or remove chlorinated or mercury containing material from incinerator feedstocks. (EC, ON, MI)

U.S. Actions:

- (45) U.S. LSBP agencies will support public education/outreach campaigns regarding the health and environmental effects of burn barrels and small incinerators and encourage local units of government to pass ordinances banning burn barrels. (EPA, MI, MN)
- (46) Michigan will evaluate adoption of a law similar to Minnesota's incinerator law prohibiting disposal of mercury bearing waste. (MI)

Canadian Action:

- (47) Canadian LSBP agencies will encourage municipalities to establish source separation programs to divert household hazardous materials including cleaners, batteries, and fluorescent lights from landfills or incinerators. (EC, ON)

Future possibilities:

- (48) Develop a universal waste rule under RCRA authority that applies to a wider variety of mercury bearing products.

- (49) Encourage a nationwide ban on small incinerators.
- (50) Develop a plastics recycling program in the basin.

2.2.11 PCB Phaseout

Although manufacture of PCBs was banned in 1977, the pressure and heat tolerance characteristics of PCBs results in old PCB bearing equipment (e.g., capacitors and transformers) still being used in the Lake Superior Basin. This includes high level equipment (e.g., >500 ppm in the US, >10,000 ppm in Canada) where PCBs were deliberately used and low level equipment where PCBs contaminated the oil during testing, refilling or maintenance. In addition, considerably smaller quantities of PCBs can be found in older household products and some other types of equipment.

This equipment is used by a variety of sectors including industry, electric utilities and municipal utilities. The U.S. EPA has urged Great Lakes utilities to accelerate phase-out of PCB bearing equipment. In Canada, the Canadian Environmental Protection Act gives consideration to the legislative phase-out of in-use electrical equipment containing PCBs. The Province of Ontario has encouraged all PCB owners to decommission the large amount of PCB equipment that was in storage in the Lake Superior Basin. Large amounts of PCBs are still contained in the Basin, however precise quantities have been difficult to establish. Progress can be measured by monitoring the number of facilities that have tested their equipment and by the amount of PCB equipment that has been decommissioned.

Binational Actions:

- (51) LSBP agencies will encourage owners of transformers and capacitors to test their equipment to identify any remaining PCBs. (EC, EPA, MN, MI, ON)
- (52) LSBP agencies will encourage PCB “mentors” (i.e., facilities that have already removed their PCBs) to assist smaller facilities that do not have access to as much environmental expertise. (EC, EPA, MI, ON, MN)
- (53) LSBP agencies will encourage the formation of PCB cooperatives that allow PCB equipment owners to achieve economies of scale by using a common contractor to remove, transport and destroy PCBs from a region within the basin. (EC, MN, ON)
- (54) LSBP agencies will include PCBs in outreach and hazardous waste collections designed for small businesses since PCBs may be contained in light ballasts, paint, well pumps, small capacitors and white goods (e.g., refrigerators). (EC, EPA, MI, ON)

Canadian Actions:

- (55) Canadian LSBP agencies will consider another round of training sessions for small PCB owners. Cooperation is promoted so that PCB owners can reduce the cost of contracted PCB services (e.g. treatment of PCB contaminated mineral oils, on-site decontamination of capacitors and transformers, shipment of PCBs to high temperature incineration facilities and carcass removal). (EC, ON)
- (56) Canadian LSBP agencies will encourage owners of PCB bearing equipment to monitor and document the ongoing status of the equipment until it is removed. (EC, ON)
- (57) Canadian LSBP agencies will continue to seek in-basin destruction capability for low level PCBs. (EC, ON)

U.S. Actions:

- (58) U.S. LSBP agencies will encourage PCB owners to destroy PCBs in use or storage. Encouragement could be done through voluntary agreements, economic incentives, and decommissioning in lieu of certain fines. (EPA, MI, MN)
- (59) U.S. LSBP agencies should consider removal of PCB bearing equipment in lieu of some fines (e.g. Supplemental Environmental Projects). (EPA, MI)
- (60) U.S. LSBP agencies will assist in the testing and removal of PCB bearing equipment, especially for municipalities, schools, hospitals and small businesses. An explanation of the financial consequences of PCB contamination of property should be included in this outreach program. (MN)
- (61) U.S. LSBP agencies will ask all the power generators in the basin to endorse the PCB reduction goals outlined in the Stage 2 LaMP and will provide Lake Superior steward awards to facilities that accept the challenge. (EPA, MI)

Future possibility:

- (62) Consider PCB identification and collection in other activities. For example, a mercury collection in an industrial facility could also target PCBs, contractor training for mercury bearing equipment could include PCBs and voluntary agreements could cover mercury, dioxin and PCBs.

2.3 Sector Specific Strategies

2.3.1 Introduction

While some reduction strategies apply across multiple sectors, others are sector specific. Recommendations for reduction strategies have been developed for the following specific sectors. Facilities within these sectors vary greatly regarding the amount of the nine critical chemicals they use. Thus, the following recommendations are to be considered sector-wide, but may not apply to every facility, equally.

2.3.2 Demolition, Salvage and Recycling

Appliances, vehicles and a variety of products that are recycled can contain significant amounts of mercury and PCBs. PCBs are found in ballasts in only the oldest refrigerators. Buildings can also contain mercury and PCBs. Burning scrap materials from buildings, appliances and vehicles can produce dioxin and possibly hexachlorobenzene. For mercury, it is estimated that 4,000 to 20,000 pounds (1,800 to 9,000 kg) of mercury in products is removed from use each year in the state of Minnesota. Based on the Minnesota data, an estimate for the Lake Superior would be approximately 389 to 1,900 pounds (235 to 1,180 kg) of mercury in products per year. A significant portion of discarded mercury bearing products will pass through the demolition, salvage and recycling sector.

There is a continued need to inform and assist people in the demolition, salvage and recycling sector about PCB and mercury bearing equipment and how to prevent it from entering the regular solid waste stream. Since the early 1990s, salvage yard operators, appliance recycling operators, and demolition contractors have been becoming more aware of mercury and PCB bearing equipment. Possible measures of progress towards this strategy could include the quantity of mercury or PCB bearing equipment removed from demolished buildings, PCB decommissioning records under TSCA or the Canadian inventory or the number of demolition contractors or salvage yard operators trained in PCB and mercury disposal.

Binational Actions:

- (63) LSBP agencies will provide training materials for appliance recyclers and auto salvage operators to assist compliance with applicable rules. (EC, MI, MN)
- (64) There are a variety of multiple sector strategies that are also applicable to this sector, including economic incentives, the Lake Superior Steward program and participating in hazardous waste collections. See Section 2.1 for additional strategies.

U.S. Action:

- (65) U.S. LSBP agencies will encourage training sessions for demolition contractors. Such training would preferably be associated with licensing requirements or other mandatory procedures. Opportunities to align the training with trade association outreach will be sought. (EPA, MI, MN)

Future Possibility:

- (66) Examine successful models (e.g., Great Printers Project) so that critical pollutants can be recovered from salvage and demolition waste streams.

2.3.3 Schools

When the twenty-year time-span of the Stage 2 load reduction schedule is considered, it is obvious that Lake Superior Basin schools have a critical role. Not only can the school foster a conserver attitude rather than a consumer attitude in its students, but the school campus itself can become a model of the zero discharge philosophy in action. No school in the Basin should be incinerating anymore, so their contribution to dioxin production has significantly dropped since 1990. Other sources of the designated chemicals remain and include mercury and PCB bearing equipment, chemical reagents, solvents and cleaning products. Some schools run their own boilers. Examples of progress in the strategies geared towards schools might be measured by the number of schools enrolling in energy conservation programs, number of students attending environmental learning centers, number of mercury thermometers collected during swaps or the payback periods identified for energy improvements.

Binational Actions:

- (67) LSBP agencies will assist schools in seeking out and disposing of mercury and PCBs on school property. (EPA, MI, MN,ON)
- (68) There are a variety of multiple sector strategies that are also applicable to this sector, including energy conservation and purchasing policies. See Section 2.1 for additional strategies.

U.S. Action:

- (69) U.S. LSBP agencies will support Basin-wide coordination of citizen and school monitoring programs such as "Lake Superior Lakewatch." LSBP agencies will support continuation of existing

programs and formation of new programs based on local interest. These programs will be used as outreach activities for the Binational Program and will increase a sense of stewardship in the Lake Superior Basin. (WI).
- (70) Minnesota will investigate the potential use of a mercury-sniffing dog to identify mercury in schools as part of this effort. (MN)

Future possibilities:
- (71) Encourage “Sister school” and “twinning” environmental projects between schools in the Basin and with green schools that are outside the Basin.
- (72) In cooperation with the Lake Superior Binational Forum, a category of the proposed Lake Superior steward program could be developed for schools. Possible activities include developing an curriculum on toxic chemicals, adopting a nearby water-body or certification from the appropriate agency that the school is PCB and mercury.
- (73) Encourage Universities to adopt “Zero Discharge Campus” programs.
- (74) Encourage schools in the Lake Superior to commit to green school programs including Energy Star, Blueprint for a Green Campus program and others.
- (75) Establish a Michigan Energy Bank to do energy audits and improve state buildings, including schools.
- (76) Encourage pollution prevention projects such as the mercury thermometer swap at Marshall School in Duluth.
- (77) Develop a computerized, interactive program that demonstrates how to “prune the use trees.” (“Use trees” are a graphic representation of the myriad ways in which the target chemicals are used and formed. They appear in the Stage 2 LaMP.)

2.3.4 Small Business

Small businesses are sometimes not regarded as a significant source of hazardous waste. However, a study on northeastern Minnesota small business found that this sector was responsible for roughly a quarter of the area’s hazardous waste. Small businesses are an important part of the hazardous waste stream and a special effort is needed to educate them to recognize and properly dispose of hazardous waste, including mercury and PCB bearing equipment, pesticides and solvents. Small businesses in the Lake Superior basin can face higher per unit costs for hazardous waste transportation and disposal because of their small quantities generated and distances involved. In some parts of the basin small business waste collection programs have been established. Two examples are the Western Lake Superior Sanitary District’s Clean Shop program in Duluth and the Northwest Wisconsin Regional Planning Commission very small quantity generator collection program. Recent expansions of the Clean Shop program include mobile collections in northeastern Minnesota and “coupons” to defray the cost to customers. Possible measures of progress would be the number of businesses who participate small businesses collection programs, the quantity of the nine designated chemicals that are collected at sites that are geared towards small business, or the number of inquiries made to such collection sites.

Binational Action:
- (78) There are a variety of multiple sector strategies that are also applicable to this sector, including energy conservation, economic incentives, the Lake Superior Steward award and purchasing policies. See Section 2.1 for additional strategies.

U.S. Actions:
- (79) U.S. LSBP agencies will assist industries and business in the Basin to conduct industrial clean sweeps and utilize economies of scale for collections and shipments of hazardous waste. Examples of successful business collection programs include Western Lake Superior Sanitary District’s clean shop program and Northwest Regional Planning Commission’s very small quantity generator collection program. (MI).
- (80) U.S. LSBP agencies will pursue funding for community and regional toxic reduction activities and networking between Lake Superior communities. In particular, the toxic reduction committees working in Marquette, Michigan; Superior, Wisconsin; and through the WLSSD in Duluth, MN, should be supported. Innovative and alternative funding should also be pursued for these and expanded efforts in communities throughout the Lake Superior basin. (WI)

Canadian Action:

- (81) Canadian LSBP agencies will encourage small businesses through an education program to utilize the permanent hazardous waste depots available to them and coordinate the local Chamber of Commerce or trade associations to run pollution prevention education and training sessions for proper waste management. (EC, ON)

Future Possibilities:

- (82) Evaluate the potential for adopting or expanding the U.S. federal universal waste rule in order to simplify collection and disposal of hazardous waste from small businesses.
- (83) Encourage and coordinate local household hazardous collection sites to take elemental mercury waste from small businesses in a one-time sweep. These sweeps will also involve an educational component to address additional disposal needs.

2.3.5 Mining

Although the mining sector has contributed significant reductions in toxic chemicals since 1990, these reductions have mostly occurred due to mines and processing facilities shutting down in Ontario and Michigan. Through a combination of old, outdated facilities, ore bodies playing out and market forces driving down the value of their products, these facilities were no longer economically viable. This will eventually happen to the remaining mines and processing facilities, even though new technologies can make lower value ore bodies more economical and other factors can extend (or shorten) the life of a facility. Algoma Ore Division iron sintering plant, formerly the largest mercury emitter in Canada, was closed in 1998; Copper Range, the largest mercury emitter in the U.S. portion of the Basin, was shut down in 1995.

Remaining mining and ore processing still have sizable impacts on the Basin. Estimates of mercury from sources in the Basin as compared to the reduction schedules indicate that reductions of mercury from mining emissions are needed in order to meet the schedule (see section 5.2.1). Most of these mercury emissions are from the Minnesota taconite industry, which represents eight facilities. Since some facilities generate their own electricity by burning coal, some portion of the mercury emitted is from the coal.

Concerning PCBs, both the U.S. and Canadian PCB data bases indicate that the majority of the PCB equipment still in use in the Basin is found in industry and certainly mining is a significant portion of the Basin's industrial sector. A 1997 survey of electrical equipment owners in the Minnesota portion of the basin found PCB transformers still in use at Minnesota taconite mines. However, these mines have made progress since 1990 in decommissioning PCB-bearing equipment. PCB-bearing equipment is also being decommissioned as part of the closure plan at the Copper Range mine in Michigan.

For dioxin, the closure of the Algoma Ore Division iron sintering plant in 1998 brought about a significant reduction in dioxin emissions. However, the technologies used at the remaining U.S. and Canadian mines and processing facilities are not known to release dioxin.

Possible measures of progress in tracking reductions from these facilities would include stack testing, amount of PCB equipment removed and tons of ore processed combined with an emission factor.

Binational Action:

- (84) There are a variety of multiple sector strategies that are applicable to the mining industry. Energy conservation is especially appropriate given the industry's large demand for power (e.g., an energy audit has benefited at least one of the Minnesota taconite mines). Other strategies that are especially applicable are purchasing policies, incentives and collections.

U.S. Actions:

- (85) U.S. LSBP agencies will identify facilities that use wet scrubbers to treat emissions. If mercury is accumulating in the scrubber water, the feasibility of recycling the water in a closed loop system rather than being discharged will be evaluated. (MN, MI)
- (86) U.S. LSBP agencies will assist the taconite industry in finding a mercury control technology. (MN)
- (87) U.S. LSBP agencies will assist facilities that produce their own electricity from coal burning to convert to alternative sources such as natural gas turbines. (MN)

Future possibilities:

- (88) Encourage facilities to accelerate their destruction program for PCBs. The Canadian Environmental Protection Act gives consideration to the legislative phase out of in-use PCB equipment.

- (89) Canadian LSBP agencies will communicate the long-term goal for energy utilities is to convert from coal burning to a natural gas energy source. In the medium-term, communicate an energy conservation ethic to households that would extend to the purchase of clean fuel.
- (90) Create a better reporting system for PCBs in U.S. mining operations.

2.3.6 Health Care

The ethics and objectives of the health care sector to do no harm and improve patients health fits well with eliminating the release of highly toxic chemicals to the environment. The health care sector, including clinics, hospitals and dental and veterinary facilities, use mercury in a variety of ways (e.g., instruments, thermometers, lab chemicals, preservatives and dental amalgam). PCBs may also be found in some equipment at facilities with physical plants (i.e., maintenance work shops). Since alternatives exist for many of the mercury bearing products, this sector has an opportunity to switch to less toxic products. For example, a new state-of-the-art hospital under construction in Thunder Bay is planning not to use mercury bearing equipment.

The health care sector also releases some toxic substances such as mercury, dioxin and hexachlorobenzene through medical waste incineration. In the Canadian portion of the Basin, reductions in dioxin emission from Canadian hospitals have occurred due to hospital and four incinerator closures. A long term problem is the shipping of frozen hospital wastes out of the Basin presumably for incineration elsewhere. Currently the two remaining hospitals are looking at alternatives to the incineration of their medical wastes. On the U.S. side, the medical waste incinerators in the Basin have been shut down and their waste is shipped to facilities outside the Basin.

Measures of progress could include the amount of mercury and PCB bearing equipment decommissioned, the amount of mercury lab chemicals avoided through purchase of alternative products, the amount of waste dental amalgam diverted from the wastewater stream as well as other changes in the purchasing and disposal methods.

Binational Actions:

- (91) LSBP agencies will encourage pollution prevention projects at hospitals, clinics, and medical, dental, and veterinary offices with an emphasis on removing mercury and making the offices “mercury free”. (EC, EPA, MN, MI, ON)
- (92) LSBP agencies will support partnerships with dental associations to develop training materials and programs for dental offices regarding the proper handling, collection, and disposal of amalgam wastes. (EC, MI, MN, ON, WI)
- (93) There are a variety of multiple sector strategies that are also applicable to this sector, including voluntary reduction agreements, energy conservation, economic incentives, the Lake Superior Steward award and purchasing policies. See Section 2.1 for additional strategies.
- (94) LSBP agencies will support and promote implementation of voluntary agreements with the health care industry to reduce use of mercury and formation of dioxin. (EC, EPA, MI, ON, WI)

U.S. Actions:

- (95) U.S. LSBP agencies will work with operators of medical waste incinerators to pursue reductions of mercury, dioxin and hexachlorobenzene through source reduction elimination/segregation, including the removal of noninfectious waste from the incinerator waste stream. (MI)

Canadian Actions:

- (96) Canadian LSBP agencies will follow up on the 1999 City of Toronto pilot among Environment Canada, suppliers and the Ontario Dental Association and apply the results to the Thunder Bay area. (EC, ON)
- (97) Ontario will investigate a regulatory exemption to dispose of mercury wastes reclaimed from dental offices. (ON)

Future possibilities:

- (98) Work with the health care sector to properly identify and dispose of batteries, fluorescent lamps, thermometers, pressure testing equipment, dental amalgam collection and recovery, preservatives and laboratory chemicals.
- (99) Evaluate lowering medical waste incinerator mercury limits.
- (100) Urge hospitals to discontinue the practice of sending mercury thermometers home with new mothers and instead use non-mercury thermometers and distribute information on the hazards of mercury in home and the actions that families can take to limit their exposure. The agencies will assist in the preparation of these materials.

