1961-01-01

Safeguarding Boundary Water Quality: A Cooperative Effort between United States and Canada

International Joint Commission

Safeguarding BOUNDARY WATER QUALITY

A COOPERATIVE EFFORT

between

UNITED STATES and CANADA

under

INTERNATIONAL TREATY

THE INTERNATIONAL JOINT COMMISSION

THE
INTERNATIONAL JOINT COMMISSION

UNITED STATES	CANADA
Tino Roncalio, *Chairman*	A. G. L. McNaughton, *Chairman*
Eugene W. Weber	J. Lucien Dansereau
Francis L. Adams	Donald M. Stephens
Harry J. Donohue, *Secretary*	D. G. Chance, *Secretary*

The International Joint Commission was created in 1912 following a treaty between the United States and Canada in 1909. The investigation and prevention of boundary waters pollution is one of the responsibilities assigned to the Commission.

"Live I, so live I,
To my neighbour honestly."

—Longfellow.

Safeguarding BOUNDARY WATER QUALITY

A Cooperative Effort Between United States and Canada

A review of an international program

for safeguarding quality in the boundary waters preterlabent

to the State of Michigan, the Province of Ontario and

the State of New York, under the terms of the references to the

International Joint Commission in 1946 and 1948.

ONTARIO

THE INTERNATIONAL JOINT COMMISSION

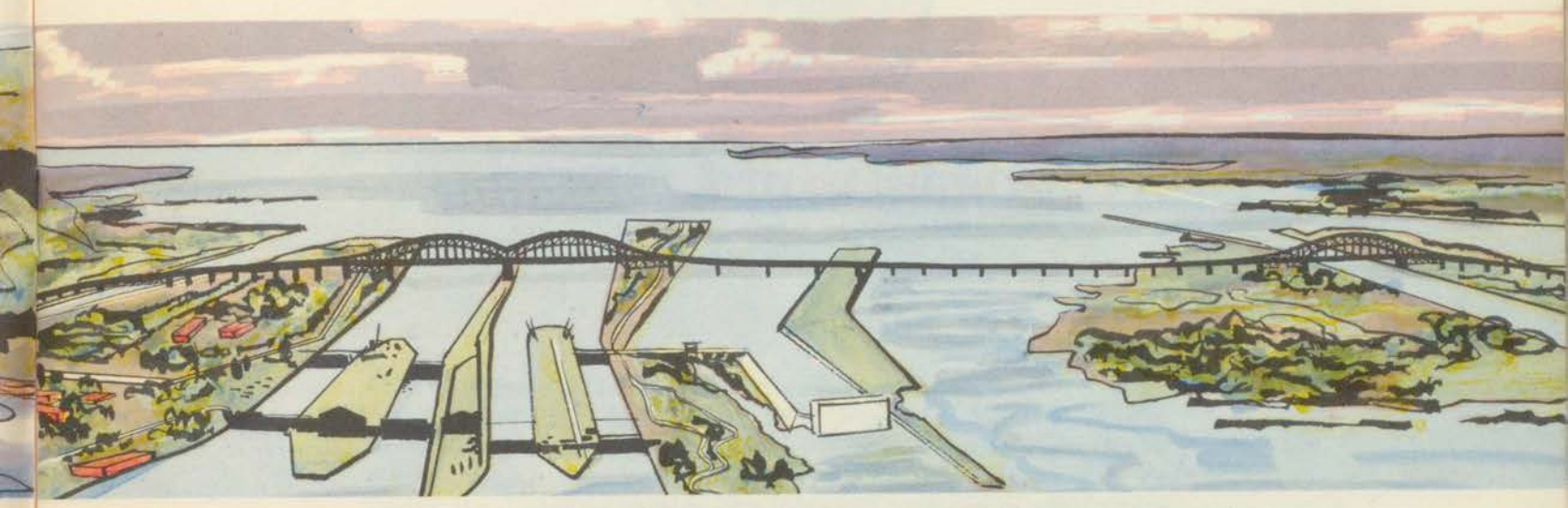
UNITED STATES **1961** CANADA

for your Information

The aim in this brochure is to draw attention to the great developments that are taking place along the boundary waters, the importance of these waters in this growth to the people of both countries, and to record some of the accomplishments in the control of water quality. If this vast stretch of water is to serve effectively the many functions expected of it—pollution control must be a prime objective. This task is a big one, but much has been done to put the program into effect. Neither sewage nor industrial wastes must impair the quality of these waters. This publication describes the steps taken by the International Joint Commission in conjunction with the pollution control agencies on both sides of the boundary. The information and data herein contained cover the period to the end of 1959.

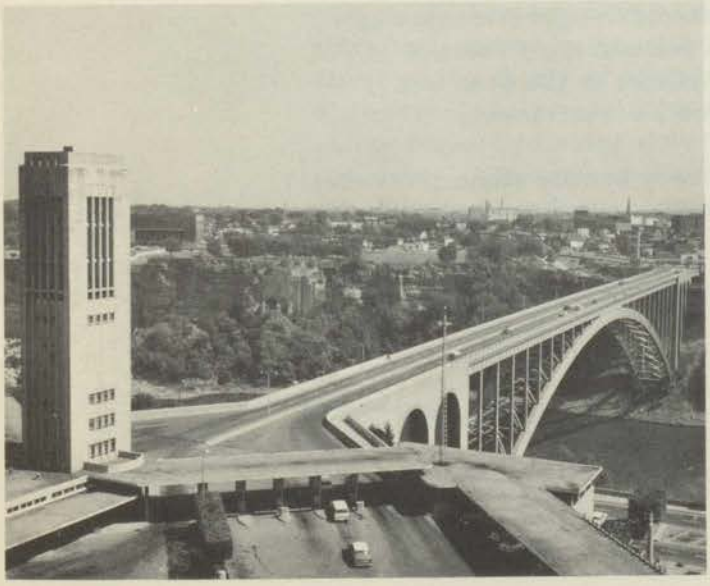
a brochure prepared by the Advisory Boards to the International

Modern bridges, conveniently located enhance



contents

Joint Commission on pollution of Boundary waters



communication across the boundary waters.

Dominion of Canada

Office of the Prime Minister

With so much that is controversial in the field of international relations, it is good to know that two countries with an extended common boundary can live as good neighbours, prepared to consider each other's viewpoints in seeking to resolve problems of mutual interest.

That this is so in respect of the United States and Canada is no accident but is the result of thoughtful and careful planning. The International Joint Commission was established by treaty dated the 11th day of January, 1909. In almost fifty years of service this commission has compiled an enviable record of success in resolving questions related to the use of boundary waters.

Not the least of the International Joint Commission's successes has been related to pollution abatement in the connecting waters of the Great Lakes Basin. It has had the support and encouragement of the governments of the States of Michigan and New York and the Province of Ontario. Industries and municipalities in the area are making excellent progress in pollution abatement.

This bulletin sets forth very briefly some interesting developments related to the safe-guarding of boundary waters quality. I commend it to you.

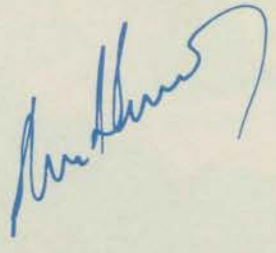
United States of America

Office of the President

Shared interests of Canada and the United States in the boundary waters have afforded another opportunity for both countries to demonstrate the ability to work together for the common good. The pattern of cooperation that has been developed over the years under the Treaty creating the International Joint Commission exemplifies the best in international relations.

The Great Lakes comprise the largest body of fresh water in the world. They are vitally important to health, recreation and the national economy of both countries. Large populations and great industries have developed along the shores of these watercourses, attracted by the available facilities so essential for domestic and industrial water supplies, recreation, drainage outlets, and for transportation and power. The welfare of these developments, and indirectly, of larger areas of both countries, is influenced in no small measure by maintenance of these waters free from objectionable pollution.

The successes attained by the International Joint Commission in pollution control are due in large measure to the coordinated effort of the States of Michigan and New York and the Province of Ontario. Municipalities and industries are to be commended on the important roles they have been performing in abating pollution. Wholehearted cooperation of those concerned has produced this record of accomplishment.




REGIONAL MAP SHOWING SECTIONS
OF
THE BOUNDARY WATERS
UNDER
1946-1948 REFERENCES
LAKE SUPERIOR
SAULT STE. MARIE
SAULT STE. MARIE
ST. MARYS RIVER
ST. JOSEPH ISLAND
ONTARIO
NORTH CHANNEL
STRAITS OF MACKINAC
MANITOULIN ISLAND
CANADA
UNITED STATES
GEORGIAN BAY
LAKE HURON
INTERNATIONAL BOUNDARY
SAGINAW BAY
ONTARIO
TORONTO
LAKE ONTARIO
MICHIGAN
PORT HURON
SARNIA
NIAGARA FALLS
NIAGARA FALLS
WELLAND CANAL
NIAGARA RIVER
BUFFALO
ST. CLAIR RIVER
MT. CLEMENS
DETROIT
BOUGE RIVER
LAKE ST. CLAIR
THAMES RIVER
CHATHAM
WINDSOR
DETROIT RIVER
MICHIGAN
OHIO
TOLEDO
CANADA
UNITED STATES
LAKE ERIE
NEW YORK
NEW YORK
PENNSYLVANIA
MAUMEE RIVER
CLEVELAND
OHIO
PENNSYLVANIA
PENNSYLVANIA
OHIO
CUYAHOGA RIVER
STATUTE MILES
25 0 25 50

an *International* activity

Each year brings into clearer focus the importance of the water resources of the North American continent. A large part of the surface waters of this continent is shared in common by the United States and Canada. The Great Lakes System of waterways constitutes the largest body of fresh water in the world. Over a third of the boundary between our two countries traverses these same waters.

It is of the utmost importance that these waters be safeguarded for the multiplicity of benefits they can confer upon the citizens of both countries. This mutuality of interest was recognized formally as early as 1909 with the signing of the Boundary Waters Treaty. In the half century since the International Joint Commission was authorized under that treaty it has been concerned with many problems. None, however, has been more worthwhile than the control of pollution in the connecting channels of the Great Lakes System.

This pollution problem has been a challenge over the years, having been the subject of two extensive international investigations, the one in 1912-18, the other in 1946-50. In the intervening period industry and population increased many fold. The Great Lakes have always been vital in supplying their needs, the most essential of which are for domestic water supplies, industrial water supplies, navigation, recreation, power, agriculture, and drainage.

