

905R86107

LAKE MICHIGAN TOXIC POLLUTANT CONTROL/REDUCTION STRATEGY

FINAL

July, 1986

Illinois Environmental Protection Agency

Indiana Department of Environmental Management

Michigan Department of Natural Resources

Wisconsin Department of Natural Resources

U.S. Environmental Protection Agency
Region V

A. INTRODUCTION

Two goals in both the Clean Water Act and the 1978 Great Lakes Water Quality Agreement are: to restore, protect and enhance the physical, chemical and biological integrity of the nation's waters, and to eliminate the discharge of pollutants to those waters.

Lake Michigan is the largest body of fresh water totally within the borders of the United States. It is used by millions as a drinking water supply and for recreation, such as boating, swimming and sport fishing. It is also an important commercial fishery and transportation resource. At present, however, lake uses are impaired because of the concentrations of toxic pollutants found in its waters, sediments, fish and birds. For example, Lake Michigan lake trout contain the second highest levels of PCB's and DDT in the Great Lakes system, and cannot be sold commercially because their level of pollutants exceed human health-related U.S. Food and Drug Administration guidelines.

In recognition of these facts, Region V and the States of Illinois, Indiana, Michigan and Wisconsin have agreed to work together to end the Lake's toxic substances pollution problem. The Lake Michigan Toxic Pollutant Control/Reduction Strategy (the Strategy) has been prepared as an implementation plan to eliminate toxic pollutant problems from the Lake Michigan system.

B. BACKGROUND: The Scott Versus Hammond Decision

In a decision dated August 16, 1984 (Scott vs. Hammond, et. al., (741 F.2nd. 992 C.A. 7, 08/16 and 21 ERC 1474) the Seventh Circuit concluded that nondevelopment and nonsubmission of total maximum daily loads (TMDL's) by a State over a period of years, may constitute a constructive decision by that State that no TMDL is, in fact, required for the particular waterway at issue. Such a decision must be reviewed by USEPA under the provisions of Section 303 of the Clean Water Act, as amended. Under the Court's specific interpretation of the Scott vs. Hammond, et al. case, the States bordering Lake Michigan were required to reach decisions on the need for TMDL's, and the U.S. Environmental Protection Agency was required to review those decisions as soon as possible, thereafter. The result of Region V's review of State decisions was presented in the Report on Lake Michigan Total Maximum Daily Load Requirements dated June 24, 1985. The report identifies nine pollutants for which additional information is needed. The report concludes that it is not appropriate to develop TMDL's for Lake Michigan at this time. Appendix A briefly describes the information available on these pollutants.

In part as a follow-up to the Region V Report, a meeting of Region V and representatives of the States which border Lake Michigan was conducted in Chicago on January 9, 1986. Participants in that meeting unanimously agreed that the preparation of a Lake Michigan Toxic Pollutant Control Reduction Strategy to aid in dealing with the Lake's problem of toxic substances contamination was both necessary and feasible.

The agreement to develop and implement a toxic pollutant control/reduction strategy for the Lake was also based on the recognition that it is not currently possible to calculate a total maximum daily load for pollutants that may be exceeding applicable water quality standards. The calculations cannot be made at present because there is a lack of understanding of the source of these pollutants, their loadings and their pathways through and transformations within the ecosystem.

This Strategy therefore is intended to define the relationship between toxicant loading rates and Lake Michigan toxicant problems, and to suggest possible remedies.

C. THE STRATEGY: Overview

The objective of the Strategy is to fully restore the multiple uses of the Lake Michigan resource and to protect human health and the Lake Michigan ecosystem via a significant reduction in the loading rates of problem toxic pollutants to the Lake. This will be accomplished by identifying sources of toxicants, quantifying toxicant inputs to the Lake, and reducing these inputs.

The two phase process described in this Strategy is intended to guide Region V and State restoration efforts for the Lake beginning in 1986 and continuing thereafter for as long as necessary. Figure 1 is the proposed timeline for Strategy implementation. An End of Year Report will be published at the end of each calendar year to summarize accomplishments and describe near term activities needed to achieve restoration of the Lake Michigan resource.

Phase I consists of several elements intended to: define, quantify and control the major toxicant problems in Lake Michigan, and enhance the States' ability to control toxicants in general. Table 1 is a preliminary list of 11 Lake Michigan Toxic Pollutants of Concern (POC's). Specific criteria for inclusion on the List were as follows: the pollutant is present at levels which appear to violate State WQS, EPA Water Quality Criteria recommendations, or IJC Objectives; or, the pollutant is present in fish at levels sufficient to constitute a public health concern; or, the pollutant concentration is increasing and it appears likely that WQS or health advisories will be exceeded in the near term. This list was derived in part from the list of Lake Michigan Basin Problem Pollutants in the 1985 EPA Region V Report on Lake Michigan TMDL Requirements. As the first step of Strategy implementation, the list will be reviewed and revised based on available data. The extent of the area of pollutant impact will be considered in determining whether a pollutant should be included on the list. The list will serve to direct lake-wide toxicant control, monitoring and modelling resources. Phase I toxicant control will focus on insuring that NPDES permits contain appropriate effluent limitations for POC's based on water quality standards and appropriately defined mixing zones. Where localized data indicate that toxicants other than POC's should be controlled, appropriate effluent limitations will be incorporated into NPDES permits. Once appropriate POC effluent limits have been incorporated into NPDES permits, the intent is to calculate a mass balance for the Lake Michigan POC's insofar as possible, based on available data.

The mass balance approach is based on the principle that the quantities of contaminants entering the system per unit time (the loading rate), less the quantities stored, transformed or degraded within the system per unit time, must be equal to the quantity leaving the system per unit time. If the mass rates do not balance, then either there are significant sources yet to be identified and quantified, or the environmental monitoring and laboratory programs need to be refined to better quantify the rates.

