ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK

FEASIBILITY REPORT

VOLUME II:
TECHNICAL APPENDICES

U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT
NORTH ATLANTIC DIVISION

FEBRUARY 1995

Atlantic Coast of New York, Jones Inlet to East Rockaway Inlet

LONG BEACH ISLAND, NEW YORK

FINAL FEASIBILITY REPORT

VOLUME II: TECHNICAL APPENDICES

STORM DAMAGE REDUCTION PROJECT

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APPENDIX A- ENGINEERING DESIGN

INTRODUCTION

A1. Description of Project Area and Vicinity. Long Beach Island, to the west of Jones Inlet, is approximately 9 miles long and varies in width from 1,500 feet to approximately 4,000 ft. It is bounded on the east by Jones Inlet, on the south by the Atlantic Ocean, on the west by East Rockaway Inlet, and on the north by Reynolds Channel. Terrain of Long Beach Island is low-lying and flat, with elevations generally less than 12 ft. above NGVD. The ocean shoreline consists of a continuous sand beach (see Figure A1). Communities on the island include Point Lookout, Lido Beach, the City of Long Beach, East Atlantic Beach and the Village of Atlantic Beach. The entire study area is located in Nassau County, New York.

A2. Coastal History of the Project Area. Since the early 1900's the project area has experienced substantial beach erosion and damage from coastal storms. The response of the local and state governments has been to build numerous coastal protective works. Previous corrective actions along the project area were the construction of timber and stone groins, timber and concrete bulkheads and the jetties at the two navigation inlets that are the limits of the project area. Available records indicate that no significant corrective work was performed along the Long Beach Island ocean front before 1928. The following paragraphs briefly describe the history of coastal protective works along the project length.

A3. During the period 1928-1933, 28 timber and 5 stone filled groins were constructed along Atlantic Beach. Four stone groins were constructed in western Lido Beach from 1930 to 1933. In 1937, in the central portion of the City of Long Beach, 15 stone and timber groins were constructed by the city. In the western portion of Long Beach, the city constructed four timber groins in 1944, which were subsequently destroyed. In 1946-1947, the New York State Department of Public Works (NYS DPW) built six stone groins in the same general area.

A4. In 1947, two stone-filled timber groins were built in Atlantic Beach. All the structures in Atlantic Beach built prior to 1948 were either replaced, removed, destroyed or buried. In 1949, about 100,000 cubic yards of fill was place at the western end of Long Beach and 100,000 cubic yards was placed at the eastern end of Atlantic Beach by the NYS DPW. In 1949, the Town of Hempstead constructed four timber groins in Point Lookout. These timber groins were replaced by three stone groins in 1953 by the New York State Department of Public Works. In 1951, NYS DPW constructed two stone groins in Atlantic Beach, and in 1955-1958 constructed 14 additional stone groins there. In 1956, two locations along Lido Beach received 50,000 cubic yards of material, which was taken from offshore. In 1959, NYS DPW placed about 380,000 cubic yards of fill in Atlantic Beach. In October 1962, the U.S. Army Corps of Engineers placed about 40,000 cubic yards of material at the western end of Lido Beach, under contract for emergency work following the March 1962 storm. Approximately 20,000 cubic yards were also placed in eastern Long Beach.

A5. The East Rockaway Inlet and Jones Inlet Jetties, built in 1933-1934 and 1952-1959, respectively, have caused a considerable amount of accretion to the east of the respective jetties. Protective structures and fill were placed along the west shore of Jones Inlet between 1939 and 1950. Three timber groins were constructed by local interests along the southern half of this shore in 1939. These structures were subsequently destroyed by erosion. During the period 1940 to 1948, the Town of Hempstead constructed a stone seawall together with 12 stone groins, covering the whole western shoreline of Jones Inlet. In 1950, 48,500 cubic yards of fill was placed by the Town of Hempstead along the seawall as a protective measure. In 1952 a stone seawall was constructed by local interests along the east shore of East Rockaway Inlet, extending northeast from the landward end of the jetty a distance of 1,500 feet. The East Rockaway Inlet jetty is presently being rehabilitated by the Army Corps.

A6. A total of 14,300 feet of bulkheading exists behind the beaches (construction dates unknown); 13,500 feet of timber construction primarily in the City of Long Beach and Atlantic Beach, and 800 feet of concrete construction in Long Beach.

A7. More recently, material dredged from the Jones Inlet Federal Navigation channel has been disposed in the Long Beach project area. The Town of Hempstead beach, which is just west of Point Lookout in the Village of Lido Beach, has received fill material six times, in 1973, 1980, 1982, 1985, 1990 and most recently, March 1994. A total of 1,478,478 cubic yards of pay and non-pay yardage have been placed in the five operations from 1973 to 1990. Approximately 720,000 cubic yards of pay and non-pay yardage was placed in March 1994. It is expected that material from future Jones Inlet dredging operations will be placed on the Town of Hempstead beach under Section 933 authority.

A8. <u>Problem Identification.</u> The problems encountered in the Long Beach project area consist of the loss of sand fronting the densely populated areas, due to storm-induced beach erosion, and the deterioration of the protective coastal structures. Erosion has reduced the width and lowered most of the beachfront areas along the project shoreline. This continuing erosion of the protective beach exposes Long Beach Island to a high risk of catastrophic damage from ocean flooding and wave attack. Throughout the period of record, the ten mile project area has had erosion in all areas at some point in time, except for the western section of Atlantic Beach, where sand has been trapped by the East Rockaway Inlet jetty.

A9. Many of the coastal structures, including the groins and jetty at East Rockaway Inlet, have deteriorated since their construction. The structures are becoming less effective in trapping sand, and increasingly susceptible to storm damage as the beach continues to erode and lower. The area is also subject to flooding, though at lower stages, from the bay side of the island. The objective of this feasibility study was to identify an optimum storm damage reduction project.

EXISTING CONDITIONS

A10. Tides and Datums. Tides along the Atlantic shore portion of the project area are semi-diurnal. Mean and Spring tide ranges are listed in Table A1 (Reference A1). Relationships between datums are listed in Table A2.

Table A1
Mean and Spring Tide Ranges

Location	Mean Range (Ft.)	Spring Range (Ft.)
Jones Inlet (Pt. Lookout)	3.6	4.3
Long Beach (outer coast)	4.5	5.4
Long Beach (Hempstead Bay)	3.9	4.7

Table A2
Relationship Between Tidal Datums

Atlantic Ocean

1941-1959 Epoch		1960-1978 Epoch (1)	
MHW	4.50 ft.	MHW	4.50 ft.
MTL	2.25 ft.	MTL	2.25 ft.
NGVD	2.19 ft.	NGVD	2.00 ft.
MLW	0.00 ft.	MLW	0.00 ft.
MLLW	-0.25 ft.	MLLW	-0.25 ft.

Reynolds Channel

1941-1959 Epoch		1960-1978 Epoch (2)	
MHW	3.90 ft.	MHW	3.90 ft.
MTL	1.95 ft.	MTL	1.95 ft.
NGVD	1.45 ft.	NGVD	1.26 ft.
MLW	0.00 ft.	MLW	0.00 ft.
MLLW	-0.25 ft.	MLLW	-0.25 ft.

(1) Source: NOAA, Tidal Datums Section (Reference A19)
(2) Latest Available Epoch

A11. Tidal Currents. Tidal currents along the ocean shore of the study area are generally weak. Currents at Jones Inlet have average maximum velocities of 3.1 knots at flood tide and 2.6 knots at ebb tide (Reference A2). Currents at East Rockaway Inlet have average maximum velocities of 2.2 knots and 2.3 knots for ebb and flood tides, respectively. Current tables published by NOAA (Reference A2) indicate that the average velocity of the rotary tidal current in the offshore areas (22 miles south of Fire Island Inlet and Fire Island Lighted Whistle Buoy 2F1) is weak, averaging about 0.1-0.2 knots respectively.

A12. Winds. Prevailing winds at sea are from the western quadrant, and from the southwest on the south shore of Long Island. The fetch from the west is very restricted, so westerly winds have little affect on the littoral drift. Winds blowing from the eastern and southern quadrants have a significant influence on littoral transport, due to virtually unlimited fetches in those directions. Winds from the southwest average 10.1 knots (Reference A3). Velocities during tropical storms exceed 60 mph, and may approach 100 mph during severe storms.

A13. Waves. Wave data for the study area was taken from the Wave Climatology Study (WIS), Phase III, Station 51 wave hindcast performed by the Waterways Experiment Station (Reference A4). The direction of wave approach to the Long Beach Island shoreline is primarily (84%) from the south and southeast. For the hindcast period, 2.3% of waves exceeded 8.2 ft. in height.

A14. A wave height-frequency curve was developed from the WIS data to obtain storm wave conditions. (Reference A5, calculation No. CS-1882-02) A plotting positions technique based on the number of observations of storm data was employed to obtain the significant deep water wave heights. Breaking wave heights were then calculated for the 10, 25, 50, 100 and 500 year return periods using the method outlined in the Shore Protection Manual (Reference A6). The results of storm wave conditions, including significant and breaking wave heights and the corresponding wave periods are summarized in Table A3.

Table A3
Storm Wave Heights by Return Period

Return Period	Period (sec)	Deep Water Wave Height, H'o (ft.)	Deep Water Breaking Wave Height, Hb (ft.)
2	9.2	14.8	17.8
5	9.4	16.0	19.2
10	9.5	17.2	20.3
25	9.8	18.1	22.0
50	10.0	19.8	23.0
100	10.5	21.0	24.8
500	12.5	24.0	28.3

A15. Stage-Frequency. Flooding in the study area is caused by the combination of storm-induced water level rise and astronomical tide. The storm-induced water level rise has several causes: 1) storm winds exert shearing forces; 2) decreasing atmospheric pressure; 3) storm waves raise the water level along the shore. The combination of the first two effects is defined as storm surge (and when added to the astronomical tide level, is called the total stage), and the third effect is called wave setup. It is the total stage levels with wave setup that are used for analysis in this report. Stage frequency curves, which relate flood water elevations to the average interval or time between storm events, were developed for the ocean shoreline and the back bay.

A16. Ocean Stage-Frequency Curves. A storm water elevation stage-frequency curve was developed by the Waterways Experiment Station (WES) for the ocean side of Jones Inlet, which is considered to be representative of the open coast stage-frequency for the entire project shoreline (Reference A7). This curve presents storm water elevations levels (including wave set-up) in feet above NGVD. The combined hurricane and northeaster curve was utilized for design purposes and for erosion model input. The combined storm water elevations for 10, 25, 50, 100 and 500 year return periods is summarized in Table A4. The stage levels are plotted in Figure A2.

Table A4
Water Level Elevation vs Return Interval

Return Period (yrs)	Water Level Elevation (ft. NGVD) (1)
10	8.4
25	9.6
50	10.8
100	12.1
500	15.3

(1) Includes wave set-up

A17. Inlet and Back-bay Stage-Frequency Curve. In addition to the open coast, the back-bay area at the project site will also be flooded by the increased water level due to flood flow through the inlets. It is anticipated that the induced flooding in the back-bay would be the same for both existing and improved conditions since there will be no hurricane barriers introduced in the current improvement plan. The stage-frequency relationship published by the Federal Emergency Management Agency (FEMA) in 1978 (Reference A8) was used for the flood damage estimates. The surge level vs. return period are shown on Table A5 and plotted in Figure A3.

A18. Sea Level Rise. The effects of possible changes in relative sea level were examined in accordance to EC 1105-2-186 (Reference

A9). The rate of land subsidence M=1.5 mm/yr for New York was obtained from the report, Responding to Changes in Sea Level - Engineering Implications (National Research Council, Reference A10). The historic, or local low level rate of rise of 0.01 ft/yr was obtained from NOAA (The National Ocean and Atmospheric Administration) for the Long Beach Area (Reference A11). Extrapolating the historic rate of sea level rise yields 0.5 ft of increased water elevation over the 50 year project life. Using NRC Curve III with an estimated land subsidence rate of 1.5 mm/year, the predicted high rate of rise is 1.30 ft over the 50 year project life.

A19. Possible changes in relative sea level may have effects on the storm stage-frequency relationships. Changes in storm stage-frequency elevations are shown in Table A5 for both low and high estimated rates of sea level rise.

Table A5

Ocean and Bay Stage Frequencies with
Low and High Rates of Sea Level Rise

	Storm Surge Elevations (ft NGVD)				
Stage-Frequency Relationship	5 yr	10 yr	50 yr	100 yr	500 yr
Ocean Year 0 (no rise)	7.6	8.4	10.8	12.1	15.3
Ocean Year 50 historic rate	8.1	8.9	11.3	12.6	15.8
Ocean Year 50 NRC high rate	8.9	9.7	12.1	13.4	16.6
Bay, Year 0 (no rise)	5.5	5.9	7.4	8.3	11.1
Bay Year 50 historic rate	6.0	6.4	7.9	8.8	11.6
Bay Year 50 NRC high rate	6.8	7.2	8.7	9.6	12.4

Should the high rate of rise occur, although this scenario is not used for design purposes since it has not yet been shown to occur, project design features would require raising to compensate for increased damage potential of storms due to increased surge elevations. The local rate of rise over 50-years of 0.5 ft is within the estimated accuracy range of the year 0 stage-frequency curve and would not require change to the design section.

A20. Storms. The study area is subject to damages from hurricanes and from extratropical cyclones known as "northeasters". Hurricanes generally strike the study area between June and December, and more frequently within this period between August and October. Northeasters generally strike the study area from October through March. A summary of storms that struck, or occurred, near the project area from 1635 to 1962 is given in Appendix E of the 1965 Survey Report (Reference A12). More detail on historic storms can be found in that document. The following paragraphs describe hurricane and northeasters, and give details on the major storms which affected the project area in the more recent past.

A21. Hurricanes. This type of storm affects the project area most severely with its high winds, waves, rainfall and tidal flooding. A hurricane is defined as a cyclonic storm with winds in excess of 74 mph which originates in the tropical or subtropical latitudes of the Atlantic Ocean and move erratically in a curved path, changing from an initial northwest to a final northeast direction. Hurricanes may affect localities along the entire Atlantic and Gulf Coasts of the United States.

A22. The hurricanes that most severely affect the study area usually approach from the south-southwest direction after recurving around eastern Florida and skirting the Middle Atlantic States. The most severe hurricane on record for the study area is Hurricane Donna, which occurred on 12 September 1960.

A23. Northeasters. Named after the predominant wind direction, these are large-scale, low pressure disturbances that are less severe than hurricanes. Northeasters have sustained wind speeds which rarely exceed 50 knots, although gusts can reach hurricane strength in a very severe northeaster. Flood damage caused by a typical northeaster is often a function of duration rather than intensity. This type of storm typically lasts two to three days, making it possible for it to act through several periods of high astronomic tide. The longer the storm, the more opportunity it has to destroy both natural and engineered flood protection features.

A24. Northeasters sometimes develop into more complex storms. Relative location of high and low pressure centers may cause wind speed in excess of what would be expected from a single storm cell. Winds reaching almost hurricane speed may occur over many thousands of square miles. The most severe northeaster of record that struck the project area occurred 6-8 March 1962. It caused serious tidal flooding and widespread damage all along the Middle Atlantic Coast.

A25. Hurricane of 21 September 1938. The center of this hurricane skirted the east coast of New Jersey and struck the south shore of Long Island near Moriches Inlet during a rising predicted tide. In New York City, the minimum barometric pressure was 28.72 inches. The U.S. Weather Bureau station near the Battery reported a gust velocity of 80 mph from the northwest. At East Rockaway Inlet a 50-foot section of the jetty was severely damaged. Along the Long Beach oceanfront 15 stone and timber groins were damaged. Sand from the beach was piled up on the roads adjacent to the shore, and many structures in this area were damaged by waves and from flooding. Along the Reynolds Channel shoreline, the main damage resulted from flooding.

A26. Hurricane of 14 September 1944. On the morning of 14 September, the hurricane reached Cape Hatteras, where a central barometric pressure of 27.88 inches and a wind speed of about 108 mph were reported by the U.S. Weather Bureau. Toward evening, the storm center passed about 100 miles east of New York Harbor during a falling predicted tide. Average wind velocity was 80 mph, with peak gusts of 95 mph. The highest tide recorded at Sandy Hook, New Jersey was 7.7 feet above NGVD. In the study area more damage was caused by wind than by storm surge or flooding. At Long Beach, waterfront cottages were damaged and the ends of a number of streets were washed out.

A27. Extratropical Storm of 25 November 1950. The storm center formed over eastern North Carolina and moved northward toward the study area. At New York City, the winds, which were less severe than during the 1938 and 1944 hurricanes, attained an average velocity of 47 mph, with gusts velocities as high as 72 miles per hour. However, the accompanying tides in the New York Harbor area were about one to two feet above the previous maximums recorded during the 1938 and 1944 hurricanes. In the study area, light stone groins were damaged and some bathhouses along the shore front were destroyed. Damage to private homes ranged from minor to complete destruction. Erosion of the beaches was extensive. In the bay area, many boats were damaged or completely wrecked. There was severe damage to property from flooding, causing many to evacuate the area.

A28. Extratropical Storm of 6-7 November 1953. This storm originated in the Gulf of Mexico and travelled east to a position off the Georgia coast, where it assumed a more northerly course. The storm intensified when a high pressure system centered over the upper Great Lakes region brought cold air into the southeastern portion of the country. The storm center moved inland in the vicinity of New York City. The passage of the storm at the time of the predicted high tide resulted in extremely high water levels in the study area. At Atlantic Beach and Long Beach, inundation reached a height of 12 inches. The barrier beach at Long Beach was breached and the ocean and bay waters met.

A29. Hurricane of 31 August 1954 ("Carol"). After five days off the eastern coast of the United States, Hurricane Carol's forward speed accelerated to 40 miles per hour and the storm center crossed the south shore of Long Island approximately 25 miles east of Westhampton Beach on the morning of 31 August near the time of predicted high tide. In the project area, seven cottages were completely destroyed and numerous cabanas were damaged. Extensive damage was caused by flooding.

A30. Hurricane of 12 September 1960 ("Donna"). This hurricane was reported about 100 miles east of Atlantic City, NJ at 11 a.m. Eastern Standard Time (EST) on September 12th. The "eye" of the storm, which passed over the project area while moving northerly at the time of predicted high tide, became elongated and extended from New York City to Montauk Point. U.S. Air Force Radar operators at Montauk Point indicated that Hurricane Donna had separated into three "eyes" upon reaching this area. At New York City, the Weather Bureau reported winds between 60 and 70 mph, with a peak gust at LaGuardia Airport of 97 mph. The Weather Bureau at New York City reported a low barometric pressure of 28.65 inches. The near coincidence of the storm's passage with the time of predicted high tide in the study area resulted in the highest recorded storm water elevations in the study area. Maximum water surface elevations at the Battery and Fort Hamilton, NY were 8.4 and 8.6 ft NGVD, respectively.

A31. Along the ocean front at Long Beach, about a mile of shore area was inundated, with water in the streets from 3 to 4 feet deep. Evacuation on a large scale took place at Atlantic Beach and Lido Beach. Erosion at Jones Inlet was severe.

A32. Extratropical Storm of 6-8 March 1962 ("Five High"). This storm resulted from the merging of two storms. One moved easterly from the midwest, while the other moved northerly up the coast. The two storms combined off the mid-Atlantic Coast and remained nearly stationary. Strong offshore winds over along fetch of ocean influenced the entire Atlantic Coast for three days. This storm has been described as one of the most destructive extratropical cyclones ever to hit the United States coastline, and is one of the most destructive to hit the study area. A continuous storm surge of 3 to 5 feet coupled with spring tide conditions resulted in significantly high water surface elevations (7.1 ft NGVD at the Battery, NY).

A33. On 16 March 1962, President Kennedy declared the coastal sections of New York City and Long Island a disaster area. In the study area, the total damage was estimated to be $ 3,812,000 as reported in 1962. Damaging high waters occurred on five successive high astronomical tides over a period of 48 hours. The momentum of these high tides, aided by the force of high waves, carried the water inland to reach buildings which would have ordinarily been beyond the reaches of these tides. The long duration of the storm caused unprecedented destruction of beaches and dunes. Boardwalks, seawalls, bulkheads, groins and jetties were damaged and houses were destroyed on sites where they had been considered safe for 60 to 80 years.

A34. Erosion of the beaches and dunes along the entire coast of Long Beach Island, from Atlantic Beach to Point Lookout was severe. At Atlantic Beach and Lido Beach, damage to the boardwalk was considerable. The high tides deposited sand along the streets of Long Beach. Extensive damage was experienced along the Reynolds Channel shoreline.

A35. Extratropical Storm of 28-30 March 1984. This severe northeaster lasted from late in the day on March 28th to midday on March 30, with low barometric pressure, high winds and driving rains. Near hurricane winds raised storm tides 5 to 6 feet above the normal astronomical tides. A maximum storm water elevation of 7.1 feet NGVD was recorded at Sandy Hook, NJ. Along the study area's oceanfront shoreline, groins, bulkheads and boardwalks were damaged, with considerable loss of beach at Long Beach, Lido Beach and the Town of Hempstead Beach. There was much accumulation of debris and inundation along the streets throughout the island.

A36. Hurricane of 27 September 1985 ("Gloria"). This storm made landfall at Fire Island, 40 miles east of the study area, at 11:00 a.m. EST on September 27th at a time of predicted low astronomical tide. The hurricane had winds up to 70 mph and a storm surge of 5-6 feet. Overall damage was far less than expected and considerably less than the extratropical storm of March 1984.

A37. Hurricane of 19 August 1991 ("Bob"). This hurricane was moving north/northeast at approximately 30 miles per hour to within 100 mile of Atlantic City, NJ. Reconnaissance aircraft reported a minimum barometric pressure in the storm center of 28.14 inches, and maximum sustained winds in excess of 115 mph. The hurricane passed within 25 miles of Montauk Point, however, flooding and wave damage to the study area were minimal due to the offshore path and to the near coincidence of the arrival of the hurricane to the time of the predicted low tide.

A38. Extratropical Storm of 30 October 1991 (Halloween Northeaster). This northeaster encompassed three, possibly four high tides. Water levels recorded at Sandy Hook, NJ were measured 4 ft. above normal astronomic high tide on October 31st, at +6.73 ft NGVD. Significant inundation, from both the ocean and Reynolds Channel caused extensive flooding along the eastern half of the island. Pt. Lookout, Town of Hempstead Beach and Lido Beach experienced scarping of the beaches. Three groins at Pt. Lookout were damaged, and water and debris washed into the streets of central Long Beach.

A39. Extratropical Storm of 11-13 December 1992. The northeaster of December 1992 stagnated over the metropolitan area for three days, stalling and changing directions several time as it moved out to sea. Several tidal cycles were impacted, resulting in prolonged effect of the surge and high waves. The storm maintained a pattern of heavy rain, high winds (gusting up to 50 mph), high coastal water elevations, severe coastal flooding and extensive beach erosion. The area experienced severe damage to beachfront properties all along the ocean fronts of New York and New Jersey. The maximum historical water elevations were exceeded at Sandy Hook, NJ, (+8.68 ft. NGVD versus +8.56 ft. NGVD, Hurricane Donna) and the maximum elevations during the storm were within one foot of the maximum historical elevations at the Battery (+7.96 ft. NGVD versus +8.35 ft. NGVD, Hurricane Donna).

A40. Extratropical Storm of 12-14 March 1993. A low pressure center, born over the Gulf of Mexico, intensified into a massive storm system as it tracked northward over the Atlantic states. It central pressure fell to 28.40 inches of mercury as it passed almost directly over the metropolitan area. Accumulations of snow ranged from 10 to 20 inches. Very high winds whipped this snow around, creating blizzard conditions for many hours. These very same winds also generated water elevations between six and nine feet above normal. Coastal flooding was significant and widespread. The maximum water elevation at Sandy Hook, NJ was +7.13 ft NGVD.

A41. Geology. Long Island lies within the Coastal Plain physiographic province and marks the southern boundary of Pleistocene glacial advance in the eastern part of the North American continent. Two end moraines form the physiographic backbone along the northern part of Long Island. These moraines are superimposed along the western half of Long Island but split in west-central Long Island and diverge around Great Peconic Bay. Terrain south of the terminal moraines originated as glacial outwash plains, and is composed of sand and gravel detritus transported south by melt-water streams during Pleistocene time. Shallow brackish-water lagoons and low relief sandy barrier islands with associated dunes are the dominant landforms along most of the southern shore of Long Island. Long Beach Island is one of these barrier islands. Metamorphic bedrock underlies sandy deposits, at depths varying from -200 ft. NGVD in northern Long Island to -2000 ft. NGVD below Fire Island.

A42. The back-barrier lagoons and elongate-barrier islands are geologically very recent features which owe their origins to coastal processes operating during the gradual worldwide rise in sea level. The barrier islands are constructional landforms built up over the past several thousand years by sand from the sea floor and by sand transported westward along the Long Island shoreface by wave-generated longshore currents. This chain of sandy barrier islands extends from the western end of Long Island eastward to Southampton and is presently broken in continuity by six tidal inlets (Figure A4).

A43. Littoral Materials. Beach sediment grab samples were collected in 1988 along ten USACE profile lines at +8, 0, -8, -18 and -30 ft. NGVD (Reference A13). Sand samples were described as tan to dark tan in color, with sizes ranging from very fine sand to coarse sand, with some shell fragments. Grain size distribution curves were then calculated based on composite beach samples for each profile line. Three overall composites were made by combining the profile composites to produce typical beach sand models for the Lido Beach, Long Beach and Atlantic Beach areas of the shoreline. These three overall composites were compared to potential borrow material to determine its suitability for beachfill. The parameters for the composite beach sand models are shown in Table A6. The median grain sizes for the three typical beach models are 0.21 to 0.22 mm, which are classified as fine sand based on the Wentworth Classification.

TABLE A6

COMPOSITE BEACH SAND PARAMETERS

Composite	Phi 16 (mm)	Phi 50 (mm)	Phi 84 (mm)
Lido Beach	1.38 (.38 mm)	2.13 (.22 mm)	2.75 (.15 mm)
Long Beach	1.31 (.40 mm)	2.17 (.22 mm)	3.03 (.12 mm)
Atlantic Beach	1.41 (.38 mm)	2.21 (.21 mm)	2.95 (.13 mm)

A44. Analyses were performed to compare offshore borrow material with the three native beach material models to determine the overfill (Ra) and renourishment (Rj) factors. Results are summarized in Table A7. Borrow material at cores C-2, C-5 and C-7 consisted of fine sand and failed suitability requirements. Cores C-14, C-15 and C-17 were found to have suitable material for depths of 14, 10 and 17 feet respectively. All other cores were found suitable for the entire 20-foot depth. Detailed evaluation to determine beach and borrow area compatibility is presented in Appendix B.

TABLE A7
VIBRACORE OVERFILL AND RENOURISHMENT FACTORS

Core	Median	Composite Beach Model					
		Lido Beach		Long Beach		Atlantic Beach	
Number	Size (mm)	Ra	Ri	Ra	Ri	Ra	Ri
C-1	0.24	1.0	0.8	<1.0	1.0	<1.0	0.8
C-2	0.19	7.5	2.6	9.7	2.3	5.4	2.2
C-3	0.40	1.0	0.1	1.0	0.2	1.0	0.2
C-4	0.29	1.0	0.3	1.0	0.5	1.0	0.4
C-5	0.21	4.7	1.8	7.3	1.7	3.5	1.6
C-6	0.29	1.0	0.5	1.0	0.6	1.0	0.5
C-7	0.25	1.4	0.8	1.2	1.0	1.3	0.8
C-8A	0.32	1.1	0.0	1.1	0.0	1.1	0.0
C-9	0.23	1.1	0.5	1.0	0.7	1.1	0.6
C-10	0.36	1.1	0.0	1.0	0.0	1.0	0.0
C-11	0.54	1.1	0.0	1.0	0.1	1.0	0.1
C-12	0.24	1.0	1.0	1.1	1.1	1.0	1.0
C-13	0.36	1.0	0.3	1.0	0.4	1.0	0.3
C-14	0.56	1.0	0.2	1.0	0.3	1.0	0.2
C-15	0.19	>10	2.5	>10	2.2	>10	2.2

A45. Shoreline Changes. Shoreline changes between 1835 and 1990 are shown in Figure A5. During this time period the barrier island/inlet system evolved to its present configuration. The following description from the 1965 report (Reference A12) describes the major movements of landforms including the formation and closure of inlets which have occurred:

"In 1835 Long Beach Island extended west from Jones Inlet approximately 6 miles. At the western end of the island there was an inlet to Hempstead Bay called Hog Island Inlet. The opposite shore of the inlet, about 3,000 feet to the northwest, was a spit jutting out in an easterly direction from the mainland. The south shore of this spit was contiguous with the south shore of the mainland which extended to the Rockaway peninsula. Between 1835 and 1855 the western end of Long Beach Island had migrated 13,000 feet west, an average of 650 feet per year, and the inlet at this end was now called East Rockaway Inlet. By 1879 this inlet had closed and two new inlets had broken through the island, one at the location of the original Hog Island Inlet and the other 8,000 feet to the west. From 1879 to 1909 the two inlets had closed and East Rockaway Inlet was open again at its 1855 location. From 1909 to 1926 the western end of the island had migrated about 4,000 feet west to about where East Rockaway Inlet is now located.

The 1835 survey shows Jones Inlet with its western shoreline 1,400 feet east of its present location. The width of the inlet at that time was 6,600 feet, but as the eastern shoreline generally migrated west at a faster rate than the western shoreline, the inlet has usually become narrower. The width of this inlet ranged from 8,000 feet in 1880 to 700 feet in 1952, immediately prior to construction of the east jetty.

The eastern shoreline of the inlet steadily moved westward by the western shoreline shifted irregularly, and surveys made in 1880, 1909, and 1926 showed that it moved east and north after 1880. A survey made in 1933-34 showed that the western shoreline had moved westward since 1926 an average of 500 feet or 71 feet per year and a survey made in 1940, immediately prior to construction of a stone seawall along this shore, showed the shoreline had retreated further to the west. By 1952 the eastern shoreline had advanced west about 7,500 feet since 1835, an average of 65 feet per year, and the western shoreline had moved approximately 1,400 feet to the west during the same period, reducing the width of the inlet to 700 feet. Construction of the seawall along the western shoreline and of the east jetty has stabilized the inlet, with a width of 2,200 feet between the two structures."

A46. Table A8 lists changes on the Atlantic shoreline broken down by community between 1835 and 1990. It is important to note the magnitude of shoreline movements, and the fluctuating patterns of accretion and erosion, as well as influences of the bracketing inlets. The magnitude of shoreline change, which has historically ranged between -23 ft/yr and +51.0 ft/yr, indicates the great potential for sediment movement which exists along the entire Long Beach shore. Stabilization efforts, namely construction of inlet jetties, groin fields, and seawalls as well as periodic beachfill have reduced the observed rates of accretion and erosion, except in the area just west of Point Lookout, where erosion rates remain extreme. In spite of human efforts, fluctuating accretion/erosion cycles remain the dominant shoreline movement pattern for the island as a whole, although the magnitude of fluctuations appears to have been reduced by shore protection activities.

A47. A predominantly erosive zone is located just west of Point Lookout, and is associated with the evolution of Jones Inlet. The erosive trend in this area is expected to continue for the foreseeable future, until growth of the offshore ebb shoal is complete. The western portion of Long Beach Island has been accretionary since the construction of the East Rockaway jetty in 1934. It is likely that impoundment capacity of this jetty is decreasing, which will reduce the accretionary trend in this area.

A48. Volumetric Changes - 1927-1963. Point Lookout and eastern Lido Beach experienced large volumes of accretion in the 1927-1963 period, largely due to changes in the offshore ebb shoal associated with Jones Inlet. Average yearly accretion volumes of +31 cy/ft of shoreline are calculated for approximately 9500 feet of shoreline from Jones Inlet westward.

Table A8
SHORELINE CHANGES
1835-1990

Reach	Time Period	Advance/Retreat	Yearly Rate (ft/yr)
Pt. Lookout (0.9 miles)	1835-1880 (45 yrs)	western half: +300 ft eastern half: -200 ft	+6.7 (1) -4.4 (1)
	1880-1934 (54 yrs)	western third: -800 ft eastern two-thirds: +700 ft	-14.8 (1) +13.0 (1)
	1934-1963 (29 yrs)	western third: +1000 ft eastern two-thirds: -200 ft	+34.5 (2) - 6.9 (2)
	1963-1990 (27 yrs)	western half: -460 ft eastern half: +102 ft	-17.1 (2) + 3.8 (2)
Lido Beach (2.2 miles)	1835-1880 (45 yrs)	eastern two-thirds: +280 ft	+ 6.2 (1)
	1880-1934 (54 yrs)	eastern two-thirds: -1250 ft	-23.1 (1)
	1934-1963 (29 yrs)	entire reach: accretion ranging from +200 ft to +1000 ft	+37.9 (2)
	1963-1990 (27 yrs)	western 2500 ft: stable eastern 9100 ft: accretion ranging from +0 to +512 ft	0.0 +19.0 (2)
Long Beach (3.3 miles)	1835-1909	In 1835 only the eastern three-fourths of this reach was in existence. By 1909 the shoreline is continuous.	-
	1835-1934 (99 yrs)	eastern three-fourths: -700 ft	-7.1 (1)
	1934-1963 (29 yrs)	entire reach: +200 ft	+6.9 (1)
	1963-1990 (27 yrs)	entire reach: fluctuates between loss of -123 ft and gain of +128 ft	-4.5 (2) +4.7 (2)
Atlantic Beach (2.8 miles)	1835-1934 (99 yrs)	The shoreline evolved to its present form over this time period.	-
	1934-1963 (29 yrs)	entire reach: stable to accretionary up to +1500 ft	+51.0 (2)
Atlantic Beach (2.8 miles)	1963-1990 (27 yrs)	eastern 2400 ft: -92 ft western 12,400 ft: +282 ft	- 3.1 (2) +10.4 (2)

(1) Average change
(2) Maximum change

A49. The mid-portion of the island, western Lido Beach through eastern Atlantic Beach (approximately 34,000 linear feet), experienced an overall erosive trend, averaging -5.0 cy/ft. of shoreline. Artificially placed fill of 642,000 cy is included in the loss rate given. Western Atlantic Beach data for 1927 does not exist. Comparison of 1934-1963 shows annual accretion of +20.5 cy/ft of shoreline occurring due in part to construction of the East Rockaway jetty and subsequent impoundment.

A50. Volumetric Changes - 1963-1988. Point Lookout and eastern Lido Beach experienced large erosional losses over the 1963-1988 time period. Profile comparison shows a loss of -11 cy/ft of shoreline annually over 9,500 linear feet. The remainder of Lido Beach and most of Long Beach (approximately 17,000 ft) shows a yearly accretion of +1.2 cy/ft of shoreline. Western Long Beach and eastern Atlantic Beach (12,000 ft of shoreline) experienced an erosional trend of -5.1 cy/ft of shoreline/year. Western Atlantic Beach (10,900 ft of shoreline) exhibited an accretionary tendency over the 1963-1988 time period, gaining +6.1 cy/ft of shoreline per year.

A51. Sediment Budget - Existing Condition. An existing condition sediment budget was developed for the study area based on comparison of beach profiles between 1963 and 1988, and records of beachfills placed in that time period (Figure A6). The pattern observed alongshore is one of alternating erosive and accretive zones. Transport is net westerly, with an overall erosive trend, losing an estimated 80,000 cy/yr over the entire Atlantic shoreline. Accretion at the western end of the island can be attributed in part to impoundment by the East Rockaway jetty. The most erosive zone is located adjacent to Jones Inlet although significant losses are found mid-island as well. Material eroded migrates westward over time along the length of the island, contributing to accretionary zones further downdrift. As seen from the historic shoreline comparisons, the location of accretive and erosive zones shifts alongshore over time, so that any given location will experience cycles of both deposition and loss.

A52. Sediment Budget - Projected 50-Year. A second sediment budget was prepared for a 50-year projection, to reflect the without-project condition. This is shown in Figure A7. Measured erosion rates were averaged over relatively long reaches to capture the effects of migrating erosive and accretive zones. Measured erosion rates from the 1963-1988 period were increased to account for several trends. First, it was assumed that the East Rockaway jetty will reach capacity early in the 50-year projection, and that impoundment in western Atlantic Beach will cease. Second, deterioration of groins alongshore will result in increased sediment movement. Third, sea level rise over a 50 year period will cause an increase in erosion rates for the entire shoreline. Additionally, the 1963-1988 time period contained relatively few severe storm events, indicating that greater losses of material are likely to occur in the future.

A53. Projected average erosion rates range from -5 cy/yr/ft of shoreline to zero. The net transport direction is westerly. Overall predicted losses for the Long Beach shoreline are estimated at 195,000 cy/yr.

A54. Existing Beach Characteristics. Existing beach characteristics were measured and tabulated from profile surveys taken in November of 1991 and topographic mapping based on aerial photography taken April 18, 1990. Characteristics are summarized in Table A9.

A55. Dunes are present on 14 out of 33 profiles. The average maximum dune elevation measured on the beach profiles is +17.75 ft NGVD, with a range of maximum elevations from +13.5 to +20 ft NGVD. Average dune crest width is 17.12 ft, ranging from no flat crest to 160 ft of crest width. Dune side slopes range from 1V:4H to 1V:12.5H. Figure A8 shows a profile of maximum dune elevations across Long Beach Island.

A56. Flat berm features are not present on all profiles. Those without well defined berms slope continually downward. Of 18 profiles showing well defined berms, the average elevation is +9.42 ft NGVD, with a range between +7 and +14 ft NGVD. Average berm width is 93.5 ft, ranging between 0 and 600 ft.

A57. Offshore slopes are steeper on the eastern end of the island, averaging 1V:21.75H for profiles 140 to 174. Offshore slopes for profiles 180 to 330 average 1V:34.52H.

A58. Sea Level Rise Effects on Shoreline Recession. Per Brunn (Reference A14) proposed a formula for computing the rate of shoreline recession from the rate of sea level rise that takes into account local topography and bathymetry. His contention is that with a rise in sea level, the beach profile attempts to reestablish the same bottom depths relative to the surfaces of the sea that existed before the sea level rise. If the along-shore littoral transport into and out of a given shoreline is equal, then the quantity of material required to reestablish the equilibrium bottom profile must be derived from erosion of the shore. The shoreline recession attributed to the historic estimate of sea level rise along the shore of the study area would be 19 feet, or 0.38 feet per year. The shoreline recession attributed to the "high" estimate of sea level rise would be 50.3 feet, or approximately 1.0 feet per year. These recessions were computed using Dr. Brunn's equation (Brunn's rule) as follows:

$x = ab/(h+d)$, where

x = Shoreline recession (in feet) attributable to sea level rise;

h = Elevation of shoreline above Mean Sea Level (+14.75 ft NGVD dune);

d = MSL depth contour beyond which there is no significant

TABLE A9
LONG BEACH, N.Y.
SUMMARY OF PROFILE EXISTING CONDITIONS OF NOV. 1991 SURVEY

PROFILE NUMBER	MAXIMUM DUNE ELEVATION (FT. NGVD)	DUNE WIDTH (FT.)	BERM ELEVATION (FT. NGVD)	FLAT BERM WIDTH (FT.)	FORESHORE SLOPE (1V: H)	OFFSHORE SLOPE (1V: H)
140	19.0	70	No Flat Berm	0	12.0	69.0
150	No Dune	0	9.0	215	24.0	N/A
160	No Dune	0	14.0	20	22.5	N/A
170	No Dune	0	11.0	125	24.0	N/A
172	20.0	40	8.0	600	23.0	N/A
174	20.0	45	7.0	535	25.0	N/A
180	18.0	160	7.5	220	31.0	N/A
182	20.0	58	No Flat Berm	0	37.0	N/A
184	20.0	30	No Flat Berm	0	34.5	N/A
190	No Dune	0	No Flat Berm	0	30.0	N/A
192	13.5	2	No Flat Berm	0	38.0	N/A
194	No Dune	0	No Flat Berm	0	35.0	N/A
196	17.5	10	No Flat Berm	0	38.0	N/A
200	No Dune	0	10.0	70	35.0	N/A
202	No Dune	0	No Flat Berm	0	42.0	N/A
204	No Dune	0	10.0	65	43.5	N/A
206	No Dune	0	No Flat Berm	0	37.5	N/A
210	No Dune	0	10.0	135	41.0	N/A
212	No Dune	0	9.5	60	38.0	N
214	No Dune	0	No Flat Berm	0	41.5	N/A
216	No Dune	0	10.0	70	40.0	N/A
220	No Dune	0	7.5	145	43.5	N/A
222	17.5	10	10.0	55	38.0	N/A
224	15.0	20	No Flat Berm	0	19.0	N/A
226	15.5	25	No Flat Berm	0	21.5	43.5
230	20.0	45	10.0	95	18.0	48.0
234	No Dune	0	10.0	80	11.0	42.5
238	15.5	50	No Flat Berm	0	20.5	35.0
250	17.0	?	No Flat Berm	0	25.0	40.0
270	No Dune	0	9.5	105	40.5	N/A
290	No Dune	0	No Flat Berm	0	44.0	N/A
310	No Dune	0	9.0	335	38.0	N/A
330	No Dune	0	7.5	155	51.0	N/A
AVERAGE	17.75	17.12	9.42	93.48		

AVERAGE SLOPE FOR PROFILE NOS. 140 TO 174 — 21.75 (use 25.0)
AVERAGE SLOPE FOR PROFILE NOS. 180 TO 330 — 34.52 (use 35.0)

sediment motion (-20' NGVD);

b = Horizontal distance (1345 foot average) from the SWL (0.25' NGVD - mean tide level) elevation to the depth contour d;

a = Specified relative sea level rise for time period t.

Additional sand volumes needed to compensate for both rates of rise were calculated. The low rate requires placement of 21.5 cy/lf of shoreline over the 50 year project life. This volume has been included in calculated nourishment volumes as part of the project design. The high rate of rise would require 55.9 cy/lf of shoreline over 50 years. Should the more rapid rate of rise occur, additional compensatory volumes will be added to future nourishment cycles.

A59. Effects of Sea Level Rise on Project Optimization. Regardless of the rate of rise, all project alternatives would require the same additional nourishment volumes and the same increase in berm and dune elevation. Therefore, sea level rise rates should have not impact on which alternative is the optimum.

A60. Existing Coastal Structures. A condition survey of the existing coastal protective structures along the project site, including groins, bulkheads (seawalls), and jetties was conducted in December of 1993. The purpose of this on-site inspection was to evaluate the current structural condition of the protective structures, to compare with the previous documentation of conditions surveys in order to assess the rate of deterioration, and to evaluate the current functioning of the structures, specifically the sand trapping effectiveness of the groins. As a result of the site inspection and evaluation, a recommendation was proposed to rehabilitate those exposed portions (i.e., not covered by the design fill) of those groins that were found in poor or fair condition.

A61. Previous Survey Records. A complete documentation of the existing protective structures along the ocean front of Long Beach Island, from Jones Inlet to East Rockaway Inlet was presented in the report entitled "Beach Erosion Control and Hurricane Protection Study, Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet" by the New York District Army Corps of Engineers, 1965 (Reference A12).

A62. An update of this condition survey was carried out in 1988. At that time, there were 50 groins existing on the Long Beach Island ocean front, extending along a total shore length of approximately 49,600 feet. This number did not include seven groins buried by accretion of the sand fillet east of the East Rockaway Inlet jetty or seven short timber groins built in earlier days on the Long Beach City beach front, which were then in very poor condition and nearly saturated. A total of 14,300 feet of bulkheading existed behind the beaches, of which 13,500 feet were of timber construction and 800 feet were of concrete construction. The East Rockaway Inlet Jetty, built in 1933-1934, has caused a considerable amount of accretion to the east of the jetty.

A63. Table A10 summarizes the structural conditions, as well as the construction types, elevations and the dimensions of the existing protective structures in 1993. To facilitate the ongoing survey, these structures were catalogued from number 1 to number 58 in order from East Rockaway Inlet Jetty east to Jones Inlet. Of the 58 catalogued structures, there are 50 groins, 7 bulkheads and 1 jetty. The spacing between groins ranges from 700 to 800 feet. During the time of survey in 1988, 1 timber groin and 1 timber bulkhead on Atlantic Beach, 16 timber and stone groins on Long Beach, 4 stone groins on Lido Beach and 1 timber bulkhead on Point Lookout were already in poor condition. The remaining structures were in fair to good condition.

A64. The approximate locations of the 58 structures are shown in Figure A38. This figure, together with Table A10 were used as the base data for the current condition survey.

A65. Field Investigations and Evaluations. The site condition survey of the existing structures was conducted during the week of December 14, 1993. This survey included on-site review of the structure dimensions and approximate elevations (hand level accuracy), the types of structure and construction materials, the armor stone sizes and interlocking conditions for stone groins, and the sand trapping effectiveness of the groins. A series of photographs were taken during the survey period to support the assessment of the existing structure conditions. The photographs of the existing structures were documented and filed separately.

A66. The results of the existing condition survey are presented in Table A10. All structure item numbers are consistent with the 1988 survey lists to facilitate comparison. The present conditions of the structures are discussed in the following paragraphs.

A67. Atlantic Beach. Of the 23 coastal structures on this stretch of beach, there is one stone jetty, 3 timber bulkheads, 3 timber groins and 16 stone groins. The 4250 foot jetty is presently being rehabilitated by the removal, replacement and/or resetting of the underlayer and armor stone to prevent sand from seeping into the inlet. A considerable amount of sand has been trapped to the east of the jetty and the sand trapping effectiveness is considered fair. Two of the three timber groins (Items 2 and 5) are visible and are in poor condition, the other was buried in sand and not visible. The deteriorated timber groins are no longer trapping sand.

A68. The 16 stone groins are in generally good condition with 5 groins missing some capstones in the exposed section. In terms of their sand trapping function, the groins are still effective with only one groin (Item 20) in fair condition.

TABLE A 10
CONDITION OF COASTAL STRUCTURES
BASED ON SURVEY CONDUCTED DURING THE WEEK OF 14 DECEMBER 1993

ITEM NO.	TYPE OF STRUCTURE	TYPE OF CONSTRUCTION	LENGTH * (FT.)	TOP WIDTH (FT.)	Approximate Top Elevation INNER END (FT. NGVD)	OUTER END (FT. NGVD)	CONDITION	LOCATION REFERENCE	YEAR CONSTRUCTED	OWNER
					ATLANTIC BEACH					
1	Jetty	Stone	4250	6 – 15	5.8	7.8	Good	East Rockaway Inlet	1933–34	U.S. Goverment
2	Groin	Timber	200	10	6.4	5.4	Poor	Eldorado Street	–	–
3	Groin	Timber	85	2	7.6	7.6	Good	Daytona Street	–	–
4	Bulkhead	Timber	150	2	7.6	7.6	Good	Daytona To Coronado	–	–
5	Groin	Timber	300	4	5.1	5.1	Poor	Coronado Street	–	–
6	Groin	Stone	550	12	5.1	5.1	Good	Acapulco Street	1955	New York State
7	Bulkhead	Timber	200	4	6.1	6.1	Good	Acapulco Street	–	–
8	Bulkhead	Timber	425	4	6.3	6.3	Poor	Plaza to Broome	–	–
9	Groin	Stone	550	12	5.0	5.0	Good	Albany Boulevard	1955	New York State
10	Groin	Stone	550	12	5.3	4.8	Good	Dutchess Boulevard	1955	New York State
11	Groin	Stone	550	12	5.2	5.3	Good	Genesee Boulevard	1955	New York State
12	Groin	Stone	550	12	5.8	6.0	Good	Jefferson Boulevard	1955	New York State
13	Groin	Stone	550	12	5.7	2.8	Good	Montgomery Boulevard	1955	New York State
14	Groin	Stone	550	12	6.2	2.8	Good	Putnam Boulevard	1955	New York State
15	Groin	Stone	600	12	6.4	2.3	Good	Suffolk Boulevard	1955	New York State
16	Groin	Stone	600	12	4.6	4.6	Good	Vernon Avenue	1955	New York State
17	Groin	Stone	600	12	4.8	3.4	Good	Yates Avenue	1955	New York State
18	Groin	Stone	600	12	4.8	2.1	Good	–	1955	New York State
19	Groin	Stone	595	12	3.4	0.0	Good	–	1958	New York State
20	Groin	Stone	585	12	7.0	3.3	Fair	–	1958	New York State
21	Groin	Stone	575	12	5.8	5.9	Good	–	1958	New York State
22	Groin	Stone	600	12	4.5	4.5	Good	Clayton Avenue	1951	New York State
23	Groin	Stone	600	12	4.4	4.0	Fair	Troy Avenue	1951	New York State

TABLE A|()(Continued)

ITEM NO.	TYPE OF STRUCTURE	TYPE OF CONSTRUCTION	LENGTH * (FT.)	TOP WIDTH (FT.)	Approximate Top Elevation INNER END (FT. NGVD)	OUTER END (FT. NGVD)	CONDITION	LOCATION REFERENCE	YEAR CONSTRUCTED	OWNER
					LONG BEACH					
24	Groin	Stone	600	12	5.4	5.4	Fair	Nevada Avenue	1946	New York State
25	Groin	Stone	600	12	6.3	6.3	Fair	Georgia Avenue	1946	New York State
26	Groin	Stone	600	12	5.3	3.8	Fair	Maryland Avenue	1947	New York State
27	Groin	Stone	600	12	5.0	5.0	Poor/Fair	Tennessee Avenue	1946	New York State
28	Groin	Stone	600	12	5.5	5.5	Fair	Wyoming Avenue	1947	New York State
29	Groin	Stone	600	12	5.0	5.0	Poor/Fair	Arizona Avenue	1946	New York State
30	Groin	Timber & Stone	600	.5	3.5	0.8	Poor	New York Avenue	1937	City of Long Beach
31	Bulkhead	Timber	11087	3.9	6.9	6.9	Buried	New York To Neptune	1937	City of Long Beach
32	Groin	Timber & Stone	600	5	4.5	0.8	Poor	Grand Boulevard	1937	City of Long Beach
33	Groin	Timber & Stone	600	5	4.0	1.8	Poor	Lindell Boulevard	1937	City of Long Beach
34	Groin	Timber & Stone	600	5	**	**	Gone	Washington Boulevard	1937	City of Long Beach
35	Groin	Timber & Stone	600	5	**	**	Gone	Lafayette Boulevard	1937	City of Long Beach
36	Groin	Timber & Stone	600	5	3.0	1.8	Gone	Laurelton Boulevard	1937	City of Long Beach
37	Groin	Timber & Stone	600	5	**	**	Gone	Magnolia Boulevard	1937	City of Long Beach
38	Groin	Timber & Stone	600	5	3.0	2.6	Gone	National Boulevard	1937	City of Long Beach
39	Groin	Timber & Stone	600	5	3.0	0.8	Poor	Edwards Boulevard	1937	City of Long Beach
40	Groin	Timber & Stone	600	5	3.0	1.7	Poor	Riverside Boulevard	1937	City of Long Beach
41	Groin	Timber & Stone	600	5	**	**	Gone	Long Beach Boulevard	1937	City of Long Beach
42	Groin	Timber & Stone	600	5	4.5	2.3	Poor	Monroe Boulevard	1937	City of Long Beach
43	Groin	Timber & Stone	600	5	3.0	3.0	Poor	Lincoln Boulevard	1937	City of Long Beach
44	Groin	Timber & Stone	600	5	6.0	5.8	Poor	Franklin Boulevard	1937	City of Long Beach
45	Groin	Timber & Stone	600	5	6.0	2.3	Poor	Neptune Boulevard	1937	City of Long Beach
46	Bulkhead	Concrete	340	4	14.8	14.8	Poor	Roosevelt Boulevard	–	–
47	Groin	Stone	550	12	6.0	5.3	Poor	Roosevelt Boulevard	1961	New York State
48	Groin	Stone	550	12	6.0	6.0	Poor	Pacific Boulevard	1961	New York State
49	Bulkhead	Concrete	460	1.5	15.8	15.8	Good	Pacific to Harding	–	–
50	Groin	Timber & Stone	200	4	3.0	3.0	Buried	Maple Boulevard	–	–
					LIDO BEACH					
51	Groin	Stone	500	20	6.0	6.0	Poor	Blackheath Road	1930	Long Beach on the Ocean,Inc
52	Groin	Stone	500	20	6.0	6.0	Poor	Fairway Road	1930	Long Beach on the Ocean,Inc
53	Groin	Timber & Stone	400	10	6.4	3.3	Poor	–	1933	Long Beach on the Ocean,Inc
54	Groin	Stone	475	10	5.0	1.8	Poor	Alleyard Street	1930	Long Beach on the Ocean,Inc
					POINT LOOKOUT					
55	Groin	Stone	750	12	5.3	4.8	Good	Town of Hempstead Park	1953	New York State
56	Groin	Stone	450	12	10.0	7.0	Good	Freeport Avenue	1953	New York State
57	Bulkhead	Timber	90	3.6	7.8	7.8	Poor	Garden City Avenue	–	Private Interest
58	Groin	Stone	220	12	4.8	4.8	Good	Inwood Avenue	1953	New York State

Note: * Groin lengths are based on permit data. Actual lengths are probably shorter due to storm damage.

** Groin is completely deteriorated, with only a few armor units remaining.

A69. Long Beach. There are 27 structures in this stretch of beach. Of the 27 structures, three are bulkheads and 24 are groins. The 11,000 feet of timber bulkhead along the north side of the existing timber boardwalk was completely buried by sand and is not functioning at the time of the survey. Two other concrete bulkheads, approximately 400 feet long each and with top elevation at +16 ft. NGVD, are in good condition and are still functioning.

A70. Of the 24 groins, 8 were constructed of stone and 16 were constructed of timber extending seaward to approximately mean sea level (+0.5 NGVD) and continued seaward with approximately 200 feet of stone section. The 8 stone groins have since deteriorated to poor or fair condition, with several capstones dislodged from the main structure or fallen to the side. The groins are close to saturation and they are only moderately effective in trapping sand.

A71. For the remaining 16 composite timber and stone groins, all the timber sections are buried with only 5 to 10 feet of the tip exposed during low tide. One groin is completely buried (Item 50). Six groins have completely deteriorated (Items 33-38, and 41). The exposed stone sections of the remaining 9 groins are in poor condition with the tips bent to the east, most of the capstones are either dislodged or missing and some of the sections are completely broken in the mid-section. The nine visible composite groins are not effective in trapping sand.

A72. Lido Beach. There are three stone groins and one timber and stone groin on this length of beach. All groins are in poor condition with capstones missing, dislodged or broken in the exposed sections. They are not effective in trapping sand.

A73. Point Lookout. Three stone groins and one timber bulkhead were listed on this stretch of shoreline. The 90 foot timber bulkhead is completely buried and not visible. The three stone groins are generally in good condition with the outer 75 foot section if Item 58 partially unraveled.

A74. Summary. The updated structure condition survey is shown in Table A10. Of the 50 groins inspected, approximately 60 percent are deteriorated. All exposed timber and concrete bulkheads are in good condition and are serving as shore protection structures. The East Rockaway Inlet Jetty is presently under rehabilitation.

A75. At Atlantic Beach, most groins are of stone construction and in good condition, still effective in trapping sand. Five groins have a few missing capstones. No groin rehabilitation is recommended in Atlantic Beach. In the City of Long Beach, the majority of the groins are of timber and stone composite construction and have deteriorated to a fair to poor condition. Of the 16 composite groins, one is covered, six are completely deteriorated, and nine are in poor condition with many dislodged, missing or broken capstone on the crest and side slopes. Eight other stone groins are in poor to fair condition. Rehabilitation is recommended for all portions of the 23 groins which remain uncovered by the design fill. At Lido Beach, all 4 groins are in poor condition. Rehabilitation is recommended for the portions of the 4 Lido Beach groins which remain uncovered by the design fill. At Point Lookout all 3 stone groins are in good condition and are generally filled to capacity, with the outer 75 feet of the easternmost groin in need of rehabilitation. The other two groins in Point Lookout do not need to be rehabiliated.

A76. The proposed groin rehabilitation design, including stone sizes and structure geometry, is fully described in Paragraph A222.

A77. <u>Interior Drainage Structures.</u> All storm-water interior drainage structures have their outlets in Reynolds Channel. Project improvements to the Long Beach Island ocean front will have no impacts on the functioning of the interior drainage systems on the island.

A78. <u>Inlet/Shoreline Interactions.</u> Jones Inlet and East Rockaway Inlet are major coastal features which act as part of the total system affecting the Long Beach project area. These inlets, like all inlets and barrier islands, are formed by wave and current forces, and by sediment transport processes. Inlets and shorelines immediately adjacent to them comprise the most dynamic portions of barrier islands (Reference A15).

A79. This section outlines the general components of natural and man-altered inlet systems, and will describe how sediment is bypassed at inlets. An estimate is made for the Long Beach area of the length of shoreline affected by inlet processes. Observed changes in the Jones Inlet ebb shoal over time are described, and changes to downdrift shorelines during the same time period are illustrated. Future trends are discussed.

A80. <u>Length of Affected Shoreline.</u> Based on historic shorelines from 1933 to the present (Figure A5), the maximum zone of influence of Jones Inlet extends along approximately 15,000 ft. west of the inlet. East Rockaway Inlet, which was stabilized by jetty construction in 1933, has a much smaller zone of influence consisting of the accretionary zone associated with growth of the updrift jetty fillet. The East Rockaway inlet zone of influence is approximately 4500 ft. Together, the inlets affect a maximum of approximately 40% of the length of the island's oceanfront shoreline.

A81. <u>The Tidal Inlet System.</u> To describe how sedimentation processes at inlets affect their adjacent shorelines, it is first necessary to define the components of the tidal inlet system, and describe natural bypassing mechanisms.

A82. In general, a natural tidal inlet system is made up of the following components:

1. Updrift and downdrift landmasses
2. Flood and ebb tidal channels creating passages for flow from the ocean to the back bay
3. Flood shoal
4. Ebb shoal
5. Swash bars located on top of the ebb shoal platform

A83. Flood and ebb shoals tend to be fan-shaped, radiating outward in a semi-circular shape from each end of the inlet (Figure A9). Both shoals are cut by tidal channels. The semi-circular ebb shoal platform forms an underwater bridge which loosely connects the updrift landmass to the downdrift landmass. Sand which bypasses the inlet travels across this bridge, eventually arriving on the downdrift shore near where the ebb shoal connects with the shoreline. The ebb and flood shoals and the adjacent land masses store large volumes of sand, and any change in their configuration affects the amount of sand stored or released, and, consequently, the amount of sand which is free to travel downdrift.

A84. Sand movement occurs on top of the shoal platforms, along the seaward edge of the ebb shoal, and within the tidal channels. A common feature of inlets is the formation of small swash bars on top of the main ebb platform. These tend to migrate shoreward, by the combined effects of tidal action and waves refracted into the inlet. The swash bars travel over the ebb shoal, eventually welding to shore where the ebb shoal connects with the adjacent land masses. Figure A10 illustrates this process, as well as showing the effects of changes in location of the main ebb channel, and the process of inlet migration and spit accretion. All of these mechanisms result in portions of the ebb shoal attaching to the downdrift shore, which moves a large volume of material past the inlet and frees it to be carried on further downdrift. Storms cause an increase in all forms of sediment movement at inlets.

A85. Those inlets which have been "stabilized" or altered by construction include man-made features such as jetties and dredged navigation channels. Construction of jetties, channels, revetments, etc. interfere with the natural migration pattern of inlets by keeping them in one place. In addition, manmade structures affect the location and rate of sand transport both within the inlet, and past the inlet to the downdrift shoreline.

A86. Sediment Bypassing at Natural Inlets. Although Jones Inlet is now a structured inlet and is frequently dredged, it was examined as a "natural" inlet for some understanding of the inlet's sediment bypassing mechanisms. Three natural mechanisms of inlet sediment bypassing were first described by Bruun and Gerritsen in 1959, and have been summarized as follows:

1. Bypassing by wave induced sand transport along the seaward periphery of the ebb delta

2. Bypassing through the transport of sand in channels by tidal currents, and

3. Bypassing by the migration of tidal channels and sand bars.

Using the equation:

$$r = Mmean/Qmax$$

where Qmax = the maximum discharge at the inlet during spring tidal conditions (cy/sec)
Mmean = longshore sediment transport rate to the inlet (cy/yr)
r = the ratio of Mmean to Qmax

Bruun and Gerritsen showed that inlets with high ratios ($r > 200-300$) bypass sand primarily by wave action along the ebb tidal periphery, and inlets with low values ($r<10-20$) bypass sand via the other two methods. Inlets with r values between 20 and 200 bypass by a combination of the three methods.

A87. Calculation of the Bruun/Gerritsen bypassing criteria for Jones Inlet yields an r value of 137, assuming a transport volume of 550,000 cy/yr and a maximum inlet flow rate of 4007 cy/sec. This indicates that both wave action and tidal flow affect sediment bypassing at Jones Inlet, and that all three mechanisms of transport are in effect.

A88. <u>The Effects of Stabilization.</u> After construction of stabilizing features, such as jetties, the inlet system will reconfigure to adapt to the changed wave, tidal, and sediment transport conditions. Reconfiguration can take many years. There is no guidance on how long it will take a particular inlet to reach a new equilibrium after stabilization, but studies have documented time periods of up to 40 years without concluding that a new equilibrium had been reached (Reference A16).

A89. <u>Effects of Jetties.</u> Construction of a jetty will reduce the amount of sediment transported past the inlet for some time. If the jetty is constructed on the updrift side of the inlet, sediment will accumulate next to the jetty in an updrift fillet. Corresponding downdrift erosion has been observed which is of the same order of magnitude as the net accretion in the updrift fillet.

A90. Changes in the flood shoal after jetty construction are relatively minor. The ebb shoal, however, shows considerable adjustment. Sand moving downdrift must move further seaward to bypass the jetty. Over time this tends to force the ebb shoal as a whole to move seaward and enlarge (see Figure A11).

A91. Any increase in storage of material within the inlet elements reduces the amount of material which bypasses and continues on downdrift. After the adjustments have reached a new equilibrium, bypassing will return to its preconstruction volumes (Reference A17).

A92. Effects of Channels. Construction of deeper than natural channels through the inlet can create sediment traps which effectively remove material from the system. Disposal of dredged material offshore, or anywhere other than downdrift of the inlet, will permanently remove that sand from the inlet system and will cause a sediment deficit downdrift of the inlet. Creation of a stable channel, i.e. one which does not migrate, will eliminate natural bypassing by channel relocation.

A93. Observed Changes at Jones Inlet Over Time. Aerial photographs of Jones Inlet were available for 20 separate years over the time period from 1952 to 1990. These photographs were examined for changes in the ebb shoal, and the updrift and downdrift ocean shorelines. Additionally, offshore depth surveys from 1933-35, 1963 and 1972 (estimated) were used to compare the -12, -18 and -30 ft. NGVD contours. Jetty construction at Jones Inlet was begun in 1953 and was completed in 1959. Initial channel dredging was completed in 1956. The channel was relocated closer to the jetty in 1963.

A94. Prestabilization. Figure A12 shows an aerial photo of Jones Inlet taken in 1952, before construction of the navigation channel and jetty (the future locations of these structures are indicated). This photo shows the inlet in close to its natural state. The line of breaking waves offshore shows the outline of the semi-circular ebb shoal connecting the updrift and downdrift shorelines. Some of the flood shoal shows as a shallow or above water mass north of the inlet. The shape of the updrift island (Jones Beach) shows the recurved spit formations associated with migration of that island westward. The western shore of the inlet had already been hardened with revetments on the east side of Pt. Lookout, so inlet migration patterns were already somewhat altered.

A95. Figure A13 shows aerial photography of Jones Inlet taken in 1955, during the construction of the updrift jetty. This photo shows the ebb shoal formation in greater detail. Both Figure A12 and Figure A13 show the wave breaking effect of the ebb shoal, which protects the shoreline immediately behind it from wave energy. Note on Figure A13 the convex shape (curved seaward) of the shoreline in the sheltered area behind the shoal, and the concave shape (curved landward) of shoreline just west of the shoal. West of the protection of the shoal, the downdrift shoreline has retreated further landward than the adjacent protected area, which indicates greater erosion taking place immediately downdrift of the shoal than behind the shoal.

A96. Observed effects of Ebb Shoal on Downdrift Shore. Examination of the 30-year photo record clearly shows a relationship between the downdrift shoreline shape and the presence or absence of an ebb shoal. Evidence of an ebb shoal offshore of the downdrift shoreline was taken to be either breaking waves in the photo, or as directly visible sand.

A97. At two times shoal material was directly observable, close to and parallel with the downdrift shore. This was observed in 1952 (Figure A12), before jetty construction, and in the early 1970's. The shoreline behind the shoal at these times is convex in shape. Further downdrift, beyond the shoal, the shoreline becomes concave. This indicates that the shoal, when close to shore and parallel with it, provides protection from wave energy and limits erosion in its shadow. Erosion is shifted westward beyond the protection of the shoal.

A98. Between 1959 and 1966 breaking waves are observed in the photographs, indicating the existence of an ebb shoal platform. The shoreline behind the breaking waves is observed to be generally straight (east-west). West of the breaking waves the shoreline is observed to be concave. Again, the offshore shoal provides some protection to the shoreline immediately behind it, and shifts the locus of erosion immediately westward.

A99. In 1966 photos show the existence of a north-south oriented sand bar near midchannel. Over the next six years this bar is observed to grow and to move westward, gradually changing its orientation to east-west. Figure A14 shows the shoal in 1969. In 1972 the bar was attached to the downdrift shoreline by placement of dredged material in Pt. Lookout (Figure A15). In August of 1973 dredged material was placed between the bar and the shoreline, filling the small lagoon. This eliminated the small shallow water area between land and the shoal, and connected the two.

A100. The attachment of the bar to shore in the early 1970's did two things. Not only did this migration of a portion of the ebb shoal shoreward provide protection from waves, it also delivered a large volume of material to the downdrift shore. The volume of material moving naturally was augmented by additional material dredged from Jones Inlet and placed at Pt. Lookout.

A101. Since the bar attachment in 1972-73, aerial photos have shown no visible shoals offshore of the downdrift shoreline. The shape of the downdrift shoreline is concave, except immediately after artificial fill operations, when the shoreline is straight. The erosional zone downdrift of the ebb shoal extends from the Pt. Lookout groins westward. The 4000 ft. immediately west of these groins shows the highest erosion rates on the island since 1963. This area (the Town of Hempstead Beach) was the site of six fill operations since 1973. Fill operations have not been of sufficient volume to offset erosion in this area, although material placed at the Town of Hempstead has reentered the littoral system, and has traveled substantially downdrift to nourish shorelines to the west as observed from profile comparisons before and after fill operations.

A102. Observed Changes at East Rockaway Inlet. Previous to jetty construction East Rockaway Inlet migrated westward, in the direction of net littoral drift. Since construction of a jetty on the updrift side of East Rockaway Inlet in 1933-1934 westward migration has been halted. The shoreline changes for Long Beach Island since that time have consisted of accretion of the updrift jetty fillet.

A103. Conclusions - East Rockaway Inlet: The shoreline updrift of the East Rockaway Inlet jetty is stable, with a fully formed updrift fillet. This portion of the shoreline is likley to require less fill than shoreline further east.

A104. Conclusions - Jones Inlet. The Jones Inlet system has been adjusting to the construction of the updrift jetty since its completion in 1959. It is uncertain if this adjustment is complete. It appears that the updrift fillet is fully formed. The ebb shoal is migrating seaward, and may still be impounding material as it grows to accommodate greater depths and larger areal extent. The net littoral drift moving past the inlet may, therefore, be at less than pre-jetty volumes, since impoundment offshore is still occurring.

A105. The phenomenon of bar migration towards downdrift shore was observed during the post-jetty period, but there is no evidence at this time which allows prediction of this bar migration occurring again in the future if at all. There is no observed wave breaking pattern or visible sand in photographs since 1976 to indicate the growth or movement of a portion of the ebb shoal landward. Based on observation of the 1972 bar migration, this process, when it occurs, delivers larger volumes of material to the downdrift shore than is provided by routine channel maintenance dredging.

A106. The three groins at Pt. Lookout appear to successfully stabilize that portion of the downdrift shore; however, the ungroined area just to the west has suffered significant erosion since 1976, due to the location of the ebb shoal.

A107. Dredging material from Jones Inlet Channel and disposing of it anywhere but immediately downdrift of the inlet permanently removes material from the inlet/island system. Suitable sand material dredged from Jones Inlet, if placed on the immediately downdrift beaches whenever maintenance dredging occurs, would serve to nourish the downdrift shoreline and keep sand material in the inlet/island littoral system.

WITHOUT PROJECT CONDITIONS
(Coastal Processes)

A108. General. The "without" project condition is identified as a continuation of long term erosion with a consequent reduction of the protective dune and beach area up to the seaward face of any major buildings, bulkheads or major transportation routes. The continued future reduction of the protective beach will expose the existing buildings to storm damage due to direct wave attack. In areas currently protected by the limited dune system, the continued future reduction of protective beach area will increase the potential for their devastation in major storms. The loss of beachfront will result in increasingly more frequent undermining of the dunes and overwash of the island. In areas without dunes the continued erosion of land will expose the existing development to storm damage on an increasingly more frequent basis. Back bay flooding will remain a continuing source of damage.

A109. To develop the impacts of the without-project conditions, coastal processes were evaluated for the project area. Coastal processes are the natural processes which affect oceanfront shorelines. The major objective of plans of improvement is to reduce the damages caused by these processes. Four coastal processes were evaluated for the project area: Long-term erosion, inundation, storm-induced erosion, and wave attack. A dune failure analysis was also performed, which used the results of the long-term erosion and storm-induced recession evaluations. The without-project conditions were analyzed on three typical profiles, which represented the characteristics of the project area shoreline. The following paragraphs describe the coastal processes evaluations which were used to estimate the without-project condition damages.

A110. Typical Profile Representation. Three typical profiles were chosen to represent the characteristics of the existing conditions of the beach for coastal processes analyses. The data used to evaluate the profiles included: May 1992 beach profiles, November 1991 beach profiles, April 1990 topographic mapping, and April 1988 beach profiles. The characteristics examined included: presence/absence of a dune, elevation and width of the dune, dune toe elevation, presence/absence of a beach berm, width of berm, elevation of berm, offshore slope(s) and foreshore slope(s), presence/absence of an offshore bar, depth of closure, and location of profile along shore. A summary of the typical profile characteristics based on the November 1991 survey is shown on Table A9.

A111. The three selected typical profiles are described below by their landward features (for convenience). Typical Profile 1 is characterized by a substantially high dune elevation (+15 to +20 ft. NGVD) and a minimal flat berm. Profile No. 182 is representative of Typical Profile 1 and is shown on Figure A16. Typical Profile 2 has no dune and a flat berm at elevation +10 ft.

NGVD. Profile No. 200 is representative of Typical Profile 2 and is shown on Figure A17. Typical Profile 3 has a medium dune elevation (+10 to +15 ft. NGVD) and a moderate sloping berm. Profile No. 238 is representative of Typical Profile 3 and is shown on Figure A18. The applicable shoreline reaches represented by these typical profiles are shown in Figure A19.

A112. Economic Reaches. The project shoreline was divided into specific lengths or reaches for the purposes of the benefit analysis. One of each of the three typical profiles was selected to represent the beach characteristics of each economic reach, however benefit analyses were computed on a profile-by-profile basis to relate the distance of development from the existing and design shoreline. The initial criterion for selection of the economic reaches was the community borders, such as the limits of the City of Long Beach. The second criterion for delineation was physical features, such as dune width and height and berm width and height, which will impact wave runup, wave attack and storm-induced erosion evaluations. A third criterion was the property development. The island was separated into six economic reaches, however, Reach 1 has subreaches of 1a and 1b to account for the split in the reach geographically along the island. Figure A20 shows the layout of the project economic reaches.

A113. Long-term Erosion Rates. The long-term shoreline erosion rates were estimated based on both the historical records and the results of volumetric calculation. Historical shorelines show a pattern of alternating accretion and erosion along the entire oceanfront length of Long Beach island. Recorded erosion/accretion rates were averaged over varying shoreline lengths to normalize the effects of the fluctuations. Construction of jetties at both inlets has resulted in predominant erosion near Jones Inlet and near stability adjacent to East Rockaway Inlet. The resulting long-term erosion rates show the greatest loss in the east, with diminishing loss rates proceeding westward. The long-term erosion rates were estimated for the six economic reaches as designated for the economic analysis, and are given in Table A11.

A114. Under the Jones Inlet Section 933 project (Reference A18), material dredged from Jones Inlet was placed on the Town of Hempstead Beach in May 1994. It has been calculated, through the use of shoreline change methodology (as described in the Section 933 report) that the diffusion of the material westward will decrease the existing long-term erosion rates in economic reaches 1 and 2. To reflect that decrease in the without-project condition where it is assumed that continued Section 933 operations will be performed every three years through the project life for the Lido Beach/Long Beach project area, the long-term erosion rates used for the economic evaluation were decreased accordingly, and are shown in Table A11.

TABLE A11
LONG-TERM EROSION RATES

Economic Reach No.	Without Project Future Erosion Rate With No Inlet Dredge Material Placement (ft/yr)	Without Project Future Erosion Rate With Inlet Dredge Material Placement (ft/yr)*
1a	5	0/1.7 **
2	5	2.7
1b	5	1.7
3	4	4
4	4	4
5	4	4
6	2	2

* This value reflects the effects of continued Jones Inlet Section 933 dredging/placement in the Town of Hempstead Beach on long-term erosion rates.
** 0 rate within groin field, 1.7 ft rate west of the groin field

A115. <u>Inundation.</u> The most widespread problem on Long Beach Island is frequent flooding, resulting in damage to homes, businesses and public facilities. This extensive flooding results from both oceanside overtopping flow due to high still water levels, wave setup, and runup, and bayside overtopping due to elevated bay still water levels.

A116. Quantification of inundation consisted of calculation of water depths for storm frequencies between 1 and 500 year recurrence intervals for every structure included in the economic analysis. Basic methodology consisted of construction of 48 water surface profiles running from the ocean to the bay, using a weir equation to determine oceanside overtopping flow and Manning's equation to determine overland flow depths. Overland flood stages across the island were based on backwater from the bayside flood stage (normal depth plus bayside ground elevation). Stages at each structure were calculated based on the bayside stage, the slope of the hydraulic profile and the location of the structure on the cross island profile. Results were compared to flood marks recorded for six storm events:

1. 25 November 1950 (northeaster)
2. 12 September 1960 (Hurricane Donna)
3. 6-8 March 1962 (northeaster)
4. 28-29 March 1984 (northeaster)
5. 27 September 1985 (Hurricane Gloria)
6. 11-13 December 1992 (northeaster)

Parameters considered included ocean and bay still water levels, wave set-up, runup elevations, dune/berm elevation, dune failure, cross-island topography, flow depths overland, elevation at structures, and residual flooding due to bay water incursion. A sample water surface profile constructed across beach profile #210 and continuing north along National Boulevard is shown in Figure A21.

A117. Topography. For the evaluation of inundation across Long Beach Island for the without project condition, 48 cross-island water surface profiles were constructed. Cross-island profile elevations were obtained from 1990 topographic mapping, plus 1991 and 1992 beach profiles. In localized ridges on the island, bayside elevations were adjusted to reflect impacts from adjacent areas.

A118. Ocean and bay stage-frequency curves. The ocean stage-frequency curve used was developed in the 1985 WES "Ocean Grid Stage-Frequency Curves for the South Shore of Long Island", and included wave setup for the oceanside of Jones Inlet (Reference A7). The bay stage-frequency curve used was developed in the NYD 1978 "FEMA Flood Insurance Study for the Township of Hempstead, Long Island" (Reference A8). These elevations are shown in Table A12 below.

Table A12
Ocean and Bay Still Water Level
Stage-Frequency Elevations in ft. NGVD

Return Period	Ocean Stage	Bay Stage
10	8.4	5.9
20	9.2	6.4
50	10.8	7.4
100	12.1	8.3
200	13.6	9.3
500	15.3	11.1

A119. Flow Rate Computations. Overtopping flow rates at the ocean boundary were calculated using the weir equation,

$$Q = c\,L\,H^{(3/2)}$$

where: Q = flow rate in cfs
c = weir coefficient = 3.0 (Reference: "Handbook of Hydraulics" 6th Ed. by Brater and King)
L = unit length of weir (1 ft.)
H = depth of water over the berm/dune crest on profile.

The resulting flow rates vs. frequency for the sample water surface profile are shown in Table A13.

Table A13
Inundation Depths, Profile 210/National Blvd.

Return Period (Years)	Ocean SWL Stage Elevation (Ft. NGVD	Total(1) Water Elevation (Ft. NGVD)	Elevation of Crest (Ft. NGVD)	Innundation Depth at Crest (Ft)	Flow Rate (cfs)
10	8.4	10.1	10.0	0.1	0.14
20	9.2	11.0	10.0	1.0	3.35
50	10.8	12.6	10.0	2.6	13.68
100	12.1	13.8	10.0	3.8	24.25
200	13.6	15.2	10.0	5.2	38.57
500	15.3	16.8	10.0	6.8	59.03

(1) Ocean SWL including setup plus runup elevation

A120. Normal Inland Depth Computation. The normal inland depths were calculated using Mannings Equation,

$$Q = \frac{1.486}{n} A R^{(2/3)} S^{(1/2)}$$

where: Q = flow rate in cfs
n = Mannings n coefficient = 0.04, (Reference: "Handbook of Hydraulics" 6th ed. by Brater and King)
A = cross-sectional area of flow in sf = depth, d for a unit width of beach
R = hydraulic mean radius = A/wetted perimeter = depth, d for a unit width of beach
S = slope

The slope was determined between the ground elevation landward of the oceanside berm or dune and the profile low point. The inland depths were computed by rearranging Mannings Equation to solve for depth, d, at the low points of the profile, and using Q as calculated from the weir equation. These computed depths are referred to as the computed normal depths, and are shown in Table A14. The resulting ocean water surface profiles were plotted between the ocean berm or dune and the profile low point. These depths are referred to as the normal depths and are shown on Figure A21.

Table A14
Computed Normal Depths, Profile 210/National Blvd.

Return Period (Years)	Inundation Depth at Berm Crest (Ft)	Flow Rate (cfs)	Profile Slope	Computed Normal Depth at Low Point (Ft.)
10	0.1	0.14	0.00102	0.27
20	1.0	3.35	0.00102	1.86
50	2.6	13.68	0.00102	4.33
100	3.8	24.25	0.00102	6.11
200	5.2	38.57	0.00102	8.06
500	6.8	59.03	0.00102	10.41

A121. Comparison of Flood Depths. For any storm, the minimum flood elevation is equal to the bayside flood stage, while the maximum flood stage is equal to the wave runup elevation synonymous with maximum water elevation with peak setup. Intermediate stages were based on the normal depth of overland flow.

A122. Comparison to Flood Marks. The methodology above was found to be a fairly accurate indicator of the ocean-induced flooding, as determined by comparison with recorded flood marks.

A123. Storm-Induced Recession. To develop the input for the economic benefit analysis of without- project conditions, the existing condition typical profiles were analyzed for storm-induced recession using the SBEACH numerical model (Reference A20). The results of the model analysis are shown in Figures A22, A23 and A24 for Typical Profiles 1, 2, and 3, respectively.

A124. The distances shown on the recession-frequency curves are measured from the economic baseline (which is a straightened approximation of the 1990 0.0 NGVD shoreline) for all cases. The relationship with variability is not a multiple of the recession without variability, because the analytic procedures in SBEACH differ from those in previous storm-induced recession models. For existing conditions, however, the variability factor in the recession-frequency relationship is the equivalent (with regards to damage calculations) to the previously used variability factor of 2.0 for existing conditions on similar projects, i.e. Sea Bright and Asbury Park, NJ. As with previous studies, 100% of the damages are calculated up to the "with variability" distance, however only 50% of the damages will be taken due to the variability of storm recession at specific locations.

A125. Existing Conditions Recession Distances. Storm events, from 2 to 500 year frequency, were run on the SBEACH model for the typical profiles to develop storm-induced recession distances. The distance from the economic baseline to the landward-most occurrence of 0.5 ft. of vertical recession was used as the storm recession parameter for the modeled storm events. Figures A25 through A28 show the SBEACH results.

A126. For some of the typical profiles, because of the physical features of the profiles and applicability of the SBEACH model, model results were not available for the less frequent events, due to overtopping of the beach profile. A conservative approach was taken to extrapolate the model results for those cases, based on Figure A25. For profile 182, the median northeaster results were used to the intersection of the median hurricane line, then the hurricane results were used. Based on Figures A26 through A28 for all other profiles the median northeaster results were used and were extrapolated for the less frequent events. The results from profiles 200 and 210 were averaged for typical profile 2. The values are given in the following tables (Tables A16 through A20).

A127. Variability Factor. To develop a measure of variability in the storm-induced recession, as can be expected along the length of the project shoreline, a comparison was made of the 90% confidence limit recession value shown on the SBEACH result figures and the median recession plus maximum contour recession distances, and is shown on Tables A16 through A20. The 90% confidence limit shown on the recession-frequency curves captures variations in recession values between storms events of the same frequency. The traditional variability factor, as developed by Savage and Birkemeier (Reference A21), reflects variations in profile response along a shoreline to the same storm event, and therefore, the two variations are not equivalent. The SBEACH median recession line with a 90% confidence limit gives a measure of recession and its variation with different storms of the same frequency.

A128. The SBEACH median recession value will be used for the 100% damage distance. The median recession plus maximum contour recession, since it generally yields more conservative recession impacts than the 90% confidence limit, will be used as a measure of variability along the length of the project shoreline, which is comparable to the variability factor of 2.0, developed for existing conditions in previous storm-induced recession studies. As stated in paragraph A124, 100% of the damages will be calculated up to the "with variability" distance, however only 50% of the damages will be taken due to the variability of storm recession at specific locations. For improved conditions, the median recession distance plus half the maximum contour recession will be used, which is comparable to the use of the variability factor of 1.5, developed for previous storm-induced recession studies.

TABLE A15

MEDIAN RECESSION PROFILE 182 (TYPICAL PROFILE 1) (1)

Return Period (yrs)	Distance to Median Recession (w/o var.) (ft)	Distance to Median Recession 90% Confidence Limit (ft)	Median plus Maximum Contour Recession (2) (w/ variability) (ft)
2	200	263	286
5	237	305	323
10	260	330	346
20	292	358	378
50	325	450	411
100	365	525	451
200	445	600	531
500	525	698	611

(1) Distance from economic baseline to landward-most occurrence of 0.5 ft. of vertical erosion.
(2) Maximum contour recession, profile 182: 86 ft. based on SBEACH results

TABLE A16

MEDIAN RECESSION PROFILE 200 (1)

Return Period (yrs)	Distance to Median Recession (ft)	Distance to Median Recession 90% Confidence Limit (ft)	Median plus Maximum Contour Recession (2) (ft)
2	266	334	382
5	290	355	406
10	304	360	420
20	321	381	437
50	345	415	461
100	360	432	476
200	372	446	488
500	398	470	514

(1) Distance from economic baseline to landward-most occurrence of 0.5 ft. of vertical erosion.
(2) Maximum contour recession, profile 200: 116 ft. based on SBEACH results

TABLE A17

MEDIAN RECESSION PROFILE 210 (1)

Return Period (yrs)	Distance to Median Recession (ft)	Distance to Median Recession 90% Confidence Limit (ft)	Median plus Maximum Contour Recession (2) (ft)
2	235	280	303
5	250	293	318
10	262	305	330
20	273	317	341
50	288	333	356
100	298	344	366
200	311	355	379
500	326	370	394

(1) Distance from economic baseline to landward-most occurrence of 0.5 ft. of vertical erosion.
(2) Maximum contour recession, profile 210: 68 ft. based on SBEACH results

TABLE A18

AVERAGE OF MEDIAN RECESSION
PROFILES 200 AND 210 (TYPICAL PROFILE 2) (1)

Return Period (yrs)	Distance to Median Recession (ft)	Distance to Median Recession 90% Confidence Limit (ft)	Median plus Maximum Contour Recession (2) (ft)
2	251	307	343
5	270	324	362
10	283	333	375
20	297	349	389
50	317	374	409
100	329	388	421
200	342	401	434
500	362	420	454

(1) Distance from economic baseline to landward-most occurrence of 0.5 ft. of vertical erosion.
(2) Maximum contour recession, typical profile 2: 92 ft. based on SBEACH results

TABLE A19

MEDIAN RECESSION PROFILE 238 (TYPICAL PROFILE 3) (1)

Return Period (yrs)	Distance to Median Recession (ft)	Distance to Median Recession 90% Confidence Limit (ft)	Median plus Maximum Contour Recession (2) (ft)
2	211	265	293
5	250	312	332
10	280	331	362
20	310	360	392
50	349	400	431
100	376	431	458
200	405	462	487
500	465	500	547

(1) Distance from economic baseline to landward-most occurrence of 0.5 ft. of vertical erosion.
(2) Maximum contour recession, profile 238: 82 ft. based on SBEACH results

A129. Existing Condition Wave Runup and Wave Attack Analysis. The wave attack analyses on existing conditions were performed to determine the position in the uprush/swash zone where the force due to a broken wave exceeds the critical force needed to destroy a structure. It was determined that a lateral force of approximately 1800 lbs./ft. was necessary to destroy a typical one story structure in the project area and was taken to be the critical force. The wave runup limit was first determined based on the slope composite method outlined in the 1984 SPM (Reference A6). The wave attack limit was then calculated based on EM-1110-2-1614 Change 2 of 30 November 1992 (Reference A22). The storm events analyzed included northeasters of 2, 5, 10, 20 year frequencies, and hurricanes of 50, 100, 200 and 500 year frequencies. Forces for multi-story structures due to wave impact from breaking waves and broken waves were not computed because economic analysis showed these damage categories to be insignificant.

A130. Wave Runup Analysis. A wave runup model was first used to determine the maximum vertical extent of the wave runup. The maximum horizontal runup extent was then determined graphically.

A131. Wave Runup Model. The model used to determine the vertical extent of the wave runup is the Wave Runup Analysis for Coastal Flood Insurance Studies prepared for the Federal Emergency Management Agency in November 1981. This model is based on the slope composite method outlined in Chapter 7 of the 1984 SPM, however it incorporates two improvements to the analysis procedure. The first improvement is a more accurate assumption of a linearly decaying wave crest profile landward of the breaking point, as opposed to the assumption made in the SPM of a nondecaying wave crest profile. The second improvement is that an array of wave heights is able to be input and computed very quickly in this PC model, which allows the realistic possibility of a wave height smaller than the maximum deep water wave height Ho, giving a larger wave runup.

A132. Profile Data. The four profiles analyzed were Typical Profile Nos. 182, 200, 210, and 238 . The wave runup was calculated on the post-storm condition of the four profiles, as predicted by the storm-induced erosion model SBEACH. The 2, 5, 10 and 20 yr. northeasters were analyzed using the post-20 yr. northeaster profiles, and the 50, 100, 200 and 500 yr. hurricanes were analyzed using the post-100 yr. hurricane profiles. Beginning with one standard post-storm eroded profile made the results of the northeasters more readily comparable and more realistic (i.e. runup increasing with storm severity), and similarly for the hurricane results.

A133. Stage-Frequency Data. The ocean stage-frequency curve at the oceanside of Jones Inlet developed by WES in the "Ocean Grid Stage-Frequency Curves, South Shore of Long Island" (dated 1985) was used for this analysis. The elevations from the curve without wave setup were used, as wave setup is already accounted for in the runup curves in the SPM and the FEMA model. These elevations are shown in Table A20.

Table A20
Stage-Frequency Elevations

Return Period (years)	Ocean Stage Elevations w/setup (ft. NGVD)	w/out setup (ft/NGVD)
2	7.0	5.6
5	7.6	6.1
10	8.4	6.6
20	9.2	7.4
50	10.8	8.9
100	12.1	10.1
200	13.6	11.4
500	15.3	13.0

A134. Wave Data. The deep water wave heights and wave periods used for this analysis are shown in Table A3. The array of wave heights, used for the analysis of the wave runup values, was made up of decreasing wave heights in increments of 2 ft. to a minimum of approximately 7 feet. For example, the array for a 100 year storm event would consist of H'o = 21, 19, 17, 15, 13, 11, 9, and 7 feet. The wave periods determined for the largest wave height were assumed to be constant for the array of wave heights.

A135. Wave Runup Results. The existing condition wave runup elevation results are shown in Table A21 and on Figure A29. It should be noted that the model is not valid for cases where the maximum runup elevation and/or the SWL (stage) elevation exceed the maximum profile elevation. For those cases, the landward profile slope was extended to elevations high enough to preclude overtopping. The runup heights determined above the hypothetical slope were assumed to approximate the runup heights on the actual profile grade. It should be noted that the runup heights for Profile No. 210 decrease for the higher level events due to the changes in the post-storm slopes for those events.

A136. Wave Attack Distances. The wave attack distances were calculated in accordance with EM-1110-2-1614 Change 2 of 30 November 1992, "Design of Coastal Revetments, Seawalls, and Bulkheads", paragraph 2-29c, equation 2-23 (Reference A22).

A137. Wave Attack Distances Results. The resulting existing condition wave attack distances measured from the 0.0 ft. NGVD location on the post-20 or 100 yr. storm-eroded profile are shown in Table A21 and on Figure A30 for the critical force of 1800 lbs/foot. It should be noted that the higher wave forces occur further seaward and the lower wave forces occur further landward, due to the gradual dissipation of wave energy as the wave runup extends up the beach slope. The results for Profile No. 210 were truncated at the 100 year storm event due to the flatness of the existing grade.

A138. Wave Attack Distance Over Time. The long-term erosion rate was assumed to erode the profiles translationally at the rates given in Table A11, adjusted for assumed placement of dredged inlet material. These erosion rates should be incrementally added to the X1 distances from economic baseline to determine wave attack impacts from broken waves over the life of the project, i.e. 50 years.

A139. Dune Failure Analysis. Dune failure is defined as a loss of protective dune elevation due to wave attack, runup and/or overtopping. Loss of fronting berm will make dunes more vulnerable to failure. Dune failure for the without project conditions was examined for a range of storm events from 1 year to 500 year return intervals. Projections were made for a 50-year future without project time period.

A140. The dune failure analysis was based on results of the SBEACH storm induced erosion modeling, using typical profiles 238 and 182. Additional data from measurements of dune failures which occurred in Ocean City, Maryland as a result of the 4 January 1992 northeaster were utilized. This storm was classified as a 100-year event at Ocean City. Based on Ocean City data, a loss of 80% of dune volume from its original location was defined as complete failure of the dune. Losses from long term erosion and storm losses were combined to determine what frequency of event would cause partial or compete dune failure. Results are summarized in

TABLE A 21

EXISTING CONDITIONS WAVE RUNUP/ATTACK ANALYSIS

PROFILE NUMBER	RETURN PERIOD (YEARS)	STAGE ELEVATION (FT. NGVD)	WAVE RUNUP (FT.)	TOTAL WATER SURFACE ELEVATION (FT. NGVD)	STATION OF 1800 LB/FT FORCE * (FT.)
182	2	5.6	1.51	7.11	179.1
182	5	6.1	1.56	7.66	223.4
182	10	6.6	1.72	8.32	251.5
182	20	7.4	1.75	9.15	277.3
182	50	8.9	2.07	10.97	293.6
182	100	10.1	2.28	12.38	310.0
182	200	11.4	2.47	13.87	374.6
182	500	13.0	2.38	15.38	504.5
200	2	5.6	1.48	7.08	245.3
200	5	6.1	1.60	7.7	264.0
200	10	6.6	1.72	8.32	293.1
200	20	7.4	1.81	9.21	323.9
200	50	8.9	2.18	11.08	340.4
200	100	10.1	2.10	12.2	374.1
200	200	11.4	2.21	13.61	518.8
200	500	13.0	2.20	15.2	753.1
210	2	5.6	1.48	7.08	188.8
210	5	6.1	1.60	7.7	212.2
210	10	6.6	1.72	8.32	248.6
210	20	7.4	1.81	9.21	296.0
210	50	8.9	1.78	10.68	511.9
210	100	10.1	1.68	11.78	795.2
210	200	11.4	1.55	12.95	795.2 **
210	500	13.0	1.54	14.54	795.2 **
238	2	5.6	2.07	7.67	191.7
238	5	6.1	2.10	8.2	220.0
238	10	6.6	2.28	8.88	224.7
238	20	7.4	2.41	9.81	251.6
238	50	8.9	2.38	11.28	316.4
238	100	10.1	2.52	12.62	370.0
238	200	11.4	2.87	14.27	377.2
238	500	13.0	3.12	16.12	428.8

NOTE: * MEASURED FROM THE 0.0 FT. NGVD CONTOUR LOCATION ON THE POST-20 OR 100 YR. STROM-ERODED PROFILE.

** RESULTS TRUNCATED DUE TO FLATNESS OF EXISTING GRADE.

Table A22 below. Long term erosion rates used for this analysis assume placement of fill material at the Town of Hempstead beach at regular intervals.

Table A22

Frequency of Event Causing Dune Failure (Years)
Without-Project Conditions

Economic Reach	Erosion Rate (ft/yr)	Analysis Year P0	P10	P20	P30	P40	P50
1A	0	92	92	92	92	92	92
	1.7	92	57	47	25	17	12
1B	2.7	500	500	500	500	500	500
2	1.7	500	500	500	500	500	500
3	4.0	92	35	17	5	1.5	1.5
4	4.0	92	35	17	5	1.5	1.5
5	4.0	92	35	17	5	1.5	1.5
6	2.0	92	57	47	25	17	12

A141. Without-Project Future Conditions. For the future without-project conditions, the existing condition economic baseline was translated by the long-term erosion rate, and the results of the storm-induced recession analysis, wave runup analysis, wave attack analysis and dune failure analysis as described in the preceeding paragraphs were applied. The historic rate of sea level rise was only included in the without-project future conditions for the inundation analysis.

PROJECT DESIGN

A141. The following paragraphs give the details of the design process for the alternative plans of improvement for storm damage reduction and shore protection. The project layout, groin design and design and nourishment quantities will also be described.

A142. Description of the 1965 Corps of Engineers Plan. The previous unauthorized federal plan in 1965 called for levees, hurricane barriers, three new groins at Lido Beach, nineteen reconstructed groins at Long Beach, and a reconstructed terminal groin at Point Lookout. The plan also specified beach fill along the entire length of the study shoreline with a dune crest elevation of +18 ft. NGVD and a 100 foot wide berm at elevation +10 ft. NGVD. This plan provided both wave attack protection on the ocean front and flood protection for the entire island. The project was never constructed.

