

OAK ORCHARD HARBOR NEW YORK

GENERAL DESIGN MEMORANDUM



DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
BUFFALO, NEW YORK 14207

FEBRUARY 1969

DEPARTMENT OF THE ARMY
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

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PERTINENT DATA

FEATURES:

Detached breakwater, east and west jetties, channel dredging.

DIMENSIONS:

Detached breakwater			
Length.....			548'
Height, above L.W.D.....			8'
Diameter of cells.....			35'
Jetties	<u>East</u>	<u>West</u>	
Crest length.....	690'±	920'±	
Crest width.....	10'	10', 12'	
Crest height, above L.W.D.....	8'	8'	
Channels	<u>Project depth</u>	<u>Width</u>	<u>Length</u>
Lake approach.....	10'	150'	1,350'±
Entrance.....	10'	90'	1,200'±
Basin.....	8'	90', 200', 240'	680'±

QUANTITIES:

Detached breakwater		
Steel piling.....		1,356,000 Lbs.
Cell fill.....		9,100 C.Y.
Concrete cap.....		1,240 C.Y.
Jetties	<u>East</u>	<u>West</u>
Cover stone, tons.....	6,100	7,400
Core stone, tons.....	7,300	8,950
Riprap, tons.....	1,300	2,750
Dredging.....		63,000 C.Y.

ESTIMATE OF COST:

Federal, C of E.....	\$ 987,000
Federal U.S.C.G.....	16,000
Non-Federal.....	248,200
	1,252,000

BENEFIT COST RATIO:.....2.5

CONSTRUCTION SCHEDULE:

Advertise.....Fall 1969
Complete construction.....Fall 1971

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TABLE OF CONTENTS

<u>Paragraph</u>		<u>Page</u>
-	PERTINENT DATA	A
1-3	PROJECT AUTHORIZATION	1
4	PREVIOUS PROJECT	2
5	INVESTIGATIONS	2
6-7	LOCAL COOPERATION	2
	LOCATION OF PROJECT AND TRIBUTARY AREA	
8	Location	3
9-10	Description of watershed	3
11	Tributary area	4
12	New York State marine park	4
13	Bridges	4
14	REFERENCE DATUM	5
	NATURAL FACTORS AFFECTING DESIGN	
15	Exposure to storms	5
16-19	Water levels and fluctuations	5
20-22	Wave characteristics	7
23	Soils	7
24-26	Geology	8
27		
27	SHORELINE CHANGES	8
28	PROJECT PLAN	9
29-33	DEPARTURES FROM PROJECT DOCUMENT PLAN	9
34	OTHER PLANS INVESTIGATED	10

TABLE OF CONTENTS (Contd)

<u>Paragraph</u>		<u>Page</u>
	DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS	
35-36	Detached breakwater	11
37-39	Jetties	11
40	Dredging	12
41	SOURCES OF CONSTRUCTION MATERIAL	13
	COST ESTIMATES	
42	First cost	14
43	Annual costs	15
44-46	Comparison of estimates	16
47	BENEFITS	18
49-49	SCHEDULES FOR DESIGN AND CONSTRUCTION	18
50	COORDINATION WITH OTHER AGENCIES	19
51	RECOMMENDATION	20

TABLES

<u>Number</u>		<u>Page</u>
1	Wind and deep water wave characteristics	7
2	Estimate of first cost	14
3	Estimate of annual costs	15
4	Comparison of estimates	16

Plates

1	General plan
2	Plan, profile and sections
3	Subsurface explorations

Charts

1	Gradation of lake bottom material
2	Sources of core stone
3	Sources of cover stone and riprap
4	Sources of aggregates

TABLE OF CONTENTS (Contd)

APPENDICES

- A DESIGN OF STRUCTURES
- B ALTERNATIVE DESIGNS OF STRUCTURES
- C CORRESPONDENCE FROM CONCERNED AGENCIES

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PROJECT AUTHORIZATION

1. Section 2 of the River and Harbor Act, (Public Law 14, 79th Congress, 1st Session), approved 2 March 1945, authorized improvement of Oak Orchard Harbor, New York, in accordance with plans and conditions set forth in House Document Number 446, 78th Congress, 2nd Session.

2. The plan recommended in the project document encompassed the following:

a. Two parallel jetties at the mouth of Oak Orchard Creek, 200 feet apart, the east jetty 1,010 feet long and the west jetty 1,090 feet long;

b. An entrance channel 100 feet wide and 10 feet deep extending from the 10-foot depth contour in Lake Ontario to a limit in Oak Orchard Creek about 200 feet upstream from the center line of Ontario Street extended; and

c. A basin in Oak Orchard Creek approximately 450 feet long, generally 400 feet wide and 8 feet deep.

3. Authorization for these improvements was made subject to the requirement that local interests agree to:

a. Make a cash contribution toward the first cost of dredging and construction of protective works in the amount of \$170,700;

b. Provide and maintain, without cost to the United States and in accordance with plans approved by the Chief of Engineers, a suitable and adequate public wharf for the accommodation of transient vessels;

c. Establish a competent and properly constituted public body empowered to regulate the use, growth and free development of harbor facilities, with the understanding that harbor facilities shall be open to all on equal and reasonable terms;

d. Hold and save the United States free from damages due to the construction and maintenance of the works; and

e. Provide without cost to the United States, all lands, easements, and rights-of-way necessary for the construction of the project, including suitable spoil disposal areas when and as required.

PREVIOUS PROJECT

4. Oak Orchard Harbor was the site of an earlier Federal navigation project. Adopted in 1836 and modified in 1881, the previous project provided, generally, for the construction of a west jetty and an east jetty about 200 feet apart, 1,300 and 920 feet in length, respectively; and the dredging of a channel 150 wide, 12 feet deep, and extending from deep water in the creek to the 12-foot depth contour in the lake. The once important commercial traffic having dwindled away (principally lumber in sailing vessels), abandonment of this project was authorized by the River and Harbor Act approved 3 March 1905. The remains of the old jetties are still in evidence, on about the same alignments as proposed for the new jetties to be constructed as part of the existing project.

INVESTIGATIONS

5. A detailed field survey, including soundings, probings and shore topography was made in December 1940 and January 1941 for use in preparation of the survey report which subsequently was published as the project document. In August and September of 1946 surveys were made to obtain more detailed information for studies and planning for a definite project report. The survey included soundings over the area covered in 1940 and 1941, random probings in areas not previously covered, locating new or changed topographic features, locating ruins of the stone filled timber cribs, that comprised the old jetties and 2 core borings to determine the character of the bottom material. A survey was also made in 1967 and during the first few weeks of 1968 for use in preparation of this design memorandum and to update and supplement the survey made in 1946. These data are shown on plates 2 and 3 accompanying this memorandum.

LOCAL COOPERATION

6. Satisfactory assurances covering the required items of local cooperation listed in paragraph 3 were furnished by the New York State Conservation Department on 25 July 1967 and accepted by the District Engineer on 5 September 1967. In addition, the Conservation Department by the same document furnished satisfactory assurances that they would also:

6. a. Make a cash contribution currently estimated at \$20,000, amounting to 50 percent of the incremental first cost of Federal construction of recreational fishing facilities, subject to final adjustment after actual costs have been determined; provided that the improvement for navigation may be undertaken independently of providing public recreational fishing facilities whenever the required local cooperation for navigation has been furnished;

b. Provide and maintain without cost to the United States access facilities and parking areas with adequate sanitary facilities for recreational fishing; and

c. Bear all costs of operation, maintenance and replacement of recreational fishing facilities, currently estimated at \$3,000 ^{9,700} on an average annual basis.

7. The name, title and address of the official responsible for fulfillment of local cooperation for the project modification is:

R. Stewart Kilborne, Commissioner
State of New York, Conservation Department
Albany, New York 12226

LOCATION OF PROJECT AND TRIBUTARY AREA

8. LOCATION

Oak Orchard Harbor 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.

9. DESCRIPTION OF WATERSHED

Oak Orchard Creek has a drainage area of 272 square miles. From its source, the creek flows northerly about 13 miles, westerly through an extensive swamp area known as Oak Orchard Swamp about 2 1/2 miles, northerly about 12 miles and northeasterly about 17 miles to the lake. The creek crosses under the Barge Canal at Medina. Barge Canal water up to 225 cfs, when available, may be discharged to the creek at Medina. Overflow of maximum level weirs permits the discharge. The Niagara Mohawk Power Company has four power stations located on the stream, with a total capacity of 6,800 kw. The lowermost station is about 5.4 miles above the mouth of the creek. The four stations use up to the 225 cfs from the canal, mentioned above, whenever low natural flows in the creek become a factor in their operation. Average creek discharge is 233 cfs; however, in peak hours the discharge from the lowermost station may be as much as 850 cfs.

10. The creek has a controlling depth of about 4 feet to the docks inside the creek mouth but is considered navigable for about 2 miles further upstream with depths ranging from 8 feet to 20 feet and width of about 100 feet. A basin about 450 feet wide and 450 feet long is located immediately within the creek mouth. The old parallel jetties in the lake at the creek mouth are dilapidated and most of the super-structures have been washed away.

11. TRIBUTARY AREA

The tributary area includes Orleans County with its four incorporated villages of Albion, Holley, Lyndonville and Medina, and Genesee County with the principal center of population in the city of Batavia. Oak Orchard Harbor, now generally known as Point Breeze, is a settlement of about 20 permanent residents and a summer resort colony of over 100 cottages. There are no industries at the locality other than catering to summer residents. In general, Orleans and Genesee Counties are chiefly agricultural areas. There are a few food processing plants in Orleans County and a variety of industrial activities in the city of Batavia. The population of the tributary area as of the 1960 census was 88,153; 18,210 of which were residents of the city of Batavia.

12. NEW YORK STATE MARINE PARK

The New York State Conservation Department is planning a marine park complex on Oak Orchard Creek. The state has acquired about 20 acres of land for this purpose on the west bank of the creek, (see plate 2). The State is in the process of acquiring another area of about 3-1/2 acres on the east bank of the creek at the mouth and at least 10 additional acres of land on the east side of the creek about 1/2 mile upstream of the mouth. Plans for the park on the west bank include a 110 boat marina, parking for more than 150 cars, a boat launching facility, camping and picnicking, game area, marine supplies and sanitary facilities. Plans for the park on the east side of the creek at the mouth include a small play area, parking for 70 cars, public dock, refreshments and comfort stations. A large picnic area and berthing for 100 small boats is planned for the other park on the east bank.

13. BRIDGES

The State of New York has obtained a permit from the U. S. Coast Guard for construction of dual highway bridges across Oak Orchard Creek upstream of the project area. They will be 90 feet apart and will provide a vertical clearance of 54 feet over a 190 foot channel width. The downstream face of the lowermost bridge will be about 3,200 feet upstream of the mouth of the creek (about 2,300 feet above the upstream project limit). The only existing bridges across the creek from its mouth to the

lowermost power station are two small highway structures about 2 miles above the mouth, and a railroad bridge just below the power station. Although the stream is not designated as navigable beyond the two highway bridges, small boats do pass beneath them. The one closest to the lake is lowest, affording a vertical clearance of about 8 feet above low-water datum.

REFERENCE DATUM

14. Low-water datum of Lake Ontario is 242.8 feet above mean water level at Father Point, Quebec, International Great Lakes Datum (1955). All depths and heights given in this memorandum are referred to this low-water datum; all elevations are referred to IGLD.

NATURAL FACTORS AFFECTING DESIGN

15. EXPOSURE TO STORMS

Oak Orchard Harbor and the site of the proposed offshore breakwater and jetties are exposed to storm waves generated by winds from the northwest through north to northeast. Fetch distances are about 60 miles in a northwesterly direction, to a little over 40 miles in a northerly direction, and over 100 miles in a northeasterly direction. There are no observed wind data available for Oak Orchard Harbor. The nearest locality for which reliable wind data are available is Rochester Harbor, New York, about 30 miles to the southeast. A wind rose showing the relative directional frequency and intensity of winds at that locality, based on United States Coast Guard recorded observations, is shown on plate 1. It is considered to reflect reasonably well the conditions that prevail at Oak Orchard Harbor.

16. WATER LEVELS AND FLUCTUATIONS

The water levels of Oak Orchard Harbor vary with and are the same as the levels of Lake Ontario. The average or normal lake level varies irregularly from year to year, but is subject to a consistent seasonal rise and fall, the highest prevailing during the summer months and the lowest during the winter months. In the 108 years from 1860-1967, inclusive, the level of Lake Ontario has fluctuated from a high monthly mean of 248.06 to a low monthly mean of 241.45 feet. The greatest annual fluctuation, as shown by the highest and the lowest monthly mean of any year was 3.58 feet, and the least annual fluctuation was 0.69 feet.

17. The levels of Lake Ontario have, since 1960, been controlled by operation of the St. Lawrence Seaway and Power project. Currently, regulations pertaining thereto require that monthly mean lake levels during the navigation season be controlled between a minimum elevation of 242.8 and a maximum of 246.8 (between 0 and +4 feet referred to low-water datum).

In the last five years the maximum monthly mean stages have ranged from 1.72 feet to 2.98 feet above low-water datum, and the minimum monthly mean stages have ranged from 1.02 feet below (in December) to 1.10 feet above low-water datum.

18. Temporary fluctuations, irregular in amount and duration, are frequently superimposed upon the monthly mean levels. Some of these temporary fluctuations, when caused by squalls and accompanying changes in atmospheric pressure cause oscillations of only a few minutes, ranging from a few inches to several feet. At other times the lake level may be affected for several hours, or an entire day by strong winds of sustained speed and direction which drive the surface waters toward the leeward end of the lake. Except in restricted bays near the ends of the lake, and shallow areas with flat inshore slopes, the effects of wind setup are comparatively small on Lake Ontario because of its depth which allows return currents beneath the surface to offset the buildup due to the wind-driven surface currents. The U. S. Lake Survey maintains automatic water level gages at Oswego Harbor, New York and at Rochester Harbor, New York. A gage was also located at Tibbets Point, New York from 1899 through 1915 inclusive. Tibbets Point is at the extreme easterly end of the lake and a wind setup of 1.7 feet occurred with a frequency of about once a year and a setup of 2 feet occurred about once in 3 years. At Oswego a setup of 1.2 feet occurs about once a year. Gage records at Rochester Harbor are only available for the 15-year period 1953-1967, inclusive, and have not been analyzed in the same detail as those for the Tibbets Point and Oswego gages. However, an indication of the amount of wind setup at Rochester was made by comparing the highest instantaneous level of each month of the period of record with the corresponding monthly mean level. On this basis, the maximum setup was found to be about 1.1 feet, with a total of 4 occurrences on the order of one foot, during the 13-year period. A similar inspection of available gage records of the Canadian Hydrographic Service at Port Weller, Ontario, for the 4-year period 1961-1964, shows a maximum setup of 0.78 foot with annual occurrences of between 0.67 and 0.78 foot. Gage records at Rochester and Port Weller, for the relatively short periods for which they are available, show no more severe conditions of wind setup than recorded at the Tibbets Point and Oswego gages where records are available for much longer periods. A wind setup of 1.5 feet occurring with a frequency of about once a year is considered a reasonable estimate of the setup for design purposes at Oak Orchard Harbor. This is about the mean of the annual occurrences at Oswego and Tibbets Point at the easterly end of the lake.