The last part of Phase I will consist of efforts to determine if Lake Michigan water quality and uses are adequately protected by current toxicant control measures. Types of analysis may include modelling and additional monitoring of Lake Michigan water and fish. The ability to carry out modelling is dependent on the availability of appropriate models. Phase I therefore includes an assessment of current modelling techniques, identification of shortfalls and enhancement of modelling capabilities.

If water quality and uses are adequately protected, then the objective of the Strategy has been met. If they are not, the Strategy provides for the development and implementation of total lake load reduction plans in Phase II. If total lake load reduction plans are necessary, plans for implementing the most cost-effective set of controls will be developed. Plans may include implementation of best management practices for nonpoint sources of pollution and additional controls for point sources. TMDL's may be developed where feasible and appropriate.

The decision regarding how total lake load reduction should be accomplished will depend on the available data and will be deferred until it is decided whether such controls are necessary.

D. RELATIONSHIP TO OTHER TOXIC POLLUTANT CONTROL INITIATIVES

1. State Permitting Authority and Water Quality Standards

All of the States bordering Lake Michigan have been delegated the authority by Region V to administer the NPDES program within their own borders. In compliance with NPDES regulations as administered by the States, dischargers must provide a level of treatment for their wastewaters which is equal to the more restrictive of technology-based or water quality-based requirements. Each State already has in place a strategy to deal with the issuance of permits to individual point sources in order to meet water quality standards. However, not all states have fully comprehensive mechanisms for controlling toxicants, and all four Lake Michigan States still need to revise the antidegradation policy portion of their WQS and develop implementation procedures. These needed revisions are part of the Strategy implementation plans. The Lake Michigan Strategy is intended to coordinate the State's localized control efforts by providing a framework which recognizes the larger scale impacts of toxic substances pollution. A summary of the toxic pollutant control portions of the WQS for the Lake Michigan States is provided in Appendix B.

Phase II

Phase I	Phase I										Phase II				
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996				
1. Review/Revise State Water Quality Standards	XXXXXXXXXXXXXX														
2. Develop Procedures to Implement "Free From" Toxics Standards	XXXXXXXXXXXXXX														
3. Review/Revise Pollutants of Concern (POC) List	XXXXX														
4. Incorporate POC Effluent Limits into Permits	XXXXXXXXXXXXXX														
5. Screening Surveys to Identify POC Sources	XXXXXXXXXXXXXX														
6. Expand Modelling Capability for Lake Michigan		XXXXXXXXXXXXXX													
7. Monitor to Estimate Loadings			XXXXX												
8. Calculate Total Points Source Loadings				XXXXXXXXXXXXXX											
9. Calculate Total NPS Loadings					XXXXXX										
10. Calculate Total Lake Loading and Mass Balance						XXXXXXXXXXXXXX									

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Phase II

[illegible]

TABLE 1

PRELIMINARY LIST: LAKE MICHIGAN TOXIC POLLUTANTS OF CONCERN

<u>SUBSTANCE</u>	<u>WHERE DETECTED</u>	<u>BENCHMARK EXCEEDED</u>
* PCB's	Tributary mouth/Harbor, nearshore and open lake waters, sediment, and biota	FDA action level, IJC fish flesh objective, EPA water quality criterion
* DIELDRIN	"	"
* HEXACHLOROBENZENE	"	EPA water quality criterion
* 2,3,7,8-TCDD	Fish from nearshore waters	"
CHLORDANE	Water column and fish from nearshore and open waters	FDA action level and EPA water quality criterion
* TOXAPHENE	"	"
HEPTACHLOR/HEPTACHLOR EPOXIDE	"	IJC objective and EPA water quality criterion
* DDT/TDE	"	"
HEXACHLOROCYCLOHEXANE	"	EPA water quality criterion
*1 PCDF's	"	By analogy to 2,3,7,8-TCDD
*2 PAH's	Fish and sediments	EPA water quality criterion

* This substance was also identified by the IJC's Water Quality Board as a
"Critical Pollutant" in the WQB's 1985 Report on Great Lakes Water Quality.

1 As 2,3,7,8-tetrachlorodibenzofuran

2 As benzo(a)pyrene

2. Great Lakes National Program Office (GLNPO) Initiatives

In August 1985 GLNPO published its "Five Year Strategy...1986-1990". The three toxic pollutant control goals of that five year strategy are:

1. to apply the ecosystems approach to Great Lakes management, treating all Great Lakes components as an integrated system;
2. to develop and pilot the application of a mass balance approach to remedial programs in specific geographic areas, such as Green Bay, considering all sources of toxic pollutants and their ultimate fate after they enter the Great Lakes system; and
3. to assist the Great Lakes States in developing, implementing and evaluating the effectiveness of Remedial Action Plans for the sites of degraded water quality in the Basin designated as "Areas of Concern" by the IJC.

