

Third Annual Report 1974

GREAT LAKES WATER QUALITY

International Joint Commission • United States and Canada

COVER

Image in a wastewater treatment facility.
The construction of such plants will greatly
contribute to cleaning up the Great Lakes.
PHOTO BY TOM SENNETT.

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Third Annual Report 1974

GREAT LAKES WATER QUALITY



International Joint Commission

Ottawa • Washington D.C. • December 1975



International Joint Commission
United States and Canada



December 17, 1975

To the

Government of Canada
Government of the United States
Government of the State of Illinois
Government of the State of Indiana
Government of the State of Michigan
Government of the State of Minnesota
Government of the State of New York
Government of the State of Ohio
Government of the State of Pennsylvania
Government of the State of Wisconsin
Government of the Province of Ontario

The International Joint Commission, in accordance with the 1972 Great Lakes Water Quality Agreement between Canada and the United States, is submitting its third annual report concerning progress during 1974 toward the achievement of the objectives of the Agreement.

Maxwell Cohen
Canadian Chairman

Bernard Beaupré

Keith A. Henry

Henry P. Smith III
United States Chairman

Charles R. Ross

Victor L. Smith

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INTRODUCTION

It is now more than three years since the Governments of Canada and the United States signed the 1972 Great Lakes Water Quality Agreement and thereby agreed to develop and implement programs and other measures deemed necessary to restore and enhance the water quality in the Great Lakes System. The International Joint Commission was directed to assist the Governments in implementing the Agreement and was assigned certain powers, responsibilities, and functions.

This, then, is the third annual report by the Commission concerning the progress toward meeting the goals of the Agreement. It covers the calendar year 1974, takes account of developments of the early months of 1975, and draws upon a much more substantial and sophisticated technical base than the previous two reports. The committee system of the Great Lakes Water Quality Board and Research Advisory Board—the Commission's principal advisers—has matured. In the process, the members have developed a clearer sense of direction with respect to the specific programs necessary and a greater sensitivity to the totality of efforts being made to clean up the Great Lakes.

The Commission is also assisted by the Upper Lakes Reference Group and the Pollution from Land Use Activities Reference Group charged with making specific long-range studies now underway. The Commission is very pleased to note the scope and variety of the scientific disciplines that have been brought to bear in the investigations being carried out by these two groups, and therefore the Commission anticipates the development of extremely useful data and advice as a cornerstone for later action.

It is not too much to say that the information, now being received by the Commission from the two Boards and the two groups, represents an almost quantum leap in the magnitude of the field study results presented for Commission evaluation. The basis, therefore, of the Commission's present report is broader, and more detailed, because of the character of the data on which its findings and recommendations to Government now rests.

Certain perspectives with respect to the implementation of the Agreement are now becoming clear. The Commission believes that the parties, in negotiating and signing the Agreement in 1972, could not have foreseen the magnitude of the problems of clean-up and the length of time that clean-up would take to achieve the water quality objectives established by the

Agreement. The Commission now speaks of a decade or more before the goals of the Agreement can be fully realized. Moreover, the Commission, not only understands more clearly the length of time it will take to achieve these goals, but it is more than ever aware that maintaining water quality, once the goals have been reached, will require a long-term effort, continuously monitoring and controlling the processes that tend to degrade water quality. Therefore, it should be recognized that clean-up is only the first phase of a long-term effort in which maintenance and enhancement of water quality become the permanent obligations of both countries for the future.

Finally, the Commission developed a further perspective on the Lakes themselves in which a dual concept about diagnosis, treatment and protection begins to emerge. There is not a single standard, but differentiated standards related to a common minimum. Each lake must be seen both in terms of its own characteristics as well as in terms of the whole basin system. And while a minimum water quality objective will be applicable to all, the lakes will differ in their potential for enhancement and in the degree of effort required both for maintenance of minimum goals and for the enhancement of water quality wherever such higher standards are possible.

It is these perspectives that mark this Third Annual Report of the Commission and which represent a turning point in the evolution of the Commission's thinking about the Agreement, and its implementation, for the near and long future.

The International Joint Commission recognizes the large number of individuals and Government agencies whose combined efforts have provided the foundation for this report. Their service is acknowledged with deep appreciation. The Commission has necessarily turned to the reports of the Great Lakes Water Quality Board, the Research Advisory Board, and the two Reference Groups for the essential information used in developing its own report. Indeed, large parts of this report reflect the language of the Great Lakes Water Quality Board's report. The Commission commends the Board's report to those who wish to obtain more detailed information on the Lakes and their connecting channels.

The Commission extends its appreciation to Mr. Herman Gordon for his assistance in preparation of this report.

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SUMMARY AND CONCLUSIONS

General

From various reports received by the Commission, the members conclude that 1974 has brought a heightened and highly accelerated bi-national effort to restore and enhance the water quality in the Great Lakes system. It is clear that the efforts of the States, the Province of Ontario, and the Federal Governments have increased each year since the Agreement was signed. While present indications are that 1975 will be characterized by the most extensive efforts to date, there may be cause for concern that the momentum will not be maintained in the future, because of the energy crisis, inflationary pressures and other factors.

The Commission detects that the public perception of the timetable for the clean-up effort is distorted. The Great Lakes Water Quality Agreement of 1972 states that "programs [to achieve] water quality objectives...shall be either completed or in process of implementation by December 31, 1975." This provision of the Agreement has led many residents of the area to believe that between 1972 and 1975 the Lakes were to be cleaned up. This is not so.

Control action on some pollutants can result in the elimination of their effects in the Lakes almost immediately. On the other hand, it should be kept in mind that, if the discharge of other pollutants to the lakes were stopped tomorrow, it could be 15 or more years before some effects of the present pollution would disappear.

Even after the international water quality objectives of the Great Lakes are achieved, it will take constant vigilance above and beyond ongoing surveillance and control programs to maintain the healthfulness and utility of the water. Part of the reason lies in the fact that rapidly changing industrial technology results in the generation of hundreds of new chemicals each year. The effects of some of these exotic substances will be unknown, but statistically it can be inferred that some will be harmful to the chemistry of water, fish, fowl or humans.

The persistence of polychlorinated biphenols (PCBs) in fish in the Great Lakes is of serious concern because of the human health implications and the possible adverse effects on fish reproduction. Early and continuing discussions on a binational level are needed to consider the consequences of strict controls on the importation, sales, use and disposal of PCBs.

One significant compliance date, December 31, 1975, is in the Agreement. As of this writing, the Commission believes that many of the programs necessary to achieve pre-scribed water quality are "completed or in the process of implementation." Nevertheless, whatever the degree of compliance, all necessary programs or measures will not be in operation by the specified date.

Water Quality Assessment

- The water quality of the open waters of Lakes Superior, Michigan and Huron is generally good. Problem areas exist along the shorelines, generally related to "point source" discharges or tributary inflows.
- Lake Erie shows apparent improvement in chlorides concentrations and shows some improvement in phosphorous concentrations in the western basin. However, the oxygen

Small muddy river empties into a lake.
Areas of depressed water quality are often found at mouths of tributaries like these.



depletion in the hypolimnion (lower strata) of the central basin has not improved and remains a serious concern. Bacterial quality at Lake Erie beaches in Ohio and Pennsylvania continues to improve.

- Lake Ontario for the first time, in 1974, shows early signs of oxygen deficiency in the deeper waters of the open lake. Local problems exist near tributary mouths and population centers along the shoreline.
- Levels of polychlorinated biphenyls (PCBs) in Lake Michigan fish show no evidence of a downward trend and are well in excess of the U.S. Food and Drug Administration (FDA) tolerance level. With the advent of more reliable data, it was evident that DDT levels in fish continued to decline. This decline was apparently due to early control measures adopted by the State of Michigan.
- Along the shorelines of the lakes and connecting channels near population centers and mouths of tributaries, there are areas of depressed water quality. Sixty-nine such geographic locations in Canada and the United States have been identified as "problem areas." (See Table 2).
- Water quality surveillance programs are currently being conducted by governments at a level that does not provide adequate information. Surveillance plans recommended by the IJC's Water Quality Board and described in its 1974 Annual Report will require increased commitments of funds and personnel.

Also:

- Lake Michigan fish continue to show dieldrin residues near the U.S. Food and Drug Administration (FDA) level of 0.3 microgram per gram ($\mu\text{g/g}$).
- St. Marys River still exhibits the adverse effects of industrial discharges from Ontario.
- Lake St. Clair fish show a continued decrease in mercury levels.
- Detroit River still has numerous discharges of both municipal and industrial wastes causing serious problems.
- Lake Erie fish from certain localized waters, on occasion, show high levels of mercury.
- Niagara River water quality remains degraded by municipal and industrial waste discharges from New York.
- Lake Ontario fish from certain localized waters, also on occasion, show high levels of mercury.
- St. Lawrence phosphorous levels remain essentially unchanged from previous years. The area also has a high potential for oil spill damage from shipping activities on the river.

