C O O R D I N A T E D G R E A T L A K E S

P H Y S I C A L D A T A

MAY 1977

Coordinating Committee on Great Lakes
Basic Hydraulic and Hydrologic Data

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COORDINATED GREAT LAKES PHYSICAL DATA

INTRODUCTION

1. Requirement for Internationally Coordinated Hydraulic and Hydrologic Data

The Great Lakes-St. Lawrence River system (Figure 1) extends easterly from the headwaters of tributary streams in northern Minnesota and western Ontario some 2,000 miles to the Gulf of St. Lawrence in the Atlantic Ocean. The system drains an interior basin of more than 295,000 square miles to the outlet of Lake Ontario, reaches almost half way across the North American continent, and borders upon eight states in the United States and two provinces in Canada. This vast series of lakes and rivers is shared by the United States and Canada. The joint use of these waters poses numerous international problems in the solution of which the two countries need coordinated basic data.

2. Prior to 1953, data pertaining to the hydraulic and hydrologic factors of the Great Lakes and St. Lawrence River were collected and compiled independently by the responsible federal agencies in Canada and the United States, with only superficial and informal correlation of some of the data. As a consequence, the data, in many instances, were developed on different bases and datums and were divergent in many respects. This situation resulted in a large volume of study and evaluation by each country of the data used by the other before international problems could be solved.

3. Establishment of International Study. The quantity and scope of the international problems were greatly increased by the advent of high lake levels in 1952 and by the imminent power and navigation development in the St. Lawrence River. Recognizing that continued independent development of the basic data was illogical under the circumstances and that early agreement upon the hydraulic and hydrologic factors was of paramount importance, the U. S. Army Corps of Engineers and the

Departments of Transport, Mines and Technical Surveys, and Resources and Development, Canada, opened negotiations early in 1953 for the purpose of establishing a basis for development and acceptance by both countries of identical data. The negotiations culminated in a meeting of representatives of the interested agencies in Ottawa, Ontario on 7 May 1953.

4. At the meeting, the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data was formed to study the problem and to establish a basis of procedure. This Committee was established advisory to the agencies of the United States and Canada which were charged with the responsibility for collecting and compiling the Great Lakes hydraulic and hydrologic data. The Committee was constituted as follows:

CANADA	UNITED STATES
T. M. Patterson, Water Resources Division, Department of Resources and Development, Chairman	G. A. Hathaway, Corps of Engineers, U.S. Department of the Army, Chairman
J. E. R. Ross, Geodetic Survey of Canada, Department of Mines and Technical Surveys	E. W. Nelson, Corps of Engineers, U.S. Department of the Army
D. M. Ripley, Special Projects Branch, Department of Transport	W. T. Laidly, Corps of Engineers, U.S. Department of the Army

The present membership of the Coordinating Committee is as follows:

CANADA	UNITED STATES
D. F. Witherspoon, Environmental Management Service, Ontario Region, Fisheries and Environment Canada, Chairman	D. J. Leonard, Corps of Engineers, U.S. Department of the Army, Chairman
W. D. Forrester, Ocean and Aquatic Sciences Fisheries and Environment Canada	C. I. Thurlow, National Oceanic and Atmospheric Administration, Department of Commerce
P. P. Yee, Environmental Management Service Ontario Region, Fisheries and Environment Canada, Secretary	B. G. DeCooke, Corps of Engineers, U.S. Department of the Army, Secretary

Messrs. C. M. Cross, A. T. Prince and R. H. Smith have also served as Canadian members of the Committee while Messrs. L. D. Kirshner, F. F. Snyder, H. F. Lawhead and F. A. Blust have served as United States members of the Committee.

5. Four working groups, designated the River Flow Subcommittee, the Vertical Control Subcommittee, the Lake Levels Subcommittee and the Physical Data Subcommittee, were formed to assist the Coordinating Committee in its work. These subcommittees were directed to conduct the required technical studies through collaboration of the appropriate agencies of Canada and the United States. The Physical Data Subcommittee which conducted the work reported herein was normally composed of one member from Canada and one from the United States. The following served at various times during the progress of the work.

CANADA	UNITED STATES
H. B. Rosenberg	F. W. Townsend
W. D. Forrester	L. T. Schutze
R. L. Pentland	
J. R. Robinson	

6. Authority. The Committee instructed its Physical Data Subcommittee to investigate source material and methods used to obtain physical data of the Great Lakes in use in Canada and the United States and to determine coordinated values for official use by the two governments.

7. Purpose and Scope. The purpose of this report is to publish the coordinated physical data of the Great Lakes compiled for the Committee and to describe the source materials and methods used to measure the data. The physical dimensions to be coordinated included water and land areas, water volumes, shoreline lengths and general sizes of the lakes.

8. Acknowledgements. The Coordinating Committee acknowledges and expresses its appreciation of the cooperation, assistance and advice received from the Canadian Hydrographic Service and the Water Resources Branch, Canada Department of Northern Affairs and National Resources; the Environmental Management Service, Fisheries and Environment Canada; the Corps of Engineers, U. S. Department of the Army; the National Oceanic and Atmospheric Administration, U. S. Department of Commerce; and the Geological Survey, U. S. Department of the Interior.

METHODS AND RESULTS

9. Water Areas. Water areas, excluding islands larger than 0.02 square mile (13 acres), of the Great Lakes and the St. Lawrence River above the power dam at Cornwall, Ontario were measured by planimeter using the latest edition of federal government navigation charts and topographic maps at scales ranging from 1:30,000 (navigation charts in St. Lawrence River) to 1:600,000 (Lake Superior navigation chart). The water areas in Canada and the United States for each lake and outflow river were measured independently by the United States and Canadian members of the Physical Data Subcommittee. Canada measured the area of water in each quadrilateral of 5 minutes extent or more containing land area or international boundary and added to areas of open water quadrilaterals as given in Smithsonian Geographic Tables, Third Edition, Second Reprint 1929. The United States members measured the water areas shown on the U. S. general navigation charts of each lake and the navigation charts of the outflow rivers.

10. The water areas in Canada and the United States measured by each member were reviewed by the other member and a value, to the nearest square mile for areas less than 1,000 square miles and to 3 significant digits for larger areas, was determined for each body of water. The coordinated water area components are shown on Table 1, page 7. Metric equivalents of the water area components are shown on Table 1 (a), page 8.

11. Land Areas. The boundary (divide) of the drainage area for each lake and outflow river was delineated on the latest federal government topographic maps at scales ranging from 1:50,000 to 1:500,000. The divide lines within each country were determined independently, reviewed by the other subcommittee member and adopted. The drainage boundaries thus determined are shown on Figures 2 through 6. These boundaries are also indicated on the Map Index Sheets, Figures 1A through 10A of Appendix A.

12. The Canadian member determined the land areas within the basin boundaries by measuring the areas directly from the available topographic maps. The United States member of the Subcommittee transferred the adopted drainage boundaries to a map of scale 1:500,000 and then measured the total area between the basin boundary and the International Boundary. The land areas were then determined by subtracting the water area of the Great Lakes from the total (land + water) area. In both cases, islands greater than 0.02 square mile were included in the land area. The coordinated land area components are also shown on Table 1, page 7. Metric equivalents of the land area components are shown on Table 1 (a), page 8.

13. Volumes. The most recent federal government navigation charts and field survey sheets were used as source material for determining lake volumes. Subaqueous contours were drawn at 10 fathom intervals from soundings shown on each chart and the area between contour lines was measured by planimeter. The incremental volume was determined by multiplying the average area contained within consecutive contours by the contour interval. The total lake volume was then obtained by adding the incremental volumes. All volumes were independently determined by each member and results coordinated. The water volume, at chart datum, for each of the lakes is shown on Table 2, page 9. Included on Figures 7 through 11, for general information purposes, are depth-volume curves for each of the lakes.

14. Shoreline Lengths. Source material consisted of both topographic maps and navigation charts. The scale for topographic maps was mainly 1:50,000 with a few at 1:250,000 and 1:500,000, and for navigation charts it varied mainly from 1:30,000 to 1:120,000.

15. The mainland shoreline lengths of the lakes and outflow rivers were independently measured by each member. In addition the shoreline lengths of all islands with perimeters of at least one mile were also measured. The coordinated mainland and islands shoreline lengths in Canada and the United States are shown on Table 3,

page 10. Metric equivalents of the shoreline lengths are shown on Table 3 (a), page 11. It should be noted that these shoreline lengths are intended for general use only. No attempt was made to include small bays and inlets, thus the accuracy obtained is reflected in the scale of the charts used.

16. General Great Lakes Dimensions. The maximum length and breadth of each lake were determined from the federal government navigation charts. These values were determined simply by measuring what appeared to be the greatest distance across the lake, as close as possible to the perpendicular to the two opposing shorelines. The maximum depths, with reference to chart datum, are the deepest soundings shown on the navigation charts. The coordinated general dimensions of the lakes are shown on Table 4, page 12.

17. Appendix A. Copies of Index Sheets of Topographic Maps of Canada and the United States are shown on Figures 1A through 10A of Appendix A. Included on these figures are the coordinated drainage basin boundaries used in the determination of the Great Lakes Physical Data.

TABLE 1

COORDINATED GREAT LAKES DRAINAGE AREAS

AREAL COMPONENTS IN SQUARE MILES

	IN CANADA		IN UNITED STATES	
	LAND*	WATER*	LAND*	WATER*
Lake Superior	32,400	11,100	16,900	20,600
St. Marys River	831	41	173	48
Lake Michigan	-	-	45,600	22,300
Lake Huron	34,700	13,900	16,000	9,100
St. Clair River	88	8	1,180	13
Lake St. Clair	3,780	268	1,020	162
Detroit River	213	16	648	23
Lake Erie	4,720	4,930	18,000	4,980
Niagara River	511	10	791	13
Lake Ontario	10,900	3,880	12,500	3,460
St. Lawrence River -				
Above Iroquois Dam	656	104	1,860	86
Above Power Dam	786	125	1,990	110

To obtain a coordinated area, add tabulated values of desired combination of components and round to three significant digits. For example: The total land area of the St. Marys River basin is 831 + 173 = 1,004 or 1,000 square miles.

* Water areas are those only of lake or river named, smaller lakes, etc., within the basin being included with the land portion.

TABLE 1 (a)

COORDINATED GREAT LAKES DRAINAGE AREAS

AREAL COMPONENTS IN SQUARE KILOMETRES

	IN CANADA		IN UNITED STATES	
	LAND*	WATER*	LAND*	WATER*
Lake Superior	83900	28700	43800	53400
St. Marys River	2150	106	448	124
Lake Michigan	-	-	118000	57800
Lake Huron	89900	36000	41400	23600
St. Clair River	228	21	3060	34
Lake St. Clair	9790	694	2640	420
Detroit River	552	41	1680	60
Lake Erie	12200	12800	46600	12900
Niagara River	1320	26	2050	34
Lake Ontario	28200	10000	32400	8960
St. Lawrence River -				
Above Iroquois Dam	1700	269	4820	223
Above Power Dam	2040	324	5150	285

To obtain a coordinated area, add tabulated values of desired combination of components and round to three significant digits. For example: The total land area of the St. Marys River basin is 2150 + 448 = 2598 or 2600 square kilometres.

* Water areas are those only of lake or river named, smaller lakes, etc., within the basin being included with the land portion.

