



# **GREAT LAKES DIVERSIONS & CONSUMPTIVE USES**



*International Joint Commission*





# **Great Lakes Diversions and Consumptive Uses**

A Report to the Governments of the  
United States and Canada under the 1977 Reference

January 1985

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# EXECUTIVE SUMMARY

## *Introduction*

The Great Lakes, their connecting channels and the St. Lawrence River have been the key to the development of the industrial heartland of North America, providing economical and efficient transportation; low-cost hydro-electric power; abundant water supplies for domestic, agricultural and industrial needs; and for depositing municipal and industrial discharges. Estimates of economic activity in 1975 amount to some \$155 billion in the United States portion of the basin and some \$27 billion in the Canadian portion. In addition to their economic and social value and the contribution the Great Lakes make to the quality of life of the citizens of the basin, their environmental value is incalculable, containing as they do numerous species of mammals, reptiles, birds, fish and plants.

The basin's abundant water supply has largely been taken for granted, for the lakes are the largest freshwater chain in the world and store about one-fifth of the world's fresh water. Serious disputes have not arisen between the United States and Canada regarding the use of this shared resource, even though all of the water the basin contains is currently being utilized in some way. There is in effect no 'surplus' resource, but rather competition among users. Yet if demands on the resource increase, the competition among users, both domestic and international, will do likewise. It is appropriate, therefore, to examine existing and potential activities that have or could have a significant impact on the supply and consequently the sharing of the resource.

This Report of the International Joint Commission concerning diversions and consumptive uses of Great Lakes water has been prepared in response to a reference from the Governments of Canada and the United States, dated February 21, 1977, and continues the Commission's long involvement in Great Lakes water quantity issues, which first emerged through concern about lake levels. The Commission established the International Great Lakes Diversions and Consumptive Uses Study Board (the Study Board) to conduct the required technical investigations.

The Commission's Report on the reference is in two parts. Part One examines the effects of existing diversions, the potential to improve extremes in Great Lakes levels by changing existing diversion flow rates, and existing and projected consumptive uses in the Great Lakes basin. Part Two provides a broader and more appropriate context within which to address the longer-term prospects for the use of Great Lakes water.

## *Part One: Diversions*

The Commission reviews the existing diversions at Long Lac, Ogoki, Chicago, and the Welland and New York State Barge Canals. The review shows that the diversions at Long Lac, Ogoki, Chicago and the Welland Canal have produced changes in Great Lakes levels and outflows, though the hydraulic effects are small in relation to the natural ranges on the lakes. The New York State Barge Canal diversion has no hydraulic effect on any of the Great Lakes. The diversions have also increased the long-term mean outflows from each lake, but the current regulation plans for Lakes Superior and Ontario have been designed to accommodate these diversions.

The Commission finds that while each diversion has been analysed to the extent possible within the constraints of the investigation, the information available is insufficient to draw any cumulative basin-wide economic or environmental implications. For many reasons discussed in the Report, the economic analysis must be treated with caution as a basis for decision-making.

With respect to the existing diversions, the Commission notes that there is a history of consultation and a recognition of the legitimate interests of both countries that has, regardless of legal considerations, by and large been reflected in mutual co-operation and concern. Nevertheless, there are several matters regarding existing diversions, both large and small, that might usefully be examined by Governments. For example, the Commission finds that although most data on existing major diversions are reported regularly to both Governments, through the Commission or otherwise, this does not appear to be the case for small diversions. In addition, the international requirements under the 1909 *Boundary Waters Treaty* with respect to both large and small diversions of boundary waters are not explicit, nor is any consistent practice followed.

The Report examines the Increased Lake Michigan Diversion at Chicago Demonstration and Study Program authorized by the U.S. Congress in October 1976. The study portion of the program resulted in several computer model simulations of large diversion increases; they determined that such increases were not economically justified. The demonstration part of the program was never funded and no actual demonstrations were conducted. The Commission finds that there are now no sponsored or approved new or changed major diversions in the basin.

The Commission's investigation shows that the present flow rates of the four diversions studied can be modified without structural change at existing locations to reduce high levels and raise low levels by various but small amounts. With respect to reducing levels, under all diversion management scenarios except one – which essentially has been in effect since 1979 and has a financial benefit – substantial net annual direct financial losses appear to accrue to the sectors considered in the analysis. The net losses are such that the further manipulation of diversions for the purpose of alleviating the adverse effects of high lake levels is not justified. As for raising low levels, the one alternative studied would result in a small net financial loss as currently assessed. However, should hydrological or economic criteria within certain sectors change significantly in the future, or should other considerations that would benefit from such a changed regime be given sufficient weight, the divergence of values under this scenario is sufficiently small that this management scenario might become more attractive.

### *Part One: Consumptive Uses*

The second major area considered in Part One involves existing and reasonably foreseeable patterns of consumptive uses in the Great Lakes basin. Large quantities of water are withdrawn from the Great Lakes and their surface and groundwater tributaries for industrial (primarily manufacturing and power generation), agricultural and domestic purposes and for other human activities. In 1975, the base year for the Study Board's work, withdrawals in the Great Lakes basin totalled roughly 2,120 cubic metres per second (75,000 cubic feet per second), with close to 95 per cent of this water being returned to the basin after use.

Consumptive uses as reported by the Commission's Study Board totalled about 140 cms (4,950 cfs) in 1975. Another estimate of consumptive uses for the U.S. portion of the basin by the United States Geological Survey differs considerably from that of the Study Board. Consequently, the Commission finds that existing (1980) consumptive uses may be in the range of 82 cms (2,900 cfs) to 159 cms (5,600 cfs). The Commission emphasizes, however, that regardless of which estimate is more accurate, existing consumptive use data need to be improved in several areas in order to establish useful historical trends and to improve forecasts.

In assessing future consumptive uses in the Great Lakes basin, the Commission carefully considered the Study Board estimates for the years 1975 to 2035. The Commission concludes that projections beyond the year 2000 are too speculative and uncertain for planning and policy decisions given the imprecision in the forecasts of economic and demographic changes and the differing estimates of existing consumptive uses in the U.S. portion of the basin. In addition, the Commission revised downward the Study Board's estimates for the two largest growth sectors, power generation and manufacturing, based on events since the Study Board completed its work.

The Commission's investigation shows that consumptive uses in the Great Lakes basin will increase and that, based on current information and analysis, the most likely projection

of consumptive uses in the year 2000 will be of the order of 161 cms (5,700 cfs) to 238 cms (8,400 cfs). The Commission concludes there is a strong need for continual improvement in information on historical and projected water use trends in general and consumptive use trends in particular within the Great Lakes basin. Should changes in public policies regarding these trends prove desirable in the future, a continuous data and information base would provide an invaluable foundation.

### *Part Two*

In this part of the Report the Commission addresses a number of matters that warrant the attention of appropriate jurisdictions in the United States and Canada as new or changed uses of Great Lakes waters are considered in the future. The Commission notes that not all existing large diversions appear to be subject to international control either by the Commission under the *Boundary Waters Treaty* or pursuant to special agreements between the Governments. The practice has been to permit domestic law and procedure to govern some large diversions, most small diversions and the consumptive use of Great Lakes water. While specific provisions of law and procedure vary from jurisdiction to jurisdiction, the legal regimes throughout the Great Lakes basin, unlike those further west, place relatively few restrictions on the use of water.

The *Boundary Waters Treaty* of 1909 contains some guidance to methods of addressing a range of issues raised recently at the initiative of one or both Governments or of individual jurisdictions. Its provisions appear sufficiently broad to permit agreed contemporary interpretation by the Parties. The Commission notes that the overall international legal regime is not to be found only in the texts of treaties. It has evolved and continues to evolve through a combination of agreements, custom, judicial decisions and writings. The jurisprudence of the International Joint Commission is a particularly significant element. In addition, it is necessary to look at history in order to put the various elements in proper perspective.

The Commission reviews recent diversion proposals involving Great Lakes water that have received press and public attention. The Report recognizes, however, that no major diversion from the Great Lakes basin is now under formal consideration and that none of the concepts is currently proposed or endorsed by any government directly involved in the management of the water. The Commission concludes that, although these large-scale diversions may be technically possible, at this time they have little political support; that they could be undertaken only at enormous, and at present unjustified cost; and that they would have unknown but likely significant social and environmental effects.

There may be circumstances in the future that could change this assessment. Changed global climatic conditions, or major shifts in current economic or political parameters, such as a world food crisis, are examples of events that could lead to a more serious interest in large inter-basin transfers of Great Lakes water. Furthermore, climate changes could lead to some reduction in basin precipitation and increased consumptive uses that would further reduce net basin supplies.

With this in mind the Commission suggests that in planning for the future Governments develop policies that would provide adaptive mechanisms for dealing with change and the unexpected. The Commission believes that this process will be evolutionary in nature, similar to the process that has emerged in addressing the issue of Great Lakes water quality. In this regard the Commission expects Governments will engage in water quantity discussions well in advance of and separate from the formal review of the 1978 *Great Lakes Water Quality Agreement*, and the Commission supports these early initiatives. It may also be useful for Governments to incorporate as they deem appropriate the relevant observations and conclusions of this Report at the time of the review.

The Commission notes that several anticipatory initiatives have already been or are being undertaken by the Parties and jurisdictions in the Great Lakes basin. The Commission believes that all these discussions and studies are important and relevant and should be encouraged, for they are all clearly germane to the issue of the diversion and consumptive uses of Great Lakes basin water.

### *Recommendations*

Based on the foregoing considerations and conclusions, the Commission's response includes the following recommendations, which the Commission believes will assist Governments in effectively addressing future considerations regarding the use of Great Lakes water:

1. Regarding the general aspects of diversions and consumptive uses –
    - a) Governments establish a bilateral data committee, separate from the Commission, to monitor all existing diversions and consumptive uses in the Great Lakes basin and publish data as appropriate, but no less frequently than biennially. This committee would also recommend appropriate additional research and monitoring efforts that would be necessary to develop the methodology and data to derive a more accurate estimate of existing consumptive uses in the Great Lakes basin. The committee's report should be made public.
    - b) Governments authorize the establishment of a bilateral task force on diversions and consumptive uses, either by a reference to the Commission or otherwise. The task force would be created periodically, but no less frequently than every five years, and would update previous consumptive use projections, assess the impacts of those projections, review the potential for new or changed diversions, and make appropriate recommendations. Governments should agree to consult on each task force report. The task force would use information from the bilateral data committee, as well as other sources, and would build on the existing methodology developed in each country. The task force should have available to it pertinent social, economic and demographic data both within and outside the Great Lakes basin context, but would likely need to concentrate initially on the principal water use sectors of power and manufacturing. Membership on each task force would be determined by the nature of the primary issues at that time.
  - c) Governments institute a co-operative review of current public policies at the federal and state/provincial levels to identify those having an effect on consumptive uses and to examine any that appear to have a significant potential for reducing such use.
  - d) Governments, taking into account the existing and possible future diversion of water into the Great Lakes, consult on the status of waters so diverted.
2. Regarding existing and future small diversions, Governments institute surveys on both sides of the border to identify and quantify existing and proposed small diversions and establish a mechanism whereby information is made available to the bilateral data committee.
  3. Regarding the management of existing diversions to ameliorate high and low levels –
    - a) Governments not consider under present conditions the further management of Great Lakes levels and outflows through the manipulation of existing diversions.
    - b) Governments take steps to ensure that better coastal zone management practices are followed to help reduce flood and erosion damage along the Great Lakes shoreline.
  4. Regarding federally, state or provincially sponsored or approved new or changed diversions –
    - a) Governments resolve the questions discussed in Chapter III of this Report.
    - b) Governments engage in a process of notice and consultation before additional new or changed diversions are approved.
  5. Regarding the broad aspects of this report, federal, state and provincial governments undertake appropriate measures to inform the public of the results of this study and to initiate an educational effort directed toward better understanding of the nature and effect of consumptive uses.



# PART ONE

## CHAPTER I

### INTRODUCTION

The Great Lakes-St. Lawrence River basin is a priceless natural resource in the heartland of Canada and the United States. Constituting the largest body of fresh water in the world, and considered one of the great waterways, no other major body of fresh water contributes so much to the health and well-being of so many people. This importance underlies the necessity for identifying factors relating to the levels and flows of the Great Lakes that have a potential for affecting the basin residents and users, particularly those factors that by misunderstanding, inadvertance or neglect could create disputes both within and between the United States and Canada.

#### The Reference

In 1977 the Governments of Canada and the United States, in response to certain recommendations in the Commission's 1976 report on *Further Regulation of the Great Lakes*, expressed concern in a reference to the Commission regarding the effects of diversions and consumptive uses on Great Lakes water levels and flows. They noted in the reference that the increasing demand for water to meet the needs of various users in the basin would have increasingly significant social, economic and environmental impacts on all citizens in the Great Lakes basin. In addition, attention in both countries, particularly during periods of extreme levels, had focused on the nature and effects of various existing basin diversions.

Specifically the 1977 reference requested the Commission to examine and report on the following matters as they affect water levels and flows, water uses, and other appropriate and relevant effects and implications:

1. existing diversions at the Welland Canal, the New York State Barge Canal, Chicago, Long Lac and Ogoki;
2. federal, state or provincially sponsored or approved proposed new or changed diversions;
3. the study and demonstration program authorized by

United States Public Law 94-587 affecting the rate of diversion at Chicago;

4. the possibility of improving the current regulation of the Great Lakes during periods of extreme high and low levels by changing the existing diversion rates; and
5. existing and reasonably foreseeable patterns of consumptive use of Great Lakes waters.

The full text of the reference appears in Appendix A.

The scope of the reference is the entire Great Lakes basin, consisting of the drainage areas for Lakes Superior, Huron, Michigan, Erie and Ontario; their connecting channels and tributaries; and the international and Canadian reaches of the St. Lawrence River (Figure 1). In carrying out this investigation, as in other references, the Commission has viewed its mandate broadly and has to the extent possible considered each existing, proposed or projected activity in the context of the entire basin. The Commission believes a holistic approach to the resource is necessary while recognizing that the *Boundary Waters Treaty* and other documents divide the resource legally or administratively into categories such as boundary waters or tributaries, surface or groundwater, and diversions or consumptive uses. As discussed more thoroughly in subsequent chapters, the Commission found that the information available is not sufficient to enable a holistic approach to be taken in all sections of this Report.

Phrases such as "boundary waters", "boundary waters of the Great Lakes system", and "waters of the Great Lakes system" are specifically defined, for example, in the *Boundary Waters Treaty* and in the *Great Lakes Water Quality Agreement* of 1978. The geographic scope of the *Boundary Waters Treaty* is not coextensive with the limits of the Great Lakes basin. In this situation, and to avoid confusion with treaty terms and provisions, the phrase "Great Lakes waters" is used throughout this Report to describe the waters of the Great Lakes basin. This phrase is descriptive of those waters and is not synonymous with terms used in the *Boundary Waters Treaty* or any other agreement.





*The Great Lakes – St. Lawrence River basin is a priceless natural resource which constitutes the largest body of fresh water in the world.*

## The Study

The Commission established the International Great Lakes Diversions and Consumptive Uses Study Board (the Study Board) and, by directive (Appendix B), requested the Board to conduct the required technical investigations. The members of the Study Board were directed to act as a unitary body and to co-ordinate and integrate their investigations in both countries (see Appendices C and D for membership).

The Commission received the Study Board's final report in September 1981. The report makes a major contribution to the body of information on, among other things, existing diversions and consumptive uses. It also projected future consumptive uses and examined alternative diversion management scenarios and their effects on Great Lakes levels and flows. Subsequently the Commission examined other related technical and legal documentation on Great Lakes diversions and existing and future consumptive uses.

To assess the hydrological effects of any change in the Great Lakes waters regime, a base-line condition must be established against which such changes can be calculated. The resulting differences in water levels or flows can then be used to evaluate economic, environmental, or other effects on the relevant interests. The actual levels and outflows during the period of record cannot be used because physical and managerial changes have occurred in the Great Lakes basin at different times over these years. The base-line con-

dition developed by the Study Board is known as the basis-of-comparison (BOC). This consists of the computed levels and flows that would have prevailed, with the historical record of water supplies to the system, if present (1977) outlet channel configurations, average diversion rates and regulation plans for Lake Superior (Plan 1977) and Lake Ontario (Plan 1958-D) had existed consistently throughout the selected period of record (1900-1976).

The findings, conclusions and recommendations of the Study Board, together with the subsequent examinations by the Commission, provide the basis for this Report. Those wishing to examine technical details beyond those contained here should refer to the Study Board's documents.

## Definitions

The definition of the terms *diversions* and *consumptive uses* is important not only to this Report, but also to any meaningful public discussion of them.

There is no inclusive definition of the term *diversion*. In the water resource literature, a diversion indicates a withdrawal of water at one point and the transfer of that water to another point some distance away. When the transfer occurs

from one watershed or basin to another (an inter-basin transfer), it should always be considered a diversion. Confusion occurs because some transfers that occur totally within one watershed (an intra-basin transfer) are called diversions while most others are not, and there are no generally accepted criteria for making the distinction. The decision to call an intra-basin transfer a diversion instead of a withdrawal appears entirely arbitrary. For example, cases where the withdrawal and return points are relatively close together, such as for most municipal, industrial or individual purposes, are often not considered diversions. The opposite case is illustrated by the diversion entirely within the Niagara River watershed for power at Niagara Falls.

The Study Board defined diversion as a transfer of water either into the Great Lakes basin from an adjacent watershed, or vice versa, or from the watershed of one of the Great Lakes into that of another. While this definition was appropriate for the Study Board to address the diversions identified in the reference, it does not include those that take place either between smaller watersheds or that are called diversions even though they occur totally within one river or lake watershed as discussed above. The reader should be aware that many other withdrawals occur that are not considered to be diversions.

Consequently the following definitions will be used in this Report:

*Diversion* the transfer of water from one watershed (or basin) to another<sup>1</sup> and those transfers that, while occurring totally within one lake or river watershed, are generally called or known as diversions.

*Withdrawal* the removal of water from the ground or from surface water for various uses, usually local, such as for municipal, industrial or individual purposes. Such removal, especially from surface water, is often returned in total or in part to approximately the same location.

*Consumptive Uses* that portion of water that has been withdrawn or withheld from the Great Lakes for various uses such as power generation, manufacturing and so on, and is either known or assumed to be lost due to evaporation during use, leakage, or incorporation into manufactured products, or for other reasons has not been returned.

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<sup>1</sup> This includes diversions either into the Great Lakes basin from an adjacent watershed or vice versa, or from the watershed of one of the Great Lakes to that of another.

## Public Consultation

Following receipt of the reference in 1977 the Commission held public hearings to receive comment on the reference, the directive and plan of study of the Study Board. During the course of its investigations the Study Board published a series of newsletters and conducted public workshops in May 1980 at various locations within the Great Lakes basin.

After completion of the Study Board report, the Commission recognized that there were additional important issues of concern to the Great Lakes community and possibly to areas outside the basin. For example, large-scale diversions have recently been the subject of considerable public discussion in both the United States and Canada. The Commission found that consideration of the policy implications of potential diversions and consumptive uses, and of the factors influencing that potential, was required to provide a comprehensive treatment of the questions raised by the reference. Therefore, in the seven public meetings held by the Commission throughout the Great Lakes basin in June 1983 to receive comments on the study, discussion included the report of the Study Board and broader policy implications.

At the public meetings statements were made by elected representatives, private individuals, citizen groups, business and industrial representatives and officials from federal, state, provincial and municipal agencies. An informal summary of the statements presented at the public meetings is contained in Appendix E. The Commission notes that a submission was not received from the Government of the United States; it is usual practice for that Government not to comment substantively on matters under investigation by the Commission until its report has been submitted.

Public statements have been included where appropriate throughout this Report. Such statements are included solely for the purpose of providing background information and must not be regarded as necessarily representing the views of the Commission. In addition, verbatim transcripts of public meetings and hearings, and all written submissions made at and subsequent to the meetings, are on file and available for examination by the public at the offices of the Commission in Ottawa and Washington, D.C.

## Organization

Part One of this Report presents information on the Great Lakes basin; on matters related to existing diversions and consumptive uses in the basin; on projected future uses including potential diversions; and on conditions the two countries may face, domestically and internationally, in the future. It also provides some conclusions and recommendations to the Governments of Canada and the United States. In Part Two the Commission discusses issues qualitatively different from those in the first part of the Report. Broader considerations and observations are presented as a starting point for further thinking by governments, institutions, citizens and the Commission itself.



## CHAPTER II

# THE GREAT LAKES BASIN

Throughout the Great Lakes basin, the supply of water supports a web of activities. This chapter describes some of those activities and how they would likely be affected by any long-term changes in lake levels. The results are expressed in general terms and emphasize certain economic benefits of resource use. This provides one context within which one can view the findings on diversions and consumptive uses. However, there are other factors, less tangible perhaps, that are becoming increasingly important to citizens of the basin; they are sometimes referred to collectively as 'quality of life'. They include the psychic importance of the resource, the view that the Great Lakes are more than just a resource to be consumed.

Sometimes referred to as North America's inland sea, the Great Lakes comprise five immense bodies of fresh water, including Lake Superior, the world's largest in area. With some 246,000 square kilometres (95,000 square miles) of water surface, the lakes cover approximately one-third of their drainage basin. The system forms a waterway that stretches more than a third of the way across North America.

The overall volume and vast water surface area of the Great Lakes account for the storage of enormous quantities of water that absorb large variations in precipitation and runoff. Consequently the outflow from each lake is remarkably steady, with a normal range of water levels of 0.3 to 0.6 metres (one to two feet) in a single year. The total water supplies are the dominant cause of fluctuations in the levels of the Great Lakes. The level of each of the Great Lakes depends on the balance between total water supplies received by that lake and its discharge to the next lower lake. The change in storage is the sum of precipitation, inflow from upstream, surface and ground water runoff, evaporation, outflow and diversions into or out of the lake. Precipitation in the form of rain or snow is the primary source of the natural water supply to the Great Lakes.

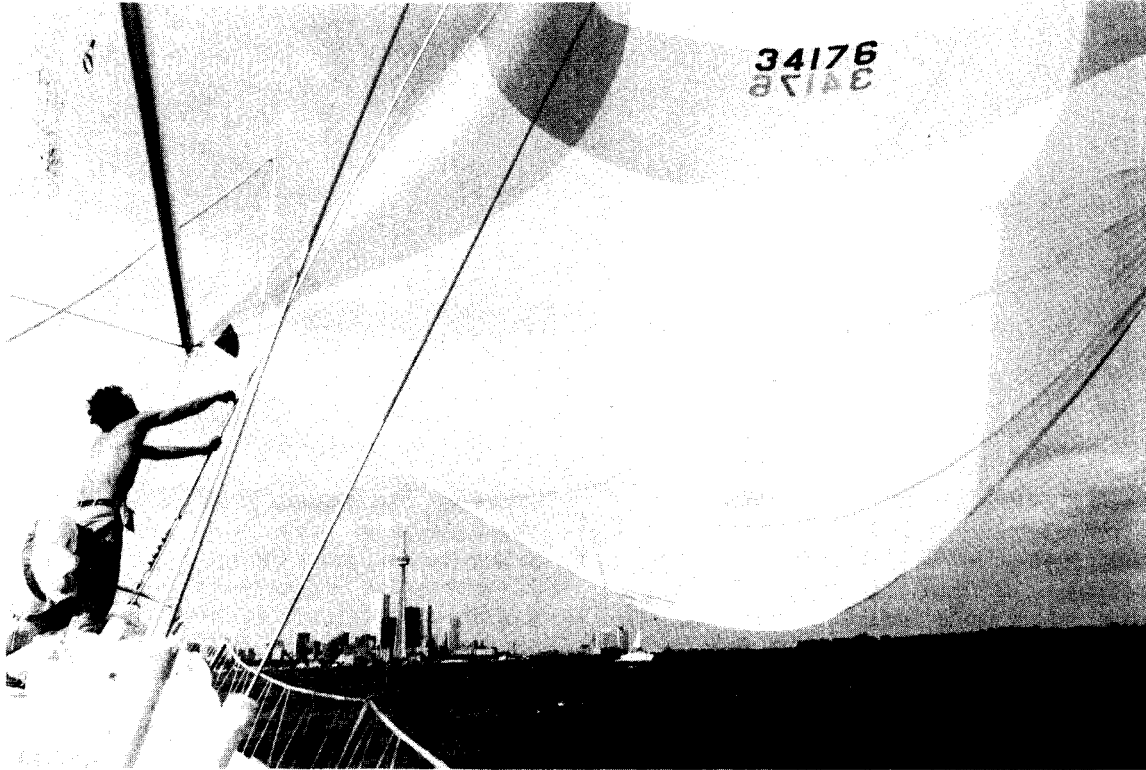
The hydraulic characteristics of the Great Lakes system have been affected by the works of man, including construction of works in the outlets of Lakes Superior and Ontario, and by dredging in the connecting channels. The operations of the control structures in the outlets of Lakes Superior and Ontario depend on plans of regulation designed to comply with Orders of Approval issued by the Commission. The natural outlets of Lakes Michigan-Huron and Erie

are not regulated, and their levels are controlled primarily by natural conditions. Interventions in the natural regime also include the diversion at Chicago to the Mississippi system, the water used at Niagara to operate the Welland and New York State Barge Canals, and the diversion into Lake Superior through the Long Lac and Ogoki projects, all of which are discussed in Chapter III. Basically the fluctuations of the lakes are natural phenomena that have to date been modified only slightly by man's intervention, except in Lake Ontario where considerable reduction in the range of water levels and the maximum level has been achieved. Nevertheless, small but permanent changes in lake level fluctuations can have significant effects on the web of activities that depend on the levels of the Great Lakes system.<sup>2</sup>

The interrelationship of Great Lakes water quantity and water quality of the Great Lakes cannot be ignored. It is generally recognized that the uses of Great Lakes water are influenced directly by the quality of the waters of the Great Lakes. The large concentrations of people, industry and agriculture in the basin have created water quality problems that both Canada and the United States are trying to solve through the *Great Lakes Water Quality Agreements* of 1972 and 1978. These agreements were entered into by the Governments to remedy the grave deterioration of water quality, which had occurred on both sides of the boundary to the extent that it was injuring health and property on the other side. They are excellent examples of the consultative process between the countries.

Largely because of water transportation, population centres in the basin grew up on the water's edge. The nearly 40 million people who live in the basin make up a third of the Canadian population and one-seventh of that of the United States. In 170 years the population of the Great Lakes basin has increased more than a hundredfold, and it is expected to double in the next 40 years. The increasing number of people living and working in the Great Lakes basin will continue to place demands on the resource, particularly in the southern and eastern portions of the basin where population densities are highest. Most of the domestic water supply for activities

<sup>2</sup> For more details of the hydrology and hydraulics of the Great Lakes basin, the reader is referred to the Commission's 1976 report on *Further Regulation of the Great Lakes* and the 1973 report on *Regulation of Great Lakes Water Levels* by the International Great Lakes Levels Board.



*Aesthetic and recreational opportunities make the waterfront an attractive place to live. The population of the Great Lakes basin is expected to double in the next 40 years.*

in the basin is drawn directly from the lakes. These water intakes and water treatment requirements are sensitive to both the quality and quantity of water levels and flows along the shoreline.

Aesthetic and recreational opportunities also make the waterfront an attractive place to live. Over 20 per cent of the 17,100 kilometres (10,600 miles) of Great Lakes shoreline has been developed as residential property. Shoreline property is subject to flooding and erosion, which are influenced by natural conditions (such as the type of shoreline, the amount of wave action and the occurrence of storms) and, to a lesser extent, by man's activities.

The most comprehensive information available on the economy of the region shows that in 1975 economic activity amounted to \$155 billion in the U.S. portion and \$27 billion in the Canadian portion of the Great Lakes basin. (Both figures are expressed in 1971 dollars.) Manufacturing accounts for over a third of the earnings of the basin's economy, with the largest industries producing transportation equipment, machinery, primary metals, fabricated metals, and food and beverage products. Industry uses the basin's water for processing, cooling, and washing, and for depositing some of its wastes.

Among the beneficial uses of the Great Lakes is hydro-electric energy. Some of the largest hydraulic power plants in the world rely on the steady flows of the Great Lakes system on the Niagara and the St. Lawrence Rivers. This power, which costs far less than thermally generated power, has contributed to the growth of industry at these locations.

Nearly 8 million kilowatts of installed hydro-electric generating capacity is now in service on the Great Lakes system. Since these plants are able to use the full river flow available to them during most periods of peak demand, hydro power is affected by any increase or reduction in water supplies to the Great Lakes. An increasing portion of power generation, however, is being provided by thermal power plants which ring the lakes and use the water for their massive condenser cooling requirements.

The Great Lakes, with the St. Lawrence Seaway and other canals, provide a vital commercial navigation route stretching some 3,900 kilometres (2,400 miles) from the Atlantic Ocean inland to the heart of North America. More than 180 million metric tons (200 million tons) of four bulk commodities – iron ore, coal, limestone and grain – currently are shipped each year, accounting for about 85 per cent of the system's commerce. The transportation system was central to the development of industry and agriculture in the region and remains important to both regional and national economies. Much of Canada's grain shipments and a substantial volume of general cargo (three-quarters of which is manufactured iron and steel products), passed through the St. Lawrence Seaway in the late 1970s. Ships loaded with cargo are sensitive to depths, especially at ships' harbours and connecting channels. Reduced depths can mean less cargo, less efficiency, and increased shipping costs. If the changes in shipping costs are significant, they are likely to have some additional effects on the economy of the basin. Navigation, however, depends on the vitality of the very industries that are consuming water, particularly the steel industry, the largest consumer of water in the basin.

The Great Lakes basin accommodates a wide variety of agricultural activities, including dairy farming, livestock production, and grain, tobacco, vegetable and fruit farming. Because irrigation requirements are low in the region, these activities have no major impact on water use in the basin, although recent studies have shown that such activities can have a significant impact on water quality. Of the almost 7.7 million hectares (19 million acres) of cropland harvested in the U.S. portion of the basin in 1975, only about 66,800 hectares (165,000 acres) were irrigated. In Ontario, of the nearly 3.2 million hectares (7.9 million acres) of cropland in 1971, about 40,000 hectares (99,000 acres) were irrigated.

The basin's forests contain a large volume of harvestable and usable timber products. There are about 181,000 square kilometres (70,000 square miles) of commercial forest land capable of producing commercial crops of timber in the Canadian portion and about 153,000 square kilometres (59,000 square miles) in the U.S. portion. Production of pulpwood, saw logs, veneer logs, and miscellaneous industrial timber products is substantial.

