Great Lakes Water Quality Board

Report to the International Joint Commission

1980 Report on Great Lakes Water Quality

1980 Report on Great Lakes Water Quality

Presented November 12, 1980
Toronto, Ontario

INTERNATIONAL JOINT COMMISSION

November, 1980

International Joint Commission
Canada and United States

Commissioners:

The Great Lakes Water Quality Board hereby submits a report to the International Joint Commission on the operation and effectiveness of programs developed and implemented to achieve the purpose of the 1978 Great Lakes Water Quality Agreement.

Respectfully,

J. McGuire
Chairman
United States Section

R. W. Slater
Chairman
Canadian Section

Table of Contents

SECTION	TITLE	PAGE
	LIST OF TABLES	v
	LIST OF FIGURES	vii
I.	SUMMARY AND RECOMMENDATIONS	1
II.	AQUATIC ECOSYSTEM QUALITY	7
	Basin Overview	7
	Lake Water Quality	8
	Problem Areas	13
	Atmospheric Deposition	19
	Fish Entrainment at Water Intakes	19
III.	MUNICIPAL PHOSPHORUS CONTROL	23
	Lower Lakes	23
	Upper Lakes	24
	Data Interpretation	24
	Data Reporting and Management	24
IV.	SURVEILLANCE AND MONITORING	31
	Great Lakes International Surveillance Plan	31
	Remedial Programs and Surveillance Information	32
	Surveillance Activities 1980-81	33
	Data Quality	34
	Point Source Biomonitoring Programs	35
V.	AGREEMENT PROGRESS	41
	Compliance with Agreement Dates	41
	Point Source Control Programs	41
	Nonpoint Source Programs	47
	Airborne Pollutant Control Programs	51
VI.	WATER QUALITY BOARD ACTIVITIES	57
	Toxic Substances Committee	57
	Water Quality Programs Committee	57
	Data Quality Work Group	57
	Dredging Subcommittee	59
	Chlorine Objective Task Force	59
	Joint Water Quality Board/Science Advisory Board Activities	60
	A Review of the Impact of Water Quality Agreement Objectives on Water Quality Standards	60

Table of Contents - cont'd.

SECTION	TITLE	PAGE
	MEMBERSHIP LIST	61
	GLOSSARY	65
	APPENDIX	Under separate cover

List of Tables

TABLE	TITLE	PAGE
1	Organochlorine Contaminant Residues in Lake Ontario Spottail Shiners	21
2	Organochlorine Contaminant Residues in Great Lakes Young-of-the-Year Spottail Samples	22
3	Organic Residue Levels in Herring Gull Eggs of Lake Michigan	22
4	Funds Committed for Municipal Sewerage Construction in the Great Lakes Basin	25
5	Reported Municipal Phosphorus Loads in the Lower Lakes Basin	26
6	Municipal Plants in the Lower Lakes over 38,000 m^3/d (10 MGD) 1979 Flow	27
7	Major Municipal Point Sources in the Lower Lakes Basin Exceeding the 1 mg/L Phosphorus Target	29
8	Municipal Plants in the Upper Lakes over 38,000 m^3/d (10 MGD) 1979 Flow	30
9	Surveillance Activities 1980/81	37
10	Surveillance Costs 1980/81	39
11	Completion Dates in the 1978 Great Lakes Water Quality Agreement	53

List of Figures

FIGURE	TITLE	PAGE
1	Nearshore Phosphorus Gradients in Lake Ontario, 1967-1979	11
2	Problem Areas 1979	15
3	Water Quality Board Structure	58

I Summary and Recommendations

INTRODUCTION

With this 1980 Report, the Board is providing the International Joint Commission with a brief status report on the health of the Great Lakes ecosystem, an update on jurisdictional programs to meet the requirements of the 1978 Agreement, and a perspective on the current and future actions the Board is undertaking to evaluate the effectiveness of such programs. The first Biennial Report as called for by the 1978 Agreement will be submitted in 1981.

ENVIRONMENTAL PROBLEMS

Throughout this report, the Great Lakes Water Quality Board draws attention to the two major environmental problems identified in the 1978 Agreement: toxic substance contamination and accelerated eutrophication. The Board considers these problems to be "whole lake" in nature since each affects all the lakes in varying degrees of severity and intensity. Yet each "problem" has its own unique characteristics and its own potential to adversely affect the chemical, physical and biological balance of the lakes.

Control technologies to abate these problems likewise vary greatly, not only in terms of their maturity, but also in terms of their applicability. For example, to address the problem of accelerated eutrophication, programs to control direct phosphorus discharges from major municipal plants are considered technically feasible and are in place or planned. Yet, achievement of the 1 mg/L phosphorus effluent limitation in the Lower Great Lakes still varies among the jurisdictions. Conversely, programs to control the input of toxic substances into the Great Lakes are highly complex as they must be designed to control not one substance, but potentially thousands with often drastically different properties and arising from numerous air, water and land sources.

With that perspective, the Board presents a status report on the response of the Great Lakes ecosystem to phosphorus and toxic substance control measures. The report also discusses the atmosphere as a critical pollutant source, the role of surveillance, problem areas, objectives, and data quality and quantity concerns.

TOXIC SUBSTANCES CONTROL

Public concern over the pervasive nature of toxic chemical pollution and its potential to adversely affect the health and well being of both aquatic and terrestrial species (including man) within the Great Lakes System has been the driving force for numerous past recommendations to the IJC from both the Water Quality and Science Advisory Boards. In response, the Parties as well as the jurisdictions have undertaken numerous legislative and programmatic initiatives. The Board has directed its newly created Toxic Substances Committee to undertake a substantive evaluation of these current and planned

toxic substance control programs to determine what progress has been made by the Parties in fulfilling the requirements of Annex 12 of the Agreement, as well as to identify deficiencies in these programs so that corrective legislative or regulatory actions can be initiated.

The Toxic Substances Committee has prepared an Interim Report to the Board which recommends a management framework for evaluating toxic substance control programs. As a first step in this evaluation, the Committee has compiled detailed information on applicable legislation and programs and is proceeding with its assessment. The Interim Report also displays the tasks which must be completed for presentation in the 1981 Biennial Report. The Board is aware that such an evaluation is a complex and time-consuming undertaking which will require extensive cooperation and participation by the jurisdictions if it is to be successful. It also notes, for evaluation purposes, that toxic substance control measures cannot easily or wisely be separated from overall pollution control programs. The Board offers, as only one example of such complexity, the fact that its Committee has already identified over 200 data information systems currently operational within the basin.

The Board does conclude that there is evidence that the Great Lakes ecosystem is responding to the controls already in place.

For example, substantial reductions in organochlorine residues have been found in small fish from Lakes Ontario and Erie. Similarly PCB, DDT and mirex residues declined in herring gull eggs from both lower lakes in 1979. Declines are also reported for herring gull eggs from Lake Huron and Lake Michigan while declines in eggs from Lake Superior were not as significant as from the other lakes. These declines represent decreased loads of contaminants into the ecosystem.

The Board cautions, however, that these declines should not be interpreted to mean that all necessary controls have been implemented.

In particular, the Board is concerned about the pollutants which enter the system via the atmosphere.

For example, recent studies indicate that atmospheric inputs of PCBs represent a significant portion of the total input from all sources for Lakes Superior, Michigan and Huron.

The Board is equally concerned about the hazardous waste disposal issue and the lack of public acceptance for the siting of such facilities.

EUTROPHICATION

Programs to control phosphorus inputs and hence abate accelerated eutrophication, particularly in the Lower Lakes, have been the corner stone of both the 1972 and 1978 Agreements. The lakes have responded to those control programs in the following manner:

Total and soluble phosphorus concentrations declined significantly in the Detroit River between 1968 and 1979. Total phosphorus loads to Lake Erie have

declined from over 90,000 kg/d in 1968 to approximately 14,000 kg/d in 1979 (a decrease of 84%) due largely to the implementation of phosphorus control programs in Detroit.

Total phosphorus levels decreased slightly in Lake Ontario in 1979 as compared with 1978 levels. In the nearshore areas between the Niagara River and Oshawa, significant downward trends in phosphorus levels were measured between 1967 and 1979, as a result of control programs implemented on the Canadian side.

Programs to limit discharge of phosphorus to 1 mg/L (as recommended by the Water Quality Board in 1976) at municipal plants on the Upper Lakes are also underway. Significant declines of municipal phosphorus discharges into all three upper lakes have been observed and are displayed in Section III.

But the Board notes that there still remains a number of municipal treatment plants on Lakes Erie and Ontario which are not yet achieving 1 mg/L and which have the potential to exceed the compliance deadlines of the 1978 Agreement.

> *The Board strongly recommends that the IJC urge the Governments to increase their efforts to ensure that these plants meet their target effluent loads. Because phosphorus loads still exceed the targets, the Board also recommends, as it has in the past, that a phosphate detergent limitation be adopted for those portions of Ohio and Pennsylvania within the Great Lakes Basin to assist in reducing phosphorus loads.*

In contrast to the plants which are not yet meeting their phosphorus target loads, the Board wishes to acknowledge and highlight the success of those municipalities on the lakes which have not only achieved 1 mg/L but which have in many cases consistently performed below 1 mg/L. A list of such plants is contained in the Appendix.

SURVEILLANCE

> *The Board recommends that the IJC accept the Great Lakes International Surveillance Plan, as revised and published in November 1980, as satisfying the requirements of Annex 11 of the Agreement.*

The Board makes this recommendation with the strong conviction that the Plan is, and must continue to be, viewed as a framework within which programs can and should be modified to address changing priorities and new environmental conditions.

> *The Board further concludes that the Great Lakes surveillance findings have had an impact on remedial programs and are necessary and essential to evaluate the effectiveness of control measures.*

Specific examples of how well surveillance has contributed to our knowledge of Great Lakes water quality is contained in Section IV.

PROBLEM AREAS

The Board has for several years reported to the IJC on specific geographic areas within the Great Lakes Basin which do not meet Agreement objectives and/or jurisdictional standards. Within this report, the Board updates the 1978 Problem Area list with the addition of three new areas in Michigan: Munising beach, Marquette beach and White Lake.

The Board wishes to advise the Commission that it will present a new perspective on Great Lakes environmental problems in the 1981 Biennial Report. This new approach will take into account the increase from 8 to 41 in specific objectives, as well as the "ecosystem" or "whole lake" emphasis contained in the 1978 Agreement.

OBJECTIVES

During 1980, the Board undertook an analysis of Agreement Specific Objectives and their impact on jurisdictional standards or objectives.

> *The Board is pleased to report that this review found that Agreement Objectives have had a decided impact on the water quality standards and objectives adopted by both Canadian and United States jurisdictions.*

DATA QUALITY AND QUANTITY

The basis for most of the information contained in this report and previous Board reports is the data collected and analyzed by the jurisdictions and the private sector scientific community. The quality and accuracy of that data is critical for evaluating progress under the Agreement, for determining compliance with regulations, and for making multi-million dollar control program decisions.

> *The Board wishes to again advise the IJC of the increasing resource constraints on all jurisdictions in the areas of analytical capacity and capability.*

The ever spiralling demands for complex organic analyses, sophisticated equipment and skilled staff must be met or it will become increasingly more difficult to provide timely and accurate information and control programs will be hindered.

> *The Board also concludes that the assessment of Great Lakes laboratory performance is an essential part of the international surveillance program and it recommends that additional resources be assigned by all jurisdictions to quality assurance programs, including the interlaboratory comparison effort.*

And finally, the Board wishes to alert the Commission that present procedures within the Windsor Regional Office for handling the enormous amounts of compliance and ambient water quality information appear to be less than adequate. The Board is reviewing the matter and will be forwarding its recommendations in the near future.

1978 AGREEMENT

The Board outlines in Section V the progress of the Parties in establishing programs to fulfill the objectives of the international Agreement. It also highlights some of the significant pollution control issues and abatement program progress.

II Aquatic Ecosystem Quality

In keeping with the ecosystem concept adopted in the 1978 Great Lakes Water Quality Agreement, this section summarizes, on a lake by lake basis, water quality issues as they relate to sediments, air and biota. Eutrophication is evaluated in terms of indicators of accelerated eutrophication brought about by man-induced additions of nutrients, particularly phosphorus. Contaminants are discussed with particular emphasis on toxic substances and are expressed as organic or inorganic residues not normally found in the system. An update on whole lake water quality problems and specific local problem areas is also provided.

BASIN OVERVIEW

The Water Quality Board, recognizing eutrophication and contamination to be the key concerns in the Great Lakes aquatic ecosystem, established these issues as highest priority in the implementation of the Great Lakes International Surveillance Plan. From surveillance programs implemented in 1979, the following represent the more significant findings:

CONTAMINANTS

General indications of declines of PCB, DDT and DDE have been found in fish and gull populations throughout the basin, indicative of decreased exposure of the biological community. In past reports, the Board noted newly identified compounds in the Great Lakes System. Although no new compounds were reported this year, systematic, annual scans of fish and gull eggs will continue in order to provide an early warning of the occurrence of contaminants in the basin and specific localities within it.

There has been a substantial decrease in the concentrations of organochlorine residues in a variety of species of small fish of Lakes Ontario and Erie. Declines in PCB concentrations have ranged between 22% and 89% in Lake Ontario fish samples and 60% and 89% in Lake Erie fish samples. The general nature of this decrease in a variety of fish species implies a decrease in input of organochlorides to the system.

Similarly PCB, DDT and mirex residues declined in herring gull eggs from both lower lakes during 1979. Declines are also reported for Lake Huron and Lake Michigan, although declines in Lake Superior were not as significant as in the other lakes. These declines also represent decreased inputs of contaminants to the Great Lakes.

EUTROPHICATION

Although the non-conservative nature of phosphorus and its extensive interaction with biological populations make it very difficult to determine the impact of controls, there are areas such as the Bay of

Quinte, Detroit River and north shore of western Lake Erie, and Saginaw Bay where point source controls have markedly affected the water quality of receiving waters.

Total phosphorus levels in Lake Ontario decreased slightly in 1979, thus continuing the trend of declining levels observed over the last decade for the whole lake. Phosphorus levels in the Toronto nearshore, though higher in 1978, are consistent with the long term decreasing trend.

The long term decline in phosphorus concentrations in the Toronto-Hamilton-Niagara River shore zone of Lake Ontario measured over the past decade is impressive. For instance, total phosphorus measured in Toronto Inner Harbour has decreased from 88 µg/L in 1968 to 28 µg/L in 1978 as a result of remedial measures.

Total and soluble phosphorus concentrations declined significantly in the Detroit River between 1968 and 1979. Total phosphorus loads to Lake Erie have declined from over 90,000 kg/d in 1968 to approximately 14,000 kg/d in 1979 largely because of the implementation of phosphorus control programs in Detroit.

PROBLEM AREAS

With the signing of the 1978 Water Quality Agreement, the number of specific objectives on which problem areas are based were increased from 8 to 41. The nature of the additional specific objectives is such that the Board plans to reassess the problem area concept to consider systematic whole lake problems. The Board will present a new perspective on Great Lakes environmental problems in the 1981 Biennial Report to the Commission.

In 1979, three new problem areas were identified by the Michigan Department of Natural Resources. Two problem areas on Lake Superior have been reported at Munising and Marquette beaches because fecal coliform and total coliform objectives were exceeded. A new problem area was also identified on Lake Michigan, at White Lake, because of elevated levels of chlorinated hydrocarbons in water, fish and in sediments.

A problem area reported earlier by the Water Quality Board in Lake Ontario at the Bay of Quinte has responded significantly to eutrophication controls. Levels of phosphorus have declined in this area resulting in decreased chlorophyll, turbidity and decreased time where micro strainers were required at the Belleville Water Treatment Plant. Nevertheless, dissolved oxygen may remain at depressed levels for some time because of the long residence time of waters in the Bay of Quinte area.

LAKE WATER QUALITY

LAKE ONTARIO

CONTAMINANTS

Since concentrations of toxic substances in water are extremely low and difficult to measure, fish, sediment and wildlife of the Great Lakes in which these substances concentrate are analyzed and used as indicators of contamina-

tion. While contaminant levels in forage fish and gull eggs may not be relevant to human consumption criteria, these organisms can provide data for determining contaminant uptake as a function of time and geographic location.

Analysis in the Lower Great Lakes of young spottail shiners, chosen because they represent localized conditions, identified significant declines in organochlorine contaminants (Table 1). Residue decreases were site specific, and ranged from 22% to 89% for PCB residues. Levels of DDT and metabolites continued to decline. Mirex residues continued to decrease and, at several sites, the concentrations in fish were below the level of detection.

Similarly, studies along the nearshore zone of New York have noted declines of PCBs since 1978. Mirex contamination of Lake Ontario and St. Lawrence River fish still exceed FDA guidelines particularly in large fish.

Open lake fish contaminant data support the nearshore observation of declines in PCB and DDT in Lake Ontario. Mean values of PCB in all top predator species exceed the Agreement objective of 1.0 µg/g. Lake trout and rainbow trout had mean levels of ΣDDT and mirex exceeding the Agreement objective of 0.1 µg/g. Coho salmon, however, had mean values less than the Agreement objectives for both ΣDDT and mirex.