TABLE 2

COORDINATED VALUES OF WATER VOLUMES OF GREAT LAKES

	VOLUME	
LAKE	CUBIC MILES	CUBIC KILOMETRES
Superior	2,900	12100
Michigan	1,180	4920
Huron	850	3540
Erie	116	484
Ontario	393	1640

TABLE 3

COORDINATED ELEMENTS OF GREAT LAKES SHORELINE LENGTHS

	SHORELINE LENGTH COMPONENTS IN MILES			
	IN CANADA		IN UNITED STATES	
	MAINLAND	ISLANDS	MAINLAND	ISLANDS
Lake Superior	866	615	863	382
St. Marys River	66	63	29	89
Lake Michigan	0	0	1,400	238
Lake Huron	1,270	1,720	580	257
St. Clair River	30	5	28	0
Lake St. Clair	71	43	59	84
Detroit River	30	33	30	39
Lake Erie	368	29	431	43
Niagara River	33	3	36	34
Lake Ontario	334	50	300	28
St. Lawrence River -				
Above Iroquois Dam	103	157	106	109
Above Power Dam	150	188	151	164

To obtain a coordinated length, add the tabulated values of the desired combination of components and round the sum to three significant digits. For example: The total shoreline length of the Lake Huron mainland and islands is 580 + 257 + 1,270 + 1,720 = 3,827, which when rounded gives 3,830 miles.

TABLE 3(a)

COORDINATED ELEMENTS OF GREAT LAKES SHORELINE LENGTHS

	SHORELINE LENGTH COMPONENTS IN KILOMETRES			
	IN CANADA		IN UNITED STATES	
	MAINLAND	ISLANDS	MAINLAND	ISLANDS
Lake Superior	1390	990	1390	615
St. Marys River	106	101	47	143
Lake Michigan	0	0	2250	383
Lake Huron	2040	2770	933	414
St. Clair River	48	8	45	0
Lake St. Clair	114	69	95	135
Detroit River	48	53	48	63
Lake Erie	592	47	694	69
Niagara River	53	5	58	55
Lake Ontario	538	80	483	45
St. Lawrence River -				
Above Iroquois Dam	166	253	171	175
Above Power Dam	241	303	243	264

To obtain a coordinated length, add the tabulated values of the desired combination of components and round the sum to three significant digits. For example: The total shoreline length of the Lake Huron mainland and islands is 2040 + 2770 + 933 + 414 = 6157, which when rounded gives 6160 kilometres.

TABLE 4

COORDINATED GENERAL GREAT LAKES DIMENSIONS

	MAXIMUM LENGTH		MAXIMUM BREADTH		MAXIMUM DEPTH	
LAKE	MILES	KILOMETRES	MILES	KILOMETRES	FEET	METRES
Superior	350	563	160	257	1,330	405
Michigan	307	494	118	190	923	281
Huron	206	332	183	295	750	229
St. Clair	26	42	24	39	21[*]	6
Erie	241	388	57	92	210	64
Ontario	193	311	53	85	802	244

NOTE: Maximum depths are the deepest soundings shown on current navigation charts of the Great Lakes.

[*] Deepest sounding outside dredged navigation channel which has project depth of 27 feet.