A143. Description of the 1989 Reconnaissance Plan. The reconnaissance investigation led to the recommendation of a cost-effective plan for storm damage reduction and shore protection for further study. This plan consisted of continuous beach fill along the shorefront except at the park area of Lido Beach and at Silver Point Park, at the western end of the island. The investigation indicated that a 110-foot wide beach berm at +10 ft. NGVD, backed by a dune system with crest elevation of +15 ft. NGVD, with suitable advanced and periodic nourishment was an implementable design. The park area of Lido Beach would receive advance fill at the time of initial construction and would be stabilized at its present position with period nourishment. In addition to the beachfill, the plan included minor to moderate rehabilitation of 30 groins and the reconstruction of the terminal groin at Point Lookout, as well as periodic nourishment. The reconnaissance plan was considered as one of the project design alternatives during this feasibility study.

A144. Design Criteria. The design criteria for the restoration and nourishment of the beachfill, groin rehabilitation and groin design is in accordance with the provisions of the following memoranda and manuals:

(a) Shore Protection Manual, Volumes 1 and 2, dated 1984, fourth edition, CERC (Reference A6)

(b) EM 1110-2-1614, dated 30 April 1985, Design of Coastal Revetments, Seawalls and Bulkheads (Reference A22)

(c) EM 1110-2-2904, dated 8 August 1986, Design of Breakwaters and Jetties (Reference A23)

(d) ER 1110-2-1407, dated 30 November 1990, Hydraulic Design of Coastal Shore Protection Projects (Reference A24)

(e) ER 1105-2-100, dated 28 December 1990, Planning Guidance (Reference A25)

A145. Design Constraints. Design constraints are technical, environmental, economic, regional, social and institutional considerations that act as impediments to successful response to the plan objectives. The design must be safe, cost effective, serve project purposes, minimize adverse impacts on surrounding areas and be environmentally acceptable.

A146. Preliminary Shore Protection Alternatives. The following preliminary design alternatives for a beach erosion control and storm damage protection project along nine miles of Long Beach Island were considered in the initial phases of plan formulation:

a) No Action
b) Beach Restoration
c) Beach Restoration with Groins
d) Seawall
e) Seawall with Beach Restoration
f) Bulkhead with Beach Restoration
g) Breakwater with Beach Restoration
h) Perched Beach with Beach Restoration

It is noted that all the above preliminary alternatives were selected to provide similar storm damage protection with the exception of (a). Similarity in the level of protection for alternatives b through h is based on the following design assumptions which were common to all alternative solutions:

(1) All alternatives used a 73-year storm event as the design storm
(2) Design wave heights, wave periods, still water levels and wave set-up elevations were the same for all alternatives considered
(3) Continuous coverage of the entire project shoreline was provided by each alternative
(4) All alternatives assumed the use of the same sand borrow source

The following paragraphs summarize the objectives and evaluation of each of the above preliminary alternatives. A summary of first and annual costs which were used to screen the preliminary alternatives for further study in this feasibility phase are presented in Table A23.

A147. No Action. The No Action alternative involved no measures to provide erosion control, recreational beach or storm damage protection to structures landward of the beach front. This preliminary alternative would not check the continuing erosion of the beaches, nor would it prevent property from becoming more subjected to higher storm damages from beach recession, flooding and wave attack. The existing groins would continue to deteriorate further accelerating the loss of beach. This plan failed to meet any of the objectives or needs of the project.

A148. Beach Restoration. This preliminary alternative involved the placement of beach fill from an offshore borrow source in order to widen and stabilize the existing beach profile. This alternative developed a design template of a 110 ft wide berm at el. +10 NGVD fronting a 25 ft. top width dune at crest elevation +15 NGVD with 1 on 5 side slopes. The foreshore slope utilized for the eastern third of the project length matched the existing predominant slope of 1 V on 25 H and the foreshore slope for the remaining two thirds of the project length matched the existing predominant slope of 1 V on 35 H. Advanced nourishment was included in initial placement. Periodic nourishment, estimated at 2,500,000 c.y. every 6 years, was planned to be placed throughout the 50 year project life in order to maintain the design profile. The total initial fill volume was 10,940,000 c.y. Existing groins in disarray that protruded above the beach fill placement were planned to be restored for stability to the adjacent beach fill and for safety to bathers.

A149. Beach Restoration with Groins. This alternative provided the same beach restoration plan as described above with the following changes: (1) a terminal groin (15 ton maximum stone) was added at the eastern end of the project adjacent to Jones Inlet for closure, (2) 7 new groins were added to 2 miles of currently ungroined project frontage near the eastern end of the project and 24 existing groins (approximately every 1500') were extended to the toe of initial fill placement (an average extension of 500 l.f.) along the remaining 7 miles of project frontage, (3) advanced fill in initial placement and nourishment fill were reduced due to the presence of the groins which reduce the erosion rate and therefore reduce the magnitude of beach nourishment. The initial fill volume including advance fill was 10,640,000 c.y. with 2,200,000 c.y. of nourishment every 6 years. The stone volume to extend 24 existing groins was 460,000 tons, the stone volume to construct 7 new groins was 245,000 tons and the stone volume for the terminal groin was 102,000 tons.

A150. The additional stone volume required for this preliminary alternative will be much more costly than the additional sand required for the periodic nourishment of the beach restoration project.

A151. Seawall. This alternative included the construction of a "Galveston type" seawall placed along the entire nine mile project length with a top elevation of +20 NGVD to prevent overtopping from a 100 year storm event. This structure included fronting toe scour stone protection, was pile supported and provided with underlying sheeting to reduce underseepage. The volume of concrete for the seawall was 498,000 c.y. This alternative would not provide any recreational beach restoration but would provide storm damage protection consistent with the other structural alternatives. It is noted that the seawall section used is approximately 10% less costly than an equivalent stone revetment section per linear foot.

A152. <u>Seawall with Beach Restoration.</u> This preliminary alternative provided the same beach restoration plan as above except that the improved dune segment fronting the Long Beach area (3.5 miles) was eliminated and replaced with the seawall to provide continuity of storm damage protection. A seawall was not selected for the entire shoreline in combination with beach restoration because of the existing dune system to the east and west of Long Beach (which essentially has no existing dune system). The seawall design was able to be slightly downsized due to the presence of the fronting beach improvement compared with the seawall above. The required initial beach fill for this preliminary alternative was 10,740,000 c.y. with the same nourishment as for the beach restoration plan. Concrete for the seawall portion of this alternative was 170,000 c.y.

A153. <u>Bulkhead with Beach Restoration.</u> This preliminary alternative was the same as the seawall with beach restoration except that a concrete capped steel sheet pile bulkhead was utilized to provide storm damage protection at Long Beach in lieu of the concrete seawall for cost comparison purposes. Thus 10,740,000 c.y. were required for initial fill, 2,500,000 c.y. were required for nourishment every 6 years and 868,000 s.f. of steel pile bulkhead were required for the 3.5 miles fronting Long Beach.

A154. <u>Breakwater with Beach Restoration.</u> This preliminary alternative included 39 offshore stone rubble mound structures each approximately 600 ft. long with 500 ft. gaps between structures placed about 700 ft offshore covering the nine mile project length. The capstone for these structures was 16 ton with a total quantity of stone of 2,145,000 tons. The beach restoration was similar to the beach restoration plan above except that the dune height was reduced since the offshore breakwater will trip the 100 year storm design wave before it intercepts the improved beach; the improved beach would be subjected to a lower impinging wave environment. In addition nourishment requirements were substantially reduced since the erosion rate would be significantly lowered by the presence of the offshore breakwaters. The initial fill placement was 8,840,000 c.y. with 500,000 c.y. of nourishment required every 6 years.

A155. <u>Perched Beach with Beach Restoration.</u> This preliminary alternative was similar to the beach restoration alternative above except that a submerged stone rubble mound structure was used to support the offshore end of the fill thus eliminating approximately the outer 300 ft. of beach profile near its closure with ocean bottom included in the beach plan. The volume of initial sand fill as well as nourishment volume was therefore reduced since no placement of sand would extend beyond the submerged structure. Initial sand fill including advance nourishment was estimated to be 8,600,000 c.y. Nourishment was estimated to be 2,000,000 c.y. required every 6 years. The stone for the submerged structure was 630,000 tons. The perched beach was not anticipated to reduce the erosion rate of the improved beach.

A156. Based on the evaluations of the storm damage reduction and shoreline protection preliminary alternatives, beach restoration with dunes were further evaluated. Alternative beachfill cross-sections and dunes were designed for the final project analyses. The construction of new groins was considered in the Point Lookout and Town of Hempstead park areas as project closure alternatives, and to reduce the requirement of nourishment fills.

A156a. In addition to the above alternatives, consideration was given to a plan consisting of rehabilitation and upgrade of the existing groin field either alone or in conjuction with on-beach placement of material dredged from regular maintenance of Jones Inlet. It became apparent early in analysis that such a plan would not provide any benefits against ocean innundation, nor would it completely overcome long term erosion losses and storm induced erosion losses. Use of dredged material for beachfill placement has the additional disadvantage of providing unpredictable volumes for placement at unpredictable intervals. Therefore, a plan limited to renovation of the existing groin field and placement of Jones Inlet dredged material was not considered further.

TABLE A23

COST COMPARISON OF PRELIMINARY DESIGN ALTERNATIVES (1/94 P.L.)

Alternative	First Cost (Million $)	Total Annual Cost (Million $)
a) No Action	0	0
b) Beach Restoration Only	75.5	8.5
c) Beach Restoration w/Groins	132.4	13.3
d) Seawall	275.1	24.2
e) Seawall w/Beach Restoration	168.0	16.8
f) Bulkhead w/Beach Restoration	150.9	15.0
g) Breakwater w/Beach Restoration	256.1	23.0
h) Perched Beach w/ Beach Restoration	116.5	11.9

A157. Project Design Alternatives Considered - Beachfill. Necessary design parameters for beachfill include dune slope, dune position, dune crest width, beach slope, berm elevation, berm width, and dune elevation. The first five of these parameters are affected by natural processes and were based on site specific existing beach characteristics. Berm width and dune elevation were varied to achieve project optimization.

A158. <u>Dune Slope.</u> Since dunes are generally above water, dune side slopes can be limited to the steepest slope that is stable for the given beach material. This reduces dune encroachment on the berm and reduces costs. Existing dune side slopes vary between 1V:4H and 1V:12.5H at the project site. Additionally, 7 out of 14 existing dune sections have slopes of 1V:5H or steeper. A dune side slope of 1V:5H was chosen for design.

A159. <u>Dune Position.</u> Following Shore Protection Manual guidance, dunes were placed as landward as possible on the berm. The design layouts tie new dunes into existing dunes where possible, allowing for smooth transitions of both the dune line and resulting seaward fill.

A160. <u>Dune Crest Width.</u> Existing dune crest widths vary widely, from 0 ft. to 160 ft. Design crest widths considered ranged between 15-40 ft, with a crest width of 25 feet being chosen for design to preclude dune instability based on previous experience.

A161. <u>Beach Slope.</u> Beach slopes are the result of on-site wave climate and the characteristics of beachfill material. Existing beach slopes are steeper in the eastern portion of the island, near the influence of Jones Inlet. Slopes from profile 140 west to profile 174 average 1V:21.75H, and slopes for profiles 180 to 330 average 1V:34.52H. Design slopes of 1V:25H and 1V:35H were chosen, based on these existing averages.

A162. <u>Berm Elevation.</u> The average flat berm elevation is +9.3 ft NGVD. Dune toe elevations average +10.2 ft NGVD. The top elevation of the berm should be in equilibrium with the prevailing wave climate to be cost effective. Over time, nature will act to ensure that such equilibrium is achieved, regardless of the elevation at which material is placed. For Long Beach Island, the natural berm top elevation is approximately +10.00 ft. NGVD. This is not expected to change significantly during the life of the project in view of existing rates of sea level rise. Berm which are lower than the equilibrium top elevation are shown to erode more quickly by models such as EBEACH and SBEACH under design storm conditions. This would result in greater nourishment costs and less protection. Therefore berms lower than +10.0 ft. NGVD were not considered. Evaluation of a berm higher than +10.0 ft. NGVD was unnecessary due to includsion of a dune as a project feature. A design berm elevation of +10 ft. NGVD was chosen to match existing conditions.

A163. <u>Berm Width.</u> Based on experience in the New York District and other districts, the berm width range considered for design was 0 ft. (no additional berm) to 160 ft. of flat berm at elevation +10 ft NGVD. Normally 50 foot increments are used to distinguish between plans. Average existing minimum beach widths (beach width is measured from the +10 ft. contour to mean high water) for Long Beach Island is 236 feet. A 50 foot flat berm at +10 ft. NGVD yields an average beach width of 237.5 feet for a 1V:25H slope, and 312.5 feet for a 1V:35H slope. Because of the width of the existing beach, the smallest plan considered was 0 ft of additional design berm except for minor shoreline straigtening in conjunction with 50 ft. of advanced nourishment. Other berm widths considered were 110 ft. and 160 ft. at +10 ft. NGVD. The 110 foot berm would be an addition of approximately 60 feet to existing beach widths. Both the 110 ft. and 160 ft. design berms would be placed in conjunction with 50 feet of advanced nourishment. The 110 ft. wide berm was the berm width from the 1989 Reconnaissance Study.

A164. Dune Elevation. The range of possible dune elevations considered was +10 ft. NGVD (i.e. no dune) to +20 ft. NGVD. Three of the optimization alternatives were designed with no additional dune placement as a lower limit. A less than 5-foot dune would provide limited protection against runup and wave attack. Accordingly, the next dune elevation chosen was +15 ft. NGVD, which would give a 5-ft. minimum dune across the project area. The highest dune elevation considered for optimization was +17 ft. NGVD, which exceeds the 500-year runup elevation.

A165. Summary of Beachfill Alternatives. In summary, nine beachfill alternatives were analyzed to achieve project optimization. These were:

1) no dune with 50 ft. advance nourishment only,
2) no dune with 110 ft. berm and nourishment,
3) no dune with 160 ft. berm and nourishment,
4) +15 ft. NGVD dune with 50 ft. advance nourishment,
5) +15 ft. NGVD dune with 110 ft. berm and nourishment,
6) +15 ft. NGVD dune with 160 ft. berm and nourishment,
7) +17 ft. NGVD dune with 50 ft. advance nourishment,
8) +17 ft. NGVD dune with 110 ft. berm and nourishment,
9) +17 ft. NGVD dune with 160 ft. berm and nourishment.

The nine alternative templates are shown on a typical profile, Profile No. 216. The three no dune alternatives are shown in Figure A31. The three 15 ft. NGVD dune alternatives are shown in Figure A32. The three 17 ft. NGVD dune alternatives are shown in Figure A33. The numerical shoreline evolution model GENESIS (Reference A20) was utilizied to evaluate the design alternatives and other project features. More details on the results of these evaluations will be presented in later sections of this appendix.

A166. Closure Alternatives. Design of the beachfill project entailed the selection of closure alternatives at the eastern and western ends of the project, and the evaluations of the closures. At the western end of the project, a 6.5 degree taper to the existing shoreline was initially selected as the closure design and was included in all the design alternatives. GENESIS simulations (Reference A20) showed that this transition angle was appropriate for the western taper. The final western design taper will be discussed in the Selected Plan section of this appendix.

A167. Three initial alternatives for the eastern terminus of the beach fill and nourishment were designed. These alternatives were:

a) a groin field consisting of five groins spaced approximately 1500 feet apart along Hempstead and Lido Beach, each with a length of approximately 700 feet, with a sand taper from the design shoreline to the existing shoreline beginning at the existing third westernmost groin in Point Lookout and progressing east to the existing terminal groin. The groin field was sited so that it would terminate at a point west of Jones Inlet where the ebb shoal no longer effects wave climate.

b) a sand taper alone, which eliminates the proposed groins from alternative (a). From profile line 150 eastward, the depth of beachfill was smoothly decreased so that the project mean high water line (elevation +2.5 ft. NGVD) is fully intercepted within the existing Point Lookout terminal groin.

c) the extension of the existing terminal groin at Jones Inlet, which allows the continuation of the full design berm for the entire Point Lookout reach. The structure was designed to a length of 970 ft., with a crest elevation ranging from +10 to +6 ft. NGVD.

The purpose of these closure alternatives was to retain the project design fill and stabilize the shoreline. The alternatives are shown in Figure A34.

A168. The closure alternatives at the eastern end of the project were analyzed. Due to limitations of the GENESIS shoreline evolution model, such as inability to account for inlet effects on adjacent shorelines, an inability to model wave transformation resulting from the Jones Inlet jetty and the ebb tidal shoal, and uncertainties concerning historical transport rates and directions near the inlet, the closures east of the westernmost Point Lookout groin were analyzed using historical shoreline evolution methods and engineering judgement, not numerical modeling. The extension of the groin field was modeled with GENESIS.

A169. Specific information needed to assess the closure alternatives were the predicted shoreline evolution, sediment losses from the existing and new groin field impacting either Jones Inlet or the remainder of the project shoreline, and the impacts of the closures on local sediment transport patterns and subsequent beach change.

A170. <u>Extension of the existing groin field.</u> The impact of the proposed groin field on the shoreline to the east of the westernmost Point Lookout groin is anticipated to be negligible, because data suggest the proposed groin field would not interfere with coastal processes along the Point Lookout shoreline. Historically, the most significant shoreline changes in Point Lookout occur due to inlet and shoal processes, with beach conditions west of Point Lookout of little impact. Therefore, the analysis of the new groin field began west of Point Lookout.

A171. The proposed groin field was input into the shoreline evolution model with the design beach fill in place. From the results of the GENESIS model simulations, the proposed groins appear to be moderately effective in mitigating shoreline recession along the Town of Hempstead beach and eastern Lido Beach. Average annual net longshore sand transport rates indicate the effect of the groin field on predicted transport magnitudes. Relative to the without-groin field predictions, the gradient in transport rate along the groined shoreline is less and magnitudes are decreased. The downdrift impacts of the groin field are negligible, and negative impacts are not predicted due to the shoreline orientation and dominent wave directions for the Lido Beach area, where the curvature of the shoreline west of the proposed groin field is naturally accretive assuming adequate sediment supply, which will be insured with the project beachfill.

A172. From the prediction of the proposed groin field performance, alterations were made to this closure alternative. The spacing of the groins was decreased, and the distance from the project berm crest (including the nourishment fill width) to the seaward crest of the proposed groins was made constant for each of the proposed new groins. The modified layout of proposed groins was carried forward for additional shoreline change analysis as the means to decrease nourishment fill required in the Town of Hempstead Beach and Lido Beach area.

A173. <u>Sand Taper.</u> This analysis was conducted using historical shoreline positions, and only focused on the sand taper in Point Lookout because it was concluded that beach nourishment activities west of Point Lookout, either with or without the proposed groin field, would have minor impact on the evolution of the sand taper and shoreline within Point Lookout. The taper angle of the fill placement in Point Lookout varied with the alternative design berm widths, tying into the existing Jones Inlet terminal groin.

A174. Comparisons of the 1972, 1978, 1984, 1990 and 1992 shorelines were made for this area. The 1978 shoreline represented a shoreline position similar to a beachfill activity, due to the shoal welding in 1972. The volume contained in the 1978 condition exceeded all the considered sand taper alternative plans. Other shorelines from 1984 to 1992 indicate that the shoreline reach is stable in the present condition, and implies the transition from the 1978 shoreline to an equilibrated position similar to the 1984-1992 shorelines (see Figure A35). Equilibration to the present condition suggests that regardless of the volume of beachfill material placed, shoreline positions along Point Lookout will return to the present stable condition. The sand tapers would supply added shoreline widths and offset the current erosion problems, and with renourishment, would remain stable.

A175. Because all the alternative beachfill sand tapers fall within the historical range of shorelines in the Point Lookout area (see Figure A36), the impact on shoaling in Jones Inlet should remain below historical observations.

A176. Terminal Groin. The third closure alternative consisted of the lengthening of the terminal groin, and the continuation of the design berm widths throughout the entire Point Lookout shoreline. The added berm width crests would be seaward of the end of the existing terminal groin, thus requiring the terminal groin extension to protect the toe of fill. Proposed terminal groin lengths varied from 965 to 1025 ft., and resulted in a hard boundary between Jones Inlet and the nourished beach.

A177. Construction of the design berm near Jones Inlet results in a wider beach than observed historically, in the eastern Point Lookout groin compartment. The design berm width in the western compartment will not exceed the historical shorelines in that compartment, and could be constructed without the extension of the terminal groin, providing a wider berm in the western compartment, without incurring the costs of terminal groin extension. Construction of the terminal groin extension would only benefit the eastern groin compartment, in terms of increasing the design protection in that area. Construction of the terminal groin is not needed to prevent excessive inlet shoaling, if the design fill in eastern compartment does not exceeded the toe of the existing terminal groin.

A178. The construction of a such a large structure, such as the extended terminal groin, and the introduction of considerable beach material within the Point Lookout groin compartments, could create a major change to the inlet/shoreline system in the vicinity of Jones Inlet. Relatively stable shorelines along Point Lookout could be influenced by altered coastal processes, driven by the new structure, possibly resulting in new erosional problems. Other potential problems could result with changes to inlet dynamics, which could cause movement of the inlet shoal and channel configuration, creating negative impacts which are not predictable with current numerical modeling capabilities. Overall, the engineering benefits of the extension of terminal groin are moderate, with significant negative impacts possible.

A179. The final closure alternative chosen was the extension of the Point Lookout groin field west into Lido Beach, which includes design beachfill transition back to the existing berm at the existing terminal groin in Point Lookout. The existing terminal groin will be rehabilitated as described in paragraph A186. This closure provided for a reduction in nourishment material required in the Town of Hempstead Beach and Lido Beach, and a cost-effective closure of the project at Jones Inlet. The detailed design and layout of the final groin field is discussed in the

Nourishment Fill Requirement section of this Appendix.

A180. Groin Rehabilitation. The alternative plans include rehabilitation of the exposed portions of the groins (i.e. not covered by design fill placement) that were found to be in poor to fair condition. A site inspection and evaluation of the existing groins between Pt. Lookout and Silver Pt. Park was conducted in December 1993. The rehabilitation for three design alternatives were evaluated which are representative of the nine alternative beachfill designs considered in plan formulation. It is noted that rehabilitation of the groins is not required as a feature for the beachfill design alternatives, nor will the rehabilitation adversely affect the project's performance. Rehabilitation of the pertinent groins was included for stability of the adjacent design beach based on historic record.

A180a. A cost comparison between rehabilitation of existing groins and increased nourishment if groins are not rehabilitated was made. Historic loss rates were used for the City of Long Beach (18,200 lf.) shoreline to compare erosion during time periods when no groin field was present with those after groin construction. Pre-groin field rates of loss before 1934 were found to average -7.9 cy/ft/yr, while losses after groin field construction dropped to -1.38 cy/ft/yr. Comparative annual costs are shown in Table A26a.

A181. Rehabilitated Groin Length. The horizontal extent between the reference line and the seaward ends of the groins to be rehabilitated were determined based on the November 1990 topographic survey. The proposed seaward extent of rehabilitation from the reference line is set equal to the average extent which is 500 ft. in Long Beach, and 240 ft. in Lido Beach. The groin lengths to be rehabilitated essentially do not extend beyond the 1990 condition groin lengths. The proposed landward extent of the crest of the rehabilitated section is approximately 50 ft. landward of the design fill section, not including the nourishment. Rehabilitation is being proposed only for those groins whose proposed seaward ends would protrude seaward of the design fill (not including the advance nourishment). The resulting number of groins to be rehabilitated for each of the design alternatives are shown in Table A24.

A182. Rehabilitated Groin Profile. Four typical groin profiles were selected based on the average existing elevations. They are shown in Table A25. Based on the existing profiles, the groin will slope continuously from the landward end to the seaward end for typical groin profiles nos. 3 and 4.

A183. Rehabilitated Groin Cross-Section . A minimum constructable crest width of approximately 13 ft. was selected. A side slope of 1V on 1.5H was selected to approximately match the existing side slopes. A seaward slope of 1V on 2H was selected. A primary armor weight of approximately 5 tons was selected in order to approximately match the existing armor stone. This size stone was

TABLE A24
NUMBER OF GROINS TO BE REHABILITATED

Alternative	Number of Groins to be Rehabilitated
+15 dune/nourish only	23
Alt. 1 (No dune/nourish only)	
Alt. 2 (No dune/110 ft. berm)	
Alt. 4 (+15 dune/nourish only)	
Alt. 7 (+17 dune/nourish only)	
+15 dune/110 ft. berm	15
Alt. 3 (No dune/160 ft. berm)	
Alt. 5 (+15 dune/110 ft. berm)	
Alt. 8 (+17 dune/110 ft. berm)	
+17 dune/160 ft. berm	9
Alt. 6 (+15 dune/160 ft. berm)	
Alt. 9 (+17 dune/160 ft. berm)	

TABLE A25
TYPICAL GROIN PROFILES

Typical Groin Profile Number	Landward Elevation (ft. NGVD)	Seaward Elevation (ft. NGVD)	Applicable Groin Numbers
1	5.0	5.0	24–29
2	3.0	3.0	30–43
3	6.0	5.0	44, 47, 48
4	6.0	3.0	45

TABLE A26
ARMOR WEIGHTS AND LAYER THICKNESSES

Layer	Comparative Weights	Weight (tons)	Units Per Layer	Layer Thickness(ft.)
primary	W	5	2	8
secondary	W/10	0.5	2	4
bedding		0.025		2

Note: Filter cloth is to be placed between the bedding layer and the exsisting grade.

checked for adequacy and was found to be within tolerable limits (less than 25% damage) for design storm conditions. The layer thicknesses were determined using EM 1110-2-2904 (Reference A23), assuming unit weight of stone of 170 lb/cf. The armor weights and successive layer thicknesses are shown in Table A26, as well as the underlying filter cloth.

A184. Armor Volumes. The armor volumes and area of the filter cloth required for the proposed groin rehabilitations are shown in Tables A27a through A27c. One foot of tolerance was included in the volume calculation. It is noted that the volumes shown in Table A27a are representative of Alternatives 1, 2, 4, and 7, those on Table A27b are representative of Alternatives 3, 5, and 8, and those on Table A27c are representative of Alternatives 6 and 9.

A185. Volume of Reusable Existing Armor. The volumes of existing (approximately 5 ton) capstone that are available for reuse were calculated based on the following assumptions. The exposed portions of the groins were measured using November 1990 topographic survey. An average groin height of 10 ft. was assumed. One layer of capstone was assumed to be available for reuse. The resulting reusable existing armor volumes are shown in Tables A28a through A28c.

A186. Terminal Groin Rehabilitation. Rehabilitation of the existing damaged outer 75 ft. of the terminal groin on the western side of Jones Inlet will be reconstructed. The following existing characteristics of the terminal groin will be used:

Existing elevation: +5.5 ft. NVGD
Existing crest width: 12 ft.
Location of seaward end: 370 ft. from end of road
Existing side slope: 1V on 1.5H
Existing Primary Armor Weight: approx. 6 tons.

It is noted that this rehabilitation is common to all of the alternative plans. It involves rebuilding the outer 75 ft. of the groin with W = 6 ton stone to crest elevation +5.5 ft. NGVD with underlying bedding stone overlying filter cloth.

A186a. Revetment Rehabilitation. The existing revetment which wraps around the western side of Jones Inlet abutting the terminal groin and extending northward has suffered extensive damage during the 1993 winter season. Rehabilitation of this structure for an estimated 640 feet beginning at the base of the terminal groin and extending northward is necessary to prevent flanking and loss of project fill material. Based on the existing structure, the following design parameters will be used:

Top elevation: +5.0 ft. NGVD
Revetment crest width: 11.5 ft.
Revetment crest width plus splash blanket: 25 ft.
Armor size: 4 ton (median)

TABLE A27a

ARMOR VOLUMES/FILTER CLOTH FOR REHABILITATED GROINS

+15' DUNE/NOURISHMENT ONLY PLAN

GROIN	PROFILE	GROIN DESIGN IN FT. ABOVE NGVD		DESIGN	EFFECTIVE	GROIN	ARMOR VOLUME IN CUBIC YARDS			AREA IN SQUARE YARDS
NUMBER	NUMBER	LANDWARD EL.	SEAWARD EL.	LENGTH (FT.)	LENGTH (FT.)	HEIGHT	W LAYER (5T)	W/10 LAYER (.5 T)	BEDDING (.025 T)	OF FILTER CLOTH
24	226	5	5	260	264	14.0	3631.5	547.6	1204.6	2026.3
25	226	5	5	260	264	14.0	3631.5	547.6	1204.6	2026.3
26	224	5	5	260	226	14.0	3108.8	468.7	1031.2	1734.7
					38	15.1	666.3	117.4	219.3	353.0
27	224	5	5	260	226	14.0	3108.8	468.7	1031.2	1734.7
					38	15.1	666.3	117.4	219.3	353.0
28	224	5	5	260	226	14.0	3108.8	468.7	1031.2	1734.7
					38	15.1	666.3	117.4	219.3	353.0
29	222	5	5	260	264	14.0	3631.5	547.6	1204.6	2026.3
30	220	3	3	210	214	14.0	2943.7	443.9	976.5	1642.6
32	220	3	3	210	214	14.0	2943.7	443.9	976.5	1642.6
33	216	3	3	200	204	14.0	2806.1	423.1	930.8	1565.8
34	216	3	3	200	204	14.0	2806.1	423.1	930.8	1565.8
35	214	3	3	210	214	14.0	2943.7	443.9	976.5	1642.6
36	212	3	3	220	224	14.0	3081.2	464.6	1022.1	1719.3
37	212	3	3	220	224	14.0	3081.2	464.6	1022.1	1719.3
38	210	3	3	220	224	14.0	3081.2	464.6	1022.1	1719.3
39	206	3	3	220	224	14.0	3081.2	464.6	1022.1	1719.3
40	206	3	3	220	224	14.0	3081.2	464.6	1022.1	1719.3
41	204	3	3	210	214	14.0	2943.7	443.9	976.5	1642.6
42	202	3	3	200	204	14.0	2806.1	423.1	930.8	1565.8
43	202	3	3	200	204	14.0	2806.1	423.1	930.8	1565.8
44	200	6	5	315	319	14.0	4388.0	661.6	1455.6	2448.5
45	200	6	3	315	320	14.0	4401.8	663.7	1460.1	2456.2
47	196	6	5	235	239	14.0	3287.6	495.7	1090.5	1834.5
48	194	6	5	250	254	14.0	3493.9	526.8	1159.0	1949.6

23 GROINS TO BE REHABILITATED

SUBTOTAL (C.Y.)	76,196.3	11,539.7	25,270.4	
SUBTOTAL (TONS)*	110,168.4	16,684.7	38,857.1	
			SUBTOTAL (S.Y.)	42,460.9

* NOTE VOID RATIO(S): ARMOR .37, BEDDING .33

TABLE A27b
ARMOR VOLUMES/FILTER CLOTH FOR REHABILITATED GROINS
+15' DUNE/110' BERM PLAN

GROIN NUMBER	PROFILE NUMBER	GROIN DESIGN IN FT. ABOVE NGVD LANDWARD EL.	GROIN DESIGN IN FT. ABOVE NGVD SEAWARD EL.	DESIGN LENGTH (FT.)	EFFECTIVE LENGTH (FT.)	GROIN HEIGHT	ARMOR VOLUME IN CUBIC YARDS W LAYER (5T)	ARMOR VOLUME IN CUBIC YARDS W/10 LAYER (.5 T)	ARMOR VOLUME IN CUBIC YARDS BEDDING (.025 T)	AREA IN SQUARE YARDS OF FILTER CLOTH
24	226	5	5	150	154	14.0	2118.4	319.4	702.7	1182.0
25	226	5	5	150	154	14.0	2118.4	319.4	702.7	1182.0
26	224	5	5	150	116	14.0	1595.6	240.6	529.3	890.4
					38	15.1	666.3	117.4	219.3	353.0
27	224	5	5	150	116	14.0	1595.6	240.6	529.3	890.4
					38	15.1	666.3	117.4	219.3	353.0
28	224	5	5	150	116	14.0	1595.6	240.6	529.3	890.4
					38	15.1	666.3	117.4	219.3	353.0
29	222	5	5	150	154	14.0	2118.4	319.4	702.7	1182.0
34	216	3	3	90	94	14.0	1293.0	195.0	428.9	721.5
35	214	3	3	100	104	14.0	1430.6	215.7	474.5	798.3
38	210	3	3	110	114	14.0	1568.1	236.4	520.2	875.0
41	204	3	3	100	104	14.0	1430.6	215.7	474.5	798.3
42	202	3	3	90	94	14.0	1293.0	195.0	428.9	721.5
43	202	3	3	90	94	14.0	1293.0	195.0	428.9	721.5
44	200	6	5	200	204	14.0	2806.1	423.1	930.8	1565.8
47	196	6	5	200	204	14.0	2806.1	423.1	930.8	1565.8
48	194	6	5	215	219	14.0	3012.5	454.2	999.3	1680.9

15 GROINS TO BE REHABILITATED — SUBTOTAL (C.Y.): 30,073.9 | 4,585.3 | 9,970.8

* NOTE VOID RATIO(S): ARMOR .37, BEDDING .33 — SUBTOTAL (TONS)*: 43,482.3 | 6,629.7 | 14,416.3

SUBTOTAL (S.Y.): 16,724.7

TABLE A27c
ARMOR VOLUMES/FILTER CLOTH FOR REHABILITATED GROINS
+17' DUNE/160' BERM PLAN

GROIN NUMBER	PROFILE NUMBER	GROIN DESIGN IN FT. ABOVE NGVD LANDWARD EL.	GROIN DESIGN IN FT. ABOVE NGVD SEAWARD EL.	DESIGN LENGTH (FT.)	EFFECTIVE LENGTH (FT.)	GROIN HEIGHT	ARMOR VOLUME IN CUBIC YARDS W LAYER (5T)	ARMOR VOLUME IN CUBIC YARDS W/10 LAYER (.5 T)	ARMOR VOLUME IN CUBIC YARDS BEDDING (.025 T)	AREA IN SQUARE YARDS OF FILTER CLOTH
24	226	5	5	90	94	14.0	1293.0	195.0	428.9	721.5
25	226	5	5	90	94	14.0	1293.0	195.0	428.9	721.5
26	224	5	5	80	42	14.0	577.7	87.1	191.6	322.4
					38	15.1	666.3	117.4	219.3	353.0
27	224	5	5	80	42	14.0	577.7	87.1	191.6	322.4
					38	15.1	666.3	117.4	219.3	353.0
28	224	5	5	80	42	14.0	577.7	87.1	191.6	322.4
					38	15.1	666.3	117.4	219.3	353.0
29	222	5	5	80	84	14.0	1155.5	174.2	383.3	644.7
44	200	6	5	130	134	14.0	1843.2	277.9	611.4	1028.5
47	196	6	5	130	134	14.0	1843.2	277.9	611.4	1028.5
48	194	6	5	110	114	14.0	1568.1	236.4	520.2	875.0

9 GROINS TO BE REHABILITATED — SUBTOTAL (C.Y.): 12,728.1 | 1,969.9 | 4,216.9

* NOTE VOID RATIO(S): ARMOR .37, BEDDING .33 — SUBTOTAL (TONS)*: 18,403.0 | 2,848.2 | 6,097.1

SUBTOTAL (S.Y.): 7,045.9

TABLE A28a
REUSABLE EXISTING ARMOR VOLUMES FOR REHABILITATED GROINS
+15' DUNE/NOURISHMENT ONLY PLAN

GROIN NUMBER	PROFILE NUMBER	EXPOSED LENGTH (FT.)	SIDE SLOPES (1V: xH)	CREST WIDTH (FT.)	GROIN HEIGHT (FT.)	VOLUME OF REUSABLE ARMOR (C.Y.) ***
24	226	309	1.5 *	12.0	10.0	2057.1
25	226	293	1.5	12.0	10.0	1950.6
26	224	212	1.5	12.0	10.0	1411.3
27	224	212	1.5	12.0	10.0	1411.3
28	224	260	1.5 *	12.0	10.0	1730.9
29	222	260	1.5	12.0	10.0	1730.9
30	220	260	1.0	5.0	10.0	1166.5
32	220	277	1.5 *	5.0	10.0	1520.9
33	216	277	1.5 *	5.0	10.0	1520.9
34	216	0	1.5	5.0	10.0	0.0
35	214	0	1.5	5.0	10.0	0.0
36	212	0	1.5 *	5.0	10.0	0.0
37	212	0	1.0	5.0	10.0	0.0
38	210	0	1.0	5.0	10.0	0.0
39	206	293	1.5	5.0	10.0	1608.7
40	206	260	1.5	5.0	10.0	1427.5
41	204	0	1.5	5.0	10.0	0.0
42	202	277	1.5 *	5.0	10.0	1520.9
43	202	325	1.5	5.0	10.0	1784.4
44	200	309	1.5	5.0	10.0	1696.6
45	200	260	1.5	5.0	10.0	1427.5
47	196	277	1.5	12.0	10.0	1844.0
48	194	228	1.5	12.0	10.0	1517.8

NOTE: * Side slope assumed
** Void ratio of armor = .37
*** One layer of capstone is assumed.

SUBTOTAL (C.Y.) 27,327.8

SUBTOTAL (TONS)** 39,511.9

TABLE A28b
REUSABLE EXISTING ARMOR VOLUMES FOR REHABILITATED GROINS
+15' DUNE/110' BERM PLAN

GROIN NUMBER	PROFILE NUMBER	EXPOSED LENGTH (FT.)	SIDE SLOPES (1V: xH)	CREST WIDTH (FT.)	GROIN HEIGHT (FT.)	VOLUME OF REUSABLE ARMOR (C.Y.) ***
24	226	309	1.5 *	12.0	10.0	2057.1
25	226	293	1.5	12.0	10.0	1950.6
26	224	212	1.5	12.0	10.0	1411.3
27	224	212	1.5	12.0	10.0	1411.3
28	224	260	1.5 *	12.0	10.0	1730.9
29	222	260	1.5	12.0	10.0	1730.9
34	216	0	1.5	5.0	10.0	0.0
35	214	0	1.5	5.0	10.0	0.0
38	210	0	1.0	5.0	10.0	0.0
41	204	0	1.5	5.0	10.0	0.0
42	202	277	1.5 *	5.0	10.0	1520.9
43	202	325	1.5	5.0	10.0	1784.4
44	200	309	1.5	5.0	10.0	1696.6
47	196	277	1.5	12.0	10.0	1844.0
48	194	228	1.5	12.0	10.0	1517.8

NOTE: * Side slope assumed
** Void ratio of armor = .37
*** One layer of capstone is assumed.

SUBTOTAL (C.Y.) 18,655.7

SUBTOTAL (TONS)** 26,973.4

TABLE A28c
REUSABLE EXISTING ARMOR VOLUMES FOR REHABILITATED GROINS
+17' DUNE/160' BERM PLAN

GROIN NUMBER	PROFILE NUMBER	EXPOSED LENGTH (FT.)	SIDE SLOPES (1V: xH)	CREST WIDTH (FT.)	GROIN HEIGHT (FT.)	VOLUME OF REUSABLE ARMOR (C.Y.) ***
24	226	309	1.5 *	12.0	10.0	2057.1
25	226	293	1.5	12.0	10.0	1950.6
26	224	212	1.5	12.0	10.0	1411.3
27	224	212	1.5	12.0	10.0	1411.3
28	224	260	1.5 *	12.0	10.0	1730.9
29	222	260	1.5	12.0	10.0	1730.9
44	200	309	1.5	5.0	10.0	1696.6
47	196	277	1.5	12.0	10.0	1844.0
48	194	228	1.5	12.0	10.0	1517.8

NOTE: * Side slope assumed
** Void ratio of armor = .37
*** One layer of capstone is assumed.

SUBTOTAL (C.Y.) 15,350.4

SUBTOTAL (TONS)** 22,194.4

TABLE A29
ARMOR VOLUME/FILTER CLOTH FOR TERMINAL GROIN REHABILITATION
ALL ALTERNATIVES

GROIN NUMBER	PROFILE NUMBER	GROIN DESIGN IN FT. ABOVE NGVD		LENGTH (FT.) TO BE REHABILITATED	EFFECTIVE LENGTH (FT.)	GROIN HEIGHT	ARMOR VOLUME IN CUBIC YARDS		AREA IN SQUARE YARDS OF FILTER CLOTH
		LANDWARD EL.	SEAWARD EL.				W LAYER (6T)	BEDDING (.025 T)	
58	140	4.8	4.8	75	80	20.0	2112.0	677.3	840.9

1 GROIN TO BE REHABILITATED

SUBTOTAL (C.Y.)	2,112.0	677.3	
SUBTOTAL (TONS)*	3,053.6	1,041.5	
SUBTOTAL (S.Y.)			840.9

* NOTE VOID RATIO(S): ARMOR .37, BEDDING .33

TABLE A29A
QUANTITIES FOR REVETMENT REHABILITATION
ALL ALTERNATIVES
(Includes Tolerance)

ITEM	DESIGN QUANTITY (CY)	LESS REUSEABLE STONE (CY)	TOTAL STONE (CY)	TOTAL STONE (TONS)	OTHER QUANTITIES (units as shown)
4-Ton Armor	10,892	798	10,094	14,594	
1.6 Ton Armor	1,166	0	1,166	1,686	
800-lb Underlayer	4,812	338	4,474	6,469	
40-lb Bedding	1,683	121	1,562	2,258	
SUBTOTAL (CY)	18,553	1,257	17,296		
SUBTOTAL (TONS)				25,007	
Rehandled Stone (Re-moved, stockpiled, reused)					
Armor	121 cy			175 tons	
Underlayer	338 cy			489 tons	
Bedding	798 cy			1,154 tons	
SUBTOTAL	1,257 cy			1,818 Tons	
Filter Fabric					6,514 sy
Excavation					18,987 cy
Sand Backfill					73 cy

Underlayer: 800 lb.
Bedding: 40 lb stone on filter cloth
Side slope: 1V:2H

In addition, an embedded type toe, with bottom elevation of -18 ft. NGVD has been included to satisfy COE design criteria and to provide additional stability for prolonged structure life. A typical cross section is shown as Figure A49a.

A187. Terminal Groin and Revetment Armor Volume. The armor volumes and area of the filter cloth for the following proposed terminal groin rehabilitation at Jones Inlet (including one foot of tolerance) is shown in Table A29. The armor volumes and area of filter cloth for revetment rehabilitation are shown in Table A29a. Volumes of reuseable stone for the revetment are included in Table A29a.

A188. Project Layout. Figure A37 presents the General Plan of improvement and Figure A38 presents the layout of Design 5, the +15 ft. NGVD dune with 110 ft. berm, for the project length from Point Lookout through East Atlantic Beach. The project layout for the other eight alternatives is similar with, a continuous fill of material. The beachfill alternatives include dunes incorporated into the existing dune system where possible and set as landward as practicable to avoid structures and provide maintenance access. Between profiles 174 and 170 it was necessary to straighten the seaward berm line somewhat in order to provide a smooth and continuous seaward shoreline. The new dunes seaward of the Long Beach boardwalk have their landward toe between 15 ft. and 25 ft. seaward of the seaward edge of the boardwalk to allow for construction and maintenance access to the landward side of the dune. The beach berm widths for the six dune plans are measured from the seaward toe of the dune. The project baseline for the alternatives without dunes is generally a straightened approximation of the existing +10 ft. NGVD contour. Beach berms for alternatives without dunes are measured from the project baseline. Profiles of Design 5, the +15 ft. NGVD dune with 110 ft. berm, are presented in Figures A39-1 through A39-33.

A189. Quantity Estimates - Design Fill. 28 beach profiles as displayed in Figures A39-1 through A39-33 were utilized to generate the required beachfill volumes for the nine alternative designs as described in paragraphs A157 through A165 of this Appendix. Profiles utilized for volume computations included Profiles 192 through 238 as established in November 1991. Profiles 140 to 192, as established in May 1992, were used to update and better reflect existing conditions in the Lido Beach and Point Lookout areas prone to higher erosion rates than the Long Beach area (Profiles 192 to 238). The beachfill cross-section template for the alternative designs were superimposed on the profiles, following the project layout guidelines described in Paragraph A188, in order to calculate the required beachfill volumes. Volumes were determined for the alternative designs by

Table A30 – Quantities for Initial Construction Alternatives

Plan Alternatives	Volume to Grade (c.y.)(a)	Tolerance (c.y.)(b)	Overfill Factor (c.y.)(c)	Total (c.y.)
1. (No Dune/Nour. Only)	4,240,100	1,060,100	132,500	5,432,700
2. (No Dune/110' Berm)	4,534,500	1,088,200	140,600	5,763,300
3. (No Dune/160' Berm)	6,423,800	1,284,800	192,700	7,901,300
4. (+15 Dune/Nour. Only)	5,542,400	1,227,000	169,200	6,938,600
5. (+15 Dune/110'Berm)	7,145,100	1,286,100	210,800	8,642,000
6. (+15 Dune/160' Berm)	9,034,400	1,361,200	259,900	10,655,500
7. (+17 dune/Nour. Only)	6,430,100	1,243,200	191,800	7,865,100
8. (+17 Dune/110'Berm)	8,032,500	1,301,000	233,300	9,566,800
9. (+17 Dune/160' Berm)	9,921,800	1,377,600	282,500	11,581,900

Note:
(a) All plan alternatives include 1,716,000 c.y. of advance nourishiment (w/o overfill).
(b) 1.0 f.t. tolerance.
(c) Overfill factor of 2.5%.

multiplying the cross-sectional areas for the design and advanced nourishment templates on each profile and their associated effective distances. The calculated volumes are shown in Table A30.

A190. Nourishment Fill Requirements. To maintain the integrity of the design beach cross-section, including the berm width and height, beachfill nourishment must be included in the project design. Without nourishment, long-shore and cross-shore coastal processes would erode the design beach, reducing the storm damage protection ability of the project design. The nourishment fill is considered a sacrificial fill volume, which protects the design fill volume. Various coastal processes were analyzed to develop an estimate of the nourishment fill volumes required.

A191. Preliminary Nourishment Design. To develop the preliminary nourishment design, the following processes were analyzed: long-term erosion losses using shoreline recession rates developed for the sediment budget, beachfill losses due to predicted (current rate) of sea level rise, and losses due to storm-induced erosion for various nourishment cycles. The results of these analyses were compared, and the volumetric requirements were combined to develop the total nourishment needs. The width of nourishment fill was developed for testing in the GENESIS shoreline evolution model, and to optimize the nourishment cycle. The nourishment design was finalized after the completion of the shoreline evolution modeling.

A192. Long Term Erosion Losses. The long-term erosion rates were developed during the sediment budget analysis. For the eastern-most 16,500 feet of shoreline (Pt. Lookout to Lido Beach), a recession rate of 5 feet/year was developed. For the Long Beach area (18,200 feet of shoreline) a recession rate of 4 ft/yr was developed.

A193. Based on a depth of closure of -20 ft. NGVD and a design berm height of +10 ft. NGVD (or an active envelope of 30 ft), each foot of beach lost from the berm landward, will equate to 1.1 cubic yards/year/foot of shoreline length. The volumetric loss per year for the Pt. Lookout/Lido area, based on the long-term erosion is:

$$\frac{\text{(5 ft. erosion)(30 ft. depth)(1 ft along shoreline)}}{\text{27 cubic feet/cubic yard}} = \text{5.5 cy/yr/ft of shoreline}$$

For the Long Beach area, the loss is 4.4 cy/yr/ft of shoreline. Averaging the two rates, the long-term erosion loss component of the nourishment fill will be 5.0 cy/yr/ft of shoreline, inclusive from Pt. Lookout to the western limit of the city of Long Beach.

A194. Sea Level Rise Losses. Using the current sea level rise rate of 0.1 feet/year, obtained from NOAA (Reference A11), and the Bruun method, the distance of shoreline retreat over the 50 year project life was determined, as described previously in Paragraph A58 of this appendix. This retreat rate was added to the long-term erosion losses and the storm-induced erosion losses to develop the nourishment estimates.

A195. A graphical representation of Bruun's Rule is given in Figure A40. If the water level rises by an amount A, the quantity of material per unit length of shoreline needed to reestablish the bottom elevation over a distance, B, seaward from the shoreline is A*B. The length B is the distance measured perpendicular to the shoreline out to a depth contour beyond which there is no significant sediment motion. The volume of sand per unit length of beach, A*B, must be derived from the active profile by a recession of the profile. The amount of the recession, x, is determined by balancing the volume A*B with the area between the two profiles. This area, given simply by x*(h+d), represents the volume of sand per unit length of beach needed to reestablish the beach to the original shoreline. Equating the two volumes gives

$$A*B = x * (h+d) \qquad (1)$$

or upon solving for x,

$$x = A*B/ (h+d) \qquad (2)$$

where

x = shoreline recession (in feet) attributable to sea level rise;
A = relative sea level rise for the time period t;
B = horizontal distance from the SWL/profile intersection to the profile closure depth, d;
h = shoreline elevation above mean sea level
d = profile closure depth; depth contour beyond which there is no significant sediment motion.

A196. For Long Beach, the following factors apply:

a) A = (50 years)(0.01ft/year) = 0.5 ft.

b) B = average of horizontal distance from SWL to profile closure depth
h = average maximum elevation above mean tide level

Using a mean tide level of +0.25 ft NGVD as the still water level and assuming a depth of closure of d= -20.0 NGVD, the following values are valid for the typical profiles:

TABLE A31
DISTANCE TO DEPTH OF CLOSURE &
MAXIMUM ELEVATION OF MEAN TIDE LEVEL

Profile	182	200	210	238	Average
B (ft)	2140	1340	980	920	1345
h (ft)	20.0	13.4	10.2	15.4	14.75

From equation (1):

$$(0.5 \text{ ft})(1345 \text{ ft}) = x(14.75 + 20.0)$$

$$x = 19.3 \text{ ft. over the 50 year project life}$$

For the annual shoreline recession due to sea level rise,

$$19.3 \text{ ft}/50 \text{ yrs} = 0.39 \text{ ft/yr}$$

Converted to a volume per linear foot of shoreline,

$$\frac{(0.39 \text{ ft})(30 \text{ ft})}{27\text{ft/cy}} = 0.43 \text{ cy/yr/ft of shoreline}$$

A197. Storm-induced Erosion Losses. The last factor to be analyzed for the nourishment design was the beachfill losses due to storm-induced erosion, for various nourishment cycle time periods. Results from the SBEACH numerical model of storm-induced erosion, for the maximum volume loss on any contour on the beach profile (Figure A41), were used for the various cycle lengths. The nourishment volume required for storm-induced erosion must be calculated to withstand the storm losses for the event which has a 50% chance of being exceeded during the nourishment cycle, from two to ten year cycles. The SBEACH values of erosion for typical profile 238 were found to be representative for the entire shoreline.

TABLE A32
STORM-INDUCED VOLUME LOSSES

Cycle Length (years)	Event w/ 50% chance of exceedence (years)	Volume Loss (cy/ft)
2	3.5	16.0
3	5.0	16.6
4	6.3	17.0
5	7.7	17.3
6	9.2	17.6
7	10.6	17.9
8	12.0	18.2
9	13.5	18.4
10	15.0	18.6

TABLE A33
PRELIMINARY DESIGN NOURISHMENT VOLUME REQUIRED

Cycle Length (years)	Event w/ 50% chance of exceedence (years)	Long-term Erosion Loss (cy/ft) (1)	Sea Level Rise Loss (cy/ft) (2)	Volume Loss (cy/ft)	Design Nourish-ment Volume Required (cy/ft)
2	3.5	10	.86	16.0	26.9
3	5.0	15	1.29	16.6	32.9
4	6.3	20	1.72	17.0	38.7
5	7.7	25	2.15	17.3	44.5
6	9.2	30	2.58	17.6	50.2
7	10.6	35	3.01	17.9	55.9
8	12.0	40	3.44	18.2	61.6
9	13.5	45	3.87	18.4	67.3
10	15.0	50	4.30	18.6	72.9

(1) Long term rate = 5 cy/ft/yr x cycle length (years)
(2) Sea level rise rate = 0.43 cy/ft/yr x cycle length (years)

A198. To develop the total nourishment volume required, the volumetric losses from the three coastal processes were combined. Table A33 shows the total nourishment design volumes required to compensate for the coastal processes losses.

A199. The equivalent berm width for the design nourishment volume required is given by the following equation:

$$50.2 \text{ cy/ft} = \frac{\text{(berm width) (30 ft height of fill)}}{\text{(27 cubic ft/cy)}}; \quad (x) = 45.2 \text{ ft.}$$

A nourishment fill width of 50 feet, which was estimated to be sufficient for a nourishment cycle length between five and seven years, was applied to the design beachfill profile for GENESIS shoreline evolution modeling simulations. The GENESIS analyses included the effects of the existing groin field on shoreline evolution for without-project conditions, and the effects of the rehabilitated groins for the with-project conditions. The results of the simulations was used to develop the recommended nourishment widths and cycle length.

A200. <u>Numerical Modeling of Shoreline Change.</u> A numerical model of shoreline change was used to evaluate the performance of the alternative beachfill designs for the Long Beach area. The GENESIS shoreline change model (Reference A20) was used for simulation of longshore sand transport processes and long-term shoreline changes along the project area. The GENESIS shoreline change model is a generalized system of numerical models and computer sub-routines which allow simulation of long-term shoreline change under a wide variety of user-specified conditions, which includes the effects of offshore bathymetry and shoreline structures. The results of the model calculation assisted in the estimation of beachfill renourishment requirements, estimation of downdrift impacts, and in the objective comparison of eastern alternative closure options as described above.

A201. Model Setup. Shorelines from May 1978, April 1984, and April 1990, were digitized from available survey maps and photographs. Waves from the Wave Information Study (WIS) (Reference A4) hindcast station offshore of the project area were selected as raw data for use in the GENESIS model, and the numerical wave transformation model, RCPWAVE, was used for the complete range of wave conditions needed to develop the wave input for GENESIS. Longshore potential sand transport was calculated for each year of the hindcast in order to determine the representative years within the hindcast period. The years 1957, 1961, 1962, 1971 and 1972 were chosen as being representative of average transport years, and were used in all model simulations. Two wave transformation data sets were developed; one with the existing offshore bathymetry, and a second with the proposed borrow area (see Appendix B, Figure B11) dredged in all suitable locations to 20 ft. below the existing bathymetry. The simulated with-borrow bathymetry reflects an extreme condition, maximum potential borrow requirements and no infilling of the borrow area, and the results of the with- and without-borrow area are expected to envelope actual impacts. Beachfills, groins and jetties were included in the simulation of measured shoreline change. Historical data concerning groin and jetty conditions and construction dates, and beachfill volumes, placement dates and locations were compiled. For with-project simulations, groin conditions reflected the rehabilitations described in preceeeding paragraphs.

A202. Model Calibration and Verification. The calibration period selected for the Long Beach project was May 1978 to April 1984, for the project length from the westernmost groin in Point Lookout to East Rockaway Inlet jetty. Genesis input conditions were continually adjusted during the calibration to produce the appropriate shoreline responses along the project length: erosional west of Point Lookout, stable in western Lido Beach, and erosional or stationary along Long Beach and Atlantic Beach. The model verification period selected was April 1984 to April 1990. Figure A42 shows the final verification simulation. Observations from the final verification simulations include the following:

1) the predictions for cells 1 through 90 are reasonable, given the inlet effects and the anomaly of the 1990 shoreline at Lido Beach (from a Jones Inlet dredging placement),

2) the prediction from the model are conservative in the Long Beach area of cells 91 to 136, and the likelihood of

overprediction of erosion in these areas should be expected and compensated for in the interpretation of model results,

3) the predictions of a stable or accretionary shoreline in cells 137 to 288 is in reasonable agreement with historical trends.

A203. The transport rates shown in the bottom portion of Figure A42 are low in comparison with historical estimates, however, the predicted sediment transport rates are of the appropriate order of magnitude and direction and were deemed adequate. Sand transport rates increase or decrease in the locations of changes in the local shoreline orientation, which is a major consideration in the interpretation of model results.

A204. Evaluation of Beachfill Design Alternatives. GENESIS simulations were conducted on the existing condition shoreline (as a simulation baseline) and on six proposed beachfill design alternatives for both a 5-year and 10-year future condition simulation. The six design alternatives chosen for simulations were Designs 1 through 6. Designs 7 through 9 (+17 ft. dune) were not analyzed due to minor differences between shoreline position for these alternatives (approximately 20 ft.) and Designs 4 through 6 (+15 ft. dune). The design shorelines modeled included the design beachfill and the 50-ft. nourishment width. A 6.5 degree transition was included in the transition from Long Beach into Atlantic Beach, ending to the west with a tie-in with the 0.0 ft. NGVD shoreline.

A205. The results from the six design alternative simulations were very similar, with variations accounted for in the quantity of placed material for the particular beachfill design. The significant predicted shoreline changes occur along Hempstead, eastern Lido Beach and eastern Long Beach, however the prediction of erosion in eastern Long Beach is conservative as stated in the discussion on the model calibration. Figure A43 shows the initial input shoreline, including the design and 50 ft. nourishment width, and the shoreline positions after 5 and 10 year simulations for Design 5. Erosion in the vicinity of the Long Beach - Atlantic Beach border can be attributed to the change in shoreline orientation in this area. Changes to the designs shorelines were made to this area in the final project layout, which includes a longer transition into Atlantic Beach.
Comparison of shoreline simulations showed the negligible difference in terms of shoreline evolution of designs of a given berm width and either the no-dune or with-dune alternatives.

A206. Figure A44 shows the predicted shoreline positions under the with-borrow wave climate. The magnitude of erosion along Hempstead and Lido Beach is predicted to be reduced, however, the erosional reach length increases and is predicted for grid cells 1-60. The major predicted impact from the dredging of the borrow area occurs along eastern Long Beach for grid cells 90 to 140, with increased magnitude of erosion in cells 120 to 140.

Accretional reaches are predicted for grid cells 65-85 and 150-180. These reaches showed increased shoreline accretion relative to without-project condition future simulations. No impacts of borrow area dredging are predicted west of grid cell 180.

A207. Altered wave refraction patterns as determined by RCPWAVE with-borrow area bathymetry force the with-borrow shoreline evolution, and indicate potentially important dredging impacts over the life of the project. Note that the assumed bathymetry represents the extreme condition as stated above, with borrow volumes corresponding to the 50-year life of the largest beach fill design alternative. Simulation with the dredged borrow also does not account for infilling of the pit, which is anticipated to occur to some extent during the life of the project. Actual impacts due to the required dredging associated with each beachfill alternative are anticipated to lie within the range of the with- and with-out borrow area simulations, with impacts from initial construction to be predicted more closely by the with-out borrow area simulations.

A208. Longshore sand transport rates predicted for all the design simulation were similar, with only slight variations resulting from differences in sand availability and effective groin lengths. The maximum transport rate for Design 1 was estimated to be 234,000 cubic yards/year, which represents a predicted increase of 39,000 cubic yards/year. The maximum transport rate for Design 6 was estimated to be 286,000 cubic yards/year, which represents an increase of 91,000 cubic yards/year. Higher transport rates result from the greater seaward extension of the larger plans. The borrow area simulations all fall within this range of changes to the maximum transport rate.

A209. <u>Nourishment Fill West of Profile 182.</u> From the results of the shoreline simulations for the six beachfill design alternatives evaluated, taking into consideration the areas where the model over-predicts erosion, the conclusion was reached that the design shoreline will be maintained in the majority of the project length with the sacrificial nourishment width of 50 ft. as designed if renourishment is scheduled in five year cycles. The nourishment plan is the same for all nine beachfill design alternatives. The nourishment width of 50 ft. is appropriate for the shoreline reach from profile 182 to Profile 216. From profile 216 westward to Profile 238 (last full design cross-section), the nourishment width will be 25 feet, as this is an accretional area, and only the storm-induced erosion losses and sea level rise impacts need to be provided in the nourishment volumes (see Table A33). The nourishment volume will taper from Profile 238 to the final transition at Nassau Avenue.

A210. <u>Extension of Point Lookout/Hempstead Beach Groin Field.</u> In the Hempstead and Lido Beach area, the 50 ft. of advance nourishment as designed does not supply sufficient sacrificial material to maintain the integrity of the design shoreline. GENESIS simulation predicted the shoreline to recede beyond the limits of advanced nourishment. As discussed in the Closure Alternatives section, an extension of the Point Lookout groin field was also modeled with GENESIS, however some alterations to the groin field were suggested. Three additional GENESIS model simulations were performed, which were called the Final Design Plans, with the same model input conditions, and the results were reported in the same format. Figure A45 shows the layout of the Final Design Plans. Note that these "Final Design Plans" were for the evaluation of additional alternatives. The results of the final evaluations led to the determination of the recommended plan. The three Final Design Plans are summarized as: 1) Final Design Plan A -increased nourishment width of 100 ft. in the Hempstead and western Lido Beach area; 2) Final Design Plan B - same increased shoreline as Final Design Plan A, with seven new groins; 3) Final Design Plan C - reduced shoreline width to match existing NGVD shoreline, 50 ft. nourishment width and six new groins. The three western most groins for Final Design Plan C had crest extents landward of the groins shown on Figure A45 for Final Design Plan C.

A211. Alterations to the originally designed groin field were included in the final design simulations. Analysis of the original simulations indicated the following: 1) groin spacing of 1500 ft. was too large and should be reduced to decrease erosion within the groin field; 2) five groins are not sufficient to mitigate erosion along Hempstead and eastern Lido Beach given the results of the without-and with-borrow area simulations; and 3) groin lengths should be consistent given the downdrift impact resulting from a longer groin at the western end of the groin compartment.

A212. The new groin field for Final Design Plan B included seven groins with compartment spacing of 800 to 1200 ft., with the first groin 1000 ft. west of the westernmost groin in Point Lookout. Groin spacing from east to west were 1000, 1200, 1200, 1200, 1200, 1000, and 800 ft. The groins were designed to be 320 ft. from the 0.0 ft. NGVD nourishment shoreline to the seaward crest. The reduced shoreline width of Final Design Plan C eliminated the need for the westernmost new groin, having a total of six new groins. The groin spacing to groin length ratio, which compares the length of groin, from the berm crest to the seaward crest of the groin (550 ft., see Figure A48), to the groin spacing, varies from approximately 1.5 to 2.2. These values are slightly smaller than the recommended spacing/length of 2 to 3 (SPM, Reference A6), however the use of a predictive model such as GENESIS may be a more reliable indication of the effects of groin spacing.

A213. The results of the simulation for Final Design Plan A show that this plan alleviates some of the predicted erosion problems in Hempstead and eastern Lido Beach, however it appears that potential erosion problems remain despite the increase in nourishment volumes. Without the extension of the Point Lookout groin field, 50 additional feet of sacrificial nourishment material would be required from Profile 150 to Profile 180 to insure the integrity of the design profile, at a more frequent nourishment cycle (i.e. two and a half to three years). Approximately 310,000 cubic yards of additional nourishment material would be required for this alternative at each more frequent nourishment operation, to maintain the design shoreline in the Hempstead -Lido Beach area.

A214. Simulations conducted for Final Design Plan B showed that the groins appear effective in retaining a majority of the fill and maintaining the shoreline seaward of design shoreline. The gradient of average annual net longshore sand transport rates along Hempstead and eastern Lido Beach were predicted to be reduced from the without-groin field simulations. As seen on Figure A46, the groin fillets remain near the initial shoreline condition. Downdrift erosion appears to be negated by the availability of material and the shoreline orientation change just west of the proposed groins. Erosion is reduced greatly from the without-groin plan. For the 5-year simulation, the groin field is predicted to be successful in protecting the design shoreline, and assuming adequate renourishment, indicates a probability for a successful project using Final Design Plan B.

A215. Final Design Plan C was evaluated to indicate the evolution of a shoreline with nourishment similar to the initial design alternatives and a groin field which maintained a straighter alignment from the existing Point Lookout groin field. The groin field for Final Design Plan C does not extend as seaward as the groin field for Final Design Plan B, and does not attempt to mimic the straightened shoreline feature of the 1990 dredged fill material in the Town of Hempstead. Six new groins were included in Final Design Plan C, of the same geometry as Final Design Plan B. The shoreline of Final Design Plan C deviated from Final Design Plans A and B from cells 20 to 55 from approximately Profiles 170 to 180 with a reduced shoreline width to match existing 0.0 NGVD.

A216. Four of the six groin compartments were predicted to be successful in protecting the design shoreline for the 5-year simulation period, however revisions were needed to the shoreline in the vicinity of grid cell 20 (see Figure A47). Given the predominant wave direction from the southeast, the shoreline orientation west of grid cell 20 induced longshore sediment transport relative to the shoreline east of grid cell 20. This orientation change, in conjuction with the groin field, subsequently was shown to cause erosion at the center of the proposed groin field in the model simulations.

A217. To decrease the changes in the shoreline orientation, and allow the nourishment fill to protect the design fill, the final proposed nourishment plan maintains a straightened shoreline from Profile 150 to Profile 174, as shown on Figure A38. Six new groins will be constructed, extending the Point Lookout groin field to the west, at the spacing given above for the first six compartments. Nourishment fill of 50 ft. per five year cycle is required in the groin compartments. The alteration as described previously in this paragraph to Final Design C was chosen as the least expensive nourishment alternative for this shoreline reach. The cost differential between the necessary material for Final Nourishment Design A (with the more frequent nourishment operations and 100 feet of nourishment) and the recommended nourishment plan (with 50 ft. of nourishment and the extended groin field) is $ 62,000 on an annualized basis.

A218. Advanced Fill and Nourishment Volumes. Table A34 shows the nourishment volume required over the 50-year life of the project. Each nourishment operation, as well as the advanced nourishment in initial construction, has been estimated to require the same volume, to be placed in 5 year cycles. Climatic events occurring between scheduled nourishment operations, major rehabilitation due to the impacts of infrequent events and post-construction beachfill monitoring may revise the quantities of nourishment operations.

A219. Fill Sources - Offshore Sources. Based on the borrow area investigations, approximately 35 million cubic yards of suitable sediment has been identified in the borrow area offshore of Lido Beach and Long Beach. This material will be used for the initial construction and renourishment operations. Further details on the borrow area identification are given in Appendix C.

A220. Fill Tolerance. Additional fill is required during the construction of the beach restoration project to provide for a design template tolerance due to the construction difficulties in obtainung the exact design elevation. A one-foot construction tolerance was utilized in this analysis which increases volumetric requirements as shown on Table A30.

A221. Overfill Volume. Since the borrow area material is not perfectly compatible with the native beach material, an additional amount of fill called overfill volume must be provided for in the total require volume. This extra amount of fill will move offshore when the project erodes, leaving the design cross-section in equilibrium. Overfill factors for the Long Beach borrow area range from 1.02 to 1.03. Average overfill factor values are listed on Table A30. Additional information on overfill factors is provided in Appendix B.

A222. Total Initial and Nourishment Fill Volumes. The total initial project fill volume is the sum of the design, advanced nourishment, tolerance and overfill quantities. Table A30 presents the total initial fill volumes for the nine beachfill alternatives. Table A34 presents the total volumes for the nourishment operations after the initial construction.

A223. Groin Design. All the alternative beachfill plans include the extension of the existing groin field at Pt. Lookout with six new groins to the west in the Town of Hempstead Beach and Lido

Table (A)[34] Quantity of Fill For Nourishment Operations

Per Operation	Volume to Grade (c.y.)	Tolerance (c.y.)(a)	Overfill Factor (c.y.)(b)	Total (c.y.)
Plans 1 thru 9	1,716,000	343,000	52,000	2,111,000

Throughout Project Life (9 Operations)

Plans 1 thru 9: 2,111,000 (c.y) * 9 = 18,999,000 (c.y.)

Note:
(a) 1.0 f.t. tolerance.
(b) Overfill factor of 2.5%

Beach. The groin field extension was included in the plan alternatives to provide the most cost effective means of maintaining the integrity of the design beach fill in the Town of Hempstead Beach and Lido Beach when compared with the required increase in renourishment volumes at this highly erosive area. The plan layout is shown on Figure A38. It is noted that beach Profile 160 was used as the representative shoreline profile for the design of the eastern three groins and beach Profile 172 was used as the representative shoreline profile for the design of the western three groins.

A224. <u>Design Wave Introduction.</u> Based on the data from the WIS Report 30, the maximum recorded wave height at the nearest wave gage to Long Beach (Station 74) between the period 1956 through 1975 was 19.3 ft., with a corresponding water depth of -59.0 ft. MLW. However, the ocean bottom depth offshore of Lido Beach where the new groins are located displays a continuous offshore bar ranging between 2,000 ft. & 4,000 ft. offshore and averaging a crest elevation of approximately. -10.5 ft. NGVD, for a 100 to 200 ft. width. Because of this bar, a depth limited wave transmission condition exists whereby wave heights on the order of 19 ft. would break 2,000 to 4,000 ft. offshore.

A225. <u>Design Wave - Eastern Three Groins.</u> To determine the maximum non-breaking wave that can be transmitted across the bar for a Still Water Level (SWL) matching the groin head crest elevation of +3.5 ft. NGVD (the SWL that yields maximum damage to the groin head section), Table 7-2 of the SPM was utilized. Using an offshore slope of m=0, a wave period of 10 seconds and a db (water depth across the bar) of 14 ft., this depth limited wave is 10.9 ft. A check was made to determine the maximum depth of breaking for this wave height of 10.9 ft. From Fig. 7-2 (SPM) the maximum depth of breaking for a wave height of 10.9 ft. and a wave period of ten seconds is 16.4 ft. This maximum depth approximates the depth at the groin head and therefore a 10.9 ft. wave is the maximum wave height that can break on the groin head.

A226. To determine the design wave for the inshore end of the trunk section (crest elevation. of +3.5 ft. NGVD), Fig 7-4 of the SPM was utilized. Based on a maximum depth of water at the structure of 10 ft. (with the SWL at +3.5 ft. NGVD), with a nearshore slope of 1 on 50 (both based on existing conditions) and a 10 second wave period, the design wave is 9.6 ft. This wave height breaking on the structure will yield maximum damage where the SWL is approximately at the crest of the groin. The outer end of the trunk section uses the previously developed 10.9 ft. design wave height.

A227. To determine the design wave for the inshore section, with crest elevation of +10 ft. NGVD, Fig. 7-2 was first utilized to determine the maximum non-breaking wave transmitted across the offshore bar. Using an offshore slope of m=0, a wave period of 10 seconds and a db (water depth across the bar) of 20.5 ft., the maximum wave transmitted across the bar is 15.9 ft. To determine the minimum depth that a 15.9 ft. wave height breaks, Fig. 7-2 was utilized. Using a nearshore slope of m=.03 (1 on 33) and a 10 second wave period with Hb=15.9 ft., the minimum depth of breaking is 17.5 ft. Based on the existing beach profile, the water depth using a SWL of +10 ft. NVGD which is associated with a maximum damage condition for the inshore section (crest elevation +10 ft. NGVD), is 11 ft. Therefore, a 15.9 ft. wave would break well seaward of the inshore end of the groin structure. To determine the actual design wave height to use for the inshore section, Fig. 7-4 of SPM was utilized. Based on a nearshore slope of 1 on 33, a depth of water at the structure of 10.8 ft. and a 10 sec. wave period, the breaking wave height becomes 11.0 ft.

A228. Design Wave - Western Three Groins. To determine the wave height to be used for designing the head section of the three westerly groins, profile 172 was utilized. Based on the previous analysis for designing the head section with a crest elevation of +3.5 ft. NGVD, a maximum wave height of 10.9 ft. will be transmitted to the groin. From Fig. 7-2 of SPM, the maximum depth for a 10.9 ft. wave to break using a nearshore slope of 1 on 35 and a 10 sec. wave period is 16.3 ft. The minimum depth for a 10.9 ft. wave under these conditions is 12 ft. (from Fig. 7-2). The actual depth of water with a +3.5 ft. NGVD SWL at the groin head is 13.5 and therefore this 10.9 ft. wave can be considered to break on the groin head to yield maximum damage conditions.

A229. To determine the wave height to be used for designing the inshore end of the three westerly groins, a limiting condition of the design section (berm width of 110 ft. from the dune) was utilized. The existing profile extends well seaward of the required design section, and can be allowed to retreat back to the design section over the life of the project. With a SWL of +10 NGVD to allow for maximum damage to the structure, the design water depth, ds, measured from the design section is 9 ft. Utilizing Fig. 7-4 of SPM with a nearshore slope of 1 on 30, and a 10 second wave period, the resulting breaking wave is 9.9 ft.

A230. Groin Design and Configuration. The design of the six new groins incorporated the requirements that they be low profile, sand tight and of rubble mound stone. Each groin has an inshore end of crest elevation +10 ft. NGVD for a length of 125 ft. to match the adjacent berm crest elevation of design beach fill and an offshore end with a trunk and head section of crest elevation +3.5 ft. NGVD for a length of 420 ft. to provide a low profile. The intermediate section of trunk transitioning between inshore and offshore ends slopes at 1V:20H and is 130 ft long. The landward extent of each groin extends between 60 and 90 ft. landward of the design fill berm crest to preclude flanking. The seaward extent of the head section crest typically extends 50 ft. beyond design fill closure at the toe of slope for the eastern three groins and at approximately the start of slope flattening for the western three groins. The landward extent of the +3.5 ft. NGVD crest elevation extends to its intercept with the design fill slope at elevation +3.5 ft. NGVD. Side slopes are 1 on 1.5 and the head section crest length is set at 50 ft., with and end slope of 1 on 2.

A231. Utilizing the design waves developed in the previous section and Hudson's equation, the required stone sizes were calculated along with required crest widths and layer thicknesses. These calculations are shown on Calculations A-1 and A-2. Typical groin sections are shown on Figure A48 and typical groin profiles are shown on Figure A49.

WITH PROJECT CONDITIONS
(Coastal Processes)

A232. General. The "with" project condition is identified as the condition with the project design in place, with long-term renourishment and maintenance of the project features. The project nourishment has been designed to insure the integrity of the design beachfill cross-section and eliminate the long-term erosion of the shoreline, however coastal processes will continue to impact the project area shoreline. The with-project coastal processes of inundation, storm-induced erosion, wave attack and dune failure were evaluated. The with-project conditions were analyzed on two different typical profiles, which reflect different offshore and upland topographies for the shoreline under project conditions. The following paragraphs describe the coastal processes which were used to estimate the with-project condition benefits.

A233. Inundation. Analysis of inundation depths for the improved condition consisted of a repeat of the without project inundation calculation adjusted for changes in topography due to construction of dunes. Storm analysis was repeated for events ranging from 2 year to 500 year return intervals. Dune failure was included in the analysis at the appropriate storm frequency for each cross-island profile. Residual flooding from the back bay was determined with the project in place. Figure A50 shows the sample cross island profile (Profile 210/National Blvd.) for the +15 dune, 110 ft. berm plan.

A234. Storm-induced Recession Distances. To develop the input for the economic benefit analysis of the with-project conditions, the improved condition alternative beachfill cross-sections were analyzed for storm-induced recession using the SBEACH numerical model (Reference A20) using the same climatic input as the without-project conditions (see Paragraphs A123 through A128). Storm events from 2 to 500 year frequency were run on the SBEACH model to develop storm-induced recession distances. The distance from the economic baseline to the landward-most occurrence of the 0.5 ft. of vertical recession was again used as the storm recession parameter for the modeled storm events. Alternative beachfill Designs 2 through 9 were analyzed for improved conditions, as improvements to Profiles 200 and 238. The two profiles were used for backshore and offshore differences. The results of the existing condition SBEACH analysis were used for Design 1 on both Profiles 200 and 238, with the assumption that long-term erosion will be prevented under improved conditions.

A235. The methodology to develop the recession distance vs. frequency relationship for improved conditions was the same as for existing conditions, however for improved conditions, the median recession distance plus half the maximum contour recession was used, which is comparable to using a variablity factor of 1.5.

Figure A51 shows the relationships of recession vs. frequency for Designs 2 through 9, Profiles 200 and 238.

A236. Wave Attack and Wave Runup Analysis. The wave attack analyses on improved conditions were performed to determine the horizontal distance to where critical impact forces occur landward of the still water level (SWL) in the runup zone, as in the Existing Conditions Wave Attack Analysis. The first stage of the analysis determined the maximum vertical extent of wave runup based on the slope composite method outlined in the 1984 SPM. The second stage determined the horizontal distances landward from the SWL to the location where the critical force (1800 lb/lf) from the wave impact occured based on EM-1110-2-1614 Change 2 of 30 November 1992. The storm events analyzed included northeasters of 2, 5, 10, 20 year frequencies, and hurricanes of 50, 100, 200 and 500 year frequencies. For further information of the methodology used, refer to the Existing Conditions Wave Attack Analysis.

A237. Wave Runup Analysis. The FEMA model was used, as for the existing conditions. The same stage-frequency (without wave setup) and wave height-frequency data utilized for the existing conditions were used, and are shown in Tables A3 and A4. Two typical profiles analyzed were: Profile No. 200 and Profile No. 238. Eight design alternatives were evaluated, and are described in Table A35. The runup and wave attack distances for design alternative 1 was assumed to be equivalent to the runup and wave attack distances calculated for the existing condition on Profile Nos. 200 and 238.

Table A35
Design Alternatives

Alternative	Berm Width (in ft.)	Dune Elevation (in ft. NGVD)
2	110	no dune
3	160	no dune
4	0	+15
5	110	+15
6	160	+15
7	0	+17
8	110	+17
9	160	+17

The wave runup was calculated on the post-storm condition of the 16 profiles (two typical profiles with eight design alternatives each), as predicted by SBEACH. And, similar to the existing conditions analysis, only the 20 yr. northeaster and the 100 yr. hurricane post-storm profiles were used, instead of the 2, 5, 10, and 20, and the 50, 100 200, and 500 yr. post-storm profiles, in order to obtain more easily comparable and consistent results.

A238. Wave Runup Results. The model output gives the maximum runup height, which when added to the SWL (stage) elevation gives the maximum vertical extent of the wave runup. The runup elevations for the 2, 5, 10, and 20 yr. frequencies were plotted on the 20 year northeaster post-storm condition profiles, and the distance from the SWL was measured. Similarly, the runup elevations for the 50, 100, 200, and 500 year frequencies were plotted on the 100 year hurricane post-storm profiles, and the distances were measured. The improved condition wave runup heights and elevations are shown in Table A36 for Profile No. 200, and in Table A37 for Profile No. 238. It should be noted that the model is not valid for cases where the maximum runup elevation and/or the SWL (stage) elevation exceed the maximum profile elevation. For those cases, the landward profile slope was extended to elevations high enough to contain the runup. The runup heights determined above the hypothetical slope were assumed to approximate the runup heights above the actual profile grade.

A239. Wave Attack Distances. EM-1110-2-1614 Change 2 of 30 November 1992, equation 2-23 was used. For further information, refer to the Existing Conditions Wave Attack Analysis. The resulting improved condition wave attack distances from the Economic Baseline are shown in Table A36 for Profile No. 200, and in Table A37 for Profile No. 238 for the 1800 lb./ft. critical force for single family structure damage. The wave attack distances for the improved and existing conditions for Profile Nos. 200 and 238 for the 1800 lb./ft/ force are shown in Figures A52 through A57.

A240. Dune Failure. Analysis of dune failure for the improved condition consisted of a repeat of the without project calculation adjusted for changes in topography due to construction of dunes and added beachfill. The storm range of 2 year to 500 year return intervals was repeated for improved conditions. The provision for repeated beach nourishment results in the same failure frequency for improved conditions for all 50 years of the project life. Results are summarized in Table A38 below.

TABLE A36
IMPROVED CONDITIONS WAVE RUNUP/ATTACK ANALYSIS
PROFILE NO. 200

DESIGN NUMBER	RETURN PERIOD (YEARS)	STAGE ELEVATION (FT. NGVD)	WAVE RUNUP (FT.)	TOTAL WATER SURFACE ELEVATION (FT. NGVD)	STATION OF 1800 LB/FT FORCE * (FT.)
2	2	5.6	1.54	7.1	110.0
2	5	6.1	1.60	7.7	122.0
2	10	6.6	1.72	8.3	137.1
2	20	7.4	1.83	9.2	152.7
2	50	8.9	1.96	10.9	229.6
2	100	10.1	2.10	12.2	366.8
2	200	11.4	2.21	13.6	418.4
2	500	13.0	2.20	15.2	517.6
3	2	5.6	1.63	7.2	80.9
3	5	6.1	1.60	7.7	89.6
3	10	6.6	1.72	8.3	100.1
3	20	7.4	1.81	9.2	134.8
3	50	8.9	1.78	10.7	207.7
3	100	10.1	1.89	12.0	318.9
3	200	11.4	1.99	13.4	363.2
3	500	13.0	2.42	15.4	368.4
4	2	5.6	1.57	7.2	166.5
4	5	6.1	1.92	8.0	186.8
4	10	6.6	1.78	8.4	205.2
4	20	7.4	2.29	9.7	214.4
4	50	8.9	2.18	11.1	207.0
4	100	10.1	2.40	12.5	225.1
4	200	11.4	2.74	14.1	261.9
4	500	13.0	3.04	16.0	302.0
5	2	5.6	1.63	7.2	29.2
5	5	6.1	1.60	7.7	45.1
5	10	6.6	1.67	8.3	58.7
5	20	7.4	1.81	9.2	76.8
5	50	8.9	1.96	10.9	140.1
5	100	10.1	2.10	12.2	211.0
5	200	11.4	2.35	13.6	217.2
5	500	13.0	2.66	15.9	232.7
6	2	5.6	1.48	7.1	−36.9
6	5	6.1	1.60	7.7	−16.3
6	10	6.6	1.72	8.3	0.6
6	20	7.4	1.81	9.2	27.4
6	50	8.9	2.18	11.1	137.7
6	100	10.1	2.31	12.4	216.7
6	200	11.4	2.43	13.8	227.6
6	500	13.0	2.66	15.9	236.9
7	2	5.6	1.63	7.2	169.8
7	5	6.1	1.76	7.9	202.4
7	10	6.6	1.82	8.4	210.6
7	20	7.4	2.41	9.8	211.2
7	50	8.9	2.18	11.1	192.1
7	100	10.1	2.76	12.9	182.1
7	200	11.4	2.96	14.4	216.7
7	500	13.0	3.04	16.0	296.4
8	2	5.6	1.63	7.2	26.6
8	5	6.1	1.76	7.9	43.2
8	10	6.6	1.72	8.3	51.8
8	20	7.4	1.81	9.2	72.0
8	50	8.9	1.96	10.9	155.2
8	100	10.1	2.10	12.2	202.6
8	200	11.4	2.43	13.6	298.4
8	500	13.0	3.04	16.0	216.4
9	2	5.6	1.55	7.1	−55.5
9	5	6.1	1.60	7.7	−31.2
9	10	6.6	1.72	8.3	−16.4
9	20	7.4	1.83	9.2	3.0
9	50	8.9	1.96	10.9	116.3
9	100	10.1	2.10	12.2	204.0
9	200	11.4	2.21	13.6	206.8
9	500	13.0	2.64	15.6	218.4

NOTE: * MEASURED FROM THE ECONOMIC BASELINE
(− IS SEAWARD, + IS LANDWARD)

TABLE A37
IMPROVED CONDITIONS WAVE RUNUP/ATTACK ANALYSIS
PROFILE NO. 238

DESIGN NUMBER	RETURN PERIOD (YEARS)	STAGE ELEVATION (FT. NGVD)	WAVE RUNUP (FT.)	TOTAL WATER SURFACE ELEVATION (FT. NGVD)	STATION OF 1800 LB/FT FORCE * (FT.)
2	2	5.6	2.30	7.9	−70.5
2	5	6.1	2.24	8.3	−57.1
2	10	6.6	2.41	9.0	−38.8
2	20	7.4	2.47	9.9	−21.0
2	50	8.9	2.38	11.3	66.4
2	100	10.1	2.73	12.6	127.0
2	200	11.4	2.87	14.3	234.3
2	500	13.0	3.12	16.1	305.9
3	2	5.6	2.24	7.8	−131.8
3	5	6.1	2.24	8.3	−114.8
3	10	6.6	2.41	9.0	−97.3
3	20	7.4	2.41	9.8	−79.7
3	50	8.9	2.38	11.3	29.5
3	100	10.1	2.52	12.6	105.0
3	200	11.4	2.65	14.1	244.6
3	500	13.0	2.88	15.9	302.2
4	2	5.6	2.24	7.8	116.2
4	5	6.1	2.24	8.3	127.5
4	10	6.6	2.43	9.0	136.1
4	20	7.4	2.88	10.1	154.3
4	50	8.9	2.97	11.9	174.4
4	100	10.1	N/A		
4	200	11.4	3.09	14.5	222.9
4	500	13.0	3.60	16.6	276.4
5	2	5.6	2.24	7.8	−94.6
5	5	6.1	2.24	8.3	−79.8
5	10	6.6	2.41	9.0	−62.4
5	20	7.4	2.45	9.9	−38.1
5	50	8.9	2.57	11.5	41.4
5	100	10.1	2.73	12.8	101.7
5	200	11.4	2.90	14.3	166.7
5	500	13.0	3.60	16.6	189.3
6	2	5.6	2.18	7.8	−155.8
6	5	6.1	2.24	8.3	−126.6
6	10	6.6	2.41	9.0	−113.1
6	20	7.4	2.35	9.8	−90.2
6	50	8.9	2.38	11.3	13.1
6	100	10.1	2.73	12.6	83.9
6	200	11.4	2.87	14.3	166.5
6	500	13.0	3.36	16.4	185.4
7	2	5.6	2.24	7.8	120.0
7	5	6.1	2.24	8.3	129.2
7	10	6.6	2.51	9.1	140.4
7	20	7.4	2.88	10.1	152.8
7	50	8.9	2.77	11.7	171.7
7	100	10.1	2.94	13.0	221.0
7	200	11.4	2.87	14.3	307.6
7	500	13.0	2.86	15.9	466.3
8	2	5.6	2.24	7.8	−112.7
8	5	6.1	2.24	8.3	−95.6
8	10	6.6	2.43	9.0	−86.3
8	20	7.4	2.47	9.9	−63.7
8	50	8.9	2.57	11.5	35.6
8	100	10.1	2.73	12.8	96.0
8	200	11.4	3.09	14.5	165.0
8	500	13.0	3.60	16.6	175.4
9	2	5.6	2.24	7.8	−162.2
9	5	6.1	2.24	8.3	−135.4
9	10	6.6	2.41	9.0	−122.5
9	20	7.4	2.41	9.8	−101.6
9	50	8.9	2.38	11.3	2.9
9	100	10.1	2.73	12.6	55.0
9	200	11.4	2.87	14.3	160.7
9	500	13.0	3.36	16.4	167.7

NOTE: * MEASURED FROM THE ECONOMIC BASELINE
(− IS SEAWARD, + IS LANDWARD)

Table A38

Frequency of Event for Dune Failure (Years)
With-Project Conditions

Design Alternative	Description	Reach 1A/1B	2	3	4	5	6
Alt. 1	Ex. Berm Ex. Dune	92/500	500	92	92	92	92
Alt. 2	110 ft. Berm Ex. Dune	200/500	500	200	200	200	92
Alt. 3	160 ft. Berm Ex. Dune	200/500	500	200	200	200	92
Alt. 4	Ex. Berm 15 ft. Dune	100/500	500	100	100	100	92
Alt. 5	110 ft. Berm 15 ft. Dune	200/500	500	200	200	200	92
Alt. 6	160 ft. Berm 15 ft. Dune	200/500	500	200	200	200	92
Alt. 7	Ex. Berm 17 ft. Dune	100/500	500	100	100	100	92
Alt. 8	110 ft. Berm 17 ft. Dune	200/500	500	200	200	200	92
Alt. 9	160 ft. Berm 17 ft. Dune	200/500	500	200	200	200	92

A241. Risk and Uncertainty. Currently, no guidance is available on the application of risk and uncertainty within the coastal arena, however risk and uncertainty were evaluated to some extent in this Feasibility study. The treatment of risk and uncertainty in the coastal processes analyses was conducted by considering multiple storm events for given return periods, with variations such as duration of event, wave height time series and wave periods. These considerations were considered in application of the SBEACH storm-induced erosion model. Joint-probablity methodolgies were used in the development of the ocean stage-frequency curve, in which hundreds of storms, both historical and synthetic, were used to develop the relationship. Considerations of risk were included in the development of the nourishment and major rehabilitation volumes, in which the risk of an event with a 50% chance of occurrence during a specified period of time was used for evaluation. Uncertainties in the rate of rise of sea level rise variations were estimated and project impacts were described.

A242. <u>Levels of Protection.</u> The existing condition within the project area provides a relatively low level of protection against storm events. The storm damage reduction beachfill design alternatives will increase protection against profile recession due to storm-induced erosion, increase protection against inundation due to high levels of ocean storm water elevations, and increase protection against wave attack damages due to wave runup and wave impacts.

A242. The beachfill design alternatives which include dunes will provide increased protection against oceanfront inundation, however the improvements will not lessen the storm water inundation from the back bay side, which will occur at more frequent storm events. The back bay inundation is from Reynolds Channel, over the existing bulkheads or through existing storm drains. Elevations as low as +4.5 ft. NGVD exist along the canals on Reynolds Channel, and the design improvements will not decrease the likelihood of flooding in these locations where there will still be the potential for frequent flood damage. The existing condition level of protection against inundation is approximately a storm event with a return period of 10 years. The improved condition designs which include dunes (Designs 4 through 9) therefore are estimated to give a level of protection against inundation for ocean surges up to a storm event with a return interval of 100 years.

A243. The level of storm-induced recession protection afforded by the existing beach and by the design beachfill and dune is defined as the return period of the storm event which would incur 0.5 ft. of vertical recession at the seaward extent of the seaward line of buildings in the project area. The existing condition level of protection for Typical Profile 2 (Profile 200) is approximately 30 years. The existing condition level of protection for other areas along the project length is similar or slightly greater than the level of protection for Typical Profile 2, especially in areas which have existing dunes. The improved condition level of protection against storm-induced recession for Design 5, Profile 200, would be over 500 years.

A244. In addition to providing protection against storm-induced recession and inundation, the storm damage reduction project will also provide protection against damage to buildings caused by wave attack and wave runup. The level of protection afforded by the existing beach and by the design beachfill and dune against wave attack was defined as the return period of the storm event which corresponds to the distance of the critical force of 1800 lbs/ft. (as described in previous sections of this appendix) to the seaward wall of the seaward line of buildings in the project area. The existing condition level of protection for Typical Profile 2 (Profile 200) is approximately 200 years. Again, as in the storm-induced recession, the existing condition level of protection against wave attack for other areas along the project length is similar or slightly greater than the level of protection for Typical Profile 2. The improved condition level of protection against wave attack for Design 5, Profile 200, would be over 500 years.

A245. Conclusions. The existing conditions provide a low level of protection against storm-induced recession, inundation and wave attack. Only the design alternatives which include the 110 ft. or 160 ft. berm widths increase the level of protection against storm-induced recession significantly. Only the design alternatives which include dunes will increase the level of protection against ocean surge inundation. The design alternatives which include the 110 ft or 160 ft. berm widths with dunes provide a significant increase in the level of protection against wave attack.

SELECTED PLAN

A246. Description. The selected plan is equivalent to the selected plan discussed in the main report. The plan is defined as the storm damage reduction and erosion control plan which maximizes beneficial contributions to the National Economic Development, while meeting the planning objectives. The selected NED plan is the Design 5, the +15 ft. NGVD dune with 110 ft. berm width, with the extension to the west of the Point Lookout groin field with six new groins and rehabilitation of 16 existing groins. This plans yields the maximum difference between annual benefits over annual costs.

A247. The following is a detailed description of the selected plan:

a) Dune and berm fill from Pt. Lookout west through East Atlantic Village to Yates Avenue, approximately 41,000 L.F. (Village of Atlantic Beach not included). The design berm fill will taper at an angle of approximately 6 degrees at the western termination, and will tie into the existing shoreline at the eastern termination at Jones Inlet.

b) Dune: Crest elevation of +15 ft. NGVD for a crest width of 25 ft. with 1 on 5 side slopes on the landward and seaward sides.

c) Berm: Fronting the dune, a berm width of 110 ft. at elevation +10 ft. NGVD with a shore slope of 1 on 25 for the easternmost 5,500 L.F. of the project, a 1,500 L.F. transition, thence a 1 on 35 slope for the remaining 34,000 L.F. of the project.

d) Total sand fill quantity of 8,642,000 c.y. including tolerance and overfill and advanced nourishment will add between approx. 100 and 400 ft. of design beach at 0.0 ft. NGVD to the existing beach. Beach placement can be accomplished by either hopper or cutterhead dredge.

e) Of the 8,642,000 c.y. of initial fill placement, 1,760,000 c.y. is for advanced nourishment.

f) The dune construction includes 29 acres of planting dune grass and 50,000 L.F. of sand fence for dune sand entrapment as well as ramps and walkovers for access over the dune.

g) Six new groins, with an average foot print of approximately 60 ft, are proposed at Lido Beach across 6,000 L.F. of beach frontage, i.e. spaced approximately 1200 ft. apart, with each groin averaging approximately 700 ft. in total length and with crest elevations varying between +10 ft. NGVD at the inshore end to +3.5 ft. NGVD at the outer end. The total stone volume for the groins is approximately 100,000 tons of underlayer and armor stone (6 to 9 tons) and 30,000 tons of bedding stone underlain by filter cloth.

h) 15 existing groins at Long Beach are to be rehabilitated as part of the project, since these groins are in disrepair and will be left exposed or partially exposed subsequent to project placement of beach fill. In addition, the outer end of the terminal groin at Pt. Lookout that is in disrepair will be rehabilitated. In total, approximately 68,000 tons are to be imported or reused from existing groins as part of this rehabilitation effort.

i) 640 lf. of revetment fronting the west side of Jones Inlet will be rehabilitated to prevent flanking and loss of project fill material. A total of approximately 26,800 tons of stone are to be imported or reused from the existing revetment as part of this rehabilitation effort.

j) Renourishment operations are scheduled every five years subsequent to the commencement of sand placement of initial construction and throughout the project life (50 years). This renourishment will replace sacrificial material fronting the design section. 2,111,000 c.y. are estimated to be placed per renourishment operation along the 41,000 L.F. of project length.

Figure A38 shows the layout of the selected plan, the location of the groins and revetment which will be rehabilitated, the dune walkovers and accessways, and the location of the new groins in Lido Beach.

