

CHAPTER III

MAJOR PROGRAMS AND ACTIVITIES

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This chapter summarizes major programs and activities undertaken or completed since the *Second Great Waters Report to Congress*. All of these programs and activities are helping to address issues relevant to the Great Waters program. The focus of this chapter primarily is on regulatory and policy initiatives as opposed to new science or research, which is covered in Chapter IV. Although some of the programs and activities described are being performed in conjunction with the EPA’s Great Waters program, most are not. Many of the activities are led by partners outside the EPA, and have been included because they contribute to emission reductions and loadings of Great Waters pollutants of concern.



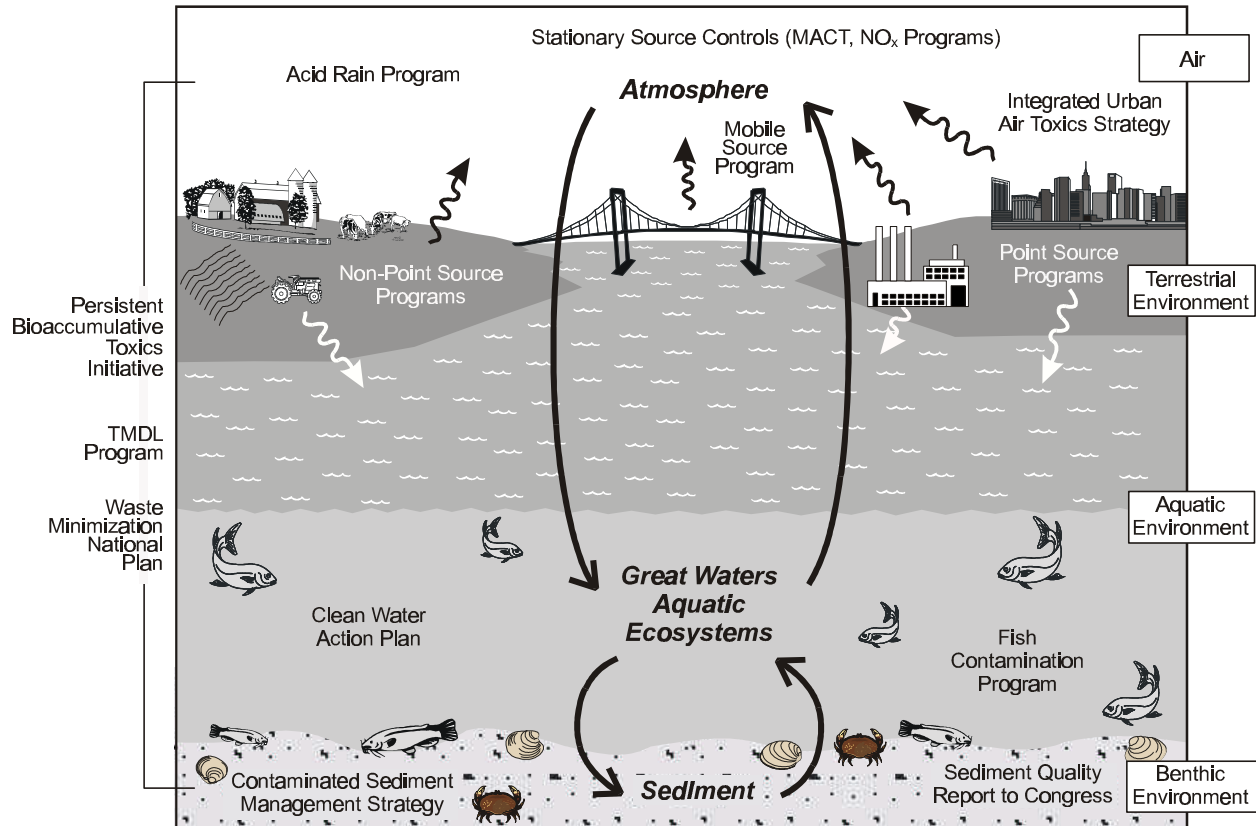
USDA Natural Resources Conservation Service, Romy Myszk

CHAPTER 3 HIGHLIGHTS

- 5 There are more than 60 programs in progress, described in this chapter, that directly or indirectly address issues of concern to the Great Waters.
- 5 Programs described in this chapter reduce the use of Great Waters pollutants of concern, reduce emissions of pollutants, restore (e.g., by sediment remediation) the Great Waters where they have been impacted, mitigate (e.g., by reducing consumption of contaminated fish) human health or ecological effects of Great Waters pollution, and provide a better scientific understanding of the sources, processes, and effects of and solutions to atmospheric deposition.
- 5 Essentially all of EPA's Program Offices and most Regional Offices are involved in national, regional, or waterbody-specific activities addressing Great Waters issues.
- 5 The EPA activities affecting Great Waters issues are performed under EPA's traditional media- and statute-specific programs (e.g., CAA programs) and under Agency-wide and inter-program multimedia initiatives (e.g., the Persistent Bioaccumulative Toxics Initiative (PBTI), Clean Water Action Plan).
- 5 In addition to EPA, numerous other parties (including other Federal agencies; municipal, State, tribal and international governing bodies; the private sector; and, academic researchers) are leading programs which address Great Waters issues and pollutants of concern.
- 5 The majority of the programs and activities described in this chapter involve collaborative partnerships, and many use community-based approaches to address local environmental priorities that are also Great Waters issues.

III.A NATIONAL PROGRAMS AND ACTIVITIES

A number of EPA's national programs and activities contribute to understanding and reducing pollutant impacts on the Great Waters. As discussed in Section I.B, most of the Great Waters pollutants of concern are also the focus of other national programs and activities. These programs and activities protect and enhance the quality of surface waters throughout the U.S., including the Great Waters. Recent accomplishments of these other programs and activities are summarized below, organized by whether they are considered multimedia activities, HAP-specific controls, mobile source program activities, or other national programs.



MULTIMEDIA ACTIVITIES

Persistent Bioaccumulative Toxics Initiative

The Persistent Bioaccumulative Toxics Initiative (PBTI) which was developed in an EPA-wide effort chaired by the Office of Prevention, Pesticides and Toxic Substances (OPPTS), supports Great Waters program goals by helping to reduce environmental releases of certain Great Waters pollutants of concern. The goal of the PBT Initiative is to further reduce risks to human health and the environment from existing and future exposure to persistent, bioaccumulative, and toxic (PBT) pollutants. The initiative seeks to accomplish this goal through increased coordination among EPA national and regional programs with the significant involvement of international, State, local, and tribal organizations, the regulated community, environmental groups, and private citizens. This effort fortifies existing EPA commitments related to priority PBTs, such as the 1997 Canada-U.S. Binational Toxics Strategy (BNS), the North American Agreement on Environmental Cooperation, and EPA's Clean Water Action Plan (see below for more information on these activities).

Guiding Principles for PBT Initiative

- 5 Address problems on multimedia basis through integrated use of all EPA tools
- 5 Coordinate with and build on relevant international efforts
- 5 Coordinate with relevant Federal programs and agencies
- 5 Stress cost-effectiveness
- 5 Involve stakeholders
- 5 Emphasize innovative technology and pollution prevention
- 5 Protect vulnerable subpopulations
- 5 Base decisions on sound science
- 5 Use measurable objectives and assess performance

The PBT Initiative initially will focus on the 12 priority pollutants identified under the Binational Toxics Strategy (BNS) (see sidebar below). The initiative includes the following steps:

1. *Develop and implement national action plans for priority PBT pollutants.* Near-term activities include pollution prevention projects, enforcement and compliance assistance, development or revision of water quality criteria, research and analysis of emission and discharge controls and other topics, and collaboration with other international efforts beyond the BNS. The draft Mercury Action Plan has been developed and includes regulatory and nonregulatory initiatives.

Binational Toxics Strategy - Level I Substances

Aldrin/dieldrin*	Mercury and compounds*
Benzo(a)pyrene*	Octachlorostyrene
Chlordane*	PCBs*
DDT (DDD/DDE)*	Dioxins and furans*
Hexachlorobenzene*	Toxaphene*
Alkyl lead*	
Mirex	

*Great Waters pollutants of concern

2. *Screen and select more priority PBT pollutants for action.* The EPA will apply selection criteria for additional pollutants in consultation with a technical panel.
3. *Prevent introduction of new PBTs.* The EPA is acting to prevent new PBT chemicals from entering commerce by (1) proposing criteria for new PBT chemicals, (2) developing a rule to prevent re-introduction of phased out PBTs, (3) developing incentives to reward development of

PBT alternatives, and (4) documenting how PBT-related screening criteria are being taken into account for approval of new pesticides and re-registration of existing pesticides.

4. *Measure progress.* The EPA is in the process of defining measurable objectives to assess progress. These could include trend detection in environmental health, direct measurements of human exposure through biomarkers, tracking of chemical releases to the environment, and program activity measures such as enforcement actions.

The EPA solicited public comments on a draft PBT Initiative published in late 1998. For further information on the status of the initiative, see the web page at www.epa.gov/pbt/strtegy.htm.

Total Maximum Daily Loads

Under the Federal Clean Water Act of 1972 (CWA), EPA is required to develop effluent guidelines for specific categories and classes of point sources. The guidelines are used to set discharge limits for specific facilities that discharge pollutants to surface waters or to municipal sewage treatment systems (63 FR 22644, April 27, 1998). However, many U.S. waterbodies do not meet applicable water quality standards, which include standards for many Great Waters pollutants of concern, despite the implementation of the CWA (see sidebar), in part because of non-point source pollution, including atmospheric deposition. Total maximum daily loads established under section 303(d)(1) of the CWA, provide a framework for addressing pollution from both point and non-point sources. A TMDL is developed for a waterbody if water quality standards within the waterbody are not being met using technology-based or other effluent controls. A TMDL establishes the maximum allowable pollutant loading for a waterbody (including allocations for point source loads and non-point source loads, and a margin of safety) that will result in the waterbody meeting established water quality standards. Specifically, TMDLs assess non-point source loads, such as atmospheric deposition, in addition to point source inputs. In some cases, TMDLs

National Water Quality Inventory

"The final National Water Quality Inventory Report to Congress for 1996 indicates that of the 72 percent of estuary waters assessed, 38 percent are not fully supporting uses/standards and 4 percent are threatened." (U.S. EPA 1998o).

Mercury TMDL Air Deposition Pilot Project

In order to assist States in preparing TMDLs for waterbodies affected by atmospheric pollutants, the EPA Office of Water (OW) and Office of Air Quality Planning and Standards (OAQPS) have initiated the Mercury TMDL Air Deposition Pilot Project. This project, a collaborative effort between OAQPS, OW, the Office of Research and Development, EPA regional offices and State agencies, will investigate tools and approaches for developing TMDLs in cases involving atmospheric pollutants. The project will design, develop, and identify uncertainties and data needs for pilot mercury TMDLs for two waterbodies receiving mercury contributions from the air. In the process, the compatibility of air and water quality modeling systems, as well as the linkages between the CWA and CAA will be evaluated. Two pilot TMDL waters have been selected for study (Devil's Lake, Wisconsin, and the Everglades Conservation Area 3a, Florida). Modeling work is under way.

attempt to identify the source of atmospheric deposition in order to implement appropriate measures to decrease the pollutant inputs to a watershed. In terms of atmospheric deposition, EPA is developing science and tools to assess the contribution of atmospheric sources to water pollution and to assist in decreasing total pollutant loadings to waterbodies.

As required by the CWA, States are directed to identify and directs States to identify and establish a priority ranking for waters that do not meet applicable water quality standards after application of technology-based and other controls, taking the severity of the pollution and the designated uses of the waterbody into consideration. The EPA's implementing regulations require States to submit these lists every 2 years. Once the list of priority waters is

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approved by EPA, the State establishes TMDLs for each waterbody on the list to restore water quality. The TMDL specifies the amount of pollution or other stressor that needs to be reduced to meet water quality standards, allocates pollution control or management responsibilities among sources in a watershed, and provides a scientific and policy basis for taking actions needed to restore a waterbody (U.S. EPA 1998o). A TMDL may also identify the need for point source or non-point source controls. The EPA recently began development of a TMDL pilot project addressing atmospheric deposition of mercury (see sidebar).

A variety of tools have been created to assist States in the process of developing TMDLs. Many of the tools were created in response to challenges encountered in allocating non-point source inputs of nitrogen compounds to specific land uses. Additional tools have been developed to assist in decreasing loadings to waterbodies. See, for example, the discussion of the Albemarle-Pamlico Estuary (NC) under the National Estuary Program in Section III.B.

Also, to assist in the implementation of TMDLs in States, EPA published a report, *TMDL Development of Cost Estimates: Case Studies of 14 TMDLs* (U.S. EPA 1996b). The selected TMDL case studies are from a variety of geographic locations, address the most common pollutants, range from small- to large-scale projects, and represent a range of complexity levels. The report also identifies funding sources and discusses benefits of TMDLs (U.S. EPA 1998v).

Pulp and Paper Cluster Rule

In April 1998, EPA promulgated the pulp and paper cluster rule – a joint CAA and CWA rule – which is designed to protect human health and the environment by reducing releases of toxic pollutants from the pulp and paper industry to air and water. This rule is the first integrated regulation to control the release of pollutants to more than one media from one industry. Implementation of the rule will further reduce paper industry air emissions and surface water discharges of certain Great Waters pollutants of concern (e.g., dioxins and furans).

By issuing joint standards, industry can consider all regulatory requirements at one time; therefore, reducing the regulatory burden and allowing mills to select the best combination of pollution prevention and control technologies that will provide the greatest protection to human health and the environment. The cluster rule requires new and existing pulp and paper mills (1) to capture and treat toxic air pollutant emissions that occur during cooking, washing, and bleaching stages of the pulp manufacturing process and (2) to meet new effluent limits for toxic pollutants in the wastewater discharged during the bleaching process and in the final discharge from mills in the bleached papergrade kraft and soda subcategory and in the bleach papergrade sulfite subcategory. The rule limits releases of toxic air pollutants from processes that are used at 155 of the 565 U.S. pulp and paper mills (i.e., the rule applies to paper and paperboard mills, also referred to as kraft, soda, sulfite, and semi-chemical mills) along with water discharges of toxics and other pollutants from the 96 of those 155 mills that bleach pulp to make paper. The new water limits are based on substituting chlorine dioxide for chlorine in the bleaching process (63 FR 18504, April 15, 1998).

The new air and water standards under the pulp and paper cluster rule will provide significant environmental benefits, including:

- C Seventy-three rivers and streams will become cleaner because of toxic release reductions;
- C Emissions of over 160,000 tons of toxic air pollutants will be eliminated;

- C Dioxin and furan discharges to water will be reduced by 96 percent; and,
- C Ultimately, all dioxin fish consumption advisories associated with the 96 mills affected by this action will be eliminated (63 FR 18504, April 15, 1998).

The pulp and paper cluster rule also includes an innovative voluntary incentives program (i.e., the Voluntary Advanced Technology Incentives Program). Under this program, mills are voluntarily subject to more stringent standards in return for rewards, such as increased compliance time, reduced monitoring requirements and inspections, greater permit certainty, reduced penalties, and public recognition (63 FR 18504, April 15, 1998). For example, mills participating in the program are allowed 6 years instead of 3 years to comply with air standards and 6 to 16 years to comply with water discharge permit limits, depending on the performance level of the new technology or process change. This program also encourages mills to consider all technology options prior to making large investment decisions, such as purchasing new emissions control devices or implementing major process changes (U.S. EPA 1997d). In the long term, this innovative program could result in additional reductions in air toxics releases and water pollutant discharges.

Mercury Research Strategy

The EPA, in an intra-agency effort led by EPA's Office of Research and Development, is developing a *Mercury Research Strategy*, which is expected to be completed in 2000. The EPA plans for the strategy to describe:

- C The key scientific questions of greatest concern to EPA for mercury risk assessment and risk management that EPA plans to investigate over the coming 5 years; and,
- C A research program which would provide information, methods, models, and data to address these key scientific questions.

The research strategy is intended to guide EPA's development of research plans and decisions about future research priorities and budgets. It may also provide useful information to others in guiding their research. However, the strategy is not intended to convey information on specific projects, nor will it provide a detailed schedule of outputs or products.

Clean Water Action Plan

Completed in February 1998, the Clean Water Action Plan is an interagency, multimedia strategy to address remaining obstacles to the original goal of the Clean Water Act – “fishable and swimmable” water for all Americans (U.S. EPA 1998a). The action plan was requested by Vice President Al Gore on October 1997 to mark the 25th anniversary of the Clean Water Act. It forms the core of President Clinton's Clean Water Initiative, which was proposed in the 1998 State of the Union Address. Together, the Clean Water

**Clean Water Action Plan:
Key Actions to Assess and Reduce Air Deposition
of Nitrogen**

“EPA and NOAA will work with other Federal, State, tribal, and local government agencies and others to better quantify the risks associated with atmospheric deposition of nitrogen compounds and other pollutants to waterbodies.”

“EPA will work through the TMDL program to evaluate the linkage of air emissions to the water quality impacts to help determine appropriate reduction actions. EPA will work with States, tribes, and Federal land management agencies to employ both Clean Water Act and Clean Air Act authorities to reduce air deposition of nitrogen compounds and other pollutants that adversely affect water quality.” (U.S. EPA 1998a)

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Action Plan and Initiative outline specific actions to strengthen and expand efforts to restore and protect water resources.

The plan identifies non-point sources (including atmospheric deposition) as the most important remaining threat to water quality. Because EPA's existing water programs do not focus on control of non-point sources, the action plan emphasizes innovative approaches such as partnerships with local stakeholders and watershed-level projects. Atmospheric deposition is among the leading non-point sources addressed by the action plan. In particular, agencies pledged to work together to better assess the risks associated with atmospheric deposition of nitrogen compounds (see sidebar) and other pollutants to waterbodies and to integrate air deposition into TMDL evaluations. In addition, EPA will include air deposition in a multiagency coastal research strategy and coordinated coastal monitoring plan, expected to be issued in 2000.

Another action in the President's Clean Water Action Plan is to conduct a national survey of levels of persistent bioaccumulative toxic (PBT) chemical levels in fish and shellfish throughout the country. Specifically, EPA and NOAA are conducting a study to estimate the national distribution of the mean levels of selected PBT chemical residues in fish and shellfish tissue in U.S. waters. The study will provide information for the Agency's PBT Initiative, which seeks to identify potential areas of concern for human and/or ecological health. The study of fish tissue may reveal where PBT chemicals not previously considered a problem are present in the environment at levels of concern. For the national fish study, fish will be obtained from lakes and reservoirs which have been selected according to a probability design. The shellfish survey will be based on the data obtained by NOAA's ongoing Mussel Watch Project. Both studies will be coordinated with State and tribal efforts to maximize geographic coverage.

Sediment Quality Report to Congress

Once deposited to surface waters from the air or other sources (e.g., industrial and municipal point discharges, urban and agricultural runoff), most of the Great Waters pollutants of concern tend to accumulate in sediments where they may reach concentrations harmful to aquatic life and the food web. In recognition of environmental and economic problems associated with contaminated sediment, Congress included in the Water Resources Development Act (WRDA) of 1992 a requirement for EPA, in cooperation with NOAA and the U.S. Army Corps of Engineers, to conduct a comprehensive national survey of data regarding the quality of aquatic sediments in the U.S.

In September 1997, EPA's Office of Science and Technology within the Office of Water published the first biennial Sediment Quality Report to Congress, entitled the *Incidence and Severity of Sediment Contamination in the Surface Waters of the United States*. The report consisted of three volumes:

- Volume 1: The National Sediment Quality Survey (U.S. EPA 1997i);
- Volume 2: Data Summaries for Areas of Probable Concern (U.S. EPA 1997j); and,
- Volume 3: The National Sediment Contaminant Point Source Inventory (U.S. EPA 1997k).

The National Sediment Quality Survey (NSQS) (U.S. EPA 1997i) describes the accumulation of chemical contaminants in river, lake, ocean, and estuary bottoms and includes a screening assessment of the potential for associated adverse effects on human and environmental health. Key findings of the NSQS are discussed in Chapter II.

In developing the NSQS, EPA compiled all available computerized data on the quantity, chemical and physical composition, and geographic location of pollutants in sediment. The database is referred to as the National Sediment Inventory (NSI) and is the largest set of sediment chemistry and related biological data ever compiled by EPA. The NSI will be updated on a regular basis in order to assess trends in both sediment quality and the effectiveness of existing regulatory programs at the Federal, State, and local levels. The NSI is discussed further in Chapter IV.

The EPA's mandate to investigate sediment contamination in the Nation's water included a directive to identify potential pollutant sources. Volume 3 of the Sediment Quality Report to Congress (U.S. EPA 1997k) evaluated point sources (i.e., direct discharges to waterbodies). In future biennial Reports to Congress, EPA will assess loadings from non-point sources, including harvested croplands, urban areas, atmospheric deposition, and abandoned and inactive mine sites (U.S. EPA 1997i). To prepare the non-point source inventory for the second Sediment Quality Report to Congress, EPA is currently compiling data from the Bureau of the Census, the U.S. Department of Agriculture, the U.S. Department of the Interior's U.S. Geological Survey and Bureau of Mines, and others.

Contaminated Sediment Management Strategy

The EPA is using data compiled for the Sediment Quality Report to Congress and other resources for a multiprogram, multimedia effort to coordinate and streamline contaminated sediment management decisions within the Agency. In April 1998, EPA's Office of Water completed the Contaminated Sediment Management Strategy (U.S. EPA 1998d), which outlines the following specific actions:

1. Control sources of sediment contamination and prevent the volume of contaminated sediment from increasing;
2. Reduce the volume of existing contaminated sediment;
3. Ensure that sediment dredging and dredged material disposal are managed in an environmentally sound manner; and,
4. Develop scientifically sound sediment management tools for use in pollution prevention, source control, remediation, and dredged material management.

The Contaminated Sediment Management Strategy identifies atmospheric deposition as an important source of sediment contamination. Specifically, the strategy directs EPA's Office of Air and Radiation to use the National Sediment Inventory (NSI) to evaluate the contribution of atmospheric deposition to sediment quality problems. This new tool will enable EPA to better assess trends in sediment pollution, including pollution from atmospheric deposition, and focus cleanup and pollution control activities. In addition, the strategy identifies the Agency's Great Waters program as a significant component of its coordinated effort to address contaminated sediment problems.

The Contaminated Sediment Management Strategy includes a research component designed to identify relationships between sediment contaminants and the viability and sustainability of benthic ecosystems. Ultimately, the research will help to formulate source control and pollution prevention strategies. In addition, the strategy outlines coordinated, multiprogram efforts of research and policy development to ensure that uniform exposure and effects assessment procedures for contaminated sediments are used throughout the Agency. For example, EPA proposed, and is currently developing, standard sediment toxicity test methods and chemical-specific sediment quality guidelines. The strategy

proposes several specific uses of the assessment procedures and sediment quality guidelines, and the Agency has begun to develop an *Equilibrium Partitioning Sediment Guidelines User's Guide*.