It is obvious that there are many reasons for protecting the quality of these boundary waters, but there is none more important than the need for protecting health and property in both nations. The rapid growth of population and industry in the Great Lakes area will continue and will intensify the pollution problems unless appropriate restraints are observed. The Commission recognized this situation and instituted measures which provide a basis for continuing supervision. Objectives for boundary waters quality control were formulated and subsequently adopted by the Governments of both countries. Canada and the United States have the technical equipment and experience to provide continued leadership in this field and to preserve and enhance the values that may be derived from their water resources.

We believe that the people of our two countries will share the Commission's appreciation of the high degree of cooperation which has been extended to it by industries, municipalities and governments on both sides of the boundary in developing solutions to these water pollution problems. It is most important that effective measures should be taken to ensure protection from the ever-present danger of pollution, and these must be understood and supported by the people concerned and by all levels of government.

In order that the noteworthy progress which has been made under joint effort in clearing up pollution in these international waters may be more widely known, the Commission has approved the publication of this account of the situation and of the remedial actions taken and in progress.

Chairman, United States Section,
International Joint Commission.

Chairman, Canadian Section,
International Joint Commission.

Large steel, paper and chemical industries centre around the development of power and transportation on the St. Marys River at Sault Ste. Marie.

The Sarnia-Port Huron area is the focal point of paper, oil refinery, and chemical industries located on the St. Clair River.

Both sides of the river at Detroit and Windsor thrive with automotive, steel, distillery, and chemical industries.

The Niagara River exerts a strong influence on the economy and welfare of large areas in both countries through world renowned power developments serving homes and a multiplicity of industries.

a Focal Point *for growth*

From the earliest settlement the boundary between United States and Canada has been a focal point for a multitude of developments. Water transportation was the original incentive. Water still continues to be the dominant factor because of its singular place in the homes and in industry, both of which have spread rapidly along the border. Here major industries of many kinds have satisfied their demands for an abundant water supply. They could not operate under other circumstances. Cities and towns have grown in population, and areas have mushroomed into thriving centres of homes and commerce.

"A river is more than an amenity, it is a treasure. It offers a necessity of life that must be rationed among those who have power over it."

JUSTICE OLIVER WENDELL HOLMES

the value of the Boundary Waters

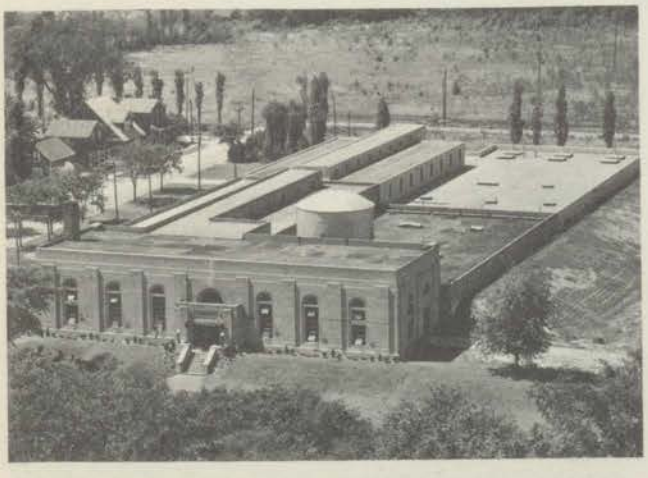
The Boundary Waters Treaty of 1909 recognized the importance of preserving the great asset which both countries possess in these boundary waters. Their value lies in the multiplicity of purposes for which they are presently utilized as well as their prospective future uses. One provision of the Treaty states:

"The following order of precedence shall be observed among the various uses enumerated hereinafter for these waters, and no use shall be permitted which tends materially to conflict with or restrain any other use which is given preference over it in this order of precedence:

1. Uses for domestic and sanitary purposes.
2. Uses for navigation, including the services of canals for the purposes of navigation.
3. Uses for power and for irrigation purposes."

Other water needs, such as for industry, for recreation, and for the support of fish and wildlife, which have come into prominence with the passing years, were not specifically cited in the treaty. It is appropriate that these expanded categories of water use must now be recognized. Irrespective of the uses specifically defined in the treaty, the controlling requirement is that these boundary waters shall not be polluted on either side to the injury of health and property on the other.

These waters constitute a natural resource which has been and continues to be developed extensively by both countries. If these resources are to be conserved for the maximum public benefit, their many and varied usages merit attention.

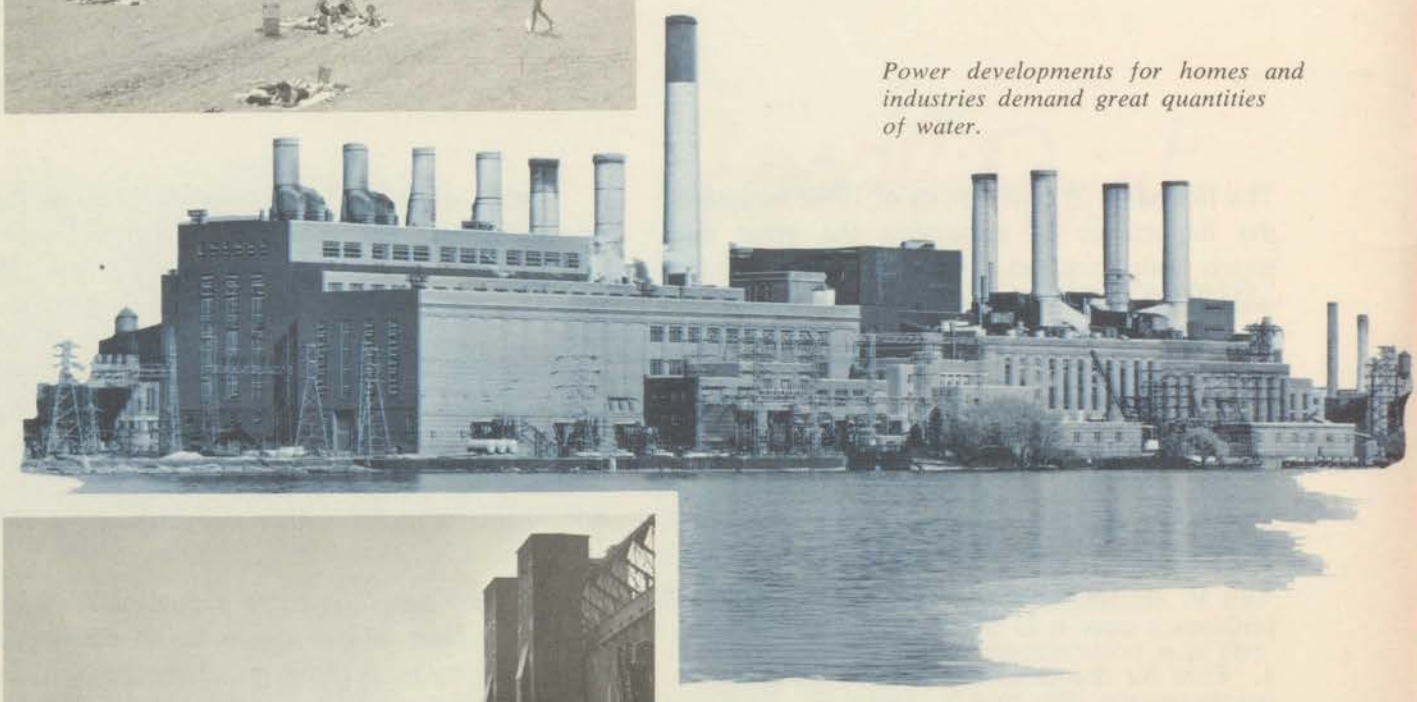


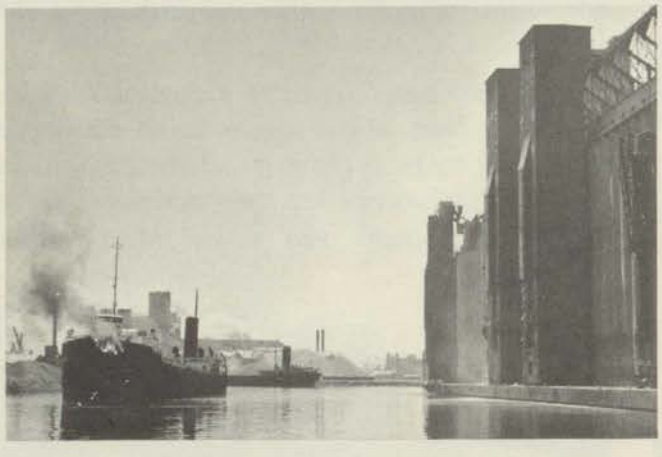
Modern purification and supply works are used to ensure adequate water supplies for domestic and sanitary purposes.

The needs of large industries for suitable water supplies are great along the boundary.

Bathing and recreation are valuable assets enjoyed by large numbers on the boundary waters.

Power developments for homes and industries demand great quantities of water.





Water transportation occupies an important place in the uses of boundary waters.

DOMESTIC WATER SUPPLY

Approximately 4,600,000 people, residing in some 90 communities, use the connecting waters of St. Marys River, St. Clair River, Lake St. Clair, Detroit River and Niagara River as a source of domestic water supply. For this purpose alone, there are 39 intakes supplying a total water use in excess of 888 million U.S. (740 million Imp.) gallons per day. This quantity serves all the major communities bordering the boundary waters as well as a considerable number located at some distance away from them. Water quality as affected by sources of pollution has been the prime factor in establishing the locations of the intakes with the result that supplies are taken from points at varying distances from shore. Nearly all of the supplies are treated by filtration and chlorination. In many instances, this treatment is augmented by measures for removal of taste and odour producing compounds of phenolic origin or their equivalents. At only three municipalities, by virtue of their locations at the head of St. Marys River and St. Clair River, are the supplies subjected to treatment only by chlorination for disinfection.

SANITARY PURPOSES

The major portion of the water withdrawn for domestic supplies is returned to the boundary waters as sewage, either treated or untreated. These waters receive the domestic sewage and industrial wastes from 100 sewer systems serving 96 municipalities having a population of 4,340,000 persons. These systems serve municipalities bordering the boundary waters and, near the larger metropolitan centers, extend to many adjoining cities and communities situated at some distance from them. In most instances their outlets are direct to the boundary waters, but a few discharge sewage and wastes to tributary watercourses in amounts sufficient to have pollutional impact on the boundary waters. While locations of the sewer outlets are distributed along extensive lengths of shorelines, the heaviest concentration of use for sewage and waste disposal occurs in the Detroit-Windsor and Buffalo-Niagara Falls districts.