Municipal Pollution Abatement

- During 1974, progress continued to be made in the construction of needed municipal treatment works. In the U.S. all funds appropriated for municipal treatment plant construction have now been released for allocation to projects. Past delays in obligating available funds have been recognized and the U.S. Environmental Protection Agency has placed high priority in accelerating the obligation of the remaining money.
- The release of impounded funds, originally authorized by the United States Congress in 1972 for the construction of municipal treatment plants, will accelerate work which might have been delayed, had the money not been made available.

- Difficulties encountered in the United States in implementing the complex requirements of the Federal Water Pollution Control Act Amendments (PL 92-500) have led to many project delays. Administrative actions taken by the Environmental Protection Agency during 1975 have significantly reduced these difficulties.
- In Canada, despite some minor delays on individual projects, most of the sewered population in the Ontario portion of the Basin was receiving adequate sewage treatment by the end of 1974.
- There is a need to continue vigorous support, including financial, for the updating and improvement of sewage treatment works to accommodate growth and correct the problems arising from combined storm and sanitary sewers.

Eutrophication and Phosphorous Control

- Programs for the reduction of phosphorous inputs to control eutrophication of the Great Lakes are progressing both in Canada and the United States. Loadings from municipal sources have been substantially reduced through implementation of programs to remove phosphorous from sewage treatment plant effluents. Additionally, three States, several U.S. municipalities, and Canada have legislation limiting the content of phosphorous in detergents.
- Inadequate data bases for both direct discharges and tributaries make accurate assessment of changes in total phosphorous loadings to the Lakes difficult, and limit the use-fulness of predictive models being developed to help determine the effect of phosphorous control programs on future levels of algal biomass. Adherence to proposed and developing IJC-surveillance programs, which include tributaries, should enable appropriate and adequate data bases to be developed.

Industrial Pollution Abatement

- Although continuing concern for the abatement of industrial source pollution is evidenced by substantial efforts on the part of Federal, Provincial and State agencies to implement their respective industrial waste control programs, the major effort for the control of industrial pollution is still to be achieved.
- In the United States, National Pollutant Discharge Elimination System (NPDES) Permits have been issued to most of the major industrial dischargers. These permits contain two important elements: effluent limitation and a schedule for attaining compliance with those limitations. The emphasis of the program is now shifting from the issuance of permits to compliance monitoring and enforcement.
- In Ontario, industrial pollution control is generally on an individually negotiated basis and the Commission believes it does not have adequate information to be able to assess progress in this area. Ontario is, however, developing better information to overcome this deficiency.
- It will be sometime before the Commission can evaluate the relative effectiveness of the different approaches to industrial pollution control in the two countries. To accomplish this the Commission believes there must be some comparability in the respective U.S. and Canadian programs. The Commission observes, however, that there is on file in the Great Lakes Regional Office in Windsor, Ontario, increasing amounts of information about industrial waste discharges by individual firms on both sides of the boundary. This information is available to the public on request.

Research

- Widespread occurrence and production of the filamentous algae *Cladophora* in nuisance quantities is an important manifestation of eutrophication in the Great Lakes. While much information is available on *Cladophora*, the significance of its role and place in ecosystem function and structure is not well-defined. Intensive studies continue.
- The reported background level of asbestiform fibre concentration in the Great Lakes varies from one million to ten million fibres per litre. Sources are natural erosion, mining and processing operations, and man's use of the manufactured products. The technology for measurement of these fibres in water is not fully developed. While the hazard of inhaling asbestos fibres is well known, their health effects when ingested are not yet well understood. Government-sponsored studies of the effects of their ingestion by humans are now underway.
- Transboundary pathways and scales of pollutant dispersal and diffusion in the Great Lakes are at present poorly known and more study is necessary.
- Early warning techniques to evaluate new toxic chemicals in the environment are under consideration. Coordinated efforts are required to standardize such techniques.
- The Research Advisory Board has published three reports:
 - Asbestos in the Great Lakes Basin
 - Directory of Great Lakes Research Projects
 - Proceedings on the Symposium on Structure-Activity Correlations in Studies of Toxicity and Bioconcentration with Aquatic Organisms

Other Activities Under the Agreement

- The purpose of the Water Quality Agreement is to restore and enhance water quality in the Great Lakes. The Agreement, therefore, calls for cleaning up existing pollution and for preventing further degradation due to population growth, resource development and increasing use of water. The latter provision indicates the need for effective water-quality related land use planning to meet the needs of future growth and development in a manner consistent with the achievement and retention of the water quality objectives. A significant number of programs and other measures are being implemented in both Canada and the United States to minimize water pollution resulting from various land use activities such as land development, transportation, mining, agriculture, recreation, forestry, the surface and subsurface disposal of wastes and shoreline landfilling.
- Compatible regulations for the control of vessel wastes, pursuant to Annex 4 of the International Agreement, have not yet been adopted by the Governments.
- The dumping of polluted dredged spoil in the open waters of Lakes Erie and Ontario is continuing, but efforts are being made to bring such dumping under tighter controls. A final report prepared by the International Working Group on the Abatement and Control of Pollution from Dredging Activities was filed with the Federal Governments during 1975 pursuant to Annex 6 of the Agreement.
- Reports on studies to prevent or control pollution from shipping activities (as provided in Annex 3 and 5 of the Agreement) have not been furnished to the Commission.
- The revised Joint Contingency Plan (described in Annex 8 of the Agreement) between Canada and

the United States for the control and clean-up of spills of oil and hazardous materials became effective April 1, 1974.

Effectiveness of the Agreement

- The true test of the effectiveness of the programs and other measures contained in the Agreement will be in meeting the water quality objectives in areas now degraded, and in protecting water quality in areas where quality now is better than the objectives. Due to the very long response times of the main-lake waters, recovery of water quality in the local or nearshore "problem areas" will provide a more timely measure of program effectiveness. Therefore, the Commission will place increasing emphasis on the 69 "problem areas" in assessing the effectiveness of the Agreement and the various programs contemplated. (See Table 2).
- In the absence of compliance schedules in the Agreement for the completion of the various programs and joint institutional activities to achieve the water quality objectives, there is need for the Governments to re-evaluate their approach to assuring the results arrived at by the Agreement. Without specific target dates, neither the Commission nor the Governments have the discipline of a timetable.
- The Commission in accordance with Article 6 of the Agreement, noting that the present water quality objectives are in some respects skeletal, plans to recommend in 1976 new or revised specific water quality objectives for a variety of substances. This is designed to increase the effectiveness of the Agreement.

What They Said on Signing the Agreement

The President of the United States:

"When the first European explorers sailed the Great Lakes three centuries ago, they were deeply moved by the Lakes' striking beauty and boundless promise, and from that time to this, generation after generation of Canadians and Americans have looked upon the Great Lakes as great highways to the future for both of our countries.

"But in recent years, as we know, the quality of the Great Lakes' waters has been declining, with ominous implications for 30 million Americans and 7 million Canadians who live near their shores.

"The signing today of the Great Lakes Water Quality Agreement represents a significant step toward reversing that decline."

The Prime Minister of Canada:

"...it marks our recognition of the fragility of our planet and the delicacy of the biosphere on which all life is dependent. This Agreement deals with the most vital of all issues —the process of life itself. And in doing so it contributes to the well-being of millions of North Americans for it promises to restore to a whole-some condition an immense area which, through greed and indifference, has been permitted to deteriorate disgracefully."

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RECOMMENDATIONS

As a result of the studies performed during the past year which have generated new and refined information as covered in this report, the International Joint Commission recommends that:

1. The Federal, State and Provincial Governments develop coordinated programs to control the use of persistent organic contaminants, particularly polychlorinated biphenyls (PCBs) now affecting fish and institute the programs at the earliest possible date.
2. Changes in water quality in the areas identified in this report as "problem areas" be used as a principal basis for assessing the effectiveness of remedial programs. Further, adequate monitoring of these areas should be carried out to establish the extent to which all water quality objectives are being met as well as any trends toward or away from meeting such objectives.
3. The Federal Governments establish agreed compliance dates for major programs and other measures required by the Agreement, so that the Commission will have a proper yardstick by which to measure the progress made.
4. The Federal, State and Provincial Governments provide sufficient funding to:
 - (a) assure the completion of municipal sewage treatment plants by the target dates set forth in Table 1.
 - (b) support an IJC-coordinated Great Lakes System Water Quality Surveillance Program (as identified in Appendix B to the Water Quality Board's 1974 Annual Report).
 - (c) support expanding participation by the various government agencies in the activities of the Great Lakes Water Quality Board so as to ensure the availability of information required in the continuing assessment of water quality and the progress of all Governments in complying with the Agreement.
5. In keeping with the previous recommendations of the Commission, the Governments adopt without further delay compatible regulations for the control of vessel wastes in accordance with Annex 4 of the Agreement.