A248. Construction Template. The 110 ft. berm width at +10 ft NGVD with slopes of 1 on 25 and 1 on 35 compromises the design cross-section. This design section represents the equilibrium profile. When the fill is placed by hydraulic methods, offshore slopes cannot be graded to the designed, equilibrium slopes. The offshore slope will adjust to the design section by wave action over the period of a few months. The seaward limit of the hydraulically placed fill is the construction template, which extends the design beach berm design beyond 110 ft. to provide equivalent volumes to the design section stated above. The initial advance nourishment material is also included in the construction template. The construction template, as shown in Figure A58, is based on hydraulic placement with foreshore and offshore slopes of 1 on 20. Table A39 displays the average adjusted construction beach berm width for the project area profiles.

Table A39
Selected Plan Construction Template
Berm Widths at +10 ft. NGVD

Profiles	Average Template Width (ft)
150-170	230
172-180	180
184-214	345
216-238	320

A249. Construction Sequence. Initial construction for beach placement and groin work is anticipated to take approximately 2 years. The anticipated schedule has flexibility to avoid sand placement at Lido Beach during the May through September environmental restrictions, but the groin work at Lido Beach requires continuous construction due to the extent of work. A construction schedule is included in the Main Text of this report.

A250. Sea Level Rise Considerations. Additional sand volumes needed to compensate for both the historical rate and the high rate of rise were calculated. The historical rate requires placement of 21.5 cy of nourishment material per foot of shoreline over the 50 year project life. This volume has been included in calculated nourishment volumes as part of the project design. The high rate of rise would require 55.9 cy of nourishment material per foot of shoreline over 50 years. Should the more rapid rate of rise occur, although not anticipated, additional compensatory volumes could be added to future nourishment cycles, however, the total volumes estimated for nourishment of the project are sufficient to compensate for even the high rate of sea level rise.

A251. Impacts on Atlantic Beach. The design berm and dune will tie-in to high ground at the western end and terminate just east of Yates Avenue in the vicinity of the Village of Atlantic Beach/East Atlantic Beach border. A taper section will be provided to smoothly transition the design fill, including the offshore portion of fill, into the existing shoreline. The taper section is approximately 2000 feet long, and will terminate the toe of the design fill into the existing shoreline at Onedia Avenue in Atlantic Beach.

A252. Although the design cross-section will end just east of the Village of Atlantic Beach, the shore protection project will impact portions of Atlantic Beach. The shoreline evolution numerical modeling (GENESIS - Reference A20) predicted stability of the existing shoreline as has been seen historically, through model simulations of future conditions, for the eastern section of Atlantic Beach from Yates Avenue to approximately Jefferson

Boulevard (near the fifth groin from the west). Impoundment of littorally transported material, derived from the movement of nourishment fill from the project shoreline, is predicted from the vicinity of Jefferson Boulevard to the East Rockaway Inlet Jetty. No negative impacts of the recommended plan of improvement are expected in Atlantic Beach.

A253. Impacts on East Rockaway Inlet. Shoaling of the navigation channel at East Rockaway Inlet has been an on-going maintenance concern in the vicinity of the project area. Maintenanace dredging has occurred in 30 of the last 57 years, since 1937. Disposal sites have varied, including offshore disposal (berms and mounds), sidecast, and placement on downdrift beaches. Some of the material has been placed on Rockaway Beach as part of a renourishment project, however recent testing has indicated that the material is fine sand, and may not be of a grain size suitable for beach placement. In the years 1989, 1990 and 1991, the total dredging yardages from the East Rockaway Inlet Channel were 226,000 cy, 192,000 cy and 160,000 cy, respectively (Reference A18). These three values average to 193,000 cy/year. This material was placed in offshore disposal mounds.

A254. It is not known exactly what volume of material bypassing the East Rockaway Inlet jetty is contributing to the shoaling of the navigation channel, as a portion of the material may be coming from Rockaway Beach. The sediment budget predicts a littoral transport rate of 279,000 cubic yards per year under existing conditions in the vicinity of the East Rockaway Inlet jetty (see Paragraph A51 and Figure A7). The net contribution of Long Beach Island to the littoral transport rate is 79,000 cy/yr.

A255. A precise prediction of the impacts of the Long Beach shore protection project on the East Rockaway Inlet maintenance dredging would be difficult at this time to make, however the GENESIS shoreline change modeling was used to make a general prediction of possible increases to the bypassing rate (and therefore channel shoaling) due to the nourishment project. As the nourishment volumes were the same for all the design alternatives, the impacts on East Rockaway Inlet were the same for all alternatives.

A256. As stated above, the shoreline change simulations indicated the probable impoundment of beachfill material at East Rockaway Inlet. Predominant wave directions from the southeast, diffraction by the jetty and sheltering of waves drive the littoral material from the nourished shoreline reach to western Atlantic Beach. Of concern is the potential growth of the fillet to a condition that exceeds the sand retention capacity of the jetty, eventually causing the nourishment material to increase the shoaling at East Rockaway Inlet. GENESIS predicted the shoreline position where significant bypassing would be initiated (indicating the time period when shoaling would potentially increase due to the nourishment project), and also predicted the net sand transport rates bypassing the jetty, providing estimates of contributions to inlet shoaling.

252a. Use of a taper extending into the private beaches westward is needed to cost effectively protect an erosive zone at the western limit of the public beaches. The model GENESIS predicts an erosive zone beginning at the western end of the City of Long Beach and extending into East Atlantic Beach (also a public beach) so that if the transition taper was located east of where it is designed, additional periodic nourishment would be required to maintain the design section. The termination of fill via the recommended taper provides necessary protection to the entire public beach area. The full design beach profile covers the total length of the public area, and minimizes the periodic nourishment needs. Additionally, the taper design creates no negative downdrift impacts, which would been likely with alternative terminations such as a terminal groin. In the event of downdrift impacts with alternative closures, additional project costs would be incurred as well as a reduction in project benefits. The annualized cost of the taper vs. a terminal groin is $130,000 vs. $210,000. Acquiring private beaches is prohibitive both politically and economically. Therefore, the proposed plan provides the most cost effective closure at the western end of the project, while at the same time allowing for the passing of littoral material to downdrift areas.

252b. The relatively steep design taper angle was chosen to minimize the length of the taper and the volume of beach fill, while still in the acceptable range for performance as a beach fill closure. A coastal expert from Headquarters agreed that the proposed taper angle is relatively steep. A steeper taper would likely result in increased erosion and the need for additional fill material during periodic nourishment. The amount of taper material to be placed in the 2000 foot long section to assure proper toe and beach berm transition is relatively small. The design taper requires approximately 200,000 cu.yd. of sand (approximately 2.3 percent of the initial beach fill amount), and the existing beach berm elevation is approximately 8-9 feet NGVD. A majority of this material will be placed at or below the high water line, with only about 50,000 cu.yd. of sand fill placed upland on the beach. This amount is less than the 1 percent of the initial beach fill amount and is clearly incidental to the overall project.

252c. The beach fill taper on the private beach does not have full cross section and will provide very limited if any, additional storm damage protection to private property. However, this incidental taper section is required for the project on public property to function properly. In accordance with paragraph 4-15(d) of ER 1105-2-100, dated 28 December 1990, and paragraph 6.h. of ER 1165-2-130, dated 15 June 1989, private property can be included "if such protection and restoration is incidental to the protection of publicly owned shores or if such protection would result in public benefits". The ER recognizes "private property", and in view of the circumstances involved in this project, the ER does not require public access to the incidental fill (taper) area that is located on private property.

(REVISED APRIL 1996)

A257. From the GENESIS analysis of a design layout which was the 110 ft. berm and +15 ft elevation dune, with the same section in Atlantic Beach, the model simulation showed that the jetty will impound material to equilibrium five years after project construction, and then have a net transport rate of approximately 78,500 to 130,800 cubic yards/year. These values are based on average wave years; extreme wave years would lead to values outside this range. These values need to be compared to the simulation values for the without project condition. GENESIS simulation value for net sand transport rate at East Rockaway Inlet under the without project condition is 36,600 cubic yards/year compared with 79,000 cy/yr from the sediment budget. The GENESIS values are lower than the predicted sediment budget values, however the comparison of the differences from the GENESIS results without and without the project are useful for prediction of project related increases.

A258. The recommended plan of improvement for this project does not include improvement at Atlantic Beach. Therefore, additional area will be available for impoundment along the Atlantic Beach shoreline. It can be expected that equilibrium would be achieved later in the project life than year five. GENESIS simulation results from the original design plans (which did not include fill at Atlantic Beach) show that the jetty will still be impounding at project year 10.

A259. To assess the impacts on the East Rockaway Inlet channel, the following scenario will be used. After year 10 of the project, impoundment of the jetty will reach its maximum, and increased bypassing will begin. Due to the possible growth of the inlet shoal, direct impact to the navigation channel is not expected immediately after the maximum jetty impoundment. This scenario predicts that it will take three years for the bypassed material to impact channel dredging rates. The range of increases to net sand transport is predicted to be 42,000 to 94,000 cubic yards/year. The average value of this range is 68,000 cy/yr, which will be used as the potential increase in shoaling at East Rockaway Inlet each year due to the Long Beach nourishment project. The cost of additional channel dredging is included as a project cost.

A260. Coordination with Jones Inlet Dredging. As mentioned previously, a Section 933 project was completed at Jones Inlet in March 1994 (Reference A28). The dredged material from the channel (approximately 720,000 cubic yards) was placed on the Town of Hempstead beach and eastern Lido Beach. This operation is anticipated to continue under the Section 933 authority whenever channel dredging is required in Jones Inlet in the with-out project future condition for the Long Beach project area. When the recommended plan is constructed, it is expected that the least costly disposal option for the dredged material will be chosen (i.e. offshore). If suitable inlet material is placed on the shoreline with the Long Beach project in place, future nourishment costs may be reduced. It is estimated that the use of inlet material may save approximately $ 25,000,000 in future nourishment costs over the life of the project, if historical rates of inlet dredging continue. Since this material is tied into the navigation of the inlet, and dredging quantities cannot be accurately anticipated, the material cannot be counted on as nourishment material and was not included in the development of the total project cost. Volumes of material necessary from the recommended borrow area for nourishment quantities were not reduced.

A261. Major Rehabilitation Plans. Major rehabilitation quantities were developed to identify additional costs to the project due to erosion losses from higher intensity storm events (see paragraphs C12 and Tables C4 through C9). Up to approximately 40% of those losses are considered permanent, and additional material would have to be placed in the project area to regain all of the design cross-section and insure the level of protection. The major rehabilitation fill volumes and costs are developed in Appendix C. The results of the storm-induced erosion model, SBEACH (Reference A20), were used to develop the required major rehabilitation volumes for the range of larger intensity storms.

A262. Monitoring Program. Pre-construction monitoring will consist of a survey of beach profile lines, sediment sampling of the beach and borrow areas, aerial photography of the project area and biological samples collected along the beach and borrow area. Post-construction monitoring will duplicate the preconstruction efforts, plus add the deployment of a directional wave gage with subsequent littoral climate measurement. Post-construction field work will be followed by lab and data analysis and summarized in reports. The proposed monitoring program will begin at the initiation of pre-construction efforts and continue for five years. The monitoring program is further described in Appendix H.

A263. Operation, Maintenance, Replacement, Repair and Rehabilitation (OMRR&R Manual). In accordance with ER1110-2-1407, ER1110-2-2902, Policy Guidance Letter #9, and Policy Guidance Letter #27 an OMRR&R Manual shall be prepared in conjunction with the PCA which outlines non-federal responsibilities after project construction for the economic life of the project. The non-federal sponsor must operate, maintain, repair, replace and rehabilitate the completed project. In general, the non-federal responsibilities are described in the following paragraphs. Specific responsibilities for the Long Beach project will be finalized during the PCA process.

A264. OMRR&R For Hardened Structures. As per Policy Guidance Letter #27, under current policy, for projects constructed since passage of WRDA 86, the non-Federal sponsor is responsible for all activities related to the OMRR&R of hardened structures. This includes features such as groins, terminal groins, and other stone structures which may be included in beachfill projects.

A265. <u>OMRR&R For Beachfill and Dunes.</u> As per Policy Guidance Letter #27, non-federal operations responsibilities include continuing oversight activities to assure that the beach design section provides storm damage reduction and promotes and encourages safe and healthful public enjoyment of the recreational opportunities provided by the beach fill. Operation activities would include protection of dunes, prevention of encroachments, monitoring of beach design section conditions, provision of lifeguards and beach patrols, and trash collection. Maintenance activities for non-federal sponsors include preservation of the design section. This can be achieved through a combination of the following:

(1) Grading and reshaping the beach and dune using sand within the project design section.
(2) Maintenance of dune vegetation, sand fencing and dune cross-overs.

The following activities, if undertaken by non-federal parties, may be classifed as continuing project construction and may be shared as periodic nourishment under the terms of the PCA:

(3) Placement of additional sand fill to restore an advanced nourishment berm.
(4) Placement of additional sand fill on the project to restore the design section.

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Design Data

Eastern 3 Groins (A, B & C)

Armor Stone Weight (Wr) = 170 lb./c.f.
Specific Gravity of Stone (Sr) = 2.65
Structure Side Slopes (cot θ) = 1.5
Stability Coefficient (KD)
Head = 1.9
Trunk = 2.0

From SPM (1984) for rough angular stone, breaking wave condition

Wave Heights (Breaking) (H)
Head Section & Outer Trunk Section = 10.9 ft.
Inshore End of Trunk (w/crest el. +3.5 NGVD) = 9.6 ft.
Inshore Section = 11 ft.

Compute Stone Weights
Armor Stone Weight

$$Wt = \frac{Wr*H^3}{KD*(Sr-1)^3*\cot\theta}$$

Head Section: $Wt = \frac{(170)(10.9)^3}{1.9*(2.65-1)^3*1.5}$ = 17,000 lbs. or say 9 Tons

Outer Trunk: $Wt = \frac{(170)(10.9)^3}{2*(2.65-1)^3*1.5}$ = 16,100 lbs. or say 8 Tons

Inner Trunk: $Wt = \frac{(170)(9.6)^3}{2*(2.65-1)^3*1.5}$ = 11,100 lbs. or say 6 Tons

Inshore Section: $Wt = \frac{(170)(11)^3}{2*(2.65-1)^3*1.5}$ = 16,600 lbs. or say 8 Tons

Underlayer Weight = Wt/10
or 1200 lbs. to 1600 lbs.

Bedding Layer - Use quarry run

Compute Structure Dimensions
Crest Width

$$B = n*k*(Wt/Wr)^{1/3}$$

Where B = crest width
n = no. of stones, = 3 (recommended in SPM)
k = layer coefficient = 1
(Table 7-13 SPM)

Head Section/Outer Trunk, B = 14 ft.
Inner Trunk, B = 13 ft.
Inshore Section, B = 14 ft.

Layer Thickness

$$r = n*k*(Wt/Wr)^{1/3}$$

Where r = layer thickness
n = no. of stones/layer = 2 (recommended in SPM)
k = layer coefficient = 1
(Table 7-13 SPM)

	Armor	Underlayer
Outer Trunk, r =	9.1 ft.	4.2 ft.
Inner Trunk, r =	8.2 ft.	3.8 ft.
Inshore Section, r =	9.1 ft.	4.2 ft.

CALCULATION A-1

Design Data

Western 3 Groins (D, E & F)

Armor Stone Weight (Wr) = 170 lb./c.f.
Specific Gravity of Stone (Sr) = 2.65
Structure Side Slopes (cot θ) = 1.5
Stability Coefficient (KD)
Head = 1.9
Trunk = 2.0

From SPM (1984) for rough angular stone, breaking wave condition

Wave Heights (Breaking) (H)
Head Section & Outer Trunk Section = 10.9 ft.
Inshore End of Trunk (w/crest el. +3.5 NGVD) = 9.9 ft.
Inshore Section = 9.9 ft.

Compute Stone Weights
Armor Stone Weight

$$Wt = \frac{Wr*H^3}{KD*(Sr-1)^3*\cot\theta}$$

Head Section: $Wt = \frac{(170)(10.9)^3}{1.9*(2.65-1)^3*1.5}$ = 17,000 lbs. or say 9 Tons

Outer Trunk: $Wt = \frac{(170)(10.9)^3}{2*(2.65-1)^3*1.5}$ = 16,100 lbs. or say 8 Tons

Inner Trunk: $Wt = \frac{(170)(9.9)^3}{2*(2.65-1)^3*1.5}$ = 12,100 lbs. or say 6 Tons

Inshore Section: $Wt = \frac{(170)(9.9)^3}{2*(2.65-1)^3*1.5}$ = 12,100 lbs. or say 6 Tons

Underlayer Weight = Wt/10
or 1200 lbs. to 1600 lbs.

Bedding Layer - Use quarry run

Compute Structure Dimensions
Crest Width

$$B = n*k*(Wt/Wr)^{1/3}$$

Where B = crest width
n = no. of stones, = 3 (recommended in SPM)
k = layer coefficient = 1
(Table 7-13 SPM)

Head Section/Outer Trunk, B = 14 ft.
Inner Trunk, B = 13 ft.
Inshore Section, B = 13 ft.

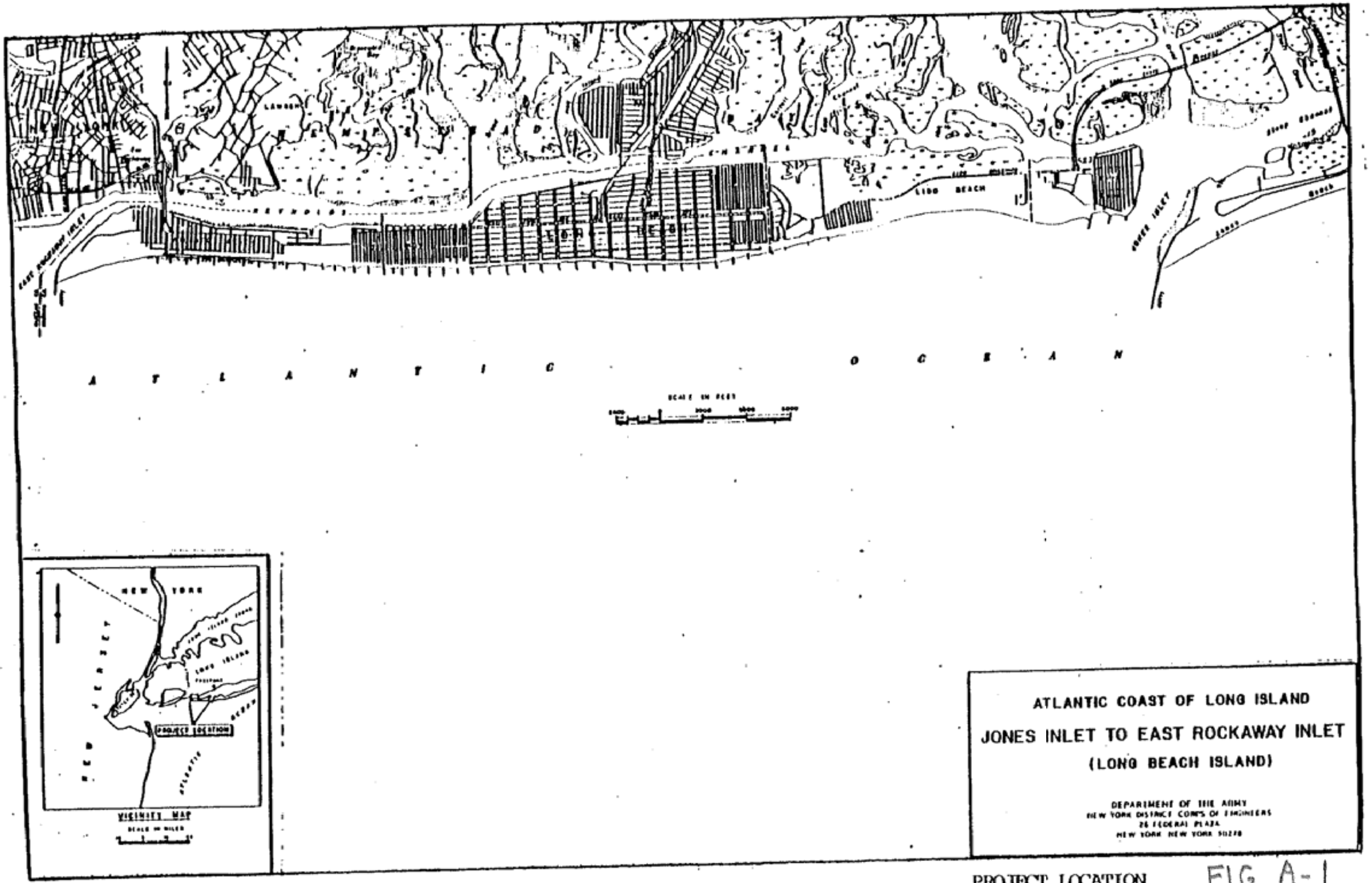
Layer Thickness

$$r = n*k*(Wt/Wr)^{1/3}$$

Where r = layer thickness
n = no. of stones/layer = 2 (recommended in SPM)
k = layer coefficient = 1
(Table 7-13 SPM)

	Armor	Underlayer
Outer Trunk, r =	9.1 ft.	4.2 ft.
Inner Trunk, r =	8.2 ft.	3.8 ft.
Inshore Section, r =	8.2 ft.	3.8 ft.

CALCULATION A-2



PROJECT LOCATION FIG A-1

FIGURE A1

FIG. A-2

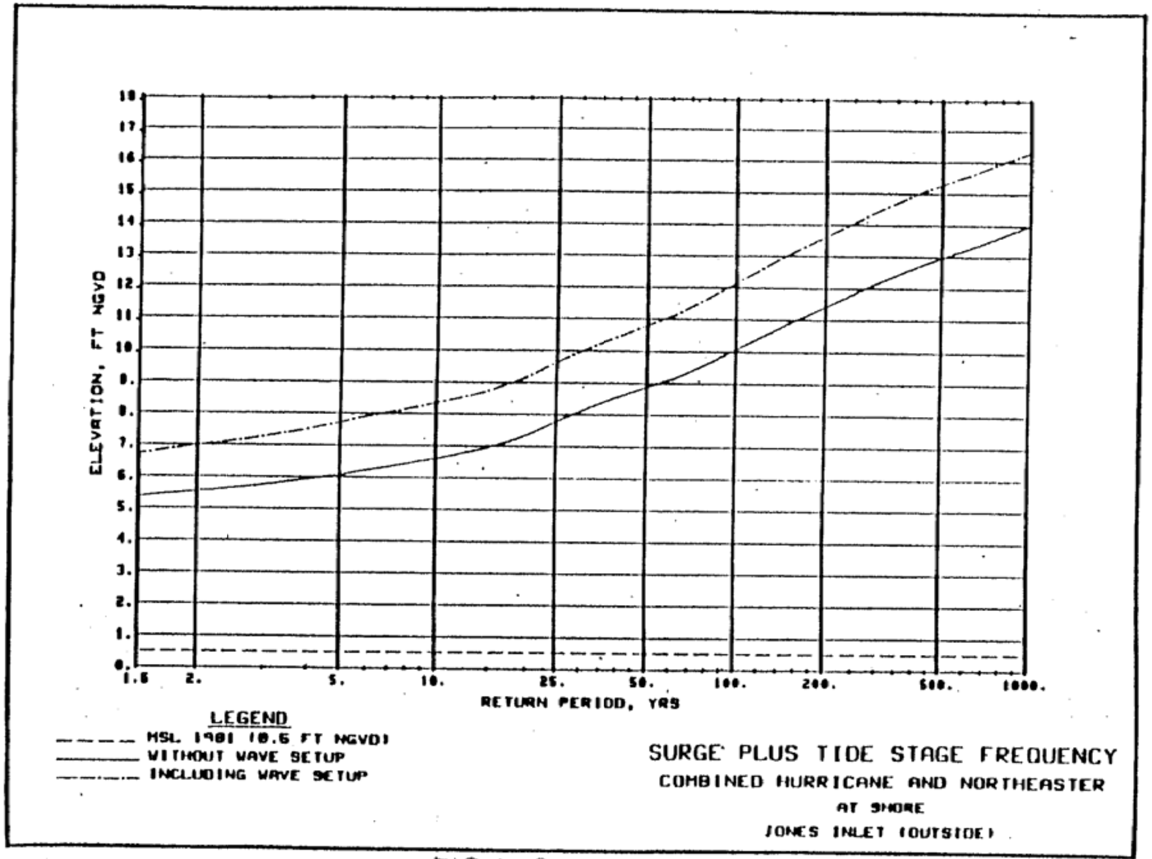


FIG A-2

OCEAN STAGE-FREQUENCY CURVE

FIGURE A2

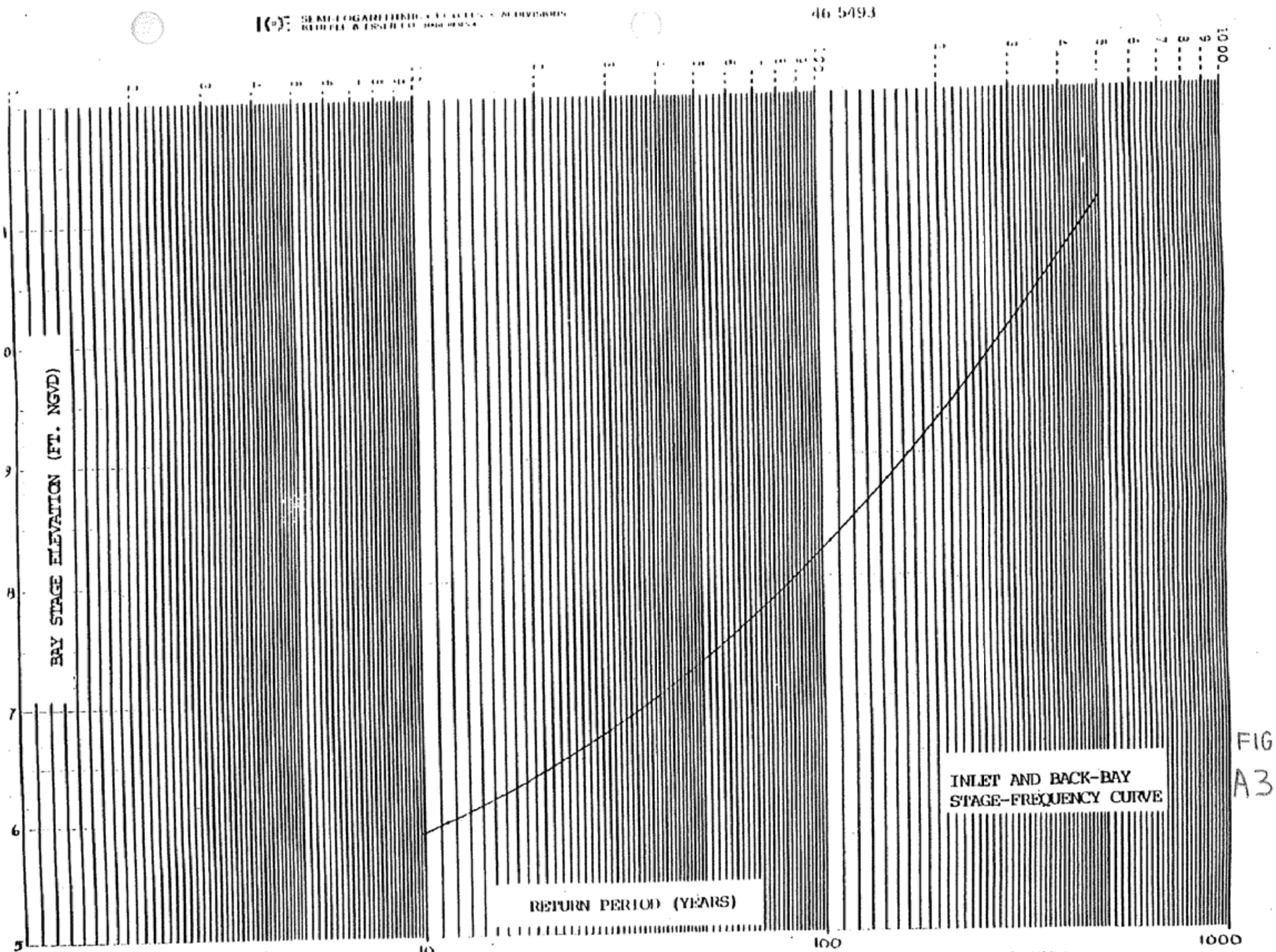
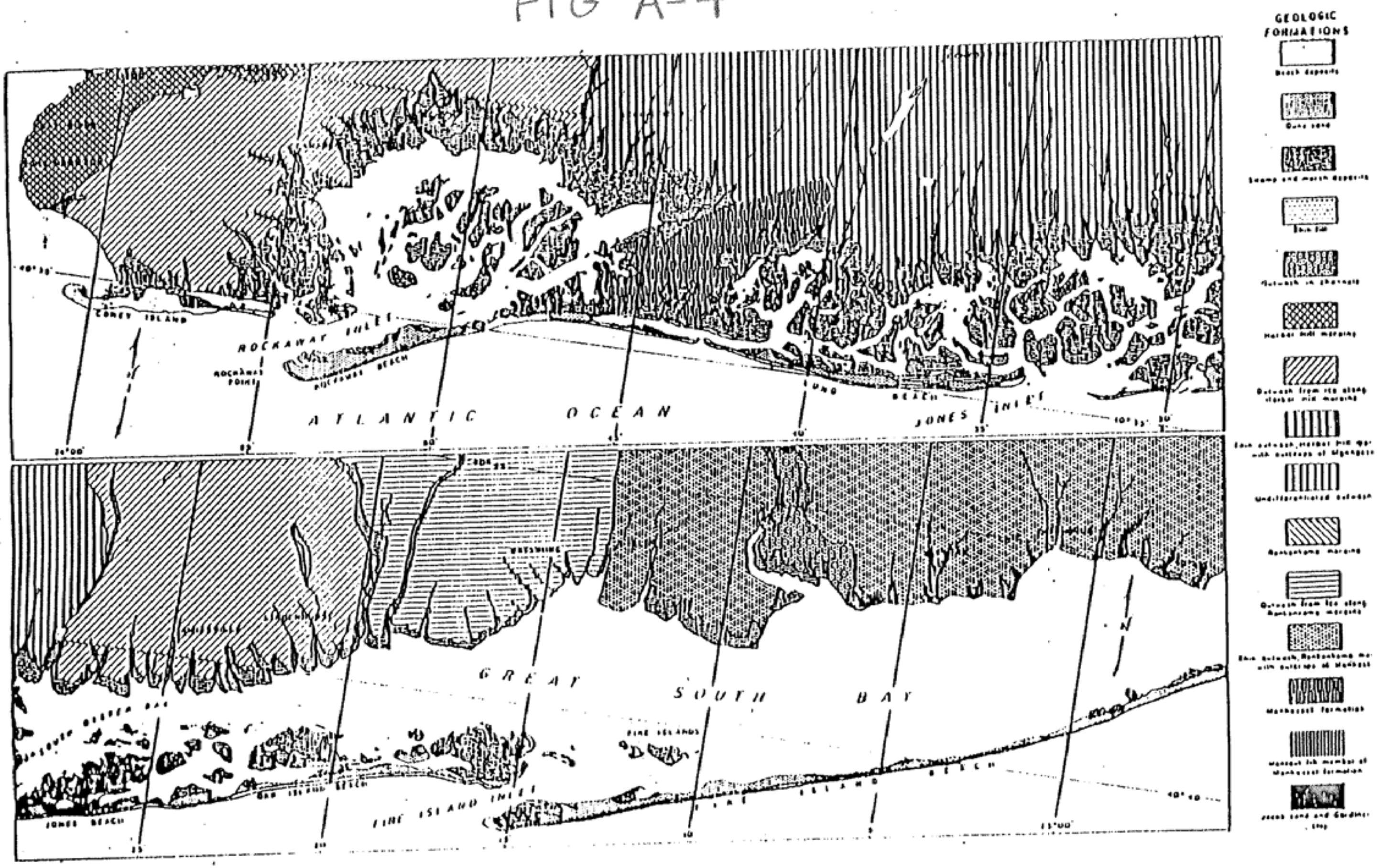

46 5493
INLET AND BACK-BAY
STAGE-FREQUENCY CURVE
BAY STAGE ELEVATION (FT. NGVD)
RETURN PERIOD (YEARS)
5
6
7
8
9
0
1
10
100
1000
FIG
A3

FIGURE A3

FIG A-4



GEOLOGIC FORMATIONS

FIGUF

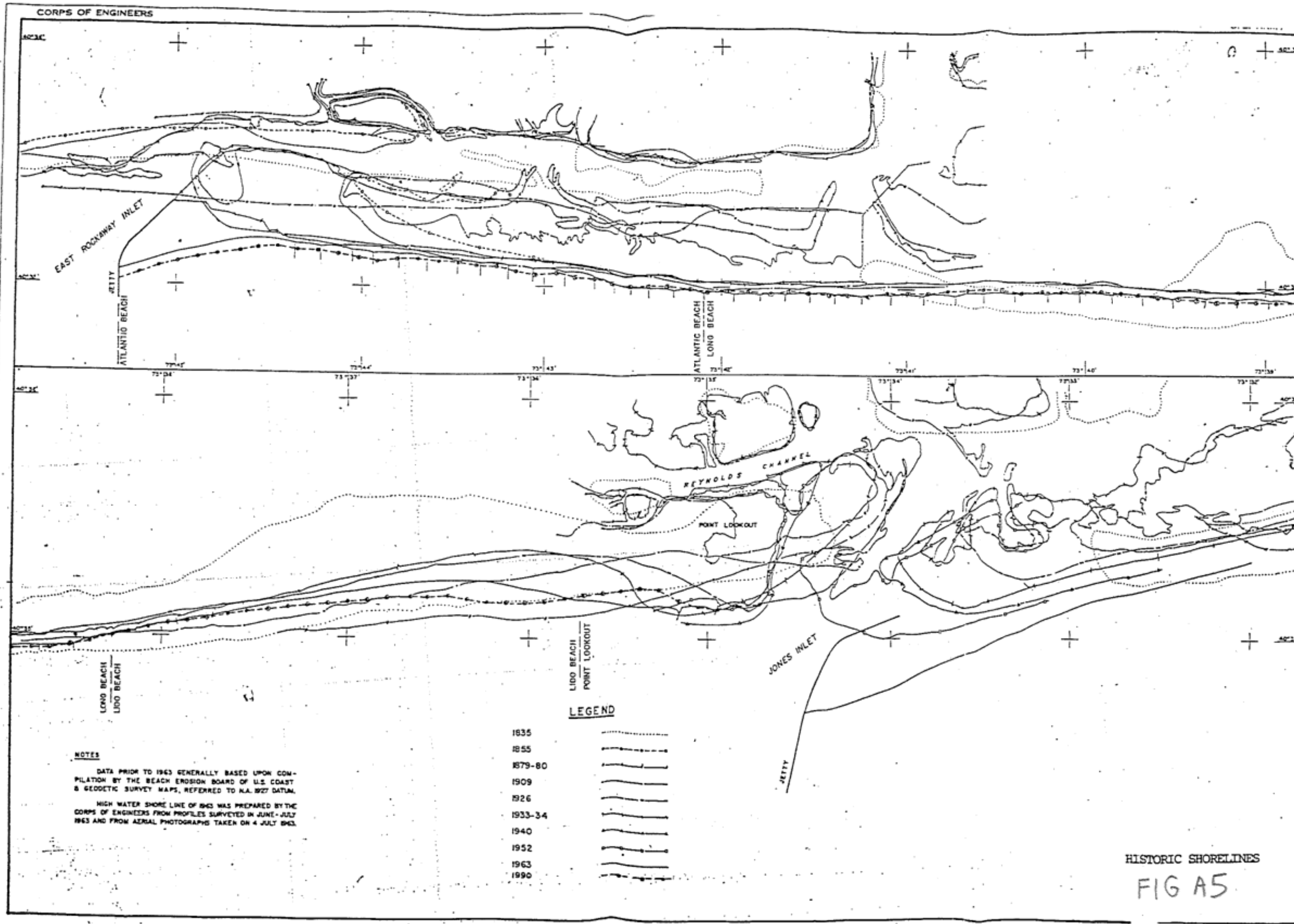

CORPS OF ENGINEERS
EAST ROCKAWAY INLET
JETTY
ATLANTIC BEACH
ATLANTIC BEACH
LONG BEACH
REYNOLDS CHANNEL
POINT LOOKOUT
LONG BEACH
LIDO BEACH
LIDO BEACH
POINT LOOKOUT
JONES INLET
JETTY
LEGEND
1835
1855
1879-80
1909
1926
1933-34
1940
1952
1963
1990
NOTES
DATA PRIOR TO 1963 GENERALLY BASED UPON COMPILATION BY THE BEACH EROSION BOARD OF U.S. COAST & GEODETIC SURVEY MAPS, REFERRED TO N.A. 1927 DATUM.
HIGH WATER SHORE LINE OF 1963 WAS PREPARED BY THE CORPS OF ENGINEERS FROM PROFILES SURVEYED IN JUNE-JULY 1963 AND FROM AERIAL PHOTOGRAPHS TAKEN ON 4 JULY 1963.
HISTORIC SHORELINES
FIG A5

FIGURE A5

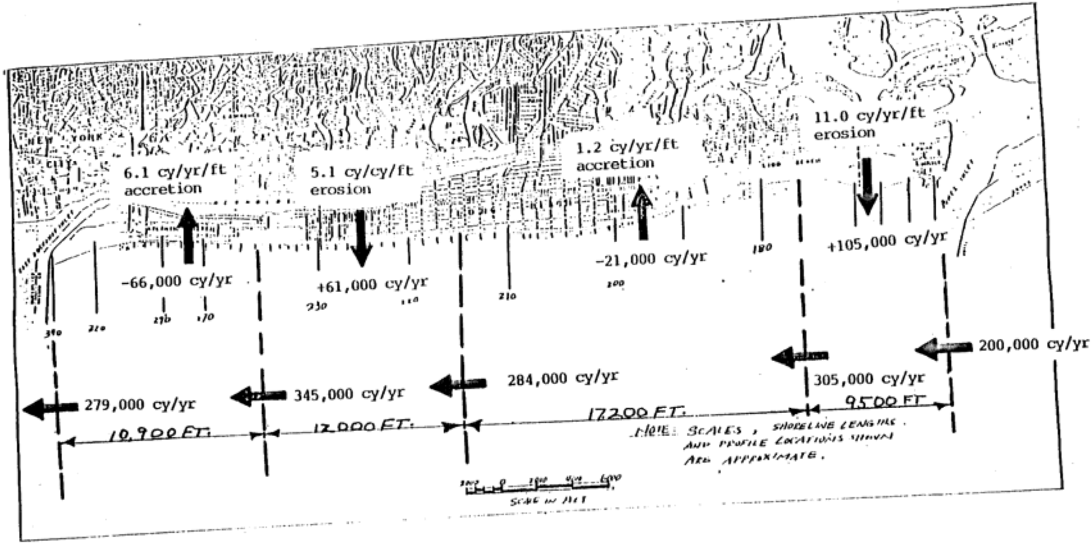


FIG A6

1963-1988 SEDIMENT BUDGET

80,000 cy/yr Overall Shoreline Losses

Note: includes 60,000 cy/yr placed fill

FIGURE A6

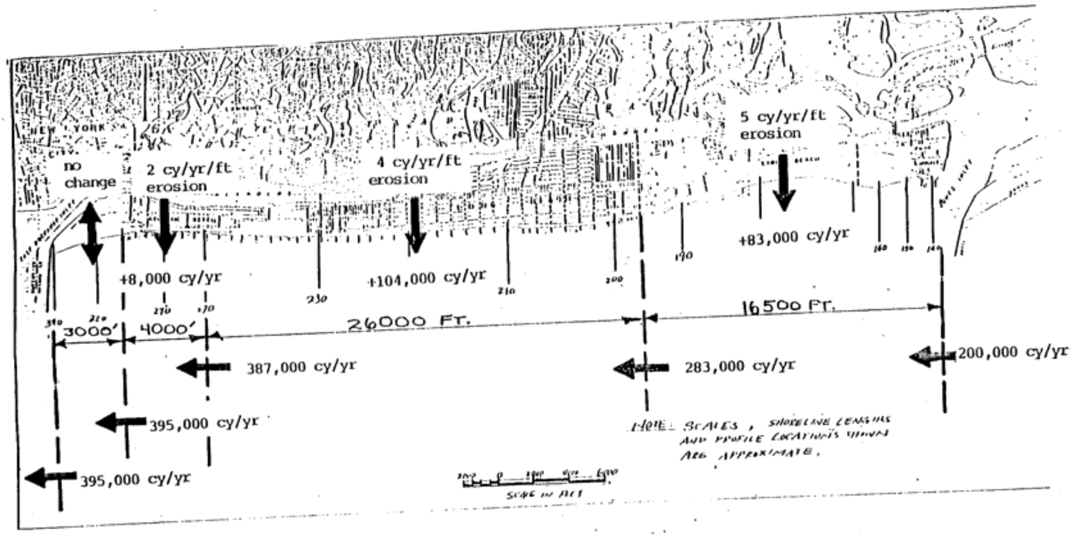
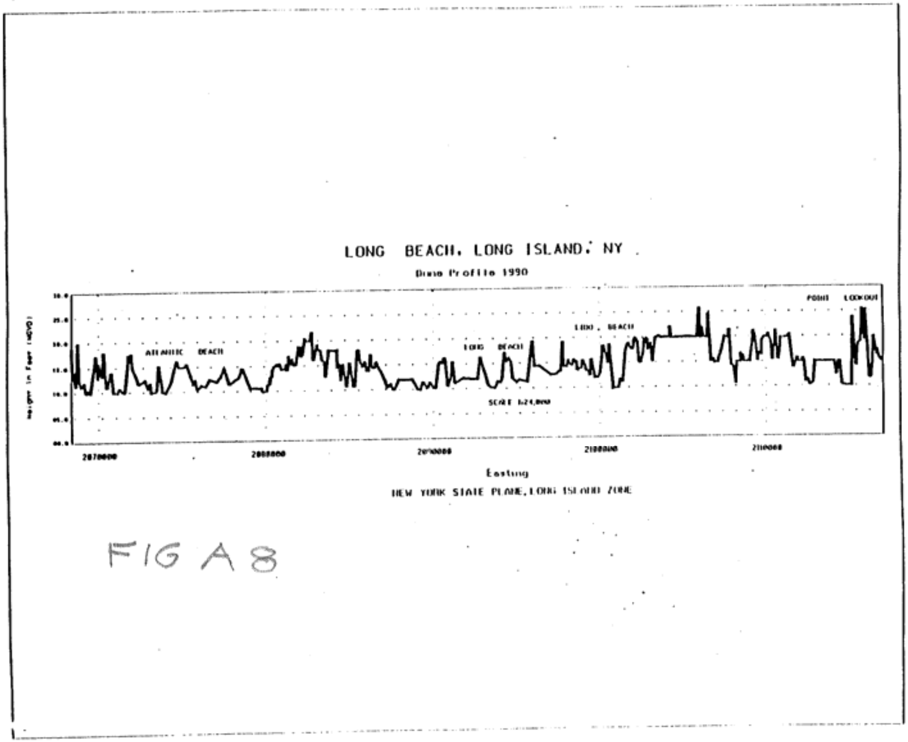


FIG A7

50-YEAR PROJECTED SEDIMENT BUDGET

195,000 cy/yr Overall Shoreline Losses

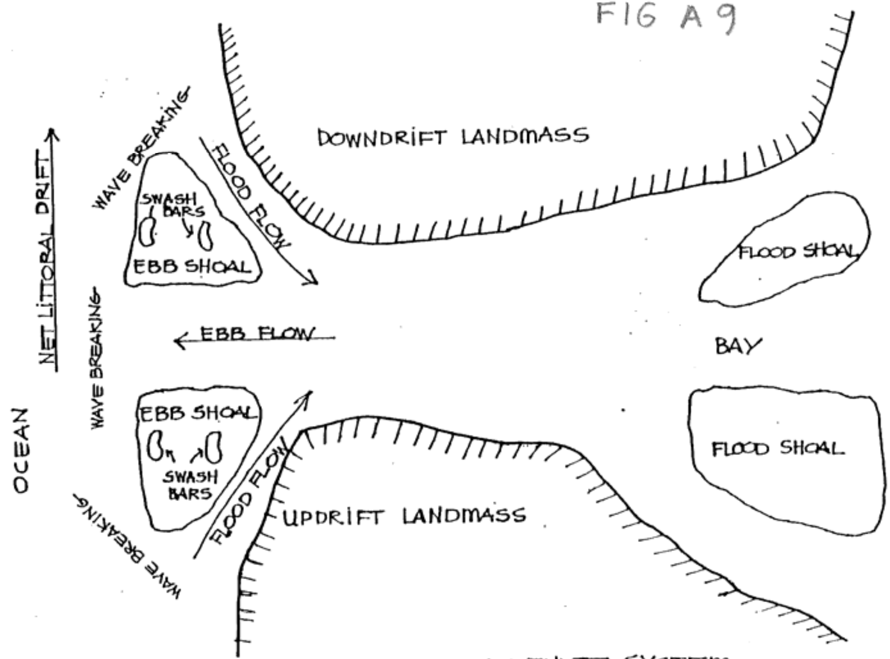
FIGURE A7



CROSS-ISLAND DUNE PROFILE

FIGURE A8

FIG A9



COMPONENTS OF AN INLET SYSTEM

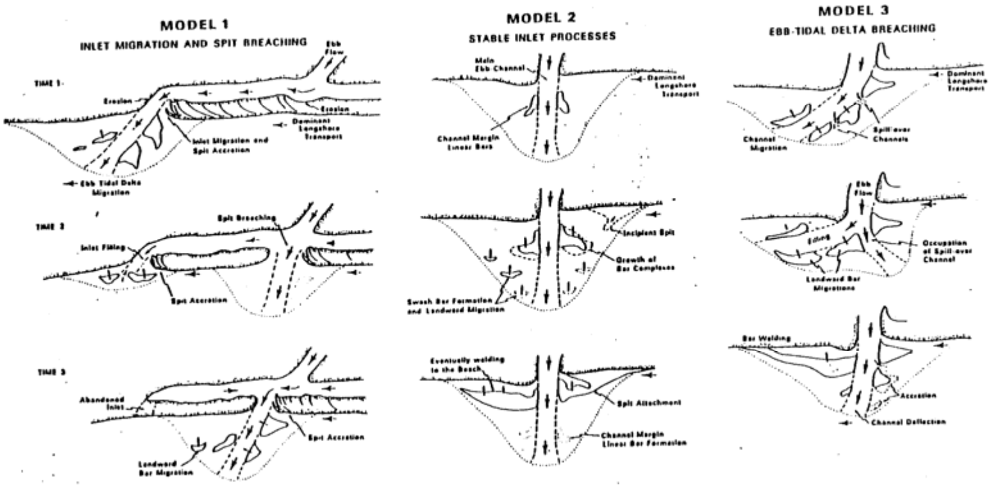
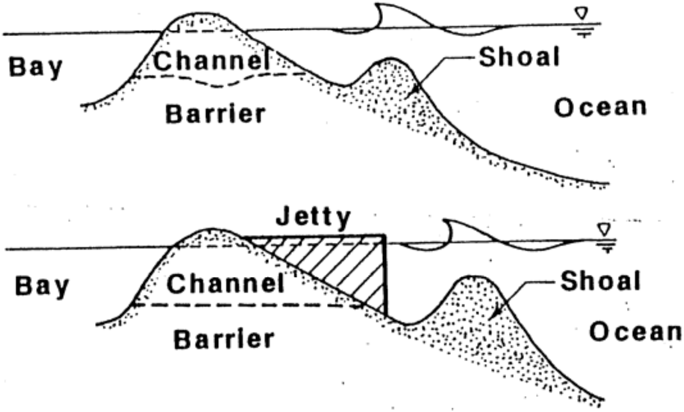


FIG A 10

Sediment Movement Mechanisms within an Inlet System

FIGURE A10

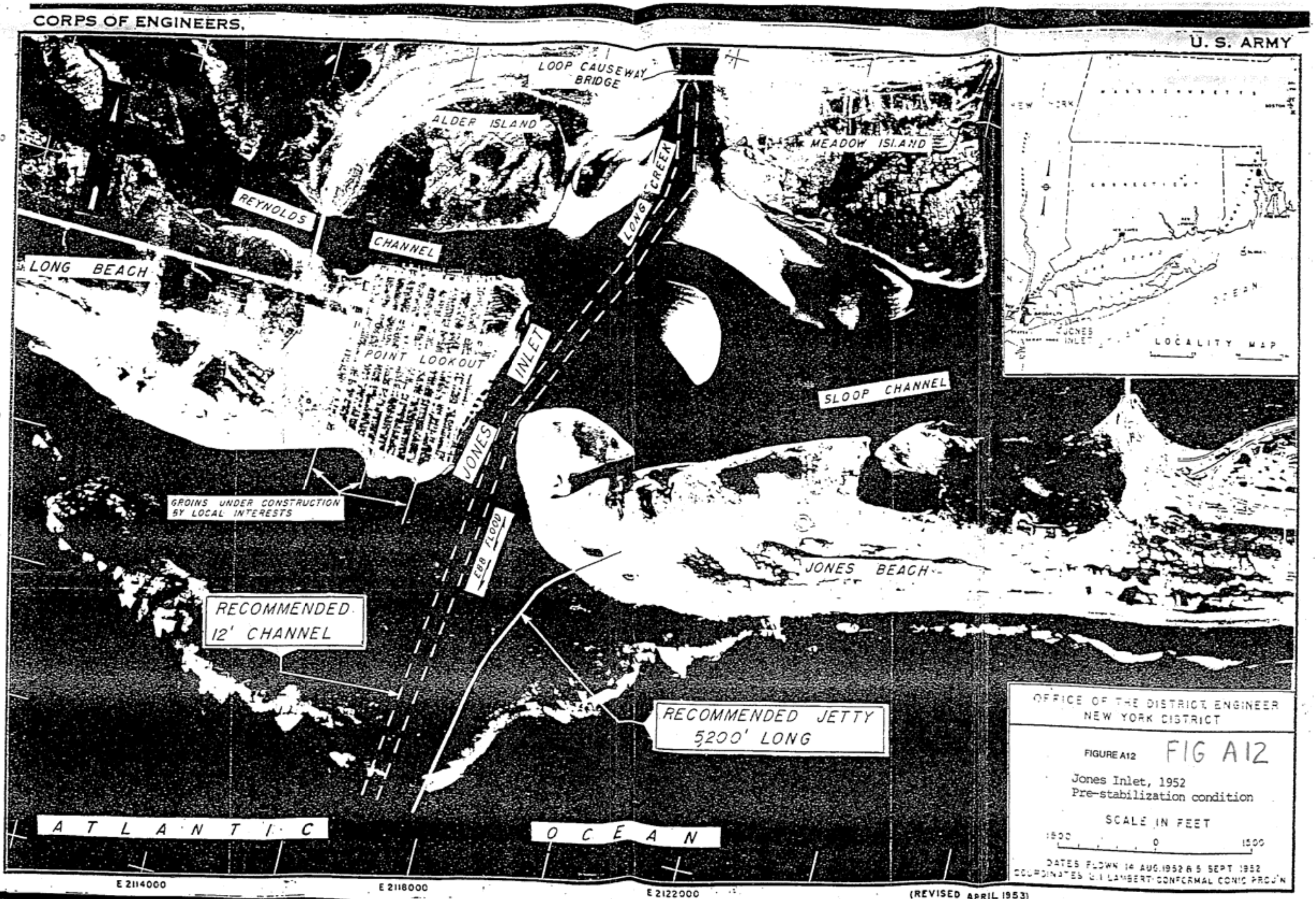
FIG A 11



a) Ebb shoal at an untrained inlet.
b) Ebb shoal at an inlet with jetties.

Seaward Movement of Ebb Shoal Following Jetty Construction

FIGURE A11



OFFICE OF THE DISTRICT ENGINEER
NEW YORK DISTRICT

FIGURE A12 FIG A12

Jones Inlet, 1952
Pre-stabilization condition

SCALE IN FEET

1500 0 1500

DATES FLOWN 14 AUG. 1952 & 5 SEPT. 1952
COORDINATES & LAMBERT CONFORMAL CONIC PROJ'N

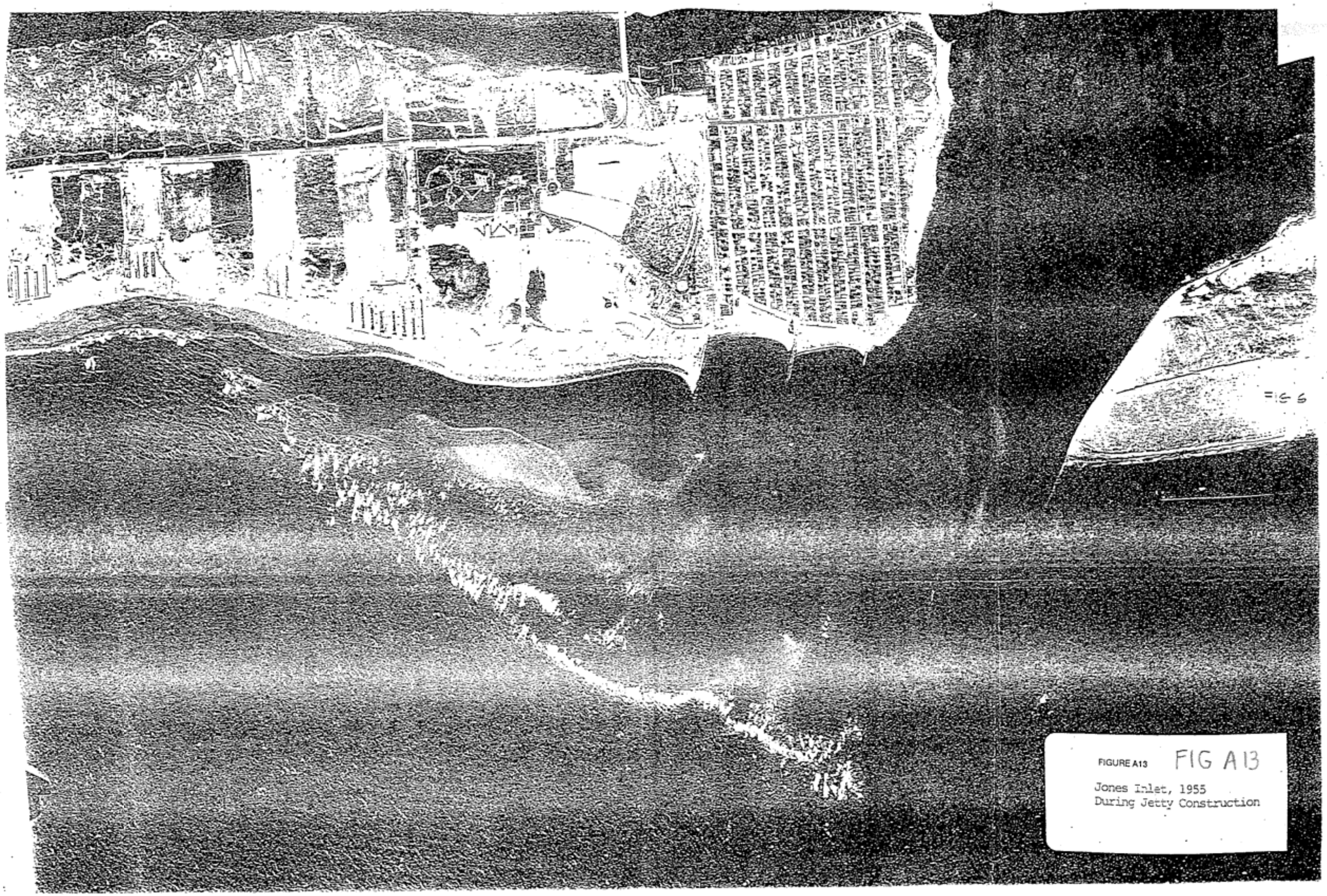


FIGURE A13 FIG A13

Jones Inlet, 1955
During Jetty Construction

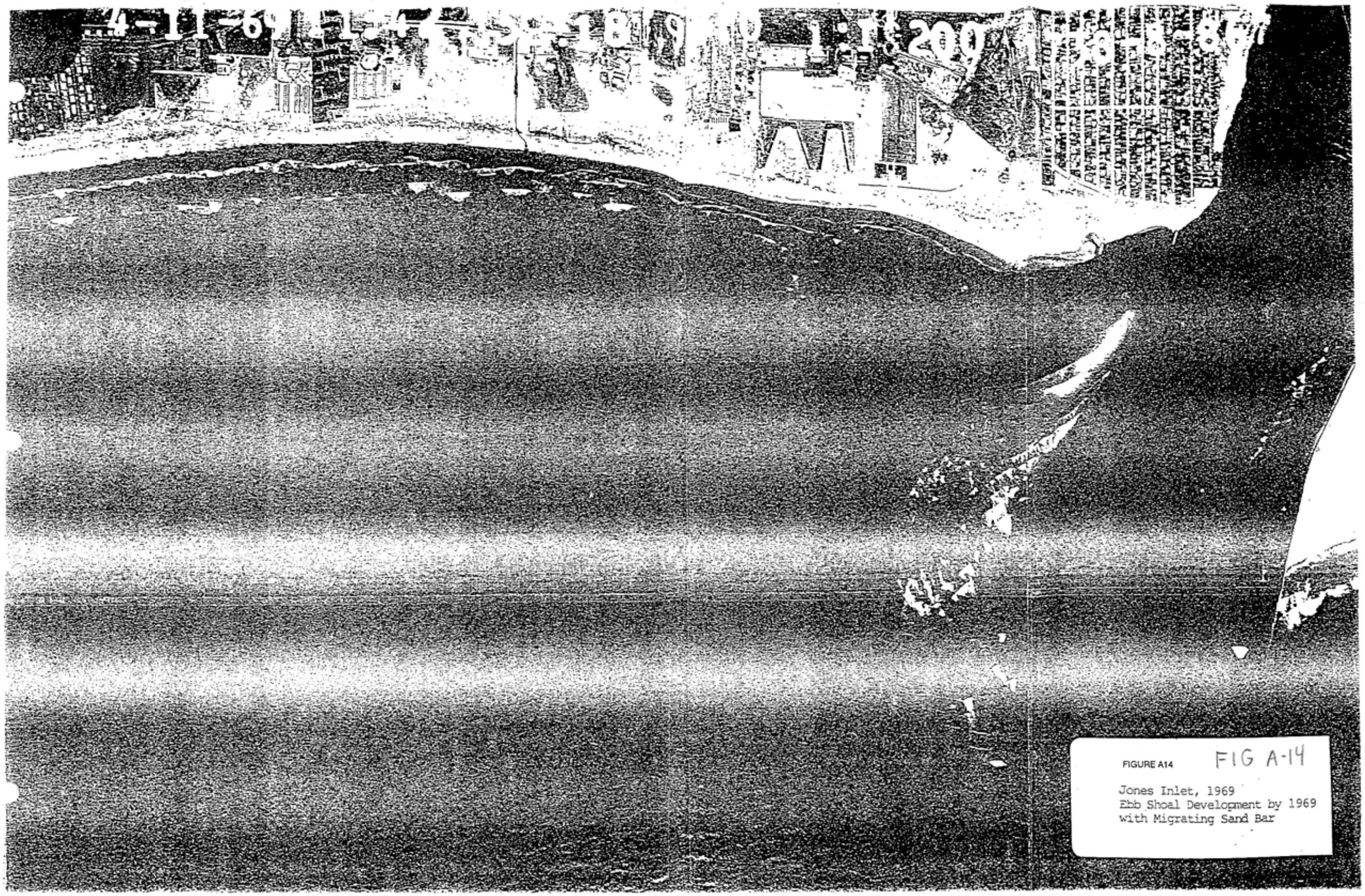
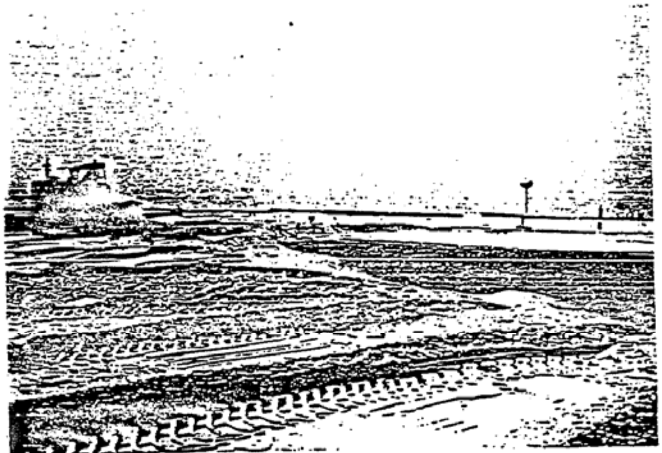


FIGURE A14 FIG A-14

Jones Inlet, 1969
Ebb Shoal Development by 1969
with Migrating Sand Bar

1972 - Bar is Welding to Shoreline



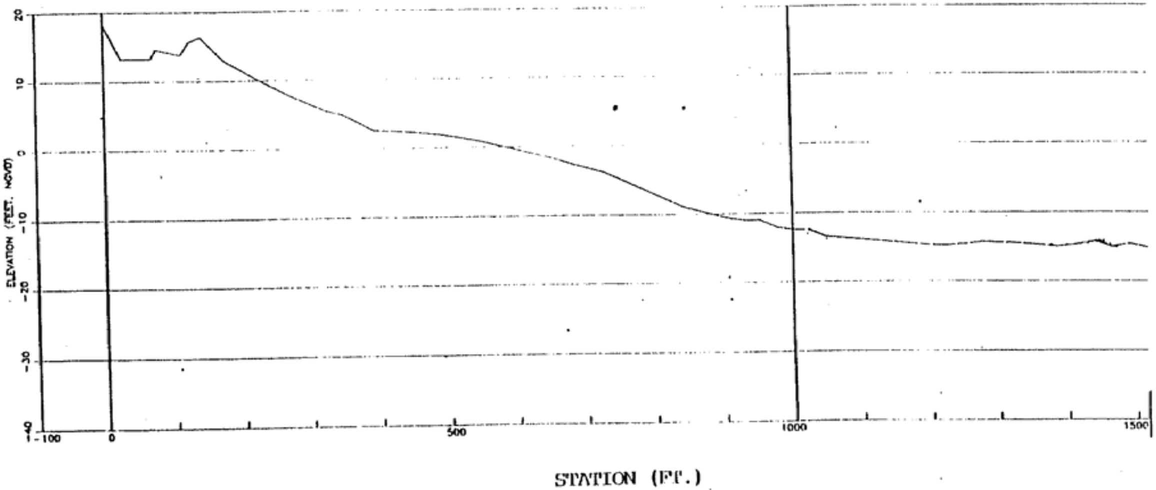
1973 - Bulldozing Fill at the Town
of Hempstead Beach, August 1973

FIG A-15

FIGURE A15

Jones Inlet, 1972 & 1973

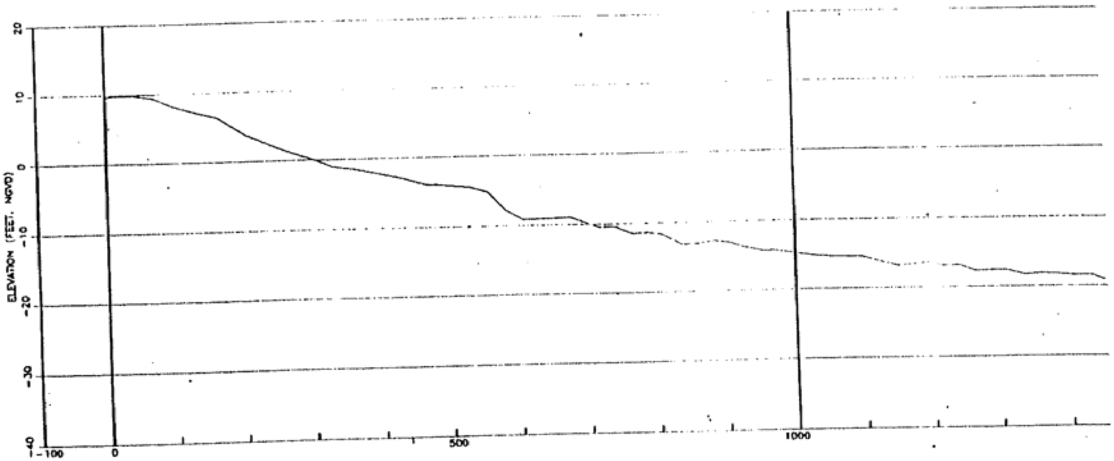
PROFILE LINE 182
SURVEY DATE: NOV. 1991



LONG BEACH, N.Y.
TYPICAL PROFILE 1
FIGURE A16

FIG A16

PROFILE LINE 200
SURVEY DATE: NOV. 1991



STATION (FT.)

LONG BEACH, N.Y.
TYPICAL PROFILE 2

FIGURE A17

FIG A17

PROFILE LINE 238
SURVEY DATE: NOV. 1991

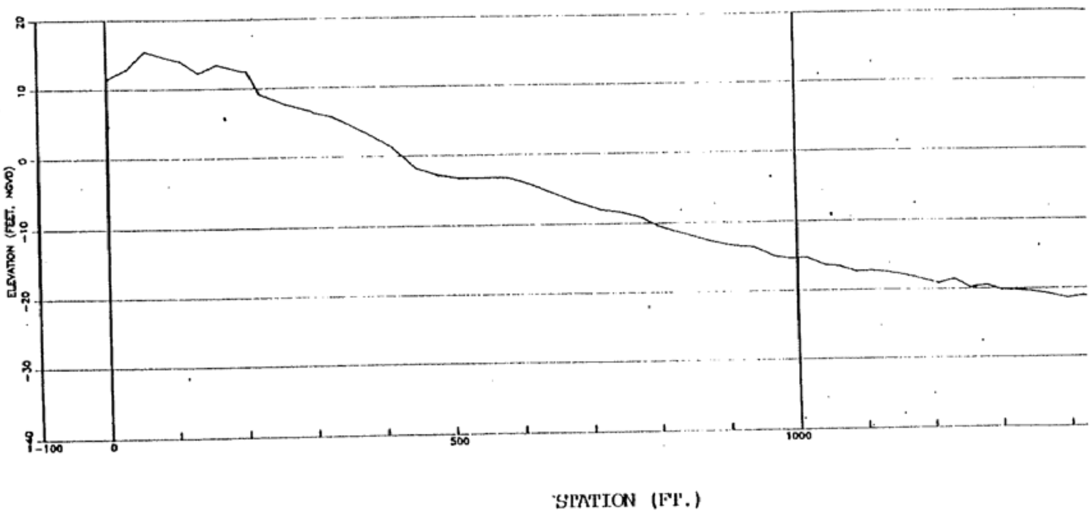
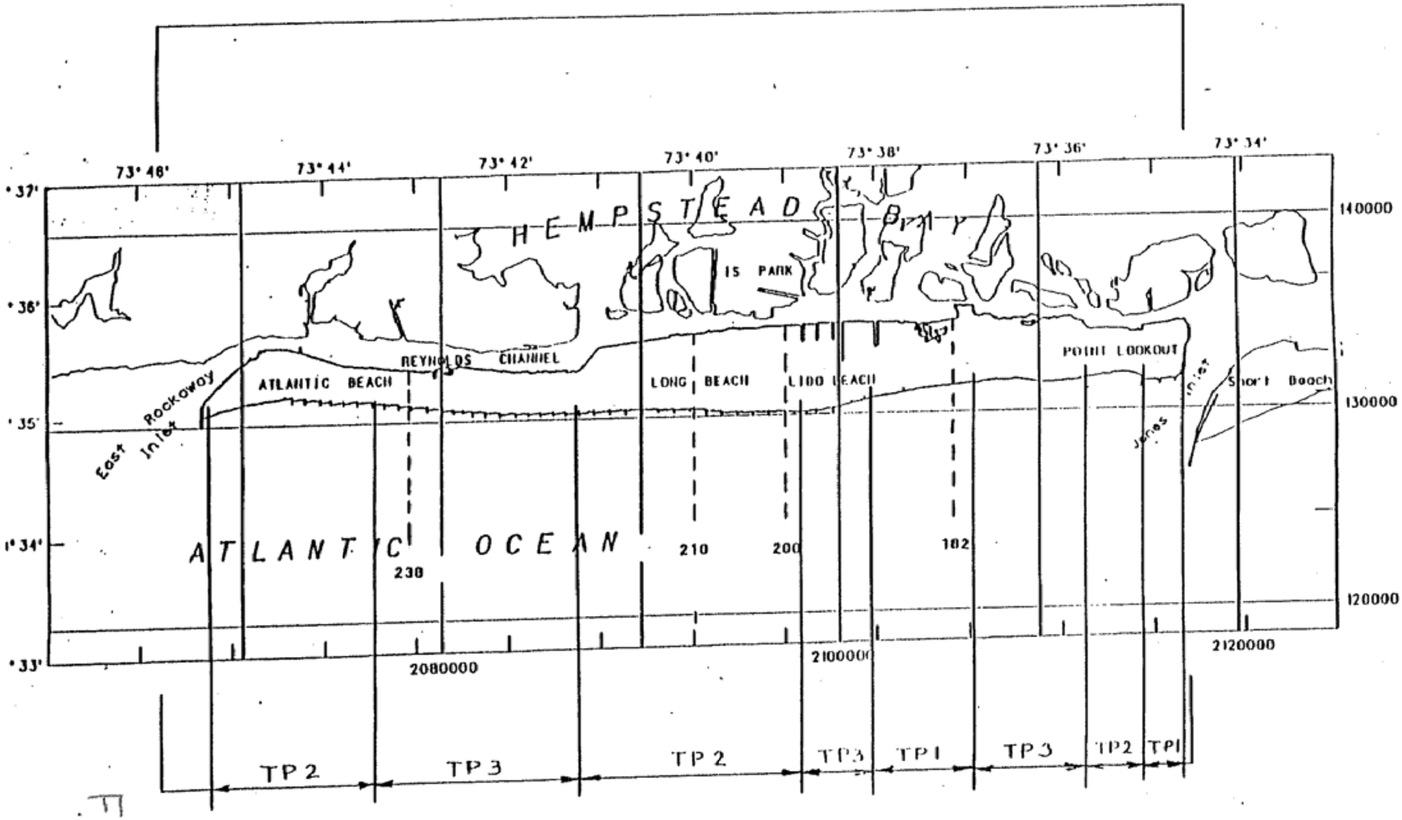


FIG A18

LONG BEACH, N.Y.
TYPICAL PROFILE 3

FIGURE A18



LONG BEACH, N.Y.
SHORELINE REACHES
REPRESENTED BY TYPICAL PROFILES

FIGURE A19

FIG A19

FIG A20

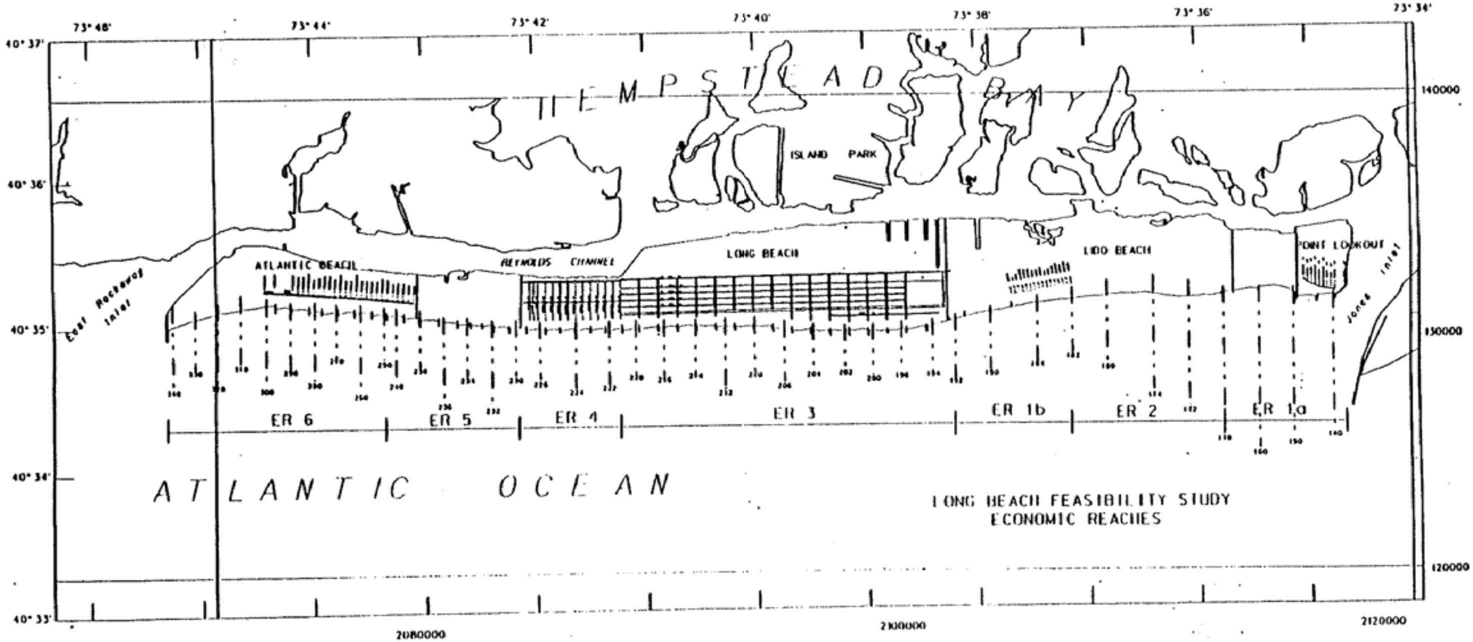
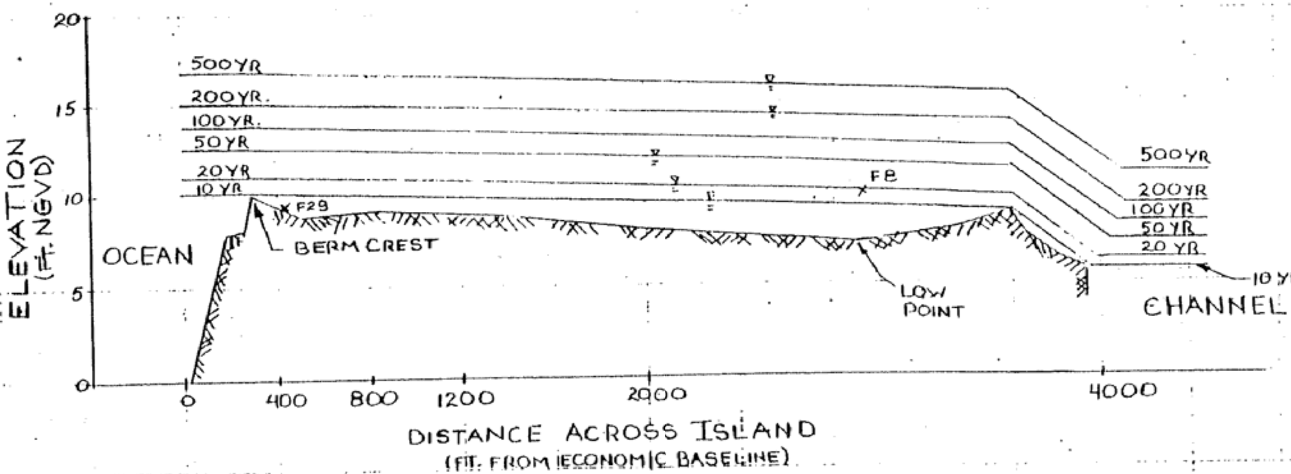


FIG A20

FIGURE A20



FLOOD MARKS
x F8 10.0' NGVD
x F29 9.4' NGVD

PROFILE #210/NATIONAL BLVD.

FIG A21

LONG BEACH
INNUNDATION PROFILES
WITHOUT PROJECT

FIGURE A21

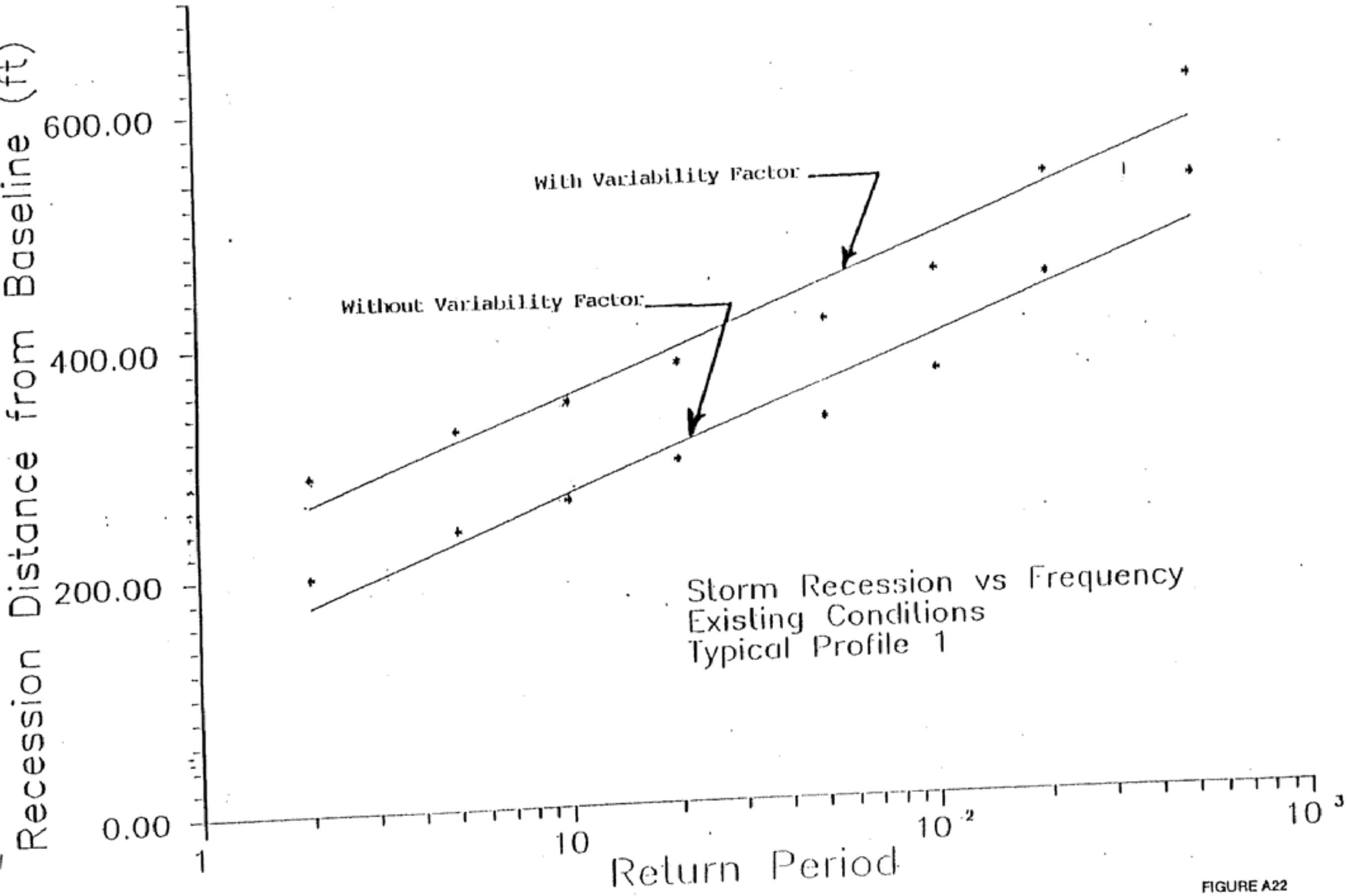


FIG A 22

FIGURE A22

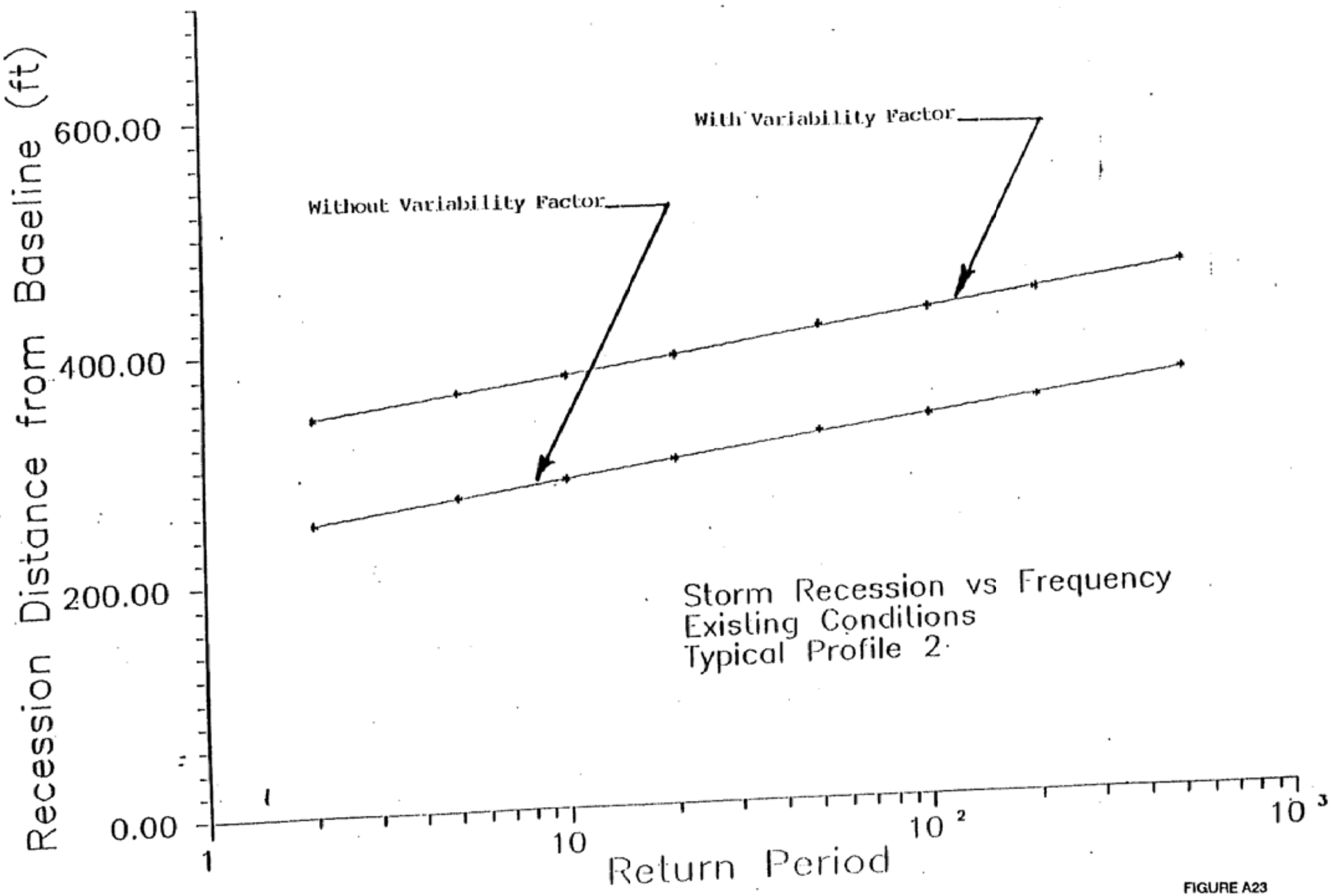
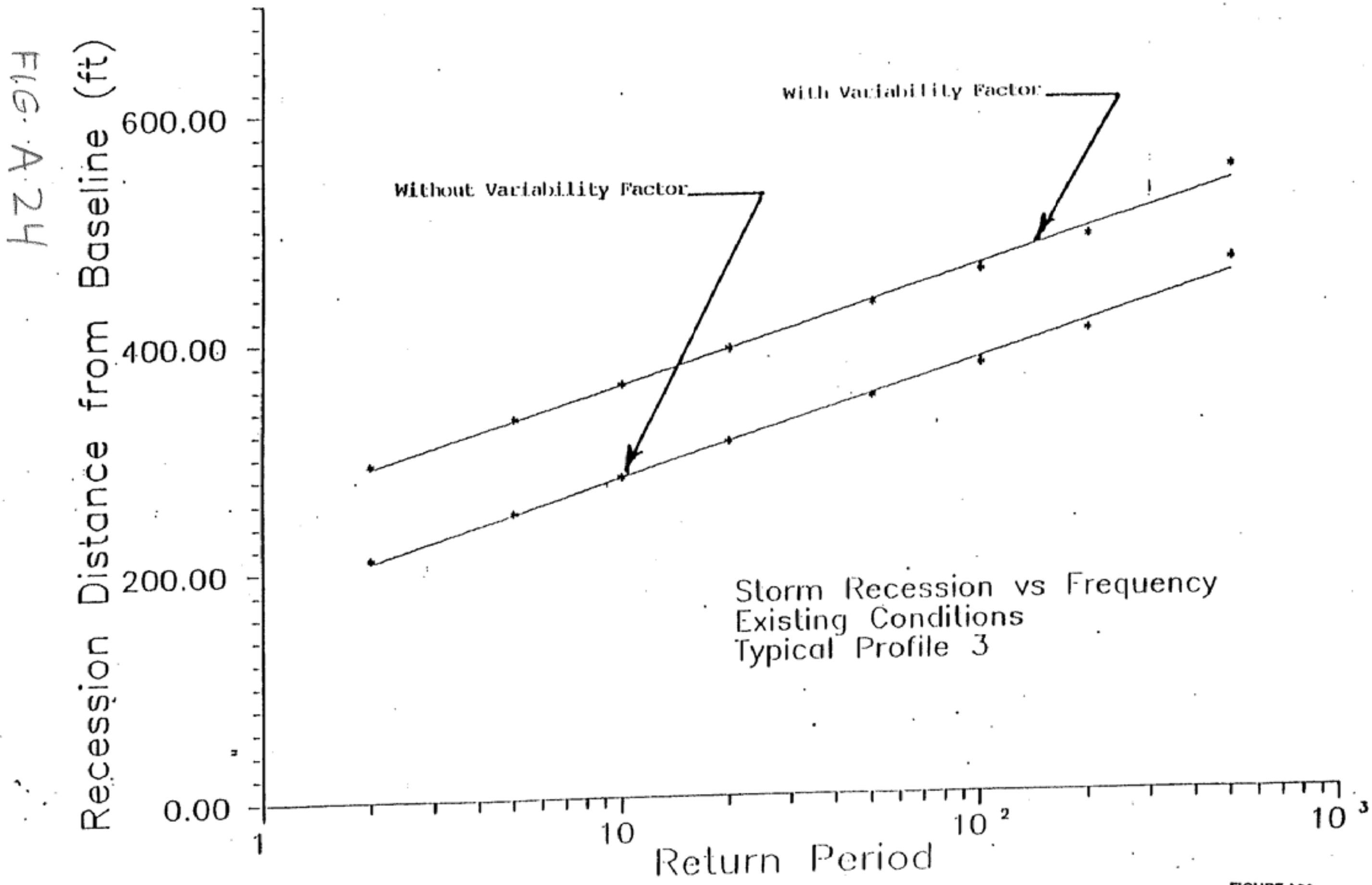


FIG A23

FIGURE A23



Recession Distance from Baseline (ft)
600.00
400.00
200.00
0.00
1
10
10 2
10 3
Return Period
With Variability Factor
Without Variability Factor
Storm Recession vs Frequency
Existing Conditions
Typical Profile 3