All major organochlorines measured in herring gull eggs from Lake Ontario, excluding HCBs (Snake Island), continued to decline at both monitored colonies in 1979 (see Appendix to this report). The half lives are short and rates of decline are rapid except for dieldrin. Rapid rates of decline reflect a decrease of inputs of these contaminants into the Lake Ontario ecosystem. Reproductive success of both monitored colonies on Lake Ontario was normal in 1979.

EUTROPHICATION

Lakewide mean concentrations of total phosphorus decreased slightly (0.8 µgP/L) in 1979 relative to 1978. In the Toronto area, total phosphorus concentrations averaged 22.8 µg/L, a 17% increase over 1978. The sharp decline to 19.5 µg/L observed in 1978 may be simply the result of physical-chemical variability in the Toronto area during the sampling period.

Spring nitrogen concentrations in Lake Ontario, measured as nitrate plus nitrite, increased 4.4 and 4.8% at 1 and 40 m depths, respectively. Results indicate nitrogen is increasing at the rate of 10.1 µgN/L annually. Specific conductance and chloride, both conservative parameters, changed less than 1% from 1978 spring levels. At 207 mg/L, total dissolved solids still exceed the water quality objective of 200 mg/L. In Black Bay and in the Niagara River (for the first time since the reports were submitted in the early 70's), the total dissolved solids objective was met.

Nearshore studies of water quality were limited to the north shore of Lake Ontario between the Niagara River and Oshawa. Significant downward trends of phosphorus levels have been measured along this section during the period of 1967 to 1979. The greatest improvement was recorded along the highly developed sector west of Toronto where phosphorus inputs were highest and where propor-

tionately the greatest degree of phosphorus reduction occurred (Figure 1). Total phosphorus in Toronto Inner Harbour has decreased from 88 µg/L in 1968 to 28 µg/L in 1978 as a result of the completion of the storm sewer collector and the Ashbridges Bay treatment plant.

LAKE ERIE

CONTAMINANTS

Contaminant levels in fish from river mouth surveys declined in 1979. Results of collections from Point Pelee over a four-year period indicated a 60% decline in PCBs and 80% decline in total DDT (Table 2).

Open lake fish contaminant studies have indicated increases of PCB in coho salmon and walleye. This difference between a nearshore decline of PCB and increase in the open lake reflects that fish contaminant levels in the open lake are responding more slowly to the PCB ban of 1972. DDT levels in coho salmon, however, have declined, and mirex was not detected.

Declining trends evident for all major organochlorine residues in herring gull eggs collected from Lake Erie have been observed (except dieldrin which showed an extremely long half-life and slow rate of decline or no significant trend). The half-lives of all residues, except for DDT, are very long in herring gulls from this lake relative to the other four lakes. Considering changes in residue levels in gull eggs and in coho salmon, this may indicate a continuous input of residues into the foodchain which is slowing more gradually in Lake Erie. Reproductive success of both herring gull monitored colonies was normal in 1979.

Organic contaminants analysis of sediment in the western basin of Lake Erie during 1979 indicated that the Detroit River was a major source of PCB contaminated sediments. Mirex was not detected in a survey of May 1979 but was detected (up to 20 µg/kg) in August of that year, suggesting a source of contamination over the intervening period. The spatial distribution and variation between 1979 surveys for organic materials such as PCBs, DDT and mirex and industrial metals such as chromium, zinc and lead indicate a significant secondary sediment translocation process occurring in the basin.

EUTROPHICATION

A detailed report on the results of open lake and nearshore sampling is being compiled by the Surveillance Work Group and is scheduled for completion in 1981.

Between 1967 and 1977, total phosphorus levels in the vicinity of Colchester Beach and Point Pelee have declined from 46 µg/L to under 30 µg/L. This decline is also observed at the Kingsville water intake, and probably reflects decreased loads from the Detroit River where phosphorus levels have declined from 190 µg/L in 1968 to 30 µg/L in 1979.

One of the major symptoms of eutrophication has been changes in the zoobenthos. Studies in 1979 in the western basin compared to studies from 1967 showed notable improvements in the composition of benthic communities.

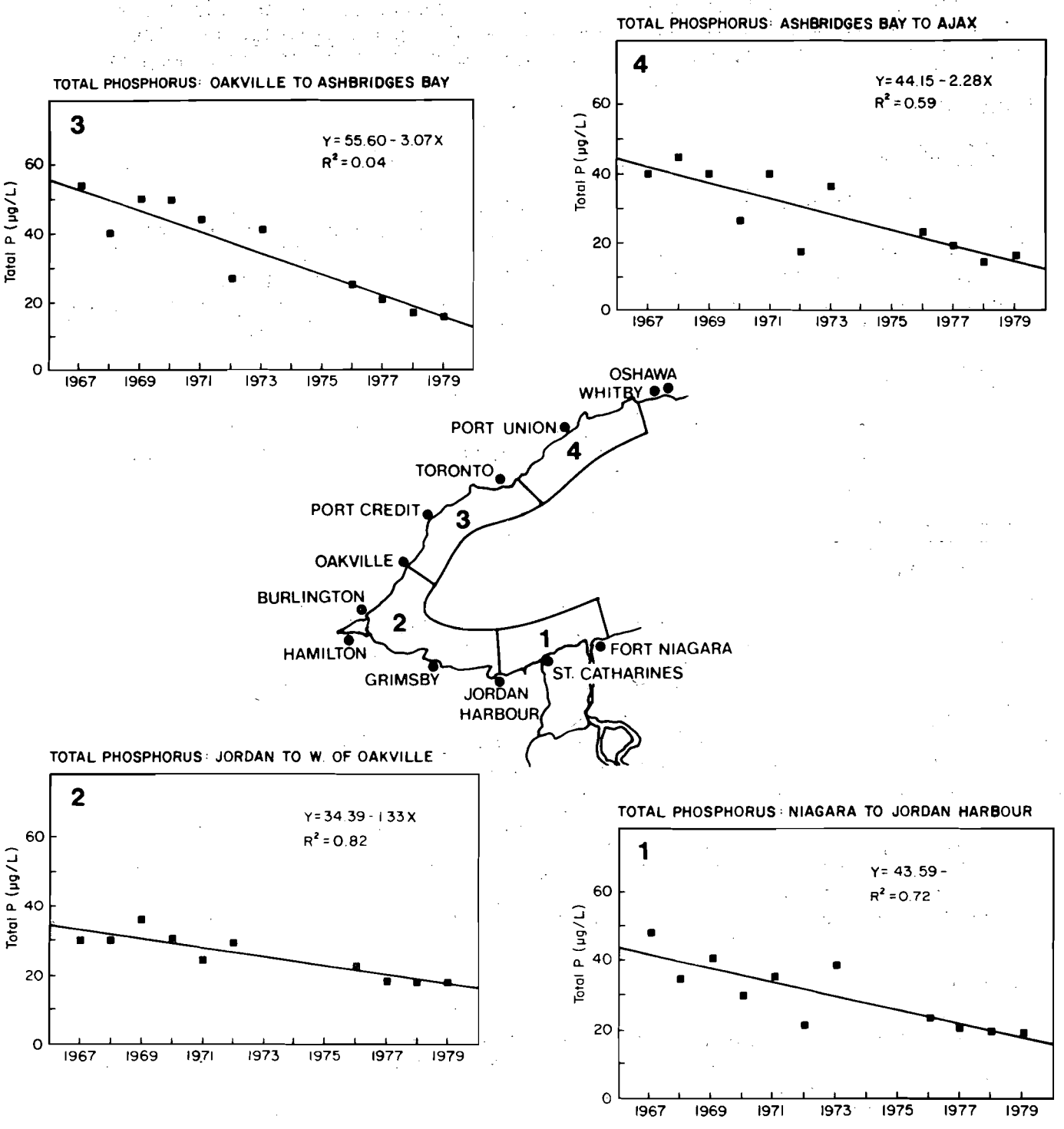

Figure 1 Nearshore Phosphorus Gradients in Lake Ontario, 1967–1979

Chironomid larvae accounted for a larger percentage of the total organisms collected during 1979 than in 1967, and the reappearance for the first time since the early 50's of the burrowing mayfly (Hexagenia Limbata) near the mouth of the Detroit River suggests an improvement in the benthic community.

LAKE HURON

CONTAMINANTS

Declining trends are evident for all major organochlorines detected in herring gull eggs from the two Lake Huron monitored colonies. Short half lives or rapid rates of decline are evident for DDE, DDT, HCB and mirex. PCBs and dieldrin are declining more slowly. This is most likely due to a more gradual slowing of the inputs of these two chemicals in the ecosystem. Reproductive success of both colonies on Lake Huron was normal in 1979.

EUTROPHICATION

No detailed assessments of the trophic status of Lake Huron were performed in 1979. During 1980, Lake Huron was surveyed intensively, and a detailed report will be submitted at a later date.

LAKE SUPERIOR

CONTAMINANTS

Annual surveys of fish contaminants in Lake Superior have been performed although data are not presently available to assess residue levels. This information will be reported in the near future.

Organic residue levels found in 1979 in herring gull eggs of Lake Superior have indicated little change in levels of PCBs and dieldrin since 1974. Levels of similar persistent organochlorines such as DDE are, however, declining at a constant rate similar to those measured in Lake Ontario colonies. The contrast in the apparent ecosystem behaviour of the chemically similar residues DDE and PCB may reflect the continuing input of PCB into Lake Superior from the atmosphere. Reproductive success of herring gulls at Agawa Rock, north of Sault Ste. Marie, was below normal and is the subject of more intensive surveillance in 1980. Reproductive success of gulls at Granite Island near Thunder Bay was normal.

EUTROPHICATION

Intensive eutrophication studies were not performed on Lake Superior in 1979. The Problem Areas section of this report outlines water quality changes in the Thunder Bay area of the lake.

LAKE MICHIGAN

CONTAMINANTS

As in Lake Superior, data collected from the open lake fish contaminant program are not available at this time. Surveillance of wildlife contaminants

utilizing herring gull eggs, however, continued in 1979 through a cooperative project between the United States Fish and Wildlife Service and the Canadian Wildlife Service.

Lake Michigan gull colonies continued to exhibit high levels of PCBs and DDE (Table 3). Levels at the Sister Island in Green Bay indicate a decline in residues in 1979. Levels of dieldrin continued to be the highest of all Great Lakes colonies. Reproductive success of herring gulls monitored at both colonies was normal.

EUTROPHICATION

Between 1976 and 1977, there was a decline in total phosphorus levels in Lake Michigan. Average total phosphorus fell from 8.0 µg/L to 5.2 µg/L in the southern basin of the lake. Secchi depth increased (5.5. m to 5.9 m) with corresponding decreases in phytoplankton numbers (4800 mL to 4100 mL), and chlorophyll *a* (1.7 µg/L to 1.4 µg/L). It was noted, however, that blue-green algae increased in relative abundance during this period.

Causes of this shift in trophic conditions are not fully understood, although they might be related to the severity of the winter of 1976-77. The extent to which the phosphorus control programs contributed to this improvement and the permanence of this improvement are the subjects of additional research and monitoring. Data from the Chicago water intake indicate that lower levels of phosphorus have persisted through 1979, with some increase noted in 1980.

PROBLEM AREAS

The following sections provide an update to problem areas defined in previous Board reports, and present an overview perspective on whole lake problems utilizing atmospheric deposition and fish entrainment as specific examples.

The term "problem area" was initially used by the Water Quality Board in 1975 to indicate localities in the Great Lakes where field measurements showed degraded water quality. The basis for these determinations is the specific water quality objectives in the Great Lakes Water Quality Agreement or the general objectives as expressed by the domestic standards or criteria.

UPDATE 1979-80

The Water Quality Board recognizes four categories of problem areas.

1. An area where water quality objectives have not been achieved because remedial programs are not yet completed.

2. An area where remedial programs have been completed, but a delay is expected before conditions in the lake show improvement.

3. An area where further remedial programs may be required.

4. An area where objectives are not likely to be achieved with present policy and technology.

The location of these problem areas is illustrated in Figure 2. Compliance of the dischargers with domestic enforcement programs is illustrated in the Appendix to this report. The Appendix also gives the detailed assessment by the jurisdiction as to whether or not completion of the remedial programs will result in compliance with Agreement objectives. A review of the problem area status is presented below on a lake by lake basis.

LAKE ONTARIO

In 1978, eleven problem areas were identified in Lake Ontario. A brief update is presented here describing responses of these areas to ongoing remedial programs.

1. Bay of Quinte

Eutrophication of the Bay of Quinte has been characterized by depressed dissolved oxygen levels. The 1978 Water Quality Agreement objective for dissolved oxygen states that the concentration should not be less than 6 mg/L. In the Adolphus Reach area in 1979, the oxygen levels were generally about 4 mg/L and fell slightly below 3 mg/L in the deepest portions of the bay. Oxygen concentrations in Adolphus Reach may not decrease from present levels and could improve as a result of the phosphorus removal program. This is a long term problem associated with local inputs and the lack of circulation within the area of Amherst Island and Prince Edward Point.

In the Bay of Quinte, phosphorus levels and algal biomass decreased significantly as a result of phosphorus controls started in 1978. Turbidity was lower and densities of algae collected weekly at the Belleville water intake were 50 and 60% lower than those recorded in 1978. Micro strainers in the treatment plant were in use only for a few weeks during 1979, whereas prior to 1978 micro strainers were necessary for four to five months of the year. The Bay of Quinte has shown substantial improvement but will continue under surveillance as a problem area until water quality objectives are fully met.

2. Niagara River

The Niagara River was previously designated as a problem area because of high phenol levels. Concern for the water quality has increased in recent years because of the abandoned waste disposal sites in the area and proposed new discharges to the river on the United States side. Recently completed surveys in the river exploring a wide range of possible contaminating substances revealed that the annual average water quality conditions in the Niagara River generally met the objectives of the 1978 Agreement. Less than 10% of the samples exceeded specific objectives.

Between 1975 and 1979, total iron levels increased but concentrations of other metals remained constant. Concentrations of copper in 1979 were 8 µg/L in the Lower Niagara, exceeding the Agreement objective of 5 µg/L. Similarly, concentrations of iron at the same site was 375 µg/L, and exceeded the Agreement objective of 300 µg/L.

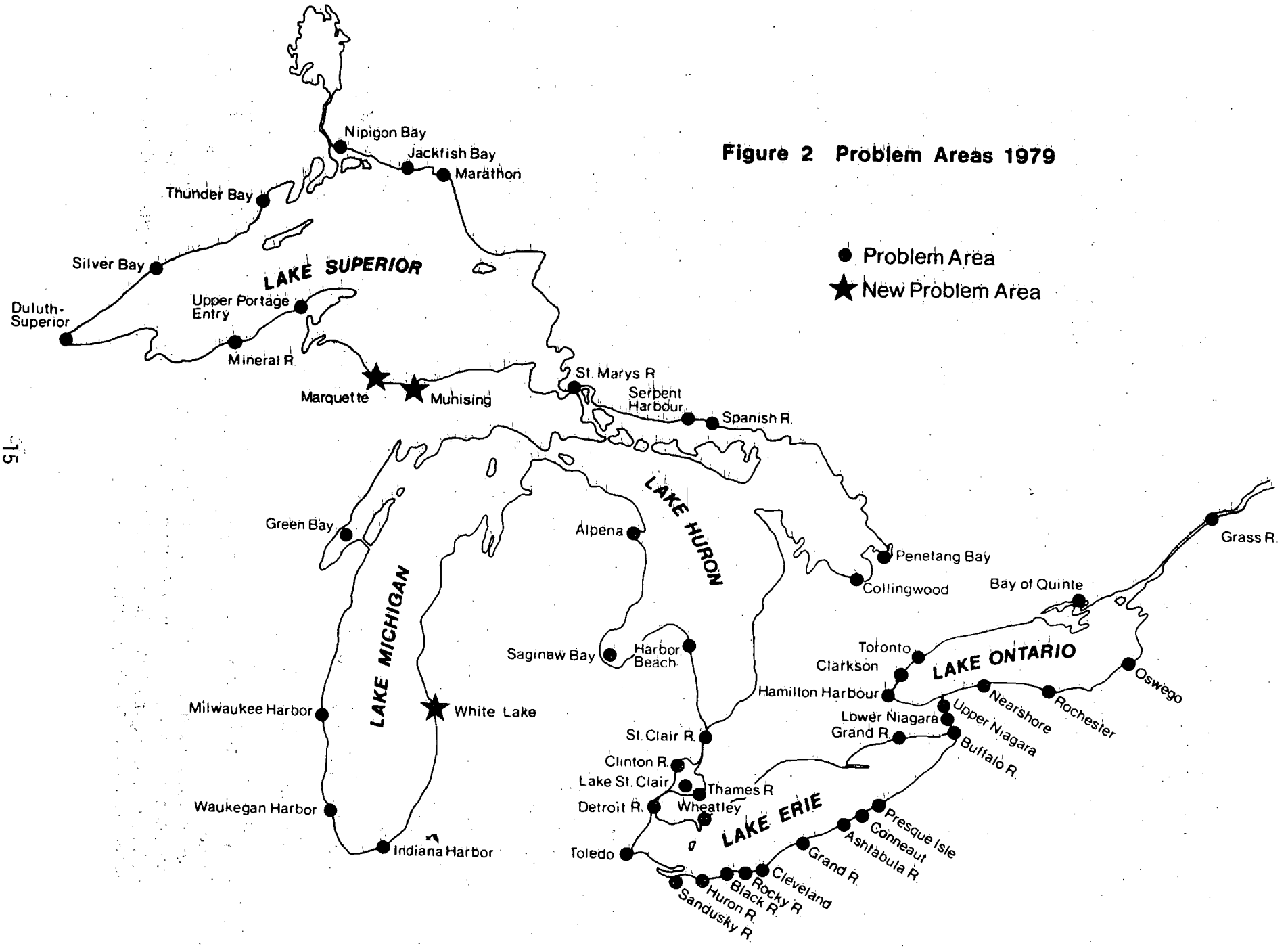
Figure 2 Problem Areas 1979
Problem Area
New Problem Area
Nipigon Bay
Jackfish Bay
Marathon
Thunder Bay
Silver Bay
LAKE SUPERIOR
Duluth-Superior
Upper Portage Entry
Mineral R.
Marquette
Muhising
St. Marys R.
Serpent Harbour
Spanish R.
LAKE HURON
Green Bay
Alpena
Penetang Bay
Collingwood
Grass R.
Bay of Quinte
LAKE MICHIGAN
Saginaw Bay
Harbor Beach
Toronto
Clarkson
LAKE ONTARIO
Oswego
Hamilton Harbour
Nearshore
Rochester
Lower Niagara
Upper Niagara
Grand R.
Buffalo R.
Milwaukee Harbor
White Lake
St. Clair R.
Clinton R.
Lake St. Clair
Thames R.
Detroit R.
Wheatley
Presque Isle
Conneaut
Ashtabula R.
Grand R.
LAKE ERIE
Waukegan Harbor
Indiana Harbor
Toledo
Cleveland
Rocky R.
Black R.
Huron R.
Sandusky R.