19. The design still water level, consisting of a temporary fluctuation of 1.5 feet superimposed on a regulated lake level of 3.5 feet above low-water datum, is 5.0 feet above low-water datum. This corresponds to superimposing a temporary fluctuation having a frequency of occurrence of once a year on a monthly mean lake level which can be expected to be equaled or exceeded about five percent of the time under regulated conditions.

20. WAVE CHARACTERISTICS

Recorded observations of wave characteristics in the vicinity of Oak Orchard Harbor are not available. Therefore the deep-water wave characteristics were determined by the procedures outlined in Technical Report No. 4 published by the Coastal Engineering Research Center in 1966.

21. Fetch distances and the average depths over the fetches were determined from U. S. Lake Survey Chart No. 2. The ratio of average depth divided by wave length for even the longest waves is greater than 1/2, therefore the method described in paragraph 1.233 of Technical Report No. 4, referred to above, was used to determine deep-water wave characteristics. The greatest wind velocities and corresponding durations which occurred at Rochester during the 18-year period, 1946 through 1963, were obtained from wind records of the U. S. Coast Guard at Rochester Harbor. The basic wind and fetch data and the computed deep water wave characteristics are shown in the following table.

TABLE 1. - Wind and deep-water wave characteristics

Direction	Fetch	Wind	Waves		
	: Length, :statute miles	:Velocity, : mph	: Duration, : hours	: Height, : feet	: Period, : seconds
NW	: 61	: 42	: 16	: 12	: 8.0
N	: 40	: 50	: 12	: 12	: 8.0
NE	: 100	: 50	: 12	: 17	: 10.0
	:	:	:	:	:

22. A wave refraction fan diagram was drawn to determine the direction of wave approach at the location of the proposed improvements. Due to refraction, all deep-water waves from the northwest through north to northeast directions have a direction of approach between N30° W and N10° E at the 12 foot depth contour. All design wave heights are governed by the depth of water at the structure and are determined by the relationship $H = .78d$. The height of the design wave at the proposed breakwater (see project plan) is 11.7 feet, and at the heads of the two proposed jetties it is 9.4 feet.

23. SOILS

The overburden materials in Oak Orchard Creek above project grades consist of loose clayey silt containing traces of organic matter and very

fine sand. Lakeward of the creek mouth, the overburden consists of gravelly sand and sand and gravel with traces of silt.

24. GEOLOGY

Oak Orchard Harbor lies within the Central Lowland province of the Interior Plains physiographic division. The region of the lower Great Lakes consists of a series of terraces or platforms descending northward from the Allegheny plateau to Lake Ontario (named the Erie, Huron and Ontario plains) and separated by northwest-facing escarpments (named Portage, Onondaga, and Niagara escarpments).

25. The Ontario plain, upon which Oak Orchard Harbor is located, extends from the Niagara escarpment on the south and west to the Laurentian plateau on the north and the Adirondack highland on the east. In New York the plain occupies a narrow belt from 250 to 500 feet above sea level along the south and east sides of Lake Ontario and a southeastward extension as far as Utica.

26. At Oak Orchard Harbor the Ontario plain has a general northwestward and northward slope. It extends beneath the water of Lake Ontario. The surface is fairly uniform except for occasional glacial ridges and stream valleys. The bedrock in the vicinity of Oak Orchard Harbor is Queenston shale of Ordovician age. It is a slightly soft to moderately hard, fine textured, slightly calcareous, indistinctly bedded, purplish-red shale that contains occasional fractures and joints (usually tight) and scattered hard, thin siltstone bands.

SHORELINE CHANGES

27. The existing remains of the old jetty structures partially obstruct the littoral movement of beach material. Some local protection in the form of dumped riprap has been installed by private property owners at the base of the bluff just east of the harbor. There is a slight predominance of drift in a easterly direction but only a small amount of suitable beach building material is supplied by erosion of the bluffs to the west. Only a small percentage of the material eroded from the silt and clay bluffs immediately west of the harbor is coarse enough to stay in the beach area. Although the proposed new jetties will completely arrest the small amount of littoral drift, the effect on the shore will be of little significance since so little littoral drift passes the creek mouth at the present time.

PROJECT PLAN

28. The project plan, shown on plates 1 and 2, comprises the following:

a. A detached breakwater in Lake Ontario, some 548 feet long, about 1,000 feet north of and parallel to shore, sheltering the opening between jetties at the mouth of Oak Orchard Creek;

b. Two parallel jetties, about 220 feet apart between center-lines, extending into the lake to protect the entrance channel, the east jetty about 670 feet long and the west jetty about 900 feet long—incorporating provisions to facilitate recreational fishing therefrom;

c. A lake approach channel, 10 feet deep and 150 feet wide from the 10-foot depth contour near each end of the detached breakwater to the outer ends of the jetties;

d. An entrance channel, 10 feet deep and 90 feet wide between jetties, from the outer ends of the jetties upstream a distance of about 1,150 feet; and

e. A basin 8 feet deep with basic width of about 200 feet, extending from the inner end of the entrance channel upstream in Oak Orchard Creek a farther distance of about 700 feet.

DEPARTURES FROM PROJECT DOCUMENT PLAN

29. Small boat harbors which have only parallel jetties protecting the entrance channel experience considerable wave action between the jetties during storms from critical directions. At times, severe wave action is experienced in inner channels and basins if they are positioned in direct line with the jetties as is the case at Oak Orchard. Therefore, a detached breakwater in the lake, sheltering the opening between the jetties, has been added to the plan.

30. In the project document plan it was contemplated that the jetties would extend from shore out to about the 10-foot depth contour in the lake. This would protect the entrance channel, laterally, for its full length. With introduction of the detached breakwater, sited near the 10-foot depth contour, to provide transverse protection, the lengths of jetties will be considerably shortened. On balance, the protection afforded by the combination of structures included in the project plan is much superior to that which the long jetties would have provided.

31. In the project document plan it was tentatively contemplated that the jetties would be constructed as cellular steel sheet pile walls. As a result of comparative studies made for selection of the project plan,

it was concluded that stone rubblemound jetties would be more economical and have greater wave absorptive characteristics than vertical sheet pile walls. For these reasons, the project plan provides for construction of a stone rubblemound structure rather than cellular steel sheet pile walls.

32. The use of the new jetties for recreational fishing was not contemplated at the time of project authorization. It has, however, since become customary to incorporate provisions therefor in Corps of Engineers projects of similar nature where justification is apparent, and it is now planned to do so here. The New York State Conservation Department has requested that such facilities be included in the project plan and has furnished assurances of sharing in the cost thereof. Further, their marine park plans include on-shore facilities for accommodation of fishermen. The U. S. Fish and Wildlife Service's conservation and development report (see Appendix C) indicates substantial benefits will be attributable to fishing from the jetties.

33. The project plan of dredging is substantially the same as the project document plan except for positioning of channel limits to conform to the location of the breakwater, jetties and planned improvements by the New York State Conservation Department. In the project document plan, a 10-foot deep entrance channel was planned to be completely within the protection of the jetties. However, a lake approach channel has been included in the project plan to provide access from the 10-foot depth contour near each end of the breakwater to the entrance channel between jetties. The project document plan contemplated an entrance channel 100 feet wide, whereas the width in the project plan will be 90 feet. This latter width is adequate for two-way passage of the local boat traffic. The reduction is necessary for maintenance purposes to provide safe clearance between channel and toe stone of the jetties. An increase in distance between rubblemound jetties would be necessary to retain the 100-foot channel width. This would increase the exposure of the entrance channel to wave action unless the detached breakwater were lengthened. The basin limits in the project plan were positioned to best fit the needs of the New York State Conservation Department in development of a marine park.

OTHER PLANS INVESTIGATED

34. As indicated in paragraph 31, several alternative types of construction, as well as the stone rubblemound type provided for in the project plan, were considered for the jetties. Also, stone rubblemound construction as an alternative to the cellular steel sheet pile construction provided for in the project plan (see paragraph 35), was considered for the detached breakwater. Data on comparative studies of the various structures are included in Appendix B.

DESCRIPTION OF PROPOSED STRUCTURES AND IMPROVEMENTS

35. DETACHED BREAKWATER

The breakwater will be of cellular steel sheet pile construction and will be located about 1,000 feet north of and parallel to shore. The structure will be alined in an east-west direction (on a bearing of about N 88°W) and will have an overall length of about 548 feet. Crest of the structure will be 8 feet above low-water datum.

36. The structure will consist of 14 circular cells with connecting arcs. The cells will be about 35 feet in diameter. S-28 piling will be used and will be toed into bedrock. The cells will be filled with granular material and covered with a 2-foot thick concrete cap reinforced with welded wire mesh. Four anchor bolts will be installed in the center of each of the end cells for installation of minor navigation lights by the U. S. Coast Guard. Ladders, for safety, will be provided at intervals on both sides of the breakwater.

37. JETTIES

The east and west jetties will be parallel and about 220 feet apart between centerlines. The jetties will be of stone rubblemound construction and on a northerly alinement from shore (on a bearing of about N 2°E). Crest length of the west jetty will be about 900 feet and of the east jetty about 670 feet. Height of both structures will be 8 feet above low-water datum, the same height as that planned for the detached breakwater and about the same height of similar structures at other harbors on Lake Ontario.

38. The core of the jetties will be dumped stone ranging in size from about 200 pounds to chips. Cover stone layer will be selected stone random placed to provide a degree of wedging or interlocking action between stones. The weight of cover stone for the east jetty will be 2 tons in the outer reach and 1 ton in the inner reach. The weight of cover stone for the west jetty will be 4.5 tons in the outer reach, 3 tons in the middle reach and 2 tons in the inner reach. Graded rip-rap ranging in weight from 12 pounds to 1 ton will be placed at or near the shore end of each jetty. Side slope of the east jetty will be 1 vertical on 1.5 horizontal, as will the inner reach of the west jetty. Side slope on the outer reach of the west jetty will be 1 vertical on 2 horizontal, with 1 on 3 around the outer toe. These flatter slopes were adopted in lieu of using weights of stone exceeding 4.5 tons as would otherwise be required.

39. A concrete walkway and guard railing will be installed on the top of both jetties to provide safe access from shore by fishermen. The width of the walkway on the east jetty, and the inner reach of the west jetty will be 10 feet; and will be 12 feet wide on the outer reach of

the west jetty. A 7.5 foot cube of concrete with anchor bolts will be placed at the outer ends of each jetty to provide a base for installation of minor navigation lights by the U. S. Coast Guard.

40. DREDGING

Summarized, details of dredging are as follows:

a. Lake approach channel. - A channel from the 10-foot depth contour near each end of the detached breakwater to the outer ends of the jetties will be dredged to a depth of 10 feet. This will include removal of the outer ends of the remains of the old jetties where they extend beyond the alignments of the new jetties.

b. Entrance channel. - A channel from station 22+25 to station 34+00 will be dredged to a depth of 10 feet. (Stationing is shown on plate 2).

c. Basin. - A basin from station 34+00 to station 40+75 will be dredged to a depth of 8 feet.

For all of the dredging, an allowance of 1 foot for overdepth will be made. Side slopes from the 10 foot depth contour in the lake to station 29+00 will be 1 vertical on 2 horizontal and 1 vertical on 3 horizontal between station 29+00 and station 40+75. The payment line will be the same slope. Dredged material will be clayey silt and sands and gravels. Some of the coarse gravels will be used as cell fill, sands and gravels will be cast on the east side and shore end of the east jetty for replenishment of downdrift beaches and the remaining dredged material will be disposed of on land to be provided by New York State. It is the material excavated from the entrance channel and basin between station 27+00 and station 40+75, amounting to about 32,000 cubic yards, that will be spoiled on shore. Remains of the old jetties will be disposed of in several ways depending on the material. Stone, cobbles, gravels and sands, depending on size, will be used as cell fill or beach replenishment. Timber and metals from the old jetty cribs will be disposed of on shore, either by burning or by burying.

SOURCES OF CONSTRUCTION MATERIAL

41. Sheet piling and other steel items required for the work are standard items available from most suppliers and steel manufacturers. Visual and manual examinations of jar samples of bottom materials from boring SS 671302 (shown in plan on plate 2) indicated the materials, which are sand and gravel, could be used as cell fill. Gradations performed on the 4 available samples proved the materials to be relatively well graded and clean. Chart 1 shows the sample gradations in relation to proposed limits for cell fill materials. (Chart 1 through 4 are attached following plate 3). Numerous sources of stone suitable for use as core stone are available within a 50 mile radius of the project. These are listed on Chart 2. There are 5 sources of stone suitable for use as cover stone and riprap below the 2 ton maximum size within a 40 mile radius of the project. However, Cleveland Quarries Company located in South Amherst, Ohio, about 255 miles from the project is the only source for 3 and 4.5 ton stone. Chart 3 lists the sources of cover stone and Chart 4 the sources of concrete aggregates.

COST ESTIMATES

42. FIRST COST

The estimated cost of the project plan, based on December 1968 price levels, is given in the following table.

TABLE 2. - Estimate of first cost

Item	Quantity	Unit	Unit cost	Amount
FEDERAL (C of E)			\$	\$
CHANNELS				
Dredging	63,000	C.Y.	1.60	100,800
Obstruction removal		L.S.		9,000
Contingencies		L.S.		16,200
TOTAL CHANNELS				126,000
BREAKWATERS				
Detached breakwater				
Steel sheet piling	1,356,000	Lb.	0.155	210,180
Place cell fill	9,100	C.Y.	2.00	18,200
Concrete cap	1,240	C.Y.	42.00	52,080
Wire mesh	1,900	S.Y.	1.05	1,995
Building paper	1,900	S.Y.	0.60	1,140
East jetty				273,515
Core stone	6,100	Ton	12.00	73,200
Cover stone, 1-2 ton	7,300	Ton	14.75	107,675
Graded riprap	1,300	Ton	12.00	15,600
West jetty				
Core stone	7,400	Ton	12.00	88,800
Cover stone, 2 ton	1,700	Ton	14.75	25,075
Cover stone, 3 ton	2,650	Ton	20.00	53,000
Cover stone, 4.5 ton	4,600	Ton	15.00	69,000
Graded riprap	2,750	Ton	12.00	33,000
Contingencies		L.S.		111,055
TOTAL BREAKWATERS				860,000
ENGINEERING AND DESIGN		L.S.	11'	89,000
SUPERVISION AND ADMINISTRATION		L.S.	7 1/2'	62,000
LESS CASH CONTRIBUTION		L.S.		-170,700
SUBTOTAL				966,300
RECREATIONAL FACILITIES				
Walkways and guardrails		L.S.		32,170
Contingencies		L.S.		4,830
TOTAL REC. FACILITIES				37,000
ENGINEERING AND DESIGN		L.S.		2,000
SUPERVISION AND ADMINISTRATION		L.S.		4,000
LESS CASH CONTRIBUTION		L.S.		-21,500
SUBTOTAL				21,500
TOTAL (C of E)				987,800

TABLE 2. - Estimate of first cost (Contd)

Item	Quantity	Unit	Unit cost	Amount
			\$	\$
FEDERAL (U.S.C.G.)				
NAVIGATION AIDS (Minor lights)	4	Ea.	4,000	16,000
NON-FEDERAL				
LANDS		L.S.		7,000 (1)
PUBLIC WHARF		L.S.		49,000 (1)
CASH CONTRIBUTIONS				
Navigation		L.S.		170,700
Recreation		L.S.		21,500
TOTAL NON-FEDERAL		L.S.		248,200
GRAND TOTAL PROJECT COST				1,252,000

(1) For minimum facilities required. Non-Federal development costs for the State's master plan of marine park facilities can be expected to be much greater. Amounts shown are based on estimate made as part of detailed design studies in 1947, escalated to December 1968 price levels.

