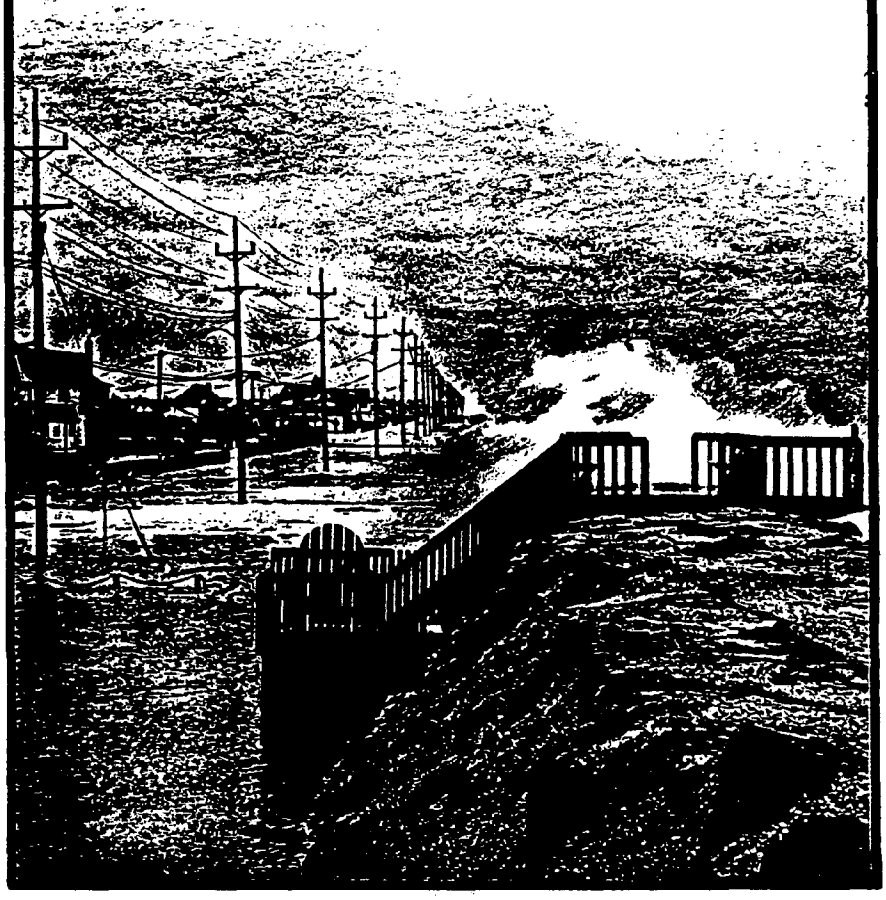
U.S. ARMY CORPS OF ENGINEERS · NEW YORK DISTRICT

ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
BEACH EROSION CONTROL PROJECT
SECTION I - SEA BRIGHT TO OCEAN TOWNSHIP, NEW JERSEY

DRAFT

GENERAL DESIGN MEMORANDUM



MAIN REPORT WITH ENVIRONMENTAL IMPACT STATEMENT

VOLUME I

May 1988

DRAFT GENERAL DESIGN MEMORANDUM

ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
BEACH EROSION CONTROL PROJECT

Section I - Sea Bright to Ocean Township

Main Report
and
Environmental Impact Statement

U.S. Army Corps of Engineers
New York District

May, 1988

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1988

SYLLABUS

The Federal project, Atlantic Coast of New Jersey from Sandy Hook to Barnegat Inlet Beach Erosion Control, was authorized by the River and Harbor Act of July 3, 1958 in accordance with reports printed in House Document No. 332, 85th Congress, Second Session. The reach of the authorized project extending from Sandy Hook to Ocean Township (Section I) was modified by the Water Resources Development Act of 17 November 1986 (PL 99-662).

This report is a General Design Memorandum concerning the approximately 12 mile reach of shore extending from Sea Bright to Ocean Township, Section I of the authorized project. The report presents the evaluation of erosion control alternatives for providing protection from damage from storm waves and erosion. Evaluation of the alternatives was accomplished within the framework of existing Federal laws and criteria. The plan recommended for construction yields the maximum benefits over cost (NED plan). The plan provides for the construction of a protective beach along the 11.8 miles of shore of the considered reach with periodic nourishment of the new beach and the notching of 15 existing groins. The design beach, which has a 100 foot wide berm at an elevation of 10 feet above MLW and a berm cap extending to an elevation of +12 feet above MLW, provides protection to upland property from erosion that would accompany a storm with a re-occurrence interval of 120 years. However, the recommended works will not protect property from damage caused by storm surges in the Shrewsbury and Navesink Rivers.

Material for construction and periodic nourishment of the project would be obtained from borrow areas offshore of Sandy Hook and Belmar, New Jersey. The estimated initial cost of the recommended plan is $192,917,000. The Federal portion of the initial cost is $158,322,000 and the non-Federal portion is $34,596,000. The estimated annual cost of interest, amortization and future nourishment is $21,454,000, with annual benefits of $36,700,000. The benefit to cost ratio is 1.71.

The local sponsor, the State of New Jersey Department of Environmental Protection, agrees to all provisions contained in the Local Cost Sharing Agreement.

GENERAL DESIGN MEMORANDUM

ATLANTIC COAST OF NEW JERSEY
FROM SANDY HOOK TO BARNEGAT INLET
BEACH EROSION CONTROL PROJECT

SECTION I - SEA BRIGHT TO OCEAN TOWNSHIP

PERTINENT DATA

Description

The recommended project provides for a protective and recreational beach along the reach of shore between Sea Bright and Ocean Township (Section I of authorized project) and for notching 15 existing groins.

Length of Beach Fill	11.83 miles
Volume of Initial Fill	17,882,000 c.y.
Width of Design Beach Berm	100 feet
Elevation of Design Beach Berm	
Beach Berm	+10 feet
Berm Cap	+ 2 feet
Total	+12 feet
Beach Slopes of Design Beach	
Onshore	1V to 10H
Offshore	1V to 35H
Renourishment	
Average Interval	6 years
Quantity	3,470,000 c.y.
Cost	
Initial	$193,000,000
Annual	$ 21,500,000
Average Annual Benefits	
Damage Reduction	$ 16,700,000
Intensification	$ 8,300,000
Land Erosion Reduction	$ 2,100,000
Reduced Maintenance (Sandy Hook Park)	$ 1,700,000
Recreation	$ 7,800,000
Benefit to Cost Ratio	1.71

Cost Apportionment (First Cost)

Features:

Federal - Initial Fill, Advance Fill, Groin Notching	$158,322,000
Non-Federal - Seawall Rehabilitation, Lands, Easements, Rights-of-Way, Outfall Extensions	$ 34,596,000

Climatology

	High	Low	Average
Temperature (° F)	110	-31	52
Precipitation (in.)	61.7	29.94	44
Relative Humidity			70

Winds

(1). Location - Sandy Hook, NJ
(2) Prevailing - Northwest
(3) Maximum - 79 mph at Long Branch (6/11/53)

Hydraulic

Tides
(1) Semi-Diurnal
(2) Tide range Mean 4.8 ft. (Sea Bright)
Spring 5.3 ft. (Sea Bright)

Waves - WIS Study

(1) Prevailing - East/Southeast
(2) Average - 1.5 ft.
(3) Largest - 22.5 ft.

Surge

(1) Maximum Storm: 10.3 ft. - 1960 Sandy Hook

NOTE: All elevations referenced to MLW.

DRAFT GENERAL DESIGN MEMORANDUM

ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
BEACH EROSION CONTROL PROJECT

SECTION I - SEA BRIGHT TO OCEAN TOWNSHIP

MAIN REPORT

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DRAFT GENERAL DESIGN MEMORANDUM

ATLANTIC COAST OF NEW JERSEY
FROM SANDY HOOK TO BARNEGAT INLET

SECTION I - SEA BRIGHT TO OCEAN TOWNSHIP, NEW JERSEY

STUDY AUTHORITY

1. The Federal Project, Shore of New Jersey from Sandy Hook to Barnegat Inlet, Beach Erosion Control, was authorized by the River and Harbor Act of July 3, 1958, in accordance with reports printed in House Document No. 332, 85th Congress, second session, as modified by the Water Resources Development Act of 17 November 1986 (PL. 99-662).

2. The original beach erosion report was produced by the U.S. Army Corps of Engineers in cooperation with the State of New Jersey under the provisions of Section 2 of the River and Harbor Act approved July 3, 1930 as amended and supplemented. The report was submitted to Congress by the Secretary of the Army on 7 March 1956 and printed in House Document No. 361, 84th Congress, second session. It was included in the next Omnibus Bill, but the Bill did not receive Presidential approval.

3. Subsequently, there was a further Congressional request to review the 1956 report for the purpose of determining what change, if any, in the recommended Federal aid would result from application of the provisions of Public Law 826, 84th Congress, approved 28 July 1956. Section 1(c) of Public Law 826 provided that periodic beach nourishment be considered as "construction" for the protection of shores when it is the most suitable and economic remedial measure. Section 1(d) provided for Federal assistance to privately owned shores if there is benefit from public use or from protection of nearby public property. The Corps conducted the review and the Chief of Engineers determined that periodic beach nourishment for this project was the most suitable and economical remedial measure for protection of the restored beach, and that such nourishment was considered eligible for Federal assistance under provisions of Public Law 826. The result was an increase in the percentage of Federal participation in the first construction and periodic nourishment costs. The above review of reports was submitted as House Document No. 332, 85th Congress, second session and approved in the River and Harbor Act on 3 July 1958.

4. Subsequently, all shore protection projects were modified for cost sharing purposes by Public Law 87-874 - River and Harbor and Flood Control Act of 23 October, 1962, which increased the percentage of Federal participation. The Water Resources Development Act of 17 November 1986 (Public Law 99-662) further modified the cost sharing for the project by stating that "the non-Federal share of the cost of construction and maintenance of the Ocean Township to Sandy Hook reach of the project shall consist of amounts expended by non-Federal interests for reconstruction of the seawall at Sea Bright and Monmouth Beach.".

DESCRIPTION OF AUTHORIZED PROJECT

5. The authorized Federal project provides for Federal participation in the initial cost of beach restoration and subsequent renourishment cost for the shore from Sandy Hook to Barnegat Inlet, New Jersey (Figure 1). Federal participation in periodic nourishment cost is authorized initially for a period of 10 years from end of initial construction. As related to the reach of shore under consideration herein, Sandy Hook to Ocean Township, the Federal project provides for placement of sand to widen the beach to a minimum width of 100 feet at an elevation of 10 feet above mean low water, the construction of 23 new groins and the extension of 14 existing groins (Figure 2). The new groins would be spaced 1000 to 1200 feet apart depending on location of existing structures. Additional project details are presented in Reference 1. The authorized project also provides for Federal participation in periodic nourishment costs for a period of 10 years from the year that the total quantity of fill placed in any of the three sections has equaled that required to restore the beach to project dimension in that section.

6. The authorized project also provides for a feeder beach at Ocean Township and a second one at the north end of Long Branch. The combined annual feeder beach volume was estimated at 175,000 cubic yards. The authorized groins were predicted to reduce the project area erosion rate by 60,000 cubic yards annually. This reduced the combined annual feeder beach volume to 115,000 cubic yards.

7. In the 1958 authorization, Federal participation in the cost of the project was subject to the conditions that local authorities would:

(a) Obtain approval by the Chief of Engineers, prior to commencement of work on any section, of detailed plans and specifications for that section, including the sequence of construction and arrangements for prosecuting the work in that section:

(b) provide at their own expense all necessary lands, easements, and rights-of-way:

(c) furnish assurances satisfactory to the Secretary of the Army that they will:

(1) Maintain the protective and improvement measures during their economic life, including periodic nourishment of the shore at suitable intervals, as may be required to serve their intended purpose;

(2) Prevent water pollution that would endanger the health of bathers; and

(3) Maintain, for the duration of the economic life of the project, continued public ownership of the publicly owned shores and their administration for public use, and continued availability for public use of the privately owned shores upon which a portion of the Federal participation is based.

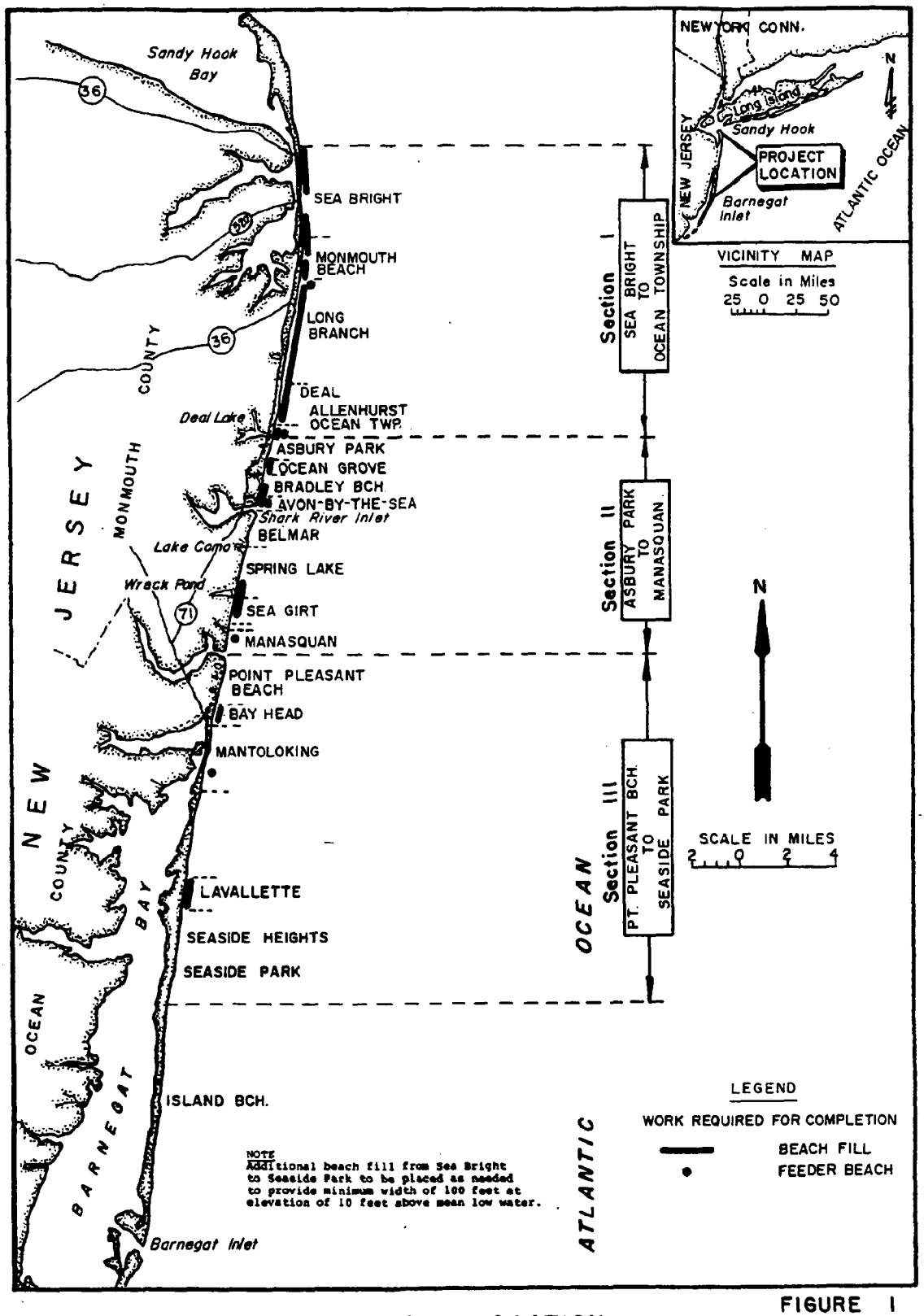

FIGURE 1

PROJECT LOCATION

8. The Water Resources Development Act of 1986 (PL 99-662) modified the 1958 authorization such that:

a) The first increment shall consist of a berm of approximately 50 feet at Sea Bright and Monmouth Beach extending to and including a feeder beach in the vicinity of Long Branch.

b) The non-Federal share of the cost of construction and maintenance of the Ocean Township to Sandy Hook reach of the project shall consist of amounts expended by non-Federal interests for reconstruction of the seawall at Sea Bright and Monmouth Beach.

c) Before initiation of construction of any increment of the project, non-Federal interests shall agree to provide public access to the beach for which such increment of the project is authorized in accordance with all requirements of State law and regulation.

The Local Cooperation Agreement for the work proposed herein is presented in another section of this report, Local Cooperation.

PURPOSE AND SCOPE

9. This report presents the results of final formulation and design of Section 1 of the authorized project. The principal thrust of the investigation and analyses were to develop adequate information to reaffirm the authorized plan and purpose or to justify a revised plan. The plan recommended herein, when approved, will be the basis for preparation and approval of plans and specifications. Consequently the scope of technical analyses is sufficient for the final design of project features and the preparation of accurate cost estimates.

10. This report was prepared in accordance with guidance presented in ER 1110-2-1150 "Engineering After Feasibility Studies" Change 1 dated 24 June, 1985. Formulation of alternatives were in accordance with procedures described in "Economic and Environmental Principles and Guidelines For Water and Related Land Resources Implementation Studies," 10 March 1982.

DESCRIPTION OF STUDY AREA

11. The authorized project includes approximately 51 miles of the New Jersey shoreline extending from the southern limit of Sandy Hook in the north to Barnegat Inlet in the south. The analysis performed for this investigation covers Section I, the most northerly 12 miles of authorized project extending from just north of the Route 36 bridge in Sea Bright, southward to the outlet of Deal Lake (Figure 2).

12. The Sea Bright to Ocean Township study area is located approximately 30 miles southeast of Newark, New Jersey, 40 miles east of Trenton, New Jersey and 65 miles northeast of Atlantic City, New Jersey. The area encompassed by the study includes the communities of Sea Bright, Monmouth Beach, Long Branch, Deal, Allenhurst and Loch Arbour (formerly a part of Ocean Township). The entire study area is within Monmouth County. Immediately to the north of the project limit is the Sandy Hook unit of the Gateway National Recreation Area and immediately to the south is the City of Asbury Park.

13. The northern portion of the study area, Sea Bright and northern Monmouth Beach, is comprised of a barrier spit complex where the shoreline is on a narrow strip of unconsolidated sand which forms a peninsula between the ocean and bay environments. The southern portion of the study area, including southern Monmouth Beach, Long Branch, Deal and Allenhurst, is classified as Headlands where the beaches are attached to the mainland.

14. The entire coastal zone within the study area is extensively developed, primarily for residential and commercial uses. The peninsula area is fronted by a seawall with elevations ranging from +14 feet to +22 feet MLW (Mean Low Water) in height which aids in the prevention of erosion, flooding and wave attack. Traversing the peninsula area is State Road 36 which is the only major north-south roadway linking the Highlands and Long Branch.

15. Prior to the construction of the Long Branch and Seashore Railroad, storms had repeatedly breached the barrier spit resulting in the formation of inlets that effectively joined the Shrewsbury River with the Atlantic Ocean. When first constructed the railroad was often subject to damage due to storm induced conditions. This resulted in the first extensive erosion control measures undertaken for the area (Reference 2). The railroad has since been abandoned and the tracks removed, however, the seawall remains. At present the peninsula varies in width from 250 to 1500 feet at an elevation ranging from 5-10 feet above the National Geodetic Vertical Datum (NGVD).

16. In the southern half of the study area, the existing bluffs once extended considerably seaward and have since been eroded back to their present position as a result of the combined effects of wind and waves. The bluffs immediately adjoining the ocean range in elevation from 10 to 25 feet NGVD, with the higher elevations located to the northern portion of the area.

DESCRIPTION OF PROBLEM

17. Erosion has seriously reduced the width of most beaches in the study area with consequent increased exposure of the shore to storm damage. Throughout the period of record the 12 mile study area has experienced continuous beach erosion and storm recession resulting in a majority of the shorefront property in Sea Bright and Monmouth Beach having no dry beach (Photos No.1 and 2). With the exception of sand fillets south of groins, very little beach width remains in the southern section of the study area (Photos No. 3, 4 and 5).

18. As erosion continues unchecked, property damage has increased along this heavily developed section of the State shoreline. Public roads and utilities have become more susceptible to storm damage. Two more recent storms, one occurring in 1962 and one in 1984, resulted in 25.3 million and 16 million dollars respectively in financial losses to the study area based on 1987 price levels.

19. Virtually all of the protective coastal structures, including the massive seawalls and 103 groins, have deteriorated since their construction. The structures are becoming less effective and increasingly susceptible to storm damage as the beach continues to erode. The recreational beach areas continue to shrink as the State recreational need increases.

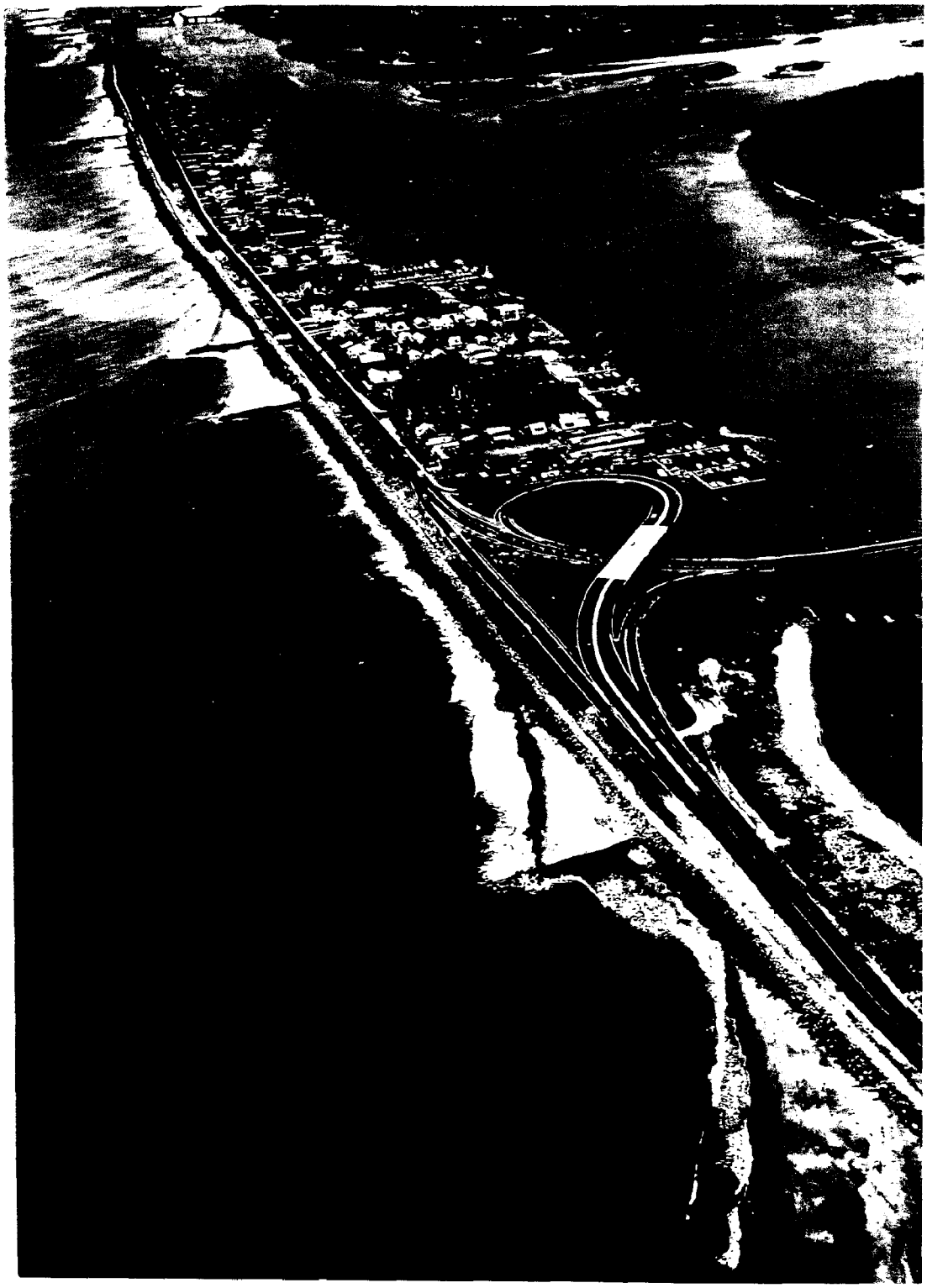

Photo No. 1

Northern section of Sea Bright near confluence of Shrewsbury and Navesink Rivers (looking south). Note absence of beach along most of seawall and proximity of Route 36 to ocean (6/8/87).

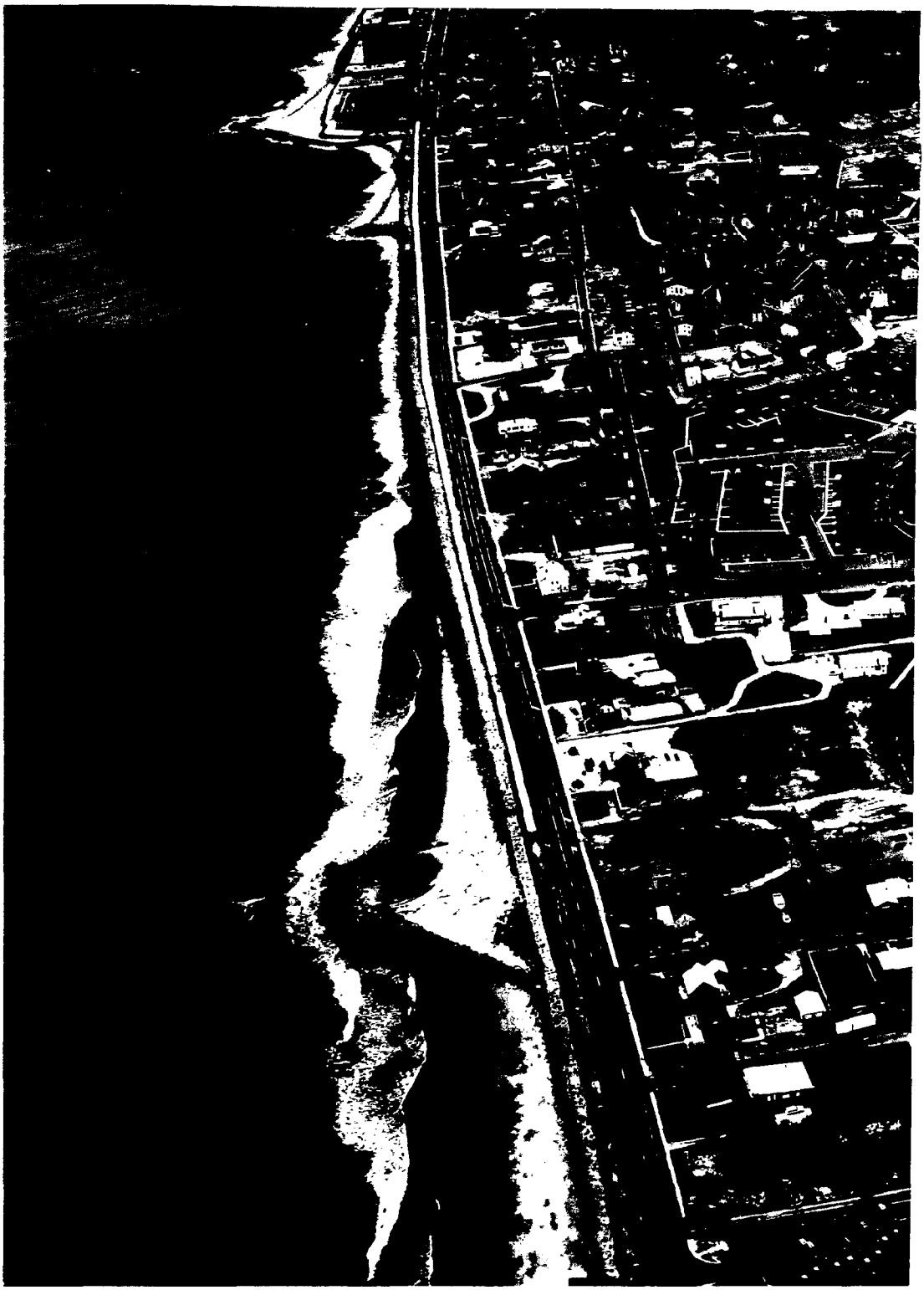

Photo No. 2

Monmouth Beach (looking south). Note absence of beach along most of seawall and proximity of Route 36 to ocean (6/8/87).

Photo No. 3

Northern Long Branch (looking south). Note minimal beach width, numerous groins and new promenade under construction (bottom of photo), (6/8/87).

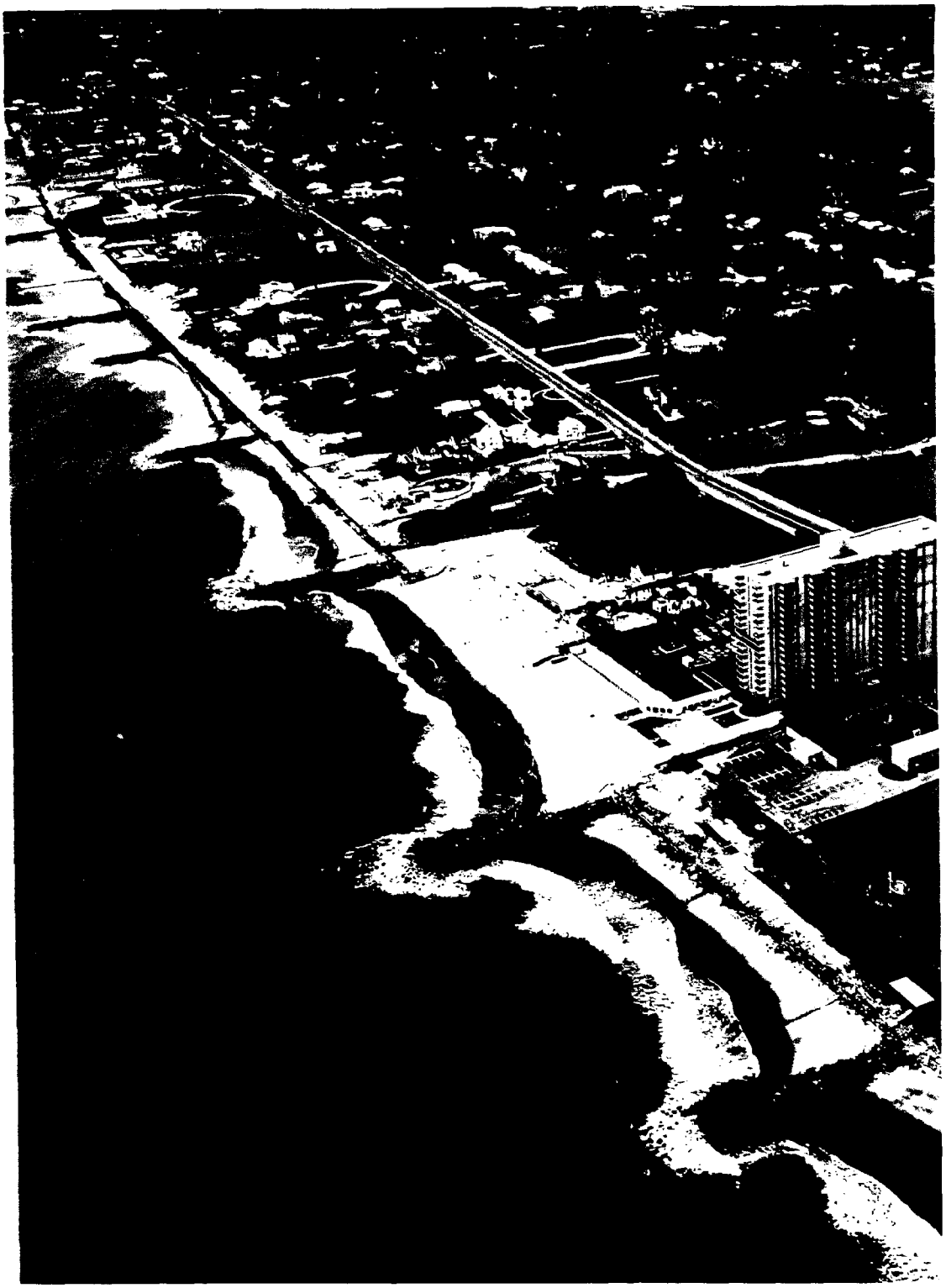

Photo No. 4

Southern Long Branch, Lake Takanasee and Deal (looking south). Note minimal beach width and numerous groins and other structures (6/8/87).

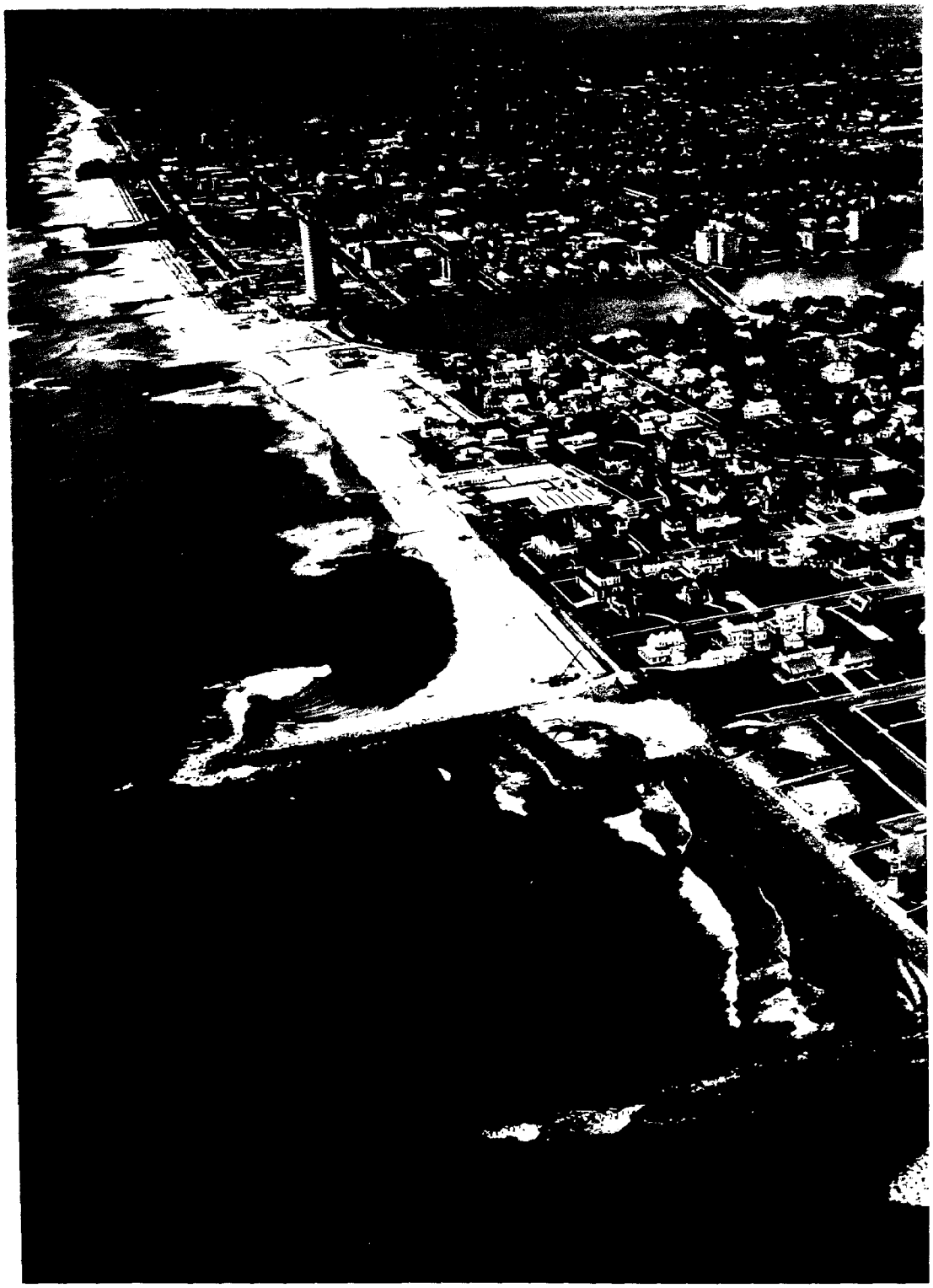

Photo No. 5

Southern Deal, Allenhurst, Loch Arbour and Deal Lake (looking south). Note minimal or absent beach (6/8/87).

20. A comparison of 1953 and 1985 hydrographic survey data indicates a loss of 10,067,000 cubic yards of sediment between Sea Bright and Ocean Township above the 30 foot MLW depth contour (Appendix A). Including the sand fraction of the 1,433,000 cubic yard emergency fill placed after the March 1962 storm, the study area lost material at an average annual rate of 349,000 cubic yards over the 32 year period.

21. The existing annual net sediment transport rate is estimated to be approximately 155,000 cubic yards toward the north at Ocean Township and 392,000 cubic yards toward the north at Sea Bright. Transport rates have decreased from the potential rates of 319,000 cubic yards at Ocean Township and 493,000 cubic yards at Sea Bright. Since the beach itself is the only source of material, it is inevitable that the beach has and will continue to erode.

22. State Route 36 is the only major north-south roadway linking Sea Bright and Monmouth Beach with Long Branch (Photos No. 1 and 2). Local authorities report that during periods of high tide in combination with prolonged periods of a steady northeast wind, the roadway is closed due to flooding resulting from wave runup overtopping the seawall (Photo No. 6). In addition, the setup in the Sandy Hook Bay contributes to the flooding problem by preventing drainage of the rivers, resulting in flooding from the back bay areas. The Route is heavily traveled and is reported by the Department of Transportation (DOT) to be at capacity during the peak recreational season. It also provides the only means of access and egress by residents located in the area.

23. The large seawall at Sea Bright and Monmouth Beach has been generally successful in protecting the area from wave action. However, analyses conducted to date indicate that the seawall is in an advanced state of decay. All sections of the wall analyzed suffer from one or more failure modes with failure from scour more prevalent. If the rate of decay is not checked, more frequent storm damage at lower storm frequencies can be expected.

24. Long term erosion has seriously reduced the size of the remaining beach in the study area. Virtually all coastal structures in the area have experienced serious deterioration. This has resulted in the development along the coast becoming increasingly vulnerable to storm erosion, wave attack and flooding.

PRIOR STUDIES AND CORRECTIVE ACTIONS

25. The reports listed on Table 1 provide information on coastal processes and prior studies for the considered reach of shore. Prinicipal corrective measures which have been implemented are discussed in the following paragraphs. Location of existing coastal structures are summarized in Figure 3.

26. Forty groins have been constructed in the Sea Bright area, some with the outer portion angled to the south. Five groins have been constructed in Monmouth Beach. A total of 45 groins have been constructed in Long Branch. Ten groins have been constructed in Deal, two in Allenhurst and one in Loch Arbour.

Photo No. 6

Wave overtopping and flooding during abnormally high tide (January 1, 1987).

TABLE 1
GENERAL STUDY AREA
PRIOR STUDIES

Year		Agency	Publication or Date of Submission to Congress
1922	Report on Erosion and protection of New Jersey Beaches. Recommended criteria for protection structures.	N.J. Board of Comm. and Navigation	Published
1924	Supplement to the 1922 report which gave further recommendations with respect to shore protection structures.	do.	Published
1930	Final report bringing up to date the data contained in the 1922 and 1924 reports and giving details of completed coastal structures.	do.	Published
1933	Interim Report. Compilation of data gathered in previous experiments, studies and investigations for general reference purposes and as a guide for future studies	Beach Erosion Board	Not Published
1945	Preliminary report on New Jersey Coast with a view to providing protection against damage resulting from floods due to tide and wind. Unfavorable. It was concluded that problems of beach erosion at critical localities might be studies in cooperation with state and local governmental agencies under existing law providing for such studies.	Corps of Engineers	Submitted to Congress on 23 November 1949
1947	A Pictorial History of New Jersey Coast. Compilation of photographs taken periodically of various shore structures for the purpose of studying their effectiveness.	Beach Erosion Board	Not Published
1950	Test of Nourishment of the Shore by Offshore Deposition of Sand, Long Branch, NJ.	Beach Erosion Board	Technical Memorandum 17
1954	Regional Study of Atlantic Coast of New Jersey. Covers the subjects of geomorphology, shore history and littoral materials and forces.	do.	
1958	Authorizing Document and Beach Erosion Control Study, House Document 332	U.S. Congress	July 1958

TABLE 1
GENERAL STUDY AREA
PRIOR STUDIES
(Continued)

Year		Agency	Publication or Date of Submission to Congress
1973	Study of the New Jersey Coastal Inlets and Beaches. Report on Area Description and Existing Conditions.	U.S. Army Corps of Engineers Philadelphia Dist.	July 1973
1981	State of New Jersey Shore Protection Master Plan	State of New Jersey	October 1981
1982	Sandy Hook Critical Zone Beach Restoration	U.S. Army Corps of Engineers	Constructed 1982-1983
1984	Reanalysis of the Federally Authorized Project with emphasis on Sea Bright to Ocean Township. Developed an erosion control plan decision matrix for State of New Jersey.	U.S. Army Corps of Engineers	June 1984

27. Between April 1962 and January 1963, an emergency beach restoration project of approximately 1,443,000 cubic yards of sand was constructed at Sea Bright and Monmouth Beach (Figure 4), (Reference 3). The fills provided a section with a horizontal berm 30 feet wide at +10 feet MLW fronted by a beach slope of 1 on 20. Most of the fill placed in the area has been lost due to fill incompatibility and long term erosion.

28. In 1982-1983 a beach nourishment project was undertaken by the New York District Corps of Engineers for the National Park Service at Sandy Hook, New Jersey. A total of approximately 2,385,000 cubic yards of fill was dredged from the navigation channels and placed at the "critical zone" located at the southern end of Sandy Hook (Reference 4).

EXISTING FEDERAL PROJECTS AND CORRECTIVE MEASURES

29. Existing projects include periodic maintenance dredging of the Shrewsbury and Navesink Rivers and the Sandy Hook Channel leading to the Naval Ammunition Depot at the Naval Weapons Station Earle, Colts Neck, New Jersey.

30. In addition, the Navy is currently planning to dredge the Sandy Hook Channel as part of their expansion plan for the ammunition depot at Earl, New Jersey. A potential exists for utilizing the dredged material as fill along the shoreline at Sea Bright and Monmouth Beach and at the Sandy Hook critical zone. Based on preliminary analyses performed for the Navy (Reference 5), approximately 3.9 million cubic yards of suitable beach fill at a lower unit cost could be made available resulting in a reduced cost for the project. At the time of this writing no detailed plans have yet been developed.

EXISTING CONDITIONS

31. Population. Population in Monmouth County increased by 168,000 persons between 1960 and 1980. While this presents a 50% increase in 20 years. Population estimates for 1985 indicate a 5.5% increase since 1980, the fifth largest percentage increase in the state. The net population increase of 27,700 persons is the third largest in the state, ranking behind the bordering counties of Ocean and Middlesex.

32. Income. The project area communities are generally more wealthy than the county average. With the exception of Long Branch the communities had a per capita income of between 124% and 196% of the county average. In four of the six communities growth in per capita income between 1969 and 1979 exceeded the county growth rate of 21%.

33. Development. The majority of land in the immediate project area contains residential development with commercial development concentrated in the centers of Sea Bright and Long Branch. Recent development in the project area mirrors the regional trend towards townhouse and condominium units, particularly in Sea Bright, Monmouth Beach and Long Branch. The coastal area has also seen a trend towards more year round housing. In areas fronted by a significant beach, such as North Long Branch, the recent high rise and townhouse development indicates the desirability of protected beachfront property.

34. Economy. The economy of Monmouth County has undergone strong growth in recent years with much of the development concentrated along major transportation routes. The majority of recent non-residential development has been for office and research facilities, probably due to the availability of comparatively inexpensive land with good access to the Northern New Jersey-New York City markets.

35. Since all sectors of the regional economy have been experiencing sustained growth (even manufacturing employment increased 6.6% between 1977 and 1985), it appears that the recent increase in per capital income and housing development will continue into the future.

36. Recreation. The severely eroded condition of project area beaches has limited their attractiveness as a recreation resource. Even though the average berm width in the project area has been reduced to only 24 feet, over 85,000 individuals utilized the public beaches in 1985.

37. Transportation. Monmouth County is accessible to major population centers through a New York State and southward to beyond Atlantic City. Route 18 extends westward to New Brunswick in Middlesex County and Route 195 extends westward to the state capital in Trenton. Direct access from these major corridors to the ocean front is provided by various state and county roads including Route 36, Route 520 and Route 71. Communities from Long Branch southward are also serviced by the shore line of New Jersey Transit which provides passenger rail access to Newark and New York City.

38. Existing Structures. Shore protection in the early stages of development of the New Jersey coast was done largely by individuals and local groups. The result was a wide variety of structures ranging from haphazard groins and seawalls to well-engineered systems of protective structures. In 1922, the State of New Jersey began to furnish financial and technical assistance and has continued to the present time.

39. In August 1985, a site inspection of the existing coastal structures was conducted. A total of 103 groins were among the located structures. Other structures inspected included approximately 6.8 miles of stone/concrete seawalls, 2 miles of timber/steel bulkheads and 0.6 miles of rock revetments. The largest continuous structure was a 9,600 foot stone seawall located in the northern Sea Bright area. Figure 4 presents existing structures along the project area.

40. Of the 103 groins inspected, only 20% were considered to be in good condition, with the remainder in fair to poor condition. Twenty-eight percent of the groins were deemed inadequate in reducing littoral losses.

41. Also located along the project area shoreline are 47 drainage outfalls. The outfalls vary from 3" to 72" in diameter, with the majority of the outfalls constructed of steel or concrete. With any increased berm width, many of the drainage outfalls must be extended to remain functional. Appendix E gives a detailed description and evaluation of the drainage outfall extensions.

42. A review of survey data indicated that the average berm height was approximately 10.2 feet (MLW) in 1985, with an average berm width in the study area of 24 feet. The onshore slope averaged 1 vertical to 10 horizontal, and the offshore slope averaged 1 on 38.

43. Climate. The climate in the study area is temperate with warm summers and moderate winters. The annual temperature averages approximately 53 degrees Fahrenheit. January is the coolest month with a mean temperature of 32° F and July is the warmest month. The average annual precipitation is about 44 inches with August being the wettest month. Snowfall averages almost 25 inches annually.

44. Waves. A 20-year wave hindcast, performed by the U.S. Army Corps of Engineers, Coastal Engineering Research Center, revealed that average wave height was approximately 1.5 feet. Sixty-three percent were less than 1.6 feet, 25 percent between 1.6 feet and 3.3 feet and 12 percent were greater than 3.3 feet. The highest wave predicted by the hindcast, was 22.5 feet (Reference 6). However, this size wave only occurred once in the 20-year study. Wave data for the area are summarized on Figure 5.

45. Tides. Tides on the New Jersey Coast area are semi-diurnal. The mean tide level for the Sea Bright area is 2.2 feet above MLW. The mean tidal range is 4.8 feet and the spring tidal range reaches 5.3 feet (Reference 6).

46. Storms. Hurricanes, which are formed in tropical latitudes, are the most destructive storms affecting the Atlantic coast. While many hurricanes have passed the coast, only 2 of 78 have directly hit the New Jersey coast. And while only 2 have hit the coast, the effects of the others, such as winds, waves and excess tides, were still experienced by the coast. A surge frequency relation for the area is summarized on Figure 6.

47. Sea Level Rise. Sea level rise has been found to be a significant factor contributing to the coastal erosion. Based on NOAA tide gauge readings between 1932 and 1980 at Sandy Hook, sea level has been increasing at an average of approximately 0.015 ft. per year (Reference 7).

48. Shoreline and Volumetric Changes. Historical information of volumetric changes in the project changes in the project area is limited, but from 1885 to 1933, the annual erosion rate above the -30 foot contour, was estimated at 256,000 cubic yards. From 1933 to 1953, the annual erosion rate was 225,000 cubic yards. This reduction was attributed to the addition of groins along the coast. The average annual erosion rate between 1953 and 1985 was 349,000 cubic yards (Appendix A). This was attributed to a decreased supply of sand from the beaches south of the study area.

49. A detailed analysis of shoreline changes, utilizing additional surveys was performed (Reference 6). The analysis indicated that the average rate of shoreline retreat has been approximately 3 feet per year over the last century along shorelines not fixed by structures. This rate represents the recession that can be expected if a beach fill project is constructed.

50. Geology and Borrow Sources. The geology of the study area consists of basal strata from the late cretaceous ages. Surficial geology consists mostly of formations from the tertiary ages with some formations from the quaternary ages present. Appendix B provides a detailed description of the various geological formations and their respective composition located in the northern section of the project area.

51. A study was performed to determine whether sediments of suitable grain size and sufficient volume are present in the location near the proposed beach nourishment project. Beach samples were taken along USACE profile lines in the project area. Possible borrow areas were identified through a seismic survey. Vibracore samples were taken within these areas to obtain grain size distribution data. From beach profile sand samples, the mean grain size was found to be 0.29mm (Reference 10). To find suitable borrow material, it is desirable to locate sediment that is as coarse or coarser than the beach material. Also, grain size distribution should be similar or better than grain size distributions from the beach profile samples.

52. Based on this criteria, the study identified 24 cores of suitable grain sizes. In the areas where suitable borrow material was identified, remote sensing surveys were performed. The purpose of the surveys was to determine the presence of artifacts or obstructions which could hinder the dredging process. Certain areas of the Sea Bright-Sandy Hook area were found to contain anomalies that would hinder dredging.

53. Finally, from the vibracore and remote sensing surveys, three suitable borrow areas were located. These are shown in Figure 7. The largest, the borrow area off of Sandy Hook-Sea Bright, contained 47 million cubic yards of material. The two other locations, southeast of Belmar, contained 1.5 million cubic yards of suitable borrow material each. Appendix C gives detailed results of the sand inventory investigation.

54. Existing Environmental Conditions. The project shoreline has been highly modified as a result of intensive human development and concomitant measures to control erosion forces. Upland areas within the project reach have been almost totally committed to residential and commercial development. Only a single length of little more than 2,000 feet retains some semblance of a natural shoreline with dunes backing the ocean berm and beach. This is the area of Seven Presidents County Park and North End Beach Club in North Long Branch. Elsewhere, the beach if present, is backed by a seawall, as in Sea Bright and Monmouth Beach, or variations of riprap construction and bulkheads, as in the southern half of the project reach. In many areas north of Long Branch, there is no beach at all in front of the seawall. In addition, a wide variety of stone and timber groins have been constructed all along the project reach to forestall sand losses along the shore.

55. The offshore ocean bottom in the vicinity of proposed borrow areas is typical of nearshore marine habitats with sandy substrates. The borrow area off Sandy Hook lies near the mouth of New York Harbor, and is subsequently affected by the water quality conditions found in that estuary. The two smaller borrow areas off Belmar and Sea Girt are located in relatively cleaner waters to the south. Benthic resource studies in the borrow areas showed a paucity of surf clams, the major commercial species, in the Sandy Hook borrow area, and low to marginal populations in the two southern areas. Portions of the three borrow areas are located in areas that have been identified as having high recreational fishing use for such species as summer flounder, striped bass, weakfish, and bluefish.

56. Without Project Future Conditions. The without project condition was identified as a continuation of long term erosion with a consequent reduction in dry land area up to the seaward face of any seawalls, revetments, bulkheads or major transportation routes. Based on conversations with state officials it was assumed that non-federal interests would continue the current pattern of maintenance and repair of such structures, effectively halting long term shoreline erosion at the seaward face. The repair of seawalls and other protective structures was assumed to be adequate to maintain the current levels of structural stability and the associated level of protection during relatively non-catastrophic event periods. As this work is generally performed as emergency patch work rather than as a capital improvement, historical trends support the assumption that no substantial increased level of protection results from the maintenance program.

57. The continued future reduction of protective beach area in front of protective structures will increase the potential for their devastation in major storms. In areas without protective structures the continued erosion of land will expose the existing development to storm damage on an increasingly more frequent basis and will reduce the size of associated properties.

58. Although the long term erosion of the shore front will result in larger areas subject to storm damage, several factors will combine to somewhat mitigate the future impacts. Since each community in the study area is currently participating in the National Flood Insurance Program (NFIP), most structures destroyed by future storms will be rebuilt to NFIP regulations which require elevating the structure to the Base Flood elevation as indicated on the adopted Flood Insurance Rate Maps (FIRM).

59. It is also most probable that decisions on the rebuilding of structures close to the waterline would tolerate no greater risk of damage from recession or wave attack than exhibited by current building practices. Based on a review of local building practices and flood insurance data, the following post storm rebuilding practices are considered the most probable future condition:

- Structures located closer to the future waterlines than current building practices allow will not be rebuilt.

- Any residential structure which is rebuilt will have its main floor at a minimum elevation of +10 feet NGVD and be protected from wave attack and recession damages up to a 25-year event.

- Due to financial considerations and physical constraints any non-residential structure which is rebuilt will be replaced in kind.

60. The impacts of continued erosion in the project area are likely to extend beyond the northern project boundary. As erosion eliminates more dry beach from the project area a decreasing amount of sediment will be transported to the southern sections of Sandy Hook National Seashore exacerbating this already critical erosion problem.

61. Communities in the project area originally developed as resorts and much of the economy is still centered around the seasonal use of these facilities. Throughout the study reach there are more than thirty establishments renting rooms to summer visitors, 689 housing units were classified as seasonal based on the 1980 census, and many of the nearly 150 townhouse and apartment complexes have seasonal rentals. The beach front is dotted with more than twenty beach clubs, as well as a major amusement center and planned convention center in Long Branch. All these facilities are in part tied directly to the value of the area beaches and if a continual degradation of the beach is permitted, they surely will suffer an economic loss. Similarly, the secondary economy such as the restaurants, concession stands, and retail stores throughout the area would realize an economic hardship through a reduction in the summer trade.

62. Although the continued erosion of the limited available beach area is likely to result in substantial hardship within the study area, without project beach visitation within the recreation resource area (defined as Sandy Hook to Belmar for this study) is predicted to increase 28% by the year 2040. This will result in increased density and probably overcrowding at the remaining beaches within the entire resource area.

NEEDS, OBJECTIVES AND CONSTRAINTS

CURRENT NEEDS

63. Over the years erosion has seriously reduced the ability of the shoreline in the project area to provide adequate protection from coastal storms. Continuation of this historic trend will increase the potential for economic losses and the threat to human life and safety.

64. The greatest need in the study area is an effective erosion and storm damage control program that eliminates long term erosion and provides acceptable levels of protection from the devastating impacts of wave attack and storm recession.

65. It is also recognized that the regional economy relies heavily on recreational beach usage and as such a need exists for protecting and enhancing this valuable resource.

PLANNING OBJECTIVES

66. Planning Objectives were identified based on the problems, needs and opportunities as well as existing physical and environmental conditions present in the project area.

67. In general, the prime Federal objective is to contribute to the National Economic Development (NED) account consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements. Accordingly, the following general and specific objectives have been identified.

General

- o Meet the specified needs and concerns of the general public within the study area;
- o Respond to expressed public desires and preferences;
- o Be flexible to accommodate changing economic, social, and environmental patterns and changing technologies;
- o Integrate with and be complementary to other related programs in the study area; and
- o Be implementable with respect to financial and institutional capabilities and public consensus.

Specific

- o Reduce the threat of potential future damages due to the effects of storms, with an emphasis on wave attack and recession.
- o Mitigate the effect of or prevent the long term erosion that is now being experienced.
- o Enhance the recreational potential of the area.

PLANNING CONSTRAINTS

68. Planning constraints are technical, environmental, economic, regional, social and institutional considerations that act as impediments to successful response to the planning objectives or reduce the theater of possible solutions.

Technical Constraints

- o Plans must represent sound, safe, acceptable engineering solutions.
- o Plans must be in compliance with Corps engineering regulations.
- o Plans must be realistic and state-of-the-art. They must not rely on future research and development of key components.

- Plans must provide storm damage protection.

- Plans must provide features to minimize the effect of shoreline erosion processes.

Economic Constraints

- Plans must be efficient. They must represent optimal use of resources in an overall sense. Accomplishment of one economic purpose cannot unreasonably impact another economic system.

- The economic justification of the proposed project must be determined by comparing the average annual tangible economic benefits which would be realized over the project life with the average annual costs. The average annual benefits must equal or exceed the annual costs.

Environmental Constraints

- Plans cannot unreasonably impact on environmental resources.

- Where a potential impact is established plans must consider mitigation or replacement and should adopt such measures, if justified.

Regional and Social

- No favoritism can be shown; all reasonable opportunities for development within the study scope must be weighed one against the other and state and local public interests' views must be solicited.

- The needs of other regions must be considered and one area cannot be favored to the unacceptable detriment of another.

Institutional

- Plans must be consistent with existing federal, state, and local laws.

- Plans must be locally supported to the extent that local interests must, in the form of a signed local cooperation agreement, guarantee for all items of local cooperation including possible cost sharing.

- Local interests must agree to provide public access to the beach in accordance with all requirements of state laws and regulations.

- The plan must be fair and find overall support in the region and state.

PLAN FORMULATION

69. The Water Resources Council's "Principles and Guidelines" require the systematic preparation and evaluation of alternative ways of addressing identified problems, needs, and opportunities under the objective of National Economic Development (NED) consistent with protecting the nation's environment.

70. With respect to the local planning objectives and the Water Resources Council's "Principles and Guidelines" objectives, a formulation and evaluation process was conducted considering all appropriate measures identified including those proposed by different agencies. Plans were evaluated through a three step planning process. These steps were: (1) identification of possible solutions, (2) development of alternatives, (3) assessment of alternatives.

INITIAL EVALUATION OF ALTERNATIVES

71. Possible solutions considered in the initial step of plan formulation are listed below:

(1) No action
(2) Buy-out Plan
(3) Revetments
(4) Revetments and beach restoration
(5) Breakwaters
(6) Breakwaters with beach restoration
(7) Seawalls
(8) Seawalls with beach restoration
(9) Perched beach with beach restoration
(10) Beach Restoration
(11) Groins
(12) Groins with beach restoration

The following paragraphs briefly describe the objective and the evaluation of each alternative. A summary of the analyses is presented on Table 2.

72. No Action: This plan, simply, means that no measures would be taken to provide for storm damage protection, erosion control, recreational beaches or to protect upland property. This plan fails to meet any of the objectives or needs for the project. While this plan was not considered for further development, it does provide the basis for which the with project benefits are measured.

73. Buy-out Plan: Permanent evacuation of existing areas subject to erosion or inundation involves the acquisition of this land and its structures either by purchase or by exercising the powers of eminent domain. Following this action, all development in these areas is either demolished or relocated. Considering the amount of development, both commercial and residential, on the project area ocean front, this plan is both prohibitively expensive and socially unacceptable and was dropped from consideration early.

TABLE 2
APPLICABILITY OF
INITIAL STORM DAMAGE PROTECTION ALTERNATIVES
SEA BRIGHT TO OCEAN TOWNSHIP, NJ

ALTERNATE PLAN	TECHNICAL FEASIBILITY	SOCIAL IMPACT	FIRST COST* ($1,000)	ANNUAL COST** ($1,000)	FURTHUR CONSIDERATION	REMARKS
A. NO ACTION	YES	EVENTUAL LOSS OF BEACH.	$0	$0	NO	NO STORM PROTECTION PROVIDED. PROVIDES NO EROSION PROTECTION.
B. BUY-OUT PLAN	YES	SOCIABLLY UNACCEPTABLE	$869,939	$78,321	NO	EXTREMELY EXPENSIVE, NON-STRUCTURAL ALTERNATIVE.
C. BEACH RESTORATION	YES	PROVIDE USABLE BEACH AREA AND STORM PROTECTION.	$153,167	$17,678	YES	CONSIDERED FOR FUTURE DEVELOPMENT.
D. AUTHORIZED GROINS	YES	REDUCED AESTHETICS. INCREASED IMPACT ON SANDY HOOK.	$8,316	$791	NO	NO STORM PROTECTION PROVIDED. FILLETS PROVIDE MINIMAL BEACH AREA. EROSION RATE REDUCED. SEVERE DOWNDRIFT EROSION.
E. GROINS WITH BEACH RESTORATION	YES	REDUCED AESTHETICS.	$162,508	$18,272	YES	CONSIDERED FOR FUTURE DEVELOPMENT.
F. SEAWALLS	YES	EVENTUAL LOSS OF DRY BEACH.	$46,676	$4,435	NO	LACK OF ADEQUATE STORM PROTECTION. SEVERE DOWNDRFIT EROSION. LACK OF EROSION CONTROL. NOT SUPPORTED BY THE STATE. POTENTIAL SAFETY HAZARD. LOSS OF RECREATIONAL BEACH.
G. SEAWALLS WITH BEACH RESTORATION	YES	PROVIDES USABLE BEACH.	$193,311	$21,811	NO	NOT SUPPORTED BY THE STATE. POTENTIAL SAFETY HAZARD. COSTS EXCEED PLAN C BY $4.1 MILLION ANNUALLY.

TABLE 2 (CONTINUED)
APPLICABILITY OF
INITIAL STORM DAMAGE PROTECTION ALTERNATIVES
SEA BRIGHT TO OCEAN TOWNSHIP, NJ

ALTERNATE PLAN	TECHNICAL FEASIBILITY	SOCIAL IMPACT	FIRST COST* ($1,000)	ANNUAL COST** ($1,000)	FURTHUR CONSIDERATION	REMARKS
H. REVETMENTS	YES	EVENTUAL LOSS OF BEACH.	$30,536	$2,902	NO	LACK OF EROSION CONTROL. LACK OF ADEQUATE STORM PROTECTION. SEVERE DOWNDRIFT EROSION. LOSS OF RECREATIONAL BEACH. NOT SUPPORTED BY THE STATE. POTENTIAL SAFETY HAZARD.
I. REVETMENTS WITH BEACH RESTORATION	YES	PROVIDE USABLE BEACH AREA.	$184,578	$20,982	NO	NOT SUPPORTED BY THE STATE. POTENTIAL SAFETY HAZARD. COSTS EXCEED PLAN C BY $3.3 MILLION ANNUALLY.
J. BREAKWATERS	MARGINAL	REDUCED AESTHETICS	$74,191	$7,051	NO	SEVERE DOWNDRIFT EROSION. LACK OF ADEQUATE STORM PROTECTION. NOT SUPPORTED BY THE STATE. POTENTIAL SAFETY AND BOAT HAZARD.
K. BREAKWATERS WITH BEACH RESTORATION	MARGINAL	REDUCED AESTHETICS	$208,831	$23,104	NO	MARGINAL FEASIBILITY. NOT SUPPORTED BY THE STATE. POTENTIAL SAFETY AND BOAT HAZARD. THE COSTS EXCEED PLAN C BY $5.4 MILLION ANNUALLY.
L. PERCH WITH BEACH RESTORATION	NO	COULD POSE HAZARD TO BATHERS & BOATERS.	$162,770	$19,128	NO	NOT PROVEN TO BE EFFECTIVE IN OCEAN ENVIRONMENT. NOT SUPPORTED BY THE STATE. POTENTIAL SAFETY AND BOAT HAZARD.

* INCLUDES INITIAL FILL AND ROCK COST ONLY
** INCLUDES INITIAL FILL AND ROCK AND MAINTENANCE FILL AND ROCK COSTS

74. Revetments: Revetments are a facing of resistant material such as rock built to protect shorelines from erosion and storm damage. They consist of an armor layer of rock placed over a dune or berm in the back portion of the beach. Revetments are designed to only protect the land immediately behind them. Erosion will continue adjacent and in front of the revetment. Because of this, the revetment must have a substantial toe foundation to prevent undermining of the structure. Erosion would accelerate at Sandy Hook. This plan is not supported by the State. This plan fails to check erosion of existing beaches and does not significantly increase storm protection and was not considered for further development.

75. Revetments with Beach Restoration: Beach restoration combined with revetments will provide added storm protection and will act to protect the revetment from undermining. The beach restoration will also prevent erosion and provide recreational beach area. However, this plan was eliminated from further development due to extremely high costs. Additional rock structures could become safety hazards. The plan is not supported by the State.

76. Breakwaters: Breakwaters are structures which protect beaches from wave action by dissipating wave energy before it reaches the beach. A decrease in wave energy will reduce sediment transport thus reducing the erosion rate. The erosion rate at Sandy Hook would increase. The breakwater does not, however, provide protection from tidal surges or reduce downdrift beach erosion and therefore this plan was eliminated from further development.

77. Breakwaters with Beach Restoration: To minimize the effect of breakwaters on downdrift beaches they should be constructed in conjunction with beach restoration. This plan would effectively check erosion and also create a wider recreational beach and provide storm protection. This plan was eliminated due to constructability constraints and associated high costs as well as potential safety hazards. A structure as large as the one required for this project area has never been constructed. It could become a significant safety and boating hazard. The plan is not supported by the State.

78. Seawalls: Seawalls provide upland erosion protection and are usually employed to protect upland structures from erosion damage. Seawalls provide some storm protection for the backshore areas. Many seawalls cause scour problems in the beaches fronting them. Seawalls would accelerate erosion at Sandy Hook. Seawalls could become a potential safety hazard. This plan is not supported by the State. The seawall plan fails to check erosion of existing beaches or provide recreational beach area and therefore was eliminated from further consideration.

79. Seawalls with Beach Restoration: With this option seawalls would provide upland storm protection, while beach restoration would check erosion along the shoreline. Beach restoration would also provide recreational beach area and provide an extra buffer for storm protection. The structure could become a safety hazard. This plan is not supported by the State. The areas not presently protected by seawalls have a high elevation. The cost of a seawall would not result in a substantial benefit for these areas. While this plan meets all project needs and objectives, it was not considered for further development due to its high costs.

80. Perched Beach with Beach Restoration: A perched beach provides a wider dry beach area for a given fill volume due to an artificial toe support. This toe support helps reduce offshore losses of sediment. Along with the beach restoration, storm protection, recreational beach and erosion reduction are provided. While this plan meets all needs and objectives of the project, it was eliminated from further development due to technical feasibility and the inability to regain sand transported seaward of the perched shoreline.

81. Beach Restoration: Beach restoration involves placement of sand directly on an eroding shoreline to restore its form and subsequently maintain an adequate beach width by means of periodic renourishment fill.

82. Groins: Groins, also referred to locally as jetties, are coastal structures which are normally constructed perpendicular to the shoreline. They extend from the back beach area into the water and are designed to trap sand. This trapped sand, called "fillet" acts to some degree to protect back beach areas. Properly placed groins will reduce or eliminate erosion. This plan fails to meet all of the objectives since the groin plan fails to provide adequate storm protection. Additional groins in the project area could result in an increased impact on Sandy Hook.

83. Groins with Beach Restoration: Groins alone, as described above, would not widen the existing beach because of a severe deficiency of sand. Beach restoration would provide a wider dry beach area while still benefiting from the erosion reduction by the groins. This measure was given further consideration.