NAVIGATION

The boundary waters are used as a highway for a large volume of vessel traffic. During a recent peak navigation season, vessel passages through the St. Marys River exceeded 22,270 carrying a total of 126,000,000 tons of commerce, primarily iron ore and grain. This exceeds in the eight month navigational season the combined tonnage passing through the Panama and Suez canals in an entire year. The importance of this waterway is illustrated by the fact that about 85% of the total iron ore produced in the U.S. is transported to steel mills via this route. The greatest concentration of vessel commerce along these boundary waters occurs through the Detroit River where total vessel passages in a recent season have exceeded 28,000 transporting 130,560,000 tons of total commerce, consisting principally of iron ore, coal, grain, limestone, and petroleum products. Vessel traffic in the Niagara River is restricted to the upper reaches at the port of Buffalo. Passages into and out of the port have totalled 15,900 carrying a net cargo of 20,000,000 tons during a navigation season.

Passenger vessel traffic is greatest through the Detroit River where approximately 1,000,000 persons are transported during a navigation season.

INDUSTRY

Boundary waters support a wide variety of industrial developments, including steel, chemical, pulp and paper, oil refining, automotive and steam power. These waters are used for processing steam power and cooling purposes. In addition, water for sanitary purposes is drawn from public supplies. It has been estimated that industry uses 2,000 million U.S. gallons per day for all purposes exclusive of steam power generation. The greatest use occurs at the industrial developments on the upper St. Clair River and the lower Detroit River, with the upper Niagara River next in magnitude. No industrial use is made of the lower Niagara River.

Most of the water is returned as wastes directly to the boundary waters, with a minor portion going to municipal sewers. The boundary waters also receive industrial wastes of some magnitude from the principal tributaries. Substantial volumes, supplied from municipal sources, ultimately reach the boundary waters by way of municipal sewers.

Fishing and hunting are favoured activities in many areas along the boundary waters.

The treated effluents discharged from sewage treatment works must be absorbed in and carried away by the boundary waters.

POWER AND IRRIGATION

Uses of boundary waters for development of hydro-electric power are centered on the St. Marys River and the Niagara River. The waters in the Lake Huron-Lake Erie section are not developed for this purpose. Hydro-electric power is generated by both countries from between two-thirds and three-quarters of the average annual flow of St. Marys River. On the Niagara River at Niagara Falls two hydro-electric plants in the United States and four in Canada have a total output of 1,049,000 kilowatts. Diversion of water for power development above the Niagara Falls is limited by treaty.

There are, as yet, no irrigation projects of any consequence along these boundary waters.

Big industries locate along the boundary waters to secure the many services provided by these waters.

Rural areas along the boundary look to these waters for agricultural uses.

RECREATION

Extensive recreational use is made of these boundary waters by the citizens of both countries. Pleasure boating and bathing are popular forms of recreation throughout the area. Registrations of pleasure craft of 16 foot length or larger, number in the tens of thousands. Innumerable craft of smaller size also ply these waters. The furnishing of docking and other services for these craft constitutes a sizeable enterprise.

Three types of bathing beaches, municipal, commercial, and private, operate in these sections of the boundary waters. While the number of beaches maintained by municipalities is not great, they provide recreational facilities for a large segment of the population. As an example, the Huron-Clinton Metropolitan Authority has established a public beach on Lake St. Clair to accommodate 40,000 people. Commercial beaches, operated for the public by private enterprise, are located mostly on Lake St. Clair. Bathing provides the basis for an ever expanding development of resorts and hotels catering to vacationers. There is bathing at private beaches in all parts of these waters. The many bays along much of the boundary waters' shoreline offer unlimited potential for extending this activity to areas which are presently developed to a limited extent.

Pollution has been an obstacle to the development of many sections of the shoreline which would otherwise be suitable for bathing.

FISH AND WILDLIFE

Fishing in the Lake Superior-Lake Huron and Lake Huron-Lake Erie Section is carried on principally by sportsmen, since commercial fishing in United States waters of these sections has not been permitted for many years. While commercial fishing on the Canadian side of Lake St. Clair continues, it has declined to an almost negligible point.

The proximity of the large centres of population of Detroit-Windsor and Buffalo-Niagara Falls to boundary waters leads to an intensive use and enjoyment of them for sports fishing. The St. Marys River is known as trout water. St. Clair River is noted as a habitat for walleyed pike. Perch fishing predominates in Lake St. Clair, but the lake is also considered to be one of the finest fishing grounds for muskellunge. Fishing continues in Lake St. Clair throughout the winter, and it is not uncommon to observe over 2,000 fishing shanties on the ice.

Both commercial and sports fishing are practiced in the waters from the eastern part of Lake Erie to Lake Ontario, except in the sections of rapid flow in the Niagara River. The value of Niagara River as a spawning area is considerable, there being large quantities of young fish in both the upper and lower river. In the upper Niagara River many man days and many thousands of dollars are expended in sports fishing. Species taken include blue and yellow pike, yellow perch, bass, northern pike and muskellunge. Ice fishing is productive for blue and yellow pike and yellow perch. The lower Niagara River in the gorge is not suitable for angling, but the lower quiescent reaches are important grounds for blue and yellow pike. Perch predominate near the mouth of the river in Lake Ontario. Commercial fishing in this section is also affected by regulations limiting the fishing methods that may be employed.

Certain areas of these waters are natural habitat for many kinds of water fowl and attract many hunters. The marshy shoals of Lake St. Clair and the lower Detroit River are particularly noted for migratory wild fowl. Many of these areas are leased as private hunting grounds. Two large areas, the St. Clair Flats and Pointe Mouillee, are protected and maintained as public hunting grounds. The Niagara River flyway is considered one of the most important in New York State and the Province of Ontario. The open areas of the river provide hunting for many species of ducks with the Golden Eye, Black and Mallard predominating. The Canada Goose also migrates along this flyway.

AGRICULTURE

Beyond the normal use of these waters for stock watering, no extensive development has been made for agricultural purposes. There is however, a distinct trend towards irrigation for agricultural purposes. Agriculture benefits by the use of these waters for processing of farm products.

Protection of water values

Many different lines of endeavor have been followed to protect the great values inherent in these boundary waters. Protection will be maintained and improved as long as attention is given to certain essential control activities. First and foremost of these must be the application of treatment measures to remove from the waste discharges those substances which may impair water quality. This must be accompanied by continuous and effective operation of waste treatment facilities, combined with observations of the effects from the uses made of the waters through means of continuous patrols, monitoring, and regular revaluation of performance of control measures. An acceptable standard of water quality as envisioned by the treaty can be assured if these actions are carried out effectively.

Monitoring of boundary waters.

Sampling and measuring waste discharges.

significance of Pollution

A heavily polluted tributary stream, with floating, offensive solids of sewage and industrial waste origin.

Oil and toxic substances kill fish and wild fowl, while organic substances deprive water of oxygen essential for aquatic life.

Pollution impairs the quality and usefulness of water. It makes it unfit for domestic or industrial use, and recreation, and may cause serious illness. It destroys fish and wildlife. It creates offensive conditions and interferes with navigation. It may create areas of desolation and render the stream useless for constructive purposes. It causes economic losses, and it reduces the capacity of the waters to perform their many beneficial and necessary functions.

The welfare of the people of both countries can be affected in no small measure by the degredation of these waters by pollution.

Solids in suspension and solution destroy the natural appearance of the water and form deposits in the river and along the shore, thereby interfering with recreation, navigation, and injuring food for aquatic animals.

The removal of deposited sewage and industrial wastes to maintain navigable channels in the tributaries results in visible offensive pollution when deposited in the boundary waters.

a United effort

Control of water pollution is an obligation upon all. It cannot be successful as an isolated effort by one party. In this instance the significance of pollution was recognized, as were the benefits of clean waters. It was essential that a united effort be made both to check on all sources of pollution and to abate these as rapidly as possible. It was recognized that the task was a formidable one in a waterway which must serve as the drainage outlet for large populations and vast industrial enterprises. The fact that this problem existed on both sides of the boundary

A HALF CENTURY OF

The 50th anniversary of the signing of the boundary wate
significant aspects of that treaty involved pollution of
It is appropriate at this time to examine the applicati

Article 4 of the Treaty stipulated that "boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other side". The International Joint Commission of six members was created under the authority of Article 7. The treaty provided procedures whereby any problem concerning rights or interests of either country along the common frontier would be submitted to the Commission. Thus any party or parties in one country may request the federal government of that country to refer the matter to the Commission. If accepted the proposal is brought to the attention of the other federal government, usually in the form of proposed terms of reference. Following discussions with other levels of government which have an interest in the problem, and after obtaining mutual agreement on the terms of reference, the problem is referred to the International Joint Commission. Set out in the reference are the questions which require answers. These negotiations are handled by the State Department in Washington, D.C., and the Department of External Affairs in Ottawa, Canada.

On receipt of the reference from the two governments the I.J.C. proceeds to investigate the questions referred to it. In references involving pollution the Commission studies and recommends courses of action which will bring about the desired remedial action. The authority for direct enforcement of pollution abatement measures is not expressly delegated by the treaty, this being largely a function of state and provincial governments. The Commission files its finding with the two governments after a thorough investigation of the facts. In arriving at its conclusions it has full authority to carry out investigations, summon witnesses, and hold public hearings.

The procedure for the Commission is to appoint advisory boards of technical experts to direct the field investigations and prepare the report of the technical findings. The report of the Commission is then prepared which includes recommendations to the two governments.

A pollution reference resulting in an investigation in 1913 covered the entire boundary waters. On April 1, 1946, the Commission received a reference concerning pollution in the waters of the St. Clair River, Lake St. Clair, and the Detroit River. This reference was later extended on two occasions, the first on October 2, 1946 to include

acted as an incentive rather than a deterrent.

