RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY

BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1

MADISON AND MATAWAN TOWNSHIPS

U. S. ARMY ENGINEER DISTRICT, NEW YORK

CORPS OF ENGINEERS

NEW YORK 3, NEW YORK

JULY 1963

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RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

I - INTRODUCTION

1. SCOPE. This design memorandum prepared in accordance with EM-1110-2-1150, dated 15 January 1962 is the first of two design memoranda that will be prepared to cover the authorized beach erosion and hurricane protection project along the south shore of Raritan Bay and Sandy Hook Bay in Northern New Jersey. The project provides for beach fill, groins, levees and interior drainage facilities for shore and hurricane protection at Madison Township, shore protection at Matawan Township and Borough of Union Beach, and hurricane protection at the Borough of Keansburg and East Keansburg. This design memorandum No. 1 will cover the portion of the project that lies in Madison and Matawan Townships. This design memorandum presents all the basic, design, cost, and economic data pertinent to the authorized beach erosion and hurricane protection plan and is not intended to be supported by any supplemental design data.

2. PROJECT LOCATION. The project area included in this design memorandum consists of about three miles of coast in Middlesex and Monmouth Counties in northern New Jersey, extending along the south shore of Raritan Bay in Madison and Matawan Townships between Cheesequake and Matawan Creeks. The sections of the shore in Madison Township are Morgan Beach, Laurence Harbor, Seidler's Beach and Knollcroft, (Figure 1). The sections of the shore in Matawan Township are Cliffwood Beach - west, starting at Whale Creek and Cliffwood Beach - east, extending beyond Matawan Point, (Figure 1).

II - PERTINENT DATA

3. GENERAL. The pertinent data, relative to the portion of the authorized project in Madison and Matawan Townships, are contained in Table 1. These items outline for ready reference, all of the pertinent project information on the physical and design features, essential costs and economics, construction schedule and local cooperation.

III - PROJECT AUTHORIZATION

4. AUTHORITY FOR THE PROJECT. The project was authorized by the Flood Control Act of 1962, dated 12 October 1962 substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 464, 87th Congress, at an estimated cost of

$3,097,000 and was modified for the cost sharing of the beach erosion portion of the project in accordance with Section 103 of the River and Harbor Act of 1962, dated 12 October 1962.

5. PROJECT PROVISIONS. In the authorizing document, the Chief of Engineers after due consideration of the recommendations of the reporting officers and the findings of the Board of Engineers for Rivers and Harbors and the Beach Erosion Board, recommended to the Secretary of the Army an improvement for prevention of beach erosion and hurricane damages along the south shore of Raritan and Sandy Hook Bays, New Jersey to provide for:

a. Construction of the various segments within the limits given in the report of the District Engineer and shown on Figure 1, to the cross-sectional dimensions and for the purposes indicated in Table 2 hereof; and

b. Accomplishment of the foregoing generally in accordance with the plan of the District Engineer, except as noted herein, with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of $3,040,000 for construction; provided that, prior to initiation of construction, local interests give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas, necessary for construction of the project;

(2) Accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

(3) Bear the percentage of total first cost for each segment as shown in Table 1, to consist of the items listed in (1) and (2) above and a cash contribution to be paid either in a lump sum prior to initiation of construction or in installments prior to commencement of pertinent items, in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs and values have been determined;

(4) Hold and save the United States free from damages due to the construction works;

(5) Maintain all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

(6) Maintain during the economic life of the project continued public ownership of the non-Federal publicly owned shores and continued availability for public use of privately owned shore

TABLE 1 - PERTINENT DATA - RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY - MADISON AND MATAWAN TOWNSHIPS

1. PROJECT LOCATION: Morgan Beach past Matawan Point in Madison and Matawan Townships, Middlesex and Monmouth Counties, New Jersey.

2. WATERWAY: Raritan and Sandy Hook Bays.

3. CLIMATOLOGY:

	HIGH	LOW	AVERAGE
a. Temperature (°F)	110	-31	52
b. Precipitation (inches)	61.70	29.94	44
c. Relative Humidity (%)			70

d. Winds (1) Reference Figure 13
(2) Prevailing: Northwest
(3) Maximum Velocity: (6/11/53) - 78 MPH (Long Branch)

4. HYDRAULIC
a. Tides (1) Semi-diurnal
(2) Mean range: 5.0 feet (South Amboy)
3.8 feet (Highlands)
(3) Spring range:
6.0 feet (South Amboy)
4.6 feet (Highlands)
(4) 25 November 1950: + 9.5 feet MSL (Perth Amboy)
(5) 12 September 1960: + 10.0 feet MSL (Perth Amboy)
b. Waves: (1) Reference: . Figure 13
(2) Computed maximum - Point Comfort, Keansburg
Direction east northeast
Wind 40 MPH
Height 14 feet
(3) Storm swells:
Sandy Hook to Rockaway Point 15 feet
Navy Pier Sandy Hook Bay 6 feet
Atlantic Highlands 5 feet
c. Surge: (1) Maximum storm (12 Sept. 60) 10.4 feet
(2) Standard project hurricane (Sandy Hook): 12.3 feet
(3) Maximum probable hurricane (Sandy Hook): 15.3 feet

5. TYPES OF SHORE IMPROVEMENT
a. Beach Protection:
(1) Purpose: to restore beach
(2) Material hydraulic sand
(3) Top elevation (feet above (msl) 5.5
(4) Bay slope 1 on 20
(5) Berm width (feet) 100
b. Bluff Protection
(1) Purpose to restore beach and to stop bluff erosion.
(2) Material hydraulic sand
(3) Top elevation (feet above msl) 10.0
(4) Bay slope 1 on 20
(5) Berm width (feet) 25
c. Hurricane - Beach Protection
(1) Purpose to protect against tidal flooding and to restore beach.
(2) Material hydraulic and dry fill
(3) Top elevation (feet above msl) 15.0
(4) Top width (feet) 25
(5) Slopes:

	waterside	protected side
hydraulic fill dike:	1 on 20	1 on 15
land fill levee:	1 on 3	1 on 3

6. AUTHORIZED PROJECT (H. Doc. No. 464)

SECTIONS	TYPE IMPROVEMENT	SHORE LENGTH (ft)
a. Madison Township	Shore and hurricane	10,250
b. Matawan Township	Shore	5,450
c. Borough Union Beach	Shore	3,000
d. Borough of Keansburg and East Keansburg	hurricane	14,150

7. PROJECT COVERED IN THIS DESIGN MEMORANDUM
a. Madison Township
(1) Morgan Beach
(a) Protection type: hurricane - beach
(b) Shore length (feet) 1,400
(c) Closure levee (feet) 900
(d) Raise Route 35 service road (feet) 700
(e) Raise Cliffwood Way (feet) 230
(f) Hydraulic sand fill (c.y.) 247,500
(g) Land fill (c.y.) 30,240
(h) Drainage lines (feet) 500
(i) Raise buildings (no.) 3
(j) Lands: permanent rights (acre) 6.0
temporary rights (acre) 1.1
(2) Laurence Harbor
(a) Protection type Bluff
(b) Shore length (feet) 3,800
(c) Hydraulic sand fill (c.y.) 207,600
(d) Remove buildings (no.) 2
(e) Lands: permanent rights (acre) 9.7
(3) Seidler's Beach
(a) Protection type beach
(b) Shore Length (feet) 2,200
(c) Hydraulic sand fill (c.y.) 7,900
(d) Drainage line (feet) 135
(e) Lands: permanent rights (acre) 5.6

(4) Knollcroft

(a) Protection type	Bluff
(b) Shore length (feet)	2,850
(c) Hydraulic sand fill (c.y.)	87,300
(d) Lands: permanent rights (acre)	9.9

b. Matawan Township

(1) Cliffwood Beach - west

(a) Protection type	beach
(b) Shore length (feet)	2,200
(c) hydraulic sand fill (c.y.)	79,900
(d) Lands: permanent rights -(acre)	4.4

(2) Cliffwood Beach - east

(a) Protection type	Bluff
(b) Shore length (feet)	3,250
(c) Hydraulic sand fill (feet)	177,100
(d) Drainage line : (feet)	350
(e) Lands: permanent rights (acre)	8.2
temporary rights (acre)	0.3

8. LOCAL COOPERATION

a. Provide without cost to the United States all lands, easements, and rights-of-way including borrow areas, necessary for construction of the project;

b. Accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

c. Bear the percentage of total first cost for each segment to consist in part of items a and b, and a cash contribution to be paid either in a lump sum prior to initiation of construction in installments prior to commencement of pertinent items, in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs and values have been determined;

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

e. Maintain all the works after completion in accordance with regulations prescribed by the Secretary of the Army;

f. Maintain during the economic life of the project continued public ownership of the non-federal publicly owned shores and continued availability for public use of privately owned shore equivalent to that upon which the recommended federal participation is based;

g. Control water pollution to the extent necessary to safeguard the health of bathers;

h. Construct, concurrently with the recommended beach fill, suitable parking fields and bathhouses open to all on equal terms .

9. ESTIMATED CONSTRUCTION COST (JULY 1963 PRICE LEVELS)

	Madison Township	Matawan Township	Total
a. FEDERAL FIRST COST (dollars)			
(1) Construction Cost	912,195	316,690	1,228,885
(2) Local Contribution	376,491	183,620	560,111
(3) Federal share	535,704	133,070	668,774
b. NON-FEDERAL FIRST COST (dollars)			
(4) Cash Contribution	376,491	183,620	560,111
(5) Lands, Easements and rights-of-way	117,615	9,510	127,125
(6) Non-Federal Share	494,106	193,130	687,236
c. TOTAL PROJECT	1,029,810	326,200	1,356,010

10. APPORTIONMENT OF COSTS

	Federal		Non-Federal Cash Contribution		Lands, easements & rights-of-way
	dollar	%	dollar	%	
a. Madison Township					
(1) Shore protection	226,080	45.2[a]	274,190	54.8	87,220
(2) Hurricane protection	309,624	70.0[b]	102,301	30.0	30,395
(3) Total	535,704	50.7	376,491	41.2	117,615
b. Matawan Township					
(1) Shore protection	133,070	42.0[a]	183,620	58.0	9,510
c. Matawan and Madison Townships					
(1) Total	668,774	54.4[a]	560,111	45.6	127,125

a. Excludes lands, easements and rights-of-way.
b. Includes lands, easements and rights-of-way.

11. BENEFIT - COST RATIO

a. Madison Township	1.9 to 1
b. Matawan Township	2.4 to 1
c. Total	2.1 to 1

12. CONSTRUCTION SCHEDULE

	1963
a. Submit and approve plans and specifications	1 - 15 August
b. Receive lands, easements and rights-of-way	15 August
c. Receive Cash Contribution	15 August
d. Advertize	15 August
e. Open bids	12 September
f. Award Contract	25 September
g. Commence work	15 October
h. Complete work	15 October 1964

equivalent to that upon which the recommended Federal participation is based;

(7) Control water pollution to the extent necessary to safeguard the health of bathers;

(8) Obtain approval of the Chief of Engineers of detailed plans and specifications for the work contemplated and arrangements for its prosecution, prior to commencement of any work on the recommended beach-protection phase of the project at Matawan Township and Borough of Union Beach or the beach-protection phase of the project at Madison Township for which Federal participation is planned, if undertaken separately from the recommended combined improvement;

(9) Construct, concurrently with the recommended beach fill, suitable parking fields and bathhouses open to all on equal terms; and

(10) At least annually inform interests affected that the hurricane improvements will not provide substantial protection from bay surges higher in elevation than that of hurricane "Donna", 12 September 1960.

c. Reimbursement to local interests in the amount of $57,000 as the Federal share of the costs incurred by them in accomplishing the beach protection work at Keansburg in 1957. The total cost to the United States for construction thus becomes $3,097,000.

6. PROJECT DETAILS. Other pertinent details of the authorized plan of improvement corresponding to data contained in Table 1 are contained in Table 2 as obtained from the report of the District Engineer and from supplemental data furnished for the report of the Chief of Engineers by 3rd Indorsement, dated 7 August 1961 to ENGBR letter, dated 29 July 1961, subject: Survey Report on Raritan Bay and Sandy Hook Bay, New Jersey (Statement A1 of Appendix A).

7. RIVER AND HARBOR ACT OF 1962 (PL 87 - 874, approved 23 October 1962) Section 103 of this act which amends PL 826, 84th Congress which amends PL 727, 79th Congress; prescribes the basis of Federal aid towards the cost of restoration and protection of Federal, non-Federal, and private shores. Pertinent portions of Section 103 applicable to this project are:

"(a) The Act approved August 13, 1946, as amended by the Act approved July 28, 1956 (33 U.S.C. 426 e-h) pertaining to shore protection is hereby further amended as follows:

(1) the word "one-third" in section 1(b) is deleted and the word "one-half" is substituted therefore;

(2) the following is added after the work "located" in section 1(b); "except that the costs allocated to the restoration and protection of Federal property shall be borne fully by the Federal government, and further, that Federal participation in the cost of a project for restoration and protection of State, county, and other publicly owned shore parks and conservation areas may be, in the discretion of the Chief of Engineers, not more than 70 per centum of the total cost exclusive of land costs, when such areas: Include a zone which excludes permanent human habitation; include but are not limited to recreational beaches; satisfy adequate criteria for conservation and development of the natural resources of the environment; extend landward a sufficient distance to include, where appropriate, protective dunes, bluffs, or other natural features which serve to protect the uplands from damage; and provide essentially full park facilities for appropriate public use, all of which shall meet with the approval of the Chief of Engineers;" . . .

(3) The cost-sharing provisions of this Act shall apply in determining the amounts of Federal participation in or payments toward the costs of authorized projects which have not been substantially completed prior to the date of approval of this Act, and the Chief of Engineers, through the Beach Erosion Board, is authorized and directed to recompute the amounts of Federal contribution toward the costs of such projects accordingly."

8. MODIFIED APPORTIONMENT OF COSTS. In accordance with the requirements contained in the 1962 modification of the beach erosion law (paragraph 7), the apportionment of cost was recomputed and submitted to higher authority by letter dated 31 January 1962, subject: Cost Sharing for Beach Erosion Control Projects under PL 87-874, and was approved by the Beach Erosion Board by 2nd Indorsement dated 5 March 1963 and by the Chief of Engineers by 3rd Indorsement dated 14 March 1963 (Statement A2 of Appendix A). The apportionment of cost contained in the report of the Chief of Engineers in the authorizing document as contained in Table 3 was revised as noted in Table 4. It is to be noted that division of cost was modified as follows:

TABLE 2 - PERTINENT DETAILS - AUTHORIZED PLAN OF IMPROVEMENT

Segment	Purpose and Type	Length (ft.)	Hydraulic Fill Required (cu. yds)	Hydraulic Fill to be pumped (cu. yds.)	Earth Fill Section Details or stone (cu. yds)	top elevation (ft msl)	Top Width (feet)	Side Slopes Land-side	Side Slopes Water side
Madison Township									
	A	1,000	168,800	211,070	-	15.0	25	1 on 15	1 on 20
Morgan Beach	D	1,140	-	-	23,940	15.0	25	1 on 3	1 on 3
Thence to Cabin Colony	B	2,600	140,600	175,800	-	10.0	25	-	1 on 20
Laurence Harbor cabin colony	A	1,583	266,700	332,690	-	15.0	25	1 on 15	1 on 20
	D	800	-	-	24,817	15.0	25	1 on 3	1 on 3
Seidler's Beach	C	1,767	42,500	53,100	-	5.5	100	-	1 on 20
Knollcroft	B	850	20,500	25,600	-	10.0	25	-	1 on 20
Thence to Whale Creek	C	1,000	20,400	25,500	-	5.5	100	-	1 on 20
Subtotal									
Hurricane and Beach protection	A	2,583	435,080	543,760	-	-	-	-	-
Shore Bluff Protection	B	3,450	161,100	201,400	-	-	-	-	-
Beach Protection	C	2,767	62,900	78,600					
Tie-back levee	D	1,940	-	-	48,757	-	-	-	-
	A-C	8,800	659,080	823,760	-	-	-	-	-
Matawan Township									
Cliffwood Beach cabin colony									
Beach protection	C	3,100	71,800	89,800	-	5.5	100	-	1 on 20
Thence to Matawan Point	B	1,700	50,400	63,000	-	10.0	25	-	1 on 20
Shore bluff protection									
Subtotal	B-C	4,800	122,200	152,800	-	-	-	-	-
Borough of Union Beach									
Beach Protection	C	3,000	100,000	125,000	-	5.5	100	-	1 on 20
Borough of Keansburg and East Keansburg									
Hurricane and Beach Protection	A	14,150	2,263,200	2,828,940	-	15.0	25	1 on 15	1 on 20
Tie-back Levee	D	13,290	-	-	545,900	15.0	8-25	1 on 3	1 on 3
Three stone groins	E	630	-	-	6,000	0 to 5.5	8	1 on 15	1 on 25 - 1 on 15
PROJECT TOTALS									
Hurricane and Beach Protection	A	16,733	2,698,280	3,372,700	-	-	-	-	-
Shore Bluff Protection	B	5,150	211,500	264,400	-	-	-	-	-
Beach Protection	C	8,867	234,700	293,400	-	-	-	-	-
Tie-back levee	D	15,230	-	-	594,657	-	-	-	-
GROINS	E	630	-	-	6,000	-	-	-	-
SHORE FRONT	A-C	30,750	3,144,480	3,930,500	-	-	-	-	-

TABLE 3 - APPORTIONMENT OF COSTS - AUTHORIZING DOCUMENT - AUTHORIZED PLAN OF IMPROVEMENT - RARITAN BAY AND SANDY HOOK BAY, N. J.
(Costs are in thousands of dollars, May 1960 prices)

Segement	Purpose and type(1)	Costs: Preauthorization studies	Construction: Federal	Construction: Non-Federal Cost	Construction: Non-Federal %	Construction: Total	Annual charges: Federal	Annual charges: Non-Federal	Annual charges: Total	Annual benefits	Benefit-cost ratio
Madison Township											
Morgan Beach	A	3.0	179.0	87.0	32.7	266.0	6.6	5.2	11.8	18.5	1.6
Thence to cabin colony	B	1.0	43.0	85.0	66.5	128.0	1.6	6.0	7.6	23.1	3.0
Laurence Harbor cabin colony	A	3.0	197.0	94.0	32.3	291.0	7.2	6.6	13.8	28.0	2.0
Seidler's Beach	C	1.0	13.0	27.0	67.5	40.0	0.5	3.0	3.5	18.9	5.4
Knollcroft	B	1.0	3.0	16.0	84.2	19.0	0.1	1.5	1.6	3.7	2.3
Thence to Whale Creek	C	1.0	5.0	14.0	73.7	19.0	0.2	1.6	1.8	2.6	1.4
Subtotal		10.0	440.0	323.0	42.4	763.0	16.2	23.9	40.1	94.8	2.4
Matawan Township											
Cliffwood Beach cabin colony	C	1.0	23.0	53.0	69.8	76.0	0.8	6.3	7.1	32.3	4.5
Thence to Matawan Point	B	1.0	10.0	43.0	81.2	53.0	0.4	4.0	4.4	6.1	1.4
Subtotal		2.0	33.0	96.0	74.4	129.0	1.2	10.3	11.5	38.4	3.3
Borough of Union Beach	C	2.0	16.0	90.0	85.0	106.0	0.6	7.4	8.0	9.5	1.2
Borough of Keansburg and East Keansburg	A	35.0	2,551.0	1,142.0	30.9	3,693.0	93.4	91.2	184.6	396.1	2.1
TOTAL		49.0	3,040.0	1,651.0	35.2	4,691.0	111.4	132.8	244.2	538.8	2.2

(1) Type A: Dredged fill with crown 25 feet wide at elevation 15 feet above mean sea level for hurricane and beach protection, including tie-back levees for hurricane protection.
Type B: Dredged fill with beach berm 25 feet wide at elevation 10 feet in front of bluffs for beach protection.
Type C: Dredged fill with beach berm 100 feet wide at elevation 5.5 feet for beach protection.

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TABLE 4 - MODIFIED APPORTIONMENT OF COSTS - RIVERS AND HARBORS ACT 1962 - AUTHORIZED PLAN OF IMPROVEMENT - RARITAN AND SANDY HOOK BAYS, NEW JERSEY
(Costs in thousands of dollars, May 1960 prices)

Segement	Purpose and type(1)	Costs: Construction: Federal Cost	Federal %	Non-Federal Cost	Non-Federal %	Total	Annual charges: Federal	Non-Federal	Total	Annual benefits	Benefit-cost ratio
Madison Township											
Morgan Beach	A	182.0	68.4	84.0	31.6	266.0	6.7	5.1	11.8	18.5	1.6
Thence to cabin colony	B	64.0	50.0	64.0	50.0	128.0	2.3	5.2	7.5	23.1	3.1
Laurence Harbor cabin colony	A	200.0	68.7	91.0	31.3	291.0	7.3	6.4	13.7	28.0	2.0
Seidler's Beach	C	19.0	47.5	21.0	52.5	40.0	0.7	2.8	3.5	18.9	5.4
Knollcroft	B	4.0	21.1	15.0	78.9	19.0	0.2	1.5	1.7	3.7	2.2
Thence to Whale Creek	C	8.0	42.1	11.0	57.9	19.0	0.3	1.5	1.8	2.6	1.4
Subtotal		477.0	62.5	286.0	37.5	763.0	7.5	22.5	40.0	94.8	2.4
Matawan Township											
Cliffwood Beach cabin colony	C	35.0	46.1	41.0	53.9	76.0	1.3	5.9	7.2	32.3	4.5
Thence to Matawan Point	B	14.0	26.4	39.0	73.6	53.0	0.5	3.8	4.3	6.1	1.4
Subtotal		49.0	38.0	80.0	62.0	129.0	1.2	10.3	11.5	38.4	3.3
Borough of Union Beach	C	25.0	23.6	81.0	76.4	106.0	0.9	7.1	8.0	9.5	1.2
Borough of Keansburg and East Keansburg	A	2,116.0	69.6	1,128.0	30.4	3,693.0	94.0	90.7	184.7	396.1	2.1
TOTAL		3,116.0	66.6	1,575.0	33.4	4,691.0	113.6	130.6	244.2	538.8	2.2

(1) Type A: Dredged fill with crown 25 feet wide at elevation 15 feet above mean sea level for hurricane and beach protection, including tie-back levees for hurricane protection.
Type B: Dredged fill with beach berm 25 feet wide at elevation 10 feet in front of bluffs for beach protection.
Type C: Dredged fill with beach berm 100 feet wide at elevation 5.5 feet for beach protection.

Locality	Percentages of total costs			
	Authorized		Revised	
	Federal	Non-Federal	Federal	Non-Federal
Townships:				
Madison	57.6	42.4	62.5	37.5
Matawan	25.6	74.4	38.0	62.0
Boroughs:				
Union Beach	15.0	85.0	23.6	76.4
Keansburg and East Keansburg	69.1	30.9	69.6	30.4
PROJECT TOTAL	64.8	35.2	66.6	33.4

9. PRIOR PROJECTS. There are no prior beach erosion or hurricane projects. However, there are nine Federal navigation projects as listed and described in Table 5.

IV - INVESTIGATIONS

10. PRIOR REPORTS. There are no prior design memoranda. There are no prior reports which specifically cover beach erosion control or hurricanes in the study area. However, a report on protection of the New Jersey coast from floods due to tide and winds was submitted to Congress by the Secretary of War on 23 November 1949 pursuant to the Flood Control Act of 22 December 1944. This report which included Raritan and Sandy Hook Bays from Keyport to Highlands, concluded that protection of this Jersey coast area was not advisable at that time. There are numerous prior reports in connection with Federal navigation improvements as summarized in Table 5.

11. PUBLIC HEARINGS. No public hearings were held after the project was authorized. However, in connection with the authorizing document, the District Engineer held a public hearing on 21 December 1955 at Long Branch, N. J. to obtain information for use in the preparation of this report. Congressman of the Third New Jersey District, representatives of the U. S. Weather Bureau, U. S. Navy, State, County, and municipalities, and private interests attended the hearing. Local interests also presented information at a public hearing held in Newark, N. J. on 1 February 1956 in connection with hurricane investigation of another area in New Jersey. During the course of investigations in connection with the authorizing document, meetings were held with local officials on 3 April 1959, and 21 July 1960 at Freehold, N. J. and on 5 August 1960 at New Brunswick, N. J. The pertinent views and desires expressed at the public hearing and meetings are contained in appendix L and paragraphs 26 through 29 of the authorizing document. (House Document No. 464).

TABLE 5 - FEDERAL NAVIGATION PROJECTS AND PRIOR REPORTS

Waterway	Report	Project authorization act	Description
		EXISTING NAVIGATION PROJECT REPORTS	
Raritan River	H. Doc. 1341, 62d Cong., 3d sess. H. Doc. 127, 70th Cong., 1st sess. H. Doc. 454, 70th Cong., 2d sess. Rivers and Harbors Committee Doc. 31, 71st Cong., 2d sess. Rivers and Harbors Committee Doc. 74, 74th Cong., 2d sess. Unprinted report on file in the Office, Chief of Engineers	2 March 1919 3 July 1930 3 July 1930 3 July 1930 26 August 1937 17 October 1940	Channels 10 to 25 feet deep. Project is about 96 percent complete.
Cheesequake Creek	S. Doc. 69, 46th Cong., 2d sess.	14 June 1880	West and east stone jetties 995 and 925 feet in length, respectively, and a channel 3 to 5 feet deep. Jetties were completed in 1883. Project is about 45 percent complete.
Matawan Creek	H. Doc. 45, 46th Cong., 3d sess.	3 March 1881	Channel 4 feet deep. Project is about 90 percent complete.
Keyport Harbor	H. Doc. 153, 42d Cong., 3d sess.	2 August 1882	Channel 8 feet deep. Project completed in 1911.
Way Cake Creek	H. Doc. 624, 77th Cong., 2d sess.	2 March 1945	Channel 8 feet deep. No work done.
Shoal Harbor and Compton Creek	H. Doc. 58, 73d Cong., 1st sess. H. Doc. 673, 76th Cong., 3d sess. H. Doc. 89, 82d Cong., 1st sess.	30 August 1935 2 March 1945 3 September 1954	Channels 8 to 12 feet deep. Project is about 78 percent complete. Local request for stone jetties extending into Sandy Hook Bay for protection at the mouth of the creek was found unjustified (see H. Doc. 89).
Sandy Hook Bay at Leonardo	H. Doc. 108, 81st Cong., 1st sess.	17 May 1950	Channel 8 feet deep. Project completed in 1957.
Sandy Hook Bay	H. Doc. 292, 75th Cong., 1st sess.	26 August 1937	Rubble-mound breakwater about 4,000 feet in length and dredging of an anchorage 8 feet deep. The breakwater was completed in 1940 and the dredging in 1941.
Shrewsbury River	H. Doc. 1296, 62d Cong., 3d sess. H. Doc. 157, 71st Cong., 2d sess. Rivers and Harbors Committee Doc. 31, 74th Cong., 1st sess. H. Doc. 285, 81st Cong., 1st sess.	2 March 1919 30 August 1935 30 August 1935 17 May 1950	Channels 6 to 12 feet deep, turning basin and anchorage 6 feet deep. Project is about 57 percent complete.
		OTHER PERTINENT REPORTS	
Cheesequake Creek	Unfavorable preliminary examination report submitted to Congress by the Secretary of the Army on 7 January 1949.	—	Indicated that raising of the existing Federal jetties would not materially alleviate shore erosion nor provide adequate protection for property at the entrance to the creek.
Sandy Hook Bay at Leonardo	Partially favorable preliminary examination report submitted to the Chief of Engineers by the Division Engineer, North Atlantic Division on 11 March 1946.	—	Concluded that breakwaters and dredging desired by the U. S. Navy are not justified from a commercial navigation standpoint and that the work can best be accomplished with military funds. The Navy submitted a preliminary report which included data on waves and swells in the Sandy Hook Bay area.
Sandy Hook Bay	Unfavorable survey review report submitted to Congress by the Secretary of the Army on 9 December 1948.	—	Concluded that the existing Federal breakwater at Atlantic Highlands provides a measure of protection against storm waves and that modification of the existing project should be deferred until the adequacy of the breakwater has been demonstrated through actual use.

12. INVESTIGATIONS - AUTHORIZING DOCUMENT. Field surveys in connection with the authorizing document consisted of U.S.C. and G.S. Chart 369 corrected to 21 April 1958 for offshore soundings (Plate 1, authorizing document), hydrographic profiles at intervals of $\frac{1}{2}$ to 1 mile taken by Corps of Engineers from May to July 1957 and aerial photos taken in April 1957 superimposed on U.S.G.S. quadrangles (1:24000) published in 1954 (Plates 2 - 4, authorizing document), and four samples of bottom materials taken by the Corps of Engineers for each profile at mean high water, mean low water, about one-half mile offshore and about one mile offshore with results of analysis contained in Appendix A of the authorizing document. Detailed studies made in connection with and contained in appendices of the authorizing document are geomorphology and Littoral Materials (Appendix A), Littoral Forces (Appendix B), Shore Line Changes, Offshore Depth Changes, Profiles, and Volumetric Accretion and Erosion (Appendix D), Existing Structures and Protective Measures (Appendix E) Pollution Data (Appendix G), and Estimates of Losses and Benefits (Appendix K).

13. INVESTIGATIONS - DESIGN MEMORANDUM. A controlled aerial mosaic of the area was flown on 23 January 1963. Sounding profiles were taken at 200 foot intervals along the shore line traverse from mean sea level to about one mile offshore. These profiles were extended upland to elevation 10 feet above mean sea level. These survey data were obtained by the government forces during the months of February through March and April 1963. Topographic surveys were made of the Morgan Beach area in January 1963.

14. An initial exploration program was performed in Raritan Bay by government forces during summer 1957. This program to determine availability of suitable sand borrow, consisted of nine wash borings with 2 inch diameter drive samples taken at 5 foot intervals or change of stratum. During winter of 1962, additional explorations were performed by contract under government supervision to investigate availability of sand borrow closer to the shoreline. This program consisted of ten $2\frac{1}{2}$ inch cased drill holes taken along an alignment approximately 1500 feet off the shore line. Continuous 2 inch diameter samples were taken for analysis. In June 1963, additional explorations were initiated in order to obtain detailed information on the foundation conditions for the levee construction at Morgan Beach and in order to determine the conditions of the marsh area at the mouth of Whale Creek. The program consisted of four 4 inch cased drill holes. Continuous disturbed and undisturbed samples were taken. Detailed discussion of foundation and material investigations and subsurface conditions are contained in Appendix B.

V. AUTHORIZED PROJECT PLAN

15. PROJECT AREA. The project area is primarily residential and recreational with some commercial developments. Although about 83 percent of the shore is privately owned, about 78 percent of the shore is accessible to the public. The condition of the area along the alignment of project in Madison and Matawan townships are shown in plan on aerial photographs, Figures 4 to 8, and in elevation by photographs, Plates 1 through 8. The major change in the area was at Laurence Harbor where the cabin colony was completely destroyed by fire, Figure 7 and Plate 4.

16. AREA FACTORS. The area factors have not changed from those reported in the authorizing document. These factors are summarized in the following paragraphs.

17. TOPOGRAPHY. Low narrow beaches front most of the area. A number of creeks namely, Cheesequake, Margaret, Whale, and Matawan Creeks intersect the shore line. The adjacent terrain ranges from high bluffs to low marshlands which are partially inundated by spring tides. The offshore hydrography is mostly very flat and shallow, with the 12 foot contour generally located over a mile offshore.

18. CLIMATOLOGY. The climate is temperate with an average temperature of 52 degrees Fahrenheit. The average annual precipitation is about 44 inches with rather uniform distribution throughout the year.

19. WINDS. Wind data from observations made at Sandy Hook, N.J. as well as data on winds observed at sea are presented on Figure 13. The data for Sandy Hook show that almost 20 percent of the total wind duration is from the northwest with around 15 percent each from the northeast and south directions. At sea, the winds from the westerly quadrants prevail. Of a total of 815 maximum daily velocity observations of winds over 30 miles per hour during the period 1924 to 1934 at Sandy Hook, 316 or about 40 percent were from the northwest. During recent storms maximum winds, as high as 78 miles per hour, have been recorded at Long Branch, N. J. about 10 miles south of the eastern end of the study area.

20. TIDES. Tides along the study area are semi-diurnal and have a mean range varying from 5.0 feet at South Amboy to 3.8 feet at Highlands. The spring range varies from 6.0 feet to 4.6 feet at the respective locations.

21. CURRENTS. Tidal currents along the shore of the study area are generally weak except at the entrances to Raritan and Shrewsbury Rivers where the average velocity at strength of the current is 1.8 and 2.6 knots, respectively. A large part of the tidal circulation in the bay occurs in relatively deep water along an east-west axis approximately

2 miles offshore from the study area.

22. WAVES. The study area is affected by ocean waves entering between Sandy Hook and Rockaway Point and by waves generated by winds across the open bay. Wave diagrams on Figure 13 indicate the height and direction of waves outside the entrance to New York Harbor and in the vicinity of Point Comfort at Keansburg, N. J. The highest waves are generated by winds from the east and east-northeast. The ocean waves entering the bay are modified by the effects of refraction and shoaling with resulting changes in wave height and direction. Computations indicate that waves as high as 14 feet are possible off Point Comfort under certain storm conditions. Estimates obtained from experienced seafaring personnel disclose that, after severe ocean storms, swells are as high as 15 feet between Sandy Hook and Rockaway Point. It has been estimated that these swells are reduced to a height not in excess of 6 feet in the area off the Navy piers in Sandy Hook Bay. Storm wave heights of about 5 feet have been reported at Atlantic Highlands.

23. ICE CONDITIONS. There are no known problems due to ice conditions along the study area frontage.

24. STORMS. The study area is subject to damage from hurricanes and extratropical cyclones which are also known as northeasters. The hurricanes originate during the months of August through October in the Caribbean area and have wind velocities in excess of 75 miles per hour. However, the winds generally weaken to maximum velocities on the order of 60 miles per hour upon reaching the North Atlantic Coast, In most cases, tropical storms have moderated considerably from their peak intensity before reaching the study area. A number of notable exceptions to this general rule have occurred and hurricanes of devastating intensity have struck the area. The paths of major hurricanes for the New York-New Jersey coast are shown on Figure 13. In a northeaster, wind speeds are generally not as great as they are in a severe hurricane. The wind field of a northeaster covers a much greater area, and the forward motion of the storm is slower. Thus, it may produce prolonged periods of shore winds which may result in longer periods of flooding. Examples are the 25 November 1950, the September 1938 hurricane and the 6 - 8 March 1962 storms.

25. Available records show that of 200 storms recorded between 1635 and 1962, six were unusually severe, 17 were severe, 81 were moderate and 96 others threatened the area. Damaging effects on the study area have been unusually severe during the following storms. All these storms were hurricanes with the exception of the November 1950 and March 1962 storms, which were northeasters (extratropical cyclone).

1723, July 29
1788, August 19
1821, September 3
1944, September 14
1950, November 25
1960, September 12
1962, March 6 - 8

26. STORM FREQUENCY. The frequency of storm occurrences per 100 years in the study area for the various categories of estimated degree of intensity is shown in Table 6. Additional data on storm frequency are contained in Appendix C of the authorizing document.

TABLE 6 - ESTIMATED STORM FREQUENCY

Intensity	Period of Record	Percent chance of occurrence
Unusually severe	1701 - 1960	3.6
Severe	1801 - 1960	14.2
Moderate	1901 - 1960	55.2
Threatened area	1901 - 1960	110.0

27. STORM LEVELS. The maximum recorded storm water elevation in the immediate vicinity of the study area was 9.5 feet above mean sea level, as obtained from a tide gage at Perth Amboy, N. J. on 25 November 1950. The peak surge for the same storm at this location was 10.4 feet. It is estimated from high water marks that the water levels along the study area during the hurricane of 12 September 1960 (Donna) exceeded those of the 1950 storm by about 0.5 foot. Additional tidal data for recent storms are given in table B-2 of Appendix B. Data on the estimated frequency of high tides in the bays are given in Figure K-1 of Appendix K of the authorizing document.

28. SHORE LINE CHANGES. The relatively small amount of material trapped at existing jetties and groins indicates that the quantity of littoral drift and volume of accretion along the shore are not appreciable. A study of topographic and hydrographic surveys reveal an estimated average rate of erosion generally in the order of 1 to 2 cubic yards per linear foot of shore per year. A summary of the shore line changes are given in Table 6 of the authorizing document. Detail data are given in appendices D and E of the authorizing document. The great shore line erosion occured during the earliest period of record with rates of recession up to 8 feet per year. The erosion in recent period of record is greatly reduced largely due to extensive bulkhead construction which has helped to hold the shore line. Artificial fill placed in the most recent years accounts for most of the accretion in that period.

TABLE 7 - SUMMARY OF ESTIMATED FIRST COSTS - MADISON AND MATAWAN TOWNSHIPS' IMPROVEMENT

No.	Item	TOWNSHIPS MADISON (costs in dollars)	MATAWAN	Total
	BREAKDOWN BY PRINCIPAL FEATURES			
	FEDERAL FIRST COST			
1	Beach fill	596,665	250,340	847,005
2	Levee (a)	124,375		124,375
3	Contingencies	108,155	37,550	145,705
4	Subtotal	829,195	287,890	1,117,085
5	Engineering and design	24,930	8,640	33,570
6	Supervision and Administration	58,070	20,160	78,230
7	Subtotal	912,195	316,690	1,228,885
8	Minus local contribution	376,491	183,620	560,111
9	Total Federal first cost	535,704	133,070	668,774
	NON-FEDERAL FIRST COST			
10	Cash Contribution	376,491	183,620	560,111
11	Lands, easements and rights-of-way (b)	92,980	7,530	100,510
12	Contingencies	13,945	1,130	15,075
13	Planning, administration, surveys, and appraisals	10,690	850	11,540
14	Total Non-Federal first cost	494,106	193,130	687,236
15	Total - Work	1,029,810	326,200	1,356,010
	BREAKDOWN BY PROTECTION PURPOSE			
	HURRICANE PROTECTION			
1	Federal First Cost	309,624	0	309,624
2	Non-Federal First Cost	132,696	0	132,696
3	Total	442,320	0	442,320
	BEACH PROTECTION			
4	Federal First Cost	226,080	133,070	359,150
5	Non-Federal First Cost	361,410	193,130	554,540
6	Total	587,490	326,200	913,690
	TOTAL WORK	1,029,810	326,200	1,356,010

a. Includes relocation, drainage and appurtenances.
b. Lands, easements, and rights-of-way, a local responsibility included in the total cost prior to apportionment and credit allowed towards non-Federal share for hurricane improvement but not included in the total cost prior to apportionment and no credit allowed towards the non-Federal share for shore protection improvement.

29. OFFSHORE DEPTH CHANGES. A study of hydrographic surveys made since 1936 fail to disclose any significant accretion or erosion in the offshore areas. The location of 6, 12, and 18 foot depth contours were obtained from surveys at various times from 1836 to 1957. There has been offshore and onshore movement of the depth contours, generally over a zone of several hundred feet, but without a consistent pattern except for the 6 foot contour. The 6 foot contour has remained practically parallel to the shore line.

30. SHORE PROFILES. Profiles based on a survey made in 1957 were prepared from the shore to approximately one mile offshore. These profiles (Plates 8 to 10 of the authorizing document) reveal that the typical present foreshore slopes generally vary from about 1 on 15 to about 1 on 40 with the average close to 1 on 30 and that underwater slopes are very flat and are around 1 on 400.

31. SURFICIAL DEPOSITS. The poor beach material would consist of marls, gravels, sands, and clays. The littoral material is small in quantity and probably originates from erosion of coast, offshore, around Sandy Hook and sediments deposited at mouths of streams. No definite trend of median diameter (diameter in millimeters at mtd point of accumulative size distribution curve) is discernible in sands along the highwater line (ranging from 0.34 mm to 1.5 mm). Generally silt is encountered at mean low water over the western half of this area and sand in the eastern half with the median diameter varying from 0.24 mm to 0.33 mm. The sorting coefficient, an index of gradation of the material (the square root of the ratio of diameter at the 25 percent point to the diameter at the 75 percent point on the accumulative size distribution curve) ranges from 8.4 to 1.4, indicating poorly sorted materials. (A well sorted beach material ranges from 1.25 to 1.5 since the optimum sorting is unity, with greater numbers indicating fineness and smaller numbers indicating coarseness). The skewness, an index of grain size distribution of the material (the ratio of the 25 percent diameter size to the 75 percent diameter size divided by the 50 percent diameter size squared) ranges from 0.84 to 7.7 indicating poor distribution of grain sizes with a predominance of fine particles.

32. The offshore materials are predominantly silt in the westerly half of the project extending from Margaret Creek to Cheesequake Creek. Sand is encountered from one to two thousand feet offshore in the easterly half extending from Margaret Creek to the Cliffwood Beach area where medium diameters are about 0.25 mm.

These materials are well sorted and graded for beach fill having sorting values of about 1.25 and a skewness coefficient of about unity.

33. DESIGN FACTORS. The following paragraphs present a summary of the design criteria including those contained in Appendix H of the authorizing document, that were used in the design memorandum for beach fill, levees, and interior drainage facilities. (Figures 14 and 15 are Plates 13 and Figure J1[1] of the authorizing document).

34. TOP ELEVATIONS. Top elevations of 15, 10 and 5.5 feet above mean sea level have been selected for protection against tidal flooding, protection against bluff erosion and for proposed beaches fronting low areas, respectively. The 15-foot elevation for beaches and levees would provide protection against the maximum of record surge of 10.4 feet produced by the extratropical storm of 25 November 1950 recurring coincidental with a predicted mean high tide, including an allowance of about 2 feet for wave run-up. Such a design would provide greater protection than that which would be required against a repetition of the 25 November 1950 storm as it actually occurred (9.5 feet), in view of the fact that it struck the area near the time of mean low tide. The 10-foot elevation at bluff areas is proposed for a beach which is designed to dissipate the energy of waves with heights up to about 9 feet before wave action reaches the base of the bluff. The design berm elevation of 5.5 feet for beaches in low areas is approximately the same as the berm elevation of natural beaches in the area. The detail development of this criteria is contained in Appendix H of the authorizing document.

35. It is to be noted that storm surges greater than the maximum of record are possible in the study area. Predictions made by the Texas A & M Research Foundation as published in Final Technical Report No. 165-3, October 1959, titled "The Prediction of Storm-Tides in New York Bay" indicates surges of 12.3 and 15.3 feet at Sandy Hook for a standard project hurricane and a maximum probable hurricane, respectively, with surges around 20 percent higher at Perth Amboy. Consideration of providing hurricane protection against storms of this intensity discloses that it would greatly interfere with local activities and in some cases would not be economically justified.

36. BEACH FILL CROSS SECTIONS. The design berm widths and slopes of the beach cross sections are based on engineering judgment and experience with artificial beaches placed by the State of New Jersey in the Keansburg area. Since the existing natural beach slopes in the study area are relatively flat, a design seaward slope of 1 on 20 was selected as best approximating the natural slope of the hydraulic fill to be used. The same design slope was used for the aforementioned beaches placed by the State and these beaches have remained relatively stable with the exception of a few areas of localized erosion. The detail development of this criteria is contained in Appendix D of the authorizing document.

37. LEVEES. The levee section has been designed in accordance with Corps of Engineers criteria. The stability of the levee has been analyzed in accordance with methods and criteria contained in EM 1110-2-1902 dated 27 December 1960, Stability of Earth and Rockfill Dams. The analysis of seepage through the foundation was made based on criteria contained in EM-1110-2-1901 dated February 1952, Soil Mechanics Design - Seepage Control. Settlement of the foundation was analyzed in accordance with EM-1110-2-1904 dated January 1953, Soil Mechanic Design - Settlement Analysis. A detail discussion of the application of the design criteria are contained in Appendix B.

38. INTERIOR DRAINAGE. The basis of interior drainage is generally in accord with Preliminary Manuscript Part CXIV, Chapter 10, Interior Drainage, Engineering Manual Civil Works; Technical Paper No. 25, Rainfall Intensity - Duration Frequency Curves published by the U. S. Department of Commerce; Engineering Manual for Military Construction, Chapter 1, dated June 1955, Surface Drainage Facilities for Airfields; and Engineering Manual for Civil Works construction, Part CXVI, chapter 2, dated 2 February 1953, Hydraulic Design, Reservoir Outlet Structures. The detailed discussion of application of the design criteria are contained in Appendix C.

39. PROJECT DESCRIPTION (DESIGN MEMORANDUM). The portion of the authorized project covered in this memorandum extends from Laurence Harbor in Madison Township to Matawan Point in Cliffwood Beach in Matawan Township. Existing conditions are typically shown in Plates 1 through 8. The plan of improvement in Madison Township, shown in detail on Figures 2 through 7, 9 and 9A comprises 2,300 feet of hurricane protection at Morgan Beach, 3,800 feet of bluff protection in Laurence Harbor from Morgan Beach to Seidler's Beach, 2,200 feet of beach protection at Seidler's Beach, and 2,850 feet of bluff protection at Knollcroft from Seidler's Beach to Whale Creek. The plan of improvement in Matawan Township, shown in detail on Figures 7 through 9, comprises 2,200 feet of beach protection and 3,250 feet of bluff protection in Cliffwood Beach extending from Whale Creek to Matawan Point.

40. MORGAN BEACH. The hurricane protection from base line station 8 + 00 to station 22 + 00 (Figures 2, 3, 4 and 9A) consists of hydraulically placed sand fill to elevation 15.0 feet above mean sea level with a 1 on 20 slope on the bay side, with a 1 on 15 slope on the protected side and with a minimum top width of 25 feet. The easterly closure at station 22 + 00 is the existing bluff (Photo 4 on Plate 2). The westerly closure is an earth levee that connects to the sand levee at station 11 + 00 and that extends generally south 500 feet to a service road, north and adjacent to New Jersey Route 35 (Photo 3 on Plate 2). The hydraulic sand fill wraps around the

levee for a distance of 400 feet and slopes vary from 1 on 20 to 1 on 3 (Figure 3). The levee has a wide berm, about 200 feet on each side, to elevation 8 feet mean sea level. Above the berm, the levee side slopes are 1 on 3 and the top width is 25 feet. The top of levee is 15.0 feet above mean sea level at junction with sand levee (levee station 0 + 00) and stays constant to levee station 4 + 54 and then slopes upward for 54 feet to 16.7 feet above mean sea level at the shoulder of the service road. The service road then slopes eastward to the closure at elevation 15.0 feet above mean sea level (Figure 9A). The soils investigations and design are contained in Appendix B. In order to complete this closure to high ground, the service road is raised for a distance of about 400 feet to elevation 15 feet above mean sea level. In order to make the protected area useable, Cliffwood Way, a local street (Photo 1 on Plate 1) will be raised for a distance of about 225 feet to meet the raised service road. A one-story frame dwelling (Photo 2 on Plate 1), frame garage and a one story frame commercial building (Photo 3 on Plate 2) are raised and fill placed around these buildings to make the area serviceable from the service road. Interior drainage is provided by a collecting ditch behind the levee with a maximum ponding level of 4.5 feet above mean sea level. The ditch discharges through a 24 inch round pipe through the levee into an existing ditch (Figure 3). The hydraulic design is contained in Appendix C. The drainage line to prevent backflow has a 24 inch round sluice gate and a 24 inch round automatic drainage gate.

41. LAURENCE HARBOR (MORGAN BEACH TO SEIDLER'S BEACH.) The bluff protection (Figures 5 and 6) consists of hydraulic sand fill to elevation 10.0 feet above mean sea level with a slope of 1 on 20 on the bayside and with a minimum berm width of 25 feet which butts against the existing high bluff (Photo 5 on Plate 3). The protection extends from base line station 22 + 00 to the site of the burnt out Laurence Harbor cabin colony at station 60 + 00 (Photo 8 on Plate 4). Two commercial buildings located on the beach at base line station 37 + 50 at Laurence Harbor center will be acquired and removed (Photo 6 on Plate 3 and Photo 7 on Plate 4).

42. SEIDLER'S BEACH. The beach protection (Figure 6) extends from base line station 60 + 00, the vicinity of Margaret Creek, to station 82 + 00, the vicinity of Madison Township sewage disposal plant (Photo 10 on Plate 5). The beach protection provides hydraulic sand fill with a 1 on 20 slope on the bayside and with a minimum berm width of 100 feet butting against high ground at elevation 5.5 feet above mean sea level. The existing 24 inch round corrugated metal culvert at base line station 66 + 00 (Photo 9 on Plate 5), the outfall for Margaret Creek, is extended through the new sand fill. The hydraulic design is contained in Appendix C.

PHOTO 1 - SERVICE ROAD AND FRAME HOUSE TO BE RAISED
LOOKING WEST PARALLEL TO NEW JERSEY ROUTE 35

PHOTO 2 - CLIFFWOOD WAY TO BE RAISED, LOOKING NORTH
FROM SERVICE ROAD

EXISTING CONDITIONS ALONG WEST CLOSURE - MORGAN BEACH
BEACH EROSION AND HURRICANE PROTECTION
MADISON TOWNSHIP, NEW JERSEY

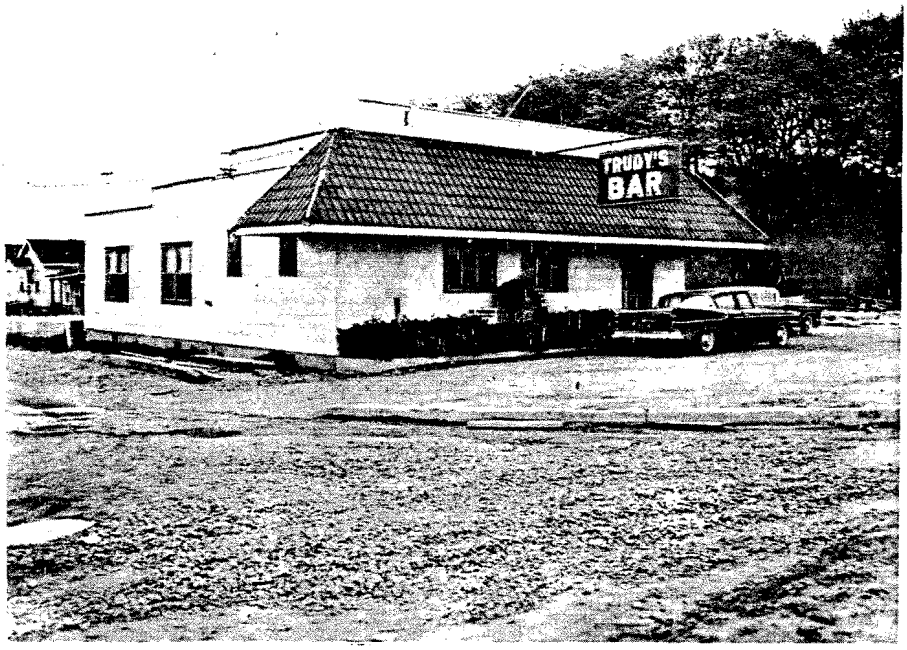


PHOTO 3 - WEST CLOSURE AT NORTHEAST CORNER OF CLIFFWOOD WAY AND SERVICE ROAD TO NEW JERSEY ROUTE 35. COMMERCIAL BUILDING TO BE RAISED.

PHOTO 4 - FROM EAST CLOSURE (STATION 22+00) LOOKING WEST, BULKHEAD AT BEACH COLONY ALONG DIKE ALIGNMENT AND JETTY AT CHEESEQUAKE CREEK IN BACKGROUND

EXISTING CONDITIONS ALONG DIKE ALIGNMENT - MORGAN BEACH
BEACH EROSION AND HURRICANE PROTECTION
MADISON TOWNSHIP, NEW JERSEY

PHOTO 5 - LOOKING EAST FROM MORGAN BEACH (STATION 22+00) ALONG HIGH BLUFF LINE TO LAURENCE HARBOR SHOWING DANCE HALL TO BE REMOVED ON ALIGNMENT OF IMPROVEMENT.

PHOTO 6 - LOOKING SOUTHEAST AT STATION 36+00 TOWARDS DETERIORATED DANCE HALL, TO BE REMOVED

EXISTING CONDITIONS ALONG HIGH BLUFF - LAURENCE HARBOR
BEACH AND SHORE BLUFF PROTECTION
MADISON TOWNSHIP, NEW JERSEY

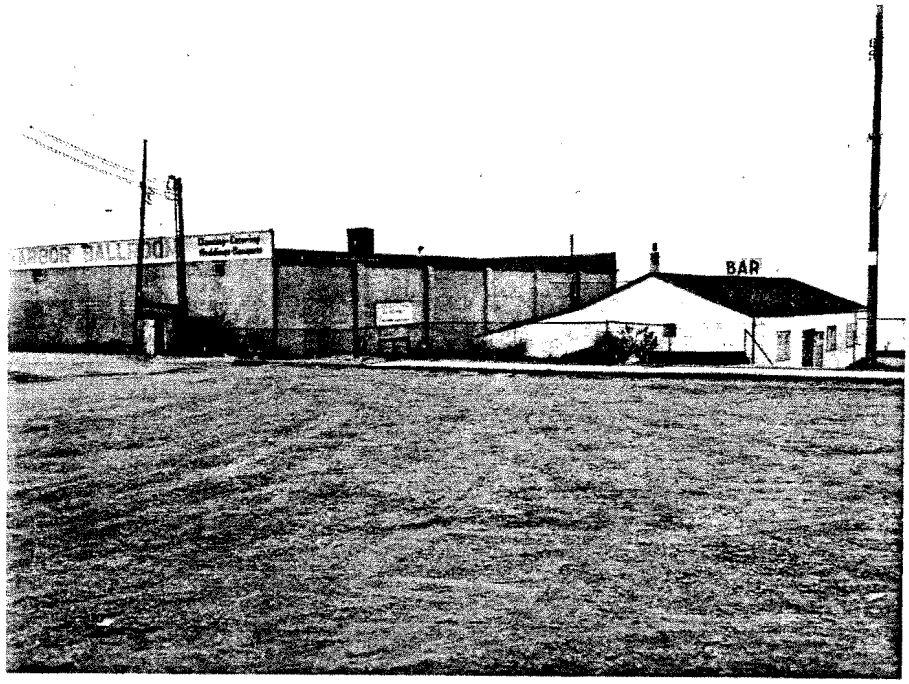


PHOTO 7 - LOOKING NORTHWEST FROM PARKING LOT (STATION 38+50) TOWARDS DANCE HALL AND COMMERCIAL BUILDING ON ALIGNMENT OF IMPROVEMENT, TO BE REMOVED

PHOTO 8 - LOOKING WEST FROM SITE OF BURNT OUT CABIN COLONY (STATION 60+00) ALONG BLUFF LINE TOWARDS DANCE HALL AND COMMERCIAL BUILDING

EXISTING CONDITIONS ALONG HIGH BLUFF - LAURENCE HARBOR
BEACH AND SHORE BLUFF PROTECTION
MADISON TOWNSHIP, NEW JERSEY

PHOTO 9 - LOOKING SOUTH (STATION 66+00) SHOWING 24-INCH CORRUGATED METAL PIPE OUTFALL AT MARGARET CREEK

PHOTO 10 - LOOKING EAST (STATION 68+00) ALONG BEACH TOWARDS NEW MADISON TOWNSHIP SEWAGE DISPOSAL PLANT

EXISTING CONDITIONS ALONG SEIDLER'S BEACH
BEACH EROSION PROTECTION
MADISON TOWNSHIP, NEW JERSEY

PHOTO 11 - LOOKING WEST (STATION 127+00) ALONG BEACH
TOWARD COMMERCIAL BUILDING AT WHALE CREEK

PHOTO 12 - LOOKING EAST ALONG BEACH (STATION 128+00)
SHOWING ROCK PROTECTION AT COMMERCIAL SWIMMING POOL

EXISTING CONDITIONS AT CLIFFWOOD BEACH
BEACH EROSION PROTECTION
MATAWAN TOWNSHIP, NEW JERSEY

PLATE 6

43. KNOLLCROFT (SEIDLER'S BEACH TO WHALE CREEK). The bluff protection extends from station 82 + 00 to station 110 + 50 (Figures 6 and 7). The protection provides hydraulic sand fill placed to elevation 10.0 feet above mean sea level with a slope of 1 on 20 on the bayside and with a minimum berm width of 25 feet which butts against the existing high bluff. This section from Madison Township sewage disposal plant to Whale Creek completes all the work in Madison Township.

44. MATAWAN TOWNSHIP. The protection in Cliffwood Beach is partly beach protection and partly bluff protection. The beach protection (Figure 7) extends from Whale Creek at station 104 + 00 to Cliffwood Beach swimming pool at station 126 + 00 (Photo 11 on Plate 6). The protection provides hydraulic sand fill with a 1 on 20 slope on the bayside and with a minimum berm width of 100 feet butting against high ground at elevation 5.5 feet above mean sea level.

45. The bluff protection (Figure 8) extends from the swimming pool at station 126 + 00 (Photo 12 on Plate 6) to past Matawan Point at station 158 + 50, the end of the improvement (Photos 15 and 16 on Plate 8). The protection consists of hydraulic sand fill placed to elevation 10.0 feet above mean sea level with a slope of 1 on 20 on the bayside and with a minimum berm width of 25 feet which butts against the existing high bluff. Two eroded openings in the bluff at base line stations 135 + 50 and 137 + 50 (Photos 13 and 14 on Plate 7) opposite Treasure Lake are closed with sand fill to elevation 10 feet above mean sea level with a top width of 50 feet and with landside slope of 1 on 15 towards the fresh water lake.

46. RELOCATION. The relocations are all located in the Morgan Beach area in Madison Township and comprise a state service road to New Jersey State Highway No. 35, a local street, Cliffwood Way, in Madison Township serving Morgan Beach, and an overhead telephone and power line. The service road is relocated 15 to 20 feet to the north of its existing location for a distance of 700 feet so as to permit it to be raised to elevation 15 feet above mean sea level (Figures 3 and 4). The road embankment is designed to meet project requirements since it acts as a tie between levee and high ground to complete the closure for the hurricane project. The standards for reconstruction of the service road are those of the state highway department for this class road. This work also involves the ramping of Cliffwood Way to meet the new grade of the service road and the relocation of a telephone and power line to meet the relocation of the service road. This work with the concurrence of the State will be performed under the Federal contract.

47. BORROW AREAS. Subsurface explorations performed along an offshore alignment from Morgan Beach to Cliffwood Beach indicate that suitable materials for placement on the beaches can be obtained offshore

in the eastern sector extending from opposite Knollcroft to past Matawan Point (Figure 10). An adequate quantity of suitable material can be obtained along the alignment which ranges from one to two thousand feet offshore (Figure 10). An alternate borrow area is in easterly portion of the bay inlet to Matawan Creek, opposite Keyport from Chingarora Creek to Conaskonk Point. Since the western sector from opposite Knollcroft to Morgan Beach contains unsuitable material, dredging will start opposite Knollcroft and progress in an easterly direction and the placement of material will start from Knollcroft and progress in a westerly direction towards Morgan Beach. When the sand fill is complete to Morgan Beach, the placement and dredging will progress easterly from Knollcroft to past Matawan Point. Suitable borrow material for use in constructing the levee section can be obtained from land borrow areas located in the vicinity of project. The details and location on the land borrow areas are contained in Appendix B.

48. ACCESS AREAS. Access to the project is readily developed from public roads through five access areas to be used during construction and thereafter to permit access to project works for the purpose of operation and maintenance. The access area at Morgan Beach provides access to drainage ditch and berm and is in extension of the public street, Cliffwood Way (Figure 3). The access area at Laurence Harbor Center is from a public road adjacent to the contractor's working area at the rear of two commercial buildings to be removed at station 38 + 00 (Figure 5). The access area to the burnt out cabin colony area at Laurence Harbor and Seidler's Beach is from the adjacent public street at station 56 + 50 (Figure 6). The access area at Knollcroft is on the west side of Whale Creek where the public road is adjacent to the contractor's working area at station 111 + 00 (Figure 7). The access area at Cliffwood Beach is from public road at station 117 + 50 (Figure 7). The access area at Matawan Point is a northwest extension of a public road to station 156 + 00 (Figure 8). These access areas will be obtained by the State as a part of the lands, easements, and rights-of-ways required for the project.

49. REAL ESTATE REQUIREMENTS. The real estate requirements are to be furnished entirely by local interest without cost to the United States. However, such real estate that is acquired in connection with the hurricane protection at Morgan Beach, is added to the total cost prior to the apportionment and then is credited against the non-Federal share. For the shore protection, the real estate is not included in the total cost prior to apportionment and no credit is made toward the non-Federal share. Further detail is given in paragraph 73. The principal items of real estate are about 43.8 acres of permanent rights-of-entry for construction and maintenance of the project, about 1.4 acres of

PHOTO 13 - LOOKING SOUTH (STATION 135+50) SHOWING BREAK-THROUGH BLUFF AT TREASURE LAKE

PHOTO 14 - LOOKING SOUTH (STATION 137+70) SHOWING BREAK-THROUGH BLUFF AT TREASURE LAKE

EXISTING CONDITIONS AT CLIFFWOOD BEACH
BEACH AND SHORE BLUFF PROTECTION
MATAWAN TOWNSHIP, NEW JERSEY

PHOTO 15 - LOOKING EAST FROM TOP OF BLUFF (STATION 144+00) SHOWING ERODED BLUFF AND ROAD

PHOTO 16 - LOOKING WEST FROM END OF PROJECT (STATION 152+00) SHOWING BEACH AND BLUFF

EXISTING CONDITIONS AT MATAWAN POINT
BEACH AND SHORE BLUFF PROTECTION
MATAWAN TOWNSHIP, NEW JERSEY

PLATE 8

temporary rights-of-entry during construction, acquisition of two buildings for removal, and raising of three buildings. The breakdown of permanent and temporary rights-of-entry are contained in Table D2 of Appendix D. The real estate needs are delineated on the local cooperation drawings with Attachment A14 of Appendix A. The estimated cost of the real estate involved is $127,125 of which $117,615 is in Madison Township and $9,510 is in Matawan Township. The detail breakdown of the real estate cost are contained in Appendix D.

50. SOURCES OF CONSTRUCTION MATERIAL. The principal construction material involved is sand fill and land fill. The source of these materials is covered in paragraph 47 and in greater detail in Appendix B. The small amount of other materials required such as concrete, top soil, bituminous material, crushed stone and gravel is commercially available in the vicinity of the project.

51. DEVIATIONS FROM DOCUMENT PROJECT PLAN. Because of changed conditions since the preparation of the document project plan in 1960 as contained in authorizing document, several deviations from the document project plan as noted in the following paragraphs, are necessary.

52. At Morgan Beach, the hurricane protection shows the raising of the service road on the north side of New Jersey Highway No. 35 (Figures 3 and 4), in lieu of raising New Jersey Highway No. 35 as proposed in document project plan. This change not only eliminates the raising of a major 4 lane highway but also eliminates the blanketing of the south side of this highway to high ground. The embankment of the raised service road acts as a closure, extending about 400 feet eastward of the levee to high ground at elevation 15.0 feet above mean sea level (Photo 2 on Plate 1). Cliffwood Way, a local street, is also raised for a distance of 225 feet to connect with the raised service road (Photo 1 on Plate 1). In addition three framed buildings, a one story dwelling, a one story commercial building and a one story garage are raised to adjust for the raised service road (Photo 3 on Plate 2). Earth fill is also placed around the raised buildings to make them accessible from the service road. The hurricane sand fill dike is wrapped around the end of the levee to create an adequate junction to resist erosion from wave action.

53. At the site of the Laurence Harbor cabin colony, the hurricane protection and closure dike as contained in the document project plan (Figure 14) has been changed to bluff protection (Figure 6) because a recent fire has completely destroyed all cabins in the area (Photo 8 on Plate 4). This change also eliminates the need for relocation of Margaret Creek.

54. Another general deviation from the document project plan is that the shore line has receded and been eroded by storm action since the preparation of the surveys for the document plan in 1957, more

specifically the storm of March 1962.

55. The document project plan did not give adequate consideration to the needs of alignment which require variation in minimum berm widths because the document project plan was based on only four cross-sections of existing conditions and typical improvement cross-sections.

56. At Laurence Harbor Center, the real estate for the document project plan fails to account for two commercial buildings on the beach that are on the alignment of the improvement and require removal and for the raising of one residential, one commercial and 1 garage at the service road at Morgan Beach. The change in plan at Laurence Harbor cabin colony requires the change in lands, easements, and rights-of-way from that required for the document project plan (Figure 14) to that for the project plan contained herein (Figure 6). At Morgan Beach, the lands required were increased from the document project plan to provide a levee berm and drainage ditch.

VI - LOCAL COOPERATION

57. PROVISIONS. The requirements of local cooperation for the authorized project are contained in paragraph 5 through 8 of this design memorandum.

58. STATUS. The coordination with local interests, the State of New Jersey, through the Department of Conservation and Economic Development was initiated in November 1962 by letter and conference when the State was requested to furnish local assurance. The assurance was executed by the State on 3 April 1963, was accepted for the government by the District Engineer on 11 April 1963, and a copy was furnished to the North Atlantic Division on 12 April 1963. A copy of the assurance with an acceptance indorsement was furnished to the State on 8 May 1963 to preclude the need by the State of a separate agreement between the Federal government and the State so as to permit the State under its laws to provide the cash contribution required as an item of local cooperation. On 8 May 1963 a bill form was executed by the government and returned to the State to cover the initial cash contribution required under this project. On 9 May 1963, the plan of improvement and the items of local cooperation were reviewed in the field with the Chief Bureau of Navigation of the New Jersey State Department of Conservation and Economic Development. On 28 May 1963, the State of New Jersey was furnished preliminary plans of improvement and maps showing the items of local cooperation. Pertinent correspondence and executed copy of the assurance are contained in Attachments A3 through A14 of Appendix A. The State of New Jersey has initiated all actions leading to actual performance of the necessary items of local cooperation and it is considered that the conditions of local cooperation will be timely met.