- (101) Support implementation of the American Hospital Association memorandum of understanding which includes three voluntary goals: 1) virtual elimination of mercury containing waste from the health care wastestream by 2005, 2) plan to reduce total volume of all wastes generated by hospitals by 33% by 2005 and 3) establishment of a stakeholders council.
- (102) Establish an incentive program for Ontario dentists that encourages them to switch to using non-mercury containing materials.

2.3.7 Energy Production

Fuel combustion, particularly coal combustion, releases new mercury and dioxin into the atmosphere. Fuel combustion is estimated as the second largest source of mercury emissions within the Lake Superior Basin, but it is a relatively small source of dioxin. A variety of facilities burn fuel, including electrical utilities (e.g., Ontario Hydro and Northern States Power), industrial utilities (e.g., power plants at taconite mills and burning Kraft liquors at pulp and paper mills) and municipal utilities (e.g., municipal steam plant in Virginia, Minnesota).

PCBs were used in electrical equipment such as transformers and capacitors. According to the 1998 EPA data base, there are 57 transformers owned by utilities in the U.S. portion of the Basin that contain high levels of PCBs or that have not been tested. Other inventories show that large numbers of high PCB capacitors are still in use by utilities.

Control technologies are not currently available to substantially reduce mercury emissions from coal fired power plants. Several on-going efforts address the issue of mercury from energy production. These broader efforts have the potential to affect the Lake Superior Basin in the long term, particularly the mercury strategies in Minnesota, Michigan, Wisconsin, and Ontario, as well as implementation of the Great Lakes Binational Toxics Strategy, U.S. federal efforts such as implementation of MACT air standards and recent U.S. requirements for utilities to report the mercury content of the coal they burn, and research and development by the utilities themselves.

Progress towards mercury reductions in this sector can be monitored by measuring mercury emissions, changes in control technology, mercury content in coal, and the amount of energy produced by alternative methods. PCB phase-out strategies in Section 2.2.11 are also applicable to this sector.

Binational Actions:

- (103) LSBP agencies will encourage the investigation of alternative energy (e.g. low mercury fuels, natural gas, solar, wind) in the Lake Superior Basin and encourage residents to purchase energy produced with lower polluting technologies. (MN, ON)
- (104) There are a variety of multiple sector strategies that are also applicable to this sector, including voluntary agreements, economic incentives, the Lake Superior Steward award, purchasing policies and PCB phase-out. See Section 2.2 for additional strategies.

U.S. Actions:

- (105) U.S. LSBP agencies will ask all the power generators in the Basin to endorse the PCB reduction goals outlined in the Stage 2 LaMP and will provide Lake Superior steward awards to facilities that accept the challenge. (EPA, MI)
- (106) U.S. LSBP agencies will assist utilities in developing mercury control technologies. Assistance may or may not take the form of funding. (EPA, MN)
- (107) U.S. LSBP agencies will assist utilities in converting from coal-burning technology, which releases mercury, to renewable source energy or natural gas technology to produce electricity (MN).

Future possibilities:

- (108) Encourage utilities to conduct special promotions of their energy conservation programs within the Lake Superior Basin. Examples of activities in this effort could include home and industry energy audits, sending mercury awareness and energy conservation information to consumers along with monthly utility bills and offers of assistance to customers in PCB decommissioning.
- (109) Hold an energy production workshop for public and industrial utilities and LSBP agencies to seek common ground, provide mentors and partners for small facilities and develop mercury reduction recommendations for this sector.
- (110) Promote the long-term goal of having energy utilities convert from coal burning to a natural gas energy source. In the medium-term, householders need to develop an energy conservation ethic that would extend to the purchase of clean fuel.

2.3.8 Forest Products

The sub-sectors of the forest products industry considered here are pulp and paper mills, sawmills and wood treatment facilities. Dioxins are released from chlorine-based bleaching processes associated with some pulp and paper mills in the basin. Pulp and paper mills and sawmills can emit dioxins when burning waste wood. Pentachlorophenol (PCP), which contains dioxins, is used in wood treatment facilities (i.e., Northern Wood Preservers site in Thunder Bay). PCP will leach off of treated wood into the surrounding soil. The released PCP will migrate through the soil and into Lake Superior. In addition, some forest product facilities may still contain PCB equipment.

Significant load reductions of the nine critical pollutants have occurred in this industry. In the past, the Canadian pulp and paper industry produced chlorine on-site using the mercury cell chlor-alkali process which released mercury into the environment. In the 1970s, the Canadian chlor-alkali industry was regulated and mercury cells plants were shut down. While U.S. legislation does not prohibit mercury cell chlor-alkali processes, there are no chlor-alkali facilities operating in the U.S. side of the Basin.

Dioxins and furans were also associated with the pulp and paper industry. In response to Canadian regulations in the 1990s on the releases of dioxins and furans from effluents, all mills have a capacity for 100 percent chlorine dioxide substitution and are functioning at near capacity. This process virtually eliminates dioxins and furans. All the US mills in the Basin either use chlorine dioxide or do not use any chlorine in their bleaching process.

Sawmills have reduced emissions through equipment changes allowing for the sale rather than incineration of wood chips, therefore, avoiding the release of dioxins and HCB. The Northern Wood Preservers facility has prevented the release of additional PCP through structural changes and through a clean-up program to collect, confine and eventually treat contaminants.

Binational Action:

- (111) There are a variety of multiple sector strategies that are also applicable to this sector, including purchasing policies and energy conservation. See Section 2.1 for additional strategies.

Canadian Actions:

- (112) Canadian LSBP agencies propose to discuss a program with the seven pulp and paper facilities: to address purchasing policies to eliminate the nine critical pollutants; to review energy reduction practices thereby reducing dependence on purchased energy that is generated from coal burning facilities which release mercury and dioxin; introduce water conservation to reduce energy use; recycle fluorescent tubes. (EC, ON)
- (113) Canadian LSBP agencies will continue energy audits of pulp and paper mills; conduct a study to identify further actions that would reduce emissions and result in cost savings. (EC, ON)
- (114) Canadian LSBP agencies will encourage the establishment of voluntary agreements to remove PCBs in use or storage so that all forest products facilities are PCB free. (EC, ON)
- (115) Pursue clean up of mercury contaminated sediments in Peninsula Harbour through a partnership among public and private sector organizations. (EC, ON)
- (116) Reduce dioxin and furan discharges from the pulp bleaching process by reducing AOX to less than 0.8kg/tonne. (ON)

Future possibilities:

Canadian:

- (117) All sectors of this industry require improved combustion technology to reduce the formation of dioxin.

Sawmills

- (118) Conduct materials audit and replace equipment containing mercury and PCBs.
- (119) Conduct energy audits of sawmills and discourage burning of wood wastes for energy and encourage use of energy efficient wood kilns.

Wood Preserving

- (120) In the long term, cease the use of pentachlorophenol (PCP) in wood preserving.

U.S.:

- (121) Encourage facilities that burn chips and waste wood for energy or heat to use the most efficient furnace possible.
- (122) Encourage saw mills to use energy efficient drying kilns.
- (123) Encourage forest sector facilities to inventory PCB and mercury bearing equipment and replace it with benign alternatives.

Binational:

- (124) Promote and encourage research into zero discharge technologies in place elsewhere in the world for effluents and emissions.

2.3.8b Other Industrial Sectors

The sector specific sections of this chapter address most of the industries operating in the Lake Superior basin that have a sector-specific role in reducing zero discharge pollutants. Although not heavily industrialized, the Lake Superior basin has several other large industrial facilities that are not covered specifically elsewhere in the document. These facilities include ship repair, lime processing, grain elevators, other shipping concerns, an oil refinery, and various manufacturing facilities. Generally, there are few sector-specific strategies applicable to these facilities. This "other industry" section of the document houses strategies applicable to industrial or manufacturing facilities in the Lake Superior basin that are not covered in other sections of the Stage 3 Lakewide Management Plan. Large industrial facilities in particular can contribute to the reduction goals for the zero discharge pollutants through PCB phase-outs, mercury-containing equipment phase-outs, purchasing policies, energy conservation, packaging choices and solid waste management, hazardous waste management, and attention to contaminants in feedstock chemicals. In addition, stormwater from industrial facilities and urbanized areas can serve as a significant source of Lake Superior critical pollutants in the lakewide and local remediation category.

Industrial and manufacturing sectors outside of the Lake Superior basin are addressed in the "Out of Basin Strategies" section of the plan.

Oil Refining:

The oil refining process is recognized as a likely source of mercury emissions which has yet to be quantified. Mercury is found as a contaminant in crude oil. This mercury then may be emitted via air emissions, water discharges, other wastes, or may end up in products. Minnesota estimates that more than 50 lbs. of mercury per year enter its two refineries (not in the Lake Superior basin) via crude oil. Murphy Oil USA's Superior, Wisconsin refinery is the only oil refinery within the Lake Superior basin.

Binational Action:

- (125) There are a number of multiple sector strategies particularly applicable to large industrial facilities including PCB phase-outs, PCB mentoring with smaller facilities, mercury equipment replacement, purchasing policies, energy conservation, participation in regional pollution prevention initiatives, attention to chemical feedstock contamination, solid and hazardous waste management.

Future possibility:

- (126) Continue to work with industrial facilities on stormwater management and best management practices for storage piles.

2.3.9 Public Sector

The public sector can take several types of action to reduce loads of pollutants to the Lake Superior Basin. Federal, state, and provincial regulatory agencies can encourage pollution prevention, mandate special protection for the Basin and promulgate new rules to minimize or eliminate pollutant loads. In addition, the public sector has many of the same opportunities as the private sector to participate in energy conservation programs as well as adopting environmentally friendly purchasing policies. Many of the important pollution prevention strategies applicable to the public sector are listed in the energy conservation, communities and households, and solid waste management sections.

Universities and schools can serve an important role in developing curricula and municipalities can implement action at a local level more efficiently than other levels of government. Municipalities and other local units of government have responsibilities and functions (i.e., solid waste management) that can influence pollutant load reductions.

The measures of progress will be as varied as the range of potential actions and could include indirect measures such as the number of U.S. communities adopting burn barrel ordinances as well as direct measures of mercury loads reduced through local or regional reduction strategies.

<u>Pollution Prevention</u>

Most of the pollution prevention actions are covered in other sections of this chapter. This section lists actions not addressed elsewhere.

Canadian Action:

- (127) Environment Canada will expand the P2 Demonstration Site Program to Canadian Federal Facilities and to First Nations in the Lake Superior basin. The program will address generation of hazardous wastes by identifying and demonstrating alternative products, practices, and technologies. (EC)

Future possibilities:

- (128) Canadian LSBP agencies will link company websites to Lake Superior websites in order to publicize and promote positive actions.
- (129) Sustain and expand pollution prevention technical assistance programs for facilities in the Lake Superior Basin. Programs include the Retired Engineer Training and Assistance Program (RETAP), Minnesota Small Quantity Generator Program, Wisconsin's SHWEC technical assistance program. LSBP agencies will use these programs to work with trade associations and individual facilities in the Basin to identify opportunities to reduce use, generation, storage, and release of Hg and PCBs and other persistent toxic substances (e.g. toxic reduction plans, voluntary audits).

<u>Control and Regulation</u>

There are significant differences in the regulatory regimes of the U.S. and Canada. Generally regulatory measures are not specific to the Lake Superior Basin. Many regulatory measures that could be used by state, provincial, or federal governments to reduce pollutant loads to Lake Superior would apply across the jurisdiction enacting them. Many regulatory actions, particularly those addressing air emissions are addressed in section 2.3, Out of Basin strategies. Actions involving clean up of contaminated sites are addressed in Chapter 3.

Binational Action:

- (130) U.S. LSBP agencies will coordinate LaMP critical pollutant reduction strategies with Total Maximum Daily Load Reductions or limits under Ontario's Certificate of Approval process. (MN, ON)

U.S. Actions:

- (131) U.S. LSBP agencies will pursue bans on non-essential uses of the nine persistent, bioaccumulative, toxic substances targeted for zero discharge (e.g. light switches in running shoes). (MN, MI)
- (132) For toxic pollutants with effluent limitations that are below reliable levels of analytical detection (e.g. nine zero discharge pollutants), U.S. LSBP agencies will require toxic reduction plans in each new or reissued NPDES permit for point sources discharges to the basin. U.S. LSBP agencies will require toxic reduction plans in new or reissued air permits for facilities that could reasonably be expected to emit any of the nine zero discharge pollutants based on knowledge of the process. (MI)
- (133) The states and U.S. EPA should 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. Also, lower emission rates should be used to define major source applicability for MACT standards. (MI, MN)
- (134) States and U.S. EPA will include pollution prevention components in enforcement settlements as appropriate. (MI)

Future possibilities:

- (135) Require new industrial facilities to demonstrate they will not release dioxin, HCB or OCS.
- (136) Acknowledge early voluntary reductions by Lake Superior Basin facilities during development of statewide and nationwide reduction programs.
- (137) Encourage local units of governments to pass ordinances banning burn barrels.
- (138) The State of Minnesota will evaluate its burn barrel law and revise if necessary.

<u>Special Designation</u>

The 1991 agreement establishing the Lake Superior Binational Program included the following three actions in the U.S. action plan.

1. Initiate appropriate state procedures to designate all waters of the Lake Superior Basin as Outstanding International Resource Waters.
2. Initiate appropriate state procedures to designate certain areas of the Lake Superior Basin as Outstanding National Resource Waters.

3. Evaluate the possibility of pursuing and/or supporting other special designations of areas in the Lake Superior Basin.

The first action item has been completed by the states of Michigan and Minnesota, which have adopted an Outstanding International Resource Water (OIRW) designation for Lake Superior. The effect of this designation is to prohibit new or increased water discharges of the nine zero discharge pollutants unless best technology in process and treatment is employed. In 1996, Wisconsin initiated rulemaking procedures for the OIRW designation and invited public comment on other possible designations, including an Outstanding National Resource Water (ONRW) designation that would prohibit discharge of an expanded list of pollutants to Lake Superior. Due to polarized public opinion, special designation rulemaking in Wisconsin was suspended in 1997. Currently the special designation issue is being explored in Wisconsin by a public advisory group established by WDNR.

The second action item from the 1991 Binational Program is an Outstanding National Resource Water (ONRW) designation with the purpose of prohibiting new or increased point source discharges of the nine target chemicals in certain areas such as national and state parks and refuges. The ONRW designation for certain areas within the Basin has not been pursued, however designations with equivalent results have been implemented. In 1984, Minnesota adopted a special designation which prohibits new or expanded discharges in certain waters in the Basin. A portion of the Lake Superior shoreline was included in this designation in 1998 as part of an agreement with the Grand Portage Band of Lake Superior Chippewa. In 1989, Wisconsin designated certain tributaries to Lake Superior such that discharges would not be allowed to lower background water quality. Michigan adopted an Outstanding State Resource Water (OSRW) designation in 1997. The OSRW designation prohibits the lowering of water quality in certain waters of the basin.

The following actions are carried forward from the 1991 Binational Program Agreement into the LaMP Stage 3.

U.S. Actions

- (139) Minnesota will consider the applicability of the ONRW designation in future reviews of water quality rules. (MN)
- (140) Tribes may consider special designations in the future.

Canadian Actions:

- (141) Canada and Ontario will evaluate the possibility of pursuing a special designation for the waters of Lakes Superior and Nipigon. (EC, ON)
- (142) Ontario will provide special designations, including protected areas, under the Ontario Living Legacy Program for a significant portion of the Canadian Lake Superior shoreline. (ON)
- (143) Canada and Ontario agree to undertake the necessary requirements to establish a National Marine Conservation Area in the Lake Superior Basin. (EC, ON)

Future possibilities:

- (144) Evaluate the possibility of pursuing and /or supporting other special designations (regulatory or non-regulatory) in the Lake Superior Basin in the future

2.3.10 Communities and Households

Actions by individuals influence release of the nine critical chemicals to the environment. For instance, many products found in households and used throughout communities contain mercury. Because of the many potential sources, education and outreach to individuals is an important activity for the zero discharge demonstration program. Community and household pollution prevention may address most of the nine zero discharge chemicals. However, mercury is a prime chemical of concern. Because communities and local units of government have responsibilities for the management of wastewater and solid waste, they are an important audience for pollution prevention education and technical assistance.

Communities also have been effective leaders and mentors in pollution prevention. Since 1990, several communities in the Lake Superior Basin have undertaken community-based toxic reduction projects. In the U.S., federal funding was provided to the Western Lake Superior Sanitary District (WLSSD) to develop a document titled “Blueprint for Zero Discharge”, which is a guide for wastewater treatment plants in conducting pollution prevention to reduce discharge of the zero discharge chemicals. The WLSSD has been able to lower its mercury discharge significantly, as a result of pollution prevention they have conducted in their community. The WLSSD has served as a mentor for other communities in the Basin. The Wisconsin Mercury Sourcebook is another guide that was developed to help communities implement source reduction. Marquette, Michigan and Superior, Wisconsin both have active community-based toxic reduction committees with a strong focus on outreach and education. In all of these efforts, staff at the municipal wastewater treatment plants have been key to the effort's success. In many respects, communities can be much more effective than government agencies with pollution prevention and outreach to households, business, and industry.