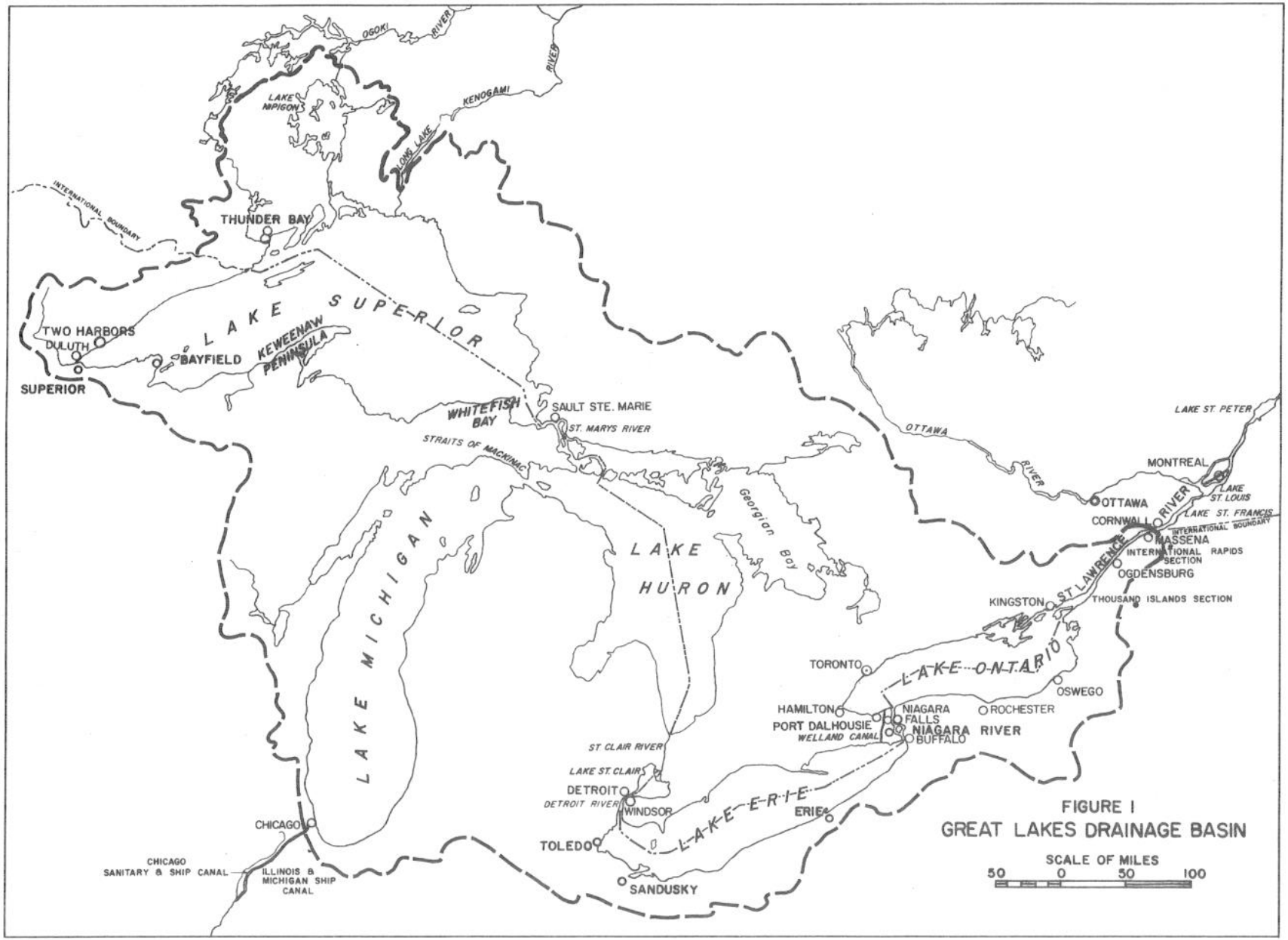


FIGURE I
GREAT LAKES DRAINAGE BASIN

CO-ORDINATING COMMITTEE ON GREAT LAKES BASIC HYDRAULIC AND HYDROLOGIC DATA

LAKE SUPERIOR DRAINAGE BASIN

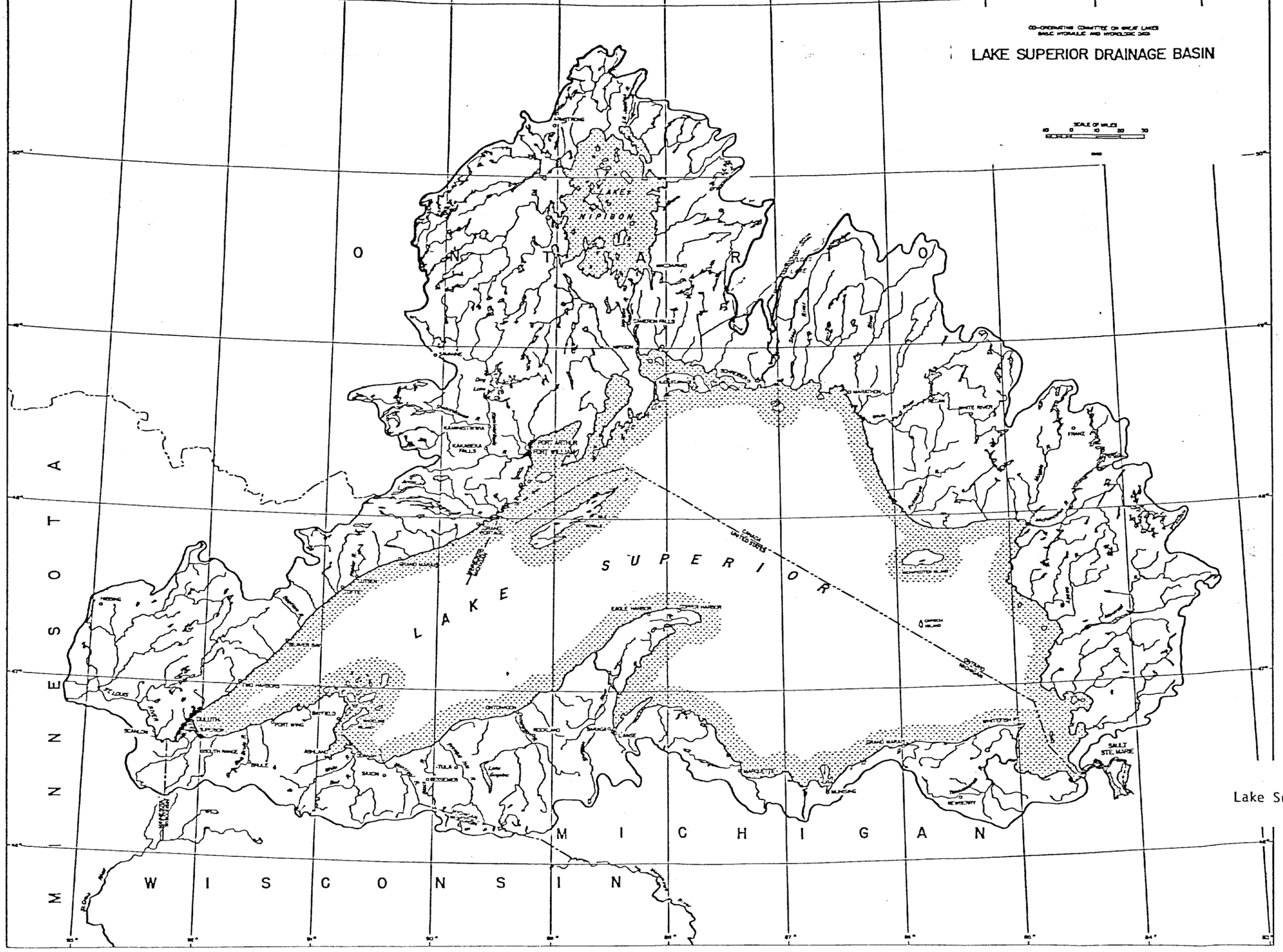


Figure 2
Lake Superior Drainage Basin

Figure 3
Lake Michigan Drainage Basin

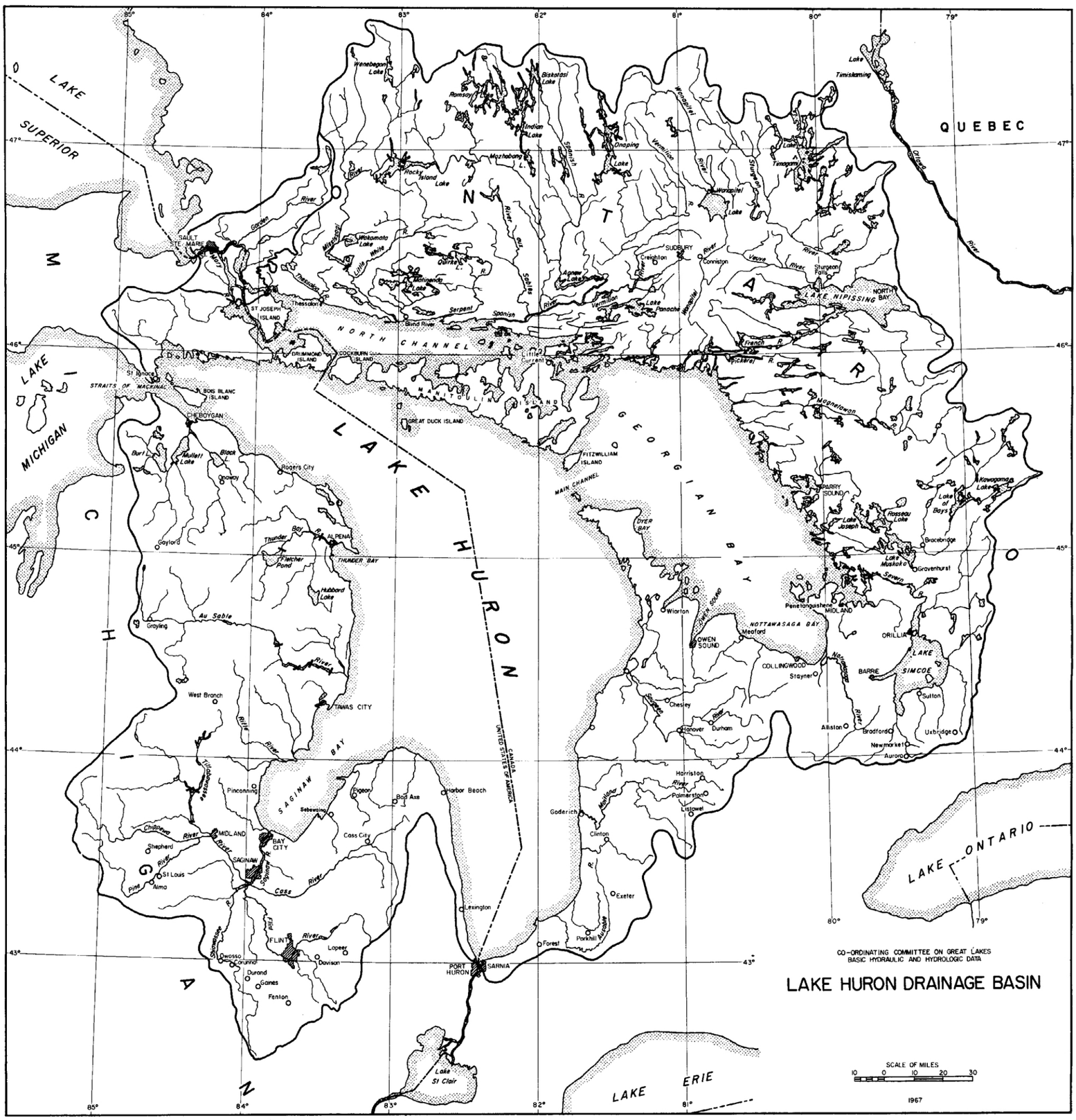


Figure 4
Lake Huron Drainage Basin

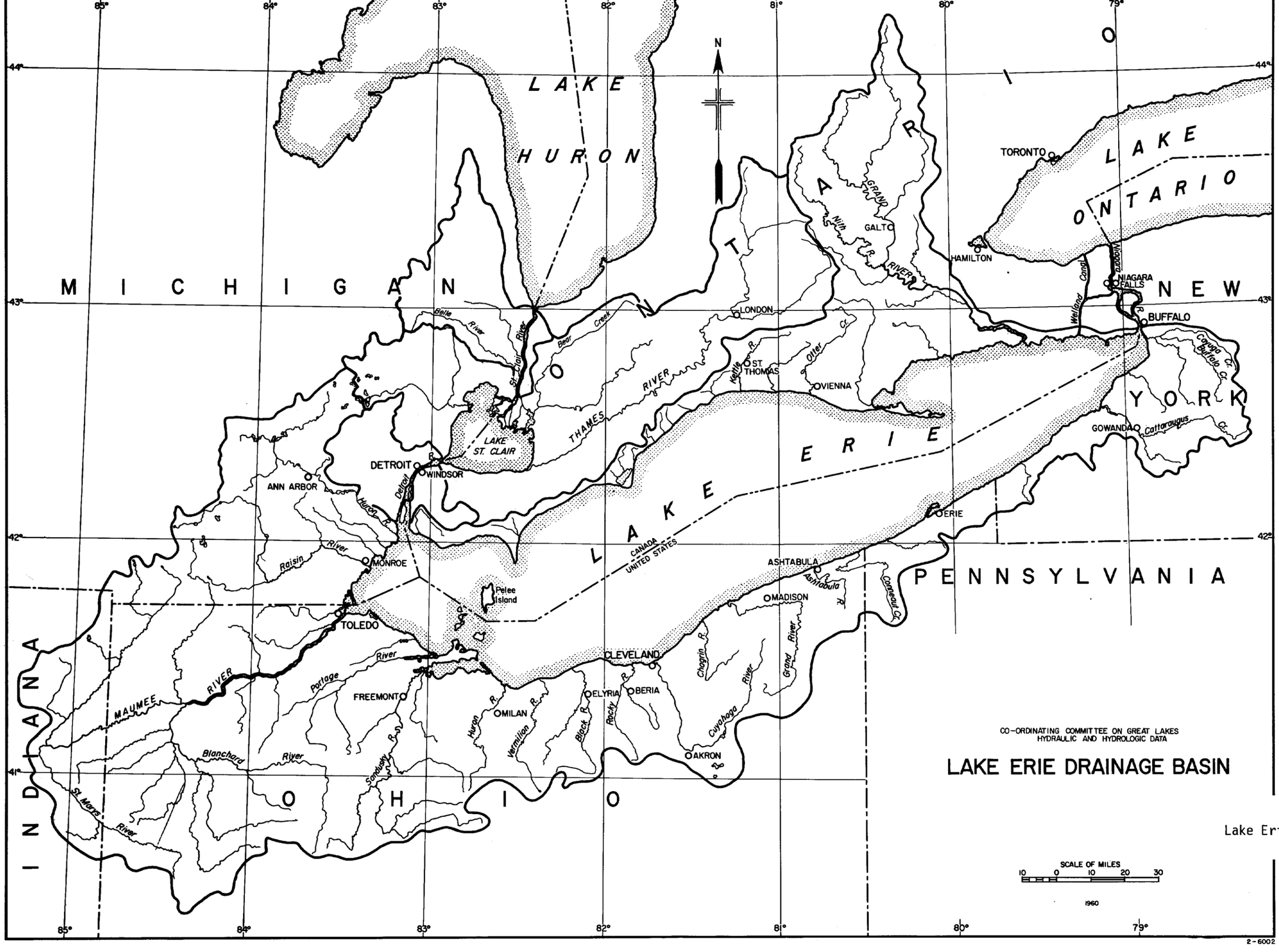


Figure 5
Lake Erie Drainage Basin

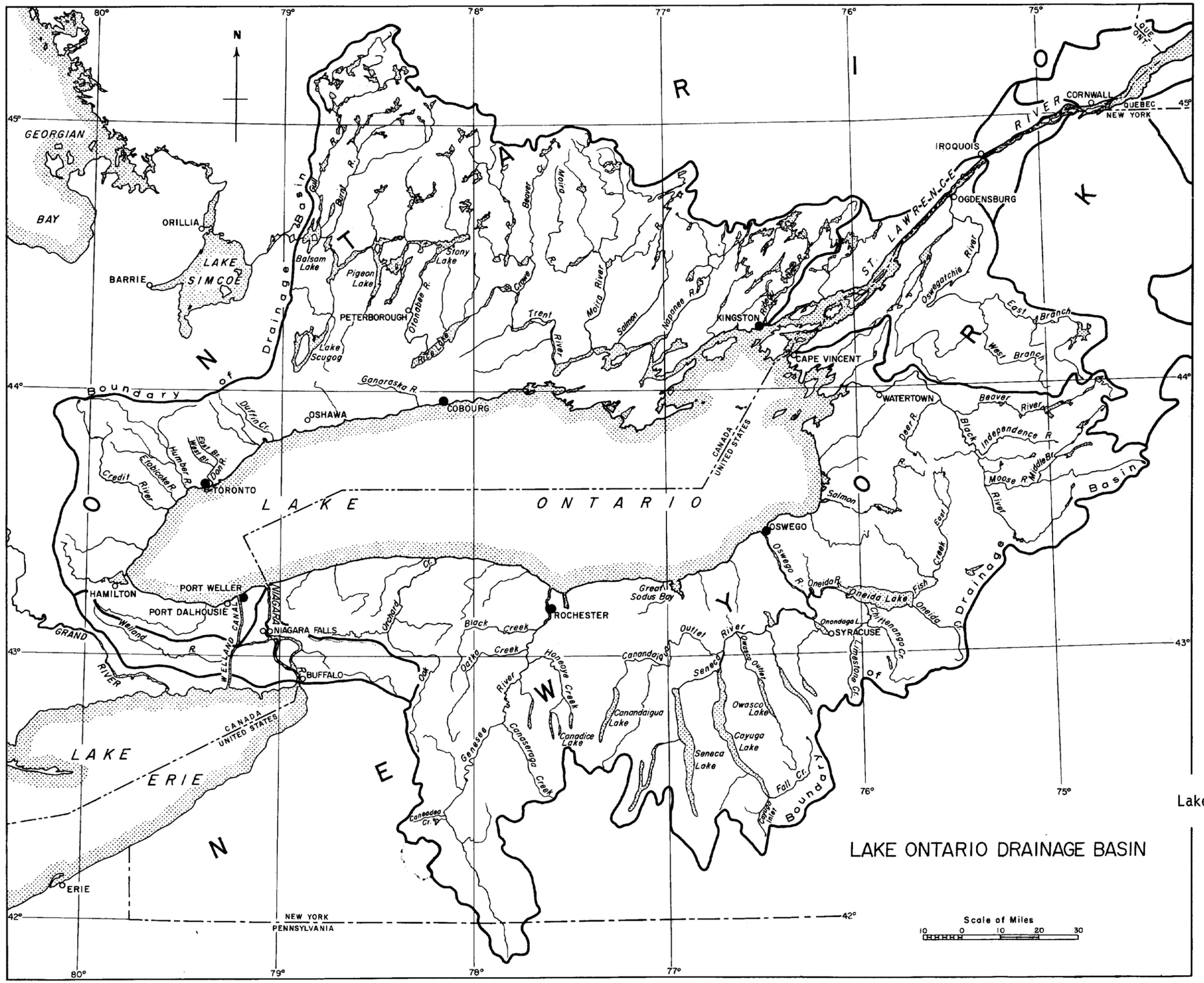


Figure 6
Lake Ontario Drainage Basin

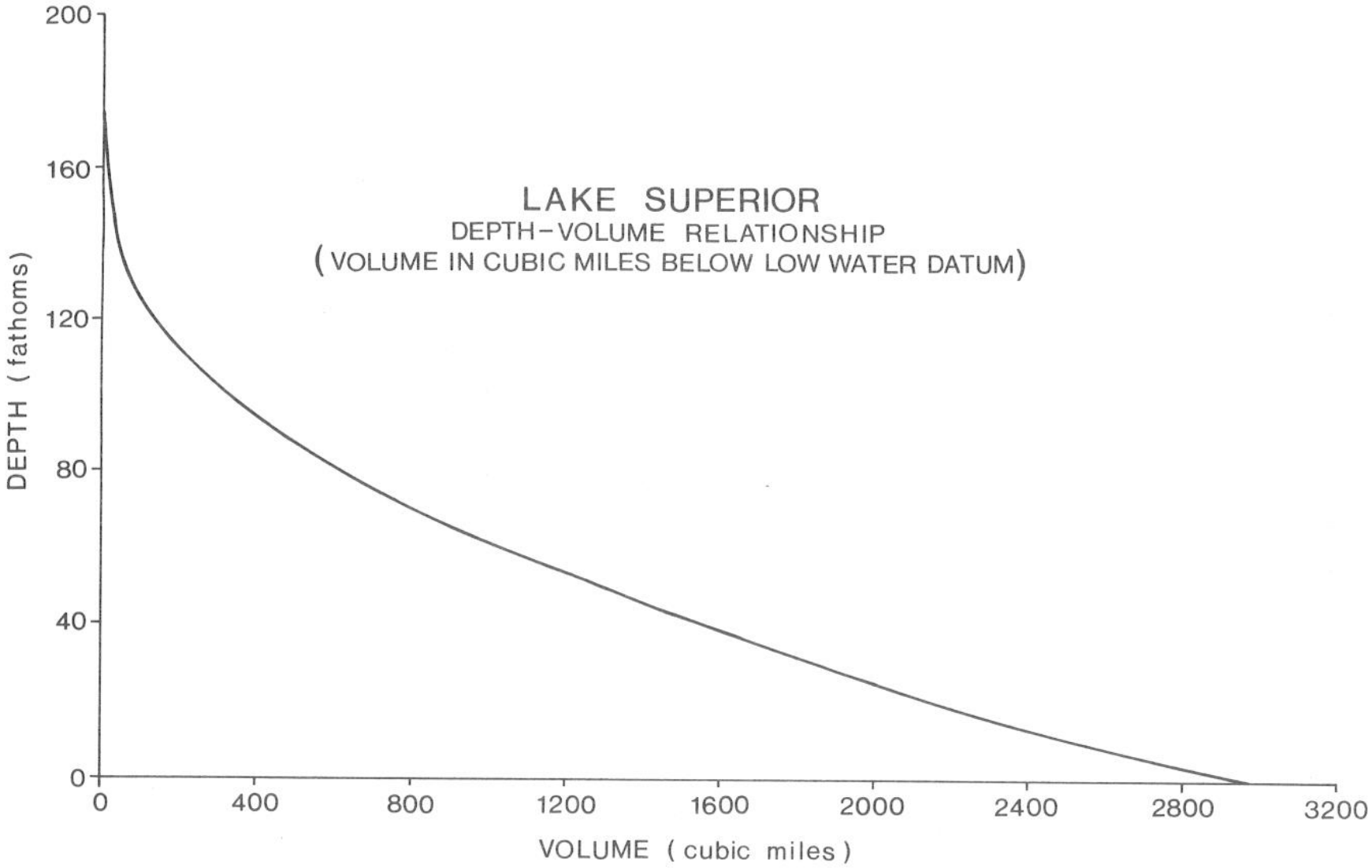

LAKE SUPERIOR
DEPTH-VOLUME RELATIONSHIP