FIGURE A24

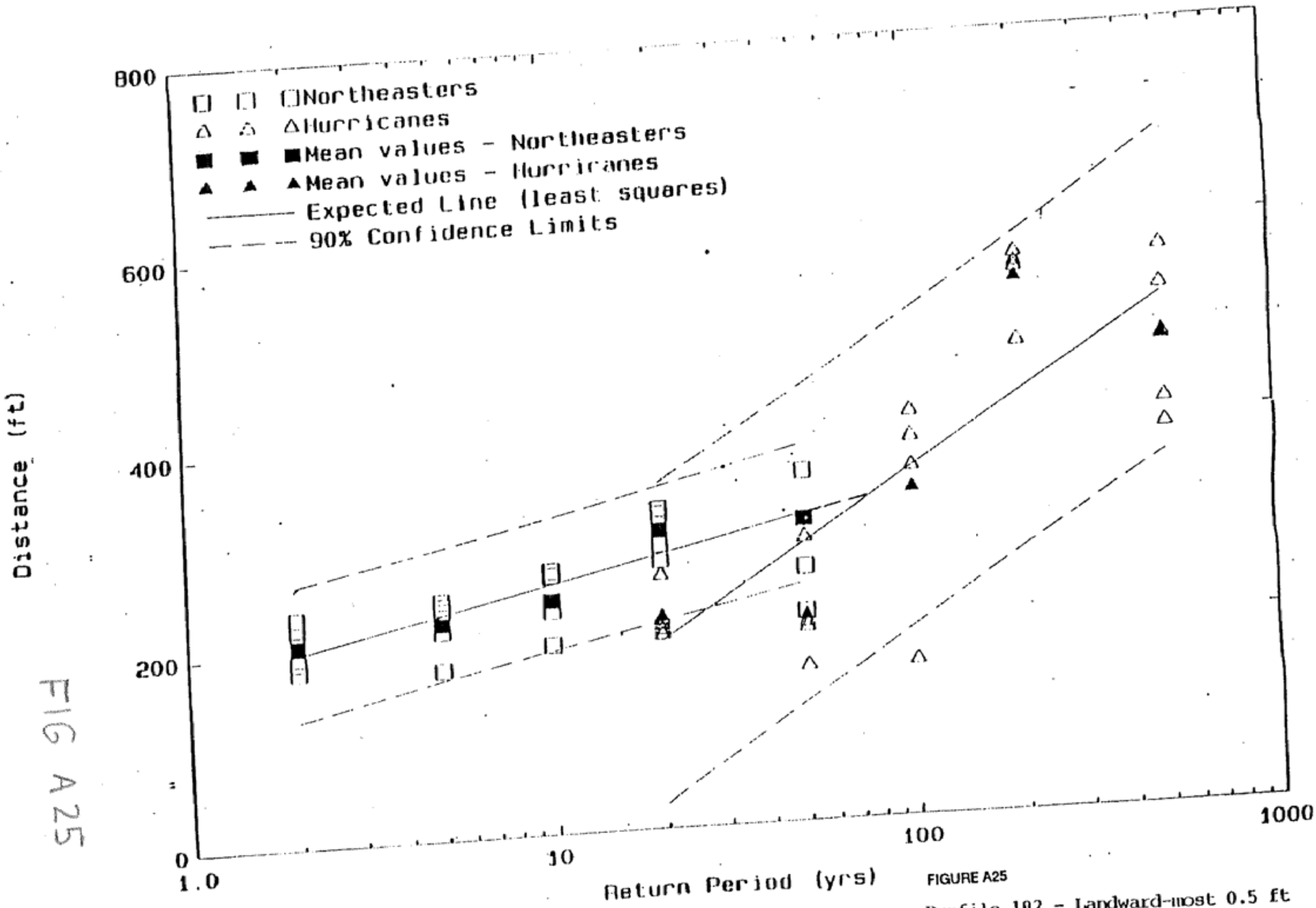


FIG A25

FIGURE A25

Profile 102 - Landward-most 0.5 ft of Vertical Erosion

FIG A26

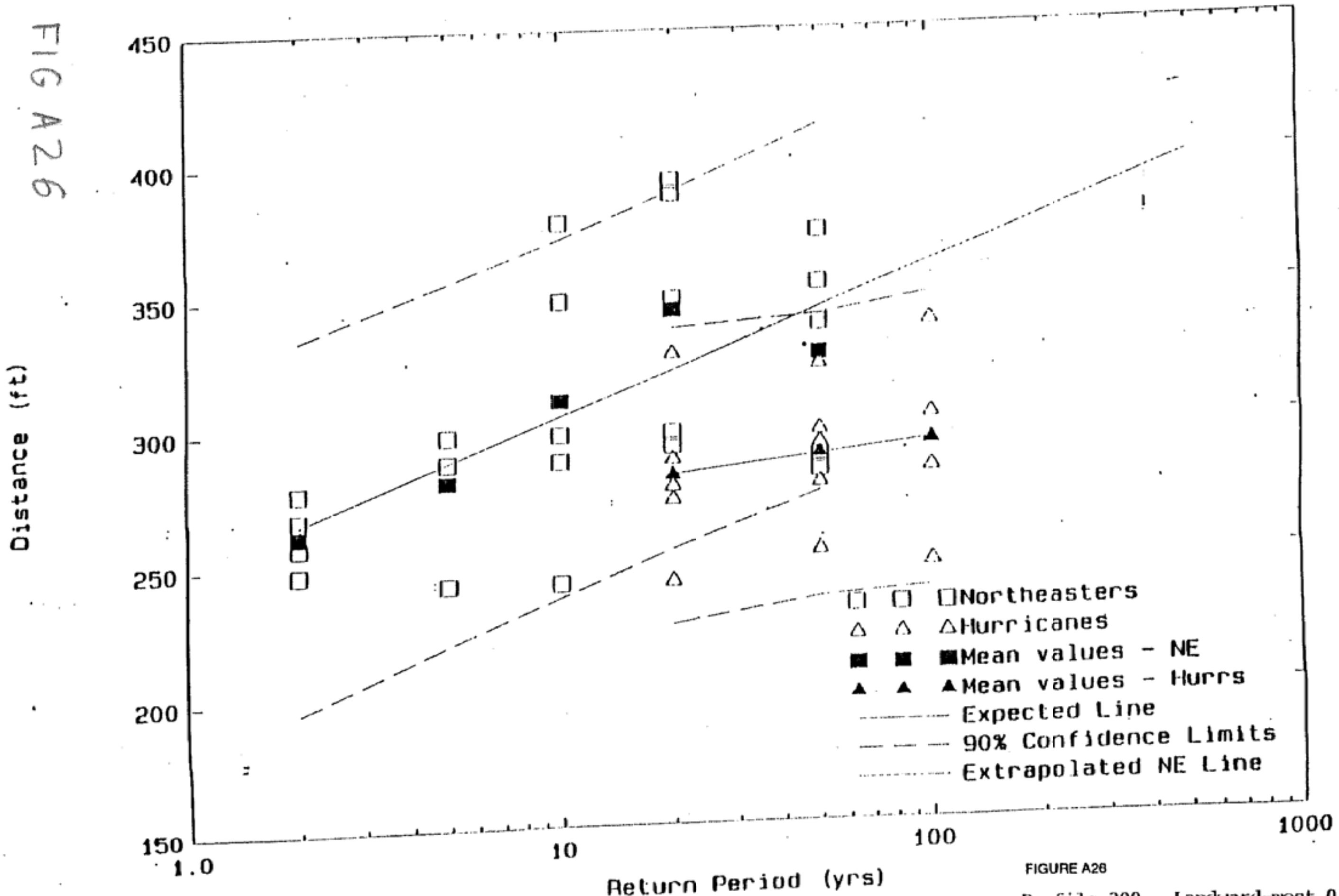


FIGURE A26

Profile 200 - Landward-most 0.5 ft of Vertical Erosion

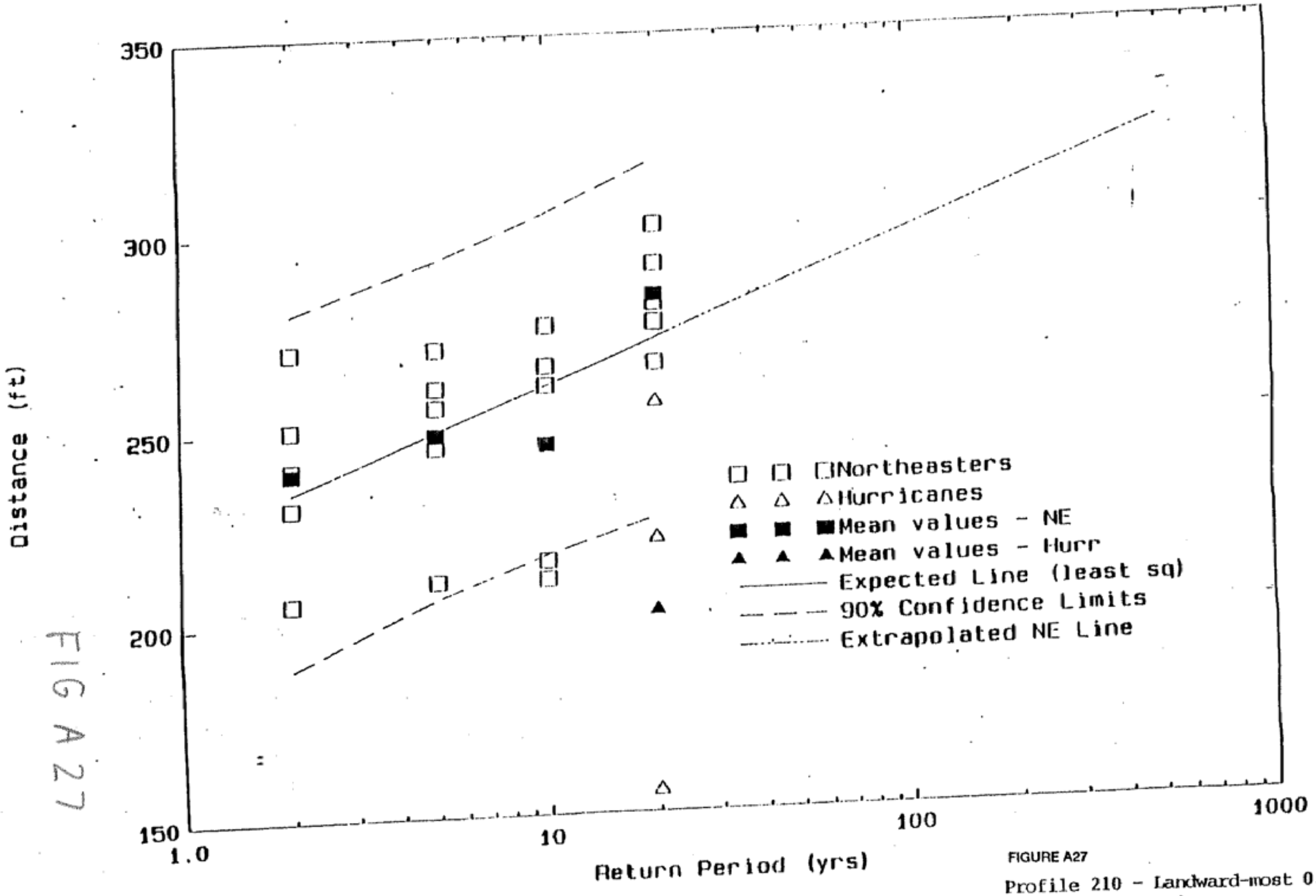


FIG A 27

FIGURE A27

Profile 210 - Landward-most 0.5 ft of Vertical Erosion

FIG A 28

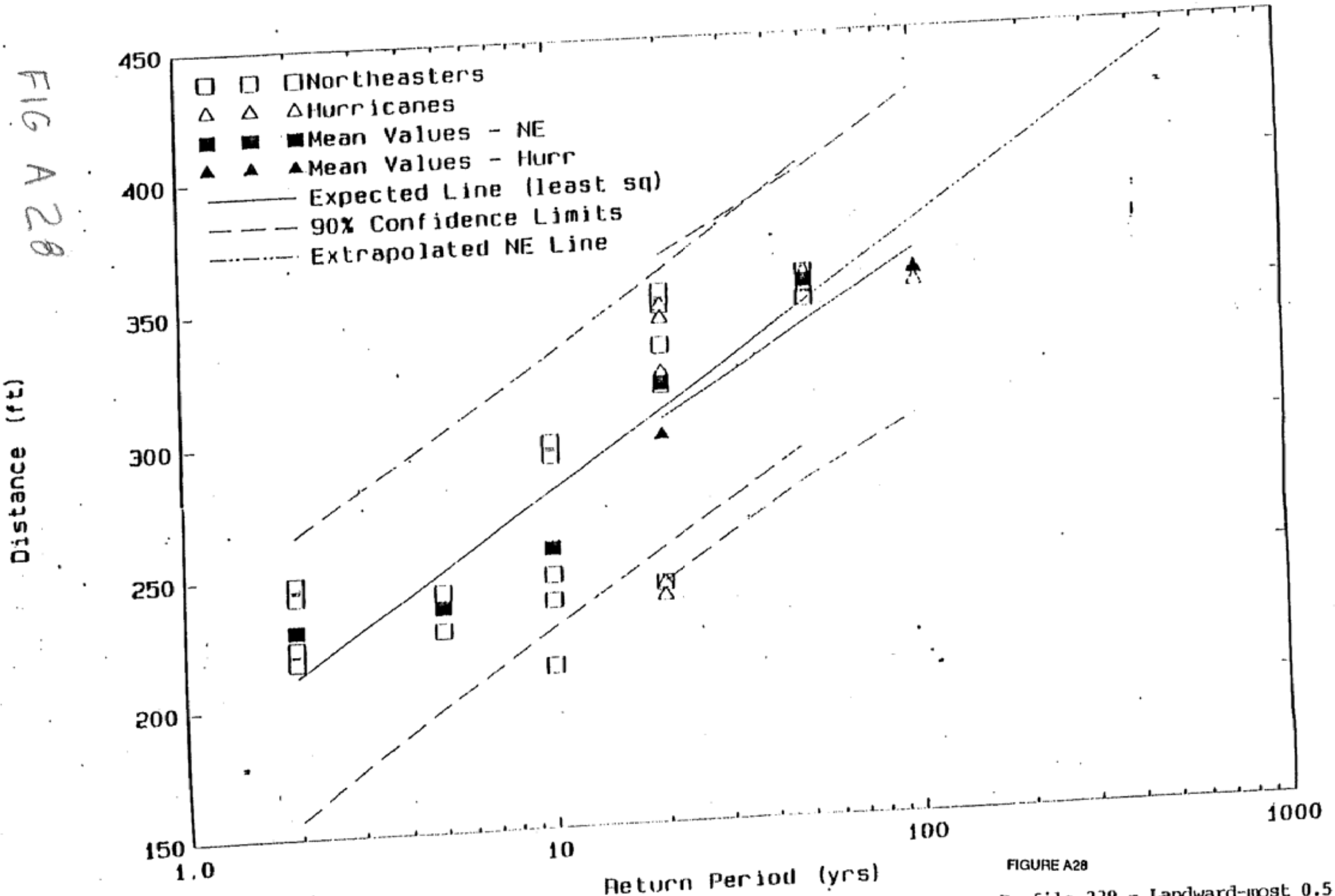
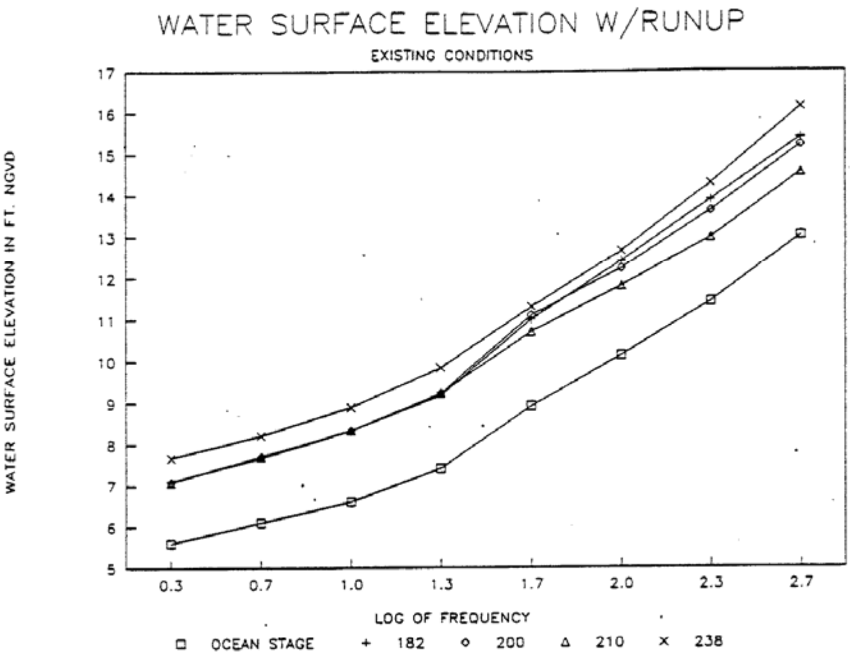


FIGURE A28

Profile 238 - Landward-most 0.5 ft of Vertical Erosion



WATER SURFACE ELEVATION W/RUNUP
EXISTING CONDITIONS
WATER SURFACE ELEVATION IN FT. NGVD
17
16
15
14
13
12
11
10
9
8
7
6
5
0.3
0.7
1.0
1.3
1.7
2.0
2.3
2.7
LOG OF FREQUENCY
OCEAN STAGE
182
200
210
238

Figure A29

FIG A 30

STATION OF 1800 LB/FT VS. FREQUENCY

EXISTING CONDITIONS

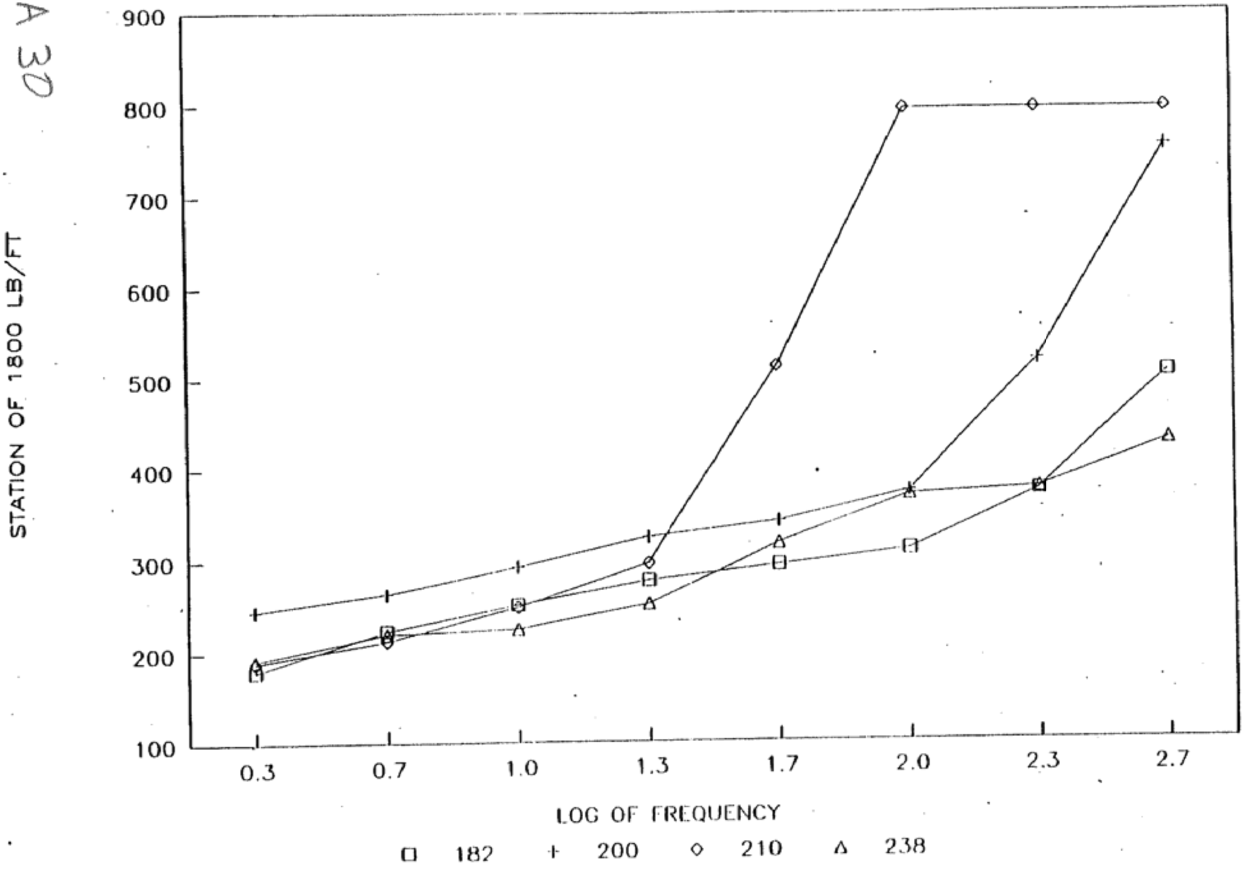


FIGURE A

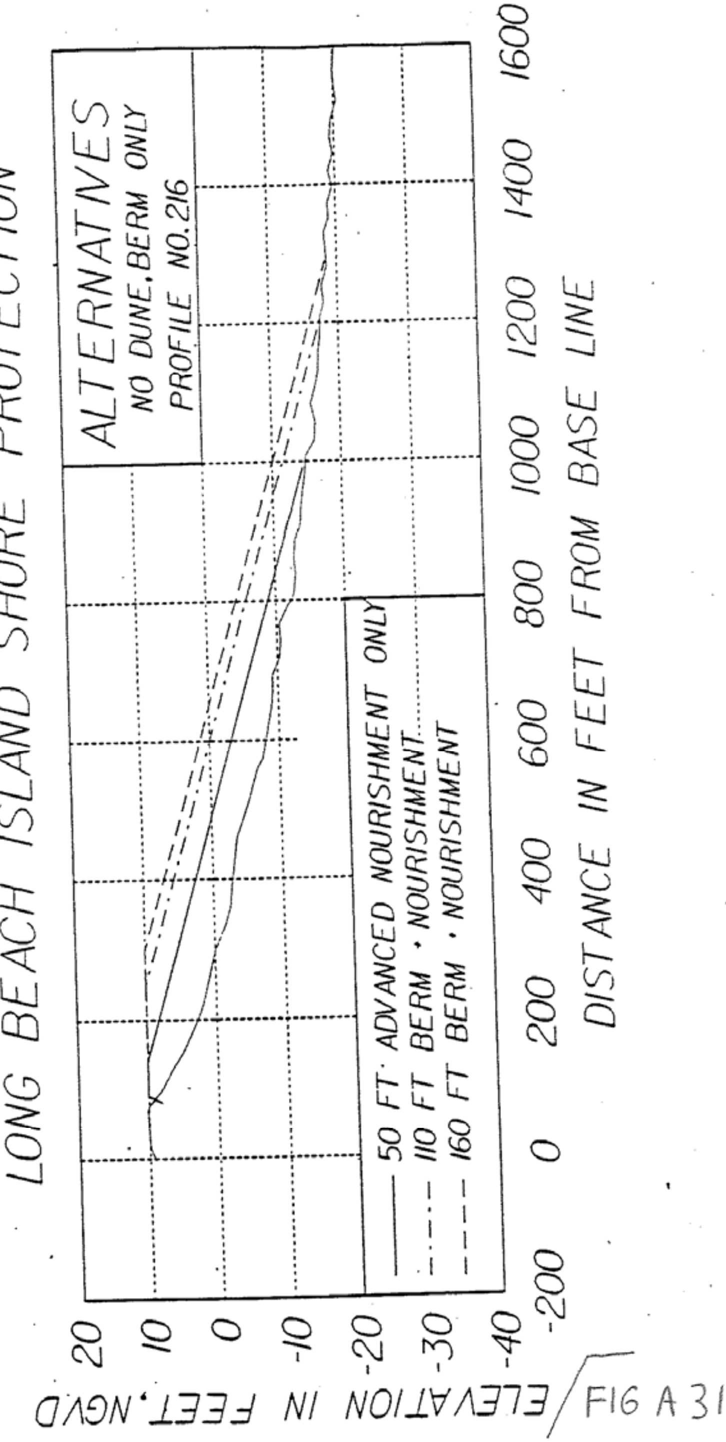
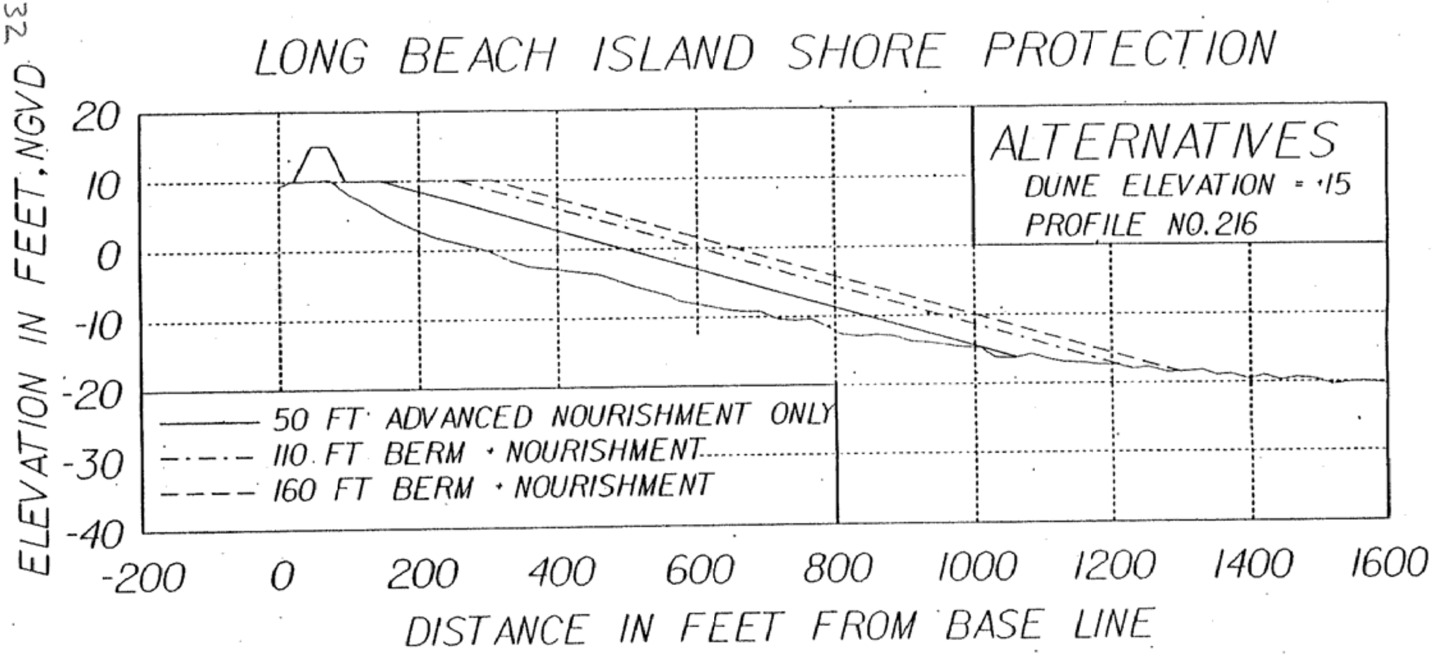

LONG BEACH ISLAND SHORE PROTECTION
ALTERNATIVES
NO DUNE, BERM ONLY
PROFILE NO. 216
50 FT ADVANCED NOURISHMENT ONLY
110 FT BERM + NOURISHMENT
160 FT BERM + NOURISHMENT
DISTANCE IN FEET FROM BASE LINE
ELEVATION IN FEET, NGVD
-200
0
200
400
600
800
1000
1200
1400
1600
20
10
0
-10
-20
-30
-40
FIG A31

FIGURE A31

FIG A32



FIGUR 2

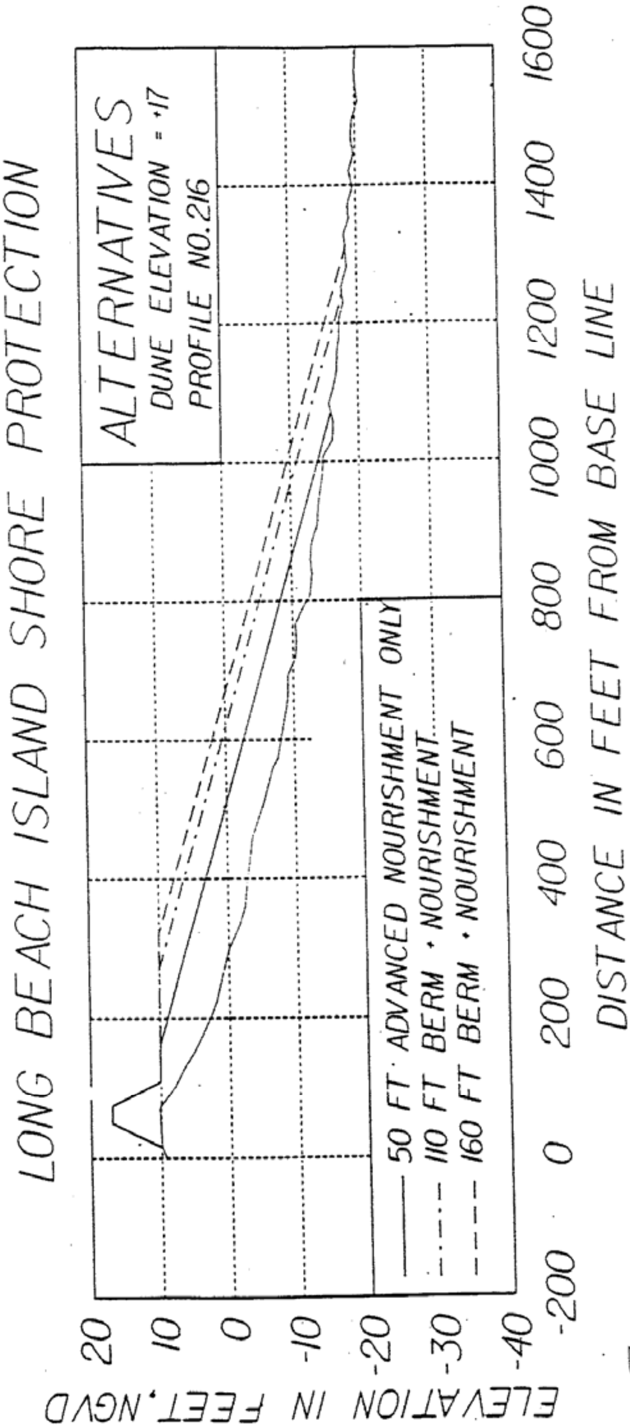


FIG A33

FIGURE A33

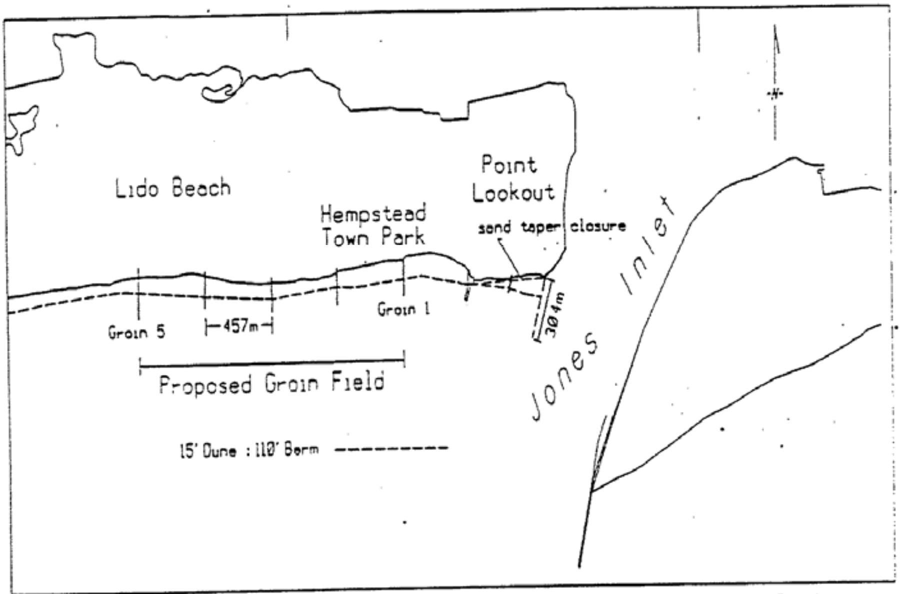


FIGURE A34 Sand Taper, Groin Field, and Terminal Groin Closure Options

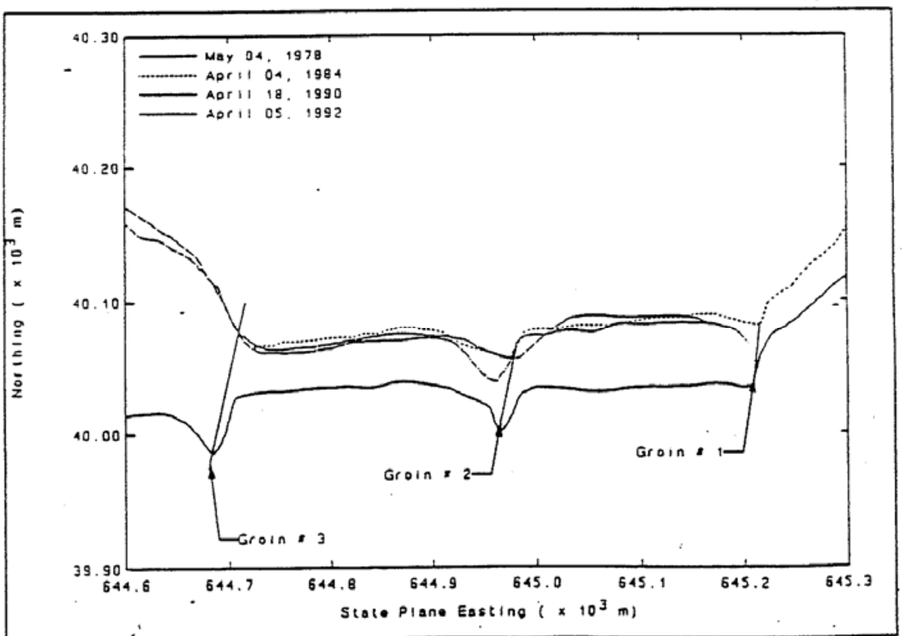


FIGURE A35 Point Lookout, New York, historical shorelines

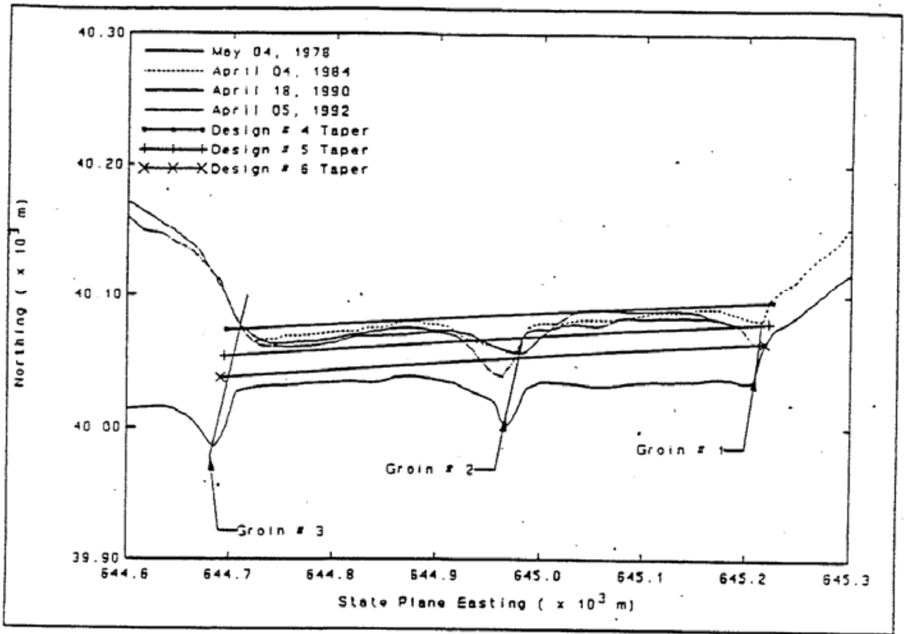


FIGURE A36 Point Lookout, New York, Sand taper closure shorelines

FIG A 36.

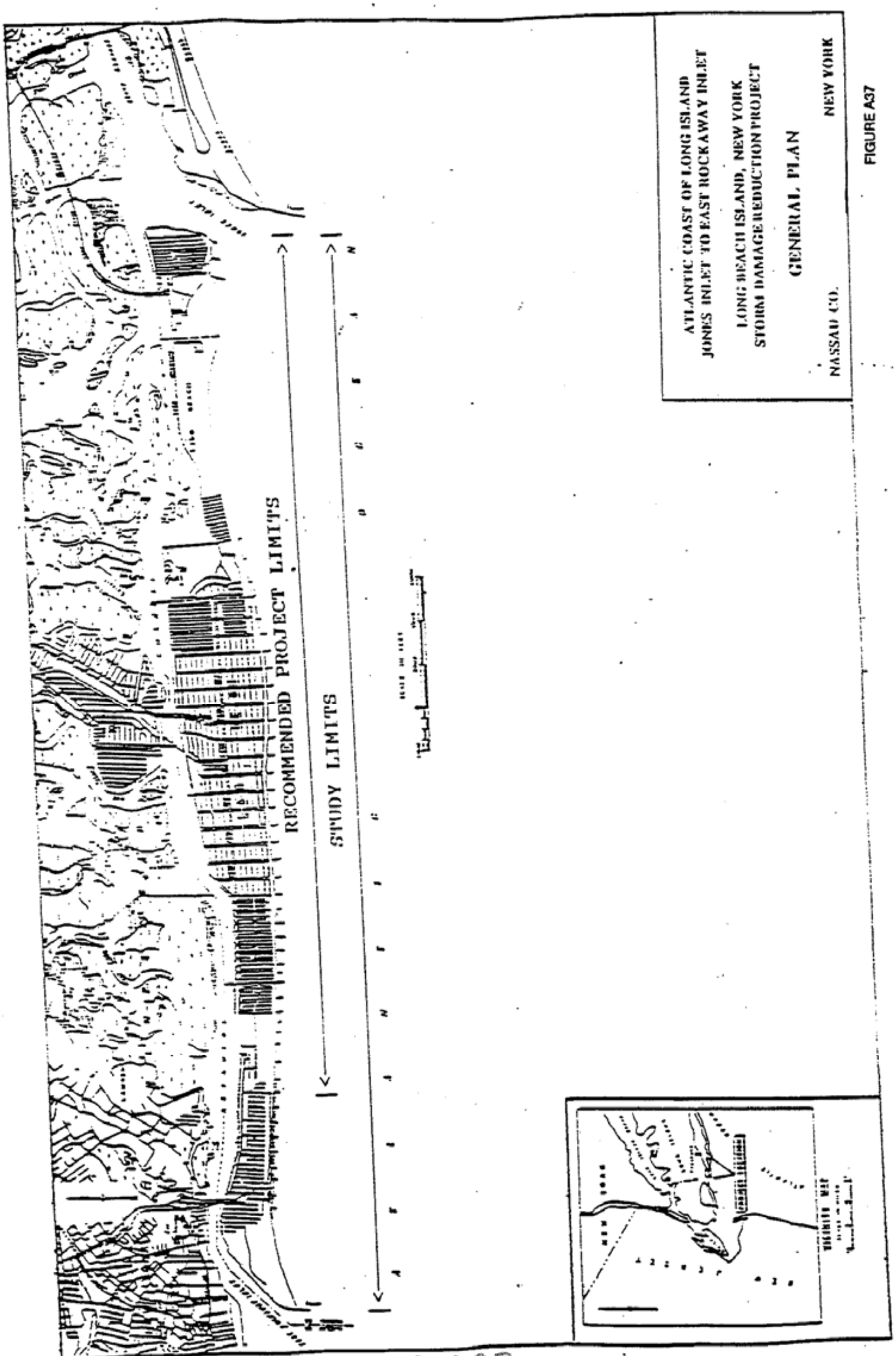
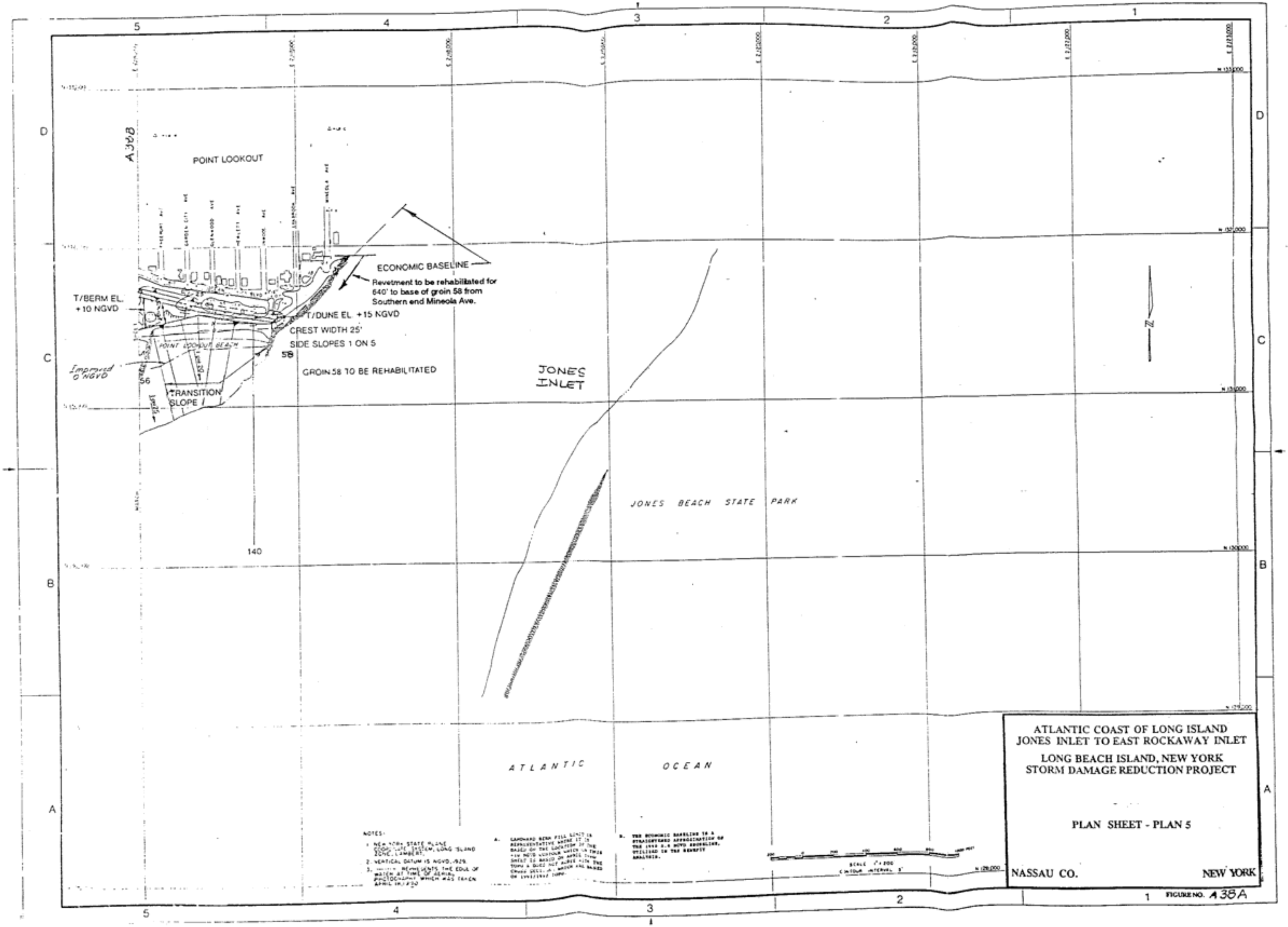
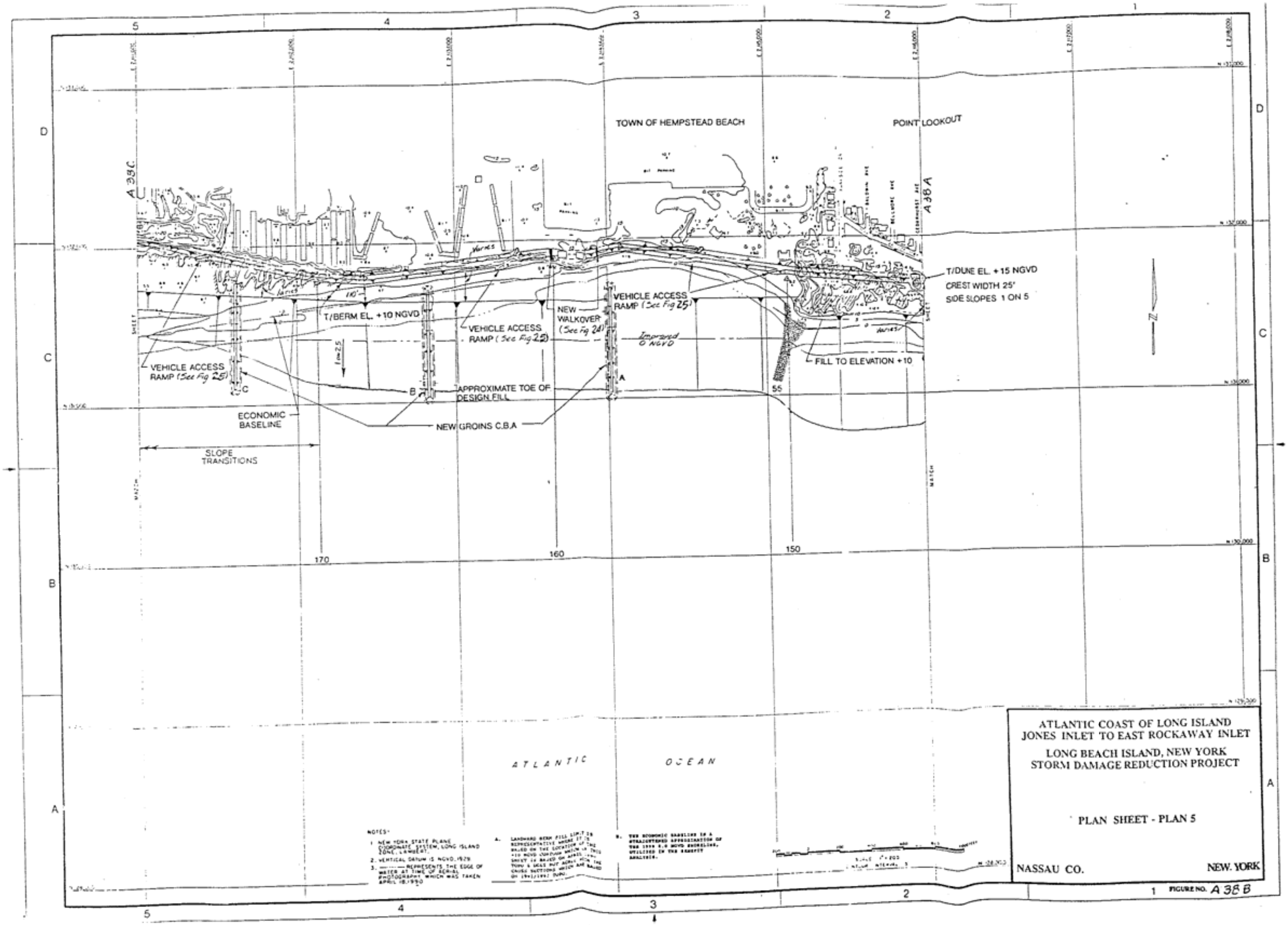
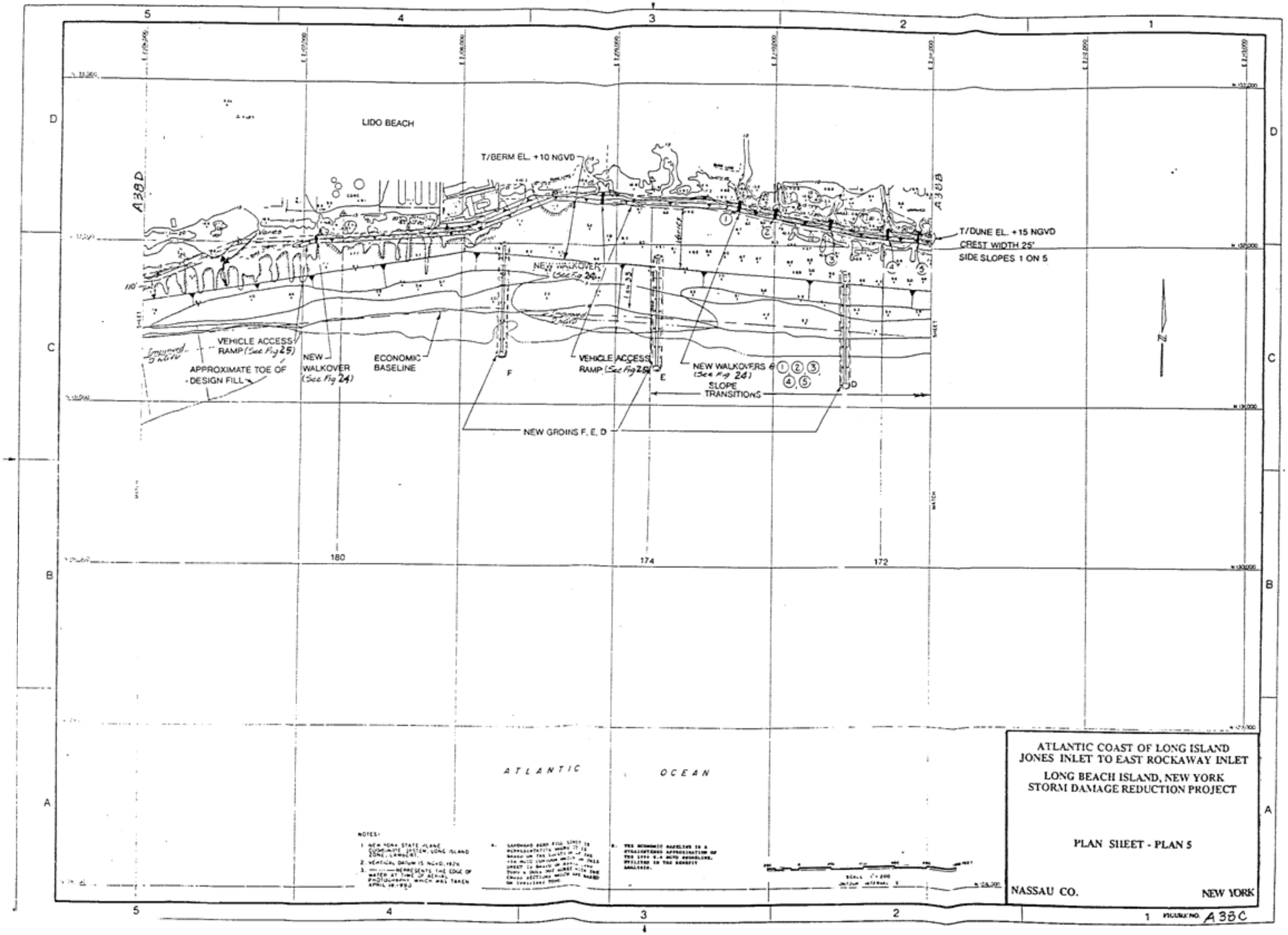

RECOMMENDED PROJECT LIMITS
STUDY LIMITS
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
GENERAL PLAN
NASSAU CO.
NEW YORK
FIGURE A37

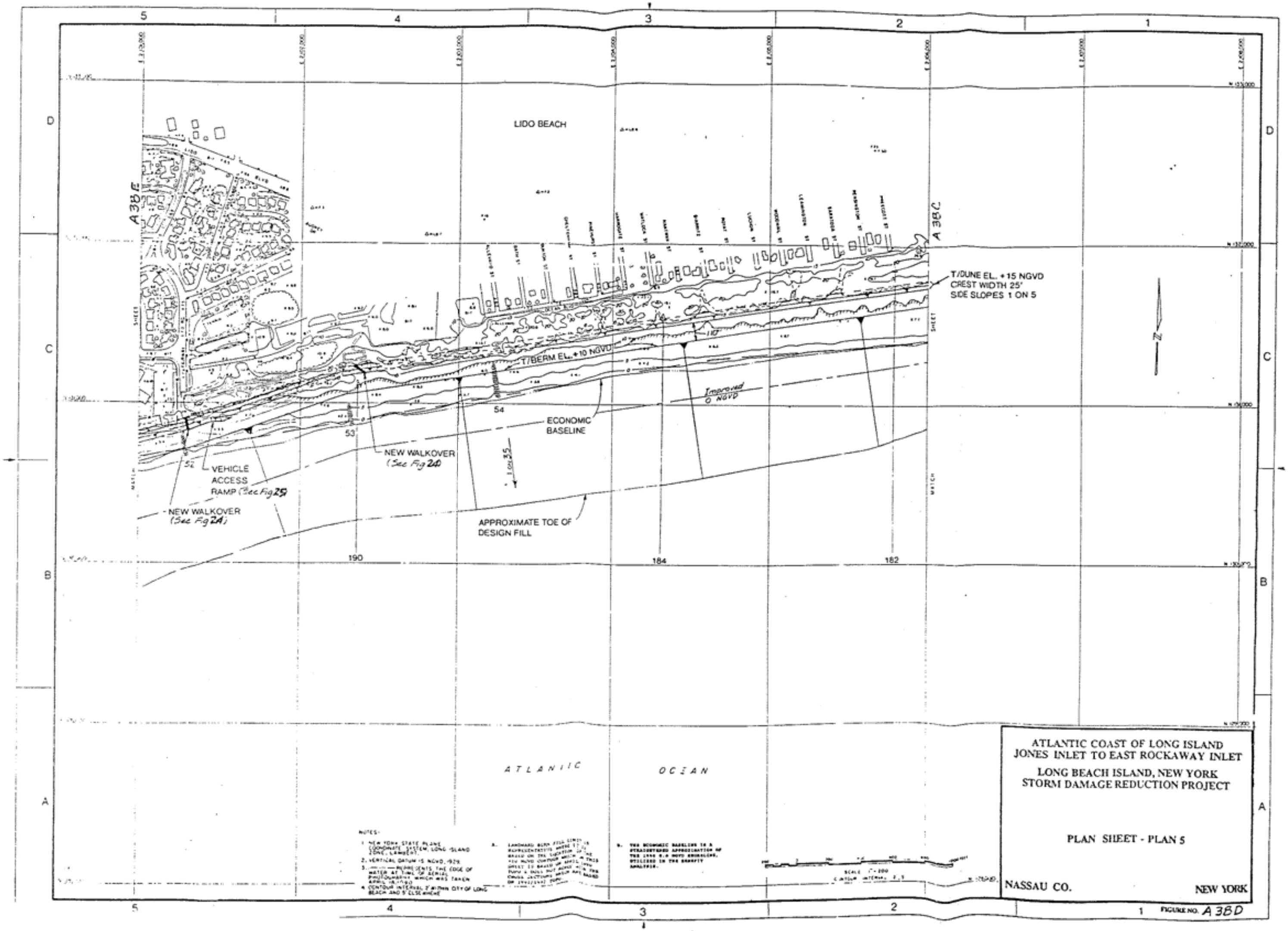
FIG A37

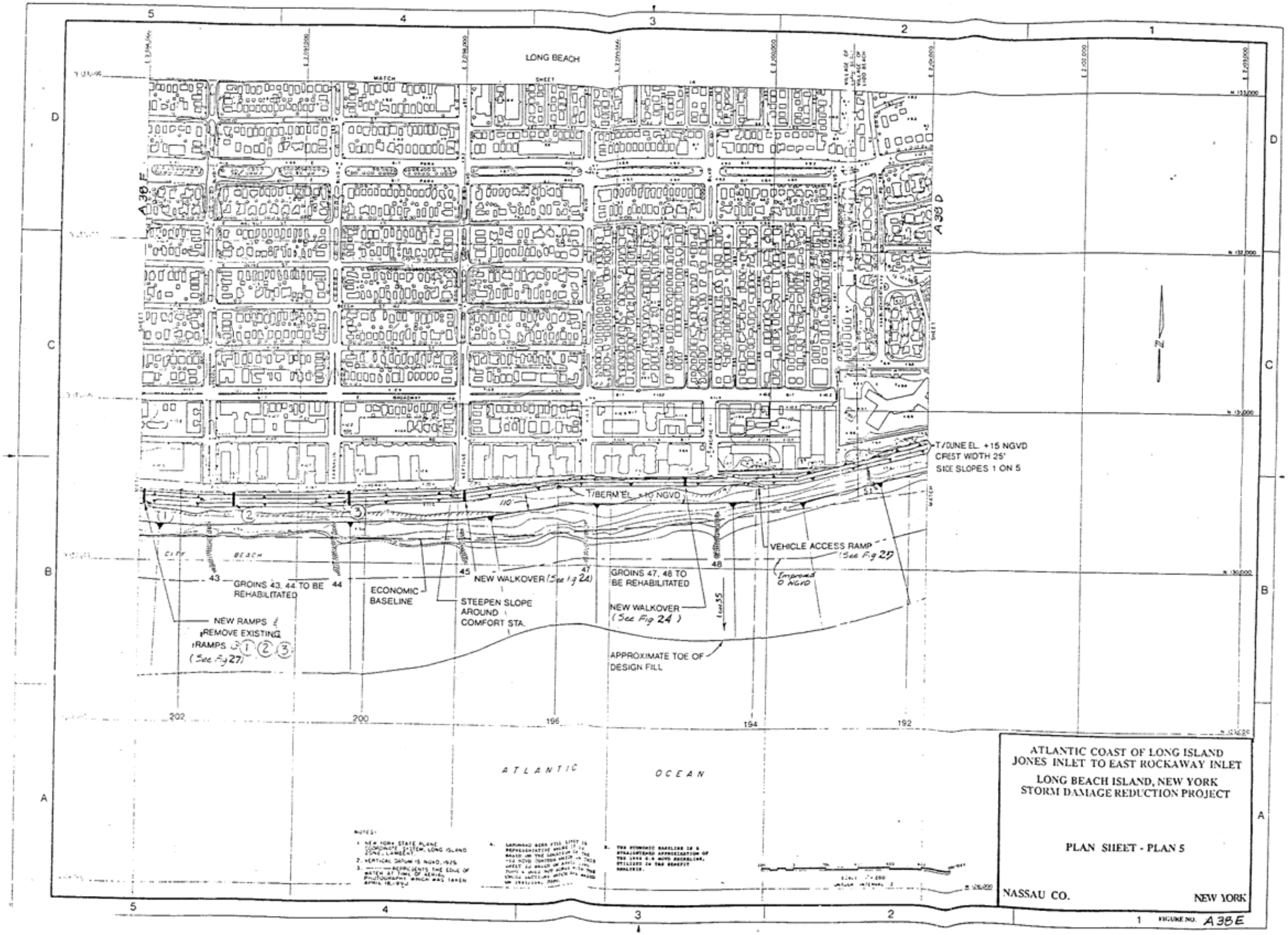


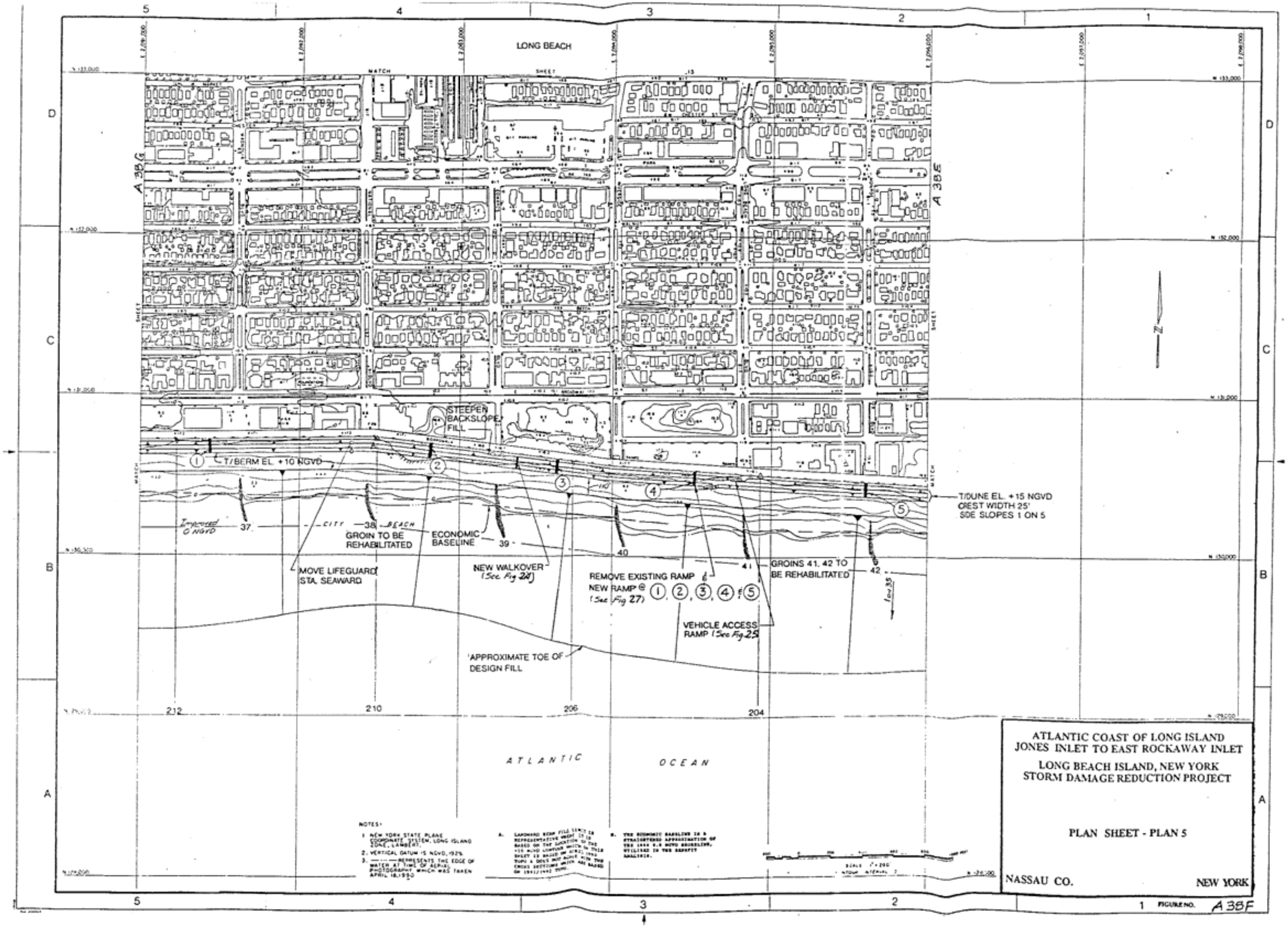
A38B
POINT LOOKOUT
ECONOMIC BASELINE
Revetment to be rehabilitated for 640' to base of groin 58 from Southern end Mineola Ave.
T/BERM EL. +10 NGVD
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
58
GROIN 58 TO BE REHABILITATED
POINT LOOKOUT BEACH
Improved 0' NGVD
56
TRANSITION SLOPE
140
JONES INLET
JONES BEACH STATE PARK
ATLANTIC OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A38A

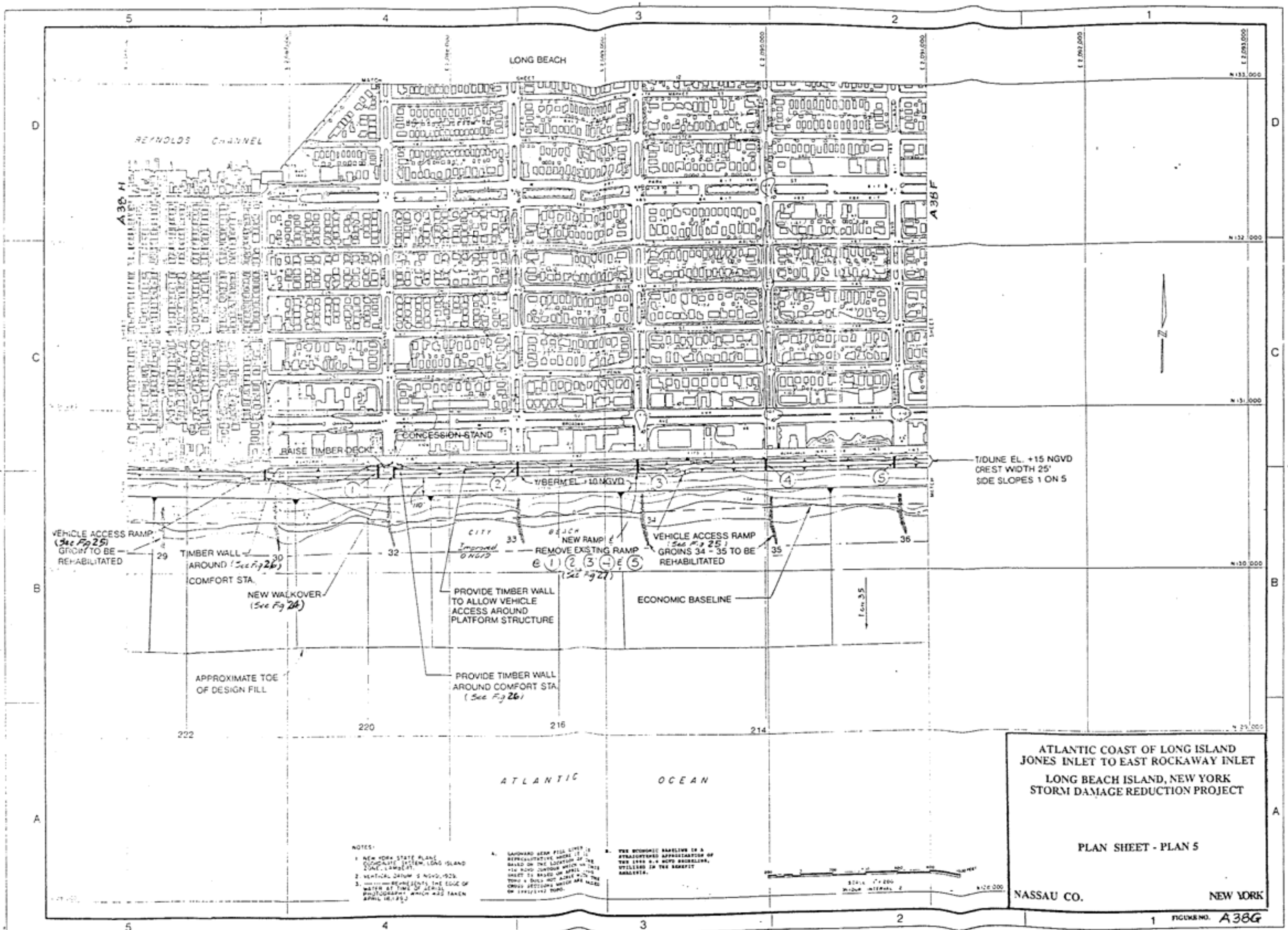

TOWN OF HEMPSTEAD BEACH
POINT LOOKOUT
A 38C
A 38A
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
VEHICLE ACCESS RAMP (See Fig 25)
T/BERM EL. +10 NGVD
VEHICLE ACCESS RAMP (See Fig 25)
NEW WALKOVER (See Fig 24)
VEHICLE ACCESS RAMP (See Fig 25)
Improved 0 NGVD
FILL TO ELEVATION +10
APPROXIMATE TOE OF DESIGN FILL
ECONOMIC BASELINE
NEW GROINS C,B,A
SLOPE TRANSITIONS
170
160
150
ATLANTIC OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A 38 B

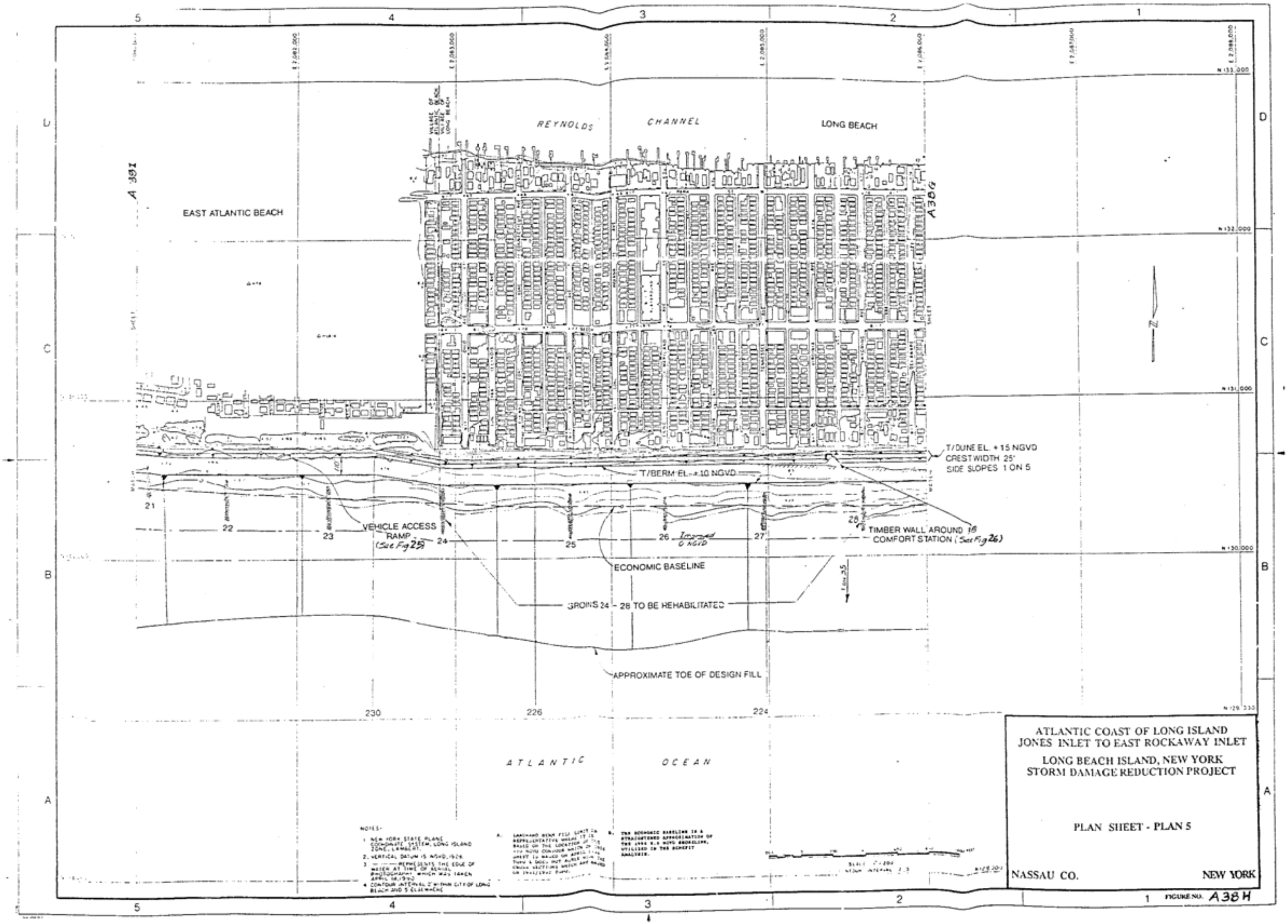

LIDO BEACH
T/BERM EL. +10 NGVD
A38D
A38B
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
NEW WALKOVER (See Fig 24)
VEHICLE ACCESS RAMP (See Fig 25)
APPROXIMATE TOE OF DESIGN FILL
NEW WALKOVER (See Fig 24)
ECONOMIC BASELINE
VEHICLE ACCESS RAMP (See Fig 25)
NEW WALKOVERS ① ② ③ ④ ⑤ (See Fig 24)
SLOPE TRANSITIONS
NEW GROINS F, E, D
F
E
D
180
174
172
ATLANTIC OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A38C


LIDO BEACH
A3BE
A3BC
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
T/BERM EL. +10 NGVD
Improved
0 NGVD
ECONOMIC
BASELINE
NEW WALKOVER
(See Fig 2A)
VEHICLE
ACCESS
RAMP (See Fig 2B)
NEW WALKOVER
(See Fig 2A)
APPROXIMATE TOE OF
DESIGN FILL
52
53
54
190
184
182
110
1 ON 35
N
MATCH SHEET
ATLANTIC
OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A3BD

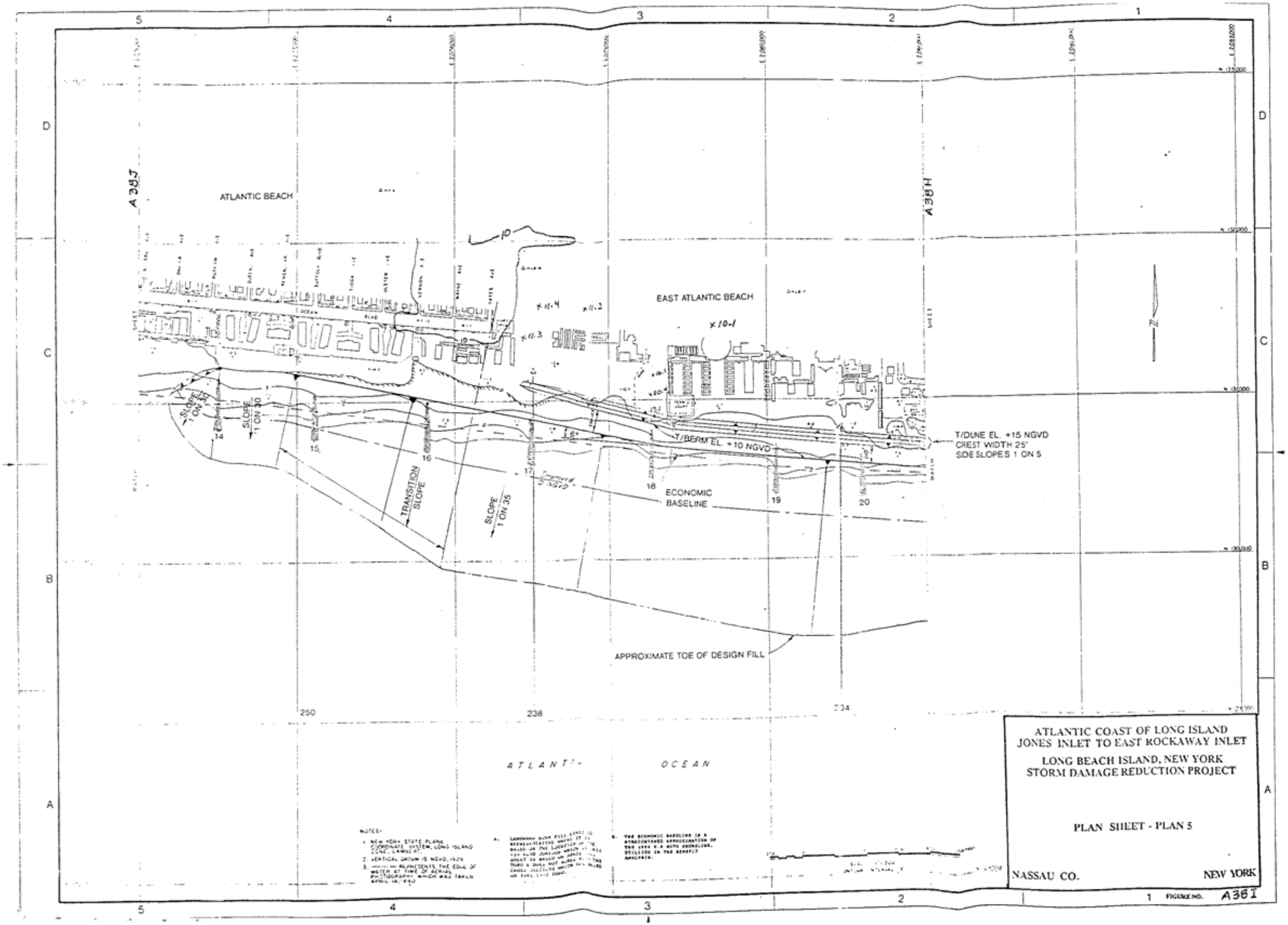

LONG BEACH
A38F
A38D
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
T/BERM EL. +10 NGVD
CITY BEACH
43
44
45
47
48
GROINS 43, 44 TO BE REHABILITATED
ECONOMIC BASELINE
NEW WALKOVER (See Fig 24)
GROINS 47, 48 TO BE REHABILITATED
VEHICLE ACCESS RAMP (See Fig 25)
STEEPEN SLOPE AROUND COMFORT STA.
NEW WALKOVER (See Fig 24)
NEW RAMPS & REMOVE EXISTING RAMPS 1 2 3 (See Fig 27)
APPROXIMATE TOE OF DESIGN FILL
202
200
196
194
192
ATLANTIC
OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A38E

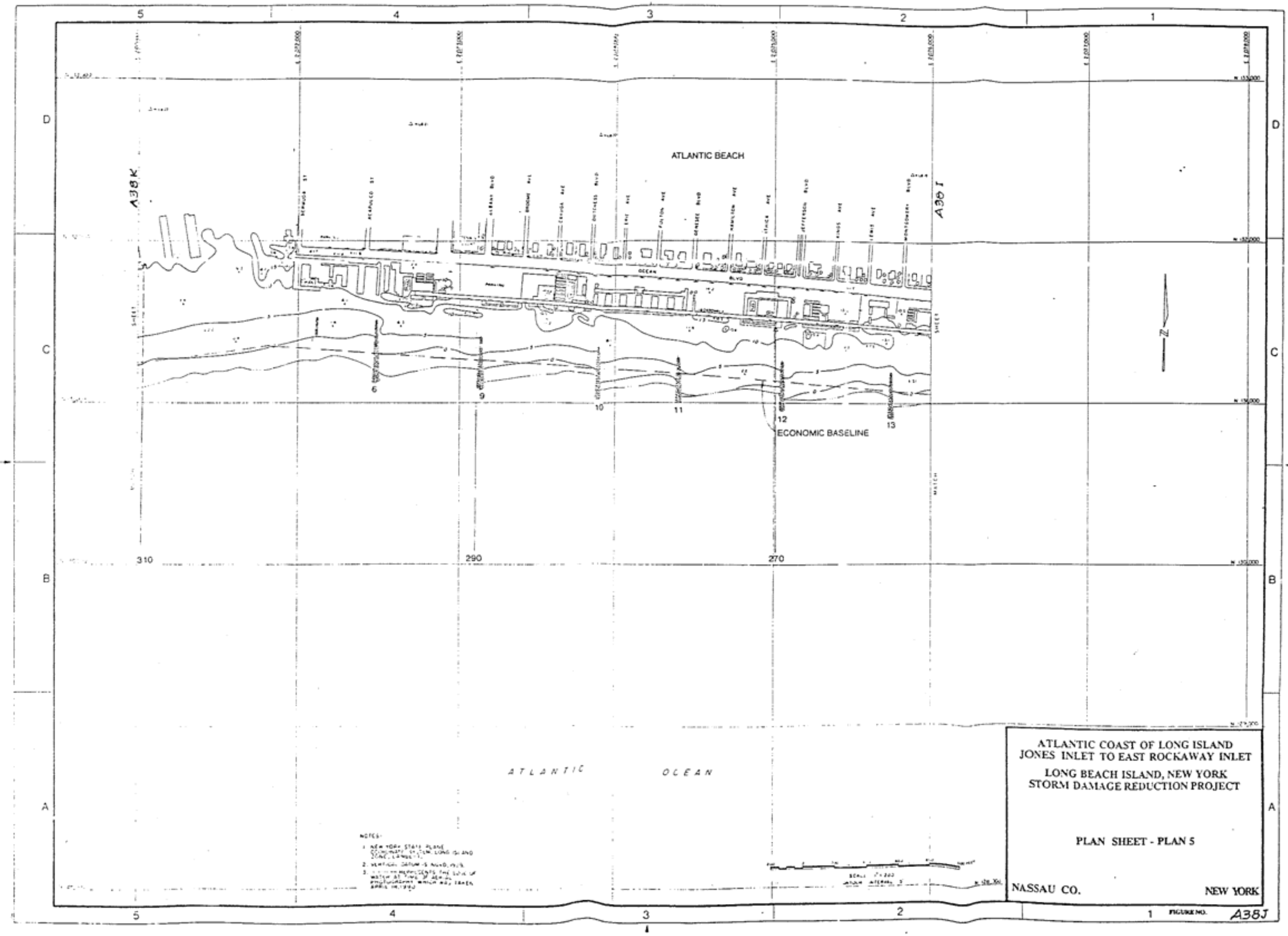

LONG BEACH
MATCH SHEET
A 38 G
A 38 E
STEEPEN BACKSLOPE FILL
T/BERM EL. +10 NGVD
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
Improved 0 NGVD
37
38
39
40
41
42
CITY BEACH
GROIN TO BE REHABILITATED
ECONOMIC BASELINE
MOVE LIFEGUARD STA. SEAWARD
NEW WALKOVER (See Fig 28)
REMOVE EXISTING RAMP & NEW RAMP @ 1, 2, 3, 4 & 5 (See Fig 27)
GROINS 41, 42 TO BE REHABILITATED
VEHICLE ACCESS RAMP (See Fig 25)
APPROXIMATE TOE OF DESIGN FILL
212
210
206
204
ATLANTIC OCEAN
NOTES:
1. NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, LAMBERT.
2. VERTICAL DATUM IS NGVD, 1929
3. REPRESENTS THE EDGE OF WATER AT TIME OF AERIAL PHOTOGRAPHY WHICH WAS TAKEN APRIL 18, 1990
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A 38F


LONG BEACH
REYNOLDS CHANNEL
A38H
A38F
CONCESSION STAND
RAISE TIMBER DECK
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
T/BERM EL. +10 NGVD
VEHICLE ACCESS RAMP (See Fig 25)
GROIN TO BE REHABILITATED
TIMBER WALL AROUND (See Fig 26) COMFORT STA.
NEW WALKOVER (See Fig 24)
PROVIDE TIMBER WALL TO ALLOW VEHICLE ACCESS AROUND PLATFORM STRUCTURE
CITY BEACH
Improved ONGVD
NEW RAMP
REMOVE EXISTING RAMP
(See Fig 27)
VEHICLE ACCESS RAMP (See Fig 25)
GROINS 34 - 35 TO BE REHABILITATED
ECONOMIC BASELINE
1 on 35
APPROXIMATE TOE OF DESIGN FILL
PROVIDE TIMBER WALL AROUND COMFORT STA. (See Fig 26)
222
220
216
214
ATLANTIC OCEAN
NOTES:
1. NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, LAMBERT.
2. VERTICAL DATUM IS NGVD, 1929.
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A38G

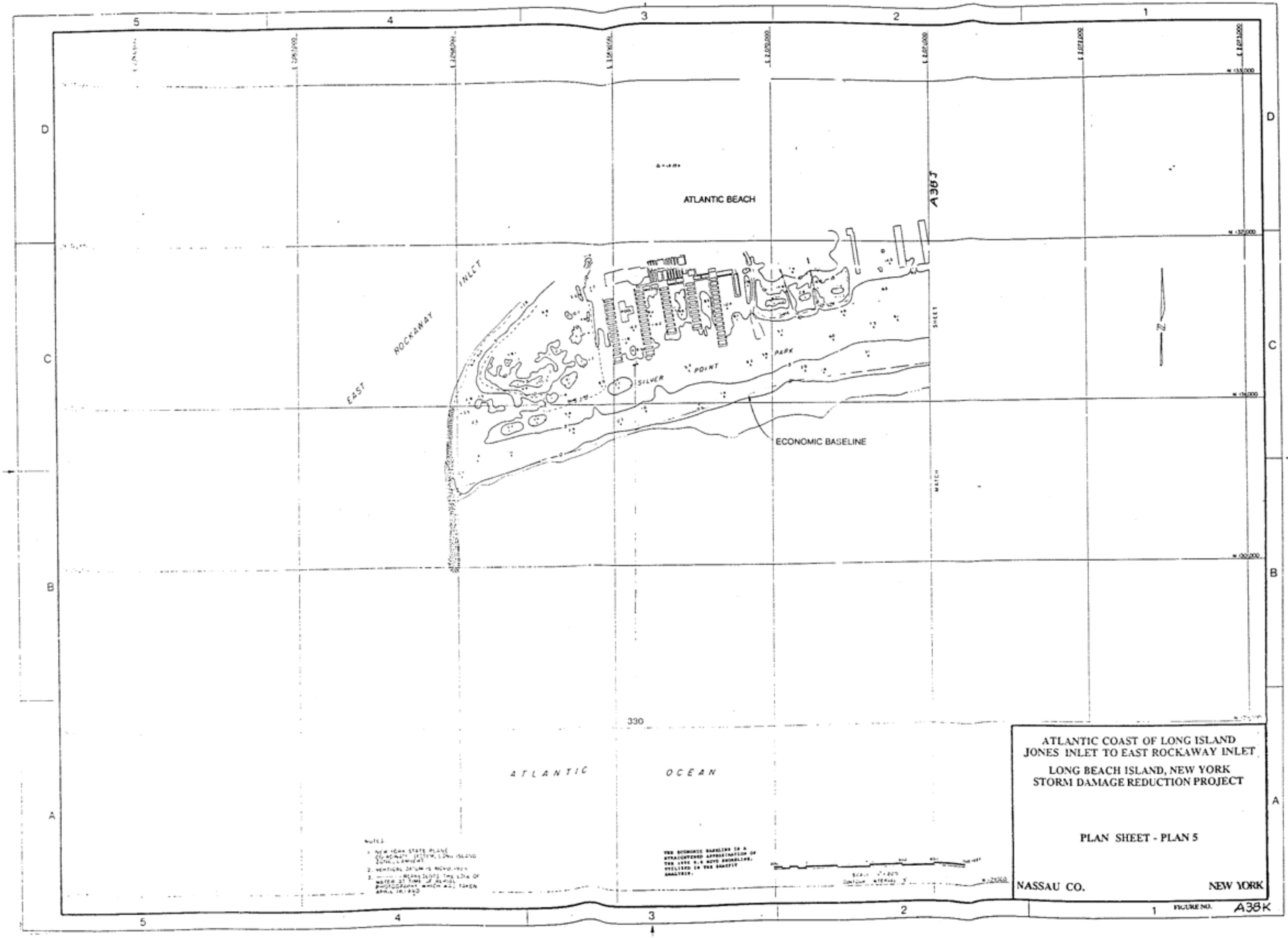


REYNOLDS CHANNEL
LONG BEACH
EAST ATLANTIC BEACH
A 38I
A 38G
T/DUNE EL. +15 NGVD
CRESTWIDTH 25'
SIDE SLOPES 1 ON 5
T/BERM EL. +10 NGVD
VEHICLE ACCESS RAMP (See Fig 25)
TIMBER WALL AROUND 18 COMFORT STATION (See Fig 26)
ECONOMIC BASELINE
GROINS 24 - 28 TO BE REHABILITATED
APPROXIMATE TOE OF DESIGN FILL
ATLANTIC OCEAN
NOTES:
1. NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, LAMBERT.
2. VERTICAL DATUM IS NGVD, 1929.
4. CONTOUR INTERVAL 2' WITHIN CITY OF LONG BEACH AND 5' ELSEWHERE
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A38H


ATLANTIC BEACH
EAST ATLANTIC BEACH
A38J
A38H
SLOPE 1 ON 30
SLOPE 1 ON 30
TRANSITION SLOPE
SLOPE 1 ON 35
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDESLOPES 1 ON 5
T/BERM EL. +10 NGVD
ECONOMIC BASELINE
APPROXIMATE TOE OF DESIGN FILL
14
15
16
17
18
19
20
250
238
234
ATLANTIC OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A38I

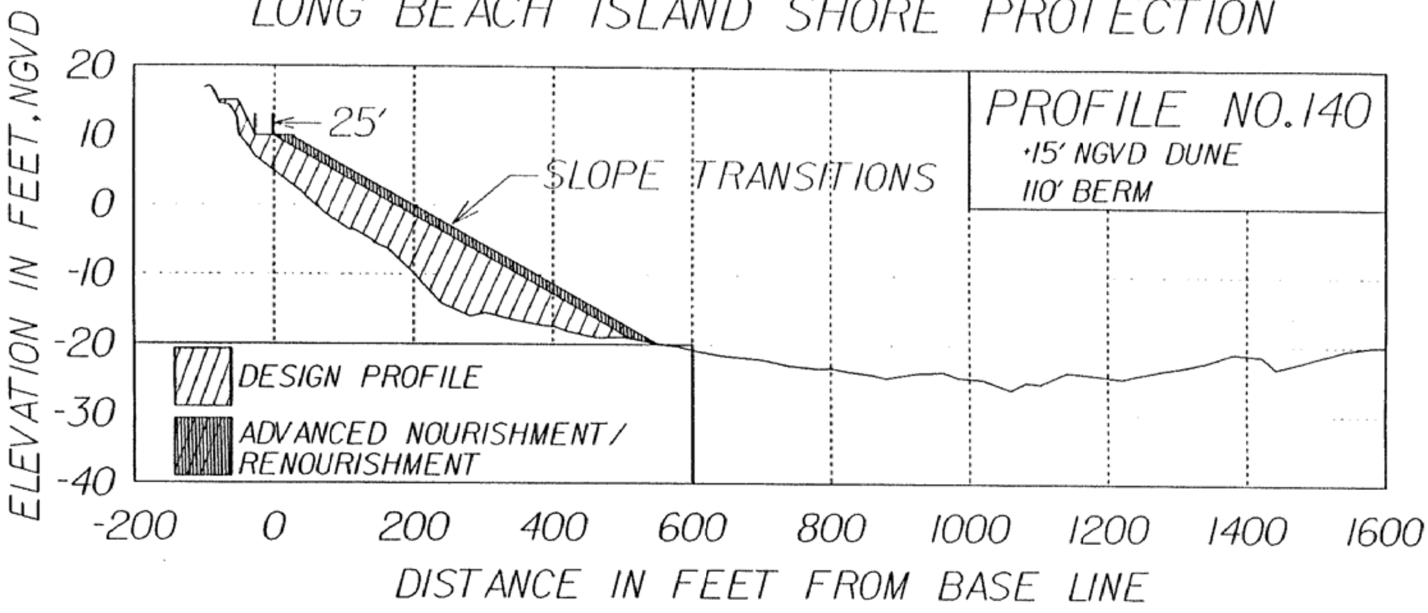


ATLANTIC BEACH
A38K
A38I
6
9
10
11
12
13
ECONOMIC BASELINE
310
290
270
ATLANTIC OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO.
A38J



ATLANTIC BEACH
A38J
EAST ROCKAWAY INLET
SILVER POINT PARK
ECONOMIC BASELINE
MATCH SHEET
330
ATLANTIC OCEAN
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
PLAN SHEET - PLAN 5
NASSAU CO.
NEW YORK
FIGURE NO. A38K

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

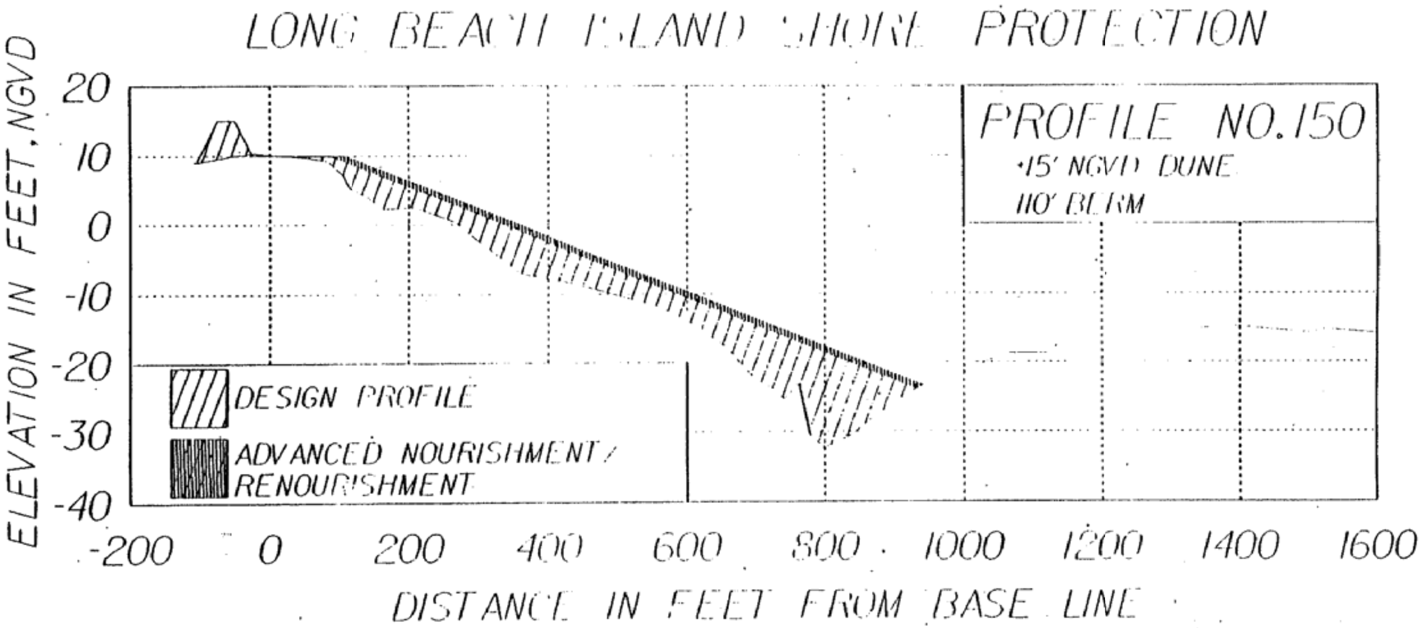
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

NASSAU CO. NEW YORK

FIGURE A39-1



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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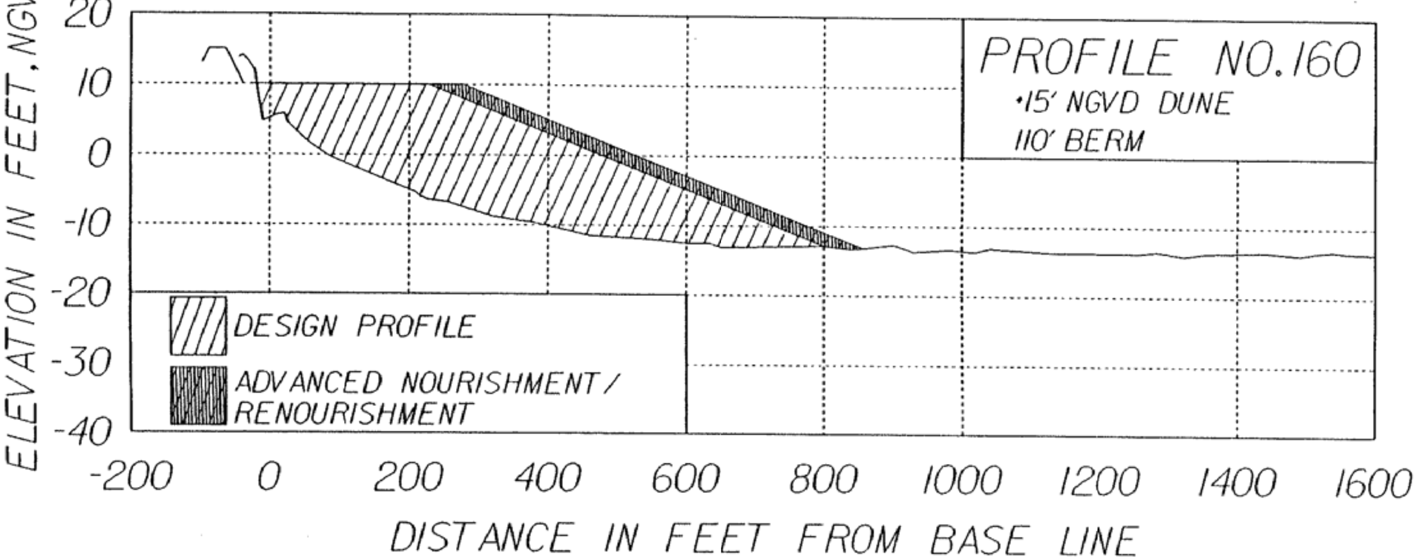
FIGURE A39-2

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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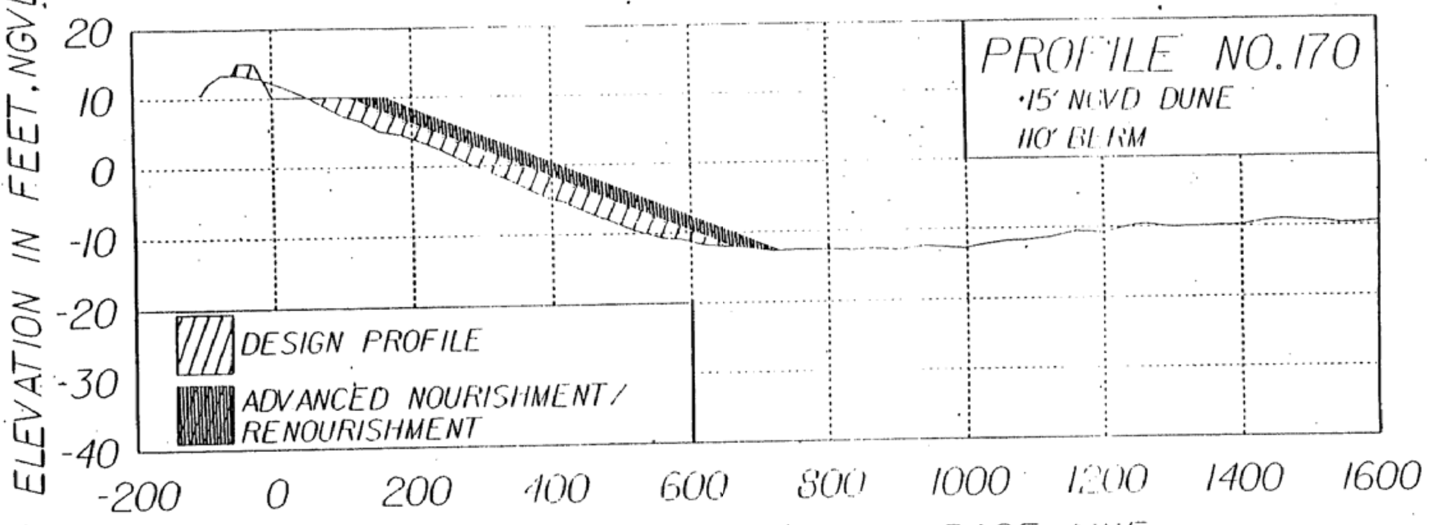
FIGURE A39-3

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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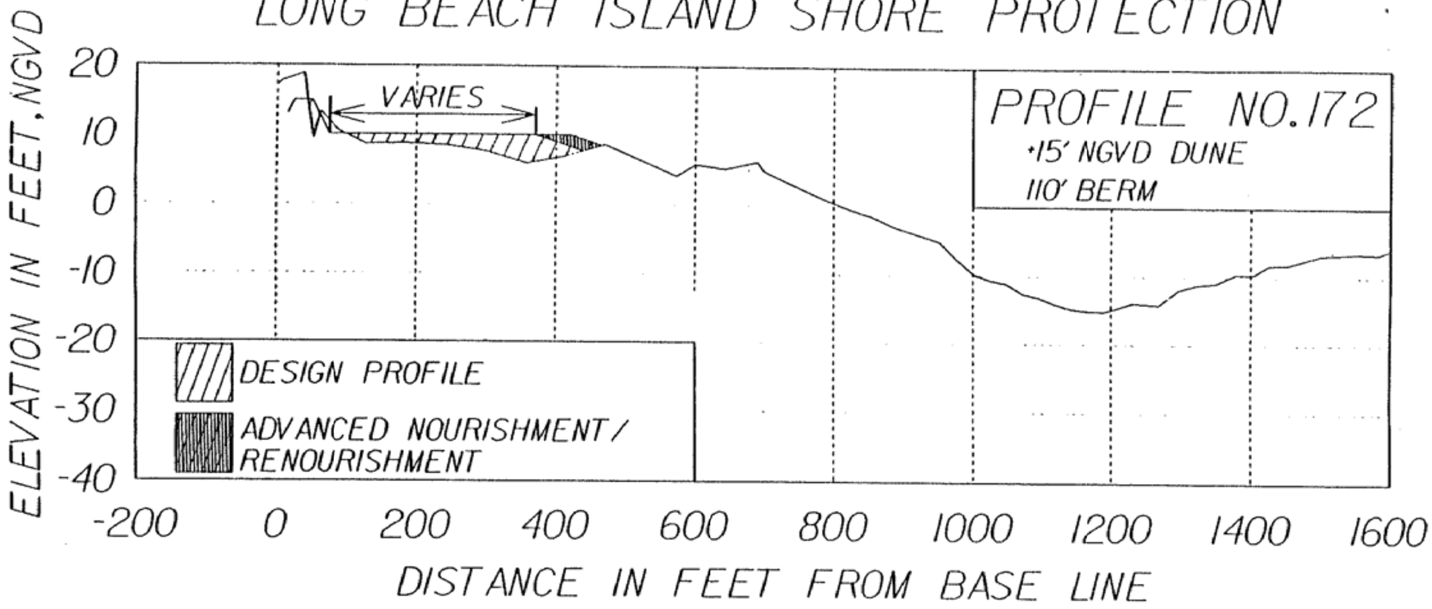
FIGURE A29-4