In Canada, the community group Thunder Bay 2002 with the support of the provincial government has established a button battery recycling program in Thunder Bay and Sault Ste. Marie. Button batteries are found in watches and other small electronic equipment. Each battery can contain as much as 2.5 grams of mercury. The initiative demonstrated that significant quantities of mercury can be removed from the waste stream by using colorful collection depots placed on the counters of major retailers. The button battery recovery project has also been a very effective means of raising public awareness around Lake Superior about the problem of mercury contamination.

Solid waste management is also another area where actions by households and communities influence release of the zero discharge chemicals. (see Section 2.1.10, Solid Waste Management).

Quantifying the amount of pollutants reduced through implementing a community toxics reduction program is expensive. In the case of the WLSSD Blueprint for Zero Discharge project, a substantial budget provided for detailed mercury sampling in the collection system. This enabled documentation of the reduced mercury discharge as a result of implementing the p2 program. Similar documentation in all communities implementing toxic reduction activities would not be cost effective. A measure of progress could be the number of communities participating in similar "zero discharge" toxic reduction programs.

Binational Actions:

- (145) LSBP agencies will work with communities to provide sector-specific pollution prevention outreach such as workshops for the medical and dental communities, and other important sectors. (EC, EPA, MI)

U.S. Actions:

- (146) U.S. LSBP agencies will pursue funding for community and regional toxic reduction activities and networking between Lake Superior communities. In particular, the toxic reduction committees working in Marquette, Michigan and Superior, Wisconsin, and through the Western Lake Superior Sanitary District (WLSSD) in Duluth, MN, should be supported. Innovative and alternative funding should also be pursued for these and expanded efforts in communities throughout the Lake Superior Basin. (WI)

Canadian Actions:

- (147) Canadian LSBP agencies will support initiatives to reduce reliance on petroleum hydrocarbons for energy production or space heating purposes at First Nations. (EC)
- (148) Canadian LSBP agencies will support First Nations with contaminated site assessments and remediation, primarily with petroleum hydrocarbon contamination. (EC)
- (149) Canadian LSBP agencies will support alternative municipal waste management practices. (EC)

Future possibilities:

- (150) Promote use of existing permanent household hazardous waste depots.
- (151) Encourage municipalities to enforce sewer use by-laws to discourage illegal release of toxic substances into the sewer system. At the same time conduct education programs for householders and small businesses for alternative disposal or pretreatment of wastes.
- (152) Encourage retailers in Thunder Bay and Sault Ste. Marie, Ontario (Radio Shack, Wal-Mart, and Japan Camera) to form a partnership with environmental organizations (Thunder Bay 2002 and Clean North of Sault Ste. Marie), the Great Lakes renewal Foundation and other community partners to recycle button batteries.
- (153) Encourage Thunder Bay 2002, Clean North of Sault Ste. Marie, and the Great Lakes Renewal Foundation to form a partnership to retrieve and recycle the mercury in fluorescent lamps and thermostats from households, industries, and institutions.
- (154) Pursue funding for a public awareness campaign in support of the community toxic reduction activities. The P2 awareness campaign should focus on preventing pollution in the home, conserving energy, using alternative products, encouraging use of clean sweep collections and other proper disposal of household hazardous wastes. Elements of the campaign could include a brochure for owners of old homes on how to dispose of banned and outdated products, and a "Get rid of it" brochure for the "nasty nine" chemicals. Consumer groups will be sought as partners in this strategy.

- (155) Establish a recognition program for all wastewater treatment plants that implement the Blueprint for Zero Discharge.
- (156) Work with municipalities to improve pretreatment programs to detect and help eliminate trace sources of mercury, PCBs, and pesticides discharging into sewage systems.
- (157) Provide technical and financial assistance to municipalities and schools to remove and properly dispose of equipment, materials, and wastes containing mercury and PCBs.
- (158) Fund a sewer cleaning demonstration project to remove historic deposits of mercury and pesticides.
- (159) Support a PVC awareness campaign with the purpose of reducing PVC consumption in the Basin.

Also see Sections 2.2.10 Solid Waste Management and 2.2.8 Collections

2.4 Out Of Basin Strategies

2.4.1 Introduction

Via the St. Marys River at Sault Ste. Marie, the Lake Superior Basin drains into the other Great Lakes and the St. Lawrence River. The Lake Superior Basin is also connected to the rest of the world through the import and export of products and the emissions it generates and receives. While the focus of the Lake Superior Binational Program remains on protecting and restoring the Basin, some action is needed outside the Basin in order to protect it. While the primary responsibility for out-of-basin reductions will depend on actions taken by the federal governments, in some cases, state governments are willing to recommend particular actions and assist the US federal agencies in their implementation. The following activities are recommended as out of Basin reduction strategies.

2.4.2 Atmospheric Deposition

The primary route by which the nine designated chemicals enter the Lake Superior Basin is from atmospheric deposition. Mercury, dioxins and furans, PCBs, pesticides and other chemicals are released into the atmosphere from sources both within and outside the Basin. The Zero Discharge Demonstration Project will continue to focus on sources within the Basin. However, the following broader efforts are important for meeting the Lake Superior goals.

Binational Actions:

- (160) The Great Lakes Binational Toxics Strategy should be pursued to meet the short-term, interim goals (e.g., 50% reduction in mercury deposited from US sources by 2006). (EPA, MI, MN, EC)
- (161) The federal governments should ensure the protection of Lake Superior during negotiations and implementation of international agreements and protocols (e.g., ECE, UN POPs, NARAPs, NAFTA).

U.S. Actions:

- (162) The U.S. federal government should evaluate lowering the nationwide limits on sewage sludge and medical waste incinerators, especially for mercury. (MN)
- (163) The U.S. EPA should close the RCRA Subtitle C loop that allows the incineration of mercury bearing hazardous waste. (MN)

Future Possibilities:

- (164) The U.S. LSBP agencies support acknowledging credit for beyond-compliance reductions for facilities that have achieved reductions of the nine designated chemicals. The purpose of these credits is to avoid penalizing facilities that have already achieved reductions before nationwide reduction programs are established.
- (165) The LSBP agencies support the U.S. EPA and STAPPA – ALAPCO (State and Territorial Air Pollution Program Administrators - Association of Local Air Pollution Control Officials) in developing a nationwide program to reduce and eventually eliminate backyard burning.
- (166) Consider dioxin releases from the transportation sector.
- (49) Encourage a nationwide ban on small incinerators.

2.4.3 Manufacturing

The Lake Superior Basin is not self-sufficient and its residents must purchase products manufactured outside the Basin. Products that contain or generate any of the nine designated chemicals are of concern because the manufacturing of these products may release these contaminants into the air. The product itself may contain these chemicals when it is brought into or disposed of in the Basin. While the Zero Discharge Demonstration Project will continue to focus on sources within the Basin, the following broader actions would support the Lake Superior goals.

Binational Action:

- (168) LSBP agencies will support federal initiatives to lower the reporting limits on persistent, bioaccumulative toxic chemicals under the TRI (US) and the NPRI (Canadian) and lower the reporting limit for PCBs under TSCA (US) even further in order to track low level waste. (EC, EPA, MN)

U.S. Actions:

- (169) Foster nationwide product stewardship and reverse distribution systems with manufacturers. (MN)
- (170) U.S. LSBP agencies will encourage a nationwide dialogue on the import of mercury bearing products. Nationwide labeling of mercury products will also be encouraged. (EPA, MN, MI)
- (171) Support federal and state initiatives to provide incentives to the utility industry to develop mercury control technology and to invest in alternative energy sources. (MN)
- (172) The U.S. federal government should tighten the reporting requirements on export shipments of pesticides, especially pesticides that are no longer used in the United States. (MN)
- (173) The U.S. federal government should consider a plan to permanently retire its mercury stockpile and to retire other sources of elemental mercury instead of recycling. (EPA, MN)

Future possibilities:

- (174) Follow the example of the Canadian government by accelerating the decommissioning of the remaining US mercury cell chlor alkali plants.
- (175) Increase dialogue with industries and manufacturers who import mercury-bearing products or products contaminated by dioxin or HCB.
- (49) Encourage a nationwide ban on small incinerators.

Chapter 3: Contaminated Sites Strategies

3.1 Introduction

Although Lake Superior is the most pristine of the Great Lakes, the Lake Superior Basin has a history of resource extraction and heavy industry. The legacy of the region's industrial history remains in areas of contaminated soils and sediments. Although the extent and magnitude of sediment contamination in Lake Superior is much less than in the other Great Lakes, Lake Superior has eight Areas of Concern (AOC) where Remedial Action Plans are underway. There are also other localized areas of contaminated sediment and soils. Decisions concerning evaluation and management of contaminated sites or sediments usually occur at a local, state, or provincial levels. However, the LaMP can serve to integrate these activities toward common lake-wide goals where appropriate. Table 3.1 lists and describes several contaminated sites in the Lake Superior basin. The table focuses on areas of contaminated sediment in the basin and lists some upland sites where the nine zero discharge pollutants have been detected or are suspected.

3.2 Overview of Lake Superior Basin Contamination

Several of the nine zero discharge pollutants have been detected in sediments from the Lake Superior AOCs. Mercury is a contaminant of concern in the St. Louis River (Duluth-Superior Harbor) AOC; Thunder Bay, Jackfish Bay, and Peninsula Harbor in Canada; St. Marys River (Michigan-Ontario), and Deer Lake in Michigan. Mercury contamination in the sediment in these areas is due in part to historical discharges of mercury used as a fungicide or slimicide in industrial applications, use of mercury reagents, and discharge by chlor-alkali plants. In general, mercury contamination is also a result of the varied ubiquitous activities that have made mercury globally distributed in the environment. Dioxins, furans, and PCBs are also among the sediment contaminants found in several Lake Superior AOCs. The extent to which contaminated sediments serve as a source for zero discharge pollutants entering the food chain in the Lake Superior ecosystem has not been determined. Loading of sediment-derived contaminants into Lake Superior from the Duluth-Superior Harbor was examined by the Minnesota Pollution Control Agency (MPCA, 1999). Although the study was based on a small number of samples, the results generally indicate a net flux of dieldrin, DDT metabolites, PCBs and PAHs into Lake Superior. Similar types of loading studies at other Lake Superior AOCs could provide important information to assess the importance of contaminated sediments in harbors and bays to the contaminant picture of the Lake as a whole.

3.3 Objectives

Restoration of impaired uses is the goal outlined in the Great Lakes Water Quality Agreement to guide development of RAPs and LaMPs. For the Lake Superior LaMP, the zero discharge demonstration program for nine target pollutants adds an additional goal. Zero discharge is the management goal for the nine target pollutants. The Stage 2 LaMP reduction targets apply to this goal. Virtual elimination from the environment is the "environmental goal" stated in the Stage 2 LaMP for these pollutants. Like zero discharge of sources, virtual elimination from the environment is a conceptual goal.

Although Remedial Action Plans address contaminated sediment cleanup on a local scale, the Lake Superior LaMP puts forward a more aggressive lake-wide goal for sediment contaminated with zero discharge pollutants. In practical terms, the virtual elimination goal for Lake Superior should serve two main purposes. It brings contaminated sediment issues into the scope of the LaMP. It also means that management decisions regarding contaminated sites and sediments should take into account how the site impacts the overall Lake Superior ecosystem rather than taking a purely local view.

Dioxin is one of the nine zero discharge / virtual elimination pollutants that is found at sites contaminated with pentachlorophenol. Pentachlorophenol contaminated soils and sediment were estimated as a Lake Superior Basin dioxin source in the Stage 2 LaMP. Pentachlorophenol has 2,3,7,8-TCDD as a potential contaminant, particularly in pre-1971 formulations. The Stage 2 LaMP included estimates of potential dioxin in soils based on pentachlorophenol data from two sites in the Basin: Northern Wood Preservers in Thunder Bay, ON and Crawford Creek / Koppers Co. site in Superior, WI. Three other wood preserving sites in Michigan, which have pentachlorophenol contamination, are listed in the Stage 1 LaMP update (1995). Again, the virtual elimination goal for Lake Superior should serve to expand the scope of clean up decisions for any of these sites, beyond local impacts.

3.4 Strategies

The nine zero discharge pollutants are the primary focus of this Stage 3 LaMP. However, other critical pollutants are responsible for sediment contamination in many AOCs and other contaminated sites in the Lake Superior Basin. These chemical groupings are found in the Stage 2 LaMP. Many of the lake-wide remediation chemicals were listed as critical pollutants for Lake Superior because they contaminate sediments at several sites in the Lake Superior Basin. PAHs are a particular case in point. This group of organic chemicals is found at levels that degrade habitat in several nearshore sediment "hot spots" around the Basin. The environmental goal for lake-wide remediation pollutants is to remove impairments and restore beneficial uses. In practical terms, the LaMP serves to highlight the cumulative impacts of lake-wide remediation pollutants such as PAHs in the Lake Superior Basin

Local remediation pollutants (listed in the Stage 2 LaMP) are the other group of critical pollutants responsible for sediment contamination in the Lake Superior Basin. This group consists of primarily metals that are responsible for localized sediment contamination, addressed through Remedial Action Plans. The role of the LaMP is more limited for this group of pollutants.

General measures of progress regarding contaminated sites include: determining the amount of contaminant removed from the environment through sediment or site remediation; and, assessing the number of contaminated areas undergoing characterization monitoring.

Actions:

- (176) LSBP agencies will initiate necessary sediment remediation measures at AOCs and other sites known to contribute persistent bioaccumulative toxic substances to the Lake Superior ecosystem. (EC, MN, ON, WI)
- (115) LSBP agencies pursue clean up of mercury contaminated sediments in Peninsula Harbour through a partnership among public and private sector organizations. (EC, ON)

Future possibilities:

- (177) LSBP agencies consider cumulative impacts on the Lake Superior Basin when making clean up decisions about sites or sediments contaminated with zero discharge or lake-wide remediation pollutants.
- (178) LSBP agencies support coordination among Lake Superior RAP committees and other local remediation and monitoring efforts to share information and work toward lake-wide goals.
- (179) LSBP agencies develop sediment quality criteria and guidance for use in identifying contaminated sediments.

Table 3.1 Contaminated Sites in the Lake Superior Basin

Location / Description	Sources	Pollutants	Status
St. Louis River AOC (MN-WI) 13,000 acre estuary and upstream areas in watershed. Sediment contamination in hot spots. Some diffuse contamination	Historical discharges: steel mill, coal gasification, wood preserving, coal and oil shipment, oil refining, shipbuilding, pulp and paper, tar and chemical, POTWs.	Mercury, PAHs, diesel range organics, PCBs, metals, dioxins/furans	Sediment characterization studies of AOC in 1992-1996. Status of hotspots varies.
USX Site (Superfund)	Steel mill operated until 1979	1993 sampling of St. Louis River sediments adjacent to site found PAHs, Mercury, Arsenic, Lead, other Metals, PCBs, Dioxin	Cleanup on land. No sediment clean- up to date.
Interlake / Duluth Tar Site (Superfund)	Coking, tar and chemical plant historical discharges	PAHs, Mercury, other metals in bay sediments	Cleanup on land. Sediment cleanup options under consideration.
Minnesota slip	Boat slip in lower harbor	PAHs, PCBs, Mercury, other Metals, pesticides	Further characterization recommended in 1994 sediment study.
Howards Bay	Shipyard and other possible waterfront activities	Lead, Arsenic, Mercury other metals, PCBs, PAHs, pesticides	On-land cleanup complete. Enforcement action continues.
Newton Creek / Hog Island Inlet	Murphy Oil refinery historical discharge	Diesel range organics, oil and grease, PAHs, lead, chromium, mercury	Murphy Oil refinery 1997 cleanup of 1.4 acres/1600 cubic yards in upstream impoundment. About 18,000 cubic yards contaminated sediment remains downstream.
Crawford Creek wetland	Wood preserving historical discharge	PAHs, penta-chlorophenol, creosote in soils and sediment in wetland	RCRA Corrective action – characterization studies continue.
WLSSD / Coffee Creek and Miller Creek embayment	Historical and current POTW, urban stormwater	Mercury, PCBs, PAHs, pesticides, heavy metals, dioxins detected in embayment sediments.	Source control. No sediment action under consideration currently.
Wisconsin Point landfill	Former municipal and industrial dump in wetland on L. Superior	Volatile and Semi-volatile Organic Compounds in old landfill.	Clay capped with monitoring wells. Possible net loading to L. Superior.