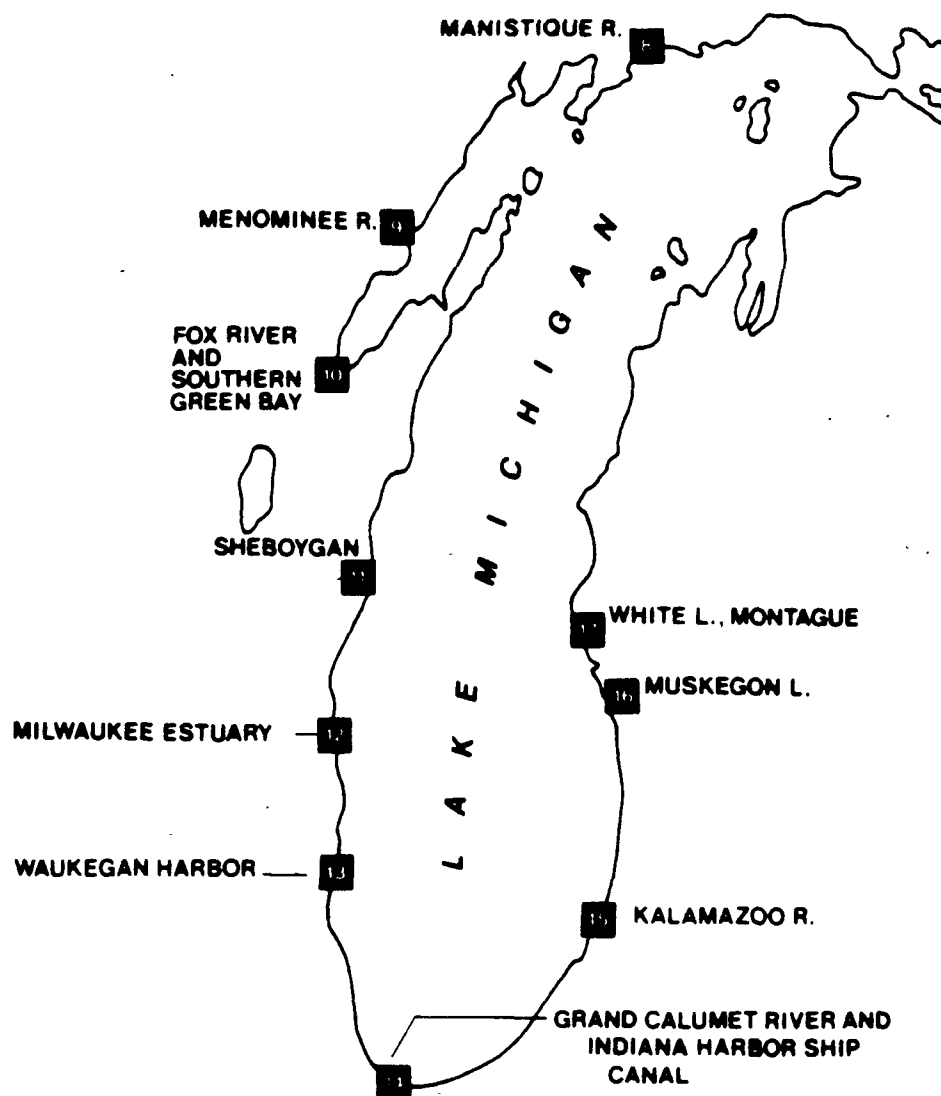
The identification of toxic pollutant sources and the evaluation of various source control and cleanup alternatives will be aided by mathematical modeling. In this way, the mass balance approach can be used to set research, remedial action and regulatory priorities as well as to direct the allocation of available environmental protection resources. The GLNPO mass balance approach is consistent with that advocated by this Strategy.

3. IJC Initiatives

a. Identification and Control of Toxic Substances

To fully implement the toxic substances control provisions of the 1978 Great Lakes Water Quality Agreement between the United States and Canada, the International Joint Commission (IJC) and its Water Quality Board (WQB) established a two track process to address the more than 500 contaminants detected in the waters, sediments and biota of the Great Lakes. This process was described in the IJC's 1985 Report on Great Lakes Water Quality. As discussed in that 1985 Report, sources of eleven Critical Pollutants on the "primary track" (i.e., on the fast track) are to be identified, quantified and reduced to the extent practicable over the next three to five years. Substances which are likely problems in Lake Michigan are included in the Strategy's Toxic Pollutants of Concern List (Table 1). In the IJC's process, remaining contaminants on the "comprehensive track" are those which may require further ambient or source monitoring, laboratory testing or modeling prior to being evaluated for addition to the primary track. Criteria for addition and deletion and the mechanism for setting further study priorities, are under development by the WQB.

FIGURE 2. Areas of Concern in Lake Michigan



MAP REF. NO	AREA OF CONCERN	JURISDICTION	PROBLEMS
8	Manistique River	Michigan	PCB's
9	Menominee River	Michigan	Arsenic
10	Fox River/Southern Green Bay	Wisconsin	PCB's, PCDF's, Mercury
11	Sheboygan	Wisconsin	PCB's
12	Milwaukee Estuary	Wisconsin	PCB's, Heavy Metals, PAH's
13	Waukegan Harbor	Illinois	PCB's
14	Grand Calumet/Indiana Harbor	Indiana	PCB's, Heavy Metals, PAH's
15	Kalamazoo River	Michigan	PCB's
16	Muskegon Lake	Michigan	PAH's, Heavy Metals
17	White Lake	Michigan	PCB's, Chromium, Chlorinated Organics

b. Areas of Concern

The International Joint Commission (IJC) has established a Water Quality Board to aid in focusing attention on specific actions necessary to restore and protect the Great Lakes. EPA and the States of Illinois, Indiana, Michigan and Wisconsin are active members of the Water Quality Board. The Water Quality Board, in turn, has identified a number of locations within the Great Lakes, including Lake Michigan, where designated beneficial uses are significantly impaired. These locations are termed Areas of Concern (AOC's) and, for the most part, they represent places where deposition of contaminated sediments has occurred to such an extent over the years that the sediments now act as reservoirs of toxic pollutants for the Lake in which they are located. Ten such AOC's have been identified for Lake Michigan. Their location and the general nature of their problems are shown in Figure 2. Remedial Action Plans (RAP's) are to be developed by the States to guide actions necessary for the environmental restoration of the individual AOC's. Work on some of the RAP's is well underway, while schedules have yet to be finalized for others.

