ERRATA

PART TWO - CHAPTER XXXVI - SPECIAL SUBJECTS SUBREGION "D"

Pg. I-11, 2nd line: Change 2,493,000 to 2,462,800.

Pg. II-119, last line of Par. 216: Add at Watertown.

Pg. III-42, Par. 91, 8th line: Change held to bold.

Pg. III-50, 11th line: Insert craft without between recreational and charge.

Pg. IV-1, Par. 2, 6th line: Change 570 to 572.

Pg. IV-2, Par. 5, 7th line: Change 244 to 246.

Pg. IV-4, Par. 13, 3rd line: Change England to York.

Pg. V-13, Par. 31, 8th line: Insert a comma after the word lands, after the word war, and delete hyphen between war and attracted.

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE
150 CAUSEWAY STREET
BOSTON 14, MASSACHUSETTS

Final revisions
Special Subjects Subregion "D"
Chapter XXXVI Part Two
Mar 3 1955

1. Attached are revised pages II-27, II-28, II-47, II-48, II-49, II-50, II-77, II-78, II-97, II-98, II-125, II-126, II-127, II-128, II-151, II-152, II-163, II-164, II-165, II-166, II-167, III-35, III-36, III-79, III-80, III-81, and III-82, comprising the final revision for Part Two, Chapter XXXVI of the Report of the New England-New York Inter-Agency Committee entitled The Resources of the New England-New York Region, Special Subjects Subregion "D." Note that each revised page is identified by the revision symbol in the lower corner. It is requested that you open the binding of your copy, remove the superseded pages, insert the added and revised pages and destroy the replaced pages.

2. Also attached is an errata sheet showing minor corrections for which no revised pages are furnished. It is requested that you make all the changes indicated on the errata sheet.

3. Upon completion of the above, the copy of the Report you have will be in final form.

G. B. Troland

G. B. TROLAND
Coordinator

FOREWORD

This book contains one chapter of Part Two of the Report of the New England-New York Inter-Agency Committee, organized by direction of the President of the United States for the purpose of making a comprehensive survey of the land, water and related resources of the New England-New York Region.

The complete report comprises three parts:

Part One - The General Report.

Part Two - The Technical Report, with detailed studies of the river basins and special subjects.

Part Three - Reference Data.

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OF THE

NEW ENGLAND-NEW YORK REGION

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THE RESOURCES

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NEW ENGLAND-NEW YORK REGION

PART TWO

CHAPTER XXXVI

SPECIAL SUBJECTS

SUBREGION "D"

NEW YORK

NEW ENGLAND NEW YORK INTER-AGENCY COMMITTEE

SPECIAL SUBJECTS, SUBREGION "D"

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SECTION I - REDEVELOPMENT OF THE NIAGARA RIVER FOR POWER

GENERAL

1. Existing reports. - The redevelopment of the Niagara River at Niagara Falls for power has been the subject of several reports. The principal reports are discussed below:

a. "Possibilities for Redevelopment of Niagara Falls for Power - 1949" by Federal Power Commission. This report considered the possiblilities for a greater utilization of the water resources of the Niagara River at Niagara Falls for the production of hydroelectric power.

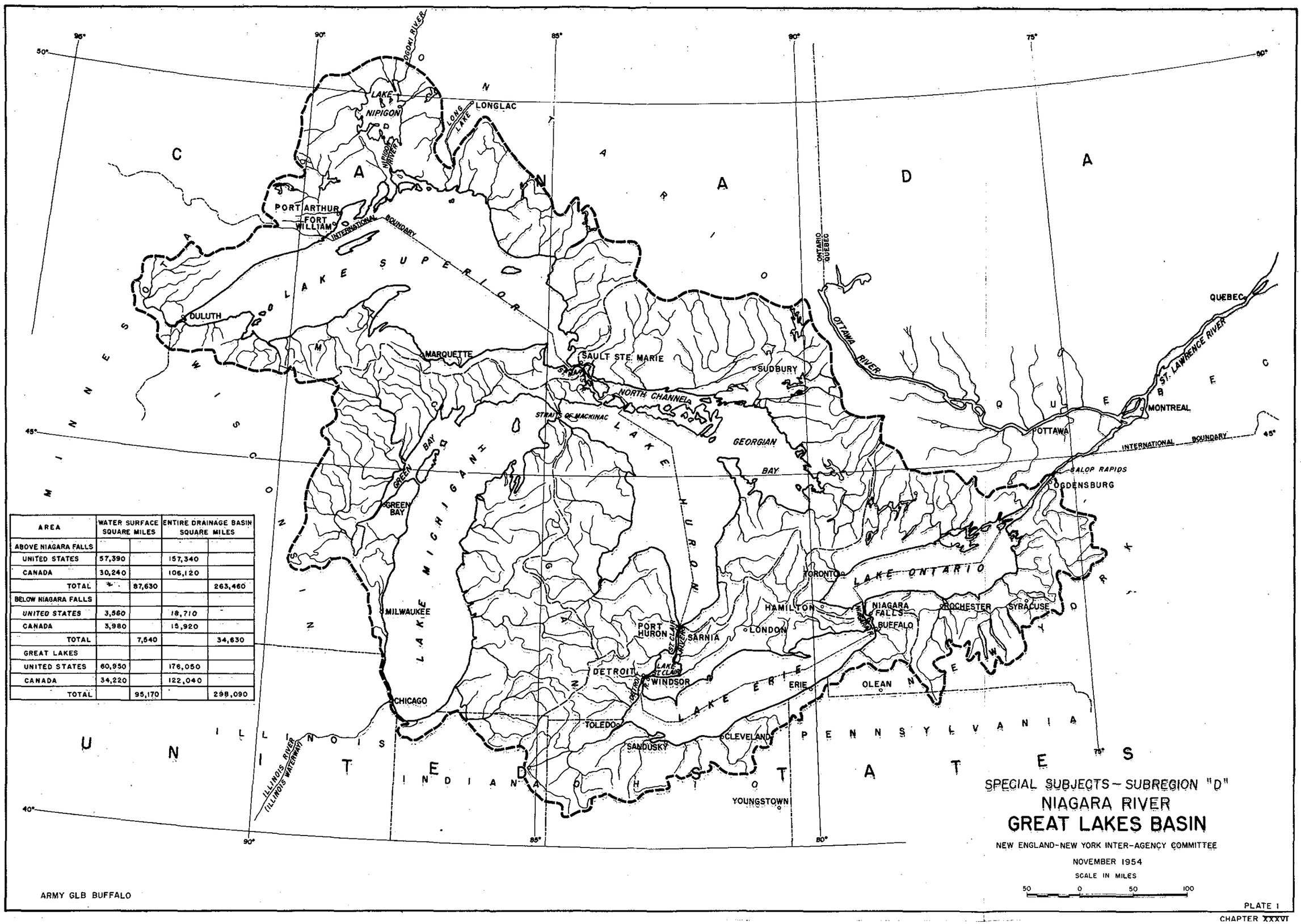
b. "Niagara River, New York, Redevelopment for Power - 1954" by the Buffalo District and North Central Division of the Corps of Engineers. This report reviews the 1949 report by the Federal Power Commission and presents a detailed plan for an initial development under the 1950 Treaty which would fit in with the plan for the comprehensive redevelopment of the river. This report is under consideration by the Board of Engineers for Rivers and Harbors.

c. "Preservation and Enhancement of Niagara Falls - 1953" by the International Joint Commission. This report considers the nature and design of works required for the preservation and enhancement of Niagara Falls under the conditions which will prevail after redevelopment of the hydro potential of the river. Certain works recommended to the two Governments were approved and construction began in December 1953. Completion is scheduled for July 1957.

d. "The Preservation and Improvement of Niagara Falls and Rapids - 1928" by Special International Niagara Board, published in Senate Document No. 128, 71st Congress, 2nd Session. This report was a study of the amount of water which might be diverted for power and other purposes consistent with the preservation of the scenic beauty of Niagara Falls and River. It recommended that the United States and Canada agree to the immediate construction of the initial remedial works recommended by the Board. By an exchange of notes dated 27 October 1941, the Governments of the United States and Canada agreed to commence the construction of remedial work in the Niagara River above Niagara Falls in 1942. Construction of a submerged weir in the Chippawa-Grass Island pool, as part of the remedial works recommended by the Board, was completed in 1947.

2. Charts and maps. - The general and local areas considered in this section are shown on Lake Survey charts Nos. 0, 3, 31, 256, 312 and 314, on U. S. Geological Survey Niagara Falls quadrangle, on Army Map Service drawings of Lewiston and Niagara Falls, and on the maps accompanying this section. Plate 1 shows the Great Lakes Basin; Plate 2 the plan of improvement for the Niagara River; and Plate 3 the profile of the Niagara River.

3. Bedrock geology. - The proposed Niagara River redevelopment is located along the gorge of the Niagara River, which cuts deeply into the northern limits of the Huron Plain from the city of Niagara Falls, New York, to the village of Lewiston. All bedrock of the area is of sedimentary origin and includes Devonian, Silurian, and probably Ordovician strata, all of which dip to the south at about 30 feet per



AREA	WATER SURFACE SQUARE MILES		ENTIRE DRAINAGE BASIN SQUARE MILES	
ABOVE NIAGARA FALLS				
UNITED STATES	57,390		157,340	
CANADA	30,240		106,120	
TOTAL		87,630		263,460
BELOW NIAGARA FALLS				
UNITED STATES	3,560		18,710	
CANADA	3,980		15,920	
TOTAL		7,540		34,630
GREAT LAKES				
UNITED STATES	60,950		176,050	
CANADA	34,220		122,040	
TOTAL		95,170		298,090

SPECIAL SUBJECTS – SUBREGION "D"

NIAGARA RIVER

GREAT LAKES BASIN

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

NOVEMBER 1954

SCALE IN MILES

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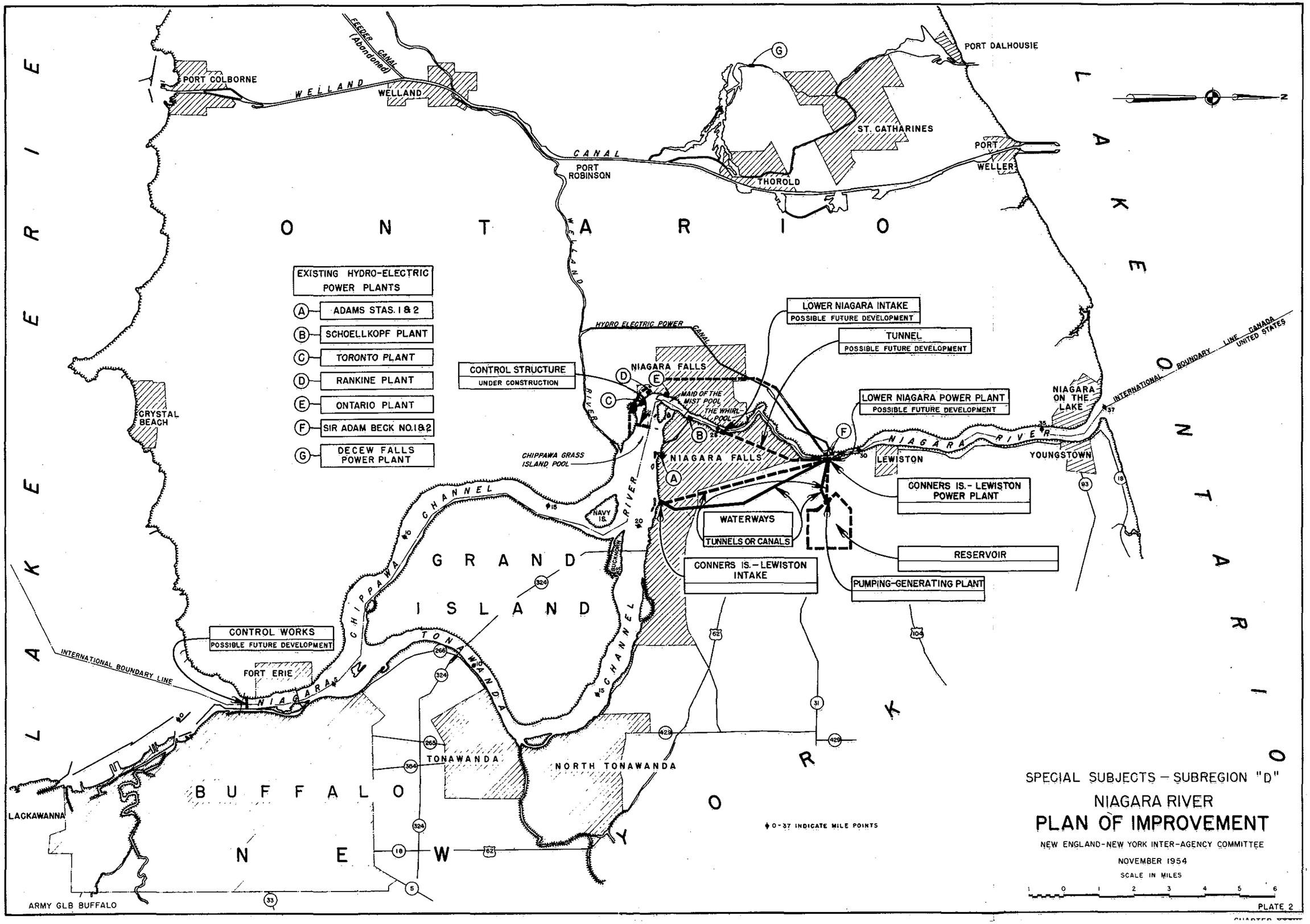
ARMY GLB BUFFALO

PLATE 1



SPECIAL SUBJECTS – SUBREGION "D"

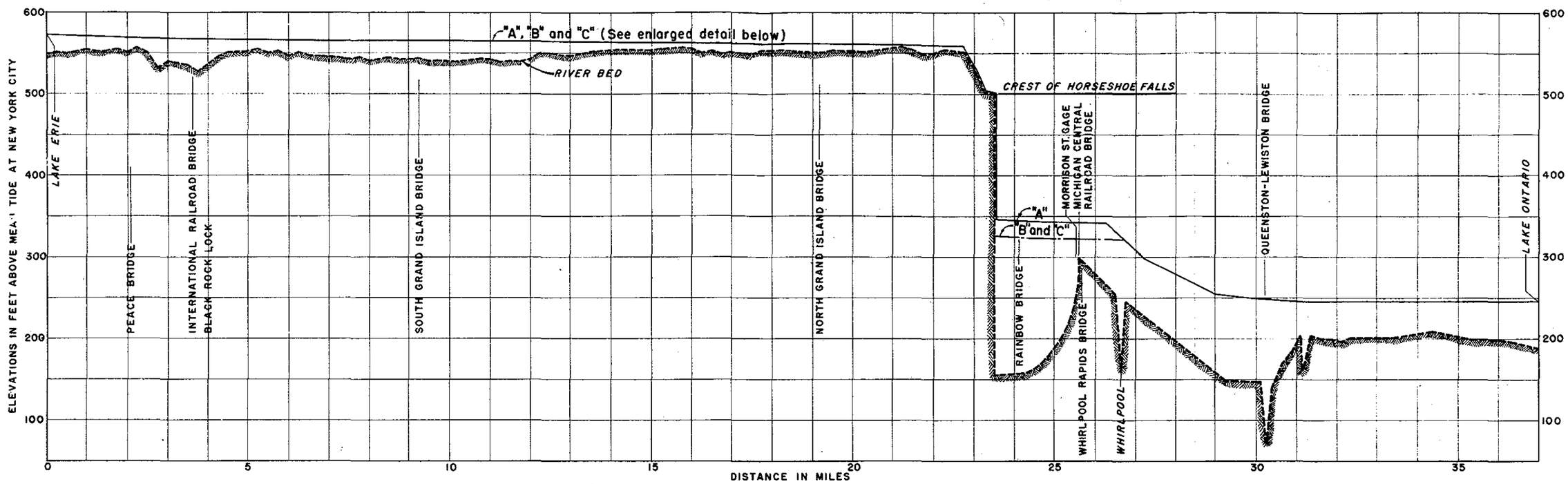
NIAGARA RIVER

PLAN OF IMPROVEMENT

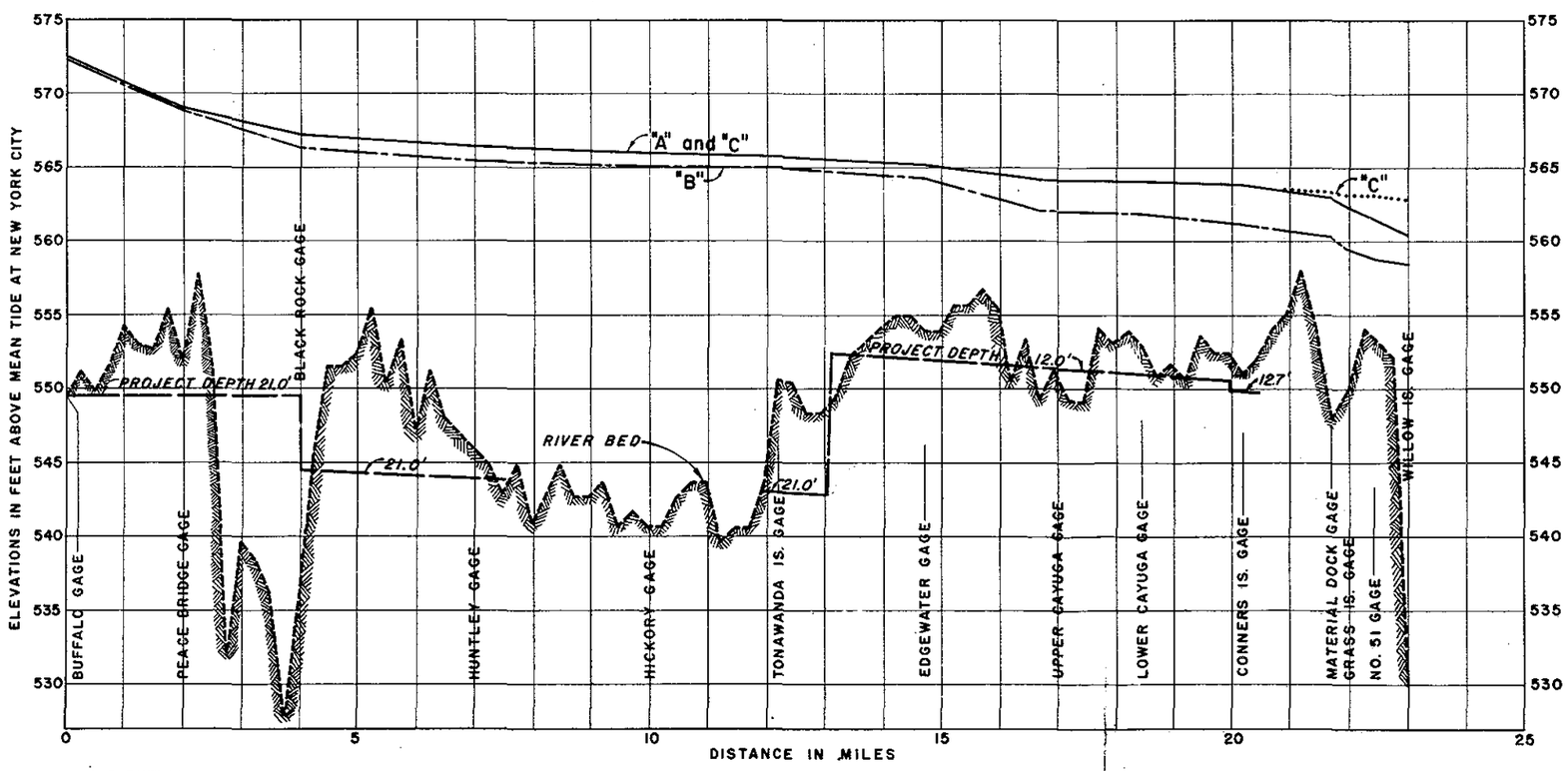
NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

NOVEMBER 1954

PLATE 2



NIAGARA RIVER



ARMY GLB BUFFALO

DETAIL OF UPPER NIAGARA RIVER

LEGEND:

Water surface profile for mean river flow under:

"A"- Present conditions of diversion.

"B"- Ultimate night-time conditions of diversion from Lake Erie to head of Cascades and Maid of the Mist Pool. No control structure at the Falls.

"C"- Same as B, above, with control structure.

NOTE:

Project depths shown are for navigation channel.

In the reach adjacent to Grand Island the profiles shown on this sheet are along the Tonawanda Channel.

SPECIAL SUBJECTS - SUBREGION "D"

NIAGARA RIVER

PROFILE

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

NOVEMBER 1954

SCALE AS SHOWN

PLATE 3

CHAPTER XXXVI

mile. Niagara Falls, near the site of the proposed power project, is formed by the water descending over the Lockport Dolomite. The rocks at the site of the proposed project belong to the Silurian and probably Ordovician systems, and include the Lockport, Clinton, Albion and Queenston formations, all of which are exposed along the gorge of the river. The extent of jointing is about normal for nonfolded sediments. In the Lockport Dolomite, which caps the Huron Plain, the jointing is very erratic and appears to have no well defined pattern. The frequency of jointing in this formation fluctuates widely over relatively small areas. Weathering is not believed to extend far below the surface generally. Investigation of exposures and drilling records of private interests show no evidence of faults or other geological disturbance in the area. In the geologic section are limestones, sandstones and shales of varying types and characteristics. From a petrographic point of view all these formations are believed to be satisfactory foundation materials.

4. Surficial geology. - The overburden in the project area averages about 16 feet thick and consists of approximately 4 feet of glacial till overlain by an average of 12 feet of dense, brown to reddish-brown, plastic clay. Near Lewiston, the site of the proposed reservoir, auger borings and test pits indicated an average of 5.6 feet of grey to reddish-brown, slightly sandy plastic clay underlain to bedrock by 4.6 feet average thickness of gravelly,

sandy silt with numerous sand lenses and with cobbles and boulders near the bottom. Both are satisfactory for impervious borrow.

5. Stream flow. - The flow in Niagara River varies with the level of Lake Erie at Buffalo. Storage in Lake Erie and the lakes above it tends to limit the range within which the discharge fluctuates. Discharge records have been maintained by the U. S. Lake Survey since 1860. The mean discharge at Buffalo for the period 1900-1949 was 194,000 cubic feet per second. The maximum and minimum monthly mean flows were 242,000 and 117,000 c.f.s., respectively. Daily mean flows since October 1935 have varied between 268,000 and 100,000 c.f.s. The minimum daily mean flow was caused by an ice jam at the head of the Niagara River in February 1936.

6. Limitations on diversion for power. - The Treaty of 1909 authorized the diversion of 20,000 c.f.s. for power in United States plants and 36,000 c.f.s. for plants in Canada. Additional diversions of 12,500 c.f.s. and 18,000 c.f.s., respectively, were authorized as emergency measures during World War II. All United States diversions are used by Niagara Mohawk Power Corporation under license from the Federal Power Commission. The 1950 Treaty provides that flow over the Falls must be at least 100,000 c.f.s. between specified hours from 1 April to 31 October and at least 50,000 c.f.s. at other times, with increases when necessary for flushing ice above the Falls or through the rapids below the Falls. The remaining flow is to be divided equally between the two countries.

15 30

7. Flow available for power. - A duration curve of water available for power, after making allowance for flow over the Falls and other authorized diversions, was prepared from synthetic flow records which were corrected for actual diversions in the past. The available flow varied from 220,000 c.f.s. to 45,000 c.f.s. with an average of 135,000 c.f.s.

8. Ice. - Ice in the Niagara River comes from two sources, the river and the lake. River ice forms only in the more quiet bays and backwater areas and is carried by the current at the next change in wind or fluctuation in water elevation. It is thin and causes no trouble. Lake surface ice forms during prolonged periods of cold weather and may be as much as a foot thick. Thin ice floes have little adverse effect downstream but windrowed ice may arrive at power plant intakes in masses which extend several feet above the water surface, indicating considerable ice depth below the surface. These formations during periods of freezing temperatures cause trouble at power plant intakes and may, under severe conditions, cause reductions in power generation. On several occasions ice jams have formed over shoals at the mouth of the river causing backwater heights up to 30 feet above normal river level.

EFFECT OF ADDITIONAL DIVERSIONS ON OTHER WATER USES

9. General. - Under the 1950 Treaty, any plan of redevelopment of Niagara River for power must recognize the primary obligation to preserve and enhance the scenic beauty of Niagara Falls and River,

and insure that conditions in the river and in Lake Erie resulting from such a plan will not adversely affect navigation or other water uses. The subject of the preservation of the scenic spectacle at Niagara Falls and the effects of increased power diversion have been reported on by several agencies, the most recent being the 1953 report by the International Joint Commission.

10. Previous studies and remedial works. - Under terms of the Treaty of 1909 in which the allowable power diversions of the United States and Canada totaled 56,000 c.f.s., the flow over the Falls for an average river discharge of 200,000 c.f.s. would have been 144,000 c.f.s. Although the spectacle with this flow was generally satisfactory, at low river discharges the flanks of the Horseshoe Falls were bare and the volume of flow over the American Falls was so small as to give a marked impression of thinness. The large volume of flow at the central portion of the Horseshoe was causing erosion and recession of the crest. In the 1928 report, the Special Board concluded that the volume of flow in the American channel could be increased by raising the surface elevation of the Chippawa-Grass Island Pool by means of a submerged weir at the head of the cascades, and that the distribution of flow around the crest of Horseshoe Falls could be improved by the construction of artificial cascades and coordinated excavation near the crest of the Falls.

11. At the time of World War II, additional diversions of water for power were authorized by temporary emergency agreements. In anticipation of periods of low river flow and to preserve the scenic

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spectacle under conditions of increasing diversions, the construction of the Niagara River submerged weir was authorized in 1941. The weir, which was completed in 1947, raised the elevation of the water surface approximately one foot at the Grass Island gage, and redistributed the flow between both Falls so that the flow over the American Falls was almost doubled. The higher elevation in the Chippawa-Grass Island Pool increased the head available for power and also facilitated the passage of ice in the river reducing the likelihood of jams at the power plant intakes.

12. International Joint Commission study. - The International Joint Commission, in accordance with Article II of the 1950 Treaty, recently completed a study of remedial works necessary to provide a suitable spectacle at the Falls under the conditions of diversion authorized by the Treaty. Extensive model tests were made by the Corps of Engineers on a model of both falls and the river at the Waterways Experiment Station at Vicksburg, Mississippi, and by the Hydro-Electric Power Commission of Ontario on a model at Islington, Ontario. Because of the adverse effect that additional diversions without remedial works would have on navigation, on the scenic spectacle at the Falls, and on existing hydroelectric power facilities, as described in the paragraphs which follow, the International Joint Commission recommended that a control structure with 13 gated openings be built in the Chippawa-Grass Island Pool extending 1,550 feet into the river from the Canadian shore immediately upstream from the Cascades. By operation of the gates in the control structure, the Chippawa-Grass Island Pool level will be

maintained in the future, under power diversions permitted by the 1950 Treaty, at the same levels as have existed above Niagara Falls since completion of the submerged weir in 1947 and under power diversions permitted prior to the Treaty. Such regulation will preserve the regimen of the river in the Chippawa-Grass Island Pool and upstream thereof and will insure that Lake Erie levels and outflows will remain unaffected. In addition, sufficient flow will be maintained over the American Falls to preserve the present satisfactory appearance prevailing since completion of the submerged weir in 1947, and scenically satisfactory flow conditions will exist at the head of Goat Island and in the vicinity of the Three Sisters Islands.

13. Effect of additional diversions on navigation. - The International Joint Commission found that under ultimate conditions of diversion there would be substantial lowering of water levels in the river above the Falls, unless works described above were provided to control the levels. This lowering of water levels in the river would be reflected to a lesser degree in a lowering of the levels of Lake Erie. At Black Rock Ship Lock and Tonawanda Harbor on the deep-draft channel, and at Conners Island at the terminus of the shallow-draft channel, water levels for a normal river discharge of 200,000 c.f.s. would be lowered about 1 foot and 2.7 feet, respectively. Comparative river surface profiles for average river discharge under present conditions and as they would be if all diversions authorized by the Treaty were taken without control works are shown on Plate 3. Present navigation utilizes the entire available navigable depth of the river and

navigation interests are requesting still greater depths from Buffalo to Tonawanda Harbor. Any lowering of levels on Lake Erie would adversely affect a large portion of the vessel traffic moving iron ore, coal, and stone on that lake by reducing depths available for navigation. After the Chippawa-Grass Island Pool control structure is completed, additional diversions for power can have no effect on navigation since the control structure will maintain the present stage-discharge relationships upstream in the Niagara River.

14. Effect of additional diversions on the beauty of the Falls. - The model studies indicated that, with a river flow of 200,000 c.f.s. and total diversions of 150,000 c.f.s., depths in the Chippawa-Grass Island Pool at the head of the upper cascades would be lowered about three feet. Under these conditions, the total flow over both the Horseshoe and American Falls would be reduced to 50,000 c.f.s. At this rate of discharge without remedial works, the flanks of the Horseshoe would be entirely exposed and the entire flow of the Horseshoe Falls would be concentrated in the central, deeper portions of the crest line. Because of the reduced depth at the head of the cascade feeding the American Channel, the flow over the American Falls would be reduced to an amount considerably below that which occurred before construction of the submerged weir. To eliminate these unsatisfactory flow conditions at the Falls, there is now under construction, under the supervision of the International Joint Commission, a control structure in the Chippawa-Grass Island Pool which will permit regulation of flow to provide a sufficient volume over the American Falls, and excavations

and crest fills in the Horseshoe Falls Cascades which will insure an unbroken crest line on the Horseshoe Falls.

15. Effect of additional diversions on ice jams. - Another effect of a reduction in river levels by additional diversions without control works would be the aggravation of the ice problem in the Niagara River. With such lowered river levels, ice packs, which under existing conditions are carried down the river and Falls without incident, could ground in the shallower portions of the river or jam against the intakes or the existing submerged weir more easily. Since the diverted water would be returned to the river at the foot of the lower rapids, additional diversions can have no effect on the possibility of the formation of ice jams at the river mouth. The Chippawa-Grass Island Pool control structure will maintain river levels upstream to eliminate adverse effects on ice in the upper river. The structure will be equipped with gates which will lower to open so that low and normal runs of ice can pass the structure while pool levels are being maintained. For unusually heavy ice runs, all sluices will remain fully open to minimize obstruction to ice. During such periods, which are usually of short duration, normal pool regulation will be suspended as the safe passage of ice would be a more important factor.

EXISTING HYDROELECTRIC PLANTS

16. General. - Upon completion of the Sir Adam Beck No. 2 plant in 1956, the hydroelectric power plant installations using water diverted

from Lake Erie or Niagara River, in the United States and Canada, will aggregate about ~~2,493,000~~ 2,462,800 kilowatts. Data on these plants are given in Table 1. The locations of the plants are shown on Plate 1.

Table 1 - Existing hydroelectric power development - Niagara River, Subregion "D"

Name of Plant	Approx. net head (ft.)	Installed capacity (kw)	Normal water use (cfs)	Normal water utilization (kw/cfs)	25-cycle generation (kw)	60-cycle generation (kw)
United States						
Adams	135	80,000	8,800	9.1	80,000	--
Schoellkopf	215	334,800	23,400	15.6	262,800	72,000
Total United States		414,800	32,200		342,800	72,000
Canadian						
Sir Adam Beck						
G.S.No. 1	294	373,000)	64,000 (2)	21.9	373,000	--
G.S.No. 2	(1)	1,200,000)		(1)	--	1,200,000
Ontario	180	138,000	11,100	12.4	138,000	--
Toronto	137	108,000	15,500	7.0	108,000	--
Rankine	135	80,000	10,600	7.6	80,000	--
DeCew	280	149,000	7,600	19.6	56,000	93,000
Total Canadian		2,048,000	108,800		755,000	1,293,000
Grand Total		2,462,800	141,000		1,097,800	1,365,000

(1) Plant under construction; data not available.
(2) Data estimated.

17. New Canadian plant. - The Hydro-Electric Power Commission of Ontario has under construction the Sir Adam Beck-Niagara Generating Station No. 2 with a total installed capacity of 1,200,000 kilowatts. A combination of tunnels (two tunnels of 20,000 c.f.s. capacity each) and open canal (40,000 c.f.s. capacity) is being constructed in connection with this station. The intake is near the present Sir Adam Beck No. 1 intake in the vicinity of Chippawa. The No. 2 Station will be located in the Niagara Gorge upstream from Plant No. 1. The first generator in the new plant went on the line in April 1954. Development of 900,000 kilowatts is scheduled for completion in 1956. The remainder of the main plant and a pumped storage reservoir and plant to the west will be built later.

18. Market for additional Niagara power. - The marketing area assumed for the Niagara Falls redevelopment comprises central and western New York, northwestern Pennsylvania and northeastern Ohio. Population of this area is shown in Table 2. It is estimated that additional power from the Niagara River could be utilized in this region together with possible power available from the United States share of the St. Lawrence River Project. It is estimated that the construction of 3,561,000 kilowatts of additional capacity in the assumed Niagara market area will be required by 1960 and that by 1975 there will be need for 12,145,000 kilowatts of additional capacity. Of these requirements 2,106,000 kilowatts are now under construction or scheduled for early construction. The remaining required capacity would provide a market for power from the

Niagara River redevelopment.

Table 2 - Population of Niagara power market area, Subregion "D" and vicinity

Location	Year and Population			
	1950	1940	1930	1920
Western and central New York	3,136,600	2,797,300	2,700,000	2,345,000
Western Pennsylvania	808,200	766,900	732,100	727,500
Northeastern Ohio	2,444,500	2,114,000	2,072,900	1,645,300
Total	6,389,300	5,678,200	5,505,000	4,718,400

PLANS FOR POWER DEVELOPMENT

19. Federal Power Commission plan. - The plan for the utilization of the United States share of the waters to be diverted for power, presented in the report referred to in paragraph 1a, was developed by the Bureau of Power of the Federal Power Commission in cooperation with the Niagara Mohawk Power Corporation and the New York State Power Authority. The main feature of the plan is a new 1,080,000 kilowatt plant to be located near Lewiston, New York, which would develop most of the head between the Chippawa-Grass Island Pool and Lake Ontario. Also included is a 22,000 acre-foot storage reservoir about one mile east of the power plant for storing water diverted during off-peak power hours for release during on-peak power hours. Since the reservoir would be higher than upper Niagara River levels, the storage of water would require a pumping plant of 375,000 horse-power. A large portion of the energy expended for pumping would be recovered when the water was released through the pumps which would be designed to act as turbines as well as pumps.

The Lewiston high-head development would utilize the portion of the United States share of the water in excess of 18,000 c.f.s. Another feature of the Commission plan contemplates the construction of a new 120,000 kilowatt plant to be located adjacent to the high-head plant to develop the head between the Maid-of-the-Mist Pool and Lake Ontario. It would utilize the same 18,000 c.f.s. diverted from the river through the existing Schoellkopf plant which would continue in operation for 25-cycle generation. The existing Adams plant would be used only for voltage regulation and for standby emergency use. The Commission plan also includes works at the head of the river for regulating the flow of Niagara River. The Commission points out that such works would permit weekly, seasonal, and cyclic regulation which would provide a very material increase in the dependable capacity of the redevelopment.

20. Corps of Engineers plan. - In the 1954 report referred to in paragraph 1b, the District and Division Engineers concluded that the most feasible plan to utilize the United States share of the water for power conforms generally with the Federal Power Commission plan and includes: a new high-head development at Lewiston, supplemented by a pumped-storage reservoir, to utilize the additional water made available by the 1950 Treaty; full integration of the facilities of existing power plants with the facilities of the other features of the ultimate development in order to make the best use of the water available for power; and weekly or seasonal regulation of the flow of the Niagara River. Since there is an immediate need for power in the Niagara area, it is feasible and advisable at this time to develop a detailed plan

for an initial development to utilize for power the additional waters made available by the 1950 Treaty. A plan for such initial development, which would be a logical first step in the ultimate development, is presented in detail in the report. It would be adaptable to the requirements of the other features of a comprehensive development. The initial development would consist of the high-head plant, supplemented by a pumped storage reservoir. The features of the comprehensive plan, upon which further studies are required, comprise the integration of the existing plants into the comprehensive plan and the weekly or seasonal regulation of the Niagara River.

21. Plan for initial development. - The plan contained in the 1954 report is described in some detail in the succeeding paragraphs to illustrate the types and magnitudes of structures needed for development of power from the additional water made available by the 1950 Treaty. Separate bills were introduced in the 83rd Congress to provide for construction of the power development by the State of New York, by private interests and by the Corps of Engineers. It is probable that the agency selected by Congress will make some changes in the plan outlined below. The features of this plan for initial development comprise: an intake in Niagara River; a canal or tunnel headrace; a 1,512,000 kilowatt powerhouse near Lewiston; a 30,000 acre-foot reservoir; a 333,000 horsepower pump generating plant at the reservoir; a canal or tunnels connecting the reservoir and the Lewiston powerhouse; and a control structure (now under construction) at the head of the Cascades for regulation of the flow over the Falls and the level of the Chippawa-Grass

Island Pool. The average annual generation would be 7,612,000,000 kilowatt-hours with the canal plan and 7,318,000,000 kilowatt-hours with the tunnel plan.

22. Conners Island intake. - The intake would be located along the shore in the vicinity of Conners Island. The intake would be a reinforced concrete building 50 feet wide and about 1,000 feet long. There would be 18 openings, 40 feet by 38 feet, with provision for trash racks, gates and stop logs with the necessary hoists and other equipment. The total area of the openings through the trash racks would permit diversion of 65,000 c.f.s. at a velocity of 2½ feet per second. A transition section about 400 feet long would connect to a headrace. The intake would necessitate relocation of an existing marine terminal. An approach channel about 3,000 feet wide and 3,400 feet long would be excavated in the bed of Niagara River leading to the intake.

23. Headrace. - Two plans for the headrace between the intake transition and the Lewiston powerhouse were considered in detail. One headrace would consist of an unlined canal with twin tunnel sections under two areas in the city of Niagara Falls where an open canal would seriously interfere with existing or proposed transportation facilities. The canal would be excavated in rock, 125 feet wide at the bottom with side slopes of 15 feet on 1. The total length of waterway, including the tunnel sections, would be about 25,100 feet. The upper end of the canal would require retaining walls as the water surface would be above the rock. Concrete lining would be provided where Rochester shale is exposed in the lower part of the canal walls for a distance of about 4,900 feet at the Lewiston end of the canal. Numerous bridges would be

required to carry through streets and railroads, and utility crossings would be extensive. The alternative tunnel headrace would consist of twin 46-foot diameter tunnels excavated in rock and lined with concrete. The total length of the tunnel waterway from the intake transition to the surge basin at the Lewiston powerhouse would be about 24,000 feet.

24. Forebay and gatehouse. - The canal would terminate in a forebay about 280 feet wide and 970 feet long located west of Lewiston Road. A reinforced concrete gatehouse 1,030 feet long and 62 feet wide would contain trash racks, stop logs and headgates for the penstocks. Penstocks would be provided with hoist-operated slide gates 20 feet wide and 34 feet high. A gated spillway would be provided at the northerly end of the forebay to limit the height of the surge in the event of a sudden shutdown of the powerhouse.

25. Tunnel manifold and surge basin. - Distribution of water from a tunnel headrace would be effected through a manifold of decreasing diameter to serve seven penstocks from each tunnel. A differential surge basin would be provided at the top of the gorge adjacent to the powerhouse. The basin would be about 170 feet wide and about 1,000 feet long and would be divided into separate basins for each tunnel with individual risers for each penstock.

26. Lewiston powerhouse. - The powerhouse would be located at the foot of the lower rapids, a short distance upstream from the Sir Adam Beck-Niagara Generating Station No. 1. The structure would be reinforced concrete and would contain fourteen 108,000-kilowatt generating units, two house service units, and an erection bay. The powerhouse

would be about 1,030 feet long and 80 feet wide. Access to the structure would be by a road along the river downstream from it or by an inclined railway opposite the erection bay which would be able to lower and raise a loaded railway car. Turbines would be vertical shaft, single runner, Francis-type, with plate steel spiral casting and concrete elbow draft tube. Turbines would be 150,000 horsepower at best gate and 303-foot head. Generators would be rated 108,000 kilowatts, 13.8 kilovolts, 120 revolutions per minute, 0.9 power factor. Transformers would be located on the draft tube deck on the river side of the powerhouse, to step up generated voltage to 115 and 230 kilovolts. Transmission lines would carry power from the transformers to the switchyard, which would be located about one-half mile east of the powerhouse for the canal plan headrace and somewhat closer for the tunnel plan. Penstocks between the forebay or tunnel manifold and the turbine inlets would be 20-foot diameter plate steel. Individual butterfly valves would be installed at the lower end of the penstocks for the tunnel waterway plan.

27. Reservoir. - The reservoir would have an area of about 1,100 acres and would be formed by a rock-filled embankment with impervious core. The top elevation of the levee would be 644.5 feet to provide freeboard of 4.5 feet above the maximum pool level of 640 feet which is the level required for a storage capacity of 30,000 acre-feet. Other reservoir arrangements are possible and should be studied in the planning stage of the project.

28. Pumping-generating plant. - The plant would be located to pro-

vide the shortest practicable waterway between the reservoir and the Lewiston plant. Different locations would be selected for the canal and waterway plans. The structure would be about 770 feet long and 70 feet wide, of reinforced concrete, and would contain nine 37,000 horsepower motor-driven pumps so designed as to perform as turbine generators under reverse flow conditions. Ten, plate steel penstocks 20 feet in diameter would be provided, each having headgates to permit unwatering of the penstock and scroll case. Gates would be located in a reinforced concrete building about 705 feet long and 60 feet wide. A hoist-operated slide gate, 17 feet wide and 26 feet high, would be provided for each penstock. The penstock not serving one of the pump-generating units would be provided with a group of three 120-inch Howell-Bunger valves to provide greater capacity for release of reservoir water.

29. Reservoir-Lewiston waterway. - Alternative waterways between the reservoir and the Lewiston forebay, consisting of an open canal or tunnels, were considered. The bottom of the canal would be level at the same elevation as the Lewiston forebay, 70 feet wide on bottom, with 15 vertical on 1 horizontal side slopes. The bottom of the canal would be in the Rochester shale and the walls would be lined with concrete where this member of the rock formation would be exposed. Twin circular tunnels of 36-foot diameter were found to be the most economical size for the alternative tunnel plan of waterway. They would be concrete lined and extend on a straight alinement from an alternatively located pumping-generating plant at the reservoir, about 1,600 feet

northwesterly of that considered for the canal plan, to the Lewiston power plant tunnels. Provision would be made for closure at both ends of the reservoir-Lewiston tunnels.

30. Economics of the power plan. - In the report of the Corps of Engineers, the economics of the plan were studied on the basis of both canal and tunnel-type headraces and private and public financing. Total first costs of the plan were estimated at $366,010,000 for the canal plan and $416,500,000 for the tunnel plan, based on July 1954 price levels. The United States share of the estimated cost of the remedial works above the Falls, described briefly in paragraph 14, were included in the total estimated cost of the redevelopment. Under private financing, interest during an average construction period of five years would increase the total investment to $402,611,000 for the canal plan and $458,150,000 for the tunnel plan. Annual charges including interest on investment, amortization, maintenance and operation, insurance and loss of taxes on lands and improvements to be taken for the project would total $46,449,000 for the canal plan and $52,790,000 for the tunnel plan. The at-site power values for capacity and energy made available by the redevelopment as determined by the Federal Power Commission are $23.00 per kilowatt-year and $0.00284 per kilowatt-hour, respectively. Based on these values, the benefit-cost ratio for the initial portion of the redevelopment of the Niagara River for power by private interests would be 1.31 to 1.0 for the canal plan and 1.14 to 1.0 for the tunnel plan, which indicates justification of both plans but a more favorable ratio for the canal plan.

31. In deciding which of the waterways should be constructed, consideration must be given to the disadvantages of canal waterways. Although adequate provision has been made in the estimates for canal waterways for all lands which would be taken for the project for permanent occupation or temporary use during construction, for the relocation of all existing utilities, for numerous highway crossings, for minimum interference with railroad facilities and for landscaping and fencing along the proposed canals, there are certain damaging effects which cannot be evaluated. There is strong local opposition to the canal plan by the city of Niagara Falls, the towns of Niagara and Lewiston and industrial and civic interests therein, because of interference with normal access and development in areas bordering the proposed canal right-of-way. The advantages and disadvantages of both types of waterway from an operational and maintenance standpoint must also be considered in selecting the most desirable plan.

SECTION II - HARBORS AND BEACH EROSION ON LAKE ONTARIO

INTRODUCTION

1. This section is concerned with navigation and beach erosion problems on the United States shore of Lake Ontario. Navigation and beach erosion problems on inland lakes and streams are minor and need not be considered in this section. Lake Ontario is the scene of considerable traffic in both deep-draft and light-draft navigation. The lake shore is used extensively for recreational purposes and many summer and year-round homes and cottages are located there.

2. In general, the New York shores of Lake Ontario are subject to varying degrees of erosion by wind-developed waves. Although rock is exposed at or above lake level for approximately one-third of the entire shore, it does not rise to sufficient height to provide full protection during storms at high stages. Most of the beaches are of insufficient height to provide protection to the bluffs or enough room for recreational use at high lake stages. Many types of shore protection have been constructed. Some are effective, but many were completely destroyed during high lake stages of 1951-1952.

3. In general, existing facilities are adequate for the needs of deep-draft navigation. Rochester Harbor, Great Sodus Bay Harbor, and Oswego Harbor have been improved to accommodate the deep-draft commercial traffic prevailing there. Other Federal improvements for smaller commercial vessels and recreational craft at Wilson Harbor, Olcott Harbor, Little Sodus Bay Harbor and Sackets Harbor adequately serve the present traffic at those ports.

4. The lake is the scene of considerable recreational boating activity. The recreational vessels operated thereon include a large number of craft permanently based in the area and a considerable number of visiting craft cruising between points on the Great Lakes and from points on the St. Lawrence River and the New York State Barge Canal. Additional facilities for basing such craft and for providing safe refuge during times when adverse weather conditions prevail on the lake are desirable.

NAVIGATION

5. Scope. - This part of the section is comprised principally of information on navigational facilities and activities at individual localities located along the United States shore of Lake Ontario. Although the Niagara River lies in the Lake Erie-Niagara River drainage, the lower part, in regard to navigation, is discussed in general terms in paragraph 14 because it is more closely related to Lake Ontario than to Lake Erie. Maps showing the shore characteristics of Lake Ontario and maps of individual localities studied along the Lake Ontario shore are included.

6. Factors affecting navigation. - General data on wind, water levels and fluctuations, and geology pertinent to Lake Ontario, are covered under the Beach Erosion portion of this section. All depths mentioned in the reports on individual harbors are referred to low water datum on the lake (244.0 feet above mean tide at New York City). The average elevation of Lake Ontario varies irregularly from year

to year, but is subject to a consistent seasonal rise and fall, the lowest stages prevailing during the winter months and the highest during the summer months. Ordinary fluctuations of the lake surface are from 4 feet above to 0.5-foot below low water datum. Occasionally, superimposed on these variations, are further fluctuations of short duration, caused by changes in wind and barometric pressure, which may range from a few inches to several feet, and which vary from point to point on the lake, being most severe at the extreme ends of the lake. The average season of deep-draft navigation on Lake Ontario is from about 15 April to 15 December. The navigation season for light-draft commercial fishing craft is from about 15 March to 15 December, and the average season of recreational boating activity is from about 30 May to 30 September.

7. Nature of traffic in study area. - Commercial navigation on Lake Ontario is predominantly Canadian. There is little intra-lake movement, commerce consisting principally of traffic to and from Lake Ontario ports to upper lakes and St. Lawrence River ports. Additional commerce originates at points inland reached through the New York State Barge Canal, entering Lake Ontario via the Barge Canal terminus at Oswego. Upper lakes traffic enters via the Canadian Welland Canal from Lake Erie. Oswego, Great Sodus Bay, and Rochester are the major United States ports on the lake and handle considerable commerce carried in deep-draft lake freighters. Canadian vessels, small enough to negotiate the locks built by the Canadian government around the rapids of the St. Lawrence River, also carry considerable tonnages of commerce

from these ports. Completion of the St. Lawrence Seaway Project will enable this traffic to move in deeper-draft vessels.

8. Light-draft commercial navigation on Lake Ontario is subdivided into two general classes; barge traffic to and from the Barge Canal terminus at Oswego and commercial fishing vessels active near the easterly and westerly ends of the lake. Lake Ontario is a popular region for recreational boating activity, with large numbers of such craft both permanently based at points along the shore and in the lower Niagara River, and visiting from ports on other connected waterways.

9. Commerce. - Commerce consists principally of the receipt and shipment of bulk commodities. Principal traffic, through U. S. ports, is the shipment of anthracite and bituminous coals from Rochester and Great Sodus Bay and the shipment and receipt of coal and receipt of grains at Oswego. Much of the coal is shipped to Canadian ports. Smaller amounts of newsprint paper, wood pulp, pulpwood, cement, and pig iron are also handled, principally at Oswego. Barge Canal traffic includes grains, petroleum products, iron and steel scrap and manufactures, chemical products, sugar, wood and paper. Most of this traffic also goes through the Welland Canal to or from Lake Erie ports.

10. The section on the St. Lawrence River Seaway and Power Project in Chapter XXIX includes a table showing the character and volume of potential commerce expected through the Seaway when it is completed. Considering the nature of the existing traffic at

the United States ports on Lake Ontario, it is believed that opening of the Seaway will have little effect on their commerce. The nature of the commodities expected to move through the Seaway is such that it is believed that the greater portion of the upbound traffic would be routed through Lake Ontario to United States ports on Lake Erie and the upper lakes, or to Canadian ports on Lake Ontario and the upper lakes. That part of the upbound and downbound traffic that will be handled at United States ports on Lake Ontario is representative of traffic that already exists and is carried in the small Canadian vessels of the St. Lawrence River type. The Seaway will permit the employment of deeper-draft vessels in this traffic and the resultant decrease in transportation cost may result in a relatively minor increase in the volume handled. However, barring new, large scale development by industries requiring large quantities of bulk raw materials, an appreciable traffic in new commodities or a large increase in existing traffic is not expected at the ports or at the inland cities served.

11. Commercial fishing on Lake Ontario centers around Youngstown on the lower Niagara River, Wilson Harbor, near the west end of the lake, and Oswego and the Chaumont Black River Bay area at the east end of the lake.

12. Harbor and channel facilities required for traffic. - Lake vessels engaged in traffic between ports on Lake Ontario and downstream on the St. Lawrence River as far as Ogdensburg are usually adequately served by depths of 20 to 22 feet. Vessels that can pass

through the existing Canadian canal locks in the St. Lawrence River require depths of 14 feet, barge traffic requires depth of about 12 feet, while commercial fishing and recreational craft are adequately served by depths of about eight feet. Harbor facilities required include wharves with adequate depths along side, cargo handling facilities, and, in regions of considerable traffic density, protected moorings and repair facilities. At present, there are no facilities available in United States ports on Lake Ontario for major repairs to large vessels.

13. Localities covered by separate reports. - The following localities along the New York State shores of Lake Ontario are discussed.

Wilson Harbor	Port Bay
Olcott Harbor	Little Sodus Bay Harbor
Oak Orchard Harbor	Oswego Harbor
Hamlin Beach State Park	Little Salmon River
Braddock Bay	Port Ontario
Rochester Harbor	North (Sandy) Pond
Irondequoit Bay	Henderson - Chaumont Bay Area
Pultneyville Harbor	Black River Bay
Great Sodus Bay Harbor	Sackets Harbor

14. Other localities considered. - In addition to the localities listed above, all of which are on Lake Ontario, the lower Niagara River below Niagara Falls, in its navigation aspects, is

also considered, since navigation thereon is more directly related to Lake Ontario than to the upper river or Lake Erie. The lower river is navigable from its mouth upstream to Lewiston, N. Y., a distance of seven miles. The only United States settlements on this reach are Fort Niagara, at the mouth; Youngstown, which is one mile upstream; and Lewiston, at the head of navigation. Youngstown is an important base for commercial fishing operations in western Lake Ontario. The only other commercial navigation activity is in lake sand which is dredged in Canadian waters of the lake and delivered to Lewiston and the Canadian passenger steamer operating between Toronto and Queenston, Ontario. Existing facilities are adequate for this commerce and there is no foreseeable development of new traffic or appreciable expansion of the existing traffic. Commercial and private facilities are available for the present extensive recreational boating activity in the area, particularly at Youngstown and Lewiston. Any future expansion in recreational traffic can be easily accommodated by expansion of these existing localities. Niagara River in this reach has an unobstructed channel from 1,500 to 2,000 feet wide, 30 to 70 feet deep, and is sheltered by high, steep banks. Since there is no present need for improvements, and since it is unlikely that such a need will arise in the foreseeable future, a separate discussion on this locality is not presented.

WILSON HARBOR, NEW YORK

15. Location. - Wilson Harbor is located in Niagara County on the south shore of Lake Ontario in northwestern New York. The harbor is at the mouth of the East Branch of Twelve Mile Creek, about 12 miles east of the mouth of the Niagara River. The nearest protected harbors are at Youngstown in the Niagara River, about 13 miles distant by water, and Olcott Harbor, six miles east of Wilson. The nearest large port to the eastward is Rochester Harbor, which is about 67 miles distant. The area is shown on Plate 7, and U. S. Lake Survey Charts Nos. 2 and 25.

16. Description of harbor and improvements. - The widened mouth of the East Branch of Twelve Mile Creek forms Tuscarora Bay which has a controlling depth of about two feet and provides good anchorage for shallow-draft vessels. The bay is approximately 400 feet wide and 0.8 mile long parallel to the lake shore and is separated from it by a narrow strip of land called "The Island". The entrance to the bay is near the eastern end through a dredged entrance channel protected by piers. There is a public dock at the east end of the bay near the entrance and also a boat livery and fish dock. Beccue Island, which is approximately 11 acres in area, lies near the center of the bay. It is formed by the mouth of the East Branch of Twelve Mile Creek on the west and an arm of the bay on the east and is connected to the mainland by a narrow isthmus. This island is the home of the Wilson Yacht Club. There are no

towns directly tributary to Wilson Harbor other than the village of Wilson. According to the U. S. Census Report of 1950 the population of the village of Wilson was 962 while the total population of the town of Wilson was 3,696. However, in summer the population of the town of Wilson is increased considerably by vacationists from Buffalo, Niagara Falls, Tonawanda, North Tonawanda, and Lockport, who occupy cottages at Wilson Harbor and along the nearby lakeshore. At Wilson Harbor, the Sunset Beach colony, located on "The Island", consists of about 200 summer cottages. The area surrounding Wilson is a rich fruit belt and the industries of the area are mainly related to the shipment or processing of orchard and agricultural products. Improved highways connect Wilson Harbor with main lines of travel leading to all parts of the country. The village itself is on a New York Central Railroad branch line leading from Tonawanda and Niagara Falls to Rochester and Oswego. However, there are no rail connections to the harbor which is about 1-1/2 miles north of the railroad. There are no bridges across the waterways used by navigation at the harbor.

17. Physical factors affecting navigation. - The controlling depth in the entrance channel of the Federal project, which begins at the 8-foot depth contour and extends 800 feet inward to Tuscarora Bay, is six feet. A channel from the scutherly end of the Federal project limit, to and alongside of the municipal dock located in Tuscarora Bay at the foot of Ontario Street, is maintained to a depth of six feet by local interests. The rest of Tuscarora Bay is

not dredged and has natural depths varying from five feet to one foot. Although storms have little or no effect on the interior of the bay due to its narrow width and the wave barrier formed by "The Island", the entrance to Wilson Harbor is exposed to storms from west through north to east. Northerly storms, with a fetch of nearly 40 miles, blow directly into the entrance channel.

18. Terminal and transfer facilities. - A village-owned dock, about 150 feet long and located at the foot of Ontario Street at the inner end of the east pier, is open to the public and is utilized by local and transient pleasure craft. Also located at the easterly end of the bay is a combined boat livery and fish dock which is used primarily by a small fishing fleet which operates out of Wilson Harbor. Beecue Island has about 600 feet of developed frontage and has slips for about 70 small craft. It also has a marine railway, a boat storage building and a yacht club building. Other facilities include open and covered boat storage space, marine supplies, repairs, and provisions. There are no commercial wharves other than the fish dock mentioned above.

19. Federal improvements and studies. - The existing Federal project at Wilson Harbor, adopted by the River and Harbor Act, approved 2 March 1945, based on report printed in House Document 679, 76th Congress, 3rd session, provides for the restoration of the east and west parallel piers, 850 feet and 832 feet in length, respectively, and for an entrance channel 80 feet wide and eight

feet deep. All aspects of local cooperation have been complied with and the existing project was completed in 1950 at a total cost of $357,317.80, of which $329,976.55 was for new work and $27,341.25 for maintenance. The latest report on Wilson Harbor, New York, is contained in the Survey Report of the Coasts of the Great Lakes for Harbors of Refuge for Light-Draft Vessels. The report was prepared by a Special Board of Engineers consisting of the District Engineers of the Milwaukee, Duluth, Buffalo, Chicago, and Detroit Districts who were appointed to carry out and report on a survey of the coasts of the Great Lakes with a view to the establishment of harbors of refuge for light-draft vessels as authorized in section 4 of the River and Harbor Act approved 26 August 1937. Wilson Harbor was one of the sites considered in this report which was submitted by the Special Board on 10 September 1942. The improvements to Wilson Harbor desired by local interests were the reconditioning of the existing piers and the providing of an entrance channel from deep water in the lake to the inner harbor. The plan of improvement considered, which would provide an adequate harbor of refuge for light-draft vessels, consisted of reconstructing the existing piers and dredging an entrance channel at an estimated first cost to the Federal Government of $134,000 and $2,000 annually for maintenance thereafter. Justification for the improvement was based on benefits accruing to recreational craft commerce and on the material incidental benefits resulting to the commercial fishing industry.

Since the scope of House Document 679, 76th Congress, 3rd session, containing the report of the Chief of Engineers of 19 March 1940, coincided with the above-noted report of 10 September 1942, the Special Board recommended that no improvements be made to Wilson Harbor other than those recommended in the above-mentioned House Document.

20. Other improvements. - In 1937 and 1938 local interests constructed a small hydraulic dredge at a cost of $3,000 and spent about $1,000 excavating the inner harbor channels. There are no other improvements to Wilson Harbor other than those mentioned previously in this section.

21. Commerce and harbor use. - Small amounts of freight were formerly brought into Wilson Harbor, but none have been reported since 1904. The fishing grounds located in Lake Ontario off Wilson Harbor have been fished commercially by boats based at Wilson for almost a century. However, at present only four fishing boats are based at Wilson Harbor. Statistics for 1952 show the net catch of fish to be 59 tons and the total round trips made by fishing vessels to be 400. However, the chief activity in Wilson Harbor centers around the use of recreational craft. There are approximately 100 pleasure craft, exclusive of outboards, based at Wilson Harbor and approximately 250 transient craft visit the harbor each season.

22. Desired improvements. - Other than for the existing Federal project at Wilson Harbor, New York, local interests have not requested

further improvement. Available information indicates that present needs of navigation are adequately served by the existing Federal project and the privately-owned facilities and improvements.

23. Conclusion. - Further improvement of Wilson Harbor is not necessary at this time, since the existing needs of navigation and commerce are adequately provided for.

OLCOTT HARBOR, NEW YORK

24. Location. - Olcott Harbor is located in the town of Newfane, Niagara County, New York, on the south shore of Lake Ontario, at the mouth of Eighteen Mile Creek. It is six miles east of Wilson Harbor, New York, the nearest improved harbor, and 61 miles west of Rochester Harbor, New York, both of which are active Federal projects. The area is shown on Plate 8 and U. S. Lake Survey Charts Nos. 2 and 25.

25. Description of harbor and improvements. - Olcott Harbor consists of a pier-protected channel way in the mouth of Eighteen Mile Creek. There is an existing Federal project at the harbor which is described in detail in paragraph 29. The width between piers is 200 feet, with the Federally improved entrance channel about 140 feet wide, extending from deep water in the lake to the inner end of the east pier. The controlling depth in the entrance channel is presently about six feet. Immediately within the creek mouth, there is an area about 300 feet long and 400 feet wide, with depths ranging up to 16 feet and averaging about six feet. There

the channel way contracts to a width of about 98 feet at the Main Street Bridge, about 600 feet upstream from the inner end of the east pier. The creek, with a drainage area of 85 square miles, rises about 14 miles south of Olcott and two miles east of Lockport. It flows westerly from its source to a point near Lockport, then turns north to Olcott. A power dam, located at Burt, about two miles above the harbor, regulates to some degree the flow in Eighteen Mile Creek. In addition to the natural run-off of the area, the creek receives a small amount of water from the New York State Barge Canal at Lockport. Depths in the creek upstream from the Main Street Bridge to about one-half mile north of Burt, range up to 16 feet with an average of about five feet. Widths of the stream proper average about 150 feet. A quarter mile from the mouth, the banks rise to a height of about 60 feet, with the tops of banks 400 feet apart. Numerous low marshy areas are adjacent to the stream.

26. Niagara County is considered to be the tributary area for Olcott Harbor. Olcott serves as a popular resort for summer vacationists; the people so visiting the area are drawn primarily from Lockport and vicinity, but some, particularly boat owners, come from as far as Niagara Falls and Buffalo. Although the major commercial activity at Olcott is catering to summer visitors, the nearby city of Lockport has plants manufacturing wood and paper containers, radiators, machine tools, metal products, chemicals, and

textiles. There are also several food processing plants in the city. Within the town of Newfane, there are several small food processing plants, a textile plant, and a machine tool factory. There are sand and gravel plants and some small stone quarries in the county, and fruit growing and general agriculture are important throughout the area. According to the 1950 U. S. Census Report, the population of Niagara County was 189,992, including 5,801 in the town of Newfane and 25,133 in the city of Lockport. There are no railroad facilities at Olcott Harbor although a branch line of the New York Central passes through Burt, about two miles south of the harbor. Improved highways serve the area while the nearest airports served by regularly scheduled flights are located at Buffalo, New York, 28 miles south, and Niagara Falls, New York, 19 miles to the southwest. The only bridge that crosses the navigable portion of Eighteen Mile Creek is the Main Street Bridge, a fixed highway bridge, located approximately 600 feet upstream from the inner ends of the piers.

27. Physical factors affecting navigation. - Water stages in the portion of Eighteen Mile Creek between the lake and the power dam at Burt are equivalent to and dependent upon the surface elevation of Lake Ontario. The occasional oscillations of the lake surface caused by changes in wind and barometric pressure are modified in the creek by the effect of the harbor basin. The harbor is exposed to storms from the west, northwest, north and northeast, with

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winds from the west and northwest, having fetches of 54 and 36 miles, respectively, being the most frequent. North winds have the greatest effect; waves from that direction enter the harbor between the piers and create turbulent conditions in the present mooring areas. The fixed highway bridge mentioned previously, due to its low vertical clearance, presents an obstacle to the expansion of mooring facilities upstream of the bridge. The bridge has a clear span of 157 feet between abutments and a vertical clearance of 8.1 feet above low water datum. Any plan for using Eighteen Mile Creek above this bridge for mooring boats larger than small inboards or outboards would necessarily involve alteration of this bridge.

28. Terminal and transfer facilities. - There are no commercial terminal or transfer facilities, as such, at the harbor. Local excursion passenger traffic, consisting of small tour boats carrying passengers for short rides on the lake, and fresh fish are handled over the shoreward 200 feet of the east pier. No public landing is located at Olcott Harbor and access to the water is over private lands and docks. On the west side of the harbor, the Olcott Yacht Club operates a marine railway for the benefit of its members. On the east side, a boat company operates another which is open to the public on equal terms. Gasoline, oil and marine supplies can be obtained from the latter, and winter storage for about 100 boats and marine repair facilities are also available.

29. Federal improvements and studies. - The original project, adopted by the River and Harbor Act of 2 March 1867, and modified in 1872 and 1891, provided for construction of two parallel timber-crib piers with a dredged channel between them from deep water in the lake to the Main Street Bridge. This project was completed in 1892 and subsequently dropped from the list of active improvements in 1896. The project was reactivated by the River and Harbor Act of June 13, 1902, but was again dropped from the list of active improvements in 1906. The existing project was adopted by the River and Harbor Act of 4 March 1913, in accordance with the report submitted in House Document 780, 62nd Congress, 2nd session. This provided for a channel 12 feet deep and 140 feet wide, from the lake to the inner ends of parallel timber-crib piers about 200 feet apart, the west pier to be 873 feet long and the east pier 850 feet long. The existing project was completed in 1918, and all aspects of local cooperation have been complied with. The wooden superstructure of the piers has been replaced with concrete on 614.6 linear feet of the west pier and 705 feet of the east pier. This work was completed in 1930. In 1949, 800 linear feet of the east pier were reinforced and repaved with steel sheet piling and concrete. At the present time, approximately 700 linear feet of the west pier are in need of repairs. The total costs and expenditures of the existing project, as of 1 July 1953, were $244,739.80 for maintenance. In addition, $6,500 was expended from

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contributed funds, $1,500 for new work, and $5,000 for maintenance. The latest report submitted on Olcott Harbor was the review of reports on Olcott Harbor submitted by the District Engineer, Buffalo, New York, on 3 May 1950, in compliance with a resolution adopted 17 June 1948, by the Committee on Public Works of the House of Representatives. Local interests desired modifications to the project to provide additional mooring space. The improvements requested included extending the Federal channel upstream from the present project limit, dredging of a mooring basin south of the Main Street Bridge, and alteration of the bridge to permit larger boats to pass beneath it; all of these requested improvements would provide more satisfactory mooring conditions. Three plans of improvement were prepared by the District Engineer in accordance with requests made by local interests; one of them involved only a minor channel extension, one considered dredging a basin south of the bridge and replacement of that structure on the existing site with a fixed bridge giving greater vertical clearances, and one involved removal of the existing bridge and construction of a new bridge about 600 feet upstream. These three plans, plus an additional plan for a detached off-shore breakwater to provide an artificial outer harbor for mooring craft, were considered in the report. Most of the work items in the first three plans are items normally provided by non-Federal interests. While most of the work included in the fourth plan is of the kind normally performed by Federal interests,

local interests would be required to make a cash contribution of about 50 percent toward the cost therefor. It was the conclusion of the District Engineer that no benefits would accrue from extension of the channel, but the other three plans considered would provide additional mooring space, substantially in excess of that required by the present and reasonably prospective fleets, and would result in some benefit thereto; however, the benefits expected to accrue would be a small fraction of the costs involved. Due to the unfavorable economic ratios of the plans considered, the expressed opposition of the State of New York regarding changes to the highway bridge crossing Eighteen Mile Creek, as well as that voiced by a large number of local business people and residents, and the likely inability and unwillingness of the small community to bear any substantial share in the cost of the improvement, it was the conclusion of the District Engineer that further investigation of Olcott Harbor by the United States was not warranted. The views of the District Engineer were concurred in by the Chief of Engineers.

30. Other improvements. - In addition to the privately-owned servicing and storage facilities for small craft mentioned previously, Krull Park, a county-owned park located just east of Olcott, has bathing, picnic and other recreational facilities which add greatly to the attractiveness of Olcott as a summer resort.

31. Commerce and harbor use. - The principal activity at Olcott Harbor revolves about the use of recreational craft. There has been little commerce at Olcott Harbor since 1915 except for

operation of small tour boats carrying passengers for short rides on the lake, and a small amount of commercial fishing. Statistics for 1952 show that 16 tons of fish were received and a total of 409 round trips were made by fishing and excursion boats having drafts ranging from nine feet to three feet and having a net registered tonnage of 4,517 tons. The total number of tour boat passengers for the same year was 11,000. Approximately 55 pleasure craft, exclusive of outboards, use the facilities of Olcott Harbor, with an additional 150 transient craft visiting the harbor each season.

32. Desired improvements. - Local and navigation interests are still seeking means to improve Olcott Harbor so as to provide more satisfactory mooring conditions to eliminate the congestion in the present harbor area. However, no definite plan of improvement has been submitted other than those improvements noted previously in this section as contained in the review of reports on Olcott Harbor of 3 May 1950.

33. Conclusions. - Nothing has occurred since the unfavorable review report of 3 May 1950, to warrant further investigation of Olcott Harbor. Consequently, it is concluded that no further study of Olcott Harbor need be initiated at this time.

OAK ORCHARD HARBOR, NEW YORK

34. Location. - Oak Orchard Harbor, New York, is located in Orleans County on the south shore of Lake Ontario at the mouth of

Oak Orchard Creek, 33 miles west of Rochester Harbor, and 28 miles east of Olcott Harbor, the nearest developed harbor. The area is shown on Plate 9 and U. S. Lake Survey Charts Nos. 24 and 2.

35. Description of harbor and improvements. - Oak Orchard Creek has a drainage area of about 152 square miles and has its source in an extensive swamp area known as Oak Orchard Swamp. From its source, it flows northeast eight miles, westerly 22 miles, northerly 1-1/2 miles, and northeasterly about 27 miles to Oak Orchard Harbor. The creek has a controlling depth of about two feet at its mouth and is navigable for about two miles upstream, having depths, generally, from eight to 20 feet, and widths averaging over 120 feet. The banks rise abruptly from the creek, except near the mouth. Immediately within its mouth the creek is approximately 450 feet wide with a naturally maintained channel in excess of 10 feet deep along the west bank. There are two small power dams located short distances upstream on the creek. Silting of the harbor is not serious because of controlled flows and flat stream gradients. There are no bridges to be considered in the development of the harbor. There is an existing Federal project at Oak Orchard Harbor which is described in paragraph 78. Oak Orchard Harbor, now generally known as Point Breeze, is a small settlement of about 200 permanent residents. It is in the town of Carlton, Orleans County, with the county seat at Albion about eight miles south of the harbor. All of Orleans County, with its four incorporated villages of Albion, Medina, Lydonville and Holley,

and Genesee County, with its principal city of Batavia, are considered to be the tributary area of Oak Orchard Harbor. According to the U. S. Census Report of 1950 the populations of Albion, Medina, Lydonville, Holley, and Batavia were 4,850, 6,179, 777, 1,551, and 17,799, respectively, while the total populations of Orleans County and Genesee County for the same year were 29,832 and 47,584, respectively. Oak Orchard Harbor has no industry other than catering to summer residents. The principal activity of the tributary area is fruit-growing and agriculture, including the storing and processing of produce. There are also a number of manufacturing plants located in Genesee County, particularly in the vicinity of Batavia, which produce metals, machinery, paper and wood products, and textiles. Improved highways serve the area and connect the harbor with arterial highways. There are no railroad facilities at the harbor although the New York Central Railroad passes about three miles south of the harbor. The nearest airports served by regularly scheduled flights are located at Rochester and Buffalo, 33 miles easterly, and 40 miles southwesterly, respectively.

36. Physical factors affecting navigation. - At Oak Orchard fluctuations in water levels, due to wind, are small. The harbor is exposed to storms from the west, northwest, north and northeast with the westerly and northwesterly storms, having fetches of 76 and 60 miles, respectively, being most frequent. The difficulties attending navigation are those inherent in an abandoned harbor. The entrance channel is shallow, narrow, and winding. The old

Federal piers at the entrance are in poor condition and constitute a hazard to vessels. Although the piers are marked by buoys, there are no published charts available to boat owners that show the harbor conditions and aids to navigation in any detail; consequently, visiting craft, not understanding the significance of the buoys, often run onto the piers and sustain damage. The coast between Olcott and Rochester, 61 miles, is devoid of any shelter for small craft in time of storm. It is considered dangerous for even the larger recreational craft cruising on Lake Ontario to be more than about 15 miles from the nearest shelter. This is about the maximum distance such vessels are able to traverse from the time the first signs of an approaching storm are detected until wave action on the lake becomes too severe for safe operation of small craft.

37. Terminal and transfer facilities. - There are no commercial terminal and transfer facilities at Oak Orchard Harbor. Terminal facilities for small-draft commercial fishing and recreational craft include three boat liveries and a dock that has a 15-20 ton marine railway. There are also two landings in the bay with fuel dispensing facilities. In addition, a yacht club, with its own pier 250 feet long and a clubhouse is available for the use of its members.

38. Federal improvements and studies. - The original project, adopted in 1836 and revised in 1881, provided for narrowing the mouth of the creek by constructing parallel piers 200 feet apart connecting with breakwaters extending along the lake shore, and

their full ability to pay, and they claim that Oak Orchard Harbor, in fulfilling an urgent need as one of a chain of harbors of refuge, would produce sufficient general benefits to warrant construction at Federal expense. The estimate of cost for new work, revised in 1953, is $601,300, excluding the $170,700 to be contributed by local interests, and exclusive of amounts expended on previous projects. The estimate for annual cost of maintenance, made in 1945, is $5,000.

39. The latest report on Oak Orchard Harbor was a review report on the harbor dated 16 June 1950, submitted by the District Engineer, Buffalo District. The authority for this report was a resolution adopted 26 July 1945, by the Committee on Commerce of the United States Senate. Although no requests were made at the public hearing, which preceded the latest report for any physical changes in the existing project, local interests did request modification of the terms requested of local cooperation which make accomplishment of the authorized plan of improvement contingent upon a cash contribution of $170,700 from local interests. After consideration of all factors, the Chief of Engineers concluded that modification of the existing project, including the conditions of local cooperation, was not warranted.

40. Other improvements. - In addition to the improvements noted previously in this report, Oak Orchard Harbor has over 100 cottages, a hotel, a dance pavilion, and bathing facilities. In 1948, the owner of the property at the foot of Ontario Street

dredging a 12-foot deep channel between the piers. In compliance with the River and Harbor Act approved 3 March 1905, unexpended funds for the harbor were returned to the Treasury and the harbor abandoned. The existing project was authorized by the River and Harbor Act approved 2 March 1945, as implemented by the report printed in House Document 446, 78th Congress, 2nd session. It provides for parallel piers, 200 feet apart, the east pier 1,010 feet long and the west pier 1,090 feet long; an entrance channel between the piers 100 feet wide and 10 feet deep extending from deep water in the lake to a point about 400 feet upstream from the inner end of the west pier, and an 8-foot deep harbor basin approximately 450 feet long and generally 400 feet wide. Construction of the project is contingent upon fulfillment of the following items of local cooperation: provision of all lands, easements, rights-of-way and spoil disposal areas required for construction and maintenance of the project; provision of a public wharf for the accommodation of transient craft; establishment of a public body to regulate the use of the project with the understanding that it shall be open to all on equal terms; and contribution of $170,700 in cash toward construction costs. Local interests have not complied with the requirements of local cooperation and no construction has been performed under the existing project. They have agreed to all conditions except that of contributing $170,700 in cash toward the cost of the project. They point out that compliance with the other provisions of local cooperation constitutes

constructed a timber pile wall, at an estimated cost of $2,000, to serve as a small boat landing and to prevent continued erosion.

41. Commerce and harbor use. - There has been no commerce at Oak Orchard Harbor for many years except for small amounts of commercial fishing. There is no indication that commercial fishing will show any appreciable increase in the future. The principal activity of Oak Orchard Harbor centers around the use of recreational craft. Although only about 35 recreational craft, exclusive of outboards, are based at Oak Orchard Harbor, with an additional 20 transient craft visiting the harbor each season, it is believed that these numbers would increase substantially with the provision of adequate harbor facilities.

42. Desired improvements. - Local interests have expressed satisfaction with the existing project, except for the requirement of the cash contribution of $170,700. They wish the Federal Government to assume the entire cost of the project since they claim the benefits to be mostly general in nature.

43. Conclusions. - Completion of the existing authorized project would adequately meet the needs of present and reasonably prospective navigation at Oak Orchard Harbor. Therefore, no further study need be initiated at Oak Orchard Harbor at this time as it is unlikely that such study would revise the conditions of local cooperation from those presently required.

HAMLIN BEACH STATE PARK, NEW YORK

44. Location. - Hamlin Beach State Park, New York, is located on the south shore of Lake Ontario, approximately 20 miles northwesterly from Rochester Harbor, New York, the nearest developed harbor, and 14 miles easterly from Oak Harbor, New York. Braddock Bay is approximately 13 miles to the southeast. The area is shown on Plate 10 and U. S. Lake Survey Chart No. 24.

45. Description of harbor and improvements. - Hamlin Beach State Park, containing about 815 acres, is located at the mouth of Yanty Creek in the town of Hamlin, in the northwesterly part of Monroe County. The creek flows generally northeast, is about nine miles long, and drains an area of approximately 13 square miles. Yanty Marsh, an irregularly shaped area at the mouth of the creek, has practically no clear water areas and the maximum depth is about four feet.

46. The park, formerly owned by the county, is now owned and maintained by the State of New York and is equipped with improved roads, paved parking areas, picnic areas, playgrounds, bathhouses, a restaurant, and a bathing beach bounded landward by a concrete sea wall about 2,300 feet in length. At the easterly end of the wall, a concrete-capped jetty eight feet wide extends into Lake Ontario for a distance of 350 feet. The jetty was constructed by the State of New York in 1939 at a cost of $24,000. No anchorage facilities are available, although the jetty constructed by the State can be used in calm weather for temporary tie-ups of the smaller types of recreational craft.

47. For the purpose of this section, the tributary area is considered to comprise the county of Monroe. The Lake Ontario shore line between Hamlin Beach State Park and Rochester Harbor is the westerly half of the north boundary of Monroe County and contains an abundance of small summer colonies and numerous beaches with most of the summer residents being from Rochester. The area under consideration in the locality of Yanty Creek is devoid of residential sites as the property is under the jurisdiction of New York State and is intended for recreational purposes. To the east of Yanty Creek is the resort colony of Onteo Beach and the Brockport waterworks which supplies the village of Brockport, about 10 miles south of the State park, and the largest community in the immediate area. There are no industries in the vicinity of Hamlin Beach State Park, the major activity being farming and fruit raising. This, in general, applies to all of Monroe County with the exception of Rochester, the industrial and distribution center of the tributary area. According to the U. S. Census Report for 1950, the populations of Rochester and Brockport, and the total for Monroe County, were 332,488, 4,748, and 487,632, respectively. The area has a network of first-and second-class highways and connecting roads that extend throughout the county. A highway bridge crosses Yanty Creek about one-half mile above its mouth. Adequate rail facilities are available at Rochester, and commercial and municipal airports are located in the vicinity of that city.

48. *Physical factors affecting navigation.* - The mouth of Yanty Creek is exposed to storms from the west through north to east with a maximum fetch of about 100 miles from a northeasterly direction. Yanty Marsh is usually land locked by a sand and gravel bar except during violent lake storms or high run-off periods from Yanty Creek when the bar is breached. Due to the marshy condition and dense growth in the creek, only a few rowboats operate within its limits.

49. Terminal and transfer facilities. - There are no commercial or publicly-owned terminal or transfer facilities at Hamlin Beach State Park. Except for the jetty mentioned previously, there are no facilities of any type for light-draft recreational craft.