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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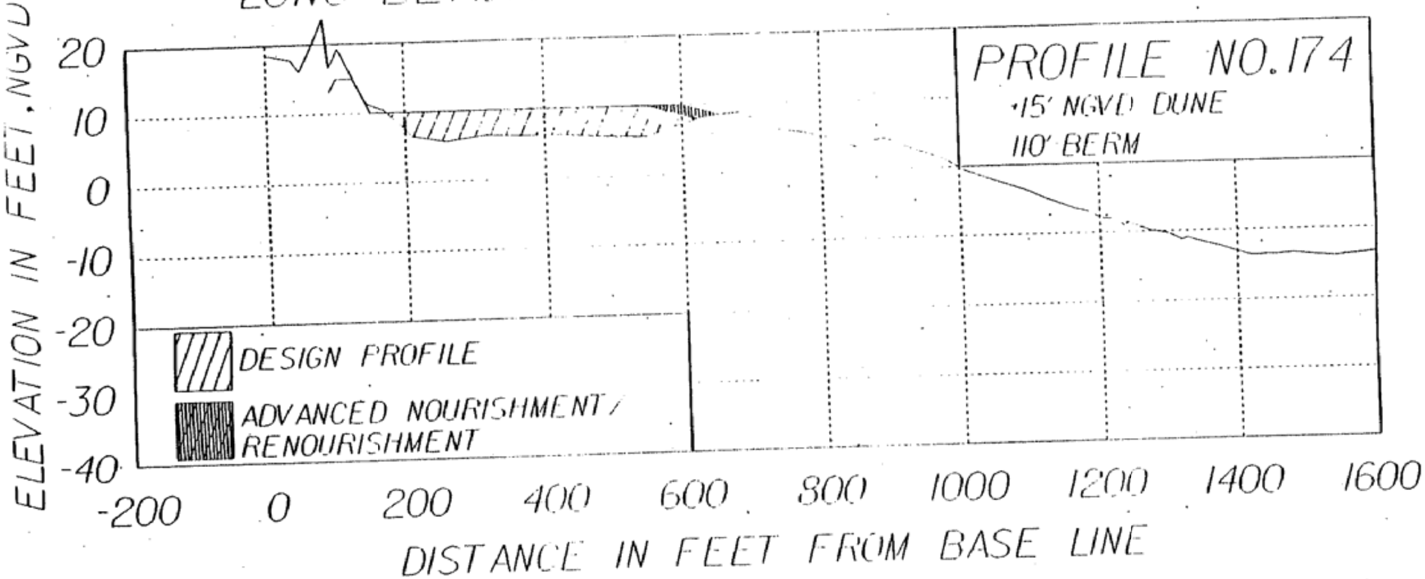
FIGURE A39-5

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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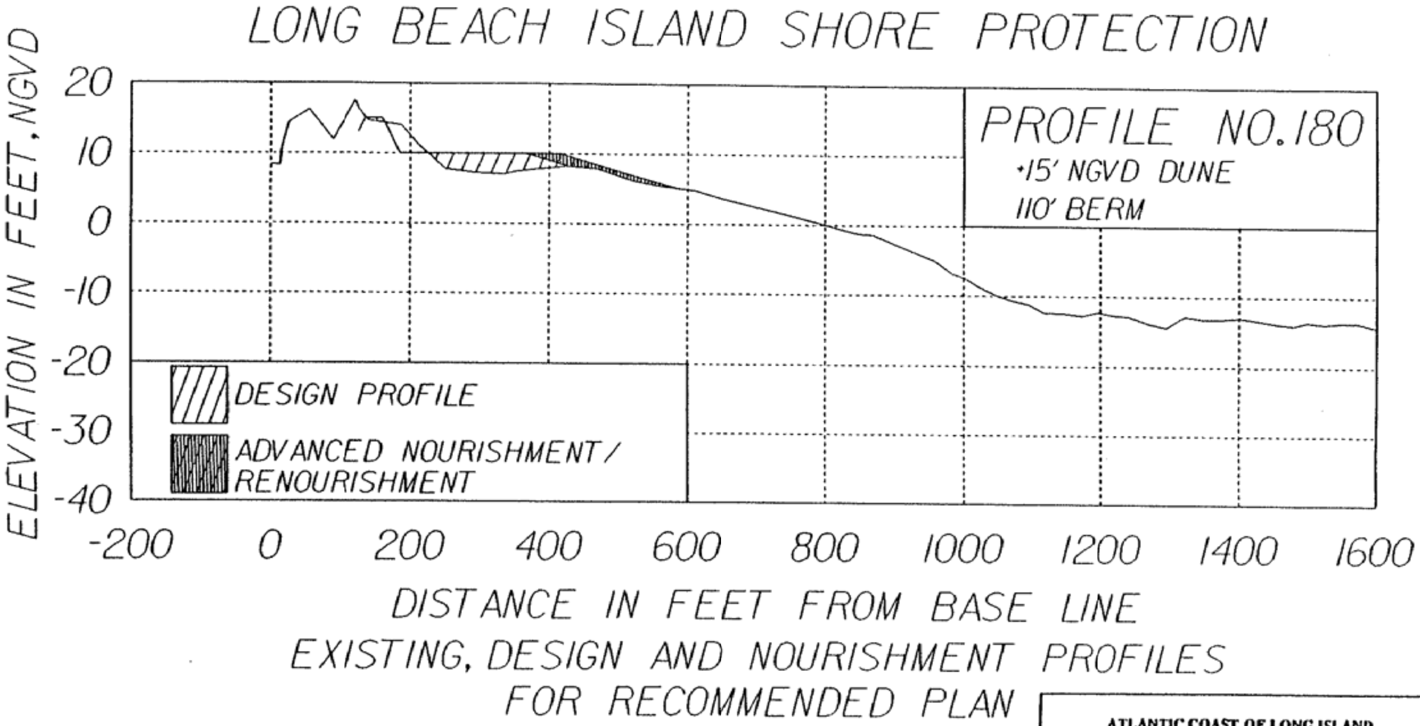
FIGURE A39-C



ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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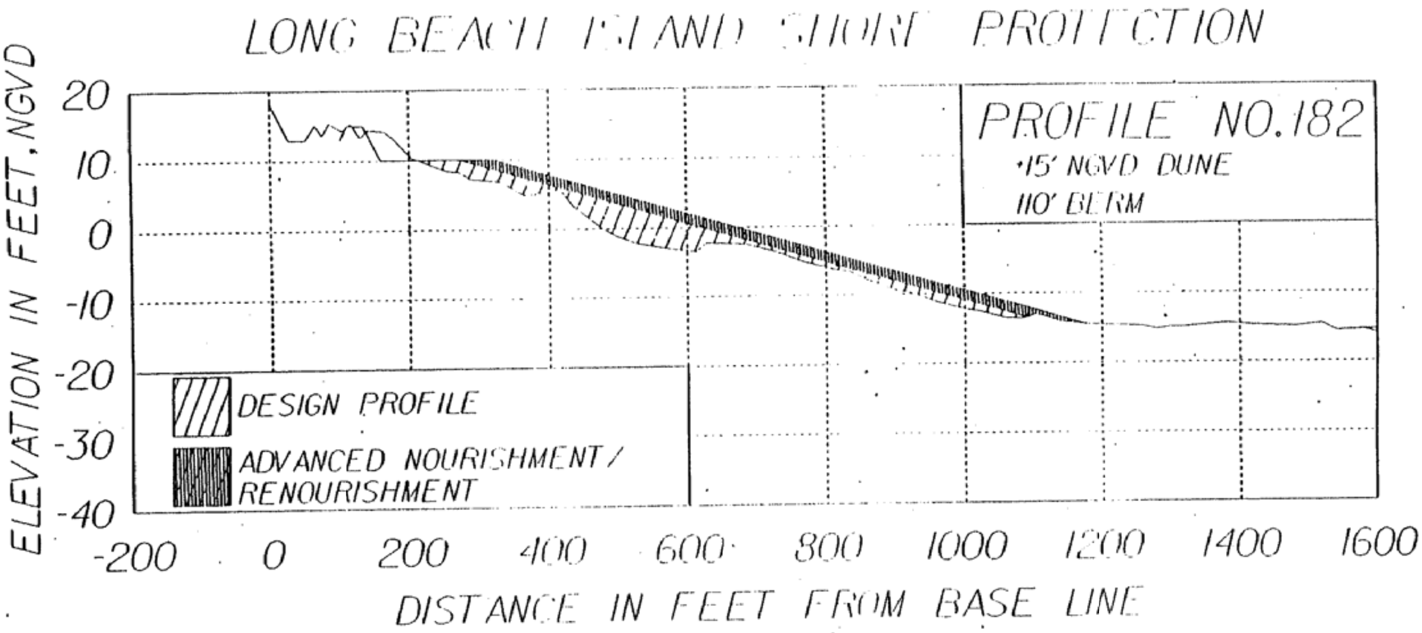
FIGURE A39-7



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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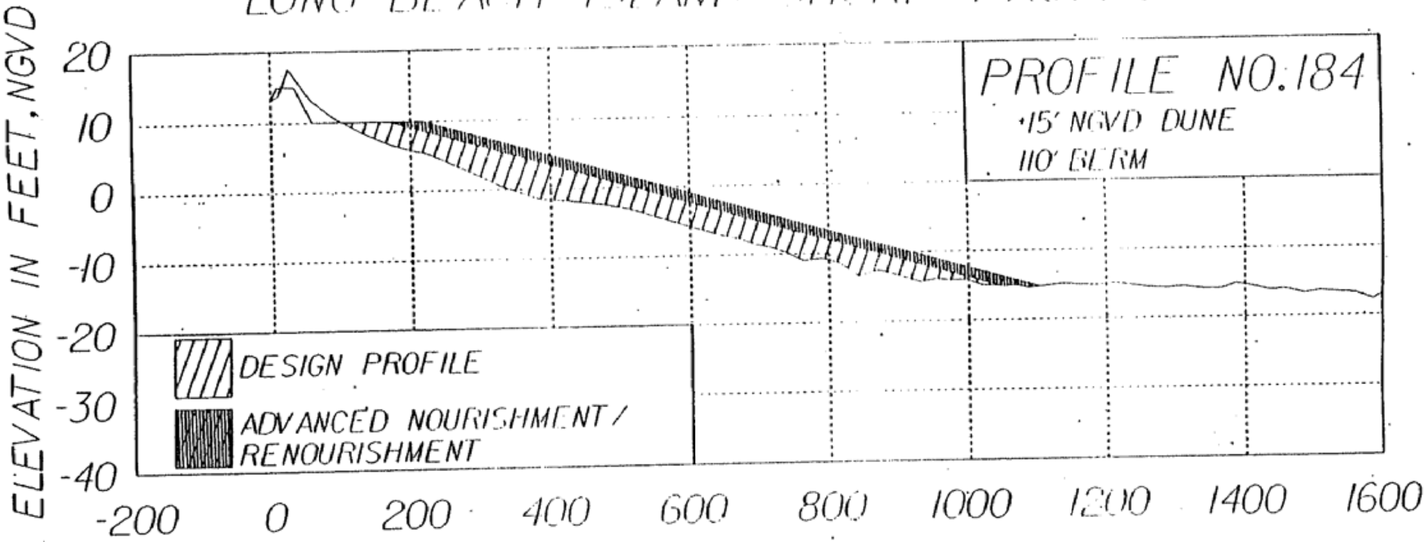
FIGURE A39

LONG BEACH ISLAND SHORE PROTECTION



DISTANCE IN FEET FROM BASE LINE

EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
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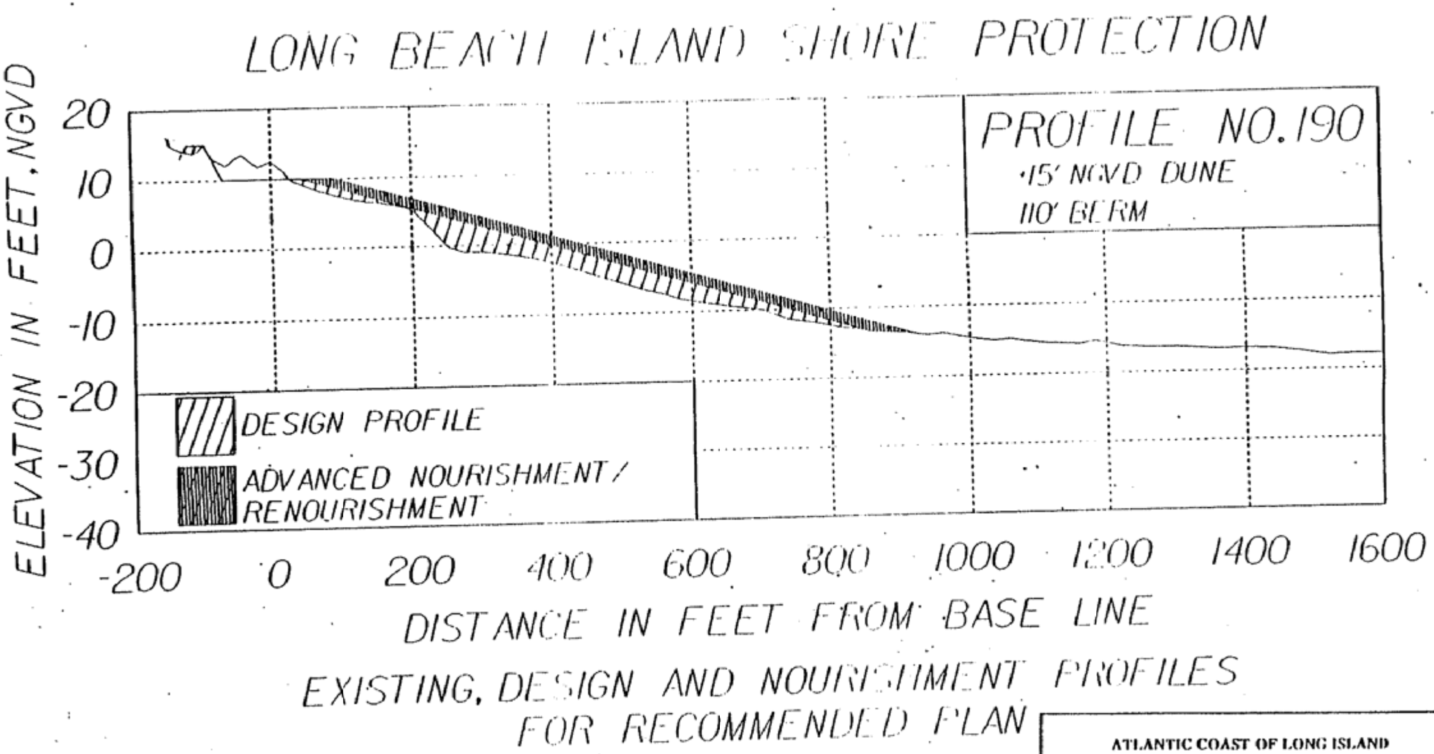
FIGURE A3[illegible]



ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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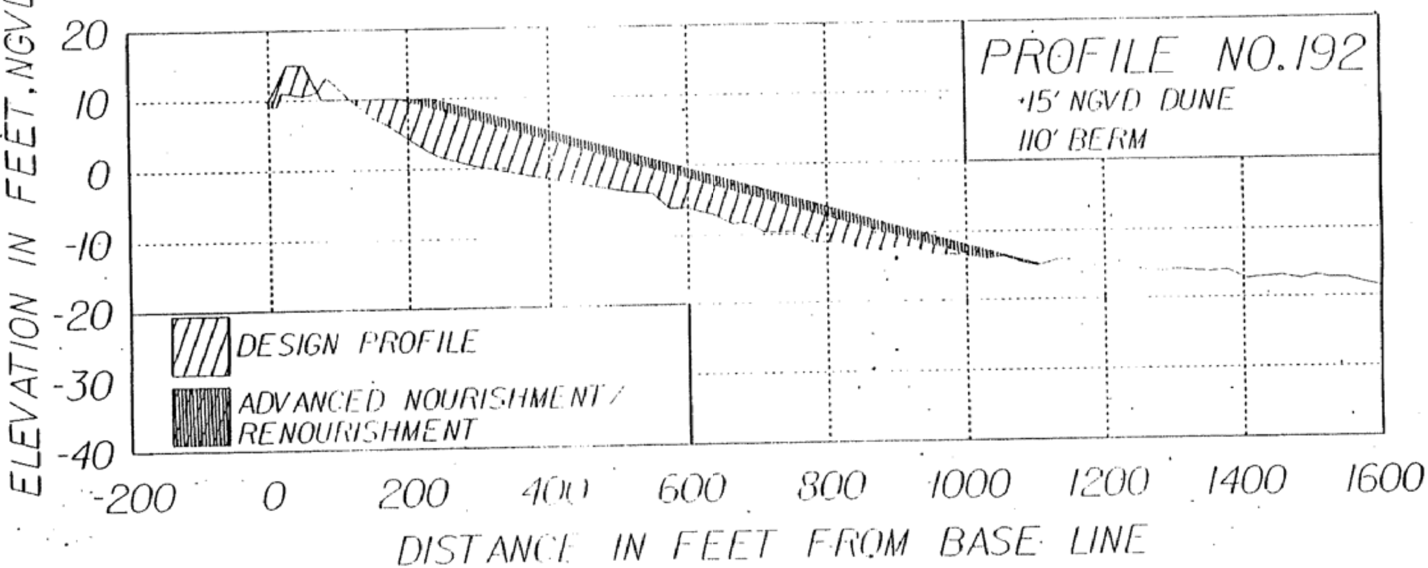
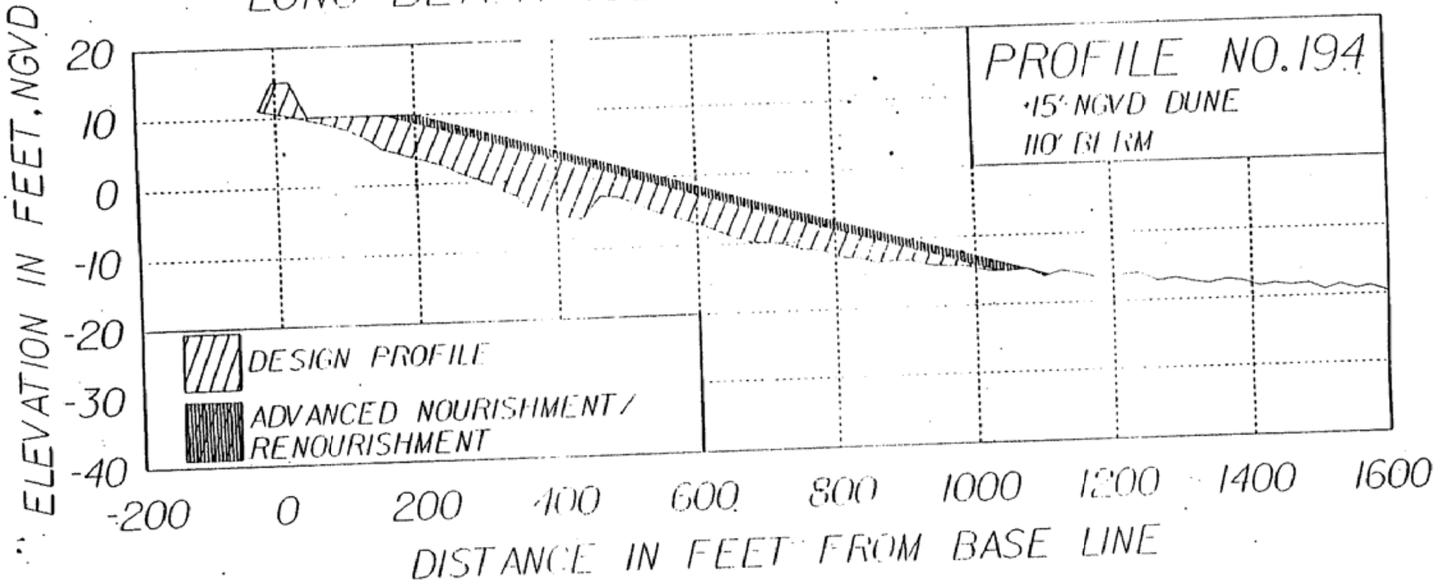
FIGURE A39-10

LONG BEACH ISLAND SHORE PROTECTION



LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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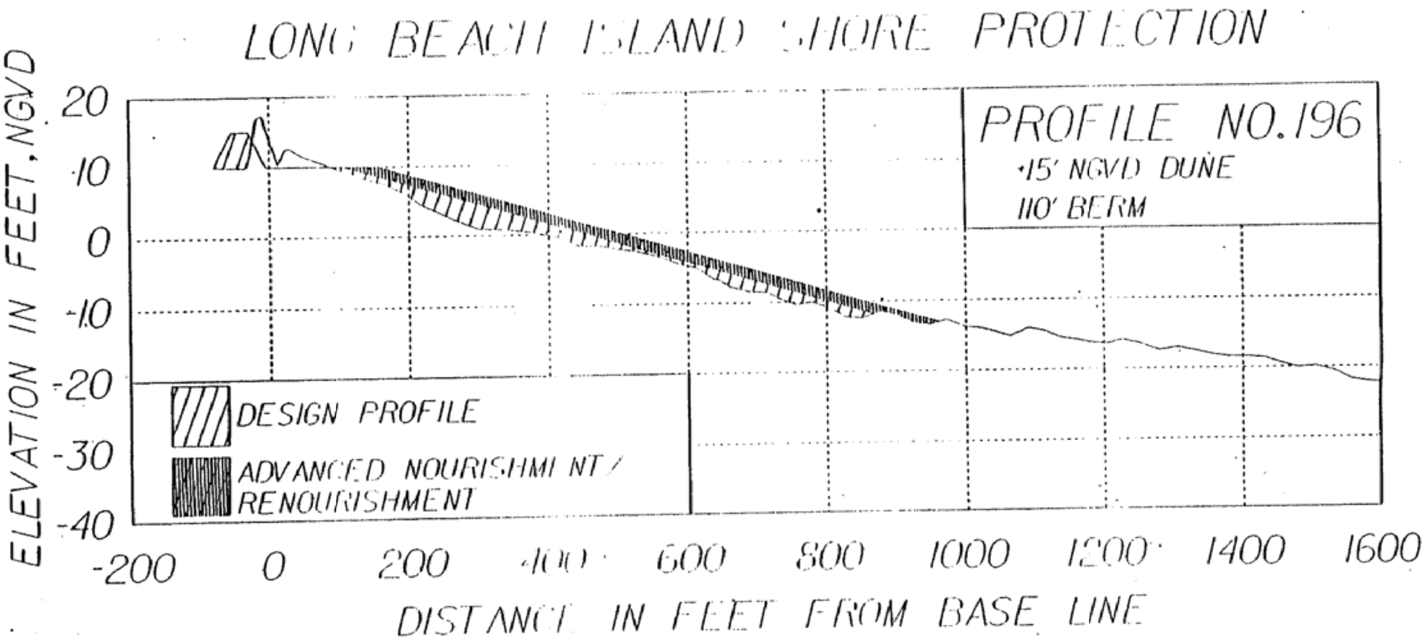
FIGURE A39



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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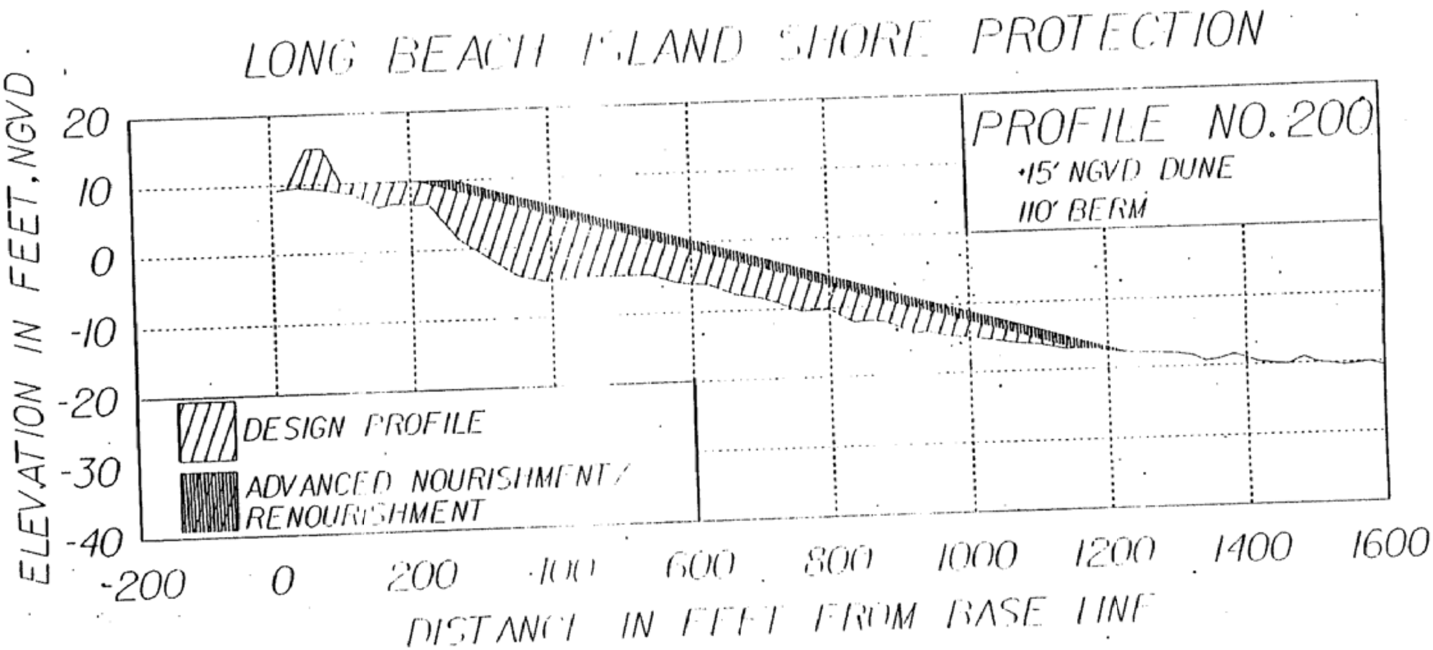
FIGURE A39–13



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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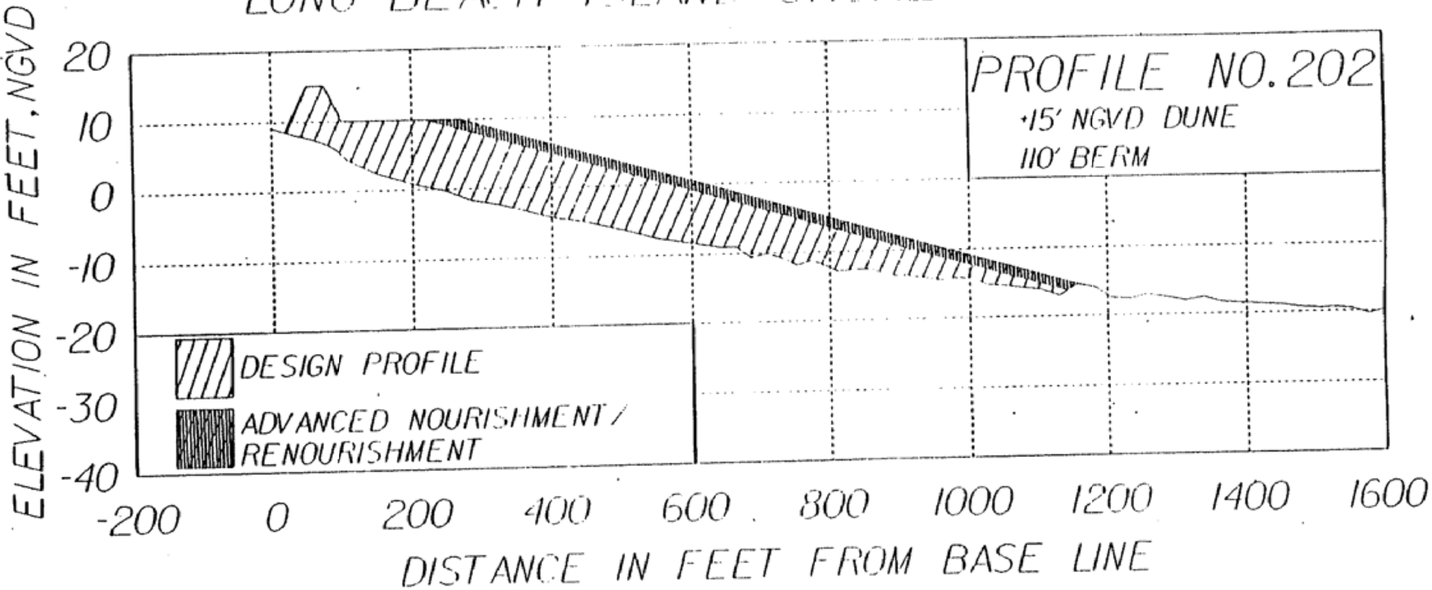
FIGURE A39-14

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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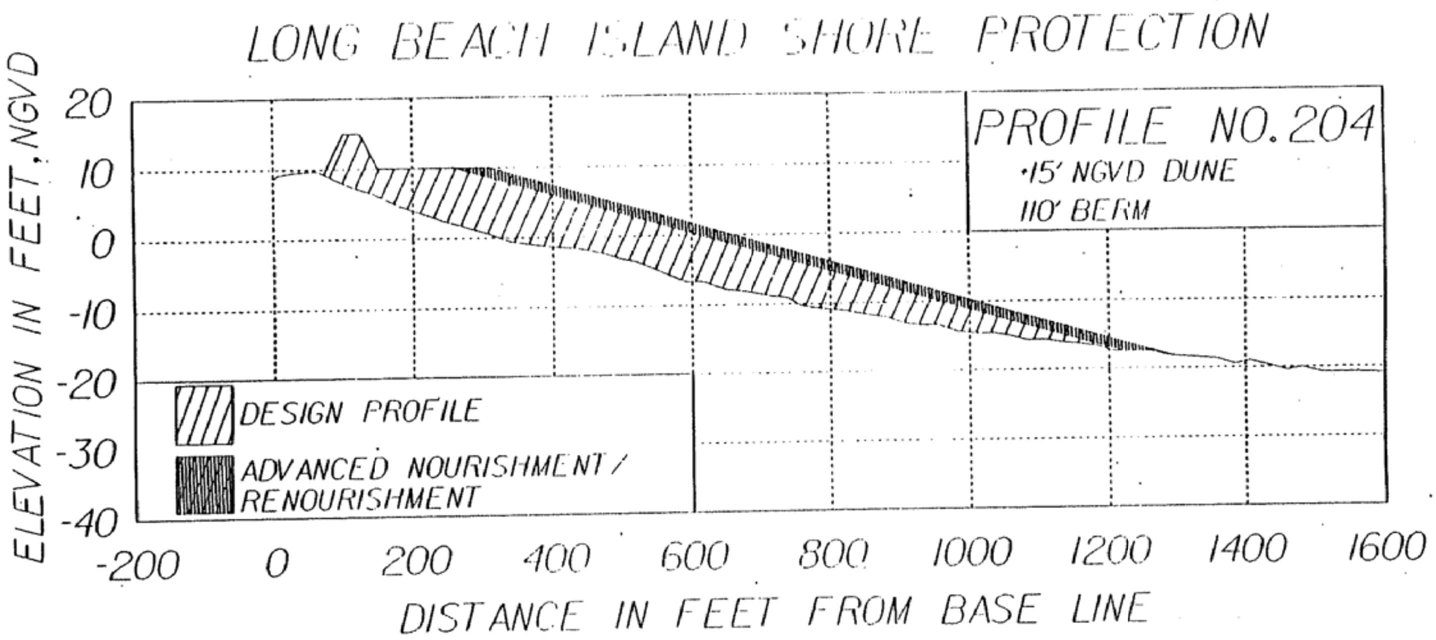
FIGURE A39-1F



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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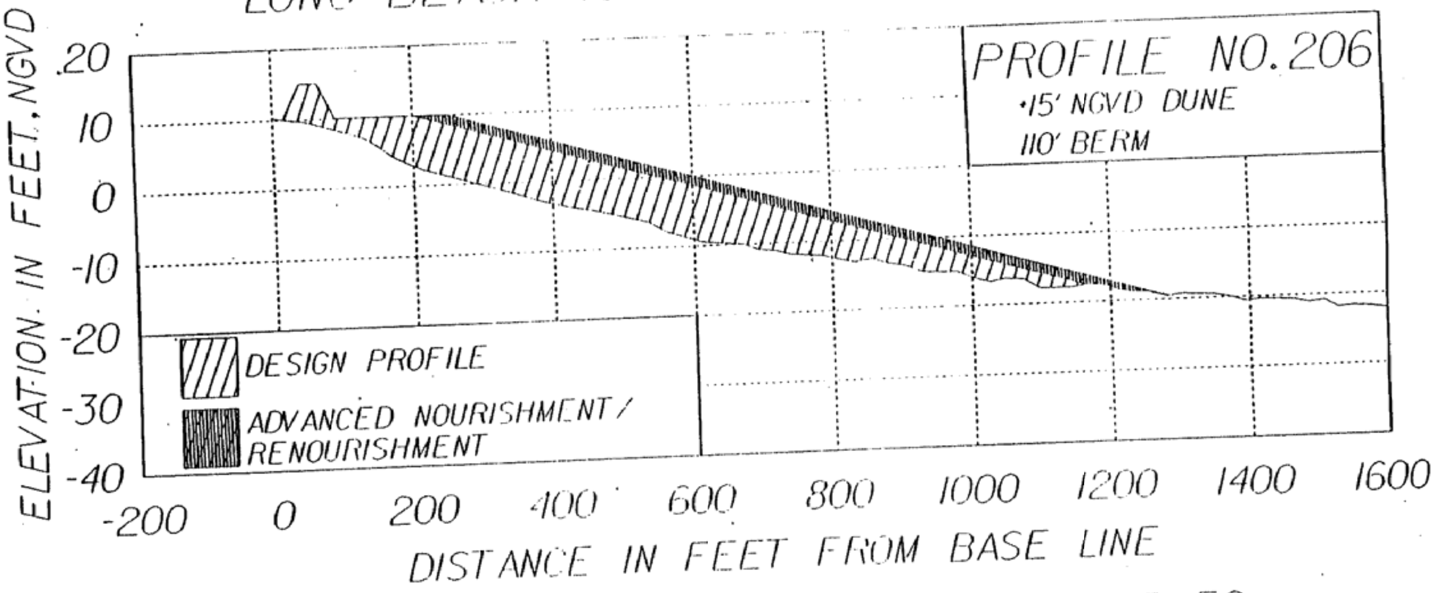
...URE A39-18

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

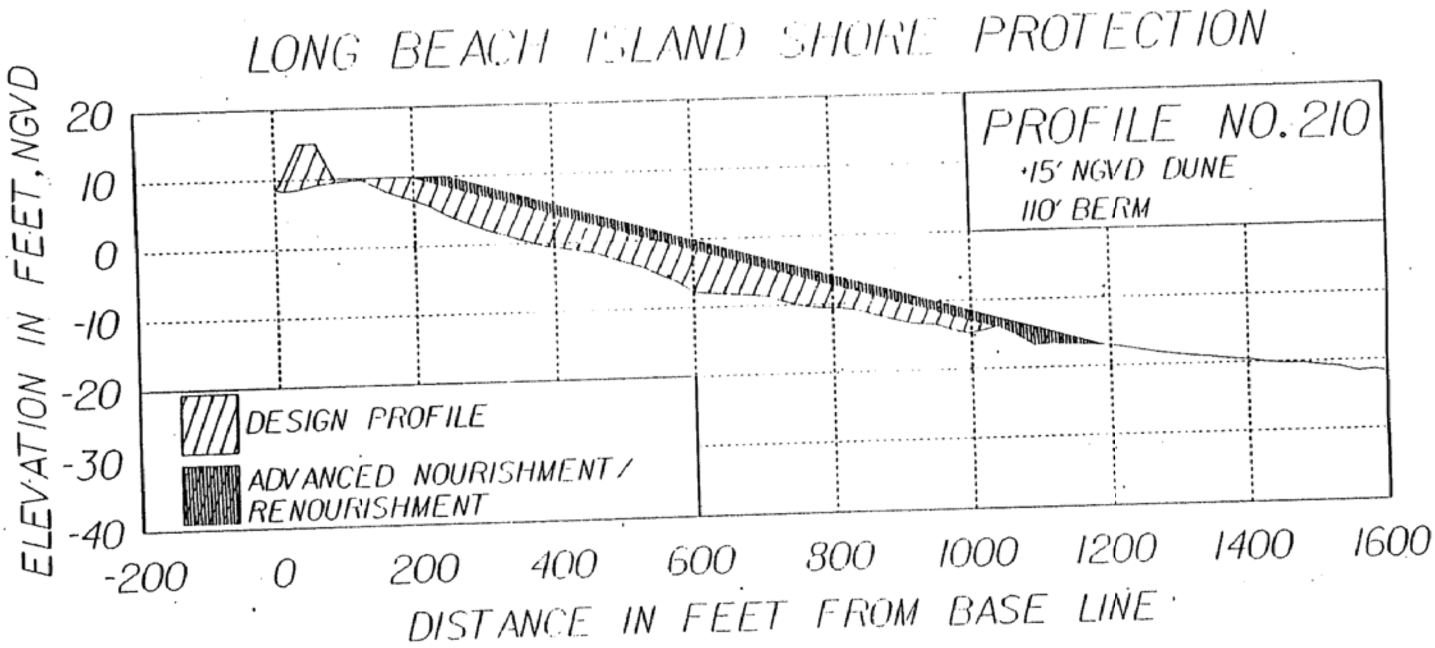
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

NASSAU CO. NEW YORK

FIGURE A39-1"



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

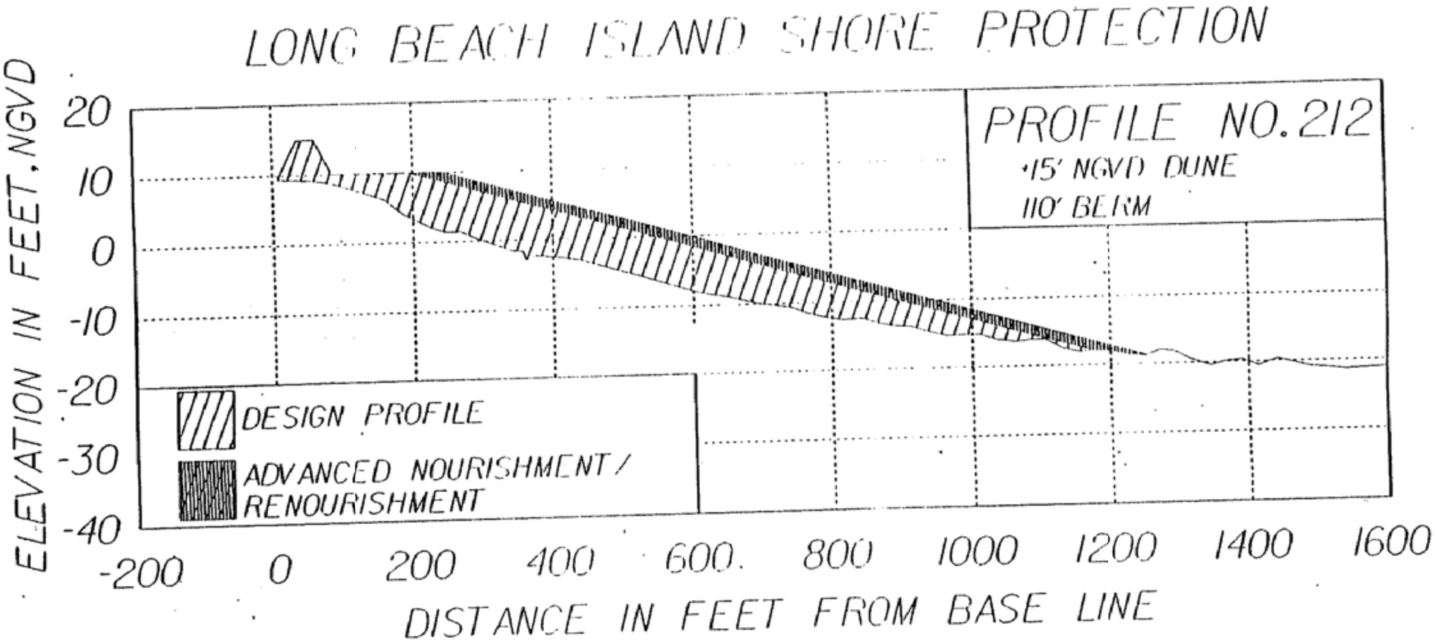
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

NASSAU CO. NEW YORK

URE A39-18



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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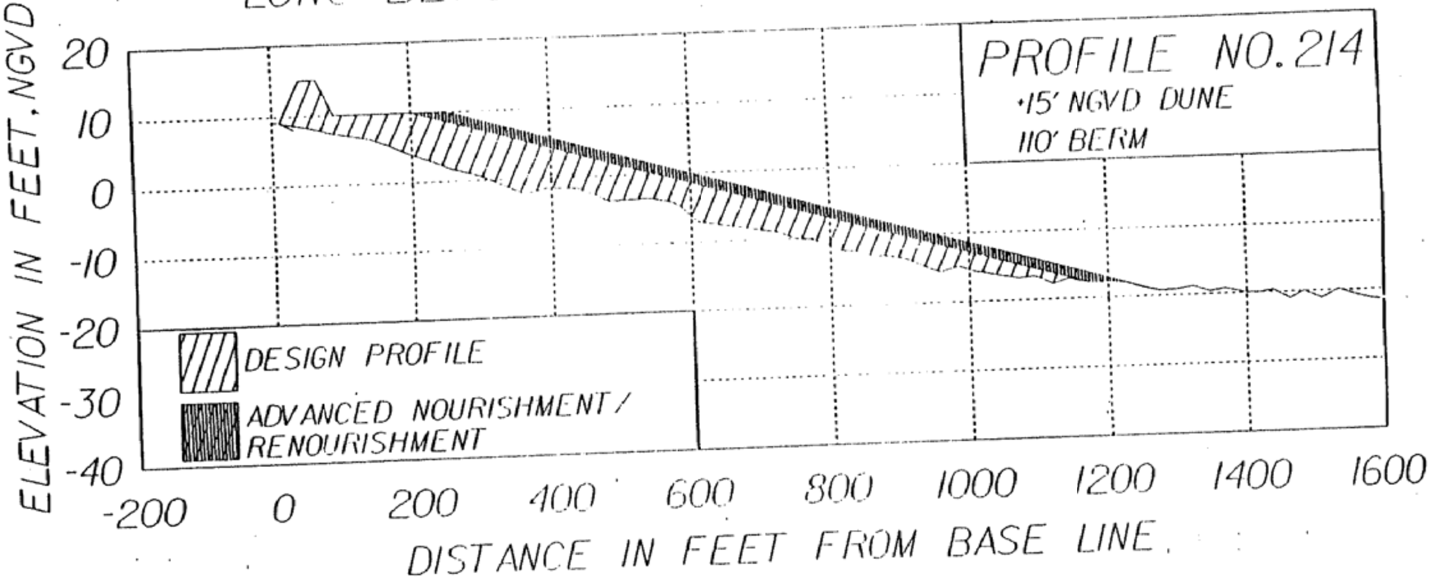
LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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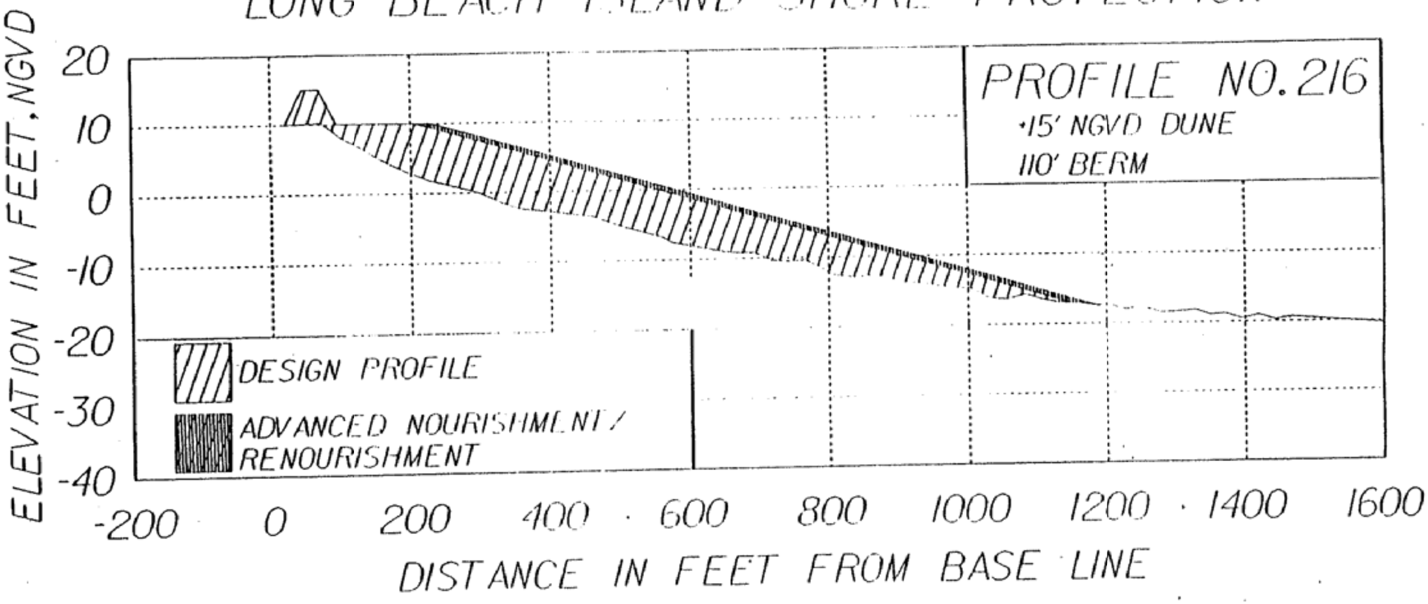
FIGURE A39-2?

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

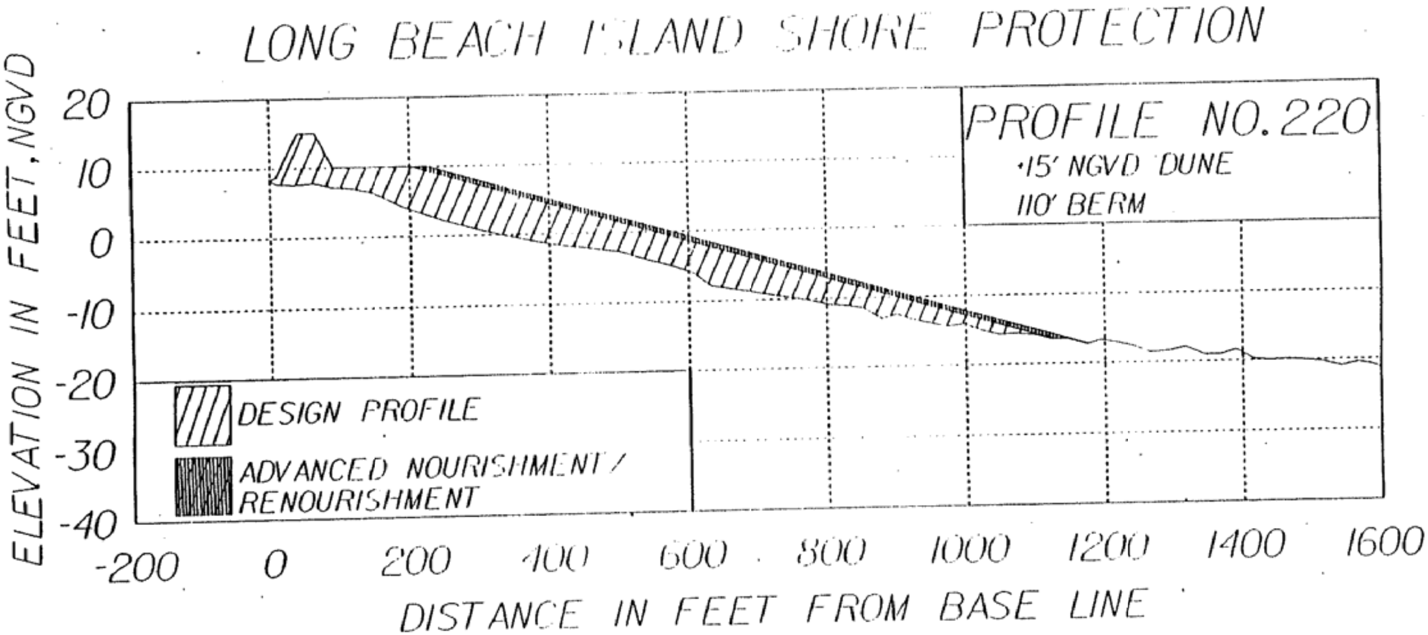
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

NASSAU CO. NEW YORK

FIGURE A39-21



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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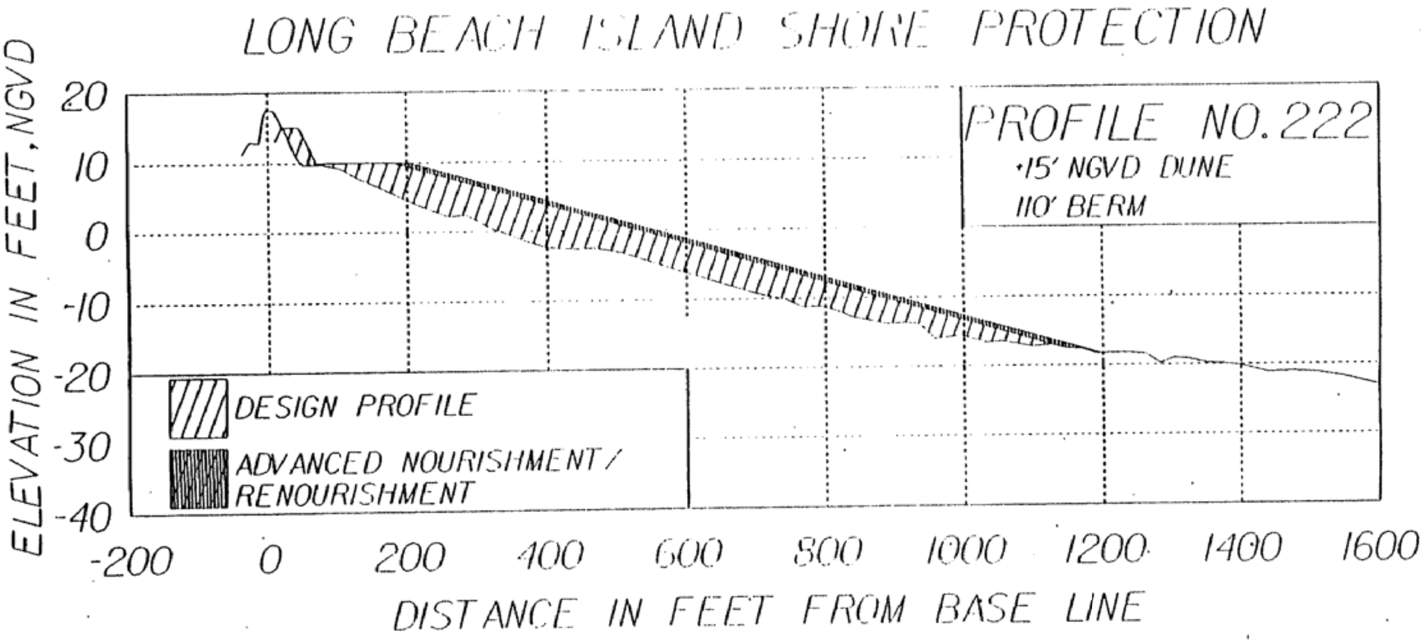
FIGURE A39-22



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

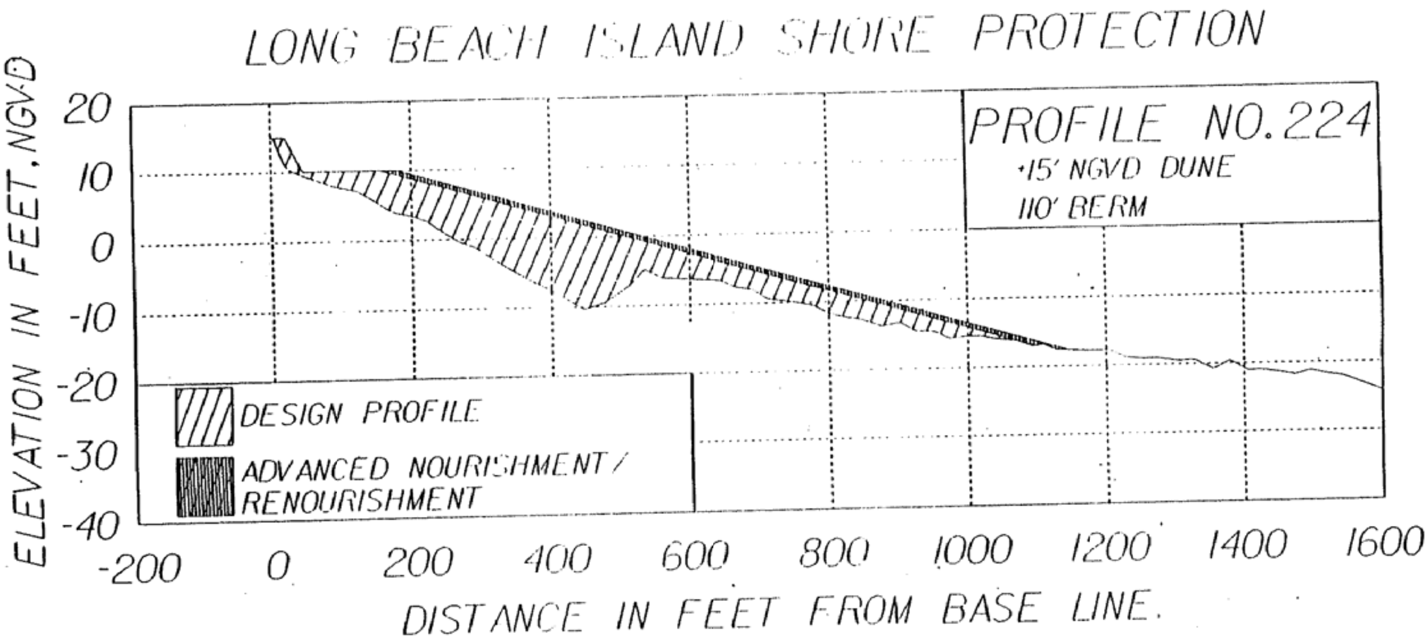
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

NASSAU CO. NEW YORK

FIGURE A39-23



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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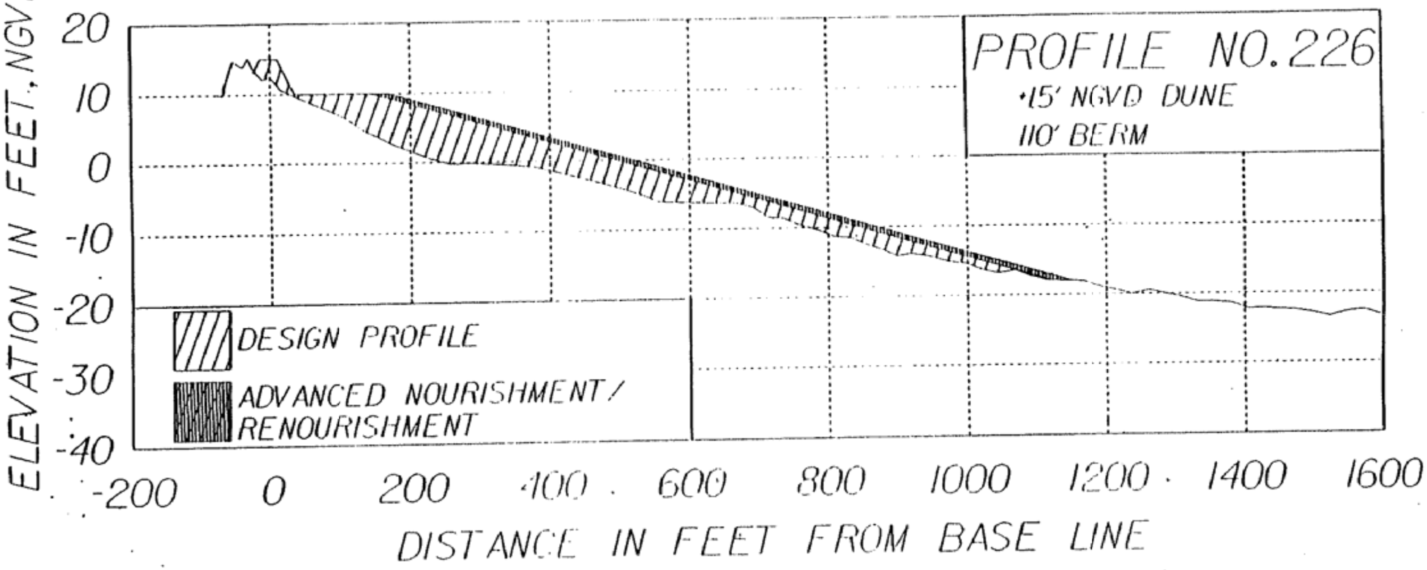
FIGURE A39-24

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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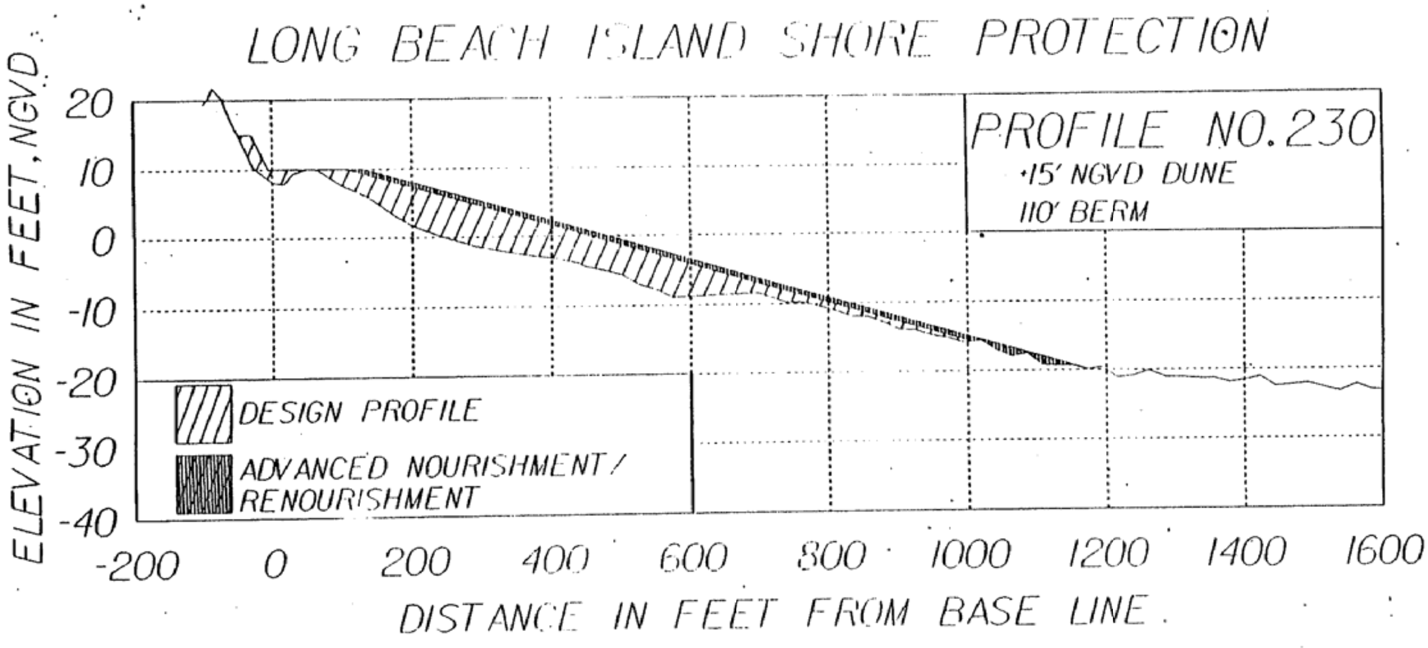
FIGURE A39–25



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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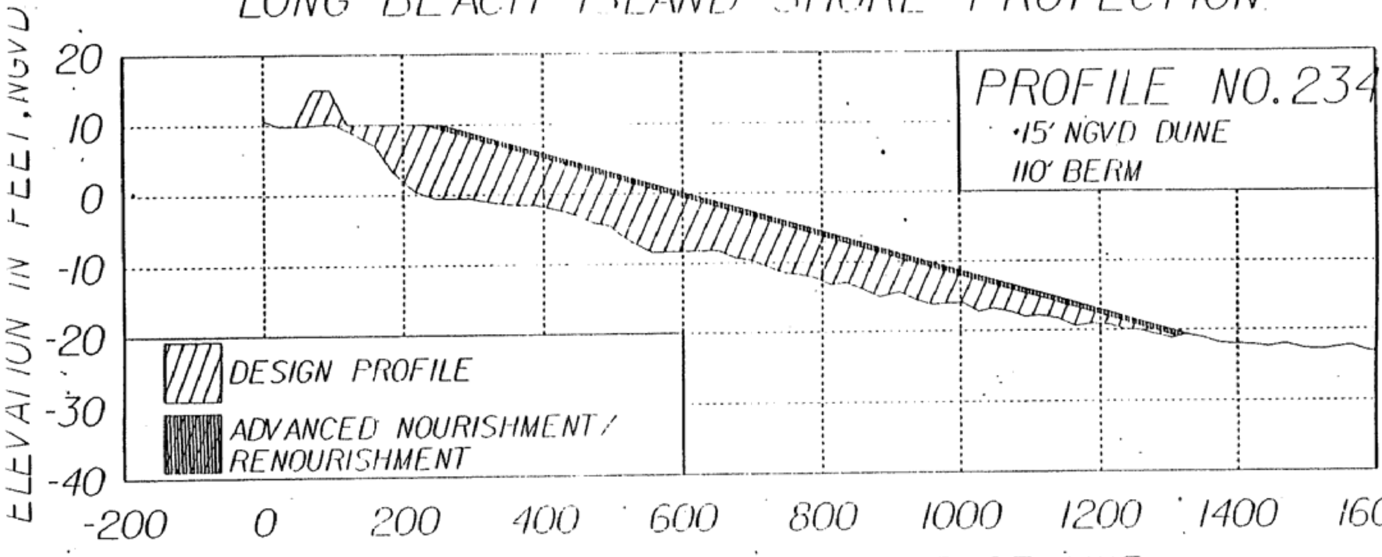
FIGURE A39-26

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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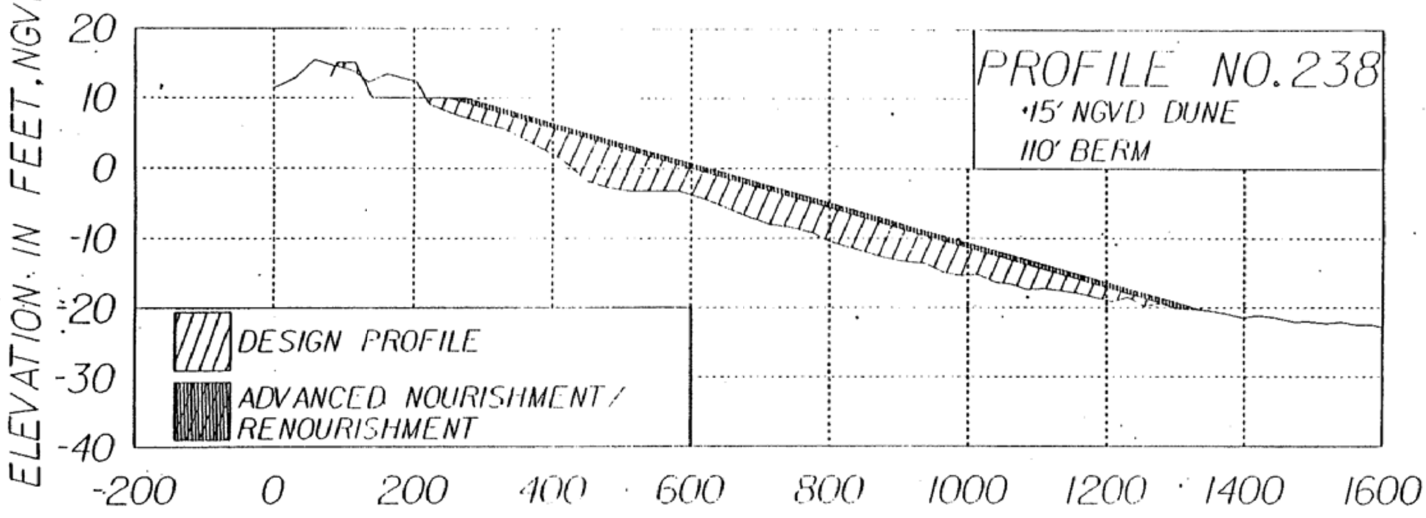
FIGURE A39-27

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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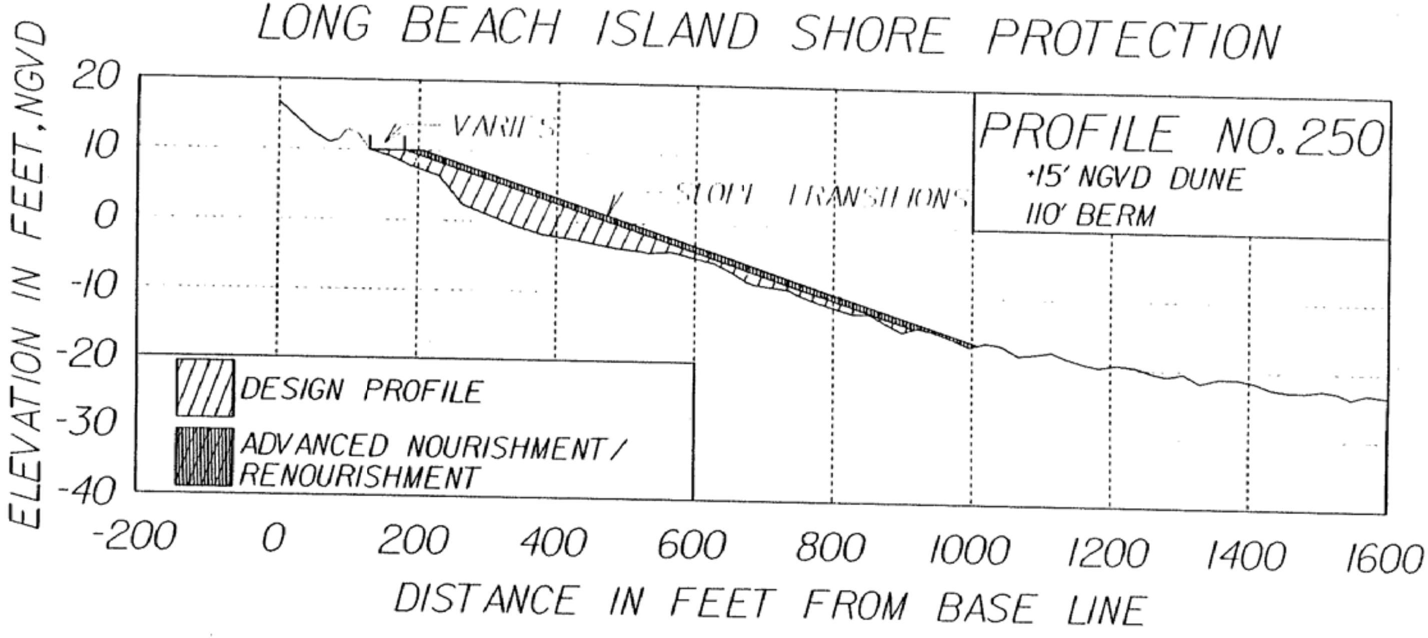
FIGURE A39-28

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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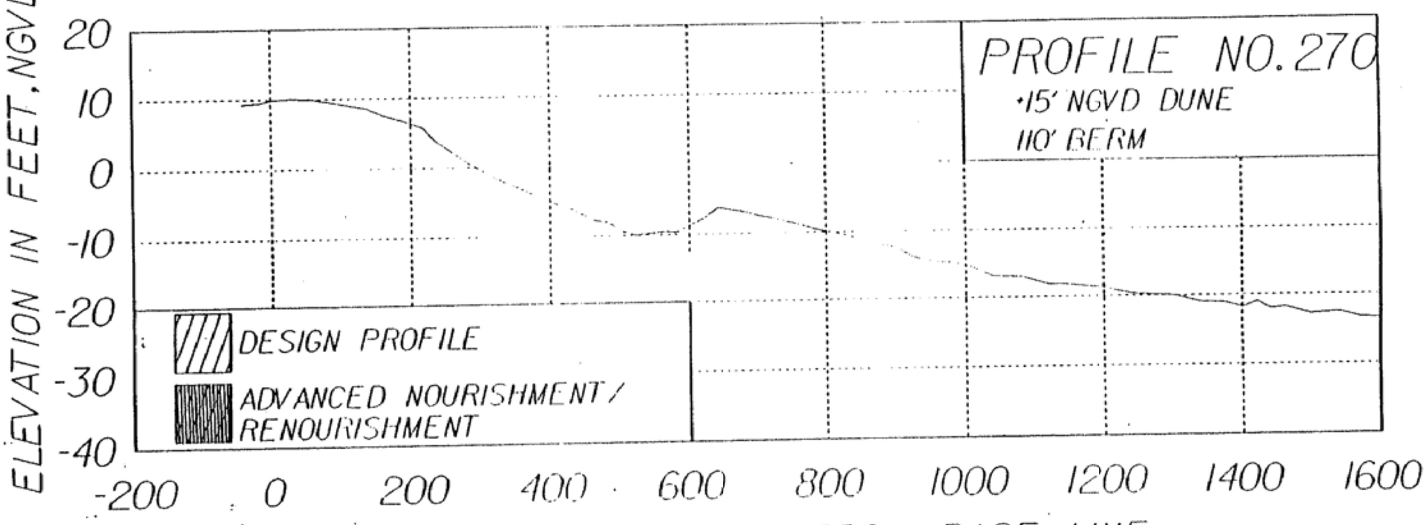
FIGURE A39-29

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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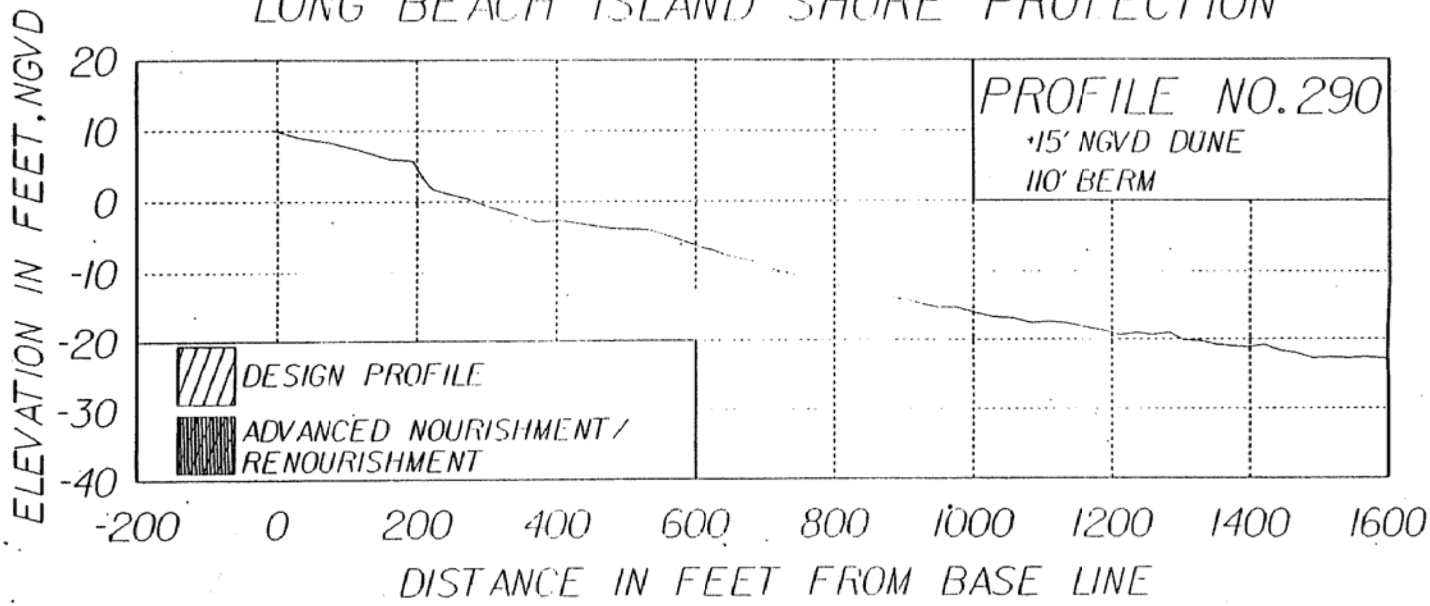
FIGURE A39-30

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES FOR RECOMMENDED PLAN

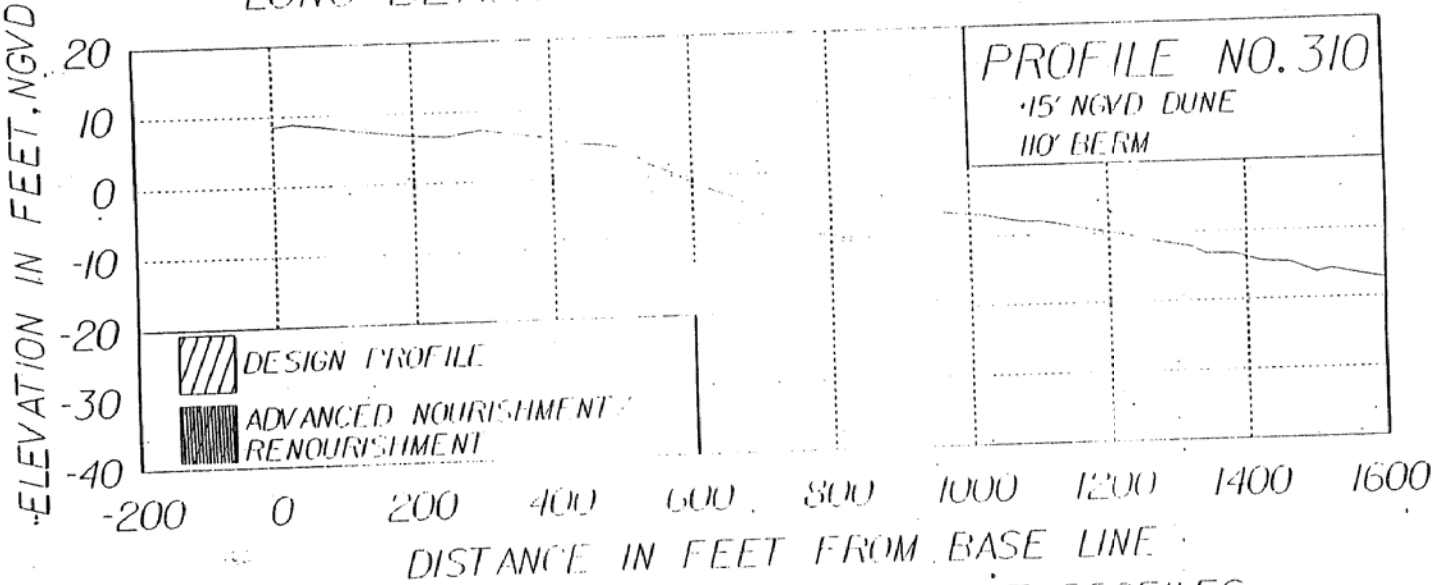
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

NASSAU CO. NEW YORK

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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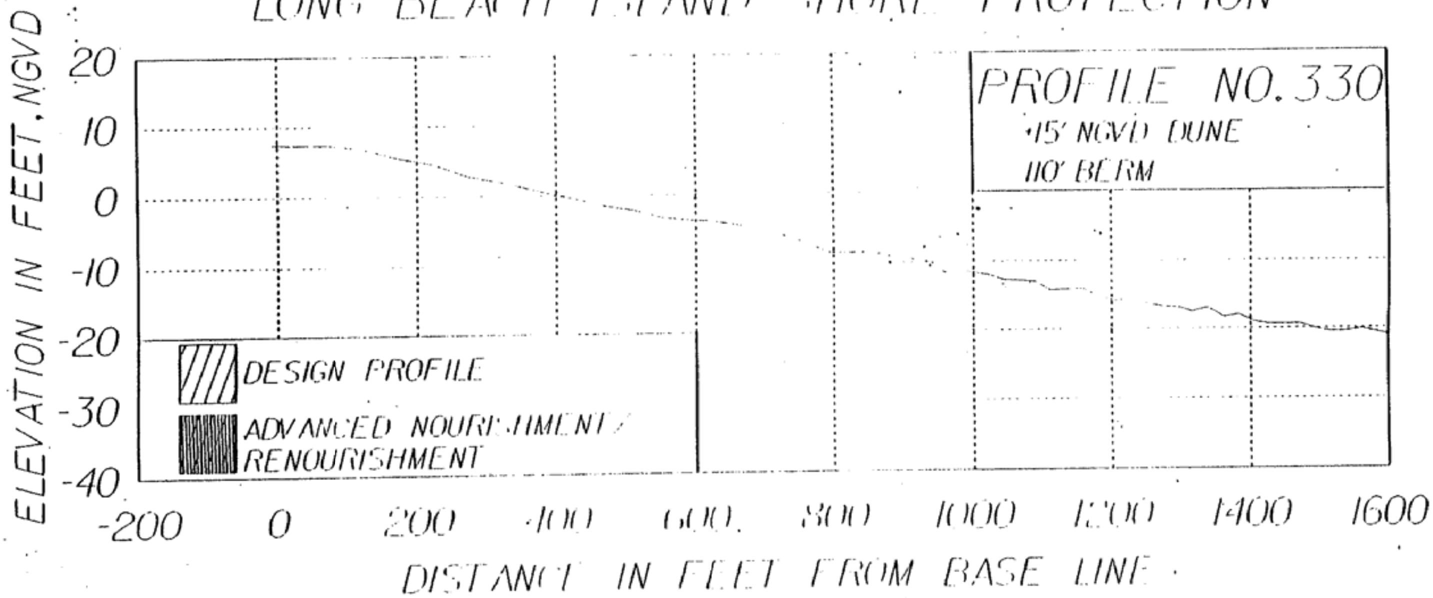
FIGURE A39-32

LONG BEACH ISLAND SHORE PROTECTION



EXISTING, DESIGN AND NOURISHMENT PROFILES
FOR RECOMMENDED PLAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

IMPROVED BEACH CROSS SECTION

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FIGURE A39

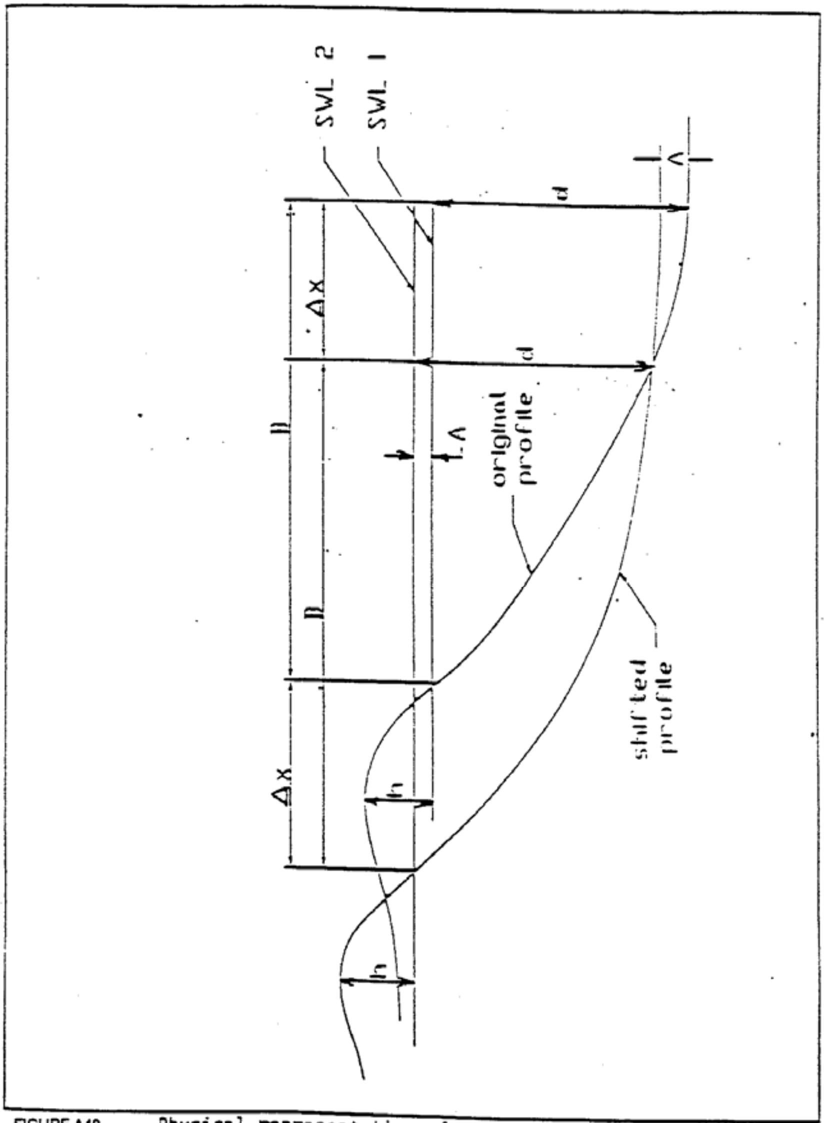
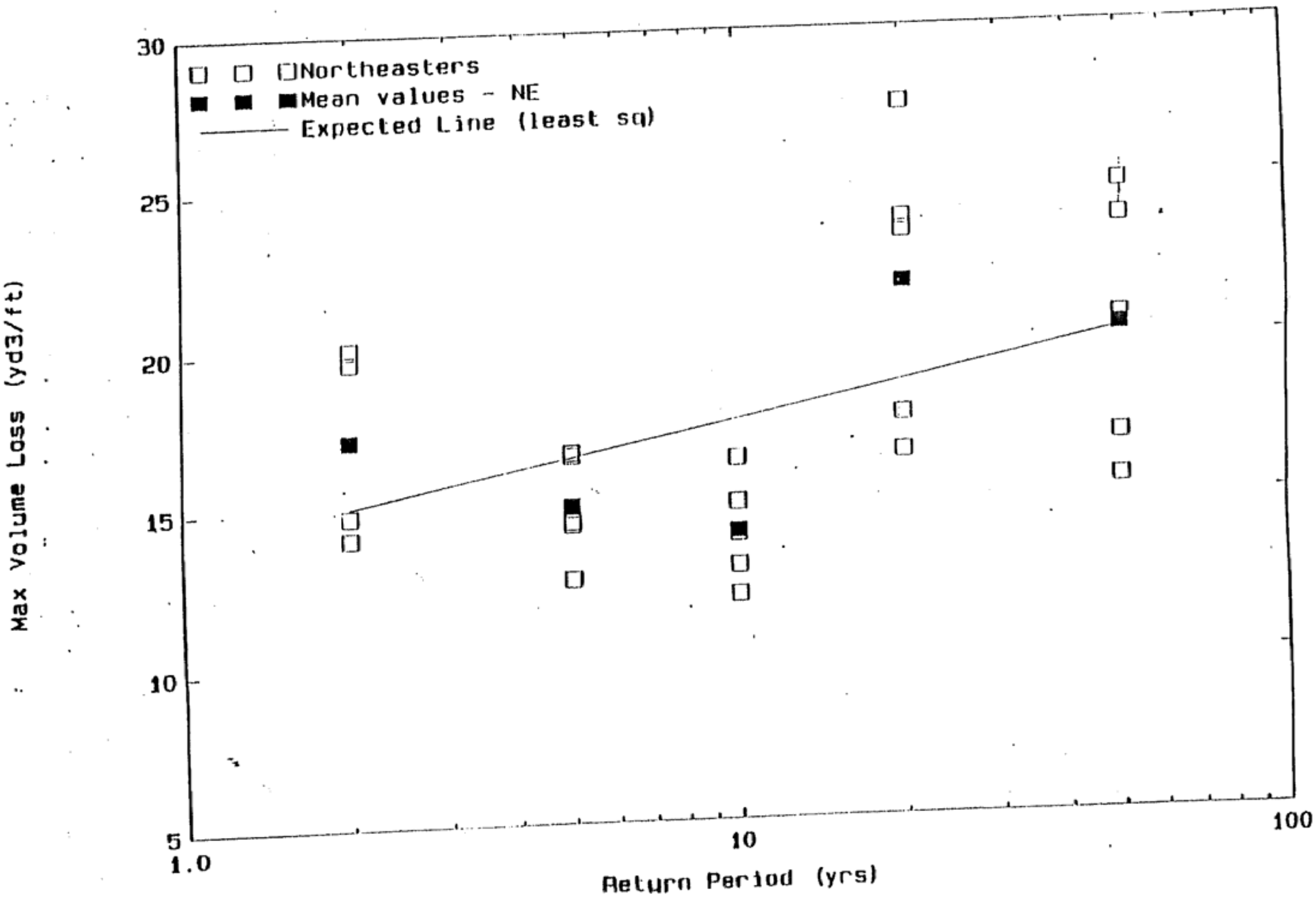
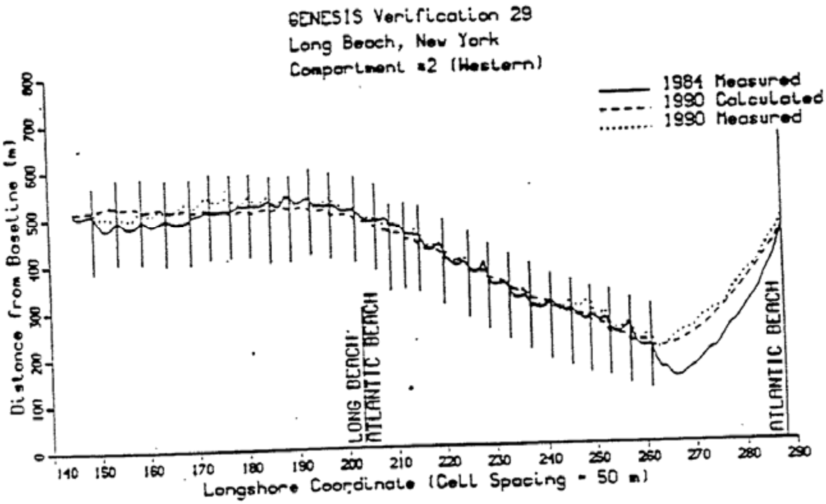


FIGURE A40 Physical representation of the Bruun Rule.

