

## SECTION 1

### INTRODUCTION

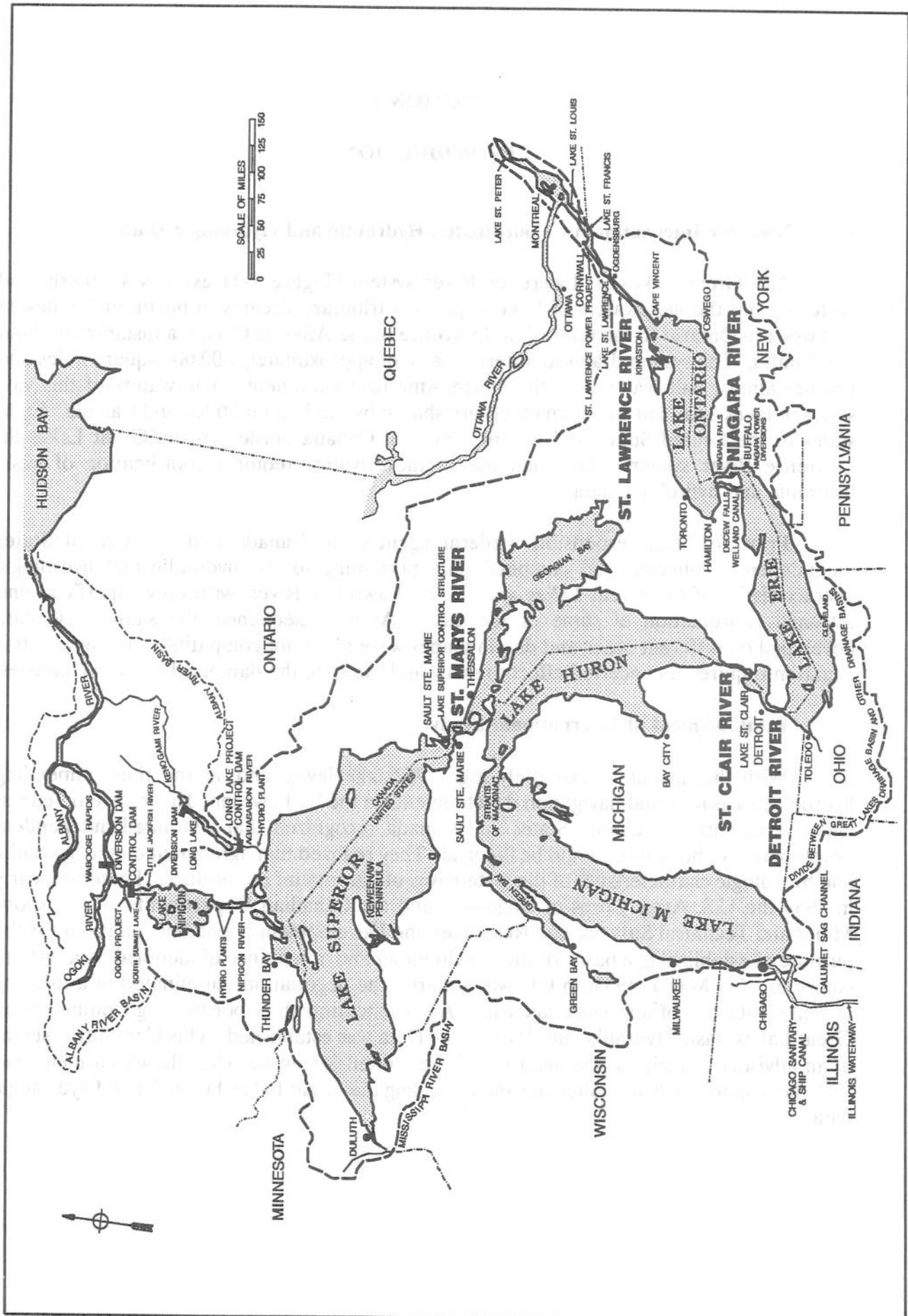
#### 1.1 Need for Internationally Coordinated Hydraulic and Hydrologic Data.

The Great Lakes-St. Lawrence River system (Figure 1-1) extends southerly and easterly from the headwaters of Lake Superior's tributary streams in northern Minnesota and western Ontario to the Gulf of St. Lawrence in the Atlantic Ocean, a distance of about 2,300 miles. The system drains an interior basin of approximately 300,000 square miles and reaches almost half way across the North American Continent. The waters of this vast series of lakes and their outlet channels are shared by the United States and Canada. Eight states of the United States and two provinces of Canada border on the Great Lakes-St. Lawrence River system. The joint use of these waters requires coordination of basic hydraulic and hydrologic data.