Waste Minimization National Plan

The Waste Minimization National Plan (WMNP), which EPA's Office of Solid Waste developed in 1994, is a voluntary, long-term effort to reduce the quantity and toxicity of hazardous waste through source reduction and recycling, including wastes bearing Great Waters pollutants of concern such as mercury and dioxin. The plan calls for a 50 percent reduction in the presence of the most persistent, bioaccumulative, and toxic (PBT) chemicals in hazardous waste by 2005 compared to a baseline year of 1991. This goal was also adopted as a Government Performance and Results Act (GPRA) measurement goal.

To assist in implementing the WMNP, the Office of Solid Waste and the Office of Pollution Prevention and Toxic Substances have developed a draft Windows-based software tool to prioritize PBT chemicals for waste minimization efforts. The Waste Minimization Prioritization Tool (WMPT) provides a screening-level assessment of potential chronic risks that chemicals, including most Great Waters pollutants of concern, pose to human health and the environment, based on their persistence, bioaccumulative potential, and human and ecological toxicity. More information about the WMPT can be found on EPA's waste minimization home page at www.epa.gov/wastemin.

The WMPT served as a starting point in developing the draft Resource Conservation and Recovery Act PBT Chemicals List (63 FR 60332, November 9, 1998). Other factors, such as quantity, prevalence, environmental presence, and degree of concern to the RCRA program, were used in the selection of chemicals for the draft list. The final list of chemicals is expected to be published in the *Federal Register* in 2000. This final list will serve to focus national waste minimization efforts and track progress toward the 2005 reduction goal.

Air Characteristic Study

The Air Characteristic Study currently being conducted by EPA's Office of Solid Waste addresses the question of whether some industrial wastes should be classified as hazardous because of risks posed by their air emissions. The overall goal of this study is to estimate the maximum waste constituent concentrations that could be present in certain waste management units and still be protective of human health.

The study is estimating potential risk to humans for 105 chemical constituents, of which 88 are HAPs under the CAA and several are Great Waters pollutants of concern (e.g., lead compounds, mercury, benzo[a]pyrene, dioxin, and others). Draft results of the risk analysis indicate that volatile toxic chemicals managed in non-storage tanks, such as aerated wastewater treatment tanks, pose the highest risk, with the waste concentrations for these aerated tanks differing from other units by an order of magnitude or more. Storage tanks, land application units, landfills, and waste piles followed aerated tanks in ranking of risk. The findings of this study, due to be completed in 2000, will assist EPA in exploring the need for regulatory changes under RCRA for these waste management units and in investigating possible options for risk reduction.

HAZARDOUS AIR POLLUTANT (HAP) CONTROLS

Under the CAA, EPA is required to regulate sources of 188 listed HAPs. All but two of the pollutants identified as Great Waters pollutants of concern are listed as HAPs. (The two Great Waters pollutants that are not HAPs are nitrogen and dieldrin.) On July 16, 1992, EPA published a list of 174 industry groups (known as source categories) that emit one or more of these air toxics. For listed categories of “major” sources (those with the potential to emit 10 tons/year or more of a listed pollutant or 25 tons/year or more of a combination of pollutants), the CAA requires EPA to develop standards under section 112(d) that require the application of air pollution reduction measures known as MACT. This performance-based approach requires EPA to set standards based on consideration of those controls in use at the best controlled facilities within an industry.

The CAA provided a 10-year schedule in which to promulgate these technology-based standards with certain standards being promulgated in the first 2 years, 25 percent in the first 4 years, an additional 25 percent no later than the 7th year, and the remaining 50 percent no later than the 10th year. The EPA has been productive in fulfilling these statutory requirements and, working in partnership with States, has built the necessary infrastructure for implementing the air toxics regulations. For the 45 source categories in the 2- and 4-year groups, EPA estimates that the regulations will reduce air toxics emissions by approximately one million tons per year. For the 42 source categories in the 7-year group, EPA has either proposed or promulgated regulations that are estimated to reduce air toxics emissions by roughly 500,000 tons per year. A list of all source categories, the MACT implementation schedule, and references to proposed and final rules is included in Appendix C of the *Residual Risk Report to Congress* (U.S. EPA 1999d).

Some regulations are already in place under section 112(d) with sources currently in compliance. The source categories affected by these rules are listed in Table III-1 below along with the emission reductions of the affected pollutants of concern, where available.

**Table III-1
Source Categories With Effective Compliance Dates
and Anticipated Reductions of HAP Emissions**

Source Category	Compliance Date	Pollutant	Nationwide Pre-MACT Emissions (tpy)	Nationwide Expected Percent Reductions
Coke oven batteries: Charging, leaks, and bypass/bleeder stacks	01/01/98	Coke oven emissions ^a	1600	94
Secondary Lead Smelting	12/23/97	All HAPs ^b	1900	65
		Lead Compounds	120	40

^a Coke oven emissions include POM.

^b HAP emissions for this category include lead compounds, dioxins/furans, mercury, and POM among other pollutants. Of these, lead compounds is the only pollutant of concern for which pollutant-specific estimates are available.

Section 112(c)(6) of the CAA directs EPA to focus attention on seven specific toxic pollutants – all of which are Great Waters pollutants of concern: alkylated lead compounds, hexachlorobenzene, POM, mercury, PCBs, dioxins, and furans. The Agency is to ensure that sources accounting for at least 90 percent of the emissions of each of these pollutants are subject to standards under section 112(d)

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(described above). Section 112(c)(6) of the CAA requires EPA to identify the source categories that emit 90 percent of the aggregate emissions for each of the seven specific pollutants and add any source categories not previously identified to the list discussed above.

Under section 112(c)(6), a review of the available data indicated that nearly all source categories emitting the seven pollutant groups had already been listed for regulation under the CAA or were subject to comparable regulation under other CAA authorities. However, two additional source categories were added to the source category list in a final *Federal Register* notice on April 3, 1998. These two categories are open burning of scrap tires and gasoline distribution (Stage I Aviation), which includes evaporative losses associated with the distribution and storage of aviation gas containing lead. A comment and response document is available along with the 1990 emissions inventory for the seven pollutants at www.epa.gov/ttn/uatw/112c6/112c6fac.html.

A different section of the CAA (section 129) is devoted to control of certain air toxics, as well as other pollutants, from solid waste combustion units. The pollutants of concern to the Great Waters covered are lead, cadmium, mercury, dioxins and furans, and NO_x. This regulatory program is discussed later in this section.

Under sections 112 and 129, several rules have either been proposed or finalized, but the compliance date has not yet been reached. A summary of these actions and their anticipated emission reductions are listed below in Table III-2. In addition, under the joint authority of section 112 and the Resource Conservation and Recovery Act (RCRA), EPA's Office of Solid Waste finalized on July 30, 1999 (signed by the Administrator) new emission standards for existing and new cement kilns, incinerators, and lightweight aggregate kilns that burn hazardous wastes. These combustors burn about 80 percent of the hazardous waste combusted annually within the U.S. When fully implemented in 2002, the MACT standard for these sources is expected to achieve significant reductions in emissions of several Great Waters pollutants of concern, including dioxin/furans, mercury, lead and cadmium. These standards will also satisfy our obligation under RCRA to ensure that hazardous waste combustion is conducted in a manner adequately protective of human health and the environment.

The remaining 50 percent of MACT regulations are expected to be issued within the next 2 years (by 2002). Based on our current knowledge of the remaining industries slated for regulation under section 112(d), those that emit pollutants of concern to the Great Waters include chlorine manufacturing (chlor-alkali plants), coke ovens (pushing, quenching and battery stacks), industrial boilers, institutional and commercial boilers, iron and steel, and refractory manufacturing. There are more MACT rules for solid waste combustion under section 129 noted later in this section.

In addition to the standards development requirements of the CAA, there are a number of other HAP program requirements that will help reduce emissions of the Great Waters pollutants of concern. These are briefly described below. Additional information regarding the air toxic program can be found on the Internet at EPA's unified air toxics web site at www.epa.gov/ttn/uatw.

Mercury Study Report to Congress

The *Mercury Study Report to Congress*, issued by EPA in December 1997 (U.S. EPA1997e), is a comprehensive document detailing the U.S. mercury emissions inventory, fate and transport of mercury in the environment, human health effects, an ecological risk assessment, a human and wildlife risk characterization, and an assessment of control technologies and their costs. The report also outlines research needs. Pertinent results and conclusions from this report are described in the mercury and compounds section of Chapter 2.

**Table III-2
Proposed and Final Rules Affecting Pollutants of Concern**

Source Category	Status	Pollutants	Nationwide Pre-MACT Emissions (tpy)	Nationwide Expected Percent Reductions
Municipal waste combustion (large combustors, > 250 tons per day)	Final rule and guidelines	Dioxins/Furans ^a	0.0025	98
		Mercury ⁱ	54	78
		Lead	64	75
		Cadmium	4.2	67
		NO _x	54,000	36
Medical waste incineration	Final rule and guidelines	Dioxins/Furans ^a	0.0002	95-97 ^b
		Mercury	16	93-95 ^b
		Lead	12	80-87 ^b
		Cadmium	1.3	75-84 ^b
		NO _x	1,300	0-30 ^b
Pulp and paper cluster ^c	Final rule	HAPs	240,000	58
Primary aluminum production	Final rule	POM	2,000	50
Secondary aluminum production	Final rule	HAP metals ^d	64.4	62.5
		Dioxins/Furans ^a	0.0009	86.6
Primary copper production	Proposed rule	Cadmium	0	0
		Lead	140	13
		Mercury	0	0
Pesticide active ingredient production ^e	Final rule	HAPs ^e	4,255	65
Portland cement manufacturing - nonhazardous waste -fired	Final rule	Dioxins/Furans ^a	0.0005	36
		Mercury	4	0
		HAP metals ^f	f	f
Mineral wool production	Final rule	HAP metals ^g	1.1	91
Hazardous Waste combustion (existing and new cement kilns, incinerators, and lightweight aggregate kilns that burn hazardous waste)	Final rule	Dioxins/Furans ^a	.000044	70
		Mercury	6.5	55
		Lead and Cadmium	88.5	88
		Other HAP Metals ^h	9.8	75

Table III-2 (continued)
Proposed and Final Rules Affecting Pollutants of Concern

^a Dioxin/Furan emissions are reported on a 2,3,7,8-TEQ basis.

^b Ranges reflect different assumptions on the number of incinerator closures.

^c Values represent air emissions affected by the cluster rule only. Values for individual HAPs were not provided in the final rule.

^d The HAP metals for secondary aluminum production are mercury, lead, and cadmium, as well as eight other HAP metals.

^e This rule covers 11 of the source categories listed for regulation. Values for individual HAPs are not available. Included are emissions of HCB and chlordane, although they are not the most prevalent HAPs in this category.

^f The rule includes a particulate matter limit, which serves as a surrogate for all non-volatile and semi-volatile HAPs, including metals. These metals are estimated to be no more than 1 percent of the total particulate matter HAPs. The rule is estimated to achieve about 20 percent reduction in particulate matter emissions.

^g The HAP metals for mineral wool production are cadmium and lead, as well as seven other HAP metals.

^h The other HAP metals for hazardous waste combustion include antimony, cobalt, manganese, nickel, and selenium.

ⁱ Emission reductions for municipal waste combustion are often cited from a 1990 baseline, other than the pre-MACT baseline presented here. For example, the rule and guidelines will reduce mercury emissions by greater than 90 percent from 1990 levels when fully implemented.

The *Mercury Study Report to Congress* is not a regulatory effort; currently it is being broadly used in support of Great Waters activities, the PBT Initiative, the Binational Toxics Strategy, the mercury research strategy, and other EPA efforts to understand and control this pollutant.

Utility Air Toxics Study and Regulatory Determination

In February 1998, EPA issued a study of the public health impacts of emissions of air toxics from utilities that burn fossil fuel (U.S. EPA 1998p). About 67 air toxics were found to be emitted from utilities, including mercury and dioxins. The report includes (1) a description of the utility industry; (2) an analysis of air toxics emissions data from coal-, oil-, and gas-fired utility plants; (3) an assessment of risks to public health from exposure to air toxics emissions through inhalation; (4) an assessment of potential risks to public health from exposure to four specific air toxics (i.e., radionuclides, mercury, arsenic, and dioxins) through other indirect means of exposure (e.g., food ingestion, dermal absorption); (5) a general assessment of the fate and transport of mercury through environmental media; and, (6) a discussion of alternative control strategies.

The report indicates that, although uncertainties in the analysis exist, on balance, mercury from coal-fired utilities is the HAP of greatest potential public health concern. The report identifies three other air toxics for which there are some potential concerns and uncertainties that may need further study: dioxins, arsenic, and nickel.

The CAA also requires EPA to make a determination, after considering the results of the utility study, as to whether emission controls for air toxics are appropriate and necessary for utility boilers. The EPA has delayed this determination until it collects additional information, and EPA's Office of Air and Radiation is currently collecting the following mercury emissions data from electric utility steam generating units:

- C Current information on the type of coal they use and on their method of particulate matter (PM) and sulfur dioxide (SO₂) control at all "traditional" coal-fired electric utility steam generating units;
- C Current information on the fuel they use and on their method of PM and SO₂ control at all independent power producers that could be identified as possibly burning coal;

- C 1 year of mercury-in-coal analyses at all coal-fired units meeting the section 112(a)(8) definition of “electric utility steam generating unit”; and
- C One series of speciated mercury emissions testing at a randomly selected subset of coal-fired units.

The regulatory determination is scheduled to be provided by December 15, 2000 (U.S. EPA 1998p).

Residual Risk Report to Congress

Under section 112(f) of the CAA, EPA is required to develop and implement a program for assessing risks remaining (i.e., the residual risk) after facilities have implemented MACT standards, and to promulgate rules, if necessary, to protect the public health with an “ample margin of safety” or to prevent adverse environmental effects. Additional risk-based regulations, if needed, are to be promulgated within 8 years after EPA promulgates an air toxics standard for a given source category. The first such risk-based regulations, if necessary, are due in 2002. If promulgated, residual risk standards could further reduce emissions of Great Waters pollutants of concern.

In March 1999, EPA issued the *Residual Risk Report to Congress*. This report reviews EPA human and ecological risk assessment methods, identifies data sources and data collection needs for conducting risk assessments, proposes methods on how to close data gaps, discusses how results of residual risk assessments will be used in the residual risk program, and includes an appendix of all MACT source categories, the MACT implementation schedule, and references to proposed and final rules. In addition, the report discusses the strategy or “framework” EPA will use in conducting residual risk assessments.

The risk assessment framework under the residual risk program was developed using knowledge gained from past risk assessments and information from other regulatory agencies and guidance from reports. This strategy calls for an iterative, tiered assessment of the risks to humans and ecological receptors through inhalation and, where appropriate, non-inhalation exposures to air toxics. The residual risk assessment framework will allow the Agency to be flexible in its decisions while ensuring that public health and the environment are protected. The EPA’s objectives also include integration of all portions of the Federal air toxics program, continuing the partnership with State/local programs in the sharing of data and expertise, and including groups who may be affected by residual risk decisions (e.g., industry, public interest groups) as part of the process.

Integrated Urban Air Toxics Strategy and Report to Congress

As part of its overall efforts to reduce air toxics, EPA published the integrated urban air toxics strategy in the *Federal Register* on July 19, 1999 (64 FR 38706). The strategy presents a framework for addressing air toxics in urban areas as required by section 112(k) of the CAA. The goals of the strategy are to reduce by 75 percent the risk of cancer and substantially reduce non-cancer risks associated with air toxics while ensuring that disproportionate risks are addressed. Specifically, the strategy does the following:

- *Outlines EPA’s approach for assessing health risks.* The EPA will evaluate risks considering the multiple sources of air toxics in our cities, whether they come from major industrial sources, smaller sources (like drycleaners or gas stations), or cars and trucks. This includes risks from consuming fish from waters contaminated by urban air toxic deposition.

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- *Builds on the substantial emission reductions already achieved from cars, trucks, fuels, and industries such as chemical plants and oil refineries.* The strategy outlines actions to reduce emissions of air toxics and to improve EPA's understanding of the health risks posed by air toxics in urban areas.
- *Identifies a list of the 33 air toxics that pose the greatest threat to public health in urban areas, considering multipathway exposure, such as fish consumption, in the identification process.* These 33 air toxics are a subset of the 188 air toxics and include the Great Waters pollutants of concern mercury, cadmium, lead, dioxins and furans, POM, PCBs, and HCB.
- *Identifies the 30 of these 33 urban air toxics with the greatest contribution from smaller commercial and industrial operations or so-called "area" sources.* The CAA requires EPA to ensure that 90 percent of the aggregate emissions of each of the 30 identified HAPs are subject to regulation through EPA's established air toxics program. In order to address this requirement, EPA identified 29 area source categories that are significant contributors to the emissions, including sources of mercury, cadmium, lead, POM, dioxins and furans. Currently, EPA has regulations under development or completed for 16 of these area source categories and intends to develop regulations for the remaining 13 area source categories over the next 5 years. The EPA intends to list additional area sources by 2003 as better inventory data become available.

The strategy also addresses the Agency's efforts to date to assess the public health risk from air toxics from mobile sources and highlights EPA's expectation for additional regulations targeting toxics emissions from motor vehicles and fuels. In the strategy, EPA describes plans to consider diesel emissions in the upcoming mobile source air toxics regulation and to issue a rule (the proposed "Tier II rule"; see page III-29) which will reduce levels of diesel emissions significantly in both urban and rural areas.

Rules for Solid Waste Combustion, Including Large Municipal Waste Combustors and Hospital/Medical/Infectious Waste Incinerators (CAA Section 129)

Section 129 of the CAA directs EPA to control solid waste combustion and set emission limits for dioxins and furans, cadmium, lead, mercury, and NO_x (all pollutants of concern to the Great Waters), as well as particulate matter, opacity, sulfur dioxide, carbon monoxide, and hydrogen chloride. For existing solid waste combustion units, section 129 requires EPA to develop emission guidelines. These guidelines do not directly regulate the units. Rather, they establish requirements for State plans, which are the vehicle by which States implement the guidelines. For new units, section 129 requires EPA to develop technology-based performance standards following section 111 of the CAA. Section 129 further subjects solid waste combustion units to the section 112(f) residual risk program, which was discussed earlier in this section.

Final rules are now in place for large municipal waste combustors (MWC) and for hospital/medical/infectious waste incinerators (HMIWI, or often called medical waste incinerators). There are also rules under development for small municipal waste combustors, commercial/industrial waste incineration, and other solid waste incineration. The commercial/industrial waste incineration rule is planned to be finalized by November 15, 2000; the small municipal waste combustor rule is planned to be finalized by 2001.

Large MWC are those units with a capacity of at least 250 tons of waste per day. The EPA initially promulgated standards for new units and guidelines for existing units on December 19, 1995 and revised them on August 25, 1997. The 24 States with large MWCs were required to submit emission guidelines implementation plans to EPA by December 19, 1997. The State plans include source and emission inventories, testing and monitoring, as well as generic or site-specific compliance schedules. The MWC Federal Plan adopted in November 1998 applies to large MWCs until State plans are approved. The Federal Plan ensures that large MWCs are on track to complete pollution control equipment retrofit schedules to meet the final compliance date of December 19, 2000. The emission guidelines affect 70 large MWCs and will reduce toxic air pollutant emissions by 112,000 tons per year. Table III-2 provides the nationwide emission estimates and expected percent reductions for pollutants of concern to the Great Waters. The control equipment expected to be used at a typical existing plant reduce dioxin emissions by 99 percent, mercury emissions by over 90 percent, NO_x emissions by 40 percent, and will sharply reduce other air pollutants like lead and cadmium, as shown in Table III-3.

Table III-3
Emission Reductions Expected from Control Equipment Used to Retrofit A Typical Existing MWC Plant

Pollutant	Typical Uncontrolled Level	Typical Controlled Level	Percent Reduction
Dioxin/furan (ng/dscm) total mass	1,000	3	99+
Particulate matter (mg/dscm)	3,700	4	99+
Cadmium (mg/dscm)	1.2	0.001	99+
Lead (mg/dscm)	25	0.01	99+
Mercury (mg/dscm)	0.65	0.02	90+
Sulfur dioxide (ppmv)	160	5	90+
Hydrochloric acid (ppmv)	500	10	95+
NO _x (ppmv)	225	130	40+

Source: U.S. EPA 1998h

For HMIWI, the emission guidelines and performance standards were published in the *Federal Register* in September 1997. The guidelines will apply to about 2,400 existing HMIWI; full compliance with them is no later than September 2002. In addition, EPA developed a new source performance standard (NSPS) that applies to new HMIWI that commence construction after June 20, 1996 or that commence modification after the effective date of the NSPS (i.e., 6 months after promulgation). In the first 5 years after promulgation, the NSPS are expected to apply to about 10 to 70 new HMIWI. The pollutants addressed, regulatory baseline emissions, and expected reductions of the emission guidelines and the NSPS are presented in Tables III-4 and III-5, respectively.

STATIONARY SOURCE CONTROLS ADDRESSING NO_x

The CAA provisions specifically addressing NO_x have had the greatest effect on controlling stationary source nitrogen compound emissions. Primarily because of these provisions, nationwide NO_x emissions are projected to decrease gradually for the next few years, ultimately leveling off at around 19 million metric tons per year around 2005, representing a decrease from the 1996 level of around 21.2 million metric tons/year (U.S. EPA 1998l). Nitrogen oxide emissions are projected to remain at about

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that level through 2010. Figure III-1 indicates projected trends in NO_x emissions through 2010. The EPA plans to update these projections in 2000 using newer models for mobile and stationary sources. Among other benefits, these reductions will reduce rates of atmospheric nitrogen deposition affecting the Great Waters.

This section summarizes recent developments in key CAA programs that have recently or will in the near future reduce NO_x emissions from stationary sources. It lists and briefly describes, in Table III-6, CAA regulatory controls that will result in NO_x emission reductions. It also presents the sources affected, compliance dates, and the emission reductions that each regulation is expected to achieve. Finally, the section discusses the effect on NO_x emissions of possible new 8-hour ozone and PM_{2.5} standards, as well as the regional haze rule.