To hasten the realization of the goals of the Great Lakes Water Quality Agreement, the Commission also recommends that:
6. Efforts continue to be made to identify the extent of, and develop programs for the control of, pollution from combined sewer overflows.
7. The Governments identify what programs and other measures are being implemented with respect to improving the design, construction, and operation of vessels to prevent the discharge of oil and hazardous substances, and expedite the completion of studies being undertaken by the U.S. Coast Guard and Canadian Ministry of Transport to prevent pollution from shipping sources.
8. All Governments (Federal, State, Provincial and local) consider the achievement of the water quality objectives as constraints in developing water management and water-related land use plans.
9. The Federal Governments formalize current informal practices by setting up a joint task force for the

purpose of coordinating the investigation of sampling and analytical problems, as well as health effects, from asbestiform fibres; also the extension of existing monitoring programs be limited until sampling and analytical techniques are more reliable and can be integrated.

10. The Governments investigate the role of *Cladophora* and its effect on fish populations and fish productivity. Additional investigative efforts should be directed to clarify the socio-economic impact of the present problem and alternative remedial programs. For example, further experimental work is needed to identify potential users for harvested *Cladophora*.
11. The Governments endorse and financially support the development of data bases for "structure activity" correlations, because of the immediate foreseeable application of this tool in predicting environ-mental hazards of organic chemicals. ("Structure-activity" correlations represent early warning mechanisms for screening new chemical substances for hazards.) (See Chapter 7).

Governments Respond to Last Annual Report

For the first time since the signing of the Great Lakes Water Quality Agreement, the Governments during 1975 formally responded to the Commission's recommendations contained in its annual reports. These responses represent a significant step forward in providing the Commission with the latest information on the Governments' efforts to achieve the objectives of the Agreement. The Commission is hopeful that Government responses to its annual reports will become a standard procedure.

The Commission notes the extensive programs which have been initiated in both countries over the last several years in response to specific recommendations by the Commission, or which, while initiated within each country's national framework, have significant relevance to the provisions of the 1972 Agreement.

Both Governments have recognized the need for a substantial increase in the commitment of resources for monitoring and surveillance and have agreed to seek the required funding. The United States construction grant funds impounded by the U.S. Executive Branch have now been released and the Environmental Protection Agency has taken steps to expedite their allocation. Substantial re-search and demonstration programs are now underway in both countries on viruses, fish contamination, and pollution from a wide range of land use activities.

There are, however, several areas in which the Commission's recommendations have not been acted upon. Although we are now, two years beyond the prescribed date set in the Agreement, the countries have not yet achieved "compatibility" of vessel waste treatment regulations. There appears to be some compatibility in the offing with respect to the Federal approaches by the two Governments, but the Commission is aware that the Provincial and State governments' policies of "no discharge" are not in agreement with those proposed Federal policies on this matter.

In another area, although some states and local jurisdictions have limited the level of phosphorous in detergents, the U.S. Government has clearly indicated it has no plans to seek national legislation which would impose such limits. Avail-able data from Canada indicate its laws have achieved substantial reductions in phosphorous loadings to Canadian receiving waters since enacting such legislation. The Commission is not satisfied that the U.S. position in this matter has been adequately explained, and the Commission regrets the present status of U.S. policy in this area.

The Second Annual Report of the Commission suggested that the two Governments should consult at an early date to assure that adequate programs are in place to reduce to a minimum the potential for the introduction of epidemiological diseases from the discharge of vessel wastes from ships originating from foreign ports. Both governments disagree with the Commission's view as to the potentiality of such an incidence, and have not, apparently, sought meetings between appropriate agencies to discuss the matter as recommended by the Commission. Until the Governments provide the necessary information about the procedures now employed to protect against such risks, the Commission cannot assess the seriousness of potential incidents.

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WATER QUALITY ASSESSMENT

A general assessment of the water quality of each of the Great Lakes and connecting channels is presently based on information obtained from all available sources and assembled to indicate the water quality in specific areas and related to specific parameters.

Lake Superior

The quality of the open waters of Lake Superior exceeds that prescribed in the water quality objectives stated in the Agreement. However, some degraded water quality conditions do exist in nearshore areas as a result of point source discharges, tributary inflows and erosion. The major problem areas are Duluth-Superior Harbor, Silver Bay, Thunder Bay and some locations along the southern shore of the lake.

Lake Michigan

Lake Michigan open waters are of generally high quality displaying only a few instances of degraded water quality that fails to meet the objectives in the Agreement. However, residues of polychlorinated biphenyls (PCBs) in Lake Michigan fish show no evidence of a downward trend and are well in excess of the U.S. Food and Drug Administration standard for human consumption. Three problem areas which have been identified as having significant water quality problems are Green Bay, Milwaukee Harbor and the Indiana Harbor Ship Canal.

St. Marys River

Phenol concentrations near the Canadian shore have increased in 1973 and 1974 in response to lower flows prevailing in the river: cyanide levels exceed the permissible level for drinking water supply; total coliforms for nearly a mile below the sewage treatment plant in Sault Ste. Marie, Ontario exceed objectives; mats of oil and wood chip fibers were present downstream from the locks as far as Lake George. There is transboundary movement of these contaminants. For most other areas, the water quality of the St. Marys River is considered to be of the same excellent quality as Lake Superior.

Lake Huron

The waters in the main body of Lake Huron and Georgian Bay are of good quality and meet the objectives. On the United States side, Saginaw Bay, one of the problem areas, exhibits high concentration of nutrients, coliforms and total dissolved solids originating from the Saginaw River system. The nature of the flora and fauna found in the Bay also indicates poor water quality.

On the Canadian side, Penetang Bay and, to a lesser degree, Midland Bay, are sensitive to nutrient inputs and support luxuriant growths close to the municipal outfalls. In addition, there are fish-tainting problems near the mouth of the Spanish River.

Lake Erie

(including St. Clair River, Lake St. Clair and Detroit River)

Detroit River. Numerous discharges of both municipal and industrial wastes cause water quality problems with coliforms, phenols and total dissolved solids in the Detroit River. These sources also contribute a large fraction of the total phosphorus load to Lake Erie. However, there is improvement in water quality conditions with general enhancement of aesthetic features.

Cleveland Area. Water quality in the Cleveland Harbor was found to be of poor quality with respect to Biochemical Oxygen Demand (BOD), phosphorous, nitrogen, total dissolved solids, and coliforms due to inadequately treated industrial and municipal wastes.

Toledo Area. The waters of Maumee Bay are of poor quality with respect to BOD, nutrients, coliforms, and total dissolved solids, due to industrial and municipal waste disposal activities as well as agricultural run-off.

Grand River (Ohio) Area. The major problems in this area are the high values of chlorides and total dissolved solids from industrial and municipal sources.

Fredonia, Westfield Area. Along the New York State portion of Lake Erie, there are two major problem areas. At Canadaway Creek near Fredonia, municipal and cannery wastes contribute to excessive nutrient loadings. In the Westfield area, Chautauqua Creek carries municipal and cannery wastes to Lake Erie. Lake Erie has been the object of concern for both the general public and scientific investigators for the past decade, resulting in a great deal of water quality information from a large number of agencies. For this reason, some major

characteristics of the Lake are assessed next, in addition to local geographic assessments.

Biology. There have been several changes in the biology of Lake Erie since 1967 which represent trends in water quality. In the open lake, plant and animal productivity coupled with external loading of organic matter remains high enough to cause serious oxygen depletion in the bottom waters of the western and central parts of the lake, and to cause decreasing levels of oxygen in the deeper eastern basin as well.

On the other hand, phytoplankton estimates from selected water intakes along the Ohio and Ontario shorelines generally show lower values than mid-lake, and a decreasing trend since 1967. It seems likely that at least some of this lesser impact may be related in some way to the high water levels of the past few years, as has been the case for one of the most common algae, *Cladophora*.

Bacteriology. Frequent violations of the IJC objectives for total and fecal coliforms occur in the St. Clair and Detroit Rivers probably resulting from stormwater overflows from municipal systems. Occasional violations are noted in the open waters of the western basin of Lake Erie, and a few are reported in the open waters of the central and eastern basins of the lake.

In the central and eastern basins violations occur near specific sources. Beach sampling data from Ohio and Pennsylvania suggest a trend of improvement which is directly attributed to pollution abatement in the vicinity of the beaches.

pH. The pH range, 6.7 to 8.5, specified in IJC objectives, is exceeded frequently. On the high end of the scale it is usually associated with high algal growth situations, and where levels are lower than 6.7, industrial sources are implicated.

Toxic Materials. At present the availability of information for toxic materials is rather limited. While no adverse reports on the quality of the water per se have been noted, measurements of sediments and biota indicate areas possible concern.