E. STRATEGY IMPLEMENTATION

Implementation of the Lake Michigan Toxic Pollutant Control Strategy will extend over several years as the Region and States gather information, make program decisions and begin to implement controls. The near term (Phase I) and long term (Phase II) elements are described below, including basic toxicant control program elements needed for this Strategy as well as for toxicant control in general.

Phase I

1. Review/Revise Water Quality Standards (1986-1988)

The States will review water quality criteria and antidegradation portions of existing WQS. By the conclusion of FY '88, they will revise WQS as determined necessary. They will develop and implement antidegradation procedures by the end of FY '87.

2. Develop Procedures to Implement "Free From" Toxics Standards (1986-1987)

The States of Illinois, Indiana and Wisconsin will develop detailed procedures for translating narrative WQS's which specify that State waters shall be free from toxic substances in toxic amounts into water quality based effluent limitations by the end of FY '87, or as soon thereafter as specified in program plan commitments. It is recommended that the States detail the procedures to be used to calculate water quality based effluent limits to protect aquatic life, human health and wildlife. Explicit procedures facilitate the calculation of appropriate effluent limits and enhance their defensibility. It may be advisable to develop these procedures in cooperation with technical representatives from the public, private and environmental sectors. Region V recommends this approach as a useful means of responding to concerns and minimizing later challenges.

3. Review/Revise Pollutants of Concern List (1986 and thereafter, as needed)

Throughout 1986 Region V, GLNPO and the States will review water quality and other environmental data for pollutants based on monitoring results in order to refine the Lake Michigan Pollutants of Concern (POC) List. An update with possible revisions will be contained in the End of Year Report to be available in December of 1986.

4. Incorporate POC Effluent Limits into Permits (1986-1989)

The States will control direct and tributary point sources of POC's by incorporating into permits the more restrictive of Best Available Technology or edge of mixing zone water quality based effluent limits by the end of fiscal year 1989. The Region and the States have agreed to reopen and modify permits as information becomes available, e.g. through pre-treatment program needs and monitoring networks. Special emphasis will be placed on dischargers to the lake and its tributaries. Limits for toxicants other than POC's should be incorporated at the same time, where data obtained from biomonitoring, chemical scans, process reviews or other appropriate sources indicate that limits are needed. The 1989 deadline means that approximately three-fifths of the Lake Michigan and tributary dischargers' permits will be reviewed, and modified as necessary, on their normal 5-year reissuance schedule. Permits for the high priority dischargers among the remaining two-fifths will have to be reviewed, and modified as necessary, on an accelerated schedule. However, it is anticipated that the number of permits requiring accelerated schedule reviews will be small.

5. Conduct Screening Surveys to Identify POC Sources (1986-1988)

Using areas of sediment deposition and resident fish species as indicators of toxic pollutant problems, GLNPO will screen tributary mouths and nearshore areas and will evaluate atmospheric deposition data to locate pollutant sources requiring more detailed study. Current monitoring efforts are summarized in Appendix C.

6. Expand Modelling Capability for Lake Michigan (1987-1991)

Region V, GLNPO and the States will cooperatively assess the adequacy of current modelling techniques, identify modelling shortfalls and develop improved modelling techniques for Lake Michigan.

7. Monitor to Estimate Loadings (1988, Plus)

Based on the results of the screening surveys (element 5, above), GLNPO with State assistance, will revise monitoring strategies and initiate monitoring for tributary loads, sediment release, atmospheric deposition and other sources of toxicants to estimate total loadings. If tributary and nearshore monitoring reveal significant loadings, Region V and GLNPO will develop a more detailed point and nonpoint source monitoring plan. Additional monitoring data will be obtained through both permittee monitoring and supplemental monitoring, as appropriate.

8. Calculate Total Point Source Loadings (1989-1990)

Region V, GLNPO, and the States will calculate total loadings to the lake from point sources after the more restrictive of BAT or WQ-based effluent limits are imposed. They will also determine the likelihood that significant loadings from other sources exist by comparing total loading estimates with point source loading data.

9. Calculate Total Nonpoint Source Loadings (1990, Plus)

Region V, GLNPO and the States will calculate loading estimates for pollutants with significant sources other than point sources.

10. Calculate Total Lake Loadings (1990-1991)

Region V, GLNPO, and the States will calculate total lake loading estimates for POC's and develop a mass balance for Lake Michigan, insofar as data allow.

11. Calculate Relationship Between Total Loadings and Nearshore and Open Water Quality (1992)

Using refined mathematical models or other appropriate methods, Region V and GLNPO in cooperation with the States will, by the end of FY '92, determine the relationship between tributary and in-place pollutant load reductions and harbor and nearshore Lake Michigan water quality, and between total loading and open Lake Michigan water quality. Currently available models are briefly described in Appendix D.

12. Determine if Water Quality is Protected by Current Toxicant Control Measures (1992-1993)

Region V, GLNPO and the States will determine if the toxicant control measures in place are adequate to ensure that Lake Michigan water quality is, and will continue to be, protective of public health and the environment.

Phase II

1. Develop Total Lake Load Reduction Plans (1994-1995)

If it is determined that point source controls are insufficient to protect public health and the environment, it may be that conservative toxicants are accumulating, or that nonpoint source or air deposition are the responsible sources. Whatever the cause, Region V, GLNPO and the States will develop total Lake load reduction plans for appropriate toxic pollutants. In developing these plans, due recognition will be given to the relative contributions of the various sources and the effectiveness with which source reductions can be instituted to achieve water quality goals in the Lake.