VII - COORDINATION WITH OTHER AGENCIES

59. DOCUMENT PHASE. During the preparation of the authorizing document as reported in Section XIII and Appendix M of the authorizing document, coordination was effected with the United States Bureau of Public Roads, United States Public Health Service, United States Fish and Wildlife Service, New Jersey State Department of Conservation and Economic Development, New Jersey State Department of Health, New Jersey State Highway Department, Interstate Sanitation Commission and the Central Railroad of New Jersey. None of these agencies indicated any objections to the authorized project. The United States Fish and Wildlife Service in a letter dated 10 October 1960 (contained in Appendix M of authorizing document) had specific recommendations to minimize impact on fin and shell fish, namely: that hydraulic fill be taken from continuous trenches with connection to deep water when possible and with a maximum width of 150 feet and depths up to 40 feet, and that silt in borrow are be removed either to shore or spoiled in deeper water so as to minimize siltation of adjacent areas.

60. DESIGN MEMORANDUM PHASE. Based on the coordination in the document phase and details of the project as contained in this design memorandum, further coordination was considered necessary and has been effected with United States Fish and Wildlife Service, New Jersey State Highway Department and New Jersey State Department of Conservation and Economic Development.

61. UNITED STATES FISH AND WILDLIFE SERVICE. The coordination with the Fish and Wildlife Service in New Jersey resulted in the report, dated 23 May 1963 contained as Statement A15 of Appendix A. The Fish and Wildlife Service reaffirms their recommendations as contained in their 10 October 1960 report (paragraph 59) and added the recommendation that dredging sites within the area east of Conaskonk Point be confined to those waters having a depth of two feet or more at mean low water. The Service also makes the request that the Fish and Wildlife Service be furnished information on specific locations and dimensions of the borrow area when data are available and that prior to dredging operations, the New Jersey Division of Shell Fisheries meet with the Corps of Engineers to make whatever arrangements may be necessary for salvaging clams and for policing the area during construction to prevent polluted clams from being marketed or consumed. The recommendations on the borrow area are being met to the maximum practical extent. Action has been initiated and will be timely consummated on the matter of salvaging and policing. (Statement A16 of Appendix A).

62. THE NEW JERSEY STATE HIGHWAY DEPARTMENT. The road changes involve a service road to New Jersey State Highway No. 35 and a connecting local road, Cliffwood Way, (Photos 1 and 2 Plate 1). The modification of the service road (Figure 9A) as to design and as to

construction under the Federal contract or a State contract was closely coordinated on 7 June 1963 with the New Jersey State Highway Department and the Department of Conservation and Economic Development as reported in Statement A17 of Appendix A. Because the modification of a section of Route No. 35 just west of the area had already been placed under contract by the State, and because the embankment under the relocated service road was a part of the closure levee for the hurricane protection at Morgan Beach, the State requested that road modifications of the service and local road be included in the Federal contract and final plans be sent to the State Highway Department and the Madison Township for review which has been done.

63. STATE OF NEW JERSEY. The coordination with the State in the design memorandum phase was started in November 1962 with the initiation of action on the assurance of local cooperation as reported in paragraph 58. On 9 May 1963 the project development was reviewed on site with the Chief Engineer, Bureau of Navigation, New Jersey Department of Conservation and Economic Development representing the State, with special emphasis on the items of local cooperation such as lands, easements, rights-of-way, acquisitions and relocation of buildings, roads and utilities. On 7 June 1963, the matter of highway and road relocation was coordinated as reported in paragraph 62. The coordination is continuing until all necessary items of local cooperation including the cash contribution are accomplished.

VIII - COST ESTIMATE

64. BASIS OF COST ESTIMATE. The quantity estimates are based on recent surveys of contract plan scope (paragraph 13) and detail plans and sections in accordance with design memorandum plan (Figures 2 through 9A). The unit prices are based on July 1963 price levels and on performance of the work by contract by the Corps of Engineers under a continuing contract in a manner described in Appendix D. The dredging unit prices are based on obtaining the sand fill from borrow areas in the bay at a minimum of 1,500 feet offshore, on use of a 16-inch or greater conventional dredge with an estimated average monthly output of 76,000 cubic yards, and measurement of material for payment in the borrow area. The dredging quantities for borrow measurements were increased over the required amounts by 15 percent to allow for loss of material due to fineness, for unsuitable material, and for dredging procedures.

65. LATEST APPROVED ESTIMATE. The current project cost estimate (PB-3) for the entire project was approved 17 April 1963, and is contained in Table D1 of Appendix D. The total cost is the same as that contained in the project document, however the division of cost between Federal and non-Federal has been adjusted

in accordance with the Rivers and Harbors Act of 1962 (paragraph 7) and results in an increase of Federal costs by $76,000 and a corresponding decrease in non-Federal costs of $76,000.

66. DETAILED DESIGN MEMORANDUM ESTIMATE OF COST FOR MADISON AND MATAWAN TOWNSHIP. The estimate of first costs of all work involved in the portion of the project, developed in this design memorandum, total $1,356,010. The detail breakdown of the cost estimates showing quantities and unit prices is given in Appendix D. A summary estimate is contained in Table 7, broken down by work features and by improvement section between Federal and non-Federal including allowances for contingencies, engineering design, supervision and administration but excluding cost of preauthorization studies. The cost to local interests for providing necessary bathhouses and parking fields has not been included because these facilities would be provided on a self liquidating basis.

67. COMPARISON OF DESIGN MEMORANDUM AND APPROVED ESTIMATE OF COST. Changes in the estimated first cost (Table D2 of Appendix D from those shown in the latest approved project estimate, as shown in Table D1 of Appendix D, and as discussed in paragraph 65, are noted in Table 8. These increases in cost are attributable to several factors as noted in Table 9. Shore erosion accounts for $81,455 or 11 percent of the total increase in estimate, refined quantities based on contract surveys accounts for $166,240 or 22 percent of the total increase in estimate, unit price increase principally of hydraulic dredging as influenced by the location of the borrow since the preparation of the authorizing document accounts for $332,590 or 45 percent of the total increase in estimate, provisions of lands, easements, and rights-of-way including properties account for $124,125 or 17 percent of the total increase in estimate, and modification of the west closure to incorporate vulnerable shore and properties accounts for $34,600 or 5 percent of the total increase in estimate.

68. SCHEDULE FOR DESIGN AND CONSTRUCTION. The sequence of operation and time required to complete the design and construction phases of this project are covered in detail in paragraph D10 of Appendix D. The funding corresponding to this time schedule by fiscal year is as follows:

Fiscal year	Funding (dollars) Federal Construction	Non-Federal Construction	Non-Federal Lands, easements, rights-of-way
1963	350,000	300,000	127,125
1964	150,000	128,000	
1965	161,495	139,390	
Subtotal	661,495	567,390	127,125
Project		1,356,010	

69. OPERATION AND MAINTENANCE. The local interests are required to operate and maintain the project as completed in accordance with regulations prescribed by the Secretary of the Army. The elements of maintenance are the replenishment of sand fill, the restoration of levee and road embankment at Morgan Beach to project levee periodically as required to offset settlement of these structures as discussed in Appendix B, removal of debris from drainage structures and beaches, and maintenance of flap gates, sluice gates, head walls, inlets and outlets for drainage structures. It is considered that the existing township and state maintenance forces can provide the necessary surveillance inspection, and operation required, by the project. The replenishment of sand fill or work on levee and road as required, if beyond the capability of the local forces, would best be done by local contract.

70. The proper operation of the project between and during period of high water will require that the project be patrolled to assure that the drainage outlet structures, one at Morgan Beach (Figures 3 and 4) and two at Matawan Point (Figure 8) are properly operating, flap gates and sluice gates in proper operation, that removal of debris is timely so as not to affect adversely the stability or recreational use of area, and that points of erosion are repaired timely so as to minimize the loss of beach. The annual cost of this maintenance, developed in Table D9 of Appendix D, has been estimated as $29,085 of which $18,830 is for Madison Township and $10,755 is for Matawan Township, all of which is to be borne by local interests.

IX - ECONOMIC ANALYSIS

71. ANNUAL BENEFITS. The improvement will result in benefits from land saved from erosion, from additional use of the beach for recreation, from decrease in maintenance cost of existing beach structures, from prevention of erosion damage, and from prevention of physical and non-physical primary damages from tidal flooding. Land enhancement benefits were not evaluated because there will be little new or higher use of land as a result of the improvement and because enhanced land value due to prevention of tidal flood damage and to improvement of beach use have been evaluated in the

TABLE 8 - SUMMARY OF INCREASE OF DESIGN MEMORANDUM
COST ESTIMATE OVER LATEST APPROVED PROJECT ESTIMATE

Section	Cost Estimates		
	Latest Approved (a) (dollar)	Design Memorandum (dollar)	Difference (dollar)
MADISON TOWNSHIP			
Morgan Beach	266,000	476,610	+ 210,610
Laurence Harbor	144,000(b)	340,830	+ 196,830
Seidler's Beach	40,000	100,870	+ 60,870
Knollcroft	38,000	111,500	+ 73,500
Subtotal	488,000	1,029,810	541,810
MATAWAN TOWNSHIP			
Cliffwood Beach - west	76,000	98,235	+ 22,235
Cliffwood Beach - east	53,000	227,965	+ 174,965
Subtotal	129,000	326,200	+ 197,200
MADISON AND MATAWAN TOWNSHIP			
Total	617,000	1,356,010	+ 739,010

(a) April 1963, Table D1 of Appendix D.
(b) Eliminated hurricane protection = $275,000

TABLE 9 - ANALYSIS OF INCREASE OF DESIGN MEMORANDUM COST ESTIMATE OVER LATEST APPROVED PROJECT ESTIMATE

Attributable Causes	Computation of Increases			Cost Increase		
	Quantity	Unit	Unit Cost (dollar)	Shore (dollar)	Hurricane (dollar)	Total
			MADISON TOWNSHIP - SHORE PROTECTION			
Shore erosion since 1960	38,000	c.y.	1.24	48,295		
Refined quantities	68,000	c.y.	1.24	84,300		
Increase prices	323,000	c.y.	.50	161,500		
Lands, easements and rights-of-way		Job	LS	87,665		
Subtotal				381,760		
			MADISON TOWNSHIP - HURRICANE PROTECTION			
Shore erosion since 1960	4,000	c.y.	1.24		4,960	
Refined quantities	22,000	c.y.	1.24		27,240	
Increase Prices						
hydraulic fill	165,400	c.y.	.50		82,700	
land fill	18,200	c.y.	1.00		18,200	
Lands, easements and rights-of-way					26,950	
Subtotal					160,050	
			MADISON TOWNSHIP - SHORE AND HURRICANE PROTECTION			
Total				381,760	160,050	541,810
			MATAWAN TOWNSHIP - SHORE PROTECTION			
Extension for new closure	30,700	c.y.	1.13	34,600		
Shore erosion since 1960	25,000	c.y.	1.13	28,200		
Refined quantities	48,000	c.y.	1.13	54,700		
Increase prices	152,800	c.y.	.46	70,190		
Lands, easements and rights-of-way		Job	LS	9,510		
Subtotal				197,200		197,200
			MADISON AND MATAWAN TOWNSHIPS			
Total						739,010

items previously listed. These benefits were carefully evaluated in Appendix K of the authorizing document. The principal change in benefits since the preparation of the authorizing document in 1960 are due to destruction of the Laurence Harbor.Cabin Colony to reevaluation of recreational benefits and to effect of price level changes. The updating of the benefits are contained in Appendix E. The evaluated annual benefits for the improvement in Madison and Matawan Townships, based on July 1963 price levels and conditions, totals $168,800 of which $143,800 is for shore protection and $25,000 is for hurricane protection. A summary of the benefits broken down by shore sections between shore protection and hurricane protection is given in Table E7 of Appendix E.

72. ANNUAL CHARGES. The annual charges are based on an interest rate of three percent for both Federal and non-Federal investments. Consultations with the cooperating agency disclosed that the above interest rate is reasonable for the non-Federal investment in the type of improvement involved. This rate has also been applied to lands, easements, and rights-of-way to be obtained for the proposed improvement. A useful life for amortizing the improvement is assumed as 50 years. No interest is included on investment during construction because the construction period is less than one year. The maintenance of the improvement is entirely non-Federal. The summary of the estimated annual charges broken down by shore and hurricane protection purposes between Federal and non-Federal interests, is given in Table D17 of Appendix D. The total annual charges are $82,300 of which $61,560 is for shore protection and $20,740 is for combined shore and hurricane protection.

73. JUSTIFICATION. The estimated annual charges and benefits and the benefit-cost ratio for the considered plan of improvement broken down for shore protection and hurricane protection by shore sections is given in Table D18 of Appendix D. The improvement for shore protection and for combined shore and hurricane protection is economically justified. However, the separable cost of the hurricane improvement is not justifiable if all the recreational benefits are applied to the shore protection. The benefit-cost ratio for the Madison and Matawan Townships improvement is 2.1 which is somewhat less than the authorizing document ratio of 2.8.

X. ALLOCATION AND APPORTIONMENT OF COSTS

74. ALLOCATION OF COSTS TO PURPOSES. The improvement for Matawan Township is single purpose, shore protection, so all costs are allotted to it. The improvement for Madison Township is multiple purpose, shore and hurricane protection, so that all costs are allocated in accordance with the separable cost-remaining benefits method as described in Appendix D.

75. APPORTIONMENT OF COSTS BETWEEN INTERESTS. The first cost and annual charges apportioned between Federal and non-Federal interests, shown in Table 7 and Table D17 of Appendix D are in accordance with current Federal laws and policy governing beach erosion control and hurricane protection improvements. The basis for apportionment of costs for the two project purposes is summarized in the following paragraphs and detailed in Appendix D.

76. SHORE PROTECTION. The apportionment of cost depends on five general categories of shore, based on ownership and use, and incidence and type of benefits; which must be considered in determining Federal aid towards the cost of shore restoration and protection (ER 1120-2-110, 5 April 1963). These categories and the levels of Federal aid applicable thereto, are listed in Table 10. For the improvement in Madison and Matawan Townships, there is no Federal owned interest (Category I) because no frontage is owned by the United States. There are no publicly owned, non-Federal parks and conservation areas (Category II). The non-Federal public interest (Categories III and IV) is the benefits accruing (a) to the public body as landowner, (b) to the general public through the use of the protected public and non-public shore, and (c) from protection of nearby public property arising from protection of non public shores. Other benefits are considered to be private (Category V). Data on non-Federal public shore and on private shore publicly used which would benefit from beach erosion control improvement, are given in Figure F-1^{1}R with Attachment A2 of Appendix A. The apportionment of costs is based on current conditions of public use and ownership and current estimate of improvement. However, the final apportionment is to be based on conditions of public use and ownership at time of construction and actual cost of construction.

77. Under Section 103 of the River and Harbor Act (PL 87-874) approved 23 October 1962, the Federal contribution towards the cost of constructing protective works along publicly-owned shore is authorized up to 50 percent (paragraphs 7 and 76). Shores other than public are eligible for Federal assistance if there is a benefit such as that arising from public use or from the protection of nearby public property or if the benefits to those shores are incidental to the project. The extent of the Federal contribution depends on ownership and use as shown in Table D12 of Appendix D. Data upon benefits are shown in Table E7 of Appendix E. Data on the apportionment of cost, not to exceed 50 percent of the cost of the project exclusive of lands, easements and rights-of-way are shown on Table D13 of Appendix D. No Federal contribution is authorized towards the cost of the shore protection maintenance work. (paragraphs 77 and 107 of the District Engineer's report in the authorizing document).

TABLE 10 - SHORE CATEGORIES ELIGIBLE FOR FEDERAL AID [a]

	Shore Category	Maximum level of Federal aid	
		Construction	Maintenance
I	Federally owned	100%	100%
II	Publicly owned, non-Federal parks and conservation areas (1)	70% *	None (2)
III	Publicly owned, non-Federal other than parks and conservation areas	50% *	None (2)
IV	Privately owned, protection will result in public benefits (3) (4)	50%* multiplied by the ratio of public benefits along Cat. IV shore to total benefits along Cat. IV shore	None (2)
V	Privately owned, protection will not result in public benefits susceptible of evaluation (4)	None	None

(1) See paragraph 7.

(2) See paragraphs 77 and 107 of authorizing document concerning periodic beach nourishment.

(3) Privately owned shores under public control, as through a sufficient long-term lease assuring realization of public benefits throughout the economic life of the project may be treated as Category III shores in determining Federal aid.

(4) See paragraph 9, below, concerning incidental protection of privately owned shores.

* Cost-sharing percentages do not apply to lands, easements and rights-of-way.

(a) taken from ER 1120-2-110 (5 Apr 63)

78. HURRICANE PROTECTION. Apportionment of the cost of hurricane protection is in accordance with the cost sharing formula adopted in the Flood Control Act of 1958 for similar projects. The first cost including the cost of lands, easements, rights-of-way, and relocations, but excluding preauthorization studies, shall be apportioned at least 30 percent to non-Federal interests and not to exceed 70 percent to the Federal government. Lands, easements, rights-of-way, relocations shall be provided by non-Federal interests without cost to the United States and will be credited toward the local share of the cost. When the fair value of these items is less than 30 percent of the first costs, the difference shall be borne by non-Federal interests as a cash contribution payable at the time of project construction. Maintenance costs are the responsibilities of non Federal interests.

79. SUMMARY. On the foregoing basis the cost of the hurricane protection at Morgan Beach in Madison Township was apportioned to Federal and non-Federal interests as developed in Tables D14 and D15 of Appendix D and summarized in Table 11. The cost of lands, easements, and rights-of-way is included in total cost prior to apportionment and then credited against the non-Federal share. The apportionment of the shore protection in Madison and Matawan Townships to Federal and non-Federal interests is developed in Tables D13 and D15 of Appendix D and summarized in Table 11.

80. The percentages of Federal participation in the cost of shore protection vary from those approved by OCE (paragraph 8) as follows:

Township	Percentages of total costs			
	Approved		Design Memorandum	
	Federal	Non-Fed.	Federal	Non-Federal
Madison	62.5	37.5	58.7	41.2
Matawan	38.0	62.0	42.0	58.0

The variation for Madison Township can be attributed to modification of protection principally at Laurence Harbor and review of shore ownership and use. The variation for Matawan can be attributable principally to extension of the west closure point beyond Matawan Point and review of shore ownership and use.

XI - RECOMMENDATIONS

81. APPROVAL. The plan of improvement is substantially accord with the authorized document adjusted for existing conditions and provides for hurricane protection along 1,400 feet of shore, bluff protection along 7,650 feet of shore, and beach protection along 2,200 feet of shore; a total of 10,250 feet of shore in Madison Township; and beach protection along 2,200 feet of shore and bluff

TABLE 11 - APPORTIONMENT OF ESTIMATED COSTS

Section	Federal Share (dollar)	(%)	Non-Federal Share: Cash Contribution (dollar)	(%)	Non-Federal Share: Lands, Easements, rights-of-way (dollar)	Total (dollar)
MADISON TOWNSHIP SHORE PROTECTION[a]						
Morgan Beach	16,720	49.4	17,130	50.6	440	34,290
Laurence Harbor	128,230	48.6	135,620	51.4	76,980	340,830
Seidler's Beach	46,820	48.1	50,510	51.9	3,540	100,870
Knollcroft	34,310	32.6	70,930	67.4	6,260	111,500
Subtotal	226,080	45.0	274,190	55.0	87,220	587,490
MADISON TOWNSHIP HURRICANE PROTECTION[b]						
Morgan Beach	309,624	70.0	102,301	30.0	30,395	442,320
MADISON TOWNSHIP SHORE AND HURRICANE [a]						
Total	535,704	58.7	376,491	41.3	117,615	1,029,810
MATAWAN TOWNSHIP SHORE PROTECTION						
Cliffwood Beach - west	44,580	46.7	50,880	53.3	2,775	98,235
Cliffwood Beach - east	88,490	40.0	132,740	60.0	6,735	227,965
Subtotal	133,070	42.0	183,620	58.0	9,510	326,200
MADISON AND MATAWAN TOWNSHIPS [a]						
Shore Protection[a]	359,150	44.0 [a]	457,810	56.0	96,730	913,690
Shore and Hurricane Protection	668,774	54.3	560,111	45.7	127,125	1,356,010

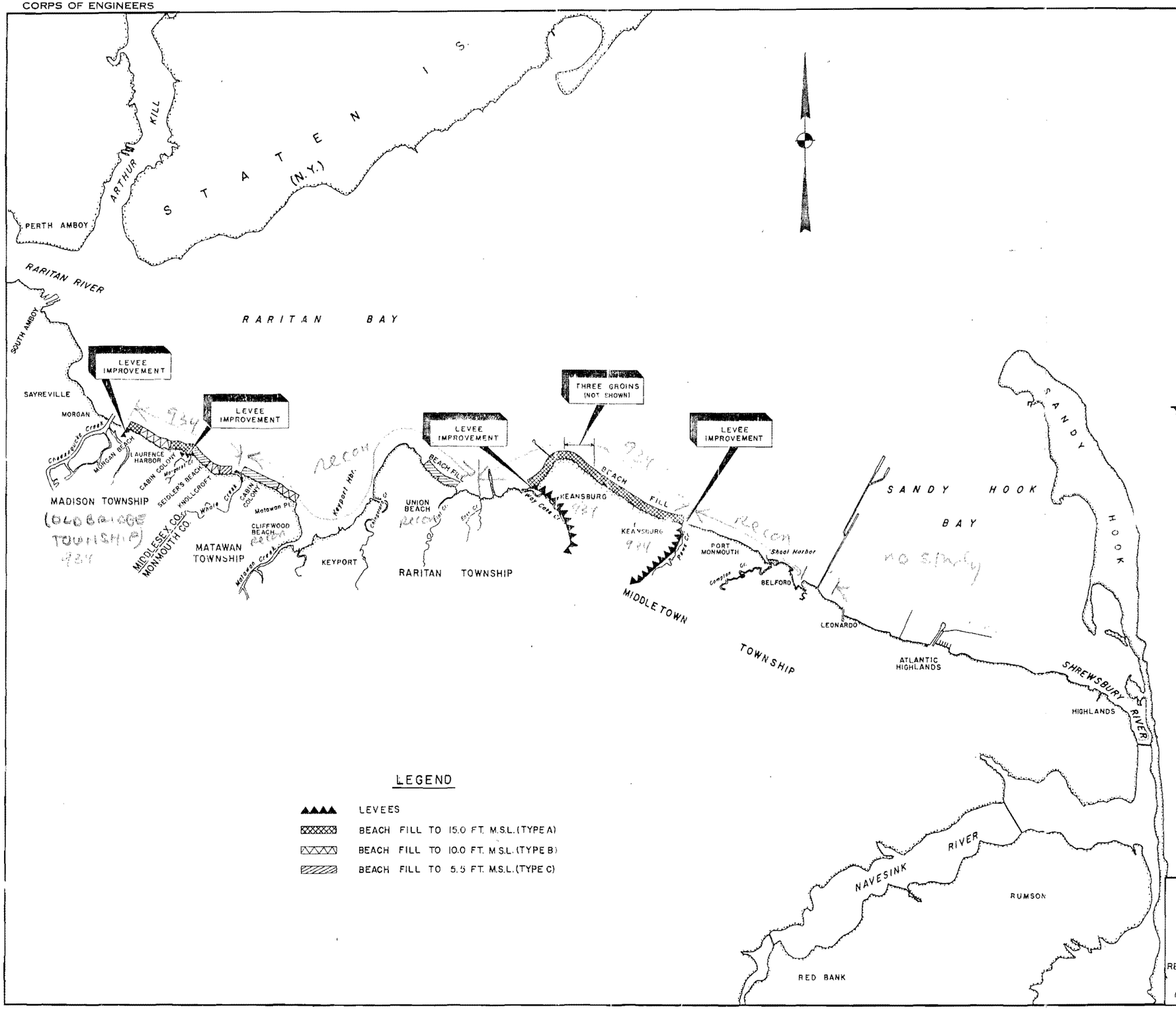
a. Percentage of construction cost exclusive of lands, easements and rights-of-way.
b. Percentage of total cost including lands, easements and rights-of-way which is creditable to local share.

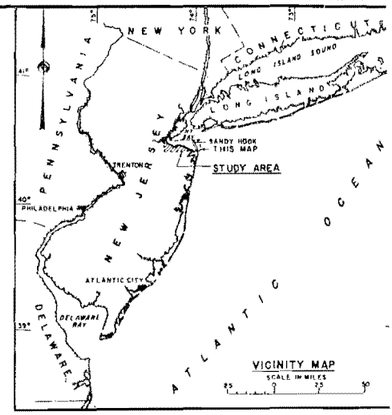
protection along 3,250 feet of shore; a total of 5,450 feet in Matawan Township. The hurricane protection provides a sand dike along the shore with levee closures to high ground, with a 25 foot top width at 15 feet above mean sea level and with bayside slope of 1 on 20 and landside slope of 1 on 15. The bluff protection provides sand fill with a 25 foot berm at 10.0 feet above mean sea level and bayside slope of 1 on 20. The beach protection provides sand fill with a 100 foot wide berm at 5.5 feet above mean sea level and a bayside slope of 1 on 20. The Cost of the plan of improvement is $1,356,010, of which $661,495 is Federal, and $694,515 is non-Federal of which $567,390 is cash contribution and $127,125 is for lands, easements and rights-of-way. The economic justification expressed as a benefit to cost ratio is 2.0.

82. It is recommended that the basis of design presented in this design memorandum be approved in order that construction plans and specifications may be readied to meet the schedule contained in this design memorandum.

CORPS OF ENGINEERS

U. S. ARMY





RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

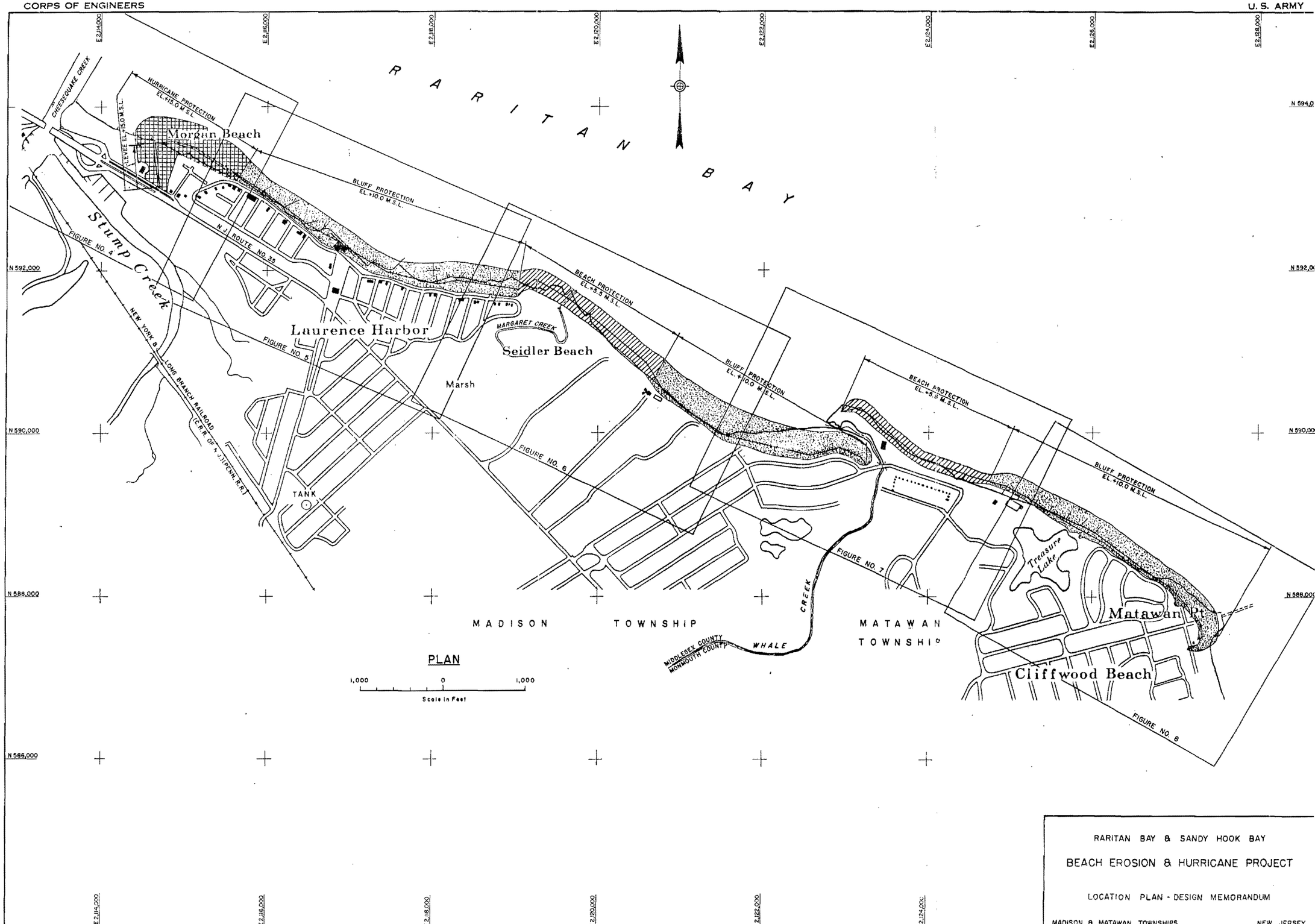
RECOMMENDED DOCUMENT IMPROVEMENT (DOCUMENT PLATE IA)

MADISON & MATAWAN TOWNSHIPS — NEW JERSEY

(PLATE IA OF AUTHORIZING DOCUMENT H.D. NO. 464) — FIGURE NO. 1

CORPS OF ENGINEERS

U. S. ARMY

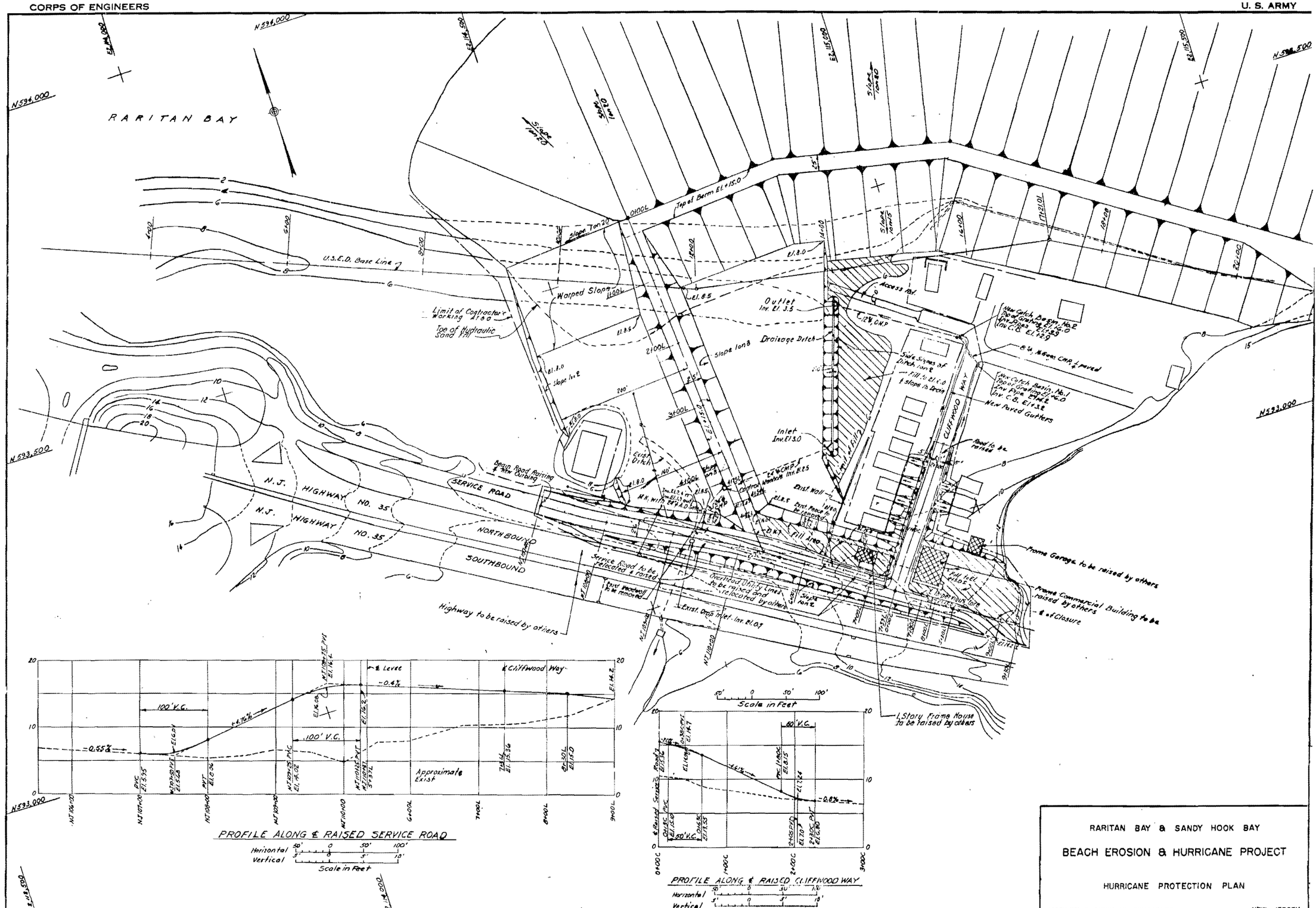


RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

LOCATION PLAN - DESIGN MEMORANDUM

MADISON & MATAWAN TOWNSHIPS NEW JERSEY



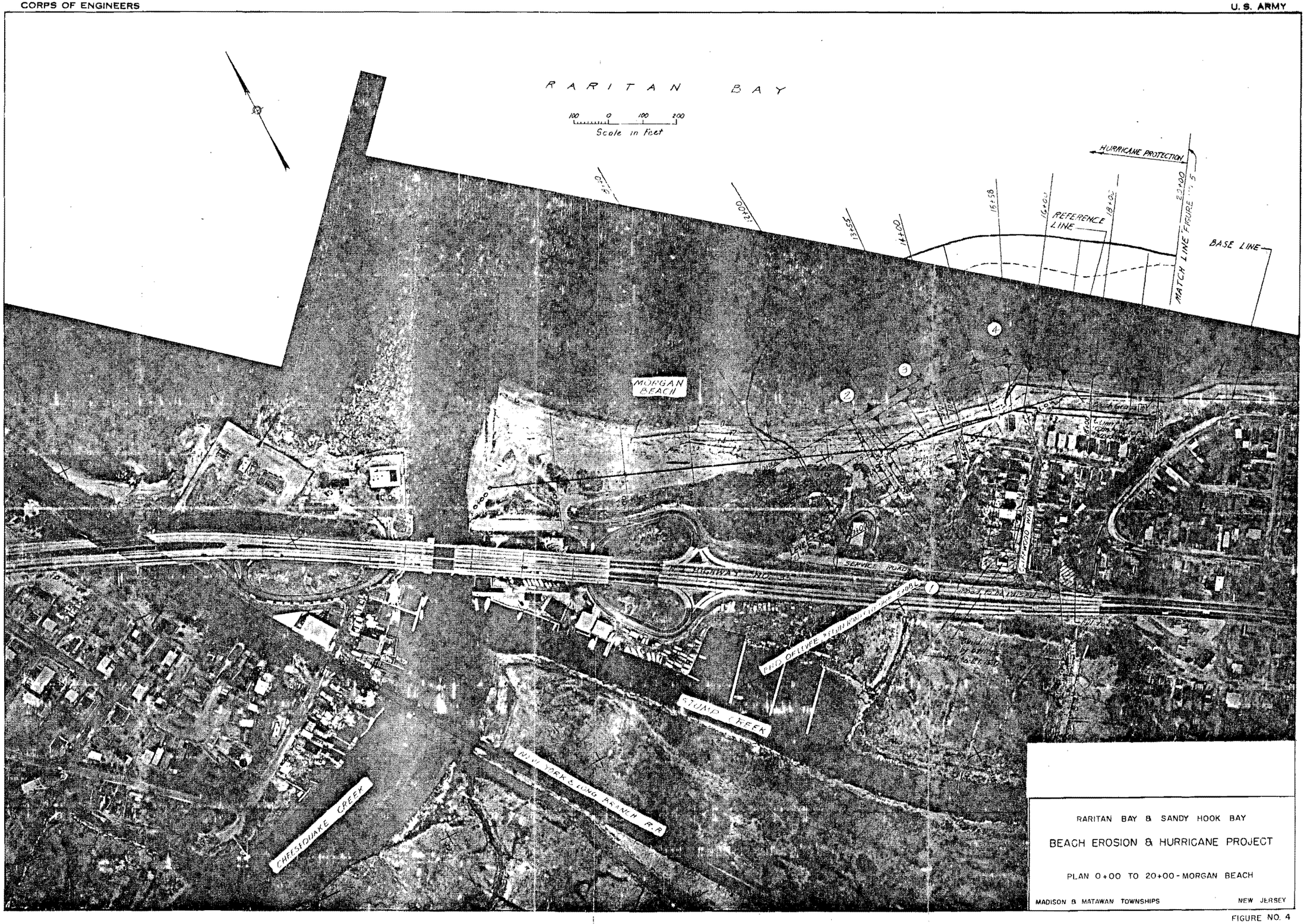
RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

HURRICANE PROTECTION PLAN

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO. 3



RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

PLAN 0+00 TO 20+00 - MORGAN BEACH

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO. 4

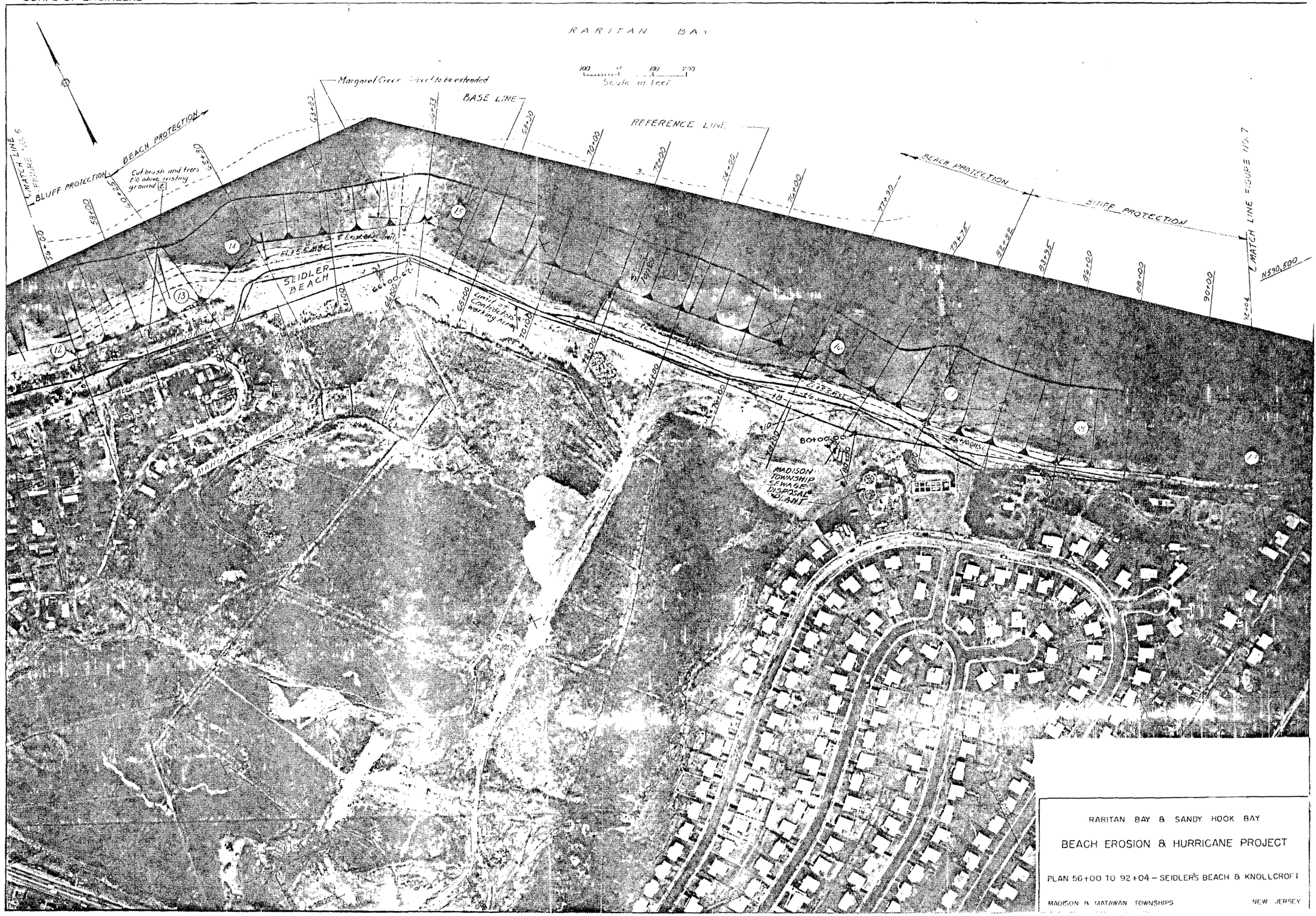
RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

PLAN 20+00 TO 56+00 - LAURENCE HARBOR

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO. 5



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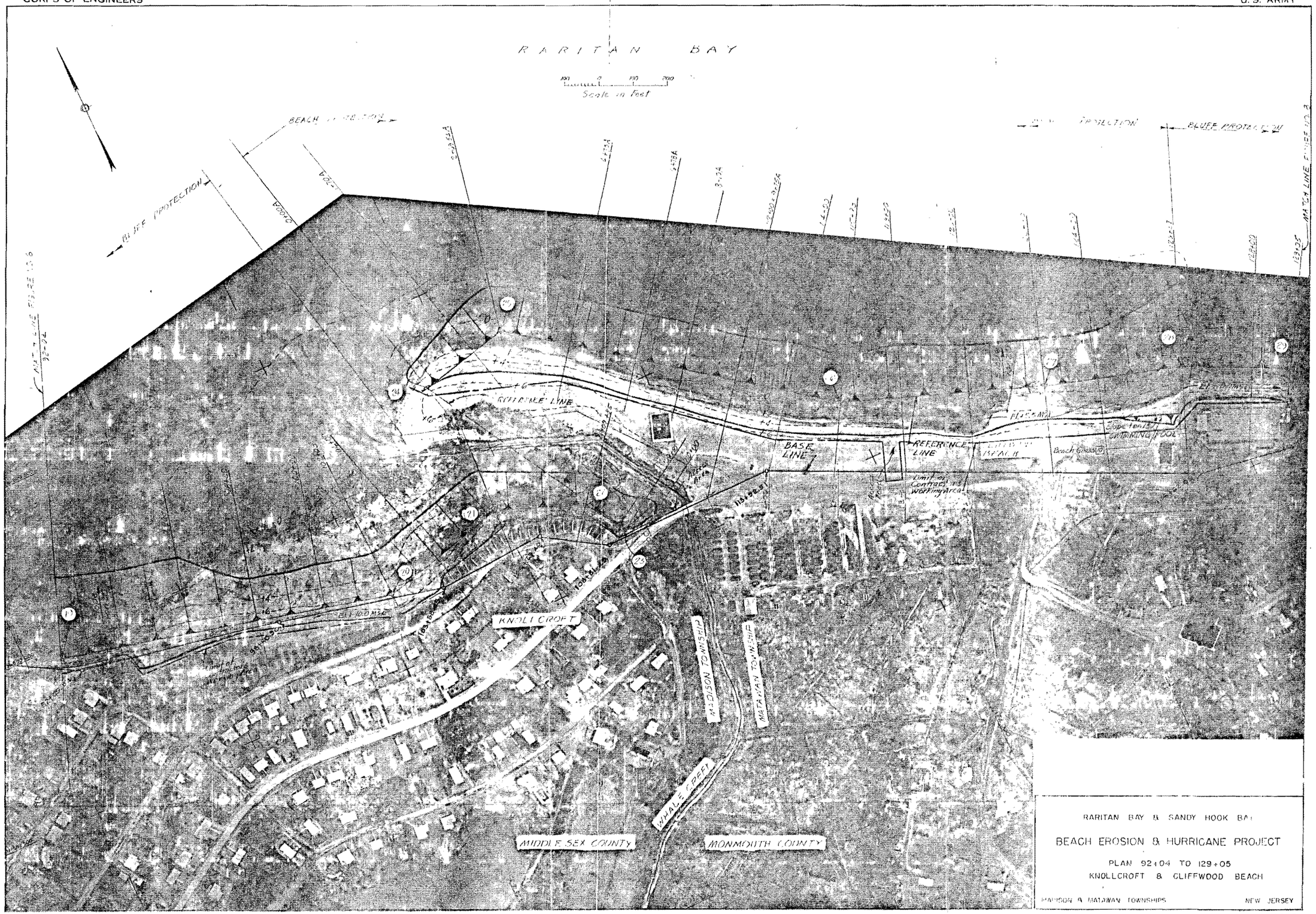
BEACH EROSION & HURRICANE PROJECT

PLAN 56+00 TO 92+04 – SEIDLER'S BEACH & KNOLLCROFT

MADISON & MATAWAN TOWNSHIPS NEW JERSEY



RARITAN BAY & SANDY HOOK BAY

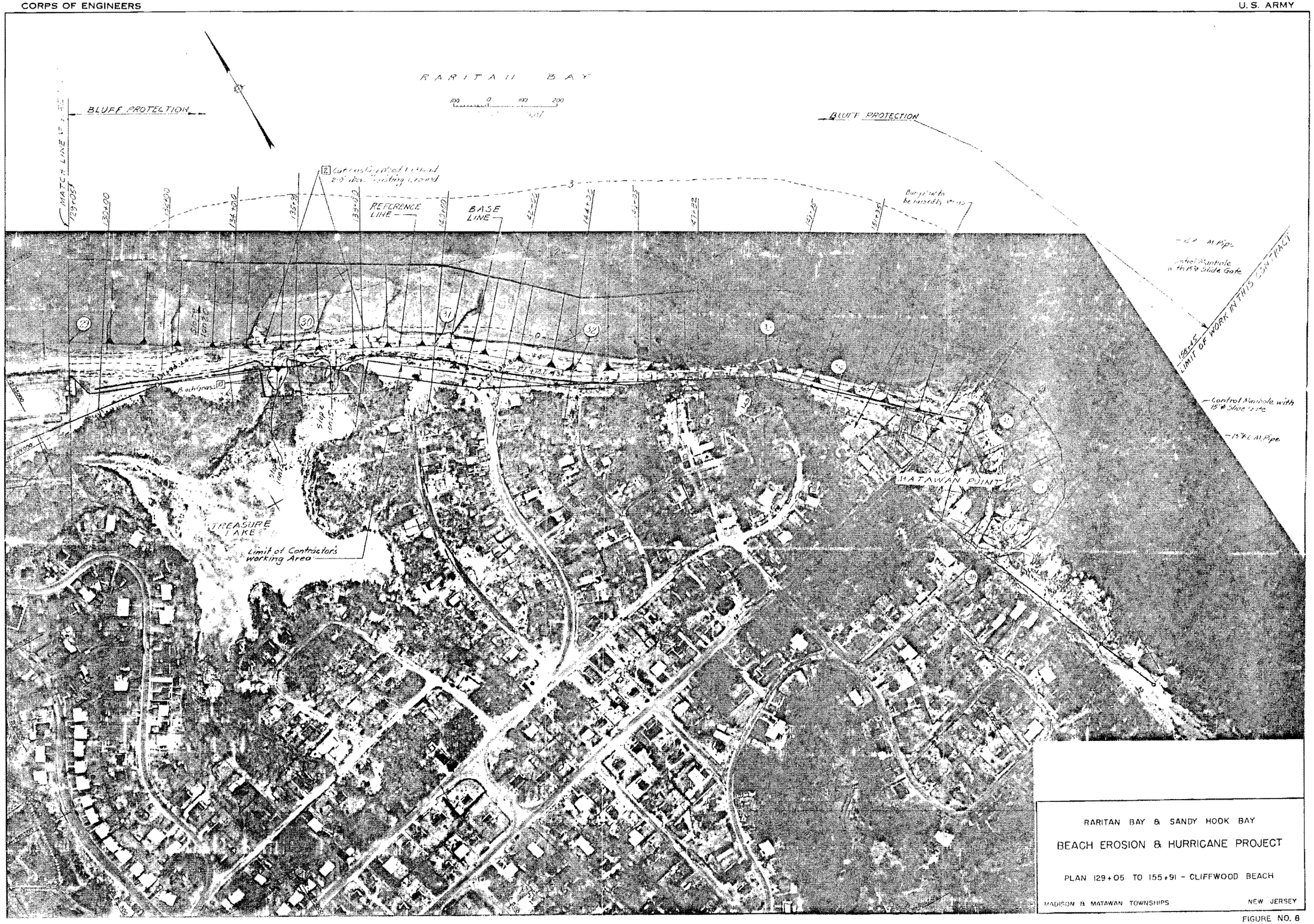
BEACH EROSION & HURRICANE PROJECT

PLAN 92+04 TO 129+05

KNOLLCROFT & CLIFFWOOD BEACH

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO 7



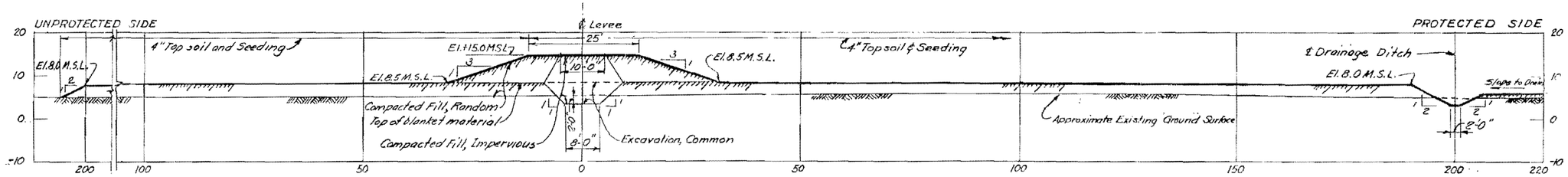
RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

PLAN 129+05 TO 155+91 - CLIFFWOOD BEACH

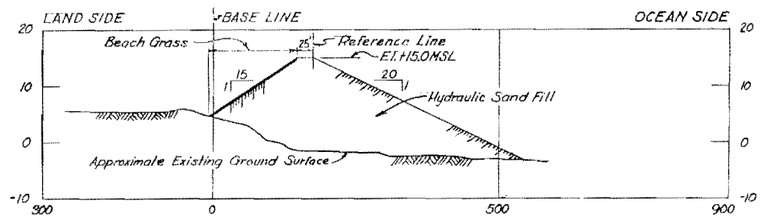
MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO. 8

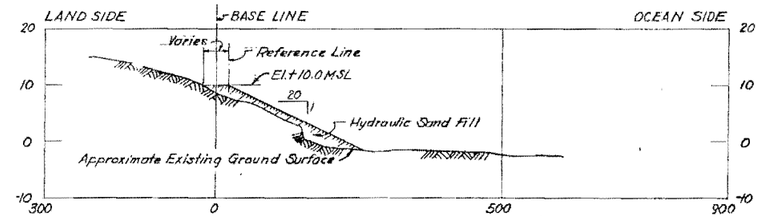


TYPICAL LEVEE SECTION — MORGAN BEACH

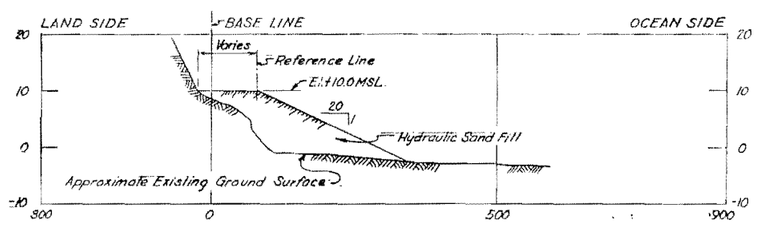
Scale in Feet.



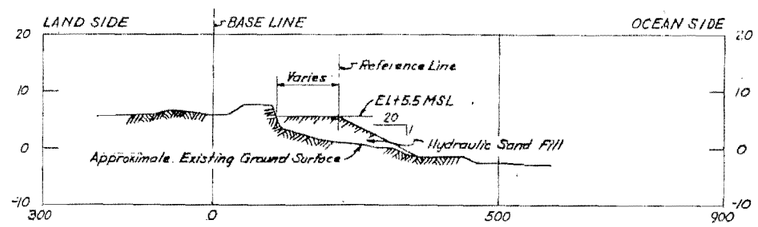
HURRICANE PROTECTION - 14+00 - MORGAN BEACH



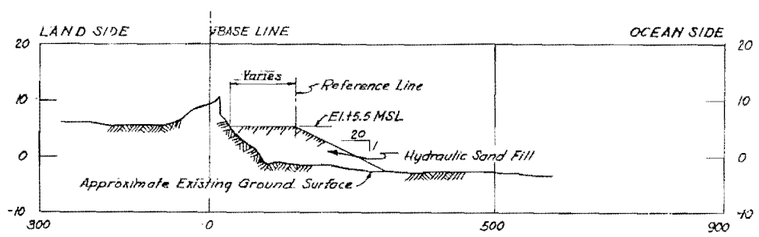
BLUFF PROTECTION - 96+00 - KNOLLCROFT



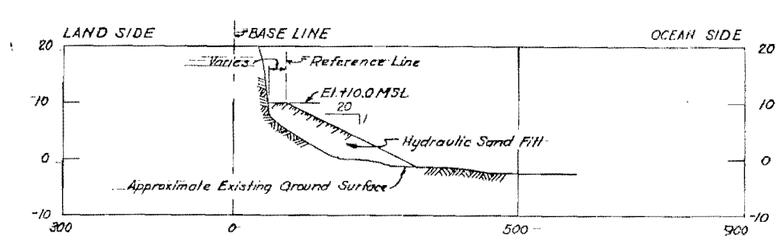
BLUFF PROTECTION - 42+00 - LAURENCE HARBOR



BEACH PROTECTION - 118+00 - CLIFFWOOD BEACH



BEACH PROTECTION - 74+00 - SEIDLER'S BEACH



BLUFF PROTECTION - 142+00 - CLIFFWOOD BEACH TO MATAWAN PT.

Scale in Feet

Vertical: 10 0 10 20

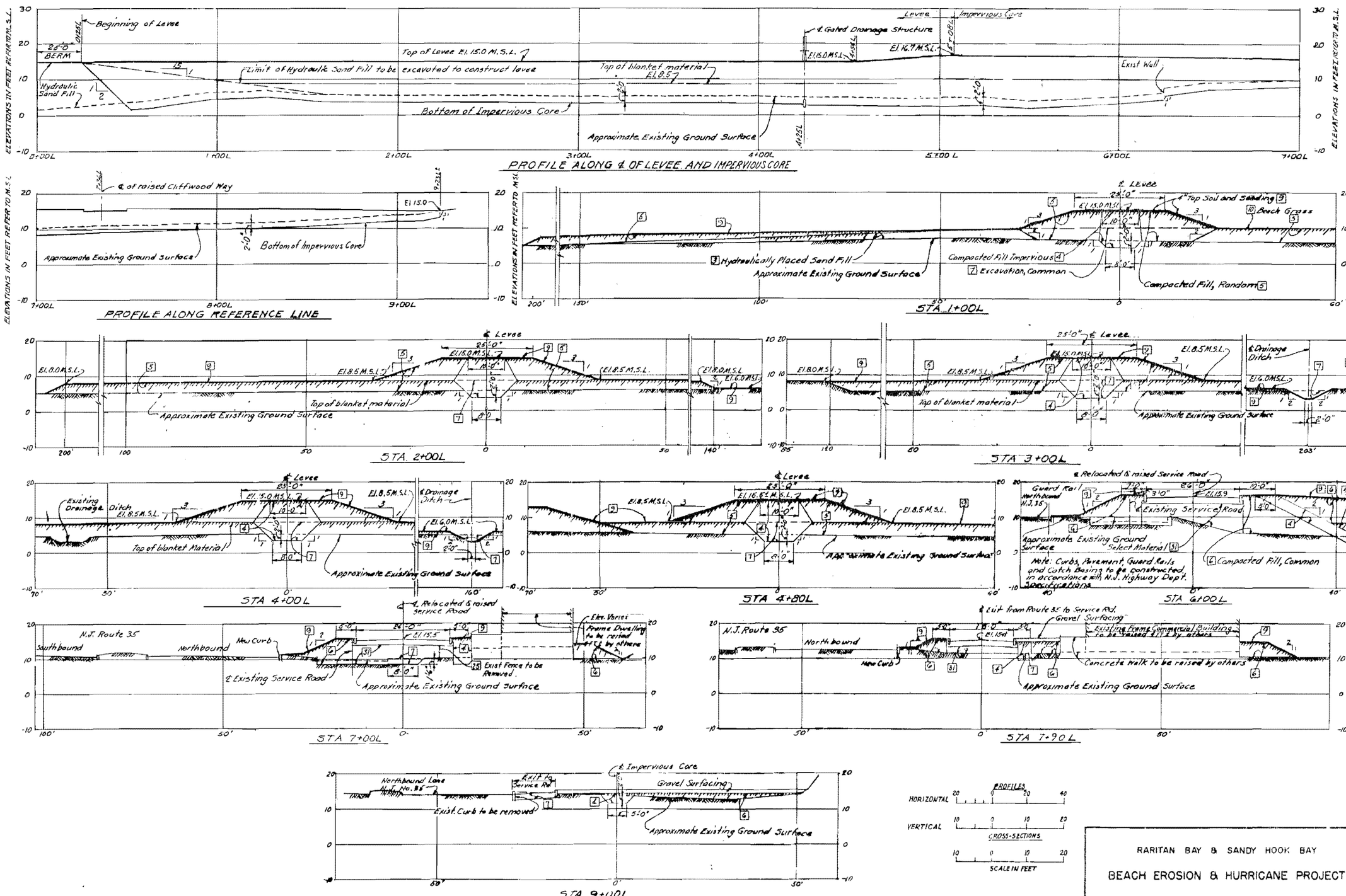
Horizontal: 100 0 100 200

RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

TYPICAL CROSS-SECTIONS

MADISON & MATAWAN TOWNSHIPS NEW JERSEY



RARITAN BAY & SANDY HOOK BAY

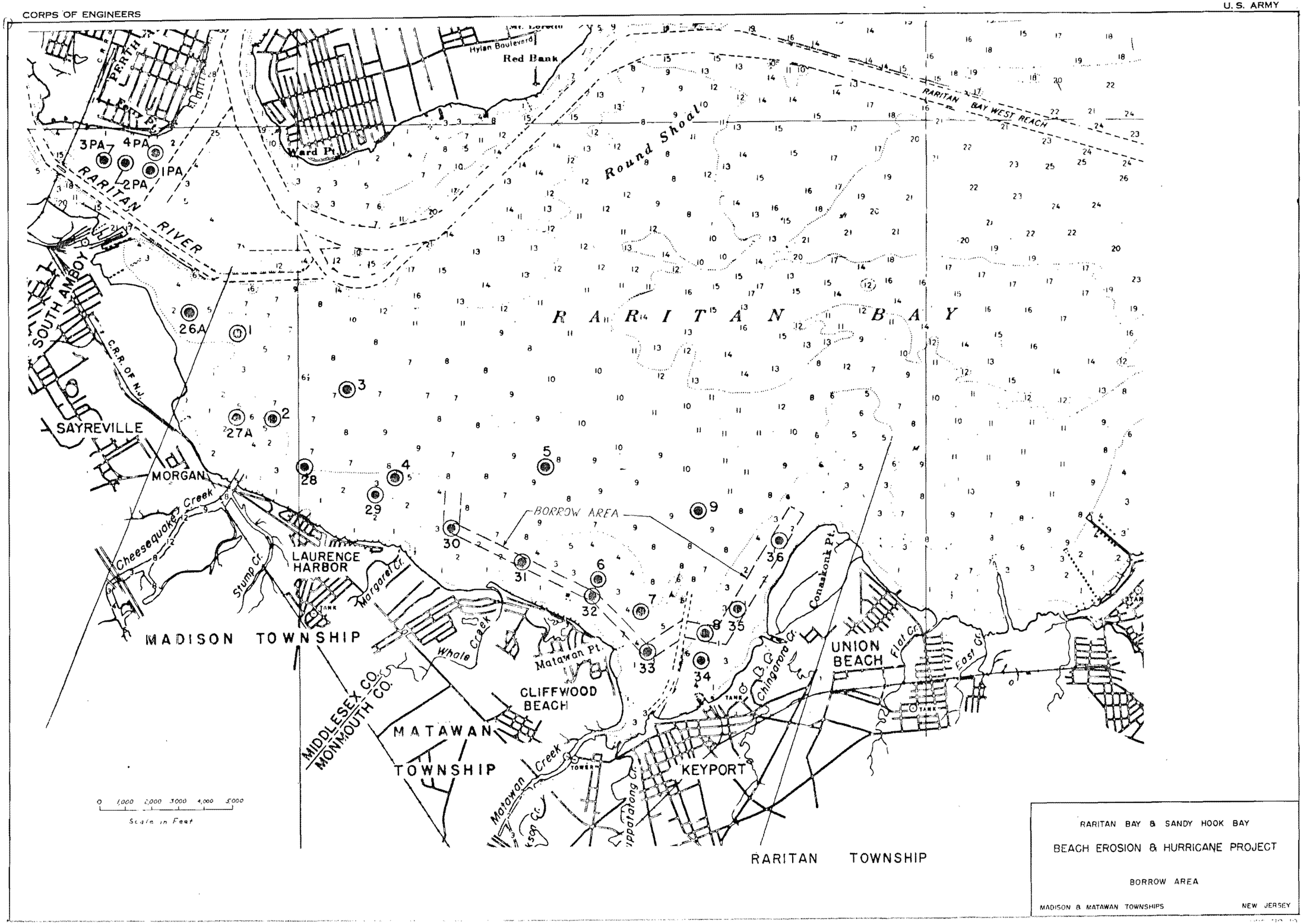
BEACH EROSION & HURRICANE PROJECT

PROFILE AND SECTIONS - LEVEE AND ROAD

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

CORPS OF ENGINEERS

U. S. ARMY

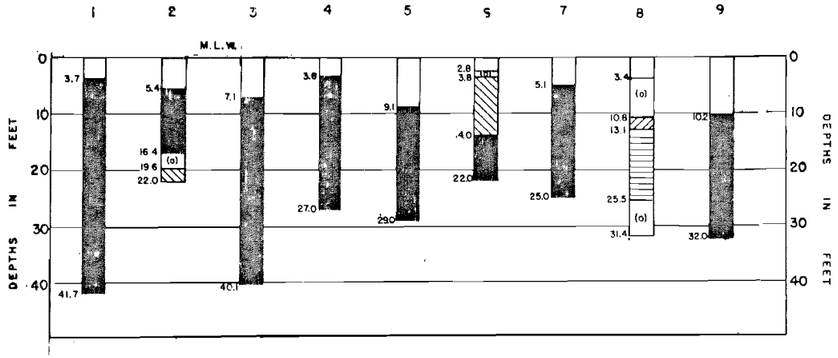


RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

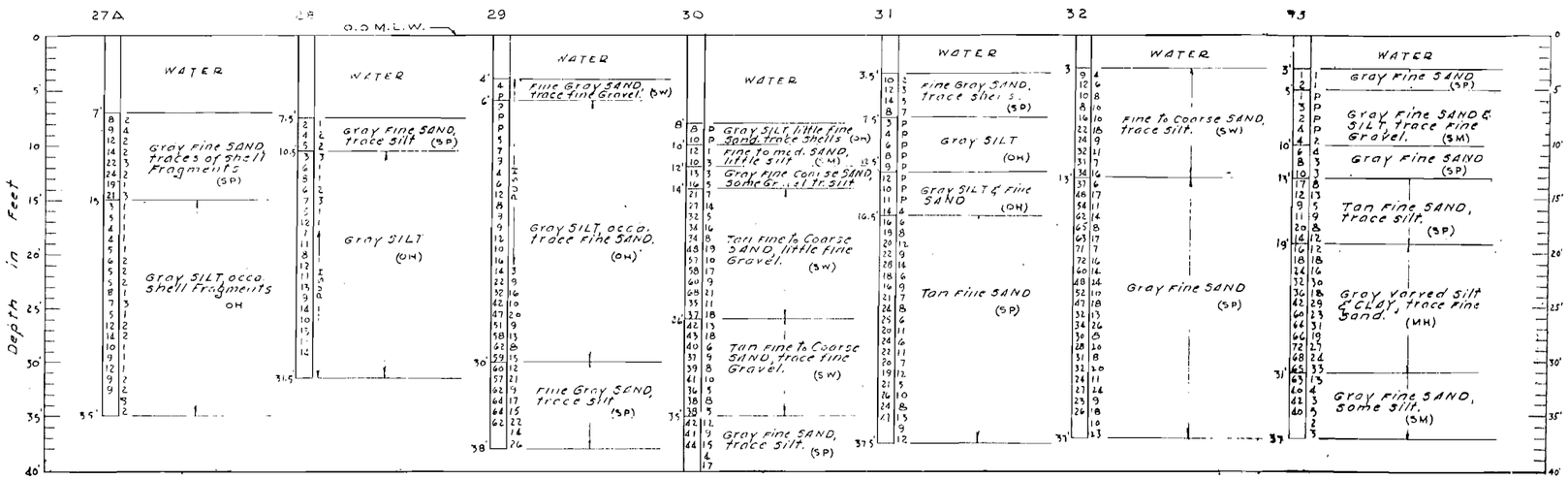
BORROW AREA

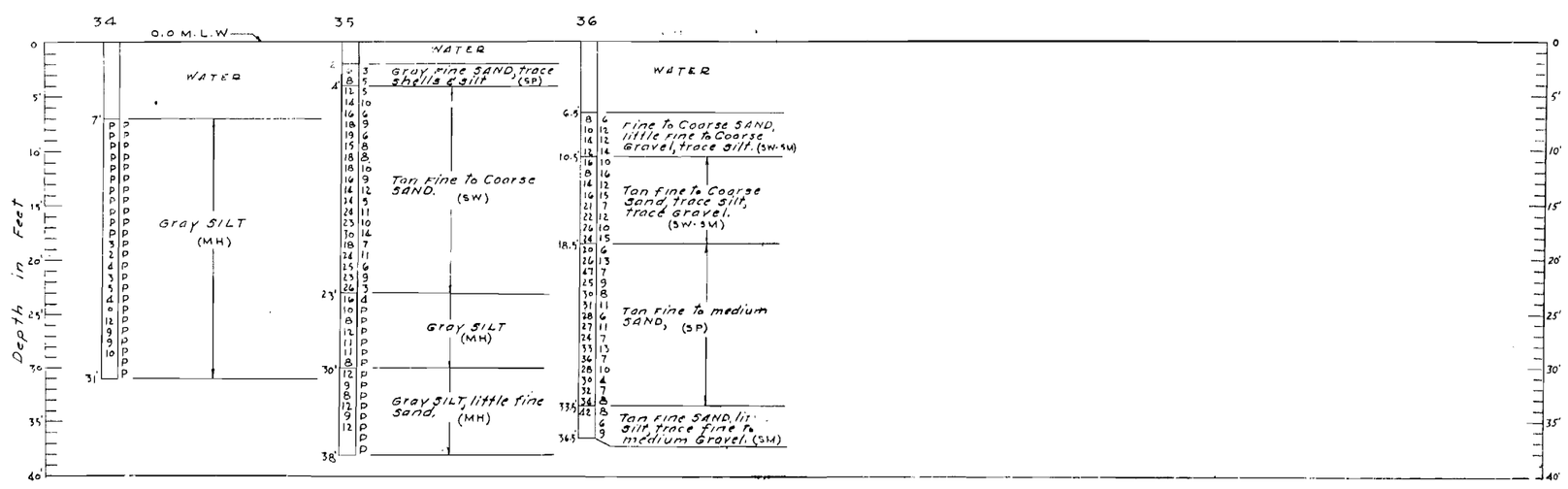
MADISON & MATAWAN TOWNSHIPS NEW JERSEY



LEGEND

SYMBOL	DESCRIPTION
	Medium to coarse sand with some gravel
	Uniform medium sand
	Fine to medium sand
	Silt, clay and other unsuitable material
	Water (a) NO SAMPLE AVAILABLE.