Location / Description	Sources	Pollutants	Status
DM&IR, Proctor (MN) Upland site in St. Louis River AOC	Railyard since 1880s. Landfills, landfarms, repair and fueling facilities.	PCBs, other contaminants.	Activity under RCRA. PCBs up to 50 mg/kg were landspread as part of an old remedy agreement with MPCA.
Kotula Iron and Metal Near Hibbing, MN. Upland site in St. Louis River watershed.	Scrapyard, transformers.	PCBs, metals, semi-volatile organic compounds, PCE	Characterization studies for Superfund.
Ashland waterfront site Ashland, WI: 10 acre contaminated sediment area in Chequamegon Bay, upland and groundwater contamination.	Historical coal gasification plant	PAHs in bay sediments	Cleanup options under consideration.
Torch Lake AOC (MI) (Superfund site) Includes Keweenaw waterway, Torch Lake, and various upland sites.	200 million tons copper ore tailings deposited 1860s-1960s	Copper, Arsenic, Lead, Chromium, other metals	Superfund Record of Decision calls for capping and re-vegetation of above-water contaminated areas to stop continued erosion of contaminants into waterways.
Hubbell “hotspot” on western shore of Torch Lake	Smelter site and bulk coal handling	Copper, PAHs	Part of Superfund site
Deer Lake AOC (MI) 906 acre impoundment of Carp River	Historic mine lab discharge of Hg reagents to WWTP	Mercury	Source addressed in 1981.
MI wood preserving sites Sites of 3 wood preserving plants in watershed: Wakefield, Munising, Newberry		Penta-chlorophenol	*Listed in Stage 1 LaMP update.*
St. Marys River AOC (ON-MI)	Steel mill, paper mill, historic discharge from tannery, WWTPs	Mercury, Heavy metals, PAHs, oil-grease, PCBs	Status of contaminated sites varies. Source control improvements in 1990s.
Algoma slip	Steel mill- coking	PAHs	20,000 cubic yards contaminated sediment removed
Cannelton Industries (Superfund site)	Historical tannery	Chromium	Remediation work completed summer 1999. Site monitoring will be carried out on an ongoing basis.
Peninsula Harbor AOC (ON)	Pulp mill and chlor-alkali plant historic discharge.	Mercury, PCBs, oil-grease, heavy metals	Pulp mill waste treatment upgrade to full secondary treatment. RAP/PAC recommends removal and confinement of highest mercury contaminated sediments, natural recovery for lesser contaminated areas.

Location / Description	Sources	Pollutants	Status
Jackfish Bay AOC (ON) Includes 14 km of Blackbird Creek from mill discharge to Jackfish Bay.	Pulp / paper mill discharge	Resin, fatty acids, tetrachloro-dibenzofurans, PCBs, HCB, phenolic compounds, Cadmium, Zinc	Full secondary treatment of all effluent installed-mill has capability to operate at 100% chlorine dioxide bleaching, decreasing AOX discharge.
Moberly Bay (Lake Superior)	Receiver for mill effluent	Same as above	Secondary treatment has resulted in improvements in sediment and biota in the bay- natural recovery is proposed by the RAP Stage 2.
Nipigon Bay AOC (ON) Localized areas of sediment contaminants in bay/AOC	Pulp-paper mill and municipal WWTPs	Metals	Secondary treatment has been installed at the mill. No sediment remediation is planned.
Thunder Bay AOC (ON)	Forest products industry (pulp-paper and wood preserving) historic discharge from chlor-alkali plant, municipal WWTP	Metals including Hg, persistent chlorinated organics, PCBs, PAHs, pentachlorophenol	The City of Thunder Bay has committed to completing a secondary sewage treatment facility by 2002.
Inner Harbor	Northern Wood Preservers, historical chlor-alkali plant discharge	Mercury, Penta-chlorophenol, creosote, PAHs, dioxins, furans	Chlor-alkali plant shut down 1968. Northern Wood Preservers sediment remediation and site contaminant project began 1997. Work is still underway.
Lower Kaministiqua River	Pulp and paper mills	Persistent chlorinated organics, metals	Secondary treatment of all mill discharges. River sediments have been dredged and placed in confined dredge spoils site.

Notes:

AOC = Great Lakes Area of Concern for Remedial Action Plans

AOX = Adsorbable Organic Halides

PAHs = Polycyclic Aromatic Hydrocarbons – a class of organic compounds. PAHs are Lakewide Remediation Critical Pollutants for Lake Superior.

POTW = Publicly Owned Treatment Works (wastewater treatment)

RAP = Remedial Action Plan for Great Lakes Areas of Concern

RCRA = Resource Conservation and Recovery Act (U.S.)

WLSSD = Western Lake Sanitary District in Duluth, MN

WWTP = Wastewater Treatment Plant

Chapter 4: Monitoring Strategies

4.1 Introduction

This Stage 3 LaMP proposes the strategies and actions that LSBP agencies, businesses, and citizens would be required to take in order to reduce and eventually eliminate the load of critical pollutants to Lake Superior. Measures for assessing progress in implementing the reduction strategies and actions are described in Chapters 2 and 3. In addition to implementing these actions, however, pollutant sources and ambient pollutant levels in Lake Superior should also be monitored to assess progress in achieving the goals of the LaMP.

This section provides a menu of possible monitoring activities that could be pursued to evaluate progress toward Lake Superior goals. These ideas are taken from the Chemical Contaminants Chapter (LSBP 1998) of the "Ecosystems Principles and Objectives, Indicators, and Targets for Lake Superior" discussion paper (LSBP 1995). More work is needed to develop a coordinated monitoring program that will enable the LSBP agencies to evaluate progress toward the Lake Superior goals. This effort should include source monitoring to determine and track releases of toxic pollutants as well as environmental monitoring for the Lake Superior ecosystem. Both types of monitoring activities are offered for comment here.

4.2 Goals

The purpose of monitoring is to document progress toward the following:

- The virtual elimination of inputs of the designated nine pollutants,
- The virtual elimination of the designated nine pollutants from Lake Superior Basin ecosystems, and
- The elimination of critical pollutant based impairments to the beneficial uses of environmental resources.

Monitoring, with regard to chemicals, is divided into source monitoring and environmental monitoring. Each is discussed below.

4.2.1 Source Monitoring

Source monitoring includes the measurement of the amount of a critical pollutant being released into the environment from an anthropogenic source, documenting the human activities that contribute to the release of critical pollutants, and documenting the locations and amounts of the critical pollutants within the Basin. Source monitoring is the method for documenting the virtual elimination of inputs to the environment of the nine designated pollutants.

4.2.2 Environmental Monitoring

Environmental monitoring is the analytical quantification of contaminant concentrations in various biotic and abiotic entities in the environment. These measured concentrations can be used to determine contaminant trends over time. This monitoring activity is designed to document the virtual elimination of the nine designated pollutants from Lake Superior Basin ecosystems.

Environmental monitoring also includes relating the measured concentrations of toxins in the biota to toxicological effects such as reduced reproduction or growth. Relating chemical body burdens to toxic effects is one way to evaluate impaired beneficial uses listed in the GLWQA (for example, bird and animal deformities or reproduction problems; degradation of fish and wildlife populations; and degradation of phytoplankton and zooplankton populations). This paradigm, in environmental toxicology, of relating contaminant body burdens to toxic effects is relatively new and therefore may currently lack the level of resolution necessary for evaluating some impaired beneficial uses. However, this approach has promise and should be pursued in conjunction with environmental contaminant monitoring.

4.3 Strategies

4.3.1 Source Monitoring

Options for source monitoring programs include the following:

- (M1) Concentrations and loads in discharges to water from permitted facilities
- (M2) Concentrations and loads in emissions to air from permitted facilities
- (M3) Continued atmospheric emission estimates for the program using the RAPIDS system
- (M4) Concentrations and loads in biosolids (sludge) from permitted facilities

- (M5) Quantity of mercury-bearing products such as thermometers, switches, thermostats, paint, and batteries purchased in the Basin
- (M6) Quantity of mercury recovered in sweeps, including household hazardous waste, commercial hazardous waste, and sweeps done within a facility
- (M7) Quantity of mercury used and disposed of by medical and dental facilities
- (M8) Use of mercury- or dioxin-contaminated feedstock chemicals
- (M9) Production of electricity
- (M10) Quantity of PCB-bearing equipment phased out in the Basin
- (M11) Mass of PCBs, HCB, mercury, and dioxin included in sediment remediation projects
- (M12) Quantity of chlordane, DDT, dieldrin, HCB, mercury, toxaphene, and dioxin- contaminated pesticides gathered in agricultural waste pesticide collections in the Basin
- (M13) Quantity of chlordane, DDT, dieldrin, HCB, mercury, toxaphene, and dioxin-contaminated pesticides gathered in household hazardous waste collections
- (M14) Combustion of different fuels (for example, wood, coal, gas, railroad ties, or tires) for energy and the amounts of dioxin and mercury released
- (M15) Mining production and the amount of mercury, dioxin, and HCB released through refining processes
- (M16) Amount of solid waste burned in residential or small business incinerators or backyard burn barrels and the amounts of dioxin, HCB, and mercury released
- (M17) Amount of solid waste and medical waste incinerated in the Basin and the amounts of dioxin, HCB, OCS, and mercury released
- (M18) "Use trees" for the prevention/investigate chemicals based on the literature search on analytical methods and media, the chemicals will be integrated into the monitoring schedule
- (M19) Inventory of all PCBs in use and storage in the Lake Superior Basin
- (M20) Survey of Very Small-Quantity Generators (VSQG) designed to identify critical pollutants in use or storage
- (M21) Look for opportunities to develop common sample collection methodologies and data reporting formats
- (M22) Look for opportunities to develop common databases for data storage and retrieval
- (M23) Develop a web site to report monitoring data to the public; include an e-mail address to allow individuals to report possible sources of pollutants, and then post the messages on the web site
- (M24) Sample sewer mains outside dental clinics with cooperation of the city public works
- (M25) Review hospital purchasing policies and replace mercury-bearing equipment with alternatives
- (M26) Remaining PCBs stored in hospitals to be removed and sent for destruction
- (M27) Review hospital purchases and conduct site inspections
- (M28) "Encourage" Ontario pulp and paper mills to continue self-monitoring
- (M29) Continue STAC program inventory of worst emitters
- (M30) Model for the aggregate impact of pulp and paper mills
- (M31) Amend Ontario MISA monitoring program to include mercury, HCB, and OCS
- (M32) Continue Environmental Effects Monitoring Program (impacts on organisms and biodiversity of receiving waters) as required under federal pulp and paper regulations and continue to monitor the cleanup of the Northern Wood Preservers site using in situ and bioassay results

4.3.2 Environmental Monitoring

- (M33) Water concentrations of zero discharge chemicals and lake-wide remediation chemicals should be monitored in the offshore waters of Lake Superior and compared to appropriate yardsticks. Samples should be collected at 2-year intervals as described in the Chemical Contaminants Chapter of the EPO (1998).
- (M34) Contaminant concentrations in key fish species will be monitored and compared to "yardsticks." Predetermined sizes of fish will be collected every 5 years. Fish contaminant monitoring objectives and methods should be coordinated with other SWG "theme teams".
- (M35) Sediment concentrations of zero discharge and lake-wide remediation chemicals should be compared to standards and yardsticks. Sediment concentrations of local remediation chemicals in AOCs would be compared to appropriate standards or guidelines used by the jurisdiction. Sediment

cores would be collected at 10-year intervals as described in the Chemical Contaminants of the EPO (1998).

- (M36) Concentrations of the designated chemicals will be monitored annually in air and precipitation and at 2-year intervals in water. Four to five air monitors should be installed around the Basin to measure air-deposited chemicals.
- (M37) At 10-year intervals, sediment cores will be taken in depositional offshore zones, sectioned, dated, and analyzed for designated chemicals.
- (M38) Monitor critical pollutants (see Table 2-1 of the Stage 2 LaMP) in a range of organisms that are found in terrestrial, terrestrial/aquatic interface, and aquatic habitats within the Lake Superior Basin for the purpose of establishing baseline concentrations, determining chemical trends both temporally and spatially, and evaluating potential toxic effects to organisms by comparing chemical body residues in field organisms to chemical body residues in laboratory organisms that have been correlated to toxic effects.
- (M39) Total load would be calculated using estimates of wet deposition, dry deposition, and gas exchange collected annually as described in the Chemical Contaminants of the EPO (LSBP 1998).
- (M40) Change in the rate of loading and whether the rate of loading is from the atmosphere to the lake or from the lake to the atmosphere.
- (M41) Look for opportunities to develop common sample collection methodologies and data reporting formats.
- (M42) Look for opportunities to develop common databases for data storage and retrieval.
- (M43) In Canada, a cohesive federal provincial air monitoring program would need to be in place to track load reductions from air emissions.

Chapter 5:
The Next Milestones

5.1 Introduction

Although the load reduction schedules extend to the year 2020, a number of interim steps should be, and have been, taken to reduce critical pollutants in the Basin. Because of the iterative nature of the LaMP process, additional updates are required. Monitoring must be conducted in order to evaluate progress. In addition, reduction strategies will change over time because new sources may be discovered and new technologies and alternatives will emerge. This section discusses the next milestones, including planning activities and the next reduction schedule milestones coming up in 2005 and 2010.

5.2 Planning Activities

The focus of efforts over the next two to three years will be on the implementation actions described in this document. However, the Lake Superior LaMP process is iterative and resources will be allocated to the development and implementation of new actions as appropriate until the goals have been achieved. Additional planning activities will be ongoing, and the results will be presented biennially. In addition, progress toward achieving the load reduction milestones will be monitored and reported.

Actions will include the following:

- Biennial preparation of LaMP updates that will (1) identify trends based on monitoring information, (2) detail actions completed; (3) outline commitments for new actions; and (4) document progress toward achieving goals of zero discharge and emission of certain persistent, bioaccumulative or toxic pollutants
- Additional analyses of source categories and prioritization of future load reduction actions
- Preparation and distribution of progress reports for special events such as the State of the Lakes Ecosystem Conference and International Joint Commission biennial meetings
- Preparation and distribution of concise “issue papers” to deal with specific topics of interest (for example, layperson summaries of progress reports, LaMP documents, and success stories)
- Coordination with RAPs and other local monitoring and remediation efforts
- Public outreach to describe steps that Basin residents may take to further the goal of zero discharge
- Development of load reduction schedules and reduction strategies for other critical pollutants; remediation of sites already contaminated by these chemicals will be given priority

5.3 Chemical Reduction Schedule

The Stage 2 load reduction schedules include a number of interim milestones after the year 2000. The next milestones are summarized below.

- 80 percent reduction in mercury releases by 2010
- Destruction of sixty percent of the PCBs stored or used in the Basin by 2005
- 80 percent reduction in 2,3,7,8-TCDD, HCB, and OCS by 2005
- Continue to track waste pesticide collections even though the schedule ends at 2000

In order to meet these milestones, additional reductions must occur. Mercury; PCBs; dioxins, HCB, and OCS; and pesticides must be reduced as discussed below. Reduction amounts are based on the 1990 baseline estimates described in this document.

5.3.1 Mercury

5.3.1.1 Current Load/Reduction Goals

The reduction goals for mercury include the following:

- 60 percent reduction by 2000
- 80 percent reduction by 2010
- 100 percent reduction by 2020

The 1999 estimate of 949 kg/yr of on-going mercury releases is a 60.5 percent reduction from the 1990 estimate of 2,405 kg/yr. An additional 468 kg/year (see Table 1.1) must be reduced in order to meet 481 kg/yr, the 2010 80% reduction milestone. Appendix A contains references and a detailed summary of estimated mercury releases for the U.S. and Canadian lake Superior Basins for 1990 and 1999.

5.3.1.2 Sources

Despite a significant reduction of mercury air emissions due to ceased operation of the White Pine Mine copper smelter in Michigan and the Algoma Ore Division iron sintering facility in Ontario, taconite production continues to be a substantial source of mercury emissions in the U.S. Basin. Fuel combustion (for example, energy production) is also a major release source. The mining and fuel combustion sectors have a combined estimated release of 700 kg/yr. These two sectors will need the most effort to achieve mercury reduction in the next 10 years. At present, there are no mercury emission limits and cost-effective technologies are still under development to limit emissions from taconite processing facilities and coal-fired utilities. In fact, the taconite industry is projected to grow in the next 10 years as is per capita consumption of electricity.

A substantial portion of mercury also enters the basin as a component of commercial products. Voluntary bans on mercury-containing paints and fungicides in the early 1990s and reduced mercury content in batteries has resulted in over an 80 percent reduction of mercury from commercial products. In 1992 and 1993, the use of mercury in round cell, alkaline, and zinc carbon batteries was discontinued (NEMA 1999), resulting in a 90 percent reduction in mercury from batteries. Reductions will continue in products, which will decrease the 329 kg/year contribution from potential releases (see Table 1.2) and the 200 kg/year from ongoing releases (see Table 1.2) from municipal, incineration, products and industrial sources. The estimated 329 kg/year to landfills and soils is a source for an additional 49 kilograms of re-emitted mercury, bringing the total ongoing releases from all sources, except mining and fuel combustion, to an estimated 249 kg in 1999.

5.3.1.3 Strategies for Reduction

If all ongoing releases from municipal, incineration, products, and industrial sources were eliminated, the total amount needed to be reduced by the mining and energy production sectors would be about 281 kg/yr. Sections 2.2.5 and 2.2.6 discuss mercury reduction strategies through purchasing policies and product stewardship.

However, it is unlikely that all municipal, incineration, products, and industrial sources will be eliminated by the year 2010. Assuming that half of these sources will be eliminated, the mining and energy production sectors should reduce mercury releases by about 368 kg/year by the year 2010. Sections 2.2.7 and 2.3.7 outline some reduction strategies that apply to energy conservation and production. Section 2.3.5 outlines reduction strategies specific to the mining sector. For mercury reduction, voluntary agreements and mercury emission control technologies offer the greatest potential for reductions. There are four major utilities and seven taconite mines in the Basin to share this responsibility.

Summarized goals for mercury reduction in 2010:

- Reduce the mercury released from municipal, incineration, products, and industrial sources by half between 2000 and 2010, resulting in a reduction of approximately 100 kg/year. For the most part, these sources ultimately originate with the purposeful use of mercury in products or processes. Important reductions from these sources have taken place between 1990 and 1999.
- Reduce mercury from the mining and energy production sectors by 368 kg/year, which is about half of the 1999 estimated emissions.
- The overall goal is a 468 kg/year reduction to meet the 80 percent reduction milestone.

5.3.2 PCBs

5.3.2.1 Current Load/Reduction Loads

The reduction goals for accessible PCBs include the following:

- 33 percent destruction by 2000
- 60 percent destruction by 2005
- 95 percent destruction by 2010
- 100 percent destruction by 2020

Currently, in the U.S. portion of the Lake Superior Basin, approximately 195 PCB transformers and 3353 PCB capacitors remain in use (see Appendix A), primarily owned by large and small utilities and industries. Though there are no PCB disposal facilities in the U.S. portion of the Lake Superior Basin, the opening of a licensed facility in Michigan should continue to result in increased disposal rates.