This investigation and the remedial measures had the active participation of a number of organizations at Federal, Provincial, State, and Municipal levels. The two advisory boards were selected from the U.S. Public Health Service, the Michigan Water Resources Commission—successor to Michigan Stream Control Commission, Michigan State Department of Health, The Water Pollution Control Board of New York, the New York State Department of Health, The Department of National Health and Welfare of Canada, The Ontario Department of Health, and later the Ontario Water Resources Commission, as well as many municipalities on both sides of the boundary. The laboratories, personnel and facilities of all these agencies were combined together in a united effort to solve an International problem of great magnitude. This project had the active support of the press, the public, and all groups interested in conservation, recreation, fish and wildlife, and nature.

OF MUTUAL ACTION

water treaty on January 11, 1909 is now passed. One of the
of the boundary waters between United States and Canada.
lication of this mutual procedure envisaged by the treaty.

the St. Marys River, from Lake Superior to Lake Huron, the second on April 2, 1948 to cover the Niagara River from Lake Erie to Lake Ontario.

The initial step by the Commission was the appointment of a board of technical advisers to consist of eight members, two from the United States Public Health Service, two from the State of Michigan, two from the Department of National Health and Welfare of Canada, and two from the Ontario Department of Health. This was formed on May 15, 1946. This board continued to function when the scope of the reference was extended to the St. Marys River. A similar board was created under the reference extended to the Niagara River. Membership on this board was from the same agencies, except that two representatives from New York State served in place of the two from Michigan. All members represented agencies having responsibility for control of water pollution.

Under the direct supervision of these advisory boards comprehensive surveys were made for the Commission during the period 1946 to 1949 on the boundary waters and tributaries, as well as the principal sources of pollution. The field work was carried out by staff of all agencies represented on the advisory boards.

The reports of the technical advisers were incorporated in the "Report of the International Joint Commission—United States and Canada on the Pollution of Boundary Waters", published in 1951. Both governments accepted the report. This concluded that the waters under reference were being polluted contrary to the treaty. Remedial measures were recommended as well as objectives for boundary waters quality control. "Recognizing the need for maintaining constant vigil over these waters the Commission recommended that it be specifically authorized by the two Governments to establish and maintain continuing supervision over boundary waters pollution through boards of control appointed by the Commission".

The International Joint Commission then appointed Advisory Boards on control of pollution of boundary waters. These Boards, like the Technical Advisory Boards they succeeded, represented the same agencies. In April, 1957, the newly formed Ontario Water Resources Commission assumed the duties of the Ontario Department of Health in respect to water pollution. The same number of members continued on each Board.

water quality Investigations

Investigations on water quality for a proper appraisal of conditions require a variety of laboratory examinations conducted over an extended period of time. The tests must be related to the different kinds of pollution. These boundary waters have been subjected to extensive examinations for the many sources of pollution.

The first comprehensive study was made in 1913 and resulted in a final report published in 1918. This was largely concerned with bacteriological pollution from municipal sewage. Industrial wastes were of little concern. The extent of the pollution at that time called for a recommendation that remedial measures be instituted for control of sewage pollution. The outbreak of world war I and subsequent events adversely affected action on these findings.

In the period between 1913 and 1946 many important changes took place in the areas contiguous to the boundary. The population increased rapidly, and industrial expansion took on an unprecedented growth rate, particularly during the period of the second world war. These factors precipitated a demand for a further survey. It was started in 1946.

The conditions then called for a much wider range of tests on these waters and the incoming wastes. They included bacteriological and biological examinations, organic oxygen consuming substances, taste and odour producing compounds, toxic materials, and inorganic solids, oils and greases, as well as numerous hydraulic and physical measurements. These additional parameters of pollution were made necessary largely by the industrial uses of these waters for waste disposal when combined with sewage outlets.

The investigations were planned to determine the effects of a daily discharge of municipal sewage in excess of 750 U.S.M.G.D. (625 Imp. M.G.D.) from a population of more than 3½ millions. They were also to measure the effects of over 2 billion U.S. Gal. (1¾ billion Imp. Gal.) per day of industrial wastes of many kinds poured into these waters, some of which were oxygen consuming, some toxic, some oils, and some of several other kinds. Wastes from vessel traffic had also to be checked as well as any other activity, such as channel dredging which might impair the quality of the waters. The sampling programs and the analyses to be made in the field and the laboratory were aimed at detecting the effects of all these substances.

Well planned monitoring programs covered all strategic sections of the boundary waters.

Objectives *in pollution control*

Comparison reveals the marked difference.

"Clear and bright it should be ever,
Flowing like a crystal river,
Bright as light and clear as wind."

Tennyson

"'Twas twilight, and the sunless day went down over the waste of waters."

Byron

These objectives are clear and simple. They call for clean waters for the use and enjoyment of all. This quality is measurable by laboratory tests, but a clean stream is a pleasant environment for man, fish, and wild fowl. A sanitary locality is conducive to good health. The contrast between a foul-laden water and a clean stream presents a marked difference. Every good neighbourhood must be kept clean.

The objectives in pollution control for the boundary waters aim to create and maintain clean and healthy surroundings, to make it possible to use these waters for all purposes, to serve the large population on their banks, to permit industry to thrive, to offer attractive recreational facilities, and to supply the needs of agriculture, navigation, power and all others. Fortunately measures are available to make it possible to use these waters over and over again as they follow their long journey to the sea and to wash them clean of all stains and soiling from use just as dirty clothing, dishes or other articles can be cleaned for repeated use. In putting these objectives into practice it will be possible to serve the needs of ever greater population and vast industries. The boundary waters offer so many advantages that they must be expected to attract these developments year after year.

A clean water will have a low bacterial count, it will be free of taste, it will have a pleasant appearance, free of oil or floating substances, an absence of toxic substances or chemical wastes, and all in all close to those natural conditions unspoiled by man's carelessness and thoughtlessness. This is the objective in the task before the enforcing agencies for the boundary waters.

Progress towards objectives

The International Joint Commission at the outset created specific objectives for water quality in the boundary waters. These were intended to restore and to maintain these waters in a condition which would permit them to serve the many purposes expected of them. The objectives required facilities to be constructed and operated to provide effective treatment of sewage and all wastes. They set values upon the quality of the treated wastes and on the receiving watercourses. Accomplishments can thus be measured in three ways:

(a) by the construction of treatment facilities.

(b) by the measurement of constituents present in waste discharges.

(c) by analyses of receiving waters to measure pollution indices.

These parameters provide a means for comparing the changes in conditions produced by this international activity.

It will be apparent that the attainment of these objectives is a task of great magnitude. It has been complicated by the large volumes of water flowing along the boundary, the diversity of current directions, the problem of representative sampling under these conditions, growth and distribution of population resulting in changes of waste loading intensities, major expansion in industry with its many varieties of wastes and their continuous change in composition, and availability of funds to finance capital waste treatment programs.

SEWAGE TREATMENT

If a comparison were being made with the conditions obtaining at the 1913 investigation only sewage treatment would be considered. While sewage disposal is still a major factor, it is now supplemented by the polluting effects of industrial wastes.

Domestic sewage consists of all liquid wastes from residences, business and commercial establishments, but would not include wastes from industry. However, the flow in public sewers will in nearly all instances carry both domestic sewage and some industrial wastes. The principal constituents of domestic sewage are solids of body and household origin, some settleable and some non-settleable, organic oxygen consuming substances, greases, and bacteria and viruses of human sewage origin, many of which are of the disease producing variety. These substances have the capacity for causing in the receiving stream deposition of solids with resulting decomposition and release of offensive odours, depletion of dissolved oxygen necessary for aquatic life and production of septic or foul conditions, objectionable scum on surfaces and banks of streams, and for creating a health menace.

Sewage treatment is aimed at the reduction of these constituents to conform with the flow and use of the stream. Sewage treatment works fall into two main groups, depending upon the degree of purification attainable. Normal domestic sewage contains about 2/10 lbs. of solids in suspension per person per day, and 17/100 lbs. of oxygen consuming material (called B.O.D. —biochemical oxygen demand) per person per day, and bacteria measured by the coliform index numbering in the millions. Primary or partial treatment can be expected to remove about 60% of these solids, 35% of the B.O.D., and a negligible amount of bacteria unless disinfection is applied, usually by chlorine. Secondary, or what is termed complete treatment can remove up to 95% solids and B.O.D., and with disinfection a reduction of the coliforms organisms to values in the hundreds. Naturally the cost of secondary treatment is considerably higher. The objectives of the commission call for adequate primary treatment as the first stage in this over-all control program.

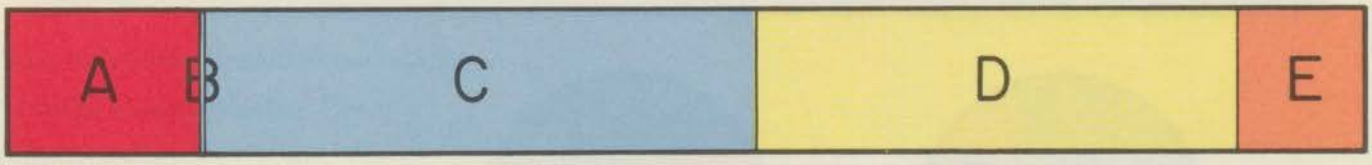
The construction of sewage treatment facilities provides one means for measuring progress.

When the investigation of boundary waters was completed it was reported that the population of the 61 municipalities in the three sections covered by the report was 3,557,900. Approximately 96% was served by sewer systems and 85% had primary treatment of the wastes before discharge. It was found that the bacterial concentration in these waters was in places three to four times greater on the average than in 1912. The total discharge of municipal wastes amounted to 750 million U.S. Gallons (625 million Imperial gallons) daily.

The status in respect to compliance with the objectives for sewage treatment is shown herewith:

STATUS OF SEWAGE TREATMENT IN MUNICIPALITIES—1959

	FIRST STAGE MET		COMPLIANCE NEEDS				ACTION ON NEEDS			
	A		B		C		D		E	
			All Facilities		Improved Facilities		Under Construction		In Planning Stage	
Bdry. Section	No.	Population	No.	Population	No.	Population	No.	Population	No.	Population
LAKE SUPERIOR LAKE HURON							4	75,100		
LAKE HURON LAKE ERIE	8	64,200	2	3,500	52	2,900,000	41	2,559,100	22	610,900
LAKE ERIE LAKE ONTARIO	19	963,900			3	12,300	4	12,500	6	57,700
TOTAL	27	1,028,100	2	3,500	55	2,912,300	49	2,571,600	28	668,600



The relationship to the different stages of compliance with the objectives in sewage treatment is reflected in this diagram.