GENERAL NOTES

1. The soil logs, notes and other test data shown are the result of interpretations made by representatives of the Corps of Engineers from personal observations made during the exploration period of the following: a) samples of subsurface materials recovered during exploration, b) records of exploration as prepared by the drill operator and Government inspector and c) other records pertinent to surface and subsurface conditions. The samples and records are available for inspection upon request to Chief, Foundations and Materials Branch, U. S. Army Engineer District, New York.

2. Explanation of the classifications and terms

a. Bedrock - Natural solid mineral matter occurring in great thickness and extent in its natural location. It is classified according to geological type and structure (joints, bedding, etc.) and described as solid, weathered, broken, fragmented or decomposed depending on its condition. When no description is shown; the rock is solid and sound.

b. Soils - Sediments or other unconsolidated accumulations of particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.

I.) Size Component Terms		Proportion Terms by Weight
Boulder.....	larger than 9 inches	Major Component is shown with all letters capitalized
Cobble or Small stone..	8 inches to 3 inches	Minor Component percentage terms of Total sample are:
Gravel.....	3 inches to 2.0 mm	
Sand.....	2.0 mm to 0.06 mm	and..... 40 to 60 percent
Silt.....	0.06 mm to 0.002 mm	some..... 20 to 40 percent
Clay.....	Finer than 0.002 mm	little..... 10 to 20 percent
		trace..... 1 to 10 percent

Gradation Terms- The terms coarse, medium and fine are used to describe gradation of Sands and Gravel. When no gradation term is used, the component is graded from coarse to fine. Other gradings are used, such as medium to fine, fine, etc.

II.) The terms used to describe the various soil components and proportions are arrived at by visual estimates of the recovered soil samples. Other terms are used when the recovered samples are not truly representative of the natural materials, such as, soil containing numerous cobbles and boulders which cannot be sampled, thinly stratified soils, organic soils, and fills. The terms (SM-GM) etc. refer to the Unified Soil Classification System as per Manual NIL-STD-619(CE) dated 30 June 1960

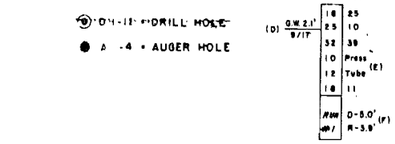
3. Ground Water The date shown directly below the ground water (G.W.) is the date on which the water level in the exploration was measured. The measurement was made during exploration work or immediately after completion, unless otherwise noted. The depth recorded is influenced by exploration methods, the soil type and weather conditions during exploration. Where no water was found it is so indicated. It is anticipated that the ground water will rise during periods of wet weather. In addition, perched ground water above the water levels indicated (or above the bottom of the hole where no ground water is indicated) may be encountered at changes in soil strata or top of rock.

LEGEND

DH-X

⊕ DH-12 = DRILL HOLE

● A -4 = AUGER HOLE



A. Surface elevation or top surface of water at time and location of exploration. DATUM M.L.W.

B. Blows per foot on 2½" diameter casing using 300 pound hammer dropped 18 inches, except where otherwise noted.

C. Blows per foot on sample spoon, 2 inches O.D. and 1½ inches I.D. using 300 pound hammer dropped 18 inches, except where otherwise noted.

D. Ground Water Depth G.W. see General Note 3.

E. Undisturbed Sample - 3 inch diameter, unless otherwise noted.

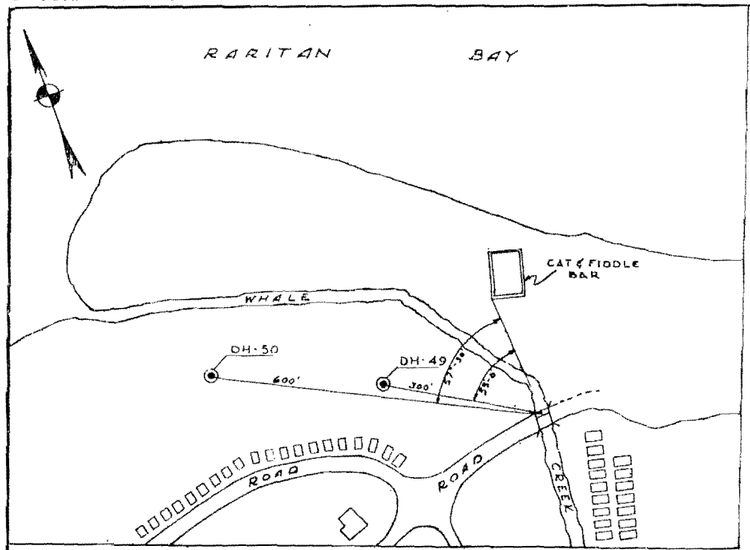
F. Rock or Boulder Drilling Data D = Length drilled, R = amount recovered of length drilled using NX diamond bit, unless otherwise noted.

RARITAN BAY & SANDY HOOK BAY

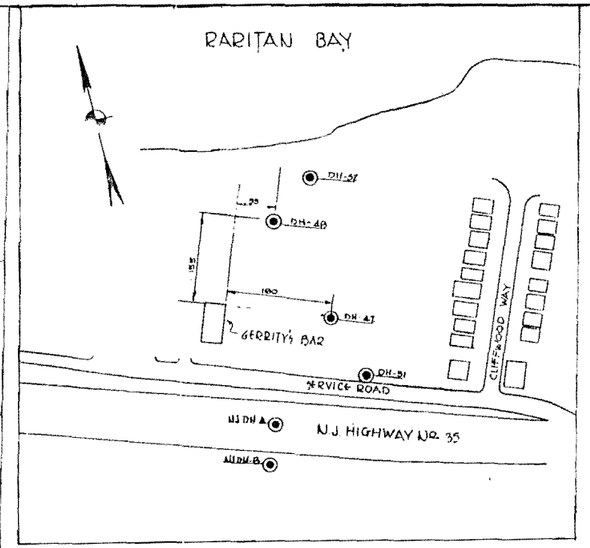
BEACH EROSION & HURRICANE PROJECT

SUB-SURFACE EXPLORATIONS

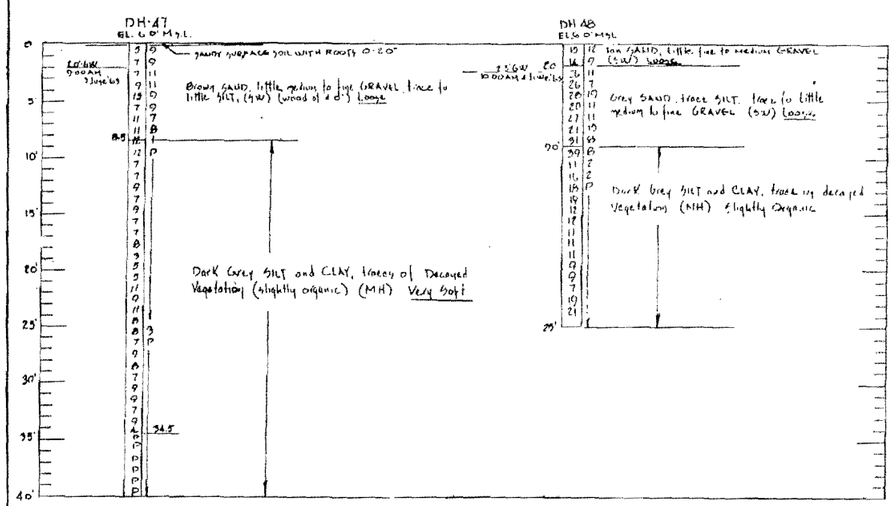
MADISON & MATAWAN TOWNSHIPS NEW JERSEY

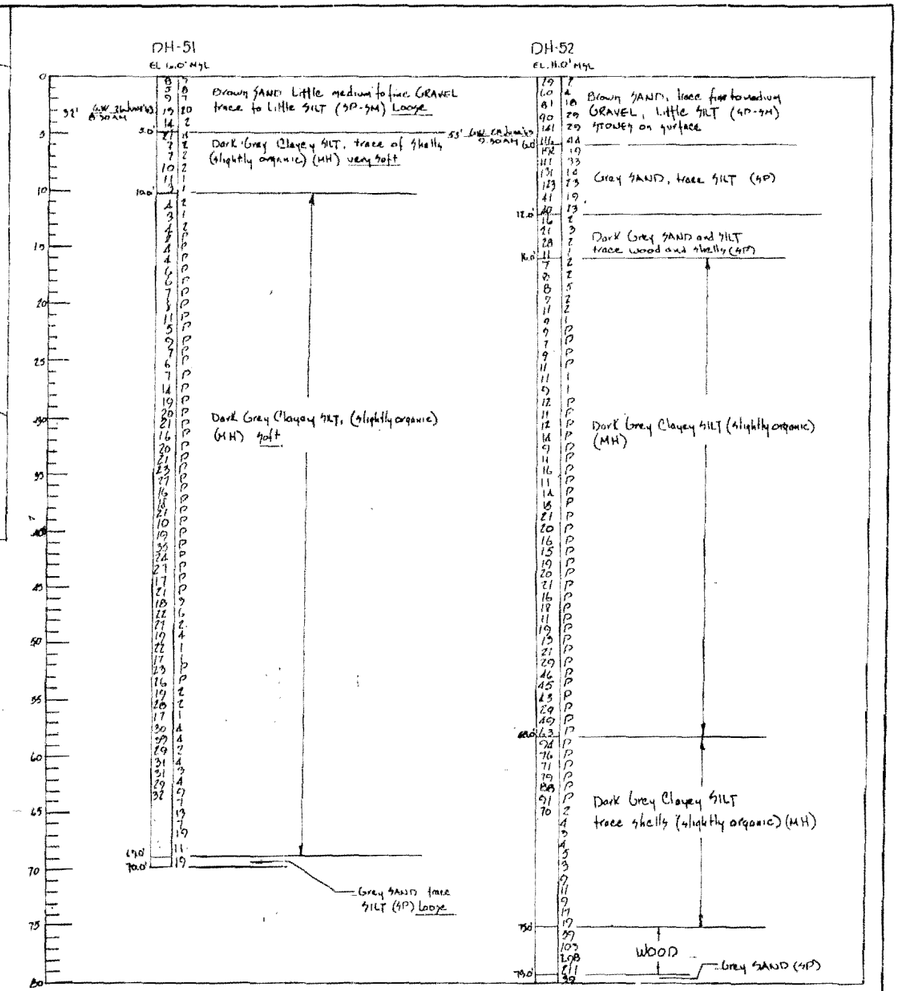


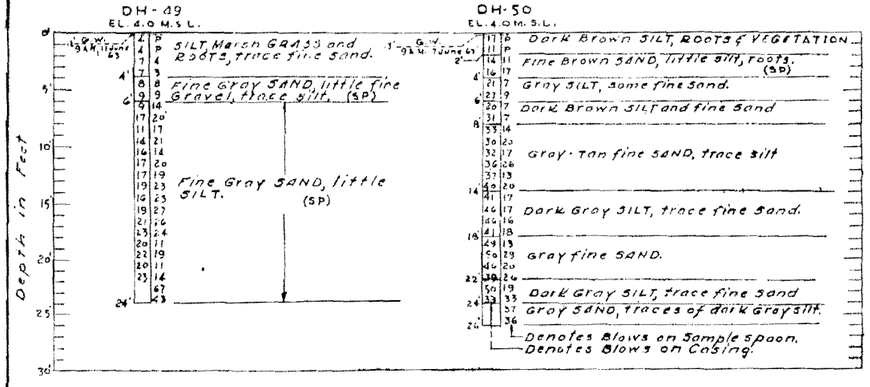
BORING LOCATION PLAN
SCALE 1" = 100'



BORING LOCATION PLAN
SCALE 1" = 100'







N.J. DH-A
+7.3' MSL TO +1.0' MSL - Stony Red & Yellow Sand
+1.0 MSL TO -1.0 MSL - Yellow Clay
-1.0' MSL TO -23.0' MSL - Coarse Red & Yellow Sand, Gravel with streaks of Yellow Clay
-23.0' MSL TO -68.0' MSL - Soft Grey Clay
Below 68.5' — Grey Sand

N.J. DH-B
+3.3' MSL TO -5.0 MSL - Vegetation, Brown & Grey Silty Clay
-5.0' MSL TO -22.0' MSL - Pebbly Grey Sand
-22.0 MSL TO -70.0' MSL - Soft Grey Silty Clay, Organic
Below 70.0' — Grey Sand

LEGEND
⊙ = DRILL HOLE

DRIVING DATA		
	SPOON	CASING
SIZE	3"	4"
HAMMER	300 LBS	300 LBS
DROP	18"	18"

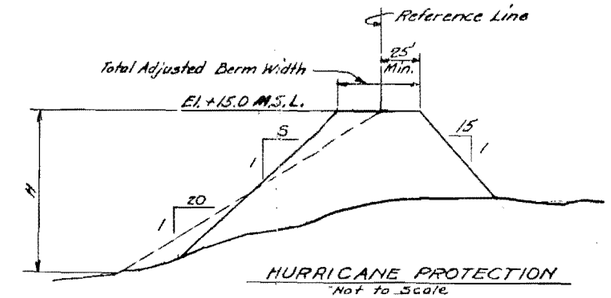
RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

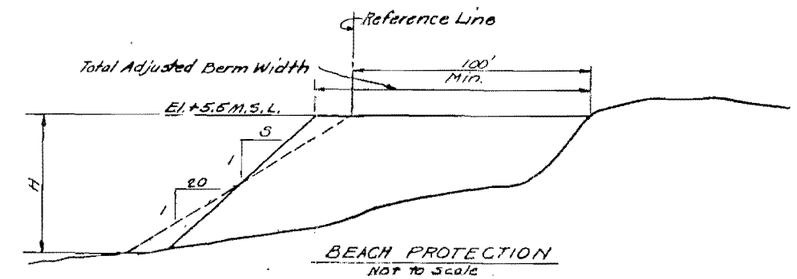
SUB-SURFACE EXPLORATIONS

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

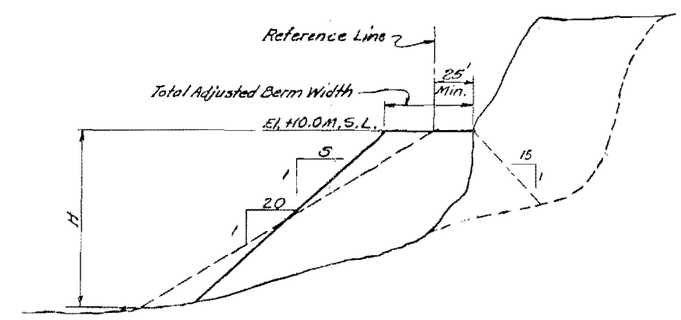
SECTION	H (Ft.)	TOTAL ADJUSTED BERM WIDTH IN FEET								
		S = 1 on 12	S = 1 on 13	S = 1 on 14	S = 1 on 15	S = 1 on 16	S = 1 on 17	S = 1 on 18	S = 1 on 19	S = 1 on 20
12+00	18.0	80.0	71.0	61.0	52.0	42.0	33.0	25.0	25.0	25.0
14+00	18.2	81.0	72.0	62.0	52.0	42.0	33.0	25.0	25.0	25.0
16+00	18.2	81.0	72.0	62.0	52.0	42.0	33.0	25.0	25.0	25.0
18+00	18.2	81.0	72.0	62.0	52.0	42.0	33.0	25.0	25.0	25.0
20+00	18.0	80.0	71.0	61.0	52.0	42.0	33.0	25.0	25.0	25.0
22+00	18.0	118.0	109.0	100.0	90.0	80.0	71.0	62.0	52.0	42.0
24+00	12.9	78.0	71.0	64.0	57.0	50.0	43.0	36.0	29.0	25.0
26+00	12.8	61.0	54.0	47.0	40.0	33.0	26.0	25.0	25.0	25.0
28+00	12.6	80.0	73.0	66.0	59.0	52.0	45.0	38.0	31.0	25.0
30+00	12.5	90.0	84.0	77.0	70.0	63.0	56.0	49.0	42.0	36.0
32+00	12.4	99.0	93.0	86.0	79.0	72.0	66.0	59.0	52.0	45.0
34+00	12.3	98.0	92.0	86.0	79.0	72.0	65.0	59.0	52.0	45.0
36+10	12.3	104.0	98.0	91.0	84.0	77.0	71.0	64.0	57.0	50.0
38+20	12.8	131.0	124.0	117.0	110.0	103.0	96.0	89.0	82.0	75.0
40+00	12.8	134.0	127.0	120.0	113.0	106.0	98.0	91.0	84.0	77.0
42+00	12.4	131.0	125.0	118.0	111.0	104.0	98.0	91.0	84.0	77.0
43+95	12.7	90.0	84.0	78.0	71.0	64.0	58.0	52.0	46.0	39.0
46+00	12.1	99.0	93.0	87.0	80.0	73.0	67.0	61.0	54.0	47.0
48+00	12.3	107.0	101.0	95.0	88.0	81.0	75.0	68.0	61.0	54.0
49+47	12.3	66.0	60.0	54.0	47.0	40.0	35.0	26.0	25.0	25.0
52+73	12.7	137.0	130.0	123.0	116.0	109.0	103.0	96.0	89.0	82.0
54+00	12.8	101.0	94.0	87.0	80.0	73.0	66.0	59.0	52.0	45.0
56+00	12.8	73.0	66.0	59.0	52.0	45.0	38.0	31.0	25.0	25.0
58+00	10.9	106.0	100.0	94.0	88.0	82.0	76.0	70.0	64.0	58.0
60+25	10.0	115.0	110.0	105	99.0	93.0	88.0	82.0	77.0	71.0
62+30	7.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
63+90	6.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
66+33	7.0	103.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
68+00	7.7	126.0	121.0	116.0	112.0	108.0	103.0	100.0	100.0	100.0
70+00	8.0	135.0	131.0	127.0	123.0	118.0	114.0	110.0	105.0	100.0
72+00	8.3	120.0	116.0	112.0	107.0	102.0	100.0	100.0	100.0	100.0
74+00	7.9	118.0	114.0	110.0	106.0	101.0	100.0	100.0	100.0	100.0
76+00	7.5	129.0	125.0	121.0	117.0	112.0	112.0	104.0	100.0	100.0
77+90	7.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
79+75	7.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
82+82	11.6	53.0	47.0	41.0	35.0	28.0	25.0	25.0	25.0	25.0
85+95	11.4	94.0	88.0	82.0	76.0	69.0	63.0	57.0	51.0	44.0
86+00	11.4	52.0	46.0	40.0	34.0	28.0	25.0	25.0	25.0	25.0
88+00	11.5	58.0	52.0	46.0	40.0	33.0	27.0	25.0	25.0	25.0
90+00	11.6	53.0	47.0	41.0	35.0	28.0	25.0	25.0	25.0	25.0
92+04	11.7	59.0	53.0	47.0	40.0	33.0	27.0	25.0	25.0	25.0
94+00	11.5	51.0	45.0	39.0	32.0	25.0	25.0	25.0	25.0	25.0
96+00	11.7	77.0	71.0	65.0	58.0	51.0	45.0	39.0	33.0	26.0
98+00	6.7	31.0	27.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
100+00	6.7	46.0	42.0	38.0	34.0	30.0	27.0	25.0	25.0	25.0
102+03	6.4	71.0	68.0	64.0	60.0	56.0	53.0	49.0	45.0	41.0
104+00	6.2	78.0	75.0	71.0	67.0	63.0	60.0	57.0	53.0	49.0
105+88	6.5	41.0	37.0	33.0	29.0	25.0	25.0	25.0	25.0	25.0
107+88	5.0	36.0	33.0	30.0	27.0	25.0	25.0	25.0	25.0	[illegible]
0+00 A	4.0	1.0	0	0	0	0	0	0	0	0
1+70 A	5.7	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0	75.0
2+69.54 A	6.8	120.0	116.0	112.0	108.0	104.0	101.0	100.0	100.0	100.0
4+78 A	7.3	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
6+78 A	7.4	107.0	103.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
8+20 A	7.3	115.0	111.0	107.0	103.0	100.0	100.0	100.0	100.0	100.0
9+78 A+110+00	6.8	120.0	116.0	112.0	108.0	104	101.0	100.0	100.0	100.0
114+00	7.3	123.0	119.0	115.0	111.0	107.0	103.0	100.0	100.0	100.0
115+88	6.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
118+00	6.9	104.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
120+00	7.1	131.0	127.0	123.0	119.0	115.0	111.0	107.0	103.0	100.0
122+30	6.9	104.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
124+00	6.7	125.0	121.0	117.0	113.0	108.0	105.0	101.0	100.0	100.0
126+27	12.1	162.0	156.0	150.0	143.0	136.0	128.0	122.0	116.0	109.0
128+00	13.0	113.0	107.0	101.0	94.0	87.0	80.0	73.0	66.0	59.0
130+00	12.4	155.0	148.0	141.0	134.0	127.0	121.0	114.0	107.0	100.0
132+00	12.5	127.0	121.0	114.0	107.0	100.0	94.0	87.0	80.0	73.0
134+00	12.5	85.0	79.0	72.0	65.0	58.0	52.0	45.0	38.0	31.0
135+43	12.6	64.0	56.0	49.0	42.0	35.0	29.0	25.0	25.0	25.0
138+00	12.4	57.0	51.0	44.0	37.0	30.0	25.0	25.0	25.0	25.0
140+00	12.1	68.0	62.0	56.0	50.0	43.0	37.0	31.0	25.0	25.0
142+00	11.5	60.0	54.0	48.0	42.0	35.0	29.0	25.0	25.0	26.0
144+00	11.0	48.0	43.0	37.0	31.0	25.0	25.0	25.0	25.0	25.0
146+05	11.2	66.0	60.0	54.0	48.0	41.0	35.0	29.0	25.0	25.0
147+82	11.6	64.0	58.0	52.0	45.0	38.0	32.0	26.0	25.0	25.0
149+35	12.0	65.0	59.0	53.0	46.0	39.0	33.0	26.0	25.0	25.0
151+35	11.7	114.0	108.0	102.0	95.0	88.0	82.0	76.0	70.0	63.0
153+95	11.6	53.0	47.0	41.0	35.0	28.0	26.0	25.0	25.0	25.0
155+91	9.9	47.0	42.0	37.0	31.0	25.0	25.0	25.0	25.0	25.0
A	10.3	48.0	43.0	38.0	32.0	26.0	25.0	25.0	25.0	25.0
B	9.2	44.0	39.0	34.0	29.0	25.0	25.0	25.0	25.0	25.0
C	4.8	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0



HURRICANE PROTECTION
Not to Scale



BEACH PROTECTION
Not to Scale



BLUFF PROTECTION
Not to Scale

RARITAN BAY & SANDY HOOK BAY

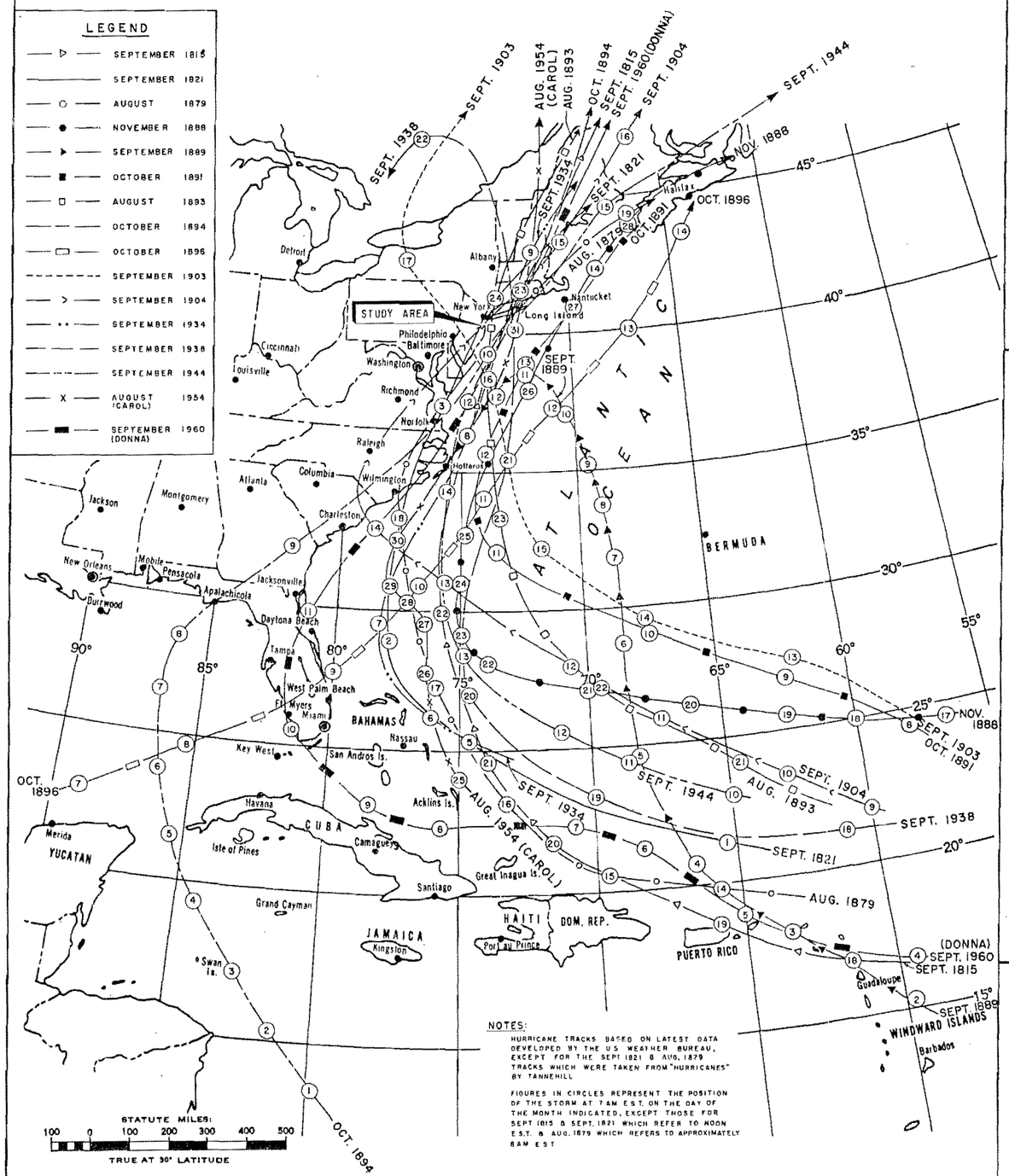
BEACH EROSION & HURRICANE PROJECT

BERM WIDTH TABLE

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

TRACKS OF MAJOR HURRICANES

NEW YORK-NEW JERSEY COASTAL AREA



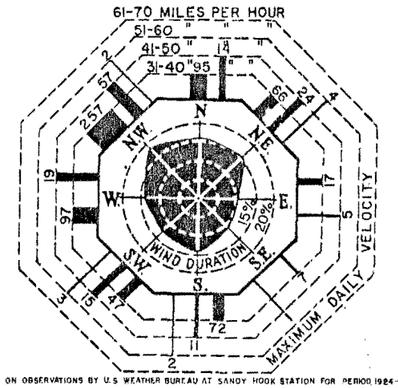
NOTES:

HURRICANE TRACKS BASED ON LATEST DATA DEVELOPED BY THE U.S. WEATHER BUREAU, EXCEPT FOR THE SEPT 1821 & AUG. 1879 TRACKS WHICH WERE TAKEN FROM "HURRICANES" BY TANNEHILL

FIGURES IN CIRCLES REPRESENT THE POSITION OF THE STORM AT 7 AM E.S.T. ON THE DAY OF THE MONTH INDICATED, EXCEPT THOSE FOR SEPT 1815 & SEPT. 1821 WHICH REFER TO NOON E.S.T. & AUG. 1879 WHICH REFERS TO APPROXIMATELY 8 AM E.S.T.

WIND DIAGRAM

SANDY HOOK, NEW JERSEY

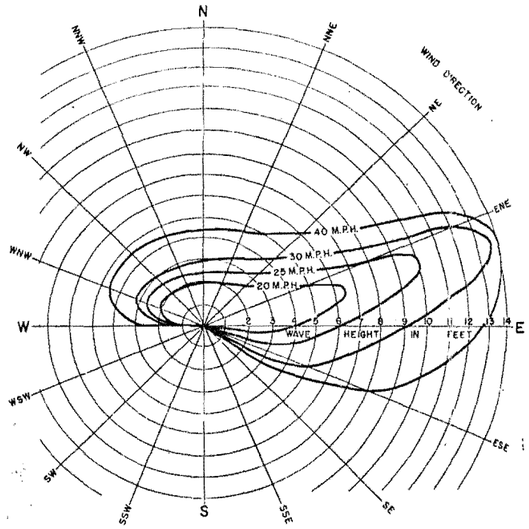


BASED ON OBSERVATIONS BY U.S. WEATHER BUREAU AT SANDY HOOK STATION FOR PERIOD 1924-1934.

THE WIDTH OF THE BARS IS ONLY APPROXIMATELY PROPORTIONAL TO THE NUMBER OF OCCURRENCES. THE NUMBERS AT THE END OF THE BARS INDICATE THE ACTUAL NUMBER OF OCCURRENCES.

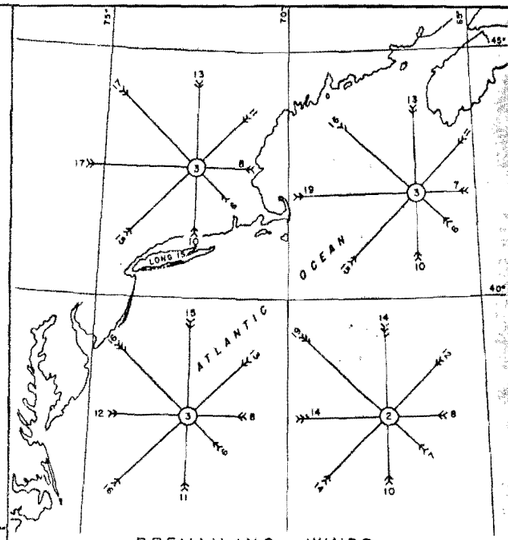
WAVE DIAGRAM

KEANSBURG, NEW JERSEY



WAVE DATA FOR VICINITY OF POINT COMFORT, KEANSBURG, N. J.

THE COMPUTED WAVE HEIGHTS ARE BASED ON AN ASSUMED STORM WATER DEPTH OF 18 FEET OFF KEANSBURG AND INCLUDE AN APPROXIMATION OF THE EFFECTS OF REFRACTION OF OCEAN WAVES ENTERING THE OPENING BETWEEN SANDY HOOK AND ROCKAWAY POINT.



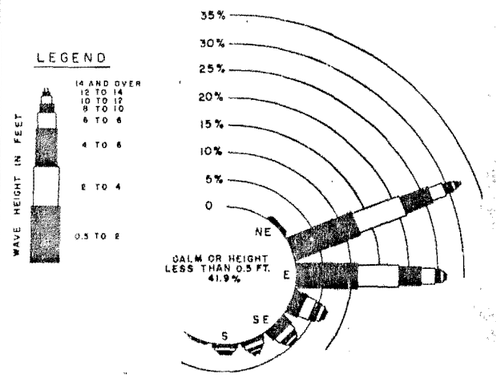
PREVAILING WINDS

WIND ROSES SHOW AVERAGE WINDS FOR 5° SQUARE OVER ENTIRE PERIOD OF RECORD. ARROWS FLY WITH THE WIND. FIGURES AT END OF ARROWS INDICATE PERCENT OF OBSERVATIONS WIND HAS BLOWN FROM THAT DIRECTION. NUMBER OF FEATHERS REPRESENTS AVERAGE FORCE, BEAUFORT SCALE. FIGURE IN CIRCLE REPRESENTS PERCENTAGE OF CALMS, LIGHT AIRS AND VARIABLES.

BASED ON OBSERVATIONS BY THE U.S. NAVY HYDROGRAPHIC OFFICE FOR 10 YEAR PERIOD 1932 – 1942

WAVE DATA

ENTRANCE TO NEW YORK HARBOR, STATION C (LAT. 40° 15' N LONG. 73° 45' W)



THE DATA, WHICH SHOW PERCENT OF TIME WAVES OF DIFFERENT HEIGHT OCCUR FROM EACH DIRECTION, WERE DERIVED BY HINDCASTING METHODS AND USE OF SYNOPTIC WEATHER CHARTS FOR THE THREE-YEAR PERIOD 1948-1950.

NOTE:

THIS PLATE IS PLATE 12 OF AUTHORIZING DOCUMENT H.D. NO. 434.

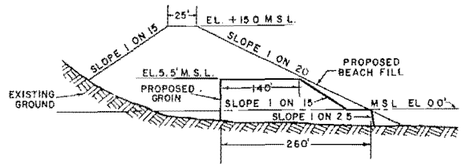
RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

STORM, WIND, AND WAVE DATA-(DOCUMENT PLATE 12)

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO 13

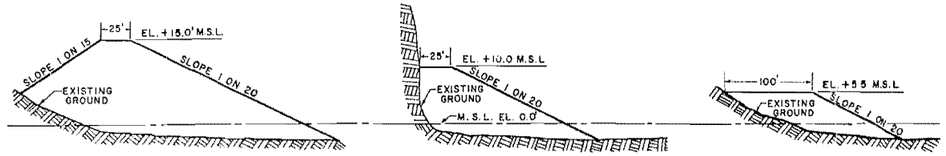


TYPICAL PROFILE OF GROIN

SCALE IN FEET

HOR 100 0 100 200

VERT 10 0 10 20



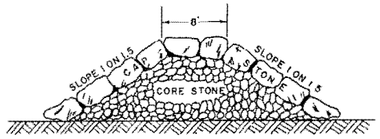
TYPE A TYPE B TYPE C

TYPICAL SECTIONS OF BEACH FILL

SCALE IN FEET

HOR 100 0 100 200

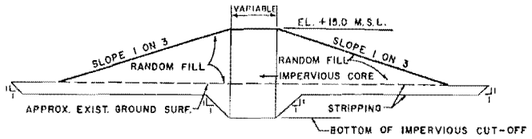
VERT. 10 0 10 20



SECTION OF GROIN

SCALE IN FEET

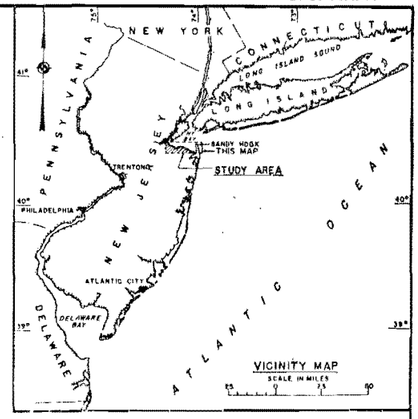
5 0 5 10



TYPICAL LEVEE SECTION

SCALE IN FEET

10 0 10 20

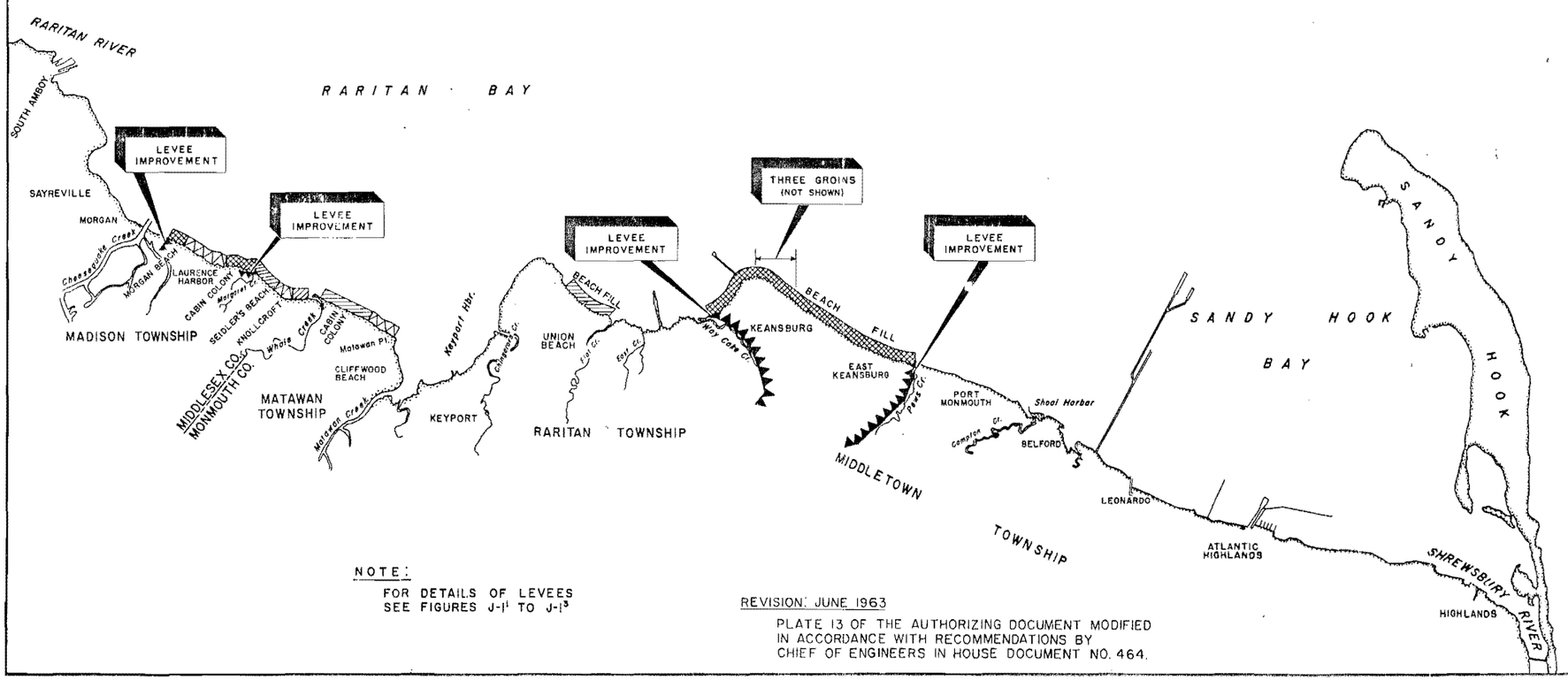


LEGEND

- LEVEES
- BEACH FILL TO 15.0 FT. M.S.L. (TYPE A)
- BEACH FILL TO 10.0 FT. M.S.L. (TYPE B)
- BEACH FILL TO 5.5 FT. M.S.L. (TYPE C)

SCALE IN FEET

5,000 0 5,000 10,000



NOTE:

FOR DETAILS OF LEVEES SEE FIGURES J-1[1] TO J-1[3]

REVISION: JUNE 1963

PLATE 13 OF THE AUTHORIZING DOCUMENT MODIFIED IN ACCORDANCE WITH RECOMMENDATIONS BY CHIEF OF ENGINEERS IN HOUSE DOCUMENT NO. 464.

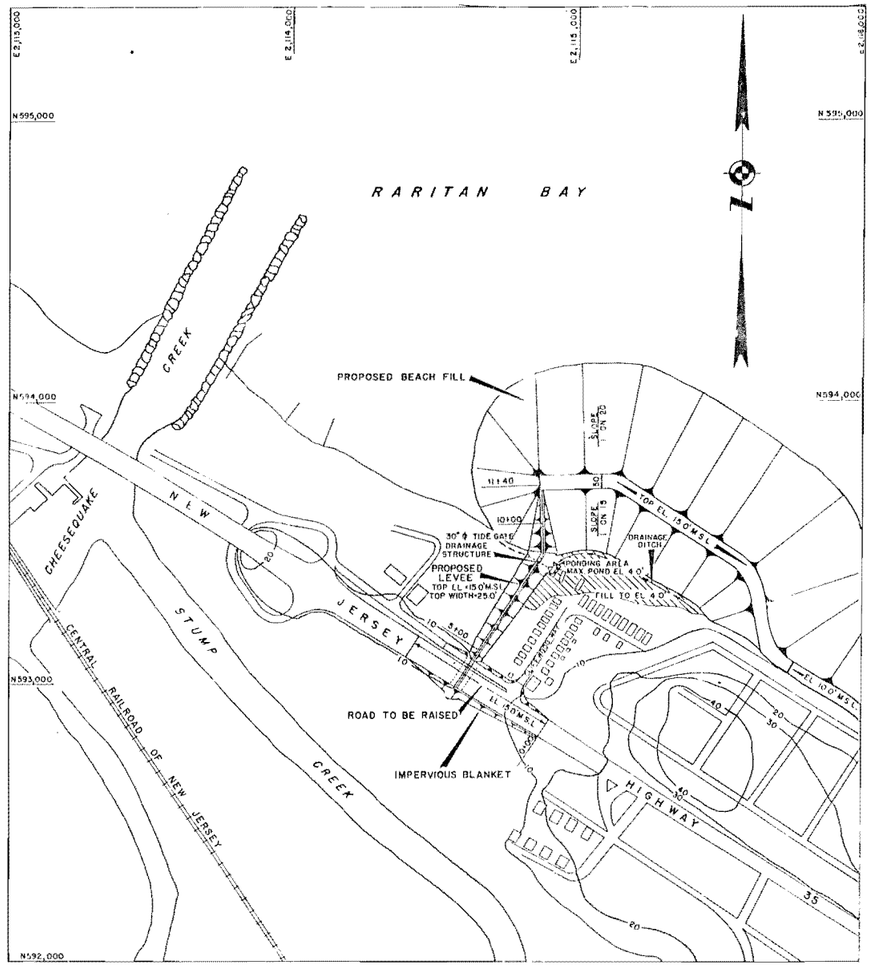
RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

PLAN OF DOCUMENT IMPROVEMENT (DOCUMENT PLATE 13)

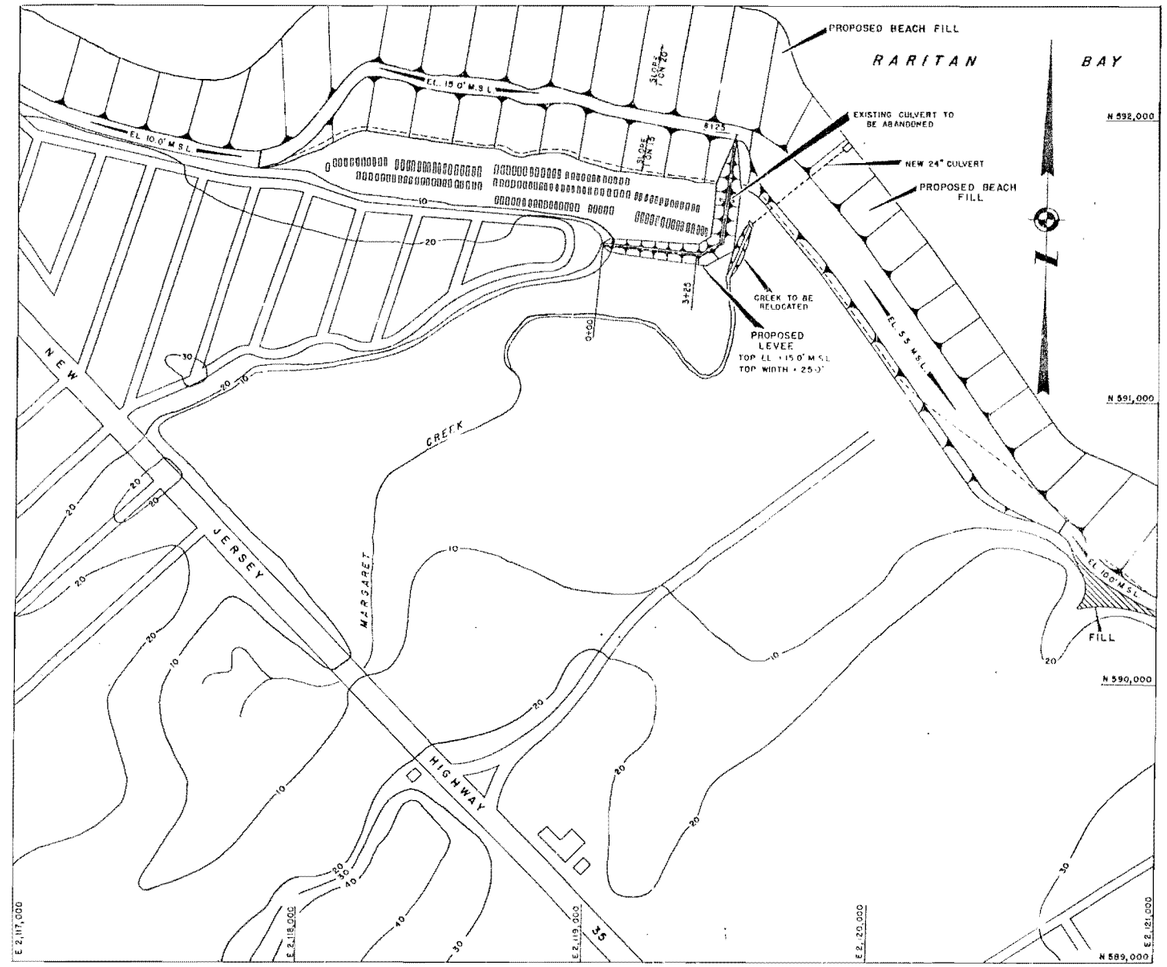
MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO. 14



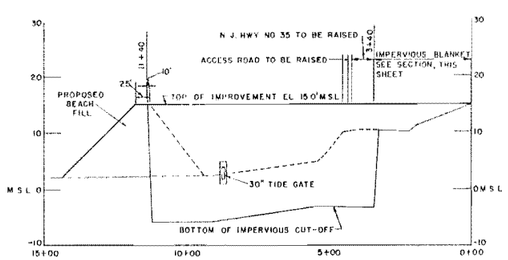
PLAN—MORGAN BEACH

SCALE IN FEET



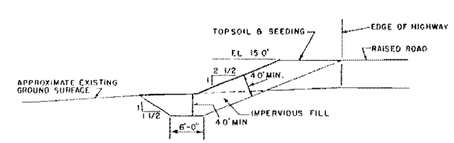
PLAN—LAURENCE HARBOR CABIN COLONY

SCALE IN FEET



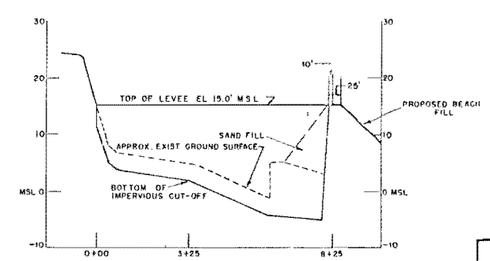
PROFILE ALONG ℄ OF LEVEE IMPROVEMENT
MORGAN BEACH

SCALE IN FEET
HOR 200 0 200 400
VERT 10 0 10 20



SECTION SHOWING IMPERVIOUS BLANKET
MORGAN BEACH

SCALE IN FEET
10 0 10 20



PROFILE ALONG ℄ OF LEVEE IMPROVEMENT
LAURENCE HARBOR CABIN COLONY

SCALE IN FEET
HOR 200 0 200 400
VERT 10 0 10 20

NOTE:

THIS PLATE IS FIGURE J-1' OF AUTHORIZING DOCUMENT H.D. NO. 464

RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

DETAILS OF DOCUMENT LEVEES (DOCUMENT FIG J-1')

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

FIGURE NO. 15

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX A - PERTINENT CORRESPONDENCE AND DATA

JULY 1963

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX A - PERTINENT CORRESPONDENCE AND DATA

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A2	MODIFICATION OF COST SHARING IN AUTHORIZING DOCUMENT	A-1
A3	LOCAL COOPERATION	A-1
A4	COORDINATION - UNITED STATES FISH AND WILDLIFE SERVICE	A-2
A5	COORDINATION - NEW JERSEY STATE HIGHWAY DEPARTMENT	A-2

LIST OF ATTACHMENTS

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	AUTHORIZATION	
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RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX A - PERTINENT CORRESPONDENCE AND DATA

A1. SUPPLEMENTAL DATA FOR AUTHORIZING DOCUMENT. The plan of improvement recommended by the reporting officers was modified by the Chief of Engineers in his report to the Secretary of the Army in accordance with the recommendations of the Board of Engineers for Rivers and Harbors and the Beach Erosion Board resulting in reduction of beach berm width to 100 feet at elevation 5.5 feet above mean sea level, of beach-bluff berm width to 25 feet at 10.0 feet above mean sea level, and of the crown of hurricane protection to 25 feet at 15.0 feet above mean sea level. These changes are reflected in Table 1 of the report of the Chief of Engineers (contained in main body of this design memorandum as Table 2). The data on which this table was developed, were obtained by the Chief of Engineers by 3rd Indorsement from the District Engineer dated 7 August 1961 to the OCE letter dated 29 June 1961, subject: Survey Report on Raritan Bay and Sandy Hook Bay, New Jersey, contained herein as Attachment A1.

A2. MODIFICATION OF COST SHARING IN AUTHORIZING DOCUMENT. The cost sharing in the authorizing document was recomputed in accordance with provisions of Section 103 of the River and Harbor Act of 1962. The provisions are delineated in paragraph 7 of the main body of this design memorandum. The approved results are contained in Table 4 of the main body of this design memorandum. The recomputations of cost sharing by the District Engineer as presented in letter dated 31 January 1963, subject: Cost Sharing for Beach Erosion Control Projects under PL 87-874, were approved by the Chief of Engineers in 3rd Indorsement dated 14 March 1963, in accordance with recommendations of the Beach Erosion Board as contained in 2nd Indorsement dated 5 March 1963, all as contained herein as Attachment A2.

A3. LOCAL COOPERATION. The coordination of local cooperation was initiated with local interests, New Jersey State Department of Conservation and Economic Development, by letter dated 2 November 1962 and by meeting on 5 November 1962 (Attachment A3). On 20 December 1962, the State was furnished pertinent cost data and schedule of operations (Attachment A4). On 10 January 1963, the State furnished a draft of an assurance acceptable to the State for approval prior to execution (Attachment A5). On 28 January 1963, the assurance was forwarded to North Atlantic Division for approval which was effected by 1st Indorsement dated 21 February 1963 (Attachment A6). On 4

April 1963, the State furnished an executed copy of the assurance (Attachment A7). On 11 April 1963, the State was advised of the acceptance (Attachment A8). On 12 April the North Atlantic Division was advised of the acceptance and furnished a copy of the Assurance. (Attachment A9). On 8 May 1963, the State was furnished a copy of the assurance with the acceptance indorsement by the District Engineer. (Attachment A10). This was effected on the basis that the assurance so indorsed (Attachment A11) would preclude the need of a separate agreement between the Federal government and the State to cover the cash contribution required from the State. On 1 May 1963, the State forwarded for execution and return a State bill form covering the initial local cash cooperation in the amount of $166,000 under the Raritan Bay - Sandy Hook Bay project and on 8 May 1963 the invoice was signed and returned to the State (Attachment A12). On 17 May 1963 the State was furnished survey data and preliminary layout of improvement as inspected in field on 9 May (Attachment A13). On 28 May 1963, the State was furnished five drawings showing information on requirements of local cooperation on lands, easements and rights of way, acquisitions, alterations and relocations of buildings, streets, and other structures (Attachment A14).

A4. COORDINATION - UNITED STATES FISH AND WILDLIFE SERVICE. The first report of the Fish and Wildlife was made on 10 October 1960 and is contained in the authorizing document. This report was reviewed in the design memorandum phase of this project and a report was made on 23 May 1963 which is contained herein as Attachment A15. In this report the recommendations contained in the early report were confirmed and recommendations were added on location of borrow, request for plans and specifications, and coordination on arrangements for policing and removing of polluted clams as discussed in paragraph 59 of the main body of this design memorandum.

A5. COORDINATION - NEW JERSEY STATE HIGHWAY DEPARTMENT. In connection with the raising of the service road to New Jersey State Highway No. 35, the details of design were closely coordinated with the New Jersey State Department of Conservation and Economic Development and the New Jersey State Highway Department. The results of the coordination are contained in a memorandum dated 10 June 1963, contained herein as Attachment A16.

ENGBR 29 June 1961

SUBJECT: Survey Report on Raritan Bay and Sandy Hook Bay, New Jersey

THRU: Chief of Engineers
Department of the Army
ATTN: ENGCW-P

TO: Division Engineer
U. S. Army Engineer Division, North Atlantic
New York, New York

1. The subject report was preliminarily considered by the Beach Erosion Board on 13 June 1961. In accordance with OCE letter ENGWD 12 March 1958, subject: "Processing Studies and Reports Involving Hurricane and Shore Protection," the Board considered the beach protection purpose of the recommended work in its entirety, and the hurricane protection purpose for technical adequacy. The Board recommended the single-purpose shore protection projects, essentially as shown in the report. However, in its comments, the Board states "The Board considers that the single-purpose shore protection plans consisting of widening the beach to provide a berm 150 feet wide at an elevation of 5.5 feet above mean sea level, or 50 feet wide at an elevation of 10 feet above mean sea level in front of the bluffs, are somewhat more than required in this locality, and that a berm width of 100 feet at elevation 5.5 feet, or 25 feet at an elevation of 10 feet in front of bluffs, will be adequate. Therefore, The Board believes that the details of the plans, particularly those relating to berm widths and selection of design wave, should be checked at the detailed design stage and modified as may be required. The Board also believes that groins will be needed at Keansburg for shore protection as well as for hurricane protection. Further consideration should also be given to the locations and dimensions of proposed groins at Keansburg, based on further experience with the beach fill to the time of construction, and to a suitable top elevation for groins to be effective in retaining the fill of the hurricane barrier during periods of high water."

2. In accordance with the procedure for processing reports of this type, the report is tentatively scheduled for consideration by the R&H Board on 8 August 1961. Action taken by the Beach Erosion Board which may effect subsequent consideration by the R&H Board pertains to the raise in grade of

the groins to a "suitable top elevation" to effectively serve the hurricane purpose, in which case the groins will serve both purposes and become a joint cost in the cost allocation. Recomputation of the cost of groins, if not covered by contingency allowance, and cost allocation and apportionment is requested, to be included in the information requested below.

3. In view of the fact that all hurricane projects to be constructed with sand fill, which the R&H Board has considered to date, would have a crown width no greater than 25 feet, it is expected that the Board will question the 50-foot width. Accordingly, supplemental information is requested, for Board information, relative to 25-foot crown width for hurricane protection, to be included in the information requested below.

4. Consultation with the staff, OCE-CW, indicates that the action taken by the Beach Erosion Board in recommending the wide beach and commenting that less width would be adequate, will require that the Chief's report include plans for the lesser beach widths. For the purpose of preparing the Chief's report, and for information of the R&H Board, supplemental information is requested pertaining to the first costs, annual charges, benefit-cost ratios, cost allocation, and cost apportionment of the recommended work, based on beach widths of 100 feet at elevation 5.5 and 25 feet at elevation 10, a 25-foot crown width for hurricane protection, and joint-use groins to a suitable top level. This information should be mailed to reach this office not later than 17 July 1961.

5. The staff, OCE-CW, is understood to believe that, in equity, local interests should be reimbursed for the work at Keansburg on the basis of single-purpose beach protection, the same as if for two-stage construction, which it is in effect. Accordingly, no additional information is required for Supplement No. 2 of the report.

FOR THE BOARD:

J. E. GOODRICH
Acting Resident Member

ENGCW-PD (29 Jun 61) 1st Ind
SUBJECT: Survey Report on Raritan Bay and Sandy Hook Bay, New Jersey

Office, Chief of Engineers, Washington 25, D. C., 30 June 1961

TO: Division Engineer, U. S. Army Engr Div, North Atlantic, New York, N. Y.

Forwarded.

FOR THE CHIEF OF ENGINEERS:

STEPHEN E. SMITH
Colonel, Corps of Engineers
Assistant Director of Civil Works
for Eastern Divisions

NADEN-R (29 Jun 61) 2d Ind
SUBJECT: Survey Report on Raritan Bay and Sandy Hook Bay, New Jersey

U. S. Army Engineer Division, North Atlantic, New York, New York
7 July 1961

TO: District Engineer, U. S. Army Engineer District, New York
New York, N. Y.

1. Forwarded for necessary action.

2. It is requested that the information desired be in this office not later than opening of business 14 July 1961.

FOR THE DIVISION ENGINEER:

PAUL H. JAENICHEN
Chief, Engineering Division

NANGS (29 Jun 61) 3rd Ind
SUBJECT: Survey Report on Raritan Bay and Sandy Hook Bay, New Jersey

U. S. Army Engineer District, New York, New York, N. Y., 7 August 1961

TO: Division Engineer, U. S. Army Engineer Division, North Atlantic, New York, N. Y., ATTN: NADEN-R

1. Mr. R. D. Murray of the Board of Engineers for Rivers and Harbors informally advised on 12 July 1961 that the Board's meeting which was tentatively scheduled for 8 August 1961 has been postponed for a month, and that additional time may be taken for preparation of the desired information.

2. Inclosed are revised tables and figure J-3 of appendix J corresponding to those in the original report, modified to reflect the desired changes in the recommended plan, as requested in paragraph 4 of the basic letter. This supplemental information gives the revised first costs, annual charges, benefit-cost ratios, cost allocation, and cost apportionment of the recommended work. It is to be noted that no change was required in tables J-5, J-6, J-9 and J-15, and that J-13A is an additional table inserted to cover cost allocation for the new multiple purpose project of Keansburg and East Keansburg resulting from joint use of the raised groins as shown on the inclosed print, figure 1.

3. Also inclosed are new tables K-4, K-7 and K-8 corresponding to those in appendix K, which reflect the reduced recreational benefits due to the reduced beach width, and tables 9 through 12 corresponding to those in the main report which summarize the revised first costs, annual charges, annual benefits, and economic justification of the recommended work.

5 Incl (6 cys)
1. Tables J-1 to J-24
2. Figure J-3
3. Figure 1
4. Tables K-4, K-7 and K-8
5. Tables 9 to 12

C. M. DUKE
Colonel, Corps of Engineers
District Engineer

NADEN-R (29 Jun 61) 4th Ind
SUBJECT: Survey Report on Raritan Bay and Sandy Hook Bay, New Jersey

U. S. Army Engineer Division, North Atlantic, New York 7, New York
8 August 1961

TO: Resident Member, Board of Engineers for Rivers and Harbors,
Washington 25, D. C.

Tables and figures for the subject report revised to include changes in the recommended plan as requested in basic letter are inclosed.

FOR THE DIVISION ENGINEER:

5 Incl
sext cy w/d

PAUL H. JAENICHEN
Chief, Engineering Division

Table J-1 - Detailed estimate of cost of artificial fill for single purpose beach erosion project[a]

Section	Length (feet)	Required quantity (cu. yds.)	Quantity to be pumped (cu. yds.)	Unit price (dollars)	Contract cost (dollars)	Engineering and contingencies (dollars)	Total cost (dollars)
Madison Township							
Morgan Beach	1,000	38,100	47,600	0.57	27,130	7,870	35,000[c]
Thence to Laurence Harbor Cabin Colony	2,600	140,600	175,800	0.57	100,210	27,790	128,000
Laurence Harbor Cabin Colony	1,583	38,100	47,600	0.57	27,130	8,870	36,000[c]
Seidler's Beach	1,767	42,500	53,100	0.57	30,270	9,730	40,000
Knollcroft	850	20,500	25,600	0.57	14,590	4,410	19,000
Thence to Whale Creek	1,000	20,400	25,500	0.57	14,540	4,460	19,000
Subtotal	8,800	300,200	375,200	--	213,870	63,130	277,000
Matawan Township							
Cliffwood Beach Cabin Colony	3,100	71,800	89,800	0.65	58,370	17,630	76,000
Thence to Matawan Point	1,700	50,400	63,000	0.65	40,950	12,050	53,000
Subtotal	4,800	122,200	152,800	--	99,320	29,680	129,000
Borough of Union Beach	3,000	100,000	125,000	0.66	82,500	23,500	106,000
Borough of Keansburg and East Keansburg[b]	--	--	--	--	--	--	--
Leonardo	5,190	153,800	192,200	0.64	123,010	34,990	158,000
Total	21,790	676,200	845,200	--	518,700	151,300	670,000
Total (excluding Leonardo)	16,600	522,400	653,000	--	395,690	116,310	512,000

(a) Estimate provides for a width of 25 feet at elevation 10 feet above mean sea level in the section between Morgan Beach and the Laurence Harbor Cabin Colony, at Knollcroft, and between the Cliffwood Beach Cabin Colony and Matawan Point. In other areas, a width of 100 feet at 5.5 feet above mean sea level would be provided.

(b) Beaches which are adequate from a beach erosion standpoint, and which provide partial protection from tidal flooding, were completed by local interests at East Keansburg in 1954 and at Keansburg in 1954 and 1957.

(c) These values also represent the joint costs for the multiple-purpose projects for the respective sections (see table J-8).

Table J-2 - Detailed estimate of separable cost of hurricane protection for Morgan Beach[a]

Description	Unit	Quantity	Unit price (dollars)	Amount (dollars)
Hydraulic fill	C.Y.	163,470[b]	0.57	93,180
Excavation	C.Y.	3,350	1.25	4,190
Stripping	C.Y.	2,290	1.25	2,860
Impervious fill	C.Y.	5,340	1.50	8,010
Random fill	C.Y.	18,600	0.75	13,950
Topsoil and seeding	acres	2.5	1,450.00	3,630
Concrete	C.Y.	42	80.00	3,360
Portland cement	bbl.	67	6.00	400
Reinforcing steel	lb.	2,613	0.22	570
Pipe-36"	ft.	72	16.00	1,150
Seepage rings	ea.	2	200.00	400
Tide gate-30"	ea.	1	600.00	600
Riprap	C.Y.	28	12.00	340
Bedding material	C.Y.	9	6.00	50
Road raising	C.Y.	8,200	1.50	12,300
Road surfacing	sq. yd.	4,870	5.25	25,570
Manhole steps	ea.	13	2.50	30
Wood sluice-30"	ea.	1	660.00	660
Contract cost	--	--	--	171,250
Engineering and contingencies				56,750
Total				228,000

(a) For cost of lands, easements and rights-of-way, see table J-5.

(b) Quantity to be pumped. Required quantity is 130,780 cubic yards.

Table J-3 - Detailed estimate of separable cost of hurricane protection for Laurence Harbor Cabin Colony[a]

Description	Unit	Quantity	Unit price (dollars)	Amount (dollars)
Hydraulic fill	C.Y.	285,090[b]	0.57	162,500
Excavation	C.Y.	984	1.25	1,230
Stripping	C.Y.	352	1.25	440
Impervious fill	C.Y.	3,120	1.50	4,680
Random fill	C.Y.	13,517	0.75	10,140
Surcharge placed	C.Y.	8,180	0.75	6,140
Surcharge removed	C.Y.	6,300	0.40	2,520
Topsoil and seeding	acres	1.2	1,450.00	1,740
Concrete	C.Y.	27	80.00	2,160
Portland cement	bbl.	43	6.00	260
Reinforcing steel	lb.	2,970	0.22	650
Pipe-24"	ft.	270	13.00	3,510
Contract cost				195,970
Engineering and contingencies				56,030
Total				252,000

(a) For cost of lands, easements and rights-of-way, see table J-5.

(b) Quantity to be pumped. Required quantity is 228,100 cubic yards.