In the Canadian Lake Superior Basin, approximately 157,977 liters of high-level PCB-contaminated liquid remained in use in 1997; 157,179 liters of PCB-contaminated liquids and 205,807 kg PCB-contaminated solids remained in storage. Between 1990-1997, 276,493 kg PCB-contaminated solids were destroyed and

138,657 liters of PCB-contaminated liquids were destroyed (Brigham 1999) These estimates indicate that the United States and Canada are making progress toward attaining the goal of 60 percent decommissioning and destruction of PCB-contaminated equipment by 2005.

5.3.2.2 Sources

Although PCB production was banned over 20 years ago, PCBs are still found in old commercial, industrial, and electrical equipment. PCBs are also produced incidentally through as many as 200 chemical processes. However, it is estimated that 95 percent of the PCB load to the Lake Superior ecosystem is via air deposition. (EPA 1998a) Volatilization of PCBs from soils and sediments is also a significant contributor to PCBs in the water column and the biota. In the Lake Superior basin, the majority of continuing releases are thought to be from electrical equipment oil spills, while small amounts could be released from fuel combustion, waste oil combustion, biomedical waste incineration, and wastewater treatment plants. Spill rates were estimated for the 1990 baseline reported in the Stage 2 LaMP. Actual spills could be underreported, based on national trends.

PCBs are also found in harbor sediments in some Lake Superior Areas of Concern. Total amounts have not been determined. The amount of PCBs in contaminated soil and landfills is also unknown.

Canadian facilities have made substantial progress in destroying PCB-contaminated equipment and materials throughout the Basin. While the major utilities in the U.S. portion of the Lake Superior Basin have made substantial progress in decommissioning and disposing of their PCB-contaminated transformers and capacitors, small utilities and industries must begin to more aggressively identify and decommission their PCB-contaminated equipment.

5.3.2.3 Strategies for Reduction

Because of the inadequacy of the U.S. PCB data base in the Lake Superior basin, it is not possible to describe a numeric goal for the mass of PCBs that the Lake Superior states should decrease. However, this Stage 3 LaMP identifies a variety of strategies that would both improve the data base and bring about reductions. It is crucial that 1) untested equipment be tested, 2) owners of PCB bearing equipment decommission that equipment and 3) governments assist their efforts to test and decommission. Section 2.2.11 lists PCB strategies that cover these areas. Section 6.3 identifies the PCB strategies that the agencies propose to emphasize in the next two to three years.

In order to meet the 2000 and 2005 PCB reduction goals, Canada will need to destroy a total of 155,834 kg and 283,355 kg, respectively, out of the original 472,255 kg in-use or in-storage in 1990. Sections 2.2, 2.3, 2.4, 3.4 and 4.3 outline possible alternative reduction strategies that apply to PCB-contaminated equipment reductions in all sectors.

5.3.3 Dioxin, HCB and OCS

5.3.3.1 Current Load/Reduction Schedules

The goal for the virtual elimination of all dioxin, HCB, and OCS sources within the Lake Superior Basin includes the following reduction schedule:

Year 2005: 80 percent reduction
Year 2015: 90 percent reduction
Year 2020: 100 percent reduction

The dioxin emission estimates reported in Chapter 1 indicate that the U.S. and Canada have made significant progress in achieving the 2005 and 2015 goals. Although few data are available to assess HCB and OCS emissions, those chemicals are thought to follow the same trend pattern as dioxin. As of 1999, dioxin air emissions have declined by 75 to 95 percent, depending on the level of the 1990 baseline estimate. Although direct measurements of HCB and OCS sources are not available, control of dioxin emissions sources is likely to bring HCB and OCS under a similar level of control.

5.3.3.2 Sources

In 1990, most of the dioxin estimated to be released to the atmosphere (370-2,400 g TEQ/year) was produced by small incinerators used at apartment buildings, nursing homes, schools, grocery stores and other small sources. Since the 1990 base line estimates were completed, virtually all of these small, inefficient incinerators have been phased out, resulting in a very large reduction in dioxin air emissions. In addition, a significant reduction of about 22 g TEQ dioxin/year resulted from the closure of the Algoma iron sintering plant in Wawa, Ontario and the White Pine Mine smelter in Northern Michigan. Closure of all medical waste incinerators in the U.S. portion of the Basin and all but three of the medical waste incinerators in the Canadian portion since 1990 has also resulted in a significant reduction in dioxin emissions.

5.3.3.3 Strategies for Reduction

The significant, remaining sources of dioxin emissions in the Basin include small industrial and other waste incinerators, backyard burning of household waste in burn barrels, and possibly the use of pentachlorophenol wood preservative. Because most large emission sources are now under control, the focus must now be placed on small, disperse sources. As a result, the control strategies applicable to these sources should include public education and outreach coupled with aggressive identification of these sources. Strategies should also include investigation of ongoing pentachlorophenol use and, in the long term, clean up of contaminated sites.

5.3.4 Pesticides

5.3.4.1 Current Load/Reduction Goals

Although pesticides continue to be collected in Minnesota, Wisconsin, Michigan, and Ontario, environmental concentrations have shown general decline in most media over the years (Pesticides Workgroup 1999). Based upon recent water concentration measurements, the quantities of these pesticides remaining in the water column of all five Great Lakes totals about 22,000 kg which is the equivalent of about 1 kg per cubic kilometer of Great Lakes water. Although concentrations of these pesticides have declined in the Great Lakes Basin, current contamination levels remain a concern as reflected by water concentrations that exceed national water quality standards, sediment concentrations the exceed sediment guidelines, and fish consumption advisories based on unacceptable levels of these pesticides in sport and commercial fish (Pesticides Workgroup 1999).

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), hexachlorobenzene, mercury pesticides, hexachlorobenzene pesticides, and 2,4,5-T (Silvex) and other pesticides contaminated by dioxin or hexachlorobenzene in the Basin by the year 2000.

5.3.4.2 Sources

DDT reached peak annual usage of some 80 to 85 million kg in 1962; toxaphene use peaked in 1972 to 1975 at close to 30 million kg per year; chlordane at 12 million kg in 197; and aldrin plus dieldrin at 9 million kg in 1966. All of these chemicals were used as pesticides. All of these pesticides were canceled (production is legal, sale and distribution is illegal in the U.S.) by the 1980s for domestic use in the United States and by the 1990s for domestic use in Canada. All but chlordane have not been in production in the United States for many years. One U.S. manufacturer of chlordane, Velsicol Corporation, ceased production for export of chlordane and heptachlor in 1997 (EPA and Environment Canada 1998b). Targeted pesticides have been detected in harbor sediments in the Duluth-Superior harbor (Schubauer, Beregan, and Crane 1997, Crane et al. 1997) Time trend atmospheric data from the Integrated Atmospheric Deposition Network (IADN) network for dieldrin, DDT and DDE, and three principal components of commercial chlordane project a decline in atmospheric concentrations to the detection limit (0.1 pg/cu meter) from about 2010 for DDT to about 2060 for DDE with dieldrin and chlordane declining between those years (EPA and Environment Canada 1998b).

5.3.4.3 Strategies for Reduction

Although U.S. and Canada domestic production has ceased and uses have been canceled, these pesticides continue to have an environmental presence. In addition, the level of toxaphene in Lake Superior has not shown a general decline over the years like the other pesticides. Collection programs in the Lake Superior basin continue to net these pesticides. Lake Superior strategies for pesticides include continued or expanded collection opportunities coupled with concerted public outreach. Sections 2.2.3, 2.2.4, 2.2.8, 2.2.9, 2.3.9, 2.3.10, 2.4.2, 3.4 and 4.3 discuss the strategies for reduction, contaminated sites and monitoring.

Out-of -basin strategies addressing pesticides would include support by the Great Lakes states and Canada for international efforts such as the Regional Treaty on Persistent Organic Pollutants, the UNEP Global Treaty on Persistent Organic Pollutants, the Commission for Environmental Cooperation Tri-lateral North American Regional Action Plans, and the NAFTA Technical Working Group on Pesticides to implement phased reduction and eventual elimination of the Binational Toxics Strategy Level 1 pesticides in other countries.

Chapter 6: Conclusions

6.1 Introduction

In Chapter 1 of this Stage 3 LaMP for Chemicals, the pollutant reductions, by chemical, that have occurred since the baseline year of 1990 are updated. In Chapters 2 and 3, pollution reduction and prevention strategies utilizing multiple sector, sector specific, out of basin and contaminated site approaches are discussed. In Chapter 4, approaches to source and environmental monitoring are explored. Chapter 5 outlines, by chemical, what additional reductions must occur in order to meet chemical reduction targets and the current technical knowledge of the major sources of each chemical pollutant. This overview provides the current scientific assessment of where, by volume, the most reductions could occur. In Chapter 5, the Lake Superior critical nine chemicals targeted for reduction are organized into four groups, 1. Mercury, 2. PCBs, 3. Pesticides and 4. Dioxin, HCB and OCS. This Chapter 6 conclusion chapter contains draft or proposed commitments for environmental actions which follow the same format.

Accomplishing the pollution prevention and reduction goals that have been established for the Lake Superior critical nine pollutants requires commitment from many entities; tribal, local, state, provincial and federal governments, industry, trade associations and society as a whole, including each individual. This draft document represents the environmental actions and strategies that have been initially selected by the partner agencies involved in the Lake Superior Binational Program to achieve these pollution reductions. It is important to bear in mind that the actions and strategies contained herein have not received complete review by all of the agencies' programs and, in the case of the tribes, all of the tribes or tribal leaders; therefore, some actions could be added, some dropped, or the priority levels altered.

The bulleted actions listed in this chapter of the draft Chemical Stage 3 Lake Superior LaMP are those that have been proposed as commitments by the specified agency or organization and identified by the presence of that organization's acronym following the action (see below). In addition, a priority ranking is designated just behind the organizational acronym to indicate the timeframe this action will be accomplished or initiated within that jurisdiction.

The agency/organization names and acronyms are:

- EC Environment Canada
- EPA United States Environmental Protection Agency-Region 5 (USEPA)
- MI Michigan Department of Environmental Quality (MDEQ)
- MN Minnesota Pollution Control Agency (MPCA)
- ON Ontario Ministry of Environment (OMOE)
- WI Wisconsin Department of Natural Resources (WDNR)
- GL **Placeholder for Tribal**

The priority ranking that appears in this report is numerical and explained as follows:

(1) Commitments - primary 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.

(2) Explore - candidate actions that require additional resources or policy decisions in order to be accomplished or supported.

(3) Future possibilities - actions that merit inclusion in the LaMP for the purposes of planning, reference and/or future funding considerations.

Actions proposed for commitment at the ranking level of (1) or (2) appear in this chapter; any actions selected at the ranking level of (3) appear in the earlier chapters of the report and are denoted as future possibilities. In addition, numbers are provided for each of the commitment actions to cross-reference with the strategies listed in Chapters 2 and 3.

This chapter groups actions by chemical. For example, the actions proposed to reduce mercury are listed together. Many actions would result in reductions of more than one of the targeted pollutants. These are often repeated in each of the chemical sections below. Some general actions, which could apply to all of the targeted pollutants are listed in their own section.

6.2 Chemicals

6.2.1 Mercury

Draft Commitment to Actions will include:

- (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. EC(1), EPA(1), MI(1), MN(1), ON(1), WI(1)
- (4) U.S. LSBP agencies will provide indirect or direct **financial support** to businesses, organizations and local governments for pollution prevention projects. Possible projects include clean sweeps, bounties on mercury products or burn barrels, mercury swaps for alternative products, education, purchasing policies, energy conservation, water conservation, pay-as-you-throw trash disposal fees and others. EPA(1), MI(1), MN(1), WI(1)
- (86) U.S. LSBP agencies will assist the **taconite industry** in finding a **mercury control technology.** MN(1)
- (12) U.S. LSBP agencies will evaluate and begin the development of **purchasing policies** to eliminate use of products that might include **mercury equipment or PCB equipment** (e.g., boilers, buildings, vehicles, electrical equipment and laboratory equipment). Policies will also examine phase-out of existing mercury or PCB containing items. MI(1), MN(2)
- (17) LSBP agencies will work with manufacturers within and outside the Lake Superior basin to develop **depots and reverse distribution systems for citizens**. Possible products to include in this strategy include batteries, paints, fluorescent lamps, thermostats, pressure testing equipment, dental amalgam, laboratory reagents and others. EC(1), EPA(1), MI(2), ON(2)
- (19) Canadian LSBP agencies will assist establishing a through municipalities **depots for mercury containing** thermometers, fluorescent tubes and other **household products** about to be discarded. EC(1), ON (1)
- (3) U.S. LSBP agencies will evaluate a variety of **economic incentives** or disincentives to promote verifiable or innovative reductions. Possible incentives include early reduction credits, tax relief, low-interest loans, grants, rebates and bounties for achievers. Possible disincentives include fees, taxes or caps on mercury bearing products or uncontrolled sources of any of the nine designated chemicals. MI(2)
- (18) U.S. LSBP agencies will encourage a nationwide dialogue on the import of mercury bearing products. Nationwide **labeling of mercury products** will also be encouraged. EPA(2), MN(2), MI(1)
- (21) LSBP agencies will promote **energy conservation programs** (e.g. U.S. Side: EPA Energy Star Program) within the Lake Superior basin, agencies will especially urge the publicly-owned facilities, schools and universities in the Lake Superior basin to participate in energy conservation programs. The agencies will also work with the utilities operating in the basin to coordinate government and utility energy conservation programs. EC(2), EPA(1), MI(1), MN(1), ON(1), WI(1)
- (22) LSBP agencies will encourage home and industry **energy audits**. EC(2), MI(1), ON(1)
- (113) Canadian LSBP agencies will continue energy audits of pulp and paper mills; conduct a study to **identify further actions that would reduce emissions** and result in cost savings. EC(2)
- (23) LSBP agencies will encourage **municipal energy councils** such as the Thunder Bay 2002 and the Duluth Citizen's Energy Council. EC(2), MN(2), ON(1)
- (24) As part of utility deregulation, the state of Minnesota will consider establishment of a **mandatory "line charge"** for demand side management energy efficiency projects. MN(2)
- (106) U.S. LSBP agencies will assist utilities in developing **mercury control technology**. Assistance may or may not take the form of funding. EPA(2), MN(2)
- (103) LSBP agencies will encourage the investigation of **alternative energy** (e.g. low mercury fuels, natural gas, solar, wind) in the Lake Superior basin and encourage residents to purchase energy produced with lower polluting technologies. MN(2), ON(2)
- (169) The U.S. EPA should foster nationwide product stewardship and reverse distribution systems with manufacturers. MN(2)
- (168) LSBP agencies will support federal initiatives to **lower the reporting limits on persistent, bioaccumulative toxics under the TRI (US) and the NPRI (Canadian)** and lower the reporting limit for PCBs under TSCA even further in order to track low level waste. EC(1), EPA(1), MN(2)

- (163) The U.S. EPA should close the **RCRA Subtitle C loop** that allows the incineration of mercury bearing hazardous waste. MN(1)
- (94) LSBP agencies will support and promote implementation of **voluntary agreements with the health care industry** to reduce use of mercury and formation of dioxin. EC (1), EPA(1), MI(1), ON(1), WI(1)
- (91) LSBP agencies will encourage **pollution prevention projects at hospitals**, clinics, and medical, dental, and veterinary offices with an emphasis on removing mercury and making the offices "mercury free." EC(1), EPA(1), MI(1), MN(1), ON(1)
- (95) U.S. LSBP agencies will work with operators of **medical waste incinerators** to pursue reductions of mercury, dioxin and hexachlorobenzene through source reduction elimination/segregation, including the removal of noninfectious waste from the incinerator waste stream. MI(1)
- (92) LSBP agencies will support **partnerships with dental associations** to develop training materials and programs for dental offices regarding the proper handling, collection, and disposal of amalgam wastes. EC(1), MI(1), MN(1), ON(1)
- (97) Ontario will investigate a regulatory **exemption** to dispose of mercury wastes reclaimed from dental offices. ON(2)
- (96) Canadian-LSPB agencies to follow up the 1999 City of Toronto **pilot** among Environment Canada, suppliers and the **Ontario Dental Association** and apply the results to the Thunder Bay area. EC(1), ON(2)
- (107) U.S. LSBP agencies will assist utilities in **converting from coal-burning** technology, which release mercury, to renewable source energy or natural gas technology to produce electricity. MN(2)
- U.S. LSBP agencies will assist facilities that produce their own electricity from coal burning to **convert to alternative sources** such as natural gas turbines. MN(2)
- (44) LSBP agencies will evaluate programs to prevent or remove chlorinated or mercury containing material from **incinerator feedstocks.** EC(2), MI(1), ON(1)
- (46) Michigan will evaluate adoption of a law similar to Minnesota's **incinerator law** prohibiting disposal of mercury bearing waste. MI(1)
- (171) The federal, state and provincial governments should provide **incentives to the utility industry** to **develop mercury control technology** and to invest in alternative energy sources. MN(2)
- (173) The U.S. federal government should consider a plan to **permanently retire its mercury stockpile** and to retire other sources of elemental mercury instead of recycling. EPA(1), MN(2)
- (162) The U.S. Federal government should evaluate lowering the **nationwide limits on sewage sludge and medical waste incinerators**, especially for mercury. MN(2)
- (145) LSBP agencies will work with communities to provide **sector-specific pollution prevention outreach** such as workshops for the medical and dental communities, and other important sectors. EC(1), EPA (1), MI(1)
- (133) The states and U.S. EPA 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. Also, lower emission rates should be used to define major source applicability for MACT standards. MI(1), MN(2)
- (132) For toxic pollutants with effluent limitations that are below reliable levels of analytical detection (e.g. nine zero discharge pollutants), U.S. LSBP agencies will require **toxic reduction plans in each new or reissued NPDES permit** for point sources discharges to the basin. U.S. LSBP agencies will require toxic reduction plans in new or reissued air permits for facilities that could reasonably be expected to emit any of the nine zero discharge pollutants based on knowledge of the process. MI(1)
- (67) LSBP agencies will **assist schools** in seeking out and disposing of mercury and PCBs on school property. EPA(1), MN(1), MI(1), ON(1)
- (70) Minnesota will investigate the potential use of a mercury-sniffing dog to **identify mercury** in schools as part of the assistance to schools effort. MN(2)
- (160) The **Great Lakes Binational Toxics Strategy** should be pursued to meet the short-term, interim goals (e.g., 50% reduction in mercury deposited from US sources by 2006). EC(1), EPA(1), MI(1), MN(2)
- (115) Pursue clean up of mercury **contaminated sediments** in Peninsula Harbour through a partnership among public and private organizations. EC(1), ON(2)