Prior to 1953, responsible Federal agencies in Canada and the United States independently collected and compiled data pertaining to the hydraulic and hydrologic characteristics of the Great Lakes and the St. Lawrence River, with only superficial and informal coordination of some of the data. As a consequence, the same basic data developed on different bases and datum planes were often not compatible. To remedy this situation required a concerted effort to study and evaluate the data used by both countries.

#### 1.2 Establishment of International Study.

With the advent of extremely high 1952 lake levels and, at the time, impending hydroelectric power and navigation developments in the St. Lawrence River system, federal agencies in both the United States and Canada recognized that continued independent development of basic data would be illogical. They realized that agreement on the hydraulic and hydrologic characteristics of the system was of paramount importance. Therefore, early in 1953 the U.S. Army Corps of Engineers and the Canadian Departments of Transport, Mines and Technical Surveys, and Resources and Development opened negotiations for the purpose of establishing a basis for the development and acceptance of identical data by both countries. On May 7, 1953, in Ottawa, Ontario, the negotiations culminated in a meeting of representatives of interested agencies. At this meeting, the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data was established. This Committee serves in an advisory capacity to the agencies of the United States and Canada who are charged with the responsibility for collecting and compiling the Great Lakes hydraulic and hydrologic data.



Great Lakes - St. Lawrence River System

The Committee was originally constituted as follows:

United States

G.A. Hathaway, Chairman  
Corps of Engineers  
Department of the Army

W.T. Laidly, Member  
Corps of Engineers  
Department of the Army

E.W. Nelson, Secretary  
Corps of Engineers  
Department of the Army

Canada

T.M. Patterson, Chairman  
Water Resources Branch  
Dept. of Resources and Development

D.M. Ripley, Member  
Special Projects Branch  
Department of Transport

J.E.R. Ross, Secretary  
Geodetic Survey of Canada  
Department of Mines and  
Technical Surveys

In the 41 years since the Coordinating Committee was formed, other Federal Agencies have become part of the Committee or its Subcommittees. In the United States, these are primarily the National Oceanic and Atmospheric Administration and the U.S. Geological Survey. In Canada, the Department of Fisheries and Oceans, Natural Resources Canada, Atmospheric Environment Service and Environment Canada. The present 1994 membership of the Committee is as follows:

United States

John W. Kangas, Chairman  
Department of the Army  
North Central Division  
Corps of Engineers

Philip C. Morris  
NOAA/National Ocean Service  
Measurement Branch

Ronald E. Wilshaw, Secretary  
Department of the Army  
Detroit District  
Corps of Engineers

Canada

Peter P. Yee, Chairman  
Great Lakes-St. Lawrence Regulation  
Office  
Environment Canada - Ontario  
Region

Peter D. Richards  
Canadian Hydrographic Service  
Department of Fisheries and Oceans

Charles F. Southam, Secretary  
Environmental Services Branch  
Environment Canada - Ontario  
Region

L.D. Kirshner, F.A. Blust, H.F. Lawhead, F.F. Snyder, C.I. Thurlow, B.G. DeCooke, H. G. Dewey and D.J. Leonard have also served as United States members of the Committee; and C.M. Cross, A.T. Prince, J.B. Bryce, R.H. Clark, J.F. Forrester, C.G. Cline,

D.F. Witherspoon, C.A. Gale, M.H. Quast, H.B. Rosenburg, R.H. Smith, F.I. Morton, E.T. Wagner, J.R. Robinson and G.M. Yeaton have served as Canadian members.

Initially, four working groups were formed to assist the Coordinating Committee in its work. These were designated as, 1) the River Flow Subcommittee, 2) the Vertical Control Subcommittee, 3) the Lake Levels Subcommittee and 4) the Physical Data Subcommittee. These subcommittees were directed to conduct required technical studies through collaboration with the appropriate agencies of Canada and the United States. In September 1969, the Vertical Control and the Lake Levels Subcommittees were combined into the Vertical Control-Water Levels Subcommittee. In November 1988, a new working group was formed, the Hydrometeorologic Modeling Subcommittee.