Table III-4
Emission Reductions Expected from Existing HMIWI

Pollutant	Baseline Emissions	Nationwide Emission Reduction	Nationwide Emission Reduction (percent)^a
Particulate matter (Mg/yr)	940	820-870	88-92
Carbon monoxide (Mg/yr)	460	340-380	75-82
Total Dioxin/Furan ^b (g/yr)	7,200	6,900-7,000	96-97
Dioxin/Furan TEQ ^b (g/yr)	148	141-143	95- 97
Hydrochloric acid (Mg/yr)	5,700	5,600	98
Sulfur dioxide (Mg/yr)	250	0-74	0-30
NO _x (Mg/yr)	1,200	0-350	0-30
Lead (Mg/yr)	11	8.6-9.4	80-87
Cadmium (Mg/yr)	1.2	0.91-1.0	75-84
Mercury (Mg/yr)	14.5	13.5-13.8	93-95

^a These reductions represent reductions from the regulatory baseline. Percent reductions have been calculated based on the actual (unrounded) values for baseline emissions and nationwide emissions reduction.

^b Total dioxin/furan reflects total tetra- through octa-chlorinated dibenzo-p-dioxins and dibenzofurans, as measured by EPA Reference Method 23. TEQ reflects the toxic equivalent quantity of 2,3,7,8-tetrachlorinated dibenzo-p-dioxin using international toxic equivalency factors.

Source: U.S. EPA 1998g

**Table III-5
Emission Reductions Expected at New HMIWI after 5 Years of NSPS Implementation**

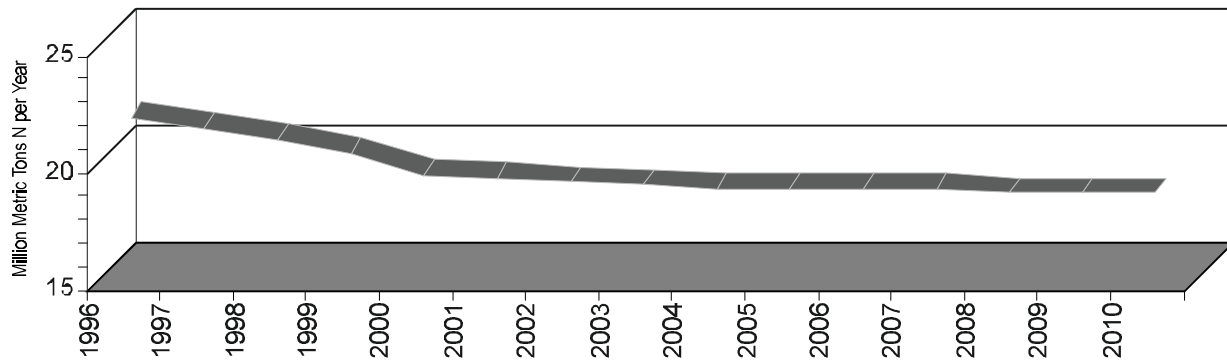
Pollutant	Baseline Emissions	Nationwide Emission Reduction	Nationwide Emission Reduction (percent) ^a
Particulate matter (Mg/yr)	28	23-25	85-92
Carbon monoxide (Mg/yr)	14	0-7.0	0-52
Total Dioxin/Furan ^b (g/yr)	47	35-41	75-87
Dioxin/Furan TEQ ^b (g/yr)	1.1	0.80-0.93	74-87
Hydrochloric acid (Mg/yr)	64	61-62	95-98
Sulfur dioxide (Mg/yr)	28	0-15	0-52
NO _x (Mg/yr)	130	0-69	0-52
Lead (Mg/yr)	0.39	0.33-0.36	85-92
Cadmium (Mg/yr)	0.051	0.042-0.046	83-91
Mercury (Mg/yr)	0.21	0.10-0.16	45-74

^a These reductions represent reductions from the regulatory baseline. Percent reductions have been calculated based on the actual (unrounded) values for baseline emissions and nationwide emissions reduction.

^b Total dioxin/furan reflects total tetra- through octa-chlorinated dibenzo-p-dioxins and dibenzofurans, as measured by EPA Reference Method 23. TEQ reflects the toxic equivalent quantity of 2,3,7,8-tetrachlorinated dibenzo-p-dioxin using international toxic equivalency factors.

Source: U.S. EPA 1998j

**Figure III-1
Projected National NO_x Emission Trends, 1996-2010
(U.S. EPA 1998l)**



**Table III-6
Recent Regulations Affecting Stationary Source NO_x Emissions**

Regulation	Compliance Date	Affected Sources	NO _x or Related Requirement	Projected NO _x Emission Reductions (year by which reductions will be achieved)
NO _x RACT ¹	May 31, 1995	Boilers and combustion units (varies from State-to-State)	Varies from State-to-State	Estimated 30 to 50 percent reduction from applicable sources. [some overlap with Title IV Acid Rain reductions]
Title IV Acid Rain NO _x	Group 1 (Phase I): January 1, 1996 Group 1 (Phase II) and Group 2: January 1, 2000	Group 1: Coal-fired dry bottom wall-fired boilers, tangentially fired boilers; Group 2: wet bottom boilers, cyclones, cell burner boilers, and vertically-fired boilers (nationwide).	Group 1 – Phase I: Dry-bottom wall-fired boilers: 0.50 lb/mmBtu Tangentially-fired boilers: 0.45 lb/mmBtu Group 1 -- Phase II: Dry-bottom wall-fired boilers: 0.46 lb/mmBtu Tangentially-fired boilers: 0.40 lb/mmBtu Group 2: Wet-bottom boilers: 0.84 lb/mmBtu Cyclones: 0.86 lb/mmBtu Cell burner boilers: 0.68 lb/mmBtu Vertically-fired boilers: 0.80 lb/mmBtu	2.06 million metric tons/yr (2000) [some overlap with NO _x RACT reductions]

¹ Although the NO_x RACT compliance date was over 4 years ago and the NO_x RACT was covered in the *Second Great Waters Report to Congress*, it is included here again for reference because it relates to some of the more recent regulations listed in this table.

Regulation	Compliance Date	Affected Sources	NO _x or Related Requirement	Projected NO _x Emission Reductions (year by which reductions will be achieved)
Ozone Transport Commission Memorandum of Understanding	Phase I (NO _x RACT--see above): May 31, 1995 Phase II: May 1, 1999 Phase III: May 1, 2003	Fossil fuel-fired boilers and indirect heat exchangers with a maximum rated heat input capacity of 250 mmBtu/hour or more (applies to northeast Ozone Transport Region, including Washington, DC and the 11 northeastern States)	Phase I: Varies from State-to-State (see NO _x RACT above) Phase II: Less stringent of 65 percent reduction for Inner Zone and 55 percent reduction for Outer Zone from baseline levels or 0.20 lb/mmBtu Phase III: Less stringent of 75 percent reduction (Inner Zone and Outer Zone) - from baseline levels or 0.15 lb/mmBtu Northern zone - Less stringent of 55 percent reduction from baseline levels or 0.20 lb/mmBtu	0.32 million metric tons/yr (2003) ²

² Based on the difference between 1990 levels (490,000 tons) and NO_x budget for 2003 (143,000 tons).

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Regulation	Compliance Date	Affected Sources	NO _x or Related Requirement	Projected NO _x Emission Reductions (year by which reductions will be achieved)
NO _x SIP Call ³	State NO _x Budget Programs (and NO _x reductions) must be implemented by May 1, 2003; budgets to be achieved by 2007	22 States and the District of Columbia (DC) ⁴	The States and DC are directed to develop regulations to meet NO _x budgets as defined by EPA and reduce NO _x and ozone transport. The EPA will implement these requirements under a Federal implementation plan if the States and DC do not.	1.05 million metric tons per ozone season (2007) ⁵

³ The EPA also proposed the Federal implementation plan in September 1998 in the event that any of the 22 States or the District of Columbia do not submit revised SIPs to meet the NO_x SIP call. At the same time, EPA proposed actions on petitions filed under section 126 of the CAA by eight northeastern States. The petitions requested that EPA make a finding that NO_x emissions from certain stationary sources contribute to ozone non-attainment problems in the petitioning States. The final action on the section 126 petitions was completed on April 30, 1999, but revised in December 1999 in light of rulings by the DC Circuit Court of Appeals related to the NO_x SIP call and the 8 hour ozone standard.

⁴ The most likely sources to be affected include electric generation units (EGUs) including units of 25 MW or less; non-EGUs, boilers, and turbines; stationary internal combustion engines; and, cement manufacturing plants. As a result of action by the DC Circuit Court of Appeals in March 2000, WI and portions of GA and MO were removed from the areas subjected to the SIP call.

⁵ Emission reductions are for the ozone season (May 1 to September 30). Includes original estimate of NO_x reductions from EGUs, non-EGUs, mobile, and area sources from areas subjected to the SIP call. This number will be slightly less with the removal of WI and portions of GA and MO.

Regulation	Compliance Date	Affected Sources	NO _x or Related Requirement	Projected NO _x Emission Reductions (year by which reductions will be achieved)
NSPS for New Fossil Fuel-Fired Steam Generating Units (NSPS Subpart Da and Db)	November 16, 1998 (effective date)	New ⁶ electric utility, industrial, commercial, and institutional steam generating units	New utility boilers: 1.6 lbs/megawatt hour of energy output (gross output) ⁷ Modified or reconstructed existing utility boilers: 0.15 lbs/million Btu emission limit ⁸ New and existing industrial boilers: 0.20 lbs/million Btu	0.04 million metric tons/yr (2002)
Section 126 Petition Rule	May 1, 2003	Utilities (capacity of 25 megawatts or greater) and industrial boilers and combustion turbines (capacity of 250 million Btu/hour or greater) in 12 eastern States and the District of Columbia (NY, NJ, PA, DE, MD, DC, VA, WV, NC, KY, IN, OH, MI)	Utilities: 0.15 NO _x /million Btu Boilers/turbines: 60 percent reduction in NO _x from controlled levels	510,000 tons of NO _x per ozone season (2007)

⁶ For which construction, modification, or reconstruction commenced after July 9, 1997.

⁷ This limit was changed from an input-based format (where emissions are linked to the fuel used) to an output-based format (where emissions are linked to the amount of energy generated).

⁸ This emission limit was revised to be equivalent to the new unit output-based limit.

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Regulation	Compliance Date	Affected Sources	NO _x or Related Requirement	Projected NO _x Emission Reductions (year by which reductions will be achieved)
Emission Guidelines for Municipal Waste Combustors	No later than December 19, 2000	Existing MWC ⁹ with combustion capacity > 250 tons/day of MSW per unit not specifically covered by an approved State plan	NO _x emission limits for affected facilities: Mass burn waterwall –205 ppmv Mass burn rotary waterwall – 250 ppmv Refuse-derived fuel combustor – 250 ppmv Fluidized bed combustor – 240 ppmv Mass burn refractory -- no limit	0.02 million metric tons/yr (2000)
Emission Guidelines for Existing Hospital/Medical/ Infectious Waste Incinerators (HMIWI) and NSPS for new HMIWI	Existing sources: no later than September 15, 1997 (effective date) New sources: March 15, 1998 or 6 months after start-up (effective date)	New HMIWI that commenced construction after June 20, 1996, existing HMIWI (built on or before June 20, 1996), and existing units that commence modification after March 15, 1998	NO _x emission concentrations for new and existing facilities: 250 ppmv	New HMIWI: 0 to 69 metric tons/yr or 0 to 52 percent per year reduction. Existing HMIWI: 0 to 390 metric tons/yr or 0 to 30 percent per year reduction
Mobile Source Regulations	Tier I Tailpipe standards: 1996	Tier I Tailpipe standards: light duty vehicles and trucks	Tier I Tailpipe standards	Tier I Tailpipe standards: 850,000 metric tons of NO _x per year (2010)

⁹ Constructed on or before September 20, 1994.

Regulation	Compliance Date	Affected Sources	NO _x or Related Requirement	Projected NO _x Emission Reductions (year by which reductions will be achieved)
	Tier II Gasoline Sulfur Program: 2004 for gasoline sulfur content nationwide; 2004-2009 for tighter NO _x standards for vehicles	Gasoline nationwide, and cars, light trucks, and SUVs up to 10,000 pounds gross weight sold outside California	Establishes NO _x standard of 0.07 gram per mile for all passenger vehicles, including light duty trucks, up to 10,000 pounds, phased in over several model years with interim standards more stringent than currently for light trucks, which are allowed the longest time to meet the 0.07 gram per mile standard. Averaging is allowed using a bin-based approach. These standards are comparable to California's LEV-2 program.	4.049 million metric tons of NO _x per year (2030)
	National Low Emission Vehicle (NLEV) Standards: 1999 in NE ozone transport region; 2001 nationwide	National Low Emission Vehicle (NLEV) Standards: light-duty vehicles and light light-duty trucks	NLEV Standards: Establishes the adoption of the California Low Emission Vehicle (CAL LEV) program throughout the Northeast Ozone Transport Region for the 1999 and 2000 model years, and across the entire Nation starting with the 2001 model year	NLEV Standards: 181,000 metric tons of NO _x per year (2007)

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Regulation	Compliance Date	Affected Sources	NO _x or Related Requirement	Projected NO _x Emission Reductions (year by which reductions will be achieved)
	Heavy-duty highway diesel standards: 2004	Heavy-duty highway diesel standards: heavy-duty highway diesel engines	Heavy-duty highway diesel standards: 2.4 g/bhp-hr for NMHC+NO _x or, 2.5 g/bhp-hr for NMHC+NO _x with a limit of 0.5 g/bhp-hr on NMHC	Heavy-duty highway diesel standards: 1 million metric tons of NO _x per year (2020)
	Heavy-duty non-road diesel standards: 1999 - 2006	Heavy-duty non-road diesel standards: heavy-duty diesel construction, agricultural, industrial engines	Heavy-duty non-road diesel standards: 9.2 g/kW-hr (different start years depending on size of vehicle)	Heavy-duty non-road diesel standards: 1.1 million metric tons of NO _x per year (2010)
	Small spark-ignition engine standards, phase I: 1997 Small spark-ignition, non-handheld engine standards, phase II: 2001-2007	Small spark-ignition engine standards, small spark-fired engines Small spark-ignition, non-handheld engine standards	Small spark-ignition engine standards: (See 40 CFR 90.103) Small spark-ignition, non-handheld engine standards	Phase I and II: 9,000 metric tons of NO _x per year (2020)
	Locomotive engine standards: 2000	Locomotive engine standards: new and rebuilt locomotive engines	Locomotive engine standards: (See 63 FR 18982, April 16, 1998)	Locomotive engine standards: 449,000 metric tons of NO _x per year (2010)

Acid Rain Program NO_x Reduction

Title IV of the CAA requires reductions in NO_x emissions from the electric power generating industry. The acid rain NO_x requirements incorporate a two-phased strategy to reduce NO_x emissions from boilers. In the first phase, which became effective January 1, 1996, certain Group 1 boilers (i.e., dry-bottom wall-fired boilers and tangentially-fired boilers) were required to comply with specific NO_x emissions limitations.¹⁰ All additional Group 1 boilers must comply in the second phase, which became effective on January 1, 2000. Also included in the second phase are NO_x emissions limits for all Group 2 boilers (i.e., wet-bottom wall-fired boilers, cyclones, boilers using cell-burner technology, and vertically-fired boilers).¹¹

In April 1995, EPA promulgated the rule establishing NO_x emission limits for Group 1 boilers. These regulations also allowed Phase II Group 1 units to use an “Early Election” Compliance Option. Under this regulatory provision, Phase II Group 1 NO_x affected units can demonstrate compliance with the higher Phase I limits for their boiler type from 1997 through 2007 and not meet the more stringent Phase II limits until 2008. If the utility fails to meet this annual limit for the boiler during any year, the unit is subject to the more stringent Phase II limit for Group 1 boilers beginning in 2000 or the year following the exceedance, whichever is later. As a result of these rules, NO_x reductions were projected to be approximately 400,000 tons per year in 1996 through 1999 (Phase I) and 2,060,000 metric tons per year in 2000 and subsequent years (Phase II).

NO_x SIP Call, Section 126 Petitions, and Federal Implementation Plans

Many States have found it difficult to attain the ozone national ambient air quality standard (NAAQS) because of widespread regional transport (i.e., from sources in other States) of ozone and its precursors, NO_x and volatile organic compounds (VOCs). In 1995, the Ozone Transport Assessment Group (OTAG) was formed to address the regional transport problem in the eastern half of the U.S. (i.e., the 37 easternmost States). The OTAG process was a collaborative effort among 37 affected States, the District of Columbia, EPA, and interested members of the public, including environmental groups and industry representatives. The OTAG concluded that further regional reductions in NO_x emissions are needed to reduce the transport of ozone and its precursors. Furthermore, OTAG recommended in July 1997 that major sources of NO_x emissions (i.e., utility and other stationary sources) be controlled under State NO_x budgets and that an emissions trading program be developed.

In response to the OTAG recommendations, EPA issued the NO_x State implementation plan (SIP) call on October 27, 1998 (63 FR 57356). The SIP call limits summer season NO_x emissions for 22 States and the District of Columbia that are significant contributors to ozone in downwind areas. The EPA directed the 23 jurisdictions to amend their SIPs to ensure that the NO_x budgets are met. The EPA set these budgets by assessing the reductions that could be obtained through cost-effective controls on electricity generating units and large industrial boilers. However, in order to meet the SIP requirements,

¹⁰ The affected dry-bottom wall-fired boilers must meet a limitation of 0.50 lbs of NO_x per mmBtu averaged over the year, and tangentially-fired boilers must achieve a limitation of 0.45 lbs of NO_x per mmBtu averaged over the year.

¹¹ The limits are 0.68 lb/mmBtu for cell burners, 0.86 lb/mmBtu for cyclones greater than 155 MWe, 0.84 lb/mmBtu for wet-bottom boilers greater than 65 MWe, and 0.80 lb/mmBtu for vertically-fired boilers.

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States can adopt NO_x trading programs. These programs will be similar to the successful SO₂ trading program under EPA's Acid Rain program. The NO_x SIP call is expected to reduce atmospheric nitrogen emissions by up to 1.05 million tons per ozone season, which should reduce loadings into the Great Waters in the eastern U.S. [NOTE: In March 2000, in response to arguments made before the court, the Circuit Court of Appeals for the District of Columbia removed Wisconsin and portions of Georgia and Missouri from the list of States subject to the call. The emission reduction estimate will be slightly less with these removals.]

At the same time that EPA promulgated the NO_x SIP call rule, EPA also proposed that NO_x Federal implementation plans (FIPs) may be needed if any State fails to respond to the final NO_x SIP call. In addition, a number of northeastern States petitioned EPA, as allowed by section 126 of the CAA, to address air pollution transported from upwind States and requested that EPA make a finding that NO_x emissions from certain major stationary sources significantly contribute to ozone nonattainment problems. Such a finding would require EPA to establish Federal emissions limits for these sources. On April 30, 1999, EPA took final action on the petitions and identified upwind sources that significantly contribute to ozone nonattainment problems. In December 1999, EPA revised the April 126 petition rule in light of the rulings by the DC Circuit Court of Appeals related to the NO_x SIP call and the 8 hour ozone standard. The FIPs and the section 126 petition action would directly impose regulatory requirements on these emissions sources, including a capped, market-based trading program for certain stationary sources.

New Source Performance Standards

New source performance standards (NSPS) require emission reductions in both attainment and nonattainment areas. Section 111 of the CAA requires EPA to identify "source categories" emitting criteria air pollutants (e.g., ozone) or precursors of criteria pollutants (e.g., NO_x and VOCs) and to establish emissions limits for new, modified, and reconstructed sources of emissions.¹² Emissions limits must be based on the "best demonstrated technology," and must apply to all new sources in the country after the effective date of the rule. To date, EPA has promulgated approximately 100 NSPS, of which approximately ten directly control NO_x emissions.

In September 1998, under court order, EPA finalized an NSPS for fossil fuel-fired utility and industrial boilers. Specifically, the final standards revised the NO_x emission limits for electric utility, industrial, commercial, and institutional steam generating units for which construction, modification, or reconstruction commenced after July 9, 1997. These final revised NO_x emission limits will reduce the projected growth in NO_x emissions from new sources by approximately 42 percent (41,500 metric tons/year) from levels allowed under current standards.

New Source Review and RACT

Under the CAA, States must apply similar requirements to major stationary sources of NO_x emissions as are applied to major stationary sources of VOCs because these two pollutants are precursors to ozone. These new NO_x provisions require (1) existing major stationary sources to apply reasonably available control technology (RACT) in certain ozone nonattainment areas and ozone transport regions, (2) new or modified major stationary sources to offset increased emissions and to install controls representing the lowest achievable emission rate (LAER) in areas that do not attain the ozone NAAQS

¹² Few sources emit ozone; rather it is formed in the atmosphere through the reaction of VOCs and NO_x. To attain the ozone standard, States typically require VOC and NO_x controls.

(i.e., ozone nonattainment areas) and ozone transport regions, and (3) new or modified major stationary sources to install the best available control technology (BACT) in ozone and NO₂ attainment areas.

MOBILE SOURCE PROGRAM ACTIVITIES

Collectively, mobile sources are major contributors of nitrogen compounds to the atmosphere. The EPA's Office of Mobile Sources (OMS) is responsible for regulatory oversight of air pollution emitted from mobile sources, primarily automobiles, but also including marine, aircraft, locomotive, and small engines such as lawn and garden equipment. The regulatory strategies often focus on both vehicle emissions and fuel composition.

Historically, OMS has led the effort to eliminate lead from gasoline and require more stringent tailpipe emissions and fuel changes that benefit air quality. Recent accomplishments by OMS that affect Great Waters pollutants of concern are focused primarily on nitrogen compounds. These include the following.

- C Between 1994 and 1996, OMS phased in Tier I tailpipe emission standards affecting light-duty vehicles and trucks. The EPA expects the standards to reduce NO_x emissions by 850,000 metric tons per year by 2010. The Tier II tailpipe emission standards, which will further limit emissions, were proposed on May 13, 1999 and, if finalized, will reduce NO_x emissions by an additional 2.8 million tons by 2030 (see below and the *Federal Register* at 64 FR 26004, May 13, 1999).
- C The national low emission vehicle, or NLEV, standard begins with model year 1999 vehicles in the Northeast Ozone Transport Region and throughout the Nation in 2001. Compliant vehicles will meet California emission standards and will reduce NO_x emissions by 181,000 metric tons per year by 2007.
- C Recent regulations for heavy-duty highway diesel engines will result in one million metric tons per year reductions in NO_x emissions by 2020. Heavy-duty non-road diesel standards covering construction, agricultural, and industrial engines will be phased in between model years 1999 and 2006 and will result in reductions of 1.1 million metric tons per year of NO_x by 2010.
- C New regulations covering small spark-ignition engines will reduce NO_x emissions by 9,000 metric tons per year in 2020.
- C New requirements for locomotive engines, both new and rebuilt, will come into effect in 2000 and result in NO_x reductions of 449,000 metric tons per year by 2010.