43. ANNUAL COSTS

Based on the foregoing estimate of first costs, an interest rate of 3-1/4% for both Federal and non-Federal investments, and an assumed 50-year project life, annual costs for the project are estimated as shown in the following table. In view of the planned sequence of construction outlined in paragraph 48, whereby realization of a substantial share of anticipated navigation benefits could begin after the first year of construction, interest during construction is generally excluded. The one exception is in connection with the non-Federal contribution toward recreation facilities; it is assumed the contribution would be made prior to advertisement of the Government's construction contract, but the work not performed until about 2 years later.

TABLE 3. - Estimate of annual costs

Item	Federal			Total
	C of E	U.S.C.G.	Non-Federal	
	\$	\$	\$	\$
First cost	987,800	16,000	248,200	1,252,000
Int. during constr.	-	-	700	700
Investment	987,800	16,000	248,900	1,252,700
Annual charges				
Interest	32,100	500	8,100	40,700
Amortization	8,100	100	2,100	10,300
Maintenance	4,000	600	1,500	6,100
	44,200	1,200	11,700	57,100

44. COMPARISON OF ESTIMATES

A comparison between previous estimates of project costs and the estimate presented in this design memorandum is provided below (price levels of the estimates are shown in parenthesis):

TABLE 4. - Comparison of estimates

Item	Project document estimate (1) (May 1941)	Latest approved estimate (2) (July 1968)	Design memorandum estimate (December 1968)
	\$	\$	\$
FEDERAL (C of E)			
Channels	54,500	370,000	126,000
Breakwaters	286,900	895,000	860,000
Engineering and design	(3)	105,700	89,000
Supervision & administration	(3)	70,000	62,000
Recreational facilities	-	-	43,000 (4)
Subtotal	341,400	1,440,700	1,180,000
Non-Federal cash contr.	-170,700	-170,700	-192,200
TOTAL (C of E)	170,700	1,270,000	987,800
FEDERAL (U.S.C.G.)			
Aids to navigation	1,800	2,000	16,000
NON-FEDERAL			
Lands	1,000	6,700	7,000
Public wharf	6,000	46,600	49,000
Cash contribution	-170,700	-170,700	-192,200
TOTAL	177,700	224,000	248,200
TOTAL PROJECT COSTS	350,200	1,496,000	1,252,000

- (1) House Document No. 446, 78th Congress, 2d session.
 (2) Project Cost Estimate (PB-3) dated 1 July 1968.
 (3) Included with estimated construction item costs.
 (4) Includes related E & D and S & A.

45. The total difference of +\$1,145,800 between the document estimate and the latest approved estimate of project costs is due primarily to price level increases (+\$1,164,500), plus refinements and adjustments indicated by detailed design studies made in 1947 (net of -\$18,700).

46. The total difference of -\$244,000 between the latest approved estimate of project costs and the design memorandum estimate is due to the following:

Federal (C of E)

Price level increase	\$ +62,300
Decrease in estimated costs for dredging due to change in limits, reduction of quantities, and reestimate of unit prices.....	-260,000
Net reduction in estimated costs for breakwaters due to addition of detached structure (+\$326,000), with reduction in length of jetties and change from steel to stone construction (-\$400,000).....	- 74,000
Reanalysis of requirements for E and D (-\$21,000) and S & A (-\$11,000) in connection with dredging and breakwaters.....	- 32,000
Addition of recreational facilities.....	+ 43,000
Increase in non-Federal cash contribution, equal to 50% of recreational facilities costs.....	- 21,500
	<u>-282,200</u>

Federal (U.S.C.G.)

Increase due to price increases, addition of 3 aids, and reestimate by U.S.C.G.....	\$ +14,000
---	------------

Non-Federal

Price level increase.....	\$ + 2,700
Addition of cash contribution toward recreational facilities.....	+21,500
	<u>+24,200</u>

BENEFITS

47. Construction of improvements described in this memorandum will provide a link in the chain of harbors of refuge for small craft cruising on Lake Ontario and a base for small boats. Related navigation benefits are estimated as about \$120,000 annually, on December 1968 price levels. The U. S. Fish and Wildlife Service estimates that additional benefits, amounting to about \$21,000 annually, will be derived from recreational fishing off the jetties. Total annual benefits are thus estimated as \$141,000. Compared to the estimate of total annual costs, \$57,100 given in table 3, this yields a benefit - cost ratio of about 2.5.

SCHEDULES FOR DESIGN AND CONSTRUCTION

48. Plans and specifications for construction of work considered in this memorandum will be prepared and submitted for review by Division Engineer, North Central, upon receipt of approval of this memorandum. Presently scheduled submission date is July 1969. Although a detailed construction schedule is not yet determinable, it is desired to complete all advance engineering and design in sufficient time to advertise in September 1969 and award a continuing-type contract by November 1969. This will permit completion of construction of all work, except the concrete cap and guardrails on the jetties, by October 1970. Construction of walkways and guardrails will be started about 1 year after completion of the jetties and be completed in about 30 days.

49. Award of a contract for the work as scheduled is desirable to insure orderly accomplishment of all features of the improvement. The contractor could order his material and supplies in the fall of 1969 and start construction of the detached breakwater and lake approach and entrance channel dredging in early spring of 1970. This will allow substantial completion of the detached breakwater and start of construction of jetties in July. After completion of the jetties, about one year will be allowed for settlement before the contractor shall be required to install the walkways and guardrails for recreational fishing, at which time he will also redress or replenish sections of the structures where displacement of the rubblemound stone may have been significant.

COORDINATION WITH OTHER AGENCIES

50. During the course of studies for this design memorandum, agencies having an interest in this project were contacted and, where appropriate, their views reflected in the plan of improvement.

a. U. S. Coast Guard. - The 9th Coast Guard District, Cleveland, Ohio, recommended that a minor light be installed on each end of the detached breakwater and on the lakeward ends of the jetties, as has been provided for in the project plan, and furnished the estimated first cost and estimated annual maintenance cost therefor used in this memorandum.

b. Federal Water Pollution Control Administration. - Samples of material to be dredged from the harbor basin within Oak Orchard Creek were furnished to the Lake Ontario Basin Office of FWPCA in Rochester, N. Y., for analysis. Their report thereon, in a letter dated 28 February 1969, is contained in Appendix C. An advance copy of this memorandum was furnished to the Great Lakes Region office of FWPCA, Chicago, Illinois. Copy of the letter response therefrom, dated 13 March 1969, together with a subsequent Buffalo District reply, is also contained in Appendix C. The Regional Director supports his Rochester office in the opinion that the material excavated from within Oak Orchard Creek should not be disposed of by dumping in Lake Ontario. Also, he suggested that the terms of local cooperation should cover disposal of watercraft wastes; in the 21 March 1969 reply it was pointed out that the pertinent requirement (as listed in paragraph 3b of this memorandum) has, as actually written in the executed assurance of local cooperation, been broadened to include this point.

c. U. S. Fish and Wildlife Service. - The U. S. Fish and Wildlife Service, Boston, Massachusetts, furnished its conservation and development report on this project 5 March 1969. A copy, with accompanying letter from the New York State Conservation Department's Division of Fish and Game, is contained in Appendix C. It outlines the provisions needed to facilitate recreational fishing from the project structures and confirms the estimate, previously furnished informally, of related benefits as used in this memorandum. It also sets forth their concern respecting final selection of spoil sites, particularly upland sites which might encroach on existing wetlands.

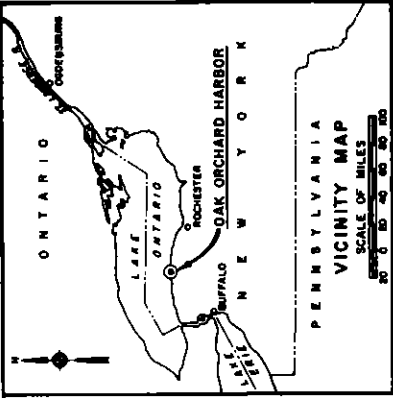
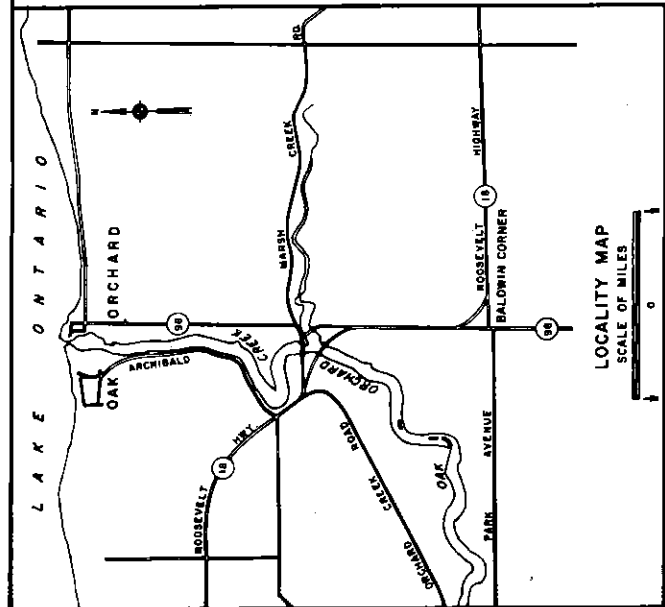
d. Genesee State Park Commission. - The limits of the harbor basin within Oak Orchard Creek were selected after coordination with the Genesee State Park Commission, to suit their projected marine park developments nearby. They also advised that they are unable to find a location on the lands over which they have jurisdiction for the planned upland disposal of a part of the material from project dredging. See 28 January and 7 February 1969 letters in Appendix C. Consequently, acquisition of

additional property especially for this purpose by the New York State Conservation Department (parent organization of the Commission), in accordance with the terms of local cooperation, appears to be indicated.

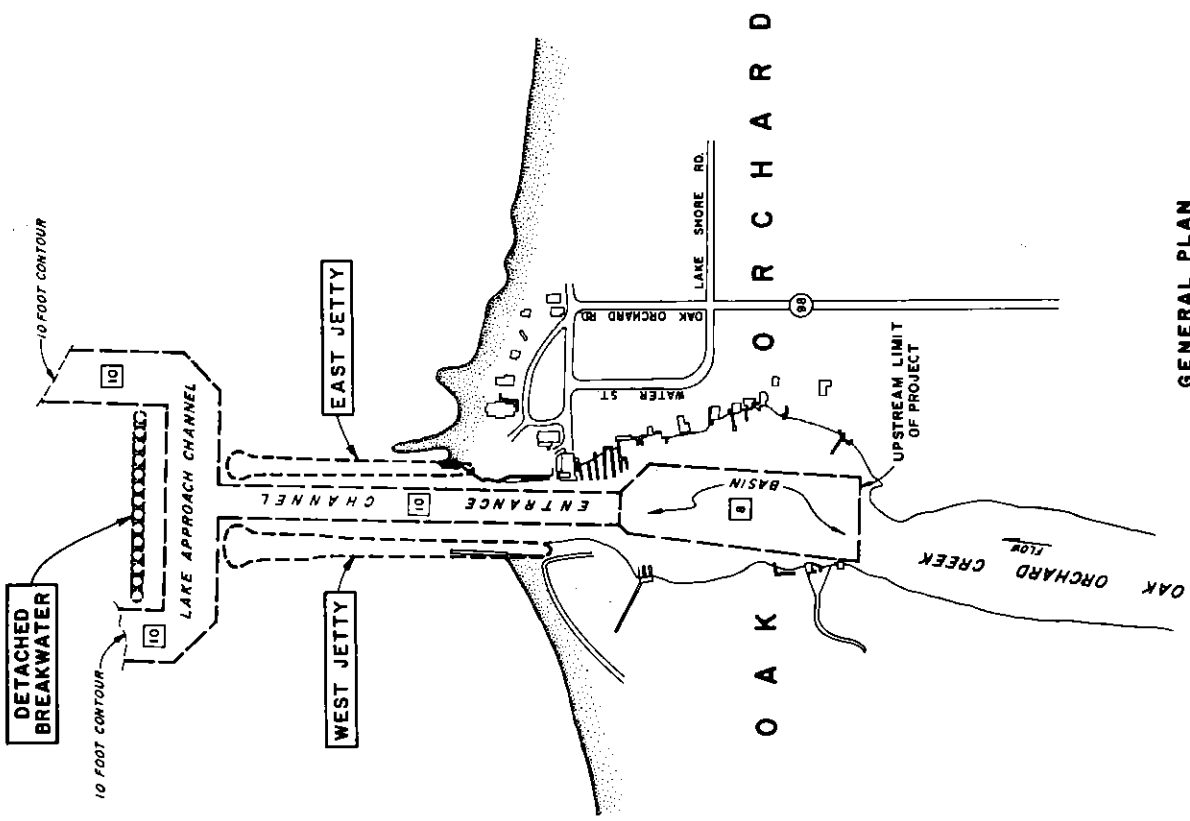
e. New York State Conservation Department. - Advance copies of this design memorandum were furnished to the Commissioner of Conservation. Copy of the letter of response, 14 March 1969, is contained in Appendix C. It is indicated that the plan of improvement as presented in the memorandum meets with the State's approval.

RECOMMENDATION

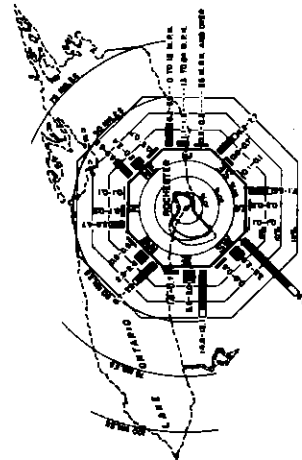
51. It is recommended that the plan for accomplishment of the Oak Orchard Harbor improvement presented in this design memorandum be approved.