In the Upper Niagara River, the water quality objectives were exceeded occasionally for cadmium, copper and iron in 1979. The objectives for zinc, dieldrin, PCB, total DDT, heptachlor epoxide and endrin were exceeded infrequently in 1979.

The 1979 loadings of PCBs, DDT, and mirex in suspended sediments to Lake Ontario were 533, 37, and 11 kg/yr, respectively. Levels of PCB and pesticides in suspended sediments in the vicinity of Grand Island and Fort Erie were equal to or less than half of the levels downstream from Grand Island. Analyses of 1979 water and suspended sediments indicated that the Buffalo River and the Tonawanda Channel are sources of such contaminants as PCB, dieldrin, DDT, arsenic, cadmium, chromium, copper, lead, nickel and zinc. In addition, the Buffalo River appears to be a source of α and γ-chlordane, lindane, α-BHC; the Tonawanda Channel is the source of HCB, endrin, heptachlor epoxide and mercury.

3. Toronto Harbour and Waterfront

Bacterial levels in Toronto Harbour at the mid-harbour and Olympic Island Station have decreased over the last two years. In the summer of 1979, mean total coliform levels in the middle of the Harbour was 678 organisms/100 mL, while the fecal coliform mean was 9 organisms/100 mL. The Olympic Island Beach exhibited a summer total coliform mean of only 128 organisms/100 mL and a fecal coliform mean of 500 organisms/100 mL. Reductions are likely attributable to remedial works constructed by the City of Toronto involving sewer separation and installation of a new mid-town intercepter.

4. Mississauga-Clarkson Area

Gulf Oil has reduced its main stream phenolic load from 27.9 kg/d in 1977 to 6.6 kg/d in 1979. There have been problems, however, with existing phenol treatment facilities. Further reductions are expected upon completion of an aerated lagoon to treat low strength, high volume waste streams. High strength, low volume phenolic wastes have been diverted to a secondary municipal sewage treatment plant.

LAKE ERIE

There has been no change in the number of problem areas reported in Lake Erie between 1978 and 1979. The following is an update of the status of the water quality problems in the Detroit River and at Wheatley Harbour.

1. Detroit River

The water quality of the Detroit River has been monitored since 1967. Total and soluble phosphorus concentrations declined significantly in the Detroit River between 1968 and 1979. Total phosphorus levels declined from over 90,000 kg/d in 1968 to approximately 14,000 kg/d in 1979. As noted in the section on Point Source Control Programs of this report, much of this reduced loading to Lake Erie is the direct result of phosphorus control at the Detroit Sewage Treatment Plant.

In 1979, it was found that concentrations of phenol exceeded the Agreement water quality objective in over 41% of the samples collected and averaged 1.2 µg/L.

Concentrations of total dissolved solids exceeded the Agreement objective in only 1% of the samples. Iron levels, however, exceeded the Agreement water quality objective in over 42% of the samples. Levels of water quality objectives for dissolved oxygen, pH, ammonia, nitrogen, lead, selenium or arsenic during 1979 did not exceed the objectives.

2. Wheatley Harbour

Recent data indicated some improvements over previous conditions which has existed at Wheatley Harbour. Water quality degradation is still prevalent in the inner harbour for oxygen, BOD, nitrogen, phosphorus and bacteria although the extent of this is believed to have been reduced by recent remedial measures. Further surveillance is required to verify these changes.

LAKE HURON

There were no new problem areas identified in Lake Huron in 1979. Below is an update of water quality problems encountered.

1. Saginaw Bay

Over the period of 1974 to 1979, extensive measurements have been made in Saginaw Bay of chlorophyll a, a parameter indicative of eutrophication. Decreasing trends in median chlorophyll a levels indicate the Bay is responding to declining phosphorus loadings. Over the six-year period, the spring chlorophyll decline has been about 6 µg/L (43%) chlorophyll a while the corresponding late summer-early fall chlorophyll a levels have declined by about 11 µg/L (55%). In addition, water treatment plant operators have noted a decrease in the frequency of complaints about taste and odour in the water supply.

The estimated annual phosphorus loads of total phosphorus from the Saginaw River have decreased 70% between 1974 and 1979. Approximately 50% of this load decrease since 1975 is a result of control programs, with the remainder associated with decreased river flow.

LAKE SUPERIOR

In Lake Superior, there were eight problem areas identified in 1978. During 1979, two new problem areas were reported by Michigan Department of Natural Resources. One was at Marquette (Shiro's Public Bathing Beach) where 16 out of 18 samples exceeded 200 counts of fecal coliform/100 mL. The beach was closed to swimming during the entire season as a result of sewage contamination from a storm drain. Remedial programs have been initiated in this area.

The second problem area identified by the State of Michigan is at Munising (Munising Municipal Beach) where again fecal coliform levels were found to be about 200 counts/100 mL. Similar to Marquette, the beach was closed to

swimming during the entire season as a result of sewage contamination from combined sewer overflows.

1. Thunder Bay

Total phosphorus concentrations were high at the mouths of Kaministikwia, McKellar, Mission, and Neebing rivers. The mean total phosphorus concentrations in the inner and outer harbours of Thunder Bay in 1979 were 26 µg/L and 24 µg/L, respectively.

A band of water extending from the river mouths up to 3.5 km offshore exceeded the microbiological objectives. Beyond these zones and for all the inner harbour (except for the Neebing River), both total and fecal coliform densities were within acceptable levels.

Results for total phosphorus, total coliform, fecal coliform and phenols in 1979 showed considerable improvement from 1977 conditions. This resulted from waste reductions from the paper industries, extended municipal sewage collection and the phasing out of the sewage treatment plant which formerly discharged to the McIntyre River. All sewage treatment is now transferred to the Thunder Bay water pollution control plant on the Kaministikwia River.

Further substantial improvements in water quality are expected up to 1985 as additional stages of pollution abatement are completed at the Thunder Bay paper mills.

Some yearling yellow perch and young-of-the-year spottail shiners exceeded the PCB plus DDT objectives. Mirex and HCB were not detected in any of the fish samples, and mercury levels of fish from the Mission Island were well below Agreement objective levels.

LAKE MICHIGAN

In 1979, a new problem area was identified at White Lake caused by toxic organic compounds seeping from waste lagoons. These compounds include carbon tetrachloride and tetrachloroethylene, and are associated with Hooker Chemical Company. A court ordered cleanup is underway, and a consent agreement has been signed with the industry.

WHOLE LAKE PROBLEMS

As observed in Appendix E of the 1978 Water Quality Board Report, contaminant problems have been found throughout the Great Lakes Basin ecosystem. Toxic material is known to accumulate in all parts of the land, air, water and biotic compartments of the ecosystem and is not readily associated with a direct source. Many of the residues such as chlorobenzenes, styrenes, ethylenes, dioxins, furans and PAH found in the system are frequently airborne in origin. Because this is a diffuse source, quite often it is very difficult to determine the area of discharge or the full ecological impact of these compounds.

Specifically, Agreement objectives for PCBs, DDT and dieldrin are frequently exceeded in predator and forage fish in any of the lakes. It is also possible that acid rain might increase the mobilization of heavy metals

throughout the basin, and either by bioconcentration or bioaccumulation, exceed specific Agreement objectives.

The Water Quality Board apprises the International Joint Commission that, consistent with the ecosystem concept of the 1978 Great Lakes Water Quality Agreement, the Board is adopting a change in perspective in which contaminant inputs and their impacts will be addressed on a system basis rather than in localized geographical areas.

ATMOSPHERIC DEPOSITION

The importance of atmospheric deposition of pollutants into the Great Lakes has been identified in the past reports of this Board, the Science Advisory Board, the Upper Lakes Reference Group and the Pollution from Land Use Activities Reference Group. For instance, atmospheric input of PCBs to Lakes Superior, Michigan and Huron is projected on the basis of current sampling programs to represent a significant portion of the total PCB load to these lakes. The significance of loadings of organics (DDT-group of pesticides, α-BHC, α endosulfan, bendosulfan, methoxychlor, PAHs and phthalate esters) and inorganics (nitrate, phosphate, aluminum, cadmium, copper, chromium, iron and nickel) to the Great Lakes via the atmosphere is more difficult to determine. The Great Lakes, particularly the Upper Lakes, are highly susceptible to impacts from atmospheric input of trace organics.

The input of pollutants to the Great Lakes may be separated into wetfall and dryfall. Wetfall may occur from the atmospheric scavenging of particulates by rain or snow or from the partitioning of atmospheric vapors with rain or snow, depending on the equilibrium partition coefficients of the individual isomers. Dryfall may occur either by the direct impact of atmospheric particles on the water surface or by partitioning of the atmospheric vapor with the lake water at the air-water interface.

The methods for measurement of these phases of atmospheric input are currently in the developmental stage and there are some aspects of sample collection and sample evaluation that require additional research to either substantiate the initial estimates of atmospheric input or adjust them. Measurements of atmospheric pollutants are now a part of the regular surveillance program, and efforts are underway to expand the program to include measurements of toxic substances deposited into the lake from the atmosphere.

FISH ENTRAINMENT AT WATER INTAKES

Fish losses at cooling water intakes in the Great Lakes were discussed by the Water Quality Board in the July 1978 report to the IJC and a recommendation was made that effects on lakewide fish populations be considered in the environmental assessment of water intakes. The Board continues to be concerned about this problem, the significance of which is apparent when it is realized that the flow of cooling water through major power plants in the Great Lakes Basin is equivalent to half the flow of the St. Lawrence River.

Studies at power plants have not addressed lakewide impacts and usually suggest that impingement and entrainment are insignificant compared to commercial catches and that populations will compensate for intake losses. To date,

most of the studies have been concerned with the local effects of individual plants rather than system-wide effects.

Canadian studies at Ontario Hydro plants indicate significant losses of local population of fish at water intakes in Lake Ontario. Studies by state and federal agencies on the western basin of Lake Erie indicate that fish populations may be at or near their compensatory limit in Lake Erie. A more thorough analysis of fish losses in western Lake Erie from entrainment and impingement is underway. This effort needs to be expanded to include losses in St. Clair and Detroit rivers where up to 10% of the river flow is withdrawn for cooling or other uses.

To properly assess these effects would require fish population studies to evaluate cumulative losses throughout the geographic range of fishery stocks. Considerably more emphasis needs to be placed on power plant siting to avoid confined locations and on design and location of intakes to minimize entrainment of fish and disruption of communities of plants and animals in the nearshore zone.

The Water Quality Board, recognizing that the potential exists for serious damage to the ecosystem through impingement and entrainment of fish at major water intakes, will continue to monitor this issue and to encourage studies of its effect on fish populations.

TABLE 1

ORGANOCHLORINE CONTAMINANT RESIDUES IN LAKE ONTARIO SPOTTAIL SHINERS
(ng/g wet weight)

SAMPLING SITE	YEAR	NO. OF SAMPLES (*)	LENGTH	% FAT	PCB	ΣDDT	MIREX
Niagara-on-the-Lake	1975	5	56	2.3	690	244	NA
	1977	7	51	2.5	654	157	13
	1978	8	51	1.9	320	99	29
	1979	8	50	2.4	153	26	TR
Twelve Mile Creek	1978	8	51	2.9	349	81	20
	1979	8	51	2.1	271	60	ND
Credit River	1976	10	62	NA	1315	278	32
	1978	8	60	2.6	590	96	28
	1979	8	56	3.7	186	69	ND
Humber River	1977	8	62	7.3	2218	265	5
	1978	8	58	5.8	2938	440	15
	1979	8	60	4.0	1223	74	ND
Presque Isle Bay	1975	5	54	2.7	520	77	NA
	1979	8	49	3.4	122	32	TR
Detection limits (ng/g)					10	5	5

TR - Trace
NA - Not Analyzed
ND - Non Detectable
* - Each sample is a composite of 10 fish

TABLE 2

ORGANOCHLORINE CONTAMINANT RESIDUES IN GREAT LAKES
YOUNG-OF-THE-YEAR SPOTTAIL SAMPLES
(Concentration in ng/g wet weight)

SAMPLING SITE	YEAR	NO. OF SAMPLES (N*)	TOTAL LENGTH (mm)	% FAT	CONCENTRATION		APPROX. % DECLINE	
					PCB	ΣDDT	PCB	ΣDDT
Mitchell Bay	1978	8	54	1.8	94	21		
Lake St. Clair	1979	7	55	1.0	ND	TR	89	76
Thames River	1977	8	59	1.5	67	13		
Lake St. Clair	1979	4	70	2.4	23	9	66	31
Point Pelee	1975	5	63	1.8	844	92		
Lake Erie	1977	8	58	1.6	467	133		
	1978	8	55	1.7	528	47		
	1979	7	61	3.4	337	18	60	80
Thunder Bay	1978	8	51	3.0	157	33		
Lake Erie	1979	5	55	1.9	31	9	80	73

TR - Trace
ND - Non Detectable
* - Each sample is a composite of 10 fish

TABLE 3

ORGANIC RESIDUE LEVELS IN HERRING GULL EGGS OF LAKE MICHIGAN
(µg/g)

	BIG SISTER ISLAND (GREEN BAY)		GULL ISLAND	
	1978	1979	1978	1979
PCBs 1260	68	69	76	82
PCBs 1254/1260	86	73	92	92
DDE	21	11	23	13
DDT	0.14	0.09	0.12	0.10
DDD	-	0.22	-	0.23
Mirex	0.25	0.31	0.15	0.14
Photomirex	0.09	0.14	0.06	0.07
Dieldrin	0.85	0.55	0.84	0.68
Heptachlor Epoxide	0.31	0.24	0.31	0.31
Oxychlordane	0.54	0.52	0.60	0.53
β-HCH	0.02	0.02	0.02	0.01
HCB	0.12	0.13	0.12	0.14

III Municipal Phosphorus Control

The principal requirement of the 1972 Agreement with respect to eutrophication was the control of point sources of phosphorus in the Lower Lakes by 1975. The International Joint Commission recommended to the Governments in September 1976 that the 1 mg/L effluent limitation on all point source discharges of phosphorus be extended throughout the entire Great Lakes System.

Pollution abatement programs implemented in both countries to control phosphorus discharges include: municipal sewage treatment plant construction (Table 4) with phosphorus removal facilities for plants discharging more than 3800 m^3/d or 1 MGD to the Lower Lakes, detergent phosphorus limitations in all jurisdictions except the states of Pennsylvania and Ohio, and control of industrial sources. The Board recommends to the International Joint Commission that a phosphate detergent limitation be adopted for those portions of Ohio and Pennsylvania within the Great Lakes Basin to assist in achieving target loads to Lake Erie.