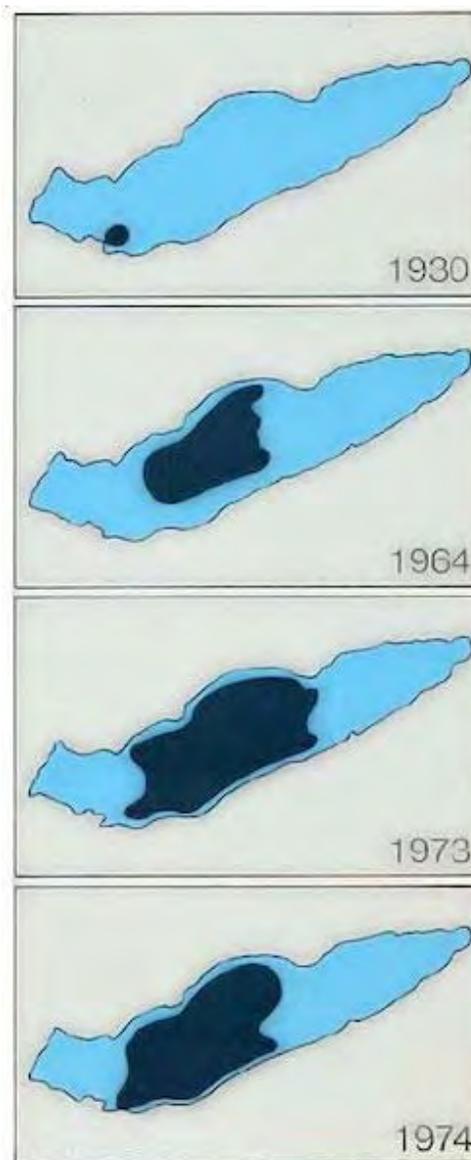
Reports on harbor dredging activities and information from sediment sampling surveys in western basin of Lake Erie indicate elevated levels of several heavy metals. These levels have not been associated with any deterioration of water quality.

Volatile organics and radioactivity levels do not appear to be any cause for concern at the moment. Pesticides generally are undetectable in the open waters of Lake Erie, but studies regarding reproduction failures

characterized by poor hatch-ability of herring gull eggs indicate contamination does exist.

Dissolved Oxygen Depletion. One of the major concerns in Lake Erie is the depletion of dissolved oxygen in the hypolimnion (lower strata) of the lake during the summer. The extent and rate of this oxygen depletion have been the subject of an extensive study in an effort to develop historical trends. The extent of oxygen depletion in the hypolimnion in the central basin (Figure 1) in the past two years has reached close to the maximum possible.

Figure 1. **EXTENT OF OXYGEN DEPLETION IN LAKE ERIE DURING SUMMERS**



The black areas represent oxygen-depleted zones in the deep-water lower levels that will not support oxygen-dependent life.

Niagara River

Water quality of the main stream of the river is basically similar to Lake Erie water; however, noticeable changes in water quality do take place along the river bank on the upper river particularly on the United States side. Bacterial contamination may be found in an area starting at the confluence of the Buffalo River and extending downstream to approximately the tip of Grand Island.

Lake Ontario

The open waters of Lake Ontario are showing some of the signs of degradation that are evident in Lake Erie. Though degradation is not as severe as in Erie, the danger signals will bear close observation in the future. Surveys in 1974 indicated a larger number of locations with low dissolved oxygen levels than in 1970. The dissolved oxygen content at many of these locations was below the 80 percent saturation level and in two locations was less than the IJC objective of 6 milligrams per litre (mg/L). The total dissolved solids measurements in the Lake exceeds the objective level of 200 mg/L.

St. Lawrence River

On the United States side of the St. Lawrence River water quality problems have been reported in at least two areas affected by the municipal inputs from Massena and Ogdensburg.

In addition it was reported the most significant water quality problem facing the St. Lawrence River is the high potential for major spillage of oil and other hazardous materials due to shipping accidents, particularly with extended navigation on the Seaway as proposed; witness the spillage from the grounding of the oil tanker Imperial Sarnia in 1974. Critical waterfowl areas and high-use recreational areas are especially susceptible to damage from spillage since experience has shown the extreme difficulty of efficient containment and cleanup in the swift river currents and narrow channels of the Thousand Islands area.

PERSISTENT CONTAMINANTS IN FISH IN THE GREAT LAKES

For several years most environmental agencies in the States and Provinces bordering the Great Lakes have monitored a variety of persistent contaminants in fish. Attention has focused on mercury and chlorinated hydrocarbons, including PCBs and their residues. Recent surveillance programs have included other metals, in addition to mercury, but trends in levels over time have been difficult to establish and the data indicate unanswered questions on the source and food chain relationships of these contaminants. Nevertheless, some general observations are possible.

Perhaps the clearest trend in contaminant levels in any of the Great Lakes is the steady decline in mercury levels in fish of Lake St. Clair. A progressive reduction in levels from year to year is evident, although the rate of decline has apparently slowed somewhat. Commercial fishing for certain species continues to be unsatisfactory pending a reduction to acceptable levels.

The Lake St. Clair data permit an evaluation of the effectiveness of regulatory controls and the dynamics of mercury in large aquatic systems. Previous estimates of the time required for mercury to return to background levels have been as long as 100 years. However, current data indicate that regulatory controls have led to a much more rapid reduction in the level of mercury contamination in Lake St. Clair fish than was anticipated.

Trends in mercury contamination elsewhere in the Great Lakes are not quite so clear. High mercury levels, (in excess of the present U.S. Food and Drug Administration action level of 0.5 µg/g) continue to be found in some fish from certain locations such as the eastern end of Lake Ontario and the western basin of Lake Erie. In other areas mercury levels have apparently declined, as in Thunder Bay and southern Lake Huron, and a resumption of commercial fishing has been possible in some cases.

Elevated levels of heavy metals have been found in sediments at numerous locations on the Great Lakes, particularly in harbor areas. In 1972 for example,



Bacterial quality around Lake Erie beaches in Ohio and Pennsylvania continues to improve.

accumulations of large quantities of metals, especially lead and chromium, were found in sediment samples from Hamilton Harbour. Levels in fish are correspondingly high in some cases. A 1973 comparison of fish from Toronto Harbour and from an unpolluted area of Lake Huron indicated that the harbor fish contained some eight times as much zinc and thirty times as much lead as did the Lake Huron fish.

While there have been increasing efforts to monitor levels of pesticides and PCBs in Great Lakes fish, most of these surveillance programs are of recent origin and relate to very specific areas. As a result assessment of levels on a lakewide basis is very difficult at this time.

Generally there has been a steady decline in the concentration of DDT in fish from Lake Michigan since the imposition of restrictions on the use of DDT by the State of Michigan in 1969-70. DDT residues in lake trout are still in excess of the tolerance levels of 5 µg/g set by the U.S. Food and Drug Administration for human consumption. Throughout the other Great Lakes, however, DDT and dieldrin residues in fish vary and are generally below the U.S. Food and Drug Administration standard. While the level of contamination of the Great Lakes by DDT and dieldrin appears to be decreasing there is no apparent decline in contamination by PCBs.

Although a voluntary program by the sole North American manufacturer of PCBs was undertaken to limit sales only for essential uses which had minimal potential for environmental contamination, the body burden of many valuable Great Lakes fish now exceeds the present U.S. Food and Drug Administration action level of 5 µg/g.

In its 1973 Annual Report the Commission warned of the persistent high levels of PCBs found in fish throughout the Great Lakes, and recommended to Governments that coordinated research programs be developed to determine its implications to human health and fish reproduction. Additional evidence now indicates that PCBs and other chlorinated hydrocarbons have contaminated fish-eating bird life in the Great Lakes to such a degree that, for example, low reproduction rates in herring gull colonies has resulted. Birth deformities have also been reported.

PCBs already released to the environment in their many uses in the Basin will continue to find their way to the Great Lakes.

The need for expanded monitoring of contaminants in wildlife, as well as fish, is strongly emphasized by these degradational impacts.

The Commission, acting upon a resolution by the Water Quality Board, again alerted the Governments in September, 1975 to the critical state of PCB contamination in the Great Lakes. It urged the Governments "to undertake the actions suggested by the resolution. Specifically these would be to undertake national public discussions on the consequence of strictly controlling the importation, sale, use and disposal of PCBs, as well as the early consideration of pending toxic and hazardous substances control legislation." In addition, the Commission notified the Governments of its intention to recommend a specific water quality objective that would afford protection to fish-eating birds and animals.

Deformed spine is result of methyl mercury Although mercury levels in Lake St Clair fish decrease, high levels continue in some fish from local waters of Lakes Erie and Ontario.



PROPOSED IJC WATER QUALITY SURVEILLANCE PROGRAM

The Water Quality Board has developed an IJC coordinated Water Quality Surveillance Program which is intended to address the following general goals:

- the measurement of loadings from sources affected by remedial programs
- the measurement of conditions in the receiving waters in order to monitor the frequency and intensity of violations of water quality objectives and,
- the provision of data which will confirm the degree and extent of the anticipated impact of -remedial programs on lake water quality as a whole.

The basic elements of the program to monitor loadings and provide impact surveillance for the Great Lakes are briefly described below and are presented in detail in Appendix B of the Water Quality Board's Annual Report. The total program was developed from detailed consideration of objectives and strategy for the proposed surveillance programs for the connecting channels and Lake Erie.