50. Federal improvements and studies. - No Federal project has ever existed at Hamlin Beach State Park. The only navigation report submitted on Hamlin Beach State Park was contained in the Review of Reports on the Coasts of the Great Lakes, Harbors of Refuge for Light-Draft Vessels, with Respect to Braddock Bay and Hamlin Beach State Park, New York. This report was authorized by a resolution adopted 25 September 1945, by the Committee on Rivers and Harbors of the House of Representatives and was submitted by the District Engineer, Buffalo District, on 23 December 1946. The improvements at Hamlin Beach desired by the State of New York, represented by the Genesee State Park

Commission and other local interests, were formally presented at the public hearing held prior to preparation of the report. It was requested that improvements be made to provide a harbor of refuge at the locality. The plan of improvement considered in the report provided for an entrance channel 100 feet wide, 10 feet deep and approximately 1,100 feet long, extending from the 10-foot contour in the lake through the existing barrier beach at the mouth of Yanty Creek; two cellular steel sheet pile piers to a height of eight feet above low water datum, the west pier about 770 feet long and the east pier about 820 feet long; a connecting channel 50 feet wide and eight feet deep extending from the entrance channel to a mooring basin for transient craft in the bay, approximately 200 feet by 300 feet and eight feet deep; and a public dock constructed adjacent thereto. Based on 1946 price levels, the total first cost of the considered plan of improvements was estimated to be $550,000, with annual costs of $28,500 and annual benefits of $24,700. In the report, the District Engineer recommended that a survey be authorized at Hamlin Beach State Park to determine the best plan of improvement, the economic justification, and the extent to which the Federal Government should participate in the project. The Chief of Engineers concurred in the views of the District Engineer, and a survey has been authorized.

51. Other improvements. - No other improvements exist at Hamlin Beach State Park than those noted.

52. Commerce and harbor use. - There is no waterborne commerce, commercial fishing, or recreational boating at the mouth of Yanty Creek. The only craft located at the mouth of and in Yanty Creek are several rowboats. The existing sand and gravel bar ordinarily prevents access to and from the lake.

53. Desired improvements. - Local interests are desirous of a harbor of refuge at Hamlin Beach State Park for light-draft recreational craft.

54. Conclusions. - The desirability for provision of small boat facilities at Hamlin Beach and the possibility of undertaking Federal improvements therefor, to be integrated with the State's plans for over-all improvement of the park facilities, will be investigated in connection with the authorized survey of the locality. Further study thereof is not necessary at this time.

BRADDOCK BAY, NEW YORK

55. Location. - Braddock Bay, New York, is located in Monroe County on the south shore of Lake Ontario approximately seven miles northwesterly of Rochester Harbor, New York, the nearest developed harbor, and 27 miles easterly of Oak Orchard, New York. Hamlin Beach State Park is located approximately 13 miles to the northwest of Braddock Bay. The area is shown on Plate 11 and U. S. Lake Survey Chart No. 24.

56. Description of harbor and improvements. - Braddock Bay, located in the town of Greece, lies between Braddock Point and Braddock Heights and is owned by the State of New York. The bay is generally rectangular in shape, approximately one mile long

paralleling the shore, and about 1/4-mile wide. The lakeward limit of the bay is defined by two narrow spits extending southeasterly and northwesterly from the mainland for distances of approximately 2,500 and 1,500 feet, respectively. The gap between their extremities is about 1,700 feet wide and forms the opening into the bay. An irregularly alined natural channel of variable width having depths to five feet below low water datum is utilized by small craft in navigating between Lake Ontario and the bay. The bay is shallow with depths ranging from 1 to 3 feet below low water datum. On the southerly side beyond the 1/4-mile width, marsh land is prevalent. Salmon Creek, one of the larger streams between Hamlin Beach State Park and Rochester, empties into the bay at its northwesterly limit. About 1-1/2 miles above its mouth, Salmon Creek, flowing in a northwesterly direction is joined by West Creek, flowing in an easterly direction. Together, the creeks drain a watershed of about 91 square miles. Buttonwood Creek which empties into the bay at the southeasterly end, flows from a southwesterly direction, is about 13 miles long, and drains an area of approximately 11 square miles. Two new bridges constructed by the State across these streams, about 2,000 feet above their respective mouths provide sufficient clearances for passage of small craft. These streams are navigable to the smaller types of craft for a distance of about two miles within their lower reaches.

57. For the purpose of this section, the tributary area is considered to consist of Monroe County. Many small summer colonies

and numerous beaches are located on the Lake Ontario shore line between Hamlin Beach State Park and Rochester. This reach comprises the westerly half of the north boundary of Monroe County. These colonies are interspersed by larger communities particularly between Braddock Bay and Forest Lawn which is located about nine miles east of Rochester Harbor. The chief communities in this stretch are Braddock Heights, Grand View Beach, Ontario Beach, Rochester Harbor, Windsor Beach, Sea Breeze, Irondequoit, and Forest Lawn. The greater percentage of the summer residents in these areas are from the city of Rochester. With the exception of Rochester, which is the industrial and distribution center of the tributary area, there are no industries in the vicinity of Braddock Bay, or elsewhere in the tributary area, the major activity being farming and fruit raising. According to the U. S. census report for 1950, the populations of the town of Greece, the city of Rochester, and the total for Monroe County were 25,508, 332,488, and 487,632, respectively. Improved highways connect the tributary area with main arterial highways leading to all parts of the country. There are adequate rail facilities in the area and commercial and muncipal airports are located in the vicinity of Rochester.

58. Physical factors affecting navigation. - Water levels in Braddock Bay are generally equivalent to the levels in Lake Ontario and subject to the consistent seasonal rise and fall of the lake surface and the occasional fluctuations of shore duration which are due to changes in wind and barometric pressure. The waters in Braddock

Bay are generally protected on the lakeward side by the two narrow spits of land extending from the mainland. The opening between the spits is exposed to storms from the northwest through north to east, with a maximum fetch of about 85 miles from a northeasterly direction. The prevailing winds of Lake Ontario are westerly, and in westerly gales, vessels find protection in the lee of Braddock Point. Prior to 1946 when timber piling was removed by the War Department from the natural entrance channel for a width of about 100 feet, the submerged and partially submerged piles of an abandoned railway trestle had added to the hazard of small-boat operation in the vicinity of the bay mouth. At present the shifting sand and gravel bars at the entrance to Braddock Bay impede free navigation between the lake and the bay.

59. Terminal and transfer facilities. - There are no commercial or public terminal or transfer facilities at Braddock Bay. The only facilities for light-draft recreational craft consist of a privately-owned boat repair dock and livery at the easterly end of the bay having 75 mooring stalls for small craft. A boat lift and fuel and lubricants are also available.

60. Federal improvements and studies. - There has never been a Federal project at Braddock Bay. The latest report submitted on Braddock Bay is contained in the review Report on the Coasts of the Great Lakes, Harbors of Refuge for Light-Draft Vessels, with Respect

to Braddock Bay and Hamlin Beach State Park, New York. The authority for this report, which was submitted by the District Engineer, Buffalo District, on 23 December 1946, was a resolution adopted 25 September 1945, by the Committee on Rivers and Harbors of the House of Representatives. The improvements desired by local interests and particularly endorsed by the State of New York were presented formally at the public hearing which preceded preparation of the report and were generally to the effect that the Federal government provide a harbor of refuge at Braddock Bay. The plan of improvement considered in the District Engineer's report provided for an entrance channel 100 feet wide, 10 feet deep and about 3,000 feet long, extending from the 10-foot contour in Lake Ontario through the northwesterly sand spit west of the natural opening into the bay; two cellular steel sheet pile piers to a height of eight feet above low water datum, the west pier about 2,040 feet long and the east pier about 2,130 feet long; a connecting channel 100 feet wide and eight feet deep, joining the entrance channel with a mooring basin for transient craft within the bay approximately 300 by 400 feet and dredged to an 8-foot depth; and a public dock constructed adjacent thereto. The estimated total first costs of the considered improvement, based on 1946 price levels, were $1,384,500 while the annual costs and annual benefits were estimated at $73,100 and $33,700, respectively. The recommendation of the District Engineer, concurred in by the Chief of Engineers, was that no

survey be authorized at Braddock Bay. The principal grounds for the unfavorable recommendation were that Rochester Harbor, seven miles to the east, afforded reasonably adequate refuge facilities for small craft in the area and it appeared that the desired improvement of Braddock Bay was not economically justified.

61. Other improvements. - Braddock Point navigation light, maintained by the Federal government, is located on Bogus Point about 2-3/4 miles northwesterly from Braddock Point. There are no other navigational improvements to Braddock Bay other than those noted previously in this report. The Genesee State Park Commission, an agency of the State of New York, has developed an elaborate plan for the improvement of Braddock Bay as a State park. Part of the over-all plan encompasses provision of extensive facilities for the accomodation of small boats. The principal features of this plan are shown on Plate 11. The work proposed, includes filling not only the surrounding marsh areas but also a considerable area in the bay itself. The ultimate configuration of Braddock Bay would be considerably altered. As yet, however, only minor beach protection structures have been constructed.

62. Commerce and harbor use. - There is no waterborne commerce at Braddock Bay although there is a minor amount of commercial fishing. Statistics for 1952, the latest year of available records, show that fishing vessels made a total of four trips resulting in a catch of one ton. According to a survey made in 1953, there were approximately five

cruisers, five sailboats, 20 inboards, and 360 outboards based in the reach between Braddock Point and Rochester. No information is available on transient vessel traffic at the bay.

63. Desired improvements. - The improvements desired by local interests are for a harbor of refuge as noted previously in this section.

64. Conclusions. - Due to the proximity of Rochester Harbor, provision of a harbor of refuge at Braddock Bay is not economically justified. The navigation improvements contemplated by the park authority will be adequate for the needs of small boats in the immediate area. Further study of Braddock Bay is unnecessary at this time.

ROCHESTER HARBOR, NEW YORK

65. Location. - Rochester Harbor, New York, is situated on Lake Ontario at the mouth of the Genesee River. It is 59 miles by water west of Oswego and 35 miles west of Great Sodus Bay Harbor, the nearest developed port. The area is shown on Plate 12 and U. S. Lake Survey Charts Nos. 2, 23, and 238.

66. Description of harbor and improvements. - The Genesee River rises in western Pennsylvania about 10 miles south of the New York-Pennsylvania boundary. The entire length of the river following the bends of the stream is about 157 miles. At Rochester, about seven miles above its mouth, the river drops about 260 feet over a series of four falls. Below the lower falls, it flows through a gorge section to within about 1½ miles of its mouth. The area tributary to the Genesee River is 2,479 square miles, of which all are in New York State except 96 square miles in Pennsylvania. The greatest discharge of the Genesee River at Rochester was about 54,000 cubic feet per second, in March 1865; the average is 2,770 cubic feet per second. Floods occur in the spring and sometimes in the summer, but vessel movements at Rochester Harbor are not endangered or hampered to any extent. The Federal channel in the harbor is 20 feet deep, 200 to 300 feet wide from Lake Ontario into the Genesee River to the New York Central Railroad bridge, a distance of about 4,500 feet, and 150 feet wide for 2¼ miles above that bridge to the head of commercial navigation at the Genesee

Docks of the Baltimore and Ohio Railroad. Above the Genesee Docks the natural river depths range from 18 to 27 feet for three miles; and for the remainder of the distance to the falls the depth is shallow. There are three bridges, constructed under Federal permit, which cross the navigable portion of the lower Genesee River.

67. The area tributary to Rochester Harbor is considered to be the entire county of Monroe, with a land area of 663 square miles. The city of Rochester serves as the commercial and marketing center for the rural area of Monroe County, which is principally an agricultural region producing general farm crops, vegetables, dairy products, and nursery stock. Rochester itself is highly industrialized, and its manufactures include clothing, photographic and optical goods, shoes, foundry and machine-shop products, dental apparatus, telephone equipment, motor vehicles, radio apparatus, furniture, refrigerators, and flour-mill products. According to the U. S. Census Report for 1950, the population of the city of Rochester was 332,488 while the total for Monroe County was 487,632.

68. Five first-class railroads serve Rochester although only two of these have direct dock connections. The improved highway net extending to Rochester connects the city and surrounding villages with main arterial highways leading to all parts of the country. Rochester also has water access via the New York State Barge Canal. However, there is no direct water connection between the harbor and the canal terminal because of the intervening falls in the Genesee

River. The Rochester Municipal Airfield located about 4½ miles southwest of Rochester, is served by regularly scheduled commercial airlines.

69. Physical factors affecting navigation. - In addition to the ordinary variations in lake surface from year to year and the consistent seasonal fluctuations, fluctuations at Rochester due to wind and barometric irregularities may range from a few inches to about four feet. However, these unusual disturbances generally occur during stormy periods and last for a few hours only. The prevailing storm direction at Rochester is southwest and has little effect on the harbor. The most troublesome storms are those out of the northeast through north to the northwest, and the fetch from these directions is 65, 50, and 60 miles, respectively. The greatest wave action in the entrance and harbor is caused by northerly storms. There are no special difficulties attending navigation in the entrance channel during ordinary weather, although during periods of heavy westerly or easterly winds, vessel operators must exercise care to avoid striking the piers.

70. Terminal and transfer facilities. - There is one coal terminal, one inactive car-ferry terminal, and one municipal passenger and miscellaneous freight terminal, all open to the public. Two yacht clubs and several other privately-owned servicing and storage docks are for recreational and other small craft. Facilities for recreational craft, include mooring slips, boat houses for storage of craft and gear, a derrick and a marine

railway, and servicing facilities including fuel, supplies, and repairs.

71. Federal improvements and studies. - The original project at Rochester Harbor was adopted by the River and Harbor Act of 2 March 1829 and, in general, provided for a channel between parallel piers extending to the 12-foot contour in the lake. Modifications to the project, consisting primarily of extending the piers and deepening the channel, were made from time to time. The latest modification authorized by the River and Harbor Act of 2 March 1945 provided for the maintenance of the channel upstream of the New York Central Railroad bridge. The existing project provides for a channel from deep water in the lake to the New York Central Railroad bridge near the mouth of the river on an alinement centrally located with respect to the entrance piers, with a width of 300 feet lakeward of the pierheads and 200 feet shoreward of the pierheads, a depth of 20 feet, and for a turning basin of the same depth, 600 feet in width, opposite the municipal terminal; thence for maintenance of a channel 20 feet deep and approximately 150 feet wide to a point 200 feet upstream from the Genesee Docks, without dredging closer than 50 feet to existing bulkheads; and for parallel piers of the timber-crib type with concrete superstructure, about 450 feet apart, from the lake to the pool at the mouth of the Genesee River, the west pier to be 3,036 feet long and the east pier 2,699 feet long. All conditions of local co-operation have been fully complied with, and the existing project was completed in 1935. The total costs

and expenditures for the existing project to July 1953, were $1,418,236.85, of which $79,092.16 was for new work and $1,339,144.69 for maintenance.

72. The latest report on Rochester Harbor was the survey report on that locality submitted by the District Engineer, Buffalo District, on 15 August 1938. The authority for this report was the River and Harbor Act approved 26 August 1937. The improvements desired by local interests, which were formally presented at the public hearing which preceded preparation of the report, were generally for extension of the Federal project upstream, a turning basin at the head of commercial navigation, and easing the bends at Rattlesnake Point. Three plans of improvement were considered in the above report: Plan 1 entailed the work originally requested by local interests; Plan 2 was the same as Plan 1, with the turning basin eliminated; while Plan 3 involved the assumption by the Federal government of the regular maintenance of the existing channel from the upstream limits of the then existing Federal project to the head of commercial navigation at the Genesee Docks. The District Engineer considered Plans 1 and 2 not justified but recommended Plan 3, which would assure full cargo depths at all times for vessels navigating the river to the Genesee Docks. The estimated costs of the proposed improvement, based on 1938 price levels, was $10,000 for the first year and $5,000 annually thereafter for maintenance. The recommendations of the District Engineer were concurred in by the Chief of

Engineers. The report was printed in House Document 139, 76th Congress, 1st Session, and, based on the recommendations contained therein, Federal assumption of maintenance of the channel to the head to commercial navigation was authorized by the River and Harbor Act approved 2 March 1945.

73. Other improvements. - Local interests maintained the river channel upstream from the New York Central Railroad bridge to the head of commercial navigation at the Genesee Docks until the Federal project was modified to include the channel. Local interests have also improved the low, swampy area along the easterly river shore between the pier and the railroad bridge as a yacht anchorage and have provided a channel connecting the anchorage to the Federal channel. In addition, a portion of the anchorage has been bulkheaded.

74. Commerce and harbor use. - Statistics for 1952, the latest year of available records, show that waterborne commerce at Rochester Harbor amounted to 947,160 tons. Of this total amount, 8,546 tons were newsprint paper imports, 936,162 tons were coal exports, and 2,452 tons were lakewise coal shipments. There were 397 round trips made by commercial vessels having drafts ranging up to 19 feet and having a total net registered tonnage of 487,021 tons. There is also considerable recreational craft activity in the harbor. A survey in 1953 showed that approximately 700 recreational craft were based in the harbor area while another 300 transient craft visit

the harbor each season. In general, the facilities for recreational craft at Rochester Harbor are used to capacity.

75. Desired improvements. - There has been no expressed desire on the part of local interests for additional improvement to Rochester Harbor other than those last formally presented at the public hearing which preceded the survey report of 15 August 1938. In recent years, local recreational boating interests at Rochester have supported movements for improvement of nearby Irondequoit Bay as a means of providing for future expansion of the recreational fleet in the area.

76. Conclusions. - Further study of Rochester Harbor is not necessary at this time. The completed Federal project is adequate for existing and prospective commerce. Improvements being considered at other nearby localities will, if implemented, adequately provide for the needs of recreational boating in the area.

IRONDEQUOIT BAY, NEW YORK

77. Location. - Irondequoit Bay is located in Monroe County, New York, on the south shore of Lake Ontario, about four miles east of Rochester Harbor, New York, the nearest developed port and 29 miles westerly of Great Sodus Bay Harbor, New York. The area is shown on Plate 13, United States Lake Survey Charts Nos. 2, 23, and 238, and United States Geological Survey, "Rochester East, New York", quadrangle.

78. Description of harbor and improvements. - Irondequoit Bay is bounded on the west by the town of Irondequoit and on the east by the towns of Webster and Penfield. The bay lies in a north-south direction between steep slopes rising to a height of about 150 feet above the surface of the bay. It has a length of about four miles, and widths varying, in general, from 1/4 to 3/4 of a mile broadening near the lake to 1¼ miles. The bay is separated from Lake Ontario by a sand spit 200 to 600 feet wide and about 6,000 feet long, upon which a railroad and a highway are located. The outlet of the bay, located about ¼ mile east of the northwestern corner of the bay, is about 50 feet wide and has a depth which varies from a few inches to about four feet depending upon the amount of silting or scouring. Fixed highway and railway bridges cross the outlet, and have vertical clearances of seven and eight feet, respectively, at low water datum. There is also a fixed highway bridge which crosses the inlet at the southern end of the bay and has a vertical clearance of 5½ feet. Irondequoit Creek, with a drainage area of about

139 square miles, discharges into the southern end of the bay but no discharge records are available. There has been no Federal project adopted at Irondequoit Bay, nor have any navigation improvements been made by local interests.

79. Rochester is the commercial, industrial, and marketing center for Monroe County and is the principal source of people seeking recreation in the Irondequoit Bay area which serves principally as a resort for summer vacationists. Numerous summer cottages have been erected along the east and west shores of the bay especially at Sea Breeze, an unincorporated community having a summer population of several hundred and located at the northern end of the west shore. Sport fisherman and recreational boating enthusiasts use the bay for recreational purposes. The easterly limits of Rochester almost touch the bay at Densmore and Irondequoit Creeks, but are in general 3/4 to 1½ miles westerly of the bay. No industries are located on Irondequoit Bay, but there are approximately 703 manufacturing industries in Monroe County, 612 of which are located in Rochester. The hinterland, however, is primarily agricultural. According to the U. S. Census Report for 1950, the populations of the towns of Irondequoit, Webster, Penfield, and the city of Rochester, were 34,417, 7,174, 4,847, and 332,488, respectively, while the total population of the county of Monroe was 487,632. Improved highways connect the Bay with surrounding communities and form a part of the Federal, State and County highway systems. A branch freight line of the New York Central System, having a

station in the town of Webster, crosses the outlet of the bay. The city of Rochester is served by five railroads and there is an airport located about 4½ miles southwest of Rochester which is served by commercial airlines.

80. Physical factors affecting navigation. - Water stages in Irondequoit Bay are dependent upon the water levels of Lake Ontario and are subject to a consistent seasonal rise and fall. Occasional oscillations of short duration in Lake Ontario, due to changes in wind and barometric pressures, are considerably modified in the bay due to the restricted entrance channel. The high lands surrounding Irondequoit Bay afford good protection, except from storms from the northwest; however, waves are seldom generated in the bay in excess of one foot in height. Storms from the northeast through north to northwest cause the most severe wave action at the entrance channel and the fetch from these directions is 80, 50 and 61 miles, respectively. However, the bay itself is affected little by storms from any direction. A marshy area, interlaced with narrow channels and having depths up to 7 feet, extends from the outlet channel south for about 3,500 feet. Thence the bay deepens abruptly to depths ranging from 33 to 75 feet for the next 2½ miles and extending to within 500 feet of the east and west shore lines. The southern 4,500 feet of the bay has depths ranging up to 11 feet. The difficulties attending navigation at Irondequoit Bay include unsafe sailing conditions which develop several times a year due to the large number of craft operating thereon and the resulting

congestion, the shallow entrance channel from the lake which frequently varies in depth and alinement, and the low vertical clearance afforded by the fixed bridges over the outlet.

81. Terminal and transfer facilities. - There are no terminal or transfer facilities or other improvements for commercial navigation on Irondequoit Bay. There are, however, a number of small-boat landings for use by recreational craft, owned and operated by boating clubs, liveries and marine service establishments, and summer hotels. Most of these are restricted and are not open to the general public. There are also numerous landings which have been constructed by individuals for their own use.

82. Federal improvements and studies. - No Federal project has ever been adopted for Irondequoit Bay. The latest report on Irondequoit Bay was the survey report on that locality submitted by the District Engineer, Buffalo District, on 30 June 1954. The authority for this report was contained in the River and Harbor Act approved 24 July 1946. The improvements requested by local interests, formally presented at the public hearings which preceded preparation of the report, were to the effect that the Federal government provide and maintain a protected channel adequate for the use of recreational craft, between Lake Ontario and Irondequoit Bay by dredging, construction of protective structures, and removal or alteration of the railroad and highway bridges that obstruct movement of craft through the bay outlet. Although several plans of improvement were studied, two

plans of improvement, differing mainly in the location of the channel and type of bridges to be constructed in replacement of the existing restrictive structures, were finally considered in the subject report. The purpose of the improvement is the accomodation of light-draft recreational craft. The plan of improvement considered to be most favorable would provide for a new entrance channel from the lake at the northeasterly end of the bay, an inner channel leading to a mooring basin and thence to deep water in the bay, parallel jetties extending into the lake to protect the entrance channel, and Federal participation in the cost of replacing the railroad bridge. This plan of improvement considered the replacement and relocation of the existing highway bridge an item of local co-operation. It was estimated that accomplishment of improvement in accordance with this plan would return annual benefits of $326,000 compared with annual costs of about $135,600. The first cost to the United States, exclusive of aids to navigation, was estimated to be $1,756,600, based on November 1953 price levels. It was the recommendation of the District Engineer that a project at Irondequoit Bay, New York, be authorized to provide, in general, for the improvement as described above.

83. Other improvements. - There are no improvements to Irondequoit Bay other than those noted.

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84. Commerce and harbor use. - There is no waterborne commerce at Irondequoit Bay. The principal activity in the bay revolves about the use of light-draft recreational craft. According to a survey made in 1953 by responsible local interests, and which is considered to be reasonably accurate, approximately 1,075 small recreational vessels were based in Irondequoit Bay. Due to the unsatisfactory navigation conditions of the present entrance channel, the number of transient craft visiting the bay is negligible.

85. Desired improvements. - The improvements desired by local interests are noted in paragraph 82 of this section.

86. Conclusions. - The survey report of 30 June 1954 contains an up-to-date analysis of the existing conditions at Irondequoit Bay; therefore, no further study of the locality is required at this time.

PULTNEYVILLE HARBOR, NEW YORK

87. Location. - Pultneyville Harbor is located in Wayne County, New York, on the south shore of Lake Ontario, at the mouth of Salmon Creek, a small stream eight miles in length, which flows into the lake at a point 22 miles east of Rochester Harbor and 10-3/4 miles west of Great Sodus Bay Harbor. The area is shown on Plate 14 and U. S. Lake Survey Charts Nos. 2 and 23.

88. Description of harbor and improvements. - The Town of Williamson, County of Wayne is considered to constitute the area tributary to Pultneyville Harbor. The surrounding area is primarily agricultural, being an important fruit growing area, and there are no industrial plants in the tributary area other than small fruit canning and processing plants. The population of the town of Williamson, as indicated by the 1950 census, was 4,226. The unincorporated village of Williamson, located about four miles south of Pultneyville Harbor on a branch line of the New York Central Railroad, is the principal marketing and trading center of the area, and had a population of 1,520 in 1950. Pultneyville is a small unincorporated community on the lake shore east of the mouth of Salmon Creek. Improved State and county highways connect the community with other improved highways leading throughout the State of New York.

89. Pultneyville Harbor is an authorized Federal project, presently inactive, and its abandonment has been recommended several times. At the present time the Government piers are dilapidated with considerable lengths gone above low water datum. The most recent

examination showed controlling depths of three feet opposite the angle in the west pier and four feet at the creek entrance. A yacht club maintains a small club house on the west bank of the creek a short distance above the mouth. Past improvements made by both the Federal governmnent and local interests are described in paragraphs 93, 94, and 95.

90. Physical factors affecting navigation. - At Pultneyville, fluctuations in lake levels due to wind are small. The harbor entrance is exposed to lake storms from the northwest through north to east, with a maximum fetch of about 70 miles from both the northwest and northeast. Owing to the shallow depths in the entrance channel the harbor can be used only by the smaller recreational craft.

91. Terminal and transfer facilities. - There are no publicly-owned docks at Pultneyville Harbor. The yacht club has bulkheaded a section of the shore, along the southern limits of the shallow basin within the mouth of the creek, for use as a dock. Other local interests have erected several small private landing stages for small boats.

92. Federal improvements and studies. - Pultneyville Harbor is an inactive, commercial Federal project. Abandonment of the harbor has been recommended by the District Engineer several times in the past, but no Congressional action to this end has been taken.

93. The project was authorized by the River and Harbor Act of 11 July 1870. It, with subsequent acts, provides for a channel 40 feet wide, eight feet deep, and 700 feet long from deep water in the lake to the mouth of Salmon Creek; for a timber crib west pier 910 feet long; and for a timber crib east pier 572 feet long. The project was completed in 1883. The last maintenance dredging was done in 1907 and the last pier repair in 1908. Abandonment of the project was recommended in the annual report of the Chief of Engineers for 1901; in 1915, in a report printed in House Document No. 375, 64th Congress, 1st Session; and in a report prepared in compliance with section 7 of the Act of Congress approved 3 March 1925 which directed preparation of a report on all river and harbor projects theretofore adopted, the further improvement of which was undesirable or in which curtailment of the plans or projects should be made. Again in 1929, in response to a further report called for by the Chief of Engineers, the District Engineer, Buffalo, New York, recommended that no attempt be made by the Federal Government to restore the project, either wholly or in part.

94. In response to a desire expressed by local interests for restoration of project depths and pier rehabilitation, a survey report, authorized by Congressional resolution, was submitted by the District Engineer, Buffalo, New York, 4 May 1932. The report was unfavorable to further improvement but it was recommended that the outer ends of the piers, which were dilapidated and had gone below water level, be removed since, in their

hidden condition, they constituted a menace to small-boat navigation. It was further recommended that, since the proposed work could be accomplished without additional legislation, no change be made in the existing project. As a result of these recommendations, the outer 398 feet of the west pier were removed as a maintenance measure; the work being completed in 1934. Since that date no work has been done at the locality.

95. The total cost to the Federal government for the work accomplished at Pultneyville Harbor under the authorized project was $88,305.96, of which $68,218.66 was for new work and $20,087.30 for maintenance.

96. The latest report on Pultneyville Harbor was contained in the comprehensive report by a special board of officers on the Coast of the Great Lakes - Harbors and Harbors of Refuge for Light-Draft Craft, dated 10 September 1942, and subsequently printed in House Document No. 446, 78th Congress, 2d Session. In the report for consideration was given to dredging a new entrance channel, 10 feet deep, from deep water in the lake into a mooring and turning basin to be dredged in the existing marshy area just within the mouth of the creek. The new channel would be located just west of the old west pier and new parallel piers of sheet steel pile construction, 700 and 800 feet long would be built to protect the lakeward end of the entrance. The reporting officers found that benefits which might accrue from such an improvement would be principally local; 83 percent of the existing movement being by locally based craft, that utilization of the harbor

as a convenient stopping place for transient craft, except when needed for refuge, was unlikely, that the capacity of the proposed mooring basin would be limited by the surrounding topography and would not provide convenient moorage for more than locally based craft, and that an appreciable increase in the small-boat traffic at the harbor is unlikely even with improvement. In view of the considerable proportion of possible benefits which would be local in nature, substantial participation by local interests in the cost of improvement would be required. No material offers of co-operation were made, and it is very unlikely that local interests concerned at Pultneyville could participate to more than a nominal extent. Accordingly, modification of the existing project was not recommended.

97. Other improvements. - A pool about 900 feet long, 40 to 60 feet wide and six to 10 feet deep, within the mouth of Salmon Creek constituted the original sheltered water area of the locality. The original controlling depth of the channel at the mouth of the creek was about 20 inches. Prior to 1871, when Federal improvement of Pultneyville Harbor was initiated, from $25,000 to $35,000 was expended by private interests in building a pier on the west side of the mouth, long since washed away, and in dredging the mouth of the creek. Other than the docks and landings constructed by local interests, there have been no other known improvements by local interests at Pultneyville since that time.

98. Commerce and harbor use. - Shipbuilding and shipping were important activities during the early history of Pultneyville. Until

construction of the Erie Canal it was believed that the harbor was destined to become an important port. The principal commodities handled at the harbor were lumber, shingles, fruit, coal, and grain. In 1877, Pultneyville was a small flourishing community, with several stores, churches, a gristmill, sawmill, planing mill, leather manufactory, a stove and bolt factory, and a lumber and coal yard. However, since the surrounding country has been provided with good land transportation routes and other water routes, the waterborne commerce of Pultneyville has entirely disappeared and the size and importance of the community has declined. Since 1908 the only vessels using the harbor have been small pleasure craft and fishing boats. At the present time there are about 50 small recreational vessels based at the harbor, 20 of which are outboards.

99. Desired improvements. - In recent years local interests have expressed no desire for further improvement of the harbor.

100. Conclusions. - Since conditions and circumstances at Pultneyville Harbor have not materially changed since the date of the last report thereon, further study of the locality is unnecessary at this time.

GREAT SODUS BAY HARBOR, NEW YORK

101. Location. - Great Sodus Bay Harbor is located in Sodus Bay on the south shore of Lake Ontario, 35 miles east of Rochester Harbor and 29 miles west of Oswego Harbor, New York. The nearest developed harbor is Little Sodus Bay located 14 miles to the east. The area is shown on Plate 15 and United States Lake Survey Charts Nos. 2, 23, and 234.

102. Description of harbor and improvements. - Great Sodus Bay, irregular in shape, extends in a southeasterly direction about 4½ miles, has a maximum width of about 2-3/4 miles, and an area of approximately five square miles. The eastern portion of the bay is separated from the lake by Charles Point, a narrow sand barrier about 1¼ miles long terminating in a headland at its western end. The narrow portion of the barrier was breached near its midpoint by storm and lake action during the high water of 1929-1930. The easterly end of this barrier is locally known as Crescent Beach. Lake Bluff, a small summer colony, is located on the east shore at the easterly end of Crescent Beach. Sodus Point, a sand barrier, separates the western portion of the bay from the lake. Sand Point, a low-lying peninsula, situated about 2,000 feet southwest of the harbor entrance, projects some 3,500 feet into the bay. Three islands in the northeast part of the bay; Islay, Arran, and Bute, have areas of 27, 107, and 52 acres, respectively. The land surrounding the bay is generally 60 feet above low water datum. The streams tributary to the bay are all small, and

the total watershed area is about 50 square miles. Deep water in the lake is connected with deep water in the bay by a Federal channel between Charles Point and Sodus Point. Federal and private improvements to the harbor are described in paragraphs 106 and 107, respectively. No bridges cross the navigable waters of the bay, but the Bay Highway Bridge crosses the swamp area at the southern end, about four miles southeast of the channel entrance. Natural depths varying from 20 to 48 feet extend from the inner end of the entrance channel to within about a mile of the Bay Highway Bridge. The unincorporated village of Sodus Point, on the west shore of the bay, and the summer colony of Lake Bluff on the east shore are the only communities on the bay. The village of Sodus is about four miles southwesterly of Sodus Point, and according to the U. S. Census Report of 1950, had a population of 1,588, while the town of Sodus in the same year had a population of 5,706. The entire county of Wayne, in which the bay is located, had a 1950 population of 57,323. The population of the immediate bay area, however, is increased during the summer by vacationists who occupy cottages on the bay. Transshipment of coal from the Pennsylvania Railroad Company's dock, minor commercial fishing, and a factory for processing hops, are the only industries at the harbor. Agricultural pursuits, especially fruit growing, make up the principal activity of the surrounding area. Improved roads connect Great Sodus Bay Harbor with main arterial highways leading to all parts of the country. The only direct

connection to the harbor is via the Pennsylvania Railroad although the New York Central Railroad has a station at Wallington, about four miles south of Sodus Point.

103. Physical factors affecting navigation. - Sodus Bay is subject to the year to year variations of the water levels of Lake Ontario and the consistent seasonal rise and fall. Fluctuations due to wind are small. The high land surrounding Sodus Bay affords good protection except from northerly storms. The wave action along the barriers is most severe during storms out of the northeast through north to west-by-north. The fetch from these directions are about 59, 61, and 123 miles, respectively. Completion, in 1940, of the work approved by the Act of 30 August 1935, eliminated the principal difficulties attending navigation at Great Sodus Bay Harbor. At the present time no particular difficulties of navigation are experienced except that during northeasterly or northwesterly storms, strong cross currents and seas at the outer ends of the piers make the entrance hazardous to inbound light vessels.

104. Terminal and transfer facilities. - The Pennsylvania Railroad Company owns and operates a two-berth coal trestle on the west side of Sodus Bay about 1-3/4 miles from the inner ends of the piers. This dock is open to all water carriers on equal terms. There is also one fish dock which is private, and one passenger tour boat dock. A yacht club dock and several other privately-owned servicing and storage docks are for recreational and other small craft. Two of these docks have marine railways and another has a boat lift.

105. Federal improvements and studies. - The original project at Great Sodus Bay was adopted 2 March 1829, and provided for the narrowing of the natural entrance channel by the construction of breakwaters and also for construction of parallel piers to confine the entrance channel. The original project was modified from time to time. Modifications consisted of widening, realigning, and deepening the channel and extending the piers.

106. The existing project provides for an entrance channel parallel to the entrance piers, extending from deep water in the lake to deep water in the bay, 22 feet deep and 300 feet wide to just lakeward of the pierheads, thence narrowing to 200-feet width with 20-foot depth between the piers, widening to 300-foot width with 20-feet depth to deep water in Great Sodus Bay; for parallel piers, 450 feet apart, of timber-cribs with concrete superstructure, the west pier 1,580 feet long and the east pier 1,653 feet long, of timber-cribs with concrete superstructure, extending from the inner end of the east pier to Charles Point, and for a west breakwater, 2,200 feet long, of stone-filled timber-cribs, extending from the inner end of the west pier to Sodus Point, not maintained. All aspects of required local cooperation have been complied with, and the existing project was completed in 1940. The total costs and expenditures of the existing project were $943,025.83, of which $249,187.20 was for new work and $693,838.63 for maintenance.

107. The latest report on Great Sodus Bay Harbor was the review of reports on that locality submitted by the District Engineer, Buffalo District, on 27 May 1941. The authority for this report was the resolution adopted 8 August 1940 by the Committee on Rivers and Harbors of the House of Representatives. Improvements requested at the public hearing subsequently held in Sodus, all pertained to the improvement of Charles Point and included structures to prevent erosion of the headland, closing of the breach in the bar just easterly of the headland, and groins to build up the strand of the bar. The plan of improvement considered, which would protect Charles Point from the effects of beach erosion, consisted of the construction of steel sheet pile bulkheads along the north and east sides of the headland of Charles Point, the construction of a series of steel sheet pile groins along the lake side of Charles Point, and the closure of the breach by gravel fill. The first costs of the considered plan of improvement were estimated to be $308,000 at 1941 price levels, while the benefits were of no appreciable value to navigation. It was recommended by the District Engineer and concurred in by the Chief of Engineers that the expenditure of Federal funds for the improvement of Charles Point was not warranted. Subsequently, in 1947, as a maintenance measure to prevent breaching of the inner end of the east breakwater, about 300 feet of the Charles Point shore line immediately east of the east breakwater was protected by steel sheet pile bulkheading erected by the Federal Government.

108. Other improvements. - Improvements, other than those noted previously in this section, include numerous small private docks for recreational or fishing craft located throughout the bay. In compliance with the conditions of local co-operation in connection with the deepening and widening of the Federal entrance channel authorized by the River and Harbor Act of 30 August 1935, the Pennsylvania Railroad dredged a 20-foot channel from deep water in the bay to its coal loading facilities. Local interests have also constructed timber-crib, stone-filled bulkheads along the north and east sides of Charles Point, and a pier on the north side of the headland.

109. Commerce and harbor use. - All of the commerce of Great Sodus Bay Harbor utilizes the entire Federal project. The commerce consists, primarily, of coal shipments from the trestle of the Pennsylvania Railroad Company. There is also a small amount of commercial fishing by craft based in the harbor. According to commercial statistics for 1952, the latest year of available records, the commerce at Great Sodus Bay Harbor totaled 1,896,841 tons, of which 1,896,837 tons were coal shipments, while the remaining four tons were fish receipts. For the same year there were 682 round trips made by commercial vessels having drafts ranging up to 20 feet and having a total net registered tonnage of 1,119,941 tons. At present, approximately 200 recreational craft, exclusive of outboards, are based at Great Sodus Bay Harbor. In addition, considerable numbers of transient craft visit the area each season.

110. Desired improvements. - Local interests desire improvements which would protect Charles Point and Crescent Beach from further erosion.

111. Conclusions. - The improvements desired by local interests would not appreciably benefit navigation at the harbor and are not economically justified in the interests of navigation. The existing Federal project is adequate for the needs of existing navigation and no further navigation study need by initiated at Great Sodus Bay Harbor at the present time.

PORT BAY, NEW YORK

112. Location. - Port Bay is located in Wayne County, New York, on the south shore of Lake Ontario about 38 miles east of Rochester Harbor, New York, and 21 miles west of Oswego Harbor, New York. It is located midway between and seven miles distant, by water, from Great Sodus Bay to the west and Little Sodus Bay (village of Fair Haven) to the east which are the nearest developed harbors. The area is shown on Plate 16 and U. S. Lake Survey Charts Nos. 2, 22, and 23.

113. Description of harbor and improvements. - Port Bay is one of a series of land-locked bays in the vicinity. The bay is irregular in shape and extends inland in a southerly direction approximately $2\frac{1}{4}$ miles. It has a maximum width of about $\frac{1}{2}$ mile at its lakeward end, and a total area of about 3/4 square mile. The bay is entirely land-locked except at high water stages, and is separated from the lake by a narrow gravel and shingle barrier extending the full width of the bay and terminating in headlands at its easterly and westerly ends. The only streams of any consequence flowing into the bay are Wolcott and Beaver Creeks, which are about 14 and three miles long, respectively. Port Bay and its tributary streams drain in an irregularly-shaped watershed of approximately 35 square miles. The southerly end of the bay is very shallow and overgrown with marsh grass, but depths increase toward the northerly or lakeward end to a maximum of about 35 feet. There are no bridges crossing either

the waters of Port Bay or Wolcott Creek within 2½ miles from its mouth. There is an existing Federal project at Port Bay upon which no work has yet been done. Other Federal and private improvements to the harbor are noted in par. 160.

114. The immediate area tributary to Port Bay consists of the westerly half of the towns of Wolcott and Butler and the easterly half of the towns of Huron and Rose, all of which are in the northeasterly portion of Wayne County, New York. According to the U. S. Census Report of 1950, the populations of the towns of Wolcott, Butler, Huron and Rose, were 3,276, 1,429, 1,409, and 2,013, respectively, while the total population of Wayne County for the same year was 57,323. The area is limited in an east-west direction by improved harbors at Great Sodus and Little Sodus Bays which offer competitive attractions and superior facilities for recreational boating activities. There are no large communities or public resort areas adjacent to Port Bay or along the lake shore in the vicinity, and the village of Wolcott on Wolcott Creek, about six miles from the lake shore, with a population of 1,516 in 1950, is the only sizable community in the tributary area. Portions of the shore line of the bay are occupied by over 200 summer homes, many of which are owned by residents of Rochester, New York. Considerable undeveloped bay and lake frontage is available for further expansion. The area tributary to Port Bay is a part of the rich fruit belt bordering the south shore of Lake Ontario. There are no industries in the area; the principal activities being fruit

growing and processing, and a small amount of dairy and truck farming. Secondary paved roads along the east and west sides of the bay connect with State and Federal highways at Wolcott. A branch line of the New York Central Railroad provides freight service, and a local interurban bus line provides passenger service between Wolcott, Rochester and Oswego, New York.

115. Physical factors affecting navigation. - Storms have little or no effect on the waters within Port Bay because of its narrow width and the protection afforded by the sand and gravel barrier across the lakeward end of the bay. The lakeward side of the barried is exposed to lake storms from the west through north to northeast-by-east, with a maximum fetch of about 130 miles from a westerly direction, 45 miles from a northerly direction, and 60 miles from a northeasterly direction. There are no difficulties attending navigation on Port Bay although navigation between the bay and Lake Ontario is restricted to short periods, usually in the fall and spring, when a high rate of run-off from the area tributary to the bay causes overflow of the barrier and erosion of a shallow opening. Frequently, when the level in the bay exceeds that in Lake Ontario, but does not reach overflow stages, formation of the opening is encouraged by digging a narrow ditch through the barrier.

116. Terminal and transfer facilities. - There are no commercial wharves or public docks at Port Bay. The only facilities located on the shores of the bay are for small craft and are of light

construction. These facilities, including a boat livery, are all privately-owned and their use is restricted.

117. Federal improvements and studies. - The latest report on Port Bay was a survey report submitted by the District Engineer, Buffalo District on 30 December 1947. Authority for the report was contained in the River and Harbor Act approved 2 March 1945. At a public hearing preceding preparation of the report, local interests requested a permanent, navigable channel through the bar separating the bay and lake to insure access to, and full utilization and development of small-boat facilities within the bay. The plan of improvement considered in the report provided for construction of arrowhead breakwaters and dredging a channel from deep water in the lake to deep water in the bay. Based on the price levels and conditions then prevailing, it was estimated that improvement in accordance with the recommendations of the reporting officer, would return annual benefits of $44,200 as compared to annual costs of $38,400. Accordingly, it was recommended that such a project be authorized at Port Bay, and this recommendation was concurred in by the Chief of Engineers.

118. The report described above was printed in House Document 293, 81st Congress, 1st Session. In accordance with the recommendations and the plan of improvement considered therein, the existing project, which is also the original project at Port Bay, was authorized by the River and Harbor Act approved 17 May 1950. The project provides for an arrowhead system of breakwaters, the east breakwater 915 feet long and the west

breakwater 910 feet long forming a 200-foot wide entrance opening at the lakeward end, with a channel eight feet deep and 100 feet wide from deep water in the bay through the bar to the opening between the breakwaters and 200 feet wide thence to the 8-foot depth contour in the lake, the over all length of the channel to be about 1,600 feet, and such modifications as in the opinion of the Chief of Engineers may be desirable.

119. No work has been done on the existing project pending compliance with the required conditions of local cooperation. Local interests are to provide, without cost to the United States, all necessary lands, easements, and right-of-way for construction and maintenance of the project; hold and save the United States free from claims for damages due to construction and maintenance of the project; provide and maintain without cost to the United States necessary mooring facilities and utilities for transient craft, including a public landing open to all on equal and reasonable terms; establish a competent and properly constituted public body empowered to regulate the use, growth, and free development of the harbor facilities with the understanding that said facilities shall be open to all on equal terms; make necessary alterations to a power transmission and distribution line at local expense; and contribute in cash 30 percent of the first costs, not to exceed $200,000, of dredging and breakwater construction.

120. The estimate of Federal first cost for the project, revised in 1953, is $701,000, and an additional contribution of $200,000 would be required of local interests. The latest

estimate of Federal maintenance cost (1947) is $10,400 annually.

121. Other improvements. - There is no record of any local improvements made at the locality prior to 1939. In 1941 and 1942 a futile attempt was made to construct a permanent opening through the bar. Local interests constructed two short timber pile jetties and dredged a channel through the bar about 80 feet long, 30 feet wide, and three feet deep at a cost of about $3,000. Subsequently, an additional $2,000 was expended in attempts to maintain the improvement, but the channel was completely shoaled and unusable within a short time. In 1949, as an emergency measure to prevent flooding from spring runoff backed up in the bay by the bar, a channel about 600 feet long, from 60 to 80 feet wide, and from four to eight feet deep was dredged through the bar at a cost of $5,000 to the United States from funds for snagging and clearing operations. Local interests attempted to protect the channel thereby provided, so that it could be used by recreational craft, by constructing short stone piers, about 125 feet long, on either side of the channel, lakeward of the bar. However, the emergency channel was completely shoaled with two years, and the stone piers are now almost completely covered by sand.

122. Commerce and harbor use. - There is no water-borne commerce at Port Bay and the only commerce in prospect is a small amount of fishing which would be dependent upon the construction of the desired improvements. The princiapl activity in Port Bay revolves about the use of recreational craft, and

is confined to the bay except for short periods when there is a temporary opening in the barrier separating the bay from the lake. At present there are approximately 21 recreational craft, exclusive of outboards, based at Port Bay.

123. Desired improvements. - Local interests desire provision of a permanent opening through the bar to connect bay and lake. Because of the comparatively high cost to local interests for local cooperation required in connection with the existing project, they have suggested various improvements of a lesser magnitude than contemplated thereby. However, only a degree of improvement similar to that contemplated by the existing project would have any lasting effectiveness at Port Bay.

124. Conclusions. - The existing project, when complete, will provide adequately for the needs of navigation at Port Bay. Therefore, no further study need be initiated at the locality, but construction of the existing project must necessarily be held in abeyance pending compliance with the conditions of local cooperation noted previously in this section.

LITTLE SODUS BAY HARBOR, NEW YORK

125. Location. - Little Sodus Bay Harbor, New York, is located in Cayuga County, on Little Sodus Bay, an indentation in the south shore of Lake Ontario, approximately 14 miles east of Great Sodus Bay Harbor, the nearest developed harbor, and 15 miles west of Oswego, New York. The area is shown on Plate 17 and U. S. Lake Survey Charts Nos. 2. and 227.

126. Description of harbor and improvements. - Little Sodus Bay extends approximately two miles due south from the shore of Lake Ontario. Its greatest width is 5/8 mile and its least width 1/4 mile. Its shores are bold, except in the bights. There is good anchorage in the bay, with clay bottom and depths generally from 24 to 36 feet. There is a State Park dock in the northeast corner of the bay, wharves and landings at Fair Haven in the southeast corner, and facilities for marine service in the southwest corner. Fair Haven Beach State Park, located along the northerly 2200 feet of the easterly shore of the bay extends 1½ miles along the lake shore to the east. There are no bridges across Little Sodus Bay. The village of Fair Haven, located in the town of Sterling is the only community on the bay and is located on its east side. According to the U. S. Census Report for 1950 the population of the village of Fair Haven was 628 while the total population of the town of Sterling was 2,050 and that of Cayuga County was 70,136. Agricultural pursuits, especially fruit growing, make up the principal activity of the surrounding area. There are no industries in the immediate locality. Large numbers of people visit Fair Haven State Park each year and excursion boats based within the bay carry a considerable number of people

on sight-seeing trips on Lake Ontario. Improved roads connect Little Sodus Bay Harbor with main arterial highways leading to all parts of the country. At one time railroad service was available to the village of Fair Haven by a branch line of the Lehigh Valley Railroad, but the service was discontinued and the railroad has removed its tracks. A branch line of the New York Central Railroad serves Crocketts, about four miles east of Fair Haven.

127. Physical factors affecting navigation. - Little Sodus Bay is subject to the year to year variations of the water levels at Lake Ontario and the consistent seasonal rise and fall. However, fluctuations due to winds are small. The harbor is exposed mainly to storms from west through northeast. The maximum fetch is about 150 miles from the west. During west winds the current across the ends of the piers in the lake is very strong, and a vessel under insufficient headway is liable to be carried to the eastward past the entrance, where the bottom is hardpan, with no holding ground for an anchor. Other hazards, but only to small-boat navigation, include the wrecks of two steamers which have been beached in shoal water in the bay.

128. Terminal and transfer facilities. - There are no commercial terminal or transfer facilities at Little Sodus Bay Harbor. There is one passenger tour boat dock and docks for small recreational craft, all of which are privately owned. Facilities available for small boats include fuel, repairs, provisions, anchorage and dockage. Small boats are available for hire and there is a marine railway at the southwest end of the bay. There is a yacht club at the bay, but it has no facilities of its own, and a local hotel serves as its headquarters.

129. Federal improvements and studies. - Previous projects at Little Sodus Bay Harbor were adopted by the River and Harbor Acts of August 30, 1852, June 23, 1866, and March 3, 1871, and provided generally for east and west entrance piers, east and west breakwaters, and a dredged entrance channel. The existing Federal project, last modified by the River and Harbor Act of June 13, 1902, provides for an entrance channel 15½ feet deep and 150 feet wide from the lake to the bay, between parallel piers of the timber crib type with concrete superstructure about 250 feet apart, the west pier to be 1,747 feet long and the east pier 1,810 feet long, connected at its inner end with a timber crib concrete breakwater 1,680 feet long. The existing project was completed in 1906. There is no record of any local cooperation required or furnished. As of 1953 the total costs and expenditures of the existing project were $604,137.01 of which $69,066.20 was for new work and $535,070.81 for maintenance. At present the structures are in poor condition. In an 800-foot portion of the west pier, and an 800-foot portion of the east pier, the concrete has disintegrated, cracked, and settled. An 800-foot portion of the east breakwater is in need of repairs. The east pier is breached for a length of 30 feet, and there is a controlling depth of 7.5 feet at low water datum in the entrance channel.

130. There is no record of any formal report being submitted on the harbor; the previous and existing projects having been based on informal letter reports and recommendations contained in annual reports of the Chief of Engineers.

131. Other improvements. - There are no other improvements to Little Sodus Bay Harbor other than those noted previously in this section.

132. Commerce and harbor use. - At one time a considerable trade in export of bituminous coal was carried on from the port, but this traffic was discontinued after 1936. At present, the principal activity in Little Sodus Bay revolves about the use of recreational craft, although excursion boats based within the bay carry considerable numbers of passengers on sightseeing trips on Lake Ontario each year. According to statistics for 1952, the latest year of available records, there was no commerce at Little Sodus Bay. However, excursion tour boats of 3-foot draft and having a net registered tonnage of 2,104 tons made 526 round trips and carried 3,156 round trip passengers. A small boat survey in 1953 indicated that approximately 125 recreational craft were permanently based at Little Sodus Bay and that an additional 175 transient craft visited the harbor each season.

133. Desired improvements. - There has been no expressed desire on the part of local interests for further improvement to Little Sodus Bay Harbor.

134. Conclusions. - Federal maintenance of the existing project provides adequately for the present needs of navigation. No further study of Little Sodus Bay is necessary at this time.

OSWEGO HARBOR, NEW YORK

135. Location. - Oswego Harbor, New York, is on the south shore of Lake Ontario near the easterly end of the lake at the mouth of Oswego River. It is 59 miles east of Rochester Harbor and 41 miles south of Sackets Harbor. The nearest developed harbor is located at Little Sodus Bay approximately 15 miles southwest of Oswego. The area is shown on Plate 18 and United States Lake Survey Charts Nos. 0, 2, 22, 185, and 225.

136. Description of harbor and improvements. - Oswego Harbor comprises both the lower 2,500 feet of Oswego River, which is generally 500 feet in width and has been improved for deep-draft navigation and which is also a part of the New York State Barge Canal system, and an outer harbor protected by breakwaters inclosing an area of about 280 acres of which about 200 acres have been improved for deep-draft navigation. There are no bridges crossing the Oswego River below the Federal project limit.

137. Oswego County, New York, is considered to be the tributary area and has an area of about 968 square miles, the county seat being the city of Oswego. The only other city in the county is Fulton, 12 miles southerly of Oswego on the New York State Barge Canal. Oswego County is primarily an agricultural area, although Oswego itself is highly industrialized and has plants producing matches, machinery, paper, textiles, tools, electrical appliances, castings, office specialties, candy, and soy meal and oil. The harbor is a distribution center for

coal and cement, and a transshipping point for grain. There are a number of paper mills in the county outside the city. A steam-electric plant at Oswego supplemented by hydroelectric developments along the Oswego River provides for the power demands of the area. According to the U. S. Census Report of 1950, the population of Oswego County was 77,181, including 22,647 and 13,922 in the cities of Oswego and Fulton, respectively. Oswego is served by three railroads and improved highways that connect with highways leading to all parts of the county. Oswego is also the Lake Ontario terminus of the New York State Barge Canal System. There is no air line service to the community. The nearest point having commercial airline service is Syracuse, about 30 miles to the southeast.

138. Physical factors affecting navigation. - At Oswego the fluctuations in water levels of Lake Ontario due to wind and barometric pressures range from a few inches to several feet, and cause pronounced surges and currents in the harbor. The harbor is exposed to storms from the west, northwest, north, and northeast with the westerly and northwesterly storms being the most frequent. Due to its location near the easterly end of the lake, the prevalent storms have a fetch of from 90 to more than 150 miles. The storms, particularly from the northerly quarter, have caused considerable damage to docks, delays in loading and unloading vessels, loss of cargo and difficulty to ships maneuvering to the various channels, slips, and entrances. Also, the presence of extensive shoal areas offshore from the entrance to the harbor tends to bring about a concentration of wave action at the harbor entrance during northerly storms.

139. Terminal and transfer facilities. - One coal terminal and two State-owned terminals for grain and barge canal traffic are open to the public. Considerable tonnages of bituminous coal are received at the private dock at the Niagara Mohawk Power Corporation for consumption at the steam power plant. Another coal terminal, one for cement, one for woodpulp, and one for fish are for private use only. There is also a dock owned by the State naval militia and a dock owned by the City of Oswego, both of which are used by recreational craft. There are no boat liveries or service facilities for light-draft craft.

140. Federal improvements and studies. - The original project at Oswego Harbor adopted by the River and Harbor Act approved 2 March 1827 was subsequently modified at various times, with the last modification authorized by the River and Harbor Act approved 2 March 1919. The existing project is an evolution of the original project, the various features having been authorized by River and Harbor Acts of 1870, 1907, 1930, 1935, 1940, 1948, and 1954 and provides for the following:

a. An outer harbor, about 280 acres in area, formed by a system of breakwaters comprising a detached breakwater 850 feet long, an outer west breakwater 4,478 feet long connected with the shore, consisting of 4,359 feet of stone-filled timber cribs with concrete superstructure and 119 feet of rubble-mound construction; a west arrow-head rubble-mound breakwater 2,700 feet long; an east arrow-head rubble-mound breakwater about 1,180 feet long; and an outer east rubble-mound breakwater about 4,900 feet long, connected with the shore.

b. Removal of shoals on the approach to the harbor to a depth of 25 feet; a depth of 21 feet in soft material and 22 feet in hard material in the west outer harbor west of the east side of the Lackawanna coal dock; a depth of 21 feet in the outer harbor between the arrow-head breakwaters, in the west outer harbor east of the Lackawanna coal dock, and between the harbor lines in the Oswego River north of the north line of Seneca Street; no dredging to be done within 100 feet of the breakwaters nor within 50 feet of the established harbor lines, except in the river.

c. A channel 250 feet wide in the east outer harbor, and an irregular shaped basin at the easterly end, with depths of 18 feet in soft material and 19 feet in hard material.

d. Maintenance of 145 feet of the west inner breakwater. All conditions of local cooperation required for the project have been complied with except those required in connection with work authorized by the River and Harbor Act of 30 June 1948; construction of the east outer harbor. Assurances of local cooperation required in connection with that work were furnished and submitted for approval. However, the assurances were returned without action because they were not in strict accordance with the requirements. Negotiations are now in progress to obtain the revised assurances. The estimate of Federal cost for new work (1953) is $17,334,600 and the (1953) estimate for annual cost of maintenance is $62,700.

141. The latest report on Oswego Harbor was the survey report on that locality submitted by the District Engineer, Buffalo District,

on 26 January 1949. This report was submitted in compliance with section 6 of Public Law 14, 79th Congress, 1st Session, approved 2 March 1945. The improvements desired by local interests, requested at a public hearing preceding preparation of the report, were provision of adequate protective structures and shoal removal at harbor entrance, for the safety of navigation, protection of harbor facilities, and reduction of navigation delays. The plan of improvement considered provided for the construction of a detached breakwater about 850 feet long at the harbor entrance and the removal of shoals in the approach to the harbor entrance to a depth of 25 feet below water datum. The first cost to the Federal Government for the above improvements plus additional aids to navigation by the U. S. Coast Guard was estimated to be $1,815,000, while annual benefits to navigation resulting therefrom were estimated to be about $82,800 compared to annual costs of $75,800, all based on 1948 price levels. Accordingly, the District Engineer recommended that the existing project at Oswego Harbor be modified so as to provide for the plan of improvement prescribed in the report, and the recommendation was concurred in by the Chief of Engineers. The report was transmitted to Congress, 21 February 1950, and has been printed in House Document 487, 81st Congress, 2d Session. The recommended improvements were authorized in 1954. The 1953 estimate of first cost is $2,459,000.

142. Other improvements. - The Oswego River is part of the New York State Barge Canal system and is canalized to a 14-foot depth between locks from Oswego Harbor to Three Rivers Point. There are

seven locks in this section with maximum usable dimensions of 43-1/2 feet in width, 300 feet in length, and 12 feet in depth. These dimensions and the 15-1/2 foot overhead clearance at bridges are the controlling dimensions in the canal system. In Oswego River, from Seneca Street south to Barge Canal Lock No. 8 above Bridge Street, the State has excavated a channel 100 feet wide and 12 feet deep for entrance to the canal. Other improvements to the waterway between Oswego and Waterford are being accomplished under a Federal project by the allotment of Federal funds to the State of New York. These latter improvements provide for: a depth of 14 feet below normal pool elevation between the locks; lowering the lock sills to provide 13 feet of water over the sills; widening the channel at various sections; construction of highway bridges and the raising of the existing bridges to 20-foot clearance above maximum navigable stage.

143. Commerce and harbor use. - Waterborne commerce is the principal activity in Oswego Harbor. Commercial statistics for 1952, the latest year that complete records are available, show that the vessel traffic handled at Oswego was 2,239,689 tons, in addition to 994,380 tons carried by vessels in transit of necessity, or "through traffic". There was a total of 1,948 round trips made by commercial vessels having drafts as deep as 22 feet and having a net registered tonnage of 2,157,176 tons. The waterborne commerce handled at Oswego Harbor consisted of wood pulp and grain imports; coal exports; lakewise receipts of grain and vegetable products, coal, and iron;

lakewise shipments of coal; and internal shipments via the Barge Canal of grain and vegetable products. The cargoes carried by vessels in transit included grain and vegetable products, paper, metals, chemicals, and petroleum products. There is a small amount of commercial fishing from Oswego Harbor which in 1952 amounted to 73 tons. Recreational navigation is purely of a transient nature, there being no recreational craft, other than outboards, based at the harbor.

144. Desired improvements. - There have been no formal requests by local interests for Federal improvement to Oswego Harbor other than those noted in the survey report on Oswego Harbor of 26 January 1949 and which have been mentioned previously in this section.

145. Conclusions. - Since completion of the existing project and modification thereof as recommended in House Document No. 487, 81st Congress, 2d Session, will adequately serve both the present and reasonably prospective needs of navigation, no further study of Oswego Harbor is necessary at this time.

LITTLE SALMON RIVER, NEW YORK

146. Location. - Little Salmon River empties into Mexico Bay, a broad recess in the southeast shore of Lake Ontario at Mexico Point, New York. The mouth of the river is approximately 14 miles northeasterly of Oswego Harbor, the nearest developed harbor, and six miles southwesterly of Port Ontario, New York. The area is shown on Plate 19 and U.S. Lake Survey Charts Nos. 2, 21, and 22.

147. Description of harbor and improvements. - Little Salmon River has a drainage area of about 90 square miles. The lower reach of the river averages about 100 feet in width and affords depths generally from seven to ten feet. The last 1000 feet traverse a swampy pool which is separated from the lake by a sand and boulder bar; this bar reduces the river width at its mouth to about 50 feet. In the spring of the year, high water erodes the bar and partially opens the channel to the lake. With the recession of high water the lake rebuilds the bar and, in late summer, navigation is much restricted or impossible due to the depth of one foot or less in the entrance channel.

148. The eastern shore of Lake Ontario, along Mexico Bay, is primarily a summer resort area and has facilities for accommodation of summer vacationists. At Little Salmon River, Mexico Point Park, a settlement of summer cottages is located on the lake shore just east of the mouth. The Mexico Point Club, a hotel, is located on the west bank just within the mouth, and cottages are scattered along the lower mile on that side of the river.

149. The area immediately tributary to the locality is the town of Mexico, Oswego County, which had a population of 3,035 in 1950. The village of Mexico, principal trading center of the tributary area, located about 4-1/2 miles south of the river mouth, had a population of 1,398 in 1950. The major occupation of the surrounding area is general farming and the only industries in the immediate tributary area are a feed and grain mill, a dairy plant, a canning plant, two small contracting firms, and a plant producing powdered milk, all of which are located in the village of Mexico. The area is served by first and second class roads which connect with main arterial highways leading to all sections of the country. A branch line of the New York Central Railroad, which runs approximately parallel to the lake shore, has a freight station at the village of Mexico. There are no bridges crossing the section of Little Salmon River under consideration.

150. Physical factors affecting navigation. - The water level in the lower Little Salmon River is dependent upon, and, in general, is equivalent to the level of Lake Ontario, and subject to the year to year variations, the consistent seasonal rise and fall and the occasional oscillations due to changes in wind and barometric pressure. The mouth of Little Salmon River is exposed to storms from the west through northwest to north having fetches of 170, 50, and 20 miles, respectively. Storms from the west to northwest are most severe. The nearest protected harbors are some distance removed and the small sports fishing craft which make extensive use of the offshore water, have no easily accessible refuge during sudden storms. The entrance into the mouth of Little Salmon River is hazardous except during calm weather and then can be

negotiated only by the smallest boats. Beginning about the middle of summer, the entrance becomes blocked by a sand and boulder bar, leaving a depth of less than one foot.

151. Terminal and transfer facilities. - There are no commercial wharves or public docks at the locality.

152. Federal improvements and studies. - There has never been a Federal project for the improvement of Little Salmon River at Mexico Point. The latest report submitted on the locality was the Review of Reports on Big Sandy Creek and Mexico Bay, New York, with a view to improving Little Salmon River, submitted by the District Engineer, Buffalo District, on February 23, 1939. This report was submitted in compliance with the resolution adopted by the Committee on Rivers and Harbors of the House of Representatives on 8 September 1938. The improvements desired by local interests, which were formally requested at the public hearing held prior to preparation of the above report were for a harbor of refuge for recreational craft and harbor facilities for prospective commercial navigation. They proposed that this be accomplished by construction of a 1000-foot breakwater normal to the shore west of the river mouth and dredging of a 16-foot depth channel east of the breakwater from the lake to a deepened harbor basin within the mouth. In preparation of the report, the District Engineer considered the feasibility of an improvement such as requested by local interests and also considered a plan to provide for a harbor of refuge for recreational craft only. The plan of improvement considered for a refuge harbor consisted of the construction of arrowhead breakwaters, dredging of an entrance channel and turning basin, and navigational aids. The total cost of the considered work, based on 1939 price

levels was estimated at $330,000 for the improvement requested by local interests and $194,500 for improvement for recreational craft only. The reporting officer found that there was no commercial navigation at Little Salmon River and no future prospect thereat, and the benefits which might accrue from provision of a harbor of refuge for recreational craft thereat, would be incommensurate with costs. Accordingly it was recommended that no survey of Little Salmon River be made. This recommendation was concurred in by the Chief of Engineers.

153. A resolution adopted by the Committee on Rivers and Harbors at the House of Representatives on 2 October 1946, requested a review of the above report and previous reports on the locality of Big Sandy Creek and Mexico Bay, New York, with a view to determining advisability of improving Little Salmon River. A public hearing has been held, but due to budgetary limitations the authorized report has not been completed.

154. Other improvements. - There are no navigational improvements at the mouth of Little Salmon River.

155. Commerce and harbor use. - There is no present waterborne commerce of any sort at the mouth of Little Salmon River at Mexico Point. Should a harbor be provided at this locality, there is a possibility that some commercial fishing vessels would be based thereat. However, no other prospect of commerce can be foreseen at this time. According to a survey made in 1953 there were approximately 135 recreational craft of the outboard type based at the mouth of Little Salmon River. There is no record of any transient craft visiting the area.

156. Desired improvements. - At a public hearing held 18 March 1947, in connection with the currently authorized review report, local interests reiterated their desire for the improvements noted previously.

157. Conclusions. - Improvement to Little Salmon River can be justified only on the basis of commercial benefits which would accrue as a result of the improvement or on its merits as a harbor for light-draft vessels. There is no present waterborne commerce and it appears unlikely that any appreciable amount would develop as a result of improvement. Little Salmon River is not favorably located for a harbor of refuge and the existing Federal project at Port Ontario, New York, six miles to the northeast, will, if constructed, serve adequately as a harbor of refuge for light-draft vessels in the area. The benefits which might accrue from improvement of the locality would be largely local, accruing to residents of the immediate area. Economic justification of an improvement is unlikely and it is highly improbable that local interests could provide the relatively large degree at local cooperation normally required for a small-boat harbor project. Further investigation of the locality is unnecessary at this time and the authorized review study thereat is currently classified as inactive.

PORT ONTARIO HARBOR, NEW YORK

158. Location. - Port Ontario, New York, is located in Oswego County in the southeasterly end of Lake Ontario, 19 miles northeasterly of Oswego Harbor, New York, the nearest developed harbor, and 32 miles southerly of Sackets Harbor, New York. The area is shown on Plate 20 and U.S. Lake Survey Chart No. 22.

159. Description of harbor and improvements. - Port Ontario is at the mouth of the Salmon River, which has a drainage area of about 267 square miles. The entire flow is controlled by two power dams about 12 miles upstream from its mouth. The beaches in the vicinity of Port Ontario are sandy. Lakeward, the bottom slopes gradually to a depth of 10 feet about 1,000 feet from shore. The bottom, both in the lake and river, is generally sand and gravel with an underlying layer of blue clay. Within the entrance to Salmon River, which is about 125 feet wide, there is a channel for about a mile having usable depths of about six to 10 feet. In a bend of the river about 1,200 feet south of the entrance, is Selkirk Lake, which is marshy, with non-navigable depths of water when Lake Ontario is at low water datum.

160. The eastern shore of Lake Ontario is primarily a summer resort area. The settlement at the mouth of Salmon River, known as Selkirk, has a number of permanent residences, summer cottages, and other facilities for the accommodation of summer colonists. The village of Port Ontario, about one mile upstream, is somewhat larger and also caters to vacationists. Selkirk Shores State Park is located on the

south bank of the river, lakeward of Port Ontario. It consists of 631 acres of ground, and its improvements include picnic grounds, cabins athletic field, hiking trails, community house, restaurant, parking grounds, bathing beach, bathhouse, a concrete decked steel sheet pile pier into the lake. State Park officials have reported the annual attendance in recent years to be over 100,000 people. Pulaski, the principal trading center of the immediate tributary area, is three miles east of Port Ontario and has several manufacturing establishments, stores and a bank. The major occupation of the balance of the surrounding area is general farming. According to the U. S. Census Report for 1950, the population of the village of Pulaski was 2,033, while the population of Oswego County was 77,181. The New York Central Railroad and numerous improved highways serve the area. No bridges cross the navigable portion of the waterway under study.

161. Physical factors affecting navigation. - The level of the lower Salmon River is generally equivalent to and subject to the variation of the surface elevation at Lake Ontario. Fluctuations due to wind are small. The mouth of Salmon River is exposed to storms from the west through northwest to north, the maximum fetch being about 185 miles from the west. There is a shifting sand bar across the mouth of the river, with a low water controlling depth of about one foot. In the spring of the year, high water flows from the river erode the bar and partially reopen the channel to the lake. With the recession of the high water in the stream, the lake gradually builds up the bar, and by the middle of summer navigation through the opening in the bar is restricted or impossible.

162. Terminal and transfer facilities. - There are no commercial terminal or transfer facilities at Port Ontario Harbor. The facilities consist of a fish dock and several temporary, small-craft landings, all of which are privately owned and restricted. There are also two small-boat liveries at Selkirk, and fuel and lubricants are available.

163. Federal improvements and studies. - The original Federal project at Port Ontario was adopted by Congress in 1836. However, the harbor was considered to have been abandoned in 1858 by authority of Executive Document No. 16, Thirty-fifth Congress, 1st session. The existing Federal project at Port Ontario Harbor provides for parallel piers, 200 feet apart, the north and south piers to be 915 and 735 feet long, respectively, with pile wall connections to shore 280 and 470 feet long, respectively; an entrance channel between the piers 100 feet wide and 10 feet deep from deep water in the lake to a point about 400 feet upstream from the inner end of the north pier; thence an inner channel of the same width, eight feet deep to a point approximately 1,800 feet upstream; and thence a turning basin 900 feet long, generally 400 feet wide, and eight feet deep; with such modifications as, in the discretion of the Secretary of the Army and the Chief of Engineers, may be desirable. The existing project, authorized by the River and Harbor Act of March 2, 1945, is subject to certain conditions of local cooperation, among which is that local interests contribute $211,300 in cash toward its construction, in addition to the conditions of local cooperation generally required of all Federal projects.

Assurances of the required cooperation have not as yet been received and construction of the project has not begun. The estimate of cost of the existing project, made in 1953, is $922,700 exclusive of the $211,300 to be contributed by local interests. The estimate for annual cost of maintenance, made in 1945, is $5,000.

164. The latest report on Port Ontario Harbor, New York, is contained in the Survey Report of the Coasts of the Great Lakes for Harbors of Refuge for Light-Draft Vessels. This report was prepared by a Special Board of Engineers consisting of the District Engineers of the Milwaukee, Duluth, Buffalo, Chicago, and Detroit Districts who were appointed to carry out and report on a survey of the coasts of the Great Lakes with a view to the establishment of harbors of refuge for light-draft vessels as authorized in Section 4 of the River and Harbor Act approved 26 August 1937. Port Ontario Harbor was one of the sites considered in this report which was submitted by the Special Board on 10 September 1942. The Board considered Port Ontario Harbor as an alternate to North (Sandy) Pond, located about four miles to the north, since the improvement of either locality would satisfy the need for a harbor of refuge in that area. Due to the lesser cost, and the proximity to other recreational facilities at Selkirk Shore State Park, Port Ontario was considered preferable. The plan of improvement considered and recommended by the Special Board served as the basis for the existing project described above. The Chief of Engineers concurred in the recommendations of the Special Board, the

report with accompanying papers was printed in House Document No. 446, 78th Congress, 2nd Session, and the existing project was subsequently authorized in accordance therewith.

165. Other improvements. - There are no other improvements to Port Ontario Harbor, New York, other than those noted previously in this section.

166. Commerce and harbor use. - There is no waterborne commerce at Port Ontario Harbor except for a small amount of commercial fishing. Statistics for 1952, the latest year of available records, show that three tons of fish were received at the harbor while the number of round trips made by fishing vessels was 140. There are approximately 76 recreational craft, in addition to about 570 outboards based at Selkirk Shores and nearby North (Sandy) Pond and South Pond. In addition, a small number of transient craft visit the area each season.

167. Desired improvements. - No further improvement, other than that which would be provided by the existing project, has been requested by local interests.

168. Conclusions. - The existing Federal project, when complete, will provide adequately for the needs of navigation at Port Ontario and will also fulfill the need for a harbor of refuge in that locality, and no further study of Port Ontario Harbor is necessary at the present time.

169. Location. - North (Sandy) Pond, New York, is located in Oswego County, at the eastern end of Lake Ontario, about 23 miles northeast of Oswego, the nearest developed harbor, and 28 miles south of Sackets Harbor. The area is shown on Plate 21 and U. S. Lake Survey Chart No. 22.

170. Description of harbor and improvements. - North (Sandy) Pond is a lagoon about 3 miles long and 1-1/2 mile to 2 miles wide, separated from the lake by a barrier beach with sand dunes. The outlet of the pond is through a gap in the barrier beach located approximately one mile north of the southerly end of the pond. The original outlet, at the southerly end of the lagoon between North Pond and South Pond, has been filled by sand. On the lake side at the barrier the bottom is sandy and slopes gently to a 12-foot depth about 1,100 feet from shore. Inside the pond, varying depths to a maximum of about 15 feet exist. The configuration and alinement of the outlet vary from time to time due to deposition of sand from the lake and erosion during highwater. In general, the maximum width at the outlet is less than 200 feet and the controlling depth is occasionally as much as four feet. North Pond, located centrally between existing developed harbors, has ample anchorage area for recreational craft and commercial fishing vessels. The surrounding area is moderately developed as a summer resort and has many cottages and a number of hotels along the shore. The villages of Sandy Creek and Laconia lie five and six miles, respectively, east of the pond, and according to the U. S. Census Report for 1950 had populations of 708 and 540, respectively, while the total population of Oswego County for the same year was 77,181. The principal

activity of the area is devoted to general and dairy farming and fruit growing, although there are some industries at the village of Sandy Creek consisting of a dairy products plant, a lumber manufacturing plant, a publishing company, and a crushed stone company. A State highway parallels the lake shore near the east limits of the pond and gravelled roads extend to the several colonies bordering it. The nearest railroad facilities are at Lacona which is served by the New York Central Railroad. There are no bridges crossing the waterway under consideration that could interfere with the improvement of North (Sandy) Pond as a harbor of refuge.

171. Physical factors affecting navigation. - The pond is ordinarily subject to the year to year variations in the water levels of Lake Ontario and the consistent seasonal rise and fall. Fluctuations due to wind are small. The outlet of North (Sandy) Pond is exposed to storms from the southwest through west to northwest with the maximum fetch being about 185 miles from the west. At each end of the outlet, shoals are formed due to interception of the northerly litteral drift by currents through the gap. Although several small streams flow into the pond, their combined discharge is insufficient to cause appreciable difference in water levels between pond and lake. The east shore of Lake Ontario is subject to a northerly littoral drift caused by the prevailing winds, and considerable wind-drift also takes place toward the east and northeast. These conditions cause instability in the dunes on the barrier, generally producing long flat slopes lakeward,

and steeper slopes pondward. There are no harbors of refuge between Oswego and Sackets Harbor, a distance of approximately 51 miles along the shore and small craft cruising in this reach find navigation at times to be extremely hazardous.

172. Terminal and transfer facilities. - There are no commercial terminal or transfer facilities at North (Sandy) Pond. The only facilities are a number of small-craft landing stages and six boat liveries, one of which has a 100-foot long marine dock. Fuel, supply and repair facilities are also available.

173. Federal improvements and studies. - There has never been a Federal project for improvement of North (Sandy) Pond. The latest report on North (Sandy) Pond, New York, is contained in the Survey Report of the Coasts of the Great Lakes for Harbors of Refuge for Light-Draft Vessels. This report was prepared by a Special Board of Engineers consisting of the District Engineers of the Milwaukee, Duluth, Buffalo, Chicago, and Detroit, Districts, who were appointed to carry out and report on a survey of the coasts of the Great Lakes with a view to the establishment of harbors of refuge for light draft vessels as authorized in Section 4 of the River and Harbor Act approved 26 August 1937. North (Sandy) Pond was considered as an alternate to Port Ontario in the report submitted by the Special Board on 10 September 1942. The improvements desired were not itemized, but local interests endorsed a proposal for a harbor of refuge at this locality. The plan of improvement considered by the Special Board to be most

feasible consisted of an entrance channel between two steel sheet pile piers each 1,800 feet long located at a narrow low opening in the dunes about 2,700 feet south of the present gap in the barrier dunes. The considered channel would be 100 feet wide and 10 feet deep and would extend from the 10-foot contour in the lake to the 10-foot contour in the pond. The total cost of the considered plan of improvement, based on 1942 price levels, was estimated to be $620,000, while the major portion of the general benefits to be realized would be derived by reason of the increased safety to small craft cruising in the reach. The Special Board, considering the higher cost of improvements at North (Sandy) Pond over that of its alternate, Port Ontario, concluded that the location of a harbor of refuge is less warranted at the former than at the latter locality. It was recommended by the Special Board, and concurred in by the Chief of Engineers, that no project for harbor improvement be adopted at North (Sandy) Pond.

174. A review survey at this locality was authorized by resolution of the Senate Public Works Committee adopted 10 February 1950, with the object of determining the feasibility of providing a harbor of refuge thereat. Due to budgetary limitations, the study has not yet been initiated.

175. Other improvements. - The present entrance channel into North (Sandy) Pond was dredged by the State of New York in 1895. No information on its original dimensions and cost is available. Subsequently, the natural outlet, which was midway between North and South Ponds, was closed by natural forces. In 1949 local interests were

issued a permit to dredge a channel 100 feet long, 40 feet wide and ten feet deep through the barrier. A contractor employed by local interests opened a channel through the barrier to a depth of about four feet below the lake level then prevailing. The channel was effective for about one month, after which shoaling made it unusable. There is no record of any other local improvements at North (Sandy) Pond.

176. Commerce and harbor use. - There is no commercial activity at North (Sandy) Pond other than a small amount of commercial fishing. Statistics for 1952, the latest year of available records, show that fishing craft made 50 trips resulting in a catch of two tons. According to a survey made in 1953, there were approximately 75 recreational craft in addition to 570 outboards based in the pond and along the 4-mile reach between North (Sandy) Pond and Port Ontario. A small number of transient craft also visits the area each season.

177. Desired improvements. - No other requests for improvement to North (Sandy) Pond, other than those noted previously in this report, have been made local interests desire construction and maintenance of a Federal channel between lakes and ponds.

178. Conclusions. - The authorized Federal project at Port Ontario New York, if completed, will serve adequately as a harbor of refuge for light-draft vessels cruising in the reach between Oswego and Sackets Harbor and will reduce the desirability of a harbor at North (Sandy) Pond. Further, it is probable that the high cost for improvement at

North (Sandy) Pond and the relatively large portion thereof usually assessed as local cooperation for small-boat projects, which it is believed would be far beyond the means of local interests, will preclude authorization of a Federal project thereat. In view of these considerations, the authorized survey report for the locality is currently classified as inactive and further study at North (Sandy) Pond is unnecessary at this time.