LOWER LAKES

Municipal phosphorus loads in 1979 to Lakes Erie and Ontario are substantially lower than the 1972 load estimates (Table 5). Canada was below the 1 mg/L target for Lake Erie and slightly exceeded the target for Lake Ontario. The United States loads have decreased substantially but still greatly exceed the target loads for both lakes. Decreased municipal loads to Lake Erie are primarily a result of phosphorus control programs at Detroit which account for 78% of this loading decrease.

Table 6 shows the five-year phosphorus control performance of municipal treatment plants discharging more than 38,000 m^3/d (10 MGD). These are the largest plants in the Lower Lakes basin and are responsible for most of the municipal phosphorus load to these lakes. Of this group, twelve out of twenty-seven United States plants and twelve out of nineteen Canadian plants discharged phosphorus at or below 1.0 mg/L. Table 7 identifies the largest sources of excess municipal phosphorus loads to the Lower Lakes. The estimated completion dates for these and other facilities in some cases extend beyond the December 31, 1982 Agreement date. Phosphorus discharge at 1 mg/L or less basinwide is unlikely before all major construction is completed.

The level of compliance of all municipal dischargers in the Lower Lakes with the 1.0 mg/L target can be found in the Appendix. The Water Quality Board notes that a number of municipalities are doing significantly better than the 1.0 mg/L requirement for the Lower Lakes. The facilities in both Upper and Lower Lakes discharging less than 1 mg/L of phosphorus are listed in the Appendix.

UPPER LAKES

While the 1972 Agreement did not require controls for phosphorus discharges to the Upper Lakes, the Water Quality Board in 1976 recommended the 1.0 mg/L phosphorus effluent limitation for municipalities discharging 3800 m^3/d (1 MGD). All United States jurisdictions require this level of treatment. The Province of Ontario has imposed an 80% removal requirement on larger facilities. Table 8 displays the four-year phosphorus removal performance of the treatment plants discharging 38,000 m^3/d (10 MGD) or more in the Upper Lakes. These are the largest plants in the Upper Lakes basin and discharge most of the municipal phosphorus load to the Upper Lakes. Muskegon County's land application system performance is particularly noteworthy. Treated effluent from the system averaged 0.06 mg/L total effluent phosphorus in 1979.

DATA INTERPRETATION

The relationship between reductions in phosphorus loads from municipal sources and the ecosystem of the receiving water is complex and cannot be readily evaluated by field measurements. There is insufficient information relating fish and plankton populations to changing phosphorus loads. It is probable that environmental changes have affected fish stocks, although other stresses are present in the system. Contaminants and over-exploitation by both commercial and recreational fisheries have made direct assessments impossible as these stresses may have a synergistic effect on biota.

Because of these gaps in knowledge of the eutrophication process, mathematical models used to estimate lake responses to changes in phosphorus loads are regarded only as planning tools, and are used to quantify and interpret data as a guide for management recommendations. Questions not addressed in the models which are based on consideration of total phosphorus include: the distinction between nearshore and deepwater zones of the lakes; the matter of seasonal succession of algal species, which is presently limited to two species; and finally the question of the bioavailability. Set against these concerns are the demonstrated actual successes of control programs for the Bay of Quinte, Toronto Harbour, Saginaw Bay and the western basin of Lake Erie.

DATA REPORTING AND MANAGEMENT

Imprecision in measurement and analysis, in combination with a lack of knowledge about loadings from bypasses and combined sewer overflows from municipal sources, has resulted in "best" estimates and "target ranges" of phosphorus loadings. The quality and accuracy of the data used to evaluate progress under the Agreement is critical, therefore, efforts must be increased to improve the quality of phosphorus loading information. The jurisdictional resource constraints on data submissions, combined with the present inadequacies at the IJC Regional Office to collate the enormous amount of material submitted, are primary concerns to be reviewed by the Board for future recommendations to the Commission. The Water Quality Board, however, considers that the gaps in the fundamental knowledge of eutrophication and phosphorus loading are not sufficient to modify the major overall point source management programs.

TABLE 4

FUNDS COMMITTED FOR MUNICIPAL SEWERAGE CONSTRUCTION
IN THE GREAT LAKES BASIN
(in millions of dollars)

YEAR	CAPITAL COMMITMENTS FOR SEWERAGE WORKS IN ONTARIO BY ALL LEVELS OF GOVERNMENT[1]	OBLIGATED STATE AND FEDERAL FUNDS IN THE UNITED STATES[2]
1971	57	370
1972	66	313
1973	138	419
1974	103	509
1975	112	950
1976	174	429
1977	150	716
1978	191	618
1979	200	456
TOTAL	1,191	4,780

[1]Figures represent total capital commitments for treatment plants and interceptor sewers.

[2]Figures represent total United States eligible project costs with federal grant approval through December 31, 1979.

TABLE 5

REPORTED MUNICIPAL PHOSPHORUS LOADS IN THE LOWER LAKES BASIN[1]
(Kilograms/Day)

LAKE BASIN	1972 LOAD ESTIMATE	PHOSPHORUS LOADINGS						
		1975	1976	1977	1978	1979	LOAD AT 1 mg/L[2]	LOAD OVER 1 mg/L[3]
ONTARIO[4]								
United States	13,000	5,000	4,210	6,149	4,297	3,965	1,906	2,059
Canada	14,000	6,780	3,620	3,130	2,935	3,315	2,558	757
ERIE								
United States	38,000	21,180	17,880	17,827	15,380	11,294	6,302	4,992
Canada	3,800	600	690	686	607	585	641	-

[1]Phosphorus loadings for 1975, 1976, 1977, 1978 and 1979 as reported for sewage treatment plants over 3,800 m^3/d (1 MGD).

[2]Target loading with all municipalities at 1.0 mg/L "P" based on 1979 flow.

[3]Excess - loading for 1979 minus calculated loading if effluent concentration were 1 mg/L.

[4]Including St. Lawrence River.

NOTE: Loadings reflect the number of plants reporting each year. Specific year-to-year comparisons are not advisable.

TABLE 6

MUNICIPAL PLANTS IN THE LOWER LAKES OVER 38,000 m^3/d (10 MGD) 1979 FLOW

MUNICIPAL PLANTS	PHOSPHORUS LOADINGS REPORTED (kg/d)					PHOSPHORUS LOADINGS LOAD AT 1 mg/L (kg/d)			AVERAGE ANNUAL EFFLUENT PHOSPHORUS CONCENTRATION (mg/L)				
	1975	1976	1977	1978	1979	1977	1978	1979	1975	1976	1977	1978	1979
LAKE ONTARIO													
United States:													
Buffalo	1,648	1,518	1,796	1,771	1,741	665	705	645	2.5	2.3	2.7	2.5	2.7
Syracuse	610	565	813	613	569	239	221	196	2.3	1.9	3.4	2.8	2.9
Rochester													
Frank Van Lare	522	398	317	336	568	244	313	568	2.0	1.4	1.3	1.1	1.0
Gates-Chili-Ogden	132	147	159	140	55	45	48	36	3.3	3.4	3.5	2.9	1.5
Northwest Quadrant	109	61	41	45	44	34	44	44	3.8	1.6	1.2	1.0	1.0
Niagara Falls	256	-	815	244	530	247	125	227	1.0	-	3.3	2.0	2.4
Tonawanda S.D.#2	259	265	312	243	48	57	59	84	5.4	5.3	5.5	4.1	0.6
Auburn	36	106	82	87*	-	36	38	-	1.0	2.5	2.3	2.3	-
Lockport	18	4	4	8	25	51	55	49	0.5	0.1	0.1	0.1	0.5
Canada:													
Toronto													
Main	2,650	880	599	567	633	698	763	763	3.4	1.1	0.9	0.7	0.8
Humber	410	320	318	377	383	344	377	383	1.2	0.9	0.9	1.0	1.0
Highland Creek	480	130	200	152	116	133	127	138	4.5	1.1	1.5	1.2	0.8
North Toronto	23	30	25	24	36	39	40	40	0.6	0.8	0.6	0.6	0.9
Hamilton	507	410	329	498	803	254	237	251	2.1	1.6	1.3	2.1	3.2
Lakeview-Mississauga	620	609	327	177	221	173	171	170	4.2	3.5	1.9	1.0	1.3
Kingston	140	47	52	60	55	58	60	57	2.5	0.8	0.9	1.0	1.0
Burlington Skyway	86	60	48	108	74	59	60	78	2.0	1.1	0.8	1.8	1.0
Cornwall	110	140	248	218	121	56	53	49	2.4	2.7	4.4	4.1	2.5
Peterborough	50	60	45	48	73	45	44	49	1.2	1.3	1.0	1.1	1.5
Oshawa	170	79	73	156	121	49	52	55	3.7	1.8	1.5	3.0	2.2
Belleville	67	58	29	35	21	36	35	30	2.1	1.4	0.8	1.0	0.7
Niagara Falls	130	65	60	41	44	46	41	44	3.5	1.7	1.3	1.0	1.0

* Estimated.

Table 6 - cont'd.

MUNICIPAL PLANTS	PHOSPHORUS LOADINGS								AVERAGE ANNUAL EFFLUENT PHOSPHORUS CONCENTRATION (mg/L)				
	REPORTED (kg/d)					LOAD AT 1 mg/L (kg/d)							
	1975	1976	1977	1978	1979	1977	1978	1979	1975	1976	1977	1978	1979
LAKE ERIE													
United States:													
Detroit	12,940	11,290	10,336	7,179	4,206	3,040	2,469	2,461	3.6	3.2	3.4	2.9	1.7
Wyandotte	1,543	993	435	299	294	272	299	256	5.7	3.7	1.6	1.0	1.2
Warren	140	140	-	91	82	-	114	101	1.2	1.2	-	0.8	0.8
Pontiac	45	46	22	15	11	99	87	62	0.6	0.6	0.2	0.2	0.2
Ann Arbor	142	174	-	122	39	-	129	66	2.3	2.2	-	0.9	0.5
Port Huron	71	62	65	58	42	34	41	42	1.1	1.1	1.9	1.4	1.0
Monroe	60	27	30	10	13	50	42	46	1.1	0.5	0.6	0.3	0.3
Cleveland													
Easterly	723	513	483	289	271	501	485	475	1.8	1.2	0.9	0.6	0.6
Southerly	417	290	898	1,203	1,064	360	377	376	1.2	0.8	2.5	3.2	2.8
Westerly	375	340	383	401	673	123	111	145	3.0	2.6	3.2	3.6	4.6
Toledo	800	558	955	747	317	377	317	352	2.5	1.4	2.5	2.4	0.9
Akron	493	439	712	380	639	298	315	340	1.4	1.4	2.3	1.2	1.9
Euclid	462	299	407	573	525	72	113	110	6.7	2.0	5.6	5.0	4.8
Lima	369	31	27	33	66	58	51	81	5.5	0.5	0.5	0.7	0.8
Lorain	93	309	271	370	158	53	60	62	1.6	5.1	5.1	6.2	2.6
Lakewood	-	143	100	33	28	43	47	42	-	2.8	2.3	0.7	0.7
Sandusky	-	36	32	36	84	39	43	42	-	0.8	0.8	0.8	2.0
Erie	383	383	438	433	360	243	195	237	2.2	2.2	1.8	2.2	1.5
Fort Wayne	105	92	94	77	63	164	134	132	0.8	0.8	0.6	0.6	0.5
Canada:													
Windsor Westerly	85	94	59	77	90	100	96	97	0.8	0.9	0.6	0.8	0.9
London Greenway	52	87	107	54	101	107	107	107	0.6	0.9	1.0	0.5	0.9
Kitchener	63	105	84	72	43	65	60	61	0.9	1.4	1.3	1.2	0.7
Guelph	39	40	37	39	9	45	44	9	1.0	0.8	0.8	0.9	1.0
Brantford	63	72	75	56	33	44	46	40	1.4	1.5	1.7	1.2	0.8
Sarnia	19	49	34	32	53	38	37	41	0.6	1.1	0.9	0.9	1.3

TABLE 7

MAJOR MUNICIPAL POINT SOURCES IN THE LOWER LAKES BASIN
EXCEEDING THE 1 MG/L PHOSPHORUS TARGET

FACILITY	JURISDICTION	BASIN	FLOW ($10^3 m^3/d$)	P LOAD (kg/d)	P CONC. (mg/L)	LOAD OVER 1 mg/L (kg/d)	COMPLIANCE DATE
Detroit STP	Michigan	Erie	2,488	4,281	1.7	1,792	1981
Buffalo S.A. STP	New York	Ontario	644	1,741	2.7	1,096	1982
Cleveland Southerly STP	Ohio	Erie	375	1,063	2.8	687	1984
Hamilton STP	Ontario	Ontario	251	603	3.2	552	1980
Cleveland Westerly STP	Ohio	Erie	145	672	4.6	527	1982
Euclid STP	Ohio	Erie	110	524	4.8	414	1986
Medina County STP 200	Ohio	Erie	57	470	7.9	410	To be abandoned
Syracuse Metro STP	New York	Ontario	193	569	3.0	376	1981
Niagara Falls STP	New York	Ontario	220	530	2.4	309	1982
Akron STP	Ohio	Erie	339	638	1.9	298	1985

TABLE 8

MUNICIPAL PLANTS IN THE UPPER LAKES OVER 38,000 m^3/d (10 MGD), 1979 FLOW

MUNICIPAL PLANTS	REPORTED PHOSPHORUS LOADS (kg/d)				LOAD AT 1 mg/L (kg/d)			AVERAGE ANNUAL EFFLUENT PHOSPHORUS CONCENTRATION			
	1976	1977	1978	1979	1977	1978	1979	1976	1977	1978	1979
LAKE SUPERIOR											
United States:											
West Lake Superior S.D.	356	224	202	77	66.1	56.2	128.7	5.2	3.4	3.6	0.6
Canada:											
Thunder Bay STP	178	278	250	320	62.2	72.0	85.9	3.6	4.5	3.5	3.7
LAKE MICHIGAN											
United States:											
East Chicago STP	93	38	48	82	53.0	53.5	61.4	1.4	0.7	0.9	1.3
Gary STP	538	320	275	242	155.0	152.5	162.9	3.0	2.1	1.8	1.5
Hammond STP	667	186	113	109	134.0	138.5	143.9	4.0	1.4	0.8	0.8
South Bend STP	287	42	42	43	155.0	152.7	159.6	1.7	0.3	0.3	0.3
Mishawaka STP	11	11	9	11	41	41	42	0.3	0.3	0.2	0.3
Elkhart STP	127.*	43	73	38	57.7	55.6	56.2	2.2	0.7	1.3	0.7
Battle Creek STP	41	78	86	81	48.0	48.0	46.6	0.8	1.6	1.8	1.8
East Lansing STP	23.*	23.*	23	31	39.0*	39.0	38.2	0.6	0.6	0.6	0.8
Jackson STP	50	46	36	39	51.4	55.6	51.1	0.9	0.9	0.6	0.8
Kalamazoo STP	261	420	291	281	127.0	120.1	128.2	2.1	3.3	2.4	2.2
Wyoming STP	53	119	278	160	45.8	49.4	50.0	1.2	2.6	5.6	3.2
Grand Rapids STP	576	689	466	561	169.0	179.3	198.0	3.4	4.1	2.6	2.9
Appleton STP	80	126	90	5.6	46.2	54.1	59.5	1.5	2.7	1.7	0.9
Milwaukee Jones Island	414	304	204	206	476.6	496.2	515	0.7	0.6	0.4	0.4
Milwaukee South Shore	742	534	380	219	248.8	308.4	317.4	3.0	2.2	1.2	0.7
Racine STP	291	143	117	92	79.6	96.3	99.7	3.8	1.8	1.2	0.9
Sheboygan STP	136	116	125	112	36.0	41.1	38.1	3.0	3.2	3.0	2.9
Neenah-Menasha	37	37	34	23	33.5	37.8	38.2	0.7	1.1	0.9	0.6
Kenosha STP	56	63	44	64	71	65.4	74.7	0.8	0.9	0.7	0.9
Muskegon	-	-	-	8.3	-	-	121.6	-	-	-	0.06
LAKE HURON											
United States:											
Bay City STP	43	158	47	17	67.4	55.6	42.5	0.9	2.3	0.9	0.4
Flint STP	-	-	113	173	85.5*	85.5	75.2	-	-	1.4	2.3
Sault Ste. Marie STP	136	121.*	81	30	12.5	15.3	13.6	11.0	7.0	5.2	2.3
Canada:											
Sault Ste. Marie STP	140	186	207	152	42.0	44.0	54.1	3.8	4.4	4.7	2.8
Sudbury STP	82	100	69	93	50.0	46.4	54.9	1.5	2.0	1.4	1.7

*Estimated.

IV Surveillance and Monitoring

One of the measures agreed to in the 1978 Great Lakes Water Quality Agreement was the implementation of a coordinated surveillance and monitoring program in the Great Lakes System to assess compliance with pollution control requirements and achievement of objectives, to provide information for measuring local and whole lake response to control measures and to identify emerging problems.