In addition to man, the shores and waters of the Great Lakes support numerous species of mammals, more than 20 species of reptiles, over 100 species of birds and over 100 species of fish. The 61,500 hectares (152,000 acres) of wetlands in the lower portion of the Great Lakes system include habitat that is essential to a wide variety of wildlife species and to the food chain for the fishery. These wetlands include habitat for several species classified as rare, endangered or threatened, including the bald eagle, eastern fox snake, spotted turtle, fowler's toad and the Lake Erie water snake. In contrast to the human user groups that are affected adversely by the extremes of lake level fluctuations, the wetlands actually depend on these periodic disturbances, which result in greater productivity and greater species diversity. Wetlands are complex ecosystems, and research studies are only now beginning to look at the responses of these systems to Great Lakes water level fluctuations. Consequently, very little detailed information exists on this subject and no general conclusions regarding effects can be made. In view of their importance, and the fact that each wetland is unique, the response of wetlands in major systems like the Great Lakes must be taken into account, but this can be assessed more effectively by site-specific studies.

The Great Lakes fishery has fluctuated greatly over the years in terms of the size and composition of its populations. Successive strains on the fishery have included the effects of forest clearing on tributary spawning grounds, overfishing, the introduction of alien species, and chemical pollution. Some improvements have been noted in recent years, including the successful introduction of coho and chinook salmon to the Great Lakes in the late 1960s. The extent to which lake level changes would affect the fishery is poorly understood. There have not been enough studies to make a quantitative assessment of the effects on fish of water level changes; thus, site-specific studies to evaluate the effects of fluctuating water levels on the Great Lakes fishery are necessary.

Although drastic changes have occurred over the past century, the Great Lakes fisheries, both commercial and recreational, are important contributors to the region's economy. In 1979, the annual dockside value of the Great Lakes

commercial fish catch was estimated to be about \$25 million. Sport fishing contributes an even greater amount to the region's economy. One estimate, published in 1979, forecast 24 million angler-days of sport fishing on the Great Lakes during that year. Those anglers were expected to spend between \$240 and \$640 million and have a total impact on the regional economy of between \$480 and \$1,600 million. More recent surveys conducted in the United States and Canada show that an estimated 55 million angler-days were spent on the Great Lakes during 1980.

A major portion of North America's fleet of pleasure boats is based in the Great Lakes system. Extreme low or high lake levels adversely affect recreational boating activities and diminish the number of docks and marina slips that can be used safely. Recreational use of beaches is also a major attraction of the Great Lakes. Three-quarters of the Great Lakes shoreline has beach zone at the water's edge, including many stretches of high-quality beach accessible to the public. A reduction in lake levels would expose a greater area of the beach zone, thus increasing opportunities for recreational use.

Tourism, which is related to outdoor recreation, has long been one of the most important industries in the Great Lakes basin. The value of tourism in the U.S. portion of the basin has been estimated at \$300 million annually. A 1971 Canadian estimate indicates that tourists' expenditures in the Great Lakes basin totalled over \$500 million. More recently, the Michigan Travel Bureau estimated that direct expenditures by travellers on pleasure trips amounted to roughly \$3 billion in 1983. Clearly these values depend on the maintenance of a clean environment and healthy fish and wildlife populations.

The Great Lakes contain a vast quantity of fresh water – 20 per cent of the world's and 95 per cent of North America's surface water. Yet these are measures of stock, a legacy from the last ice age, not the replenishable supply. It has been shown that many of the activities discussed in this chapter would be affected adversely by any long-term reduction in flows or levels, while others would be jeopardized by increases. Any intervention in water supplies thus has greater implications than absolute quantities might suggest. Moreover, they will be felt throughout the system – perhaps, as noted at one of the Commission's public meetings, as far down as the estuary of the St. Lawrence.

While large engineering structures have been built at Sault Ste. Marie and Niagara Falls, in the St. Lawrence River and elsewhere, it is clear that the overall effect of people on lake levels or flows to date has been minor. Natural variations in lake levels are large by comparison and depend upon the pattern of precipitation over a number of years, which cannot be predicted. However, the cumulative effect of individual increases in consumptive use can, over time, be significant for water quantity, just as it has more obviously been for water quality. Relatively small changes in the present regime of lake level fluctuations can cause multi-million dollar changes in dependent economic values. Flood damage can also be substantial; beach fronts are eroded by the same forces that created them. Thus, wise management of the available water supplies in the Great Lakes basin will require broad and thorough consideration of the full range of activities that affect supplies and those that depend on them.



## CHAPTER III

### THE REFERENCE: DIVERSIONS

#### Existing Diversions

The 1977 reference requested the Commission to examine and report upon five existing diversions of water into, out of, or within the Great Lakes system. They include the diversions into Lake Superior from Long Lac and Ogoki, out of Lake Michigan at Chicago, between Lakes Erie and Ontario at the Welland Canal, and between the Niagara River and Lake Ontario through the New York Barge Canal System. These diversions were selected because attention in both countries had focused on their nature and effects during periods of extreme lake levels, and because of the possibility of enhanced regulation of Great Lakes levels through changes in the existing diversions. The other major diversions in the basin are discussed briefly below.

Development of hydro-electric power at the head of the rapids in the St. Marys River, a boundary water between Lakes Superior and Huron, began in 1893 and has been periodically increased, the last expansion being completed in 1983. Although the power flows are withdrawn and returned entirely within the St. Marys River basin, they are commonly referred to as diversions since they redirect water around part of the natural channel and the fish habitat in it. Privately owned power plants on both sides of the river operate under Orders of Approval issued by the Commission, while navigation locks on each side are controlled by the federal governments. The U.S. Government also owns and operates a hydro-electric power plant. Gated control works across the upstream end of the river were completed in 1921 to counteract the lowering of Lake Superior that would have resulted from an increased discharge capacity. Operations of the control works are regulated in accordance with the Commission's plan of regulation (known as Plan 1977). The levels of Lakes Superior, Michigan and Huron, as well as the flows for power, navigation and the main river channel, are monitored and reported monthly by the Commission's International Lake Superior Board of Control.

Hydro-electric power is also developed by Ontario Hydro and the New York Power Authority by diverting water from Lake Erie and the upper Niagara River around Niagara Falls. The terms of Article V of the *Boundary Waters Treaty* of 1909, which governed diversion of the Niagara River for the production of power, were replaced in 1950 by those of the *Niagara River Water Diversion Treaty* between the United States and Canada. The International Niagara Committee,

established to administer the 1950 Treaty, reports to both Governments and, for information purposes, to the Commission on the amounts of water used for power diversions at Niagara Falls and in the Welland and New York State Barge Canals.

In 1932 and again in 1941, the two Governments attempted to reach agreement regarding the development of the Great Lakes-St. Lawrence basin. The proposed 1932 St. Lawrence Deep Water Treaty and the proposed 1941 Great Lakes-St. Lawrence Basin Development Agreement would have provided for the construction of a deep waterway and the development of water power. In addition, they were intended to effect a general settlement of questions relating to the diversion of waters from or into the Great Lakes system through the establishment of agreed principles and mechanisms for resolving disputes. These proposed agreements were signed for both Governments but were not consented to by the United States Senate.

In 1952 the Governments of Canada and the United States applied to the Commission for approval to construct certain works for the development of power in the international rapids section of the St. Lawrence River. These works involved the obstruction, rather than diversion, of boundary waters. The construction, maintenance and operation of the works, now part of the joint St. Lawrence Seaway and Power Project, were approved by the Commission subject to a number of conditions in its 1952 Order of Approval as supplemented in 1956. Outflows from Lake Ontario to the St. Lawrence River are governed by the Commission's Regulation Plan 1958-D and reported weekly by the Commission's International St. Lawrence River Board of Control. These three major projects are not discussed further in this Report since they are currently controlled as to levels and flows through treaty in the case of Niagara, or by the Commission through Orders of Approval in the case of the St. Marys and St. Lawrence River projects. Other small existing diversion projects in the Great Lakes basin are discussed briefly later in this chapter.

The hydraulic effects and, to a limited extent, the environmental and economic effects of the five existing major diversions were examined. These evaluations have been made by comparing a common base set of lake levels and outflows with the diversions in place at current average levels (termed the basis-of-comparison), with the conditions that would exist without one of the diversions.

One component of the Study Board's analysis of the effects of existing diversions and their further management was the assessment of economic impacts. The basic methodology for the assessment was developed for and is discussed in detail in the report of the International Lake Erie Regulation Study Board (July 1981) and will not be repeated here.

The economic analysis concentrates on three sectors and examines a fourth in a limited way. They are the coastal zone, hydro-electric power, navigation, and recreational beaches and boating respectively. These are the major economic interests directly affected by variations in levels and flows in the Great Lakes and those that have been conventionally of interest to water use planners and managers.

Coastal zone effects include erosion, flooding and, to a lesser degree, the water pumping implications of changed levels. Overall damage or costs generally increase as lake levels rise along any given shoreline. The values were calculated by determining the physical impact of changed levels and converting them into the dollar values of lost (or saved) real estate, flood damage caused (or prevented), and lower (or higher) pumping costs.

The implications for hydro-electric power generation were calculated for the facilities on the entire Great Lakes connecting channels and the international section of the St. Lawrence River and were related to the incremental costs or savings of relatively inexpensive hydro generation compared with alternative sources for the affected amount of power. Overall, decreases in levels or flows reduce the system's capability to generate hydro power, which then must be replaced by higher-cost energy.

The economic effects on commercial navigation reflect the incremental costs or savings of operating ships under different loading factors on the Great Lakes, connecting channels and associated harbours. Reduced water levels mean that ships may have to reduce the size of loads because of depth limitations at critical points in the navigation system.

A limited assessment was made of the values of access to public recreational beaches and recreational boating at commercial facilities. Beach values were calculated on the basis of an estimated cost-to-use; boating values were based on the cost of an equivalent boat-for-hire. The evaluation did not include the beaches on Lakes Michigan, Huron and Superior or their connecting channels. Recreational boating was examined only in the United States portion of the basin from Lake Huron to the point where the St. Lawrence River becomes entirely Canadian. In addition, this estimate examined the effects of lowering high lake levels but did not include any effects of raising low levels. Generally, lowering high levels benefits beaches and harms boating.

The limitations inherent in evaluating economic impact suggest caution in using these evaluations. The Commission discusses its reservations in more detail at the end of this chapter.

### *The Long Lac and Ogoki Diversions*

*History:* These two diversions are separate but they are often

considered together because both divert to Lake Superior waters that originally drained north into James Bay. The Long Lac diversion, completed in 1941, connects the headwaters of the Kenogami River with the Aguasabon River, which naturally discharges into Lake Superior about 250 kilometres (155 miles) east of Thunder Bay, Ontario (Figure 2). The Ogoki diversion, completed in 1943, connects the upper portion of the Ogoki River to Lake Nipigon and from there flows into Lake Superior 96 kilometres (60 miles) east of Thunder Bay (Figure 3). These diversions were developed to generate hydro-electric power and also, in the case of the Long Lac diversion, to transport pulpwood logs southward.

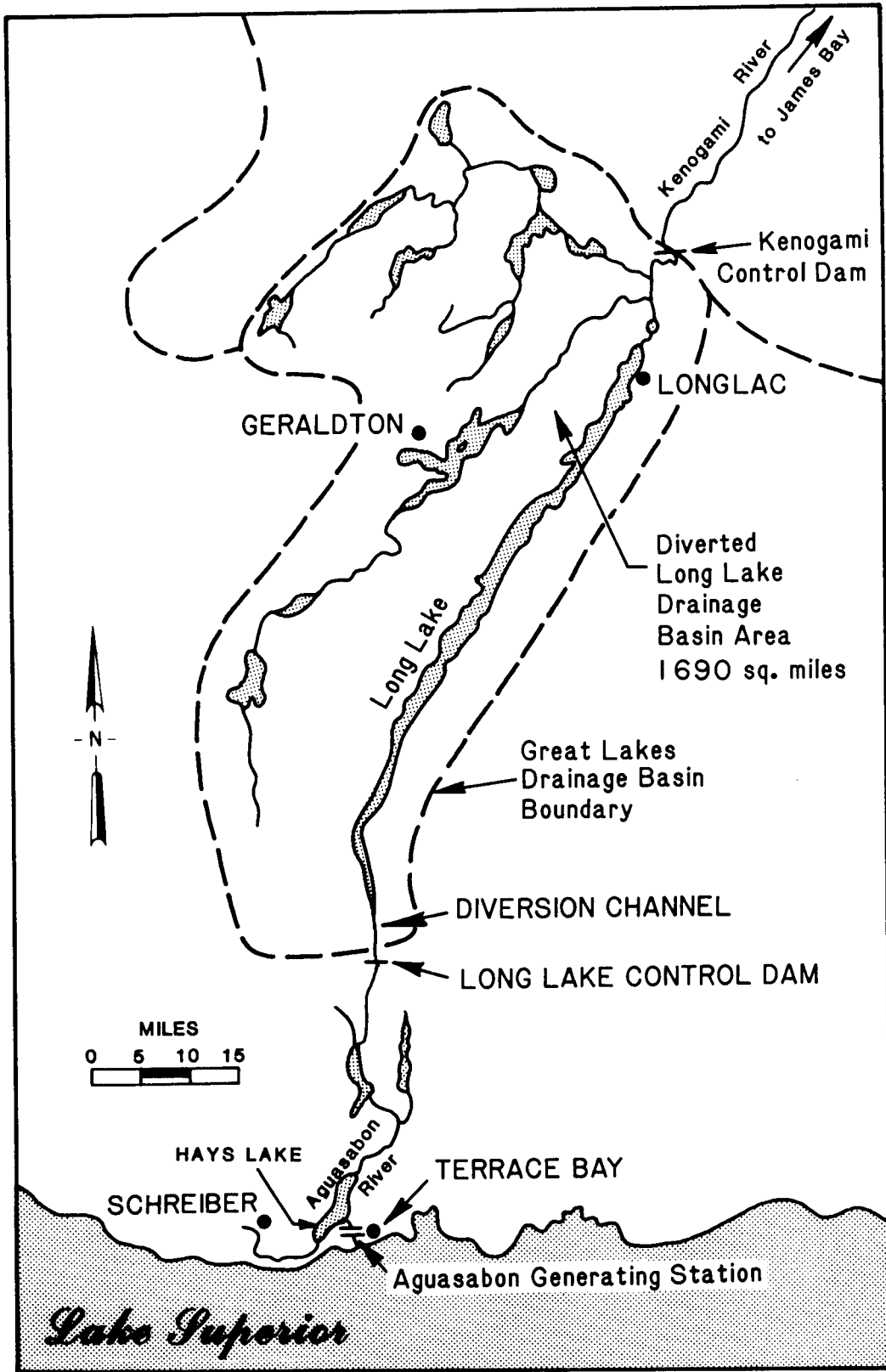
The economic potential of diversions into the Great Lakes, such as Long Lac and Ogoki, was the subject of discussion between the Governments of Canada and the United States in the 1930s and 1940s.<sup>3</sup> As part of the negotiations that led eventually to an understanding on the Long Lac and Ogoki diversions, Canada proposed in 1938 an agreement that would have provided in effect that, notwithstanding Articles V and VIII of the *Boundary Waters Treaty*, Canada would have exclusive rights to the use of waters from the Long Lac diversion. However, the United States responded that it was not prepared to entertain such a proposal without consideration being given to a number of other matters. In 1940, the Governments did conclude an arrangement through an exchange of notes relating to the early development of certain portions of the Great Lakes-St. Lawrence Basin project (Long Lac-Ogoki diversions). It provided in part that: to assist in providing an adequate supply of power to meet Canadian defense needs and contingent upon the Province of Ontario's agreeing to provide immediately for diversions into the Great Lakes System of waters from the Albany River Basin which normally flow into Hudson Bay, the Government of the United States will interpose no objection, pending the conclusion of a final Great Lakes-St. Lawrence Basin agreement between the two countries, to the immediate utilization for power at Niagara Falls by the Province of Ontario of additional waters equivalent in quantity to the diversions into the Great Lakes basin above referred to.<sup>4</sup>

Subsequently, both governments ratified the *Niagara River Water Diversion Treaty* of 1950, Article III of which provides that the "waters which are being diverted into the natural drainage of the Great Lakes System through the existing Long Lac and Ogoki works shall continue to be governed by the notes."

The notes provide flexibility in operation because no diversion amounts are specified, but initial use at Niagara Falls was to be 142 cubic metres per second (5,000 cubic feet per second). An Exchange of Memoranda of October 20 and November 14, 1941 allowed the province of Ontario the choice of using the diverted water for hydro-electric power at Niagara Falls or at the DeCew Falls plant via the Welland Canal (see discussion under Welland Canal diversion). Because of greater plant efficiency, power is generated at

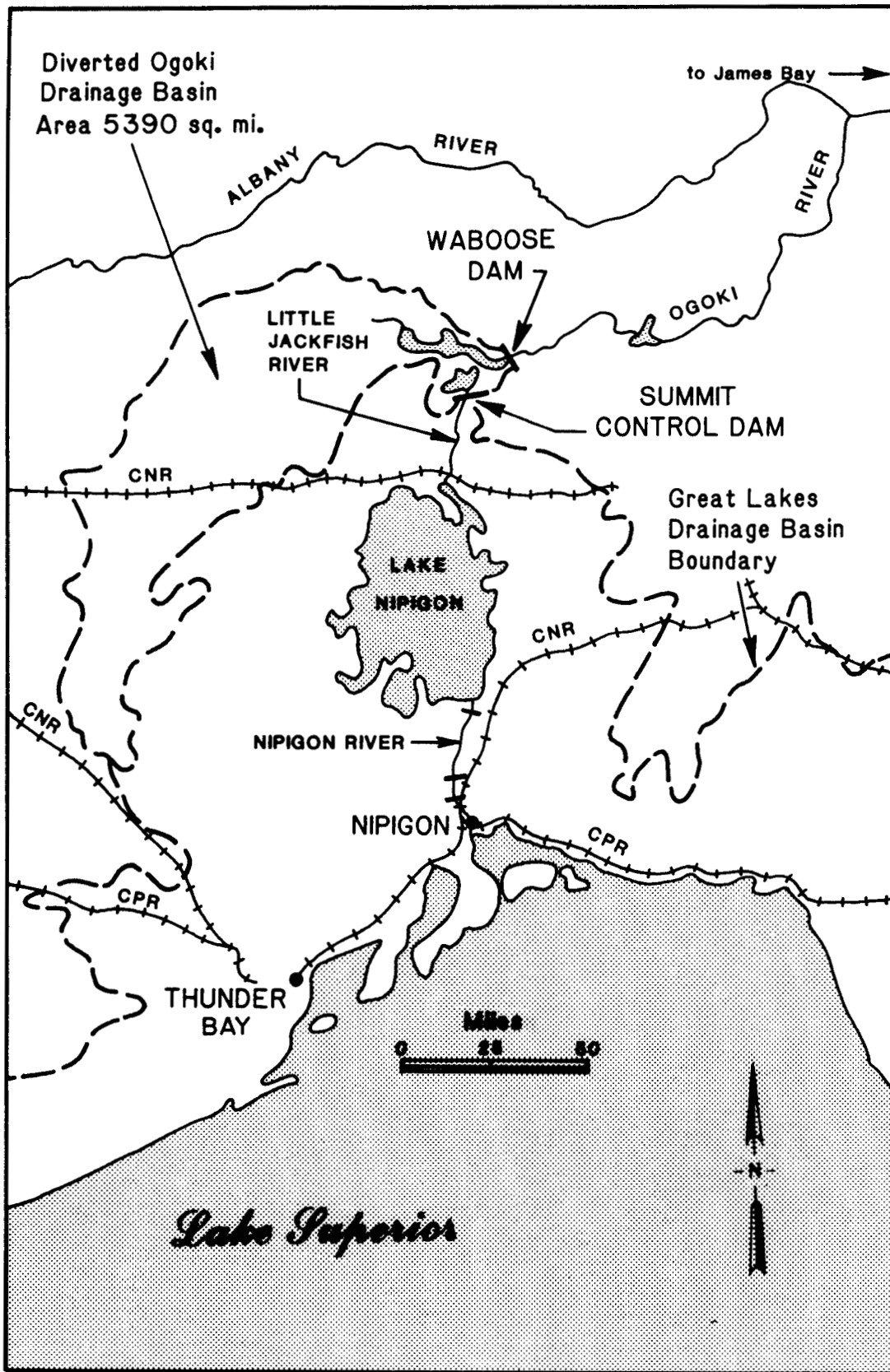
<sup>3</sup> See also page 9.

<sup>4</sup> Exchange of Notes (October 14, 1940) between the Government of the United States of America and the Government of Canada, including Supplementary Notes (October 31 and November 7, 1940).



**Long Lac Diversion**

**Figure 2**



**Ogoki Diversion**

**Figure 3**





*The Lake Michigan Diversion at Chicago is part of one of the most heavily used navigation systems in the United States.*

DeCew Falls. Copies of these notes and memoranda are contained in Appendix F.

From July 1943 to December 1979 the combined diversion averaged about 159 cms (5,600 cfs), although it has been the practice of the Parties to use a constant figure of 142 cms (5,000 cfs) in calculating the Canadian and U.S. shares of water available for power under the Niagara Treaty instead of the actual diversion amounts as permitted by the notes. Apparently this practice is a pragmatic solution to the problem of trying to use the actual diversion rates, which vary frequently and whose arrival time at Niagara, about 1,600 kilometres (1,000 miles) downstream, cannot be calculated accurately. The maximum and minimum annual combined diversions have been 227 cms (8,020 cfs) and 72 cms (2,530 cfs) respectively. Although the diversions are under Canadian control there have been consultations between Governments during emergency periods. Examples of mutual cooperation occurred in 1952 and 1973 when, in response to a request by the United States, Canada reduced or stopped both diversions in an attempt to alleviate problems created by high lake levels. The amount of water diverted into Lake Superior by these diversions is reported to the Commission, through its International Lake Superior Board of Control, by Ontario Hydro.

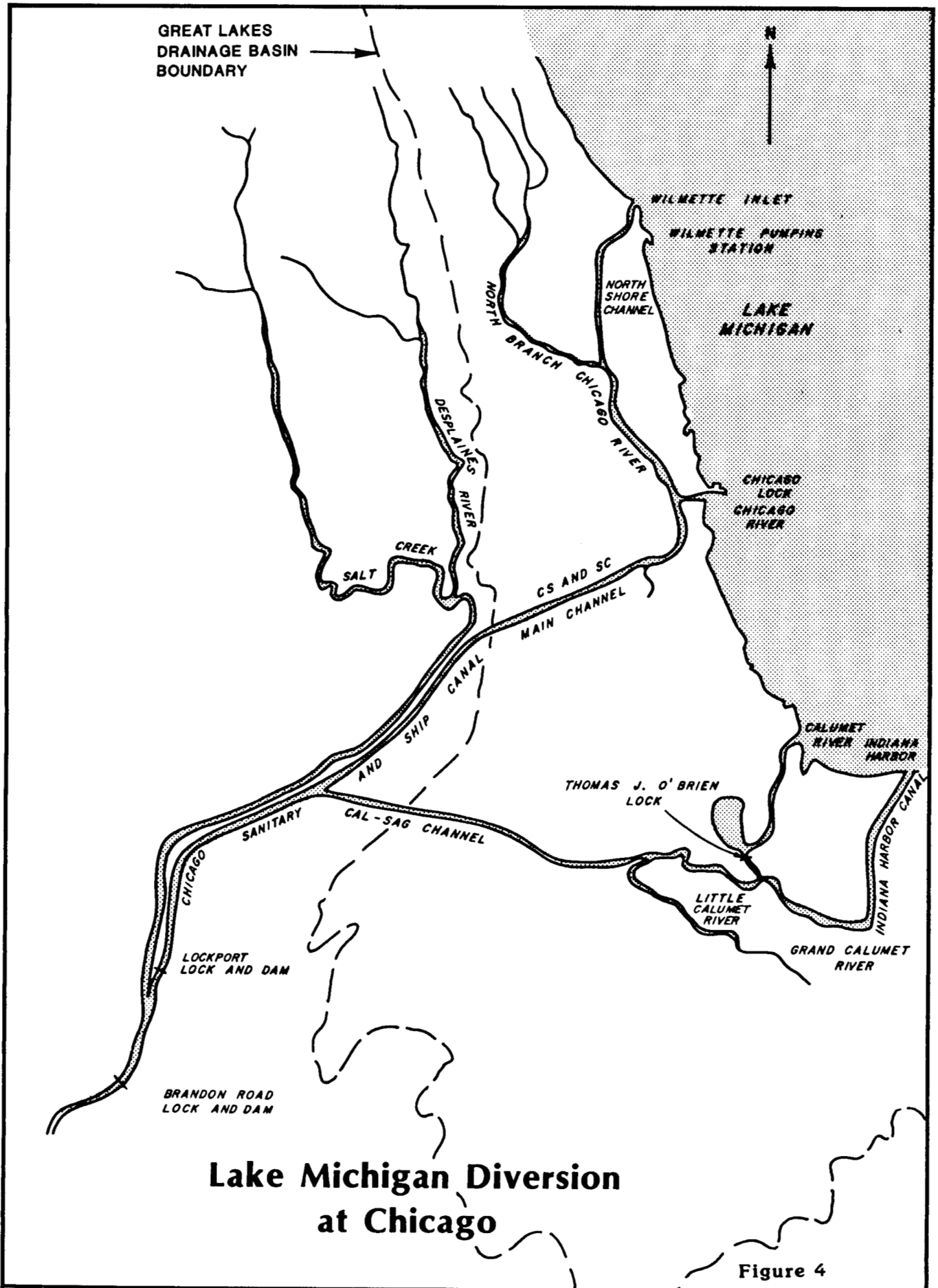
At the Commission's public meeting in Toronto in June 1983, the Commission received a submission on behalf of the province of Ontario relating to, among other matters, the existing diversions at Long Lac and Ogoki. The submission

noted that "At power facilities at Niagara Falls, by treaty,<sup>5</sup> this diverted water is credited to Ontario. At Cornwall, the diverted water is shared equally through negotiation as part of the St. Lawrence Seaway and Power Project. At Sault Ste. Marie, however, the diverted waters are shared equally without formal agreement." It also stated that "water diverted to the Great Lakes system from other watersheds in Ontario continue to be considered as Ontario's water throughout the system." Similar views have been expressed from time to time by the Government of Canada.

*Effects:* These diversions increase the supply of water to the Great Lakes. The hydrological effect has been to increase the mean levels of each of the lakes. The mean level of Lake Superior has been increased by 6.4 cm (0.21 feet), Lakes Michigan-Huron by 11.3 cm (0.37 feet), Lake Erie by 7.6 cm (0.25 feet), and Lake Ontario by 6.7 cm (0.22 feet). Under the Commission's current regulation plans for Lakes Superior and Ontario, the maximum criteria levels for these lakes are unaffected by these diversions.

Various economic interests in the Great Lakes system have been affected by these two diversions. The dollar value

<sup>5</sup> The treaty referred to is the 1950 *Niagara River Water Diversion Treaty*, Article III of which states in part, "Waters which are being diverted into the natural drainage of the Great Lakes System through the existing Long Lac-Ogoki works shall continue to be governed by the exchange of notes...on October 14 and 31 and November 7, 1940, and shall not be included in the waters allocated under provisions of this Treaty".



**Lake Michigan Diversion  
at Chicago**

Figure 4

of annual losses to coastal zone interests was calculated at \$4.8 million, while the amounts of direct annual benefits to navigation and power were estimated at \$17.6 million and \$40.2 million respectively. The Study Board therefore estimated that total calculated direct benefits attributed to these diversions, including benefits to the pulp and paper industry located on the Aguasabon River, exceeded calculated losses by an average of \$57 million annually. The recent increase in the average Welland Canal diversion from 198 cms (7,000 cfs) to about 260 cms (9,200 cfs) would change slightly the estimated economic values of the effects of the Long Lac and Ogoki diversions.

The Long Lac and Ogoki diversions have had significant local environmental effects on fish spawning areas and habitat as a result of the original construction and operation of diversion structures on the main stem rivers, the construction and alteration of diversion channels, the creation of reservoirs, the greatly altered flow regimes, and the use of waterways for log transportation. However, no significant basin-wide environmental effects from these two diversions have been documented.

### *The Lake Michigan Diversion at Chicago*

*History:* Water has been diverted from the Great Lakes basin via the Lake Michigan diversion at Chicago (Chicago diversion) since the completion of the Illinois and Michigan Canal in 1848 (Figure 4). The diversion of water through the Illinois waterway to the Mississippi River is for water supply, sewage disposal, power generation and navigation. The diversion consists of three components:

- (a) water supply withdrawn directly from Lake Michigan for domestic and industrial purposes and then discharged into the Illinois River as treated sewage;
- (b) runoff that once drained to Lake Michigan but is now diverted to the Illinois River; and
- (c) water diverted directly from Lake Michigan into the Illinois River and canal system for navigation and dilution purposes in the Chicago area.

Until 1900, water diverted from Lake Michigan to the area's canal system averaged about 14 cms (500 cfs). The completion of the Chicago Sanitary and Ship Canal in 1900 and the Calumet-Sag Channel in 1922 made possible the diversion of pollutants to the Illinois River system and away from Lake Michigan, the source of Chicago's water supply at the time the *Boundary Waters Treaty* came into force in 1910. That year, the volume of water to be withdrawn was limited by a permit of the U.S. Secretary of War to 118 cms (4,167 cfs) for domestic, sanitary and navigation purposes. Shortly afterward, however, the Chicago Sanitary District exceeded this amount, thereby touching off the first British note of protest on behalf of Canada in 1913, as well as protracted litigation between the District and the United States of America, joined at later stages by the State of Illinois, three other cities and several other Great Lakes states. The dispute reached the U.S. Supreme Court, was settled by several judicial decrees issued over the past 50 years, and remains under the Supreme Court's continuing jurisdiction. The aver-

age amount of 90 cms (3,200 cfs) authorized by the 1980 decree is that which has occurred since 1938, except in emergency situations.