2. Implement Total Lake Load Reduction Plans (1996, Plus)

The precise mechanism for development and subsequent implementation of total Lake load reduction plans is, as yet, undetermined, but it is likely that the plans will consist of a mix of controls for point sources, nonpoint sources, and air deposition. Plans would include provisions for Region V and the States to revise ambient and source compliance monitoring as necessary to assess the effectiveness of the total Lake load reduction plan in reducing the loadings and concentrations of POC's.

E. FISCAL YEAR 1986 AND 1987 ACTION STEPS

Listed below are specific action steps for the States and Region V for fiscal years 1986 and 1987. The action steps set forth below were derived from the Strategy Implementation (Section D) and the Present Mechanism for Point Source Toxic Pollutant Control (Appendix B). Details for implementing the State action steps for FY '87 will be negotiated in each State as a part of the annual program planning process.

State Action Steps for Fiscal Year 1986

Action steps 1-3 are Strategy-specific; steps 4-8 address toxicant control in general.

1. The States will review water quality and other environmental data for substances on the Lake Michigan Pollutants of Concern List and will recommend changes to the List, where appropriate.
2. The States will identify the highest priority dischargers for imposition of appropriate effluent limits for POC's based upon an analysis of treatment technologies, manufacturing processes, effluent characteristics and proximity to the Lake. The States will then schedule permit issuance/reissuance such that all high priority dischargers have appropriate effluent limitations for POC's by the end of FY '89.
3. The States will develop/retain information for inclusion in the End of Year Report and will assist Region V in the preparation of this Report.
4. The States will initiate Remedial Action Plan development for the IJC AOC's in Lake Michigan, in accordance with State commitments to the IJC Water Quality Board and with agreements reached with Region V and GLNPO.
5. The States will complete the Lake Michigan monitoring identified in their FY '86 Program Plans, and identify additional monitoring activities needed for subsequent Fiscal Years.

6. The States will monitor Lake Michigan basin point sources for compliance with toxicant effluent limitations and take enforcement action, as needed.
7. The States will review the water quality criteria and antidegradation portions of their existing WQS. They will complete any related tasks presently identified in their FY '86 Water Pollution Control Program Plans. The States will then list any additional tasks and timeframes, as determined necessary to complete adequate revisions of their WQS.
8. The States of Illinois, Indiana and Wisconsin will complete the development of detailed procedures for translating narrative "free from toxic substances in toxic amounts" WQS language into water quality based effluent limitations which are presently identified for completion in their FY '86 Program Plans. These States will then schedule any additional tasks necessary to complete development and institute implementation of effluent limitation procedures by the end of FY '87 or as specified in program plan commitments.

Region V and GLNPO Action Steps for Fiscal Year 1986

Action Steps 1-5 are Strategy-specific; steps 6-10 address toxicant control in general.

1. Region V and GLNPO will review water quality and other environmental data for the substances on the Lake Michigan Pollutants of Concern List. The Region and GLNPO will recommend revisions to the List, as appropriate, based on this review.
2. Region V and GLNPO, in conjunction with the States, will develop a list of necessary environmental monitoring activities, including identification of data gaps, recommended timeframes and responsible parties. Development of the list will be coordinated with the States.
3. Region V and GLNPO, in conjunction with the States, will develop a list of necessary modelling activities, including recommended timeframes and responsible parties. Development of the list will be coordinated with the States.
4. GLNPO will begin to apply the mass balance approach in Green Bay. This is part of an ongoing commitment to pilot special studies to provide information needed to develop appropriate management and long term monitoring plans for toxic pollutants entering the Lake Michigan ecosystem.
5. Region V and GLNPO will develop/retain information for inclusion in the End of Year Report and will develop this Report in cooperation with the States.

6. Region V will support states in developing appropriate State Specific guidance relating to procedures for translating narrative "free from toxic substances in toxic amounts" WQS language into water quality-based effluent limitations, for utilization in the FY '87 Program Planning Process negotiations with Illinois, Indiana and Wisconsin.
7. Region V will follow-up the results of point source compliance monitoring, if necessary, to ensure compliance with applicable NPDES permits.
8. Region V, in coordination with the States, will complete development of a biomonitoring strategy and will identify the highest priority Lake Michigan dischargers for inclusion of biomonitoring requirements within their permits.
9. Region V will continue to work with the States and the Army Corps of Engineers to assess the effectiveness and environmental impacts of confined disposal facilities. Results of activities will be reported annually in the End of Year Report.
10. Region V and GLNPO will assist the States in FY '86 activities necessary to produce Remedial Action Plans.

State Action Steps for Fiscal Year 1987

Action steps 1-4 are Strategy-specific; steps 5-7 address toxicant control in general.

1. The States will issue/reissue permits to the high priority dischargers, in accordance with the list described above in the FY '86 State Action Steps, and with the results of the FY '87 Program Planning Process negotiations.
2. The States will conduct monitoring for Lake Michigan specified in their FY '87 Program Plans as necessary to implement the Strategy.
3. The States will continue Lake Michigan basin point source compliance monitoring and enforcement, as necessary.
4. The States will develop/retain information for inclusion in the second End of Year Report and will assist Region V in the preparation of this Report.
5. The States will complete development and begin implementation of Remedial Action Plans for Lake Michigan AOC's, in accordance with program plan commitments, with continuing Region V and GLNPO support.

6. The States of Illinois, Indiana and Wisconsin will complete any steps necessary to adopt water quality-based effluent limitation procedures, and will begin implementation of those procedures as soon as possible thereafter, in accordance with program plan commitments.
7. The States will continue the WQS revision process to ensure adequate protection of Lake Michigan by the end of FY '88.