Fulfillment of the requirement to implement a surveillance plan based on the 1975 Water Quality Board Annual Report is discussed in this chapter. Further, the progress of the Canadian and United States Governments in cooperation with the states and provincial governments in developing and conducting a joint surveillance and monitoring program is reviewed.

GREAT LAKES INTERNATIONAL SURVEILLANCE PLAN

The Great Lakes International Surveillance Plan (GLISP) was developed by the Surveillance Work Group of the Water Quality Board to provide a general framework for a coordinated United States-Canada surveillance effort in the Great Lakes. The plan primarily addresses the two key issues of eutrophication and contaminants. The development and philosophy of the plan are briefly discussed below. The development of the GLISP marks the continuation of a common Canada-United States approach to scientifically assess the water quality of the Great Lakes ecosystem.

DEVELOPMENT

Numerous studies on Great Lakes water quality coordinated through the International Joint Commission have been conducted between 1909 and the present. After the 1964 Reference studies on the Lower Great Lakes, the IJC recommended to the Governments of both Canada and United States that short term studies to assess the sources and nature of pollutants be conducted, along with longer term research and monitoring programs to assure the best solutions. The 1969 report of several advisory boards to the Commission specifically recommended:

> "that adequate water quality surveillance and monitoring activities be maintained in the referenced waters including inputs from tributaries to allow for the assessment of and adjustment to programs on enforcement, management, planning and research."

In its 1975 report, the Water Quality Board presented a general framework for surveillance program in the Great Lakes, including an estimate of total costs. In January 1976, a symposium was held in Windsor to discuss the state of the art with respect to surveillance activities and the best approach to

develop a coordinated surveillance plan for the Great Lakes. Subsequent to this, the Lake Erie Surveillance Plan was developed in considerable detail. This plan served as the template for the development of plans for the other Great Lakes.

OBJECTIVES

The Great Lakes International Surveillance Plan is basically a strategy to assess water quality in the Great Lakes in a comprehensive, bilaterally coordinated and cost-effective manner. Continuing surveillance of the lakes and connecting channels is required to determine the effectiveness of remedial programs to ensure that water quality objectives of the 1978 Water Quality Agreement are being met.

The objectives of the plan are those outlined in Annex 11 of the 1978 Agreement. Specifically, they relate to: (1) compliance; (2) achievement of General and Specific Objectives; (3) evaluation of water quality trends; and (4) identification of emerging problems. In addition to these general objectives, one of the major underlying concept is the prevention of the deterioration of waters whose quality is better than Agreement specific objectives, jurisdictional standards, criteria or guidelines, whichever are the most stringent.

It is not intended that the GLISP be a rigid requirement for performance. Rather it is intended that the plan be flexible in order to respond to new issues or changing priorities. The plan is characterized by an effective flow of information among its elements, which are conducted by several different agencies. Through this framework, the plan represents a balanced approach to meet the specific information needs of remedial program managers. Its output is a systematic view of water quality in the Great Lakes aquatic ecosystem.

REMEDIAL PROGRAMS AND SURVEILLANCE INFORMATION

Annex 11 of the 1978 Water Quality Agreement states the need for surveillance and monitoring activities and specifies the direction to be taken in a joint program to be developed by the Parties and the state and provincial governments.

One of the fundamental functions of the surveillance program is to obtain information on water quality to evaluate the need for new programs and effectiveness of the existing programs. The following are examples of positive actions to improve the water quality of the Great Lakes that were based on field data collected and assembled in accordance with the GLISP.

Early measurements of phosphorus content of the lakes and the dissolved oxygen levels in Lake Erie formed a basis for the determination that phosphorus control was needed and resulted in the implementation of basinwide phosphorus control programs.

More recently, continuing measurement of phosphorus has documented improvements in Lake Ontario and more localized areas in other lakes. For example, surveillance programs in the Bay of Quinte documented algal and oxygen level responses to phosphorus loading requirements. However, these

same studies indicated further phosphorus loading reduction were needed to meet water quality objectives. Eight sewage treatment plants discharging to the Bay and immediately upstream in the Trent River are now required to meet effluent phosphorus levels of 0.5 mg/L during the critical months of May and October and the Agreement target of 1.0 mg/L during the rest of the year.

Monitoring of the contaminant levels in Great Lakes fish showed that PCB levels in fish flesh continued to be above the United States Food and Drug Administration allowable levels for human consumption, despite a voluntary ban by Monsanto in 1971 on the sale of PCBs for use in open systems. This resulted in the closing of the Green Bay commercial fisheries.

Wisconsin Department of Natural Resources surveys at Fox River pulp and paper industries revealed the discharge of 105 organic compounds, 20 of which are on the United States EPA toxic substance priority list. Wisconsin DNR reissued discharge permits requiring industry to identify sources of these substances and to propose corrective measures. United States EPA and Wisconsin DNR are currently considering additional permit requirements for control of the discharge of the toxic substances.

Lake surveys before and after operation of major industrial facilities in the Nanticoke, Ontario area provided a basis for decisions on the treatment system design and outfall location requirements for Stelco steel mills. The surveillance information is also being used in the planning of sewage facilities to serve the community which is expected to grow as a result of the industrial expansion.

Water quality surveys during the early 1970's in the Cleveland area of the Cuyahoga River demonstrated the need for more stringent industrial and municipal effluent controls. As a result of water quality studies, Republic Steel was required to install carbon column treatment for its blast furnace and coke plant effluents, a requirement which was more stringent than the best practicable treatment technology required nationally. Current water quality data show that the dissolved oxygen problem associated with ammonia still exists in the Cuyahoga. Further treatment by the Republic Steel facility may be required to meet water quality and best available treatment technology requirements for ammonia.

The Water Quality Board concludes that the GLISP in its present form represents a viable realistic plan incorporating the experience of past activities in this field with state-of-the-art surveillance technology and satisfies the requirements of the Water Quality Board under the 1978 Agreement. The plan is a framework around which joint international surveillance activities can be conducted to meet current goals and can be readily modified to address new problems as they arise.

SURVEILLANCE ACTIVITIES 1980-81

Present activities of both Parties represent the implementation of a major portion of the GLISP. A two-year survey of Lake Erie during 1978-80 has been completed and a report on the ecosystem quality of Lake Erie is expected by mid-1981. In 1980, the one-year survey on Lake Huron was initiated. This

surveillance effort consists of three open lake cruises by the United States EPA vessel, Roger R. Simons, operated by the Great Lakes National Program Office (GLNPO) and three cruises by the Canadian federal vessel, Limnos, operated by the Environment Canada.. The Province of Ontario and the State of Michigan are conducting nearshore programs.

The preliminary estimates for a Great Lakes surveillance program prepared by the Water Quality Board in 1975 indicated a need for a $16 million annual expenditure. Subsequent revisions and refinements in the plan now place the required average annual expenditure at approximately $10 million. The costs shown in Table 10 are for comparison purposes and are not intended to represent a measure of the usefulness or effectiveness of the surveillance program.

Tables 9 and 10 present a summary of 1980 surveillance programs and costs for individual jurisdictions. Cost estimates for the implementation of the GLISP for 1980 were in the order of $9.4 million. Actual funds were $9.1 million and although these costs include programs exclusive of GLISP, the major components of the plan, in particular the coordinated studies in Lake Huron, were implemented.

Comparison with total surveillance costs from previous years indicates a stable level of funding since 1978 although some decreases in surveillance funds have occurred in several agencies. The Water Quality Board recognizes, however, that as the contaminant issue and control programs develop, additional surveillance resources will be required to increase analytical laboratory capability which at the present time is severely limited in all jurisdictions.

DATA QUALITY

The data obtained from the surveillance and monitoring program, as well as that obtained from point source and nonpoint source discharges, must be consistently compatible from all sources and be of sufficient accuracy to evaluate progress under the Agreement. Annex 11, Section 3 states that the surveillance and monitoring programs of the Parties and the states and provincial governments shall include "baseline data collection, sample analysis, evaluation, and quality assurance programs (including standard sampling and analytical methodology, interlaboratory comparisons and compatible data management)".

The program for comparison of laboratory performance is in its initial phases and has shown on phosphorus analysis, for example, that the major laboratories have compared well while many smaller laboratories show erratic results. The comparability of the various laboratories is not yet established for other more difficult analytical procedures such as analysis for toxic organics and inorganics in fish, sediment and water. Comparability studies for these more difficult evaluations should be initiated and will require the preparation of reference samples by a laboratory of proven competency.

The Water Quality Board concludes that the assessment of laboratory performance is a necessary part of the surveillance program and that additional resources should be assigned by all jurisdictions to their quality assurance programs. A single lead laboratory in the Great Lakes Basin should

be identified to conduct interlaboratory studies and to develop the necessary bulk reference materials to be used in the laboratory comparison programs. All jurisdictions should participate in the program and contribute to the additional operational costs incurred by the lead laboratory.

POINT SOURCE BIOMONITORING PROGRAMS

The Canadian and United States agencies are implementing techniques and procedures in their surveillance and monitoring programs to identify pollutants that may not be adequately removed by the conventional waste treatment controls.

The current effluent controls provide treatment for known conventional pollutants and major toxic pollutants. However, there is no certainty that the existing treatment systems will adequately control other toxic contaminants found in industrial waste streams. Biomonitoring with live fish is an effective method for detection of the presence of effluent contaminants injurious to human health, aquatic life and wildlife. Routine biomonitoring programs include algal growth tests, tests involving embryo-larval fish, bioaccumulation studies and the Ames assay test for mutagenicity. Tests for the presence of carcinogens or teratogens may also be considered.

The results from these monitoring programs are used to identify discharges needing further analysis to identify the specific toxic contaminants and to determine additional treatment needed to ensure compliance with water quality objectives.

UNITED STATES PROGRAMS

United States EPA has determined that as part of its national permit policy, biomonitoring will be used where necessary to identify potentially toxic discharges. Last year, the Region V Office of the United States EPA sponsored a seminar entitled "Biological Monitoring and Its Use in the NPDES Permit Programs". The seminar program covered methods for measuring acute and chronic toxic effects of effluents on fish and invertebrates, as well as determining the potential for bioaccumulation, carcinogenicity or mutagenicity associated with point source discharges into the aquatic ecosystem. Also discussed were biomonitoring techniques used to discover and limit the discharge of toxic substances.

In the Great Lakes Basin, the United States EPA employs mobile bioassay units with capabilities for flow-through and static bioassays and each regional office maintains central laboratory facilities to conduct bioassays. The Ames test for mutagenicity is also conducted in conjunction with screening tests. The states in the Great Lakes Basin currently are developing biomonitoring capabilities for point source discharges. Biomonitoring programs have been required in some NPDES permits and several Great Lakes states have fully operable biomonitoring programs in place. These state programs primarily use static flow-through bioassays with fish for point source monitoring. Only the Illinois Environmental Protection Agency is using both bioaccumulation studies and Ames tests in its biomonitoring strategy.

CANADIAN PROGRAMS

Federal water pollution control programs under the Fisheries Act specify in part a requirement for 96-hour static rainbow trout lethality test. Test facilities include a biomonitoring laboratory with a capability to do 96-hour static and flow through tests, and two mobile laboratories with 96-hour static test capability. The test species are generally rainbow trout, perch and Daphnia. Approximately 150 tests are conducted annually on a variety of effluents to ensure that they meet regulatory requirements on a continuing basis.

Provincial biomonitoring requirements are developed under the Environmental Protection Act and the Ontario Water Resources Act. Screening studies are being conducted on many industrial effluents in the Province to qualify and quantify the discharge of persistent toxic substances. Samples of these effluents are being examined to determine their biological activity by means of Ames, DNA repair and chromosome aberration tests. In addition, protocols are being developed to analyze fish exposed to river water in the vicinity of industrial effluents to determine accumulation and clearance rates of persistent toxic substances in these fish.

A survey program has been implemented by the Ontario Ministry of Environment to collect and analyze spottail shiner minnows near the outfalls of many high density industrial areas to quantify the presence of chlorinated organic compounds. Spottail shiner minnow studies complement the site specific industrial evaluations by taking a wider approach to contaminant discharge detection for future site specific evaluations. As the data base develops, this "in situ" evaluation approach is expected to provide information on the dynamics of compounds in receiving waters.

New regulatory initiatives, industry-wide or site specific, will be based on the results of the screening studies and the spottail shiner sampling program.

TABLE 9

SURVEILLANCE ACTIVITIES 1980/81

LAKE	JURISDICTION	PROGRAM DESCRIPTION
ONTARIO	MOE	Nearshore water quality studies including water intakes, fish contaminant and phosphorus loading measurements. Special studies on the Bay of Quinte, Cornwall, Hamilton Harbour, Toronto Harbour, Niagara River and areas where Cladophora growths have impacted water use.
	DOE	Main Lake: 3 full-chemistry cruises - 94 stations: nutrients, major ions. Connecting Channels: St. Lawrence R. - daily monitoring at Wolfe Island for output. Niagara River - weekly organics in suspended sediment and water. 7-day intensive sampling for organic contaminants in water and suspended sediments. Daily monitoring for loadings.
	DFO	Open lake studies in fish contaminants, phytoplankton, zooplankton relationships and reproduction of lake trout.
	CWS	Continued studies in herring gull egg contaminant levels, ecological implications and relation to reproduction in herring gull populations.
	NYSDEC	Water intake, tributary phosphorus loading and problem area surveys to provide check on water quality status. Nearshore fish contaminant program.
	US FWS, EPA	Fish sample collection and preparation for EPA analysis. Perform organic scans of selected samples.
ERIE	MOE	Water intake studies are combined with programs studying phenolic compounds in the St. Clair River and baseline assessment of macrozoobenthos in the Detroit River.
	DFO	Fish and plankton studies.
	CWS	Continued studies in herring gull egg contaminant levels, ecological implications and relation to reproduction in herring gull populations.
	ECDH	Main Lake: 2 "core" stations-WQN 601-WQN 622 (601-4 x year) (622-3 x year) Chemical and bacterial samples. Nearshore: Presque Isle Bay-Chemical and bacteriological beach sampling (140 samples-bacteriological along the PA shoreline). Tributary: (4 x year) 3 tribs--Elk Creek, Walnut Creek, Sixteen Mile Creek. Chemical and bacterial samples and macroinvertebrates.
	Ohio EPA	Water intakes, tributary phosphorus.
	MDNR	Annual surveys on the Detroit River, water intakes, and tributaries.
	EPA	Annual monitoring program consisting of 27 stations in the central basin to determine extent of anoxic conditions, 7 stations for biological studies, and 19 stations (including 12 station transects) to define trophic status in the western basin.
	US FWS	Fish sample collection and preparation for EPA analysis. Perform organic scans of selected samples.

Table 9 - cont'd.

LAKE	JURISDICTION	PROGRAM DESCRIPTION
HURON	MOE	Intensive studies as designated in the Great Lakes International Surveillance Plan to delineate nature and extent of areas of noncompliance with 1978 Agreement or MOE water quality objectives. Mass balance studies at outlet from Lake Huron to estimate nutrient inflow/outflow relationships are combined with sediment and benthos studies on ecosystem assessment in Lake Huron.
	DFO	Phytoplankton information, trend in time date on loadings and responses of atmospheric pollutants. Fish contaminant programs including trace metals and persistent organic contaminants.
	DOE	Main lake surveillance, 3 cruises as designed in Great Lakes International Surveillance Plan.
	CWS	Continued studies in herring gull egg contaminant levels, ecological implications and relation to reproduction in herring gull populations.
	MDNR	Problem area survey in coordination with the EPA open lake program.
	EPA	Whole lake intensive, special studies in Saginaw Bay and Michigan nearshore zone as described in GLISP.
	US FWS	Fish sample collection and preparation for EPA analysis. Perform organic scans of selected samples.
SUPERIOR	MOE	Nearshore fish contaminant studies and water intake programs to maintain annual assessment of ecosystem quality. Tributary loadings are also included.
	DFO	Fish collection for contaminant studies.
	DOE	No active surveillance program for 1980/81.
	CWS	Continued studies in herring gull egg contaminant levels, ecological implications and relation to reproduction in herring gull populations.
	WDNR	14 coastal stations for tissue analyses, 4 ambient water quality monitoring rates on tributaries.
	MPCA	Tributary sampling on the Beaver and St. Louis Rivers. Nearshore fish contaminant program.
	EPA	No active surveillance program for 1980/81.
	US FWS	Fish sample collection and preparation for EPA analysis. Perform organic scans of selected samples.
	MDNR	Tributary, problem area surveys.
MICHIGAN	EPA	One cruise to assess nutrient conditions.
	WDNR	46 coastal stations for tissue analyses, plus 11 ambient water quality tributary stations.
	ISBH	Water quality assessment and drinking water intake analysis. Tributary monitoring.
	US FWS	Fish sample collection and preparation for EPA analysis. Perform organic scans of selected samples.
	CWS	Continued studies in herring gull egg contaminant levels, ecological implications and relation to reproduction in herring gull populations.
	MDNR	Fish contaminant, tributary monitoring. Problem area surveys.