Table J-4 - Detailed estimate of cost of hurricane protection for Borough of Keansburg and East Keansburg[a]

Description	Unit	Quantity	Unit price (dollars)	Amount (dollars)
Hydraulic fill	C.Y.	2,828,940[b]	0.53	1,499,340
Stone groins	tons	13,165	15.00	197,480
Stream diversion	l.s.	-	-	32,400
Excavation	C.Y.	52,372	1.25	65,470
Stripping	C.Y.	30,005	1.25	37,510
Impervious fill	C.Y.	68,421	1.50	102,630
Random fill	C.Y.	398,586	0.75	298,940
Surcharge placed	C.Y.	78,943	0.75	59,210
Surcharge removed	C.Y.	67,437	0.40	26,970
Topsoil and seeding	acres	74.0	1,450.00	107,300
Concrete	C.Y.	414	77.00	31,880
Portland cement	bbl.	660	5.70	3,760
Reinforcing steel	lb.	36,657	0.21	7,700
Pipe-18"	ft.	71	12.00	850
Pipe-24"	ft.	169	13.00	2,200
Pipe-30"	ft.	51	16.00	820
Pipe-36"	ft.	46	20.00	920
Pipe-42"	ft.	134	30.00	4,020
Seepage rings	ea.	16	200.00	3,200
Tide gate-18"	ea.	1	290.00	290
Tide gate-24"	ea.	3	500.00	1,500
Tide gate-30"	ea.	1	650.00	650
Tide gate-36"	ea.	1	740.00	740
Tide gate-42"	ea.	2	750.00	1,500
Riprap	C.Y.	189	12.00	2,270
Bedding material	C.Y.	65	6.00	390
Fencing	ft.	235	6.00	1,410
Road raising	C.Y.	10,130	1.50	15,200
Road surfacing	sq. yd.	7,970	5.25	41,840
Wood piles	ea.	85	100.00	8,500
Closure structures	l.s.	-	-	50,000
New bridge	l.s.	-	-	15,000
Raise bridge	l.s.	-	-	10,000
Manhole covers	ea.	7	200.00	1,400
Manhole steps	ea.	74	2.50	190
Wood sluice-18"	ea.	1	420.00	420
Wood sluice-24"	ea.	3	535.00	1,610
Wood sluice-30"	ea.	1	660.00	660
Wood sluice-36"	ea.	1	820.00	820
Wood sluice-42"	ea.	2	1,080.00	2,160
Raise portion of steamboat pier	l.s.	-	-	25,000
Bulkhead	ft.	350	100.00	35,000
Contract cost				2,699,150
Engineering and contingencies				868,850
Total				3,568,000

(a) For cost of lands, easements and rights-of-way, see table J-5.

(b) Quantity to be pumped. Required quantity is 2,263,200 cubic yards.

Table J-5 - Estimate of cost for lands, easements and rights-of-way in dollars (hurricane protection)[a]

Section	Lands	Easements	Buildings	Total
Morgan Beach	3,000	0	0	3,000
Laurence Harbor Cabin Colony	3,000	0	0	3,000
Borough of Keansburg and East Keansburg	41,000	14,000	70,000	125,000
Total	47,000	14,000	70,000	131,000

(a) Estimated costs include contingencies and real estate planning expenses, administration, surveys and appraisals.

Table J-6 - Distribution of preauthorization study costs (dollars)

Section	Hurricane study	Beach erosion study	Total
South Amboy	1,000	1,000	2,000
Sayreville	2,000	2,000	4,000
Madison Township			
Morgan Beach	2,000	1,000	3,000
Thence to Laurence Harbor Cabin Colony	0	1,000	1,000
Laurence Harbor Cabin Colony	2,000	1,000	3,000
Seidler's Beach	0	1,000	1,000
Knollcroft	0	1,000	1,000
Thence to Whale Creek	1,000	1,000	2,000
Subtotal	5,000	6,000	11,000
Matawan Township			
Cliffwood Beach Cabin Colony	4,000	1,000	5,000
Thence to Matawan Point	1,000	1,000	2,000
Subtotal	5,000	2,000	7,000
Keyport	1,000	1,000	2,000
Union Beach	12,000	2,000	14,000
Raritan Township	5,000	0	5,000
Keansburg	20,000	2,000	22,000
Middletown Township			
East Keansburg	13,000	2,000	15,000
Port Monmouth	1,000	2,000	3,000
Belford	1,000	1,000	2,000
Leonardo	2,000	2,000	4,000
Subtotal	17,000	7,000	24,000
Highlands	1,000	1,000	2,000
Atlantic Highlands	6,000	1,000	7,000
Total	75,000	25,000	100,000

Table J-7 - Summary of first costs (dollars)

Section	Artificial fill and groins	Levees, interior drainage, etc.	Lands, easements and rights-of-way	Preauthorization studies[a]	Total
Madison Township					
Morgan Beach	152,000	111,000	3,000	3,000	269,000
Thence to Laurence Harbor Cabin Colony	128,000	-	-	1,000	129,000
Laurence Harbor Cabin Colony	240,000	48,000	3,000	3,000	294,000
Seidler's Beach	40,000	-	-	1,000	41,000
Knollcroft	19,000	-	-	1,000	20,000
Thence to Whale Creek	19,000	-	-	1,000	20,000
Subtotal	598,000	159,000	6,000	10,000	773,000
Matawan Township					
Cliffwood Beach Cabin Colony	76,000	-	-	1,000	77,000
Thence to Matawan Point	53,000	-	-	1,000	54,000
Subtotal	129,000	-	-	2,000	131,000
Borough of Union Beach	106,000	-	-	2,000	108,000
Borough of Keansburg and East Keansburg	2,139,000	1,429,000	125,000	35,000	3,728,000
Leonardo	158,000	-	-	2,000	160,000
Total	3,130,000	1,588,000	131,000	51,000	4,900,000
Total (excluding Leonardo)	2,972,000	1,588,000	131,000	49,000	4,740,000

(a) For Morgan Beach, Laurence Harbor Cabin Colony, and Keansburg, cost is combined cost of beach erosion and hurricane studies; for East Keansburg, cost is for hurricane study only; and for all other areas, cost is that of beach erosion study only.

Table J-8 - Summary of first costs for cost allocation by separable costs-remaining benefits method (dollars)

Section and item	Multiple-purpose project				Alternative single-purpose projects	
	Separable costs					
	Shore protection	Hurricane protection[a]	Joint costs[a]	Total costs	Shore protection[b]	Hurricane protection[c]
Morgan Beach						
Artificial fill	0	117,000	35,000	152,000	35,000	152,000
Levees, interior drainage, etc.	0	111,000	0	111,000	0	111,000
Lands, easements and rights-of-way	0	3,000	0	3,000	0	3,000
Preauthorization studies	1,000	2,000	0	3,000	1,000	2,000
Total	1,000	233,000	35,000	269,000	36,000	268,000
Laurence Harbor Cabin Colony						
Artificial fill	0	204,000	36,000	240,000	36,000	240,000
Levees, interior drainage, etc.	0	48,000	0	48,000	0	48,000
Lands, easements and rights-of-way	0	3,000	0	3,000	0	3,000
Preauthorization studies	1,000	2,000	0	3,000	1,000	2,000
Total	1,000	257,000	36,000	294,000	37,000	293,000
Borough of Keansburg and East Keansburg						
Artificial fill	0	1,878,000	0	1,878,000	0	1,878,000
Groins	0	86,000	175,000[d]	261,000	175,000[d]	261,000
Levees, interior drainage, etc.	0	1,429,000	0	1,429,000	0	1,429,000
Lands, easements and rights-of-way	0	125,000	0	125,000	0	125,000
Preauthorization studies	2,000	33,000	0	35,000	2,000	33,000
Total	2,000	3,551,000	175,000	3,728,000	177,000	3,726,000

(a) Based on consideration of the beach erosion single-purpose project as the joint cost and all other costs as being separable costs of hurricane protection.

(b) Based on a beach fill with a berm of 100 feet at 5.5 feet above mean sea level (see table J-1).

(c) Assumed the same as the multiple-purpose project, except for the costs of preauthorization studies.

(d) Cost of groins with a top elevation of 5.5 feet above mean sea level.

Table J-9 - Estimate of annual cost of beach replenishment

Section	Annual rate of replenishment (cu.yds.)	Quantity to be pumped (cu.yds.)	Unit price (dollars)	Contract cost (dollars)	Engineering and contingencies (dollars)	Total cost (dollars)
Madison Township						
Morgan Beach	1,100	1,380	0.66	910	190	1,100
Thence to Laurence Harbor Cabin Colony	2,800	3,5[illegible]	0.66	2,310	590	2,900
Laurence Harbor Cabin Colony	1,700	2,130	0.66	1,410	390	1,800
Seidler's Beach	1,900	2,380	0.66	1,570	430	2,000
Knollcroft	900	1,130	0.66	750	150	900
Thence to Whale Creek	1,100	1,380	0.66	910	190	1,100
Subtotal	9,500	11,900	-	7,860	1,940	9,800
Matawan Township						
Cliffwood Beach Cabin Colony	4,300	5,380	0.66	3,550	850	4,400
Thence to Matawan Point	2,300	2,880	0.66	1,900	500	2,400
Subtotal	6,600	8,260	-	5,450	1,350	6,800
Borough of Union Beach	3,500	4,380	0.75	3,290	810	4,100
Keansburg and East Keansburg	28,300	35,380	0.66	23,350	5,850	29,200
Leonardo	3,300	4,130	0.75	3,100	800	3,900
Total	51,200	64,050	-	43,050	10,750	53,800
Total (excluding Leonardo)	47,900	59,920	-	39,950	9,950	49,900

Table J-10 - Summary of estimated costs of beach replenishment and maintenance (dollars)

Section	Beach replenishment	Maintenance of hurricane protection[a]	Groin maintenance[b]	Total
Madison Township				
Morgan Beach	1,100	900	-	2,000
Thence to Laurence Harbor Cabin Colony	2,900	-	-	2,900
Laurence Harbor Cabin Colony	1,800	1,300	-	3,100
Seidler's Beach	2,000	-	-	2,000
Knollcroft	900	-	-	900
Thence to Whale Creek	1,100	-	-	1,100
Subtotal	9,800	2,200	-	12,000
Matawan Township				
Cliffwood Beach Cabin Colony	4,400	-	-	4,400
Thence to Matawan Point	2,400	-	-	2,400
Subtotal	6,800	-	-	6,800
Borough of Union Beach	4,100	-	-	4,100
Borough of Keansburg and East Keansburg	29,200	15,800	3,900	48,900
Leonardo	3,900	-	-	3,900
Total	53,800	18,000	3,900	75,700
Total (excluding Leonardo)	49,900	18,000	3,900	71,800

(a) Based on 0.5 percent of first cost.

(b) Based on 5 dollars per foot of groin.

Table J-11 - Summary of annual charges for cost allocation by separable costs-remaining benefits method (dollars)[a]

Section and item	Multiple-purpose project				Alternative single-purpose projects	
	Separable costs					
	Shore protection	Hurricane protection	Joint costs	Total costs	Shore protection	Hurricane protection
Morgan Beach						
Investment	1,000	233,000	35,000	269,000	36,000	268,000
Interest and amortization	0	8,400	1,300	9,700	1,300	9,700
Nourishment and maintenance	0	900	1,100	2,000	1,100	2,000
Total	0	9,300	2,400	11,700	2,400	11,700
Laurence Harbor Cabin Colony						
Investment	1,000	257,000	36,000	294,000	37,000	293,000
Interest and amortization	0	9,300	1,300	10,600	1,300	10,600
Nourishment and maintenance	0	1,300	1,800	3,100	1,800	3,100
Total	0	10,600	3,100	13,700	3,100	13,700
Borough of Keansburg and East Keansburg						
Investment	2,000	3,551,000	175,000	3,728,000	177,000	3,726,000
Interest and amortization	100	128,300	6,300	134,700	6,400	134,700
Nourishment and maintenance	0	46,000	3,900	49,900	3,900	49,900
Total	100	174,300	10,200	184,600	10,300	184,600

(a) The interest and amortization charges are based on an interest rate of 2-5/8 percent and a useful life of 50 years (capital recovery factor .03614). A breakdown of nourishment and maintenance costs is given in table J-10.

Table J-12 - Allocation of costs by separable costs-remaining benefits method, Morgan Beach (dollars)

Item	Shore protection	Hurricane protection	Total
1. Allocation of annual costs			
a. Benefits	7,400	11,100	18,500
b. Alternative cost	2,400	11,700	14,100
c. Benefits limited by alternative cost	2,400	11,100	13,500
d. Separable cost	0	9,300	9,300
e. Remaining benefits (1c minus 1d)	2,400	1,800	4,200
f. Allocated joint cost (in proportion to 1c)	1,400	1,000	2,400
g. Total allocation of project costs (1d plus 1f)	1,400	10,300	11,700
2. Allocation of nourishment and maintenance costs			
a. Separable cost	0	900	900
b. Allocated joint cost (in proportion to 1e)	700	400	1,100
c. Total allocation (2a plus 2b)	700	1,300	2,000
3. Allocation of investment			
a. Annual investment cost (1g minus 2c)	700	9,000	9,700
b. Allocated investment (in proportion to 3a)	19,000	250,000	269,000

Table J-13 - Allocation of costs by separable costs-remaining benefits method, Laurence Harbor Cabin Colony (dollars)

Item	Shore protection	Hurricane protection	Total
1. Allocation of annual costs			
a. Benefits	4,300	23,700	28,000
b. Alternative cost	3,100	13,700	16,800
c. Benefits limited by alternative cost	3,100	13,700	16,800
d. Separable cost	0	10,600	10,600
e. Remaining benefits (1c minus 1d)	3,100	3,100	6,200
f. Allocated joint cost (in proportion to 1e)	1,500	1,600	3,100
g. Total allocation of project costs (1d plus 1f)	1,500	12,200	13,700
2. Allocation of nourishment and maintenance costs			
a. Separable cost	0	1,300	1,300
b. Allocated joint cost (in proportion to 1e)	900	900	1,800
c. Total allocation (2a plus 2b)	900	2,200	3,100
3. Allocation of investment			
a. Annual investment cost (1g minus 2c)	600	10,000	10,600
b. Allocated investment (in proportion to 3a)	17,000	277,000	294,000

Table J-13A - Allocation of costs by separable costs-remaining benefits method, Borough of Keansburg and East Keansburg (dollars)

Item	Shore protection	Hurricane protection	Total
1. Allocation of annual costs			
a. Benefits	70,400[a]	325,700	396,100
b. Alternative cost	10,300	184,600	194,900
c. Benefits limited by alternative cost	10,300	184,600	194,900
d. Separable cost	100	174,300	174,400
e. Remaining benefits (1c minus 1d)	10,200	10,300	20,500
f. Allocated joint cost (in proportion to 1e)	5,100	5,100	10,200
g. Total allocation of project costs (1d plus 1f)	5,200	179,400	184,600
2. Allocation of nourishment and maintenance costs			
a. Separable cost	0	46,000	46,000
b. Allocated joint cost (in proportion to 1e)	1,900	2,000	3,900
c. Total allocation (2a plus 2b)	1,900	48,000	49,900
3. Allocation of investment			
a. Annual investment cost (1g minus 2c)	3,300	131,400	134,700
b. Allocated investment (in proportion to 3a)	91,000	3,637,000	3,728,000

(a) For basis of beach erosion benefits, see paragraph 4 of supplement 2.

Table J-14 - Summary of allocation of first cost (dollars)[a]

Section	Shore protection	Hurricane protection	Total
Madison Township			
Morgan Beach	19,000	250,000	269,000
Thence to Laurence Harbor Cabin Colony	129,000	-	129,000
Laurence Harbor Cabin Colony	17,000	277,000	294,000
Seidler's Beach	41,000	-	41,000
Knollcroft	20,000	-	20,000
Thence to Whale Creek	20,000	-	20,000
Subtotal	246,000	527,000	773,000
Matawan Township			
Cliffwood Beach Cabin Colony	77,000	-	77,000
Thence to Matawan Point	54,000	-	54,000
Subtotal	131,000	-	131,000
Borough of Union Beach	108,000	-	108,000
Borough of Keansburg and East Keansburg	91,000	3,637,000	3,728,000
Total	576,000	4,164,000	4,740,000

(a) Includes preauthorization studies.

Table J-15 - Shore ownership of areas with considered improvements (feet)[a]

Section	Ownership				Private shore with public benefit
	Federal	Non-Federal public	Private	Total	
Madison Township					
Morgan Beach	0 (0)	839 (83.9)	161 (16.1)	1,000 (100.0)	0 (0)
Thence to Laurence Harbor Cabin Colony	0 (0)	1,876 (72.2)	724 (27.8)	2,600 (100.0)	724 (27.8)
Laurence Harbor Cabin Colony	0 (0)	0 (0)	1,583 (100.0)	1,583 (100.0)	1,583 (100.0)
Seidler's Beach	0 (0)	0 (0)	1,767 (100.0)	1,767 (100.0)	1,767 (100.0)
Knollcroft	0 (0)	0 (0)	850 (100.0)	850 (100.0)	850 (100.0)
Thence to Whale Creek	0 (0)	0 (0)	1,000 (100.0)	1,000 (100.0)	1,000 (100.0)
Subtotal	0 (0)	2,715 (30.9)	6,085 (69.1)	8,800 (100.0)	5,924 (67.3)
Matawan Township					
Cliffwood Beach Cabin Colony	0 (0)	0 (0)	3,100 (100.0)	3,100 (100.0)	3,100 (100.0)
Thence to Matawan Point	0 (0)	0 (0)	1,700 (100.0)	1,700 (100.0)	1,700 (100.0)
Subtotal	0 (0)	0 (0)	4,800 (100.0)	4,800 (100.0)	4,800 (100.0)
Borough of Union Beach	0 (0)	1,133 (37.8)	1,867 (62.2)	3,000 (100.0)	300 (10.0)
Borough of Keansburg and East Keansburg	0 (0)	7,171 (50.7)	6,979 (49.3)	14,150 (100.0)	4,217 (29.8)
Total	0 (0)	11,019 (35.8)	19,731 (64.2)	30,750 (100.0)	15,241 (49.6)

(a) Figures in parentheses are percent of total frontage. For entire shore ownership, see table 3 of main report.

Table J-16 - Apportionment of first cost of shore protection

Item	Morgan Beach	Thence to Laurence Hbr. Cabin Colony	Laurence Hbr. Cabin Colony	Seidler's Beach	Knollcroft	Thence to Whale Creek	Cliffwood Beach Cabin Colony	Thence to Matawan Point	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
Federal shore											
Percent of total frontage	0	0	0	0	0	0	0	0	0	-	-
Federal contribution (percent)[a]	0	0	0	0	0	0	0	0	0	-	-
Non-Federal Public shore											
Percent of total frontage	83.9	72.2	0	0	0	0	0	0	37.8	-	-
Federal contribution (percent)[b]	28.0	24.1	0	0	0	0	0	0	12.6	-	-
Private shore with public benefit											
Percent of total frontage	0	27.8	100.0	100.0	100.0	100.0	100.0	100.0	10.0	-	-
Annual benefits											
Public (dollars)	0	6,300	3,500	17,900	1,700	2,100	29,900	3,300	1,400	-	-
Private (dollars)	0	0	800	1,000	2,000	500	2,400	2,800	200	-	-
Total (dollars)	0	6,300	4,300	18,900	3,700	2,600	32,300	6,100	1,600	-	-
Public (percent of total benefits)	0	100.0	81.4	94.7	45.9	80.8	92.6	54.1	87.5	-	-
Federal contribution (percent)[c]	0	9.2	27.1	31.6	15.3	26.9	30.9	18.0	2.9	-	-
Total Federal contribution (percent)	28.0	33.3	27.1	31.6	15.3	26.9	30.9	18.0	15.5	31.6[d]	-
Apportionment of first cost											
First cost (dollars)	19,000	129,000	17,000	41,000	20,000	20,000	77,000	54,000	108,000	91,000	576,000
Preauthorization studies (dollars)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	2,000	2,000	12,000
Net cost (dollars)	18,000	128,000	16,000	40,000	19,000	19,000	76,000	53,000	106,000	89,000	564,000
Federal share	5,000	43,000	4,000	13,000	3,000	5,000	23,000	10,000	16,000	28,000	150,000
Non-Federal share	13,000	85,000	12,000	27,000	16,000	14,000	53,000	43,000	90,000	61,000	414,000

(a) Based on 100 percent Federal contribution towards the cost of protecting Federal shores.

(b) Based on one-third as the Federal contribution towards the cost of protecting non-Federal public shores.

(c) Based on one-third adjusted by a factor of the ratio of public benefits to total benefits as the Federal contribution towards the cost of protecting private shores with public benefits. (See table K-7, appendix K).

(d) See paragraph 5 of supplement 2 for computation of Federal contribution.

Table J-17 - Apportionment of first cost of hurricane protection in dollars[a]

Item	Morgan Beach	Laurence Harbor Cabin Colony	Borough of Keansburg and East Keansburg	Total
Construction cost	247,000	274,000	3,512,000	4,033,000
Lands, easements and rights-of-way	3,000	3,000	125,000	131,000
Total first cost	250,000	277,000	3,637,000	4,164,000
Less preauthorization studies	2,000	2,000	33,000	37,000
Net cost	248,000	275,000	3,604,000	4,127,000
Federal share (70% maximum)	174,000	193,000	2,523,000	2,890,000
Non-Federal share (30% minimum)	74,000	82,000	1,081,000	1,237,000
Cash contribution	71,000	79,000	956,000	1,106,000
Lands, easements and rights-of-way	3,000	3,000	125,000	131,000

(a) Apportionment based on a minimum non-Federal share of 30 percent of the total first cost (less preauthorization studies) including lands, easements and rights-of-way.

Table J-18 - Summary of apportionment of first cost of shore and hurricane protection in dollars[a]

Section	Construction costs						Lands, easements, and rights-of-way[b]	Total costs	
	Shore protection		Hurricane protection		Total				
	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal		Federal	Non-Federal
Madison Township									
Morgan Beach	5,000	13,000	174,000	71,000	179,000	84,000	3,000	179,000	87,000
Thence to Laurence Harbor Cabin Colony	43,000	85,000	-	-	43,000	85,000	0	43,000	85,000
Laurence Harbor Cabin Colony	4,000	12,000	193,000	79,000	197,000	91,000	3,000	197,000	94,000
Seidler's Beach	13,000	27,000	-	-	13,000	27,000	0	13,000	27,000
Knollcroft	3,000	16,000	-	-	3,000	16,000	0	3,000	16,000
Thence to Whale Creek	5,000	14,000	-	-	5,000	14,000	0	5,000	14,000
Subtotal	73,000	167,000	367,000	150,000	440,000	317,000	6,000	440,000	323,000
Matawan Township									
Cliffwood Beach Cabin Colony	23,000	53,000	-	-	23,000	53,000	0	23,000	53,000
Thence to Matawan Point	10,000	43,000	-	-	10,000	43,000	0	10,000	43,000
Subtotal	33,000	96,000	-	-	33,000	96,000	0	33,000	96,000
Borough of Union Beach	16,000	90,000	-	-	16,000	90,000	0	16,000	90,000
Borough of Keansburg and East Keansburg	28,000	61,000	2,523,000	956,000	2,551,000	1,017,000	125,000	2,551,000	1,142,000
Total	150,000	414,000	2,890,000	1,106,000	3,040,000	1,520,000	131,000	3,040,000	1,651,000

(a) Excluding costs of preauthorization studies.

(b) This portion of the hurricane protection phase of the plan of improvement would be a non-Federal cost.

Table J-19 - Estimate of annual charges of shore protection in dollars

Item	Morgan Beach	Thence to Laurence Hbr. Cabin Colony	Laurence Hbr. Cabin Colony	Seidler's Beach	Knollcroft	Thence to Whale Creek	Cliffwood Beach Cabin Colony	Thence to Matawan Point	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
Federal											
First cost	5,000	43,000	4,000	13,000	3,000	5,000	23,000	10,000	16,000	28,000	150,000
Preauthorization studies[a]	500	500	500	500	500	500	500	500	1,000	1,000	6,000
Total cost	5,500	43,500	4,500	13,500	3,500	5,500	23,500	10,500	17,000	29,000	156,000
Interest and amortization	200	1,600	200	500	100	200	800	400	600	1,000	5,600
Non-Federal											
First cost	13,000	85,000	12,000	27,000	16,000	14,000	53,000	43,000	90,000	61,000	414,000
Preauthorization studies[a]	500	500	500	500	500	500	500	500	1,000	1,000	6,000
Total cost	13,500	85,500	12,500	27,500	16,500	14,500	53,500	43,500	91,000	62,000	420,000
Interest and amortization	500	3,100	500	1,000	600	500	1,900	1,600	3,300	2,200	15,200
Beach replenishment	700[b]	2,900	900[b]	2,000	900	1,100	4,400	2,400	4,100	1,900[c]	21,300
Annual charges	1,200	6,000	1,400	3,000	1,500	1,600	6,300	4,000	7,400	4,100	36,500
Total annual charges	1,400	7,600	1,600	3,500	1,600	1,800	7,100	4,400	8,000	5,100	42,100

(a) The preauthorization study costs for the beach erosion study are 50 percent Federal and 50 percent non-Federal contributed funds.

(b) This value is that portion of the cost of beach replenishment allocated to shore protection. See tables J-12 and J-13.

(c) Groin maintenance allocated to shore protection.

Table J-20 - Estimate of annual charges of hurricane protection (dollars)

Item	Morgan Beach	Laurence Harbor Cabin Colony	Borough of Keansburg and East Keansburg	Total
Federal				
First cost	174,000	193,000	2,523,000	2,890,000
Preauthorization studies	2,000	2,000	33,000	37,000
Total cost	176,000	195,000	2,556,000	2,927,000
Interest and amortization	6,400	7,000	92,400	105,800
Annual charges	6,400	7,000	92,400	105,800
Non-Federal				
First cost	74,000	82,000	1,081,000	1,237,000
Preauthorization studies	0	0	0	0
Total cost	74,000	82,000	1,081,000	1,237,000
Interest and amortization	2,700	3,000	39,100	44,800
Maintenance and beach replenishment	1,300	2,200	48,000	51,500
Annual charges	4,000	5,200	87,100	96,300
Total annual charges	10,400	12,200	179,500	202,100

Table J-21 - Summary of estimate of annual charges of shore and hurricane protection in dollars[a]

Section	Shore protection	Hurricane protection	Total
Madison Township			
Morgan Beach	1,400	10,400	11,800
Thence to Laurence Harbor Cabin Colony	7,600	-	7,600
Laurence Harbor Cabin Colony	1,600	12,200	13,800
Seidler's Beach	3,500	-	3,500
Knollcroft	1,600	-	1,600
Thence to Whale Creek	1,800	-	1,800
Subtotal	17,500	22,600	40,100
Matawan Township			
Cliffwood Beach Cabin Colony	7,100	-	7,100
Thence to Matawan Point	4,400	-	4,400
Subtotal	11,500	-	11,500
Borough of Union Beach	8,000	-	8,000
Borough of Keansburg and East Keansburg	5,100	179,500	184,600
Total	42,100	202,100	244,200

(a) Including costs of preauthorization studies.

Table J-22 - Economic analysis of shore protection

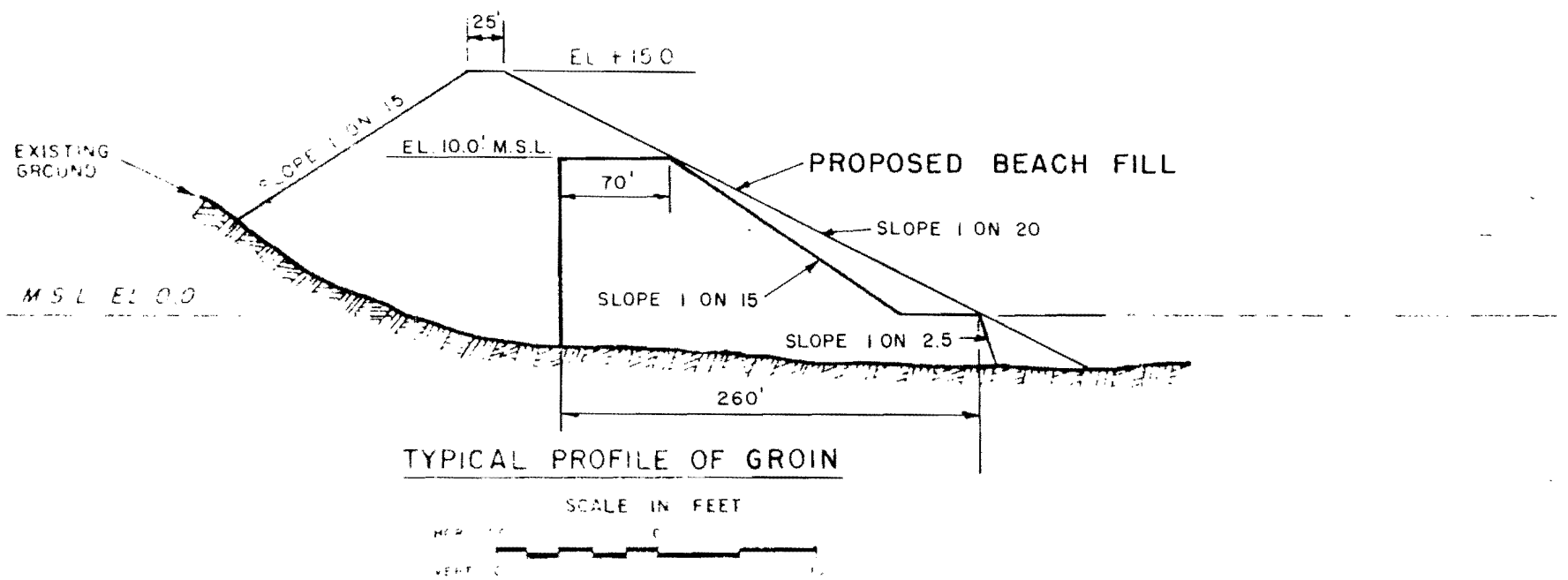
Section	Annual benefits (dollars)	Annual charges (dollars)	Benefit-cost ratio
Madison Township			
Morgan Beach	7,400	1,400	5.3
Thence to Laurence Harbor Cabin Colony	23,100	7,600	3.0
Laurence Harbor Cabin Colony	4,300	1,600	2.7
Seidler's Beach	18,900	3,500	5.4
Knollcroft	3,700	1,600	2.3
Thence to Whale Creek	2,600	1,800	1.4
Subtotal	60,000	17,500	3.4
Matawan Township			
Cliffwood Beach Cabin Colony	32,300	7,100	4.5
Thence to Matawan Point	6,100	4,400	1.4
Subtotal	38,400	11,500	3.3
Borough of Union Beach	9,500	8,000	1.2
Borough of Keansburg and East Keansburg	70,400	5,100	13.8
Total	178,300	42,100	4.2

Table J-23 - Economic analysis of hurricane protection

Section	Annual benefits (dollars)	Annual charges (dollars)	Benefit-cost ratio
Morgan Beach	11,100	10,400	1.1
Laurence Harbor Cabin Colony	23,700	12,200	1.9
Borough of Keansburg and East Keansburg	325,700	179,500	1.8
Total	360,500	202,100	1.8

Table J-24 - Economic analysis of shore and hurricane protection

Section	Annual benefits (dollars)	Annual charges (dollars)	Benefit-cost ratio
Madison Township			
Morgan Beach	18,500	11,800	1.6
Thence to Laurence Harbor Cabin Colony	23,100	7,600	3.0
Laurence Harbor Cabin Colony	28,000	13,800	2.0
Seidler's Beach	18,900	3,500	5.4
Knollcroft	3,700	1,600	2.3
Thence to Whale Creek	2,600	1,800	1.4
Subtotal	94,800	40,100	2.4
Matawan Township			
Cliffwood Beach Cabin Colony	32,300	7,100	4.5
Thence to Matawan Point	6,100	4,400	1.4
Subtotal	38,400	11,500	3.3
Borough of Union Beach	9,500	8,000	1.2
Borough of Keansburg and East Keansburg	396,100	184,600	2.1
Total	538,800	244,200	2.2



RARITAN AND SANDY HOOK BAYS
NEW JERSEY

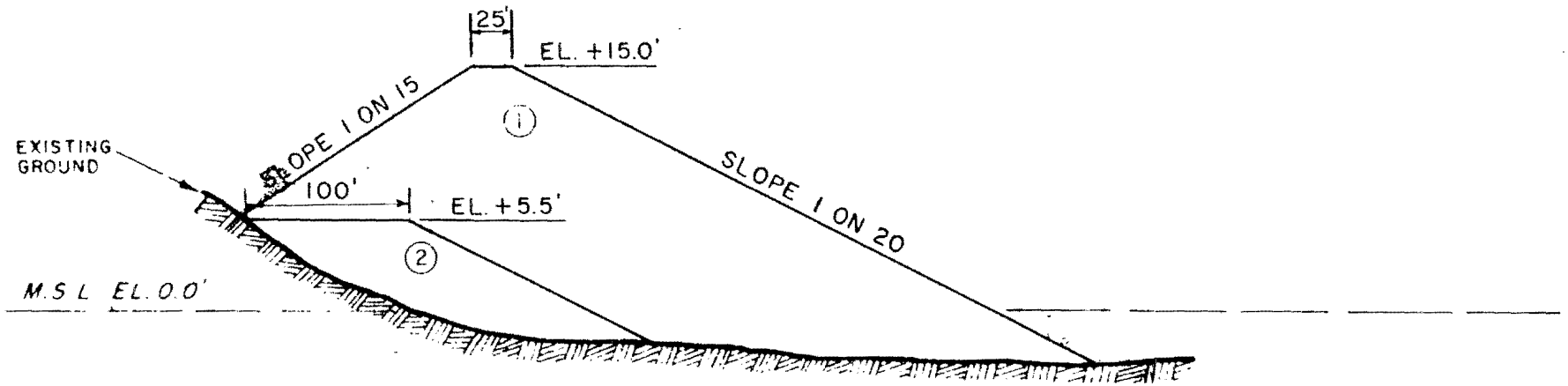
GROIN PROFILE

U S ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS NEW YORK, N.Y

JULY 1961

FIGURE 1

FIGURE J-3
REVISED



TYPICAL PROFILE OF BEACH FILL

SCALE IN FEET

HOR 100 0 100

VERT 10 0 10

LEGEND

1. SEPARABLE COST OF HURRICANE PROTECTION
2. JOINT COST, AND ALTERNATIVE SINGLE-PURPOSE PROJECT FOR SHORE PROTECTION

RARITAN AND SANDY HOOK BAYS
NEW JERSEY

BASIS FOR DIVISION OF COSTS

BETWEEN SHORE AND HURRICANE PROTECTION

SEPARABLE COSTS–REMAINING BENEFITS METHOD

U. S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS NEW YORK, N. Y.

JULY 1961

Table K-4 - Estimated annual public recreational benefit from additional beach use as a result of shore protection (dollars)

Section	Annual benefit	Distribution of benefit	
		Public shore	Private shore
Madison Township			
Morgan Beach	6,800	6,800	0
Thence to Laurence Harbor Cabin Colony	21,100	15,200	5,900
Laurence Harbor Cabin Colony	3,200	0	3,200
Seidler's Beach	17,900	0	17,900
Knollcroft	1,700	0	1,700
Thence to Whale Creek	2,100	0	2,100
Subtotal	52,800	22,000	30,800
Matawan Township			
Cliffwood Beach Cabin Colony	29,900	0	29,900
Thence to Matawan Point	3,300	0	3,300
Subtotal	33,200	0	33,200
Borough of Union Beach	6,700	5,300	1,400
Middletown Township			
Leonardo	3,300	3,300	0
Total	96,000	30,600	65,400
Total (excluding Leonardo)	92,700	27,300	65,400

Table K-7 - Breakdown of estimated annual benefits from shore protection (dollars)

Section and item	Benefit from land to be saved from erosion		Recreational benefits (a)	Decreased maintenance costs of structures		Prevention of erosion damages		All benefits		
	Public	Private	Public	Public	Private	Public	Private	Public	Private	Total
Morgan Beach										
Public shore	0	0	6,800	500	0	0	0	7,300	0	7,300
Private shore with public benefit	0	0	0	0	0	0	0	0	0	0
Private shore with no public benefit	0	100	0	0	0	0	0	0	100	100
Total	0	100	6,800	500	0	0	0	7,300	100	7,400
Total public and private benefits	100		6,800	500		0		7,400		
Thence to Laurence Harbor Cabin Colony										
Public shore	700	0	15,200	400	0	500	0	16,800	0	16,800
Private shore with public benefit	0	0	5,900	400	0	0	0	6,300	0	6,300
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	700	0	21,100	800	0	500	0	23,100	0	23,100
Total public and private benefits	700		21,100	800		500		23,100		
Laurence Harbor Cabin Colony										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	400	3,200	300	400	0	0	3,500	800	4,300
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	400	3,200	300	400	0	0	3,500	800	4,300
Total public and private benefits	400		3,200	700		0		4,300		
Seidler's Beach										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	800	17,900	0	200	0	0	17,900	1,000	18,900
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	800	17,900	0	200	0	0	17,900	1,000	18,900
Total public and private benefits	800		17,900	200		0		18,900		
Knollcroft										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	400	1,700	0	0	0	1,600	1,700	2,000	3,700
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	400	1,700	0	0	0	1,600	1,700	2,000	3,700
Total public and private benefits	400		1,700	0		1,600		3,700		
Thence to Whale Creek										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	500	2,100	0	0	0	0	2,100	500	2,600
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	500	2,100	0	0	0	0	2,100	500	2,600
Total public and private benefits	500		2,100	0		0		2,600		
Cliffwood Beach Cabin Colony										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	2,200	29,900	0	200	0	0	29,900	2,400	32,300
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	2,200	29,900	0	200	0	0	29,900	2,400	32,300
Total public and private benefits	2,200		29,900	200		0		32,300		
Thence to Matawan Point										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	1,200	3,300	0	0	0	1,600	3,300	2,800	6,100
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	1,200	3,300	0	0	0	1,600	3,300	2,800	6,100
Total public and private benefits	1,200		3,300	0		1,600		6,100		
Borough of Union Beach										
Public shore	800	0	5,300	500	0	0	0	6,600	0	6,600
Private shore with public benefit	0	200	1,400	0	0	0	0	1,400	200	1,600
Private shore with no public benefit	0	1,000	0	0	300	0	0	0	1,300	1,300
Total	800	1,200	6,700	500	300	0	0	8,000	1,500	9,500
Total public and private benefits	2,000		6,700	800		0		9,500		
Leonardo										
Public shore	500	0	3,300	0	0	0	0	3,800	0	3,800
Private shore with public benefit	0	400	0	200	0	0	0	200	400	600
Private shore with no public benefit	0	1,000	0	0	300	0	0	0	1,300	1,300
Total	500	1,400	3,300	200	300	0	0	4,000	1,700	5,700
Total public and private benefits	1,900		3,300	500		0		5,700		
Grand total public and private benefits	10,200		96,000	3,700		3,700		113,600 (b)		
Grand total (excluding Leonardo)	[illegible]		92,700	[illegible]		3,700		107,900 (b)		

(a) All recreational benefits are public.

(b) Excludes $70,400 benefits for Keansburg, which are evaluated in paragraph 4 and table 3 of Supplement 2 of the original report.

Table K-8 - Summary of estimated annual benefits from shore and hurricane protection (dollars)

Section	Shore protection benefits	Hurricane protection benefits	Total benefits
Madison Township			
Morgan Beach	7,400	11,100	18,500
Thence to Laurence Harbor Cabin Colony	23,100	0	23,100
Laurence Harbor Cabin Colony	4,300	23,700	28,000
Seidler's Beach	18,900	0	18,900
Knollcroft	3,700	0	3,700
Thence to Whale Creek	2,600	0	2,600
Subtotal	60,000	34,800	94,800
Matawan Township			
Cliffwood Beach Cabin Colony	32,300	0	32,300
Thence to Matawan Point	6,100	0	6,100
Subtotal	38,400	0	38,400
Borough of Union Beach	9,500	0	9,500
Borough of Keansburg and East Keansburg	70,400(a)	325,700	396,100
Leonardo	5,700	0	5,700
Total	184,000	360,500	544,500
Total (excluding Leonardo)	178,300	360,500	538,800

(a) For evaluation of this benefit see paragraph 4 and table 3 of Supplement 2 of the original report.

Table 9 - Summary of first cost broken down by shore and hurricane protection (dollars)[a]

Section	Shore protection	Hurricane protection	Total
Madison Township	246,000	527,000	773,000
Matawan Township	131,000	0	131,000
Borough of Union Beach	108,000	0	108,000
Borough of Keansburg and East Keansburg	91,000	3,637,000	3,728,000
Total	576,000	4,164,000	4,740,000

(a) Includes costs of preauthorization studies.

Table 10 - Estimate of annual charges (dollars)[a]

Item	Madison Township	Matawan Township	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
	Shore protection				
Federal					
Interest and amortization	2,800	1,200	600	1,000	5,600
Non-Federal					
Interest and amortization	6,200	3,500	3,300	2,200	15,200
Beach replenishment	8,500	6,800	4,100	1,900[b]	21,300
Subtotal	14,700	10,300	7,400	4,100	36,500
Total shore protection	17,500	11,500	8,000	5,100	42,100
	Hurricane protection				
Federal					
Interest and amortization	13,400	0	0	92,400	105,800
Non-Federal					
Interest and amortization	5,700	0	0	39,100	44,800
Maintenance and beach replenishment	3,500	0	0	48,000	51,500
Subtotal	9,200	0	0	87,100	96,300
Total hurricane protection	22,600	0	0	179,500	202,100
Total shore and hurricane protection	40,100	11,500	8,000	184,600	244,200
Rounded					244,000

(a) Includes costs of preauthorization studies.

(b) Groin maintenance.

Table II - Summary of estimated annual benefits (dollars)

Section and item	Shore protection	Hurricane protection	Total
Madison Township			
Land to be saved from erosion	2,900	-	2,900
Recreational benefit	52,800	-	52,800
Decreased maintenance of structures	2,200	-	2,200
Prevention of erosion damage	2,100	-	2,100
Prevention of damages from tidal flooding	-	34,800	34,800
Subtotal	60,000	34,800	94,800
Matawan Township			
Land to be saved from erosion	3,400	-	3,400
Recreational benefit	33,200	-	33,200
Deceased maintenance of structures	200	-	200
Prevention of erosion damage	1,600	-	1,600
Subtotal	38,400	-	38,400
Borough of Union Beach			
Land to be saved from erosion	2,000	-	2,000
Recreational benefit	6,700	-	6,700
Decreased maintenance of structures	800	-	800
Subtotal	9,500	-	9,500
Borough of Keansburg and East Keansburg			
Land to be saved from erosion	6,000	-	6,000
Recreational benefit	61,300	-	61,300
Decreased maintenance of structures	3,100	-	3,100
Prevention of damages from tidal flooding	-	325,700	396,100
Subtotal	70,400	325,700	396,100
All sections			
Land to be saved from erosion	14,300	-	14,300
Recreational benefit	154,000	-	154,000
Decreased maintenance of structures	6,300	-	6,300
Prevention of erosion damage	3,700	-	3,700
Prevention of damages from tidal flooding	-	360,500	360,500
Grand total	178,300	360,500	538,800
Rounded	178,000	361,000	539,000

Table 12 - Economic justification

Section and item	Annual benefits (dollars)	Annual charges (dollars)	Benefit-cost ratio
Madison Township			
Shore protection	60,000	17,500	3.4
Hurricane protection	34,800	22,600	1.5
Subtotal	94,800	40,100	2.4
Hatawan Township			
Shore protection	38,400	11,500	3.3
Borough of Union Beach			
Shore protection	9,500	8,000	1.2
Borough of Keansburg and East Keansburg			
Shore protection	70,400	5,100	13.8
Hurricane protection	325,700	179,500	1.8
Subtotal	396,100	184,600	2.1
All sections			
Shore protection	178,300	42,100	4.2
Hurricane protection	360,500	202,100	1.8
Grand total	538,800	244,200	-
Rounded	539,000	244,000	2.2

U. S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS
111 EAST 16TH STREET
NEW YORK 3, N. Y.

IN REPLY REFER TO
NANEN-Rb

31 January 1963

SUBJECT: Cost Sharing for Beach Erosion Control Projects under PL 87-874

TO: Division Engineer
U. S. Army Engineer Division, North Atlantic
New York, New York
ATTENTION: NADEN-R

1. Reference is made to Circular No. 1120-2-2 dated 31 December 1962 from Office of the Chief of Engineers, subject as above.

2. The information requested for the following projects which are in the fiscal year 1964 budget, is contained in inclosures 1 through 3.

Fire Island Inlet to Jones Inlet, N. Y.
Fire Island Inlet to Montauk Point, N. Y.
Raritan Bay and Sandy Hook Bay, N. J.

The shore ownership for these projects, which is shown on the plates and figures contained in the inclosures, has been revised on the basis of information obtained from the Long Island State Park Commission, the Suffolk County Department of Public Works, and the Navigation Bureau of the New Jersey State Department of Conservation and Economic Development. A comparison of the old and new apportionment of costs for these projects is given in inclosure 4.

3. Similar information for the Sandy Hook to Barnegat Inlet project, which is not in the fiscal year 1964 budget, will be furnished in February.

M. M. MILETICH
Colonel, Corps of Engineers
District Engineer

3 Incl (in quad)
Project Data
1. Fire Island Inlet to Jones Inlet
2. Fire Island Inlet to Montauk Point
3. Raritan Bay and Sandy Hook Bay
4. Comparison of Apportionments

ATTACHMENT 2

NADEN-R(31 Jan 63) 1st Ind
SUBJECT: Cost Sharing for Beach Erosion Control Projects under PL 87-874

U.S. Army Engineer Division, North Atlantic, New York, New York
7 February 1963

TO: President, The Beach Erosion Board, Washington, D.C.

1. The attached reapportioned first cost for each of the following beach erosion control projects included in the 1964 budget request, reapportioned in accordance with instructions in Circular No. 1120-2-2, dated 31 December 1962, subject as above, has been reviewed by this office and is recommended for approval:

a. Fire Island Inlet to Jones Inlet, N.Y.

b. Fire Island Inlet to Montauk Point, N.Y.

c. Raritan Bay and Sandy Hook Bay, N.J.

2. Your attention is directed to paragraph 3 of the basic letter in which it is stated that the reapportioned first cost for the Sandy Hook to Barnegat Inlet project, not included in the fiscal year 1964 budget request, will be furnished by 15 February 1963.

FOR THE DIVISION ENGINEER:

Allen Jensen

4 Incl
2 cys ea w/d

ALLEN JENSEN
Colonel, CE
Deputy Division Engineer

ENGBE-PD (31 Jan 63) 2d Ind
SUBJECT: Cost Sharing for Beach Erosion Control Projects under PL 87-874

Beach Erosion Board, Corps of Engineers, Washington, D. C., 5 March 1963

TO: Chief of Engineers, Department of the Army, Washington, D. C.
ATTN: ENGCW-PD

1. The Beach Erosion Board considered recomputations of Federal shares of costs submitted with basic letter at its meeting on 28 February 1963.

2. The Board concurs in the recomputation of Federal share of costs allocated to erosion control for Fire Island Inlet to Montauk Point, N. Y. as submitted by the District and Division Engineers except for the East Hampton Maidstone Bathhouse area. For that area the Board was uncertain whether an adequate width of park area exists to provide the buffer zone meeting the criteria for park and conservation areas and proposes examination of additional physical data and determination of status of eligibility by the President of the Board. Accordingly the Board recommends, pending reexamination of data by the President of the Board, approval of the recomputation by substituting 1/2 for 1/3, except that for Fire Island State Park, Smith Point Park and East Hampton Amagansett Beach Club 70 percent would be substituted for 1/3. The original and resulting composite percentages of Federal aid are:

Section	Original	Recomputed
Fire Island Inlet to Moriches Inlet	12.3%	23.1%
Moriches Inlet to Shinnecock Inlet	3.6%	10.1%
Shinnecock Inlet to Southampton	2.6%	6.6%
Southampton to Beach Hampton	4.2%	7.1%

3. The Board concurs in the recomputation of Federal share for Fire Island Inlet to Jones Inlet, N. Y. as submitted by the District and Division Engineers, except for Gilgo Town Beach. The Board noted that between the inhabited sections on the 11,200-foot frontage there is an uninhabited section about 3,400 feet long which it considers eligible for 70 percent Federal share as a park and conservation area, provided that local interests furnish assurances that habitation will not be permitted in this section. Accordingly the Board recommends approval of the recomputation by substituting 70 percent for 1/3 except for about 7,800 feet of frontage at Gilgo Beach for which the Federal share would be 50 percent. The resulting composite percentage of Federal aid based on PL 87-874 would thus be 67.9 percent. In the event necessary assurances cannot be obtained, the composite percentage would be 67.0 percent.

4. In the Raritan and Sandy Hook Bays projects, the remaining beach erosion control work at Keansburg consists only of deferred groins which will not be located in the shore section considered by the District Engineer to be eligible for 70 percent Federal share. The Board recommends approval of the recomputations for Raritan and Sandy Hook Bays, N. J.

on the basis of substitution of 1/2 for 1/3. The original and recomputed composite percentages of Federal shares of costs allocated to the erosion control purpose on this basis are:

Section	Original	Recomputed
Madison Township	30.4%	45.8%
Matawan Township	25.6%	38.0%
Union Beach	15.6%	23.3%
Keansburg and East Keansburg	31.6%	47.4%

FOR THE PRESIDENT:

Milton E. Stevens

MILTON E. STEVENS
Lt. Colonel, CE
Executive

4 Incl
1 cy ea wd

ENGCW-PD (31 Jan 63) 3rd Ind
SUBJECT: Cost Sharing for Beach Erosion Control Projects under PL 87-874

Office, Chief of Engineers, Washington 25, D. C., 14 March 1963

TO: Division Engineer, U. S. Army Engr Div, North Atlantic, New York, N. Y.

1. The Chief of Engineers in accordance with Section 103c of the River and Harbor Act (PL 87-874) approved 23 October 1962, approves the recomputation of the Federal Share of the estimated costs of remaining work on authorized beach erosion control projects, as recommended by the Beach Erosion Board in 2d indorsement ENGBE-PD (31 Jan 63) dated 5 March 1963, above subject, subject to the following comment and additional action.

2. The recomputations of the Federal share of the estimated costs are to be adjusted for final settlement based on actual costs incurred. No Federal funds are to be disbursed on these projects until local interests have furnished additional satisfactory assurances, as for the original requirements of local cooperation and cost-sharing for the projects involved, indicating that they will meet the additional requirements of local cooperation specified in Public Law 87-874 for conservation and park areas that are found to warrant up to 70 percent Federal participation. Copies of such modified or additional assurances should be furnished this office for review and approval in accordance with paragraph 8 of EC 1120-2-2, 31 December 1962.

FOR THE CHIEF OF ENGINEERS:

Incls w/d

JACKSON GRAHAM
Brigadier General, USA
Director of Civil Works

CC: U. S. ARMY ENGINEER DISTRICT, NEW YORK, w/atts

NAD EN-R (31 Jan 63) 4th Ind.
SUBJECT: Cost Sharing for Beach Erosion Control Projects under PL 87-874

U. S. Army Engineer Division, North Atlantic, New York 7, N. Y.,
25 March 1963

TO: District Engineer, U. S. Army Engineer District, New York
ATTN: NANEN-Rb

- [ ] Approved.
- [ ] For review and comment.
- [ ] For necessary action.
- [ ] For your information and guidance.
- [ ] For the information requested.
- [ ] Request reply not later than _____.
- [ ] For information on which to base a reply.
- [ ] For compliance.
- [ ] Direct reply is authorized, copy to this office.
- [X] To note and for necessary action.

FOR THE DIVISION ENGINEER:

PAUL H. JAENICHEN
Chief, Engineering Division

NAD FL 0-199 (15-9) Edition of 1 Apr 57 may be used until exhausted.
1 Jun 58

GPO 953725

COST SHARING FOR BEACH EROSION CONTROL PROJECTS
UNDER PL 87-874

RARITAN BAY AND SANDY HOOK BAY BEACH EROSION CONTROL
AND HURRICANE PROTECTION PROJECT

Revision 15 May 1963

1. Tables 1 through 5 were modified in accordance with 2nd Indorsement dated 5 March 1963 from Beach Erosion Board to basic letter dated 31 January 1963, subject: Cost Sharing for Beach Erosion Projects under PL 87-874, to reflect no public park or conservation area.

2. Tables 6 and 7 were added after modification in accordance with apportionment approved by Beach Erosion Board.

JANUARY 1963

COST SHARING FOR BEACH EROSION CONTROL PROJECTS UNDER
PL 87-874 (1962 MODIFICATION)

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Number	Description
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TABLE 1 - RARITAN BAY AND SANDY HOOK BAY BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT
OWNERSHIP AND USE OF OCEAN FRONTAGE (FEET)(a)
(BASED ON BEST AVAILABLE INFORMATION AS OF JANUARY 1963 APPORTIONMENT AS APPROVED BY THE BEACH EROSION BOARD, 5 MARCH 1963)

Section	Ownership					Private shore publicly used
	Federal	Non-Federal public		Private	Total	
		Park and conservation	Other			
Madison Township						
Morgan Beach	0 (0)	0 (0)	839 (83.9)	161 (16.1)	1,000 (100.0)	0 (0)
Thence to Laurence Harbor Cabin Colony	0 (0)	0 (0)	1,876 (72.2)	724 (27.8)	2,600 (100.0)	724 (27.8)
Laurence Harbor Cabin Colony	0 (0)	0 (0)	0 (0)	1,583 (100.0)	1,583 (100.0)	1,583 (100.0)
Seidler's Beach	0 (0)	0 (0)	0 (0)	1,767 (100.0)	1,767 (100.0)	1,767 (100.0)
Knollcroft	0 (0)	0 (0)	0 (0)	850 (100.0)	850 (100.0)	850 (100.0)
Thence to Whale Creek	0 (0)	0 (0)	0 (0)	1,000 (100.0)	1,000 (100.0)	1,000 (100.0)
Subtotal	0 (0)	0 (0)	2,715 (30.9)	6,085 (69.1)	8,800 (100.0)	5,924 (67.3)
Matawan Township						
Cliffwood Beach Cabin Colony	0 (0)	0 (0)	0 (0)	3,100 (100.0)	3,100 (100.0)	3,100 (100.0)
Thence to Matawan Point	0 (0)	0 (0)	0 (0)	1,700 (100.0)	1,700 (100.0)	1,700 (100.0)
Subtotal	0 (0)	0 (0)	0 (0)	4,800 (100.0)	4,800 (100.0)	4,800 (100.0)
Borough of Union Beach						
Borough beach			983			
Street ends			150			
Balance of frontage				1,867		
Subtotal	0 (0)	0 (0)	1,133 (37.8)	1,867 (62.2)	3,000 (100.0)	300 (10.0)
Borough of Keansburg and East Keansburg[b]						
Borough beaches		0	2,396			
Street ends			75			
Subtotal	0 (0)	0 (0)	2,471 (41.3)	3,517 (58.7)	5,988 (100.0)	3,517 (58.7)

(a) Figures in parentheses are percent of total frontage. This table is similar to table J-15 of the District Engineer's report.

(b) Frontage affected by shore protection improvement only. See paragraph 4 of Supplement 2 of District Engineer's report.

TABLE 2 - RARITAN BAY AND SANDY HOOK BAY BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT
APPORTIONMENT OF FIRST COST OF SHORE PROTECTION(a)
(BASED ON MAY 1960 COST ESTIMATES AND 1962 BEACH EROSION LAW APPORTIONMENT AS APPROVED BY BEACH EROSION BOARD, 5 MARCH 1963)

Item	Morgan Beach	Thence to Laurence Hbr. Cabin Colony	Laurence Hbr. Cabin Colony	Seidler's Beach	Knollcroft	Thence to Whale Creek	Cliffwood Beach Cabin Colony	Thence to Matawan Point	Borough of Union Beach	Borough of Keansburg and East Keansburg(e)	Total
Federal shore											
Percent of total frontage	0	0	0	0	0	0	0	0	0	0	-
Federal contribution (percent)(b)	0	0	0	0	0	0	0	0	0	0	-
Non-Federal public park and conservation areas											
Percent of total frontage	0	0	0	0	0	0	0	0	0	0	-
Federal contribution (percent)(c)	0	0	0	0	0	0	0	0	0	0	-
Other non-Federal public shore											
Percent of total frontage	83.9	72.2	0	0	0	0	0	0	37.8	41.3	-
Federal contribution (percent)(d)	42.0	36.1	0	0	0	0	0	0	18.9	20.6	-
Private shore with public benefit											
Percent of total frontage	0	27.8	100.0	100.0	100.0	100.0	100.0	100.0	10.0	58.7	-
Annual benefits(e)											
Public (dollars)	0	6,300	3,500	17,900	1,700	2,100	29,900	3,300	1,400	37,300	-
Private (dollars)	0	0	800	1,000	2,000	500	2,400	2,800	200	3,600	-
Total (dollars)	0	6,300	4,300	18,900	3,700	2,600	32,300	6,100	1,600	40,900	-
Public (percent of total benefits)	0	100.0	81.4	94.7	45.9	80.8	92.6	54.1	87.5	91.2	-
Federal contribution (percent)(f)	0	13.9	40.7	47.4	23.0	40.4	46.3	27.1	4.4	26.8	
Total Federal contribution (percent)	42.0	50.0	40.7	47.4	23.0	40.4	46.3	27.1	23.3	47.4	
Apportionment of first cost											
First cost (dollars)(e)	19,000	129,000	17,000	41,000	20,000	20,000	77,000	54,000	108,000	91,000	576,000
Preauthorization studies (dollars)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	2,000	2,000	12,000
Net cost (dollars)	18,000	128,000	16,000	40,000	19,000	19,000	76,000	53,000	106,000	89,000	564,000
Federal share	8,000	64,000	7,000	19,000	4,000	8,000	35,000	14,000	25,000	42,000	226,000
Non-Federal share	10,000	64,000	9,000	21,000	15,000	11,000	41,000	39,000	81,000	47,000	338,000

(a) This table is similar to table J-16 of the District Engineer's report.
(b) Based on 100 percent Federal contribution towards the cost of protecting Federal shores.
(c) Based on 70 percent Federal contribution towards the cost of protecting non-Federal public parks and conservation areas.
(d) Based on one-half Federal contribution towards the cost of protecting other non-Federal public shores.
(e) Annual benefits and first costs are from data furnished Board of Engineers for Rivers and Harbors by third indorsement to letter of 29 June 1961.
(f) Based on one-half adjusted by a factor of the ratio of public benefits to total benefits as the Federal contribution towards the cost of protecting private shores with public benefit.

TABLE 3 - RARITAN BAY AND SANDY HOOK BAY BEACH EROSION CONTROL AND HURRICANE PROTECTION PROJECT
SUMMARY OF APPORTIONMENT OF FIRST COST OF SHORE AND HURRICANE PROTECTION IN DOLLARS(a)
(BASED ON MAY 1960 COST ESTIMATES AND 1962 BEACH EROSION LAW APPORTIONMENT AS APPROVED
BY BEACH EROSION BOARD, 5 MARCH 1963)

Section	Construction costs						Lands, easements, and rights-of-way(c)	Total costs	
	Shore protection		Hurricane protection(b)		Total				
	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal		Federal	Non-Federal
Madison Township									
Morgan Beach	8,000	10,000	174,000	71,000	182,000	81,000	3,000	182,000	84,000
Thence to Laurence Harbor Cabin Colony	64,000	64,000	-	-	64,000	64,000	0	64,000	64,000
Laurence Harbor Cabin Colony	7,000	9,000	193,000	79,000	200,000	88,000	3,000	200,000	91,000
Seidler's Beach	19,000	21,000	-	-	19,000	21,000	0	19,000	21,000
Knollcroft	4,000	15,000	-	-	4,000	15,000	0	4,000	15,000
Thence to Whale Creek	8,000	11,000	-	-	8,000	11,000	0	8,000	11,000
Subtotal	110,000	130,000	367,000	150,000	477,000	280,000	6,000	477,000	286,000
Matawan Township									
Cliffwood Beach Cabin Colony	35,000	41,000	-	-	35,000	41,000	0	35,000	41,000
Thence to Matawan Point	14,000	39,000	-	-	14,000	39,000	0	14,000	39,000
Subtotal	49,000	80,000	-	-	49,000	80,000	0	49,000	80,000
Borough of Union Beach	25,000	81,000	-	-	25,000	81,000	0	25,000	81,000
Borough of Keansburg and East Keansburg	42,000	47,000	2,523,000	956,000	2,565,000	1,003,000	125,000	2,565,000	1,128,000
Total	226,000	338,000	2,890,000	1,106,000	3,116,000	1,444,000	131,000	3,116,000	1,575,000

(a) Excluding costs of preauthorization studies. This table is similar to table J-18 of District Engineer's report except for the use of reduced costs taken from data furnished Board of Engineers for Rivers and Harbors by third indorsement to letter of 29 June 1961.

(b) No change in apportionment of hurricane protection costs.

(c) This portion of the hurricane protection phase of the plan of improvement would be a non-Federal cost.

Table 4 - Raritan Bay and Sandy Hook Bay Beach Erosion Control and Hurricane Protection Project[a]
Summary of Final Apportionment of Costs for Total Project
(Based on May 1960 cost estimates and 1962 beach erosion law apportionment as approved by Beach Erosion Board, 5 March 1963)

Section	Federal cost (dollars)	Percent of total	Non-Federal cost (dollars)	Percent of total	Total (dollars)
Madison Township					
Morgan Beach	182,000	68.4	84,000	31.6	266,000
Thence to Laurence Harbor Cabin Colony	64,000	50.0	64,000	50.0	128,000
Laurence Harbor Cabin Colony	200,000	68.7	91,000	31.3	291,000
Seidler's Beach	19,000	47.5	21,000	52.5	40,000
Knollcroft	4,000	21.1	15,000	78.9	19,000
Thence to Whale Creek	8,000	42.1	11,000	57.9	19,000
Subtotal	477,000	62.5	286,000	37.5	763,000
Matawan Township					
Cliffwood Beach Cabin Colony	35,000	46.1	41,000	53.9	76,000
Thence to Matawan Point	14,000	26.4	39,000	73.6	53,000
Subtotal	49,000	38.0	80,000	62.0	129,000
Borough of Union Beach	25,000	23.6	81,000	76.4	106,000
Borough of Keansburg and East Keansburg	2,565,000	69.6	1,128,000	30.4	3,693,000
Total	3,116,000	66.6	1,575,000	33.4	4,691,000

(a) This table similar to table 1 of the report of the Chief of Engineers in the project document.

Table 5 - Supporting Data on Public Park and Conservation Areas
Raritan Bay and Sandy Hook Bay, New Jersey

Keansburg public beach (P21 on Figure F-1^{2}R). This public beach includes the land between Sandy Hook Bay and the borough street parallel to the shore. There are no permanent residences. The beach is suitable for recreational use and provides for the preservation and conservation of the natural resources of the environment. Beach facilities include parking areas and refreshment stands.

(This item not approved by Beach Erosion Board by 2nd Indorsement dated 5 March 1963 to basic letter dated 31 January 1963 from District Engineer, subject: Cost Sharing for Beach Erosion Projects under Public Law 87-874, therefore contents of this document were modified to reflect approved apportionment).

TABLE 6 - ESTIMATE OF ANNUAL CHARGES OF SHORE PROTECTION IN DOLLARS (d)
(BASED ON APPROVED APPORTIONMENT OF COST IN ACCORDANCE WITH 1962 MODIFICATION OF BEACH EROSION LAW

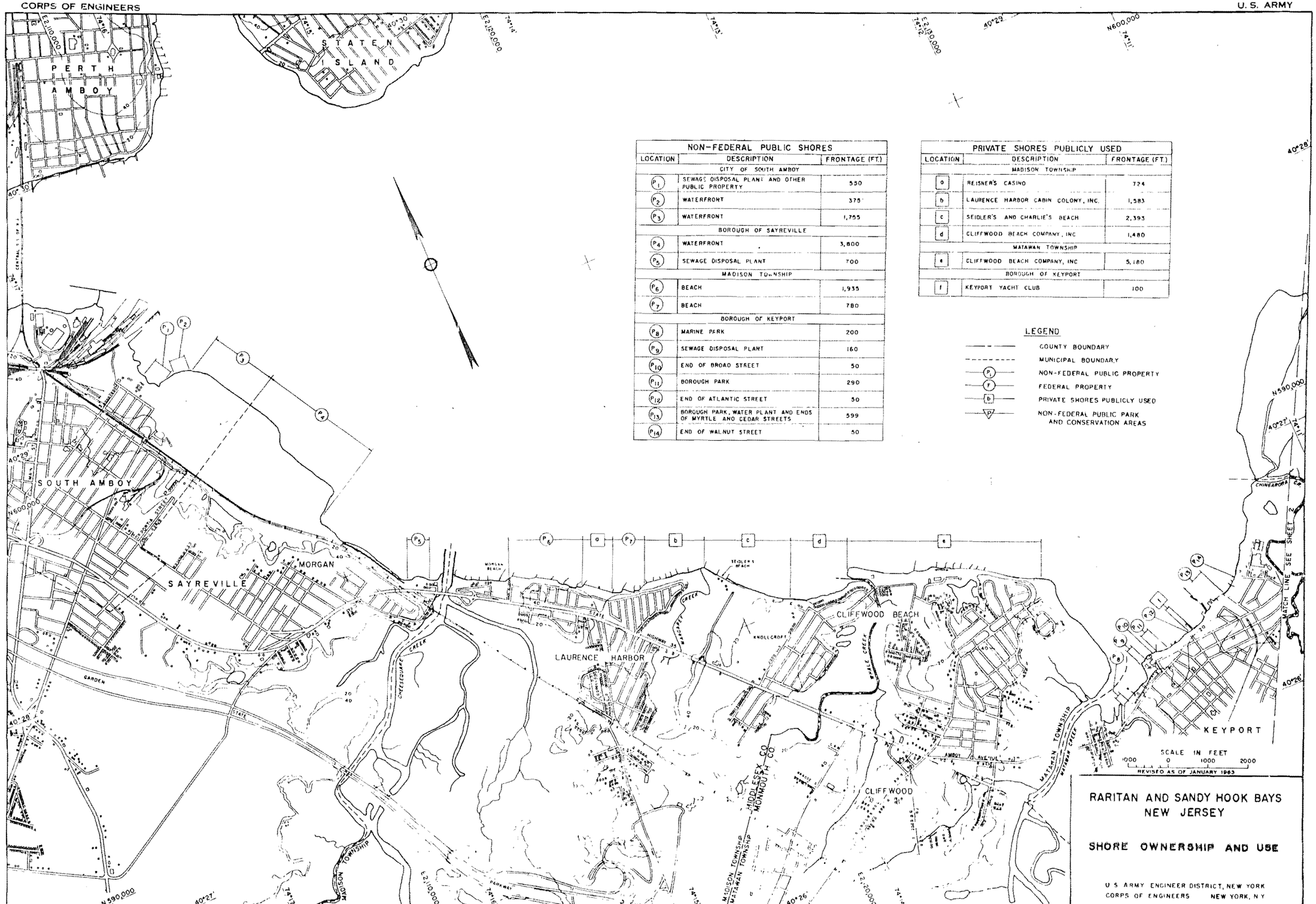
Item	Morgan Beach	Thence to Laurence Hbr. Cabin Colony	Laurence Hbr. Cabin Colony	Seidler's Beach	Knollcroft	Thence to Whale Creek	Cliffwood Beach Cabin Colony	Thence to Matawan Point	Borough of Union Beach	Borough of Keansburg and East Keansburg	Total
Federal											
First cost	8,000	64,000	7,000	19,000	4,000	8,000	35,000	14,000	25,000	42,000	226,000
Preauthorization studies[a]	500	500	500	500	500	500	500	500	1,000	1,000	6,000
Total cost	8,500	64,500	7,500	19,500	4,500	8,500	35,500	14,500	26,000	43,000	232,000
Interest and amortization	300	2,300	300	700	200	300	1,300	500	900	1,600	8,400
Non-Federal											
First cost	10,000	64,000	9,000	21,000	15.000	11,000	41,000	39,000	81,000	47,000	338,000
Preauthorization studies[a]	500	500	500	500	500	500	500	500	1,000	1,000	6,000
Total cost	10,500	64,500	9,500	21,500	15,500	11,500	41,500	39,500	82,000	48,000	344,000
Interest and amortization	400	2,300	300	800	600	400	1,500	1,400	3,000	1,700	12,400
Beach replenishment	700[b]	2,900	900[b]	2,000	900	1,100	4,400	2,400	4,100	1,900[c]	21,300
Annual charges	1,100	5,200	1,200	2,800	1,500	1,500	5,900	3,800	7,100	3,600	33,700
Total annual charges	1,400	7,500	1,500	3,500	1,700	1,800	7,200	4,300	8,000	5,200	42,100

(a) The preauthorization study costs for the beach erosion study are 50 percent Federal and 50 percent non-Federal contributed funds.
(b) This value is that portion of the cost of beach replenishment allocated to shore protection. See tables J-12 and J-13, Statement 1.
(c) Groin maintenance allocated to shore protection.
(d) This table was added after approval of apportionment contained herein and is a revision of Table J19, Statement A1.