179. Location. - The area under consideration is located in Jefferson County at the extreme easterly end of Lake Ontario, just southerly of the head of the St. Lawrence River. Included are Henderson Bay, Chaumont Bay, and nearby Galloo and Stony Islands. Black River Bay, located midway between Henderson and Chaumont Bays, is actually an integral part of the area; however, because of the nature of improvements desired by local interests thereat, it is discussed in a separate report, following, as is Sackets Harbor, which is located thereon. The area is shown on Plate 22 and U. S. Lake Survey Charts Nos. 2, 21, and 211.

180. Description of harbors and improvements. - Henderson Bay is located approximately 35 miles north-northeast from Oswego and 16 miles southeasterly from the head of the St. Lawrence River. Its northeasterly limit is about one mile from Sackets Harbor, an authorized Federal project. The bay is about seven miles long in a northeast-southwest direction parallel to the shore and about two miles wide, normal to the shore. The lakeward limit of the bay is defined by shoals and several islands, some of which form a continuous barrier about two miles long, extending northeasterly from the northerly headland of Stony Point to Six Town Point. The remainder is open to the northwest to Lake Ontario. Snowshoe Bay is an inlet located at the headland end of this barrier and opens into Henderson Bay. Depths in Henderson Bay range from 40 feet near the center to 20 feet near the west, south, and southeast shores, but along the northeast shore the 20-foot depth lies

1/2 mile offshore. One artificial and three natural channels provide access to the bay. Two natural channels, one on each side of Bass Island, have depths of over 25 feet, while the channel between Six Town Point and Lime Barrel Shoal has but 13 feet. In Snowshoe Bay, depths range from 14 feet near Henderson Bay to three feet near Snowshoe Cut, which is an artificial channel, cut by local interests, through the isthmus connecting Stony Point and the barrier islands. Depths lakeward of the cut increase rapidly and attain 12 feet above 250 feet offshore. Henderson Harbor, a small village, is located on the mainland side of Henderson Bay, about two miles southeast from Snowshoe Bay, and about two miles northwest from the village of Henderson.

181. Stony Island lies about six miles due west of Henderson Bay and originally consisted of two elongated islands separated by a narrow strait. Wind and wave action have formed a gravel bar across the southerly and northerly ends of the strait, forming a sheltered lagoon. The portion of the island on the westerly side of the lagoon thus formed is about two miles long and 3/4 mile wide, and the portion on the easterly side of the lagoon is about three miles long and 1/2 mile wide. The lagoon has depths varying from 22 feet near the center to ten feet about 600 feet from the north entrance and seven feet near the southerly end. Dutch John Bay, located lakeward of the north entrance, is a deep water bight, and the 12-foot depth contour is only 200 feet offshore. Local interests have opened channels through the barriers at each end of the bay, and have constructed short, parallel piers at each location. The southerly entrance channel is crossed by two short drawbridges; one for

light vehicular traffic and one for pedestrian crossings. The bridges are kept in the open position except when in use. There are no settlements on the island, which is given over to scattered cottages, summer homes, and a private lodge.

182. Galloo Island, located about 2-1/2 miles northwesterly of Stony Island, is approximately four miles long in a northeast-southwest direction, and has a maximum width of 1-1/4 miles. There are no settlements on the island, which is given over to general farming and a few camps occupied by vacationists in the summer months. The United States Coast Guard maintains a station at Gill Harbor on the northeasterly side of the island. The harbor consists of an elongated area lying in a northeast-southwest direction, separated from Lake Ontario on the southeast side by a gravelly reef with top elevation near low water datum about 1/2 mile offshore. Entrance to the harbor is by a narrow channel passing between the reef and a point of land at the southern end of the harbor. The entrance channel is about 30 feet wide and is maintained to a depth of about ten feet by the Coast Guard. Controlling depth in the harbor area in the vicinity of the entrance and the Coast Guard station is nine feet and increases gradually to about 13 feet near the center of the harbor.

183. Chaumont Bay, extending generally in a northeast-southwest direction, is almost continuously confined by an irregular shore line except for a wide entrance on the southwest. The entrance is exposed only to southwesterly winds, and is approximately five miles north of Six Town Point on Henderson Bay. The Bay is irregular in shape and

about eight miles long. Within the northeasterly reaches lie Guffin Bay, Sawmill Bay, the mouth of Chaumont River, and Three Mile Bay. Point Peninsula, roughly triangular in shape, bounds the southerly side of the bay and is connected to the mainland by an isthmus at the northwesterly apex. A rocky shoal area extends about 1/2 mile lakeward off the southerly tip of the peninsula. The entrance channel to Chaumont Bay has depths ranging from 25 to 60 feet. At its narrowest point it is about one mile wide, with deep water close to shore. The Bay is navigable for light-draft vessels over its entire area except at the easterly end near the mouth of Chaumont River. In general, depths adjacent to the shores quickly descend to about 12 feet, and then gradually increase to approximately 25 feet near the center of the bay. The village of Chaumont is located at the head of Sawmill Bay, on the peninsula formed by that bay and the mouth of Chaumont River.

184. The area under consideration is characterized by numerous islands, shoals, bays, and inlets which make the locality very attractive for recreational boating and fishing. The waters of the area abound with fish life, and the State of New York has reserved an area covering approximately 90 square miles in Lake Ontario as a game fish preserve. As shown on Plate 22 this area includes the waters at Henderson Bay and those surrounding Galloo and Stony Islands. Shoals in the vicinity of these islands and off the head of Point Peninsula offer excellent grounds for bass fishing, and vacationists, sportsmen, and yachtsmen are attracted to the locality from all parts of New York State and the surrounding region. Small boats, owned and operated by

local residents and by residents throughout the State who have erected summer homes along the shores in the vicinity, are based primarily at Chaumont in Sawmill Bay, Sackets Harbor in Black River Bay, and Henderson Harbor. The locality has been developed into an important resort area, particularly along the easterly shore of Henderson Bay. Otherwise, the tributary area, which is comprised of parts of Jefferson, Lewis, and Oswego Counties, is primarily agricultural although it contains numerous villages and the city of Watertwon, which is the financial and shopping center. According to the 1950 census, the population of the counties of Jefferson, Lewis and Oswego were 85,521, 22,521, and 77,181, respectively. The permanent populations of the minor political subdivisions in Jefferson County immediately tributary to the area under consideration were as follows: town of Brownville - 3,806, including 1,038 in the village of Dexter; town of Henderson - 1,171; town of Hounsfield - 2,630, including 1,247 in the village of Sackets Harbor; town of Lyne - 1,453, including 513 in the village of Chaumont; and the city of Watertown - 34,350. However, the number of summer residents in the immediate tributary area exceeds the number of permanent residents, particularly in the town of Henderson where there are three times as many summer residents.

185. Physical factors affecting navigation. - As indicated in paragraph 6, lake levels vary from year to year but are subject to consistent seasonal rise and fall, the lowest prevailing during the winter months and the highest during the summer months and, in addition, there are occasional fluctuations of short duration ranging from a few

inches to several feet. The areas pertinent to this section are particularly susceptible to such changes due to their location at the extreme easterly end of Lake Ontario.

186. The New York State Game Fishing Preserve in the waters surrounding Galloo and Stony Islands is exposed to storms from the south through west to northwest with fetches of about 30 miles from the south, 192 miles from the west, and 20 miles from the northwest. The prevailing winds are from the southwest and west, and frequent sudden storms quickly create unsafe conditions for small craft in the area. The north entrance to Stony Island Lagoon and the entrance to Henderson Bay are reasonably well protected from storms from the west and southwest by headlands and islands. The area between Stony Island and Henderson Bay and the entrance to Chaumont Bay are moderately protected from storms from all directions except the southwest. Henderson Bay and Chaumont Bay are well protected by headlands and islands, but the large fetches within them make these waters unsafe for the smaller types of recreational craft during storms, particularly those from the southwest and northeast on Henderson Bay and from the southwest on Chaumont Bay. Gill Harbor, during periods of high lake levels, offers little protection to small craft, and is exposed to storms from the northeast through south to southwest.

187. Terminal and transfer facilities. - There are no publicly-owned wharves or transfer facilities on Galloo or Stony Islands, on Point Peninsula, in Henderson or Chaumont Bays, or in Black River Bay or at Sackets Harbor. The U. S. Coast Guard maintains a dock and launchway

and there are several private landing stages of temporary construction in Gill Harbor at Galloo Island. Gasoline, lubricants, and supplies are available on Point Peninsula at a boat livery with a small dock. There are several landings in Henderson Bay, the principal one being at Henderson Harbor. Wharves at the harbor are used by charter guide boats for sport fishing and small motor vessels carrying passengers and small shipments of materials to Galloo and Stony Islands. There are six service docks for small craft and a yacht club maintains a mooring area. Gasoline, lubricants, water, supplies, boat and engine repairs, covered storage, and a boat lift are available and obtainable at the harbor. In Chaumont Bay, at the village of Chaumont on Sawmill Bay, there are commercial fishing docks, a boat-building yard with a dock and boat lift at which gasoline, lubricants, supplies, and boat and engine repairs are obtainable, and a yacht club with mooring facilities. Another boat yard is located at Dexter at the head of Black River Bay and additional small-boat servicing facilities are available at Sackets Harbor. Details concerning the facilities at these latter two points are contained in the separate reports thereon which follow. Throughout the area there are resort docks and private docks located on the shore at numerous points.

188. Federal improvements and studies. - There are no previous or existing Federal improvement projects in the area other than for Black River Bay and Sackets Harbor, described in the separate reports thereon.

189. The possibility of improving Gill Harbor on Galloo Island was investigated in connection with the report prepared by a special

board of officers on The Coast of the Great Lakes - Harbors and Harbors of Refuge for Light-Draft Craft, dated 10 September 1942, and subsequently published in House Document No. 446, 78th Congress, 2d Session. The plan of improvement considered involved dredging a new entrance channel, 100 feet wide and eight feet deep, at the northerly end of the harbor, thereby relocating the channel more nearly parallel to the prevailing winds. It was determined that an appreciable increase in traffic at the harbor is unlikely, either with or without improvement, and the existing facilities maintained by the U. S. Coast Guard are satisfactory for accommodation of the traffic at the harbor. In view thereof, and since local interests expressed no desire for improvements at Gill Harbor, a Federal project was not recommended.

190. A preliminary examination report on Chaumont River, New York, was submitted by the District Engineer, Buffalo, New York, on 9 January 1946. At the public hearing held prior to preparation of the report, representatives of the yacht club and the boat yard at Chaumont on Sawmill Bay requested that a navigation light be created to mark the shoal off Point Peninsula; a submerged pier on Johnson Shoal be removed or marked with an obstruction buoy; and a 100-foot wide channel with depths suitable for large sailing craft be dredged through Sawmill Bay with a turning basin at the inner end. Local interests at Depauville, six miles upstream from Chaumont on the Chaumont River, requested that the river be cleared of sand bars and other obstructions to provide a depth of three or four feet as far upstream as Depauville. Local interests were advised that requests for establishment of aids to naviga-

tion should be addressed to the United States Coast Guard Service, and both the shoal off shore from Point Peninsula and Johnson Shoal have subsequently been marked by that organization. It was determined that the cost of improving Chaumont River to Depauville to a depth of four feet, which would be even then inadequate for recreational craft, would be excessive in comparison with the benefits that might be derived. It was concluded, however, that improvements in Sawmill Bay, substantially as requested by local interests, would result in considerable benefits to light-draft navigation and probably would be economically justified. Accordingly, a detailed survey of the locality was recommended. The details of the proposed improvement are shown on Plate 22.

191. A preliminary examination report on Henderson and Chaumont Bays, New York, was submitted by the District Engineer, Buffalo, New York, on 19 April, 1946. At public hearings held prior to preparation of the report, the following improvements were requested by local interests:

a. Improvement and maintenance of Snowshoe Cut to a depth of six feet, construction of piers on both sides of the channel lakeward of the bar, and alterations to an existing bridge, if required.

b. Improvement and maintenance of a channel, six feet deep, through the bars at both ends of the lagoon on Stony Island, and construction of piers lakeward of the bars and bridges across the channel.

c. Construction of a breakwater, 100 feet long, normal to the shore, extending into the entrance to Chaumont Bay, at the head of Point Peninsula.

d. Improvement and maintenance of a channel, six feet deep, through the isthmus which connects Point Peninsula with the mainland, and a channel bridge to give land traffic access to the peninsula. All of the improvements requested would provide additional and more accessible refuge to the commercial, charter, and private sports fishing traffic in the area. In addition, local interests asserted that improvement of Snowshoe Cut and a channel through the Point Penninsula isthmus would result in considerable savings in time and operating costs to vessels enroute to fishing grounds in the lake, and improvement of Stony Island would be a convenience to island farmers in receiving supplies and shipping farm products.

192. It was determined that adequate maintenance of Snowshoe Cut would insure a dependable entrance to the sheltered waters of Snowshoe Bay and would contribute materially to the safety of small craft in the lake fishing areas. However, this improvement would not in itself be sufficient in providing safe fishing conditions in most parts of the fish preserve. The lagoon at Stony Island, located near the center of the game fish preserve, would provide a desirable harbor of refuge. Dependable channels through either bar would require construction of relatively short protective piers extending into the lake and a bridge across the channel to provide means of access from one side of the island to the other. The south entrance would require the longer piers and would open in the direction of prevailing winds, whereas the north entrance opens to the north into a deep water bight, and is nearer to the center of fishing activity. The desired 100-foot breakwater at the

head of Point Peninsula would extend in a southeasterly direction, and craft could seek refuge in the lee thereof during southwesterly storms. However, the breakwater would have to be considerably longer to provide shelter for any material number of craft, and would be no closer to fishing areas at the heads of Galloo and Stony Islands than is Snowshoe Bay. The desired cut through the Point Peninsula would require excavation through shoal waters lakeward and bayward of the isthmus, and construction of a highway bridge over the channel. It would open to the southwest in the direction of prevailing storms and long protective structures would be required. The improvement would provide refuge for vessels fishing in the immediate vicinity, but would be no closer to the shoal waters at the heads of Galloo and Stony Islands than is Snowshoe Cut. Furthermore, commercial fishing interests operating from Chaumont Bay, who would be the principal beneficiaries of the improvement, oppose the improvement on the grounds that it would destroy spawning beds located at the western end of Chaumont Bay and seriously interfere with their operations.

193. As a result of the study, it was concluded that improvement of Snowshoe Cut and construction of a harbor of refuge on Stony Island would make recreational boating and sport fishing in the vicinity safer and more attractive. The plan of improvement considered for Snowshoe Cut includes a channel 50 feet wide through Snowshoe Bay extending from Lake Ontario to Henderson Bay; a single-lane highway bridge connecting the mainland with the barrier islands with a 50-foot horizontal and 12-foot vertical clearance; and channel protection piers consisting of

steel sheet pile cantilever walls at the inner ends and steel sheet pile cells at the outer ends, extending from the bridge abutments to the 10-foot contour in the lake, a distance of 175 feet. Channel depths would be ten feet lakeward and eight feet bayward of the bridge. The plan of improvement considered for the north entrance to Stony Island lagoon would be essentially the same; identical controlling depths and clearances being selected for construction of the channel, piers and bridge. It was concluded that construction, in accordance with the proposed plan of the improvement considered for Snowshoe Cut, would probably be economically justified through benefits to guide-boat fishing traffic from Henderson Harbor, recreational boating, the boat building industry, and savings in boat maintenance and operating costs. It was also concluded that the proposed improvement at the north entrance to Stony Island Lagoon, although not justified by computable benefits, probably would return sufficient additional intangible benefits from refuge and safety provided, to justify its construction. Accordingly, it was recommended that detailed surveys of these two localities be authorized.

194. As a result of the various reports that have been submitted, a combined survey of the Chaumont-Henderson Bay area has been authorized for the detailed study of the improvements proposed at Chaumont on Sawmill Bay, Snowshoe Cut, and Stony Island.

195. Other improvements. - In 1928 the Association Island Corporation dredged a channel 200 feet long, 40 feet wide and six feet deep, connecting Snowshoe Bay and Lake Ontario through property owned

by that corporation. This channel is now known as Snowshoe Cut. Maintenance of the channel has been inadequate as it has been financed by public subscription, except in 1941, when, in response to a request for Federal aid, the lakeward portion of the channel was dredged at Government expense. At the upper end of Sawmill Bay, a pier about 200 feet long, constructed by the Crescent Yacht Club, provides a protected mooring area. The channels and piers at the northerly and southerly end of the Stony Island Lagoon were constructed by local interests subsequent to the preliminary examination of the area in 1946. Except for these improvements, the Coast Guard installation and facilities established at Gill Harbor in 1934, and the many private dock and servicing facilities discussed previously, there are no other navigation improvements at any of the localities under consideration in this section.

196. Commerce and harbor use. - Small motor vessels carry small shipments of miscellaneous freight and farm produce to and from Galloo and Stony Islands, Sackets Harbor and Henderson Harbor. In 1952 this commerce was distributed as follows:

	Receipts	Shipments	Round trips
Henderson Harbor	-	74 tons	44
Sackets Harbor	27 tons	12 tons	9
Galloo Island	31 tons	27 tons	13
Stony Island	55 tons	-	40
	113 tons	113 tons	

Commercial fishing operations in the area are centered around Chaumont Bay. In 1952 commercial fishing vessels based therein reported 486

round trips and a catch of 30 tons. Other commercial fishermen operate out of Dexter at the head of Black River Bay. That traffic and other commercial traffic to Dexter and Sackets Harbor are discussed in the separate reports thereon.

197. The greater amount of traffic in the area is made up of recreational boating traffic, private sports fishing craft, and the charter guide boats operated from Henderson Harbor for fishing expeditions to the New York State Game Fishing Preserve. There are about 400 recreational craft permanently based in Chaumont Bay, 40 on Point Peninsula, 430 on Henderson Bay, and each permanent resident on Galloo and Stony Islands operates a small vessel of some description. Over 1,100 transient craft visit various points in the locality each year, not including the vessels permanently based at Sackets Harbor, Dexter and other points in Black River Bay. Henderson Harbor is the principal base for recreational boating and fishing activities in the area, and has hotel accommodations, fishing guides, boat liveries, several wharves which, although privately-owned, are open to the public, and the servicing facilities previously discussed. A large guide business has developed with about 36 guide boats, carrying three to eight passengers each, now in service. These boats are chartered by sports fishermen and are a source of considerable revenue to the guides and boat owners.

198. Desired improvements. - The only known improvements desired by local interests are those requested at the public hearings which were held in connection with prior reports prepared on the locality. The improved channels into Stony Island Lagoon, constructed by local in-

terests, adequately accomodate the vessels used in the surrounding lake waters. Although the island is privately-owned and posted, boat operators are in no way prohibited from entering the lagoon to seek refuge; consequently, further improvements thereat are not required. Contacts with local interests indicate that their desire for other improvements, particularly at Snowshoe Cut, has not lessened.

199. Conclusions. - Improvements in the area under consideration are desirable for accommodation of the extensive small-boat traffic in the area and to provide more adequate refuge therefor during sudden lake storms. The improvements under consideration at Chaumont and Sawmill Bay and at Snowshoe Cut, in connection with the authorized survey of that area, will, if determined to be justified and adopted as projects, satisfactorily answer the needs of light-draft navigation in the vicinity.

BLACK RIVER BAY, (NEW YORK)

200. Location. - Black River Bay is an arm of Lake Ontario and joins the lake at its easterly end 15 miles from the head of the St. Lawrence River. The Black River flows into the easterly end of the bay and the village of Dexter is located on the river, one mile upstream from its mouth. Sackets Harbor is located on the south shore of the mouth of Black River Bay. Cape Vincent Harbor, New York, 26 miles to the north, is the next nearest developed harbor. The area is shown on Plate 24 and U.S. Lake Survey Charts Nos. 2, 21, and 211.

201. Description of harbor and improvements. - Black River Bay is approximately 5½ miles long and 1¼ miles wide to within 1¼ miles of the easterly end, where it increases in width, southerly, to about two miles. The Black River and four smaller streams, Perch River, Muskalonge, Mill, and Gill Creeks, discharge into the bay. The bay at the easterly end is marshland and there has been considerable shoaling caused by the Black and Perch Rivers and Muskalonge Creek discharging into the area. The Black River, approximately 115 miles long, rises near the western slope of the Adirondack Mountains in Herkimer County, flows through a soil of sandy loam until within approximately 30 miles of its mouth. For the remaining distance to Black River Bay, it flows through solid rock. The average fall of the river in this latter reach is 16 feet per mile. The village of Dexter, at one time the head of navigation and a port of entry, is one mile above the mouth, and the width of the river in this vicinity is about 300 feet. Sackets Harbor, near the mouth of the bay, is discussed in the separate report thereon, following. No bridges cross any portion of Black River Bay.

202. The area tributary to the bay from the standpoint of waterborne commerce includes the commercial and industrial area along the Black River and the mineral and agricultural resources within the Black River Bay vicinity. The principal communities on the Black River and the bay, all of which are in Jefferson County, include the villages of Dexter, Brownville, Carthage and Sackets Harbor and the city of Watertown. According to the U.S. Census Report for 1950, the populations of Dexter, Brownville, Carthage, Sackets Harbor, and Watertown were 1,038, 1,013, 4,420, 1,247, and 34,350, respectively, while the total for Jefferson County was 85,521. Watertown is the industrial and distribution center of the tributary area and paper mills are located in Carthage, Brownville, and Dexter, while the remainder of the tributary area is primarily agricultural. Improved roads connect the tributary area with main arterial highways leading to all sections of the country. The New York Central Railroad serves all of the principal communities in the tributary area with the exception of Sackets Harbor. The nearest airport having commercial airline service is the Watertown Airport.

203. Physical factors affecting navigation. - Water levels in Black River Bay are generally equivalent to the levels in Lake Ontario and are subject to the year to year variations and the consistent seasonal rise and fall thereof. In addition to seasonal variations, fluctuations due to wind and barometric pressures cause occasional oscillations of short duration, ranging from a few inches to several feet, which produce pronounced surges and currents. The bay is appreciably affected only by storms out of the southwest through west to west by north, and the fetches from these directions are about 85, 46, and 43

miles, respectively. Depths in Black River Bay vary from 60 feet, 300 feet offshore near the mouth of the bay to a depth of 18 feet 3/4 mile from shore and 1½ miles from the easterly end of the bay. The depth in the remaining area at the easterly end of the bay decreases to shoal and marshy water. In the Black River, the controlling depth from the mouth to Dexter is about six feet, and from Dexter to Carthage, about 31 miles upstream, rapids and falls are common. The shallow depths and marsh conditions at the easterly end of the bay and the irregular rock bed of the Black River preclude navigation in this area except by light-draft vessels during periods of high water.

204. Terminal and transfer facilities. - There are no public docks or terminal facilities on Black River Bay or on the Black River at Dexter. The only commercial terminal and transfer facilities on the bay are those at Sackets Harbor which are described in the following report. There has been no terminal or dockage development along the shores of Black River Bay east of Sackets Harbor and no facilities exist along the Black River. At Dexter, a small wharf formerly used by a paper mill has deteriorated from inactivity.

205. Federal improvements and studies. - Little data are now available on the old Federal project at the head of Black River Bay except for the knowledge that it extended from the easterly end of the bay to the head of navigation at Dexter. The work, formerly done by the Federal government, consisted of two jetties, constructed 1837-38, designed to provide a channel through the shoal area at the mouth of the river. The jetties were further extended in 1839 and 1844. They were temporarily effective but the formation of shoals below the jetties caused

the channel to revert to its former inadequate depth. No maintenance or improvement work on these jetties has been performed since 1844. In 1873 a channel was dredged through the shoals, but it soon was refilled and disappeared. No record of work can be found since the above date.

206. A preliminary examination report, dated 20 July 1905, for the mouth of Black River and Dexter Harbor, New York, was published in House Document No. 157, 59th Congress, 1st Session. In the report consideration was given to dredging a navigable channel from deep water in Black River Bay to the wharves at Dexter, one mile above the mouth of Black River. This report received unfavorable action by higher authority as benefits were not commensurate with costs.

207. Abandonment of the harbor in Black River Bay was recommended in House Document No. 467, 69th Congress, 1st Session; however, no Congressional action has been taken.

208. The latest report on the locality of Black River Bay was the Preliminary Examination Report at and in the vicinity of Sackets Harbor, New York, submitted by the District Engineer, Buffalo District, on 20 September, 1946. This report was authorized by Section 6 of Public Law 14, 79th Congress, 1st Session, approved 2 March 1945. Prior to preparation of the report it was determined, through public hearings and contacts with interests concerned, that local interests desired improvements for the restoration of a commercial harbor which once existed at the easterly end of Black River Bay. The plan of improvement considered by the District Engineer in his report provided for 2,900 feet of cellular type steel sheet pile breakwater with a top elevation of eight feet above low water datum and normal to the north shore of Black

River Bay; 2,200 feet of cellular-type steel sheet pile breakwater with a top elevation of ten feet above low water datum and normal to the south shore of the bay; a channel 200 feet wide extending easterly from the 20-foot contour in the bay approximately 7,300 feet and increasing in width to provide for a turning basin about 1,200 feet square, channel and basin to have depth of 20 feet below low water datum in earth with one-foot overdepth and 21 feet in rock with one-foot overdepth. The estimated first costs of the considered improvements, based on April 1946 price levels, was $3,482,000 while the estimated annual costs and annual benefits were $188,000 and $162,000, respectively. It was the recommendation of the District Engineer that a survey be authorized for Black River Bay, to determine more definitely the prospective commerce, the best plan of improvement, and the extent to which local interests should participate. The recommendation of the District Engineer was generally concurred in by the Chief of Engineers except that he recommended the survey be authorized to include the south shore of Black River Bay as far west as Horse Island, inclusive. The authorized survey has not yet been completed.

209. Other improvements. - There are no improvements on Black River Bay other than those mentioned previously in this section.

210. Commerce and harbor use. - At present Black River Bay is used mainly by recreational craft although there is a small amount of commerce at Sackets Harbor. According to a survey made in 1953 there were approximately 170 recreational craft, exclusive of outboards, based in the Black River Bay area in addition to about 500 transient craft which visit the bay each season.

211. In the event a large commercial harbor is provided at Black River Bay, local interests indicate that considerable savings in transportation costs to industry will result from waterborne receipt of pulpwood, coal, sulphur, other commodities, and possibly shipments of iron ore. Under existing conditions, considering the nature of traffic on Lake Ontario, it is unlikely that sufficient commerce would be generated to justify economically the high cost of improvement, although it is quite probable that such a harbor would be utilized for receipt of pulpwood for consumption at nearby paper mills. Completion of the St. Lawrence Seaway, with the resultant increase in traffic in the area, may create additional traffic that could be handled in Black River Bay, although based on the predicted commerce through the Seaway, the only appreciable commerce that could reasonably be anticipated would be in pulpwood.

212. Desired improvements. - Local interests are desirous of the restoration of the commercial harbor which once existed at the easterly end of Black River Bay.

213. Conclusions. - In connection with a recent review of outstanding flood control and navigation investigations, it was recommended that the authorized survey of Black River Bay be deferred. Since the imminent construction of the St. Lawrence Seaway will have considerable bearing on the justification of the work local interests have requested, the desirability of prosecuting the authorized survey is uncertain. Prosecution of the study is inadvisable until such time as more information is available and the impact of the seaway on this area can be realistically evaluated.

SACKETS HARBOR, NEW YORK

214. Location. - Sackets Harbor is located in a cove on the south shore of Black River Bay at the easterly end of Lake Ontario, about 41 miles distant by water northerly of Oswego Harbor, New York, and 26 miles southerly of Cape Vincent Harbor, New York, the nearest developed harbor. The area is shown on Plate 25 and U. S. Lake Survey Charts Nos. 2, 21 and 211.

215. Description of harbor and improvements. - Sackets Harbor is a shallow indentation in the shore line near the mouth of Black River Bay, partially closed by Navy Point (known locally as Shiphouse Point), a narrow spit extending about 800 feet easterly into the bay. No bridges cross the harbor area and no streams discharge into Sackets Harbor. There is an existing Federal project at the harbor, which is described in paragraph 221.

216. Sackets Harbor is located at the village of Sackets Harbor, in Jefferson County, New York. The area tributary to the harbor from the standpoint of water-borne commerce includes the commercial and industrial area along the Black River and the mineral and agricultural resources within the Black River Bay vicinity. The principal communities in the area are villages of Dexter, Brownville, Carthage, and the city of Watertown, 6, 9, 37 and 14 miles, respectively, northeasterly and easterly of Sackets Harbor. According to the U. S. Census Report of 1950 the population of Jefferson County was 85,521, including 34,350,

4,420, 1,038, 1,013, and 1,247, in the city of Watertown, and the villages of Carthage, Dexter, Brownville, and Sackets Harbor, respectively. There is no major industry in Sackets Harbor. The manufactures at Watertown, which is the industrial and distribution center of the tributary area, include foundry and machine shop products, plumbing supplies, air brakes, paper machinery and paper products, flour and grist mill products, and textiles. Paper mills are located in Carthage, Brownville, and Dexter, while the remainder of the tributary area is primarily agricultural. Improved roads connect Sackets Harbor with main arterial highways leading to all sections of the country. The New York Central Railroad serves all of the principal communities in the tributary area with the exception of Sackets Harbor itself. The railroad has recently taken up its tracks, thereby eliminating rail transportation into and out of Sackets Harbor. The nearest airport having commercial airline service is the airport at Watertown.

217. Physical factors affecting navigation. - In addition to the yearly and seasonal variations of water levels, at Lake Ontario fluctuations due to wind and barometric pressures cause occasional oscillations of short duration ranging from a few inches to several feet. Sackets Harbor and Black River Bay are appreciably affected only by storms out of the southwest through west to west-by-north. The fetches from these directions are about 85, 46, and 43 miles, respectively. The fetch from the west-southwest through west-by-south is broken by Galloo and Stony Islands, located in Lake Ontario, about 13 and nine miles, respectively from the harbor entrance.

218. The project at Sackets Harbor is not maintained and depths within the project area vary from seven to 15 feet. Controlling depth is at present about nine feet. Although Sackets Harbor is well protected, it is small for maneuvering vessels larger than those of the Barge Canal type.

219. Terminal and transfer facilities. - There are no public docks or terminal facilities at Sackets Harbor. A petroleum and a commercial dock front on the existing project. Other adjacent wharves are in a dilapidated condition, and the property east of two former railroad docks is owned by an oil company, but is undeveloped. On the wharf of the petroleum dock operated by the Burdick Oil Corporation, an affiliate of the Shell Oil Company, is a 12,000-barrel storage tank for petroleum products. There are no special cargo handling facilities at any of the docks. A Naval Reserve dock and several small boathouses and recreational craft slips are located at the western end of the harbor area. Fuel and supplies are available for recreational craft and there is also a marine railway and a boat lift. About 3/8 mile west of the harbor on deep water in the bay is a mooring crib which is owned by the Socony-Vacuum Oil Co., and used as a petroleum products terminal. There are six tanks with a storage capacity of 72,740 barrels located about one-half mile inland from the mooring crib.

220. Federal improvements and studies. - Previous projects at Sackets Harbor were adopted by the River and Harbor Acts of 20 May 1826, and 23 May 1828, and provided for clearing and deepening the harbor.

The existing project was adopted by the River and Harbor Act of 2 August 1882. The project was modified in 1888 and became inactive in 1898, although abandonment of the project was never authorized. Futher modification at the harbor was authorized in 1945 and the existing project now provides for the following:

a. Depths of 12 feet in earth and 13 feet in rock with an L-shaped area; the inner or westerly leg of the "L" to be 250 feet wide and 600 feet long; the easterly leg to extend from the westerly leg to natural deep water in Black River Bay, and to have a width of 250 feet at the junction of the legs, flaring at an angle of 40° to form the entrance to the harbor; the project limit to be 50 feet from the face of existing wharves along Main and Ogden Streets, and approximately 100 feet from the jetty on Navy Point.

b. A timber-crib mooring place, 18 feet square, off the end of Shiphouse Point, and a brush and stone jetty extending across Shiphouse Point to the crib.

c. Two stone groins perpendicular to the shore line of Navy (Shiphouse) Point.

Accomplishment of the latest project modification is subject to the condition that local interests give satisfactory assurances that they will:

a. Hold and save the United States free from damages due to construction of the project;

b. Develop the proposed petroleum products terminal at Sackets Harbor; and

c. Dredge and maintain to project depth the areas between the proposed petroleum products terminal wharves and the established project limits.

All of the required assurances of local cooperation have not yet been received. The existing project is presently inactive and is about seven percent complete. The estimate of cost for new work, made in 1953, is $383,000, exclusive of amounts expended on previous projects. Of this amount, $364,000 is for work remaining to complete the project. The estimate for annual cost of maintenance, made in 1945, is $2,500.

221. The latest report on Sackets Harbor was the Preliminary Examination Report on that locality submitted by the District Engineer, Buffalo District, on 20 September 1946. This report was authorized by the River and Harbor Act approved 2 March 1945. Two public hearings were held prior to preparation of the report. At the first hearing, requests were made by local interests for several varied improvements in the area, including improvements to Sackets Harbor desired by the petroleum industry. At the later hearing, it was revealed that local interests actually desired full development of Black River Bay as a large commercial port, and it was with this subject that the report of 20 September 1946 was mainly concerned. Such a harbor would be entirely separate from the project at Sackets Harbor and has been discussed in the detailed report on Black River Bay.

222. The latest report specifically concerned with improvements at Sackets Harbor, was the review of reports thereon, submitted by the

District Engineer, Buffalo District, on 13 July 1942. In that report the reactivation of the Federal project at Sackets Harbor, and dredging the harbor area to a depth of 12 feet below low water datum was recommended. The recommendations were concurred in by the Chief of Engineers and the report was subsequently printed in House Document 732, 79th Congress, 2nd Session. The latest modification to the project, authorized by the River and Harbor Act of 2 March 1945, resulted from the recommendations contained therein.

223. Other improvements. - No navigation improvements, other than those provided by the Federal government, have been made at Sackets Harbor.

224. Commerce and harbor use. - At present the harbor is used mainly by recreational craft. There is, however, a small amount of commerce consisting mainly of receipts of petroleum products at the Burdick Oil Co. dock and at the Socony-Vacuum Oil Co. dock, 3/8 mile west of the harbor, which is accessible without using the Federal project. Statistics for 1952, the latest year of complete available records, show that commerce at Sackets Harbor amounted to 33,346 tons, of which 26,636 tons were received at the Socony-Vacuum dock and 6,671 tons were received at the Burdick Oil Terminal, all petroleum products via the lake or New York State Barge Canal at Oswego. The remaining 39 tons were miscellaneous receipts and shipments in small craft. There was a total of 35 round trips made by commercial vessels having drafts of from 14 to four feet and having a net registered tonnage

of 22,319 tons. There are approximately 170 recreational craft, exclusive of outboards, based at the harbor, in addition to about 500 transient craft which visit the harbor each season.

225. Desired improvements. - The only known improvements desired by local interests at Sackets Harbor proper, are the improvements requested by petroleum interests at the first public hearing held in connection with the preliminary examination report of 20 September 1946. Completion of the existing project at Sackets Harbor, by deepening the harbor area to 12 feet, will adequately care for the petroleum traffic and satisfy the requests of local interests.

226. Conclusions. - Upon completion of the existing project Sackets Harbor will adequately meet the needs of present and reasonably prospective navigation thereon, and futher consideration of additional improvements is unnecessary.

BEACH EROSION

227. Location. - This portion of the section covers the Lake Ontario shores of New York State from the mouth of the Niagara River at the west end of the lake, along the south and east shores of the lake, to Tibbetts Point at the head of the St. Lawrence River, a shore line distance of approximately 290 miles. The shore line under consideration includes portions of seven counties: Niagara, Orleans, Monroe, Wayne, Cayuga, Oswego, and Jefferson counties. The shores are shown on U.S. Lake Survey Charts Nos. 2, 21, 22, 23, 24, 25, 211, 225, 234, and 238, on quadrangles of the Army Map Service, and on maps accompanying this section.

228. Prior reports. - Only five beach erosion control reports have been made, or are being made on the south and east shores of Lake Ontario. Table 3 lists these reports.

229. Description. - Lake Ontario, the smallest and most easterly of the Great Lakes chain, has an area of 7,540 square miles. It is approximately 190 miles long and 50 miles wide with its main axis in an east-west direction. It is comparatively deep, the maximum recorded depth being 778 feet. The major inflow is from the Niagara River, carrying the surplus waters from the upper Great Lakes. It enters Lake Ontario on the south shore, approximately 35 miles east of its westerly extremity, while the outlet to the St. Lawrence River is located at the northeasterly extremity of the lake. The entire lake shore is shown on Plate 4. The south and east shores are shown on Plates 5 and 6, respectively, at a larger scale.

Table 3. - Beach erosion reports, Subregion "D"

Title	Status	Recommendations
Niagara County, N.Y. Beach Erosion Study	Published as H.D. 271, 78th Cong., 1st session	(1) That protection by stone revetment be provided where economically justified. (2) That desired beaches at Tuscarora and Krull Parks be built with artificial fill and protected by groins. (3) That stone revetment be built along highway east of Wilson.
Beach Erosion Control Reports on Cooperative Study of the New York State Parks on Lake Ontario:		
(a) Selkirk Shores State Park	Report of Chief of Engineers dated 12/28/53, published as H.D. 343, 83d Congress 2d session	(1) That improvement of about 900 feet of beach be made by artificial fill, construction of one groin, modification of an existing groin and stabilization of Grindstone Creek Outlet by 2 jetties. (2) That protection of 4,400 feet of shore be provided by stone revetment.
(b) Fair Haven Beach State Park	Forwarded to the Secretary of the Army by the Chief of Engineers	(1) That 2,700 feet of beach be improved by artificial fill and modification of Sterling Creek Outlet structures, and alteration of 1 groin.

Table 3 - (Continued)

Title	Status	Recommendations
(c) Hamlin Beach State Park	Report under review by Chief of Engineers	(1) That approximately 4,350 linear feet of shore at the west end of the park frontage be protected and improved by placement of sand fill, the construction of 4 new groins, and alteration of 3 existing groins.
(d) Braddock Bay State Park	Report under review by Chief of Engineers	(1) Unfavorable for improvement at this time.

230. From Burlington Bay, Ontario, the westerly extremity of the lake, the shore extends in an east by north direction for about 30 miles to Jordan Harbor, Ontario. The shore in the next 90 miles forms a generally smooth convex curve to Irondequoit Bay, New York, the maximum deviation from an east-west line being about 12 miles. A second convex curve, somewhat flatter than the first, forms the next 30 miles of shore line to Sodus Bay. At Sodus Bay the shore turns to a northeasterly direction for 20 miles to Nine Mile Point where it turns abruptly east to Selkirk Shores State Park, at the southeasterly extremity of the lake. The shore then extends with a smooth alinement in a northerly direction for about 20 miles to Stony Point. From there to Tibbetts Point at the head of the St. Lawrence River, the shore line becomes very irregular and is characterized by many bays, peninsulas, and islands.

231. Table 4 lists the seven counties bordering Lake Ontario and their political subdivisions along the shore, and shows the population trends and a brief summary of the use, condition, and character of their shore line. The general characteristics of the south and east shores of Lake Ontario are shown graphically on Plates 5 and 6 and summarized by counties in paragraph 243.

232. Development. - About one-half of the total shore under consideration is either undeveloped or is used for agricultural purposes. There are only two cities located on the United States shore of Lake Ontario, Rochester and Oswego. The former has had an increase in population of only one percent during the last two decades while Oswego has had a slight loss. The shores of Niagara, Monroe, and to a lesser degree, Wayne Counties were originally developed for summer residence only; however, during the last decade the trend has been to year-round use of the homes. A large section of Wayne County is being subdivided for residential use; with roads already constructed, a decided increase in population along the shore may be expected in the future. The shores of Jefferson and Oswego Counties are still largely used for summer residences only.

233. There are eleven public parks in the area and seven other major publicly-owned properties. Pertinent data on publicly-owned lake frontages including the length, type and condition of the shores, and facilities and attendance at parks, are summarized in Table 5 and described in more detail in paragraphs 259 through 262.

Table 4. - Shoreline data, Lake Ontario, Subregion "D".

Political subdivision	Population: 1930 Census	Population: 1950 Census	Population: Increase or Decrease	Use of shore; (length in miles): Total	Publicly owned 1/	Public parks	Condition of shore, (length in miles): Residential	Commercial	Agricultural	Protected	Unprotected	Eroding	Stable	Glacial till	Shore characteristics: Bluffs, (length in miles) Earth: Silt, sand, gravel 2/	Sand dunes	Bluffs Earth Top El. above L.W.D.: From	To	Bluffs Rock Top El. above L.W.D.: Rock	From	To	Beaches: Length in miles: In front of bluffs	Barrier	Average width, feet	Material: Sand	Gravel	Cobbles	Ledge rock, length in miles	Marsh shore, length in miles
Niagara County																													
Town of Porter	2,954	4,276	+1,322	8.7	1.0	-	7.7	-	-	5.0	3.7	3.7	5.0	-	8.3	-	8	40	-	-	-	8.3	0.4	10	x	x	-	-	-
Town of Wilson	2,141	2,734	+ 593	7.0	0.4	-	4.0	-	2.6	3.5	3.5	3.5	3.5	-	7.0	-	8	40	-	-	-	3.5	-	20	x	x	-	-	-
Village of Wilson	660	962	+ 302	0.8	-	-	0.8	-	-	0.8	-	-	0.8	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Town of Newfane	4,225	5,801	+1,576	6.2	-	0.2	3.0	-	3.0	1.5	4.7	4.7	1.5	-	6.2	-	8	40	3.2	0	10	5.0	-	20	x	x	-	3.2	-
Town of Somerset	1,892	2,227	+ 335	8.5	0.3	-	1.7	-	6.5	0.5	8.0	8.0	0.5	-	8.5	-	8	20	8.5	0	8	8.0	-	15	x	x	2.0	-
Totals, Niagara County	11,872	16,000	+4,128	31.2	1.7	0.2	17.2	-	12.1	11.3	19.9	19.9	11.3	-	30.8	-	8	40	11.7	0	10	24.8	0.4	15	x	x	x	5.2	-
Orleans County																													
Town of Yates	1,914	2,086	+ 172	8.1	-	-	2.5	-	5.6	-	8.1	8.1	-	8.1	-	-	8	15	5.0	0	4	7.1	-	10	-	x	x	1.0	-
Town of Carlton	1,699	1,775	+ 76	10.0	-	-	4.5	-	5.5	1.0	9.0	9.0	1.0	10.0	-	-	8	20	1.5	0	2	9.0	-	20	-	x	x	1.0	-
Town of Kendall	1,311	1,343	+ 32	6.3	-	-	3.0	-	3.3	-	6.3	6.3	-	-	6.3	-	8	15	-	-	-	6.3	-	15	-	x	x	-	-
Totals, Orleans County	4,924	5,204	+ 280	24.4	-	-	10.0	-	14.4	1.0	23.4	23.4	1.0	18.1	6.3	-	8	20	6.5	0	4	22.4	-	15	x	x	x	2.0	-
Monroe County																													
Town of Hamlin	2,079	2,321	+ 242	10.0	-	2.1	3.5	-	4.4	2.5	7.5	7.5	2.5	1.0	2.0	-	8	80	-	-	-	3.0	5.0	20	x	x	x	-	-
Town of Parma	3,222	4,049	+ 827	3.3	-	-	2.6	-	0.7	1.6	1.7	1.7	1.6	-	0.7	-	8	15	-	-	-	0.7	2.6	20	-	x	x	-	-
Town of Greece	12,113	25,058	+12,945	8.0	-	1.0	6.0	-	1.0	4.0	4.0	4.0	4.0	-	3.5	-	8	40	-	-	-	3.1	4.3	30	x	-	-	-	-
City of Rochester	328,132	332,488	+ 4,356	2.6	-	1.3	1.3	-	-	0.8	1.8	1.5	1.1	-	2.6	-	8	30	-	-	-	1.6	-	15	x	-	-	-	-
Town of Irondequoit	18,024	34,417	+16,393	2.5	-	-	2.0	0.5	-	1.5	1.0	-	2.5	-	2.5	-	8	30	-	-	-	2.0	0.4	20	x	-	-	-	-
Town of Webster	4,778	7,174	+ 2,396	8.6	-	0.3	5.1	1.2	2.0	3.6	5.0	5.0	3.6	7.6	-	-	8	40	6.5	0	6	5.6	0.8	15	-	x	x	-	-
Totals, Monroe County	368,348	405,507	+ 37,159	35.0	-	4.7	20.5	1.7	8.1	14.0	21.0	19.7	15.3	8.6	11.3	-	8	80	6.5	0	6	16.0	13.1	20	x	x	x	-	-
Wayne County																													
Town of Ontario	2,713	3,297	+ 584	6.4	-	-	2.6	-	3.8	-	6.4	6.4	-	6.4	-	-	8	20	2.0	0	4	6.4	-	20	-	x	x	1.0	-
Town of Williamson	3,504	4,226	+ 722	6.6	-	-	3.4	-	3.2	-	6.6	6.6	-	6.6	-	-	8	20	1.0	0	4	6.6	-	20	-	x	x	0.5	-
Town of Sodus	5,003	5,706	+ 703	9.7	0.4	-	6.5	-	2.8	0.6	9.1	8.6	1.1	6.9	2.0	-	8	60	0.9	0	3	8.1	1.5	20	-	x	x	0.9	-
Town of Huron	1,313	1,409	+ 96	7.6	-	-	1.5	-	6.1	-	7.6	7.6	-	4.3	-	-	8	140	0.2	0	4	4.3	3.3	20	x	x	x	0.1	-
Town of Wolcott	2,876	3,276	+ 400	6.4	-	-	0.3	-	6.1	-	6.4	6.4	-	3.1	-	-	8	90	-	-	-	3.1	3.3	30	x	x	-	-	-
Totals, Wayne County	15,409	17,914	+ 2,505	36.7	0.4	-	14.3	-	22.0	0.6	36.1	35.6	1.1	27.3	2.0	-	8	140	4.1	-	4	28.5	8.1	20	-	x	x	2.5	-
Cayuga County																													
Town of Sterling	1,404	1,422	+ 18	7.4	-	1.3	0.5	-	5.6	0.3	7.1	7.1	0.3	5.9	-	-	8	90	-	-	-	5.9	1.5	30	x	x	x	-	-
Village of Fair Haven	562	628	+ 66	0.8	0.6	0.2	-	-	-	0.4	0.4	-	0.8	0.2	-	-	7	20	-	-	-	0.2	0.4	200	x	x	x	-	-
Totals, Cayuga County	1,966	2,050	+ 84	8.2	0.6	1.5	0.5	-	5.6	0.7	7.5	7.1	1.1	6.1	-	-	8	90	-	-	-	6.1	1.9	200	x	x	x	-	-
Oswego County																													
Town of Oswego	1,830	2,106	+ 276	5.2	0.4	-	1.7	-	3.1	0.2	5.0	5.0	0.2	4.0	-	-	8	60	1.2	0	6	3.8	1.0	20	-	x	x	0.2	-
City of Oswego	22,652	22,647	- 5	3.6	0.4	-	-	2.7	0.5	1.5	2.1	1.8	1.8	3.6	-	-	8	60	1.0	0	4	2.1	-	10	-	x	x	1.0	-
Town of Scriba	1,973	2,248	+ 275	7.0	-	-	1.0	-	6.0	-	7.0	6.5	0.5	7.0	-	-	8	40	2.0	0	20	6.8	-	20	-	x	x	1.8	-
Town of New Haven	1,116	1,259	+ 143	5.8	-	-	2.5	3.3	-	-	5.8	5.5	0.3	4.3	-	-	8	40	0.3	0	20	4.0	1.5	10	-	x	x	-	-
Town of Mexico	2,720	3,035	+ 315	1.5	-	-	1.3	-	0.2	-	1.5	1.5	-	0.9	-	-	8	60	-	-	-	0.9	0.6	15	-	x	x	-	-
Town of Richland	3,816	4,067	+ 251	6.3	-	1.2	2.4	-	2.7	-	6.3	3.6	2.7	0.5	1.7	2.5	8	60	-	-	-	3.0	4.3	30	x	x	x	-	-
Town of Sandy Creek	2,156	2,354	+ 198	4.6	-	-	0.6	-	4.0	-	4.6	-	4.6	-	-	4.6	8	60	-	-	-	-	4.6	100	x	x	x	-	-
Totals, Oswego County	36,263	37,716	+ 1,453	34.0	0.8	1.2	9.5	6.0	16.5	1.7	32.3	23.9	10.1	20.3	1.7	6.7	8	60	4.5	0	20	20.6	12.0	15	x	x	x	3.0	-
Jefferson County																													
Town of Ellisburg	3,026	3,116	+ 90	10.2	-	-	0.9	-	9.3	-	10.2	-	10.2	-	-	9.7	8	60	0.5	0	4	0.5	9.7	150	x	-	x	-	-
Town of Henderson	1,165	1,171	+ 6	26.0	-	0.5	10.4	3.0	12.1	1.7	24.3	10.0	16.0	15.9	-	1.0	8	20	16.0	0	20	11.9	5.9	10	-	x	x	8.0	-
Town of Ellisfield	1,246	1,383	+ 137	8.7	-	-	1.7	-	7.0	-	8.7	3.0	5.7	3.0	0.2	0.5	8	20	2.5	0	20	2.0	-	30	x	x	x	3.0	5.0
Village of Sackets Harbor	1,680	1,247	- 433	3.2	0.5	0.1	1.0	0.3	1.3	0.5	2.7	1.5	1.7	2.0	1.2	-	8	20	2.0	0	20	2.0	-	15	x	x	-	-	-
Town of Brownville	3,489	3,806	+ 317	18.3	-	-	7.0	-	11.3	1.0	17.3	10.0	8.3	14.2	-	-	8	20	9.5	0	15	6.8	0.6	20	-	x	x	7.7	3.5
Town of Lyme	989	945	- 44	37.2	-	0.8	15.2	-	21.2	0.8	36.4	14.0	23.2	31.0	-	-	8	20	13.8	0	5	20.4	3.0	15	-	x	x	13.0	3.0
Village of Chaumont	596	513	- 83	3.8	-	-	1.7	1.6	0.5	-	3.8	-	3.8	1.2	-	-	6	20	1.5	0	10	-	-	-	-	-	-	-	0.3
Town of Cape Vincent 3/	1,060	1,030	- 30	12.4	-	-	1.0	-	11.4	-	12.4	6.0	6.4	8.2	-	-	8	15	8.2	0	5	3.0	3.0	10	x	x	x	8.2	1.2
Totals, Jefferson County	13,251	13,211	- 40	119.8	0.5	1.4	38.9	4.9	74.1	4.0	115.8	44.5	75.3	75.5	1.4	11.2	8	60	54.0	0	20	46.6	22.2	20	x	x	x	39.9	13.0
Totals, Lake Ontario	452,033	497,602	+ 45,569	289.3	4.0	9.0	110.9	12.6	152.8	33.3	256.8	174.1	115.2	155.9	53.5	17.9	8	140	87.3			165.0	57.7		x	x	x	52.6	13.0

1/ Exclusive of public parks.
Numerous publicly owned properties with individual shore frontages of less than 0.1 mile in length are not included in this column.

2/ Includes sand, silt, gravel, of glacial, lacustrine, or alluvial origin.
3/ Includes population for entire town, but shoreline of Lake Ontario only (St. Lawrence River shoreline excluded).

Table 5 - Summary of data on publicly owned shore - Lake Ontario, Subregion "D"

Name and (Owner)	Approximate shore frontage, feet	Bluff: Material	Bluff: Height, feet	Beach: Width, feet	Beach: Length, feet	Beach: Material	Shore: Eroding, length, feet	Shore: Stable, length, feet	Existing structures	Proposed improvements	Existing facilities: Tent sites	Cabins	Bathhouse	Pavilion	Refreshment	Picnic	Attendance 1953
1. Old Fort Niagara (State of New York)	1,500	Lacustrine 1/	20	-	-	-	-	1,500	Concrete sea wall and riprap	None	-	-	-	-	-	-	
2. Fort Niagara (U. S. Military Reservation)	4,000	Lacustrine	20	15	4,000	gravel	4,000	-	20 stone filled timber crib groins	None	-	-	-	-	-	-	
3. N. Y. State Highway	2,100	Lacustrine	15	-	-	-	-	2,100	Quarry stone revetment (1941)	None	-	-	-	-	-	-	
4. Krull Park (Niagara County)	1,700	Lacustrine	20	15	1,400	sand and gravel	-	1,700	5 groins and seawall	None	-	-	x	x	x	x	
5. Hamlin Beach State Park (State of New York	12,000	Lacustrine	8-40	15-50	2,200	sand	2,200	-	1 groin (1953)		-	-	x	x	x	x	225,000
		Lacustrine	8-15	0	2,400	-	-	2,400	Conc. groin and sea wall (1938) 2 stone groins (1952)	Groins, artificial beach fill and revetment							
		Glacial till	8-12	0	1,000	-	-	1,000	1 stone groin and revetment (49-52)								
		Glacial till	8-12	5	2,600	gravel	2,600	-	1 stone groin (52)								
		Barrier beach	8	10	3,800	gravel	3,800	-	None								
6. Lake Ontario State Parkway (State of New York)	5,300	Barrier beach	8	10	5,300	gravel	5,300	-	None	None	-	-	-	-	-	-	Not developed
7. Braddock Bay State Park (State of New York)	5,300	Barrier beach	8	5	3,000	sand	2,100	900	2 stone groins and revetment	Artificial fill and entrance channel structure 3/	-	-	-	-	-	-	Not yet developed
8. Ontario Beach (City of Rochester)	1,500	Lacustrine	10	50-150	1,500	sand and gravel	-	1,500	U. S. west jetty at east end	None	-	-	x	x	x	x	83,100
9. Durand Eastman Park (City of Rochester)	5,000	Lacustrine	15-30	25-50	5,000	sand	-	5,000	None	None. Beach inundated at high lake stages	-	-	x	x	x	x	(Closed)
10. Webster Park (Monroe County)	1,500	Lacustrine	8-50	25-30	600	gravel	-	600	None	Raise sea wall, fill behind	-	-	x	x	x	x	500,000
			8-50	-	1,000	-	-	1,000	Concrete groin and sea wall								
11. Fair Haven Beach State Park (State of New York)	8,000	Glacial till	8-20	0-200	500	sand	-	900	Sea wall	Artificial fill, groins, revetment and improved outlet structures 4/	x	x	x	x	x	x	220,000
		Barrier beach	8-12	0-200	2,000	sand and gravel	2,000	-	Sterling Cr. outlet structure								
		Glacial till	8-90	0-5	1,200	gravel	-	1,200	Groin, sea wall								
		Glacial till	8-90	0-30	2,100	gravel	2,100	-	None								
		Barrier beach	8-12	30	2,200	gravel	2,200	-	None								
12. New York State Teachers College	1,200	Glacial till	8-15	0-15	1,200	shelf rock	-	1,200	None	None	-	-	-	-	-	-	
13. Old Fort Ontario (State of New York)	2,500	Glacial till	8-30	-	-	-	-	2,500	Stone revetment	None	-	-	-	-	-	-	Not delivered
14. Selkirk Shores State Park (State of New York)	6,200	Barrier beach	8-12	10-30	2,200	gravel	2,200	-	None	Artificial fill, revetment stabilization of creek outlet 5/	x	x	x	x	x	x	103,000
		Lacust and till	8-50	10-20	3,800	gravel	3,200	600	2 groins and revetment								
15. Westcott Beach State Park (State of New York)	2,600	Sand dunes	8-25	50	2,600	sand	-	2,600	None	None	-	-	x	x	x	x	74,500
16. Sackets Harbor, Battlefield (State of New York)	600	Vertical rock	15-20	-	-	-	-	600	None	None	-	-	-	-	-	x	48,900
17. Madison Barracks (U. S. Military Reservation)	2,300	Rock and till	12-30	0-50	500	cobbles	-	1,000	None	None	-	-	-	-	-	-	
			12-15	0-15	1,300	cobbles	-	1,300	Concrete sea wall	None							
18. Long Point State Park (State of New York)	3,700	Rock and till	8-15	10	300	gravel	-	3,700	None	None	x	-	x	x	-	x	10,300

1/ Lacustrine includes sand, silt, and gravel.
2/ See Beach Erosion Control Report on Cooperative Beach Erosion Study - New York State Parks on Lake Ontario - Hamlin Beach State Park.
3/ See Beach Erosion Control Report on Cooperative Beach Erosion Study - New York State Parks on Lake Ontario - Braddock Bay Area.
4/ See Beach Erosion Control Report on Cooperative Beach Erosion Study - New York State Parks on Lake Ontario - Fair Haven Beach State Park.
5/ See Beach Erosion Control Report on Cooperative Beach Erosion Study - New York State Parks on Lake Ontario - Selkirk Shores State Park.

234. There are numerous short stretches of publicly-owned shore which have not been listed in Table 5. These include road ends and minor holdings of public utilities such as waterworks properties. Most of these short strethces of shore have been protected where erosion was severe.

235. Surficial geology. - The surficial geology of the area was formed during the glacial period when underlying rocks were scoured of their overburden and weathered rock which was replaced by a thin layer of glacial till, and deposits of silt, sand, and gravel of glacial, lacustrine, or alluvial origin. The drainage pattern of the area was changed by deposits and scouring.

236. There were four preglacial rivers which traversed the plains south of the present Lake Ontario. The Niagara-St. Davids crossed the line of the present Niagara at the Whirlpool in a northwesterly direction. Irondequoit Bay is in the valley of the preglacial Genesee-Dansville River, while Sodus Bay is in the valley of the former Susqueseneca River. The preglacial Oneida-Mohawk River crossed the plain about five miles westerly of the southeasterly corner of the lake.

237. Rivers. - There are now five important rivers entering the lake along the south shore: the Niagara, Genesee, Oswego, Salmon (Oswego County), and Black. The Niagara, forming the boundary between Canada and the United States, enters the lake about 35 miles east of the lake's westerly extremity. Due to its high velocity and

tremendous volume of water, the main current carries most of the sediment far into the lake before depositing it on the Niagara Shoals. The outer edge of the shoal is some five miles from shore. There is a small current of slower moving water, carrying little or no sediment, which follows closely along the shore easterly from the river mouth.

238. The Genesee River enters the lake at Rochester, approximately 80 miles east of the Niagara River. Although it has a drainage area of 2,479 square miles, little beach-building material enters the lake from the river because of the federally-maintained navigation project extending three miles up the river from its mouth. About 250,000 cubic yards of material have been removed annually in the past 10 years. Much of this material is sand, which is removed by hopper dredges and deposited in deep water in the lake. In 1949 dredged material was placed in depths of about 20 feet as close to shore as the dredge could safely navigate just east of the harbor. Surveys over a 2-year period following placement of this material showed little or no movement of the material and further attempts at beach nourishment by this method were therefore abandoned.

239. The Oswego River enters the lake through Oswego Harbor, located about 55 miles east of the mouth of the Genesee River. The river with its tributaries has a drainage area of 5,122 square miles. Its two main tributaries, the Oneida and Seneca Rivers, form a part of the New York State Barge Canal System for 40 and 70 miles, respectively, above their junction at Three Rivers to form the Oswego River. The latter is also canalized as part of the same

system for its entire length, although the canal is separate from the river in the lower 1 1/2 miles. The lower 1,500 feet of the river and a large outer harbor formed by breakwaters are maintained as a Federal navigation project. As a result, little, if any, beach-building material is made available to the lake shore from this source.

240. The Salmon River (Oswego County), draining an area of 267 square miles, enters Lake Ontario about one mile north of the southeasterly corner of the lake. The Niagara-Mohawk Power Company regulates the river for power development at a point about 20 miles above the mouth. Because of this regulation and because the stream flows for about two miles through a swamp area where most of its sediment is dropped before entering the lake, this river cannot be considered a source of beach-building material.

241. The Black River, draining an area of 1,916 square miles, enters Lake Ontario through Black River Bay located about in the center of the easterly lake shore. Black River Bay is about six miles long and about one mile wide; the upper 1 1/2 miles of the bay consists of marsh where most of the sediment carried down by the river is deposited. The Black River is, therefore, not considered to be a source of beach-building material.

242. There are many smaller streams which first empty into ponds or bays, where all sedimentary material is deposited before reaching the lake.

243. Composition of the shore. - The general composition of the shore, by counties, is discussed in the following subparagraphs.

a. Niagara County. - The bluffs along the approximately 31 miles of shore in Niagara County vary from eight to 40 feet in height. Bedrock of Medina sandstone forms the base of the bluffs along approximately the easterly 12 miles of the county and rises to a maximum height of about ten feet above low water datum. The bluffs, in general, consists of unconsolidated silts and clays with some sand and gravel. Erosion is severe except where the shore has been protected, where rock forms a substantial part of the bluff, or where a wide sand beach has accumulated such as that immediately west of the west jetty at Olcott Harbor.

b. Orleans County. - The approximately 24-mile shore line of Orleans County is characterized by a low bluff of fairly even height, the bluffs ranging only from eight to 20 feet. About 18 miles of the bluff consist of unconsolidated glacial till, the remainder of silts and fine sand. Medina sandstone is exposed at low water datum for about 6.5 miles. It occasionally rises to a height of four feet, but remains near lake level for the greater part. During normal lake stages the shore is stable where rock outcrops; however, at high lake stages the entire shore is subject to erosion.

c. Monroe County. - Monroe County's 35-mile shore line is varied. The westerly two miles consist of easily eroded silt and sand bluffs rising to a maximum height of 80 feet with a wide silt and sand beach at the toe. The next 20 miles is characterized by low barrier beaches fronting swamps, bays, and ponds along the lake, alternated by the eroding ends of low drumlins which separate

the individual swamps, bays, or ponds. The narrow, steep beaches consist of gravel and cobbles eroded from the glacial till of the drumlins. The next six miles, including the shores of the city of Rochester and the town of Irondequoit, consist of bluffs of fine sand and silt up to 30 feet in height fronted by narrow sand beaches, except for the half-mile on each side of the government jetties forming the entrance to Rochester Harbor, where the beaches widen to over 100 feet. Along the easterly two miles of this section and across a one-mile barrier beach to the east, a railroad occupies the shore frontage and the bluff has been protected by dumped riprap. At the easterly end of the barrier beach sandstone outcrops along the shore rising to a maximum height of about six feet. The bluffs in this easterly 8-mile stretch of Monroe County shore rise to a maximum height of 40 feet and consist of an unconsolidated glacial till. Over one-half of this latter section is protected by sea walls. In general, there are no beaches in front of the sea walls but there are cobble beaches about 20 feet in width along the remainder of the shore. Erosion is active along the unprotected shore of the county except for the one-half mile on each side of Rochester Harbor entrance structures.

d. Wayne County. - The shore line of Wayne County is about 37 miles long. The westerly 13 miles are characterized by bluffs of unconsolidated glacial till which rise only 20 feet above the lake. Medina sandstone is exposed at lake level for about three

miles. Beaches of gravel and cobbles front the bluffs. About seven miles west of Sodus Bay the character of the shore changes and presents an undulating profile of the eroding ends of drumlins up to 140 feet in height, alternated by low barrier beaches fronting swamps, bays, and ponds. The drumlins consist of a hard glacial till with rock fragments, boulders, cobbles, and sand. Beaches with an average width of 20 feet front the bluffs. Rock is exposed at lake level for only about one mile in this latter stretch. Erosion is present along the entire shore except immediately west of the harbor structures at Sodus Bay.

e. Cayuga County. - The shore line of Cayuga County is only about eight miles long. It is similar to the easterly portion of Wayne County. Erosion is severe except west of the government jetties at the entrance to Little Sodus Bay where a gravel beach over 200 feet in width is being maintained.

f. Oswego County. - The 34-mile shore line of Oswego County is divided into a westerly 25-mile section along the south shore of the lake and a 9-mile section along the east side of the lake. The westerly 25 miles is similar to Cayuga County and the easterly part of Wayne County, with an undulating profile of eroding bluffs alternated by barrier beaches. The bluffs rise to a maximum height of 60 feet and, in general, consist of a hard glacial till with included rock fragments, gravel and boulders. The beaches are narrow averaging about 15 feet in width and consist of gravel and cobbles. Oswego Harbor is a Federally-maintained navigation project.

The outer harbor, formed by a system of breakwaters, covers about 270 acres and protects about 7,000 feet of shore. Rock is present near lake level for a total of three miles on both sides of the harbor. A second outcrop occurs at Nine Mile Point where rock reaches a height of 20 feet in a vertical face for about one-half mile. The nine-mile stretch of Oswego County shore line extending along the east end of the lake is characterized by its straight alinement. Wide, flat sand beaches up to 300 feet in width and fronting sand dunes forms a barrier between the lake and marshes or ponds. Erosion in this latter section is minor and occurs only during high lake stages, while erosion is active along the south shore, except where protected by structures or rock outcrops.

g. Jefferson County. - The 120-mile shore line of Jefferson County is also divided into two parts, the southerly ten miles to Stony Point being a continuation of the last-mentioned section of Oswego County, with straight alinement, wide sand beaches and dunes fronting ponds and marshes. At Stony Point the character and alinement of the shore abruptly changes, the alinement becomes very irregular with deep open-mouthed bays, peninsulas, islands, and rock shoals. Bed rock (Trenton, Watertown, and Lowville limestone) never far below the surface of the land, is exposed in the shore bluffs for about 50 percent of the 110-mile irregular shore line and ledge rock sometimes overlain by a thin covering of sand, gravel or cobbles forms the beach for about three-quarters of this distance. In places, ledge rock is close to lake level up to one-half mile offshore, while in other places depths of over 30 feet are found within 1,000 feet of shore. There are seven miles of gravel barrier beaches. Where these are exposed to the predominant wind

and wave approach, erosion has been severe. There are also about seven miles of marsh shore located at the inner end of bays and at river mouths. This stretch of shore is exposed to the greatest fetch on the lake and since the predominant storms are from the westerly direction the maximum temporary rise in lake levels occurs in this area, as well as the largest waves. At normal lake levels little erosion occurs along the shores where rock is exposed above lake level; however, erosion is severe along the remainder of the exposed shore even at normal lake levels. At high lake stages only those shores where rock is present to a height of 8 or 10 feet are free from erosion.

GENERAL STATEMENT OF THE PROBLEM

244. The natural characteristics of the shore of Lake Ontario between the Niagara River and the head of the St. Lawrence River divide it into three general parts: the southerly shore, the straight alined 20 miles of the east shore, and the very irregular northerly part of the east shore.

245. The southerly shore, in general, consists of eroding bluffs of glacial clay, alluvium or rock, varying in height from 8 to 140 feet alternated by low barrier beaches of sand, gravel, or cobbles fronting low marsh areas or ponds along the lake. The shore is stable only for short distances west of the harbor structures at Olcott, Rochester, Sodus Bay, Little Sodus Bay, and Oswego, the east side of Rochester Harbor, and short stretches of shore protected by rock outcrops or adequate structures. Where detailed studies

have been made to determine its rate, erosion has averaged about four feet annually over a period of about 75 years. The rate of erosion is not constant. It is relatively negligible in times of low lake levels and rapid during times of high lake levels. Many structures have been built to protect short stretches of shore, some of which are not effective. Because of the scarcity of suitable beach-building material carried by litteral currents, groins are not generally successful in building beaches by natural accretion.

246. Along the southerly portion of the easterly shore of the lake where, in general, an almost continuous beach of fine sand up to 300 feet in width, fronting sand dunes up to 60 feet in height, separates the lake from low lying swamps and ponds, the shore is relatively stable under normal lake levels. During high lake stages the relatively flat beaches are partially inundated and waves attack and erode the dunes. There is a definite northerly movement of litteral currents and drift.

247. The character of the irregular northerly part of the easterly shore varies greatly. Bedrock, close to the surface throughout the section, forms at least the toe of the bluff for about 50 percent of the distance. Where it forms a substantial portion of the bluff erosion is negligible; however, at high lake stages only those places where rock forms the greater part of the bluff are free from erosion. The offshore slopes also vary greatly. Along some sections of shore shelving rock at shallow depths extends up to one-half mile from shore and forms good protection by causing the larger waves to break well

off shore during normal lake stages; however, some erosion does occur at high lake stages. Along other stretches of shore 30-foot depths occur within 1,000 feet of shore and large waves can approach close to shore even at normal lake stages and cause severe erosion. There is a definite easterly litteral current along the east-west shores but little evidence of any current along most of the north-south shores except on Stony Point where it is northerly. There are numerous barrier beaches along the north-south stretches where the beaches have retreated eastward at a rapid rate during high lake stages. Generally there is little erosion at the easterly end of the long bays where marshes have been built by the material brought down by streams and rivers and deposited in the relatively still water of the bays.

248. Throughout the entire length of the lake shore many short sea walls and short stretches of revetment have been constructed with varying degrees of success. Many sea walls which were fully effective at times of normal lake levels were ineffective or destroyed during times of high lake stages. Revetment failed in some instances where it was constructed entirely of large stone which allows the fine materials in the bluff to be lost through piping action during wave attack. In general, the problem is to prevent further erosion of the shores and beaches of Lake Ontario within the State of New York, and also to provide plans for the restoration, improvement, or creation of recreational beaches at publicly-owned parks. The State of New York requested a cooperative study to provide plans for recreational beaches at Selkirk Shores,

Fair Haven Beach and Hamlin Beach State Parks and the proposed State Park in Braddock Bay area. Niagara County's request for a cooperative study in 1939 included a request for plans for a beach at Krull Park.

FACTORS PERTINENT TO THE PROBLEM

249. Wind. - Wind records of the U. S. Coast Guard at Rochester, New York, for the period 1 January 1947 to 31 December 1952, and for Oswego, New York for the period 1 January 1936 to 31 December 1947, were compiled and converted to yearly averages. The resulting data are shown diagrammatically on Plate 4. The wind duration for each direction is classified in three groups of velocities: 0-12, 13-24, and 25 miles per hour and over. The data have also been broken down into the ice period, January and February, and the ice-free period March to December, inclusive. The length of the solid portion of each bar represents the percent of the total duration for winds of that direction and velocity group for the ice-free period; the outlined portion represents the ice period. The curves in the center of the diagram show the percent of the total wind movement occurring during the ice-free period and the combined ice and ice-free periods. A summary of wind data is given in Table 6.

Table 6 - Yearly average winds at Rochester and Oswego, N. Y., Subregion "D"

Direction	Wind duration, percent of time				Wind movement, percent of total			
	Rochester		Oswego		Rochester		Oswego	
	Total	Ice-free	Total	Ice-free	Total	Ice-free	Total	Ice-free
North	5.39	4.75	9.20	7.61	4.69	4.02	9.46	7.78
N.E.	9.49	8.08	8.05	6.74	11.95	9.65	8.04	6.88
East	8.47	7.64	4.68	3.68	8.43	7.34	2.67	2.09
S.E.	9.35	7.41	13.70	11.12	6.97	5.54	9.07	7.26
South	6.34	4.81	17.54	15.01	3.87	2.82	11.24	9.38
S.W.	24.80	20.52	13.77	11.94	21.95	16.59	14.87	12.41
West	22.60	19.10	18.27	16.09	25.20	19.97	21.64	17.80
N.W.	13.56	11.41	14.79	11.55	16.95	13.85	23.01	17.75
Total	100.00	83.72	100.00	83.74	100.00	69.78	100.00	81.35

250. Lake levels. - Variations in lake levels greatly influence the rate of erosion in the study area. Wave attack occurring during high lake stages is more damaging than that occurring at lower lake stages. Minimum lake levels during any particular year usually occur in January on Lake Ontario when precipitation over the Great Lakes watershed is being stored in the form of ice and snow. Maximum levels usually occur in June when the full effect of the run-off from the watershed of Lake Ontario and the upper lakes is felt. Fluctuations of short duration, of 1.2 feet, may be expected to occur about once a year, and 2.0-foot fluctuations once in about 8½ years on Lake Ontario in the vicinity of Oswego Harbor. Since these fluctuations are caused by winds pushing the water to the leeward end of the lake, greater temporary fluctuations than the above would occur at the ends of the lake. Fluctuations of the same frequency of occurrence at Tibbets Point at the head of the St. Lawrence

River are 1.7 feet and 2.6 feet, respectively. In 1859 the U. S. Lake Survey established water level gages on all the Great Lakes, one of which is located at Oswego, New York. Pertinent data on fluctuations of Lake Ontario as recorded at Oswego are given in Table 7.

Table 7 - Water level fluctuations - Lake Ontario, Subregion "D"

Item	High stage feet 1/	Date	Low stage ft. 1/	Date	Variation feet	Elevation ft. 2/
Extreme stage, monthly mean (1860-1952)	+5.29	June 1952	-1.32	Nov.1934	6.61	
Extreme stage, instantaneous, (1900-1952)	+6.19	June 1952	-1.83	Dec.1934	8.02	
Maximum seasonal variation in calendar year	+4.46	June 1867	+0.88	Dec.1867	3.58	
Minimum seasonal variation in calendar year	+1.63	July 1920	+0.94	Feb.1920	0.69	
Mean lake level	From	Jan.1860	to	Dec.1953	incl.	246.033
	From	Jan.1900	to	Dec.1953	incl.	245.867
Average lake level for months March to Dec. incl. From 1900 to 1953 incl.						245.987

1/ Referred to low water datum, 244.0 feet above mean tide at New York City. All stages computed from monthly means, except instantaneous high and low.

2/ Referred to mean tide at New York City.

251. Waves. - Waves up to 16 feet in height and of 9-10-second periods may be developed on Lake Ontario; however, these are very uncommon. Waves of 12 to 13 feet in height with periods of eight to nine seconds may be expected to occur in deep water about once a year.

252. Littoral currents and drift. - In general, the predominant direction of littoral currents and drift along the south shore of Lake Ontario from Burlington Bay, Ontario, to Selkirk Shores State Park is west to east as indicated by the accumulation of material to the west of harbor structures at Port Weller, Ontario, and at Rochester Harbor, Little Sodus Harbor, and Oswego Harbor, New York. There are local reversals due to the configuration of the shore line and short term reversals due to changes in the direction of storms. Along the southerly portion of the easterly shore the predominant direction of littoral currents and drift is northerly, while in the remainder of the easterly shore the predominant direction is easterly toward the heads of the bays.

253. Ice action. - Under normal conditions during late December, spray freezes and forms a coating of ice on the shore to heights up to ten feet above lake levels thereby armoring the beach and bluffs against further wave action. During the latter part of December, ice also begins to form in the shallow water near shore, and during severe winters may freeze for a mile or more offshore. The ice may attain a thickness of up to three feet near shore. Storms break up the ice and force it into windrows just offshore which further protect the shore from storm wave action. Normally the ice fields break up early in March. Occasionally the break-up extends to shore and floating ice fields may damage shore structures. In general, the windrowed ice which rests on the

bottom of the lake prevents such action. The windrows become honeycombed and disintegrate early in March. Although increased loads are applied to shore structures due to its weight, ice usually has a net beneficial effect in preventing wave action from reaching the shore and bluffs during the ice period.

254. Sources of beach-building material. - Along the south shore of Lake Ontario, the rivers and streams tributary to the shore cannot be considered a source of beach material as explained in paragraphs 229 to 231. The only source of material available for building beaches by natural forces is from erosion of the bluffs themselves. Where these are protected, an outside source of material must be used if it is desired to construct beaches. The beaches along the southerly part of the east shore of the lake are of adequate width to prevent erosion of the shores at all but maximum lake stages, and here the dunes can supply any additional material necessary. Along the irregular shore line of the northerly section of the east shore there are only a few short stretches of shore located in protected areas where sand is available for beaches.

EXISTING CONDITIONS AND PRIOR CORRECTIVE ACTION

255. Laws pertaining to beach erosion control. - Portions of the Federal laws pertaining to beach erosion control are quoted below:

Public Law No. 520, Seventy-first Congress

"The Chief of Engineers of the United States Army,

under the Direction of the Secretary of War, is authorized and directed to cause investigations and studies to be made in cooperation with the appropriate agencies of various States on the Atlantic, Pacific, and Gulf coasts and on the Great Lakes, and the Territories, with a view of devising effective means of preventing erosion of the shores of coastal and lake waters by waves and currents" * * * That no moneys shall be expended under authority of this section in any State which does not provide for cooperation with the agents of the United States and contribute to the project such funds and/or services as the Secretary of War may deem appropriate and require; * * *."

Public Law 727, Seventy-ninth Congress

"* * *. That with the purpose of preventing damage to public property and promoting and encouraging the healthful recreation of the people, it is hereby declared to be the policy of the United States to assist in the construction, but not the maintenance, of works for the improvement and protection against erosion by waves and currents of the shores of the United States that are owned by States, municipalities, or other political subdivisions: Provided, That the Federal contribution toward the construction of protective works shall not in any case exceed one-third of the total cost: * * *."

256. There are at present no laws providing for participation of the State of New York in any studies of erosion control or construction of works for the protection or improvement of shores other than those owned by the state. There are no laws providing for Federal or State aid in constructing works for the protection of privately-owned property against erosion by wave action or currents on Lake Ontario.

257. Existing Federal navigation structures. - The Federal Government has constructed harbor structures at Wilson, Olcott, Rochester, Sodus Bay, Little Sodus Bay, and Oswego.

a. Wilson Harbor structures consisting of parallel jetties at the mouth of Twelve Mile Creek were originally

constructed by local interests in 1846. The harbor became a Federal project in 1875. The jetties accumulated a wide shingle beach to the west until early in the 1940's when the structures deteriorated to such an extent that they no longer prevented material from moving eastward and the beach was lost. New jetties were constructed about 1949, but because of the lowered beach to the west and high lake stages considerable material has passed over the top of the narrow beach just west of the jetties and been deposited in the harbor. Erosion has been severe on the downdrift side of the jetties and the shore for about two miles has been protected by sea walls and revetment. The present project includes jetties about 667 and 664 feet long and 200 feet apart.

b. Olcott Harbor became a Federal navigation project in 1867 with the construction of parallel jetties 200 feet apart. The existing jetties are 850 and 873 feet long, and have impounded a wide beach to the west, while to the east, erosion was severe until the shore was protected by sea walls and revetment.

c. In 1829 the improvement of the mouth of the Genesee River was commenced as a Federal navigation project by the construction of parallel jetties. Because of its location in respect to the general alinement of the shore on either side and the direction of the prevailing winds and wave approach, the jetties accumulated material on both sides which required lakeward extension of the jetties from time to time. At the present time the west jetty is

3,036 feet long; the east jetty, 2,699 feet long. The jetties are 450 feet apart. The shore has been relatively stable for about 25 years.

d. Great Sodus Bay Harbor became a Federal navigation project in 1829 with the construction of parallel jetties across the bar separating the bay from the lake. Construction and repair have been intermittent. The project now includes a west jetty 1,580 feet long, an east jetty 1,294 feet long and an east and west breakwater 1,653 and 2,200 feet long, respectively. The latter is not maintained. The breakwaters were constructed along the lake shore line. A wide sand and gravel beach has accumulated lakeward of the west breakwater, adjacent to the west jetty, while to the east of the jetties, erosion has moved progressively eastward.

e. Little Sodus Bay Harbor's first Federal appropriation was made in 1852. Construction commenced in 1854 to provide a channel through the bar across the mouth of the bay. Construction of jetties and breakwaters was intermittent. The west jetty is now 1,747 feet long and a wide gravel beach has accumulated to the west of it. The east jetty is now 1,810 feet long. Erosion of the bar to the east commenced upon completion of the first jetties and the progressive construction and extension of an east breakwater followed. The breakwater was finally connected to the headland to the east in 1912 after being extended to a total length of 1,680 feet.

f. Oswego Harbor became a Federal navigation project in 1827, with provision for the construction of a breakwater across the cove at the mouth of the river, having a 350-foot opening for vessels to enter the river. The project was completed in 1829. The project providing for an outer harbor was adopted in 1870 and completed in 1881. It provided for a west breakwater 4,879 feet long, parallel to, and 1,100 feet from shore; a westerly shore arm 916 feet long, and a 246-foot easterly return. The project was revised in 1930 to include an arrowhead entrance, the westerly arrowhead to be 2,700 feet; the easterly, 2,200 feet. It included the removal of the easterly 962 feet of the west breakwater and the 246-foot easterly return. Since the construction of the westerly shore arm and breakwater, considerable gravel has accumulated to the west of it.