Tier II Emission Standards for Vehicles and Gasoline Sulfur Standards for Refineries

In December, 1999 (65 FR 6698), EPA issued new, more protective standards for tailpipe emissions from all passenger vehicles (including sport utility vehicles (SUVs), minivans, and pick-up trucks) and new standards to reduce sulfur levels in gasoline to ensure the effectiveness of low emission-control technologies in vehicles. These new standards were in response to EPA's July 1998 Tier II Report to Congress which concluded that more stringent vehicle standards are needed to meet the ozone and particulate matter air quality standards, and that technology would be available to meet such standards cost-effectively. The EPA designed the new standards in close consultation with the auto and

oil industries, emissions control manufacturers, the States, and public health, consumer, and environmental groups (U.S. EPA 1999c).

Under the Tier II standards, SUVs, minivans, and pickup trucks are required to meet the same protective standards as passenger cars, regardless of the type of fuel used. The standards also reduce the amount of sulfur in gasoline, which will ensure the effectiveness of low emission-control technologies in vehicles and reduce harmful air pollution. When fully implemented in 2030, the new tailpipe and gasoline standards are expected to reduce NO_x emissions from vehicles by 2.8 million tons, emissions of particulate matter (i.e., soot) by 35,000 tons, and SO₂ emissions from vehicles by 334,000 tons. The significant environmental benefits of this program are expected to come at an average cost increase of less than \$100 per car and less than \$200 per light-duty truck. Consumers would pay less than 2 cents per gallon more for gasoline, or about \$100 more over the life of an average vehicle (U.S. EPA 1999c). Additional information is available at <http://www.epa.gov/otaq/tr2home.htm>.

OZONE AND PM NAAQS AND THE REGIONAL HAZE RULE

Since the *Second Great Waters Report to Congress*, EPA made revisions to the particulate matter (PM) and ozone NAAQS. In addition, in April 1999, EPA issued the final regional haze rule to address visibility impairment in national parks and wilderness areas (also known as Class I areas) caused by numerous sources located over broad regions. Some of these Class I areas are associated with Great Waters waterbodies, such as Isle Royal National Park in Lake Superior and Swan Quarter National Wildlife Refuge in the Albemarle-Pamlico Estuary. Implementation of the NAAQS in conjunction with the regional haze program is anticipated to improve visibility across the country as well as reduce NO_x emissions and consequently nitrogen deposition to coastal waters, particularly in the eastern U.S. The EPA will have a better understanding of the NO_x emission reductions resulting from these programs when emissions and monitoring data are collected from the States, nonattainment areas are designated, and the States submit implementation plans (U.S. EPA 1998f).

However, on May 14, 1999, in response to a suit by the American Trucking Associations, Inc., a panel of the Circuit Court of Appeals for the District of Columbia issued a decision vacating the revised PM₁₀ standard and stopping implementation of the new ozone standard. The U.S. Department of Justice has appealed this decision. The court did not, however, prevent EPA from designating nonattainment areas for the new ozone standard, and therefore EPA is considering doing so in 2000. For the new PM_{2.5} standards, which the court ruled should stay in place, EPA currently plans to designate attainment and nonattainment areas as soon as air quality data are collected and analyzed, which is anticipated to be in 2004 or 2005.

OTHER NATIONAL PROGRAMS

Fish Contamination Program

The EPA's Fish Contamination Program (FCP) provides technical assistance to States, tribes, and others on matters related to persistent bioaccumulative toxics in fish and wildlife and associated potential health risks to consumers. Since 1992, the FCP has worked with State and tribal agencies to establish nationally-consistent methods and protocols for assessing contaminants in fish and wildlife for the purpose of developing and managing consumption advisories. Additional activities of the FCP include publishing guidance documents, maintaining national databases (e.g., of fish consumption advisories), sponsoring conferences and training workshops, providing grants for advisory development

and special studies, developing outreach materials, and assisting States and tribes in the issuance of consumption advisories.

Since 1993, the FCP has published an annual report on trends in the number of fish and wildlife consumption advisories. *The National Listing of Fish and Wildlife Advisories* (NLFWA) identifies all State-, tribal-, and Federally-issued fish consumption advisories in the U.S. Recently, it has been expanded to include Canadian provinces and territories. According to the 1998 NLFWA, the number of consumption advisories in the U.S. rose by 125 in 1997 to a total of 2,299, a 5 percent increase from 1996. The number of waterbodies under advisory in 1997 represented 16.5 percent of the Nation's total lake acres and 8.2 percent of the Nation's total river miles. The total number of advisories in the U.S. increased for three major pollutants – mercury, dioxin, and DDT. The increase in advisories issued by the States generally reflects an increase in the number of assessments of the levels of chemical contaminants in fish and wildlife tissues, rather than an increase in contaminant levels (U.S. EPA 1998m).

Environmental Justice Initiatives

Research indicates that people of different racial and ethnic backgrounds and income levels often do not eat the same kinds and amounts of food (U.S. EPA 1995). For example, Native Americans and the urban poor are at a greater risk for adverse health effects due to high rates of consumption of potentially contaminated fish. Fetuses and young children are at risk because they are more vulnerable to the effects of the pollutants of concern. Thus, these subpopulations may be disproportionately affected by deposition of air pollutants to the Great Waters.

The EPA recognizes the relationship between health risks, environmental pollutants, and diet as a potential environmental justice issue. Since 1992, EPA's Office of Environmental Justice has served as the point of contact for environmental justice outreach and educational activities, has provided technical and financial assistance, and has disseminated environmental justice information. In conjunction with regional and headquarters offices, this office has initiated many programs to address the environmental concerns among minority, low-income, and Native American and Alaska Native communities (U.S. EPA 1995). Likewise, EPA created the American Indian Environmental Office in 1994 for the purpose of coordinating the EPA-wide effort to strengthen public health and environmental protection on Native American lands (U.S. EPA 1998u). An example of EPA's efforts is the passage of a resolution by the National Environmental Justice Advisory Council of EPA's Office of Environmental Justice in December 1998 that was developed by the Indigenous People Subcommittee pertaining to the effects of mercury contamination on American Indian populations. This resolution requires EPA's Office of Pollution Prevention and Toxic Substances to share the 1998 Mercury Action Plan with tribes, to provide educational and health information to tribes, to adopt a Mercury Action Plan and regulatory authority to eliminate anthropogenic mercury emissions by 2010, to establish baseline emission standards, and to adopt enhanced reporting requirements for mercury emission sources.

Recent studies continue to examine the relationship between increased health risks in certain subpopulations and the consumption of fish from the Great Lakes. Study results show that some subpopulations are not as aware of fish advisories as other populations, and that human health effects from consumption of fish from contaminated areas vary. Chapter II describes additional relevant research relating to exposure and effects of Great Waters Pollutants of concern and sensitive or highly-exposed subpopulations.

Children's Health Initiatives

Children face environmental health threats from many of the Great Waters pollutants of concern. In addition, child exposures to pollutants tend to occur through multiple exposure routes, including inhalation, ingestion, dermal contact, and prenatal (transplacental) exposure. For example:

- C Prenatal and childhood exposure to contaminants, such as lead, PCBs, and mercury, via multiple exposure pathways may inhibit a child's intellectual development and ultimately may result in behavioral problems.
- C Exposure to endocrine disrupting chemicals, such as organochlorine pesticides and PCBs, may cause birth defects and alterations of normal childhood growth and development (Browner 1998, U.S. EPA 1998w).

Children Experience Increased Risk From Environmental Hazards Because:

Their systems are still developing making them more susceptible to environmental threats.

They eat more food, drink more fluids, and breathe more air per pound of body weight making them more exposed to environmental hazards.

Their behavior, such as crawling on the ground, and lack of ability to protect themselves exposes them to hazards that adults can easily avoid.

In an effort to protect children from environmental health threats, EPA published its *National Agenda to Protect Children's Health from Environmental Threats* in April 1996. This agenda calls for the consideration of children's risks in all appropriate agency actions and a greater emphasis on research to support children's risk assessment activities (U.S. EPA 1996a). In addition, EPA established its Office of Children's Health Protection (OCHP) in May 1997 to ensure the implementation of the President's 1997 Executive Order to Protect Children from Environmental Health and Safety Threats. The OCHP's mission is to make the protection of children's health a fundamental goal of public health and environmental protection in the U.S. The office supports and facilitates EPA efforts to protect children from environmental threats (U.S. EPA 1998t).

The President's Executive Order requires all Federal agencies to address health and safety risks to children, coordinate research priorities on children's health, and ensure that their standards take into account special risks to children. The EPA documents its current actions in regard to children's health in *The EPA Children's Environmental Health Yearbook* (U.S. EPA 1998q). The yearbook includes sections on asthma and respiratory effects, childhood cancer, developmental and neurological toxicity, health effects of pesticides, and potential risks from contaminated surface and ground water. To coordinate research efforts, EPA and the National Institute of Environmental Health Services developed a grant program to support the establishment of Centers for Children's Environmental Health and Disease Prevention Research. The purpose of these centers is to foster the advancement of children's health through enhancing the public's understanding of basic disease mechanisms and promoting community-based prevention activities related to children's respiratory disorders, childhood learning, and growth and development (U.S. EPA 1998t).

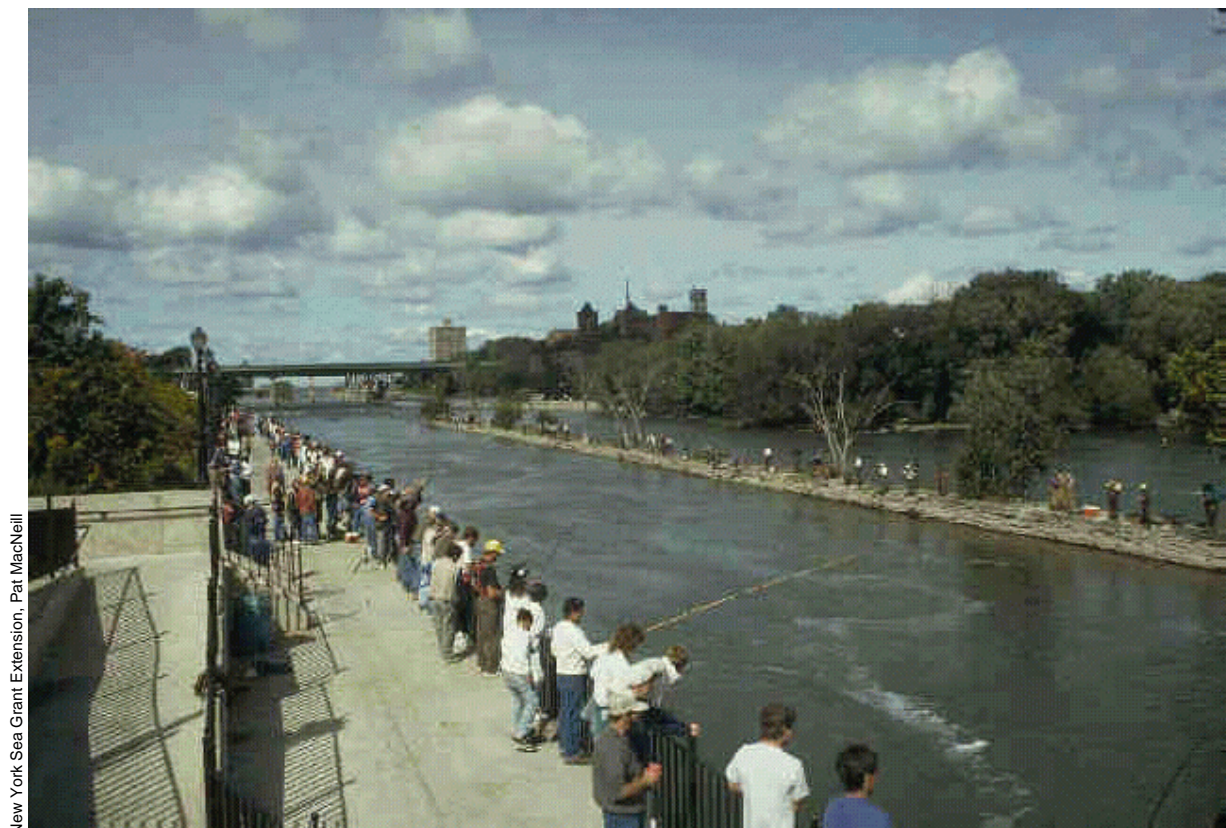
The EPA, in coordination with other Federal agencies, has begun several efforts to address these specific threats. Most notably, EPA has conducted an Agencywide Risk Assessment Forum colloquium on children's risk and has begun to review and revise several of its risk assessment guidance documents to identify areas where children's health protection is or should be considered. Mercury, lead, dioxin, HCB, and PAHs are among the chemicals included in this risk characterization (Browner 1998). As part of this effort, EPA requested that the Federal Children's Health Protection Advisory Committee (CHPAC) recommend existing standards that may merit reevaluation in order to further protect children's environmental health. One recommendation was to reevaluate the chlor-alkali NESHAP

(mercury). In response, EPA has begun a process to revise this standard, including a risk assessment of mercury emissions from chlor-alkali plants (64 FR 5277, February 3, 1999). Also, EPA, the Department of Health and Human Services, and other Federal agencies have begun to develop a comprehensive cross-government strategic plan to address the causes of children's asthma and the scope of the problem (Browner 1998).

III.B REGIONAL AND WATERBODY-SPECIFIC PROGRAMS

All of the Great Waters are affected by the policies and activities of multiple communities and governments on their shores. The Great Lakes, for example, are affected by the environmental management decisions of two nations, one Canadian Province, eight States, a number of tribes, and countless municipalities. Intergovernmental or multistakeholder institutions (e.g., the Lake Michigan Forum) have been established for many of the Great Waters to coordinate resource management decision making and resolve conflicts. In addition, EPA and NOAA, as directed by Congress, administer several programs to address particular regional and waterbody-specific environmental challenges. These programs lead or support many efforts to evaluate or control the impacts of pollution, including pollution via atmospheric deposition, on the Great Waters ecosystems.

The EPA has found that regional environmental challenges, such as those facing the Great Waters, are often best solved through collaboration with local stakeholders and with a holistic approach that addresses human social and economic needs as they relate to environmental quality. The EPA has used these approaches in a number of place-based (i.e., geographically-based) programs, including the National Estuary Program; Great Lakes, Chesapeake Bay, and Clean Lakes Programs; and, the Regional Geographic Initiative. These approaches are further developed in EPA's Community-Based Environmental Protection (CBEP) program. The EPA's Strategic Plan (EPA 1997c) recognized CBEP as the Agency's main tenet for "reinventing" its approach to environmental protection by considering environmental problems across organizational and political boundaries and in a multimedia fashion. The Agency is now using the CBEP approach in several of the regional and waterbody-specific programs and activities described in this section.



New York Sea Grant Extension, Pat MacNeill

GREAT LAKES PROGRAM

Administered by EPA's Great Lakes National Program Office (GLNPO), the Great Lakes Program consists of programs and activities initiated by EPA, States, tribes, and their partners that are designed to address challenges facing the Great Lakes ecosystem. Several of these activities involve atmospheric deposition and Great Waters pollutants of concern.

The GLNPO has provided funds for monitoring of toxics in conjunction with the Episodic Events/Great Lakes Experiment (EEGLE) Study research effort. The EEGLE Study is being funded by the National Science Foundation and NOAA to study nutrient transport in a plume that occurs in Lake Michigan annually. This effort enables the study of air-water exchange of toxics in this plume. This information will be used in support of the Lake Michigan Mass Balance Study (LMMBS) by providing insight into the air/water exchange of PCBs and PAHs. The project will also provide information necessary to determine the spatial and temporal variation of loadings across large lakes. This project is a pilot for future air/water toxics sampling projects, such as planned additional over-water measurements for the Integrated Atmospheric Deposition Network (IADN) program.

In addition to these activities, the Great Lakes Program is continuing to utilize remedial action plans (RAPs) for areas of concern (AOCs) and lakewide management plans (LaMPs) to target ecological problems on a geographic basis, in accordance with the 1978 Great Lakes Water Quality Agreement (GLWQA) between Canada and the U.S. The LaMPs and RAPs are tools for reducing the input of pollutants to the Great Lakes and restoring the environmental quality of the Great Lakes basin.

The LaMPs and RAPs target ecological problems on a geographic basis and provide a community-based approach to identifying and solving environmental problems. Both tools were originated in response to the GLWQA goals of restoring and maintaining the chemical, physical, and biological integrity of aquatic ecosystems. The RAPs were first established in 1985 to provide more uniform guidance on how to restore uses in AOCs. Rivers, connecting channels, harbors, and embayments of the Great Lakes are designated as AOCs if there is an impairment of beneficial use or the area's ability to support aquatic life. Unlike RAPs, the development and implementation of LaMPs for each of the five Great Lakes was a specific objective of the GLWQA. The LaMPs are frequently integrated with RAPs and other efforts that are best suited to address issues of local concern.

The Great Lakes Water Quality Board of the International Joint Commission (IJC) established 42 AOCs in the Great Lakes basin (Figure III-2): 26 within the jurisdiction of the U.S., 12 within Canadian jurisdiction, and 5 shared by both countries. The RAPs are being developed for each of these AOCs to address impairments to any one of the 14 beneficial uses (e.g., restrictions on fish and wildlife consumption, dredging activities, or drinking water consumption) associated with these areas. The RAPs are prepared and implemented by the eight Great Lakes States and the Province of Ontario, with help from Federal agencies and organizations, local governments, industry, environmental groups, and individuals. Although there has been significant progress in developing and implementing most RAPs (including the delisting of the Collingwood Harbor AOC in Canada), considerable challenges remain.

IJC Identified Seven AOCs That Have Developed Particularly Successful Remediation Strategies

- / Black River (Ohio)
- / Grand Calmumet River/Indiana Harbor Ship Canal
- / Hamilton Harbor (Ontario)
- / Ashtabula River (Ohio)
- / Bay of Quinte (Ontario)
- / Manistique River (Michigan)
- / Muskegon and White Lakes (Michigan)

Figure III-2
The 42 Areas of Concern in the Great Lakes Basin

Lake Superior

1. Peninsula Harbour
2. Jackfish Bay
3. Nipigon Bay
4. Thunder Bay
5. St. Louis Bay/R.
6. Torch Lake
7. Deer Lake-Carp Creek/R.

Lake Michigan

8. Manistique River
9. Menominee River
10. Fox River/Southern Green Bay
11. Sheboygan River
12. Milwaukee Estuary
13. Waukegan Harbor
14. Grand Calumet River/Indiana Harbor Canal
15. Kalamazoo River
16. Muskegon Lake
17. White Lake

Lake Huron

18. Saginaw River/Saginaw Bay
19. Severn Sound
20. Spanish River

Lake Erie

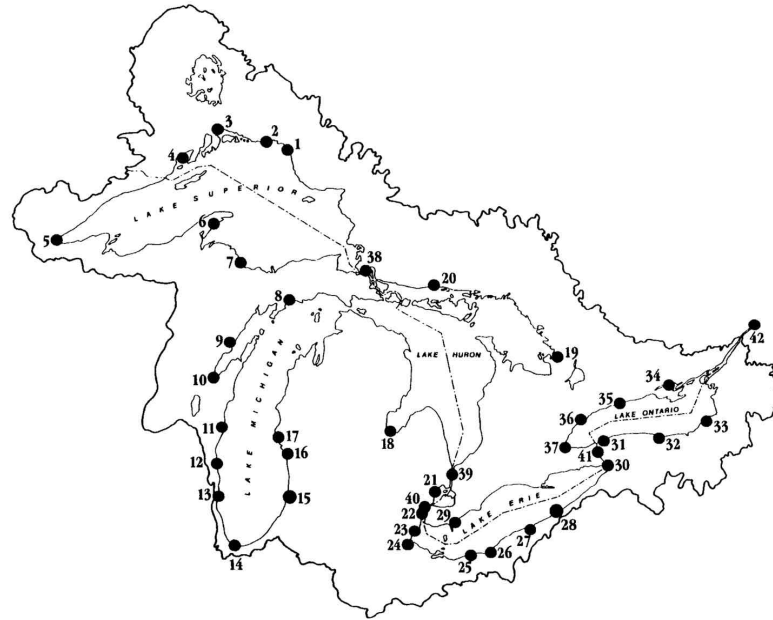
21. Clinton River
22. Rouge River
23. River Raisin
24. Maumee River
25. Black River
26. Cuyahoga River
27. Ashtabula River
28. Presque Isle bay
29. Wheatley Harbour

Lake Ontario

30. Buffalo River
31. Eighteen Mile Creek
32. Rochester Embayment
33. Oswego River
34. Bay of Quinte
35. Port Hope
36. Metro Toronto
37. Hamilton Harbour

Connecting Channels

38. St. Marys River
39. St. Clair River
40. Detroit River
41. Niagara River
42. St. Lawrence River (Cornwall/Massena)



Source: Adapted from Hartig et al. 1997

One of the major problems facing the AOCs today is toxic contamination of sediments, contributing to beneficial use impairments.

Both the U.S. and Canadian governments are charged with developing LaMPs for each of the Great Lakes, with the exception of Lake Michigan. Because Lake Michigan lies entirely within the boundaries of the U.S., the Lake Michigan LaMP was developed solely by the U.S. government. The LaMPs are in various stages of development for each of the Great Lakes (see sidebar). Not all of the LaMPs have been completed; however, commitments have been made by key stakeholders in the respective basins to pursue toxics reductions and actions are being taken to achieve these goals. Each LaMP addresses a different list of critical pollutants, commonly including mercury, PCBs, hexachlorobenzene, dioxins, furans, chlordane, DDT and metabolites, and dieldrin, all of which are Great Waters pollutants of concern.

Current Status of LaMPs in the Great Lakes	
Superior	Binational Program to Restore and Protect the Lake Superior Basin announced (1991) Stage 1 LaMP submitted to IJC (1995) Stage 2 LaMP released (1999) Stage 3 LaMP in development
Michigan	LaMP published in Federal Register (1994)
Huron	LaMP not established
Erie	LaMP Management Committee formed (1994)
Ontario	Lake Ontario Toxics Management Plan (1989) LaMP Workplan signed (1993) Stage 1 LaMP released (1998)

The Lake Superior LaMP is unique in that it is being developed in stages. The Stage 1 LaMP was submitted to the IJC in 1995. The Stage 2 LaMP, which addresses critical pollutants, is available on EPA's web site at www.epa.gov/grtlakes/lakesuperior/stage2lamp.html. The Stage 3 LaMP, which is currently in development and is available as a review draft on EPA's web site at www.epa.gov/grtlakes/lakesuperior/stage3/review.html, addresses selection of remedial measures and management strategies to achieve critical pollutant load reduction targets.