A preliminary cost estimate for the various components of the monitoring and surveillance program resulted from a broad but well defined study of the essentials necessary to meet the objectives and strategy developed for the connecting channels and Lake Erie. The purposes of the surveillance program for the connecting channels are:

- to monitor the water quality in order to determine compliance with the water quality objectives established in the Great Lakes Water Quality Agreement
- to investigate and determine the fate of contaminants
- to determine trends in the water quality in order to provide information relevant to the need for, or assessment of, remedial programs and,
- to accurately determine loadings in order to calculate material balances at the head and mouth of the channels.

The strategy for Lake Erie, which may be

extended to all lakes, entails specific components for monitoring. They are:

Loading Aspects

- tributary monitoring
- atmospheric fall-out
- direct municipal and industrial dischargers

Impact Surveillance

- whole lake monitoring
- near source monitoring
- water intake monitoring
- fish and wildlife monitoring

The following table summarizes the estimated level of costs in thousands of dollars for the proposed program as developed through 1978/79. In large measure ongoing programs of the Federal Governments, States, and the Province provided the funds for the 1975/76 fiscal year.

	1975/ 76 (Ongoing)	1976/ 77	1977/ 78	1978/79
Canada	\$1,930	\$2,500	\$2,800	\$2,900
United States	840	3,200	3,600	4,100

These costs do not include the fisheries monitoring program for which development and costing have not been completed. Persistent toxic contaminants may be present in lake waters in quantities which cannot be measured with precision but when biomagnified in the food chain are measurable with adequate precision to determine the detrimental and other physical characteristics.

All components are essential for an integrated co-operative program to be shared by Canada and the United States and their Provincial and State Great Lakes jurisdictions. This surveillance program was developed by the Board with full knowledge of existing Provincial and State surveillance programs.

The Commission recommends that such a basin-wide integrated surveillance system be adopted as an integral part of the effective pollution control and abatement as contemplated by the Agreement. Such a system is essential to the Commission's capability to assess the progress of water quality trends and to establish a comparable data base among the various jurisdictions.

4

MUNICIPAL POLLUTION ABATEMENT

During 1974, progress continued to be made in both countries in the construction of needed municipal waste treatment works.

There are, however, some important differences in the current municipal waste treatment of each country which should be noted. Canada has completed most of its major municipal construction facilities required to provide adequate treatment by 1975 under the terms of the International Agreement. Primary attention in Ontario has now shifted towards treatment plant expansion to accommodate future growth. On the other hand, the United States program is of greater magnitude, and while many projects have been initiated, completion of several of the major projects will not be achieved for a number of years. (See Table 1).

Status of Projects

According to the 1970 census, the latest official figures available, there were approximately 21 million people residing in the U.S. portion of the Great Lakes Basin, of whom over five million were unsewered. These totals do not include the 10 million people of the Chicago metropolitan area whose domestic and industrial waste effluent is drained out of the Basin through the Chicago Sanitary Canal and eventually into the Mississippi River.

At the same time, in the Ontario or Canadian portion of the Great Lakes Basin there were approximately 6.5 million people in residence, of whom 1.7 million were unsewered.

In the United States 25 projects, consisting mostly of up-grading existing secondary treatment plants, were completed in 1974. The release in 1975 of \$9 billion of impounded funds, originally authorized by the United States Congress in 1972, is a significant step forward and will accelerate work which might have been delayed had the money not been made available.

Nevertheless, difficulties encountered in the United States in implementing the complex requirements of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) have led to many project delays. During 1975, however, administrative actions taken by the Environmental Protection Agency have substantially reduced the difficulties. Municipal treatment plants constructed by the end of 1974 were providing adequate treatment for 46 percent of the estimated sewer-

population, and will probably reach 60 percent by the end of 1975. "Adequate treatment" in the United States is defined by law (PL 92-500) to mean a minimum of secondary treatment.

Completion of 11 major projects serving an additional 6.3 million people will be deferred beyond 1975. They are Detroit, Duluth, Gary, Cleveland (3 plants), Euclid, Niagara Falls, Tonawanda, Syracuse and Buffalo.

In Ontario, at the end of 1974, adequate treatment (not necessarily secondary treatment) was being provided to 85 percent of the estimated sewer- population. It is anticipated that the projects at Marathon, Midland, Parry Sound, Trenton and Iroquois, serving a total of 34,000 people will be delayed until 1976. A major project at Thunder Bay, serving 106,000 people will be delayed until 1977.

It is important to recognize that the status of progress relates to sewer- population only. Perhaps, a quarter of the population in the Great Lakes Basin have no sewer connections to municipal facilities. The extent of their contribution to the pollution loads of the lakes (including phosphorous) is unknown. International studies are underway which should provide baseline information.

The major cities with delayed projects are listed in Table 1 together with their sewer- populations and anticipated completion dates. The Great Lakes Water Quality Board's annual report for 1974 contains a discussion of these projects, their current status, progress during 1974, and the reasons given for delay.

Expenditures

Construction funds made available by the various government- agencies in support of municipal treatment programs, reflect a steady increase of funds committed by both Countries.

Funds approved for sewage treatment and trunk sewer construction in Ontario over the period 1971-1974 totalled \$415 million. By 1975 additional expenditures in excess of \$120 million are expected for sewage treatment and trunk sewer construction. The value of construction remaining to overcome the backlog of works in Ontario which will not be completed by 1975 will exceed \$20 million. In order to maintain the adequacy of present programs, some \$300 million in total spending will be required in 1976 and 1977.

In the United States, funds obligated for sewerage works in the Great Lakes Basin from 1971-1974 totalled about \$1.6 billion. Considerable concern was expressed over the impoundment of construction funds appropriated by the United States Congress for the Great Lakes in meeting the 1975 needs. Nine Billion dollars of the \$18 billion appropriated nationally for Fiscal Year

1973 through Fiscal Year 1975 were impounded by the United States Executive Branch.

On January 24, 1975, the President released \$4 billion of the impounded funds for the construction grant program. As a result of the February 18, 1975 Supreme Court decision, the Environmental Protection Agency has allocated an additional \$5 billion from withheld funds. Therefore, the entire \$18 billion authorized by Congress in the Federal Water Pollution Control Act Amendments of 1972 for Fiscal Year 1973, Fiscal Year 1974 and Fiscal Year 1975 is expected to be obligated by September 1977.

These Federal funds represent 75% of the estimated total costs of sewerage works authorized by Public Law 92-500. The balance is funded by the States and municipalities.

STORMWATER AND COMBINED SEWER OVERFLOWS

Stormwater and combined sewer overflows have been identified as a major problem in most of the urban areas in the Great Lakes Basin.

The Commission notes that action has been taken by both Governments to comply with the Agreement to reduce pollution from overflows of combined storm and sanitary sewers through practical means. While it is recognized that the action consists presently of research, studies, and demonstration projects, the implementation of practical programs should be undertaken at the earliest possible date.

SLUDGE DISPOSAL OR UTILIZATION

The disposal or utilization of sludge from wastewater treatment plants is a very significant component of any comprehensive water quality management program. The sludge, highly concentrated in organics, heavy metals and nutrients, can create severe pollutional problems if improperly handled.

Quantities of sludge resulting from sewage treatment have increased greatly where chemicals for phosphorous removal are added. Methods of disposal of sludge in common usage in the Great Lakes Basin are incineration, landfill, lagooning, and agricultural applications depending on a number of economic, social and environmental factors. These methods have led to a number of specific problems for which individual jurisdictions have provided short term remedial measures.

In summary, sludge disposal remains a very significant problem in the overall environment. As more phosphorous removal facilities are installed and become more effective in municipal treatment plants within the Basin, more sludge will be produced. Some municipalities in Ohio have been forced to curtail the addition of chemicals for phosphorous removal due to an inability to handle the increased volumes of sludge produced. While all the jurisdiction are cognizant of the sludge disposal problems and the necessary long term remedial measures, the Province of Ontario and the State of Minnesota have taken definite steps toward this goal by way of their Resource Recovery Programs which include financial assistance to municipalities..

Facility	Sewered Population	Anticipated Completion Dates	Current Project Costs (Millions of Dollars)
United States	—	-	—
Detroit, Mich	3,129,000	1979 (phased construction)	121.4
Duluth, Minn (Western Lake Superior Sanitary District)	126,000	1977	84.5
Gary, Indiana	175,400	1377	34.0
Cleveland, Ohio (Westerly)	250,000	1979	90.0
(Easterly)	700,000	expansion for advance treatment planned	10.0
(Southerly)	635,000	1981	180.0
Euclid, Ohio	71,550	1977	12.0
Niagara Falls, N.Y.	102,400	1976	63.0
Tonawanda, N.Y. (Sanitary District No. 2)	107,700	1976	62.0
Syracuse Metro, N.Y.	287,200	1979	108.0
Buffalo, N.Y.	750,000	1978-79	158.0
Canada			
Thunder Bay	106,000	1977	10.7

5

EUTROPHICATION AND PHOSPHORUS CONTROL

Programs for the control of eutrophication of the Great Lakes through the reduction of phosphorous inputs are progressing both in Canada and the United States. Loadings from municipal sources have been substantially reduced through implementation of programs to remove phosphorous from sewage treatment plant effluents. Additionally, three of the States, several U.S. municipalities and Canada have legislation limiting the content of phosphorous in detergents.