258. The amount of accretion is relatively small updrift of all of these structures considering the time required to accumulate it.

259. Federally-owned frontages. - The Federal Government owns several pieces of lakefront property used for military reservations, Coast Guard Stations, and other purposes. These frontages are described in the following subparagraphs:

a. Fort Niagara Military Reservation, presently a Federal military post, adjoins Old Fort Niagara along the shore to the east. Erosion became severe in the early 1930's and a series

of stone-filled timber crib groins were constructed along the shore. Although they have slowed erosion of the bluff, there has been very little accretion and where the spacing of the groins is greater toward the east, erosion has occurred during recent high lake stages.

b. A 500-foot frontage, located 2¼ miles west of Wilson Harbor, is used by the Navy and Air Force in connection with guided missiles shot over the lake. The unprotected 15-foot bluff of silt is fronted by a 15-foot sand and gravel beach. Erosion is active.

c. Thirty-Mile Point Lighthouse Reservation, with a 675-foot frontage, is located near the easterly boundary of Niagara County. The shore along the reservation consists of a 20-foot gravel beach retained by a concrete groin near the easterly boundary. Rock is present in the bluffs to elevation +8 feet. Erosion is active.

d. Braddock Point Lighthouse Reservation is located about ten miles west of Rochester. The shore frontage, 1,328 feet long, consists of an eroding boulder clay bluff only about ten feet high fronted by a 10-foot gravel and cobble beach. Erosion is active.

e. The U. S. Coast Guard Sodus Point Light Station is located immediately west of the west pier at the entrance to Sodus Bay. Its 525-foot frontage is an area of accretion. There is no erosion problem at this point.

f. The U. S. Coast Guard Fairhaven Light Station has a 373-foot frontage adjoining the west pier at the entrance to Little Sodus Bay Harbor. There is no erosion problem at this point.

g. The Stony Point Light Station Reservation of the U. S. Coast Guard is located on the southwesterly tip of Stony Point Peninsula, about the center of the easterly shore of Lake Ontario. Its 1,503-foot frontage is subject to moderate erosion. There are no protective structures along this frontage.

h. Madison Barracks, a United States Military Reservation, is located on the south shore of Black River Bay and is situated in the village of Sackets Harbor. The westerly 500 feet of shore consists of a vertical rock bluff, the next 500 feet consists of a low bluff with cobble beach, while the easterly 1,300 feet have been protected by a concrete sea wall. There is no problem of erosion at the present time at Madison Barracks.

i. Chaumont Harbor Light Station of the U. S. Coast Guard is located on the southwesterly tip of Independence Point about one mile southwesterly of the village of Chaumont. Of its frontage of 515 feet, 212 feet are protected. There is no problem of erosion.

j. Tibbetts Point Light Station is located at the northeast corner of Lake Ontario at the head of the St. Lawrence River. It has a shore frontage of 780 feet, 90 feet of which are protected. Erosion, though not severe, is active.

260. State-owned frontages. - The State of New York, principally through its Conservation Department and Department of Education, owns numerous frontages on Lake Ontario.

a. Old Fort Niagara, an historical site, administered by the State Conservation Department, through the Old Fort Niagara Association, is located at the mouth of the Niagara River. Erosion threatened to undermine the foundations of the old fort during the 1930's and a concrete sea wall was constructed. Later the toe of the wall was revetted by addition of large quarry stone. The shore is presently in good condition.

b. State Highway No. 18 closely parallels the shore for about one-half mile immediately east of Wilson. In 1939 erosion threatened the highway and the State dumped large stone along the shore in 1940. Although some of the stone has disintegrated the protection is still in good condition and effective.

c. Hamlin Beach State Park is located just east of the Orleans-Monroe County line and has a shore frontage of approximately 2.3 miles. Construction of protective structures commenced in 1938 when a 350-foot concrete groin founded on wooden piles and stone-filled timber cribs and a 2,300-foot concrete sea wall were built. The top of the sea wall is at elevation 249.0 to 250.0 feet. Waves overtopping the sea wall allowed erosion of the bluff to continue and in 1946 about 1,600 feet of retaining wall were constructed behind the sea wall. Erosion of the bluff in this

area has been halted. In 1949, 150 feet of quarry stone revetment were constructed and in 1952 an additional 850 feet were added. Construction of a concrete wall and curb along the top of the 150-foot section of the revetment was started in 1951 and completed in 1952. Five quarry-stone groins were constructed in 1952, ranging in length from 50 to 150 feet. The sea walls and revetment are effectively protecting the shore and bluffs behind them from erosion, however, the groins are relatively ineffective in building protective beaches, due to lack of sufficient littoral drift. Erosion is still active along the unprotected shore which consists of high bluffs of fine sand and silt along the westerly portion of the part frontage, low soft clay bluffs along the central portion, and steep gravel barrier beaches along the easterly portion.

d. The Lake Ontario State Parkway property includes two stretches of shore frontage between Hamlin Beach and Braddock Bay, with a total length of about one mile. The shore consists of unprotected barrier beaches fronting swamp areas. No improvements have been constructed and erosion is active.

e. The State of New York acquired approximately 860 acres in the vicinity of Braddock Bay which it intends to convert to a State park featuring bathing beaches. Since about one-third of the park area is water, the State also plans to develop a small-boat harbor in the bay. There is a lakeshore frontage of approximately one mile. It consists principally of two sand spits extending

toward each other across the mouth of the bay from the high ground located at each side of the bay. There is an opening of approximately 1,500 feet near the center of the bay mouth where the outer ends of the spits have been turned bayward by wave action. In 1900 a low concrete sea wall bordered the spits along the lakeward side. Approximately 2,000 feet of the wall are still in existence; however, because of its low top elevation (246.0 to 248.0 feet) waves have overtopped the walls and eroded the sand spits behind them. The portions of walls still existing lie up to 200 feet lakeward of the present shore line. In 1951-1952, the State constructed two quarry-stone groins about 300 feet long. The first is located at the easterly property line, the second, 700 feet to the west. A quarry-stone revetment or dike joins the inner ends of the groins and continues 150 feet to the west of the westerly groin. The revetment has prevented a complete break-through of the easterly spit. Improvements proposed by the State for the lake shore frontage include artificial fill for a beach and an improved navigable entrance to the bay.

f. Fair Haven Beach State Park, covering an area of 816 acres, has a lake frontage extending eastward from Little Sodus Bay approximately 1½ miles. The shore has an undulating profile of three bluffs alternating with low barrier beaches. The westerly 500 feet of frontage consists of a low graded bluff. A 2,000-foot long barrier beach fronting Sterling Pond joins the bluff, with a

central bluff having a lake frontage of 2,000 feet and rising to a height of 90 feet at the eroding face. A second barrier beach, 700 feet long, separates a marsh area from the lake and joins the central high bluff with a 900-foot long eroding bluff about 20 feet high. An easterly 900-foot long barrier beach joins the low bluff with high ground at the east end of the park and fronts a second swamp area.

(1) Construction of the jetties that form the entrance to Little Sodus Bay was commenced by the Federal Government in 1854. Erosion of the barrier beach separating the bay from the lake east of the jetties began almost at once and the construction of an east breakwater followed the progressive erosion of the barrier until in 1912 it had reached the lakeward end of the ridge separating the bay from Sterling Pond. In 1929 the State constructed guide walls to stabilize the outlet from Sterling Pond. The walls extend 570 feet lakeward from the bridge which crosses the outlet. In 1934 the State constructed a masonry sea wall in extension of the U. S. East Breakwater along the westerly 500-foot long bluff to halt the progressive erosion. Erosion was also active at the easterly end of the barrier beach across Sterling Pond and the State constructed a 230-foot concrete groin near the westerly end of the high bluff in an attempt to halt it. In 1948 the State constructed a stone-filled metal crib sea wall extending along the shore from 300 feet west to 950 feet east of the groin. The sea

wall was badly damaged during high lake stages and during 1952 the part west of the groin was reinforced by a concrete facing along the lower part of the crib and the easterly section was reinforced by driving steel sheet piling in front of the wall.

(2) The westerly bluff, where it is protected by the masonry sea wall, is stable but some loss of beach has occurred both there and along the entire park frontage. Erosion of the toe of the bluff has been halted by the metal crib sea wall; however, the bluff slope behind the wall has not yet become stable. Erosion of the entire bluff is occurring along the frontage easterly of the east end of the sea wall.

g. The Oswego State Teachers College is situated immediately west of the Oswego city limits. The shore consists of a low boulder clay bluff with a maximum height of 15 feet. The toe of the bluff is sandstone which also forms a shelving beach about 15 feet wide. Erosion along this shore is minor.

h. Old Fort Ontario, now under the jurisdiction of the State Department of Education, overlooks the lake and harbor from the top of a 50-foot bluff which is located on the east bank of the Oswego River mouth. The bluff is skirted about 15 feet above the lake by a railroad which has been protected with heavy riprap stone.

i. Selkirk Shores State Park is located at the southeasterly extremity of the lake, about 15 miles easterly of Oswego. The park, containing 631 acres, has a lake shore frontage of

approximately 6,000 feet. The central 3,800 feet consists of a bluff rising from 20 to 30 feet above the lake, fronted by a narrow gravel beach. The southerly 1,200 feet consists of a barrier beach of sand and gravel fronting a swamp area. Grindstone Creek meanders through this swamp before passing through the barrier beach to the lake. The northerly 1,000 feet of park shore line, a second barrier beach, fronts a low swamp area.

(1) Between 1929 and 1933 the State constructed a timber retaining wall extending 1,500 feet northerly from the south end of the bluff area. In 1930 a 276-foot groin was constructed at the south end of the bluff area. The timber retaining wall was not satisfactory and in 1934 the State began to replace it with a closed-face, concrete crib wall founded on concrete footers. The wall, completed in 1936, extended from 300 to 2,800 feet north of the groin.

(2) In 1947 the combined effect of the meandering of the mouth of Grindstone Creek and storm waves caused the loss of the inner 76 feet of the groin. The inner end of the groin was rebuilt the same year and a concrete sea wall was constructed which extended 210 feet southerly along the shore from the groin, then turned landward 190 feet. A concrete wall was also constructed along the shore north of the groin for a distance of 300 feet to the concrete crib wall.

(3) These structures were all in good condition in September 1951, but by June 1952 only a six-foot section of

crib wall remained north of the groin. High lake stages resulted in larger waves reaching the walls carrying boulders and debris. Under this pounding the crib wall disintegrated and the concrete wall north of the groin was flanked and overturned.

j. Westcott Beach State Park, located about four miles south of Sackets Harbor on a sandy stretch of shore, has an area of 320 acres and a 2,600-foot sand beach backed by sand dunes. The general direction of the shore changes at the park, extending northerly to Sackets Harbor and southwesterly to Henderson Harbor. Islands create some protection from westerly storms. The park is comparatively new and no shore problems have arisen as yet.

k. Sackets Harbor Battlefield is a State Historical Park under the jurisdiction of the State Conservation Department. Its 600-foot frontage consists of a vertical rock bluff about 15 feet in height. There is no shore erosion problem.

l. Long Point State Park, situated near the easterly end of the north shore of Point Peninsula, is located on a small peninsula containing about 22 acres. The southerly shore of the park is rock; the northerly shore consists of a steep cobble beach except for a small crescent-shaped gravel beach. Erosion is not a serious problem at this park at the present time.

261. <u>County-owned frontages</u>. - Only two county-owned parks are located on Lake Ontario, Niagara County's Krull Park and Monroe County's Webster Park.

a. Krull Park is located in the village of Olcott about one-half mile east of the harbor. Originally a private park, it was deeded to the county in the late 1930's. The impermeable inner 200 feet of a 550-foot pier, formerly used by excursion boats has acted as a groin for many years. It is located about 300 feet east of the westerly park boundary. To prevent erosion of the shore the county constructed a stone-filled concrete crib groin about 250 feet east of the old pier, and constructed a concrete sea wall along the westerly 300 feet of shore in 1942. Erosion along the easterly portion of the park became severe and in 1952 the county constructed three more groins using material from grading the bluffs to make beaches artificially. The condition is improved; however, it is too soon to draw definite conclusions as to the complete success of the protection.

b. Webster Park, a Monroe County park, is located 5½ miles east of Durand Eastman Park. A concrete sea wall extends along the easterly 1,000 feet of the 1,500-foot frontage. The top of the wall, at elevation 248.5 feet, is too low to prevent overtopping and erosion behind the wall by waves during high lake stages. There is a gravel and cobble beach about 100 feet in width west of the sea wall, but none in front of the wall. The county's present plans for improvement of the shore include raising the sea wall and filling behind it.

262. City-, town-, and village-owned frontages. - Numerous villages and towns own shore frontages, which are used for water works pumping stations. They are usually quite short stretches and have been protected where erosion was active. The larger of

these are briefly described in the following subparagraphs together with two city-owned parks.

a. The village of Wilson sewage disposal property has a 150-foot lake frontage immediately east of the harbor piers. It is well protected by heavy stone revetment.

b. The village of Barker water works property, about 165 feet in length, has been protected by three concrete groins and revetment.

c. The village of Brockport water works property, about 300 feet in length, has been protected by a substantial concrete sea wall.

d. Ontario Beach, owned by the city of Rochester, consists of a 1,500-foot frontage immediately west of the 3,000-foot west jetty at the Rochester Harbor entrance. The original construction of two jetties at the mouth of the Genesee River was undertaken in 1829 by the Federal government. In 1882 it was reported that the inner 440 feet could be abandoned because of the advance of the shore lines. Since that time there has been little change in the location of the shore line. The beach, about 100 feet wide lakeward of the area now sodded, is primarily fine sand, although gravel and shingle are present along the waters edge near the jetty. No improvements are proposed by the city in the near future.

e. Durand Eastman Park, also owned by the city of Rochester, has a 5,000-foot shore frontage. The New York Central Railroad has a right-of-way along the lake front, and has revetted its frontage to protect it from wave attack. Lakeward of the

railroad during normal lake levels there is a sand beach over 50 feet in width which is used for bathing purposes. The bathing beach was closed during 1952 and 1953 because of inundation of the beach due to high lake stages. No other protection has been constructed along the park shore and none is proposed by the city.

IMPROVEMENTS DESIRED OR NEEDED

263. Improvements desired. - A cooperative beach erosion study of the Niagara County shore line of Lake Ontario was initiated by formal application by the Niagara Frontier Planning Board dated 13 September 1939. The purpose of the study was to determine the best method of preventing further erosion of the Niagara County shores, especially at the State highway property east of Wilson Harbor, New York, and to develop plans for building and maintaining beaches on publicly-owned properties at or near Wilson and Olcott, New York. The report recommended that those portions of the shore where stabilization is economically justified be protected by riprap revetment combined with slope treatment; that the development of beaches at Tuscarora and Krull Parks be accomplished by the construction of artificially-filled beaches protected by groins; and that the riprap protection of the State highway property be increased in cross section and extended to cover the entire lake frontage of the highway property. This report is published as House Document No. 271, 78th Congress, 1st Session.

264. A cooperative beach erosion control study of four State parks on Lake Ontario was initiated by the Division of Parks, Conservation Department of the State of New York, by a formal application dated 1 March 1953. Its purpose was to develop the most

suitable plans for the protection and improvement of the shores of four State parks, namely: Selkirk Shores, Fair Haven Beach, Hamlin Beach, and Braddock Bay, with a view to preventing further erosion of the bluffs and beaches and developing or improving bathing beaches in certain specified areas.

a. Selkirk Shores State Park. - The desired improvement included the restoration and protection of a beach 900 feet in length, the stabilization of the outlet of Grindstone Creek, and the protection of approximately 4,400 feet of shore by the most suitable and economical means. A complete description of the recommended plan of improvement is given in the Beach Erosion Control Report on Cooperative Study of New York State Parks on Lake Ontario - Selkirk Shores State Park, dated 30 June 1953. The plans of improvement recommended in the report included:

(1) The modification of an existing groin.

(2) The construction of one new groin.

(3) The construction of parallel jetties to stabilize the creek outlet and to act as a groin to contain the 900-foot artificially-filled beach.

(4) The protection of the shore by approximately 4,400 feet of quarry stone revetment.

b. Fair Haven Beach State Park. - The improvements desired by the State of New York include the restoration, improvement, and protection of the beach along the westerly 2,700 feet of

the lake frontage of the park, the improvement of a proposed bathing area having a frontage of about 1,000 feet at the easterly end of the park and the protection of the intervening frontage of about 2,700 linear feet by the most suitable and economical means. Complete descriptions of the considered plans of improvement are given in the Beach Erosion Control Report on Cooperative Study of New York State Parks on Lake Ontario - Fair Haven Beach State Park. The report recommended adoption of a cooperative project by the Federal Government and the State of New York for the restoration and improvement of the westerly beach area by the construction of one new groin, alteration of an existing groin and the outlet structures at the mouth of Sterling Creek and placement of sand beach fill. The report also developed plans for the improvement of the easterly beach area by construction of one new groin and placement of sand fill. Plans were also prepared for protection of the bluff area between the two beach areas by means of stone revetment. Adoption of a project for protection and improvement of the easterly beach area and the bluff area was not recommended.

c. Hamlin Beach State Park. - The improvements desired by the State of New York include the restoration and improvement of three beach areas and protection of the intervening park frontage by the most suitable and economical means. Complete descriptions of the considered plans of improvement are given in the Beach Erosion Control Report on Cooperative Study of New York State Parks on Lake Ontario - Hamlin Beach State Park. The report recommended adoption of a cooperative project by

the Federal Government and State of New York for restoration and improvement of approximately 4,350 linear feet of beach frontage at the westerly end of the park by the construction of four new groins, alteration of three existing groins and placement of sand fill. Although adoption of a project for the improvement of the remainder of the park frontage was not recommended, the report developed plans for the restoration and improvement of beach frontages of about 2,100 linear feet near the center of the park and about 1,300 feet at the easterly end of the park by the construction of groins and placement of sand fill. Plans were also prepared for the protection of additional frontage by stone revetment.

d. Braddock Bay State Park. - The improvements desired by the State of New York include the restoration and improvement of the beach across the mouth of Braddock Bay to be used as a bathing beach and for the protection against erosion of proposed park improvements on reclaimed land and a proposed small boat harbor in the bay area. The State also desires that the outlet of Braddock Bay be relocated near the west side of the bay. A complete description of the recommended plan of improvements is given in the Beach Erosion Control Report on Cooperative Study of New York State Parks on Lake Ontario - Braddock Bay State Park. The report did not recommend adoption of a project at this time but developed plans for the desired improvements consisting of construction of parallel

jetties at the location of the proposed bay outlet, alteration of an existing groin at the east end of the bay mouth at the park property line and placement of sand fill between these structures.

265. General plans of improvement. - General criteria for the design of sea walls, revetment and beaches are given below.

a. Sea walls. - A well designed sea wall includes a firm foundation carried well below the level to which scour may be expected to occur in front of the wall. The height should be such that it will protect the shore behind it from wave attack by the maximum wave capable of attacking it at extreme high lake levels. The wall should be designed to resist overturning by forces caused by the fill behind it.

b. Revetment. - Stone revetment should consist of a protective belt of stone, with individual stones in the face of the protection of such size that wave action will not displace them. The remainder of the stone should be of such sizes that the stones will not be lost between the cover stones and wave action will not remove fine material from the bluffs by piping action.

c. Beaches. - Where beaches created by nature are too small to protect the bluffs, or where there are no beaches, they may be created in one of the following ways:

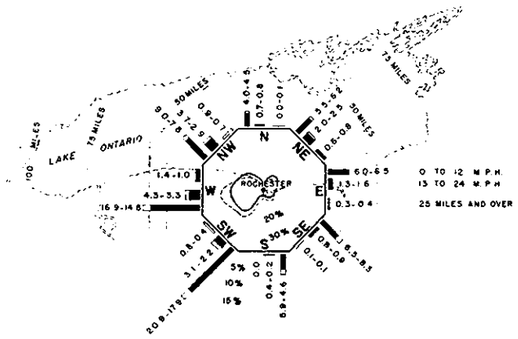
(1) The supply of beach-building material available to the area may be increased by placing additional material in stock piles updrift of the area and allowing natural forces to distribute it along the shore.

(2) Where littoral currents are weak, the material may be placed directly in the desired area to a suitable profile to prevent wave action reaching the bluffs.

(3) Where there is a strong littoral current and a sufficient supply of littoral drift, groins may be used to retard the littoral currents and drift and accumulate a beach.

(4) Where there is a decided littoral current but an insufficient amount of littoral drift a beach may be constructed artificially and then contained by groins to reduce the rate of removal of material.

Periodic replenishment of sand may be required to maintain beaches created by any of these methods.



WIND DIAGRAM FOR ROCHESTER, N. Y.

NOTES

■ INDICATES DURATION FOR ICE FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

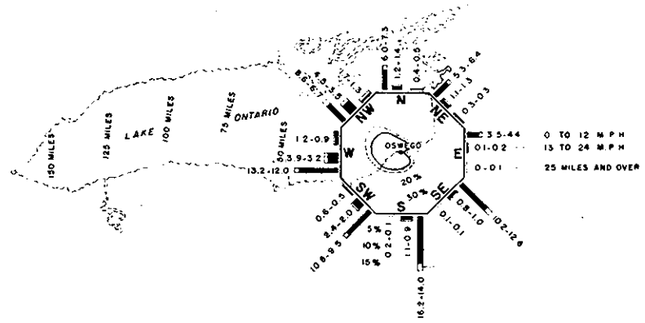
□ INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

〰 INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE FREE PERIOD.

-·-·- INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE FREE PERIODS

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE FREE PERIOD AND COMBINED ICE FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U.S. COAST GUARD AT ROCHESTER, N.Y. FOR PERIOD 1 JAN. 1947 TO 31 DEC. 1952 INCLUSIVE.



WIND DIAGRAM FOR OSWEGO, N. Y.

NOTES

■ INDICATES DURATION FOR ICE FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

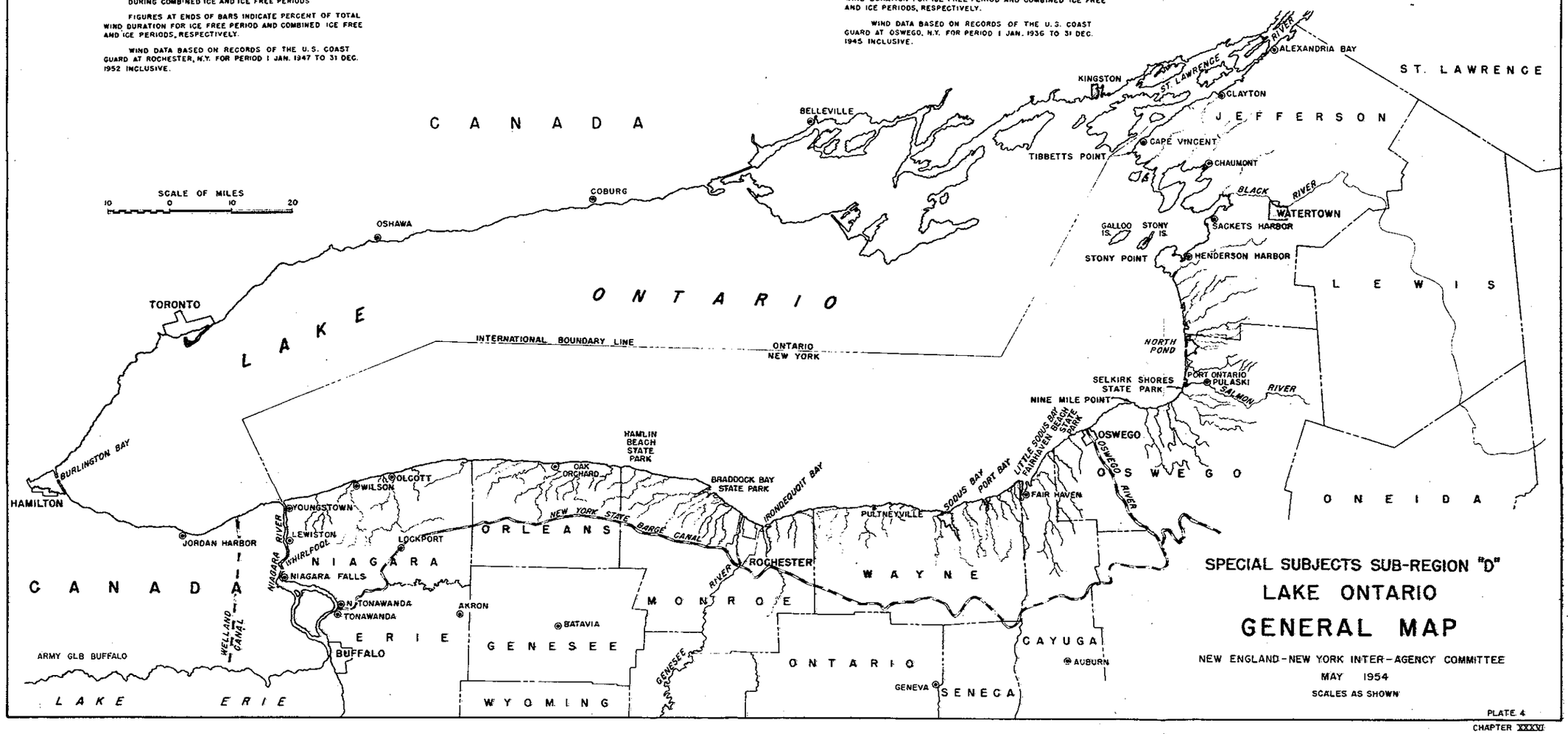
□ INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

〰 INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE FREE PERIOD.

-·-·- INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE FREE PERIOD AND COMBINED ICE FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U.S. COAST GUARD AT OSWEGO, N.Y. FOR PERIOD 1 JAN. 1936 TO 31 DEC. 1945 INCLUSIVE.



SPECIAL SUBJECTS SUB-REGION "D"
LAKE ONTARIO
GENERAL MAP

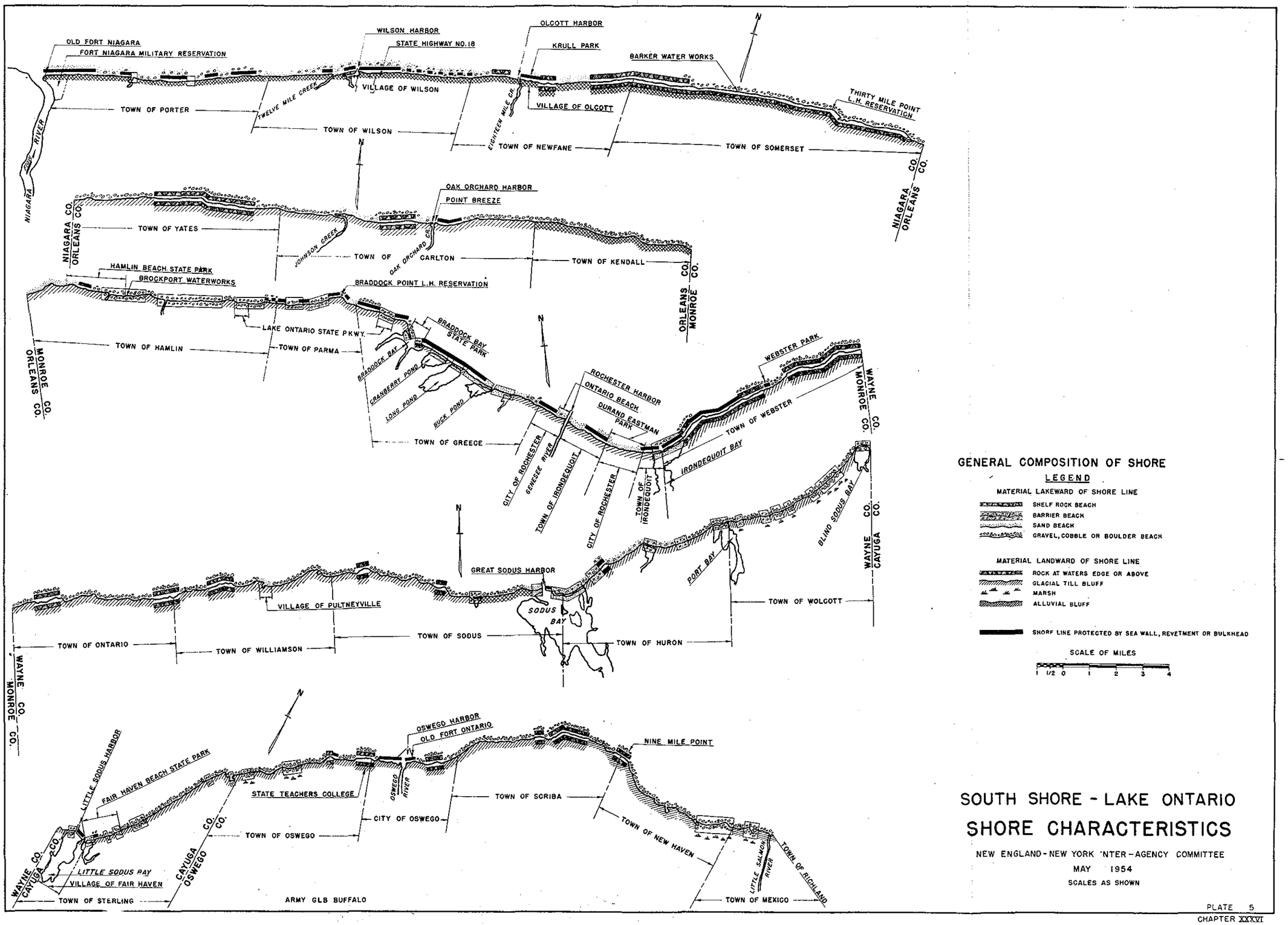
NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

MAY 1954

SCALES AS SHOWN

PLATE 4

CHAPTER XXXVI



SOUTH SHORE - LAKE ONTARIO
SHORE CHARACTERISTICS

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

MAY 1954

SCALES AS SHOWN

PLATE 5

CHAPTER XXXVI

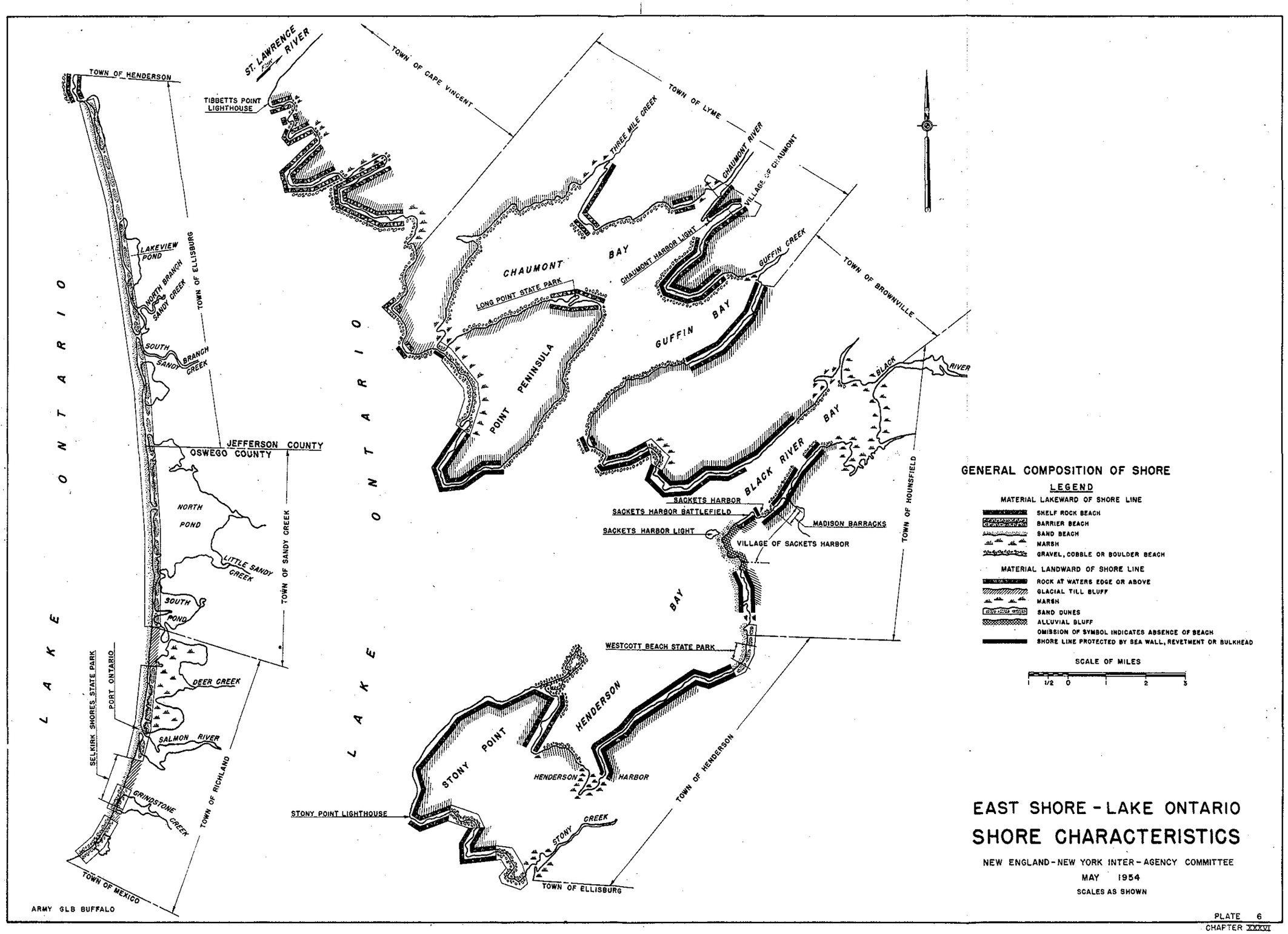
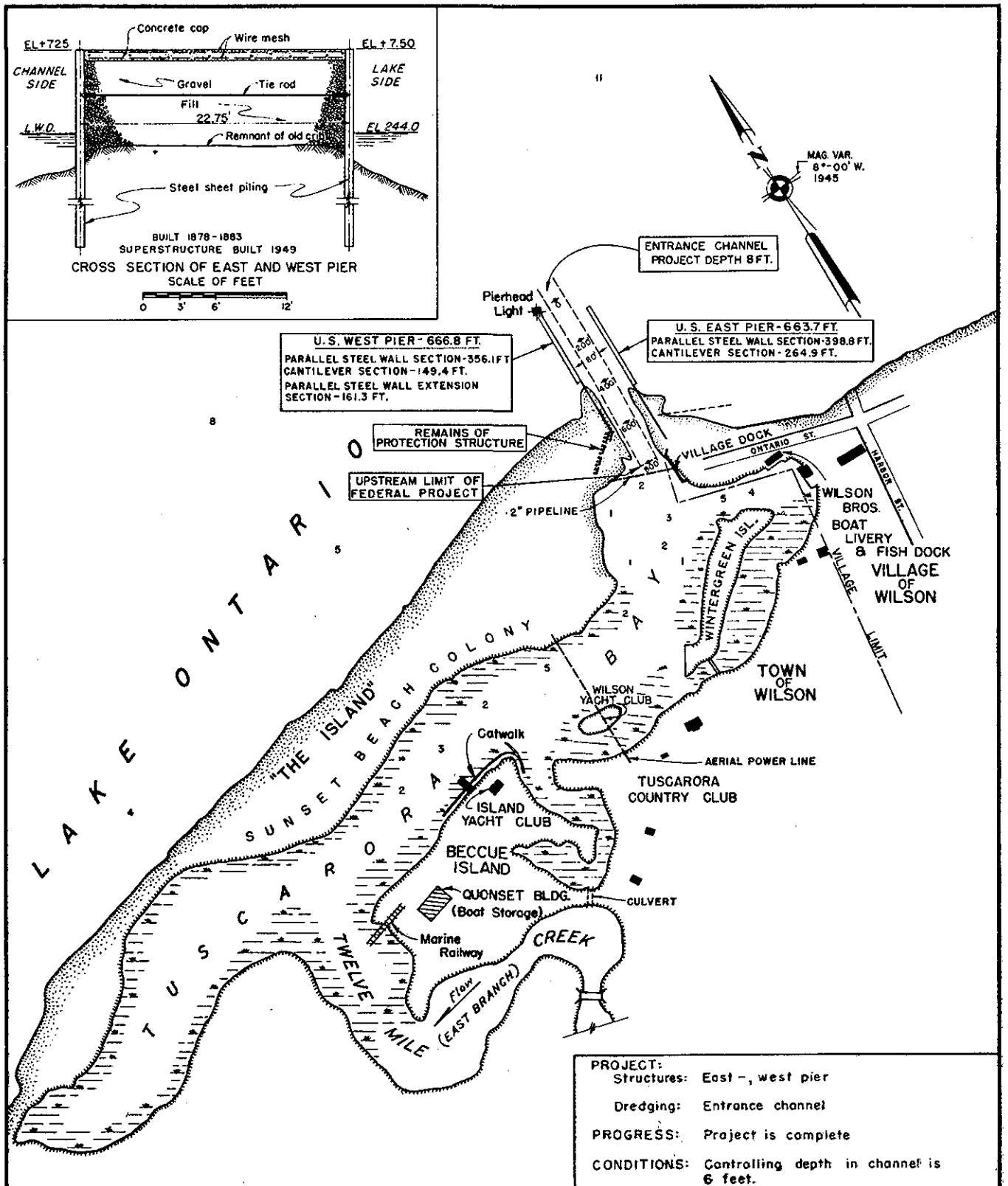


PLATE 6
CHAPTER XXXVI



PROJECT:
Structures: East -, west pier
Dredging: Entrance channel
PROGRESS: Project is complete
CONDITIONS: Controlling depth in channel is 6 feet.

NOTES:
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEV. 244.0 FEET ABOVE MEAN TIDE AT NEW YORK CITY.
200 INDICATES FEET FROM OUTER END OF W. PIER.

WILSON HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

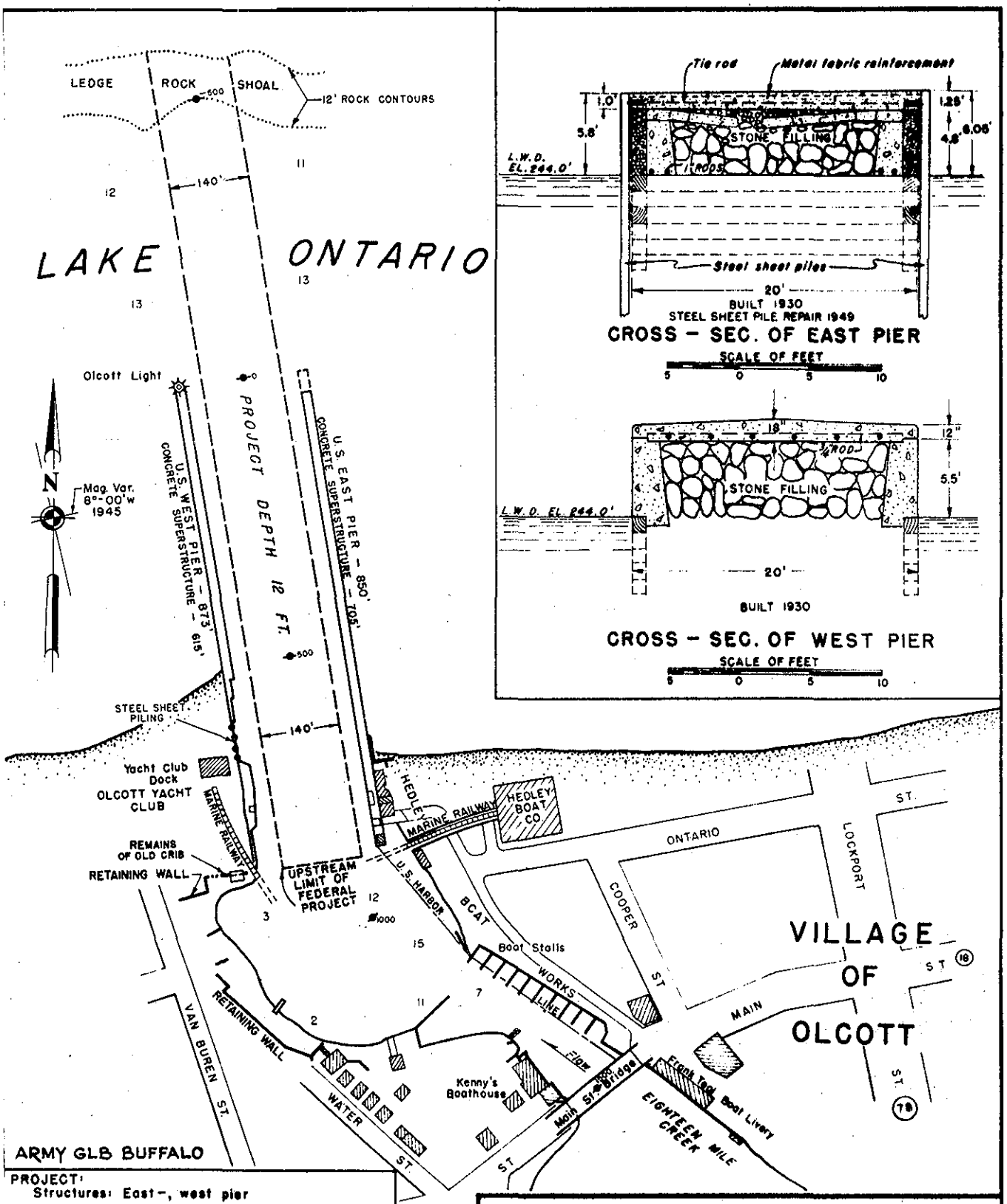
SCALE OF FEET
300 0 300 600 900

AUGUST 1954

ARMY GLB BUFFALO

PLATE 7

CHAPTER XXXVI



ARMY GLB BUFFALO

PROJECT:
Structures: East-, west pier
Dredging: Channel
PROGRESS: Project is complete
CONDITIONS: *Controlling depth in channel is 7 feet.*

-NOTES-
Project depths and soundings are referred to Low Water Datum, elevation 244.0 feet above Mean Tide at New York City.
•500 Indicates feet from Olcott Lt. at outer end of W. Pier.
(18) State Route

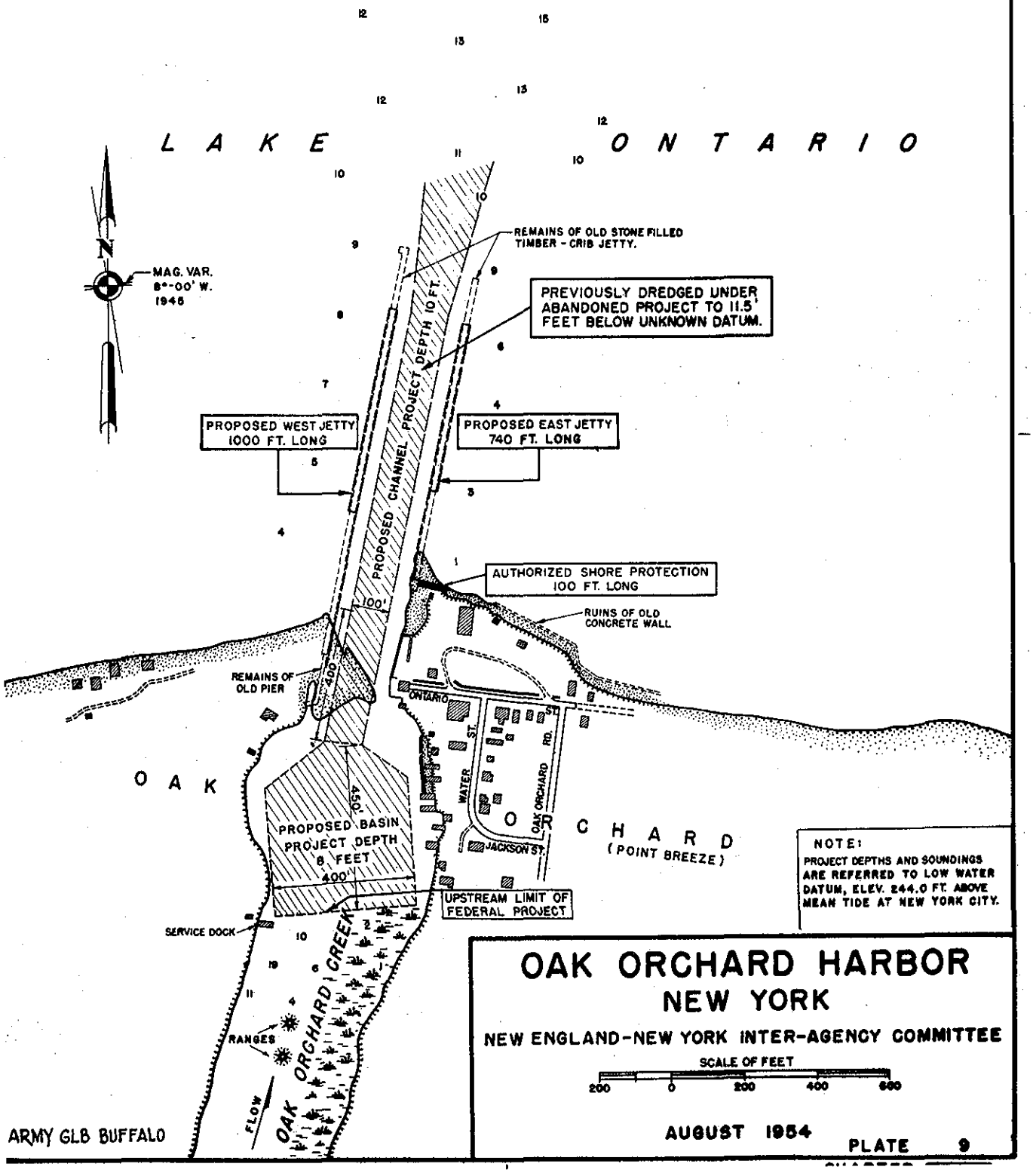
OLCOTT HARBOR
NEW YORK
NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

100 0 100 200 300 400

AUGUST 1954

PLATE 8

PROJECT:
Structures: East-, west jetty; shore protection
Dredging: Entrance channel; harbor basin
PROGRESS: No work has been done



NOTE:
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEV. 244.0 FT. ABOVE MEAN TIDE AT NEW YORK CITY.

OAK ORCHARD HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

SCALE OF FEET
200 0 200 400 600

AUGUST 1954

ARMY GLB BUFFALO

PLATE 9

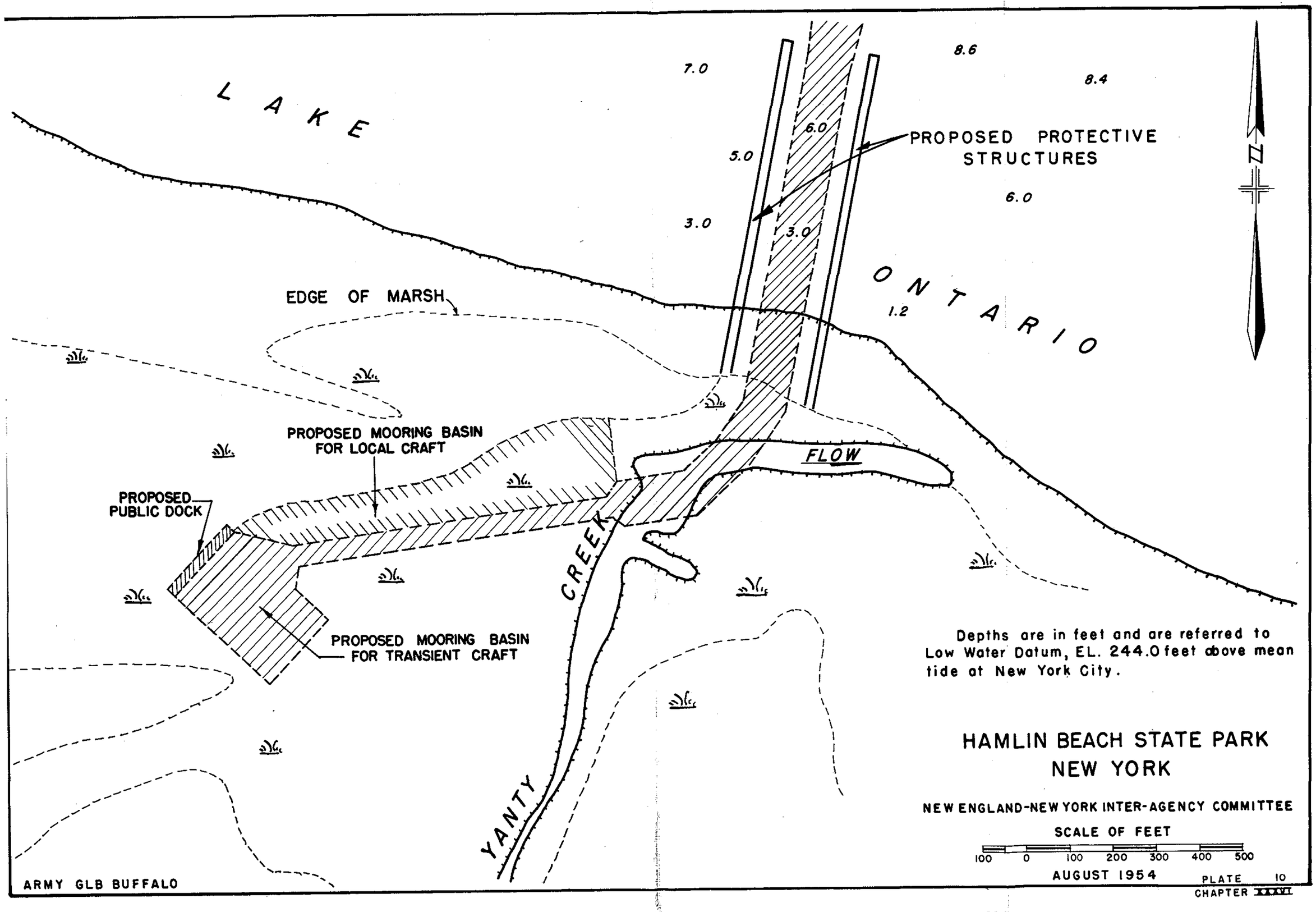
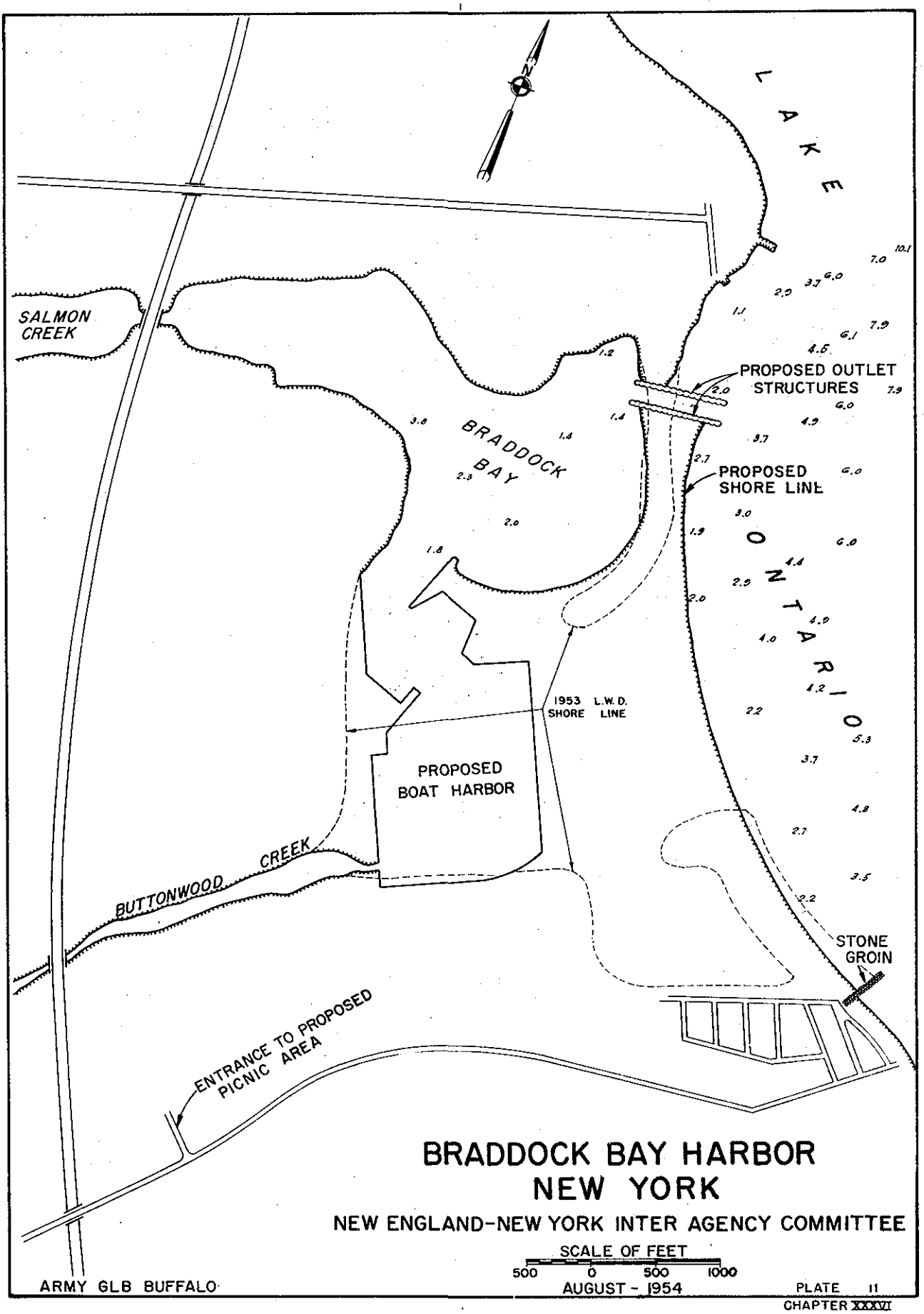


PLATE 10
CHAPTER XXXVI



BRADDOCK BAY HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER AGENCY COMMITTEE

ARMY GLB BUFFALO

AUGUST - 1954

PLATE 11

CHAPTER XXXVI

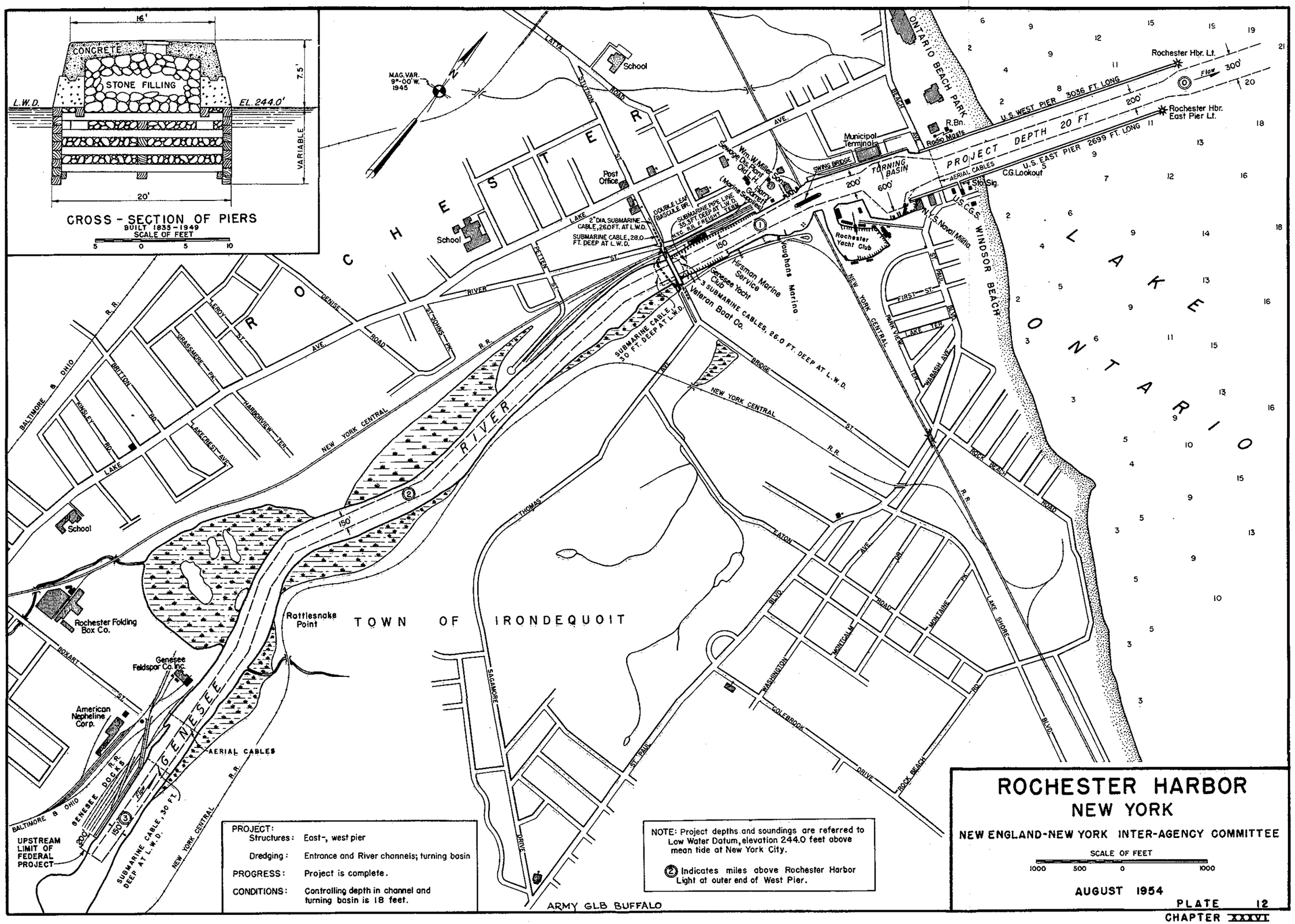


PLATE 12
CHAPTER XXXVI

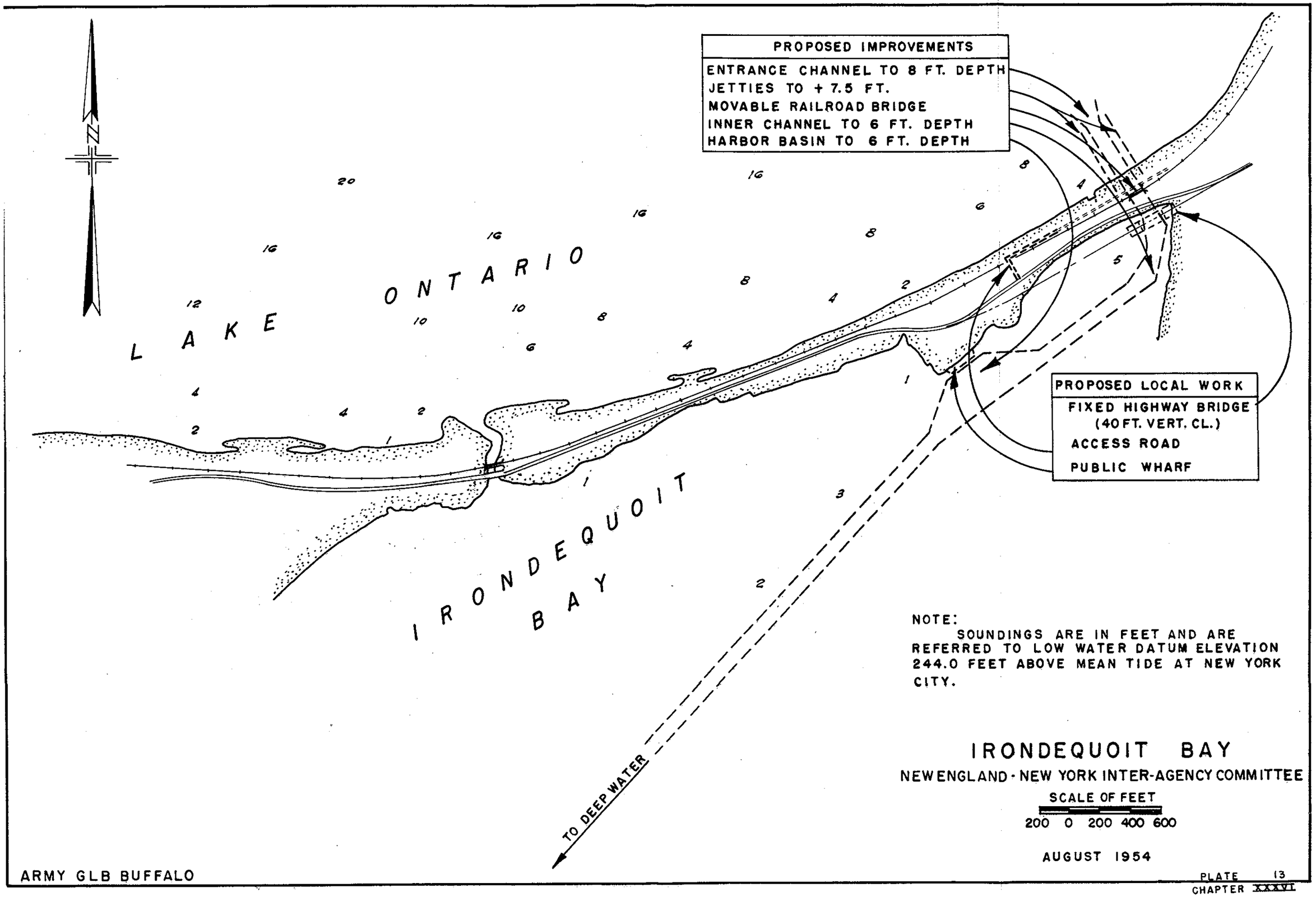
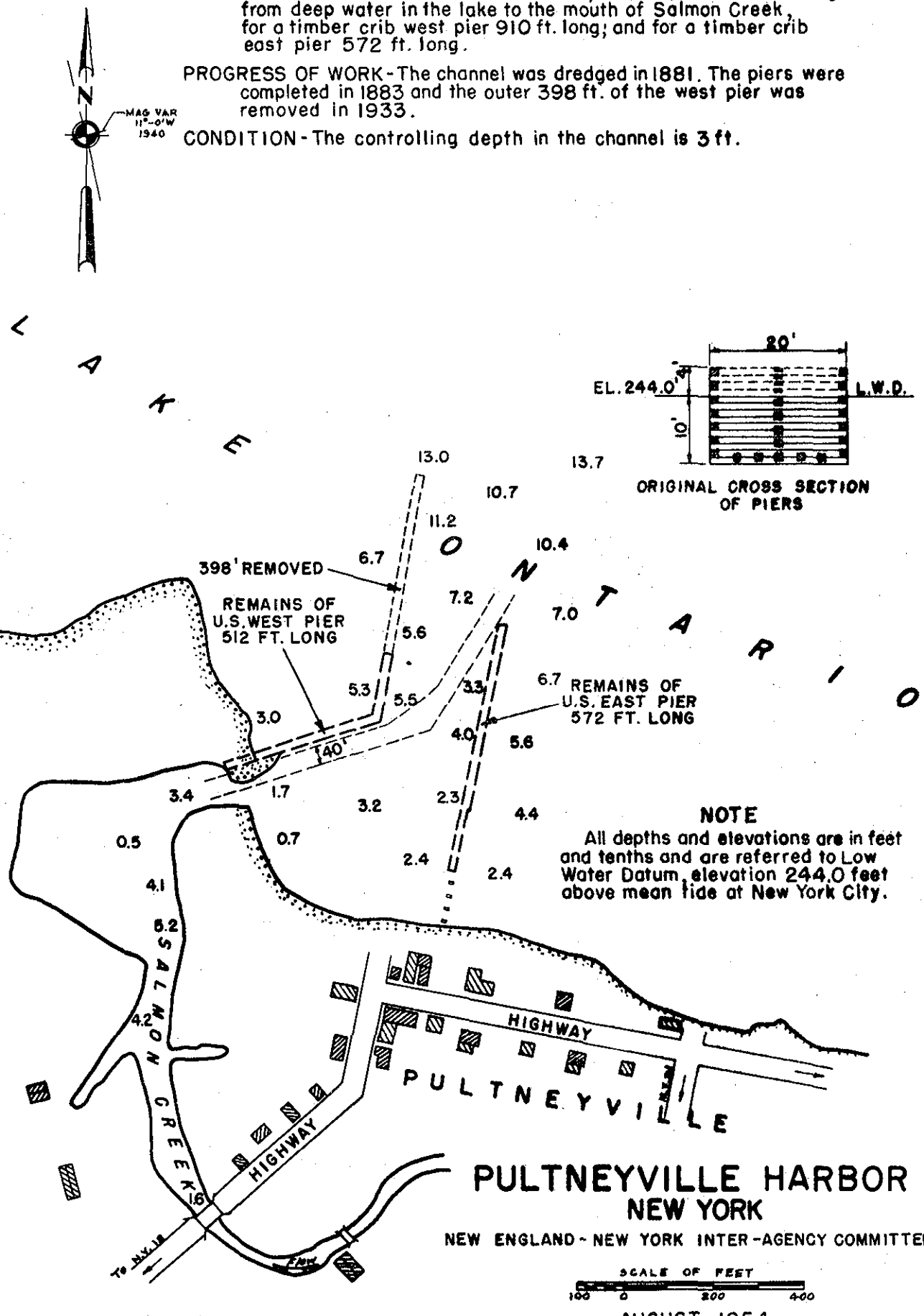


PLATE 13
CHAPTER XXXVI

PROJECT- Provides for a channel 40 ft. wide, 8 ft. deep and 700 ft. long from deep water in the lake to the mouth of Salmon Creek, for a timber crib west pier 910 ft. long; and for a timber crib east pier 572 ft. long.

PROGRESS OF WORK- The channel was dredged in 1881. The piers were completed in 1883 and the outer 398 ft. of the west pier was removed in 1933.

CONDITION- The controlling depth in the channel is 3 ft.



PULTNEYVILLE HARBOR
NEW YORK

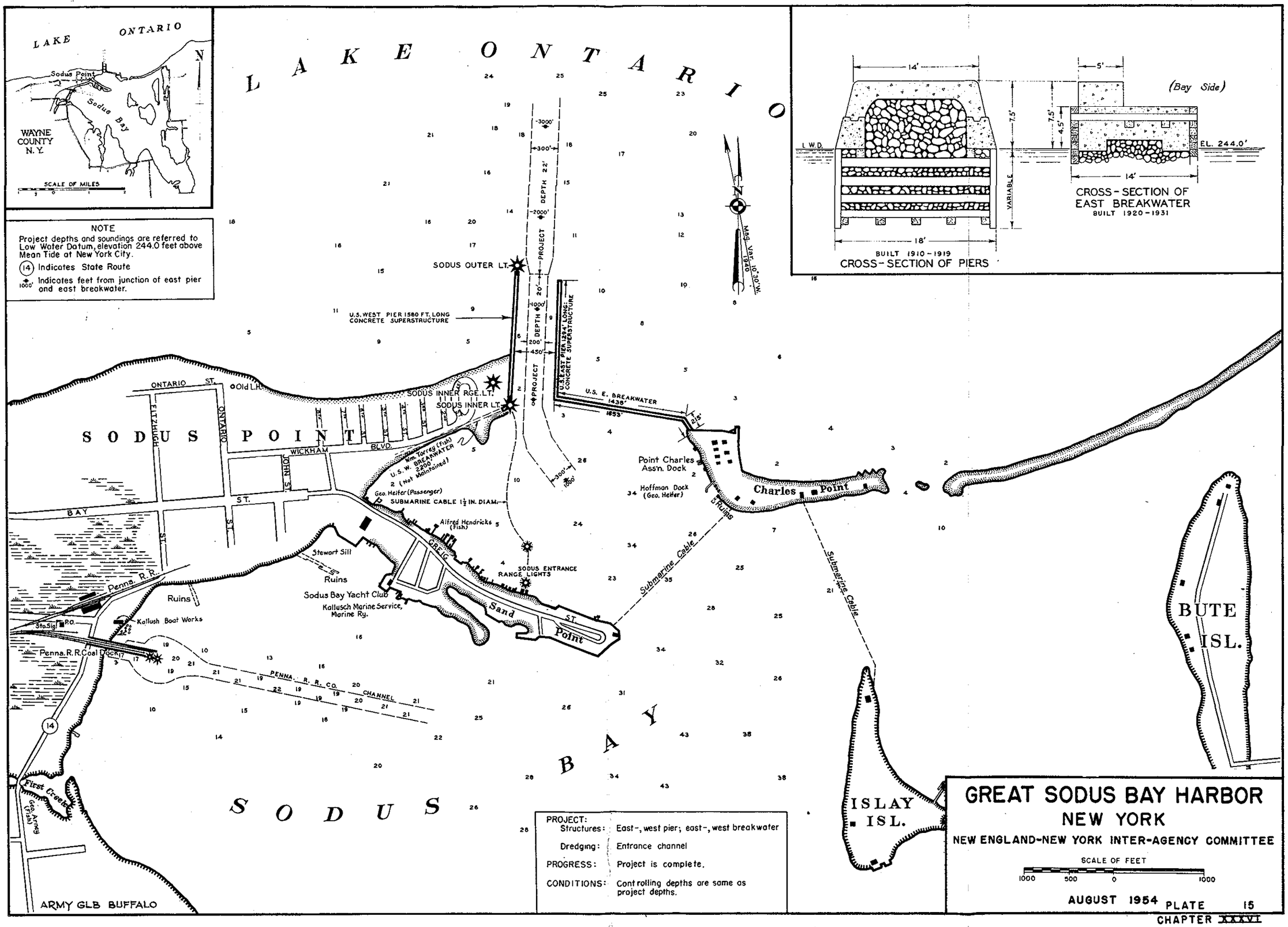
NEW ENGLAND - NEW YORK INTER-AGENCY COMMITTEE

ARMY GLB BUFFALO

AUGUST 1954

PLATE 14

CHAPTER XXXVI


LAKE ONTARIO
Sodus Point
Sodus Bay
WAYNE COUNTY N.Y.
SCALE OF MILES
NOTE
Project depths and soundings are referred to Low Water Datum, elevation 244.0 feet above Mean Tide at New York City.
(14) Indicates State Route
1000' Indicates feet from junction of east pier and east breakwater.
LAKE ONTARIO
SODUS OUTER LT.
U.S. WEST PIER 1580 FT. LONG CONCRETE SUPERSTRUCTURE
PROJECT DEPTH 22'
PROJECT DEPTH 20'
U.S. EAST PIER 1294' LONG CONCRETE SUPERSTRUCTURE
SODUS INNER RGE. LT.
SODUS INNER LT.
U.S. E. BREAKWATER 1438'
Point Charles Ass'n. Dock
Hoffman Dock (Geo. Helfer)
Charles Point
Submarine Cable
Wm. Torrey (Fish) U.S.W. BREAKWATER 2200' (Not Maintained)
Geo. Helfer (Passenger)
SUBMARINE CABLE 1½ IN. DIAM.
Alfred Hendricks (Fish)
SODUS ENTRANCE RANGE LIGHTS
Sand Point
Stewart Sill
Ruins
Sodus Bay Yacht Club
Kallusch Marine Service, Marine Ry.
Kallush Boat Works
Penna. R.R.
Penna. R.R. Coal Dock
PENNA. R.R. CO. CHANNEL
SODUS POINT
ONTARIO ST.
Old L.H.
WICKHAM BLVD.
BAY ST.
FITZHUGH ST.
JOHN ST.
GREIG ST.
Sto. Sig.
P.O.
First Creek
Geo. Arney (Fish)
SODUS BAY
ISLAY ISL.
BUTE ISL.
ARMY GLB BUFFALO
Mag. Var. 10°30' W. 1940
14'
5'
(Bay Side)
L.W.D.
7.5'
4.5'
VARIABLE
EL. 244.0'
18'
BUILT 1910-1919
CROSS-SECTION OF PIERS
CROSS-SECTION OF EAST BREAKWATER
BUILT 1920-1931
PROJECT:
Structures: East-, west pier; east-, west breakwater
Dredging: Entrance channel
PROGRESS: Project is complete.
CONDITIONS: Controlling depths are same as project depths.
GREAT SODUS BAY HARBOR
NEW YORK
NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE
SCALE OF FEET
1000 500 0 1000
AUGUST 1954
PLATE 15
CHAPTER XXXVI

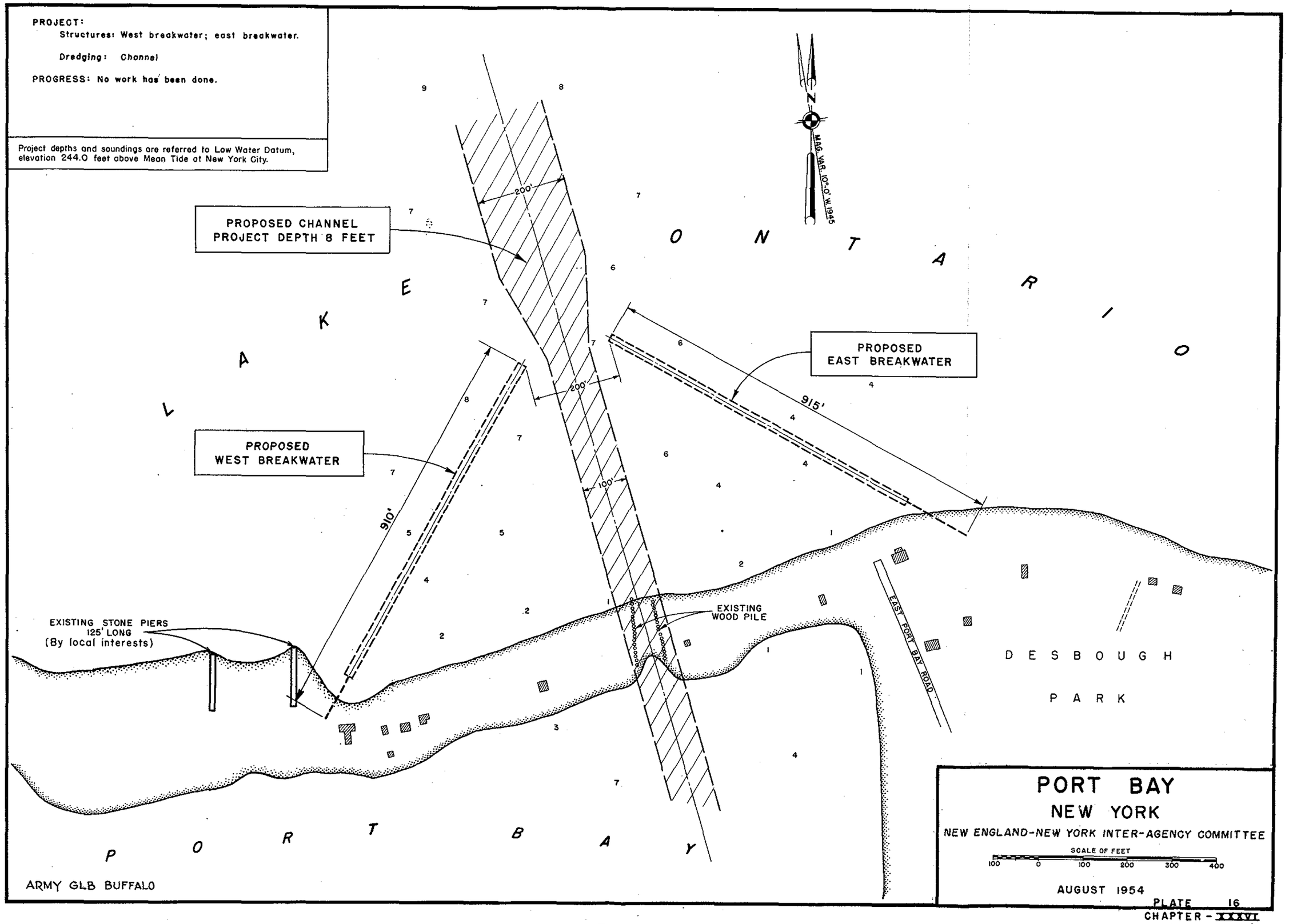
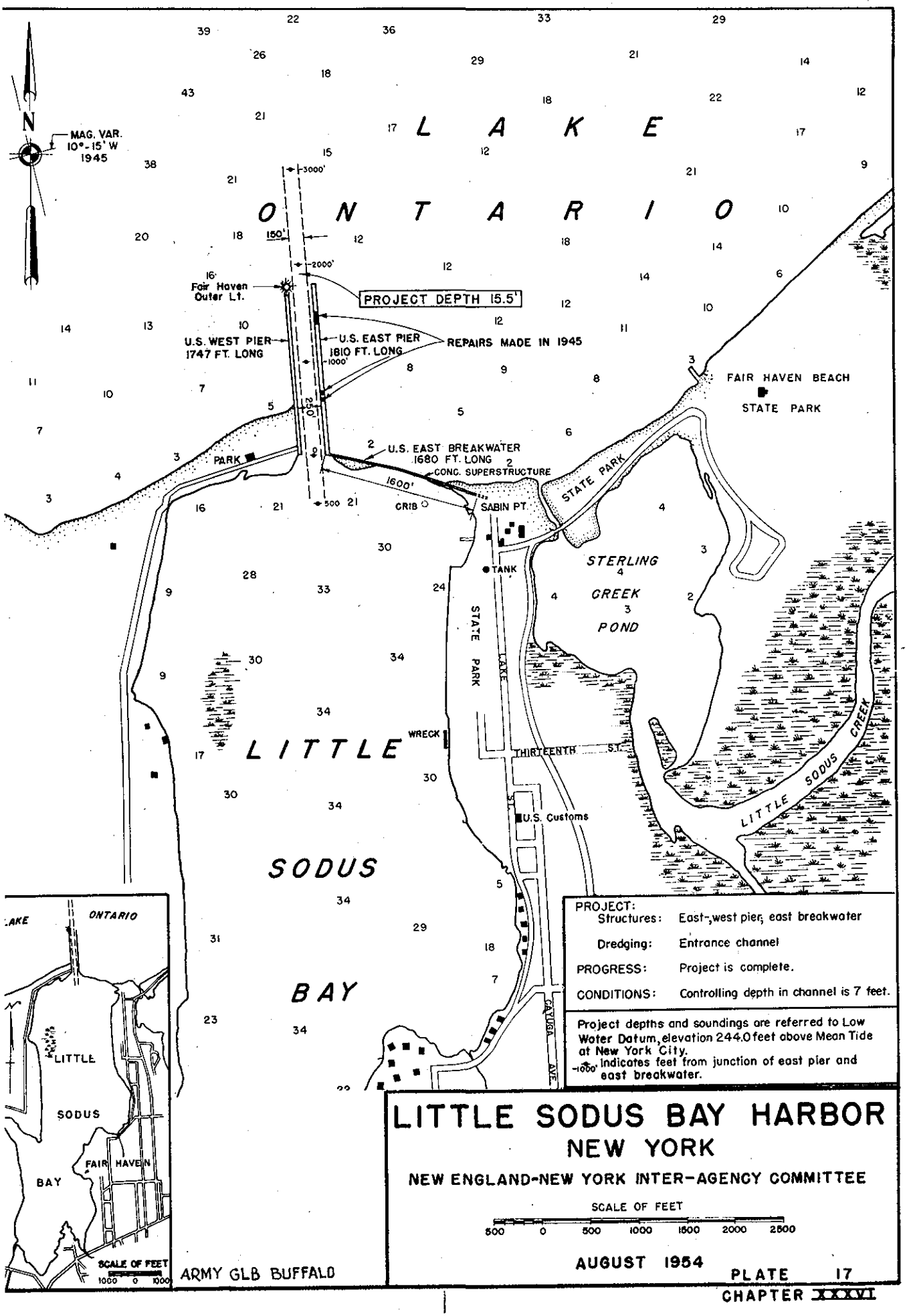


PLATE 16
CHAPTER - XXXVI



PROJECT:
Structures: East-, west pier, east breakwater
Dredging: Entrance channel
PROGRESS: Project is complete.
CONDITIONS: Controlling depth in channel is 7 feet.