Region V and GLNPO Action Steps for Fiscal Year 1987

Action steps 1-4 are Strategy-specific; steps 5-7 address toxicant control in general.

1. Region V and GLNPO will undertake Lake monitoring activities identified for FY '87 by the FY '86 Region V Action Steps. Region V and GLNPO will also track and assess the activities of other parties responsible for Lake monitoring. This information will be made available to the States.
2. Region V and GLNPO will accomplish the FY '87 modeling activities identified for FY '87 by the FY '86 Region V Action Steps. The results of these activities will be made available to the States.
3. GLNPO will decide on the type of sampler to be used for toxic pollutant monitoring of atmospheric deposition, and GLNPO will also initiate steps to place the first of these samplers at a station in Green Bay. Additional samplers will be placed on the Lake if funds are available.
4. Region V and GLNPO will draft the FY '86 End of Year Report; by December 1986 and will complete the Report in cooperation with the States. Region V and GLNPO will also develop/retain information necessary to produce the FY '87 Report.
5. Region V and GLNPO will complete FY '87 activities necessary to produce Remedial Action Plans, in accordance with agreements reached with the States.
6. Region V will continue working with the Army Corps of Engineers to bring the study on Confined Disposal Facilities to a satisfactory conclusion. The results will be made available to the States. In addition, Region V, in coordination with the States, will complete an In-Place Pollutant Strategy.
7. Region V will evaluate the results of point source compliance monitoring, to ensure compliance with applicable permits and take enforcement action as needed.

APPENDIX A

POLLUTANTS FOR WHICH TMDL CALCULATIONS MAY BE REQUIRED

Polychlorinated Biphenyls (PCB's)

PCB's are highly persistent, highly bioaccumulative and highly toxic pollutants. Present levels in some commercial and sport fish species are believed to constitute a threat to the public health and thus have damaged the Lake Michigan fisheries. PCB's are still in use for electrical purposes pending replacement, and there appears to be recycling of the pollutant to the Lake from contaminated sediments and the atmosphere.

The 1985 Great Lakes Water Quality Board Report noted that all samples of resident fish collected from 30 major harbors and tributaries between 1981 and 1984, contained fish which exceeded the IJC Agreement water quality objective of 0.1 mg/kg total PCB. Extremely high concentrations of PCB (up to 790 mg/kg) were also reported in fish from the lower Sheboygan River. Elevated PCB concentrations (10-30 mg/kg) also were noted in fish samples from White Lake and the Kinnickinnic, Milwaukee, St. Joseph, Kalamazoo and Fox Rivers.

Chlorinated Benzenes, Hexachlorobenzene, Hexachlorocyclohexane, Polycyclic Aromatic Hydrocarbons (PAH's), Polychlorinated Dibenzofurans (PCDF's), and 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (2,3,7,8-TCDD)

These pollutants have been detected in fish flesh at some locations within Lake Michigan. The IJC referred to these substances as "emerging problems" in its 1983 Great Lakes Water Quality Board Report. In addition, the 1985 Great Lakes Water Quality Board Report noted dibenzofurans in the Grand Calumet River and the Indiana Harbor and Ship Canal. Elevated levels of 2,3,7,8-TCDD were found in a fish caught off Saugatuck, Michigan and in the eggs of a Green Bay colony of Forster's terns, as reported in the 1985 Water Quality Report.

PCDF's were noted in Lake Trout (Saugatuck), Common Carp (Waukegan), and Large Mouth Bass (Waukegan) in the Surveillance Appendix to the 1983 Great Lakes Water Quality Board Report. In this regard it should also be noted that PCDF's frequently occur as trace contaminants of PCB's. Therefore, where PCB's are found, PCDF's are also likely to be present. PAH's have been found in sediments from a number of Lake Michigan locations, primarily outside of harbors and river mouths. Sources include atmospheric deposition of combustion products, coke production and petroleum refining. Chlorinated benzenes, especially the tetra- and penta-isomers, were found in Fox River fish and sediments. Hexachlorobenzene (HCB) was found in fish from the Sheboygan River, Milwaukee River, Menominee River and the Kinnickinnic River, as well as fish from the open waters of Lake Michigan. The atmosphere is likely to be the most significant source of the higher chlorinated benzenes, dibenzofurans and dioxin detected in fish from the open waters of the lake, while elevated tributary mouth and nearshore levels are more likely to be attributable to point sources.

APPENDIX A - Continued

Selenium and Silver

Concentrations of total selenium in Lake Michigan water have been reported to be as high as 4.5 ug/l, and Lake concentrations of dissolved selenium as high as 3.7 ug/l have also been reported (Trace Metal Concentrations in the Offshore Waters of Lakes Erie and Michigan, Ronald Rossmann; 1984). Rossmann further notes that dissolved selenium appears to be increasing at the rate of 0.252 ug/l/Y, while no trend is apparent for total selenium concentrations. Ambient values for this metal do not currently violate State WQS or the USEPA recommended water quality criterion of 10 ug/l. The IJC objective of 1 ug/l is being violated, however.

Lake Michigan concentrations of silver have been reported at widely varying levels, but they appear to cluster between 1 and 3 ug/l. Rossmann's work (Op. Cit.) is the most recent determination and reports mean concentrations for dissolved and total silver of 0.053 and 0.061 ug/l respectively. These latter concentrations are well below current Illinois and Indiana WQ criteria of 30 and 50 ug/l, but they are near the 0.1 ug/l level as recommended by the IJC and USEPA for the protection of aquatic life. In addition, elevated sediment concentrations of silver have been reported in STORET at various Lake Michigan stations. Atmospheric deposition of fly ash could be a significant source of both selenium and silver in the open waters of the lake.