TABLE 10

SURVEILLANCE COSTS 1980/81
($1000)

LAKE	ONTARIO	CANADA	E P A		U.S. FWS	J U R I S D I C T I O N							TOTAL
			GLNPO	LLRS		N.Y.	PENN.	OHIO	MICH.	IND.	WISC.	MINN.	
ONTARIO	895	1,430			20	192							2,537
ERIE	250	236	335		20	58	5	80	234				1,218
HURON													
Main Lake		670	665		20								1,355
Nearshore	665		510	210					120				1,505
SUPERIOR	40	78			20				67		20	25	250
MICHIGAN	-	33			20				143	200	99		495
BASIN*	460	-	1,328										1,788
1980	2,310+	2,447	2,838	210	100	250	5	80	564	200	119	25	9,148
1979	2,590+	2,447	3,376		160	250	31	80	564	200	87	25	9,811
1978	2,045+	2,671	3,560		160	130	29	80	485	200	84	11	9,455

*General programs include surveillance components such as atmospheric input, tributary monitoring and biomonitoring.

+Under the Canada-Ontario Agreement on Great Lakes Water Quality, the Federal Government pays for 50% of Ontario Great Lakes Surveillance Program.

V Agreement Progress

The 1978 Water Quality Agreement commits the United States and Canadian Governments to develop and implement programs and other measures to fulfill the purpose of the Agreement. This chapter reviews the progress made in compliance with the Agreement and discusses highlights and significant developments in program implementation.

COMPLIANCE WITH AGREEMENT DATES

The 1978 Great Lakes Water Quality Agreement specified dates or time intervals by which certain actions should be accomplished. Table 11 lists those paragraphs in the Agreement which contain time constraints and describes the progress made toward completion of the activities by Governments.

Progress has been made in meeting the requirements for major programs, such as industrial and municipal controls. These programs were underway in compliance with the 1972 Agreement. Programs such as controls on nonpoint sources and toxic substances were not a part of the 1972 Agreement but are required by the 1978 Agreement, and while some progress has been made, the programs are still in the early stages of development at this time.

Two major programs, Annex 2 - Limited Use Zones and Annex 3 - Control of Phosphorus, were not completed by the dates specified in the Agreement. The Parties have not submitted annual reports as required by Annex 2 of the Agreement.

In an exchange of notes between Canada Department of External Affairs and the United States Department of State on September 1980, the timetable for completion of confirmation of future phosphorus loads and establishment of compliance schedules as specified in Annex 3 has been extended one year, until May 1981.

POINT SOURCE CONTROL PROGRAMS

The following descriptions of significant developments in point source control programs are indications of the progress being made to control pollution from known major sources. The progress reported here represents accomplishments that resulted from intensive efforts sometimes extending over many years.

RESERVE MINING

On March 16, 1980, Reserve Mining Company halted the dumping of asbestos-laden ore tailings into Silver Bay, Minnesota, Lake Superior. The Company's action in response to a May 26, 1977 United States Federal Court Order ended the dumping of some 67,000 tons daily of tailings into Lake Superior over a 25-year period. The Company was also ordered to stop emitting asbestos fibers into the atmosphere and to pay more than $1 million in fines and penalties.

Remedial programs include an on-land disposal system to manage both coarse and fine particles. Construction of a 5.8 square mile basin capable of holding 823 million tons of tailings has been completed. The $370 million (estimated) on-land disposal system was put into operation on June 24, 1980. Tailings will be pumped in a water slurry to the basin with closed-loop recycle of water. The basin will be kept flooded to prevent off-site migration of asbestos fibers. Air and water sampling programs in and around Silver Bay will continue under surveillance of the Minnesota Pollution Control Agency to monitor for adverse environmental effects from the new system.

Reserve Mining has also installed electrostatic precipitators at its ore processing plant in Silver Bay to remove asbestos fibers from the plant's air emissions. Measures to control the migration of asbestos from a tailings delta that extends into the lake have been initiated. A rock wall has been built that will eventually form a subsurface breakwater that will close off the tailings delta, preventing fibers from migrating any further.

DETROIT

The Detroit Metropolitan Wastewater Treatment Plant is the largest in the Great Lakes Basin. The wastewaters of over 3 million people have been discharged to the Detroit River with only primary treatment because of construction delays in the secondary treatment system.

In 1977, a Federal Court action brought by the United States EPA and the State of Michigan identified the problems with the Detroit wastewater treatment facility. The result of this action was a Consent Judgment which outlined the specific deficiencies affecting the adequate operation of the water pollution control facility. Specific dates for compliance in each area were specified in the Consent Judgment.

At the request of the Federal Court, a full-scale evaluation of the Detroit wastewater treatment plant was conducted from August 1 to October 26, 1979. The plant was operated as an activated secondary wastewater treatment system producing an effluent quality in compliance with current effluent limitations but at a flow substantially lower than average flow and well below design flow. The limitations which were to take effect on December 31, 1979 were also met with the exception of total suspended solids concentrations and a minor deviation in oil and grease concentration. This represents the first time the Detroit wastewater treatment plant was operated as a full-scale secondary treatment facility since its construction in 1940.

Significant improvements in effluent quality have been documented. Total phosphorus concentrations in Detroit's effluent averaged 1.7 mg/L from July 1979 to June 1980. This is a significant decrease when compared to the effluent concentration reported in 1963 of 11.9 mg/L. When expressed as a loading, this represents an 88 percent decrease in the amount of total phosphorus discharged to the Detroit River since 1963.

The Detroit wastewater treatment plant is not expected to operate continuously as a secondary treatment facility until construction and modification of secondary settling tanks are completed in June of 1981.

SYRACUSE METROPOLITAN SEWAGE TREATMENT PLANT

The Metropolitan Syracuse Sewage Treatment Plant, a major wastewater treatment facility in Onondaga County, New York, serves a population of 344,000.

The original facility was completed in 1960 and secondary treatment with phosphorus removal was completed in the spring of 1979. The secondary treatment processes are operating well with the exception of phosphorus removal. Phosphorus removal will begin in mid-1980 upon completion of the facilities needed to transmit lime waste from the Allied Chemical waste beds to the plant. Phase I work of the pretreatment program will be completed by December 30, 1980.

LOVE CANAL, NEW YORK

The Love Canal is a rectangular, 16-acre, below-ground-level former landfill located in the southeast corner of the City of Niagara Falls, about one-quarter mile north of the Niagara River. It was excavated as part of a proposed canal in the 1890's and subsequently used as a dump site for chemical wastes by Hooker Chemical Company and others over a period of 20 to 30 years. Wastes include such chemicals as benzene, toluene, lindane, trichloroethylene, carbon tetrachloride and a significant amount of trichlorophenol.

Water infiltration into the Canal has caused material to leach out of the waste into surrounding area of primarily single family houses. Some migration has also occurred into the storm sewer system in the residential neighborhood surrounding the Canal and into Black and Cayuga creeks on the northern end. The storm sewer system is in two sections. The northern section drains into Black, Bergholtz, and Cayuga creeks and thence into the Niagara River. The southern section drains directly into the Niagara River. Dioxin (2,3,7,8-isomer) has been detected in a leachate sample taken from the Canal as well as in sediments and biota in Black and Bergholtz creeks to the north and sediments in the storm sewers in the vicinity of the southern part of the Canal.

A leachate collection trench has been constructed during the past two years to completely ring the Canal and intercept outward migrating leachate. The leachate collected is treated on-site by a granular-activated carbon unit before discharge into the City of Niagara Falls sanitary sewer system. The treatment unit operates 3 days a week and treats about 20,000 gallons per day. The top of the landfill has been capped with clay to reduce water infiltration.

New York State is seeking funds under Section 311 of the Clean Water Act for cleanup of contaminated material that has escaped from the Canal and now lies attached to sediment in the stormwater sewer system both in the northern and southern sections of the Canal as well as in Black and Bergholtz creeks to the north. This material is outside the leachate collection trench and hence is capable of further migration.

EPA has begun a comprehensive air, soil and groundwater monitoring program in the Love Canal area.

CITY OF NIAGARA FALLS, NEW YORK

The City of Niagara Falls STP was first started in April 1977. The carbon beds were used on a limited basis beginning in January 1978, stopped in March 1978, and began again in April 1978. In early summer 1978, structural failures were discovered. The plant experienced a rupture of several carbon bed bottoms and after removing the carbon, extensive corrosion and damage to the precast filter bottoms and gullet wall projections was discovered. The operation of the carbon filter beds was suspended and the plant has been providing only primary treatment since that time. This treatment level is not adequate for the industrial and municipal wastes being discharged to the Niagara River from this plant.

A project was approved by the United States EPA on April 24, 1980 for remedial work on the carbon beds which required the City to hire an independent consultant to conduct a review of its 48 MGD wastewater treatment system. The study is expected to be underway in September 1980 and completed in 28 weeks.

STELCO HILTON WORKS, HAMILTON, ONTARIO

Since 1970, the company has undertaken the following major projects to reduce water discharge loadings. By-product plant wastewaters, together with sanitary wastes, were diverted to the Hamilton Sewage Treatment Plant to reduce BOD_5, ammonia, phenols and to eliminate bacteriological contamination. Additional thickeners at the blast furnace were installed and later modified with recycle systems to reduce cyanide and suspended solids. A major filtration plant has been installed in two phases to reduce suspended solids and iron discharges. Other control facilities consist of the construction of a waste oil treatment plant for all discharges or ion exchange plant for chrome discharges and an acid regeneration plant. The Ontario Ministry of the Environment expects to publish its assessment of the effectiveness of these controls in 1981.

DOFASCO, HAMILTON, ONTARIO

During the period 1970-1980, reduction of wastewater pollution to the harbour from Dofasco has been achieved by the following projects. Ammonia stripping sewers and a biological treatment plant were constructed to remove ammonia and phenols from by-product wastewaters. Suspended solids were reduced from blast furnaces by construction of a new thickener system. A new thickener system was also installed to improve suspended solids removal from the melt shop gas washwater. A filtration plant was installed to treat hot mill wastewaters to reduce suspended solids and iron. Other facilities include an acid regeneration plant, oil treatment plant and ion exchange plant.

STELCO - LAKE ERIE DEVELOPMENT

At Stelco's new Lake Erie Development, 90% of the water used is recirculated. The blowdown from the various recirculating systems in the mill, such as blast furnaces and steelmaking facilities, is treated by the alkaline breakpoint chlorination method of chemical oxidation (blowdown treatment plant). When the coke ovens are placed in operation, wastewaters will be pre-treated in a biological treatment plant before discharge to the blowdown

treatment plant. The effluent from the blowdown treatment plant is held in a lagoon prior to discharge to Lake Erie. Stormwater is separated and sent to settling ponds before discharge. These programs are expected to comply with Water Quality Agreement Objectives and Ontario requirements.

ALGOMA STEEL CORPORATION, SAULT STE. MARIE, ONTARIO

The major pollution abatement achievement at Algoma Steel over the past ten years has been the construction of the "coke ovens by-products" plant as a result of which the following reductions in loadings have occurred:

	FROM	TO
Phenols	2000 ppb	400 ppb
NH_3	33 ppm	11 ppm
H_2S	12 ppm	3 ppm
HCN	7 ppm	2 ppm

The Ministry of the Environment is currently negotiating a new Control Order for further abatement of pollutants.

SCA CHEMICAL WASTE SERVICES, INC.

SCA Chemical Waste Services, Inc. operates an industrial waste management facility at Model City in the towns of Porter and Lewiston, Niagara County, New York.

The Company requested modification of an existing New York State discharge permit to increase the discharge from a maximum of .1 MGD to a maximum of 2 MGD and changes in discharge parameters and monitoring requirements for discharge to the Niagara River and Six Mile Swale (tributary to Lake Ontario). They also requested a permit for construction of an outfall for discharge of treated effluent to the Niagara River and approval of plans for a pipeline from Model City to the Niagara River.

It was determined that an adjudicatory hearing would be held in two phases, the first phase concentrating on the permit modifications and the discharge to Niagara River because of the known accumulation of 86,000,000 gallons of treated effluent and the long term need for discharge of treated leachate from existing landfill facilities. The second phase would review all remaining matters.

The New York State Department of Environmental Conservation (NYSDEC) determined that the project may have adverse environmental effects attributable to improper treatment or storage of hazardous industrial waste. The Draft Environmental Impact Statement concluded, however, that all significant adverse impacts on the environment could be satisfactorily controlled. The NYSDEC also determined that the discharge modifications would not have a significant effect on the environment.

Phase I hearings began June 25, 1979 and included testimony from NYSDEC and the company. A substantial part of the hearing focussed on the proposed discharge into a portion of the Niagara River known as Peggy's Eddy, about 3 miles from Lake Ontario.

The objectors included the Town of Porter, Operation Clean and many individual citizens from both the United States and Canada. Interest in the hearing was high with 50 to 100 persons attending each session.

In February 1980, the State of New York issued a permit along with approval to construct a pipeline. Several lawsuits from the Town of Porter followed. The town also refused to issue a permit for the SCA to excavate. The Company then sued the town for issuance of the permit. The United States Corps of Engineers recently issued a permit to construct the outfall structure in the Niagara River. This permit takes effect only after all local permits are issued.

SCA Chemical Waste Services, Inc. has purchased pipeline materials and some vandalism has occurred. Citizens are disrupting construction by their physical presence. The NYSDEC estimates that it will take at least one year to resolve the various lawsuits.

HOOKER CHEMICALS AND PLASTICS

The Hooker Chemical and Plastics Company owns and operates a chemical manufacturing facility in the City of Niagara Falls, New York, located along the Niagara River. The Company is authorized by an SPDES permit to discharge treated process wastewater and cooling water through five outfalls to the Niagara River. These outfalls also contain some storm drainage from the plant site. Monitoring reports indicate a total daily average flowrate from all five outfalls of 30 to 50 million gallons per day (MGD).

Under the terms of its permit, Hooker is required to monitor its effluents monthly for nineteen specific organic chemicals. Hooker is also required to monitor its effluents for the pesticide "mirex", twice per year. A two-day monitoring program for PCBs and trichlorotoluene was also required by the permit.

The State of New York determined that the discharge proposed would not cause a violation of present water quality standards for the Niagara River or endanger public water supplies.

As required by its permit which will expire on March 31, 1981, Hooker has completed a study, identifying the sources of potentially toxic pollutants, contained in the discharge and is required to submit an engineering report on the major sources, including contaminated groundwaters at the plant site. This report is to recommended a plan of remedial action. These studies will serve as one basis for identifying "Best Available Technology Economically Achievable (BAT)". The renewal permit will require that BAT effluent limitations for toxic pollutants be achieved not later than July 1, 1984, as mandated by the Clean Water Act.

ST. CLAIR RIVER

A water quality study was recently completed by the Ontario Ministry of the Environment comparing 1977 water quality information with similar information obtained in 1968. Significant improvements in river quality have occurred between the two studies. They are attributed to upgrading of existing treatment systems and the building of new facilities in the Sarnia-Lambton area. Further improvements in water quality are expected.

In the late 60's and early 70's, control of oil and suspended solids was accomplished by separation of waste streams and the installation of dual-media filtration systems.

Attention was then directed to the reduction of dissolved organic material. Five biological oxidation units have been completed, resulting in a substantial reduction in total organic carbon, phenols and BOD; the sixth is scheduled for completion in 1982. Granular activated carbon removes other organic materials to overcome problems of fish toxicity in the St. Clair River. Accidental discharges of contaminants are minimized by construction of contingency ponds in the effluent system and the addition of special loading equipment on the docks.

Advanced analytical equipment capable of measuring in the parts per trillion range is used in both the waste and process systems to improve waste discharge control and reduce the number of process upsets.

NONPOINT SOURCE PROGRAMS

The 1978 Water Quality Agreement Article VI-1(e) requires the Parties to develop and implement measures for the abatement and control of pollution from agricultural, forestry and other land use activities. The following briefly describes those programs currently underway to reduce the pollution from those sources referred to as nonpoint or diffuse to distinguish them from specific point sources such as the discharge pipes of municipal and industrial treatment plants.

UNITED STATES

NATIONWIDE URBAN RUNOFF PROGRAM

In 1979-80, EPA will be funding 30 urban storm runoff prototype projects nationwide with 208 planning grants. The projects will test various best management practices (BMP) (e.g. street sweeping, detention basin storage) and determine the resultant impact on water quality. By the end of FY 82, EPA plans to have developed a number of effective control measures. The program will culminate with a report to Congress in 1983 on effects, causes and controls, and will continue thereafter to assure implementation. Projects approved within the Basin are located in or near Milwaukee, Wisconsin; Chicago, Illinois; Detroit, Ann Arbor, and Lansing, Michigan.

RURAL CLEAN WATER PROGRAM

The United States Department of Agriculture, its Soil Conservation Service will enter into 5- to 10-year contracts with owners or operators or rural lands "for the purpose of installing and maintaining measures incorporating

rural lands "for the purpose of installing and maintaining measures incorporating BMP to control nonpoint source pollution". The Saline Valley (tributary to the River Raisin) watershed in Southeastern Michigan and the Lower Manitowoc in Wisconsin have recently been designated as project areas under this program.