In this table "First Stage" in compliance with the objectives means adequate sedimentation plus disinfection. The column on "Compliance Needs" divides the municipalities into those where no sewage treatment was in operation at the end of 1959, and therefore "All facilities" were required. The others had facilities which needed enlargement or improvements of some kind. The action being taken to meet the objectives in these municipalities is further subdivided in the final column of the table. It shows those which were under construction, and those in the planning stage.

There is much encouragement to be found in the progress on the Construction of plants where none had existed previously and in the continuing program of planning and preparation for construction of new and improved facilities in the immediate future. This program as at present envisaged provides for all municipalities to reach the first stage objective.

Continuing recognition of the needs of increasing population will be required to ensure that sewage treatment facilities keep pace through enlargement and modernization. It is only in this way that the program for cleanliness and quality in these boundary waters can be fulfilled and maintained.

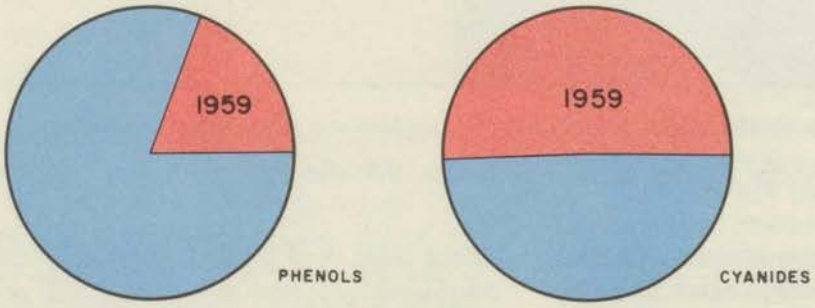
The 1946-48 investigation revealed an average daily discharge of industrial wastes into these boundary waters of more than 2 billion U.S. gallons (approximately 1¾ billion Imperial gallons). This was in addition to these industrial wastes discharged to public sewers and mixed with domestic sewage. While much of this was condenser and cooling water which had not been adversely affected, an appreciable amount of harmful pollutants was reaching the waters. These included some 13,000 pounds of phenols, 8,000 pounds of cyanides, 25,000 pounds of ammonium compounds and large quantities of oils and suspended solids of all types. These industrial wastes, in addition to the toxic effects had a biochemical oxygen demand (B.O.D.) equivalent to the oxygen demand of the untreated sanitary wastes from a population of more than 4,000,000. Thus the industrial wastes were producing a greater oxygen requirement on the receiving streams than the combined total of the domestic wastes of the entire area.

The industrial wastes were divided among the three sections of the boundary as follows in 1948:

INDUSTRIAL WASTES 1948

WASTES	LAKE SUPERIOR LAKE HURON	LAKE HURON LAKE ERIE	LAKE ERIE LAKE ONTARIO	TOTAL
M.G.D. (U.S.)	148	1,430	496	2,074
M.G.D. (Imp.)	124	1,191	413	1,728
Phenols — pounds	280	6,340	6,370	12,990
Ammonium compounds — pounds	3,500	11,625	10,565	25,690
Cyanides — pounds	3,170	3,695	1,755	8,620
Oils — Gal. (U.S.)	1,020	18,730	1,890	21,640
Gal. (Imp.)	850	15,590	1,575	18,015
B.O.D. — pounds	217,900	354,500	96,000+	668,400+
Pop. equivalent — persons	1,282,000	2,110,000	565,100+	3,957,100+
Suspended Solids — pounds	75,000	2,295,900	757,130	3,128,030

In these circles the total areas wastes discharging in 1948. represent the wastes b



The significance of these improvements in control of industrial wastes must be related to the conditions created by each. The objectives for boundary waters control are designed to maintain these wastes at such figures that they will not impair the quality of the water in these streams.

Phenols, if uncontrolled can be responsible for objectionable tastes and odours in the water, for tainting of fish, and general interference with the use of the water. Cyanides are toxic substances which can kill aquatic life. Oils are objectionable in many ways including appearance, swimming, boating, and wildlife. The B.O.D. can cause depreciation in oxygen of the water and when this reaches a low level it endangers aquatic life, produces odour and offensive appearances. Thus the maintenance of these below specific limits means a major improvement in water quality.

The wastes contributed by navigation as part of the industrial problem is more uniformly

These large quantities of industrial wastes had a deleterious effect by adversely affecting taste and odours, aquatic life, cost of water treatment, waterfront property values, and recreation.

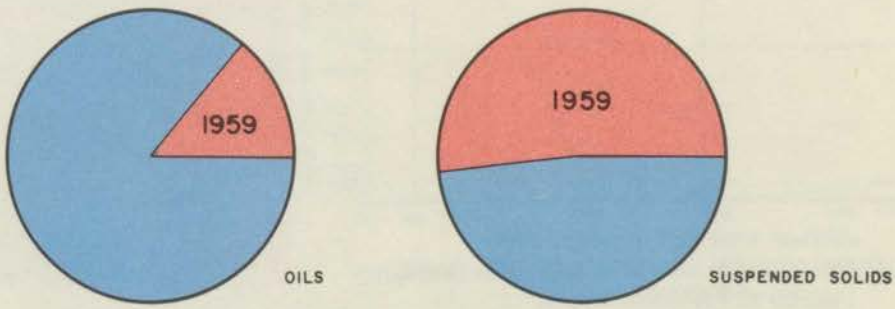
In the intervening period from 1948 to 1959 major accomplishments have been made in reducing these industrial wastes to the point where they can meet the objectives for water quality. The improvements made to date can in part be shown by statistics, but in doing so it is essential to keep in mind that great industrial expansion has taken place in this area in 10 years, and if no improvement had been made in these waste treatment processes the extent of water pollution would have grown to a great extent. The reduction in the discharge of these quantities of waste products has even greater significance than if no growth or change had occurred in industry. The volume of waste in gallons does not decrease but the constituents are altered.

Some measures of industrial waste improvement are shown in these tables:

INDUSTRIAL WASTES 1959

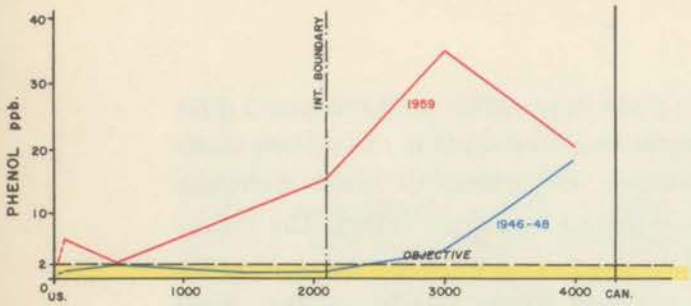
WASTES	LAKE SUPERIOR LAKE HURON	LAKE HURON LAKE ERIE	LAKE ERIE LAKE ONTARIO	TOTAL
Phenols — pounds	530	1,233	730	2,496
Ammonium compounds — pounds	61,287	24,721	8,120	94,128
Cyanides — pounds	3,729	384	245	4,358
Oils — Gal. (U.S.)	260	2,301	475	3,036
Gal. (Imp.)	217	1,918	396	2,531
Suspended Solids — pounds	61,950	1,065,400	493,550	1,620,900

represent the amount of the particular
The portions identified as 1959
being discharged in that year.

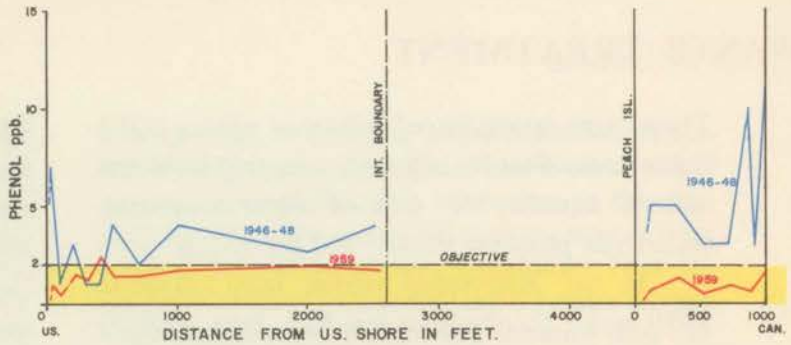


distributed than others. While still objectionable it shows less conspicuously in the sampling programs for these waters. In 1948 it was estimated that the sewage from vessels at the height of the navigation season was equivalent to the wastes contributed by a population of 1,000 in the St. Marys River and a population of 3,900 in the St. Clair-Detroit River area. In addition to this was the problem of disposal of garbage, bilge water and water ballast; especially in ports and congested areas.

The navigation problem has been attacked in an effort to reduce this pollution to where it will not create either an objectionable appearance or impair the usefulness of the water. This remains a continuing problem with ever closer supervision and rigid requirements. Similarly the disposal of material from the dredging of channels is an intermittent problem requiring careful planning to avoid pollution of waters in any place to interfere with their proper use.