(VOLUME IN CUBIC MILES BELOW LOW WATER DATUM)
DEPTH (fathoms)
200
160
120
80
40
0
0
400
800
1200
1600
2000
2400
2800
3200
VOLUME (cubic miles)

FIGURE 7.

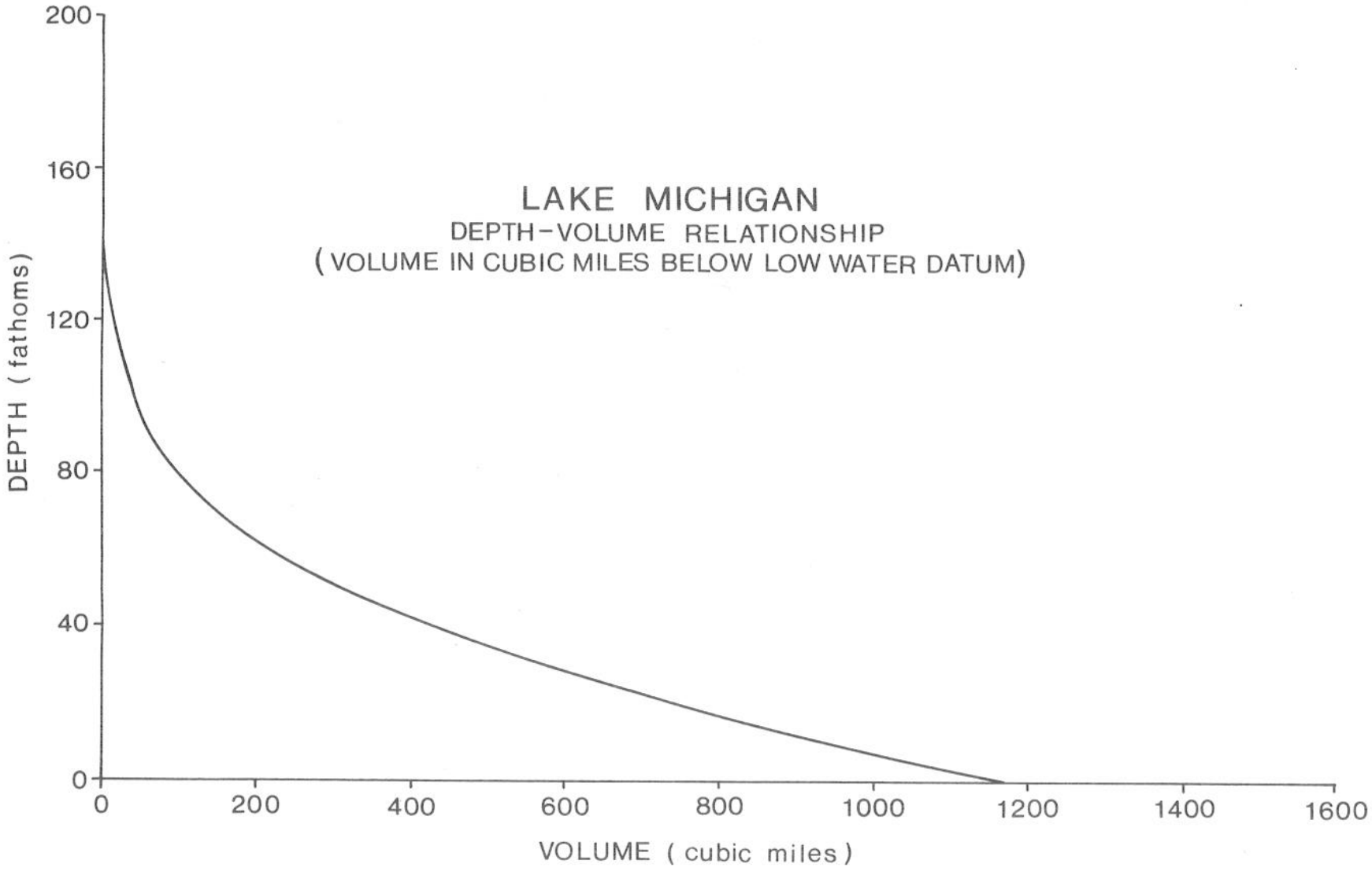

LAKE MICHIGAN
DEPTH-VOLUME RELATIONSHIP
(VOLUME IN CUBIC MILES BELOW LOW WATER DATUM)
DEPTH (fathoms)
200
160
120
80
40
0
0
200
400
600
800
1000
1200
1400
1600
VOLUME (cubic miles)

FIGURE 8.

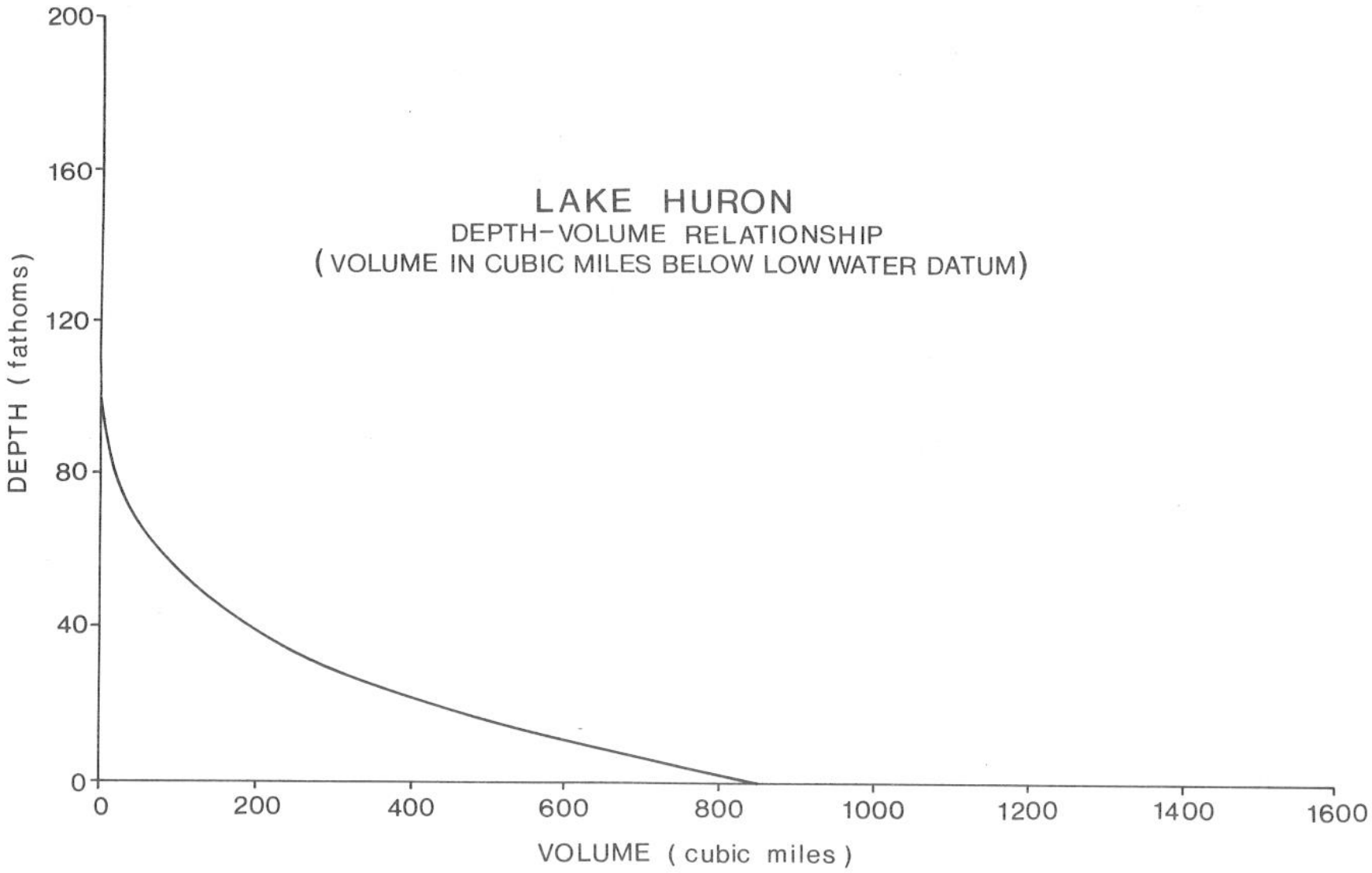

LAKE HURON
DEPTH-VOLUME RELATIONSHIP
(VOLUME IN CUBIC MILES BELOW LOW WATER DATUM)
DEPTH (fathoms)
200
160
120
80
40
0
0
200
400
600
800
1000
1200
1400
1600
VOLUME (cubic miles)