84. Based on a comparison of the storm damage protection alternatives considered, only beach restoration and beach restoration with groins meet the planning objectives and were carried forward for more detailed analyses.. The no action alternative is carried throughout the plan formulation for consideration and comparison.

EVALUATION OF SELECTED ALTERNATIVES

85. Description. The two plans carried forward were further evaluated based on a comparison of berm widths of 50, 100 and 150 feet. A comparison of two different groin plans was also performed, the authorized groin plan and an updated groin plan that reflects current coastal engineering methods.

86. The design berm width was added at the +10 foot MLW elevation. The design profile sloped with an onshore slope of 1 on 10 to Mean Low Water and continued with an offshore slope of 1 on 35 until it intersected with the existing profile. A risk analysis was performed in accordance with ER 1110-2-1407 to develop the total annual maintenance requirements. The analysis demonstrated that 478,000 cubic yards of maintenance fill are needed annually to meet the risk analysis for a 6-year maintenance interval.

87. The 1958 authorized project required the construction of 23 new groins and the extension of 14 existing groins. These groins would be spaced 1000 to 1200 depending on the location of the various existing groins. The authorized groin field was initially designed to reduce erosion by 30% (Reference 1), but the erosion reduction was decreased to 15% based on the fact that only half of the project shoreline will be protected by the groin fillets. Based on 1985 surveys, the authorized groin plan was reduced to 17 new groins and 15 extensions. This decreased amount of new groins was due to the construction of groins between 1958 and 1985. The beach fill design for the authorized groins was the same as the fill only plan with the exception of fillets to the north of each groin.

88. The updated groin plan utilized the same fill design as the authorized project with the groin spacing and length determined by least cost and optimum erosion reduction. Based on the analysis, the groins would be spaced 450 feet apart with a length of 290, 340 and 390 feet for the 50, 100 and 150 feet design berms. A groin toe depth of -4 feet MLW provided an erosion reduction of 20.5%, reducing the maximum potential littoral drift rate of 493,000 cubic yards to 392,000 cubic yards. This reduction would not have an adverse affect on Sandy Hook, since it would equal the current drift rate. Additional design details are presented in Appendix A.

89. Quantity Estimates. The total initial project fill volume is the sum of the design, feeder, advance, tolerance and overfill quantities. The maintenance project fill volume is the sum of the feeder, advance, tolerance and overfill quantities. Table 3 summarizes the initial and maintenance fill quantities for the three design berm widths. The fill quantities for the authorized groin and fill widths of 50, 100 and 150 feet are also presented in Table 3. The fill for the updated groin plan including the reduction in erosion, is given in Table 3 for the 50, 100 and 150 foot fill widths. Table 4 presents rock quantities for the 50, 100 and 150 foot berm width with the authorized groins. The rock quantities based on lengths of 290, 340 and 390 feet are also presented in Table 4 for the 50, 100 and 150 foot berm widths.

90. It became evident during the optimization phase of the analysis that a berm having an elevation of +10 feet MLW would be subject to frequent overtopping. Accordingly, storm berm caps of various heights were analyzed. Berm caps of 0, 2 and 4 feet were added to the 100 ft. wide beach in order to yield a berm cap that optimizes net economic benefits. Initial fill quantities for these three berm caps are listed in Table 5. Maintenance quantities are independent of berm height.

91. Cost Estimates. The first and annual costs of the three final alternative plans at the three berm widths based on a continuous sequence of construction of all reaches were calculated and presented in Table 6. These costs are developed in detail in Appendix B. Included in the total cost is outfall extension, groin notching, seawall rehabilitation and real estate costs. The first and annual cost of the berm caps analyzed for the fill only plan are listed in Table 7.

TABLE 3
TOTAL FILL AND MAINTENANCE QUANTITIES

PROJECT	50 FOOT BERM FILL VOLUME (C.Y)	100 FOOT BERM FILL VOLUME (C.Y)	150 FOOT BERM FILL VOLUME (C.Y)
FOR FILL ONLY PLAN (WITHOUT BERM CAP) -			
TOTAL PROJECT			
REACH 1 (CONTRACT A)	3,957,898	5,068,610	6,381,295
REACH 1 (CONTRACT B)	2,516,653	3,314,687	4,135,766
REACH 2	3,193,716	4,514,413	5,964,106
REACH 3	3,103,183	4,320,727	5,665,788
MAINTENANCE	3,492,534	3,522,214	3,552,374
FOR AUTHORIZED GROIN PLAN (WITHOUT BERM CAP) -			
TOTAL PROJECT			
REACH 1 (CONTRACT A)	4,151,843	5,108,480	6,334,990
REACH 1 (CONTRACT B)	2,674,927	3,354,441	4,109,586
REACH 2	3,447,176	4,590,093	5,940,885
REACH 3	3,225,395	4,362,012	5,661,283
MAINTENANCE	3,206,999	3,236,679	3,266,839
FOR UPDATED GROIN PLAN (WITHOUT BERM CAP) -			
TOTAL PROJECT			
REACH 1 (CONTRACT A)	3,966,479	5,024,145	6,340,808
REACH 1 (CONTRACT B)	2,543,293	3,337,878	4,158,957
REACH 2	3,465,178	4,688,122	6,070,979
REACH 3	3,103,207	4,320,752	5,665,813
MAINTENANCE	2,208,839	2,238,520	2,268,679

TABLE 4
TOTAL ROCK QUANTITIES

PROJECT	50' BERM (TONS)	100' BERM (TONS)	150' BERM (TONS)
FOR AUTHORIZED GROIN PLAN - TOTAL PROJECT			
REACH 1 (CONTRACT A)	55,110	55,110	55,110
REACH 1 (CONTRACT B)	70,300	70,300	70,300
REACH 2	11,670	11,670	11,670
REACH 3	20,820	20,820	20,820
FOR UPDATED GROIN PLAN - TOTAL PROJECT			
REACH 1 (CONTRACT A)	83,574	124,581	178,125
REACH 1 (CONTRACT B)	66,010	100,646	141,155
REACH 2	28,026	43,892	62,503
REACH 3	0	0	0

TABLE 5
INITIAL FILL QUANTITIES
SELECTED PLAN WITH - 2 FOOT BERM CAP
ENTIRE PROJECT CONSTRUCTED IN PHASES

PLAN DESIGN BERM WIDTH	DESIGN FILL VOLUME (C.Y.)	ADVANCE** FILL VOLUME (C.Y.)	FEEDER*** BEACH VOLUME (C.Y.)	TAPER VOLUME (C.Y.)*	SUB-TOTAL FILL VOLUME (C.Y)	SUB-TOTAL PLUS 15% TOLERANCE VOLUME (C.Y.)	OVERFILL FACTOR	TOTAL INITIAL FILL VOLUME (C.Y.)
REACH 1A	3,687,585	477,042	258,000	99,700	4,522,327	5,090,420	1.02	5,192,228
REACH 1B	2,618,674	307,180	0	21,500	2,947,354	3,343,380	1.02	3,410,248
REACH 2	3,491,419	355,188	147,000	38,200	4,031,807	4,561,250	1.02	4,652,475
REACH 3	3,128,907	252,780	492,000	55,100	3,928,787	4,406,388	1.01	4,450,452
TOTAL	12,926,585							17,705,403

* INCLUDES 110,00 CUBIC YARDS FOR FILL LANDWARD OF THE BASELINE
NOTE: TOLERANCE NOT APPLIED TO ADVANCE FILL OR FEEDER BEACHES

** ADVANCE FOR REACH 1A = 477,042*(6/6)
ADVANCE FOR 1B = 368,616*(5/6)
ADVANCE FOR 2 = 532,782*(4/6)
ADVANCE FOR 3 = 505,560*(3/6)

*** TEMP. FEEDER FOR REACH 1A = 129,000*2 years
TEMP. FEEDER FOR REACH 2 = 147,000*1 years
TEMP. FEEDER FOR REACH 3 = 164,000*3 years

TABLE 6
FINAL ALTERNATIVES - FIRST AND ANNUAL COST SUMMARY

PLAN*	BERM WIDTH (FT.)	FIRST COST*** ($)	ANNUAL COST** ($)
FILL ONLY	50	151,220,860	17,668,161
	100	188,955,995	21,097,295
	150	229,688,582	24,796,772
AUTH. GROIN	50	165,041,864	18,664,613
	100	198,297,468	21,690,630
	150	236,855,582	25,189,577
UPDATED GROIN	50	162,581,862	17,411,806
	100	203,448,473	21,146,575
	150	249,392,580	25,342,999

* FOR +10' MLW BERM HEIGHT
** USING 8.875% INTEREST FOR 50 YR. PROJECT LIFE
*** INCLUDES OUTFALL, GROIN NOTCHING, SEAWALL, FILL AND REAL ESTATE COSTS.

TABLE 7
TOTAL FIRST AND ANNUAL COSTS
FILL ONLY PLAN WITH 100' BERM WIDTH AND BERM CAPS

BERM CAP	INITIAL FILL COSTS ($)*	GROIN NOTCH. COSTS ($)*	OUTFALL EXT. COSTS ($)*	SEWALL REHAB. COSTS ($)*	REAL ESTATE COSTS ($)*	TOTAL FIRST COSTS ($)	ANNUAL COSTS ($)**
0'	153,166,528	1,193,878	2,400,089	11,644,000	20,551,500	188,955,995	21,097,295
2'	157,127,861	1,193,878	2,400,089	11,644,000	20,551,500	192,917,328	21,453,892
4'	160,304,789	1,193,878	2,400,089	11,644,000	20,551,500	196,094,256	21,739,930

* INCLUDES CONTINGENCIES, E&D, AND S&A (SEE APPENDIX A)
** BASED ON 8.875% INTEREST OVER 50 YR. PROJECT LIFE

BENEFITS

92. Details of the benefit analyses are presented in Appendix D and summarized in the following paragraphs. The benefits attributable to project implementation fall into five principal categories:

Storm Reduction
Reduction in Lost Land
Intensification
Recreation
Reduced Maintenance at Sandy Hook

Figures 8 and 9 provide schematic profiles of benefit and damage locations. In order to avoid double counting the following assumptions were made:

- Storm reduction benefits apply to existing improvements such as buildings, roads and utilities only. Future increases in value are limited to a projected growth in residential content value.

- Benefits attributable to a reduction in lost land are based on the current value of the existing land without improvements and result from project maintenance which will offset the impact of long term erosion.

- Intensification benefits are based on the net increase in value of existing land due to reduced risk of storm damage.

- Recreation benefits are based on the net increased value from existing conditions and do not include the future impacts of continued erosion as they are accounted for in the reduction of loss of land.

- Reduced maintenance at Sandy Hook considers the project's impact on the current deficit in sediment at the Sandy Hook critical erosion zone.

93. For analysis purposes the 12-mile project was broken into 14 economic reaches as presented in Figures 10 and 11. Estimates of monetary benefits were based on April 1987 price levels which were updated to September 1987, a 50-year project life and an interest rate of 8-7/8 percent and reflect the economic development of the flood plain as of July 1985. Regional growth in population and per capita income are assumed to be equal for both the with and without project conditions with an intensification of the future development along the shoreline for the with project condition. The base year for the proposed project is 1990. Reduced Flood Insurance Administration costs have not been considered since the project will not provide a total 100-year level of protection from all damage mechanisms, which is the criteria for determining the need for flood insurance. Even with the project in place, low lying portions of Route 36 which is the principal north-south corridor will be subject to flooding from the Shrewsbury River. Benefits associated with protecting the road system itself have been considered.

STORM REDUCTION BENEFITS

94. The storm reduction benefits include:

- Reduction in inundation of structures
- Reduction of wave attack to structures
- Reduction of damage associated with long-term impacts of shoreline erosion and short term storm induced recession including damage to roads, utilities and structures
- Reduced maintenance costs for seawalls
- Reduced public emergency costs.

95. The initial step in developing the storm reduction benefits was to conduct a windshield survey of the project area and together with a utility survey develop a data base of all damageable structures within the project area. Buildings within this project area are subject to damage from inundation, wave attack, long-term erosion and storm recession. To obtain the pertinent data, such as depth damage relationships, contents to structure ratios, etc., over 200 on-site investigations were conducted during the summer of 1985.

Inundation Damage

96. To evaluate inundation damage, information obtained during the on-site field investigation was utilized to generate damage functions to apply to the remainder of the building population. Each damage function was related to the structures main floor which in turn was referenced to the National Geodetic Vertical Datum (NGVD) (1929 MSL at Sandy Hook) during the windshield survey. Utilizing the common datum, damages per reach were readily summed per foot of increased flood stage. The stage-damage relationships were then integrated with stage-frequency data to evaluate annual inundation damages. Inundation within the project area occurs from three sources:

- Ocean storm surge
- Seawall overtopping
- Flooding on the Shrewsbury and Navesink Rivers

97. To evaluate inundation reduction benefits, storm surge models were run for both the ocean and river estuaries. Flooding due to overtopping of the seawall was evaluated utilizing existing flood marks in combination with overtopping discharge rates for existing conditions. The rates for overtopping were established using procedures set forth in the Corps of Engineers Shore Protection Manual. Flooding from overtopping of the seawall was only considered up to the frequency at which it is anticipated the seawall will fail. For frequencies above seawall failure, flood stages will relate directly back to the ocean storm surge. To evaluate with project conditions, the same overtopping discharge rates were used because the historic depth data was available and only the frequency to cause the overtopping discharge rate was altered. For delineation of inundation areas see Appendix D.

Wave Attack

98. Wave attack damages were evaluated for the fifty-year life of the project and were investigated as total failure of the building. Due to the unpredictability of wave damage no attempt was made to consider partial failure of the structure due to wave attack. Zones or bands of potential wave attack were isolated based on the transmission of breaking waves landward and wave runup. For without project conditions, the zones were delineated for present conditions, base year of project and for successive 10-year increments thereafter for the 50-year project life, taking into account the impacts of long-term erosion. For the with project conditions, maintenance will limit long-term erosion so the analysis with time was not required. For the 500-year 1985 Flood Plain the building population was stratified into four categories for the analysis:

- Wood frame structures not on piles or piers
- Masonry structures not on piles or piers
- Buildings on piles or piers greater than 4 feet above grade.
- Buildings on piles or piers less than 4 feet above grade.

99. Within each category the population was analyzed to develop an average structure size. Using techniques presented in the "Shore Protection Manual", as well as the Federal Emergency Management Agency (FEMA) manual "Elevating to the Wave Crest Level", each average structure was analyzed based on the force of a breaking wave to determine the size of wave necessary to cause failure due to overturning or displacement. Utilizing the basic assumption that a wave will break when its height reaches 78% of the water depth, the water depth necessary to transmit the breaking wave was used to trigger structural failure under the with and without project conditions. Structural failure due to wave runup was also considered. This was evaluated by determining the lateral extent of runup for various frequency events such that the remaining force would be equivalent to that of the breaking wave force necessary to cause failure of the wood frame structures. Wood frame structures were selected as the controlling force since they represented over 80% of the wave zone population. Damage was assigned based on the total value of the structure and contents for physical damage, and considered to be equivalent to 12 feet of inundation depth above the main floor as derived from the inundation depth damage curves for Lost Income and Emergency costs. These latter two figures represent the reasonable upper limits of total loss value. Project benefits associated with wave attack result primarily from the reduced runup as a result of beach placement and the increased structural stability of the seawall, which limits the extent of wave attack. For delineation of areas subject to wave attack see Appendix D.

100. Long Term Erosion. Long term erosion refers to the wearing away of land as measured over extended periods of time. Included are the impacts of sea level rise, deficits in sediment transport and the net impacts of storms, including post-storm accretion. Benefits were analyzed by advancing the shoreline landward for the without project conditions over the fifty-year period. This landward retreat then leaves shorefront structures more susceptible to damage in future years. The evaluation of long-term erosion included three basic assumptions:

1) Structures destroyed by long-term erosion would not be rebuilt and thus will not exist in future years.

2) Long-term erosion would not be allowed to interdict seawalls or roadways as man would intercede. Project benefits include the reduced maintenance costs for roadways and seawalls.

3) Once long-term erosion advanced to the seaward edge of an individual structure (not roadway or seawall) it was taken as a total failure.

101. With the project in place, long-term erosion was considered non-existent because feeder beaches and maintenance associated with the cost of the project will prevent future deterioration of the project beaches.

Storm Recession

102. Storm recession is the scour and erosion that occurs during major storm events and to some extent replenishes itself within a relatively short period of time after the storm passes. Because it occurs over a short time span during a single storm event, it has the capacity to extend beyond seawalls and through roadways as it would not be anticipated that man would have time to react and halt the landward march during the storm. Recession damage was considered for all structures within the study area. For buildings, damage was taken to be zero at the leading edge of the structure and 100 percent once it passed halfway through the building. Linear interpolation was used to evaluate the intermediate values. For utilities, such as gas mains, telephone lines, sewer mains, etc., total damage was taken once the recession distance reached the item. For roadways, damage started at the leading edge and was calculated on a square foot basis reaching total value once recession extended to the far edge.

103. Based on storm recession model studies and as presented in the report titled "Coastal Processes at Sea Bright to Ocean Township, NJ" (CERC, 1987, Reference 6) a variability of 2.0 was included in the analysis of without project conditions. The variability factor adjusted the mean recession rates obtained from the storm recession model to reflect historic data as described in Appendix A. It has been shown that recession rates vary significantly with cusps extending far beyond the average recession provided by modeling studies. Through pre- and post-storm measurements, it has been shown that the variability factor of 2.0 will account for about 75% of the farthest recession points on a natural beach. Therefore in the economic evaluation, the recession rates were doubled, but since there is an equal probability that the maximum point does not occur as there is that it will, only 1/2 the total dollar amount of damage was considered.

104. For the with project conditions, a variability factor of 1.5 was used because it was determined, due to the more homogenous nature of the project beaches, recession more closely reflects the averages produced by modeling studies. Recession frequency relations are shown on Figure 11. Delineations of recession damage limits are provided in Appendix D.

105. Reduced Seawall Maintenance Costs. Included in the project cost estimates are the costs necessary to rehabilitate and maintain the seawall. The expenditures presently being allotted by local governments and the State

to maintain the seawall therefore become a benefit derived by the project. Data provided by the New Jersey Department of Environmental Protection for maintenance costs over the 20-year period from 1963 to 1983 were the foundation for developing an annual maintenance cost. The values were adjusted to September 1987 price levels using the Consumer Price Index and divided by the 20-year period of record to annualize the results. Reduced seawall maintenance benefits were only considered for reaches 1 through 5 (Sea Bright and Monmouth Beach) since no maintenance data was available for the existing seawalls in the southern part of the project and it is presumed no maintenance has taken place.

106. Reduced Public Emergency Costs Public emergency costs are associated with additional municipal, county and state services associated with flooding. These include overtime for police, fire and emergency personnel. To evaluate the public emergency costs, data was obtained for the March 1984 Northeaster and the September 1985 Hurricane (Gloria). This data was then utilized to develop a frequency damage relationship utilizing the general shape of the building, damage-frequency data adjusted to the historical public emergency costs.

107. Critical Damages. In order to avoid double counting of damages between inundation damages, wave attack and storm recession, only the "critical damage" was utilized in selection of the NED plan. The "critical damage" was based on the maximum damage resulting from any one of the three damage mechanisms for a given storm recurrence interval. For each frequency evaluated, the damage attributable to each source was identified and compared with only the maximum value being reported. It should be noted that on a structure by structure basis, the sources of critical damage can switch from one to another as storm frequencies change. That is for more frequent flooding inundation may be the principal cause of damage. At intermediate return periods, storm recession may begin to impact causing higher levels of damage than inundation. Prior to complete failure due to recession, wave attack may occur and destroy the building at a lower frequency event. For each scenario only the maximum value was utilized in the economic analysis. Figure 12 presents a schematic of critical damage.

108. As described in the without project future conditions certain restrictions to the rebuilding of structures have been assumed. In order to account for these changing future conditions, the critical damage at each year and frequency was multiplied by the probability that the structure exists and is subject to damage at that frequency event. The probability of existence for each structure was calculated using the maximum probability of total damage from wave attack or storm recession for each 10-year period analyzed with straight line interpolation for the intervening years.

109. The 1985 condition stage vs damage relationship developed utilizing this methodology is presented in Table 8. In order to provide a comparison to historic storm data all damages related to flooding in the Shrewsbury River have been adjusted to the corresponding still water ocean stage. Comparison of the predicted damages to the historic damage indicates concurrence with the March 1984 storm. Considering the impact of over 20 years of shoreline erosion, intensive development, the regional increase in real estate value, and seawall degradation to the point where a recurrence

of the 1962 storm would result in total failure of major sections, the difference between damages reported in March 1962 and those predicted for 1985 conditions appear reasonable.

REDUCTION IN LOST LAND

110. Benefits associated with a reduction in lost land were directly attributable to the halting of long-term erosion under the with project scenario. In the without project condition there is a continual reduction in real property as the shoreline retreats landward. This loss in property represent a real loss in value to the property owner. Using the long-term erosion rate of three feet per year and the current gross value estimates of property values as described in Sub-Appendix D-1, the annual cost of lost land was determined for the 50-year project life. The analysis involved determining the amount of land lost at 10-year intervals with straight line interpolation for the years between intervals. As described previously, the long-term erosion was assumed to be arrested once seawalls or roadways were encountered. For each of the 50 years, the amount of property lost was multiplied by the value of the land and a present worth analysis performed to bring the values back to the 1990 base year. The results were then summed and amortized over the project life utilizing the Capital Recovery Factor at an interest rate of 8-7/8%.

TABLE 8

SEA BRIGHT TO OCEAN TOWNSHIP
STAGE DAMAGE SUMMARY
1985 CONDITIONS - APRIL 1987 PRICE LEVEL

Ocean Still Water Stage (NGVD)[1]	Approximate Return Period Years	Predicted Damage (Millions)	Reported Damage (Millions)
6 ft	3.5	$ 10.8	-
6.4 ft[2] (March 1984)	5	18.0	16.0[2]
7.6 ft[3] (March 1962)	17	70.0	25.3[3]
8 ft	25	91.4	-
10 ft	100	169.9	-
12 ft	350	240.8	-

NOTES:

1. Ocean Still Water Stage not including wave setup or runup.
2. Data from "Post Storm Evaluation March 29, 1984 Northeaster. Stage is maximum recorded at Long Branch, NJ.
3. Data from "Report on Operation Five High". Stage is maximum recorded at Sandy Hook, NJ.

REDUCED MAINTENANCE AT SANDY HOOK

111. Presently, the National Park Services maintain a major public recreation facility at the Sandy Hook Section of the Gateway National Recreation Area. As a result of a low sediment supply from beaches south of the project, the natural south to north littoral drift is unable to feed the beach at Sandy Hook creating a deficit at what is now known as the "critical zone". In order to protect against the historic losses of parking facilities and access roads, the Park services has initiated a beach restoration program. Based on the sediment budget analysis for existing conditions conducted in connection with this study, the beach restoration will have to make up an annual deficit of approximately 101,000 cubic yards. Utilizing a six-year maintenance cycle the annual maintenance cost was calculated to be $1,701,000. This could be entirely made up by the construction of the project utilizing a pure beach fill approach and thus would be a project benefit. With the incorporation of the authorized groin into the project, the additional sand trapping capacity of the groins reduces the south to north transport of sand by approximately 15% reducing the annual benefit associated with reduced maintenance at Sandy Hook to $1,490,000. When the plans incorporate the updated groins, their capacity to trap sand reduces the transport to no appreciable change from existing conditions and thus no reduced maintenance benefits would be attributable to the updated groin plan. The critical area at Sandy Hook is shown on Figure 13.

INTENSIFICATION BENEFITS

112. The plan of improvement will generate intensification benefits as defined in ER 1105-2-40, Section IV, pages 2.4.2 (b)(2). As detailed in Sub-Appendix D-1 "Land Appraisal Attachment", the implementation of a project will increase land values. To calculate the annual benefits associated with intensification, the increase in land value was amortized at 8-7/8% interest over the life of the project. It is estimated that project implementation will yield $8,157,000 intensification benefits.

113. This increased land value is driven by the storm protection erosion control accomplishments of the project. A local example of this process is the area near 7 President's Park in North Long Branch where a minimal protective beach has been maintained. Development has intensified from primarily older single and multi-family rental housing towards high quality townhouses and condominiums.

RECREATION BENEFITS

114. The Contingent Value Method was used to evaluate the potential recreation benefits that would accrue as a result of project implementation. The basic premise of the analysis is that there will be an enhanced recreational experience associated with the project beaches and that this enhanced experience translates into an increased willingness to pay (WTP), increased visitation or both.

115. The implementation of a beach erosion control project will add new and improved beaches throughout the study area. The construction of new beaches and increasing the width of existing beaches will result in less crowding and may reduce the travel distance to a desirable beach recreation site, all of which may be perceived as a more desirable experience.

116. In addition to benefits associated with enhanced usage of the beach, benefits were also evaluated based on the value associated with beach existence. Existence values being a one-time fee that a person would be willing to pay not to use the beach but to assure its perpetuity for future generations.

117. To quantify the recreational benefits associated with project implementation three determinations were necessary for each project berm size evaluated.

1. Value and use of the existing beaches.
2. Value and use of the new and improved (project) beaches.
3. Beach visitation by users of the project beaches both initially and in the future.

118. The estimates of the above factors allowed calculation of the benefits from the provision of improvements to the existing beaches and the construction of new beaches. These benefits were measured as WTP for the beach with- and without-the project. Therefore, benefits were estimated as the difference between the total value of the new and improved beaches and the value of the existing beaches.

119. The impacts of beach restoration relate to the geographic recreation "market" defined by the location of potential user populations. The recreation market as defined for this analysis extended from Sandy Hook in the North, to Belmar in the South and included Sea Bright, 7 Presidents Park, Monmouth Beach and Long Branch within the project area and Sandy Hook, Asbury Park and Belmar outside the project area.

120. General Plan of the Analysis. The approach to estimating NED benefits was to use data generated from a contingent valuation survey of current beach users. To this end 2917 contingent value surveys were collected during the period from July to September 1985. The data from the survey was integrated with beach visitation data to estimate simulated demand curves and forecasts of beach usage. The major tasks were:

1. Design the contingent valuation survey and sampling procedure.
2. Collect and document the data.
3. Analyze the beach attendance data.
4. Estimate WTP and existence value bid functions.
5. Generate simulated demand curves.
6. Estimate use models.
7. Forecast beach usage.
8. Calculate NED benefits.

121. Analysis of Data. Data was collected for proposed 30, 50 and 100-foot berm widths. Subsequently, the 30-foot berm was dropped from the analysis because it was determined that respondents could not effectively differentiate between it and the existing and/or the 50-foot berm. Data obtained from the contingent value survey was analyzed in conjunction with demographic data to define explanatory equations to more accurately describe the bid function (WTP) and visitation functions. The exploratory data was then integrated with total visitation data obtained from the beach attendants to estimate the incremental use value for the proposed beaches under present conditions. State and county population forecasts were then used to forecast increases in the visitation over the 50-year project life based on a proportioning of visitation to population growth. Existence value was evaluated based on present population of beach users within the market area based on the bid function and number of people visiting the beach.

122. 150-Foot Berm Width. Subsequent to the Contingent Value Survey, it was determined for the purpose of optimization that a 150-foot berm had to be analyzed. Utilizing the theory that within limits the value of the recreational experience is proportional to the increase in beach area, recreational use values were estimated by extrapolating data obtained for the 50 and 100 foot berm widths. Since the berm area increased 100% going from the 50 to 100-foot berm and resulted in a 29.3% increase in use value, a 50% increase in area, going from the 100-foot to the 150-foot berm would be anticipated to increase the use value of the 100-foot berm by 14.6%. Data obtained for the existence value showed no statistically reliable difference between berm widths and so no adjustment was made.

123. Summary of Recreation Benefits. Annual benefits were forecasted for the year 1990-2040 using the with- and without-project visitation forecasts. The procedure for forecasting benefits is to multiply baseline benefits by the increase in visitation. Forecasts for years in-between decades were estimated using straight-line interpolation. The forecast of net benefits are multiplied by the 8.875 percent discount factor to yield the present value amounts. The sum of the present value benefits has been converted to an annuity or equivalent annual cash flow.

124. A summary of the equivalent annual benefits at July 1985 Price levels and at an interest rate of 8.875 percent, are presented in Table 9. These benefits are presented for the 50, 100 and 150-foot berm widths as well as by the annualized use and existence value components. Table 10 reflects the same data adjusted, using the Consumer Price Index to April 1987 price levels.

125. Annual Recreation Benefits are approximately 6.1 million dollars for the 50-foot berm, 7.6 million dollars for the 100-foot berm and 8.6 million dollars for the 150-foot berm in 1987 dollars.

TABLE 9

EQUIVALENT ANNUAL RECREATION BENEFITS
1990 - 2040
DISCOUNTED AT 8.875%
(July 1985 Price Levels)

	50 FOOT BERM	100 FOOT BERM	150 FOOT BERM
Annualized Use Value	$4,866,000	$6,292,000	$7,214,000
Annualized Existence Value	997,412	997,412	997,412
TOTAL	$5,863,412	$7,289,412	$8,211,412

TABLE 10

EQUIVALENT ANNUAL RECREATION BENEFITS
1990 - 2040
DISCOUNTED AT 8.875%
(April 1987 Price Levels)

	50 FOOT BERM	100 FOOT BERM	150 FOOT BERM
Annualized Use Value	$5,090,000	$6,581,000	$7,546,000
Annualized Existence Value	1,043,293	1,043,293	1,043,293
TOTAL	$6,133,293	$7,624,293	$8,589,293

SUMMARY OF BENEFITS

126. Authorized Berm Height. Utilizing the procedures described in the previous paragraphs the benefits associated with berm widths of 50 feet, 100 feet and 150 feet at 10 feet MLW were evaluated for three plans; fill only, beach fill with authorized groins and beach fill with updated groins. The NED benefits associated with each plan at the April 1987 price level are presented in Tables 11 through 13.

SEABRIGHT TO OCEAN TOWNSHIP
TOTAL BENEFITS IN THOUSANDS
SUMMARY TABLE 11
(APRIL 1987 PRICE LEVEL)

BENEFIT CATAGORY	BERM WIDTH BERM HEIGHT	FILL ONLY 50 FT 10 FT MLW	100FT 10 FT MLW	150 FT 10 FT MLW
BENEFITS TO BUILDINGS				
PHYSICAL		$7,003.7	$8,292.5	$8,806.0
EMERGENCY		$273.7	$348.8	$369.3
LOST INCOME		$71.0	$83.2	$85.7
BUILDING TOTAL (NO AFFLUENCE)		$7,348.4	$8,724.5	$9,261.0
ADJUSTMENT FOR AFFLUENCE		$382.4	$418.5	$457.1
BUILDING TOTAL (W/ AFFLUENCE)		$7,730.8	$9,143.0	$9,718.1
REDUCED DAMAGE TO SEAWALLS		$4,078.1	$5,337.1	$5,665.9
REDUCED DAMAGE TO ROADS AND INFRASTRUCTURE		$663.1	$765.9	$772.5
PUBLIC EMERGENCY COSTS		$6.5	$8.5	$9.1
REDUCED MAINTENANCE COSTS FOR SEAWALL		$389.0	$389.0	$389.0
TOTAL STORM REDUCTION BENEFITS (NO AFFLUENCE)		$12,485.1	$15,225.0	$16,097.4
TOTAL STORM REDUCTION BENEFITS (W/ AFFLUENCE)		$12,867.5	$15,643.5	$16,554.5
INTENSIFICATION BENEFIT		$8,157.0	$8,157.0	$8,157.0
VALUE OF LAND ERODED		$2,078.1	$2,078.1	$2,078.1
REDUCED MAINTENANCE AT SANDY HOOK		$1,701.3	$1,701.3	$1,701.3
RECREATION BENEFITS				
EXISTENCE		$1,043.3	$1,043.3	$1,043.3
USE		$5,090.0	$6,581.0	$7,546.0
TOTAL RECREATION BENEFITS		$6,133.3	$7,624.3	$8,589.3
TOTAL BENEFITS (NO AFFLUENCE)		$30,554.9	$34,785.7	$36,623.1
TOTAL BENEFITS (W/ AFFLUENCE)		$30,937.3	$35,204.2	$37,080.3

SEABRIGHT TO OCEAN TOWNSHIP
TOTAL BENEFITS IN THOUSANDS
SUMMARY TABLE 12
(APRIL 1987 PRICE LEVEL)

ECONOMIC REACH	BERM WIDTH BERM HEIGHT	BEACH FILL WITH AUTHORIZED GROINS 50 FT 10 FT MLW	100FT 10 FT MLW	150 FT 10 FT MLW
BENEFITS TO BUILDINGS				
PHYSICAL		$7,003.7	$8,292.5	$8,806.0
EMERGENCY		$273.7	$348.8	$369.3
LOST INCOME		$71.0	$83.2	$85.7
BUILDING TOTAL (NO AFFLUENCE)		$7,348.4	$8,724.5	$9,261.0
ADJUSTMENT FOR AFFLUENCE		$382.4	$418.5	$457.1
BUILDING TOTAL (W/ AFFLUENCE)		$7,730.8	$9,143.0	$9,718.1
REDUCED DAMAGE TO SEAWALLS		$4,078.1	$5,337.1	$5,665.9
REDUCED DAMAGE TO ROADS AND INFRASTRUCTURE		$663.1	$765.9	$772.5
PUBLIC EMERGENCY COSTS		$6.5	$8.5	$9.1
REDUCED MAINTENANCE COSTS FOR SEAWALL		$389.0	$389.0	$389.0
TOTAL STORM REDUCTION BENEFITS (NO AFFLUENCE)		$12,485.1	$15,225.0	$16,097.4
TOTAL STORM REDUCTION BENEFITS (W/ AFFLUENCE)		$12,867.5	$15,643.5	$16,554.5
INTENSIFICATION BENEFIT		$8,157.0	$8,157.0	$8,157.0
VALUE OF LAND ERODED		$2,078.1	$2,078.1	$2,078.1
REDUCED MAINTENANCE AT SANDY HOOK		$1,489.9	$1,489.9	$1,489.9
RECREATION BENEFITS				
EXISTENCE		$1,043.3	$1,043.3	$1,043.3
USE		$5,090.0	$6,581.0	$7,546.0
TOTAL RECREATION BENEFITS		$6,133.3	$7,624.3	$8,589.3
TOTAL BENEFITS (NO AFFLUENCE)		$30,343.5	$34,574.3	$36,411.7
TOTAL BENEFITS (W/ AFFLUENCE)		$30,725.9	$34,992.8	$36,868.9

SEABRIGHT TO OCEAN TOWNSHIP
TOTAL BENEFITS IN THOUSANDS
SUMMARY TABLE 13
(APRIL 1987 PRICE LEVEL)

BEACH FILL WITH UPDATED GROINS

BENEFIT CATAGORY	BERM WIDTH BERM HEIGHT	50 FT 10 FT MLW	100FT 10 FT MLW	150 FT 10 FT MLW
BENEFITS TO BUILDINGS				
PHYSICAL		$7,003.7	$8,292.5	$8,806.0
EMERGENCY		$273.7	$348.8	$369.3
LOST INCOME		$71.0	$83.2	$85.7
BUILDING TOTAL (NO AFFLUENCE)		$7,348.4	$8,724.5	$9,261.0
ADJUSTMENT FOR AFFLUENCE		$382.4	$418.5	$457.1
BUILDING TOTAL (W/ AFFLUENCE)		$7,730.8	$9,143.0	$9,718.1
REDUCED DAMAGE TO SEAWALLS		$4,078.1	$5,337.1	$5,665.9
REDUCED DAMAGE TO ROADS AND INFRASTRUCTURE		$663.1	$765.9	$772.5
PUBLIC EMERGENCY COSTS		$6.5	$8.5	$9.1
REDUCED MAINTENANCE COSTS FOR SEAWALL		$389.0	$389.0	$389.0
TOTAL STORM REDUCTION BENEFITS (NO AFFLUENCE)		$12,485.1	$15,225.0	$16,097.4
TOTAL STORM REDUCTION BENEFITS (W/ AFFLUENCE)		$12,867.5	$15,643.5	$16,554.5
INTENSIFICATION BENEFIT		$8,157.0	$8,157.0	$8,157.0
VALUE OF LAND ERODED		$2,078.1	$2,078.1	$2,078.1
REDUCED MAINTENANCE AT SANDY HOOK		$0.0	$0.0	$0.0
RECREATION BENEFITS				
EXISTENCE		$1,043.3	$1,043.3	$1,043.3
USE		$5,090.0	$6,581.0	$7,546.0
TOTAL RECREATION BENEFITS		$6,133.3	$7,624.3	$8,589.3
TOTAL BENEFITS (NO AFFLUENCE)		$28,853.6	$33,084.4	$34,921.8
TOTAL BENEFITS (W/ AFFLUENCE)		$29,236.0	$33,502.9	$35,379.0

BERM CAP BENEFITS

127. Analysis of Berm Cap Benefits. In order to further maximize storm protection at the least cost the benefits associated with increasing the level of protection above the authorized berm height were evaluated. This additional protection may be provided by constructing a cap on the 100-foot wide fill only plan which was identified as the alternative providing the maximum net benefits at the authorized berm height. Berm caps of 0 foot, 2 feet and 4 feet above the authorized height of 10 feet MLW were evaluated. The calculation of berm cap benefits was based on the reduced probability of damage occurring.

128. Of the total pool of residual damages, 73.6% are due to flooding in the Shrewsbury and Navesink Rivers and will not be mitigated by any shore protection project. Towns south of Monmouth Beach incur only $248,000 in annual residual damages.

129. The impacts of a 2-foot berm cap on the various damage parameters are as follows:

- Storm recession is reduced by a distance of three feet with an approximate reduction of 25% in damage probability.

- Wave attack from runup of the 100-foot berm is reduced by a distance of 3 feet with varying impacts on damage probability.

130. A summary of benefits for the evaluated berm caps is presented in Table 14. Table 15 lists the net benefits for each berm cap. The greatest incremental net benefit occurs for the 2 foot berm cap.

PLAN SELECTION

COMPARISON OF SELECTED ALTERNATIVES

131. Table 16 presents annual costs and benefits for the fill only, the authorized groin plan and the updated groin plans with 50, 100 and 150 ft. berm widths. To determine the optimum berm width, a plot of annual cost vs. berm width and annual benefits vs. berm width was constructed (Figures 14, 15 and 16). The optimum berm width was the point where the tangency of the benefits curve is equal to the slope of the cost plot. This method yields the largest difference between annual benefits and annual costs. Based on the optimization curves, the 100 foot berm width with the fill only plan provides the maximum net benefits.

132. A berm having an elevation of +10 foot MLW would be subject to frequent overtopping. Accordingly, storm berm caps of various heights were analyzed. Berm caps of 0, 2 and 4 feet were added to the 100 ft. wide beach in order to yield a berm cap that optimizes net economic benefits. The berm caps provided additional storm protection at a relatively low incremental cost. Table 17 provides total project first costs for the 0, 2 and 4 foot berm caps while Table 6 presents total annual costs and benefits. The alternative providing a protective beach with a 100 foot wide berm at an elevation of 10 feet and a 2 foot high berm cap yields the maximum net benefits (Figure 17).

Table 14

SEA BRIGHT TO OCEAN TOWNSHIP
TOTAL BENEFITS SUMMARY TABLE

April 1987 Price Level
(In Thousands of Dollars)

Fill Only Plan

Benefit Category	Berm Width Max Berm Height	100 ft. 10 ft. MLW	100 ft. 12 ft. MLW	100 ft. 14 ft. MLW
Storm Damage Reduction		$15,643.5	$16,391.5	$16,543.5
Intensification		8,157.0	8,157.0	8,157.0
Prevention of Land Erosion		2,078.1	2,078.1	2,078.1
Reduced Maintenance @ Sandy hook		1,701.3	1,701.3	1,701.3
Recreation		7,624.3	7,624.3	7,624.3
TOTAL ANNUAL BENEFITS		$35,204.2	$35,952.2	$36,104.2

Table 15

BERM CAP ANALYSIS
NET BENEFIT SUMMARY

April 1987 Price Level
(In Millions of Dollars)

Fill Only Plan

	Berm Width Max Berm Height	100 ft. 10 ft. MLW	100 ft. 12 ft. MLW	100 ft. 14 ft. MLW
Annual Benefits		$35.9	$36.7	$36.8
Annual Costs		$21.1	$21.5	$21.7
Net Benefits		$14.8	$15.2	$15.1
Benefit Cost Ratio		1.70	1.71	1.70

Table 16

BENEFIT AND COST COMPARISON
ALTERNATIVE PLANS WITH 10-FT MLW BERM HEIGHT
September 1987 Price Level

EROSION CONTROL PLAN	BERM WIDTH (FT.)	ANNUAL BENEFITS (x $000,000)	ANNUAL COSTS (x $000,000)	NET BENEFITS (x $000,000)	INCREMENTAL NET BENEFIT (x $000,000)	BCR
Fill Only Plan	50	31.6	17.1	13.9	0.0	1.79
	100	35.9	21.1	14.8	.9	1.70
	150	37.8	24.8	13.0	-1.8	1.52
Fill With Authorized Groins	50	31.3	18.7	12.6	0.0	1.67
	100	35.7	21.7	14.0	1.4	1.65
	150	37.6	25.2	12.4	-1.6	1.49
Fill With Updated Groins	50	29.8	17.4	12.4	0.0	1.71
	100	34.2	21.1	13.1	0.7	1.62
	150	36.1	25.3	10.8	-2.3	1.43

Table 17

BENEFIT AND COST COMPARISON
FILL ONLY PLAN WITH BERM CAPS
September 1987 Price Level

EROSION CONTROL PLAN	CAP ELEV. (FT.)	ANNUAL BENEFITS (x $000,000)	ANNUAL COSTS (x $000,000)	NET BENEFITS (x $000,000)	INCREMENTAL NET BENEFIT (x $000,000)	BCR
Fill Only Plan	0	35.9	21.1	14.8	0.0	1.70
100 Ft. Berm Width	2	36.7	21.5	15.2	0.4	1.71
	4	36.8	21.7	15.1	0.1	1.70

NED PLAN

133. The alternative providing a protective beach with a 100 foot wide berm at an elevation of +10 feet, and a 2-foot high berm cap yields the maximum net benefits. Accordingly, this alternative is designated as the NED plan.

134. Selection of Environmentally Preferred Plan. The Environmental Quality (EQ) Plan is the plan which has the highest EQ value while meeting the planning objectives. Of the structural plans considered, the beach restoration plan is environmentally preferred because it has the least irreversible and irretrievable commitment of resources in the sense that there will be no additional permanent hard structures placed on the project shore. The plan with the smallest feasible berm (50 feet) is preferred to the other berm widths as a result of its reduced impact relative to offshore dredging and disposal activity. The no action alternative would not entail the adverse environmental impacts of structural plans, but it would not meet the project planning objectives. Under no action, the erosion problem at Sandy Hook would likely continue to intensify, necessitating continued stopgap measures with their own attendant environmental impacts. In addition, no action would mean continued deterioration of project area beaches and no prospect for environmental improvement within the 50-year design life of the project. In view of these considerations, the 50 foot fill only berm design of the beach restoration alternative is designated the EQ Plan.

135. Trade-off Analysis. Since the EQ and NED plans differed, a trade-off was required. Since the EQ plan provided fill 50 feet wide at +10 feet MLW and the NED plan provided fill 100 feet wide at +10 feet MLW with a 2 foot berm cap, the NED plan provided greater storm protection. In addition, the 50 ft. fill only plan did not meet criteria for design survivability as presented in ER 1110-2-1407 "Hydraulic Design for Coastal Shore Protection Projects." The added storm protection of the NED plan was desired even though environmental impacts were slightly greater.

136. Selection of Final NED Plan. The NED plan was selected as the final design plan. This plan provides for a beach fill with a 100 foot wide berm at an elevation of 10 feet, a 2-foot high berm cap and periodic nourishment.

137. Future With Project Conditions. Implementation of the selected plan will provide adequate advanced fill and maintenance quantities to address the existing deficit in littoral transport and to stabilize the established shoreline position. Rehabilitation of the seawalls and the construction of wider beaches will provide increased protection from storm damage by moving damage zones offshore. Since this plan incorporates existing coastal structures and enhances their effectiveness, levels of protection vary throughout the project area.

138. In general terms, the plan will provide storm benefits by reducing the impacts of storm recession, wave attack with associated runup and flooding due to wave runup overtopping the protective seawall. In many areas a significant portion of the reduction in damages is attributable to the enhanced ability of the seawall to prevent waves, storm recession or high ocean stages from impacting the structures behind it. The proposed improvement would not provide complete protection from storm damage since many low-lying areas area subject to inundation from high stages in the

Shrewsbury and Navesink Rivers. This condition will remain unabated and will cause over 3 million dollars in annual damage. In addition, some storms with return periods greater than 35 years will still result in minor seawall overtopping.

139. The proposed improvements will eliminate the historic loss of land due to long term erosion. This will prevent a decrease in usable land area within the project boundaries along with any decline in real property values. The additional storm protection and recreational opportunities provided by this plan will in fact increase the value of existing land within these communities through intensification of usage and is likely to provide a beneficial increase in economic activity.

140. The proposed project will provide significant additional recreational opportunities in close proximity to major population centers. The added beach area will result in an improved recreation experience as expressed by a higher willingness to pay and an increase in visitation. The net increase in beach visitation and value within the entire recreation resource area provides an annual recreation use benefit of over 6.5 million dollars.

141. The proposed project will increase the amount of sediment crossing the northern project limit towards Sandy Hook from 392,000 cubic yards yearly to the full drift rate potential of 493,000 cubic yards. This will significantly reduce the need for beach maintenance at the Sandy Hook critical zone. Since the full drift rate potential is currently reached immediately north of the critical zone, there will be no increase in deposition or maintenance costs at Sandy Hook Channel.

DETAILED DESCRIPTION OF RECOMMENDED PLAN

DESIGN DETAILS

142. Constructable Reaches. Due to its length, the project area was divided into constructable reaches based on engineering and administrative considerations. Reach 1 includes Sea Bright and Monmouth Beach. Due to the length and construction quantities required for Reach 1 it will be sub-divided into two construction contracts; contract A extends from the southern limit of Monmouth Beach to just north of the Rumson Neck Bridge in Sea Bright, contract B covers the remaining length of Reach 1 to the northern limit of Sea Bright. Reach 2 covers the entire length of Long Branch. Reach 3 extends from the north limit of Deal through the south limit of Loch Arbour. Constructable reaches are presented in Figures 18-1 and 18-2.

143. Design Section. The selected plan includes a protective beach along the 12 miles of coast between Sandy Hook and Ocean Township. The cross-section configuration of the beach provides a 100 foot wide berm at an elevation of +10 feet MLW with an onshore slope of 1 to 10H and an offshore slope of 1 to 35H. Placed upon the berm will be a two-foot storm berm cap. Also, a plus one foot of tolerance will be allowed on top of the design profile. In locations where the +10 foot MLW berm station was landward or seaward of the project baseline, the berm width was adjusted accordingly. A plan view of the recommended plan is presented on Figures 19-1 through

19-5. Recommended design cross-sections are presented in Figures 20-1 through 20-14. These design cross-sections do not include advance, feeder or overfill volumes.

144. Fill Quantity. The initial fill quantities consist of design fill volumes, advance fill volumes, feeder beach volumes, taper volumes, tolerance, and overfill volumes. Table 5 presents the fill quantities for the selected plan. Feeder beaches were designed for Reaches 1A and 2 to compensate for the lack of the feeder beach in Reach 3 during the first three years of construction. Advance fill quantities were reduced by 1/6, 2/6 and 3/6 for Reaches 1B, 2 and 3 respectively, due to the length of time for initial construction. Taper volumes were needed since tapers must be built at every exposed end of the constructed reaches. Tolerance volumes equalling 15% of design and taper fill volumes provided for a 1-foot fill tolerance. Overfill volumes compensated for fines that will wash out after construction is completed. Overfill factors are presented in Table 5 and Appendix C.

145. Renourishment Requirement. For the maintenance quantities, the risk analysis that was performed indicated a need of 478,000 cubic yards per year of maintenance fill (Appendix A). Taper volumes must also be included at the north and south project limits every renourishment period. Including tolerances and overfill, the total six-year renourishment quantity is 3,522,200 cubic yards.

146. Feeder Beach. Due to the nature of the coastal process within the project area, the maintenance fill must be separated into two separate types. A feeder beach, which is a large stockpile of sand, must be placed at the southern end of the project area to compensate for the littoral drift deficit. In addition, advance fill, which is a continuous strip of fill, must also be placed along the entire project area to compensate for the increasing littoral drift within the project area limits. The sediment budget identified a littoral drift deficit of 164,000 cubic yards at the south end of the project. For the six-year renourishment cycle, 984,000 cubic yards will be placed along an 8,540 foot long feeder beach located at the southern end of Reach 3 to offset the sediment deficit (Figure 19-4 and 19-5). The remaining 314,000 cubic yards of maintenance fill will be distributed evenly along the entire project length to serve as advance fill to offset the effect of increasing littoral drift deficiencies along the shoreline. This quantity is also necessary to meet the volumetric requirements of the risk analysis performed on the maintenance fill based on ER 1110-2-1407 (par. A75d). The ER requires the 6-year maintenance fill to be able to withstand the storm recession of a 9-year event.

147. Berm Height Survivability. Wave runup and scour calculations were performed to evaluate the survivability of the berm height. Overtopping was acceptable as long as the berm was not frequently overtopped and the berm height was not scoured below +10 feet MLW. For a storm with a return period of 10 years, the berm with the two foot cap experienced slight, if any overtopping. Without the berm cap, the berm would scour to an elevation of +8.6 feet MLW.

148. Sea Level Rise. Based on the average increase of sea level of 0.015 feet/year, the fill quantities must compensate for recession due to sea level rise. This can be accomplished in two methods. First, since the sea level rise will amount to 0.75 feet over the 50-year project life, the berm height could be increased 0.75 feet. Secondly, extra fill can be added every six-year renourishment cycle. The second option is more feasible since it requires less cost and provides the protection as it is needed. The annual shoreline recession for the design profile is 0.869 feet/year. Based on 1 foot of recession = 1.3 cubic yards of fill lost, the maintenance fill requires 414,000 every six years to keep the recession due to sea level rise in check. Since the advance fill volume is 1,884,000 cubic yards every six years, the erosion due to sea level rise is compensated for by the excess advance fill.

149. Construction Template. It is important to recognize that the sediment along the seaward edge of the construction profile will adjust seaward to some limiting depth during the project construction and subsequent to placement of the fill. While the onshore slope is kept the same for the construction template (1:10) the offshore slope can not be graded to the design slope (1:35). For this reason, the offshore construction slope is estimated at (1:20). This construction template will adjust to a more natural equilibrium profile as sediment is redistributed along the profile. To balance the required initial fill quantity, the berm width of the construction template will be greater than the berm width of the design profile. A typical construction template is shown in Figure 21.

150. Sequence of Construction. Due to the vulnerability of the seawall in Reach 1 and Public Law 99-662, the project will be constructed from the north at Sea Bright to the south at Ocean Township. Since the project length requires four and one-half years of construction time, the entire project will be constructed in phases starting with Reach 1A, followed by Reach 1B, then Reach 2 will be constructed followed by Reach 3. The project base is set at 1990. Since Reach 1A will be constructed first, a feeder beach that would last until Reach 2 is constructed must be designed. This results in two years worth of feeder beach fill for initial construction of Reach 1A. Reach 1A would also receive 6 years worth of advance fill. Tapers at both ends of Reach 1A would also be present. Reach 1B would have no feeder beach fill but would have 5 years worth of advance fill and a taper at the north end of Reach 1B. Reach 2 would then be constructed during the third year of construction. It would contain one year's worth of feeder beach to protect the project until Reach 3 was constructed in the following year. Reach 2 would also have three years' worth of advance fill and a taper at the south end. The final reach, Reach 3, would be constructed during the fourth year of construction. The final constructed reach would have 3 years worth of feeder beach along with 3 years of advance fill. A taper would be constructed at the south end of Reach 3. The three years' worth of feeder and advance fill would protect the shore from erosion until 1993, when the first of eight renourishment periods begins. Figure 22 illustrates the sequence of construction along with year of construction. A construction schedule is presented on Figure 26.

151. If any of the three constructable reaches were built independent of the remaining reaches, then a feeder beach would be required to compensate for the sediment deficit. The feeder beach would need to be placed at the south end of the reach. This would increase the cost of an individually constructed reach by about 14% over the cost of the reach constructed as part of a continuous project.

152. Outfall Construction. Outfall extensions, including timber crib supports, would be constructed after the fill is placed under the pipe alignment. Once the outfalls and timber crib are constructed, the fill would then be placed over the pipe allowing placement of final grades over the pipe. This method is consistent with current outfall construction methods along the New Jersey coast.

153. Groin Notching. The fill of the selected plan will bury many of the existing groins. However, 15 existing groins will still extend seaward beyond the design shoreline and affect the movement of littoral drift. To

prevent an impact of these groins on the design fill, notches will be constructed in the structures to allow sediment to pass through the groins and prevent sediment impoundment (Figure 23).

154. Seawall Rehabilitation. Due to the deteriorated conditions of large sections of the seawalls in Sea Bright and Monmouth Beach, the State of New Jersey has initiated a seawall rehabilitation program. The rehabilitation plan will increase the structure's chance of survivability against annual events prior to construction of the beach fill project. The State's plan involves rehabilitation in kind with the original section. The plan includes placement of 5-8 ton rock at the toe of the wall along critical areas of seawall deterioration. The design is described in detail in Appendix F and presented in Figures 24-1 through 24-7.

155. Risk Analysis. Situations of risk are defined as those where the potential outcomes can be described in terms of the probability distributions. An example of risk is a situation where an event occurs on the average once in 50 years. Because it is unknown when the 50 year event will occur there is a risk involved. In this regard, the with-project level of protection from significant overtopping provided by the seawall corresponds to an exceedence frequency of 0.02 percent. There is a 64 percent risk that this event could occur at least once over the 50 year economic life of the project.

156. The risks of exceeding various project design frequencies in any 10 year, 30 year, 50 year or 100 year time period are presented in Table 18. Due to the high probability of residual flooding from the Shrewsbury River the associated risk is greater than 99 percent for any 10 year period.

ECONOMICS

157. Benefits. The recommended plan will provide $36.7 million in annual benefits (September 1987 Price Level) over a project life of 50 years with net benefits of $15.2 million annually and a BCR of 1.71.

158. Of the total benefits, $28.9 million are attributable to the project's damage prevention accomplishments and $7.8 million are attributable to an increase in recreation. The damage prevention benefits include $16.7 million in reduced storm damage and emergency costs for physical structures such as buildings and roads, $2.1 million for the prevention of land erosion, $1.7 million in reduced maintenance at the Sandy Hook critical zone, and $8.3 million in increased land value due to intensified usage.

159. Sensitivity. The analysis of net project benefits is conservative in that the 1987 fiscal year discount rate of 8-7/8% results in higher annual charges than the 1988 discount rate of 8-5/8%. Due to the volume of calculations required for plan formulation and the need to compare all plans on an equal basis, the detailed analysis has been presented with the 1987 discount rate. In order to assess uncertainty in the plan selection process and to ensure the viability of the project the economics of the selected plan and an equivalent plan including construction of the authorized groins are presented at a discount rate of 8-5/8% in Table 19. This evaluation indicates that the selected plan is not impacted by minor variations in interest rates and that the project has greater net benefits when evaluated with the current interest rate.

TABLE 18

RISK ANALYSIS FOR SELECTED PLAN

Time Period	Probability of Event Occurring at Least Once				
	Berm Overtopping		Design Profile Recession	Seawall Overtopping* (Wave Runup)	Seawall Failure
	Wave Runup	Still Water			
Exceedence Frequency (1 Year Risk)	10%	0.9%	0.8%	2.0%	0.2%
10 Year Risk	65%	9%	8%	18%	2%
30 Year Risk	96%	24%	22%	35%	6%
50 Year Risk (Project Life)	99%	37%	34%	48%	10%
100 Year Risk	100%	60%	57%	73%	18%

* Overtopping resulting in force at the landward edge of the seawall, critical damage necessary to destroy a house.

Table 19

INTEREST RATE SENSITIVITY
COSTS VS. BENEFITS
DISCOUNT RATE 8-5/8%

September 1987 Price Level
(In Millions of Dollars)

	Recommended Plan	Authorized Groin Plan With 100-Foot Berm and 2-Foot Cap
Annual Benefits	36.4	36.2
Annual Cost	21.0	21.6
Net Benefits	15.4	14.6
BCR	1.73	1.68

160. Residual Damage. The recommended plan will eliminate damages from wave attack and storm recession for all but the largest storms and will reduce the severity of flood damage. Some portions of the project area, however, will remain vulnerable to flooding and will continue to suffer significant economic losses. The residual flooding condition is most severe in the northern reaches of the project which are impacted by high stages in the Shrewsbury River. Route 36 in Sea Bright and Monmouth Beach will remain subject to closure with low lying section of the roadway beginning to flood at a two-year storm. Since a 100-year storm would still cause flood depths to exceed seven feet in low lying areas it is essential that flood plain management and evacuation procedures be maintained. Residual annual storm damage from all causes is presented in Table 20. Of the total $3,603,000 in damage, flooding in the Shrewsbury River causes $3,214 or 89%. Storm damage limits for 1985 conditions and for the with project conditions are displayed in Appendix D.

PROJECT COSTS

PRICE LEVEL

161. All costs presented in this GDM are based on September 1987 price levels.

INITIAL COSTS

162. The initial cost of the project will be $192,917,300. This includes $157,127,900 for fill placement, mobilization/demobilization costs, 15% contingency, 3% engineering and design, 4.5% for supervision and inspection. The initial cost includes $1,193,900 for the notching of groins, $2,400,100 for the extension of drainage outfalls, $11,644,000 for rehabilitation of the seawall in Sea Bright and Monmouth Beach and $20,551,500 for real estate. Figure 26 presents a schedule of initial costs.

Table 20

RESIDUAL DAMAGE
100 FOOT BERM WITH 2 FOOT CAP
(In Thousands of Dollars)

Economic Reach	Residual Damage April 1987 Price Level	Residual Damage September 1987 Price Level
1	358	365
2	1,805	1,841
3	296	302
4	780	796
5	60	61
6A	43	44
6B	2	2
7	4	4
8A	4	4
8B	0	0
9A	3	3
9B	4	4
10	23	24
11	150	153
Total	3,532	3,603

RENOURISHMENT COSTS

163. The renourishment costs are based on a six year renourishment cycle. The total costs include advance, feeder and taper volumes with a unit cost of $7.40. Also included is $750,000 mobilization/demobilization costs, costs for tolerance and overfill volumes and 10% contingency, 1.5% engineering and design and 1.5% supervision and inspection for each renourishment cycle. The total cost every six years for the renourishment project is $29,240,400.

LOCAL COSTS

164. Real Estate. Real estate requirements included fill easements, temporary and permanent access easements, and borrow area easements., The borrow area easements will be provided at no cost by the State of New Jersey. Fill easement costs are $12,463,000 for the entire project area

(see Appendix G). Temporary and permanent easements for construction access and public storage cost $5,676,200. The total real estate cost was calculated to be $20,551,000.

165. Outfall Extensions. Outfalls that do not extend past the construction template will require extensions so they remain functional. Outfall extension quantities and costs are given in detail in Appendix E. The total cost of all outfall extensions is $2,400,100.

166. Seawall Rehabilitation. This plan involves placement of 5-8 ton rock at the seawall toe to act as toe protection until the erosion control project is constructed. The rehabilitation plan will bring weak points of the seawall up to a structurally sound condition. Total cost of the seawall rehabilitation is $11,644,000 (see Appendix F).

COST APPORTIONMENT

167. As provided by Section 854 of the Water Resources Development Act of 1986, the non-federal share of the cost of construction and maintenance of the Ocean Township to Sandy Hook reach of the project for beach erosion control, Sandy Hook to Barnegat Inlet, New Jersey, shall consist of amounts expended by non-Federal interests for reconstruction of the seawall at Sea Bright and Monmouth Beach. In addition to the seawall construction costs, the costs for all lands, easements and rights-of-way, the cost for extending the necessary outfalls. Other non-federal responsibilities are included in the Local Cooperation Agreement (LCA). Table 21 presents annual and total cost apportionment. Table 21A presents annualized first costs for the recommended plan.

ANNUAL COSTS

168. Annual costs are comprised of the sum of the cost of initial construction, the present worth of the cost of periodic nourishment and all local costs amortized over the 50-year period of analyses at an interest rate of 8 7/8 percent.

TABLE 21
APPORTIONMENT OF COSTS
RECOMMENDED PLAN*
(September 1987 Price Level)

First Cost	
Federal	$158,321,739
Non-Federal	$ 34,595,589
Total	$192,917,328
Annual Cost	
Federal	$ 18,249,251
Non-Federal	$ 3,204,641
Total	$ 21,453,892

*From Appendix B

TABLE 21A

ANNUALIZED FIRST COST OF
RECOMMENDED PLAN @ 8-7/8%

	Initial Fill and Renourishment	Groin Notching	Seawall Rehabilitation	Real Estate	Outfalls	Project Monitoring
Federal	$14,039,008	$107,485	-	-	-	$107,226
Non-Federal	-	-	$1,048,309	$1,850,252	$216,080	-

PLAN IMPLEMENTATION

169. The total time required for design and construction of the project is estimated to be four and one-half years. Included in the complete work effort is pre-construction and post-construction monitoring, contract plans and specifications, bidding and advertising and actual project construction.

170. Pre-construction monitoring would take approximately 14 months and include benthic and surf clam monitoring in the borrow areas. Post-construction monitoring will include the periodic surveying of beach profiles, collection of short cores and sediment samples, biological samples on the beach and in borrow areas, and aerial photographs to illustrate shoreline changes. Post-construction monitoring will occur at 3-month increments during the first 2 years following construction, 6-month increments during the third year and once at the end of the fourth year.

Task 1 of the program will involve monitoring the fill placement. The project will be monitored at selected intervals before and after construction along 25 profile lines. Sediment samples will be collected during each profiling survey at three sample locations per profile line. Volumetric changes and sediment characteristics will be computed after each survey. Task 2 will include monitoring of the borrow areas. Surface sediment samples will be taken before and after dredging. Cores will be taken at each borrow area during the fourth year of monitoring.

Task III of the program will include monitoring of shoreline change. Nine aerial photography overflights of the project area will be performed. A report on post-construction shoreline change rates will be prepared. Task IV will be a biological assessment of the project. Biological surveys of both beach and borrow areas will be conducted at selected intervals before and after construction. A report will describe and quantify the changes to, or the re-establishment of, the biological community in the fill placement area and borrow areas and a comparison to control sites. A detailed description of the monitoring program and a schedule is provided in Appendix A.

171. Contract plans and specifications include pre-construction surveys and complete approval of project plans and specifications. This work would require 9 months and commence after approval of the final GDM. The bidding process would take 2 months. The actual construction would be complete in 52 months. A detailed construction and funding schedule is presented in Appendix B.

DEPARTURES FROM PREVIOUS PLANS

PLAN IN HOUSE DOCUMENT 332/85/2

172. A comparison of the recommended plan and the project prescribed in HD 332/85/2 is summarized on Table 22. The principal deviations of the recommended plan from the plan recommended in HD 332/85/2 is the addition of a berm cap and the provision of 6 years of advanced nourishment in the initial fill. In addition, the prescribed groin construction and modifications were not included in the recommended plan. Also, the offshore and onshore slopes were changed from 1 on 25 to 1 on 10 for the onshore slope and from 1 on 25 to 1 on 35 for the offshore slopes. These slopes represented the average equilibrium slopes. Seawall rehabilitation has also been provided in the selected plan.

NEW JERSEY MASTER PLAN

173. In 1981 the New Jersey Department of Environmental Protection (NJDEP) completed a Shore Protection Master Plan to assist in efficient management of erosion and coastal development. In late 1987, the NJDEP indicated to the Corps that it intends to modify the original 1981 Master Plan by adopting the Federal plan identified in this report as part of its revised Shore Protection Master Plan.

TABLE 22

COMPARISON OF PHYSICAL FEATURES AND COSTS

SEA BRIGHT TO OCEAN TOWNSHIP, NJ

SEA BRIGHT TO OCEAN TOWNSHIP	H.D. 85-332	PL 99-662	DRAFT GDM SELECTED PLAN
		1st. CONSTRUCTION INCREMENT (SEA BRIGHT TO MONMOUTH BEACH ONLY)	
1. BEACH FILL - INITIAL			
BERM WIDTH - FT.	100	Approx. 50	100
BERM HEIGHT - MLW	10	10	10
BERM CAP - FT.	0	0	2
ONSHORE SLOPE	1:25	1:25	1:10
OFFSHORE SLOPE	1:25	1:25	1:35
LENGTH - FT.	62,657	28,023	62,436
QUANTITY - C.Y.	10,114,400	3,413,000	17,705,403
2. COST			
FEDERAL - $	92,980,000	21,200,000	158,321,739
NON-FEDERAL - $	12,300,000	18,800,000	34,595,589
TOTAL - $	105,280,000 (A)	40,000,000 (B)	192,917,328 (C)
3. RENOURISHMENT			
QUANTITY - C.Y.	115,000/YR.	N/A	3,470,172
FREQUENCY - YRS.	N/A	N/A	6
COST - $	10,500,000	N/A	29,240,393
4. STRUCTURAL MEASURES			
a). INIITAL:			
GROINS	23 NEW - 14 EXT.	0	0
LENGTH - FT.	400	0	0
GROIN NOTCHING	0	0	15
SEAWALL,BULKHEADS, etc...	NONE	REPAIRS	REPAIRS
b). MAINTENANCE:			
SEAWALL,BULKHEADS, etc...	NONE	REPAIR AS NEEDED	REPAIR AS NEEDED
GROINS	REPAIR AS NEEDED	NONE	NONE
5. BORROW SOURCES			
LOCATION	SEA BRIGHT/BELMAR	SEA BRIGHT/BELMAR	SEA BRIGHT/BELMAR
QUANTITY AVAILABLE - C.Y.	47,200,000	47,200,000	47,200,000

A - Does not include LERR costs, outfall modification, or groin notching costs.

B - Does not include LERR costs, outfall modification, or groin notching costs.

C - Includes LERR costs, outfall modification, seawall rehabilitation and groin notching costs.

PLAN IN PUBLIC LAW (PL) 99-662

174. A comparison of the recommended plan identified herein and the plan presented in Section 854 of Public Law 99-662 is summarized on Table 22. Due to the vulnerable condition of the seawall at Sea Bright and Monmouth Beach, Public Law 99-662 modified the original authorized project by providing that the first construction increment of the Sea Bright to Ocean Township reach shall consist of a berm approximately 50 feet wide at Sea Bright and Monmouth Beach with a feeder beach in the vicinity of Long Branch.