The phosphorous removal program for municipal dischargers is progressing well. The effect of this program is evident in reduced phosphorous loadings from direct municipal sources in all the Great Lakes except Lake Michigan. Lake Michigan's increased loading may be attributed to actual reported loadings from Wisconsin as compared to what were only estimated values for the previous year.

However, actual phosphorous loadings from tributaries as reported in 1974 were generally higher than estimated loadings in previous years throughout the entire Basin with the most notable rise in Lake Erie. It is not clear whether the increases are due to actual loadings or are the result of previous underestimations. Thus, it is difficult at this time to determine any trends in phosphorous loadings to the Lakes from tributaries.

The decrease in phosphorous loadings to Lake Erie from municipal sources was approximately equal to the increase in the 1974 reported loadings over the 1973 estimated loadings. Thus, no net change from tributaries in total loadings to the Lake could be accurately determined.

The Commission believes that the United States Government should take cognizance of the contribution of phosphorous to the Lake system from the unsewered populations. Although the degree of adverse impact on water quality from this source is unknown, the control of the use of phosphorous in detergents would contribute to the reduction in the ultimate loadings of phosphorous to the system.

The ultimate assessment of the effectiveness of phosphorous reduction programs must be made in terms of the changes in algal biomass in the Great Lakes. There are some preliminary indications of improving conditions. Some water intake data on Lake Erie show declines in nearshore chlorophyll *a* concentrations. There appears to be some reduction of both phosphorous and chlorophyll *a* concentrations in open waters of the western basin of Lake Erie. There is no clear indication, however, that these changes are due to remedial programs. They may be due to dilution effects caused by high water levels. Recent modelling efforts for Lake Ontario indicate that lake response times are in the order of 15-20 years and equilibrium levels of algal biomass have not yet been achieved in open lake waters. The impact of phosphorous reduction programs should be most obvious in Lake Erie due to the relatively short flow-through time. It should be noted that current open lake conditions result from phosphorous loads that entered the lakes years ago, possibly three to five years ago, in the case of Lake Erie. Even if there had been substantial phosphorous reductions occurring during 1973 and 1974, the impact on open lake algal biomass would not be expected to occur until perhaps 1977 to 1979.

6

INDUSTRIAL POLLUTION ABATEMENT

A significant number of problems and problem areas have been associated with discharges from industrial sources, both in Canada and the United States. Continuing concern for abatement of such pollution is evidenced by substantial efforts on the part of Federal, Provincial and State agencies to implement their respective industrial waste control programs. Basic differences which exist between the Canadian and United States program approaches do not allow for direct comparisons of progress. Nevertheless, program objectives are generally compatible—achievement of best practicable pollution control technology and attainment of water quality consistent with the objectives of the Agreement.

It will be sometime before the Commission can evaluate the relative effectiveness of the different approaches to industrial pollution control in the two countries. To accomplish this the Commission believes there must be some comparability in the respective U.S. and Canadian programs. The Commission observes, however, that there is on file in the Great Lakes Regional Office in Windsor, Ontario, increasing amounts of information about industrial waste discharges by individual firms on both sides of the boundary. This information is available to the public on request.

United States

The National Pollutant Discharge Elimination System (NPDES) permit program demonstrated significant progress during 1974 and the first part of 1975.

The permits contain two important elements: effluent limitations and a schedule for attaining compliance with those limitations. Each permit lists chemical and physical characteristics of the effluent and specifies average and maximum loadings and/or concentrations which may be present in the effluent. The schedule of compliance specifies dates for such events as submission of plans, initiation of construction, completion of construction, attainment of operational levels, etc. Additionally, the permit specifies monitoring and self-reporting requirements. Generally, as a minimum, best practicable technology is to be achieved by July 1, 1977 and best available technology is to be achieved no later than July 1, 1983 unless changed by Congress.

On the United States side of the Great Lakes Basin, NPDES permits have been issued for 292 of 312 major industrial dischargers.

Monitoring Compliance and Enforcement

The major program emphasis is gradually shifting from permit issuance to compliance tracking, monitoring and enforcement. In addition to tracking compliance by examining self-monitoring reports required by the permits, both the Environmental Protection Agency and the States are conducting compliance monitoring surveys and inspections. This involves sampling of the dischargers' outfalls, analysis for chemical parameters that are specified in the permits, and inspection of operating procedures. When violations are discovered, permit conditions may be enforced by issuing Administrative Orders or through civil and criminal proceedings in court. During 1974, several enforcement actions against minor industrial dischargers in the Great Lakes Basin were taken by the Environmental Protection Agency and State agencies. The number of enforcement actions undertaken during 1975 is expected to be of greater significance since many permits were not issued until the latter part of 1974.

Canada

Ontario regulates and controls liquid industrial wastes under the authority of the Ontario Water Resources Act and the Environmental Protection Act. The Province has assumed responsibility for implementation of national regulations and guidelines for industrial wastes under the Canada Fisheries Act. Effluent guidelines and standards are employed to limit the discharge of effluents from individual industrial operations and consideration is given to the impact on the quality of the receiving waters. Proposals for industrial waste control are evaluated and engineering plans for waste treatment and control facilities are reviewed for approval. Analyses of environmental impacts of major industrial projects, where proposed, are undertaken cooperatively by both the Provincial and Federal Governments.

Gradual progress is being made in reduction of outstanding problems and on Lake Superior the paper mills are implementing staged programs of control to be completed by 1977.

Surveillance and Enforcement Actions

Surveillance activities by the Ontario Ministry of the Environment involve field inspection of industrial operations and treatment facilities employed by power generating facilities, basic iron and steel producers, petroleum and chemical complexes, food-processing plants, pulp and paper mills, mining and metallurgical operations. Surveillance of sources of radioactivity is conducted in cooperation with the Atomic Energy Control Board and other interested Federal and Provincial agencies.

A computerized system is under development for review of compliance of industrial discharges with

Ministry requirements. Computations are made for monthly loadings and concentrations to facilitate the exercise of control when control limits are exceeded. Under design and going into operation in 1975 is a system to process data describing treatment facilities planned, approved, developed or installed, to permit evaluation of performance with respect to operating criteria, objectives, costs and pollution control effectiveness.

As in the United States, only a few enforcement actions were taken against industrial dischargers during 1974 by the Province.

Previous IJC Reports Under the Agreement

The Water Quality Agreement sets out certain water quality objectives for the Great Lakes and outlines a wide range of remedial programs to be undertaken by the Governments to achieve them.

The Commission has been given the responsibility of coordinating programs set out in the Agreement. evaluating their effectiveness and assessing progress in pollution abatement. The Agreement also directs the Commission to report to Governments and the public at least annually on its evaluation of the progress and effectiveness of the Agreement.

The Commission's first report was released in July 1973 and covered Agreement activities for calendar year 1972. It reported on the formation of a Great Lakes Water Quality Board, a Research Advisory Board. and a regional office as authorized in the Agreement. The two Boards serve as principal advisors to the Commission on matters pertaining to the Agreement and are continuing bodies composed equally of United States and Canadian water pollution experts.

In this first report, the Commission said it was too early to assess progress and evaluate programs being implemented, but expressed cautious optimism that the two Countries were making satisfactory progress in implementing the Agreement. In addition. the report said the continuing increased rate of degradation of Lake Erie and Lake Ontario appeared to be slowing down.

The Commission's second annual report, released in 1974 on 1973 activities. concluded that the increasing rate of degradation in Lake Erie appeared to be halted. although it had no comprehensive scientific data to support its views. The lack of funds and personnel in the various government agencies to carry out a water quality assessment program was a serious deficiency. Considerable data were being collected but an adequate capability to evaluate and interpret on a uniform technical basis did not exist for all the governments or agencies involved. Until such a capability is developed, the Commission asserted, it would not be able to report on progress with any scientific accuracy.

7

RESEARCH

The Research Advisory Board is the principal adviser to the Commission on the coordination of Great Lakes water quality research and the dissemination of such information.

During the reporting period, the Board published and transmitted to the Commission reports on: "Asbestos in the Great Lakes Basin" and "Proceedings of the Symposium on Structure-Activity Correlations in Studies of Toxicity and Bioconcentration with Aquatic Organisms." Acting upon a request from the Upper Lakes Reference Group, a report on "Total Dissolved Solids in the Upper Great Lakes" was completed for the use of this Group.

A directory of Great Lakes research projects was also published and distributed to all members of institutions under the Great Lakes Water Quality Agreement and to all contributors from the Great Lakes research community.