FIGURE 9

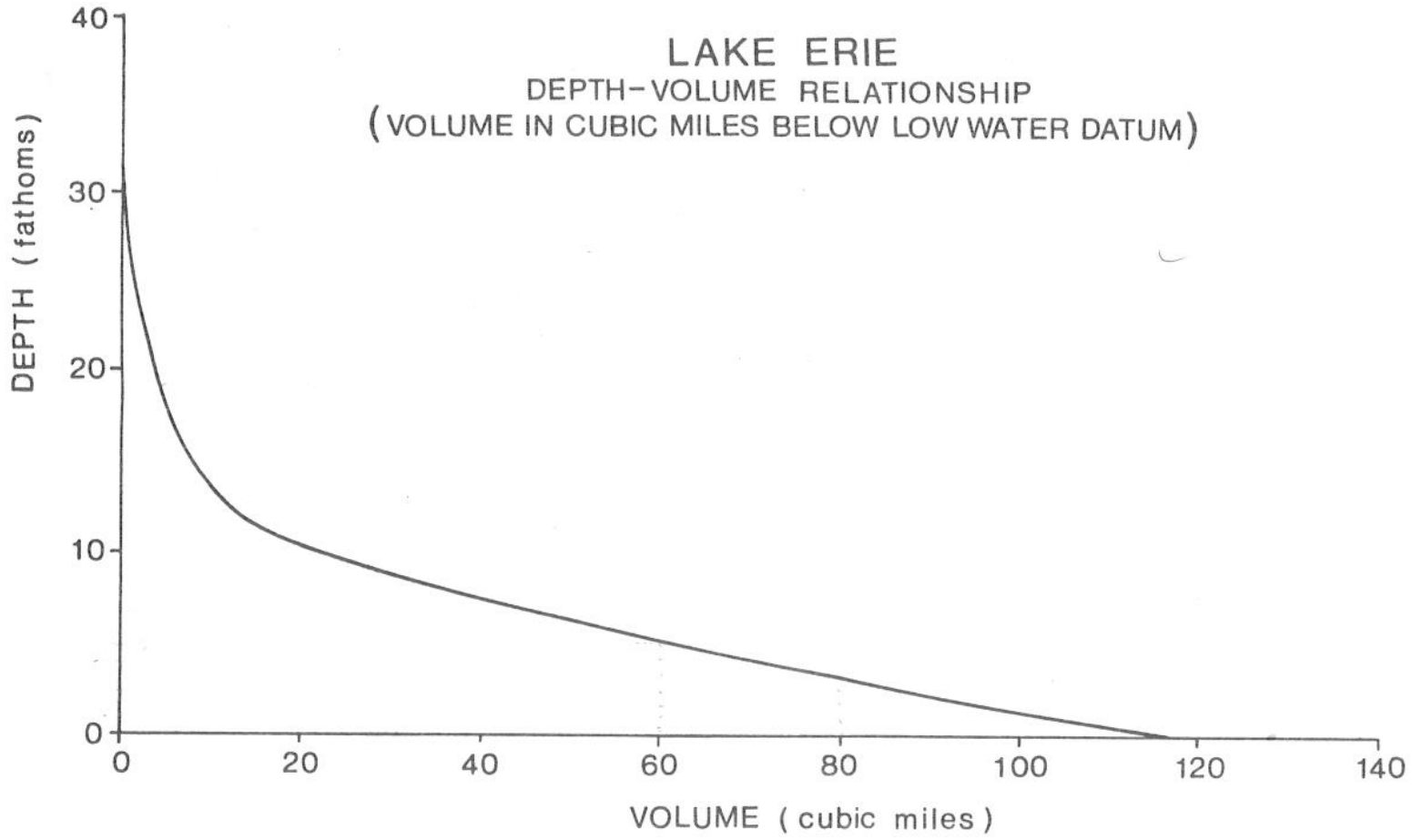

LAKE ERIE
DEPTH-VOLUME RELATIONSHIP
(VOLUME IN CUBIC MILES BELOW LOW WATER DATUM)
DEPTH (fathoms)
40
30
20
10
0
0
20
40
60
80
100
120
140
VOLUME (cubic miles)

FIGURE 10.

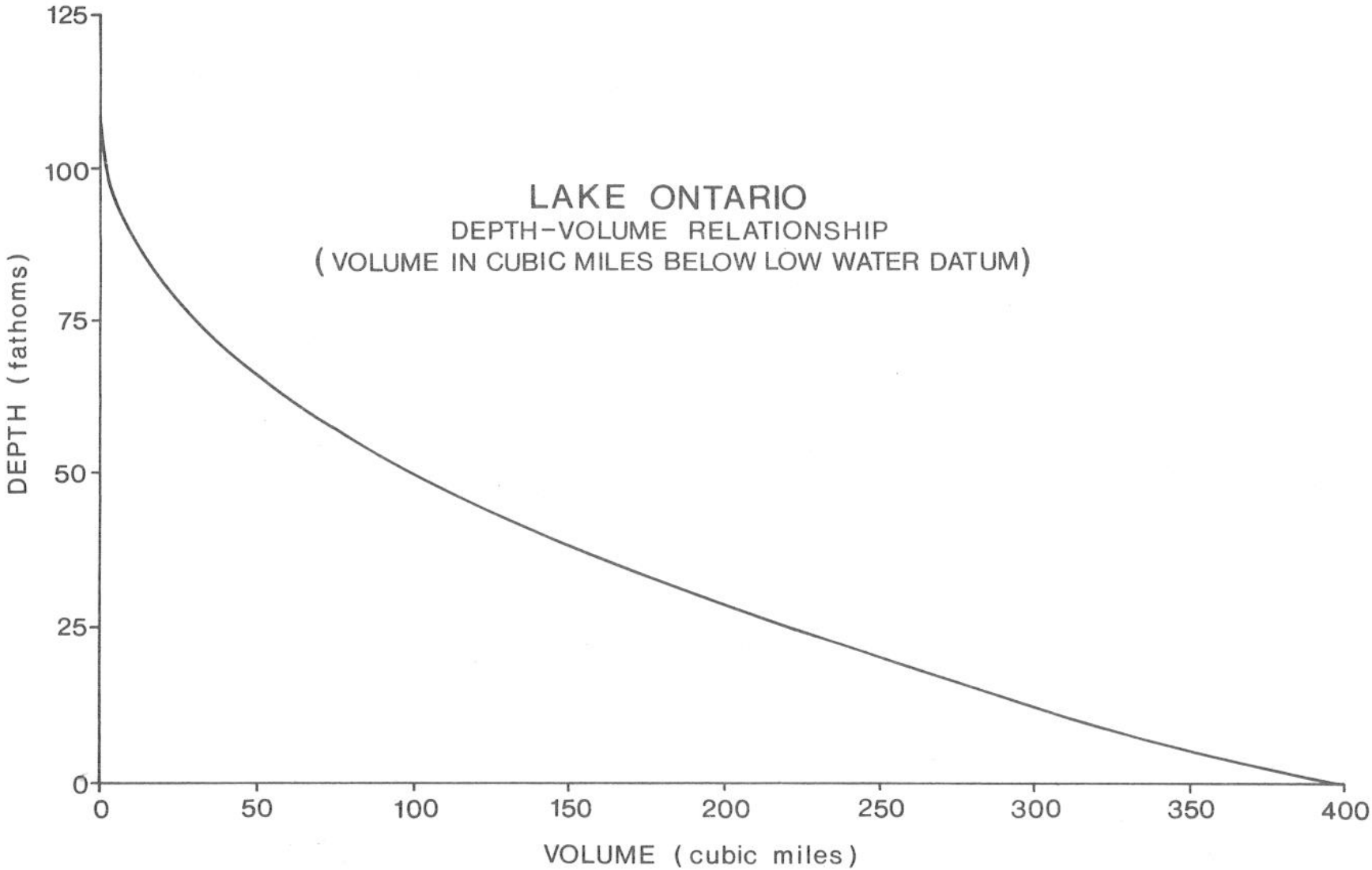
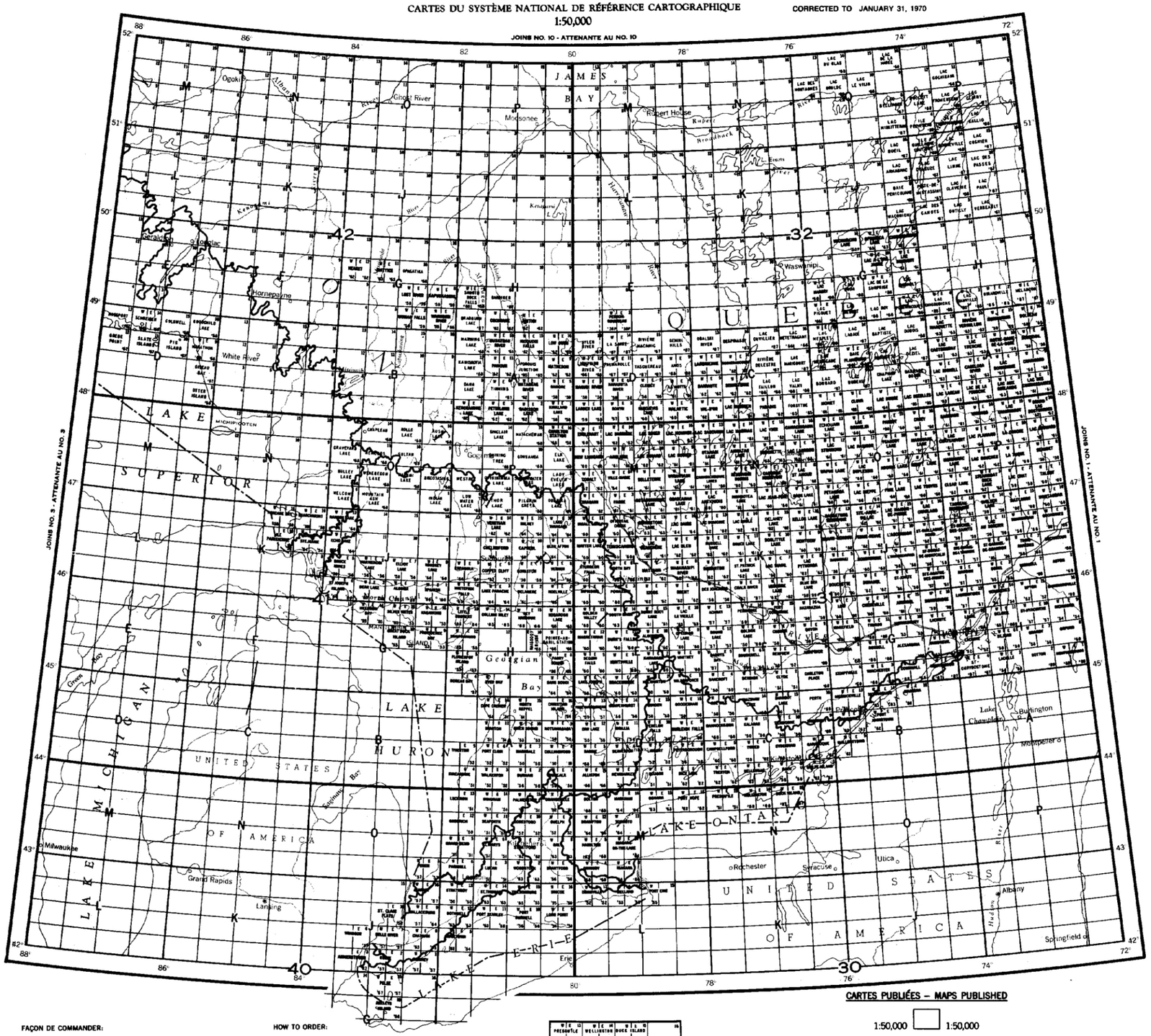