L A K E O N T A R I O



GENERAL PLAN
SCALE OF FEET
0 500 1000



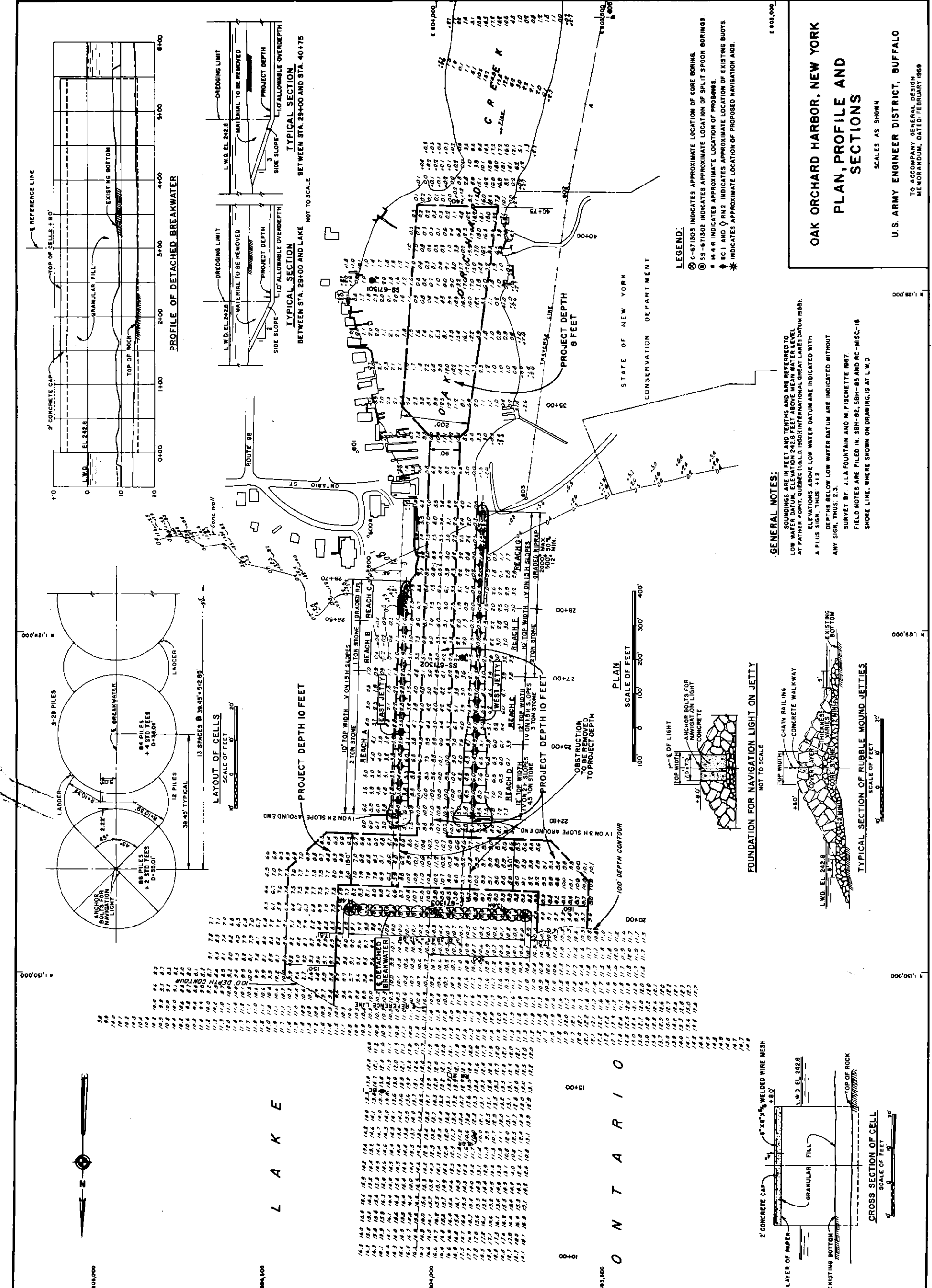
NOTES
 1. INDICATES DURATION FOR ICE-FREE PERIOD (MARK TO DEC. 15) AND FOR TOTAL OPERATION.
 2. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 3. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 4. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 5. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 6. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 7. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 8. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 9. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.
 10. INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.

NOTES:
 FOR GENERAL NOTES, SEE PLATE 2
 [Symbol] INDICATES PROJECT DEPTH BELOW L.W.D.
 --- AUTHORIZED PROJECT AND CHANNEL LIMITS

OAK ORCHARD HARBOR, NEW YORK
GENERAL PLAN
 SCALES AS SHOWN
 U.S. ARMY ENGINEER DISTRICT, BUFFALO
 TO ACCOMPANY GENERAL DESIGN MEMORANDUM, DATED FEBRUARY 1969

OAK ORCHARD HARBOR, NEW YORK PLAN, PROFILE AND SECTIONS

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN
MEMORANDUM, DATED FEBRUARY 1968
SCALES AS SHOWN



- LEGEND:**
- ⊙ C-671503 INDICATES APPROXIMATE LOCATION OF CORE BORING.
 - ⊙ 14.4 R INDICATES APPROXIMATE LOCATION OF SPLIT SPOON BORINGS.
 - ⊙ 14.4 R INDICATES APPROXIMATE LOCATION OF PROBLEMS.
 - ⊙ BC 1 AND 2 INDICATES APPROXIMATE LOCATION OF EXISTING BUOYS.
 - ⊙ INDICATES APPROXIMATE LOCATION OF PROPOSED NAVIGATION AIDS.

GENERAL NOTES:

SOUNDINGS ARE IN FEET AND TENTHS AND ARE REFERRED TO LOW WATER DATUM. ELEVATION 242.8 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (I.L.D. 1963) INTERNATIONAL GREAT LAKES DATUM (1985).

ELEVATIONS ABOVE LOW WATER DATUM ARE INDICATED WITH A PLUS SIGN, THUS: +1.2

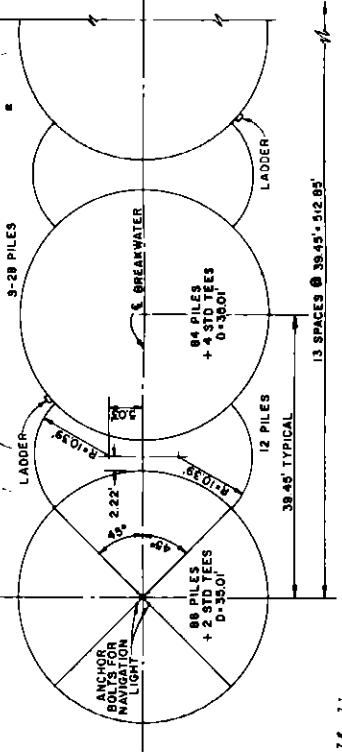
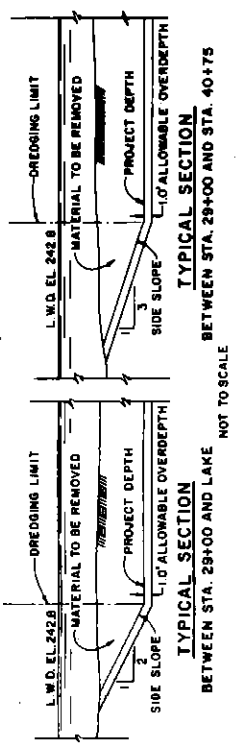
DEPTHS BELOW LOW WATER DATUM ARE INDICATED WITHOUT ANY SIGN, THUS: 2.3

SURVEY BY: J. LA FOUNTAIN AND M. FISCHETTE (407)

FIELD NOTES ARE FILED IN: SBP-82, SBM-85 AND RC-MISC-16

SHORE LINE, WHERE SHOWN ON DRAWING, IS AT L.W.D.

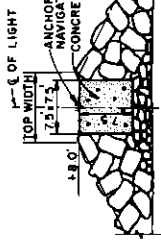
PROFILE OF DETACHED BREAKWATER



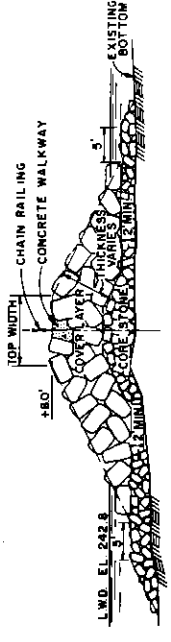
LAYOUT OF CELLS

PROJECT DEPTH 10 FEET

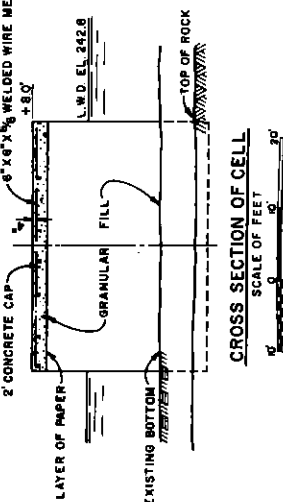
PLAN SCALE OF FEET



FOUNDATION FOR NAVIGATION LIGHT ON JETTY



TYPICAL SECTION OF RUBBLE MOUND JETTIES



CROSS SECTION OF CELL

1:50,000

1:50,000

1:50,000

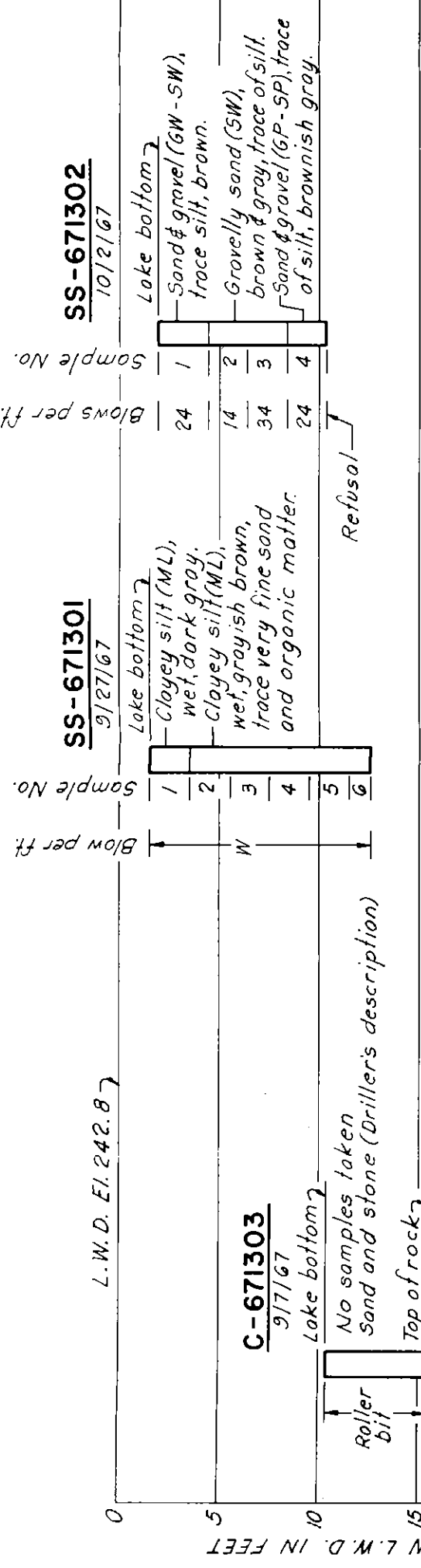
1:50,000

1:50,000

1:50,000

1:50,000

1:50,000



SS-671301
9/27/67

SS-671302
10/2/67

C-671303
9/7/67

LEGEND: (Subsurface Explorations)

- W Sampler advanced by static weight of rods and hammer alone.
- ML Silt, inorganic, little to no plasticity.
- GW Gravel, well graded.
- GP Gravel, poorly graded.
- SW Sand, well graded.
- SP Sand, poorly graded.
- GW-SW or SW-SP Borderline between sand & gravel.

ABBREVIATIONS

- bdd. bedding
- frac (s) fractures
- num. numerous
- pln. plane
- hor. horizontal
- sis. siltstone
- vert. vertical

100.0% percent core recovered in bedrock
2 1/8" diameter of bedrock core

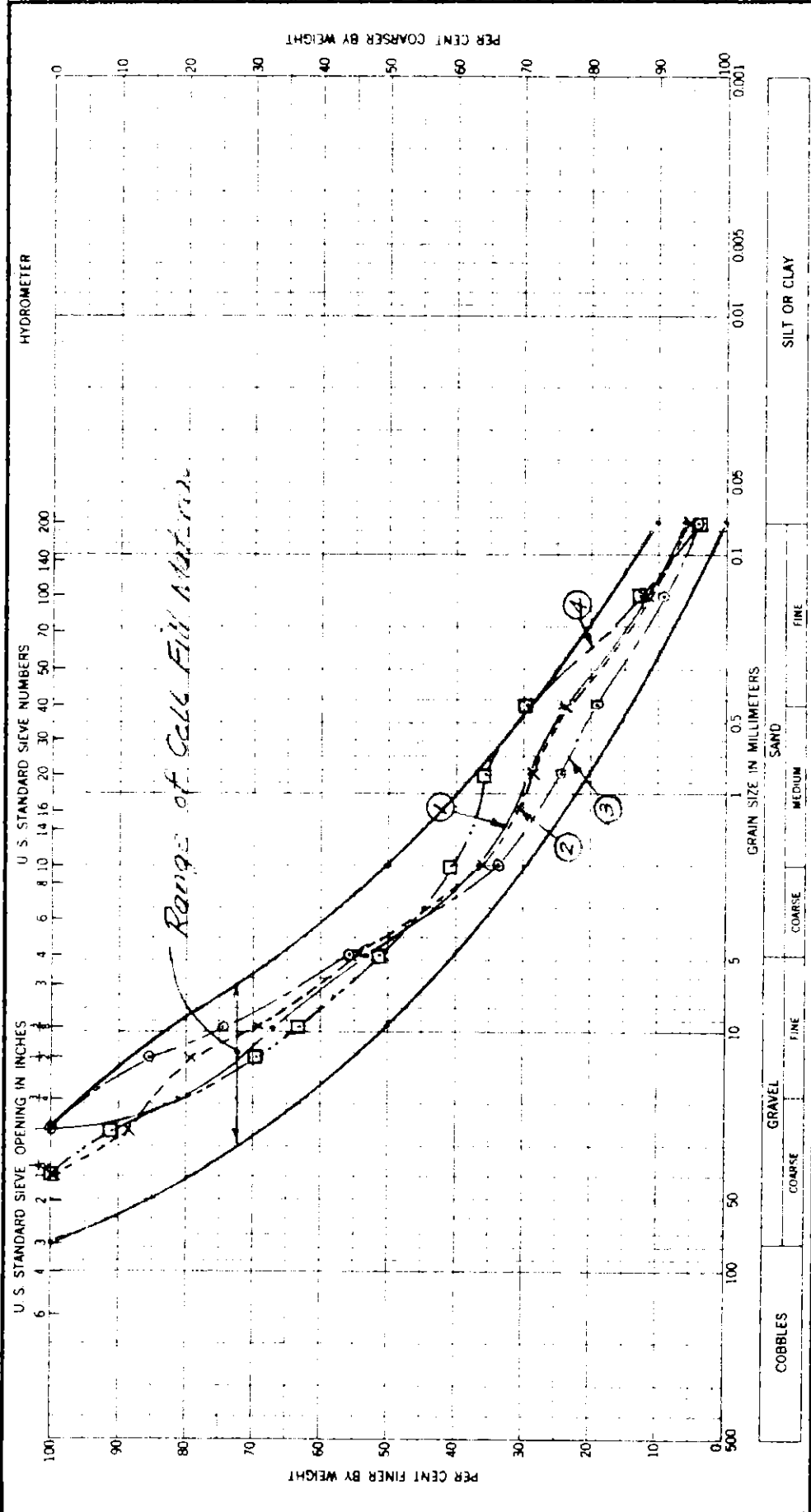
NOTES: (Subsurface Explorations)

1. Approximate locations of borings are shown on plan, see plate number 2.
2. Samples were obtained with a 1 1/2 inch I.D. standard split spoon sampler advanced by a 140-lb. hammer falling 30 inches.
3. Blows per foot indicate resistance of soil to penetration by the sampler.
4. Soil and rock descriptions are based on visual and manual examination of the samples.
5. The bedrock is classified as Queenston shale and is described, in general, as follows: purplish red, slightly soft to moderately hard, indistinctly bedded, fine textured, calcareous SHALE containing occasional tight horizontal fractures along bedding planes and occasional tight angle and vertical fractures and contains scattered thin bands of red, hard, calcareous SILTSTONE.
6. Soil and rock samples are available for inspection at the office of the District Engineer, Buffalo, N. Y.