175. The principal deviations are a result of the 50 foot plan identified in PL 99-662 being unable to meet Corps engineering criteria with regard to design survivability. The plan recommended in this report calls for construction of the first increment identified in PL 99-662 plus an additional increment to meet Corps survivability criteria, resulting in a 100 foot wide berm. An additional 2 foot high berm cap, above the originally authorized height of +10 feet MLW was also incorporated in the recommended design to provide additional protection from frequent overtopping.

LOCAL COOPERATION

COORDINATION

176. As part of the public involvement program for the project a steering committee was organized for the purpose of providing an adequate exchange of information and to insure local concerns were addressed. The steering committee was composed of the Mayors of the affected communities, Borough Engineers, State Legislators, personnel from New Jersey Department of Environmental Protection, Congressional District Representatives and personnel from the New York District Corps of Engineers.

177. Extending from the period beginning 1984 to the present, numerous coordination meetings were held with the non-federal sponsor and other concerned agencies to insure their input was incorporated into both preliminary and final designs and plan selection.

178. On April 6, 1987 a notice of intent to file an EIS by the New York District, U.S. Army Corps of Engineers was published in the Federal Register.

VIEWS OF NON-FEDERAL SPONSOR

179. The State of New Jersey Department of Environmental Protection, by letter dated December 3, 1987 has indicated that after review of the draft Local Cooperation Agreement (LCA) it is prepared to enter into a formal agreement for cooperation with the Corps of Engineers for this project. The The Local Cooperation Agreement reads as follows:

LOCAL COOPERATION AGREEMENT
BETWEEN
THE DEPARTMENT OF THE ARMY
AND
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
FOR CONSTRUCTION OF THE BEACH EROSION CONTROL PROJECT
ATLANTIC COAST OF NEW JERSEY,
SANDY HOOK TO BARNEGAT INLET
SECTION I, SEA BRIGHT TO OCEAN TOWNSHIP

THIS AGREEMENT, entered into this day of , by and between the DEPARTMENT OF THE ARMY (hereinafter referred to as the "Government"), acting by and through the Assistant Secretary of the Army (Civil Works), and the STATE OF NEW JERSEY (hereinafter referred to as "State"), acting by and through the Department of Environmental Protection

WITNESSETH THAT:

WHEREAS, the Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet Section I, Sea Bright to Ocean Township, was authorized by the River and Harbor Act of 1958 in accordance with House Document No. 332, 85th Congress, second session; and,

WHEREAS, the Water Resources Development Act of 1986, Public Law 99-662, specifies the cost-sharing requirements applicable to the Project; and

WHEREAS, the State has the authority and capability to furnish the cooperation hereinafter set forth and is willing to participate in project cost-sharing and financing in accordance with the terms of this Agreement;

NOW THEREFORE, the parties agree as follows:

ARTICLE I - DEFINITIONS

For purposes of this Agreement:

1. The term "project" shall mean the project for Beach Erosion Control Sandy Hook to Barnegat Inlet, New Jersey Section I, Sea Bright to Ocean Township shall consist of construction of a berm 100 ft. wide at an elevation of +10 ft. MLW with an additional 2 ft. high storm berm cap extending from Sea Bright to Ocean Township.

2. The term "total project costs" shall mean all costs incurred by the State for the rehabilitation of the seawall and the Government for the beach directly related to construction of the project. Such costs shall include, but not necessarily be limited to, actual construction costs, costs of applicable engineering costs incurred after October 1, 1985, supervision and administration costs, costs of project construction contract dispute settlements or awards, but shall not include any costs for betterments or operation and maintenance.

3. The term "period of construction" shall mean the time from the advertisement of the first construction contract to the time of acceptance of the project by the Contracting Officer.

4. The term "Contracting Officer" shall mean the Commander of the U.S. Army Engineer District, New York, or his designee.

5. The term "highway" shall mean any highway, thoroughfare, roadway, street, or other public or private road or way.

6. The term "Subsequent Nourishment" shall mean placement of additional quantities of fill material as needed in order to maintain the beach to design specifications subsequent to construction.

ARTICLE II - OBLIGATIONS OF THE PARTIES

a. The Government, subject to the completion and acceptance of rehabilitation measures for the seawall at Sea Bright to Monmouth Beach by the State and acceptance of an approved public access plan that meets all State laws and regulations and using funds appropriated by the Congress, construct the project applying those procedures usually followed or applied in a Federal project, pursuant to Federal laws, regulations, and policies. The State shall be afforded the opportunity to review and comment on all contracts, including relevant plans and specifications, prior to the issuance of invitations for bids. The State shall be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. The Government will consider the views of the State, but award of the contracts and performance of the work thereunder shall be exclusively within the control of the Government.

b. When the Government determines that project, or functional element thereof, is complete, the Government, subject to the availability of funds, shall participate in periodic beach nourishment for a period up to 50 years after which time the Government shall turn the project or element over to the State, which shall accept the project or element and be solely responsible for operating, maintaining, replacing, and rehabilitating the project or element in accordance with Article VIII hereof. In addition the State after completion of the rehabilitation of the Seawall shall be solely responsible for operating, maintaining, replacing, and future rehabilitation of the Seawall.

c. The States's share of the cost of construction and maintenance of the Ocean Township to Sandy Hook reach of the project for beach erosion control, Sandy Hook, to Barnegat Inlet, New Jersey, shall consist of amounts expended by the State for rehabilitation of the seawall presently estimated at $18,800,000 at Sea Bright and Monmouth Beach, New Jersey, in addition to those costs as presented in Article III hereof.

d. Before initiation of construction of any increment of the project for beach erosion control, Sandy Hook to Barnegat Inlet, New Jersey, the State shall provide certification in a form acceptable to the Government by the proper State official that public access to the beach for which such increment of the project is authorized is in accordance with all requirements of State law and regulations.

e. As further specified in Article III hereof, the State shall provide all lands, easements, rights-of-way, and borrow areas and perform all relocations and alterations of buildings, utilities, highways, railroads, bridges (other than railroad bridges), sewers, and related and special facilities determined by the Government to be necessary for construction of the project.

f. No less than once each year the State shall inform affected interests of the limitations of the protection afforded by the project.

g. The State shall publicize floodplain information in the area concerned and shall provide this information to zoning and other regulatory agencies for their guidance and leadership in preventing unwise future development in the floodplain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project.

ARTICLE III - LANDS, FACILITIES, AND RELOCATION ASSISTANCE

a. Prior to the advertisement of any construction or renourishment contract, the State shall furnish at no cost to the Government all lands, easements, and rights-of-way, including suitable borrow areas, as may be determined by the Government to be necessary for construction of the project, and shall furnish to the Government evidence supporting the State's legal authority to grant rights-of-entry to such lands.

b. Upon notification from the Government, the State shall accomplish or arrange for accomplishment at no cost to the Government of all alterations and relocations of buildings, highways, railroads, bridges (other than railroad bridges), storm drains, utilities, cemeteries, and other facilities, structures, and improvements determined by the Government to be necessary for construction of the project.

c. The State shall comply with the applicable provisions of the Uniform Relocations Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved January 2, 1971, in acquiring lands, easements, and rights-of-way for construction and subsequent renourishment of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

ARTICLE IV - CONSTRUCTION PHASING AND MANAGEMENT

a. To provide for consistent and effective communication between the State and the Government during the term of construction shall assign representatives to coordinate on scheduling, plans, specifications, modifications, contract costs, and other matters relating to construction of the project.

b. The representatives appointed above shall meet as necessary during the term of project construction and shall make such recommendations as they deem warranted to the Contracting Officer.

c. The Contracting Officer shall consider the recommendations of the representatives in all matters relating to the project, but the Contracting Officer, having ultimate responsibility for construction of the project, has complete discretion to accept, reject, or modify the recommendations.

ARTICLE V - METHOD OF PAYMENT

a. The State shall provide, prior to construction and subject to the approval and acceptance of the Government, corrective measures for Seawall rehabilitation. Total project costs are presently estimated to be $192,917,000.00. In order to meet its share, the State must perform the Seawall rehabilitation presently estimated to be $11,644,00.00, provide all drainage structure and utility modifications presently estimated at $2,400,000.00 and, in addition, provide all lands, easements, rights-of-way and relocation at no cost to the government, presently estimated at $20,551,500.

b. Upon completion of the project, or an agreed-upon separable element and resolution of all relevant contract claims and appeals, the Government shall compute the total project costs, or the cost of the separable element and tender to the State a final accounting of its share of project costs.

ARTICLE VI - DISPUTES

Before any party to this Agreement may bring suit in any court concerning an issue relating to this Agreement, such party must first seek in good faith to resolve the issue through negotiation or other forms of nonbinding alternative dispute resolution mutually acceptable to the parties.

ARTICLE VII - OPERATION, MAINTENANCE, AND REHABILITATION

a. The Government, agrees subject to the availability of funds to provide periodic beach nourishment for a period of 50 years. The State shall operate, maintain, replace, and rehabilitate the Seawall, or functional element thereof, in accordance with regulations or directions prescribed by the Government.

b. The State hereby gives the Government a right to enter, at reasonable times and in a reasonable manner, upon land which it owns or controls for access to the Project for the purpose of inspection, and, if necessary, for the purpose of completing, operating, repairing, maintaining, replacing, or rehabilitating the project. If an inspection shows that the State for any reason is failing to fulfill its obligations under this Agreement without receiving prior written approval from the Government, the Government will send a written notice to the State. If the State persists in such failure for 30 calendar days after receipt of the notice, then the Government shall have a right to enter, at reasonable times and in a reasonable manner, upon lands the State owns or controls for access to the project for the purpose of completing, operating, repairing, maintaining, replacing, or rehabilitating the project. No completion, operation, repair, maintenance, replacement, or rehabilitation by the Government shall operate to relieve the local sponsor of responsibility to meet its obligations as

set forth in this Agreement, or to preclude the Government from pursuing any other remedy at law or equity to assure faithful performance pursuant to this Agreement.

ARTICLE VIII - RELEASE OF CLAIMS

The State shall hold and save the Government free from all damages arising from the construction, operation, and maintenance of the project, except for damages due to the fault of negligence of the Government or its contractors.

ARTICLE IX - MAINTENANCE OF RECORDS

The Government and the State shall keep books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to this Agreement to the extent and in such detail as will properly reflect total project costs. The Government and the State shall maintain such books, records, documents, and other evidence for minimum of three years after completion of construction of the project and resolution of all claims arising therefrom, and shall make available at their offices at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the parties to this Agreement.

ARTICLE X - FEDERAL AND STATE LAWS

In acting under its rights and obligations hereunder, the State agrees to comply with all applicable Federal and State laws and regulations, including section 601 of Title VI of the Civil Rights Act of 1964 (Public Law 88-352) and Department of Defense Directive 5500 II issued pursuant thereto and published in Part 300 of Title 32, Code of Federal Regulations, as well an Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army."

ARTICLE XI - RELATIONSHIPS OF PARTIES

The parties to this Agreement act in an independent capacity in the performance of their respective functions under this Agreement, and neither party is to be considered the officer, agent, or employee of the other.

ARTICLE XII - COVENANT AGAINST CONTINGENT FEES

The State warrants that no person or selling agency has been employed or retained to solicit or secure this Agreement upon agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide established commercial or selling agencies maintained by the State for the purpose of securing business. For breach or violation of this warranty, the Government shall have the right to annul this Agreement without liability, or, in its discretion, to add to the Agreement or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE XIII - TERMINATION OR SUSPENSION

a. If at any time the State fails to meet any requirements identified herein, the Secretary of the Army shall terminate or suspend work on the project until the State is in compliance, unless the Secretary determined that continuation of work on the project is in the interest of the United States.

b. If the Government fails to receive annual appropriations in amounts sufficient to meet project expenditures for the then-current or upcoming fiscal year, the Government shall so notify the State. After 60 days either party may elect without penalty to terminate this agreement or to suspend activities relating to the project and proceed to a final accounting in accordance with Article V.

ARTICLE XIV - NOTICES

a. All notices, requests, demands, and other communications required or permitted to be given under this Agreement shall be deemed to have been duly given if in writing and delivered personally, given by prepaid telegram, or mailed by first-class (postage-prepaid), registered, or certified mail, as follows:

If to the State:
Commissioner
New Jersey Department of Environmental Protection
CN 400
Trenton, New Jersey 08621
ATTN: Director Division of Coastal Resources

If to the Government:
Commander
NY District Army Corps of Engineers
26 Federal Plaza
New York, New York 10278
ATTN: CENAN - PL

b. A party may change the address to which such communications are to be directed by giving written notice to the other in the manner provided in this section.

c. Any notice, requires, demand, or other communication made pursuant to this Article shall be deemed to have been received by the addressee at such time as it is personally delivered or on the third business day after it is mailed, as the case may be.

ARTICLE XV - CONFIDENTIALITY

To the extent permitted by law governing each party, the parties agree to maintain the confidentiality or exchanges information when required to do so by the proving party.

IN WITNESS WHEREAS, the parties herein have expected this Agreement as of the day and year first above written.

THE DEPARTMENT OF THE ARMY

BY:

ROBERT W. PAGE, SR.
Acting Assistant Secretary
of the Army (Civil Works)

DATE:

THE STATE OF NEW JERSEY

BY:

MR. ROBERT P. DEWLING
Commissioner
New Jersey Department of
Environmental Protection

DATE:

Kathy Cummins

UNITED STATES DEPARTMENT OF COMMERCE
The Chief Scientist
National Oceanic and Atmospheric Administration
Washington, D.C. 20230

Maggie

July 11, 1988

See me

MEMORANDUM FOR: Jim Blizzard, Acting Director
Office of Ocean and Coastal Resource Management

FROM: David Cottingham DC
Ecology and Environmental Conservation Office

SUBJECT: DEIS 8807-01--Atlantic Coast of New Jersey Sandy Hook to Barnegat Inlet, Beach Erosion Control Project Section I - Sea Bright to Ocean Twonship, New Jersey

I am sending Jim Burgess the above Draft Environmental Impact Statement for review and possible comment. Its control number is given above. Please refer to this control number if you comment on the DEIS. If you have comments, I will need them by August 22, 1988.

Enclosure

cc: N/ORM3-J. Burgess (with document)

CERTIFICATE OF AUTHORITY

I, _____, do hereby certify that I am the Attorney General of the State of New Jersey, that the New Jersey public body with full authority and legal capacity to perform terms of the Agreement between the United States of America and the State of New Jersey in connection with the Beach Erosion Control Project Atlantic Coast of New Jersey Section I Sea Bright to Ocean township, and to pay damages, if necessary in the event of failure to perform, in accordance with Section 221 of Public Law 91-611, and that the person who has executed the Agreement on behalf of the State of New Jersey, acting by and through its Department of Environmental Protection has acted within his statutory authority.

IN WITNESS WHEREOF, I have made and executed this Certificate the _____ day of _____ 1988.

_____

STATE OF NEW JERSEY)
) SS:
COUNTY OF)

On this _____ day of _____ in the year 1988, before me, a Notary Public of New Jersey, personally came _____, to me known and know to me to be the ATTORNEY GENERAL OF THE STATE OF NEW JERSEY, and the same person described in and who executed the within certificate of Authority, dated _____, and he acknowledged he executed the same as the ATTORNEY GENERAL OF THE STATE OF NEW JERSEY FOR THE STATE OF NEW JERSEY.

_____
A Notary Public of New Jersey

DRAFT ENVIRONMENTAL IMPACT STATEMENT
ATLANTIC COAST OF NEW JERSEY: SANDY HOOK TO BARNEGAT INLET
BEACH EROSION CONTROL PROJECT
SECTION I - SEA BRIGHT TO OCEAN TOWNSHIP,
MONMOUTH COUNTY, NEW JERSEY

The responsible lead agency is the U.S. Army Engineer District, New York.

Abstract: The project area, Sea Bright to Ocean Township, is an approximately 12-mile segment of ocean shoreline at the northern end of New Jersey's Atlantic Coast. The New York District has investigated public concerns within the project area related to beach erosion control, storm damage protection, and public recreation. The preferred alternative (beach restoration) consists of the construction of a sand berm 10 feet above mean low water (MLW) and a sloping beach along the entire 12-mile project. Other practical alternatives considered include groin construction in combination with beach restoration. The sand, an estimated 18.0 million cubic yards, would be acquired from ocean borrow areas, one off Sandy Hook, New Jersey and two small areas off Belmar, New Jersey. There is no viable alternative sand source that could provide the quantity of material needed for this project.

The recommended plan proposes beach restoration having a berm 100 feet wide with an additional 2-foot storm berm cap above the authorized 10-foot berm height. A beach slope of 1 on 10 will grade from the outer end of the berm to existing mean low water then proceed at a slope of 1 on 35 to depth of closure. The proposed plan is designated the NED plan because it provides the greatest net benefits of all plans considered. A 50-foot berm plan is environmentally preferred, but its selection would give up considerable economic benefits for little environmental gain. Because the environmental impacts of all alternative beach restoration plans are comparable, the NED plan, 100-foot berm plan, is the selected plan.

SEND YOUR COMMENTS
TO THE DISTRICT ENGINEER
BY _____.

If you would like further information concerning this concerning this statement, please contact:

Ms. Karen Sullivan
U.S. Army Engineer District,
New York
Environmental Analysis Branch
26 Federal Plaza
New York, New York 10278-0090
Commercial Telephone (212) 264-4662

SEA BRIGHT TO OCEAN TOWNSHIP, MONMOUTH COUNTY, NEW JERSEY
DRAFT ENVIRONMENTAL IMPACT STATEMENT
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Summary

1.01 Major Conclusions and Findings: The 100-foot berm beach restoration plan is designated the NED Plan because it satisfies the planning objectives and provides the greatest net economic benefits of the plans considered in detail. The least environmentally damaging plan is the 50-foot berm beach restoration plan because it would reduce the sand quantities needed for project construction, minimizing impacts at the offshore borrow sites and the shore deposition sites. This plan, however, would have considerably lower net benefits relative to the NED Plan, would not meet Corps criteria based on risk and uncertainty and would necessitate more frequent beach nourishment. In view of the overall quantities to be dredged and deposited, the fact that benthic populations at the project sites are relatively low, and the expectation that benthic resources will recover within a short time, the environmental effects of implementing any given alternative beach restoration plan would be similar. The least environmentally damaging plan is not considered significantly different from the NED plan in terms of long-term adverse effects. For this reason the NED plan has been chosen as the selected plan.

1.02 Areas of Controversy: There are no known major areas of controversy regarding the subject study among the public interests.

1.03 Unresolved Issues: There are no known unresolved major disagreements among the study area interests. It should be noted that additional baseline biological sampling in the form of pre-construction monitoring has been programed to help quantify the potential for adverse impacts to biological productivity in the borrow areas and disposal sites. This baseline sampling, to be conducted immediately prior to project construction, will establish water chemistry conditions and benthic populations in the areas of impact so that changes wrought by project implementation can be measured by subsequent monitoring studies. The New Jersey Department of Environmental Protection (NJ DEP) recommended sampling of area fisheries as well as benthos and water quality. On the assumption that benthic and water quality sampling will establish project area fishery habitat conditions, it has been determined that sampling specifically for fisheries is not necessary for impact assessment.

1.04 Relationship to Environmental Requirements: The choice of a selected alternative has taken into account legislation relating to the environment and attempts to balance project cost with environmental protection. Table 1 shows the environmental laws applicable to the project area and the status of compliance with these laws. Table 2 summarizes the selected plan's effects on resources of principal national recognition.

Table 1

COMPLIANCE WITH ENVIRONMENTAL QUALITY PROTECTION STATUTES AND OTHER ENVIRONMENTAL REVIEW REQUIREMENTS

ACT	COMPLIANCE
Archaeological and Historic Preservation Act	Full
Archaeological Recovery Act	Full
Clean Air Act	Full
Clean Water Act	Full
Coastal Zone Management Act	Full
Endangered Species Act	Full
Estuary Protection Act	Full
Federal Water Project Recreation Act	Full
Fish and Wildlife Coordination Act	Full
Land and Water Conservation Fund Act	Full
Marine Protection Research and Sanctuaries Act	Full
National Environmental Policy Act	Full
National Historic Preservation Act	Full
River and Harbor Act	Full
Watershed Protection and Flood Prevention Act	Full
Wild and Scenic Rivers Act	Full
Public Law 99-592 (Gateway National Recreation Area Establishment Act)	Full
EO 11988, Floodplain Management	Full
EO 11990, Protection of Wetlands	Full
Executive Memorandum on Prime and Unique Farmlands	Not Applicable

Table 2

Effects of Selected Plan on Resources of Principal National Recognition

Type of Resources	Principal Sources of National Recognition	Measurement of Effects
Air Quality	Clean Air Act, as amended (42 U.S.C. 1857h-7 et seq.)	Minor Construction Effects
Areas of Particular Concern Within the Coastal Zone	Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1451 et seq.)	Significant Effect-Beach berm will be restored along 12-mile project shoreline; Littoral drift to Sandy Hook will be restored
Endangered and Threatened Species	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.	No adverse Effect
Fish and Wildlife Habitat	Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.)	Short-term Effect-Loss of benthos in 2-sq. mi. borrow area and in 2.5-sq. mi. disposal area Long-term Effect - Creation of offshore borrow pits; Restoration of beach berm and slope; Maintenance of Sandy Hook coastal habitats

Table 2
(Continued)

Floodplains	Executive Order 11988, Floodplain	No Effect
Historic and Cultural Properties	National Historic Preservation Act of 1966, as amended (16 U.S.C. Sec. 470 et seq.)	No adverse Effect
Prime and Unique Farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing NEPA.	Not present in project area
Water Quality	Clean Water Act of 1977 (33 U.S.C. 1251 et seq.)	Local short-term Effects No Measurable long-term Effect
Wetlands	Executive Order 11990, Protection of Wetlands Clean Water Act of 1977 (42 Y, S, C, 1857h-7, et seq.)	No Adverse Effect
Wild and Scenic Rivers	Wild and Scenic Rivers Act, as amended (16 U.S.C. 1271 et seq.)	Not present in project area

2. NEED FOR AND OBJECTIVES OF ACTION

2.01 Study Authority: The Atlantic Coast of New Jersey, Sandy Hook to
Barnegat Inlet, Beach Erosion Control Study was first authorized by the River and Harbor Act of July 3, 1930, as amended and supplemented. The report was submitted to Congress by the Secretary of the Army on March 7, 1956 and printed in House Document No. 361, 84th Congress, second session. After a Congressional request to review this report in light of new provisions, the project was included in House Document No. 332, 85th Congress, second session and approved in the River and Harbor Act of July 3, 1958. Subsequently, all shore protection projects were modified for cost-sharing purposes by Public Law 87-874, River and Harbor and Flood Control Act of 23 October, 1962, which increased the percentage of Federal participation and insured full public use. The Water Resources Development Act of November 17, 1986 (Public Law 99-662) further modified the cost-sharing for the project by again increasing Federal participation.

2.02 Public Concerns: Erosion has seriously reduced the width of most beaches in the study area with consequent exposure of the shore to storm damage. Throughout the period of record the 12-mile study area has experienced continuous beach erosion and storm recession, resulting in a majority of the shorefront property in Sea Bright and Monmouth Beach having no dry beach. With the exception of sand fillets south of groins, very little beach width remains in the southern section of the study area. Virtually all of the protective coastal structures, including massive seawalls and 103 groins, have deteriorated since their construction. The structures are becoming increasingly susceptible to storm wave damage as the beach continues to erode. The recreational beach areas continue to shrink as the State recreational need increases. State Route 36 lies immediately behind the seawall through Sea Bright and Monmouth Beach and is the only major roadway linking those communities to other coastal areas. The needs of the study area, then, include shoreline erosion reduction and protection from coastal storms. The need for recreational beaches is also recognized.

2.03 Problems and Opportunities: The problem of beach erosion and storm damage is described in the paragraph above. The proximity of the project area to the New York-New Jersey metropolitan area offers opportunities for enhancing beach recreation. Locating offshore sand borrow areas is subject to the constraints of finding suitable sand material and avoiding potential impacts to cultural and natural resources.

2.04 Planning Objectives: Planning objectives were developed based on the problems and needs identified and on the physical and environmental constraints within the project area. In general, the prime Federal objective is to contribute to the National Economic Development (NED) account consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements. The specific planning objectives are stated as follows:

a. Reduce the threat of potential future damages due to the effects of storms, with an emphasis on wave attack and recession.

b. Mitigate the effect of or prevent the long-term erosion that is now being experienced.

c. The proposed project must be economically justified, that is, the average annual benefits must equal or exceed the annual costs.

d. Preserve and maintain existing environmental resources and habitats suitable to indigenous fish and wildlife, where possible.

e. Preserve historical, archaeological, and cultural resources within the project area, if any.

3. ALTERNATIVES

Introduction

3.01 Pre-construction engineering and design efforts were directed towards addressing the current problems and opportunities in the area from Sea Bright to Ocean Township, and entailed review and evaluation of the authorized plan presented in the 1954 survey report and evaluation of any new alternatives, including those suggested by different interest groups. Possible alternative storm damage protection measures were evaluated through a three-step planning process. These steps were (1) identification of possible solutions (2) development of alternatives (3) assessment of alternatives.

3.02 In order to accomplish the initial alternative evaluation, possible plans of improvement that met some or all of the objectives were classified under one of two categories. The first category consisted of those plans that deviated significantly from the authorized plan. They included the following:

(1) No action
(2) Buy-out Plan
(3) Revetment
(4) Revetments and beach restoration
(5) Breakwaters
(6) Breakwaters with beach restoration
(7) Seawalls
(8) Seawalls with beach restoration
(9) Perched beach with beach restoration

The second category included those plans that fell within the envelope of the authorized plan. They were:

(10) Beach restoration
(11) Groins
(12) Groins with beach restoration

The following paragraph briefly describes the objectives and evaluation of each alternative. A summary is presented in Table 2.

No Action (Maintain Base Condition)

3.03 The no-action alternative means that there would be no coordinated Federal action to provide for storm damage protection and erosion control either in the project area or at Sandy Hook, recreational beach restoration or to protect upland property. The base condition in the project reach entails continuation of the existing serious erosion problem and storm damage threat with reliance on emergency and a temporary evacuation measures, floodplain regulations as required under Federal, State, and local authorities, and flood insurance under Federal programs. Due to limited resources this alternative may be accompanied by limited State or local efforts to contain erosion and storm damage. All the communities within the study area are currently enrolled in the National Flood Insurance Program.

Plans Eliminated From Further Study

3.04 Buy-out: Of the 11 action alternatives considered, one, the buy-out plan, is non-structural. The buy-out plan means permanent evacuation of existing areas subject to erosion or inundation and acquisition of this land and its structures either by purchase or by exercising the powers of eminent domain. Following this action, all development in these areas is either demolished or relocated. For this alternative, one must consider that the stretch including Sea Bright to Ocean Township is one of the most heavily developed seashore areas in New Jersey, and along the East Coast. The investment in land, infrastructure, utilities, and other development in the immediate vicinity of the shoreline (within 500 feet) totals billions of dollars in value. Evacuation of the shoreline would essentially spell the demise of the Borough of Sea Bright as well as significant portions of Monmouth Beach and four other municipalities, directly displacing thousands of permanent residents. Under these conditions the buy-out plan is both prohibitively expensive and socially unacceptable, and it was dropped from consideration. All other plans under consideration are structural, and are meant to protect shoreline from beach erosion and storm damage.

3.05 Revetments: Revetments are a facing of energy dissipating material such as quarry stone built to protect shorelines from erosion and storm damage. They consist of an armor layer of stone placed over a dune or berm in the landward portion of the beach. Revetments are designed to protect only the land immediately behind them. Erosion will continue adjacent to and in front of the revetment. Because of the erosion, the revetment must have a substantial toe foundation to prevent undermining of the structure. This plan fails to check erosion of existing beaches and provides no recreational opportunity, and was not considered for further development. Beach restoration combined with revetments will provide added storm protection and will act to protect the revetment from undermining. The beach restoration will also control erosion and provide recreational beach area; however, this plan was eliminated from further development due to extremely high costs.

3.06 Breakwaters: Breakwaters are structures which protect beaches from wave action by dissipating wave energy before it reaches the beach by forcing waves to break offshore. A decrease in wave energy will reduce sediment transport and thus reduce the erosion rate. The breakwater does not, however, provide protection from tidal surges and provides only minimal recreational beach; therefore, this plan was eliminated from further development. To minimize the effect of breakwaters on downdrift beaches the breakwaters should be constructed in conjunction with beach restoration. This plan would effectively check erosion, create a wider recreational beach and provide storm protection. This plan was eliminated due to constructability constraints and associated high costs.

3.07 Seawalls: Seawalls provide upland erosion protection and are usually employed to protect upland structures from erosion damage. Since seawalls are massive structures, they provide storm protection for the backshore area. The seawall plan fails to check erosion of

existing beaches or to provide recreational beach area; therefore, it was eliminated from further consideration. Combined with beach restoration, seawalls would provide upland storm protecting while checking erosion along the shoreline. Beach restoration would also provide upland storm protection and provide an extra buffer for storm protection. While this plan meets all project needs and objectives, it was not considered for further development due to its initial high costs.

3.08 Perched Beach: A perched beach provides a wider dry beach area for a given fill volume due to an artificial toe support. This toe support helps reduce offshore losses of sediment. Along with the beach restoration, storm protection, recreational beach and erosion reduction are provided. While this plan meets all needs and objectives of the project, it was eliminated from further development due to technical feasibility considerations, including the inability to regain sand transported seaward of the perched toe support.

3.09 Beach Restoration: Beach restoration alone would introduce no new hard structures to the project shoreline. This alternative would provide upland storm protection, check erosion along the shoreline, and provide recreational beach area. This plan meets all project needs and objectives at reasonable cost and is one of the plans considered in detail. Further discussion of this alternative is found below.

3.10 Groins: Groins, also referred to locally as jetties, are linear structures which are constructed perpendicular to the shoreline. They extend from the back beach area into the water and are designed to trap sand on the updrift side. This trapped sand, called a "fillet", acts to some degree to protect back beach areas. Properly placed groins will reduce or eliminate erosion in the target area, but increase erosion in adjacent downdrift areas. Construction of a groin system without the use of the beach fill would not result in any significant restoration of the shoreline within the project area, since erosion of beaches and upland property could be expected to continue. Groins combined with beach restoration would provide a wider usable beach area, reduce erosion along project beaches, and mitigate the potential for increased erosion in downdrift beaches. The groins-with-beach-restoration alternative was considered in detail as discussed below:

Updated Groins	- 35 new groins
	- 28 extensions
Authorized	- 18 new groins
	- 13 extensions

<u>Development of Intermediate Plans</u>

3.11 Based on the comparison of preliminary alternatives, only those erosion control plans that met the objectives of the authorized plan, namely, beach restoration and beach restoration with groins, were carried further into the intermediate-stage evaluation process.

During this stage, the two alternatives outlined above were further evaluated using different berm widths of 30, 50, 100, and 150 feet,

all at an elevation of 10 feet above mlw. Two alternative groin plans were considered, the authorized groin plan and an updated groin plan. Information developed during this intermediate stage of plan selection showed that the 30-foot berm plan did not meet the survivability criteria for coastal shore protection projects set by the Corps policy; accordingly, the 30-foot berm plan was dropped from further consideration. Analysis also showed that a berm having an elevation of 10 feet above mlw would be subject to frequent overtopping. For this reason storm berm caps of various heights were analyzed as part of the detailed planning process. Thus, the final evaluation of plans was limited to those plans providing beach restoration or beach restoration with groins. Beach widths of 50, 100, and 150 feet at an elevation of 10 feet above mlw in addition to various berm cap elevations were evaluated and are discussed in the following sections.

Plans Considered in Detail

3.12 Beach Restoration: The beach restoration plan (without groins) considered here is basically the authorized plan updated to 1985 conditions. The design berm elevation is 10 feet above mlw. The onshore slope is 1 to 10 to the 0 foot mlw contour and the offshore slope is 1 on 35 to the natural bottom. The design beach slope will extend approximately 1,000 feet beyond the outer edge of the berm, to a depth of about 25 feet below mlw. Three options to this alternative were considered, varying in berm width: 50, 100, and 150 feet. In places where erosion has caused the shoreline to recede behind the project baseline, berm widths would be greater in order to insure a more uniform shorefront. In addition, storm bermcaps of varying height over the basic 10-foot design berm were considered for an extra measure of protection against wave overtopping for the selected plan. Notching of the existing groins was also considered in order to eliminate interruptions in the littoral process. Sand volumes required for initial construction of this alternative vary from 13.1 million cubic yards for the 50-foot berm to 22.6 million cubic yards for the 150-foot berm. Based on risk criteria, nourishment volumes to be added on a 6-year maintenance schedule amount to 3.7 million cubic yards for each of the options considered.

3.13 Beach Restoration with Authorized Groins: The first of the two groin plans in combination with beach restoration is the authorized plan updated to 1985 conditions. A typical authorized plan groin profile is shown in Figure 7 in the Main Report. The inshore section, 200 feet in length, has a top elevation of +10 feet MLW. Beyond this, the top slopes at a grade of 1 on 12 to a minimum top elevation of +2 feet MLW, extending to an offshore depth of -2 feet MLW after placement of beach fill, for a total additional length of about 200 feet. It was proposed that the groins have a crest width of 8 feet and side slopes of 1 on 1.5. The groins would be constructed on a bedding layer of stone overlaid on filter cloth. An armor layer of 8 to 10 ton capstone would cover a core of smaller rock.

3.14 The original authorized project included 14 new groins in Sea Bright, but since two of these groins have been constructed since project authorization, the updated authorized project allows for extensions of those groins to achieve the authorized length of 400 feet. One groin, to be constructed in the south end of Sea Bright,

has an authorized length of 450 feet to be consistent with existing structures in the area. Four new groins were authorized in Monmouth Beach, two 400 feet long and two 210 feet long. The updated authorized project makes the length of all of these groins 400 feet. Long Branch has an authorized 13 groin extensions and two new groins. Since two groins were constructed in 1959 to within 300 feet of the authorized length, the two new groins were eliminated in the authorized dated project. It is proposed to extend one of these groins at Long Branch to the authorized length of 400 feet in addition to the remaining 13. Two new groins and one extension are authorized for Deal and one new groin is authorized for Ocean Township, but since the combined groin and beach fill alternative includes a feeder beach at the south end of the project, these groins were eliminated in the updated authorized proposal.

3.15 The authorized berm width for this alternative is 100 feet, but widths of 50 and 150 feet were also considered. Sand volumes required for initial construction of this alternative are comparable to those for the beach restoration alternative. Periodic nourishment volumes, however, will be less, about 3.5 million cubic yards every 6 years. This is due to the sand trapping effect provided by the groins. The quantity of rock needed for groin construction and extension totals more than 157,000 tons.

3.16 Beach Restoration with Updated Groin Plan: A second groin plan was considered because studies showed that the authorized groin configuration would not afford optimal erosion reduction to the project shoreline. Low profile groins also will be used for this plan, but with a somewhat different design. The inshore section would have a top elevation of +10 feet MLW but will vary in length according to the berm width selected. Berm widths of 50, 100, and 150 feet were considered. From the inshore section, the groin would slope at a grade of 1 on 10 to a height of +5 feet MLW, and continue at that height to a depth of approximately -4 feet MLW after placement of the design beach fill. The 5-foot elevation was chosen to provide public safety to bathers and boaters by being exposed at all normal tide stages. The groins have crest width of 10 feet and side slopes of 1 on 1.5. The seaward end of the groins would have a 1 on 3 slope. Total groin lengths would vary from 290 feet for a 50-foot wide berm to 390 feet for a 150-foot wide berm.

3.17 Groins would be spaced at 450-foot intervals along the project shoreline from just south of the Long Branch Pier northward to the northern project limit, a distance of nearly 7 miles. Thirty-five new groins would be constructed along with 28 groins extensions for a total complement of 63 groins. A feeder beach placed at the southern project limit would nourish the beaches south of the groin field as well as the groin field itself. The initial fill volumes for this plan will be comparable to those of the other two plans, but periodic nourishment requirements will be significantly less. The 6-year nourishment requirement will be 2.4 million cubic yards. Rock quantities needed for groin construction vary from 177,600 tons for the 50-foot berm to 381,800 tons for the 100-foot berm.

3.18 Constructable Reaches Evaluation: Due to the large scale of this project, construction of any of the final plans will proceed over

a number of years. Although the proposed project estimates assume a continuous construction schedule over 4 1/2 years, an alternative project schedule was developed for costing purposes that breaks the project down into discrete components, or separate constructable reaches. This alternative was developed in order to take account of possible delays in construction sequencing or project budgeting. The main constraint in the construction schedule is the capacity to dredge and distribute sand along the project reaches. Constructable reaches can function on their own but remain compatible with the overall construction plan of the entire Sea Bright to Ocean Township project. Three reaches have been designated for the 12-mile project area. Reach 1 covers Sea Bright and Monmouth Beach; Reach 2 includes Long Beach south to Lake Takanassee; and Reach 3 covers the area from Lake Takanassee to the Deal Lake outlet. Reach 1 is additionally subdivided: Reach 1A contains Monmouth Beach and the part of Sea Bright south of the Sea Bright-Rumson Bridge; and Reach 1B covers the northern part of Sea Bright.

3.19 The preferred project schedule is construction generally from north to south with Reach 1 being the first increment, since this is the most eroded and vulnerable shoreline of the project. Reach 1A would be constructed first, followed by Reach 1B in northern Sea Bright. Reach 1A would require a temporary feeder beach until the final phase, Reach 3, constructed at the south end of the project area. The preferred plan calls for a single feeder beach at the south end of the project, from the Deal Lake outlet northward to Deal, to nourish project beaches between periodic maintenance operations.

3.20 The separate constructable reaches plan differs from the proposed plan primarily in having feeder beaches for each of the constructable reaches rather than only one at the southern project limit. Thus, for each of the final plans considered, feeder beaches would be placed at Monmouth Beach to nourish Reach 1, at Long Branch north of Lake Takanassee to nourish Reach 2, and at the southern project limit to nourish Reach 3. This allows each constructable reach to perform independently of any other. Under the groin plans, any groins scheduled in the overall plan for these feeder beach stretches would be deleted in the separate constructable reaches plan. It is assumed that groins will be built in feeder beach areas when and if construction of updrift reaches are completed.

3.21 Project Details: The following items have all been incorporated into the design of each of the final project plans: feeder beaches; advance fill; and storm berm caps. Feeder beaches are needed to compensate for littoral drift deficit at the south (updrift) end of the project area. The calculations used in estimating the littoral drift potential in the project area led to the design of feeder beaches that will increase the project berm width by approximately 90 feet in the immediate area where they will be placed.

3.22 Advance fill is needed in addition to feeder beaches to compensate for the increasing rate of littoral drift within the project area. Advance fill is a sacrificial quantity of sand placed on the beach in addition to the design fill quantity. The advance fill will be placed along the entire project length and add another 23 feet of width to the design project berm. Due to the increased

efficiency of the reduced maintenance groin plan, the beaches in the groin fields will not require advance fill; however, the areas not protected by the groins will require advance fill.

3.23 Because of the risk of wave overtopping with the authorized 10-foot (MLW) berm height, the addition of a storm cap was investigated. By increasing the design berm height to 12 feet, frequent scour damage by overtopping waves would be reduced. This 2-foot storm cap over the 10-foot authorized berm height was found to help preserve the integrity of the project features at relatively little additional cost, and was included in the final selected plan.

3.24 In addition to feeder beaches, advance fill, groin notching and a 2-foot berm cap, a 15% tolerance was added to the design fill volumes to give a one-foot construction tolerance. An overfill volume was also added, based on the suitability of the borrow material, to arrive at the total initial fill volume for all of the final plans. Scheduled maintenance sand volumes were also increased as a result of a maintenance fill risk analysis. Based on the projection of the historic sea level rise, the additional risk analysis fill is sufficient to compensate for sea level rise for all berm heights considered. A final consideration for project construction concerns existing drainage outfalls along the 12-mile project shoreline. Forty-four outfalls must be extended to accommodate the proposed berm and feeder beaches: 7 in Reach 1; 9 in Reach 2; and 28 in Reach 3. The 50-foot berm width would require outfall extensions in Reach 3 only.

3.25 Project Costs and Benefits: The cross comparison of annual benefits and costs for the entire project is presented in Table 6 of the Main Report. The 100-foot berm fill-only plan has a B/C (benefit-to-cost) ratio of 1.71. The B/C ratio of the 150-foot berm fill-only plan is 1.52. Project implementation by constructable reaches significantly increases project construction cost.

3.26 Comparative Impacts of Alternatives: The fill-only alternative will introduce no new hard structures to the project shoreline, and therefore is most compatible with changing coastal conditions. It will have the effect of restoring historical rates of littoral drift reaching Sandy Hook, without the potential of interrupting that flow. The two groin alternatives, on the other hand, will mean a substantial irreversible and irretrievable commitment of resources to establish extended groin fields within the project area. While the groins will be constructed in conjunction with fill placement, they have the potential to disturb sediment transport in the project area with possible adverse consequences for Sandy Hook.

3.27 Plans with the 50-foot berm will have fewer adverse impacts relative to the other berm widths. Engineering considerations of project survivability rate the 50-foot berm unsatisfactory. However, its environmental impact is less than the larger-scale projects. The 50-foot berm plan will reduce the need for offshore borrow material, reducing the size and depth of offshore borrow areas. Other environmental considerations are equivalent for the three berm widths. The environmentally preferred plan is the fill-only alternative with a 50-foot wide berm.

3.28 Selected Plan: Engineering considerations of project survivability led to the rejection of the 50-foot berm plans. The two groin alternatives, authorized groins and optimal groins, were found to provide no benefits to Sandy Hook, and were less economical; therefore they were rejected. Groins are considered less acceptable environmentally because they are hard structures that may disrupt natural shore processes. The 100-foot berm fill-only plan optimizes benefits among the plans considered most acceptable from engineering and environmental stand-points. This plan offers the greatest net economic benefit consistent with protecting the Nation's environment and is therefore designated the National Economic Development Plan. It will help restore historical littoral drift rates reaching Sandy Hook, thus alleviating chronic erosion on Sandy Hook beaches and helping to maintain their environmental quality. It is also the selected plan, with an annual cost of $21.4 million and annual benefit of $36.7 million.

3.29. Borrow Area Alternatives: Sediment suitability surveys of the offshore region showed concentrations of good quality beach-grade sand in the area off Sandy Hook and in discrete patches off the coast from Belmar to Sea Girt. The proposed borrow areas are those sites most suitable that are closest to the project area. To limit potential impacts on coastal processes, the 30-foot MLW line is the inshore boundary; engineering constraints place the offshore limit at 60-feet MLW. Any potential cultural resource sites have been avoided, as have topographic features that may attract marine biota. The scarcity of suitable offshore sand deposits limits the options for selecting borrow areas. The quantity of sand needed for project construction precludes the consideration of upland borrow sources.

3.30 Dredge Alternatives: Alternatives for dredging and deposition of project sand will be determined by the distance of the borrow areas to the proposed project sites. To minimize costs, the borrow area closest to each project reach will be used. The Sandy Hook borrow area will be used for Reaches 1 and 2, and the Belmar borrow areas will be used for Reach 3. Reach 1B, nearest to the Sandy Hook borrow area, is close enough to make a 27-inch hydraulic pipeline dredge economically feasible. For Reach 1A and the other project reaches, a hopper dredge with pump-out capacity must be used. Use of either dredging method is expected to have acceptable environmental impacts. The large quantity of sand needed for the selected plan, nearly 18 million cubic yards, requires 4-1/2 full dredging seasons for completion of project construction.

3.31 Mitigation Measures: Good engineering practices will, in most instances minimize adverse environmental impacts from the proposed project. Use of large-grain-size sand will minimize short-term water quality and sedimentation impacts. While adverse impacts to marine biota are not expected to be significant, pre- and post-construction monitoring programs have been scheduled to confirm these expectations and to aid in the designation and use of borrow areas for periodic beach nourishment. In areas where the reconstructed beach berm is much wider than the authorized 100 feet, additional treatment of the excess width may provide habitat to regionally sensitive nesting colonial shorebirds. Recommendations made by concerned

agencies are discussed in Section 6 of the EIS.

4. AFFECTED ENVIRONMENT

Environmental Conditions

4.01 The project area, Sea Bright to Ocean Township, is a 12-mile length of ocean frontage in Monmouth County, in east-central New Jersey. It is part of a larger authorized beach erosion control project, covering the Atlantic Coast of New Jersey from Sandy Hook to Barnegat Inlet, which stretches a total of 51 miles along the northern half of New Jersey's Atlantic Coast. The immediate project area, identified as Section I, encompasses all shore areas from the southern boundary of Sandy Hook south to the Deal Lake outlet at the northern border of Asbury Park. This section includes the following six municipalities, north to south: Sea Bright; Monmouth Beach; Long Branch; Deal; Allenhurst; and Loch Arbor, in Ocean Township.

4.02 The Borough of Sea Bright and the northern portion of the Borough of Monmouth Beach occupy a barrier peninsula, the northern terminus of which is Sandy Hook, a unit of the Gateway National Recreation Area. The barrier peninsula, including the ocean beach, separates Shrewsbury River, which has a Federal navigation project, from the Atlantic Ocean. The barrier peninsula is relatively narrow, generally less than 1,000 feet wide, and has an elevation of about 5 to 10 feet above mean sea level (msl). South of the peninsula, the rest of the project area lies within the headland portion of the mainland coastal plain. This area of low bluffs has been eroded by wind and waves during the recent geologic past, and the erosion continues to the present. The bluffs immediately adjoining the ocean range in elevation from 10 to 25 feet above msl. Two coastal ponds, Lake Takanassee and Deal Lake, and the Poplar Brook drainage have controlled outlets directly entering the Atlantic Ocean in the southern portion of the project area.

4.03 The project shoreline, while naturally a sandy berm and beach, has been highly modified as a result of intensive human development and concomitant measures to control erosion forces. Erosion has nevertheless narrowed most of the project beaches, exposing shoreline development to storm damage. In the barrier portion of the project the beach, if present, is backed by a seawall. Further south variations of riprap construction and bulkheads protect the bluffs and adjacent shoreline development. In addition, a wide variety of stone and timber groins have been constructed all along the project shore. Upland areas have been almost totally committed to residential and commercial development. Only a single length of little more than 2,000 feet retains some semblance of a natural shoreline, with dunes backing the ocean, berm and beach. This is the area of Seven Presidents County Park and North End Beach Club in North Long Beach.

4.04 Geologically, the project area lies in the Atlantic coastal plain province. In Monmouth County, this consists of layers of sands, gravels, marls, and clays deposited during the Cretaceous and Tertiary Periods (roughly 1 to 135 million years ago). These sediments are frequently overlain by Quarternary deposits and are exposed directly to ocean wave attack south of Monmouth Beach. From that point north, they are protected by the barrier beach. The submerged coastal plain

or continental shelf is a flat sandy plain sloping moderately southeastward for almost 100 miles to the steeply declining continental slope. The surface of the shelf has an undulating topography of broad swells and shallow depressions approximately parallel to the present shoreline. Over the past geologic ages the shoreline has migrated many times across the 150 miles of coastal plain province. Successive sedimentary formations were deposited, exposed to erosion, submerged again, and buried by younger sediments. Pleistocene formations were deposited in valleys cut into older formations as the sea rose and fell between points many miles seaward and landward of the present shoreline. The existing beach line was formed as sea the level experienced its most recent rise.

4.05 The geologic formations of the coastal plain dip toward the south east with successively younger formations aligned to the south. At the northerly portion of the study area near the Navesink Highlands, Tilton loam and Red Bank sand appear at the surface. Cemented ironstone, resulting from the infiltration of iron oxide, has resisted erosion and resulted in hills standing as landmarks almost 300 feet above the ocean. From Monmouth Beach to North Long Branch lies a bed of glauconite mixed with sand and clay termed Hornerstown marl. A conspicuous feature of this formation is the shell topping which has been observed at numerous localities. Through the city of Long Branch as far south as Lake Takanassee the Vincentown sand outcrops. This formation has two facies, a calacareous or lime-sand phase and a glauconite quartz-sand phase. The two may occur in alternate layers; however, the latter is more common in the study area. From Lake Takanassee to Deal Lake, the Manasquan and Shark River marls appear. These formations are similar in content, consisting generally of a mixture of glauconite with greenish-white clay or light-colored earth. The barrier peninsula in the northern portion of the project area is an elongate sandy spit of recent age that extends northward from the coastal headlands and separates the Navesink highlands from the Atlantic Ocean.

4.06 Waves approach the project area from a southward orientation relative to the shoreline, generating a prevailing northward longshore current that carries with it littoral drift that has resulted in the formation of the barrier peninsula in the north. Longshore sand quantities passing the northern project limit at Sea Bright average about 350,000 cubic yards per year, while quantities leaving the northern tip of Sandy Hook are almost 500,000 cubic yards per year. The deficit of 150,000 cubic yards of littoral drift is made up by erosion of the Sandy Hook beaches in an area that has come to be known as the critical zone. The average wave height in the project area is approximately 1.5 feet while storm waves may reach heights of 6 feet or more. Tides on the New Jersey Coast are semi-diurnal. The mean tide level for the Sea Bright area is 2.2 feet above mean low water (mlw). The mean tidal range is 4.8 feet and the spring tidal range reaches 5.3 feet.

4.07 Prevailing winds on a seasonal basis are from the south from April through September and from the west from October through March. Most winds are of moderate velocity (14 to 28 miles per hour) and winds of greater velocities (29 miles per hour and over) are usually from the northeast. Hurricanes, formed in tropical latitudes, are

the most destructive storms affecting the Atlantic Coast, but extratropical storms, which blow from the east or northeast and are known locally as "northeasters," can be nearly as destructive, and are particularly effective in eroding beaches. From 1938 to the present 5 hurricanes and 4 extratropical storms have had an impact on the project shoreline.

4.08 The climate of the project area is dominated by continental air masses directed by the westerly winds of the mid-latitudes, but the Atlantic coastal waters superimpose a moderating influence. The average annual temperature, as measured at John F. Kennedy International Airport, New York is 52 degrees F, with extremes of -14 degrees F and 104 degrees F. Relative humidity is high, averaging about 70%. The average annual precipitation at Sandy Hook is approximately 45 inches. The distribution of precipitation throughout the year is rather uniform, with a slightly higher amount during the summer months. Most of the rainfall from June through September comes from showers, and therefore is brief but relatively intense. From October to April precipitation is generally associated with widespread storm areas, so day-long rain or snow is common.

4.09 The affected environment of the project area includes the shoreline and immediate upland areas, as well as three offshore bottom areas proposed for sand borrow: one large area off Sandy Hook; and two smaller areas off Belmar and Sea Girt, about 6 miles south of the project's landward limits. The project shore has an average berm height of 10.2 feet above mlw and an average berm width of approximately 23 feet. The onshore slope averages 1 vertical to 10 horizontal, while the offshore slope averages 1 to 38. The proposed borrow areas have thick sand layers on the ocean bottom and range from 0.5 to 3.0 nautical miles offshore in water depths of from 30 to 60 feet below mlw.

4.10 Water quality conditions in the project area are affected by effluents leaving New York Harbor as well as by local drainage and sewer outfalls emptying into the ocean. With occasional exceptions, project beaches meet all standards for primary contact recreation. The waters of the Sandy Hook borrow area are condemned for shellfish harvesting but are otherwise adequate for all marine water uses. The two southern borrow areas, which are more distant form New York Harbor influences, are located in waters that meet shellfish harvesting standards, the highest classifi-cation for marine waters.

4.11 Upland habitats in the project area are restricted to the vicinity of Seven Presidents County Park in North Long Branch. Sandy Hook, which harbors a variety of upland and coastal habitats, lies to the north (down-drift) of the project area. The eroded project area beaches are a highly disturbed environment that offer little in terms of natural habitat. Offshore, the borrow areas provide habitat for organisms characteristic of sandy ocean bottoms. Low populations of surf clams have been found in the Sandy Hook borrow area and relatively higher concentrations have been found in the southern borrow areas. Areas of high-use recreational fisheries, including portions of the three proposed borrow areas, have been noted in the near-offshore region between Sandy Hook and Manasquan Inlet.

4.12 There are no known prehistoric sites within the limits of either the onshore or offshore portions of the project area. Sites dating from the Late Archaic, approximately 6,000 to 3,000 years Before Present (B.P.), through the Middle Woodland (2,500 to 1000 B.P.) periods have been identified to the west of the project area. Isolated prehistoric artifacts have been recovered from the continental shelf to the south of the proposed sand borrow area. A number of historic sites are located in the general project area.
4.13 Except for Seven Presidents County Park, the project area is completely developed with residential and commercial land uses and private beach clubs. Of the 12 miles of beaches in the project area, about 3 miles are currently in public ownership, most of them in the city of Long Branch. Long Branch also has the most concentrated development in the project area, with a highly developed commercial/recreational beachfront and multi-story residential buildings nearby. The other municipalities are lower-density seaside communities with a mixture of seasonal and year-round traditional beach houses and modern condominiums. The Borough of Deal is an exception in that it contains large homes of high value on sizable properties atop the coastal bluffs. The total year-round population of the six municipalities in the project area is about 40,000, with Long Branch alone accounting for more than 30,000. Seasonal populations are considerably greater.

Significant Resources

4.14 Water Quality: Water quality concerns are applicable to three geographical regions within the project area: coastal beaches; the Sandy Hook borrow area; and the Belmar borrow area, northeast and southwest. The coastal beaches all meet water quality standards for primary contact recreation, but as a result of heavy coastal development, nearshore waters are closed to shellfish harvesting. In Sea Bright the shellfish closure zone extends to three nautical miles from the shoreline; in the rest of the project area, and continuing south to Spring Lake, the shellfish closure zone extends 1.5 nautical miles from the shoreline.

4.15 Coastal waters in the northern part of the project area are affected by effluents leaving New York Harbor, but elsewhere local drainage and sewage outfalls have an impact on coastal water quality. Five local and regional sewage outfalls are distributed along the project shoreline with a combined design flow of about 31 million gallons per day (mgd). In addition, two outfalls along Sandy Hook have a combined output of about 7 mgd and the Asbury Park outfall, just south of the project shoreline, has a design flow of 5.5 mgd. Regional water quality monitoring by the New Jersey Department of Environmental Protection (NJDEP) and the U.S. Environmental Protection Agency (EPA) confirm the overall adequacy of the project coastal waters in meeting ocean bathing standards. Occasional incidences of lowered water quality are usually related to high levels of pollutants leaving New York Harbor or overloading of sewage treatment plants, but only rarely are water quality conditions degraded to the point of necessitating beach closure, and then usually only for a short-term period. In 1986, all project beaches were open for swimming all summer with the exception of the area around Chelsea Avenue in Long Branch, which seemed to have an ongoing discharge of storm water

contaminated by fecal coliform bacteria from an unknown source.

4.16 The Sandy Hook borrow area lies on the north side of the immediate project shoreline, and is geographically associated with several known sources of possible contamination, 1) the background outflow of waters from the New York City Harbor, (4 miles to the north), 2) the dump sites directly offshore of the Sandy Hook Highlands area, namely, the Dredge Material Dumping Site, the Cellar Dirt Dump Site and the Sewage Sludge Dump Site (4-10 miles to the east) 3) the Bayshore Regional Outfall System of Monmouth County (on the southwest corner). Studies indicate that despite the proximity of these pollution sources, the waters at the Sandy Hook borrow area retain relatively good quality. The site is located in the closure zone for shellfish harvesting that surrounds the mouth of New York Harbor, but regular monitoring shows that water quality conditions at the borrow area typically meet shellfishing standards. There is no record of contamination in any of the borrow area sediments, and there are no long-term water quality concerns that would restrict use of those sediments for beach nourishment. Periods of degraded water quality, such as low dissolved oxygen or high coliform bacteria, have been recorded on occasion, but these are typically regional phenomena, not limited to the Sandy Hook borrow area, and are short-term in nature. Studies by the New York City Department of Environmental Protection have indicated a 15-year trend of improvement in the quality of the waters of New York Harbor, and the recent completion of two new sewage treatment plants in Manhattan and Brooklyn promise additional improvement in this major regional pollution source. As a result, water quality conditions in the Sandy Hook borrow area are expected to remain the same or improve somewhat within the foreseeable future.

4.17 The two southern borrow areas, Belmar northeast and Belmar southwest, are located approximately 2 miles offshore of the South Monmouth Regional Sewage Outfall, and are otherwise well removed from any known pollution source. These borrow areas are located in waters that are approved for and meet, shellfish harvesting standards, the most stringent marine water quality classification. Rare events, such as the low dissolved oxygen episode in 1976 that covered more than 3,000 square miles of the New York Bight, temporarily degrade the waters of the Belmar borrow areas, but water quality conditions are otherwise excellent. Borrow area sediments have been found to be clean sand suitable for beach nourishment, and there are no serious water quality concerns regarding these sites.

4.18 Coastal Biological Resources: The major resources of the project shoreline are the beaches and coastal ponds stretching from Sea Bright to the Deal Lake outlet at Ocean Township. Although coastal areas are among the most productive and critical areas for fish and wildlife resources, beaches are often biologically impoverished and support only those only those species able to cope with constantly changing ocean conditions. Beaches can generally be divided into upper, middle and lower zones. The upper zone, extending from dune areas to just above the high water line is dry except during storm events or extra high tides. Ghost crabs and sand fleas make up a major portion of the fauna. Where human disturbance is not significant, this zone (along with the middle zone) provides nesting

and feeding areas for shore birds. Due to extensive development in the project area, natural dunes have been greatly diminished. A few remaining dunes occur near Long Branch. Influenced by tidal fluctuations, the middle beach zone is often submerged and animals are more susceptible to desiccation. Few species occur here. However, there may be large numbers of adapted species. These include various copepods, ciliates, tardigrades, gastrotrichs and turbellarians. In addition, amphipods, annelid worms, small clams and mole crabs, as well as other molluscs and crustaceans, can be expected to inhabit this zone.

4.19 Naturally occurring rocky intertidal zones are absent from the project area. However, man-made structures such as seawalls, jetties, groins and bulkheads occur and provide a substitute habitat. Barnacles, small crustaceans, polychaetes and molluscs occur on and around these structures. The mussel, *Mytilus* is a dominant member of this community. Fish such as flounder, common sea bass and striped bass may use the areas with structures for feeding and shelter. Thus, the relatively low productivity of sandy beach is supplemented by the jetty-groin system.

4.20 The affected shoreline environment includes subtidal areas down to 25 feet below mlw, taking the shallowest portion of the nearshore zone, which extends approximately to the 90-foot depth contour. This permanently inundated marine habitat hosts a large variety of bottom-dwelling organisms, including those not able to withstand the periodic desiccation of the beach zones. Phytoplankton in this zone are an important food source for filter-feeding bivalves, and the faunal list includes commercially important shellfish species. The inshore portion of the nearshore zone is periodically affected by the scour of high-energy storm waves, interrupting the generally stable conditions of this ocean habitat as well as the successional stages of benthic fauna development associated with it.

4.21 In addition to the ocean shoreline, habitats are found in two coastal ponds within the project area, Lake Takanassee in southern Long Branch, and Deal Lake at the southern limit of the project. These linear ponds have controlled outlets, but Deal Lake experiences some tidal fluctuation. These outlets have been recently renovated and the NJDEP has installed an anadramous fish ladder in the Lake Takanassee outlet. The fish ladder is intended to permit access to the pond by anadramous fishes, such as blueback herring (*Alosa aestivalis*). Presumably, Deal Lake has always remained somewhat accessible to anadramous fishes. Lake Takanassee is a freshwater body while Deal Lake is brackish near the outlet but mostly freshwater in its inland extensions, up to 2 miles from the outlet. Freshwater fish species that may be found in these ponds would be typical of urban and suburban coastal environments, for example: American eel (*Anguilla rostrata*); goldfish (*Carassius auratus*); carp (*Cyprinus carpio*); shiners (*Notropis* spp.); bullhead (*Ictalurus* sp.); bluegill sunfish (*Lepomis macrochirus*); and largemouth bass (*Micropterus salmoides*).

4.22 Borrow Area Biological Resources: The significant resources of the proposed borrow areas are the benthos (bottom fauna) and fin-fisheries. The borrow areas lie in the nearshore zone which extends from a depth of about 2 meters to the 30-meter contour. Phytoplankton

in this zone are an important food source for filter-feeding bivalves. A sand fauna community is found in the proposed borrow area sediments. Polychaete worms (mostly Spiophanes bombyx and Prionospio malmgreni) are the most numerous macrobenthic organisms, but bivalves often dominate in terms of biomass. The most important bivalve species are the surf clam (Spisula solidissima), the tellin (Tellina agilis), and the razor clam (Enis directus). In addition there are gastropods, amphipods, isopods, sand dollars, starfish, and decapod crustaceans. Common decapod species include blue claw crab, (Callinectes sapidus), American lobster (Humarus americanus), rock crab (Cancer irroratus), hermit crab (Pagurus longicarpus), and lady or calico crab (Ovalipes ocellatus). Several benthic species in the near-shore zone are commercially exploited, including the surf clam, rock clam and the American lobster. The offshore surf clam fishery is the single most valuable fishery in the region covering New York, New Jersey, Delaware, Maryland and Viriginia (U.S. Department of Commerce, 1986). The diverse benthic fauna provides food for demersal fish species. The nearshore area provides a migratory pathway and a spawning mackerel, feeding and nursery area for many species common to the mid-Atlantic region. Important recreational species include black sea bass, summer and winter flounder, weakfish, bluefish, red and silver hake and Atlantic mackerel. Commonly occurring commercial species include bluefish, weakfish, Atlantic mackerek, American shad, Atlantic menhaden and the American lobster.

4.23 Shipwrecks and artificial reefs in the nearshore zone provide habitat for attaching organisms not found on sandy bottoms. Within the project area 14 shipwrecks exist within one mile of the shore. Shipwrecks and aritficial reefs provide shelter for fish and invertebrates. Hydroids, sponges, barnacles, mussels, polychaetes, crabs and lobsters are some of the organisms expected to use shipwrecks, artificial reef structures and irregular bottoms. Atlantic cod, pollock, hake and black sea bass are among the common species associated with this high profiles and thus, these areas are important to both recreational and commercial fisheries.

4.24 Shellfish resources within the three proposed borrow areas were surveyed in 1985. As noted in Sections 4.13-4.16 above, shellfish resources in the Sandy Hook borrow area are closed to commerical harvest whereas those in the two Belmar borrow areas are in waters approved for commercial shellfishing. In none of the three borrow areas were high densities of surf clams found. The Sandy Hook borrow area had minimal surf clam concentrations. The two Belmar sites had relatively greater surf clam numbers, but these were at best only marginal from the stand-point of commercial harvest. In addition, juvenile surf clams and 17 other taxa, including bottom fishes, were recovered in grab samples within the borrow areas. These specimens were of commonly occurring species in New Jersey coastal waters, and did not distinguish the proposed borrow areas in diversity or abundance from other neighboring sandy bottom habitats. This is a community that if disturbed is usually readily re-established through in-migration and/or setting of larval stages during the reproductive periods.

4.25 A number of important recreational and commerical fisheries are found along the Atlantic Coast of New Jersey. The Bureau of Marine Fisheries of NJDEP conducted a fishing use survey of the project area in the summer of 1987 to ascertain the extent of commercial and recreational fishing within the proposed borrow sites. Their survey, which covered an area stretching from Sandy Hook to Manasquan Inlet, consisted of a questionnaire circulated to 111 charter and party boat captains and 138 commercial fisherman/shellfishermen. Survey results based on data from 91 respondents, show the several areas within the proposed borrow sites support high-use recreational fisheries. Specifically, the inshore portion of the Sandy Hook borrow area and, secondarily, the two Belmar borrow areas were indicated as having high recreational fishing use for such species as fluke, striped bass, weakfish, and bluefish. While its nearness to the New York/New Jersey metropolitan area raises the importance of the northeast New Jersey recreational marine fishery, the survey did not identify the proposed borrow areas as uniquely important habitats. Only one site in the survey area stood out, that being the Shrewsbury Rocks, a natural rock reef offshore of Monmouth Beach. To a lesser extent, heavy fisherman use was made of areas in the north closest to the mouth of New York Harbor, in inshore waters the length of the survey area, and in a patchily distributed area offshore between Shark River Inlet on the north and Manasquan Inlet on the south. Collectively, the proposed borrow areas occupy a negligible fraction of the high-use recreational fishing area along the northeast New Jersey coast.

4.26 Gateway National Recreation Area - Sandy Hook Unit: Sandy Hook is the terminal 6 miles of barrier spit that stretches northward from recreational coastal headland portion of Monmouth Beach. As a unit of Gateway National Recreation Area, it is managed by the National Park Service for natural resource management and recreational purposes. Although Sandy Hook, itself, is not within the project limits, it will be affected by any action along the beach to the south, since the project beaches are the source of sand that maintains Sandy Hook and its beaches. Based on wave refraction studies of the proposed Sandy Hook borrow area; no change to the wave climate acting on the beaches at Sandy Hook is expected.

4.27 Because of its position on a coastal peninsula and because it remains largely undeveloped, Sandy Hook contains a variety of biota that is unique to the northern New Jersey coast. Its ocean beaches, unlike those of the project area, are backed by vegetated dunes, providing habitat for nesting shorebirds and other terrestrial wildlife. Back dune thickets and forests create a diveristy of habitats not known anywhere else along the New Jersey coast. On the bayside of Sandy Hook are salt marshes and other estuarine habitats that provide calmer and more stable conditions than the oceanside. Sandy Hook's water quality, as that of northern project area in general, is heavily influenced by the outflow from New York Harbor; nevertheless, the ocean waters remain suitable for recreational bathing, and the beaches, which are the largest and most accessible in northern New Jersey, also host the greatest number of visitors in the region.

4.28 Although Sandy Hook has high natural resource and recreational values, like the project area it suffers from a chronic erosion problem. The southern bathing beaches in particular are undergoing severe erosion. Many dune areas have been washed away and one area, termed the "critical zone", may be subject to breaching and inlet formation. Causes of this erosion are both natural (shortage of sand in the transport system) and man-made (the system of coastal protection structures to the south). Periodic deposits of sand from various sources, such as harbor channel dredging, have forestalled the threat of a breach in the critical zone, but there has been no long-term solution to the problem.

4.29 Threatened and Endangered Species: There are no threatened or endangered species within the 12-mile long project shoreline or within the sandy bottom of the proposed borrow areas (U.S. Fish and Wildlife Service, letter dated September 23, 1987). Sandy Hook, however, hosts a number of designated nesting shorebird species. The Federally threatened piping plover (*Charadrius melodus*) and State endangered least tern (*Sterna albifrons*) annually nest along the ocean beach and dunes. The State endangered black skimmer (*Rynchops nigra* also nest at Sandy Hook, but less regularly. Historical records show that the Federally endangered roseated tern (*Sterna dougalli*) nested in small numbers along the New Jersey coast, but the last record for Sandy Hook was of a possible nesting in 1976. A State endangered plant species, caudate wormwood (*Artemisia candata*) grows abundantly in Sandy Hook in interdune swales. Two Federally designated sea turtles, the endangered leatherback and the threatened loggerhead, are known to occur in the nearshore waters of the New York Bight on a seasonal basis, and may be found within the proposed borrow areas during the summer months. The Federally endangered Kemp's ridley sea turtle may also occur within the project area. They are known to occur in shallow bays where benthic organisms provide a major food source, however, their movements through nearshore waters are poorly understood and information about their disribution is known almost exclusively through standings (National Marine Fisheries Service, letter dated December 30, 1987). Referenced letters are included in the Pertinent Correspondence Appendix following the Main Report.