- (85) U.S. LSBP agencies will identify facilities that use **wet scrubbers** to treat emissions. If mercury is accumulating in the scrubber water, the feasibility of recycling the water in a closed loop system rather than being discharged will be evaluated. MN(1), MI(2)
- (47) Canadian LSBP agencies will encourage municipalities to **establish source separation programs** to divert household hazardous materials including cleaners, batteries, and fluorescent lights from landfills or incinerators. EC(1), ON(1)
- (30) LSBP agencies will seek funding to initiate or continue permanent household and agricultural (e.g. pesticides) **hazardous waste (HAHW) collection depots** in the largest Lake Superior basin cities. Furthermore, U.S. LSBP agencies will seek funding to initiate and continue periodic or mobile collections for the more remote locations within the Lake Superior basin. Collections will not be limited to pesticides but will include a focus on mercury containing products (e.g. thermometers, abandoned appliances). U.S. LSBP agencies will seek funding to initiate and continue Lake Superior basin HAHW education programs that will include information about how individuals can practice home environ- mental stewardship; how to identify HAHW; and how to properly dispose of HAHW. EC(1), EPA(1), MI(1), MN(2), ON(1), WI(1)
- (131) U.S. LSBP agencies will pursue **bans on non-essential uses of the nine** persistent, bioaccumulative, toxic substances targeted for zero discharge (e.g. light switches in running shoes). MN(2), MI(2)
- (10) In cooperation with the Lake Superior Binational Forum, LSBP agencies will establish a **Lake Superior steward project**. A special effort will be made to identify suppliers of products that are free of mercury, dioxin and HCB. EC(2), EPA(2), MI(1), ON(1), WI(2)

6.2.2 PCBs

Draft Commitment to Actions will include:

- (51) LSBP agencies will encourage owners of transformers and capacitors to test their equipment to **identify any remaining PCBs**. EPA(1), MI(2), MN(1)
- (58) U.S. LSBP agencies will encourage PCB owners to **destroy PCBs** in use or storage. Encouragement could be done through voluntary agreements, economic incentives, or decommissioning in lieu of certain fines. EC(1), EPA(1), MI(2), MN(2), ON(1)
- (53) LSBP agencies will encourage the formation of **PCB cooperatives** that allow PCB equipment owners to achieve economies of scale by using a common contractor to remove, transport and destroy PCBs from a region within the basin. EC(1), MN(1), ON(1)
- (60) U.S. LSBP agencies will assist in the **testing and removal of PCB** bearing equipment, especially for municipalities, schools, hospitals and small businesses. An explanation of the financial consequences of PCB contamination of property should be included in this outreach program. MN(2)
- (56) Canadian LSBP agencies will encourage owners of PCB bearing equipment to monitor and **document the ongoing status** of the equipment until the equipment is removed. EC(1), ON (1)
- (52) LSBP agencies will encourage **PCB "mentors"**(i.e., facilities that have already removed their PCBs) to assist smaller facilities that do not have access to as much environmental expertise. EC(1), EPA(1), MI(2), MN(2)
- (54) LSBP agencies will include **PCBs in outreach and hazardous waste collections** designed for small businesses since PCBs may be contained in light ballasts, paint, well pumps, small capacitors and white goods (e.g., refrigerators). EC(2), EPA(1), MI(2), ON(1)
- (57) Canadian LSBP agencies will continue to seek **in-basin PCB destruction capability** for low level PCBs only. EC(1), ON(1)
- Through voluntary agreements **remove PCBs** in storage so that all pulp and paper mills are PCB free. EC(1), ON(1)
- (59) U.S. LSBP agencies should consider **removal of PCB bearing equipment** in lieu of some fines (e.g. Supplemental Environmental Projects). EPA(1), MI(1)
- (55) Canadian LSBP agencies to consider another round of **training sessions for small PCB owners**. Cooperation is promoted so that PCB owners can reduce the cost of contracted PCB services (e.g., treatment of PCB contaminated mineral oils, on-site decontamination of capacitors and transformers, shipment of PCBs to high temperature incineration facilities and carcass removal). EC(1), ON(1)
- (65) U.S. LSBP agencies will encourage **training sessions for demolition contractors.** Such training would preferably be associated with licensing requirements or other mandatory procedures.

Opportunities to align the training with trade association outreach will be sought. EPA(2), MI(2), MN(1)

- (63) LSBP agencies will provide **training materials for appliance recyclers and auto salvage operators** to assist compliance with applicable rules. EC(2), MI(1), MN(1)
- (67) LSBP agencies will **assist schools** in seeking out and disposing of PCBs and mercury on school property. EPA(1), MI(1), MN(1), ON(1)
- (12) U.S. LSBP agencies will evaluate and begin the development of **purchasing policies** to eliminate use of products that might include **PCB or mercury equipment** (e.g., boilers, buildings, vehicles, electrical equipment and laboratory equipment). Policies will also examine phase-out of existing mercury or PCB containing items. MI(1), MN(2)
- (61) U.S. LSBP agencies will ask all the power generators in the basin to endorse the **PCB reduction goals** outlined in the Stage 2 LaMP and will provide Lake Superior steward awards to facilities that accept the challenge. EPA(1), MI (2)
- LSBP agencies will work with individual facilities in the basin to identify opportunities to **reduce storage, use or release of mercury and PCBs** (e.g., toxic reduction plans, voluntary audits, "check lists" to be included in the permit application.). EPA(1), MI(1)
- (32) U.S. LSBP agencies will seek funding to initiate and continue periodic abandoned **"white goods" collections**. MI(2)
- (168) LSBP agencies will support federal initiatives to **lower the reporting limits on persistent, bioaccumulative toxics under the TRI (US) and the NPRI (Canadian)** and lower the reporting limit for PCBs under TSCA even further in order to track low level waste. EC(1), EPA(1), MN(2)
- (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. EC(1), EPA(1), MI(1), MN(1), ON(1), WI(1)
- (160) The **Great Lakes Binational Toxics Strategy** should be pursued to meet the short-term, interim goals (e.g., 90% reduction nationally of high-level PCBs (>500 ppm) used in electrical equipment, US sources by 2006). EC(1), EPA(1), MI(1), MN(2)

6.2.3 Pesticides

Draft Commitment to Actions will include:

- (30) LSBP agencies will seek funding to initiate or continue permanent household and agricultural (e.g. pesticides) **hazardous waste (HAHW) collection depots** in the largest Lake Superior basin cities. Furthermore, U.S. LSBP agencies will seek funding to initiate and continue periodic or mobile collections for the more remote locations within the Lake Superior basin. Collections will not be limited to pesticides but will include a focus on mercury containing products (e.g. thermometers, abandoned appliances). U.S. LSBP agencies will seek funding to initiate and continue Lake Superior basin HAHW education programs that will include information about how individuals can practice home environ- mental stewardship; how to identify HAHW; and how to properly dispose of HAHW. EC(1), EPA(1), MI(1), MN(2), ON(1), WI (1)
- (4) U.S. LSBP agencies will provide indirect or direct **financial support** to businesses, organizations and local governments for pollution prevention projects. Possible projects include **clean sweeps**, bounties on mercury products or burn barrels, mercury swaps for alternative products, education, purchasing policies, energy conservation, water conservation, pay-as-you-throw trash disposal fees and others. EPA(1), MI(1), MN(1), WI(1)
- (31) U.S. LSBP agencies will assist industries and business in the basin to conduct industrial **clean sweeps** and use economy of scale for collections and shipments of hazardous waste. Examples of successful business collection programs include Western Lake Superior Sanitary District's clean shop program and Northwest Regional Planning Commission's very small quantity generator collection program. MI(2)
- (172) The U.S. federal government should tighten **the reporting requirements on export shipments of pesticides**, especially pesticides that are no longer used in the United States. MN(2)
- (36) LSBP agencies will pursue urban initiatives that increases awareness, through outreach, of the risk of **pesticide use**. EPA(1), ON(2)

- (160) The **Great Lakes Binational Toxics Strategy** should be pursued to meet the short-term, interim goals (e.g., 50% reduction in mercury deposited from US sources by 2006). EC(1), EPA(1), MI(1), MN(2)
- (81) Canadian LSBP agencies will encourage **small businesses** through an **education program** to utilize the permanent hazardous waste depots available to them. and coordinate the local **Chamber of Commerce or trade associations** to run pollution prevention education and training sessions for proper **waste management**. EC(2), ON(1)

6.2.4 Dioxin, HCB and OCS

Draft Commitment to Actions will include:

- (4) U.S. LSBP agencies will provide indirect or direct **financial support** to businesses, organizations and local governments for pollution prevention projects. Possible projects include clean sweeps, bounties on mercury products or burn barrels, mercury swaps for alternative products, education, purchasing policies, energy conservation, water conservation, pay-as-you-throw trash disposal fees and others. EPA(1), MI(1), MN(1), WI(1)
- (44) LSBP agencies will evaluate programs to prevent or remove chlorinated or mercury containing material from **incinerator feedstocks.** EC(2), MI(1), ON(1)
- (43) LSBP agencies will insist on the highest standards and best available technology for **new incinerators**. EC(2), EPA(2)
- (95) U.S. LSBP agencies will work with operators of **medical waste incinerators** to pursue reductions of mercury, dioxin and hexachlorobenzene through source reduction elimination/segregation, including the removal of noninfectious waste from the incinerator waste stream. MI(1)
- (45) U.S. LSBP agencies will support **public education**/outreach campaigns regarding the health and environmental effects of **burn barrels** and small incinerators and encourage local units of government to pass ordinances banning burn barrels. EPA(1), MI(1), MN(1)
- (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. EC(1), EPA(1), MI(1), MN(1), ON(1), WI(1)
- (94) LSBP agencies will support and promote implementation of **voluntary agreements with the health care industry** to reduce use of mercury and formation of dioxin. EC(1), EPA(1), MI(1), WI(1)
- (112) Canadian LSBP agencies propose to discuss a program with the seven **pulp and paper facilities**: to address purchasing policies to eliminate the nine critical pollutants; to review energy reduction practice thereby reducing dependence on purchased energy that is generated from coal burning facilities which release mercury and dioxin; introduce water conservation to reduce energy use; recycle fluorescent tubes. EC(1), ON(2)
- (116) Reduce dioxin and furan discharges from the pulp bleaching process by reducing AOX to less than 0.8 kg/tonne. ON(1)
- (168) LSBP agencies will support federal initiatives to **lower the reporting limits on persistent, bioaccumulative toxics under the TRI (US) and the NPRI (Canadian)** and lower the reporting limit for PCBs under TSCA even further in order to track low level waste. EC(1), EPA(1), MN(2)
- (160) The **Great Lakes Binational Toxics Strategy** should be pursued to meet the short-term, interim goals (e.g., 50% reduction in mercury deposited from US sources by 2006). EC(1), EPA(1), MI(1), MN(2)
- (10) In cooperation with the Lake Superior Binational Forum, LSBP agencies will establish a **Lake Superior steward project**. A special effort will be made to identify suppliers of products that are free of mercury, dioxin and HCB. EC(2), EPA(2), MI(1), ON(1), WI(2)

6.2.5 General Strategies (applicable to several targeted pollutants)

Draft Commitment to Actions will include:

- (160) The **Great Lakes Binational Toxics Strategy** should be pursued to meet the short-term, interim goals (e.g., 50% reduction in mercury deposited from US sources by 2006). EC(1), EPA(1), MI(1), MN(2)
- (176) LSBP agencies will **initiate necessary sediment remediation measures at AOCs** and other impaired sites known to contribute persistent, bioaccumulative substances to the Lake Superior ecosystem. EC(1), MN(2), ON(1), WI (2)

- (134) States and U.S. EPA will include **pollution prevention components in enforcement settlements** as appropriate. MI(1)
- (130) U.S. LSBP agencies will coordinate LaMP critical pollutant reduction strategies with **Total Maximum Daily Load requirements** or limits under Ontario's Certificate of Approval process. MN(1), ON(1)
- (139) Minnesota will consider the applicability of the **ONRW designation** in future reviews of water quality rules. MN(1)
- (20) The province of Ontario will investigate the **feasibility of redrafting existing legislation** to accommodate product stewardship strategies involving waste disposal. ON(1)
- (69) U.S. LSBP agencies will support basin-wide coordination of citizen and school monitoring programs such as "Lake Superior Lakewatch." U.S. LSBP agencies will support continuations of existing programs and formation of new programs based on local interest. These programs will be used as outreach activities for the Binational Program and will increase a sense of stewardship in the Lake Superior Basin. WI(2)
- (146) U.S. LSBP agencies will pursue funding for community and regional toxic reduction activities and networking between Lake Superior communities. In particular, the toxic reduction committees working in Marquette, Michigan; Superior, Wisconsin; and through the Western Lake Superior Sanitary District (WLSSD) in Duluth, MN, should be supported. Innovative and alternative funding should also be pursued for these and expanded efforts in communities throughout the Lake Superior basin. WI(1)
- (127) Canadian LSBP agencies will **expand the Pollution Prevention Demonstration Site Program** to both Canadian Federal facilities and First Nations in the Lake Superior drainage basin. The program addresses the generation of hazardous waste through such activities as identification and demonstration of alternative products, practices and technologies. EC(1)
- (147) Canadian LSBP agencies will support initiatives to **reduce reliance on petroleum hydrocarbons for energy production** or space heating purposes at First Nations (use of alternative technologies/green power). EC(1)
- (148) Canadian LSBP agencies will support First Nations on contaminated site assessment and remediation (primarily petroleum hydrocarbon contamination). EC(1)
- (149) Canadian LSBP agencies will support **alternate municipal waste management** practices. EC(1)

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Appendix A
Compound Estimates and Assumptions

This appendix documents the data sources and assumptions used to characterize the compound emission, use, and disposal estimates provided in chapters 1 and 5 of this report. The appendix is organized in three subsections:
Appendix A.1: Mercury Emission and Disposal Estimates
Appendix A.2: PCB Use Estimates
Appendix A.3: Dioxin Emission and Disposal Estimates

The assumptions and data sources underlying the pesticide collection information are documented in chapters 1 and 5.

A.1 Mercury Emission and Disposal Estimates

This section is organized into two subsections: A.1.1, U.S. mercury emission and disposal estimates and A.1.2, Canadian mercury emission and disposal estimates. Following the tabular summaries of the emission and disposal estimates (Tables A.1 and A.2) in each section is a description of the specific data sources and assumptions supporting each estimate.

A.1.1 Mercury Emission and Disposal Estimates for the U.S. Lake Superior Basin

Table A.1 1999 Mercury Emission Estimates For The U.S. Lake Superior Basin

Source/Use Category	**1990 Emissions (kg/yr)**			**1990 Use, Disposal, Soils (kg/yr)**	**1999 Emissions (kg /yr)**			**1999 Use, Disposal, Soils (kg/yr)**
	Water	Air	Total Releases		Water	Air	Total Releases	
Industrial								
General industrial activity	0.04	8.9	8.94		0.04	8.9	8.94	
Petroleum refining	0.0006	1.85	1.856		0.006	1.85	1.856	
Industrial Total	**0.05**	**10.8**	**10.85**		**0.05**	**10.8**	**10.85**	
Mining								
Copper		550	550					
Iron		362	362			384.64	384.64	
Mining Total		**912**	**912**			**384.64**	**384.64**	
Fuel Combustion								
Oil		22.6	22.6			22.6	22.6	
Natural Gas		24.8	24.8			24.8	24.8	
Wood		1	1			2.4	2.4	
Coal		88.5	88.5			142.73	142.73	
Fuel Combustion Total		**136.9**	**136.9**			**192.53**	**192.53**	
Incineration								
WLSSD		11.2	11.2			10.95	10.95	
Small incinerators		48	48					48
Other sludge		1	1			1	1	
Medical waste		22.7	22.7			0.959983	0.959983	
Cremation		2.5	2.5			1.50375	1.50375	
Incineration Total		**85.4**	**85.4**			**14.41373**	**14.41373**	**48**
Commercial Products								
Dry cell batteries				851				85.1
Electric lighting		14.6	14.6	37.9		0.82	0.82	20.1

Source/Use Category	1990 Emissions (kg/yr)			1990 Use, Disposal, Soils (kg/yr)	1999 Emissions (kg /yr)			1999 Use, Disposal, Soils (kg/yr)
	Water	Air	Total Releases		Water	Air	Total Releases	
Fever thermometers				22.9				22.9
Thermostats				15.9				15.9
Light switches				0.57				0.57
Pigments				14.1				14.1
Paint		131.9	131.9	25.6				
Fungicides		3.8	3.8					
Commercial ProductsTotal		**150.3**	**150.3**	**968**		**0.82**	**0.82**	**158.67**
Commercial/ Municipal Activities								
WLSSD	21.5		21.5		0.46		0.46	9.19
Landfills		38.8	38.8			38.8	38.8	
Dental uses, hospitals, and labs	0.08	0.48	0.56	6.2	0.08	0.48	0.56	6.2
Residential, Other	0.32		0.32		0.32		0.32	
Commercial/Municipal Total	**21.9**	**39.3**	**61.2**	**6.2**	**0.86**	**39.28**	**40.14**	**15.39**
ANTHROPOGENIC TOTAL	21.95	1334.7	1356.65	974.2	0.91	642.4837	643.3937	222.06

It is assumed that the final disposition of 10 percent of mercury in total Commercial/Municipal effluent is in sludge (Lohse-Hanson 1999). Therefore, not including the WLSSD, there was 4 kg/yr of mercury in sludge in 1990 and 4 kg/yr of mercury in sludge in 1999.