**OAK ORCHARD HARBOR, NEW YORK
SUBSURFACE EXPLORATIONS**

SCALES AS SHOWN

U.S. ARMY ENGINEER DISTRICT, BUFFALO
TO ACCOMPANY GENERAL DESIGN
MEMORANDUM, DATED: FEBRUARY 1969



Project *CAK ORCHARD HARBOR, NY*
Gradations of lake bottom
 materials from boring
 Boring No. *55 671302*
 Date *Feb 68*

GRADATION CURVES

CHART 1 - Gradation of lake bottom material

RT 2 - SOURCES OF CORE STONE

RECORD		SERVICE RECORD			REMARKS
OBJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION		
-	1968	NYS: HAMLIN BEACH STATE PARK (RIPRAP)	NOT EVALUATED		
-	UNKNOWN	UNKNOWN	UNKNOWN		
-	UNKNOWN	UNKNOWN	UNKNOWN		
-	UNKNOWN	UNKNOWN	UNKNOWN		
OATKA CREEK, WARSAW, N.Y. (RIPRAP)	1967	OATKA CREEK, WARSAW, N.Y. (RIPRAP)	OCCASIONAL PIECE SEPARATING ALONG FRACTURES AND SHALE PARTINGS		
-	UNKNOWN	NYS: BARGE CANAL (RIPRAP)	NOT EVALUATED		
SOIL DISPOSAL DIKE, BUFFALO, N.Y. (RIPRAP)	1967	SPOIL DISPOSAL DIKE, BUFFALO, N.Y. (RIPRAP)	OCCASIONAL PIECE SEPARATING ALONG FRACTURES AND SHALE PARTINGS		
SMOKES CREEK (II), LACKAWANNA, N.Y. (RIPRAP)	NOT USED	-	-		
-	UNKNOWN	UNKNOWN	UNKNOWN	QUARRY NOT INSPECTED FOR THIS SURVEY	
-	UNKNOWN	UNKNOWN	UNKNOWN	QUARRY NOT INSPECTED FOR THIS SURVEY	
-	UNKNOWN	UNKNOWN	UNKNOWN	QUARRY NOT INSPECTED FOR THIS SURVEY	
SMOKES CREEK (III), LACKAWANNA, N.Y. (RIPRAP)	1966-1967	SMOKES CREEK (III), LACKAWANNA, N.Y. (RIPRAP)	OCCASIONAL PIECE SEPARATING ALONG FRACTURES AND SHALE PARTINGS		
-	UNKNOWN	NYS OR COUNTY : HIGHWAY BRIDGES (RIPRAP)	NOT EVALUATED		

OAK ORCHARD HARBOR, NEW YORK
SOURCES OF CORE STONE
 U.S. ARMY ENGINEER DISTRICT, BUFFALO
 GDM DATED: FEBRUARY 1969

CHART 2

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD	
				DATE TESTED	LABORATORY
CONCRETE MATERIALS INC. QUARRY AT BROCKPORT, N.Y.	LOCKPORT DOLOMITE	CORE STONE	19 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
GENERAL CRUSHED STONE CO. QUARRY AT LEROY, N.Y.	ONONDAGA LIMESTONE	CORE STONE	28 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
LERoy LIME AND CRUSHED STONE CO. QUARRY AT LEROY, N.Y.	ONONDAGA LIMESTONE	CORE STONE	29 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
DOLOMITE PRODUCTS CO. QUARRY AT GATES, N.Y.	LOCKPORT DOLOMITE	CORE STONE	30 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
COUNTY LINE STONE CO. QUARRY AT AKRON, N.Y.	ONONDAGA LIMESTONE	CORE STONE	31 MI.	9 JUNE 1967	OHIO RIVER DIVISION
FRONTIER STONE PRODUCTS INC. QUARRY AT LOCKPORT, N.Y.	LOCKPORT DOLOMITE	CORE STONE	32 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
LANCASTER STONE PRODUCTS CO. QUARRY AT CLARENCE, N.Y.	ONONDAGA LIMESTONE	CORE STONE	36 MI.	30 OCT. 1967	OHIO RIVER DIVISION
HOUDAILLE CONSTRUCTION MATERIALS INC. QUARRY AT CLARENCE, N.Y.	ONONDAGA LIMESTONE	CORE STONE	37 MI.	15 SEP. 1965	OHIO RIVER DIVISION
DOLOMITE PRODUCTS CO. QUARRY AT PENFIELD, N.Y.	LOCKPORT DOLOMITE	CORE STONE	40 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
NIAGARA STONE PRODUCTS INC. QUARRY NEAR PLETCHERS CORNERS, N.Y.	LOCKPORT DOLOMITE	CORE STONE	41 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
GENERAL CRUSHED STONE CO. QUARRY AT HONEOYE FALLS, N.Y.	ONONDAGA LIMESTONE	CORE STONE	41 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
FEDERAL CRUSHED STONE CO. QUARRY AT CHEEKTOWAGA, N.Y.	ONONDAGA LIMESTONE	CORE STONE	44 MI.	18 NOV. 1965	OHIO RIVER DIVISION
GENERAL CRUSHED STONE CO. QUARRY AT OAKS CORNERS, N.Y.	ONONDAGA LIMESTONE	CORE STONE	66 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-

SPOIL DISPOS
(RIPRAP)

SMOKES CREEK
(RIPRAP)

SMOKES CREEK
(RIPRAP)

SOURCES OF COVER STONE AND RIPRAP

RECORD

SERVICE RECORD

PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION	REMARKS
-	1967-68(?)	HAMLIN BEACH STATE PARK (?) N.Y. (EROSION CONTROL)	NOT EVALUATED	PROPOSED SOURCE RESTRICTED TO ZONES OF LOCKPORT DOLOMITE FREE OF DELETERIOUS SHALE PARTINGS AND FRACTURES. HAMLIN BEACH STATE PARK SITE NOT INSPECTED.
-	UNKNOWN	UNKNOWN	UNKNOWN	PROPOSED SOURCE RESTRICTED TO ZONES OF LOCKPORT DOLOMITE FREE OF DELETERIOUS SHALE PARTINGS AND FRACTURES.
-	UNKNOWN	N.Y.S. BARGE CANAL, N.Y. (RIPRAP)	NOT EVALUATED	PROPOSED SOURCE RESTRICTED TO THE GASPORT LIMESTONE MEMBER; OTHER ZONES OF LOCKPORT DOLOMITE SUITABLE WITH SELECTIVE QUARRYING (I.E. THE SELECTION OF PIECES FREE FROM DELETERIOUS SHALE PARTINGS AND FRACTURES).
-	UNKNOWN	UNKNOWN	UNKNOWN	PROPOSED SOURCE RESTRICTED TO ZONES OF LOCKPORT DOLOMITE FREE OF DELETERIOUS SHALE PARTINGS AND FRACTURES. QUARRY NOT INSPECTED FOR THIS SURVEY.
-	UNKNOWN	UNKNOWN	UNKNOWN	PROPOSED SOURCE RESTRICTED TO GASPORT LIMESTONE MEMBER; OTHER ZONES OF LOCKPORT DOLOMITE SUITABLE WITH SELECTIVE QUARRYING (I.E. THE SELECTION OF PIECES FREE FROM DELETERIOUS SHALE PARTINGS AND FRACTURES). QUARRY NOT INSPECTED FOR THIS SURVEY.
EVELAND SPOIL DISPOSAL DIKE, EVELAND, OHIO (GR)	NOT USED	-	-	-
-	1958-1959	OSWEGO DETACHED BREAKWATER. OSWEGO, N.Y. (COVER STONE)	SATISFACTORY	OCCASIONAL SEPARATION ALONG SHALE PARTING OR STYLOLITIC ZONE: SOME DEGREE OF SELECTIVITY REQUIRED AT SOURCE.
-	1963	RUBBLE MOUND SHORE CONNECTION EAST BREAKWATER SHORE ARM LORAIN HARBOR, OHIO	NOT EVALUATED	
-	10 OR MORE YEARS	BUFFALO DISTRICT BREAKWATER REPAIRS	NOT EVALUATED	

NOTES:

4.5T - 4.5 TONS
 3T - 3 TONS
 2T - 2 TONS
 1T - 1 TON
 GR - GRADED RIPRAP

OAK ORCHARD HARBOR, NEW YORK
SOURCES OF COVER STONE

CHART 3 - SOURCE

SOURCE	ROCK TYPE	PROPOSED USE	RADIAL DISTANCE	LABORATORY TEST RECORD	
				DATE TESTED	LABORATORY
CONCRETE MATERIALS INC. QUARRY AT BROCKPORT, N.Y.	LOCKPORT DOLOMITE	2T. IT	19 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
DOLOMITE PRODUCTS CO. QUARRY AT GATES, N.Y.	LOCKPORT DOLOMITE	2T. IT, GR	30 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
FRONTIER STONE PRODUCTS INC. QUARRY AT LOCKPORT, N.Y.	LOCKPORT DOLOMITE	2T. IT, GR	32 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
DOLOMITE PRODUCTS CO. QUARRY AT PENFIELD, N.Y.	LOCKPORT DOLOMITE	2T. IT, GR	40 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
NIAGARA STONE PRODUCTS INC. QUARRY NEAR PLETCHERS CORNERS, N.Y.	LOCKPORT DOLOMITE	2T. IT, GR	41 MI.	NOT TESTED BY THE BUFFALO DISTRICT	-
CLEVELAND QUARRIES CO. QUARRIES AT SOUTH AMHERST, OHIO	BEREA SANDSTONE	4.5T. 3T. 2T. 1T. GR	255 MI. (AROUND LAKE ERIE)	9 AUG. 1967	OHIO RIVER DIVISION

CLEVELAND SPOT
CLEVELAND, OHIO

ART 4 - SOURCES OF AGGREGATES

RECORD			SERVICE RECORD		REMARKS
PROJECT FOR WHICH TESTED	DATE USED	PROJECT	EVALUATION		
S (FINE AGGREGATE) SMOKES CREEK (II). (FINE AGGREGATE)	UNKNOWN 1965-1968	UNKNOWN SMOKES CREEK (II & III)	UNKNOWN NOT EVALUATED		FINE AGGREGATE TESTED AND ACCEPTED FOR TYPE "B" NYS CLASSIFICATION
COARSE S (FINE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN		COARSE AGGREGATE TESTED AND ACCEPTED FOR TYPE "A" INCLUDING EXPOSED CONCRETE.
COARSE S (FINE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN		COARSE AGGREGATE TESTED AND ACCEPTED FOR TYPE "A" INCLUDING EXPOSED CONCRETE
COARSE S (FINE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN		COARSE AGGREGATE TESTED AND ACCEPTED FOR TYPE "A" INCLUDING EXPOSED CONCRETE
COARSE S (FINE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN		COARSE AGGREGATE TESTED AND ACCEPTED FOR TYPE "A" INCLUDING EXPOSED CONCRETE
COARSE S (FINE AGGREGATE)	UNKNOWN	UNKNOWN	UNKNOWN		COARSE AGGREGATE TESTED AND ACCEPTED FOR TYPE "A" INCLUDING EXPOSED CONCRETE

OAK ORCHARD HARBOR, NEW YORK
**SOURCES OF FINE
 AND COARSE AGGREGATE**

U.S. ARMY ENGINEER DISTRICT, BUFFALO
 GDM DATED: FEBRUARY 1969

OAK ORCHARD HARBOR, NEW YORK
GENERAL DESIGN MEMORANDUM

APPENDIX A
DESIGN OF STRUCTURES

TABLE OF CONTENTS

<u>Paragaph</u>	<u>Subject</u>	<u>Page</u>
A1	PURPOSE	A1
	BASIC DATA AND ASSUMPTIONS	
A2	References	A1
A3	Survey datum	A1
A4	Weights of material	A2
A5	Horizontal equivalent fluid pressure	A2
	JETTIES	
A6	General	A2
A7-A8	Design	A3
A9-A10	Alternative designs	A3
	DETACHED BREAKWATER	
A11	General	A3
A12	Wave force	A4
A13	Stability of cells	A4
A14	Alternative design	A4
	TYPICAL COMPUTATIONS	
	West jetty reach A	A5
	Wave forces for detached breakwater	A6-A7
	Steel sheet pile cell	A8-A11

OAK ORCHARD HARBOR, NEW YORK
GENERAL DESIGN MEMORANDUM

APPENDIX A
DESIGN OF STRUCTURES

PURPOSE

A1. The following paragraphs cover the design criteria, basic data and assumptions used in the design of the jetties and the detached breakwater. A description of the structures with loading conditions is included to show the design procedure. Typical structural design computations are submitted to assist in the review of the design.

BASIC DATA AND ASSUMPTIONS

A2. REFERENCES.

The loading conditions, design assumptions and other criteria are based on the applicable parts of the following references:

EM 1110-2-2904, "Design of Breakwaters and Jetties"

EM 1110-2-2906, "Design of Pile Structures and Foundations"

"Shore Protection, Planning and Design", TR. No. 4, by U.S. Army Coastal Engineering Research Center.

"Cellular Cofferdams and Docks", Proc. of American Society of Civil Engineers, Waterways and Harbors Division, Vol. 83, WW3, Paper 1366, September 1957.

"Stability and Stiffness of Cellular Cofferdams" Transactions Vol. 110 of American Society of Civil Engineers.

Accepted engineering practice has been employed in cases where the Engineering Manuals do not apply.

A3. SURVEY DATUM.

All elevations and soundings are in feet and tenths and are referred to low water datum of Lake Ontario, elevation 242.8 feet above mean water level at Father Point, Quebec (I.G.L.D. 1955) (International Great Lakes Datum 1955.)

A4. WEIGHTS OF MATERIAL:

Water	62.5 lbs. per cubic foot
Stone ;;;:.....	145 lbs. per cubic foot
Moist fill material.....	120 lbs. per cubic foot
Saturated fill material.....	124 lbs. per cubic foot
Submerged fill material.....	62 lbs. per cubic foot
Concrete.....	150 lbs. per cubic foot

A5. HORIZONTAL EQUIVALENT FLUID PRESSURE:

a. Active earth pressure (the angle of internal friction,
 $\phi = 30$ deg.)

Moist fill material.....	40 lbs. per square foot
Saturated fill material.....	41 lbs. per square foot
Submerged fill material.....	21 lbs. per square foot

b. Passive earth pressure (the angle of internal friction,
 $\phi = 30$ deg.)

Moist fill material.....	360 lbs. per square foot
Saturated fill material.....	372 lbs. per square foot
Submerged fill material.....	186 lbs. per square foot

JETTIES

A6. GENERAL

The ruins of the existing east and west jetties are mainly below low water datum. New jetties will be constructed to provide protection for an entrance channel leading in to Oak Orchard Creek. The jetties will be rubblemound stone type of structures as shown on plate 2 and located along the alinements of the existing east and west jetties. The cover stone layer will be selected stones, random-placed to provide a degree of wedging or interlocking action between individual units. The crest elevation will be 8.0 feet above low water datum. This elevation was determined by a comparison of similar structures on Lake Ontario.

A7. DESIGN

The design wave heights are governed by the depth of water at the jetties. Due to the variation in the depth of water, several reaches were established along the jetties. The shoreward end of the jetties will extend to high ground. From investigations of quarries which might be used to supply the stone requirements it was determined that 4.5 ton stone was the maximum size available for construction of the jetties. Computations based on the stability formula developed by Robert Y. Hudson were made to determine the side slopes and size of cover stones. At the shoreward end reaches of the jetties where wave heights would be reduced by shallow water, the size of channel slope stones was selected to resist the action of waves generated by passing motorboats.

A8, Sample computations for Reach A of the west jetty are shown on page A5. Computations for the other reaches are similar and therefore not included.

A9. ALTERNATIVE DESIGNS

Consideration was given to alternative designs as follows:

(a) Precast concrete armor units in lieu of cover stone on the side slopes of the stone structures.