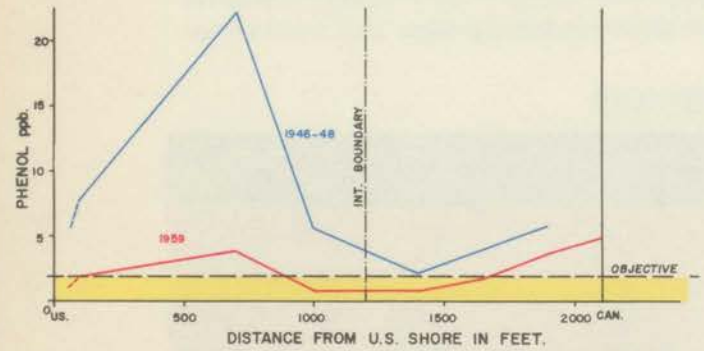


PHENOLS BELOW SAULT STE MARIE
(SMD. 2·0)

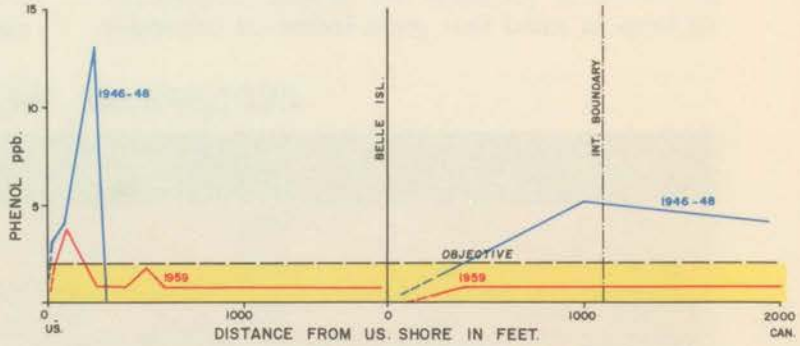


PHENOLS - ENTRANCE DETROIT RIVER
(30·8 W. AND 30·7 E)

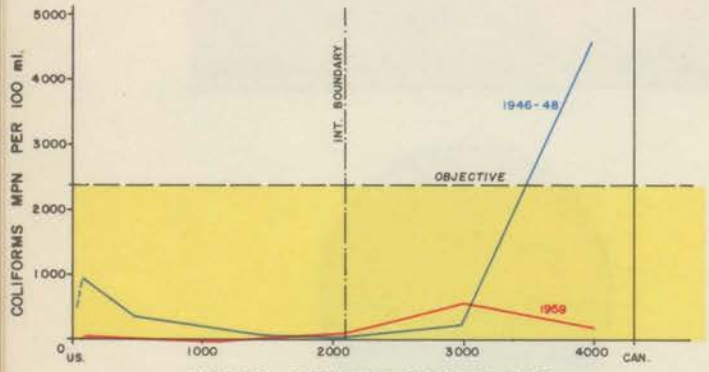
THE PHENOL RESULTS REFLECT THE PRESENCE OF CERTAIN INDUSTRIAL



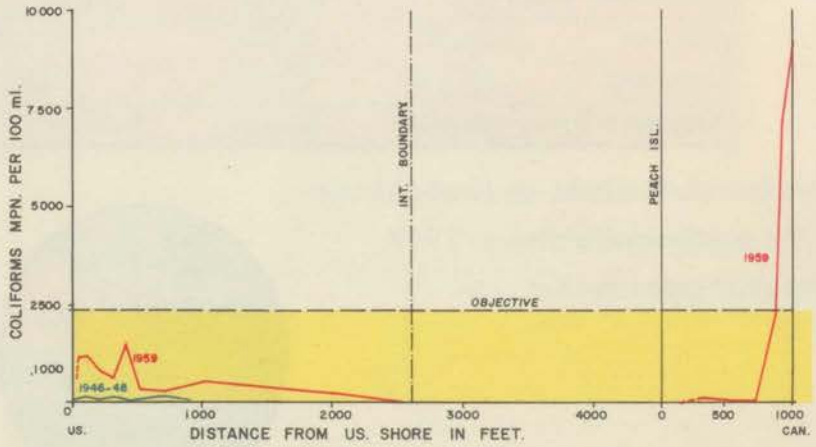
PHENOLS - ST. CLAIR RIVER AT PORT LAMBTON
(SR 13·7)



PHENOLS - DETROIT RIVER AT BELLE ISLAND
(29·2 W. AND E.)

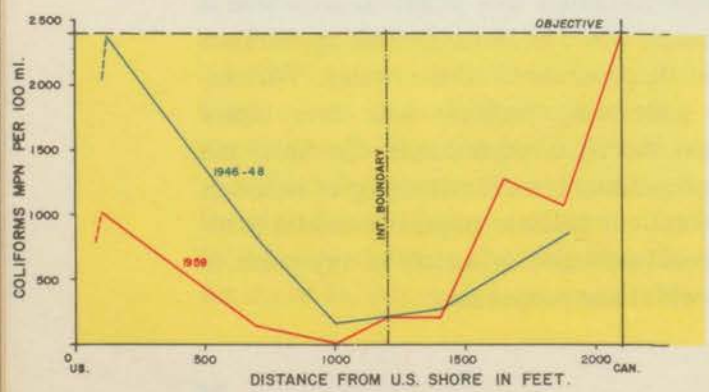


COLIFORM COUNTS BELOW SAULT STE. MARIE
(SMD 2·0)

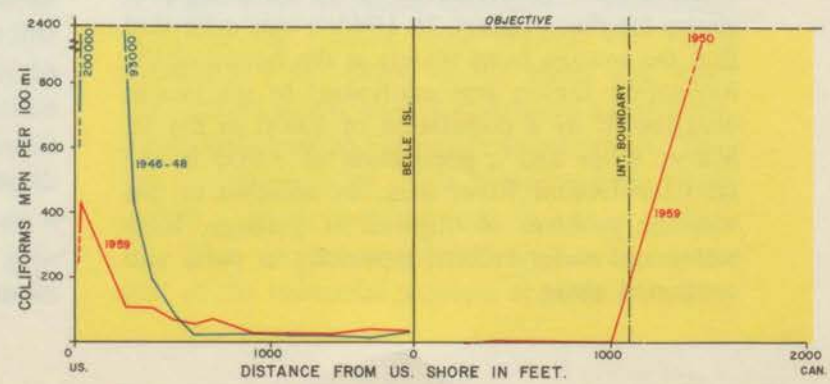


COLIFORM COUNTS - ENTRANCE DETROIT RIVER
(30·8 W. AND 30·7 E.)

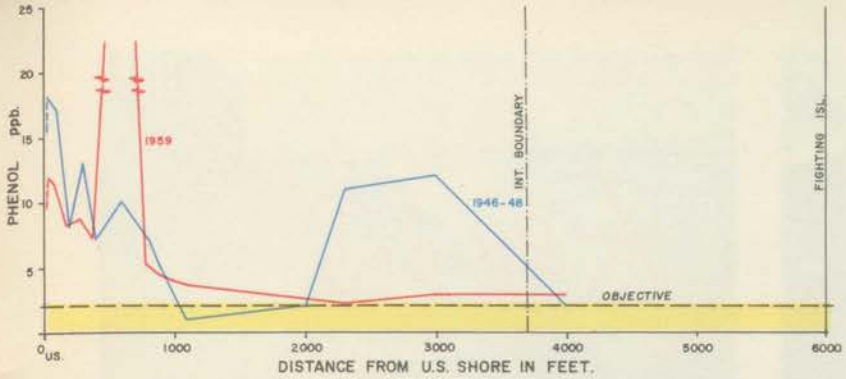
THE COLIFORM RESULTS ARE INDICATIVE OF POLLUTION BY WASTES



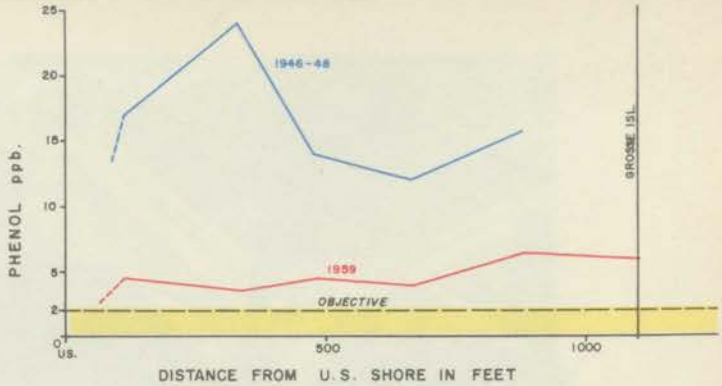
COLIFORM COUNTS - ST. CLAIR RIVER AT
PORT LAMBTON (SR 13·7)



COLIFORM COUNTS DETROIT RIVER AT BELLE ISLAND
(29·2 W. AND E.)



PHENOLS - DETROIT RIVER AT FIGHTING ISLAND
(14·6W)



PHENOLS - DETROIT RIVER - TRENTON CHANNEL
BELOW WYANDOTTE (12·0W)

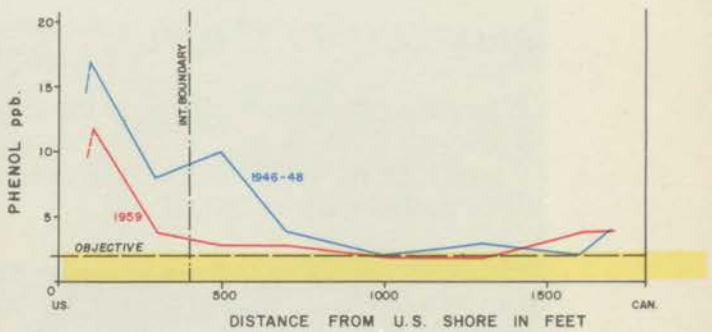
AL **WASTES WHICH CAUSE A VARIETY OF OBJECTIONABLE EFFECTS.**

POLLUTION INDICES FOR WATER QUALITY

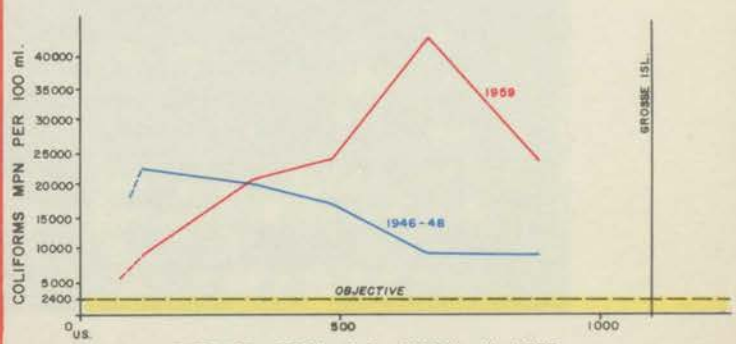
The second parameter used for determining the accomplishments in this period involves sampling of the boundary waters at specific points. The reduction in the discharge of untreated sewage, the various industrial wastes and other controls put into effect must be reflected in improved water quality. These should reveal the relationship with the objectives of the Commission, as well as showing what further steps are necessary.

The tests made on the receiving waters are for the most part the same as those on the wastes being discharged. They include bacterial analyses (coliform figures), phenols, cyanides, oils, ammonium compounds, B.O.D., and suspended solids. Some are more significant than others in measuring the improvement in this period.

These changes in water quality can be seen by the accompanying graphs which show comparisons at selected sampling stations between the 1948 results and the later ones.