Industrial
- General and Petroleum refining: The 1990 estimates were used (LSBP 1999).

Mining
- Copper: White Pines closed (Michigan Mercury Pollution Prevention Task Force 1996)
- Iron: Taconite production estimates for Minnesota (Jiang 1999)

Fuel Combustion
- Oil: 1990 estimates were used (LSBP 1999).
- Natural Gas: 1990 estimates were used (LSBP 1999). The following facilities use natural gas: Hibbing Public Utility, Duluth Steam Plant, GLT-Cloquet, NNG-Carlton, NNG-Wrenshall, USG, Georgia Pacific, and Louisiana Pacific.
- Wood
  - ⇒ The 1999 estimate is 1 pound/year (LSBP 1999)
  - ⇒ MN Power ML Hibbard estimate (3 pounds/year) is based on 1995 emission estimates (Hagley 1999).
  - ⇒ Louisiana Pacific and Georgia Pacific emission estimates based on 1998 estimates for the amount of wood burned and emission factor for wood-burning unit with electrostatic precipitators (ESP) control devices. Louisiana Pacific has ESP and catalytic afterburner for 14,289 tons of wood and a centrifugal collector and fabric filter for 5,026 tons of wood. Georgia Pacific has a multiclone and ESP for 6,327 tons of wood and a ESP on 8,789 tons of wood (Kim 1999). An emission factor was only available for ESP control ($2.6 * 10^{-6}$ pound/ton) (EPA 1997).

    Louisiana Pacific: ($2.6 * 10^{-6}$ pound mercury/ton) * 19,315 tons/year = 0.502 lb mercury/year = 0.023 kg mercury/year

    Georgia Pacific: ($2.6 * 10^{-6}$ pound mercury/ton) * 15,116 tons/year = 0.039 lb mercury/year = 0.018 kg mercury/year

- Coal
  - ⇒ 1990 estimates were based on Minnesota statewide figures, extrapolated to the population of the Lake Superior basin (Tetra Tech Inc. 1996)
  - ⇒ 1999 estimates are based on facility-specific information for the Lake Superior basin
  - ⇒ 1997 mercury emissions for LTV Mining (50 lb/yr), MN Power Laskin Units 1 (17 lb/yr) and 2 (16 lb/yr), Northshore Mining Company (26 lb/yr), and Potlach Corporation (<3 lb/yr) (Oliaei 1999)
  - ⇒ 1998 emissions for NSP Bayfront (2.3 lb/yr) and University of Wisconsin Superior (1.215 lb/yr) (Cabrera-Rivera 1999)
  - ⇒ 1995 emissions for City of Marquette (16 lb/yr) (City of Marquette 1997) and 1998 emissions for Wisconsin Electric (150 lb/yr) (Michaud 1999)
  - ⇒ 1998 emissions for Hibbing Public Utility based on amount of subbituminous coal used in cyclone and spreader stoker units (Kim 1999) multiplied by an emission factor for ESP control (EPA 1997)

    64,931 tons/year * (0.052 * 10-3 lb mercury/ton coal) = 3.38 lb

    mercury/year = 1.53 kg mercury/year
  - ⇒ 1998 emissions for the Duluth Steam Plant based on amount of pulverized coal used in a dry bottom unit that has a multiclone with a fabric filter (Kim 1999). An emission factor was used for bituminous coal with multiclone control (EPA 1997).

    38,198.26 tons of coal/year * (0.78 *10-3 lb mercury/ton coal) = 29.79 lb

    mercury/year = 13.51 kg mercury/year

Incineration

- WLSSD: 1999 estimates were provided by the WLSSD (Tuominen 1999).
- Small incinerators: 1990 estimated emissions were moved to the use and disposal category for 1999, since most incinerators in this category have ceased operating since 1990.
- Other sludge: 1990 estimates were used (LSBP 1999).
- Medical waste: Michigan has two medical incinerators remaining with no control devices (Troutman 1999), Minnesota has no medical incinerators remaining in the Basin (Lohse-Hanson 1999), and Wisconsin has no medical incinerators remaining in the Basin (Larson 1999). The 1999 emission estimate was determined by multiplying the amount of medical waste burned by the emission factor for medical waste with combustion control (EPA 1997). This emission factor was the most conservation emission factor available.
  - ⇒ Escanaba Hospital: 16.3 tons of medical waste/year * (74 * 10^{-3} lb mercury/ton waste) = 1.21 lb mercury/year = 0.55 kg/year
  - ⇒ Crystal Falls Hospital: 12.3 tons of medical waste/year * (74 * 10^{-3} lb mercury/ton waste) = 0.412 lb mercury/year = 0.41 kg/year
- Cremation: The 1999 estimate was determined by calculating what percentage the Basin population [425,548] (Tetra Tech Inc. 1996) is of the total Michigan, Minnesota, and Wisconsin 1998 population [19,766,161] (U.S. Census 1998). This percentage (2.15%) was multiplied by the number of total projected cremations in Michigan, Minnesota, and Wisconsin for 2000 [46,569] (EPA 1997) to obtain the total number of cremations in the Basin. The number of cremated bodies [1,002.6] was multiplied by the emission factor of 1.50E-03 kg/body for cremation (EPA 1997).
  - ⇒ 425,548/19,766,161 = 2.15%
  - ⇒ .0215 * 46,569 = 1,002.6
  - ⇒ 1,002.6 bodies/yr * 1.50E-03 kg mercury/body = 1.50375 kg mercury/yr

Commercial Products

- Batteries: A Hennepin County study showed about a 90-94 percent decrease since the early 90's (NEMA 1999). In addition, the volume of mercury used in batteries has declined by over 95% (Ross

& Associates 1994). Battery sorting studies have shown about a 95% decrease in mercury content since the late 1980's (Erdheim 1999). Therefore, 1990 estimates were decreased by 90 percent.

- Electric lighting :
  - ⇒ *Air emissions*: The 1999 estimates are based on a population extrapolation and Minnesota mercury emission estimates from fluorescent lamp breakage for 2000 [9.07 kg/yr], which are based on the proportion of lamps not recycled and industry figures on mg/lamp (MPCA 1999). A U.S. Basin population of 425,548 was used (Tetra Tech Inc. 1996).
    - ⇒ 9.07 kg/yr/ 4725419 people in MN = 0.816966 kg/person/yr
    - ⇒ 0.816966 * 425,548 = 0.82
  - ⇒ *Disposal/use*: The average mercury content of a four foot lamp in 1994 was 22.8 mg; the National Electric Manufacturers Association expects the mercury content of a four foot lamp to be < 12 mg [47% decrease] by 2000 (EPA and Environment Canada 1998c). Therefore, 1990 estimates were decreased by 47% to obtain 1999 estimates.
- Thermometers, thermostats, light switches, pigments: 1990 estimates were used (LSBP 1999).
- Paint and Fungicides: Paint registrations were canceled in 1991 and fungicides were canceled in 1993 (Ross and Associates 1994).

Commercial/Municipal

- WLSSD: 1999 estimates provided by the WLSSD. Half of sludge being generated is applied to land (Tuominen 1999).
- Landfills; dental uses, hospitals, and labs; and residential and other: 1990 estimates were used (LSBP 1999).

Table A.2 1999 Mercury Emission Estimates For The Lake Superior Canadian Basin

Source/Use Category	1990 Emissions (kg/yr)			1990 Use, Disposal, Soils (kg/yr)	1999 Emissions (kg /yr)			1999 Use, Disposal, Soils (kg/yr)
	Water	Air	Total Releases		Water	Air	Total Releases	
Industrial								
Forest Products	10.99	11	21.99	0.001	10.99	7.863512	18.853512	0.001
Mining	0.4	604	604.4		0.4	0.015314	0.415314	
Metal Finishing	1.53		1.53		1.53		1.53	
Photoprocessing	0.005	0.0004	0.0005		0.0005	0.0004	0.0005	
Industrial Total	**12.925**	**614.0004**	**627.9205**	**0.001**	**12.925**	**7.879226**	**20.799326**	**0.001**
Fuel Combustion								
Ontario Hydro – Thunder Bay	0.44	100	100.4	10	0.5	50.33307	50.83307	10
Oil		8	8			8	8	
Natural Gas		12	12			12	12	
Wood		0.34	0.34			0.34	0.34	
Coal		5	5			5	5	
Fuel Combustion Total	**0.44**	**125.34**	**125.74**	**10**	**0.5**	**75.67307**	**76.17307**	**10**
Incineration								
Small incinerators								
Medical waste		0.12	0.12	0.02		0.4	0.4	
Cremation		1.1	1.1			0.6	0.6	
Incineration Total		**1.22**	**1.22**	**0.02**		**1**	**1**	
Commercial Products								
Batteries				300				300
Electric lighting		5.4	5.4	16.2		0.29	0.29	8.6

Source/Use Category	1990 Emissions (kg/yr)			1990 Use, Disposal, Soils (kg/yr)	1999 Emissions (kg /yr)			1999 Use, Disposal, Soils (kg/yr)
	Water	Air	Total Releases		Water	Air	Total Releases	
Fever thermometers		6.2	6.2			6.2	6.2	
Thermostats		9	9			9	9	
Light switches		0.2	0.2			0.2	0.2	
Pigments		5.6	5.6			5.6	5.6	
Paint		0.12	0.12			0	0	0
Fungicides		1.2	1.2	4.27		0	0	0
Instruments (other)		13.1	13.1	52.35		13.1	13.1	52.35
Commercial ProductsTotal		**40.81**	**40.81**	**372.82**		**34.39**	**34.39**	**90.95**
Commercial/ Municipal Activities								
Wastewater treatment plants	3.89	4.63	8.52	2.08	3.89	4.63	8.52	2.08
Runoff	0.7		0.7		0.7		0.7	
Landfills		15	15			15	15	
Hospital/medical	26	1.1	27.1		26	1.1	27.1	
Pharmaceutical		1.26	1.26			1.26	1.26	
Commercial/Municipal Total	**30.59**	**21.99**	**52.58**	**2.08**	**30.59**	**21.99**	**52.58**	**2.08**
ANTHROPOGENIC TOTAL	**43.955**	**804.3604**	**848.2705**	**384.921**	**44.015**	**171.5223**	**184.9424**	**103.031**

A.1.2 Mercury Emission and Disposal Estimates for the Canadian Lake Superior Basin

Industrial

- Forest Products: The 1999 estimate includes 1995 estimates for Kimberly Clark, Avenor-Thunder Bay, Abitibi Price - Prov. Paper, Abitibi Price Fort William, Northern Wood Preserves, Norampac Packaging-RR, Weldwood of Canada Ltd., and Fort James-Marathon (Brigham 1999
- Mining : The Algoma Steel Plant in Wawa, Ontario closed. The 1999 estimate includes the 1995 estimate for Williams Operations gold ore (Brigham 1999).
- Metal Finishing and Photoprocessing: The 1990 estimates were used (LSBP 1999).

Fuel Combustion

- Oil, Natural Gas, Wood, and Coal: The 1990 estimates were used (LSBP 1999).

Incineration

- Medical waste: The 1999 estimate includes 1995 estimates for St. Joseph's General and McClausland hospitals (Brigham 1999).
- Cremation: The 1999 estimate includes 1995 estimates for Riverside Cemetery and Sunset Crematorium (Brigham 1999).

Commercial Products

- Batteries **-** A Hennepin County (in Minnesota) study showed about a 90-94 percent decrease since the early 90's (NEMA 1999). In addition, the volume of mercury used in batteries has declined by over 95% (Ross & Associates 1994). Battery sorting studies have shown about a 95% decrease in mercury content since the late 1980's (Erdheim 1999). Therefore, 1990 estimates were decreased by 90 percent.
- Electric lighting :
  - ⇒ *Air emissions*: The 1999 estimates are based on a population extrapolation and Minnesota mercury emission estimates from fluorescent lamp breakage for 2000 [9.07 kg/yr], which are based on the proportion of lamps not recycled and industry figures on mg/lamp (MPCA 1999). A U.S. Basin population of 150,000 was used (Thompson 1994).
    - ⇒ 9.07 kg/yr/ 4725419 people in MN = 0.816966 kg/person/yr
    - ⇒ 0.816966 * 150,000 = 0.29 kg/year
  - ⇒ *Disposal/use*: The average mercury content of a four foot lamp in 1994 was 22.8 mg; the National Electric Manufacturers Association expects the mercury content of a four foot lamp to be < 12 mg [47% decrease] by 2000 (EPA and Environment Canada 1998c). Therefore, 1990 estimates were decreased by 47% to obtain 1999 estimates.
- Thermometers, Thermostats, Light switches, Pigments, Instruments (other): 1990 estimates were used (LSBP 1999).
- Paint and Fungicides: Paint registrations were canceled in 1991 and fungicides were canceled in 1993 (Ross and Associates 1994).

Commercial/Municipal Activities

- Wastewater Treatment Plants, Runoff, Landfills, Pharmaceuticals: 1990 estimates were used (LSBP 1999).
- Hospital/Medical : The 1990 estimate was used (Brigham 1999).

A.2 PCB Use Estimates

This section is organized into two sections. Section A.2.1 summarizes PCB use estimates for the U.S. portion of the Lake Superior Basin, and section A.2.2 provides documentation for PCB use in the Canadian portion of the basin.

A.2.1 PCB Emission Estimates for the U.S. Lake Superior Basin

- Methods used to extrapolate MPCA capacitor and transformer data to Lake Superior Basin:

Population of Minnesota in Lake Superior Basin:	232,928
Minnesota MPCA data:	
Number of capacitors > 500 ppm (Minnesota Power)	2935
Number of capacitors > 500 ppm (other industry/utilities)	418
Number of transformers and capacitors < 500 ppm	195
Capacitors > 500 ppm PCB per capita (industry/utilities other than MN Power),	1.79x10-3
Transformers and capacitors < 500 ppm PCB per capita, Minnesota	8.73x10-4
Capacitors > 500 ppm PCB in Basin (1.79x10-3 x 232,928 + 2935 MN Power)	**3353**

Transformers and capacitors < 500 ppm PCB in Basin (8.73x10-4 x 232,928) **195**

- Method for determining the mass of PCB in U.S. portion of Basin from transformers > 500 ppm PCB and all capacitors:

*Assumptions re: volume and concentrations**

Capacitors > 500 ppm	3 gallons & 175,000 ppm each
Transformers < 500 ppm**	
95.5%	15 gallons & 150 ppm each
0.5%	2500 gallons & 250 ppm each
Transformers > 500 ppm	15 gallons & 550 ppm each

* Equipment volume and concentration estimates based on personal communication with Gene Beadey, Minnesota Power PCB Program Manager (Beadey 1999)

** also applied to capacitors < 500 ppm

Calculations to find mass of PCBs

# caps > 500 ppm		326
Volume of caps > 500ppm	(3353 x 3 gal)	10,059 gal
Volume of caps > 500ppm	(10,059 gal x 3.785 liters/gal)	38,077 liters
Mass PCB***	(38,077 liters x 175,000 ppm [mg/l] / 1000000 mg/kg)	**6664 kg**
# caps & tfs < 500 ppm		195
Volume of tfs < 500 ppm, 15 gal	(195 caps x .955 x 15 gal)	2793 gal
Volume of tfs < 500 ppm, 15 gal	(2793 gal x 3.785 liters/gal)	10,574 liters
Mass PCB***, 15 gal	(10,574 liters x 150 ppm [mg/l]/ 1000000 mg/kg)	**1 kg**
Volume tfs < 500 ppm, 2500 gal	(195 caps x .005 x 2500 gal)	2438 gal
Volume tfs < 500 ppm, 2500 gal	(2438 gal x 3.785 liters/gal)	9227 liters
Mass PCB***, 2500 gal	(9227 liters x 150 ppm [mg/l]/ 1000000 mg/kg)	**2 kg**

*** assuming ppm = mg/l, thus density of oil = 1

TOTAL **6667 kg**

- Note regarding U.S. treatment of PCB generating processes

U.S. EPA has concluded that the quantity of PCBs inadvertently generated and released into the environment is inconsequential compared to releases from items with intentional PCBs and, therefore, did not ban these processes. However, U.S. EPA did add certification, recordkeeping and reporting requirements to the facilities that inadvertently produce PCBs. (EPA 1998a)

A.2.2 PCB Emission Estimates for the Canadian Lake Superior Basin

- 1997 data for Canada are from Brigham (1999)
- In Canada, quantities are reported as PCB contaminated materials and fluids. Liquids are generally reported in litres. Conversion to kilograms was made assuming 1.15 kg/litre.
- 1990 data for Canada were taken from the Stage 2 LaMP.
- Data for total quantity destroyed in Canada are from pgs 30 and 37 of the Zero Discharge report, adding all of the data for the provincially monitored sites and the total for the federally monitored sites. However, pg 36 of the Zero Discharge report provides higher quantities for provincially monitored sites (in the summary table) and would result in a total of 435,949 kg destroyed between 1990-1997, a difference of 91,918 kg. The data presented are for provincially monitored and federally monitored sites and are not presented by sector.
- The total amount of PCBs in use in Canada in 1997 is drawn from the Zero Discharge report, pg 31, indicating the total quantity of high level PCB liquids only. It is not known whether there is an additional quantity of low level PCB liquids still in use in 1997.
- Though it would appear that Canada has already exceeded the reduction goals for 2005 based upon the quantity destroyed 1990- 1997 (as presented in the Zero Discharge report) and the baseline quantity in use and storage in 1990 (as presented in the Stage 2 LaMP), there is an additional 96,012 kg in use and storage in 1997 (as presented in the Zero Discharge report). The reason for this discrepancy is not

known, though it may be the result of the discovery of additional PCB storage and use since completion of the 1990 inventory.
- High level liquid and solid PCB materials are defined as containing greater than 10,000 ppm PCBs.
- Low level liquid and solid PCB materials are defined as containing 50-10,000 ppm PCBs.
- The federally monitored sites do not report whether the stored materials are high or low level waste and, therefore, it is all classified as high level waste.