FIGURE A41 Maximum Volume Loss at any Point on the Profile: Profile 238





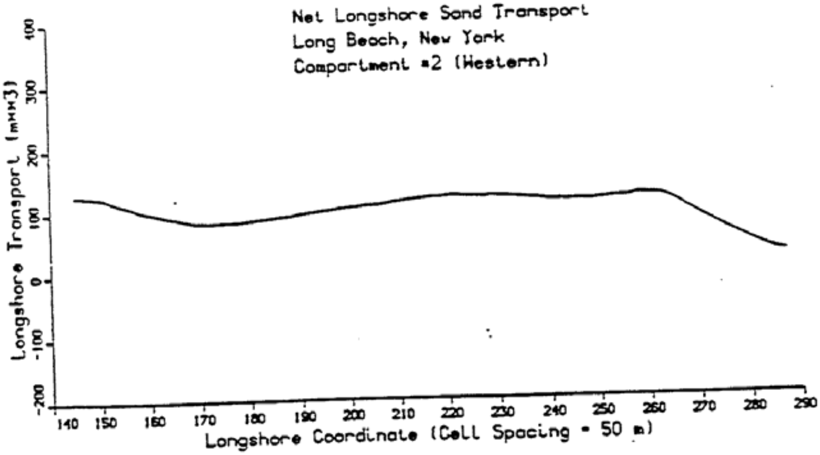
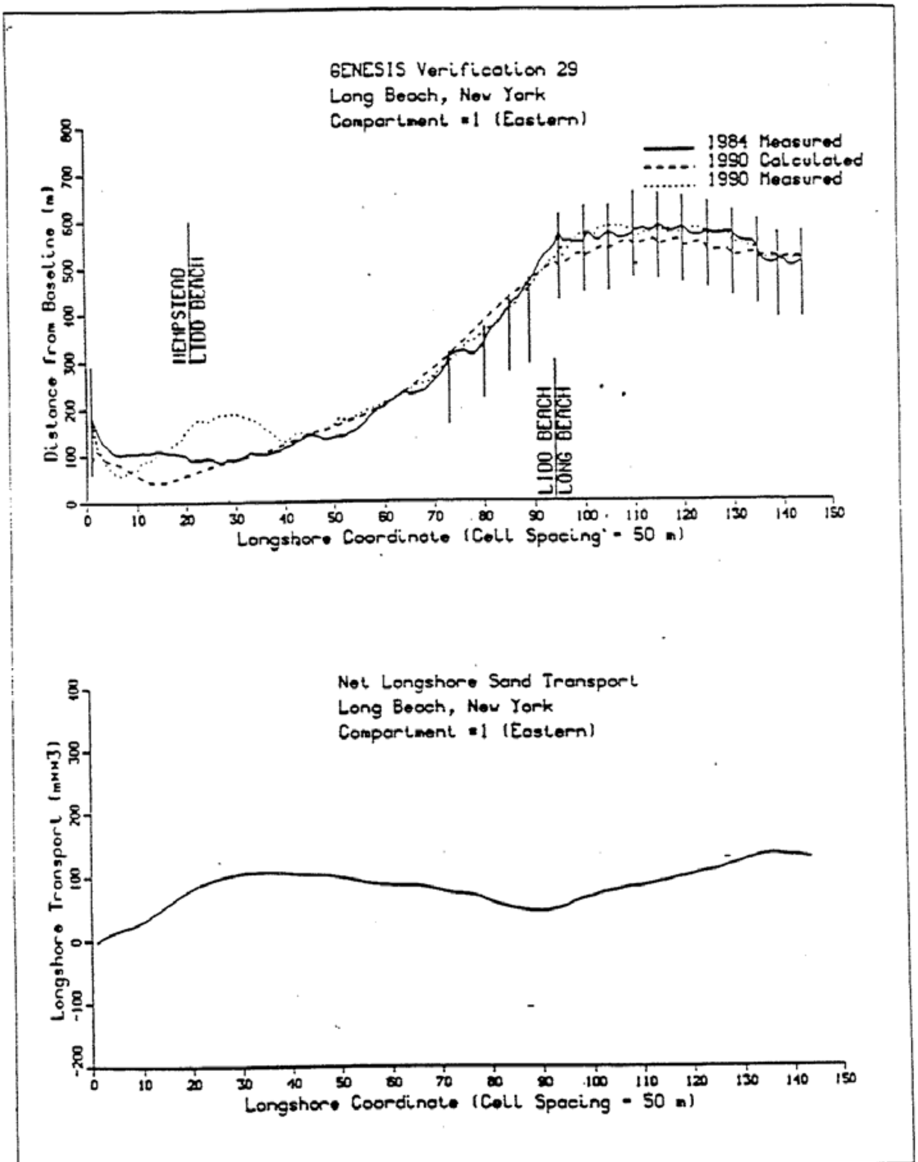
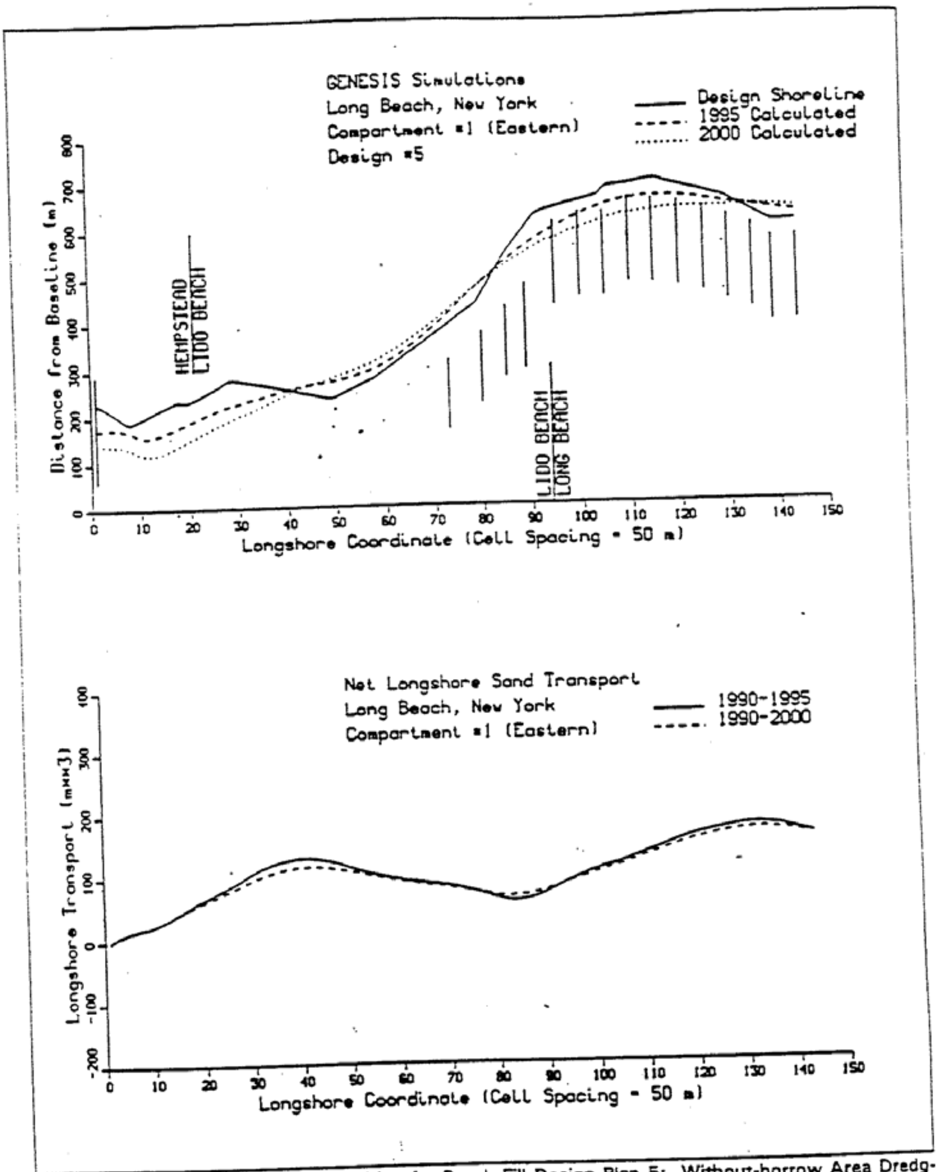


Figure A42. Long Beach, New York, Final Verification Simulation



FigureA42b Long Beach, New York, Final Verification Simulation



FigureA43a Predicted Shoreline Position for Beach Fill Design Plan 5: Without-borrow Area Dredging

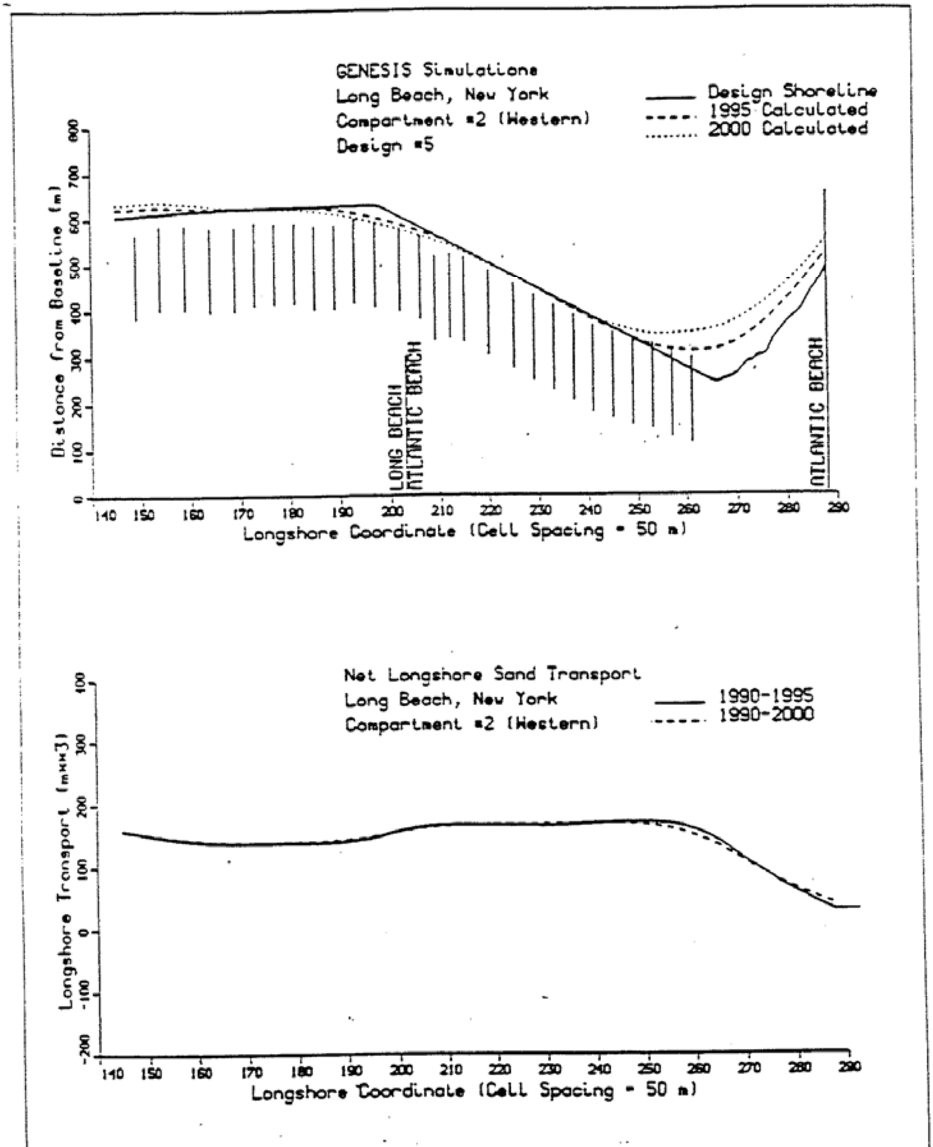


Figure A43b Predicted Shoreline Position for Beach Fill Design Plan 5: Without-borrow Area Dredging

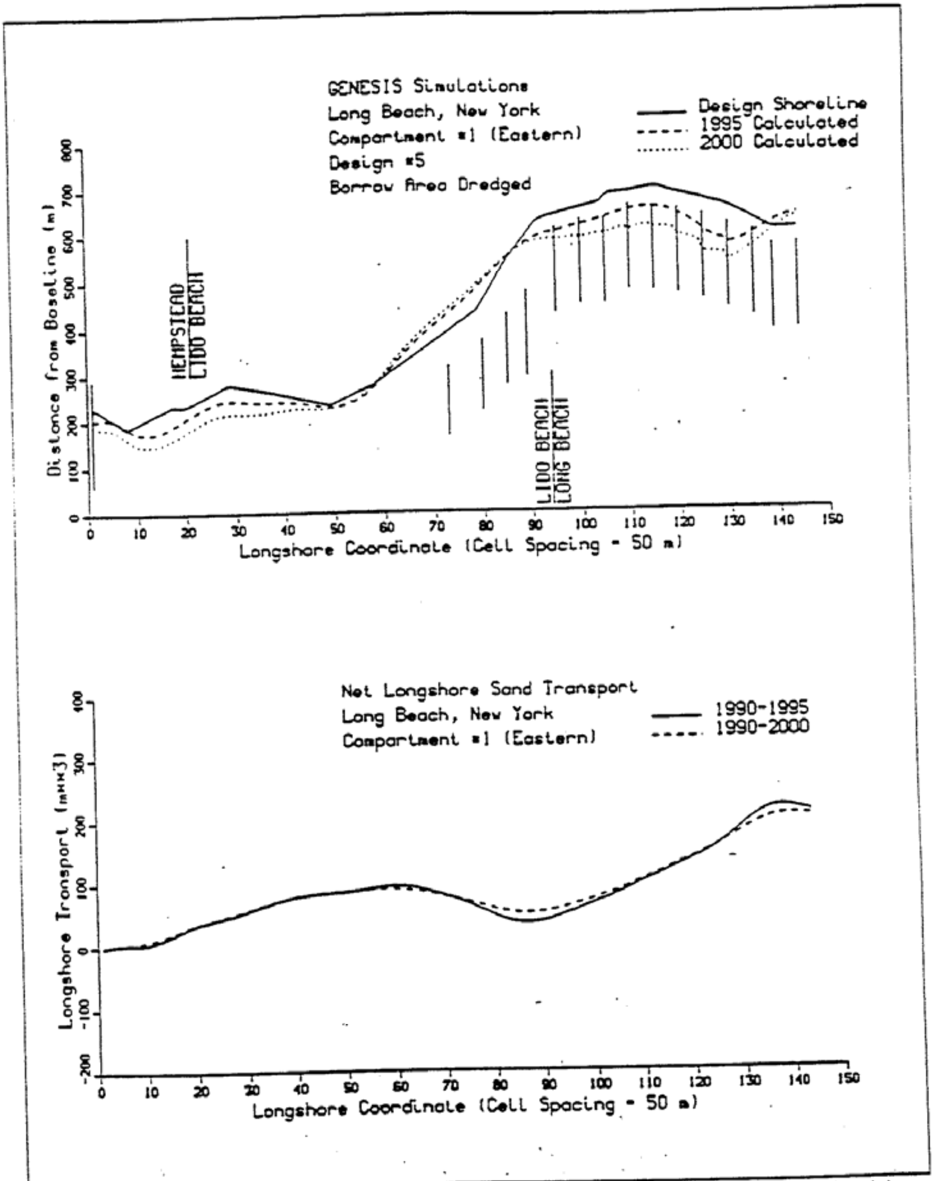


Figure A44a Predicted Shoreline Position for Beach Fill Design Plan 5: With-borrow Area Dredging

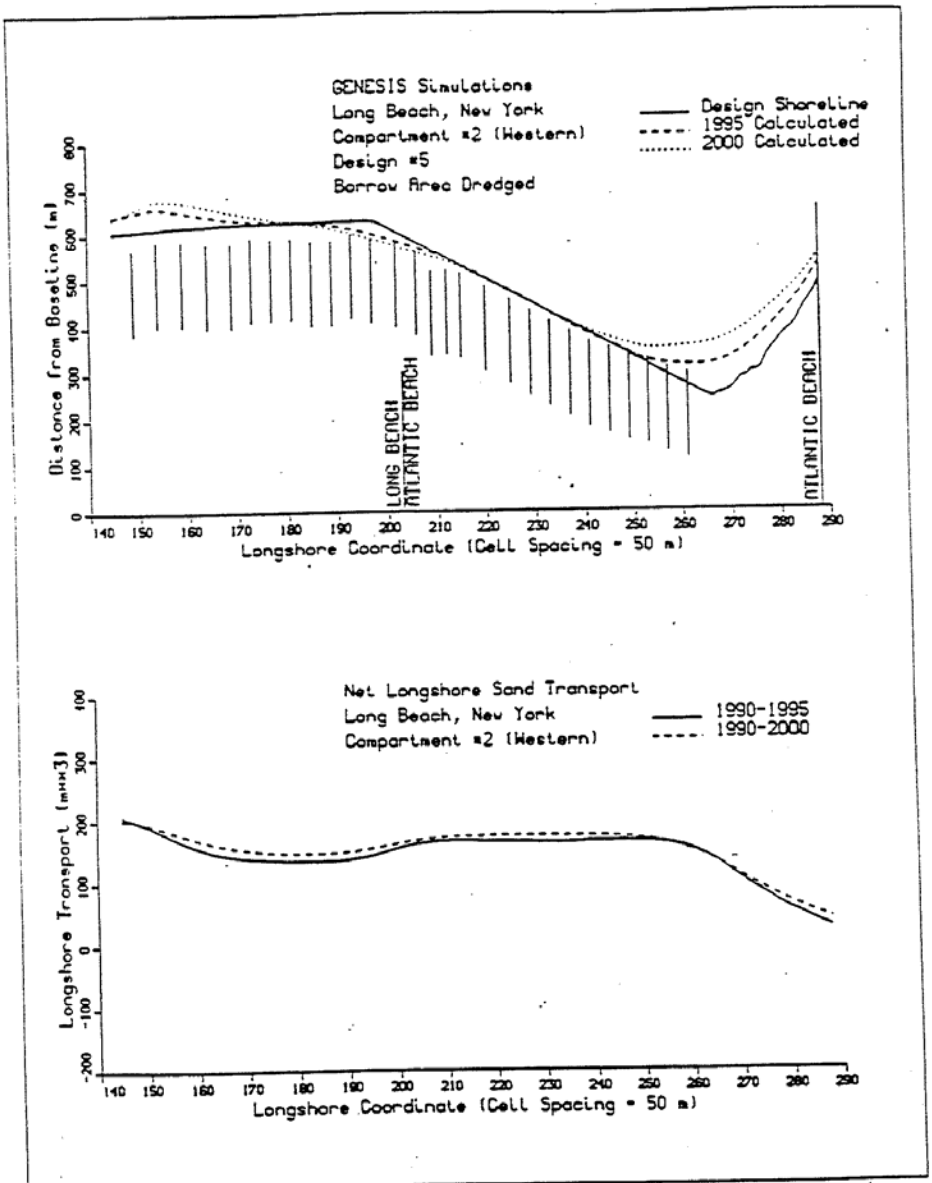


Figure A44b Predicted Shoreline Position for Beach Fill Design Plan 5: With-borrow Area Dredging

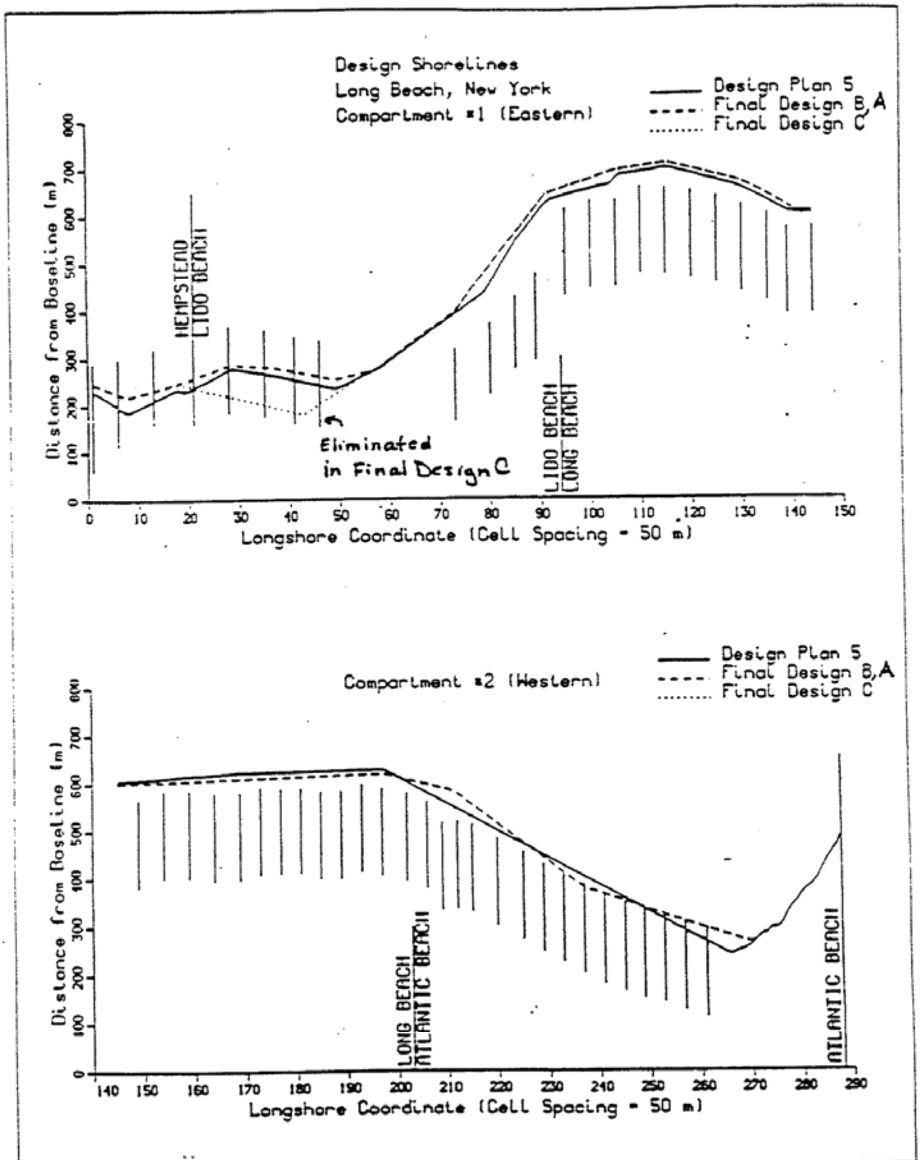


Figure A45 Final Design Shorelines Relative to Design Plan 5

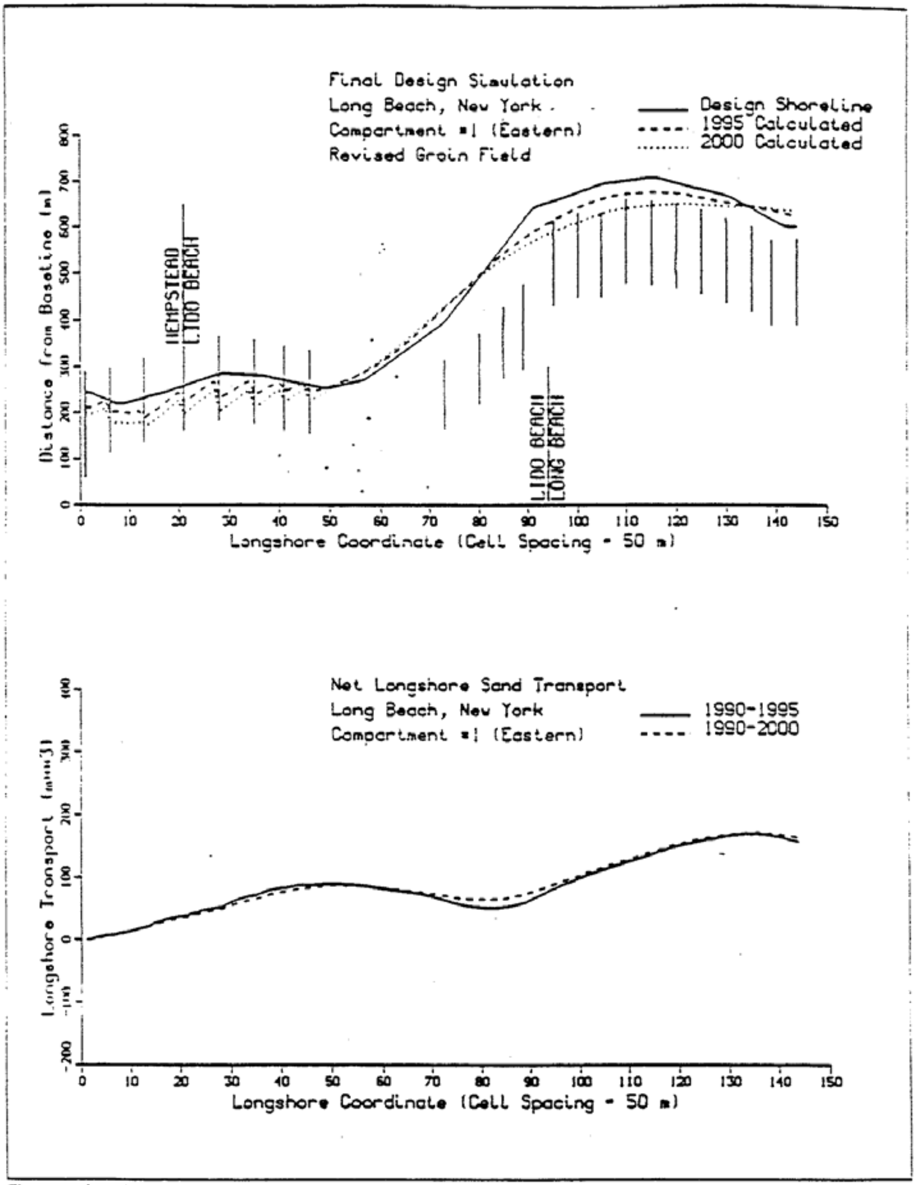


Figure A46 Predicted Shoreline Position for Design Plan B: Without-borrow Area Dredging

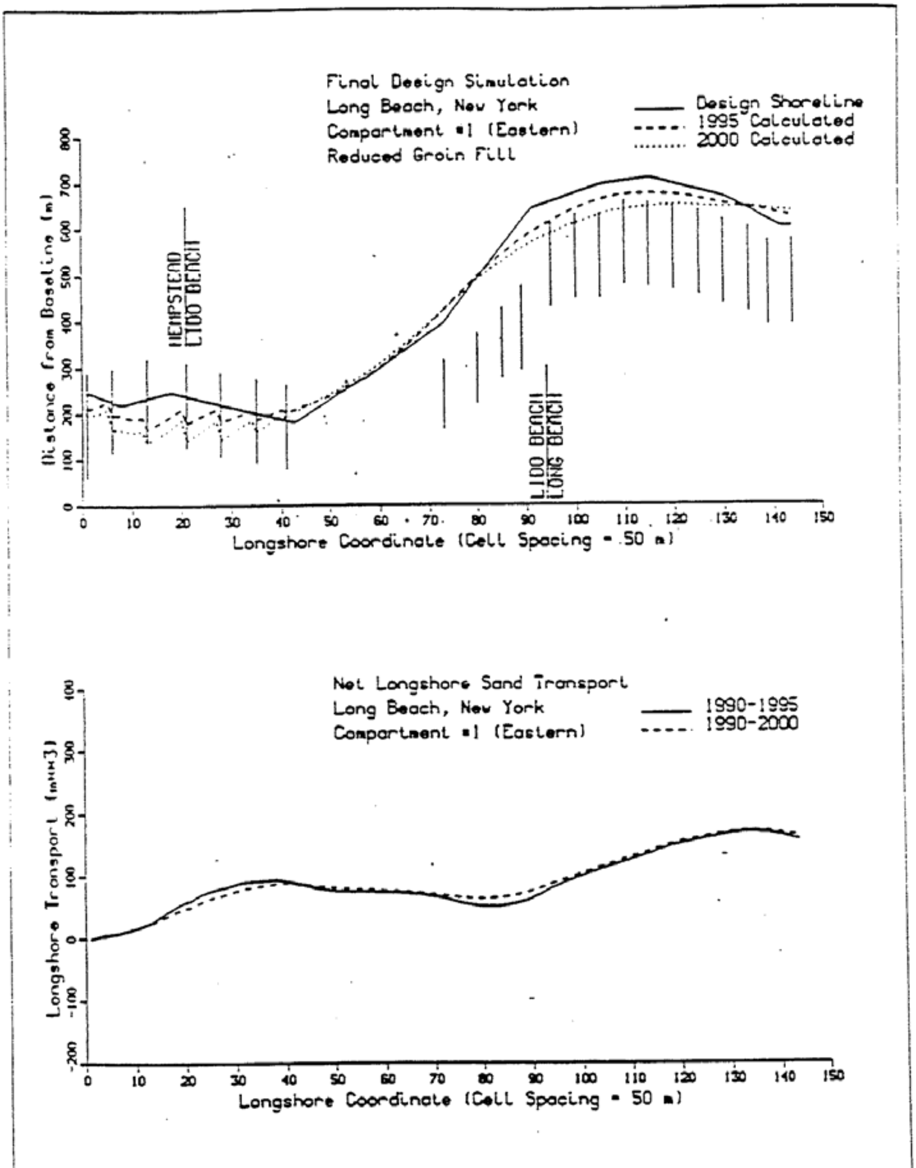
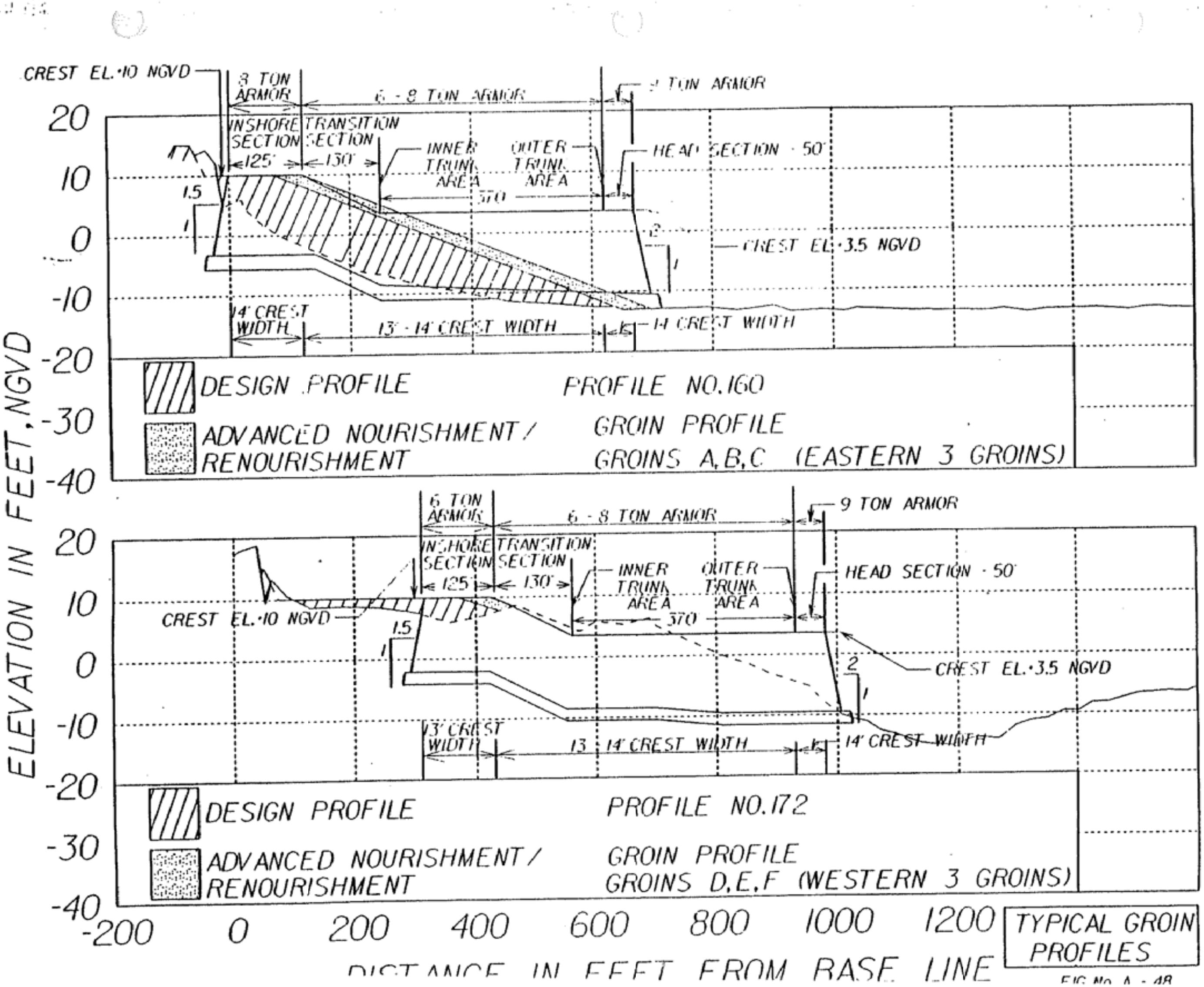


Figure A47 Predicted Shoreline Position for Final Design Plan C: Without-borrow Area Dredging



CREST EL.·10 NGVD
3 TON ARMOR
6 - 8 TON ARMOR
9 TON ARMOR
INSHORE SECTION
TRANSITION SECTION
125'
130'
INNER TRUNK AREA
OUTER TRUNK AREA
370'
HEAD SECTION · 50'
CREST EL.·3.5 NGVD
14' CREST WIDTH
13' - 14' CREST WIDTH
14' CREST WIDTH
DESIGN PROFILE
ADVANCED NOURISHMENT / RENOURISHMENT
PROFILE NO.160
GROIN PROFILE
GROINS A,B,C (EASTERN 3 GROINS)
6 TON ARMOR
6 - 8 TON ARMOR
9 TON ARMOR
INSHORE SECTION
TRANSITION SECTION
125'
130'
INNER TRUNK AREA
OUTER TRUNK AREA
370'
HEAD SECTION · 50'
CREST EL.·10 NGVD
CREST EL.·3.5 NGVD
13' CREST WIDTH
13 - 14' CREST WIDTH
14' CREST WIDTH
DESIGN PROFILE
ADVANCED NOURISHMENT / RENOURISHMENT
PROFILE NO.172
GROIN PROFILE
GROINS D,E,F (WESTERN 3 GROINS)
ELEVATION IN FEET, NGVD
DISTANCE IN FEET FROM BASE LINE
TYPICAL GROIN PROFILES

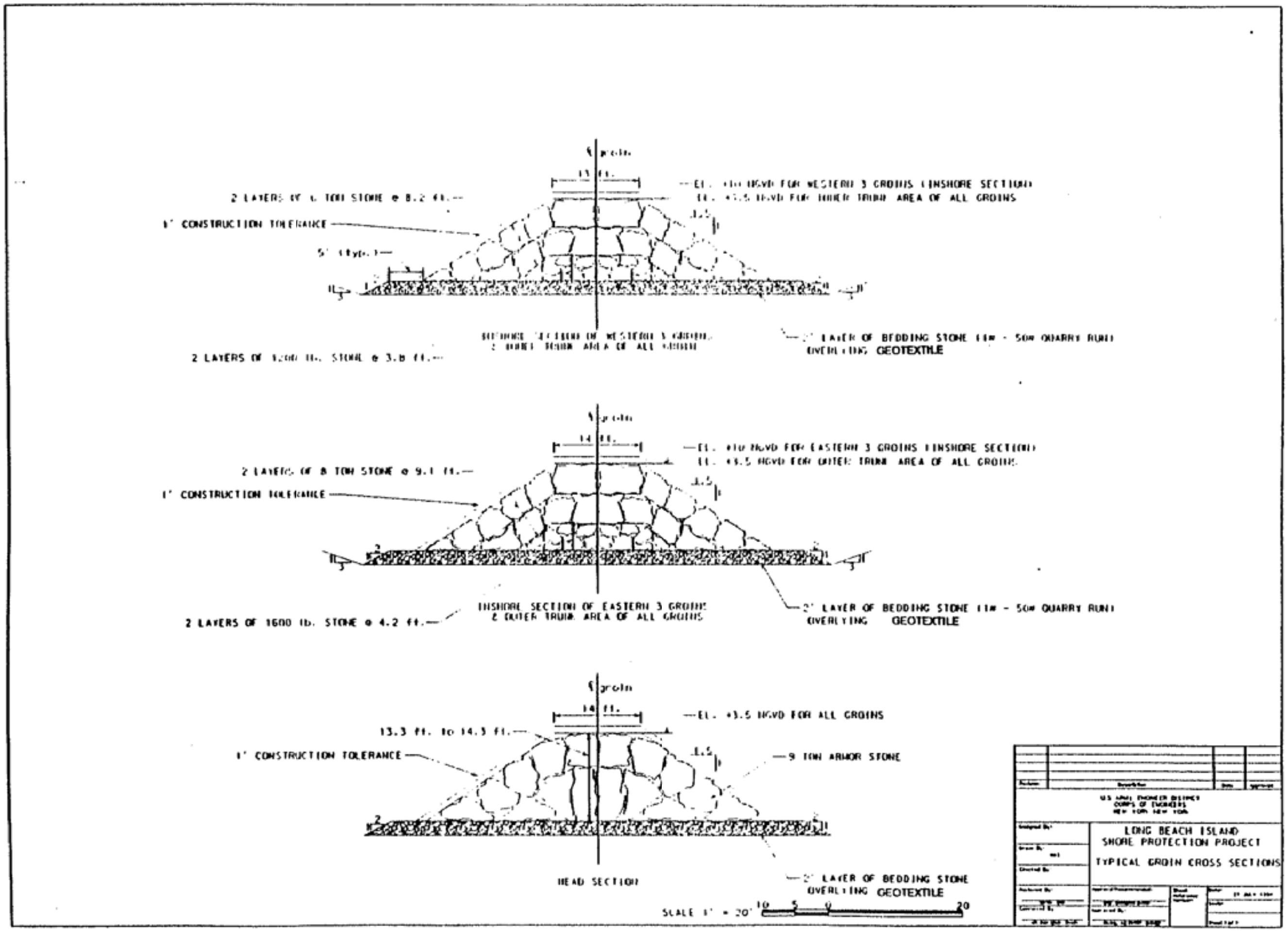
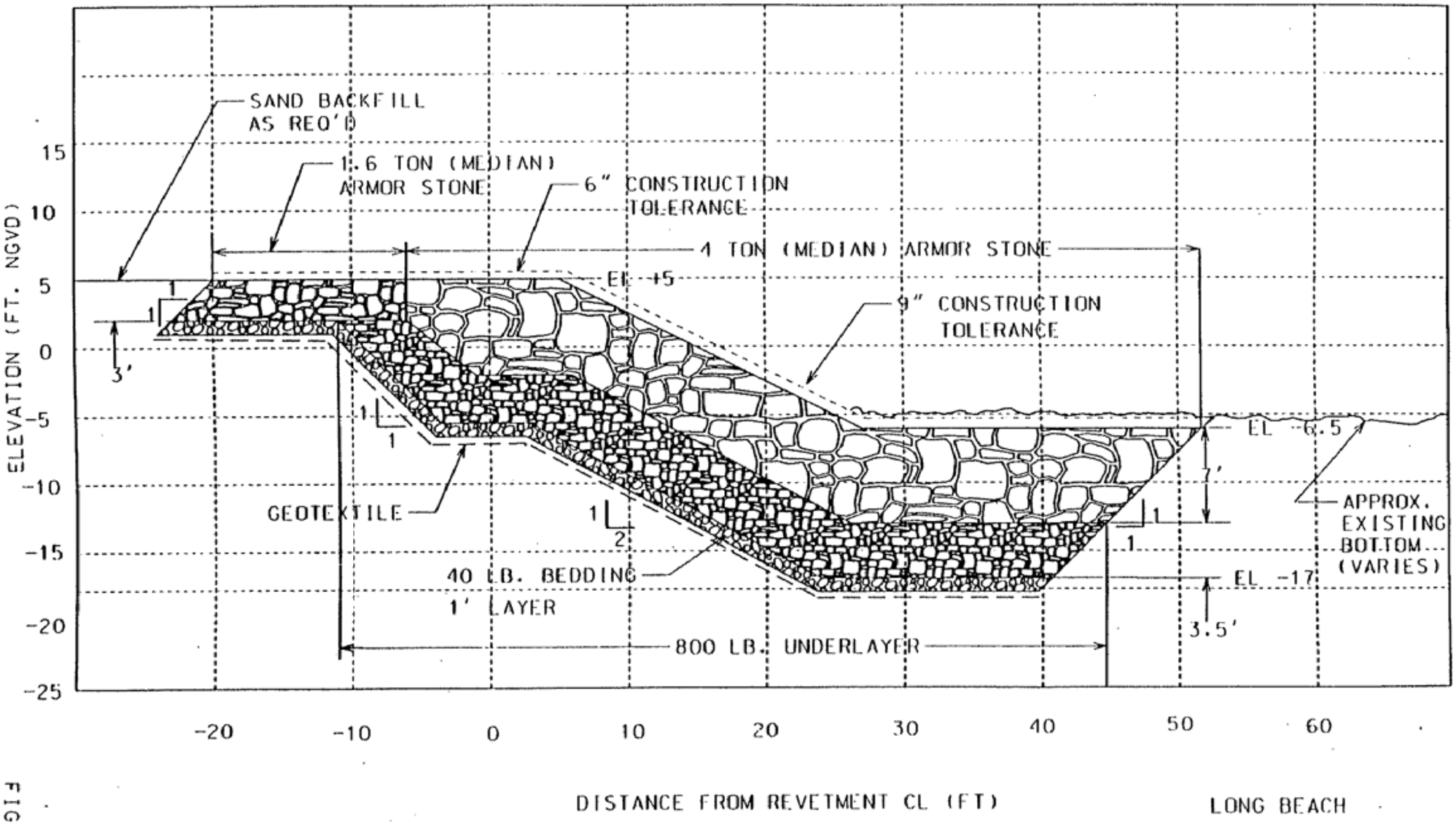

2 LAYERS OF 6 TON STONE @ 8.2 ft.
1' CONSTRUCTION TOLERANCE
2 LAYERS OF 1200 lb. STONE @ 3.8 ft.
2' LAYER OF BEDDING STONE (1# - 50# QUARRY RUN) OVERLYING GEOTEXTILE
2 LAYERS OF 8 TON STONE @ 9.1 ft.
1' CONSTRUCTION TOLERANCE
EL. +10 NGVD FOR EASTERN 3 GROINS (INSHORE SECTION)
EL. +3.5 NGVD FOR OUTER TRUNK AREA OF ALL GROINS
INSHORE SECTION OF EASTERN 3 GROINS & OUTER TRUNK AREA OF ALL GROINS
2 LAYERS OF 1600 lb. STONE @ 4.2 ft.
2' LAYER OF BEDDING STONE (1# - 50# QUARRY RUN) OVERLYING GEOTEXTILE
14 ft.
EL. +3.5 NGVD FOR ALL GROINS
13.3 ft. to 14.3 ft.
1' CONSTRUCTION TOLERANCE
9 TON ARMOR STONE
HEAD SECTION
2' LAYER OF BEDDING STONE OVERLYING GEOTEXTILE
SCALE 1" = 20'
LONG BEACH ISLAND
SHORE PROTECTION PROJECT
TYPICAL GROIN CROSS SECTIONS

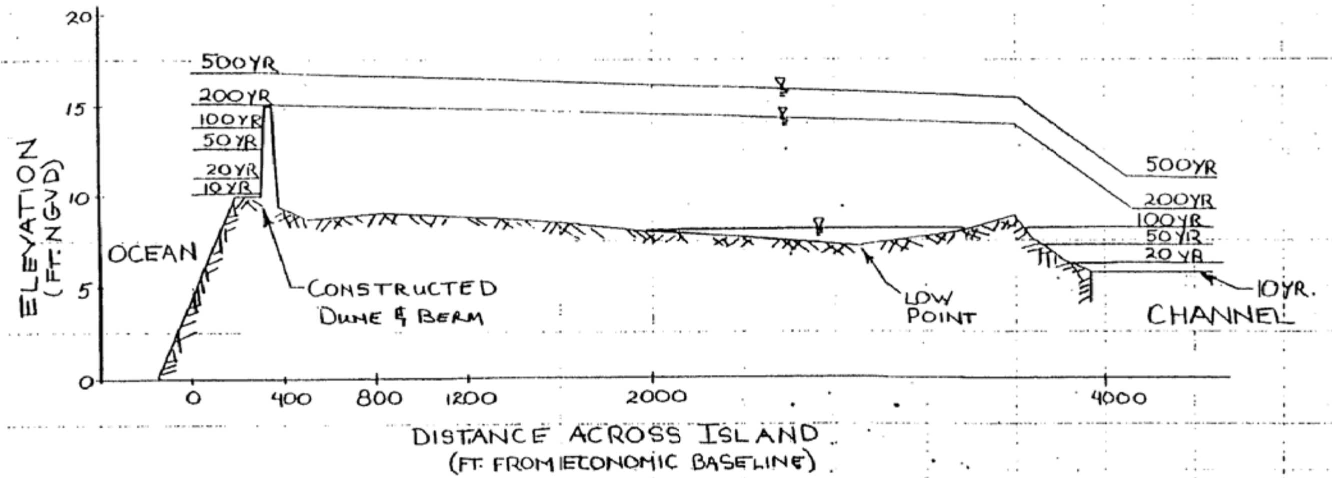
FIG. No. A -



LONG BEACH

TYPICAL PROFILE
REVETMENT
REHABILITATION

FIG. A-49A

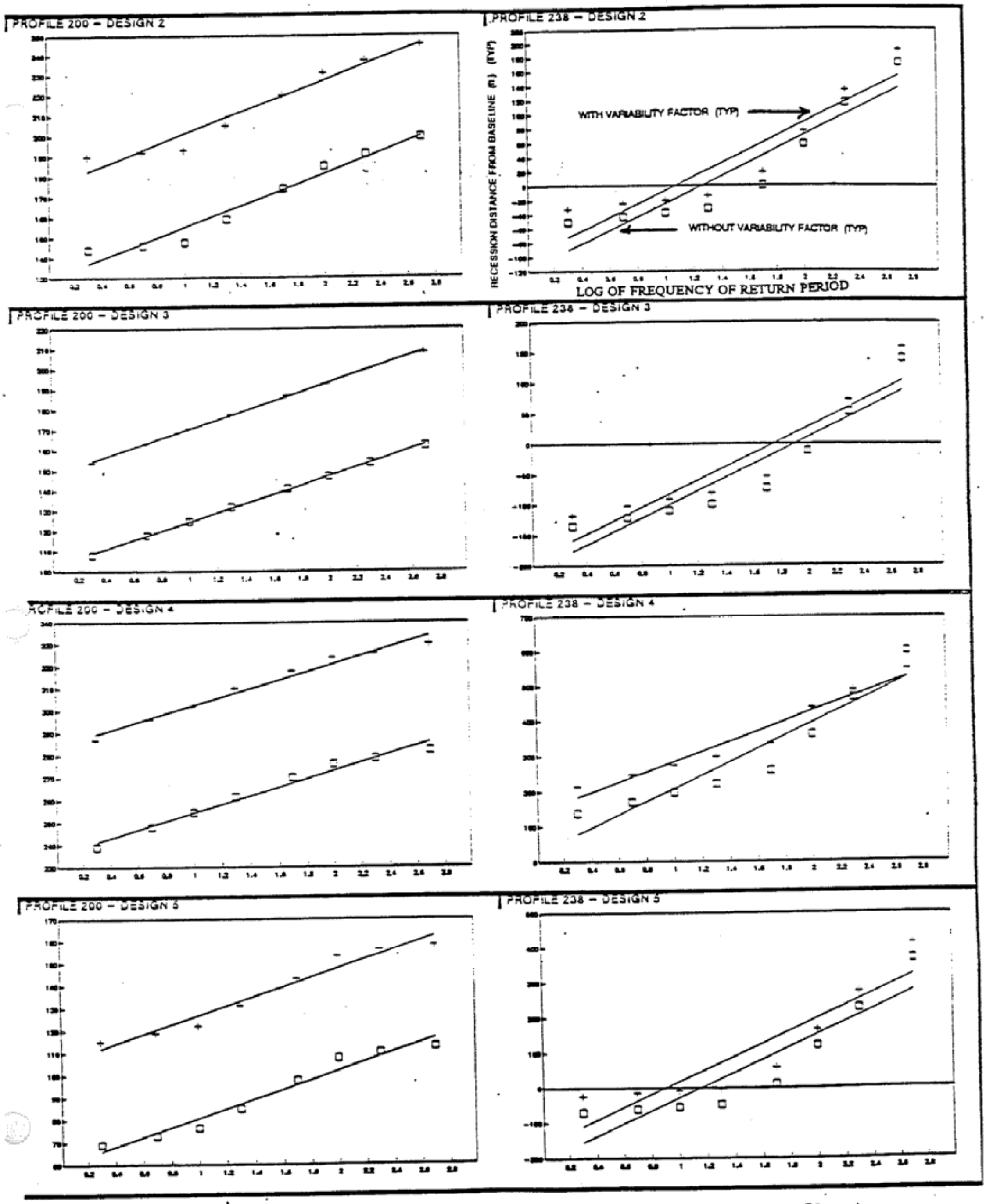


PROFILE #210 / NATIONAL BLVD.

NOTE: DUNE FAILURE OCCURS AT 200-YR EVENT

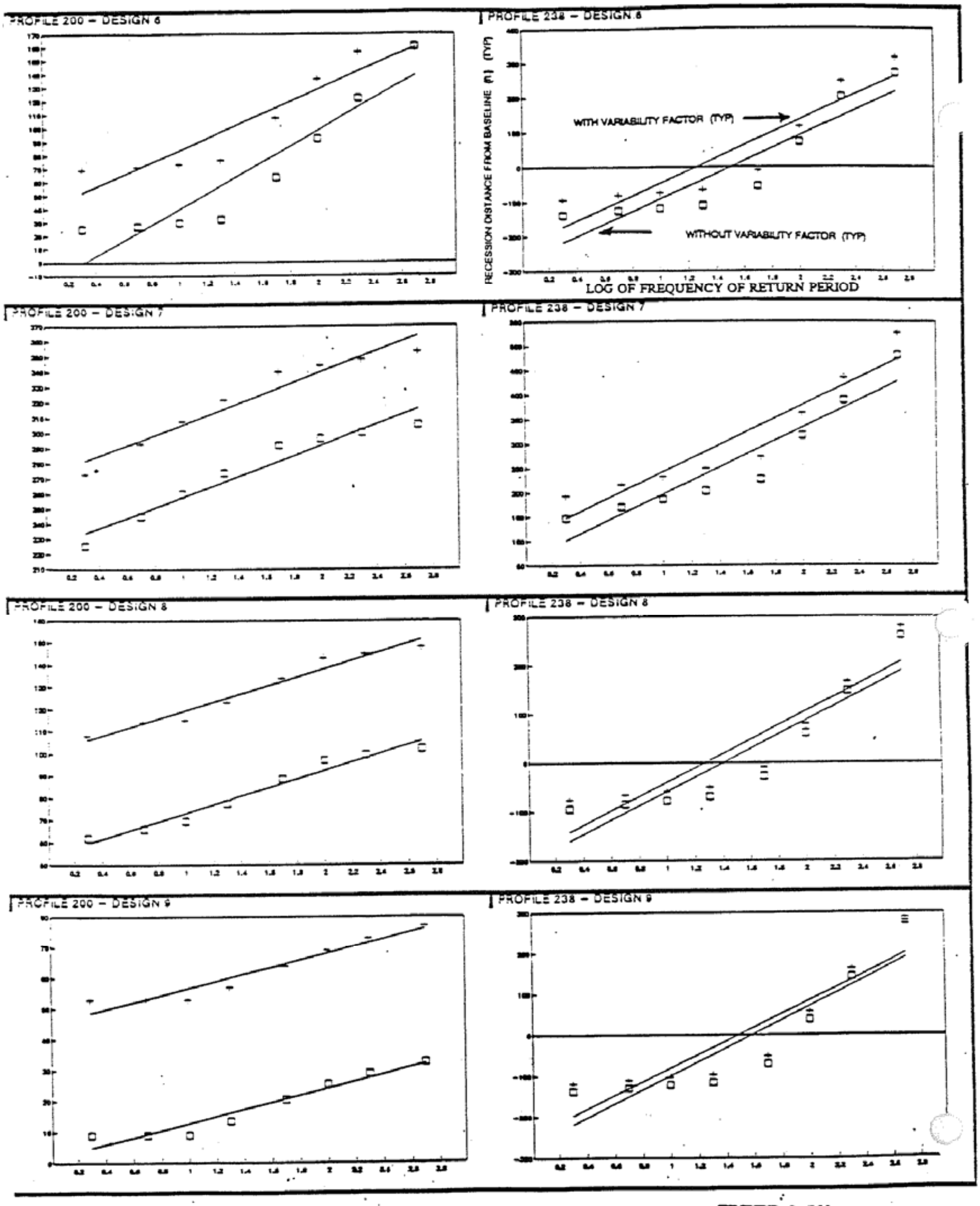
LONG BEACH
INNUNDATION PROFILES
IMPROVED CONDITION
PROJECT YEAR 0
+15' NGVD DUNE, 110' BERM

FIGURE A50



Improved Condition Storm-Induced Recession

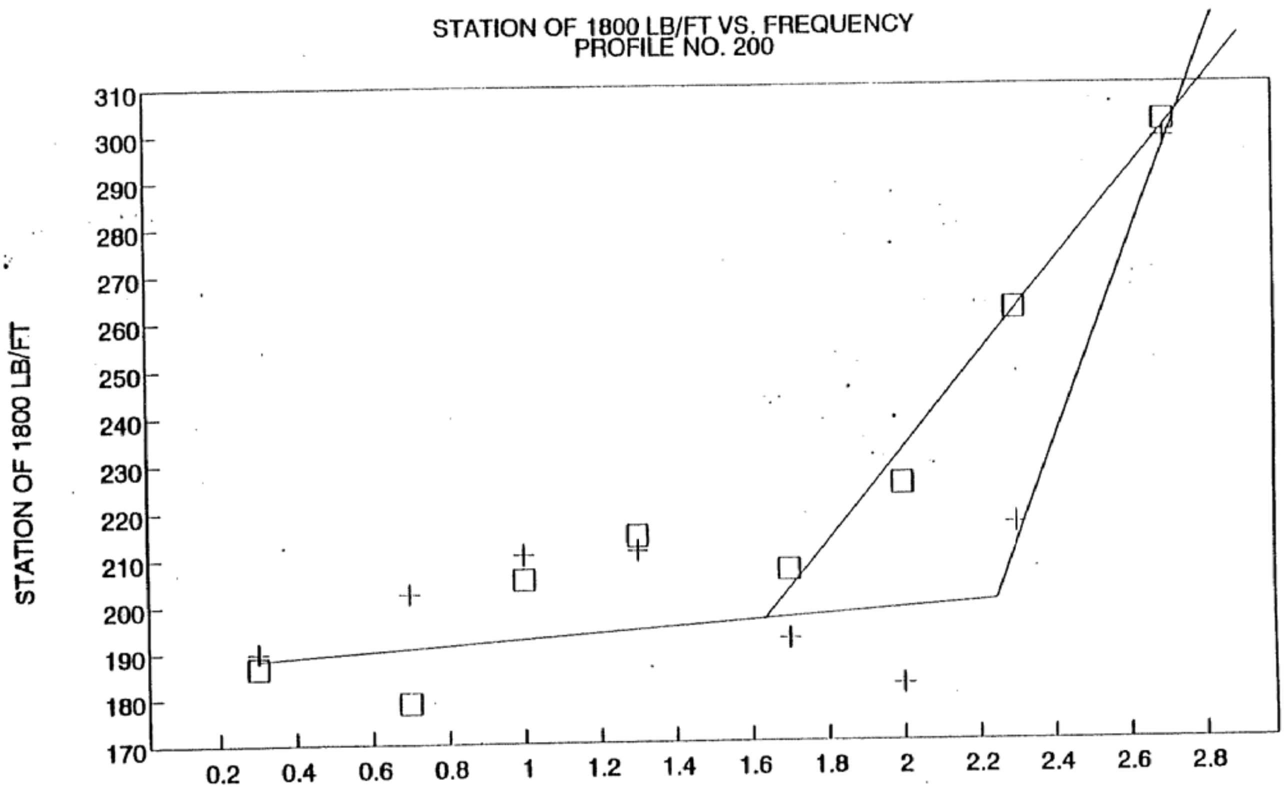
FIGURE A 51a



Improved Condition Storm-Induced Recession

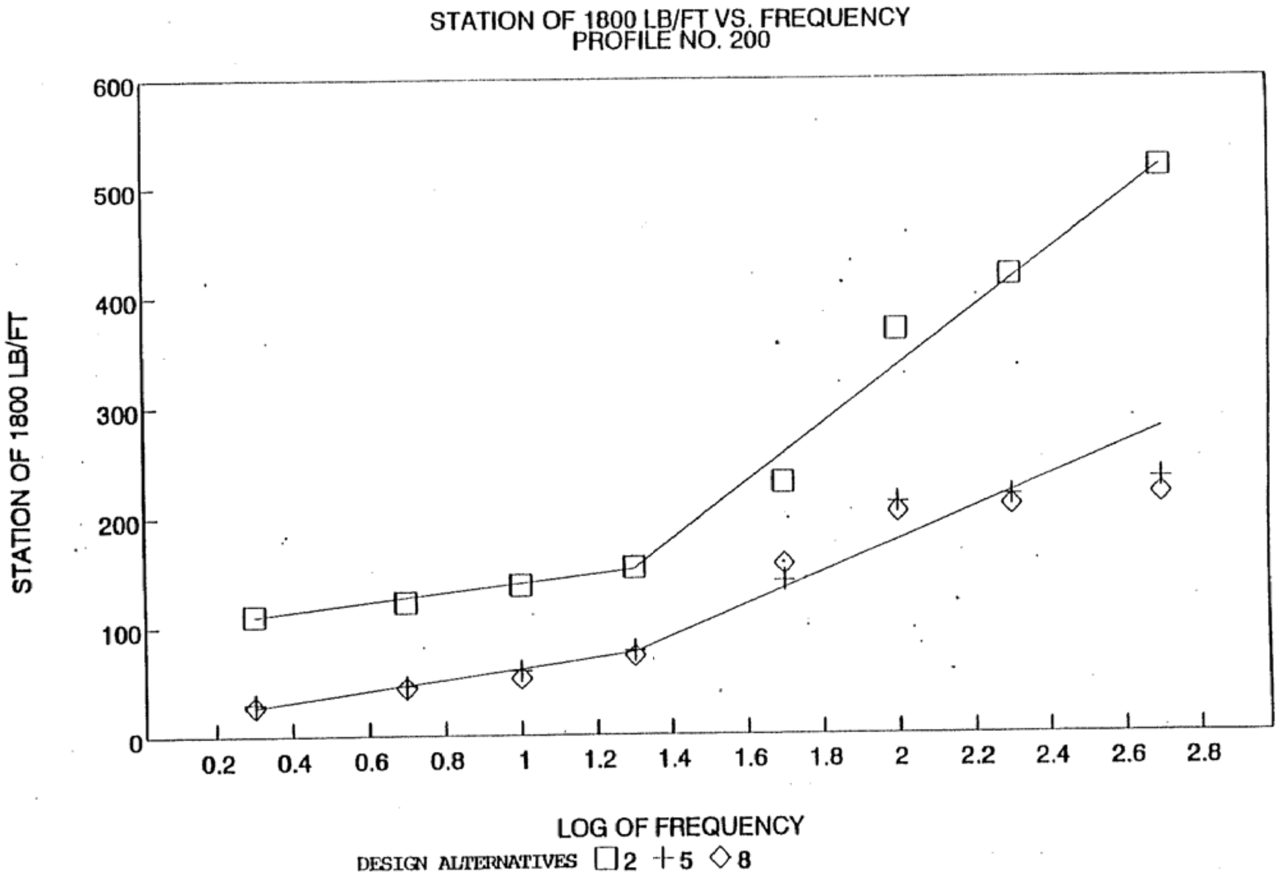
FIGURE A 51b

STATION OF 1800 LB/FT VS. FREQUENCY
PROFILE NO. 200



DESIGN ALTERNATIVES □ 4 + 7

FIGURE A52


STATION OF 1800 LB/FT VS. FREQUENCY
PROFILE NO. 200
STATION OF 1800 LB/FT
0
100
200
300
400
500
600
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
LOG OF FREQUENCY
DESIGN ALTERNATIVES □2 +5 ◇8

'URE A53

STATION OF 1800 LB/FT VS. FREQUENCY
PROFILE NO. 200

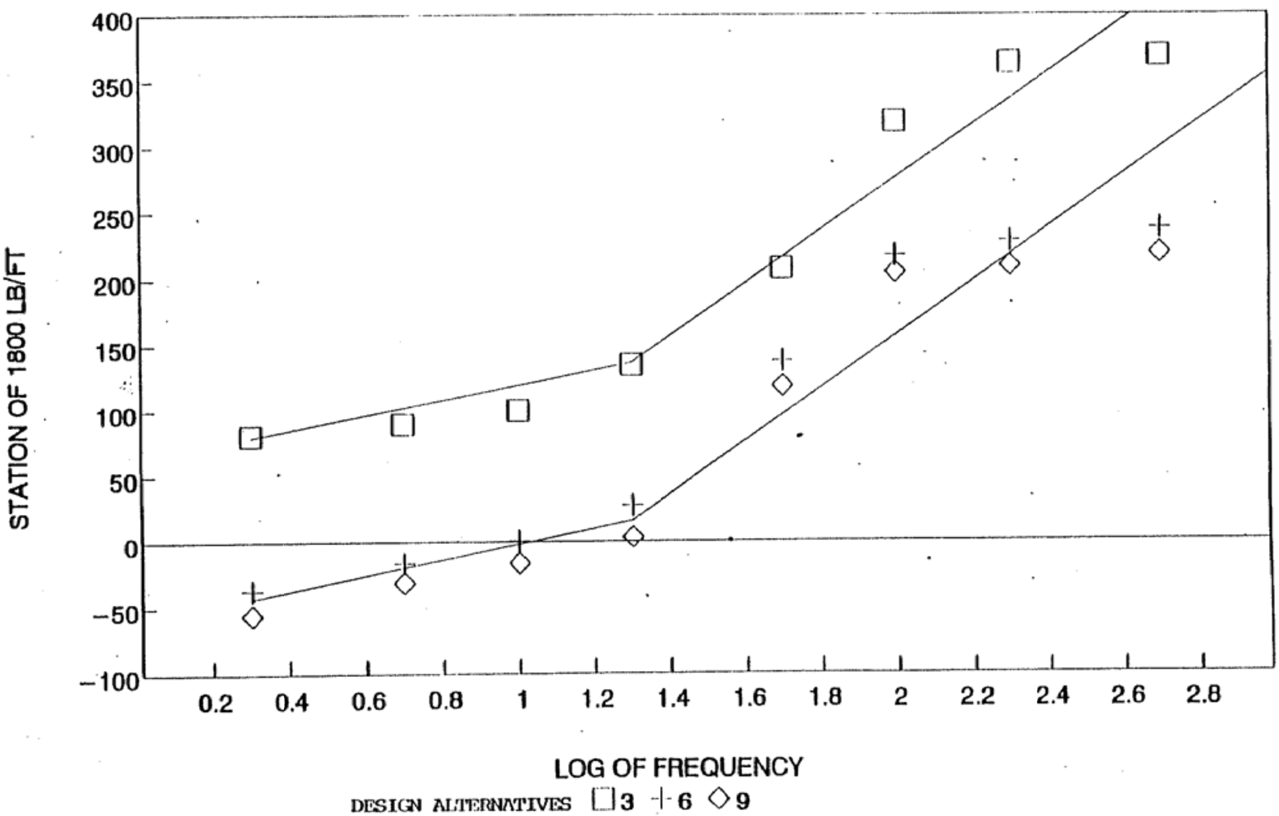


FIGURE A54

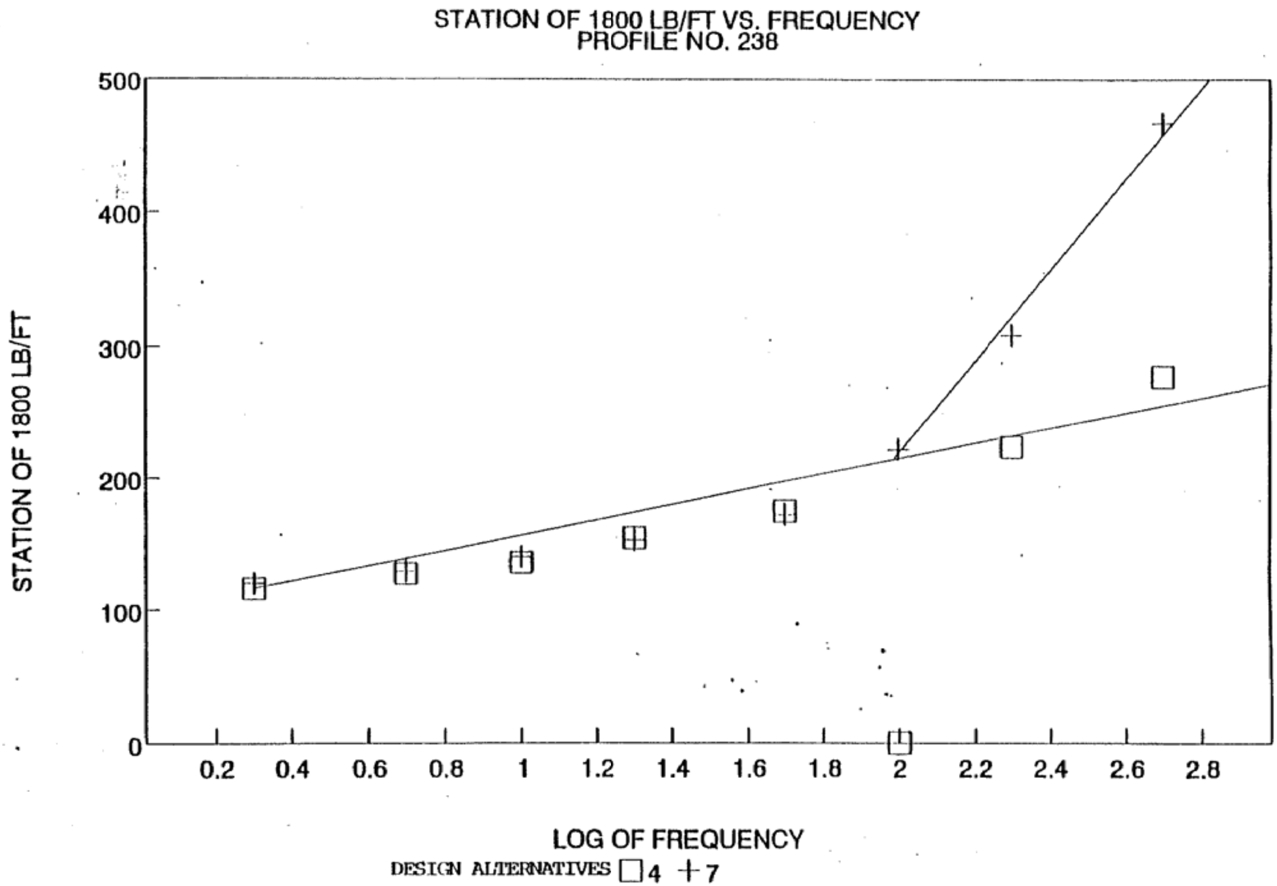

STATION OF 1800 LB/FT VS. FREQUENCY
PROFILE NO. 238
STATION OF 1800 LB/FT
500
400
300
200
100
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
LOG OF FREQUENCY
DESIGN ALTERNATIVES 4 7

FIGURE A55

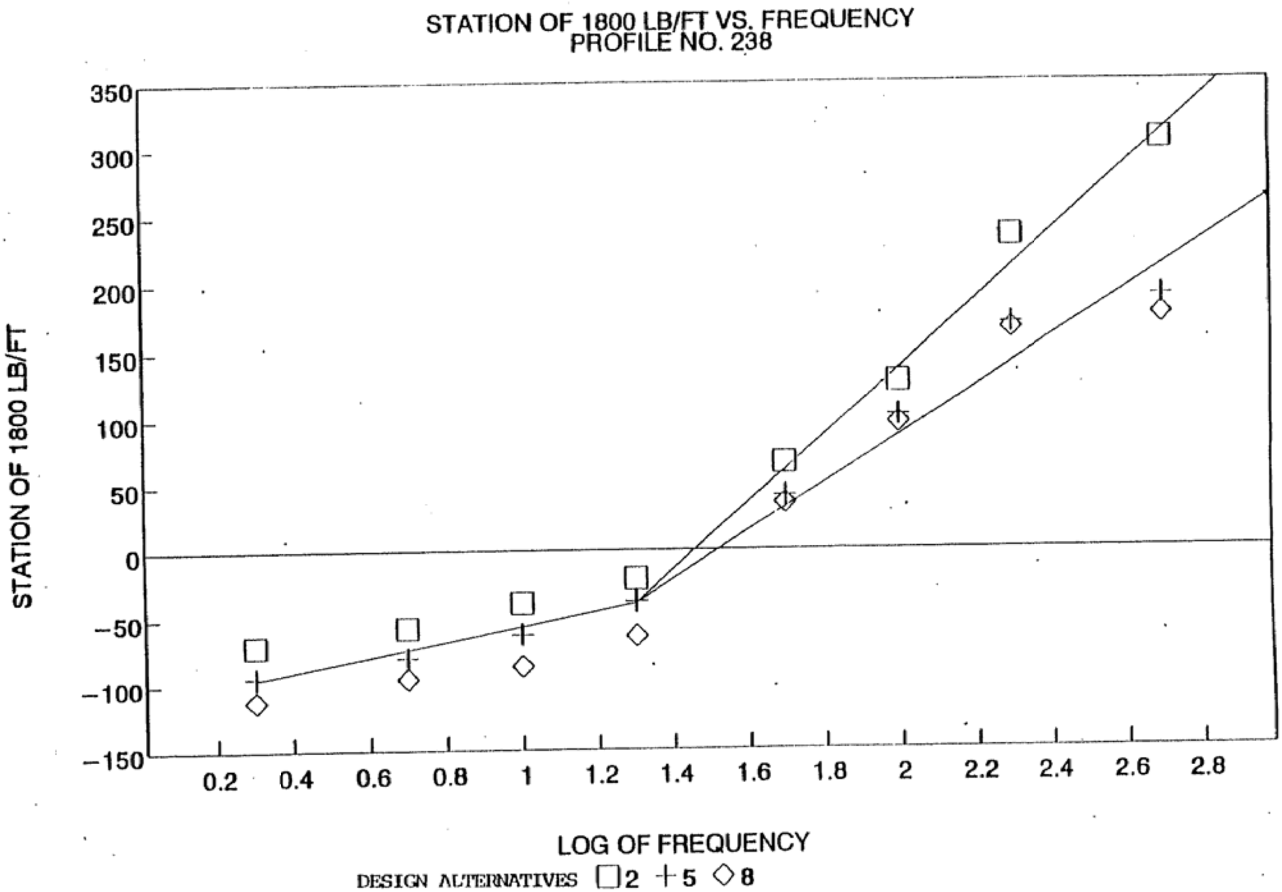

STATION OF 1800 LB/FT VS. FREQUENCY
PROFILE NO. 238
STATION OF 1800 LB/FT
350
300
250
200
150
100
50
0
−50
−100
−150
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
LOG OF FREQUENCY
DESIGN ALTERNATIVES 2 5 8

FIGURE A58

STATION OF 1800 LB/FT VS. FREQUENCY
PROFILE NO. 238

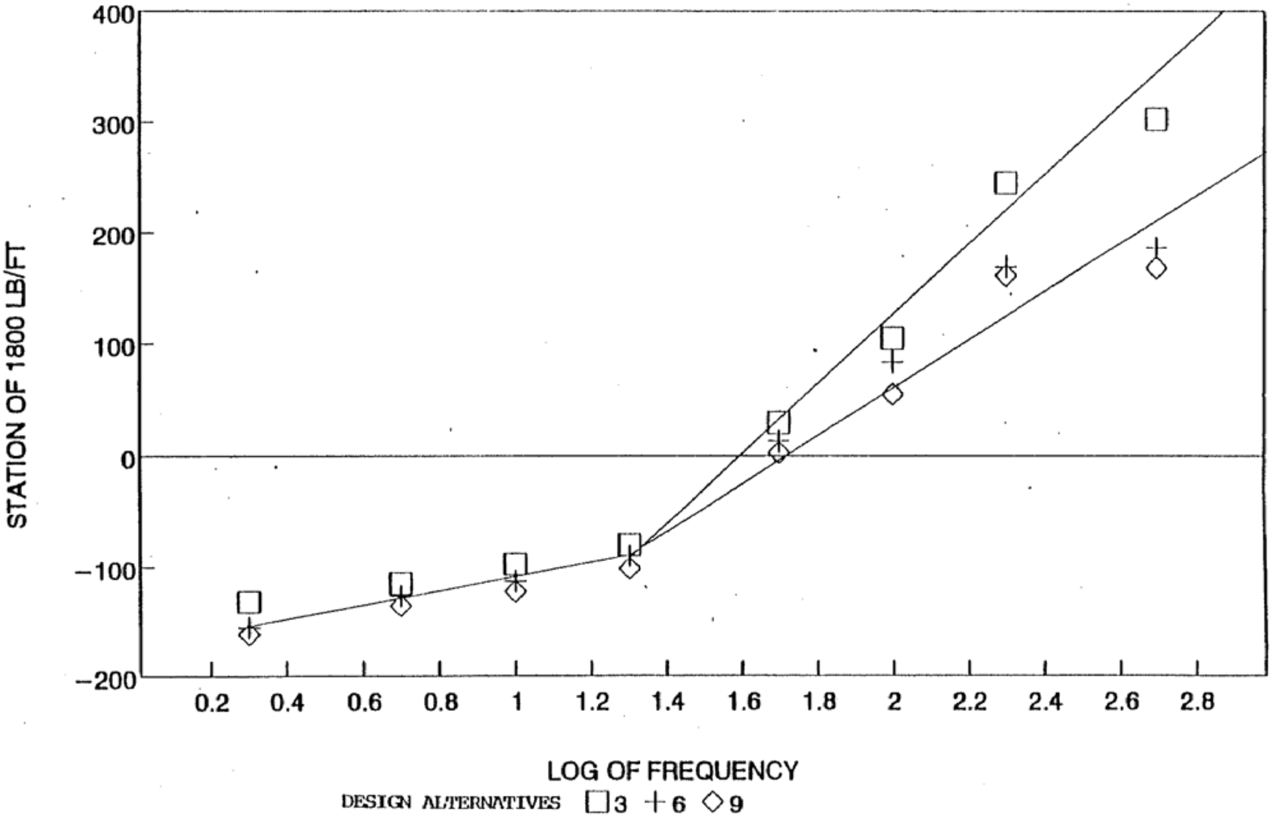
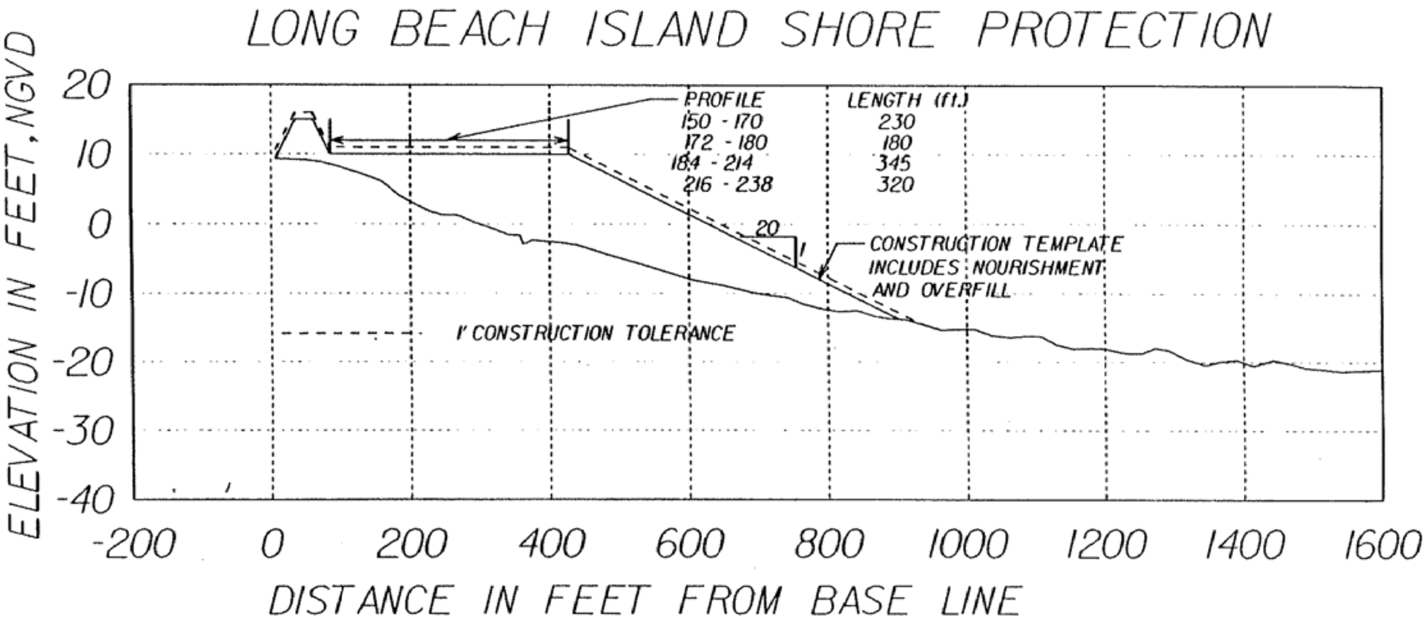


FIGURE A57



CONSTRUCTION TEMPLATE

FIG. No. A - 58

APPENDIX B

BORROW AREA INVESTIGATION

B

APPENDIX B - BORROW AREA APPENDIX

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APPENDIX B - BORROW AREA INVESTIGATION

PROJECT LOCATION AND DESCRIPTION

B1. The general study area is located along the Atlantic Coast of Long Island, New York from Jones Inlet westerly to East Rockaway Inlet. The area lies within Nassau County, New York and from east to west includes the communities of Point Lookout, the Town of Hempstead, the City of Long Beach, and the Village of Atlantic Beach.

B2. The terrain of the island is low-lying and flat with elevation generally less than 10 feet above the National Geodetic Vertical Datum (NGVD). The ocean shoreline of Long Beach Island consists of a continuous strip of generally low-lying beach with a series of groins constructed along much of the oceanfront.

GEOLOGY

B3. Long Island lies within the Coastal Plain physiographic province and marks the southern boundary of Pleistocene glacial advance in the eastern part of the North American continent. Two end moraines form the physiographic backbone along the northern part of Long Island. These moraines are superimposed along the western half of Long Island but split in west-central Long Island and diverge around Great Peconic Bay. Terrain south of the terminal moraines originated as glacial outwash plains, and is composed of sand and gravel detritus transported south by melt-water streams during Pleistocene time. Shallow brackish-water lagoons and low relief sandy barrier islands with associated dunes are the dominant landforms along most of the southern shore of Long Island. Long Beach Island is one of these barrier islands. Metamorphic bedrock underlies sandy deposits, at depths varying from -200 ft. NGVD in northern Long Island to -2000 ft. NGVD below Fire Island.

B4. The back-barrier lagoons and elongate-barrier islands are geologically very recent features which owe their origins to coastal processes operating during the gradual worldwide rise in sea level. The barrier islands are constructional landforms built up over the past several thousand years by sand from the sea floor and by sand transported westward along the Long Island shoreface by wave-generated longshore currents. This chain of sandy barrier islands extends from the western end of Long Island eastward to Southampton and is presently broken in continuity by six tidal inlets. Figure B1 show the geologic formations along the south shore of Long Island described in the late 1800's, from Fire Island to Coney Island.

BORROW AREA INVESTIGATION METHODOLOGY

B5. The primary objective of the borrow area investigation was to identify and delineate sources of sand borrow material in the offshore waters of Long Island for use as design fill and beach nourishment material for the Long Beach project, which extends from Jones Inlet to east Atlantic Beach. Sediments were sought which were of suitable grain size, and present in sufficient volume, within a reasonable distance from the project shoreline.

B6. Offshore investigations included subbottom seismic reflection profiling (geophysical profiling), and sediment sampling by vibracore coring. Grain size distributions of the offshore subbottom sediments were obtained from core samples, and were compared to grain size distributions of sand samples taken from the project area beaches to determine the compatibility of the offshore sediments with beach (native) sediments. Those areas which passed suitability criteria and contained sufficient depth of suitable sediment were designated as potential borrow areas. Volumes of suitable sands were computed in the potential borrow areas. The search for borrow areas continued until sufficient volume of suitable material was located to suffice for estimated project needs over 50 years.

BEACH SAND EVALUATION

B7. Eroded beaches that are in need of renourishment are considered to have remnant sediments of a grain size distribution that is reasonably stable. Native beach sediments must be matched with similar grain size borrow area sediments so that the beach replenishment will endure over a reasonable period of time. In order to determine this representative sediment, samples of native beach must be collected and analysed for grain size distribution. Beach sample parameters derived from the grain size distribution (gsd) curves are then compared mathematically with the gsd curves of the borrow area sediments to detemine the overdredge (Ra) and stability (Rj) factors of potential borrow sediments.

B8. Beach sediment grab samples were collected in 1988 along ten USACE profile lines (Figure B2) at +8, 0, -8, -18 and -30 ft. NGVD. Grain size distribution curves were then calculated based on composite beach samples for each profile line. Beach composite parameters are given in Table B1.

TABLE B-1

BEACH PROFILE COMPOSITE PARAMETERS

Profile	Phi 16	Phi 50	Phi 84
150	1.52	2.22	2.71
172	1.24	1.85	2.48
182	1.44	2.29	3.31
194	1.23	1.94	2.83
210	1.44	2.29	3.19
224	1.26	2.20	2.95
234	1.42	2.22	3.03
240	1.22	2.05	2.84
290	1.45	2.18	2.80
330	1.54	2.31	3.00

B9. Three overall composites were made by combining the profile composites to produce typical beach sand models for the Lido Beach, Long Beach and Atlantic Beach areas of the shoreline. These three overall composites were compared to potential borrow material to deterimine their suitability for beachfill. The parameters for the composite beach sand models are shown in Table B-2. As indicated in Table B-2, the median grain sizes (Phi 50) for the three typical beach models are 0.21 to 0.22 mm, which are classified as fine sand based on the Wentworth Classification (Figure B3). Grain size distribution curves for the three typical beach sand models are shown in Figures B4-B6.

TABLE B-2

COMPOSITE BEACH SAND PARAMETERS

Composite	Phi 16 (mm)	Phi 50 (mm)	Phi 84 (mm)
Lido Beach	1.38 (.38 mm)	2.13 (.22 mm)	2.75 (.15 mm)
Long Beach	1.31 (.40 mm)	2.17 (.22 mm)	3.03 (.12 mm)
Atlantic Beach	1.41 (.38 mm)	2.21 (.21 mm)	2.95 (.13 mm)

OFFSHORE INVESTIGATIONS

B10. Several offshore investigations were conducted along the southern Long Island shoreline from 1966 to 1991. In general, these studies included two types of data collection; subbottom seismic profiles (geophysical profiles), and vibracore core samples. Seismic profiling effectively covers wide areas, and delineates the depth and extent of sediment layers beneath the surface. Seismic profiling is used to pinpoint locations for core sampling, and to estimate volumes of subbottom sediments. Core samples show precisely what types of sediment exist, and their associated depths. Core information is used for comparison with native beach material, and in computation of sediment volumes.

B11. Summary of Offshore Investigations.

a. ICONS Investigation - 1976. The geophysical investigations of 1976 consisted of 735 lines miles of subbottom seismic reflection profile data and 70 vibracores (Figure B7). Also included in the report are the results of coring done in the 1960's by Nassau and Suffolk counties for sewer outfall construction. This study indicated an abundance of sand suitable for beach replenishment off of the Long Island coast and throughout the New York Bight area. Quantities in the region were estimated at eight billion cubic yards of sand available for retrieval by present dredging techniques (Reference B1).

b. Survey Report - 1965. In the 1965 Long Beach Island Erosion Control and Hurricane Protection Report (Reference B3), the New York District Corps of Engineers proposed to use borrow areas in Reynolds Channel and Jones Inlet for beach fill. Boring logs of subsurface explorations across Reynolds Channel, Long Creek, Swift Creek and Sloop Channel were presented in this report. Preliminary examinations were made based on the boring logs to determine the characteristics and the potential volume of materials in these areas. Material was found to be unsuitable for beachfill, consisting primarily of silty sand and organic deposits.

c. Jones Inlet 933 Study, 1991. Dredge material from Jones Inlet has been used for beachfill on the Town of Hempstead beach numerous times in the past, and is likely to be used regularly in the future. Thirteen sediment grab samples were taken in Jones Inlet and seven in East Rockaway Inlet in November 1991. Grain size distribution curves were prepared for all grab samples and those from Jones Inlet were compared to the native beach material from the Lido Beach model. Grab sample locations are shown in Figure B8. Jones Inlet sand parameters are shown in Table B-3. The sand from the inlet was found to have a relatively high Ra factor of 1.44.

TABLE B-3

JONES INLET SAND PARAMETERS

Grab Sample	Phi 16	Phi 84
JI1	2.01	2.78
JI2	1.86	2.72
JI3	1.61	2.43
JI4	1.61	2.68
JI5	0.26	1.16
JI6	1.04	1.85
JI7	1.05	1.84
JI8	1.17	1.93
JI9	1.14	1.98
JI10	0.79	2.17
JI11	1.07	1.73
JI12	1.69	2.86
JI13	1.14	2.01

LONG BEACH OFFSHORE INVESTIGATION, 1991

B12. Summary. The New York District performed a geophysical investigation in the coastal waters just south of the Long Beach project site in the fall of 1991. The intention was to find a 50-year supply of sand for beach reconstruction/renourishment for the beaches of Long Beach Island. The geophysical survey consisted of 30 line miles of subbottom siesmic reflection profiles and 15 twenty-foot vibracores. Figures B9 and B10 show the locations of the seismic lines and vibracores. Core material was then compared to the project beach sand models a potential borrow area containing 35.8 MCY of suitable material was delineated (Figure B11).

B13. Seismic Investigation. Thirty line miles of seismic reflection profiles were taken as the first phase of the 1991 offshore investigation (Figure B9). Fourteen parallel lines were run in the north-south direction spaced at an interval of 2,000 feet, for a north-south length of about 6,000 feet. Three tie lines were run in an east-west direction, separated by an interval of 2,000 feet. All seismic reflection records were studied to determine the patterns of geological strata. Vertical cross-sections were constructed to show the positions of fixes along each trackline, the orientation of the seafloor and relative positions of interpreted seismic reflections below the seafloor. Sites for vibracoring were chosen for those areas which gave indication of sufficient sand resources.

B14. Core Analysis. During the vibracore operation, graphical recordings were made of the penetration rates of the coring head into the subbottom for each successive foot of penetration, to serve as an indicator of the type of sediment material being cored. The recovered cores were cut into manageable sections. Vibracore sections were then cut open longitudinally and the contents visually logged according to the Wentworth Classification System. Each section was photographed at one-foot intervals. Samples were extracted from each core. Extracted core samples were sieved by a soils laboratory to analyze the contents and prepare grain size distribution curves. (Core grain size distribution curves and penetration logs are shown in Figures B12-B41.)

B15. Classification. The core material was classified according to the Wentworth classification system. This classification is widely used by geologists and engineers designing beach fills. The limits of the size classes vary by powers of 2 millimeters, with the largest class consisting of boulders (>256 mm) and the smallest class containing colloids (<0.0024 mm). Figure C gives limits of the various size classes in the Wentworth classification system.

Sediment size was also given in phi units. The phi unit scale is based on the definition:

$$\text{Phi units} = -\log_2(\text{diameter in mm})$$

The phi unit scale is indicated by writing 'phi' after the numerical value. Advantages of the phi unit scale are:

(1) Limits of Wentworth size classes are whole numbers in phi units.

(2) Sand size distributions typically are near lognormal, so that a unit based on the logarithm of the size better emphasized the small significant differences between the finer particles in the distribution.

(3) The normal distribution is described by its mean and standard deviation.

B16. Based on the core sample length, an overall "weighted" grain size distribution curve was plotted for each vibracore. From the final grain size distribution curves, the phi-16 and phi-84 values were determined. The phi-16 and phi-84 values were compared to native beach sand phi-16 and phi-84 values to determine the overdredge (Ra) and renourishment stability (Rj) factors.

SUITABILITY CRITERIA

B17. The suitability of sediments from potential borrow sites considered as a source of supply for beach reconstruction were evaluated by use of techniques and mathematical equations presented and discussed by James, 1975, (Reference B6) and by Hobson, 1977 (Reference B5). These publications provided the source for the development of a computer program to evaluate two numbers, the Adjusted Fill Factor, Ra, and the Renourishment Ratio, Rj. New York District suitability criteria divides sediment into three categories: suitable, marginal and unsuitable. The Ra and Rj ranges for these criteria are listed in Table B-4. A sample calculation for computing Ra and Rj is shown as Calculation C-1.

TABLE B-4

SEDIMENT SUITABILITY CRITERIA FOR LONG BEACH, NEW YORK

Ra	Classification	Rj
1.00 - 1.20	Suitable	0 - 1.00
1.20 - 1.50	Marginal	1.00 - 1.10
1.50 - ++	Unsuitable	1.10 - ++

B18. The Adjusted Fill Factor, Ra, predicts the amount of overdredge of a given borrow material which will be required to produce, after natural beach sorting, one cubic yard of beach material which will have a mean grain size similar to or coarser than the original native sediment. Losses due to the dredging process are in addition to these natural sorting losses. The more desirable Ra factors are those closest to 1.00. An Ra factor of

1.0 to 1.1 is considered as representing the most suitable material. An overdredge of ten percent or less produces the desired sediment volume on the beach for Ra values between 1.0 and 1.1. An Ra factor of 1.1 to 1.3 means that an overdredge of ten to thirty percent would be required to produce one cubic yard of beach material. For this project, the limits for suitability based on Ra factor were $1.0 < Ra < 1.2$.

B19. The Renourishment Ratio, Rj, is a measure of the stability of the placed borrow material relative to the native sands. The more desirable Rj factors are those closest to or less than 1.0. An Rj ratio of 1.0 means the native and borrow sands are of equal stability, having very similar grain size distributions. A renourishment factor of one-third, Rj = 0.33, means that the borrow material is three times as stable as the natural beach sands, or that renourishment with this borrow material would be required one-third as often as the native-like sediments. For this project, the limits for suitability based on the Rj ratio were $0 < Rj < 1.0$.

RESULTS

B20. Cross-Section Plots. Figures B42-B44 show representative cross-section plots prepared from seismic and core data. The cross-sections show the surface of the seafloor and subbottom reflector lines, positioning fixes, and vibracore locations with types and depths of material. Sand layers are shown to be continuous between core samples.

B21. Compatibility. Based on the suitability criteria given above, the fifteen vibracores were analyzed for compatibility with native beach sands. Vibracore material parameters are listed in Table B-5. Median sediment sizes range from 0.15 mm to 0.60 mm which falls in the fine sand to coarse sand range based on the Wentworth Classification. Analyses were performed to compare the borrow material with the three native beach material models to determine the overfill (Ra) and renourishment (Rj) factors. Results are summarized in Table B-6. Borrow material at cores C-2, C-5 and C-7 consisted of fine sand and failed suitability requirements. Cores C-14, C-15 and C-17 were found to have suitable material for depths of 14, 10 and 17 feet respectively. All other cores were found suitable for the entire 20-foot depth.

B22. Borrow Area Delineation. A borrow area containing material suitable for beach reconstruction and renourishment was outlined and is shown in Figure B11.

B23. Volume Estimates. Estimates of suitable borrow material volumes are summarized in Table B-8, and are shown on Figure B11. The total volume of suitable beach placement material found is 35.8 MCY (million cubic yards).

B24. Cultural Resources. A cultural resources investigation will be performed prior to the preparation of Plans and Specifications which may result in location of potential submerged cultural resources. If this is the case, volumes of sand available for placement on the beach may be reduced due to avoidance of potential cultural resources.

TABLE B-5

VIBRACORE SAND PARAMETERS

Core Number	Depth (Feet)	Phi 16	Phi 50	Phi 84
C-1	0-19.5	1.25	2.15	2.80
C-2	0-19.1	2.05	2.45	3.25
C-3	0-20.0	0.10	1.30	2.35
C-4	0-20.0	0.65	1.80	2.65
C-5	0-19.5	1.85	2.30	2.70
C-6	0-18.0	0.90	1.80	2.70
C-7	0-19.9	1.30	2.10	3.40
C-8A	0-19.9	-1.10	1.70	2.75
C-9	0-19.9	1.00	2.15	3.00
C-10	0-17.0	-1.15	1.50	2.20
C-11	0-19.5	-0.50	0.95	2.40
C-12	0-19.5	1.40	2.15	2.80
C-13	0-18.4	0.50	1.55	2.20
C-14	0-13.7	0.25	0.35	1.70
C-15	0-19.8	2.05	2.40	2.70

TABLE B-6

VIBRACORE OVERFILL AND RENOURISHMENT FACTORS

		Composite Beach Model					
Core	Median	Lido Beach		Long Beach		Atlantic Beach	
Number	Size (mm)	Ra	Ri	Ra	Ri	Ra	Ri
C-1	0.24	1.0	0.8	<1.0	1.0	<1.0	0.8
C-2	0.19	7.5	2.6	9.7	2.3	5.4	2.2
C-3	0.40	1.0	0.1	1.0	0.2	1.0	0.2
C-4	0.29	1.0	0.3	1.0	0.5	1.0	0.4
C-5	0.21	4.7	1.8	7.3	1.7	3.5	1.6
C-6	0.29	1.0	0.5	1.0	0.6	1.0	0.5
C-7	0.25	1.4	0.8	1.2	1.0	1.3	0.8
C-8A	0.32	1.1	0.0	1.1	0.0	1.1	0.0
C-9	0.23	1.1	0.5	1.0	0.7	1.1	0.6
C-10	0.36	1.1	0.0	1.0	0.0	1.0	0.0
C-11	0.54	1.1	0.0	1.0	0.1	1.0	0.1
C-12	0.24	1.0	1.0	1.1	1.1	1.0	1.0
C-13	0.36	1.0	0.3	1.0	0.4	1.0	0.3
C-14	0.56	1.0	0.2	1.0	0.3	1.0	0.2
C-15	0.19	>10	2.5	>10	2.2	>10	2.2

TABLE B-7

VOLUMES OF SUITABLE BORROW MATERIAL
(million cubic yards)

Block Location	Depth (ft)	Area (M sf)	Volume (MCY)
C-1	20	4.0	3.0
C-3	20	4.0	3.0
C-4	20	4.0	3.0
C-6	20	4.0	3.0
C-8A	20	6.0	4.5
C-9	20	4.0	3.0
C-10	17	6.0	3.8
C-11	20	4.0	3.0
C-12	20	4.0	3.0
C-13	20	4.0	3.0
C-14	14	4.0	2.0
C-15	10	4.0	1.5
		Total Volume	35.8 MCY

REFERENCES

B1. Williams, S.J., 1976. "Geomorphology, Shallow Subbottom Structure, and Sediments of the Atlantic Inner Continental Shelf Off Long Island, New York", Technical Paper No. 76-2, US Coastal Engineering Research Center, Ft. Belvoir, VA. 123 pp.

B2. Gahagan and Bryant Associates, 1988. Atlantic Coast of New York, Jones Inlet to East Rockaway Inlet (Long Beach Island Area) Sediment Sampling Data; prepared for US Army Corps of Engineers, New York District, New York, Contract DACW 51-88-D-0003.

B3. Beach Erosion Control and Interim Hurricane Study, Atlantic Coast of Long Island, New York, Jones Inlet to East Rockaway Inlet, New York District, US Army Corps of Engineers, 1965.

B4. Section 933 Evaluation Report, Jones Inlet, New York, New York District, US Army Corps of Engineers, 1992.

B5. Hobson, R.D., 1977, Review of Design Elements for Beach Sand Evaluation, Tech. Paper 77-6, CERC, U.S. Army Corps of Engineers, Ft. Belvoir, VA 51 pp.

B6. James, W.R., 1975, Techniques of Evaluating Suitability of Borrow Material for Beach Nourishment; Tech Memorandum No. 60, CERC, U.S. Army Corps of Engineers, Ft. Belvoir, VA, 81 pp.

B7. Total Feasibility, Engineering & Design, Atlantic Coast of Long Island Jones Inlet to East Rockaway Inlet, Long Beach Island, New York Detailed Investigation of Borrow Areas; prepared for the New York District, US Army Corps of Engineers by Frederick R. Harris, Inc., 1992.

Calculation B-1

Adjusted Overfill (Ra) and Renourishment (Rj) Factors

1. Adjusted Overfill Factor (Ra)

The adjusted overfill criteria developed by James (Reference B6), presented graphically below, give a solution for the adjusted overfill factor, Ra, where

Ra= the estimated number of cubic yards of fill material required to produce 1 cubic yard of beach material when the beach is in a condition compatible with the native material,

σ_ϕ = the standard deviation and is a measure of sorting where

$$\sigma_\phi = \frac{(\text{phi-84} - \text{phi-16})}{2}$$

M_ϕ = the phi mean diameter of grain-size distribution where

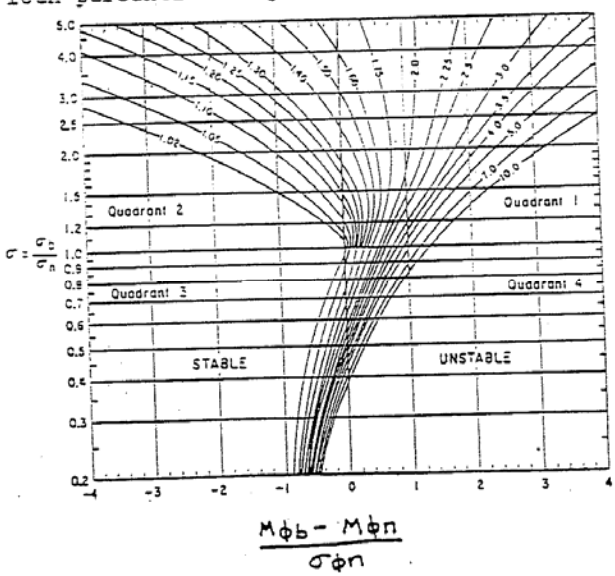
$$M_\phi = \frac{(\text{phi-84} + \text{phi-16})}{2}$$

b = subscript b refers to borrow material

n = subscript n refers to natural sand on beach

phi-84 = 84th percentile in phi units

phi-16 = 16th percentile in phi units



Isolines of the adjusted overfill factor, Ra, for values phi values of mean difference and phi sorting ratio (from James, 1975).

The Automated Coastal Engineering System (ACES), Version 1.06, Coastal Engineering Research Center, 1991, was used to calculate the Ra factors shown in Table B6.