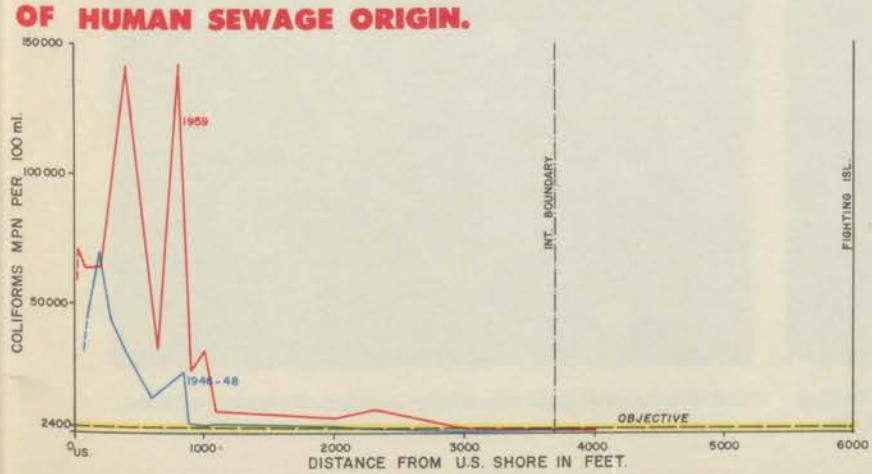


PHENOLS NIAGARA RIVER BELOW BUFFALO
(34·3)

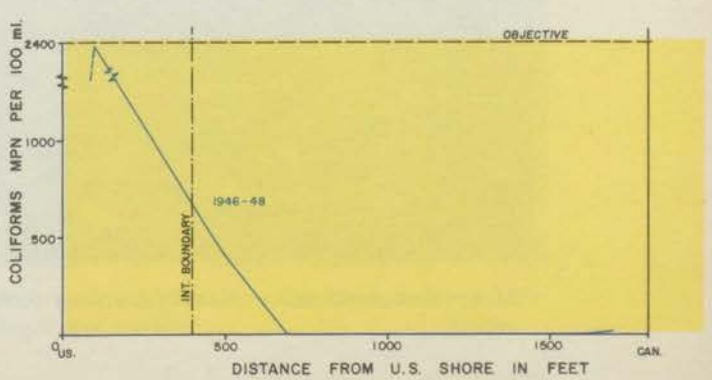


COLIFORM COUNTS - DETROIT RIVER - TRENTON CHANNEL
BELOW WYANDOTTE (12·0W)

ES **OF HUMAN SEWAGE ORIGIN.**



COLIFORM COUNTS - DETROIT RIVER AT FIGHTING ISLAND
(14·6W)



COLIFORM COUNTS - NIAGARA RIVER BELOW BUFFALO
(34·3)

Results

PROGRESS IN COLIFORM REDUCTION

These coliform analyses as seen in the graphs for the periods 1946-48 and 1959 are related to the objective set by the Commission of 2,400 Most Probable Number per 100 ml.

Since the most significant source of coliform counts is domestic sewage it can only be expected that improvements will follow when treatment facilities are in operation. Much work is in progress in this field, and the most encouraging feature is the plan which will shortly include treatment of all these wastes. The graphs reveal that at certain stations in the ranges shown the coliform counts still exceed the objective. In other places, such as at the mid-section of the river, they are well below this desired figure. The program of sewage treatment and control of wastes is aimed at restoring all parts of these waters to the condition where they will meet the prescribed objective.

PROGRESS IN PHENOL REDUCTION

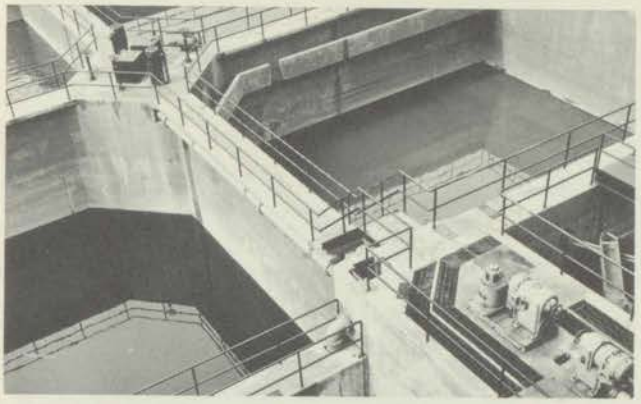
Phenolic compounds are important polluting substances. For this reason it is important to note the change made in the interval between the two surveys, 1946-48 and 1959. This is reflected both in the overall reduction in phenolic discharges and in the analyses of the receiving waters. The total discharge of phenol was reduced from the initial figure of 12,990 lbs. per day to 2,496 lbs. per day.

The graphs shown for phenol concentrations at selected ranges reveal the amounts in the waters at each survey and show comparisons of these figures with the objective of not more than 2 ppb average. The improvement brought about between the two surveys has been most marked. While further changes are needed at some locations this program is well advanced towards meeting the very rigid requirements of this objective.

Many sewage treatment plants have been built in this period.

A waste problem solved by a phenol recovery plant.

The oil industry acts to prevent oil wastes polluting the waters.

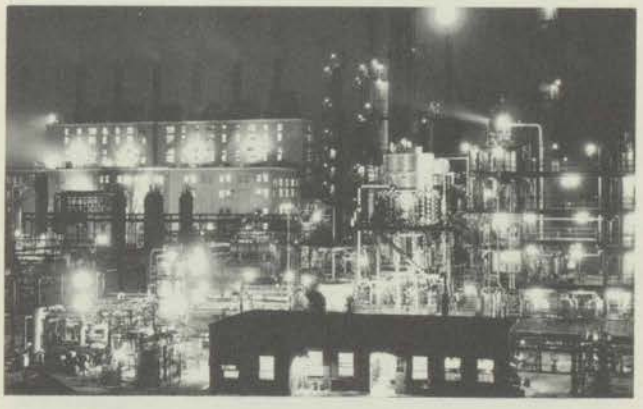


The removal of toxic substances protects fish and aquatic life.

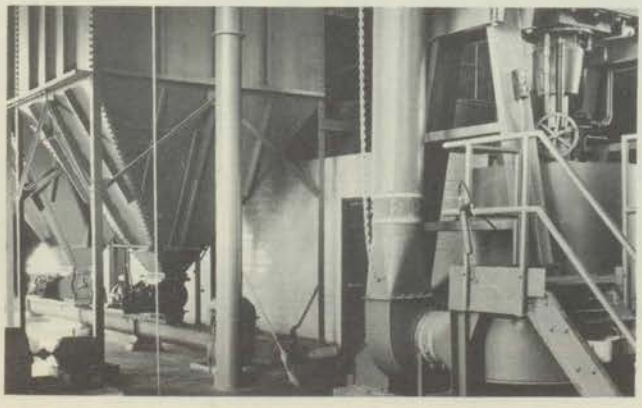
The removal of solids from the automotive industry's wastes.

Treatment of chemical wastes to prevent tastes and odours in water.

Steel mills treat their solids and oil-bearing wastes.



Large industries require extensive waste treatment facilities.



Recovery of by-products from distillery wastes prevents organic-type pollution.

A waste treatment plant for a modern industry safeguarding water quality.

Continuing Activities

In keeping with the directive of the Federal Governments the International Joint Commission has put into effect a comprehensive program of continuing activities. These cover a wide field embracing the Advisory Boards, relationship with other agencies and special projects.

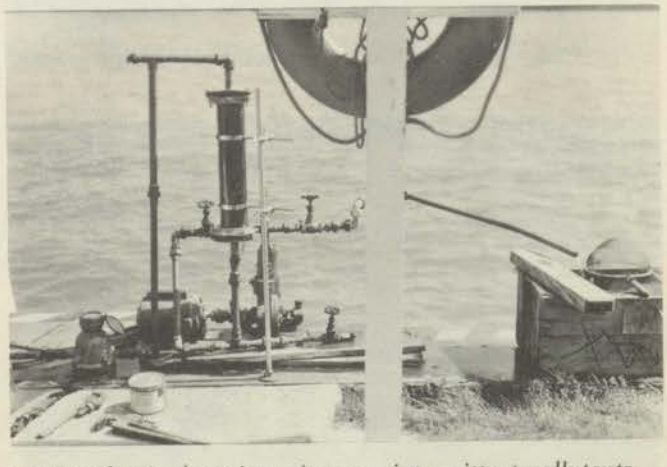
Advisory Boards to the International Joint Commission

The Advisory Boards to the International Joint Commission maintain continuous supervision over water quality in all sections of these boundary waters. One Board now functions for the Lake Superior-Lake Huron-Lake Erie section with representatives from the United States, Canada, Michigan and Ontario. A second Board operates for the Lake Erie-Lake Ontario section, and consists of representatives of Canada, United States, Ontario and New York. The members keep their particular areas of jurisdiction under surveillance and report at semi-annual meetings of the progress in abating and controlling pollution. A formal report on the preceding six months' activities is submitted twice a year to the Commission.

In the continuing activities of the Commission, the Advisory Boards perform the function of supervising special survey units established by the respective Federal Governments and appropriate enforcement agencies. These measures

Relationship with Other Agencies

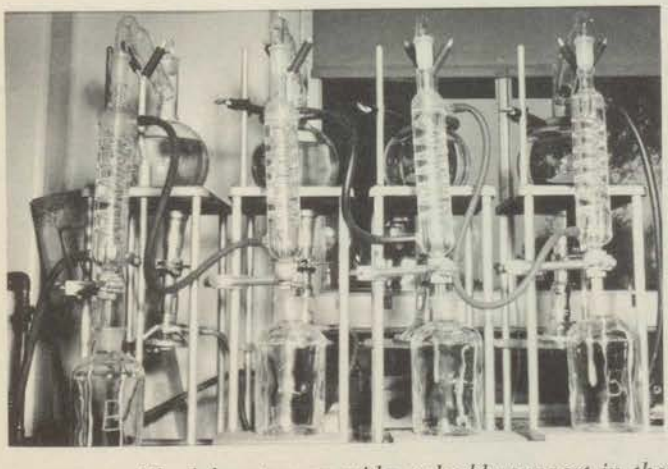
The prime responsibility for the control of pollution of these boundary waters rests with the States of Michigan and New York and the Province of Ontario. Besides the objectives of the International Joint Commission, these governmental agencies have their own laws, rules and regulations relating to pollution of waters under their jurisdiction. These enactments are specific as to the requirements of adequate treatment of all sanitary and industrial wastes before discharge to the waters from all new installations. There are also legislative requirements with reference to control of waste discharges which existed at the time the legal controls were adopted. While it is



Monitoring devices are of great value in detecting minute or intermittent pollutants.

include such devices and procedures as continuous sampling at critical locations for the detection by specially designed techniques of minute quantities of pollutants, periodic sampling of river cross-sections, examination of the water received at the intakes of water systems, evaluation of the performance of waste treatment facilities, appraisal of the effects of waste discharges on the boundary waters, and all other matters relating to the safeguarding of boundary waters' quality in accordance with the Treaty and the objectives.

a relatively simple matter to incorporate waste control features into a plant that is in the planning stage, it is much more difficult to abate pollution from an existing plant. The control agencies have rendered effective service to the Commission in abating pollution as can be seen from the accomplishments recorded.