Although the average diversion rate has not changed for some time, the potential for increases in that amount has been a concern to Canada and to those in the vicinity that might possibly be affected adversely by higher water levels or velocities. The major U.S. interests include commercial navigation, recreational boating, hydro-electric power generation, residential flood damage, agriculture and wetland habitat. Article II of the *Boundary Waters Treaty* provides that the United States and Canada reserve to themselves exclusive jurisdiction and control over the use and diversion of waters on their own side of the line, waters that in their natural channels would flow across the boundary or into boundary waters, subject to certain provisions with respect to injuries.<sup>6</sup>

Over the years, several proposals have been made in the U.S. Congress to increase the amount of the Chicago diversion; none of the proposals was successful. In the 1950s two bills authorizing an increase in the diversion were passed by the Congress but vetoed by President Eisenhower who cited, among other reasons, opposition expressed by Canada. More recently, Congress passed the *Water Resources Development Act* of 1976 which included authorization for a study and demonstration program affecting the rate of the Chicago diversion. A discussion of the program, as requested by the reference, begins on page 22.

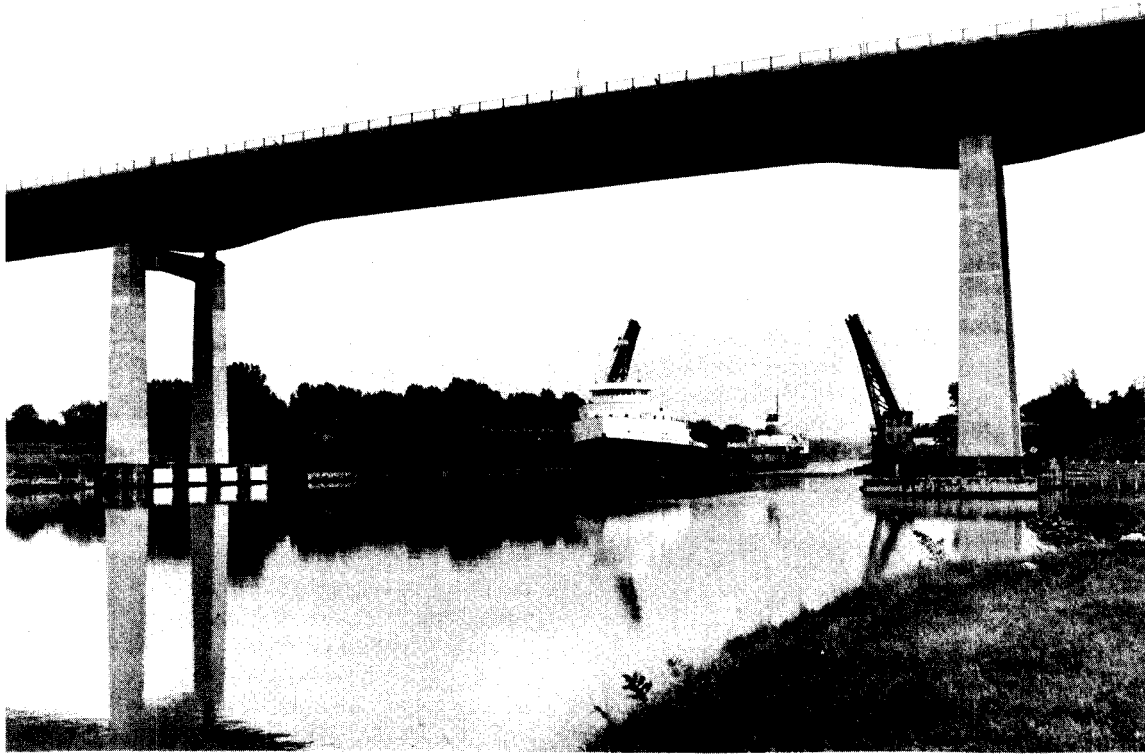
Canada has objected, through diplomatic notes and other communications, to each of the proposals to increase the Chicago diversion.<sup>7</sup> The Commission notes that the U.S. Government has been at pains to ensure that decision-makers in the United States are aware of the Canadian Government's views and that indeed they have been taken into account.

*Effects:* The Chicago diversion decreases the water supply to Lake Michigan and creates an additional outflow channel from Lake Michigan. The effect of the diversion on lake levels has been to reduce the mean levels of Lakes Michigan-Huron by 6.4 cm (0.21 feet), Lake Erie by 4.3 cm (0.14 feet) and Lake Ontario by 3.0 cm (0.10 feet). Under the current regulation Plan 1977 for Lake Superior, the diversion also reduces the mean level of that lake by 2.1 cm (0.07 feet).

For several reasons, even the limited economic evaluation applied to the Long Lac and Ogoki diversions was not undertaken for this diversion. First, estimates could not readily be made of the specific but clearly sizable benefits attributable to the users of the diversion. Second, it was not considered realistic to assume reduction of the diversion to zero, because there are no apparent alternatives for water supply and navigation. Any evaluation would also be somewhat hypothetical since the diversion predated the large investments that now

<sup>6</sup> See also page 9.

<sup>7</sup> Most recently, in a statement tabled at the public meetings held by the International Joint Commission in June 1983, the Government of Canada reiterated its "long-standing opposition to unilateral increases in diversions from the Great Lakes system" and its view that "such proposals should be considered only after consultation and agreement between Canada and the United States." In its submission, the Province of Ontario restated its opposition to any such unilateral increases.



*The Welland Canal is an integral part of the St. Lawrence Seaway system.*

permit or could, if expanded, permit the realization of further benefits in the Great Lakes system for navigation and power. Nevertheless, an estimation of the major benefits that might otherwise have been generated on the Great Lakes does have some descriptive value in the context of the effects of other diversions. If the diverted water were available and used, downstream navigation and power interests could generate additional revenue while coastal zone interests would experience some increased damage. Overall, however, it is obvious that the present diversion's net benefits exceed those of any alternative uses by a significant margin, even without taking into account the many indirect benefits of the diversion being in place and its prior existence.

No significant environmental impact on the Great Lakes basin has been documented as a result of this diversion; there have, however, been important local effects on the Illinois waterway, which is one of the most heavily used navigation systems in the United States and is a major conduit for agricultural and industrial commodities as well as treated sewage effluent. In the upper reaches of the waterway, water quality is rather poor, creating unfavourable conditions for natural habitat and poor biological resources. In the mid and lower reaches, the water is of relatively higher quality. Sedimentation has had a significant influence on changing the character of the Illinois River.

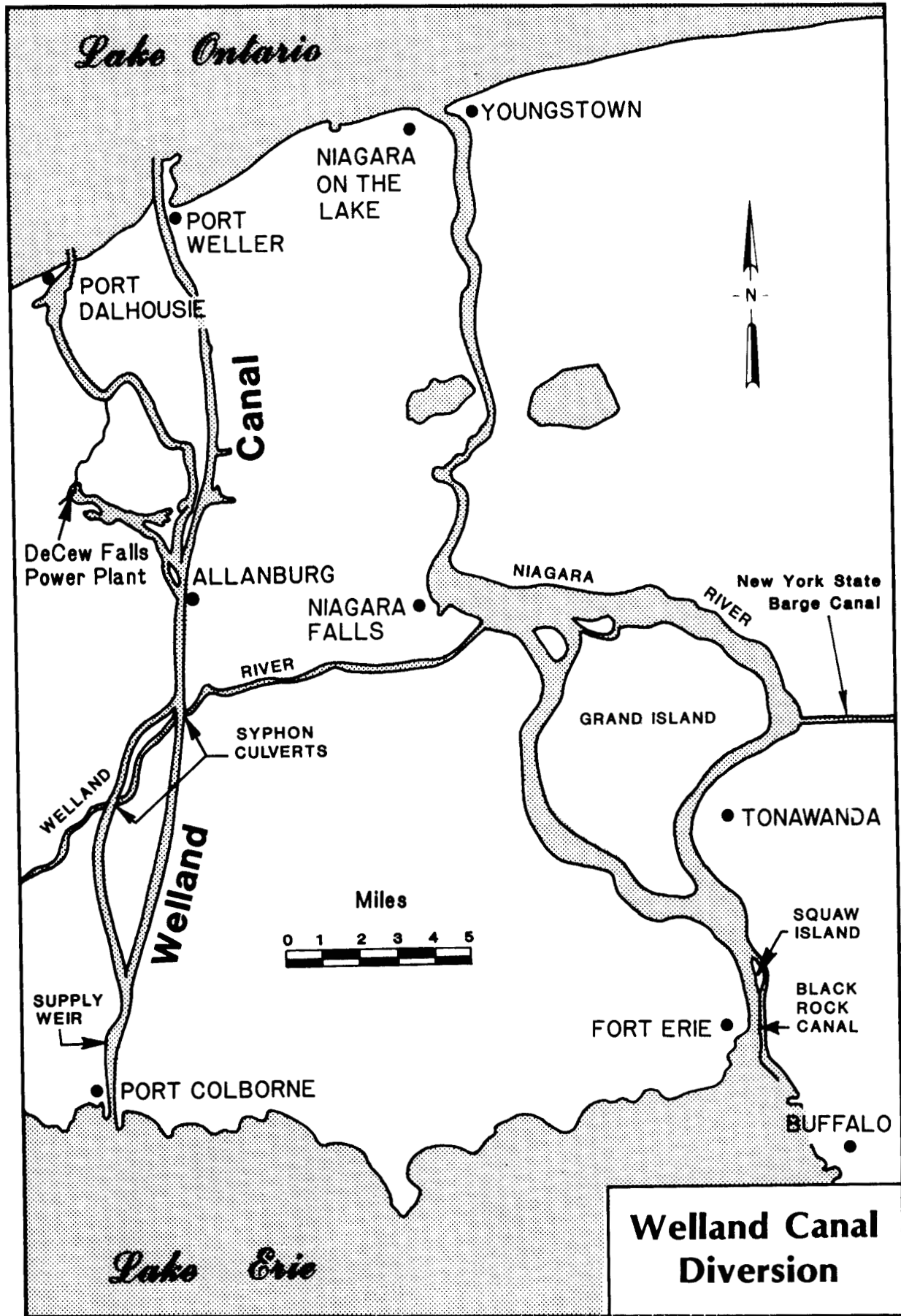
### *The Welland Canal*

*History:* The Welland Canal takes water from Lake Erie at Port Colburn and diverts it across the Niagara Peninsula to

Lake Ontario at Port Weller, bypassing the Niagara River and the Falls (Figure 5). The canal is used primarily as a deep draft navigational waterway and for power generation at Ontario Hydro's DeCew Falls generating stations. The diversion also supplies water for industrial and municipal use and for water quality enhancement.

Originally built in 1829, the canal has been reconstructed, lengthened and realigned several times. The present Welland Canal is a modified version of that built between 1913 and 1932. Since 1959 the canal has been operated as an integral part of the St. Lawrence Seaway system by the St. Lawrence Seaway Authority, a Canadian Crown corporation. Under an agreement with the Seaway Authority, Ontario Hydro takes water out of the canal at Allanburg and rediverts it to the DeCew Falls hydro-electric power generating plants. This water is discharged into Lake Ontario through Twelve Mile Creek. While most of the remainder is discharged directly into Lake Ontario from the canal, a small portion is redirected into the Welland River to maintain its water quality and is discharged to the Niagara River.

The first power development using Welland Canal water at DeCew Falls began about 1887 and was completed in 1913. At completion, at flow of 31 cms (1,100 cfs) was allocated for power. Since the period of power development straddles the 1910 effective date of the *Boundary Waters Treaty*, the Commission presumes that it was the intention of the Parties that the final 1913 power flow constituted a diversion "heretofore permitted" under Article III of the Treaty. Total canal flow in 1913 was 68 cms (2,400 cfs) and varied annually between 62 and 85 cms (2,200 and 3,000 cfs) through 1940.



**Welland Canal  
Diversion**

Figure 5

**Table 1**  
**WELLAND CANAL DIVERSIONS<sup>8</sup>**

Purpose	Amount		Comments
	cms	cfs	
Navigation	31	(1,100)	Approximate average flow during the navigation season.
	10	(350)	Approximate annual flow for hydro-electric power generation required to service navigation facilities year-round.
Power	31	(1,100)	Diversion for power at DeCew Falls plant prior to the <i>Boundary Waters Treaty</i> .
	159	(5,600)	Approximate diversion for power at DeCew Falls plant based on the current average annual diversions into Lake Superior from Long Lac and Ogoki as authorized by exchange of notes and memoranda between Governments. For practical reasons this amount is taken as a constant 142 cms (5,000 cfs) in calculations determining the amounts available for power at Niagara Falls.
Water Quality	20	(690)	Estimated flows taken from the canal at four separate locations for dilution of sewage or prevention of stagnation. Approximately 5 cms (190 cfs) is returned to the Welland River and becomes available for power generation at Niagara Falls.
Domestic	2	(79)	Four separate withdrawals from the canal. Approximately 0.5 cms (19 cfs) are returned to the Welland River.
Industrial	4	(128)	Nine separate withdrawals from the canal. Approximately 0.3 cms (12 cfs) are returned to the Welland River. An unreported amount of these flows is consumed by plant operation or products and is not returned to the system.
Totals (rounded)	257	(9,050)	Typical navigation season uses.
	226	(7,950)	Typical non-navigation season uses.

<sup>8</sup> Report by On-Site Representatives to the International Niagara Committee on Welland Canal Diversions, May 1982 (Revised October 14, 1982).

Further increases of flows through the Welland Canal have been due mainly to the installation of additional power generation capacity in the 1940s. The supply of water for this purpose appears to be governed by the international agreements discussed in the section on the Long Lac and Ogoki diversions. The exchange of notes between Canada and the United States of October 14, 1940, reaffirmed by the 1950 Niagara Treaty, allocate to Ontario the volume of water equivalent to the Long Lac and Ogoki diversions, currently averaging 159 cms (5,600 cfs), to be used at Niagara Falls. By 1951 the diversion was at a maximum rate of 210 cms (7,400 cfs) and averaged 215 cms (7,600 cfs) through 1970. Beginning in about 1973, increased flows for power generation were put through the canal, without structural change, raising its current (1980) rate to about 260 cms (9,200 cfs) on an annual basis.

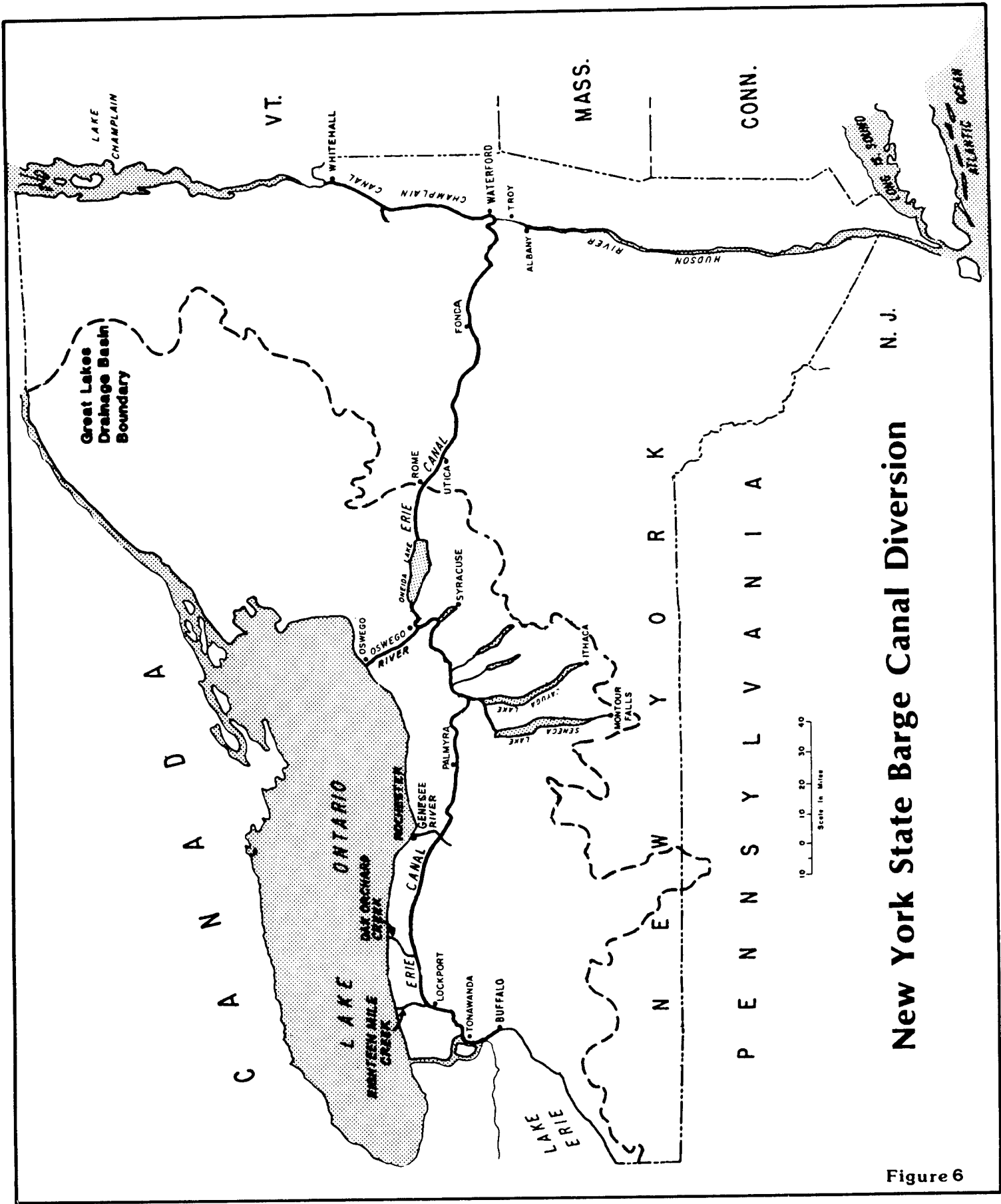
A breakdown of the Welland Canal diversion by purpose is shown in Table 1.

Considering that the requirements of each user fluctuate in amount over time, the current average annual diversion of 260 cms (9,200 cfs) is relatively close to the accounting shown in the table. The diversion amounts are reported to Governments by the International Niagara Committee as provided for in the 1950 Niagara Treaty. This is not a Committee of the International Joint Commission, but was estab-

lished separately by Governments to administer the 1950 treaty.

*Effects:* The diversion of water through the Welland Canal increases the outflow capacity of Lake Erie and has lowered the mean level of that lake by about 13.4 cm (0.44 feet), at the current diversion rate of 260 cms (9,200 cfs). Because the level of Lake Erie naturally affects the levels of Lakes Michigan-Huron and, by regulation, Lake Superior, the mean levels of these lakes have also dropped about 5.5 cm (0.18 feet) and 1.8 cm (0.06 feet) respectively. There is no effect on the mean level of Lake Ontario but the minimum, maximum and range have been affected (see Tables 2a and 2b, page 21).

As with the Chicago diversion, no detailed economic evaluation was performed for the Welland Canal diversion since this would have entailed determining the costs of alternative water supplies and other modes of transportation between Lakes Erie and Ontario. While the diversion has lowered the mean levels of all the lakes upstream from Lake Ontario, the benefits of navigation through the canal itself exceed by a wide margin any losses attributable to lower Great Lakes levels. With the same amount of water, more power can be generated at the DeCew Fall plants, due to their greater efficiency, than at Niagara Falls. Overall there appears to be a net benefit to power generation, significant



**New York State Barge Canal Diversion**

**Figure 6**

benefits to navigation, and some benefit to coastal zone interests.

The Welland Canal has had a significant effect on the indigenous fishery in the basin. Sea lamprey reached the upper lakes from Lake Ontario through the Welland Canal and lake trout stocks in the upper three lakes virtually disappeared, primarily as a result of sea lamprey predation.

### *The New York State Barge Canal*

*History:* The New York State Barge Canal, comprising the interconnected Champlain, Erie, Oswego and Cayuga-Seneca Canals, takes water primarily for navigation purposes from the Niagara River at Tonawanda, New York, and returns all of it to Lake Ontario through several tributaries and the Oswego Canal (Figure 6). Construction of the Erie Canal began in 1817 and was completed in 1925. Work began on the present canal in 1905 and was completed in 1918. Consequently, the canal is a diversion "heretofore permitted" under Article III (1) of the *Boundary Waters Treaty*. In addition, the barge canal is included in the provisions of Article III of the *Niagara River Diversion Treaty*, which allows the continuation of existing water "used and necessary for domestic and sanitary purposes and for the service of canals for the purpose of navigation". However, the Commission has been unable to ascertain the exact amount of the diversion either by the 1905-1918 project or in 1950 when the Niagara treaty was signed.

The amount of water diverted from the Niagara River by the canal is currently not measured but is estimated on the basis of flow measurements made in the 1950s. The amount varies seasonally; the average is taken to be about 20 cms (700 cfs), with a maximum flow during the navigation season (April to November) estimated at about 31 cms (1,100 cfs). Water is diverted from the canal at various locations and for various purposes, including irrigation and power production, but the exact amounts used for these purposes, and the manner in which water is diverted, are unclear. Furthermore, it is not known whether waters used downstream for irrigation and power generation are merely subsequent uses of water required upstream for the navigation service.

The Governments are informed regularly about this diversion by the International Niagara Committee.

*Effects:* This diversion has no hydraulic effect on any of the Great Lakes. All of the flow is returned to Lake Ontario, and the point of withdrawal from the Niagara River is downstream from the natural hydraulic control of Lake Erie.

For reasons similar to those at the Chicago and Welland Canal diversions, no economic analysis was undertaken of the barge canal diversion. However, considering the large number of municipal, recreational and industrial users along the entire canal system, its benefits would appear to outweigh by far any alternative uses of that relatively small amount of water.

Throughout the region traversed by the New York State Barge Canal system, both waters and wildlife have been modified extensively. In some parts of the system, fish fauna have increased while in other parts reductions have occurred.

Anadromous fish runs have been blocked by dams, and wetland spawning areas have been eradicated by drainage and dredging programs. Water quality in natural streams has deteriorated as a result of domestic, agricultural and industrial pollution. Lakes have been created and/or modified by flood control projects, and stream flows and temperature regimes have been altered by engineering works. In most instances, however, the extent of the impact on aquatic resources has not been well documented. In addition, no significant basin-wide environmental effects as a result of the New York Barge Canal diversion have been documented.

### *Cumulative Effects of Existing Diversions*

The theoretical effects of the diversions just described, excluding the relatively minor New York State Barge Canal diversion, are presented in Tables 2a, b. The numbers were derived by reducing the current rates to zero, individually and in combination. The table shows that, based on the approximate existing rates of these diversions, each current diversion has an effect over the total range of levels on each of the Great Lakes.

The diversions have increased the long-term mean outflow from Lake Superior by 159 cms (5,600 cfs); that of Lakes Michigan-Huron, Erie and Ontario by about 68 cms (2,400 cfs); and outflow from Lake Erie by 193 cms (6,800 cfs). However, the regulation plans in operation on Lakes Superior and Ontario have been designed to accommodate these diversions, and they satisfy the Commission's criteria for the regulation of those lakes to the extent possible, given the large fluctuations in supplies. If these diversions had not been present, the regulation plans would be different, but approximately the same level regime would be produced.

The second cumulative effect of the diversions is that the mean levels of Lakes Superior and Ontario have been increased by 2.1 cm (0.07 feet) and 2.4 cm (0.08 feet) respectively while the mean levels of Lakes Michigan-Huron and Erie have been reduced by 0.6 cm (0.02 feet) and 10.1 cm (0.33 feet) respectively.

While each diversion has been analysed to the extent possible within the constraints of this investigation, the information available is insufficient to draw any cumulative basin-wide economic or environmental implications.

### *Other Existing Diversions*

Although not specifically named in the reference, two additional diversions, both involving relatively small amounts of flow, are known to the Commission, and there appear to be others.

Since 1975, the Detroit domestic water supply system has withdrawn approximately 4 cms (145 cfs) from Lake Huron, the bulk of which is returned to the system in the lower Detroit River. This diversion has no measurable effects on the levels of Lakes Huron or Erie, and the Commission has not issued an Order of Approval for the project.

In 1968 the Commission issued an Order of Approval for a diversion of 0.7 cms (25 cfs), to last up to 100 days annually,



Table 2a

**THEORETICAL EFFECT OF EXISTING DIVERSION RATES ON GREAT LAKES WATER LEVELS  
(CENTIMETRES)**

Diversion	Rate (cms)	Mean	Superior			Michigan-Huron				Erie				Ontario <sup>1</sup>			
			Max	Min	Range	Mean	Max	Min	Range	Mean	Max	Min	Range	Mean	Max	Min	Range
Long Lac/Ogoki Lake Michigan at Chicago	159	+6.4	+3.7	+25.9	-22.3	+11.3	+11.0	+13.1	-2.1	+7.6	+7.9	+8.5	-0.6	+6.7	+38.4	+44.8	-6.4
Welland Canal <sup>2</sup>	91	-2.1	0	-1.8	+1.8	-6.4	-6.1	-7.3	+1.2	-4.3	-4.6	-4.6	0	-3.0	-55.5	-14.6	-40.8
	266	-1.8	0	-1.8	+1.8	-5.5	-5.5	-5.5	0	-13.4	-12.8	-14.6	+1.8	0	-2.1	+0.3	-2.4
Combined	159																
	91	+2.1	+3.4	+22.3	-18.9	-0.6	-1.8	+1.2	-3.0	-10.1	-9.8	-11.0	+1.2	+2.4	+19.5	+18.0	+1.5
	266																

**Notes:** 1. Lake Ontario levels were computed under the current regulation Plan 1958-D without application of the International St. Lawrence River Board of Control discretionary deviations.

2. The Study Board evaluated a rate of 266 cms for the Welland Canal, a rate that could likely occur in the future. The evaluation of the current rate of 260 cms would give very similar results.

3. The (-) sign signifies a reduction in level while a (+) signifies an increase.

**Source:** The Study Board.

Table 2b

**THEORETICAL EFFECT OF EXISTING DIVERSION RATES ON GREAT LAKES WATER LEVELS  
(FEET)**

Diversion	Rate (cfs)	Mean	Superior			Michigan-Huron				Erie				Ontario <sup>1</sup>			
			Max	Min	Range	Mean	Max	Min	Range	Mean	Max	Min	Range	Mean	Max	Min	Range
Long Lac/Ogoki Lake Michigan at Chicago	5,600	+ .21	+ .12	+ .85	- .73	+ .37	+ .36	+ .43	- .07	+ .25	+ .26	+ .28	- .02	+ .22	+ 1.26	+ 1.47	- .21
Welland Canal <sup>2</sup>	3,200	- .07	0	- .06	+ .06	- .21	- .20	- .24	+ .04	- .14	- .15	- .15	0	- .10	- 1.82	- .48	- 1.34
	9,400	- .06	0	- .06	+ .06	- .18	- .18	- .18	0	- .44	- .42	- .48	+ .06	0	- .07	+ .01	- .08
Combined	5,600																
	3,200	+ .07	+ .11	+ .73	- .62	- .02	- .06	+ .04	- .10	- .33	- .32	- .36	+ .04	+ .08	+ .64	+ .59	+ .05
	9,400																

**Notes:** 1. Lake Ontario levels were computed under the current regulation Plan 1958-D without application of the International St. Lawrence River Board of Control discretionary deviations.

2. The Study Board evaluated a rate of 9,400 cfs for the Welland Canal, a rate that could likely occur in the future. The evaluation of the current rate of 9,200 cfs would give very similar results.

3. The (-) sign signifies a reduction in level while a (+) signifies an increase.

**Source:** The Study Board.

from Lake St. Lawrence into the Raisin River in eastern Ontario. This diversion is used to improve flow conditions in the Raisin River during the summer months. The water is returned to the St. Lawrence River below Cornwall, Ontario, thus bypassing the hydro-electric generating station. The diversion has no measurable impact on levels of the St. Lawrence River. The Commission's order is still active; it is monitored by the Commission's International St. Lawrence River Board of Control.

The fact that one of these minor diversions operates under a Commission Order of Approval and the other does not points out the necessity for clarifying the Commission's role in such instances, a point that was also raised at the Commission's public meetings in 1983. According to Article III(1) of the *Boundary Waters Treaty*, the Commission's jurisdiction covers "uses, obstructions and diversions affecting the natural level or flow of boundary waters on the other side of the line...". However, it is uncertain whether a minor diversion, which by itself does not affect levels and flows in a measurable fashion, is meant to be encompassed. This uncertainty is

compounded by Article III(2), which provides that neither Commission approval nor special agreement between the Parties is required for the ordinary use of waters for domestic and sanitary purposes.

The proponent of a minor diversion may not be required under domestic law to inform either federal government. In practice, if neither federal government is informed, no application would be made to the Commission, since under Commission rules applications are to be submitted through the Parties. If one of the Parties is so informed, it may convey the application to the Commission, or it might seek agreement with the other country, thereby exempting the project from the Commission process.

These uncertainties are not new. In 1966 and 1967 the Commission was informed through discussions with Governments about two such special agreements allowing minor diversions to proceed. The Commission followed up on this issue with a letter to Governments in 1970, but received no direct response. In terms of governmental practice, however,

with the exception of the Raisin River diversion, no applications for approval of minor diversions have since been submitted to the Commission. This matter is also discussed in Part Two.

There is the possibility that the number of small diversions is sufficient that, collectively, their effects on basin and lake waters could be measurable. For example, one publication indicates that in 1975 small diversions into the U.S. portion of the basin totalled about 0.8 cms (30 cfs). This estimate does not include any diversions that are occurring between small watersheds within the basin.