APPENDIX B

THE PRESENT MECHANISM FOR POINT SOURCE TOXIC POLLUTANT CONTROL

The Clean Water Act provides for a national goal, where attainable, of water quality suitable for maintenance/enhancement of well balanced fish and aquatic life populations as well as recreation on and in the water. To ensure compliance with this goal, the Act provides both technology-based and water quality-based requirements. Both of these requirements are enforceable through discharger-specific permits as the major component of the National Pollutant Discharge Elimination System (NPDES).

The applicable technology-based requirement for industrial dischargers of toxic pollutants is Best Available Treatment (BAT). BAT is individually defined for classes of dischargers identified in the Clean Water Act taking the industry-wide availability of treatment technologies and economic achievability into consideration. The analogous technology-based requirement for municipalities is secondary treatment plus compliance with applicable Pretreatment Program requirements. If effluent limitations derived from the application of technology-based guidelines are found to be inadequate to implement applicable WQS at the edge of a defined mixing zone, the additional increment of treatment as judged necessary to meet these standards in the receiving waters must be provided by the discharger.

At a minimum of once every three years, states are required to review, and thereafter revise as determined necessary, WQS for their surface waters. The WQS embody specific environmental goals to be attained, and provide the basis for developing enforceable effluent limits for NPDES permits. Antidegradation policy is an integral part of water quality standards and is, therefore, to be implemented in the permit issuance/reissuance process.

At present, none of the Lake Michigan State antidegradation programs fully meet the requirements of 40 CFR 131.12. Region V considers adequate policies and procedures to be high priority items for immediate development and implementation.

A summary of the toxic pollutant control portions of the WQS for the Lake Michigan States is presented below.

Illinois

Any substance toxic to aquatic life shall not exceed one-tenth of the 96-hour median tolerance level (96-hr. MTL) for native fish or essential fish food organisms. Detailed procedures necessary to apply the foregoing general requirement to specific dischargers are in preparation, but are not yet available for use.

APPENDIX B - Continued

Indiana

Concentrations of toxic substances shall not exceed one-tenth of the 96-hour median lethal concentration (LC₅₀) for important indigenous aquatic species and those artificially propagated by the Indiana Department of Natural Resources. More stringent application factors can be used when justified on the basis of available evidence and approved by the Board, after public notice and the opportunity for a public hearing.

Organic contaminants which can be demonstrated to be persistent, to have a tendency to bioconcentrate in aquatic biota, and are likely to be toxic on the basis of available scientific evidence, will be limited as determined by the Department of Environmental Management after public notice and the opportunity for a hearing.

Selenium is not to exceed 10 ug/l at any time, and silver is not to exceed 50 ug/l at any time.

Detailed procedures necessary to apply the foregoing general requirements to specific dischargers are in preparation, but are not yet available for use.

Michigan

Toxic substances are not to be present in the waters of the State at levels which are, or which may become, injurious to the public health, safety, welfare; plant and animal life; or the designated uses of those waters. Allowable levels of toxic substances shall be determined by the Commission using appropriate scientific data.

For purposes of developing water quality based effluent limits for the NPDES permit program, allowable levels of toxic substances in the surface waters, after mixing with the receiving water, will be determined by applying an adequate margin of safety to the "maximum acceptable toxicant concentration" (MATC), "no observable adverse effects level" (NOAEL), or other appropriate effect end points, based on knowledge of the behavior of the toxic substance, the characteristics of the receiving water, and the organisms to be protected. In addition, the discharge of nonthreshold carcinogens must not create a level of risk to the public health greater than 1 in 100,000 in the surface water after mixing with the receiving water. In addition, the Commission may require a greater degree of protection where determined necessary to comply with the applicable antidegradation provisos.

Michigan has adequate procedures to apply the State's WQS requirements to specific dischargers.

APPENDIX B - Continued

Wisconsin

Waters of the State are to be free from substances in concentrations which are found to be of public health significance. In addition, substances must not be present at any location in amounts which are acutely harmful to animal, plant or aquatic life. Furthermore, concentrations of substances are not permitted that, alone or in combination with other materials present, are toxic to fish or other aquatic life based on current scientific information.

Wisconsin has historically incorporated effluent limits for some toxic substances in industrial permits and has initiated actions to do the same for municipal permits. The detailed procedures for translating the narrative water quality standards into effluent limits are being formalized, but are not yet available.

APPENDIX C

MONITORING

In any given year, there is a substantial amount of monitoring of sediments and harbors, open water, fish, waste water effluents and air deposition in and around Lake Michigan. Agencies which undertake one or more types of the aforementioned monitoring activities include Region V, GLNPO, the States bordering the Lake, universities/colleges, water supply utilities, and the U.S. Fish and Wildlife Service. Though much useful information on the Lake and its contaminants has been gathered, efforts to date have not always focused on those initiatives necessary to control/reduce toxic pollutant loadings to the Lake. The Region and the States are currently developing monitoring strategies that will address this situation.

Because identification of in-place pollutants as major remaining sources of contaminants, and the availability of analytical capability to allow the measurement of toxic organics, are both relatively recent developments, only a very limited and disjointed data base exists for organic contaminant levels in sediments. To fill the void, GLNPO has embarked on a multi-year effort to determine the level of toxic substances in Great Lakes river and harbor sediments.

Open lake monitoring to provide basic limnology data (chemical and biological) and to evaluate nutrient trends in Lake Michigan is conducted by the Great Lakes National Program Office. The Chicago and Milwaukee MSD's also conduct extensive nearshore and open lake monitoring to evaluate water quality trends near these cities' water supply intakes, and the University of Wisconsin is investigating the use of Milwaukee and Chicago water supply intakes as representative of open lake waters and to assess the structure and function of long-term biological change in lake primary production. These activities will have to be reviewed, and restructured if determined necessary, to assure that such activities are sufficient to support the development of whole Lake loading estimates.