(b) Cellular steel sheet pile structures in lieu of pell-mell stone type structures.

A10. Comparative estimates of construction costs and annual maintenance costs were prepared for these alternatives. It was concluded that the use of stone would be cheaper than precast armor units on the basis of construction costs and annual maintenance. In the case of cellular versus stone structures, the stone type would be cheaper for the jetties, whereas the cellular type would be cheaper for the detached breakwater discussed in the following paragraphs.

DETACHED BREAKWATER

A11. GENERAL

A detached breakwater will be used across the entrance channel. This will prevent waves from a northerly direction entering the entrance channel. The breakwater will be a cellular steel sheet pile structure, with granular fill and a concrete cap. Diaphragm cells, although offering some economy in material requirements, were not used due to the hazards and complications during construction. Diaphragm cells are

structurally interdependent and, in order to prevent distortion of the cross walls, must be filled gradually so that the level in all cells is nearly equal at all times. Consequently, no portion of a diaphragm structure is entirely stable until the whole structure is complete. Circular cells are individually stable and may therefore be erected and filled independently. A storm during the construction period could result in the destruction of the entire diaphragm cells structure, whereas only one cell would be endangered with the circular cells structure. Circular cells have an additional advantage in that the tops of the filled cells may be utilized as working areas and equipment platforms during construction of the remaining cells.

A12. WAVE FORCE

In the wave force computations, water levels were used varying from 2 feet below low water datum to the design still water level of 5 feet above low water datum. The heights of the waves were determined by the depth of water at the structure (see computations page A7). Because the waves striking the structure may or may not break, both the Sainflou and Molitor methods were employed and the greater of the resulting two forces was used in the design.

A13. STABILITY OF CELLS

A 35.01-foot diameter cell was selected for the structure on the basis of stability against overturning. The cell was also investigated for failure by horizontal shear, interlock tension and sliding. Using Cumming's method, the factor of safety exceeded 1.5 in the investigation of horizontal shear. Sample computations for the wave force and stability of the cells are shown on pages A7 thru A11.

A14. ALTERNATIVE DESIGN

Consideration was given to a rubblemound structure as an alternative to the cellular steel sheet pile structure. Preliminary construction and maintenance cost estimates were prepared for the two types of structures. It was concluded that the cellular steel sheet pile structure would be the more economical.

Subject OAK ORCHARD HARBOR, N. Y.Computation of WEST JETTY REACH AComputed by H. A. J.Checked by J. P.Date 19 April 1968Design of cover stone

Top of structure	+ 8.0'
Sill water level	+ 5.0
Depth of water	12.0'
Height of wave (breaking)	$H = 9.4'$
Weight of stone	$\gamma = 145 \text{ \#/c.f.}$
Specific gravity of stone	$S_r = 2.31$
Side slope 1 vert. on 2 horz.	$\cot \alpha = 2.0$
Number of stones	$n = 3 \text{ or } 2$
Coefficient (friction)	$K_D = 3.0$
Layer coefficient	$K_A = 1.0$

Min. weight of individual stone:

$$W = \frac{\gamma H^3}{K_D (S_r - 1)^3 \cot \alpha} = \frac{145 (9.4)^3}{(3.0) (2.31 - 1)^3 (2.0)} = 8933 \text{ \#}$$

say 4.5 tonTop width of structure (use 3 stones)

$$W = n K_A \left(\frac{W}{\gamma} \right)^{\frac{1}{3}} = 3 (1.0) \left(\frac{8933}{145} \right)^{\frac{1}{3}} = 11.8'$$

Use 12.0'Thickness of cover stone layer (2 layers of stone)

$$r = n K_A \left(\frac{W}{\gamma} \right)^{\frac{1}{3}} = (2) (1) \left(\frac{8933}{145} \right)^{\frac{1}{3}} = 7.88'$$

Use 8.0'

Subject OAK ORCHARD HARBOR, N. Y.

Computation of WAVE FORCES FOR DETACHED BREAKWATER

Computed by R. G. B.

Checked by J. W. L.

Date April 22, 1968

WAVE FORCE ON CELL (SAINFLOU)

SWL at +5

Ref - SHORE PROTECTION, PLANNING AND DESIGN, TR NO. 4, 3RD ED.

Period = 10.0 Sec.

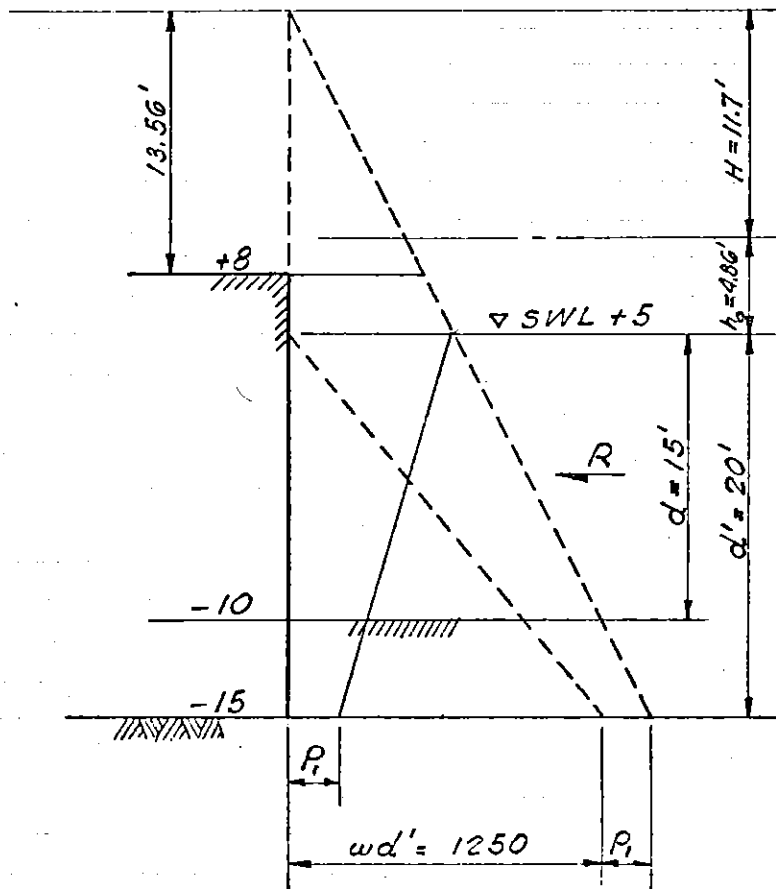
Wave Height, $H = .78d = .78(15.0) = 11.7'$

$$L_0 = 5.12(10.0)^2 = 512.0', \quad \frac{d}{L_0} = \frac{15.0}{512.0} = 0.02929$$

$$\frac{d}{L} = 0.07044, \quad L = \frac{15.0}{0.07044} = 212.95', \quad h_0 = \frac{\pi H^2}{L} \coth h \frac{2\pi d}{L}$$

$$\tanh h \frac{2\pi d}{L} = 0.4157, \quad h_0 = \frac{3.1416(11.7)^2}{212.95(0.4157)} = 4.86'$$

$$P_i = \frac{wH}{\cosh h \frac{2\pi d}{L}}, \quad \cosh h \frac{2\pi d}{L} = 1.0995, \quad P_i = \frac{62.5(11.7)}{1.0995} = 665$$



Subject OAK ORCHARD HARBOR, N.Y.Computation of WAVE FORCES FOR DETACHED BREAKWATERComputed by R.G.B. Checked by J.W.L.Date April 23, 1968WAVE FORCE (Cont.)Resultant pressure = R

$$R = \frac{(d+h_0+H)(wd'+p_1) - wd'^2}{2}$$

$$R = \frac{(20+4.86+11.7)(1250+665) - 62.5(20)^2}{2} = 22,506 \#$$

$$- \text{Overtopping: } 31.25(13.56)^2 = \underline{-5,746 \#}$$

$$R = 16,760 \#$$

$$M_o = \frac{(d+h_0+H)^2 (wd'+p_1) - wd'^3}{6}$$

$$M_o = \frac{(20+4.86+11.7)^2 (1250+665) - 62.5(20)^3}{6} = 343,276 \#'$$

$$- \text{Overtopping: } 31.25(13.56)^2(27.52) = \underline{-158,131 \#}$$

$$\text{Net overturning moment, } M_o = 185,145 \#'$$

$$\text{Point of application} = \frac{M_o}{R} = \frac{185,145}{16,760} = 11.05' \text{ above } -15' = \text{El. } -3.95$$

Subject OAK ORCHARD HARBOR, N.Y.Computation of STEEL SHEET PILE CELLComputed by R.G.B.Checked by J.W.L.Date May 28, 1968DESIGN OF CELL

Top of cell	+8.0' L.W.D.
still water level	+5.0' L.W.D.
Lake bottom (assumed)	-10.0' L.W.D.
Rock surface	-15.0' L.W.D.
Concrete cap, 2' thick, resting on cell fill	150#/c.f.
Cell fill material	
Weight, moist	120#/c.f.
weight, submerged	62#/c.f.
angle of internal friction, ϕ	30°
Bottom material	
weight submerged	62#/c.f.
angle of internal friction, ϕ	30°

Subject OAK ORCHARD HARBOR, N. Y.Computation of STEEL SHEET PILE CELLComputed by R. G. B. Checked by J. W. L.Date Nov 28, 1958**COMPUTE THE EQUIVALENT WIDTH TO RESIST OVERTURNING**

If the resultant of the wave force and the weight of the structure is to fall on the middle third point of the equivalent rectangular section then:

$$b^2 = \frac{6M}{.8wh}$$

Where b = width of equivalent rectangle based on equal section moduli of a rectangular and cellular wall

$$\Sigma \lambda h = 150(2) + 1(120) + 20(62) = 1660 \#$$

M = Wave moment - external earth resistance

$$M = 185,145 - \frac{\lambda h^3}{6} [\tan^2(45^\circ + \frac{\phi}{2}) - \tan^2(45^\circ - \frac{\phi}{2})]$$

$$= 185,145 - \frac{62(5)^3}{6} [2.9999 - 0.3333] = 185,145 - 3444$$

$$M = 181,701 \#$$

$$b^2 = \frac{6(181.7)}{.8(1.66)} = 820.9$$

$$b = 28.7'$$

USE $b = 29.2'$

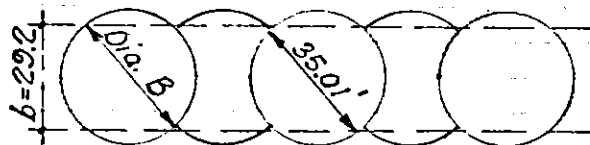


Fig. 1

Subject OAK ORCHARD HARBOR, N.Y.

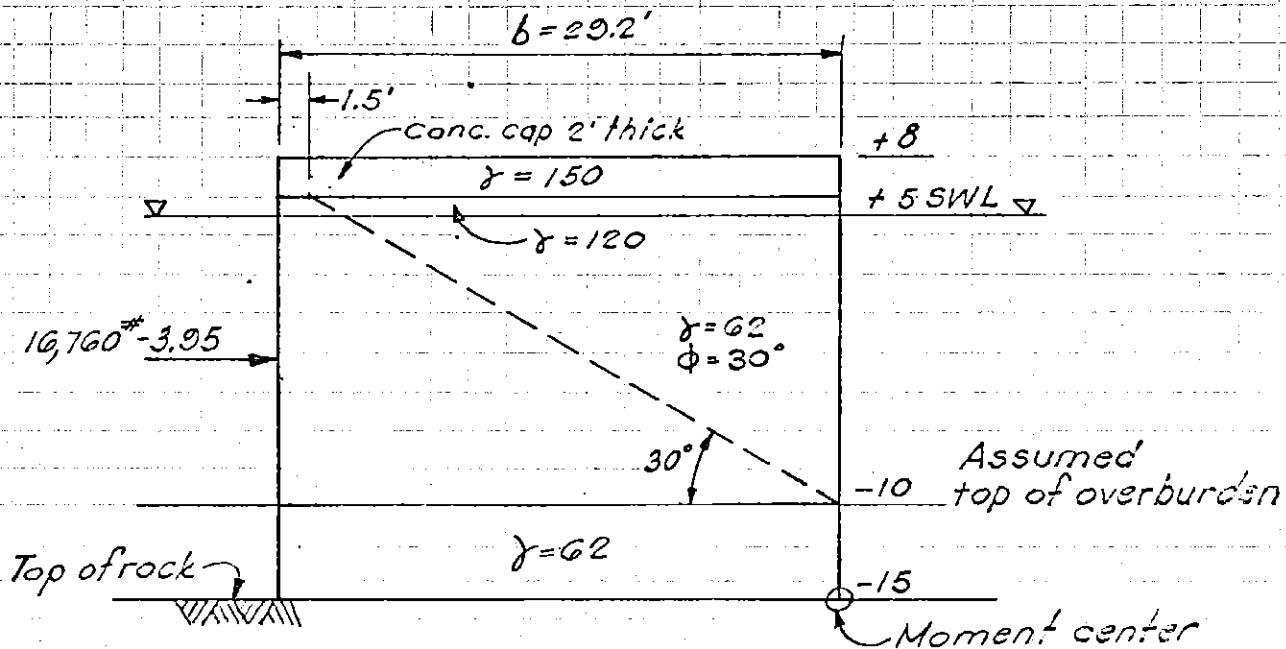
Computation of STEEL SHEET PILE CELL

Computed by R.G.S.

Checked by J.W.L.