4.30 Recreation: Located within reach of the New York/New Jersey metropolitan area, the northern New Jersey coast receives heavy seasonal recreational use. Sandy Hook, with the largest public beach in the area, accommodates over 2 million visits a year, the vast majority of them beach visits. Belmar, a community south of the project area with a relatively large public beach, receives nearly 1 million beach visits each year. By contrast, the 12-mile long project area, Sea Bright to Ocean Township, handles fewer than 500,000 beach visits per year. The relatively low beach use in the project area is due to the more restricted access and fewer amenities in addition to the generally poorer condition of the beaches when compared to nearby areas.

4.31 Cultural Resources: In 1985, a Cultural Resource Reconnaissance was conducted for the Corps in order to locate and assess the significance of historic and archaeological properties in the onshore portion of the project area (U.S. Army Corps of Engineers 1985). The Reconnaissance also evaluated the potential for submerged cultural resources, such as shipwrecks ans archaeological sites, in the offshore borrow area. Predictive models for archaeological sites, were developed for the onshore project area and focused on the relationship between sea level rise, shoreline transgression, and reconstructed land use patterns. The Reconnaissance Report concluded that the active barrier island complex in the northern portion of the project area, where sedimentation could have protected sites prior to shoreline transgression, however, field reconnaissance of the onshore project area and examination of exposed stratigraphy documented extensive disturbance of the present shoreline due to erosion, deep ocean scour, and residential and commerical development.
The reconnaissance did not locate intact archaeological properties and no areas, in which undisturbed cultural deposits warranting further testing might be present, were identified. The Cultural resource reports for this project are on file with the New York District and the office of the New Jersey SHPO.

4.32 Inundation of the offshore portion of the project area is estimated to have occurred between 7,000 and 4,000 B.P. Prior to and during this period, the Reconnaissance Report postulated that during time of lower sea level the offshore study areas would have included bay, riverine, and headland environments. A predictive model suggested that these ecological zones would have been attractive to prehistoric populations. Coring data from the offshore borrow areas indicated that lagoonal conditions existed at the east of Sandy Hook, within the northern offshore study area. The slow accumulation of lagoonal sediments resulting from sea level rise may have preserved evidence of prehistoric occupation. Modern shorelines and barrier island complexes began forming approximately 4000 B.P. As these complexes developed, ocean scour and erosion would have disturbed surface sites. The Reconnaissance Report concluded that the offshore zone had a relatively high potential for the preservation of any prehistoric sites protected by the thick layers of sediments.

4.33 Inundated historic period terrestrial sites were not expected to survive shoreline erosion processes. Recent attempts to control beach erosion have increased the depth of oceanfront scour within the project area. These geomorphological processes further reduced the likelihood that surface or slightly buried historic properties were preserved. Documentary reconstruction of historic land use patterns argues against the probability that deeply buried deposits or very substantial structures were present in the project area. No evidence for intact historic resources was encountered during the field reconnaissance. A number of historic structure and potential historic districts were identified adjacent to the project area, well outside the zone of project impacts. The Report found two, potentially

National Register of Historic Place (NRHP) eligible properties closer to the project area. These are the Lake Takananssee Lifesaving Complex and the Monmouth Beach Bath and Tennis Club. The seawall and groin complex adjacent to the Monmouth Beach Bath and Tennis Club were found to contribute to the property's historic value.

4.34 The Cultural Resource Reconnaissance Report collated data on the location of known shipwrecks and obstructions. Within the limits of the proposed sand borrow areas, known wrecks clustered north of the Shrewsbury Rocks. Other shipwrecks were located throughout the study areas without any consistent pattern. Taking these data into account, areas known to have wrecks were eliminated from further consideration as sand sources. However, the Reconnaissance Report also concluded that there was a strong probability that other shipwrecks, for which it was not possible to define a location, existed within the offshore study areas. The report recommended that an intensive remote sensing survey be conducted in order to identify and assess any submerged cultural properties, once the boundaries of the borrow areas were determined.

4.35 On the basis of remote sensing data and geological coring, three offshore areas containing materials suitable for beach nourishment were identified. The northern area was located to the east of Sandy Hook, north of the Navesink River. Two smaller potential borrow areas, located at the south end of the project area, were called Belmar N.E. and Belmar S.W. (Figure 7 in the Main Report). A Remote Sensing Survey of these three areas was conducted (U.S. Army Corps of Engineers 1986). Side scan sonar, magnetometer and subbottom profiler were utilized to test for submerged cultural resources. Survey lines were spaced at 30 meter intervals to provide 100% coverage of the borrow areas. Positioning was recorded with a Mini-Ranger microwave range positioning system. The Cultural resource reports prepared for this project are on file with the New York District and Office of the New Jersey SHPO.

4.36 Three anomalies were encountered during the Remote Sensing Survey in the northern borrow area. They were identified as being a sewer outfall pipe, an anchor and chain, and a discontinuous strip comprised of patches of rough topography. The latter is interpreted as being materials and sediments dumped from barges or dredges on route to the authorized dump site located a few miles to the east. Anomalous geological formations identified as buried clay strata were also found within the northern borrow area. These strata may be continuous with nearby clay deposits radio carbon dated to 4800 to 1600 B.P. The Remote Sensing Report concluded that the clays may represent lagoonal sedimentation anticipated by the Reconnaissance Report. It is possible that evidence for prehistoric settlement has been preserved below these deposits. While none of the discovered anomalies were considered by the Corps to be eligible for listing in the National Register of Historic Places (NRHP), all of these zones in which they were encountered have been eliminated as sources of borrow material.

5. ENVIRONMENTAL EFFECTS

5.01 Water Quality: There will be short-term adverse water quality impacts during the construction period of this project. Dredging the proposed borrow areas will generate turbidity and sedimentation impacts within the immediate vicinity of the operation, but the generally large grain size of the material will keep the area of impact small and will ensure that there are no impacts beyond the period of construction. Because the construction period will last a minimum of four years, however, localized water quality impacts will be experienced in one or the other of the proposed borrow areas for that duration. Similar short-term water quality impacts will occur at the deposition sites along the 12-mile project shore. Fill operations will deliver a slurry of sand to the receiving shore, increasing turbidity in the immediate area. This effect, however, will not be significant since turbidity levels in the high-energy surf area are naturally high.

5.02 Significant long-term impacts on water quality are not expected to occur as a result of project implementation. Turbidity and other water quality parameters at the borrow areas and disposal sites will rapidly return to preconstruction levels with no lingering impact. With changes in bathymetry in the proposed borrow areas, however, there is a potential for decreased water quality in the newly-created borrow pits. Depths below the existing grade will be restricted in order to limit the potential water quality problems that might come with reduced circulation and increased deposition of fine material within the pits. Previous dredging operations in nearshore ocean borrow areas, have not identified any long-term adverse impacts, but water quality monitoring in the proposed borrow areas will be conducted to help assure that there will be no significant impacts from this project. Periodic beach nourishment, which is expected to be required every 6 years, will have water quality impacts similar to those for initial construction, but maintenance will be completed within one dredging season. Long-term impacts of maintenance are not to be significant.

5.03 Coastal Biological Resources: The proposed sandfill operation on the project beaches will cover an area of the shore and nearshore up to a maximum of approximately 25 feet below mean low water (mlw) will be covered with a deposit of sand for the entire 12-mile project length. Approximately one-third of this area of beach fill, or about .8 square mile, will be raised from tidal or subtidal elevations to above the level of mean high water. The tidal zone will be displaced offshore from its present location and will experience no net loss in total area. In fact, in areas such as Sea Bright where there is no existing beach and erosion zone area as the tidal zone is pushed offshore from the steep face of the seawall to more gradual sandy beach slope. Almost all the increase in beach berm and slope will be a result of the net loss of shallow nearshore zone.

5.04 The loss of littoral zone area will mean a direct reduction in habitat for benthic marine invertebrates. This loss is negligible in view of the existing nearshore area available. The loss in biomass will be a short-term impact since resident species are adapted to periodic disturbance and rapid recolonization. The new sand bottom will be recolonized by benthos within a period of months following beach reconstruction. Tidal zone species will have an area of habitat equivalent to that at present, and there are expected to be no significant long-term impacts to these species.

5.05 The creation of additional sandy beach implies a positive impact since terrestrial species associated with this habitat may benefit from its increased availability; however, the increase in sandy beach area is also expected to increase human use of the shore, and this would partly offset benefits for wildlife resources. In some areas, where the reconstructed beach berm will be particularly wide due to existing shore irregularities, it may be possible to protect an area from human disturbance to favor sensitive shorebird species.

5.06 The proposed project will not have any effect on coastal ponds or other drainages entering the Atlantic Ocean. Outfalls and the coastal pond outlets will be extended through the project beach berm so that there will be no interference or interruption of drainage pathways. There is no anticipated adverse effect on anadromous fishes using Lake Takanassee and Deal Lake.

5.07 Borrow Area Biological Resources: Potential adverse impacts within the borrow areas include the following: destruction of benthic organisms; altered benthic diversity following recolonization; changes in circulation patterns; modified sediment deposition; and creation of oxygen depleted zones. Loss of benthos will be the most direct and most immediate impact in the borrow areas. Mortality will occur as organisms pass through the dredging plant or as a result of transport to an unsuitable environment. Burial of benthic organisms occurs from resuspended and redeposited sediments. Sessile species are eliminated by direct burial. Benthic studies have shown the borrow areas to have relatively marginal shellfish resources, so the immediate impacts to the surf clam will be minimal. Additional monitoring studies will quantify the benthic biomass within the borrow areas and record its recovery following dredging. If the water quality conditions and bottom substrates in the dredged pits are not significantly altered from those at present, then there will be no serious impact to the recovery of the bottom fauna. The depth of the borrow pits will be limited where possible in order to minimize the potential for altering the bottom conditions within the pits.

5.08 Habitat changes wrought by dredging within the borrow areas include changing circulation patterns on the bottom where newly-dredged pits are created. This may set up conditions whereby fine sediments are deposited, replacing the sandy bottom and leading to a depletion of oxygen within the pits. Because many species are substrate-specific or nearly so, biological communities can be altered as a result of these changes. Filter feeding organisms are most susceptible to fine sediments, and a change from a filter feeding community to a deposit feeding community in the area of the borrow pits may develop. Experience with borrow pits in the area of the New York Bight do not show the likelihood of severe adverse impacts to the borrow area benthic community. The ocean location of the proposed borrow areas should mitigate against the development of depleted oxygen zones, which would depress potential benthic recovery and productivity. On the other hand, nearness of the Sandy Hook borrow area to the mouth of New York Harbor, with its nutrient-rich waters, affirms the concern for potential impact. Water quality and bottom sediment studies following construction will monitor bottom habitat conditions to confirm the assessment that there will be no significant adverse impact.

5.09 The project will have no serious direct impact on marine fisheries. Some bottom fishes may be entrained in the intake stream of the hydraulic dredge, but most fishes are active swimmers and can avoid areas of disturbance. There will be little impact to fish eggs and larvae because the dredge areas are not sites where these life stages are concentrated. The impact to fisheries will be due to the reduced forage base within the borrow areas as a result of the destruction of benthos. Because benthic recovery is expected to be rapid following project completion, this impact to fisheries is an anticipated to be short-term. There is some evidence to show that the creation of borrow pits may actually enhance fisheries by attracting fish to these areas of changed bottom contours, a situation that may be related to the "edge" effect, or ecotones. Sampling for benthic recovery and water quality parameters will help monitor project impacts, including fishery impacts.

5.10 Gateway National Recreation Area - Sandy Hook Unit: The proposed project will have a net positive effect on the National Park Service unit at Sandy Hook. By restoring the beach to the south, the project will also restore the rate of littoral drift reaching Sandy Hook, thus reducing the erosion of Sandy Hook beaches. While dredging the borrow area off Sandy Hook has the potential to increase incoming wave energy reaching the shore, the borrow area configuration and depth has been designed to minimize this potential. Overall, there will be a benefit to the maintenance of the beaches and minimal adverse impacts on Sandy Hook.

5.11 Threatened and Endangered Species: The project will have no adverse impact, and may have some beneficial impact, on threatened and endangered species within the vicinity of the proposed project. Restoration of littoral drift rates reaching Sandy Hook will help maintain colonial shorebird nesting areas on the beach there. In

addition, there are stretches where the project beaches will have greater than the design width because of existing irregularities in the shoreline. It may be possible to attract nesting shorebirds to these wider beach sections by restricting human access to limited areas during the nesting season, and thereby, benefit these species. The species most likely to attempt nesting in the project area would be the piping plover and the least tern In the offshore borrow areas, there is little likelihood of adversely affecting listed sea turtles. The dredge plant will be established early in the year prior to the seasonal occurrence of sea turtles, and it will be operated continuously for the duration of the dredging season. Migrant sea turtles would be expected to avoid the area of dredge operation and experience no net adverse impact.

5.12 Recreation: The proposed project will significantly improve opportunities for recreational beach use. Where beaches now are narrow or non-existent, a usable recreational beach at least 150 feet wide will stretch 12 miles along the project shore. This will draw additional visitors to the New Jersey shore and provide a more equitable distribution of beach users, lessening pressure on nearby public beaches at Sandy Hook, Asbury Park, and Belmar.

5.13 Cultural Resources: Cultural resources in the project area were identified in a Cultural Resource Reconnaissance Report (U.S. Army Corps of Engineers, 1985) and Remote Sensing Survey (U.S. Army Corps of Engineers, 1986). The Cultural resource reports prepared for this project are on file with the New York District and the office of the New Jersey SHPO. Only two historic properties, potentially eligible for listing in the National Register of Historic Places, were discovered: The Lake Takanassee Life Saving Complex; and the Monmouth Beach Bath and Tennis Club. These structures extend along the shoreline and across the beach within the zone of beach nourishment. However, sand placement in their vicinity will not be an impact on them. Overall, the project will benefit historic properties by providing protection from erosion. As a result, the Corps determined that the Sea Bright to Ocean Township Beach Erosion Control Project would have no effect on cultural resources. The New Jersey State Historic Preservation Officer was furnished with copies of all studies prepared for this project. The SHPO was notified for the Corps determination of no effect on March 1987. Therefore, pursuant to 36 CFR Part 800.5(b), the Corps had, with the conclusion of the SHPO review period, completed Section 106 coordination.

5.14 Subsequent to those consultations it was determined that the northern offshore borrow area would have to be enlarged (Figure 7) in order to provide sufficient quantities of sand for long-term maintenance. Prior to the final boundary area delineations for the borrow area, a supplemental remote sensing survey for submerged cultural resources will be conducted in those areas not previously investigated. The supplemental survey will follow the same methodology employed in the original (U.S. Army Corps of Engineers

1986). Impacts to any encountered anomalies will be avoided by deleting that zone from further consideration as a borrow area. This will ensure that the project will have no effect on cultural properties. The SHPO will be furnished with copies of the supplemental survey report and afforded an opportunity to comment on the Corps' determination.

5.15 Cumulative Impacts: The proposed project is one of several Federal projects within the northern Atlantic coast of New Jersey. The impacts of this project, therefore, may be considered to be additive to the impacts resulting from the total Federal activity in the region. Following is a discussion of the other Federal projects and the impacts of the proposed project relative to them.

5.16 As stated in previous sections of the EIS and main report, the proposed project is only one portion, Section I, of the overall authorized study for the Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet, beach erosion control study. The subject project encompasses 12 miles of the 51-mile study region authorized. At present there is no active Federal study for comprehensive beach erosion control at the 6 miles of ocean beach at Sandy Hook. To the south of the subject project area, a second beach erosion control study is in progress. This study covers 9 miles of beach immediately south of the subject project and stretches from Asbury Park to Manasquan Inlet at Manasquan. This second study is designated Section II of the overall project. It may provide for a beach compatible with that proposed for Section I, but because of the generally better conditions of the beach there, the amount of sandfill needed for Section II will be considerably less. About 8 million cubic yards of sand will be needed and will acquired from ocean borrow areas off of the area from Belmar to Sea Girt, near where the two Belmar borrow areas for Section I are located. The study for Section II is in an earlier stage than the subject study, and may not be completed before construction for Section I is started. The remainder of the authorized beach erosion study, approximately 26 miles of ocean shore from Point Pleasant to Barnegat Inlet, comprises Section III, but there are no studies programmed for this reach in the near future.

5.17 The use of borrow areas for sand fill for Reach II may impact cumulatively with those used for construction and maintenance of Reach I. Maintenance of Reach I, itself, will necessitate enlarging the borrow areas beyond those limits already identified. It is expected that these impacts will not be significant either individually or cumulatively. Planned monitoring studies for water quality and benthos within the borrow pits will help assure this assessment and be helpful in developing additional borrow areas as needed.

5.18 The northern end of the proposed project is in proximity to the New York Harbor Federal Navigation Project. Two existing channels, the Ambrose Channel and the Sandy Hook Channel, provide deepwater access from the ocean to the inner New York Harbor channels and berths. The Sandy Hook Channel in particular passes just offshore of the tip of Sandy Hook. It is a channel generally 800 feet wide by 35

feet deep, and is maintained by dredging on a regular basis. Recent dredging operations have included disposal of sand dredged from the channel onto the critically eroded beaches of Sandy Hook. The proposed project will not affect maintenance operations in the Sandy Hook Channel since the rate of littoral drift reaching Sandy Hook channel is not expected to change. The Ambrose Channel is the main Federal Navigation Channel entering New York Harbor, with a width of 2,000 feet and a depth of 45 feet. This channel lies midway between Sandy Hook and Rockaway Point, the two sand spits bracketing the enhance to New York Harbor. Ambrose Channel lies beyond the limit of proposed project impacts.

5.19 Gateway National Recreation Area is a component of the National Park System and was established in 1972. It consists of four units, three in the outer coastal waters of New York City, and one at Sandy Hook. The Sandy Hook Unit contains nearly 4,688 acres and is managed to preserve significant natural and recreational features. As noted in Section 5.10 above, the proposed project is compatible with the goals of the national recreational area by helping to alleviate a critical erosion problem on the ocean beaches, and by helping to maintain colonial shorebird nesting habitat. Implementation of the proposed project will not cause any significant adverse effect on this Federal park property.

LIST OF PREPARERS

The following people were primarily responsible for preparing this Environmental Impact Statement:

NAME	EXPERTISE	EXPERIENCE	PROFESSIONAL DISCIPLINE
Joseph Vietri	Coastal/Ocean Engineering	4 years Project Manager, NY District 2 years, Marine Construction	Civil Engineer
Robert Dieterich	Wildlife Biology	12 years, EIS Studies, NY District	Physical Scientist
Karen Sullivan	Aquatic Ecology	6 years EIS Studies NY District	Biologist
Stuart Chase	Civil Engineering	20 years, Project Development, NY District	Civil Engineer
Lynn Bocamazo	Hydraulics/Coastal Engineering	4 years, Hydraulic Studies, NY District	Hydraulic Engineer
Norman Blumenstein	Economics	21 years, Economist NY District and North Atlantic Division	Economist
Roselle Henn	Archaeology	3 years, Cultural Resource Management, NY District	Archaeologist
Flavia Williams-Rutkosky	Wildlife Biology	6 years, US Fish and Wildlife Service	Fish and Wildlife Biologist
Richard Hunter	Archaeology	Principal Investigator, Heritage Studies, Inc.	Archaeologist
Charles Dill	Geology	Principal Investigator, Alpine Ocean Seismic Survey	Geologist

6. PUBLIC INVOLVEMENT

6.01 Public Involvement Program: As part of the public involvement program for the Sea Bright to Ocean Township project a steering committee was organized for the purpose of providing an adequate exchange of information and to insure local concerns were addressed. The steering committee was composed of the Mayors of the affected communities, Borough Engineers, State Legislators, personnel from the New Jersey Department of Environmental Protection, Congressional District Representatives and personnel from the New York District Corps of Engineers. Extending from the period beginning 1984 to the present, numerous coordination meetings were held with the non-federal sponsor and other concerned agencies to insure their input was incorporated into both preliminary and final designs and plan selection. On April 16, 1987 a notice of intent to file an Environmental Impact Statement (EIS) by the New York District, U.S. Army Corps of Engineers was published in the Federal Register. No formal scoping meeting was held for the project. However, the Corps coordinated with U.S. Fish and Wildlife Service and other concerned Federal, State and local agencies during preparation of the Draft EIS.

6.02 Required Coordination: The subject draft EIS will be sent to various government agencies for review and comment. Copies will also be sent to individuals who have so requested or who have indicated an interest in the subject project. A final EIS, incorporating comments received to the draft document, will then be circulated to complete public coordination. Specific coordination with the US Fish and Wildlife Service (FWS) and the New Jersey Department of Environmental Protection (NJDEP) will also be continued in order to finalize the specific measures of environmental mitigation required by this project. The Corps has concluded the Section 106 consultation process for cultural resources in areas where cultural surveys have been completed. Since it will become necessary to conduct a supplemental remote sensing survey prior to completion of plans and specifications for submerged cultural resources in the extended offshore borrow area, the Corps will again coordinate with the New Jersey State Historic Preservation Office when the supplemental survey report is completed.

6.03 Distribution of Draft EIS: The following agencies, groups, and individuals will be sent copies of the Draft Environmental Impact Statement:

<u>Federal Offices</u>

Advisory Council of Historic Preservation
Environmental Protection Agency
    Office of Federal Activities
    Region II
Department of Agriculture
    Forest Service
    Soil Conservation Service
Department of Commerce
    National Oceanic and Atmospheric Administration -
        Office of Ecology and Conservation
    Deputy Assistant Secretary for Environmental Affairs

Department of Energy
Department of Health and Human Services
    Office of the Secretary
    Public Health Service-Centers for Disease Control
Department of Housing and Urban Development
Region II
Department of the Interior
    Office of Environmental Project Review
    U.S. Geological Survey
    Fish and Wildlife Service
National Park Service
Department of the Navy
Chief, Naval Operations
Department of Transportation
    Federal Highway Administration
    Federal Railroad Administration
U.S. Coast Guard
Federal Emergency Management Administration
Interstate Commerce Commission
Senator William Bradley
Senator Frank Lautenberg

Regional Offices

Interstate Sanitation Commission
Port Authority of New York and New Jersey

State, County, and Local Offices

Governor Thomas Kean

New Jersey State Review Process
    Intergovernmental Review and Assistance Unit
New Jersey Department of Commerce and Economic Development
    Maritime Advisory Council
New Jersey Department of Community Affairs
New Jersey Department of Environmental Protection
    Division of Coastal Resources
    Division of Fish, Game & Shellfisheries
    Division of Marine Services
    Division of Water Resources Planning
    Office of Environment and History
    Planning Group
New Jersey Department of Labor and Industry
    Economic Development Authority
New Jersey Department of Transportation
New Jersey State Historic Preservation Office

Monmouth County Planning Board
Borough of Allenhurst
    Office of the Business Administrator
Borough of Deal
    Borough Clerk
Village of Loch Arbor

Long Branch
    Office of the Business Administrator
Borough of Monmouth Beach
    Office of the Mayor
Ocean Township
    Township Engineer
Borough of Sea Bright
    Borough Clerk
Deal Lake Commission

Groups and Individuals

American Littoral Society
Association of New Jersey Environmental Commissions
Environmental Defense Fund
National Wildlife Federation
Natural Resources Defense Council
The Nature Conservancy, Eastern Regional Office
New Jersey Alliance of Action
New Jersey Audubon Society
New Jersey Historical Society
New Jersey League of Women Voters
New Jersey Marine Science Consortium
New Jersey Public Interest Research Group
Sierra Club, New Jersey Chapter
Marine Sciences Center, Rutgers University
Rutgers University, Department of Environmental Sciences
Marine Sciences Research Center, SUNY at Stony Brook
Marine Sciences Research Group, CUNY, Brooklyn College
Newark Star Ledger
Asbury Park Press
Red Bank Register
Middletown Courier
Shrewsbury Daily Register

6.04 Public Views and Responses: The primary concern expressed by local officials and residents was the desire to reduce beach erosion damages. All plans considered have had this objective as the chief goal. Other community concerns involved property values, community cohesion, and environmental attributes. There was a general disfavor for nonstructural measures among the affected population. Other public concerns dealt with the cost of project features and their efficacy in achieving project goals.

6.05 Concerns for environmental impacts resulting from the dredging of proposed borrow areas have been expressed by FWS and NJDEP, and measures to ensure minimal impact have been recommended by those agencies. In their Draft Coordination Act Report (January 27, 1988), FWS made several recommendations concerning project implementation. In response to these recommendations and as a result of further coordination with FWS and NJDEP (see Corps letter dated May 10, 1988 and FWS letter dated May 19, 1988) the Corps has agreed to the following: where practicable sand removal from high value areas will be avoided until all less valuable area have been dredged, each year's construction will be scheduled to avoid areas of relatively high resource value during the requested June 1 -September 30 period,

dredging activities will be conducted in a manner which minimizes development of degraded water quality within the borrow pits, the New Jersey Bureau of Shellfisheries will be notified if pre-project benthic sampling discloses commercially valuable quantities of surf clams and a pre- and post-construction monitoring and assessment program of water quality and benthic resources will be implemented. The New York District is presently coordinating with FWS, NJDEP and the Corp's Coastal Engineering Research Center (CERC) to develop a scope of work for the proposed monitoring. A description of the program will be included in the Final EIS. Referenced coordination letters are included in the Pertinent Correspondence Appendix of the Main Report.

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Appendix A

Section 404 (b)(1) Evaluation
Sea Bright to Ocean Township

I. PROJECT DESCRIPTION

a. Location and General Description

The proposed project is located on the Atlantic Coast of New Jersey from Sea Bright (south of Sandy Hook) to Ocean Township (at the Asbury Park boundary), and includes the nearshore ocean waters to a depth of approximately 60 feet. The project involves the placement of sand along the entire project shoreline (approximately 12 miles) and notching of the existing groins to recreate a beach berm 100 feet wide at elevation +10 feet above mean low water (mlw). The authorized project calls for a feeder beach at Ocean Township and a second one at the north end of Long Branch. To avoid frequent overtopping of the 10-foot high berm, a 2-foot storm cap of sand as "freeboard" is also proposed.

b. Authority and Purpose

The Sea Bright to Ocean Township Reach (Reach I) is authorized as part of the Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet, Harbor Act of July 3, 1958, in accordance with House Document No. 332, 85th Congress, second session, as modified by the Water Resources Development Act of 17 November 1986 (PL 99-662). The purpose of the project is to control erosion in the highly developed coastal areas of the northern New Jersey ocean shoreline.

c. General Description of Dredged and Fill Material

The material proposed to be deposited along the project shoreline is predominantly beach grade sand. Approximately 17.8 million cubic yards of material will be deposited during initial construction, and nourishment quantities, to be deposited on a 6-year maintenance schedule, will amount to nearly 2.4 million cubic yards each. The material will be dredged from three ocean borrow areas, one off Sandy Hook and two off Belmar.

d. Description of Proposed Discharge Sites

The discharge sites are the unconfined beach berm and nearshore littoral zone of the New Jersey ocean shoreline stretching from and including Sea Bright to Ocean Township, a stretch about 12 miles long. The sand will be place in a band along the shore up to 1,200 feet wide, for a total discharge area of about 2.5 square miles. The habitats in the discharge areas include sandy beach and intertidal and subtidal zones. The discharge is scheduled to occur year-round for a period of three years.

e. Description of Disposal Method

Two disposal methods will be used. In areas suitably close to the offshore borrow areas, material will be dredged and disposed using a hydraulic dredge and pipeline. Where hydraulic dredging is not economically advantageous, material will be delivered to the disposal area by hopper dredge.

II. FACTUAL DETERMINATION

a. Physical Substrate Determinations

The substrate at the disposal site is the eroded sandy berm of the ocean shore. In some areas little sand remains, and ocean waters impinge directly on the seawall protecting coastal properties. Series of stone
groins have been constructed over the years all along the project reach and form part of the disposal area substrate. The elevation of the discharge areas grades from +10 feet mlw at the inshore end to -20 feet mlw at the offshore end for an average slope of about 2.5%. There is a prevailing northward littoral drift along the project shore, with sand ultimately being deposited at Sandy Hook. To sustain this littoral drift and to maintain the project beach berm, feeder beaches will be constructed at Ocean Township and at the north end of the Long Branch. Disposal will smother benthic organisms in the project area, but will not change the substrate type; recovery of benthic populations in this high energy environment is expected to occur within one year following disposal. There are no other physical effects associated with the disposal of this material. Good engineering practices during construction will help to minimize the physical impacts of this project.

b. Water, Circulation, Fluctuation, and Salinity Determinations

The proposed disposal of dredged material will not have any serious effects on water quality parameters in the discharge area. Because the beachfill material will be primarily clean sand there will be no impacts on salinity, water chemistry, color, odor, nutrients, or eutrophication. Clarity and dissolved gas levels may be affected during the disposal period, but ambient conditions will be restored shortly following disposal, and there will be no long-term impacts. Taste is a parameter that does not apply to the Atlantic Coast of New Jersey. There will be no significant changes in current patterns and circulation resulting from the proposed discharge. The beachfill material will be placed in the high-energy surf zone of the project shore, but will not alter prevailing current patterns and flow, or velocities. There will be no impact on stratification or hydrologic regime in the project area. The project will shift the high water line offshore of its present location, but will not alter normal water levels or tidal fluctuations, nor will it affect salinity gradients. Use of clean beach grade sand to the maximum extend practicable will minimize any potential short-term effects.

c. Suspended Particulate/Turbidity Determinations

Turbidity levels in the disposal area will rise during the period of disposal, but this will not have a significant impact in the high-energy surf zone of the ocean shore. The level of suspended particulates in the longshore current will be higher throughout the project life due to the effort to compensate for the natural deficit of sand within the area's sediment budget. Most chemical and physical properties of the water column will not be impacted over the long-term, and short-term impacts will be negligible. These properties include: light penetration; dissolved oxygen; and aesthetics. Toxic metals and organics are not applicable to this discharge because of the relatively large grain-size of the dredged material. coliform bacteria levels in the dredged material may be a short-term concern, but exposure of the reconstructed beach berm to air and light will dissipate pathogenic levels within a period of weeks for no long-term impacts. Increases in turbidity and suspended particulates may have minor impacts on primary production, suspension/filter feeders, and sight feeders within the discharge area, but changes in this low productivity, high energy environment will not be noticeable. Use of clean, beach grade sand will help to minimize any deleterious effects of the disposal.

d. Contaminant Determinations

The proposed dredged material for disposal is all clean sediments derived from offshore ocean borrow areas, and there is no danger of spreading contaminants during project implementation. The Sandy Hook borrow area is in the general vicinity of the Dredged Material Disposal Site outside of New York Harbor, but the borrow area is at least 4 miles away from the disposal site, and at a considerably shallower depth. There is no record of contamination outside the bounds of the Dredged Material Disposal Site. The Bayshore Regional Outfall is located near the southwest corner of the Sandy Hook borrow area, but there is no record of contamination from this source either. No sand will be dredged from within 1,000 feet of this outfall. There are no major sources of contamination in the vicinity of the two borrow areas located offshore of Belmar, and therefore, there are no containment concerns regarding these sediments. Preliminary testing of the borrow area sediments at both Sandy Hook and Belmar gives no cause for concern regarding potential contaminants. The sediments are primarily sand, and do not have contaminant concentrations above ambient levels.

e. Aquatic Ecosystem and Organisms Determinations

Effects on biota will be restricted to the physical impacts of dredged material disposal and resulting turbidity and suspended sediment concentrations. Effects on plankton will be insignificant. Benthos will be destroyed in the discharge area, but recovery following disposal will occur within a year. Nekton, the actively moving organisms within the water column, will be able to avoid areas of disposal activity, and will experience no significant adverse

effects. In conclusion, there will be no significant effects on the aquatic food web. There are no special aquatic sites in the project area, such as, sanctuaries and refuges, wetlands, mudflats, vegetated shallows, coral reefs, and riffle and pool complexes; therefore, there will be no impact to special aquatic sites. No threatened or endangered species or other wildlife will be effected by the proposed discharge. Good engineering practices and use of predominantly large grain-size material will ensure that there are minimal impacts resulting from this work.

f. Proposed Disposal Site Determination

The mixing zone at the discharge site ranges from the line of mean high water (mhw) to about 20 feet below mean low water (mlw), in the high-energy shore and surf zone of the Atlantic Coast of New Jersey. Sediments are not stratified, but readily mixed, in this area. Rates of discharge may be as high as 18,000 cubic yards per day for hydraulic dredging; less for the hopper dredge operation. Constituent concentrations in the proposed dredged material are comparable to the ambient levels found at the disposal sites. The dredged material, about 90% sand, will be discharged on a continuous basis over approximately 3 years. The proposed discharge will not contravene any applicable water quality standards outside the mixing zone. Turbidity and bacterial levels in the mixing zone may exceed ambient water quality standards, but these levels will quickly dissipate to acceptable ambient concentrations outside the mixing zone. Chemical, dissolved oxygen, temperature, toxic or hazardous substances, and ammonia ambient water quality standards are not likely to be contravened at any time during discharge. During hydraulic pipeline disposal, dredged material will be discharged above the water line, allowing much of the turbidity and other constituents to settle out before reaching the water column. The proposed disposal is not applicable to municipal and private water supply and will have no net effect or a positive effect on recreational and commercial fisheries, water related recreation, and aesthetics. The Sandy Hook Unit of Gateway National Recreation Area, which lies just north of the project area, will receive a net benefit due to the increased volume of sand reaching it by means of the prevailing northward littoral drift.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

The cumulative effect of the proposed discharge will be to restore a functional beach berm and nearshore slope to a 12-mile section of the New Jersey ocean shore. In so doing, historical littoral drift patterns will be recreated, benefiting both the project beaches and those at Sandy Hook, which have experienced severe erosion over recent years. The proposal will protect the project shores from beach erosion with no serious detriment to water quality or the aquatic ecosystem. Short-term adverse impacts will be felt with each periodic nourishment, estimated at 6-year intervals, but the magnitude and duration of the impacts will be less than those for the initial project construction.

h. Determinations of Secondary Effects on the Aquatic Ecosystem

The secondary impacts of the proposed disposal include impacts resulting from dredging the proposed offshore borrow areas to provide the sand for project construction. Potential impacts include changes in bathymetry, sediment type, water circulation and current patterns, turbidity, and benthos. Borrow area design has incorporated these concerns to minimize physical and biological impacts. The proposed dredging will limit changes in bathymetry to minimize possible circulation and sedimentation impacts. Benthic populations in the borrow areas have been found to be, for the most part, rather low. Follow-up benthic and water quality sampling in the borrow areas will help to assure that there will be no significant impacts resulting from the dredging operation. Restoring historical rates of sand flow to Sandy Hook will be a beneficial secondary impact of the proposed dredged material disposal. Increasing recreational use of the project shoreline will be an additional secondary impact, but the existing infrastructure is adequate to accommodate the increased recreational activity without significant adverse effects. Little land in the project area remains undeveloped; therefore, there will be minimal induced development effects from this project.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

a. No significant adaptations of the guidelines were made relative to this evaluation.

b. The designation of discharge site is determined by the stated project purpose, namely, to provide beach erosion control to a portion of the Atlantic Coast of New Jersey. The only practicable alternative is no discharge, which would not meet the project purpose, and would not necessarily have a less significant impact. All potential impacts of the proposed action have been considered, and steps have been taken to ensure that these impacts will be at acceptable levels.

c. The proposed disposal of dredged material would not violate any applicable State water quality standards with the exception of turbidity, and possibly coliform bacteria. Turbidity standards may be violated outside the allowable mixing zone, but the effects will be short-term and insignificant. Coliform bacteria levels generally meet State standards within the proposed borrow area sediments, but episodes of high concentrations that violate those standards have been recorded. This is transient concern related to effluent output of New York Harbor and exposure to light and air will rapidly dissipate any residual levels of coliform bacteria in the disposed sediments. The disposal operation will not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

d. The proposed disposal activity will not affect any endangered species or their critical habitat or negatively affect the Sandy Hook Unit of Gateway National Recreation Area. There will be no impact or marine sanctuaries designated by the Marine Protection, Research, and Sanctuaries Act of 1972.

e. The proposed discharge of dredged material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability will not occur. Impacts to recreational, aesthetic, and economic values will be beneficial.

f. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems include good engineering practices and use of dredged material which is compatible with the sediments on the receiving shores.

g. On the basis of the guidelines, the proposed discharge site for dredged material is specified as complying with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the aquatic ecosystem.

CONCLUSIONS

180. Federal interest is established in the construction of a plan for beach erosion control for the project area on the basis that the beneficial effects exceed any possible adverse effects.

181. In light of the overall public interest, the proposed action has been reviewed and evaluated as well as the State of New Jersey's views and those of other interested agencies and the concerned public, relative to the various practicable alternatives for beach erosion control extending from Sea Bright to Ocean Township, New Jersey.

182. The possible consequences of these alternatives have been evaluated for engineering feasibility, economic effects including regional and national economic development, environmental and social well-being. In evaluation of the selected and other viable alternatives, the following elements were considered pertinent.

a. Engineering feasibility

b. Economic factors of local, regional and national resources development

c. Environmental impacts

d. Social well-being

183. The purpose of the project is to meet the demands for beach erosion control from Sea Bright to Ocean Township, New Jersey. Erosion has seriously reduced the width of most beaches with consequent increased exposure of the shore to storm damage as a direct result of wave attack and recession.

184. All of the alternatives available for meeting the beach erosion control needs for Sea Bright to Ocean Township have been considered. It has been concluded that the 100 foot fill only plan at an elevation of 10 feet above mean low water with an additional 2 foot storm berm cap as described in the report, is the best plan to meet these needs. The 100 ft. fill only plan will provide increased levels of protection from the effects of wave attack and recession as a result of storms. It is economically justified with a benefit-to-cost ratio of 1.7 and maximum net benefits of $15,200,000. This plan will halt the continued effects of long term erosion and mitigate the effects of storm damage from wave attack and recession, thereby reducing the risk to life and property for those that live in the project area. This plan will also enhance the recreational potential of the area by creating new public beaches.

185. In evaluating the selected plan and the alternatives, the following points were considered pertinent:

a. From an engineering standpoint, the plan of improvement selected as described in this report, represents the most practical plan of improvement to provide storm damage protection for this section of the New Jersey shoreline. The plan can be constructed and maintained in an efficient manner using currently accepted methods.

b. From an economic standpoint, findings indicate the benefits that stem from the recommended works exceed the cost of the project. The principal benefits are a direct result of the reduction in damage from storm waves and erosion. Ancillary benefits include recreation and reduction in maintenance for Sandy Hook and the seawall.

c. From an environmental standpoint, adverse effects will consist of the temporary disturbance of biotic habitats in the sand borrow areas and along the littoral zone in the immediate area of beach renourishment. No endangerment of any species inhabiting the project area is expected. Positive benefits would also be accrued by restoring historical drift rates reaching Sandy Hook, thus alleviating chronic erosion on Sandy Hook beaches and helping to maintain and improve their environmental quality.

d. From the aspect of social well-being the project will result in improved social well-being for shorefront property owners where homes and development would be removed from danger. The creation of additional public beach frontage for recreational use will also add to the overall social well-being of those who utilize the area's beaches.

186. The plan of action is based upon thorough analysis and evaluation of the various practicable alternatives for achieving the stated objectives; the recommended plan of action is consistent with national policy, and administration directives; and on balance, the total public interest would best be served by the implementation of this plan.

187. Changes to the authorized project are not significant as defined by current regulations and such changes can be handled by Post Authorization Change (PAC) procedures. As outlined in PL 99-662, section 854, this project for beach erosion control is subject to section 903 (a) of the above mentioned law. Section 903(a) sets forth the procedure for certain projects authorized for construction. In summary, Section 903(a) states that: "in the case of any project authorized for construction by PL 99-662 which is specifically made subject to this subsection, no construction may be commenced until the secretary has reviewed and commented on such project and reported thereon to the Congress, or until 90 days have passed following receipt of the proposed plan of the project from the Chief of Engineers, whichever first occurs."

188. The final GDM will serve as a 903(a) report requiring Secretary of the Army approval, thereby satisfying the required PAC procedures.

RECOMMENDATIONS

Prefatory Statement

In making the following recommendations, I have given consideration to all significant aspects of this GDM level study as well as the overall public interest in protective measures for the New Jersey shoreline. The aspects considered include engineering feasibility, economic effects, environmental, social and compatibility of the project with the policies, desires, and capabilities of the State and other non-Federal interests.

Recommendations

I recommend that the authorized project for beach erosion control Sandy Hook to Barnegat Inlet, New Jersey, Section 1 - Sea Bright to Ocean Township, authorized by the River and Harbor Act of 1958 and modified by the Water Resources Development Act of 1986 (PL99-662) be further modified to provide for the implementation of a Federal project for beach erosion control, in accordance with the plan selected herein, with such further modifications, thereof, as in the discretion of the Chief of Engineers may be advisable, at a first cost to the United States estimated at $158,321,739 (September 1987 price levels), with annual operation, maintenance costs to the United States estimated at $3,888,319 (September 1987 price levels) provided that non-federal interests comply with all the requirements listed in the local cooperation agreement printed in this report.

Disclaimer

The recommendations contained herein reflect the information available at this time and current Department policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for authorization and/or implementation funding.

Marion L. Caldwell, Jr.
Colonel, Corps of Engineers
District Engineer

REFERENCES

1. U.S. Congress, "Shore of New Jersey from Sandy Hook to Barnegat Inlet, Beach Erosion Control Study," House Document No. 332, 85th Congress, 2nd Session, July 1958.

2. U.S. Army Corps of Engineers, "Atlantic Coast of New Jersey, Sandy Hook to Barnegat Inlet, Beach Erosion Control Survey Report," New York District, March 1954.

3. U.S. Army Corps of Engineers, "Study of the New Jersey Coastal Inlets and Beaches, Draft Interim Report, Sandy Hook to Island Beach State Park," Philadelphia District, July 1973.

4. Phillips, J.D., Psuty, N.P. and McCluskey, J.M., "The Impact of Beach Nourishment at South Beach, Sandy Hook, New Jersey," Center for Coastal and Environmental Studies, Rutgers University, June 1984.

5. Gahagan & Bryant Associates, "Cost Certification Report of P-867 Dredging Phase (II) Naval Weapons Station, Earle," Contract No. N62472-85-C-1125, Northern Division Naval Facilities Engineering Command, December 1986.

6. U.S. Army Corps of Engineers, Coastal Engineering Research Center, "Coastal Processes at Sea Bright to Ocean Township, New Jersey", Waterways Experiment Station, Vicksburg, Mississippi, August 1986.

7 National Oceanic and Atmospheric Administration, "Sea Level Variations for the United States, 1855-1980," U.S. Department of Commerce, Rockville, Maryland, January 1983.

8. Gorman, Laurel T., "Geomorphic Development of the Atlantic Coast of New Jersey, Sea Bright to Ocean Township", CERC; prepared for US Army Corps of Engineers, New York District, New York, October, 1987.

9 Division of Coastal Resources, "New Jersey Shore Protection Master Plan," State of New Jersey, Department of Environmental Protection, Trenton, New Jersey, October 1981.

10. Alpine Ocean Seismic Survey, Inc., "Final Report - Detailed Investigation of Offshore Sand Borrow Sources," Contract DACW51-C-0011, November 1987.

ACKNOWLEDGMENTS

This General Design Memorandum and Environmental Impact Statement has been developed under the Planning Division, New York District Corps of Engineers, Samuel P. Tosi Chief, Richard Maraldo Assistant Chief; with the assistance of the U.S. Fish and Wildlife Service, the New Jersey Department of Environmental Protection, Division of Coastal Resources and the Division of Fish and Game along with a dedicated group of consultants, architectual engineers, and other professionals.

Overall Plan Formulation and management was provided by Bruce A. Bergmann, Chief, Plan Formulation Branch.

All design control and direct project management actions were under Mr. Joseph Vietri, Senior Project Manager.

Functional Management, was effected under Mr. Silvio Calisi and Mr. Michael Thompson, Chiefs, Navigation and Coastal Section.

Coastal Engineering was directed by Jesse Rosen, Chief Civil Resources Branch, Mr. James Urbelis and Mr. Robert Alpern, Chiefs Coastal Engineering and Hydraulics and Mr. Stuart Chase Chief, Project Development.

Day to day engineering management was performed by Ms. Lynn Marie Bocamazo Project Hydraulic Engineer.

Assisting Engineering firms were:

Coastal Planning and Engineering:	3200 N. Federal Highway Suite 123 Boca Raton, FL 33431 Mr. Thomas Campbel P.E. Mr. Norman Beumel
URS Consultants:	Mack Centre II, Mack Center Drive Paramus, New Jersey 07652 Mr. Thomas MacAllen P.E. Mr. Michael Cannon
Ocean Seismic Survey:	80 Oak Street Norwood, New Jersey 07648 Mr. Gino Macarini Mr. Henry Miller Mr. Chuck Dill
T&M Associates:	1060 Highway 35 Middletown Township, N.J. Mr. Richard Koesinski P.E. Mr. Richard Morales P.E.

VEP Associates:

1140 Bloomfield Ave
West Caldwell, N.J. 07006
Mr. Val Manov P.E.

Additional Engineering Services were rendered by the following New York District Personnel:

Mr. Gilbert Nersessian
Chief, Coastal Engineering

Mr. Richard Wright
Chief, Civil Projects Branch

Surveys, Model Studies, Geomorphic Analysis and Monitoring program developed at the Waterways Experiment Station, Coastal Engineering Center by Mr. Bill Birkemeier, Mr. Lee Butler, Dr. Nick Kraus, Dr. Norman Scheffner, Dr. Hans Hanson, Ms Lucia Chou, Ms. Mary Cialone, Ms. Jane Smith, Thomas A. Hardy, Dr. Don Staubel, Dr. Cliff Truit, Ms. Laurel Gorman, and Mr. David Nelson.

Economic Studies were coordinated under the control of Ms. Cathy Revicki, Chief Economic and Social Analysis Section and Ms. Maureen O'Connor, Acting Chief Economic and Social Analysis.

Day to Day Economic Management was under Mr. Norman Blumenstein, Senior Economist.

Recreation Analysis Support was provided by Institute for Water Resources, Messrs. Mark Dunning and Dave Moser.

Assisting Economic Consultants:

Dr. Jay Silberman
Professor
University of Baltimore

Environmental Analysis was conducted under the general guidance of Dr. Simeon Hook, Chief, Environmental Analysis.

Day to day environmental management was performed by Mr. Robert Dieterich, Ms. Karen Sullivan; Project Biologists. Cultural Resources investigations were managed by Ms. Roselle Henn, Project Archaeologist.

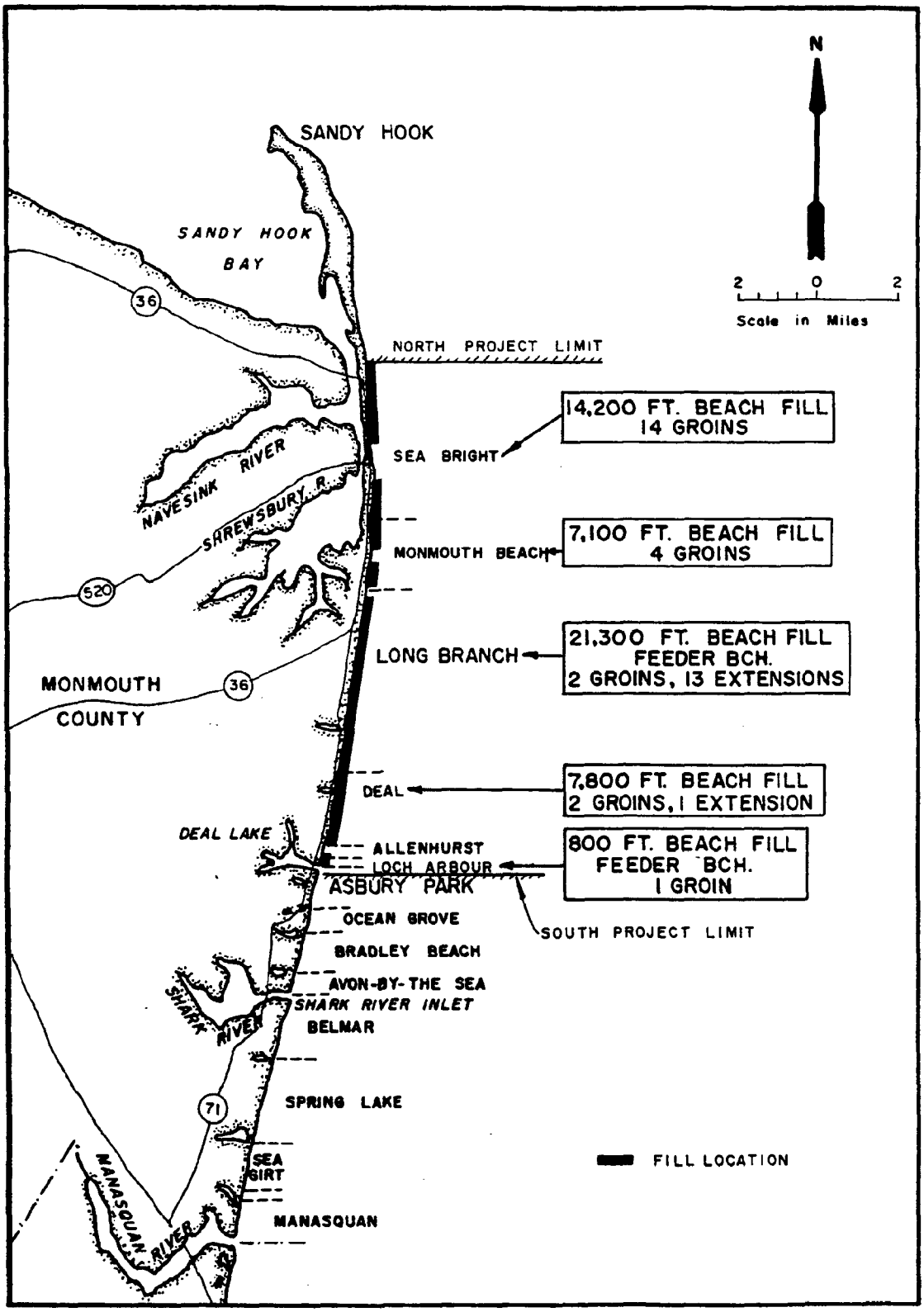
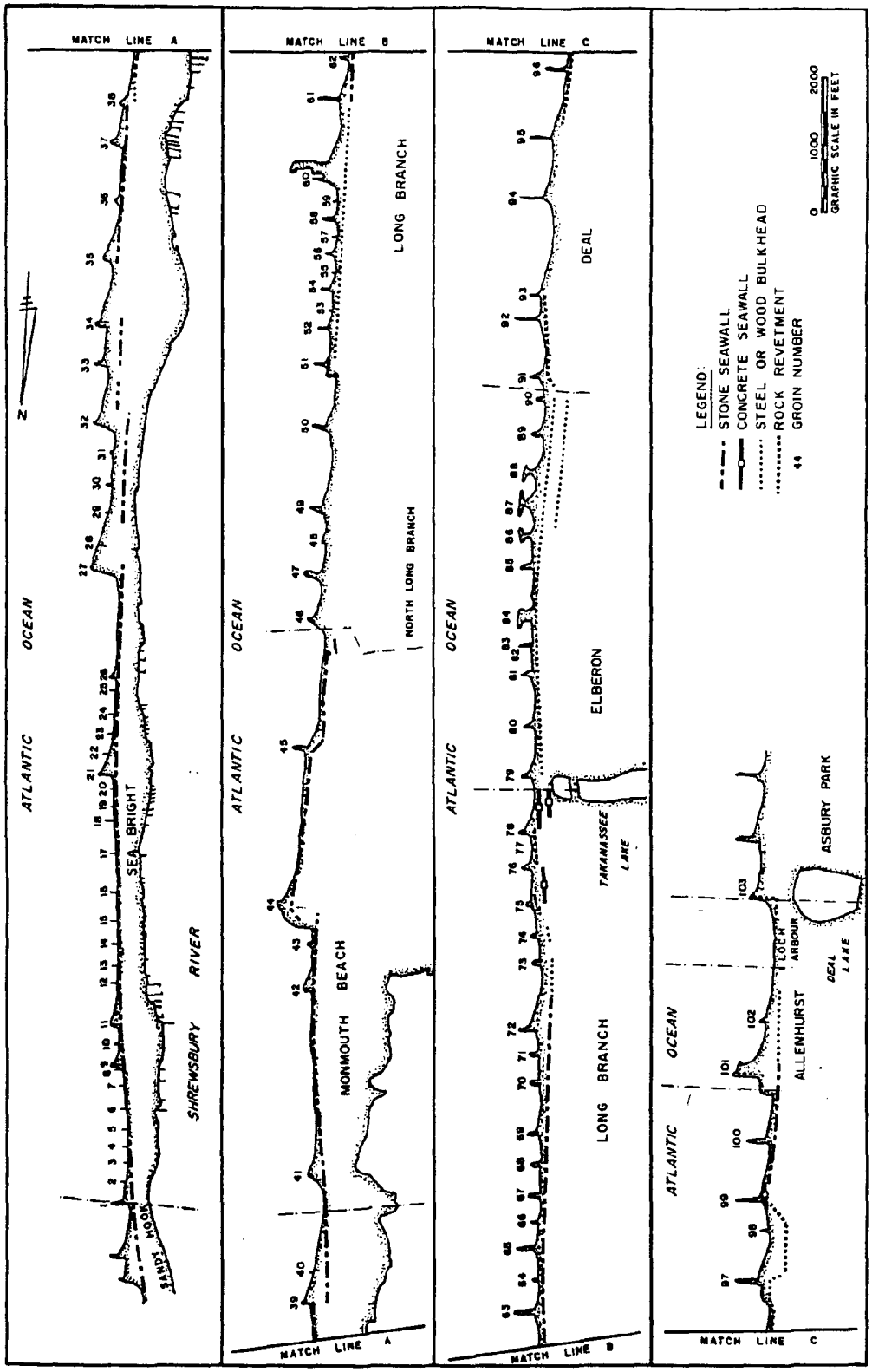


FIGURE 2

AUTHORIZED PROJECT

SEA BRIGHT TO OCEAN TOWNSHIP REACH



LOCATION OF EXISTING COASTAL STRUCTURES

FIGURE 3

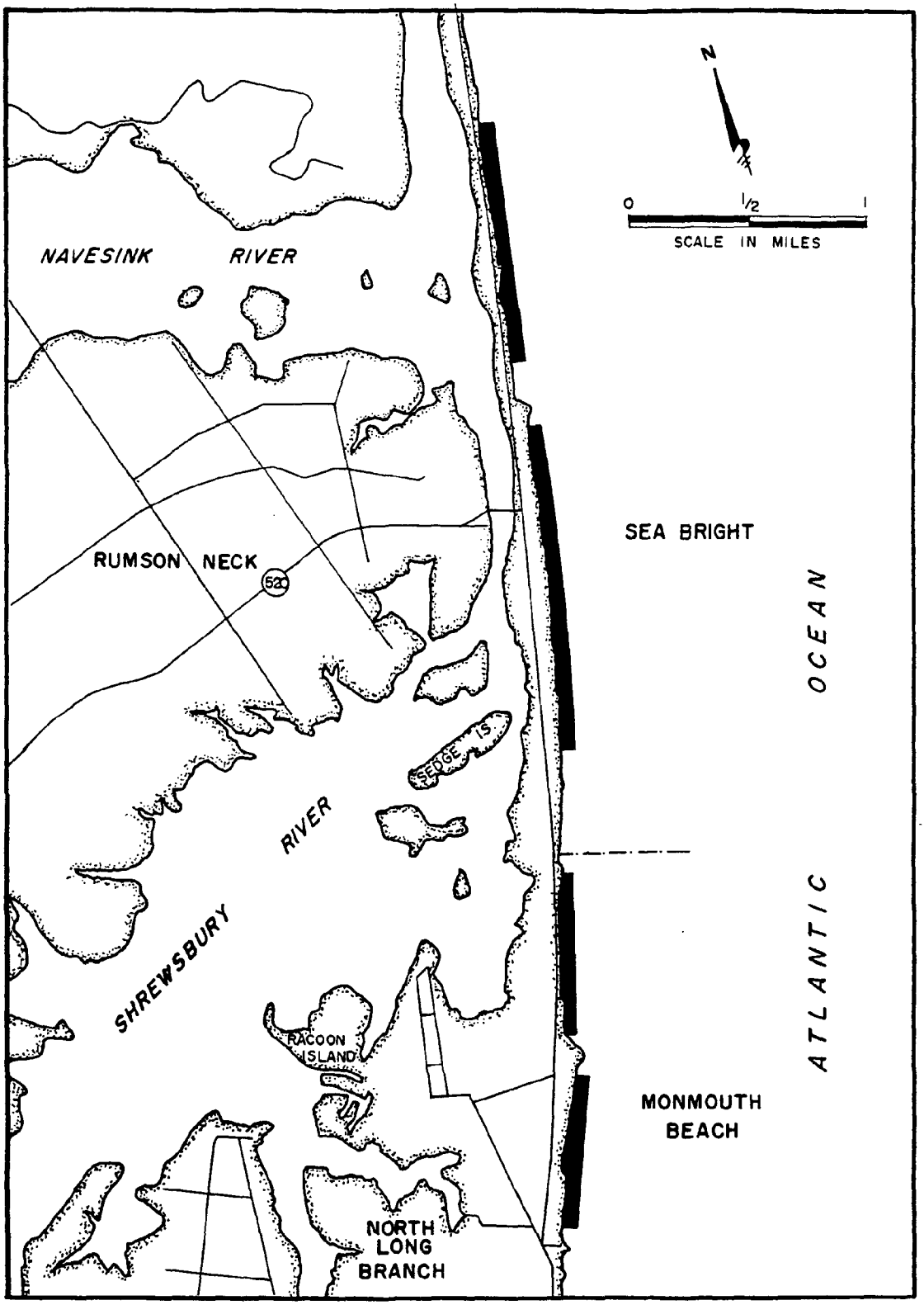
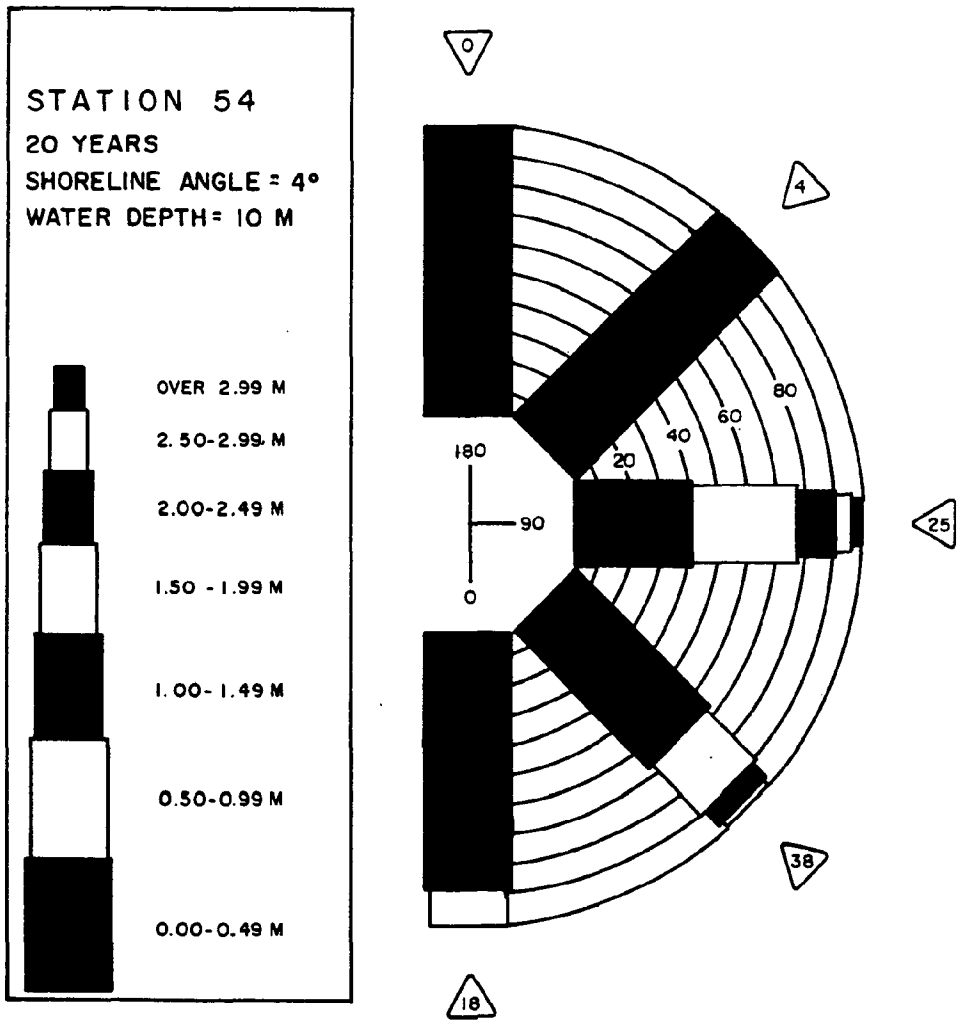


FIGURE 4

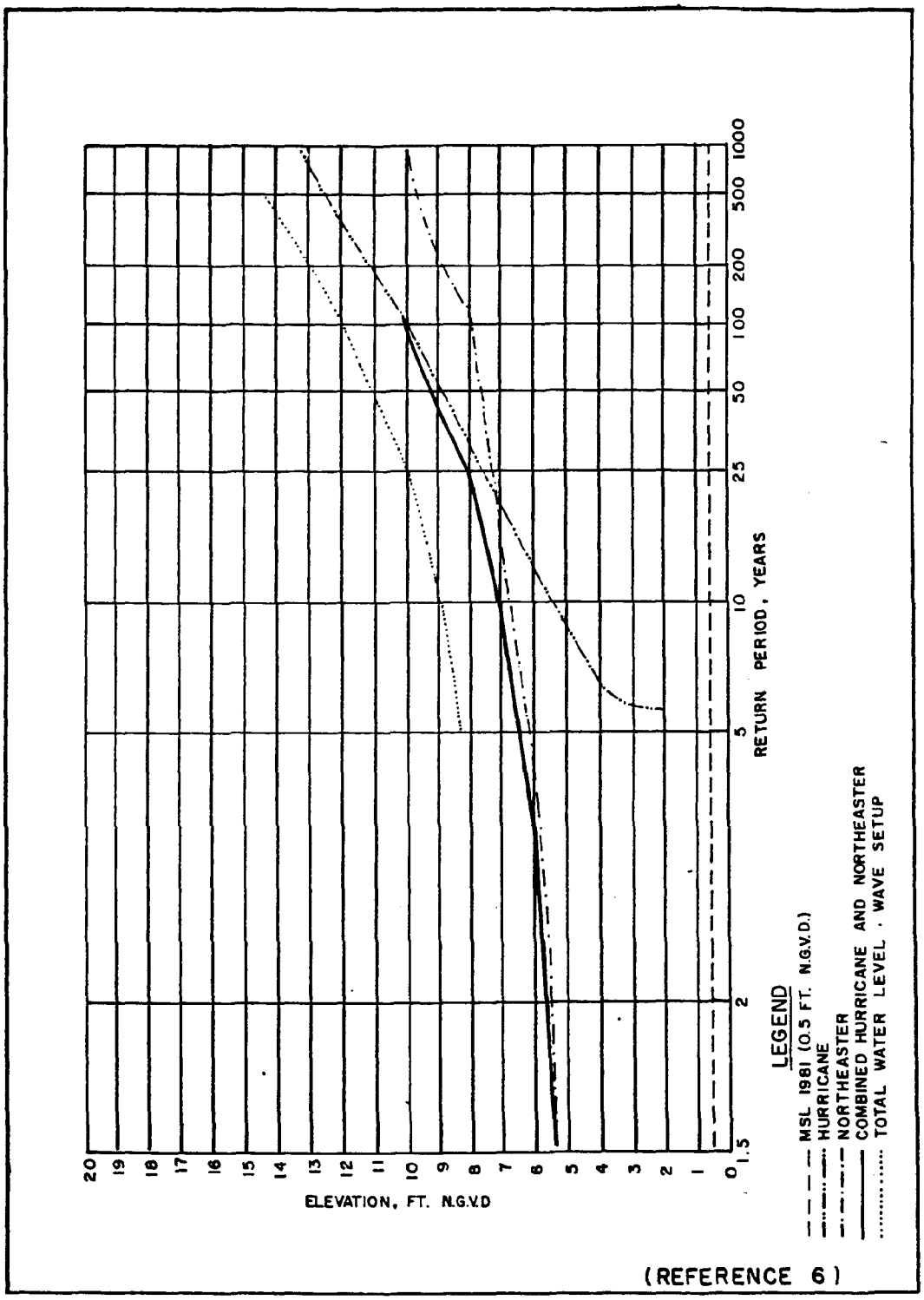
LOCATION OF 1962 EMERGENCY FILL PROJECT IN SEA BRIGHT AND MONMOUTH BEACH



(FROM REFERENCE 6)

WAVE ROSE

FIGURE 5



(REFERENCE 6)

FIGURE 6

SURGE PLUS TIDE STAGE FREQUENCY
MONMOUTH BEACH, N.J.