LAKE ONTARIO
DEPTH-VOLUME RELATIONSHIP
(VOLUME IN CUBIC MILES BELOW LOW WATER DATUM)
DEPTH (fathoms)
125
100
75
50
25
0
0
50
100
150
200
250
300
350
400
VOLUME (cubic miles)

FIGURE 11.

MAPS OF THE NATIONAL TOPOGRAPHIC SYSTEM
CARTES DU SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE
1:50,000

INDEX No. 2

CORRECTED TO JANUARY 31, 1970



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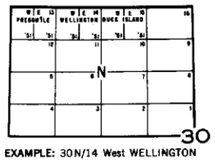


EXAMPLE: 30N/14 West WELLINGTON

CARTES PUBLIÉES – MAPS PUBLISHED

1:50,000 ☐ 1:50,000

1:63,360 ☐ 1:63,360

Indique une carte sans courbes de niveau — P — indicates an uncontoured map

INDEX No. 2

CORRIGÉE JUSQU'À LA DATE DU 31 JANVIER, 1970

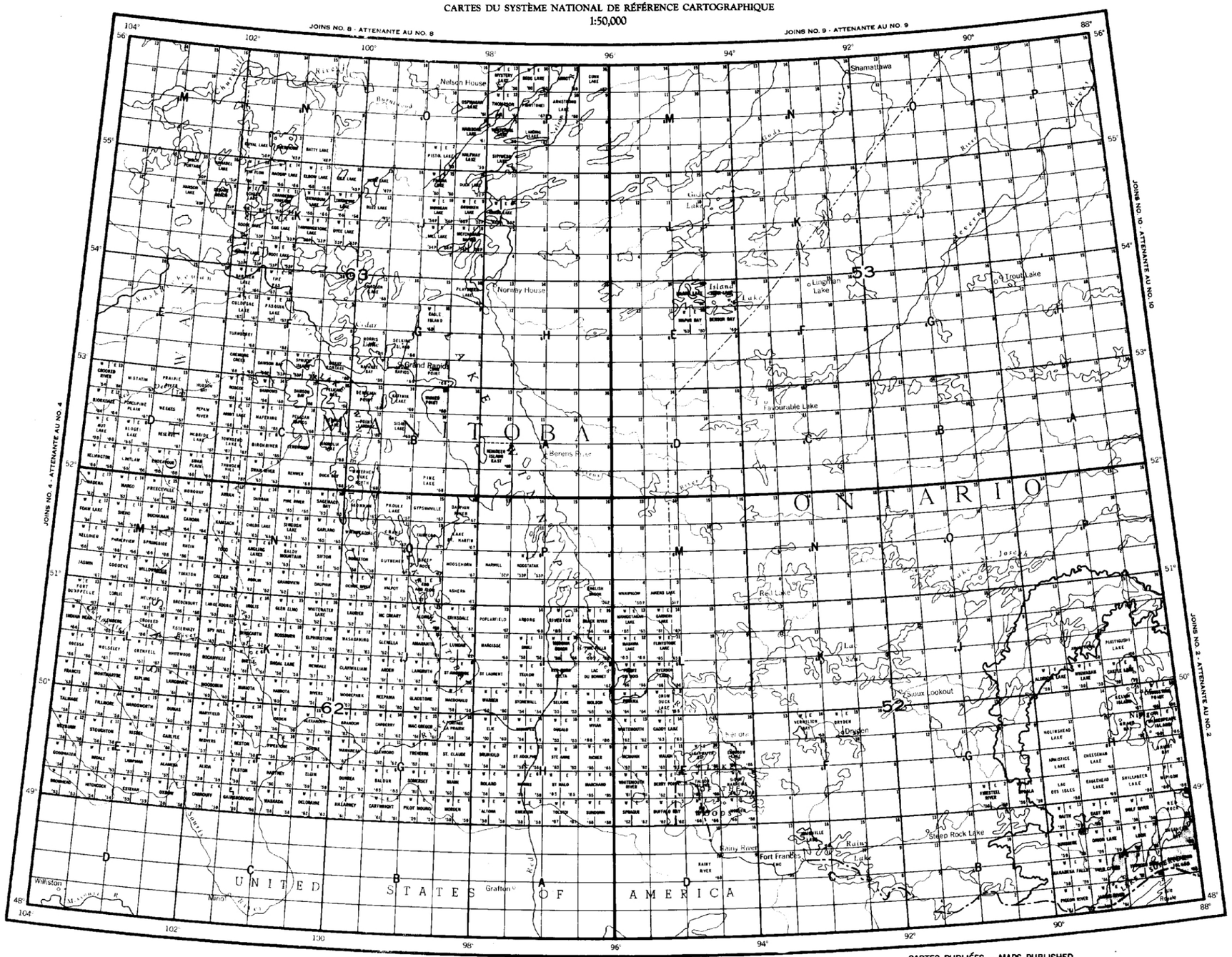
Figure 1A
Map Index Sheet
Canadian Basin

CANADA

MAPS OF THE NATIONAL TOPOGRAPHIC SYSTEM
CARTES DU SYSTÈME NATIONAL DE RÉFÉRENCE CARTOGRAPHIQUE
1:50,000

INDEX No. 3

CORRECTED TO MARCH 31, 1970



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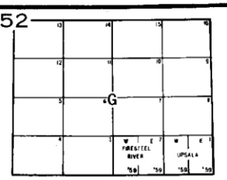


EXAMPLE: 52G/2 West FIRESTEEL RIVER

CARTES PUBLIÉES — MAPS PUBLISHED

1:50,000 — 1:50,000

1:50,000 ÉPREUVE PRÉLIMINAIRE (épreuve tirée du manuscrit, en noir–pas de noms) — 1:50,000 ADVANCE PRINT (print of manuscript in black–no names)