### Conclusions

In light of these findings the Commission has reached the following conclusions:

- 1. The review of existing diversions at Long Lac, Ogoki, Chicago and the Welland Canal has shown that they have produced changes in Great Lakes levels and outflows, but the hydraulic impacts are small in relation to the natural ranges on the lakes. The New York State Barge Canal diversion has no hydraulic effect on any of the Great Lakes. The effects on the connecting channels and rivers where diversions are located are more significant, but they are localized.**
- 2. The hydraulic effects of these diversions on the Great Lakes and connecting channels can be translated into dollar terms for certain major interests in the basin such as hydro-electric power. However, such an analysis is of questionable utility, since the sizable economic benefits to respective users of the diversions have not been calculated, except for the Long Lac and Ogoki diversions, and would have limited analytical or decision-making value.**
- 3. The environmental evaluation of existing diversions was limited by the reasonably available ecological and other data. The study found certain important localized environmental effects, but no significant basin-wide effects have been documented.**
- 4. The history of consultation with respect to diversions and recognition of the legitimate interests of both countries, regardless of legal considerations, has by and large reflected mutual co-operation and concern. This Report has discussed several matters regarding existing diversions (e.g., the status of waters diverted into the Great Lakes, the changed Welland Canal diversion and the amount and status of the New York State Barge Canal diversion), some of which might usefully be examined by Governments.**
- 5. Although data on existing major diversions are reported regularly to both Governments through the Commission or other mechanisms, (e.g., flows in the Chicago diversion are reported to the U.S. Supreme Court and are available to the public), this does not appear to be the case for small diversions. There is no single repository for information on all existing diversions in the Great Lakes basin, and there may be**

**instances where small diversions are unknown to either or both Governments.**

- 6. The international requirements under the *Boundary Waters Treaty* with respect to both large and small diversions of boundary waters are not explicit, nor is any consistent practice followed. This matter is discussed further in Part Two.**

## Federal, State or Provincially Sponsored or Approved New or Changed Diversions

The Commission has found no federal, state or provincially sponsored or approved new or changed major diversions in the basin. There is one new diversion, which is considered minor, from the Lake Simcoe (Lake Huron) drainage basin, and a change in the Welland Canal diversion as discussed earlier in this chapter. The previously authorized increase in the Lake Michigan diversion for demonstration purposes, which expired in 1981, is discussed separately below.

The Simcoe diversion, which has been approved by Ontario authorities, is a municipal sewage disposal project that is still in the development stage. Sewage from several municipalities in the Lake Simcoe-Georgian Bay drainage basin will be pumped to the Lake Ontario drainage basin via the York-Durham sewer system for treatment at Pickering, Ontario. The flow is estimated to reach 0.7 cms (25 cfs) by the year 2000 and constitutes a diversion from Lake Huron to Lake Ontario.

As discussed earlier in this chapter, the Commission believes there may well be other minor diversions approved or under active consideration by various levels of government in both countries.

Proposed large-scale diversions from the Great Lakes to parts of the North American continent, the issue that received so much attention at the Commission's public meetings in June 1983, are considered in Part Two and Appendix G of this Report.

## The Study and Demonstration Program Authorized by United States Public Law 94-587

The reference requested the Commission to report on the Increased Lake Michigan Diversion at Chicago Demonstration and Study, which was authorized by U.S. Public Law (P.L.)94-587 in October 1976 to evaluate the effects of increasing the diversion from its present limit of 91 cms (3,200 cfs) up to an average of 283 cms (10,000 cfs). Diversion increases would be for improving water quality of the Illinois waterway through dilution and reducing shoreline

erosion along Lake Michigan caused by high lake levels. Criteria specified in the study authorization did not allow increased diversion when river stages approach or were predicted to approach bankfull conditions at the established flood warning stations on the Illinois River. Increased diversion was prohibited when the level of Lake Michigan is below its average level, or when increased diversion would adversely affect water levels necessary for navigational requirements on the St. Lawrence Seaway.

By its note of October 7, 1976 to the United States Department of State, the contents of which were provided to the U.S. Congress, the Canadian Government reiterated its objection to any unilateral increase in the diversion from Lake Michigan at Chicago. The note also pointed out that the legislation was without prior consultation with Canada.

The program's study and demonstration parts were subsequently separated by the action of the U.S. Congress. The study portion was funded through fiscal year 1981 and resulted in several computer model simulations of large diversion increases. These studies also determined that such increases were not economically justified. Although there were indications that significantly smaller increases might be beneficial overall, no additional study funds have been provided.

The demonstration part of the program was never funded and no actual demonstrations were conducted. The authority for this activity expired in 1981 and cannot be undertaken without the enactment of new legislation.

## The Possibility for Improved Regulation of The Great Lakes during Extreme High and Low Levels

The reference from Governments requested the Commission to investigate the possibility of improving the regulation of Great Lakes levels by manipulating the existing diversions. This section reports on the feasibility of reducing extreme high and raising extreme low lake levels by varying the flow rates in the Long Lac, Ogoki, Welland and Chicago diversions. The New York State Barge Canal and existing diversions at Sault Ste. Marie and Niagara Falls were not included; the former does not affect lake levels, and the latter two were examined in this respect by previous studies.

In considering the possible flow variations at each diversion, the Study Board recognized several practical limitations or constraints. First, no structural changes to the diversion were considered. Consequently, potential flow changes were limited to what could be obtained under existing physical conditions. Second, it was found that the Long Lac and Ogoki diversions could not be increased above their existing rates during times of low lake levels, as there was no additional water available in their natural drainage areas. Third, it was not realistic to consider reducing either the Chicago diversion below its current rate or the Welland Canal below 74 cms (2,600 cfs) as there are no practical alternatives to provide for the domestic water supply, sanitary and navigational purposes served by these flows.

The next phase of the Study Board's investigation was the mathematical modeling of various assumed diversion rates, individually and in combination, to determine whether some amelioration of extreme lake levels, both high and low, could be achieved within the constraints cited above. An indicator based on water supply to the Great Lakes was selected to signal when a change in the diversion rate should occur. Thirty-six different diversion scenarios were developed to encompass the full range of flows over which the diversion rates could be altered. Five scenarios to reduce high water levels and one scenario to raise low water levels were selected for further hydrological analysis and an economic review. The Commission's reservations about the prescriptive utility of the analyses that are generally undertaken in this regard is discussed at the end of this chapter. Nevertheless, the estimated economic values are cited to provide an indication of the order of magnitude of certain defined benefits and costs within the sectors analysed and can be used in that context.

### *Reducing High Levels*

Of the five scenarios for reducing high levels selected for detailed examination, the maximum-effect diversion scenario, which achieves the greatest reduction, occurs with the following assumptions: the Long Lac and Ogoki diversions are reduced to zero, the Chicago diversion is increased to 246 cms (8,700 cfs), and the Welland Canal flow is increased to 255 cms (9,000 cfs) from its 1979 average rate of 204 cms (7,200 cfs). Under this scenario there would be a lowering of the maximum level of Lake Superior by 3.0 cm (0.10 feet), of Lakes Michigan-Huron by 17.4 cm (0.57 feet), of Lake Erie by 13.7 cm (0.45 feet), and of Lake Ontario by 42.7 cm (1.4 feet). The large effect on Lake Ontario is due to operating under the fixed maximum and minimum releases of Regulation Plan 1958-D and reflects the full impact of all upstream actions.

According to the Study Board's analysis, the maximum-effect diversion scenario would generate annual economic benefits to coastal zone interests (\$6.0 million) and recreational beach users (\$1.8 million); however, it would cause significant annual losses to navigation (\$13.8 million), power generation (\$61.3 million), pulp and paper (\$4 million), and recreational boating interests (\$1.6 million). For this scenario therefore, the estimated net economic loss would be about \$73 million annually. Except for one scenario discussed below, all the remaining scenarios to reduce high levels were calculated to generate annual losses ranging from about \$23 million to \$73 million. Even within the limitations of the analysis, as discussed later in this chapter, such dollar disparities are of sufficient magnitude to indicate that the further manipulation of diversions for the purpose of alleviating extreme lake levels is without merit on the basis of conventional benefit-cost criteria.

The Study Board's economic analysis of one scenario to reduce high lake levels showed a net benefit of \$1.3 million, primarily due to increased power generation. This scenario had the Long Lac and Ogoki diversions at 142 cms (5,000 cfs), the Chicago diversion at 91 cms (3,200 cfs) and the Welland Canal diversion at 255 cms (9,000 cfs); essentially, this scenario became fact during the course of the study. The

Welland Canal flow currently averages 260 cms (9,200 cfs), the Long Lac and Ogoki diversions 159 cms (5,600 cfs). The scenario has no calculated effect on the Lake Superior maximum level and lowers the maximum levels of Lakes Michigan-Huron by 1.8 cm (0.06 feet), Lake Erie by 3.0 cm (0.10 feet), and Lake Ontario by 0.9 cm (0.03 feet).

Since the maximum-effect scenario would have the greatest effect on levels and flows, it was the only one evaluated for environmental impact. Although limited in detail, the environmental evaluation covered fisheries, wildlife, wetlands and water quality. A review of the published literature pertaining to those resources indicates that effects are not quantitatively definable using existing data. Although any effects might be subtle and indirect, and could add to or act in synergy with stress factors the system's resources are already experiencing, it is expected that the overall environmental effects on the Great Lakes system would be indistinguishable from those experienced as a result of existing water level fluctuations.

During the Commission's public meetings, a widespread comment was that no further consideration should be given to managing Great Lakes levels and flows through existing diversions. The view of the representatives from the province of Ontario and the state of Illinois, among others, was that the problem of flooding and erosion should be approached through proper land use planning and public information. With the exception of riparians, most speakers opposed further regulation of lake levels by manipulating existing diversions, citing a lack of knowledge about the effects on water quality and the Great Lakes ecosystem and a lack of evidence of economic feasibility or desirability. They also claimed that it would not be in the public interest or in the interests of certain key sectors of the economy of both nations, such as power and navigation. All submissions that addressed this issue, including those from the Government of Canada, the provinces of Ontario and Quebec, and several U.S. state agencies, were in accord with the Study Board's conclusion that all diversions should be monitored and their effects assessed periodically. Some environmental and natural resource agencies called for a recommendation to address high lake levels, recognizing that manipulation of existing diversions was not going to be feasible to accomplish this. Others suggested that existing environmental information is not adequate to evaluate proposals affecting Great Lakes levels and urged that better environmental baseline information be generated.

### *Raising Low Levels*

Under the scenario to raise low water levels, the Long Lac and Ogoki diversions are assumed to be 142 cms (5,000 cfs), the Chicago diversion is maintained at 91 cms (3,200 cfs), and the Welland Canal diversion is assumed to be at the minimum acceptable level of 74 cms (2,600 cfs).

Hydrologically, this scenario would raise lake levels as follows: the minimum and mean levels of Lake Superior by 0.3 cm (0.01 feet), the Lakes Michigan-Huron minimum level by 2.1 cm (0.07 feet) and the mean by 1.2 cm (0.04 feet), and the Lake Erie minimum level by 6.4 cm (0.21 feet)

and its mean by 3.0 (0.10 feet). The effects on the maximum levels of these lakes are 0.6 cm (0.02 feet) or less. A varying effect is shown on Lake Ontario; that is, its minimum is lowered by 3.7cm (0.12 feet) and its mean and maximum are raised by 0.3cm and 3.4 cm (0.01 feet and 0.11 feet) respectively. This varying effect is due to the manner in which outflows from Lake Ontario are regulated.

This scenario was estimated in the Study Board's analysis to generate annual direct dollar losses to coastal zone interests (\$0.8 million) and power (\$4 million), and annual benefits to navigation (\$2 million). The economic effects on recreational boating and beaches were not calculated. The net annual direct dollar loss considered by the analysis was estimated at about \$2.7 million.

### *The Limitations of Economic Analysis*

The Study Board's analysis, despite a considerable expenditure of effort, was not a complete assessment. For only two diversions – the combined effect of Long Lac and Ogoki – was a full assessment of the benefits and costs of the existing diversions, as well as their effect on the Great Lakes system, even attempted. It was decided that an evaluation of the Chicago diversion or of fundamental alternatives to the diversion was beyond the scope of the study. Similarly, only adjustments to the power portion of the diversion at Welland were evaluated, and there was no economic analysis of the New York Barge Canal.

A second concern with this kind of economic analysis lies in the incompleteness of the accounting of benefits. As indicated at the beginning of this chapter, only four economic sectors, albeit important ones, were selected for analysis, and one of those was geographically incomplete. Multiplier or secondary effects within and outside the area of concern were not included. Other direct economic effects, such as employment and increases in the supply and service industries (which often include other primary users, such as commercial navigation and power) were not included in the analysis, nor were the indirect benefits accruing from the use of alternative sources of power or transportation modes. Finally, despite an exhaustive and standardized effort, even the benefits that were calculated can reflect actual economic values attributable to the hydraulic impacts only within a considerable margin of uncertainty because of the number of assumptions involved and their evolution over time. For example, interest rates and energy costs change, as do real estate values and the amount of shoreline development. A specific example is that of the estimated replacement costs for hydro-electricity at Niagara, which are on the order of \$16 thousand per gigawatt-hour on the Canadian side and \$110 thousand per gigawatt-hour on the United States side. Clearly these estimates are based on vastly different assumptions that are open to debate.

In addressing the management of water use, diversion flows and, indeed, most resource management decisions, considerable emphasis has normally been placed on economic analysis. Government agencies and the Commission, in this Report and in other studies, generally use conventional measures of economic valuation, using techniques

such as benefit-cost analysis. The Commission wishes to emphasize, however, the limitations of this type of analysis in assessing management and policy questions such as those pertaining to Great Lakes levels.

Benefit-cost analysis is a technical measurement of economic efficiency, or overall dollar gains or losses. It cannot properly be used outside that context and should not be used in isolation from other decision criteria. Benefit-cost analysis is not able to deal with concepts such as equity and income distribution, which are matters of social value and responsibility. It is also generally recognized that despite some progress in measurement methodology, monetary valuation techniques have considerable difficulty incorporating non-market or intrinsic values inherent in resource-use decisions, such as aesthetics and environmental integrity.

In the case of the Great Lakes, it is possible to calculate certain economic gains of changed water levels to navigation and hydro-electric power generation, and to balance those off against certain technically derived measures of erosion and flooding losses to individual riparians. Yet the substantial direct economic benefits to large or corporate interests are not easily or equitably compared with the social, personal and economic losses to the individual. Not all articles of apparently equal monetary value are necessarily of the same intrinsic or social value, and the marginal value of additional units of income or of a commodity may not be equal at all times or equal for all recipients. It can also be argued that protecting a resource or its use has a collective social importance and a value higher than the strict equivalency of dollar gains and losses indicated by benefit-cost analysis. The techniques are inadequate to measure all the 'soft' costs to society (as individuals or collectively) of shore damage or of wetland losses resulting from changing Great Lakes levels, for example.

In light of these considerations, the Commission believes that the economic analysis contained in the Study Board's report must be treated with caution as a basis for making decisions that have broad implications for society and for the interests of many individual citizens.

Nevertheless, some empirical basis is required for decision-making. Benefit-cost analysis does have value as one measure of 'hard' GNP exchanges. Despite the limitations discussed in this report, the Study Board's evaluation does indicate marked differences in the economic values generated by further management of the existing diversions. These values provide an indication of the order of magnitude of economic effects, but not a definitive and precise statement of benefits and costs or of social utility. The evaluation is sufficient for the Commission to agree with the Study Board that, without overwhelming reasons such as a significant shift in the beneficial uses of Great Lakes water, the further

management of existing diversions to affect high and low water levels is unlikely to be justifiable in overall terms.

### *Conclusions*

In light of these findings the Commission has reached the following conclusions:

- 1. Present diversion rates can be modified without structural change at existing locations. Reduction of high levels in the Great Lakes system could be achieved by altering diversion rates to provide a general lowering of the maximum levels, a small lowering of minimum levels, and a net reduction in the range of levels.**
- 2. Under all diversion management scenarios except the one discussed under 3 below, which essentially has been in effect since 1979, significant net annual direct financial losses would appear to accrue to the sectors considered in the analysis. Generally, diminishing levels and flows in the Great Lakes system by managing diversions has a negative effect on hydro-electric and navigation costs that exceeds shoreline protection benefits. The dollar values are of sufficient magnitude to indicate that, on the basis of conventional cost-benefit criteria and under existing economic conditions, the further manipulation of diversions for the purpose of alleviating the adverse effects of high lake levels is not justified.**
- 3. Under one scenario, which lowered high levels by increasing flow in the Welland Canal, there is a calculated net financial benefit of \$1.3 million annually. This potential became fact during the course of the study.**
- 4. The ecological effects of changes in lake levels from managing existing diversions are not definable in a quantitative sense using existing data, but any changes would add to existing stress factors on the resource.**
- 5. With respect to raising low levels, only one alternative was considered feasible to evaluate economically. It would involve curtailing power production through the Welland Canal diversion and would result in a small net financial loss as currently assessed. Increases in lake levels under this scenario are relatively small, except for Lake Erie. Should hydrological or economic criteria within certain sectors change significantly in the future, or should other considerations that would benefit from such a changed regime be given sufficient weight, the divergence of values is sufficiently small that this management scenario might become more attractive.**



## CHAPTER IV

### THE REFERENCE: CONSUMPTIVE USES

#### Existing Consumptive Uses

The reference requested the Commission to examine and report on the effects of existing and reasonably foreseeable patterns of consumptive uses on Great Lakes levels and flows. As defined in Chapter 1, a consumptive use refers to that portion of water withdrawn or withheld from the Great Lakes and assumed to be lost to them due to evaporation during use, transpiration from irrigated crops, leakage, incorporation into manufactured products, or similar occurrences during use. Consumptive uses affect levels and flows by reducing or removing the water supply that would otherwise flow in the Great Lakes. No attempt was made to examine the benefits generated by the activities that result in consumptive uses. Consumptive uses are normally not measured directly, but are derived from metered withdrawals.

#### *Study Board Estimates*

Large quantities of water are withdrawn from the Great Lakes and their surface and groundwater tributaries for industrial, agricultural and domestic purposes and for other human activities. In 1975, the base year for this study, withdrawals in the Great Lakes basin totalled roughly 2,120 cms (75,000 cfs). Because close to 95 per cent of this water is returned to the system after use, the large withdrawals do not have a commensurate effect on Great Lakes levels and flows, although the return flows have implications for water quality.

Total consumptive uses in the Great Lakes basin were about 140 cms (4,950 cfs) in 1975, as reported by the Study Board. Tables 3a and 3b display the Study Board's findings for existing withdrawals and consumptive uses, broken into the seven principal water use sectors the study employed. Manufacturing, municipal and power uses together accounted for just over 75 per cent of all consumptive uses and almost 97 per cent of all withdrawals in 1975.

Briefly, the water use sectors are defined as follows:

*Manufacturing* use includes both self-supplied water users and those supplied by central water distribution systems. This sector alone accounted for about half of all consumptive uses in 1975. Primary metals manufacturing consumes considerably more water than any other single industry in the Great Lakes basin and accounts for nearly 70 per cent of U.S. manufacturing consumptive uses. The second and third

largest water-consuming industries are paper and chemicals. The chemicals industry accounts for the largest portion of Canadian manufacturing consumptive uses in the basin.

*Municipal* use includes all water uses supplied by centralized water distribution systems throughout the Great Lakes basin except for manufacturing uses. This sector is the second largest consumer of water in the basin (17 per cent) and third largest in terms of water withdrawals. Consumptive use in this sector includes estimated net leakage – the relatively small portion of total leakage that does not return directly through the sewer lines to the surface waters. While not contributing significantly to the consumptive uses of water in the Great Lakes basin, the high leakage rates in some distribution systems may nonetheless warrant correction for other reasons.

*Power* use considers thermally generated power only, because hydro-electric power generation does not consume a significant amount of water. Withdrawals by the power sector amount to over half of all withdrawals in the Great Lakes basin, but only 10 per cent of total consumptive uses at present.

*Irrigation* use includes the watering of all lands except those supplied by the municipal sector. This sector accounts for about 7 per cent of total basin consumptive uses. Agricultural irrigation requirements per acre are small in the Great Lakes basin relative to other parts of North America because rainfall is normally abundant. Golf course irrigation constitutes the primary recreational irrigation demand.

*Rural-Domestic* refers to private water uses, usually associated with rural populations and groundwater sources. This sector accounts for about 7 per cent of total basin consumptive uses.

*Mining* refers to water used for ore extraction and the reduction of metallic and non-metallic minerals and in the production of coal, petroleum and natural gas. This sector accounts for about 5 per cent of total basin consumptive uses.

*Livestock-watering* includes animal drinking water, evaporation from stockwater ponds, and water used for cleaning. This sector accounts for about 4 per cent of total basin consumptive uses.

Tables 3a and 3b indicate that in 1975 about 82 per cent of withdrawals and about 87 per cent of consumptive uses in the

Table 3a

**GREAT LAKES BASIN 1975 WITHDRAWALS (W) AND CONSUMPTIVE USES (CU) BY SECTOR: STUDY BOARD FINDINGS (CUBIC METRES PER SECOND)**

Water Use Sector	United States		Canada		Great Lakes Basin	
	W	CU	W	CU	W	CU
Manufacturing	579	64	158	6	737	70
Municipal	174	19	26	4	200	23
Power	948	12	187	2	1,135	14
Irrigation	10	7	4	3	14	10
Rural-Domestic	14	9	2	1	16	10
Mining	31	7	4	0	35	7
Livestock	4	4	2	2	6	6
<b>Total</b>	<b>1,760</b>	<b>122</b>	<b>383</b>	<b>18</b>	<b>2,143</b>	<b>140</b>

Table 3b

**GREAT LAKES BASIN 1975 WITHDRAWALS (W) AND CONSUMPTIVE USES BY (CU) SECTOR: STUDY BOARD FINDINGS (CUBIC FEET PER SECOND)**

Water Use Sector	United States		Canada		Great Lakes Basin	
	W	CU	W	CU	W	CU
Manufacturing	20,450	2,270	5,580	220	26,030	2,490
Municipal	6,130	680	930	150	7,060	830
Power	33,470	420	6,600	60	40,070	480
Irrigation	350	260	130	100	480	360
Rural-Domestic	500	300	60	30	560	330
Mining	1,080	250	130	0	1,210	250
Livestock	130	130	80	80	210	210
<b>Total</b>	<b>62,110</b>	<b>4,310</b>	<b>13,510</b>	<b>640</b>	<b>75,620</b>	<b>4,950</b>

basin occurred in the United States portion of the basin. Consumptive uses are greater there because of higher economic output, larger population, and wastewater discharge requirements that encourage water recycling in the power and manufacturing sectors as a means of pollution control.

Of the water now being consumed in the Great Lakes basin, 50 per cent results from withdrawals from "boundary waters" as defined in the *Boundary Waters Treaty*, 30 per cent results from withdrawals from tributary rivers and groundwater sources, and 20 per cent results from withdrawals taken directly from Lake Michigan. In the Canadian portion of the basin, consumption is concentrated in the Lake Ontario basin, followed by the Lake Erie and Lake Huron basins (Tables 4a, b); all are within the province of Ontario. In the U.S. portion of the basin, the states of Michigan and Ohio together account for over half of U.S. consumptive uses (Table 5). The percentages in Table 5 were obtained by allocating the Study Board's consumptive use estimates for each sector among the states in each basin, using the distribution reported in the Great Lakes Basin Commission Framework Study of 1975.

### *U.S. Geological Survey Estimates*

The Commission examined another estimate of consumptive uses to provide a perspective on the Study Board's findings. The United States Geological Survey (USGS) publishes estimates of consumptive uses in the United States; it reported in 1983<sup>9</sup> that consumptive uses in the U.S. portion of the Great Lakes basin totalled about 60 cms (2,140 cfs) in 1980 (see Table 6). This differs significantly from the Study Board's projected estimate of 138 cms (4,870 cfs) for 1980 as well as its finding of 122 cms (4,310 cfs) for the 1975 level of consumptive use in the U.S. portion of the basin.

The Commission considers the USGS National Water-Use Information Program very important in recognizing the need for uniform, current, and reliable information on water use. Ultimately, this should help ensure that major attention is given to water management issues in both the United States and Canada, as the Commission recommends in Chapter V.

<sup>9</sup> *Estimated Use of Water in the United States in 1980*, Geological Survey Circular 1001; Wayne B. Solley, Edith B. Chase, and William B. Mann IV.



Table 4a

**GREAT LAKES BASIN 1975 WITHDRAWALS (W) AND CONSUMPTIVE USES (CU) BY SUB-BASIN:  
STUDY BOARD FINDINGS (CUBIC METRES PER SECOND)**

Sub-Basin	United States		Canada		Total	
	W	CU	W	CU	W	CU
Superior	44	6	22	1	66	7
Michigan	720	44	—	—	720	44
Huron	109	8	67	4	176	12
Erie	690	57	81	5	771	62
Ontario	197	7	213	8	410	15
Great Lakes Basin	1,760	122	383	18	2,143	140

Table 4b

**GREAT LAKES BASIN 1975 WITHDRAWALS (W) AND CONSUMPTIVE USES (CU) BY SUB-BASIN:  
STUDY BOARD FINDINGS (CUBIC FEET PER SECOND)**

Sub-Basin	United States		Canada		Total	
	W	CU	W	CU	W	CU
Superior	1,550	220	790	30	2,340	250
Michigan	25,420	1,530	—	—	25,420	1,530
Huron	3,850	280	2,370	150	6,220	430
Erie	24,320	2,020	2,840	190	27,160	2,210
Ontario	6,970	260	7,510	270	14,480	530
Great Lakes Basin	62,110	4,310	13,510	640	75,620	4,950

Table 5

**U.S. CONSUMPTIVE USES, APPROXIMATE  
SHARE BY STATE, 1975**

State	% of U.S. Total
Michigan	33
Ohio	20
New York	14
Indiana	12
Illinois	9
Wisconsin	8
Minnesota	3
Pennsylvania	1

The program uses information at both the U.S. state and national levels; the current report is intended to improve past estimates of U.S. national water use, which have been published by USGS since 1950.

Comparing Tables 3a and 3b with Table 6 shows that the Study Board's estimate for withdrawals in the manufacturing sector is about twice that reported by the USGS, although the USGS manufacturing sector does not include the relatively minor component of industrial users supplied by municipal water systems. For the power sector, the USGS withdrawal estimate is about 25 per cent higher than that of the Study

Board. The two studies are much closer in their estimates of total withdrawals, because these differences tend to cancel each other out.

In addition to the different withdrawal estimates, the two studies also employ dissimilar water use coefficients, the most significant being in the power sector. Consumptive uses are typically estimated by multiplying measured withdrawals by a coefficient representing the average rate of water consumption for a particular plant or industry. The accuracy of the consumptive use estimate therefore depends as much on the choice of coefficients as on the measurement of withdrawals. Rates of consumption vary a great deal from plant to plant, however, because of differences in technology, process and degree of compliance with wastewater discharge requirements. The variation occurring over a region as large as the Great Lakes basin makes the derivation of accurate coefficients a considerable task. In addition, it is necessary to update the coefficients continually as new plants come on line and new processes are adopted.

While differences between the two estimates have been identified, there is not sufficient information now available to conclude with any confidence that either is more appropriate for the existing level of consumptive use in the U.S. portion of the basin. Consequently, both are included in this report. Regardless of which estimate is more accurate, the Commission is drawing attention to the need for more information and assessment in a variety of areas that affect water use. The specific recommendations are contained in Chapter V.

**Table 6**  
**U.S. PORTION, GREAT LAKES BASIN 1980 WITHDRAWALS(W) AND CONSUMPTIVE USES(CU):**  
**USGS FINDINGS (IN CMS AND (CFS))**

Water Use Sector	W		CU	
Public Supply (Industry, Commercial & Domestic)	170	( 6,000)	14	( 480)
Rural-Domestic	12	( 420)	3	( 120)
Livestock	4	( 130)	3	( 120)
Irrigation	15	( 530)	15	( 510)
Self-Supplied Industrial				
Thermo-electric	1,189	(42,000)	4	( 150)
Other (fresh water)	249	( 8,800)	16	( 570)
Other (saline water)	18	( 650)	5	( 190)
<b>TOTAL</b>	<b>1,657</b>	<b>(58,530)</b>	<b>60</b>	<b>( 2,140)</b>

### Conclusions

In light of these findings the Commission has reached the following conclusions:

- 1. The Study Board summarized the base (1975) level of consumptive use in the Great Lakes basin, in both the United States and Canada, under seven main use categories. The findings of the Study Board and of a related study by the USGS, while close in their estimated total withdrawals for the U.S. portion of the basin, differ considerably in their estimates of existing consumptive uses, particularly in the manufacturing sector.**
- 2. The information available at this time is not sufficient to determine whether one estimate is more appropriate than the other. Consequently, existing (1980) consumptive uses of water in the basin may be in the range of about 82 cms (2,900 cfs) to 159 cms (5,600 cfs).**
- 3. Existing consumptive use data, by sector, need to be improved in coverage, accuracy and consistency in order to establish useful historical trends and to improve forecasts. This could be achieved by more complete co-ordination and reporting, additional flow measurements at key locations, and by research on consumptive use coefficients.**

### Future Consumptive Uses

The Commission was asked to consider reasonably foreseeable patterns of consumptive uses of Great Lakes waters. In assessing future consumptive uses, the Commission has carefully considered the Study Board estimates from 1975 to 2035 but has concluded that projections beyond the year 2000 are too uncertain to be useful for planning and policy decisions. In addition, the Commission has updated the Study Board's estimates using more recent forecasts and has included the USGS estimate on existing consumptive uses. As a result, the Commission's projection reflects a shorter time frame and a somewhat lower estimate than that of the Study Board. This section discusses the Study Board's estimates, presents relevant comments received at the Commis-

sion's public meetings, and provides an update of the Study Board's projections, concentrating on the power and manufacturing sectors.

### Study Board Estimates

The Study Board estimated future consumptive uses by projecting water use for each water use sector from 1975 to 2035. The Study Board used economic forecasts for the region to predict the level and geographic distribution of activities that would require water. Consumptive use estimates were then derived by applying available data on water use and assumptions regarding technology and policy.

The Study Board's projections of consumptive uses were based on existing data and foreseeable economic and demographic trends at the time of the study (1980). Because of the uncertainties confronting long-term forecasting, the Study Board developed multiple alternative projections to establish a range. This produced alternative high and low projections centred on the Study Board's most likely projection (termed the MLP). The MLP was the projection judged by the Study Board to have the highest probability of occurring relative to the other projections considered. For example, the high and low projections of consumptive uses to the year 2000 were about 20 per cent above and below the value of the MLP. In the year 2035, the range extended nearly 40 per cent above and below the MLP.

A considerable body of work, including detailed national economic and water use forecasts, already existed in the United States. The water use projections produced by the U.S. Water Resources Council for the Second National Water Assessment, published in 1978, served as the basis, with some modifications, for the MLP for six of the seven U.S. water use sectors in the United States. The Study Board made its own projection for the power sector.

In Canada, more fundamental data analysis and model development were required. The data for manufacturing, mining, thermal power and municipal uses were the result of detailed surveys and measurements. An econometric input-output model for Ontario was developed to predict how changes in one industry would affect interconnected indus-

tries. In addition, a range of constant growth rates for individual industries was developed based on historical data since 1950. The Study Board recognized that data from this period would probably lead to an upward bias in long-term growth rates.