A.3 Dioxin Emission and Disposal Estimates

This appendix is organized in two sections. Appendix A.3.1 summarizes dioxin emission and disposal estimates for the U.S. portion of the Basin, and Appendix A.3.2 provides estimates for the Canadian portion of the Basin.

A.3.1 Dioxin Emission Estimates for the U.S. Lake Superior Basin

Table A.3.1 summarizes U.S. estimates for the 1990 baseline and 1999.

Table A.3.1 U.S. Lake Superior Basin Dioxin Emission and Disposal Estimates

Source/Use Category	**1990 Emissions (g TEQ/yr)**			**1990 Use, Disposal, Soils (g TEQ/yr)**	**1999 Emissions (g TEQ/yr)**			**1999 Use, Disposal, Soils (g TEQ/yr)**
	Water	Air	Total Releases		Water	Air	Total Releases	
INDUSTRIAL								
Forest products	0 – 0.6		0 – 0.6		0-0.3		0 - 0.3	
Petroleum refining	$1.5x10^{-5}$		$1.5x10^{-5}$					
Wood preserving				$2.9x\ 10^{-3}$ [a]				$2.9x\ 10^{-3}$
Mining		0.1	0.1					
Industrial Total	**$1.5x10^{-5}$-0.6**	**0.1**	**$1.5\ x\ 10^{-7}$–0.7**	**$2.9x\ 10^{-3}$**	**0-0.6**		**0 - 0.6**	
FUEL COMBUSTION								
Coal		0.73	0.73			0.53	0.53	
Wood		2.7	2.7			0.40	0.40	
Fuel Combustion Total		**3.43**	**3.43**			**0.93**	**0.93**	
INCINERATION								
Burn barrels						6.97	6.97	
Medical and industrial		134	134			83	83	
Small incinerators		235 – 2,274	235 – 2,274					
WLSSD		0.19	0.19			0.19	0.19	
Incineration Total		**369 - 2408**	**369 – 2,408**			**90.2**	**90.2**	
MUNICIPAL/ RESIDENTIAL								
Wastewater treatment plant sludge				0.014				0.014
Municipal/Residential Total				**0.014**				**0.014**
COMMERCIAL PRODUCTS								
Pentachlorophenol use				18.0				18.0
PCB spills				0.0006				0.0006
Commercial Products Total				**18.0**				**18.0**
TOTAL	**0.8**	**373 – 2,412**	**374 – 2,413**	**18**	**0.06**	**90.2**	**90.2**	**18.0**

[a] Estimate of dioxin presence in soils at one site in the U.S. portion of the basin. This is not an annual release.

Summary of Sector Assumptions
Industrial

- Forest products: Dioxins are generated in pulp and paper mills from the paper bleaching process, especially in plants using elemental chlorine as a bleaching agent. In recent years, pulp mills in the Basin have modified their bleaching processes by substituting chlorine dioxide for elemental chlorine, thereby virtually eliminating dioxins from pulp and paper mill effluents (Stromberg et. al. 1996). However, low level monitoring data were not available to assess the degree to which dioxin effluent concentrations have declined since 1990 for the five pulp and paper mills in the U.S. portion of the Basin (two of which discharge directly to the lake). As a result, the 1990 baseline estimate of 0 to 0.6 g TEQ/yr included only the two facilities discharging to Lake Superior, one of which has since closed. The other three mills discharge to Western Lake Superior Sanitary District (WSLSSD). The 1999 estimate has been reduced to 0 to 0.3 TEQ/yr.
- Petroleum refining: Dioxins can be formed when catalysts used in petroleum refining are reactivated by burning off coke deposits at 380 degrees C to 525 degrees C in the presence of chlorinated compounds (Bear et. al. 1993). Prior to 1991, 1.5×10^{-5} g TEQ/yr was measured in the effluent of the Murphy Oil facility in Superior, Wisconsin. The dioxin in the effluent was thought to be associated with the regeneration of the catalyst reformer. Waste from this process has since been segregated and is disposed in a hazardous waste facility (LSBP 1996). As a result, dioxin emissions in effluent are assumed to have been reduced to below measurable levels in 1999.
- Wood preserving: Past industrial use of pentachlorophenols (PCP) to treat timber, railroad ties, and utility poles are a potential source of dioxins in the Basin (Tetra Tech 1996). The estimate of dioxin contamination in soil is based on an estimate of pentachlorophenol present in soils in the vicinity of the Koppers Inc. facility in Superior, Wisconsin. The facility used PCP to treat railroad ties until 1979. Characterization studies under Resource Conservation and Recovery Act (RCRA) corrective action are ongoing at the site.
- Mining: Non-ferrous metal, especially copper, smelting and refining are a known source of dioxin emissions accounting for approximately 1.36×10^{-2} lb/yr TEQ air emissions in the United States (EPA 1997). In the U.S. portion of the Lake Superior Basin, the Copper Range, White Pine Mine smelter operated in Northern Michigan until 1995. With the closure of the White Pine mine smelter, dioxin emissions from copper smelting were eliminated from the U.S. portion of the Basin.

Fuel Combustion
The combustion of wood and coal as an energy source for industrial and residential use is a known source of dioxins (EPA 1997). Increased attention has been devoted over the past several years to estimate the dioxin emission factors associated with these processes. Table A.3.2 provides estimates of the wood and coal combustion rates in the U.S. portion of the LSB and the current emission factors used to estimate dioxin TEQ emissions from those sources.

Table A.3.2 Dioxin Emissions from Wood and Coal Combustion

Fuel and Combustion Type	Quantity of Fuel Burned in U.S. Lake Superior Basin (kg)[a]	Emission Factor (ng TEQ/kg fuel combusted)	Dioxin Emissions (g TEQ/yr)[d]
Coal, coal fired utilities and industrial boilers	1.8×10^{9}	0.087[b]	0.16
Coal, commercial and residential boilers	1.7×10^{7}	22[c]	0.37
Wood, industrial wood furnace	1.2×10^{8}	0.82[b]	0.10
Wood, commercial and residential	1.5×10^{8}	2[b]	0.30
TOTAL			0.93

[a] Adapted from Tetra Tech (1996).
[b] EPA 1998

[c] Tetra Tech 1996
[d] 1 ng = 10^{-9} g

Incineration

- Burn Barrels: In the 1990 baseline estimate, private household waste incineration was not assessed as a source of dioxin air emissions because of an absence of data to characterize the source. In the past several years, additional research has found that household "burn barrels" may be a significant dioxin source. WLSSD (1992) estimated that burn barrels produce 20 times more 2,3,7,8-TCDD per unit of household garbage burned than a controlled incinerator (e.g., a municipal waste combustor (MWC)). Lemieux (1998) estimated that 1.5 to 4 households that burn their waste in the open (e.g., in burn barrels) equal the dioxin generating potential of a fully-operational MWC. Overall, household waste combustion in burn barrels appears to be an overlooked, but potentially significant source of dioxin and other toxic air emissions.
  The average person in the U.S. generates between 800 and 1,350 pounds of household waste in a year (MDEQ 1999). The U.S. EPA estimates that 40 percent of people living in non-metropolitan areas burn their waste and that 63 percent of their daily waste is burned in burn barrels. Nationally, this amounts to over 1.8 billions pound of household waste burned in burn barrels every year. Normalized for the U.S. Lake Superior Basin population, this amounts to over 4.5 million pounds of household waste openly burned in the Basin each year.
  While such household waste burning is suspected to be a significant source of dioxin and other toxic air emissions, research findings differ as to the rates of dioxin emission per unit of household waste burned (Cohen 1999). Table A.3.3 summarizes dioxin generation emission factors for several recent studies. The table illustrates that emission rate estimates vary over several orders of magnitude. As a result, these emission factor estimates are provided to illustrate the potential significance of the source. Much additional work remains to be completed to properly estimate the dioxin emissions from household waste burning that is occurring in the Basin.

Table A.3.3 Emission Factors for Household Waste Combustion in Burn Barrels

Source	Emission Factor (g TCDD/lb household waste burned)
Cohen (1999)	3.6×10^{-8} [b]
Lemieux (1998) (recycler)[a]	1.04×10^{-7}
Lemieux (1998) (non-recycler)	7.4×10^{-6}
Two Rivers Regional Council (1994)	6.2×10^{-10}
WLSSD (1992)	1.8×10^{-9}

[a] Recyclers were assumed to reduce the proportion of newspaper, plastic, and some metals in their household waste.
[b] Expressed as grams TEQ/yr.

To illustrate the potential magnitude of household hazardous waste burning in the U.S. portion of the Basin, Table A.3.4 applies the Cohen (1999) emission factor to potential household hazardous waste burn rates in the U.S. Lake Superior Basin counties to generate an annual TEQ dioxin emission estimate. Extrapolation of national estimates on burning rates to the Lake Superior basin yields an estimate of about 7g TEQ/yr.

Table A.3.4 Dioxin Generated from Household Waste Combustion in Burn Barrels

County Name	State Name	Population 1996	Estimated Annual Waste Generation (pounds)	Estimated Annual Pounds Burned	Estimated g TEQ/yr Emissions
St. Louis	Minnesota	196,101	264,736,350	66,184,087.	2.38
Lake	Minnesota	10,500	14,175,000	3,543,750	0.13

County Name	State Name	Population 1996	Estimated Annual Waste Generation (pounds)	Estimated Annual Pounds Burned	Estimated g TEQ/yr Emissions
Bayfield	Wisconsin	15,037	20,299,950	5,074,987	0.18
Carlton	Minnesota	30,554	41,247,900	10,311,975	0.37
Douglas	Wisconsin	43,015	58,070,250	14,517,562	0.52
Ashland	Wisconsin	16,534	22,320,900	5,580,225	0.20
Iron	Wisconsin	6,616	8,931,600.00	2,232,900	0.08
Cook	Minnesota	4,546	6,137,100	1,534,275	0.06
Keweenaw	Michigan	1,988	2,683,800	670,950	0.02
Houghton	Michigan	36,853	49,751,550	12,437,887	0.45
Ontonagon	Michigan	8,625	11,643,750	2,910,937	0.10
Baraga	Michigan	8,182	11,045,700	2,761,425	0.10
Marquette	Michigan	70,457	95,116,950	23,779,237	0.86
Gogebic	Michigan	18,158	24,513,300	6,128,325	0.22
Luce	Michigan	5,548	7,489,800	1,872,450	0.07
Alger	Michigan	9,859	13,309,650	3,327,412	0.12
Schoolcraft	Michigan	8,806	11,888,100	2,972,025	0.11
Iron	Michigan	13,209	17,832,150	4,458,037	0.16
Mackinac	Michigan	11,077	14,953,950	3,738,487	0.13
Chippewa	Michigan	37,587	50,742,450	12,685,612	0.46
Total		653,753	882,566,550	220,641,637	6.72

- Medical and industrial: In the 1990 baseline estimate, medical and industrial incinerators were estimated to contribute 134 g TEQ/yr in dioxin air emissions. As of 1999, all medical incinerators have been closed in the U.S. portion of the Basin. The remaining industrial incinerators are estimated to account for approximately 83 g TEQ/yr (after Jackson 1993) in air emissions. As a result, dioxin air emissions are estimated to have declined to 83 g TEQ/yr for this sector in 1999.
- Small incinerators: In the 1990 baseline, small incinerators (e.g., those operated by schools, apartment buildings , and retailers) were estimated to contribute 235 to 2,274 g TEQ/yr in dioxin air emissions. As of 1999, all small incinerators are assumed to be closed in the U.S. portion of the Basin. As a result, no dioxin air emissions are estimated for this sector in 1999.
- WLSSD: The Western Lake Superior Sanitary District (WLSSD) operates the only municipal solid waste incinerator in the Basin (Stage 2 LaMP 1999). Estimated dioxin releases of 0.19 g TEQ/yr are based on stack testing. This incinerator is expected to close in 2000.

Municipal/Residential

- Wastewater treatment plant sludge: The WLSSD receives indirect discharges from three pulp and paper mills, as well as other industrial and commercial facilities. In addition, new cotton clothing and other household items have also been found to contain dioxins, which come out in the wash and are discharged to the wastewater treatment facility (Horstmann and McLachlan 1994). In 1990, WLSSD treatment plant sludge contained 0.014 g TEQ. Dioxin TEQ concentrations are assumed to remain constant in 1999.

Commercial Products

- Pentachlorophenol use: Pentachlorophenol has been used to preserve a variety of commercial products, including textiles and leather goods in the United States and abroad. In the past, pentachlorophenol was widely used as a pesticide although most of those uses are now restricted. Dioxin contamination in pentachlorophenol could contribute as much as 10,500 g TEQ dioxins/yr in the United States (Slants and Trends 1995). Based upon the normalized population of the LSB, approximately 18.0 g TEQ/yr of dioxin are assumed to be found in the Basin. The 1990 estimate was based on this national figure. A 1999 estimate should probably show a decrease because of declining use of pentachlorophenol. However, no updated estimates are available.

A.3.2 Dioxin Emission Estimates for the Canadian Lake Superior Basin

Table A.3.5 summarizes the estimated dioxin emissions in the Canadian portion of the Lake Superior Basin 1990 to 1999. The assumptions used to generate these estimates are presented in the following section.

Table A.3.5 Canadian Lake Superior Basin Dioxin Emission and Disposal Estimates

Source/Use Category	**1990 Emissions (g/yr)**			**1990 Use, Disposal, Soils (g /yr)**	**1999 Emissions (g /yr)**			**1999 Use, Disposal, Soils (g /yr)**
	Water	Air	Total Releases		Water	Air	Total Releases	
INDUSTRIAL								
Forest products	0.47	0.09	0.56	13.18	0.47	0.09	0.56	13.18
Mining/Sintering		21.8	21.8					
Wood preserving	1.52		1.52	1.53	1.52		1.52	1.53
Contaminated Soils			**0.1**	**31.38**[a]				
Industrial Total	**1.99**	**21.89**	**23.88**	**14.71**	**1.99**	**0.09**	**2.08**	**14.71**
FUEL COMBUSTION								
Coal		0.89	0.89	0.001		0.89	0.89	0.001
Wood		0.08	0.08			0.08	0.08	
Natural Gas		0.05	0.05			0.05	0.05	
Gasoline		0.02	0.02			0.02	0.02	
Fuel Combustion Total		**1.04**	**1.04**			**1.04**	**1.04**	
INCINERATION								
Medical		0.13	0.13	94		0.13	0.13	94
Small incinerators		NA						
Incineration Total		**0.13**	**0.13**	**94**		**0.13**	**0.13**	**94**
MUNICIPAL/RESIDENTIAL								
Wastewater treatment plant sludge	0.04	0.01	0.05		0.04	0.01	0.05	
Municipal/Residential Total	**0.04**	**0.01**	**0.05**		**0.04**	**0.01**	**0.05**	
COMMERCIAL PRODUCTS								
Pentachlorophenol use		0.27	0.27			0.27	0.27	
PCB spills			0.003	70[b]			0.003	70[b]
Commercial Products Total		**0.27**	**0.27**			**0.27**	**0.27**	
TOTAL	**2.03**	**23.34**	**25.37**	**108.71**	**2.03**	**1.48**	**3.51**	**108.7**

[a] Contaminated soils – not an annual rate of disposal.

[b] Resulting from spills – not included in annual disposal estimate.

All 1990 estimates are drawn from the Stage 2 LaMP (LSBP 1999) and are expressed in terms of dioxins and furans, rather than TEQs. As a result, the values are not directly analogous to the U.S. estimates reported in Table A.3.1, unless specifically noted . Emissions and dioxin/furan levels in soil and disposal are assumed to remain constant through 1999 except for the following changes:

Industrial

- Forest Products: Yearly average dioxin concentrations in the wastewater effluent form the kraft mills in the Thunder Bay Region have generally declined form 1990 to 1994, although information on total dioxin load has not been reported. As a result, dioxin load in wastewater from this sector is assumed to remain constant from 1990 to 1999 (Brigham 1999).
- Mining/Sintering: The Algoma Ore Division iron sintering plant in Wawa, Ontario closed in 1998, thereby eliminating the 21.8 g/yr in dioxin emissions estimated for this sector in 1990.

Incineration

- Medical: The number of medical incinerators in the Canadian Lake Superior Basin has declined from seven in 1990 to three in 1999 (Brigham 1999). As a result, dioxin emissions are assumed to have declined proportionally to 0.07 g dioxin/yr.