SOIL AND WATER RESOURCES ACT OF 1977

The Act was proposed by Congress "to provide for furthering the conservation, protection, and enhancement of the Nation's soil, water, and related resources for sustained use". An appraisal of and program plan for soil and water conservation were required to be developed by December 31, 1979 and are to be updated at five-year intervals. The draft Appraisal was recently completed.

LAKE ERIE WASTEWATER MANAGEMENT STUDY (LEWMS)

Phases I & II of the study by the United States Corps of Engineers, Buffalo District described the pollutant loads from both point and diffuse sources entering Lake Erie. They also addressed the question of lake response to reduced phosphorus loads and made initial estimates of load reductions needed to meet in-lake objectives.

Phase III will run through October 1981 when the final report, presenting a management plan for the United States portion of the Lake Erie watershed, will be published. The Honey Creek Watershed Management Project is one of the major programs of Phase III. The end result will be a work plan for management of the entire watershed with emphasis on problem identification and development of site specific management practices.

As one of the components of the study, mulch-till and no-till demonstration plots were established on several farms representing a range of soils and management systems. Crop productivity, time savings, costs, and effect on water quality are being well documented. Bean Creek, Michigan; South Branch of the Cattaraugus, New York; West Branch of the Rocky River, Sandusky River Basin and Ottawa River, all in Ohio, are five additional watersheds which have been selected to provide complete representation of conditions existing in the Lake Erie Basin.

DEMONSTRATION PROJECTS

Federal grants authorized by the Clean Water Act support demonstration of technology and management practices for control of nonpoint sources. Nonpoint source projects have been completed for: Agriculture in Black Creek in Indiana; Red Clay Erosion into Western Lake Superior; Agriculture and Urbanization in Washington County, Wisconsin; and Combined Sewer Overflows in Rochester, New York. Additional demonstrations are underway for: Agricultural Tillage Practices in Tuscola County, Michigan and Allen County, Ohio; and Combined Sewer Overflow Control in Cleveland, Ohio and Saginaw, Michigan.

CUYAHOGA RIVER RESTORATION STUDY

A Revised Plan of Study was issued in July 1977 which included study plans for alleviating erosion and sedimentation problems, flood control and debris removal. The United States Geological Survey completed a sediment sampling

program in the Cuyahoga basin in FY 1980 between Old Portage and Independence which verified that areas within the reach were contributing inordinate amounts of sediment. The United States Soil Conservation Service, under a two-year agreement with the United States Corps of Engineers, has recently completed a study of streambank and upland erosion on the river and two Cuyahoga tributaries.

The final product of the Cuyahoga Restoration Study will identify the prime sources of sediment in this reach of the river and recommend areas where erosion control efforts should be initialed. Alternative methods for control will be analyzed and the relative benefits versus cost determined.

AGRICULTURAL CONSERVATION PROGRAM (ACP)

Environmentally approved practices for each locality are recommended by state and county ACP development groups. These practices to prevent soil loss, improve water quality and conserve water will reduce sediment loading and therefore pollution to the Great Lakes. The government's share of the cost ranges from 30% to 80%, depending on the farmer's financial status. Special projects are designated by ACP to solve community-wide agricultural water pollution problems. One of the largest of these projects is located in the Saginaw Bay basin.

WISCONSIN NONPOINT SOURCE WATER POLLUTION ABATEMENT PROGRAM

The Program was established by the Wisconsin legislature in 1978 to provide the administrative framework and technical and financial assistance necessary for implementing measures designed to meet the needs identified in water quality management plans. Cost-sharing is available to municipalities, land owners and land operators for installing best management practices. Grants are made on the basis of expected water quality benefits and financial need. Funding is concentrated on selected "priority watersheds" where nonpoint source pollution is a critical problem. The Lower Manitowoc River watershed is one of the first five "priority watersheds" selected for inclusion in the 1979 program. The objective is to reduce the amount of phosphorus entering the nearshore waters of Lake Michigan by 50%.

CANADA

Canada and Ontario have initiated a review of nonpoint pollution control programs and expects to respond in 1981 to the Commission's recommendations for control of pollution from land use activities.

Since their inception, the Conservation Authorities of Ontario, which are a combined provincial body, have recognized that the goal of controlling many nonpoint sources of pollution will be accomplished best by cooperative ventures to assist private landowners. Annually, Conservation Authorities have been part of 40 projects to control erosion on private land, including streambank stabilization, gully protection and grassing waterways. They have implemented 600 private land reforestation projects. In 1978, Authorities stabilized approximately 20 km of streambanks costing several million dollars.

With the funding of the Strategic Plan for Ontario Fisheries, the Ontario Government provided funds to rehabilitate degraded fish habitat in lakes and streams. In 1979, and again in 1980, projects costing approximately two

hundred thousand dollars will fence livestock from streams and plant trees and shrubs to control erosion adjacent to streambanks. The Ministry of Natural Resources is testing fast-growing hybrid poplar to intercept eroded topsoil and assimilate associated nutrients. Research contracts with universities include surveying landowners for attitudes about cooperative projects on private land, and analyses of width requirements for buffer strips to prevent erosion along streambanks and seasonal watercourses.

To date, a number of initiatives have been undertaken to meet the challenge of managing nonpoint sources by Canada and Ontario. Many of these programs apply across the entire Canadian portion of the basin and others are restricted to application within one lake basin.

GREAT LAKES - AGRICULTURE

The Ontario Ministry of Agriculture & Food, through its Ontario Farm Productivity Incentive Program, offers a cost share program with farmers to assist them with the capital costs of soil management and erosion control practices, manure storage facilities and alternate livestock watering facilities. Grants are also made available to local farm groups interested in establishing educational and demonstration programs leading to the improved environmental management of agriculture. As an integral part of the program, in-house staff training programs have been conducted to improve awareness concerning soil management problems and solutions.

Further refinement of the information base established during the PLUARG agricultural watershed studies is also being carried out. Canada is continuing to undertake studies to gain more accurate measures of phosphorus input to streams due to land runoff as a direct result of snow-melt and subsurface drainage.

GREAT LAKES - URBAN

Following the development of a draft policy on urban drainage under the Canada-Ontario Agreement, an interministerial committee has been established to review the implications of policy implementation and to develop implementation guidelines by autumn 1981. Specific research directed towards assessment of urban stormwater remedial measures is ongoing in the Grand River study.

LAKE ERIE BASIN

The predominant environmental concern is with the Lake Erie Basin. The Province of Ontario has undertaken a water management study of the Grand River Basin and expects to publish this in 1980. It will include measures for the control of erosion and phosphorus from various sources.

The Thames River Implementation Committee formed in 1976 to implement the recommendations of the 1975 Thames River Water Management Study has proceeded to promote a variety of activities which will contribute to improved phosphorus control in the Lake Erie Basin. These measures include: control of soil erosion and farm waste discharges and the environmental assessment of land drainage and construction practices. Current activities involve identification of hydrologically active areas and demonstration of improved land

use management practices to curb soil erosion and the adverse impacts of agricultural activities. A phosphorus budget has been adopted for the Avon River (a tributary of the Thames River) and a demonstration program for reducing pollutants from agricultural and urban runoff has begun.

LAKE HURON BASIN

In the Lake Huron Basin, erosion control studies are being conducted by the Saugeen River Conservation Authority and the Maitland Valley Conservation Authority. In addition, on the Maitland River, a demonstration project in an artificial marsh to lessen phosphorus loadings from a municipal/industrial waste treatment system is underway.

AIRBORNE POLLUTANT CONTROL PROGRAMS

The 1978 Water Quality Agreement Article VI-1 (1) requires the Parties to identify pollutant sources and relative source contributions, including the more accurate definition of wet and dry deposition rates, for those substances which may have significant adverse effects on environmental quality, including the indirect effects of impairment of tributary water quality through atmospheric deposition in drainage basins.

Airborne pollutant sampling programs are underway in both the United States and Canada. Sampling networks have been established in the Great Lakes Basin which include both wet/dry and bulk samplers to measure atmospheric deposition of contaminants related to the issues of eutrophication, toxic substances and acid rain. Sampling equipment, optimum siting techniques and data interpretation methods are still in the developmental stages and more evaluation is needed before full comparability of programs is established.

MEMORANDUM OF INTENT BETWEEN CANADA AND UNITED STATES

On August 5, 1980, United States Secretary of State Edmund Muskie and Canadian Ambassador Peter Towe signed a Memorandum of Intent to work toward a formal treaty to control transboundary air pollution and to take interim steps to reduce emissions that affect both countries. The Memorandum calls for the establishment of a "United States/Canada Coordinating Committee which will undertake preparatory discussions immediately and commence formal negotiations no later than June 1, 1981, of a cooperative agreement on transboundary air pollution".

The Annex to the Memorandum established five work groups to provide information to be used by the Coordinating Committee as a basis for their proposals for an agreement on transboundary air pollution. The work groups are to address the following aspects of transboundary air pollution:

1. Impact Assessment
2. Atmospheric Modelling
3. Strategies Development and Implementation
4. Emissions, Costs and Engineering Assessment Sub-group
5. Legal, Institutional Arrangements and Drafting.

Specifically, these groups will:

- "provide information on the current and projected impact of air pollutants on sensitive receptor areas . . ."

- "provide information based on cooperative atmospheric modelling activities leading to an understanding of the transport of air pollutants between source regions and sensitive areas . . ."

- "identify, assess and propose options for the "control" element of an Agreement."

The Memorandum also calls upon both Governments to take interim actions under existing authorities, including development of domestic air pollution control policies, enforcement of existing laws and increased advance notification of proposed actions involving risk and transboundary air pollution. The Governments also agreed to exchange research information on air transport and technology, maintain and develop a coordinated program for monitoring and evaluation of impacts and exchange of data on emissions of air pollutants.

TABLE 11

COMPLETION DATES IN THE 1978 GREAT LAKES WATER QUALITY AGREEMENT

ARTICLE OR ANNEX	PROGRESS TOWARD MEETING COMPLETION DATES SPECIFIED IN 1978 AGREEMENT
ARTICLE IV - SPECIFIC OBJECTIVES Section 1 (e) The Parties recognize that in certain areas of inshore waters natural phenomena exist which, despite the best efforts of the Parties, will prevent the achievement of some of the Specific Objectives. As early as possible, these areas should be identified explicitly by the appropriate jurisdictions and reported to the International Joint Commission.	There have been no areas in this category reported to the IJC.
ARTICLE VI - PROGRAMS AND OTHER MEASURES Section 1 (a) Pollution from Municipal Sources. Programs for the abatement, control and prevention of municipal discharges and urban drainage into the Great Lakes System. These programs shall be completed and in operation as soon as practicable, and in the case of municipal sewage treatment facilities no later than December 31, 1982.	Programs are underway in both U.S.
Section 1 (b) Pollution from Industrial Sources. Programs for the abatement, control and prevention of pollution from industrial sources entering the Great Lakes System. These programs shall be completed and in operation as soon as practicable and in any case no later than December 31, 1983.	and Canada to control municipal and industrial point sources.
Section 1 (c) Inventory of Pollution Abatement Requirements. Preparation of an inventory of pollution abatement requirements for all municipal and industrial facilities discharging into the Great Lakes System in order to gauge progress toward the earliest practicable completion and operation of the programs listed in sub-paragraphs (a) and (b) above. This inventory, prepared and revised annually, shall include compliance schedules and status of compliance with monitoring and effluent restrictions, and shall be made available to the International Joint Commission and to the public. In the initial preparation of this inventory, priority shall be given to the problem areas previously identified by the Water Quality Board.	The Parties have not prepared inventories for submission to the International Joint Commission.

Table 11 - cont'd.

ARTICLE OR ANNEX	PROGRESS TOWARD MEETING COMPLETION DATES SPECIFIED IN 1978 AGREEMENT
ARTICLE VII - POWERS, RESPONSIBILITIES AND FUNCTIONS OF THE INTERNATIONAL JOINT COMMISSION	
Section 3	
The Commission shall make a full report to the Parties and to the State and Provincial Governments no less frequently than biennially concerning progress toward the achievement of the General and Specific Objectives including, as appropriate, matters related to Annexes to this Agreement. This report shall include an assessment of the effectiveness of the programs and other measures undertaken pursuant to this Agreement, and advice and recommendations. In alternate years the Commission may at any time make special reports to the Parties, to the State and Provincial Governments and to the public concerning any problem of water quality in the Great Lakes System.	The Water Quality Board and the Science Advisory Board are preparing reports to the IJC which may be used as supporting and advisory information for both biennial and alternate year reports to the Governments.
ANNEX 2 - LIMITED USE ZONES	
Section 1	
The Parties, in consultation with the State and Provincial Governments, shall take measures to define and describe all existing and future limited use zones, and shall prepare an annual report on these measures.	
Section 2	The Parties have not submitted information on Limited Use Zones.
Limited use zones within the boundary waters of the Great Lakes System shall be designated for industrial discharges, and for municipal discharges in excess of 1 million gallons per day before January 1, 1980.	
ANNEX 3 - CONTROL OF PHOSPHORUS	
Section 3	
The Parties, in cooperation with the State and Provincial Governments, shall within eighteen months after the date of entry into force of this Agreement confirm the future phosphorus loads, and based on these establish load allocations and compliance schedules, taking into account the recommendations of the International Joint Commission arising from the Pollution from Land Use Activities Reference. Until such loading allocations and compliance schedules are established, the Parties agree to maintain the programs and other measures specified in Annex 2 of the Great Lakes Water Quality Agreement of 1972.	Consultations have been initiated between the Governments but have not yet been completed. The Phosphorus Management Strategies Task Force completed a report on phosphorus loadings and control in July 1980 which will be used as reference information in the allocation procedures. In September 1980, the Parties extended the timetable for their confirmation of loadings and schedules for the upper and lower lakes until May 1981.

Table 11 - cont'd.

ARTICLE OR ANNEX	PROGRESS TOWARD MEETING COMPLETION DATES SPECIFIED IN 1978 AGREEMENT
ANNEX 6 - REVIEW OF POLLUTION FROM SHIPPING SOURCES	
Section 2	
Consultation. Representatives of the Canadian Coast Guard and the United States Coast Guard, and other interested agencies, shall meet at least annually to consider this Annex. A report of this annual consultation shall be furnished to the International Joint Commission prior to its annual meeting on Great Lakes water quality.	The Canadian and U.S. Coast Guards and other interested agencies met in July 1979 and July 1980. Reports of each meeting were forwarded to the IJC.
ANNEX 7 - DREDGING	
Section 1 (a)	
Review the existing practices in both countries relating to dredging activities, as well as the previous work done by the International Working Group on Dredging, with the objective of developing, within one year of the date of entry into force of this Agreement, compatible guidelines and criteria for dredging activities in the boundary waters of the Great Lakes System.	The Dredging Subcommittee, established in December 1978, completed its report on criteria and guidelines in Nov. 1979 which was forwarded to the IJC by the Water Quality Board. The Subcommittee is currently preparing a register of major dredging projects in the Great Lakes.
ANNEX 8 - DISCHARGES FROM ONSHORE AND OFFSHORE FACILITIES	
Section 4 (a)	
Each Party shall submit a report to the International Joint Commission outlining its programs and measures, existing or proposed, for the implementation of this Annex within six months of the date of entry into force of this Agreement.	To date, there has been no specific report to IJC from the Parties on programs for implementation of this Annex. Currently, both U.S. and Canada are preparing reports on this Annex.
ANNEX 12 - PERSISTENT TOXIC SUBSTANCES	
Section 3	
Programs. The Parties, in cooperation with the State and Provincial Governments, shall develop and adopt the following programs and measures for the elimination of discharges of persistent toxic substances:	The programs under Annex 12 are under development.
Section 3 (a)	
Identification of raw materials, processes, products, by-products, waste sources and emissions involving persistent toxic substances, and quantitative data on the substances, together with recommendations on handling, use and disposition. Every effort shall be made to complete this inventory by January, 1982.	
Section 3 (c)	
Joint programs for disposal of hazardous materials to ensure that these materials such as pesticides, contaminated petroleum products, contaminated sludge and dredge spoils and industrial wastes are properly transported and disposed of. Every effort shall be made to implement these programs by 1980.	

VI Water Quality Board Activities

The Water Quality Board established supporting groups in May 1980 to more efficiently respond to the reporting and review requirements of the 1978 Great Lakes Water Quality Agreement (Figure 3).

TOXIC SUBSTANCES COMMITTEE

The Toxic Substances Committee is responsible for analysis of the programs to control persistent toxic substances and to recommend to the Board actions needed to comply with the Water Quality Agreement.

The Committee has assembled a list of toxic substance control laws, regulations and programs currently in operation in the Great Lakes Basin and has begun an evaluation of the effectiveness and compatibility of the component parts of the Canadian and United States programs. The goal of the Committee is to recommend an orderly effective approach to the control of toxic substances in the basin. An interim report was published in November 1980.