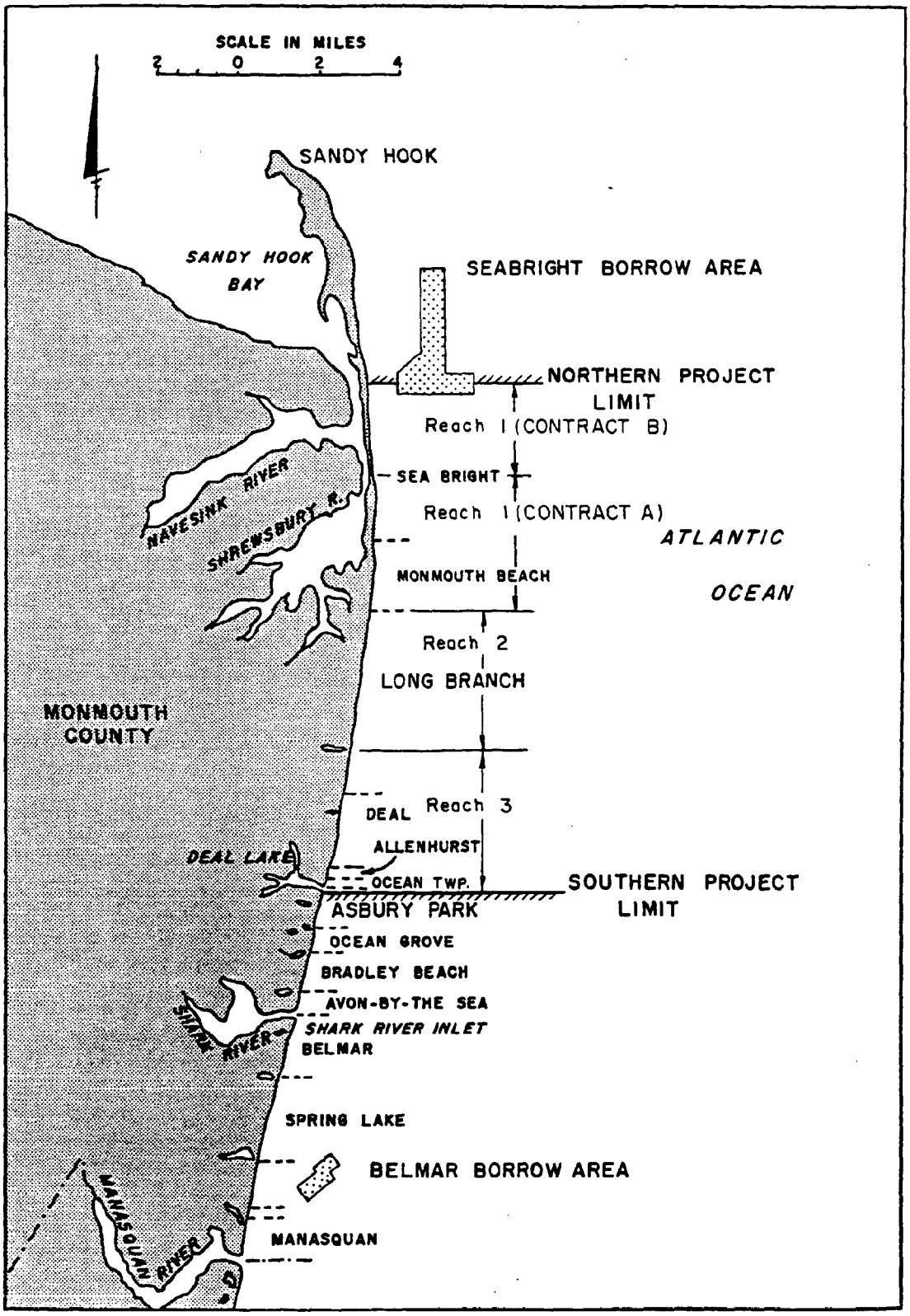
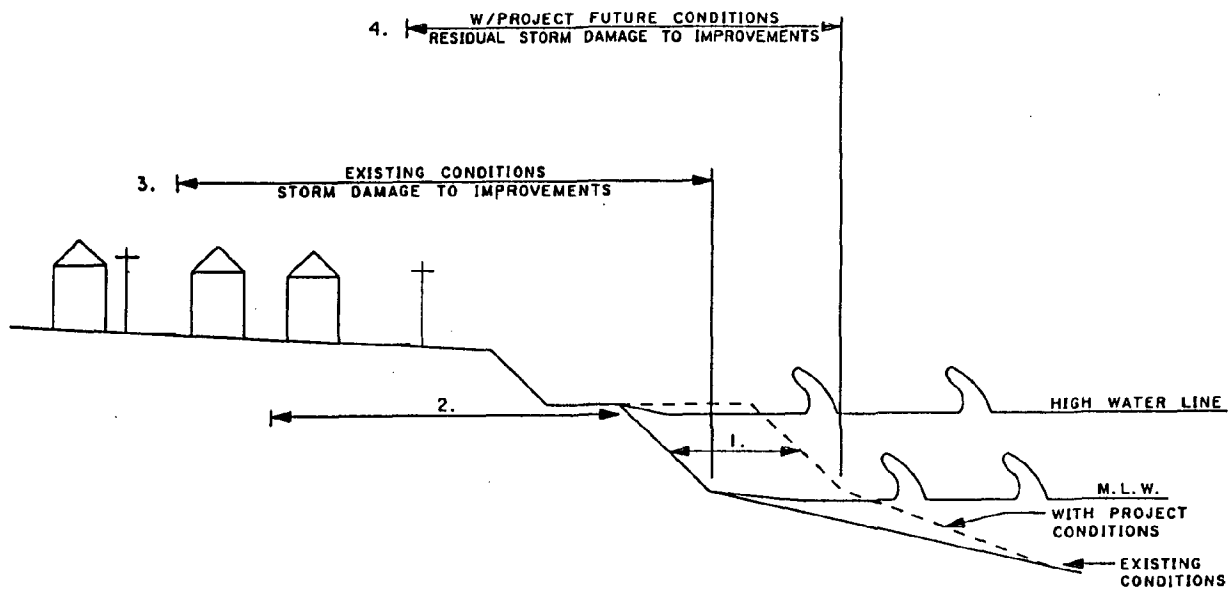


FIGURE 7

BORROW AREA LOCATIONS



1. ADDED BEACH AREA. VALUE OF INCREASED RECREATION CLAIMED.

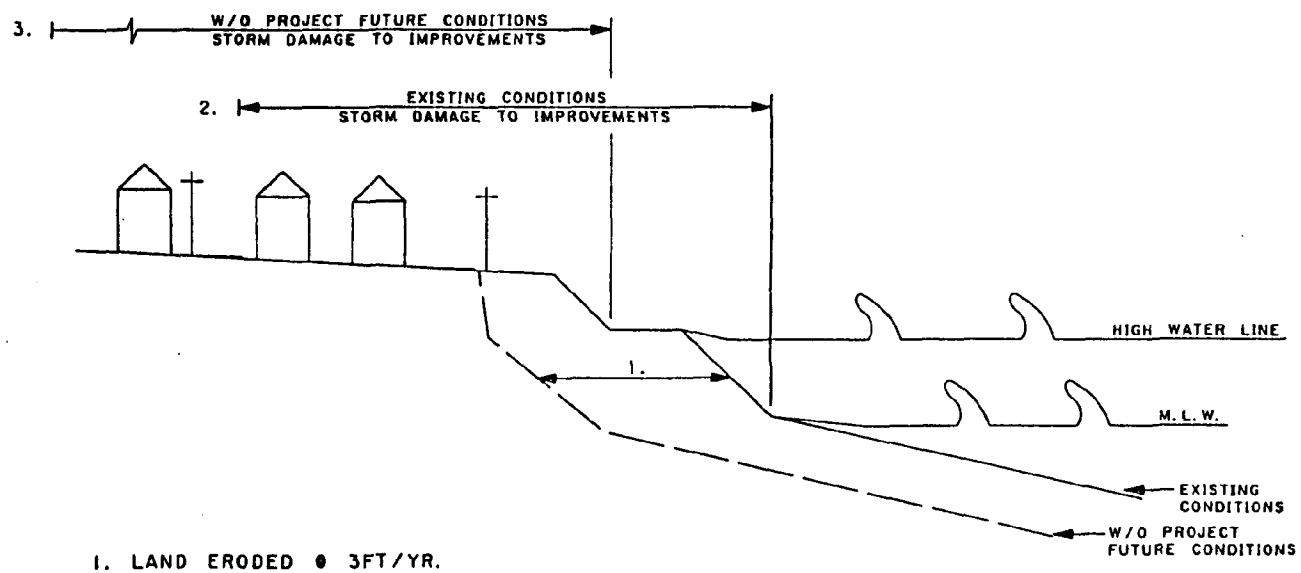
2. EXISTING LAND AREA WITHIN 250' OF H.W.L. NET INCREASE IN LAND VALUE CLAIMED AS INTENSIFICATION.

3. STORM DAMAGE TO IMPROVEMENTS (BUILDINGS, ROADS AND UTILITIES) AT EXISTING CONDITIONS.

4. STORM DAMAGE TO IMPROVEMENTS W/PROJECT FUTURE CONDITIONS. RESIDUAL DAMAGES CALCULATED AS EQUIVELENT ANNUAL DAMAGE 1991-2040.

SCHEMATIC OF BENEFIT LOCATIONS

FIGURE 8



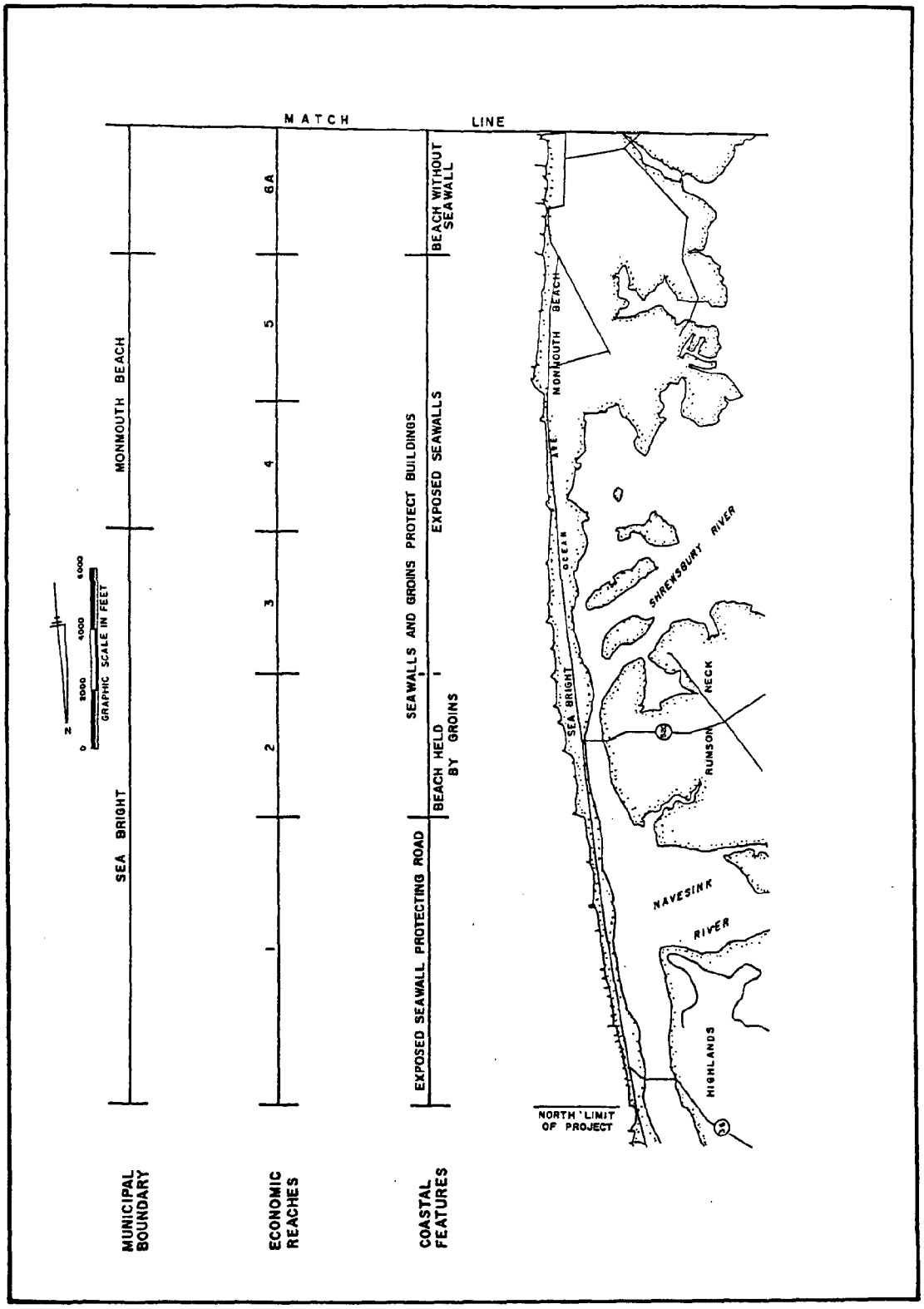
1. LAND ERODED @ 3FT/YR.
   (HALTED @ MAJOR ROAD)
   EXISTING VALUE OF LAND
   ERODED 1991-2040 CLAIMED.

2. STORM DAMAGE TO IMPROVEMENTS
   (BUILDINGS, ROADS AND UTILITIES)
   AT EXISTING CONDITIONS.

3. STORM DAMAGE TO IMPROVEMENTS
   W/O PROJECT FUTURE CONDITIONS.
   WITHOUT PROJECT DAMAGES CALCULATED
   AS EQUIVELENT ANNUAL DAMAGE
   1991-2040.

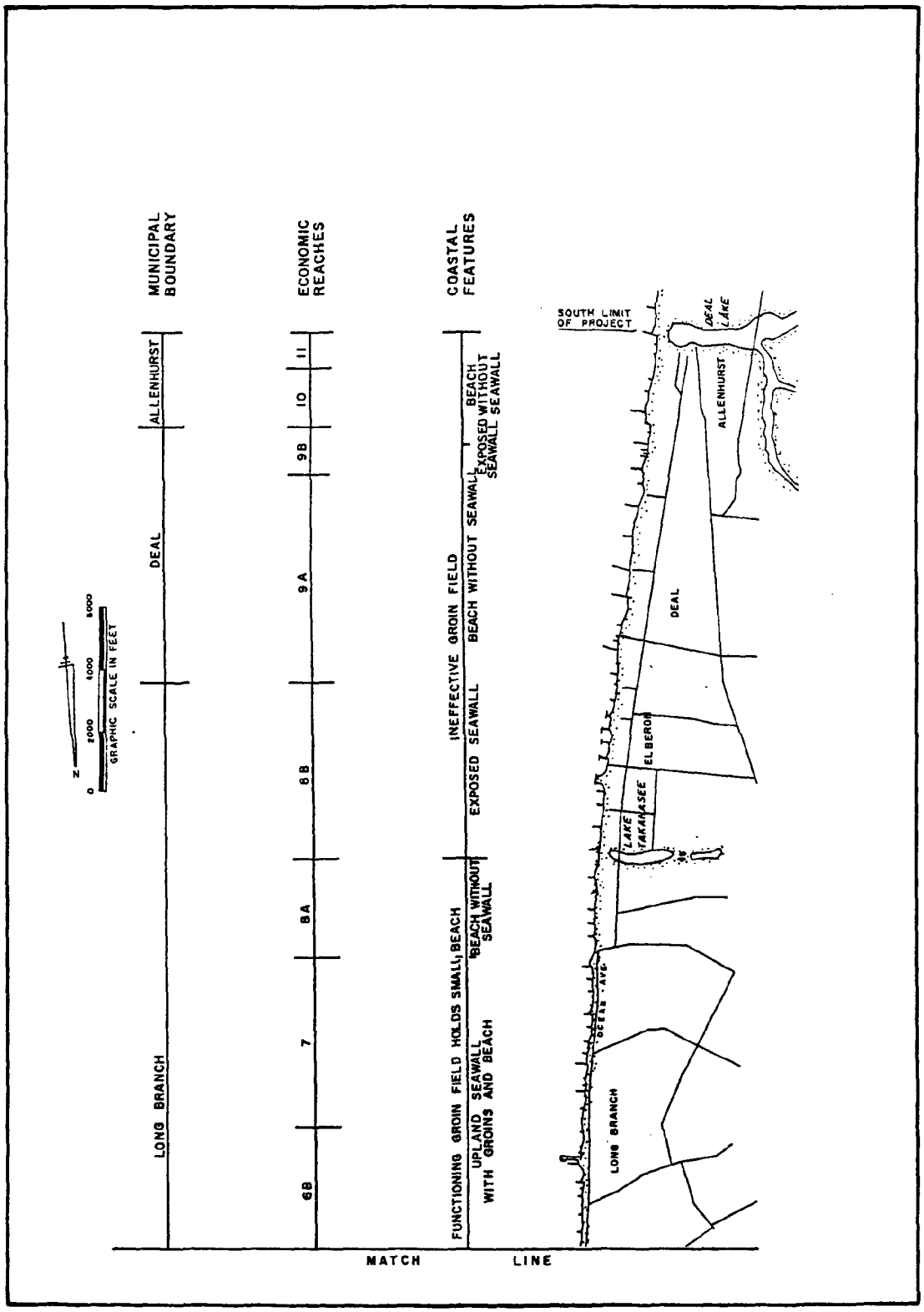
SCHEMATIC OF DAMAGE LOCATIONS

FIGURE 9



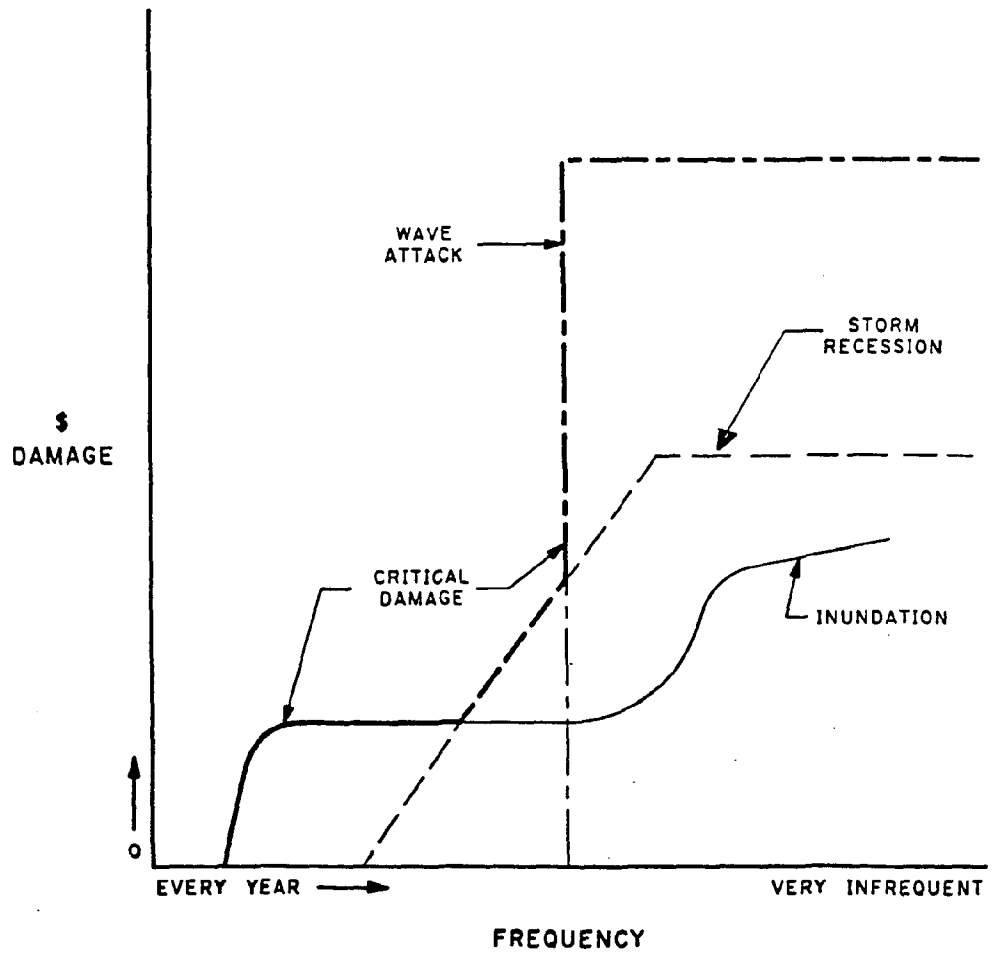
ECONOMIC REACH BOUNDARIES

FIGURE 10



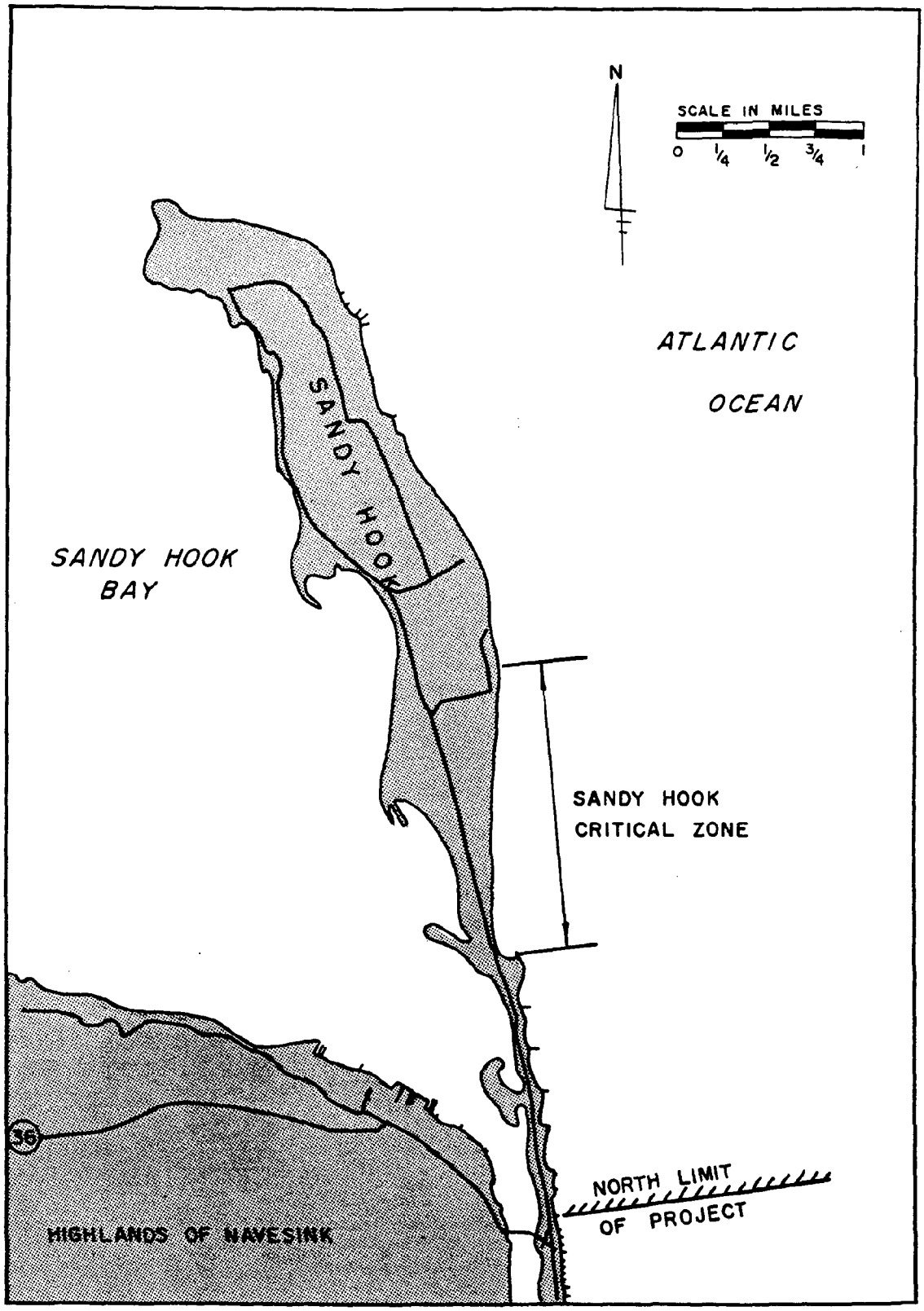
ECONOMIC REACH BOUNDARIES

FIGURE 11

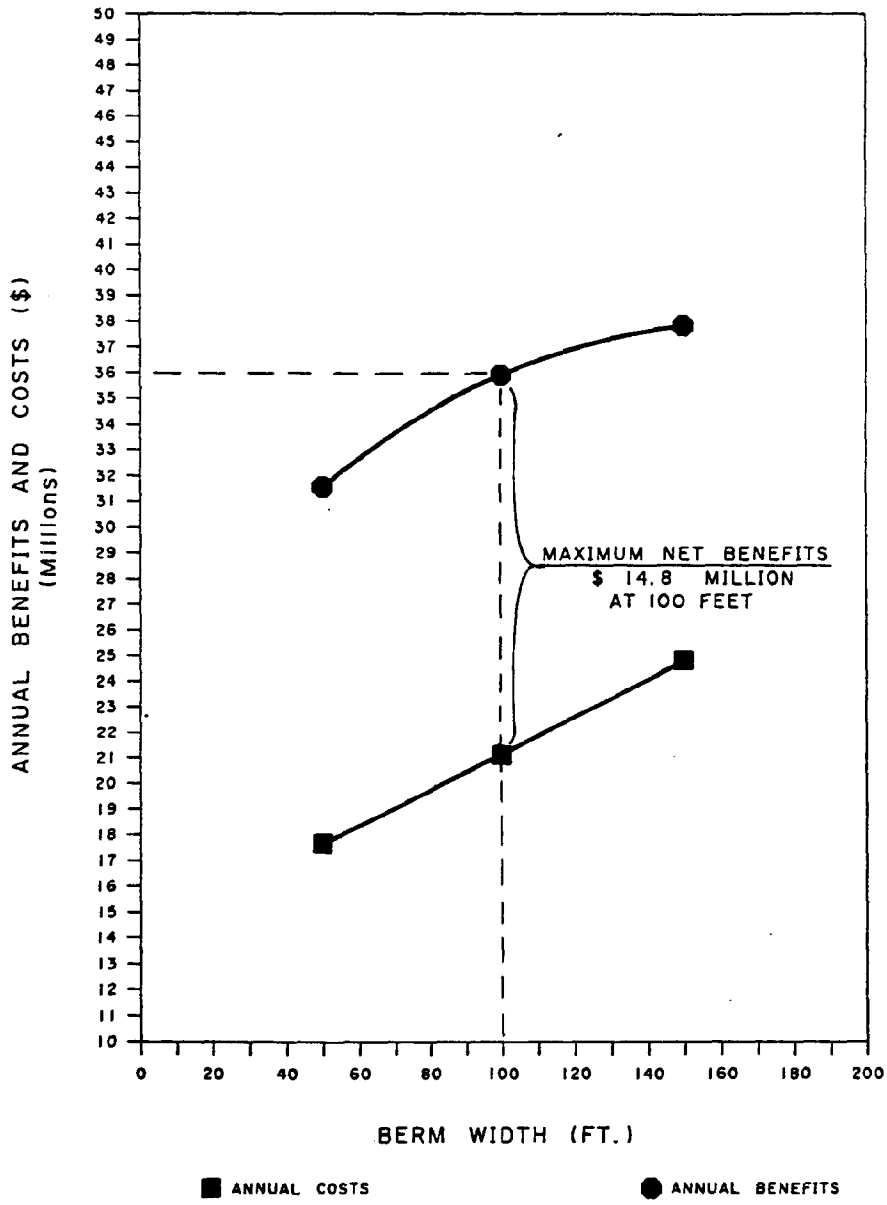


SCHEMATIC OF CRITICAL
DAMAGE ANALYSIS

FIGURE 12

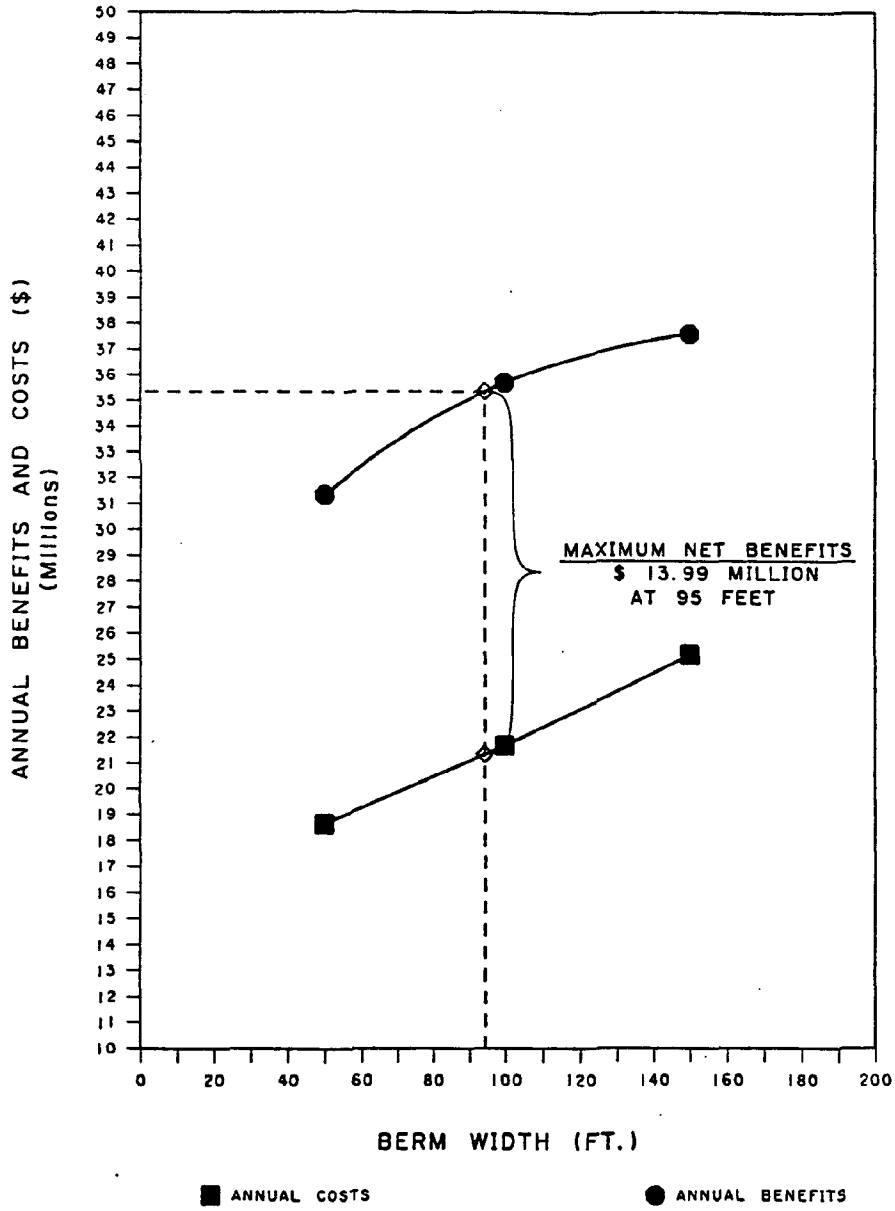


SANDY HOOK CRITICAL ZONE FIGURE 13



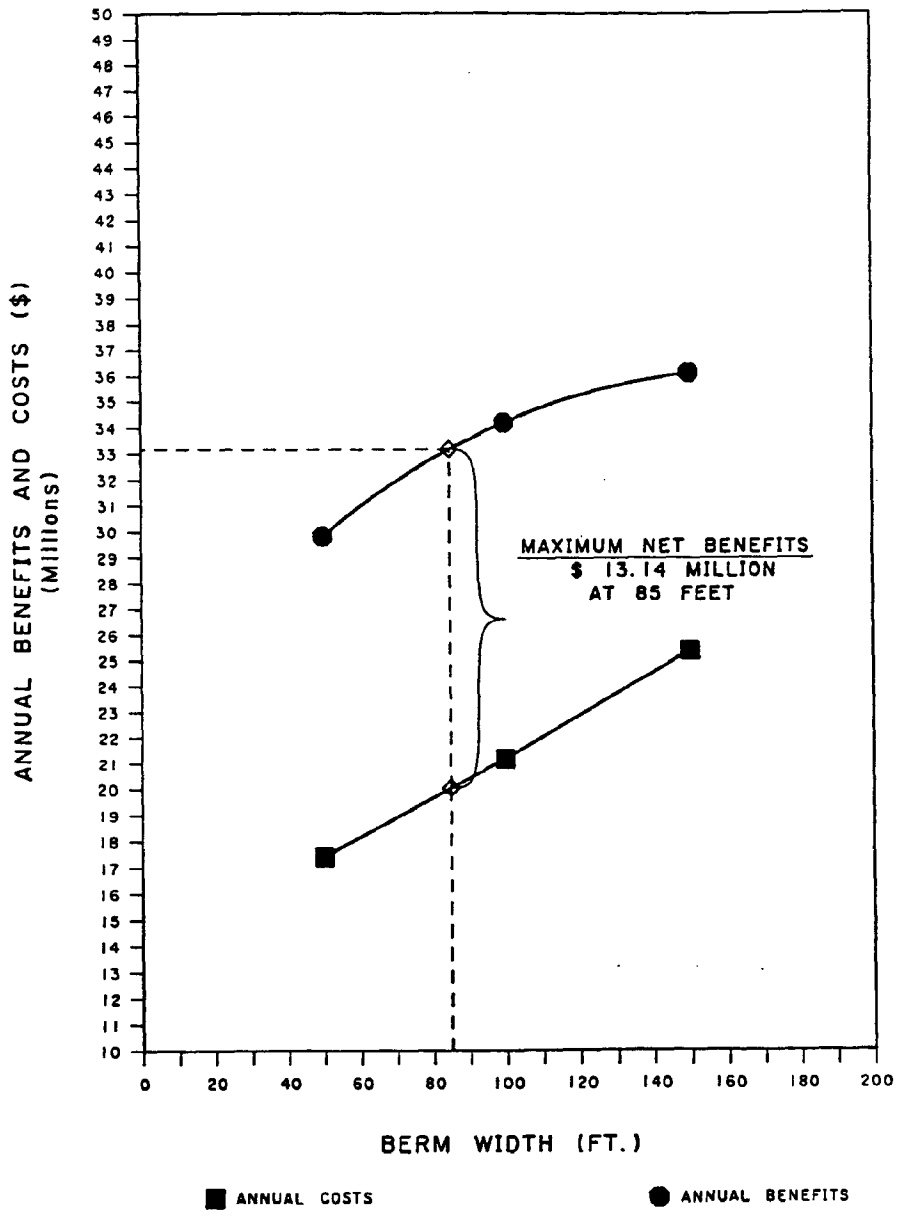
MAXIMUM NET BENEFITS
FILL ONLY PLAN
SEA BRIGHT TO OCEAN TOWNSHIP

FIGURE 14



MAXIMUM NET BENEFITS
AUTHORIZED GROIN PLAN
SEA BRIGHT TO OCEAN TOWNSHIP

FIGURE 15



MAXIMUM NET BENEFITS
UPDATED GROIN PLAN
SEA BRIGHT TO OCEAN TOWNSHIP

FIGURE 16

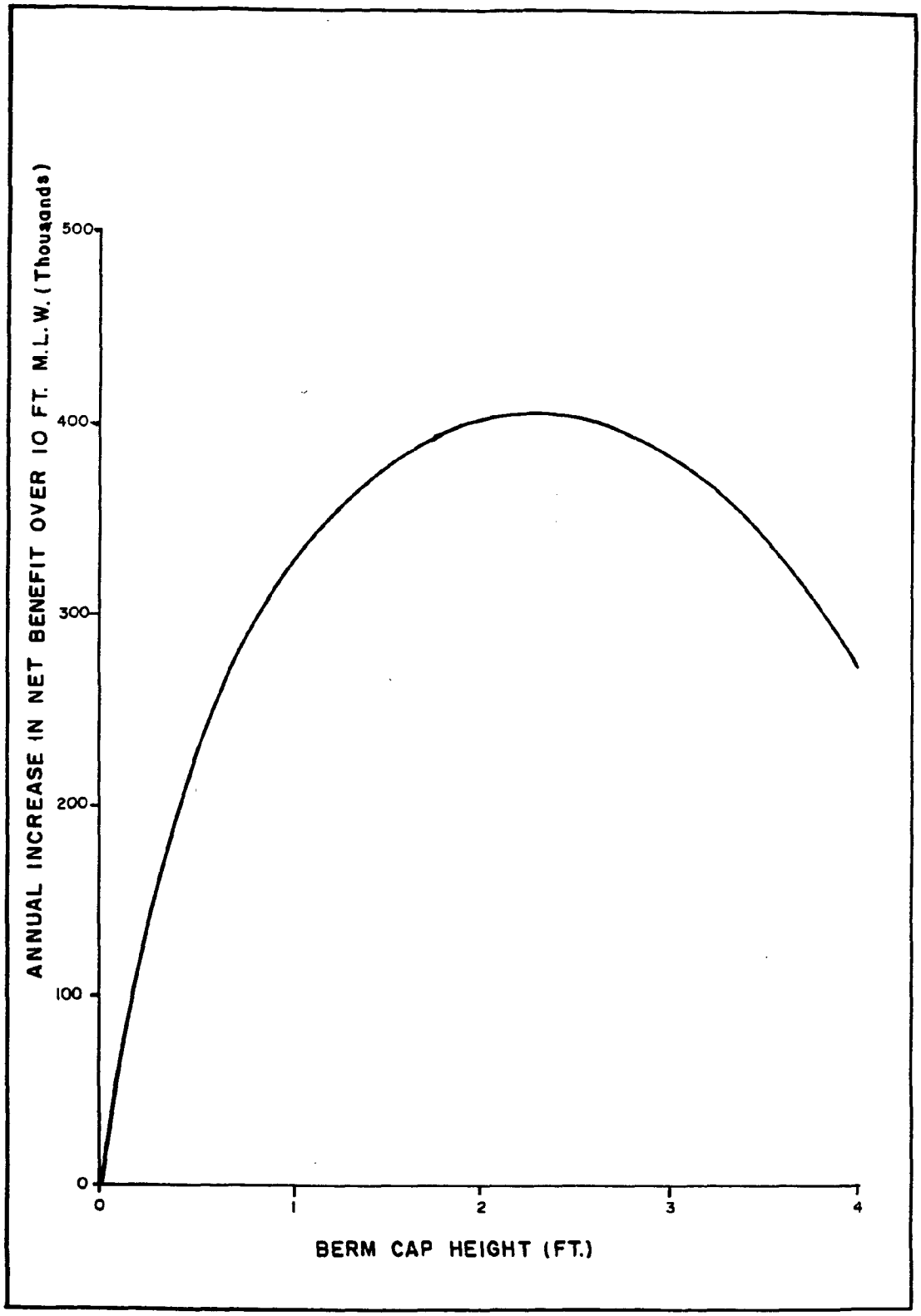


FIGURE 17

ANNUAL NET BENEFITS
FOR BERM CAPS OVER
10' FT. M.L.W.

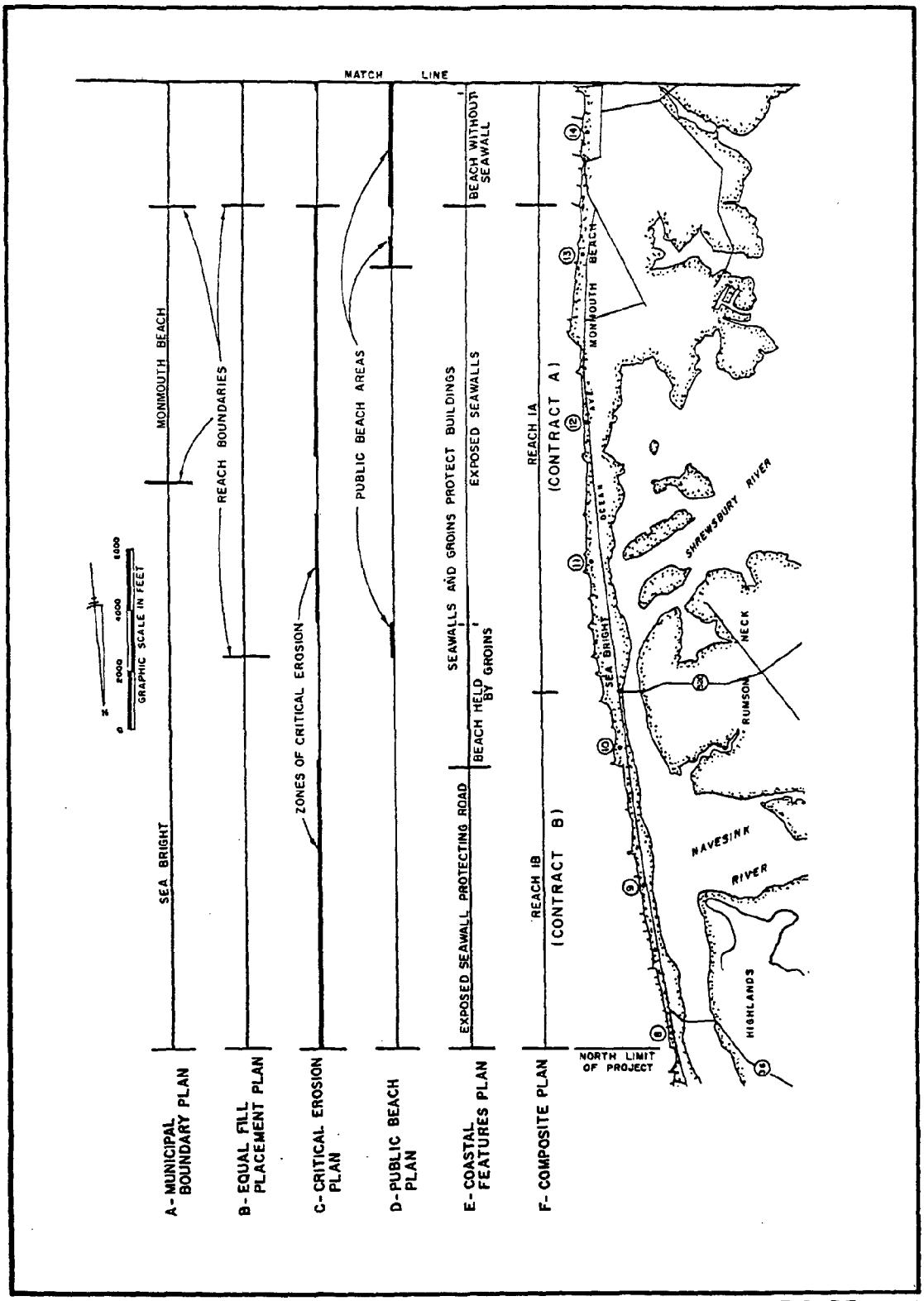
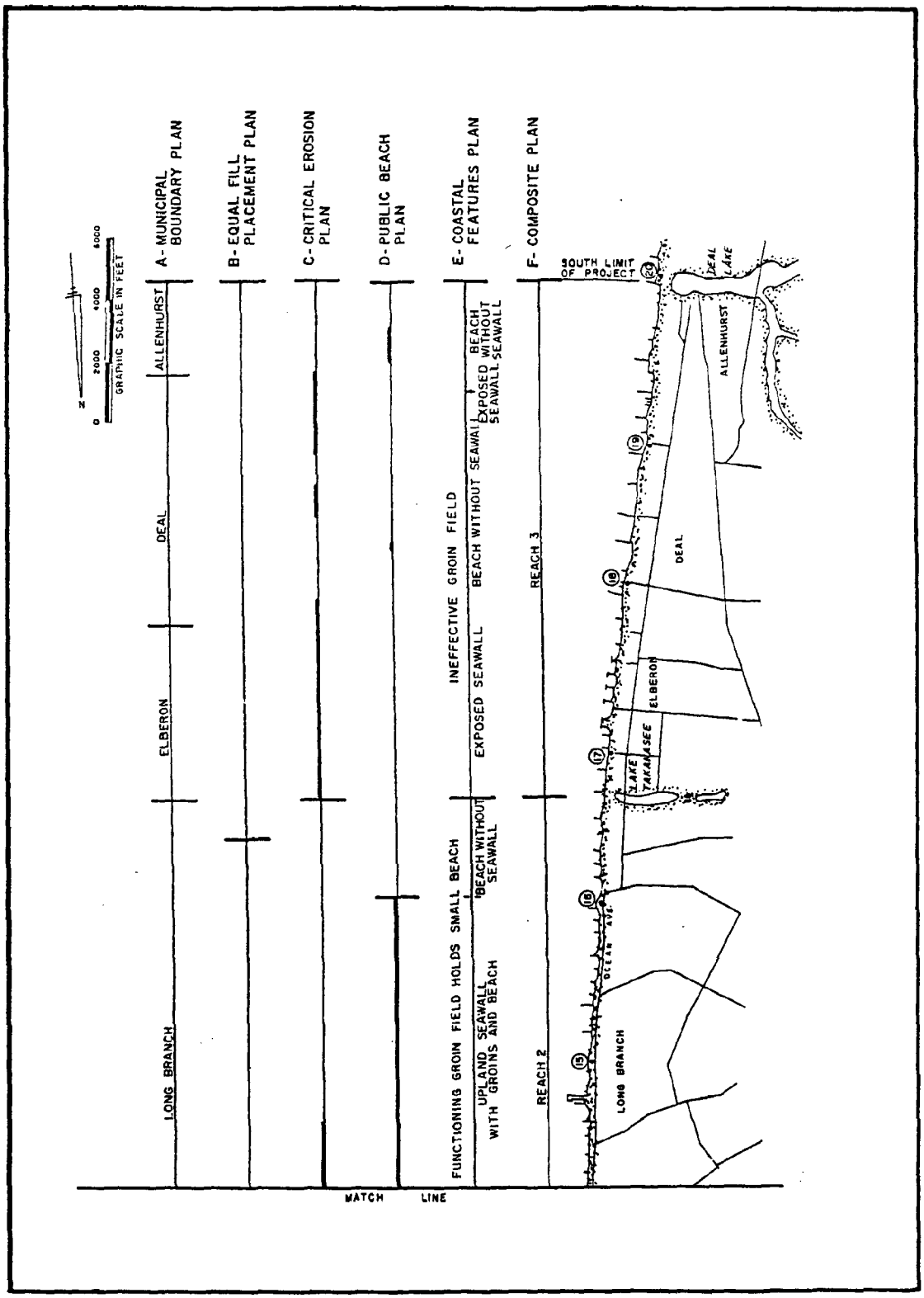


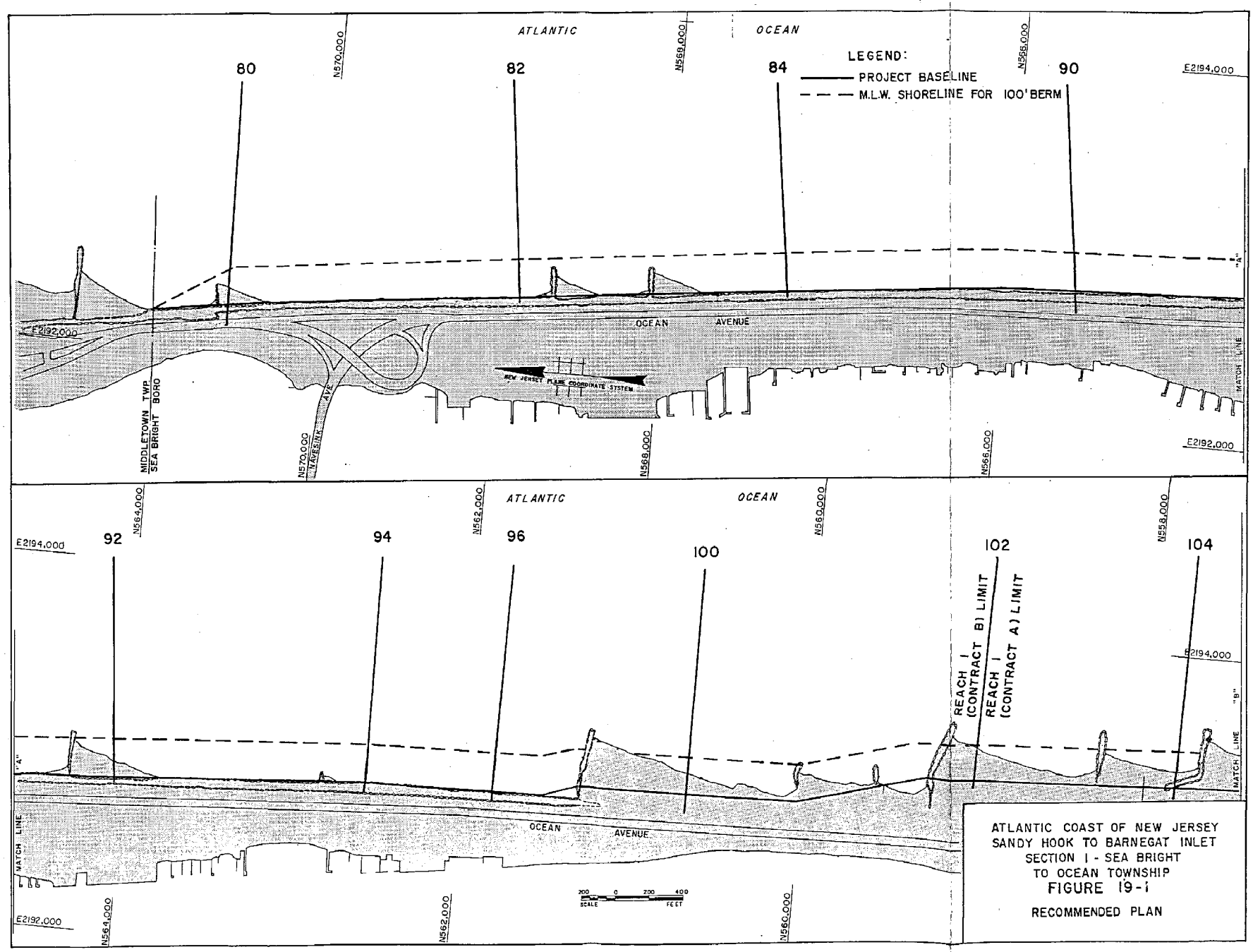
FIGURE 18-1

COMPARISON OF ALTERNATE PLANS

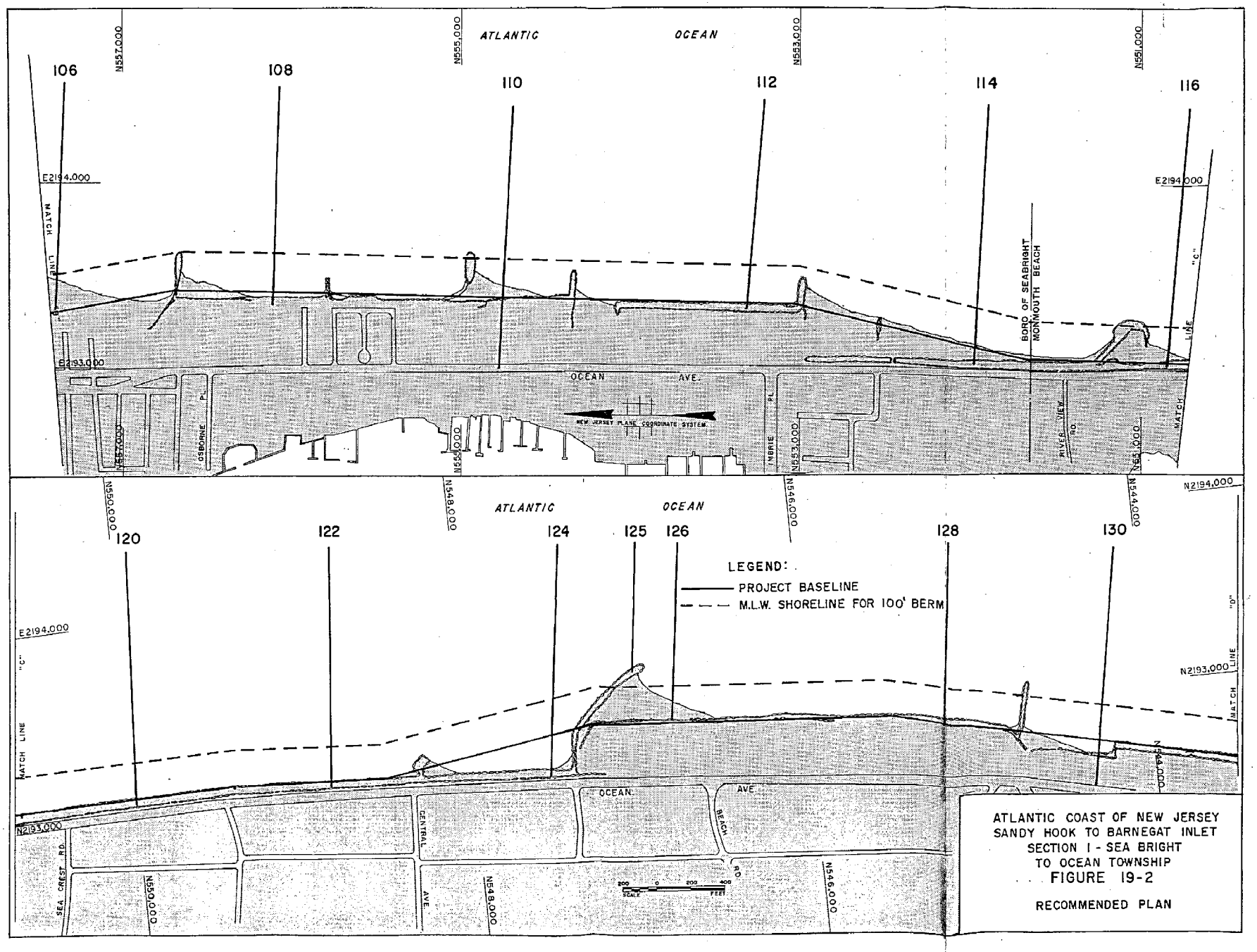


COMPARISON OF ALTERNATE PLANS

FIGURE 18-2

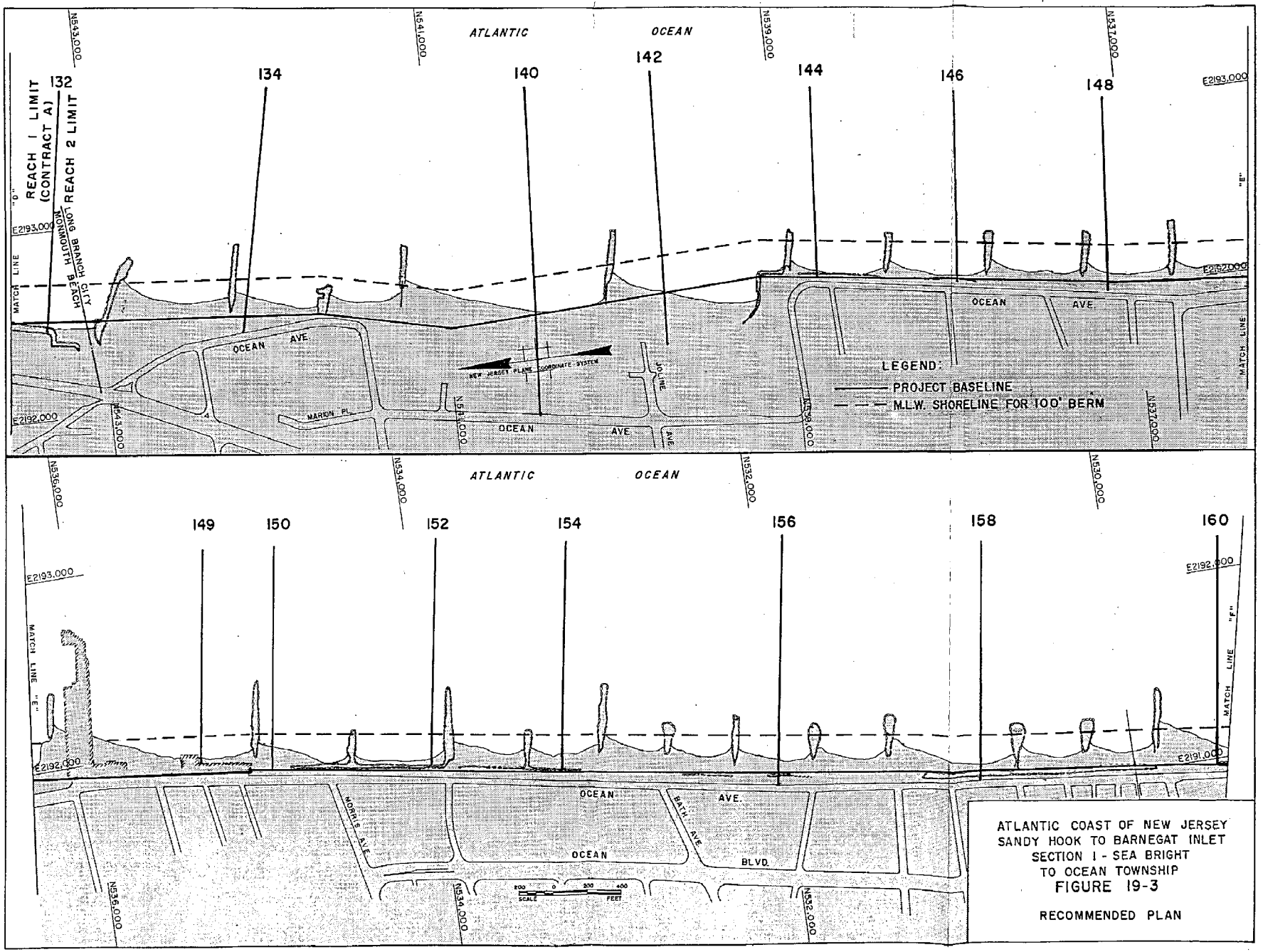


ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
SECTION I - SEA BRIGHT
TO OCEAN TOWNSHIP
FIGURE 19-1
RECOMMENDED PLAN



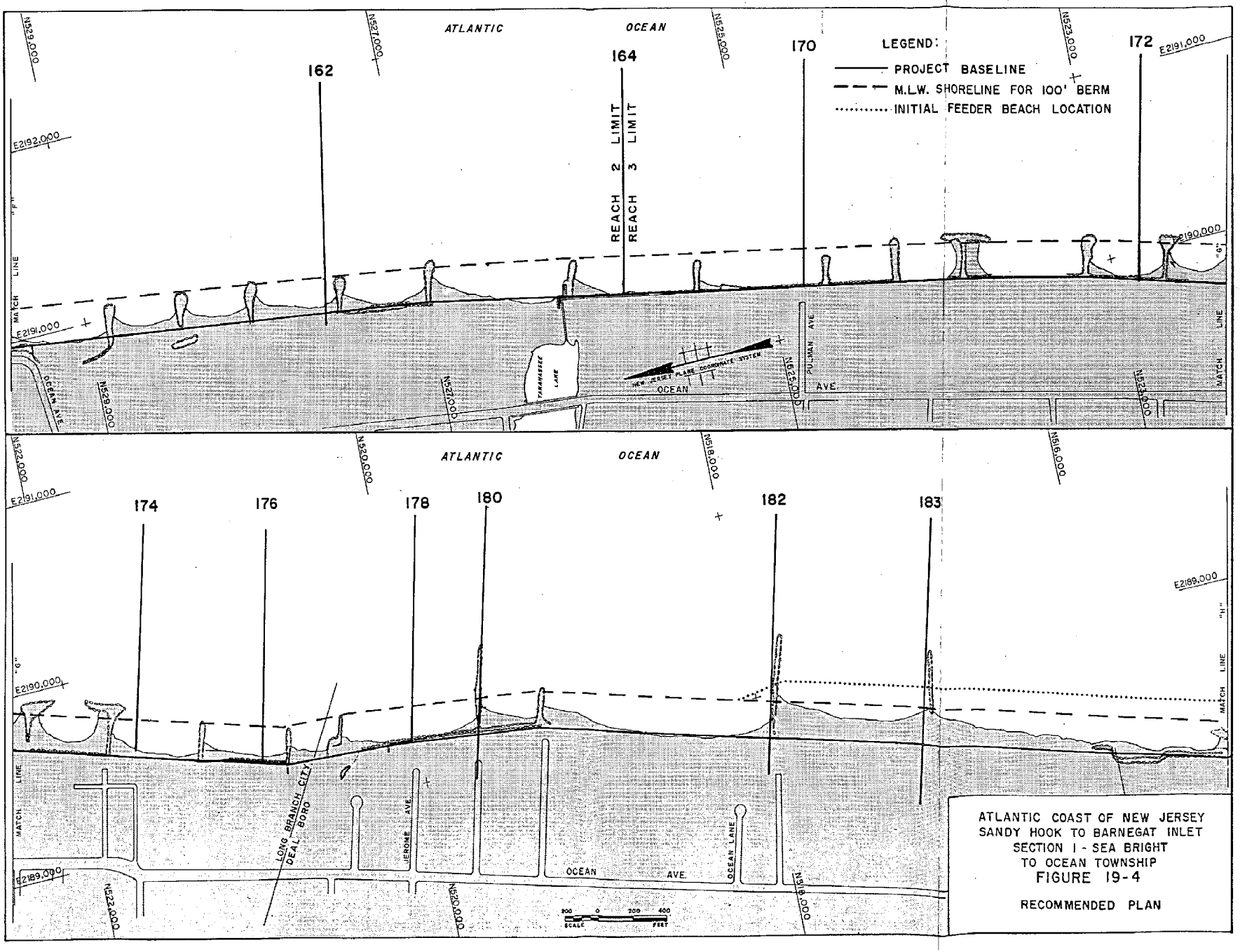
ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
SECTION I - SEA BRIGHT
TO OCEAN TOWNSHIP
FIGURE 19-2

RECOMMENDED PLAN



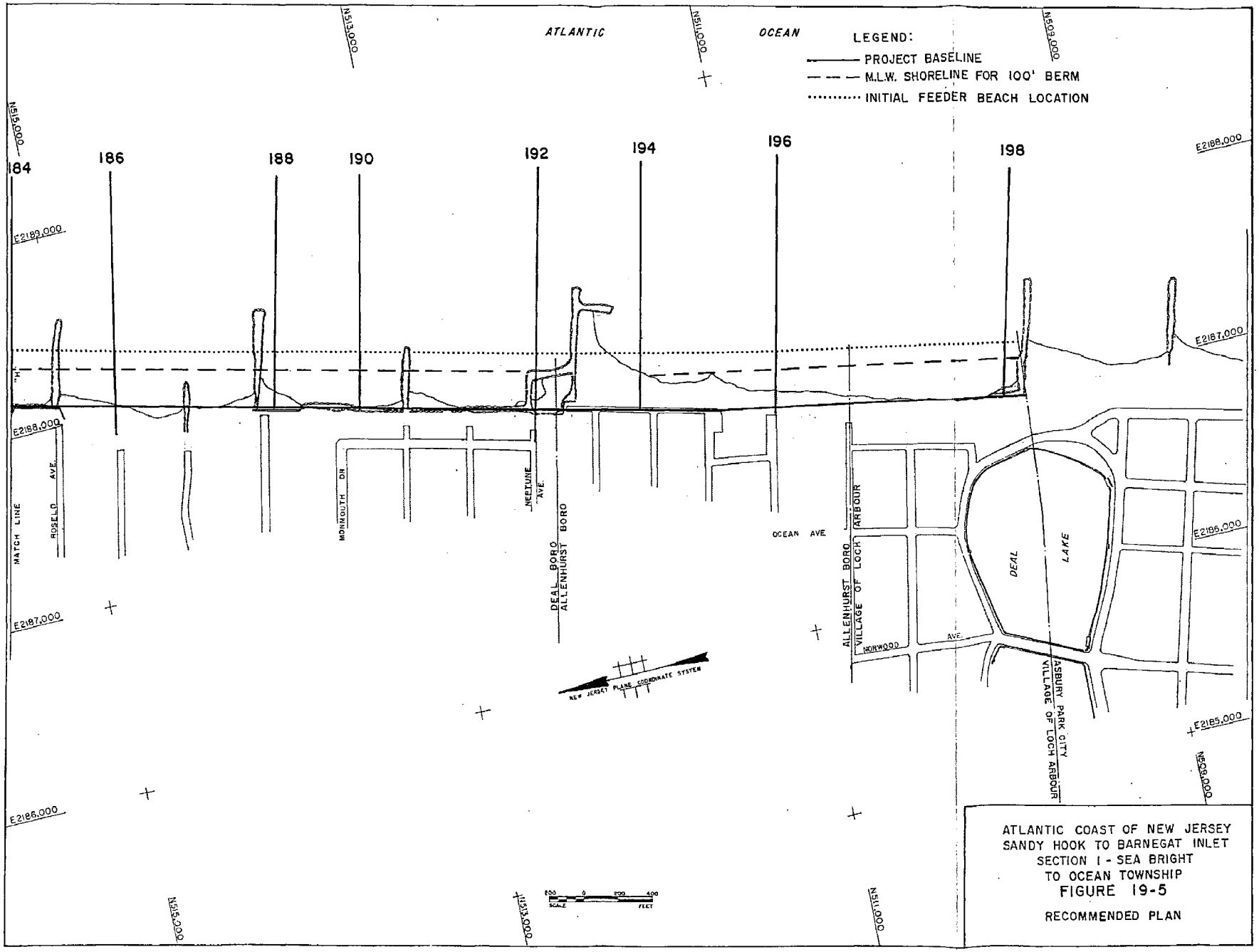
ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
SECTION 1 - SEA BRIGHT
TO OCEAN TOWNSHIP
FIGURE 19-3