Project depths and soundings are referred to Low Water Datum, elevation 244.0 feet above Mean Tide at New York City.
-1000'- Indicates feet from junction of east pier and east breakwater.

LITTLE SODUS BAY HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

AUGUST 1954

PLATE 17

CHAPTER XXXVI

STONE DATA

DECK STONE.	Minimum weight 10 tons
COVERING STONE "A"	Minimum weight stone 3 tons, not less than 60% 6 tons or more.
COVERING STONE "B"	Minimum weight 100 pounds, 50% by weight not less than 3 tons each.
CORE STONE "C"	Quarry run stone with not more than 3% in pieces of less than 1 pound in weight, and 50% in pieces weighing more than 100 pounds

CROSS SECTION OF BREAKWATER AT "I-I" AND "J-J"
BUILT 1931-1932

CROSS SECTION OF BREAKWATER AT "K-K"
BUILT 1882, 1931, 1942

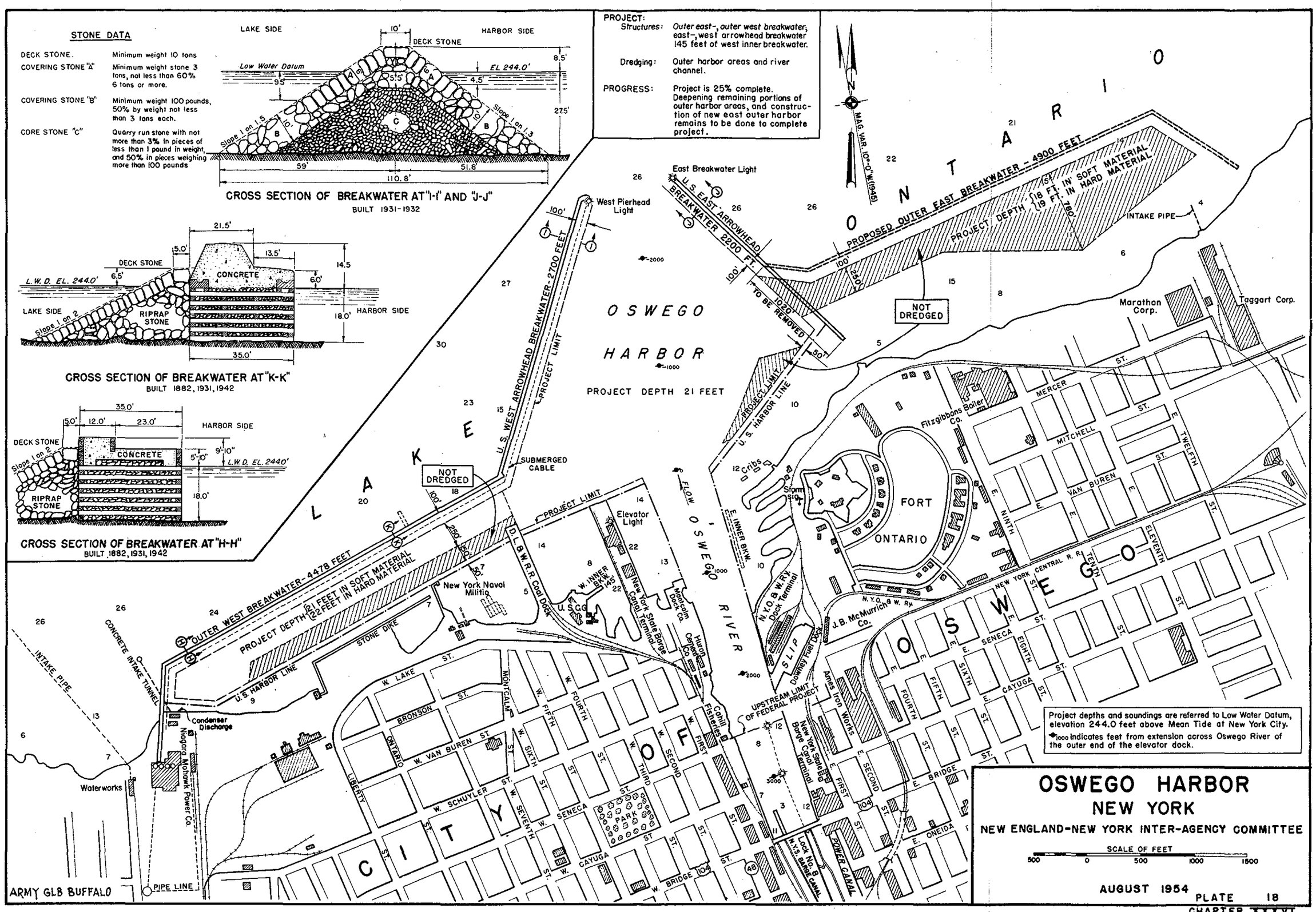
CROSS SECTION OF BREAKWATER AT "H-H"
BUILT 1882, 1931, 1942

PROJECT:

Structures: *Outer east-, outer west breakwater; east-, west arrowhead breakwater 145 feet of west inner breakwater.*

Dredging: Outer harbor areas and river channel.

PROGRESS: Project is 25% complete. Deepening remaining portions of outer harbor areas, and construction of new east outer harbor remains to be done to complete project.



Project depths and soundings are referred to Low Water Datum, elevation 244.0 feet above Mean Tide at New York City.

1000 indicates feet from extension across Oswego River of the outer end of the elevator dock.

OSWEGO HARBOR
NEW YORK

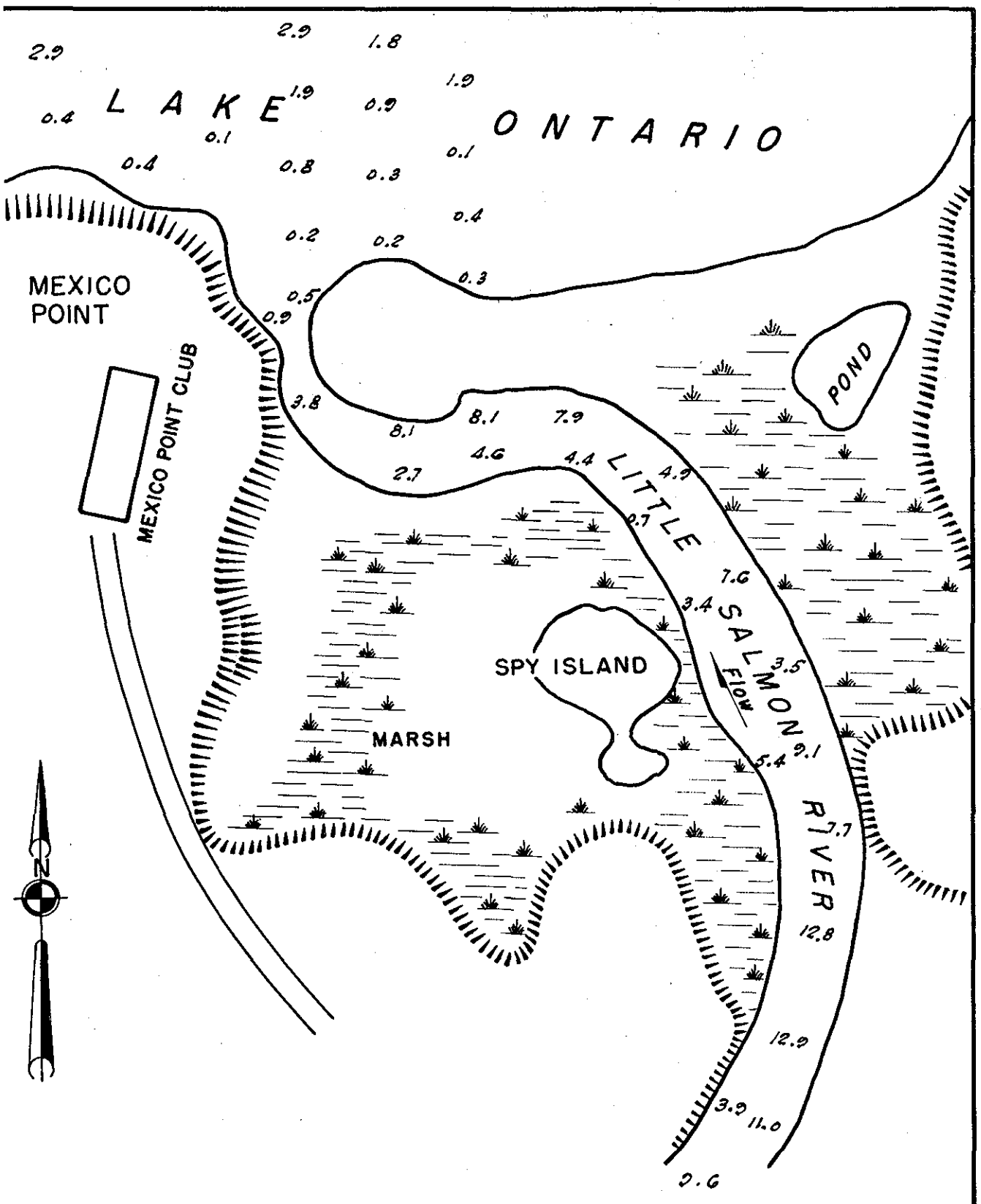
NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

SCALE OF FEET
500 0 500 1000 1500

AUGUST 1954

PLATE 18

CHAPTER XXXVI



LITTLE SALMON RIVER

NEW ENGLAND - NEW YORK INTER AGENCY COMMITTEE

SCALE OF FEET

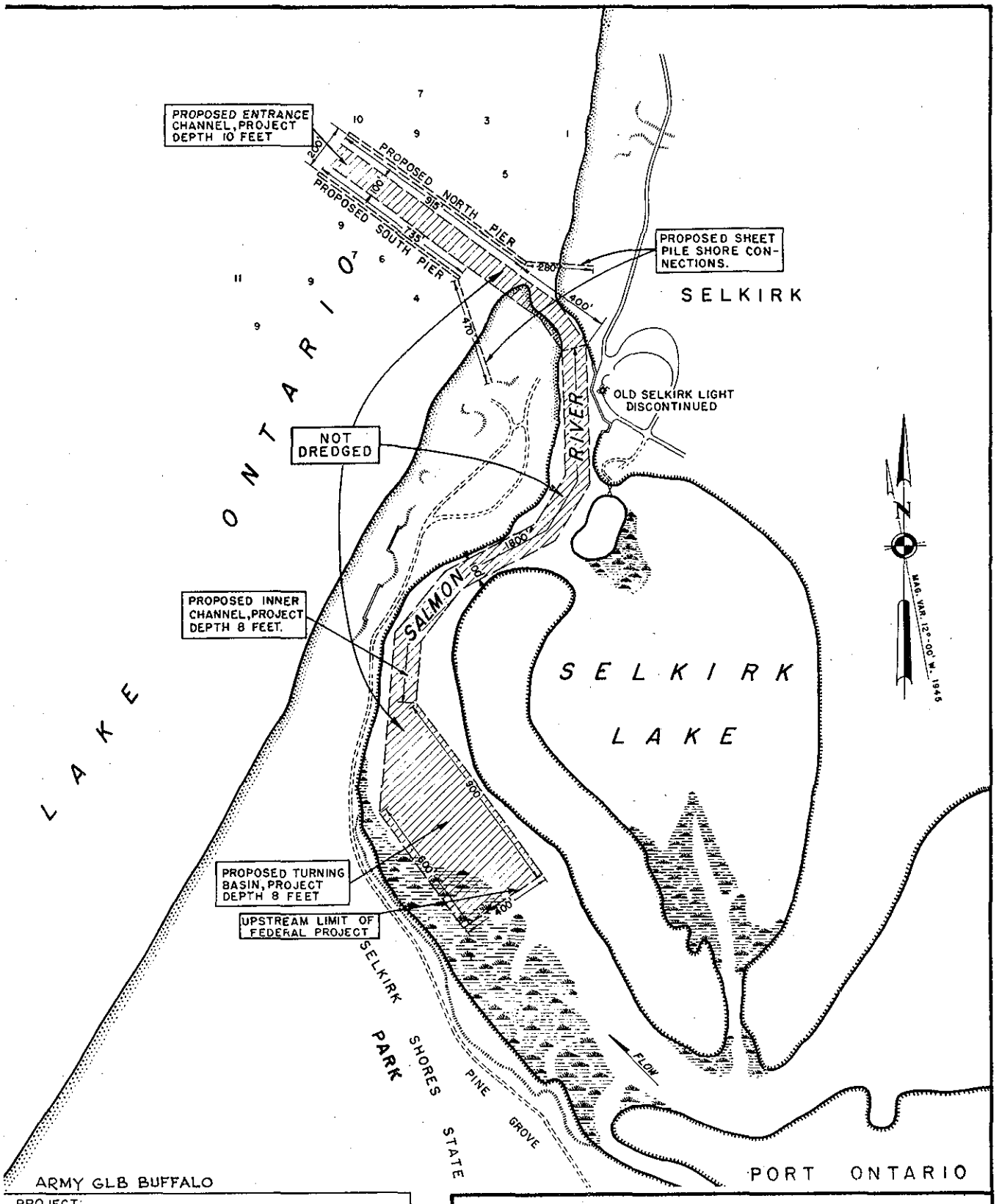
0 100 200 300 400

AUGUST 1954

ARMY GLB BUFFALO

PLATE 19

CHAPTER XXXVI



ARMY GLB BUFFALO

PROJECT:
Structures: North-, south pier, with steel sheet pile shore connections.

Dredging: Entrance-, inner channel and turning basin.

PROGRESS: No work has been done.

NOTE
Project depths and soundings are referred to Low Water Datum, elevation 244.0 feet above Mean Tide at New York City.

PORT ONTARIO HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

SCALE OF FEET
300 0 300 600 900

AUGUST 1954

PLATE 20
CHAPTER XXXVI

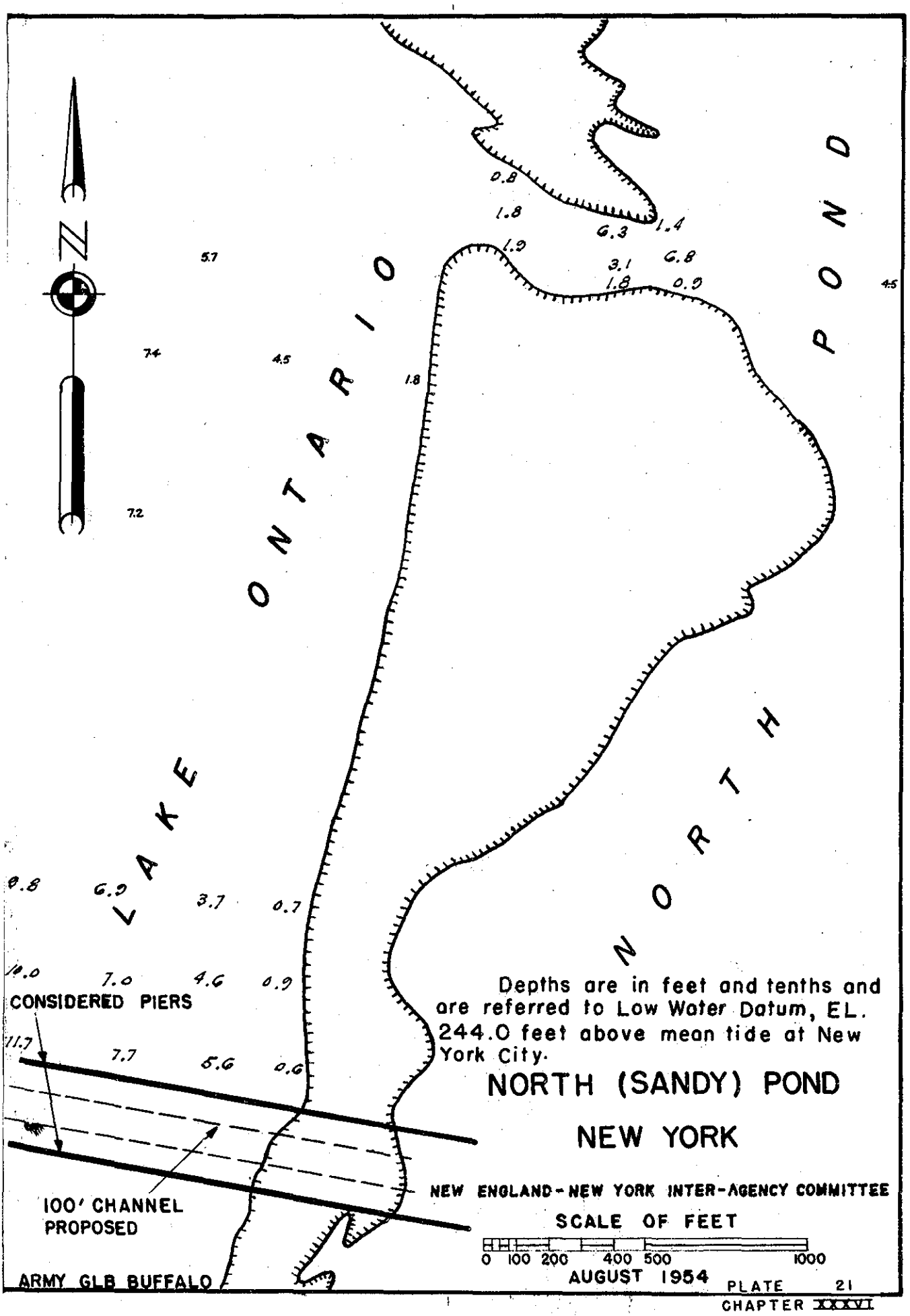
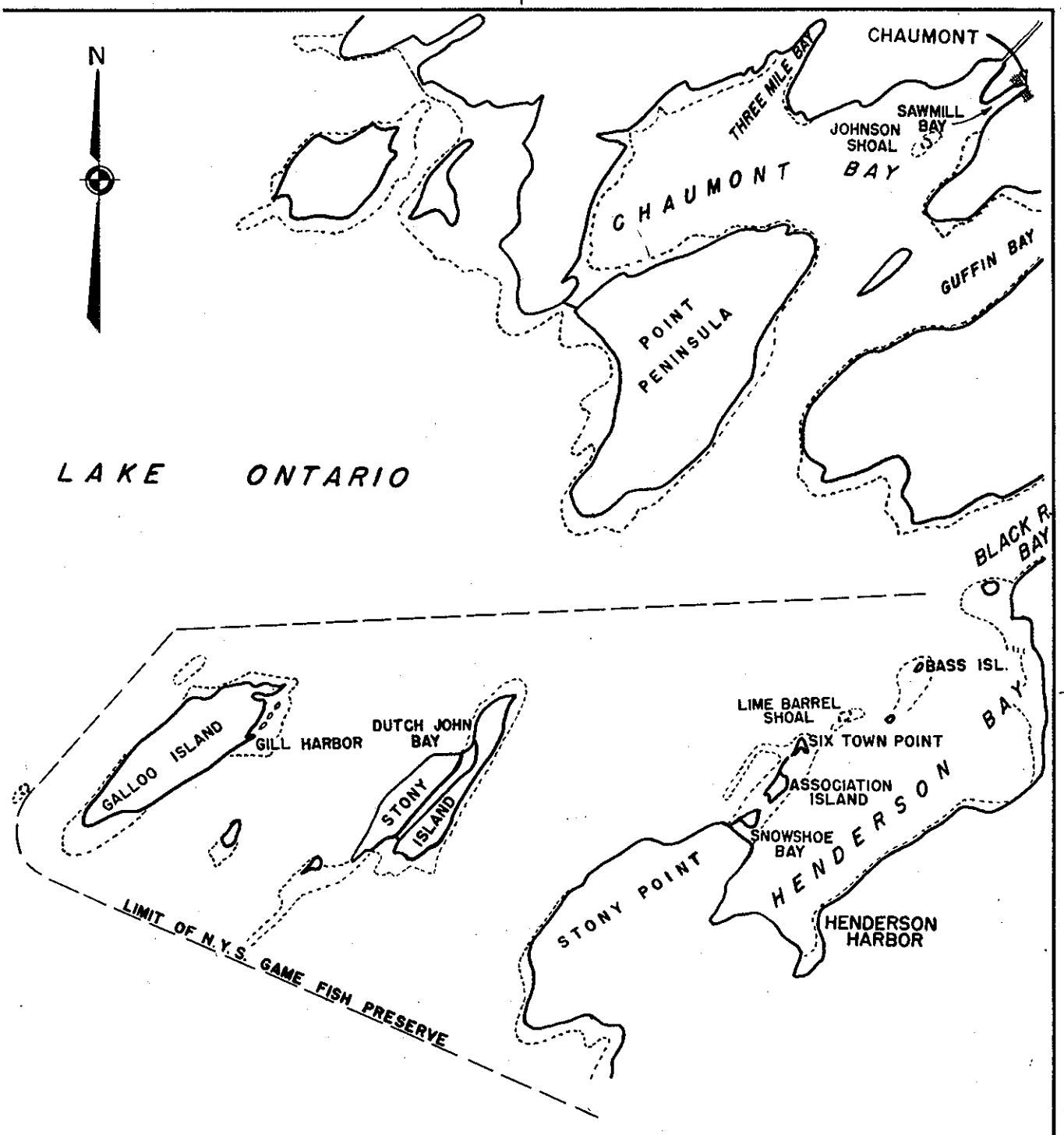


PLATE 21
CHAPTER XXXVI



HENDERSON-CHAUMONT BAY AREA
NEW YORK

NEW ENGLAND NEW YORK INTER AGENCY COMMITTEE

AUGUST 1954

SCALE OF MILES

1 1/2 0 1 2 3 4 5

ARMY GLB BUFFALO

PLATE 22

CHAPTER XXXVI

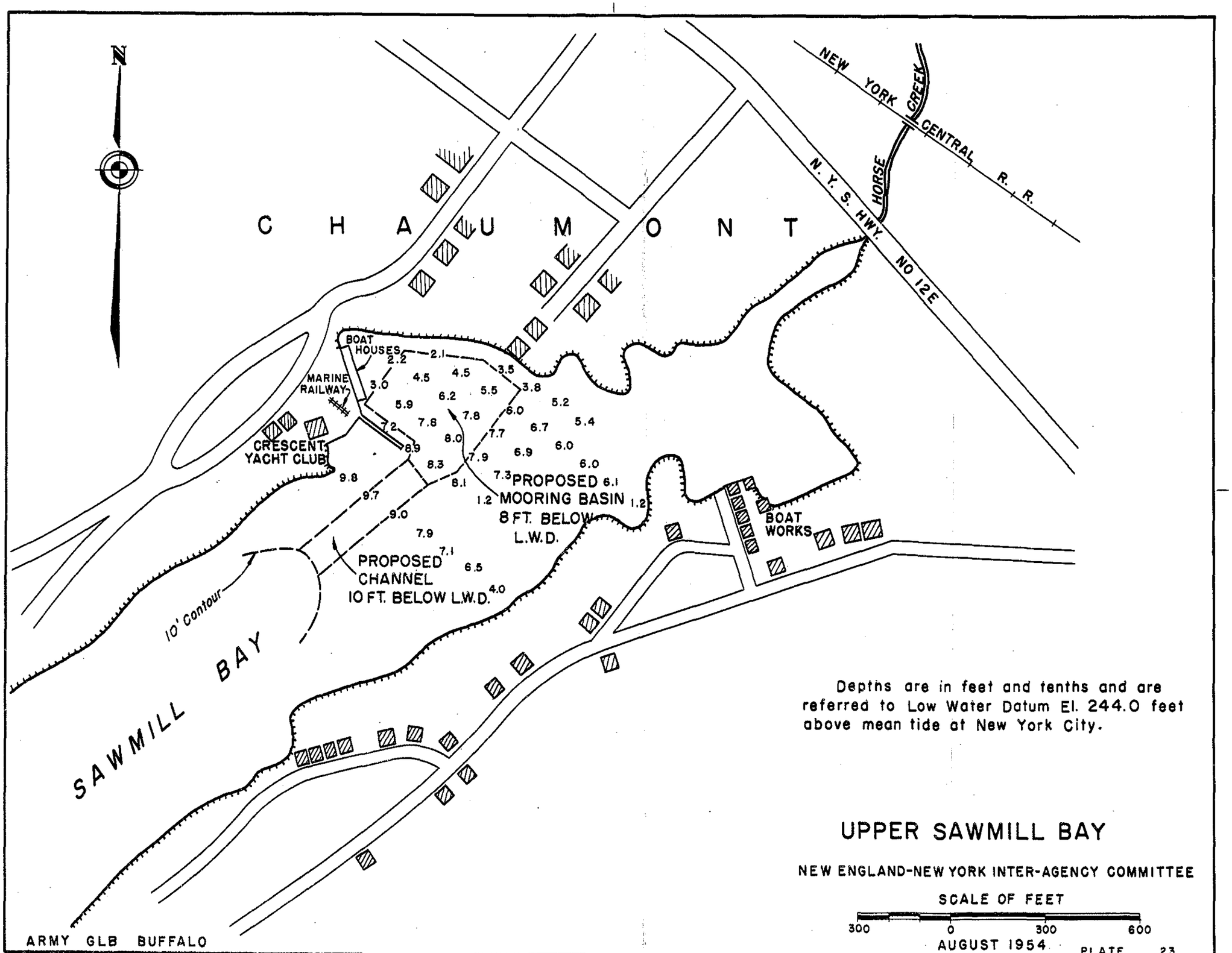
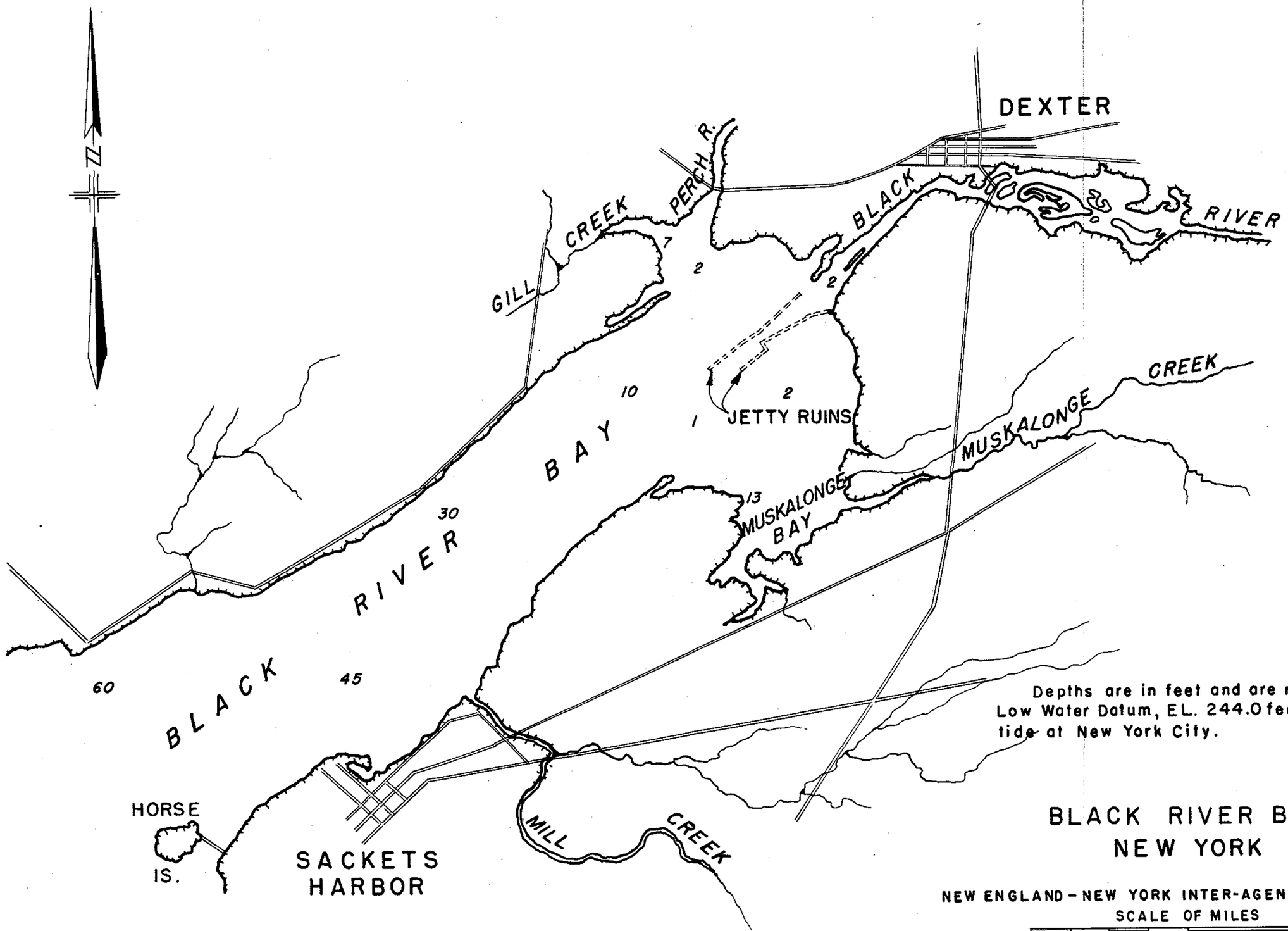


PLATE 23
CHAPTER XXXVI



Depths are in feet and are referred to Low Water Datum, EL. 244.0 feet above mean tide at New York City.

BLACK RIVER BAY NEW YORK

NEW ENGLAND - NEW YORK INTER-AGENCY COMMITTEE

SCALE OF MILES

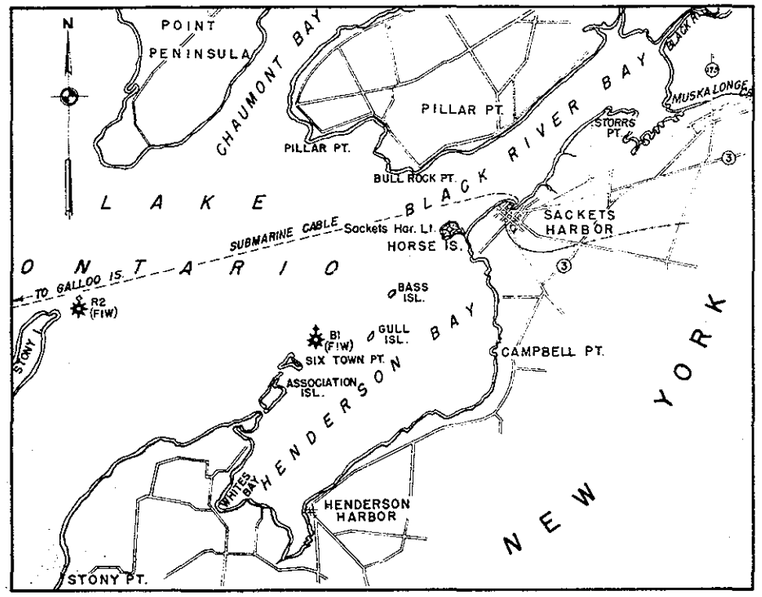
1 ½ 0 1

AUGUST 1954

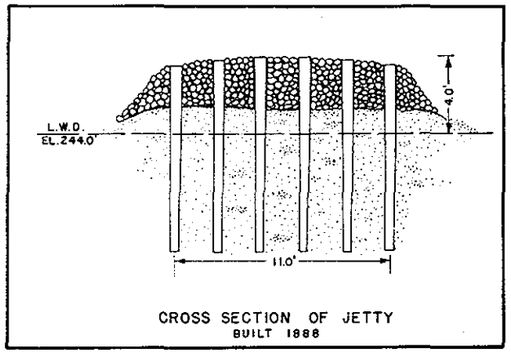
ARMY GLB BUFFALO

PLATE 24
CHAPTER XXXVI

PROJECT:
Structures: Brush and stone jetty; 2 stone groins.
Dredging: L-shaped harbor area.
PROGRESS: Project is 7% complete. Deepening project area remains to be done to complete project.
CONDITIONS: Controlling depth of harbor area is 9 feet.

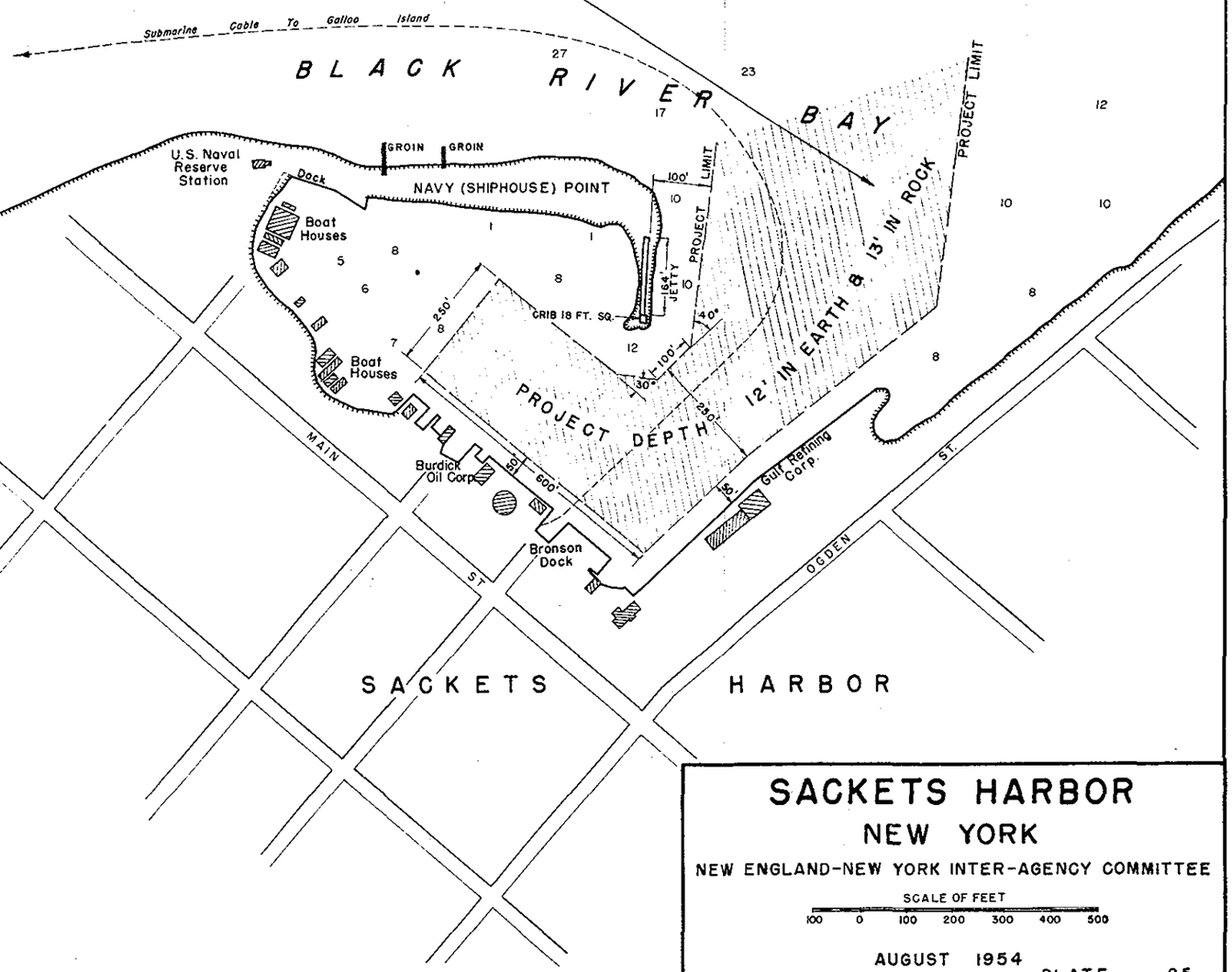


LOCALITY MAP
SCALE OF MILES
0 ½ 1 2 3 4



CROSS SECTION OF JETTY
BUILT 1888

UNDER PREVIOUS PROJECT PORTIONS OF THIS AREA WERE DREDGED TO 12 FEET EXCEPT WHERE PREVENTED BY LEDGE ROCK.



-NOTE-
Project Depths and Soundings are referred to Low Water Datum, Elevation 244.0 Feet above Mean Tide at New York City.

SACKETS HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

SCALE OF FEET
100 0 100 200 300 400 500

AUGUST 1954

ARMY GLB BUFFALO

PLATE 25
CHAPTER XXXVI

SECTION III - HARBORS AND BEACH EROSION ON LAKE ERIE AND THE NIAGARA RIVER

INTRODUCTION

1. This section is concerned with navigation and beach erosion problems on the New York State shore of Lake Erie and on the main stem of the Niagara River. Navigation and beach erosion problems on inland lakes and streams are minor and need not be considered in this section. Lake Erie and Niagara River are used extensively by both commercial and recreational navigation. The New York State shore line of Lake Erie and the shores of Grand Island in Niagara River are used extensively for recreational purposes.

2. In general, the New York shores of Lake Erie, with the exception of the shores of the cities of Buffalo and Lackawanna, are of rock and subject only to nominal erosion, although the winds from the westerly quadrant have a fetch of about 200 miles. The water front of the City of Buffalo and the larger part of the City of Lackawanna are artificially protected by sea walls and offshore breakwaters. The Niagara River shore above the Falls has suffered severe erosion from waves in several locations in the past; however, shore protection has been provided along most of the affected shore during the last few years. Below the Falls only the lower mile of shore is subject to wave action and erosion. There are only 13 public beaches in the study area, and these in general are located

in areas where there is a natural or artificial sand covering over the rock. The principal problem, insofar as beach erosion is concerned, is in connection with creating and maintaining a deeper sand covering.

3. In general, existing facilities are adequate for the needs of deep-draft navigation. Buffalo Harbor, at the east end of Lake Erie and at the head of Niagara River, and the upper 13-1/2 miles of the river, from its head at Buffalo downstream to Tonawanda Harbor, have been extensively improved to accommodate the considerable amount of existing deep-draft commercial traffic. Other Federal improvements for shallow-draft commercial vessels have been accomplished for traffic to Dunkirk Harbor and the city of Niagara Falls. The area considered in this section is also the scene of considerable small-boat activity; the traffic in both commercial fishing and recreational boating being extensive. Recreational vessels include large numbers permanently based in the area and also those visiting craft cruising between points on the Great Lakes and from points on the New York State Barge Canal which terminates at Tonawanda. Additional facilities for basing such craft and to provide safe refuge therefor, during times when adverse weather conditions prevail on the lake, are desirable.

4. This section is divided into two parts. The first part contains information on individual harbors on Lake Erie and the upper Niagara River above the Niagara Falls. Navigation aspects of

Niagara River below the Falls are discussed in Chapter XXXIV. The second part is concerned with beach erosion on the New York State shore line of Lake Erie and on the Niagara River.

NAVIGATION

5. Scope. - This part of the section presents information on individual localities along the New York State shores of Lake Erie and the Niagara River. General data on wind, water levels and fluctuations and geology are covered in the beach erosion portion of this section. Maps showing the shore characteristics and maps of individual localities accompany this part of the section.

6. Nature of traffic. - Navigation on the portion of Lake Erie under consideration consists principally of commerce to or from ports in the area. Buffalo is the major port in the area and has an extensive commerce carried by deep-draft lake freighters. Light-draft commercial traffic is sub-divided into two general classes: barge traffic principally to and from the New York State Barge Canal and fishing vessels from the western end of the area. The lake and Niagara River are popular recreational and sport-fishing regions and there are basings of recreational craft at all localities where facilities are available for their accommodation.

7. Commerce. - Commerce in the area consists principally of the receipt and shipment of bulk commodities. Deep-draft lake vessels trading to the Buffalo-Tonawanda region bring in large amounts of iron

ore, limestone, grain, and petroleum products, and smaller amounts of lumber, pulpwood, automobiles, sand and gravel, and iron and steel products. Shipments by deep-draft vessel consist principally of bituminous coal. Barge canal traffic includes petroleum products, grain and manufactured goods. Commercial fishing centers around Barcelona and Dunkirk.

8. Harbor and channel facilities required for traffic. - Lake vessels engaged in traffic to Lake Erie and the Niagara River require depths up to 25 feet. Barge traffic requires depths of about twelve feet, while commercial fishing and recreational craft are adequately served by depths of about eight feet. Harbor facilities required include wharves with adequate depths alongside, cargo-handling facilities, and in regions of considerable traffic density, protected moorings and repair facilities.

9. Localities covered by separate reports. - The following localities along the New York State shores of Lake Erie and the Niagara River are discussed.

Barcelona Harbor

Lake Erie State Park

Dunkirk Harbor

Silver Creek

Cattaraugus Creek

Grand View Bay

Sturgeon Point

Hamburg Park

Buffalo Harbor

Black Rock Channel and Tonawanda Harbor

Grand Island

Niagara Falls

10. Other localities considered. - In addition to the above-listed localities, several other localities were considered, the most important of which was Eighteen Mile Creek. Investigation showed that bedrock is encountered at shallow depths and that the creek banks are high and steep. Excavation of the necessary channel and basin, and provision of land access would be difficult and very expensive. For that reason Eighteen Mile Creek was not further considered. The navigation aspects of the lower Niagara River are discussed in Chapter XXXIV, Small Streams Tributary to Lake Ontario, since that reach of the river has no direct relation, navigationwise, with the river above the falls and Lake Erie.

11. Survey report for navigation on south shore of Lake Erie. - The River and Harbor Act approved 2 March 1945 authorized a preliminary examination and survey of the south shore of Lake Erie for harbors and and harbors of refuge for light-draft craft. Under this authority, a preliminary examination report dated 19 July 1946 was prepared by

Special Board of Engineers comprised of the District Engineer, Detroit, Michigan, and the District Engineer, Buffalo, New York. The report recommended surveys at thirty-three localities on Lake Erie to determine the advisability of improvement by the United States for the benefit of light-draft navigation. In the preliminary examination, the reporting officers did not evaluate benefits for each specific locality at which small-boat improvements were considered feasible. It was estimated that the benefits which would accrue from construction of facilities at each of the localities selected as links in a chain of small-boat harbors and harbors of refuge on Lake Erie, would result in an overall ratio of benefits to costs of about 1.53 to 1.0. After consideration of the board's report, the Chief of Engineers authorized preparation of a survey report to cover the thirty-three localities. In New York State the following localities were included in these recommended for survey:

Lake Erie State Park

Dunkirk Harbor

Silver Creek

Cattaraugus Creek

Sturgeon Point

Hamburg Park

Buffalo Harbor

Field surveys have been completed at a number of these localities, but due to lack of funds, no further progress has been made on the

authorized survey report. Recreational boating in the area is expanding and there is need for additional harbor facilities. Expenditure of funds is warranted to complete the survey report of the south shore of Lake Erie for harbors and harbors of refuge for light-draft craft.

BARCELONA HARBOR, NEW YORK

12. Location. - Barcelona Harbor is located in Chautauqua County on the south shore of Lake Erie about 28 miles northeasterly of Erie, Pennsylvania, and 17 miles southwesterly of Dunkirk, New York, which are the nearest improved harbors. See Plate No. 29 and U. S. Lake Survey Charts Nos. 3 and 32.

13. Description of harbor and improvements. - Barcelona Harbor is a small indentation in the south shore of Lake Erie with a headland on the west projecting about 750 feet into the lake, and affording some natural protection against storms from west through south to northeast. The existing harbor contains several mooring cribs used by local fishing craft for mooring prior to lightering cargoes to shore. There are no bridges crossing any portion of the waterway under consideration.

14. The area tributary to Barcelona Harbor is the town of Westfield which includes the small unincorporated village of Barcelona, and the village of Westfield which is about one mile southwesterly

from Barcelona. According to 1950 census figures, the population of the town of Westfield is 5,001, and that of the village of Westfield is 3,663. The area surrounding Barcelona is a rich fruit belt. The village of Westfield is a center for processing, packing and shipping of fruits and vegetables and is served by the New York Central and Nickel Plate Railroads. The village of Barcelona is on a main highway connecting with main arterial highways loading to all parts of the country.

15. Physical factors affecting navigation. - Ordinary fluctuations of water level are from 3.5 feet above to 0.5 feet below low water datum, and extreme fluctuations produced by wind and other causes are from six feet above to three feet below that plane. The depths in Barcelona Harbor are very shallow near the shore, and the fishing vessels must tie up at mooring cribs while lightering cargoes to shore. Depths increase to about 12 feet at a distance of 1,400 feet from shore. Barcelona Harbor is exposed to storms from northwest through north to northeast with fetches of approximately 44, 35, and 43 miles, respectively. Due to adverse weather and ice conditions, the average season of navigation, as referenced to the nearest adjacent port of Dunkirk, New York, is from March 31 to December 10.

16. Terminal and transfer facilities. - There are no public docks or terminal facilities at Barcelona Harbor. There are seven stone-filled timber mooring cribs, all of which are privately-owned and used exclusively by fishing vessels. With the exception of two

boat liveries, there is little in the way of recreational craft facilities.

17. Federal improvements and studies. - A previous project, for which there is little information available, was adopted by the River and Harbor Act of June 4, 1836. This project was considered as abandoned in 1858. The existing project was authorized by the River and Harbor Act, approved March 2, 1945 and provides for a harbor formed by an east and a west breakwater, 890 and 950 feet long, respectively, with an opening 200 feet wide at the outer end; an entrance channel 100 feet wide and ten feet deep, extending from deep water in the lake to a point 160 feet from the outer end of the east breakwater; and a harbor basin eight feet deep, 800 feet long, and from 100 to 350 feet wide; with such modifications as in the discretion of the Secretary of the Army and the Chief of Engineers may be desirable. The existing project is subject to certain conditions of local cooperation among which are the contribution of cash, the providing of lands, and assurances that the United States will be held free from damages due to the construction and maintenance of the works. Assurances of the required local cooperation have been received, and were approved by the Secretary of the Army on 20 December 1949. The estimate of cost for new work, revised in 1953, is $1,004,500, excluding $7,500 to be contributed by local interests, and exclusive of amounts expended on previous projects. No construction or dredging has been done on this project.

18. The latest report submitted by the Department of the Army for Barcelona Harbor was the survey report of the Coasts of the Great Lakes, Harbors of Refuge for Light-Draft Vessels, dated 11 December 1943, printed in House Document No. 446, 78th Congress, 2nd Session. This report was prepared by a Special Board of the Corps of Engineers created for the purpose of making the survey which was authorized by Section 4 of the River and Harbor Act approved 26 August 1937 and which is the basis for the authorized project at Barcelona Harbor. By authority of the Chief of Engineers the review of reports on Barcelona Harbor separately authorized by resolution of the Committee on Rivers and Harbors, House of Representatives on 24 January 1939, was combined with the above-mentioned survey report of the coasts of the Great Lakes. In the latter report the Board of Engineers recommended construction of a harbor of refuge at Barcelona and several other localities. The recommendations were concurred in by the Chief of Engineers, and the recommended projects were adopted by the River and Harbor Act of 2 March 1945.

19. Other improvements. - There are no improvements at Barcelona Harbor other than those mentioned above.

20. Commerce and harbor use. - Activities in Barcelona Harbor consist of commercial fishing and recreational movements. Commercial statistics for 1952 show that local receipts of fish received at Barcelona Harbor totaled 104 tons while round trips made by the

fishing vessels were 620. There are approximately five commercial fishing vessels and 50 outboards presently based at Barcelona Harbor.

21. Desired improvements. - The improvements generally desired by local interests include the construction of a pier extending lakeward from the peninsula, a detached east breakwater, and the dredging of an inclosed basin and the entrance channel to a depth of ten feet.

22. Conclusions. - No further consideration needs to be given to additional studies for the improvements of Barcelona Harbor, since it is already the site of an existing Federal project. Although construction of the Federal project has not yet begun, it is believed that upon completion it will provide adequately for present and reasonably prospective navigation requirements at Barcelona Harbor.

LAKE ERIE STATE PARK, NEW YORK

23. Location. - Lake Erie State Park, New York, is located in Chautauqua County on the south shore of Lake Erie about nine miles by water southwesterly of Dunkirk Harbor, New York, the nearest United States port, and about 11 miles by water northeasterly of Barcelona Harbor, New York. See Plate 30 and U. S. Lake Survey Charts No. 3 and 32.

24. Description of harbor and improvements. - Lake Erie State Park consists of 240 acres of land with facilities for bathing, picnicking, and camping. A concrete decked, stone-filled timber-crib pier extends 130 feet into the lake. Access to the lake is provided over park roads. Two small unnamed streams about ten feet wide at their mouths, and with normal depths of 1/2-foot, empty into the lake in the vicinity. The stream beds are shale thinly overlaid with gravel. Lakeward the bottom slopes gradually to a depth of ten feet about 1,000 feet offshore. No bridges cross that portion of the waterway under consideration.

25. The area immediately tributary to Lake Erie State Park is predominantly agricultural consisting of the town of Portland and a portion of the town of Pomfret. The village of Brocton, the principal trading center of the immediate tributary area is located 2.5 miles southwesterly of Lake Erie State Park. The 1950 population of the town of Portland was 3,339, including 1,380 in the village of Brocton. Park visitors are predominantly from western New York.

The New York Central and Nickel Plate Railroads and numerous improved highways serve the area.

26. Physical factors affecting navigation. - The reach of shore line in this area is exposed to effects of storms from southwest through north to northeast, the maximum fetch being about 170 miles from the southwest. There is no shelter for any craft at Lake Erie State Park and depths at the existing pier allow only very shallow-draft vessels such as small outboards to tie up there. There is no adequate shelter in the reach of shoreline between Erie Harbor and Dunkirk Harbor so that light-draft vessel traffic in this area is very limited. Due to adverse weather and ice conditions the average season of navigation, as referenced to the nearest adjacent port of Dunkirk, New York, is from 1 April to 10 December. The normal season for recreational boating is from about 30 May to 30 September. Ordinary fluctuations of water levels are from 3.5 feet above to 0.5 feet below low water datum, and extreme fluctuations produced by wind and other causes are from six feet above to three feet below that plane.

27. Terminal and transfer facilities. - There are no terminal or transfer facilities at Lake Erie State Park. The only existing facility is the concrete decked, stone-filled timber crib pier extending about 130 feet into the lake as mentioned previously.

28. Federal improvements and studies. - There are no existing Federal improvements or projects at Lake Erie State Park. The

only report submitted by the Department of the Army concerning Lake Erie State Park was the Preliminary Examination Report of Shores of Lake Erie for Harbors and Harbors of Refuge for Light-Draft Vessels, dated 19 July 1946. The plan of improvement considered therein would result in a harbor of refuge for light-draft craft, and would include construction of a rubble-mound breakwater 1,675 feet long and ten feet high; dredging an entrance channel 100 feet wide and ten feet deep to the end of the breakwater, thence flaring to 200 feet wide at the 10-foot depth contour in the lake, an inner channel generally 100 feet wide, eight feet deep and about 800 feet long, and a mooring area for transient craft approximately 200 by 200 ft. and eight feet deep; and construction of 300 feet of timber crib bulkhead five feet high to serve as a public dock. The work would be accomplished by extending the existing pier lakeward in a north by northwest direction for a distance of about 750 feet, thence, about 725 feet in a northeast direction with a return arm at the end about 200 feet long in a southeast direction. The inner channel and mooring basins would be dredged in the sheltered area afforded thereby. The initial cost of the improvement, based on August 1946 price levels, was estimated to be $1,051,000. In accordance with the recommendations of the reporting officers, preparation of a report of survey scope, to include Lake Erie State Park, has been authorized by the Chief of Engineers.

29. Other improvements. - The only improvement at Lake Erie State Park is the 130-foot pier which serves as a groin for the

building of the bathing beach, but which is occasionally used by very shallow-draft vessels of the outboard type.

30. Commerce and harbor use. - There is no commercial fishing or commerce of any other type at Lake Erie State Park. Light-draft vessel activity is limited to a few outboards owned by summer residents of the community and other small craft which tie up occasionally at the existing pier.

31. Improvements desired. - Although no specific improvements at Lake Erie State Park were requested by local interests, area yachting interests, in general, made strong representations for a chain of harbors and harbors of refuge for light-draft craft on Lake Erie.

32. Conclusions. - In the reach of shore line on Lake Erie between Barcelona and Dunkirk Harbors, a distance of 19 miles, there are no small-boat harbors or harbors of refuge for light-draft vessels. Since Lake Erie State Park is located about halfway between the existing harbors, it is advantageously situated for this purpose. A study should be made to determine the feasibility of developing a harbor for light-draft vessels at Lake Erie State Park.

DUNKIRK HARBOR, NEW YORK

33. Location. - Dunkirk Harbor is located on the south shore of Lake Erie about 37 miles southwesterly by winter from Buffalo, New York, the nearest developed United States harbor, and 45 miles northeasterly by water from Erie, Pennsylvania. Barcelona Harbor, New York, is located 17 miles southwesterly. See Plate 31 and U. S. Lake Survey Charts No. 3 and 32.

34. Description of harbor and improvements. - Dunkirk Harbor is an indentation in the shore of Lake Erie between Battery Point on the east and Point Gratoit on the west. These two points are 9,600 feet apart and the indentation within the headlands is about 3,600 feet. The protected area of the harbor consists of about 60 acres. Harbor improvements, other than the existing Federal project which is complete and which is described in subsequent paragraphs, include a yacht club dock located approximately 1,200 feet west of the city dock, a rock dike, 800 feet long, protecting the yacht club mooring area, and a boat yard with a small marine railway in the southwest corner of the harbor.

35. The area tributary to Dunkirk comprises Chautauqua County with a population of 135,189 in 1950. Jamestown and Dunkirk are the major cities in the county with populations of 43,354 and 18,007, respectively. There are many industries manufacturing various products and food stuffs in the city of Dunkirk. Principal products manufactured are tool steel, steel wire, garden implements, locomotive parts, oil refinery equipment, radiators, boilers, glass products, engines and motors, sanitary receptacles, silk products

and processing of seeds. In addition to manufacturing, there is a large steam-electric generating station and a considerable fishing industry within the community. In the city of Jamestown, New York, located 30 miles south of Dunkirk Harbor, there are over 65 industrial plants which manufacture a variety of products, including washing machines, automobile radiators, tools, metal office equipment, metal kitchen equipment, metal casings, castings, tooling machines, electrical products, wooden furniture of all types, doors, and windows. The neighboring villages of Fredonia, Brocton, and Westfield, near Dunkirk, are primarily engaged in the processing of grapes, other fruits, and vegetables. The adjacent rural area is primarily agricultural, grape and fruit culture being the principal activity. Dunkirk is served by the Erie, the New York Central, the Pennsylvania, and the New York, Chicago and St. Louis Railroads. Dunkirk is also served by adequate truck highways.

36. Physical factors affecting navigation. - The controlling depth within the dredged portion of the harbor is 16 feet. In the entrance channel lakeward of the pierhead the easterly half has a controlling depth of 16 feet, while the westerly half is badly shoaled with depths as low as 5 feet. Depths in the undredged part of the harbor vary from 14 feet to one foot, with depths alongside the city dock also varying from 14 feet to one foot. Ordinary fluctuations of water level are from 3.5 feet above to 0.5 feet below low water datum, and extreme fluctuations produced by winds

and other causes are from six feet above to three feet below that plane. The entrance channel is exposed from west through north to northeast, westerly storms with a fetch of 120 miles being most frequent. The harbor area is unprotected from the northeast except for shoals which tend to give some protection. The rock dike provides protection to pleasure craft in the yacht club mooring area. There are no bridges across any portion of the harbor. Due to adverse weather and ice conditions, the average season of navigation at Dunkirk for a deep-draft navigation is from 31 March to 10 December. The navigation season for light-draft commercial fishing craft is from about 15 March to 15 December, and for recreation craft from about 30 May to 30 September.

37. Terminal and transfer facilities. - There is a city dock about 750 feet long located at the foot of Central Avenue. Four railroad tracks owned by the Erie Railroad run the full length of the dock and connect to all railroads passing through the city. A 25-ton locomotive crane is permanently stationed at the locality for transferring cargo. The dock is open to all on equal terms. The Dunkirk Yacht Club dock is for pleasure craft and is limited to members only. This dock is about 150 feet long and provides accommodation for mooring about 28 shallow draft vessels. There are no other permanent facilities for mooring although some commercial fishing vessels utilize ruins of the old piers east of the city dock.

There are mooring buoys and mooring space available for pleasure craft. There is a small floating boat landing and a small marine railway in the southwest corner of the harbor.

38. Federal improvements and studies. - Dunkirk Harbor in its original condition was an indentation in the south shore line of Lake Erie with natural depths of about ten feet. Bedrock, covered with sand and clay, occurred at depths of 15 to 16 feet. The original project was adopted by the River and Harbor Act approved 2 March 1827, and was modified by the River and Harbor Act approved 2 March 1867. This provided for a west pier, a detached breakwater, and an entrance channel 13 feet deep. The project was progressively modified to provide for repair and extension of the pier and breakwater, deepening of the entrance channel, and modification of the area to be dredged within the harbor by River and Harbor Acts approved 3 June 1896, 25 June 1910, and 30 June 1948.

39. The existing project provides for an outer entrance channel with depths of 17 feet in earth and 18 feet in rock, with a least width of 190 feet just inside the harbor structures flaring to a width of 320 feet about 600 feet lakeward thereof and extending to deep water; an inner entrance channel and basin to a depth of 16 feet, the channel limit to be a prolongation landward of the west limit of the outer entrance channel to a point about 635 feet landward of the center line of the west pier, thence extending to a point about 200 feet west of the west face of the city dock on a line parallel

to and 25 feet south of the outer end of the city dock, thence, extending eastward to a point about 420 feet east of the east face of the city dock, thence northerly about 270 feet meeting a line parallel to and 50 feet from the channel arm of the east breakwater; removal of a rock shoal on the west side of the inner entrance channel to a depth of 17 feet; for a pier 1,410 feet in length to the west of the entrance channel extending to shore, 1,037 feet of timber cribs with concrete superstructure, 15-1/2 feet with stone super-structure, and 357-1/2 feet of the shore end not maintained; and for a detached breakwater extending eastward from the entrance channel 2,814 feet in length, 987 feet of timber cribs with concrete super-structure, and 1,827 feet with stone super-structure. Construction of the existing project was subject to the conditions that local interests give assurances satisfactory to the Secretary of the Army that they would hold and save the United States free from damages due to the work and subsequent maintenance, and provide adequate facilities for the transfer of pulp wood at the city dock. Assurances were received and approved. All prior conditions have also been complied with. The existing project was completed in 1951. The total cost for the existing project was $1,113,362.72 including $695,188.62 for maintenance.

40. The latest report regarding deep-draft navigation improvements to Dunkirk Harbor submitted by the Department of the Army was

a Review of Reports on Dunkirk Harbor dated 15 November 1946. This report was submitted by the District Engineer, Buffalo, New York, in accordance with a resolution adopted 18 September 1945 by the Committee on Rivers and Harbors of the House of Representatives. Local interests desired deepening to 19 feet in the outer entrance channel and to 18 feet in the inner harbor; however, the Chief of Engineers recommended that the then existing project be modified to provide a depth of 17 feet in earthand 18 feet in rock in the outer entrance channel and a depth of 16 feet in the inner entrance channel, so arranged that the bend in the entrance channel would be moved lakeward about 635 feet. He also recommended removal of a hazardous rock shoal then located along what is now the westward channel edge. First cost was estimated to be $309,000 which would have entailed annual costs of about $12,000. Annual benefits were estimated as $16,500. The recommended work was authorized by the River and Harbor Act of 30 June 1948 and completed in 1951.

41. The latest report, noted above, was concerned only with improvements in the interest of deep-draft commercial navigation. The recreational boating aspects of the locality are covered in detail in the Preliminary Examination Report on Shores of Lake Erie for Harbors and Harbors of Refuge for Light-Draft Vessels, dated 19 July 1946. The plan developed contemplates a pier-protected basin located adjacent to and west of the city dock and construction of a double-row steel sheet pile breakwater 1,070 feet long capped

with a concrete spray wall to a total height of eight feet; dredging a channel 100 feet wide, eight feet deep and about 550 feet long from the harbor area into the basin, a mooring area for transient craft approximately 200 by 250 feet and eight feet deep; and removal of loose rock shoal and old piling. The initial cost of the improvement, based on 1946 price levels, was estimated to be $343,000. This plan would require certain modifications in view of subsequent improvements by local interests. In accordance with the recommendations of the reporting officers, preparation of a survey scope report, to include Dunkirk Harbor, has been authorized by the Chief of Engineers.

42. Other improvements. - Other improvements in Dunkirk Harbor consist of the previously mentioned city dock and sheet pile retaining wall along the south side of the harbor; the yacht club dock; a small rock dike built by the city within the limits of the main harbor; and the privately owned marine railway. The rock dike constructed by the city encroaches slightly on the area considered for construction of a small-boat basin in accordance with the plan proposed by the Special Board of Engineers, as described in paragraph 41.

43. Commerce and harbor use. - Activities in Dunkirk Harbor include commercial, fishing, and recreational movements. Commercial statistics for 1952 show that total commerce at Dunkirk Harbor amounted to 14,900 tons, of which 3,500 tons were lakewise receipts of sand,

gravel, and rock, and 200 tons were local fish receipts. There was a total of 1,281 round trips made by steamers and motor vessels with a net registered tonnage of 18,140 tons and having drafts up to 19 feet. There are approximately ten commercial fishing boats and 50 pleasure craft, exclusive of outboards, presently based at Dunkirk Harbor.

44. Desired improvements. - During a field investigation by the Special Board of District Engineers, local interests pointed out that protection of some type was required west of the municipal pier in order to render that area safe for light-draft vessels during westerly and southwesterly s torms.

45. Conclusions. - The construction of a pier-protected basin west of the city dock would provide a safe refuge for light-draft vessels under all weather conditions. A study should be made to determine the feasibility of developing a harbor for light-draft vessels at Dunkirk Harbor in the light of present and prospective light-draft navigation use.

SILVER CREEK, NEW YORK

46. Location. - The village of Silver Creek, New York is located at the mouth of Silver Creek, on the south shore of Lake Erie, about 12 miles northeasterly of Dunkirk, New York, the nearest developed United States port, and about nine and 29 miles southwesterly of Grand View Bay and Buffalo, New York, respectively. See Plate 32 and U. S. Lake Survey Charts Nos. 3 and 32.

47. Description of harbor and improvements. - Silver Creek is about 150 feet wide at its mouth with a maximum depth of water of two feet. During periods of low water a bar forms across the creek mouth reducing its width to 30 feet. The creek is crossed by two fixed railroad bridges about 600 and 750 feet from the mouth having vertical clearances of 25 and 35 feet and clear spans of 60 and 50 feet, respectively. A highway bridge also crosses the creek about one-half mile above the mouth, having two 30-foot spans and a vertical clearance of 30 feet. The bay into which the creek flows has a maximum width of 3,300 feet between headlands narrowing to about 2,100 feet at its head in a distance of about 900 feet. The lowlands area through which the creek flows for its lower 600 feet is occupied by small summer cottages and a fish and game club. There are no public improvements for the accommodation of small craft.

48. The tributary area consists of the towns of Hanover and Sheridan in Chautauqua County, New York with populations of 6,375 and 2,037, respectively, and the town of Brant, in Erie County, New York,

with a population of 1,934 in 1950. The village of Silver Creek, located in the town of Hanover with a 1950 population of 3,068, is the principal trading center of the area and has two canneries and seven small manufacturing plants. General farming and fruit growing are the principal occupations carried on in the tributary area, with the exception of the immediate lake shore, which is devoted to catering to summer residents. The village of Silver Creek is served by the New York Central, Nickel Plate, and Pennsylvania Railroads, and by adequate trunk highways leading to all parts of the country.

49. Physical factors affecting navigation. - The shallow depths and shale bottom in the mouth of Silver Creek preclude its use for all except very shallow-draft vessels of the outboard type. The bay at the mouth of Silver Creek has adequate depths for recreational and all fishing craft but does not provide adequate protection from storms under existing conditions, being exposed to storms from the north through northeast. The maximum fetch is about 27 miles from the northeast. Ordinary fluctuations of water level are from 3.5 feet above to 0.5 feet below low water datum and extreme fluctuations produced by wind and other causes are from six feet above to three feet below that plane. Due to adverse weather and ice conditions, the average navigation season on Lake Erie for light-draft commercial fishing craft is from about 15 March to 15 December, and for recreational craft from about 30 May to 30 September.

50. Terminal and transfer facilities. - The facilities at Silver Creek consist of six boat liveries and a boating club, having portable

rail ramps, trailers, temporary docks, and one aerial tramway. One boat livery has an open concrete storage area about 100 feet square. There are no public improvements or commercial terminal or transfer facilities in Silver Creek.

51. Federal improvements and studies. - There is no existing Federal improvement at Silver Creek. The only report submitted by the Department of the Army for Silver Creek was the Preliminary Examination Report of Shore of Lake Erie for Harbors and Harbors of Refuge for Light-Draft Vessels, dated 19 July 1946. This report considered the cove in the lake shore at the mouth of Silver Creek as a feasible alternative site to Cattaraugus Creek where specific requests for improvements for light-draft vessels have been made.

52. The considered improvement which would result in a harbor of refuge for light-draft craft includes construction of two rubble-mound breakwaters, 850 feet long and ten feet high, and 400 feet long and eight feet high; dredging an entrance channel 100 feet wide and ten feet deep, thence flaring to 200 feet wide at the 10-foot depth contour in the lake, a distance of about 700 feet; a turning basin and inner channel approximately 150 feet wide by 600 feet long and eight feet deep, and a mooring area for transient craft approximately 200 by 250 feet and eight feet deep; and construction of 150 feet of cellular steel sheet pile bulkhead five feet high and filling landward thereof to serve as a public dock. The initial cost of the improvement based on 1946 price levels was estimated to be $582,000. On the

basis of the above examination the special board considered that the inclusion of Silver Creek in a comprehensive survey was warranted and preparation of a report of survey scope to determine the feasibility of small-boat projects at the localities selected has been authorized by the Chief of Engineers.

53. Other improvements. - The only improvements in Silver Creek are the boat livery and boating club facilities mentioned previously.

54. Commerce and harbor use. - Commercial navigation is non-existent at Silver Creek, navigation activities being limited to recreational craft only. Approximately 260 pleasure craft (exclusive of outboards) are based in the immediate area, most of these being based in nearby Cattaraugus Creek.

55. Desired improvements. - Although no specific requests were made for improvements for light-draft vessels at Silver Creek, yachting interests, in general, made strong representations for a chain of harbors for light-draft craft on Lake Erie.

56. Conclusions. - Of the sites investigated in the reach of shoreline between Dunkirk and Buffalo, Silver Creek is considered a feasible alternate site to Cattaraugus Creek which is about 2.5 miles by water northeasterly therefrom and where specific requests for improvements for light-draft vessels have been made. Present and prospective light-draft recreational craft navigation on Lake Erie and particularly along the lake shore from Dunkirk to Buffalo warrants expenditure of funds to determine the feasibility of developing a harbor for light-draft vessels at Silver Creek as a part of the survey of the south shore of Lake Erie.

CATTARAUGUS CREEK, NEW YORK

57. Location. - The mouth of Cattaraugus Creek, New York, is located on the south shore of Lake Erie, about 1¼ miles northeasterly from Dunkirk, New York, the nearest developed United States port, and 27 miles southwesterly from Buffalo, New York. See Plate 33 and U. S. Lake Survey Charts Nos. 3 and 32.

58. Description of harbor and improvements. - Cattaraugus Creek has widths varying from 200 to 300 feet and has depths ranging to ten feet. About 3,600 feet upstream from its mouth, the creek is separated into two channels by an island 1,500 feet long and 300 feet wide at its widest point. The easterly channel has a width of about 200 feet and a maximum depth of four feet; the westerly channel is about 100 feet wide with a maximum depth of three feet. A natural lagoon of about five acres is located at the mouth and easterly of the creek. The Cattaraugus Indian Reservation borders the right or east bank of the creek at and near its mouth and the summer colony of Sunset Bay is located between the mouth of the creek and Silver Creek to the southwest. The only navigation improvements are several temporary small-craft landings constructed by commercial fishermen and recreational craft owners. There are no bridges crossing that portion of the waterway under consideration.

59. The area tributary to Cattaraugus Creek consists of the towns of Hanover and Sheridan in Chautauqua County, New York, with population of 6,375 and 2,037, respectively, and the town of Brant

in Erie County, New York, with a population of 1,934 in 1950. The village of Silver Creek, located in the town of Hanover with a 1950 population of 3,068, is the principal trading center of the area and has two canneries and seven small manufacturing plants. General farming and fruit growing are the principal occupations carried on in the tributary area, with the exception of the immediate lake shore, which is devoted to catering to summer residents. The village of Silver Creek is served by the New York Central, Nickel Plate, and Pennsylvania Railroads, and by adequate truck highways leading to all parts of the country.

60. Physical factors affecting navigation. - At the mouth of Cattaraugus Creek, a sand and gravel bar, driven by the prevailing southwesterly winds and by the action of waves and currents along the shore, advances northerly across the mouth of the creek each year. The channel is usually closed or nearly closed by fall. The mouth of the creek is exposed to storms from southwest through west to north. The maximum fetch is about 180 miles from the southwest. Ordinary fluctuations of water level are from 3.5 feet above to 0.5 feet below low water datum and extreme fluctuations produced by wind and other causes are from six feet above to three feet below that plane. Due to adverse weather and ice conditions the average navigation season on Lake Erie for light-draft commercial fishing craft is from about 15 March to 15 December, and for recreational craft from about 30 May to 30 September.

61. Terminal and transfer facilities. - The only navigation improvements in Cattaraugus Creek consist of several small craft landings constructed by commercial fishermen and recreational craft owners. All are privately owned and their use is restricted. There are no public improvements in the creek.

62. Federal improvements and studies. - There are no existing Federal improvement projects at Cattaraugus Creek. Between 1836 and 1838 Federal funds were appropriated for harbor improvement at Cattaraugus Creek; all had been expended by 1844 and the project was considered abandoned in 1858 by Executive Document No. 16, 35th Congress, 1st Session. A preliminary examination report for a flood control project at Cattaraugus Creek was submitted to Congress, 11 July 1939, and a review report for this locality was submitted 20 December 1946. Both of these reports were unfavorable. The last report submitted by the Department of the Army for navigation improvements at the locality was contained in the Preliminary Examination Report of Shores of Lake Erie for Harbors and Harbors of Refuge for Light-Draft Vessels, dated 19 July 1946.

63. The improvements considered for Cattaraugus Creek in the latter report, would result in a harbor of refuge for light-draft craft thereat and would include construction of two steel sheet pile jetties, totaling 2,540 feet in length; dredging an entrance channel

1,500 feet long, 100 feet wide and ten feet deep to the end of the west pier thence flaring to a width of 200 feet at the 10-foot depth contour in the lake; an inner channel 1,100 feet long, 100 feet wide and eight feet deep; and an irregular-shaped mooring area for transient craft, approximately 300 by 300 feet and eight feet deep; and construction of a steel sheet pile bulkhead, 200 feet long and five feet high, to serve as a public dock. The initial cost of this considered improvement, based on 1946 price levels, was estimated to be $500,000. In accordance with the recommendations of the reporting officers, preparation of a report of survey scope has been authorized by the Chief of Engineers, which will include Cattaraugus Creek as one of the localities to be studied.

64. An additional authorization for a navigation study at Cattaraugus Creek was contained in the River and Harbor Act of 24 July 1946, and was subsequently combined with the authorization for the comprehensive survey. By resolution dated 6 January 1950, the Senate Public Works Committee authorized a review of reports of the mouth of Cattaraugus Creek to determine whether improvements thereof were advisable in connection with sedimentation and its effect on navigation and control of floods. It appears that the most effective method for alleviating the sedimentation problem thereat, which occasionally results in flooding near the mouth of the creek, would be through provision of a stabilized and deepened channel into the mouth. This would be a feature of the small-boat project, if adopted under the authorization for the comprehensive survey.

65. Other improvements. - The only improvements in Cattaraugus Creek are the privately-owned boat landings mentioned previously in this section.

66. Commerce and harbor use. - Activities in Cattaraugus Creek are concerned primarily with recreational craft. Although there is some commercial fishing, it is restricted by the unstable condition of the creek mouth caused by littoral drift and storm action. Approximately 260 pleasure craft (exclusive of outboards) are based in the area, most of these being based in Cattaraugus Creek.

67. Desired improvements. - Although local interests submitted no specific plan of improvement they made reference to previous studies calling for protective entrance piers and dredging. The Niagara Frontier Planning Board also indicated interest in a harbor of refuge in this locality in the event the authorized improvement at Grand View Bay, six miles northeasterly thereof, does not materialize.

68. Conclusions. - Cattaraugus Creek is considered a feasible alternative site to the cove in the lake shore at the mouth of Silver Creek about 2.5 miles by water southwesterly therefrom. Present and prospective light-draft recreational craft navigation at Cattaraugus Creek and along the lake shore from Dunkirk to Buffalo warrants the making of a study to determine the feasibility of developing a harbor for light-draft vessels at Cattaraugus Creek.

GRAND VIEW BAY, NEW YORK

69. Location. - Grand View Bay, New York is located in Erie County on the south shore of Lake Erie, about 21 miles southwesterly of Buffalo Harbor, New York, and 18 miles northeasterly of Dunkirk Harbor, New York, the nearest developed United States ports. It is located four miles southwesterly of Sturgeon Point, New York, which has been considered as an alternative site to Grand View Bay for possible harbor improvements in the locality. See Plate 34 and U. S. Lake Survey Charts Nos. 3 and 32.

70. Description of harbor and improvements. - Grand View is a broad bay formed by a low headland (Dibbles Point) on the west and the northerly sweep of the shore to the east. The beach at the head of the bay is about 100 feet wide, and is composed of sand, gravel and shingle. The shore is sandy and gently sloping, generally, but near the northern extreme of Dibbles Point it is rocky and rises abruptly in a 20-foot shale bluff. The bottom slopes uniformly from the shore line to the 10-foot depth contour, approximately 1,200 and 600 feet offshore at the west and east limits of the bay, respectively. A pier composed of four stone-filled timber-cribs connected by walkways that are put up and removed each year extends into the bay about 600 feet. This pier is owned by the South Shore Yacht Club. There are several other small craft landings, also privately owned. No bridges cross that portion of the locality under consideration.

71. The tributary area consists of the town of Evans with a 1950 population of 7,663. The village of Angela, with a population of 1,936 in 1950, serves as the principal trade center for the area. Angela contains several industries including a bicycle plant, a brewery equipment company, a novelty manufacturing company and a cannery; and is served by the New York Central, Nickel Plate and Pennsylvania Railroads. Grand View Bay Community, located on the bay shore, is well developed as a summer colony, containing about 700 (in 1942) residences, several health camps, a public park and picnic grounds, and facilities for outdoor sports. Evans Town Park on Grand View Bay and Bennett Beach belonging to the city of Buffalo, about 3/4-mile north are frequented by thousands of week-end visitors. There are no manufacturing plants or railroads at Grand View Bay. The community is served by improved public highways connected to the shore areas by two semi-private roads.

72. Physical factors affecting navigation. - The bay is exposed to storms from west through north with fetches of about 60 and 16 miles, respectively. Partial protection is afforded by Dibble Point on the west and by a shoal lying about 3,500 feet offshore to the northwest. The bay is shallow and has no existing facilities for mooring craft except the South Shore Yacht Club Dock which has depths along side of about two feet. Ordinary fluctuations of water level are from 3.5 feet above to 0.5 feet below low water datum and extreme fluctuations produced by wind and other causes are from 6 feet above

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to 3 feet below that plane. Due to adverse weather and ice conditions, the average navigation season on Lake Erie for light-draft commercial fishing craft is from about March 15 to December 15, and for recreational craft from about May 30 to September 30.

73. Terminal and transfer facilities. - There are no public docks or commercial terminal or transfer facilities at Grand View Bay. The only existing navigation facilities are the 600-foot dock of the South Shore Yacht Club and other privately-owned landings for small craft.

74. Federal improvements and studies. - The existing project was authorized by the River and Harbor Act approved 2 March 1945, and provides for a breakwater in Lake Erie 700 feet long, extending southwesterly from about the 10-foot contour in the lake; and a harbor basin southeasterly of the breakwater about 550 feet wide, 10 feet deep and extending from deep water in the lake to a line about 450 feet from the outer end of the breakwater; with such modifications as in the discretion of the Secretary of the Army and the Chief of Engineers may be desirable. The estimate of cost for new work revised in 1953 is $405,700, excluding $79,300 to be contributed by local interests. The estimate for annual cost of maintenance, made in 1945, is $3,300. Construction of the existing project is subject to certain conditions of local cooperation among which are the contribution of cash, the providing of lands, and assurances that the United States will be held free from damages due to construction and maintenance

of the works. No assurances of the required local cooperation have been received. No work has been done on the construction of the existing project.

75. The latest report submitted by the Department of the Army for Grand View Bay, upon which the authorization for the existing project is based, was the Survey Report of the Coasts of the Great Lakes for Harbors of Refuge for Light-Draft Vessels, dated 11 December 1943, (printed in House Document No. 446, 78th Congress, 2nd Session) submitted by a special board of Corps of Engineers created for the purpose of making the survey which was authorized by Section 4 of the River and Harbor Act approved August 27, 1937. It was recommended by the Special board and concurred in by the Chief of Engineers that a harbor of refuge be developed at Grand View Bay to afford shelter to light-draft vessels cruising adjacent waters which are at times caught in unexpected storms and forced to seek refuge for the preservation of vessel and safety of crew and passengers.

76. Other improvements. - The only improvements at Grand View Bay are the privately-owned, 600-foot pier and several small craft landings mentioned previously.

77. Commerce and harbor use. - There is no commerce or commercial fishing at Grand View Bay. The only harbor activity consists of recreational craft movements. Approximately 150 outboard motor boats are

based in the Grand View Bay area, the number of other types of small craft being limited by the lack of facilities.

78. Desired improvements. - There were no specific requests for improvement at Grand View Bay, although South Shore Yacht Club members and local sportsmen requested establishment of a harbor of refuge there. Subsequently, the Niagara Frontier Planning Board and sportsmen from the Buffalo area also expressed their interest in the improvement of Grand View Bay.