1:63,360 — 1:63,360

Indique une carte sans courbes de niveau — P indicates an uncontoured map

INDEX No. 3 CORRIGÉE JUSQU'À LA DATE DU 31 MARS, 1970

Figure 2A
Map Index Sheet
Northwestern Lake Superior

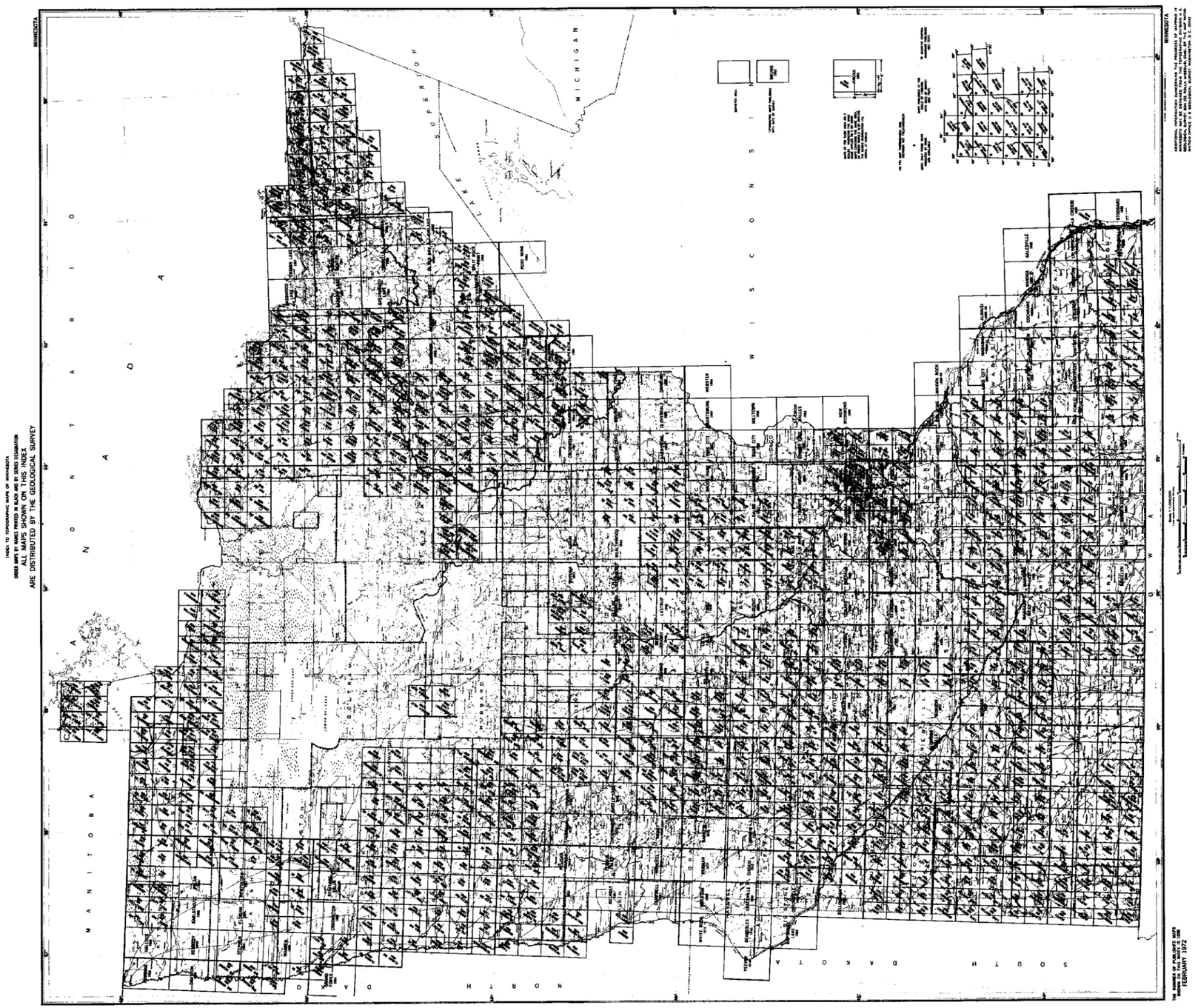


Figure 3A
Map Index Sheet
Western Lake Superior

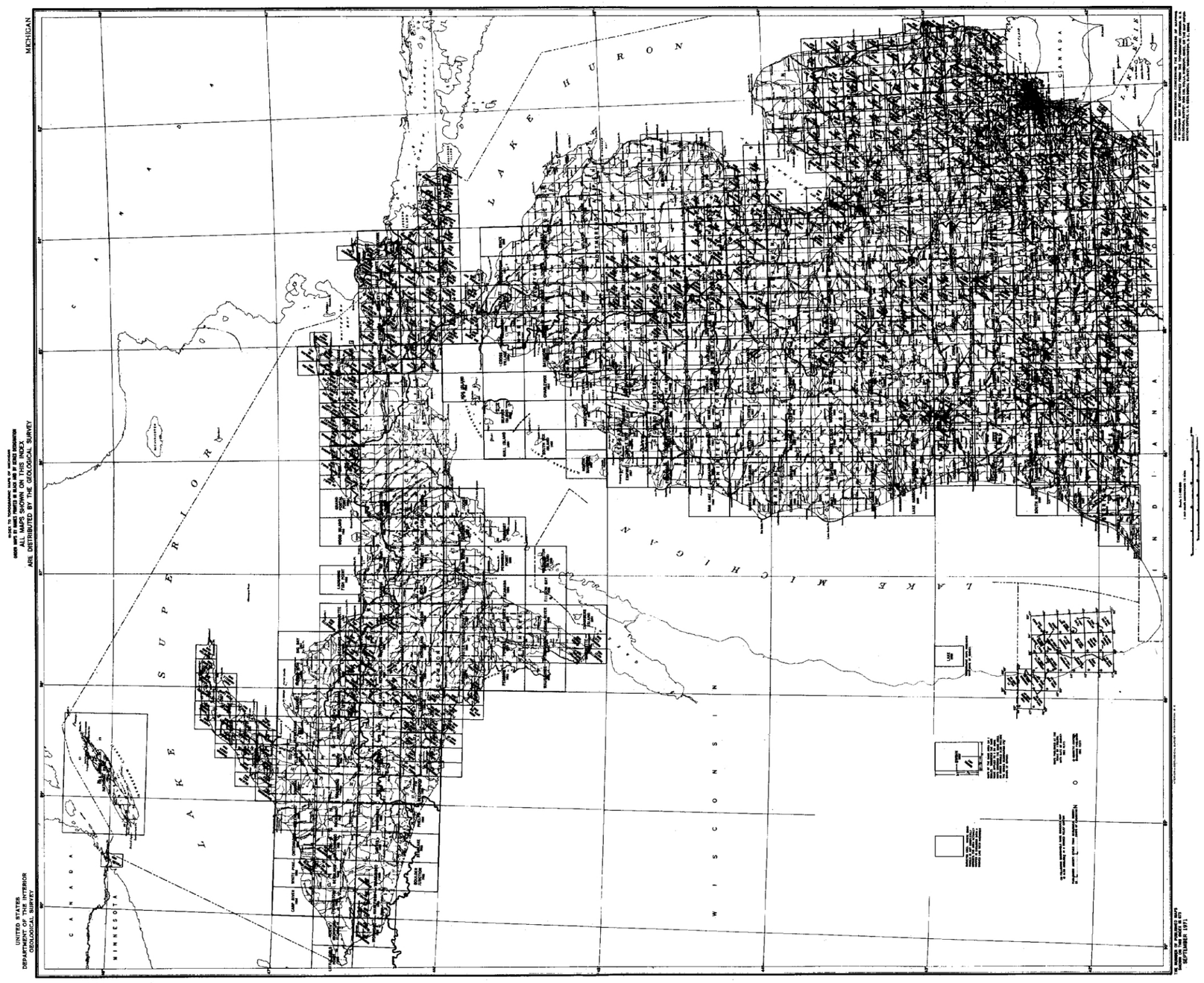


Figure 4A
Map Index Sheet
Southern Lake Superior
and
Southern Lake Huron

Figure 5A
Map Index Sheet
Western Lake Michigan

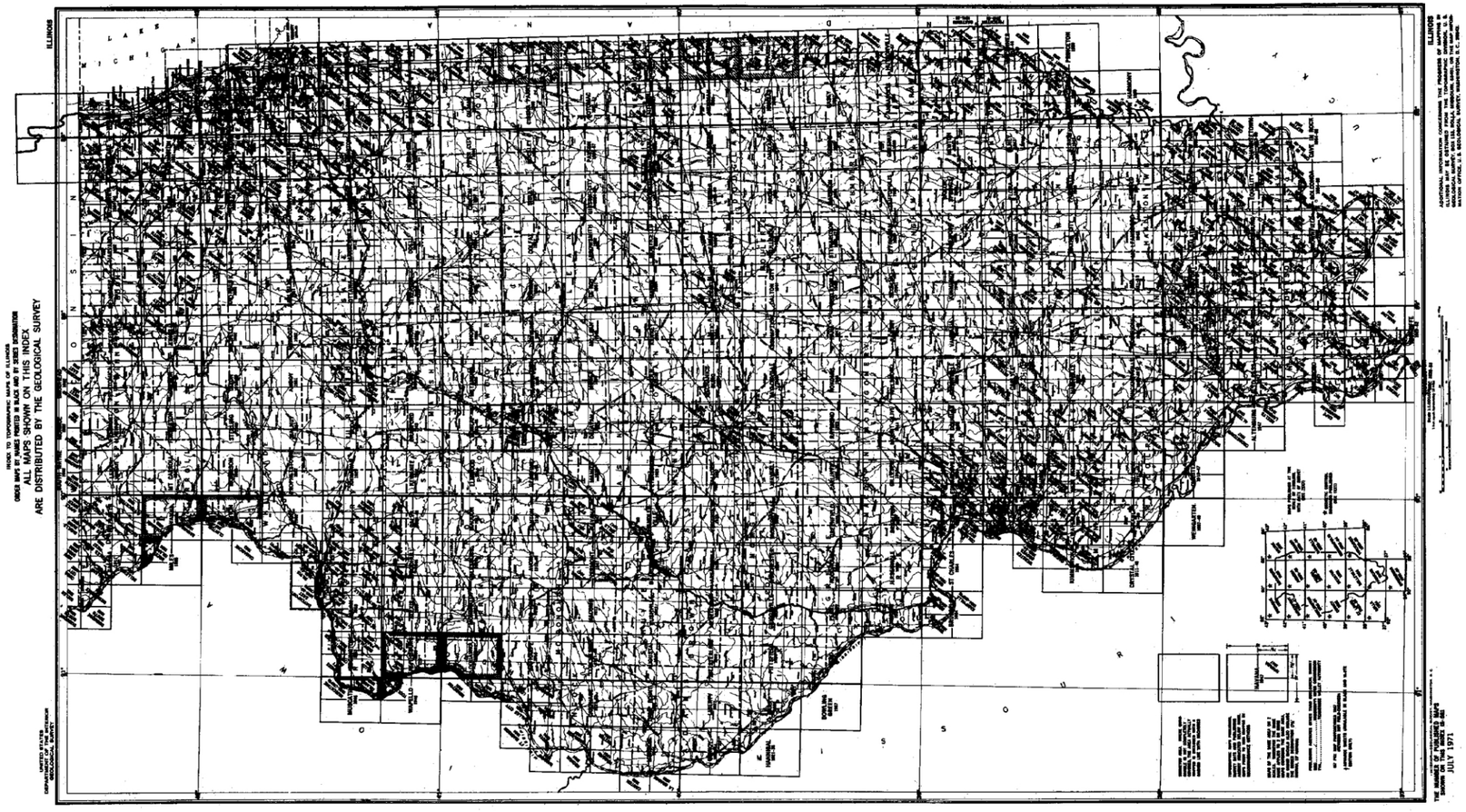


Figure 6A
Map Index Sheet
South Western Lake Michigan

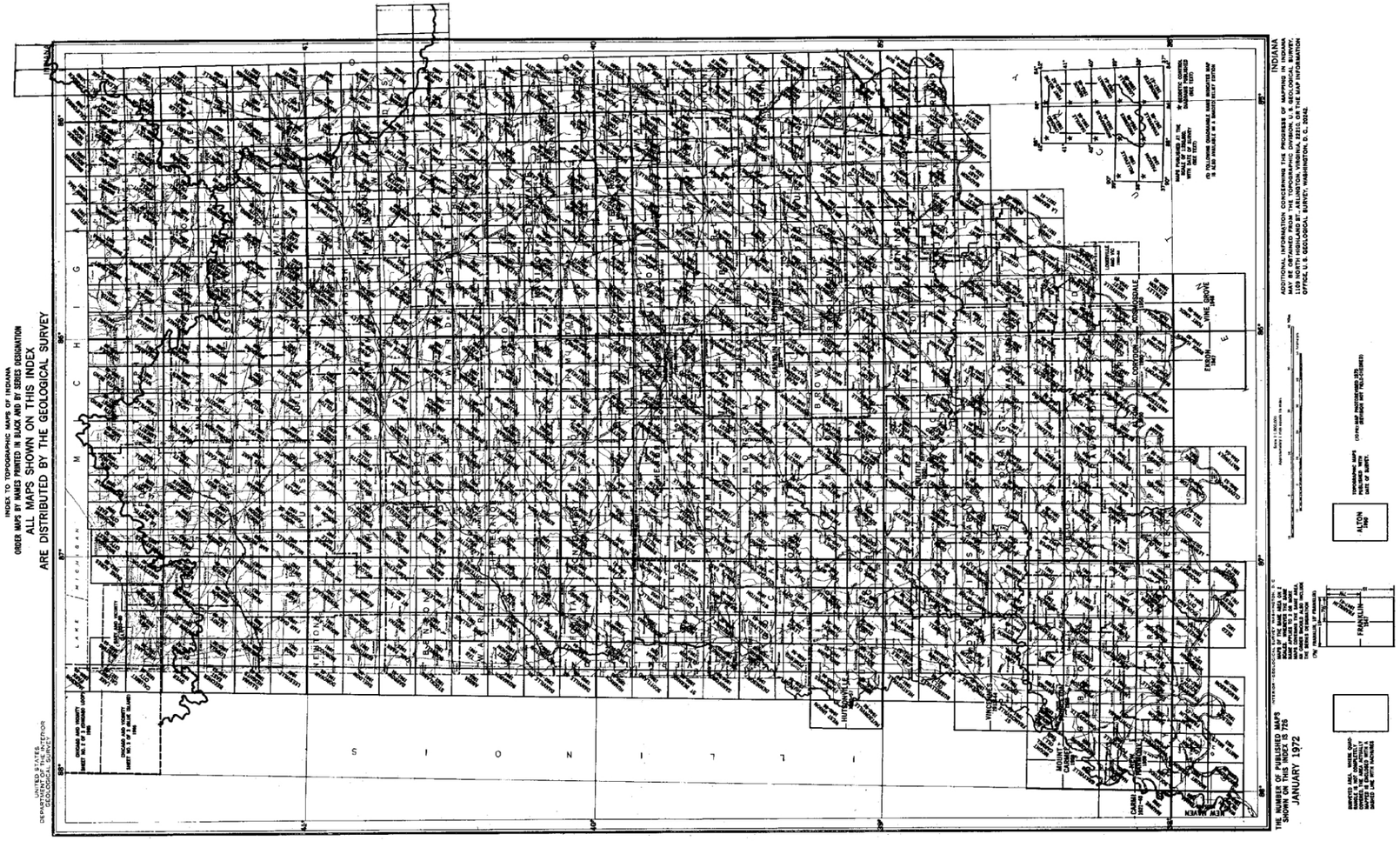


Figure 7A
Map Index Sheet
Southern Lakes Michigan and Erie

Figure 8A
Map Index Sheet
Southern Lake Erie

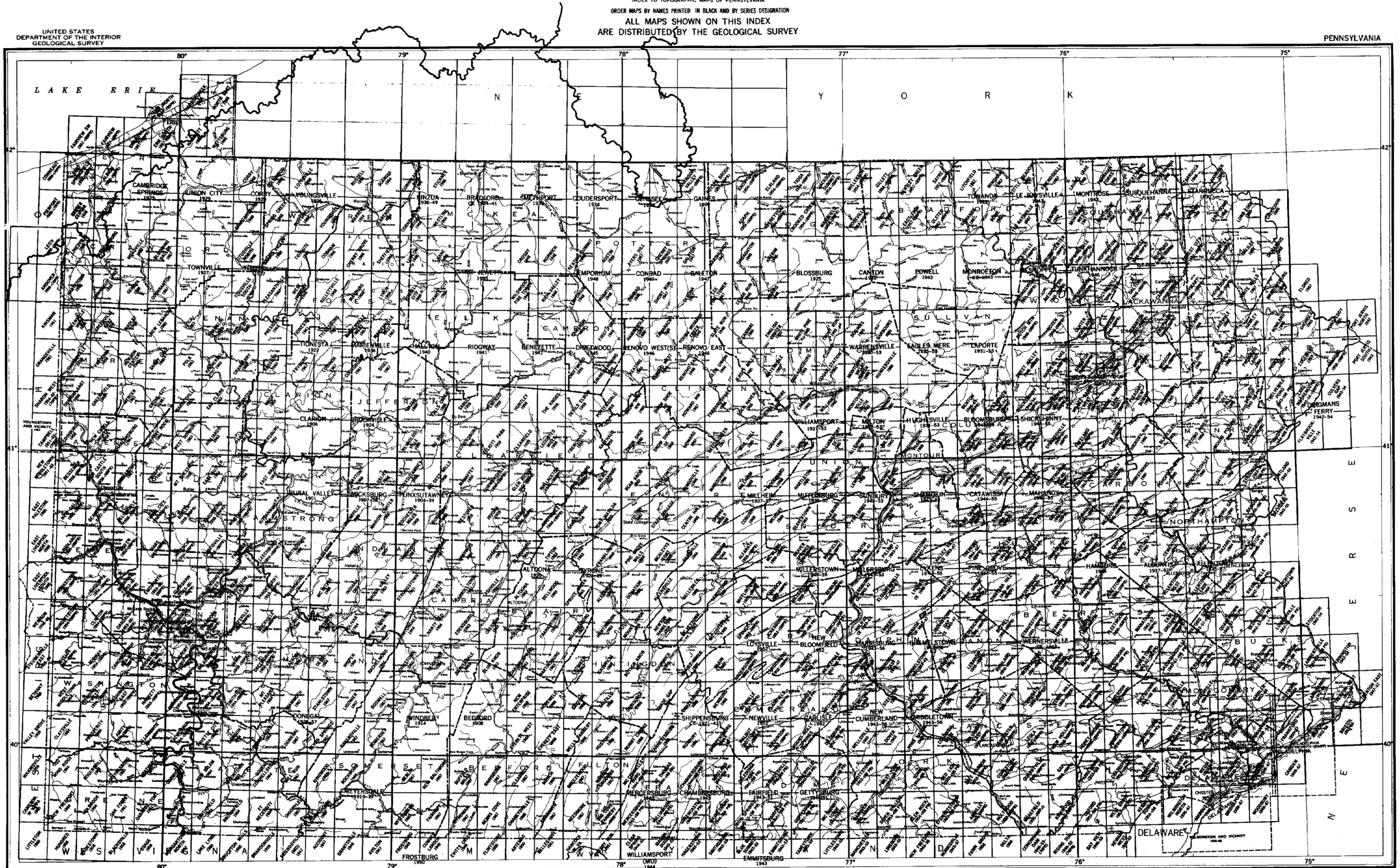
INDEX TO TOPOGRAPHIC MAPS OF PENNSYLVANIA

ORDER MAPS BY NAMES PRINTED IN BLACK AND BY SERIES DESIGNATION

ALL MAPS SHOWN ON THIS INDEX ARE DISTRIBUTED BY THE GEOLOGICAL SURVEY

UNITED STATES DEPARTMENT OF THE INTERIOR GEOLOGICAL SURVEY

PENNSYLVANIA



INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.

PENNSYLVANIA

THE NUMBER OF PUBLISHED MAPS SHOWN ON THIS INDEX IS 765
JANUARY 1972

MAPS PUBLISHED AT THE SCALE OF 1:250,000, WITH DATE OF SURVEY (SEE TEXT)

★ GEODETIC CONTROL DIAGRAMS PUBLISHED (SEE TEXT)

PUBLISHING AGENCIES OTHER THAN GEOLOGICAL SURVEY