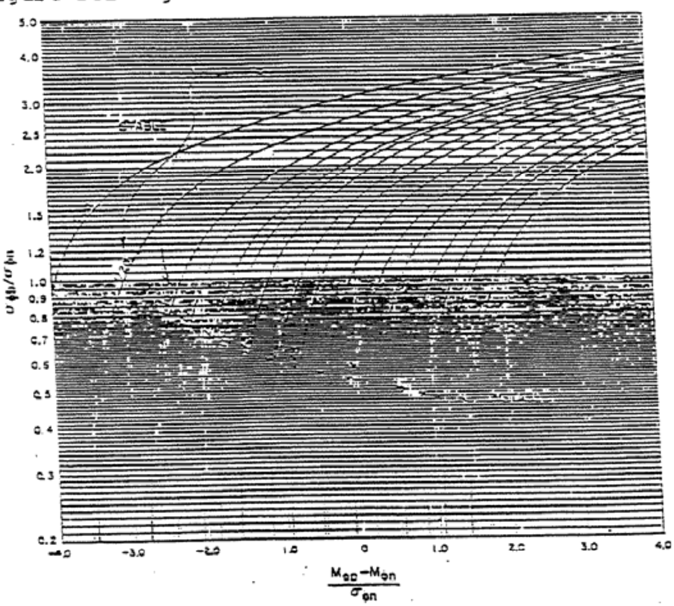
2. Renourishment Factor (Rj)

To determine the periodic renourishment requirements, James (1975) defines a renourishment factor, Rj, which is the ratio of the rate at which borrow material will erode to the rate at which natural beach material is eroding. The renourishment factor is given as:

$$R_J = \exp\left[\Delta\left(\frac{M_{\phi b} - M_{\phi n}}{\sigma_{\phi n}}\right) - \frac{\Delta^2}{2}\left(\frac{\sigma^2_{\phi b}}{\sigma^2_{\phi n}} - 1\right)\right]$$

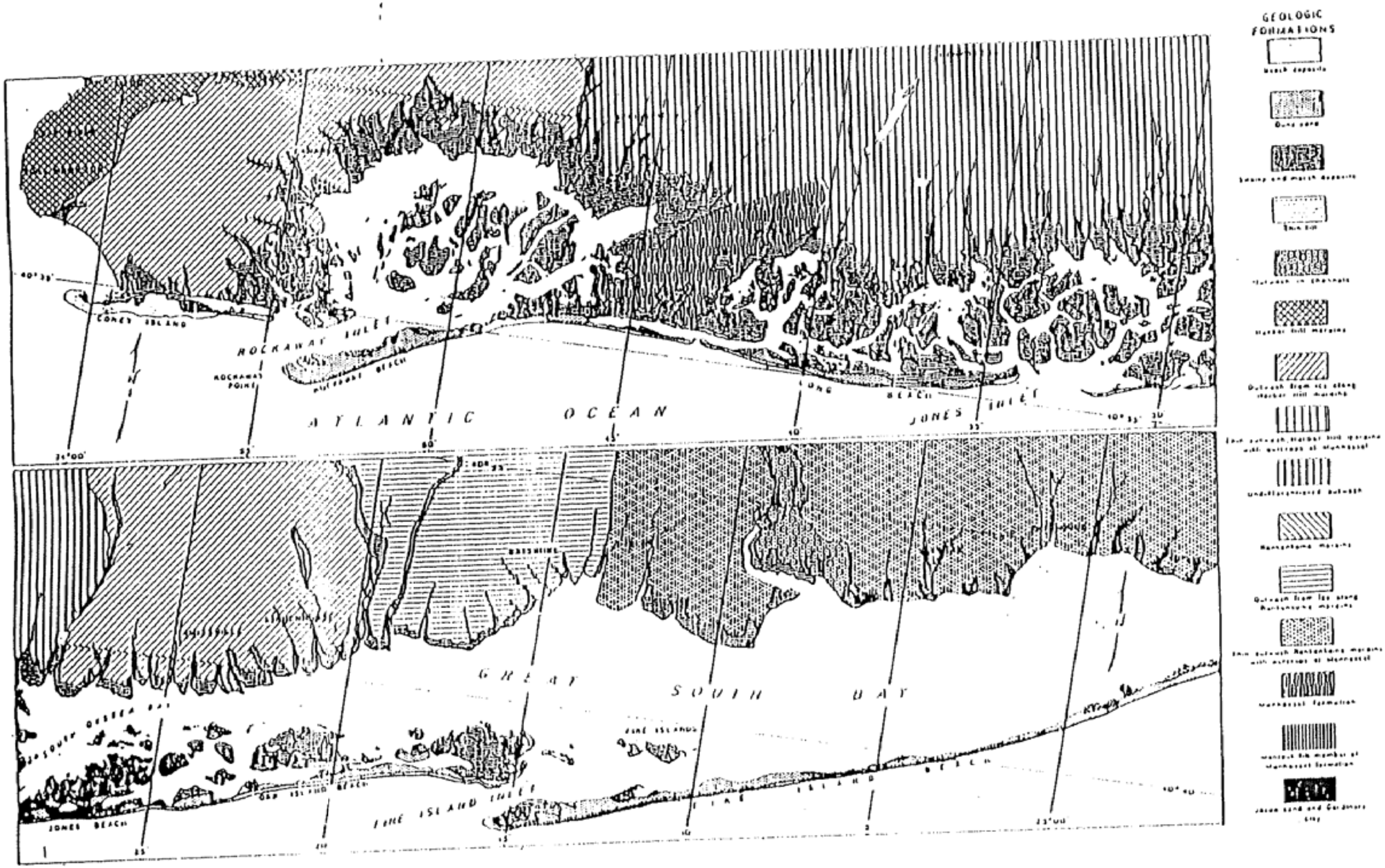
where Δ = winnowing function = 1.0 (recommended value)

The figure below gives the values for Rj.



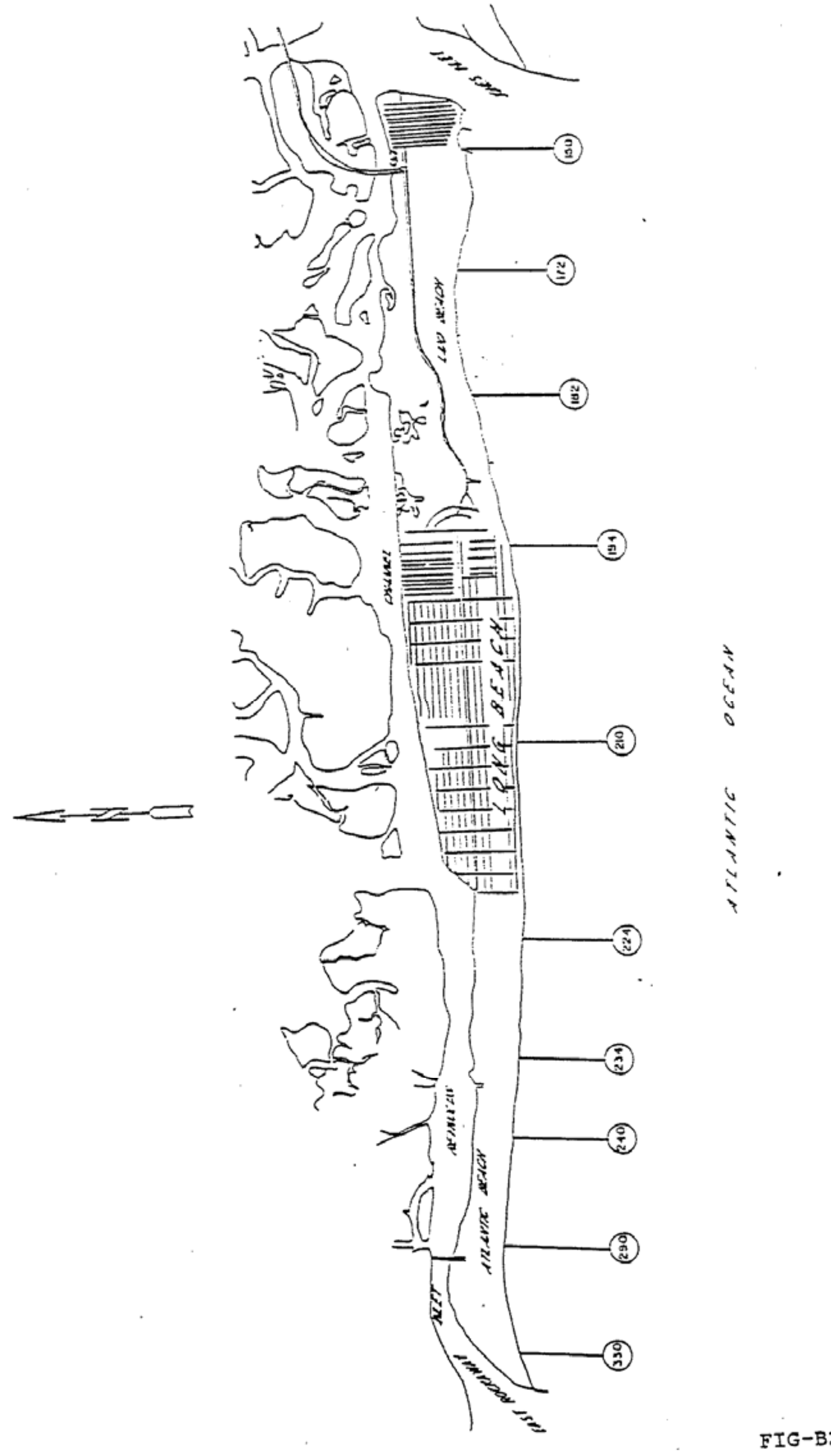
Isolines of the renourishment factor, Rj, for values of phi mean difference and phi sorting ratio, Δ = 1.0 (from James, 1975).

The Automated Coastal Engineering System (ACES), Version 1.06, Coastal Engineering Research Center, 1991, was used to calculate the Rj factors shown in Table B6.



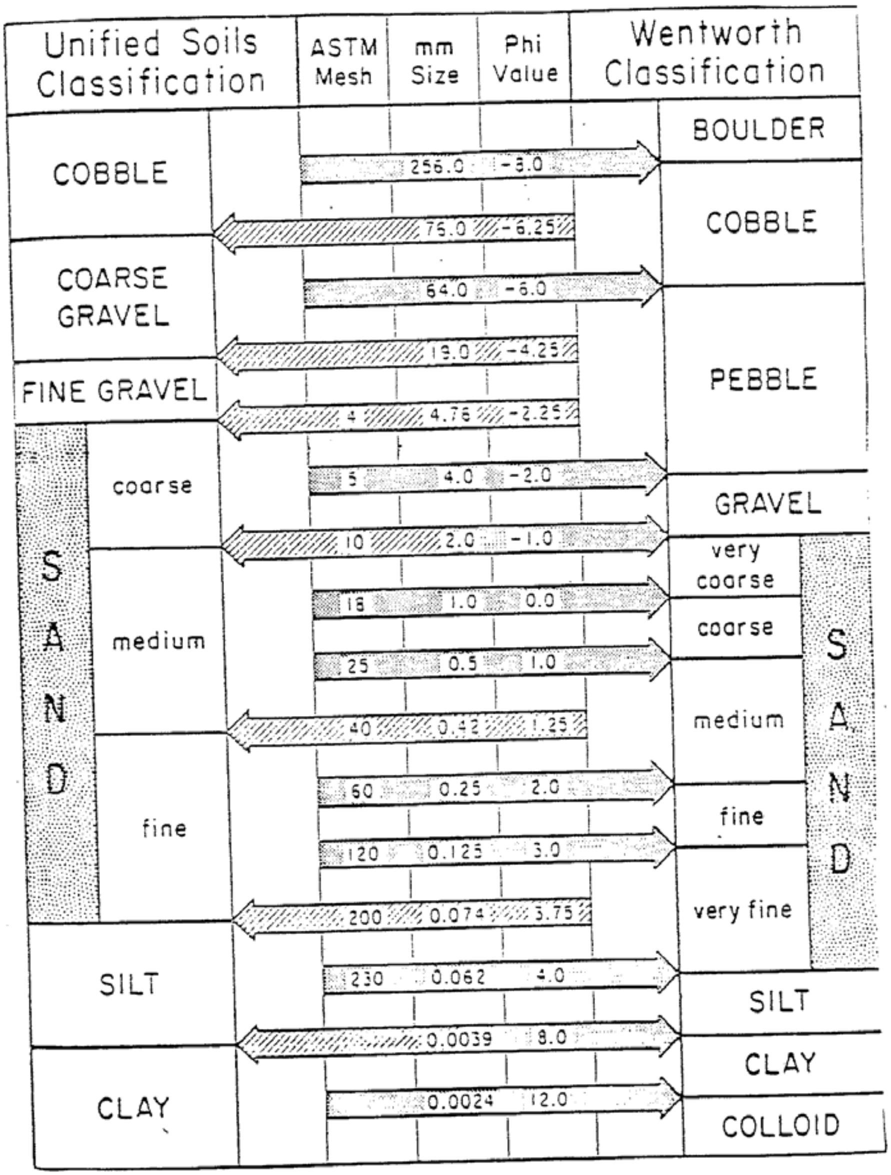
GEOLOGIC FORMATIONS

FIG-B1



BEACH SEDIMENT GRAB SAMPLE LOCATIONS

FIG-B2



SOIL CLASSIFICATION

FIG-B3

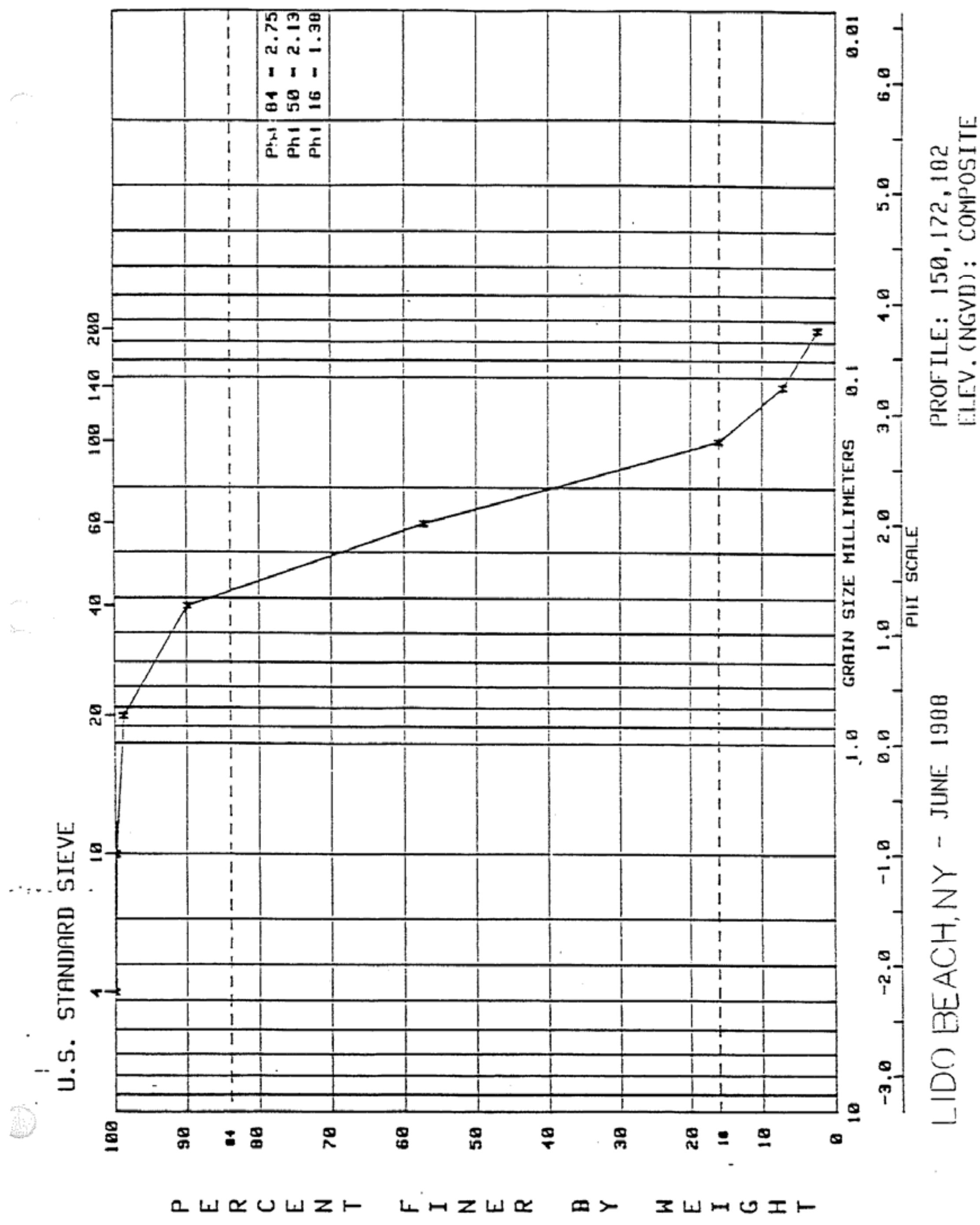
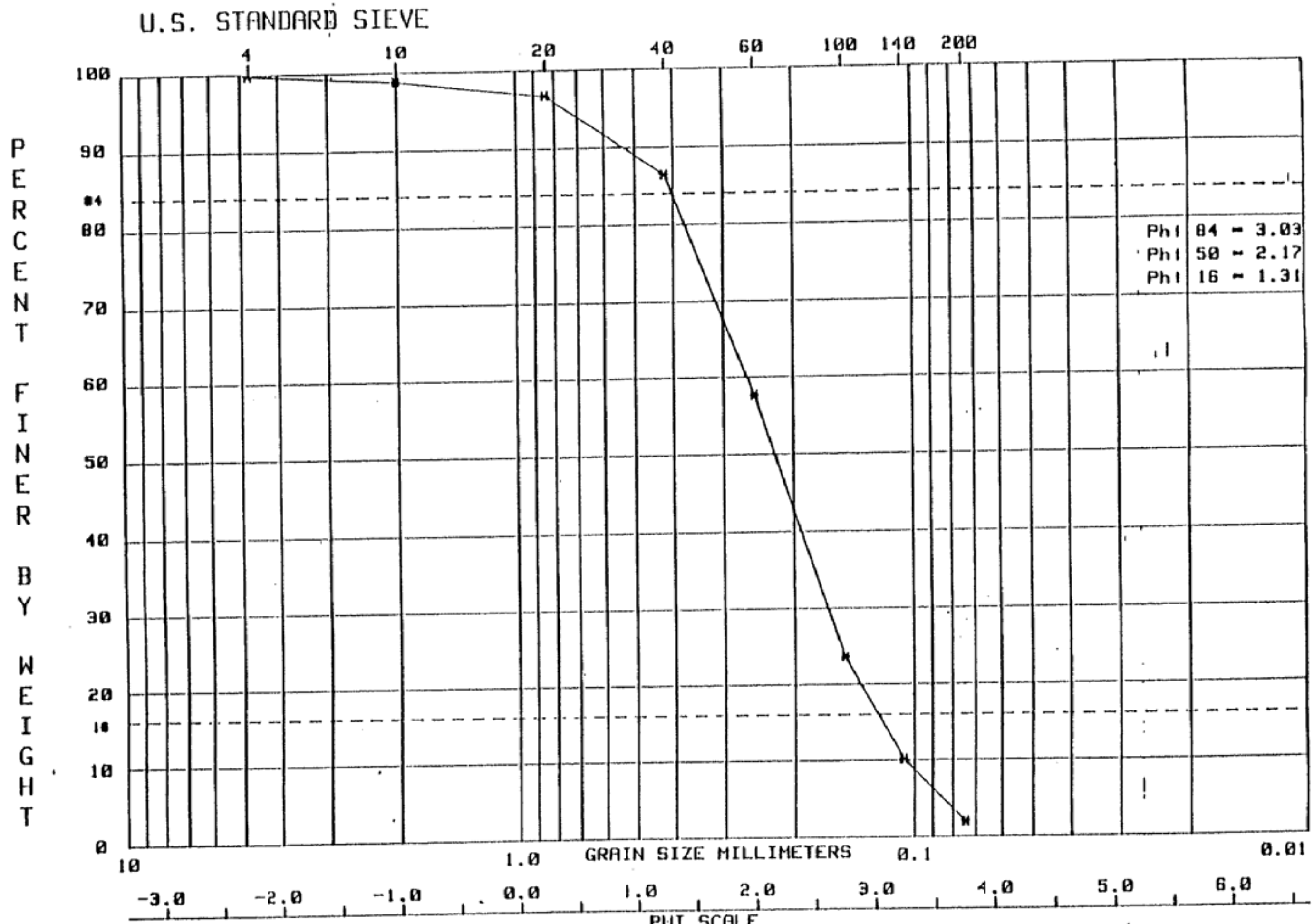

U.S. STANDARD SIEVE
4
10
20
40
60
100
140
200
Phi 84 = 2.75
Phi 50 = 2.13
Phi 16 = 1.30
GRAIN SIZE MILLIMETERS
1.0
0.1
0.01
PHI SCALE
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
PERCENT FINER BY WEIGHT
100
90
84
80
70
60
50
40
30
20
16
10
0
LIDO BEACH, NY - JUNE 1988
PROFILE: 150,172,182
ELEV.(NGVD): COMPOSITE

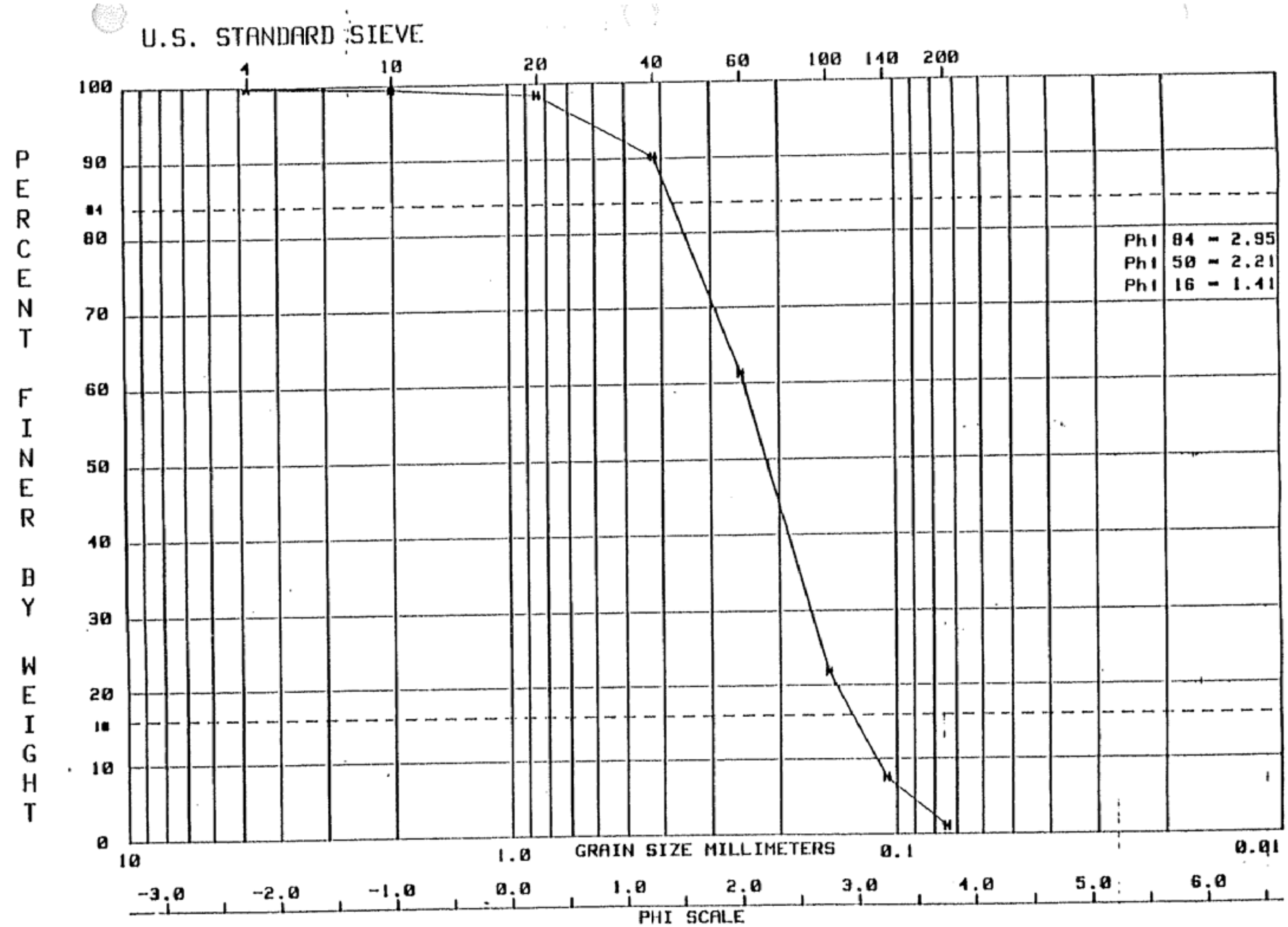
FIG-B4



LONG BEACH, NY - JUNE 1988

PROFILE: 194,210,224
ELEV.(NGVD): COMPOSITE

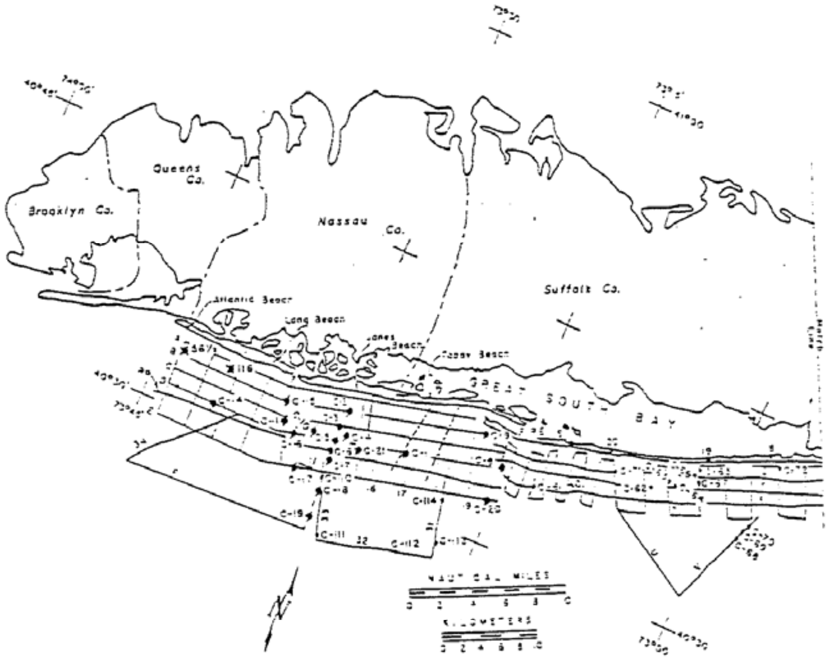
FIG-B5



ATLANTIC BEACH, NY - JUNE 1988

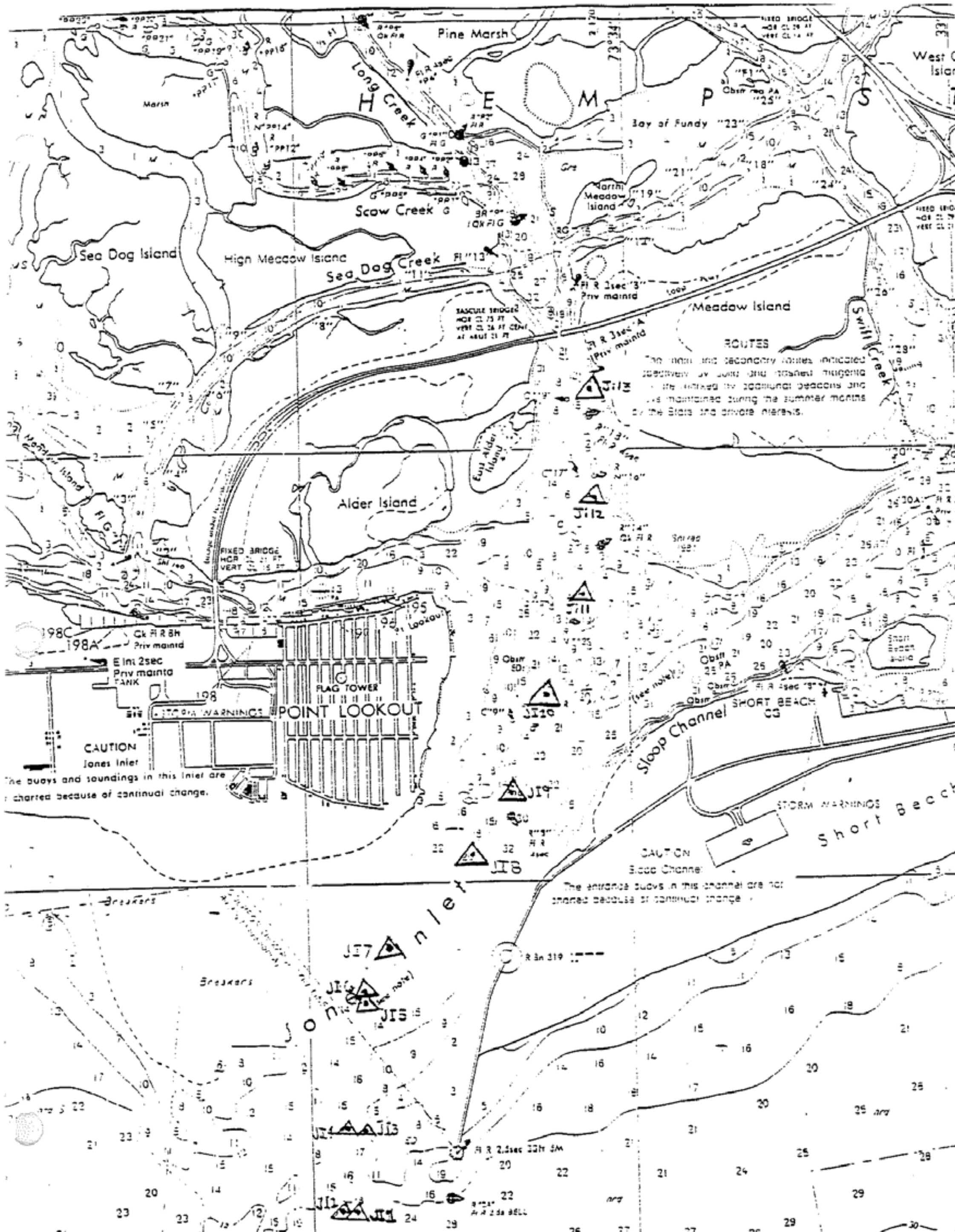
PROFILE: 234,240,290,330
ELEV. (NGVD): COMPOSITE

FIG-B6



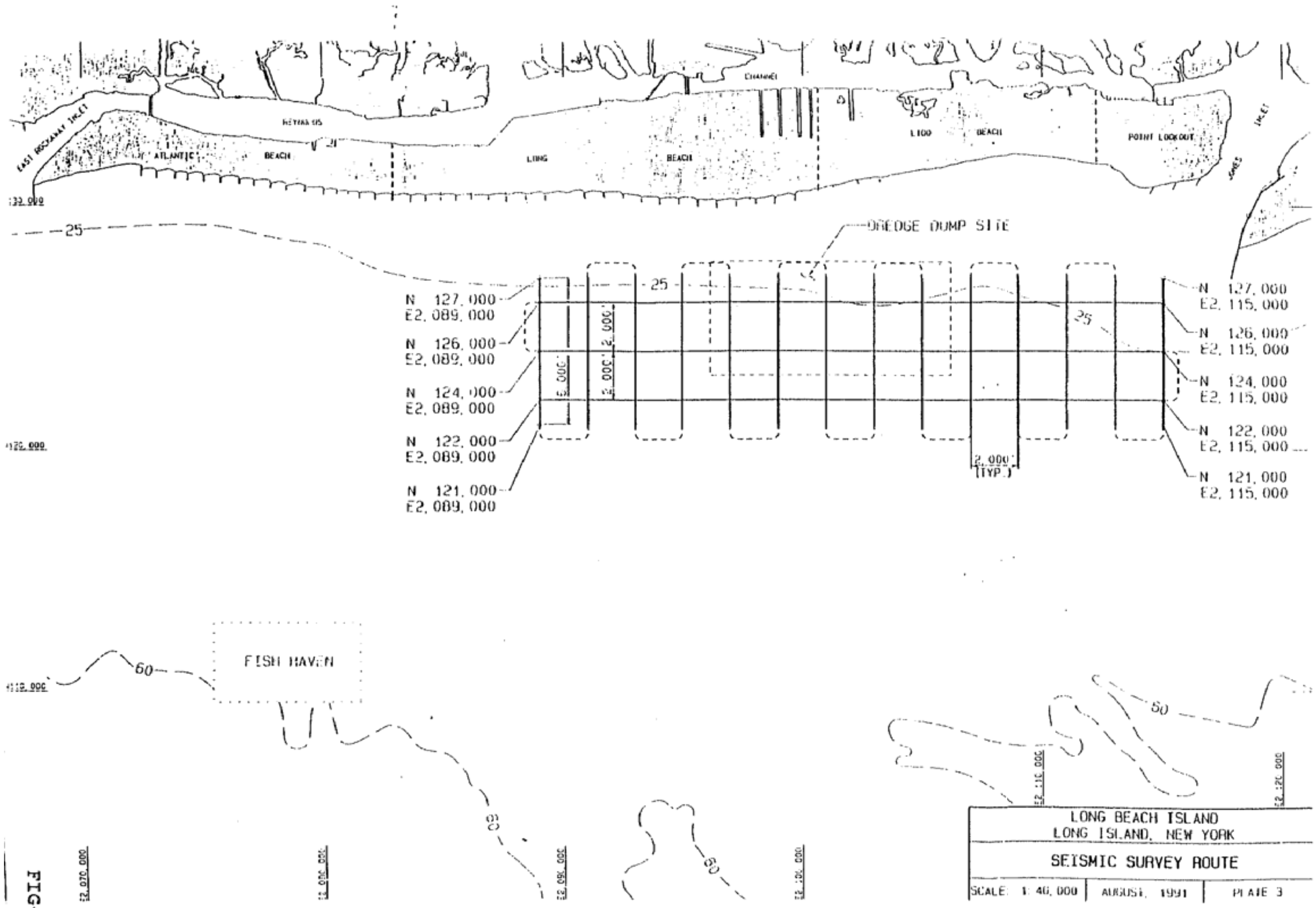
ICONS SEISMIC TRACKS AND CORE LOCATIONS

FIG-B7



JONES INLET GRAB SAMPLES LOCATIONS

FIG-B8



LONG BEACH ISLAND
LONG ISLAND, NEW YORK

SEISMIC SURVEY ROUTE

SCALE: 1:40,000	AUGUST, 1991	PLATE 3

FIG-B9

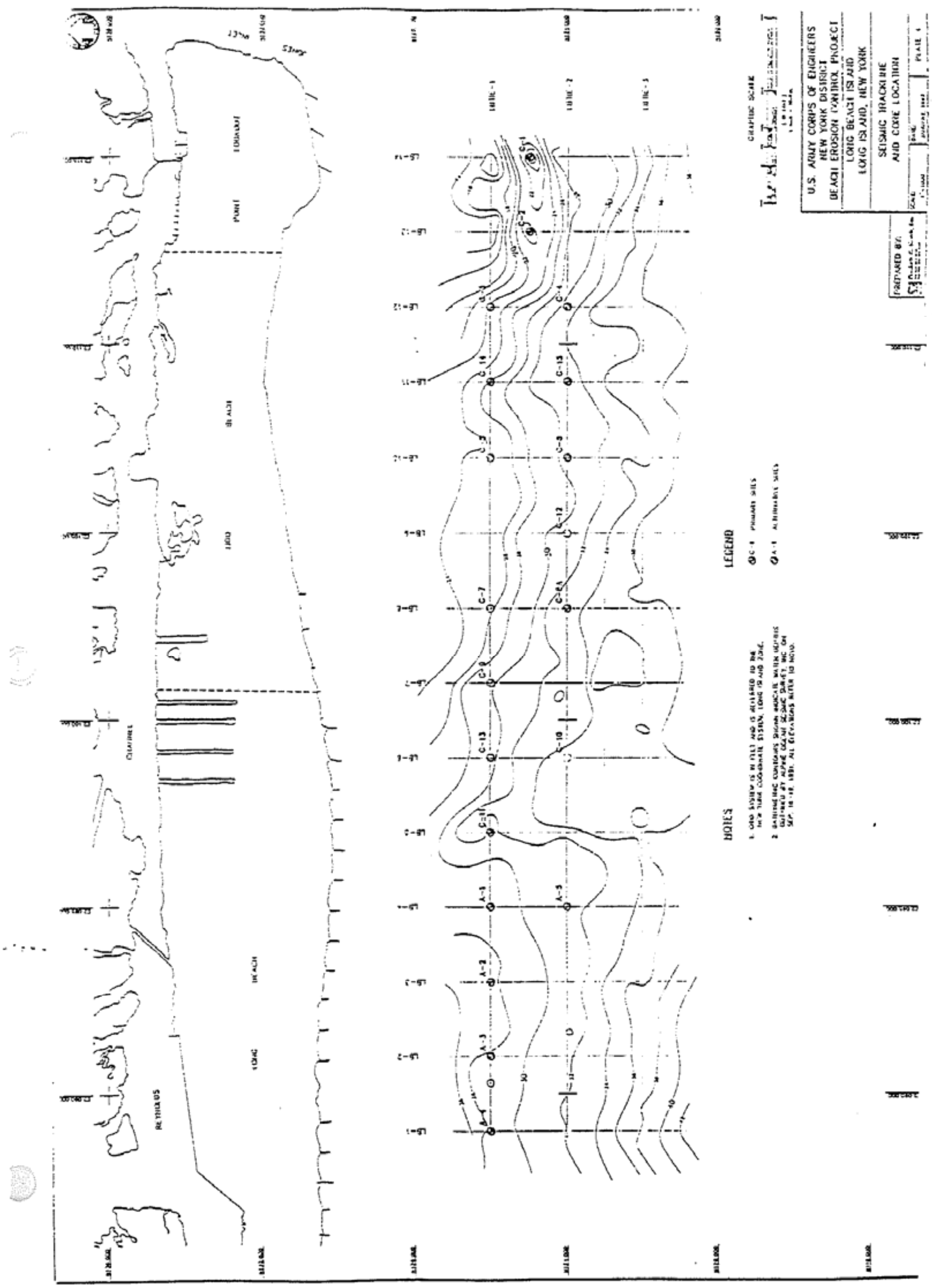
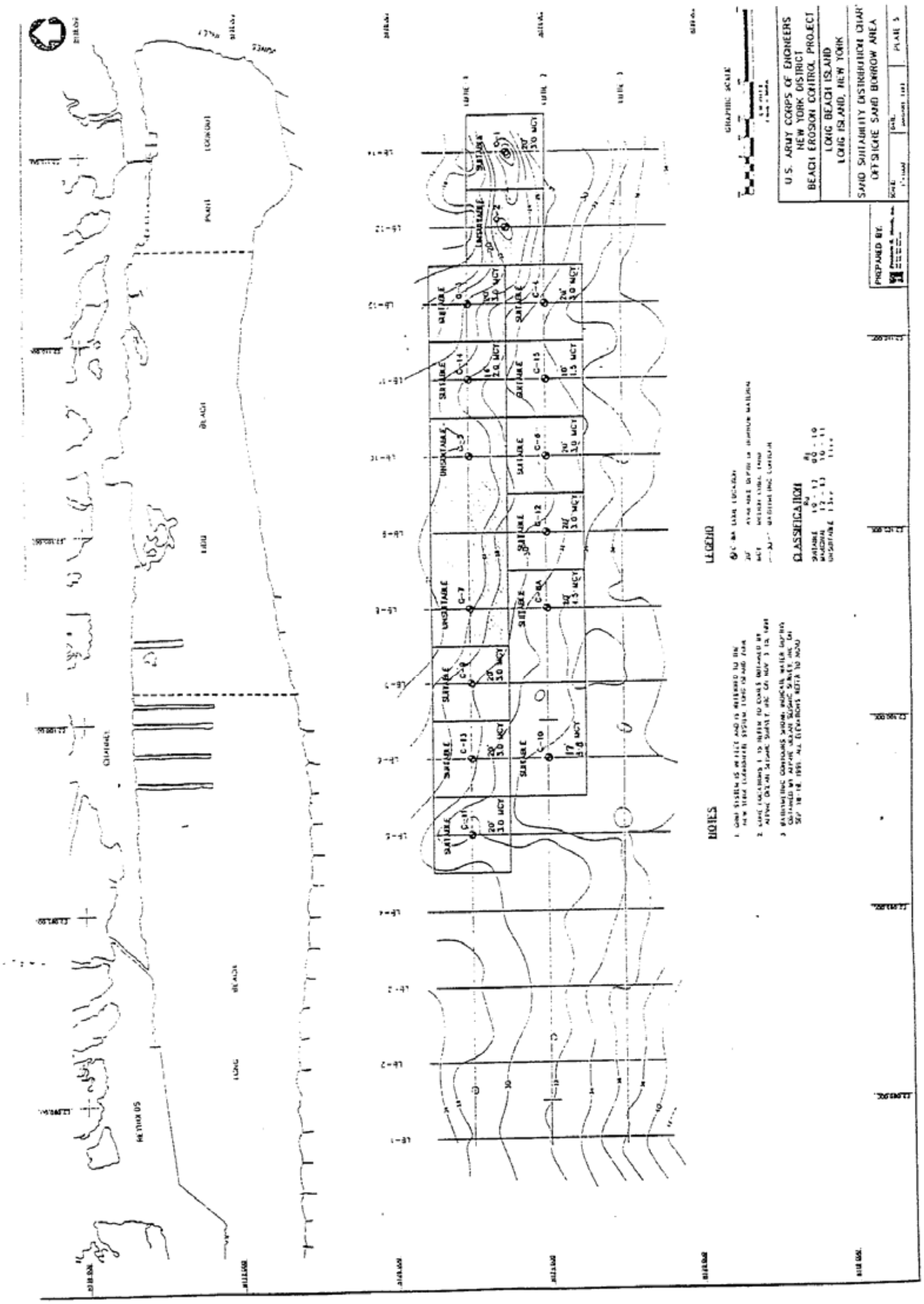
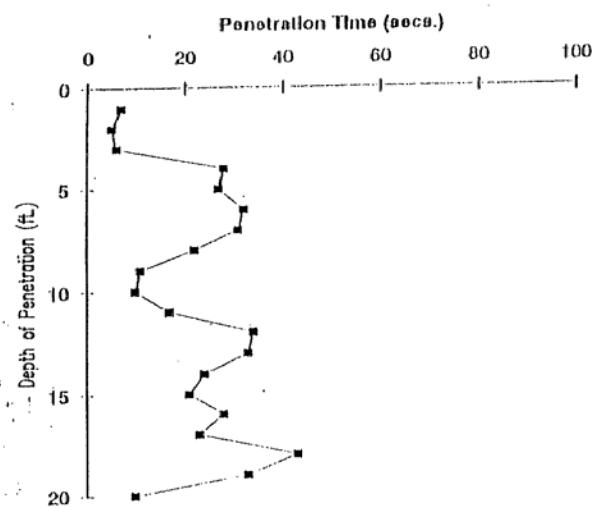

U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT
BEACH EROSION CONTROL PROJECT
LONG BEACH ISLAND
LONG ISLAND, NEW YORK
SEISMIC TRACKLINE
AND CORE LOCATION
PREPARED BY:
GRAPHIC SCALE
LEGEND
NOTES
POINT LOOKOUT
LIDO BEACH
LONG BEACH

FIG-B10



GRAPHIC SCALE
U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT
BEACH EROSION CONTROL PROJECT
LONG BEACH ISLAND
LONG ISLAND, NEW YORK
SAND SUITABILITY DISTRIBUTION CHART
OFFSHORE SAND BORROW AREA
PREPARED BY:
LEGEND
CLASSIFICATION
NOTES
SUITABLE
UNSUITABLE

FIG-B11



DATUM - MLLW

WATER DEPTH 22.0 FEET

CORE DESCRIPTION

0.0' - 5.0'	Whitish gray fine sand 94%, trace medium sand 4%, trace silt 2%, clean.
5.0' - 9.0'	Gray fine sand 47%, and medium sand 40%, trace coarse sand 8%, trace silt 3%, trace fine gravel 2%, trace shells.
9.0' - 19.5'	Light gray fine sand 82%, little medium sand 13%, trace silt 3%, trace coarse sand 2%, trace silt.
Composite 0.0' - 19.5'	Gray fine sand 83%, little medium sand 13%, trace coarse sand 2%, trace silt 2%, trace shells.

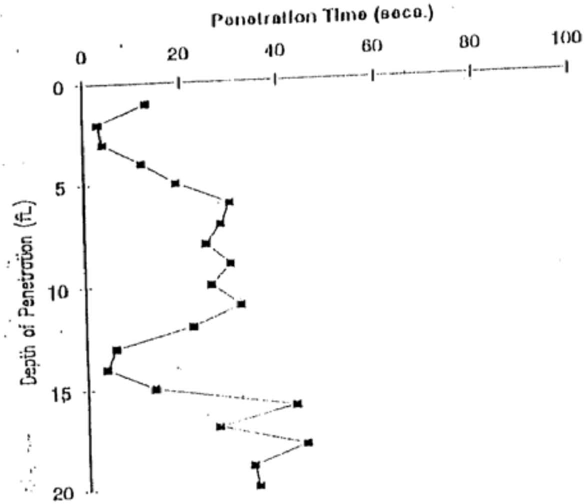
Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2114927.8
Northing:	124738.9
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-1

DATUM - MLLW

WATER DEPTH 19.5 FEET



CORE DESCRIPTION

0.0' - 8.0'	Light gray fine sand 92%, trace medium sand 5%, trace silt 3%, clean.
8.0' - 14.5'	Medium gray fine sand 77%, little silt 16%, trace medium sand 6%, trace coarse sand 1%, trace shells.
14.5' - 19.0'	Medium gray fine sand 93%, trace silt 5%, trace medium sand 2%.
Composite 0.0' - 19.1'	Gray fine sand 88%, trace silt 7%, trace medium sand 5%, trace shells.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

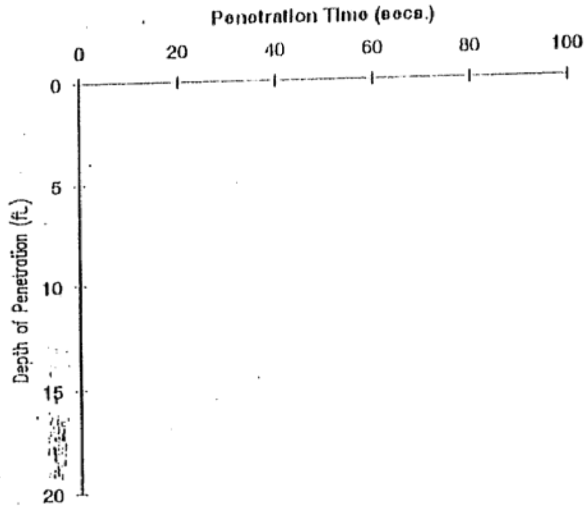
GRID:	NY State, Long Island Zone
Easting:	2113187.9
Northing:	123481.6
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-2

FIG-B13

DATUM - MLLW

WATER DEPTH 24.0 FEET



CORE DESCRIPTION

0.0' - 10.0'	Whitish gray fine sand 87%, trace medium sand 8%, trace silt 3%, trace coarse sand 1%, fine gravel 1%, trace shells, interbedded thin lenses silt.
10.0' - 20.0'	Light gray medium sand 52%, and fine sand 37%, little course saand 10%, trace fine gravel 5%, trace silt 1%, some shell fragments, clean.
Composite 0.0' - 20.0'	Light gray fine sand 55%, and medium sand 40%, trace coarse sand 4%, trace fine gravel 1%, some shells, clean.

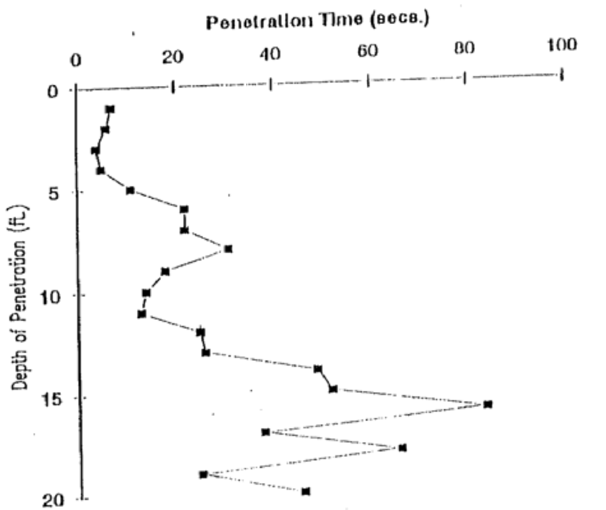
Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2111011
Northing:	125976
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-3

DATUM - MLLW

WATER DEPTH 32.0 FEET



CORE DESCRIPTION

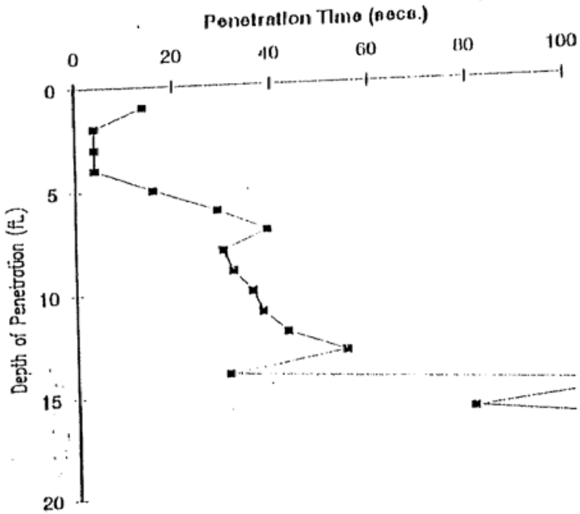
0.0' - 3.0'	Gray medium sand 30%, and fine sand 32%, some coarse sand 20%, little fine gravel 15%, trace silt 3%, trace shells.
3.0' - 10.0'	Gray fine sand 85%, little medium sand 13%, trace silt 2%.
10.0' - 20.0'	Gray fine sand 67%, some medium sand 28%, trace silt 3%, trace coarse sand 2%.
Composite 0.0' - 20.0'	Gray fine sand 71%, some medium sand 20%, trace coarse sand 4%, trace silt 4%, trace fine gravel 1%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2111004.8
Northing:	124039
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-4

FIG-B15



DATUM - MLLW

WATER DEPTH 28.0 FEET

CORE DESCRIPTION

0.0' - 4.3'	Medium gray fine sand 68%, little medium sand 22%, trace silt 7%, trace coarse sand 3%, clean, trace shells.
4.3' - 19.5'	Light gray fine sand 96%, trace silt 3%, trace medium sand 1%, clean.
Composite 0.0' - 19.5'	Gray fine sand 94%, trace medium sand 3%, trace coarse sand 2%, trace silt 1%, clean.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

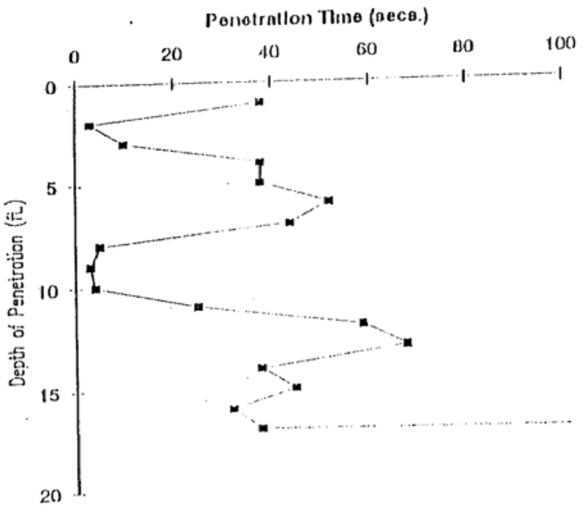
GRID:	NY State, Long Island Zone
Easting:	2107002.6
Northing:	126028.4
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-5

FIG-B16

DATUM - MLLW

WATER DEPTH 31.4 FEET



CORE DESCRIPTION

0.0' - 8.0'	Medium gray fine sand 84%, little medium sand 14%, trace coarse sand 1%, trace silt 1%, trace shells.
8.0' - 18.0'	Medium gray fine sand 70%, little medium sand 24%, trace dark gray silt 5%, trace coarse sand 1%.
Composite 0.0' - 18.0'	Medium gray fine sand 70%, little medium sand 24%, trace dark gray silt 5%, trace coarse sand 1%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

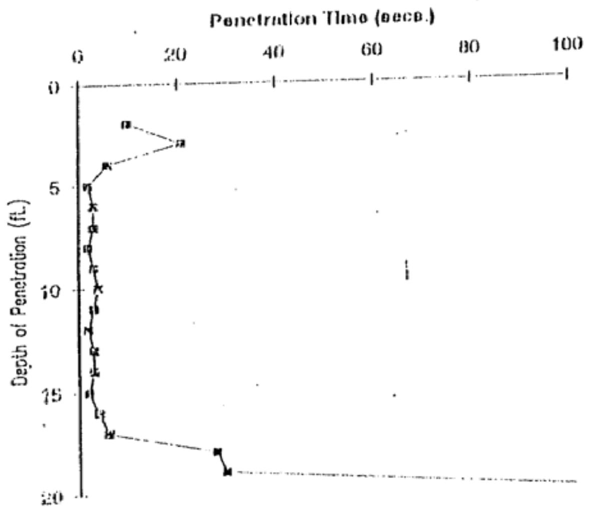
GRID:	NY State, Long Island Zone
Easting:	2106985.5
Northing:	124011
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-6

FIG-B17

DATUM - MLLW

WATER DEPTH 20.0 FEET



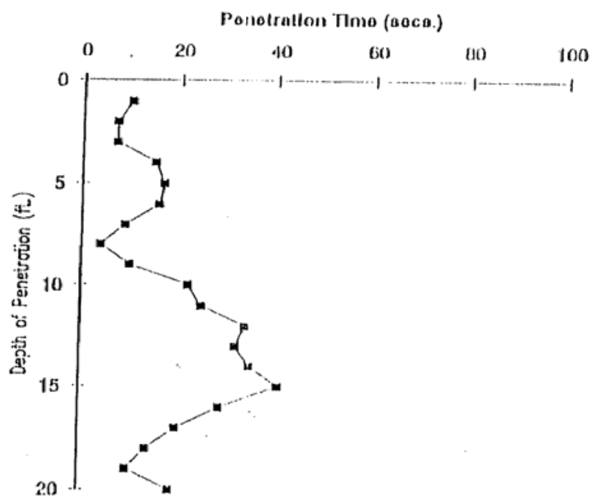
CORE DESCRIPTION

0.0' - 15.0'	Dark gray sand 70%, some silt 19%, trace medium sand 8%, trace coarse sand 2%, trace fine gravel 1%.
15.0' - 19.9'	Medium fine sand 87%, trace medium sand 8%, trace silt 5%.
Composite 0.0' - 19.9'	Dark gray fine sand 73%, little medium sand 14%, little silt 12%, trace coarse sand 1%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2102985.9
Northing:	126024.3
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-7



DATUM - MLLW

WATER DEPTH 35.0 FEET

CORE DESCRIPTION

0.0' - 10.0'	Whitish gray fine sand 77%, little medium sand 17%, trace coarse sand 3%, trace silt 3%.
10.0' - 15.0'	Whitish gray fine sand 90%, trace medium sand 6%, trace silt 4%.
15.0' - 19.9'	Dark gray fine sand 40%, and medium sand 36%, little coarse sand 13%, trace fine gravel 6%, trace silt 5%.
Composite 0.0' - 19.9'	Gray fine sand 61%, little medium sand 18%, little fine gravel 12%, trace coarse sand 5%, trace silt 4%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

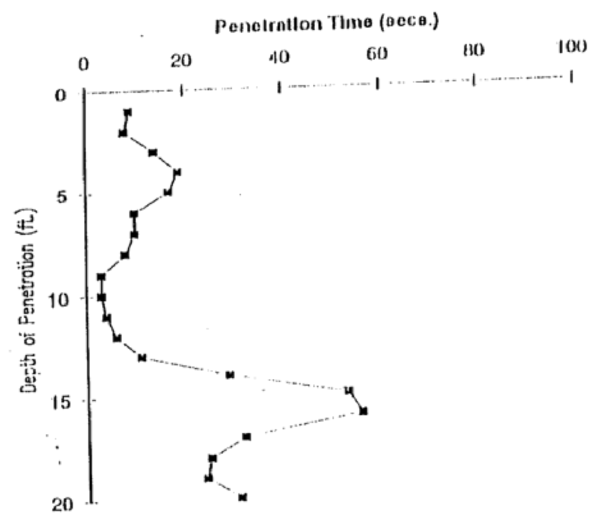
GRID:	NY State, Long Island Zone
Easting:	2103000.9
Northing:	124012.7
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-8A

FIG-B19

DATUM - MLLW

WATER DEPTH 30.5 FEET



CORE DESCRIPTION

0.0' - 7.5'	Medium gray fine sand 44%, some medium sand 40%, little coarse sand 10%, trace fine gravel 5%, trace silt 1%, trace shell fragments.
7.5' - 12.5'	Dark gray fine sand 76%, little silt 19%, trace medium sand 5%.
12.5' - 19.0'	Medium gray fine sand 67%, little medium sand 21%, little silt 10%, trace coarse sand 2%, few interbedded minute silt lenses.
Composite 0.0' - 19.9'	Medium gray 71%, little medium sand 18%, trace silt 9%, trace coarse sand 2%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

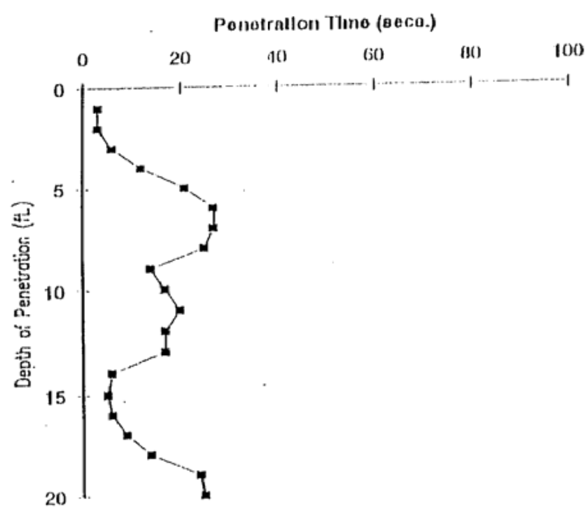
GRID:	NY State, Long Island Zone
Easting:	2100991.7
Northing:	126041.5
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-9

FIG-B20

DATUM - MLLW

WATER DEPTH 33.5 FEET



CORE DESCRIPTION

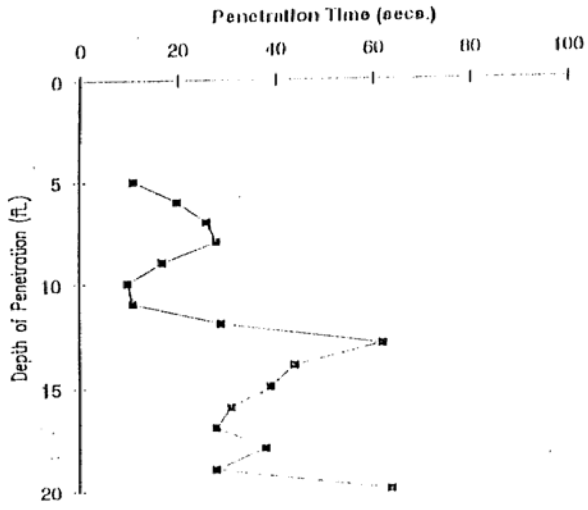
0.0' - 8.0'	Whitish gray fine sand 95%, trace medium sand 4%, trace silt 1%, clean, trace shell fragments.
8.0' - 17.8'	Gray fine sand 31%, and medium sand 32%, some fine gravel 21%, little coarse sand 12%, trace silt 4%.
17.8' - 20.0'	Dark gray clay, very dense, stiff, slightly plastic.
Composite 0.0' - 17.0'	Gray fine sand 57%, some medium sand 22%, trace coarse sand 9%, trace fine gravel 9%, trace silt 3%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2098991.6
Northing:	124039.1
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-10

FIG-B21



DATUM - MLLW

WATER DEPTH 30.0 FEET

CORE DESCRIPTION

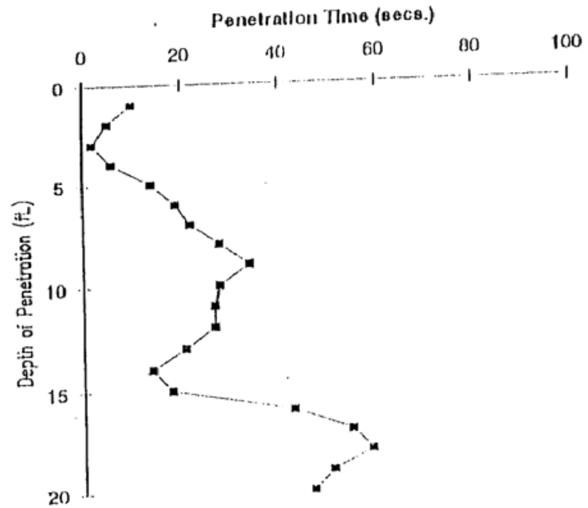
0.0' - 4.0'	Light brown medium sand 60%, little fine sand 16%, little coarse sand 16%, trace fine gravel 4%, trace silt 4%.
4.0' - 12.5'	Whitish gray fine sand 72%, some medium sand 23%, trace silt 3%, trace coarse sand 2%.
12.5' - 19.3'	Whitish gray fine sand 70%, some medium sand 25%, trace silt 5%.
Composite 0.0' - 19.3'	Whitish gray medium sand 50%, and find sand 36%, trace coarse sand 7%, trace silt 4%, trace fine gravel 3%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2097007.2
Northing:	125988
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-11

FIG-B22



DATUM - MLLW

WATER DEPTH 31.0 FEET

CORE DESCRIPTION

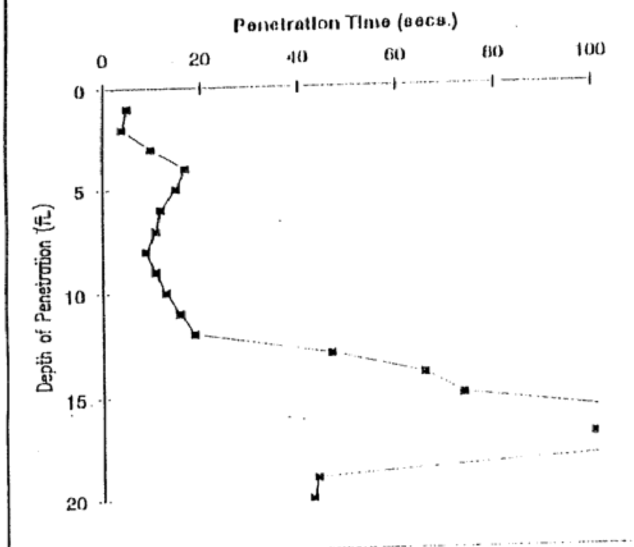
0.0' - 9.5'	Gray fine sand 83%, little medium sand 11%, trace silt 6%, trace shells.
9.5' - 19.3'	Gray fine sand 81%, little medium sand 12%, trace silt 4%, trace coarse sand 3%.
Composite 0.0' - 19.3'	Gray fine sand 81%, little medium sand, trace silt 4%, trace coarse sand 2%, trace fine gravel 1%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2104985.9
Northing:	123988.6
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-12

FIG-B23



DATUM - MLLW

WATER DEPTH 31.5 FEET

CORE DESCRIPTION

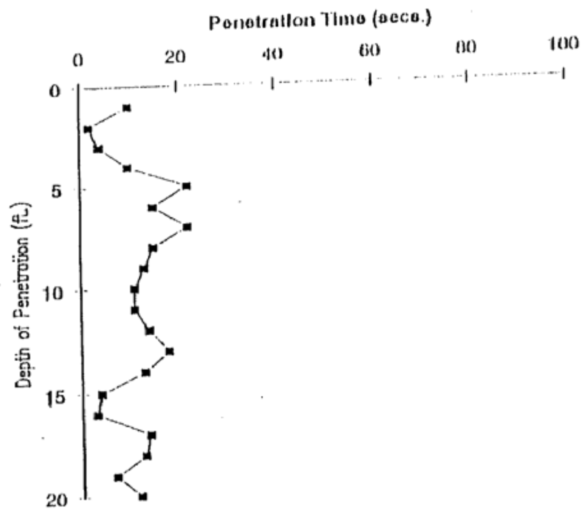
0.0' - 10.0'	Gray fine sand 72%, some medium sand 23%, trace silt 3%, trace coarse sand 2%.
10.0' - 18.4'	Gray fine sand 69%, some medium sand 24%, trace silt 6%, trace coarse sand 1%.
Composite 0.0' - 18.4'	Gray fine sand 65%, some medium sand 24%, trace silt 5%, trace fine gravel 4%, trace coarse sand 2%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2099009.1
Northing:	125965.2
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-13

FIG-B24



DATUM - MLLW

WATER DEPTH 27.6 FEET

CORE DESCRIPTION

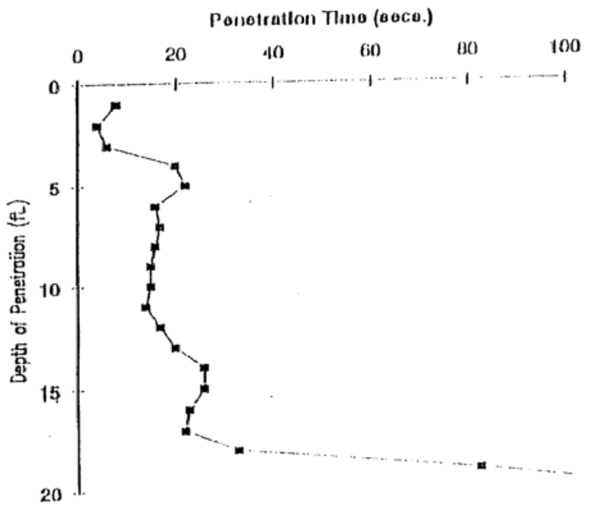
0.0' - 10.0'	Whitish gray medium sand 70%, some fine sand 24%, trace coarse sand 3%, trace fine gravel 2%, trace silt 1%.
10.0' - 13.7'	Light gray medium sand 59%, some fine sand 35%, trace coarse sand 4%, trace fine gravel 2%, trace shell fragments.
13.7' - 19.9'	Dark gray silt, highly plastic, and clay.
Composite 0.0' - 13.7'	Light gray medium sand 60%, some fine sand 35%, trace coarse sand 5%.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2109034.9
Northing:	126010
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-14

FIG-B25



DATUM - MLLW

WATER DEPTH 32.0 FEET

CORE DESCRIPTION

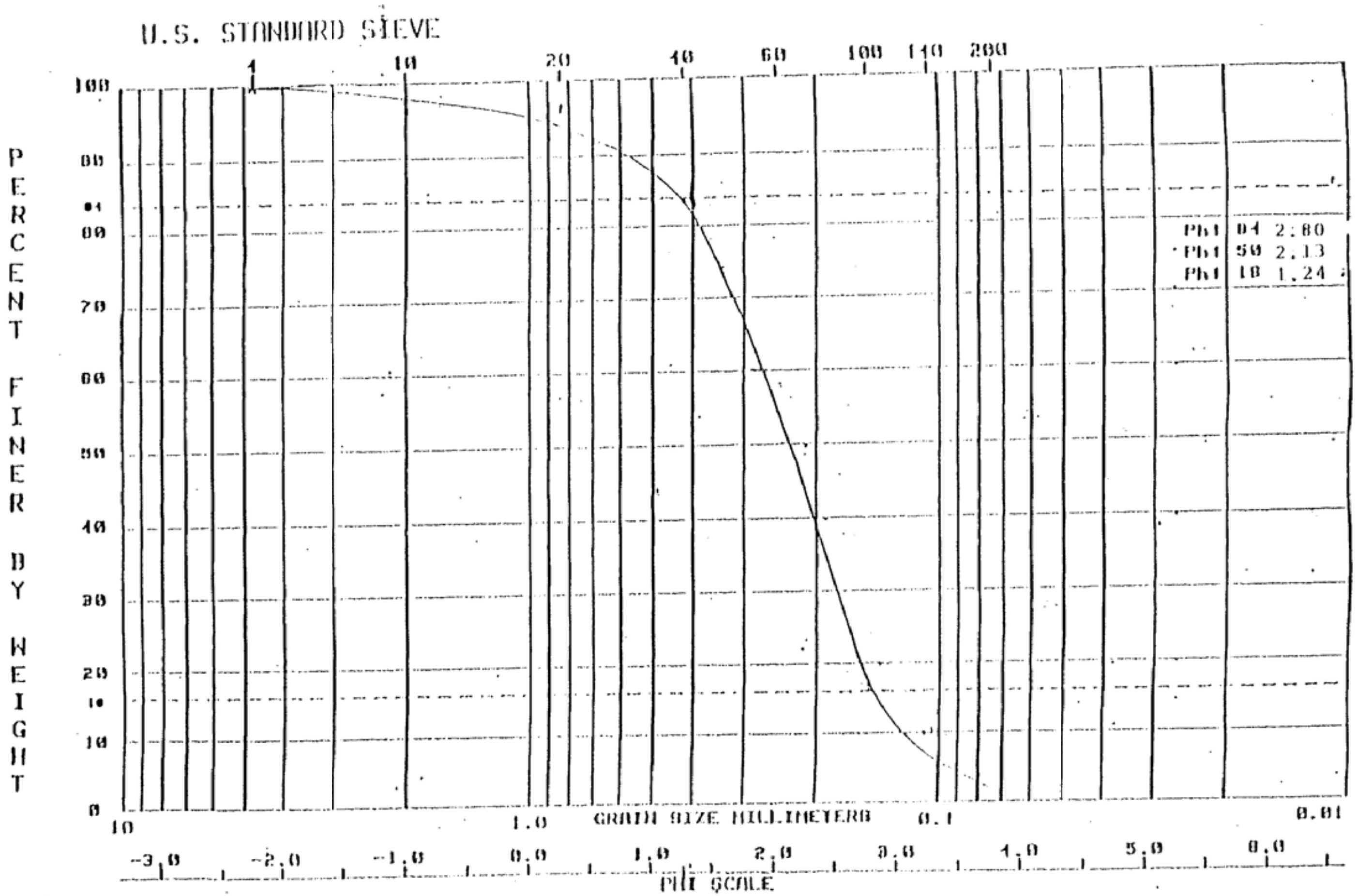
0.0' - 10.0'	Whitish gray fine sand 82%, little medium sand 18%, trace shells.
10.0' - 19.8'	Whitish gray fine sand 100%.
Composite 0.0' - 19.8'	Whitish gray fine sand 96%, trace medium sand 4%, trace shells.

Project:	Long Beach - Borrow Sources
Client:	Frederic R. Harris New York, New York
By:	Alpine Ocean Seismic Survey, Inc.
Date:	November, 1991
Project No:	AOSS - 1119

GRID:	NY State, Long Island Zone
Easting:	2108997.4
Northing:	123975
Drilling Method:	Vibracore 20'
Location:	Off Shore Long Beach Island

CORE NO. C-15

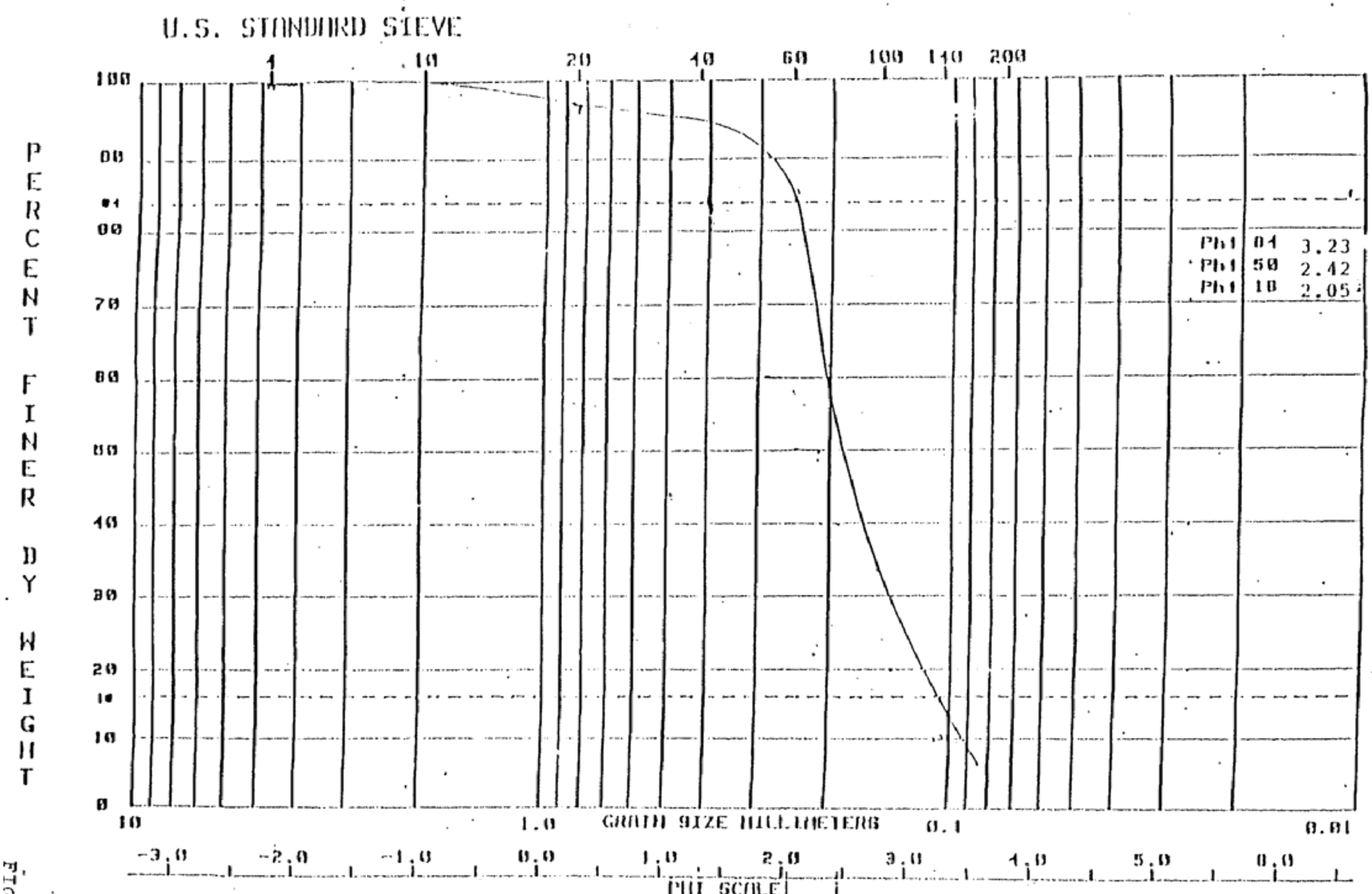
FIG-B26



LONG BEACH, NY –

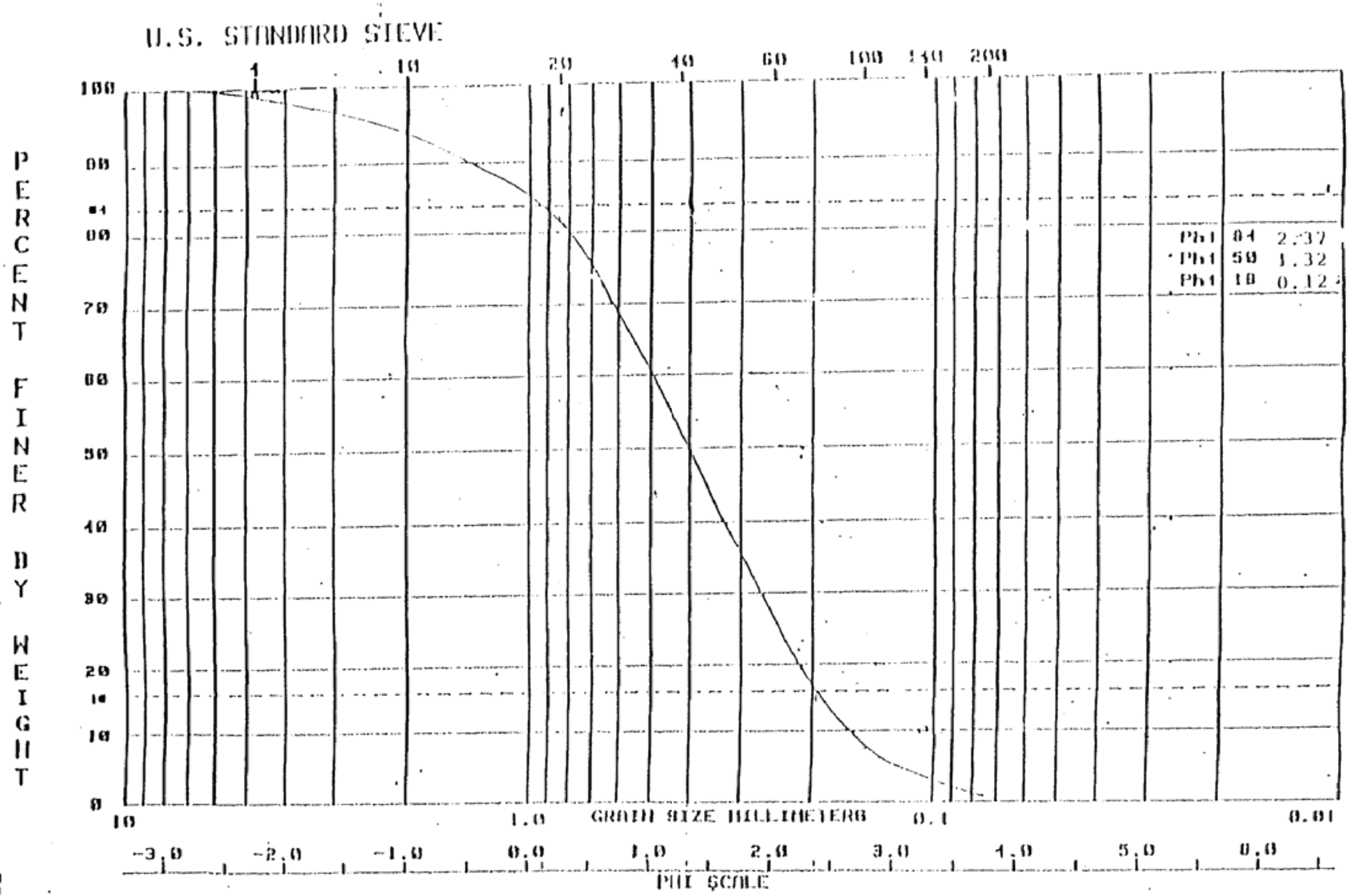
C-1
S-8
0-19.5'

FIG-B27



LONG BEACH, NY -- C-2
S-12
0-19'1"

FIG-B28



LONG BEACH, NY - C-3
5-16
0-20'

FIG-B29

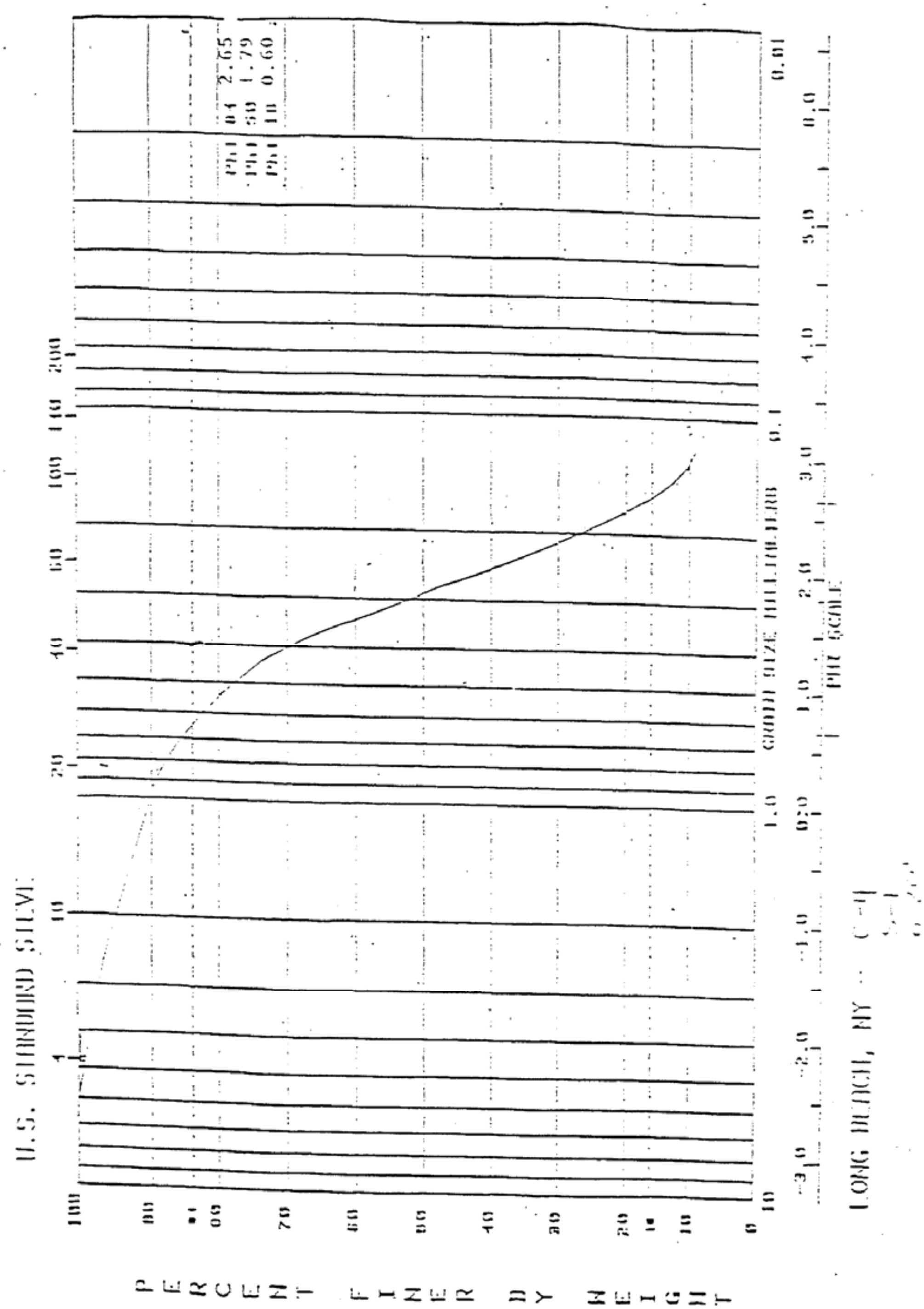
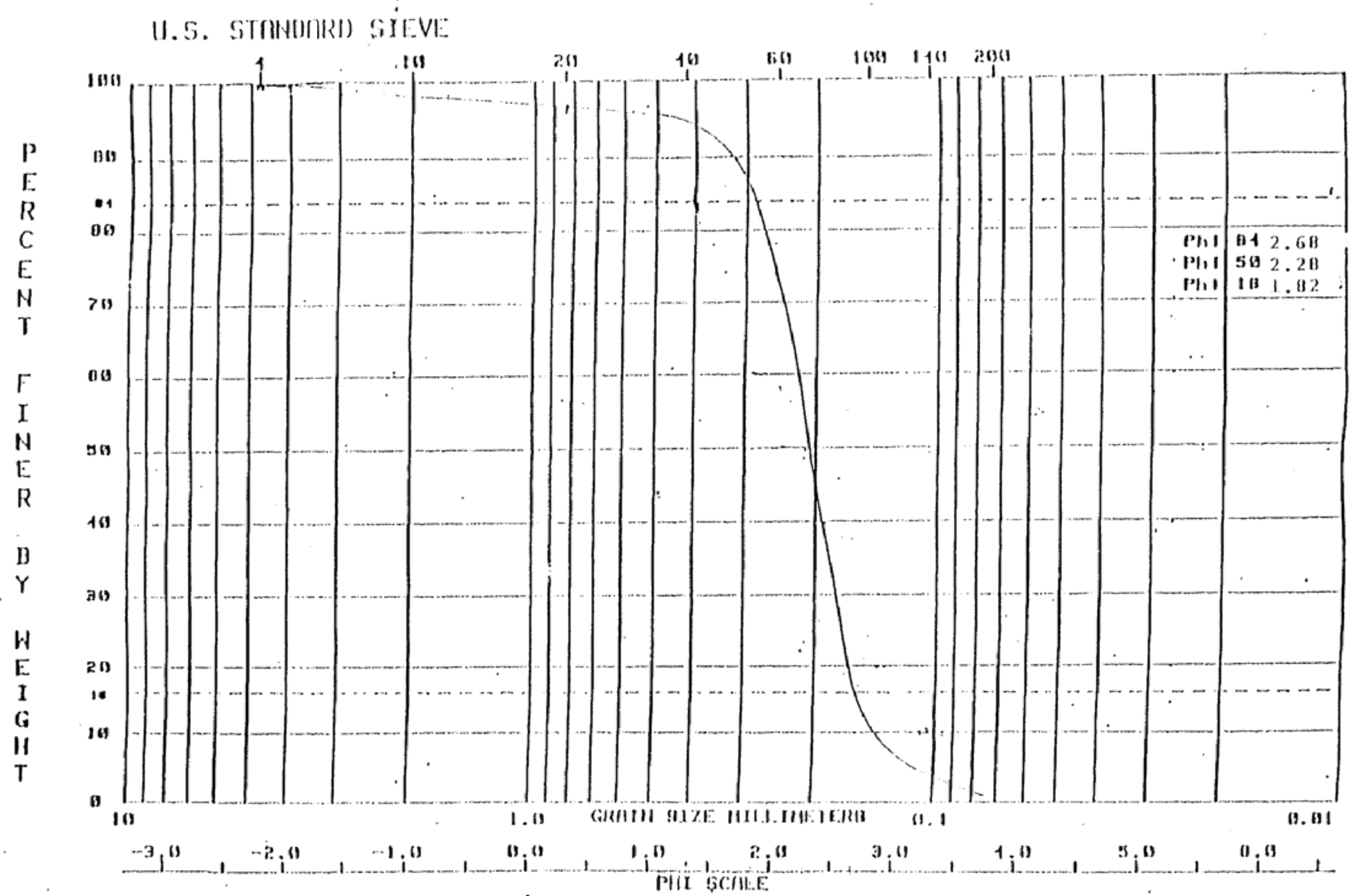

U.S. STANDARD SIEVE
PERCENT FINER BY WEIGHT
GRAIN SIZE MILLIMETERS
PHI SCALE
LONG BEACH, NY
PHI 84 2.65
PHI 50 1.79
PHI 16 0.60

FIG-B30



LONG BEACH, NY - C-5
S-5
0-1'5"

FIG-B31

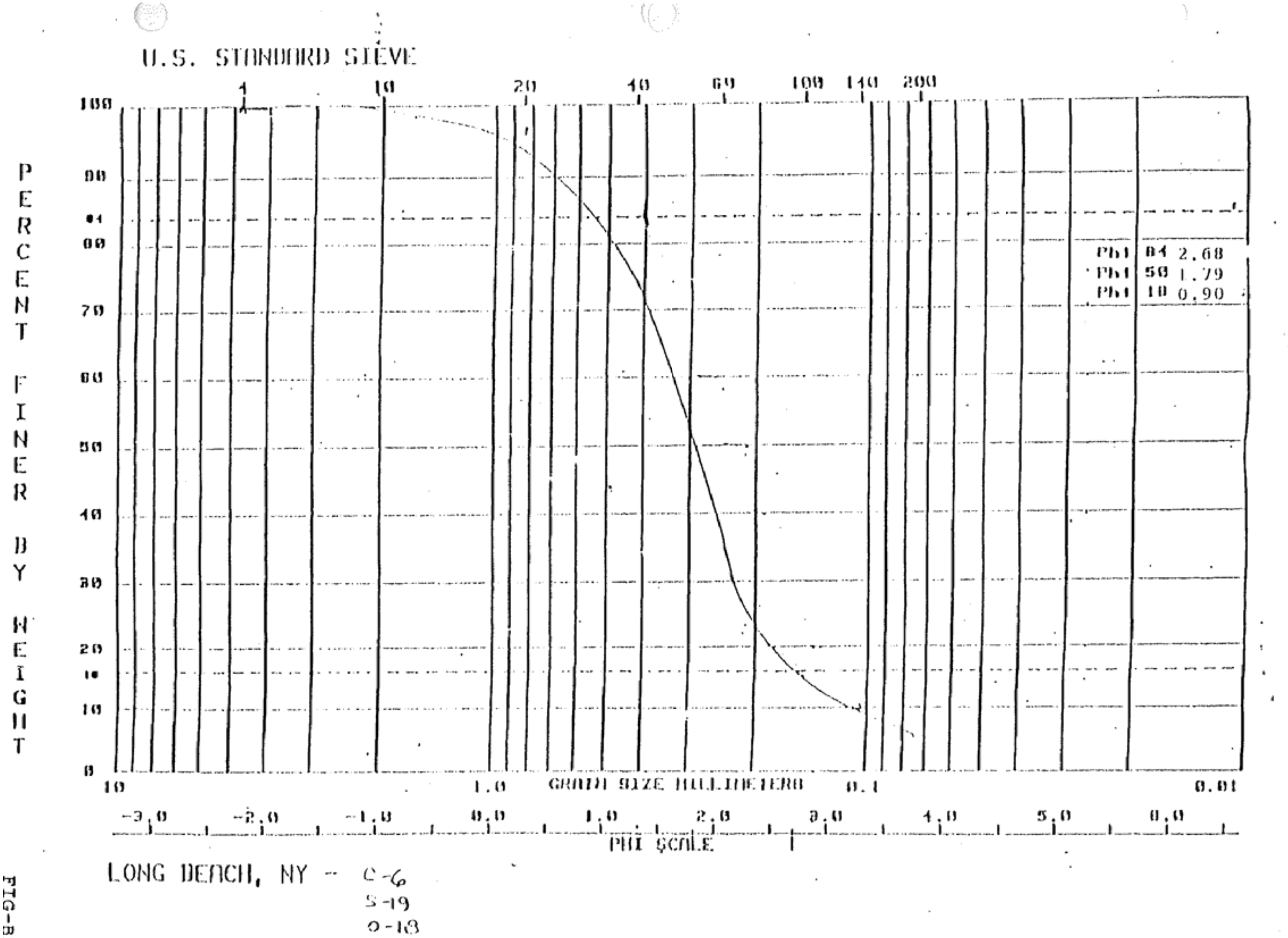

U.S. STANDARD SIEVE
4
10
20
40
60
100
140
200
PERCENT FINER BY WEIGHT
100
90
84
80
70
60
50
40
30
20
16
10
0
10
1.0
GRAIN SIZE MILLIMETERS
0.1
0.01
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
PHI SCALE
Phi 84 2.68
Phi 50 1.79
Phi 16 0.90
LONG BEACH, NY - C-6
S-19
0-13

FIG-B32

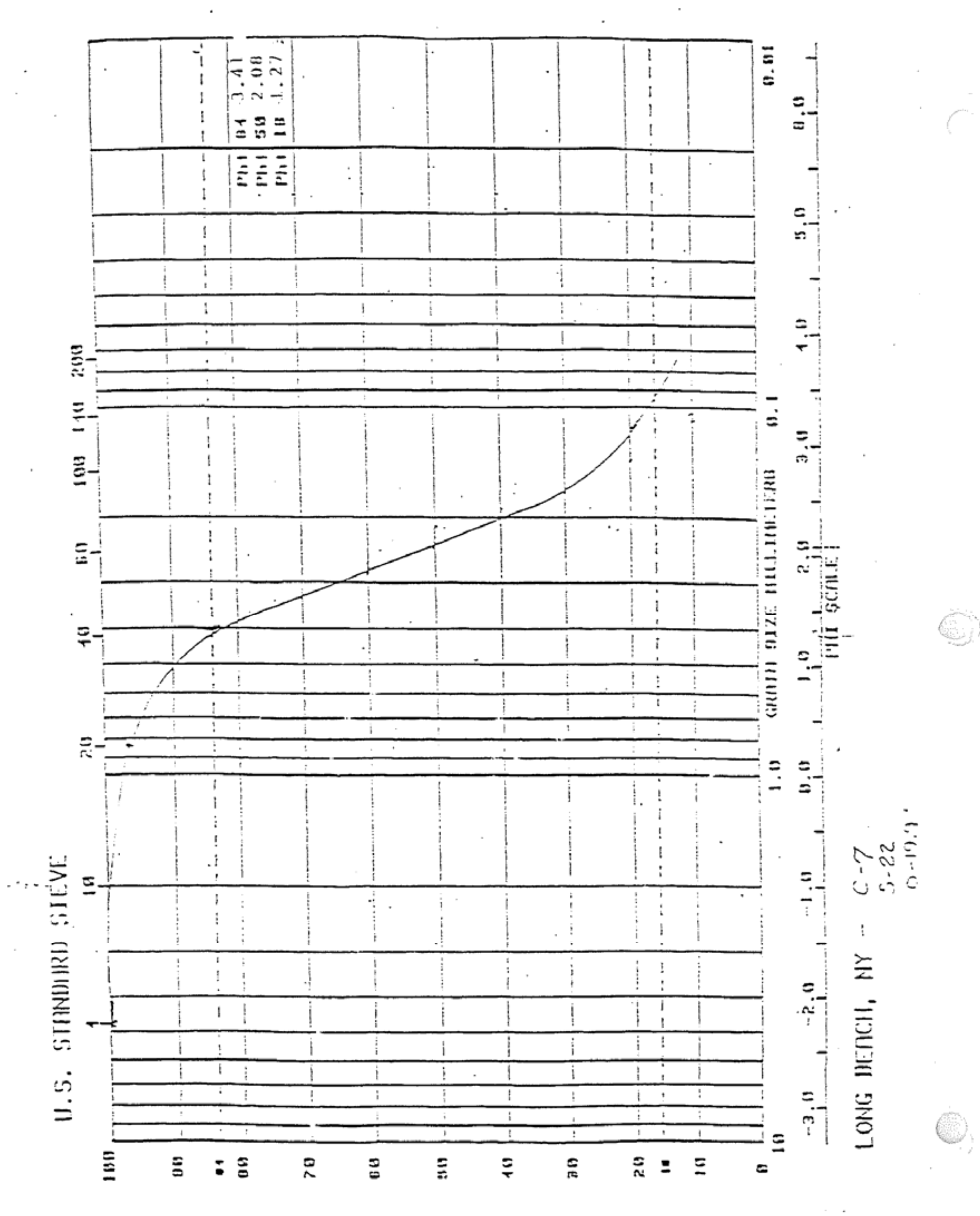
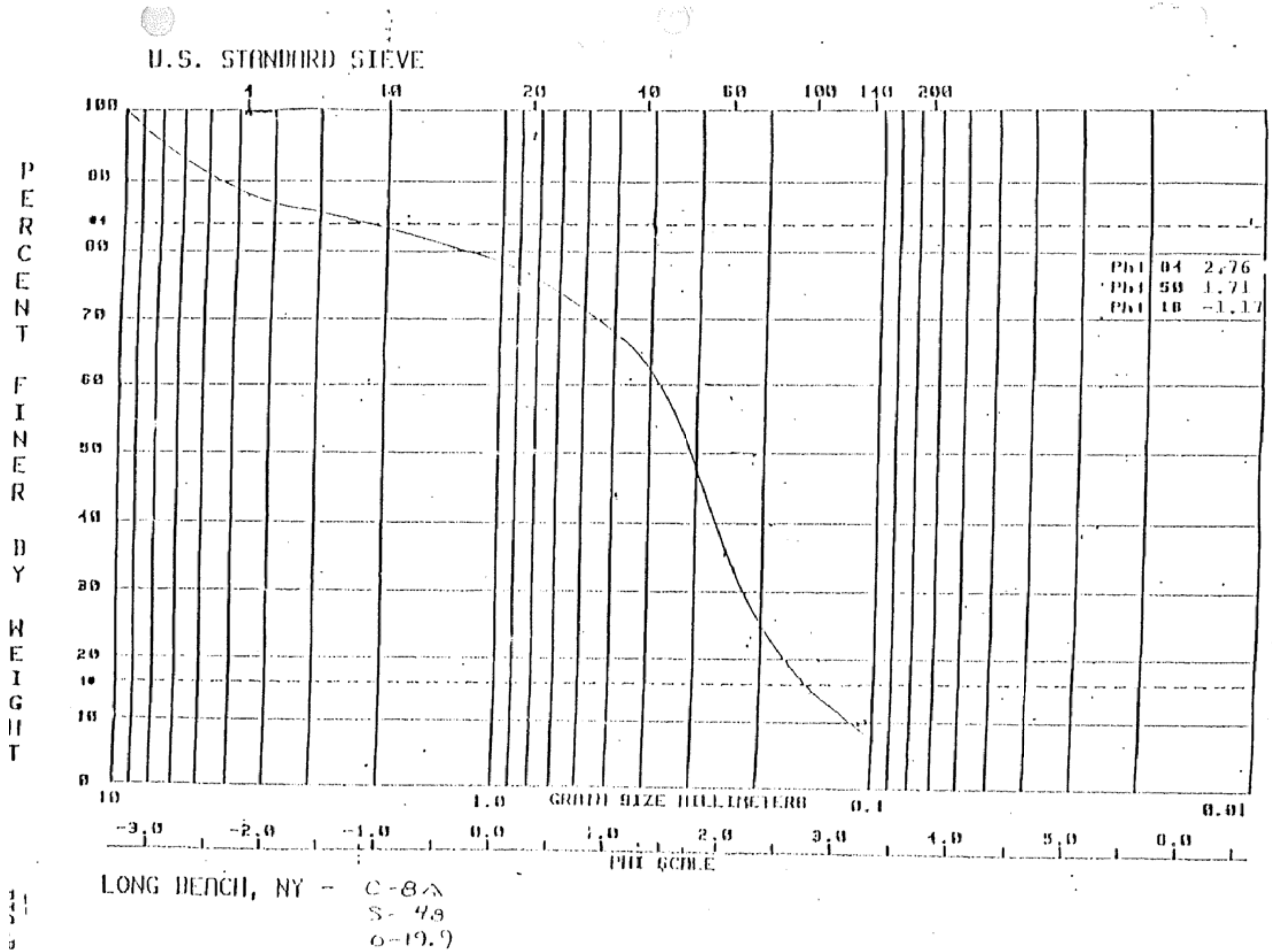
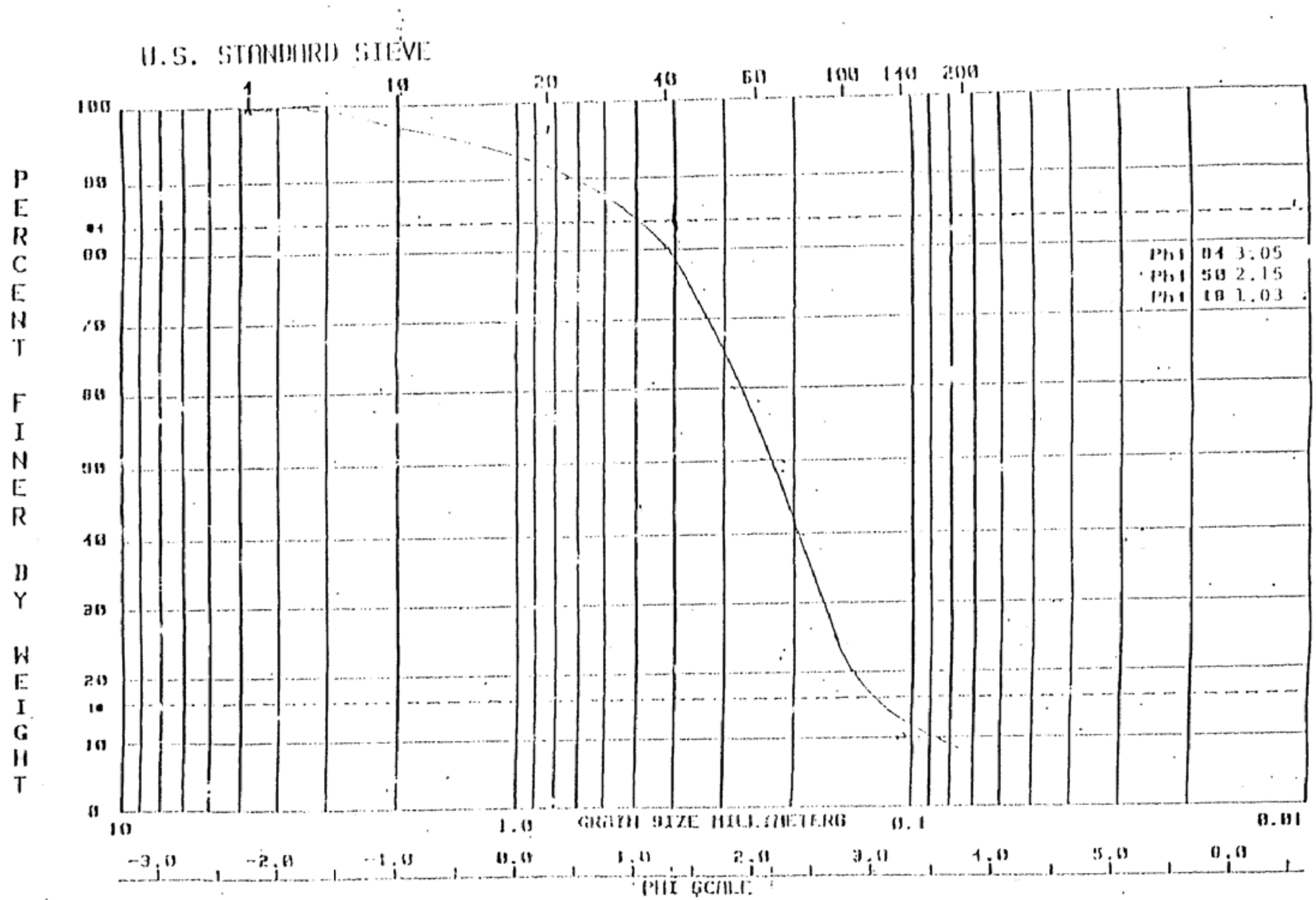