Asbestos in the Great Lakes Basin

Asbestos is a generic name for several fibrous silicates. The reported background level of asbestiform fibre concentration in the Great Lakes varies from close to one million to ten million fibres/litre. Sources of asbestiform fibres are natural erosion, mining and processing operations, and man's use of the manufactured products. That inhaled asbestos is related to an increased incidence of cancer is reasonably well understood, but the effects of ingested asbestiform fibres have only recently come under study and the demonstrable hazard to health has not yet been defined.

On the basis of the report "Asbestos in the Great Lakes Basin," it is clear that existing sampling, analytical and monitoring techniques and programs are limited and that there is inadequate knowledge of health effects from ingestion of asbestos.

Cladophora in the Great Lakes

Widespread occurrence and production of *Cladophora*, a nuisance filamentous alga which forms in nutrient-laden waters, is an important manifestation of eutrophication in the Great Lakes. While much general information is available on *Cladophora*, the significance of its role and place in ecosystem function and structure is not well defined. Investigations need to be undertaken to define this role with particular emphasis on interrelationships with fish populations and fish productivity as well as the escalating impact of pollutants through food chains. Additional investigative effort should be directed to solving the problem of *Cladophora*-clogged beaches and fouled near-shore

recreational areas. Further experimental work to determine alternative remedial programs and to identify potential uses for harvested *Cladophora* is needed.

A symposium on the problem was held in February, 1975 and the proceedings are now available.

Measurements of Long-Term, Large-Scale Drift and Dispersal Patterns in the Great Lakes

Transboundary pathways and scales of pollutant dispersal and diffusion in the Great Lakes are at present poorly known. Equipment and techniques for measuring drift and dispersal patterns are improving, particularly along with the development of electronic navigation and communications systems. The Research Advisory Board held a workshop in February, 1975 where the participants, identified the need for reliable operational data collection and processing facilities to measure long-term, large-scale drift and dispersion of pollutants.

Proceedings of this workshop are being published.

Structure-Activity Correlations in Studies of Toxicity and Bioconcentration in Aquatic Organisms

Early warning mechanisms are lacking for screening new chemical substances that may present unreasonable risks to health and to the environment. Although organic chemicals generally have complex molecular structure, they can be grouped into families with similar molecular base structures. The impact of a specific chemical on the environment may be related to effects of chemicals in the same family by the consideration of their structural similarities. The technique of such relationships is described as "structure-activity" correlations and has been used by the pharmaceutical industry in the development of new drugs. These correlations have been demonstrated to predict toxicity and bioaccumulation of organic chemicals in aquatic organisms. A standard method for "structure-activity" correlations to develop an adequate data base for use in predicting environmental hazards is required, and should be developed at the earliest possible date.



Left—Conveyor discharges taconite tailings into Lake Superior. These tailings are a source of asbestos fibers which have been found in drinking water.

Below—The study of fish in the laboratory tells us much about the quality of water and the effects on man.

Center— Laboratory) investigator is counting fish eggs in an effort to define the role of *Cladophora* in fish productivity.

Bottom—Widespread occurrence of the alga *Cladophora* is an unpleasant by-product of eutrophication in the Great Lakes.



8

OTHER ACTIVITIES UNDER THE AGREEMENT

In addition to implementing remedial programs to control pollution from municipal and industrial sources the Agreement requires that measures be taken to reduce pollution from land use activities, shipping activities, dredging activities, onshore and offshore facilities and that a Joint Contingency Plan be implemented and hazardous polluting substances be identified.

Land Use Activities

In its 1973 report, the Commission recommended that the appropriate governments give early consideration to the control of pollution from land use activities. Most jurisdictions have made significant progress in many aspects of this complex problem. None has yet developed comprehensive programs with adequate resources to meet the goals envisioned by the Agreement. Programs for environmental assessment of land use activities are under development in all jurisdictions.

The International Reference Group on Great Lakes Pollution from Land Use Activities has published a two-volume report on its United States "Task A" study. The report presents a state-of-the-art assessment of current United States management programs on land use activities which may affect water quality in the Great Lakes.

The Reference Group on Pollution from Land Use Activities reports that its basic reference study on pollution from land use activities is 50% completed, and estimates its final report will be available in 1978, after a 5-year study. The study represents a significant effort to examine the impact of all forms of land drainage on the water quality of the Great Lakes.

Special Upper Lakes Study

When the Agreement was signed, it represented a response by the two Governments to the Commission's 1970 recommendations based on its study of Lakes Erie and Ontario and the International Section of the St. Lawrence River. In 1972 the two Governments requested the Commission to conduct a similar study of the water quality in Lakes Huron and Superior and indicate the most practicable remedial measures to restore and protect the quality of these waters.

The Commission established the Upper Lakes Reference Group to undertake this special study and the Group's final report is expected in July, 1976.

Shipping

The Agreement requires measures to control pollution from shipping activities which include the adoption of compatible regulations from the control of vessel wastes and the consideration of vessel design, construction, operation, navigational aids, etc., as they could reduce or control pollution from shipping activities.

Vessel Waste Regulations

Compatible vessel waste regulations as required by the Great Lakes Water Quality Agreement are still not in place even though the Agreement stipulates that such regulations were to be developed within a year after its signing in April 1972. In both its first and second annual reports the Commission called attention to this fact and recommended that the Parties to the Agreement should adopt compatible regulations "without further delay."

The Commission is aware that there have been a number of meetings between the United States Coast Guard and Canadian Ministry of Transport representatives to discuss vessel waste regulation in their respective countries and to assess their compatibility. The Commission is also aware that the two Federal agencies have recognized the acceptability of flow-through devices and perhaps in this sense have come close to compatibility. It also recognizes, however, that in general, the State and Provincial approach is to achieve a "no-discharge" condition. This is emphasized by the fact that the Commission's own Water Quality Advisory Board has reported that the "majority of the Board continues to support regulations based on a complete prohibition of the discharge of sewage".

The Commission recognizes the problems of the various regulation schemes and their application to both commercial vessels and pleasure craft. Nevertheless, it is the Commission's view that equal application of compatible regulations to control waste discharges from all classes of vessels using the Great Lakes, both domestic and foreign, must be achieved if the pollution of the Lakes from this source is to be satisfactorily brought under control.

The Commission, therefore, recommends that the Parties undertake immediately consultations with each other and State and Provincial agencies on an urgent basis—a factor which the Commission believes has been absent to the present time—and that agreement in principle be announced no later than July 1, 1976. To do less, the Commission suggests, is to weaken the spirit of the Agreement.

Vessel Design, Construction and Operation, and Pollution from Shipping

As pollution from point sources is abated, navigation-related pollution sources increase in importance. The International Joint Commission's Board is continuing to inquire about the progress being made by the Government

agencies concerned with studies and analyses of these problems and has been disappointed by the lack of information on progress, if any, in these important assignments.

Dredging

There has been a marked increase in construction activities along the coastlines of the Great Lakes. These have included harbor facilities, channels, marinas, industrial installations, utilities and sub-division and landfill improvements with various effects upon the ecosystem of the lakes.

The United States Environmental Protection Agency, in cooperation with the Corps of Engineers, is developing guide-lines which are being applied for disposal of dredged materials in open lake and inland navigable waters. In Canada, dredging activities are being controlled by cooperative arrangements between the Federal and Provincial governments. Restrictions are placed on every project by the governments of both countries.

The dumping of polluted dredged spoil in the open waters of Lakes Erie and Ontario is continuing. but efforts are being made to bring such dumping under tighter controls. A final report prepared by the International Working Group on the Abatement and Control of Pollution from Dredging Activities was filed with the Federal Governments during 1975 pursuant to Annex 6 of the Agreement. The Report reviews existing dredging practices, programs, laws and regulations. and contains recommendations for compatible programs governing the disposal of dredged spoil in open waters.

Onshore and Offshore Facilities

Programs for the control of oil from onshore and offshore facilities in Canada are being implemented through the federal Petroleum Refinery Effluent Regulations and Guidelines and provincial requirements under the Ontario Water Resources and Environmental Protection Acts as well as the Ontario Gasoline Handling Act. On the United States side discharges of oil are being effectively handled by the United States Oil Pollution Prevention Regulations.

Specific programs for the control of hazardous polluting substances from onshore and offshore facilities are still in early stages of development in both Canada and the United States.

Joint Contingency Plan

The revised Joint United States-Canadian Oil and Hazardous Material Contingency Plan for the Great Lakes Region became effective April 1, 1974. The Plan establishes clear lines of authority and action, preventing delayed response due to jurisdictional disputes.

Experience gained in implementing the Plan during several spills in 1974 indicated a need for some improvements in communication which have been undertaken.

Hazardous Polluting Substances

During the past year, the Canadian and United States groups working on the development of an Annex identifying hazardous polluting substances pursuant to the Agreement met to discuss status of the Annex and related programs and other measures for controlling such materials from vessels and onshore/offshore facilities in the event of contingencies. Both groups are well along in the development of the Annex.

