
Hydraulic Discharge Measurements and Regimen Changes on the Great Lakes Connecting Channels and The International Section of the St. Lawrence River

1841-1993

Appendix C

Table Summaries of Discharge Measurements



March 1994
Coordinating Committee on
Great Lakes Basic Hydraulic
and Hydrologic Data

**HYDRAULIC DISCHARGE MEASUREMENTS
AND REGIMEN CHANGES
ON THE
GREAT LAKES CONNECTING CHANNELS AND THE
INTERNATIONAL SECTION OF THE
ST. LAWRENCE RIVER**

APPENDIX C

**TABLE SUMMARIES OF
DISCHARGE MEASUREMENTS**

1841 - 1993

March 1994

Coordinating Committee on Great Lakes Basic
Hydraulic and Hydrologic Data

SYNOPSIS

An important part of the Great Lakes system's data collection program is the measurement of the discharge (flow) 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. As such, at a meeting of the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data, on June 23, 1976, the Committee's River Flow Subcommittee was requested to prepare two documents, the first outlining the procedures employed for measuring the flows in the Great Lakes connecting channels and the International Section of the St. Lawrence River, and the second to document the history of all flow measurements and regimen changes in the same water bodies. The first report was published in October 1991, and was entitled "Discharge Measurement Procedures on the Great Lakes Connecting Channels and the International Section of the St. Lawrence River". The document herein is intended to satisfy the second part of the committee's request. It provides a comprehensive list of all recorded measurements taken in the Great Lakes connecting channels and International Section of the St. Lawrence River, beginning in the 1800s and continuing through 1993. It not only includes a description of the measuring sections but also provides results of the measurements, including recorded water levels and computed flows.

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.

This Appendix contains supporting tables to the main report. The tables summarize the various discharge measurement series. They have been identified so that the first digit of each table designation reflects the same section number in the main report. This also holds true for page numbering. The "C" before the page number reflects Appendix C.

The water levels associated with the flow measurements presented herein are referenced to a number of different vertical datum planes. These datum planes have three main purposes. First, they provide a reference for depiction of depths on navigation charts. Second, they provide a reference for determining depths to which improved navigation channels are dredged, and lastly, they act as a reference for all hydrologic data collected on the Great Lakes. The earliest lake hydrographers often recorded water depths only in terms of water levels at the times of their surveys, and it took more than 50 years to develop the modern concept of datum planes. Planes of reference prior to 1876 were most often related to the high levels recorded in 1838. Beginning in 1876 and until 1901, the datum planes used on the Great Lakes were the mean lake levels between 1860 and 1875. The U.S. Coast and Geodetic Survey made an adjustment in the levels of 1877 which changed the values of sea level elevations established on the Great Lakes and became known as the 1903 Datum. Corresponding changes were also made to the 1901 Datum Plane by the Corps of

Engineers to formulate the planes of 1909. The Corps Office of the Chief of Engineers in 1933, approved a single datum plane for each lake. Each of these planes became known as Low Water Datum on its lake and represented what might be described as the lake's average low water level. At the time of the establishment of the 1933 planes, it was recognized that progressive differences between water levels at different location on the same lake were occurring. The phenomenon became known as "crustal movement", or "differential gauge site movement". The changes were sufficient to require bench mark elevations to be adjusted to provide at a given time the same water surface elevation at all points on a lake. The adjustment is known as the 1935 Datum. Between 1934 and 1941, new level lines were run between the lakes and a new connection was made to Mean Tide at New York. Previous references to Mean Tide at New York were developed by the U.S. Coast and Geodetic Survey from mean levels of 1860-1875 and Standard Low Water for 1901 and 1909. This involved a spirit level transfer of sea levels from New York City to Greenbush, New York, on the Hudson River, and a further spirit level and water transfer into the Great Lakes by the U.S. Lake Survey, Corps of Engineers. In the early 1950s a joint effort by the Lake Survey, the Canadian Hydrographic Service and the Geodetic Survey of Canada was undertaken to again adjust bench mark elevations for differential gauge site movement. This resulted in the creation of the International Great Lakes Datum 1955 (IGLD 1955), with a sea level reference at Pointe-au-Père, Québec, on the Gulf of St. Lawrence. This effort took place under the auspices of the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data, which was formed in 1953. The committee undertook a subsequent datum revision in the 1970s and 1980s, to be known as IGLD 1985, which was introduced in January 1992 (new reference, Rimouski, Québec, on the Gulf of St. Lawrence). Brief descriptions of the datums can be found in "History and Theory of Datum Planes of the Great Lakes" by Frank A. Blust, 1972; the Coordinating Committee's report "Establishment of International Great Lakes Datum (1955)", "December 1979; and the Committee's January 1992 brochure titled "IGLD 1985".

Table 1 shows a comparison of the early planes on the Great Lakes referenced to Mean Tide at New York, 1903 Datum. The differences between values represent differences between the physical positions of the planes and do not represent low water datum.

Table 2 shows the Low Water Datum (LWD) elevations representative of each of the Great Lakes for IGLD 1955 and IGLD 1985.

Table 3 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. 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.

TABLE 1

Comparison of Datum Planes
Elevations in feet above Mean Tide at New York,
1903 Datum

Lake	Mean Lake Levels 1860-1875	Planes of 1901	Planes of 1909		Planes of 1933	Planes of 1955	
			Nominal Values	Adopted Values		Nominal Values	Adopted Values
Superior	603.22	600.56	600.56	600.50	601.6	601.63	601.60
Michigan-Huron	581.64	578.51	578.51	578.50	578.5	578.54	578.50
Erie	572.77	569.91	569.91	570.00	570.5	570.55	570.50
Ontario	246.55	242.96	242.96	243.00	244.0	244.03	244.00

TABLE 2

Comparison of LWD Elevations and Master Gauge Locations
for each of the
Great Lakes under IGLD 1955 and IGLD 1985
(in feet)

Lake	IGLD 1955	Master Gauge	IGLD 1985	Master Gauge
Superior	600.0	Point Iroquois	601.1	Point Iroquois
Michigan-Huron	576.8	Harbor Beach	577.5	Harbor Beach
St. Clair	571.7	Grosse Pte Yacht Club	572.3	St. Clair Shores
Erie	568.6	Cleveland	569.2	Fairport
Ontario	242.8	Oswego	243.3	Oswego

TABLE 3

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 3 (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 3 (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.

**HYDRAULIC DISCHARGE MEASUREMENTS AND REGIMEN CHANGES ON THE
GREAT LAKES CONNECTING CHANNELS AND THE INTERNATIONAL SECTION
OF THE ST. LAWRENCE RIVER**

APPENDIX C

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