CE..........CORPS OF ENGINEERS

NOTE: WHEN MORE THAN ONE PUBLISHING AGENCY IS INDICATED, SEPARATE MAPS BY EACH AGENCY ARE DISTRIBUTED BY THE GEOLOGICAL SURVEY

(S) FOLLOWING QUADRANGLE NAME INDICATES MAP IS ALSO AVAILABLE IN A SHADED RELIEF EDITION

(68 PR): MAP PHOTOREVISED 1968 (REVISION NOT FIELD-CHECKED)

MAPS OF THE SAME AREA ON 2 SCALES. WHEREVER THE SAME NAME APPLIES TO 2 OR MORE MAPS COVERING THE SAME AREA, AN ORDER SHOULD ALSO INCLUDE THE SERIES DESIGNATION (7½' DRIFTWOOD, 15' DRIFTWOOD)

TOPOGRAPHIC MAPS PUBLISHED. SURVEY DATE AND PUBLISHING AGENCY INDICATED BELOW NAME. MAPS PRIOR TO 1896 MAPPED BY RECONNAISSANCE METHODS

SURVEYED AREA

Scale 1:750,000
1 inch equals approximately 12 miles

ADDITIONAL INFORMATION CONCERNING THE PROGRESS OF MAPPING IN PENNSYLVANIA MAY BE OBTAINED FROM THE TOPOGRAPHIC DIVISION, U. S. GEOLOGICAL SURVEY, 1109 NORTH HIGHLAND ST., ARLINGTON, VIRGINIA, 22210, OR THE MAP INFORMATION OFFICE, U. S. GEOLOGICAL SURVEY, WASHINGTON, D. C., 20242.

Figure 9A
Map Index Sheet
Southern Lakes Erie and Ontario

UNDER MAPS BY INDEX PRINTED IN BLACK AND BY SERIES DESIGNATION
ALL MAPS SHOWN ON THIS INDEX
ARE DISTRIBUTED BY THE GEOLOGICAL SURVEY

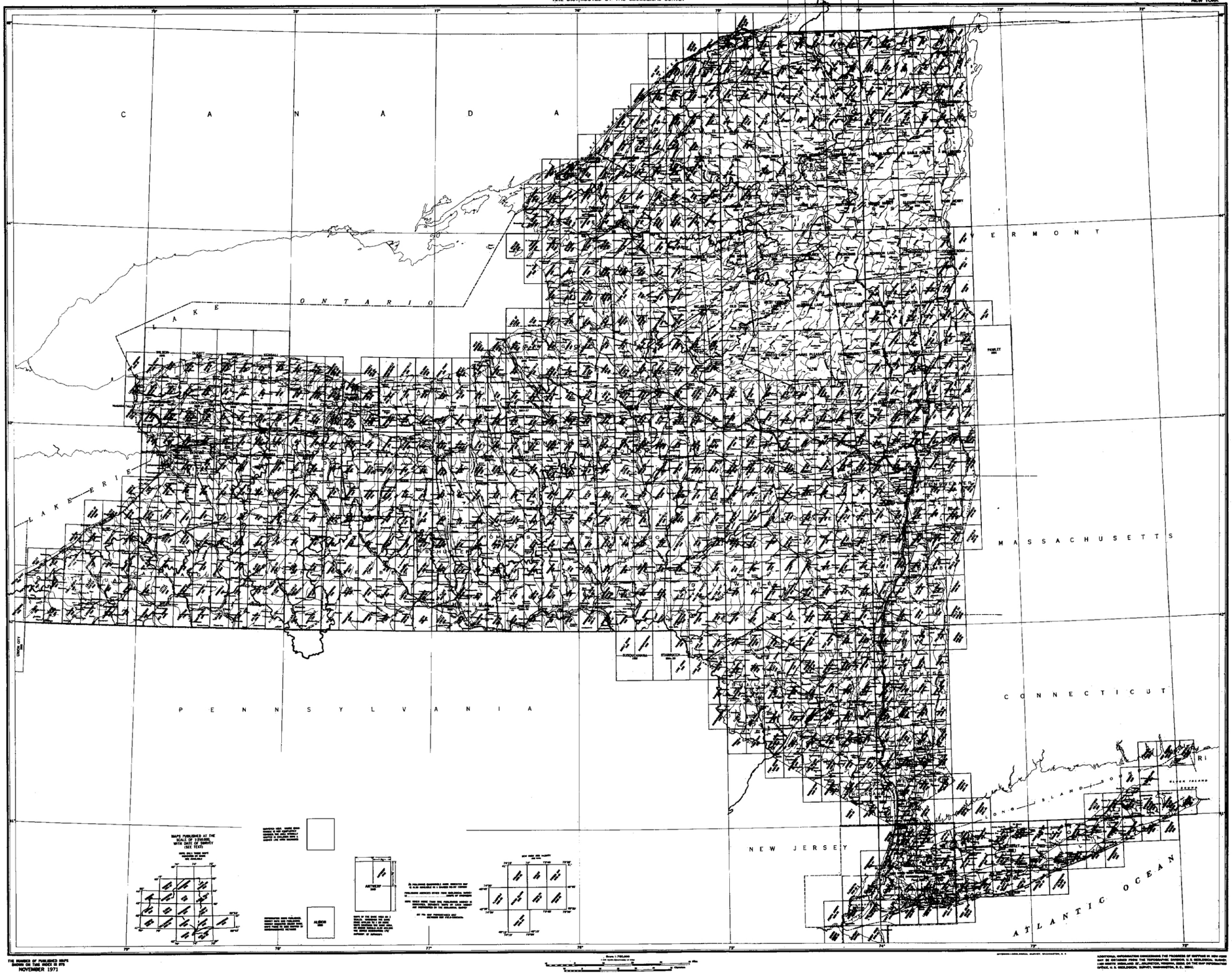


Figure 10A
Map Index Sheet
Southeastern Lake Ontario