LAKE CHAMPLAIN BASIN PROGRAM

Since the *Second Report to Congress*, the Lake Champlain Basin Program (LCBP) has continued to develop and implement a comprehensive pollution prevention and restoration plan for the lake and its watershed, as called for by the Lake Champlain Special Designation Act of 1990. In October 1996, the LCBP finalized *Opportunities for Action, An Evolving Plan for the Future of the Lake Champlain Basin* (LCBP 1996a, b). The final plan differs little from the draft plan, which was described in detail in the *Second Report to Congress*. Environmental issues addressed by the plan include high phosphorus levels, toxic substances (most notably PCBs and mercury) in biota and sediment, and invasive non-native species. Atmospheric deposition of mercury to Lake Champlain basin is the subject of research efforts described in Chapter II.

The LCBP supported and published several technical reports on the Lake Champlain basin and the Lake Champlain ecosystem. For example, in October 1997, the LCBP published Phase II of the Lake Champlain Sediment Toxics Assessment Program (McIntosh et al. 1997). The first phase, which was discussed in the *Second Report to Congress*, accomplished a lakewide screening of surface sediments for an array of organic and inorganic trace contaminants, more intensive evaluations at nine sites with elevated contaminants levels, and an assessment of PCB bioaccumulation from sediment by the macroinvertebrate *Mysis relicta*. Phase II further targeted investigations to the three most contaminated

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areas of the lake: Cumberland Bay, Malletts Bay, and Burlington Harbor. Results of the Phase II investigation are presented in Chapter II above.

Other recent research projects sponsored by LCBP include development and compilation of Geographic Information Systems data for the basin (VCGI 1996, Millette 1997); hydrodynamic and water quality modeling and monitoring (ASA 1996, Lake Champlain Basin Program 1998); food web modeling (LeBar and Parrish 1996); and, other ecological subjects. Numerous other LCBP-supported publications address economic, educational, recreational, and other resource management subjects. Future research will focus on environmental indicators. In addition, the Lake Champlain Steering Committee, which evolved from the Management Conference, includes the Province of Quebec as a member. Involvement of Quebec will ensure that both U.S. and Canadian concerns are addressed.

CHESAPEAKE BAY PROGRAM

The Chesapeake Bay Program (CBP) is a unique regional partnership (see sidebar) that has been responsible for directing and implementing the restoration of the Chesapeake Bay since 1983. Since that time, the highest priority has been placed on restoring the living resources of the bay, including finfish, shellfish, bay grasses, and other aquatic life and wildlife. Examples of specific actions undertaken by the CBP include agricultural best management practices, pesticide collection and disposal programs, public education, Biological Nutrient Removal at wastewater treatment facilities, and a phosphate detergent ban (Chesapeake Bay Program 1998d). In addition, the CBP is working with NOAA's Chesapeake Bay Environmental Effects Committee which supports research on contaminated sediment to better understand issues related to the management of contaminated sediments.

Chesapeake Bay Program Partners

- P State of Maryland
- P Commonwealth of Virginia
- P Commonwealth of Pennsylvania
- P District of Columbia
- P Chesapeake Bay Commission
- P U.S. EPA (representing all Federal agencies, e.g., NOAA, U.S. FWS)

As discussed in the *Second Report to Congress*, the 1994 Chesapeake Bay Basinwide Toxics Reduction and Prevention Strategy is an integral part of the CBP. The primary goal of the strategy is a "Chesapeake Bay free of toxics by reducing or eliminating the input of chemical contaminants from all controllable sources to levels that result in no toxic or bioaccumulative impact on the living resources that inhabit the bay or human health." The strategy contains commitments in the following five areas: (1) regional focus – calls for assessing the status of chemical contaminant effects on the living resources of the bay and its tidal waters and implementing reduction and prevention activities in those areas; (2) directed toxic assessments – calls for the characterization of chemical contaminant conditions in the bay, the assessment of low level toxics exposure to living resources as well as the update of the Toxics Loading and Release Inventory to identify toxics sources; (3) regulatory program integration – calls for Chesapeake Bay Program activities to complement and enhance Federal, State, and local regulatory programs; (4) pollution prevention – includes facility-based pollution prevention, pesticide management, and consumer/household hazardous waste activities and goals; and, (5) strategy implementation – outlines how the strategy will be implemented.

The strategy addresses non-point source pollution, committing the CBP signatories to "establish more complete loadings baselines and source identification for storm water runoff, atmospheric deposition, and acid mine drainage, and set reduction targets from that baseline to be achieved over the next decade." The CBP will use the updated *1999 Chesapeake Bay Basinwide Toxics Loading and Release Inventory*, which provides updated chemical contaminant loadings estimates for atmospheric

Reducing Pesticide Use in the Chesapeake Bay Watershed

The CBP has been working toward goals to reduce pesticide use in the Chesapeake Bay watershed. Recent accomplishments include the following:

U Pesticide collection and disposal programs have been offered in all Virginia and Pennsylvania counties and 75 percent of Maryland counties in the watershed. Over 1.1 million pounds of pesticides have been collected;

U Between 1993 and 1998, nearly 600,000 pesticide containers have been collected and recycled.

U Integrated Pest Management is now used on nearly 4.4 million acres (61 percent) of agricultural cropland in the watershed.

deposition and other point and non-point sources to address this commitment. The inventory reports atmospheric deposition loads from chemical contaminants in the air that are deposited onto the bay and its tidal rivers. These estimates are updated and expanded using recent field measurements and improved theoretical understanding of deposition processes. Volatilization of organic contaminants from the surface waters to the air is considered for the first time in calculating a “net” atmospheric loading to the bay and tidal rivers. Initial estimates of the contribution of urban areas to atmospheric deposition loads to the bay and tidal rivers are also reported. Only loads to tidal waters (below the fall line) are reported. The TRI database for industrial air releases was not included in this inventory, as it was in 1994,

since the improved and expanded atmospheric loadings data (to tidal waters) are based on measured data and are a much better representation of loads than the TRI data estimates of releases. The inventory reports that atmospheric deposition loads to the tidal waters increase in areas of the bay and tidal rivers adjacent to urban areas (Chesapeake Bay Program 1999a).

To focus toxic reduction and prevention efforts, the CBP developed a list of Chesapeake Bay toxics of concern (i.e., chemicals that cause or have a potential to cause adverse impacts on the bay system, such as mercury, PAHs, and PCBs -- see sidebar). By 2000, the CBP is directed to reevaluate and revise the 1994 toxics strategy. Future plans for the Chesapeake Bay Program include research in support of regional action plans for areas with known toxics problems, with a particular emphasis on how to deal with contaminated sediment. In addition, data collected over the past decade will continue to be analyzed to determine which chemicals have been detected in water, sediment, shellfish, and finfish to identify other toxics problems in the bay (Chesapeake Bay Program 1998c).

Chesapeake Bay Program Toxics of Concern

Atrazine	Chromium
Benz[a]anthracene (PAH)*	Chrysene (PAH)*
Benzo[a]pyrene (PAH)*	Copper
Cadmium	Fluoranthene (PAH)*
Chlordane*	Lead*
Naphthalene (PAH)*	Mercury*
Tributyltin	PCBs*

* Great Waters pollutants of concern

Nitrogen reduction in the bay is an ongoing focus of the CBP. Recent modeling efforts indicate that approximately 21 percent of the nitrogen entering the bay is from atmospheric deposition. Therefore, the CBP is working to quantify and address atmospheric nitrogen and toxics emissions and sources along with their associated impacts on the bay resources. A current effort involves assessing the benefits that will be experienced due to the implementation of the CAA. The CBP is also supporting scientific research which is being conducted to better understand the integrated, multimedia relationships of the ecosystem. In addition, the Chesapeake Bay Program is developing a strategy to better understand and quantify the various forms of nitrogen which may be affecting living resources and water quality in the Chesapeake Bay. Part of an integrated basinwide monitoring effort, this strategy will help to fill in gaps in our knowledge of atmospheric

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deposition of nitrogen compounds, focusing in the near term on measuring deposition of ammonia and ammonium in the coastal areas (Chesapeake Bay Program 1998a).

In addition, recent actions taken under the Clean Water Act resulted in listing portions of the Chesapeake Bay and its tidal rivers as impaired waters. These actions have emphasized the regulatory framework of the Clean Water Act along with the ongoing cooperative efforts of the Bay Program as the means to address the nutrient enrichment problems within the Bay and its rivers. In response, the Bay Program partners have committed to a process for integrating the cooperative and statutory programs of the Chesapeake Bay and its tributaries. In the new Chesapeake Bay Agreement, the partners are committed to developing goals for improving water quality in the Bay and its tributaries so these waters may be removed from the impaired waters list prior to the timeframe when regulatory mechanisms under section 303(d) of the Clean Water Act would need to be applied.

The CBP is helping bay partners to incorporate air pollution impacts in the management of lakes, rivers, and streams. For example, the CBP is encouraging States to account for air deposition in TMDL development (for background information on TMDLs, see the TMDL discussion on page III-5) and helping bay States account for atmospheric deposition of nitrogen compounds in developing tributary strategies to protect the bay. Tributary strategies are “clean-up plans” for each major river that flows into the bay. The Commonwealth of Virginia is developing tributary strategies for their southernmost bay tributaries, and the CBP is providing modeled information on how different management scenarios for atmospheric nitrogen emissions will affect deposition loads. This will give States an idea of different options for cleaning up lakes, rivers, and streams. For example, an understanding of how much nitrogen will not enter the bay by implementing certain air controls will allow States to count the cost of all of the options of reducing nitrogen inputs. In comparing methods of nutrient reduction in waters in the Chesapeake Bay area, it may be that cleaning up the air is more cost-effective than some water-based controls, such as additional storm water management in cities.

Despite the progress made to date in reducing inputs of nitrogen to the Chesapeake Bay, the Chesapeake Executive Council announced that unless current efforts are accelerated, the nitrogen reduction goal of the Chesapeake Bay Agreement will not be met by the year 2000. In 1997, the Executive Council developed three new directives to accelerate the reduction of nitrogen inputs to the bay.

1. *The Baywide Nutrient Reduction Progress and Future Reductions* directive outlines a series of actions aimed to further commitments made in the Chesapeake Bay Agreement. One of the actions is to “Work toward additional reductions of airborne nitrogen delivered to the Bay and its watershed from all sources including States outside the watershed, and seek improved understanding of how airborne nitrogen affects the Bay and its watershed..” The directive includes a time line for completing refinements of computer modeling as well as water quality monitoring. Outputs from monitoring and modeling efforts will be used to help

Growing Attention to Sources of Ammonia and Urea to the Chesapeake Bay

Ammonia and urea are other forms of nitrogen that are receiving increased attention from researchers and regulatory agencies, in part because these forms are more biologically available. One of the sources of ammonia and urea is manure from animal farming operations. With the increase in animal farming in the bay watershed and surrounding States, particularly hog and poultry farming, it is important to investigate pollutant emissions to the air and the distances they travel in the air before being deposited to land or water surfaces. The CBP sponsored a workshop on atmospheric organic nitrogen (e.g., urea) and is coordinating with NOAA to determine atmospheric concentrations of ammonia, estimate ammonia deposition to land and water surfaces, and evaluate the importance of ammonia transport and deposition.

set nutrient goals for Virginia tributaries and to develop a protocol to determine whether nutrient reduction efforts can be further targeted to areas of persistent high loadings.

2. The *Wetlands Protection and Restoration Goals* directive provides quantifiable wetland restoration goals to assure no net loss of wetlands and to move in the direction of a net gain of wetland areas.
3. The *Community Watershed Initiative* will develop a community watershed strategy to ensure that Chesapeake Bay Program goals and objectives are integrated at the community watershed scale (Chesapeake Bay Program 1998b).

GULF OF MEXICO PROGRAM

The Gulf of Mexico Program emphasizes community-based, ecosystem management approaches to environmental protection, including (1) equal partnership among government agencies and private and non-government interests to define problems and implement solutions, (2) use of the best science and knowledge available to support decisions and guide actions, and (3) public involvement in all phases of the program to generate the consensus needed for action. The Gulf of Mexico Program is not a regulatory program, although some of the partner agencies at the Federal and State levels have regulatory responsibilities.

The program provides a forum whereby issues that cross political or social boundaries can be clearly identified, discussed, and collaboratively resolved to benefit the ecological and economic resources of the Gulf of Mexico.

Given the vast geographic scope of the gulf, protection of these critical resources requires a long-term commitment and focused attention. A strategic assessment process is being implemented to focus future efforts, identify resources at greatest risk, and establish quantitative goals to measure progress. Currently, the Gulf of Mexico Program is addressing four priority environmental concerns, two of which are relevant to the Great Waters program: (1) protecting the public from contaminated shellfish and recreational waters, and (2) excessive nutrient enrichment.

Excessive nutrient enrichment is attributable to a multitude of terrestrial and atmospheric sources throughout the Gulf States and the watersheds (e.g., the Mississippi River basin) that drain into the gulf. The Gulf of Mexico Program, as a multiagency effort, is working with State and community partners on several projects to protect the gulf from the deleterious effects of nutrient enrichment.



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For example, the Gulf of Mexico Program is working with the Gulf States to address nutrient enrichment problems in the gulf, such as a zone of hypoxia along the Louisiana coast. Hypoxia in the northern gulf represents one of the largest zones of oxygen-deficient bottom waters in the western Atlantic Ocean. Nitrate and other nutrients discharged from the Mississippi River are the probable cause, making agricultural and municipal runoff and atmospheric deposition potential sources to investigate.

In addition, the Gulf of Mexico Program is supporting two initiatives of a multiagency scientific team established by the White House's Committee on Environment and Natural Resources (CENR). In particular, the Gulf of Mexico Program is supporting studies to characterize the ecological and economic consequences of hypoxia in the gulf and nutrient sources and loads to the gulf from the Mississippi River. Further discussion of the CENR process can be found in Chapter IV of this report.

NATIONAL ESTUARY PROGRAM

Coastal waters addressed by the Great Waters program include all estuaries covered by the National Estuary Program (NEP). In 1987, Congress established the NEP as part of the Clean Water Act. The NEP's mission is to protect and restore the health of the estuaries while supporting economic and recreational activities. The EPA periodically calls for nominations of estuaries to the NEP from State governors. If an estuary meets the Agency's criteria, EPA may then designate it as an estuary of national significance. As depicted in Figure I-2, there are currently 28 estuaries around the country and in Puerto Rico in the National Estuary Program.

To date, at least 19 NEPs have identified atmospheric deposition of pollutants as a threat to the health of their estuaries. Many of these NEPs either have initiated studies on the contribution of atmospheric deposition to annual loadings of nitrogen and/or other pollutants, or have expressed serious interest to EPA in conducting such projects. In 1999, EPA provided funds to establish new atmospheric deposition monitoring sites in five NEPs, expanding the National Atmospheric Deposition Network in the coastal waters and improving the ability to compare coastal data to data collected from inland sites. Peconic Bay NEP and Maryland Coastal Bays NEP are monitoring for nitrogen and sulfur compounds, San Francisco Bay is monitoring for mercury compounds, and Mobile Bay NEP is monitoring for sulfur, nitrogen, and mercury compounds. In addition, a site measuring dry deposition of sulfur and nitrogen compounds (part of the CASTNet monitoring network) is being established near Indian River Lagoon NEP. The following describes other NEP sites and their associated atmospheric deposition research activities to date.

NEPs Conducting Atmospheric Deposition Studies

- g Albemarle-Pamlico Estuary (NC)
- g Casco Bay (ME)
- g Charlotte Harbor (FL)
- g Coastal Bend Bay and Estuary (TX)
- g Delaware Inland Bays (DE)
- g Indian River Lagoon (FL)
- g Long Island Sound (NY, CT)
- g Massachusetts Bay (MA)
- g Maryland Coastal Bays (MD)
- g Mobile Bay (AL)
- g New York/New Jersey Harbor (NY, NJ)
- g Peconic Bay (NY)
- g San Francisco Bay (CA)
- g Santa Monica Bay (CA)
- g Sarasota Estuary (FL)
- g Tampa Bay (FL)

c Albemarle-Pamlico Estuary (NC). Nitrogen deposition studies in eastern North Carolina are primarily focusing on the emissions and deposition of ammonia. Concern has been spurred by the explosive growth of large-scale hog farming operations in the coastal plain over the last few years. For example, long-term analysis of National Atmospheric Deposition Program (NADP) data from a site near the center of an intensive animal operations (i.e., Sampson County, NC) indicate at least a doubling of NH_4^+ deposition since the early 1980s (Paerl 1997b). Monitoring efforts led by researchers from the University of North Carolina at Chapel Hill (UNC-CH) and

North Carolina State University (NCSU) are aimed at quantifying atmospheric levels of both gas and aerosol forms of ammonia to aid in the development of regional-scale, air quality models (Robin Dennis, NOAA/EPA). Monitoring began in fall 1998, but data obtained in the 1999 summer season will be critical in understanding seasonal emission and deposition patterns. Additional efforts are aimed at developing nitrogen budgets for the Neuse River basin. These projects began with State funding and, when completed, will put the atmospheric contribution into the context of the overall nitrogen load to the Neuse River basin (W. Robarge, NCSU; H. Paerl, UNC-CH). The EPA is also funding research to examine the biological ramifications (e.g., eutrophication) of atmospheric nitrogen inputs in the Neuse River basin and the adjacent coastal waters.

- c Casco Bay (ME).** The Casco Bay Air Toxics Deposition Study, begun in 1998, is a multiyear collaborative effort by the Casco Bay Estuary Project, the Maine Department of Environmental Protection, EPA Region I, and university research scientists (University of Massachusetts, Lowell). The study focuses on atmospheric deposition of five contaminant groups (i.e., mercury, toxic trace elements, PAHs, nitrogen, and fine particulates) and is funded by the Great Waters program as part of the national strategy to determine the environmental health and status of key NEP ecosystems. The objectives of the study are to characterize seasonal and annual depositional patterns of toxic air compounds to Casco Bay and to develop a generic assessment method that can be used by other community-based programs.
- **Charlotte Harbor (FL).** The Charlotte Harbor NEP atmospheric deposition study received funding in 1999 and will begin activities in 2000.
- c Coastal Bend Bay and Estuary Program (TX).** The concentrations of nutrients and organic contaminants (including PAHs, PCBs, and some pesticides) in wet and dry atmospheric deposition is being measured or calculated at two representative sites on Corpus Christi Bay. An EPA grant expanded the pollutants measured at one station to include organic contaminants. The wet nutrient deposition data are comparable to other air monitoring programs, including the NADP, but this is one of the only NEP studies that measures the deposition rate of organic contaminants. This study is being conducted in conjunction with other studies in the area (including EPA's Environmental Monitoring and Assessment Program (EMAP) and NOAA's National Status and Trends Program) to measure the inputs to the bay and estuary of organic pollutants, trace metals, and nutrients from other sources (e.g., other non-point sources, point sources). This will allow the Coastal Bend Bay and Estuary Program to calculate the importance of atmospheric deposition for each pollutant and target control measures where they are most effective.
- c Delaware Inland Bays (DE).** The University of Delaware Graduate College of Marine Studies is undertaking three studies to address atmospheric deposition issues related to the Delaware Inland Bays. The first study, currently in progress and funded by the Delaware Department of Natural Resources and Environmental Conservation (DNREC), has two primary objectives: (1) to accurately quantify the atmospheric loading of nitrogen to the Delaware Inland Bays; and (2) to assess, in cooperation with the University of Delaware Center for Climatic Studies, the meteorological transport patterns which contribute to the observed nitrogen deposition. The second study, also funded by the DNREC, will examine the episodic impact of large precipitation events on the loading of nitrogen to the Delaware Inland Bays by both direct (deposition to the water surface) and indirect (via watershed transmission) pathways.

The third study, which is funded by the EPA National Estuary Program, will address the impacts of local sources (e.g., a coal-fired power plant, poultry-rearing facilities) on nitrogen deposition to the Delaware Inland Bays and distinguish the impacts of local sources from the impacts of regional sources. Research to date indicates a 60 percent increase in the wet deposition of ammonia over the past two decades. Although the explanation is uncertain, the working hypothesis is that the increase is related to the large increase in poultry production on the Delmarva Peninsula. The NEP grant will test this hypothesis. An analogous situation exists in coastal North Carolina where the approximate doubling of the concentration of ammonia in precipitation over the past 10 years has been attributed to the proliferation of hog farms in the region (Paerl 1997b). Such increases in atmospheric ammonia deposition are not only important because of the additional sources of nitrogen to surface waters, but also because ammonia represents the most readily-available form of nitrogen for most aquatic organisms.

- c Long Island Sound Estuary Program (NY, CT).** The Long Island Sound Study (LISS) Estuary Program has been evaluating atmospheric nitrogen sources leading to the development of a final nitrogen control plan. Wet and dry deposition monitoring studies have expanded in recent years through a cooperative effort with the Connecticut Department of Environmental Protection (CTDEP) and the University of Connecticut (UConn). The UConn now maintains eight sampling stations spread throughout Connecticut where wet and dry monitoring of nutrients and mercury is conducted. The data have been key to estimating nitrogen deposition loads, which are about 10 lb/acre-year in the Long Island Sound region. The anthropogenic component of the atmospheric deposition delivered to Long Island Sound is estimated to be around 6,700 tons of nitrogen annually including about 3,700 tons that fall directly on the sound. This combined direct and indirect deposition represents about 15 percent of the total load of nitrogen to Long Island Sound from the New York and Connecticut portions of the watershed. Additional nitrogen loadings come from atmospheric deposition onto the Long Island Sound drainage basins north of Connecticut, the watersheds of the New York/New Jersey Harbor and Narragansett Bay, and from direct deposition on the Atlantic Ocean that currents transport into Long Island Sound. In February 1998, the States of New York and Connecticut and EPA agreed to a reduction target of 58.5 percent below a 1990 baseline for point and terrestrial non-point source enrichment. While achieving that target will greatly improve oxygen conditions in the sound, it will not attain existing State water quality standards for dissolved oxygen. In a TMDL analysis being prepared by Connecticut and New York, additional actions are identified, including atmospheric reductions of nitrogen planned under the CAA. The analysis identifies that reducing atmospheric sources of nitrogen will be key to long term efforts to attain water quality standards.
- **Massachusetts Bays (MA).** Wet and dry deposition of toxic compounds, including metals and PAHs, were measured from September 1992 to September 1993 at two sites, one in the northern bay and one in the southern bay on Cape Cod. Dry deposition was greater at the northern site (close to Boston) for most metals. Wet deposition, on the other hand, was greater at the southern site for the metals. The high dry deposition rates at the northern site are probably due to its proximity to Boston. The high wet deposition rates on Cape Cod are probably from sources upwind in southern New England, New York, and New Jersey. Both dry and wet deposition of PAHs were higher at the northern site, also probably from sources in the Boston metro area, including Logan Airport. Dry deposition was highest at both sites in the winter. No PCBs were found at either site.