Table 7 - Summary of annual charges of shore and hurricane protection in dollars (a)
(Based on approved apportionment of cost in accordance with 1962 modification of beach erosion law)

Section	Shore (c) protection	Hurricane(b) protection	Total
Madison Township			
Morgan Beach	1,400	10,400	11,800
Thence to Laurence Harbor Cabin Colony	7,500	-	7,500
Laurence Harbor Cabin Colony	1,500	12,200	13,700
Seidler's Beach	3,500	-	3,500
Knollcroft	1,700	-	1,700
Thence to Whale Creek	1,800	-	1,800
Subtotal	17,400	22,600	40,000
Matawan Township			
Cliffwood Beach Cabin Colony	7,200	-	7,100
Thence to Matawan Point	4,300	-	4,400
Subtotal	11,500	-	11,500
Borough of Union Beach	8,000	-	8,000
Borough of Keansburg and East Keansburg	5,200	179,500	184,700
Total	42,100	202,100	244,200

(a) Including costs of preauthorization studies.
(b) See Table J20, Statement A1.
(c) See Table J19, Statement A2.
(d) This Table was added after approval of apportionment contained herein and is a revision of Table J21, Statement A1.



NON-FEDERAL PUBLIC SHORES		
LOCATION	DESCRIPTION	FRONTAGE (FT.)
	CITY OF SOUTH AMBOY	
P_1	SEWAGE DISPOSAL PLANT AND OTHER PUBLIC PROPERTY	550
P_2	WATERFRONT	375
P_3	WATERFRONT	1,755
	BOROUGH OF SAYREVILLE	
P_4	WATERFRONT	3,800
P_5	SEWAGE DISPOSAL PLANT	700
	MADISON TOWNSHIP	
P_6	BEACH	1,935
P_7	BEACH	780
	BOROUGH OF KEYPORT	
P_8	MARINE PARK	200
P_9	SEWAGE DISPOSAL PLANT	160
P_{10}	END OF BROAD STREET	50
P_{11}	BOROUGH PARK	290
P_{12}	END OF ATLANTIC STREET	50
P_{13}	BOROUGH PARK, WATER PLANT AND ENDS OF MYRTLE AND CEDAR STREETS	599
P_{14}	END OF WALNUT STREET	50

PRIVATE SHORES PUBLICLY USED		
LOCATION	DESCRIPTION	FRONTAGE (FT.)
	MADISON TOWNSHIP	
a	REISNER'S CASINO	724
b	LAURENCE HARBOR CABIN COLONY, INC.	1,583
c	SEIDLER'S AND CHARLIE'S BEACH	2,393
d	CLIFFWOOD BEACH COMPANY, INC	1,480
	MATAWAN TOWNSHIP	
e	CLIFFWOOD BEACH COMPANY, INC	5,180
	BOROUGH OF KEYPORT	
f	KEYPORT YACHT CLUB	100

LEGEND

- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- P_1 NON-FEDERAL PUBLIC PROPERTY
- F FEDERAL PROPERTY
- b PRIVATE SHORES PUBLICLY USED
- P NON-FEDERAL PUBLIC PARK AND CONSERVATION AREAS

RARITAN AND SANDY HOOK BAYS
NEW JERSEY

SHORE OWNERSHIP AND USE

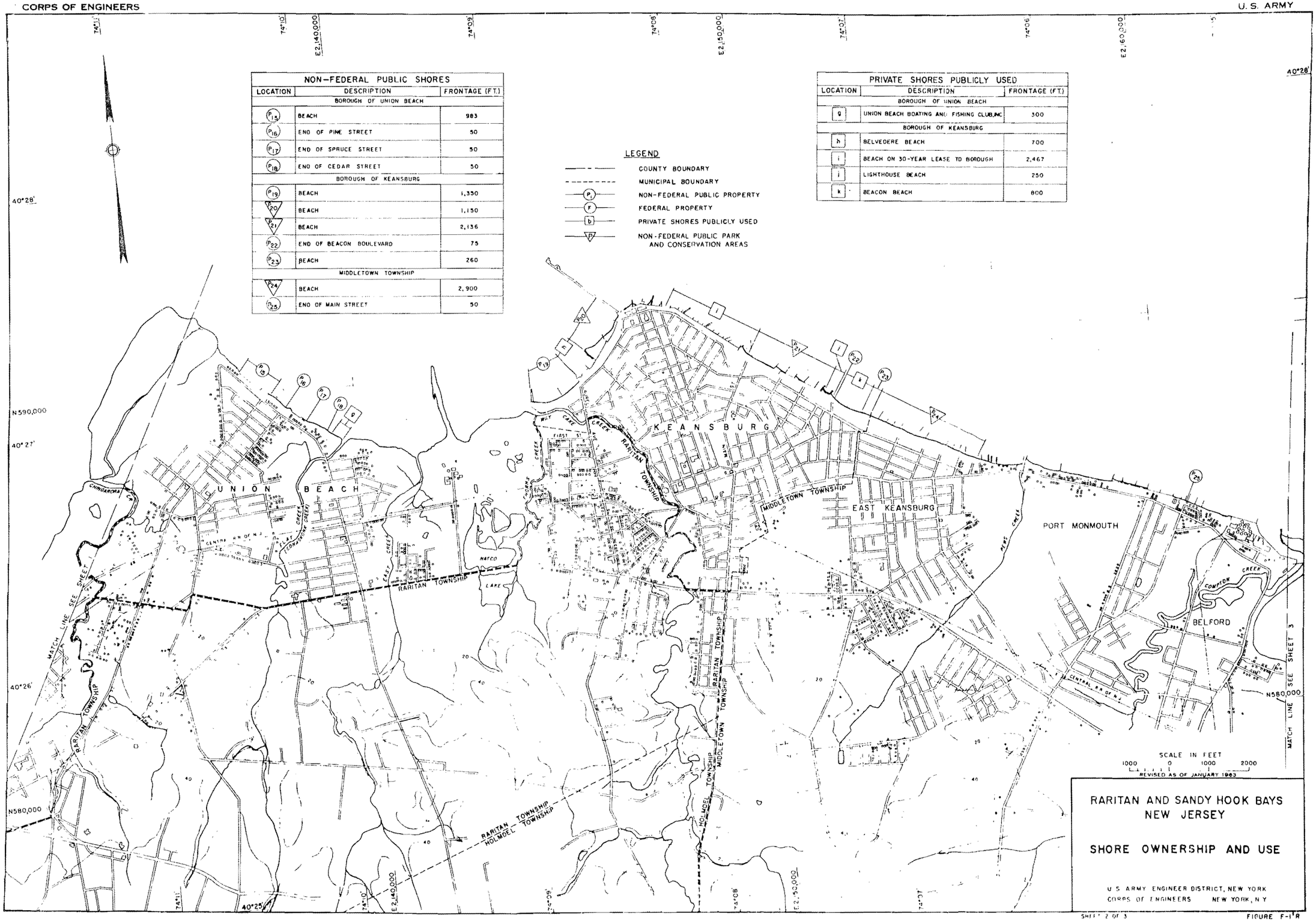
U S ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS NEW YORK, N Y

NON-FEDERAL PUBLIC SHORES		
LOCATION	DESCRIPTION	FRONTAGE (FT.)
	BOROUGH OF UNION BEACH	
P15	BEACH	983
P16	END OF PINE STREET	50
P17	END OF SPRUCE STREET	50
P18	END OF CEDAR STREET	50
	BOROUGH OF KEANSBURG	
P19	BEACH	1,350
P20	BEACH	1,150
P21	BEACH	2,136
P22	END OF BEACON BOULEVARD	75
P23	BEACH	260
	MIDDLETOWN TOWNSHIP	
P24	BEACH	2,900
P25	END OF MAIN STREET	50

PRIVATE SHORES PUBLICLY USED		
LOCATION	DESCRIPTION	FRONTAGE (FT.)
	BOROUGH OF UNION BEACH	
g	UNION BEACH BOATING AND FISHING CLUB, INC	300
	BOROUGH OF KEANSBURG	
h	BELVEDERE BEACH	700
i	BEACH ON 30-YEAR LEASE TO BOROUGH	2,467
j	LIGHTHOUSE BEACH	250
k	BEACON BEACH	800

LEGEND

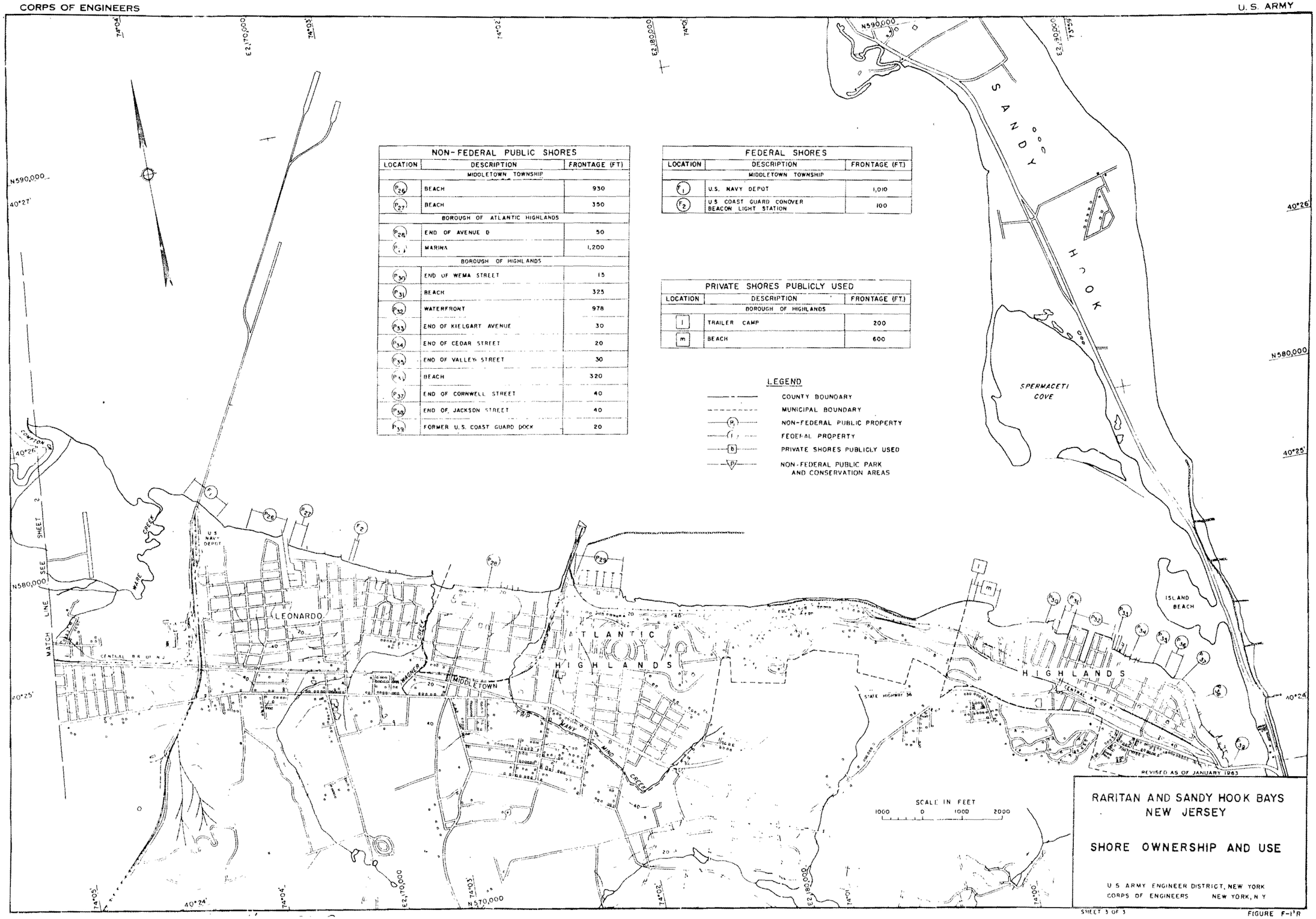
- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- NON-FEDERAL PUBLIC PROPERTY
- FEDERAL PROPERTY
- PRIVATE SHORES PUBLICLY USED
- NON-FEDERAL PUBLIC PARK AND CONSERVATION AREAS



RARITAN AND SANDY HOOK BAYS
NEW JERSEY

SHORE OWNERSHIP AND USE

U.S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS NEW YORK, N.Y.



NON-FEDERAL PUBLIC SHORES

LOCATION	DESCRIPTION	FRONTAGE (FT)
	MIDDLETOWN TOWNSHIP	
P26	BEACH	930
P27	BEACH	350
	BOROUGH OF ATLANTIC HIGHLANDS	
P28	END OF AVENUE D	50
P29	MARINA	1,200
	BOROUGH OF HIGHLANDS	
P30	END OF WEMA STREET	15
P31	BEACH	325
P32	WATERFRONT	978
P33	END OF KIELGART AVENUE	30
P34	END OF CEDAR STREET	20
P35	END OF VALLEY STREET	30
P36	BEACH	320
P37	END OF CORNWELL STREET	40
P38	END OF JACKSON STREET	40
P39	FORMER U.S. COAST GUARD DOCK	20

FEDERAL SHORES

LOCATION	DESCRIPTION	FRONTAGE (FT.)
	MIDDLETOWN TOWNSHIP	
F1	U.S. NAVY DEPOT	1,010
F2	U.S. COAST GUARD CONOVER BEACON LIGHT STATION	100

PRIVATE SHORES PUBLICLY USED

LOCATION	DESCRIPTION	FRONTAGE (FT.)
	BOROUGH OF HIGHLANDS	
l	TRAILER CAMP	200
m	BEACH	600

LEGEND

- COUNTY BOUNDARY
- MUNICIPAL BOUNDARY
- (P) NON-FEDERAL PUBLIC PROPERTY
- (F) FEDERAL PROPERTY
- (b) PRIVATE SHORES PUBLICLY USED
- (P) NON-FEDERAL PUBLIC PARK AND CONSERVATION AREAS

RARITAN AND SANDY HOOK BAYS NEW JERSEY

SHORE OWNERSHIP AND USE

U.S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS NEW YORK, N.Y.

SHEET 3 OF 3

FIGURE F-13R

NANEN-Rb

2 November 1962

H. Mat Adams, Commissioner
Department of Conservation and
Economic Development
State of New Jersey
205 West State Street
Trenton 25, New Jersey

Dear Mr. Adams:

Funds have been made available to this office for engineering and design and for initiation of construction in the fiscal year ending 30 June 1963 of the Raritan Bay and Sandy Hook Bay beach erosion control and hurricane protection project authorized by Congress in the Flood Control Act of 1962 (Public Law 87-874, 87th Congress).

Before work can be undertaken on the project, it is necessary that formal assurances of local cooperation is furnished by the State. In order to expedite the execution of such assurances, a sample form, which is subject to approval by our higher authority, is inclosed for your consideration in preparing a draft of the required formal assurances. It would be appreciated if your draft were furnished for our approval as soon as possible. While the assurance is of a general nature, it is to be noted that the local cooperation to be effected at any one time need be only to the extent required to match the Federal activity.

Arrangements have been made with Mr. James K. Rankin, Chief Engineer, Bureau of Navigation, for a meeting in his office on 5 November 1962 to discuss further details regarding this project.

Yours truly,

1 Incl
Sample form of
assurance

M. M. MILETICH
Colonel, Corps of Engineers
District Engineer

NANEN-Rb 20 December 1962

H. Mat Adams, Commissioner
Department of Conservation
and Economic Development
State of New Jersey
205 West State Street
Trenton 25, N. J.

Dear Mr. Adams:

Reference is made to my letter to you dated 2 November 1962, the meeting with Mr. James K. Rankin, Chief Engineer, Bureau of Navigation, on 5 November 1962, and the letter to Mr. Rankin, dated 6 November 1962 regarding assurances of local cooperation for the Raritan Bay and Sandy Hook Bay beach erosion control and hurricane protection project. In order not to delay initiation of construction, it would be appreciated if you would forward a draft of the assurances at an early date so that it may be reviewed for the approval of appropriate authority prior to its execution.

In accordance with the provisions of local cooperation contained in the authorizing document (H. Doc. 624, 87th Cong.) and as quoted in the sample assurance inclosed with my letter of 2 November; local interests, in addition to other items of local cooperation are required to make a cash contribution in the amount of a certain percentage of the cost of the project. At the time of preparation of the authorizing document, the estimated local cost was 35.2 percent of the total first cost, a sum then estimated at $1,651,000. The items of local cooperation involved in the estimated local cost were all lands, easements and rights-of-way, all alterations and relocations of buildings and other structures, and a cash contribution then estimated at $1,520,000.

The final cost to local interest will be made after actual costs and other values of items of local cooperation have been determined. This final cost determination will be made with due regard to change in

public use and ownership and other changes prior to construction such as the change in the beach erosion law as contained in the 1962 River and Harbor and Flood Control Omnibus Act. For your information a tentative recomputation of costs based on its authorizing document show that the change in the law will result in a slight reduction in the local share of the cost of the project.

In order to enable the State to effect the necessary local cooperation to match the Federal activity in this fiscal year, the following schedule of operations is submitted. This schedule has been prepared in such a manner as to enable expenditure of all of the Federal funds appropriated for fiscal year 1963 and the matching local funds on the basis of two continuing contracts covering the Madison Township, Mattawan Township and Keansburg-East Keansburg areas. The selection of these areas for initiation of construction was mutually made at the meeting with Mr. Rankin on 5 November.

Completion of field surveys	30 Jan 63
Coordination with local interests	15 Feb 63
Establishment of lands, easements and rights-of-way requirements, preparation of necessary maps, and negotiation with local interests	28 Feb 63
Completion of contract plans and specifications	1 Mar 63
Cash contribution to Federal Government	5 Mar 63
Advertising of jobs	5 Mar 63
Opening of bids	25 Mar 63
Furnishing lands, easements and rights-of-way	29 Mar 63
Award of contracts	1 Apr 63
Initiate construction	10 Apr 63

The work in the aforementioned areas will principally involve beach fill and groin and levee construction under Federal contracts at a total previously estimated cost of $4,585,000 ($763,000 for Madison Township, $129,000 for Matawan Township, and $3,693,000 for the Keansburg-East Keansburg area). Based on the authorizing document the non-Federal share of construction costs for these areas, exclusive of previously estimated non-Federal costs for lands and for relocations is 41.9 percent for Madison Township, 74.4 percent for Matawan Township, and 28.5 percent for Keansburg-East Keansburg area, or a weighted average of 32.1 percent. Based on Federal appropriations for fiscal year 1963 in the amount of $350,000 for initiation of project construction, the amount of cash contribution from local interest for fiscal year 1963 is $166,000.

NANEN-Rb 20 December 1962

H. Mat Adams, Commissioner Dept. of Cons. & Econ. Dev., Trenton, N. J.

Accordingly, it is requested that a check in the amount of $166,000 payable to the order of the Treasurer of the United States be forwarded to this office, Attention: Finance and Accounting Officer, as soon as practicable but not later than 20 March 1963.

In order to be able to accomplish the work in accordance with the schedule outlined herein, close and continuing coordination of the various phases of the project will be effected with your Department by this office. We plan to keep you constantly informed of all our activities in connection with this project.

Please advise me concerning any questions you may have in this matter.

Yours truly,

M. M. MILETICH
Colonel, Corps of Engineers
District Engineer

STATE OF NEW JERSEY
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
OFFICE OF THE COMMISSIONER
TRENTON 25

Colonel M. M. Miletich
District Engineer
Corps of Engineers
111 East 16th Street
New York 3, New York

RE: Raritan Bay - Sandy Hook Bay Hurricane and Shore Protection Project

Dear Colonel:

With reference to your letter of December 20, 1962, File NANEN-Rb, 1st paragraph, we enclose four (4) copies of State Assurance Agreement for your review prior to execution. This draft dated November 5, 1962 was prepared following meeting with your representatives and contains the decisions reached at that time. It has been reviewed by this Department and the Attorney General's Office and no changes have been made. Please advise if in order for execution.

It is the intent of the State to furnish the local cash cooperation of $166,000.00 in full to your office with reimbursement of municipal shares to the State. We have just been advised that it will be necessary to arrange a contract with your office as basis for payment.

We will prepare and forward draft of a suitable agreement for your approval prior to execution.

Sincerely yours,

H. Mat Adams
Commissioner

HMA:RS

January 10, 1963

ATTACHMENT A5

U. S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS
111 EAST 16TH STREET
NEW YORK 3, N. Y.

IN REPLY REFER TO
NANEN-Rb

28 January 1963

SUBJECT: Assurance of Local Cooperation, Beach Erosion Control and Hurricane Protection Project, Raritan Bay and Sandy Hook Bay, New Jersey

TO: Division Engineer
U. S. Army Engineer Division, North Atlantic
New York, N. Y.
ATTENTION: NADRE-A

1. Submitted herewith for approval is a draft of an assurance of local cooperation forwarded by the State of New Jersey on 10 January 1963 for the beach erosion control and hurricane protection project of Raritan Bay and Sandy Hook Bay, New Jersey. The draft is generally as suggested to the State by this office.

2. Field surveys for use in connection with the Design Memorandum are now being made. Formal assurances will be requested from the State as soon as the draft is approved. In order not to delay initiation of construction it is desired that approval of the draft be expedited in order that such assurances be effected at an early date.

1 Incl (in dupe)
Draft of Assurance

M. M. MILETICH
Colonel; Corps of Engineers
District Engineer

ATTACHMENT A6

NADRE-A (28 Jan 63) 1st Ind
SUBJECT: Assurance of Local Cooperation, Beach Erosion Control and Hurricane Protection Project, Raritan Bay and Sandy Hook Bay, New Jersey

U. S. Army Engineer Division, North Atlantic, New York, New York
21 February 1963

TO: District Engineer, U. S. Army Engineer District, New York
New York, N. Y.

1. We note that the subject draft of assurances of local cooperation does not comply strictly with the requirements of House Document 464, 87th Congress, 2nd Session, in that it does not include a provision for local interests to obtain the prior approval of the Chief of Engineers of plans and specifications for work on the beach-protection phase of the Matawan-Union Beach-Madison projects, if undertaken separately from the recommended combined improvement. It is apparent that this omission is based on the consideration that this work will be accomplished by the Corps and, therefore, this provision is not applicable. If this is the case, then we concur in this view. However, if there is any question as to who will perform this work, the above requirement, which is contained in paragraph 8. b (b) of the report of the Chief of Engineers in the above cited House Document 464, will be included in the assurances of local cooperation. The State should be specifically advised that the acceptance of the assurances is subject to the above.

2. Upon receipt of properly executed assurances, the State should be advised that the assurances are accepted and that the requirements of local cooperation can be met only by actual performance. A copy of the letter to the State should be furnished for our files.

3. In future submissions to this Division for approval of assurances for local cooperation which are not in strict compliance with the pertinent Act of Congress, it is desired that an explanation for the deviation be furnished, together with the comments and recommendations of the District Engineer.

FOR THE DIVISION ENGINEER:

for [illegible]
[illegible]
Colonel, [illegible]
Deputy Division Engineer

1 Incl
n/c

State of New Jersey

DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
TRENTON 25

DIVISION OF RESOURCE DEVELOPMENT

PLEASE ADDRESS REPLY TO:

April 4, 1963

Navigation Bureau
137 E. State St.
Trenton 25, N.J.

U. S. Army Corps of Engineers
New York District Engineers
111 East 16th Street
New York, New York

ATTENTION: Mr. Frank Panuzio

RE: Project 33.01:420-401-880; Federal Project for Hurricane and Shore Protection, Raritan Bay and Sandy Hook Bay Shorefronts.

Gentlemen:

Further reference is made to Commissioner H. Mat Adams' letter of March 28, 1963 in reply to your letter of March 7, 1963, File NANEN.

We enclosed executed copy of Assurance that was to have been enclosed in the above mentioned letter

Very truly yours,

BUREAU OF NAVIGATION

BY: James K. Rankin
Chief Engineer

JKR:ms
enc.

ATTACHMENT A7

NANEN

11 April 1963

Ref: Approved Assurance - Raritan and Sandy Hook Bays - Hurricane and Shore Protection Project

Mr. H. Mat Adams, Commissioner
Office of the Commissioner
State of New Jersey
Department of Conservation & Economic Development
Trenton 25, New Jersey

Dear Mr. Adams:

The executed assurance forwarded by you with your letter of 28 March 1963 on referenced subject is accepted for the United States of America this date, by the undersigned as District Engineer, United States Army Engineer District, New York. However, the requirements of local cooperation can be met only by actual performance. Inclosed is a copy of the executed assurance.

The copies of draft agreement required to facilitate payment of cash contribution for fiscal year 1963, forwarded with your letter is presently under review and will be the subject of a separate letter.

Yours truly,

M. M. MILETICH
Colonel, Corps of Engineers
District Engineer

1 Incl (in dupe)
Executed Assurance

ATTACHMENT A8

NANEN 12 April 1963

SUBJECT: Assurance of Local Cooperation - Beach Erosion and Hurricane Protection Project, Raritan Bay and Sandy Hook Bay, N. J.

TO: Division Engineer
U. S. Army Engineer Division, North Atlantic
New York, N. Y.
ATTN: NADRE-A

1. Reference is made to the following:

a. NAN letter, dated 28 January 1963 to NAD, subject as above and 1st Indorsement dated 21 February 1963 to NAN approving the draft of assurance.

b. NAN letter, dated 7 March 1963 to State of New Jersey, Department of Conservation and Economic Development on the above subject forwarding approved draft of assurance for execution by the State on the basis that all work under this project will be performed by the Corps of Engineers.

2. A copy of the instrument executed by the Commissioner, New Jersey State Department of Conservation and Economic Development, provides for the conditions of local cooperation as required by the authorizing document on the basis that all work will be done by the Corps of Engineers is inclosed. These assurances were accepted for the United States by the District Engineer, U. S. Army Engineer District, New York on 12 April 1963.

3. The State of New Jersey was notified on 11 April 1963 that its assurance of local cooperation was accepted and a copy of letter of notification is attached.

2 Incl
1. Ltr frm Commissioner, N.J. State Dept. of Conservation & Eco. Development w/assurance, 28 March 1963
2. Cy ltr to Commissioner, N.J. State Dept. of Conservation & Eco. Development, dtd 11 April 1963

M. M. MILETICH
Colonel, Corps of Engineers
District Engineer

NANEN

8 May 1963

Signed Assurance -
Raritan and Sandy Hook
Bays - Hurricane and
Shore Protection Project

Mr. James K. Rankin
Chief Engineer, Navigation Bureau
N. J. State Department of Conservation
and Economic Development
137 East State Street
Trenton 25, N. J.

Dear Mr. Rankin:

Reference is made to letter from this office to Mr. H. Mat Adams dated 11 April 1963 advising acceptance of assurances for the subject project and forwarding a copy of the assurance as signed by Mr. Adams for the State of New Jersey.

Copy of the assurance with the acceptance indorsement by Colonel Miletich who accepted assurance on 11 April 1963 for the United States of America is forwarded herewith.

Please advise if the assurance as now executed will be adequate for payment of cash contribution for the subject project without any further agreement.

Yours truly,

1 Incl (in trip)
Signed Assurance

CHARLES K. PANISH
Chief, Engineering Division

ASSURANCE of Local cooperation for the beach erosion control and hurricane protection project for Raritan Bay and Sandy Hook Bay, New Jersey furnished in pursuance of the Flood Control Act of 1962 (Public Law 87-874, 87th Congress).

WHERAS, By Act of Congress approved 23 October 1962 (Public Law 87-874, 87th Congress), designated herein as the "Flood Control Act of 1962", a project for beach erosion control and hurricane protection for Raritan Bay and Sandy Hook Bay, New Jersey was authorized to be constructed substantially in accordance with the recommendations of the Chief of Engineers in his report dated 30 April 1962, which report is contained in House Document No. 464, 87th Congress, 2d Session; and

WHEREAS, It is recommended by the Chief of Engineers in said House Document No. 464 that adoption of said project be conditioned upon the furnishing by local interests of assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas, necessary for construction of the project;

(2) Accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

(3) Bear the percentage of total first cost for each segment as shown in Table 1 of the report of the Chief of Engineers, to consist of the items listed in (1) and (2) above and a cash contribution to be paid either in a lump sum prior to initiation of construction or in installments prior to commencement of pertinent items, in accordance with

construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made after actual costs and values have been determined;

(4) Hold and save the United States free from damages due to the construction works;

(5) Maintain all the works after completion in accordance with regulations precribed by the Secretary of the Army;

(6) Maintain during the economic life of the project continued public ownership of the non-Federal publicly owned shores and continued availability for public use of privately owned shore equivalent to that upon which the recommended Federal participation is based;

(7) Control water pollution to the extent necessary to safeguard the health of bathers;

(8) Construct, concurrently with the recommended beachfill, suitable parking fields and bathhouses open to all on equal terms; and

(9) At least annually inform interest affected that the hurricane improvements will not provide substantial protection from bay surges higher in elevation than that of hurricane "Donna", 12 September 1960;

WHEREAS, by R.S. 12:6A of New Jersey, as amended, and Chapter 448 of New Jersey Laws of 1948, the State of New Jersey is authorized to participate in programs for beach protection and prevention and control of beach erosion; and

WHEREAS, The Department of Conservation and Economic Development of the State of New Jersey is authorized by said R.S. 12:6A, as amended, to perform beach protection work along Raritan Bay and Sandy Hook Bay; and

WHEREAS, said Chapter 448 provides for formulation by the State of comprehensive policies for the prevention and control of beach erosion;

NOW THEREFORE, in compliance with the conditions of local cooperation above recited and provided that the Legislature of the State of New Jersey shall appropriate the necessary funds therefor, the Commissioner of the Department of Conservation and Economic Development, in pursuance of said R.S. 12:6A, as amended, and Chapter 448 of the Laws of 1948, hereby assures the Secretary of the Army as follows:

(1) The State will provide without cost to the United States all lands, easements, and rights-of-way, including borrow areas, necessary for construction of the project.

(2) The State will accomplish without cost to the United States all alterations and relocations of buildings, streets, storm drains, utilities and other structures made necessary by the construction;

(3) The State will bear the percentage of total first cost for each segment as shown in Table 1 of the report of the Chief of Engineers, to consist of the items listed in (1) and (2) above and a cash contribution to be paid either in a lump sum prior to initiation of construction or in installments prior to commencement of pertinent items, in accordance with construction schedules as required by the Chief of Engineers, the final apportionment of cost to be made on the basis of federal laws then existing after actual costs and values have been determined;

(4) The State will hold and save the United States free from damages due to construction works;

(5) The State will maintain all the works after completion in accordance with the regulations prescribed by the Secretary of the Army;

(6) The State will maintain during the economic life of the project continued public ownership of the non-Federal publicly owned shores and continued availability for public use of privately owned shore equivalent to that upon which the recommended Federal participartion is based;

(7) The State will control water pollution to the extent necessary to safeguard the health of bathers;

(8) The State will construct, concurrently with the recommended beach fill, suitable parking fields and bathhouses open to all on equal terms;

(9) The State will at least annually inform interests affected that the hurricane improvements will not provide substantial protection from bay surges higher in elevation than that of hurricane "Donna" 12 September 1960; and

(10) That both the State and local interests will adopt appropriate laws prior to construction, to provide for the preservation of the restored beaches and protective works;

In undertaking these local assurances, it is understood that the State will be required only to effect such local cooperation at any one time to the extent required to match the Federal Activity.

IN WITNESS WHEREOF, I have set my hand and the Great Seal of the State of New Jersey this 3rd day of April 1963

19

STATE OF NEW JERSEY

ATTEST:

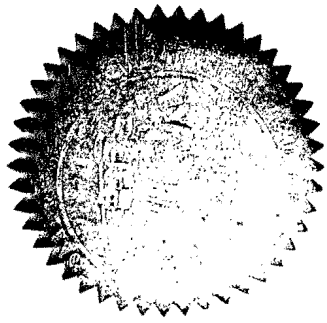
BY:

Chief Engineer, Bureau of Navigation

Commissioner of Department of Conservation and Economic Development.

STATE OF NEW JERSEY)
COUNTY OF MERCER) SS:
CITY OF TRENTON)

On this 3rd day of April in the year One Thousand Nine Hundred Sixty-three, before me, the subscriber, personally came H. Mat Adams to me known and known to me to be the Commissioner of Department of Conservation and Economic Development of the State of New Jersey and the same person described in and who executed the within instrument and he duly acknowledged that he executed the same as such Commissioner pursuant to the Statutes herein as therein provided.



Robert J. Burkhardt

ROBERT J. BURKHARDT
SECRETARY OF STATE

ASSURANCE of Local cooperation for the beach erosion control and hurricane protection project for Raritan Bay and Sandy Hook Bay, New Jersey furnished in pursuance of the Flood Control Act of 1962 (Public Law 87-874, 87th Congress). signed on the 3rd day of April 1963 by H. M. Adams, Commissioner of Department of Conservation and Economic Development for the State of New Jersey is accepted for the United States of America on this 11th day of April 1963 by:

Colonel, Corps of Engineers
District Engineer
New York Engineer District, New York

NANCT-F

8 May 1963

State of New Jersey
Department of Conservation and Economic Development
Division of Resource Development
137 E. State Street
Trenton, New Jersey

ATTENTION: Chief, Navigation Bureau

Gentlemen:

Inclosed is executed invoice in the amount of $166,000.00 required in connection with local cash cooperation under the Raritan Bay - Sandy Hook Bay Project.

Yours truly,

1 Incl
Invoice dtd 1 May 63

L. J. WILCOX
Comptroller

State of New Jersey

DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
TRENTON 25

DIVISION OF RESOURCE DEVELOPMENT

PLEASE ADDRESS REPLY TO:
137 E. State Street
Trenton, N. J.

May 1, 1963

District Engineer,
Corps of Engineers,
111 East 16th Street,
New York, New York

Att: Frank Panuzio

Re: PROJECT NO. 32:01: 420-401-880; RARITAN BAY AND SANDY HOOK BAY

Dear Sir:

Enclosed for execution and return is State bill form covering local cash cooperation in amount of $166,000.00 under the Raritan Bay-Sandy Hook Bay project.

Very truly yours,

For Chief, Navigation Bureau

By James K. Rankin
Chief Engineer

JKR/avb
enc.

- ... (REV. 8/60) INSTRUCTIONS – REVERSE SIDE

ORIGINAL INVOICE

STATE OF NEW JERSEY

FOR USE OF ACCOUNTING BUREAU

1. OBLIGATION (UA, PA, CO.)	2. FISCAL YEAR	TO BE COMPLETED BY VENDOR *(Print or Type)*
		6. DEPARTMENT – INSTITUTION: CONS. & ECON. DEV.
		7. DIVISION: RESOURCE DEVELOPMENT
3. ACCOUNT TITLE: BEACH PROTECTION		8. BUREAU: NAVIGATION
		9. PURCHASE ORDER NO. HR OJ.32:01
4. STATE AGENCY BILL NUMBER		10. ACCOUNT NUMBER: 420-401-880
5. SCHEDULE NUMBER		11. BILLING DATE 5/1/63 — 12. TERMS net

13. VENDOR'S NAME	14. ADDRESS	15. VENDOR'S INVOICE NUMBERS
TREASURER OF THE UNITED STATES	Corps of Engineers	
	111 East 16th Street	
	New York, New York	

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	AMOUNT
1.			Local cash cooperation required in fiscal year 1963		
			pursuant to the Flood Control Act of 1962 (P.L.87-8-74)		
			for a project for beach erosion control and hurricane		
			protection for Raritan Bay and Sandy Hook Bay as set		
			forth in House Document No. 464, 87th Congress, 2nd		
			Session.		$166,000.00

CERTIFICATION

I certify that the above articles have been received and/or services rendered as stated herein.

SIGNATURE OF STATE CERTIFYING EMPLOYEE

APPROVED FOR $ 166,000.00

APPROVAL OFFICER

TITLE

DECLARATION BY VENDOR OR PERSON RENDERING SERVICE

I do solemnly declare that the within bill is correct in all its particulars; that the articles have been furnished or services rendered as stated therein, and that no bonus has been given or received on account of said bill.

SIGN HERE

OFFICIAL POSITION

DATE , 19

FOR USE OF ACCOUNTING BUREAU

NANEN-Ds

17 May 1963

Mr. James K. Rankin,
Chief Engineer, Bureau of Navigation,
New Jersey Department of Conservation
& Economic Development
137 East State Street
Trenton 25, New Jersey

Re: Raritan Bay & Sandy Hook Bay Beach Erosion & Hurricane Protection Project, Laurence Harbor to Matawan Point, New Jersey

Dear Sir:

Transmitted herewith under separate cover are copies of survey data and preliminary layouts of areas in referenced project as requested by you at field inspection of project site with representatives of this office on 9 May 1963.

The above transmittal contains the following inclosures:

1. One print of topographic survey of area in the vicinity of Morgan Beach at scale of 1"=50', marked Inclosure No. 1.

2. One set of 5 prints of controlled aerial mosaics of the project site at scale of 1"=100', marked Inclosure No. 2.

3. One set of 5 prints of beach cross-sections at scale of 1"=100' horizontal to 1"=10' vertical, marked Inclosure No. 3.

4. One print of proposed road raising profiles at scale of 1"=50' horizontal to 1"=5' vertical, marked Inclosure No. 4.

5. One advance print of contract drawing showing proposed improvements at Morgan Beach at scale of 1"=50', marked Inclosure No. 5.

NANEN-Ds
Mr. James K. Rankin

17 May 1963

6. One set of 14 sheets of base line data and station descriptions, marked Inclosure No. 6.

The above information is forwarded in order to assist you in the development of local cooperation requirements for the referenced project.

Yours truly,

CHARLES K. PANISH
Chief, Engineering Division

6 Incl (und sep cov)

NANEN-Rp

28 May 1963

Ref: Raritan Bay and Sandy Hook Bay
Beach Erosion & Hurricane Project,
Lawrence Harbor to Matawan Point
Local Cooperation Requirements

Mr. James K. Rankin
Chief Engineer, Navigation Bureau
N. J. Department of Conservation
and Economic Development
137 East State Street
Trenton 25, N. J.

Dear Mr. Rankin:

Reference is made to assurances of local cooperation on the above project executed by you and Mr. H. Mat Adams on 3 April 1963 and to letter from this office to Mr. Adams dated 11 April 1963 advising acceptance of these assurances.

Submitted herewith for your information in obtaining the lands, easements and rights-of-way and accomplishing the acquisitions, alterations and relocations of buildings, streets and other structures made necessary for construction of the project are five drawings of local cooperation requirements Nos. CC-RS-101, 102, 103, 104 and 105.

Permanent easements for this project total about 39.2 acres including 1.1 acres for ponding, and temporary easements total about 1.9 acres. Local interests must also acquire two structures located on the project site. Work to be performed by local interests consists of raising a service road, an intersecting street and the utilities along these streets, raising three buildings and a power line and filling in a low area. All of the acquisitions and work to be performed by local interests are shown on the inclosed drawings.

In order that this work may be placed under contract expeditiously, your advice is requested as to the earliest practicable date that the rights-of-entry for the project can be obtained. On or about 10 June we will furnish you with a final estimate of project requirements for local funds.

ATTACHMENT A14

NANEN-Rp 28 May 1963

SUBJECT: Raritan Bay and Sandy Hook Bay, Beach Erosion & Hurricane Project, Lawrence Harbor to Matawan Point, Local Cooperation Requirements

We would appreciate the coordination of this matter with the pertinent State Departments and the local communities involved. Please feel free to call upon this office for any additional information.

Yours truly,

1 Incl (in dupe)
Dwg. Local Coop. Req.
CC-RS-101, 102, 103, 104,
105 (5 sheets)

M. M. MILETICH
Colonel, Corps of Engineers
District Engineer

Item	Description	Quantity
A	Proposed Area of Permanent Rights 5.84 ac	
B	Proposed Area of Temporary Rights 1.17 ac	
C	Proposed Area of Temporary Rights 4.1 ac	
	Deleted Temporary Rights	

WORK TO BE PERFORMED BY LOCAL INTERESTS

ITEM	DESCRIPTION	QUANTITY
D	Service Road to be raised, Utilities to be raised as req'd	
E	Clubhouse Walk to be raised, Utilities to be raised as req'd	
F	Frame Commercial building to be raised	
G	Frame Garage to be raised	
H	1 St. Frame to be raised	
I	Areas to be filled to El 15.0' MSL	
J	Power Lines to be raised	
N	New 9"x 20" Curb	
P	Highway Guard Rails	

Point	Northing	Easting	Bearing	Distance	Remarks
1	593,673	214,359			
92	593,534	214,430	92-93	269.60	S03-50-33E
93	593,266	214,449	93-94	53.76	N89-19-56E
94	593,309	214,451	94-95	17.98	S57-40-49E
95	593,269	214,539	95-96	77.10	S33-53-46W
96	593,205	214,495	96-97	43.00	Due South
97	593,160	214,435	97-98	96.08	S54-23-57E
8	593,439	214,314	8-9	145.29	S11-[illegible]
9	593,314	214,514	9-10	215.08	S89-51-31E
10	593,266	214,640	10-11	244.39	S89-02-10E
11	593,401	214,914	11-61	26.58	S34-17-19W
61	593,389	214,893	61-62	[illegible]	S54-41-11E
62	593,356	214,916	62-63	33.00	S54-29-59W
63	593,[illegible]	214,[illegible]			
98	593,973	214,752	98-99	251.20	N13-33-17E
99	593,973	214,819	99-100	20.00	Due North
100	593,993	214,819	100-101	255.21	N17-47-44E
101	593,242	214,[illegible]	101-[illegible]	195.30	S55-00-29E

STATION 0+00

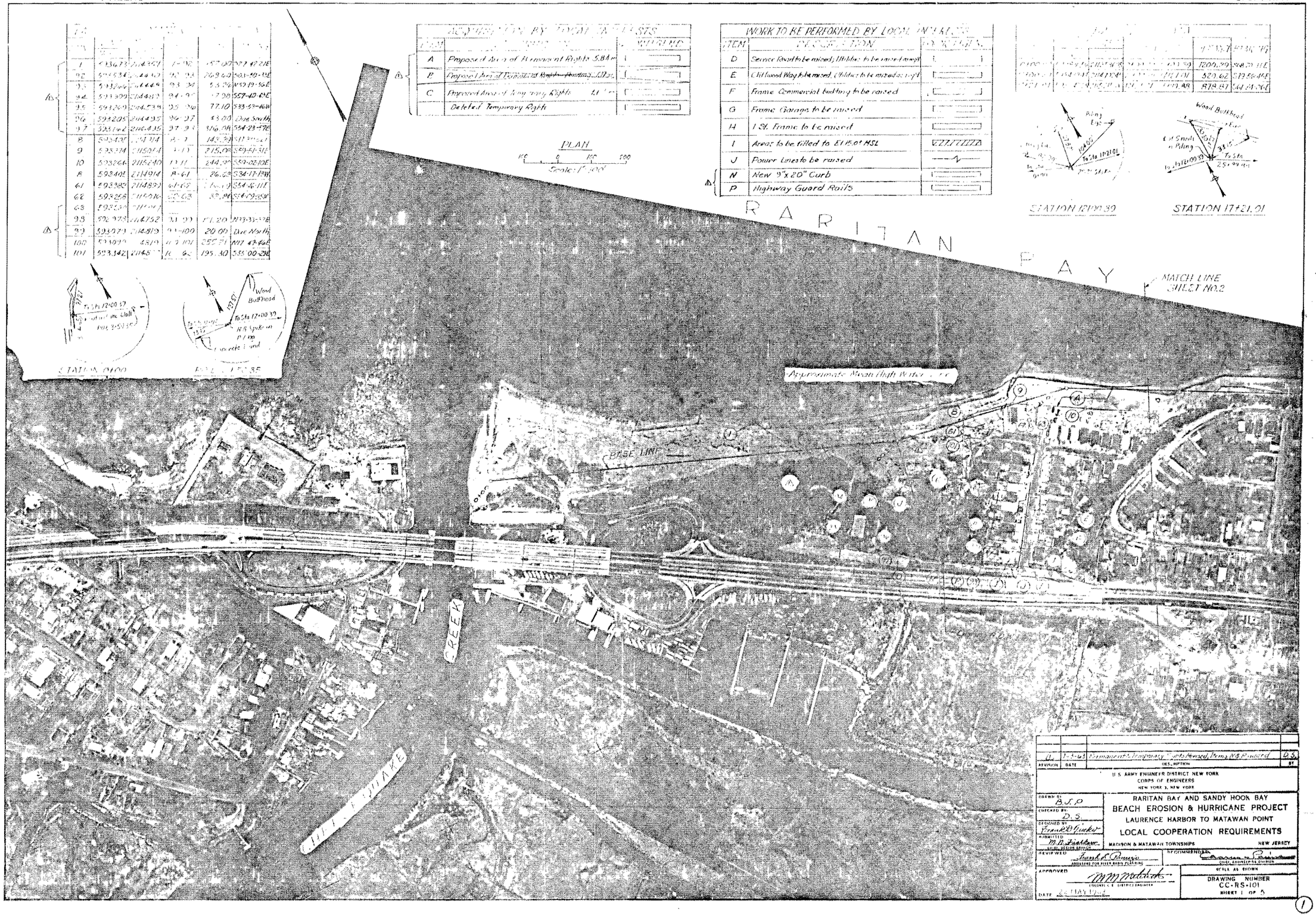
STATION 12+50.35

PLAN

Scale: 1" = 100'

STATION 12+00.39

STATION 17+21.01



REVISION	DATE	DESCRIPTION	BY
A	7-8-63	Permanent & Temporary Rights revised, Items N & P added	D.S.

U. S. ARMY ENGINEER DISTRICT NEW YORK
CORPS OF ENGINEERS
NEW YORK 3, NEW YORK

DRAWN BY B.J.P.
CHECKED BY D.S.
DESIGNED BY Frank D. Decker
SUBMITTED M. M. Fiebber
CHIEF DESIGN BRANCH

RARITAN BAY AND SANDY HOOK BAY
BEACH EROSION & HURRICANE PROJECT
LAURENCE HARBOR TO MATAWAN POINT
LOCAL COOPERATION REQUIREMENTS
MADISON & MATAWAN TOWNSHIPS NEW JERSEY

REVIEWED Frank A. Brown
ASSISTANT FOR RIVER BASIN PLANNING

RECOMMENDED [illegible]
CHIEF, ENGINEERING DIVISION

APPROVED M M Mitchell
COLONEL, C.E. DISTRICT ENGINEER

DATE 28 MAY 1963

SCALE AS SHOWN

DRAWING NUMBER CC-RS-101
SHEET 1 OF 5

ACQUISITION BY LOCAL INTERESTS		
ITEM	DESCRIPTION	COLOR LEGEND
A	Proposed Area of Permanent Rights Area	
C	Proposed Area of Temporary Rights 6.0 Acres	
K	1 story concrete block commercial building to be demolished	
L	1.5 story frame commercial building to be acquired	

BASE LINE DATA					
STATION	COORDINATES NORTH	COORDINATES EAST	COURSE	DISTANCE	BEARING
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	S 61°24'06"E
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	S 51°10'40"E
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	S 47°39'40"E
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	S 76°28'27"E
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	S 84°22'45"E

PLAN
100 0 100
Scale 1" = 100'

MATCH LINE SHEET NO. 3

BASE LINE

REVISION	DATE	DESCRIPTION	BY
[illegible]	[illegible]	Township & Service Roads revised	[illegible]

U.S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS
NEW YORK 3, NEW YORK

DRAWN BY: [illegible]
CHECKED BY: [illegible]
DESIGNED BY: [illegible]
SUBMITTED: [illegible]
COLLECTION BRANCH

RARITAN BAY AND SANDY HOOK BAY
BEACH EROSION & HURRICANE PROJECT
LAURENCE HARBOR TO MATAWAN POINT
LOCAL COOPERATION REQUIREMENTS
MADISON & MATAWAN TOWNSHIPS NEW JERSEY

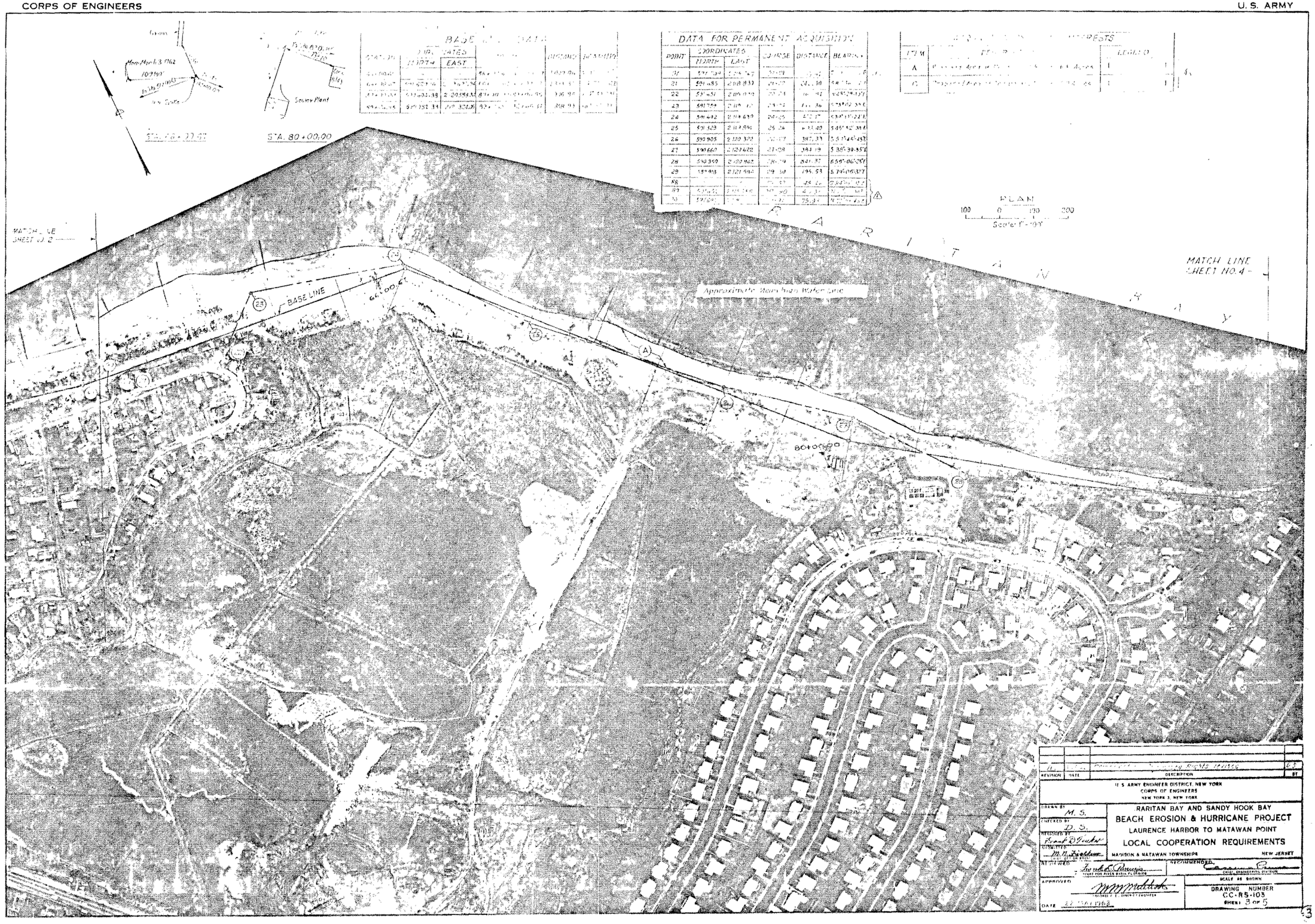
REVIEWED: [illegible]
ASSISTANT FOR PLANS & REPORTS
RECOMMENDED: [illegible]
CHIEF, ENGINEERING DIVISION

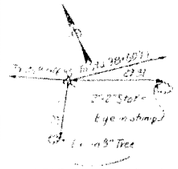
SCALE AS SHOWN

APPROVED: [illegible]
COLONEL C.E., DISTRICT ENGINEER

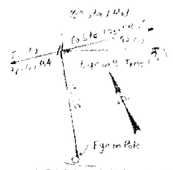
DATE 28 MAY 1963

DRAWING NUMBER
CC-RS-102
SHEET 2 OF 5

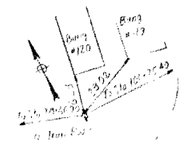

STA. 80+00.00
BASE LINE
Sewer Plant
MATCH LINE SHEET NO. 2
MATCH LINE SHEET NO. 4
Approximate Bank Line
PLAN
Scale 1" = 100'
DATA FOR PERMANENT ACQUISITION
POINT
COORDINATES
NORTH
EAST
COURSE
DISTANCE
BEARING
RARITAN BAY
U. S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS
NEW YORK 3, NEW YORK
RARITAN BAY AND SANDY HOOK BAY
BEACH EROSION & HURRICANE PROJECT
LAURENCE HARBOR TO MATAWAN POINT
LOCAL COOPERATION REQUIREMENTS
MADISON & MATAWAN TOWNSHIPS
NEW JERSEY
DRAWN BY M. S.
CHECKED BY D. S.
RECOMMENDED
APPROVED
SCALE AS SHOWN
DRAWING NUMBER CC-R5-103
SHEET 3 OF 5
REVISION
DATE
DESCRIPTION
BY



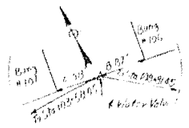
STATION 92+60.14



STATION 93+00.00



STATION 103+34.80



STATION 104+18.40

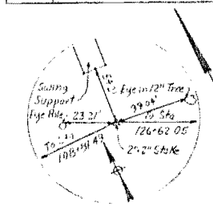
STATION 109+51.49

MATCH LINE SHEET NO. 3

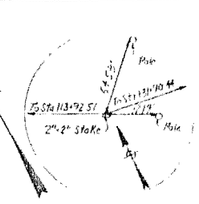
DATA FOR PERMANENT AQUISITION					
POINT	COORDINATES NORTH	COORDINATES EAST	COURSE	DISTANCE	BEARING
29	-	-	23-30	196.63	S79-06-21
30	589531	2121[illegible]	30-31	63.76	S14-41-30E
31	589520	2121192	31-32	172.66	S[illegible]
32	589401	2122064	32-33	103.21	S[illegible]
33	589613	2122145	33-34	155.05	N[illegible]
34	589671	2122297	34-35	29.91	N11-31-40E
35	589710	2122301	35-36	71.34	N84-22-00E
36	589717	2122378	36-37	170.76	N71-22-44E
37	589711	2122540	37-38	210.93	S71-18-45E
38	589704	2123410	38-39	21.20	S72-44-46E
39	589671	2123185	39-40	90.92	S79-41-00E
40	589592	2123258	40-41	226.14	N81-54-25E

DATA FOR PERMANENT ACQUISITION					
POINT	COORDINATES NORTH	COORDINATES EAST	COURSE	DISTANCE	BEARING
41	589600	2123416	41-42	318.06	N27-66-05W
42	589881	2123297	42-43	450.85	N68-54-59W
43	590096	2122905	-		
44	590220	2122813	44-45	132.65	S40-24-20E
45	590219	2122995	45-46	379.20	S10-46-10E
46	590094	2123369	46-47	654.81	S49-38-44E
47	589570	2123702	47-[illegible]	[illegible]	[illegible]
48	589400	2124306	48-49	566.61	S09-00-22E
49	589197	2124835	49-50	109.38	N67-26-44E
50	589239	2124946	50-51	210.38	S65-00-35E
51	589539	2124848	51-52	193.13	S20-54-14W
52	589415	2124709	52-53	49.38	S71-06-22E
53	589400	2124746	53-54	41.75	N19-31-22E
54	[illegible]	[illegible]	54-55	244.16	[illegible]

ACQUISITION BY LOCAL INTERESTS		
ITEM	DESCRIPTION	COLOR LEGEND
A	Proposed Area of Permanent Rights 41 Acres	
C	Proposed Area of Temporary Rights 5 Acres	



STATION 115+92.51



STATION 126+62.05

BASE LINE DATA					
POINT	COORDINATES NORTH	COORDINATES EAST	COURSE	DISTANCE	BEARING
[illegible]	-	-	[illegible]	328.99	S60-17-09E
[illegible]	[illegible]	[illegible]	[illegible]	295.06	S78-49-40E
[illegible]	[illegible]	[illegible]	[illegible]	497.16	S76-48-[illegible]E
[illegible]	[illegible]	[illegible]	[illegible]	317.36	N86-[illegible]-48E
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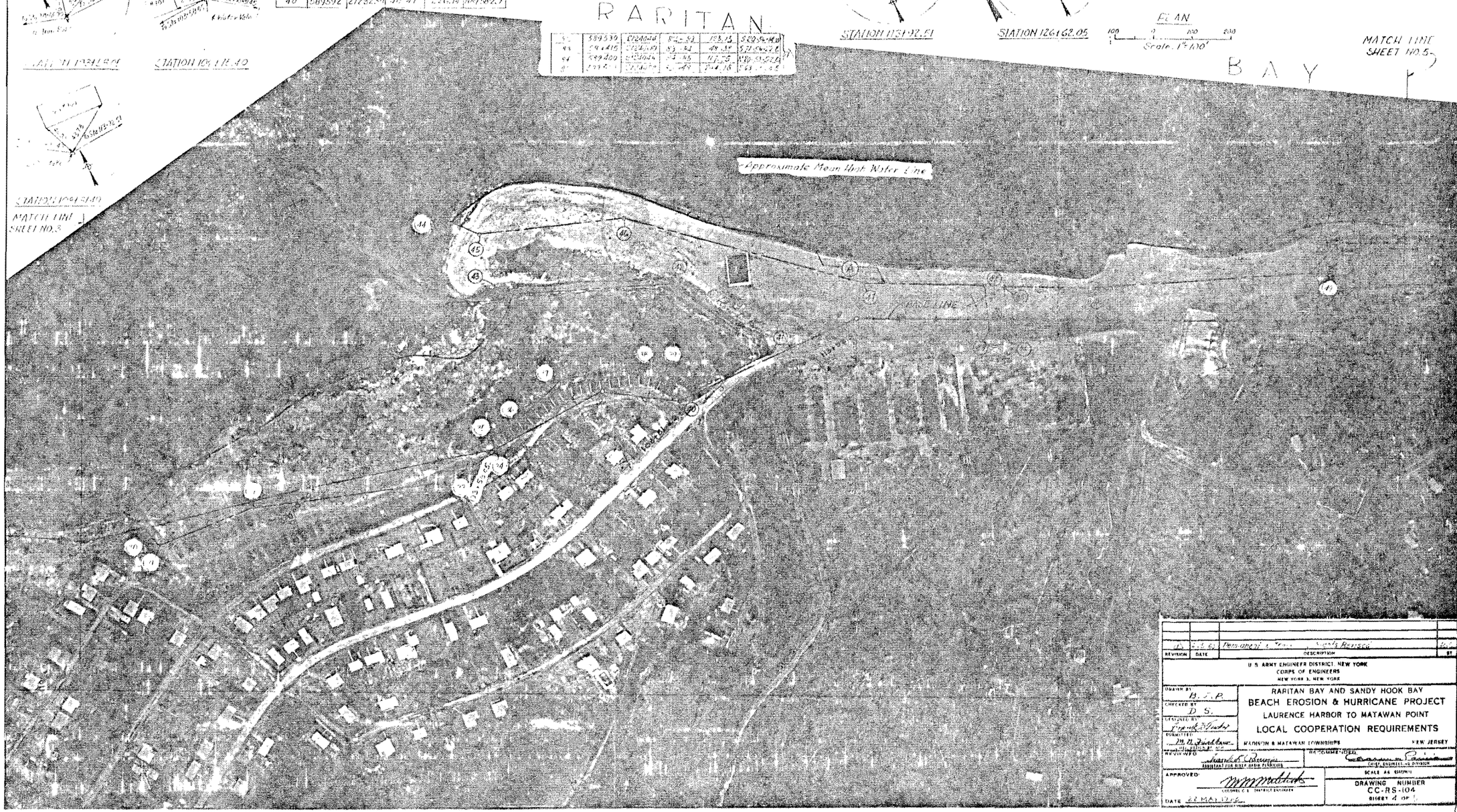
[illegible]	[illegible]	[illegible]	[illegible]	1269.14	S[illegible]-31-18E
[illegible]	[illegible]	[illegible]	[illegible]	528.83	S[illegible]-[illegible]-34E

PLAN

Scale: 1" = 100'

MATCH LINE SHEET NO. 5



REVISION	DATE	DESCRIPTION	BY
[illegible]	[illegible]	Permanent [illegible]	[illegible]

U. S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS
NEW YORK 3, NEW YORK

DRAWN BY: B. J. P.
CHECKED BY: D. S.
DESIGNED BY:
SUBMITTED:
REVIEWED: ASSISTANT FOR RIVER AND HARBOR PLANNING
RECOMMENDED: CHIEF, ENGINEERING DIVISION
APPROVED: COLONEL C. E. DISTRICT ENGINEER
DATE: 22 MAY 1956

RARITAN BAY AND SANDY HOOK BAY
BEACH EROSION & HURRICANE PROJECT
LAURENCE HARBOR TO MATAWAN POINT
LOCAL COOPERATION REQUIREMENTS
MADISON & MATAWAN TOWNSHIPS NEW JERSEY

SCALE AS SHOWN
DRAWING NUMBER CC-RS-104
SHEET 4 OF 5

(1)

MATCH LINE SHEET NO. 4

DATA FOR PERMANENT ACQUISITION

POINT	COORDINATES NORTH	COORDINATES EAST	COURSE	DISTANCE	BEARING
68	[illegible]	[illegible]	68-69	[illegible]	[illegible]
69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
70	[illegible]	[illegible]	70-71	[illegible]	[illegible]
71	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
72	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
75	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
76	[illegible]	[illegible]	75-76	[illegible]	[illegible]
77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
78	[illegible]	[illegible]	78-79	[illegible]	[illegible]
79	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
80	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
81	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

DATA FOR PERMANENT ACQUISITION

POINT	COORDINATES NORTH	COORDINATES EAST	COURSE	DISTANCE	BEARING
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51	189129	2125172	51-52	74.73	S15-21-01E
52	189007	2125192	52-53	101.19	S4-01-00E
53	188810	2125267	53-54	86.44	S20-33-22W
54	188790	2125621	54-55	314.19	S85-05-11E
55	[illegible]	[illegible]	55-56	137.80	N44-55-31E
56	189105	2125343	56-57	271.23	S27-21-17E
57	188537	2126436	57-58	164.77	S64-49-00E
58	188405	2126671	58-59	[illegible]	S24-21-7E
59	187971	2127018	59-60	[illegible]	[illegible]
60	[illegible]	[illegible]	60-68	104.92	[illegible]

ACQUISITION BY LOCAL INTERESTS

ITEM	DESCRIPTION	COLOR LEGEND
A	Proposed Area of Permanent Rights - 8.0 Acres	
C	Proposed Area of Temporary Rights - 0.5 Acres	

WORK TO BE PERFORMED BY LOCAL INTERESTS

ITEM	DESCRIPTION	COLOR LEGEND
M	House to be raised	

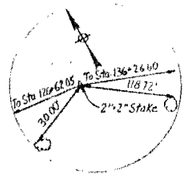
PLAN

100 0 100 200

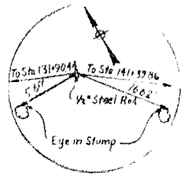
Scale: 1" = 100'

BASE LINE DATA

STATION	COORDINATES NORTH	COORDINATES EAST	COURSE	DISTANCE	BEARING
126+69.09	-	-	126+69.09 - 131+90.44	528.39	S88-17-34E
131+90.44	189286.08	2125974	131+90.44 - 136+26.60	436.16	S67-58-18E
136+26.60	189480.09	2126777.8	136+26.60 - 141+39.86	513.26	S52-19-14E
141+39.86	188906.13	2126935.18	141+39.86 - 149+91.55	851.67	S62-28-55E
149+91.55	188113.01	2126988.6	149+91.55 - 155+91.55	600.00	S47-36-08E
155+91.55	187708.45	2127381.15			



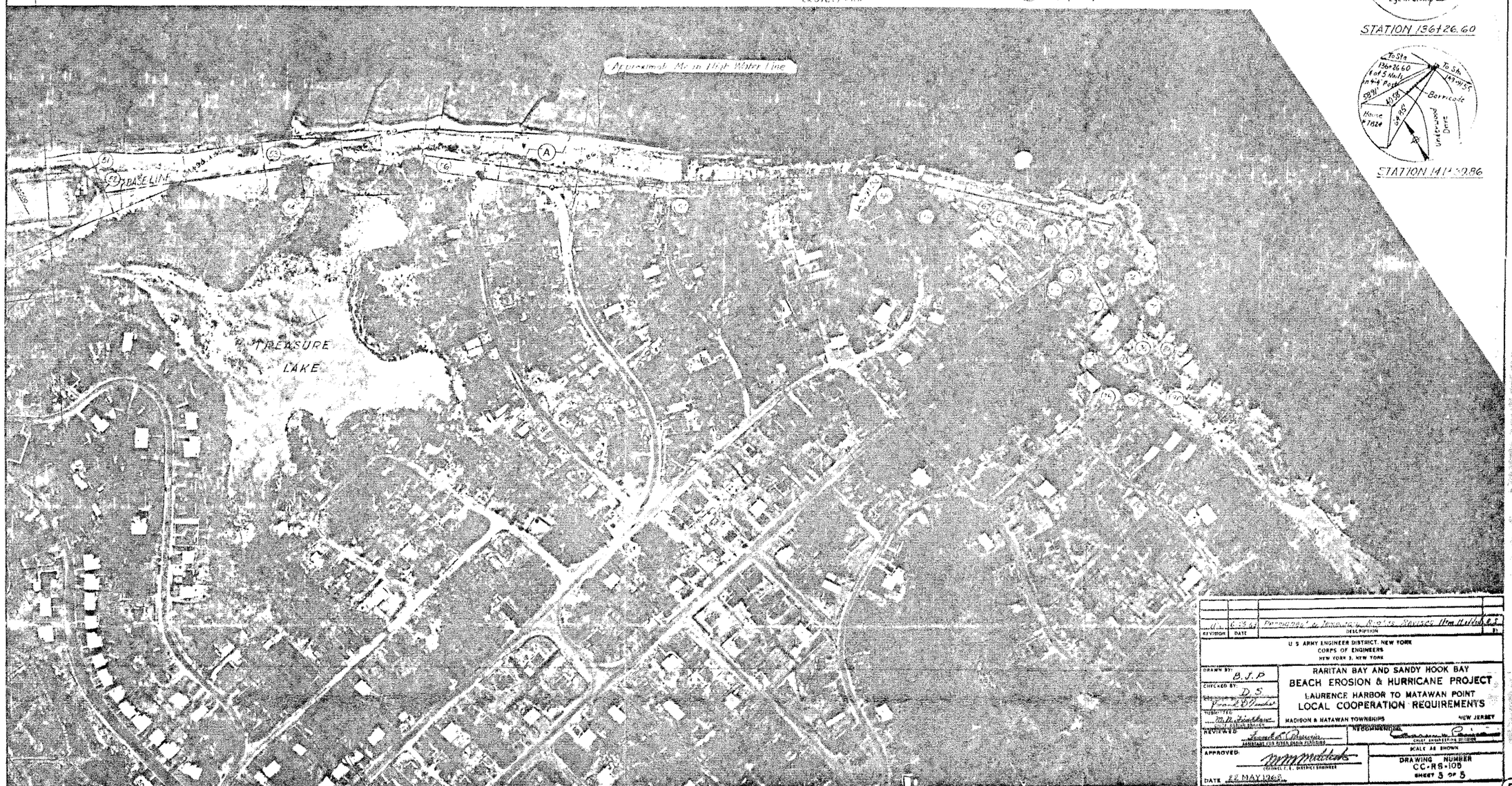
STATION 131+90.44



STATION 136+26.60

STATION 141+39.86

R A R I T A N B A Y



REVISION	DATE	
A	6-26-65	Permanent & Temporary Rights Revised Item Added

U. S. ARMY ENGINEER DISTRICT, NEW YORK
CORPS OF ENGINEERS
NEW YORK 3, NEW YORK

DRAWN BY: B.J.P.
CHECKED BY: D.S.
SUBMITTED:
REVIEWED: ASSISTANT FOR RIVER & HARBOR PLANNING
APPROVED: COLONEL, C.E., DISTRICT ENGINEER
DATE 22 MAY 1965

RARITAN BAY AND SANDY HOOK BAY
BEACH EROSION & HURRICANE PROJECT
LAURENCE HARBOR TO MATAWAN POINT
LOCAL COOPERATION REQUIREMENTS

MADISON & MATAWAN TOWNSHIPS NEW JERSEY

RECOMMENDED: CHIEF, ENGINEERING DIVISION

SCALE AS SHOWN

DRAWING NUMBER CC-RS-105
SHEET 3 OF 5

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
59 Temple Place
Boston 11, Massachusetts

May 23, 1963

District Engineer
New York District
U. S. Army Corps of Engineers
111 East 16th Street
New York 3, New York

Dear Sir:

This letter is a supplement to our report dated October 10, 1960 and is intended to assist you in your planning on the Raritan and Sandy Hook Bays beach erosion and hurricane project, New Jersey, authorized under Public Law 71, 84th Congress, approved June 15, 1955. It answers Mr. Panuzio's verbal request of January 23, 1963 that we specify areas that could be used for beach fill material at a distance of not more than 1,500 feet from shore. This report was prepared under the authority of the Fish and Wildlife Coordination Act (48 stat. 401, as amended; 16 U.S.C. 661 et seq.), in cooperation with the New Jersey Division of Fish and Game and the New Jersey Division of Shell Fisheries. Those agencies concur in the report as indicated in their letters of March 11, 1963 and May 21, 1963, respectively.