Date MAY 28, 1953

RESISTANCE TO FAILURE BY HORIZONTAL SHEAR



Elev.	Layer Thickness	Prism			Lateral Resistance	Lever Arm	Resisting Moment	
		Width	$\epsilon \gamma h$	W_{gross}				W_{net}
+6.0	1.0'	3.2'	420	1,344#	1,344#	775#	20.5'	15,888' #
+5.0	5.0'	11.9'	730	8,687#	7,343#	4,237#	17.5'	74,148' #
0.0	5.0'	20.5'	1040	21,320#	12,633#	7,289#	12.5'	91,112' #
-5.0	5.0'	29.2'	1350	39,420#	18,100#	10,444#	7.5'	78,330' #
-10.0								
	Passive resistance in layer -10.0 to -15.0: $0.5(5)^2(62)(2.9998) = 2325\#$				2325#	1.7'		3,952' #
	shear @ -15.0: $29.2(0.577)(1660) = 27,968\#$							
-15.0	Available increment = $27,968 - 22,745 = 5223$				5223#	2.5'		13,058' #
	Resisting moment due to interlock friction = (see next page)					29.2		39,416' #

$\Sigma MR = 315,904\#'$

* see next page "Limiting shear"

Subject OAK ORCHARD HARBOR, N. Y.Computation of STEEL SHEET PILE CELLComputed by R.G.B.Checked by J.W.L.Date MAY 28, 1968Interlock friction:

$$\text{for } \phi = 30^\circ, K_a = .33; f = 0.3$$

$$\frac{[2(150)(1.0) + 0.5(1.0)^2(120) + 15.0(420) + 0.5(150)^2(62)](0.3)(.33) = 1,350\#$$

Limiting shear @ -10:

$$S = (\sum \lambda h \tan \phi) b = 1350(.577)(29.2)$$

$$S = 22,745\#$$

$$F.S. = \frac{\sum M_R}{\sum M_o} = \frac{315,904}{185,145}$$

$$F.S. (\text{against tilting}) = 1.7 > 1.5 \text{ Allowable}$$

Diameter = 35.01' using 5-28 piles

Tension in interlocks

Given S.W.L. at -1.0 (minimum), Lake bottom @ -10.0'

$$\tan^2(45 - \frac{\phi}{2}) = 0.5 \text{ (Terzaghi)}$$

$$W = 150(2.0) + 120(7.0) + 62(9.0) = 1698\#/\text{s.f.}$$

$$\text{Active earth pressure} = 1698(0.5) = 849\#/\text{s.f.}$$

$$\text{Tension, } t = \frac{Pr}{12} = \frac{849(17.51)}{12} = 1,239\#/\text{inch}$$

$$\text{Allowable } t = 8,000\#/\text{inch}$$

Sliding stability

$$\text{Required coef. of friction; } \tan \phi = \frac{\sum H}{\sum \lambda R b}$$

$$\tan \phi = \frac{R + P_a - P_p}{\sum \lambda R b} = \frac{16,760 + (\frac{1}{2})(0.3333)(5)^2(62) - (\frac{1}{2})(2.9998)(5)^2(62)}{(1660)(29.2)}$$

$$= \frac{14,69347}{48,472} = 0.303 < .577 \text{ the } \tan \phi \text{ of existing material}$$

CONTENTS

CONTENTS

Page	Page
1	2
3	4
5	6
7	8
9	10
11	12
13	14
15	16
17	18
19	20
21	22
23	24
25	26
27	28
29	30
31	32
33	34
35	36
37	38
39	40
41	42
43	44
45	46
47	48
49	50
51	52
53	54
55	56
57	58
59	60
61	62
63	64
65	66
67	68
69	70
71	72
73	74
75	76
77	78
79	80
81	82
83	84
85	86
87	88
89	90
91	92
93	94
95	96
97	98
99	100

Page	Page
101	102
103	104
105	106
107	108
109	110
111	112
113	114
115	116
117	118
119	120
121	122
123	124
125	126
127	128
129	130
131	132
133	134
135	136
137	138
139	140
141	142
143	144
145	146
147	148
149	150
151	152
153	154
155	156
157	158
159	160
161	162
163	164
165	166
167	168
169	170
171	172
173	174
175	176
177	178
179	180
181	182
183	184
185	186
187	188
189	190
191	192
193	194
195	196
197	198
199	200

OAK ORCHARD HARBOR, NEW YORK

GENERAL DESIGN MEMORANDUM

APPENDIX B

ALTERNATIVE DESIGN OF STRUCTURES

GENERAL

B1. In selection of the project plan for construction of the detached breakwater and jetties, consideration was also given to construction of a stone rubblemound detached breakwater and to several types of protective armour for the east and west jetties. Cellular steel sheet pile construction was also considered for the east and west jetties.

DETACHED BREAKWATER

B2. Two types of construction were considered for the detached breakwater, stone rubblemound and cellular steel sheet pile. A cellular steel sheet pile structure, as recommended in this memorandum, will cost less to build and maintain than a rubblemound structure. Steel sheet piling is readily available from several manufacturers within a 50 mile radius of the project, whereas the closest known source of acceptable large cover stone is about 250 miles distant. The lake bottom at the location of the breakwater is suitable for either rubblemound or cellular steel sheet pile construction. Rubblemound breakwaters dissipate wave energy better than vertical faced structures. However, the savings in first cost and annual maintenance were deciding factors in selection of a cellular steel sheet pile breakwater.

JETTIES

B3. GENERAL

Five types of construction were considered for the jetties, 3 with various sizes of stone, 1 with concrete tetrapods as armour and a cellular steel sheet pile structure. Assumptions were made for some of the types and limited experience data were available for others. The five types, designated as Plans A through E, are discussed in the following paragraphs.

B4. PLAN A: 1 TON TO 6 TON, STONE FROM NEARBY QUARRIES

Although a study was made of constructing jetties using stone from quarries nearby, there is considerable doubt that 1 ton to 6 ton stone of adequate durability can be so obtained. Contacts with owners of nearby quarries indicate operators would probably be unwilling to produce stone of the size required on a schedule to meet a reasonable construction timetable.

B5. PLAN B: 1 TON TO 4.5 TON, STONE FROM AMHERST, OHIO

Stone of adequate quality ranging in size from 1 ton to 4.5 ton is available from Cleveland Quarries Company in Amherst, Ohio. However, this size stone is not the size range normally quarried and would require a special operation to produce the smaller sizes. The special operation would result in higher than usual cost for the smaller stone. Stone greater than 4.5 tons cannot be produced by Cleveland Quarries Company because the ratio of length to thickness required by our specifications cannot be met.

B6. PLAN C: LAKESIDE COVER STONE 3 TON TO 4.5 TON FROM AMHERST, OHIO, AND REMAINDER 1 TON TO 2 TON FROM NEARBY QUARRIES

Stone ranging in size from 3 ton to 4.5 ton of adequate quality and durability is a standard production size from Cleveland Quarries Company in Amherst, Ohio. Stone up to a 2 ton size of adequate quality and durability is available in nearby quarries, although there is some question whether operators will produce the stone in quantity to meet our construction schedule.

B7. PLAN D: 5 TONE TETRAPODS MADE IN CONCRETE PLANT ON PROJECT SITE

For this type of construction, a concrete plant would be set up at the project site. Sand would be obtained from Boonville, New York, and coarse aggregates from a quarry at Leroy, New York. Local transit mix would be cheaper but the durability of aggregates is questionable. The entire cost of the forms for the tetrapods, which could be reused for other projects, were included in the overall cost of constructing the jetties with use of tetrapod armor.

B8. PLAN E: CELLULAR STEEL SHEET PILE

Materials for this type of structure are readily available from nearby suppliers and there should be no difficulty in meeting construction schedules. However it would be necessary to remove most of the remains of the old jetties before the structure could be built which would greatly increase the overall cost of the structure.

The vertical, rather smooth, faces of cellular steel sheet pile structures are less effective than rough sloping-faced structures in dissipating wave energy. It is most important in relatively narrow confined channels that wave action be at a minimum.

PRELIMINARY ESTIMATES OF COSTS

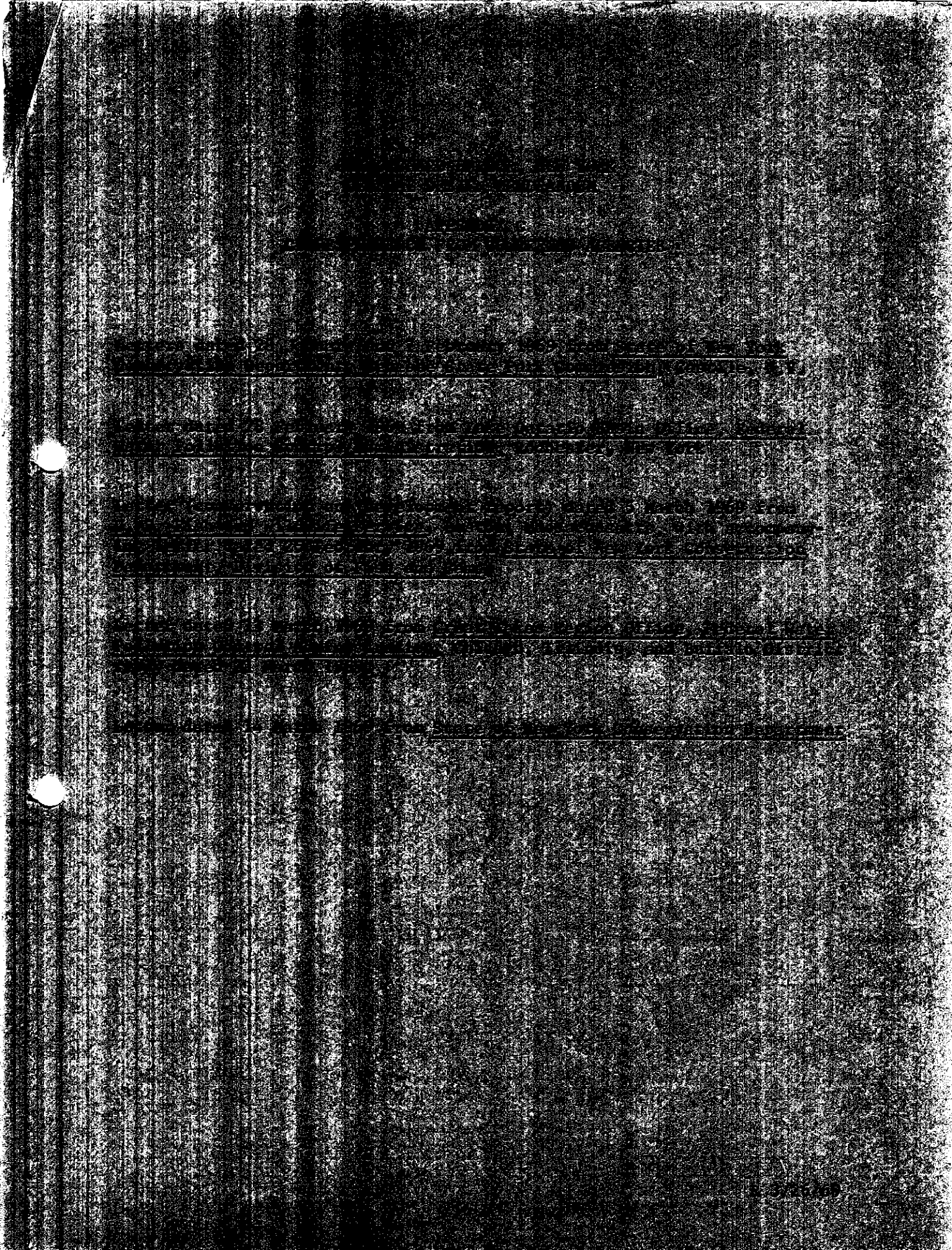
B9. Preliminary estimates of comparative costs were made for a rubblemound detached breakwater and for a cellular steel sheet pile structure. The rubblemound structure was estimated to cost about \$100,000 more to construct than the cellular structure, and more to maintain. Comparative cost estimates for the 5 types of construction investigated for the jetties are shown in the following table.

TABLE B1. Comparative estimates of cost

Plan:	Type of armor (1)	Size in tons	Source of armor	Estimated cost	Annual maintenance cost
				\$	\$
A	Stone	1 to 6	Nearby quarries	464,000	2,000
B	Stone	1 to 4.5	Amherst, Ohio	549,000	2,000
C	Stone	1 to 2	Nearby quarries	490,000	2,000
		3 to 4.5	Amherst, Ohio		
D	Tetrapods	5	Concrete plant		
			at project site	510,000	2,600
E	Steel sheet pile	-	Nearby suppliers	575,000	500

(1) Core stone for Plans A, B, C and D would be obtained from nearby quarries.

B10. As indicated in table B1, differences in cost between Plan A and Plan C are slight. As indicated in paragraph B4, it is doubtful that the larger size stone for Plan A is available from nearby quarries, or if stone of the size required could be quarried fast enough to meet construction schedules. Therefore, Plan C was selected as the most feasible plan of construction, involving little uncertainty as to availability of materials.





UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
U. S. POST OFFICE AND COURTHOUSE
BOSTON, MASSACHUSETTS 02109

March 5, 1969

District Engineer
Buffalo District
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Sir:

This letter is our conservation and development report on the navigation improvements being considered for Oak Orchard Harbor, Orleans County, New York. This project was authorized by the River and Harbor Act of 1945; however, no construction has been done, and the project was classified as deferred for re-study until recently. Our report has been prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 incl.), in cooperation with the New York State Conservation Department, Division of Fish and Game and has the concurrence of that agency as indicated by letter dated February 26, 1969. It has also been coordinated with and represents the views of the Bureau of Commercial Fisheries.

It is our understanding that the improvements being considered consist of dredging a dual lake-approach channel ten feet deep, an entrance channel ten feet deep, a basin eight feet deep just inside the mouth of Oak Orchard Harbor, construction of land-tied jetties along each side of the entrance channel, and construction of a detached (offshore) breakwater to protect the opening between the jetties.

We are pleased to note that you are considering provisions for recreational fishing which will include access roads, parking areas, and walkways and guardrails on the jetties. We understand that some of the dredged material will be used as cell fill in construction of the detached breakwater. Sand and gravel will be placed on the lake side and at the shore end of the east jetty for replenishment of downdrift beaches.

Smallmouth bass, northern pike, yellow perch, sheepshead, brown bullhead, and white bass are the important sportfish species in the area. Smallmouth bass provide excellent fishing along the south shore of Lake Ontario. No significant commercial fishery is operating out of Oak Orchard Harbor.

Waterfowl and shorebirds found in the area consist of goldeneye, bufflehead, black duck, wood duck, mallard, great blue heron, bittern and other species.

The construction of the channel and basin, and the jetties and breakwater will have no adverse effect on the fish and wildlife resources of the area. If the jetties are provided with walkways and guardrails and if parking space for 40 fishermen's cars, in addition to space needed for general recreationists is provided, the jetties will yield significant sport-fishing benefits. The east jetty will have a fishable length (that portion extending into water four feet or more in depth) of 200 feet; the fishable length of the west jetty will be 400 feet. The two jetties will provide an average of 14,000 fisherman-days annually over the project life, having a net recreational benefit of \$21,000. A minor amount of fisherman use can be expected on the detached breakwater.

The project will have no effect on the commercial fishery.

Depending on the location, amount, and method of disposal of dredged material excess to that needed in the construction of the detached breakwater, the fish and wildlife resources could be adversely affected. For this reason no spoil should be placed on wetlands, and if located adjacent to wetlands, the spoil should be adequately diked to prevent a reflux of the spoil onto wetlands or water courses. This office should be advised of any spoil sites that may be considered during the course of your planning so that we can investigate the suitability of the sites.

We recommend:

1. That no spoil be placed on wetland areas.
2. That any upland spoil site adjacent to a wetland area be adequately diked to prevent a reflux of spoil onto wetlands or water courses.
3. That this Bureau be advised of any spoil sites that may be considered by your office.

Sincerely yours,



Acting Regional Director



CONSERVATION DEPARTMENT

Division of Fish and Game

ALBANY, NEW YORK 12226

STEWART KILBORNE
Commissioner
MASON LAWRENCE
Deputy Commissioner
LEIGHTON A. HOPE
Deputy Commissioner
ROBERT E. YOUNG
Deputy Commissioner
IRWIN H. KING
Secretary

A.G. Hall
Director
(518) 457-5690
D.M. Wallace
Deputy Director
of Fish and Game
for Marine Region
(516) 585-5400
W.G. Bentley
Assistant Director
for Fish and Game
(518) 457-5690
W.J. Goodman
Assistant Director
for Law Enforcement
and Field Services
(518) 457-5680

February 25, 1969

Mr. Thomas A. Schrader
Assistant Regional Director
U. S. Fish and Wildlife Service
U. S. Post Office and Courthouse
Boston, Massachusetts 02109

Re: Review Draft of Conservation and
Development Report on Navigation
Improvements being considered for
Oak Orchard Harbor, Orleans County,
New York

Dear Mr. Schrader:

We have studied the review draft in response
to your letter of February 12, 1969.

We concur with your comments as set forth
in the review draft and have no revisions to suggest.