Wet nitrogen deposition data from four regional (three in Massachusetts and one in coastal Maine) NADP sites were also analyzed from the early 1980s (1980, 1981, or 1982, depending on the site) through 1993. Dry deposition data were collected from a literature search. Direct

deposition to the bays was estimated to be 6-8 percent of the total nitrogen load. Approximately two-thirds were in the form of wet deposition. The percentage of nitrogen in the surface layer, where a large portion of the biological activity occurs, was also estimated in an attempt to quantify the biological availability of atmospherically deposited nitrogen. Direct deposition was estimated to be approximately 2 percent of this surface-layer nitrogen during the winter months. However, this is probably the lowest percentage that occurs during the year, and deposition may be an important source of nitrogen in the summer months. Uncertainties related to *in situ* dry deposition sampling and wet dissolved organic nitrogen sampling require additional research.

- c** **New York/New Jersey Harbor Estuary Program (NY, NJ).** New York-New Jersey Harbor is currently the focus of several studies relating to sources of nutrient and toxic pollution loadings to the harbor. These studies will help to quantify pollutant loadings under the TMDL determination. As part of that effort, four air deposition monitoring stations were set up in the harbor area for limited monitoring for PCBs, PAHs, dioxin, heavy metals, and nitrogen. This information will then be available to determine the total loadings of contaminants that are not meeting criteria from all sources. Control options for meeting the TMDLs may include a reduction of air sources. This work is being conducted in cooperation with the New Jersey Department of Environmental Protection and the Hudson River Foundation.
- c** **San Francisco Estuary (CA).** The San Francisco Estuary Project (SFEP) is working with the Bay Area Stormwater Management Agencies Association (BASMAA) to identify sources of air emissions resulting in deposition of pollutants onto the land and to quantify the contribution of air pollutants reaching the estuary in storm water runoff. The pollutants of concern are primarily toxics, including copper, mercury, PCBs, and PAHs. This study is being coordinated with the San Francisco Estuary Regional Monitoring Program for Trace Substances (see page II-76). The San Francisco Estuary Institute (SFEI) coordinates the Regional Monitoring Program, which includes water, sediment, and tissue monitoring and is now being expanded to monitor air deposition. The SFEI is conducting a pilot study to evaluate pollutants which are being deposited from the air directly onto the estuary waters. Based on these studies, local and State agency partners will be able to assess the cost-effectiveness of emission reduction options and quantify the benefits associated with emission reduction strategies.
- c** **Santa Monica Bay (CA).** The Santa Monica Bay NEP has proposed an air transport/deposition study to (1) quantify emissions of the toxic materials and nitrogen in the Los Angeles air basin that are subsequently deposited in the bay and its watershed; (2) identify pollutant sources and their relative contributions to total pollutant loading to the bay; and, (3) evaluate the relative impacts of air deposition and the benefit of various emission reduction options in order to recommend the most cost-effective measures to control the identified sources. Initially, the Santa Monica Bay study will quantify the wet and dry toxic and nitrogen deposition to the bay surface. Indirect deposition over the landscape will be calculated using a model developed locally for the region that uses air concentrations, local meteorology, and surface types (trees, pavement) to calculate deposition velocities and loadings. This study will measure air concentrations over water, a difficult process that is not often done but that is necessary to improve the understanding of direct deposition processes. The study will also measure the impact of air deposition during “events” (fire storms, rain storms, Santa Ana winds) to understand how these weather patterns contribute to local air deposition.

c Sarasota Estuary (FL). The Sarasota Bay NEP is involved in four large research projects.

Atmospheric Monitoring Site on Sarasota Bay. For the average rainfall year, it is estimated that atmospheric deposition directly to the water surface provides 26.5 percent of the total nitrogen load to the bay. Under cooperative agreements with EPA, the Southwest Florida Water Management District (SWFWMD), and local governments, the Sarasota Bay NEP initiated an intensive, 1-year atmospheric deposition monitoring effort (within the national NADP/AIRMoN program) in September 1998. The intensive monitoring program is designed to establish relationships between emission sources or source regions and deposition to specific receptors.

Atmospheric Transport and Dispersion Model. Preliminary modeling by EPA using the Regional Atmospheric Deposition Model (RADM) at an 80 km grid suggested that 70 percent of the atmospheric nitrogen deposited to Sarasota Bay may originate from outside the watershed. Therefore, the Sarasota Bay NEP contracted with the University of South Florida to develop a regional atmospheric transport and dispersion model to determine the impact of NO_x emissions on Sarasota Bay water quality. Investigators modeled atmospheric dispersion, transport, chemical transformation, and deposition of NO_x, nitric acid, and nitrate from stationary and mobile sources using CALMET/CALPUFF, a Lagrangian puff model. A regional domain of 250 km by 500 km with a 20 km grid was modeled and included emissions from the metropolitan areas of Tampa, Orlando, Miami, and Fort Myers. The model indicated that Sarasota Bay shared the same airshed as Tampa Bay and the airshed encompassed the entire modeling domain. The model further indicated that mobile source emissions may be responsible for the majority (81 percent) of atmospheric nitrogen sources to Sarasota Bay. One caveat of the modeling, however, was that modeled wet deposition was approximately a factor of five lower than measured fluxes. Furthermore, utilities were found to contribute disproportionately to wet deposition. Therefore, the total contribution of utilities to atmospheric deposition may be underestimated and that of mobile sources may be overestimated.

Biological Effects of Atmospheric Deposition. Areas of the Sarasota Bay that receive the greatest percentage of nitrogen loading from atmospheric sources are also associated with the highest water quality; however, total nutrient loads to these segments are lower. Therefore, an investigation of the effects of atmospheric deposition on algal assemblages was initiated by the Sarasota Bay NEP through cooperative funding by SWFWMD and is being conducted by Mote Marine Laboratory. The growth response of phytoplankton to rainwater and nutrient additions is being determined by changes in major taxon composition, changes in particle size distribution, and through high performance liquid chromatography of photosynthetic pigment composition. The final results of this study should yield information on the major taxon composing a nutrient-rich (nearshore) and nutrient-depleted (offshore) algal regime, changes in growth rates as a result of rainfall and nutrient additions, and the potential of rainfall to act as a trigger for algal blooms in each regime. This research should provide information on the biological effects of atmospheric deposition.

Stable Isotopes to Trace Nitrogen Sources. This on-going study funded by EPA will use stable nitrogen isotope ratios (¹⁵N/¹⁴N) to determine the relative contributions of different types of sources (e.g., wastewater treatment plant effluent, fertilizer runoff, animal waste, and combustion processes), including air deposition of nitrogen. Both nitrogen isotopes are naturally-occurring, but the ratio of ¹⁵N/¹⁴N varies depending on the source. Measuring the ratio in emissions from different sources, in rainwater (wet deposition), and in phytoplankton, macroalgae, seagrasses, and the water column will help researchers identify the sources of atmospherically-deposited

nitrogen and its effects once it reaches the estuary. This is the only NEP air deposition study that measures nitrogen in the food web.

c Tampa Bay Atmospheric Deposition Projects (FL). The EPA and its partners in the Tampa Bay NEP (TBNEP) are currently working on eight separate but related projects to characterize the sources and impacts of atmospheric deposition to Tampa Bay and its watershed. A brief summary and status for each of these projects follows:

- (1) An intensive monitoring site, sponsored by TBNEP and EPA's Great Waters program, was created to quantify nitrogen loading from atmospheric deposition to the surface of Tampa Bay, estimate relative contributions from wet and dry deposition, assess temporal variability of wet and dry deposition, and assess the relative contribution of different nitrogen species to atmospheric deposition in Tampa Bay. Preliminary results indicate that atmospheric deposition directly to the bay's surface accounts for approximately one-third of the new nitrogen delivered from all sources to the bay.
- (2) The TBNEP initiated a study to estimate the contribution of atmospherically-deposited nitrogen to storm water loading from residential basins and estimate attenuation of nitrogen from atmospheric deposition in residential basins. The results indicated that approximately 15-20 percent of atmospherically-derived nitrogen was discharged from these basins per rainfall event.
- (3) Toxic materials sampling, sponsored by TBNEP, EPA, Florida Department of Environmental Protection (FDEP), and the Environmental Protection Committee of Hillsborough County (EPCHC), is being initiated to quantify metal concentrations and other contaminants in ambient air and to estimate potential loadings to water and the watershed.
- (4) The TBNEP and the Great Waters program will fund ammonia sampling to map the pattern of ambient air ammonia concentrations. Initial results from a pilot study indicate a strong gradient in ambient ammonia from the highly industrialized east bay to background levels at the existing intensive monitoring site. The overall objective is to develop a surface map showing relative concentrations of ammonia across the northern Hillsborough Bay area.
- (5) Beginning in the fall of 1998, the FDEP funded a study in which the Florida State University and the University of Virginia used N-isotopic ratios to identify nitrogen source types affecting Tampa Bay. In particular, the researchers are using isotopic ratios to attribute the relative contribution from different source types to atmospheric nitrogen, including combustion engines, coal-fired power plants, and diesel engines.
- (6) Local governments and the TBNEP have cooperatively developed and are operating a long-term spatial monitoring network for atmospheric deposition in the Tampa Bay region. The purpose of the monitoring network is to track the contribution and temporal trends of atmospheric nitrogen loading throughout the region.
- (7) The EPA is using RADM to identify relative contributions to nitrogen deposition in Tampa Bay from near and far sources. This effort also examines deposition to the bay and watershed.

- (8) In 1999, the FDEP is scheduled to initiate the Bay Regional Atmospheric Chemistry Experiment (BRACE) to (1) refine estimates of annual deposition of nitrogen species (HNO_3 , NH_3 , NH_4NO_3) to Tampa Bay and its watershed; (2) predict urban ambient ozone and $\text{PM}_{2.5}$ concentrations; and, (3) estimate contributions of primary emissions from motor vehicles and stationary sources. This project will include high resolution deposition-daily event samples analyzed for nutrients and trace metals (including mercury), and a 1-year field monitoring program using a Differential Optical Absorption Spectrometer to measure sulfur dioxide, ozone, nitric oxide, nitrogen dioxide or nitrite, benzene, toluene, organics, metals, pesticides, and xylenes.

NOAA ACTIVITIES

National Estuarine Research Reserve System

Under the 1972 Coastal Zone Management Act, Congress created the National Estuarine Research Reserve System (NERRS) to enhance the scientific understanding and management of the Nation's estuaries and coastal habitats. The NERRS is a network of protected estuarine areas in which Federal, State, and local partnerships work to promote stewardship, education, and research. As of 1999, 23 reserves were designated as NERRS sites, encompassing about 960,000 acres of estuarine waters, wetlands, and uplands. Four additional sites have been proposed and are in the process of development and designation. See Figure I-2 for the location of NERRS sites. All NERRS estuaries are included in the definition of "Great Waters."

The NOAA's Estuarine Reserves Division is working with all NERRS sites to implement a System-wide Monitoring Program (SWMP) to track the status and trends in coastal ecosystem health. This national monitoring program will be coordinated with other national and regional programs (i.e., NEP, EMAP, National Status and Trends). The overall goal of SWMP is to identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional, and site specific coastal zone management.

Currently, SWMP is focusing on compiling water quality and weather data. Within 22 reserves in the system (Kachemak Bay NERR, Alaska was designated in February 1999 and is not yet implementing SWMP), two locations – one non-impacted (baseline) and one non-point source impacted – are designated as water quality monitoring sites where water quality parameters are measured every 30 minutes. In addition, meteorological data collection began at each NERRS site in February 1998 to allow local weather events to be related to water quality conditions (NOAA NERRS 1998). Although SWMP does not include atmospheric deposition monitoring, it will provide data useful for tracking the ecological health of the coastal Great Waters.

Assessing Relative Nitrogen Inputs to Coastal Waters From the Atmosphere

With funding from EPA's Office of Water and Great Waters program, NOAA's Air Resources Laboratory (ARL) is performing a comprehensive assessment of nitrogen deposition to estuaries. In 1998, NOAA held two workshops involving experts from government, academia, and other institutions to assemble and evaluate nitrogen deposition data and assessment procedures for approximately 40 estuaries on the Atlantic and Gulf of Mexico coasts. Workshop participants evaluated the adequacy of existing nitrogen deposition data and attempted to develop standard nitrogen loading and mass balance

assessment methods. Standard assessment methods are needed to improve comparisons between studies and locations. The report is being produced in 2000.

Coastal Zone Management Program

The Coastal Zone Management Act of 1972 established the national coastal zone management (CZM) program, a voluntary partnership between the Federal government and the coastal States and territories of the U.S., with the following goals:

- C Preserve, protect, develop, and (where possible) restore and enhance the resources of the Nation's coastal zone for this and succeeding generations;
- C Encourage and assist the States and tribes to effectively exercise their responsibilities in the coastal zone to achieve the wise use of land and water resources of the coastal zone, giving full consideration to ecological, cultural, historic, and aesthetic values as well as the needs for compatible economic development;
- C Encourage the preparation of special area management plans to provide increased specificity in protecting significant natural resources, reasonable coastal-dependent economic growth, improved protection of life and property in hazardous areas, and improved predictability in governmental decision making; and,
- C Encourage the participation, cooperation, and coordination of the public, Federal, State, tribal, local, interstate, and regional agencies and governments affecting the coastal zone.

Since 1974, at least 32 Federally-approved CZM State programs have protected more than 99 percent of the Nation's 95,000 miles of oceanic and Great Lakes coastline.

As a component of the overall CZM effort, NOAA and EPA are currently developing a Coastal Non-Point Pollution Control Program for each CZM State program. The EPA has created pollution management and control measures for five non-point source categories: agricultural runoff, urban runoff, forestry runoff, marinas, and hydromodification.

OZONE TRANSPORT COMMISSION (OTC)

Section 184 of the CAA delineates a multistate ozone transport region (OTR) in the Northeast and requires specific additional NO_x and VOC controls for areas in this region, including attainment areas. In addition, section 184 of the CAA established the Ozone Transport Commission (OTC) to assess the degree of ozone transport in the OTR and to recommend strategies to mitigate the interstate transport of pollution. States in the OTR include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, parts of northern Virginia, and the District of Columbia. The OTC has concluded that regional reductions of NO_x emissions are particularly important in reducing ozone.

To further control NO_x emissions in the OTR, the OTR States agreed to implement RACT on major stationary sources of NO_x and to a phased approach for additional controls, beyond RACT, for power plants and other large fuel combustion sources. This agreement, the OTC Memorandum of Understanding (MOU) for stationary source NO_x controls, was approved on September 27, 1994. All OTC States, except Virginia, are signatories to the MOU. The MOU establishes an emissions trading

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system to reduce the costs of compliance with the control requirements. In addition, in developing State budgets for the NO_x SIP call, EPA considered the NO_x reductions each OTR State committed to in the MOU.

III.C STATE, LOCAL, AND TRIBAL ACTIVITIES

This section describes State, local, and tribal activities that will make significant contributions to understanding or reducing atmospheric deposition of toxic air pollutants to the Great Waters. Unlike the regional and waterbody-specific programs and activities described in Section III.B, these programs are led by State, local, or tribal agencies, not Federal agencies. However, EPA and other Federal agencies are partners in some of the programs.



Minnesota Sea Grant, Jeff Gunderson

STATE AND LOCAL ACTIVITIES

The projects described below are examples of State and local projects that support the goals of the Great Waters program. It is likely that there are many additional relevant State and local programs that were not identified for this report.

Ammonia Study in North Carolina: An Example of Progress in Understanding

The State of North Carolina recognizes nitrogen enrichment and eutrophication as a serious environmental concern for certain coastal plains, nitrogen-sensitive estuaries, and coastal waters (see, for example, the discussion of the Albemarle-Pamlico Estuary on page III-42). Atmospheric emissions and deposition of ammonia from intensive livestock operations are the subject of particular attention, in addition to atmospheric nitrates and water-borne discharges and runoff. A workshop on atmospheric

nitrogen compounds was held at North Carolina State University (NCSU) in March 1997 (Aneja et al. 1998).

The State of North Carolina Department of Environment and Natural Resources, in conjunction with NCSU, University of North Carolina at Chapel Hill, U.S. Department of Agriculture, and EPA, has begun a coordinated research program on ammonia emissions from large-scale livestock operations, and on the transport and deposition of ammonia, with possible effects of eutrophication in aquatic systems and on forest and crop production. Ammonia and other NH_x compounds have much different atmospheric lifetimes and interactions in the environment than do oxidized nitrogen compounds or NO_x (primarily NO and NO_2). The research program on nitrogen compounds will quantify the emissions, verify or improve existing emission factors, and begin modeling studies of deposition patterns, especially in the Coastal Plains of North Carolina.

Several aspects of the research program are already under way. New data on emissions of ammonia from waste lagoons and animal barns/houses have been gathered and are under review. Studies of deposition, deposition velocities, and movements of ammonia in the environment have begun, and a nitrogen balance is being developed to better understand sources, sinks, and exchanges of nitrogen compounds. Emissions data for ammonia and NO_x sources have been produced. Modeling using the Regional Atmospheric Deposition Model (RADM) and Models-3 is under way. A general conference on ammonia and other atmospheric nitrogen compounds was held in June 1999, in addition to intensive reviews of the North Carolina research program as individual studies are completed. These analyses will contribute to an understanding of which sources or source categories are generating the most environmental impact and which should be the focus of additional management efforts (Personal Communication with George Murray, NC DENR, September 9, 1998).

Maryland's Power Plant Research Program

The Maryland Department of Natural Resources (DNR), Power Plant Research Program, in cooperation with other partners, has several projects ongoing in the Chesapeake Bay watershed. These include applying the CALPUFF model to develop estimates of Maryland's contribution of atmospheric deposition of nitrogen to the Chesapeake Bay; using CALPUFF to assess the implications of possible utility emissions trading under title I of the CAA and impacts of deregulation on power plant emissions. The DNR also supports studies on air toxics, particularly mercury from coal-fired power plants, the migration of metals and nitrate through watersheds (including coastal wetlands and forests), and economic resource valuations associated with implementation of the CAA.

Florida's Mercury Rule: Progress in Reducing Atmospheric Mercury Emissions

The amount of mercury in Florida's municipal solid waste stream has been dropping rapidly due to the implementation of statutes and rules designed to reduce or replace mercury in the manufacture of widely used products, recycle mercury-containing items such as fluorescent lamps, and control mercury at the point of release. One tool the Florida Department of Environmental Protection uses to reduce atmospheric mercury emissions is a rule (i.e., "The Mercury Rule") adopted in 1993 that limits mercury emissions from municipal waste combustors (MWCs) to a level that is more stringent than the applicable EPA standard. Florida's strict mercury emissions standard is currently being met by over half of the MWCs in the State, and all MWCs in the State are expected to meet the standard in the year 2000. The rule also requires that every MWC unit perform a mercury stack test at least once each year. With over 5 years of test data available, it is clear that the uncontrolled (i.e., no up-front sorting of waste and no fine

particulate control) MWC units in Florida are emitting about 65 percent less mercury than just 5 years ago. With post-combustion controls (e.g., carbon injection) designed to capture mercury, the stack emission rates at some Florida MWCs have been reduced an additional 80 percent. In 1997, the average mercury emission rate for south Florida MWC units was 31 µg/dry standard m³ at 7 percent oxygen (Memorandum from Michael M. Hewett to Howard L. Rhodes, August 26, 1998).

South Florida Mercury Science Program

Mercury bioaccumulation in wildlife is extensive in Florida (FDEP 1996). High levels of mercury in several species of fish have resulted in bans or restrictions on their consumption in over half of the fresh waters of the State. The entire Florida Everglades is covered by fish consumption bans. In addition, the mercury problem places at risk a variety of wildlife within the Everglades, most notably top predators such as the endangered Florida Panther. The contribution of atmospheric deposition of mercury to this regional environmental problem is a subject of several current research efforts.

Participants in the South Florida Mercury Program

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The South Florida Mercury Science Program is a broad, multidisciplinary effort by scientists from State and Federal agencies, State universities, industry groups, and others (see sidebar) working together to understand and address mercury bioaccumulation in South Florida (FDEP 1996). The program is designed to determine the following:

- Potential risks to humans and wildlife from mercury in South Florida;
- How mercury enters the aquatic food chain and concentrates in predators;
- Chemical and biological pathways for transformation of inorganic mercury into methylmercury;
- The origin of mercury in South Florida's atmosphere and waters;
- How mercury moves through air, water, and soil; and,
- Actions that could be taken to reduce levels of mercury in fish and wildlife.

The Florida Everglades is currently the focus of the most in-depth and comprehensive research on mercury in the environment. Scientific findings in the areas of atmospheric mercury deposition, aquatic chemistry and cycling of mercury, and bioaccumulation of mercury in food chains have broad application to many of the Great Waters (see Chapter II for information on mercury in the Great Waters). In addition, scientists studying mercury in South Florida hope to incorporate their findings into a model that could be applied to other ecosystems.

Studies to date identified the atmosphere as the primary source (>95 percent) of mercury impinging on the Everglades. Much remains to be learned, however, about the sources of mercury as well as its fate in the environment. Several of the key projects currently under way are described below.

Florida Atmospheric Mercury Study (FAMS)

The FAMS was a large, regional-scale study conducted from 1992-1996 and designed to measure long-term temporal and spatial trends in atmospheric mercury transport and deposition in Florida. While most of the sites were remote, some were extremely close to or in urban areas (e.g., the Fort Meyers site). Data were collected over a 3-year period at nine sites (seven in South Florida), including monthly integrated samples of mercury in rainfall and weekly integrated vapor phase and particulate phase mercury samples. Preliminary analysis of the FAMS data indicated the following:

- More than 90 percent of the mercury found in the Everglades was from atmospheric deposition, while less than 10 percent was from agricultural runoff;
- Wet deposition of mercury to South Florida was high – approximately double what has been observed at other North American remote sites;
- Particulate mercury levels were relatively low;
- Mercury deposition exhibited a strong seasonal trend – 85 percent of annual deposition occurs in the summer; and,
- Slight spatial trends were evident in South Florida.

Although the FAMS study design limited its ability to differentiate between local, regional, and global sources of atmospheric mercury, the researchers conducting the study suggested that local source contributions of mercury to the Everglades are less dominant (<30 percent) than regional and/or global contributions (Guentzel et al. 1995).