Report on Joint Activities

Subsequent to presentation of the Water Quality Board's 1974 annual report to the Commission, the Board submitted a special study on the progress of United States-Canadian "joint activities" as described in the Agreement. The study reinforced the Commission's concern about the lack of information, and in some cases, apparent lack of action on some of the joint activities. Considerable difficulty has been encountered by the Water Quality Board in determining the status of the various activities.

The Commission is taking steps to obtain the necessary information on these activities from relevant agencies in order that it can report more fully on these matters in the future.

Institutional Arrangements

The Commission's Boards and Groups concerned with reporting on Great Lakes water quality consist of a large number of representatives from Federal, State and Provincial governments. In many instances the requirements for their gathering, assessing and reporting information constitute considerable additional workload on the part of these governmental jurisdictions.

The Great Lakes Water Quality Board has reported to the Commission that representatives of the State and Provincial governments have emphasized that the assignment of staff to International Agreement assessment activities will be constrained due to competition for available budget funds. As a result, the Commission is seeking funds which, if made available, will help to alleviate these constraints.

In addition the Commission notes that the implementation of essential new and expanded monitoring and surveillance programs could be severely restricted because of funding deficiencies. These deficiencies will inhibit data gathering, analysis and assessment and will prevent adequate participation by the various jurisdictions in essential institutional activities.

Further the Commission is convinced that these funding deficiencies must be avoided through the appropriation of adequate funds in accordance with the constitutional procedures of the Federal governments and by the cooperation of the State and Provincial governments as set forth in the Agreement.

9

EFFECTIVENESS OF THE AGREEMENT

- Present surveillance and remedial programs are designed to meet the requirements outlined in the International Agreement. More important, however, is a pressing need to assess realistically the effectiveness of these programs to determine whether adjustments to them are needed. By April 1977, a re-assessment of the Agreement is required. Its effectiveness and that of programs in support of it should be assessed in terms of measurable water quality improvements.

The determination of changes in water quality in these large bodies of water over a short period of time is difficult, if not impossible. Nearshore areas respond to remedial measures more rapidly and the effectiveness of programs can be monitored through improvement in water quality in those areas.

Within the Great Lakes Basin, there are geographical locations where the water quality objectives are not being met. These areas have been identified as "problem areas" in Table 2. In most cases, the problem areas are situated at either the mouths of tributaries or in the vicinity of populated urban centers. The cause of water quality degradation can often be attributed to some significant waste dischargers.

- Development and adoption of common water quality objectives for the Great Lakes is recognized as one of the primary program elements of the Canada-United States Great Lakes Water Quality Agreement of 1972. Common objectives provide direction for all water quality surveillance programs, are of critical importance in evaluating the success of remedial programs, and should assure protection for designated uses (water supply, recreation, etc.).

Staff and Technical Assistance

At the time of the signing of the Water Quality Agreement, the Governments referred to the Commission two major problems related to Great Lakes water quality. In addition to its general oversight role under the Agreement, the Commission was requested to undertake a water quality study of Lake Superior and Lake Huron, much the same as it had been requested to do on Lake Erie and Lake Ontario almost 10 years before. Secondly, the Commission was requested to investigate the effects of various land use activities in the Great Lakes Basin on the water quality of the lakes.

Special teams of United States and Canadian scientists were organized by the Commission in 1973 to undertake the studies. By 1974 the investigations of the Upper Lakes Reference Group and the Pollution from Land Use Activities Reference Group were well underway. Over 200 Federal, State and Provincial government scientists and technicians are currently involved in carrying out the field studies.

To assist the Commission and its Boards and Groups in the task of coordinating programs initiated in both Countries under the terms of the Agreement and to make a continuing assessment of the progress, the Commission established a regional office in Windsor, Ontario. With an authorized staff of over 30, it serves primarily as a Secretariat and as technical support of the Great Lakes Water Quality Board, the Research Advisory Board and the two Reference Groups. In addition, it serves as a focal point for the collection and storage of water quality data and related information, and its facilities are in daily use by the numerous groups, committees and subcommittees organized to carry out the programs specified in the Agreement. The United States and Canada share equally in the total cost of its operations, as well as in the composition of the professional staff.

Table 2. AREAS IN GREAT LAKES NOT MEETING WATER QUALITY OBJECTIVES				
Lake Superior Basin	Lake Michigan Basin	Lake Huron Basin	Lake Erie Basin	Lake Ontario Basin
Thunder Bay Harbour Marathon-Peninsular Harbour Jackfish Bay Nipigon Bay Sliver Bay St. Louis River Duluth Harbor, MN Duluth Harbor, WI Area from Duluth to Sand Point Chequamegan Bay Area from Chequamegan Point to Montreal River	Green Bay Area Milwaukee Harbor Indiana Harbor Ship channel and inner harbor basin	Saginaw Bay St. Mary's River Penetang Bay Midland Bay North Channel (near Spanish River) Serpent River McCurry Lake Outlet Maitland River Douglas Point	Cleveland Area Toledo Area Sandusky River Huron River Vermilion River Rocky River Ashtabula River Conneaut Creek Chagrin River Portage River Black River Grand River, Ontario Detroit River St Clair River Thames River Sydenham River Western Lake Erie Pelee Island Wheatley Harbour Big Otter Creek Big Creek and Lynn River Kettle Creek Grand River OH Long Point Bay Fredonia Area Westfield Area	Niagara River Twelve Mile Creek Hamilton Harbour Toronto Harbour Oshawa Creek Etobicoke Humber River Duffin Creek Don River Highland Creek Moir River Port Hope Harbour Bay of Quinte Buffalo River Tonawanda Creek Niagara Beach Olcott Harbor Rochester Harbor Area Oswego Harbor Area Black River St Lawrence River
<p>NOTE: Except for connecting channels, problem areas identified with rivers refer to areas in the boundary waters at the mouth of the river</p>				

Annex I of the Agreement sets forth specific water quality objectives. The Annex provides for amendment whenever the Commission recommends new or revised objectives which are agreed to by the Federal Governments. The Great Lakes Water Quality Board has developed and proposed new and modified specific water quality objectives as described in its 1974 annual report.

The Commission expects additional specific water quality objectives being developed by the Boards will soon be proposed and is now in the process of evaluating all proposed objectives for possible recommendation to the Governments. The establishment of more stringent objectives will increase the effectiveness of the Agreement.

- The Commission notes with some concern that with the expiration of the December 31, 1975 date, there will be no significant dates for program achievement in the Agreement. It will contain no schedule or timetable for the achievement of general and specific water quality objectives nor for any required programs or other measures to achieve the goals. Experience at local, regional, and Federal levels in achieving environmental goals suggests that specified achievement dates are useful, giving pressure and substance to the difficult reality of goal achievement. The Governments of the United States and Canada should consider whether the effectiveness of the Agreement would be enhanced by the introduction of agreed target dates. The

Commission is convinced that a series of meaningful target dates would sharpen the intent of the Agreement. Accordingly, the Commission has requested its Great Lakes Water Quality Board to consider and render advice to the Commission on those areas of the Agreement which are amenable to specific target dates, which are reasonable and desirable, to achieve the objectives of the Agreement and to measure progress. It is the Commission's intention to identify such target dates to all interested parties as early as practicable.

- One last point..The true test of the effectiveness of the Agreement is now beginning to take form. Heretofore, the Commission believes, the Governments' efforts have been almost exclusively related to implementing Federal, State, and Provincial laws. The essential motivation for control efforts in the Great Lakes region did not emanate from the Agreement, but from the peoples' determination in each country to clean up the waters regardless of what effect was taking place on the other side of the border. Now, however, the presence of the Agreement will loom larger as a force in stimulating and gauging progress. As each year passes there is increasing public appreciation of the long-known concept that water pollution knows no boundaries.

History of Great Lakes Water Quality Agreements

The Commission's first involvement with boundary water pollution problems began in its first year of operation, 1912. After a major study, concluded in 1918, the Commission warned the two countries that problems were developing in the Great Lakes and would become acute if remedial programs for handling municipal and industrial wastes were not undertaken.

With the accelerated industrial and municipal development in the Great Lakes Basin in the 1930's and during the World War II period, Lake Erie and Lake Ontario were hard hit by excessive and uncontrolled waste discharges. In 1946 the Commission was requested to investigate the water quality problems in the various connecting channels of the Great Lakes because of serious industrial pollution, particularly in the Detroit and Niagara Rivers. In 1950 the Commission outlined the problems, and recommended remedial action and international water quality objectives. The objectives were the forerunner of water quality requirements later established by the two Governments as a major control measure.

Then in 1964 the two Governments requested the Commission to investigate the seriously polluted condition of the lower Great Lakes—Erie and Ontario and the international section of the St. Lawrence River—and to make recommendations. In 1970 the Commission filed its report, listing a wide range of remedial programs and actions that would be required to avert a major catastrophe in the Great Lakes.

Based on the Commission's recommendations, the Governments began a series of bilateral discussions that were concluded on April 15, 1972, with the signing of the Great Lakes Water Quality Agreement by President Nixon and Prime Minister Trudeau.