RECOMMENDED PLAN



ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
SECTION 1 - SEA BRIGHT
TO OCEAN TOWNSHIP
FIGURE 19-4

RECOMMENDED PLAN



ATLANTIC COAST OF NEW JERSEY
SANDY HOOK TO BARNEGAT INLET
SECTION I - SEA BRIGHT
TO OCEAN TOWNSHIP
FIGURE 19-5

RECOMMENDED PLAN

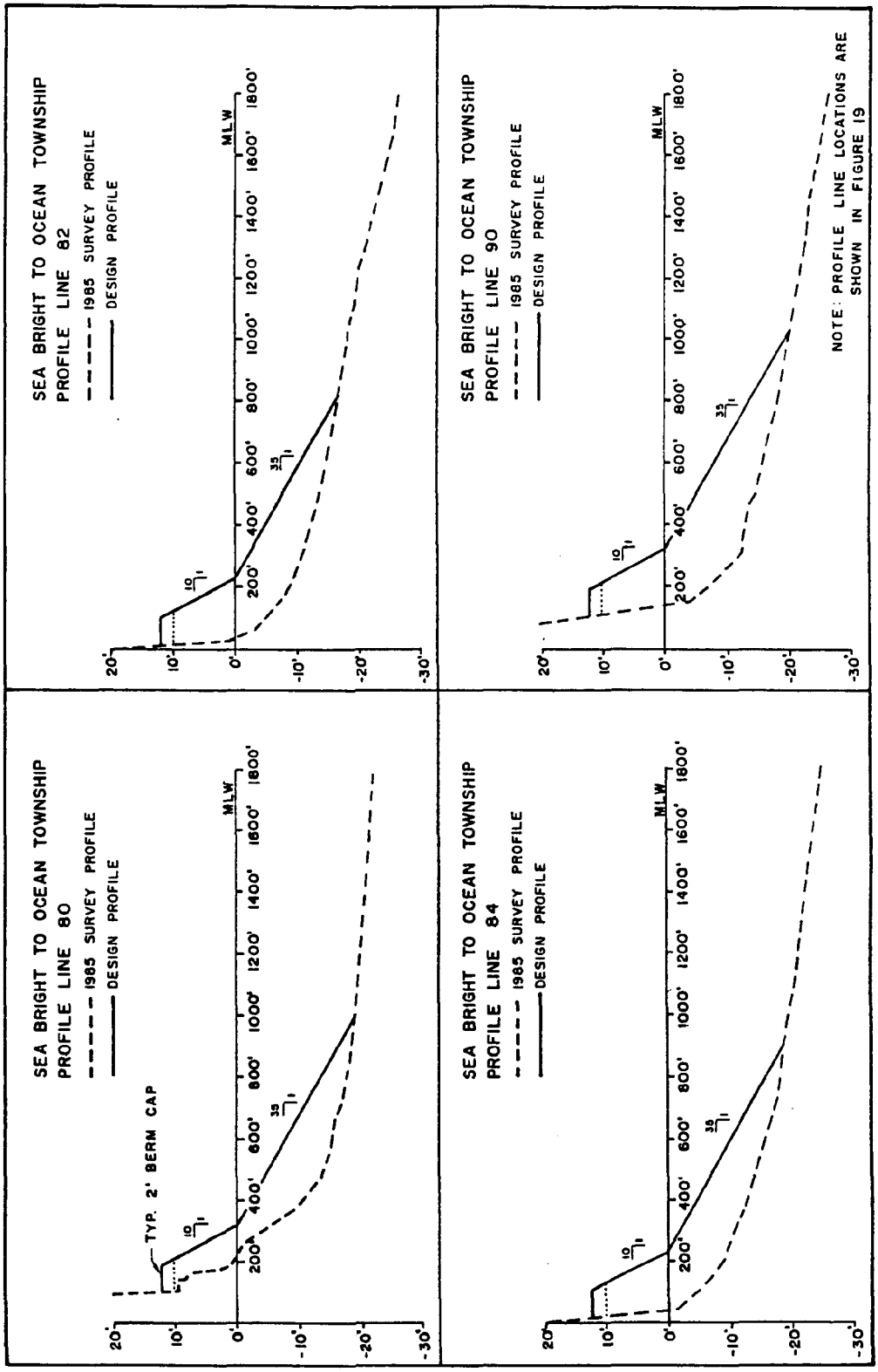


FIGURE 20-1

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

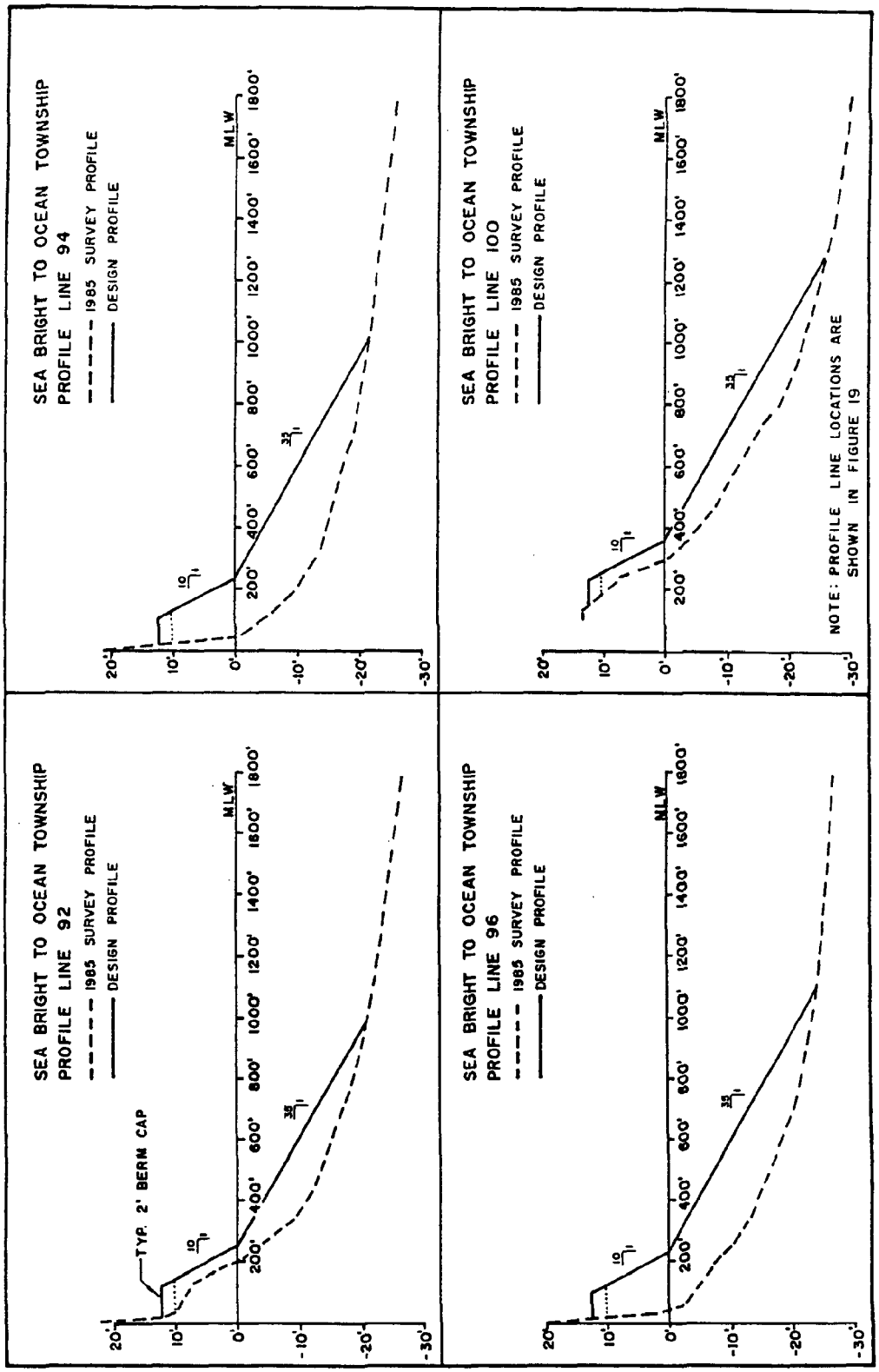


FIGURE 20-2

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN (100 FT. BERM WITH 2 FT. CAP)

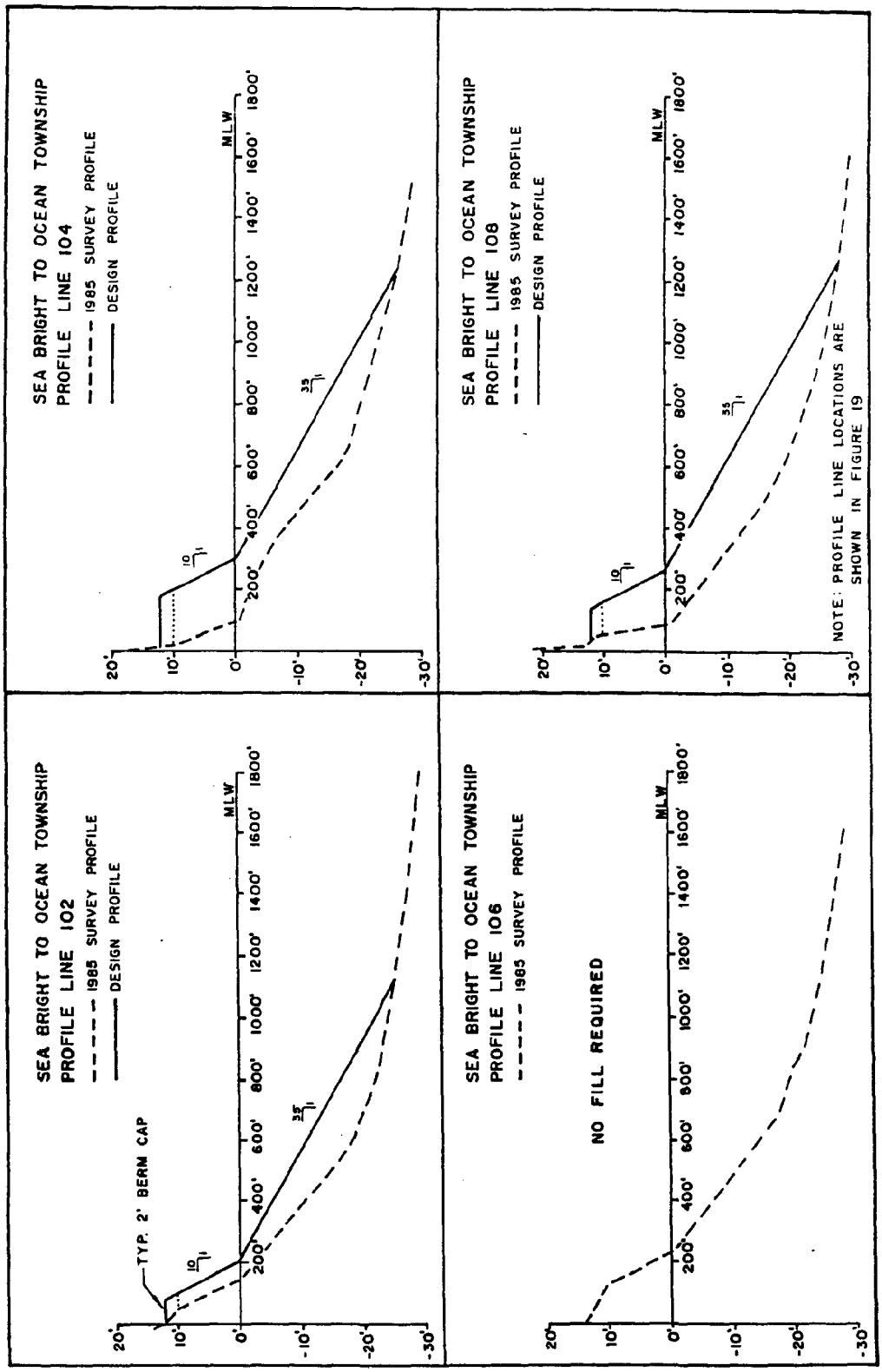


FIGURE 20-3

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

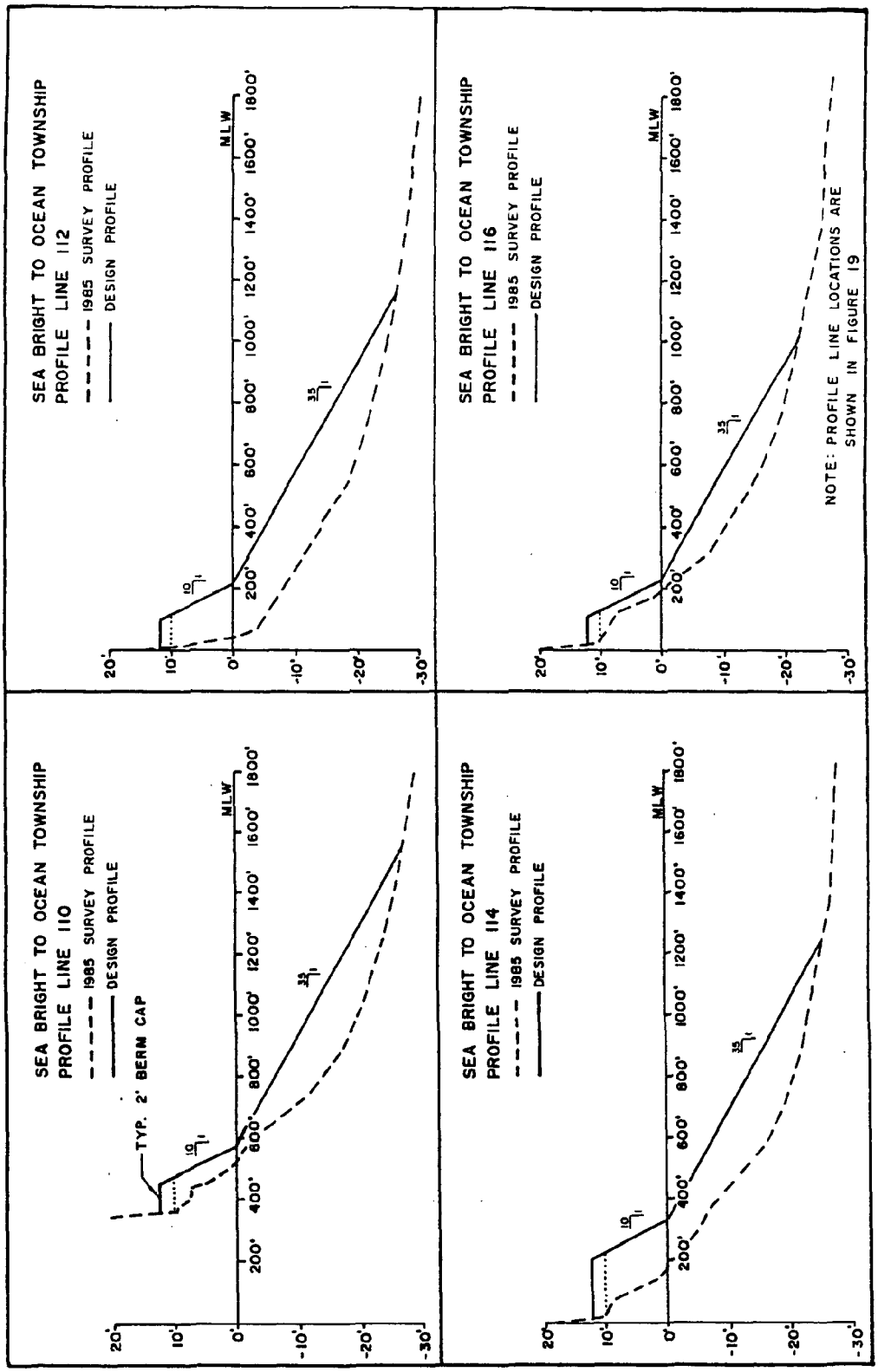


FIGURE 20-4

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

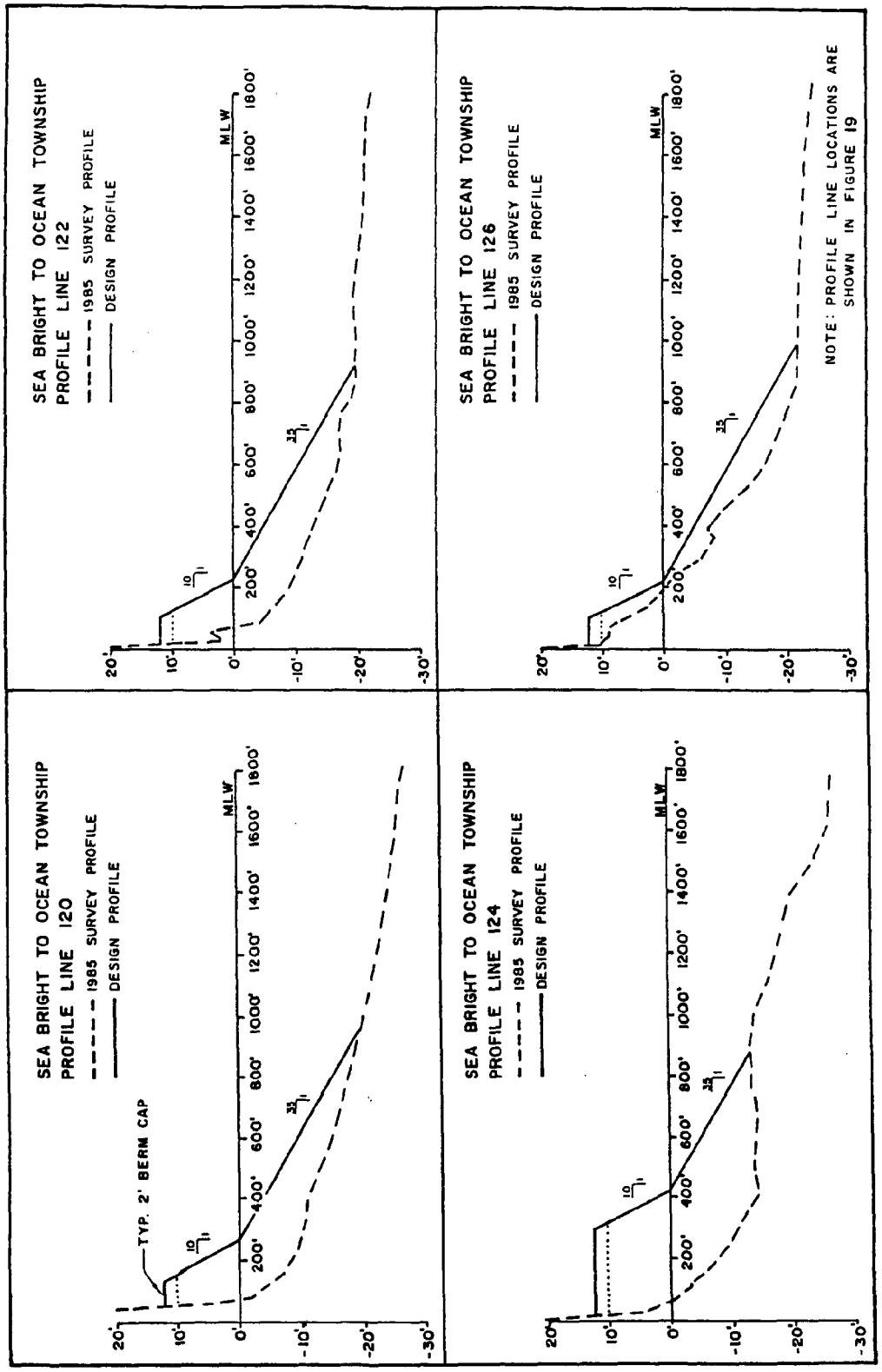


FIGURE 20-5

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

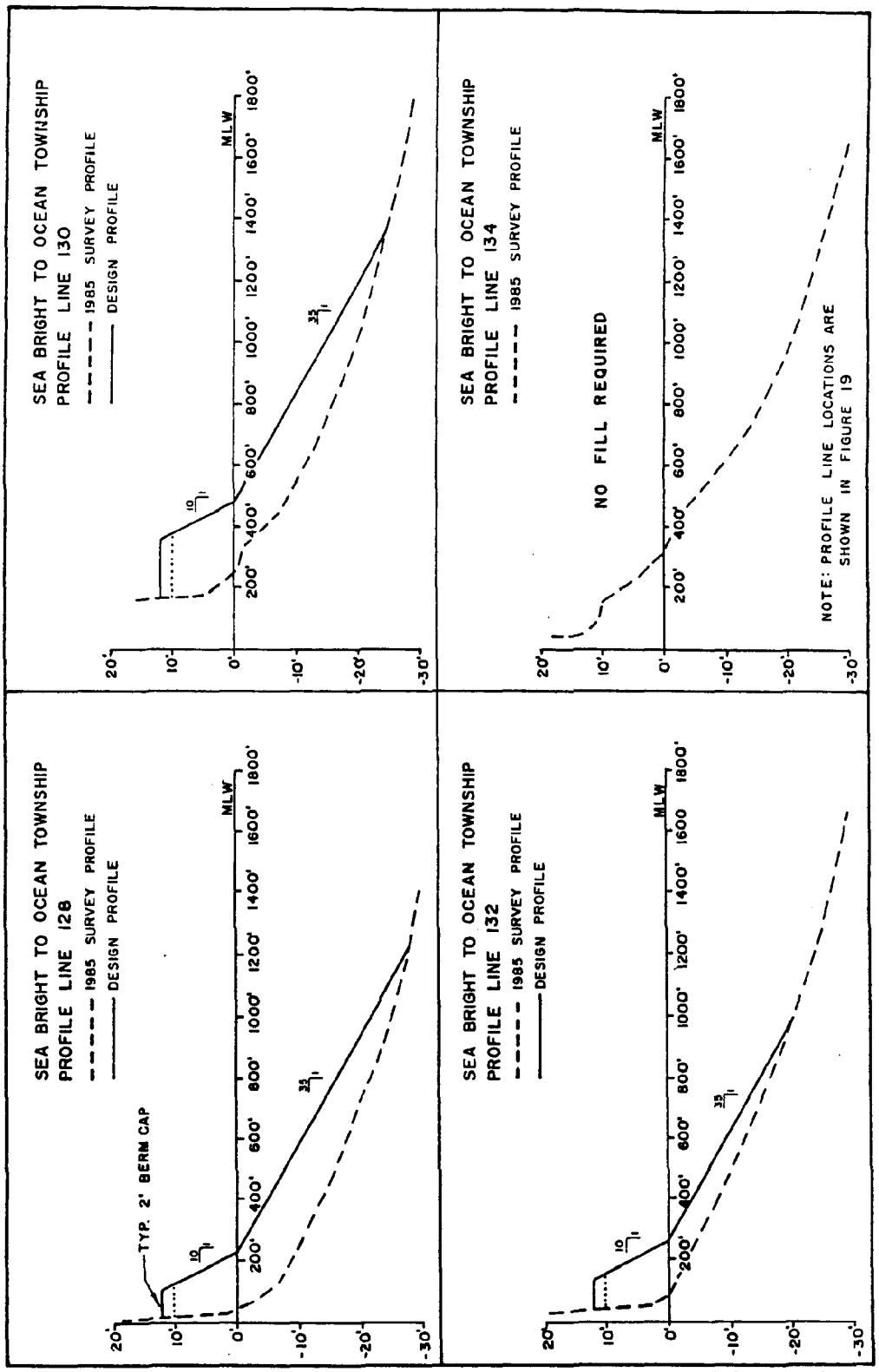


FIGURE 20-6

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

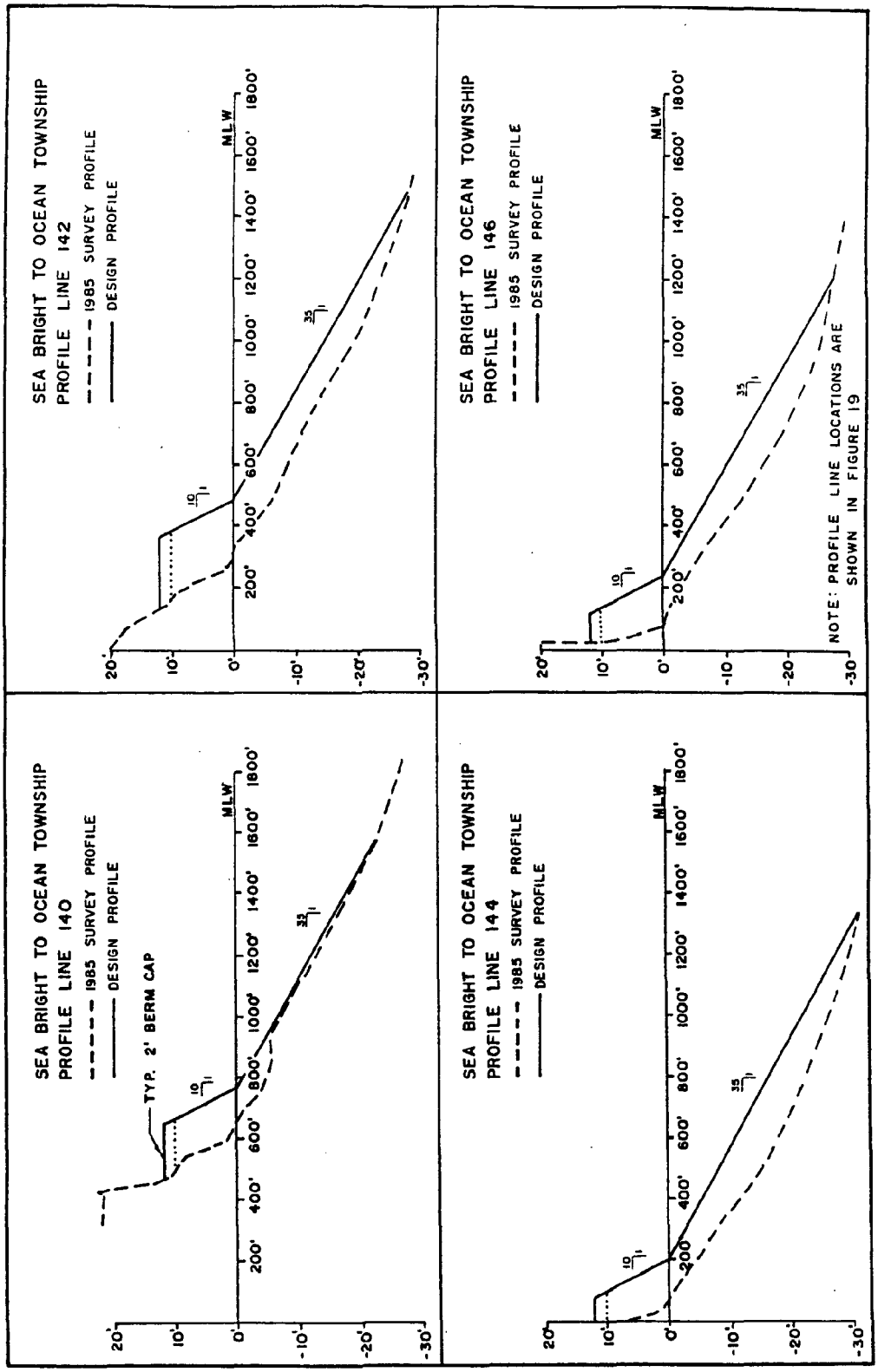


FIGURE 20-7

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

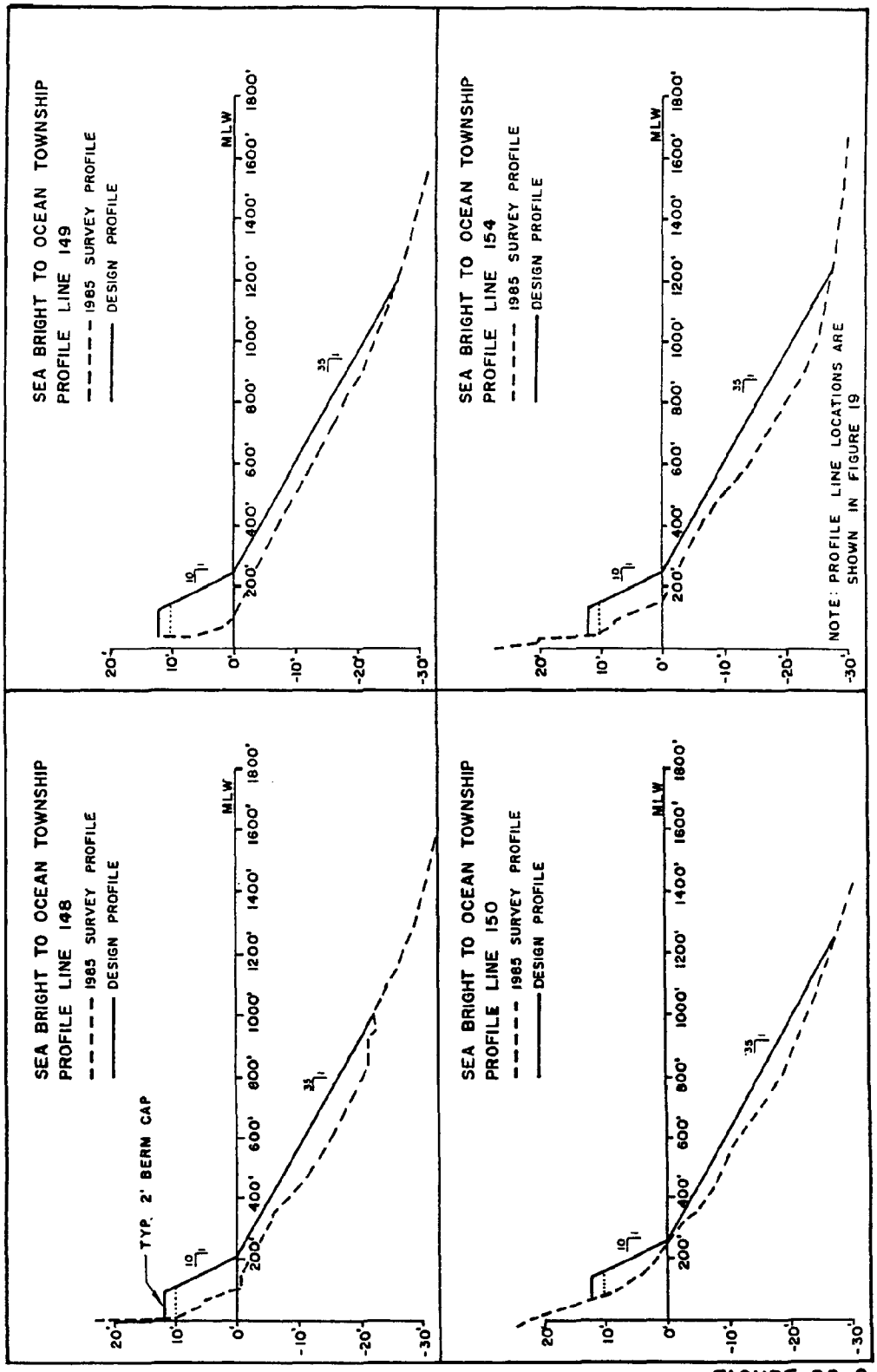


FIGURE 20-8

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

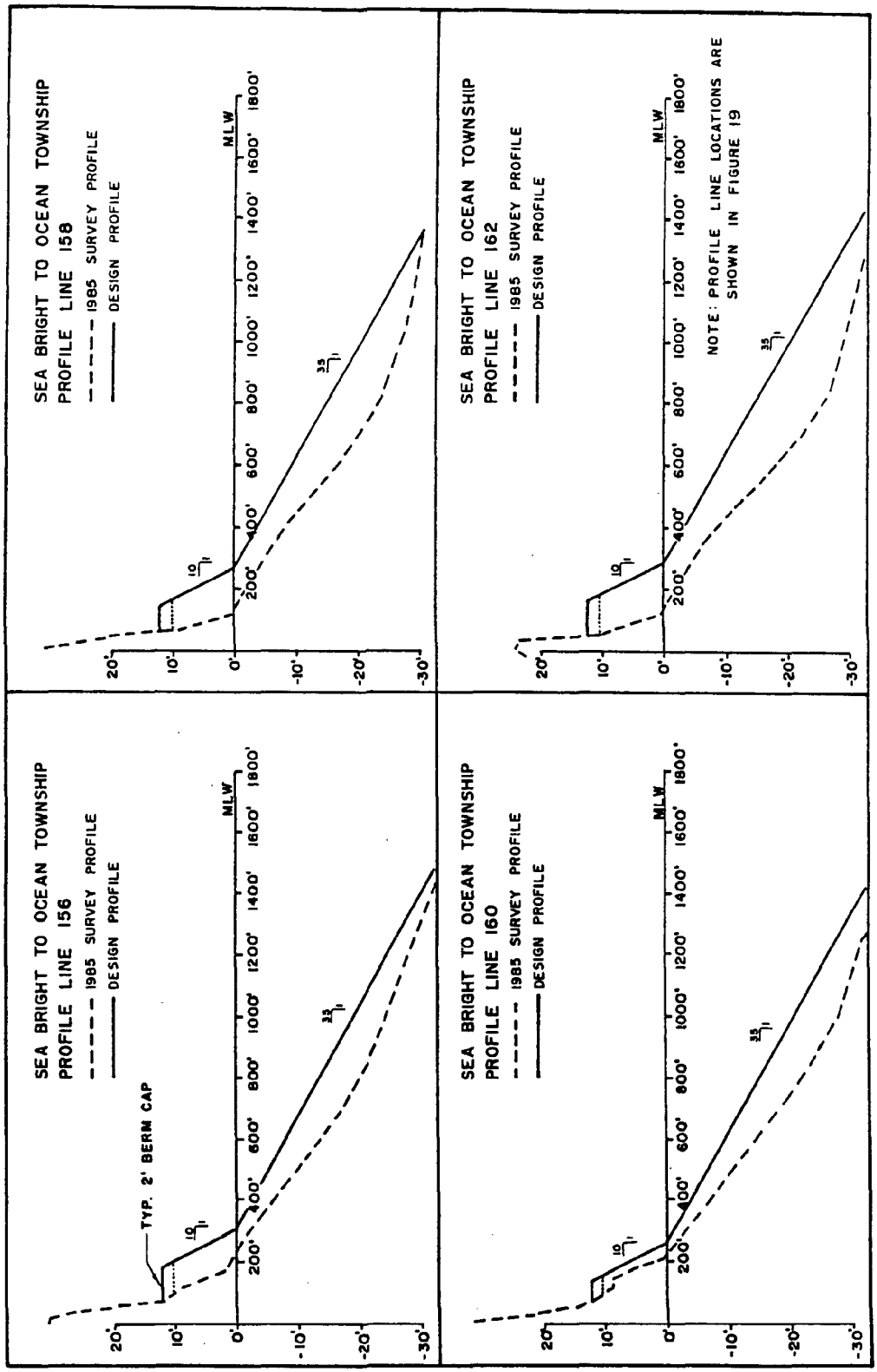


FIGURE 20-9

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

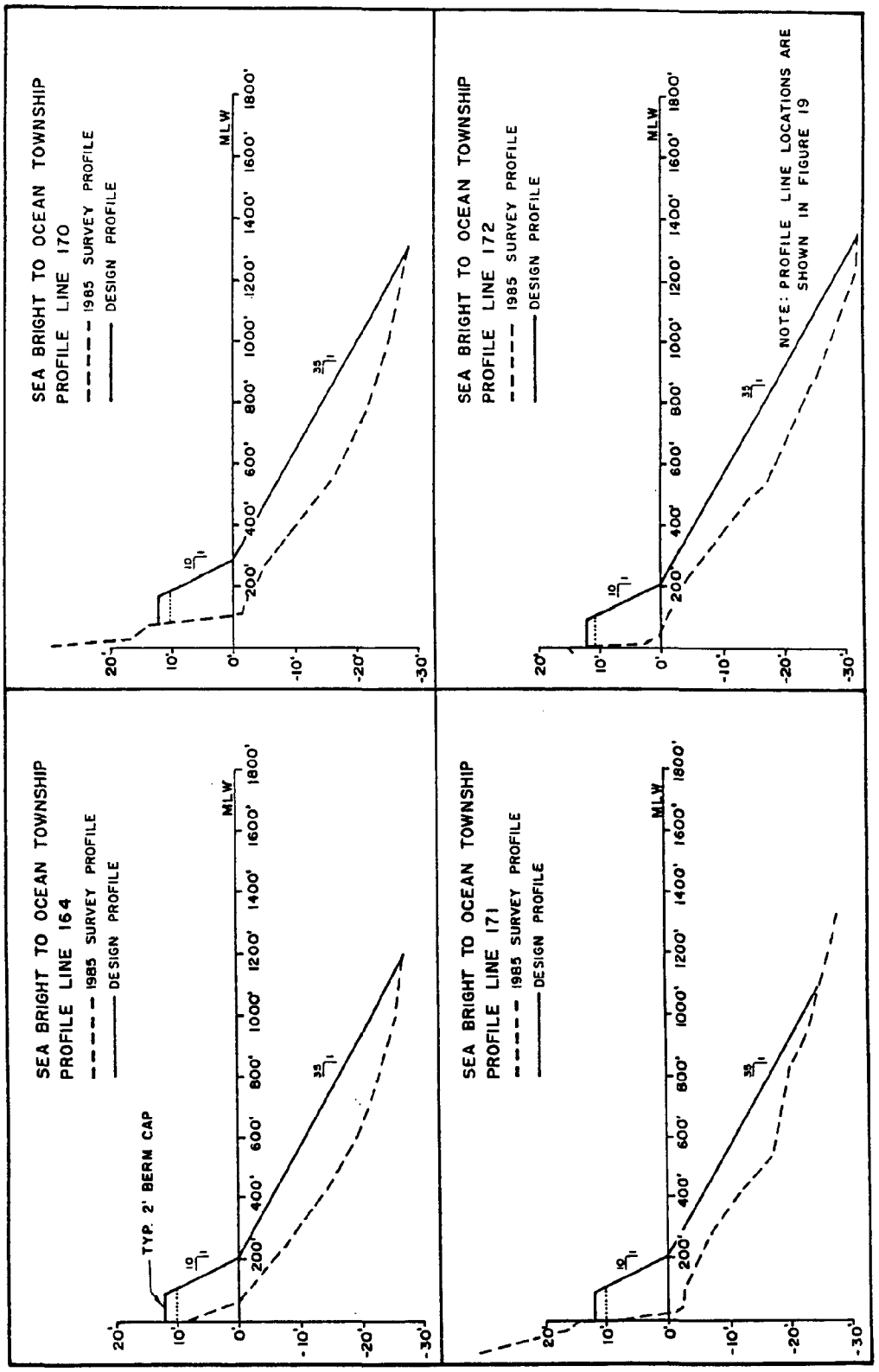


FIGURE 20-10

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

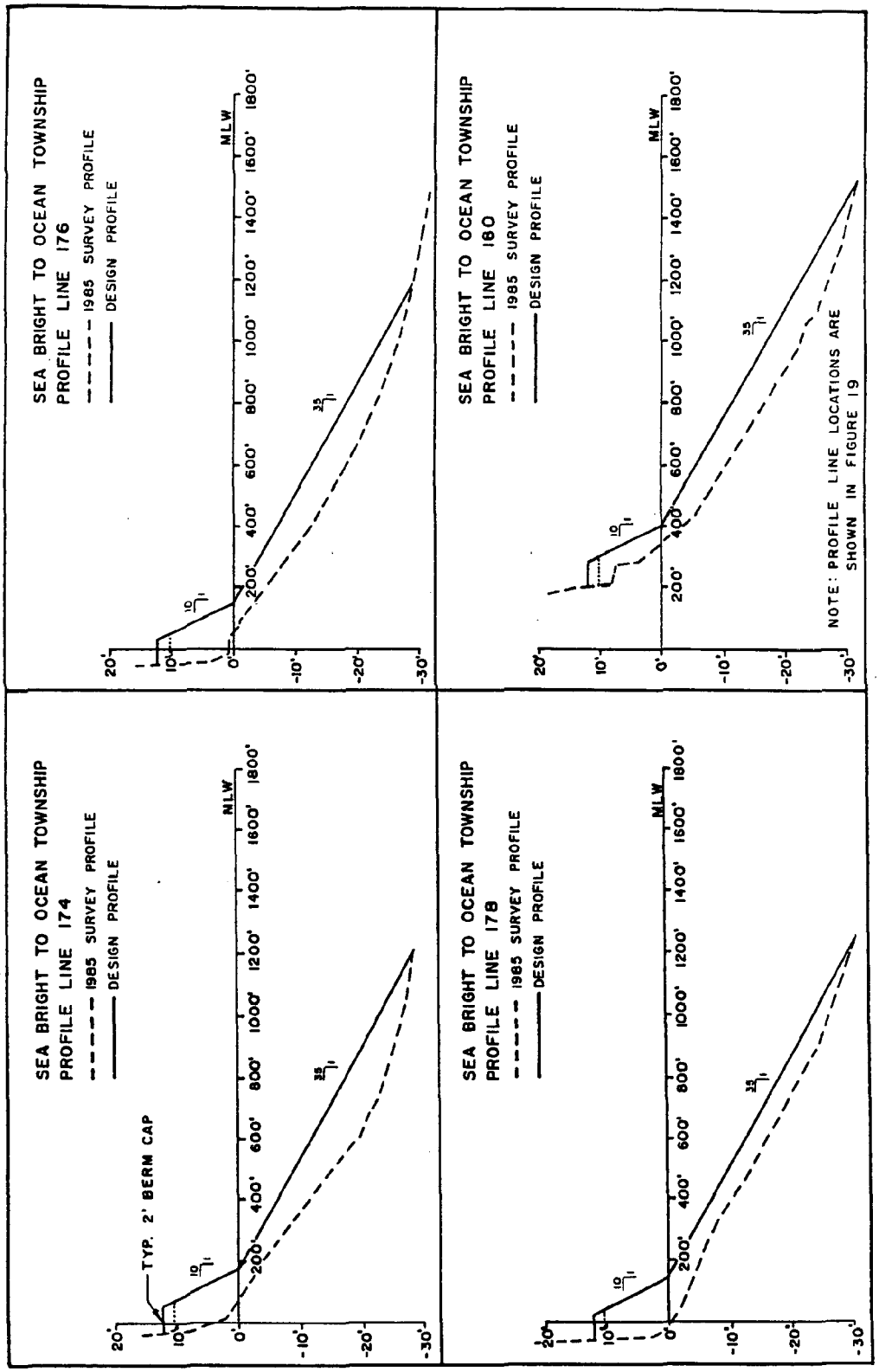


FIGURE 20-11

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

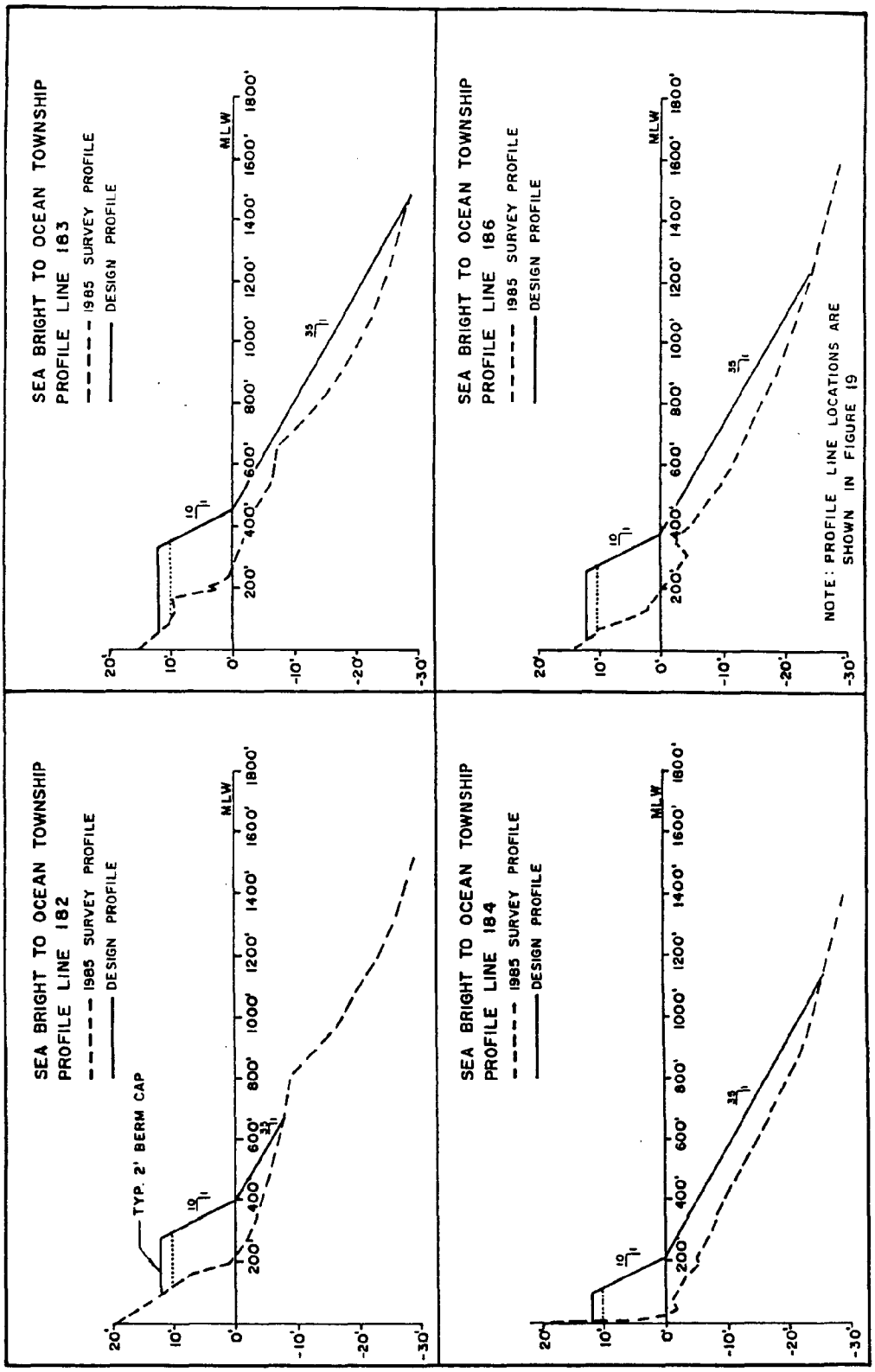


FIGURE 20-12

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

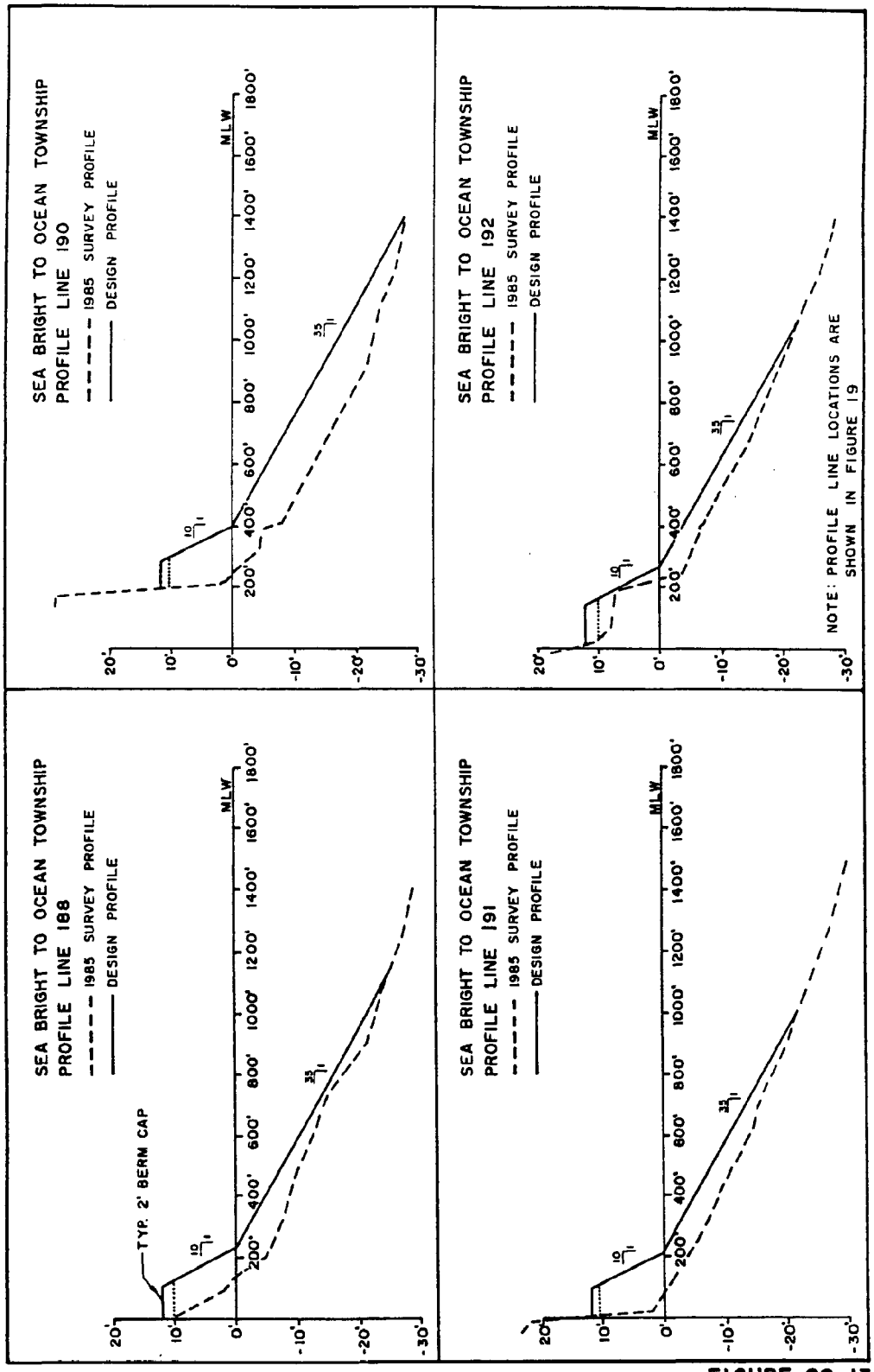


FIGURE 20-13

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)

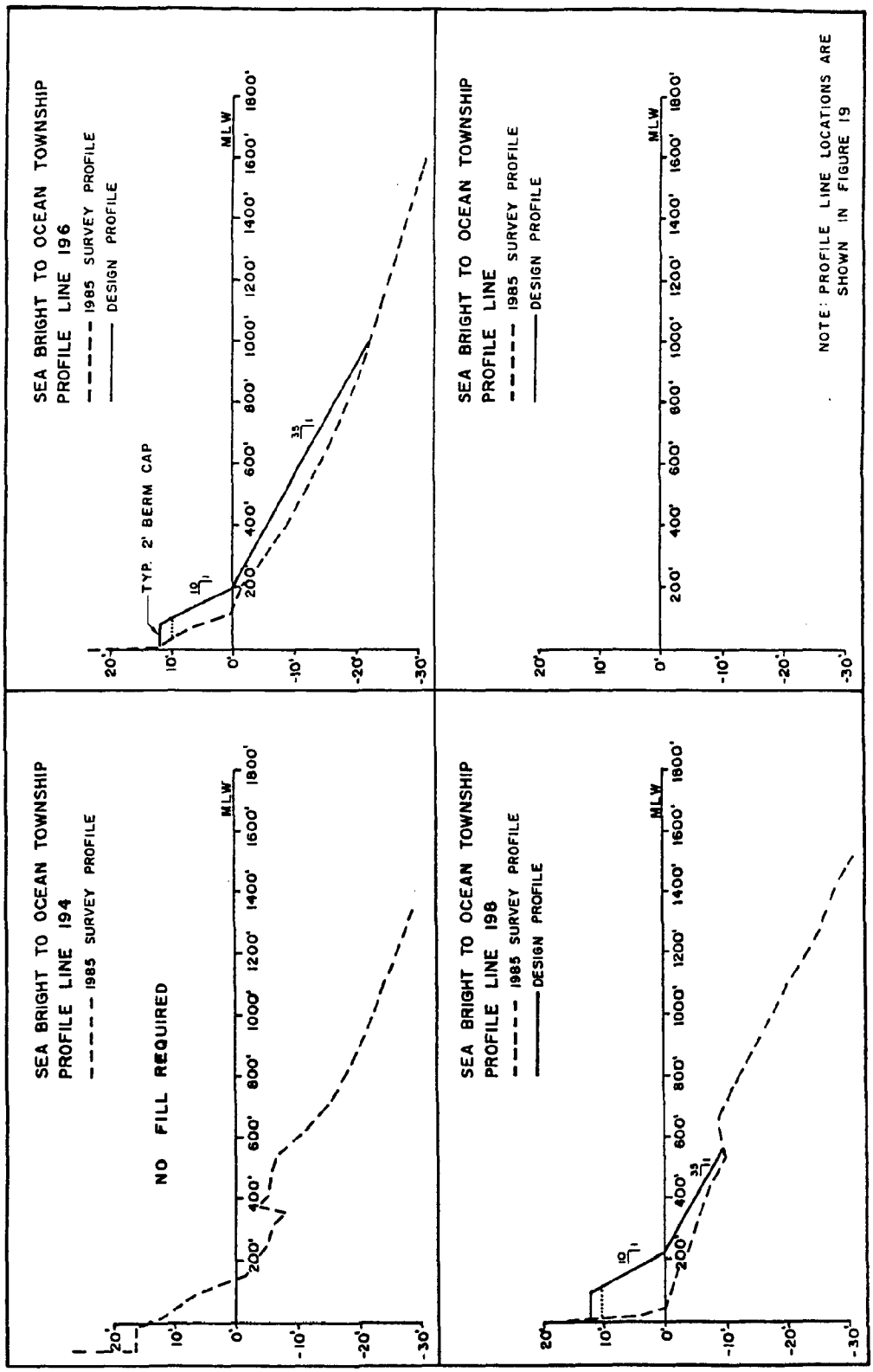
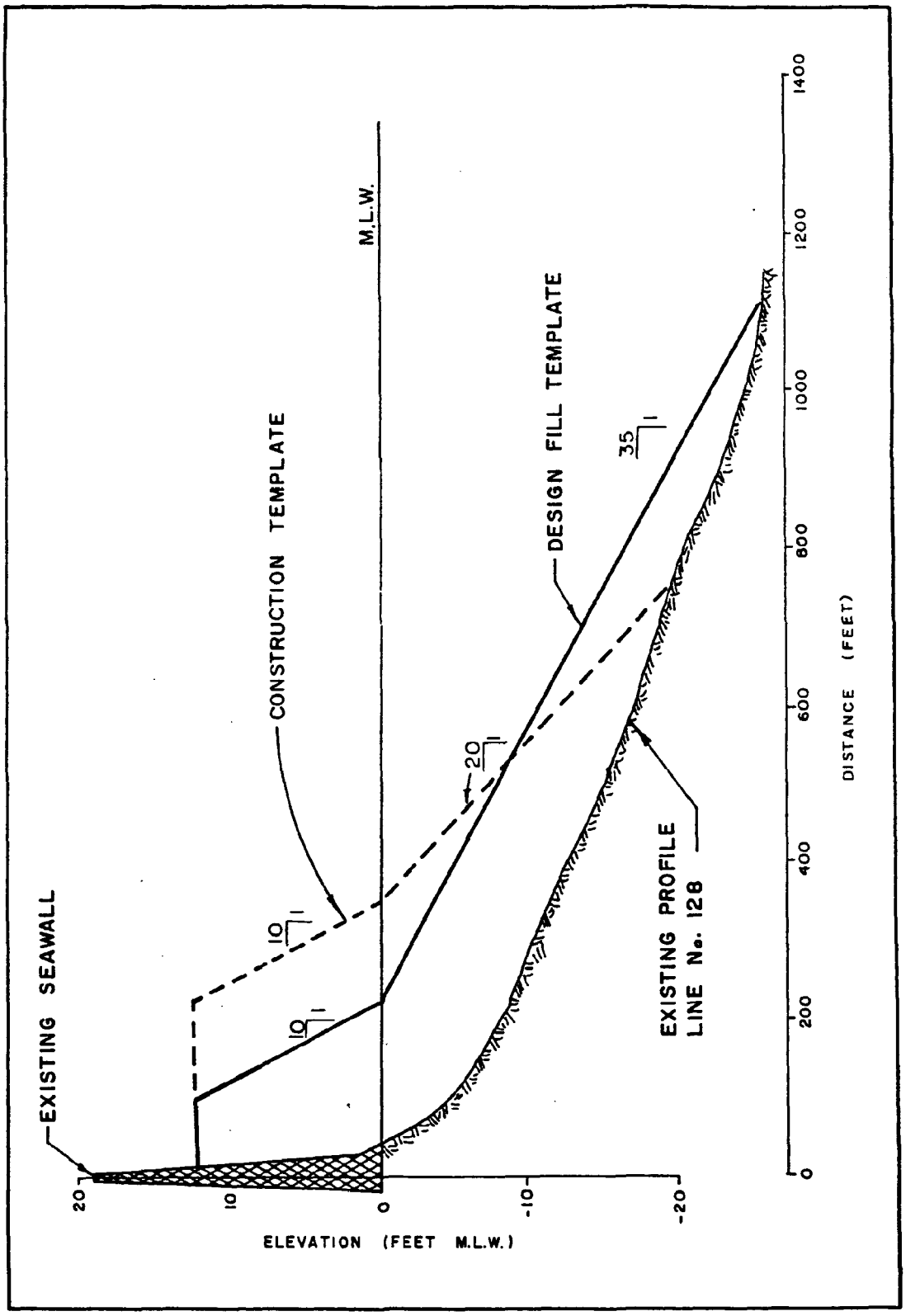


FIGURE 20-14

EXISTING AND DESIGN PROFILES FOR RECOMMENDED PLAN

(100 FT. BERM WITH 2 FT. CAP)



TYPICAL CONSTRUCTION TEMPLATE FIGURE 21

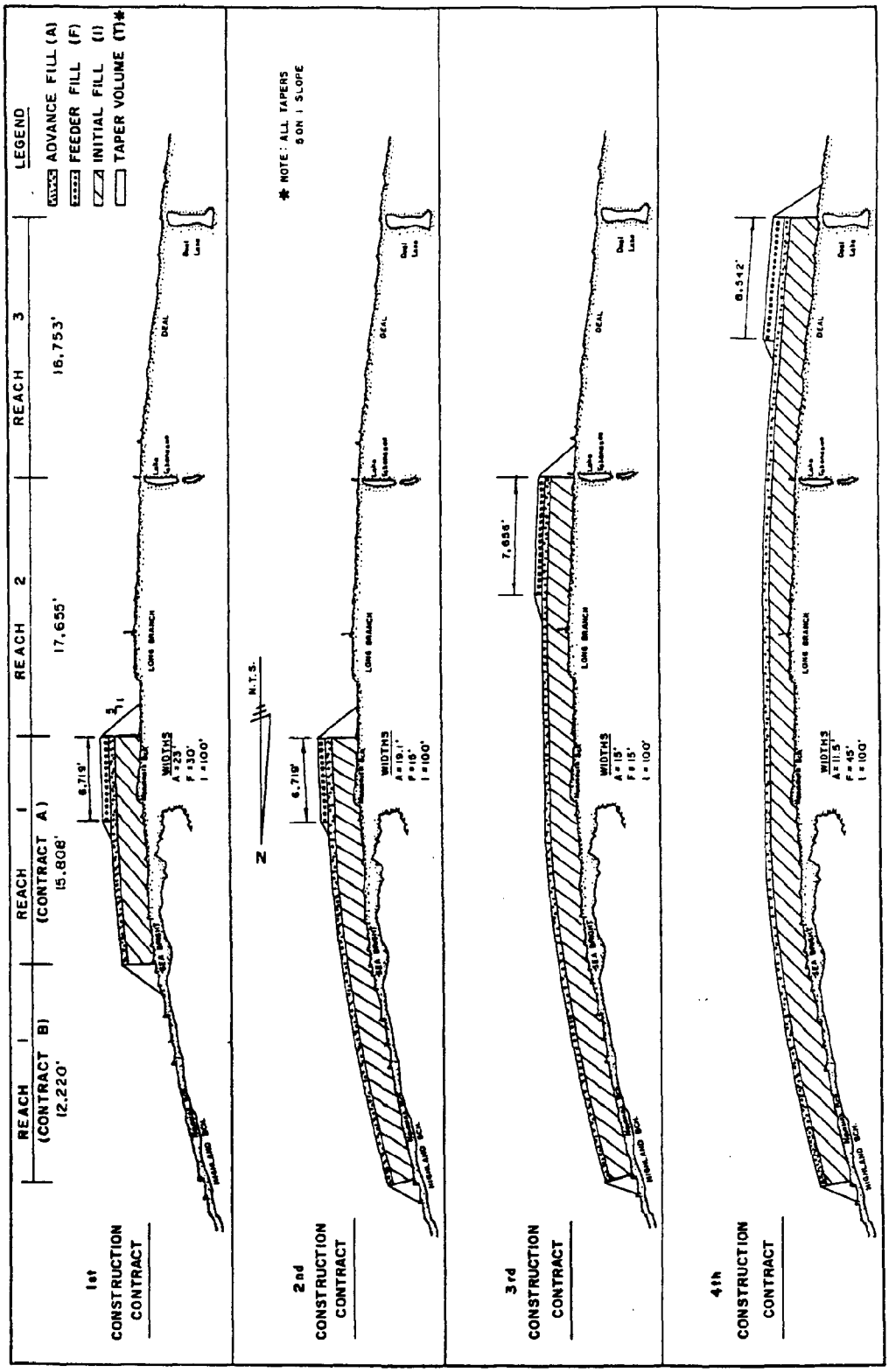
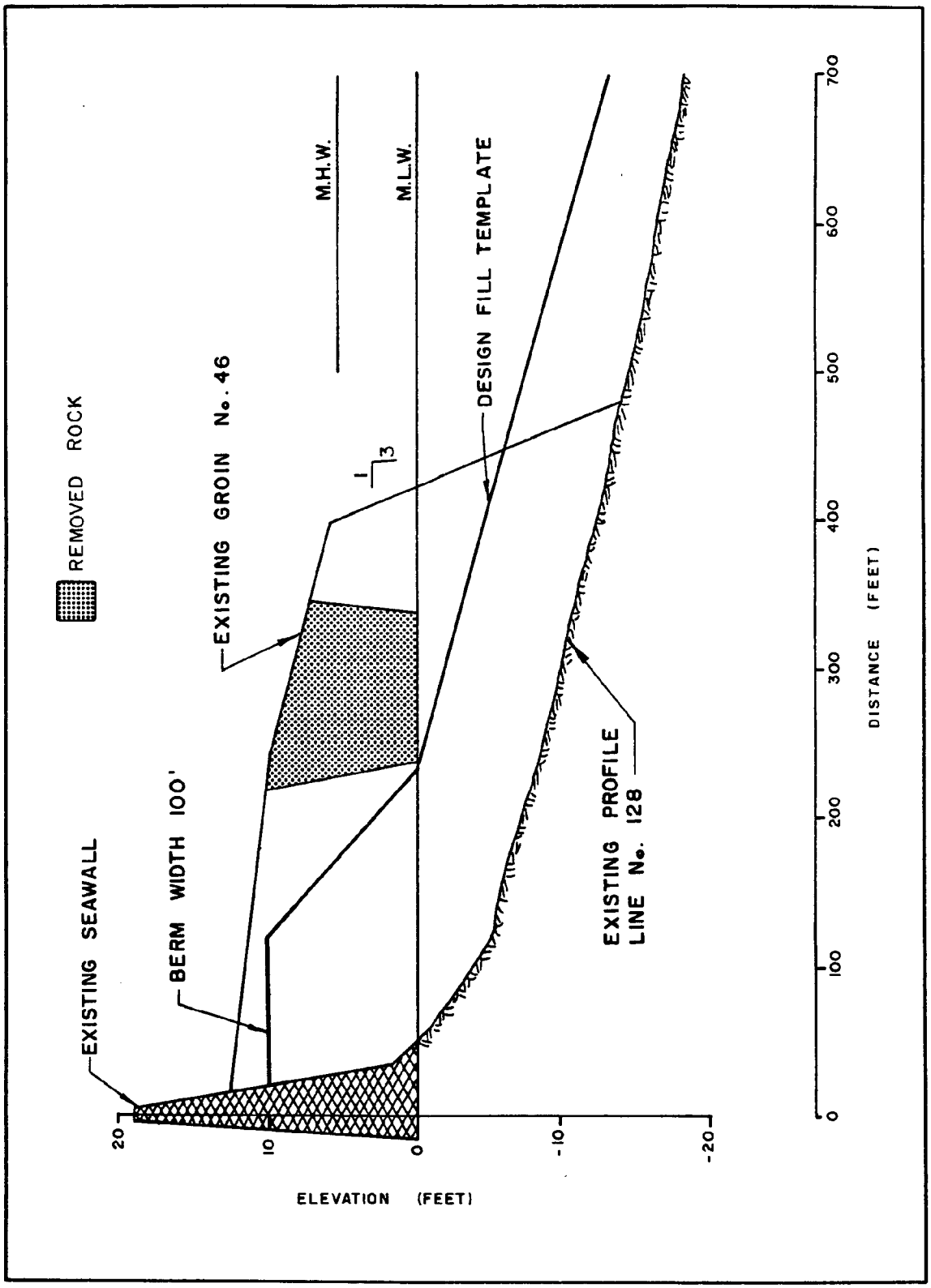


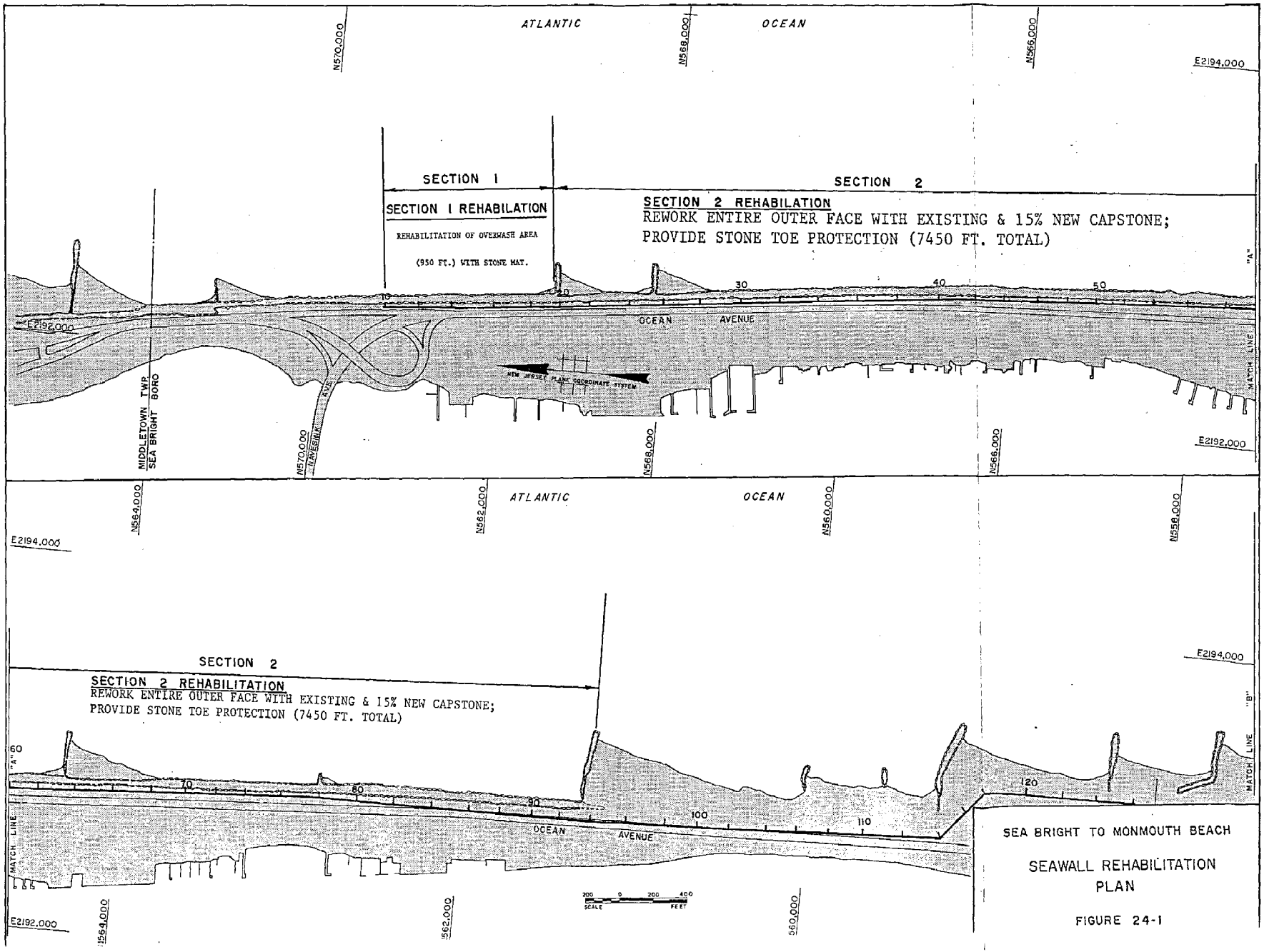
FIGURE 22

SEQUENCE OF CONSTRUCTION FOR RECOMMENDED PLAN
(CONTINUOUS PROJECT CONSTRUCTED IN PHASES)