Our earlier report described in a general way the fish and wildlife resources which might be affected by construction of this project. The following additional information on shellfish resources is pertinent to the determination of areas from which beach fill material could be obtained with a minimum of damage to the resources.

In the area west of Conaskonk Point, shellfishery resources are limited to a few hard clams of little significant value. East of Conaskonk Point there are valuable soft-clam beds in all coastal waters to Sandy Hook. These areas have a standing crop of soft clams averaging 2,600 bushels per acre capable of sustaining an average annual harvest of 650 bushels worth $4,000 per acre.

Hard clam beds of significant value are located in all of the area east of Conaskonk Point and within 1,500 feet of shore. They are capable of producing an average annual yield of about 50 bushels per acre. The better hard-clam areas are in the deeper waters where competition with soft clams is not so great. Based on an average price of $7 per bushel of hard clams, the average annual harvest from an acre of hard-clam habitat in this section of the project area would be $350.

Since the submission of our previous report the remaining portions of Raritan Bay have been closed to the harvest of shellfish due to increased pollution of the waters; therefore, none of the previously described shellfish resources are harvestable at present. Nevertheless, they are important from the standpoint of future production. Experiments are presently being conducted relative to transplanting to clean waters or otherwise purifying polluted shellfish rendering them acceptable for human consumption. Also, recent advances in the science of pollution abatement should presently result in the reopening of certain of these shellfish areas to commercial harvests.

From the standpoint of the shellfish resources we would have no objections to removal of material from any portion of that area west of Conaskonk Point; however, in order to protect the finfish resources, recommendation no. 1 of our previous report should be adopted. That recommendation states that whenever possible, hydraulic fill be taken from continuous trenches with sloping sides and not isolated pits. Trenches should connect with deeper water whenever possible.

Within 1,500 feet of shore east of Conaskonk Point, any area selected could be expected to contain both soft and hard clams. Since all soft-clam harvest is by hand digging on dry bottom at low tide, these areas should not be used as a source of borrow material. Dredging should be confined to waters having a depth of two feet or more at mean low water. Dredging in the permanently inundated areas would also be most desirable from the finfishery standpoint.

Prior to dredging operations, the New Jersey Division of Shell Fisheries will meet with the Corps of Engineers to make whatever arrangements may be necessary for salvaging clams. Plans will also be made for policing the area during construction to prevent polluted clams from being marketed or consumed.

We reaffirm our recommendations contained in our October 10, 1960 report, namely--

1. That whenever possible, hydraulic fill be taken from continuous trenches with sloping sides and not isolated pits. Trenches should connect with deeper water whenever possible.

2. That these trenches be as deep as possible to minimize the loss to the shellfishery. A trench up to 40 feet deep having a minimum width of 150 feet and sloping sides should give the desired effects.

3. That silt from borrow pits be removed either to shore or to deeper waters to minimize siltation of adjacent shellfish.

In addition to to the above we recommend--

1. That dredging sites within the area east of Conaskonk Point be confined to those waters having a depth of two feet or more at mean low water.

Please keep us informed as your planning progresses so that any further reports which may be required of this Service can be prepared in time to meet your needs. We would be particularly interested in receiving information on specific locations and dimensions of the borrow areas when these data are available.

Sincerely yours,

M. A. Marston
Acting Regional Director
Bureau of Sport Fisheries & Wildlife

Russell T. Norris
Acting Regional Director
Bureau of Commercial Fisheries

NANEN-Dc
Memorandum for the Record

Highway and Local Cooperation Problems, Raritan Bay, Sandy Hook Bay Beach Erosion and Hurricane Protection Project.
Frank D. Tucker 10 June 1963

1. A meeting was held at the District Office of the New Jersey Highway Department 1147 Amboy Ave., Metuchen, N.J. on 7 June 1963 at 9:45 A.M. to discuss highway problems and local cooperation problems in referenced project. The following individuals were present:

James K. Rankin, Chief Engineer Navigation Bureau, NJ Department of Conservation and Economic Development.

R. A. Peterson, Ass't District Engineer, N.J. Highway Dept.

Frank D. Tucker, Corps of Engineers, N.Y. District

2. The N. J. Highway Dept. advertised a contract to regrade N.J. Highway No. 35 Section 11A on 7 June 1963. A portion of the service road on the north side of the highway will be raised. In order not to disrupt the contract documents of the State, it was agreed that the raising of the service road would be placed in the Federal Beach Erosion and Hurricane Project Contract documents. Mr. Peterson outlined the criteria for the Corps of Engineers to use in raising the service road which is under State maintenance. Mr. Rankin indicates that the local street to be raised known as Cliffwood Way is under the jurisdiction of Madison Township. The raising of this street will also be placed in the Federal contract.

3. A sanitary sewer line extends down the center of the service road and also down Cliffwood Way. Mr. Rankin said he would contact Madison Township authorities immediately and forward information to this office as soon as possible concerning sanitary sewers and other underground utilities. He will also send the location of the outfall in Raritan Bay from the Madison Township Sewage Disposal Plant.

4. Mr. Peterson will send an annotated print of the Corps hurricane protection plan indicating the horizontal alignment and any desired changes, to this office concerning the service road after advise and approval of the N.J. Highway Dept. at Trenton, N.J.

5. Borings taken by the N.J. Highway Dept. for N.J. Route 35 are available in Trenton, N.J.

6. Mr. O.H. Jansen, Dept. of Highways, Soils Division, Telephone No. Tuxedo 2-3000, Extension 436 should be contacted in Trenton, N.J. for the borings. Reference should be made to Route 35 (1953) Section 11 and Route 35 (1927) Section 38A. Considerable settlement has taken place in the area at Morgan Beach on this highway.

ATTACHMENT A16

7. Contract drawings which show the raising of the service road should be sent to the Highway Department at Trenton, N.J. for review. Contract drawings for the raising of Cliffwood Way should be sent to Madison Township for review.

8. A set of contract drawings for regrading N.J. Route 35 were given to Mr. Tucker for use in coordinating the State contract with the Federal Contract. All necessary details for the raising of the road are included in the contract prints except guard rails, a detail of which will be forwarded to this office by Mr. Peterson.

9. The following criteria is to be used in developing contract drawings for the service road.

a. Width of raised service road shall be 26' curb to curb.

b. Pavement section as shown and detailed on State Drawings shall be used.

c. Fill side slopes shall be 1 or 2.

d. Distance between toe of slope and curbline on Route 35 shall be 5 to 7 feet. Shoulder width at top of service road on south side shall be 5 to 7 feet. Shoulder width on north side of service road shall be 7 to 10 ft.

e. Crown of service road shall slope 2% to curbs.

f. Shoulders on service road shall slope $\frac{1}{4}$" per ft. toward curb line.

g. Horizontal slope of service road east from levee to entrance to Route 35 shall be 0.4% to allow for drainage.

h. Entrance radii to service road to be decreased in order that cars must slow down to enter service road. This decreases danger of thru traffic accidently veering into service road.

i. Top soil and seed shoulders and side slopes.

j. Vertical differential of 5' or more between shoulders and adjacent ground require guard rails.

10. Mr. Rankin confirmed the fact that the three buildings at Morgan Beach will be raised by local authorities. Fill around raised buildings shall be placed by Federal Contractor.

NANEN-Dc
SUBJECT: Highway and Local Cooperation Problems, Raritan Bay, Sandy Hook Bay Beach Erosion and Hurricane Protection Project.

Mr. Rankin was further advised that local cooperation maps would be revised to show additional right-of-way required for relocated service road.

FRANK D. TUCKER
Structural Engineer

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX B - SOILS INVESTIGATIONS AND DESIGN

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX B - SOILS INVESTIGATIONS AND DESIGN

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RARITAN BAY - SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROTECTION PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
APPENDIX B - SOILS INVESTIGATIONS AND DESIGN

I - INTRODUCTION

B1. PROJECT LOCATION AND DESCRIPTION. The beach erosion and hurricane protection project is located along the beach front of Raritan Bay extending from Morgan Beach to past Matawan Point in Middlesex and Monmouth Counties, New Jersey, as shown on Figure 2 of the main part of this design memorandum. The improvement plan provides for the construction of hurricane protection in the vicinity of Morgan Beach and beach and bluff protection for the remainder of the shore to past Matawan Point, as shown on Figures 2 through 9A of the main part of this design memorandum.

II - GEOLOGY

B2. The area lies within the Coastal Plain Province which forms the eastern margin of the State of New Jersey. Its surface has a gentle slope to the southeast, generally not exceeding 5 or 6 feet to the mile. The surface of the plain extends eastward with the same gentle slope beneath the Atlantic Ocean for about 100 miles to the end of the continental shelf, where the depth is approximately 100 fathoms. At this point, the ocean bottom drops abruptly to greater depths. The moderate elevation of the Coastal Plain, which rises to 400 feet in some areas but is generally lower than 200 feet, has prevented the streams from cutting valleys of any considerable depth. Throughout the greater portion of the plain, the relief is insignificant and the streams flow in open valleys that lie at only slightly lower levels than the broad, flat divides.

B3. The project area, which is contained in Middlesex and Monmouth counties, lies in that area of the Coastal Plain which is above the sea level. This generally dissected plain rises gradually from sea level at the coast to nearly 400 feet in central New Jersey. It then declines to a broad shallow depression less than 100 feet above sea level extending to the Delaware River at Trenton. Some conspicuous features of this plain are the marshes which border the stream courses and the submerged or drowned valleys which were formed by erosion when the land was at a higher elevation than at present. During geologic history, the sea level fluctuated to a large extent. The rise and fall of the water resulted in a wide migration of the shoreline across the Coastal Plain. The subaerial region was

especially influenced by these fluctuations during the Cretaceous Period.

B4. The Cretaceous Period resulted in many successive sedimentary formations, each of which were subject to erosion, deposition, submersion and emergence. Realizing that all of the New Jersey's geomorphology was determined by weathering and its associated agents, this geological period had great influence on the study area. The resulting Cretaceous formations are composed of highly stratified layers of unconsolidated sand, clay and silt which dip 25 to 60 feet per mile to the southeast and have a thickness in places of 500 to 1,000 feet. The sediments rest on a sloping formation of deep seated hard rocks. The present surface features were most recently determined during the glacial Pleistocene Period and by subsequent erosion.

B5. SUBSURFACE GEOLOGY. The subsurface geology of the Coastal Plain has been determined by study and correlation of subsurface explorations, well logs and by interpretation of seismic profiles. The Coastal Plain consists of Cretaceous to Recent sediments lapping on the basement material which is composed of crystalline rock with locally infolded or infaulted Triassic sediments. The basement surface slopes at about 75 feet per mile, reaching a depth of more than 6,000 feet near the coast. A semi-consolidated sedimentary formation, varying in thickness to a maximum of about 13,000 feet, rests upon the basement material. An unconsolidated formation, which overlies the semi-consolidated material, consists of approximately equal thickness of the Upper Cretaceous and Tertiary sediments. The Cretaceous sediments are of prime importance in Raritan and Sandy Hook Bays area. The maximum thickness of the sediments (both Cretaceous and Tertiary) is about 4,800 feet near the edge of the continental shelf.

III - INVESTIGATIONS

B6. EXPLORATIONS. Initial subsurface explorations to locate suitable materials for borrow were performed by Government forces during August 1957. These explorations consisted of nine wash borings with drive samples taken at regular intervals or change of strata. During the winter of 1962 an exploration program was performed in order to investigate a proposed borrow area closer to the shoreline. The program consisted of ten $2\frac{1}{2}$ inch diameter cased drill holes. Continuous samples of the bay bottom materials were obtained for classification identification and analysis. This program was performed by contract under Government supervision. In order to obtain information on the foundation conditions for the levee section at Morgan Beach and in the marsh area at the mouth of Whale Creek an exploration program consisting of six 4 inch diameter cased drill holes was performed in June 1963.

Continuous disturbed and undisturbed samples were obtained for analysis. This work was performed by contract under Government supervision.

B7. SOIL CLASSIFICATIONS. Soil samples have been classified in accordance with the M.I.T. method of soil classification based on grainsize distribution. The presentation used on the boring logs is as follows: predominate constituents of the soils are capitalized, while minor constituents are indicated by lower cased letter prefixed by the qualifying words of "and", "some", "little" and "trace" which denote percentages of 50 to 40, 40 to 20, 20 to 10 and 10 to 1 respectively. The soil sizes and the soil type symbols used on the boring logs are in accordance with the Unified Soil Classification System, Corps of Engineers contained in Manual MIL-STD-619 (CE) dated 30 June 1960.

B8. LABORATORY ANALYSIS. Laboratory tests were performed on representative samples obtained from drill holes in the borrow and project areas and on borrow pit samples. Most of the testing was performed by a commercial laboratory under contract to the Government. The basic classification tests were performed by Corps of Engineers personnel. The testing program in the borrow areas consisted of visual analysis and mechanical analysis. The testing program in the project area of Morgan Beach consisted of visual analysis, mechanical analysis, natural moisture contents and unconfined compression tests. Typical test curves of borrow material are presented on Figures B2 through B5, of the beach material at high and low water line on Figures B6 and B7, and of foundation material at Morgan Beach on Figures B8 through B10. A soil test summary is given on Figure B11.

IV - EVALUATION OF OFF-SHORE BORROW MATERIALS

B9. GENERAL. The materials encountered during the exploration program were evaluated for suitability as beach fill borrow on the basis of medium diameter coefficients of sorting and skewness, and the percentage by weight passing the No. 140 square mesh sieve. The suitable values of medium diameter (M_d), coefficient of sorting (S_o) and coefficient of skewness (S_k) were based on those found for sand on the shore between low and high water lines. Information furnished by the Beach Erosion Board at a conference held after the March 1962 tidal storm, notes that material finer than the No. 140 mesh sieve (0.1 mm) will wash off the beach during placement or after several tidal cycles and that to offset this loss the amount of sand placed on the beach should be increased an amount equivalent to the percent by volume passing the No. 140 mesh sieve of soil material sampled after placement on the beach.

B10. SAND FILL CRITERIA. In order to evaluate the suitability of the potential borrow material, criteria were established based on the medium diameter and coefficients of sorting and skewness of the material found on the existing beach. The medium diameter (M_d) is the mid value of the particle diameters in millimeters so that 50 percent of the total weight of sample is composed of particles of smaller diameter and 50 percent of larger diameter particles. The coefficient of sorting (S_o), which indicates the degree of sorting of the material, is a function of the first quartile diameter (Q_1) and the third quartile diameter (Q_3) expressed as the square root of Q_1/Q_3. The skewness, which indicates the symmetry of the grain size distribution, is derived from Trask's formula: $S_k = Q_1 Q_3/M_d^2$. The material to be placed on the beach must have medium diameter, coefficients of sorting and skewness of approximately the same order of magnitude as those that exist on the beach. In addition, the placed material shall not have more than 20 percent by weight passing the 140 mesh square sieve, as sampled in the borrow area. This latter limitation was arrived at as a matter of economics, considering the amount of overpumping which would be required to compensate for the loss of the fine grain soils and the practical consideration that sands with excessive amounts of silt will not stay on the beach during the pumping operations.

B11. LITTORAL MATERIALS. Soil samples of the bottom and beach materials were taken by the U. S. Army Corps of Engineers in Raritan-Sandy Hook Bays in 1957 and again in 1962 after the severe March storm. The soil characteristics for the samples taken from the beach at high water and low water lines in 1957 are shown on Table B1 and Figures B6 and B7. Similar values were obtained for the 1962 samples except for those in the Morgan Beach area where the medium diameter was 8.0 mm (a gravel soil), a result of filling operations and segregation of soil due to beach erosion processes.

B12. OFFSHORE BORROW AREAS. The first considered alignment of the borrow area, approximately 5,000 feet offshore, was investigated in 1957 by five wash borings with drive samples taken at irregular intervals, usually at changes in strata. The location of these explorations is shown on Figure 10 of the main part of this design memorandum. The soil profile in this area, shown on Figure B1, is generally unsuitable gray silt and clay with little to no sand. The alignment of the borrow area was shifted shoreward to approximately 1,500 feet offshore. This area was investigated with 11 drill holes in which continuous drive samples were obtained. The location of these explorations is indicated on Figure 10 of the main part of this design memorandum. The probable soil profile is shown on Figure B1. The material from the westerly end of the project off Morgan Beach (Station 0 + 00) to the area off Knollcroft in the vicinity of the Madison Township

sewage disposal plant (station 80 + 00) was found to be unsuitable silt and clay similar to the material along the borrow line at 5,000 feet offshore. Small isolated pockets of discontinuous lenses of suitable sand as shown on Figure B1 were found close to the surface of the bay bottom, but they are considered too small and spotty for an economical, efficient dredging operation. A typical grain size distribution of these unsuitable soils are shown in Figure B2.

TABLE B1 - COMPARATIVE SAND CHARACTERISTICS

Sample Location	Date	Reference Figure	Medium diameter diameter M_d (mm)	Sand Characteristics: Coefficients of sorting S_o $\sqrt{Q_1/Q_3}$	Sand Characteristics: Coefficients of skewness S_k $Q_1 Q_3/M_d^2$
BEACH AREA - Morgan Beach to Matawan Point					
Highwater	1957	B6	0.34-1.50	3.5-8.4	1.22-3.13
Low water	1957	B7	0.24-0.33	1.37-3.87	0.84-7.68
BORROW AREA - Knollcroft - Matawan Area					
Silty Sand (SP-SM)	1962	B3	0.12-0.40	1.40-2.00	0.50-1.10
Sand	1962	B4	0.20-0.50	1.30-2.10	0.50-2.00
BORROW AREA - Chingarora Creek to Conaskonk Point					
Sand (SP)	1962	B5	0.35-0.80	1.20-3.00	1.10-2.80

B13. KNOLLCROFT - MATAWAN AREA. This borrow area is located from Knollcroft (Station 80 + 00) to Matawan Point (Station 158 + 50). As shown by log of drill holes 30 to 33 on Figure B1, sandy material is obtainable by dredging with the exception of the area around drill hole 34. Because the soils are stratified, pockets of clay-silt and silty sands will occur. The silty sands, while not being the most desirable, are satisfactory for beach fill. The soils deeper than 18 feet below mean low water are generally a medium to fine (predominately fine) sand with only minor amounts of silt. A typical grain size distribution for the upper silty sand is shown on Figure B3. The medium diameter, and coefficients of skewness and sorting are shown in Table B1. A typical grain size distribution for the deeper sands is shown on Figure B4. The medium diameters, and coefficients of skewness and sorting are shown in Table B1.

B14. KEYPORT AREA. The soil material continues to improve in characteristics on the easterly side of the inlet bay to Matawan Creek from Chingarora Creek to Conaskonk Point. The material is a tan coarse to fine sand, with occasional traces of silt, as shown by the log of the drill holes 8, 35 and 36 on Figure B1. A typical

gradation curve is shown on Figure B5 and the medium diameter, coefficients of sorting and skewness are given in Table B1.

B15. SUITABILITY OF MATERIALS. An analysis of the soil characteristics show that the material on the beach at the low water line has finer particles, less sorting of particle and a larger distribution of particle sizes than the material found at the high water line. This is due in the most part to the wash action of the daily tides on upland materials. The material in Chingarora borrow area is coarser than those in the Knollcroft borrow area. Both borrow area materials satisfy the lower range of soil characteristics found on the beach. These materials more adequately meet the characteristics of the low water beach material. Therefore, to provide for the loss of the finer materials from the highwater to the low water levels, overpumping of the required quantities is provided.

B16. DREDGING OPERATIONS. For economy in dredging costs, the area proposed for borrow is that section of the bay lying about 1,500 feet offshore between Knollcroft (Station 80 + 00) and Matawan Point (Station 158 + 50). The borrow area size and alignment with access channels are shown on Figure 10 of the main part of the design memorandum. The dredging plant would commence opposite Knollcroft (Station 80 + 00) and progress in an easterly direction and the dredged material would be placed on the beach in a westerly direction toward Morgan Beach. The extension of the pipeline will progress westward as each beach section is completed. When the sand fill to Morgan Beach is completed, the pipeline will be transferred to Knollcroft (Station 80 + 00). Filling operation will start in an easterly direction past Matawan Point (Station 158 + 50) and the floating plant will also progress in an easterly direction.

B17. During the placement in the westerly section (Station 0 + 00) to Station 80 + 00), it is estimated that the borrow area required would be approximately 400 feet wide and 1,650 feet long if sand is dredged to 30 feet below mean low water or 1,460 feet long if sand is dredged to 40 feet below mean low water. The dredging depth depends on type of dredging equipment used. These figures allow for an estimated 20 percent wastage of unsuitable silt and clay material. The borrow area for the next westerly section (Station 80 + 00 to Station 126 + 00) could be reduced to 150 foot width and then increased to 200 feet for the remainder of the improvement.

B18. The other borrow area that was considered is offshore from Union Beach from Chingarora Creek to Conaskonk Point as shown on Figure 10 of the main part of the design memorandum. The area offers a more suitable coarse sand (Table B1) with much less wastage because of the absence of unsuitable layers of silt and clay. The disadvantage in using this borrow area is that it is approximately 5,000 feet east

of Matawan Point, the easterly end of the project. To pump the material from this borrow area along the project from Matawan Point at the easterly end to Morgan Beach at the westerly end would require a pipeline from 5,000 to 21,000 feet with an average of over 10,000 feet. This pumping distance would require one and possibly two booster pumps with resulting increase in dredging costs.

V - LEVEE DESIGN - MORGAN BEACH

B19. GENERAL. The area of the hurricane protection at Morgan Beach is situated at the westerly end of the project. It is just north of New Jersey State Highway No. 35. This section of the highway and the bridge over the Cheesequake Creek was constructed in the 1940's. The area in which the highway was constructed, was dredged to an approximate elevation of 40 feet below mean sea level and backfilled hydraulically with sand from the bay. The poor material was removed and replaced in order to minimize the stability problems for the high earth road embankment fill and to reduce the settlement.

B20. SUBSURFACE EXPLORATIONS. Soil explorations were made at the site of the levee in June 1963. The location and logs of the four drill holes, DH 47, 48, 51 and 52, are shown on Figure 11A of the main part of the design memorandum. The first two holes were carried to depths of 25 feet and 40 feet and the last two holes to depths of 70 and 80 feet. Continuous three inch drive samples were obtained together with undisturbed samples.

B21. FOUNDATION CONDITIONS. The material encountered can be generally classified as follows:

0 - 8 feet	SAND, probably hydraulic fill
8 - 75 feet	Dark Grey Clayey SILT, trace fine sand.
75 feet	Sand

The soil layer from 8 - 75 feet is a very soft, highly sensitive clayey silt. There was considerable difficulty in obtaining truly undisturbed samples because of the highly sensitive nature of this layer. This condition is typical of fine grained marine deposits. The laboratory tests, discussed in paragraph B8, on this layer have therefore been subject to engineering evaluation of their validity. Because the samples were disturbed, the shear strength values determined from unconfined compression test and the consolidation characteristics were evaluated as to their validity prior to their use in the levee analysis.

B22. LEVEE AND FOUNDATION DESIGN. The levee is to be constructed to elevation 15 feet above mean sea level with a 25 foot top width and with 1 on 3 side slopes. The existing surface

elevation is 6 feet above mean sea level. The service road adjacent to New Jersey Route No. 35 will be raised to elevation 15.0 feet above mean sea level to function as a closure levee to high ground. In the initial design the area on the land side of the levee was to be cut to about 2 feet to elevation 4 feet above mean sea level for drainage. It was determined from a stability analysis using a shear strength of 0.2 kips per square foot for the clayey silt layer that the embankment would be unstable. The drainage swale was eliminated and a two foot berm was included to an elevation of 8 feet above mean sea level to act as a counter balance to overturning forces. The shear and stability analysis for this section is presented on Figure B12. Because the section is not stable without the berm, the construction procedures must assure the placement of the berm section prior to the buildup of the levee. Slope control stakes, piezometers and a settlement plate will be used in the construction to insure complete stability of this section. With respect to settlement, computations presented on Figures 13 to 16 show that an ultimate settlement of 2.4 feet will occur in approximately 50 years. The anticipated time settlement curve is shown on Figure 16.

B23. Because of the settlement, maintenance fill will be required. Based on a permissible six inch lowering of the protection elevation to 14.5 feet above mean sea level, it is anticipated that the levee will have to be raised a total of 3 to 4 times during the 50 year life of the project. The service road embankment will have similar settlement conditions. Based on a permissible three inch lowering of the road embankment both for flood reasons and vehicular safety, the embankment will have to be raised, road resurfaced, and appurtenances adjusted 5 to 6 times during the life of the project.

B24. EMBANKMENT DESIGN. Because of the thin layer of sandy soil lying on a deep layer of critical clayey silt overlying a sandy base, and the type of borrow material within a reasonable distance, a complete cutoff against seepage through the foundation was not feasible. Therefore in order not to disturb the stability conditions of the existing foundation, and utilize the available borrow, an inspection trench is provided through the berm material and two feet into the existing sand layer. A center core of impervious material is provided from the bottom of the inspection trench through the berm to the top of the levee. Figure 9A of the main part of the design memorandum. Considering the duration of high water, the length of seepage path and the permeability of the remaining thin layer of sand below the cutoff and above the clayey silt, it is considered that the seepage is reduced to a tolerable amount that can be accommodated in the interior drainage design. Because of the detrimental heaving characteristics of an impervious core under the road surface and because of the width of the embankment, the impervious core was offset to the protected side of the road embankment.

B25. PERMEABILITY. The overlying sand layer in the levee area (paragraph B21) by visual inspection and comparison with tested samples is generally a fine to medium sand with varying amounts of silt and some fine gravel. It is estimated that the material passing the 200 mesh sieve is in the order of 10 to 20 percent. The gradation of this material and the amount of fines are indicative of a fairly low permeability factor in the order of 0.1×10^{-4} cm per second. On this basis, it is estimated that no significant seepage would occur through the sand layer between the bottom of the levee core and the top of the underlying clay silt. Therefore no special provisions were considered necessary in the design of the embankment or the interior drainage facilities.

B26. LAND BORROW. An investigation was made of all sources of borrow material to determine the availability of a uniform material with sufficient strength and impermeability for the construction of the levee. However, within a reasonable distance of the project, soils are the result of marine and fluvial deposition. These soils are highly sorted and stratified and range in character from clay to uniform sand deposits. Glacial soils were found north of Perth Amboy, but there are no available borrow pits because the area is highly developed. The investigated borrow areas with suitable material are contained in the following paragraphs.

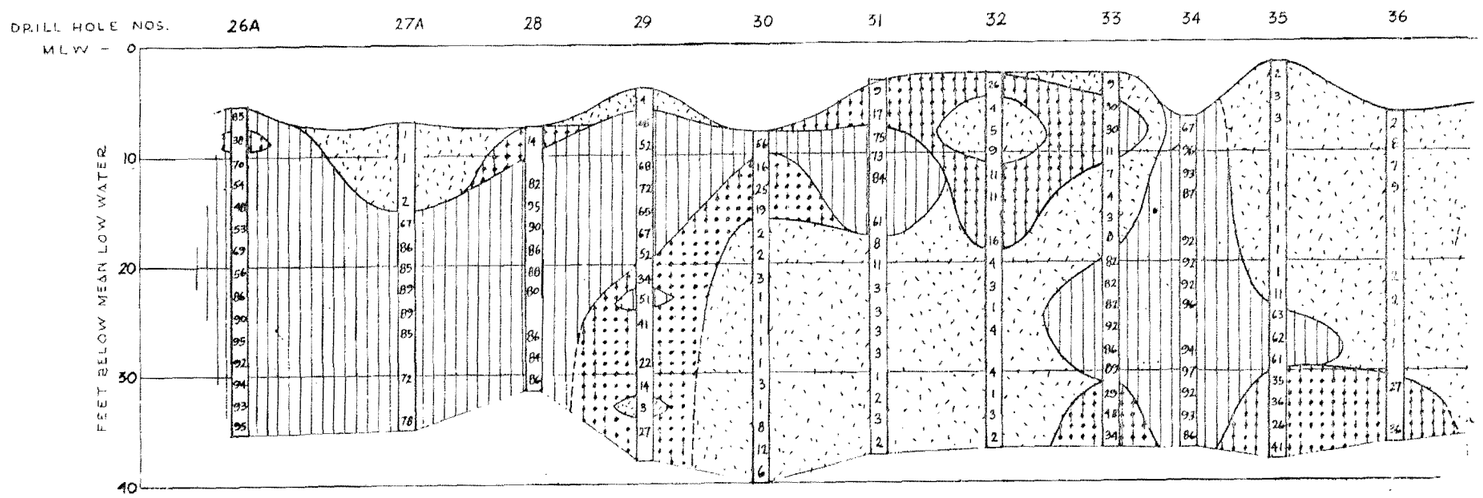
B27. MANZO ASPHALT PLANT PIT. The borrow pit is located on the South Amboy Road between Eraston and Old Bridge (Figure B17). This pit contains sufficient impervious and random material. The impervious soil is a silt and clay with a plasticity index of from 15 to 20. The random material is a uniform medium to fine sand with a trace of silt.

B28. GARDEN STATE PARKWAY PIT. This borrow pit is located along the Garden State Parkway between Morgan and Ernston (Figure B17). The pit was probably used as fill for the Garden State Parkway. It contains an abundant supply of random material. The soil is a medium to fine sand with a trace of silt.

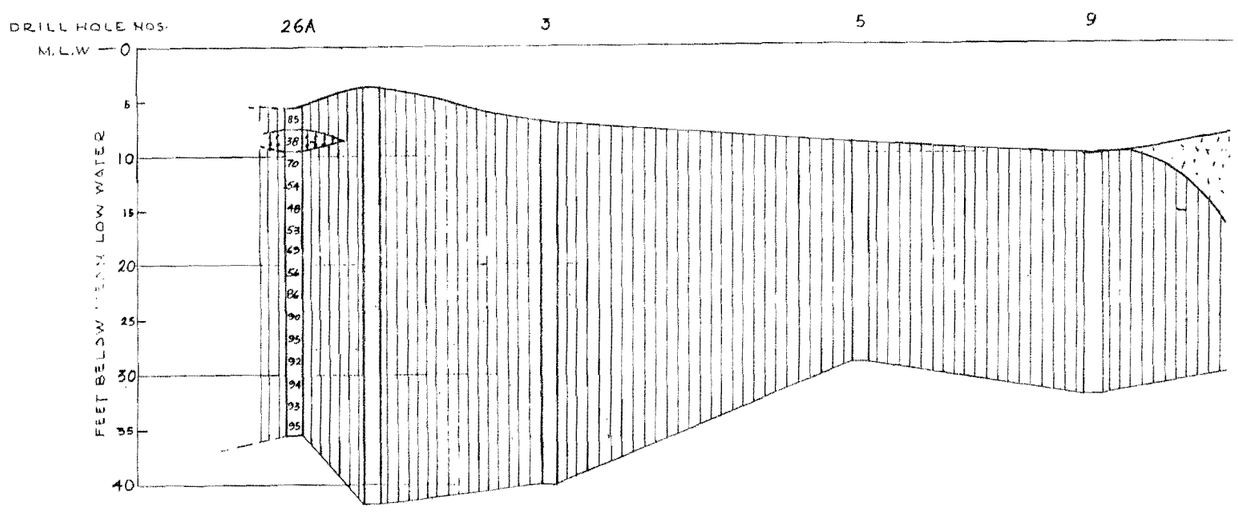
B29. SAVITSKY BROS. PIT. This borrow area is located just off Route 35 at Morgan (Figure B17). The pit contains a sufficient amount of sand and a very limited supply of impervious soil. Therefore, the pit can only be used for random material. The pit operator advised of other areas that contained impervious soils, however, the location was not determined.

B30. OSCHWALD BUCH YARD PIT. This borrow area in Madison contains suitable impervious soil consisting of clay and silt in adequate quantities (Figure B17).

B31. ROUTES 4 AND 9 BORROW PIT. This borrow area is located at the intersection of Routes 4 and 9 (Figure B17), just above the Cheesequake Creek swamp. This borrow area is a large, apparently abandoned sand pit. This material would be suitable for random borrow.



1500' INSHORE SOIL PROFILE



5000' OFFSHORE SOIL PROFILE

LEGEND

SP - Sand - Poorly "Medium to Fine"
SW - Sand - Well Graded

SM - Silty Sand with from 12 to 50 percent silt
SP-SM - Silty Sand with from 5 to 50 percent silt

ML - SILT, Inorganic
OL - SILT, Organic

NUMBER INSIDE COLUMNS FOR DRILL HOLE LOCATIONS INDICATE THE AMOUNT OF MATERIAL PASSING THE #140 MESH SIEVE.

DRILL HOLE LOCATION PLAN IS SHOWN ON FIGURE 10 OF MAIN BODY

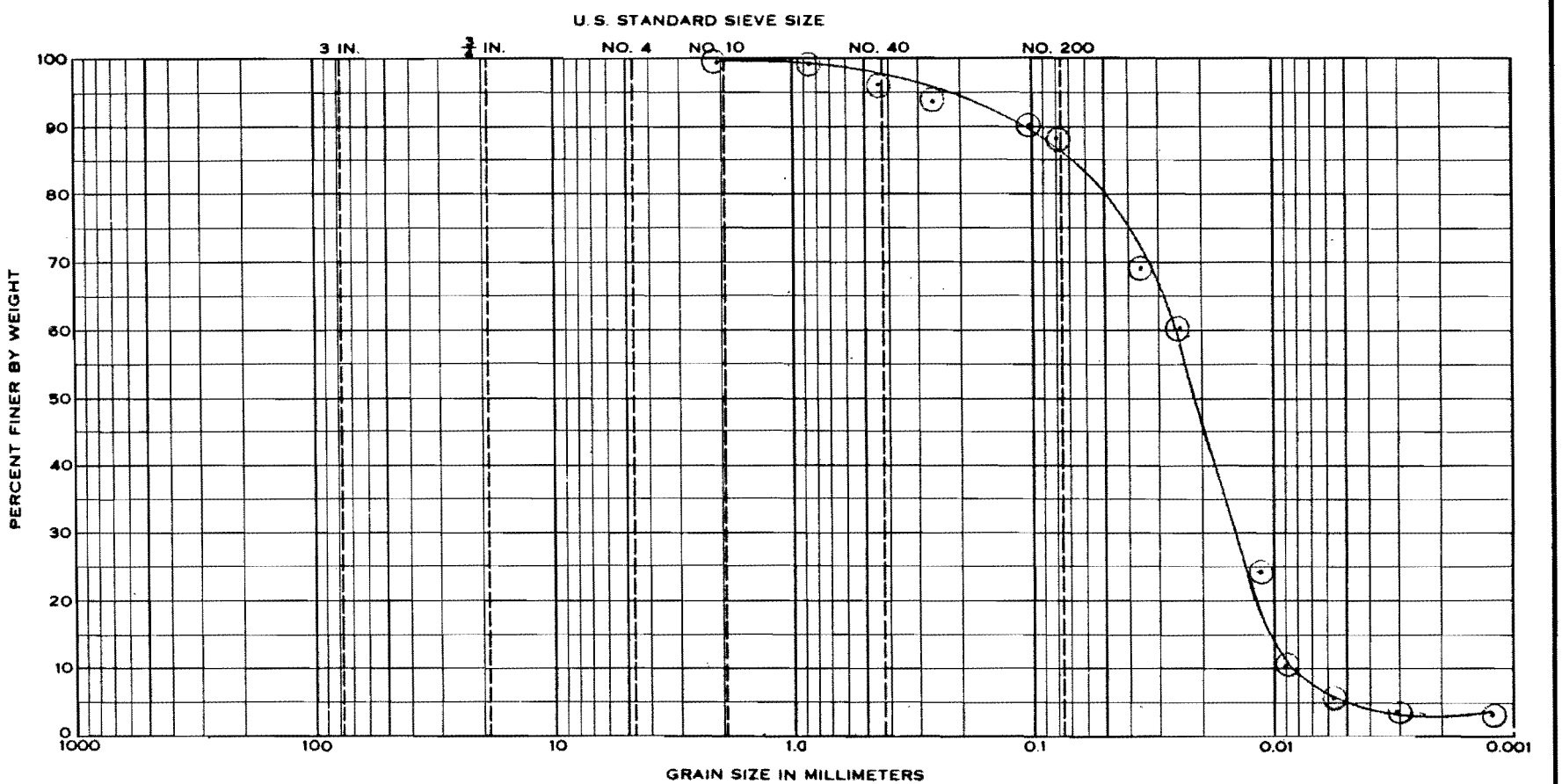
RARITAN BAY & SANDY HOOK BAY

BEACH EROSION & HURRICANE PROJECT

SOIL PROFILE

MADISON & MATAWAN TOWNSHIPS — NEW JERSEY

FIGURE B 1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
4	18'-20'	SIEVE & HYDROMETER					
EL.	15.5 to 17.5						

Project BEACH EROSION & HURRICANE

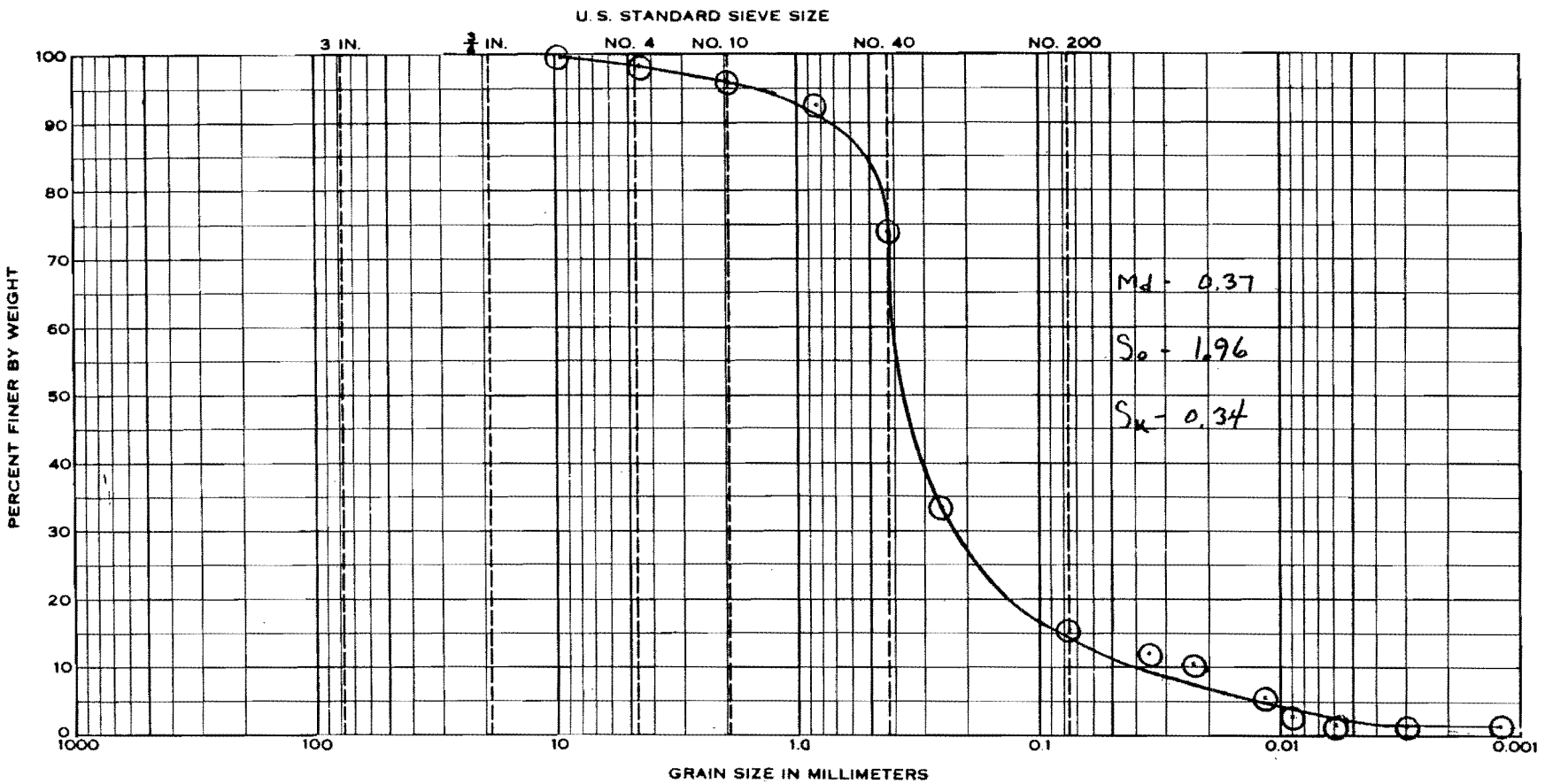
Area RARITAN & SANDY HOOK BAYS

Boring No. 28

Date 2-14-63

GRADATION CURVES

FIGURE B-2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev ~~Depth~~	Classification	NatWC	LL	PL	PI
2	5.5 to 7.5	SIEVE & HYDROMETER				

Project BEACH EROSION & HURRICANE

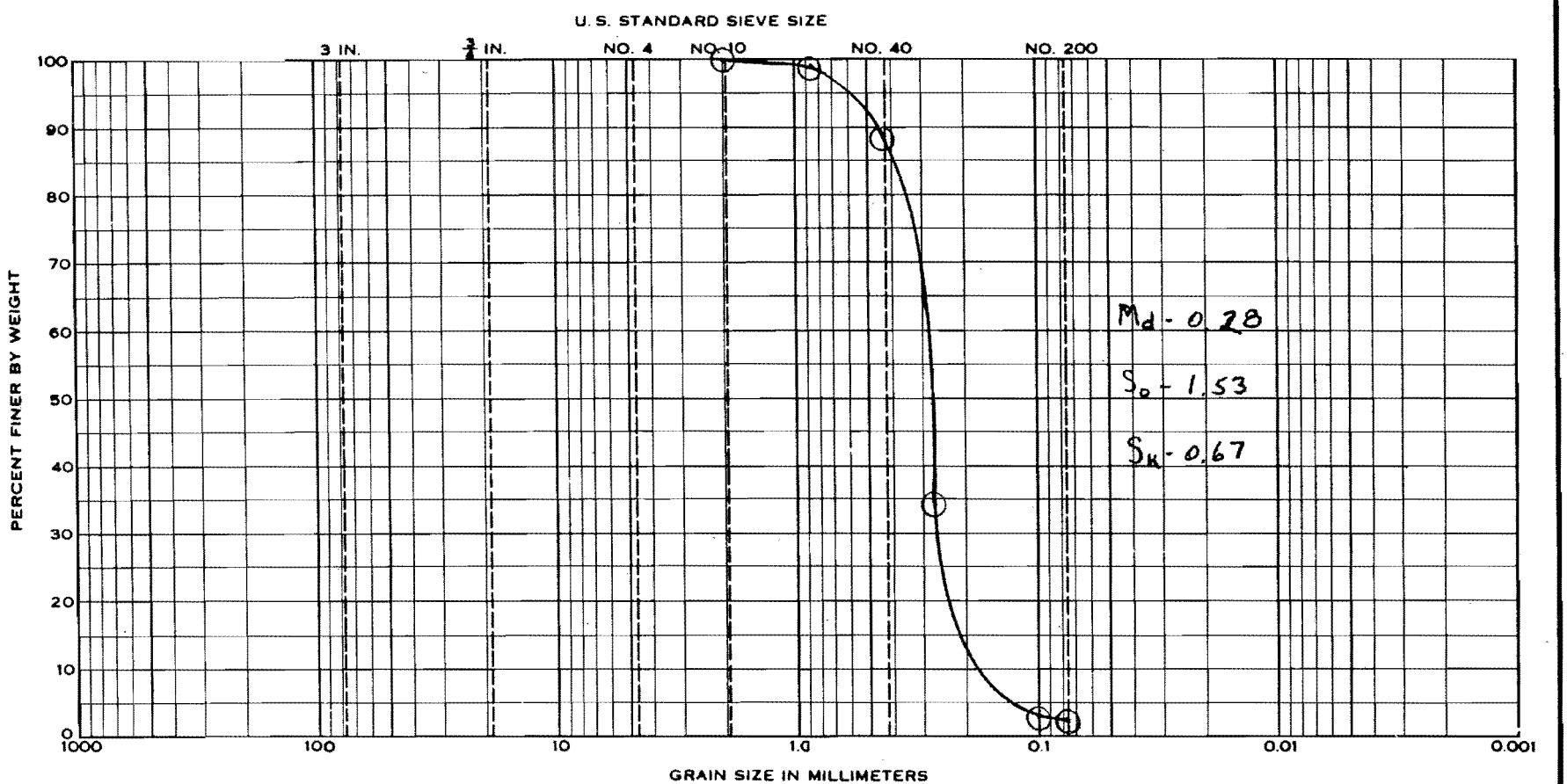
Area RARITAN & SANDY HOOK BAYS

Boring No. 31

Date 2-14-63

GRADATION CURVES

FIGURE B-3



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev ~~or Depth~~	Classification	NatWC	LL	PL	PI	
10	23.5 to 25.5	SIEVE ANALYSIS					

Project BEACH EROSION & HURRICANE

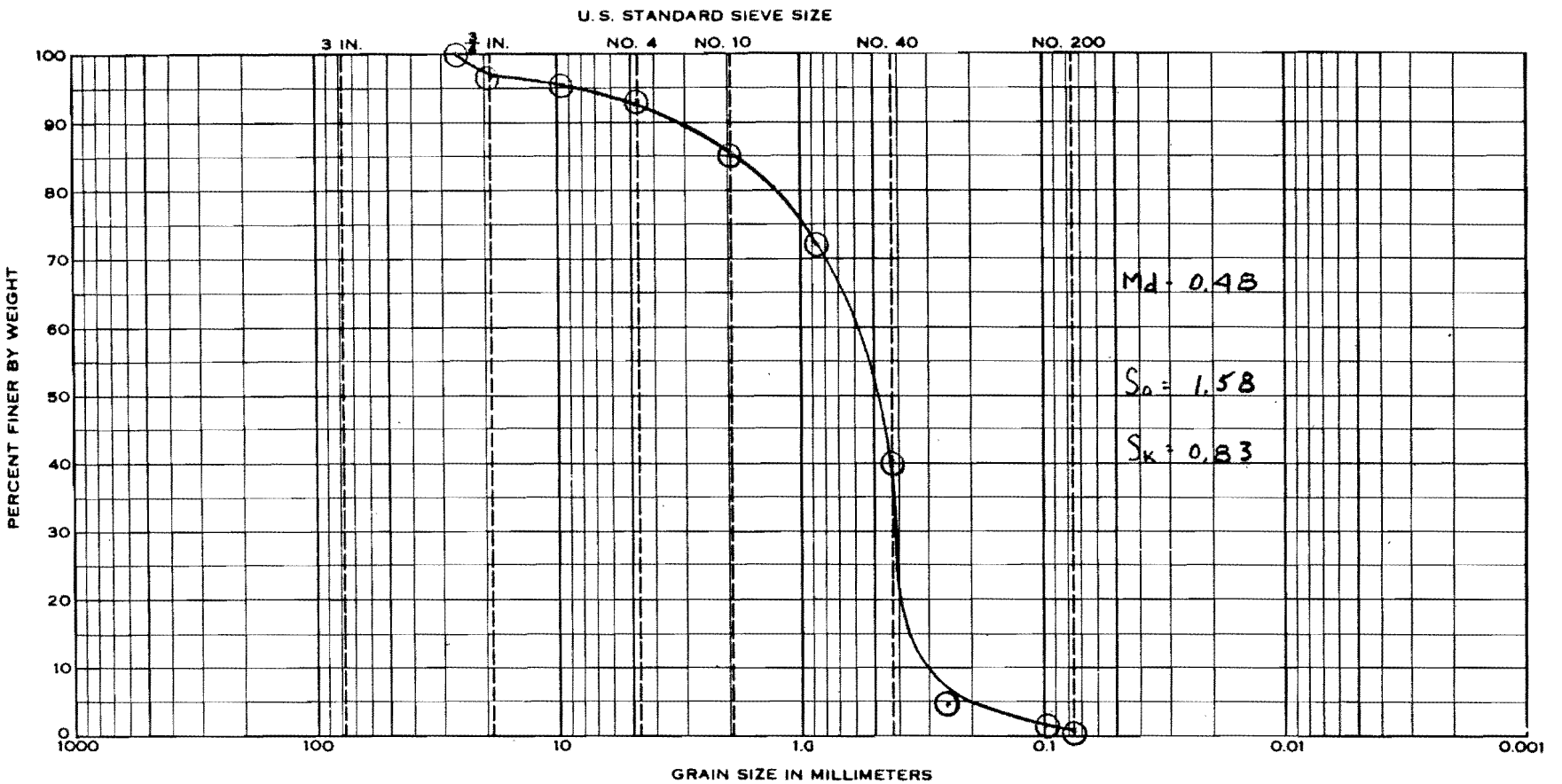
Area RARITAN & SANDY HOOK BAYS

Boring No. 31

Date 2-1-63

GRADATION CURVES

FIGURE B-4



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev ~~or Depth~~	Classification	NatWC	LL	PL	PI
6	12 to 14	SIEVE ANALYSIS				

Project BEACH EROSION & HURRICANE

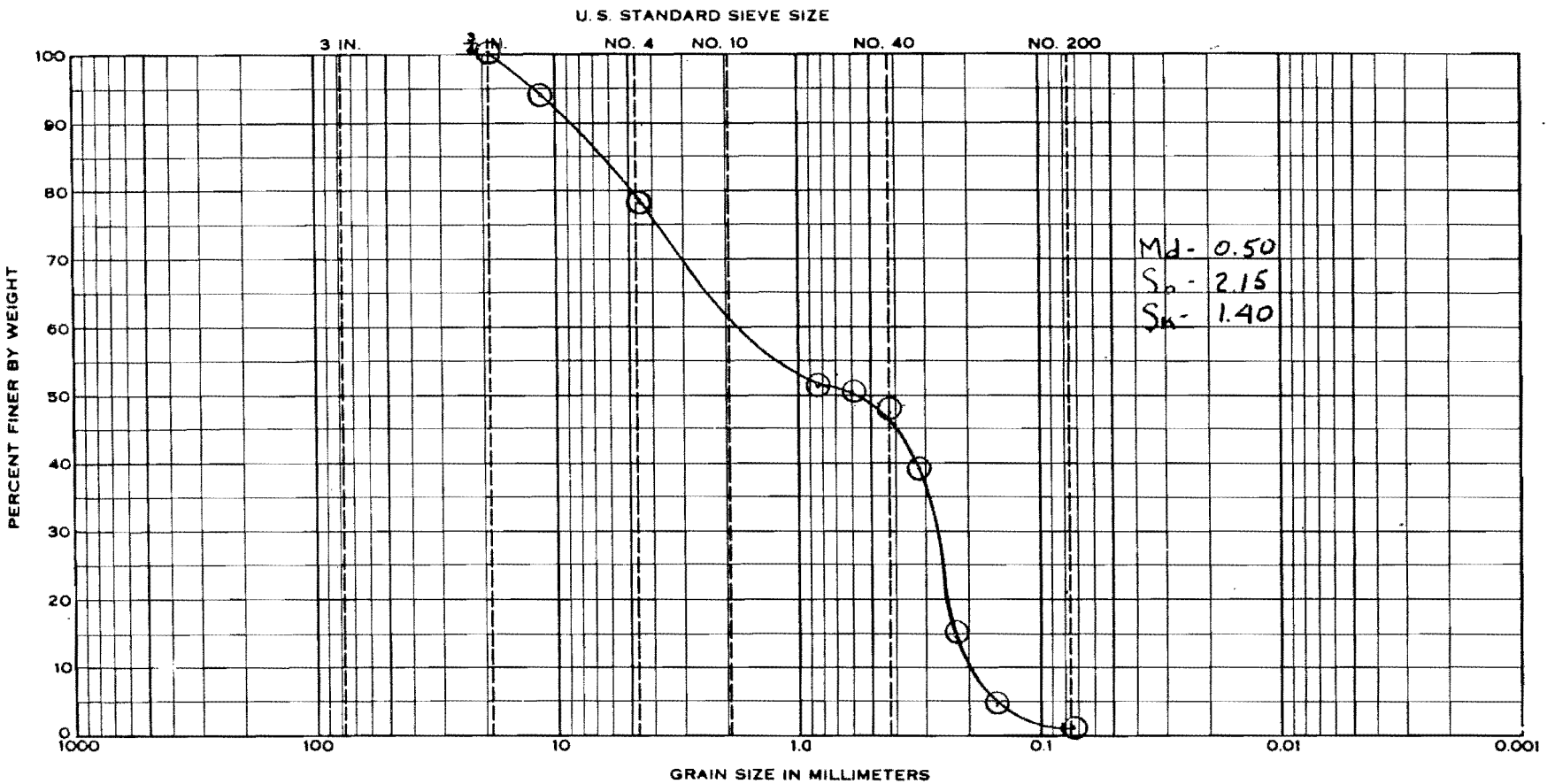
Area RARITAN & SANDY HOOK BAYS

Boring No. 35

Date 2-5-63

GRADATION CURVES

FIGURE B-5



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	NatWC	LL	PL	PI	
HIGH WATER		Moist, Brown Gravely SAND					14 May 62

Project RARITAN BAY, N.J.

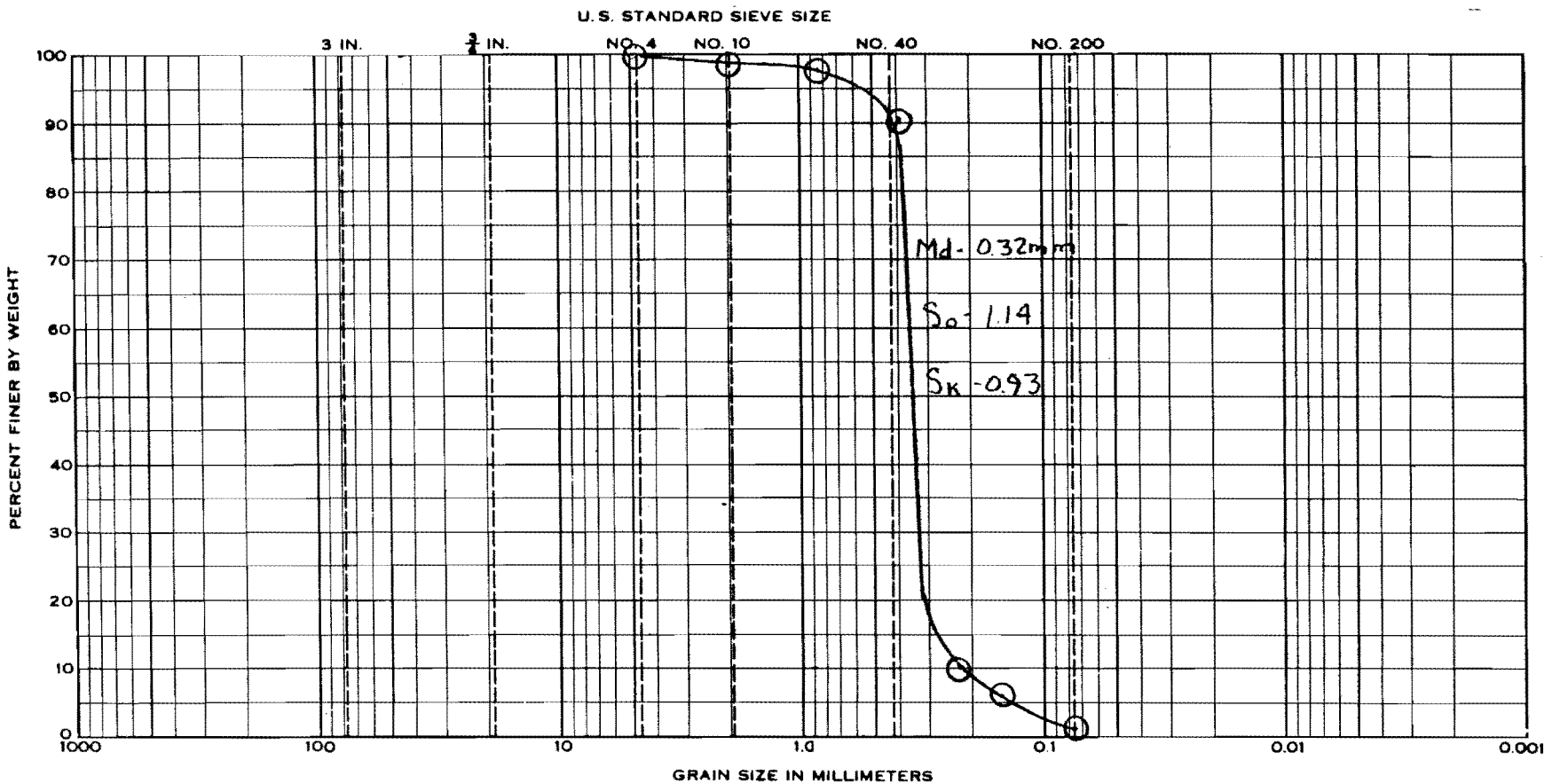
Area CLIFFWOOD BEACH

Boring No.

Date 6-28-62

GRADATION CURVES

FIGURE B-6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	Coarse	Fine	Coarse	Medium	Fine	

Sample No.	Elev or Depth	Classification	Nat WC	LL	PL	PI	
LOW WATER		Moist, Brown SAND					16 MAY 62

Project RARITAN BAY N.J.

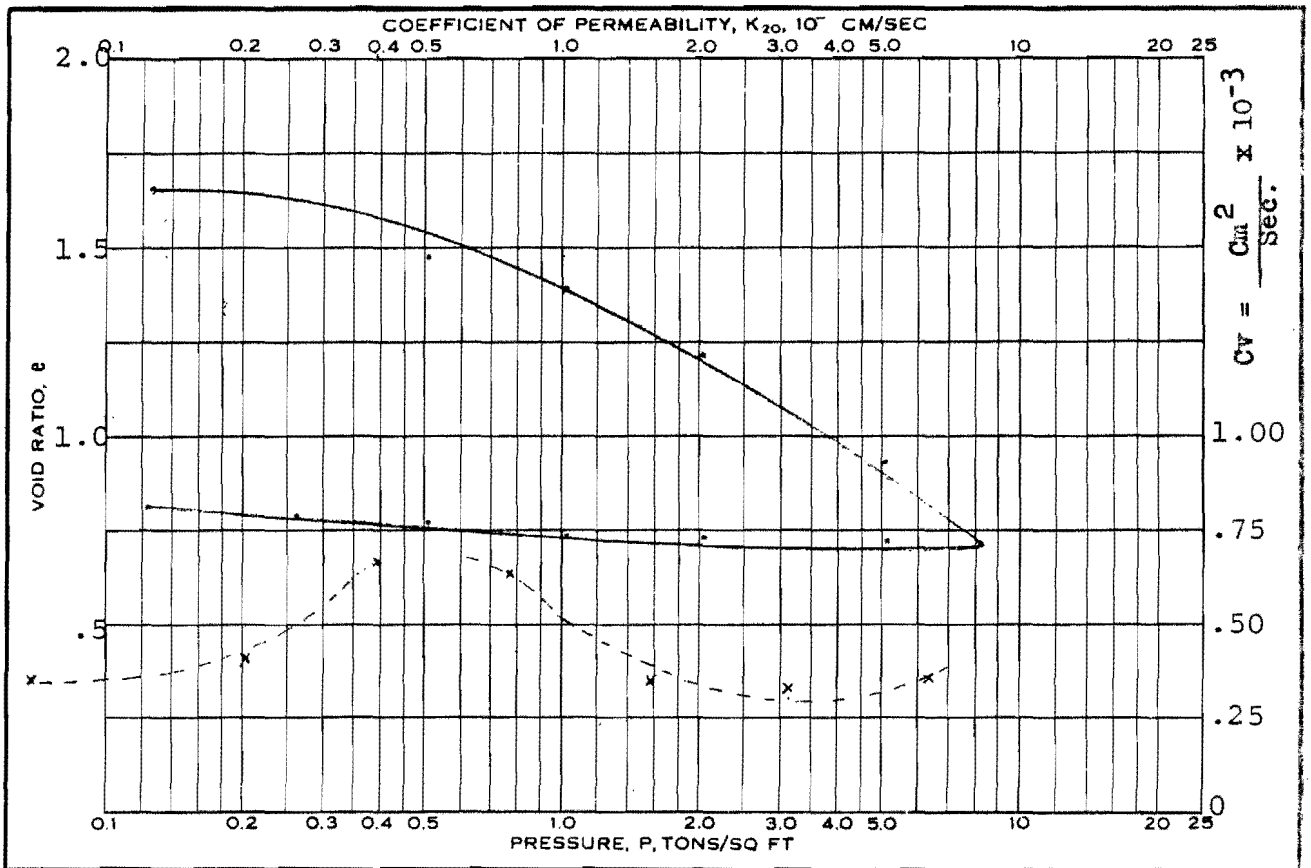
Area CLIFFWOOD BEACH

Boring No.