The Great Lakes National Program Office's Great Lakes Fish Monitoring Program (GLFMP) has, since its inception in 1980, been a coordinated effort by numerous State and Federal agencies to monitor several aspects of the fish contaminant problem in the Great Lakes. Some states also conduct their own fish contaminant monitoring programs.

The broad areas that are or will be addressed by GLNPO and the States in these monitoring programs include 1) trend monitoring in the open lake; 2) detection of emerging problems in harbors and tributary mouths; 3) monitoring potential human exposure; 4) monitoring local trends in problem compounds as identified in # 3; and 5) monitoring indicators of ecosystem and fishery health. No significant changes in fish monitoring activities appear necessary at this time other than possible adjustment of priorities as necessary to support implementation of the Lake Michigan Toxic Pollutant Control/Reduction Strategy.

APPENDIX C - Continued

The Great Lakes National Program Office presently operates an atmospheric deposition monitoring network consisting of seven (7) sites in and around Lake Michigan. This network, which is part of the Great Lakes Atmospheric Deposition (GLAD) Network, collects precipitation samples that are analyzed in the USEPA Region V laboratory for selected nutrients and metals. Some States also operate air deposition monitoring stations over and above the GLAD Network. At the present time, however, none of the potential TMDL pollutants are sampled in air monitoring activities. As a first step to remedy this monitoring deficiency, GLNPO awarded a 2-year research grant in the Spring of 1985 to the University of Minnesota to evaluate five different types of precipitation samplers for assessing the atmospheric inputs of trace organic compounds. When a decision on the type of sampler to be used for toxic pollutant monitoring has been made a master atmospheric deposition monitoring station will be installed near Green Bay to assess the potential loading of toxic pollutants of concern.

APPENDIX D

MODELLING

Mathematical modelling and trend monitoring are important tools in the implementation of the mass balance approach. Once a mass balance budget has been calculated for each pollutant of concern, the long term effects of various source reduction strategies on water quality of the lake can be simulated using best estimates of the transport and fate of toxic pollutants. If mathematical modelling reveals that water quality will remain or become degraded at the present or projected toxic pollutant loading rate from all sources, load reduction efforts can be directed to the sources most amenable to control and clean-up efforts.

A number of mathematical models of toxic substances transport and fate have been developed for quantitatively relating loading rates to concentration profiles in aquatic ecosystems. Existing generic models include the Simplified Lake and Stream Analysis (SLSA) modelling framework, developed by HydroQual Inc. of Mahwah, New Jersey, which treats the lake as a well-stirred reactor in both steady state or time-dependent modes. Aquatic fate processes taken into account include partitioning between water and particles, particle settling and resuspension, chemical and photochemical reaction, volatilization and sedimentation. Similar to SLSA is USEPA's EXAMS II model, a microcomputer-implementable version of the EXAMS model developed by Larry Burns and co-workers at US EPA's Athens, Georgia research laboratory. It divides the water column and sediment into (25) compartments, each of which is treated as a well-stirred reactor which can exchange matter with its nearest neighbors, according to a specified flow regime. EXAMS II does not, however, allow inputs for particle settling, sedimentation or resuspension rates. Although SLSA and EXAMS II are similar, in that they both assume instantaneous equilibrium between water and particles, only EXAMS II contains a biological component for modelling bioaccumulation.

SERATRA, developed by Yasuo Onishi of Battelle Northwest in Richland, Washington, is a fully dynamic, time-dependent toxic pollutant transport and fate model which allows for vertical and lateral mixing without compartmentalizing the environment by solving fundamental flow, momentum and energy equations. Rather than assuming instantaneous equilibrium partitioning between water and sediment particles, SERATRA employs rate equations based on adsorption/desorption kinetics. SERATRA omits a biological component.

APPENDIX D - Continued

Other models developed for specific Great Lakes applications incorporate many of the same features as SLSA, EXAMS II or SERATRA. These models probably could be adapted for use at a number of locations within Lake Michigan. For example, toxics models for Great Lakes embayments include the Saginaw Bay PCB model developed by USEPA's Large Lakes Research Station (LLRS), which includes an empirically-based, wind-driven hydrodynamics component, and a cell model developed by LimnoTech, Inc. of Ann Arbor, Michigan. With regard to a specific area within Lake Michigan, Canale and Auer have developed a model of Green Bay nutrient dynamics which may also have application to the Bay's problems involving toxics transport and fate.

Toxics models developed for the open waters of the Great Lakes which may very well have utility for Lake Michigan include Manhattan College's WASTOX, presently being adapted to the IBM PC-AT under contract to LLRS. This model includes a biological component which accounts for food chain-driven bioaccumulation. A general version of WASTOX is now available for utilization on an IBM PC-AT from EPA's Environmental Research Laboratory, Athens, Georgia. In addition, Thomann and DiToro have applied a simplified whole lake model of toxic substances fate to PCB accumulation in Lake Michigan.

Overall, it appears that reasonable progress is being made to develop modelling techniques which will ultimately be sufficient to help decision makers understand the relative effectiveness of various control scenarios and to assess the likely impacts of ongoing programs. In order to assure continued progress at a rate sufficient for strategy implementation purposes, EPA will have to systematically assess modelling capabilities, identify shortfalls which potentially prevent development of estimates for whole Lake loadings and concentrations, define the steps necessary to remedy shortfalls and find the resources necessary to complete modelling tasks on a timely basis.