NOTCHED GROIN CROSS-SECTION

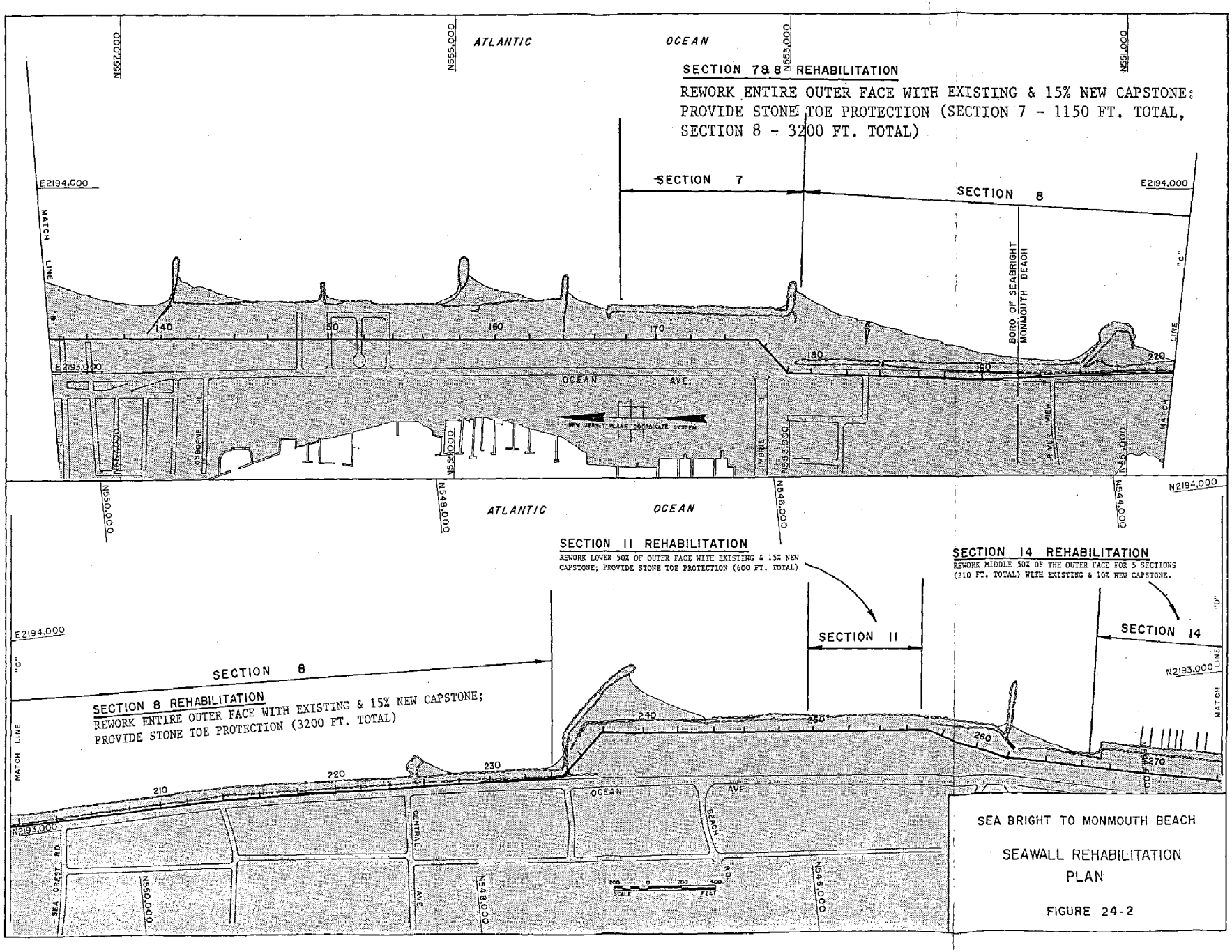
FIGURE 23



SEA BRIGHT TO MONMOUTH BEACH

SEAWALL REHABILITATION PLAN

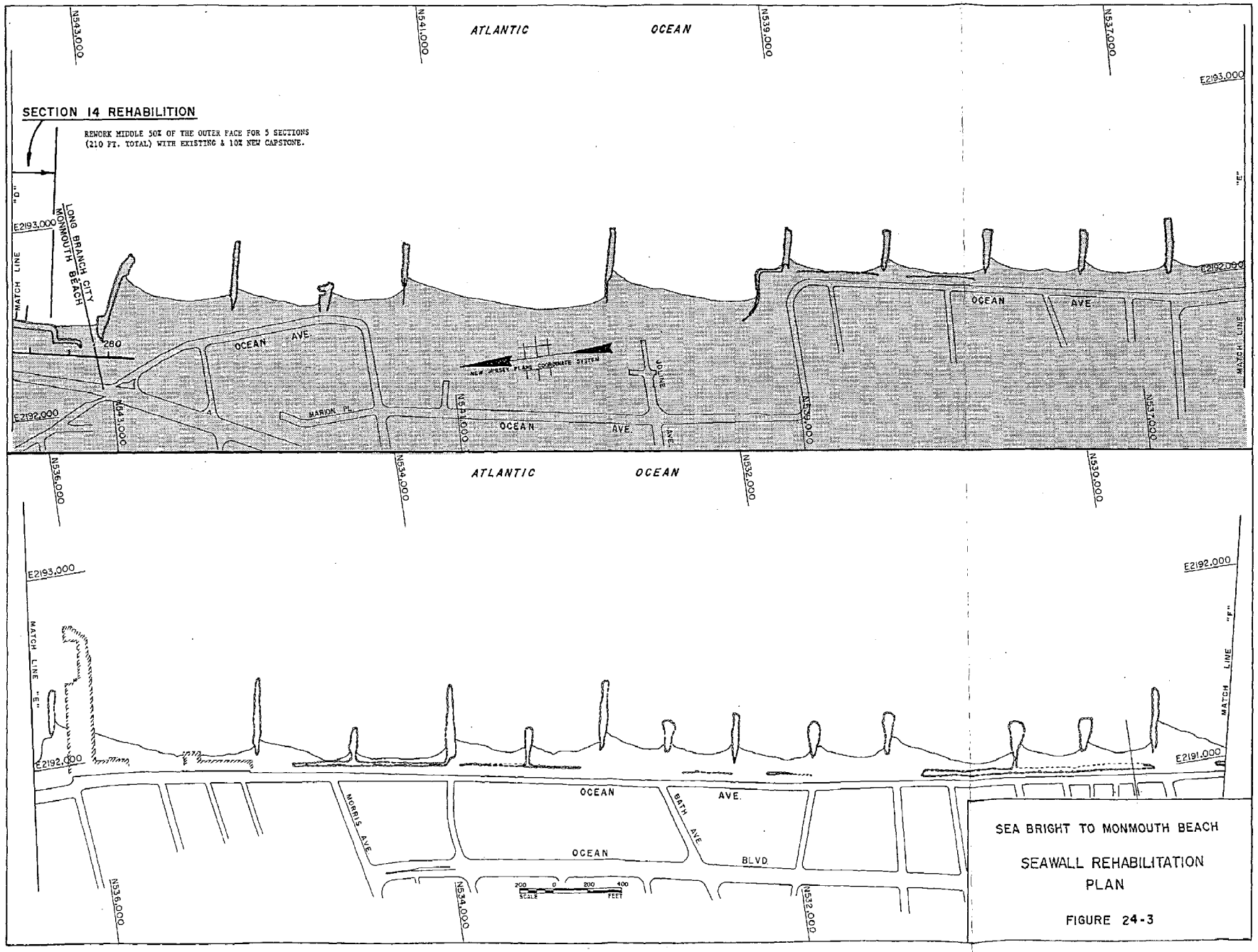
FIGURE 24-1



SEA BRIGHT TO MONMOUTH BEACH

SEAWALL REHABILITATION PLAN

FIGURE 24-2



SEA BRIGHT TO MONMOUTH BEACH

SEAWALL REHABILITATION PLAN

FIGURE 24-3

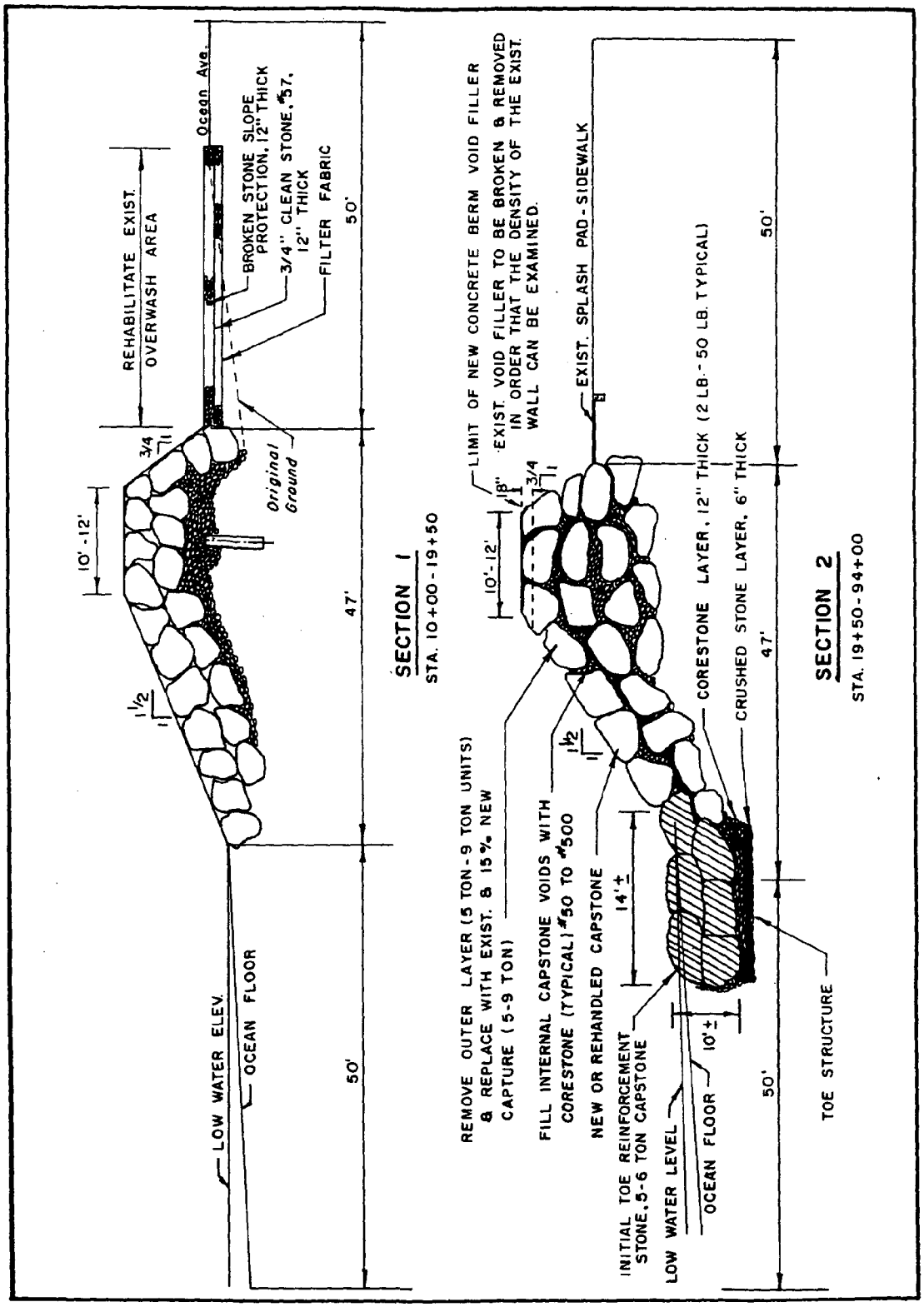


FIGURE 24-4

SEA BRIGHT TO MONMOUTH BEACH
SEAWALL REHABILITATION
TYPICAL CROSS SECTION

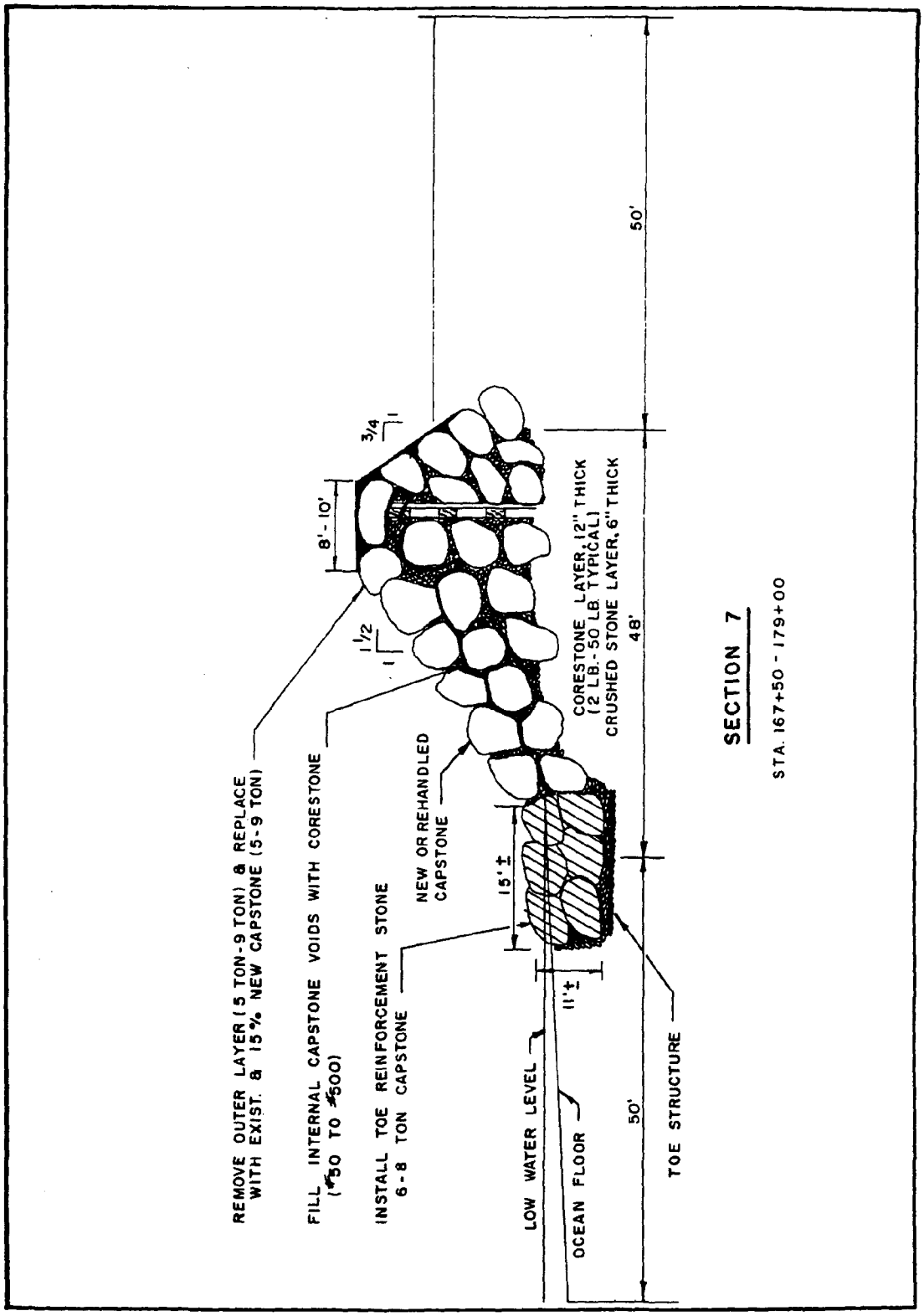


FIGURE 24-5

SEA BRIGHT TO MONMOUTH BEACH
SEAWALL REHABILITATION
TYPICAL CROSS SECTION

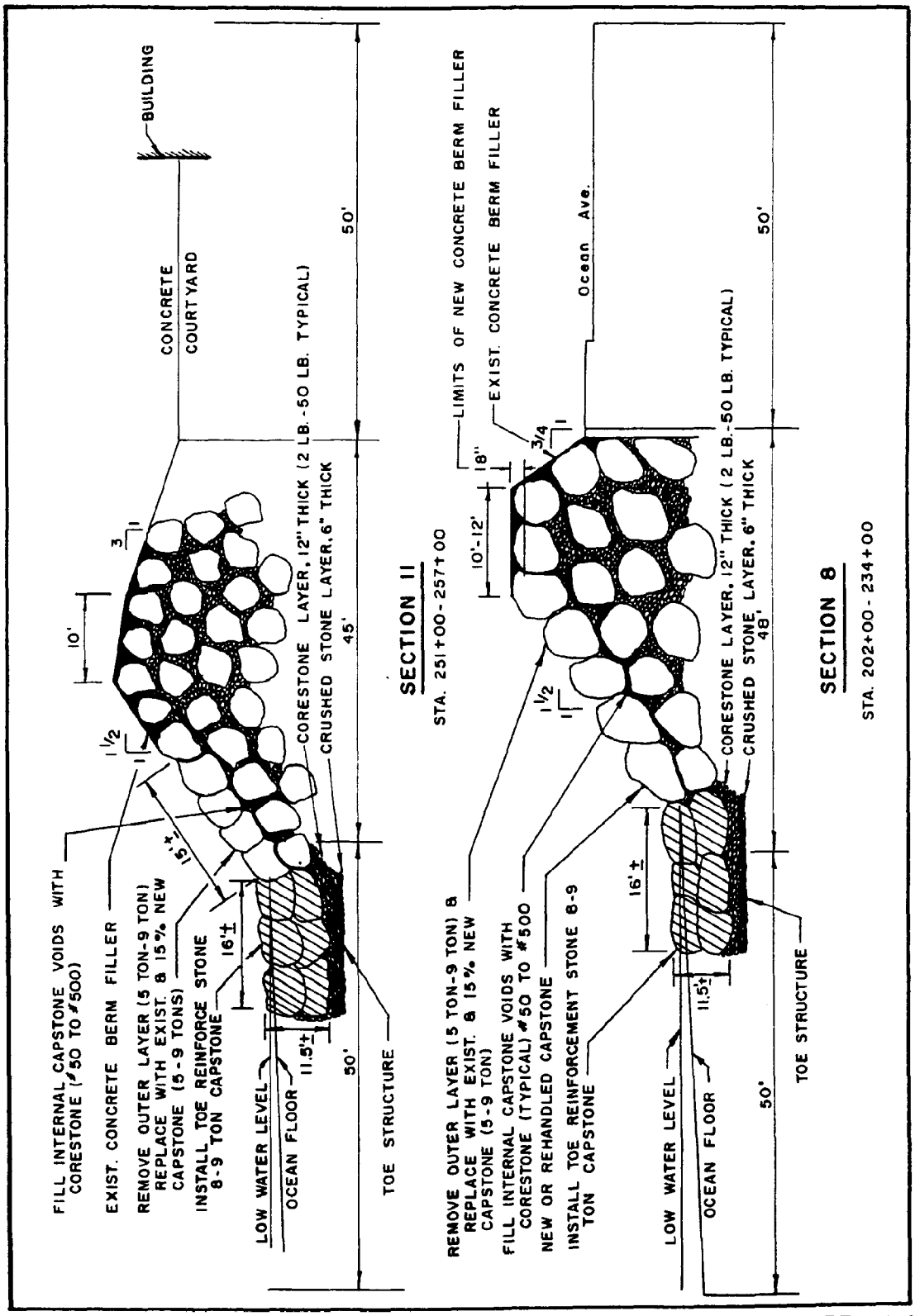


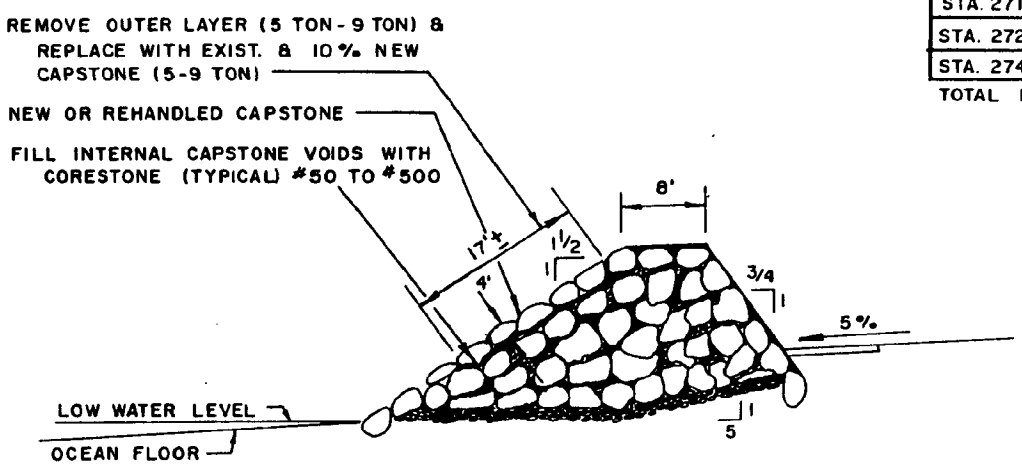
FIGURE 24-6

SEA BRIGHT TO MONMOUTH BEACH
SEAWALL REHABILITATION
TYPICAL CROSS SECTION

REHABILITATION SCHEDULE

STATION	LENGTH	WIDTH	DEPTH
STA. 269+50± TO 270+00±	50'	17'	4'±
STA. 270+60± TO 270+90±	30'	17'	4'±
STA. 271+35± TO 271+65±	30'	17'	4'±
STA. 272+50± TO 273+00±	50'	17'	4'±
STA. 274+25± TO 274+75±	50'	17'	4'±

TOTAL LENGTH WORK THIS SECTION = 210'



SECTION 14

STA. 267+00 - 277+00

SEA BRIGHT TO MONMOUTH BEACH
SEAWALL REHABILITATION
TYPICAL CROSS SECTION

FIGURE 24-7

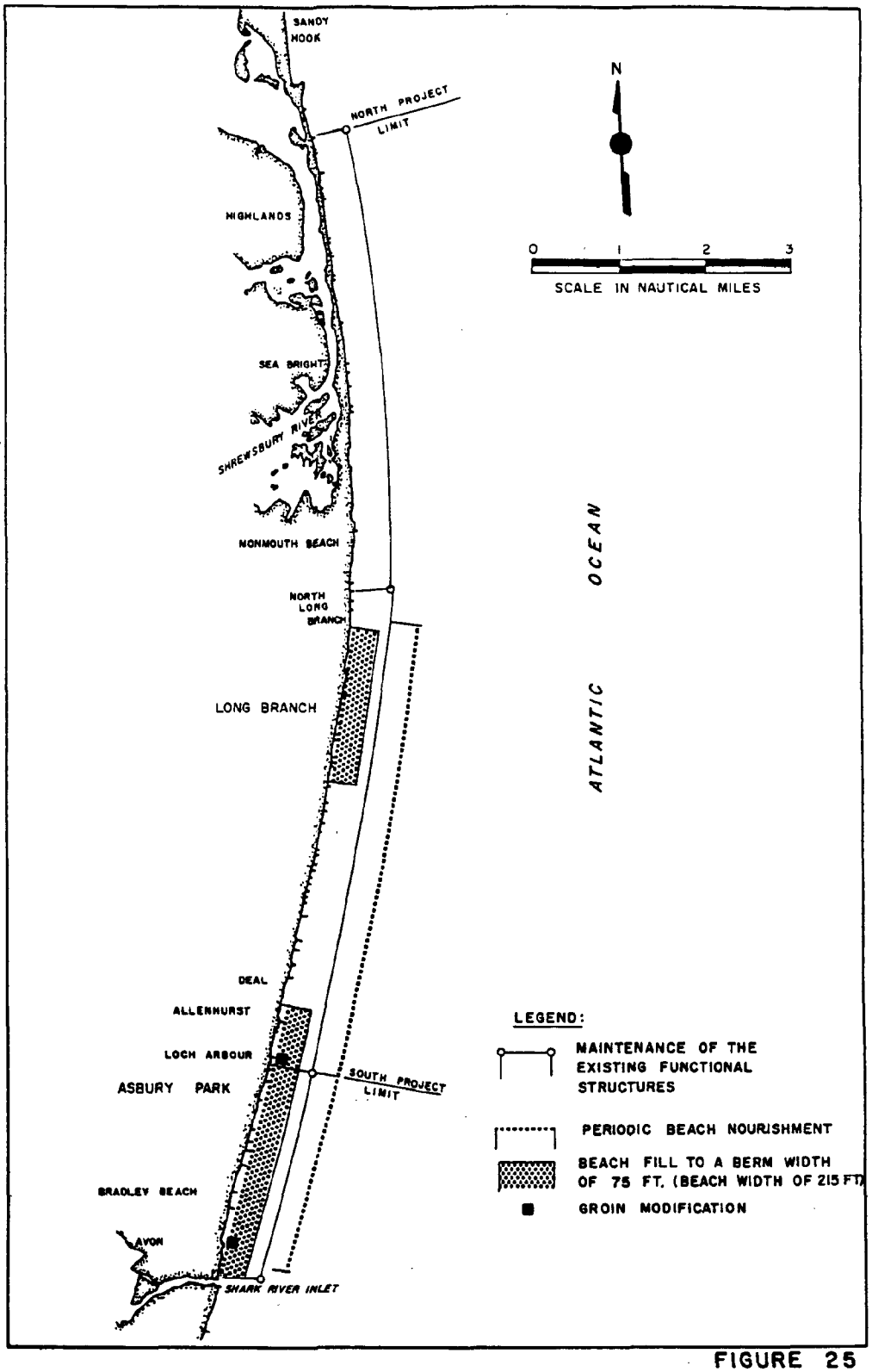


FIGURE 25

NEW JERSEY STATE MASTER PLAN

SEA BRIGHT TO OCEAN TOWNSHIP, NEW JERSEY
BEACH EROSION CONTROL PROJECT
CONSTRUCTION AND EXPENDITURE SCHEDULE (DOLLARS) SEPTEMBER 1987 PRICE LEVEL

	PRIOR YEARS	1987 (J F M A M J J A S O N D)	1988 (J F M A M J J A S O N D)	1989 (J F M A M J J A S O N D)	1990 (J F M A M J J A S O N D)	1991 (J F M A M J J A S O N D)	1992 (J F M A M J J A S O N D)	1993 (J F M A M J J A S O N D)	1994 (J F M A M J J A S O N D)	FIRST COST TOTALS
PREPARATION OF DRAFT GDM	$3,750,000									
REVIEW AND APPROVAL OF FINAL GDM										
PREPARATION OF PLANS & SPECIFICATIONS				$210,000 (REACH 1A)	$210,000 (REACH 1B)	$210,000 (REACH 2)	$210,000 (REACH 3)			
REVIEW & APPROVAL OF PLANS & SPECIFICATIONS										
ADVERTISE, OPEN & EVALUATE BIDS										
ENGINEERING DURING CONSTRUCTION (FEDERAL WORK)					$55,838	$111,564	$121,212	$139,301	$128,447	
ENGINEERING & DESIGN (NON-FEDERAL WORK)			$50,000	$223,345	$8,564	$17,126	$9,218	$44,692	$52,516	$5,551,823
SUPERVISION & ADMINISTRATION	$1,080,000			$60,000	$528,307	$1,417,003	$1,093,163	$1,412,770	$935,030	
A. S, I & A (FEDERAL WORK)	PRE-CONSTRUCTION						CONSTRUCTION $1,191,000*	POST-CONSTRUCTION (5 YEARS)		
B. MONITORING				$46,875	$28,125					
C. S, I & A (NON-FEDERAL WORK)			$20,000	$496,671 PRE-CONSTRUCTION	$103,541	$201,184	$231,979	$322,346	$26,258	$7,703,252
1.) CONSTRUCTION OF RECOMMENDED PLAN										
REACH 1 (CONTRACT A)					$13,224,801	$26,449,603				
REACH 1 (CONTRACT B)						$11,871,637	$5,828,849			
REACH 2							$13,074,828	$26,149,655		
REACH 3								$12,963,129	$25,926,258	$145,488,760**
2.) OUTFALL EXTENSIONS										
REACH 1 (CONTRACT A)					$142,720	$285,439				
REACH 2							$153,621	$307,241		
REACH 3								$437,632	$875,263	$2,201,916**
3.) GROIN NOTCHING										
REACH 2							$192,950	$385,900		
REACH 3								$168,832	$337,662	$1,085,344**
SEAWALL REHABILITATION PLAN				$10,933,333						$10,933,333**
REAL ESTATE				$2,644,570	$3,308,630	$6,420,700	$7,579,000			$19,952,900**
TOTAL EXPENDITURES		$4,900,000		$14,614,794	$17,610,526	$46,984,256	$38,494,820	$42,031,498	$28,281,434	$192,917,328
TOTAL FEDERAL		$4,900,000		$316,875	$14,047,071	$40,059,807	$30,521,002	$41,219,587	$27,327,397	$158,321,739
TOTAL NON-FEDERAL		$.0		$14,297,919	$3,563,455	$6,924,449	$7,973,818	$811,911	$954,037	$34,595,589

NOTE: * NOT INCLUDED IN FIRST COST OF TOTAL S & A COSTS OR EXPENDITURES.
** INCLUDES CONTINGENCIES.

FIGURE 26

APPENDIX H

PERTINENT CORRESPONDENCE

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

TRENTON

DIVISION OF COASTAL RESOURCES

PLEASE ADDRESS REPLY TO
CN 401
TRENTON, N. J. 08625

December 3, 1987

Colonel Marion L. Caldwell
New York District
Corps of Engineers
26 Federal Plaza
New York, NY 10278

Dear Colonel Caldwell:

On behalf of the Department of Environmental Protection, be advised we have reviewed the draft Local Cooperation Agreement for the construction of the Federally authorized Sandy Hook to Barnegat Inlet Shore Protection Project, Section 1 Sea Bright to Ocean Township.

The department stands ready to enter into a more formal agreement and provide to the Corps the following:

a) All lands, easements and right-of-ways
b) To undertake the reconstruction of the seawall in in Sea Bright and Monmouth Beach and to carry out this construction in accordance with Corps of Engineers criteria
c) Provide public access to the beachfront area
d) Hold and save the government free from all damages arising from the construction except for damages due to to the fault of negligence of the contractor or the government

Please be assured that this office stands ready to continue cooperating with the district in order to carry this project to completion.

Please feel free to contact myself or Bernard J. Moore at 1433 Hooper Avenue, Toms River, New Jersey, 08753 or 201-286-6447.

Sincerely,

John R. Weignart
Director

BJM:mm

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF COASTAL RESOURCES

CN 401
TRENTON, N.J. 08625

PLEASE ADDRESS REPLY TO
1433 HOOPER AVENUE
TOMS RIVER, N.J. 08753
201-286-6447

January 13, 1988

Mr. Samuel Tosi, Chief
Planning Branch
New York District
Corps of Engineers
26 Federal Plaza
New York, NY 10278

Dear Mr. Tosi:

Submitted for your review and approval is a proposal for the rehabilitation of the Sea Bright/Monmouth Beach seawall. This rehabilitation is part of the state effort towards the Sandy Hook to Barnegat Inlet Federally Authorized Project-Section 1.

For state purposes, the total construction cost for the rehabilitation of the seawall is set at $9,461,388. This cost will be shared between the state and the Boroughs of Monmouth Beach and Sea Bright. In order to comply with the Corps of Engineers directives, a sum of $467,683 has been added to the estimate for support services such as; engineering, surveying, administrative, permitting, etc. In addition to that, an additional 15 percent has been added to cover contingencies that may arise between now and the start of the project. This brings the total cost of this project to $11,533,432.

As of this writing, be advised that the State of New Jersey is planning to move forward with the repairs to this seawall and at the same time obtain all the necessary easements, rights-of-ways for the overall project including the beachfill. As part of the state's committment, in accordance with state policy, additional parking facilities will be provided within the construction area. Provisions will be made to have people access the beach via access points over the existing seawall to the proposed beach area. All this work is being undertaken with the idea that the Federal Government will be in a positive position in 1990-1991 to begin the massive beachfill in this area.

We appreciate very much the help and technical assistance that was provided to this office, from members of my staff and if there is any other information required to move this project along, please contact us immediately.

Sincerely,

Bernard J. Moore
Assistant Director for
Coastal Engineering

mm
Enclosure

UNITED STA , DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Habitat Conservation Branch
Management Division
2 State Fish Pier
Gloucester, MA 01930-3097

December 30, 1987 F/NER74:TPM

Mr. Samuel P. Tosi
Department of the Army
New York District
Corps of Engineers
Jacob K. Javits Federal Building
New York, NY 10278-0090

Dear Mr. Tosi:

This is in response to your request for information concerning the presence of endangered and threatened species within a beach erosion control project from Sea Bright to Ocean Township, New Jersey pursuant to Section 7(c) of the Endangered Species Act (ESA). The project plans will involve the placement of sand to construct a beach berm and the construction of groins. Off shore borrow areas will vary in depth from 30 to 60 feet below mean water.

The National Marine Fisheries Service, Habitat Conservation Branch indicated that loggerhead and leatherback sea turtles may be present in the project area in a letter dated March 31, 1987. In addition, the endangered Kemp's ridley sea turtle may also occur within the project site. They are known to occur in shallow bays where benthic organisms provide a major food source. Kemp's ridley turtles may have been found in Long Island Sound and the Delaware and Chesapeake Bay in summer and fall. However, their movements through nearshore waters are poorly understood and information about their distribution is known almost exclusively through strandings.

No other species within the Northeast Region are proposed for listing under the ESA of 1973, as amended.

For additional information or coordination regarding this project, please contact Tracey McKenzie at FTS 838-6258 or (401) 782-3258.

Sincerely,

Douglas W. Beach
Fisheries Biologist

DRAFT

FISH AND WILDLIFE COORDINATION ACT REPORT

Section 2(b)

Atlantic Coast of New Jersey - Sea Bright to Ocean Township
Beach Erosions Control Study

Analysis of the Corps of Engineers Selected Plan

Prepared for:

U.S. Army Corps of Engineers
New York District
New York, New York 10278-0090

Prepared by:

U.S. Department of the Interior
Fish and Wildlife Service, Region 5
Absecon, New Jersey 08201

February 1988

Preparer: Flavia Williams-Rutkosky
Project Leader: Clifford G. Day

DRAFT

FISH AND WILDLIFE COORDINATION ACT REPORT

Section 2(b)

Atlantic Coast of New Jersey - Sea Bright to Ocean Township
Beach Erosion Control Study

Analysis of the Corps of Engineers Selected Plan

Prepared by

U.S. Department of the Interior
Fish and Wildlife Service

February 1988

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I. INTRODUCTION

This constitutes the Fish and Wildlife Service's (Service) report on fish and wildlife impacts which can be expected as a result of implementation of the Army Corps of Engineers (Corps) selected plan to address beach erosion along the Atlantic Coast of New Jersey - Sea Bright to Ocean Township, Monmouth County. The report has been prepared pursuant to Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and is for inclusion into the New York District's Phase 1 Stage 3 report to the North Atlantic Division.

The authorized project area covers approximately 51 miles of shoreline extending from Sea Bright to Barnegat Light. This report considers a 12-mile segment, identified as Reach I, extending from the southern boundary of the Sandy Hook Gateway National Recreation Area (Sea Bright) southward to the outlet of Deal Lake (Loch Arbor) (Figure 1). Reach I encompasses the municipalities of Sea Bright, Monmouth Beach, Long Beach, Deal, Allenhurst and Loch Arbor. The entire coastal zone within the study area is extensively developed, primarily for residential and commercial use. Erosion has seriously reduced the width of most beaches, exposing shoreline development to storm damage. Corps study objectives are reduction of shoreline erosion, protection from coastal storms and provision of recreational beach areas.

The Service submitted two planning aid reports to the Corps concerning the Atlantic Coast of New Jersey - Beach Erosion Control Study. In February 1986, the Service submitted a planning aid report investigating shellfish and

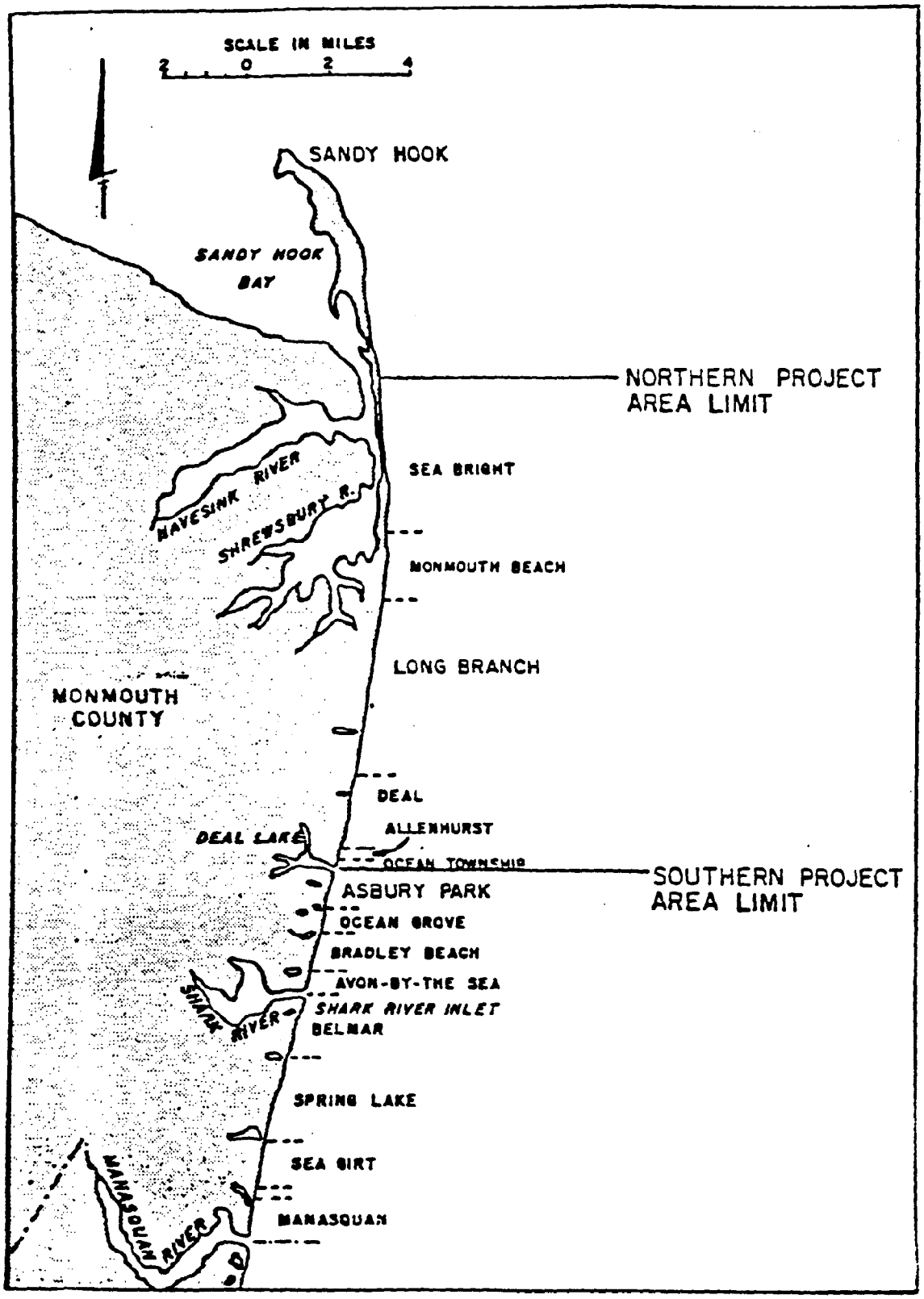

Figure 1. Location of project area.

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finfish resources within the proposed sand borrow areas (Figure 2). In September 1987, the Service submitted a PAR evaluating four erosion control alternatives proposed by the Corps and recommending means and measures to minimize impacts to fish and wildlife resources and their supporting ecosystems.

The Service requests that no part of this report be used out of context and if the report is reproduced, it should appear in its entirety. Any information excerpted from the report should be properly cited and include the page number from which the information was taken.

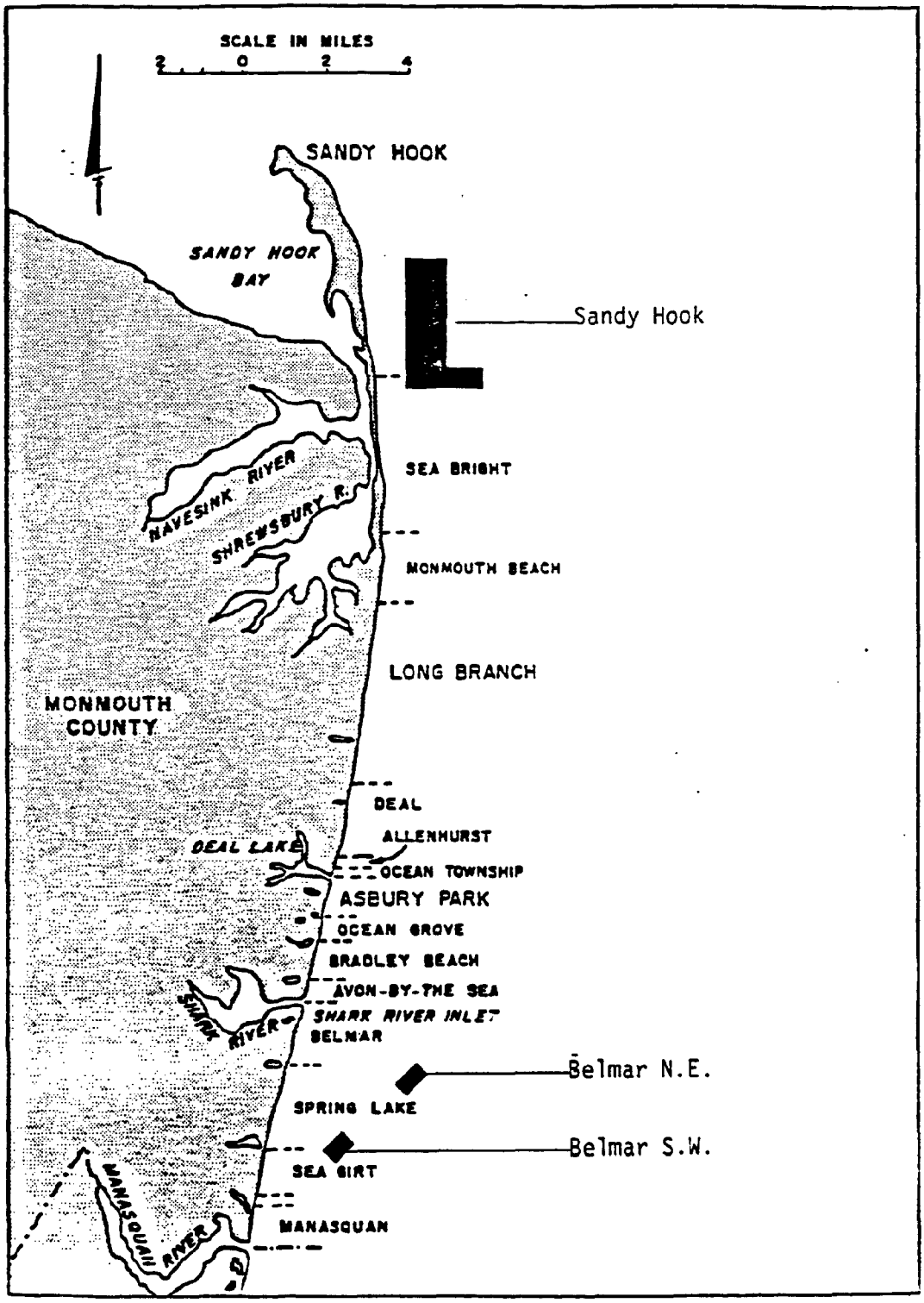

Figure 2. Location of proposed borrow areas.

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II. DESCRIPTION OF THE SELECTED PLAN

The selected plan is fill only beach restoration, involving the artificial placement of sand to widen beachs to a minimum of 100 feet at an elevation of 10 feet above mean low water. To avoid overtopping of the berm, a 2-foot storm cap has been added to the design. The plan includes repair of the seawall located in Sea Bright. Existing groins will be covered by sand and depending upon safety considerations, any groin sections not covered will be removed (Dieterich, 1987). The Corps has determined that this alternative meets all study objectives.

The study area has been divided into 4 construction reaches: Reach 1-B, Reach 1-A, Reach 2 and Reach 3. The borrow area closest to each reach will be used as a source of sand. Based on proximity to the proposed borrow area, a 24-inch pipeline dredge will be used for Reach 1-B. A hopper dredge will be required for Reaches 1-A, 2 and 3.

A new beach at Sea Bright to Ocean Township would suffer severe erosion at the southend of the project as a result of updrift littoral drift deficiencies. A feeder beach constructed in Ocean Township is expected to compensate for the updrift deficiencies. A 6-year supply of advance fill is specified in the project design to supply sand to allow for the increase in littoral drift along the project area.

Implementation of the selected plan would require an initial fill of 17.7 million cubic yards of sand. Included in this figure is the total of the

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design fill volume, fillet volume, advance fill volume, feeder beach volume and taper volume, plus a 15 percent tolerance added to the design fill, fillet and taper volumes. In addition, 3.7 million cubic yards of sand are required for periodic nourishment. This volume is calculated based on a 6-year maintenance interval, except in the area between Sea Bright and Monmouth Beach (Reach 1-A), where construction would occur over a 2-year period due to large initial construction quantities. The periodic nourishment total includes advance fill, feeder beach fill and taper fill volume along with 15 percent tolerance and overfill. The total amount of sand required for the project is approximately 21 million cubic yards.

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III. FUTURE WITHOUT THE PROJECT

A. NON-BIOLOGICAL

The Service anticipates that without shoreline protection improvements, existing protective mechanisms would deteriorate, eroding beaches and exposing coastal communities to extensive property damage and loss. Left unabated, shoreline erosion would continue, causing a landward movement of the beach and inundation of areas occupied by coastal development.

B. BIOLOGICAL

Coastal beaches are generally in a state of dynamic equilibrium, responding to waves, winds, currents and tides. Such an environment is occupied by organisms with the ability to adapt to the continually changing conditions. Beaches can generally be divided into three zones: the upper (beach) zone; the middle (surf) zone; and, the lower (nearshore) zone.

The upper zone, extending from dune areas to just above mean high water line is dry except during storm events or extra high tides. Burrowing animals are the dominant invertebrates. Species diversity and abundance is limited and distribution is patchy (Naqvi and Pullen, 1985). Ghost crabs (Ocypoda spp.) and sand fleas (Talitridae) constitute a major portion of the fauna. Further down (below mean high water) species diversity remains low; however, large numbers of individuals are found (Naqvi and Pullen, 1985). Here the fauna is characterized by worms (annelids), coquina clams (Donax spp.) and mole crabs (Emerita spp.). Where human disturbance is not limiting, this zone (along with the middle zone) provides nesting and feeding areas for shorebirds. Due

to the extensive development within the project area, natural dunes have greatly diminished. A few remaining dunes occur near Long Beach.

The middle beach zone is heavily influenced by tidal flucuations. This is the area of breaking waves and is often submerged, varying both in location and area. Organisms in this zone are susceptible to desiccation. Few species occur here; however, there may be large numbers of adapted species, including copepods, ciliates, tardigrades, gastrotrichs and turbellarians.

The lower beach zone is nearly continuously flooded and, therefore, is a more physically stable area, supporting a diverse fauna that includes polychaetes, crustaceans and molluscs. The greatest abundance of commercial and sport finfish and shellfish are found here.

Naturally occurring rocky intertidal zones are absent from the project area. However, man-made structures such as seawalls, jetties, groins and bulkheads occur and provide a substitute habitat. Barnacles, small crustaceans, polychaetes and molluscs occur on and around these structures. The mussel, Mytilus is a dominant member of this community. Fish such as flounder, common sea bass and striped bass may use the areas with structures for feeding and shelter. Thus, the relatively low productivity of sandy beach is supplemented by the jetty-groin system.

The nearshore zone extends from a depth of about 2 meters to the 30-meter isobar. Phytoplankton in this zone are an important food source for filter-feeding bivalves. Several benthic species in this zone are commercially

exploited, including the surf clam (Spisula), rock crab (Cancridae), and the American lobster (Homarus americanus). These and other benthic fauna provide food for demersal fish species.

The nearshore area provides a migratory pathway and a spawning, feeding and nursery area for many species common to the mid-Atlantic region. Important recreational species include black seabass (Centropristes striatus), summer and winter flounder (Paralichthys dentatus and Pseudopleuronexctes americanus), weakfish (Cynoscion regalis), bluefish (Pomatomus saltatrix), red and silver hake (Urophycis chuss and Merluccius bilinearis) and Atlantic mackerel (Scomber scombrus). Commonly occurring commercial species include bluefish, weakfish, Atlantic mackerel, American shad (Alosa sapidissima), Atlantic menhaden (Brevoortia tyrannus) and the American lobster.

Shipwrecks and artificial reefs in the nearshore zone provide habitat for attaching organisms not found on sandy bottoms. Within the project area 14 shipwrecks exist within one mile of the shore. Additionally, the Monmouth Beach Reef has been constructed by the State of New Jersey within the project area about 1.8 miles east of Monmouth Beach (State of New Jersey, 1981). Shipwrecks and artificial reefs provide shelter for fish and invertebrates. Hydroids, sponges, barnacles, mussels, polychaetes, crabs and lobster are some of the organisms expected to use shipwrecks, artificial reef structures and irregular bottoms. Atlantic cod (Gadus morhua), pollock (Pollachius virens), hake and black seabass are among the common species associated with this habitat. Mackerel and bluefish congregate around structures with high profiles and are important to both recreational and commercial fisheries.

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The importance of the mid-Atlantic Bight, from the intertidal zone to the edge of the continental shelf, is high in terms of fisheries for both finfish and shellfish (Saila and Pratt, 1973). Three types of bottom faunal groups have been identified as widespread on the continental shelf of the mid-Atlantic Bight: 1) sand fauna; 2) silty sand fauna; and, 3) silt clay fauna. Each group is based on sediment type and the presence of associated species (see Figure 3) (Pratt, 1973).

Sand fauna occupy the proposed borrow sites which occur at depths where currents intermittently transport sediments. This habitat merges with the sandy beach and extends to depths of 30 to 50 meters. Ripple marks and sand waves indicate the mobility of the substrate and animals inhabiting these areas are adapted for movement in sand and recovery from burial. Oxygen levels are generally high and suspended food is abundant. Thorson (1957, as cited in U.S. Fish and Wildlife Service, 1979) has reported that in communities where Spisula is dominant, such communities may exhibit the greatest known productivity from the ocean bottom. The offshore surf clam fishery is the single most valuable fishery in the region covering New York, New Jersey, Delaware, Maryland and Virginia (U.S. Department of Commerce, 1986).

Shellfish resources within the 3 proposed borrow areas were surveyed and previously discussed in the Service's 1986 planning aid report (U.S. Fish and Wildlife Service, 1986). Twenty-nine stations within the proposed borrow areas were sampled on August 22-23, 1985. A 5-minute tow was taken at each

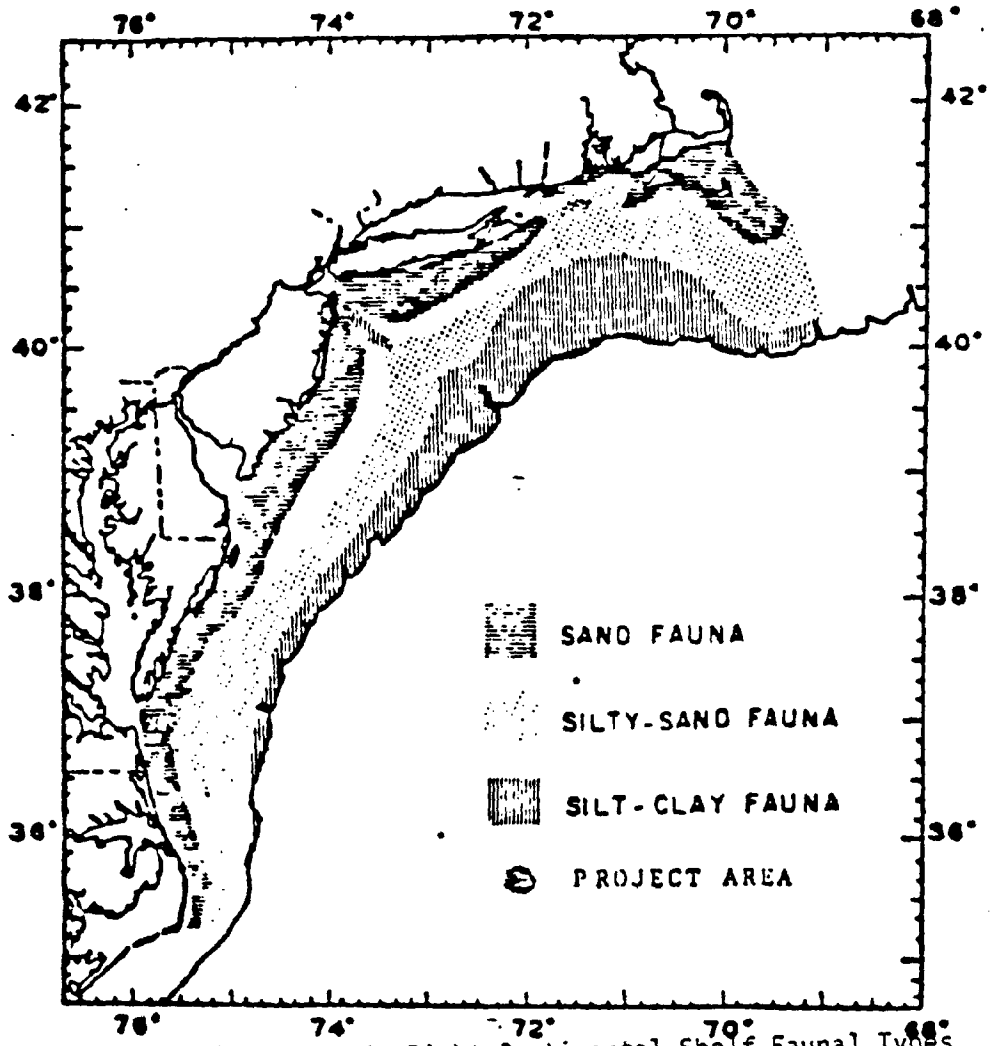

Figure 3. Mid-Atlantic Bight Continental Shelf Faunal Types.

A map of continental shelf faunal types in the Mid-Atlantic Bight showing general areas occupied by proposed faunal types. From Pratt (1973)

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station using a conventional hydraulic clam dredge. A Petersen grab bottom sample for juvenile surf clams was taken at each station.

Study results disclosed that surf clams collected from the borrow areas ranged from 41 to 194 mm in length, indicating the presence of several age classes. Uneven size is a common occurrence, since predation often greatly reduces the survivability of larvae and small clams. Thirteen benthic species other than Spisula were taken by the hydraulic dredge, not including four bottom feeding fish. Additional benthic species were collected via Petersen grab. All are considered common inhabitants of the ocean bottom. Study results are given in Tables 1 through 5, Appendix C.

Surf clam populations within the Sandy Hook borrow area were very small and could not be expected to support commercial clamming, even if the area were not condemned waters. The clam density within the Belmar borrow was barely sufficient for commercial harvest and the total standing stock within all proposed borrow areas represents an insignificant portion of the total resource in the State. This does not infer that these areas do not have the potential to support large densities. With different conditions, including less predation, the areas can be expected to produce larger populations. The volumes of old shells in the dredge samples (see Table 3) reflects the historical productivity of these sites. Anoxic water conditions during 1976 and the predation by a number of invertebrate and vertebrate predators are probable causes for the present low population densities (U.S. Fish and Wildlife Service, 1986).

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Finfish resources were also discussed in the Service's 1986 planning aid report (U.S. Fish and Wildlife Service, 1986). Long and Figley (1982) provided the primary source for finfish data. Table 6, Appendix D, lists sport and commercial species present and Figures 4 and 5 (from Freeman and Walford, 1974) illustrate potential finfish species along with locations of fishing grounds and shipwrecks.

Data resulting from National Marine Fisheries Service groundfish cruises could not be used to assess site specific resources due to the low sampling intensity (Himchak, 1987). However, site specific data was obtained by the New Jersey Bureau of Marine Fisheries, which conducted a fishing use survey of the project area. The Bureau determined the extent of commercial and recreational fishing within the proposed borrow areas using a questionnaire that was developed in coordination with the Service and the New York District. The questionnaire was sent to 111 charter and party boat captains and 138 individuals involved in commercial harvesting of finfish and shellfish. Survey results based on data from 91 respondents, show that several areas within the proposed borrow sites support high-use recreational fisheries. Specifically, blocks 9, 13 and 15, 69, 70 and 74 (Figure 6) received high recreational fishing use for various species, including summer flounder, striped bass, weakfish and bluefish. Based upon the findings of the survey, the Bureau recommended that sand mining activities avoid the high use blocks to the maximum extent practicable.

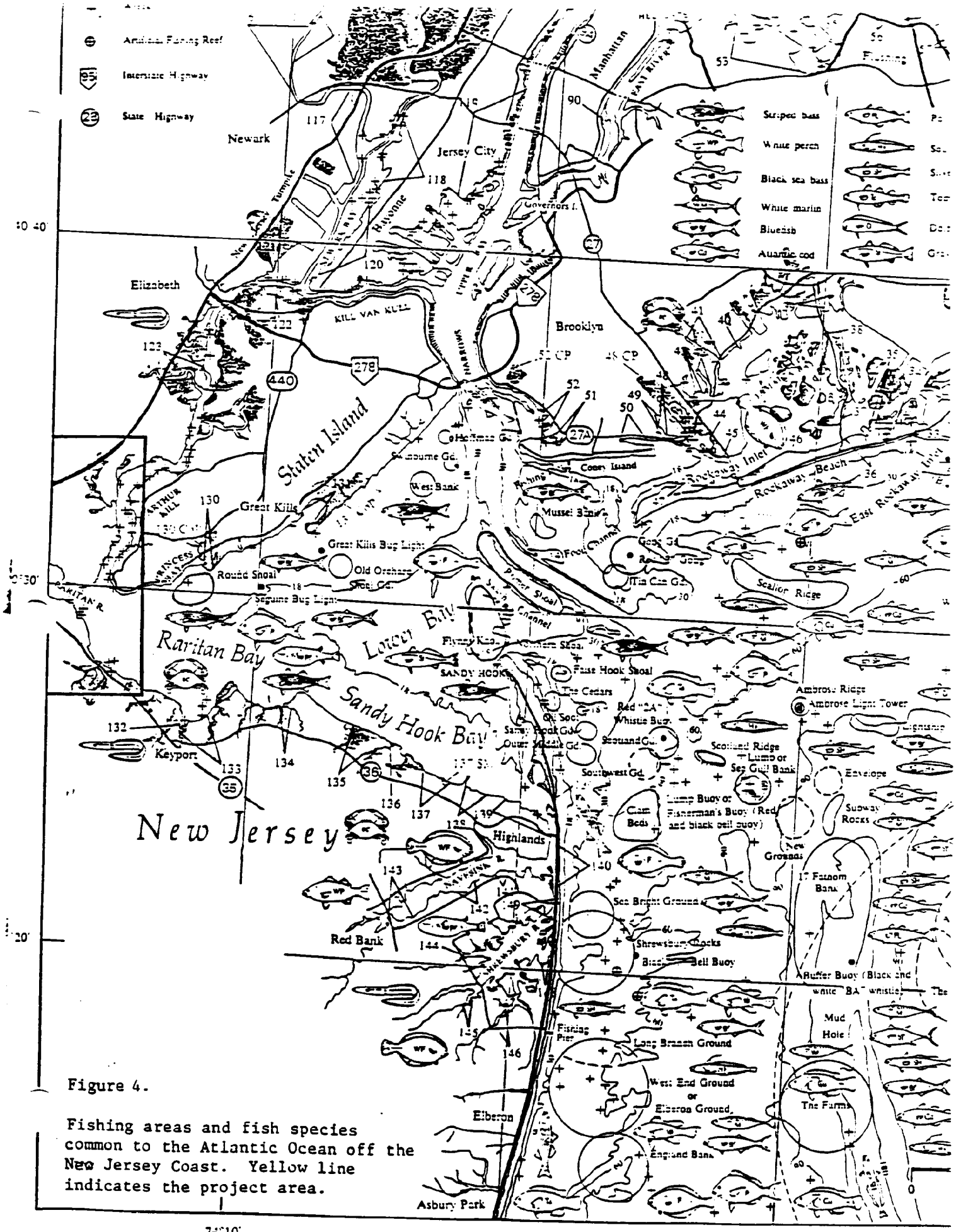


Figure 4.

Fishing areas and fish species common to the Atlantic Ocean off the New Jersey Coast. Yellow line indicates the project area.

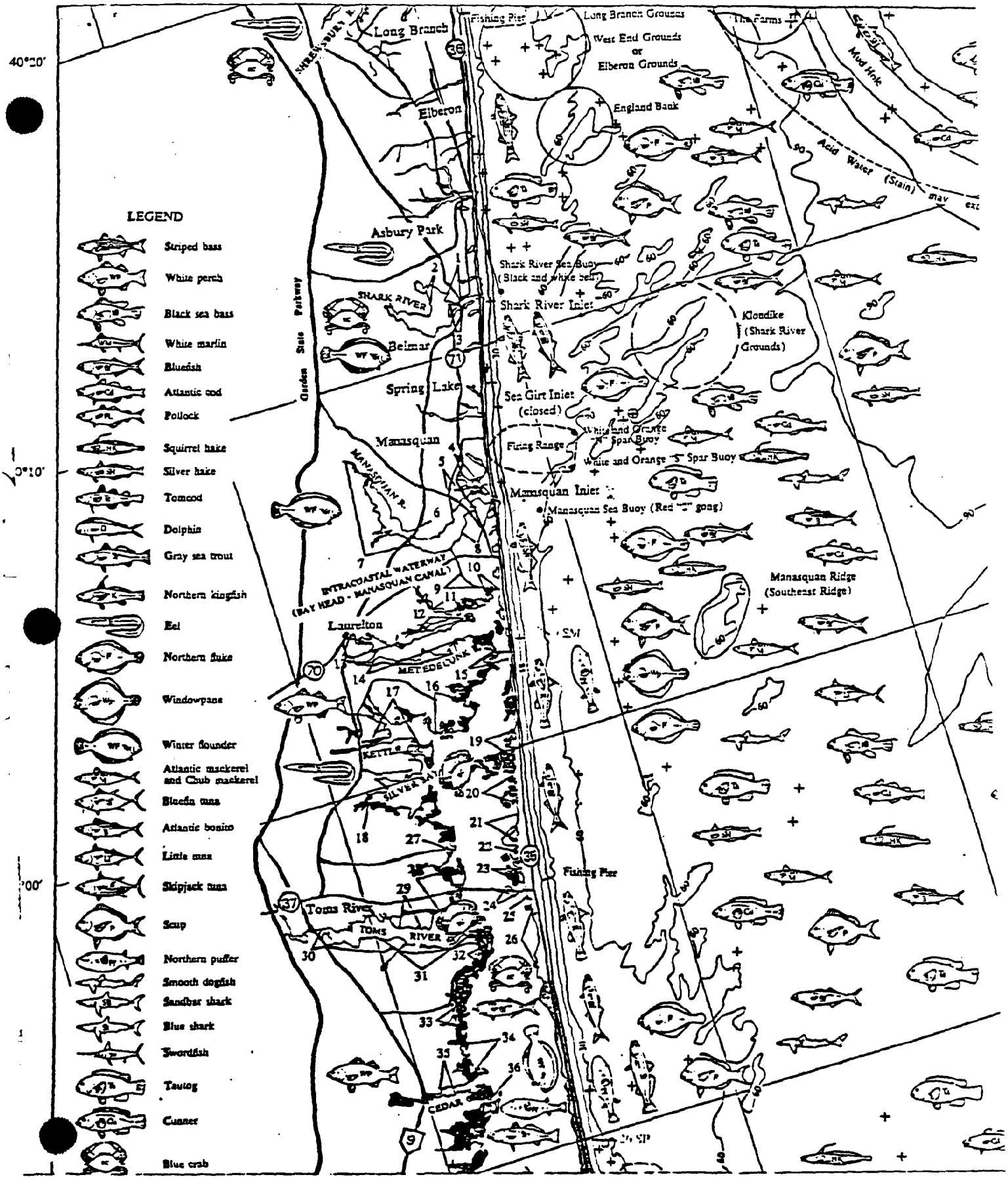
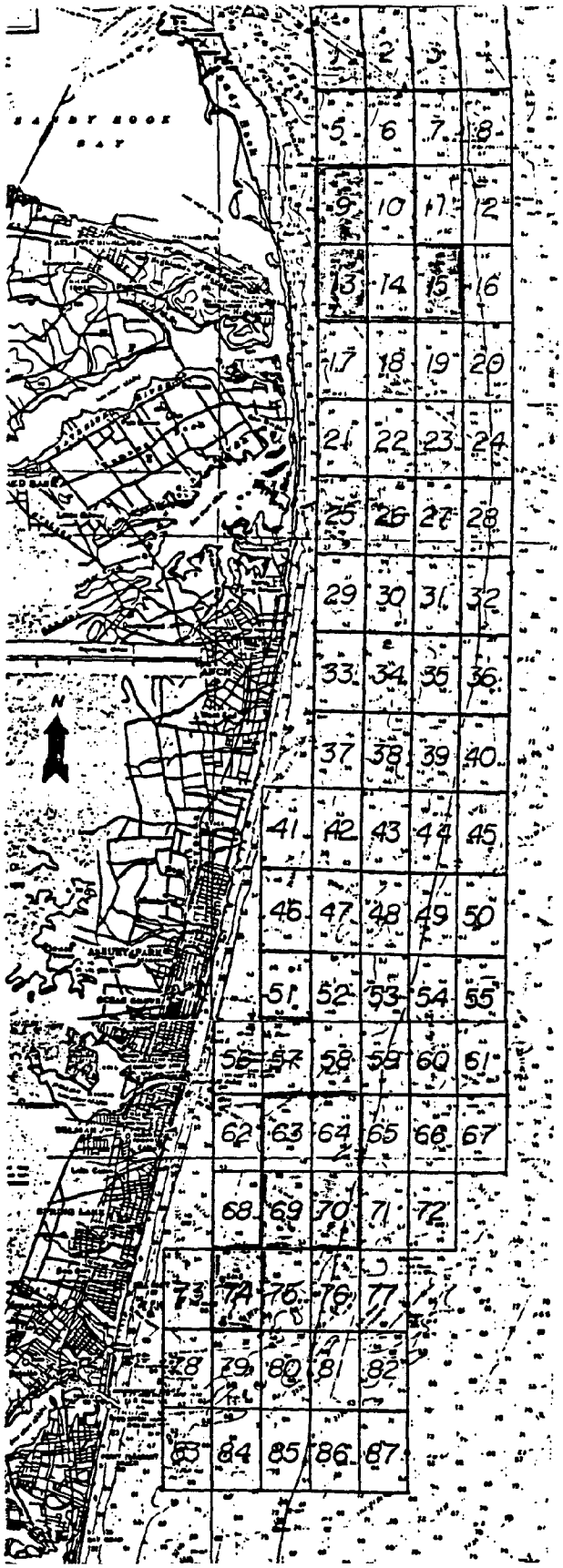


Figure 5. Fishing areas and fish apecies common to the Atlantic Ocean off the New Jersey Coast. Yellow line indicates project area.