79. Conclusions. - The scope of improvement now authorized at Grand View Bay is the minimum required for the intended purpose. The extent of local cooperation required is also the minimum amount that could be assigned to local interests for a small-boat project at the locality. It is very unlikely that additional studies would result in a decrease in mandatory local cooperation, the existing amount of which has thus far precluded construction of the authorized improvement. Therefore, no further consideration need be given to improvement at Grand View Bay, other than in connection with the existing Federal project authorized thereat.

STURGEON POINT, NEW YORK

80. Sturgeon Point, New York, is located in Erie County, on the south shore of Lake Erie about 17 miles southwesterly of Buffalo Harbor and 22 miles northeasterly of Dunkirk Harbor, the nearest developed United States ports. It is about four miles northeasterly

of Grand View Bay at which a Federal project is authorized but as yet not constructed. See Plate 35 and U. S. Lake Survey Charts Nos. 3, 31 and 32.

81. Description of harbor and improvements. - Sturgeon Point is a low headland extending about 100 feet into the lake forming a narrow bay to the east. Beaches in the vicinity are generally sand, gravel, and shingle, terminating landward at the foot of banks which rise to a maximum height of about 20 feet. The beaches vary in width from 50 to 150 feet. Local interests have developed the locality as a recreation center. The facilities provided include a bath house, refreshment stand, boat livery, parking and service facilities for automobiles, and a 350-foot "L" shaped pier which affords shelter for light-draft vessels.

82. The town of Evans, which may be considered as the area tributary to Sturgeon Point, had a 1950 population of 7,663. The village of Angela, with a population of 1,936 in 1950, is the principal trading center of the tributary area and is located about four miles south of Sturgeon Point. Several small manufacturing plants are located in Angela and the village is served by the New York Central, Nickel Plate, and Pennsylvania Railroads. Sturgeon Point is accessible to within 500 feet by public roads, but an extension thereof to the beach is privately owned and restricted. No bridges cross that portion of the locality under consideration.

83. Physical factors affecting navigation. - Sturgeon Point is exposed to storms from southwest through north to northeast, the maximum fetch being about 205 miles from the west by southwest. The protected area at Sturgeon Point is exposed to storms from north through northeast with fetches of approximately 12 and 14 miles, respectively. This protected area is shallow but affords good protection and docking facilities for outboards and other very shallow draft boats. Depths of 12 feet are reached about 1,200 feet offshore; however, depths in some parts of the existing harbor have been reduced to 1 foot or less by wind-blown sand and litteral drift. Ordinary fluctuations of water levels are from 3.5 feet above to 0.5 feet below low water datum and extreme fluctuations produced by wind and other causes are from 6 feet above to 3 feet below that plane. Due to adverse weather and ice conditions, the average season of navigation, as referenced to the port of Buffalo, New York, is from 11 April to 23 December; however, the season for recreational craft on Lake Erie is from about 30 May to 30 September.

84. Terminal and transfer facilities. - There are no public docks or commercial terminal or transfer facilities at Sturgeon Point.

85. Federal improvements and studies. - There is no existing Federal project for harbor improvement at this locality. The latest report submitted by the Department of the Army for Sturgeon Point was the Preliminary Examination Report of Shores of Lake Erie for Harbors and Harbors of Refuge for Light-Draft Vessels, dated 19 July 1946.

That report considers Sturgeon Point as an alternative site for harbor improvement to the authorized, but as yet unconstructed, harbor of refuge at Grand View Bay. The general features of the considered plan of improvement, which would result in a harbor of refuge for light-draft craft at Sturgeon Point, include construction of two cellular steel sheet pile breakwaters totaling 1,100 feet in length and 10 feet high; dredging an entrance channel about 150 feet long, and an irregular-shaped turning basin and mooring area, for transient craft approximately 200 by 500 feet and 8 feet deep. The work would be accomplished by extending the existing pier about 200 feet lakeward in a north by northeast direction; raising the existing portion of this structure to a uniform height of 10 feet; adding a 750-foot long east pier to extend from shore in a north by northwest direction, the outer end of which would be approximately 200 feet east of the west pier extension; and by dredging the entrance channel through the opening thereby provided, with the mooring basin in the sheltered area afforded by the breakwaters. The initial cost of this considered improvement, based on 1946 price levels, was estimated to be $600,000. In accordance with the recommendations of the reporting officers, preparation of a report of survey scope has been authorized by the Chief of Engineers, which will include Sturgeon Point as one of the localities to be studied.

86. Other improvements. - The only improvements at Sturgeon Point are the privately-owned "L" shaped pier and the boat livery.

87. Commerce and harbor use. - Commercial fishing at Sturgeon Point is negligible, and there is no other commercial activity in the harbor. The principal activity of the harbor centers around the use of recreational craft, the harbor area at Sturgeon Point being utilized by about 135 craft (mostly outboards) annually.

88. Desired improvements. - Local interests made no specific requests for improvement at Sturgeon Point nor did they indicate that they favored or opposed Federal consideration thereof. Yachting interests, however, indicated the desirability of harbors for light-draft craft spaced at reasonable cruising distances along the lake shore, and improvements at Sturgeon Point have been considered in this connection because of its location.

89. Conclusions. - Present and prospective light-draft recreational craft navigation at Sturgeon Point and along the lake shore from Dunkirk to Buffalo warrant further consideration of harbor improvements in this vicinity. The lack of local interest in the authorized harbor of refuge site at Grand View Bay, four miles away, warrants consideration of an alternative site at Sturgeon Point. A study should be made to determine the feasibility of developing a harbor for light-draft vessels at Sturgeon Point.

HAMBURG PARK, NEW YORK

90. Location. - Hamburg Park, New York is located in Erie County on the southerly shore of Lake Erie about 31 miles northeasterly

of Dunkirk Harbor and 8 miles southerly of Buffalo Harbor, the nearest developed United States ports. It is about 13 miles northeasterly of Grand View Bay where construction of a small-boat harbor is authorized but as yet not constructed. See Plate 36 and U. S. Lake Survey Charts No. 3 and 31.

91. Description of harbor and improvements. - Hamburg Park consists of about nine acres of land lying between State Highway No. 5 and the lake, with a lake frontage of about 1,100 feet. Facilities for recreation consist of a combination boat and bath-house and dance pavillion, a bathing beach, and a floating pier and a launching device for the accommodation of small craft. During the summer months life guards and a lifeboat are maintained at the beach. The shore in the vicinity is generally ~~held~~ bald with 40-foot shale bluffs rising almost vertically from the waters edge. At the park, however, the bluffs recede landward and, with a flattening of their slopes, access is provided to the lake. The beach is shale thinly overlaid with sand and gravel and varies in width from 15 to 30 feet. The lake bottom slopes gently to a 12-foot depth of water about 1,500 feet offshore. The tributary area consists primarily of the town of Hamburg with a 1950 population of 25,067. The village of Hamburg, which is the principal trading center of the tributary area, is located four miles southeast of Hamburg Park, and has a population of 6,938. During the summer months an estimated 10,000 additional inhabitants are attracted to the lake shore area

from Buffalo and vicinity. The area is predominantly agricultural with the exception of the northern portion adjacent to the highly industrialized city of Lackawanna where a part of the steel plants and allied industries is located in the town of Hamburg. Improved highways serve the entire area and connect with arterial highways leading to all parts of the country. The village of Hamburg is served by the Erie Railroad. The New York Central, the Pennsylvania and the New York, Chicago and St. Louis Railroads serve points along the lake shore. There are no bridges crossing any portion of the waterway under consideration.

92. Physical factors affecting navigation. - Hamburg Park is exposed to effects of storms from southwest through west to north with a maximum fetch of about 210 miles from the southwest. There are no adequate harbors of refuge between Buffalo and Dunkirk. Existing rock shoals within 1/4 mile of the shore line are dangerous to light-draft vessels in the reach adjacent to Hamburg Park. The high lake shore cliffs dropping almost vertically to waters edge prevent landing except at a few unprotected localities. Due to absence of suitable mooring facilities, recreational and sport fishing craft are limited to outboards easily launched from trailers. Ordinary fluctuations of water level are from 3.5 feet above to 0.5 feet below low water datum and extreme fluctuations produced by winds and other causes are from 6 feet above to 3 feet below that

plane. Due to adverse weather and ice conditions, the average season of navigation, as referenced to the nearby port of Buffalo, N. Y., is from 11 April to 23 December.

93. Terminal and transfer facilities. - There are no public docks, or commercial terminal or transfer facilities at Hamburg Park. The only recreational craft facilities are those mentioned elsewhere in this section.

94. Federal improvements and studies. - There is no existing Federal project for harbor improvement at Hamburg Park. The latest report submitted by the Department of the Army for Hamburg Park is the Preliminary Examination Report of Shores of Lake Erie for Harbors and Harbors of Refuge for Light-Draft Vessels, dated 19 July 1946. The plan of improvement considered in that report provided for: the construction of two rubble-mound breakwaters totaling 1,900 feet in length and 10 feet high; dredging an entrance channel 150 feet long, 100 feet wide and 10 feet deep to the lakeward ends of the breakwaters, thence flaring to 200 feet wide at the 10-foot depth contour in the lake, an inner channel 300 feet long, 100 feet wide and 8 feet deep, a turning basin 350 feet long, 100 feet wide and 8 feet deep and a mooring area for transient craft about 250 by 200 feet and 8 feet deep; constructing 170 linear feet of steel sheet pile bulkhead to serve as a public dock; and constructing 110 linear feet of concrete wall extension to the west breakwater. The initial cost of the improvement, based on 1946 price levels, was estimated

to be $984,000. In accordance with the recommendation of the reporting officers, preparation of a report of survey scope has been authorized by the Chief of Engineers which will include Hamburg Park as one of the localities on the south shore of Lake Erie to be studied as a possible site for small-boat improvements.

95. Other improvement. - The improvements at Hamburg Park consist of a reinforced concrete sea wall, an aerial electric tramway, a 160-foot temporary dock, a trailer ramp, and a boat house with a 16 boat capacity. Other improvements include the previously mentioned bathhouse and dance pavilion and also parking areas, walks and picnic facilities.

96. Commerce and harbor use. - Commerce in the past along the lake frontage of town of Hamburg has been limited to a little commercial fishing which has not been of sufficient volume to be reported. Other than this there is no commercial activity at the Hamburg Park harbor area. The only navigational activity centers around the use of light-draft recreational craft mainly of the outboard type. There are an estimated 500 recreational craft based in the locality of Hamburg Park, most of which are outboards.

97. Desired improvements. - Local interests requested a breakwater to be placed about 600 feet offshore as protection against storms from the west and southwest. In addition, dredging to a 6-foot depth for local boats and whatever depth is deemed adequate for transient vessels were requested.

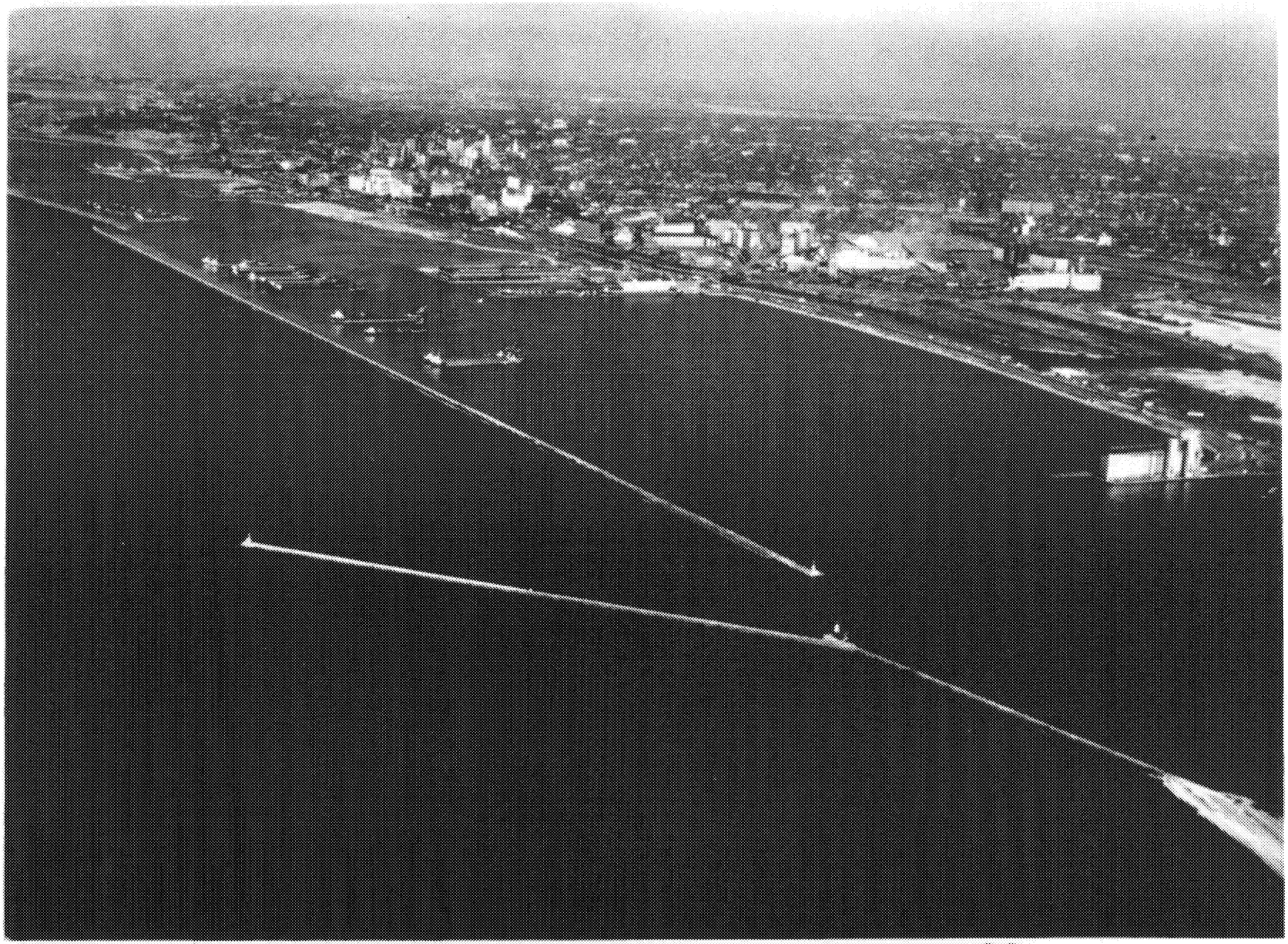
98. Conclusions. - There are no adequate harbors of refuge between Buffalo and Dunkirk although Hamburg Park is favorably located to serve as such a harbor. Present and prospective light-draft recreational craft navigation at Hamburg Park, New York, and from Buffalo to Dunkirk, warrant further consideration of harbor improvement in this vicinity. A study should be made to determine the feasibility of developing a harbor of refuge for light-draft vessels at Hamburg Park.

BUFFALO HARBOR, NEW YORK

99. Location. - Buffalo Harbor, New York, is located in Erie County at the eastern end of Lake Erie at the head of Niagara River. It is 37 miles northeasterly of Dunkirk Harbor, New York, the nearest developed United States port on Lake Erie, and 22 miles east of Port Colborne, Ontario, which is the Lake Erie terminus of the Welland Ship Canal. See Plate 37 and United States Lake Survey Charts Nos. 3, 31, 312 and 314.

100. Description of harbor and improvements. -

a. Buffalo Harbor, New York, a Federal deep-draft project, consists of an outer harbor protected by breakwaters, and an inner harbor comprised of the Buffalo River, Buffalo Ship Canal, and the Erie Basin. The outer harbor, connecting channels in the Niagara River, and the Buffalo River entrance portion of the inner harbor,



Navigation facilities. Buffalo Harbor, New York. Subregion "D".

have been improved and are maintained by the Federal Government. The channels in the Buffalo River and the Buffalo City Ship Canal, upstream from the foot of Commercial Street, have been improved by both the city of Buffalo and the Federal government and are maintained by the United States. The Erie Basin is controlled and maintained by the State of New York.

b. Outer harbor. - The outer harbor is about four miles long and has entrance channels at the north and south ends. There is an established United States harbor line about 1,600 feet from and parallel to the breakwaters. The area of the outer harbor is about 715 acres. At the southerly end of the outer harbor is the Lackawanna Canal which extends 3,800 feet into the Bethlehem Steel Company's Lackawanna Plant at Stony Point. Nearby, the Union Canal extends into the properties of the Great Lakes Portland Cement Company, the Pennsylvania Railroad and the Hanna Furnace Corporation which are approximately 600 feet north of the south city line. The south entrance and the outer harbor from the southerly end to 2,000 feet north of the South Buffalo North Side Light have been dredged to 21 feet. These areas have been authorized for additional deepening to 25 feet, but only a portion of the work has been accomplished under this latest authority. Over the remainder of the outer harbor, with the exception of a narrow strip along the landward project limit, the project depth of 23 feet has been attained. The north entrance has been dredged to 23 feet. The outer harbor area is all good

anchorage ground, except that the bottom south of the middle gap is very soft clay and there are limited mooring facilities along part of the breakwater.

c. Inner harbor. - Buffalo Creek, known as Buffalo River within the city limits, rises in Wyoming County, New York, follows a northwesterly course, and in its lower reaches meanders through the City of Buffalo to discharge into the northern end of Buffalo outer harbor. The discharge does not materially affect vessel traffic or water levels in Buffalo Harbor. The river, the entrance to which is protected by piers on each side, has been improved upstream from its mouth for about 5-1/2 miles. The channel in this stretch of the river is from 175 to 300 feet wide with a mid-channel depth of 20 feet. The Buffalo Ship Canal is an artificial waterway extending southeasterly from the basin at the inner end of the Buffalo River entrance channel. The waterway is nearly straight and about 1-1/2 miles long, generally 300 feet wide, and 18 to 21 feet deep. The distance of one mile in the northerly portion public waterway maintained by the United States. Erie Basin, located just north of the Buffalo River Entrance, is used as a barge canal terminal. It is formed by the New York State Breakwater inclosing an area about 2,500 feet long and from 300 to 1,000 feet wide. There is a depth of 18 feet for a width of 160 feet through the middle of the basin. There are 8 movable bridges over the navigable portions of the Buffalo River, 3 of which are highway bridges, the remaining

5 being railway bridges. A high-level highway bridge is under construction.

101. The area tributary to Buffalo Harbor is known as the Niagara Frontier. It comprises Erie and Niagara counties and has a total area of 1,587 square miles. There are six cities, Buffalo, Lackawanna, Tonawanda, North Tonawanda, Niagara Falls, and Lockport, within the area. The distribution of population, according to the United States Census of 1950 is as follows:

Population - 1950

Location	Population
Erie County	
Buffalo	580,132
Lackawanna	27,658
Tonawanda	14,617
Towns and villages	276,831
Total, county	899,238
Niagara County	
Lockport	25,133
Niagara Falls	90,872
North Tonawanda	24,731
Towns and villages	49,256
Total, county	189,992
Grand total	1,089,230

There are about 1,700 manufacturing establishments within the tributary area. The principal industrial activities are grain milling and transfer, manufacture of iron and steel, production of chemicals, cement, metals, small tools and castings, building materials, automobile parts, and the distribution of petroleum

products. Due to the strategic location of the area in regard to inland waterway transportation system, the locality is particularly adapted as a transfer point for lake and rail traffic. Improved roads connect with the trunk highways of the United States and Canada and adequate bus and truck service is available. The City of Buffalo is served by 12 railroads and has regularly scheduled air service. In addition, two industrial railroads, the Buffalo Creek and the South Buffalo, serve the industrial and harbor areas. Buffalo is also the western terminus of the New York State Barge Canal which has a project depth of 12 feet in its Western Division. The canal, which is open to recreational craft without charge, connects with the Finger Lakes in central New York State, Lake Ontario at Oswego, New York, the Hudson River near Albany, New York, and with Lake Champlain.

102. Physical factors affecting navigation. - Controlling depths are: 25 feet in the south entrance channel and in the extreme southerly portion of the outer harbor; 21 feet in the northerly portion of the 25-foot project area; 23 feet in the completed portion of the northerly section of the outer harbor; 21 feet in the north entrance channel; 20 feet in Buffalo River Entrance Channel; 20 feet in Buffalo River; and 20 feet in the Buffalo Ship Canal. Water stages are equivalent to and dependent upon the surface of Lake Erie. Ordinary fluctuations of water level at the harbor are from 3.5 feet

above to 0.5 feet below low water datum with occasional extreme fluctuations which have ranged from 10 feet above to 4 feet below that plane, as discussed in paragraph 176. These fluctuations of short duration may cause pronounced surges and currents in the outer and inner harbors. The harbor is exposed to westerly and southwesterly storms, but has adequate anchorage behind its breakwaters. Maximum fetch is about 231 miles from a southwesterly direction. The average navigation season at Buffalo Harbor is 257 days with an average opening date on 11 April and a closing date on 23 December. Under normal conditions, the currents in Buffalo River are slight and offer no difficulties to navigation. Rapid fluctuations in Lake Erie produce quite strong currents in the river and heavy rainfalls and spring freshets are attended by strong outflowing currents due to rapid rises of the river and the subsequent discharge of flood water. These conditions cause difficulties to navigation and sometimes damage to vessels by tearing them from their moorings, but they occur only 2 or 3 times each year and for only a few hours at a time. Deep-draft vessels experience considerable difficulty in navigating Buffalo River, due to the narrowness of the channel and the many sharp bonds therein.

103. Heavy ice forms in the river, usually in January. A narrow channel is kept open through the ice by tugs, but the ice remains in place because Lake Erie also freezes over, and the harbor entrance is usually blocked with ice from January to March or April. The ice

usually goes out in the spring during a freshet in the river, and the combined effect of the then prevailing strong outflowing currents and the heavy moving ice is at times very great and may last for 2 or 3 days. During this time the liability of damage to vessels is considerable. Heavy ice also forms in the Buffalo Ship Canal. Although a narrow channel is kept open through the ice by tugs, the ice remains in place, as in Buffalo River; however, the breaking up of the ice in spring is not attended with the same liability to cause damage as in the river. After the spring breakup, ice in the lake is driven to the east end by the prevailing southwest wind, where it finally melts or is carried down the Niagara River. An ice field several miles in extent may form, blocking navigation to Buffalo Harbor. Because Buffalo has usually been the last Lake Erie port to be opened to navigation, a Coast Guard icebreaker was permanently assigned to Buffalo in the summer of 1954.

104. Terminal and transfer facilities. - There are approximately 50 terminals for the handling of various types of cargo, the most important of which are iron ore, coal, grain, limestone, sand and gravel, steel products, automobiles, and sulphur. In general, the terminals operated by the railroads and lake transportation companies and grain elevators are open to the public. The City of Buffalo owns two piers in the outer harbor, one of which is leased to private interests as an automobile receiving terminal. The city also has a dock for mooring a city-owned fireboat and has provided three public

docks on Buffalo River which are open to all water carriers on equal terms. Other facilities in the outer harbor consist of ore, stone, and coal terminals on the Lackawanna and Union Canals, a Coast Guard Station, a grain elevator, a food terminal, a privately-owned slip, and two small, protected areas available for mooring of light-draft recreation and commercial craft. In the inner harbor there are 16 grain elevators; 2 ore docks, 2 coal docks, a scrap and pig iron dock, 12 docks for unloading limestone, sand, gravel, petroleum products, chemicals, newsprint, molasses, and cement, 3 lake passenger and freight docks, a dock used by summer excursion steamers, 3 dry docks equipped to accommodate the larger lake vessels, and 6 docks for ship repair, mooring tow boats and supply and service boats.

105. The only public recreational boat facility is the Buffalo City Boat Harbor in the outer harbor north of the Merchants Refrigeration Company's dock on Fuhrman Boulevard. This area is protected by a rock dike and has three docks with slips to accommodate small craft, and also a safe mooring area for small craft. There is also a commercial marine sales and service establishment with open mooring space located at the foot of Tifft Street. All other light-draft vessel navigation improvements are privately-owned. North of Buffalo Harbor, within the limits of the adjacent Federal project for Black Rock Channel and Tonawanda Harbor, there is a considerable concentration of small-boat and marine service establishments.

106. Federal improvements and studies. - The original project was adopted by the River and Harbor Act of 20 May 1826, and provided for rebuilding the piers at the entrance to Buffalo River which were constructed earlier by local interests. The project was modified at various times to provide breakwaters and enlargements thereof, greater depths, and a general extension of the Federal project. The existing project is considered to have begun with the River and Harbor Act of 25 July 1912, and provides for the following:

a. An outer harbor about 4 miles long and 1,600 feet wide, formed by a breakwater system approximately parallel to the lake shore, extending from Stony Point to the head of Niagara River and having a total length of 23,704 feet, with entrances near the north and south ends and consisting of the Stony Point breakwater (including the south entrance arm) 3,603 feet long; the south breakwater 10,289 feet long; the old breakwater 7,608.5 feet long; the north breakwater 2,203.5 feet long; a south entrance 550 feet wide; a centrally located circulation gap about 150 feet wide and a natural depth of 20 feet; and a north entrance 1,300 feet wide. The types of construction are as follows: 9,550 linear feet of rubble mound; 14,154 linear feet of timber-crib substructure surmounted with 9,113 linear feet of concrete, 370.5 linear feet of stone and 4,670.5 feet of stone-concrete superstructures.

b. A south pier at the entrance to the inner harbor (Buffalo River) 1,760 feet long, of timber cribs and piles with concrete and stone superstructure.

c. A depth of 25 feet in the south entrance and that portion of the outer harbor south of a line perpendicular to and 2,000 feet north of the southerly end of the south breakwater, and a depth of 23 feet north of that line with the westerly project limit 150 feet from the axes of the breakwaters and the easterly project limit 50 feet from the United States Harbor line; and removal to a depth of 27 feet of three small shoals located on the direct route of approach to the south entrance.

d. A north entrance channel 800 feet wide with a depth of 25 feet in earth and 26 feet in rock from deep water in the lake to the outer harbor; and a depth of 22 feet in earth and 23 feet in rock in the Buffalo River entrance channel from the outer harbor to the junction of Buffalo River and Buffalo Ship Canal, with the southern project limit 5 feet from the south pier and the northern project limit 40 feet from the dock of the Delaware, Lackawanna and Western Railroad Company.

e. Channels in Buffalo River and Buffalo Ship Canal with depths of 22 feet in earth and 23 feet in rock to the upper Delaware, Lackawanna and Western Railroad Company bridge and to the Lehigh Valley Railroad Canal, respectively, with widths generally of 150 and 125 feet, respectively, without dredging closer than 25 feet to dock lines except at bonds, and with the rock ledge just above the Ohio Street bridge out back approximately 13 feet.

The requirements of local cooperation have been met. The estimate of cost for new work (1953) is $17,314,800, exclusive of amounts

expended on previous projects. The 1953 estimate for annual cost of maintenance is $290,000. The existing project as of 30 June 1953 was approximately 28 percent complete.

107. The latest report submitted by the Department of the Army for Buffalo Harbor was the Review of Reports on Buffalo Harbor, New York, dated 4 April 1951, submitted by the District Engineer, Buffalo, New York, in accordance with the resolution adopted 2 June 1949 by the Committee on Public Works which requested a review of the reports submitted in House Document No. 352, 78th Congress, 1st session. Local interests desired deepening of the entrance and river channels, elimination of certain river bonds, new entrances to the inner harbor, and easing of other river bonds. Three plans of improvements were considered, the estimated first costs of which varied from about $20,000,000 to $40,000,000. Annual costs for the plans ranged from about $1,000,000 to $1,800,000, while annual benefits for each of the plans approximated $300,000. While each of the plans considered would return large benefits, they would entail rock excavation, construction of highway and railroad bridges, relocation of highways and railroads, and substantial damages to industrial and residential property. The tangible benefits to be derived from each plan of improvement appeared to be in the savings in time to vessels destined for upper river docks, reduction in damage to vessels from hazardous river conditions and savings in transportation costs through the use of larger and more

efficient vessels. The estimated annual benefits were incommensurate with the annual costs for any one of the proposed plans, and it was the conclusion of the Chief of Engineers that further improvement of Buffalo Harbor was not advisable at that time.

108. The latest report, noted above, was concerned only with improvements in the interest of deep-draft navigation. The recreational boating aspects of the locality are covered in detail in the Preliminary Examination Report of Shores of Lake Erie for Harbors and Harbors of Refuge for Light-Draft Vessels, dated 19 July 1946. The plan of improvement considered by the special board would provide for the construction of four boat basins to be located in the outer harbor at the foot of Michigan Avenue beginning at a point about 1,000 feet south of the harbor north entrance and extending about 6,000 feet in a southerly direction. The plan contemplates the utilization of the existing municipal piers. The initial cost of the considered improvements, based on 1946 price levels was estimated to be $1,400,000. In accordance with recommendations of the reporting officers, preparation of a report of survey scope, to include Buffalo Harbor, has been authorized by the Chief of Engineers.

109. Other improvements. - The only other improvements at Buffalo Harbor are the privately-owned facilities and the improvements mentioned previously. As part of its long-range program, the City Planning Commission of Buffalo intends, at some time in the future, to develop the area in the outer harbor between the Coast Guard Station and the

Ranahan-McCarthy Marine Terminal as an additional small-boat basin.

110. Commerce and harbor use. - The principal activity of Buffalo Harbor is comprised principally of grain, iron ore, coal, and limestone commerce. The classification of commodities received and shipped from Buffalo Harbor varies little from year to year, although receipts and shipments of petroleum products, sand, gravel, and automobiles have shown increases in recent years. It is probable that future commerce will consist of the same commodities and approximate volumes as at present. Statistics show that the total amount of waterborne commerce at Buffalo Harbor for 1952 was 16,641,661 tons transported in 4,472 round trips by vessels with drafts ranging up to 23 feet and having a net registered tonnage of 12,083,393 tons. There is no commercial fishing at Buffalo Harbor. There is a small amount of recreational boating in the outer harbor but none in the inner harbor due to the fouled condition of the waterways. Recreational craft based in the immediate Buffalo area total approximately 1,000 inboards, 185 sailboats, and 2,000 outboards. In addition, a large number of transient craft visit the area each season.

111. Desired improvements. - The improvements desired fall into two categories:

a. Deep-draft. - Local interests still strongly desire deepening of the entrance and river channels, elimination of certain river bends, easing of other river bonds, and provision of new entrances to the inner harbor.

b. Light-draft. - At a public hearing held in Buffalo, New York, on 8 May 1945, local interests submitted a comprehensive plan for the development of the city waterfront. The proposed plan provided for four small-boat harbors all of which would require the construction of piers and bulkheads, dredging and fill. There is a continued interest and desire on the part of local interests for these improvement.

112. Conclusions. - It appears that no deep-draft navigation study of Buffalo Harbor needs to be undertaken at this time since it is believed that the needs of deep-draft navigation will be adequately provided for upon completion of the existing project. In regard to light-draft navigation improvements, a study should be made of the harbor to determine the feasibility of developing small-boat harbors for light-draft vessels in Buffalo harbor area.

BLACK ROCK CHANNEL AND TONAWANDA HARBOR, NEW YORK

113. Location. - Black Rock Channel and Tonawanda Harbor, New York, involve essentially, the improvement of the upper Niagara River from its head at Lake Erie to a point in the river opposite the foot of Sixth Avenue, North Tonawanda, New York, a distance of about 13-1/2 miles, and of Tonawanda Inner Harbor, which consists of the improvement of Little River between Tonawanda Island and the mainland and of Tonawanda Creek to the Main-Webster Street Bridge. About 5

miles below Lake Erie, Grand Island, about 8 miles long and 6-1/2 miles wide, divides Niagara River into two branches. The international boundary lies in the westerly branch. The southerly 4-1/4 miles of the Black Rock Channel is known as the Black Rock Canal. This part of Black Rock Channel was originally a part of Niagara River, but, prior to 1825, the State of New York, by the construction of Bird Island pier, Squaw Island dike, and a ship lock at the foot of Bridge Street, Buffalo, separated the channel from the river. Buffalo Harbor is located at the southerly end of Black Rock Channel while Niagara Falls, New York, is located on the Niagara River about 7-1/2 miles downstream from Tonawanda Harbor. See Plate 38 and U. S. Lake Survey Charts No. 3, 31, and 314.

114. Description of harbor and improvements. - Improvements, both Federal and private, to Black Rock Channel and Tonawanda Harbor are described in detail elsewhere in this section. In general, however, the improvement authorized by Congress provides for a channel 21 feet deep and of various widths. Its southerly section, about 4.2 miles long, consists of Black Rock Canal and its entrance from Buffalo Harbor. The canal is separated from Niagara River by islands, dikes, and piers, and is provided with a lock at its lower or northerly end. The channel in the canal is, in general, 200 feet wide and is the narrowest part of the waterway. Ship entrance to the canal is made from Buffalo Harbor through a channel 400 feet wide with a flared entrance. From the northerly end of the canal the waterway

is in the open Niagara River to North Tonawanda. Here Tonawanda Island separates the river into two channels. The westerly of these has been improved as the deep-draft ship channel leading to a turning basin at the foot of the island. The easterly channel along the city waterfront is known as Little River and has a project depth of 16 feet. The New York State Barge Canal, 12 feet deep, enters Little River through Tonawanda Creek. Provision of a depth of 16 feet in the lower 1,400 feet of this creek is a part of the Black Rock Channel project. There are 6 bridges crossing the Black Rock Channel and Tonawanda Harbor project, of which 3 are highway bridges, 1 is a railroad bridge, and the other 2 are combined highway and railroad bridges. One of the highest bridges is a bascule type while the other 2 are fixed. The railroad bridge and the combination highway and railroad bridges are all of swing type design. The area tributary to the Black Rock Channel and Tonawanda Harbor is generally the same as the tributary area of Buffalo Harbor, consisting of the cities of Buffalo, Niagara Falls, Lackawanna, North Tonawanda, Tonawanda, Lockport, and adjacent suburban communities, all in Erie and Niagara Counties. The distribution of population at this tributary area, according to the U. S. census of 1950, is shown in paragraph 101 of the discussion of Buffalo Harbor.

115. The strategic location of the area with reference to the inland waterway transportation system and its use as a transfer point for lake, canal, and rail commerce has contributed to the

industrial development of the area. There are about 1,700 manufacturing establishments within the tributary area. The principal industrial activities are grain milling and transfer, manufacture of iron and steel, production of chemicals, cement, metals, small tools and castings, building materials, automobile parts, and the distribution of petroleum products. Improved roads connect with the truck highways of the United States and Canada and adequate bus and truck service is available. All cities and principal villages in the tributary area are served by rail. The railroad systems operating into the area are the New York Central, Erie, Pennsylvania, the Delaware, Lackawanna and Western, Lehigh Valley, Baltimore and Ohio, Canadian National, Michigan Central, Wabash, the New York, Chicago and St. Louis, Chesepeake & Ohio, and Canadian Pacific, In addition, two industrial railways serve the industrial and harbor sections at Buffalo. Seven commercial airline companies serve the area with regularly scheduled passenger, express, and freight flights. Buffalo is also the western terminus of the New York State Barge Canal. This canal, which is open to recreational craft without charge, connects with the Finger Lakes in central New York State, Lake Ontario at Oswego, New York, the Hudson River near Albany, New York, and with Lake Champlain. Natural resources within the region include hydroelectric power at Niagara Falls, gas deposits in the nearby territory and some oil resources in southwestern New York and neighboring Pennsylvania.

116. Physical factors affecting navigation. - Depths in the canal section of Black Rock Channel are referred to low water datum for Lake Erie, 570.5 feet above mean tide at New York City, and the stages and fluctuations in the canal correspond with those for Lake Erie. In the Niagara River section and Tonawanda Harbor, depths are referred to the sloping surface of Niagara River when Lake Erie is at low water datum. The level of Tonawanda Harbor, corresponding to low water datum for Lake Erie, is 564.3 feet above mean tide at New York City. River fluctuations decrease as the distance from Lake Erie increases, and in general, the fluctuations at Tonawanda are about 70 percent of those at Buffalo. The controlling depths at low water datum are 21 feet at Black Rock Channel, 20 feet in the Niagara River section of the channel and in the Tonawanda turning basin, 14 feet in Tonawanda inner harbor, and in Tonawanda Creek channel, 12 feet. A strong cross-current running at nearly right angles to the 400-foot wide section of the Black Rock entrance channel, makes navigation of this reach hazardous. At times, vessels negotiating the entrance require the aid of two tugs. Further, the available 240-foot width, with rock shoulders at the sides, in the curve section of the canal, extending from the foot of Maryland Street to just northerly of the foot of Porter Avenue, requires great care by navigators of the larger vessels. The Black Rock Lock has a usable length of 625 feet, width of 68 feet, dimensions too small to

accommodate modern lake vessels. Lift of the lock is five feet. The average navigation season in the Black Rock Channel and Tonawanda Harbor is 241 days, with an average opening date of 22 April and an average closing date of 18 December. Black Rock Channel and Tonawanda Harbor are exposed to storms from the southwest.

117. Terminal and transfer facilities. - At the southerly end of Black Rock Channel are Buffalo Harbor and Erie Basin. The former contains extensive terminal and transfer facilities for deep-draft commercial shipping. Erie Basin, a canal-lake transfer terminal owned by the State of New York, is an operating unit of the Barge Canal. The terminal and transfer facilities of Black Rock Channel and Tonawanda Harbor are as follows:

a. Black Rock Canal section. - There are no commercial terminals within the canal, but the transfer of cargo over the towpath wall may be made under permit. The municipal marine airport and the small craft basins of the Buffalo Yacht Club, the Buffalo Motorboat Club, and the New York State Naval Militia Dock are located hereon. The marine airport is open to the public but the basins and dock are private. Two commercial marine sales and service establishments with limited mooring and winter storage space are located on the canal near the mouth of Scajaquada Creek.

b. Niagara River section. - This portion extending from Black Rock lock to Tonawanda Harbor, contains 10 docks which are used to handle sand and gravel, molasses, limestone, coal, iron ore, and

petroleum products. In addition to these commercial docks, there are private docks for small craft, none of which are open to the public, a small-boat building establishment, 3 commercial small-boat sales and service establishments and 5 boat liveries.

c. Tonawanda Harbor. - The facilities available here include seven docks which are used to handle sand and gravel, coal, limestone, pulpwood, lumber, iron ore, and petroleum products. There are also private small-craft docks, none of which are open to the public, a small-boat building concern on Tonawanda Island, and another small-boat building concern and a boat livery a short distance upstream on the Barge Canal. The existing terminal and and transfer facilities are considered adequate for present and prospective needs of commercial shipping. Mooring facilities for small craft, however, are crowded and inadequate, particularly southerly of Black Rock Lock, and additional public mooring and docking facilities for transient recreational craft are needed.

118. Federal improvements and studies. - The original project for Black Rock Harbor and Channel was adopted by the River and Harbor Act of March 2, 1892, while the original project for Tonawanda Harbor and Niagara River was adopted by the River and Harbor Act of March 3, 1881. These projects were consolidated into one under the present name by the River and Harbor Act of 27 July 1916. The existing Federal project provides for a channel

21 feet deep from the Buffalo Harbor north entrance channel, to opposite Sixth Avenue, North Tonawanda, total length 13-1/2 miles, as follows: From Buffalo north entrance channel to the foot of Maryland Street, Buffalo, a distance of about 4,200 feet, about 1,000 to 500 feet wide, with a short branch channel leading to Erie Basin; thence 350 feet wide, narrowing to 200 feet wide, 500 feet northwest; thence generally 200 feet wide through Black Rock Channel to the ship lock at the foot of Bridge Street, a distance of 3.3 miles, widening at the curve opposite the foot of Porter Avenue and at the angle immediately south of the International Bridge. From the lock the channel is 400 feet wide in the Niagara River to the natural deep water pool at the upstream end of Rattlesnake Island, a distance of 3.4 miles; thence through natural deep water to the downstream end of the deep water pool at the Tonawanda waterworks intake crib, a distance of about 4.7 miles, widened to 500 feet opposite the Colorado and Fuel Iron Corporation's plant, by the removal of 200 feet of the westerly end of Rattlesnake Island Shoal; thence 400 feet wide to the foot of Tonawanda Island opposite Second Avenue, North Tonawanda, a distance of 5,000 feet, ending in a turning basin about 1,230 feet long and 1,250 feet wide extending to a point opposite Sixth Avenue. The existing project also provides for the removal of rock shoals from the Lake Erie

entrance to the canal, and in the canal south of Ferry Street Bridge, to a depth of 22 feet; for a channel 16 feet deep, 6,800 feet long, and generally 400 feet wide in Tonawanda inner harbor; for a channel 16 feet deep, 1,400 feet long, and generally 180 feet wide in Tonawanda Creek; for a ship lock at Bridge Street, Buffalo; for the repair and 800-foot extension of Bird Island pier, for the improvement and extension of the guide pier; and for the repair of the towpath wall. The existing project is about 92 percent complete. The estimate of cost for new work (1953) is $11,246,000, exclusive of amounts expended on previous projects while the 1953 estimate for annual cost of maintenance is $300,000, including $200,000 for operation and care. All aspects of local cooperation have been fully complied with.

119. The latest report on Black Rock Channel and Tonawanda Harbor, New York, was the review of reports by the District Engineer, submitted 23 April 1952. The authority for this report was the resolution adopted 21 October 1946 by the Committee on Rivers and Harbors of the House of Representatives. The improvements desired by local and navigation interests were generally concerned with the widening and deepening of the present channel. The requested improvements considered were combined into five plans according to general purpose. Only a portion of one of these plans was considered to be justified, and this provided, in general, for an extension of the 21.0-foot project at Tonawanda Harbor for the accommodation of present

and prospective traffic. The estimates of benefits and costs on January 1953 price levels are: annual benefits - $103,800, annual costs - $24,300; first cost to United States - $270,000; and additional annual maintenance - $3,000. In regard to light-draft navigation, it was the finding of the District Engineer that no further Federal improvement to serve recreational craft was advisable. The Chief of Engineers in his letter to the Secretary of the Army of 4 March 1954, recommended modification of the existing project for Black Rock Channel and Tonawanda Harbor to provide for deepening of the lower 1,500 feet of Tonawanda Inner Harbor and minor enlargement of the turning basin, all to a depth of 21 feet below low water datum and generally in accordance with the plan of the District Engineer. The Secretary of the Army submitted the report to Congress on 28 May 1954, and it has been printed as House Document No. 423, 83d Congress, 2nd session. The recommended improvement was subsequently authorized by Congress in the River and Harbor Act approved September 3, 1954.

120. Other improvements. - Improvements, other than those noted previously in this report, include the construction of the Barge Canal and the development of Erie Basin, both by the State of New York. Also the city of Buffalo has a bulkhead wall in front of the city waterworks pumping station and Centennial Park which is provided with mooring bits and ladder wells, suitable for the use of transient small craft. As a part of its long-range program, the City Planning

Commission of Buffalo intends, at some future date, to develop small-boat basins on the Niagara River shore of Squaw Island downstream from the sewage disposal plant and at Riverside Park near the foot of Ontario Street downstream from Black Rock Lock.

121. Commerce and harbor use. - The principal activity of Black Rock Channel and Tonawanda Harbor is deep-draft waterborne commerce consisting principally of iron ore, coal, limestone, petroleum products, sand and gravel, lumber and pulpwood. The classification of commodities received and shipped varies little from year to year, and it is believed that future commerce will consist of the same commodities and approximate volumes as at present. Statistics taken from the latest review of reports, dated 23 April 1952, show that for the year 1947, the last year considered in this report, the total amount of waterborne commerce of Black Rock Channel and Tonawanda Harbor amounted to 3,699,154 tons and included iron ore, coal, limestone, petroleum products, sand and gravel, lumber, and pulp wood. The vessel traffic through Black Rock Lock in 1947 totaled 1,258 round trips by vessels with drafts up to 22 feet and having a net registered tonnage of 1,708,249 tons. The vessel traffic through Tonawanda Harbor for the same year totaled 811 round trips by vessels with drafts up to 20 feet and having a net registered tonnage of 732,191 tons. There is also considerable recreational craft activity in the area. Recreational craft based in the area

total approximately 1,000 inboards, 185 sailboats, and 2,000 outboards. In addition a large number of transient craft visit the area each season.

122. Desired improvements. - The improvements desired by local and navigation interests are generally those set forth in the review of reports dated 23 April 1952 and include easing the major bends, deepening the channel to 23.0-foot project depth, provision of a new, larger lock, widening the channel to a minimum width of 300 feet, and extending the project at Tonawanda Harbor, New York.

123. Conclusions. - No further deep-draft study of Black Rock Channel and Tonawanda Harbor needs to be undertaken at this time since the latest review of reports has been just recently submitted to Congress by the Secretary of the Army. In regard to light-draft navigation, no further Federal study is necessary at the present time since the only light-draft recreational craft requirements are for docks and mooring facilities, and these are considered to be the responsibility of local interests.

GRAND ISLAND, NEW YORK

124. Location. - Grand Island, New York, is located in Erie County, about five miles below Lake Erie. It is about 8 miles long and 6½ miles wide, and divides Niagara River into east and west branches which unite at the foot of the island about 4 miles above the cataract of Niagara Falls. The international boundary follows the west branch from 200 to 400 feet channelward of the west bank of the island. The nearest adjacent port is Tonawanda Harbor, New York, approximately ½ mile due east from Grand Island's most easterly point. See Plate 28 and U. S. Lake Survey Charts Nos. 31 and 312.

125. Description of harbor and improvements. - There is no existing Federal project at Grand Island and private improvements to Grand Island are described in paragraph 129. The west channel of the Niagara River to Niagara Falls is in Canadian waters, on the west side of Grand Island, but crosses into American waters below Buckhorn Island. The least width of this channel is about 300 feet and the available depth about 11 feet. The east channel, northward from the turning basin at North Tonawanda, and included in the existing project for Niagara River, New York, has a ship channel with a width of 300 feet and a depth of 12 feet. The New York State Barge Canal which enters Niagara River through Tonawanda Creek has a least width of about 180 feet and a project depth of 12 feet. A high level highway bridge which is named the South Grand Island Bridge crosses the east branch of the Niagara River about 3-3/4 miles north of the city line of Buffalo, connecting the town of Tonawanda

with Grand Island. The North Grand Island Bridge, also a high level highway bridge, crosses the Niagara River at the north end of Grand Island and connects the island with Niagara Falls, New York. The area tributary to Grand Island includes the town of Grand Island, and the cities of Niagara Falls, Tonawanda, and North Tonawanda. The area surrounding Grand Island, where much of the island's population is employed, is highly industrialized producing such products as chemicals, paper, metals, automobile parts, and abrasives. However, Grand Island itself has no manufacturing interests, but consists of residential areas, the usual business establishments, and private boat houses and facilities. According to the U. S. census for 1950, the population of the town of Grand Island was 3,090, Niagara Falls, 90,872, Tonawanda, 14,617, and North Tonawanda, 24,731. Improved roads throughout the tributary area connect with trunk highways of the United States and Canada. Construction of that section of the New York State Thruway which will connect the North and South Grand Island Bridges and which will parallel the present express highway is expected to begin in 1954. There is adequate rail service to all points in the tributary area, but none to the island itself.

126. Physical factors affecting navigation. - Depths in this part of the Niagara River are referred to the sloping surface of the river when Lake Erie is at low water datum. The level of Niagara River approximately at the mid-point of Grand Island and directly opposite,

and including Tonawanda Harbor, is 564.3 feet above mean tide at New York City. River levels are dependent upon the level of Lake Erie and fluctuate generally in accordance with fluctuations of the lake, decreasing as the distance from Lake Erie increases. In general, there are no navigation difficulties that interfere with small-boat navigation at and in the vicinity of Grand Island. The average navigation season at Grand Island is from about 22 April to 18 December. The northerly shore of Grand Island, and the improved channel between Buckhorn Island and Tonawanda Island, is exposed to storms from the northwest. The balance of the shore and the offshore channels are exposed to storms from the southwest.

127. Terminal and transfer facilities. - There are no commercial terminal or transfer facilities at Grand Island. However, there are numerous docks and facilities which cater to the needs of recreational craft owners. There is both a yacht club and a sailing club each having its own clubhouse and dock, a privately-owned marina having a dock with 51 slips, another dock with 40 slips, and a boat livery.

128. Federal improvements and studies. - There is no existing Federal project for the improvement of Grand Island nor has there ever been a Federal study at that locality.

129. Other improvements. - Improvements at Grand Island, other than the small-boat facilities mentioned previously in this section, include Beaver Island State Park located at the southerly end of the island and Buckhorn Island State Park located at the northerly end. The facilities available at Beaver Island State Park include picnic

grounds, bathing and bathhouse facilities. Buckhorn Island Park is relatively unimproved, having picnicking and fishing facilities only. The Niagara Frontier State Park Commission intends, at some future date, to construct a boat basin in Beaver Island State Park and to construct a small-boat haven by dredging the mouth of a small creek on the west shore of Grand Island.

130. Commerce and harbor use. - There is no water-borne commerce at Grand Island, navigation being limited to recreational boating. There are approximately 235 inboards, 200 outboards, and 55 sailboats, based at Grand Island. In addition, a large number of transient craft visit the area each season, many of which are based in the section of the Niagara River between Buffalo and Niagara Falls.

131. Desired improvements. - There has been no expressed desire on the part of local or navigational interests for Federal improvement of Grand Island.

132. Conclusions. - In view of the fact that there has been no expressed interest for Federal improvement to Grand Island, and since it appears that the needs of light-draft vessels will be adequately provided for at that locality with completion of planned improvements, no further study of Grand Island is necessary at the present time.

NIAGARA FALLS, NEW YORK

133. Location. - The city of Niagara Falls, New York, is located in Niagara County on Niagara River about 20 miles north of Buffalo, New York, and about 7½ miles downstream from Tonawanda Harbor, the nearest improved U. S. port. Little River, located within the city limits of Niagara Falls, is a narrow branch of Niagara River separated from the main east branch of the Niagara River by Cayuga Island, which is located about 6 miles above Niagara Cataract and about 5 miles below Tonawanda Island. The total length of Little River is about 1½ miles, and its width between banks is about 90 feet. Cayuga Island is about 0.35 mile wide at its widest point and approximately 1¼ miles long. Cayuga Creek, a small stream having a drainage area of about 35 square miles, flows into Little River approximately opposite the middle point of Cayuga Island. See Plate 39 and U. S. Lake Survey Charts Nos. 31 and 312.

134. Description of harbor and improvements. - An existing Federal project covers that portion of the Niagara River from Tonawanda Harbor, New York, to Niagara Falls, New York, a distance of 7½ miles. There is no existing Federal project for the improvement of Little River at Cayuga Island. This section, however, includes both the area covered by the existing Federal project and also the area of Little River at Cayuga Island. Federal and private improvements to the areas being considered are described in paragraphs 137 through 140. The area tributary to Niagara Falls consists primarily of the city of Niagara Falls, New

York. However, residents of several smaller communities, particularly in Wheatfield and the town of Niagara, participate to some extent in recreational boating in Little River in the vicinity of Cayuga Island. The general tributary area is highly industrialized, the availability of electric power from the hydro-electric developments at Niagara Falls having attracted a large number of industries to the area which manufacture a great diversity of products including abrasives, chemicals, machinery, metals, paper and pulp, and pharmaceutical products. According to the U. S. Census Report for 1950, the population of the city of Niagara Falls was 90,872, the town of Niagara was 4,729, and the town of Wheatfield was 4,720. The immediate area adjacent to Little River at Cayuga Island is a residential area and the site of a large number of permanent homes. The perimeter of Cayuga Island and a portion of the mainland shore of Little River are occupied by numerous homes with facilities for mooring and housing recreational craft. The Niagara Falls area is served by excellent highways leading to all parts of the State. Railroads which serve the city of Niagara Falls include the New York Central and the Erie, which cross Cayuga Creek about ¼ mile upstream from its confluence with Little River, and the Canadian National, Chesapeake and Ohio, the Michigan Central, and the Lehigh Valley. The bridges crossing the waterway considered in this section are 5 highway bridges and 2 railroad bridges, all of fixed design, which cross Cayuga Creek, 1 fixed highway bridge which crosses Little River, and the high-level North Grand Island highway bridge which crosses the improved channel in Niagara River.

135. Physical factors affecting navigation. - Water levels in Little River, Niagara River, and the lower end of Cayuga Creek, are influenced and controlled primarily by the water elevation of Lake Erie. All depths mentioned in this section are referred to the sloping surface of Niagara River corresponding to low water datum on Lake Erie, 570.5 feet above mean tide at New York City. Corresponding levels at low water datum are 564.1 at the head of the existing improved 12-foot channel starting at North Tonawanda, 563.0 at Little River and 562.4 at Niagara Falls. Depths in Little River are from about 2 to 10 feet when Niagara River is at low water datum. The shallowest depths are found at the upstream and downstream junctions with Niagara River. The downstream end is very shallow and overgrown with grass and reeds except for a circuitous channel approximately 40 feet wide having depths varying from 2 to 8 feet. For this reason the mouth of Little River is navigable at low water stages only by rowboats or outboard craft. The head of Little River has a minimum depth of about 2 feet at low water datum through a natural channel about 40 feet wide bordered with reeds in water from 1 to 2 feet deep. Mid-channel depths exceed 5 feet in a major portion of the inner channel. In Cayuga Creek from its mouth to Lindbergh Avenue, depths vary from about 2 feet to 13 feet. The Niagara River is navigable from its head at Lake Erie to a short distance beyond Navy Island Channel, where navigation is interrupted by dangerous rapids and the Falls of Niagara. The controlling depth in the improved channel in Niagara River from Tonawanda Harbor to Niagara Falls, New York, is 11.4 feet at low water datum. The current in the river below Tonawanda varies

from 1½ to 2 miles per hour between that point and the head of the rapids above the Falls. The average navigation season at Niagara Falls, New York, and approaches, is from 4 May to 19 November. The area is exposed to storms from the southwest.

136. Terminal and transfer facilities. - There are no existing commercial terminal or transfer facilities in the vicinity of Little River at Cayuga Island. A sizable establishment, which caters to the needs of small boats in this area, is located at the mouth of Cayuga Creek. Facilities include a marine railway, inside and outside storage, fueling and supply service, and boat building and repair shops. The same firm conducts a boat livery at the site and owns three work boats, a scow, and a pile driver mounted on a scow, which are used frequently for the construction of private wharves and bulkheads in the vicinity. There are a total of about 19 boathouses, 10 slips, and 9 piers on Little River with considerable river frontage improved with bulkheading of various types. The terminal and transfer facilities on the Niagara River at Niagara Falls, New York, consist of two docks, one at the foot of Hyde Park Boulevard and the other at the foot of Iroquois Street. The Hyde Park Boulevard dock is about 660 feet long, extending easterly from the foot of Hyde Park Boulevard to within about 100 feet of the easterly end of the Iroquois Street dock. There is a controlling depth of 12 feet at low water datum along the face of the dock. It is equipped with one wide gage, electrically operated locomotive crane and one standard gage, steam-operated locomotive crane, both operating

with clamshell buckets. The Iroquois Street dock is about 200 feet long and has a controlling depth of 14 feet at low water datum along its face. It is not equipped with unloading facilities. Both docks are owned by the Niagara Falls Power Company. The Hyde Park Boulevard dock is occupied under lease by the Empire Builders Supply Company and reserved for their private use. The Iroquois Street dock is open to all water carriers on equal terms of rental.

137. Federal improvements and studies. - The existing Federal project for improvement of the Niagara River provides for a channel 12 feet deep and 300 feet wide in the east channel from the downstream end of the existing 21-foot channel opposite Sixth Avenue, North Tonawanda, to the upstream end of the 12.7-foot channel near the Niagara Falls waterworks intake crib; and for a channel 12.7 feet deep and from 300 to 400 feet wide from the Navy Island channel (natural) to the foot of Hyde Park Boulevard (formerly called Sugar Street), Niagara Falls, New York. The project also provides for the construction of compensating works just above the contracted section of the river at Fort Erie. The work of deepening the improved channels to project depths was completed in 1934 at a cost for new work of $463,000. No work has been done on the compensating works. The 1953 estimate of cost of annual channel maintenance is $4,000. All aspects of local cooperation have been fully complied with. The 1953 estimate of cost for the compensating works is $2,776,000.

138. The last deep-draft navigation report on Niagara River, New York, was the survey report on Niagara River, New York, submitted by the District Engineer, Buffalo, New York, on 23 July 1929, pursuant to the River and Harbor Act of 21 January 1927 which authorized a preliminary examination and survey of the locality. The improvement originally desired by local interests, which was considered in the preliminary examination report dated 28 September 1927, was an extension of the 21-foot channel in the east branch of Niagara River from its existing downstream end, opposite Sixth Avenue, North Tonawanda, New York, to the westerly line of Sugar Street (later renamed Hyde Park Boulevard), Niagara Falls, New York, with a harbor and turning basin at its downstream end. However, the plan of improvement recommended for further study by the District Engineer provided for a channel 300 feet wide and 12 feet deep at low water datum, from the downstream end of the present 21-foot channel opposite the foot of Sixth Street, North Tonawanda, New York, to the upstream end of the 13-foot channel near the waterworks intake crib at Niagara Falls, New York. The estimate of cost for the proposed improvement, as contained in the survey report, was $743,600 with annual maintenance costs of $4,000. Annual benefits were estimated at approximately $70,000. The above plan of improvement was authorized by the River and Harbor Act of 3 July 1930.

139. The latest report on Little River at Cayuga Island was the survey report submitted by the District Engineer, Buffalo District on 16 February 1951, pursuant to the River and Harbor Act of 2 March 1945,

which authorized a preliminary examination and survey of the locality. The improvements generally requested by local interests were deepening and providing entrance channels to Little River, and deepening Cayuga Creek. The plan of improvement recommended by the District Engineer and concurred in by the Chief of Engineers was for the improvement of Little River only, and provided for an entrance channel 8 feet deep, 50 feet wide at the lower end of the river channel, approximately opposite 76th Street, diverging to 100 feet wide in 400 feet on the axis of the river channel extended, thence diverging riverward to a width of 200 feet in about 600 feet approximately at the 8 - foot depth contour in the river. This plan of improvement would eliminate the hazardous entrance conditions to Little River, and would provide access to and fuller utilization of existing dock and service facilities. The first cost to the United States was estimated to be $29,100, exclusive of aids to navigation, and $1,600 annually for maintenance. The estimated first cost to local interests for a public wharf, access road, and cash contribution toward channel construction was $57,000. Annual benefits were estimated to be $16,700. The report was submitted to Congress by the Department of the Army, 4 September 1953, and printed in House Document No. 246, 83d Congress, 2nd Session. The recommended improvement was subsequently authorized by Congress in the River and Harbor Act approved September 3, 1954. The 1953 estimate of first cost is $36,900 plus a local cash contribution of $45,100.

140. Other improvements. - Improvements on the waterways under consideration, other than those previously noted in this section, include a portion of the north shore of Cayuga Island opposite the mouth of Cayuga

Creek which is owned by the city and developed as a recreational area known as Jayne Park, and also about 2,500 feet of frontage on Little River, bordering Jayne Park, which is also municipally owned and bulkheaded.

141. Commerce and harbor use. - Statistics for 1952 show that commercial activity at the docks on Niagara River at Niagara Falls, New York, totaled 9,354 tons and consisted primarily of sand and gravel, chemicals, and metals. These materials were carried in vessels having drafts up to 12 feet and having a net registered tonnage of 5,432 tons. A total of 11 round trips were made. There is no waterborne commerce on Little River at Cayuga Island other than recreational boating activity, nor is there the likelihood of any developing. However, there is considerable recreational boating in the area. Recreational craft based in the area including Niagara Falls, the Tonawandas, and Grand Island, total approximately 440 inboards, 550 outboards, and 65 sailboats. In addition, a large number of transient craft visit the area each year, many of which are based in the immediate Buffalo area.

142. Desired improvements. - There has been no expressed desire on the part of local interests for further improvement of Niagara River at Niagara Falls, New York. However, public interests are still desirous of the improvements to Little River at Cayuga Island noted in paragraph 139.

143. Conclusions. - No further study needs to be made at this time either of the Niagara River at Niagara Falls, New York, or of Little River at Cayuga Island. The existing Federal project providing for the

improvement of the Niagara River from Tonawanda Harbor to and including Niagara Falls, New York, adequately provides for the needs of commercial navigation in that reach. The requirements of light-draft navigation in Little River at Cayuga Island will be provided for upon construction of the improvement recently authorized by Congress as a result of the survey report of 16 February 1951. The only other needs of recreational craft are for docks and mooring facilities, and these are considered the responsibility of local interests.

BEACH EROSION

144. Location. - The shores under consideration lie within the Lake Erie-Niagara River Drainage Basin. They include the Lake Erie shores of Chautauqua and Erie Counties with a length of 75 miles, and the Niagara River shores of Erie and Niagara Counties with a total shore line of 69 miles. The shores are shown on U. S. Lake Survey Charts Nos. 3, 31, 32, 312, and 314, on quadrangles of the Army Map Service, and on maps accompanying this section.

145. Prior reports. - No prior reports on beach erosion control have been made on the shores of the area under consideration.

146. Description. - Lake Erie, the shallowest of the Great Lakes chain, is an elongated body of fresh water, 241 miles long in an east-northeast direction, 57 miles wide near the center, and has an area of 9,940 square miles. It was formed during the glacial period and is comparatively shallow with an average depth of less than 100 feet and a maximum recorded depth of 210 feet. It is the only one of the Great Lakes whose bottom is not below sea level. The lake is constricted to a width of about 25 miles at two places: between Point Pelee, Ontario, and Marblehead, Ohio, located about 55 miles from the westerly end of the lake, and between Long Point, Ontario and Presque Isle Peninsula, Pennsylvania, located about 75 miles from the easterly end. The lake west of Point Pelee and Marblehead is characterized by many islands and shoals while the remainder of the lake is free of islands except for a few shoals found near the extreme easterly end of the lake. The Detroit River, carrying the waters from the upper lakes, enters Lake Erie at the

northwesterly corner and the lake discharges into the Niagara River at the northeasterly corner.

147. The south shore line of Lake Erie is comparatively straight for about 170 miles from Cleveland, Ohio to Lackawanna, New York, where it turns abruptly north-northwesterly for eight miles to the head of the Niagara River. Within the study area there are three minor promontories: Van Buren Point, Gratiot Point, and Sturgeon Point, located 22, 26, and 47 miles, respectively, east of the New York-Pennsylvania line. A straight line drawn from the shore at the New York-Pennsylvania line to the shore at the southeasterly extremity of the lake shows the shore line to deviate a maximum of 3½ miles landward about 2 miles east of Silver Creek, about 2 miles landward just east of Van Buren Point and shows Sturgeon Point to lie about 1 mile lakeward of the line.

148. The Niagara River carries the surplus waters of the Upper Great Lakes from Lake Erie seaward to Lake Ontario. In its 36-mile course northerly to Lake Ontario it drops from the mean lake level of Lake Erie, elevation 572.5 feet to elevation 246.0 feet, the mean lake level of Lake Ontario. Its width, velocity, and gradient vary greatly throughout its length. A complete description of the river is given in the following paragraphs.

149. The Niagara River with its head at Buffalo, New York, drains an area of approximately 260,400 square miles. In its course to Lake Ontario, it is joined by Scajaquada, Tonawanda, Ellicott and Cayuga Creeks, in Niagara County, on the United States side.

150. At the head of the river opposite the foot of Porter Avenue in Buffalo, it has a width of about 5,800 feet. At the Peace Bridge, about 3/4 mile downstream, it narrows to 2,000 feet continuing at this width for about 2½ miles to the foot of the Black Rock Ship Lock. The river in this first 3-mile section flows northerly and drops about 5 feet. The velocity is high and vessel traffic moves through the Black Rock Channel paralleling the easterly shore and separated from the river by Bird Island Pier and Squaw Island. The lock is located at the lower end of Squaw Island where vessels are raised or lowered from the river level to lake level, approximately 5 feet. Below the lock the river turns to a northwesterly direction and widens to 6,000 feet about 2 miles below the lock. The river is then divided into two branches by Grand Island which has a 25-mile shore line.

151. The West Branch of the river flows westerly for 1 mile, northwesterly for 4 miles, then northerly 5 miles to join the East Branch at the lower end of Grand Island. The width varies from 1,300 to 3,000 feet.

152. The East Branch, averaging 2,000 feet in width, curves to a northeasterly direction in the 6 miles to its confluence with Tonawanda Creek at Tonawanda. Immediately below the confluence, Tonawanda Island, with a shore line of 2 miles is separated from the mainland by a 500-foot channel. In the first mile below Tonawanda the river flows northerly, then gradually curves to flow almost due west at the end of the next 4 miles, then continues westerly for 6 miles to the crest of the Falls. Cayuga Island, with a 3-mile shore line, is located about 5 miles below

Tonawanda, and is separated from the mainland by a 100-foot channel. In the 9 miles from Tonawanda to the foot of Grand Island the East Branch widens from 2,000 feet to 4,000 feet.

153. Just below the confluence of the East and West Branches the river is about 5,000 feet wide, but narrows to 3,000 feet at the head of the Cascades located about 1 mile above the crest of the Falls. From Black Rock Lock to the head of the Cascades the river drops only about 5 feet, and the velocity is moderate.

154. The river drops 60 feet in its 1-mile Cascade section to the crest at the Falls and is divided by Goat Island with a 1.6-mile shore line. It then drops over the brink in two sections, the Horseshoe and the American Falls. The sheer drop over the Falls is 160 feet.

155. Below the Falls the river flows generally northerly between vertical banks of shale, sandstone, and limestone. In the first 6 miles to just above Lewiston, the banks range to 330 feet in height and the river varies from 300 to 1,000 feet in width. The flow is swift as the river drops about 90 feet in this section.

156. From Lewiston to Lake Ontario the river continues to flow northerly between perpendicular banks up to 100 feet in height for the last 6 miles. The drop in the last 6 miles is only 5 feet and the current is moderate.

157. The area under consideration includes the lake shore of Chautauqua County, the Lake Erie and Niagara River shores of Erie County, and the Niagara River shores of Niagara County. Table 8 lists the three

counties, their political subdivisions bordering the shores, with a brief summary of the use, condition, and characteristics of the shores thereof, and an indication of population trends. The characteristics of the shore are shown graphically on Plates 27 and 28. Table 9 gives pertinent data on publicly owned parks in the area.

158. Development. - Table 8 shows that the population of the towns, villages and cities in Chautauqua and Erie Counties which have frontages on Lake Erie has increased about 5 percent in the past 20 years. There is also a seasonal increase during summer of about 8 and 4 percent in Chautauqua and Erie Counties, respectively. The increase in summer population in Erie County is steadily decreasing as more homes are converted to year round use. The area is served by New York State Highway No. 5, which, in general, parallels the shore for the greater part and by many county and town roads, three railroads and numerous bus lines. The population of the City of Buffalo has increased only about one percent in the 20-year period 1930 to 1950, while the population of the City of Tonawanda, and the towns of Grand Island and Tonawanda, in Erie County, have increased almost 100 percent during the same period. The cities, villages and towns adjoining the Niagara River in Niagara County have increased approximately 30 percent during the same period. The Niagara Frontier is served by many railroads, bus and air lines, as well as many State and county highways.

159. Niagara Falls, one of the "seven natural wonders of the world" draws large numbers of tourists from all parts of the world. The Niagara

Table 8 - Shore line data, Lake Erie and Niagara River
Subregion "D"

Political subdivision	Population			Use of shore - Length in miles							Condition of shore, Length in miles				Shore characteristics 1/														
																		Bluff(length in miles)						Beaches Length in miles		Beach material			
	1930 Census	1950 Census	Increase	Total	Publicly owned	Public parks	Residential	Commercial	Agricultural or Undeveloped	Protected	Unprotected	Eroding	Stable	Glacial till	Alluvia	Artificial fill	Sand dunes	Top elev. above lake From	Top elev. above lake To	Rock	Top elev. above lake From	Top elev. above lake To	In front of bluffs	Barrier	Average width, feet	Sand	Gravel	Shingle	Ledge rock
Chautauqua County											LAKE ERIE																		
Town of Ripley	2,254	2,694	440	7.0	-	-	-	-	7.0	-	7.0	-	7.0	-	7.0	-	-	20	25	7.0	12	20	3.0	-	15	x	x	x	-
Town of Westfield	4,785	5,001	216	7.2	-	0.2	-	0.2	6.8	-	7.2	-	7.2	-	7.2	-	-	15	30	6.8	10	20	2.2	-	20	x	x	x	x
Town of Portland	3,001	3,339	338	9.0	-	1.0	2.0	-	6.0	-	9.0	-	9.0	-	9.0	-	-	20	40	7.0	8	10	4.0	-	30	x	x	x	-
Town of Pomfret	8,062	9,596	1,534	0.6	-	-	0.3	-	0.3	0.2	0.4	-	0.6	-	0.6	-	-	8	15	0.2	0	10	0.6	-	30	x	x	-	x
Town of Dunkirk	726	887	161	4.0	-	-	2.0	1.0	1.0	0.3	3.7	-	4.0	-	4.0	-	-	30	35	3.7	5	30	2.7	-	30	-	-	x	-
City of Dunkirk	17,802	18,007	205	4.6	0.4	2.2	0.3	1.0	0.7	2.2	2.4	1.6	3.0	-	4.6	-	-	8	30	2.0	6	20	1.5	-	50	x	x	-	x
Town of Sheridan	2,035	2,037	2	7.4	-	0.1	3.0	-	4.3	-	7.4	-	7.4	-	7.4	-	-	20	50	7.4	0	40	1.5	-	25	-	x	x	x
Village of Silver Creek	3,160	3,068	- 92	0.8	-	-	0.7	-	0.1	0.1	0.7	0.2	0.6	-	0.8	-	-	8	30	0.3	0	30	0.5	-	30	x	x	-	-
Town of Hanover	2,833	3,307	474	2.1	-	0.1	1.1	-	0.9	0.8	1.3	-	2.1	-	1.6	-	0.5	8	30	0.7	0	30	0.6	-	100	x	x	-	-
Totals, Chautauqua County	44,658	47,936	3,278	42.7	0.4	3.6	9.4	2.2	27.1	3.6	39.1	1.8	40.9	-	42.2	-	0.5	8	50	35.1	0	40	16.6	-	-	-	-	-	-
Erie County																													
Town of Brant	1,693	1,934	241	3.2	-	0.7	2.0	-	0.5	-	3.2	2.5	0.7	-	2.6	-	0.6	8	30	2.5	0	20	2.4	-	50	x	-	-	-
Town of Evans	13,827	7,663	3,836	11.8	0.3	0.5	10.4	-	0.6	1.0	10.8	3.8	8.0	1.6	8.5	-	1.5	8	60	6.8	0	25	8.1	0.2	60	x	-	-	-
Town of Hamburg	13,058	25,067	12,009	9.3	0.1	0.2	6.8	0.7	1.5	2.0	7.3	4.3	5.0	4.0	4.5	-	-	8	85	6.7	0	80	6.9	0.8	40	x	-	-	-
City of Lackawanna	23,948	27,658	3,710	2.0	-	-	-	2.0	-	2.0	-	-	2.0	-	-	2.0	-	0	50	-	-	-	-	-	-	-	-	-	-
City of Buffalo	573,076	580,132	7,056	5.0	2.7	0.6	-	1.0	0.7	3.0	2.0	2.0	3.0	-	-	5.0	-	0	15	-	-	-	3.0	-	20	x	-	-	-
Totals, Erie County	615,602	642,454	26,852	31.3	3.1	2.0	19.2	3.7	3.3	8.0	23.3	12.6	18.7	5.6	15.6	7.0	2.1	8	85	16.0	0	80	20.4	1.0	40	x	-	-	-
Totals for Lake Erie	660,260	690,390	30,130	74.0	3.5	5.6	28.6	5.9	30.4	11.6	62.4	14.4	59.6	5.6	57.8	7.0	2.6	-	-	51.1	-	-	37.0	1.0	-	x	x	x	x

Table 8 (Continued)

Political subdivision	Population			Use of shore - Length in miles						Condition Length in miles				Shore characteristics 1/ Bluffs (length in miles)								Beaches Length in miles			Material		
	1930 Census	1950 Census	Increase	Total	Publicly owned	Public parks	Residential	Commercial	Agricultural or Undeveloped	Protected	Unprotected	Eroding	Stable	Glacial fill	Alluvia	Artificial fill	Top elev. above river From	Top elev. above river To	Rock	Top elev. above river From	Top elev. above river To	In front of bluffs	Barrier	Average width	Sand	Gravel	Swamp
Erie County																											
City of Buffalo:											NIAGARA RIVER																
Mainland				4.3	0.2	0.5	0.5	3.1	-	4.3	-	-	4.3	-	-	4.3	8	15	-	-	-	-	-	-	-	-	-
Squaw & Bird Islands				3.4	3.4	-	-	-	-	1.5	1.9	1.9	1.5	-	1.0	2.4	5	8	-	-	-	-	-	-	-	-	-
Total, City of Buffalo	573,076	580,132	7,056	7.7	3.6	0.5	0.5	3.1	-	5.8	1.9	1.9	5.8	-	1.0	6.7	5	15	-	-	-	-	-	-	-	-	-
Town of Tonawanda	25,006	55,270	30,264	4.8	1.2	-	-	2.6	1.0	1.6	3.2	2.0	2.8	-	2.0	2.8	4	8	-	-	-	-	-	-	-	-	-
City of Tonawanda	12,681	14,617	1,936	1.8	1.4	-	0.2	0.2	-	0.8	1.0	1.0	0.8	-	-	1.8	4	8	-	-	-	-	-	-	-	-	-
Town of Grand Island	626	3,090	2,464	23.1	0.1	11.4	7.7	0.3	3.6	6.7	16.4	10.6	12.5	14.8	-	4.0	4	25	-	-	-	7.3	-	10	x	x	4.3
Totals, Erie County	611,389	653,109	41,720	37.4	6.3	11.9	8.4	6.2	4.6	14.9	22.5	15.5	21.9	14.8	3.0	15.3	4	15	-	-	-	7.3	-	10	x	x	4.3
Niagara County																											
City of North Tonawanda																											
Mainland				2.9	0.3	0.2	-	1.4	1.0	2.9	-	-	2.9	-	-	2.9	4	8	-	-	-	-	-	-	-	-	-
Tonawanda Island				1.8	0.2	-	-	1.6	-	1.6	0.2	0.2	1.6	-	-	1.8	4	8	-	-	-	-	-	-	-	-	-
Total, City of No. Tonawanda	19,019	24,731	5,712	4.7	0.5	0.2	-	3.0	1.0	4.5	0.2	0.2	4.5	-	-	4.7	4	8	-	-	-	-	-	-	-	-	-
Town of Wheatfield	2,212	4,720	2,508	2.3	-	-	2.0	-	0.3	1.5	0.8	0.3	2.0	0.8	-	1.5	4	7	-	-	-	1.0	-	10	x	x	-
City of Niagara Falls																											
Mainland above Falls				6.5	0.3	1.3	1.5	2.7	0.7	4.5	2.0	1.5	5.0	-	1.0	5.5	4	8	1.0	0	5	-	-	-	-	-	-
Cayuga Island				2.8	-	0.5	1.9	-	0.4	2.0	0.8	-	2.8	-	-	2.8	3	8	-	-	-	-	-	-	-	-	-
Goat Island				1.1	-	1.1	-	-	-	0.3	0.8	-	1.1	0.8	-	0.3	2	20	0.8	0	170	-	-	-	-	-	-
Mainland below Falls				4.3	0.1	0.6	-	0.3	3.3	0.3	4.0	-	4.3	-	4.3	-	155	340	4.3	160	330	-	-	-	-	-	-
Total, City of Niagara Falls	75,460	90,872	15,412	14.7	0.4	3.5	3.4	3.0	4.4	7.1	7.6	1.5	13.2	0.8	5.3	8.6	2	340	6.1	0	330	-	-	-	-	-	-
Town of Lewiston	2,407	5,295	2,888	5.3	0.1	-	-	-	5.2	-	5.3	-	5.3	-	5.3	-	65	330	5.3	60	320	-	-	-	-	-	-
Village of Lewiston	1,013	1,626	613	1.0	-	-	0.2	0.3	0.5	0.3	0.7	-	1.0	-	1.0	-	45	105	1.0	40	100	-	-	-	-	-	-
Town of Porter	2,315	3,344	1,029	2.3	1.0	-	-	-	1.3	0.5	1.8	0.3	2.0	-	2.3	-	0	65	2.0	0	60	-	-	-	-	-	-
Village of Youngstown	639	932	293	1.2	-	-	0.6	0.6	-	0.6	0.6	-	1.2	-	1.2	-	0	35	1.0	0	30	-	-	-	-	-	-
Totals, Niagara County	103,065	131,520	28,455	31.5	8.0	3.7	6.2	6.9	12.7	14.5	17.0	2.3	29.2	1.6	15.1	14.8	0	340	15.4	0	330	1.0	-	10	x	x	-
Totals, Niagara River	714,454	784,629	70,175	68.9	8.3	15.6	14.6	13.1	17.3	29.4	39.5	17.8	51.1	16.4	18.1	30.1	0	340	15.4	0	330	8.3	-	10	x	x	4.3

1/ Shown graphically on Plates 27 and 28.

Table 6 - Parks on Lake Erie and Niagara River, Subregion "D"

	Name	Owner	Recreational building	Refreshment stand	Bathhouse	Beach	Picnic facilities	Annual 1/ attendance	Park frontage	Park area	Length of beach	Beach material	Artificial protection
1	Ottaway Beach	Village of Westfield				x	x		700		700	Shale	
2	Lake Erie State Park 2/	State of New York	x	x	x	x	x	65,400	5,300	240	5,300	Gravel and shale	
3	Point Gratiot Park	City of Dunkirk		x		x	x		3,600		3,600	Gravel and shale	
4	City of Dunkirk Beach	City of Dunkirk				x			600		600	Sand	
5	Memorial Park	City of Dunkirk							1,800			None	1800 foot sea wall
6	Wright Boulevard and Park	City of Dunkirk				x	x		6,000		2,000	Sand	4,000 foot sea wall
7	Sheridan Town Park	Town of Sheridan	x	x	x	x	x		330		350		None
8	Hanover Town Park	Town of Hanover				x			407		407	Sand	None
9	Brant Town Park	Town of Brant	x	x	x	x	x					Sand and gravel	None
10	Evangola State Park	State of New York		x	x	x	x	3/	4,500		4,500	Sand	None
11	Evans Town Park	Town of Evans	x	x	x	x	x		400		400	Sand	None
12	Bennett Beach	City of Buffalo	x	x	x	x	x		900		900	Sand	None
13	Hamburg Town Park	Town of Hamburg	x	x	x	x	x		1,500		1,000	Sand, gravel and shale	1000 foot sea wall
14	LaSalle Park	City of Buffalo							3,000		None		3,000 foot sea wall
15	The Front	City of Buffalo		x					1,800		None		Partially revetted
16	Riverside Park	City of Buffalo	x	x	x				1,300		None	Swimming pool	1,300 foot sea wall
17	Beaver Island State Park	State of New York	x	x	x	x	x	553,975	12,000	722	2,500	Sand	
18	West River State Pkwy.	State of New York							36,200			Sand and gravel	12,500 foot revetment
19	Buckhorn Island State Park	State of New York						31,450	19,000	923	None	None	
20	Undeveloped Parks	City of North Tonawanda							1,760		None	None	1,760 foot slag revetment
21	Griffon Park	City of Niagara Falls							1,500		None		Under development
22	Jayne Park	City of Niagara Falls	x	x			x		2,600		None		Retaining wall
23	Porter Park	City of Niagara Falls							180		None		180 foot sea wall
24	Niagara Reservation	State of New York	x	x			x	2,355,350	11,000	428	None		Partial revetment

1/ Attendance figures are for 1952 season. Available only for State parks. 2/ Cabins and tent sites are also available. 3/ Park opened in 1954.