South Florida Atmospheric Mercury Monitoring Pilot Study (SoFAMMS)

The SoFAMMS was a short-term, very intensive pilot study focused on determining the ability of state-of-the-art sampling, measurement, and modeling techniques to track mercury from sources to receptors. As a complement to FAMS, SoFAMMS was carried out to assess the influence of local mercury sources in the developed Southeast Florida Coast on the atmospheric deposition of mercury to the Everglades. Over a 1-month period (August 6, 1995 - September 6, 1995), SoFAMMS measured mercury emissions from three source types (municipal waste incinerator, medical waste incinerator, and coal-fired cement plant), meteorological conditions across the study area (surface and upper air), and several forms of atmospheric mercury and deposition at 17 ambient monitoring sites. The data were subjected to extensive dispersion, receptor, elemental composition, and meteorological modeling. The study found a wide range in spatial variability of mercury wet deposition. Volume weighted mean concentrations ranged from 13 to 31 ng/l across the 17 sites. The highest mercury concentrations were observed in the urban areas (19-31 ng/l). The sites in the Everglades were lower but still elevated, ranging from 13-20 ng/l. Those precipitation events in the Everglades with high mercury concentrations were also found to contain elevated concentrations of other trace element species known to be tracers for anthropogenic sources. The precipitation data were subjected to extensive meteorological, atmospheric dispersion, and source apportionment modeling. The results of the modeling indicated that greater than 70 percent of the mercury wet deposited to the Everglades were accounted for by waste incineration and

oil combustion sources, contrary to the preliminary FAMS results that indicated that local sources contribute less than 30 percent (Dvonch et al. 1998). Furthermore, monitoring data from these three sources were the first data to indicate that a high percentage of emissions from incinerators are in the form of divalent (reactive) mercury. Based on these results, EPA's Office of Research and Development has begun methods development efforts for ambient and source mercury speciation techniques.

Mercury Cycling in the Florida Everglades Project

The overall objective of this project is to provide resource managers scientific information on the hydrological, biological, and geochemical processes controlling mercury cycling in the Everglades (Krabbenhoft 1996). Specific areas of research include geochemical studies of mercury, mercury methylation and demethylation studies, interactions between dissolved organic carbon and mercury, mercury accumulation in sediments, physical and chemical processes in peat, sulfur cycling studies, biological uptake of mercury and lower food chain transfer pathways, and groundwater/surface water exchange. The USGS is leading this research effort, and participating scientists are from USGS, SFWMD, FDEP, EPA, Wisconsin Department of Natural Resources, and University of Wisconsin-Madison.

South Florida Ecosystem Assessment Project

This project is part of the EPA Region IV Regional Environmental Monitoring and Assessment Program (R-EMAP), which was designed to monitor the condition of ecological resources in South Florida (Stober et al. 1996). The project was intended to address several issues that threaten the Everglades ecosystem, including mercury contamination.

The project assessed mercury concentrations (e.g., in water, soil, algae, mosquitofish) at approximately 700 sampling sites. Interim findings provide an indication of the spatial distribution of mercury within the Florida Everglades as well as the levels of mercury contamination at various trophic levels in the food chain (Stober et al. 1996). The spatial distribution of mercury within the Everglades is relevant to the Great Waters research because it helps define the environmental conditions under which methylation and bioaccumulation occur. For example, the highest concentrations of methylmercury were found in fish, birds, and algae from the marsh sites between Alligator Alley and Tamiami Trail. North of Alligator Alley, the organic compounds and reduced sulfate are believed to bind the mercury and methylmercury so it is not available for uptake by organisms. South of Tamiami Trail, lower concentrations of sulfate and total phosphorous probably limit microbial methylation and organic production rates, respectively. In addition, researchers have found methylating bacteria associated with periphyton (attached algae) mats, which are more common in the marsh sites between Alligator Alley and Tamiami Trail.

Additional sampling has been conducted, and an updated report is expected soon. The study results will be used to answer the seven questions identified for mercury. The EPA Region IV is also studying the complex interactions between mercury contamination and other issues, such as eutrophication, habitat alteration, and hydropattern modification.

Midwestern Pollution Prevention Activities

Since the *Second Great Waters Report to Congress*, State and local pollution prevention activities have helped to reduce releases of Great Waters pollutants of concern. Six such activities in the Midwest are described below.

State Pesticide Clean Sweep Programs

Over time, unwanted pesticides have accumulated in the barns, sheds, and storage areas of farmers, ranchers, golf courses, pest control operators, and other pesticide users. The pesticides may be unwanted for a variety of reasons – the products could be banned, unusable, or not needed. Farmers and other small businesses may have difficulty determining how to properly manage these pesticides since some (but not all) may be hazardous wastes when they are disposed.

States have addressed the problem of accumulated unwanted pesticides by establishing waste pesticide collection and disposal programs, commonly called “Clean Sweeps.” These programs provide a simple way to properly dispose of unwanted pesticides at little or no cost to the participants. Because each State has designed its program to fit its own needs and funding sources, there is no single “typical” Clean Sweep program. Some of the variations include the following:

- *Format* – The pesticides may be collected by holding single-day collection events, picking up pesticides from individual farms, or establishing permanent collection sites;
- *Type of waste collected* – Waste pesticide collections may be combined with household hazardous waste programs either by consolidating all of the waste or by collecting both waste types at a single site but handling them separately;
- *Organizer* – The programs may be run by a State regulatory agency, the agricultural extension service, a county, or a combination of these;
- *Funding source* – Clean Sweep programs may be funded through State pesticide registration fees, State legislature appropriations, Federal grants, or fees assessed to participants; and,
- *Participants* – Some programs are limited to farmers, while others are open to households and/or small businesses.

State Clean Sweep programs have been extremely successful in removing pesticides from the environment and ensuring the proper management of these materials. A few highlights of their accomplishments through 1997 include the following:

- Clean Sweep programs have collected and disposed of more than 12 million pounds of pesticides;
- Over 40 States have collected and disposed of some pesticides;
- About 20 States have had on-going Clean Sweep programs since 1995 (or earlier); and,
- The collections bring in an average of 200-300 pounds of pesticide per participant (where 100 pounds is equivalent to about 11 gallons of liquid pesticide).

In addition, Table III-7 presents the amounts of pesticides that have been collected nationwide based on the limited data that have been collected. Despite this progress, efforts in this area need to continue. There is a large, but unquantified, amount of unused and/or unwanted pesticides that needs to be collected.

**Table III-7
Pounds of Pesticides Collected through Clean Sweep Programs Nationwide**

Pesticide	Average Percent (per collection)	Total Amount in U.S. (pounds)
DDT	3.86	463,200
Toxaphene	2.98	357,600
Chlordane	1.46	175,200
Mercury	1.53	183,600
Dieldrin	0.48	57,600

Illinois Clean Sweep Partners for PCB and Mercury Wastes

The presence of mercury and PCBs in the environment is partially attributable to their widespread use in commercial and consumer products, particularly electrical equipment. While newer technologies in products, such as transformers, capacitors, thermostats, and switches, are PCB and mercury free, older products are not and still pose potential health and environmental risks. Currently, much of the PCB- and mercury-containing equipment encountered during maintenance, remodeling, and demolition work is disposed of in the municipal solid waste stream. Because mercury and PCBs may be released into the environment throughout the disposal process – from the point of disposal, the garbage truck, a transfer station, and the solid waste landfill – the PCB and Mercury CleanSweep Partnership in Cook County, Illinois is attempting to reduce the amount of PCB- and mercury-bearing equipment entering the municipal solid waste stream.

The Cook County PCB and Mercury CleanSweep Partnership is a nonregulatory program sponsored by public and private entities. The CleanSweep Partners have joined resources to help small businesses and local governments identify and properly manage PCB- and mercury-containing materials through a convenient and cost saving program. Through literature and training, the CleanSweep Partners' goal is to educate and assist small businesses and local agency field personnel in a voluntary, public-private initiative to educate and motivate small business operators, particularly electrical and demolition contractors, to manage and dispose of mercury- and PCB- bearing equipment in identifying, handling, transporting, and disposing of mercury- and PCB-bearing equipment. For more information, call the CleanSweep Partners hotline at 1-888-SWEEP22 or visit the web site at www.erc.uic.edu/cleansweep.

The CleanSweep Partners are Commonwealth Edison, Electric Association, City of Chicago Department of the Environment, Cook County Department of Environmental Control, Metropolitan Water Reclamation District of Greater Chicago, Illinois Environmental Protection Agency, EPA, Clean Harbors Environmental Services, National Oil Recyclers Association, Safety-Kleen Corp., North Business - Industrial Council (NORBIC), and the University of Illinois at Chicago School of Public Health.

Michigan Mercury Pollution Prevention Task Force

The Michigan Mercury Pollution Prevention task force, which first convened in August 1994, has been active in many mercury pollution prevention activities throughout Michigan. Significant accomplishments include (1) a household hazardous waste collection program in 22 counties sponsored

Chapter III

Major Programs and Activities

by the Michigan Department of Environmental Quality (MDEQ), resulting in the collection of 200 pounds of mercury; (2) distribution of 16,000 copies of the “Merc Concern” brochure throughout Michigan; (3) development of a mercury pollution prevention web page at <http://www.deq.state.mi.us/ead/p2sect/mercury>; and, (4) distribution of mercury outreach materials to science teachers. Additional accomplishments of the Michigan Mercury Pollution Prevention task force are described below.

- The Michigan Mercury Pollution Prevention task force worked with the automobile manufacturers to phase out the use of mercury in automobiles, including identification of several uses of mercury in automobiles (e.g., in switches, anti-lock brakes, active ride control devices). To date, the manufacturers have made great progress in eliminating mercury switches from automobiles.
- A cooperative effort initiated by the Detroit Wastewater and Sewage Department that included the National Wildlife Federation, the Michigan Dental Association, and MDEQ collected approximately 1,400 pounds of elemental mercury from 400 dentists at 11 drop-off sites.
- The MDEQ, Michigan Department of Agriculture, Michigan Farm Bureau, Michigan Department of Community Health, Michigan Milk Producers Association, Independent Cooperative Milk Producers, and Michigan State University collaborated on a dairy farm mercury manometer pilot collection effort in two counties in Michigan. A total of 16 out of 18 manometers were replaced with a mercury-free substitute, and 12 pounds of mercury were collected and properly disposed. This program may be expanded Statewide.
- Detroit Edison identified 1,500 pounds of mercury used in current product applications and eliminated its use. Consumers Energy identified over 2,900 pounds of mercury used in product applications in 1996 and is now replacing mercury-containing products with mercury-free alternatives.

Indiana Statewide Mercury Awareness Program

The Indiana Statewide Mercury Awareness Program is a State and local partnership dedicated to identifying commercial uses of mercury, investigating pollution prevention opportunities, and developing and implementing outreach strategies. In October 1998, the Indiana Department of Environmental Management initiated an effort to collect and recycle household items containing mercury.

Minnesota Mercury Reduction Initiative

In 1997, the Minnesota Pollution Control Agency (MPCA) began the Mercury Contamination Reduction Initiative, aimed at reducing mercury contamination in fish in Minnesota lakes. A major part of this effort is to receive advice and comments from the public regarding the goals of the initiative. The MPCA established a Mercury Advisory Council that includes representatives from government, business, and environmental groups.

The council’s charter is to devise a package of recommendations to reduce mercury contamination in the environment. In January 1999, the council agreed to adopt a goal of reducing mercury releases to Minnesota’s air and water by 70 percent (compared to 1990 levels) by 2005, to be established in statute in the upcoming legislative session.

The recommendations that the council voted to forward to the MPCA include the following:

- Encouragement of voluntary commitments on the part of sources of mercury emissions (e.g., power plants, taconite facilities, sewage sludge incinerators) to reduce or work toward reducing mercury emissions;
- Development of a package of seven strategies that the State will advance at the national level to encourage States and the Federal government to act in concert to reduce national mercury emissions; and,
- Development of a package of strategies to persuade consumers to reduce their purchases and use of mercury-containing products and encourage counties to collect more mercury-containing waste in their household hazardous waste pickups.

Western Lake Superior Sanitary District (WLSSD) Pollution Prevention Efforts

The WLSSD is the largest wastewater treatment facility that discharges to the Lake Superior watershed. The WLSSD developed a multimedia mercury zero discharge pilot project with hospitals, clinics, educational institutions, laboratories, and dental practices. As part of this effort, WLSSD partnered with the Northeast District Dental Society to develop recycling procedures for materials containing amalgam particles. In the first year of the project, over 500 pounds of waste material containing amalgam was collected for recycling. Based on the results of the WLSSD pilot project, WLSSD compiled the *Blueprint for Mercury Elimination*, which is a document designed for use by other wastewater treatment facilities in developing and implementing mercury reduction programs.

Northeast States and Eastern Canadian Provinces Mercury Study

During 1996 and 1997, the Northeast States (i.e., Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont) and Canadian Eastern Provinces (i.e., New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and Quebec) held a series of meetings and workshops to address shared mercury pollution issues. In June 1997, the New England Governors and Premiers of Eastern Canada subsequently signed a Mercury Resolution that called for cooperative efforts including the completion of the Northeast Mercury Study. The study, which was completed in February 1998, reflects the combined contribution of State and provincial air, waste, and water management agencies throughout the northeastern U.S. and eastern Canada. It is an informational resource and serves as the foundation for future regional activities, including the development of a coordinated action plan (see below) to reduce the environmental and public health impacts of mercury pollution.

The study reports on emission inventories, transport and deposition modeling, multimedia monitoring and assessment, communication (public and political outreach), and control strategies and effectiveness of controls. The report recommends (1) identifying mercury as a hazardous air contaminant under State air regulations to achieve the most stringent emission rate; (2) conducting an emissions inventory of airborne sources of mercury; (3) implementing the Federal standards for municipal waste combustors and medical waste incinerators by the year 2000; and, (4) forming in-State task forces to assess, evaluate, and communicate mercury-related public health and environmental information.

Northeast Mercury Action Plan

In June 1997, the Conference of New England Governors and Eastern Canadian Premiers charged its Committee on the Environment with developing a regional Mercury Action Plan. The plan was released in May 1998 with the endorsement of the New England Governors and Eastern Canadian Premiers. The Mercury Action Plan identifies steps to address those aspects of the mercury problem in the Northeast that are within the control or influence of the region. The ultimate goal of the plan is the virtual elimination of anthropogenic mercury releases in the northeastern U.S. and eastern Canadian Provinces. In all, the plan lays out 45 specific recommendations addressing the following:

- C The establishment of a Regional Mercury Task Force to coordinate the implementation of the plan;
- C Mercury emission reduction targets for identified sources such as municipal solid waste combustors, medical waste incinerators, sludge incinerators, utility and non-utility boilers, and industrial and area sources;
- C Source reduction and safe waste management practices, including recycling;
- C Outreach and education, especially for high-risk populations;
- C Research, analysis, and strategic monitoring to further identify and quantify sources of mercury deposition and to monitor deposition patterns and develop meaningful environmental indicators to measure and track progress; and,
- C Mercury stockpile management.

TRIBAL ACTIVITIES

Deposition of toxic air pollutants to the Great Waters adversely affects resources (e.g., fisheries) that are of particular cultural and economic importance to many Native American tribes. This section describes partnerships between tribal, State, and Federal governments that have enabled tribes to better assess the ecological and human health risks posed by exposure to the Great Waters pollutants of concern. Financial and/or technological support from Federal and State sources (through projects such as the Effects on Aboriginals from the Great Lakes Environment (EAGLE), the Baseline Assessment Project, and the American Indian Lands Environmental Support Project) and programs initiated by tribal governments (such as aquaculture, CWA section 106 programs, or educational programs) are enabling tribes to successfully conduct better quality assessments of their environment.

Effects on Aboriginals from the Great Lakes Environment (EAGLE)

The EAGLE, a partnership between the Assembly of First Nations and the Medical Services Branch of Health Canada, is a community-based epidemiological project to research health effects of environmental contaminants potentially affecting approximately 100,000 people in 63 First Nation communities in the Great Lakes basin. The EAGLE's main activities to date include (1) a survey of fish and wild meat consumption in Great Lakes First Nations communities, (2) a program to establish safe fish consumption guidelines for First Nations communities, and (3) a health survey accompanied by blood and tissue sampling. Recognizing that even the perception of contamination can have a tremendous impact on the relationship that First Nation communities have with the land, studies to assess

the socio-cultural impact of environmental contamination are also being conducted. Future activities for the EAGLE project will focus on communication/outreach strategies and helping communities develop environmental plans.

Baseline Assessment Project

The EPA initiated a Baseline Assessment of Indian Country in order to provide easy-to-use and accessible environmental data to assist tribal governments and EPA in making sound environmental decisions. A work group, led by the American Indian Environmental Office (AIEO), is gathering and analyzing the existing information on environmental conditions in Indian country. In addition, EPA's program offices have identified 37 priority data sets that need to be developed to track environmental management activities (see sidebar for priority data sets relevant to the Great Waters program). Next, EPA will develop a data management system to meet the data needs. In addition, EPA's Office of Water is reassessing the 2,200 hydrologic unit basins of the U.S. so that tribal lands can be geographically located within specific watersheds.¹³ Therefore, environmental conditions on tribal lands, as evaluated through the baseline assessment, will be comparable to conditions on non-tribal lands within the same watersheds.

Draft Baseline Assessment Priority Data Sets
⊗ Ambient air monitoring
⊗ Air toxics
⊗ Point and non-point source loadings
⊗ Fish consumption advisories
⊗ Ecological status of wetlands
⊗ Contaminated sediment
⊗ Pesticide use
⊗ Blood lead screening
⊗ PCB ballast in buildings

American Indian Lands Environmental Support Project

Established by EPA's Office of Enforcement and Compliance Assurance, the American Indian Lands Environmental Support Project (AILESP) is designed to assess the impact of toxic chemicals from permitted point sources on tribal lands. The AILESP integrates release data for multiple sources and media, and information on the potential impact of a variety of contaminants with compliance histories of facilities within 3.1 miles of tribal lands. The information is assembled into a geographic information system (GIS) to help users understand the sources and impacts of pollutants on tribal lands. Preliminary AILESP data include release of trace metals (including cadmium, lead, and mercury) and nitrogen compounds (including nitrogen dioxide, ammonia, nitrate, and NO_x) from certain facilities.

Aquaculture

Interest in aquaculture in tribal communities has recently been stimulated by the desire to preserve ancestral traditions while avoiding health risks associated with the consumption of contaminated fish. Aquaculture is based on the premise that uncontaminated fish can be obtained by breeding and rearing them at uncontaminated sites (e.g., isolating them from contaminated sediments) and feeding them high-quality commercially-supplied food (i.e., circumventing the contaminated food chain). Buttner (1997) aided aquaculture efforts by three tribal communities: Akwesasne Mohawks (St. Regis Mohawks), Mohawks of the Bay of Quinte, and Ojibway of Sucker Creek. Although the programs had varying degrees of success, it was clear that aquaculture had the potential for producing "clean" fish, while creating jobs and minimally impacting the environment.

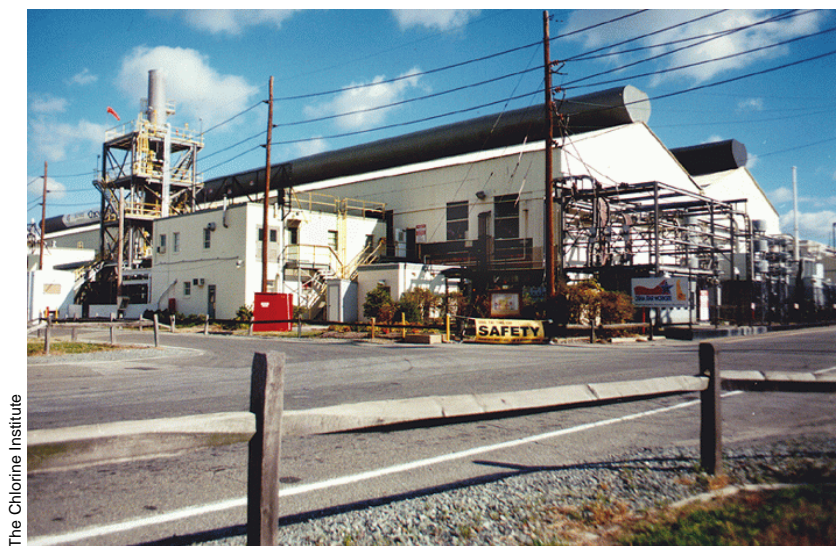
¹³ Personal Communication with Ed Liu, EPA. October 26, 1998.

Tribal Air Quality Programs

In 1998, EPA issued a rule that authorizes tribes to develop air quality programs under the CAA. The EPA has also increased its financial support and technical assistance to tribes that choose to adopt air quality programs. Numerous tribes have begun to develop these programs, including programs for collecting air quality monitoring data and programs that address toxic pollutants that are generated in Indian country. The EPA will regulate larger sources of air pollution in Indian country until tribes develop their own regulatory programs. The EPA is also updating data on the number, type, and location of sources of toxic pollutants that are located in Indian country.

III.D INDUSTRY ACTIVITIES

A number of industry activities currently contribute to reduced emissions of Great Waters pollutants of concern. These industry activities were developed by cooperative partnerships involving industry groups, EPA, and other agencies. Some of the activities are noted under other sections of this chapter, such as under the Michigan Mercury Pollution Prevention Task Force. The EPA has found that nonregulatory partnerships can be an effective means of achieving or surpassing environmental goals. In addition, industry is phasing out the use of some Great Waters pollutants of concern in the manufacture of certain products. For example, the amount of mercury used for the manufacture of electric switches and thermostats has been decreasing because of the shift to solid state devices and other alternatives (see Volume II of EPA's 1997 *Mercury Study Report to Congress* (U.S. EPA 1997e)).



CHLOR-ALKALI INDUSTRY MERCURY REDUCTION GOAL

In July 1997, the Chlorine Institute, on behalf of its members, committed to reduce mercury use in the chlor-alkali industry by 50 percent to help the U.S. achieve the mercury reduction goals of the Binational Toxics Strategy (see page III-66). The baseline average annual mercury usage by mercury cell chlor-alkali plants for the 1990-1995 period was 160 tons per year. The industry's goal is to reduce mercury usage to 80 tons per year by 2005. In addition, as part of the agreement, the Chlorine Institute will submit an annual progress report to EPA. The first annual report was submitted to EPA in May 1998.

To ensure that appropriate oversight is provided for monitoring the progress in achieving the commitment, the Chlorine Institute's Board of Directors established ad hoc committees for technical and management issues. All chlor-alkali producers using mercury cell technology are represented on both committees. In addition, seven technical task groups were formed to address specific issues such as identification of new mercury reduction control techniques and preparation of guidance documents to assist industry members in achieving mercury reduction goals.

VOLUNTARY MERCURY AGREEMENT WITH NORTHWEST INDIANA STEEL MILLS

On September 25, 1998, the Lake Michigan Forum, the Indiana Department of Environmental Management (IDEM), and EPA signed a voluntary agreement with three northwest Indiana steel mills, including Bethlehem Steel Burns Harbor, Ispat Inland Inc. Indiana Harbor Works, and U.S. Steel Gary Works. The mills agreed to inventory mercury in equipment, materials, storage, and waste streams, and to develop facility-specific plans for mercury pollution prevention. The companies signed the agreement as part of the Lake Michigan Primary Metals Project, which is a pollution prevention effort initiated by the Lake Michigan Forum. The Lake Michigan Forum is a stakeholder group that provides input to EPA on the Lake Michigan Lakewide Management Plan and includes representatives from academia, business, environmental and sportfishing groups, and local governments.