Figure 6.

Areas of High Fishing Use Within Proposed Borrow Areas.
The proposed borrow areas are outlined in green.
The yellow blocks support a high-use recreational fishery.



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FISH AND WILDLIFE MITIGATION POLICY

The Service's views and recommendations on this project are guided by its Mitigation Policy (Federal Register/Vol. 46, No. 15/January 23, 1981). This policy reflects the goal that the most important fish and wildlife resources should receive the greatest level of mitigation. The term "mitigation" is defined as (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and, (e) compensating for the impact by replacing or providing substitute resources or environments.

The Service may recommend support for projects when the following criteria are met: 1) the project is environmentally sound; 2) the least environmentally damaging alternative is selected; 3) every reasonable effort has been made to avoid or minimize damage or loss of fish and wildlife resources and uses; 4) all important recommended measures have been adopted with guaranteed implementation to satisfactorily compensate for unavoidable damage or loss consistent with the mitigation goal; and, 5) for wetlands and shallow water habitats the proposed activity is clearly water dependent and there is a demonstrated public need. The Service may recommend that the project not be implemented for those projects that do not meet all of the above criteria and where there is likely to be a significant fish and wildlife resource loss.

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IV. FUTURE WITH THE PROJECT

A. NON-BIOLOGICAL

Implementation of the selected plan will provide benefits which fall into three principal categories: storm reduction, intensification and recreation (U.S. Army Corps of Engineers, 1987).

Storm reduction benefits include:

- reduction of structural inundation;
- reduction of wave attack to structures;
- reduction of damage associated with long-term and storm induced erosion;
- reduction in lost land;
- reduced seawall maintenance cost;
- reduced maintenance costs at Sandy Hook; and,
- reduced public emergency costs.

Intensification benefits are increases in land value expected to result from project implementation. Recreational benefits are enhanced recreation potential provided by increased beach area.

B. BIOLOGICAL

The selected plan calls for the initial dredging and placement of 17.8 million cubic yards of sand along the shoreline within the project area. As previously discussed in the Service's September 1987 PAR (Rutkosky, 1987), activities associated with beach restoration (i.e., dredging and disposal) can

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The Service has determined that the sandy beach in the project area has moderate habitat value and is relatively abundant on a national basis. Continued loss of sandy beach is anticipated without the project. We have also determined that the ocean bottom in the project area has moderate habitat value for shellfish and high value for finfish and is relatively abundant on a national basis. The Service's mitigation goal for either habitat is no net loss of habitat value, while minimizing the loss of in-kind habitat value. No change in the amount or quality of ocean bottom is anticipated without the project.

be expected to cause at least temporary adverse impacts to fish and wildlife resources and their supporting ecosystems. These impacts will occur both at the borrow and nourishment sites.

NOURISHMENT SITE IMPACTS

Beach nourishment has been shown to have profound impacts on organism density and community structure (Reilly & Bellis, 1978), due to the elimination of non-motile organisms. The survival of motile species is dependent upon the depth of the nourishment material, the length of burial time, the time of year the nourishment is undertaken and the particle size distribution of the material (Naqvi & Pullen, 1982). Other habitat factors of particular species must also be considered.

Adverse impacts are not confined to beach areas and include: failure of adult intertidal organisms to return from near-offshore wintering areas; reductions in organism density on adjacent unnourished beaches; and, an inhibition of pelagic larval recruitment effort. Studying beach nourishment in North Carolina, Reilly & Bellis (1978, 1983) report that the nourished beach recovered slowly, and during the recovery period, secondary productivity remained low. Measures of community structure indicated low diversity, and low secondary productivity, resulting in reduced utilization of the nourished beach by migrating consumers.

Naqvi and Pullen (1982) also report that in many cases where faunal enrichment has been observed following nourishment activities, this was related to invasion by opportunistic species.

Gorzelany (1983, as cited in Nelson, 1985) found no negative impacts for any element of the nearshore infaunal community associated with beach nourishment carried out during a period of low biological standing stock and low recruitment (mid-October through January). Restricting construction activities to winter months is recommended.

Artificially constructed beaches generally exhibit steeper profiles than natural beaches (Halsey, 1987). Since beach zonation characterization includes levels above water, water land interface and total submergence, profile alternations may change beach zonation and thus, community structure. Construction of a 100-foot wide beach will result in the elimination of a greater amount of shallow water marine habitat than would occur with lesser beach widths. (Borrow area impacts will thus also be increased due to the quantity of sand required, both for initial construction and periodic maintenance).

Very little published information is available regarding the impacts of beach nourishment (as opposed to borrow area dredging) on nearshore fish. One Florida study (Holland, et al., 1980, cited in Nelson, 1985) has examined the effects of beach nourishment on nearshore species. The results of the before and after study reported a temporary increase in fish abundance along the newly created beach.

Although the available evidence suggests that beach nourishment causes minimal biological impacts, the Service recommends that deposition areas be monitored.

This recommendation will be discussed further in Section VI, "Recommendations for Mitigation."

BORROW SITE IMPACTS

Cerrato & Scheier (1983) present a discussion of the effects of borrow pits on benthic organisms. Conditions at the bottom of borrow pits have been found to differ from ambient bottom conditions. Pits often act as reservoirs for fine-grained sediments, organic materials and pollutants. Bottom water exchange may be impeded if areas are dredged substantially below adjacent areas. The resultant reduced flushing in combination with the decay of accumulated organic matter may cause an increase in oxygen demand, giving rise to depleted oxygen levels near the bottom. Reduced mixing may produce salinity, temperature and oxygen stratification.

Cerrato and Scheier (1983) have summarized borrow pit impacts on benthic organisms as documented in studies conducted in New York (Swartz & Brinkhuis, 1978), New Jersey (Muraski, 1969), Maryland (Drobeck, 1970), Virginia (Boesch & Rackley, 1973), Florida (Taylor & Saloman, 1968; Sykes & Hale, 1970; Saloman, 1974; Turbeville & Marsh, 1982; Culter & Mahadeuan, 1982) and Texas (Harper, 1973; Poag, 1973; Rodgers & Darnell, 1973). Cerrato & Scheier (1983) note that ecological effects were attributed to dredging in a majority of the cases. In many instances dredging substantially altered the physical environment, such that species diversity, abundance and composition decreased as compared to control areas. These impacts persisted for more than 10 years after dredging. An exception is the Turbeville and Marsh (1982) study which reported no adverse impacts, relating the health of benthic fauna in the pit

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to the strong currents within the study area.

Where alterations have occurred within macrobenthic communities in the New York Bight, the result has been reductions in populations of species which are predominant food items for demersal fish and invertebrates (Boesch, 1982). Bokuniewicz, et al. (1985) also report differences in faunal composition in borrow pits and control sites in the lower Bay of New York Harbor. Faunal composition at control sites was more stable and diverse over time than at the borrow sites and borrow pits appeared to influence benthic fauna in adjacent areas.

In addition to the initial dredging and disposal the selected plan calls for the dredging and disposal of 3.7 million cubic yards of material at 6-year intervals for the life of the project (50 years). Reported estimates of benthic recovery time after dredging range from less than one year to greater than 18 years (Drobeck, 1970; Harper, 1973; Rodgers & Darnell, 1973; Saila, 1976; Oliver, et al., 1977; Rhoads, et al., 1978; Brinkhuis, 1980; Saloman, et al., 1982; Culter & Mahadeven, 1982; Turbeville & Marsh, 1982; Cerrato & Scheier, 1983).

Recovery periods can be prolonged as a result of repeated disturbance. This project has the potential to cause long-term, perhaps "permanent" loss of faunal productivity and therefore, less frequent maintenance is preferable with regards to minimization of adverse impacts on aquatic resources.

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Further minimization of adverse impacts can be realized through confining construction activities to winter months (Brinkhuis, 1980; Naqvi & Pullen, 1982; Nelson, 1985). Studies conducted by the U.S. Army Corps of Engineers, Coastal Engineering Research Center indicate that construction during the winter protects biological resources (Naqvi & Pullen, 1982). During winter, biological productivity is low, thus engineering activities carried our during this period would be less detrimental.

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V. RECOMMENDATIONS FOR ENHANCEMENT

The Service's September 1987 planning aid report recommended that the Corps consider providing public access facilities (i.e., parking) to realize the potential for recreational use afforded by beach improvements. We continue to offer this recommendations.

The selected plan for the proposed project involves the construction of a beach 100-feet wide along the entire project area. At some locations this construction will require the placement of sand in excess of 100-feet. We recommend that the Corps investigate the potential to create shorebird habitat or to construct dunes in these areas. The Service is available to provide technical assistance regarding this recommendation.

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VI. RECOMMENDATIONS FOR MITIGATION

Beach nourishment and sand removal from borrow areas can adversely affect benthic communities and higher trophic level organisms that use these communities. Direct mortalities occur as a result of dredging activities and from sand deposition. Changes in sediment character may prohibit reestablishment of certain species or populations, perhaps for extended periods. Significant changes in benthic communities can result from modification of wave energies and sediment dynamics brought about by dredging activities (Bokuniewicz et al., 1985; Hanlon, 1984; Reilly and Bellis, 1978). Secondary impacts would be short- or long-term disruptions to food chains caused by reductions in invertebrate populations (Reilly and Bellis, 1978; Reilly, et al. 1980; Boesch, 1982).

Summarizing his review of the literature, Nelson (1985) notes that although considerable information exists on the effects of dredging on benthic communities, much less is known about the specific consequences of beach nourishment. Recent literature on the quantitative effects of beach nourishment on benthic organisms is derived largely from studies funded or conducted by the Coastal Engineering Research Center of the Corps of Engineers (Pullen, et al., 1980) or individual Corps Districts (Naqvi and Pullen, 1982). Many of these studies tend to support the view that, although dredging and beach nourishment virtually destroys existing organisms, the effects are temporary or short-term and, therefore, are not significant. It should be noted that most of these studies were conducted in southern states such as North Carolina, Texas and Florida. In Florida many species spawn almost year-

round and extrapolation of these results to potential impacts in New Jersey poses risks.

Nelson (1985) identified only four beach nourishment studies which contain data to compare benthic populations at nourishment sites before and after nourishment, Parr, et al., 1978; Reilly and Bellis, 1978, 1983; Nelson and Gorzelany, 1983 and Saloman and Naughton, 1984. In discussing these studies, Nelson (1985) indicates that there are decided deficiencies in terms of spatial or temporal adequacy, (Parr, et al., 1978 and Nelson and Gorzelany, 1983), or in data analysis (Reilly and Bellis, 1978, 1983) and states that the need for biological monitoring of beach nourishment sites will not diminish until a more substantial body of well-designed and analyzed studies is available. Naqvi & Pullen (1982) recommend that biotic surveys be carried out at nourishment sites, before, during and after nourishment. Pre-project data are needed to recognize possible project impacts.

A one-year post-dredging study of benthos in borrow areas associated with the New York District's Rockaway Beach Erosion Control Project (Spight, 1977) suggests that while borrow area repopulation was rapid, the resulting population may be a transient one. Over time, dredged areas may accumulate organisms and organic matter leading to depletion of oxygen supplies. Muraski (1969) reports that low oxygen levels are typical in dredged holes in New Jersey waters and Spight (1977) notes possible indications of a similar fate for the areas he studied, concluding that future events were not predictable from the data available for one-year post-dredging.

Drobeck (1970, as cited in Cerrato and Scheier, 1983) found few benthic invertebrates in pits dredged 7 and 15 years prior to his study. Dredged areas in San Antonio Bay had not recovered former abundance 18 years after dredging (Rodgers and Darnell, 1973). About 80 percent recovery was reported for dredge cuts aged 18 years and older. Previously cited reports of benthic recovery time range from one year to greater than ten years (Rutkosky, 1987).

Where benthic populations recover to pre-nourishment levels within 1 to 2 years, the effects probably are "short-term" and are, therefore, "insignificant." However, the effect of stress events on an ecosystem is dependent upon many factors, including the nature, magnitude, frequency/duration of the event. Thus, repeated disturbance of borrow areas which could occur as a result of renourishment dredging has the potential to cause more "permanent" reductions in benthic populations and a consequent decrease in the commercial and recreational fishery within the project area.

The proposed beach nourishment project has the potential for long-term, significant adverse impacts to fish and wildlife resources and their supporting ecosystems. It is our opinion that appropriate mitigation for such projects at this time are impact assessment studies designed to determine the resource losses associated with the project. Economics and personnel limitations often result in restricted data acquisition; thus, it is important that monitoring efforts focus on areas of direct impact. Mobile organisms, such as fish and crabs will be indirectly affected in that they can escape areas of dredging or deposition. The need to seek new food sources will result in redistribution which can be expected to cause increased competition

for food. While such indirect effects are important, the effects on the benthic fauna are the most direct and severe. Thus for this particular project, impact assessment efforts should focus on benthic populations (including surf clams) and water quality. A well-designed study will provide documentation of any significant resource losses. Documentation of these losses will lead to the development of measures to avoid, minimize or compensate the losses. Such measures can then be incorporated into ongoing and future beach nourishment projects. The following section (Recommendations For Impact Studies) outlines the Service's recommendations for impact assessment studies to evaluate the effects of the proposed project on the benthic invertebrate populations and water quality (including sediment characteristics), both within the borrow areas and at the nourishment sites.

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VII. RECOMMENDATIONS FOR IMPACT ASSESSMENT STUDIES

Review of the available literature suggests the potential for long-term, significant adverse impacts to fish and wildlife resources and their supporting ecosystems resulting from the proposed beach erosion control project. Monitoring is the primary means currently available for meeting the equal consideration for wildlife provision of the Fish and Wildlife Coordination Act. Due to the importance of the benthic populations to commercial and recreationally valuable fishes within the project area, a study should be implemented which would monitor the borrow areas and the nourishment sites during and after construction. Pre-project data must be collected to provide a "standard" against which to detect a change for this project and potentially for future projects of the same type.

The following discussion of impact study design is taken from Green (1979) wherein he discusses 4 prerequisites for an impact study. The first is that the impact should not have yet occurred, enabling before-impact data to be used as a temporal control to which after-impact data can be compared. Second, the type of impact and time and place of occurrence must be known to enable a sampling design appropriate to tests of hypotheses to be developed. Otherwise what is being conducted is a monitoring study to detect impact, rather than an impact study which will test against the null hypothesis of no change due to impact. Third, measurements of relevant variables must be obtainable. Fourth, a control area must be available.

These prerequisites then suggest a design having, at a minimum, one sampling before and one after the impact begins, and at least two locations differing in degree of impact. Such a design is an areas-by-times factorial design in which the evidence for impact effects is a significant areas-by-times interaction. Given these prerequisites, the choice of sampling design and statistical methodology must consider the following criteria. First, it must be possible to test the null hypothesis that any change in the biological community of the impact area, over a period of time which includes the impact, does not differ from a control area. Second, it must be possible to relate to the impact, any demonstrated change unique to the impact area and separate effects caused by natural environmental variation unrelated to the impact. Third, the method should lead to both an efficient and effective visual display of both change due to impact in relation to other sources of variation, and the relationship between impact-related change in the biological variables. Fourth, the results should be applicable to subsequent biological monitoring to detect future impacts of the same type. Lastly, the test of the null hypothesis must be as conservative, powerful and robust as possible.

Pre-construction surveys should be conducted to provide quantitative information on the benthic fauna, sediments and current selected water quality characteristics within the proposed nourishment and borrow areas.

Benthic data should characterize existing species composition, diversity and abundance. Within benthic communities, seasonal variability and spatial patchiness is large and may mask all but the largest effects of a project;

therefore, benthic organisms should be evaluated on a seasonal basis (Green, 1979: Naqvi and Pullen. 1982 and Nelson. 1985).

Measurements of turbidity, total and suspended solids, dissolved oxygen and temperature should be collected at each station where benthic data is collected. In addition, sediment samples for grain size analysis should be collected at these stations. Replicate samples should be collected where possible. Depths should be recorded at each station in order to chart changes in the shape of the borrow area.

Data collection should begin at a minimum one full year prior to beginning of construction and should continue for a minimum of 5 years after construction, unless pre-project conditions return prior to the end of this period. Post-impact sampling should begin as soon after impact as possible because of potential interim changes not associated with the project.

The Service recommends that the following sampling schedule be implemented:

1. Pre-construction sampling to occur in April, July, October and again in April.

2. Post-construction sampling to being within two weeks of the activity, followed by sampling 3 months later, 6 months later and at six month intervals for the next three years. Thereafter, sampling should occur annually for the remainder of the assessment period.

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The sampling design should be determined by the requirement of the method(s) employed for data analysis. Design and sampling considerations are extensively treated in Nelson, 1985 and Green, 1979. Methodologies for sampling high energy sand beaches are also presented in Cox, 1976; Hurme, et al., 1979 and Gonor and Kemp, 1978.

The costs of sampling efforts were discussed with the New Jersey Bureau of Marine Fisheries. The following cost figures are based on these discussions and include costs for data analysis and report preparation. Actual study cost is related to the magnitude of the effort required to collect and analyze the data. In order to approximate a cost, the Bureau of Marine Fisheries figures were transposed into "per sample cost" for benthic and surf clam data. Water quality costs (which include sediment collection) are presented as costs per day of boat operation.

BENTHIC SAMPLING:	$ 167.00 per sample
SURF CLAM TOW:	$1000.00 per tow
WATER QUALITY:	$ 600.00 per day for a 30-foot boat

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VIII. CONCLUSIONS

Implementation of the proposed project has the potential to cause significant adverse impacts with respect to fish and wildlife resources and their supporting ecosystems. Beach nourishment will convert aquatic areas to dry beaches and the invertebrate and vertebrate inhabitants would be destroyed or displaced. Coastal waters can be expected to experience turbidity and sedimentation increases. Suspended sediments may adversely impact spawning of certain commercial and recreational fish species. Avoidance of nourishment operations during late spring, summer and early fall can reduce this impact.

Dredging will generate turbidity and cause sedimentation both in and around the dredged area. Effects on aquatics will vary with species. Decreases in dissolved oxygen may result from the resuspension of organically-enriched sediments, as well as changes in currents or tidal movement within the borrow pits. Extremely low levels of dissolved oxygen will selectively eliminate sensitive benthic invertebrate species and inhibit the use of the area by fishes.

Adverse effects on photosynthetic plankton, an important food source, can be expected to result from reduced light penetration due to increased turbidity. High sedimentation levels can be expected to inhibit growth of filter-feeding organisms by clogging the feeding apparatus.

Pre-construction sampling should be conducted at nourishment sites, within the proposed borrow areas and in control areas, which will not be disturbed.

Post-dredging observations should be conducted for a sufficient period of time to allow patterns of invasion and community reestablishment to be determined.

If pre-project sampling indicates that shellfish populations have improved to levels acceptable for commercial harvest, the New Jersey Bureau of Shellfisheries should be provided with advanced notification to allow time to inform clammers who may be interested in harvesting the area before the sand removal occurs.

Reducing the amount of sand removed, and thus the depth of the borrow pits, should lessen the potential for adverse impacts. Reduction of pit side slopes to prevent steep drop-off may minimize any water circulation problems. Preliminary plans for corrective measures should be formulated prior to the initiation of construction so that corrective measures can be implemented in a timely manner.

Borrow areas identified as supporting high use commercial and recreational fishing (Rutkosky, 1987) should be avoided as sources of beach fill to the extent practicable. Therefore, the Service recommends that those areas of lesser value be used as sand sources before dredging in higher value areas.

Development and implementation of an impact assessment study to identify any significant resource losses associated with the proposed project is recommended. It is the opinion of the Service that such a study represents appropriate mitigation for beach nourishment projects at this time. Documentation of resource losses will enable the development of measures to

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avoid, minimize and compensate the losses, for this project and for future beach nourishment projects.

In summary, the Service recommends that the following measures be included in project plans to minimize adverse impacts to fish and wildlife resources:

1. avoid sand removal from high value areas until all less valuable areas have been dredged;

2. avoid construction operations during the period June 1 through September 30;

3. conduct dredging activities in a manner which minimizes development of degraded water quality within the borrow pits;

4. notify the New Jersey Bureau of Shellfisheries if pre-project benthic sampling discloses commercially valuable quantities of surf clams; and,

5. conduct an impact assessment study of the proposed project as described in Section VII (Since this study is the mitigation plan for the proposed project, we recommend that the study design be included in the Environmental Impact Statement prepared for the proposed project).

The Corps should also consider providing public access facilities (i.e., parking) to facilitate public use of the restored beach area. Further, we recommend that the Corps investigate the potential for development of

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shorebird habitat and dune creation within the project area.

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APPENDIX A

Coordination with the New Jersey Division of Fish, Game and Wildlife

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APPENDIX B

Federally Listed Endangered and Threatened Species in New Jersey

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES
IN NEW JERSEY

Common Name	Scientific Name	Status	Distribution
FISHES:			
Sturgeon, shortnose*	Acipenser brevirostrum	E	Hudson and Delaware Rivers plus other Atlantic coastal rivers
REPTILES:			
Turtle, green*	Chelonia mydas	T	Oceanic summer visitor coastal waters
Turtle, hawksbill*	Eretmochelys imbricata	E	Oceanic summer visitor coastal waters
Turtle, leatherback*	Dermochelys coriacea	E	Oceanic summer visitor coastal waters
Turtle, loggerhead*	Caretta caretta	T	Oceanic summer resident coastal waters rarely nests: Cape May and Atlantic Counties
Turtle, Atlantic ridley*	Lepidochelys kempii	E	Oceanic summer resident coastal waters
BIRDS:			
Eagle, bald	Haliaeetus leucocephalus	E	Entire state
Falcon, American peregrine	Falco peregrinus anatum	E	Entire state - re-establishment to former breeding range in progress
Falcon, Arctic	Falco peregrinus tundrius	E	Entire state migratory - no nesting
Piping Plover	Charadrius melodus	T	Entire State
Roseate Tern	Sterna dougallii dougallii	E	Entire State
MAMMALS:			
Cougar, eastern	Felis concolor couguar	E	Entire state - probably extinct
Whale, blue*	Balaenoptera musculus	E	Oceanic
Whale, finback*	Balaenoptera physalus	E	Oceanic
Whale, humpback*	Megaptera novaeangliae	E	Oceanic
Whale, right*	Balaena glacialis	E	Oceanic
Whale, sei*	Balaenoptera borealis	E	Oceanic
Whale, sperm*	Physeter catodon	E	Oceanic
MOLLUSKS:			
None			
PLANTS:			
Small whorled pogonia	Isotria medeoloides	E	Sussex County

*Except for sea turtle nesting habitat, principal responsibility for these species is

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APPENDIX C

Data from proposed borrow area
benthic and surf clam
survey (Tables 1 - 5)

TABLE 1

NUMBER OF DREDGED SURF CLAMS AT GIVEN LENGTH TAKEN FROM PROPOSED BORROW SITES (Sandy Hook)

LENGTH (MM)	STATION NUMBER 15	16	17	18	20	22	27	28	29
	NUMBER OF CLAMS								
41			1						
44									
47									
50									
53									
56									
59									
62									
65									
68									
71									
74									
77									
80									
83									
86									
89									
92	1								
95	1								
98									
101				1					
104									
107									
110									
113									
116	2								
119	1								
122									
125									
128	2								
131	1	1							
134	3								
137	1								
140									
143					1				
146					3			1	
149					1				
152		1				1		1	
155					1				
158		2			1				
161					1			1	
164	1	1					1		
167	1					1	1	2	
170						1			1
TOTAL	14	5	1	1	8	3	2	5	1

MEAN LENGTH AREA B = 126
NUMBER OF CLAMS = 21

MEAN LENGTH AREA C = 157
NUMBER OF CLAMS = 19

Table 2

BENTHIC SPECIES OTHER THAN *Spisula* TAKEN IN HYDRAULIC CLAM DREDGE

	BELMAR														SANDY HOOK															
STATION	1	2	3	4	5	6	7*	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	TOTAL
Mollusca spp.																														
Bivalvia																														
Astarte castanea						1																								1
Ensis directus	1				1																									2
Pitar morrhuana		1	4	3																										8
Gastropoda																														
Lunatia heros	3			2	4	4		1	5	3		3	2		26	1	3	8	5	33	8		2	35	6	10	21	19	7	216
Cephalopoda																														
Loligo spp. (Eggs)												X		X																
Xiphosura																														
Limulus polyphemus					1	1						1			1			2	1				1	7		1	9			25
Crustacea																														
Decapoda																														
Cancer	3			1		1		2	2	1			1	1	1								1	2					1	17
Libinia spp.	1				1	2								1	1		1			2	7	1	1	7	7		20	3	1	56
Pagurus pollicaris		2						2	2		6	1	1	2				7		1					1		2			27
Ovalipes ocellatus	6	9	1	11	21	8		16	9	6	8	8	13	8	10	1	1	7		17	15	11	12	253	19	14	63	15	6	568
Echinodermata																														
Echinarachnius parma	>100				>100			>100	>50	>100			>75		1															
Asterias forbesi						2		5		6		26			1			3		5							19	4	2	73
Sipunculida																X			X			X								
Finfish																														
Scopthalmus aquosus								1	1				3		2							7	4	5	1	1				25
Trinectes maculatus																					1									1
Paralichthys dentatus																								1		1	1			3
Prionotus spp.																									1					1

MUD HAUL

*Dredge filled with mud. Not brought on board.
**X=present but not quantified

TABLE 3

Surf Clam Catch At Stations In Proposed Borrow Areas

DATE	STATION NO.	LORAN C	LOCATION * LAT.	LONG.	DEPTH M.	DEPTH FT.	TEMP. (°C) SURF.	TEMP. (°C) BOT.	CLAMS IN BU.	CLAM VALVES & SHELL TRASH IN BU.	MEAN CLAM LENGTH (MM)
Belmar		9960X-9960Y									
8/22/85	1	26929-43527	40° 09.95'	73° 58.84'	15.2	50	20.1	20.1	1.8	4.9	161
	2	26924-43526	40° 09.65'	73° 57.95'	17.7	58	21.0	19.5	0.4	0.7	158
	3	26920-43524	40° 09.45'	73° 57.45'	18.9	62	21.0	20.0	0.1 (6 CLAMS)	2.9	149
	4	26923-43524	40° 09.40'	73° 57.80'	18.3	60	20.0	19.2	0.2	10.5	132
	5	26926-43523	40° 09.33'	73° 58.20'	16.8	55	22.0	19.6	0.5	1.6	123
	6	26923-43521	40° 09.15'	73° 57.90'	18.9	62	21.0	21.0	1.0	12.0	163
	7	26926-43521	40° 08.95'	73° 58.38'	16.8	55	-	-	0	0	-
	8	26930-43521	40° 09.50'	73° 58.90'	17.3	57	22.0	21.5	1.6	2.1	156
	9	26926-43516	40° 08.65'	73° 58.50'	16.4	54	21.0	19.9	2.0	5.6	155
	10	26928-43519	40° 08.88'	73° 58.78'	17.0	56	21.0	19.5	1.0	2.8	163
	11	26933-43521	40° 08.95'	73° 59.30'	15.2	50	22.0	20.0	1.0	5.6	166
	12	26929-43515	40° 08.55'	73° 59.00'	16.8	55	21.0	21.0	1.0	1.3	155
	13	26931-43514	40° 08.46'	73° 59.20'	16.4	54	22.0	21.0	0.6	1.1	162
	14	26934-43517	40° 08.53'	73° 59.63'	17.3	57	21.0	20.8	2.0	12.8	138
Sandy Hook											
8/23/85	15	26962-43675	40° 24.30'	73° 57.65'	9.1	30	21.0	21.0	0.2	4.0	128
	16	26959-43675	40° 24.28'	73° 57.31'	10.4	34	21.0	21.0	4 CLAMS	7.2	152
	17	26956-43674	40° 24.10	73° 56.90'	12.2	40	21.0	20.8	1 CLAM	17.0	121
	18	26954-43676	40° 24.35'	73° 56.65'	11.9	39	21.5	20.0	1 CLAM	3.0	160
	19	26958-43675	40° 24.30'	73° 57.20'	11.9	39	21.5	21.0	0	9.9	-
Sandy Hook											
8/23/85	20	26958-43682	40° 24.90'	73° 56.90'	10.7	35	21.0	21.0	0.1 (8 CLAMS)	1.2	150
	21	26959-43688	40° 25.60'	73° 56.65'	10.7	35	21.0	21.0	0	1.0	-
	22	26960-43692	40° 26.00'	73° 56.81'	12.2	40	22.0	21.3	3 CLAMS	0.5	163
	23	26961-43696	40° 26.40'	73° 56.80'	12.2	40	22.0	22.0	0	0.5	-
	24	26963-43694	40° 26.20'	73° 57.20'	10.1	33	23.0	22.0	0	0	-
	25	26963-43691	40° 25.80'	73° 57.30'	9.4	31	22.0	21.0	0	0	-
	26	26963-43690	40° 25.80'	73° 57.40'	8.5	28	22.0	21.5	0	0	-
	27	26962-43686	40° 25.40'	73° 57.35'	9.1	30	22.0	21.0	2 CLAMS	0.8	165
	28	26959-43682	40° 25.00'	73° 57.10'	10.4	34	22.0	21.4	5 CLAMS	0.2	158
	29	26961-43684	40° 25.20'	73° 57.30'	10.4	34	23.0	21.4	1 CLAM	0.8	170

*LOCATIONS SHOWN ARE APPROXIMATE MID-TOW POSITIONS.

TABLE 4

Juvenile Surf Clams in Petersen Grabs

	BELMAR	SANDY HOOK		
Total Number of Juvenile Surf Clams	162	32	567	761
Average Number of Juveniles per $0.1M^2$	12.4	5.8	57	27.1
Average Size of Juveniles	1.9	5.4	11.4	8.3

Table 5

Benthic Invertebrates In Petersen Samples

STATIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
			BELMAR												/		SANDY HOOK											
Bivalves																													
Astarte castanea	NO GRAB TAKEN						NO PETERSEN TAKEN	1			2	JAR BROKEN		3							1								
Ensis directus			1																										
Nucula proxima		1	2	2	138	2			1										1										
Pandora gouldiana		1	1						1														2			2			
Periploma leanum																												1	
Pitar morrhuana		1		2	2																								
Spisula solidissima		2	3	1		82		3	21	1	65			2	2	3	24	3		9			10	39	16	3	360	12	118
Tellina agilis		2	12		1	8		1	15	1	14		3	1	2	1		1		4	6	7	9	3			3	1	1
Gastropods																													
Nassarius trivitattus		1						1	1		1																		
Lunatia heros																													1
Polchaeta																													
Ampharete acutifrons								1	1														1						
Aricidea jeffreysii					1																	4							
Glycera americana					1										1							1							
G. capitata																13			5		1	8	2		4	5		1	
G. dibranchiata			1	1	1																								
Lumbrineris tenuis				7	4				1						3				1										
Magelona rosea								1	1								1												1
Nephtys incisa			4		3			3	1	4			1		2		1	5					3	4		1	1		2
N. picta																	3				2	2							
Nereimyra punctata																		1		1			16	1			7		16
Ophelina acuminata				3	1						1				1														
Scoloplos fragilis								1																					
Sthenelais limicola										1	1															1			
Crustacea																													
Isopoda																													
Cirolana concharum																												2	
Amphipoda																													
Haustorius canadensis																		1	1	7			1	1	1			1	2
Mysidacea																													
Neomysis americana																	1	1	1					5					
Decapoda																													
Ovalipes ocellatus						2									1		1			1							2		
Echinodermata																													
Echinarachnius parma													18																
Nemertea																													
Cerebratulus lacteus				1																									
Micrura leidyi						2			2						1		1	1											
Procephalothrix spiralis																						5	1			1			
Vertebrata																													
Ammodytes americanus (sand lance)																									3	1		3	

APPENDIX D

Fishes Common to the project area
(Table 6)

TABLE 6

FISH SPECIES COMMON TO THE PROJECT AREA

RECREATIONAL SPECIES

GADIDAE	
Merluccius bilinearis	(silver hake/whiting)
Urophycis chuss	(red hake/ling)
PERCICHTYIDAE	
Morone saxatilis	(striped bass/rockfish)
SERRANIDAE	
Centropistis striata	(black sea bass)
POMATOMIDAE	
Pomatomus saltatrix	(bluefish)
SCIAENDAE	
Cynoscion regalis	(weakfish/gray sea trout)
LABRIDAE	
Tautoga onitis	(tautog/slippery bass)
SCOMBRIDAE	
Scomber scombrus	(Atlantic mackerel)
BOTHIDAE	
Paralichthys dentatus	(summer flounder/northern fluke)
PLEURONECTIDAE	
Pseudopleuronectes americanus	(flounder/winter flounder)

COMMERCIAL SPECIES

POMATPMIDAE	
Pomatomus saltatrix	(bluefish)
SCIAENDIDAE	
Cynoscion regalis	(weakfish)
SCOMBRIDAE	
Scomber scombrus	(Atlantic mackerel)
CLUPEDIDAE	
Alosa sapidissima	(American shad)
Brevoortia tyrannus	(Atlantic menhaden)
ASTACIDAE	
Homarus americanus	(American lobster)

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

REPLY TO
ATTENTION OF

March 25, 1988

Environmental Analysis Branch

Mr. Clifford G. Day
U.S. Fish and Wildlife Service
P.O. Box 534
705 White Horse Pike
Absecon, New Jersey 08201

Dear Mr. Day:

The New York District has reviewed your Draft Coordination Act Report dated January 27, 1988 for the Atlantic Coast of New Jersey -Sea Bright to Ocean Township Beach Erosion Control Study.

In general, we are in agreement with your description of the proposed project and assessment of project impacts. We do not concur with your statement that the proposed project has the potential for long-term significant adverse impacts to fish and wildlife resources and their supporting ecosystems. While there will be repeated disturbance of the borrow areas, the amount of sand required for project maintenance is approximately one fifth of the amount to be dredged and placed on the beach for initial construction. Disturbance during maintenance work will be of a lesser magnitude and impacts to aquatic resources will be less severe than those associated with the initial work. In addition, with regard to the State of New Jersey Department of Environmental Protection's Fishermen Use Survey, we consider the survey blocks referenced in the Coordination Act Report to be of moderate rather than high value relative to the entire area included in the survey. The region around the Shrewsbury Rocks and areas lying in the inshore edge of the survey area are of higher value than the referenced blocks and would be subject to greater environmental impacts. The Corps will, however, attempt to avoid dredging the higher value areas until all less valuable areas have been dredged to the maximum extent practicable.

Lastly, we would like to clarify the issue of pre- and post-construction monitoring. At a meeting in Trenton, New Jersey on December 2, 1987, attended by your agency, NJDEP and the Corps, it was agreed that NJDEP would be responsible

for pre-construction monitoring for the first dredging site. Once construction funds become available the New York District would be responsible for future monitoring.

Further comments on the report including our response to recommended mitigation measures is enclosed with this letter. Following your review of our comments we would like to arrange a meeting to discuss any outstanding issues of concern. If you have any questions please contact Ms. Karen Sullivan of my staff at 212-264-4662. Your continued cooperation in this matter is appreciated.

Sincerely,

Samuel P. Tosi, P.E.
Chief, Planning Division

Enclosure

Enclosure 1

Comments to FWS Coordination Act Report January 1988
Sea Bright to Ocean Township Beach Control Study

1. P. 6 - The first complete sentence should be changed to, "In addition, 3.47 million cubic yards of sand are required for periodic nourishment."

2. P. 6 - The last sentence should be revised to, "The amount of sand required for initial construction of the project is approximately 21 million cubic yards."

3. P. 9, para. 3 - The third sentence should be changed to, "Additionally, the Monmouth Beach Reef has been constructed by the State of New Jersey offshore of the project area about 1.8 miles east of Monmouth Beach.

4. P. 13, para. 2 - Although blocks 9, 13, 15, 69, 70 and 74 support high use recreational fisheries relative to other sample blocks within the project area, except for block 13, they are of moderate value relative to the entire sampling area. Other blocks in the sampled area which support higher recreational use (including block 13) have been identified. The higher value blocks included the region around Shrewsbury Rocks and blocks lying in the inshore edge of the survey area. The paragraph should give a better indication of the relative value of the referenced blocks within the sampling area.

5. P. 21, para. 1; P. 24 - As indicated in the Corps response to your Planning Aid Report (letter dated November 3, 1987) for the project, this recommendation cannot be implemented. This is discussed below in the Corps' responses to recommended mitigation measures.

6. P. 21, para. 2 - The proposed project will result in no net loss of shallow water habitat. Following construction, the beach fill is expected to shift somewhat as it adjusts to existing wave conditions, resulting in an intertidal zone that, between maintenance fills is similar in size and conformation to the present intertidal zone. The intertidal zone will be displaced seaward and any net loss of area resulting from the project would involve subtidal marine habitat.

7. P. 23, para. 3 - This paragraph does not reflect the fact that after the initial dredging and placement of 17.8 million cubic yards of sand, maintenance will consist of the dredging and placement of 3.47 million cubic yards of sand. Since a much smaller area will be disturbed during project maintenance, impacts to aquatic resources will be less severe than those associated with the initial work.

8. P. 25, para. 1; P. 36, last para. - As part of the local cooperation items presented in P.L. 99-662, the non-Federal sponsor must provide for public access before construction of any portion of the project could begin. The first federal construction increment is slated for Sea Bright and Monmouth Beach with a feeder beach in the

vicinity of Long Branch. Accordingly, a public access plan has been submitted for the Borough of Sea Bright and one is expected shortly for Monmouth Beach and Long Branch.

9. P. 25, para. 2, P. 36, last para. - The Corps will investigate the potential to create shorebird habitat or to construct dunes in areas where project construction requires the placement of sand in excess of 100 feet.

10. P. 30, para. 1 - At a meeting held in Trenton, New Jersey on December 2, 1987 and attended by your agency, the New Jersey Department of Environmental Protection (NJDEP) and the Corps, it was agreed that NJDEP would be responsible for pre-construction monitoring for the first dredging site. Once construction funds become available the New York District would be responsible for future monitoring.

11. PP. 32 and 33 - The details and scheduling for the recommended sampling studies will be worked out with the Corps' Coast Engineering Research Center (CERC). CERC will be providing technical assistance for project monitoring. Proposed monitoring schemes will be coordinated with your agency.

12. P. 35, para. 2 - By the nature of the dredging process, sand will naturally form gentle side slopes along the edge of the borrow pits. Corrective measures will not be necessary to minimize water circulation problems.

13. P. 35, para. 4; P.36, no. 5 - In the first sentence, the term "impact assessment study" should be changed to monitoring program.

Recommendations

1. Avoid sand removal from high value areas until all less valuable areas have been dredged - This recommendation will be implemented where practicable.

2. Avoid construction operations during the period June 1 through September 30 - Based on NJDEP's Fisherman Use Survey, the area to be dredged is of moderate recreational value relative to the entire sampling area. The Corps does not believe that the proposed dredging will result in significant impacts to fishery resources in the effected areas. Construction and maintenance of the Rockaway Beach, New York Erosion Control Project, directly across the Ambrose Channel from Sandy Hook, has proceeded for 12 years without any seasonal restrictions on dredging, and without any changes in local fisheries of water quality. Restricting dredging to the period between mid-October through January would prevent work during the best part of the season. Dredging during the winter is not a workable alternative because of the severe climate that reduces efficiency and safety. If the project were constructed under this restriction, implementation and maintenance costs would be significantly greater due to the longer duration of dredging operations. As is noted elsewhere in the FWCA report, most of the referenced CERC studies were conducted in southern states where

dredging in the winter does not present the same concerns for safety and efficiency.

3. Conduct dredging activities in a manner which minimizes development of degraded water quality within the borrow pits - This recommendation will be implemented.

4. Notify the New Jersey Bureau of Shellfisheries if pre-project benthic sampling disclosed commercially valuable quantities of surf clams - This action will be implemented.

5. Conduct an impact assessment study of the proposed project as described in Section VII - The Corps will implement a pre-construction and post-construction monitoring program of water quality and benthic resources of the project area. Information about the proposed monitoring program is included in Appendix A of the GDM and will be discussed in the Draft EIS. As previously noted, NJDEP will be responsible for pre-construction monitoring before initial construction. This was agreed to at a meeting held in Trenton, New Jersey on December 2, 1987 and attended by USFWS, NJDEP and the Corps.

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

REPLY TO ATTENTION OF

May 10, 1988

Environmental Analysis Branch

Mr. Clifford G. Day
Supervisor
U.S. Fish and Wildlife Service
P.O. Box 534
705 White Horse Pike
Absecon, NJ 08201

Dear Mr. Day:

This is in reference to the meeting District staff held May 3, 1988 with Michael Chezik and Flavia Rutkosky of your office and Bernard Moore and Bill Andrews of the New Jersey Department of Environmental Protection (NJDEP).

At the meeting it was agreed that the District would send a letter to your office confirming some of the points we had discussed. Specifically, I would like to clarify the following issues:

a. Seasonal restrictions on dredging. As noted in the District's March 25 letter commenting to the January 1988 Fish and Wildlife Coordination Act report, for this project it is not practicable to avoid dredging June 1 - September 30, because the costs of doing this would be prohibitive. For instance, mobilization and demobilization costs would be enormous, the time required to construct the project would lengthen from four years to perhaps eight years and, because large amounts of sand would be lost from the unfinished edges of partially constructed beaches during each demobilization period, the quantity of sand required to construct the project would significantly increase. This increased need for sand would result in an increase in the size of the borrow areas. However, where practicable we are willing to schedule each year's construction to avoid areas of relatively high resource value during the requested June 1 - September 30 period. We will include a statement to this effect in the Draft Environmental Impact Statement (DEIS) for the project.

b. Monitoring. It was agreed at the meeting that the Service would change its description of the proposed benthic and water quality studies to monitoring and assessment. I

want to emphasize that this program will include not only the collection of pre-construction and post-construction data, but a commitment to take remedial actions if the monitoring reveals that the work is causing a significant problem in either the borrow areas or the disposal sites. The purpose of the monitoring will be to document both before and after conditions in the project area in order to determine if unacceptable impacts are occurring (or if conditions which could lead to an unacceptable impact are developing) and to document predisposal predictions. The program will be designed with the intent of providing the District with clearly interpretable information, within a reasonable time, about whether an adverse condition has been reached or is likely to occur, so that decisions about continued or modified site use can be made. At this time the District believes that there will be no serious impact to recovery of either bottom fauna or finfish after construction, provided water quality conditions and bottom substrates in the dredged borrow pits are not significantly altered from present conditions. A description of the proposed monitoring and assessment program will be included in the DEIS and the General Design Memorandum (GDM), as will the conceptual monitoring plan (copy enclosed) developed for us by our Coastal Engineering Research Center (CERC). We will include your office in the development of the final plan and should be contacting you soon to arrange a meeting with representatives of CERC.

c. Funding for pre-construction data collection at the first dredging site. Mr. Bernard Moore, Chief of the Bureau of Coastal Engineering in the NJDEP, indicated at the meeting that his office was ready to fund at least a large part, and probably all, of this part of this initial work.

I hope that the above resolves your remaining concerns regarding this stage of the study, and look forward to your continued involvement in the project.

Sincerely,

for Samuel P. Tosi, P.E.
Chief, Planning Division

Enclosure

A109. Performance of Design Beach Fill Project. An analysis was conducted to assure the reliability of the beach fill design. The method used for this fill performance evaluation is not sensitive to berm width. Shoreline change models which can be used for this type of evaluation use the angle of waves between adjacent shoreline sections to compute sediment transport rates. Since the fill is continuous, a detailed shoreline model study would probably show similar changes for different berm widths. For this reason only one fill performance discussion is presented for each erosion control plan.

A110. Shoreline Change. A model would predict changes at the project ends and feeder beach limits. If not provided for during construction, a sand fillet would form at the south end of the project. This could cause erosion of the project by acting as a groin. However, since 1 on 5 fill tapers are to be constructed in conjunction with the fill project, the project end effects are expected to be minimal.

A111. During construction of erosion control projects with groins, an effort should be made to notch the groins in order to minimize the impact of the structures on downdrift beaches. Ideally, groin notches should be constructed at the same time as the fill is being constructed. This would prevent the excessively long groins from trapping littoral drift material and negatively impacting downdrift beaches.

A112. Continuous Project Constructed in Phases. A beach fill project placed in Section I (Sea Bright to Ocean Township) without feeder beaches would suffer severe erosion at the south end to make up for updrift littoral drift deficiencies. The erosion problem would be similar to the phenomena experienced in the Sandy Hook critical section. The remaining beach in Section I would erode uniformly in response to a linear increase in the littoral drift along the project length.

A113. The updated fill plan provides for one feeder beach at the southern end of the project area to compensate for the sediment deficit at that location. The projected erosion rate of the feeder beach is 164,000 cubic yards per year for a total of 984,000 cubic yards over the 6-year maintenance cycle. The length of the feeder beach at Ocean Township is estimated as 8,540 feet and is based on the erosion at the Sandy Hook Critical Zone. The updated project also provides for continuous advance fill over the entire project area including the feeder beach at Ocean Township. Advance fill will be placed at a rate of 314,000 cubic yards per year for a total volume of 1,884,000 cubic yards at each 6-year maintenance renourishment project. This quantity includes 174,000 cubic yards per year to offset the effects of the increasing littoral drift component and an additional 140,000 cubic yards a year required to comply with the maintenance fill risk analysis. Movement of the additional 140,000 cubic yard risk analysis quantity out of the project area by littoral forces is not expected. Expected offshore losses due to sea level rise will be adequately supplied in the maintenance volume.

A114. Once littoral drift deficiencies are made up by the Ocean Township feeder beach, there is no apparent advantage to stockpiling additional fill at other feeder beach locations along the project as suggested by Reference 5. The updated design fill and maintenance fill would bury all

but a few of the longest existing groins. The impact of these structures on the sediment transport rate would be minimized by notching the groins at the design shoreline.

A115. Individually Constructed Reaches. If any of the three constructable reaches were built independent of the remaining reaches, then a feeder beach would be required to compensate for the sediment deficit. The feeder beach would need to be placed at the south end of the reach. The fill quantity and lengths of these feeder beaches were developed in Section III of this appendix.

A116. The shoreline north of the feeder beach in an independently constructed reach would also be subject to the increasing littoral drift potential. This would require continuous advance fill in addition to the feeder beach material. The maintenance fill of any constructable reach will positively impact the shoreline to the north of that reach. The feeder beach and advance fill will generally increase the sediment transport along the reach to the potential rate. This will eliminate the need for a feeder beach along the shoreline north of any independent reach. The shoreline will be subject only to the increasing littoral drift rate.

A117. Impact on Sandy Hook. The current erosion problem at the Sandy Hook Critical Zone is due to an inadequate supply of sediment from the beaches to the south. Based on the Existing Conditions Sediment Budget, the present supply of sand to Sandy Hook is approximately 392,000 cubic yards annually. The littoral drift potential for the base of Sandy Hook is approximately 493,000 cubic yards a year. A beach erosion control project which could increase the supply of sand to Sandy Hook above the present rate would have a positive impact on the erosion problem. An erosion control project which would decrease the sediment supply to the Hook would accelerate the erosion of the Critical Zone.

A118. Impact on Sandy Hook Navigation Channel. The project is not expected to have a significant impact on the shoaling rate of the Sandy Hook navigation channel. Construction of the selected plan will not increase the littoral drift rate beyond the potential rate. The maximum potential rate will occur, as it does presently, in Sandy Hook just north of the critical zone. The rate decreases to the north approaching the channel. The amount of material moving north into the channel will remain constant. The amount of fines in the fill material is very low. Most of the fines will move offshore and settle in deeper water.

A119. Monitoring Program. Pre-construction monitoring will consist of a survey of beach profile lines, sediment samples of the beach and borrow area, aerial photographs of the project area and biological samples collected along the beach and the borrow sites. Post-construction monitoring will duplicate the pre-construction effort at intervals of 3 months during the first two years, six months during the third year, and once in the fourth year. Post-construction field work will be followed by lab and data analysis and summarized in reports. The proposed monitoring program will begin in 1990 and extend through 1994. Monitoring is divided into 4 tasks:

A120. Task I - Fill Placement. The beach fill project will be monitored at selected intervals before and after placement along 25 profiles as scheduled in Table A42. The 25 profiles consist of 23 sites evenly spaced within the fill area and two control profiles, one mile north and south of the project limits. Sediment samples will be collected during each profile survey, at three sample locations (Mean High Water - MHW, Mid-Tide level - MTL and Mean Low Water - MLW) per profile line. A total of 15 short cores will be collected (3 sampling locations on 5 selected profile lines) on the pre-fill placement sampling trip to characterize native beach seasonal and storm related variability in sediment distribution.

A121. A monitoring team will survey the 25 profiles once yearly, collecting both onshore and offshore data to identify the seaward depth of profile closure and to characterize the active envelope of fill response. Sediment redistribution across the entire profile will be monitored during this survey by collecting seven surface sediment grab samples (1 MHW, 2 MTL, 3 MLW, 4 bar trough, 5 offshore bar crest, 6 offshore bar seaward slope, and 7 at closure depth).

Beach Fill Area Sediment Sampling Scheme:

Year	Times/year	Number of Samples	Total
pre-construction	1	15 cores (3 cores x 5 profiles) 60 surface (3 samples x 20 profiles)	75
post-construction	1	3 surface x 25 profiles	75
1	4	3 - 3 surface x 25 profiles + 1 - 7 surface x 25 profiles	400
2	4	3 - 3 surface x 25 profiles + 1 - 7 surface x 25 profiles	400
3	2	1 - 3 surface x 25 profiles + 1 - 7 surface x 25 profiles	250
4		1 - 7 surface x 25 profiles	175

Monitoring fill after major storm events (greater than 20 year return) would include sediment sampling at 3 surface x 25 profiles = 75 samples/storm event and would be performed as an add-on cost to the scope of work.

A122. Data Analysis will include: profile volume change and shape readjustment, area of loss or gain on profile, volume of fill remaining on project, assessment of alongshore and cross shore fill movement, and seasonal and storm response. Sediment analysis will include grain size statistics of native and fill material with readjustment over monitoring period, seasonal and storm grain size response and assessment of fill and renourishment factors for future fill requirements. Report writing will summarize behavior and response of beach fill to local and regional coastal and geomorphic processes.

A123. Task II - Borrow Area. Borrow area monitoring will include collection of surface sediments before dredging and immediately after dredging to support biological monitoring and assessment of fill suitability. These tasks will be coordinated with a biologist for concurrent collection period. Table A43 summarizes the borrow sampling.

A124. During the fourth (last) year of monitoring, the monitoring team will collect 18 cores, 5 at Sandy Hook borrow (2 transects) and 10 at Belmar borrow (4 transects). Transects will include control sites outside of immediate borrow pits. About 6 samples will be taken per core (20 ft. Long) for a total of 108 samples. This sampling will also be coordinated with biological sampling of the borrow area.

A125. Data analysis will include sediment statistics in tabular and graphic form for sediment fill suitability, borrow area sedimentology to support biological analysis and usability of borrow area for future projects and analysis of subcontractors bathymetric surveys for changes in borrow pits and calculation of infilling rates. Report writing will evaluate borrow changes, determine the rate of borrow area infilling, and identify current patterns in the immediate area.

A126. Task III - Shoreline Change. Subcontractor will provide 9 aerial photography overflights of the project area and construct a base map. Coverage will be a single flightline with 60% overlap stereo coverage of entire project area shoreline, including control profile locations one mile north and south of project limits. Black and white or color infrared film with a 9 x 9 inch film format will be specified. The scale of the photographs will be sufficient to identify shoreline features. A scale of 1:500 is suggested for the base map and aerial photography. Proposed aerial flight times are listed on Table A42 and should be coordinated to occur during ground surveys.

A127. Data analysis will include shoreline changes and profile changes from pre- and immediate post-construction and bi-annually as in Table A42. Products provided will be tables and maps on shoreline change rates and volume calculations of fill remaining at each flight time. Report will augment the acquired data base of historic shorelines to determine the readjusted rates of accretion nd erosion within each littoral cell or within each section. This is important along shoreline reaches consisting of groin fields, where profiles in each groin pocket are not feasible.

A128. Task IV - Biological Assessment. Biological surveys of both beach and borrow areas will be conducted. One biologist and technician will join the field team for the proposed field trips listed in task I and II. Field collection will consist of grab samples offshore and quadrate of beach areas to assess presence of infauna.

A129. Data analysis will evaluate changes in infauna in the fill area, effects of turbidity on fauna of the beach and borrow area and the effects of dredging activities on borrow area infauna. Report will describe and quantify the changes to or the reestablishment of the biological community in the fill placement area and borrow and compare to control sites.

TABLE A42
SAMPLING SCHEDULE FOR BEACH FILL MONITORING

		PRE-FILL PLACEMENT	POST-FILL AS-BUILT	FIRST YEAR 3 mo.	6 mo.	9 mo.	12 mo.
CERC	Profiles	X	X	X	X	X	
	Sediment	X	X	X	X	X	
FRF	Profile						X
	Sediment						X
AIR PHOTOS		X	X		X		X
BIOLOGICAL samples		X	X	X	X	X	X

		SECOND YEAR 3 mo.	6 mo.	9 mo.	12 mo.	THIRD YEAR 6 mo.	12 mo.	FOURTH 12 mo.
CERC	Profiles	X	X	X		X		
	Sediment	X	X	X		X		
FRF	Profile				X		X	X
	Sediment				X		X	X
AIR PHOTOS			X		X	X	X	X
BIOLOGICAL samples		X	X	X	X	X	X	X

TABLE A43
BORROW AREA SAMPLING SCHEDULE

		PRE-DREDGING	POST-DREDGING	FOURTH YEAR
CERC	sediment cores surface samples	X	X	X
BIOLOGICAL samples		X	X	X
SUBCONTRACTOR boat		X	X	X

United States Department of the Interior

FISH AND WILDLIFE SERVICE

P.O. Box 534
705 White Horse Pike
Absecon, New Jersey 08201
(609-646-9310)

May 19, 1988

Mr. George Howard, Director
New Jersey Department of Environmental
Protection
Division of Fish, Game and Wildlife
CN 400
Trenton, New Jersey 08625

Dear Mr. Howard:

This letter is in reference to the May 3, 1988 interagency coordination meeting with the New York District Corps of Engineers regarding the Atlantic Coast of New Jersey - Sea Bright to Ocean Township Beach Erosion Control Study, attended by William Andrews from the Bureau of Marine Fisheries.

In a follow up letter to the Fish and Wildlife Service (Service), dated May 10, 1988, the New York District has summarized their views about issues discussed at this meeting. Copies of their letter have been provided to the Bureau of Marine Fisheries and a copy is enclosed for your convenience. The Service is currently preparing the final Fish and Wildlife Coordination Act report [Section 2(b)] for submission to the District and we are requesting your review and comment on the information in the enclosed Corps of Engineers correspondence.

Seasonal dredging restrictions are addressed in part (a) of the letter. The Service has recommended that construction operations be avoided during periods of high biological productivity (June 1 - Sept 30). However, we also recommended that sand removal be avoided in the "high value" areas (as identified by the Bureau of Marine Fisheries) until all less valuable areas are dredged. The latter "sequenced" approach was suggested by the Bureau of Marine Fisheries at the December 2, 1987 interagency coordination meeting and subsequently incorporated into our draft Section 2(b) report. The current proposal put forth by the District would preclude the adoption of the recommended "sequenced" dredging.

It is our understanding that the "monitoring and assessment" program addressed in part (b), would at a minimum collect benthic (including surf clams), water quality and sediment data as described in the Section 2(b) report. The description of a monitoring program attached to the District's letter provides a generic concept only. The final study design will be an interagency effort. To this end, we have provided William Andrews with information describing a benthic resource assessment technique (BRAT) developed by the U.S. Army Engineers Waterways Experiment Station. This technique is designed to produce quantitative estimates of the fishery value of unvegetated soft bottom habitat.

The Service's Section 2(b) report is to be included in the District's environmental impact statement for the project. As such, we request your further comments, if any, by June 6, 1988.

Your attention to this request is appreciated. If there are any questions, please contact Flavia Rutkoskey at this office.

Sincerely,

Clifford G. Day
Supervisor

Enclosure

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
26 FEDERAL PLAZA
NEW YORK, N. Y. 10278-0090

March 4, 1987

REPLY TO
ATTENTION OF:

Environmental Analysis Branch

Mr. Gregory A. Marshall
Deputy State Historic Preservation Officer
Office of New Jersey Heritage
New Jersey Department Protection
CN 404
Trenton, New Jersey 08625

Dear Mr. Marshall:

The New York District, Corps of Engineers, has previously requested Section 106 comments from your office on cultural resources studies prepared as part of the Sea Bright to Ocean Township, New Jersey Section of the Sandy Hook to Barnegat Inlet Beach Erosion Control Project (Enclosure 1). We have not had a response to this request.

The Corps has determined, on the basis of the following cultural resource studies which have been provided to your office, that this project will have no effect on cultural resources eligible for or listed on the National Register of Historic Place.

"A Cultural Resources Reconnaissance for the New Jersey Shore from Highland Beach, Sea Bright to Deal Lake, Loch Arbour, Boroughs of Sea Bright and Monmouth Beach City of Long Branch, Borough of Deal and Allenhurst, Village of Loch Arbour, Monmouth County, New Jersey." Prepared for the New York District, U.S. Army Corps of Engineers, (1985).

"Final Report for Atlantic Coast of New Jersey, Sea Bright to Ocean Township, Monmouth County, Remote Sensing of Proposed Offshore Sand Borrow Areas." Prepared for the New York District, U.S. Army Corps of Engineers (1986).

If we receive no comments from your office in fifteen days, we will assume you are in concurrence with this determination, as pursuant to 36 CFR Part 800.5.

If you or your staff have any questions on this subject, please contact Roselle Henn of the Environmental Analysis Branch at (212) 264-4662.

Enclosures

Sincerely,

Richard J. Marabb

for Samuel P. Tosi, P.E.
Chief, Planning Division

DEPARTMENT OF EN..RONMENTAL PROTECTION
DIVISION OF PARKS AND FORESTRY
OFFICE OF NEW JERSEY HERITAGE
CN-404
TRENTON, N.J. 08625
(609) 292-2023

17 March 1986

Mr. Samuel P. Tosi, P.E.
Chief, Planning Division
U. S. Army, Corps of Engineers,
New York District
26 Federal Plaza
New York, NY 10278-0090

Monmouth County, New Jersey
Multiple Municipalities
Highland Beach to Deal Lake, or Sea Bright to Loch Arbour
Sea Bright to Ocean Township [a.k.a. Sandy Hook to Barnegat Inlet] Beach Erosion Control
U. S. Army, Corps of Engineers
Department of Defense

Dear Mr. Tosi:

Thank you for affording us the opportunity to review, as professional staff to the New Jersey State Historic Preservation Officer, a draft version of A cultural resources reconnaissance for the New Jersey shore from Highland Beach, Sea Bright to Deal Lake, Loch Arbour, Boroughs of Sea Bright and Monmouth Beach, City of Long Branch, Boroughs of Deal and Allenhurst, Village of Loch Arbour, Monmouth County, New Jersey, 1 August 1985, by Heritage Studies of Princeton, New Jersey.

It is an excellent report; no changes are suggested. When the final version is issued, the copy destined for this office should contain original photographic prints or enlargements.

We concur with the investigator's conclusions and agree with his recommendations for off-shore research. This phase of the work should be thoroughly discussed and carefully planned in view of the uncertainties and unknowns and the high cost of underwater archaeological surveys.

Sincerely yours,

Jonathan Gell

Jonathan Gell
Principal Environmental Specialist

JG:oho

6 August 1986

Environmental Analysis Branch

Mr. Gregory A. Marshall
Deputy State Historic Preservation Officer
Office of New Jersey Heritage
New Jersey Department of Environmental Protection
CN 404
Trenton, New Jersey 08625

Dear Mr. Marshall:

The New York District, Corps of Engineers, is pleased to furnish you with a copy of the final report for Atlantic Coast of New Jersey Sea Bright to Ocean Township, Monmouth County, Remote Sensing of Proposed Offshore Sand Borrow Areas. We request that you furnish us with Section 106 comments on the findings of this report.

In our 30 May 1986 letter to your office we requested Section 106 comments on the final report for the onshore portion of this project. We would appreciate receiving those comments as well, so that we may proceed with project plans.

We thank you for your cooperation and interest in this project. If you or any of your staff have any questions, please contact Roselle Henn of the Environmental Analysis Branch at (212) 264-4662.

Sincerely,

Enclosure

Samuel P. Tosi, P.E.
Chief, Planning Division

May 30, 1986

Environmental Analysis Branch

Mr. Greg Marshall
Deputy State Historic Preservation Officer
Office of New Jersey Heritage
New Jersey Department of Environmental Protection
CN 404
Trenton, New Jersey 08625

Dear Mr. Marshall:

The New York District is pleased to forward to you a copy of the final report entitled A Cultural Resources Reconnaissance for the New Jersey Shore from Highland Beach, Sea Bright to Deal Lake, Loch Arbour, Boroughs of Sea Bright and Monmouth Beach, City of Long Branch, Boroughs of Deal and Allenhurst, Village of Loch Arbour, Monmouth County, New Jersey, prepared by Heritage Studies.

Your office has previously commented on the adequacy of the draft report. At this time we request that you review the final report and provide us with Section 106 comments for the onshore portion of the project.

If you or your staff have any questions, please contact Ms. Jan Ferguson of the Environmental Analysis Branch at (212) 264-4662. Thank you for your cooperation with regard to this project.

Sincerely,

Samuel P. Tosi, P.E.
Chief, Planning Division

Enclosure

September 9, 1985

Environmental Analysis Branch

Mr. Greg Marshall
Deputy State Historic Preservation Officer
Office of New Jersey Heritage
New Jersey Department of Environmental Protection
CN 402
Trenton, New Jersey 08625

Dear Mr. Marshall:

We are pleased to enclose for your review a copy of a report entitled A Cultural Resource Reconnaissance for the New Jersey Shore from Highland Beach, Sea Bright to Deal Lake, Loch Arbour. Monmouth County, New Jersey. This report was prepared as part of the New York District, U.S. Army Corps of Engineers, proposed Sea Bright to Ocean Township Beach Erosion Control Project.

Please review this report and provide us with Section 106 comments for this project. If you or your staff have any questions, please contact Jan Ferguson or Roselle Henn of the Environmental Analysis Branch at (212) 264-4662. Thank you for your time and interest in this project.

Sincerely,

Enclosure

Samuel P. Tosi, P.E.
Chief, Planning Division

[illegible] segment of sheet piling to [illegible] depth without buckling it or ruining its interlocking seam is forced to dig out the boulder or obstacle with the aid of heavy equipment in the stream bed. The resulting unacceptable levels of disturbance would be an equally serious concern of the New York State Dept. of Env. Conservation.

I suggest that either the sheet piling solution or the rip-rap channel plan will produce disturbance during the construction period and that the N.Y.S.D.E.C. should resign itself to accepting the levels of disturbance for one yearly cycle of water levels in order to save the lives and welfare of the people using the Route 9N thoroughfare for years to come. So, I ask you not to dismiss the rip-rap channel plan on this particular D.E.C. objection.

I implore you to dismiss the steel sheet piling plan because of its completely inappropriate appearance, and because of the aforementioned scenario. The rip-rap plan is the solution. It will be a long-lasting answer to the problem that exists and will harmoniously blend in with the natural and man-made conditions in the mid-19th Century Hand-Hale Historic District.

Sincerely,

James A. Kinley

James A. Kinley,
Director, Adirondack
Center Museum &
Essex Co. Historian

cc: Marion L. Caldwell, Jr., U.S. Army, Corps of Engineers
Karen A. Gustina, " " " " "
Stanley Fafinski, " " " " "
J.R. Lambert, N.Y.S. Dept. of Transportation
Bruce Fullem, N.Y.S. Dept. of Parks & Rec. & Historic Preservation

Historical Society

Brewster Library Colonial Garden

Court Street
Elizabethtown, N.Y. 12932
(518) 873-6466

February 23, 1988

Chief of Planning Division
Dept. of the Army
N.Y. District, Corps of Engineers
Jacob K. Javits Federal Building
New York, N.Y. 10278-0090

RE: PIN 1116.26.101
Streambank erosion
protection, Route 9N
Elizabethtown, N.Y.

Dear Mr. Tosi,

Thank you for sending along a copy of the Environmental Assessment for The Branch of the Boquet River Streambank Erosion Control Project in Elizabethtown, Essex County, N.Y. for my review.

After reading through the information, I would like to state my opposition to the project as it has been proposed and recommend that you reconsider using the rip-rap channel plan as originally stated (Alternative C). My major concern is one of aesthetics in the historic Hand-Hale District.

During the early 1980's my wife and I with painstaking effort completely restored the exterior of the Hand House as well as many of the office and meeting spaces inside. We now operate the Adirondack Center Museum which will soon be annexed to the Hand-Hale District, and I also serve as the Essex County Historian. My wife and I participate in many of the activities of the Elizabethtown Social Center which now owns the Hale House, and my wife serves as a Trustee on the Board of the Boquet River Association. This involvement is why I feel compelled to write to you and voice my concern.

In the selected alternative, the 750' of steel sheet piling with a concrete cap and a 4-foot metal picket fence bisecting the Historic District will be a conspicuous eyesore. The plan promises to introduce three different materials, shapes and forms from the late 20th Century engineering world and to prominently expose them in the middle of the mid-19th Century Historic District. This construction will stick out like a sore thumb; it is a poor choice.

In analysis of the glacial deposits that line the bed of the Branch one must raise a skeptical eyebrow with the New York State Dept. of Transportation's soil boring data. Boulders surely exist.

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New York State Office of Parks, Recreation and Historic Preservation
The Governor Nelson A. Rockefeller Empire State Plaza
Agency Building 1, Albany, New York 12238
518-474-0456

Orin Lehman
Commissioner

March 9, 1988

Ms. Leslie Eisenberg
Department of the Army
New York District, Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

Dear Ms. Eisenberg:

Re: CORPS
Bouquet River Stabilization
Elizabethtown, Essex County

The State Historic Preservation Officer (SHPO) has reviewed the above project in accordance with Section 106 of the National Historic Preservation Act of 1966 and the Advisory Council on Historic Preservation's regulations, 36 CFR 800/801.

This project has been previously reviewed by this office through NYS Department of Transportation activities. The information submitted by your department is consistent with that previously reviewed and it is the opinion of the SHPO that this project will have no effect upon districts, sites, buildings, structures, objects or archeological resources in or eligible for inclusion in the National Register of Historic Places. The SHPO knows of no other significant cultural resources other than the listed Hand-Hale Historic Distric which might be impacted by the project.

If you have any questions, please contact the project review staff at (518) 474-3176.

Sincerely,

Julia S. Stokes
Deputy Commissioner for
Historic Preservation

JSS:LMG:sm
PR9 (9/87)

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