This report was written and compiled under the direction of the River Flow Subcommittee, whose membership in 1979, the year of authorization of the report, was:

United States

R.E. Wilshaw  
Department of the Army  
Detroit District  
Corps of Engineers

F.H. Quinn  
Department of Commerce  
National Oceanic and  
Atmospheric Administration  
Great Lakes Environmental  
Research Laboratory

Canada

J.R. Robinson  
Environment Canada  
Inland Waters Directorate  
Ontario Region  
Cornwall

M.H. Quast  
Environment Canada  
Inland Waters Directorate  
Ontario Region

Present (1994) membership of the Subcommittee is as follows:

United States

Ronald E. Wilshaw  
Department of the Army  
Detroit District  
Corps of Engineers

Canada

David M. Fay  
Great Lakes-St. Lawrence Regulation  
Office  
Environment Canada - Ontario  
Region

Frank H. Quinn  
Department of Commerce  
National Oceanic and  
Atmospheric Administration  
Great Lakes Environmental  
Research Laboratory

Robert Myslik  
Monitoring and Systems Branch  
Environment Canada - Ontario  
Region

Former members of the Subcommittee include B.G. DeCooke, P. Tomandl, F.W. Townsend, I.M. Korkigian and P.L. Cox, all of the Department of the Army, Detroit District Corps of Engineers, from the United States; and C.G. Cline, J.B. Bryce, B.E. Russell, E.A. MacDonald, E.T. Wagner, L.J. Kamp and S. Dumont of Environment Canada, Water Resources Branch, Ontario Region, from Canada.

### **1.3 Authority.**

An important part of the Great Lakes system's data collection program is the measurement of the discharge in the system's connecting channels - the St. Marys, St. Clair, Detroit and Niagara Rivers - and in the International Section of the St. Lawrence River. At a meeting of the Coordinating Committee, on June 23, 1976, the River Flow Subcommittee was requested to prepare a document outlining the procedures employed for measuring the flows in the Great Lakes connecting channels and the International Section of the St. Lawrence River. The scope of this assignment was to also include a listing of all sites at which discharge measurements had been made in the past. In September 1979, the Coordinating Committee authorized the preparation of two reports: "Procedures for Discharge Measurements in the Great Lakes Connecting Channels and St. Lawrence River" and "Hydraulic Discharge Measurements and Regimen Changes on the Great Lakes Connecting Channels and St. Lawrence River." The first was published in October 1991, entitled "Discharge Measurement Procedures on the Great Lakes Connecting Channels and the International Section of the St. Lawrence River." The second is being addressed through the preparation of this report.

The first recorded discharge measurements in the connecting channels were made in 1841 on the Niagara River. Since that time, thousands of measurements have been taken in these channels by public and private organizations in both the United States and Canada. However, only those measurements taken by federal agencies in the exercise of their mandates to advance the public interest are within the scope of this report.

### **1.4 Purpose and Scope.**

The purpose of this report is to document the regimen changes and the hydraulic history of discharge measurements that have been made in the Great Lakes connecting channels and the International Section of the St. Lawrence River. Included is a general description of each river, a description and summary of every identifiable survey of discharge measurements, the present data reduction program and a history of channel changes,

particularly those affecting the discharge capabilities of the rivers.

Information related to the various series of discharge measurements include the purpose for the measurements, a description of the measurement sections, the measurement techniques used and the discharge computation method. Appendix A includes a description of the Automated Discharge Computation Program currently used by the River Flows Subcommittee. Both regimen changes (Appendix B) and tables summarizing the various measured discharge series (Appendix C) are provided under separate cover. The measurements are more fully documented in project report files, stored as indicated in the report's text. The federal agencies presently responsible for the system's discharge measurements are the U.S. Army Corps of Engineers, Detroit District (measurements were previously conducted by the U.S. Lake Survey District, Corps of Engineers) and the Monitoring and Systems Branch, Environment Canada - Ontario Region (previously known as the Water Survey of Canada, Ontario Region, Environment Canada). The Lake Survey District was redesignated the Lake Survey Center, on October 3, 1970, and was officially transferred to the National Oceanic and Atmospheric Administration. Under the reorganization certain Lake Survey elements stayed with the Corps of Engineers; including the measuring and computing of river flows.

The water levels presented herein are referenced to a number of different vertical datum planes, as they relate to the year in which the discharge measurements were made. The levels are provided as reported in the referenced documents or files noted in this report. No attempt was made to adjust the levels to a consistent datum. When this discharge measurements documentation project was initiated in 1979, IGLD 1955 was the official vertical datum for the Great Lakes. Prior to report completion, a new official datum was established, the International Great Lakes Datum 1985 (IGLD 1985). Table 1.1 on the following pages provides the elevations of controlling bench marks for various existing water level gauges as established on various datums. This information can be used to adjust water levels to alternate datums. It is emphasized that the difference between datums is very site specific. It can and does vary significantly between sites on the same lake or river. See the Synopsis in Appendix C for a brief description of vertical datum planes. Additional information on vertical datums and conversion between datums can be obtained from the U.S. National Ocean Service of the National Oceanic and Atmospheric Administration and from the Canadian Marine Environmental Data Service, Department of Fisheries and Oceans.