The laboratory provides valuable support in the continuing appraisal of water quality.

Special Projects

Special programs or projects have been undertaken to supplement the original investigation and the later action on pollution control. These are intended both to prevent pollution and to detect small quantities in the streams as well as to aid in waste purification. These programs are under constant review and are carried on as part of an energetic campaign to protect water quality.

Research into new methods of detecting waste or incipient impairment of water quality is a primary part of these special projects. Devices such as carbon filters are being refined and utilized for detection of minute quantities of polluting materials. These are used at a number of check points in the boundary waters. Similarly, the effects of these wastes on aquatic life are being assayed by biological means using fish and other organisms for testing purposes. Thus, research becomes an important ally in the field investigation.

Accidental spills of pollution must always be considered where complex industrial systems are in use. Efficient warning systems to downstream water users have been instituted along these boundary waters. They have been developed to the point that when any unexpected or accidental condition occurs, others likely to be affected are quickly notified so that appropriate action can be taken.

Efforts are constantly being made to improve waste treatment processes. The trend is towards higher quality of treated effluents. This applies to all wastes but more particularly to those from industrial processes. The complex and varying nature of these make research and plant studies most valuable. Measures are being taken to meet this challenge.

The evaluation of effects of overflows from combined sewers during storms is under review and investigation. This work is directed towards determining the effects on boundary water quality in relation to the objective.

Conclusions

This review of accomplishments would not be complete without indicating what can be expected in the future. Can these waters be so protected that they will be an international asset capable of serving the many uses for which they are intended?

The results to date in pollution abatement are gratifying. They reveal reductions in pollutants and improvements in water quality. Municipal sewage treatment works have been either built or planned for practically all urban centres on the boundary. Industry has taken major steps to give effective treatment to their wastes. Such difficult wastes as phenol, oil, toxic substances, solids and others have been markedly reduced.
The receiving watercourses have responded to this program, and the analytical results show these improvements. The attainment of the objectives of the Commission has come nearer. Equally, or even more important is a growing recognition of an international resource, the boundary waters. Municipalities are responding to their responsibilities in sewage treatment, and industry has recognized the importance of its part in this overall international program.
This cooperation among all parties augurs well for the future.

In spite of the good results attained to date, there still remains a major program to ensure that all sections of the boundary waters will reach the desired objectives and continue in this condition. Population increases, as well as industrial expansion all along the boundary will result in greater use of these waters for carrying away wastes. Water quality can only be safeguarded by the application of high standards of waste treatment. The programs of State, Provincial and Federal agencies, coupled with research and construction schedules are striving to reach that goal.

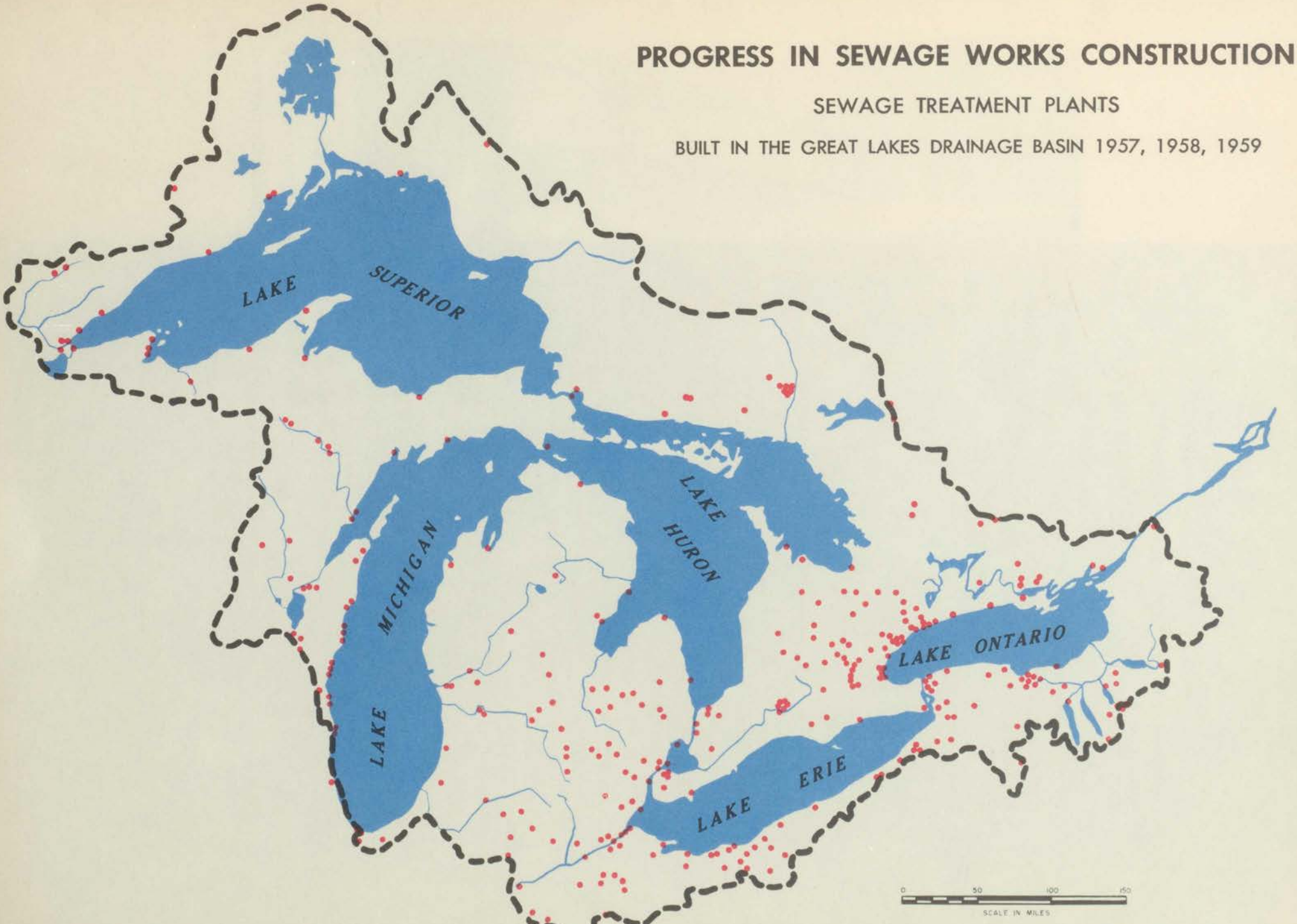
The satisfactory quality of these waters in the future can be secured and maintained. They can be used and enjoyed by the people of both countries continuing as one of the greater natural resources as long as the rain falls and the rivers flow. This will be possible only if there is a public acceptance of these abatement programs and continued and active support by all. These agencies in the States and the Province share in the burden of advancing this program. Only through full support given to the Commission and the enforcing agencies at the State and Provincial levels will this hope be realized.

"Clear and Gentle Stream!
Known and Loved so Long."
BRIDGES

PROGRESS IN SEWAGE WORKS CONSTRUCTION

SEWAGE TREATMENT PLANTS

BUILT IN THE GREAT LAKES DRAINAGE BASIN 1957, 1958, 1959



"I see what was, and is, and will abide;
Still glides the stream, and shall forever glide;
The form remains, the function never dies."

WORDSWORTH

On the boundary waters pleasure boating and other recreational uses are compatible with intensive industrial developments.

ADVISORY BOARDS ON CONTROL OF POLLUTION OF BOUNDARY WATERS

FOR THE UNITED STATES

L. F. Warrick, Sanitary Engineer Director, Department of Health, Education and Welfare, U.S. Public Health Service, Washington, D.C. (1952-).

H. H. Black, Sanitary Engineer Director, Department of Health, Education and Welfare, U.S. Public Health Service, Cincinnati, Ohio. (1952-1959).

S. C. Martin, Regional Engineer, U.S. Public Health Service, New York, New York. (1959-).

H. W. Poston, Regional Program Director, Water Supply and Pollution Control, U.S. Public Health Service, Chicago, Illinois. (1959-).

FOR CANADA

J. Ross Menzies, Chief Public Health Engineering Division, Department of National Health and Welfare, Ottawa, Ontario. (1952-)

W. R. Edmonds, Assistant Chief, Public Health Engineering Division, Department of National Health and Welfare, Ottawa, Ontario. (1952-).

FOR MICHIGAN

L. F. Oeming, Chief Engineer, Michigan Water Resources Commission, Lansing, Michigan. (1952-).

J. M. Hepler, Director, Division of Engineering, Michigan Department of Health, Lansing, Michigan. (1952).

W. F. Shephard, Director, Division of Engineering, Michigan Department of Health. (1952-1959).

J. E. Vogt, Director, Division of Engineering, Michigan Department of Health. (1959-).

FOR ONTARIO

A. E. Berry, General Manager and Chief Engineer, Ontario Water Resources Commission, Toronto, Ontario. (1952-).

A. V. DeLaporte, Director of Laboratories and Research, Ontario Water Resources Commission, Toronto, Ontario. (1952-1959).

F. A. Voege, Director of Laboratories, Ontario Water Resources Commission, Toronto, Ontario. (1959-).

FOR NEW YORK

Earl Devendorf, Director, Bureau of Environmental Sanitation, New York State Department of Health, Albany, New York. (1952-).

C. R. Cox, Chief, Water Supply Section, Bureau of Environmental Sanitation, New York State Department of Health, Albany, New York. (1952-1954).

A. F. Dappert, Executive Secretary, New York Water Pollution Control Board, Albany, New York. (1954-).

THE INTERNATIONAL JOINT COMMISSION

UNITED STATES 1961 CANADA

Printed in Canada