WATER QUALITY PROGRAMS COMMITTEE

The Water Quality Programs Committee was formed to review the progress of the Governments in developing and implementing programs to fulfill the purpose of the Water Quality Agreement and to prepare draft materials for the Water Quality Board reports. The Committee also directs and coordinates the activities of its subcommittees and work groups.

The Committee, under the direction of the Water Quality Board, prepared the 1980 Board report to the International Joint Commission and, through its work group structure, is currently assembling the basic information for development of the 1981 Water Quality Board report.

SURVEILLANCE WORK GROUP

The Surveillance Work Group is responsible for the review and maintenance of the Great Lakes International Surveillance Plan. It also reviews the results of the surveillance activities and reports on the water quality conditions as they relate to the Great Lakes Ecosystem.

The Work Group obtained the basic water quality data for this report to the IJC. Water Quality information is published in the Appendix to this report. The Work Group also completed the Great Lakes International Surveillance Plan in the fall of 1980.

DATA QUALITY WORK GROUP

The Data Quality Work Group reviews the effectiveness of evaluation and quality assurance programs relating to water quality information for the Great

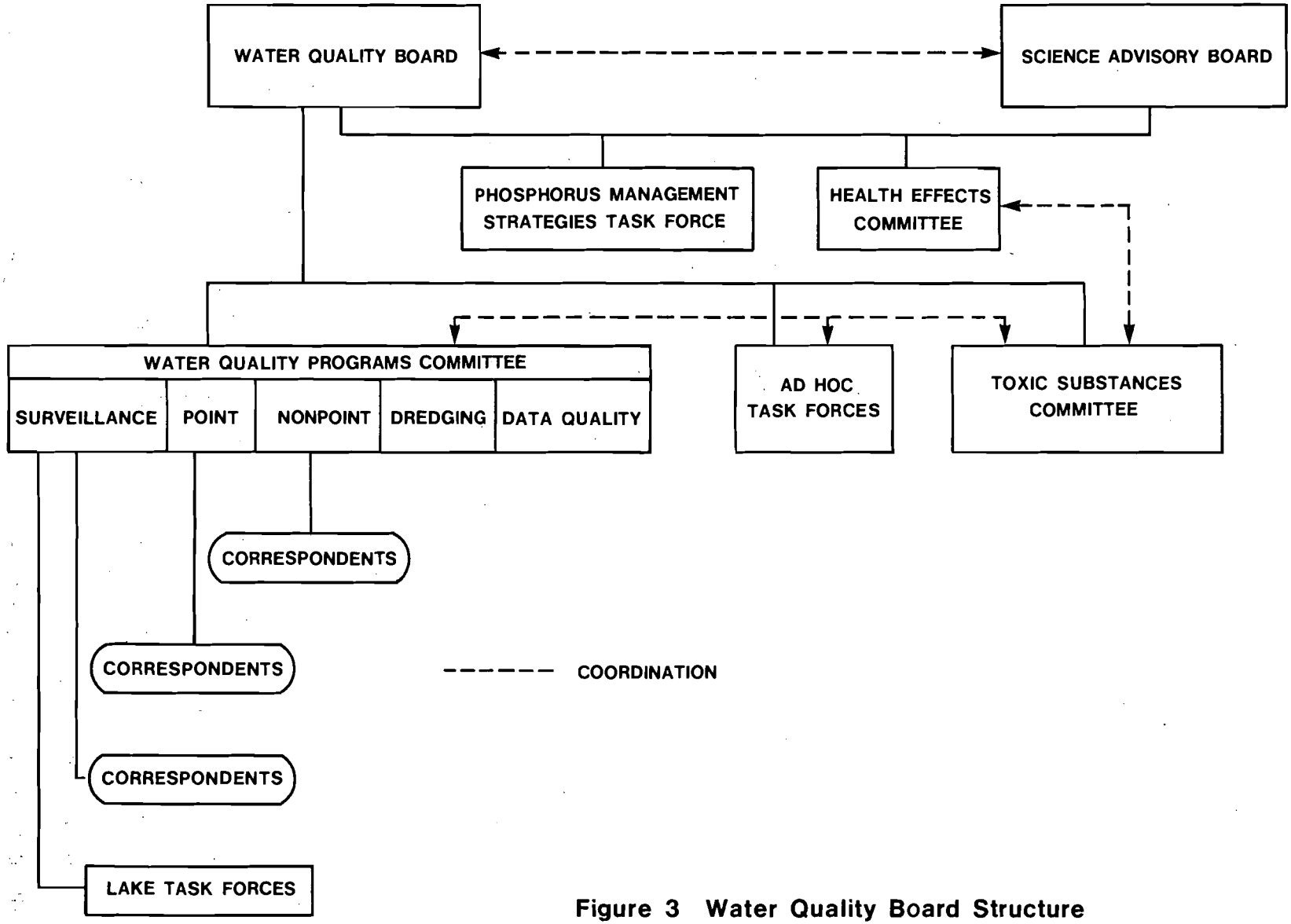

Figure 3 Water Quality Board Structure

Lakes. They compile records of field and laboratory methodology used by the surveillance agencies and recommend compatible methods for analysis and data management.

In 1980, the Work Group conducted a series of interlaboratory comparison tests to analyze the performance of laboratories providing Great Lakes water quality data. They also developed and distributed guidelines for intra-laboratory controls and procedures for reporting low level data.

DREDGING SUBCOMMITTEE

As required by Annex 7 of the 1978 Great Lakes Water Quality Agreement, the Dredging Subcommittee was formed in February 1979 and completed an interim report on compatible guidelines and criteria for dredging activities by December 1979. In its report, the Subcommittee reaffirms the site specific approach to the environmental review of dredging projects as previously recommended by the International Working Group on Dredging, and has produced guidelines and criteria to be considered in such a review. The conceptual approach taken in the guidelines does not differ markedly from that presently used on the Great Lakes and is similar to procedures followed in the ocean dumping legislation of the United States and Canada.

A register of dredging projects in the Great Lakes will be completed in the fall of 1980. The register information will be used for the assessment of the environmental effects and pollution loadings of both dredging and disposal operations and to identify specific criteria for the classification of polluted sediments of designated areas of intensive and continuous dredging activities. The register and interim report will be published in early 1981.

CHLORINE OBJECTIVE TASK FORCE

This second Chlorine Objective Task Force was established in 1978 to assess the social and economic implications of approaching or achieving the proposed ambient objective for total residual chlorine of 0.002 mg/L in surface waters. The Task Force did not undertake a traditional economic cost-benefit analysis but instead specified the kinds of data and information that jurisdictions should compile in order to make social and economic assessments of this nature.

An examination of the sources and relative importance of free and combined chlorine residuals revealed that sewage treatment plants constitute the major continuous source of combined chlorine residual. The amounts of chlorinated organic residues generated at sewage treatment plants are miniscule compared with the chlorinated residuals discharged by industry. The primary source of chlorinated organic compounds in municipal water supplies is the result of actual drinking water chlorination which combines with humic matter in the raw source of water. The Task Force concludes that the elimination of disinfection year-round is a viable option to be considered.

The Task Force's Final Report "Alternatives for Managing Chlorine Residuals: A Social and Economic Assessment" was published in April 1980.

JOINT WATER QUALITY BOARD/SCIENCE ADVISORY BOARD ACTIVITIES

PHOSPHORUS MANAGEMENT STRATEGIES TASK FORCE

The Task Force reviewed the phosphorus loading calculation techniques used for reporting loading information as well as the models used for establishing target loads. Phosphorus control management strategies were also discussed. A report on the findings of the Task Force, "Phosphorus Management for the Great Lakes", was published in July 1980.

The Water Quality Board and the Science Advisory Board will provide the IJC with their comments on the Task Force report at the November 1980 Commission meeting in Toronto.

COMMITTEE ON ASSESSMENT OF HUMAN HEALTH EFFECTS OF GREAT LAKES WATER QUALITY

The 1980 Annual Report of this Committee will contain a discussion of viruses in the water environment and a hazard ranking of compounds found in the Great Lakes water. The Committee reviewed the 1978 Water Quality Board Appendix E, which listed 381 toxic substances found in the Great Lakes waters, and identified 89 compounds which are known to have acute or chronic toxic effects on humans or animals. The Water Quality Board has instructed the Surveillance Work Group to include these substances in the surveillance plans. This report was published in November 1980.

A REVIEW OF THE IMPACT OF WATER QUALITY AGREEMENT OBJECTIVES ON WATER QUALITY STANDARDS

The Water Quality Board conducted a review of the use of Water Quality Agreement Objectives in the water quality standards used by jurisdictions in their regulatory programs (see Appendix).

In the Canada-Ontario Agreement on Great Lakes Water Quality, Canada and Ontario agreed to adopt the water quality objectives as the minimal basis for establishing water quality standards respecting the boundary waters. They also agreed that the objectives would be the basis for designing and assessing pollution abatement programs in the Great Lakes.

In accordance with the Water Quality Agreement, the United States Federal Government will ensure that the water quality objectives are considered in the State Water Quality Standards review process.

The Water Quality Board concluded that the Agreement Objectives have had a decided impact on the water quality standards and objectives adopted by both Canadian and United States jurisdictions. Some agencies have related their programs to the Agreement more than others. In some states, the last revision of standards preceded the 1978 Agreement and, therefore, do not reflect those Objectives. The revisions now under consideration will recognize the Agreement and Objectives to a greater extent.

NOTE: Reports listed above are available from the IJC Regional Office, Windsor, Ontario.

Membership List
Great Lakes Water Quality Board

CANADIAN SECTION

R. W. Slater (Canadian Chairman)
Regional Director General
Ontario Region
Environment Canada
Toronto, Ontario

D. P. Caplice
Regional Director
Central Region
Ontario Ministry of the Environment
Don Mills, Ontario

D. M. Foulds
Inland Waters Directorate
Ontario Region
Burlington, Ontario

R. W. Parsons (Appointed 1980)
Chief
Pollution Prevention Division
Ship Safety Branch
Canadian Coast Guard
Transport Canada
Ottawa, Ontario

J. R. Hickman
Director
Bureau of Chemical Hazards
Health & Welfare Canada
Ottawa, Ontario

W. A. Steggles
Environmental & Technical Advisor to the Deputy Minister
Ontario Ministry of the Environment
Toronto, Ontario

D. P. Dodge
Supervisor
Environmental Dynamics Section
Fisheries Branch
Ontario Ministry of Natural Resources
Toronto, Ontario

L. Naud (Appointed 1979)
Adviser to the Minister of Environment for Quebec
Environmental Protection Service
Quebec City, Quebec

CANADIAN SECTION - continued

E. T. Wagner (Appointed 1980)
Regional Director
Environmental Managemenr Service
Ontario Region
Burlington, Ontario

D. S. Caverly (Resigned 1979)
Environmental Assessment Board

L. Germain (Resigned 1979)
Transport Canada

UNITED STATES SECTION

J. C. McGuire (Appointed United States Chairman 1979)
Regional Administrator
United States EPA, Region V
Chicago, Illinois

A. S. Earl
Secretary
Wisconsin Department of Natural Resources
Madison, Wisconsin

L. E. Richie (Appointed 1980)
Deputy Executive Director
Minnesota Pollution Control Agency
Roseville, Minnesota

O. H. Hert
Technical Secretary
Indiana Stream Pollution Control Board
Indianapolis, Indiana

W. A. Lyon
Deputy Secretary for Planning
Pennsylvania Department of Environmental Resources
Harrisburg, Pennsylvania

M. P. Mauzy
Acting Director
Illinois Environmental Protection Agency
Springfield, Illinois

E. F. Seebald
Director
Division of Water
New York State Department of Environmental Conservation
Albany, New York

J. A. McAvoy
Director
Ohio Environmental Protection Agency
Columbus, Ohio

R. Courchaine (Appointment pending)
Chief
Water Quality Division
Michigan Department of Natural Resources
Lansing, Michigan

Glossary

With the intent of giving the general public a better understanding of its report, the Water Quality Board prepared this glossary of terms and abbreviations commonly used in the field of water quality control.

Adequate treatment - (For municipalities) United States: minimum of secondary treatment with maximum effluent concentrations of 30 mg/L each for BOD and for suspended solids and 1.0 mg/L for total phosphorus; Canada: minimum of secondary treatment or equivalent with maximum concentrations of 20 mg/L each for BOD and suspended solids.

Ames test - a measure of mutagenicity.

BAT - Best Available Treatment

Bioaccumulation - concentration of substances in living organisms.

Bioassay - use of living organism to determine the biological effect(s) of a substance, condition or factor.

Biomagnify - increase in concentration in the food chain.

Biomass - the amount of living matter present in a habitat in a specific amount of water.

BOD - Biochemical Oxygen Demand; amount of oxygen used by micro-organism present in a water or sewage sample in 5 days. It is a measure of the effect of decomposition of organic matter on the oxygen content of the water.

BPT - Best Practicable Treatment

Carcinogen - capacity to stimulate cancer symptoms.

Chlorophyll a - a pigment whose concentration is used as an indicator of trophic status.

Chromosome aberation test - determination of change in (translocation, polyploidy, etc.) in chromosonal structures or numbers.

Cladophora - a nuisance algal species which is found in nutrient-rich areas of the Great Lakes.

Coliform - bacteria from the colon of a warm blooded animal.

Consent Decree - a judgement by a court which puts into effect a legally enforceable remedy.

Contaminant - a substance foreign to natural system and/or present at unnatural concentrations.

Control order/requirement and direction order - enforceable orders in Ontario.

Criteria - numerical limits of pollutants established to protect specific water uses.

/d - per day

Deleterious substance - substance which can be harmful.

DNA - Deoxyribonucleic acid; genetic material.

D.O. - dissolved oxygen. Oxygen dissolved in water, necessary to support aquatic life.

Ecosystem - interactive system of a biological communities and their environment.

Effluent - water discharged from a pipe or treatment plant.

Entrainment of fish - when fish are pulled into and through pumps and pipes such as are used in processes requiring cooling waters.

EPA - United States Environmental Protection Agency

Eutrophic - abundant in nutrients; waters highly productive in plants and organisms.

GLISP - Great Lakes International Surveillance Plan

GLNPO - Great Lakes National Program Office

Guidelines - suggested criteria for programs or effluent limitations.

IJC - International Joint Commission. Established by the Boundary Waters Treaty of 1909 with 3 United States and 3 Canadian members.

Impingement of fish - when fish are forced against a structure.

in situ - in place

isomer - compound of similar molecular weight and composition but differing in tertiary structure.

L - litre

Leachate - water that perculates or drains through a material.

Loadings - total weight of pollutant to a water body over a specified time, e.g. tonnes per year of phosphorus.

m^3/d - cubic meters per day

MGD - millions of gallons per day

mg/L - milligrams per liter

Mixing zones - a designated area in which Agreement water quality objectives need not be met; area where discharges mix with receiving waters.

MOE - Ontario Ministry of the Environment

Mutagenicity - capacity to alter genetic code.

NPDES - National Pollutant Discharge Elimination System; a permit system limiting municipal and industrial discharges, administered by EPA and the states.

Nutrient - materials that are necessary for growth, principally phosphorus and nitrogen.

Partition coefficient - measure of affinity of compounds between octanol and water.

Persistent compound - substance which remains in the environment.

pH - a measure of the acidity or alkalinity of water on a scale from 0 to 14; 7 is neutral; low numbers indicate acidic conditions, high numbers alkaline.

Phosphate - salt of one of several phosphoric acids used as building block for detergents, a constituent of fertilizer.

Primary treatment - mechanical removal of floating or settleable solids from wastewater.

Problem area - location of degraded water quality where measurements show that Great Lakes Agreement water quality objectives or domestic criteria are exceeded.

Residue - compounds fractionated into discrete groups based on size, structure, molecular weight, etc.

SAB - Great Lakes Science Advisory Board

Secondary treatment - primary treatment plus bacterial action to remove organic parts of the waste.

Sludge - solids removed from sewage.

STP - Sewage Treatment Plant

t - tonne (metric ton) = 1,000 kilograms = 2,205 pounds

Teratogen - capacity to cause birth defects.

Toxic Substances - those compounds which, in sufficient amount on or in an organism can cause death, disease, mutation, deformity or malfunction in that organism or its offspring. These include organochlorines such as DDT, DDE, mirex, PCB, HCB, trichlorotoluene, dieldrin, endrin, heptachlor epoxide, chlordane, lindane and methoxychlor. Other organic substances such as toluene, dioxin, phthalate esters, furans and styrenes are also toxic substances. Toxic metals include arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium and zinc. This list is by no means complete but includes those substances of concern in this report.

µg/g - micrograms per gram

Water quality objectives - under the Great Lakes Water Quality Agreement, goals set by the Governments of United States and Canada for protection of the uses of the Great Lakes.

Water quality standard - a criterion or objective for a specific water use that is incorporated into enforceable regulations.

WQB - Great Lakes Water Quality Board

International Joint Commission
Great Lakes Regional Office
100 Ouellette Avenue
Eighth Floor
Windsor, Ontario
N9A 6T3