A large number of assumptions were built into the Study Board's consumptive use projections. Those most important to the MLP included

- annual population growth rate of 0.9 per cent in the U.S. portion of the basin and 1.4 per cent in the Canadian portion of the basin to the year 2000;
- continuation of existing uses of energy;
- attainment by the year 2000 of U.S. requirements under the *Clean Water Act* of 1977, and continuation of existing practices in Canada; and
- annual growth of the gross national product at 3.2 per cent in the U.S. portion of the basin and at 3.5 to 4.0 per cent in Ontario.

Analytical limitations also imposed certain assumptions. For example, while evaporation caused by use, particularly in the manufacturing and power generation sectors, accounts for the greatest portion of consumptive uses, it was assumed that water consumed at any point in the basin is lost to the system and does not return in the form of precipitation. This assumption was made by the Study Board because the state of the art in meteorology does not permit quantifying such precipitation quantities and patterns.

The Study Board projected that under their MLP, consumptive uses in the basin would double the 1975 estimate of 140 cms (4,950 cfs) by about the year 2000. These findings are summarized in Tables 8a, b on page 36. Most of the projected increases would occur in the power and manufacturing sectors, and these would be driven by two primary factors: substantial growth in these sectors in both the U.S. and Canadian portions of the basin, and changing water use requirements and technology. Steady increases in basin population and per capita consumption of municipally supplied water and the expansion of lands under irrigation would also contribute to the projected increases in consumptive uses, though to a much lesser extent.

The Study Board expected that changes in water use in the United States would result first from implementation of the *Clean Water Act*. In the power sector, different types of closed-cycle cooling systems are being incorporated into new power plants to eliminate thermal discharges. Water recirculation is being used increasingly in the manufacturing sector, primarily to meet other effluent water quality standards. Both changes increase consumptive use. The corollary is that any proposal to reduce these consumptive uses in the U.S. portion of the basin would have to take the possible water quality implications into account. Both the shift to recycling and the type of cooling technology used will affect water consumption. At present, alternative technologies are too expensive or do not meet U.S. regulatory requirements.

During the Commission's public meetings there was much discussion concerning consumptive uses. A representative from the state of Michigan noted there are obvious benefits

derived from withdrawals and consumptive uses, but that these were not quantified in the Study Board's report. Consideration should be given to the net economic benefits occurring at the place of use. The province of Ontario expressed concern about the unequal distribution of existing consumptive uses, especially in relation to future trends in these uses. The province suggested a reference to the Commission to examine these and other concerns.

Many statements presented at the Commission's public meetings, including those of the Government of Canada, the provinces of Ontario and Quebec, and several U.S. state agencies, expressed concerns regarding the consumptive use projections in the Study Board report. They addressed the assumptions used in the projections, the environmental and economic implications of a significant drop in water levels, and the future monitoring of consumptive uses. There was widespread support for a monitoring activity in the basin and several requests for the Commission to review the Study Board's projections in light of developments that occurred after the Study Board submitted its report. It was also stated several times that the Commission should be given a new reference to study consumptive uses, and there was a suggestion that any decrease in the flow from the Great Lakes due to consumption should be offset by a corresponding increase by diversion into the Great Lakes or an increase in their capacity to retain water.

### *Power and Manufacturing Projections Update*

The projections for power and manufacturing are discussed in some detail because the overall consumptive use projections are most sensitive to the assumptions used for these two sectors. In addition, several submissions at the Commission's public meetings challenged the Study Board's projections in these areas. The Commission's analysis concentrates on projections to the year 2000 because, for several reasons, those beyond 2000 are too uncertain a basis for planning and policy decisions. First, the projections are sensitive to assumptions that have changed and are changing rapidly. Second, projections have a compounding effect as base values grow higher. Third, there is a strong possibility of major shifts in the economies of both countries. Finally, the Commission questions the need to plan far ahead except with respect to general trends, especially in view of the process envisaged by the Commission and recommended in Chapter V. Because long-range water use projections typically have substantial errors, the Commission believes shorter-range forecasts may be of greater value.

Experience gained during the recent energy crisis and economic recession has demonstrated that demand for power in both countries is sensitive to economic conditions in general and world energy prices in particular. Energy conservation practices have resulted in a lowering of energy growth rates. Whether these practices are permanent is speculative. The dramatic downward adjustments in electric utility expansion programs that have occurred in recent years, coupled with the difficulty of predicting energy prices over the long term, underscore the uncertainties of projections.

*Power:* The Study Board's MLP for the power sector in the U.S. portion of the basin was most sensitive to assumptions



*Power plants using cooling towers eliminate the discharge of heated water to the source. It has been projected that the power sector will use about one quarter of all water consumed by the year 2000.*

**Table 7**

**U.S. POWER SECTOR, PROJECTED CONSUMPTIVE USE TO THE YEAR 2000 (IN CMS AND (CFS))**

Sub Basin	Study Board 1981 Estimates	Current Estimates	Difference	Approximate Percentage Reduction
Lake Superior	1 ( 30)	1 ( 30)	( 0)	0
Lake Michigan	26 (910)	19 (650)	7 (260)	28
Lake Huron	5 (190)	3 (120)	2 ( 70)	37
Lake Erie	19 (670)	17 (600)	2 ( 70)	10
Lake Ontario	13 (460)	4 (150)	9 (310)	67
U.S. Portion of Great Lakes Basin	64 (2,260)	44 (1,550)	20 (710)	32

regarding the shift from once-through to closed-cycle cooling and the projected rate of growth of conventional thermal plants. In a once-through system, hot cooling water is returned to the source, whereas the discharge of heated water is eliminated in closed-cycle systems by passing it through cooling towers or plants. Since it was assumed that power plants in the Canadian portion of the basin would continue using once-through cooling and established trends in technology, the growth rate was the most important assumption for the Canadian power MLP. In both portions of the basin, the MLP was also sensitive to the amount of electricity generated by nuclear plants as they consume more water than fossil-fuel plants. Because the projection of any trend should be re-evaluated over time, the Commission examined the consumptive use projections in light of information available since the Study Board completed its work.

The Study Board assumed an average annual rate of growth for power generation in the U.S. portion of the basin of about 4.1 per cent from 1975 to 1980 and 4.7 per cent to 2000. In 1983, the U.S. North American Electric Reliability Council (NAERC) issued an annual tabulation of power demand and supply with projections to the year 2000. For the U.S. portion of the Great Lakes basin, this projection, incorporating recent cancellations and delays of both fossil-fuel and nuclear plants, uses an average annual growth rate of approximately 2.5 per cent to the year 2000.

In the United States, increased regulatory requirements, costs and construction time for nuclear power plants have combined with public opposition to delay licensing. Massive cost increases to bring nuclear plants on line have resulted in the cancellation of many nuclear plants that were planned or under construction. In the U.S. portion of the Great Lakes basin, recent nuclear plant cancellations total nearly 12,000 megawatts.

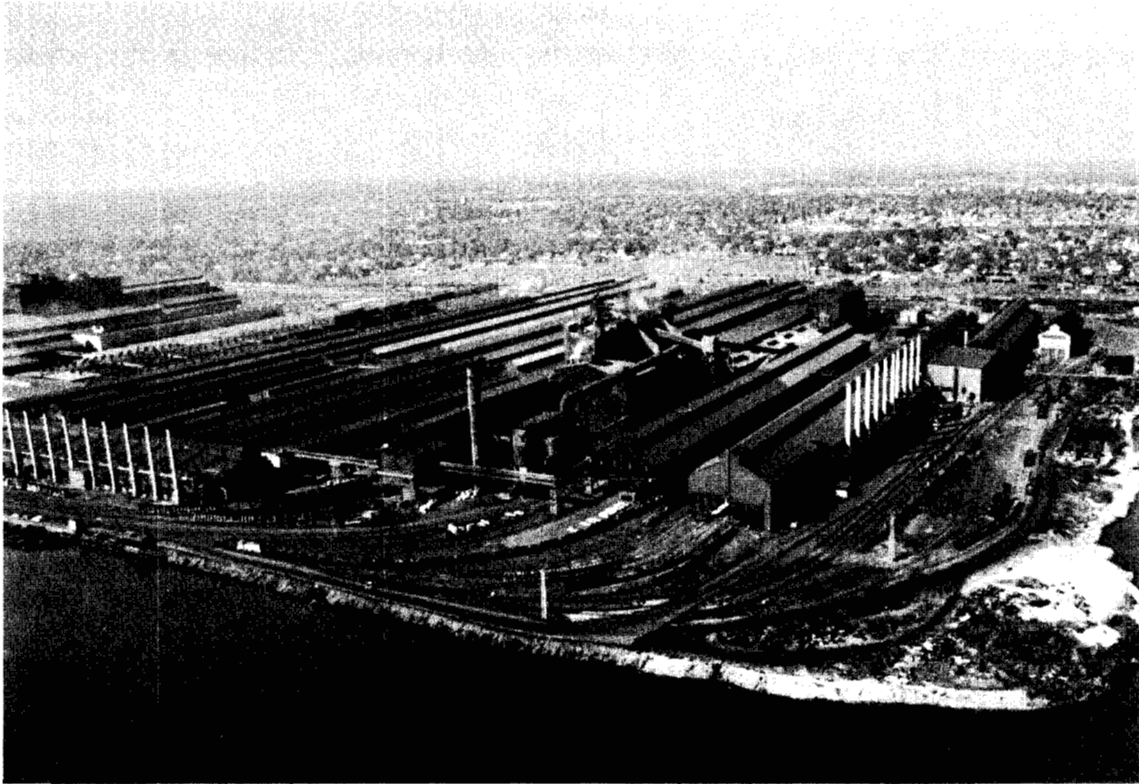
The effect of these cancellations, coupled with delays in bringing other plants on line, has been estimated by the Commission to reduce the most likely projection of the nuclear share from 39 per cent to 28 per cent by the year 2000. Since nuclear plants consume approximately 35 per cent more water than fossil-fuel plants, assuming closed-cycle cooling, these cancellations significantly reduce consumptive use for power.

Combining the lower power growth figure with the reduction in the share used by nuclear plants yields the Commission's revised estimates for consumptive use in the U.S. portion of the basin (see Table 7).

Revised demand growth for electrical power in Ontario (*Electric Power in Canada: 1982*) is an overall 2.1 per cent per annum for the period 1982-2000, compared to the 4.5 per cent MLP rate in the Study Board report. Canadian and Ontario policy, as it affects the Great Lakes, is more clearly supportive of continued growth in nuclear power, in part because coal is seen as having undesirable environmental side-effects. Thus, nuclear power is expected to increase to 51 per cent of thermal and 40 per cent of total electrical power generating capacity by 1991. This is a somewhat lower share than that assumed by the Study Board's MLP. Because of the assumption that Canadian power plants will continue to employ once-through cooling, consumptive uses are projected to increase less than in the U.S. portion of the basin, but withdrawals would increase dramatically and surpass those in the U.S. power sector just beyond the year 2000. In summary, the Commission believes the Study Board's low-growth scenario in the Canadian power sector is the one that corresponds most nearly with present forecasts. Using this analysis, the Study Board's MLP of 9 cms (310 cfs) for the power sector in the Canadian portion of the Great Lakes basin to the year 2000 has been revised by the Commission to 6 cms (200 cfs).

*Manufacturing:* The Study Board's MLP for the U.S. manufacturing sector assumed the primary metals industry would continue to be the principal component in water consumption. Consumptive use by paper and allied goods would be second largest, while the largest increase would occur in the chemicals industry, with consumptive use quadrupling between 1975 and 2000. Manufacturing consumptive uses in Canada will continue to be dominated by the chemicals industry. Primary metals and paper would consume a much smaller portion of the Canadian total. Water use technology is assumed to remain fairly constant, though it was recognized that trends in environmental controls could also lead to some change in water recirculation practices in Canada.

The projections for the U.S. portion of the basin are particularly sensitive to the growth of primary metals produc-



*Over the long term, uses of water by the manufacturing sector could be substantially less than projected, although still accounting for almost one half of total consumptive uses.*

tion. The Study Board's MLP is based on the *OBERS*<sup>10</sup> Series-E Projections, published in 1974, which forecast moderate growth for the primary metals industry in the Great Lakes basin. Current information suggests, however, that steel, the major primary metals industry, will continue to produce below the historical levels used in these projections through the 1980s for the nation as a whole.

The *1984 U.S. Industrial Outlook*, published by the Department of Commerce, contains short-term forecasts of U.S. industrial activity. This publication indicates that for the United States as a whole, iron and steel consumption (including imports minus exports) averages about 95 million metric tons (105 million tons) for the 1970s. Shipments in the 1980s have averaged 69 million metric tons (76 million tons) and are forecast to rise to about 82 million metric tons (90 million tons) by 1988, which would be about 5 per cent below the average for the 1970s. Department of Commerce steel industry experts indicate that, compared to the entire U.S. industry, the portion in the Great Lakes basin appears to be the most stable; whatever industry shrinkage and restructuring can be anticipated for the industry as a whole have already taken place for that portion in the Great Lakes basin.

<sup>10</sup> An integrated set of projections developed by the Bureau of Economic Analysis, formerly Office of Business Economics (OBE), U.S. Dept. of Commerce, and the Economic Research Service (ERS), U.S. Dept. of Agriculture. Widespread acceptance of the term OBERS has led to its use as a descriptive title of the program.

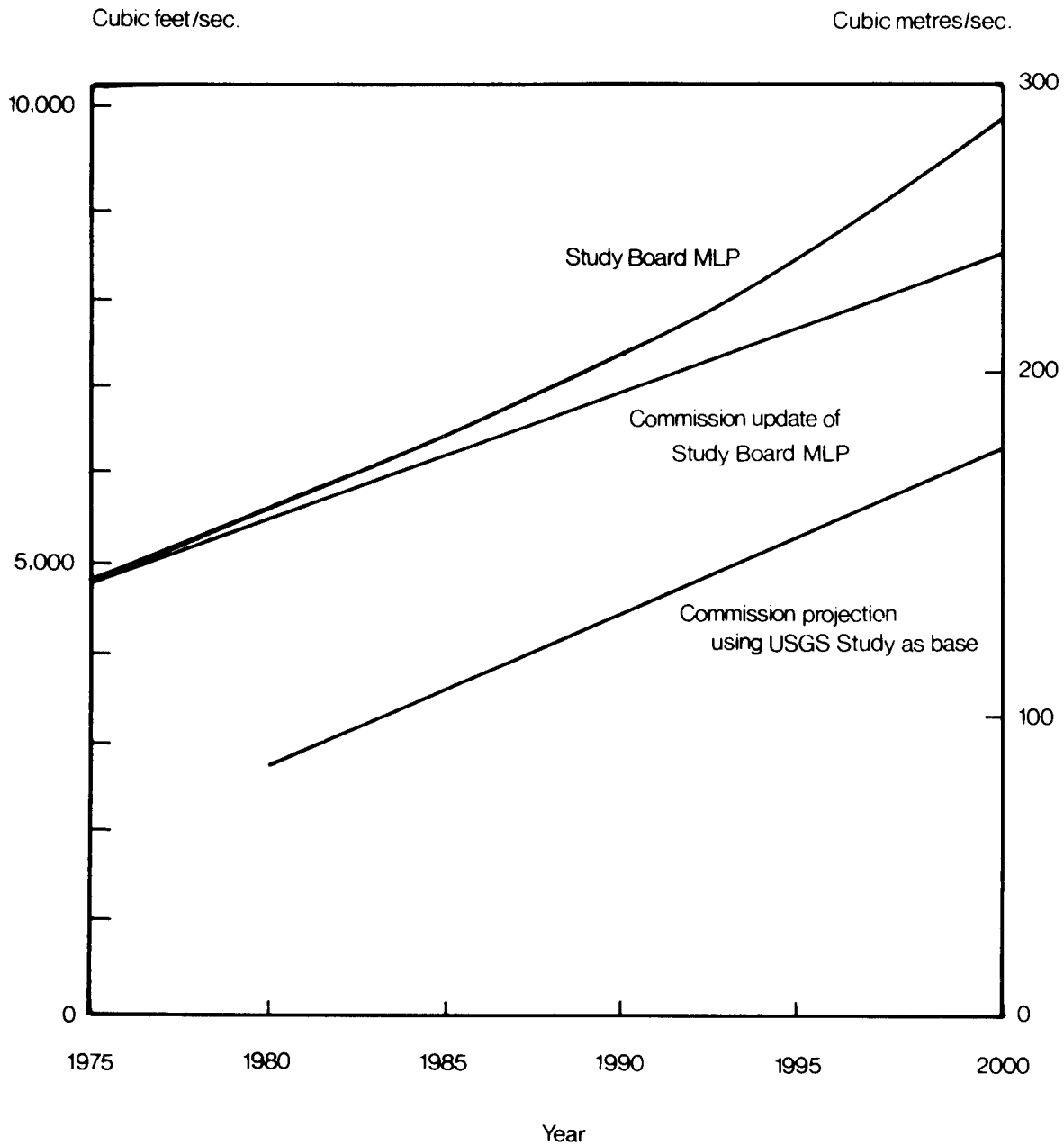
In the Commission's view, production in the steel industry is not likely to rise to the levels built into the Study Board's MLP in the near term. Over the long term, consumptive uses for the U.S. manufacturing sector could be substantially less than projected. For example, the Study Board's low projection for this sector differs from the high projection only in that primary metals production in the Lake Erie basin is assumed to decline instead of grow. Under the low projection, consumptive uses would be nearly 25 cms (900 cfs) less than the MLP in the year 2000. Trends established in recent years, including stronger competition by foreign producers and a product mix oriented toward lighter weight products, suggest that even if the economy of the Great Lakes basin were to return to the long-term growth rates forecast in the early 1970s, steel production might not. For these reasons, the Commission used a revised consumptive use estimate in the year 2000 of 100 cms (3,500 cfs) for the U.S. manufacturing sector and 14cms (500 cfs) for the Canadian manufacturing sector, based on its judgement that the Study Board's low-growth scenario is more appropriate.

### *Summary of Consumptive Use Projections*

The Commission recognizes that the Study Board's work represents a major contribution to and refinement of the body of knowledge on water use forecasts. The Study Board recognized that long-range forecasting becomes increasingly tenuous when applied far into the future and, for this reason, developed a band of future values centred on the MLP. The

# Figure 7

## Comparison of Projections



Commission emphasizes this point, as well as that the Study Board's findings were based on a number of assumptions using the best information and judgement available at the time. As the foregoing discussion shows, however, critical assumptions about the future can be subject to significant readjustment a short time after they are made. This point is addressed further in Part Two. The Study Board's projections of consumptive uses for the Great Lakes basin to the year

2000 are presented in Tables 8a, b. The Commission's update of the power and manufacturing sectors, based on information that became available in the three years subsequent to the Study Board's report, is presented in Table 9.

Figure 7 compares the Study Board's MLP, the Commission's update of the Board's MLP and a third projection, which uses the USGS estimate of existing consumption and

**Table 8a****GREAT LAKES BASIN MOST LIKELY PROJECTION FOR THE YEAR 2000 WITHDRAWALS (W) AND CONSUMPTIVE USES (CU): STUDY BOARD FINDINGS (IN CMS)**

Water Use Sector	United States		Canada		Great Lakes Basin	
	W	CU	W	CU	W	CU
Manufacturing	648	115	428	17	1,076	132
Municipal	228	25	38	5	266	30
Power	1,364	64	1,170	9	2,534	73
Irrigation	17	14	5	4	22	18
Rural-Domestic	16	9	3	2	19	11
Mining	46	9	10	—	56	9
Livestock	4	4	3	3	7	7
<b>Total</b>	<b>2,323</b>	<b>240</b>	<b>1,657</b>	<b>40</b>	<b>3,980</b>	<b>280</b>

**Table 8b****GREAT LAKES BASIN MOST LIKELY PROJECTION FOR THE YEAR 2000 WITHDRAWALS (W) AND CONSUMPTIVE USES (CU): STUDY BOARD FINDINGS (IN CFS)**

Water Use Sector	United States		Canada		Great Lakes Basin	
	W	CU	W	CU	W	CU
Manufacturing	22,870	4,050	15,110	600	37,980	4,650
Municipal	8,050	870	1,350	200	9,400	1,070
Power	48,170	2,260	41,270	310	89,440	2,570
Irrigation	600	500	190	130	790	630
Rural-Domestic	550	330	90	60	640	390
Mining	1,610	320	370	10	1,980	330
Livestock	130	130	120	120	250	250
<b>Total</b>	<b>81,980</b>	<b>8,460</b>	<b>58,500</b>	<b>1,430</b>	<b>140,480</b>	<b>9,890</b>

**Table 9****POWER AND MANUFACTURING SECTORS, MOST LIKELY PROJECTION FOR THE YEAR 2000 CONSUMPTIVE USES: IJC UPDATE OF STUDY BOARD FINDINGS (IN CMS AND (CFS))**

Water Use Sector	United States		Canada		Great Lakes Basin		Reduction from Study Board MLP (Tables 8a, b)
	W	CU	W	CU	W	CU	
Power	44	(1,550)	6	(200)	50	(1,750)	23 (820)
Manufacturing	100	(3,500)	14	(500)	114	(4,000)	18 (650)

the Commission's projected increases.

The projections are shown to the year 2000 because in the Commission's view projections beyond then are too uncertain for the necessary planning and policy decisions. Based only on revised figures for the power and manufacturing sectors, the Commission estimates total consumptive use in the Great Lakes basin at about 238 cms (8,420 cfs) in the year 2000, using the Study Board's 1975 level of use and 161 cms (5,670 cfs), using the USGS 1980 estimate. The Commission has not examined the consumptive use projections in the other sectors.

The Study Board calculated the hydrological effects of their MLP on Great Lakes levels and outflows using three

alternative methods. The Study Board results, quoted for the year 2000 only, show that based on average supply conditions, consumptive uses could reduce mean lake levels in Lake Superior by 2.1 cm (0.07 feet) and Lakes Michigan-Huron and Erie by 6.1 cm (0.20 feet). Because the Commission has updated and reduced the Study Board's MLP, the Study Board results would be reduced slightly.

Results for Lake Ontario present an anomaly. Under one methodology, Lake Ontario levels fall, while under another they actually rise as a result of consumptive uses. This is because of the way the current regulation Plan 1958-D responds to the consumptive use projections and water supplies. It indicates that revisions to Plan 1958-D would be



required in the future if water supplies were reduced due to increasing consumptive uses and if the criteria for regulation were to continue to be satisfied. For these reasons the effects of consumptive uses on Lake Ontario levels are not quoted in this Report.

### *Economic Evaluation of Projected Consumptive Uses*

The Study Board reported selected economic effects resulting from changing lake levels due to the Study Board's projected consumptive uses to the year 2035. As the Study Board used the same methodology developed for analysing diversion management scenarios, the Study Board's analysis in this regard is subject to the same reservations as the Commission expressed in Chapter III. Furthermore, the Commission has indicated the unreliability of projections beyond 2000 and has revised the Study Board's projections downward because changing conditions affected certain assumptions. Consequently, the Commission is not reporting or commenting further on the Study Board's values.

### *Conclusions*

In light of these findings the Commission has reached the following conclusions:

- 1. Based on current information and analysis, the most likely projection (MLP) of consumptive uses in the basin in the year 2000 is on the order of 161 cms (5,700 cfs) to 238 cms (8,400 cfs).**
- 2. The Study Board succeeded quite well in identifying the factors that affect consumptive use trends, including the sectors and location in the Great Lakes basin where increases are likely to occur, and developed a useful range of consumptive use projections.**
- 3. The Study Board's MLP for the two largest growth sectors, power and manufacturing, had to be revised downward in light of events since the Study Board completed its work. However, the Commission's revised MLP remains within the Study Board's range of projections.**
- 4. Because of the uncertainty regarding estimates of existing consumptive uses in the U.S. portion of the basin prepared by the Study Board and the United States Geological Survey, both estimates have been used as a base in the Commission's projection of consumptive uses.**
- 5. Projections of consumptive use beyond the year 2000 are too speculative and uncertain for planning and policy decisions, given the concerns regarding forecasts of economic and demographic changes and existing consumptive uses discussed in 4 above.**
- 6. There is a strong need for continual improvement in information on historical and projected water use trends in general and consumptive use trends in particular within the Great Lakes basin. Should changes in public policies regarding these trends prove desirable in the future, a continuous data and information base would provide an invaluable foundation.**



## CHAPTER V

### RECOMMENDATIONS

The Commission believes the following recommendations will assist Governments in effectively addressing future considerations regarding the use of Great Lakes water. The Commission recommends a broad scope of information and assessment, frequently updated and including national and global trends, in a variety of key policy areas that could affect water use directly and indirectly. The Commission also believes the design and implementation of the necessary mechanisms for review, consultation and action should incorporate flexible decision-making criteria so that the rate and scope of change can be measured and handled in a way that might anticipate and thereby minimize conflict.

Based on these considerations, and in conjunction with the more detailed matters examined in this Report, the Commission's recommendations are as follows:

1. Regarding the general aspects of diversions and consumptive uses—
  - a) Governments establish a bilateral data committee, separate from the Commission, to monitor all existing diversions and consumptive uses in the Great Lakes basin and publish data as appropriate, but no less frequently than biennially. This committee would also recommend appropriate additional research and monitoring efforts that would be necessary to develop the methodology and data to derive a more accurate estimate of existing consumptive uses in the Great Lakes basin. The committee's report should be made public.
  - b) Governments authorize the establishment of a bilateral task force on diversions and consumptive uses, either by a reference to the Commission or otherwise. The task force would be created periodically, but no less frequently than every five years, and would update previous consumptive use projections, assess the impacts of those projections, review the potential for new or changed diversions, and make appropriate recommendations. Governments should agree to consult on each task force report. The task force would use information from the bilateral data committee, as well as other sources, and would build on the existing methodology developed in each country. The task force should have available to it pertinent social, economic and demographic data both within and outside the Great Lakes basin context, but would likely need to concentrate initially on the principal water use sectors of power and manufacturing. Membership on each task force would be determined by the nature of the primary issues at that time.
  - c) Governments institute a co-operative review of current public policies at the federal and state/provincial levels to identify those having an effect on consumptive uses and to examine any that appear to have a significant potential for reducing such use.
  - d) Governments, taking into account the existing and possible future diversion of water into the Great Lakes, consult on the status of waters so diverted.
2. Regarding existing and future small diversions, Governments institute surveys on both sides of the border to identify and quantify existing and proposed small diversions and establish a mechanism whereby information is made available to the bilateral data committee.
3. Regarding the management of existing diversions to ameliorate high and low levels—
  - a) Governments not consider under present conditions the further management of Great Lakes levels and outflows through the manipulation of existing diversions.
  - b) Governments take steps to ensure that better coastal zone management practices are followed to help reduce flood and erosion damage along the Great Lakes shoreline.
4. Regarding federally, state or provincially sponsored or approved new or changed diversions —
  - a) Governments resolve the questions discussed in Chapter III of this Report.
  - b) Governments engage in a process of notice and consultation before additional new or changed diversions are approved.
5. Regarding the broad aspects of this report, federal, state and provincial governments undertake appropriate measures to inform the public of the results of this study and to initiate an educational effort directed toward better understanding of the nature and effect of consumptive uses.



# PART TWO

## Introduction

In Part One of this Report, the Commission responded principally to the physical-engineering aspects of the 1977 Reference on Great Lakes Diversions and Consumptive Uses. It has taken as its point of departure the report of the Study Board and the comments on that report at public meetings held in June 1983. The Commission has examined existing diversions and the capacity of the structures further to control Great Lakes levels. It has noted that no major new diversions, or changes in existing ones, have been proposed or endorsed by any level of government. It has noted that small diversions can have a cumulative effect. It has analysed existing consumptive uses and made some projections of future consumptive uses, based on current knowledge, experience and recent history. The Commission's specific conclusions and recommendations in Part One flow from all that information and its own work.

Notwithstanding the thorough work of the Study Board and the task assigned to it by the Commission in May 1977, the Commission for several reasons is not satisfied with ending its response to the reference at this point. To provide a broader and more appropriate context within which to address the longer-term prospects for the use of Great Lakes water, it seems desirable to consider a wider range of issues within the spirit and intent of the reference. These include the following:

- the legal framework, which continues to evolve with respect to the use of Great Lakes waters;
- longer-term climatic variations and structural economic change, which might have an effect on the Great Lakes region as well as on other regions of the continent and the globe, and which, in conjunction with other factors, could modify thinking about the possible and desirable use of Great Lakes water, including the possibility of future large-scale diversions; and
- the need to consider the interrelationship of Great Lakes water quantity and water quality in the context of an ecosystem, including the other than economic importance of this vast body of water to the millions of people who live and will live in the basin.

In this part of the Report, therefore, the Commission will turn its attention to the human, the historical, the diplomatic, the legal, the economic and the climatic considerations that might usefully be kept in mind by Governments as they discuss the harder and more technical conclusions and recommendations in Part One of the Report. Our intent is to assist Governments in an area where the requirement may not

be just for a series of immediate, practical recommendations but also for observations and counsel that may bear on longer-term development. In so doing, the Commission encourages Governments to keep in touch with and be responsive to dialogues now in progress on these issues, which also bear on the future of all diversions and consumptive uses, including those discussions initiated by the governors of the Great Lakes states and the premiers of the Great Lakes provinces.

## Legal Considerations

While there is a body of domestic legislation and case law dealing with water quantity, deriving from common law, Roman (civil) law and prior appropriation, legislation in the two countries has paid greater attention to water quality. The same can be said for the international regime in the Great Lakes basin. There is nothing comparable to the detailed provisions of the *Great Lakes Water Quality Agreements* of 1972 and 1978 to guide and control the actions of Governments and of citizens when it comes to the management of Great Lakes water.

For the past twelve years, the Commission has been assigned by Governments major reference responsibilities with regard to the *Great Lakes Water Quality Agreements*. In carrying out these responsibilities the Commission has observed the positive results of co-ordinated federal-state and federal-provincial efforts in achieving mutually agreed goals. This experience suggests to the Commission that similarly advantageous results might accrue to the two countries through co-operative efforts in the field of water quantity management.

Not all existing large diversions appear to be subject to international control either by the Commission under the *Boundary Waters Treaty* or pursuant to special agreements between the Governments. The practice has been to permit domestic law and procedure to govern some large diversions, most small diversions and the consumptive use of Great Lakes water. While specific provisions of laws and procedures vary from jurisdiction to jurisdiction, the thrust of the legal regimes throughout the Great Lakes basin, unlike those further west, places relatively few restrictions on the use of water.