The agreement will result in facility-specific reduction plans outlining pollution prevention activities through equipment substitutions, purchasing practices, recycling, better management, and employee education. The EPA (including the Mercury Work Group of the Binational Toxics Strategy) and IDEM will provide the companies with information on typical mercury sources, substitutions for mercury in equipment, and recycling options. Both agencies and the Lake Michigan Forum will receive progress reports from the mills. The reports will also be available to the public. The forum will promote the initiative and its results throughout the Lake Michigan basin. This effort could serve as a model for other companies and industries that use mercury-containing devices.

AMERICAN HOSPITAL ASSOCIATION MOU

On June 24, 1998, the American Hospital Association (AHA), which consists primarily of health care provider organizations, established a Memorandum of Understanding (MOU) with EPA's Office of Prevention, Pesticides, and Toxics and EPA Region V. The MOU is intended to provide AHA members with enhanced tools for minimizing the production of pollutants and reducing the volume of waste generated. The information should also reduce the waste disposal costs incurred by the health care industry.

Hospitals Produce Mercury Wastes

"Medical waste incinerators are the fourth largest releasers of mercury to the environment, constituting approximately 10 percent of all emissions sources, and hospitals are responsible for producing 1 percent of the total municipal solid waste in the entire country." (U.S. EPA 1998d)

The MOU outlined multiple primary goals and activities designed to aid in the exchange of information between EPA and the health care industry. Highlights include the following:

- C Development of a Mercury Waste Virtual Elimination Plan to eliminate mercury-containing waste from the health care industry waste stream by the year 2005;
- C Development of a Total Waste Volume Reduction Plan to reduce the volume of waste generated by the health care industry by 33 percent by 2003 and by 50 percent by the year 2010; and,
- C Investigation of pollution prevention opportunities with respect to ethylene oxide and other persistent, bioaccumulative, and toxic pollutants.

This MOU specifically supports the goals and objectives of the PBT Initiative, the Mercury Action Plan, and the Waste Minimization National Plan, and is also expected to help reduce atmospheric deposition of mercury and other persistent toxic pollutants to the Great Waters (U.S. EPA 1998d).

ELECTRIC POWER RESEARCH INSTITUTE STUDIES

The Electric Power Research Institute (EPRI) has a broad-based research program which conducts a large amount of research cooperatively with Federal and State agencies. Research sponsored by EPRI on air toxics and nitrogen is the largest privately-funded program in the U.S. Current air toxics studies focus on mercury, nickel, dioxins, and arsenic. These studies include atmospheric global, regional, and plume modeling of mercury; measurement of natural mercury fluxes; historic patterns of mercury deposition (sediment and peat cores); environmental effects and mercury cycling in lakes; human health effects of mercury exposure; and, mercury and multimedia risk assessment. Research characterizing emissions of air toxics has, and is, leading to better emission inventories relevant to a number of air quality issues. The EPRI also conducts or sponsors research in atmospheric chemistry and physics, including atmospheric modeling and measurement of PM, ozone, and their precursors (including nitrogen species). On-going nitrogen research of specific interest to the Great Waters includes a small study on measurement of organic nitrogen in precipitation near the Chesapeake Bay; development of a nutrient model for the Chesapeake Bay airshed, watershed, and bay; a study on the feasibility of using isotopic composition of ammonium in wet deposition for source attribution; and, research on the effects of nitrogen speciation in atmospheric deposition on phytoplankton community composition and productivity. In addition, EPRI is a contributor to a study with substantial funding from EPA and NOAA that is being carried out by the Ocean Studies Board and Water Science and Technology Board of the National Research Council's Commission on Geosciences, Environment, and Resources to assess eutrophication, coastal processes, and watershed management. The study report, due in spring 2000, will review existing knowledge and make recommendations for action and research to reduce eutrophication in coastal ecosystems through more effective watershed management.

Businesses for the Bay

Since its launching by the Chesapeake Executive Council in 1996, more than 230 businesses have joined the *Businesses for the Bay*. This includes not only private industries, but State and local government facilities as well. Under this voluntary program, businesses commit to pollution prevention activities and goals. In 1998, member facilities voluntarily reported that they had reduced or recycled 222 million pounds of waste. Of these, 13 facilities reported a resulting cost savings of \$1.4 million, and 15 of the facilities offered pollution prevention training to 6,300 employees. Businesses have also volunteered more than 70 of their technical experts to act as mentors to offer pollution prevention advice to other companies on an as-needed basis. In 1998, *Businesses for the Bay* received 2 national awards from the National Pollution Prevention Roundtable and the National Environmental Education and Training Foundation for its successes as a model program.

III.E WORK WITH OTHER COUNTRIES

The U.S. works with other nations on many issues concerning shared resources (e.g., the Great Lakes) and transboundary environmental problems. A number of international activities concern the Great Waters and Great Waters pollutants of concern. International activities relevant to air deposition of pollutants to the Great Waters are discussed below.



CANADA - U.S. BINATIONAL TOXICS STRATEGY

On April 7, 1997, the U.S. and Canada signed the Great Lakes Binational Toxics Strategy (BNS). The BNS sets forth a collaborative process by which Canada and the U.S. will work toward the goal of virtual elimination of persistent toxic substances resulting from human activity from the Great Lakes basin, in order to protect and ensure the health and integrity of the Great Lakes ecosystem. The goal of virtual elimination will be achieved through a variety of programs and actions that encourage cooperation among all relevant sectors of society and which place primary emphasis on pollution prevention.

This coordinated strategy provides the framework to achieve quantifiable goals in a specified timeframe. As noted in the discussion of the PBT Initiative (see page III-4), there are 12 Level I pollutants that represent an immediate priority and are targeted for reduction and eventual elimination through pollution prevention and other incentive-based actions. Nine of these 12 pollutants are Great Waters pollutants of concern.

Both the U.S. and Canada have set “challenge” goals to achieve reductions in releases of the targeted pollutants. One of these challenges is the commitment of both countries to work together to assess atmospheric inputs of persistent toxic substances to the Great Lakes with the goal of evaluating and reporting jointly on the contribution and significance of long-range transport of these substances from worldwide sources. In addition, Environment Canada will complete inventories of ten selected air pollution sources to support assessment of environmental impacts of air toxics by 1999 and will demonstrate alternative processes to reduce emissions from five predominant sources by 2001. The BNS includes several specific reduction goals or challenges for the Level I pollutants. For the U.S., these reductions will be based on the most recent and appropriate inventory for each pollutant (e.g., the mercury inventory is based on 1990 levels). Canada plans to use an inventory from 1988.

At the initial June 1997 BNS stakeholder meeting, participants developed a plan to implement the strategy, which applied the following steps to address each priority substance or category of substance: (1) information gathering, (2) assessment of current regulations and programs, (3) identification of cost effective options for further reductions, and (4) recommendations and implementation of actions.

Since the initial stakeholder meeting, substance-specific work groups have been established and are gathering information about baseline levels and sources of pollutants, as well as current programs affecting the pollutants. In addition, some work groups are attempting to identify cost-effective options to achieve reductions. Specific highlights of the mercury work group activities include the AHA MOU (see page III-64), work with the chlor-alkali industry (see page III-63), and an agreement with the steel industry (see page III-64). The PCB work group has supported Clean Sweep programs (e.g., the Illinois Clean Sweep Program described on page III-57) to reduce existing stockpiles. With the International Joint Commission, the BNS participants developed a draft report on sources, pathways, and transformations of the BNS compounds. This report, *Identifying Source Regions of Selected Persistent Toxic Substances in the U.S.*, identifies and ranks source regions for BNS pollutants, identifies regulatory and voluntary programs to control emissions of these compounds, and determines the emissions inventory and control gaps that exist for the BNS compounds. In addition, EPA’s Great Lakes National Program Office released a *Draft Pesticides Report in Response to the Great Lakes Binational Toxics Strategy* in December 1998 (see sidebar). Many additional activities that support the Binational Strategy have been implemented by a wide variety of stakeholder groups and are outlined in the *Draft Great Lakes Binational Toxics Strategy: Activities by Partners* (U.S. EPA and Environment Canada 1998). Table III-8 describes the BNS challenge goals for the U.S. for each Level I substance and summarizes recent activities with respect to those goals.

BNS Pesticides in the Great Lakes

In December 1998, EPA’s Great Lakes National Program Office (GLNPO) released a draft report entitled, *Draft Pesticides Report in Response to the Great Lakes Binational Toxics Strategy*. A final report will be released in fall 1999. The report presents and analyzes data on the environmental presence of five banned pesticides (i.e., chlordane, aldrin/dieldrin, DDT, mirex, toxaphene) in the Great Lakes, along with probable and suspected sources. The report fulfills a “challenge” created by the Binational Toxics Strategy for EPA to confirm by 1998 the elimination of uses and releases of the pesticides from sources that enter the Great Lakes.

The report concludes that although environmental concentrations of the pesticides in the Great Lakes basin have gradually declined for 20 years, they remain at levels of concern in water, sediment, and fish. The EPA found no evidence of environmentally-significant, purposeful releases of the pesticides in the U.S. and concluded that continuing inputs to the Great Lakes are likely to originate from remaining stockpiles of the pesticides held by consumers, long-range transport from countries where the pesticides are not banned, and releases of the pesticides from reservoir sources (e.g., contaminated sites). Based on these findings, EPA concluded that there is a continuing need to pursue activities set forth under the Binational Toxics Strategy.

**Table III-8
U.S. BNS Challenge Goals and Activities for Level I Substances**

Level I Substance	U.S. Challenge Goal	Progress/Activities
Mercury and Compounds	By 2006, a 50 percent reduction in deliberate use and a 50 percent reduction in release from human-activity sources. This release reduction applies to the aggregate releases to the air nationwide and to releases to the water in the Great Lakes basin.	BNS work group activities are focusing on voluntary actions. Formal collaborative efforts are under way with the chlor-alkali industry, the American Hospital Association, and three Indiana steel mills. Outreach projects are ongoing with manufacturers and users of mercury relays and switches, utilities, and laboratories.
Dioxins and Furans	By 2006, a 75 percent reduction in total releases from human-related activities. This release reduction applies to the aggregate releases to the air nationwide and to releases to the water in the Great Lakes basin.	The BNS dioxin work group is coordinating closely with the PBT Initiative dioxin efforts, including a Great Lakes State pilot to target air emissions using cross-media authorities. Voluntary reduction efforts are also planned.
PCBs	By 2006, a 90 percent reduction nationally of high-level PCBs (>500 ppm) used in electrical equipment. Ensure that all PCBs retired from use are properly managed and disposed of to prevent accidental releases.	The BNS PCB work group is developing a work plan. Voluntary actions are being pursued through expanding EPA Region V's PCB phasedown program, encouraging national replication of the phasedown program, implementing a clean sweep pilot in Chicago, and encouraging a national PCB reduction effort.
Chlordane, DDT, Aldrin/Dieldrin, Mirex, Toxaphene, Octachlorostyrene	Confirm, by 1998, that there is no longer use or release from sources that enter the Great Lakes basin. If ongoing long-range sources from outside the U.S. are confirmed, use existing international frameworks to reduce or phase out releases.	A final BNS status report on use and release from Great Lakes basin sources is due fall 1999. The BNS work group is also developing a work plan. The EPA will continue clean sweeps to reduce stockpiles in the Great Lakes basin and will work with stakeholders and Great Lakes States to reduce pesticide reliance. The BNS octachlorostyrene work group is focusing on defining sources, releases, and environmental loadings (and, to some extent, toxicity and bioaccumulation).
Alkyl Lead	Confirm no use in automotive gasoline by 1998. Support and encourage stakeholder efforts to reduce alkyl lead releases from other sources.	The EPA issued a "confirmation of no use in automotive gasoline" report under the BNS in December 1998, broaden stakeholder involvement, encourage stakeholder minimization of use/release from other sources (e.g., aviation, racing,) and track efforts to develop unleaded alternatives for aviation and racing fuel.
Hexachlorobenzene	Seek, by 2006, reductions in releases that are within or may have potential to enter the Great Lakes basin from sources resulting from human activity (percentage goal not yet established).	An initial step under the BNS is to quantify loadings to set a realistic percentage goal. The BNS work group will consider approaches to reduce releases during pesticide manufacturing and use, chlorinated solvent manufacturing, and possibly aluminum manufacturing.

Level I Substance	U.S. Challenge Goal	Progress/Activities
Benzo[a]pyrene	Seek, by 2006, reductions in releases that are within or may have potential to enter the Great Lakes basin from sources resulting from human activity (percentage goal not yet established).	The BNS work group was developing a work plan in 1998.

INTERNATIONAL JOINT COMMISSION

Originally created in 1909 for the purpose of resolving disputes between the U.S. and Canada, the International Joint Commission (IJC) is charged with the responsibility of evaluating and assessing the progress of commitments made by Canada and the U.S. under the 1978 Great Lakes Water Quality Agreement (GLWQA). In keeping with this responsibility, the IJC prepares a biennial report outlining its findings and recommendations. These recommendations are based on information compiled from the Great Lakes Water Quality Board (WQB), Science Advisory Board (SAB), International Air Quality Advisory Board (IAQAB), Council of Great Lakes Research Managers, various task forces, and through a variety of public consultation activities. In 1985, the WQB established a list of 11 critical pollutants which remain the focus of IJC's efforts today. Nine of the critical pollutants overlap with the Great Waters pollutants of concern and the PBT Initiative: DDT/DDE, dieldrin, hexachlorobenzene, lead, mercury, PCBs, dioxins and furans, and toxaphene.

The IJC's *Ninth Biennial Report on Great Lakes Water Quality*, published in June 1998, focused on the issue of persistent toxic substances in the Great Lakes ecosystem, which has been the major focus of IJC's biennial reports since 1990. The IJC continues to stress the importance of eliminating these substances. As in previous biennial reports, IJC developed targeted recommendations to aid Canada and the U.S. to achieve the objectives under the GLWQA. Historically, these recommendations have been incorporated into existing or planned programs, and a few have achieved specific and direct results, including *The Great Lakes Binational Toxics Strategy*. Recommendations to the U.S. and Canada from the 1998 report include the following:

- C Accelerate the development of integrated, binational programs to reduce and eliminate sources of persistent toxic substances to the atmosphere;
- C Develop and communicate a comprehensive strategy for reducing mercury and NO_x emissions associated with energy production and use;
- C Expand research into endocrine disrupting chemicals in humans and wildlife;
- C Support the development and application of ecosystem models;
- C Identify, assess, and support surveillance and monitoring programs essential to track contaminant loadings to, and concentration trends for, each of the Great Lakes; and,
- C Focus reduction and elimination efforts on dioxins, furans, mercury, and PCBs.

The IJC presented additional recommendations on agricultural practices, communication of scientific information, radioactivity, ecological economics, and contaminated sediment in areas of concern (AOCs).

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE LRTAP PROTOCOLS ON HEAVY METALS AND POPS

In 1979, members of the United Nations Economic Commission for Europe (UN-ECE) created the Long-Range Transboundary Air Pollution (LRTAP) convention to provide a framework for participating countries to limit, gradually reduce, and eventually prevent air pollution. Today, the 57 countries included in the UN-ECE region are the Russian Federation, the Newly Independent States, Central and Eastern Europe, Western Europe, Canada, and the U.S. Protocols to the LRTAP convention negotiated since its creation establish more specific and legally-binding controls and emission reduction targets for certain air pollutants.

In June 1998, the members of the UN-ECE signed protocols on persistent organic pollutants (POPs) and heavy metals. The POPs are defined as organic substances that possess toxic characteristics, are persistent, bioaccumulate, are prone to long-range transboundary transport and deposition, and are likely to cause significant adverse human health and environmental effects. The POPs protocol bans the production and use of eight compounds (i.e., aldrin, chlordane, dieldrin, endrin, hexabromobiphenyl, kepone, mirex, and toxaphene) and limits the production and use of five compounds (i.e., DDT, heptachlor, hexachlorobenzene, lindane, and PCBs). In addition, the POPs protocol requires countries to apply best available technology methods to limit air emissions from stationary sources of dioxins, furans, PAHs, and hexachlorobenzene. The protocol on heavy metals regulates cadmium, lead, and mercury. The protocol bans the use of lead in gasoline and the use of mercury in batteries and requires the application of best available technology to limit air emissions from major stationary sources of all three metals.

Both of these protocols to the LRTAP convention incorporate less stringent obligations for countries with economies in transition, and the protocols offer alternative compliance options to allow some parties to apply different control strategies, provided these strategies achieve equivalent emission reductions. The protocols also commit participating parties to reduce total national air emissions to below the levels reported for a reference year (between 1985 and 1995).

Most recently, in December 1999, the U.S. and Canada, along with European members, signed the LRTAP Protocol to Abate Acidification, Eutrophication and Ground-level Ozone. This Protocol is the most sophisticated environmental agreement so far because it creates the first comprehensive, multinational structure to simultaneously reduce the long range transport of the various pollutants that, in different combinations, cause acid rain, smog and other serious air pollution problems. The signing of this agreement also initiates a new phase within LRTAP to increase emphasis on implementation, compliance, review and extension of existing protocols. In order to accommodate the domestic (acid rain) and bilateral (ozone) processes which are currently under way in both countries, both Canada and the United States will incorporate their emission reduction commitments for sulphur dioxide, nitrogen oxides and volatile organic compounds into the Protocol at the time of its ratification. This accommodates the timing of the bilateral initiative to complete negotiations in the year 2000 of an ozone annex to the U.S. - Canada Air Quality Agreement (see below).

Further information on the LRTAP Convention and its Protocols can be found at <http://www.unece.org/env/lrtap>.

UNITED NATIONS ENVIRONMENT PROGRAM GLOBAL POPS INITIATIVE

At its 19th session in February 1997, the United Nations Environment Program (UNEP) Governing Council concluded that international action, including a global, legally-binding instrument, is needed to reduce the risks to human health and the environment arising from the release of 12 POPs: aldrin, dieldrin, DDT, endrin, chlordane, hexachlorobenzene, mirex, toxaphene, heptachlor, PCBs, dioxins, and furans. The Governing Council decided that immediate international action should be initiated to reduce and/or eliminate the emissions and discharges of the 12 POPs, and, where appropriate, eliminate production and subsequently the remaining uses of those POPs that are internationally produced. Accordingly, the first session of the Intergovernmental Negotiating Committee (INC) for an International Legally Binding Instrument for Implementing International Action on Certain Persistent Organic Pollutants was held in Montreal in June 1998. The INC is expected to complete an Internationally Legally Binding Instrument by the middle of the year 2000.

Currently, the INC is establishing an expert group for the development of science-based criteria and a procedure for identifying additional POPs as candidates for future international action. In addition, UNEP has initiated a number of immediate actions, such as studies to identify alternatives to POPs, current PCB inventories, sources of dioxins and furans, and available POP destruction capacity.

NAFTA COMMISSION ON ENVIRONMENTAL COOPERATION SOUND MANAGEMENT OF CHEMICALS PROGRAM

On January 1, 1994, the U.S., Canada, and Mexico officially established the North American Agreement on Environmental Cooperation (NAAEC) to foster greater cooperation on environmental issues, including the management and control of several Great Waters pollutants of concern. Subsequently, the NAAEC created the Commission on Environmental Cooperation (CEC) to address regional environmental concerns, prevent potential trade and environmental conflicts, and promote effective enforcement of environmental law. One of the CEC's first activities was to develop a program to identify, measure, and mitigate the environmental impacts of the North American Free Trade Agreement (NAFTA) (NAAEC 1999).

In 1995, the CEC established a Sound Management of Chemicals (SMOC) Work group to address the issues of persistent toxic substances and their effects in and transport between the North American countries. The original duties of the work group members included the development of a North American Regional Action Plan (NARAP) for the management and control of PCBs (Commission for Environmental Cooperation 1998). Since 1995, NARAPs have been developed for PCBs, DDT, chlordane, and mercury. The CEC is currently developing a Phase II NARAP for mercury, which represents an amendment to the first mercury NARAP. The CEC is developing NARAPs for dioxins and furans, and hexachlorobenzene. Draft and final NARAPS and additional information related to this effort is available at www.cec.org/programs_projects/pollutants_health/smoc/smoc-rap.cfm?varlan=english.

Recent Developments on the Mercury North American Regional Action Plan

In October 1998, the North American Implementation Task Force on Mercury held a Science Experts Workshop that focused on mercury source identification, fate, transport, and monitoring and the identification of research needs in these areas. The workshop resulted in a *Strategy for the Development of a Trilateral North American Mercury Baseline* for mercury concentrations and fluxes (Draft Agenda, October 6-8, 1998, Science Experts Workshop on Mercury, Las Vegas, NV).

U.S.-CANADA AIR QUALITY AGREEMENT

The U.S.-Canada Air Quality Agreement, which was signed in March 1991, addresses transboundary air pollution between the two countries. The agreement focuses on acid rain and ozone transport issues, prevention of deterioration of air quality and visibility, development of emissions monitoring systems, notification and assessment of major projects which could affect transboundary air quality, and coordinated research activities. The two countries established the Air Quality Committee (AQC) to help implement the agreement. In the past, the AQC focused primarily on acid rain and notification issues and is currently expanding the focus to address transboundary ground-level ozone and fine particles (U.S. EPA 1998s).

The agreement includes commitments by the U.S. and Canada to reduce SO₂ and NO_x emissions. Specifically, for NO_x, the U.S. and Canada agreed to reduction goals amounting to about 10 percent of the national NO_x emissions for both countries by 2000. This is equal to approximately two million tons in the U.S. and 100,000 tons in Canada. The U.S. expects to meet this goal through mobile and stationary source NO_x emission measures, a large part of which will be realized through Acid Rain Program reductions of emissions from coal-fired electric power plants. After 2000, the U.S. expects to achieve additional reductions in NO_x from implementation of the ozone NAAQS and the NO_x SIP call (see page III-27). Canada has measures in place to reduce NO_x emissions from stationary sources by 100,000 tons by 2000 through national emissions limits for new fossil-fueled power plants, retrofits at several existing power plants, new source standards for boilers, process heaters, and cement kilns, and reconstruction of a metals smelter. In addition, by 2010, Canada anticipates a 10 percent decline in NO_x emissions from 1990 levels as a result of improved emission standards for vehicles.

In April 1997, the Canadian Minister of the Environment and the EPA Administrator reiterated their commitment to addressing transboundary air pollution by signing a Joint Plan of Action for Addressing Transboundary Air Pollution. The commitment focuses on the common concern of both countries for ground-level ozone and fine particles and for protecting public health on both sides of the U.S. - Canada border. Currently, the U.S. and Canada are negotiating an ozone annex to the U.S. - Canada Air Quality Agreement which is expected to be completed by December 2000. This annex will fulfill the two countries' obligations under the LRTAP Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (see discussion above).