Frontier is also one of the gateways to Ontario, Canada. Many people use the shorter highway through Ontario from the Niagara Frontier to Detroit. There are 4 vehicular bridges across the Niagara River, 1 at Buffalo, 1 at Lewiston and 2 at Niagara Falls. One of the latter also carries a railroad. There is also a separate railroad bridge at Buffalo and a second at Niagara Falls. As a result of its natural beauty and strategic location, the frontier is a mecca for tourists. The City of Niagara Falls and surrounding area are well equipped to handle the influx of tourists which was estimated to be about 4,500,000 persons in 1953. The influx reaches peaks on 30 May, 4 July, and Labor Day estimated at between 40,000 and 60,000 persons.

160. Geology. - The area is located in the Glaciated Plains section of the physiographic province known as the Central Lowlands, It is a post-glacially elevated region of moderate relief consisting of a series of terraces ascending from Lake Ontario to the Allegheny Plateau, separated by northerly facing escarpments. The terraces, commencing from Lake Ontario include the Ontario, Huron, and Erie Plains. They are elevated marine peneplains modified by lake changes and the Wisconsin Ice Sheet which moved across the area in a general southwesterly direction scouring the bed rock of its former overburden and weathered rock and replacing it by a thin layer of glacial till and alluvium.

161. The Niagara Escarpment is well defined where it crosses the Niagara River at Lewiston, New York, separating the Ontario Plain from the Huron Plain. The Onondaga Escarpment, separating the Huron Plain

from the Erie Plain, is rather poorly defined at Buffalo. The Portage Escarpment, separating the Erie Plain from the Allegheny Plateau, is well defined as it skirts the south shore of Lake Erie. Near the New York-Pennsylvania State line the escarpment is only about 2 miles south of the lake shore while at the southeasterly extremity of the lake it is approximately 8 miles to the south.

162. Bedrock. - The bedrock along the south shore of Lake Erie between Buffalo and the New York-Pennsylvania boundary is of the Hamilton group of shales, sandstones and limestones. It is exposed in the bluffs along the shore for the greater part of the distance. It varies in height from near lake level to about 90 feet above the lake and, in general, presents a nearly perpendicular face. At Buffalo, Onondaga limestone is uppermost. Although it is not exposed in the shore on the United States side it is present near river and lake level on the Canadian side. Near the Buffalo Sewage Disposal Plant the Cayuga group of limestone and shales is uppermost and is present to the lower end of Cayuga Island. Although not appearing in the shore bluffs it is close to the river surface at numerous places along the shores. From Cayuga Island to the Niagara Escarpment the uppermost bedrock is of the Niagara group of limestones, dolomites, and shales. These are exposed along the shore immediately above the Falls, and in the deep gorge they are exposed in the almost perpendicular walls, along with shales, sandstone, and limestones of the Medina group. Queenston shale of the Medina group is exposed in the shore bluffs from the foot of the Niagara Escarpment to about two miles from Lake Ontario.

163. Streams. - There are three major streams entering the lake within the area, namely: Buffalo River, Cattaraugus Creek, and Eighteen Mile Creek. The only major tributary of Niagara River is Tonawanda Creek. The characteristics of these streams are discussed in the following paragraphs.

164. The Buffalo River, with its two main tributaries, Cayuga (Erie County) and Cazenovia Creeks, has a drainage area of 435 square miles. It enters Lake Erie at Buffalo about two miles above the foot of the lake. The river and its two tributaries all rise near Java, New York, about 30 miles southeast of Buffalo, and in general flow in a northwesterly direction. Although they carry considerable sediment, little of this finds its way to the lake in this manner. The lower 5½ miles of the river has been improved as a Federal navigation project and most of the sediment is deposited in this improved channel from which it is removed by dredges and spoiled in the lake, either in deep water or just offshore from the city of Lackawanna.

165. Cattaraugus Creek rises near the sources of Buffalo, Cazenovia, and Cayuga Creeks, flows southerly for about 15 miles, then turns westerly and forms the southerly boundary of Erie County, to enter the lake about three miles east of the village of Silver Creek. It drains an area of 555 square miles and brings considerable quantities of sand and gravel to its lower reaches and the lake. Some sand is recovered commercially from the stream bed and some from the lake shore immediately east of the mouth.

166. Eighteen Mile Creek, rising near Springville, New York, about 25 miles east of the village of Silver Creek, flows generally northwesterly to enter the lake about 16 miles northeasterly of the village. Some sand and gravel are carried to the lake as sediment from its 120 square mile drainage area.

167. Tonawanda Creek, the largest tributary to the Niagara River, enters the river between Tonawanda and North Tonawanda, New York. The creek together with its main tributary, Ellicott Creek, drains an area of 648 square miles. It rises near North Java, New York, about 30 miles southeast of Buffalo. It flows generally northerly to Batavia then generally westerly for 12 miles to Indian Falls, then flows northerly 5 miles then westerly forming the boundary between Erie and Niagara Counties. The lower 12½ miles of the creek forms a part of the New York State Barge Canal.

168. There are many small unnamed streams only a few miles in length which flow down the Portage Escarpment directly to the lake and minor streams entering the Niagara River. Table 10 gives data on the more important streams.

Table 10 - Stream data,
Subregion "D"

Name	Location of mouth	Drainage area, square miles
Tributary to Lake Erie		
Chautauqua Creek	Barcelona, New York	34.6
Canadaway Creek	½ mile west of Dunkirk	38.4
Silver Creek	Village of Silver Creek	51.2
Muddy Creek	7 miles northeast of Silver Creek	12.0
Delaware Creek	10 miles northeast of Silver Creek	9.6
Big Sister Creek	13 miles northeast of Silver Creek	48.6
Little Sister Creek	13¼ miles northeast of Silver Creek	11.1
Smoke Creek	City of Lackawanna	32.0
Tributary to Niagara River		
Scajaquada Creek	City of Buffalo ½ mile above Black Rock Lock	27.0
Cayuga Creek (Niagara County)	Cayuga Island, city of Niagara Falls	30.2

STATEMENT OF THE BEACH EROSION PROBLEM

169. The New York State shore line of Lake Erie and the Niagara River falls readily into four categories due to natural characteristics and man-made improvements. These categories are as follows:

a. The Lake Erie shore line, exclusive of that of the cities of Buffalo and Lackawanna.

b. The shore lines of the cities of Buffalo and Lackawanna.

c. The shore line of the Niagara River above the Falls, exclusive of the city of Buffalo shore line.

d. The shore line of the Niagara River below the Falls.

170. The Lake Erie shore line. - Bedrock is exposed at or above lake level along two-thirds of the shore line. The frontage which are experiencing moderate to serious erosion are, in general, those frontages where erosion has previously removed the overburden of till or alluvium and exposed the bedrock to wave action. Although bedrock, in general, is more resistant to wave action, its resistance varies greatly. In some instances no measurable erosion has occurred during the past 20 years, while in others the loss has been as high as four feet annually during the past period of high lake stages. About one-third of the shore bluffs consist entirely of glacial till or alluvium. In general, these shores are relatively stable with narrow beaches of sand and

gravel protecting the relatively stable bluffs from wave attack. Although there are beaches along approximately one-half of the shore, many of them consist of only a thin veneer of sand and gravel over bedrock.

171. The cities of Buffalo and Lackawanna. - The only frontages which are subject to erosion along the shores of these cities are undeveloped areas in the process of being artifically filled. Protection of these areas is not a problem at the present time.

172. Upper Niagara River. - During the last 10 years a large portion of this shore line has been protected by both public and private interests. There are about 15 miles of shore line which are subject to moderate erosion by wave action at the present time.

173. Lower Niagara River. - There is less than one-half mile of shore on the lower river which is subject to erosion by wave action. This area is located near the mouth of the river where waves generated on Lake Ontario enter the river and attack the shore.

FACTORS PERTINENT TO BEACH EROSION

174. Wind. - The New York shore line of Lake Erie is exposed to the effects of winds from the southwest through north to northeast, with the greatest fetch from the westerly quadrant. The shore of the Niagara River above the Falls is also affected by winds from the westerly quadrant. Wind data, recorded by the U. S. Coast Guard, Buffalo, N. Y., for the 15-year period

1936-1943 and 1947-1953 were compiled and converted to average yearly percentages. The resulting data are shown diagramatically on Plate 26. Wind duration for each direction is classified in three groups of velocities: 0-12, 13-24, and 25 miles per hour and over. The data have also been broken down into the ice period, January and February, and the ice-free period, March to December, inclusive. The length of the solid portion of each bar represents the percentage of the total duration during which winds of that direction and velocity group blew during the ice-free period, the ice period is represented by the outlined portion of the bar. The curves in the center of the diagrams represent the percent of the total wind movement during the ice-free period and the combined ice and ice-free periods. A summary of the wind data is given in Table 11.

Table 11 - Wind data - Buffalo, New York, Subregion "D"

(Wind record for 15-year period 1936-1943 and 1947-1952)

Direction	Wind duration, percent of time		Wind movement, percent of total	
	Total	Ice-free	Total	Ice-free
North	3.63	3.19	2.63	2.31
Northeast	11.56	9.64	8.18	6.62
East	6.25	5.30	3.98	3.32
Southeast	6.66	5.67	5.03	4.19
South	8.24	6.95	7.09	5.93
Southwest	37.30	31.52	42.97	34.88
West	13.90	11.06	16.83	13.00
Northwest	12.46	10.44	13.29	11.04
Totals	100.00	83.77	100.00	81.29

175. **Water levels.** - Levels of the Great Lakes fluctuate irregularly from year to year and month to month, depending upon the volume of water present, which in turn depends upon many other factors. The volume present changes with variation in supply of water from precipitation on the lake surfaces and from runoffs from the land area of the drainage basin and with variations in extractions by water outflow and evaporation from lake surfaces. Over the period of record since 1860, the range of fluctuations for Lake Erie between the lowest and the highest monthly mean levels has been 5.27 feet. The pattern of seasonal variation is low levels in winter and high levels in summer with extremes usually occuring in January and June. Lake Erie reached its lowest monthly mean level of record in February 1936, and its highest monthly mean level in May 1952.

176. In addition to the cyclic and seasonal variations of level, Lake Erie is subject to fluctuations of irregular duration and amount. Variations in barometric pressure produce changes in level ranging from a few inches to several feet. These temporary fluctuations may extend over a few minutes or several days. At times lake levels are affected by winds of sufficient velocity and duration to drive the surface water forward in greater volume that it can be carried by return currents, thus raising the lake elevation on the lee shore and lowering it on the weather shore. The effect of wind on the level of Lake Erie is shown by the gage

records at Buffalo, N. Y., and Cleveland and Toledo, Ohio. On 1 January 1942, all gages recorded the lake at elevation 571 feet. On 2 January velocities of westerly winds of 59, 36, and 30 miles per hour, respectively, were recorded, and lake stages of 577, 568, and 563 feet, respectively, resulted. On 3 January the wind velocity dropped to normal and the lake again assumed a stage of 571 feet at all gages. Fluctuations of short duration of 5 feet or over have occurred about once a year at Buffalo, New York, and rises of 7 feet or more may be expected about once in 6 years. Fluctuations in lake levels affect the elevation of the surface of Niagara River, the river level closely following lake stages but to a lesser degree. Data on fluctuations of Lake Erie as recorded by the U. S. Lake Survey gages at Cleveland, Ohio, since 1859, which is used for the official stage of Lake Erie, and the Buffalo, N. Y., gage which records the temporary rises at the easterly end of the lake, are given in Table 12.

177. Waves. - From 3 years of synoptic weather records for the area, it has been established that waves up to 17 feet in height with a period of 7 seconds may be generated in deep water at the easterly end of Lake Erie. Waves 8 feet high or higher may be expected once a month; 12-foot waves, once a year; and 16-foot waves, once in 10 years. Waves five feet in height have been observed on the upper Niagara River when westerly storms work against the current along both East and West Branches of the river.

The characteristics of waves change as they pass through shallow water to the shore.

Table 12 - Water level fluctuations - Lake Erie, Subregion "D"

	High 1/	Date	Low 1/	Date	Variation
Extreme stage, monthly mean 2/	+4.20	May 1952	-1.07	Feb. 1936	5.27
Extreme stage, instantaneous:					
Cleveland, Ohio	+5.47	June 1952	-2.85	Feb. 1936	8.32
Buffalo, New York	+10.28	Jan. 1889	-4.20	Jan. 1939	14.48
Maximum seasonal variation in 1 year 2/	+3.83	June 1947	+1.08	Mar. 1947	2.75
Minimum seasonal variation in 1 year 2/	+1.08	June 1895	+0.21	Nov. 1895	0.87
Mean lake level 3/ 1860-1953-572.335					
Mean lake level 3/ 1900-1953-572.055					
Mean lake level 3/ March-December, incl.; 1900-1953, 572.167					

1/ Referred to low water datum, elevation 570.5 feet above mean tide at New York City.
2/ Monthly means as recorded by Cleveland, Ohio gage.
3/ Feet above mean tide at New York City.

178. Littoral currents and drift. - Because of the predominant and prevailing westerly winds in the area, there is a predominant and prevailing west to east littoral current along the easterly part of the south shore of Lake Erie. Because of the prevalence of shale at the waters edge, there is a scarcity of drift; however, where drift is available and structures or promontories extend into the lake there is, in general, an accumulation on the westerly side.

There are local exceptions where due to the configuration of the shore there are local reversals of direction. The Niagara River currents have little effect on the shore line, since the currents follow the deeper parts of the river usually some distance from shore. Where the currents do come in contact with the shore, the shore generally consists of bedrock and is not affected by the current.

179. Ice action. - Under normal conditions during late December, spray freezes and forms a coating of ice on the shore to heights up to 10 feet above lake level, thereby armoring the bluff against wave attack. During the latter part of December ice also begins to form in the shallow water near shore and during severe winters may freeze completely across the lake. Storms break up the ice and force it into windrows just offshore which protect the shore from wave action. Normally the ice fields break up early in March. When the breakup extends to shore, floating ice fields may damage shore structures. In general, the windrowed ice resting on the bottom of the lake prevents such action. The windrows become honeycombed and disintegrate early in March. Ice, therefore, usually has a net beneficial effect in preventing wave action from reaching the shore and bluff during the ice period.

180. Sources of beach building material. - No appreciable amount of beach building material is supplied to the lake shore by streams entering the lake, with the exception of Cattaraugus and

Eighteen Mile Creeks, and since bedrock forms at least the lower part of the shore bluffs for about 2/3 of the distance, the bluffs cannot be considered a good source of material for beach building. Although narrow beaches of sand, gravel, and shingle front bluffs for 1/2 of the shore line, these beaches, in general, are only a thin veneer covering a sloping bedrock beach. Where beaches are desired they must, in general, be constructed artificially. In Lake Erie there are sand deposits at one or two locations in the offshore area from which sand can be obtained. The only sand deposit in the upper Niagara River is Strawberry Island located upriver from Grand Island. However, no further dredging is allowed in this vicinity. The Niagara Shoals, located in Lake Ontario at the mouth of the Niagara River, is used by commercial dredges as a source of sand and gravel.

EXISTING CONDITIONS AND PRIOR CORRECTIVE ACTION

181. Laws pertaining to beach erosion control. - Portions of the Federal laws pertaining to beach erosion control are quoted below:

a. Public Law No. 520, Seventy-first Congress, Section 2 -

"The Chief of Engineers of the United States Army, under the direction of the Secretary of War, is authorized and directed to cause investigations and studies to be made in co-operation with appropriate agencies of various States on the Atlantic, Pacific, and Gulf coasts and on

the Great Lakes, and territories, with a view of devising effective means of preventing erosion of the shores of coastal and lake waters by waves and currents. Provided further, that no money shall be expended under authority of this section in any State which does not provide for cooperation with the agents of the United States and contribute to the project such funds as the Secretary of War may deem appropriate and require..."

b. Public Law 727, Seventy-ninth Congress, 2nd Session -

"That with the purpose of preventing damage to public property and promoting and encouraging the healthful recreation of the people, it is hereby declared to be the policy of the United States to assist in the construction, but not the maintenance, of works for the improvement and protection against erosion by waves and currents of the shores of the United States that are owned by States, municipalities, or other political subdivisions; Provided, That the Federal contribution toward the construction of protective works shall not in any case exceed one-third of the total cost..."

182. At the present time, there are no laws providing for the participation of the State of New York in any studies of erosion control or construction of works for the improvement or protection of shores other than those owned by the State.

183. There are no laws providing for Federal or New York State aid in the construction of works for the protection of privately-owned property against erosion by wave action or currents on Lake Erie of the Niagara River.

184. Existing Federal navigation structures. - The Federal Government has constructed navigation structures at Dunkirk Harbor, New York, Buffalo Harbor, New York, and the Black Rock Channel and Lock structures, at Buffalo. See Plates 31, 37, and 38, respectively, for the areas mentioned in the previous sentence.

a. Dunkirk Harbor structures consist of a west pier 1,410 feet long and a detached breakwater 2,814 feet long. Originally, the west pier extended eastward from about the center of Gratiot Point, through shallow water to the west side of the entrance channel. As the area south of the pier has since been filled and a steam power plant built on it, the pier is now acting as a sea wall. A sand beach has accumulated along the westerly end and covered the pier, resulting in abandonment of about 360 feet of pier at the west end. The westerly end of the breakwater is directly across the entrance channel from the easterly end of the pier. The breakwater extends about 577 feet in a southeasterly direction, then turns parallel to the west pier for 2,237 feet to end about 2,400 feet offshore.

b. Buffalo Outer Harbor extends along the Buffalo lake front from the city of Lackawanna to the Buffalo River, a distance

of approximately four miles. It is protected by a breakwater system fully described under Buffalo Harbor, Federal improvements, paragraph 106.

c. The Black Rock Channel and Lock were constructed to allow ships to bypass the swift current in the first few miles of the Niagara River. The channel extends for about 3-1/2 miles along the easterly shore from Buffalo Outer Harbor to the Black Rock Lock. It is separated from the river by the Bird Island Pier and Squaw Island. The pier varies in construction from rubble mound, to stone filled timber crib, to timber crib with concrete superstructure in its 9,724-foot length. The easterly side of the channel, in general, protected by a masonary wall. Due to the low elevation of Squaw Island, the Squaw Island Dike, 3,900 feet long, was constructed extending southerly from the vicinity of the present International Bridge. It is of earth construction and was originally built in 1882. This central portion of the island is now being filled by the city of Buffalo. Northerly from the railroad bridge the westerly side of the channel is protected by 800 feet, and the easterly side by 500 feet of steel sheet piling. The walls of the approach to the lock and the lock walls are concrete. A guide pier extends 1,300 feet downstream from the lock. It is of timber crib and concrete superstructure construction.

185. Existing State navigation structures. - The State of New York constructed the 1,800-foot New York State breakwater

parallel to and about 1,000 feet from the shore. It is located northerly from the mouth of Buffalo River and protects the Erie Basin located between the river mouth and the head of the Black Rock Channel.

186. Other Federally-owned frontages. - Plates 26 through 39 in this section show features of the following areas:

a. The U. S. Coast Guard's Gratiot Point Lighthouse Reservation at Dunkirk, New York, occupies about 8 acres at the outer end of Point Gratiot. Its 1,400-foot shore line consists of a vertical bluff, the lower 10 feet of which is shale, the upper 10 feet, silt and clay. Except around the extreme point, there is a 15-foot shelf rock beach. The point extends approximately 3/4 mile lakeward of the general shore line and is exposed to all storms from the southwest through north to northeast, resulting in a more rapid erosion of the shale then is generally found along the Lake Erie shore. The only protective structure at the reservation is a 120-foot wall at the outer end. The area adjoins Gratiot Park, a city park, and is open to the public.

b. The U. S. Coast Guard, Buffalo, New York Base is located at the entrance to Buffalo River. The northerly side of the reservation extends along the South Pier, the westerly boundary extends 1,000 feet along the Outer Harbor. This latter side is developed for docks and slips and is well protected from erosion.

c. The Corps of Engineers, Buffalo, New York, District Office, adjoins the Black Rock Lock. It is well protected by the

lock structures and a mooring slip at river level is protected by a steel sheet pile bulkhead.

d. The U. S. government owns a 500-foot frontage on the lower Niagara River about 4 miles above the mouth. The reservation was acquired for a pumping station for the Lake Ontario Ordnance Works. There are no protective structures, and erosion is not a problem.

e. Fort Niagara Military Reservation extends along the river for approximately 3,500 feet. About 1,500 feet at the downstream end of the reservation has been protected by stone filled timber cribs and large quarry stone where waves generated on Lake Ontario can attack the shore. The remainder of the shore is considered stable.

f. The U. S. Coast Guard, Niagara Lifeboat Station is located between the military reservation and Old Fort Niagara located at the mouth of the river. The Niagara Station has a river frontage of about 870 feet. It is protected by 690 feet of steel sheet pile bulkhead and along the portion exposed to waves generated on Lake Ontario heavy riprap stone has been added. Erosion is not a problem at the present time.

187. Other State-owned frontages. - Plates 26 through 39 show various features of the following locations:

a. Lake Erie State Park is under the jurisdiction of the Allegany State Park Commission. It is located about 7 miles southwest of Dunkirk, New York, and has an area of 240 acres and a shore

frontage of 5,300 feet. See Plate 30. At the westerly end of the park bedrock is exposed to a height of about 6 feet in the shore bluffs and forms the beach. Bedrock gradually drops below lake level near the center of the park and continues to drop toward the east. The bluffs about 30 feet high are nearly perpendicular in the westerly 1,300 feet. There are no bluffs in the central 2,000 feet, the land sloping gently upward from the water's edge. In the easterly 2,000 feet bluffs of lacustrine material up to 30 feet high repose on a stable slope. The beach, which at the westerly park limit consists of about 20 feet of shelf rock, changes gradually to gravel and shingle covered shale and finally to sand and gravel about 75 feet wide at the easterly boundary.

b. The New York State Naval Reserve Armory, Dunkirk, New York, adjoins the lighthouse reservation on the south. It has a 600-foot frontage with vertical shale bluffs and narrow shale beach. Erosion along this frontage is minor.

c. Evangola State Park, located on the lake shore at the Brant-Evans town line is under the jurisdiction of the Niagara Frontier State Park Commission. The property was acquired by the State late in 1953. The shore, about 4,000 feet in length, lies between two promontories. Farnham Pt., the southerly point consists of a 20-foot vertical shale bluff. The height of the shale diminished to about 10 feet at the northerly park limit. The northerly point is unnamed. The shale is covered by a thin layer of sandy overburden. The shale forms a steep shelving beach below lake

surface at the points and is covered by a sand beach up to 100 feet in width near the center. The central part was formerly operated as a beach and picnic area for a fee and is equipped with limited bathhouse facilities, picnic tables, and fire places. The height of the existing beach is insufficient to prevent the erosion of the thinly bedded shale found along the entire frontage.

d. The State of New York owns a 1,200-foot frontage of undeveloped land on Buffalo Outer Harbor, acquired in connection with the Niagara Thruway. It is filled land without protection and is subject to moderate erosion.

e. The New York State Barge Canal terminal facilities are located just north of the Buffalo River entrance on the Erie Basin. They have a total frontage of about 1,100 feet which is protected by wharves.

f. The New York State Thruway Authority owns a 2,000-foot frontage on the Niagara River in the town of Tonawanda adjoining the city of Buffalo. The area is being artificially filled and protected by stone riprap. The Thruway also owns a 400-foot frontage in the town of Tonawanda at the easterly easterly end of the South Grand Island Bridge and 600 feet in the town of Grand Island at the westerly end of the bridge. These frontages are unprotected and erosion is moderate.

g. Beaver Island State Park, under the jurisdiction of the Niagara Frontier State Park Commission, extends across the head

of Grand Island. It has a 12,000-foot frontage of which 2,500 feet has been developed artificially for a bathing beach. A large portion of the shore is low and swampy. There is no serious erosion along this park which is well developed for bathing and picnicking with bathhouse, restaurant, pavilion and picnic facilities. The attendance in 1953 was 567,075 persons.

h. West River Parkway, also under the jurisdiction of the Niagara Frontier Park Commission, extends for approximately seven miles along the westerly side of Grand Island. This is a scenic highway with parking areas for sight-seeing. The shore bluffs, in general, have been graded and about 1/3 of the shore, where erosion was very active, has been protected from wave action by stone revetment.

i. Buckhorn Island State Park, also under the jurisdiction of the Niagara Frontier State Park Commission, occupies about 923 acres at the foot of Grand Island. This park is to be retained to a great extent in its natural condition as a wild life sanctuary. At the present time there are no facilities for bathing or picnicking. The area for the most part is low and moderate erosion is experienced on both the East and West River shores. A few short stretches, where erosion was severe, have been protected by dumped stone riprap. During 1953, approximately 40,000 persons visited the park.

j. The New York State Thruway Authority owns a 600-foot frontage in the city of Niagara Falls at the mainland end of the North

Grand Island Bridge. The shore is low and consists of easily eroded till which has now been protected from wave attack by dumped stone revetment.

k. The Niagara Reservation is the headquarters of the Niagara Frontier State Park Commission and the focal point of visitors to Niagara Falls. It has an area of 428 acres and extends along the mainland shore for about 5,000 feet above the crest of the American Falls and along the Gorge from the Horseshoe Falls to within 90 feet of the Rainbow Bridge. It also includes Goat Island which separates the Horseshoe Falls from the American Falls. There is parking for approximately 800 cars, picnic facilities, restaurant, pavilion, and scenic tours behind the American Falls and a boat ride up the lower river to the foot of the Falls. The one-day peak attendance in 1953 was 40,000 persons and the total attendance was estimated at 2,833,000 persons. The shores, where not protected naturally by rock, have been revetted by riprap stone. The Commission also owns Whirlpool Park which is located on the rim of the Gorge at the Whirlpool, but has no shore frontage on the river. Over 220,000 persons visited this park, while 138,400 persons visited Devils Hole Park also located at the top of the Gorge, at the lower city limit of Niagara Falls.

188. Other publicly-owned frontages. - There are numerous frontages along the lake and river owned by cities, villages, and towns. Plates 26 through 39 show various features of the sites

listed below.

a. The town of Ripley, New York, owns two lake frontages:

(1) The town sewage disposal plant occupies a 200-foot frontage. The shore bluff is vertical shale and erosion is minor.

(2) The second frontage is used as a town dump. It has a 350-foot shore frontage vertical shale with no erosion problem.

b. Ottaway Park which is owned by the village of Westfield is a new, only partially developed, park, located about two miles east of Barcelona Harbor. It has a shore frontage of about 1,000 feet and an area of 11 acres. Only picnic facilities are presently available. The shore consists of a vertical shale bluff.

c. The shore line of the City of Dunkirk is 57 percent publicly-owned, the city itself owning approximately 47 percent of the shore.

(1) Gratiot Point Park occupies a 5,300-foot lake frontage on the westerly side of Gratiot Point adjoining the lighthouse property on the south. At the northerly park limit the vertical bluff consists of 10 feet of shale with 10 feet of silt and clay. The bluffs become gradually lower towards the southerly boundary where the shale is about at lake level and the bluffs only 8 to 10 feet high. Erosion is very active along this shore which is exposed to the predominant and prevailing wind and wave

approach. There are no protective structures and in the spring of 1954 erosion was within a few feet of the road and plans were being considered to relocate the road further inland. There is a narrow shale beach thinly covered by gravel in places but no bathhouse. There are picnic facilities available. The park is popular but no attendance figures are available.

(2) The city bathing beach is located on the easterly side of Gratiot Point along the westerly 600 feet of the west pier which has become buried by a beach of fine sand. There are no facilities at the beach and no erosion problems.

(3) Memorial Park is situated between the southerly harbor shore and Route 5. It has an 1,800-foot frontage protected by a substantial sea wall. The only facilities available are park benches.

(4) The city wharf about 100 feet wide and 800 feet long extends into the harbor from the foot of Central Avenue.

(5) Wright Boulevard and Park commences about 2,000 feet east of the city wharf and extends 6,000 feet along the shore to the east. The westerly 4,000 feet is protected by a substantial sea wall, the easterly 2,000 feet is being improved. Along the easterly 1,000 feet of the sea wall there is a sand beach up to 30 feet wide. At the end of the sea wall the beach widens to 75 feet. The bluffs in the easterly portion are vertical faced, with shale outcropping at elevation 2 feet at the westerly end and gradually rising to 30 feet at the east end. The overburden consisting of

silt and clay varies from elevation 15 to 35 feet. Erosion is active. Storms during early 1954 have weakened a section of the sea wall near the center by scouring away the sand from the toe of the wall. Erosion of the bluff in the easterly section is also severe where the shale is low. No attendance figures are available.

d. Sheridan Town Park occupies a 350-foot lake frontage about 3 miles east of Dunkirk. The park is well equipped with bathhouse, refreshment stand, pavilion and picnic facilities. The shore bluffs are vertical shale and vary in height from 10 to 30 feet. There is a narrow shale beach covered by a thin layer of sand and gravel. Erosion is minor. No figures on attendance are available.

e. The village of Silver Creek owns an undeveloped 66-foot frontage just west of the mouth of Silver Creek. The shore consists of an unprotected sand beach which rises gently to elevation eight feet. Erosion is minor.

f. Hanover Town Park has a lake frontage of 407 feet on the westerly side of the mouth of Cattaraugus Creek. It is undeveloped and consists of a wide beach of fine sand backed by a sand dune. There is no erosion problem.

g. Brant Town Park is located on the Cattaraugus Indian Reservation at its easterly boundary. Its shore frontage is officially given as 350 feet, although a larger frontage is being actually used. The shore consists of a 50-foot sand beach backed by sand

dunes to 20 feet in height. Rock is present in the dunes to elevation 8 feet. The park is equipped with bathhouse, refreshment stand, pavilion and picnic facilities. Erosion is not a problem at the present time.

h. Evans Town Park is located about 1/4 mile west of Delaware Creek. It has a shore frontage of 400 feet of fine sand. The park is well equipped for both bathing and picnics with bathhouse, pavilions, refreshment stand and picnic facilities. There is no problem of erosion at the present time. No attendance figures are available.

i. The village of Angola water works occupies a shore frontage of 100 feet. There is a wide sand beach along the frontage and no problem of erosion.

j. The city of Buffalo Municipal Bathing Beach (Bennett Beach) is located about 2,000 feet south of the mouth of Big Sister Creek and adjoins the Angola water works on the north. It has a 75-foot wide sand beach along its 900-foot frontage backed by a sand dune up to 25 feet in height. Bathhouse, pavilion, refreshment stand and excellent picnic facilities are available. There is no problem of erosion at this park at the present time.

k. Erie County owns a large unimproved area with a shore frontage of 1,800 feet immediately east of Sturgeon Point. The shore consists of a vertical shale bluff 30 feet high with no beach. Erosion is very minor.

(1) The Wanakah Sewer Distric occupies about 60 feet of lake shore near the junction of Route 5 and the Old Lake Shore Road. Erosion is not a problem at the present time.

m. Hamburg Town Park located about 1 mile west of the southeasterly corner of the lake has a shore frontage of about 1,500 feet. There is a sand and gravel beach in front of a 1,000-foot concrete sea wall. The bathhouse occupies the lower floor of a building housing the New York State Police.

n. Erie County Water Authority has a shore frontage of approximately 100 feet immediately south of the city of Lackawanna. The shore at this point consists of about a 300-foot sand beach. It is an area of accretion.

o. The city of Buffalo owns numerous shore frontages improved and unimproved:

(1) Along the Buffalo Outer Harbor the city owns:

(a) A 600-foot unimproved frontage with a 30-foot beach.

(b) A 2,500-foot undeveloped artificially filled area.

(c) A 2,500-foot frontage developed for a small boat harbor and protected by a slag dike.

(d) A 1,000-foot frontage developed for commercial shipping with wharves.

(e) A 4,400-foot frontage artificially filled but otherwise undeveloped.

(2) A commercial shipping wharf and dock with a 100-foot frontage adjoining the New York State Barge Canal Terminal on the south.

(3) Frontages along the Black Rock Channel and Niagara River:

(a) A 700-foot frontage developed for use as a Marine airport.

(b) LaSalle Park, with a 3,000-foot frontage, is protected by a substantial sea wall. The park is only partially developed with benches and roads being the only facilities.

(c) The Ward pumping station of the Water Department adjoins the park on the north. It has a 1,100-foot frontage protected by a sea wall.

(d) The Front, another city park, has an 1,800-foot frontage along Black Rock Channel. Portions of the park are leased to the Buffalo Yacht Club, the New York State Naval Militia, and the Sea Scouts; the remainder of the shore is undeveloped, although protected by stone revetment.

(e) Two short frontages 100 and 300 feet, respectively, are leased for residential purposes. Both frontages are protected by stone revetment.

(f) A 200-foot frontage at the mouth of Scajaquada Creek is leased to a marine supply company.

(g) Squaw Island and Bird Island are divided into three parts. The upper portion forms a park and is occupied

by the Bird Island sewage disposal plant. The shore of approximately 4,600 feet is protected by steel sheet piling or stone revetment. The central section extending downstream to the International Bridge is being filled and is the site of the new incinerator plant. The channel shore is protected by stone revetment, the river shore is unprotected. The shore in the first 800 feet below the bridge is protected on the channel side by steel sheet piling forming the approach channel to the locks. Below this point the island shore draws away from the channel and both sides of the island are unprotected. Of the 3.4 miles of shore line 1.5 is protected and 1.9 unprotected. The river shore is actively eroding; however, since most of the unprotected area is in the process of being filled, no protection is considered necessary until filling is completed.

(h) Riverside Park, located immediately south of the city limit has a 1,300-foot frontage protected by a substantial masonry sea wall and promenade. From the top of the wall the graded bluffs rise to a highway. The main part of the park lies on the other side of the highway. Its facilities include a swimming pool, boathouse, refreshment stand and picnic facilities.

p. The Erie County Highway Department has jurisdiction over an 11,000-foot frontage in the town and city of Tonawanda. It is the former Erie Canal right-of-way which has been or is being artificially filled. The frontage has been improved for about

3,000 feet as a park and 1,500 feet have been protected by stone revetment. Erosion in the portion within the city has been severe during high river stages.

q. The city of Tonawanda water intake property has a river frontage of only ten feet.

r. The city of North Tonawanda owns six river frontages.

(1) A frontage of 400 feet on the Little River which is adjacent to two slips is leased for boat house purposes. The shore is protected by a double row of close-driven round piles.

(2) The water intakes for the city of North Tonawanda and the city of Lockport occupy frontages of 12 and 22 feet, respectively. The shore line is protected.

(3) A frontage of 50 feet on the river adjacent to a slip is also leased for use as boat house sites.

(4) The site of the proposed sewage disposal plant has a 1,000-foot frontage. The area, protected by a double row of close driven piles, is also a former blast furnace slag dump. It is well protected at the present time.

(5) Two other frontages similar to the disposal plant property have been set aside for park purposes. They have frontages of 450 and 1,310 feet, respectively.

s. The city of Niagara Falls has 3 river front parks and 2 publicly-owned properties used for other purposes:

(1) Griffon Park located on the main land shore of the river opposite the head of Cayuga Island has a shore frontage

of 1,500 feet. Filling in of the former swamp area has been recently completed. The shore is being protected by stone revetment. No park facilities are available at the present time.

(2) Jayne Park is located on Cayuga Island and extends for 2,300 feet upstream along the inner side of the island from the 86th Street Bridge, leading to the island. The shore which is low has been protected for the entire frontage. The park has picnic and game facilities only.

(3) The city of Niagara Falls Waterworks property has a shore frontage of 944 feet. The enlargement of the station is still in progress and the shore is in the process of being filled.

(4) Porter Park, located immediately upstream of the intake canal to the power company, has a frontage on the river of only 180 feet. It is protected by a substantial masonry wall along the river and the canal. Park benches are the only facilities available.

(5) The city owns a 622-foot frontage along the shore of the lower river about 1 mile below the Rainbow Bridge. It is unprotected and undeveloped, and was acquired by tax sale.

PLANS OF IMPROVEMENT

189. General plans of improvement. - General criteria for the design of seawalls, revetment, and beaches are given below:

a. Seawalls. - A well designed seawall includes a firm foundation carried well below the level to which scour may be

expected to occur in front of the wall. The height should be such that it will protect the shore behind it from wave attack by the maximum wave capable of attacking it at extreme high lake levels. The wall should also be designed to resist overturning caused by the fill behind it.

b. Revetment. - Stone revetment should consist of a protective belt of stone with individual stones in the face of the protection of such size that wave action will not displace them. The remainder of the stones should be of such sizes that the stones will not be lost between the cover stones and wave action will not remove fine material from the bluffs by piping action.

c. Beaches. - Where beaches created by nature are too small to protect the bluffs from wave attack, or where there are no beaches, they may be created in one of the following ways:

(1) The supply of beach material available to the area may be increased by placing additional materials in stock piles updrift of the area and allowing natural forces to distribute it along the shore.

(2) Where littoral currents are weak, the material may be placed directly on the beach on the desired area to a suitable profile to prevent wave action reaching the bluff.

(3) Where there is a strong littoral current and a sufficient supply of littoral drift, groins may be employed to retard the current and drift and accummulate a beach.

(4) Where there is a strong littoral current but an insufficient amount of drift, a beach may be constructed by artificially placing material to the desired profile and containing it by groins to reduce the rate of removal.

Periodic replenishment of sand may be required to maintain beaches created artificially by any of these methods.

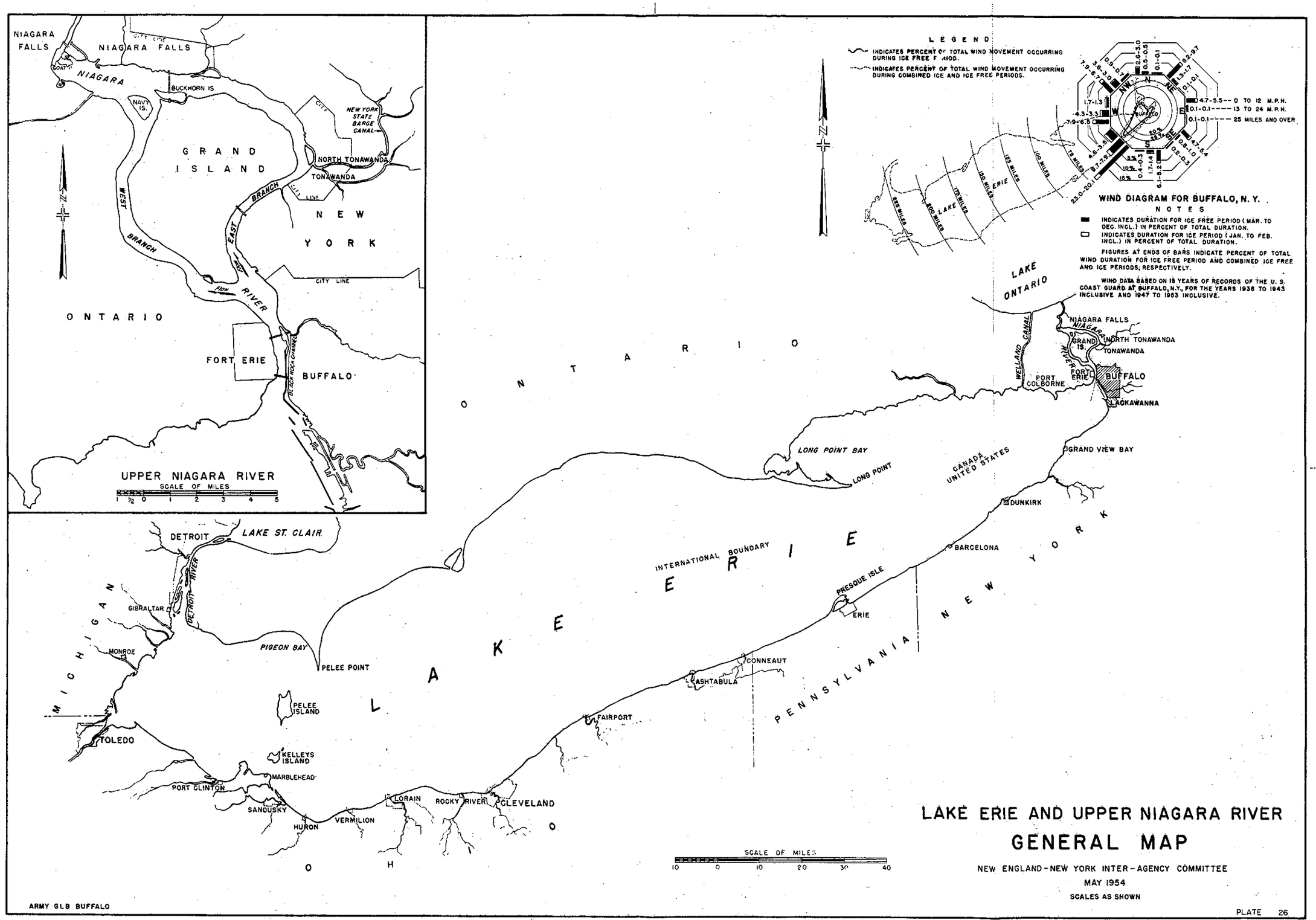
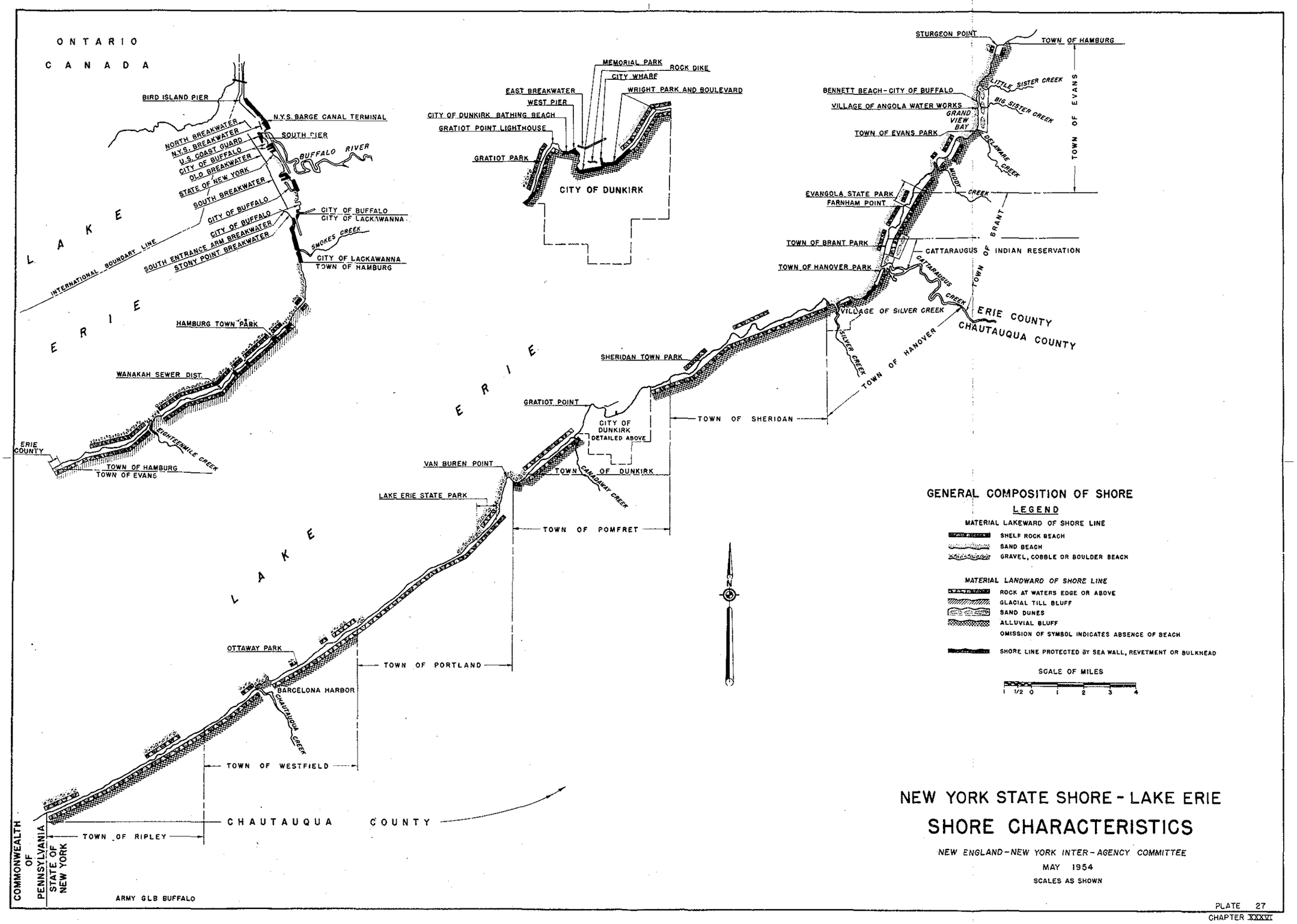


PLATE 26
CHAPTER XXXVI

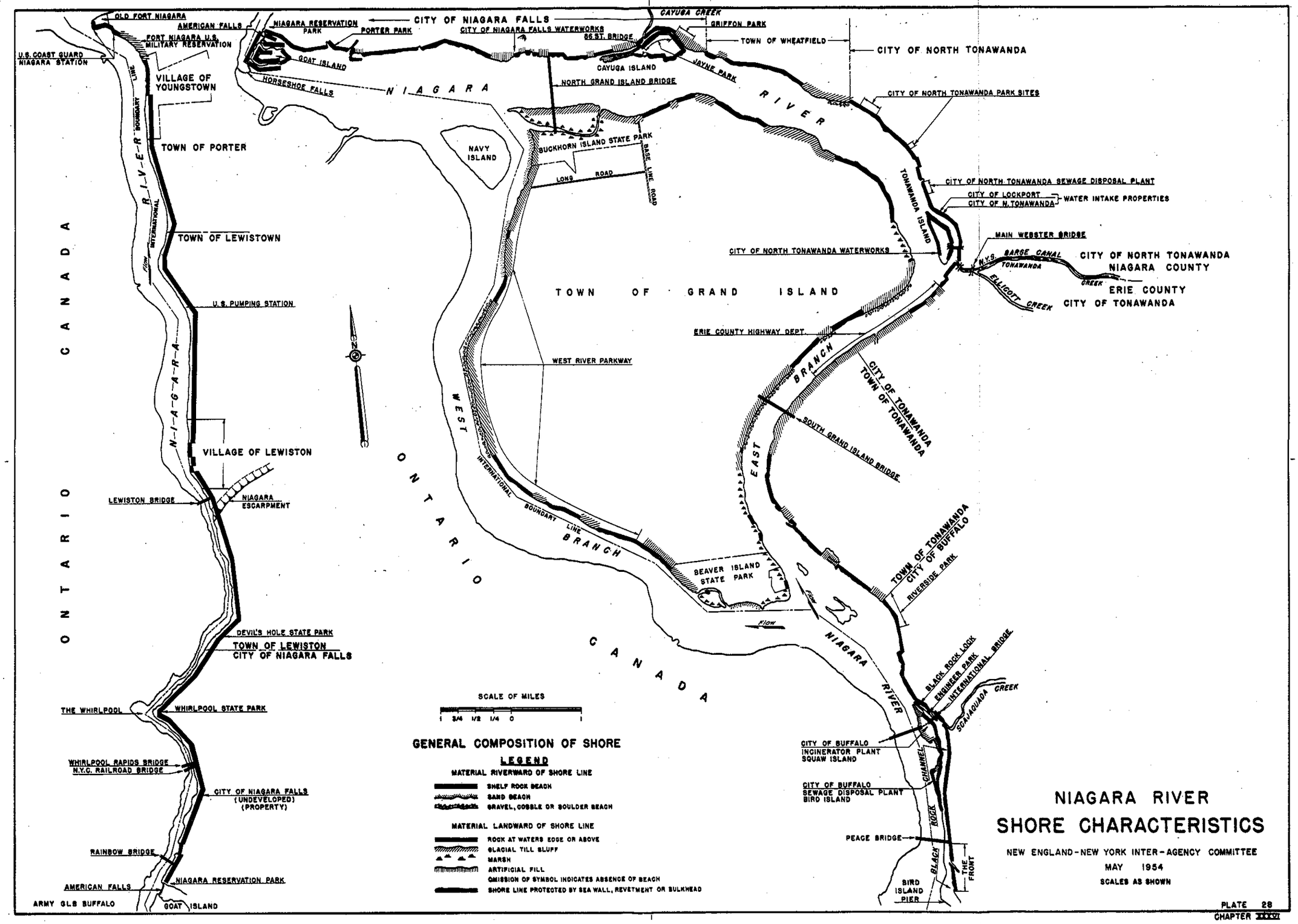


NEW YORK STATE SHORE - LAKE ERIE
SHORE CHARACTERISTICS

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

MAY 1954

SCALES AS SHOWN



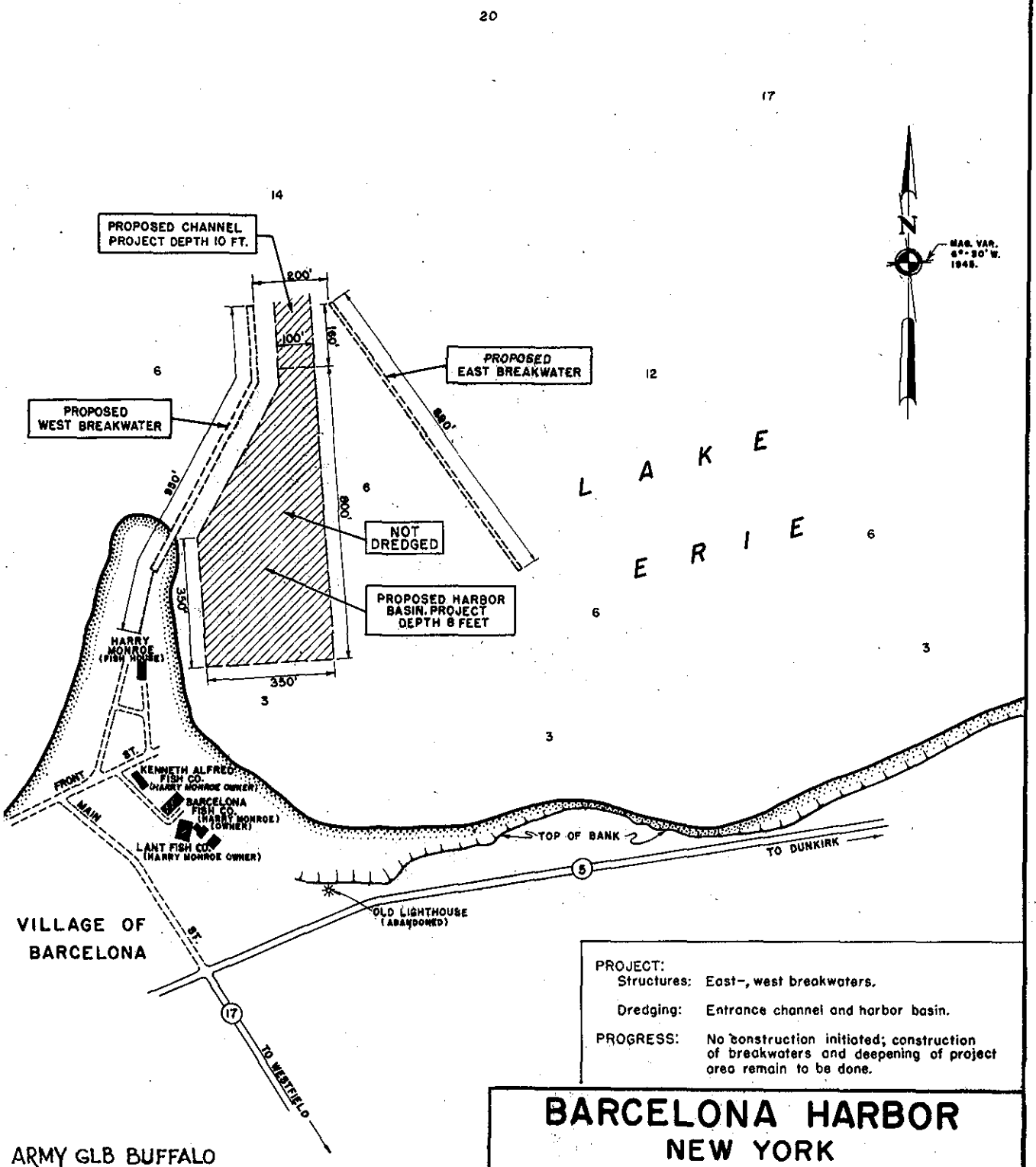
NIAGARA RIVER
SHORE CHARACTERISTICS

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

MAY 1954

SCALES AS SHOWN

PLATE 28
CHAPTER XXXVI



PROJECT:
Structures: East-, west breakwaters.
Dredging: Entrance channel and harbor basin.
PROGRESS: No construction initiated; construction of breakwaters and deepening of project area remain to be done.

ARMY GLB BUFFALO

NOTES

PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 570.5 FT. ABOVE MEAN TIDE AT NEW YORK CITY.

(17) = STATE ROUTE

BARCELONA HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

SCALE OF FEET
200 100 0 200 400 600

AUGUST 1954

PLATE 29

CHAPTER XXXVI

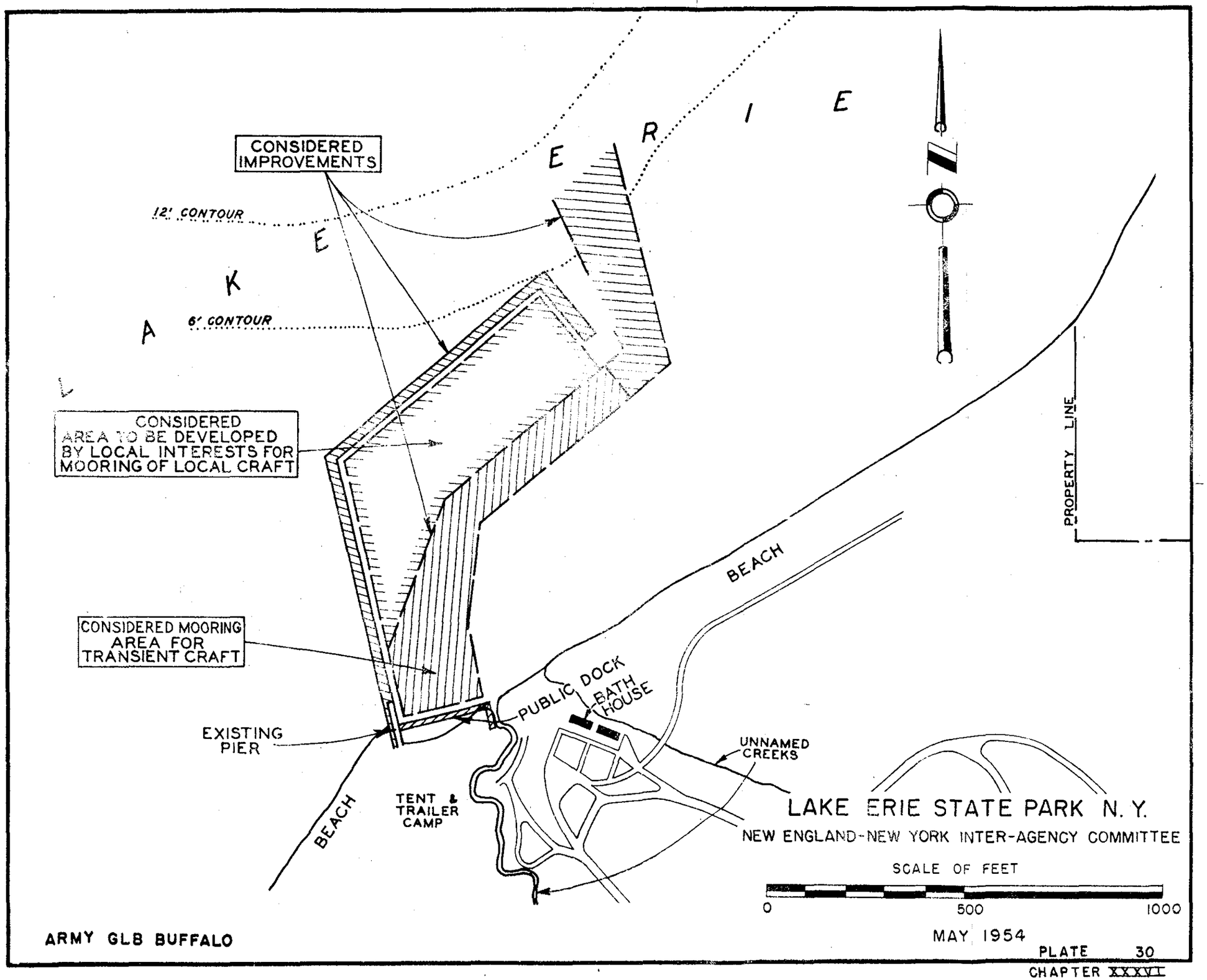


PLATE 30

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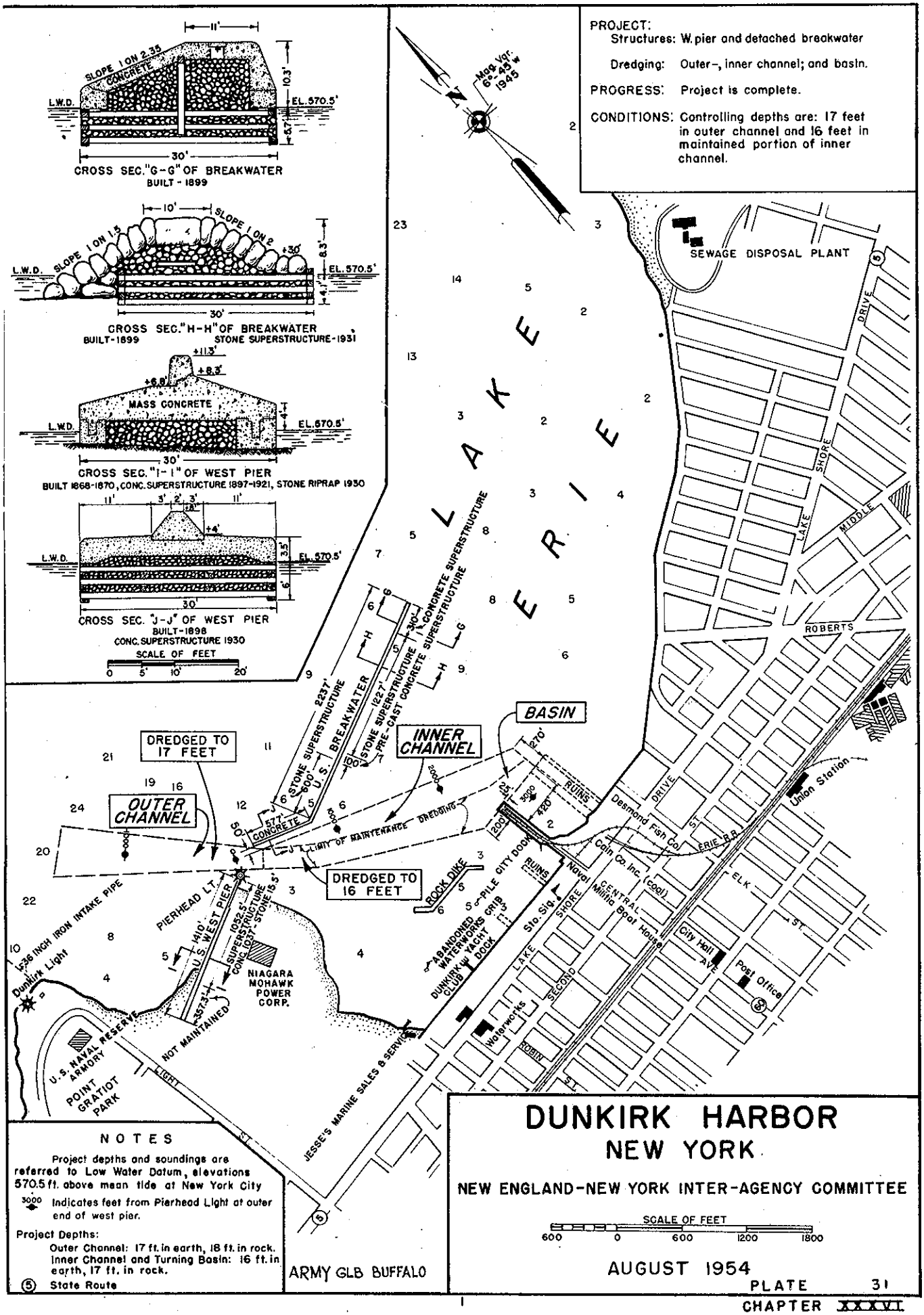

PROJECT:
Structures: W. pier and detached breakwater
Dredging: Outer-, inner channel; and basin.
PROGRESS: Project is complete.
CONDITIONS: Controlling depths are: 17 feet in outer channel and 16 feet in maintained portion of inner channel.
CROSS SEC. "G-G" OF BREAKWATER
BUILT - 1899
CROSS SEC. "H-H" OF BREAKWATER
BUILT-1899
STONE SUPERSTRUCTURE-1931
CROSS SEC. "I-I" OF WEST PIER
BUILT 1868-1870, CONC. SUPERSTRUCTURE 1897-1921, STONE RIPRAP 1930
CROSS SEC. "J-J" OF WEST PIER
BUILT-1898
CONC. SUPERSTRUCTURE 1930
SCALE OF FEET
Mag. Var. 6°-45' W 1945
SEWAGE DISPOSAL PLANT
LAKE ERIE
DREDGED TO 17 FEET
OUTER CHANNEL
INNER CHANNEL
BASIN
DREDGED TO 16 FEET
U.S. BREAKWATER
STONE SUPERSTRUCTURE
CONCRETE SUPERSTRUCTURE
PRE-CAST CONCRETE SUPERSTRUCTURE
LIMIT OF MAINTENANCE DREDGING
ROCK DIKE
PILE CITY DOCK
ABANDONED WATERWORKS CRIB
DUNKIRK YACHT CLUB DOCK
Naval Militia Boat House
Cain Co. Inc. (coal)
Desmond Fish Co.
Union Station
City Hall
Post Office
Waterworks
Sta. Sig.
NIAGARA MOHAWK POWER CORP.
PIERHEAD LT.
U.S. WEST PIER
36 INCH IRON INTAKE PIPE
Dunkirk Light
U.S. NAVAL RESERVE ARMORY
POINT GRATIOT PARK
NOT MAINTAINED
JESSE'S MARINE SALES & SERVICE
ARMY CLB BUFFALO
NOTES
Project depths and soundings are referred to Low Water Datum, elevations 570.5 ft. above mean tide at New York City
3000 Indicates feet from Pierhead Light at outer end of west pier.
Project Depths:
Outer Channel: 17 ft. in earth, 18 ft. in rock.
Inner Channel and Turning Basin: 16 ft. in earth, 17 ft. in rock.
(5) State Route
DUNKIRK HARBOR
NEW YORK
NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE
SCALE OF FEET
600 0 600 1200 1800
AUGUST 1954
PLATE 31
CHAPTER XXXVI

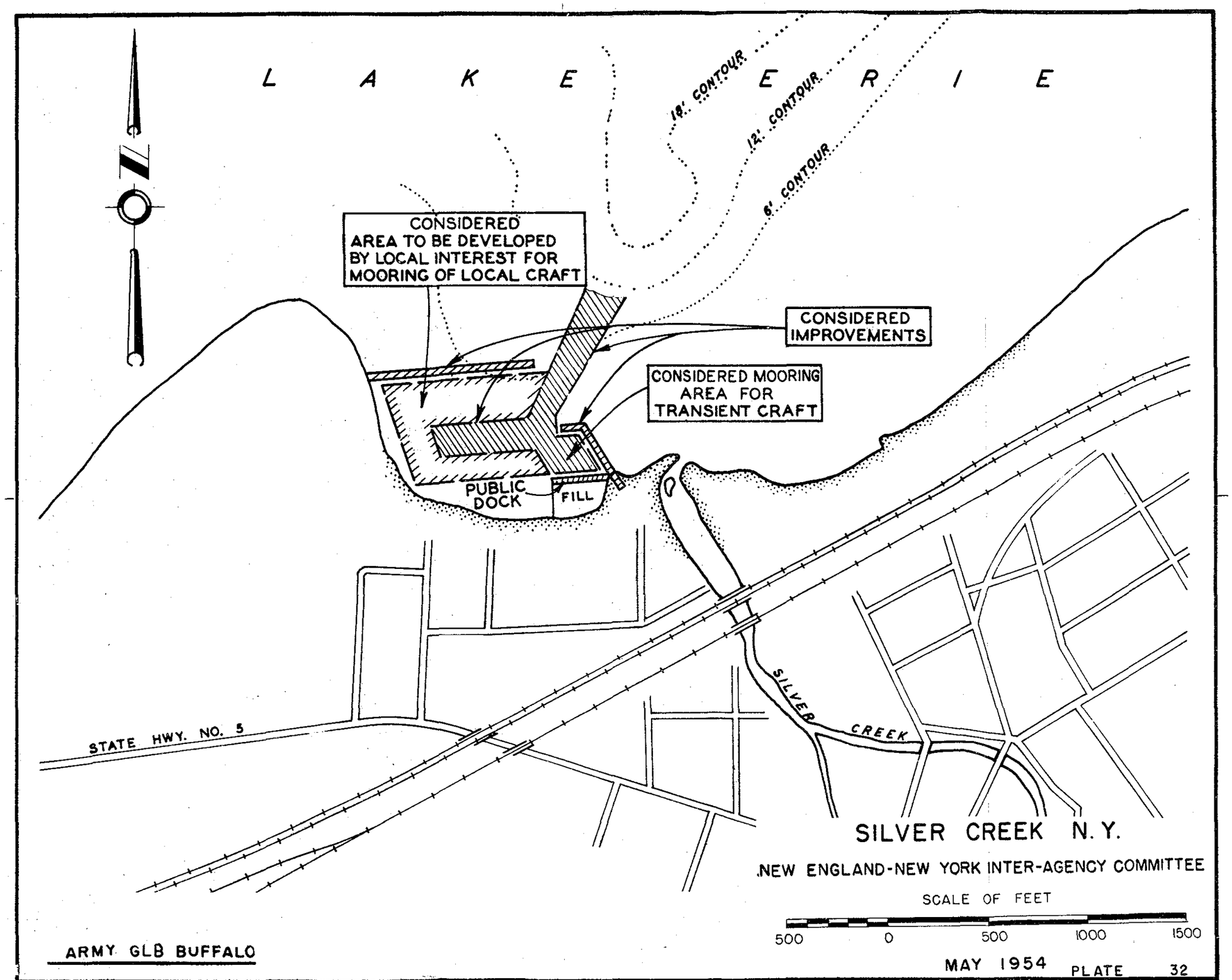
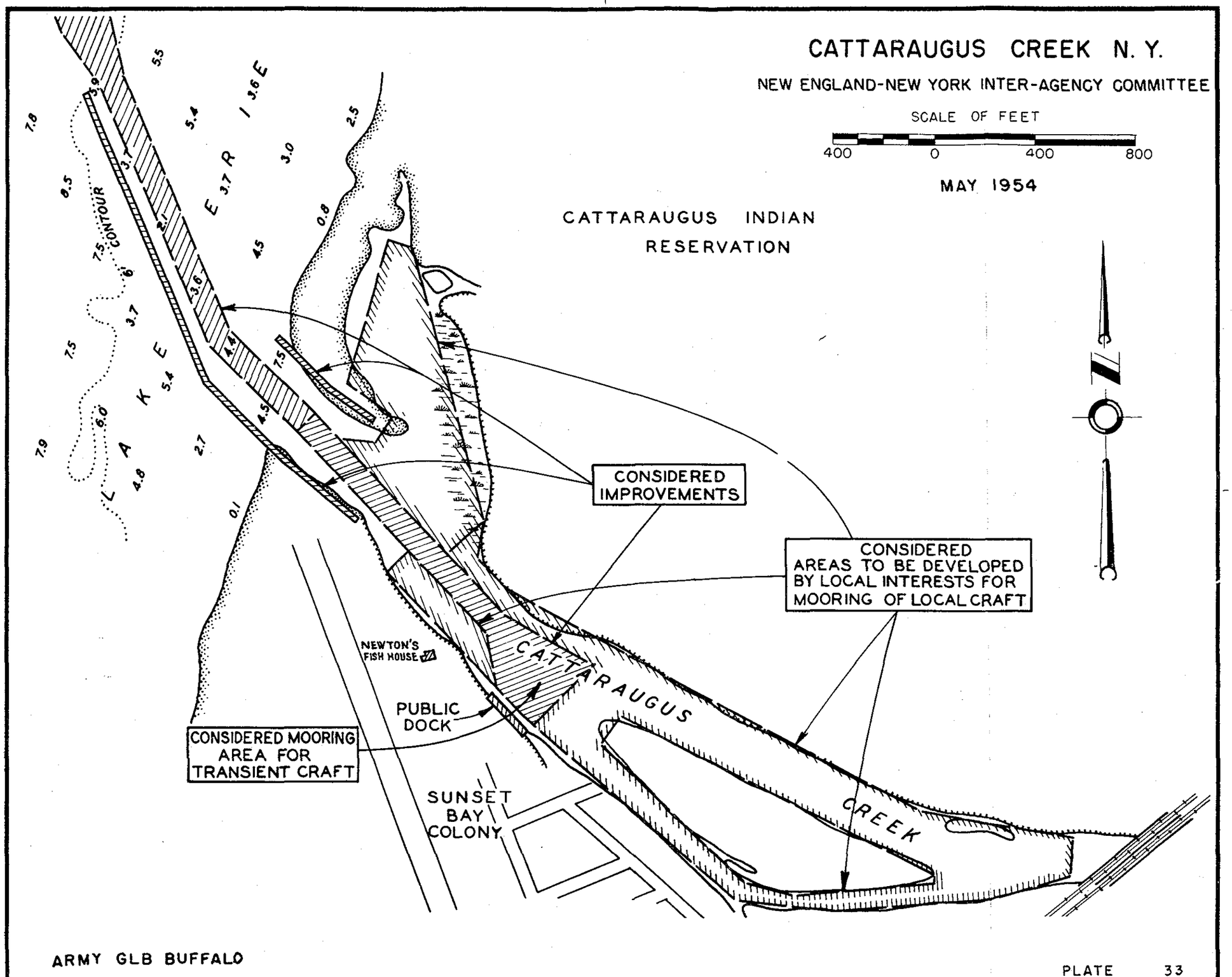


PLATE 32

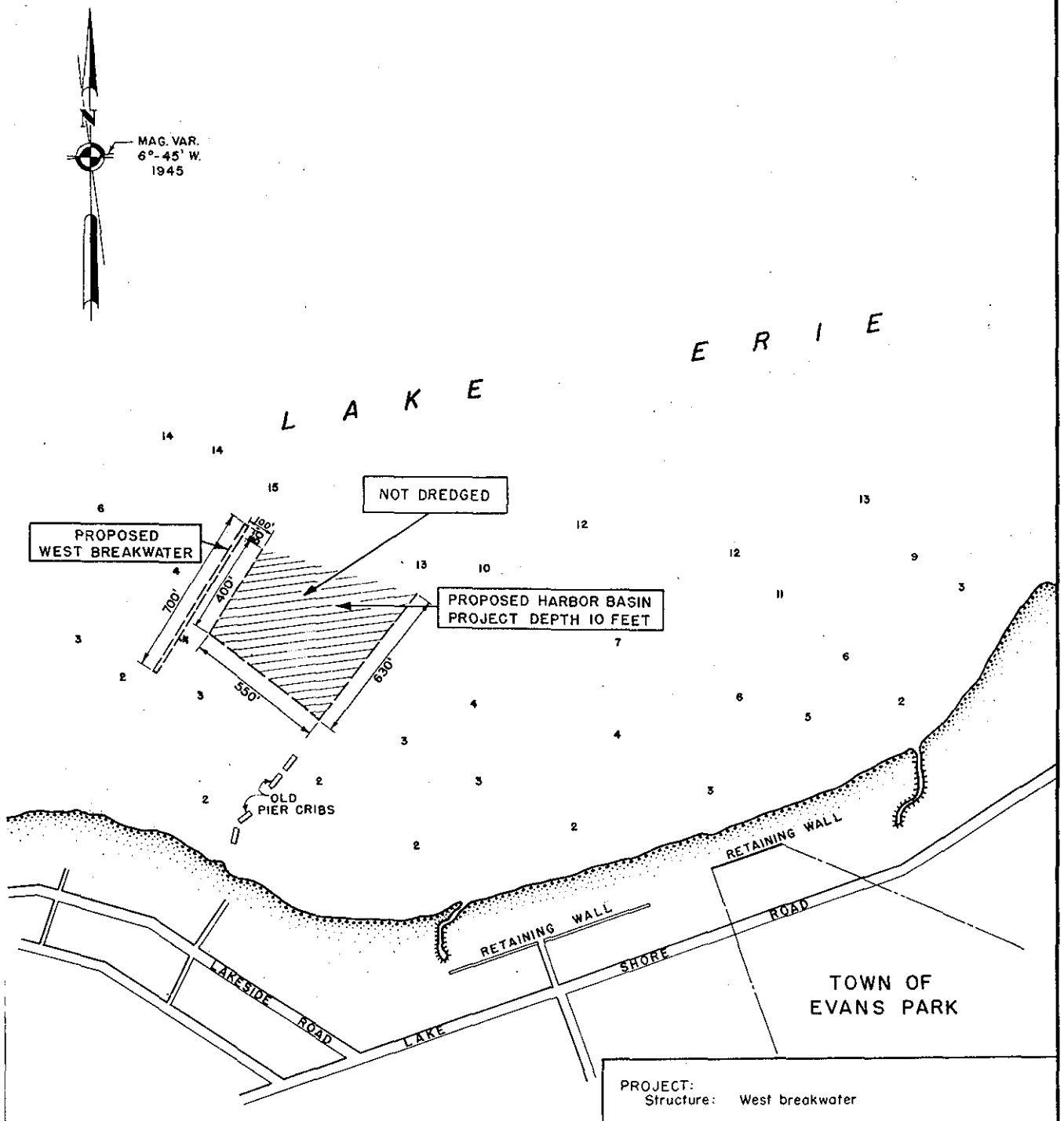
CHAPTER XXXVI



ARMY GLB BUFFALO

PLATE 33

CHAPTER XXXVI



PROJECT:
Structure: West breakwater
Dredging: Harbor basin
PROGRESS: No work has been done

ARMY GLB BUFFALO

NOTE:
PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEV. 570.5 FT. ABOVE MEAN TIDE AT NEW YORK CITY.