### *The Treaty*

The *Boundary Waters Treaty* of 1909, the basic document dealing with boundary and transboundary waters, has much

to say about uses, obstructions and diversions that affect levels and flows on the other side of the boundary. It does not purport to require a basin-wide, comprehensive approach to the management of shared waters. The reasons are readily apparent. First, the *Boundary Waters Treaty* derives from a period when water supply, certainly in the Great Lakes, was regarded as virtually unlimited. Second, comprehensive river basin planning to deal with complex interrelated issues was not practised in the early part of the century.

Neither the *Boundary Waters Treaty* nor other Canada-U.S. agreements dealing with waters within the basin have addressed in a clear fashion a whole range of issues raised at the initiative of one or both Governments or of individual jurisdictions. Such issues include the method of dealing with changes in pre-existing diversions; the status of tributaries of boundary waters; entitlements to subsequent use of water diverted into the Great Lakes from either country and the effect of diversions on entitlement generally; the cumulative effect of small diversions; the cumulative effect of incremental consumptive use; the broad question of entitlement to use or allocation or 'ownership' of Great Lakes water by either country; and the regulation of water uses.

There is some guidance to methods of addressing these matters in the *Boundary Waters Treaty*, and its provisions are sufficiently general to permit agreed contemporary interpretation by the Parties. "Boundary waters" are those along which the international boundary between the United States and Canada passes, "including all bays, arms, and inlets thereof", but not including tributary waters.<sup>11</sup> Each country reserves exclusive control over the "use and diversion, whether temporary or permanent", of waters on its own side of the line which would, "in their natural channels", flow across the boundary or into boundary waters (i.e., tributary waters) although if resultant injury occurs on the other side, an injured party is entitled to the same legal remedies as if such injury took place in the country where the diversion or interference occurred. Such remedies, however, are not applicable with respect to pre-existing diversions and may not be applicable to diversions covered by special agreement between the Parties; but both Parties retain the right to object to any diversion that would do injury to its navigation interests.<sup>12</sup>

As for boundary waters, "no further or other uses or obstructions or diversions, whether temporary or permanent" that would affect the natural level or flow on the other side are to be made except by authority of the Parties, within their respective jurisdictions and with the approval of the Commission, unless they are the subject of special agreement between the Parties. The "ordinary use of such waters for domestic and sanitary purposes" is not subject to international control; nor are governmental activities undertaken "for the benefit of commerce and navigation", provided they are wholly on one side of the boundary line and do not materially affect the level or flow of boundary waters on the other.<sup>13</sup> Domestic regulatory procedures have determined

what constitutes "ordinary use". With few exceptions, domestic law has governed minor diversions and consumptive uses, which individually may have no measurable effects but cumulatively could be very important.

Article VIII of the *Boundary Waters Treaty* requires the IJC to apply certain rules or principles when considering cases under its jurisdiction involving the use, obstruction or diversion of waters. Each Party is to have, on its own side of the boundary, "equal and similar rights" in the use of boundary waters, with the following order of preference: domestic and sanitary purposes, navigation, and power and irrigation.<sup>14</sup> The Commission is permitted to suspend "the requirement for an equal division" in cases of temporary diversions along boundary waters at points where an equal division cannot be made advantageously, provided the diversion does not diminish elsewhere the amount available for use on the other side.<sup>15</sup> The diversion of waters has also been considered in other agreements between Canada and the United States.<sup>16</sup>

### *The History and the Practice*

The 1964 reference on Great Lakes levels, on which the Commission reported in 1976, and the current reference on diversions and consumptive uses share the objective of attempting to deal with a defined problem throughout the basin; both references were extended pursuant to Article IX of the *Boundary Waters Treaty*. The Commission's work leading to the 1972 and 1978 *Great Lakes Water Quality Agreements* was similarly inspired by a basin-wide, even an ecosystem approach, and also derived from Article IX references extended to the Commission.

The fact that the *Boundary Waters Treaty* does not deal specifically with water use questions of current concern does not mean that such matters have been or can be ignored, any more than it can be said that the *Boundary Waters Treaty* is insufficient for the contemporary setting. In these circumstances Governments have, within the context of the prevailing legal regime, done what they believe to be in their best interests, decided what should and what should not be referred to the Commission, or simply remained silent, which may or may not mean that they acquiesce. In other cases, for instance with respect to the Chicago and Long Lac and Ogoki diversions, they have taken clearer positions.

Serious disputes have not arisen between Canada and the United States regarding the sharing of Great Lakes waters. This may be attributable to the fact that, as is noted under the section on the Chicago diversion in Chapter III of Part One of this Report, even where no specific understanding has been reached, the Governments have often engaged in a commendable degree of consultation, co-operation and accommoda-

<sup>11</sup> *Boundary Waters Treaty*, Preliminary Article.

<sup>12</sup> *Ibid.*, Article II.

<sup>13</sup> *Ibid.*, Article III.

<sup>14</sup> *Ibid.*, Articles VIII(2) and VIII(3).

<sup>15</sup> *Ibid.*, Article VIII(5).

<sup>16</sup> For example, Article VI of the treaty between Canada and the United States of America concerning Diversion of the Niagara River, 1950, and the Exchange of Notes (October 14 and 31 and November 7, 1940) relating to the early development of certain portions of the Great Lakes-St. Lawrence Basin project (Long Lac-Ogoki Works).

tion, taking into account the interests and the views of the Great Lakes partner. It may also be attributed to the fact that the increasing use of the waters for one purpose has not yet become so significant as to cause serious inconvenience for alternative uses: there has been enough to go around. Yet if the projected increase in consumptive uses of Great Lakes waters, even at levels less than that foreseen by the Commission, were to materialize, there would be a potential for dispute and conflict between different users and between the two countries. The same potential exists should there be strong pressure for new major diversions out of the Great Lakes basin – which the Commission does not believe to be a strong possibility, at least in the near future. (This is discussed later in this part.)

It is worth noting that attempts have been made to add precision and clarification to a number of clauses of the *Boundary Waters Treaty*. In the circumstances of today and tomorrow, when we face the prospect that escalating use of Great Lakes waters by some may limit its use by others, it might be useful for the Governments to review the principles discussed and, in some cases, agreed upon in earlier years, with respect to both boundary waters and transboundary flows, to see whether they can provide guidance for a mutually acceptable course of action in the future.

Any consideration of matters pertaining to Great Lakes waters requires an awareness of the scope and content of the relevant international legal regime. In this regard, the significance and accomplishments of the *Boundary Waters Treaty* must not be under-estimated. The overall international legal regime is not, however, to be found only in the texts of treaties. It has evolved and continues to evolve through a combination of agreements, custom, judicial decisions and writings. The jurisprudence of the International Joint Commission is a particularly significant element. In addition, it is necessary to look at history in order to put the various elements in their proper perspective.<sup>17</sup>

The process that has led to our current understanding and what might be called an action program with respect to water quality issues in the Great Lakes may also be applicable to the question of water quantity and use. Article IV of the *Boundary Waters Treaty* contains a simple but powerful commitment by the two Governments:

It is further agreed that the waters herein defined as boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property of the other.

From this provision has emerged the more detailed *Great Lakes Water Quality Agreements* along with associated institutional mechanisms in both countries. But this did not occur overnight. It has been a long evolutionary process, and it is not yet complete. Since early in the century there have been concerns regarding water quality in the basin, particularly the connecting channels. In 1964 the Commission was asked to report on water quality in Lakes Erie and Ontario. Its report was submitted in 1970, but it was not until 1972, when public and governmental concern regarding the

lakes was very high, that the first *Great Lakes Water Quality Agreement* was signed. Since that time our understanding of the parameters of the water quality issue has expanded greatly. We now have greater knowledge of the seriousness of toxic pollutants and pollution from non-point sources. Much of what we have learned has been incorporated into the more comprehensive 1978 *Great Lakes Water Quality Agreement*. But again, the process is not complete, and the Commission anticipates that significant improvements will be made when the 1978 Agreement is formally reviewed by Governments in the next few years.

The Commission expects Governments will be undertaking certain water quantity discussions well in advance of and separate from the formal review of the 1978 *Great Lakes Water Quality Agreement*, and the Commission supports these early initiatives. It may be useful, however, for Governments to incorporate as they deem appropriate the relevant observations and conclusions of this Report at the time of the review.

The Commission considers that, based on the experiences of the United States and Canada with regard to the 1972 and 1978 *Great Lakes Water Quality Agreements*, the two Governments would be well advised at this stage to engage in broad but systematic discussion of their use of Great Lakes water before they are faced with any sense of crisis, actual or imminent, and before any relationships deteriorate or become jeopardized. In drawing the attention of the Governments to the lack of specificity in the *Boundary Waters Treaty*, the Commission is not proposing either revision of the Treaty or the acceptance by the Governments of a specific principle to guide them in all approaches to the use of the shared waters of the Great Lakes. An attempt at comprehensive legal codification, while attractive in some respects, might have the effect of making national positions too rigid and practical solutions to practical problems more difficult.

On the issue of diversions and consumptive uses of Great Lakes water, we are at an early stage in the process of developing appropriate national and international policies. It is too early to view the matter as a crisis. The projected increases in consumptive uses are significant enough, however, to warrant initiating a process to enable the two countries to take appropriate actions to preserve the priceless shared natural resource that is the Great Lakes. The Commission believes that the two Governments should consider plans or mechanisms that could contribute to their ability to recognize and assess warning signs and to prevent conflict as the pressures on the natural resource base increase.

## New Diversion Proposals

The Study Board found that, with the exception of those projects identified in Chapter III, there are no significant new or changed diversions proposed for the Great Lakes – at least none having federal, state or provincial sponsorship or approval. It is nonetheless presumed that minor diversions of water could continue to occur in the future. The principal concern over new diversion proposals, however, as the sub-

<sup>17</sup> See also page 9

ject has recently received press and public attention, relates to possible larger-scale diversions of water from the Great Lakes to other regions.

The attention being given to the possibility of diversions from the Great Lakes is due primarily to a general perception in the basin of the need for the water elsewhere. At the Commission's public meetings around the Great Lakes in June 1983, the most persistent theme was strong opposition to any new diversions from the Great Lakes, with their potentially adverse consequences for navigation, recreation, power generation, industry in general and the environment. Almost the only contrary views were those of some riparians favouring manipulation of existing diversions, and possibly constructing new ones, in the hope of reducing high lake levels and finding a solution to shoreline erosion and flooding concerns. Several intervenors urged the Commission to examine possible new diversions out of the Great Lakes. To this end, the Commission held a special seminar to become better informed with respect to the diversion proposals that have from time to time been suggested, including the cost of diverting water out of the Great Lakes basin.

Diversions are not new. They date back to biblical times as a means of advancing human welfare through expanded production and service to larger population centres. There have been many diversions, both large and small, in Canada and the United States in order to use water in locations sometimes far distant from its source. Diversions have been constructed for the water needs of expanding communities, for irrigation, for flood control, for power generation and to improve or construct new navigation channels. In Canada, approximately sixty existing water transfers have been identified, and there are several hundred in the United States.

A number of major diversions at several locations on the continent have been propounded over the past three decades. Appendix G includes a list and description of these possible diversions, some of which would have international effects. Of those listed, only the GRAND Canal proposal, to the Commission's knowledge, is still being publicly and actively discussed. In response to recent public concerns regarding possible new diversions, three hypothetical diversions from the Great Lakes to the Missouri, upper Mississippi, and Ohio river basins, have been examined to estimate their potential cost. These three estimates are also included in Appendix G. It is important to recognize, however, that no major diversion from the Great Lakes basin is under formal consideration and that none of these concepts is currently proposed or endorsed by any government directly involved in the management of the water.

The Commission has reviewed these large-scale diversion concepts. It has concluded that, although they may be technically possible, at this time they have little political support; that they could be undertaken only at enormous, and at present unjustified cost; and that they would have unknown but likely significant social and environmental effects. Under current circumstances, such diversions are extremely unlikely. All of these conclusions, including lack of economic justification, also apply to the potential for significantly increasing the Lake Michigan diversion at Chicago, except that its construction costs would be relatively small.

There may be circumstances in the future under which this assessment could change. For example, as discussed in the next section, the basis for regarding major diversions as unlikely may itself change under changed global climatic or economic conditions. The economics of major diversions, the demand – and therefore the price – for the products the diversions would serve, and even the views of Great Lakes residents and politicians about the use to be made of 'their' water – all these may change over the longer term. Governments would therefore be well advised to establish a process that would broaden the current dialogue with regard to the future of fresh water use in the United States and Canada. In this respect, the Commission is encouraged by and supportive of the national dialogue recently initiated in Canada by way of the Inquiry on Federal Water Policy.

Small-scale diversions, both into and out of the Great Lakes basin, are another matter. The Commission expects that if the Great Lakes region is to experience economic growth, there will be new and changed demands for water. Modifications to hydro-electric installations and new or changed water uses for domestic sanitary and water supply purposes, wildlife and fisheries management, and industrial purposes are likely to occur from time to time. Therefore it is anticipated that the construction of some small-scale diversions will continue. The exact amounts of flows involved are unknown, as are the number and geographical distribution. While some may involve diversions into or out of the Great Lakes basin, others are expected to occur between smaller watersheds within the basin. The Powder River Coal Slurry Pipeline Project, described in Appendix G, is an example of the type of proposal that potentially could divert a small amount of water either from or into Lake Superior. Governments might therefore wish to discuss the desirability of having systems in place to report small-scale diversions and consider their cumulative impact on the Great Lakes ecosystem.

## A Non-Linear Future: Are We Prepared?

Major changes in the economic and social conditions of our two nations have occurred in the past, and substantial policy shifts have taken place in reaction to them. One has only to think first of the Great Lakes in the early 1800s, not greatly different from what they were before the arrival of Europeans, and then of the Great Lakes a century later, at the centre of a rapidly industrializing and urbanizing North America. The Great Lakes made this change possible with their seemingly unlimited supply of water for domestic and industrial use, for navigation, for power generation, for recreation; but they also paid the price in terms of pollution and eutrophication. In little more than a century, an apparently inexhaustible supply of pure water had become fully committed – if not over-committed – to supporting a variety of beneficial uses, leading inevitably to a variety of control measures to balance the needs of competing forces.

If this rapid a change could occur in little more than a century, discontinuities must also be expected in the future.





*A change in attitudes or in economic imperatives could make water a widely accepted article of commerce.*

Though some trends leading to major change may be discernible now, their nature and scope are to a large extent unpredictable, for the Great Lakes and elsewhere. For example, a change in attitudes or in economic imperatives could make water a widely accepted article of commerce. The impetus for change may come from within the basin, or it may originate well outside the affected area.

### *Climatic Change*

While its workings are still imperfectly understood, climatic change, both natural and man-induced, may have a significant effect on supplies to the Great Lakes and on demands for Great Lakes water. In recent decades the region has, on the whole, experienced higher precipitation levels than the historical norm, but climatologists now think that we may have a cyclical return to warmer and drier conditions. In addition to this natural change, a global and largely man-made change is occurring in the gaseous mixture of the atmosphere, due especially to increasing amounts of carbon dioxide from the burning of fossil fuels – the so-called ‘greenhouse effect’. Predictions as to the rate and extent of change vary, but the expectation is for a gradual warming effect on the earth’s climate. The effects will be more pronounced in northerly regions.

On the North American continent, the warming effect from the build-up of CO<sub>2</sub> and other active trace gases could lead to an increase of as much as 3°C in the mean annual temperature in the Great Lakes region within the next six to ten decades. An overall shift in temperatures of this magnitude is very significant in terms of space heating and cooling, water evaporation losses and agricultural growing seasons. Preliminary climate model studies suggest that reductions in basin water supplies may occur. The amount of the reductions has been characterized variously as ranging between modest and substantial. Further, the extent to which increased evaporation losses may be offset by increased precipitation is poorly understood.

Perhaps even more significant, however, are the results of the ‘greenhouse effect’ on other areas of the continent and the globe, particularly as they affect agricultural production and markets. Higher temperatures and slightly lower precipitation in the middle-latitudes could be particularly serious for the southern and western parts of the United States, the southern Canadian prairies, and other relatively arid or semi-arid areas in these latitudes around the globe. Increased difficulties for agricultural production in these regions might be offset by a lengthened growing season in more northerly climes. But adjustment to the change in terms of the mobility of capital goods and labour would not be easy. Pressures could well increase to bring water from more temperate regions, such as the Great Lakes basin, to where it was acutely needed for irrigation of crops as well as industrial and other human activity.

The changes that may come as a result of increased carbon dioxide in the atmosphere or long-term climatic cycles will be slow; they will take place over decades and centuries. As a recent study of the National Academy of Sciences pointed out, however, one of the ways people react to climate change is by moving. If changes in climate during the past several

thousand years have been small in comparison with the changes we must consider possible during the coming hundred years, the latter are also small by comparison with the changes that large parts of the world’s population have undergone in populating the western hemisphere. Nevertheless, there is still the prospect of climate change within the coming century that takes us outside the boundaries experienced within the past 10,000 years. The economic, social and environmental implications of climate change could be severe and largely unavoidable, so that anticipation and preparedness for adaptation are required.

### *World Food Supply and Demand*

With or without long-term climate change, the tremendous increase in world population, especially in the developing countries, will require increased agricultural production, while the trend to urbanization will mean even fewer people producing their own food supplies. These factors will require either a major improvement in agricultural productivity in the developing countries or increased production and export of food products from agriculturally more proficient countries such as the United States and Canada.

Agriculture is a mainstay of both national economies, with food production substantially exceeding the direct needs of their peoples. A major portion of grains and considerable quantities of other commodities are shipped overseas. Should there develop a stronger world demand for food that the developing countries were unable to meet, there could be intense pressure on the United States and Canada, for economic or humanitarian reasons, to provide large increases in food exports.

The relevance of these issues from the perspective of this Report is their potential effect on the demand for water for North American agricultural production. Low-cost water and low-cost energy have contributed to our low-cost food. The demand and prospects for greatly increased food exports could lead to either heavy subsidization of water supply projects or an increase in food prices to permit the water used in agricultural production to approach its economic price. Either way, Great Lakes water could be looked at as a source of supply. Despite the current high cost and low likelihood of further large-scale diversions out of the Great Lakes, major shifts in economic or political parameters, such as a world food crisis, could lead to a more genuine interest in considering large inter-basin transfers of water.

### *Other Trends*

One factor that could significantly affect the future of the Great Lakes is a fundamental shift in the economies of the United States and Canada with the move into the post-industrial or electronic age. This has led and will continue to lead to a structural realignment away from heavy industry toward lighter and service industries as the most active growth sectors. A parallel trend is the shift of productive capacity for the resource-intensive industries to other parts of the world, along with a growing desire for industrial development in the Third World, to provide new, low-cost sources of



*The needs of future generations demand that the shared waters of the Great Lakes receive close attention.*

traditional goods as well as emerging markets for technological and intellectual commodities. In the Great Lakes region, these changes may reduce growth rates for the consumptive use of water characteristic of heavy industry and thermal power installations.

### *Thinking Ahead*

The possible effects of discontinuities such as climate change and shifts in world food supply and demand all suggest a different approach to planning for the future, an approach based on the need to be responsive to a broad range of societal concerns and values and adaptive to unexpected change. Additional diversions and a systematic approach to water sharing could require dialogue in the future. National and binational mechanisms, methodologies and policies should therefore take these possibilities into account.

The future will always remain to some extent shrouded in uncertainty, but the direction of trends in consumptive use, the nature of their effects, and trends in uncertainty itself suggest the need, at minimum, to monitor the changes that will occur. This matter is addressed specifically in the conclusions and recommendations of Part One of the Report. In addition to monitoring, continually updated consumptive use projections could also provide Governments with some basis

for anticipatory planning and appropriate policy formulation. A series of statistical data relating to factors influencing water consumption such as those addressed in this Report should be provided. It might include current data, trends and projections on

- basic basin and national demographic data, including population and its distribution (by sub-national region, urban-rural);
- regional, national and selected global shipments, exports and capital expenditures by water-consumptive industries, including iron and steel, other metals, certain chemicals, and forest products, as well as agriculture; and
- regional electrical production and capital forecasts by type of generation.

Most of the data will be collected currently in some form or other, but may need to be adjusted or specially aggregated. Additional information might be supplied by governmental agencies in the form of narratives on present and possible future trends in the areas listed or other relevant sectors, on technological developments relating to water withdrawals and consumption, and on legislative or administrative developments that would have an impact on the amount of

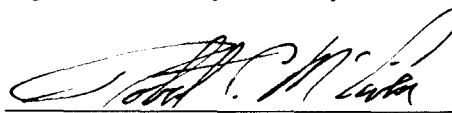
water used and the condition in which it would be returned to the Great Lakes.

The comparison has often been drawn, during the Commission's hearings and deliberations, between the future supply and demand for water and the energy crisis. The sudden, then permanent shock to oil prices and availability in the early 1970s, notably in those countries dependent on cheap, abundant energy, is well known. There followed massive ramifications throughout the world economy, including petrodollar investment. Though our institutional mechanisms were not well designed to adjust quickly to the new situation, there were substantial effects on government policies and public attitudes toward energy use and production, partially as a result of deliberate initiatives, but also in response to economic considerations. Whatever the stimulus, it is clear that despite initial confusion a major conservation effort has occurred without serious, long-term effects on the standard of living.

The question basic to this Report is whether institutions in the United States and Canada will be any better prepared to deal with a water crisis – should one occur in the decades ahead as some predict – than they were to deal with the energy crisis. While the Commission does not believe that there is now a critical situation, at least one that would be felt in the Great Lakes region with respect to the quantity of water, it questions whether the institutions of government are in a position to make thoughtful and forward-looking decisions about the use of water, should the need arise. We know with little precision the present and future uses and values of Great Lakes water. Policies should therefore provide adaptive mechanisms for dealing with change and the unexpected.

The Commission is encouraged that the two Governments and other Great Lakes jurisdictions have already taken some anticipatory initiatives. In Canada, a federal water inquiry is to provide a comprehensive report in 1985. At a Water Resources Conference convened by the Premier of Ontario in June 1984, concern was expressed by spokesmen for government, industry and the public about a broad range of water issues. Discussion in the United States at the federal and state level subsequent to the 1978 presidential policy review, and the resurgence of involvement in water matters by a number of states are symptomatic of increasing interest and activity.

Signed this 18th day of January, 1985, at the International Joint Commission, Washington, D.C.



Robert C. McEwen



L. Keith Bulen



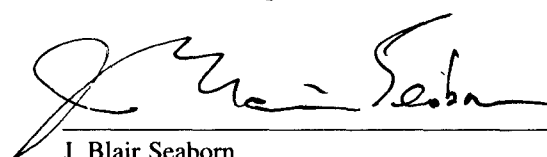
Donald L. Totten

The governors of the eight Great Lakes basin states and the premiers of Ontario and Quebec have urged Governments, through the Commission, to undertake a broad inquiry into consumptive uses, including the need periodically to calculate consumptive uses and trends. They have also recommended an examination of existing laws and regulations, conflicts with existing national policy, economic impact, associated environmental effects, and the time required for implementing control strategies. Aside from the question of whether the Commission should undertake such a study, a consideration properly reserved to Governments, the Commission endorses what it believes to be the underlying assumption in the request of the governors and premiers. Specifically, they appear to have recognized that the future of Great Lakes water should, in addition to appropriate unilateral and bilateral studies, be addressed in a binational forum.

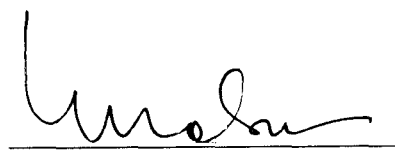
Recently, the Commission notes that the United States Government has taken an initiative to commence discussions with the Government of Canada on the issue of consumptive water uses in the Great Lakes basin.<sup>18</sup>

The Commission believes that all these discussions and studies are important and relevant. They should be encouraged to continue and to expand their consideration of a broad range of views concerning future water policy. They are all clearly germane to the central theme of this Report, the diversion and consumptive uses of Great Lakes water.

The shared waters of the Great Lakes have a regional, national and international significance that requires that they be treated as a joint responsibility of the Governments and peoples of both nations. They are a priceless natural resource in their own right. The multiplicity of uses to which they are put makes it imperative that closest attention be paid not only to the present needs of diverse users but also to the needs of future generations. The waters must be protected, conserved and managed with insight, determination and prudence if they are to continue to play the role they have played in the past. The Commission therefore urges the Governments of the two nations and the people whom they represent to examine carefully the conclusions, recommendations, observations and counsel to be found in this Report. The Commission stands ready to provide whatever assistance the Governments may request in this regard.



J. Blair Seaborn



E. Richmond Olson

<sup>18</sup> Diplomatic Note from the Government of the United States of America to the Government of Canada, March 31, 1984.

## Appendix A

### TEXT OF REFERENCE



## Text of Reference to the International Joint Commission

On February 21, 1977, the Secretary of State for External Affairs for the Government of Canada, and the Secretary of State for the Government of the United States sent the following Reference to the International Joint Commission, through identical letters addressed respectively to the Canadian and United States Sections of the Commission:

I have the honor to inform you that the Governments of Canada and the United States have agreed, pursuant to Article IX of the Boundary Waters Treaty of 1909, and in light of the second recommendation contained in the International Joint Commission's report entitled "Further Regulation of the Great Lakes", in response to the October 7, 1964 Reference from Governments, to request the Commission to examine into and report upon the effects of existing and proposed diversions within, into or out of the Great Lakes Basin, and the effects of consumptive uses on Great Lakes water levels and flows.

The Governments are concerned about the increasing demand for water to meet the needs of domestic and municipal supply and sanitation, navigation, industry, power generation, irrigation and other such uses, which will have increasingly significant socio-economic and environmental impact on all interests in the Great Lakes Basin.

During periods of extreme lake levels, attention in both countries has focused on the nature and effects of the various diversions within, into and out of the Basin. The Governments consider further study of these important hydrological features important in the context of the Commission's on-going efforts to promote a greater understanding of the Great Lakes system and to investigate possibilities of enhanced levels regulation consistent with the conclusions of the Commission's Report.

In light of the foregoing, and with reference to the following specific criteria:

- (a) Domestic water supply and sanitation;
- (b) Navigation;
- (c) Water supply for power generation and industrial purposes;
- (d) Agriculture;
- (e) Shore property, both public and private;

- (f) Flood Control;
- (g) Fish and wildlife, and other environmental aspects;
- (h) Public recreation; and
- (i) Such other effects and implications which the Commission may deem appropriate and relevant.

the Commission is requested to examine into and report upon the following matters which have, or may have, material effects on water levels and flows of the Basin, including the international and Canadian reaches of the St. Lawrence River:

1. Existing and reasonably foreseeable patterns of consumptive uses of Great Lakes waters;
2. Existing diversions, including the Welland Canal and the New York State Barge Canal, and federally, state or provincially sponsored or approved proposed new or changed diversions, within, into or out of the Basin; and, in particular,
3. Existing diversions at Chicago and at Long Lac/Ogoki, and the proposed study and demonstration program authorized by United States P.L. 94-587 affecting the rate of diversion at Chicago.

The Commission, upon the availability of adequate funding, should proceed with the above studies as expeditiously as practicable, and report to Governments by March 1, 1979, and on an interim basis if deemed appropriate.

In the conduct of its investigation and the preparation of its report, the Commission shall make use of information and technical data heretofore available or which may become available in either country during the course of its investigations. In addition, the Commission shall seek the assistance, as required, of specially qualified personnel in Canada and the United States. The Governments shall make available or, as necessary, seek the appropriation of the funds required to provide the Commission promptly with the resources needed to discharge the obligations under this Reference fully within the specified time period. The Commission shall develop as early as practicable cost projections for the studies under reference for the information of Governments.

An identical letter is being sent to the Secretary of the United States Section of the Commission by the United States Department of State.