Sincerely,

A.G. Hall
A. G. Hall
Director
Division of Fish and Game

RECEIVED

MAR 4 1969

R. E. S.

RECEIVED

MAR 3 1969

Region 5 - Boston



UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
33 EAST CONGRESS PARKWAY, ROOM 410
CHICAGO, ILLINOIS 60605

March 13, 1969

Colonel A. L. Wright
District Engineer, Buffalo District
Corps of Engineers
1778 Niagara Street
Buffalo, New York 14207


Dear Colonel Wright:

We have reviewed the "General Design Memorandum," Oak Orchard Harbor, New York" submitted with your letter of March 6, 1969. We concur with the opinion expressed by our Lake Ontario Basin Office in their letter dated February 28, 1969, a copy of which is bound with your report, that the type of material analyzed should not be dumped in the lake but disposed of by other suitable means.

We also feel that the local cooperation requirements should include an item requiring that adequate provision be made for the removal and disposal of all watercraft wastes by means of a suitable shore facility. The local cooperation requirement in its present form refers to adequate sanitary facilities for recreational fishing only.

The opportunity to review and comment on this proposed project is appreciated.

Sincerely yours,


H. W. Poston
Regional Director

NCBED-PB

21 March 1969

Mr. H. W. Poston, Regional Director
Great Lakes Region
Federal Water Pollution Control Administration
33 East Congress Parkway, Room 410
Chicago, Illinois 60605

Dear Mr. Poston:

Your letter of 13 March 1969 with comments on the General Design Memorandum for Oak Orchard Harbor, New York is appreciated.

Assurances of local cooperation referred to in paragraph 6 of the Design Memorandum includes an item that the State of New York will: "Provide and maintain, without cost to the United States, in accordance with plans approved by the Chief of Engineers, a suitable public wharf for the accommodation of transient vessels, together with adequate sewage retention and/or disposal facilities therefor;".

We believe this item to be broad enough to comply with your suggestion that adequate provision be made for the removal and disposal of all watercraft wastes by means of a suitable shore facility.

Sincerely yours,

A. L. WRIGHT
Colonel, Corps of Engineers
District Engineer



STATE OF NEW YORK
CONSERVATION DEPARTMENT
ALBANY

R. STEWART KILBORNE
COMMISSIONER

March 14, 1969

Col. A. W. Wright, District Engineer
Buffalo District Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Col. Wright:

RE: Oak Orchard Harbor of Refuge

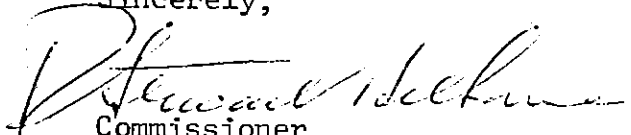
Review of your general design memorandum of the proposed Oak Orchard Harbor Project has been completed.

With specific reference to paragraphs 3, 6 and 40, the Non-Federal \$21,500 increased estimate associated with recreational fishing benefits has been noted and is agreed upon.

The report as contained in your memorandum is, therefore, herewith approved.

Please accept my thanks for the continuing thoughtful cooperation of your office.

Sincerely,


Commissioner

COMMISSIONERS:

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ROBERT E. WATERS, MEDINA

STATE OF NEW YORK



CONSERVATION DEPARTMENT
GENESEE STATE PARK COMMISSION

GENESEE STATE PARKS

LETCWORTH STATE PARK
HAMLIN BEACH STATE PARK
BRADDOCK BAY STATE PARK
LAKESIDE BEACH STATE PARK
SILVER LAKE STATE PARK
DARIEN LAKES STATE PARK
LAKE ONTARIO STATE PARKWA

GORDON W. HARVEY
REGIONAL PARK MANAG

ADMINISTRATION HEADQUARTE
LETCWORTH STATE PARK
P. O. CASTILE, N. Y. 14427
TEL. 716-493-2611

January 28, 1969

Mr. Robert McKee
Corp of Engineers
1776 Niagara Street
Buffalo, New York

Re: Oak Orchard Harbor of Refuge

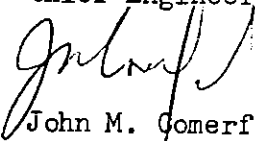
Dear Mr. McKee:

I have had our technical staff investigate the possibility of using the surplus material from your project in an area under our jurisdiction. Unfortunately, it wasn't possible to find a location to use this quantity and type of material.

Yours very truly,

GENESEE STATE PARK COMMISSION

Gordon W. Harvey
Chief Engineer & Regional Park Manager


John M. Comerford
Assistant Regional Park Manager

JMC:gb

COMMISSIONERS:

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STATE OF NEW YORK



CONSERVATION DEPARTMENT
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LETCWORTH STATE PARK
P. O. CASTILE, N. Y. 14427
TEL. 716-493-2611

February 7, 1969

Mr. Tom Joyce
Corp. of Engineers
1776 Niagara Street
Buffalo, New York

Re: Oak Orchard Harbor of Refuge

Dear Sir:


This will confirm my discussion with Mr. Rogers of your office during which I indicated we concur with the basin outline shown in green on the map entitled "Oak Orchard Harbor, New York 1945 Project Modification - Plan, Profile and Sections".

If there are any additional questions on this matter, we would be happy to clarify them for you.

Yours very truly,

GENESEE STATE PARK COMMISSION

Gordon W. Harvey
Chief Engineer and Regional Manager


John M. Comerford
Assistant Regional Park Manager

JMC:eb



UNITED STATES
 DEPARTMENT OF THE INTERIOR
 FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
 GREAT LAKES REGION
~~ROCHESTER PROGRAM OFFICE~~
 P. O. BOX 4748: 4664 LAKE AVENUE
 ROCHESTER, NEW YORK 14612

LAKE ONTARIO
 BASIN OFFICE

February 28, 1969

Mr. Ralph H. Gallinger
 Chief, Engineering Division
 Buffalo District, Corps of Engineers
 1776 Niagara Street
 Buffalo, New York 14207

Dear Mr. Gallinger:

In response to your letter of February 3, 1969 regarding the proposed improvements to Oak Orchard Harbor, New York, analyses have been completed on two of the six samples taken from sampling location SS-671301. The data obtained are as follows:

<u>Depth (1)</u>	<u>%Total Solids (Wet basis)</u>	<u>%Vol. Solids (Dry Wt.)</u>	<u>Oil and Grease (2)(3)</u>	<u>PO₄-P (2)</u>	<u>Total N (Kjeldahl) (2)</u>
4.0'-6.0'	43.9	11.7	364	950	3186
6.0'-8.0'	28.3	22.4	3400	900	6697

- (1) Below LWD
- (2) mg/Kg (dry weight)
- (3) Hexane extraction

Based on the above information, a limited amount of sample and perhaps not a good sampling point, it would be the opinion of this office that the type of material analyzed should not be dumped into the lake but disposed of by other suitable means.

We hope the above information will satisfy your needs for the proposed project at this time. If you have any questions, do not hesitate to call.

Sincerely yours,

L. E. Townsend
 L. E. Townsend
 Director

DRAFT

February 12, 1969

District Engineer
Buffalo District
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Sir:

This letter is our conservation and development report on the navigation improvements being considered for Oak Orchard Harbor, Orleans County, New York. This project was authorized by the River and Harbor Act of 1945; however, no construction has been done, and the project was classified as deferred for restudy until recently. Our report has been prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 inc.), in cooperation with the New York State Conservation Department, Division of Fish and Game.

It is our understanding that the improvements being considered consist of dredging a dual lake approval channel ten feet deep, a entrance channel ten feet deep, a basin eight feet deep just inside the mouth of Oak Orchard Harbor, construction of land-tied jetties along each side of the entrance channel, and construction of a detached (offshore) breakwater to protect the opening between the jetties.

We are pleased to note that you are considering provisions for recreational fishing which will include walkways and guardrails on the jetties, parking areas, and access roads. We understand that some of the dredged material will be used as cell fill in construction of the detached breakwater. Sand and gravel will be placed on the lake side and at the shore end of the east jetty for replenishment of downdrift beaches.

Smallmouth bass, northern pike, yellow perch, sheepshead, brown bullhead, and white bass are the important sportfish species in the area. Smallmouth bass provide excellent fishing along the south shore of Lake Ontario. No significant commercial fishery is operating out of Oak Orchard Harbor.

Waterfowl and shorebirds found in the area consist of goldeneye, bufflehead, black duck, wood duck, mallard, great blue heron, bittern and other species.

The construction of the channel and basin, and the jetties and breakwater will have no adverse effect on the fish and wildlife resources of the area.

If the jetties are provided with walkways and guardrails and if parking space for 40 fishermen's cars, in addition to space needed for general recreationists, is provided, the jetties will yield significant sport-fishing benefits. The east jetty will have a fishable length (that portion extending into water four feet or more in depth) of 200 feet; the fishable length of the west jetty will be 400 feet. The two jetties will provide an average of 14,000 fisherman-days annually over the project life, having a net recreational benefit of \$21,000. A minor amount of fisherman use can be expected on the detached breakwater.

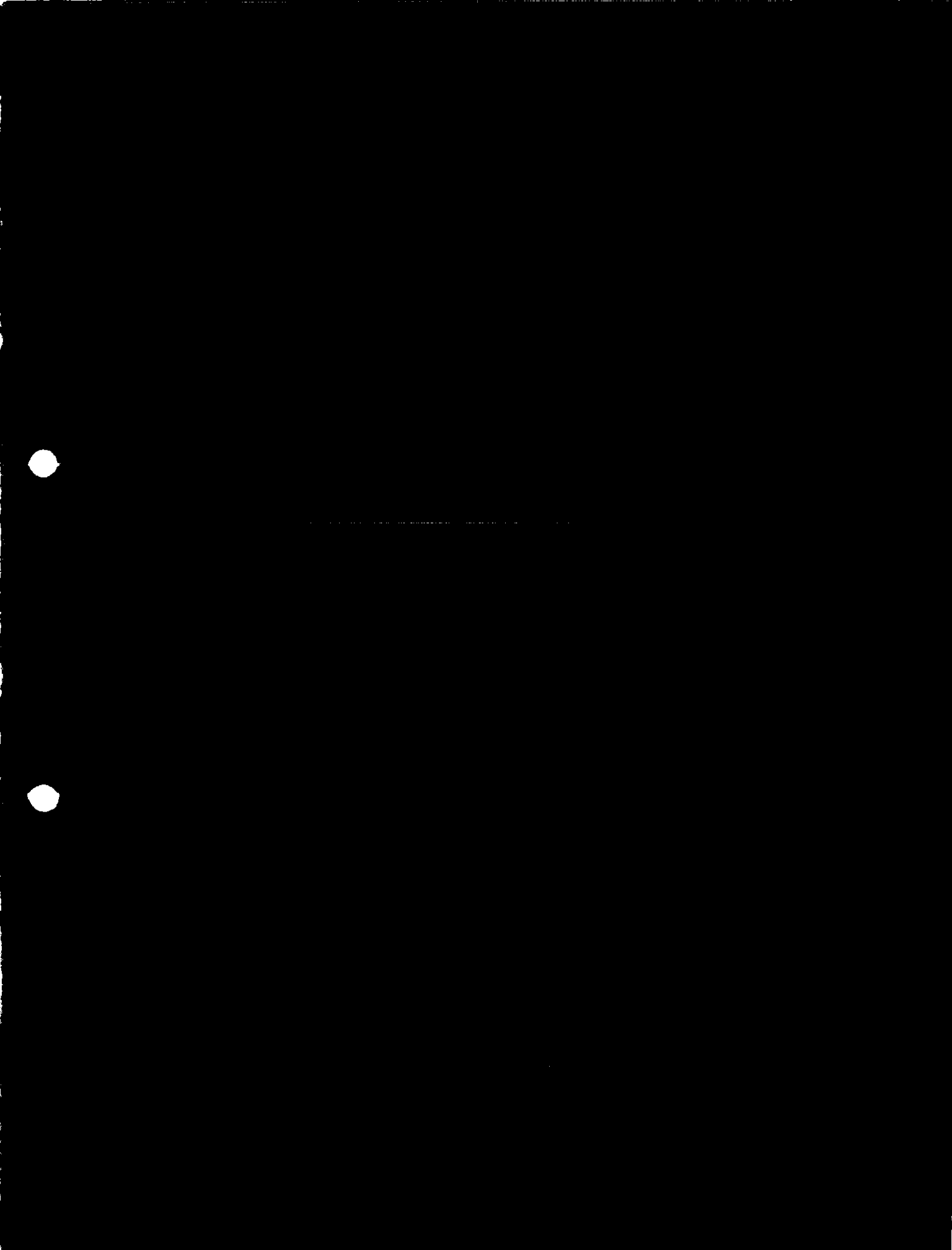
The project will have no effect on the commercial fishery.

Depending on the location, amount, and method of disposal of dredged material excess to that needed in the construction of the detached breakwater, the fish and wildlife resources could be adversely affected. For this reason no spoil should be placed on wetlands, and if located adjacent to wetlands, the spoil should be adequately diked to prevent a reflux of the spoil onto wetlands or water courses. This office should be advised of any spoil sites that may be considered during the course of your planning so that we can investigate the suitability of the sites.

We recommend:

1. That no spoil be placed on wetland areas.
2. That any upland spoil site adjacent to a wetland area be adequately diked to prevent a reflux of spoil onto wetlands or water courses.
3. That this Bureau be advised of any spoil sites that may be considered by your office.

Sincerely yours,



COORDINATION WITH OTHER AGENCIES

50. During the course of studies for this design memorandum, agencies having an interest in this project were contacted and, where appropriate, their views reflected in the plan of improvement.

a. U. S. Coast Guard. - The 9th Coast Guard District, Cleveland, Ohio, recommended that a minor light be installed on each end of the detached breakwater and on the lakeward ends of the jetties, as has been provided for in the project plan, and furnished the estimated first cost and estimated annual maintenance cost therefor used in this memorandum.

b. Federal Water Pollution Control Administration. - Samples of material to be dredged from the harbor basin within Oak Orchard Creek were furnished to the Lake Ontario Basin Office of FWPCA in Rochester, N. Y., for analysis. Their report thereon, in a letter dated 28 February 1969, is contained in Appendix C. An advance copy of this memorandum was furnished to the Great Lakes Region office of FWPCA, Chicago, Illinois. Copy of the letter response therefrom, dated, is also contained in Appendix C. It is indicated.....

c. U. S. Fish and Wildlife Service. - The U. S. Fish and Wildlife Service, Boston, Massachusetts, furnished its conservation and development report on this project.....A copy, with accompanying letter from the New York State Conservation Department's Division of Fish and Game, is contained in Appendix C. It outlines the provisions needed to facilitate recreational fishing from the project structures and confirms the estimate, previously furnished informally, of related benefits as used in this memorandum. It also sets forth their concern respecting final selection of spoil sites, particularly upland sites which might encroach on existing wetlands.

d. Genesee State Park Commission. - The limits of the harbor basin within Oak Orchard Creek were selected after coordination with the Genesee State Park Commission, to suit their projected marine park developments nearby. They also advised that they are unable to find a location on the lands over which they have jurisdiction for the planned upland disposal of a part of the material from project dredging. See 28 January and 7 February 1969 letters in Appendix C. Consequently, acquisition of additional property especially for this purpose by the New York State Conservation Department (parent organization of the Commission), in accordance with the terms of local cooperation, appears to be indicated.

e. New York State Conservation Department. - Advance copies of this design memorandum were furnished to the Commissioner of Conservation. Copy of the letter of response,, is contained in Appendix C. It is indicated.....

RECOMMENDATION

51. It is recommended that the plan for accomplishment fo the Oak Orchard Harbor improvement presented in this design memornadum be approved.