GRAND VIEW BAY
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

SCALE OF FEET
300 0 300 600 900

AUGUST 1954

PLATE 34

CHAPTER XXXVI

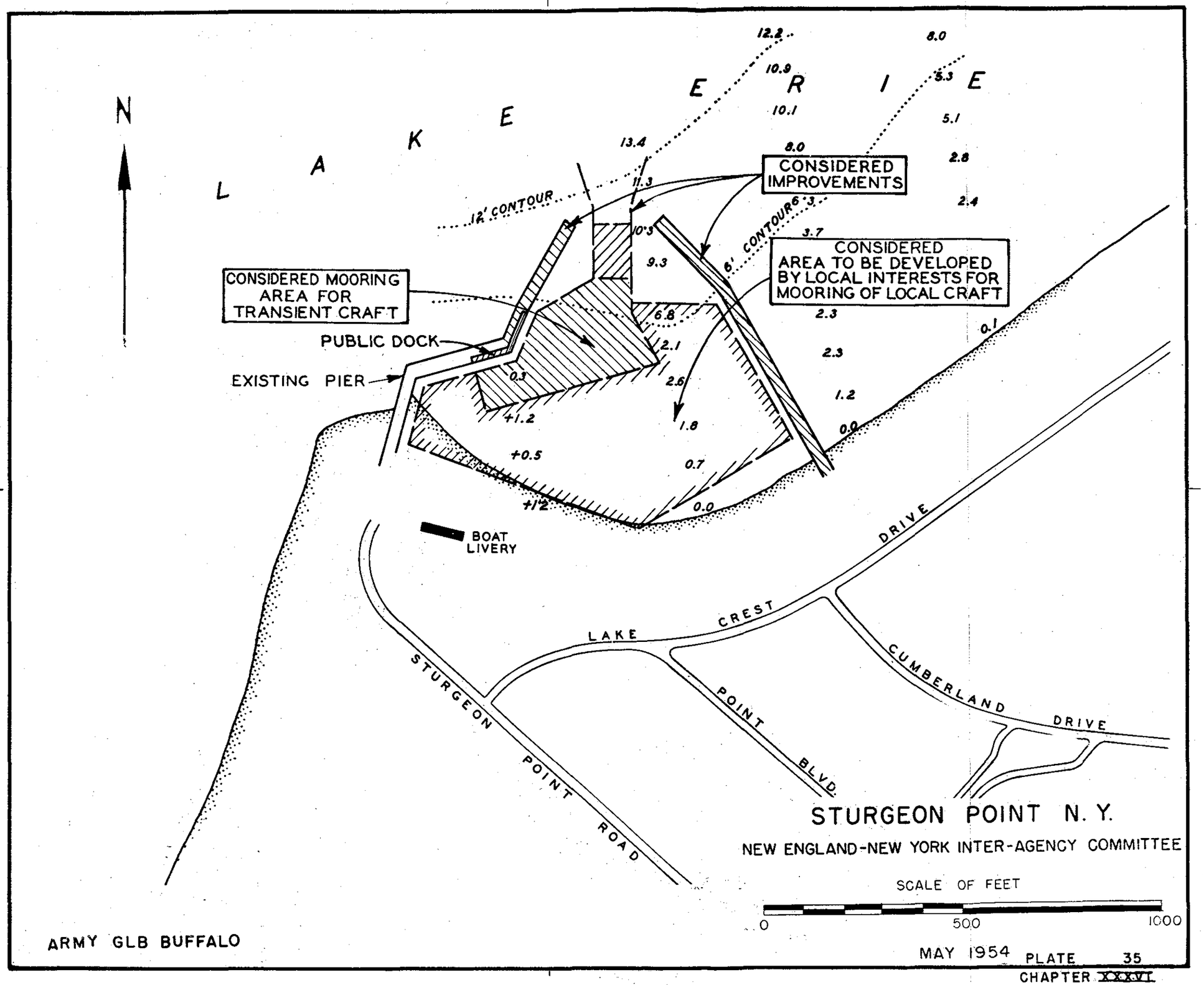


PLATE 35

CHAPTER XXXVI

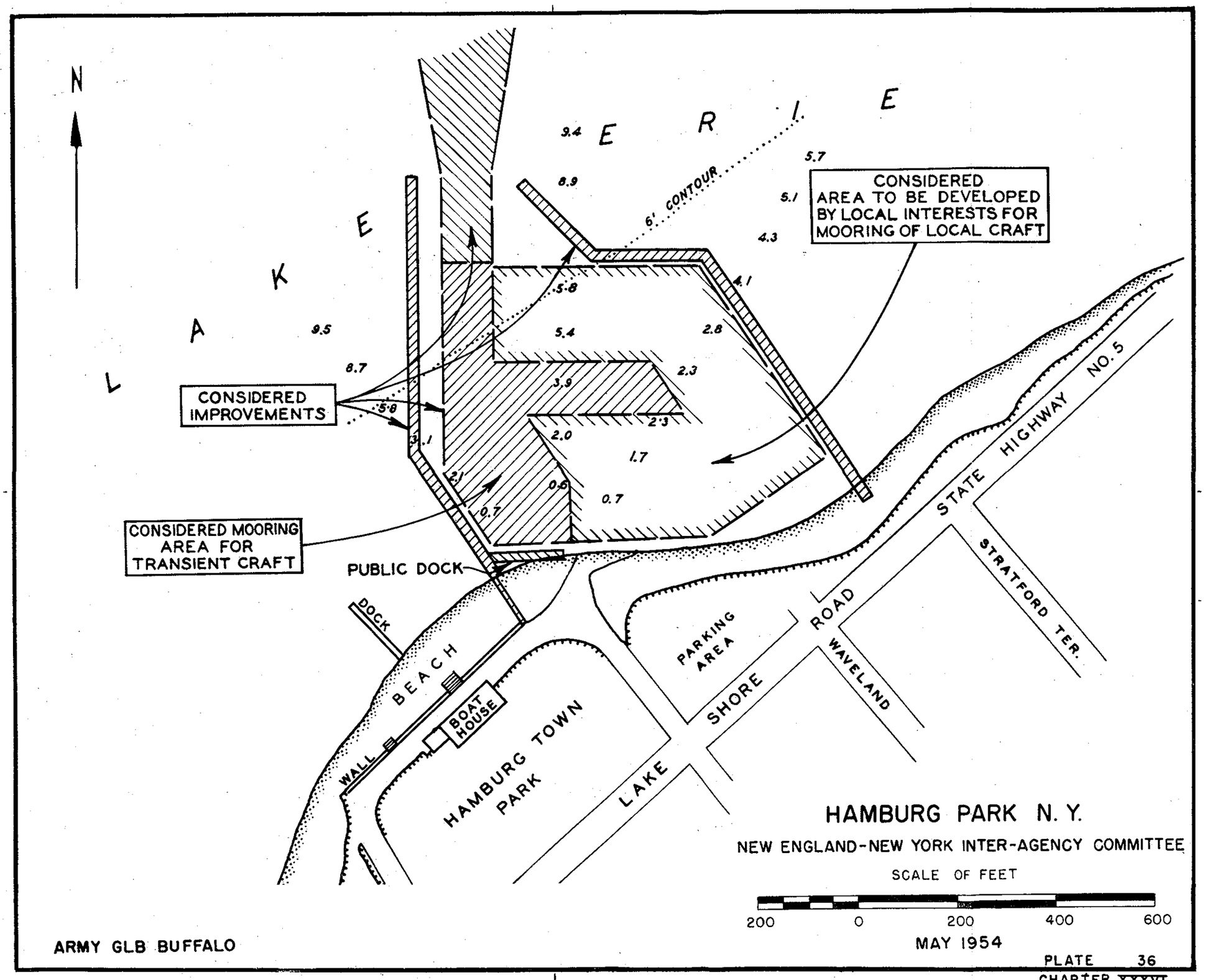
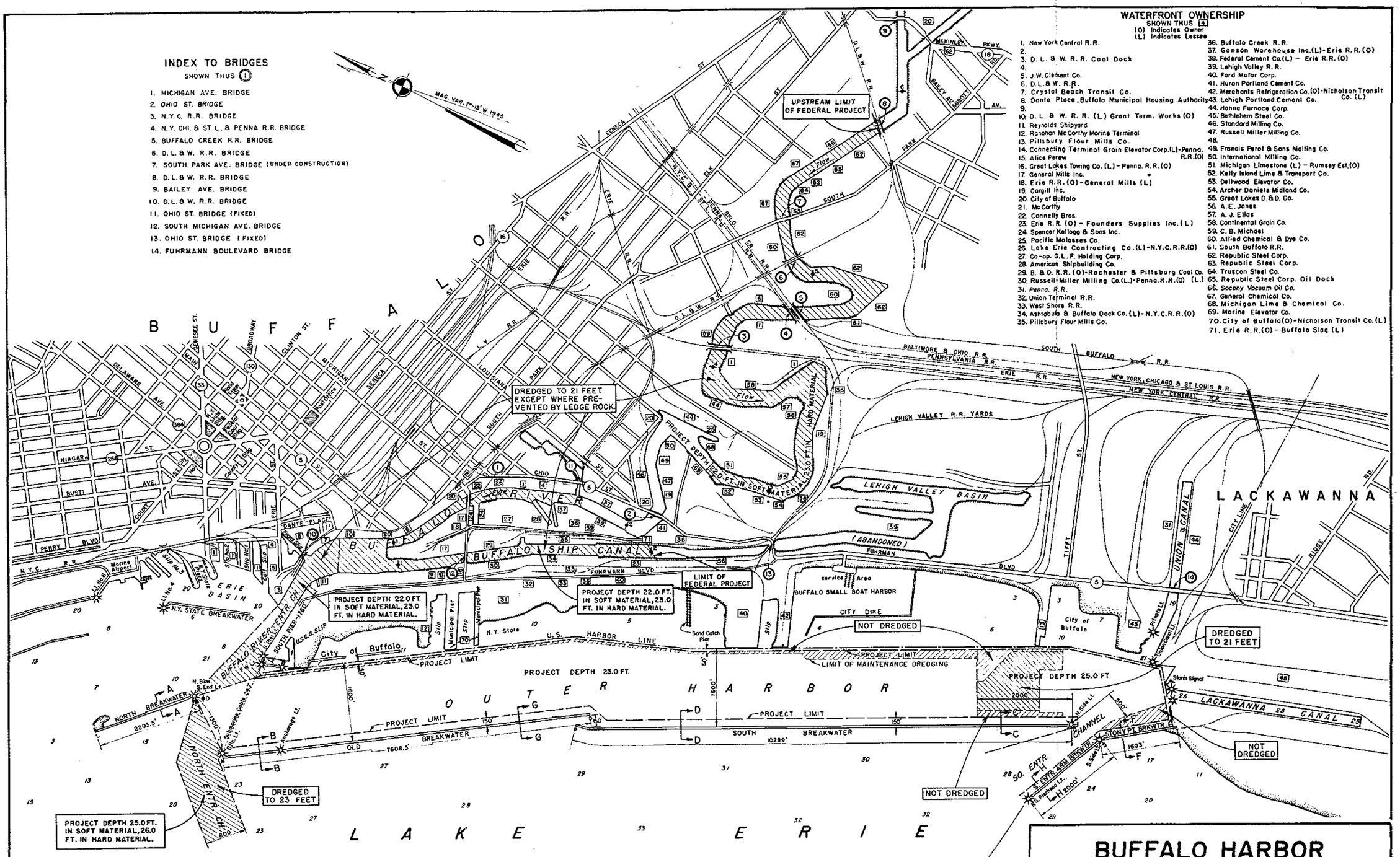


PLATE 36
CHAPTER XXXVI



WATERFRONT OWNERSHIP

SHOWN THUS [4]
(O) Indicates Owner
(L) Indicates Lessee

1. New York Central R.R.
2.
3. D. L. & W. R. R. Coal Dock
4.
5. J.W. Clement Co.
6. D.L.& W. R.R.
7. Crystal Beach Transit Co.
8. Dante Place, Buffalo Municipal Housing Authority
9.
10. D. L. & W. R. R. (L) Grant Term. Works (O)
11. Reynolds Shipyard
12. Ranahan McCarthy Marine Terminal
13. Pillsbury Flour Mills Co.
14. Connecting Terminal Grain Elevator Corp.(L)-Penna. R.R.(O)
15. Alice Perew
16. Great Lakes Towing Co. (L) - Penna. R.R. (O)
17. General Mills Inc.
18. Erie R.R. (O) - General Mills (L)
19. Cargill Inc.
20. City of Buffalo
21. McCarthy
22. Connelly Bros.
23. Erie R.R. (O) - Founders Supplies Inc. (L)
24. Spencer Kellogg & Sons Inc.
25. Pacific Molasses Co.
26. Lake Erie Contracting Co. (L)-N.Y.C.R.R.(O)
27. Co-op. G.L.F. Holding Corp.
28. Americos Shipbuilding Co.
29. B. & O. R.R. (O)-Rochester & Pittsburg Coal Co.
30. Russell Miller Milling Co.(L.)-Penna.R.R.(O) (L.)
31. Penna. R.R.
32. Union Terminal R.R.
33. West Shore R.R.
34. Ashtabula & Buffalo Dock Co. (L)-N.Y.C.R.R.(O)
35. Pillsbury Flour Mills Co.
36. Buffalo Creek R.R.
37. Ganson Warehouse Inc.(L)-Erie R.R.(O)
38. Federal Cement Co.(L) - Erie R.R.(O)
39. Lehigh Valley R.R.
40. Ford Motor Corp.
41. Huron Portland Cement Co.
42. Merchants Refrigeration Co.(O)-Nicholson Transit Co. (L)
43. Lehigh Portland Cement Co.
44. Hanna Furnace Corp.
45. Bethlehem Steel Co.
46. Standard Milling Co.
47. Russell Miller Milling Co.
48.
49. Francis Perot & Sons Malting Co.
50. International Milling Co.
51. Michigan Limestone (L) - Rumsey Est.(O)
52. Kelly Island Lime & Transport Co.
53. Dellwood Elevator Co.
54. Archer Daniels Midland Co.
55. Great Lakes D.& D. Co.
56. A.E. Jones
57. A. J. Elias
58. Continental Grain Co.
59. C. B. Michael
60. Allied Chemical & Dye Co.
61. South Buffalo R.R.
62. Republic Steel Corp.
63. Republic Steel Corp.
64. Truscon Steel Co.
65. Republic Steel Corp. Oil Dock
66. Socony Vacuum Oil Co.
67. General Chemical Co.
68. Michigan Lime & Chemical Co.
69. Marine Elevator Co.
70. City of Buffalo(O)-Nicholson Transit Co.(L)
71. Erie R.R.(O) - Buffalo Slag (L)

PROJECT:
Structures: North -, old -, south -, south entrance orm -, Stony Point breakwater; south pier.
Dredging: Outer harbor; south -, north -, Buffalo River entrance channel; Buffalo River and Buffalo Ship Canal channels; removal of rock shoals on approach to south entrance channel.

PROGRESS: Project is 30% complete.
Completion of deepening of north -, and Buffalo River entrance channels, Buffalo River and Ship Canal, and remaining portions of outer harbor, all to project depths, remains to be done to complete project.

CONDITIONS: Controlling depths are: 25 feet in south entrance channel and the completed portion of the southerly section of the outer harbor; 21 feet in the uncompleted section of the southerly outer harbor; 22 feet in completed portion of northerly section of outer harbor; 21 feet in north entrance channel; 20 feet in Buffalo River entrance channel, Buffalo River, and Buffalo Ship Canal.

NOTES

Project depths and soundings are referred to low water datum, elevation 570.5 feet above Mean Tide at New York City.
-2 Indicates miles above N. Breakwater S. End Light.
(65) Indicates U. S. Route.
(5) Indicates State Route

REMOVAL OF THREE SHOALS 1 2/5-3 3/4 MI. (AZ 275° 45') FROM SOUTH PIERHEAD LT. TO PROJECT DEPTH OF 27 FEET COMPLETED DURING 1953

ARMY GLB BUFFALO

BUFFALO HARBOR
NEW YORK

NEW ENGLAND-NEW YORK INTER-AGENCY COMMITTEE

SCALE OF FEET
1000 0 1000 2000 3000

AUGUST 1954 PLATE 37

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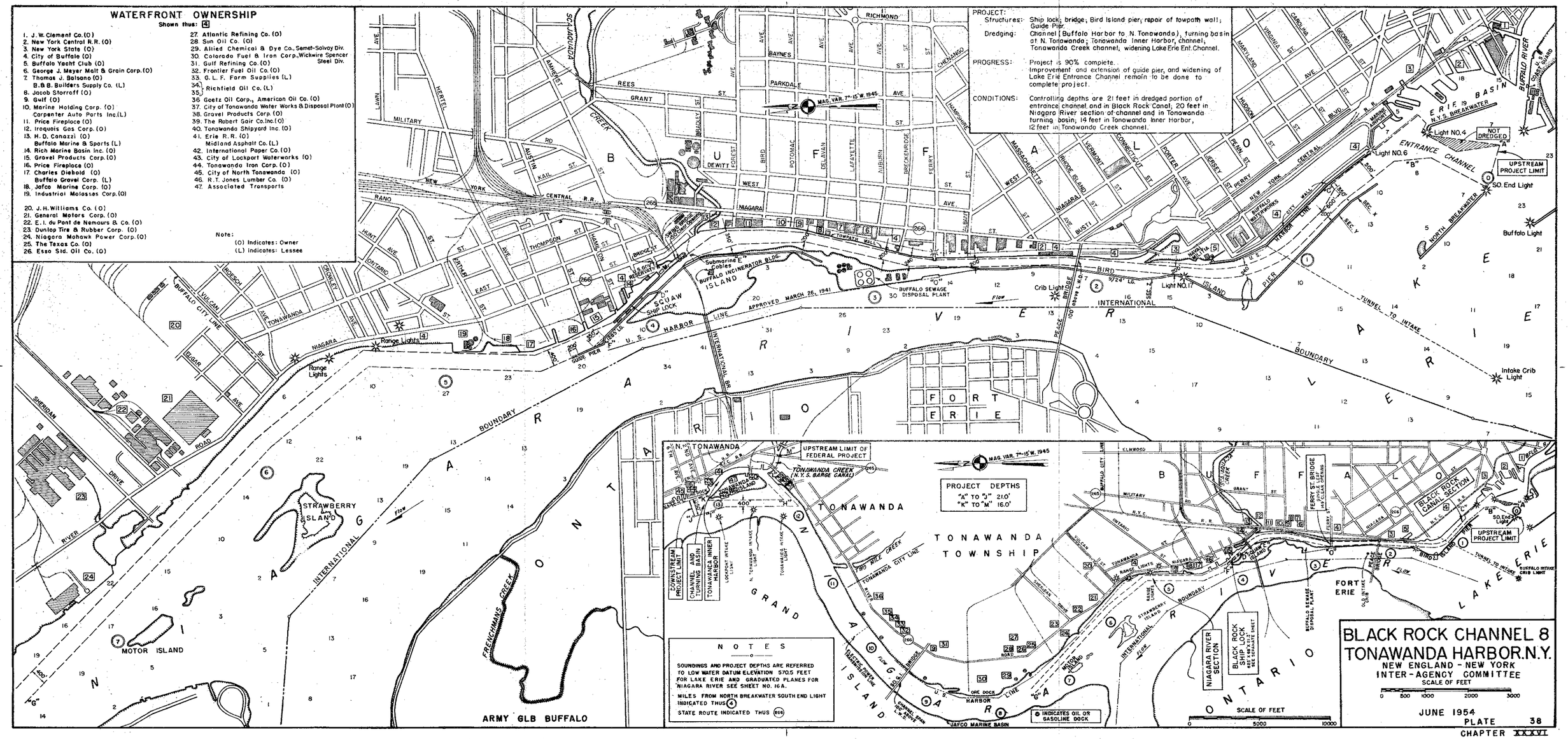

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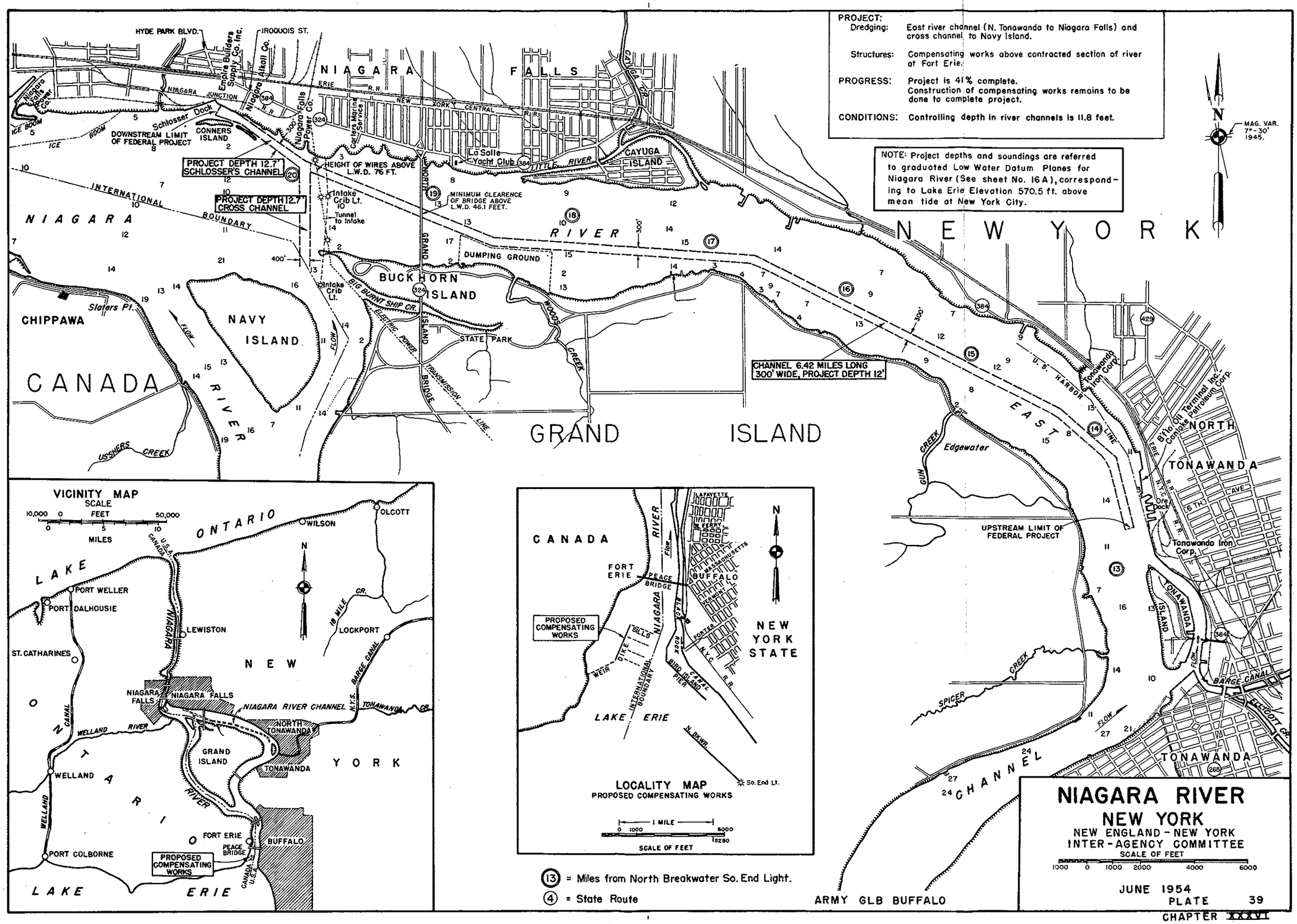
PROJECT:
Dredging: East river channel (N. Tonawanda to Niagara Falls) and cross channel to Navy Island.
Structures: Compensating works above contracted section of river at Fort Erie.
PROGRESS: Project is 41% complete. Construction of compensating works remains to be done to complete project.
CONDITIONS: Controlling depth in river channels is 11.8 feet.
NOTE: Project depths and soundings are referred to graduated Low Water Datum Planes for Niagara River (See sheet No. 16A), corresponding to Lake Erie Elevation 570.5 ft. above mean tide at New York City.
MAG. VAR. 7°-30' 1945.
NIAGARA FALLS
NEW YORK
CANADA
NIAGARA RIVER
GRAND ISLAND
NAVY ISLAND
BUCKHORN ISLAND
CAYUGA ISLAND
CHIPPAWA
NORTH TONAWANDA
TONAWANDA
EAST CHANNEL
PROJECT DEPTH 12.7' SCHLOSSER'S CHANNEL
PROJECT DEPTH 12.7' CROSS CHANNEL
CHANNEL 6.42 MILES LONG 300' WIDE, PROJECT DEPTH 12'
HEIGHT OF WIRES ABOVE L.W.D. 76 FT.
MINIMUM CLEARENCE OF BRIDGE ABOVE L.W.D. 46.1 FEET.
DOWNSTREAM LIMIT OF FEDERAL PROJECT
UPSTREAM LIMIT OF FEDERAL PROJECT
DUMPING GROUND
STATE PARK
INTERNATIONAL BOUNDARY
VICINITY MAP
SCALE
FEET
MILES
LAKE ONTARIO
LAKE ERIE
NEW YORK
NIAGARA RIVER CHANNEL
PROPOSED COMPENSATING WORKS
LOCALITY MAP
PROPOSED COMPENSATING WORKS
SCALE OF FEET
(13) = Miles from North Breakwater So. End Light.
(4) = State Route
NIAGARA RIVER
NEW YORK
NEW ENGLAND - NEW YORK
INTER-AGENCY COMMITTEE
SCALE OF FEET
JUNE 1954
PLATE 39
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SECTION IV - FISHERY RESOURCES OF LAKE ERIE AND LAKE ONTARIO

1. This section presents the extent and value of the fishery resources of Lake Erie and Lake Ontario; the management and development practices in operation; and a summary of the measures designed to maintain or develop these resources.

THE LAKES AS FISH HABITAT

2. Lake Erie is the fourth in size of the Great Lakes and exceeds only Lake Ontario in size. Its waters wash the shores of the States of Michigan, Ohio, Pennsylvania, and New York as well as those of the Province of Ontario. It is 240 miles long, 57 miles wide, and has a water surface area of 9,940 square miles. Its mean water surface is ~~570~~ 572 feet above sea level. Because of various favorable characteristics, including the fact that it is comparatively shallow (maximum depth 210 feet), Lake Erie is noted for its fish production.

3. Since the maximum depth in the lake is only 210 feet, a depth conducive to productivity, Lake Erie is noted for its fish production. In 1951 Lake Erie produced 38.3 percent of the total catch of fish in The Great Lakes.

4. Lake Ontario is the smallest of the Great Lakes and is bounded on the north and west by the Canadian Province of Ontario and on the south and east by the State of New York. It has a length of 185 miles and an average width of 40 miles. Its total area is about 7,300 square miles.

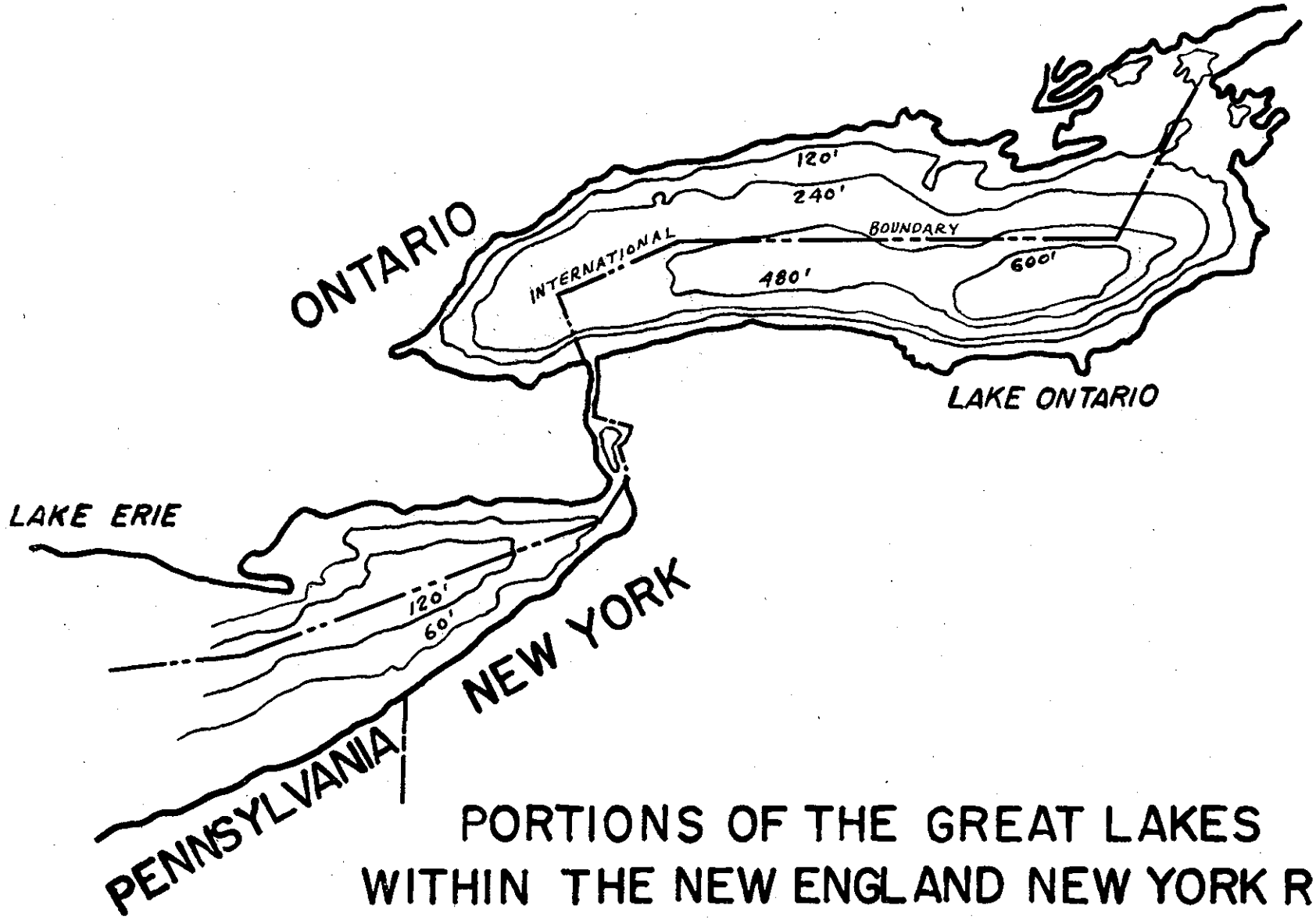
5. The shores of Lake Ontario slope rapidly into deep water, most rapidly on the New York side. The deepest point, 780 feet, is in New York waters and is part of a deep trough extending almost the entire length of the lake. The bottom over most of the lake is clay, with narrow stretches of sand and rock along the shores, particularly among the islands at the eastern end. The mean elevation of the surface is only ~~241~~ 246 feet. Much of the lake bottom, therefore, is actually below sea level.

6. Because shallow water is so important in the production of both food and game fish, Lake Ontario, for its area, is a poor fish producer. In 1951, the latest year for which data are available, Lake Ontario ranked last among the Great Lakes, producing only 3.3 percent of the total catch.

HISTORY OF THE GREAT LAKES FISHERIES

7. The fisheries of the Great Lakes began at the time the first white settlements were established on their shores. In Lake Ontario the first species sought were the whitefish and lake trout. These were taken along the shore with seines, which were used as early as 1807. Fishing by this method was conducted principally on the northeastern and eastern shores, but seines were also drawn wherever the bottom was suitable.

8. According to all accounts, large numbers of sturgeon and herring were included with the whitefish and lake trout, but these were not desired and were destroyed as nuisances along with the smaller



PORTIONS OF THE GREAT LAKES WITHIN THE NEW ENGLAND NEW YORK REGION

CONTOUR DEPTHS IN FEET

STATUTE MILES

10 5 0 10 20 30 40 50

PLATE 40
CHAPTER XXXVI

whitefish. The commercial catch was salted before being sent to the markets. The catch of trout and whitefish in American waters declined rapidly and dropped off to insignificance as early as 1885.

9. Since only a narrow shelf along the American shore is suited for shore fishing, this area was thoroughly exploited from the beginning and the fishermen had to turn to other species in place of the whitefish and trout. About 1875, a large deep-water herring was discovered which supported the fishing industry at Oswego for about 12 years. These fish were known as bloaters and were caught with $3\frac{1}{2}$ to 4-inch gill nets. Bloater fishing spread along the shore, and by 1890 was established at Wilson. However, by 1895 this fishery also declined and the bloater fishery was practically extinct. In recent years most of the commercial fishery in Lake Ontario has been for blue pike and whitefish.

10. The salmon, once apparently plentiful, disappeared from Lake Ontario between 1880 and 1900, apparently the direct result of the erection of dams on the Salmon and other rivers near Pulaski.

11. A highly specialized fishery has grown up on the east end of the lake in the shallow waters of Chaumont Bay. In this bay, the local farmers employ small trap nets to take bullheads, eels, suckers, carp, sunfish, and perch in spring and fall.

12. At the present time the sport angling for smallmouth bass in the Thousand Islands and the eastern part of the lake is undoubtedly

more important than the commercial fishery because of the vast number of people who take part in the sport and because of the economic importance of this sport fishery.

13. Lake Erie fishermen, in the early days, took cisco, pikeperch, and whitefish. At the present time whitefish, blue pike, perch and white bass are the principal species taken by New ~~England~~ York fishermen. Although no data are available, it is believed that sport fishing on Lake Erie is more extensive than on any other of the Great Lakes. The only exception is the black bass fishery in the eastern end of Lake Ontario.

PRINCIPAL FISH SPECIES

14. Blue pikeperch. - The blue pikeperch is now the principal commercial species both in Lake Erie and Lake Ontario. In Lake Erie it is taken by both gill nets and trap nets. The Lake Ontario catch is mainly by means of gill nets. The Lake Erie grounds include most of the New York State waters, while in Lake Ontario the grounds are limited to the larger river mouths and the larger bays.

15. Lake trout. - This species is commercially extinct in Lake Erie at the present time. In Lake Ontario a relatively small poundage is taken, mostly in gill nets set for whitefish. The lake trout grounds in Lake Ontario are practically limited to the eastern end and the best portions lie in Canadian waters.

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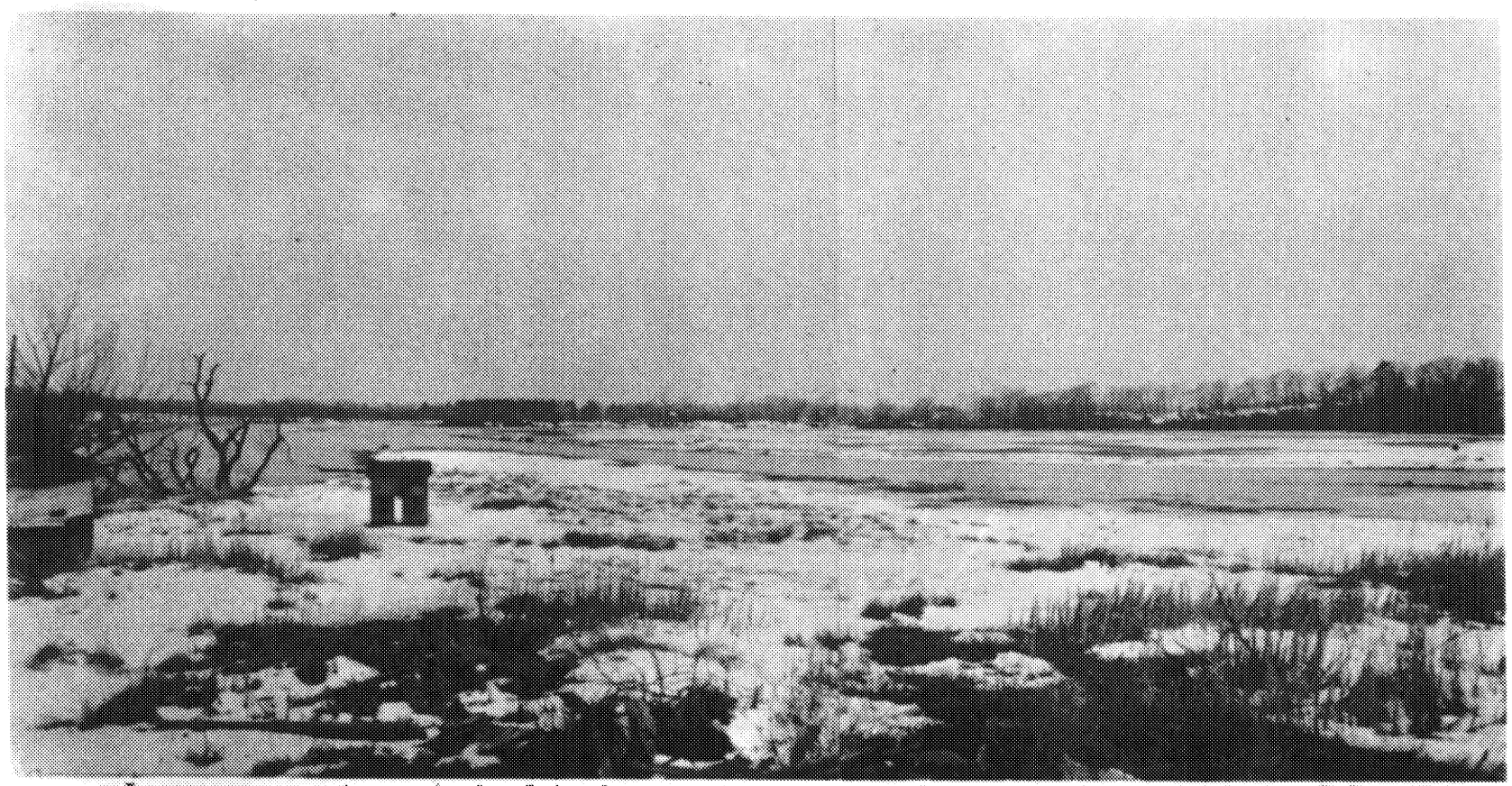

Important spawning area for Lake Ontario fish. Salmon River, New York. Subregion "D".

16. Whitefish. - The whitefish is an important species in Lake Erie and is the backbone of the summer gill net fishery off Dunkirk and Barcelona. In Lake Ontario the whitefish rates second in poundage produced and value of all species sought. The principal grounds are in the east end of Lake Ontario and in the Bay of Quinte region. Since the prohibition of the deep trap net in Lake Ontario the whitefish catch is now entirely by gill nets.

17. Deep-water ciscoes. - These fish are not present in Lake Erie. In Lake Ontario the deep-water ciscoes, which consist of three principal species, occur in waters 8 to 100 fathoms deep. In general, this resource is not fully exploited, the present fishery being limited to the eastern end of the lake and in Canadian territory although favorable grounds are known to occur in other parts of the lake. Whether or not these fish are sought at all depends much on the market.

18. Sturgeon. - Pound for pound, the sturgeon is now the most valuable species in the lakes although it was practically valueless in the early days of the fishery. While relatively scarce at present, several fishermen make particular efforts to capture it. Probably the regulation prohibiting commercial fishing within one-half mile of the shore limits the take of sturgeon in Lake Ontario.

19. White bass. - The white bass catch in Lake Erie is incidental to fishing for blue pikeperch and yellow perch in the fall. It is not a valuable species and only the larger individuals (3/4 of a pound or larger) are marketed. The species is also of minor importance in Lake Ontario. Sport fishing is mostly limited to tributary waters of these lakes.

20. Lake herring. - The lake herring, once the backbone of the commercial fishery of Lake Erie, is now of relatively minor importance. In Lake Ontario the species is sought only when the market is favorable. It is believed to be much less abundant than formerly.

21. Yellow pike. - The yellow pike is of minor importance as a commercial fish in both Lake Erie and Lake Ontario. Those taken are caught mostly during the fishing for the blue pikeperch. The species is commonly sought by sport fishermen along Lake Erie but its importance as a sport fish in Lake Ontario is small.

22. Smelt. - The smelt resource of both Lake Erie and Lake Ontario is little utilized in American waters. The regulation whereby nets are restricted within the one-half mile from shore areas limits this fishery. The species is of nuisance proportions at times in Lake Erie in the gill net fishing for whitefish and blue pike. The resource is utilized some by sport fishermen along the shores and in the tributaries of both lakes where dipping is permitted during the spawning runs.

23. Rock bass. - This species is utilized little by the gill net fisheries of Lakes Erie and Ontario. Its chief utilization is in Chaumont Bay where it is taken by trap nets.

24. Yellow perch. - The yellow perch is an important commercial species in Lake Erie. It is taken principally by gill nets along

with the blue pikeperch. The species is of less importance in Lake Ontario where the catch is variable.

25. Bullheads. - While not widely utilized in Lake Erie and Lake Ontario the bullhead is the principal species taken by trap nets in Chaumont Bay. The market is local since there is little demand for this species in the New York City area.

26. Carp. - Carp were introduced into the United States in 1876, thus completing the round-the-world spread of this species through the agency of man. It is a native of China, was brought to the European continent in the 13th century, to England in the 16th century, and finally to America. Quickly establishing itself, the carp multiplied rapidly and is now abundant and widely distributed. Commercial fishermen took carp from the Great Lakes for the first time in the 1880's and now catch about four million pounds a year from those waters. Even with this rather large production, the population of carp could probably support a larger fishery were it not for a limited demand.

27. Carp feed on plants and small animals as shellfish, insect larvae and crustaceans. They are extremely hardy and can stand a wide range of temperatures. They spawn in May and June. Growth of carp varies widely, but is fairly rapid. They average about a pound when a year old.

COMMERCIAL FISHING INDUSTRY

28. Data in Table 13 show the commercial catch in Lake Ontario, except Chaumont Bay, by New York fishermen. Data on the commercial catch in Chaumont Bay are given in Table 14.

29. The blue pikeperch, whitefish and deep water ciscoes comprise the principal species taken in the open lakes, while the bullhead, eel, carp, rock bass, and sunfish are the main species taken in Chaumont Bay.

30. In 1949, the value of the Lake Ontario catch was $53,268; in 1950, it was $44,488; and in 1951, $106,936. Data as to the total value are not available for 1952 and 1953. A review of the commercial catch records reveals that the present New York production of fish is far below that taken earlier. The records show that the average annual catch in pounds in the period 1879-90 was 3,044,215. At the time the Canadian catch was also over three million pounds. Canadian production has been maintained at or near that level while New York production has fallen off considerable.

31. Commercial fishing gear licensed by the State of New York for Lake Ontario and Chaumont Bay in the years 1950-54 is shown in Tables 15 and 16. These data reflect the difference in the type of

Table 13. - Commercial fish catch, Lake Ontario, Subregion "D"
For New York State waters (Except Chaumont Bay) only
(All gear)

(In pounds landed)

	1949	1950	1951	1952	1953
Lake trout	17	0	1,963	1,575	2,701
Whitefish	1,081	21,028	33,668	22,807	31,741
Herring	*45,615	*12,376	5,719	5,146	1,158
Deep-water cisco			38,878	9,150	17,380
Yellow Pike	213	208	0	291	324
Smelt	1,684	0	715	1,015	1,340
Eels	0	90	0	206	3
Blue pike	77,289	46,491	246,813	464,784	60,276
Perch	7,621	1,477	2,327	2,329	1,678
Common suckers	7,480	0	3,833	3,740	309
Red fin suckers	0	0	174	5	0
Carp	1,074	434	0	30	246
Catfish	0	0	0	36	0
Bullheads	4,922	3,389	5,465	1,794	2,992
Sheepshead	0	73	0	0	340
Sunfish	66	712	0	35	78
Rock bass	243	1,264	655	598	247
White bass	0	680	201	93	2,717
Sturgeon	2,499	1,113	847	1,652	4,245
White perch	0	0	0	0	247
Alewives	0	0	200	0	180
Totals	149,804	89,335	341,458	515,286	128,202

* The figures given for these two years are misleading as the bulk of the catch reported as "herring" was probably deep-water cisco, but not correctly reported.

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Table 14 - Commercial fish catch, Chaumont Bay, Subregion "D"

(All gear)
(In pounds landed)

	1949	1950	1951	1952	1953
Bullheads	82,224	78,888	73,301	67,227	28,310
Eels	19,480	1,406	12,423	17,949	2,494
Yellow perch	11,093	1,035	6,473	5,464	2,364
Great Northern pike	5,348	0	0	0	0
Suckers	19,081	2,578	16,903	14,749	1,625
Sunfish	8,704	3,384	6,123	12,629	7,924
Carp	19,519	2,453	10,095	14,243	12,840
Cisco	328	0	175	287	72
Yellow pike	1,659	116	1,057	187	92
Whitefish	1,345	0	57	39	51
Blue pike	8,465	207	4,975	3,347	237
Sturgeon	0	325	212	0	0
Rock bass	19,934	2,103	10,810	8,100	1,861
Catfish	481	50	0	83	0
Silver bass	31	0	35	195	565
Smelt	2,387	0	6,689	1,947	5,201
Bowfin	0				
Totals	200,079	93,951	155,291	151,156	66,342

Table 15. - Commercial fishing gear licensed for Lake Ontario*
In New York State only, 1950-1954
Subregion "D"

	1950	1951	1952	1953	1954 (to Nov.1)
Power boats (Gill nets)	15	27	30	20	17
Outboards (Gill nets)	0	0	8	7	6
Rowboats (Gill nets)	14	15	12	18	21
Trap nets	4	3	4	9	8
Fyke nets	2	1	2	2	0

* Except Chaumont Bay.

Table 16. - Commercial fishing gear licensed for Chaumont Bay-1950 to 1954,
Subregion "D"

	1950	1951	1952	1953	1954 (to Nov.1)
Gill nets	2	6	6	7	6
Trap nets	104	102	86	89	76
Fyke nets	77	77	98	93	80
Seines	2	1	3	2	3

fishing. In the deep waters of the lake gill nets are used, while in the shallow waters of Chaumont Bay trap and fyke nets are the chief means of taking fish.

32. In the 10-year period, 1941 to 1950, the latest year for which data are available, the total number of fishermen and boats in Lake Ontario has remained about the same. In 1941, there was a total of 143 fishermen; six on two vessels over five tons, and 137 on 84 small boats or on shore. In 1950 there was only one vessel over five tons with four fishermen and 142 fishermen on 94 small boats or on shore. The big change was the reduction in the number of fishermen who fished full time, 61 in 1941 to 32 in 1950. There was a corresponding increase in the number of casual fishermen, 76 in 1941 and 110 in 1950.

33. Data in Table 17 show the commercial catch of fish in the New York waters of Lake Erie in the years 1948-1953. Whitefish and blue pike dominated the catch during this period, comprising over 90 percent of the catch in 1953. The monetary values of the New York commercial catch in Lake Erie are a small fraction of the total United States landed value and vary from two to nine percent. In 1948, the New York catch was valued at $83,223; in 1949, $349,655; in 1950, $78,553; and in 1951, $90,968. Data are not available for 1952 and 1953.

Table 17. - Commercial fish catch, Lake Erie, New York State only, Subregion "D"

(All gear)
(In pounds landed)

	1948	1949	1950	1951	1952	1953
Whitefish	301,547	1,012,839	155,001	136,945	362,667	359,773
Herring	19,013	3,454	2,928	13,074	5,246	5,592
Yellow pike	1,552	5,648	4,977	3,474	3,273	4,608
Smolt			131			
Blue pike	553,015	904,631	177,502	109,497	153,018	265,080
Perch	30,253	11,098	6,472	21,339	38,770	21,344
Common suckers	2,335	6,113	5,417	2,146	2,499	3,436
Carp	1,015	9	7,138	13		108
Catfish	658	730	545	430	444	1,586
Bullheads			33	4		5
Sheepshead	38		1,420	230	637	1,963
Ling	6,170	4,396	13,918	6,412	9,020	5,150
Sunfish				5		8
Rock bass				35	15	8
White bass	7,655	4,687	9,599	8,628	17,628	23,849
Sturgeon	100	38		987	463	715
Totals	923,351	1,953,733	385,081	303,219	598,984	693,225

34. Records available for Lake Erie cannot be broken down to show industrial data for the commercial fishery of New York. The data do show that, for the lake as a whole, there has been an increase in the number of large vessels although the number of small boats and fishermen has remained about the same.

35. In 1941 there were 18 fishery processing or manufacturing plants in New York with 87 regular employees. In 1950, this number had increased to 32 plants and 188 regular employees.

36. The State of New York regulates the mesh size of nets for the several species of fish, size and species of fish to be taken, and the time and length of the commercial fishing season. Other regulations limit the placing of nets in regard to the distance from shore. State licenses are required for both fishermen and fishing boats. Table 13 lists the commercial gear licensed for Lake Erie.

INTERNATIONAL COOPERATION

37. Almost as old as intensive fishing in these lakes is the recognition that their management poses a unique problem because of divided ownership. All of the lakes except Lake Michigan are shared with Canada and all, except Ontario and Huron, are shared by two or more

States. New York and the Province of Ontario participate in the fishing in Lake Ontario, and New York, Pennsylvania, Ohio, Michigan, and the Province of Ontario participate in the fishing in Lake Erie. In this situation, a number of stocks of fish is shared by people from several States and the Province of Ontario. Consequently, it is not possible for one State or Province by itself to obtain the information basic to better development of these fisheries or to manage them effectively. The only practical solution to this problem--cooperative action of all the interested parties-- was recognized as early as 1875 when the State of Michigan urged the necessity for uniform regulations.

Table 18. - Commercial fishing gear licensed for Lake Erie in New York State only, 1950-1954, Subregion "D"

	1950	1951	1952	1953	1954 (to Nov. 1)
Power boats (Gill nets)	33	24	26	25	17
Outboards (Gill nets)	6	4	7	3	0
Rowboats (Gill nets)	1	2	2	2	1
Trap nets	23	20	24	46	27

38. In the years after 1875 many interstate and international meetings and discussions were held to consider the problems of the Great Lakes Fisheries. While progress was made, the basic problem remained because there was no effective means of establishing truly cooperative action. This led to the establishment in 1940 of the International Board of Inquiry for the Great Lakes Fisheries to consider and recommend measures for the conservation of that resource. The Board of Inquiry submitted its report in 1942. A Great Lakes Fisheries Treaty, incorporating the recommendations of the Board of Inquiry and providing for the establishment of an International Commission for the Great Lakes Fisheries, with authority to develop specific research programs and a comprehensive plan for the management of the fishery resources and to make necessary regulations, was signed in 1946. This treaty was not ratified by the United States because of the opposition of one or two States and some fishermen.

39. However, the failure of ratification of the 1946 Treaty did not put an end to this type of approach. A continuation and intensification of the conservation problems on some of the fisheries of the Great Lakes led to a renewed demand from many people of that area for a review of the situation and negotiation of a new treaty.

40. After several years of negotiation, the representatives of Canada and the United States signed the Convention on Great Lakes Fisheries in September, 1954. The Commission will have,

however, no regulatory powers. The authority to regulate the fisheries will remain in the hands of the State as at present. In the performance of its functions the Commission will, wherever feasible, make use of the existing State, Provincial, and Federal agencies in each country.

41. The 1954 Treaty provides for joint action by the United States and Canada in fishery research and in control of the sea lamprey in the Great Lakes. To carry out this work both governments agree to establish a Great Lakes Fishery Commission of three appointees from each country.

42. The duties of the Commission include the development of research programs on the Great Lakes Fisheries and the development and carrying out of programs for control of lamprey. The Commission may recommend to the governments, on the basis of research findings, measures to make possible the maximum sustained yield of Great Lakes Fisheries.

43. The Treaty, with an initial duration of 10 years, will become effective upon ratification by both countries.

DISCUSSION

44. The commercial fisheries in the Great Lakes bordering New York have undergone drastic changes since early settlement days. The decline in yield has been attributed by some authorities to overfishing and by others to various changes in habitat conditions, principally, at least in Lake Erie, to siltation.

45. The research program of the New York State Conservation Department has shown that there is room for expansion of both the commercial fishery and the sport fishery. Some commercial species such as white bass, alewives, and ling, which are often present in tremendous numbers, are now only harvested in limited amounts. The smelt resource is largely unharvested sine it is available only at spawning time in shallow water where netting is now prohibited.

46. The smallmouth bass fishery of eastern Lake Ontario and the St. Lawrence River has long been an intensive and famous one. It continues to attract more fishermen each year along with a growing interest in fishing for pike, walleyes, perch, and bullheads in the shallow bays and shore areas.

47. In Lake Erie, the blue pikeperch and smallmouth bass are the species most sought by the sports fisherman. The fishing season for smallmouth bass was lengthened in 1954 to permit better utilization of this resource. Some indications that this population had been increasing also favored this change.

48. The sea lamprey is an important predator in the other Great Lakes where it has recently been introduced. It has always been present in Lake Ontario and has reached a balance with the other fish populations. It was introduced in Lake Erie with the opening of the Welland Canal. The sea lamprey requires rocky or gravelly streams for spawning purposes, but it does not find suitable spawning habitat in Lake Erie, since most of the tributary streams are either muddy or have natural barriers to prevent spawning.

SECTION V - HISTORICAL BACKGROUND

PREHISTORIC PEOPLES

1. The succession and development of prehistoric peoples and cultures in the State of New York have been worked out in considerable detail under the direction of the New York State Museum, with the aid of professional and amateur archeologists throughout the State. In Subregion "D" are found archeological sites associated with all the successive prehistoric cultures from the primitive, wandering Lamoka hunters, dated at about 3500 B.C., to the sedentary, agricultural Iroquois, who were in possession when Europeans first arrived.

2. Central New York, including the Finger Lakes, is by far the richest archeological section of the State. Every culture from the Lamoka to the Iroquois, with one possible exception, is represented here. It was the homeland of the Iroquois and it has provided the bulk of the information available on the Owasco people, the immediate predecessors of the Iroquois, dated at about 500 A.D. In the western part of the State, the Genesee Valley was the center of the Lamoka culture and was occupied later by others, including the Iroquois. Farther west the Early Woodland culture is most strongly represented, with later and more conspicuous remains of the Hopewell. The eastern shore of Lake Ontario was the route of migration of several prehistoric peoples entering New York, from the Laurentian, who gradually overspread the whole region beginning about 3000 B.C., to the Onondaga

Iroquois, who came this way only a few centuries before the beginning of historic times.

3. The traces left by this long succession of varied prehistoric peoples have been carefully studied and collated, producing one of the most detailed culture sequences known to American archeology. Many of the sites that have produced valuable scientific data are physically negligible. This is particularly true of the sites that have revealed the story of the oldest cultures, such as the Lamoka and Laurentian. The Hopewellians, on the other hand, left occasional large burial mounds, while the Owasco people and their successors, the Iroquois, constructed fortified villages which are sometimes still traceable here and there on hilltops.

LAND OF THE IROQUOIS

4. When Samuel de Champlain made the first recorded European contact with the Iroquois in 1609, this group of confederated tribes occupied Central New York from the Mohawk River to the Genesee. The five associated tribes, from East to West, were the Mohawks, the Oneidas, the Onondagas, the Cayugas, and the Senecas. West of the Genesee were the related but unaffiliated "Neutral" Iroquois, while along the shore of Lake Erie were the Eries, also of Iroquois stock but outside the Confederacy. The eastern shore of Lake Ontario seems to have been uninhabited, but was used by the Onondagas as hunting ground.

5. The Iroquois Confederacy had not been in existence very long; some writers place the date of its formation under the leadership of the legendary Hiawatha as late as 1570. It was essentially a device for preventing inter-tribal conflict, and the Iroquois sometimes styled themselves "Keepers of the Great Peace". The Confederacy became an expanding, imperialist power with a conscious foreign policy emerging only as an outgrowth of conditions that developed with the coming of the white man, his fascinating and often useful trade goods, and his desire for beaver skins.

6. The capital of the Confederacy was at the principal town of the Onondagas, the "Keepers of the Council Fire", where the grand council of the tribes convened at the call of any one tribe. The league was thought of as a "longhouse", like the long bark houses built by its members in their palisaded hilltop villages. The Mohawks were the "Keepers of the Eastern Door", the Senecas of the "Western".

7. The only proper material for a European gentleman's hat in the 17th and 18th centuries was beaver felt. This foible of fashion and the eager market it provided drove the white trader ever onward into the interior of North America, and set remote tribes to killing and skinning the beaver hundreds of miles beyond the farthest outpost. The firearms, "firewater", iron tools, woolen goods, brass kettles, and ornaments that were his stock in trade quickly became necessities of life to the tribes that learned their use. Native crafts were forgotten and the Indians in a generation or two became dependent upon the whites for the very means of existence.

8. By accident of geography, the Iroquois Confederacy was located almost between the Dutch, and later the English, on the Hudson and the French on the St. Lawrence, and stood across the routes of both to the far interior. The Iroquois, trading mainly with the Dutch, who were closer than the French and whose goods were cheaper, quickly exhausted the beaver in their own country. Better armed with the white man's weapons than the more distant tribes, eager to control more fur-bearing country or to serve as middlemen in the flow of furs to the market at Fort Orange (Albany), they set out on a career of conquest that carried them far.

9. As early as 1626 they drove the Mahicans eastward from the lower Mohawk across the Hudson. Between 1649 and 1680 they destroyed, as organized tribes, the powerful Huron and Tobacco nations of modern Ontario, the so-called "Neutrals" west of the Genesee, the Eries south of Lake Erie, and the Andastes on the Susquehanna. They humbled the Delawares along the Delaware River and levied tribute on tribes in New England. They even made war on the distant Illinois.

10. Dutch and English interest lay in maintaining a close friendship with the Iroquois, as the greatest single channel for furs to the trading posts on the Hudson. For the most part this policy was followed throughout the Colonial period. French interest offered perplexing alternatives. To keep their traffic with the tribes in the interior open the French had the choice of winning the Iroquois over or of conquering them.

11. In practice, the French tried both methods of dealing with the Iroquois. Beginning in the 1650's, for more than half a century French missions were maintained among the several tribes as opportunity offered. The Jesuit missionary of that period was a zealot often welcoming martyrdom, and he needed no stimulus from the civil authorities. Nevertheless, his influence, wherever and whenever he lived among the Iroquois, was in favor of French Canada as against her rival, and tended to divert trade from Albany to Montreal. British colonial authorities in New York realized this fully and constantly urged the Iroquois to drive out the "black robes", eventually with complete success.

12. French traders, either accompanying the missionaries or operating on their own, frequently ventured into the Iroquois country. Sometimes they paid with their lives for their temerity; sometimes they stayed to gain great influence with the tribesmen. French traders, like French priests, often acted as ambassadors for the Canadian authorities.

13. British influence was always strongest among the Mohawks and least powerful among the distant Senecas. French efforts for many years were most successful among the Senecas and eventually succeeded in permitting the peaceful passage of French trade to the upper Great Lakes by the Niagara portage.

14. But through most of the 17th century the relations between the Iroquois and the French more often took the shape of open hostilities. The first French contacts with the Confederacy, under Champlain in 1609 and 1615, had been hostile operations carried on in aid of

Indian allies. French armies several times marched into the lands of the Mohawks, the Senecas, the Onondagas and the Oneidas, cutting down the cornfields and burning the villages. Iroquois raids in retaliation sometimes reached to the walls of Montreal and spread terror even on the lower St. Lawrence, threatening French Canada with complete destruction.

15. After the first of the colonial wars between France and England (1689-1697), in which the Iroquois suffered heavy losses at the hands of the great French governor Frontenac, their policy, though never entirely consistent, was largely to play off one great power against the other. They permitted the French to build a strong fort at Niagara (1725), balancing this concession by letting the British build a trading post, and later a fort, at Oswego (1722-1728).

16. French vigor in exploiting the key military positions in the interior of the continent, then and later, and frequent French successes in battle, roused the admiration of these shrewd warriors, and at times they tended to swing over to the side of France. The Albany traders, moreover, took to dealing with the French themselves, in defiance of imperial interests and to the detriment of the Iroquois. But in mid-century, the astute and vigorous Sir William Johnson, first as a private trader and later as British commissioner of Indian affairs, brought his powerful influence to bear in favor of the old alliance. By persistent diplomacy, by blocking the illegal trade to Montreal, by his own military activity, and by gifts as lavish as he could persuade the home government to issue, he kept the Iroquois, at least nominally,

Historic site. Fort Ontario. Oswego, New York. Subregion "D".

in the status of British allies during the last great inter-colonial conflict (1754-1760).

17. Dissatisfaction of the tribes of the Great Lakes at the treatment they received from the British, after the expulsion of the French, brought about the conspiracy of the Ottawa chief Pontiac (1763-1764), a widespread effort to destroy all the British posts in the interior. The Senecas took part in the hostilities for a time, ambushing a British supply train on the Niagara portage, but Johnson's strenuous efforts kept the rest of the Iroquois in line and soon induced the Senecas, in council at Niagara, to end hostilities. Pontiac's failure to capture Detroit after a long siege, and a British expedition from Fort Pitt into the Ohio country, broke up the Indian uprising and established all the Iroquois as members of the British alliance. Pontiac himself came to Oswego in 1766 and made formal peace in a grand council with Johnson.

18. Up to this time the Iroquois, with the exception of the Mohawks, had kept firm control of their homeland, and claimed vast territories around it by right of conquest. They regarded, with a jealous eye, attempts to assert control over them and only reluctantly permitted the building of forts on their borders and the passage of troops over the Oswego and Niagara routes. As late as 1767 they insisted that a British fort at the outlet of Lake Oneida be destroyed. This fiat was carried out.

19. After the destruction of French power and the failure of Pontiac, however, British supremacy was an obvious fact. The Iroquois, with some misgivings, were persuaded to relinquish a portion of their territorial claims to the south and east, in New York and Pennsylvania. The Treaty of Fort Stanwix (later Rome), which they evidently considered as the instrument which established a permanent boundary, was a diplomatic achievement of Sir William Johnson and opened up a considerable area to settlement. Even this treaty left the Iroquois west of the Mohawk River still masters of their own homes. The line agreed upon ran from near Pittsburgh northeast through Pennsylvania to the forks of the Susquehanna, thence east to the Delaware, north along the Unadilla, and northwest to Fort Stanwix, at the portage between the Mohawk and Oswego Rivers. The towns of the Mohawks to the east of this line were reserved to them.

20. For a few years, at the close of the Colonial period, the lands opened to settlement by this treaty more than absorbed the expansive energies of New York. Both land speculation and actual settlement had also been greatly stimulated by the removal of the French threat. The acquisition of land, either as investment or as home, had come to be an economic objective and activity far outweighing the fur trade in the minds of the colonists. British imperial policy now discouraged the further advance of settlement toward the west, in New York as elsewhere in the colonies, and continued to favor the fur trade. It was only a question of time, however, before the Iroquois would be put under heavy pressure in their homeland.

FINAL DEFEAT OF THE INDIANS

21. Within a year or two after the outbreak of the American Revolution, most of the Iroquois threw in their lot with the British. Sir William Johnson had died in 1774, just before the beginning of the conflict, but his memory was fresh and potent among the Indians and his authority had been transferred to his heirs. In 1776 Johnson's son and nephew, Sir John Johnson and Guy Johnson, left their homes on the Mohawk and fled to Canada with their white followers. There they and other New York Tories organized Loyalist troops. Sir John Johnson and the two Butlers, John and Walter, returned to New York by Lake Ontario with the British expedition under St. Leger in 1777. They were able to induce a large number of Iroquois warriors, from all the original tribes except the Oneidas, to join in the attack which moved, in support of Burgoyne's invasion up the Oswego to Fort Stanwix.

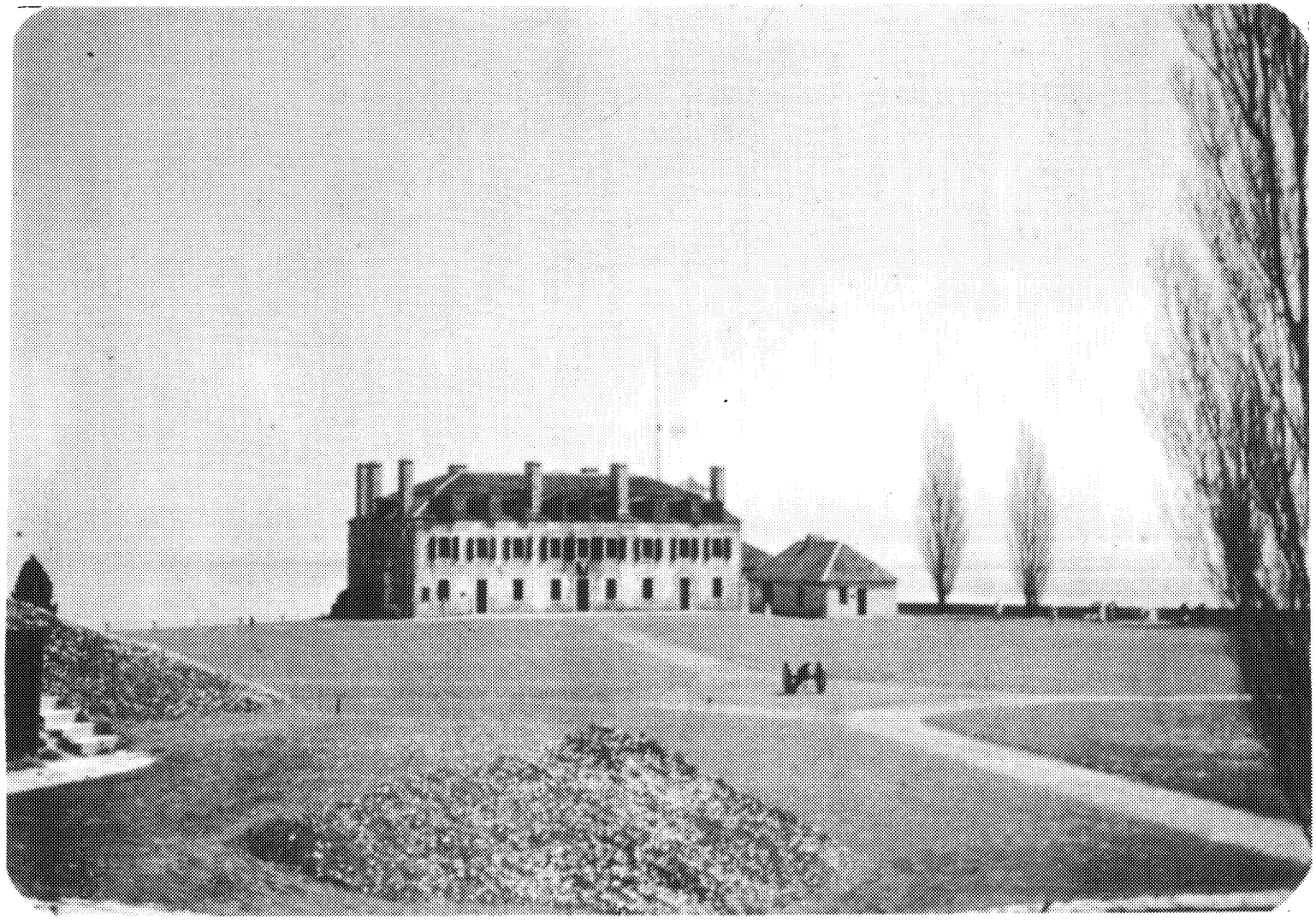
22. Heavy losses inflicted on the Indians in the bloody battle of Oriskany, with St. Leger's failure to take Stanwix, discouraged the Iroquois and many of them would have preferred to stay out of the conflict from then on. The Oneidas and the Tuscaroras, an Iroquoian tribe from North Carolina that had been admitted to the Confederacy early in the century, generally favored the American cause. The great Confederacy was broken and was destined never to function again as a unified power.

23. The British authorities in Canada labored constantly to keep as many as possible of the Iroquois on the warpath against the American

rebels. The British were still the source of essential trade goods which the blockaded Americans could not or would not supply, and they were able to assure the Indians that their policy was the more benevolent. The imperial policy of restricting the advance of settlement in favor of the fur trade had, in fact, been one of the causes of the war, and it was the settler that the native was coming to recognize as his real enemy. From a base established at the old fort of Niagara, Johnson and the Butlers, with the able chief Joseph Brant of the Mohawks, succeeded in recruiting large war parties to accompany their Tory troops in raid after raid on the frontier in New York and Pennsylvania.

24. It was these raids that forced Washington to take vigorous action against the Iroquois. A large force under Generals Sullivan and Clinton was sent into the Iroquois country, after careful preparation, in 1779. A quick raid from Fort Stanwix first destroyed the Onondaga villages. Sullivan then moved up the Susquehanna through Pennsylvania and Clinton moved down river to join him by way of the Mohawk and Otsego Lake.

25. From the forks of the Susquehanna the combined armies advanced north into the Finger Lakes region. A brief battle at Newton, near present day Elmira, was won with slight loss, the Indians breaking quickly under unaccustomed artillery fire. Thereafter the Americans moved at will through the lands of the Cayugas and Senecas, burning some 40 towns and villages, cutting down the ripening corn and the orchards, and killing the hogs and the cattle which the Iroquois had learned to keep.



Historic site. "The Castle." Fort Niagara; New York, Subregion "D".

26. Sullivan's orders had included an attack on Niagara but having reached the Seneca towns on the Genesee River he turned back. Niagara was left in British hands and continued to be a base of operations against the frontier until the end of the war. Many of the Iroquois now left their desolated homes and took shelter under the British guns. At the close of hostilities, parts of several tribes went on into Canada. Their hold on their ancestral lands had been greatly weakened by Sullivan's expedition, at the same time that American soldiers, particularly those from New England regiments, had taken full note of the beauty and richness of the country.

27. At the peace treaty in 1783, nothing was said of the rights of the Iroquois to their lands. Many Americans argued that these tribes, by taking the British side in the Revolution, had forfeited all territorial rights. This was not the view of either the State of New York or the new Federal government. The process of dispossession was therefore carried on by formal treaty and tribal sale, though the bargaining power of the Indians steadily approached the vanishing point, and the process was almost as relentless as if the lands had been declared forfeited.

28. The first United States treaty with the Iroquois was signed at Fort Stanwix in 1784. It established formal peace and friendship and deprived the Onondagas, Cayugas, and Senecas of their claims to territory outside of New York and Pennsylvania, that is, to the lands of tribes they had once conquered in the Ohio Valley and elsewhere in

the new public domain of the United States. This treaty also opened the way for the States to deal with the tribes for their remaining lands. A series of New York State treaties with various tribes between 1785 and 1789 cleared all the lands east of the Seneca Lake region for settlement, with the exception of certain tribal reservations.

29. Most of the home territory of the Senecas, greatest landholders of all the Iroquois, lay in an area claimed by both New York State and Massachusetts. A compromise was reached in 1786 by which a "Preemption Line" was drawn north and south through Seneca Lake. Lands to the west of this line were awarded to Massachusetts, as far as ownership was concerned, but jurisdiction was awarded to New York.

30. Between 1788 and 1791 Massachusetts disposed of her titles in all of this large region to private land speculators. It was not until 1797, however, that the Senecas finally relinquished their rights. At the Treaty of Big Tree, or Geneseo, the Senecas sold to the speculator Robert Morris their title to 4,000,000 acres, comprising almost the whole of western New York State beyond the Genesee, for $100,000, or 2½ cents an acre, reserving to themselves some minor areas on the Allegheny and elsewhere. Thus, before the end of the 18th century, the once-powerful Iroquois had been dispossessed and the whole of central and western New York was open to white settlement.

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THE GREAT LAND COMPANIES

31. New York as a colony had been developed largely through the awarding of huge grants of land to private individuals. This process was continued by the independent State after the Revolution, except that the grants were straight sales which brought in substantial public revenue, and did not carry governmental powers like those of the colonial lords of the manor. Land speculation was the favored form of investment of men of means for some time after the Revolution as well as before it. New York lands, opened as a result of the war, attracted capital not only from its own citizens but also from speculators in other States and in Europe.

32. While land speculation in colonial times had often preceded settlement by whole generations, and returns had sometimes been extremely slow, the expansive power of the American people at the close of the Revolution was so great as to promise profits to anyone who could protect his investment for a few years. New England, in particular, with its excess farm population working a stony soil and suffering from post-war depressions, was in a state of ferment. Veterans of the Sullivan expedition, with their stories of the Genesee Valley where corn grew fifteen feet high, added impetus and direction to the movement.

33. The State of New York reserved a military tract of about 1,500,000 acres, east of Seneca Lake and reaching from the southern tip of that lake to the shore of Lake Ontario, as a bonus for Revolutionary veterans. By the time that surveys had been completed and distribution

had begun in 1791, many veterans had sold their land warrants to speculators, and many squatters had moved in. There was considerable confusion over titles, and the region for a time had a bad reputation with bona fide settlers. Partly for this reason, and partly because of more active promotion, the settlement of lands farther west proceeded more rapidly.

34. After the agreement between New York and Massachusetts covering the territory west of Seneca Lake, the latter state accepted an offer from two promoters, Oliver Phelps and Nathaniel Gorham, for the purchase of the whole of her acquired lands. These gentlemen were able to secure Seneca title to only the country between Seneca Lake and the Genesee River; not being able to keep up payments, they turned back the rest to Massachusetts. Phelps and Gorham sold part of their confirmed holdings to Robert Morris of Philadelphia, who, in turn, disposed of it to a group known as the London Associates, headed by Sir William Pulteney.

35. It was the London Associates who undertook the development and settlement of the lands between Seneca Lake and the western edge of the Genesee Valley. Under a manager by the name of Charles Williamson, a broad promotional program got under way, on the theory that generous investments in internal improvements would attract settlers, raise prices, and result in greater profits. Williamson spent lavishly in laying out towns, building hotels, mills, and even a race course. After he had spent nearly a million dollars, the London company recalled him in 1800, and sent out a more conservative agent. While he had cost the company

much money, he had brought about the settlement of a part of the Genesee country much faster than would otherwise have happened.

36. After Phelps and Gorham had turned back the rest of their vast purchase, Massachusetts sold it to Robert Morris. He, in turn, interested Dutch bankers who formed the Holland Land Company. This company, which also invested in lands elsewhere in New York and Pennsylvania, became the proprietor of 3,300,000 acres in western New York, including most of the country west of the Genesee. Morris was not able to secure Seneca title to complete the sale until the Big Tree Treaty in 1797, but after this the company began development almost at once.

37. Joseph Ellicott, brother of Andrew Ellicott, Surveyor General of the United States, was hired by the Holland Land Company to survey its huge holdings. Ellicott, with a staff of 130 men, made a careful survey of the whole area into ranges of townships six miles square following the new Federal survey system. This was completed by 1800 and the company then made him its manager for the sale of the lands.

38. Ellicott set up his headquarters at Batavia, which he laid out and named in honor of the company, Batavia being the classical name for Holland. From Batavia, where land sales began in 1801, the great Holland Purchase was managed for the next thirty-five years. Ellicott, as a manager for the Holland Land Company, was the great developer of western New York State. He laid out the basic system of roads and founded many towns, including Buffalo, though his improvements were not

on such a lavish scale as those of Williamson in the Genesee had been. By the time of his retirement in 1821, there was a population of 100,000 within the lands of the Holland Purchase.

39. The Holland Land Company had also purchased from New York State a smaller area east of the military tract in the old Oneida country, and another north of the Mohawk. These tracts were managed by other agents, and involved some rather expensive experimental development along the Williamson line. Cazenovia, named for Theophile Cazenove, general American agent for the company, and Boonville, named for Gerrit Boon, its northern agent, were the centers of these developments.

40. The largest single sale of land made by the State of New York was the Macomb Purchase of 1791, in the northern part of the State. Alexander Macomb, a former fur trader, with a group of associates bought 4,000,000 acres, embracing a large part of what New Yorkers still call the North Country. Most of this enormous area was soon resold, usually in large tracts, to other speculators.

41. Promoters who followed up their purchases with actual settlement in the region east of Lake Ontario included William Constable, founder of Constableville, and Jacob Brown, founder of Brownville and later a distinguished soldier. Settlement pushed up along the belt of land lying between the lake and the Adirondacks, following parallel routes by the lake shore and the Black River Valley. By the beginning of the War of 1812 there were scattered settlements all the way from the old Iroquois boundary near Rome (Fort Stanwix) west to Lake Erie and north to the St. Lawrence.

42. Much of the action of the War of 1812 took place in this region. The Niagara frontier was the most continuously active single theater of operations during the conflict, and the naval base which had been established at Sacket's Harbor, near the mouth of the Black River, was a key strategic point. Oswego, at the end of the Mohawk-Oswego water route from Albany, played much the same role that it had in the French and Indian War. Troops and supplies forwarded from Albany were routed through Oswego to the Niagara and eastern Lake Ontario fronts, and Oswego therefore, became a prime British objective. The slower and more difficult land routes to Niagara and Sacket's Harbor were used during the periods when the British were in control of Lake Ontario.

43. Naval supremacy on the lake was, in fact, of the greatest importance to both sides. In this respect, the war became a shipbuilding contest between the Americans at Sacket's Harbor and the British at Kingston, Ontario. Neither side was able to gain and hold naval supremacy long enough to back up any decisive land operations, while more than once the failure of naval support at a crucial moment brought promising land activities to an abrupt halt.

44. American land operations in this region, as well as in the Lake Champlain theater farther east, were largely unsuccessful during the first two years of the war. New York State militia troops far numbered the regulars, and they were usually badly disciplined,

poorly led, and reluctant to cross the Canadian border. Regular Army troops and commanders were little better at first, and there was poor coordination between them and the militia. An attempted invasion of Canada from the Niagara line in the autumn of 1812 was quickly broken up with heavy loss. In 1813 an American expedition by lake captured and burned York (Toronto), but naval support failed and it accomplished little else. Late in the same year British forces crossed the Niagara River, stormed Fort Niagara, and burned Lewiston, Black Rock, and Buffalo.

45. At Sacket's Harbor a British naval attack in July 1812 was beaten off in one of the first actions of the war. A more serious amphibious operation from Kingston in the spring of 1813 was defeated under the vigorous leadership of General Jacob Brown, who was the local militia commander but proved himself an able soldier.

46. Brown was thereafter commissioned a major general in the Regular Army and, in 1814, took command of the Niagara frontier. With a small but excellent army drilled by a young brigadier named Winfield Scott, he took the offensive. The campaign of this year involved the brilliant victory of Chippawa, the fiercely fought battle of Lundy's Lane, and the successful defense of Fort Erie. Naval support was lacking and nothing decisive was accomplished, but the American Army had at least redeemed its reputation.

47. Brown's operations on the Canadian side of the Niagara practically ended the war in this theater, although Fort Erie was later blwon up and abandoned, and Fort Niagara remained in British hands until peace was proclaimed.

48. As settlement pushed farther and farther beyond the Hudson and the Mohawk, problems of transportation became steadily greater. The turnpike roads from Albany that led west along both sides of the Mohawk were extended into the new country, and others were laid out supporting them farther south. Road building was also one of the basic operations of all the great land development agencies.

49. As the roads leading back to the markets on the Hudson grew longer, the possibility of shipping farm products at a profit grew less. The new country was almost entirely agricultural and there was little that the settlers could sell each other. Only cheap access to an outside market would provide them with anything beyond subsistence. The new West began to demand better transportation. The needs of the armies at Niagara and Sacket's Harbor offered a temporary market for beef and grain, but this advantage passed with the close of the war. It was the new settlements in the central and western parts of the State that gave Governor DeWitt Clinton his most vigorous support in his campaign for canals from the lakes to the Hudson.

50. The Erie Canal, which ran through the heart of the new country from Rome to Buffalo and was opened full length in 1825, induced a period of expansion in the region and in the Great Lakes country beyond. Such towns as Syracuse, Rochester, Lockport, and

Buffalo, on the line of the canal, were either created by the canal or began to take on the proportions of cities almost over night with its completion, while dozens of little canal ports sprang up to serve the farmers living within wagon hauling distance on each side. Lateral canals to Oswego, to the Finger Lakes, and up the Genesee were built to bring the benefits of cheap water transport to the farmers in more remote districts. Within ten years after its completion, the demands of traffic on the Erie Canal were so great that extensive rebuilding was undertaken to provide greater capacity.

51. The canal brought with it powerful stimuli to commerce and manufacturing as well as farming. Syracuse could now export to advantage the salt from the salt springs along Onondaga Lake. Rochester, with abundant water power, took to milling flour for export. Buffalo became a great port for the transfer of emigrants and manufactured goods from canal barge to lake vessel, and of grain and other bulky produce from lake vessel to barge.

52. While the New England back country had furnished the great bulk of the immigration to central and western New York during the generation and more following the Revolution, this stream of migration was soon met by a cross-current moving north from Pennsylvania via the Susquehanna Valley. The town of Penn Yan on Keuka Lake illustrates this, the name being a combination of the first syllables of Pennsylvania and Yankee.

53. With the building of the canal came thousands of Irish, laborers on the canal line, many of whom stayed to build the rail-

roads and to blend gradually with the older settlers. With the Irish came the Catholic Church to compete with transplanted New England Puritanism. To the rising cities came Germans in increasing numbers, as workmen and craftsmen. German contributions to the pattern of the region were both cultural and industrial, including the introduction of musical and athletic organizations and such specialized industries as the optical manufacture that paved the way for the cameras of Rochester.

54. New York State west of the Mohawk, therefore, became basically New England in its population and cultural pattern, modified by an early mixture of other elements. This development is visible in the architecture of the region today. Many of its small towns and villages, with their fan-lighted houses, steepled white churches, and open central squares lined with arching elms, are essentially New England in character. But other influences are apparent, including such purely local developments as the cobblestone houses along the Lake Ontario shore. In this region, moreover, the first period of prosperity happened to coincide with the early popularity of the Greek Revival architecture, and this style was perhaps more extensively used here than elsewhere.

55. The New England element brought with it a strong religious tradition, but at a time when new creeds were beginning to compete with old-fashioned Calvinist Congregationalism. In the new soil new cults sprouted freely. In the course of the early 19th century

central and western New York were the scene of varied religious experimentation, from the celibate colony of the Jemimakins, the followers of Jemima Wilkinson, the "Public Universal Friend", on the Keuka Lake, to the founding of the Church of the Latter Day Saints, or Mormons, by Joseph Smith, after protracted visions and revelations on his farm near Palmyra.

56. The region also took an active part in the various reform movements of the period. The first Women's Rights Convention assembled at Seneca Falls in 1848, and here were brought together such formidable and versatile reformers as Amelia Jenks Bloomer and Elizabeth Cady Stanton, later joined by Susan B. Anthony. One of the great centers of the Abolitionist movement was in central New York. Peterboro, in the old Oneida country, was the home of Gerrit Smith, active in the Underground Railroad that led fleeing slaves to freedom in Canada, and one of the founders of the Liberty Party. Near Auburn, Harriet Tubman, born a slave, operated a notable station on the Underground to aid slaves who were escaping. There were other stations leading into Rochester.

57. In politics the new region early began to assert itself. Peter B. Porter of Buffalo was one of the "War Hawks" in the Congress that brought on the War of 1812. It was in western New York that the Anti-Masonic party of the 1820's was formed, the vehicle used by Thurlow Weed to rise to eminence as a dominant figure in the Whig party. William H. Seward, of Auburn, another Anti-Masonite who

joined the Whigs, was elected Governor in 1838. He later served as Senator and was one of the founders of the Republican party. Seward's national prestige became so great that his defeat by Lincoln for the Presidential nomination in 1860 came as a distinct surprise. He closed a distinguished career as Lincoln's, and later Johnson's, Secretary of State. It was Seward who brought about the purchase of Alaska from Russia. Millard Fillmore, of Buffalo, was elected Vice President in 1848 and became President two years later on the death of Zachary Taylor.