## Appendix B

### DIRECTIVE TO THE STUDY BOARD



## Directive to the International Great Lakes Diversions and Consumptive Uses Study Board

On May 3, 1977, the International Joint Commission established the International Great Lakes Diversions and Consumptive Uses Study Board to undertake, through appropriate governmental or other agencies in the United States and Canada, the necessary investigations and studies and to advise the Commission on all matters which it must consider in making its reports to Governments under the attached Reference. The following Directive to the Board was issued on May 10, 1977:

1. The Governments of the United States and Canada have forwarded the attached Reference, dated February 21, 1977, to the Commission for examination and report pursuant to Article IX of the Boundary Waters Treaty of 1909.
2. The Commission established the International Great Lakes Diversions and Consumptive Uses Study Board on May 3, 1977, to undertake, through appropriate governmental or other agencies in the United States and Canada, the necessary investigations and studies and to advise the Commission on all matters which it must consider in making its reports to Governments under the attached Reference.
3. The Board shall undertake an investigation of the following matters which have, or may have, material effects on water levels and flows in the Great Lakes Basin, including the international and Canadian reaches of the St. Lawrence River:
  - (a) existing and reasonably foreseeable patterns of consumptive uses of Great Lakes waters;
  - (b) existing diversions, including Welland Canal and the New York State Barge Canal, and federal, state or provincially sponsored or approved proposed new or changed diversions, within, into or out of the basin, and in particular;
  - (c) existing diversions at Chicago and at Long Lac/Ogoki and the proposed study and demonstration program authorized by United States P.L. 94-587 affecting the rate of diversion at Chicago.In conducting this investigation, the Board shall examine the effects of the above on:
  - (a) domestic water supply and sanitation;
  - (b) navigation;
  - (c) water supply for power generation and industrial purposes;
  - (d) agriculture;
  - (e) shore property, both public and private;
  - (f) flood control;
  - (g) fish and wildlife, and other environmental aspects;
  - (h) public recreation; and
  - (i) such other matters as the Commission may indicate to the Board during the course of the study.
4. In its studies the Board should note the concerns of the Governments expressed in the Reference about the increasing demand for water to meet the needs of domestic and municipal supply and sanitation, navigation, industry, power generation, irrigation and other such uses, which will have increasingly significant socio-economic and environmental impact on all interests in the Great Lakes Basin.
5. The Board should in particular assess the effects of varying the rate of existing diversions during periods of extreme levels on the Great Lakes.
6. The Board shall prepare and submit for Commission approval by June 15, 1977, a plan of study for the investigations that it proposes to undertake, and a schedule of the estimated time and costs involved in the completion of each of the necessary phases of the study and submission of a final report to the Commission. In preparing its plan of study, the Board should be guided by the following considerations:
  - (a) Provision should be made for the investigation of all environmental impacts of the matters under investigation as described in paragraphs 3, 4 and 5 of this directive.
  - (b) The Board shall act as a unitary body, carrying out its investigations jointly in both countries as a coordinated and integrated effort, and
  - (c) Provision should be made, where appropriate, for public information and participation throughout the course of the study.
7. The Board shall carry out the programs in accordance with the plan of study approved by the Commission. If it appears to the Board at any time in the course of its investigations and studies that the programs should be modified, it shall so advise the Commission and request instructions.
8. The Board shall submit its final report, and appendices, if any, in the necessary quantity for public distribution, to the Commission no later than September 1, 1978.
9. In the conduct of its investigation and in the preparation of its report or reports, the Board should make use of information and technical data heretofore available, or which may become available during the course of the investigation. The Board's attention is specifically drawn to the Final Report of the International Great Lakes Levels Board, and the Report of the International Joint Commission on Further Regulation of the Great Lakes.
10. The Board will consist of a United States Section and a Canadian Section, each having five (5) members. The Commission will appoint one member of each Section to be Chairman of that Section. At the request of any member, the Commission may approve in each case an alternate member to act in the place and stead of such member whenever the said member, for any exceptional reason, is not available to act as a member of the Board.
11. Members of the Board, and of its committees and working groups, whether or not employed by departments or agencies of government, are not representatives of their employers. They serve in a personal and professional capacity under the direction of the Commission, and their employers or superior officers are not committed in any way by the actions of the individual members or of the Board.
12. The Chairmen of the two Sections shall be joint Chairmen of the Board and shall be responsible for maintaining proper liaison between the Board and the Commission and between their respective sections of the Board and the corresponding sections of the Commission.
13. Each Chairman shall ensure that the other members of his Section of the Board are informed of all instructions, inquiries and authorizations received from the Commission; also of activities undertaken by or on behalf of the Board, progress made and any developments affecting such progress.
14. A Chairman, after consulting the other members of his Section

- of the Board, may appoint a Secretary of that Section and a Public Information Officer of that Section. Under the general supervision of the Chairman, these individuals shall carry out such duties as are assigned to them by the Section.
15. The Board may establish such committees and working groups as may be required to discharge its responsibilities effectively and may enlist the cooperation of federal, provincial or state departments or agencies in the United States and Canada. The duties and composition of any such committees shall be subject to prior approval by the Commission. The Board should consider and advise the Commission whether it would be desirable to appoint a coordinator to assist the Board in its investigation in view of the severe time constraints imposed on the study. Board and Committee members will make their own arrangements for reimbursement of necessary expenditures for travel.
  16. The Board shall maintain liaison with the International Lake Erie Regulation Study Board, the International Lake Superior Board of Control, the International Niagara Board of Control and the International St. Lawrence River Board of Control, so that each may be aware of any activities of the other Boards which may be useful to it or may have a bearing on its activities.
  17. The Chairmen shall keep the Commission currently informed of the Board's plans and progress and of any developments, actual or anticipated, which are likely to impede, delay or otherwise affect the carrying out of the Board's responsibilities.
  18. The Chairmen shall submit, at least semi-annually and more often if necessary, reports to the Commission describing the progress that has been made and any problems that have arisen in the investigation. All such reports shall be sent to the Secretaries of the Commission. Regular semi-annual reports should be submitted at least two weeks prior to the Commission's April and October meetings.
  19. If, in the opinion of the Board, there is a lack of clarity or precision in any instructions, directive or authorization received from the Commission, the matter shall be referred promptly to the Commission for appropriate action.
  20. Documents, letters, memoranda and communications of every kind in the official records of the Commission are privileged and become available for public information only after release by the Commission. The Commission considers all documents in the official records of the Board or of any of its committees to be similarly privileged. Accordingly, all such documents shall be so identified and maintained in separate files. They shall become available for public information only after Commission approval.
  21. In its dealing with the public and news media, the Board shall observe the principles of the attached documents on Public Relations Policy dated 27 July 1973 and 20 September 1974 of the Commission as supplemented by the provisions of the study plan of the Board when approved by the Commission.

## Appendix C

### MEMBERSHIP OF THE STUDY BOARD



# Membership of the International Great Lakes Diversions and Consumptive Uses Study Board

When the International Great Lakes Diversions and Consumptive Uses Study Board submitted its report to the International Joint Commission, the Study Board membership was as follows:

## **United States**

Brigadier General Scott B. Smith, Chairman

North Central Division  
U.S. Army Corps of Engineers

William D. Marks  
Department of Natural Resources  
State of Michigan

Dr. Frank L. Kudrna, Jr.  
Division of Water Resources  
State of Illinois

R. Timothy Weston  
Department of Environmental Resources  
State of Pennsylvania

James D. Hebson  
Federal Energy Regulatory Commission

Zane M. Goodwin (Alternate)  
North Central Division  
U.S. Army Corps of Engineers

Donald J. Leonard (Secretary)  
North Central Division  
U.S. Army Corps of Engineers

## **Canada**

Ralph L. Pentland, Chairman

Inland Waters Directorate  
Environment Canada

Ralph Smith  
Waterways Development  
Transport Canada

Donald N. Jeffs  
Waters Resources Branch  
Ontario Ministry of the Environment

Bertrand Bouchard  
Hydraulic Development Service  
Quebec Department of Natural Resources

Roy A. Walker  
Ontario Hydro

D.A. MacMillan (Secretary)  
Inland Waters Directorate  
Environment Canada

## **Former Board Members**

Major General Richard L. Harris (Chairman)  
Colonel Andrew C. Remson, Jr. (Chairman)  
Brigadier General Robert L. Moore (Chairman)  
all with North Central Division U.S. Army  
Corps of Engineers

Clifford H. McConnell  
Pennsylvania Department of Natural Resources

Peter L. Wise  
Illinois Division of Water Resources

Norton H. James (Chairman)  
Inland Waters Directorate  
Environment Canada

Grant H. Mills  
Ontario Ministry of the Environment





## Appendix D

### MEMBERSHIP OF THE STUDY BOARD'S TECHNICAL COMMITTEES AND SUPPORTING GROUPS



# Membership of the Study Board's Technical Committees and Supporting Groups

When the Study Board submitted its report to the International Joint Commission, its subcommittees and supporting groups consisted of the following members:

## Working Committee

### United States Section

Colonel Robert V. Vermillion (Chairman)  
Detroit District  
U.S. Army Corps of Engineers

Mogens Nielson  
Michigan Department of Natural Resources

Daniel Inferd  
Illinois Division of Water Resources

Steven Runkle  
Pennsylvania Department of  
Environmental Resources

Martin Inwald  
Federal Energy Regulatory Commission

John B.W. Corey  
Illinois Department of Water and Sewers

### Canadian Section

John Bathurst (Chairman)  
Inland Waters Directorate  
Environment Canada

G. Reginald Golding  
Transport Canada

John M. Spratt  
Ontario Hydro

Tom M. Kurtz  
Ontario Ministry of Natural  
Resources

Ronald C. Hore  
Ontario Ministry of the Environment

## Diversions Subcommittee

Benjamin G. DeCooke (Chairman)  
Detroit District  
U.S. Army Corps of Engineers

Philip Gersten, Gordon Larson and Nanette Tack  
all from Detroit District, U.S. Army Corps  
of Engineers

David F. Witherspoon (Chairman)  
Inland Waters Directorate  
Environment Canada

## Consumptive Uses Subcommittee

Dr. Arthur Pinsak (Chairman)  
National Ocean and Atmospheric Administration

C. Frederick Jenkins and  
Heather D. Wicke, both from  
National Ocean and Atmospheric Administration

Ronald C. Hore (Chairman)  
Ontario Ministry of the Environment

Donald Tate  
Environment Canada

Douglas Vallery  
Ontario Ministry of the Environment

## Environmental Evaluation Subcommittee

John R. Collis (Chairman)  
Detroit District  
U.S. Army Corps of Engineers

Dr. James E. Galloway  
Detroit District  
U.S. Army Corps of Engineers

Douglas I. Gillespie (Chairman)  
Environment Canada

## Public Involvement Group

Philip Gersten and Michael Perrini,  
both from Detroit District  
U.S. Army Corps of Engineers

Raimo Kallio and Dana Vindasius,  
both from Environment Canada

**Liaison, Lake Erie Regulation Study**

William Erdle  
Buffalo District  
U.S. Army Corps of Engineers

Dr. Al R. LeFeuvre and Peter Yee,  
both from Environment Canada

**Technical Advisers**

Paul Mohrhardt  
Chicago District  
U.S. Army Corps of Engineers

J.T. Brown  
Environment Canada

Chris P. Potos and Joseph Tynsky,  
both from U.S. Environmental Protection Agency

## Appendix E

### SUMMARY OF PUBLIC MEETINGS



## Summary of Public Meetings June 7-16, 1983

The following is an informal summary of statements presented at public meetings of the Commission in June 1983. Verbatim transcripts of meetings and hearings, and written submissions made at or subsequent to the meetings, are on file and available for examination by the public at the Commission's offices in Washington, D.C. and Ottawa.

CHICAGO, ILLINOIS, June 7, 1983

### **Phillip D. Peters, Northeastern Illinois Planning Commission (NIPC):**

NIPC supports the conclusions and recommendations of the International Great Lakes Diversions and Consumptive Uses Study Board. Reduced diversions at Chicago would be damaging to the region's economy, seriously impair future economic plans, result in the eventual depletion of groundwater resources in the region and could lead to increased water quality violations. NIPC supports legislation to prohibit the export of Lake Michigan water outside the Great Lakes states.

### **Neil R. Fulton, Illinois Division of Water Resources, Illinois Department of Transportation (DOT):**

The Illinois DOT agrees with the findings, conclusions and recommendations of the Board. The Illinois DOT was active in the development of the June 1982 resolution by Great Lakes Governors and Premiers that IJC be given a Reference to monitor consumptive uses, to study possible control measures and the impacts of the control measures. Continued IJC involvement is essential if effective control strategies are to be developed.

Governors and Premiers oppose new diversions outside of Great Lakes states or provinces because water is needed for current and future demands in the states and provinces, and because losses to hydro-power and commercial and recreational navigation industries would result.

Some communities in this area historically have had leakage from the underground supply system of 40 to 50 per cent. Illinois has established a requirement that it be reduced to 8 per cent by 1985.

### **Judith Kiriazis, Lake Michigan Federation:**

The Board's study is a good first step and indicates a definite unwillingness to tamper with the Great Lakes ecosystem any further.

The IJC should begin now to develop strong and well thought out policy guidelines for water use within the Great Lakes basin. The focus must shift from studying levels and flows to grappling with the question of who uses how much water, for what purpose, and in what condition it is returned to the ecosystem. The IJC should promote water conservation in a big way.

### **Fred Brown, Michiana, Michigan:**

My 100-foot lot on Lake Michigan, originally worth \$30,000 to \$50,000, is only worth \$500 as a picnic area now that a minimum setback of 75 feet has been imposed. There are hundreds of miles of shoreline on the Great Lakes and multiplying \$30,000 by a mere 10,000 lots, the number is \$300 million. This is much more than the \$4-6 million figure in the status report of the U.S. Army Corps of Engineers.

### **Lee Botts, Center for Urban Affairs and Policy Research at Northwestern University:**

In addition to presenting a recommendation to the Governments informing them that it is not feasible to regulate the Great Lakes like a plumbing system, the IJC should interpret the significance of that recommendation to the public and engage in public education on this issue. There is an opportunity with this study to interpret an issue of the greatest concern to hundreds of thousands of property owners throughout the Great Lakes.

The IJC should make it very clear to the public that the projections on consumptive uses are based on assumptions.

### **Bill Rustem, Center for the Great Lakes:**

In addition to the resolution adopted at the Governors Conference last year, those sentiments were echoed by the new governors of the Great Lakes states at an economic summit called by Governor Celeste in Ohio just a couple of weeks ago.

### **Dr. James R. Gale, Michigan Technological University, Houghton:**

The economic literature reveals no relationship between the availability of water for consumptive use and the location of industry. Water is a very small part of the input costs. It might have some effect within a region, but not in the choice between regions.

Most of the water diverted between regions is used for irrigation. Because of the costs of transporting the water the economic justification for the individual farmer is simply not there. The taxpayers have to foot the bill as has been done in western states. The large farm bloc is water wise. This is not an efficient use of the resource, looking purely at the production side of agriculture.

If water was diverted to the high plains region, about 4.1 million acre feet, or 5,500 cubic feet per second would be necessary to sustain current agricultural production. This would amount to a 2-per cent reduction of the outflow into the St. Lawrence River. This would not be a major economic factor in terms of supplies available to the Great Lakes region.

### **Tom Merz, Michigan Technological University, Houghton:**

There has been a lot of publicity that jobs should move to the Great Lakes rather than have water move to the jobs. That is not likely to happen.

### **Tom Berry, for Patrick W. Simmons, Legislative Director for Illinois, United Transportation Union:**

The study methodology looked at the costs of allocation in production dollars which means all kinds of scenarios, such as using electric appliances, can be justified. Pipelines can make money and it can be said that this economically justifies the otherwise wasteful use of water. But, if there is an adverse economic impact someplace else, if you lose a hundred jobs someplace else, then the benefit to society is lost. Address these things in any subsequent studies.

DULUTH, MINNESOTA, June 8, 1983

### **James Ulland, State Senator and Chairman of the Minnesota Commissioners to the Great Lakes Commission:**

The Great Lakes Commission concludes that water is the most environmentally and economically sound manner to transport bulk

cargoes and the most environmentally sound manner to produce electric power. The Great Lakes Commission objects to any new diversion out of the Great Lakes for use outside the Great Lakes States.

The port of Duluth-Superior is the twelfth largest tonnage port in the country. The draft levels of the port as well as the tourism potential of this area must be protected.

**William Richard, for Congressman James L. Oberstar:**

This series of hearings must become the first step for the development of a major long-term water protection and enhancement policy for the Great Lakes.

**Jim McCarville, Port Director of Superior, Wisconsin:**

A reduction of the level of Lake Erie by 8-9 inches would have a very severe impact on navigation. Each inch of draft lost for a thousand-foot vessel means about 200 tons in cargo. It is also quite possible that navigation interests will soon be required to pay for some or all of the costs of maintaining the channels.

**Alden Lind, Izaak Walton League:**

While the Board found no new proposed diversions, a schematic for a coal slurry pipeline was presented to the Minnesota Environmental Quality Board in February by the Powder River coal slurry pipeline organization.

A 24-inch pipeline, pumping at 11 cubic feet per second, would take about 2,000 cfs out of the basin. This would reduce water levels at Montreal by somewhere in the vicinity of 0.6 to 0.9 feet. This indicates vividly that there isn't much water to spare, a point that needs to be brought forcefully to the attention of the American public and decision-makers. The IJC needs to pay greater attention to the prospect of a very substantial political struggle on the question of water export.

To make a diversion pipeline economically feasible, additional users would probably be sought to reduce per unit costs. When the Powder River trial balloon was floated, a lot of people in South Dakota got very excited and started asking if they could get some of the water that was coming through.

**Alison Contos, Save Lake Superior Association:**

The Lake Superior Association opposes diversion of Great Lakes water to any place outside the Great Lakes Basin for any reason.

**Henry M. Buffalo, Jr., Great Lakes Indian Fisheries Commission:**

Decisions are being made at this level without the type of input that the Great Lakes Indian Fisheries Commission would like to provide. This Commission looks forward to developing an advisory relationship to the IJC similar to what has been developed with the Great Lakes Fishery Commission.

Governments have the obligation and the duty to protect the exercise of treaty-guaranteed rights to fish. Since the viability of the fishery is so closely related to the water, the duty naturally extends to an interest in the uses of the water. Nine years ago, in a landmark decision known as *United States v. Washington*, 384 F. Supp. 312 (W.D. Wash. 1974), the federal court reaffirmed the treaty fishing rights of nineteen Western Washington tribes and the resultant responsibility to ensure that everything is done to protect the fishery from environmental degradation.

**Bill Newstrand, Minnesota Department of Transportation (DOT):**

Water diversions can have a detrimental impact on Minnesota's commercial navigation and specifically on the state's agriculture and iron mining industries.

The Minnesota DOT urges the IJC to review carefully the economic and the environmental effects of any additional diversions before they occur, especially with the strong probability of the institution of user fees for maintenance of the channels.

**Gene Hollenstein, Minnesota Department of Natural Resources (DNR):**

With regard to the Study's findings, the Minnesota DNR is uncertain of the validity of "i" (no known proposed diversions) and "j" (consumptive uses of water are projected to increase from the 1975 rate).

The DNR generally agrees on the establishment of a mechanism for institutional consultation, but the states and provinces must be able to express adequately their views and concerns.

**Elmer Berglund, United Transportation Union of Minnesota:**

In the event that federal eminent domain rights were granted today, there are about eight pipelines that would take away somewhere between 40,000 and 50,000 railroad jobs. If the IJC receives a request from a pipeline company, the United Transportation Union of Minnesota asks that the IJC turn it down.

**William Miller, Duluth City Planning Commission:**

The City Planning Commission supports conclusion "d" (consumptive uses should be monitored) and recommendation "b" (establish mechanism for institutional consultation). Because of the importance of shipping to Duluth's economy, the impacts discussed in the study are clearly of concern to all the citizens of Duluth.

**Milton Pelletier, Minnesota Conservation Federation:**

Water quality is important to this area and there is a significant investment in it. Water should be taken from places like the lower Mississippi for areas where the aquifers are drying up.

**Betty Hetzel, League of Women Voters:**

The Board should have been active when the league of women voters was fighting Plan 1977. The league maintained that the highs and lows could not be changed by opening and closing gates. Is anybody monitoring Plan 1977 and is it working?

*Response by Ben DeCooke, U.S. Army Corps of Engineers:*

From a technical standpoint, it is working.

**Bob Eikum, Great Lakes Committee, Sierra Club:**

The suggestion that Lake Superior water be diverted to supplement irrigation in Nebraska and Kansas is of concern, as is the proposal for a slurry pipeline to bring coal to Duluth harbor and pipe water out west. The IJC should extend its study to determine the effects of those two possibilities.

WINDSOR, ONTARIO, June 9, 1983

**William D. Marks, Michigan Department of Natural Resources:**

In the short time since the study was initiated, citizen concern about the lakes has shifted from narrow specific problems such as lake level fluctuations to ones of wider perception concerning the intrinsic value of the lakes; this has been reflected by governments at all levels. A wider spectrum of society now is showing concern for the Great Lakes.

There should be no future diversions from the lakes without the concurrence of the states and provinces, and some institutional mechanism to achieve concurrence should be sought. The *Boundary Waters Treaty* gives some recognition to the question of diversions but does not fully take into account the riparian situations of the states and provinces.

Consumptive uses require the most attention. Projections in the report of the Board may be wrong because development of basic industries is not likely to be the same as it has been in the past. There are obviously benefits to consumptive uses and these were not recognized in the report. In considering the future, the net economic benefits occurring at the place of use will have to be recognized; it is easier to see where economic losses occur but future planning will require considering where the economic benefits occur.

A need exists to set in place a measuring technique to keep tabs



on the impacts in both countries of consumptive uses and small diversions. It is technically possible to do this but no mechanism is now in place.

**Marie E. Sanderson, Great Lakes Institute, University of Windsor:**

The Board report is excellent but two topics of importance have not been included: the impact of possible large-scale diversions out of the Great Lakes and the impact of possible climatic changes on the levels of the lakes. Preliminary studies indicate that a climatic warming may take place, with corresponding decreasing lake levels.

Water quality is going to be the big problem in the Great Lakes in the not-too-distant future. The IJC should encourage research into the implications, including legal implications, for the lakes of large-scale diversions and climatic changes.

**Justine Magsig, Rivers Unlimited, Cincinnati, Ohio:**

To reduce farm chemicals in the Great Lakes, alternatives to stream channelization should be supported by the Commission. Water consumed by millions has become a chemical brew, and over-fertilization of Lake Erie resulted in algae blooms and water that is unpalatable. The Commission should recommend the adoption of land use procedures for agriculture that will clean up the waters flowing into the Great Lakes.

**Wayne Schmidt, Michigan United Conservation Clubs:**

The Michigan public is indignant at the idea of massive inter-basin diversions of water from the Great Lakes to the western United States. The debate is healthy because it focuses attention on the importance of the lakes to the region. The Great Lakes are not for sale, and a growing militancy will fight any new diversions out of the Great Lakes watershed. The people of Michigan see the threat as real. Despite the speculative nature and seemingly astronomical costs, history proves that "water flows uphill to money" and price is no object.

There are many reasons to be concerned about the possibility of diversions, including the depletion of aquifers, legislation being considered to permit coal slurry pipelines and a court decision prohibiting a ban on the interstate export of water.

There is a danger in considering the giving of permission to restrict diversions only to within Great Lakes states and provinces; this may have political merit but has no ecological merit. The Board's report on consumptive uses shows that there is a threat to water levels even without diversions outside the basin. Ignorance of the Great Lakes ecosystem is so profound that it is difficult to know what questions to ask.

Despite what the report says, the people of Michigan are not convinced that losses through irrigation and the impacts on the lakes from uses of groundwater, inland lakes and tributaries are benign. There is a fear that Ontario may be considering the sale of water when it should be joining Michigan to fight diversions.

MUCC agree that regulating levels by manipulation of diversions is not feasible or desirable. The Commission should help educate the public about consumptive uses.

**John P. Nash, Association in Defence of Man and Nature:**

Riparians have been asked to subsidize shipping, hydro, industry and municipalities through accepting man-made changes to the lakes system. The works of man cause erosion, not nature.

**Mark Van Potten, National Wildlife Federation (NWF):**

The NWF, the largest environmental group in the United States with 4.2 million members, has adopted a resolution opposing any plan to divert water outside the Great Lakes basin for any purpose.

It is a mistake for the Commission to confine itself to quantity in determining if a diversion is significant. Project momentum where a great deal of money has been invested is cause for concern. The Commission should not wait until diversion projects are made

before developing the institutional structures or defining the realm of discourse.

The challenge for the Commission is its ability to influence national policy on diversions through its recommendations. "Philosophically, it is in the best interests of the psychic, economic and social health of both of our societies to attempt to adapt our lifestyle more to the ecosystem rather than the manufacture of massive plumbing systems to change our ecosystem."

**Harlan L. Gaddy, United Transportation Union:**

There is a need to establish priorities for water use, and the use of water to move coal is not justifiable in light of the damage it would cause to the ecology. Transportation methods already exist to move coal and these should be used because they cause less damage and cost less. Great pressure will be exerted on the Commission to allow the diversion of water if coal slurry legislation passes and billions are invested. The Commission should raise its voice against passage of such legislation before the problem has to be dealt with in the future.

**Frank Kudrna, Great Lakes Commission (GLC):**

The Great Lakes Commission opposes any new diversion of Great Lakes water out of the basin, as do the Great Lakes states' governors and the provinces. The Great Lakes Commission and governors also favour the giving of a reference to the IJC to monitor uses of Great Lakes water. The GLC supports development of contour mapping and resource inventory techniques.

The provisions of the coal slurry bill being heard before the House Committee on Interior and Insular Affairs are inadequate to protect the Great Lakes. An individual riparian state could take action allowing diversions of water from the Great Lakes without agreement from other states and provinces.

**Elizabeth Harris, East Michigan Action Council, Michigan Environmental Council:**

There is no vital shortage of water in the West, only inefficient use of water. Transferring water from the Great Lakes will cause people in the West to regard the Great Lakes as an economic commodity to be sold, rather than as a precious resource to be protected. There is a danger that project momentum will overcome reasoned debate about diversions. Diversions present economic and environmental threats. Present legal mechanisms do not provide adequate protection against the threat of diversions. The Commission should develop a comprehensive plan for the use of Great Lakes water.

**John D. O'Doherty, Michigan Department of Transportation:**

There is reason to be concerned about the potential impacts on commercial navigation of large-scale diversions or increased consumptive uses of Great Lakes water. The economic benefits of maritime-related activities to the United States are substantial; the economic impact of the port industry for the Great Lakes is \$21.8 billion, for ship operations \$4 billion and for shipbuilding \$2.93 billion. Hundreds of businesses are engaged in support for commercial navigation activities.

Traffic growth on the Great Lakes is forecast to be considerable but for this to occur, an adequate and efficient system of channels and harbours must be maintained. Significant water diversion would be a threat because of the increased dredging which would be necessary. Large diversions would create "devastating impacts".

**J. Menard, Reeve of Sandwich Township:**

Concern, basically, is with the lack of stabilization of water levels in the basin and the effect this has on local municipalities. Whether any diversion programs will come with a guarantee is important to municipalities adjacent to the Great Lakes.

**James A. Desper, Resident of Illinois:**

(tabled a deposition against diversions)

**Thomas O'Dwyer, Windsor Chapter, Decisions for the Great Lakes:**

On behalf of a binational group recently exposed to a variety of issues through an intensive course at the University of Windsor, unanimous opposition to further diversions is registered until their exact impact can be determined. There is still not enough known about the impacts of even small-scale diversions on wetlands, and lower water levels hit particularly hard on Lakes Erie and St. Clair. There is a need to know much more about the Great Lakes system before considering diversions.

**Mrs. D.L. Dawdell, Resident of Windsor:**

Concerns relate to erosion, particularly that caused by the traffic of very large boats on the Detroit River. Large boats built to operate on the upper lakes are used regularly on the lower lakes and cause increased erosion.

CLEVELAND, OHIO, June 13, 1983

**Anthony J. Russo, for C. Thomas Burke, Executive Director, Port Authority of Cleveland:**

Attempts to regulate the lake levels to an extent causing substantial changes are not in the public interest. Although there are no known significant new diversions proposed for the Great Lakes, the rest of the country is eyeing the possible use of our precious resource. Every effort should be made to safeguard the water and water transportation. Specifically, port operations in the Great Lakes Region require a 27-foot draft along the piers. Unnecessary increases in lake levels are also detrimental because vessels, when moored, cause more damage to the piers, and waves breaking over the docks reduce utilization.

**Ellen Knox**

The issue of possible diversions of water to the southwest should worry everyone, particularly because of the needless polarization among regions. Residents of the Great Lakes basin must go beyond their own region and address the rest of the country and then the whole world, so that all realize that we have the job of being immediate stewards for this resource.

**Glen Nekvasil, Lake Carriers' Association:**

The Association supports the findings and conclusions of the Board. In opposing the reduction of extreme high levels by diversions, the IJC should consider the vital role shipping plays in the economy of the Great Lakes Region. The director of the Center for the Great Lakes has predicted that for every inch the water level falls below the 27-foot level, shippers will lose upwards of \$200 million, utilities \$10 million, and the recreation industry \$3-12 million. In addition, higher transportation costs could have a severe impact on the steel industry, on iron ore and coal mining and on grain prices.

The IJC should recommend that the U.S. Congress, working with their Canadian counterparts, begin to develop guidelines to control consumption. The Association does not oppose all increases in consumption, because the Great Lakes are an under-used asset. However, the health of our region and industries should not be weakened by indiscriminate siphoning of our life's blood. There is a need to develop strict but fair guidelines before there is a crisis.

**Mimi Becker, Great Lakes Tomorrow:**

*Great Lakes Tomorrow concurs in general with the study findings. There is, however, at least one proposal to divert water in large quantities for the Powder River Coal Company. IJC should assess this proposal before reporting to the Governments of the United States and Canada.*

The IJC should detail a specific monitoring strategy for both diversions and consumptive uses, including the specific responsibility for this monitoring. There should be a standing board on Great Lakes Diversions and Consumptive Uses with the following responsibilities: update data on Great Lakes levels and flows;

monitor proposals for increased usage of Great Lakes water; evaluate various proposals for diversions; assess U.S. and Canadian riparian law, including U.S. Supreme Court decisions, to identify IJC's constraints and opportunities under the *Boundary Waters Treaty* to regulate levels and flows, and to see if there is need for new joint Canadian-U.S. decisions on diversions; provide a basis for IJC to review the ecosystem impacts of additional diversions or consumptive uses; serve as a uniform data base for both sides; and serve as an incentive for Governments to provide adequate and up-to-date information.

There is a tremendous mythology about what causes changes in lake levels, and the IJC is probably blamed for 90 per cent of the changes. There needs to be improved public information.

The Great Lakes Water Quality Agreement Institutions should look at the findings of other boards to ensure that all commitments under the Agreement have been considered.

**James W. Cowden, Great Lakes Tomorrow:**

Three problems will eventually be of concern to the IJC: First, there is a lack of goals for uses of Great Lakes water due to the fragmentation of the agencies charged with management. The IJC should encourage the major jurisdictions to think about the allocation of water. Second is the whole question of water conservation which must be given serious consideration in light of projected consumptive uses. The third matter is that while the report has looked at large-scale uses of water in the aggregate, an examination of the micro-economic aspects would be necessary to reveal the more critical problems.

**John Cousins, for Lt. Governor Myrl H. Shoemaker, Director of the Ohio Department of Natural Resources:**

Ohio supports the resolution of the Great Lakes Commission and the similar resolution adopted by the Great Lakes governors and premiers in 1982. The latter concludes that the IJC should be given a reference "to monitor consumptive use of Great Lakes water and study possible control measures, along with their impacts".

The Lake Erie shoreline is subject to flooding and erosion, problems that are aggravated by high lake levels. The annual economic benefits to the coastal zone interests that can be achieved by the "maximum effect diversion scenario" are small when compared to the attendant losses to navigation and power, yet the problems persist. Some positive and constructive recommendations to address these high lake level problems should be developed.

**Nancy Martl, League of Women Voters:**

At the IJC's Great Lakes Water Quality Meeting of November 1981, the Powder River diversion was just rumoured. The IJC was asked if a cost-benefit analysis of transporting the water, cleaning it up, and the damage done to the railroad industry had ever been done?

*Reply by Commissioner Bulen:* The High Plains project concluded that diversion would be absolutely infeasible, economically, at this time.

*Nancy Martl:* With all the talk of water shortages in the southwest, has anyone done a cost-benefit analysis of shipping water from places like the Great Lakes versus desalinization of the Pacific Coastal waters?

*Commissioner Bulen:* Most information on desalinization suggests that it is even more costly, by far, in the amounts that are anticipated, than the transfer of fresh surface water.