Date 6-28-62

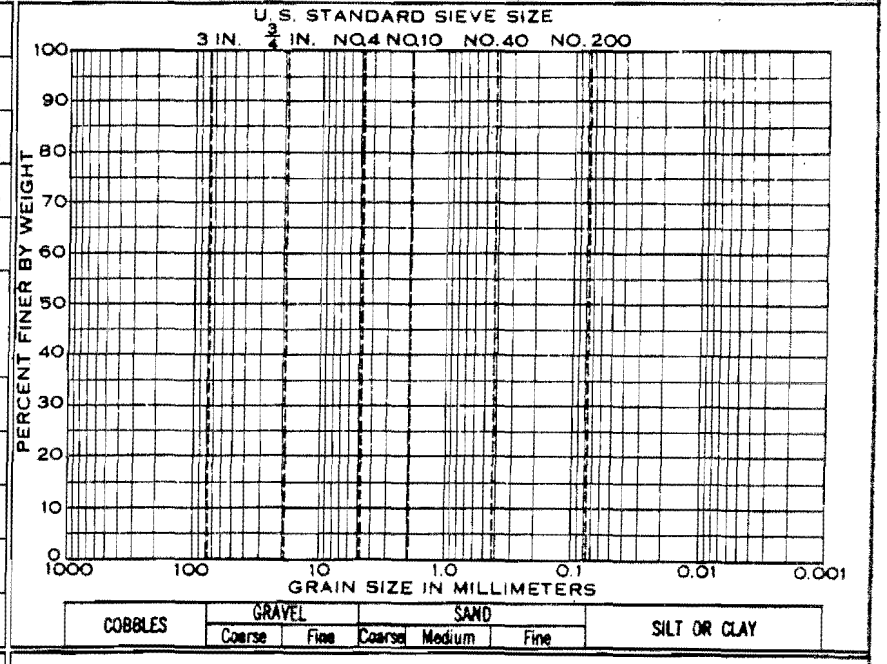
GRADATION CURVES

FIGURE B-7



TEST DATA

Type of Specimen	Undisturbed Tube
Overburden Pressure, P_0	Tons/Sq Ft
Preconsol Pressure, P_c	Tons/Sq Ft
Compression Index, C_c =	- 0.80
Permeability at Initial e	K_{20} _____ x 10^{-} Cm/Sec _____ Ft/Min
Initial Ht. .7870 in.	Diam. 2.5 in.
Initial Saturation, S_0 %	100
Final Saturation, S_f %	100
Initial Dry Density Lbs/Cu Ft	54.0
Initial Water Content, W_0 %	76.7



Remarks:

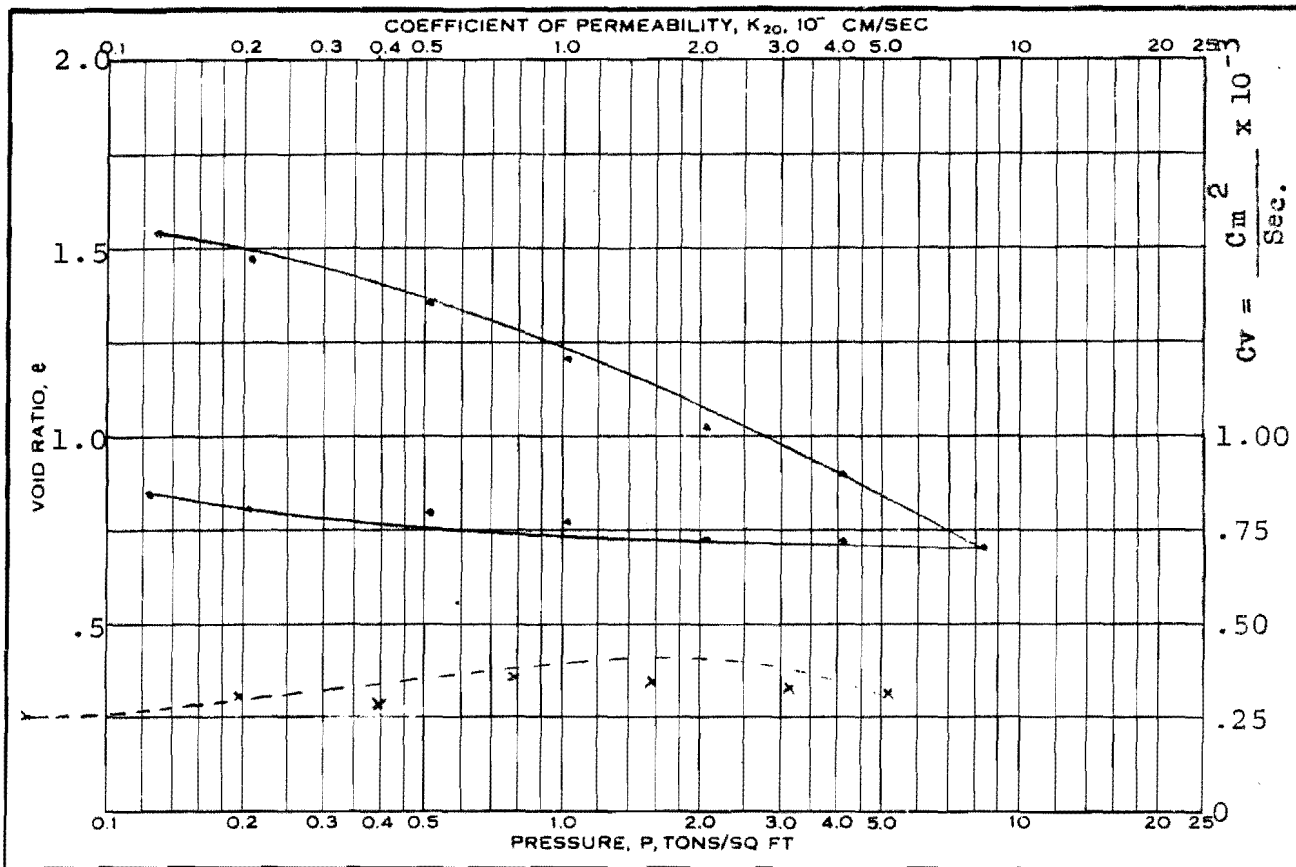
Classification	OH
LL 73.1	G 2.49
PL 44.0	D_{10} -

Project	Raritan Bay, Morgan Beach Levee
	Corps of Engineers 63-16
Area	
Boring No. DH 47	Sample No.
Elev or Depth 34.0'-37.0'	Date June 18, 1963

CONSOLIDATION TEST REPORT

ENG FORM 1 DEC 61 2090 (EM 1110-2-1803) Translucent

FIGURE B-8



TEST DATA

Type of Specimen: Undisturbed Tube

Overburden Pressure, P_o Tons/Sq Ft

Preconsol Pressure, P_c Tons/Sq Ft

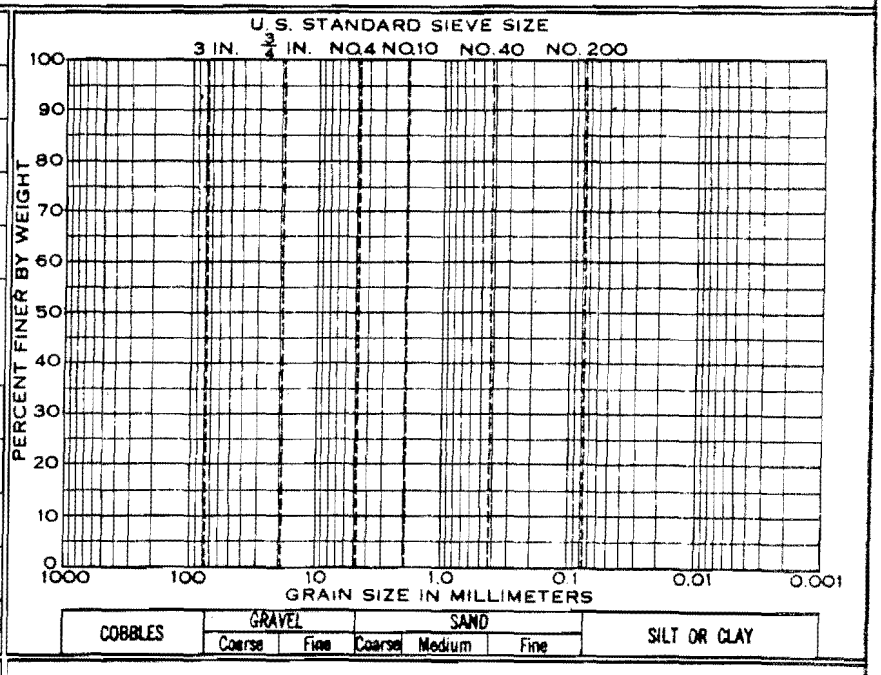
Compression Index, C_c = - 0.70

Permeability at Initial e

K_{20} _____ x 10^{-} Cm/Sec

_____ Ft/Min

Initial Ht.	.7920 in.	Diam.	2.5 in.
Initial Saturation, S_o	%	100	
Final Saturation, S_f	%	100	
Initial Dry Density	Lbs/Cu Ft	54.3	
Initial Water Content, W_o	%	77.0	



Remarks:

Classification OH

LL 69.1	G 2.51
PL 49.7	D_{10}

Project Raritan Bay, Morgan Beach Levee

Corps of Engineers 63-16

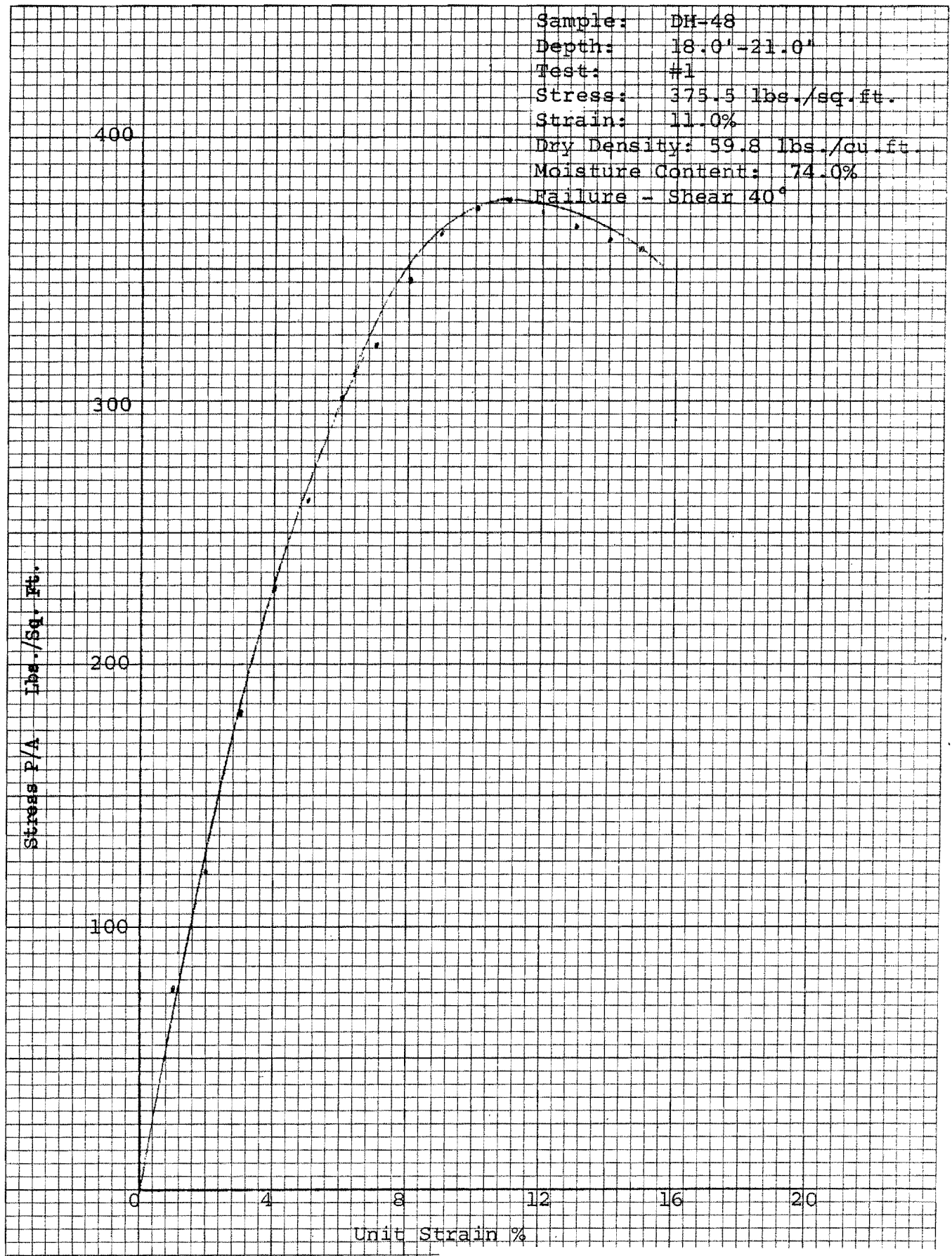
Area

Boring No. DH 48	Sample No.
Elev or Depth 19.0'-21.0'	Date June 18, 1963

CONSOLIDATION TEST REPORT

ENG FORM 1 DEC 51 2090 (EM 1110-2-1803) Translucent

FIGURE B-9



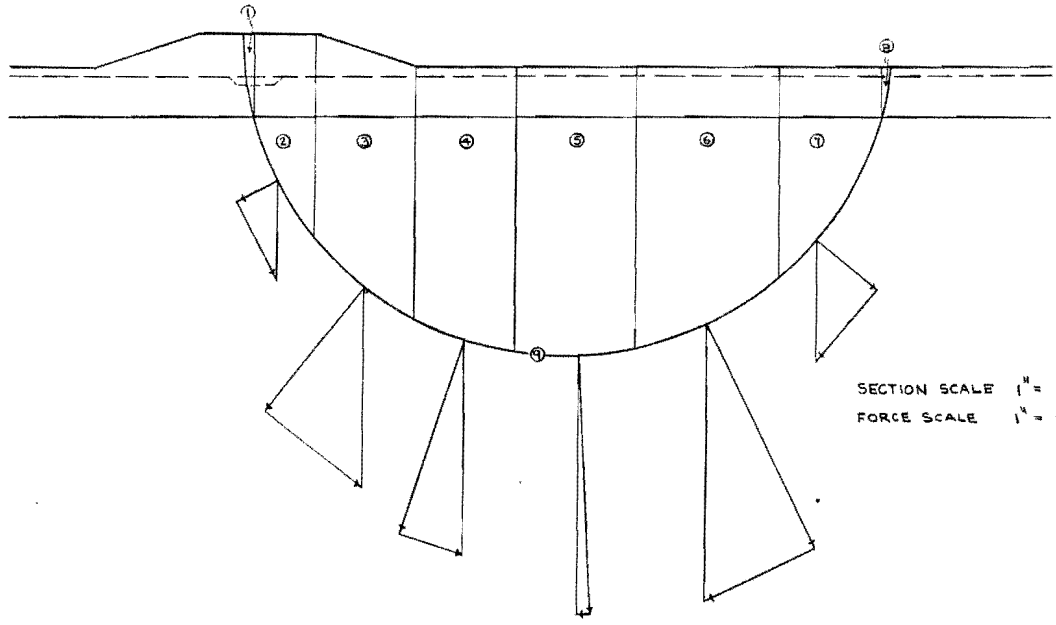
UNCONFINED COMPRESSION TEST
RARITAN BAY, MORGAN BEACH LEVEE

FIGURE B-10

SUMMARY OF SOIL TEST

Sample	Depth	Natural Moisture Content	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Plastic Index		Unconfined Compression: Stress(lbs./sq.ft.)	Unconfined Compression: Strain
DH 47	34' - 37'	84.4%	73.1	44.0	29.1	Test 1	158.9	14.0%
						Test 2	148.3	16.0%
DH 48	19' - 21'	89.3%	69.1	49.7	19.4	Test 1	375.5	11.0%
						Test 2	157.5	11.0%
DH 51	14' - 16'	82.4%	60.9	40.4	20.5		84.7	9.0%
DH 51	24' - 26'	88.7%	71.5	33.3	38.2		76.5	9.0%
DH 51	34' - 36'	74.5%	78.9	48.5	30.4		106.0	13.0%
DH 51	44' - 46'	103.2%	87.1	53.6	33.5		150.5	7.0%
DH 51	52' - 54'	104.4%	93.8	53.2	40.6		(Material too disturbed for testing)	

FIGURE B-11



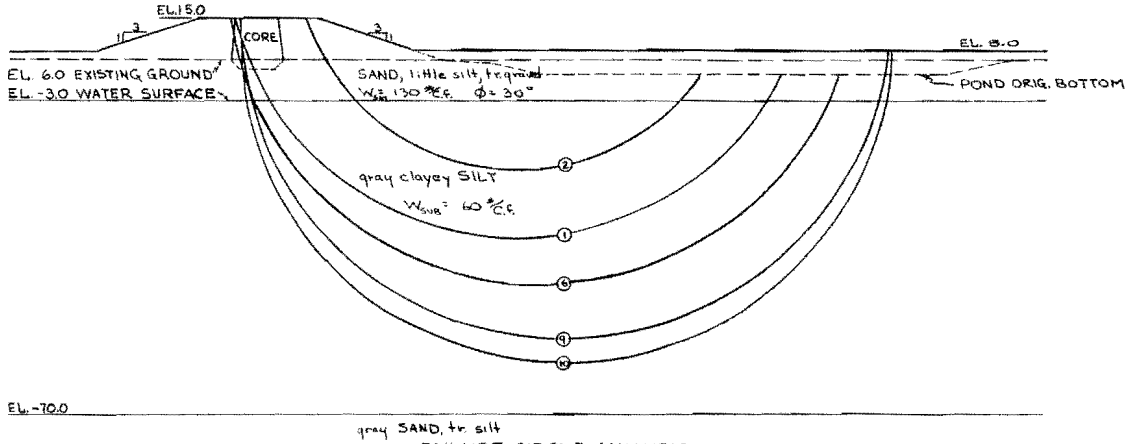
SECTION SCALE 1" = 20'
FORCE SCALE 1" = 40 KIPS

	ABOVE -3.0 FT. EL.						BELOW -3.0 FT. EL.						TOTALS		
SLICE	HT. LT. SIDE SLICE	HT. RT. SIDE SLICE	AVG. HT. OF SLICE	HORIZ. WIDTH	AREA	WT. OF SLICE KIPS	HT. LT. SIDE SLICE	HT. RT. SIDE SLICE	AVG. HT. OF SLICE	HORIZ. WIDTH	AREA	WT OF SLICE KIPS	TOTAL VERT. LOAD	NORMAL COMP.	TANG. COMP.
1	0	18	9	3	27	3.5	-	-	-	-	-	-	3.5	0.8	+ 3.2
2	18	18	18	13.5	243	31.6	0	26.5	13.25	13.5	178.9	10.7	42.3		+ 36.0
3	18	11	14.5	21.5	311.8	40.5	26.5	43.5	35.0	21.5	752.5	45.2	85.7		+ 53.0
4	11	11	11	21.5	236.5	30.8	43.5	50.0	46.75	21.5	1,005.1	60.3	91.1		+ 27.0
5	11	11	11	25	275	35.8	50.0	49.5	49.75	25	1,243.8	74.6	110.4		- 4.0
6	11	11	11	30.25	332.8	43.3	49.5	34.25	41.87	30.25	1,266.6	76.0	119.3		- 51.0
7	11	11	11	21.25	233.8	30.4	34.25	0	17.13	21.25	364	21.8	52.2		- 41.0
8	11	0	5.5	2	11	1.4	-	-	-	-	-	-	1.4	0.3	- 1.2
Σ														1.1	22.0

CONDITIONS OF ANALYSIS

1. END OF CONSTRUCTION
2. LEVEE-CORE AND BERM ARE FULLY SATURATED
3. GROUND WATER CORRESPONDS TO LOW WATER TIDE ELEVATION

$$\text{STABILITY RATIO} = \frac{CL + N\tan\phi}{\Sigma\,\text{TANG.}} = \frac{(200 \times 179.5) + (1.1 \times 577)}{22.0} = 1.66$$



FAILURE CIRCLE ANALYSIS

STATION 3+00 L

TRIAL CIRCLE	1	2	6	9	10
STABILITY RATIO W/ POND	0.81	1.69	0.74	0.67	0.87
STABILITY RATIO W/ 8' FILL	-	-	-	1.66	1.81

BEACH EROSION AND HURRICANE PROTECTION PROJECT
RARITAN - SANDY HOOK BAYS
STABILITY ANALYSIS STA. 3+00 LEVEE MORGAN BEACH, N.J.

FIGURE B 12

CORPS OF ENGINEERS, U. S. ARMY
NEW YORK DISTRICT, NEW YORK 13, N. Y.

Sheet 1 of 4

Subject RARITAN BAY AND SANDY HOOK BAY BEACH EROSION & HURRICANE PROJECT, N. J.

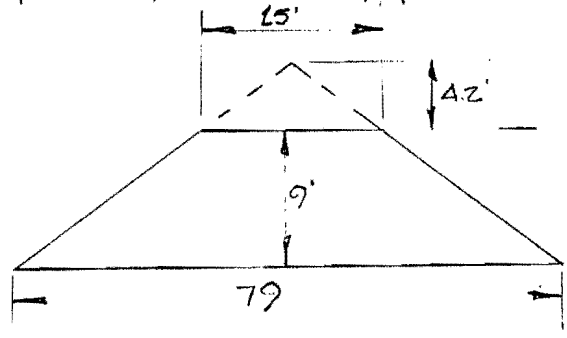
Computation SETTLEMENT ANALYSIS No.

Computed by J.C. Checked by F.C. Date 15 July 1963

SETTLEMENT COMPUTATIONS

PRESSURE DISTRIBUTION BENEATH ℄ OF LEVEE

PLUMMER & WORKS SOIL MECHANICS & FOUNDATIONS PG. 147 FIG. 78



b = 39.5

@ 10' 13.2(120)(.8388) - 4.2(120)(.58) = 1036

@ 20' 13.2(120)(.680) - 4.2(120)(.38) = 894

@ 30' 13.2(120)(.60) - 4.2(120)(.75) = 824

@ 40' 13.2(120)(.50) - 4.2(120)(.1) = 742

@ 50' 13.2(120)(.43) = 682

@ 60' 13.2(120)(.36) = 610

@ 70' 13.2(120)(.34) = 539

FIGURE B-13

CORPS OF ENGINEERS, U. S. ARMY
NEW YORK DISTRICT, NEW YORK 13, N. Y.

Sheet 1 of 4

Subject RARITAN BAY AND SANDY HOOK BAY BEACH EROSION & HURRICANE PROJECT, N.J.

Computation SETTLEMENT ANALYSIS No.

Computed by J.C. Checked by F.C. Date 15 July 1963

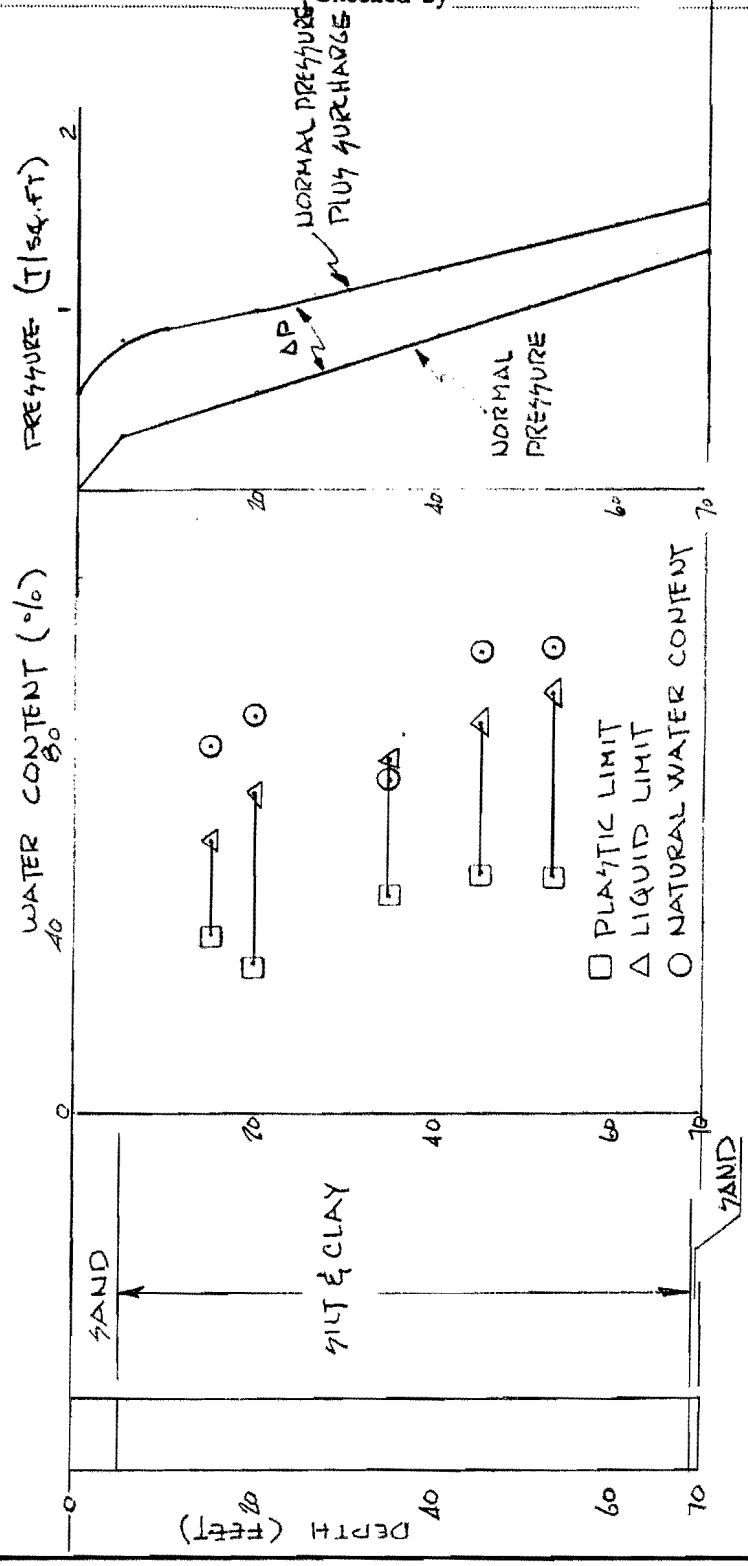


FIGURE B-14

CORPS OF ENGINEERS, U. S. ARMY
NEW YORK DISTRICT, NEW YORK 13, N. Y.

Subject: RARITAN BAY AND SANDY HOOK BAY BEACH EROSION & HURRICANE PROJECT, N.J.

Computation: SETTLEMENT ANALYSIS No.

Computed by: J.C. Checked by: F.C. Date: 15 July 1963

$S = \frac{2H_1}{1+e_1}(e_1 - e_2)$ P.C. Midpoint of clay-silt layer

$5(120) + 32.5(32.3) = 1650$ $e_1 = 1.44$

S.G. = 2.49 $\Delta P = 767$

Dry Density = 54.0 #/ft³ e_2 @ 2417 = 1.35

$\gamma_b = \frac{G_s - 1}{G_s} \times \gamma_d = \frac{2.49 - 1}{2.49} \times 54 = 32.3$

$$S = \frac{2(32.5)}{1+1.44}(1.44 - 1.35) = \underline{2.4'}$$

NORMAL SOIL PRESSURE AT MID POINT OF CLAY-SILT LAYER = 1650 #/ft²

INCREASE IN PRESSURE AT MID POINT OF CLAY-SILT LAYER DUE TO ADDITION OF LEVEE SECTION = 767 #/ft²

Avg. pressure 1650
2417
4067
$\frac{4067}{2(2000)} = 1.02$ T/ft²

$C_v = 0.52 \frac{cm^2}{sec} \times 10^{-3}$

$t = \frac{T_v H^2}{C_v}$

U = 10% T_v = .01 $t_{yrs} = \frac{.01(32.5)^2(144)(2.54)^2}{0.52(10^{-3})(60)(60)(24)(365)} = .60$ yrs

U = 20% T_v = .03 t_{yrs} = 1.8 yrs

U = 30% T_v = .07 t_{yrs} = 4.2 yrs

U = 40% T_v = .125 t_{yrs} = 7.5 yrs

U = 50% T_v = .19 t_{yrs} = 11.4 yrs

U = 60% T_v = .29 t_{yrs} = 17.4 yrs

U = 70% T_v = .40 t_{yrs} = 24.0 yrs

U = 80%, T_v = .57, t_{yrs} = 34.2 yrs

U = 90%, T_v = .86, t_{yrs} = 51.6 yrs.

FIGURE B-15

CORPS OF ENGINEERS, U. S. ARMY
NEW YORK DISTRICT, NEW YORK 13, N. Y.

Sheet 4 of 4

Subject RARITAN BAY AND SANDY HOOK BAY BEACH EROSION & HURRICANE PROJECT, N.J.

Computation SETTLEMENT ANALYSIS No.

Computed by J.C. Checked by F.C. Date 15 July 1963

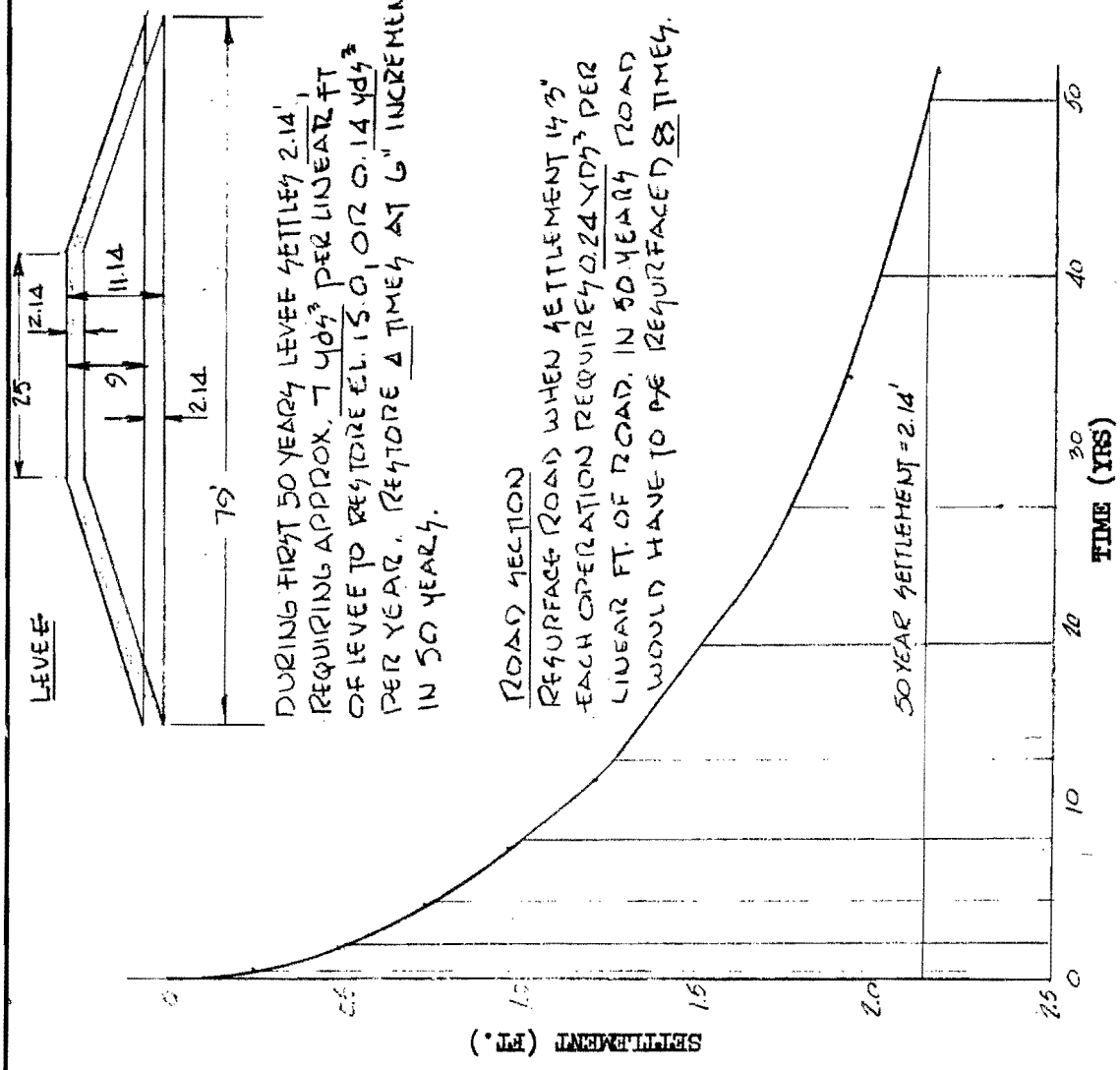
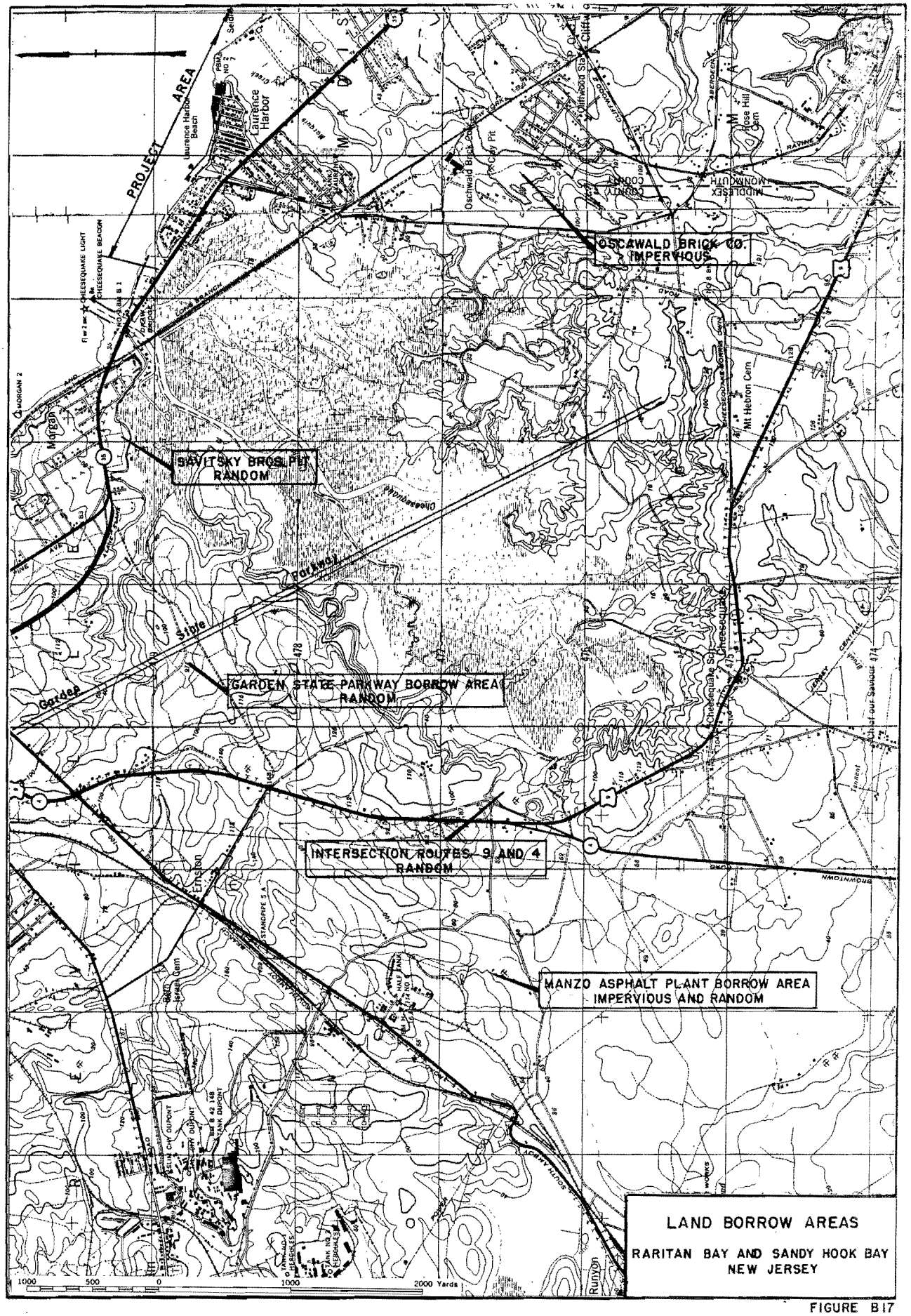


FIGURE B-16



LAND BORROW AREAS

RARITAN BAY AND SANDY HOOK BAY
NEW JERSEY

FIGURE B17

RARITAN BAY AND SANDY HOOK, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECTS

DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX C - INTERIOR DRAINAGE DESIGN

JULY 1963

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX C - INTERIOR DRAINAGE DESIGN

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RARITAN BAY AND SANDY HOOK, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECTS

DESIGN MEMORANDUM NO. I
MADISON AND MATAWAN TOWNSHIPS

APPENDIX C - INTERIOR DRAINAGE DESIGN

I - GENERAL

C-1. BASIS OF DESIGN FOR INTERIOR DRAINAGE: The basis of design is generally in accord with Preliminary Manuscript, Part CXIV Chapter 10, Interior Drainage, of the Engineering Manual, Civil Works. The drainage works of the considered plan are shown on Figures 3, 4 and 7 of the main body.

C-2. In general, continuous swales or ditches draining directly or through ponding area to culverts will provide for the passage of runoff from the interior areas through the hurricane improvement works. To prevent backflooding from Raritan Bay, the outlet culverts will be provided with automatic drainage gates (A.D.) and sluice gates to assure for positive closure in case the A.D. gates are lodged open during flood tides.

II - RUNOFF DETERMINATION CRITERIA

C-3. INTERIOR DRAINAGE RUNOFF: The runoff from the interior drainage areas was determined by the rational method using the formula $Q = CIA$, where Q equals runoff in cubic feet per second, C equals coefficient of runoff, I equals intensity of rainfall in inches per hour for the concentration time of the area and A equals area of interior drainage in acres.

C-4. DRAINAGE AREAS: The limit of the interior drainage areas were determined from topographic maps to a scale of 1 inch equals 200 feet, Figure C1 and 1 inch equals 1,000 feet, Figure C2.

C-5. RUNOFF COEFFICIENTS. A weighted value of perviousness was developed for each sub area. The pervious values used were 0.90 for watertight roof and concrete surfaces, 0.70 for macadam pavements, 0.10 to 0.30 for pervious soils with turf and 0.30 to 0.50 for impervious soils with turf.

C-6. RAINFALL INTENSITY. The rainfall intensity curve used for the design of the interior drainage works in conformance with good engineering practice is the 10 year frequency curve. The 10 year rainfall frequency curve applicable to the area of improvement, is shown

in Technical Paper No. 25, Rainfall Intensity-Duration Frequency Curves published by the U. S. Department of Commerce. The curve developed for Sandy Hook, New Jersey was used for the project area.

C-7. CONCENTRATION TIME. The time of concentration was determined by assuming that the runoff would travel through each drainage area in some combination of overland, swale or pipe flow. The time for the overland flow was determined in accordance with the Engineering Manual for Military Construction, Part XIII, Chapter 1, dated June 1955, Surface Drainage Facilities for Airfields. The time of flow in swales in the drainage area was determined with an initial velocity of 2 feet per second and a final velocity based on the ground slope, an "n" equal to .050, side slopes of 1 on 10 and the length of swale.

III - DESIGN CRITERIA FOR OUTLET CULVERTS

C-8. CULVERT CRITERIA. The hydraulic computations for the culverts were made in accordance with the Engineering Manual for Civil Works Construction, Part CXVI, Chapter 2 dated 2 February 1963, Hydraulic Design, Reservoir Outlet Structures. The culverts were designed to discharge runoff from the 10 year rainfall against the spring tide, elevation 3.6 feet above mean sea level. Hydraulic computations disclosed that a slight increase in elevation of ponding at the culvert inlets, would discharge the runoff 100 year frequency rainfall against the spring tide of 3.6 feet above mean sea level. (Computation C-2).

C-9. The energy head losses assumed in the computation are as follows:

Table C-1 - Energy Head Loss Coefficients in Terms of Velocity Head

Type of Energy Loss	Coefficient (K) in terms of Velocity Head $\left(\frac{v^2}{2g}\right)$
Friction n = .013 concrete n = .035 swales & ditches	$\frac{2\,gl}{C^2\,R}$
Entrance	0.50
Manholes	0.10
Trash Racks	0.15
Automatic Gates	0.10
Exit	1.00

IV - INTERIOR DRAINAGE DESIGN

C-10. MORGAN BEACH AREA. The interior drainage at the Morgan Beach area that is intercepted by the proposed Hurricane protection works at elevation 15.0 above mean sea level is 19.4 acres (Fig. C-1). The area is developed as a residential area. Runoff from the drainage area reaches Raritan Bay by overland flow. The drainage works that will be required with the protection works consists of a 24 inch culvert, Automatic Drainage and Sluice gate. The culvert will discharge against the spring tide of 3.6 feet above mean sea level. The 10 year runoff of 10.5 c.f.s. with a water surface elevation of 4.40 feet above mean sea level at the culvert entrance and the 100 year runoff of 15.0 c.f.s. with water surface elevation of 4.96 feet above mean sea level. Computation C-1, C-2.

C-11. MARGARET CREEK AREA. The interior drainage at the Margaret Creek area that is intercepted by the proposed beach fill at elevation 5.5 feet above mean sea level is 440 acres, Figure C2, at present, a 24 inch corrugated metal pipe passes the flows of Margaret Creek through the existing beach area into Raritan Bay. Computations indicate that a 48 inch pipe would be required to discharge the 10 year runoff of 62 c.f.s. against the spring tide of 3.6 feet above mean sea level with a water surface elevation of 4.28 feet msl at the culvert entrance and the 100 year runoff of 89 c.f.s. with a water surface elevation of 5.0 feet above mean sea level. Computation C-1, C-2. However an existing swamp area through which Margaret Creek flows between the beach and New Jersey Route 35 is capable of storing the entire design storm runoff without spillage over the top of the proposed beach fill at elevation 5.5 mean sea level. Therefore the existing 24 inch culvert is considered adequate and is extended through the proposed beach fill section. If the swamp area is reclaimed in the future, the size of the culvert should be increased at this location.

COMPUTATION C-1 - DRAINAGE AREAS - RUNOFF FACTORS

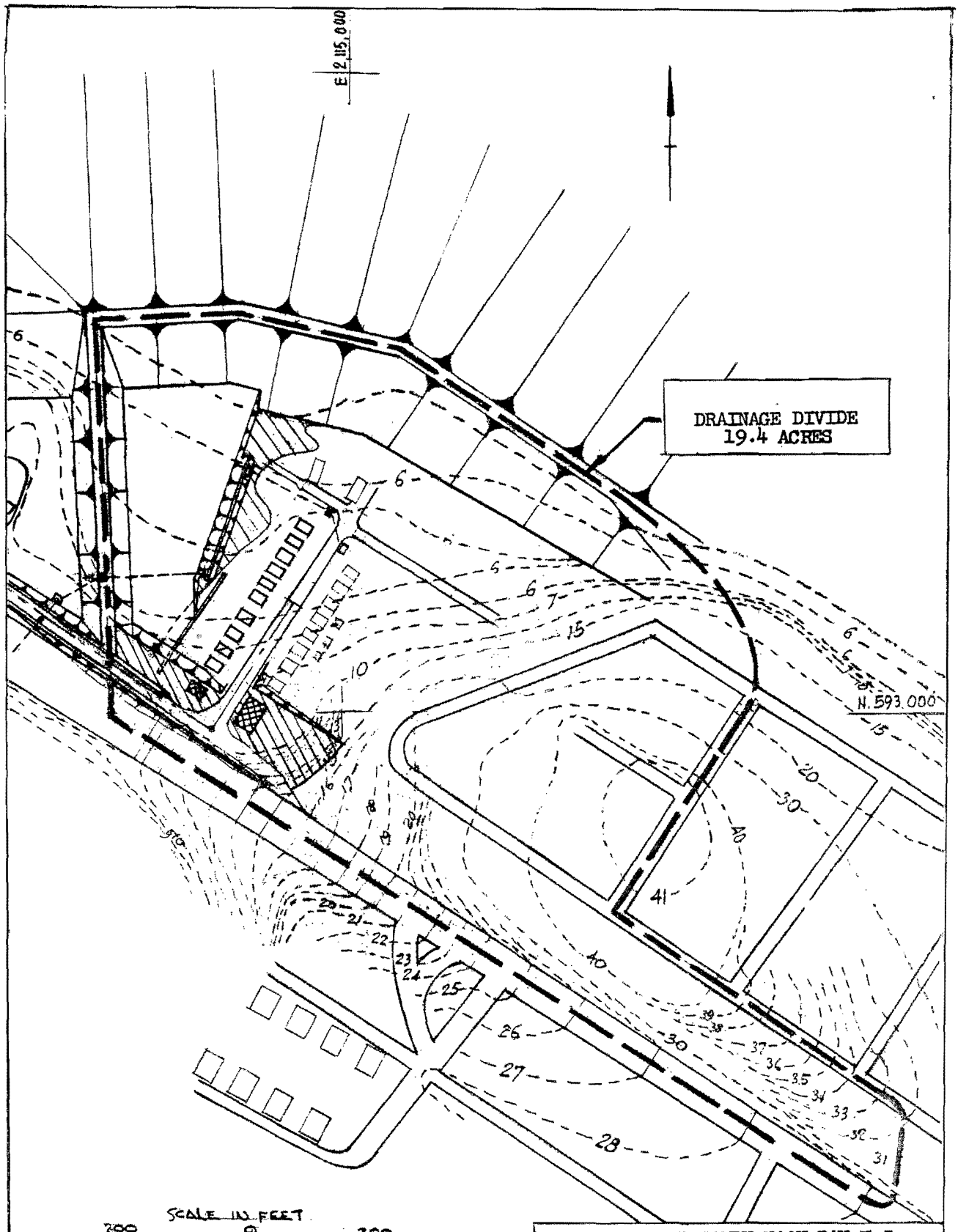
Location	Area	Area (acres)	Runoff Coefficient "C"	Time of Concentration (minutes)	Rainfall Intensity inches/hour	Q = CIA (cfs)	Frequency (Years)
Morgan Beach	A	19.4	0.20	30	2.7	10.5	10
					3.9	15.0	100
Margaret Creek	Ba	440	0.20	146	1.2	62.0b	10
		440	0.20	146	1.7	89.0b	100

a - Runoff From Area "B" was computed by the Snyder Synthetic Unit Hydrograph Method Using average coefficients of C_t = 2.0 and 640 Cp = 400.

b - Without Swamp pondage.

COMPUTATION C-2 - DESIGN OF INTERIOR DRAINAGE CONDUITS

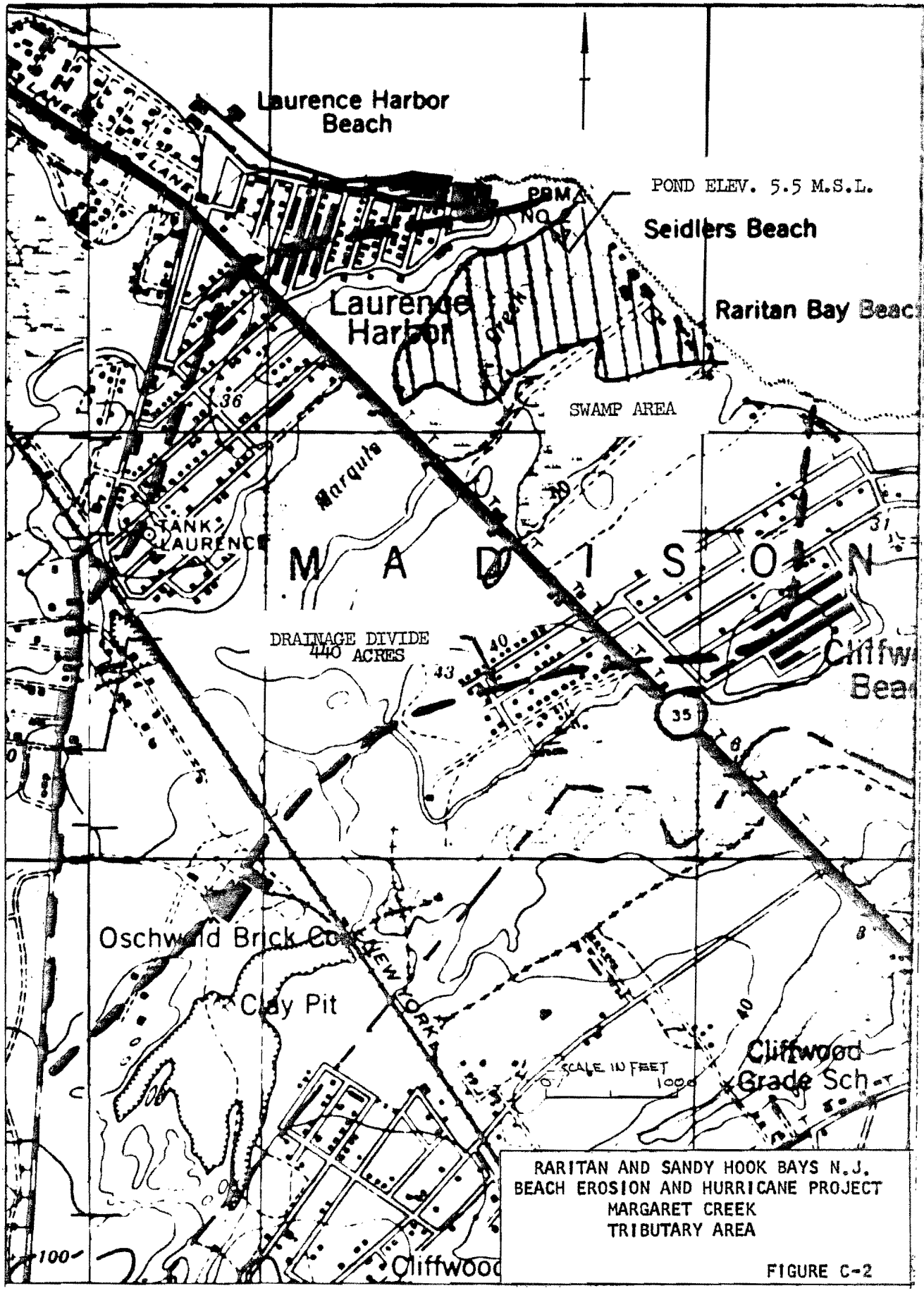
Area	Size (in.)	Length (ft.)	Invert Elevation Upper (ft. msl)	Invert Elevation Lower (ft. msl)	Diff. (ft.)	Slope (ft.)	HEAD LOSSES = K $V^2/2g$ Ent.	Frict.	Other	Exit	Total	Coeff. "C"	Area (sq.ft.)	Water Surface Ent.	Water Surface Exit	Diff. Head (ft.)	DISCHARGES Available (cfs)	DISCHARGES Require (cfs)
A	24	95	3.0	2.5	0.5	.0051	0.5	2.17	0.1	1.0	3.77	0.51	3.14	4.40	3.60	0.90	12.2	10.5
														4.96	3.60	1.36	15.0	15.0
B	48	360					0.5	0.42		1.0	1.92	.72	12.56	4.28	3.60	.68	62	62
														5.0	3.60	1.4	89	89



RARITAN AND SANDY HOOK BAY N.J.
BEACH EROSION AND HURRICANE PROJECT

MORGAN BEACH
TRIBUTARY AREA

FIGURE C-1



RARITAN AND SANDY HOOK BAYS N.J.
BEACH EROSION AND HURRICANE PROJECT
MARGARET CREEK
TRIBUTARY AREA

FIGURE C-2

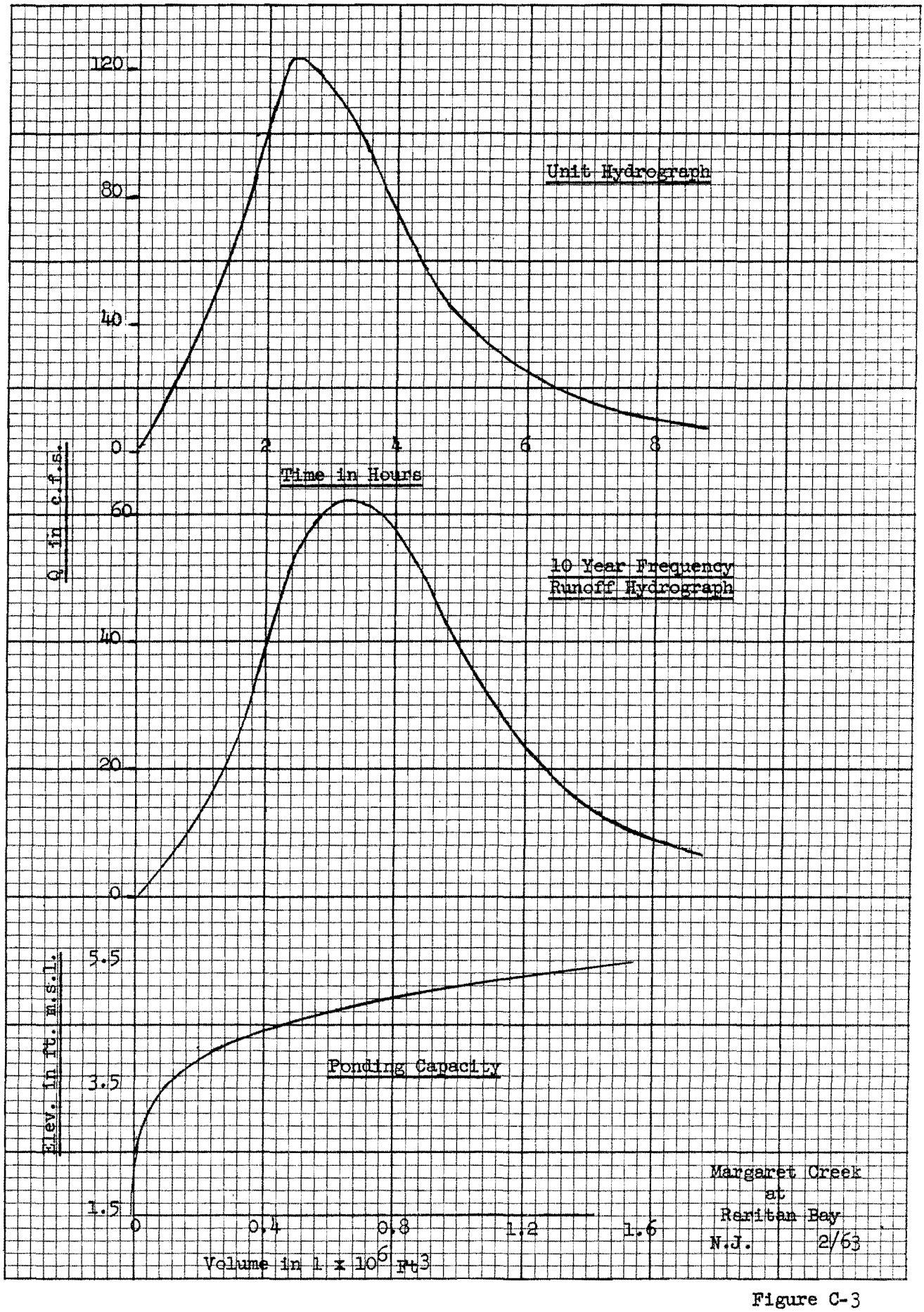

120
80
40
0
2
4
6
8
Unit Hydrograph
Time in Hours
Q in c.f.s.
60
40
20
0
10 Year Frequency
Runoff Hydrograph
Elev. in ft. m.s.l.
5.5
3.5
1.5
Ponding Capacity
0
0.4
0.8
1.2
1.6
Volume in 1 x 10^6 ft^3
Margaret Creek
at
Raritan Bay
N.J.
2/63

Figure C-3

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX D - COST ESTIMATES, CHARGES AND ALLOCATIONS

JULY 1963

RARITAN BAY AND SANDY HOOK BAY, NEW YORK
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX D - COST ESTIMATES, CHARGES AND ALLOCATIONS

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RARITAN BAY AND SANDY HOOK BAY, NEW YORK
BEACH EROSION AND HURRICANE PROJECT

GENERAL DESIGN MEMORANDUM NO. 1
MADISON AND MATAWAN TOWNSHIPS

APPENDIX D - COST ESTIMATES, CHARGES AND ALLOCATIONS

D1. BASIS OF COST ESTIMATES. The detailed cost estimates for shore and hurricane protection, based on July 1963 price levels, are broken down into six shore sections as shown in the detail plans, Figure 2 through 9A of the main body of this design memorandum. The quantities are based on these plans which were developed in accordance with the authorizing document for current prevailing conditions as shown by the 1963 field survey. The unit prices were developed on the basis that construction procedure and schedule will be as herein noted, that the sand fill will be obtained by dredging from offshore areas in the Raritan Bay and that the other fill will be obtained from land sources as discussed in Appendix B.

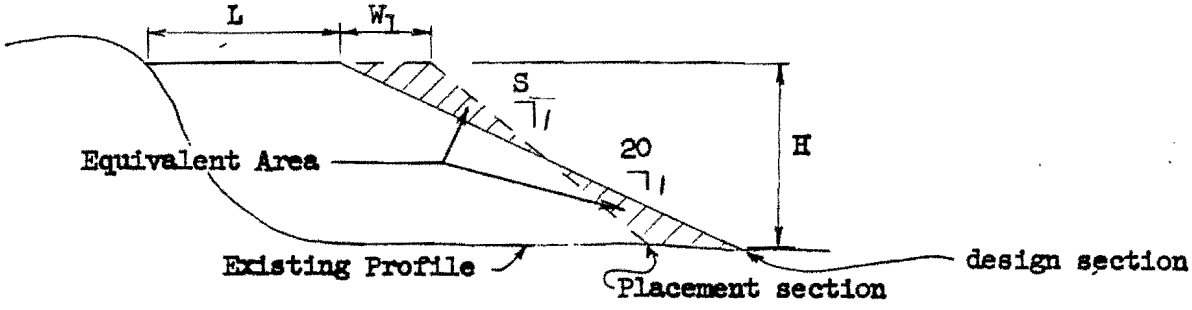
D2. CONSTRUCTION PROCEDURE. Because of the location of the offshore borrow areas in order to obtain suitable sand fill, a 16 inch hydraulic dredge or larger will be used. The dredging operations will start at the west end of the borrow area, located offshore of Seidler's Beach. The placement will start with the bluff protection at Laurence Harbor and move westward to Morgan Beach. An extra quantity of hydraulic fill will be stock piled at Morgan Beach so that it can be wrapped around the bayside of the north end of the levee. The placement would then start at Seidler's Beach and move eastward to past Matawan Point to eastward terminus of the work. If contractor elects to take advantage of better dredging conditions by the performance of the work in a shorter period, a second dredge could start placement of the beach fill at Cliffwood Beach, starting at Whale Creek and moving eastward to the end of the project, past Matawan Point.

D3. The dredging operation will require a minimum of one 16 inch hydraulic dredge for a period of more than eleven months. However, a second dredge could be used effectively if it becomes necessary to cut down the construction time. In order to place the required amount of material along the beach, to minimize the placement of underwater fill and to meet the placement slopes obtainable with hydraulic dredge without mechanical placement, the design sections are squeezed so that an equivalent amount of material is

placed on the shore. Then, the material, under wave action, would eventually be moved until the resultant section approaches the design section.

D4. SECTION ADJUSTMENT FOR HYDRAULIC FILL. The following method was devised to obtain an equivalent squeezed section for placement of hydraulic fill when actual hydraulic fill slopes obtainable from the utilized hydraulic dredge are steeper than the design slope. The adjustment was developed in two parts, each of which adds or subtracts from the design berm width of "L". The adjusted areas have been transposed into linear lengths to form a simplified table giving the total berm widths based on the hydraulic slope obtainable with the hydraulic dredge being used.

D5. The first adjustment is necessary to obtain a placement section equivalent to the design section by increasing the berm width and modifying the slope so that area taken from offshore is placed shoreward at berm.



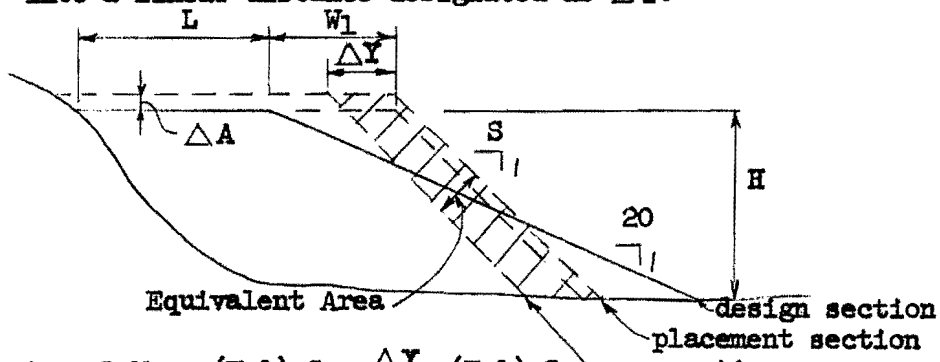
This adjustment is expressed in terms of the increased berm width "W_1", to the design berm width "L" for a vertical height "H" from top of berm to intersection of design slope "S" with the existing ground. Then:

$$W_1 = \frac{20H - SH}{2} = \frac{H\ (20 - S)}{2}$$

The design berm width "L" varies from a minimum of 25 feet for hurricane and bluff protection to a maximum of 100 feet for beach protection.

D6. The second adjustment is necessary to obtain an equivalent area to allow for a one foot overpumping tolerance from the land side edge of berm to the intersection with existing ground. This allowance

is subtracted from the total berm width and has been transposed into a linear distance designated as ΔY.



$$A_t = L+W_1 + (H+1)\ S = \frac{\Delta Y}{S}\ (H+1)\ S$$

$$\Delta Y = \frac{L+W_1 + S\ (H+1)}{H + 1} = \frac{L + W_1}{H + 1} + S$$

D7. A typical example follows:

GIVEN: - STATION 24 + 00
H = 12.9 feet
L = 45 feet
S = 12:1 (for dredge)

THEN:

$$W_1 = \frac{12.9\ (20 - 12)}{2} = 51.6 \text{ use}$$

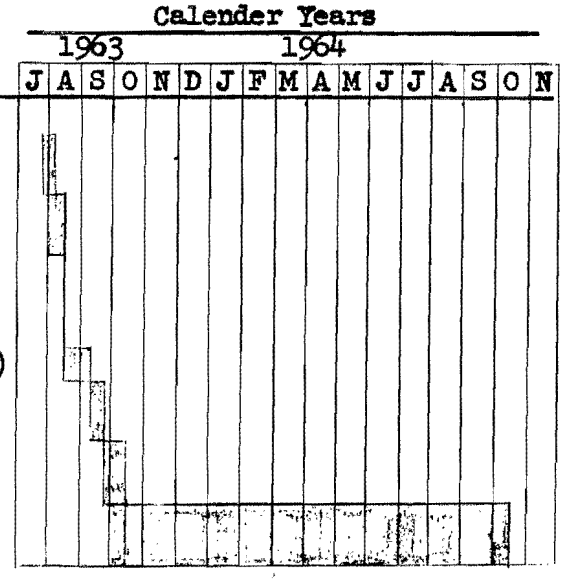
	+ 52.0 feet
$\Delta Y = \frac{45 + 52}{12.9 + 1} + 12 =$	- 19.0 feet
Total Adjustment	+ 33.0 feet
Design Berm Width (L)	+ 45.0 feet
Total Contract Berm Width	+ 78.0 feet

D8. The total adjusted minimum berm width shall be not less than 25 feet for hurricane and bluff protection and 100 feet for beach protection. The adjusted berm widths computed in accordance with the foregoing are shown on Figure 12 of the main body of the design memorandum.

D9. After placement of the sand fill at Morgan Beach, the levee construction would be started by placing the berm to elevation 8 feet above mean sea level with compacted land borrow, from the sand fill to the vicinity of the service road on the north side of New Jersey Route No. 35. Then an inspection trench would be excavated through

the berm and into the original ground to permit the placement of the impervious core and the construction of the levee to dimensions shown on Figure 9A of the main body of the Design Memorandum. The construction of the road embankment between the levee and high ground to complete the closure and construction of the service road and Cliffwood Way will be done during the off season months to minimize the effect on business and recreational facilities. Interior drainage facilities and fill around buildings will be phased with the placement of the embankment. Top soil and seeding and planting of beach grass will be phased with completion of levees and road embankment. Interior drainage through the sand fill will be phased with placement of the sand fill.

D10. CONSTRUCTION SCHEDULE. The time schedule for construction is based on the ability of local interests to perform the necessary items of local cooperation, principally the acquisition of lands, easements and rights-of-way and the provision of a cash contribution; and the foregoing construction procedure.