## **1.5 Acknowledgements.**

The Coordinating Committee acknowledges and expresses its appreciation for the cooperation and assistance received from the U.S. Army Corps of Engineers, Detroit District; the Monitoring and Systems Branch, Environment Canada - Ontario Region; and the U.S. National Ocean Service and the Great Lakes Environmental Research Laboratory, both of the National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

TABLE 1.1

Water Level Gauges  
Controlling Bench Mark Elevations\*  
(in feet)

WATER LEVEL GAUGE	CONTROLLING BENCH MARK	U.S. LAKE SURVEY 1903 DATUM	U.S. LAKE SURVEY 1935 DATUM	IGLD 1955 DATUM	IGLD 1985 DATUM
Marquette	No. 6	628.414	628.253	626.554	
	No. 11			618.805	619.938
SW Pier	Meridian	607.834	608.010	606.431	
	Q			605.629	606.529
U.S. Slip	B	588.629	588.854		
	Brady			585.156	586.050
Harbor Beach	E	583.207			
	Boulder		582.296	580.569	
	Huron			581.901	582.602
Fort Gratiot	Fort Gratiot Lighthouse	590.342	590.364 590.329 (1949 Adj.)	588.684	
	Retaining Wall			588.490	589.085
Dunn Paper	Gorge		585.268 (1949 Adj.)		
	Mallard			587.238	
	3060			587.062	587.667
Mouth Black River	I	585.361			
	Gulf		586.742 (1949 Adj.)	585.070	
	4090-D				583.346
Dry Dock	17	596.726	596.726 596.691 (1949 Adj.)		
	Grate Bar		597.242 597.207 (1949 Adj.)		
	Grate Bar A			595.118	
	School			606.502	607.123
Marysville	Creek		586.320 586.228 (1949 Adj.)	584.495	
	Mary				585.364

TABLE 1.1 (cont'd)

Water Level Gauges  
Controlling Bench Mark Elevations  
(in feet)

WATER LEVEL GAUGE	CONTROLLING BENCH MARK	U.S. LAKE SURVEY 1903 DATUM	U.S. LAKE SURVEY 1935 DATUM	IGLD 1955 DATUM	IGLD 1985 DATUM
St. Clair SP	M	588.758			
	Gage-M		588.788 588.746 (1949 Adj.)	587.040	
	C-32-A			601.714	602.297
Algonac	28	585.149	585.198 585.134 (1949 Adj.)		
	Zieske			581.216	
	Treat				580.275
St. Clair Shores	SC-30			584.363	
	Food				580.610
Windmill Point	W	582.760	582.734		
	D-1			582.889	
	D-2			582.652	583.268
Fort Wayne	8	601.508			
	Corner		581.207		
	Fort			586.636	587.264
Wyandotte	4	585.737			
	HLM 90		578.089	576.182	
	Meyers			575.609	
	Chief				577.818
Gibraltar	Gibraltar	582.528	582.566	580.718	
	D 54			582.793	583.468
Cleveland	2	577.737			
	Doorstep		582.435	580.494	
	Steps				586.565
Fairport	Lighthouse		614.819	612.781	
	Flag			576.585	577.159

TABLE 1.1 (cont'd)

Water Level Gauges  
Controlling Bench Mark Elevations  
(in feet)

WATER LEVEL GAUGE	CONTROLLING BENCH MARK	U.S. LAKE SURVEY 1903 DATUM	U.S. LAKE SURVEY 1935 DATUM	IGLD 1955 DATUM	IGLD 1985 DATUM
Niagara Intake	WL 139			572.306	
	Intake				568.832
American Falls	Park		556.541	554.828	
	Frontier				563.829
Ashland Avenue	N-32 A		371.171	369.474	
	Pool			365.053	365.577
Oswego	A	251.898	251.898	250.671	
	Lake				254.222
Alexandria Bay CG	B	284.243	284.474	283.421	
	Land				282.713
Ogdensburg	D	251.022	251.310	250.363	
	A			277.234	277.605

\*Bench Mark elevations contained in the table were obtained from the following three publications of the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data:

- 1) Establishment of International Great Lakes Datum (1955), Second Edition, December 1979.
- 2) History of Water Level Gauges, Lower Great Lakes and International Section of the St. Lawrence River, March 1987.
- 3) History of Water Level Gauges, Upper Great Lakes and the St. Clair - Detroit Rivers, January 1978.