**Walter Hoag, City of Euclid, Ohio:**

The so-called "hundred-year storms", such as that of April 6, 1982, have caused billions of dollars in property loss each year. Whatever the public sector can do to alleviate the hardship of these hundred-year storms, which, by the way, have occurred three times in the last decade, will be an investment in some of the most valuable property in this nation. The IJC should support legislation regarding Coastal Zone Revenue Sharing, which is currently being considered in Washington, D.C.

**Mrs. Gerry Armstrong, League of Women Voters, Geauga County:**

There is a major need for laws and regulations to prevent diversion of water to other areas of the country and indiscriminate consumptive uses of Great Lakes water. These regulations should be made as soon as possible and not after it's too late.

**Kenneth Scott**

Back as far as your records show, until they built the power stations on the Niagara River, the lake levels were stable. Then the power stations took more water and there were a few years of really low levels. Then diversion canals were built to allow the watershed of part of Canada to be diverted into the Great Lakes. There have been numerous other diversions and control dams built which are now all controlled to the benefit of the power and shipping interests.

Looking back on the monthly reports, it seems that the level of Lake Erie is considerably higher and going up each year because your averaging has a higher level added to it each year. If the lake level could be left as it was originally for numerous centuries, there would be no problems. Since the levels are being raised beyond their natural levels, the shore owners should be protected. Those who receive the benefits from the higher levels should pay for raising the level and also for the damage caused.

**Roy Curtis, Property Owner on Middle Bass Island:**

The lake level has steadily increased since I bought my property in 1968, and 20-some feet of beautiful land has disappeared into the lake. There are problems with infiltration since sewer lines are constantly under water. Certain things about the Board's report are just not credible. It says that the outflow of Lake Erie is increased, but does not say that the flow through the Welland Canal was reduced when it was repaired.

*Response by Ben DeCooke, U.S. Army Corps of Engineers:* What happened is that more water was put through the Welland Canal prior to that so that when the closing occurred, there would be no impact on Lake Erie.

*Roy Curtis:* The regulation of the Diversion at Chicago was instituted because too much water was being taken. It took years to do and nobody has bothered to change it now that the lake levels are high. Look seriously at the future economics of this region and seriously challenge projections for consumptive uses.

ROCHESTER, NEW YORK, June 14, 1983

**Edward J. Rutkowski, Erie County Executive:**

Erie County has over 90 miles of Great Lakes shoreline when the Niagara River is included. Erie County's location has created an economy that is heavily dependent upon Great Lakes water. The Port of Buffalo generates over ten million dollars a year to the local economy, and local industrial production depends heavily on hydro-electric power.

The IJC should undertake three very important initiatives: First, the IJC should follow through on the recommendations of the Board and undertake a comprehensive study of water consumption in the Great Lakes basin. Second, the IJC should prepare or participate in a water resources management plan for the basin or lobby Governments to undertake a management plan. Such a plan must describe mechanisms for controlling consumption and define actions the various governments should take to minimize the impacts of increasing consumption. Third, several studies, most notably the *Six State High Plains Ogallala Aquifer Regional Resources Study*, have indicated how critical the need for water is in the arid southwest. The IJC should undertake an analysis of the effects of large-scale diversions of Great Lakes water out of the basin.

**John A. Finck, for Commissioner Henry Williams, New York State Environmental Conservation Commission:**

The IJC did not appoint anyone from New York State to the

Board or the work groups. IJC should include New York State in its future planning and management of the Great Lakes.

Federal legislation for coal slurry pipelines has been proposed. For many years there has been speculation about the diversion of Great Lakes water to recharge the High Plains aquifer. A procedure should be developed to evaluate the effects of these proposals even if the proposals are not definite.

For some time essential environmental baseline information has been lacking. The IJC and Corps of Engineers continually undertake studies that only use available information. The U.S. Fish and Wildlife Service, in co-ordination with the Great Lakes States, has identified the environmental studies that are required.

**Scott Lilly, New York Power Authority (NYPA):**

NYPA charges very low rates for power generated at hydro-electric plants. If somebody had to replace it, it would cost twelve times as much at today's prices. This is not the IJC's responsibility, but somebody should devise other remedies for those parts of the United States facing water shortages and get them working on those alternatives before they come around trying to connect their pipes to the Great Lakes.

The Board noted the benefits to power production from the increase of the Welland Diversion. Those figures should be re-examined in light of the possible expansion of our facilities at Niagara. The likelihood of the matter is that it would be better to put that water through a highgate plant than a lowgate plant. The Board must have reached its conclusion on the assumption that there wasn't room for it at the high plant.

**Robert Berggren, Monroe County Human Relations Commission:**

If acid rain is menacing the quality of the water in the Great Lakes system, as indicated by scientific investigation, it might merit further investigation by the IJC.

**Peter W. Frank, Lake Bay Association:**

Existing diversions have produced changes in the Great Lakes levels to the detriment of riparian owners. The Lake Ontario Land Development and Beach Protection Association instituted a lawsuit against the Canadian government for damages caused by the Long Lac and Ogoki Diversions. The association won and was paid twenty years later.

It was proven in the spring of 1973 that 350,000 cfs can be released by opening Long Sault Dam with the Canadian rivers running full downstream. That is a passage for letting out 800,000 cfs. There is no reason for high water unless somebody wants it.

Water is not and never will be a problem in the Great Lakes basin, which has too much water. Water should be diverted to the southwest United States to prevent flooding on the Great Lakes.

**Paul F. Fox, Rochester, N.Y.:**

The last communication received from the IJC provides answers to a list of questions previously raised by various concerned riparian owners. The response came back saying only what cannot be done. A positive approach should be taken by the IJC and its Boards to come up with answers that people can live with.

Is it possible to work toward controlling the lake at some intelligent level and say that it may be off by a certain percentage? A periodic report could be produced factoring in trends when there are going to be several years of wet weather or dry weather. By knowing how much it may be off, riparians could decide whether to build floating docks or stationary docks and what kind of a calculated risk to take.

**John B. Sheffer, New York State Assembly:**

Since Lake Erie and Lake Ontario are the most downstream of the Great Lakes, the cumulative effect of diversions out of the Great Lakes basin would have more of a devastating impact on New York than on any other state or province in the basin. An "over my dead body" approach to diversion proposals is necessary. Serious work

must be done to have the legal foundation and political clout to protect this huge asset.

While water alone cannot solve all economic problems, the Great Lakes can provide the impetus for a sound and enduring economic recovery in the state of New York. The production of a single automobile requires about a hundred thousand gallons of water and then thirty thousand more to produce the tires. The Great Lakes region will truly be the most logical place for many such industries. It takes nearly fifteen thousand gallons of water to grow a single bushel of wheat and twenty gallons of water to get an egg on the breakfast table. Agriculture is the number one industry in the state of New York and the resource that makes it thrive must never be given up.

**William Mayer:**

The lake level is too high again. It is being used for hydro. A lot of residents up and down the lake front have cellar pumps running. These residents insist that lake levels be lowered.

**Martin J. Manchalla, for Donald J. Riley, Supervisor of the Town of Greece, N.Y.:**

Regulating the levels of the Great Lakes to the extent necessary by managing existing diversions is not feasible. Plan 1958-D, even with its discretionary authority to make small deviations from the plan, does not provide enough flexibility to its managers to account for major changes within the Lake Ontario basin such as have been experienced this spring. A revision of Plan 1958-D to allow for greater flexibility in dealing with the level of Lake Ontario is needed. Take the necessary steps to initiate a timely study on the matter so that all interests may be served satisfactorily by the proper regulation of lake levels.

TORONTO, ONTARIO, June 15, 1983

**Alan Pope, Minister of Natural Resources, Ontario:**

The Province concurs with the Board's recommendation against trying to manage levels by manipulating diversions and agrees that consumptive uses should be monitored. The Province opposes any additional direct or indirect diversion of water from the Great Lakes system.

It is difficult to overstate the importance of the Great Lakes to Ontario. The economic value is "staggering". Wetland must be preserved and "...the system is of fundamental importance to the ecology of our province and a part of our lifestyle."

The Chicago diversion is "a sort of wildcard" providing potential for unilateral U.S. withdrawal of waters from the system, bypassing the processes of balancing interests and uses. Ontario is concerned about the long-term implications of the imbalance in consumptive uses between Canada and the United States. "We do not use the system equally, but we share losses equally." It is important to resolve outstanding questions dealing with equity of use and the potential for unilateral withdrawals.

Everyone, including the International Joint Commission, must become more concerned with public information. This is necessary in order to resolve issues and face challenges as they emerge.

**Doug J. Symington, Great Lakes Power Limited:**

Any consumptive uses or diversion of waters upstream of Sault Ste. Marie will directly and adversely affect the availability of water for power generation and penalize a considerable portion of Northern Ontario residents through higher costs for electricity. Great Lakes Power emphasizes its opposition to any move that could allow water to be diverted from the Great Lakes basin or otherwise irrecoverably used.

**M.H. Pryce, Ontario Hydro:**

Ontario Hydro opposes any increased diversions from the Great Lakes basin as it would mean higher costs for users of electricity in Ontario. The Board recommendations not to manage levels by

manipulating diversions and to establish a monitoring mechanism so policies can be formulated on future impacts of diversions and consumptive uses is supported.

**Tony O'Donohue, Environmental Probe Limited:**

Water problems are political more than anything else. Sale of water isn't advocated but more attention should be paid to seeing what can be done with "this wonderful resource." Engineer Tom Kierans' plan to redirect water into the Great Lakes and then draw it off for sale should receive more study. "It pains me to see billions of gallons of fresh water flowing into an empty ocean and just swallowed up when there are millions of people without water in the world."

**William L. Clink:**

"Disturbed" to read in the paper that a member of the Commission was quoted as saying Great Lakes area residents wished to "hoard" one-fifth of the world's fresh water. The "illogic" of the statement merits a reply because the figure of one-fifth of the world's water is, essentially, a red herring.

**Brian Charlton, Member of the Provincial Parliament:**

The Board's recommendations not to use diversions for regulating water levels and to monitor diversions and consumptive uses should be supported. It is important to develop a water management strategy because the myth of superabundant water supplies has made Canadians careless in the use of the resource. It is impossible to ignore rumours of "more ambitious" diversion proposals, and Canadians would be "singularly unprepared if presented with a major proposal from the United States". Water management has not been given the attention it deserves by either government.

New diversions could present other than economic problems to the Great Lakes region. Of serious concern are the environmental repercussions, "particularly slow water flows which would affect the abilities of the Great Lakes to cleanse themselves."

CANDU reactors are a cause for concern as they could have adverse impacts on Great Lakes water. Any major diversions of water must be strongly opposed. In addition, the Commission should look at the effects on water quality of such consumptive uses as that for nuclear power plants now under construction.

**Lois James, Save the Rouge Valley System:**

The public would like to know that someone is in charge when diversion projects are being considered, and it wants to know what criteria the IJC has to guide the assessment of such projects, especially at the local levels. "In turn, IJC could request that the environmental assessment procedures in a state or in a province shall include consideration of the implications for the whole Great Lakes system, as well as the local impacts." IJC support for the ecosystem approach will encourage the province to assume a planning co-ordination role. "The ecosystem approach on the local level will result in great benefits for the Great Lakes basin ecosystem as a whole."

**J.A. Curtin, Planning Consultant:**

Changes in the demand for electric power could have a very large effect on the projections for consumptive uses and on the economic figures of the Board. The Lake Ontario area has a particular claim for the Commission's concern because it is the end body of water in the Great Lakes chain and suffers cumulatively from diversions, and the effect is the same as far as toxics are concerned. "Make a major distinction (in your reports) between diversions within the watershed, from lake to lake within the watershed, as against diversions from the Great Lakes basin out of the basin."

**Sarah Miller, Stop Contaminating our Waterfront group:**

There are concerns about the water quality at the Toronto lakefront and these problems will be amplified if water levels are lowered. Toronto may be a microcosm for what might happen in at least every port in Lake Ontario should lake levels decrease signifi-

cantly. All harbours will have to have busy dredging programs to maintain navigation if lake levels are reduced and this will add to water pollution problems, not just in the harbours but in the entire lake. The Commission should pay considerable attention to the long-term effects of increased dredging.

**Henry Regier, University of Toronto:**

The perception of the Great Lakes as a vast storehouse of water is a misconception. "The important consideration is the flow, not the amount, and the flow is not that great." The Great Lakes should be thought of as an aquifer, not a river. There is a possibility that decreased flows in the St. Lawrence brought about by increased consumption could affect the fisheries in the Gulf of St. Lawrence, and someone should look at this.

**Judy Bush:**

Has the problem been studied of what might happen if the real source of wealth in North America – our water and our agricultural capabilities – is undermined? Growing of food requires water and our priorities should reflect this. Water should not be used to do jobs which the railroads can do, such as the transportation of coal.

CORNWALL, ONTARIO, June 16, 1983

**Billy Two Rivers, Mohawks of Kahnawake:**

The Mohawks of Kahnawake are encountering a problem with a project called Project Archipel, which is a hydro-electric and water management plan in the Montreal area. "We are in total opposition...because it would forever destroy the last natural rapids within the whole Great Lakes system."

North American society's need for water uses and electrical development "always seems to fall, the burden always seems to fall, on Indian people." Some control must be put on the governments of the United States, Canada and the province of Quebec. "We have no more to sacrifice."

**John Adams, St. Lawrence Seaway Development Corporation:**

The diversion of water needed to operate Seaway locks is very small and will remain so even in the distant future if forecast shipping increases are realized; it is never expected to rise above 1,000 cfs, even if the proposed additional locks are built. Lowered levels in Lake Ontario would mean significant losses to shipping, and the Seaway Corporation is very concerned about such a possibility.

**Edward R. Beane, 1000 Islands Association:**

The Association is concerned about the environmental evaluation of the Board's maximum effect scenario: There is reason to "question the use of the word 'limited' insofar as the environmental impact is concerned...a total overall drop (of water levels) would...create enormous impact environmentally on...wetlands."

A base change would also have disastrous effects insofar as resolving riparian law, which is already "an extremely grey area".

Increased consumptive use of lake water could adversely affect the water quality of the St. Lawrence River, which has been showing signs of improvement. The quality of the river has a very great effect on the quality of life for those in the area.

**Bernard Harvey, Government of Quebec:**

The forecast increase in consumptive use of Great Lakes water will have grave economic and environmental consequences for the province of Quebec. Hydro production and shipping will be hit very hard economically. Lowered water flows could impact adversely on Quebec's efforts to improve water quality in the St. Lawrence River. Quebec supports the idea of monitoring diversions and consumptive uses so that the effects can be assessed on a regular basis.

Quebec believes that any reduction of water supply to the Great Lakes due to consumption should be offset by a corresponding increase in diversion toward the lakes or else an increase in the retention capacity of the Great Lakes.

**Richard Spencer, Great Lakes United Save the River:**

Great Lakes United adopted a resolution at its annual meeting calling upon the governments of Canada and the United States to send a reference to the International Joint Commission requesting it to monitor consumptive uses of Great Lakes water and to study possible control measures for managing consumptive uses. Such a study should include a commitment to no future diversions out of the Great Lakes basin.

Under the *Boundary Waters Treaty*, the IJC does have the legal authority to regulate, to make plans that will alter consumptive uses as well as diversions. Alternatives such as water conservation should be given a chance before considering diversions to stop people in the West "dying of thirst".

**Statement Tabled by the Government of Canada**

The Government of Canada noted the Study Board's conclusion, that it is uneconomical to alter existing diversions to reduce extreme high lake levels and impractical to do so to raise extreme low levels. The Government also reiterated its view that increases in the diversion from Lake Michigan at Chicago should be considered only after consultations and agreement between Canada and the United States. The statement endorsed the Board's conclusion that periodically all diversions, regardless of size, should be monitored and their accumulated effects estimated, evaluated and reported upon so that appropriate public policies can be developed.

The statement also referred to the increasing concern in the basin over the potential for major new diversions and to three 1982 resolutions of the Great Lakes Governors and Premiers with which the Government of Canada is in general agreement.

The Government of Canada expressed considerable concern regarding possible economic losses to power and navigation interests and any adverse environment impacts that would result from the Board's projected increase in water consumption.



## Appendix F

### EXCHANGE OF NOTES AND MEMORANDA RELATING TO THE LONG LAC AND OGOKI DIVERSIONS, AND ARTICLE III OF THE NIAGARA TREATY OF 1950





# Exchange of Notes and Memoranda and Article III of the Niagara Treaty of 1950

## Exchange of Notes

On October 14, 1940 the United States Secretary of State sent the following Note to the Canadian Minister in Washington:

I have the honor to refer to the conversations which have taken place recently between officials of the Governments of the United States and Canada in regard to the desirability of taking immediate steps looking to the early development of certain portions of the Great Lakes-St. Lawrence Basin project. These conversations have indicated that there is apprehension in both countries over the possibility of a power shortage; these apprehensions have been heightened by the necessity for increased supplies of power in consequence of Canada's war effort and of the major national defense effort in the United States.

In the light of these considerations the Government of the United States proposes that each Government appoint forthwith a Temporary Great Lakes-St. Lawrence Basin Committee consisting of not more than five members. These two Committees would co-operate in preliminary engineering and other investigations for that part of the project which is located in the International Rapids Section of the St. Lawrence River, in order that the entire project may be undertaken without delay when final decision is reached by the two Governments. The Government of the United States is prepared to advance the necessary funds up to \$1,000,000 to pay for these preliminary engineering and other investigations, on the understanding that their cost shall ultimately be prorated by agreement between the two Governments.

Meanwhile, to assist in providing an adequate supply of power to meet Canadian defense needs and contingent upon the Province of Ontario's agreeing to provide immediately for diversions into the Great Lakes System of waters from the Albany River Basin which normally flow into Hudson Bay, the Government of the United States will interpose no objection, pending the conclusion of a final Great Lakes-St. Lawrence Basin agreement for power at Niagara Falls by the Province of Ontario of additional waters equivalent in quantity to the diversions into the Great Lakes Basin above referred to.

I shall be glad if you will let me know if your Government is in accord with the foregoing proposals.

On October 14, 1940 the Canadian Minister in Washington sent Note No. 316 to the United States Secretary of State:

I have the honour to refer to your note of October 14, in which you proposed that the Governments of Canada and the United States take immediate steps looking to the early development of certain portions of the Great Lakes-St. Lawrence Basin project.

I am instructed to inform you that the Canadian Government is in accord with the proposals which you have made.

On October 31, 1940 the Canadian Minister in Washington sent Note No. 340 to the United States Secretary of State:

I have the honour to refer to the third paragraph of your note of October 14, concerning the Great Lakes-St. Lawrence Basin project, in which you state that to assist in providing an adequate supply of power to meet Canadian defence needs and contingent upon the Province of Ontario's agreeing to provide immediately for diversions into the Great Lakes System of waters from the Albany River Basin which normally flow into Hudson Bay, the Government of the United States would interpose no objection, pending the conclusion of a final Great Lakes-St. Lawrence Basin Agreement between the two countries, to the immediate utilization for power at Niagara Falls by the Province of Ontario of additional waters equivalent in quantity to the diversions into the Great Lakes Basin above referred to.

I am instructed to inform you that the Canadian Government has received appropriate assurances that the Hydro-Electric Power Commission of Ontario is prepared to proceed immediately with the Long Lac-Ogoki diversions and that this action has been approved by the Government of the Province.

The Canadian Government is therefore giving appropriate instructions to authorize the additional diversion of 5,000 cubic feet per second at Niagara by the Hydro-Electric Power Commission of Ontario.

On November 7, 1940 the United States Secretary of State sent the following Note to the Canadian Minister in Washington:

I have the honor to acknowledge the receipt of your Note No. 340 of October 31, 1940, stating that the Hydro-Electric Power Commission of Ontario is prepared to proceed immediately with the Long Lac-Ogoki diversions of waters from the Albany River Basin into the Great Lakes System and that this action has been approved by the Government of the Province.

I note also that the Canadian Government is giving appropriate instructions to authorize the additional diversion of 5,000 cubic feet per second of water at Niagara Falls by the Hydro-Electric Power Commission of Ontario.

## Exchange of Memoranda

On October 20, 1941 the Canadian Legation at Washington sent the following Memorandum to the United States Department of State:

The Canadian Legation has been asked to discuss at the same time the use of water permitted under the Exchange of Notes of October 14th, 1940. It enabled water, equivalent to that which was being diverted into the Great Lakes System from the Albany River Basin, to be utilized by the Province of Ontario for power at Niagara Falls. It now appears to be essential, in order to carry out the broader program, to make this water available for utilization by the Province

of Ontario at Niagara or in the Welland Canal. It would be appreciated if the State Department would confirm this understanding.

On November 14, 1941 the United States Department of State sent the following Memorandum to the Canadian Legation at Washington:

Reference is made to a memorandum dated October 20th, 1941, from the Canadian Legation in which it was stated that it would be appreciated if the Department of State would confirm the understanding of the Canadian Government that water diverted under the exchange of Notes of October 14, 1940, might be made available for utilization by the Province of Ontario at Niagara or in the Welland Canal.

The Department of State is glad to confirm the Canadian Government's understanding as stated above. This Government's consent to utilization through the Welland Canal of additional water which the Province of Ontario is permitted to divert for power purposes under the exchange of Notes of October 14, 1940, should not be interpreted as constituting recognition of any rights of diversion around Niagara Falls for power purposes in excess of those established by the 1909

treaty as modified by subsequent exchanges of Notes between the two Governments.

## The Niagara Treaty of 1950

### Article III

The amount of water which shall be available for the purposes included in Articles IV and V of this Treaty shall be the total outflow from Lake Erie to the Welland Canal and the Niagara River (including the Black Rock Canal) less the amount of water used and necessary for domestic and sanitary purposes and for the service of canals for the purposes of navigation. Waters which are being diverted into the natural drainage of the Great Lakes System through the existing Long Lac-Ogoki works shall continue to be governed by the notes exchanged between the Government of the United States of America and the Government of Canada at Washington on October 14 and 31 and November 7, 1940, and shall not be included in the waters allocated under the provisions of this Treaty.

## Appendix G

### NEW DIVERSION PROPOSALS



## New Diversion Proposals

The following is a brief summary of proposals and studies that have recently received press and public attention.

● **The Great Recycling and Northern Development (GRAND) Canal Concept.** The GRAND Canal concept proposes the conversion of James Bay into a freshwater lake with the construction of a 160 kilometre (100-mile) dike separating it from the sea, and recycling the fresh water recovered from the tributary rivers into the Great Lakes. According to its advocate, T.W. Kierans, the total volume of associated runoff would be more than 11,300 cms (400,000 cfs). The transmission of water from the new freshwater lake to the Great Lakes storage area would possibly involve a number of James Bay rivers combined with the Ottawa, Mattawa and French River valleys. Stepped pumping and flow control structures would be required in the transmission system. The distribution system from the Great Lakes would include new two-way channel and pump transfer arrangements connecting the major rivers that drain the mid-continent and the Canadian prairies.

Reliable estimates of the economic costs and benefits of the GRAND canal concept are not available. Kierans has estimated that cost would be \$79 billion with a construction time of 8 years for the numerous elements of the project. While some assert that the project would have multiple economic and other benefits, others argue that the direct costs are astronomical and that the project is likely to have devastating and irreversible ecological effects, particularly for inhabitants of northern Canada.

● **The North American Water and Power Alliance (NAWAPA).** NAWAPA was first presented in 1963 by Ralph M. Parsons and Co., a firm of engineering consultants. The NAWAPA scheme would divert water southward from rivers in Alaska, Yukon and British Columbia by means of a massive reservoir canal river system. In 1963 NAWAPA's total cost was estimated at about \$100 billion, with construction taking about 20 years. The proponents suggested that 33 U.S. states, seven provinces and territories in Canada and three northern states in Mexico would benefit directly. The total list of benefits is extensive, as are the dimensions of the project. However, since the project was first conceived no additional work has been done to address the technical feasibility, the enormous economic costs and suggested benefits, the institutional obstacles, and the social and ecological effects. NAWAPA was an in-house design exercise by the Parsons firm and has never been and is not now being considered by either federal government or other possible proponents.

● **The Ogallala Aquifer Study.** This study was undertaken primarily because of concern over the continuing depletion of the groundwater resources in the High Plains of the central United States and the resultant effect on the regional economy. This study area comprises over 570,000 square kilometres (220,000 square miles) overlying the Ogallala and associated aquifers. It extends from west Texas and eastern New Mexico northward through western Oklahoma, western Kansas, and eastern Colorado through central and western Nebraska. Over 90 per cent of the regional water supply is obtained from the Ogallala and associated aquifers. Since recharge is small in the southern part of the aquifer, current uses have severely reduced the amount of water remaining in storage.

A number of alternatives for augmenting or extending the availability of water for irrigation were studied, ranging from voluntary

conservation to interstate and inter-basin transfers. With respect to these transfers, the U.S. legislation authorizing the study limited the investigation to sources in "adjacent areas", which meant sources on the Missouri River and streams in Arkansas.

The study found that the duration of availability of water from the Ogallala aquifer can be extended through a variety of conservation measures. However, without massive inter-basin transfers, groundwater levels will continue to decline, with ultimate exhaustion in some areas of the region. Major shifts in irrigated cropping patterns, both in type and distribution, will occur. It appears that adjustments to dryland farming are already being made and that further adjustments will be made when required.

The principal findings regarding the potential for water transfers to the High Plains from the adjacent states shows that very large amounts of energy for pumping costs would far exceed the users' repayment capability, certainly for agricultural uses. Consequently, massive subsidies would be required; moreover, there appears to be significant political resistance to any diversions from the adjacent areas. The findings of the study have sparked considerable concern among Great Lakes jurisdictions which fear mounting pressure for the large-scale diversions that the study found were the only way to avert exhaustion of the groundwater resource in certain areas.

The study will be completed when the U.S. Secretary of Commerce transmits his report to the Congress, as required by the legislation.

● **A Preliminary Study of Three Great Lakes Diversions.** A study recently completed by Professor J.W. Bulkley at the University of Michigan looks at the preliminary costs and energy requirements associated with a large-scale [280 cms (10,000 cfs)] diversion from Lake Superior into the Missouri River basin to make up for water diverted to the Ogallala region. This study was undertaken for the sole purpose of discovering whether such a diversion was reasonably feasible from an economic point of view and was not intended as a diversion proposal.

The capital cost of this Lake Superior diversion conveyance has been estimated at about \$20 billion, with a total length of 984 kilometres (611 miles) and a total static lift of 1130 metres (3,700 feet). It is also estimated that 18 pumping plants would be required to lift the water from Lake Superior and transport it to the Missouri basin. In addition, the equivalent of seven 1,000-megawatt power plants would be required to provide the energy needed to pump the water. These seven power plants are estimated to have an initial cost of \$1 billion each. Thus the conveyance system itself, plus the initial cost of the power plants, totals more than \$27 billion. The average cost at the Missouri River would be more than \$285 per cubic decametre (\$350 per acre-foot) of water. This contrasts with a typical range of costs of \$15-\$50 per cubic decametre (\$20-\$60 per acre foot) for other irrigation water. All operating and maintenance costs, which are expected to be significant, would be additional.

Bulkley and others have also examined, in similar fashion and for the same purpose, the possibility of increasing the Chicago diversion and building a new diversion from Lake Erie to the Ohio River. For the diversion out of Lake Erie, cost comparisons with the Lake Superior diversion indicate a total construction cost of \$3.2 billion, with an average cost of \$35 per cubic decametre (\$45 per acre-foot). As above, operation and maintenance costs are not included. No cost figures have been prepared for additional diver-

sion at Chicago since facilities are partially in place. It is assumed that costs would be somewhat less than the other two schemes.

●**Powder River Coal Slurry Pipeline Project.** The Powder River Coal Slurry Pipeline Project is a proposal that has received considerable attention recently. This is a plan for a coal slurry pipeline from the Powder River Basin in Montana and Wyoming to serve markets across the midwest and in the Great Lakes basin. The proposed system would transport up to 33 million metric tons (36 million tons) of coal per year, primarily to electric utilities and large industrial users and, depending on the selected route, would be about 2,100 kilometres (1,300 miles) long. The proponents believe there is a need for such a coal slurry pipeline due to the expanding use of coal in the United States, the rising cost of rail transportation, and anticipated environmental advantages over rail transport.

Slurry technology is not new, having been used in many parts of the world to transport various commodities. Coal suspended in water was the first slurry system, constructed in England in 1914. Water is a popular slurry medium and would be used in this project, but the amount required is relatively small – a fact not generally recognized. For example, comments at the Commission's public meetings in June 1983 hypothesized the need for large diversions of water from the Great Lakes to maintain the slurry. However, the project would require only an estimated 31,000 cubic decametres (25,000 acre-feet) per year, or about 1 cms (35 cfs). The source of surface water is a key element of the project, and although originally thought to require diversion of Great Lakes water, the project as now conceived will discharge water into the Great Lakes, and water quality effects may be of more concern.

**Table 10**  
**SUGGESTED DIVERSIONS THAT HAVE INTERNATIONAL IMPLICATIONS**

Proposal (Author)	Year Identified	Water Source	Volume of Diversion in Millions of acre-ft.	Estimated Cost in Billions of \$
Grand Canal Plan (Kierans)	1959	James Bay dyked rivers "recycled" to Great Lakes	?	79
Great Lakes-Pacific Waterways Plan (Decker)	1963	Skeena, Nechako & Fraser of B.C., Peace, Athabaska, Saskatchewan of Prairie Provinces	115.0	?
North America Water & Power Alliance (NAWAPA)	1964	Primarily the Pacific & Arctic drainage of Alaska, Yukon & B.C.; also tributaries of James Bay	110.0	100
Magnum Plan (Magnusson)	1965	Peace, Athabaska & North Saskatchewan in Alberta	Initially 25.0 at border	?
Kuiper Plan (Kuiper)	1967	Peace, Athabaska & North Saskatchewan in Alberta	150.0	50
Central North America Water Project (CeNAWP) (Tinney)	1967	Mackenzie, Peace, Athabaska, N. Saskatchewan, Nelson & Churchill	150.0	30-50
Western States Water Augmentation Concept (Smith)	1963	Primarily Liard & Mackenzie drainages	38.0 at border	75
NAWAPA + MUSHEC or Mexican-States Hydroelectric Commission	1968	NAWAPA Sources + Lower Mississippi & Sierra Madre, Oriental rivers of southern Mexico	158 + 129 NAWAPA MUSHEC	?

Source: Biswas, Asit K. "North American Water Transfers: An Overview", *Water Supply and Management*, 1978, Vol. 2.