D11. DETAILED ESTIMATES OF COST. The detailed estimates have been prepared by work feature, by shore section, by protection purpose, and by townships to facilitate allocation of costs to Federal and non-Federal interests as follows. Table D1 presents the latest approved estimate (PB3). Table D2 presents the detail estimate of cost for the authorized project in Madison and Matawan Townships. Table D3 presents the detail estimate of a single purpose beach erosion project in Madison and Matawan Townships. Table D4 presents the detail estimate of

separable cost of hurricane protection for Morgan Beach. These costs are in addition to the cost of shore protection given in Table D3 for Morgan Beach. Table D5 presents the detail breakdown of the unit price of dredging and placing sand on the beach. Table D6 presents the distribution of preauthorization study not included in the construction costs.

D12. SUMMARY. The total estimated first cost of the improvement for Madison and Matawan townships is $1,356,010 of which $1,071,485 is for beach fill, $157,400 for levee and appurtenant work, $127,125 for lands, easements and rights-of-way. The cost of preauthorization study is $18,000. A breakdown summary of these costs by shore segments is given in Table D7.

II. ALLOCATION AND APPORTIONMENT OF FIRST COSTS AND ANNUAL CHARGES

D13. ALLOCATION - FIRST COSTS. All costs are allocable to only shore protection in all sections of the work except at Morgan Beach where it is allocable to shore and hurricane protection. The method of cost allocation for distributing the cost between shore and hurricane protection is separable costs - remaining benefits method. In this method, each purpose should provide enough benefits to carry at least the separable cost of including it in the project, no purpose should carry costs in excess of benefits that it produces or in excess of the cost of an alternative method of providing purpose, and all purposes share equally in the joint costs.

D14. The breakdown of the total estimated cost of the multiple purpose project at Morgan Beach is given in Table D8. This table shows the separable costs for work which is to be used exclusively for one purpose project and the remaining joint costs for work which will be utilized for more than one project purpose.

D15. ALLOCATION - ANNUAL CHARGES. The estimates of annual charges are based on an interest rate of three percent. Since initial work would require less than two years to complete, no interest was charged during construction. Amortization is based on a useful life of 50 years. The charges also include the annual costs of periodic beach replenishment and maintenance of hurricane protection works.

D16. Estimates of annual maintenance for the hurricane and shore protection provide for restoration of dike and road embankment to compensate for settlement, for repair of the sand fill due to the wind and water and other reasons, and for maintenance and operation of drainage facilities. The breakdown estimate of the annual cost of

maintenance for Madison and Matawan Townships is contained in Table D9. For cost allocation purposes at Morgan Beach, the annual cost of beach replenishment has been taken as a joint cost and the hurricane project maintenance as a separable cost of that function.

D17. ALLOCATION TO PURPOSES. The allocation of joint costs between purposes for Morgan Beach is given in Table D10. The summary of the allocation to purposes for the entire project is given in Table D11.

D18. APPORTIONMENT BETWEEN FEDERAL AND NON FEDERAL INTERESTS. The apportionment of project costs between Federal and non Federal interests is based on the current Federal laws and policies governing apportionment of costs of beach erosion control (shore protection) and hurricane protection improvement as described in paragraph 71 of the main part of this design memorandum.

D19. APPORTIONMENT OF FIRST COST. The shore ownership for areas included in the project, are given in Table D12. Details of the apportionment of the first cost of shore protection is given in Table D13.

D20. The apportionment of the cost of hurricane protection is as described in paragraph 74 of the main part of this design memorandum. The apportionment of cost for hurricane protection at Morgan Beach is given in Table D14.

D21. A summary of the apportionment of first cost for shore and hurricane protection as heretofore developed is given in Table D15.

D22. ANNUAL CHARGES. Separate estimates of the annual charges for shore protection and hurricane protection are given in Table D16. A summary of the annual charges are given in Table D17.

III. ECONOMIC ANALYSIS

D23. ECONOMIC JUSTIFICATION. An economic analysis based on cost and benefit data presented in this design memorandum for the portion of the project in Madison and Matawan Townships, for each shore section, and for shore and hurricane protection is shown in Table D18.

TABLE D1 - CURRENT PROJECT COST ESTIMATE (PB-3)

PROJECT COST ESTIMATE (PB-3) (AMOUNTS IN THOUSANDS OF DOLLARS)	DIVISION: North Atlantic	APPROPRIATION TITLE: Construction, General	PROJECT: Raritan Bay and Sandy Hook Bay, N. J.	DATE PREPARED: 5 Apr 63
	DISTRICT: New York	CLASS: Local Protection Projects (Flood Control)		EFFECTIVE DATE: 1 Jul 62
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COST ACCT. NO.	ITEM	H.L.	COST ESTIMATE: CURRENT	COST ESTIMATE: PREVIOUS H.D. (OCE)	AMOUNT OF CHANGE: TOTAL	AMOUNT OF CHANGE: PRICE LEVEL	AMOUNT OF CHANGE: OTHER	% COMMITTED	JUSTIFICATION OF REVISION
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Total Cost								Authorization: F.C. Act of 1962 (H D 464/87/2)
01	LANDS	0	61.0	61.0	0	0	0	10	Includes 6.0 for Madison Twp and 55.0 for Borough of Keansburg to E. Keansburg.
02	RELOCATIONS	0	70.0	70.0	0	0	0	0	For Borough of Keansburg & E. Keansburg
10	BREAKWATERS AND SEAWALLS (Groins)	0	227.0	227.0	0	0	0	0	For Borough of Keansburg & E. Keansburg
11	LEVEES	0	1,342.0	1,342.0	0	0	0	0	
	Madison Twp		(141.0)	(141.0)					
	Borough of Keansburg & E. Keansburg		(1,201.0)	(1,201.0)					
17	BEACH REPLENISHMENT	0	2,660.0	2,660.0	0	0	0	0	
	Madison Twp		(533.0)	(533.0)					
	Matawan Twp		(114.0)	(114.0)					
	Borough of Union Beach		(95.0)	(95.0)					
	Borough of Keansburg & E.Keansburg		(1,724.0)	(1,724.0)					
	Keansburg		(194.0)	(194.0)					Reflects cost of prior work completed by local interests, of which 57.0 will be reimbursed by Gov't.
29	PREAUTHORIZATION STUDIES	100	49.0	49.0	0	0	0	100	Financed under Gen. Invest. appropriation. Federal 43.0; Non-fed Cash Contrib: 6.0.
30	ENGINEERING & DESIGN	100	167.0	167.0	0	0	0	31	
31	SUPERVISION & ADMINISTRATION		358.0	358.0	0	0	0	1	
	TOTAL COST		4934.0	4934.0					

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TABLE D1 - CURRENT PROJECT COST ESTIMATE (PB-3) Cont'd.

PROJECT COST ESTIMATE (PB-3) (AMOUNTS IN THOUSANDS OF DOLLARS)	DIVISION: North Atlantic	APPROPRIATION TITLE: Construction, General	PROJECT: Raritan Bay and Sandy Hook Bay, N. J.	DATE PREPARED: 5 Apr 63
	DISTRICT: New York	CLASS: Local Protection Projects (Flood Control)		EFFECTIVE DATE: 1 Jul 62
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COST ACCT. NO.	ITEM	H.T.	COST ESTIMATE CURRENT	COST ESTIMATE PREVIOUS	AMOUNT OF CHANGE TOTAL	AMOUNT OF CHANGE PRICE LEVEL	AMOUNT OF CHANGE OTHER	% COMMITTED	JUSTIFICATION OF REVISION
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Total Cost Breakdown		4,934.0	4,934.0	0	0	0	2	
	Total Federal Cost		3,216.0	3,140.0	+76.0	0	+76.0	3 #	#Federal and Non-Federal shares revised to conform to cost sharing provisions of R&H Act of 1962.
	Total Non-Federal Cost		1,718.0	1,794.0	-76.0	0	-76.0	1 #	(Federal share of first cost excluding preauth. studies and Keansburg reimbursement work, increased from 64.8% to 66.4%).
						Adjustment of Previous Rounding*	Due To Revised Cost Sharing#		
	Total Non-Federal Cost Breakdown				TOTAL				
	CASH CONTRIBUTION		1,450.0	1,526.0	-76.0	0	-76.0		*Represents differences in previous true unrounded estimate from the previous estimate as rounded or adjusted to nearest 10,000 for construction features. (Now, estimates are rounded to nearest 1,000, to enable easier computation based on section percentages as work progresses).
10	BREAKWATERS & SEAWALLS		(82.0)	(110.0)	(-28.0)	(-16.0)	(-12.0)		
11	LEVEES		(371.0)	(350.0)	(+21.0)	(+21.0)	(0)		
17	BEACH REPLENISHMENT		(825.0)	(880.0)	(-55.0)	(-1.0)	(-54.0)		
29	PREAUTHORIZATION STUDIES		(6.0)	(6.0)	(0)	(0)	(0)		
30	ENGINEERING & DESIGN		(50.0)	(56.0)	(- 6.0)	(- 5.0)	(- 1.0)		
31	SUPERVISION & ADMINISTRATION		(116.0)	(124.0)	(- 8.0)	(+1.0)	(- 9.0)		
	OTHER NON-FEDERAL COSTS		268.0	268.0	0	0	0		
01	LANDS AND DAMAGES		(61.0)	(61.0)	(0)	(0)	(0)		
02	RELOCATIONS		(70.0)	(70.0)	(0)	(0)	(0)		
17	BEACH REPLENISHMENT (Keansburg)		(137.0)	(137.0)	(0)	(0)	(0)		
	Total Non-Federal Cost		1,718.0	1,794.0	-76.0	0	-76.0		

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TABLE D1 - CURRENT PROJECT COST ESTIMATE (PB-3) Cont'd.

PROJECT COST ESTIMATE (PB-3) (AMOUNTS IN THOUSANDS OF DOLLARS)	DIVISION: North Atlantic	APPROPRIATION TITLE: Construction, General	PROJECT: Raritan Bay and Sandy Hook Bay, N. J.	DATE PREPARED: 5 Apr 63
	DISTRICT: New York	CLASS: Local Protection Projects (Flood Control)		EFFECTIVE DATE: 1 Jul 62
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COST ACCT. NO.	ITEM	H.T.	COST ESTIMATE CURRENT	COST ESTIMATE PREVIOUS	AMOUNT OF CHANGE TOTAL	AMOUNT OF CHANGE PRICE LEVEL	AMOUNT OF CHANGE OTHER	% COMMITTED	JUSTIFICATION OF REVISION
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	SUMMARY OF ESTIMATED PROJECT COSTS								
	Federal Cost								
	Corps of Engineers		3,216.0	3,140.0	+76.0	0	+76.0	3	#
	U.S. Coast Guard - None								
	Required Non-Federal Costs								
	Cash Contribution		1,450.0	1,526.0	-76.0	0	-76.0	0	#
	Other Costs		268.0	268.0	0	0	0	1	
	Total Project Costs								
	Federal and Required Non-Federal		4,934.0	4,934.0	0	0	0	2	

Basis of Estimate:

Based on the authorization estimate (HD 464/87/2, OCE transmittal) at May 1960 price levels, including preauthorization studies costs and the local work accomplished at Keansburg to be reimbursed by the Government, deemed adequate as of 1 July 1962, with minor rounding, and with Federal and Non-Federal shares revised to conform to the cost sharing provisions of the R&H Act of 1962 (PL 87/874). (The HD estimate was based on the cost sharing provisions of PL 826/84).

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TABLE D1 - CURRENT PROJECT COST ESTIMATE (PB-3) Cont'd.

PROJECT COST ESTIMATE (PB-3) (AMOUNTS IN THOUSANDS OF DOLLARS)	DIVISION: North Atlantic	APPROPRIATION TITLE: Construction, General	PROJECT: Raritan Bay and Sandy Hook Bay, N. J.	DATE PREPARED: 5 Apr 63
	DISTRICT: New York	CLASS: Local Protection Projects (Flood Control)		EFFECTIVE DATE: 1 Jul 62
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COST ACCT. NO.	ITEM	H.L.	COST ESTIMATE: CURRENT	COST ESTIMATE: PREVIOUS	AMOUNT OF CHANGE: TOTAL	AMOUNT OF CHANGE: PRICE LEVEL	AMOUNT OF CHANGE: OTHER	% COMMITTED	JUSTIFICATION OF REVISION
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	CONTINGENCY ALLOWANCES								
	Project Status (31 Mar 63)		Estimated Cost	Direct Costs	Conting Allow	Percent Conting.			
	Completed		137.0	137.0	0	0			
	Uncompleted but Committed		0	0	0	0			
	Not Yet Committed		4,223.0	3,675.0	548.0	15			
	Total		4,360.0	3,812.0	548.0	14			
	(a) Status of Work Committed but Uncompleted (approx. % complete)							-	
	(b) Status of Planning for Work Not Yet Committed (approx. % complete)							46	
	ANALYSIS OF SUPV & ADMIN		Total Cost	Costs to 3-31-63	Bal. to Complete				
	(1) Total Contract Cost		4,092.0	0	4,092.0				
	(2) Total H.L. Cost		-	-	-				
	(3) Distr. O/H Rate for Contr. Work		1.9%	-	-				
	(4) Distr. O/H Rate for H.L. Work		8.4%	-	-				
	(5) Direct Costs - Project Office		-	-	-				
	(6) Direct Costs - Other Offices		230.0	0	0				
	(7) District Overhead		128.0	a) 3.7	124.3				a) Reflects O/H on completed portion of E&D
	(8) Area Overhead		-	-	-				
	TOTAL SUPV. & ADMIN.		358.0	3.7	124.3				

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TABLE D-2 - DETAILED ESTIMATE OF COST - AUTHORIZED PROJECT - MADISON AND MATAWAN TOWNSHIPS (JULY 1963 PRICE LEVELS)

ACCT. NO.	ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE (DOLLARS)	ESTIMATED COST (DOLLARS)
	I	MADISON TOWNSHIP				
17		BEACH REPLENISHMENT				
	1.	Morgan Beach (1400 Feet - Beach and Hurricane Protection)				
	a.	Mobilization and Demobilization		Job	LS	3,000
	b.	Sand Fill	247,500	c.y.	.90	222,750
	c.	Beach grass	14,500	s.y.	.15	2,175
	d.	Permanent sign		Job	LS	25
	e.	Subtotal				227,950
	2.	LAURENCE HARBOR (3800 Feet - Bluff Protection)				
	a.	Mobilization and Demobilization		Job		11,200
	b.	Clearing of site	2	Acre	260	520
	c.	Sand Fill	207,600	c.y.	.90	186,840
	d.	Removing structures	6,000	s.f.	1.25	7,500
			2,925	s.f.	.85	2,490
	e.	Permanent sign		Job	LS	25
	f.	Subtotal				208,575
	3.	SEIDLER'S BEACH (2,200 Feet - Beach Protection)				
	a.	Mobilization and Demobilization		Job	LS	4,200
	b.	Sand Fill	79,000	c.y.	.90	71,100
	c.	Drainage line (24 inch ø C.M)	135	L.F.	10	1,350
	d.	Timber bents	6	EA	45	270
	e.	Permanent sign	-	Job	LS	25
	f.	Subtotal				76,945
	4.	KNOLLCROFT (2850 Feet - Bluff Protection)				
	a.	Mobilization and Demobilization		Job	LS	4,600
	b.	Sand Fill	87,300	c.y.	.90	78,570
	c.	Permanent sign		Job	LS	25
	d.	Subtotal				83,195
	5.	Subtotal Beach Replenishment				596,665
	6.	Contingencies (15%)				89,500
	7.	Subtotal				686,165
	8.	Inspection, supervision and administration (7%)				48,030
	9.	Engineering and design (3%)				20,600
	10.	Total - BEACH REPLENISHMENT				754,795
11.		LEVEE				
	1.	MORGAN BEACH (510 feet)				
	a.	Mobilization and Demobilization		Job	LS	1,500
	b.	Compacted Fill, Impervious	3,542	c.y.	3.00	10,600
	c.	Compacted Fill, Random	18,210	c.y.	1.75	31,900
	d.	Compacted Fill, Common	520	c.y.	1.75	900
	e.	Excavation, Common	1,620	c.y.	1.00	1,620
	f.	Gravel Road Surfacing (Access Rd.)	156	s.y.	3.00	470
	g.	4" Top Soil and Seeding	4.0	Acres	2400.00	9,600
	h.	Concrete	36	c.y.	80.00	2,880
	i.	Reinforcing Steel	2,000	lbs.	0.16	320
	j.	Portland Cement	59	BBL	5.75	340
	k.	8" ø CMP - 16 Guage, ¼ paved	53	LF	5.00	265
	l.	12" ø CMP - 16 guage, ¼ paved	182	LF	6.00	1,090
	m.	24" ø CMP - 16 guage, ¼ paved	250	LF	10.00	2,500
	n.	24" ø AD gate	1	EA	600.00	600
	o.	24" ø Sluice Gate (Flush Bottom)	1	EA	1500.00	1,500
	p.	Paved gutter	680	LF	1.00	680
	q.	Steel grate and frame	1	EA	150.00	150
	r.	Catchbasin grate and frame	2	EA	100.00	200
	s.	Manhole steps	17	EA	7.00	120
	t.	Subtotal Levee				67,235
	u.	Contingencies 15%				10,085
	v.	Subtotal				77,320
	w.	Inspection, supervision and administration (7%)				5,440
	x.	Engineering and design				2,340
	y.	TOTAL LEVEE				85,100
.02		RELOCATIONS				
	1.	MORGAN BEACH				
	a.	Mobilization and Demobilization		Job	LS	1,000
	b.	Road Raising				
	(1)	Excavation, Common	225	c.y.	1.00	225
	(2)	Select Material	2,663	c.y.	1.75	4,660
	(3)	Compacted Fill, Common	5,310	c.y.	1.75	9,300
	(4)	New Curbing	1,570	LF	3.50	5,500
	(5)	Curbing to be removed	410	LF	3.00	1,230
	(6)	Fence to be removed		Job	LS	265
	(7)	Fence to be replaced		Job	LS	265
	(8)	Macadam Surfacing (3" Thick)	310	Ton	13.00	4,030
	(9)	Gravel Surfacing	800	s.y.	3.00	2,400
	(10)	Bituminous Stabilized base Course (4")	414	Ton	13.00	5,400
	(11)	Sub-Base Course (12")	626	c.y.	3.50	2,190
	(12)	MH Frame & Cover		Each	150.00	150
	(13)	Drop Inlet Type B		Each	500.00	500
	(14)	18" R.C. Pipe	13	L.F.	8.00	105
	(15)	Guard Rails	700	L.F.	6.00	4,200
	(16)	Utilities (underground)		Job	LS	5,000
	(17)	Top soil and seeding	0.3	Acre	2400.00	720
	c.	Overhead Utility Lines		Job	LS	10,000
	d.	Sub-total at Relocations				57,140
	e.	Contingencies (15%)				8,570
	f.	Subtotal				65,710
	g.	Inspection, supervision and administration				4,600
	h.	Engineering and design				1,990
	i.	TOTAL RELOCATIONS				72,300

TABLE D-2 - DETAILED ESTIMATE OF COST - AUTHORIZED PROJECT - MADISON AND MATAWAN TOWNSHIPS (JULY 1963 PRICE LEVELS)

ACCT. NO.	ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE (DOLLARS)	ESTIMATED COST (DOLLARS)
.01		LANDS				
	1.	MORGAN BEACH				
	a.	Permanent rights	6.0	Acres	500.00	3,000,000
	b.	Temporary rights	1.1	Acres	100.00	110.00
	c.	Raise - 1 story frame house		Job	LS	6,000.00
	d.	Raise - 1 story commercial bldg.		Job	LS	9,000.00
	e.	Raise - 1 story frame garage		Job	LS	2,000.00
	f.	Compacted Fill - Common	1,720	c.y.	1.75	3,070.00
	g.	Four inch top soil and seeding	0.5	Acre	2400.00	1,200.00
	2.	LAURENCE HARBOR				
	a.	Permanent Rights	9.7	Acres	500.00	4,850.00
	b.	Acquire 1½ story commercial Bldg.		Job	LS	18,000.00
	c.	Acquire 1 story commercial Bldg.		Job	LS	38,000.00
	d.	Sub-Total				60,850.00
	3.	SEIDLER'S BEACH				
	a.	Permanent Rights	5.6	Acres	500.00	2,800
	b.	Subtotal				2,800
	4.	KNOLLCROFT				
	a.	Permanent Rights	9.9	Acres	500.00	4,950
	b.	Subtotal				4,950
	5.	Subtotal Lands				92,580
	6.	Contingencies (15%)				13,945
	7.	Subtotal				106,525
	8.	Inspection, supervision and administration (7%)				7,485
	9.	Engineering and design (3%)				3,205
	10.	TOTAL LANDS				117,615
		MADISON TOWNSHIP TOTAL				1,029,810
	II	MATAWAN TOWNSHIP				
17		BEACH REPLENISHMENT				
	1.	Cliffwood Beach - West (2,200 Ft. - Beach Protection)				
	a.	Mobilization and Demobilization		Job	LS	3,500
	b.	Sand Fill	79,900	c.y.	.90	71,900
	c.	Permanent Sign		Job	LS	50
	d.	Subtotal				75,450
	2.	Cliffwood Beach - East (3,250 Ft. - Bluff Protection)				
	a.	Mobilization and Demobilization		Job	LS	9,500
	b.	Removing old Bulkhead	1,200	LF	.50	600
	c.	Sand Fill	177,100	c.y.	.90	159,390
	d.	Beach grass	1,000	s.y.	.15	150
	e.	15" ø CMP - 16 gauge, ¼ paved	350	LF	7.00	2,450
	f.	15" ø sluice gate	2	EA	1,000.00	2,000
	g.	Manhole concrete	4	c.y.	80.00	320
	h.	Portland Cement	7	BBLS	5.75	40
	i.	Reinforcing steel	345	lbs	0.16	55
	j.	Steel frame and grate	2	EA	150.00	300
	k.	Manhole steps	5	EA	7.00	35
	l.	Permanent Sign		Job	LS	50
	m.	Subtotal				174,890
	3.	Subtotal Beach Replenishment				250,340
	4.	Contingencies (15%)				37,550
	5.	Subtotal				287,890
	6.	Inspection, supervision and administration (7%)				20,160
	7.	Engineering and design (3%)				8,640
	8.	TOTAL - BEACH REPLENISHMENT				316,690
.01		LANDS				
	1.	Cliffwood Beach - West				
	a.	Permanent rights	4.4	Acre	500.00	2,200
	b.	Sub-Total				2,200
	2.	Cliffwood Beach - East				
	a.	Permanent rights	8.2	Acre	500.00	4,100
	b.	Temporary rights	0.3	Acre	100.00	30
	c.	Raise building		Job	LS	1,200
	d.	Subtotal				5,330
	3.	Subtotal - Lands				7,530
	4.	Contingencies (15%)				1,130
	5.	Subtotal				8,660
	6.	Inspection, supervision, and administration (7%)				600
	7.	Engineering and design (3%)				250
	8.	TOTAL - LANDS				9,510
		MATAWAN TOWNSHIP TOTAL				326,200
		PROJECT COST				1,356,010

TABLE D3 - DETAILED ESTIMATE OF COST - SINGLE PURPOSE BEACH EROSION PROJECT (a)

ITEM	DESCRIPTION	MADISON TOWNSHIP MORGAN BEACH	LAURENCE HARBOR	SEIDLER'S BEACH	KNOLLCROFT	TOTAL MADISON	MATAWAN TOWNSHIP CLIFFWOOD BEACH WEST	EAST	TOTAL MATAWAN	TOTAL REACH
	CONSTRUCTION									
1.	Type of Protection	Beach	Bluff	Beach	Bluff		Beach	Bluff		
2.	Shore length (feet)	1,400	3,800	2,200	2,850	10,250	2,200	3,250	5,450	15,700
3.	Sand Quantity									
	a. Required (c.y.)	48,800	180,500	68,700	75,900	373,900	69,500	154,000	223,500	597,400
	b. Pumped (c.y.)	56,100	207,600	79,000	87,300	430,000	79,900	177,100	257,000	687,000
4.	Dredging (cents/c.y.)	90	90	90	90	90	90	90	90	90
5.	Contract Cost (dollars)	50,490	186,840	71,100	78,570	387,000	71,900	159,390	231,290	618,290
6.	Mob. and Demob.	3,000	11,200	4,200	4,600	23,000	3,500	9,500	13,000	36,000
7.	Remove Buildings	0	9,990	0	0	9,990	0	0	0	9,990
8.	C.M. Outlets (no.)	0	0	1	0	1	0	2	2	3
	a. size (inches)	0	0	24ø	0	24ø	0	15ø	15ø	-
	b. length (feet)	0	0	135	0	135	0	350	350	-
	c. Total cost (dollars)	0	0	1,620	0	1,620	0	5,200	5,200	6,820
9.	Clearing of site		520			520		600		1,120
10.	Permanent sign	10	25	25	25	85	50	50	100	185
11.	Beach Grass	0	0	0	0	0	0	150	150	150
12.	Subtotal (items 5 - 11)	53,500	208,575	76,945	83,195	422,215	75,450	174,890	250,340	672,555
13.	Contingencies (15%)	8,025	31,285	11,545	12,480	63,335	11,320	26,230	37,550	100,885
14.	Engineering (3%)	1,845	7,195	2,650	2,870	14,560	2,610	6,030	8,640	23,200
15.	Supr. Insp. Admin. (7%)	4,305	16,795	6,190	6,695	33,985	6,080	14,080	20,160	54,145
16.	Subtotal (items 12-15)	67,675	263,850	97,330	105,240	534,095	95,460	221,230	316,690	850,785
	LANDS, EASEMENTS AND RIGHTS OF WAY									
17.	Lands (acres)	1.4	9.7	5.6	9.9	26.6	4.4	8.5	12.9	39.5
	a. Acquisition (dollars)	700	4,850	2,800	4,950	13,300	2,200	4,130	6,330	19,630
18.	Acquire Building (dollars)	0	56,000	0	0	56,000	0	0	0	56,000
19.	Raise Buildings (dollars)	0	0	0	0	0	0	1,200	1,200	1,200
20.	Subtotal (items 17-19)	700	60,850	2,800	4,950	69,300	2,200	5,330	7,530	76,830
21.	Contingencies (15%)	105	9,130	420	740	10,395	330	800	1,130	11,525
22.	Planning (3%)	25	2,100	95	170	2,390	75	180	255	2,645
23.	Appraise Survey (4%)	30	2,800	130	230	3,190	95	245	340	3,530
24.	Administration (3%)	25	2,100	95	170	2,390	75	180	255	2,645
25.	Subtotal (items 20-24)	885	76,980	3,540	6,260	87,665	2,775	6,735	9,510	97,175
26.	Project Total (items 16 + 25)	68,560	340,830	100,870	111,500	621,760	98,235	227,965	326,200	947,960

a. Protection provides for beach protection at Morgan Beach, Seidler's Beach, and Cliffwood Beach - West (5800 feet) with a 100-foot berm width at 5.5 feet above mean sea level and for bluff protection at Laurence Harbor, Knollcroft, and Cliffwood Beach - East (9900 feet) with a 25-foot berm width at 10 feet above mean sea level.

b. This cost also represents joint cost for multiple purpose project beach erosion and hurricane protection. Separable hurricane cost is shown in Table D2.

TABLE D4 - DETAILED ESTIMATE OF SEPARABLE COST OF HURRICANE PROTECTION FOR MORGAN BEACH (JULY 1963 PRICE LEVELS)

Acct. No.	Item No.	Description	Estimated Quantity	Unit	Unit Price (dollars)	Estimated Cost (dollars)
17		BEACH REPLENISHMENT				
	1	Hydraulic Sand Fill	191,400	c.y.	.90	172,260
	2	Beach grass	14,500	s.y.	.15	2,175
	3	Permanent sign				15
	4	Subtotal				174,450
	5	Contingencies (15%)				26,170
	6	Subtotal				200,620
	7	Inspection, Supervision and administration (7%)				14,040
	8	Engineering and design (3%)				6,040
	9	TOTAL BEACH REPLENISHMENT				220,700
11.		LEVEE				
	10	Mobilization and Demobilization		Job	LS	1,500
	11	Compacted Fill, Impervious	3,542	c.y.	3.00	10,600
	12	Compacted Fill, Random	18,210	c.y.	1.75	31,900
	13	Compacted Fill, Common	520	c.y.	1.75	900
	14	Excavation, Common	1,620	c.y.	1.00	1,620
	15	Gravel Road Surfacing	156	s.y.	3.00	470
	16	4" Top Soil and Seeding	4	Acres	2,400.00	9,600
	17	Concrete	36	c.y.	80.00	2,880
	18	Portland Cement	59	BBL	5.75	340
	19	Reinforcing steel	2,000	LB	.16	320
	20	8" ø CMP - 16 gauge - ¼ paved	53	LF	5.00	265
	21	12" ø CMP - 16 gauge - ¼ paved	182	LF	6.00	1,090
	22	24" ø CMP - 16 gauge - ¼ paved	250	LF	10.00	2,500
	23	24" ø A.D. Gate	1	EA	600.00	600
	24	24" ø Sluice gate, flush bottom	1	EA	1,500.00	1,500
	25	Paved gutter	680	LF	1.00	680
	26	Steel Grating and Frame	1	EA	150.00	150
	27	Catch basin grating and frame	2	EA	100.00	200
	28	Manhole steps	17	EA	7.00	120
	29	Subtotal Levee				67,235
	30	Contingencies (15%)				10,085
	31	Subtotal				77,320
	32	Inspection, supervision & administration (7%)				5,440
	33	Engineering and design (3%)				2,340
	34	TOTAL LEVEE				85,100
.02		RELOCATIONS				
	35	Mobilization and Demobilization		Job	LS	1,000
	36	Excavation - common	225	c.y.	1.00	225
	37	Select Material	2,663	c.y.	1.75	4,660
	38	Compacted fill, Common	5,310	c.y.	1.75	9,300
	39	Removal of existing structures		Job	LS	1,495
	40	Concrete curbing	1,570	LF	3.50	5,500
	41	Replacement of existing fence		Job	LS	265
	42	Gravel surfacing	800	s.y.	3.00	2,400
	43	Macadam Surfacing	310	Ton	13.00	4,030
	44	Bituminous Stabilized base course (4")	414	Ton	13.00	5,400
	45	Subbase course	626	c.y.	3.50	2,190
	46	Manhole frame and cover	1	EA	150.00	150
	47	Drop Inlet - Type B	1	EA	500.00	500
	48	8" ø R.C. Pipe	13	LF	8.00	105
	49	Top soil and seeding	0.3	Acre	2,400.00	720
	50	Guard rails	700	LF	6.00	4,200
	51	Utilities		Job	LS	15,000
	52	Subtotal Relocation				57,140
	53	Contingencies (15%)				8,570
	54	Subtotal				65,710
	55	Inspection, supervision & administration (7%)				4,600
	56	Engineering and design (3%)				1,990
	57	TOTAL RELOCATIONS				72,300
.01		LANDS				
	58	Permanent rights	4.6	Acres	500	2,300
	59	Temporary rights	1.1	Acres	100	110
	60	Raise buildings		Job	LS	17,000
	61	Compacted Fill, Common	1,720	c.y.	1.75	3,070
	62	Top soil and seeding (4")	0.5	Acre	2,400	1,200
	63	Subtotal Lands				23,680
	64	Contingencies (15%)				3,550
	65	Subtotal				27,230
	66	Inspection, supervision & administration (7%)				1,905
	67	Engineering and Design (3%)				815
	68	TOTAL LANDS				29,950
		SUMMARY - HURRICANE PROTECTION - MORGAN BEACH (SEPARABLE COST)				
17	69	Beach Replenishment				174,450
11	70	Levee				67,235
02	71	Relocations				57,140
01	72	Lands				23,680
	73	Subtotal				322,505
	74	Contingencies				48,375
	75	Subtotal				370,880
	76	Inspection, supervision, administration				25,985
	77	Engineering and Design				11,185
	78	Total Separable cost				408,050

TABLE D-5 - BREAKDOWN ESTIMATE OF UNIT HYDRAULIC - DREDGING COST (JULY 1963 PRICES)

ITEM	DESCRIPTION	UNIT	QUANTITY	COST (DOLLARS)
1	Estimated quantity to be placed			
	a. Required on beach	c.y.	765,200	
	b. Allowance (15%)	c.y.	114,800	
	c. Total pay yardage (a - b)	c.y.	880,000	
2	Output of 16 inch hydraulic dredge/day	c.y.	3,800	
3	Effective working time per month	day	20	
4	Output of dredge per month	c.y.	76,000	
5	Time required to complete job (1e/4)	mo.	11.5	
6	Monthly operating cost of dredge and attendant plant (1 dredge, 2 tugs, 2 scows, 1 launch, 1500' pontoon, 6000' pipe, bulldozer)			44,000
7	Cost for job (5 X 6)			506,000
8	Material and construction costs (included in 6)			0
9	Field engineering and supervision (11.5 X 875)			10,060
10	Mobilization and demobilization (included in general (contract)			0
11	Sub-Total (7 + 8 + 9 + 10)			516,060
12	Distributed costs (taxes, ins., etc.)			50,870
13	Vacation and holiday pay			18,430
14	Overtime pay for 6 day week			23,630
15	Sub-Total (11 + 12 + 13 + 14)			608,990
16	Contractors overhead 12 percent			73,080
17	Bond costs			5,120
18	Sub-Total (15 + 16 + 17)			687,190
19	Profit			103,080
20	Total contract cost (18 + 19)			790,270
21	Estimated unit cost (20/1c = 0.898)	c.y.		0.90
22	Revised total contract cost (21 X 1c)			792,000
23	Contingencies, 15 percent			118,800
24	Plans and specifications (3%)			23,800
25	Surveys before dredging (1%)			7,900
26	Surveys after dredging (1%)			7,900
27	Inspection and supervision (3%)			23,800
28	District overhead (2%)			15,800
29	Total costs			990,000
30	Overall unit cost (29/1c)	c.y.		1.13

TABLE D-6 - DISTRIBUTION OF PREAUTHORIZATION STUDY COSTS (DOLLARS)

Section	Hurricane study	Beach erosion study	Total
South Amboy	1,000	1,000	2,000
Sayreville	2,000	2,000	4,000
Madison Township			
Morgan Beach	2,000	1,000	3,000
Laurence Harbor - west	0	1,000	1,000
Laurence Harbor - east	2,000	1,000	3,000
Seidler's Beach	0	1,000	1,000
Knollcroft	0	1,000	1,000
Thence to Whale Creek	1,000	1,000	2,000
Subtotal	5,000	6,000	11,000
Matawan Township			
Cliffwood Beach - west	4,000	1,000	5,000
Cliffwood Beach - east	1,000	1,000	2,000
Subtotal	5,000	2,000	7,000
Keyport	1,000	1,000	2,000
Union Beach	12,000	2,000	14,000
Raritan Township	5,000	0	5,000
Keansburg	20,000	2,000	22,000
Middletown Township			
East Keansburg	13,000	2,000	15,000
Port Monmouth	1,000	2,000	3,000
Belford	1,000	1,000	2,000
Leonardo	2,000	2,000	4,000
Subtotal	17,000	7,000	24,000
Highlands	1,000	1,000	2,000
Atlantic Highlands	6,000	1,000	7,000
Total	75,000	25,000	100,000

TABLE D7 - SUMMARY OF ESTIMATED FIRST COSTS (DOLLARS) - MADISON AND MATAWAN TOWNSHIPS (JULY 1963 PRICES)

Section	Length (feet)	Protection	Sand fill	Levee and appurtenances	Lands, easements & rights-of-way	Total	Preauthor-zation studies
MADISON TOWNSHIP							
Morgan Beach	1,400	Hurricane	288,375	157,400	30,835	476,610	3,000
Laurence Harbor	3,800	Bluff	263,850	--	76,980	340,830	4,000
Seidler's Beach	2,200	Beach	97,330	--	3,540	100,870	1,000
Knollcroft	2,850	Bluff	105,240	--	6,260	111,500	3,000
Total - MADISON	10,250		754,795	157,400	117,615	1,029,810	11,000
MATAWAN TOWNSHIP							
Cliffwood Beach - west	2,200	Beach	95,460	--	2,775	98,235	5,000
Cliffwood Beach - east	3,250	Bluff	221,230	--	6,735	227,965	2,000
Total - MATAWAN	5,450		316,690	--	9,510	326,200	7,000
TOTAL - MADISON & MATAWAN	15,700		1,071,485	157,400	127,125	1,356,010	18,000

TABLE D8 - SUMMARY OF FIRST COST AND ANNUAL CHARGES FOR COST ALLOCATION BY SEPARABLE COSTS - REMAINING BENEFITS METHOD (DOLLARS) - MORGAN BEACH

No.	Item	Multiple Purpose Project: Separable costs: Protection: shore	Multiple Purpose Project: Separable costs: Protection: hurricane a.	Multiple Purpose Project: Joint costs a.	Multiple Purpose Project: Total costs	Alternative Project: Single purpose costs: Protection: shore b.	Alternative Project: Single purpose costs: Protection: hurricane c.
I.	FIRST COSTS						
1.	Artificial fill	0	220,700	67,675	288,375	67,675	288,375
2.	Levees, interior drainage	0	157,400	--	157,400	--	157,400
3.	Lands, easements, rights-of-way	0	29,950	885	30,835	885	30,835
4.	Total (d)	0	408,050	68,560	476,610	68,560	476,610
II.	ANNUAL CHARGES						
1.	Investment	0	408,050	68,560	476,610	68,560	476,610
2.	Interest and amortization (e)	0	15,861	2,665	18,526	2,665	18,526
3.	Nourishment and Maintenance (Table D9)	0	2,380	2,330	4,710	2,330	4,710
4.	Total	0	18,241	4,995	23,236	4,995	23,236

a. Based on consideration that beach erosion single purpose project is joint cost (Table D3) and that all other costs and separable costs of hurricane protection (Table D4).
b. Beach fill with a 100 foot berm at 5.5 feet above mean sea level (Table D4).
c. Assumed the same as the multiple purpose project (Table D2).
d. Preauthorization costs not included (Table D6)
e. Capitol recovery factor value for 50 years at 3 % interest = 0.03887

TABLE D9 - ESTIMATE OF ANNUAL BEACH MAINTENANCE - MADISON AND MATAWAN TOWNSHIPS

Section	Length Beach (feet)	Annual rate to replenish (c.y.)	Quantity to be pumped (c.y.)	Unit Price (dollars)	Contract cost (dollars)	Contingency (dollars)	Engineering Supervision Administration (dollars)	Total cost (dollars)
			BEACH REPLENISHMENT					
MADISON TOWNSHIP								
Morgan Beach	1,400	1,600	1,840	1.00	1,840	277	213	2,330
Laurence Harbor	3,800	4,200	4,830	1.00	4,830	724	556	6,110
Seidler's Beach	2,200	2,400	2,760	1.00	2,760	414	316	3,490 a
Knollcroft	2,850	3,100	3,570	1.00	3,570	538	412	4,520
Subtotal	10,250	11,300	13,000		13,000	1,953	1,497	16,450
MATAWAN TOWNSHIP								
Cliffwood Beach, west	2,200	3,000	3,450	1.00	3,450	518	397	4,365
Cliffwood Beach, east	3,250	4,400	5,050	1.00	5,050	758	582	6,390 a
Subtotal	5,450	7,400	8,500		8,500	1,276	979	10,755
			HURRICANE-LEVEE AND APPURTENANCES					
MADISON TOWNSHIP - MORGAN BEACH								
Levee Fill	500	42	--	5.60	234	37	29	300
Road Fill	900	28	--	7.30	204	32	24	260
Road Surfacing - Macadam	700	20	--	65.00	1,310	200	150	1,660 b
- Gravel	200	7	--	6.60	46	8	6	60 c
Drainage Outlets			--	--	80	12	8	100
Subtotal					1,874	289	217	2,380

a. Includes maintenance of drainage outlets.
b. Includes removal and replacement of curbs and Guard Rails.
c. Includes removal and replacement of Paved Gutter.

TABLE D10 - ALLOCATION OF COSTS BY SEPARABLE COSTS - REMAINING BENEFITS METHOD, MORGAN BEACH (DOLLARS)

ITEM	DESCRIPTION	SHORE PROTECTION	HURRICANE PROTECTION	TOTAL
1.	ALLOCATION OF ANNUAL COSTS			
a.	Benefits	13,530	25,000	38,530
b.	Alternative Cost	4,995	23,236	28,231
c.	Benefits limited by alternative cost	4,995	23,236	28,231
d.	Separable cost	0	18,241	18,241
e.	Remaining benefits (1c minus 1d)	4,995	4,995	9,990
f.	Allocated joint cost (in proportion to 1e)	2,498	2,497	4,995
g.	Total allocation of project costs (1d plus 1f)	2,498	20,738	23,236
2.	ALLOCATION OF MAINTENANCE AND NOURISHMENT COSTS			
a.	Separable cost	0	2,380	2,380
b.	Allocated joint cost (in proportion to 1e)	1,165	1,165	2,330
c.	Total allocation (2a plus 2b)	1,165	3,545	4,710
3.	ALLOCATION OF INVESTMENT			
a.	Annual investment cost (1g minus 2c)	1,333	17,193	18,526
b.	Allocated investment (in proportion to 3a)	34,293	442,317	476,610
	Say	34,290	442,320	476,610

TABLE D11 - SUMMARY OF ALLOCATION OF FIRST COST (DOLLARS) FOR MADISON AND MATAWAN TOWNSHIPS SHORE PROTECTION PROJECT

SECTION	SHORE PROTECTION	HURRICANE PROTECTION	TOTAL
MADISON TOWNSHIP			
Morgan Beach	34,293	442,317	476,610
Laurence Harbor	340,830	0	340,830
Seidler's Beach	100,870	0	100,870
Knollcroft	111,500	0	111,500
Subtotal	587,493	442,317	1,029,810
MATAWAN TOWNSHIP			
Cliffwood Beach - west	98,235	0	98,235
Cliffwood Beach - east	227,965	0	227,965
Subtotal	326,200	0	326,200
MADISON AND MATAWAN TOWNSHIPS - TOTAL	913,693	442,317	1,356,010
Say	913,690	442,320	1,356,010

TABLE D12 - SHORE OWNERSHIP OF AREAS - MADISON-MATAWAN TOWNSHIPS' IMPROVEMENT [a]

Section	Ownership				Private shore with public benefit
	Federal	Non-Federal public	Private	Total	
Madison Township					
Morgan Beach	0 (0)	600 (42.8)	800 (57.2)	1400 (100)	800 (57.2)
Laurence Harbor	0 (0)	2115 (55.6)	1685 (44.4)	3800 (100.0)	1685 (44.4)
Seidler's Beach	0 (0)	0 (0)	2200 (100.0)	2200 (100.0)	2200 (100.0)
Knollcroft to Whale Creek	0 (0)	0 (0)	2850 (100.0)	2850 (100.0)	2850 (100.0)
Subtotal	0 (0)	2715 (26.5)	7535 (73.5)	10250 (100.0)	7535 (73.5)
Matawan Township					
Cliffwood Beach - Whale Creek - east	0 (0)	0 (0)	2200 (100.0)	2200 (100.0)	2200 (100.0)
Cliffwood Beach - Matawan Point - west	0 (0)	0 (0)	3250 (100.0)	3250 (100.0)	3250 (100.0)
Subtotal	0 (0)	0 (0)	5450 (100.0)	5450 (100.0)	5450 (100.0)
Total	0 (0)	2175 17.3	12985 82.7	15700 (100.0)	12185 77.6

(a) Figures in parentheses are percent of total frontage. For entire shore ownership, see Figures F-1[1]R, F-1[2]R, and F-1[3]R of Attachment A2 of Appendix A.

TABLE D13 - APPORTIONMENT OF FIRST COST OF SHORE PROTECTION
(BASED ON JULY 1963 PRICES AND 1962 BEACH EROSION LAW)

ITEM	MORGAN BEACH	LAURENCE HARBOR	SEIDLER'S BEACH	KNOLLCROFT	MADISON TOWNSHIP	CLIFFWOOD BEACH WEST	CLIFFWOOD BEACH EAST	MATAWAN TOWNSHIP	TOTAL
FEDERAL SHORES									
Percent of total frontage	0	0	0	0	-	0	0	-	-
Percent - Federal SHARE (a)	0	0	0	0	-	0	0	-	-
NON-FEDERAL PUBLIC PARK AND CONSERVATION AREAS									
Percent of total frontage	0	0	0	0	-	0	0	-	-
Percent - Federal Share (b)	0	0	0	0	-	0	0	-	-
OTHER NON-FEDERAL PUBLIC SHORE									
Percent of total frontage	42.8	55.6	0	0	-	0	0	-	-
Percent - Federal Share (c)	21.4	27.8	0	0	-	0	0	-	-
PRIVATE SHORE WITH PUBLIC BENEFITS									
Percent of total frontage	57.2	44.4	100	100	-	100	100	-	-
Annual Benefits									
Public (dollar)	4,900	12,540	28,600	6,900	52,940	30,000	18,600	48,600	101,540
Private (dollar)	100	870	1,140	3,680	5,790	2,170	4,650	6,820	12,610
Total (dollar)	5,000	13,410	29,740	10,580	58,730	32,170	23,250	55,420	114,150
Public Percent of total	98.0	93.5	96.2	65.2	90.1	93.3	80.0	87.7	90.0
Percent - Federal Share (d)	28.0	20.8	48.1	32.6	45.1	46.7	40.0		
TOTAL FEDERAL CONTRIBUTION Percent	49.4	48.6	48.1	32.6	-	46.7	40.0	-	-
APPORTIONMENT OF FIRST COST									
First cost									
Construction	33,850	263,850	97,330	105,240	500,270	95,460	221,230	316,690	816,960
Lands	440	76,980	3,540	6,260	87,220	2,775	6,735	9,510	96,730
Total	34,290	340,830	100,870	111,500	587,490	98,235	227,965	326,200	91,369
Federal Share									
Construction	16,720	128,230	46,820	34,310	226,080	44,580	88,490	133,070	359,150
Non-Federal Share									
Construction	17,130	135,620	50,510	70,930	274,190	50,880	132,740	183,620	457,810
Lands (e)	440	76,980	3,540	6,260	87,220	2,775	6,735	9,510	96,730
Subtotal	17,570	212,600	54,050	77,190	361,410	53,655	139,475	193,130	554,540

a. Based on 100 percent Federal share towards cost of protecting Federal shore.
b. Based on 70 percent Federal share towards cost of protecting non-Federal public parks and conservation areas.
c. Based on 50 percent Federal share towards cost of protecting other non-Federal public shores.
d. Based on 50 percent adjusted by a factor of the ratio of public benefits to total benefits as the Federal contribution towards the cost of protecting private shores with public benefits.
e. Based on zero percent Federal share towards costs of lands, easements and rights-of-way.

TABLE D14 - APPORTIONMENT OF FIRST COST OF HURRICANE PROTECTION (DOLLARS)
MORGAN BEACH

ITEM	DESCRIPTION	
I.	FIRST COSTS	
1.	Construction	411,925
2.	Lands, easements and rights-of-way	30,395
3.	Total first cost	442,320
II.	APPORTIONMENT [a]	
4.	Federal Share (70%)	309,624
5.	Non-Federal Share (30%)	132,696
	a. Cash Contribution	102,301
	b. Lands, Easements and rights-of-way	30,395

a. Apportionment based on a minimum non-Federal share of 30 percent of the total first cost including lands, easements and rights-of-way. Cost of preauthorization studies excluded.

TABLE D15 - SUMMARY OF APPORTIONMENT OF FIRST COST OF SHORE AND HURRICANE PROTECTION (DOLLARS)

Section	SHORE PROTECTION		HURRICANE PROTECTION		TOTAL		Lands Easements & rights-of-way	TOTAL COSTS	
	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal		Federal	Non-Federal
MADISON TOWNSHIP									
Morgan Beach	16,720	17,130	309,624	102,301	326,344	119,431	30,835	326,344	150,266
Laurence Harbor	128,230	135,620	0	0	128,230	135,620	76,980	128,230	212,600
Seidler's Beach	46,820	50,510	0	0	46,820	50,510	3,540	46,820	54,050
Knollcroft	34,310	70,930	0	0	34,310	70,930	6,260	34,310	77,190
Subtotal	226,080	274,190	309,624	102,301	535,704	376,491	117,615	535,704	494,106
MATAWAN TOWNSHIP									
Cliffwood Beach - west	44,580	50,880	0	0	44,580	50,880	2,775	44,580	53,655
Cliffwood Beach - east	88,490	132,740	0	0	88,490	132,740	6,735	88,490	139,475
Subtotal	133,070	183,620	0	0	133,070	183,620	9,510	133,070	193,130
MADISON AND MATAWAN TOWNSHIPS									
Total	359,150	457,810	309,624	102,301	668,774	560,111	127,125	668,774	687,236
									1,356,010

TABLE D16 - ESTIMATE OF ANNUAL CHARGES SHORE AND HURRICANE PROTECTION (DOLLARS)

No.	Item	HURRICANE SHORE PROTECTION							
		Morgan Beach	Morgan Beach	Laurence Harbor	Seidler's Beach	Knollcroft	Cliffwood Beach West	Cliffwood Beach East	Total
I.	FEDERAL								
1.	Investment								
a.	First Cost	309.624	16,720	128,230	46,820	34,310	44,580	88,490	668,775
2.	ANNUAL CHARGES								
a.	Interest & Amortization (b)	12,035	650	4,985	1,820	1,335	1,735	3,440	26,000
II.	NON-FEDERAL								
3.	Investment								
a.	First Cost	102,301	17,130	135,620	50,510	70,930	50,880	132,740	560,110
b.	Lands, easements, and rights-of-way	30,395	440	76,980	3,540	6,260	2,775	6,735	127,125
c.	Total	132,695	17,570	212,600	54,050	77,190	53,655	139,475	687,235
4.	ANNUAL CHARGES								
a.	Interest and amortization (b)	5,160	685	8,265	2,100	3,000	2,085	5,420	26,715
b.	Maintenance (a)	3,545	1,165	6,110	3,490	4,520	4,365	6,390	29,585
c.	Total	8,705	1,850	14,375	5,590	7,520	6,450	11,810	56,300
III.	TOTALS								
5.	First costs	442,320	34,290	340,830	100,870	111,500	98,235	227,965	1,356,010
6.	Annual charges	20,740	2,500	19,360	7,410	8,855	8,185	15,250	82,300

a. Includes beach replenishment Table D9.
b. Based on 50 year life at three percent (capital recovery factor .03887)

TABLE D17 - SUMMARY OF ANNUAL CHARGES OF SHORE AND HURRICANE PROTECTION
(DOLLARS)

SECTION	SHORE PROTECTION	HURRICANE PROTECTION	TOTAL (a)
MADISON TOWNSHIP			
Morgan Beach	2,500	20,740	23,240
Laurence Harbor	19,360	0	19,360
Seidler's Beach	7,410	0	7,410
Knollcroft	8,855	0	8,855
Subtotal	38,125	20,740	58,865
MATAWAN TOWNSHIP			
Cliffwood Beach - west	8,185	0	8,185
Cliffwood Beach - east	15,250	0	15,250
Subtotal	23,435	0	23,435
MADISON AND MATAWAN TOWNSHIPS			
Total	61,560	20,740	82,300

a. Excludes preauthorization studies.

TABLE D18 - ECONOMIC ANALYSIS OF SHORE AND HURRICANE PROTECTION

SECTION	ANNUAL BENEFITS (DOLLAR)	ANNUAL CHARGES (DOLLAR)	BENEFIT COST RATIO
	SHORE PROTECTION		
MADISON TOWNSHIP			
Morgan Beach	13,530	2,500	5.4
Laurence Harbor	34,500	19,360	1.8
Seidler's Beach	29,740	7,410	4.0
Knollcroft	10,580	8,855	1.2
Subtotal	88,350	38,125	2.3
MATAWAN TOWNSHIP			
Cliffwood Beach - west	32,170	8,185	3.9
Cliffwood Beach - east	23,250	15,250	1.5
Subtotal	55,420	23,435	2.4
	HURRICANE PROTECTION		
MADISON TOWNSHIP			
Morgan Beach	25,000	20,740	1.2
Total shore and Hurricane Protection	38,530	23,240	1.7
MADISON AND MATAWAN TOWNSHIPS			
Total	168,770	82,300	2.1

RARITAN BAY AND SANDY HOOK BAY, NEW JERSEY
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APPENDIX E - BENEFITS

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APPENDIX E - BENEFITS

T A B L E O F C O N T E N T S

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L I S T O F T A B L E S

Number	Description	
E1	ESTIMATED ANNUAL BENEFIT FROM LAND TO BE SAVED FROM EROSION AS A RESULT OF SHORE PROTECTION	E-3
E2	ESTIMATED ANNUAL PUBLIC RECREATIONAL BENEFIT FROM ADDITIONAL BEACH USE AS A RESULT OF SHORE & HURRICANE PROTECTION (DOLLARS)	E-4
E3	ANNUAL BENEFIT FROM DECREASE IN MAINTENANCE COSTS OF EXISTING STRUCTURES	E-5
E4	ESTIMATED ANNUAL BENEFIT FROM PREVENTION OF EROSION DAMAGES	E-6
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APPENDIX E - BENEFITS

E1. GENERAL. The benefits that may accrue to the improvement are based on (1) prevention of primary damages from tidal flooding, (2) land to be saved from erosion, (3) recreational benefits from additional beach use (4) decrease in maintenance costs of existing beach structure and (5) prevention of erosion damage. The primary changes in these benefits since their development in 1960, in the Appendix K of the authorizing document are the destruction by fire of Laurence Harbor Cabin Colony and the elimination of hurricane protection at this point and the changes in price levels.

E2. PRIMARY FLOOD BENEFITS. The detailed computation for these benefits are contained in paragraphs 36 - 38 of Appendix K of the authorizing document. The annual benefits at Morgan Beach adjusted to July 1963 price levels are $12,200 (11,100 X 1.10). There are no flood benefits at Laurence Harbor Colony because all structures were destroyed by fire and the area was completely cleared.

E3. LAND TO BE SAVED FROM EROSION. The project will provide sufficient direct fill and nourishment along the shores of Madison and Matawan Townships to eliminate loss of land due to erosion. The annual land to be saved from erosion is based on the average annual rate of recession of the shore during the period 1836 to 1886 (paragraph 39 of Appendix K of the authorizing document) and on the effect of the existing shore structures with due consideration to the July 1963 price levels, the benefits accruing from this type of shore protection are given in Table E1.

E4. RECREATIONAL BENEFITS FROM ADDITIONAL BEACH USE RESULTING FROM SHORE PROTECTION. The beaches in the study area are inadequate for the present recreational needs. The accomplishment of the project would result in recreational benefits to the public from additional beach use. The basis of computing the recreational benefits are contained in paragraphs 40 - 42 of Appendix K of the authorizing document. The recreational benefits to account for current conditions and price levels were adjusted by using the net recreational value per person per beach use to $0.50. The recreational benefits thus computed are contained in Table E2.

E5. RECREATIONAL BENEFITS AT MORGAN BEACH. In the authorizing document, recreational benefits at Morgan Beach were attributable only to the additional beach use caused by the shore protection portion of the improvement works. However, since hurricane protection is also provided at this location, the actual usable beach area is almost doubled when compared with the beach area utilized in the authorizing document. Consequently, recreation benefits at this location were reevaluated in the same manner as that described in the authorizing document to represent actual beach use over and above present use. A base value of 75 square feet per person was utilized, modified by a 2.5 factor to provide for access and other support features, over a period of 90 days per season and assuming an average daily attendance at the rate of one third the peak attendance as determined by the amount of available beach area. As a result, recreational benefits at Morgan Beach totals $25,600 annually of which $12,800 is attributable to shore protection and $12,800 is attributable to hurricane protection.

E6. DECREASE IN MAINTENANCE COSTS OF EXISTING BEACH STRUCTURES. The basis for these benefits is contained in paragraph 43 of Appendix K of the authorizing document. The estimated reduction in annual maintenance of shore structures adjusted for price levels would be about 10 percent higher (ENR Index: May 1960 - 822.58/July 1963 - 905.85 = 1.10). The resulting benefits are given in Table E3.

E7. PREVENTION OF EROSION DAMAGE. The basis of these damages is given in paragraph 44 of Appendix K of the authorizing document. The estimated benefits adjusted for current conditions and July 1963 price levels are given in Table E4.

E8. SUMMARY. The breakdown of the total benefits that would accrue to the Madison and Matawan Townships shore improvement including a separation of benefits between public and private interests is given in Table E5, and a summary in Table E6. A summary of the benefits accruing to each shore section from shore and hurricane protection is given in Table E7.

TABLE E1 - ESTIMATED ANNUAL BENEFIT FROM LAND TO BE SAVED FROM EROSION AS A RESULT OF SHORE PROTECTION

Section	Length (feet)	Acres per year	Value per acre (dollars)	Annual benefit (dollars)	Distribution of annual benefit (dollars)		
						Private benefit	
					Public benefit to public shore	Private shore with public benefit	Private shore with no public benefit
Madison Township							
Morgan Beach	1,400	0.03	7,000	200	100	100	0
Laurence Harbor	3,800	0.15	7,000	1,100	700	400	0
Seidler's Beach	2,200	0.13	7,000	900	0	900	0
Knollcroft	2,850	0.20	7,000	1,400	0	1,400	-
Subtotal	10,250	0.51	--	3,600	800	2,800	0
Matawan Township							
Cliffwood Beach - west	2,200	0.18	8,000	1,400	0	1,400	0
Cliffwood Beach - east	3,250	0.27	8,000	2,200	0	2,200	0
Subtotal	5,450	0.45	--	3,600	0	3,600	0
TOTAL	15,700	0.96	--	7,200	800	6,400	0

TABLE E2 - ESTIMATED ANNUAL PUBLIC RECREATIONAL BENEFIT FROM ADDITIONAL BEACH USE

Section	Length (feet)	Annual benefit (dollar)	Distribution of benefit: Public shore (dollar)	Distribution of benefit: Private shore (dollar)
SHORE PROTECTION (DOLLARS) (a)				
Madison Township				
Morgan Beach	1,400	12,800	7,600	5,200
Laurence Harbor	3,800	31,700	20,000	11,700
Seidler's Beach	2,200	28,600	0	28,600
Knollcroft	2,850	6,900	0	6,900
Subtotal	10,250	80,000	27,600	52,400
Matawan Township				
Cliffwood Beach - west	2,200	30,000	0	30,000
Cliffwood Beach - east	3,250	18,600	0	18,600
Subtotal	5,450	48,600	0	48,600
Total (Shore Protection)	15,700	128,600	27,600	101,000
HURRICANE PROTECTION (DOLLARS) (a)				
Madison Township				
Morgan Beach	1,400	12,800	7,600	5,200
Total (Hurricane and Shore Protection)	15,700	141,400	35,200	106,200

(a) This benefit was determined in accordance with the procedure outlined in paragraphs E4 and 5 of this appendix and in accordance with paragraphs 40 - 42 of Appendix K of the authorizing document.

TABLE E3 - ANNUAL BENEFIT FROM DECREASE IN MAINTENANCE COSTS OF EXISTING STRUCTURES

Section	Length of structures (feet)				Annual benefit (dollars)(a)				
		Private shore with public benefit		Private shore		Private shore with public benefit		Private shore	
	Public shore	Public structure	Private structure	no public benefit	Public shore	Public benefit	Private benefit	no public benefit	Total
Madison Township									
Morgan Beach	964	0	0	0	530	0	0	0	530
Laurence Harbor	709	1,530	860	0	390	840	470	0	1,700
Seidler's Beach	0	0	440	0	0	0	240	0	240
Knollcroft	0	0	0	0	0	0	0	0	0
Subtotal	1,673	1,530	1,300	0	920	840	710	0	2,470
Matawan Township									
Cliffwood Beach - west	0	0	350	0	0	0	200	0	200
Cliffwood Beach - east	0	0	300	0	0	0	170	0	170
Subtotal	0	0	650	0	0	0	370	0	370
Total	1,673	1,530	1,950	0	920	840	1,080	0	2,840

(a) Computed on basis of 55 cents per foot of structure.

TABLE E4 - ESTIMATED ANNUAL BENEFIT FROM PREVENTION OF EROSION DAMAGES

Section	Length (feet)	Estimated total damage (dollars)	Annual benefit (dollars)
Madison Township			
Morgan Beach	1,400	0	0
Laurence Harbor	3,800	0	0
Seidler's Beach	2,200	0	0
Knollcroft	2,850	60,000	2,280[a]
Subtotal	10,250	60,000	2,280
Matawan Township			
Cliffwood Beach - west	2,200	15,000	570[a]
Cliffwood Beach - East	3,250	60,000	2,280[a]
Subtotal	5,450	75,000	2,850
Total	15,700	135,000	5,130

(a) Private benefit to private shore open to public use.

TABLE E5 - BREAKDOWN OF ESTIMATED ANNUAL BENEFITS FROM SHORE PROTECTION (DOLLARS)

Section and item	Benefit from land to be saved from erosion		Recreational benefits (a)	Decreased maintenance costs of structures		Prevention of erosion damages		Summation		
	Public	Private	Public	Public	Private	Public	Private	Public	Private	Total
MADISON TOWNSHIP										
Morgan Beach										
Public shore	100	0	7,600	530	0	0	0	8,230	0	8,230
Private shore with public benefits	0	100	5,200	0	0	0	0	5,200	100	5,300
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	100	100	12,800	530	0	0	0	13,430	100	13,530
Total public and private benefits	200		12,800	530		0		13,530		
LAURENCE HARBOR										
Public shore	700	0	20,000	390	0	0	0	21,090	0	21,090
Private shore with public benefit	0	400	11,700	840	470	0	0	12,540	870	13,410
Private shore with no public benefits	0	0	0	0	0	0	0	0	0	0
Total	700	400	31,700	1,230	470	0	0	33,630	870	34,500
Total public and private benefits	1100		31,700	1700		0		34,500		
SEIDLER'S BEACH										
Public shore	0	0	0	0	0	0 0	0	0	0	0
Private shore with public benefits	0	900	28,600	0	240	0	0	28,600	1,140	29,740
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	900	28,600	0	240	0	0	28,600	1,140	29,740
Total public and private benefits	900		28,600	240		0		29,740		
KNOLLCROFT										
Public shore	0	0	0	0	0	0	0	0	0	
Private shore with public benefit	0	1,400	6,900	0	0	0	2,280	6,900	3,680	10,580
Private shore with public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	1,400	6,900	0	0	0	2,280	6,900	3,680	10,580
Total public and private benefits	1400		6,900	0		2,280		10,580		
TOTAL MADISON TOWNSHIP										
Public shore	800	0	27,600	920	0	0	0	29,320	0	29,320
Private shore with public benefit	0	2,800	52,400	840	710	0	2,280	53,240	5,790	59,030
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	800	2,800	80,000	1,760	710	0	2,280	82,560	5,790	88,350
Total public and private benefits	3600		80,000	2470		2,280		88,350		
MATAWAN TOWNSHIP										
Cliffwood Beach - west										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	1,400	30,000	0	200	0	570	30,000	2,170	32,170
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	1,400	30,000	0	200	0	570	30,000	2,170	32,170
Total public and private benefits	1400		30,000	200		570		32,170		
Cliffwood Beach - east										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	2,200	18,600	0	170	0	2,280	18,600	4,650	23,250
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	2,200	18,600	0	170	0	2,280	18,600	4,650	23,250
Total public and private benefits	2200		18,600	170		2280		23,250		
TOTAL MATAWAN TOWNSHIP										
Public shore	0	0	0	0	0	0	0	0	0	0
Private shore with public benefit	0	3,600	48,600	0	370	0	2,850	48,600	6,820	55,420
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	0	3,600	48,600	0	370	0	2,850	48,600	6,820	55,420
Total public and private benefits	3600		48,600	370		2850		55,420		
TOTAL										
Public shore	800	0	27,600	920	0	0	0	29,320	0	29,320
Private shore with public benefit	0	6,400	101,000	840	1,080	0	5,130	101,840	12,610	114,450
Private shore with no public benefit	0	0	0	0	0	0	0	0	0	0
Total	800	6,400	128,600	1,760	1,080	0	5,130	131,160	12,610	143,770
Total public and private benefits	7200		128,600	2840		5130		143,770		

(a) All recreational benefits are public.
(b) Exclude $70,400 benefits for Keansburg, which are evaluated in paragraph 4 and table 3 of Supplement 2 of the original report.

TABLE E6 - SUMMARY OF ESTIMATED ANNUAL BENEFITS (DOLLARS)

ITEM	SECTION	SHORE PROTECTION	HURRICANE PROTECTION	TOTAL
	MADISON TOWNSHIP			
1	Land to be saved from erosion	3,600		3,600
2	Recreation benefit	80,000	12,800	92,800
3	Decreased maintenance of existing structures	2,470		2,470
4	Prevention of erosion damage	2,280		2,280
5	Prevention of damages from tidal flooding	--	12,200	12,200
	Subtotal	88,350	25,000	113,350
	MATAWAN TOWNSHIP			
1	Land to be saved from erosion	3,600		3,600
2	Recreational benefit	48,600		48,600
3	Decreased maintenance of existing structures	370		370
4	Prevention of erosion damage	2,850		2,850
5	Prevention of damages from tidal flooding	--	--	--
	Subtotal	55,420	0	55,420
	Grand Total	143,770	25,000	168,770
	Rounded	143,800	25,000	168,800

TABLE E7 - SUMMARY OF ANNUAL BENEFITS FROM SHORE AND HURRICANE PROTECTION (DOLLARS)

ITEM	SECTION	SHORE PROTECTION BENEFITS	HURRICANE PROTECTION BENEFITS	TOTAL
	MADISON TOWNSHIP			
1	Morgan Beach	13,530	25,000[a]	38,530
2	Laurence Harbor	34,500		34,500
3	Seidler's Beach	29,740		29,740
4	Knollcroft	10,580		10,580
6	Subtotal	88,350	25,000	113,350
	MATAWAN TOWNSHIP			
1	Cliffwood Beach - west	32,170		32,170
2	Cliffwood Beach - east	23,250		23,250
3	Subtotal	55,420		55,420
	MADISON AND MATAWAN TOWNSHIPS			
1	Total	143,770	25,000	168,770
	ROUNDED	143,800	25,000	168,800

(a) Paragraphs E2 and E5 and Table E2.