U.S. STANDARD SIEVE
GRAIN SIZE MILLIMETERS
PHI SCALE
PERCENT FINER BY WEIGHT
Phi 84 3.41
Phi 50 2.08
Phi 16 1.27
LONG BEACH, NY - C-7

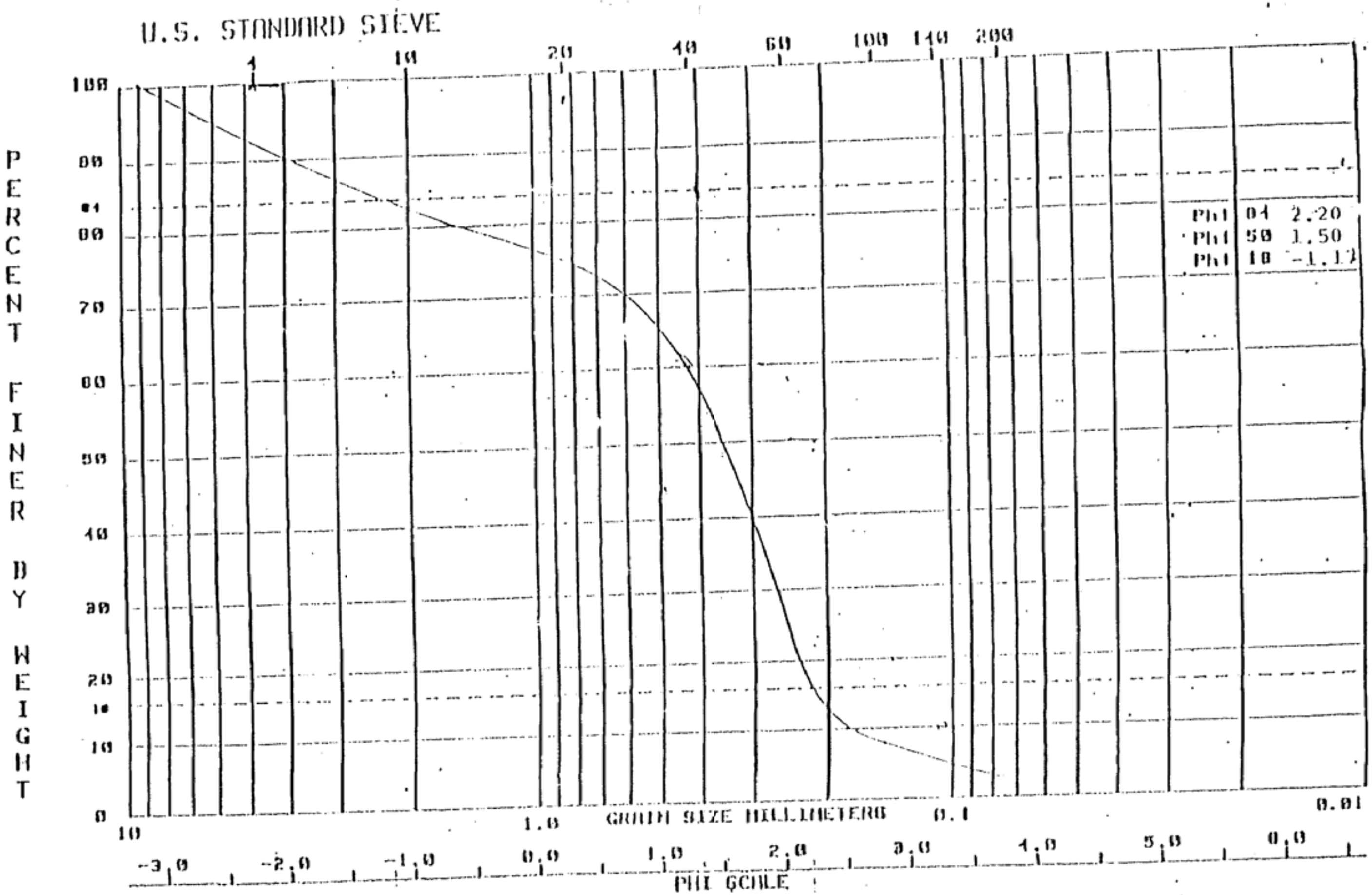
FIG-B3


U.S. STANDARD SIEVE
4
10
20
40
60
100
140
200
PERCENT FINER BY WEIGHT
100
90
84
80
70
60
50
40
30
20
16
10
0
Phi 84 2.76
Phi 50 1.71
Phi 16 -1.17
10
1.0
GRAIN SIZE MILLIMETERS
0.1
0.01
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
PHI SCALE
LONG BEACH, NY -
C-8A
S- 49
σ-19.9



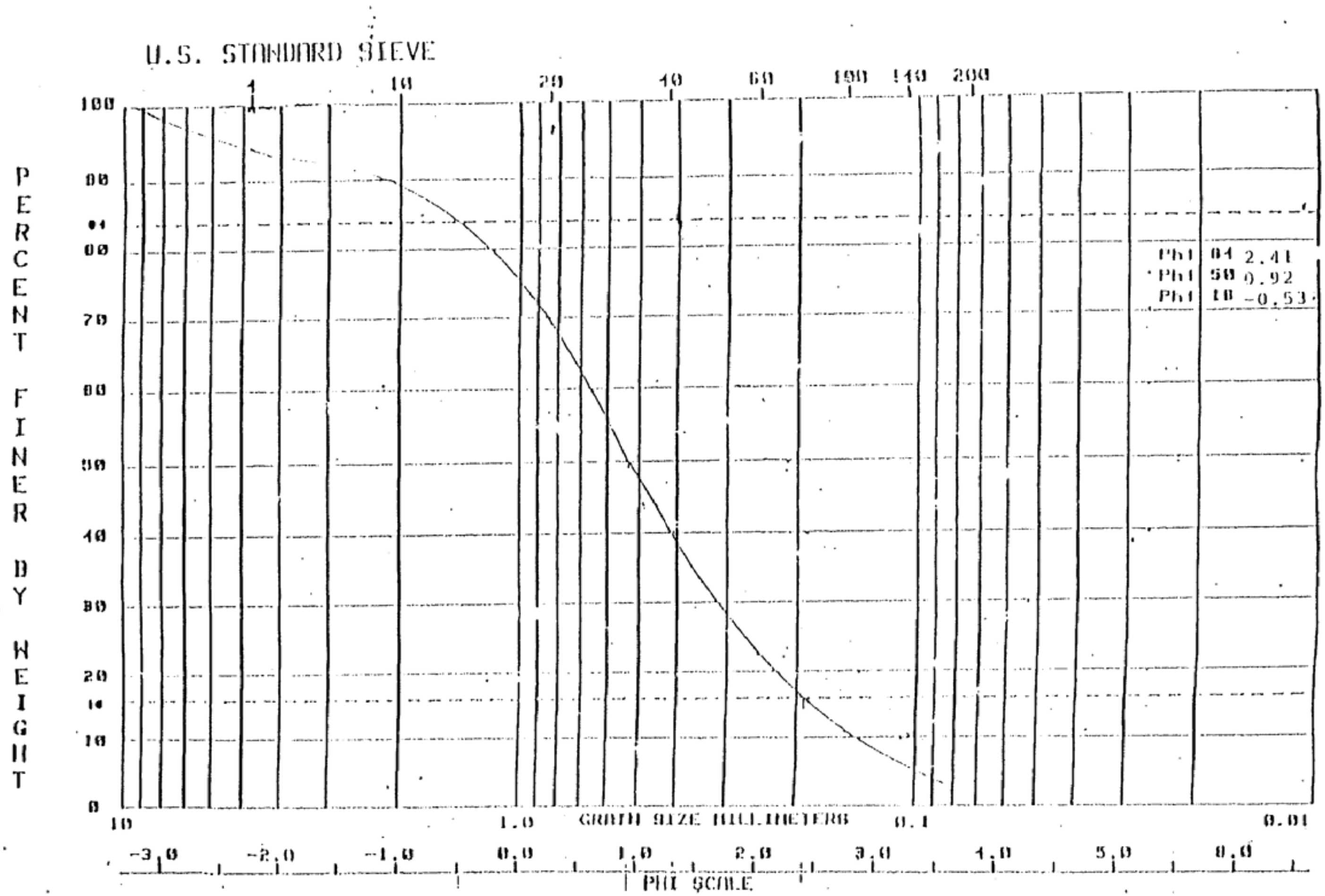
LONG BEACH, NY - C-9
S-25
0-19.9

FIG-B35



LONG BEACH, NY -- C-10
S-29
0-17

FIG-B36



LONG BEACH, NY – C-11
S-32
0-19.3'

FIG-B37

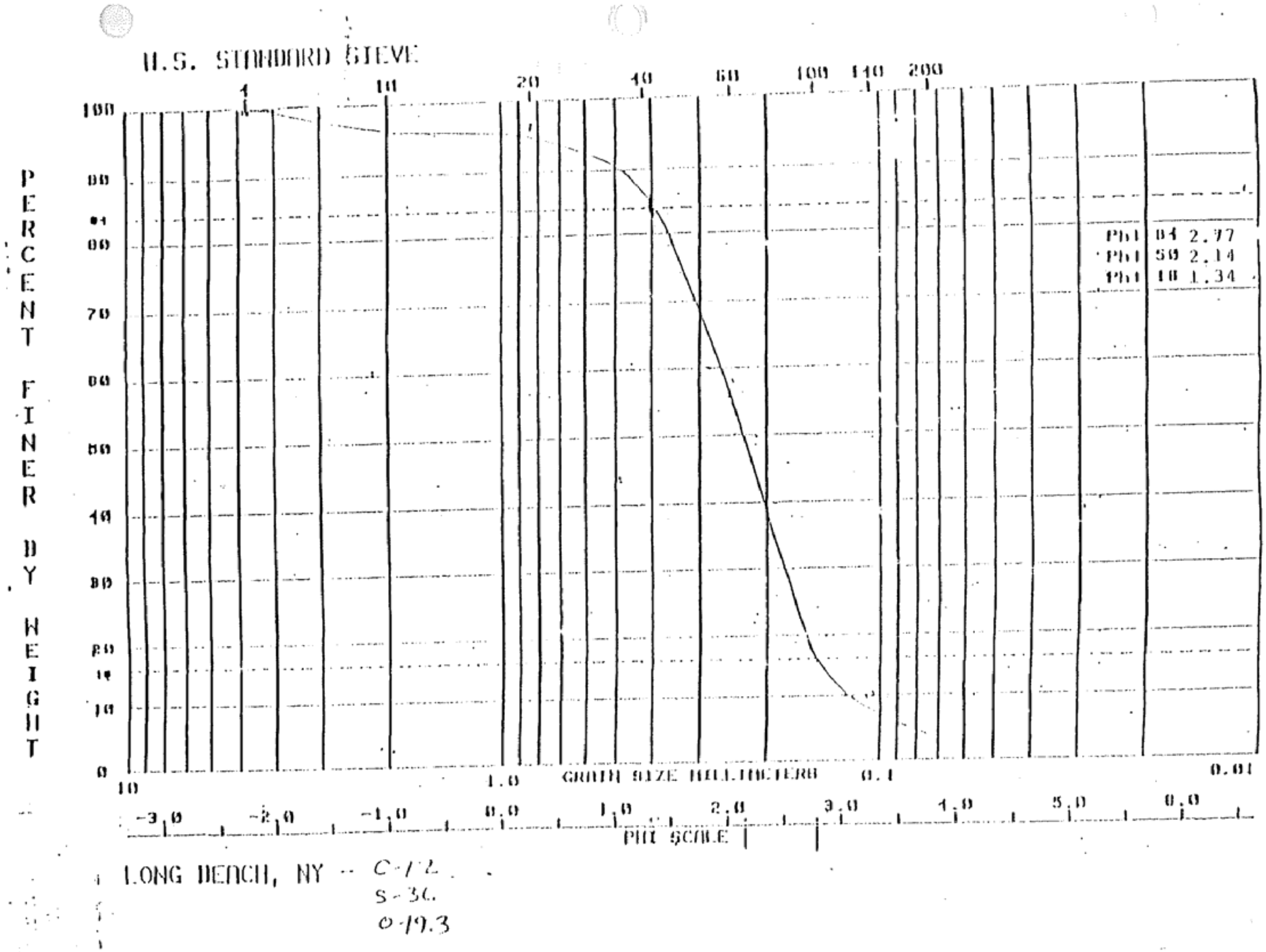
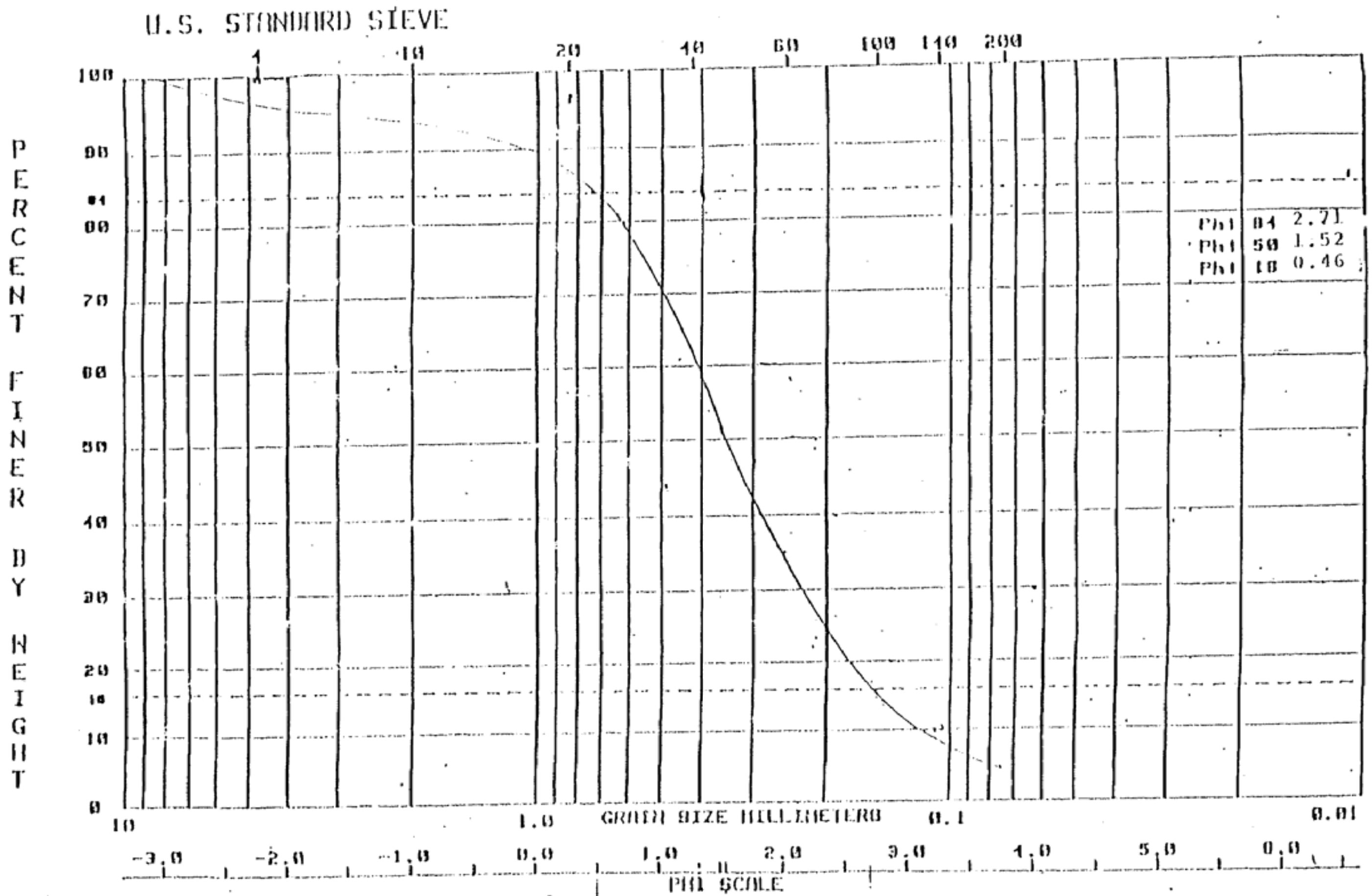
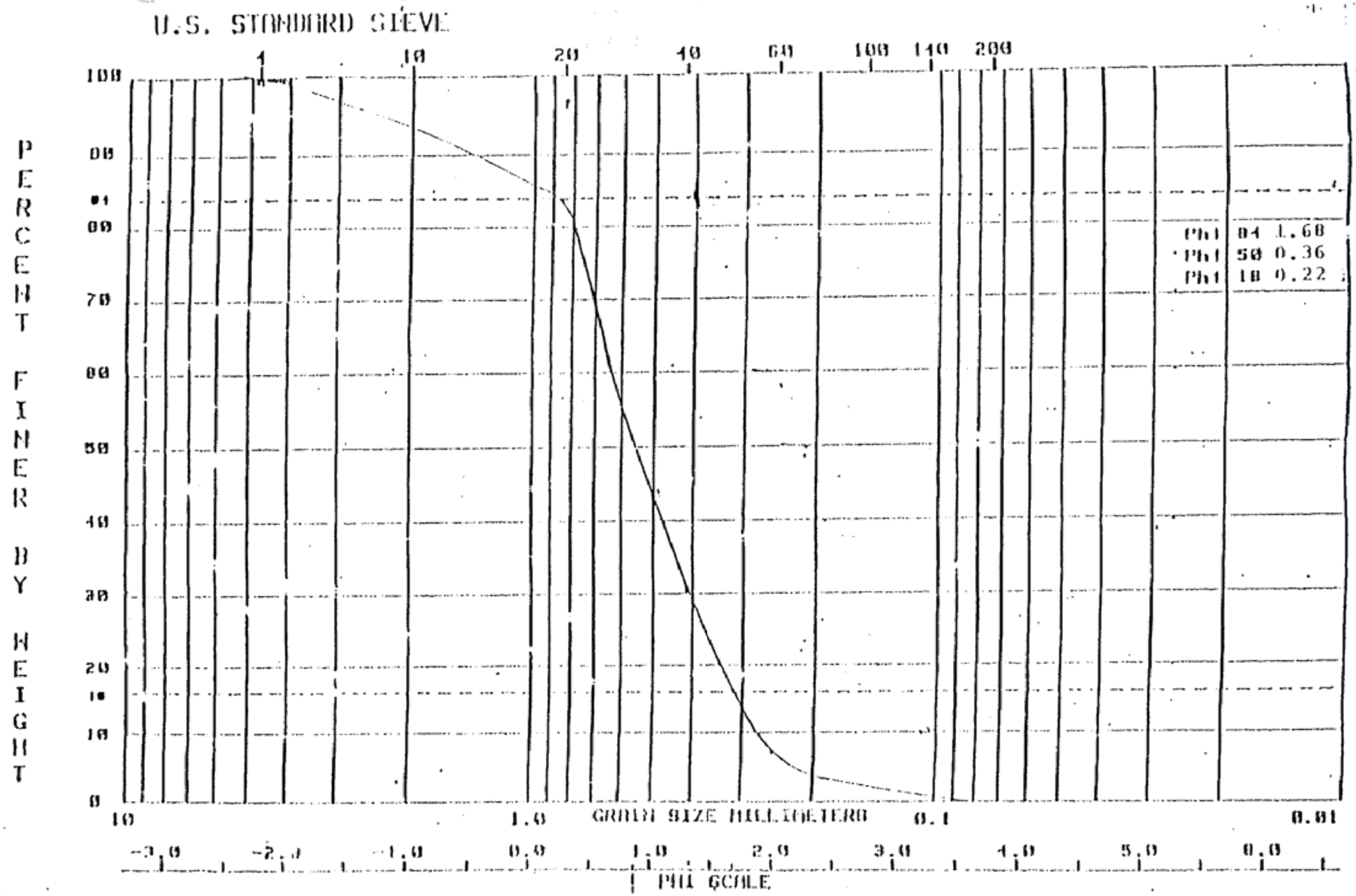

U.S. STANDARD SIEVE
4
10
20
40
60
100
140
200
PERCENT FINER BY WEIGHT
100
90
84
80
70
60
50
40
30
20
16
10
0
10
1.0
GRAIN SIZE MILLIMETERS
0.1
0.01
-3.0
-2.0
-1.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
PHI SCALE
Phi 84 2.77
Phi 50 2.14
Phi 16 1.34
LONG BEACH, NY -- C-72
S-36
0-19.3

FIG-B38



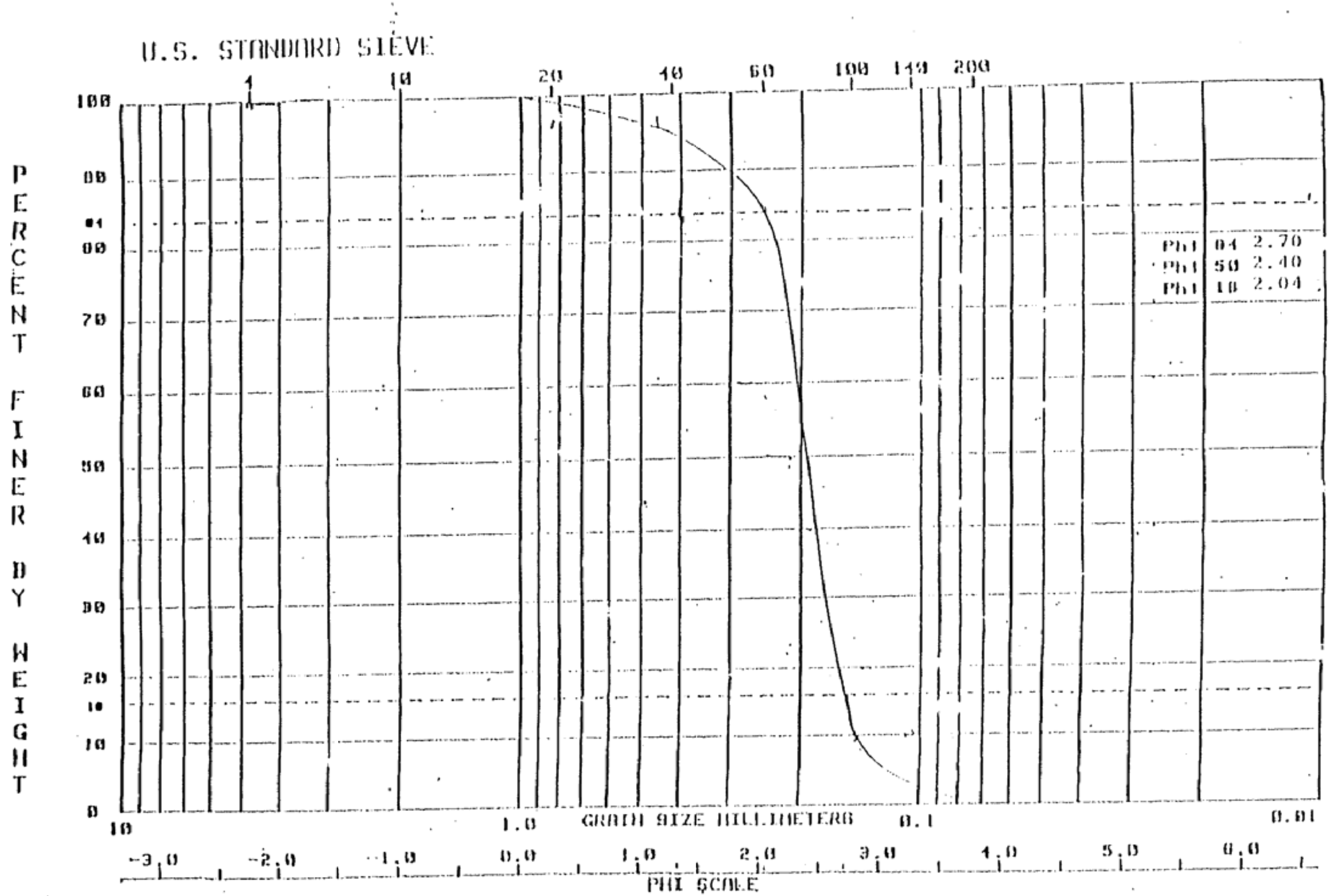
LONG BEACH, NY - C-13
3-39
0-18.4

FIG-B39



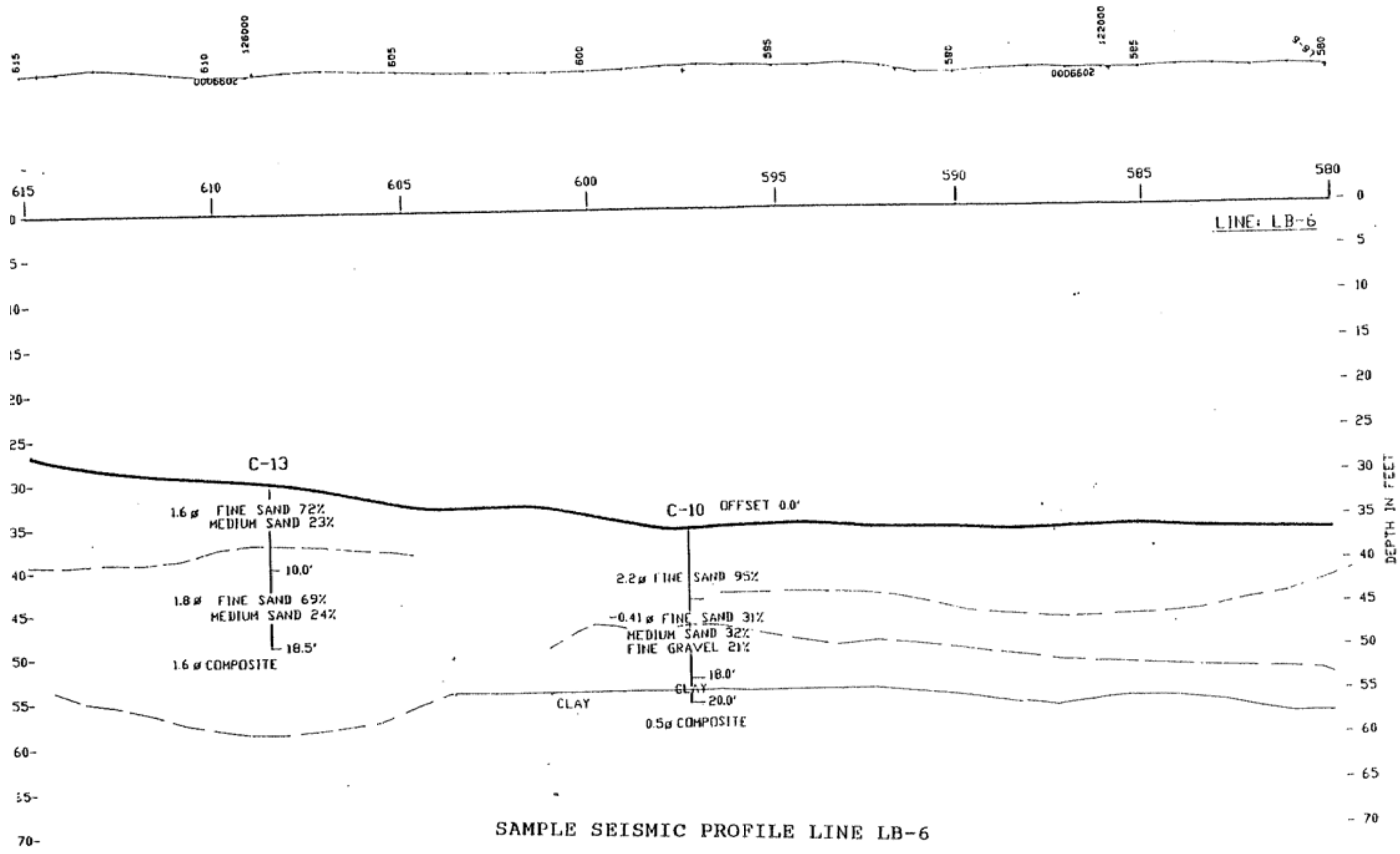
LONG BEACH, NY – C-14
S-42
0-13.7

FIG-B40

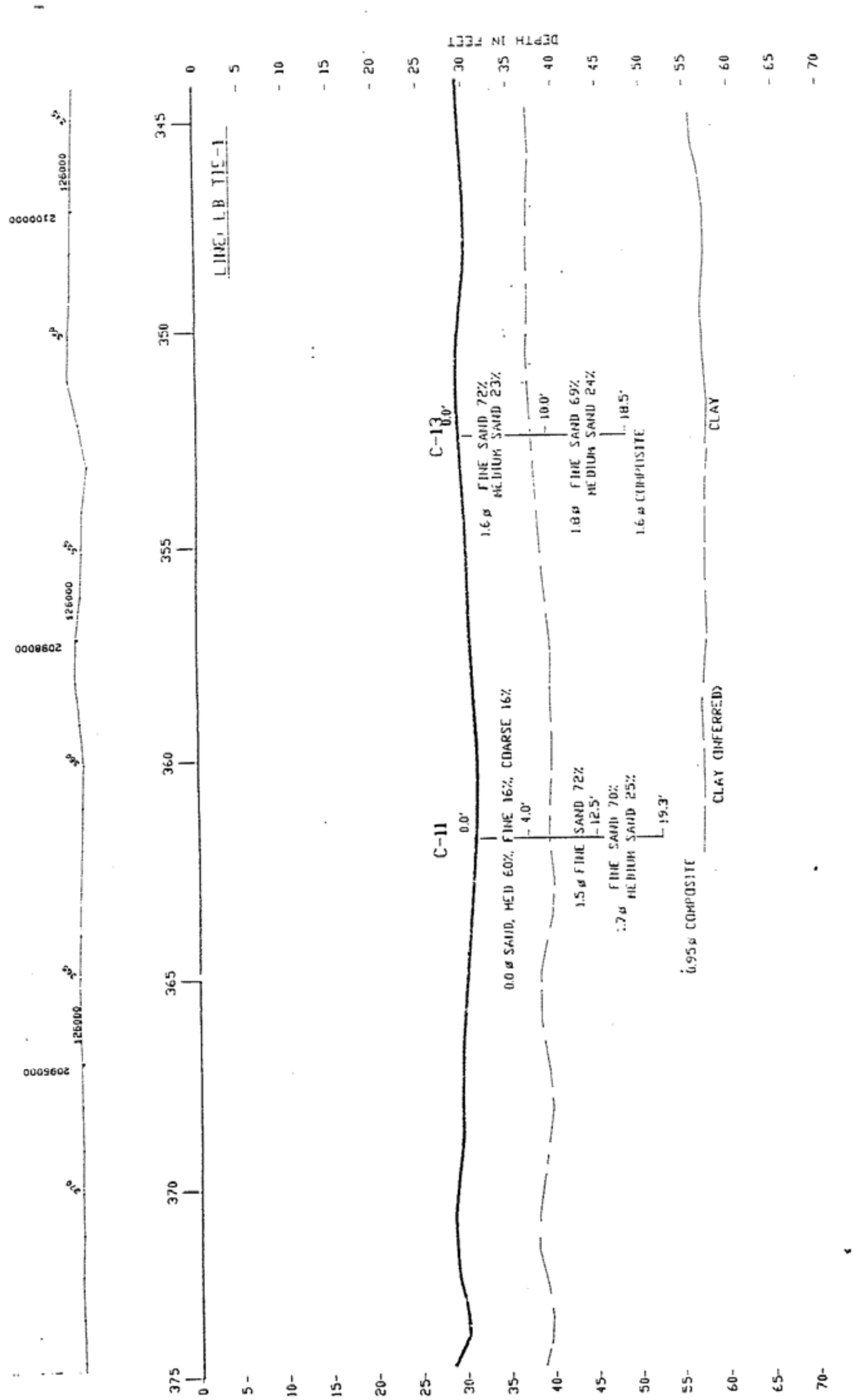


LONG BEACH, NY – C-15
S-45
0-19.8'

FIG-B41

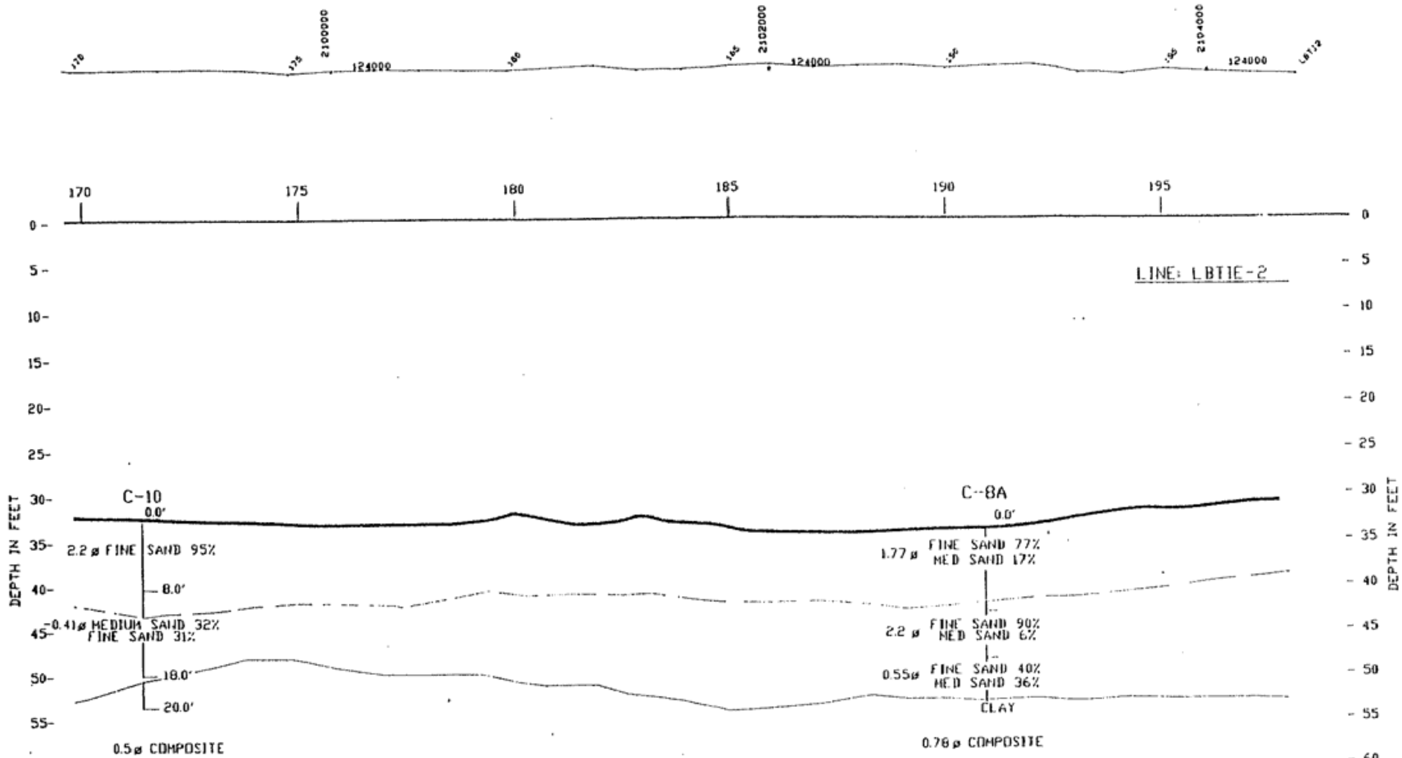


SAMPLE SEISMIC PROFILE LINE LB-6



SAMPLE SEISMIC PROFILE LINE LB TIE-1

FIG-B43



SAMPLE SEISMIC PROFILE LINE LB TIE-2

FIG-B44

APPENDIX C

COST ESTIMATE

C

Long Beach Island
Storm Damage Reduction Project

APPENDIX C - COST ESTIMATES

LIST OF TABLES

Appendix C - Cost Estimates

C1. General. This appendix presents detailed cost estimates for initial construction, nourishment, maintenance, monitoring and major rehabilitation resulting in total and annualized project costs for alternative storm damage reduction plans for the subject project. The nine alternative plans developed from Point Lookout through East Atlantic Village include: (1) Plan 1 - no dune, nourishment only, (2) Plan 2 - no dune, 110' wide berm at el. +10 NGVD, (3) Plan 3 - no dune, 160' wide berm at el. +10 NGVD, (4) Plan 4 - dune to el. +15 NGVD, nourishment only, (5) Plan 5 - dune to el. +15 NGVD, 110 ft. fronting berm at el. +10 NGVD, (6) Plan 6 - dune to el. +15 NGVD, 160 ft. fronting berm at el. +10 NGVD, (7) Plan 7 - dune to el. +17 NGVD, nourishment only, (8) Plan 8 - dune to el. +17 NGVD, 110' fronting berm at el. +10 NGVD and (9) Plan 9 - dune to el. +17 NGVD, 160' fronting berm at el. +10 NGVD. The dune for all alternatives has a 25 ft. wide berm crest with 1 on 5 side slopes. Included in the initial construction of all the above plans are the following: (a) 6 new groins added to the existing groin field at Lido Beach, (b) design and advanced nourishment beach fill including sand fence and dune grass as well as new and modified access ramping and dune walkovers and (c) groin rehabilitation of existing groins at Long Beach & Lido Beach for those groins in poor condition and left exposed after placement of improved design beach fill and (d) rehabilitation of the stone revetment (640') adjacent to the terminal groin on the west side of Jones Inlet. All the plans provide for periodic nourishment at 5 year intervals, maintenance of the dune, groin field extension and stone revetment, monitoring and major rehabilitation to restore the design beach profile damaged by significant storm events beyond that designed for in the nourishment cycle volumes. There are no utility extensions or modifications required for this project. The plan layout of Plan 5 is displayed on Fig. A38 with typical improved beach sections on Fig. A39 and typical groin profile & sections on Fig. A48 and A49 all of Appendix A. In addition, first and annual costs were developed for a plan alternative that supplements Plan 5 (above) with dune (top el. +15 NGVD) with nourishment for the Atlantic Village reach west of E. Atlantic Village.

C2. Basis of Cost. Cost estimates presented herein are based on June 1994 price levels. Initial beach fill quantities are based on beach surveys taken in Nov. 1991 and May 1992. The groin rehabilitation work was based on a groin condition survey for the study area accomplished in Nov. 1993. The revetment work was based on a condition survey accomplished in November 1994. The unit prices were developed on the basis that construction procedures will be as outlined herein. All first and annual costs presented in this appendix are NED costs.

C3. Initial and periodic nourishment fill costs are based on the use of a mid size hopper dredge (3,500 c.y. - 4,000 c.y. capacity) for placement of beach fill for the western portion of the project area and on the use of a 30" hydraulic cutterhead dredge for the eastern portion closer to the borrow area. Included in the hopper dredge operation is a pumpout mooring barge located approximately 2,000 ft. offshore. The location of the borrow area is shown on Fig. B11 of Appendix B

C4. Stone costs for new groin and groin rehabilitation and revetment work are based on barging from the quarry at Poughkeepsie, N.Y. on the Hudson River to a project constructed docking area along Reynold's Channel on the bay side opposite the project. The stone will be rehandled from the barges and trucked to the project site. Stone quantities and costs are displayed on Table C1. Because of the large volume of stone required for groin work, it is anticipated that three to four stone placement crews will be utilized. Groin work is based on utilization of land based equipment with construction/reconstruction proceeding from the landward end of the groin crest out to the seaward crest. Access stone is required overlying design stone for the construction of the outer ends of the new groins with a design crest el. of +3.5 NGVD to provide freeboard for normal wave activity during construction. After construction of the outer end, the access stone will be removed. The inshore end of the groin will require open cut excavation in order to construct the design section.

C5. Real estate costs as displayed in Table C1 are included as administrative costs. For more information refer to the Real Estate Appendix.

C6. <u>Alternatives Considered</u>. Alternative plans were developed in two phases for the plan selection process. In the first phase 8 alternative plans (Jan. 1994 price levels) were compared: (1) the no-action plan with a total annual cost of $0, (2) the beach restoration only plan with a total annual cost of $8.5 million, (3) beach restoration with groins with a total annual cost of $13.3 million, (4) seawall with a total annual cost of $24.2 million, (5) seawall with beach restoration with a total annual cost of $16.8 million, (6) bulkhead with beach restoration with a total annual cost of $15.0 million, (7) breakwater with beach restoration with a total annual cost of $23.0 million and (8) perched beach with beach restoration with a total annual cost of $11.9 million. For more information on these plans refer to paragraphs A146 thru A155 of the Design Appendix. Based on an analysis of these total annual costs with their associated benefits, the beach restoration only plan was selected for the second phase for final plan optimization & selection. It is noted that new groin work as part of the beach restoration only plan is included to reduce nourishment costs at Lido Beach only (one fifth of the project length) whereas the beach restoration with groins alternative includes new groin work for the entire 41,000 ft. of project length.

C7. The costs for the nine alternative plans as described in paragraph C1 for this second phase of plan selection is displayed in Table C2.

C8. Estimated First Cost. The estimated project first cost for Plan 5 - (+15 NGVD top of dune with 110 ft. fronting berm at el. +10 NGVD) is $69,893,699 which includes placement of 8,641,900 c.y. of hydraulically placed design and advanced nourishment beach fill, the construction of 6 new groins, the rehabilitation of 16 existing groins and 640 ft. of stone revetment, the construction of 16 dune walkovers, 13 timber ramps for boardwalk access and 12 vehicular earthen access ramps over the dune, and the placement of 29 acres of dune grass and 90,000 L.F. of sand fence, real estate administration costs and pertinent contingency, engineering and design and construction management costs. Details of the first cost estimate are shown on Table C1.

C9. Contingency, Engineering and Design and Construction Management. Engineering and design costs include preparation of the subsequent project design memorandum, plans & specifications, cultural, coastal and environmental pre construction monitoring and the development of the PCA. Of the $2,450,800 for engineering and design, $1,226,000 is for the total pre-construction monitoring effort. Construction management costs are based on 7 % of the direct construction costs. Pertaining to contingencies: 15% was applied to beach placement work to account for larger required beach fill quantities at the time of construction due to future pre-construction erosion; 15% was applied to groin and revetment work to account for design refinements dictated by changing beach profiles at the groin and revetment locations and for the uncertainty of the available quantity of qualified reusable stone to supplement imported stone; 20% was applied to walkovers, timber walls, & ramps to account for design refinements and 15% was applied to dune grass and sand fencing to account for variances in the beach profile at the dune location due to future pre-construction shifting and/or eroding beach conditions.

ANNUAL CHARGES

C10. General. The estimates of annual charges for all alternatives are based on an economic project life of 50 years and an interest rate of 8%. The annual charges include the annualized first cost and interest during construction, the annualized periodic nourishment costs, the annualized major rehabilitation costs, the annualized increased cost for dredging from this project's impacts on East Rockaway Inlet, post construction monitoring costs and annual dune and new groin maintenance. It is noted that interest during construction was developed for the first cost of the project constructed over between a two to three year period (depending on the alternative plan) at an 8% annual interest rate. Total annual charges are summarized in Table C10 for all nine alternatives. For Plan 5, the total annual cost is $8,954,000.

C11. Periodic Nourishment. The periodic nourishment volume to be placed at 5 year cycles subsequent to commencement of construction and throughout the 50 year economic life is 2,111,000 c.y. which includes overfill and tolerance. The placement of this material will follow the constructability outlined in paragraph C3. For more details on the development of the periodic nourishment quantity refer to paragraphs A191 through A218 of the Design Appendix. The borrow area for periodic nourishment is shown on Fig. B11. Periodic nourishment costs are developed in Table C3.

C12. Major Rehabilitation Costs. Major rehabilitation costs are included as an additional annualized cost for significant storm events beyond that designed for in the renourishment cycle to restore the design profile. The threshold at which major rehabilitation costs are incurred for each plan alternative is based on the storm event that causes the erosion volume (based on SBEACH analysis) to exceed 15 c.y. per linear ft. along the beach front. This is the average nourishment volume anticipated to be available at the midpoint of the renourishment cycle since the significant storm event has a 50% chance of occurring earlier or later than the cycle midpoint. Major rehabilitation costs for each alternative are developed in Tables C4 through C9.

C13. Monitoring Costs. Post construction monitoring costs include coastal monitoring over the 50 year project life and environmental monitoring over the first five years of the project. Annualized monitoring costs are shown on Table C10 for all the alternatives.

C14. East Rockaway Inlet Impacts. NED costs were included for the project impacts to the E. Rockaway Inlet navigation channel pertaining to increased shoaling caused by the project. Annualized E. Rockaway Inlet impact costs are shown on Table C10. The annualized cost is based on an anticipated 68,000 c.y./year increase in channel shoaling subsequent to the complete filling of the Inlet's east jetty fillet 12 years after project construction.

CONSTRUCTION AND FUNDING SCHEDULE

C15. General. The construction and pre-construction sequence and time schedule of Plan 5 is given in Table 9 of the Main Body. The schedule is based on the timeliness of the report's approval and allocation of funds by Congress, the foregoing construction procedures and the ability of local interests to implement the necessary items of local cooperation. These items of local cooperation are principally the furnishing of offshore borrow easements by the State of New York as well as required shoreline real estate easements, and the relocation items for beach access.

Tc irst Cost – Long Beach Feasibility Study, New .k

TABLE C-1 PLAN 5

ACCT CODE	DESCRIPTION	Qty	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONT. AMOUNT	CONT. %
01	LANDS AND DAMAGES						
01.02	ACQUISITIONS	1	JOB		7,575	1,137	15%
01.05	APPRAISALS	1	JOB		2,790	418	15%
	TOTAL LANDS AND DAMAGES				10,365	1,555	11,920
02	RELOCATION						
02.03.47	STRUCTURES						
02.03.47.02.01	TIMBER DUNE WALKOVER	16	EA	10,000	160,000	32,000	20%
02.03.47.02.02	TIMBER RAMP W/STAIRS & RAILINGS	13	EA	20,000	260,000	52,000	20%
02.03.47.02.03	RELOCATE LIFE GUARD STATION	1	EA	31,305	31,305	6,261	20%
02.03.47.02.04	EARTH ACCESS RAMP	12	EA	15,479	185,748	37,150	20%
02.03.47.02.05	RAISE TIMBER DECK	1	EA	9,096	9,096	1,819	20%
	TOTAL RELOCATION				646,149	129,230	775,379
10	BREAKWATERS AND SEAWALLS						
10.00	MOBILIZATION, DEMOBILIZATION, AND PREPARATORY WORK	1	LS	294,284	294,284	44,143	15%
10.00.46	BREAKWATERS						
10.00.46.02	SITEWORK FOR NEW GROINS						
10.00.46.02.01	PLACEMENT OF ACCESS STONES	6,200	TONS	39.27	243,472	36,521	15%
10.00.46.02.03	EXCAVATION	40,000	CY	10.71	428,341	64,251	15%
10.00.46.02.04	GEOTEXTILE	38,800	SY	9.77	379,257	56,889	15%
10.00.46.02.05	BEDDING STONES	29,400	TON	47.33	1,391,527	208,729	15%
10.00.46.02.06	UNDERLAYER STONES 1200–1600 LBS	11,600	TON	56.74	658,172	98,726	15%
10.00.46.02.07	6–9 TON CAPSTONE	89,000	TON	68.84	6,126,325	918,949	15%
10.00.46.03	SITEWORK TO RECONSTRUCT GROINS						
10.00.46.02.02	REMOVE STOCKPILE GROIN STONES	28,200	TON	34.56	974,598	146,190	15%
10.00.46.02.03	EXCAVATION	61,600	CY	10.71	661,788	99,268	15%
10.00.46.02.04	GEOTEXTILE	16,700	SY	9.77	163,237	24,486	15%
10.00.46.02.05	BEDDING STONES	14,400	TON	47.33	681,564	102,235	15%
10.00.46.02.06	UNDERLAYER STONES	6,600	TON	56.74	374,477	56,172	15%
10.00.46.02.07	8 TON CAPSTONE	46,600	TON	56.40	2,628,470	394,271	15%
10.00.46.02.11	DISPOSE EXCESS STONES (AT SITE)	5,300	TON	13.82	73,266	10,990	15%
10.00.47	SEAWALL						
10.00.47.02	SITEWORKS FOR REVETMENT REHABILITATION						
10.00.47.02.01	4-TON ARMOR STONES	13,440	TON	83.29	1,119,424	167,914	15%
10.00.47.02.02	BACKFILL (SAND)	73	CY	3.19	233	35	15%
10.00.47.02.03	EXCAVATION	18,987	CY	7.78	147,750	22,163	15%
10.00.47.02.04	GEOTEXTILE	6,514	SY	9.77	63,672	9,551	15%
10.00.47.02.05	BEDDING STONES	2,083	TON	47.33	98,590	14,789	15%
10.00.47.02.06	UNDERLAYER STONES 800 LBS	5,980	TON	56.74	339,299	50,895	15%
10.00.47.02.07	1.8 TON ARMOR STONES	1,686	TON	68.84	116,056	17,409	15%
10.00.47.03	SITEWORKS FOR RECONSTRUCT REVETMENT						
10.00.47.03.02	REMOVE, STOCKPILE & REUSED ARMOR	1,154	TON	49.92	57,608	8,641	15%
10.00.47.03.05	REMOVE, STOCKPILE & REUSED BEDDING	175	TON	49.92	8,736	1,310	15%
10.00.47.03.05	REMOVE, STOCKPILE & REUSED UNDERLAYER	489	TON	49.92	24,411	3,662	15%
	TOTAL BREAKWATER AND SEAWALL				17,054,559	2,558,189	19,612,748
17.00.01	MOBILIZATION, DEMOBILIZATION, AND PREPARATORY WORK	1	LS	1,236,443	1,236,443	185,466	15%
17.00.16	PIPELINE DREDGING						
17.00.16.02	SITE WORK						
17.00.16.02.01	SAND FILL PLACEMENT	8,641,900	CY	4.01	34,648,406	5,197,261	15%
17.00.99	ASSOCIATED GENERAL ITEMS						
17.00.99.02.01	DUNE GRASS	29	ACR	7,518	218,012	32,702	15%
17.00.99.02.02	SAND FENCE	90,000	LF	6.48	583,065	87,463	15%
17.00.99.02.03	TIMBER WALL, 4' HIGH	570	LF	97.24	55,428	11,086	20%
	TOTAL BEACH REPLENISHMENT				36,741,374	5,513,978	42,255,352
30	ENGINEERING AND DESIGN	1	LS		2,226,000	222,600	10%
31	CONSTRUCTION MANAGEMENT	1	LS		3,830,000	957,500	25%
	TOTAL PROJECT FIRST COST (JUNE 1994 PRICE LEVEL)				60,510,447	9,363,252	69,893,699

Table C2–A

Plan 1 – (No Dune/Nourishment Only)
Total First Cost

Code of Account	Description	Amount (with 15% contingency)
01	Lands and Damages	$11,920
02	Relocations	$0
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (b)	$10,949,585
	Groin Rehabilitation (24 groins) (a)	$17,264,074
	Stone Revetment (640 ft) (b)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 5,432,700 c.y. of sand	$25,052,896
	Subtotal	$56,972,530
	E&D	$2,450,800
	Construction Management	$4,421,500
	Total First Cost	$63,844,830

(a) includes importing & rehandling 113,300 tons of 5 ton stone, importing 16,700 tons of underlayer stone and 40,000 tons of bedding stone with 225,000 c.y. of excavation and 42,500 s.y. of geotextile.
(b) For quantities refer to Table C1.

Table C2–B

Plan 2 – (No Dune/110' Berm)
Total First Cost

Code of Account	Description	Amount (with 15% contingency)
01	Lands and Damages	$11,920
02	Relocations	$0
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (b)	$10,949,585
	Groin Rehabilitation (24 groins) (a)	$17,264,074
	Stone Revetment (640 ft) (b)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 5,763,300 c.y. of sand	$26,577,458
	Subtotal	$58,497,092
	E&D	$2,450,800
	Construction Management	$4,520,800
	Total First Cost	$65,468,692

(a) For quantities refer to footnote (a) of Plan 1
(b) For quantities refer to Table C1.

Table C2–C

Plan 3 – (No Dune/160' Berm)
Total First Cost

Code of Account	Description	Amount (with 15% contingency)
01	Lands and Damages	$11,920
02	Relocations	$0
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (a)	$10,949,585
	Groin Rehabilitation (16 groins) (a)	$6,391,017
	Stone Revetment (640 ft) (a)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 7,901,300 c.y. of sand	$36,436,845
	Subtotal	$57,483,422
	E&D	$2,450,800
	Construction Management	$4,454,900
	Total First Cost	$64,389,122

(a) For quantities refer to Table C1.

Table C2–D

Plan 4 – (+15 NGVD Dune/Nourishment Only)
Total First Cost

Code of Account	Description	Amount (with 15% contingency) (a)
01	Lands and Damages	$11,920
02	Relocations (ramp, walkovers misc.)	$775,379
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (c)	$10,949,585
	Groin Rehabilitation (24 groins) (b)	$17,264,074
	Stone Revetment (640 ft) (c)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 6,938,600 c.y. of sand	$31,997,354
	Dune grass, sand fence & timber wall	$987,776
	Subtotal	$65,680,143
	E&D	$2,450,800
	Construction Management	$5,004,500
	Total First Cost	$73,135,443

(a) Contingency of 20% for relocations, 15% for everything else.
(b) For quantities refer to footnote (a) of Plan 1.
(c) For quantities refer to Table C1.

Table C2–E

Plan 5 – (+15 NGVD Dune/110' Berm)
Total First Cost

Code of Account	Description	Amount (with 15% contingency)(a)
01	Lands and Damages	$11,920
02	Relocations (ramps, walkovers & misc)	$775,379
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (b)	$10,949,585
	Groin Rehabilitation (16 groins) (b)	$6,391,017
	Stone Revetment (640 ft) (b)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 8,641,900 c.y. of sand	$39,845,667
	Dune grass, sand fence & timber wall	$987,776
	Subtotal	$62,655,399
	E&D	$2,450,800
	Construction Management	$4,787,500
	Total First Cost	$69,893,699

(a) Contingency of 20% for relocations, 15% for everything else.
(b) For quantities refer to Table C1.

Table C2–F

Plan 6 – (+15 NGVD Dune/160' Berm)
Total First Cost

Code of Account	Description	Amount (with 15% contingency)(a)
01	Lands and Damages	$11,920
02	Relocations (ramps, walkovers & misc)	$775,379
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (c)	$10,949,585
	Groin Rehabilitation (10 groins) (b)	$2,792,683
	Stone Revetment (640 ft) (c)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 10,655,500 c.y. of sand	$49,137,838
	Dune grass, sand fence & timber wall	$987,776
	Subtotal	$68,349,236
	E&D	$2,450,800
	Construction Management	$5,178,200
	Total First Cost	$75,978,236

(a) Contingency of 20% for relocations, 15% for everything else.
(b) Includes importing & rehandling 21,500 tons of 5 ton stone, importing 2,900 tons of underlayer stone & 6,100 tons of bedding stone with 26,000 c.y. of excavation & 7,100 s.y. of geotextile.
(c) For quantities refer to Table C1.

Table C2–G

Plan 7 – (+17 NGVD Dune/Nourishment Only)
Total First Cost

Code of Account	Description	Amount (with 15% contingency) (a)
01	Lands and Damages	$11,920
02	Relocations (ramps, walkovers & misc.)	$775,379
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (c)	$10,949,585
	Groin Rehabilitation (24 groins) (b)	$17,264,074
	Stone Revetment (640 ft) (c)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 7,865,100 c.y. of sand	$36,269,909
	Dune grass, sand fence & timber wall	$987,776
	Subtotal	$69,952,698
	E&D	$2,450,800
	Construction Management	$5,284,400
	Total First Cost	$77,687,898

(a) Contingency of 20% for relocations, 15% for everything else.
(b) For quantities refer to Plan 1 footnote (a).
(c) For quantities refer to Table C1.

Table C2–H

Plan 8 – (+17 NGVD Dune/110' Berm)
Total First Cost

Code of Account	Description	Amount (with 15% contingency) (a)
01	Lands and Damages	$11,920
02	Relocations (ramps, walkovers & misc.)	$775,379
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (b)	$10,949,585
	Groin Rehabilitation (16 groins) (b)	$6,391,017
	Stone Revetment (640 ft) (b)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 9,566,800 c.y. of sand	$44,117,298
	Dune grass, sand fence & timber wall	$987,776
	Subtotal	$66,927,030
	E&D	$2,450,800
	Construction Management	$5,085,000
	Total First Cost	$74,462,830

(a) Contingency of 20% for relocations, 15% for everything else.
(b) For quantities refer to Table C1.

Table C2–I

Plan 9 – (+17 NGVD Dune/160' Berm)
Total First Cost

Code of Account	Description	Amount (with 15% contingency) (a)
01	Lands and Damages	$11,920
02	Relocations (ramps, walkovers & misc.)	$775,379
10	Breakwaters & Seawalls	
	New Groin Work (6 groins) (c)	$10,949,585
	Groin Rehabilitation (10 groins) (b)	$2,792,683
	Stone Revetment (640 ft) (c)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 11,581,900 c.y. of sand	$53,409,932
	Dune grass, sand fence & timber wall	$987,776
	Subtotal	$72,621,330
	E&D	$2,450,800
	Construction Management	$5,462,400
	Total First Cost	$80,534,530

(a) Contingency of 20% for relocations, 15% for everything else.
(b) For quantities refer to Plan 6 footnote (b).
(c) For quantities refer to Table C1.

Table C2–J

Plan 5 Plus Dune (+15 NGVD) with
Nourishment Only in Atlantic Beach
Total First Cost

Code of Account	Description	Amount (with 15% contingency)
01	Lands and Damages	$5,414,920
02	Relocations (ramps, walkovers & misc.)	$775,379
10	Breakwaters & Seawalls	
	New Groin Work	$10,949,585
	Groin Rehabilitation	$6,391,017
	Stone Revetment (640 ft)	$2,272,146
17	Beach Replenishment	
	Mob & Demob	$1,421,909
	Placement of 9,750,200 c.y. of sand	$44,963,047
	Dune grass, sand fence & timber wall	$1,157,399
	Subtotal	$73,345,402
	E&D	$2,450,800
	Construction Management	$5,508,800
	Total First Cost	$81,305,002

Table C3
Nourishment Costs

Per Operation

2,111,000 c.y. @ $4.01/c.y. =	$8,465,110
Mob & Demob	$1,236,443
Subtotal	$9,701,593
Contingency 15%	$1,455,233
E&D	$506,000
Construction Management	$1,004,000
Total Cost Per Operation	$12,660,786
	= $12,661,000

Annualized Cost of Nourishment (a) =
($12,661,000)(2.07)(.08175) = $2,143,000

(a) Based on nourishment every 5 years and an 8% interest rate where 2.07 is the total present worth of all renourishment operations and .08175 is the capitol recovery factor.

Table C4
Long Beach Major Rehabilitation Costs
Existing Condition
Distance 41,000 Feet
DESIGN PLAN 1

Return Interval (yrs)	Frequency	Frequency Interval	Permanent Loss Factor	Erosion Volume (cy/ft)	Emergency Fill (cy/ft)	Emergency Fill Cost ($/ft)	Average Emergency Fill Cost ($)	Annual Emergency Fill Cost ($)	Annual Emergency Fill Cost ($/ft)
10.00	0.100		0.16	22.50	3.60	$46.80			
		0.050					$2,571,725	$128,586	$3.14
20.00	0.050		0.22	27.50	6.05	$78.65			
		0.030					$3,878,908	$116,367	$2.84
50.00	0.020		0.27	31.50	8.51	$110.57			
		0.010					$5,212,740	$52,127	$1.27
100.00	0.010		0.33	33.50	11.06	$143.72			
		0.005					$7,047,593	$35,238	$0.86
200.00	0.005		0.38	40.50	15.39	$200.07			

Total Annualized Emergency Fill Cost	$332,319 / $8.11

Notes:

Loss Factor: This is the percent of eroded volume permanently lost to profile. The factors are based on eperience at Ocean City, MD

Erosion Volume: Maximum erosion volume landward of a given profile position computed from SBEACH (50, 100 and 200 year storms extrapolated from northeasters)

Emergency Fill Cost: Based on $13/cy for trucked sand

TABLE C5

Long Beach Major Rehabilitation Costs

Design Plan 2

Distance 41,000 Feet

Return Interval (yrs)	Frequency	Frequency Interval	Permanent Loss Factor	Erosion Volume (cy/ft)	Emergency Fill (cy/ft)	Emergency Fill Cost ($/ft)	Average Emergency Fill Cost ($)	Annual Emergency Fill Cost ($)	Annual Emergency Fill Cost ($/ft)
20.00	0.050		0.22	15.50	3.41	$44.33			
		0.030					$2,261,519	$67,846	$1.65
50.00	0.020		0.27	18.80	5.08	$65.99			
		0.010					$3,199,599	$31,996	$0.78
100.00	0.010		0.33	21.00	6.93	$90.09			
		0.005					$4,338,087	$21,690	$0.53
200.00	0.005		0.38	24.60	9.35	$121.52			
						Total Annualized Emergency Fill Cost		$121,532	$2.96

Notes:

Loss Factor: This is the percent of eroded volume permanently lost to profile. The factors are based on experience at Ocean City, MD

Erosion Volume: Maximum erosion volume landward of a given profile position computed from SBEACH (50, 100 and 200 year storms extrapolated from northeasters)

Emergency Fill Cost: Based on $13/cy for trucked sand

TABLE C6

Long Beach Major Rehabilitation Costs
Design Plan 3
Distance 41,000 Feet

Return Interval (yrs)	Frequency	Frequency Interval	Permanent Loss Factor	Erosion Volume (cy/ft)	Emergency Fill (cy/ft)	Emergency Fill Cost ($/ft)	Average Emergency Fill Cost ($)	Annual Emergency Fill Cost ($)	Annual Emergency Fill Cost ($/ft)
20.00	0.050		0.22	16.40	3.61	$46.90			
		0.030					$2,472,587	$74,178	$1.81
50.00	0.020		0.27	21.00	5.67	$73.71			
		0.010					$3,665,708	$36,657	$0.89
100.00	0.010		0.33	24.50	8.09	$105.11			
		0.005					$4,990,213	$24,951	$0.61
200.00	0.005		0.38	28.00	10.64	$138.32			
Total Annualized Emergency Fill Cost								$135,786	$3.31

Notes:

Loss Factor: This is the percent of eroded volume permanently lost to profile. The factors are based on eperience at Ocean City, MD

Erosion Volume: Maximum erosion volume landward of a given profile position computed from SBEACH (50, 100 and 200 year storms extrapolated from northeasters)

Emergency Fill Cost: Based on $13/cy for trucked sand

TABLE C7

Long Beach Major Rehabilitation Costs

Design Plan 4,7

Distance 41,000 Feet.

Return Interval (yrs)	Frequency	Frequency Interval	Permanent Loss Factor	Erosion Volume (cy/ft)	Emergency Fill (cy/ft)	Emergency Fill Cost ($/ft)	Average Emergency Fill Cost ($)	Annual Emergency Fill Cost ($)	Annual Emergency Fill Cost ($/ft)
20.00	0.050		0.22	18.90	3.72	$48.33			
		0.030					$2,573,857	$77,216	$1.88
50.00	0.020		0.27	22.00	5.94	$77.22			
		0.010					$3,772,841	$37,728	$0.92
100.00	0.010		0.33	24.90	8.22	$106.82			
		0.005					$5,015,264	$25,076	$0.61
200.00	0.005		0.36	27.90	10.60	$137.83			
Total Annualized Emergency Fill Cost								$140,020	$3.42

Notes:

Loss Factor: This is the percent of eroded volume permanently lost to profile. The factors are based on eperience at Ocean City, MD

Erosion Volume: Maximum erosion volume landward of a given profile position computed from SBEACH (50, 100 and 200 year storms extrapolated from northeasters)

Emergency Fill Cost: Based on $13/cy for trucked sand

Table C8
Long Beach Major Rehabilitation Costs
Design Plan 5,8
Distance 41,000 Feet

Return Interval (yrs)	Frequency	Frequency Interval	Permanent Loss Factor	Erosion Volume (cy/ft)	Emergency Fill (cy/ft)	Emergency Fill Cost ($/ft)	Average Emergency Fill Cost ($)	Annual Emergency Fill Cost ($)	Annual Emergency Fill Cost ($/ft)
20.00	0.050		0.22	15.00	3.30	$42.90			
		0.030					$2,153,054	$64,592	$1.58
50.00	0.020		0.27	17.70	4.78	$62.13			
		0.010					$3,023,709	$30,237	$0.74
100.00	0.010		0.33	19.90	6.57	$85.37			
		0.005					$3,978,046	$19,890	$0.49
200.00	0.005		0.38	22.00	8.36	$108.68			
Total Annualized Emergency Fill Cost								$114,719	$2.80

Notes:

Loss Factor: This is the percent of eroded volume permanently lost to profile. The factors are based on eperience at Ocean City, MD

Erosion Volume: Maximum erosion volume landward of a given profile position computed from SBEACH (50, 100 and 200 year storms extrapolated from northeasters)

Emergency Fill Cost: Based on $13/cy for trucked sand

Table C9
Long Beach Major Rehabilitation Costs
Design Plan 6,9
Distance 41,000 Feet

Return Interval (yrs)	Frequency	Frequency Interval	Permanent Loss Factor	Erosion Volume (cy/ft)	Emergency Fill (cy/ft)	Emergency Fill Cost ($/ft)	Average Emergency Fill Cost ($)	Annual Emergency Fill Cost ($)	Annual Emergency Fill Cost ($/ft)
50.00	0.020		0.27	16.40	4.43	$57.59			
		0.010					$2,835,560	$28,356	$0.69
100.00	0.010		0.33	18.80	6.21	$80.73			
		0.005					$3,712,345	$18,562	$0.45
200.00	0.005		0.38	20.30	7.72	$100.36			

Total Annualized Emergency Fill Cost	$46,918	$1.14

Notes:

Loss Factor: This is the percent of eroded volume permanently lost to profile. The factors are based on epeience at Ocean City, MD

Erosion Volume: Maximum erosion volume landward of a given profile position computed from SBEACH (50, 100 and 200 year storms extrapolated from northeasters)

Emergency Fill Cost: Based on $13/cy for trucked sand

Table C10
Summary of Total First Cost & Total Annual Cost

Plan	Total First Cost	Interest During Construction	Total Investment Cost	Annual Investment Cost (d)	Annualized Nourishment Cost (e)	Annual Major Rehabilitation Cost (f)	Annual Monitoring	Dune & Groin Maintenance	Rockaway Inlet Impacts	Annual NED Costs
1	$63,644,800	$8,555,200 (a)	$72,400,000	$5,915,100	$2,143,000	$333,000	$250,000	$55,000	$121,000	$8,817,100
2	$65,468,700	$8,772,800 (a)	$74,241,500	$6,065,500	$2,143,000	$122,000	$250,000	$55,000	$121,000	$8,756,500
3	$64,389,100	$5,859,400 (b)	$70,248,500	$5,739,300	$2,143,000	$136,000	$250,000	$55,000	$121,000	$8,444,300
4	$73,135,400	$9,800,100 (a)	$82,935,500	$6,775,800	$2,143,000	$140,000	$250,000	$95,000	$121,000	$9,524,800
5	$69,893,700	$6,360,300 (b)	$76,254,000	$6,230,000	$2,143,000	$115,000	$250,000	$95,000	$121,000	$8,954,000
6	$75,978,200	$6,914,000 (b)	$82,892,200	$6,772,300	$2,143,000	$47,000	$250,000	$95,000	$121,000	$9,428,300
7	$77,687,900	$10,410,200 (a)	$88,098,100	$7,197,600	$2,143,000	$140,000	$250,000	$95,000	$121,000	$9,946,600
8	$74,462,800	$6,776,100 (b)	$81,238,900	$6,637,200	$2,143,000	$115,000	$250,000	$95,000	$121,000	$9,361,200
9	$80,534,500	$9,503,100 (c)	$90,037,600	$7,356,100	$2,143,000	$47,000	$250,000	$95,000	$121,000	$10,012,100
5 plus Atlantic Beach	$81,305,000	$7,398,800 (b)	$88,703,800	$7,247,100	$2,288,000	$140,000	$250,000	$100,000	$121,000	$10,146,100

(a) Based on 3.2 years of construction @ 8%
(b) Based on 2.3 years of construction @ 8%
(c) Based on 2.8 years of construction @ 8%
(d) i = 8%, n = 50 years
(e) From Table C3
(f) From Table C4 through C9

TOTAL – CONTRACTS *** TOTAL PROJECT ST SUMMARIES ***

This estimate is based on the scop… contained in this project's FEASIBILITY STUDY dated SEPTEMBER 1994

LONG BEACH
JONES INLET TO E. ROCKAWAY, NY

DISTRICT: NEW YORK
POC: J CHEW, C, COST ENGR BR

ACCOUNT NUMBER	FEATURE DESCRIPTION	CURRENT MCACES ESTIMATE PREPARED: JUNE 1994 / EFFECTIVE PRICING LEVEL: JUNE 1994 COST [$K]	CONT [$K]	CONT [%]	TOTAL [$K]	AUTHOR/BUDGET YEAR / EFFECT PRICE LEVEL: OCT '94 OMB [%]	COST [$K]	CONT [$K]	TOTAL [$K]	..... FULLY FUNDED ESTIMATE ..... / FEATURE MIDPOINT: OCTOBER 1998 OMB [%]	COST [$K]	CONT [$K]	TOTAL [$K]
02	RELOCATION	646	129	20.00%	775	0.65%	650	130	780	9.98%	711	142	853
10	BREAKWATERS & SEAWALLS	17,055	2,558	15.00%	19,613	0.65%	17,165	2,575	19,740	9.98%	18,757	2,813	21,570
17	BEACH REPLENISHMENT	36,741	5,514	15.01%	42,255	0.65%	36,980	5,550	42,530	9.98%	40,408	6,064	46,472
	TOTAL CONSTRUCTION COST =>	54,442	8,201	15.06%	62,643		54,796	8,255	63,051		59,875	9,020	68,895
01	LANDS AND DAMAGES	10	2	15.00%	12	0.00%	10	2	12	11.19%	12	2	13
30	ENGINEERING & DESIGN	2,228	223	10.00%	2,451	0.00%	2,228	223	2,451	11.19%	2,477	248	2,725
31	CONSTRUCTION MANAGEMENT	3,830	958	25.00%	4,788	0.00%	3,830	958	4,788	11.19%	4,259	1,065	5,323
	TOTAL PROJECT COST	60,510	9,383	15.51%	69,894		60,864	9,437	70,301		66,623	10,334	76,957

NOTE: INFLATION WAS DEVELOPED USING EC11-2-159 DTD 31 MARCH 1994

TOTAL FEDERAL COST 48,926
TOTAL NON-FEDERAL COST 20,968
(First Cost)

DISTRICT APPROVAL:

______ CHIEF, COST ENGINEERING
______ CHIEF, REAL ESTATE
______ CHIEF, PLANNING
______ CHIEF, ENGINEERING
______ CHIEF, CONSTRUCTION
______ CHIEF, PROGRAMS MANAGEMENT
______ PROJECT MANAGER
______ DDE (PM)

DIVISION APPROVED:

______ CHIEF, COST ENGINEERING
______ DIRECTOR, REAL ESTATE
______ CHIEF, PROGRAMS MANAGEMENT
______ DIRECTOR OF PPMD

APPROVAL DATE: ______

APPENDIX D

BENEFITS

D

ATLANTIC COAST OF LONG ISLAND,
JONES INLET TO EAST ROCKAWAY INLET
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DRAFT FEASIBILITY REPORT

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JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
DRAFT FEASIBILITY SUBMISSION

APPENDIX D - DAMAGES AND BENEFITS

INTRODUCTION

Purpose

This Appendix presents the benefits and associated analysis procedures used in the determination of the economic viability for federal participation in erosion control and storm protection throughout the study area, and the identification of the plan providing the maximum economic return on investment.

Benefits were calculated for the plans which were anticipated to be the most implementable with respect to local support, survivability and storm protection criteria. Alternative project dimensions were evaluated and compared to establish the most economically efficient project design.

Benefit Types

Benefits to be derived from the improvements are:

1. Reduction of damage associated with long-term and storm surge-induced erosion to structures,
2. Reduction of wave attack to structures,
3. Reduction in inundation of structures,
4. Reduced emergency response costs and cleanup,
5. Reduced costs for stabilizing the existing shoreline,
6. Maintenance of existing recreation value,
7. Increased recreation value, and
8. Prevent loss of land.

The first five benefit categories are storm damage reduction benefits.

Conditions

Estimates of economic benefits were based on January 1994 price levels and a 50-year project life and reflect the economic condition of the floodplain as of 1992. The base year, or first year the plan is to become operational, is 2000. All calculations utilize the fiscal year 1994 discount rate of 8%.

Exclusions

Reduced Flood Insurance Administration (FIA) costs have not been considered since residents of the project area extensively purchase flood insurance even outside the regulatory floodplain. Benefits due to reduced traffic delays have also not been included since even with the project in place, low-lying roads may be subject to flooding. While benefits have been analyzed for Long Beach Island only, the physical presence of the barrier island may offer some measure of protection against flooding and wave attack to the shores surrounding Hempstead Bay (such as the Community of Island Park)

DESCRIPTION OF THE STUDY AREA

Location

As shown on Figure D-1, the study area consists of the Atlantic Coast of Long Island between Jones Inlet and East Rockaway Inlet. The area lies within Nassau County, New York and from east to west encompasses the communities of Point Lookout, Lido Beach, City of Long Beach and Atlantic Beach. All unincorporated areas are under the jurisdiction of the Town of Hempstead. The 9-mile long barrier island (Long Beach Island) varies in width from 1,500 to 4,000 feet and is bounded on the east by Jones Inlet, on the south by the Atlantic Ocean, on the west by East Rockaway Inlet and on the north by Reynolds Channel. Point Lookout and Lido Beach are year-round residential communities and consist primarily of single and two-family residences of 1/4 acre or less. The City of Long Beach and Village of Atlantic Beach are also year-round communities but are more highly developed than Point Lookout and Lido Beach. The predominant land use is moderate density residential development consisting primarily of single family units and two- to three-story condominiums, and high-density residential development made up of high-rise (5- to 10-story) apartments and condominiums. Beach clubs, apartment house co-ops, condominium complexes and hotels predominate along the ocean shore, while the shore of Reynolds Channel is occupied mostly by private homes and some publicly owned facilities.

Accessibility

Nassau County is accessible to major population centers through a network of modern highways. The Southern State Parkway runs eastward to Montauk Point and westward to Queens, Brooklyn, Staten Island and New Jersey. The Cross Island Parkway extends northward to the Throgs Neck Bridge leading to Interstate 95 providing access to Westchester County and Connecticut. Route 495 (Long Island Expressway) extends from New Jersey and New York City into Long Island and extends eastward to Riverhead in Suffolk County. The Northern State Parkway also provides access eastward from New York City. The Meadowbrook Parkway extends from the Northern State and Long Island Expressway South to the Long Beach Island and the Jones Beach Area. Direct access from the major corridors to the Island is provided by three vehicular bridges from: Franklin Avenue and Long Beach Road, Meadowbrook State and Loop Parkways, and Rockaway Boulevard. The communities are also served by the Long Island Railroad, which provides passenger rail service from New York City. Sidewalks within the beach community provide local access to the oceanfront.

Population

Population in the City of Long Beach has decreased from a 1980 total population of 34,073 to a 1987 total of 32,890 (a decrease of 3.6%). This trend continues in the population projections of Nassau County until 1995. Projections from 2000 to 2025 show an increase in population. Most visitors to Long Beach are from Nassau, Kings and New York Counties. Population projections from these counties are shown in Table D-1.

TABLE D-1

PROJECTION OF FUTURE POPULATIONS
NASSAU, KINGS & NEW YORK COUNTIES

	Nassau	Kings	New York
1988	1,318,100	2,314,300	1,509,900
1990	1,226,700		
1992	1,317,500	2,322,500	1,514,500
1995	1,317,000	2,328,600	1,518,000
2000	1,336,800	2,347,500	1,539,900
2005	1,355,700	2,368,800	1,562,800
2010	1,375,200	2,394,400	1,588,000
2015	1,393,900	2,421,600	1,610,700
2020	1,412,800	2,449,200	1,633,800
2025	1,414,600	2,450,200	1,635,900

Shore Development

The south shore of Long Beach Island is a continuous strip of sand beach serving the year-round inhabitants as well as the influx of summer visitors and vacationers, with an average of 1.5 million beach visitors per year. Visitors from Nassau, Kings and New York counties represent 94% of the total visitation.. Adjacent to the beach are several densely populated communities which are described in the paragraphs below. These communities extend across the width of the island to the north shore. Within the developed reaches of the north shore, the shoreline is generally bulkheaded. Outside the developed reaches, the shoreline remains in its natural state.

Point Lookout. The unincorporated community of Point Lookout extends from Jones Inlet on the east to Lido Beach on the west, a distance of 0.9 miles. The eastern portion of Point Lookout is primarily a densely populated residential area. The westerly portion of this area is comprised of Hempstead Town Park, a recreational beach facility for town residents. The park consists of bathhouses, cabanas, refreshment stands, comfort stations, a large public parking area and supporting facilities.

Lido Beach. This unincorporated area extends for 2.3 miles from Hempstead Town Park on the east to the City of Long Beach on the west. The area south of Lido Boulevard, the principal traffic artery, has been developed with a hotel, densely spaced dwellings, beach clubs and Lido Beach Town Park, which extends one-half mile along the oceanfront. The area north of Lido Boulevard was originally a low-lying saltwater marshland. The area has undergone considerable development with densely spaced dwellings, the Long Beach High School and a public golf course. The northeastern portion of the area, however, still remains partially in its natural state.

City of Long Beach. This city extends from Lido Beach to Atlantic Beach, a distance of 3.4 miles. It is primarily residential in character with a high concentration of commercial and public facilities. The area is almost completely developed, with little space available for expansion. A boardwalk skirts almost the entire oceanfront which consists of a continuous public beach. Fringing the north side of the boardwalk are many commercial establishments consisting of retail stores, refreshment stands, amusement arcades, hotels and rooming houses. Most recently, the area has experienced economic revitalization with a significant portion of the strip being upgraded with new high-rise cooperative apartment buildings and condominium complexes. Commercial concentrations are also located on both sides of several streets further inland.

Atlantic Beach. This area extends for 2.8 miles from the City of Long Beach to East Rockaway Inlet. At the eastern end, fronting the Atlantic Ocean, is a public beach of the Town of Hempstead. The central portion of this stretch of the Island comprises the Incorporated Village of Atlantic Beach. It is residentially developed with densely spaced dwellings and beach clubs fronted by a private beach with a boardwalk in much of the area. The western portion of the area, known as Silver Point Park, extends to East Rockaway Inlet. The area has been developed with beach clubs, and the U.S. Coast Guard maintains a lookout tower in the vicinity.

Income

Per capita income is an indicator of the economic strength of a community. The figures given in Table D-2 indicate the change in per capita income that Long Beach has experienced, and shows a higher rate of growth than the State of New York, but slightly less than that of Nassau County and the Town of Hempstead.

TABLE D-2 PER CAPITA INCOME FOR LONG BEACH ISLAND				
Community	Per Capita Income			1979-1985 % Change
	1979	1985	1989	
New York State	$11,109	$11,765	$	5.9
Nassau County	14,774	16,326	23,352	10.5
Town of Hempstead	13,451	14,693	20,955	9.2
City of Long Beach	12,479	13,518	20,933	8.3

DESCRIPTION OF THE PROBLEM

The Erosion Problem

The problems encountered in the Long Beach study area include of the loss of sand fronting the densely populated areas due to storm-induced erosion and the deterioration of the protective coastal structures. Erosion has reduced the width of most beachfront areas in the study area. This continuing erosion of the protective beach exposes Long Beach Island to a high risk of catastrophic damage from ocean flooding and wave attack.

The sediment budget calculations indicate that most of the study area shoreline has experienced a net erosion, except the shoreline in Atlantic Beach which has experienced a net accretion due to the construction of the East Rockaway Inlet Jetty, which intercepts a portion of the westerly littoral flow.

Many of the coastal structures, such as groins and jetties, have deteriorated since their construction. The structures are becoming less effective and increasingly susceptible to storm damage as the beach continues to erode.

The Storm Problem

The study area is subject to extensive damage during both tropical and extra tropical storms. Prior storms have resulted in building failure due to both the force of waves and loss of supporting material. The most widespread damage, however, results from waves overwashing the beach dunes, rushing to meet the rising waters of Reynolds Channel.

Based on the current Federal Emergency Management Agency (FEMA) delineation of the 100-year tidal inundation area, the Long Beach Island Regional Planning Board estimates that over 3,000 homes would be flooded, directly impacting over 8,000 residents. With roadway flooding likely to isolate the island from the mainland, the consequences of such a storm could be devastating.

Coastal storms have been a continuing source of damage and economic loss within the study area with significant events occurring in September 1938, November 1940, September 1944, November 1953, August 1954, September 1960, March 1962, March 1984, September 1985, October 1991 and December 1992. The December 1992 storm caused severe erosion, wave attack and extensive flooding with the ocean meeting the bay in at least one location. This storm resulted in an estimated $35,000,000 in losses to the study area based on December 1992 price levels, while the March 1962 storm was estimated to result in $12,000,000 in losses.

Due to continuing shoreline erosion with attendant degradation of protective structures, the potential economic losses and threat to human life and safety continue to rise with each passing year.

Without Project, Future Conditions

The without project condition is identified as a continuation of long-term erosion with a consequent reduction in dry land area seaward of major buildings, bulkheads or transportation routes. When erosion reaches these structures, non-federal interests indicate that they would maintain them, effectively halting long-term shoreline erosion at the seaward face. Based on the minimum stable beach slopes in the area, the future maintenance was assumed to require a minimum beach of 75 feet from the seaward face of the protected structure. In partial response to this continued erosion, there have been numerous efforts to stabilize the eastern portion of the shoreline using materials dredged from Jones Inlet. These activities most recently accomplished under the authority of Section 933 of the Water Resources Development Act of 1986, somewhat mitigate the potential for long-term erosion. Protective dunes within the study area are considered to be subject to the impacts of long-term erosion with no intervention. This results in an increasing frequency of dune failure as long-term erosion reduces the available protective beach. Dunes which fail during a storm event are assumed to be subsequently restored to their pre-failure conditions.

The continued future reduction of protective beach area will increase the potential for devastation in major storms. 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.

The extent and frequency of storm damage on Long Beach Island are also expected to increase in relation to predictions of a continued rise in sea level. Future conditions considered, sea level will rise on a long-term trend of an average of 0.01 feet per year (Appendix A).

Although rising sea level and the long-term erosion of the shore front will result in larger areas becoming subject to storm damage, several factors will combine to somewhat mitigate the future impacts. Since communities in the study area are currently participating in the National Flood Insurance Program (NFIP), most structures destroyed by future storms will be rebuilt to the NFIP base flood elevation.

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. Therefore, the following post-storm rebuilding practices were considered for the economic evaluation:

- Structures located closer than 350 feet to the future eroded shoreline will not be rebuilt.

- Any residential structure which is rebuilt will have its main floor at a minimum elevation equal to the FIA Base Flood Elevation (BFE) and be protected from the wave attack and storm recession associated with surge heights below the BFE.

EXTENT AND SCOPE OF ALTERNATIVES

The authorized project provides for federal participation in the restoration and protection of nine miles of shore from East Rockaway Inlet to Jones Inlet. The following design alternatives were considered in the initial screening for plan formulation:

1. No Action
2. Beach Restoration
3. Beach Restoration with Groins
4. Seawall
5. Seawall with Beach Restoration
6. Bulkhead with Beach Restoration
7. Breakwater with Beach Restoration
8. Perched Beach with Beach Restoration.

It is noted that all the above alternatives to provide similar storm damage protection with the exception of Alternative 1. The design objectives and evaluation of each of the above alternatives are described in Appendix A. A summary of first and annual costs are presented in Table D-3.

TABLE D-3

SCREENING OF ALTERNATIVES
COST COMPARISON OF PRELIMINARY DESIGN ALTERNATIVES
(1994 Price Level, 50 Year Project Life, 8% Interest)

Alternative	Preliminary First Cost (Million $)	Preliminary Annual Cost (Million $)
1) No Action	0	0
2) Beach Restoration Only	75.5	8.5
3) Beach Restoration w/Groins	132.4	13.3
4) Seawall	275.1	24.2
5) Seawall w/Beach Restoration	168.0	16.8
6) Bulkhead w/Beach Restoration	150.9	15.0
7) Breakwater w/Beach Restoration	256.1	23.0
8) Perched Beach w/Beach Restoration	116.5	11.9

Based on a comparison of alternative costs and the ability to meet planning objectives, the Beach Restoration alternative was selected as most suitable for this location. In order to identify the proper project dimension in detail the nine beachfill alternatives were then considered include:

a) no dune with 50 ft. advance nourishment only,
b) no dune with 110 ft. berm and nourishment,
c) no dune with 160 ft. berm and nourishment,

d) +15 ft. NGVD dune with 50 ft. advance nourishment,

e) +15 ft. NGVD dune with 110 ft. berm and nourishment,

f) +15 ft. NGVD dune with 160 ft. berm and nourishment,

g) +17 ft. NGVD dune with 50 ft. advance nourishment,

h) +17 ft. NGVD dune with 110 ft. berm and nourishment,

i) +17 ft. NGVD dune with 160 ft. berm and nourishment.

STORM DAMAGE

The base year for this economic evaluation is year 2000 and the project life is 50 years. Damages were evaluated for the period using the fiscal year 1994 interest rate of 8%.

Methodology and Assumptions

Benefits from the proposed plans of improvement were estimated by comparing damages with and without the proposed project under existing and future development conditions. In calculating storm damage reduction benefits, the type of damage causing the maximum impact was identified at each structure for various storm frequencies. To prevent double counting, only this maximum damage was included in the calculation of project benefits. Structures destroyed by long-term erosion were removed from the analysis for future years as it was determined they would not be reconstructed because the site was destroyed. For buildings destroyed by storm recession and/or wave attack, existing development patterns indicate that they would be rebuilt unless subject to wave or storm recession damage from storms on a frequent basis. This was based on the proximity of existing development to the shore line.

For residential structures, the replaced building was considered to be elevated to meet the NFIP criteria, however, due to the impracticality of elevating the majority of low-lying commercial establishments, non-residential structures were considered to be replaced in kind. Structures which have been replaced at an increased level of protection are assumed to suffer no damage at events associated with a surge elevation of less than 11 feet NGVD, the predominant Base Flood Elevation.

For high-rise structures, complete destruction was not considered due to their structural stability and deep pile foundations.

Figure D-2 provides a generalized Flow Chart of the analysis and methodology which is described in detail in the following sections.

Structure Inventory. To accomplish the benefit analysis, the initial consideration was the development of the structural database to assist in predicting storm damages. The structural database was generated through a complete windshield survey of structures on the island. Data on oceanfront high rise buildings obtained through a review of construction plans was used to supplement the data obtained through the windshield survey of the area using aerial mapping at a scale of 1" = 200'.

Survey Methodology. The structural database was generated through a survey of the structures adjacent to the project area and includes buildings, utilities, bulkheads seawalls and roadways. The building data were obtained through a windshield survey of the area using topographic mapping with a scale of 1" = 200' with a 2-foot contour interval. Table D-4 indicates the type of physical characteristics obtained for the building inventory. For utilities, bulkheads, boardwalks, etc., the inventory data were taken from the topographic mapping and are primarily targeted toward physical characteristics such as size and length in order to assign a replacement value. A key element in both aspects of the structure inventory is the front of structure setback and mid-point setback data, used to locate each structural element relative to the berm line. This was the primary mechanism used to trigger damage due to long-term erosion, storm recession and wave runup.

TABLE D-4

PHYSICAL CHARACTERISTICS OBTAINED FOR BUILDING INVENTORY

1.	Type - Residential, Commercial, etc.	12.	Basement/Foundation
2.	Town	13.	Ground Elevation
3.	Wave Zone	14.	Main Floor Height
4.	Location ID	15.	Low Opening
5.	Map Number	16.	Number of Garage Openings
6.	Structure ID	17.	Exterior Material
7.	Setback Distance	18.	Units on First Floor
8.	Mid-point Distance	19.	Total Units
9.	Structure Size	20.	Number of Buildings
10.	Stories	21.	Quality/condition
11.	Usage/occupancy	22.	Owner Operator

The data collected were used to categorize the structure population into groups having common physical features. Data pertaining to structure usage, size and stories assisted in the stratification of the building population. For each building, data were also gathered pertaining to its damage potential including its main floor elevation, lowest opening, construction material and proximity to the water. Replacement value was calculated for the residential and commercial structures using standard estimating guides in conjunction with size, occupancy, and construction material data, with adjustments for the presence of basements and garages. Replacement costs were adjusted to reflect depreciation based on the quality and condition of the structures.

For non-building structures, such as roads, boardwalks, utility lines, seawalls, etc., a similar inventory was conducted by extracting data from the mapping supplemented by field inspection. Once collected, the information was encoded for use on a computerized database giving an overall picture of the floodplain population.

Damage Surveys

Following the completion of the building inventory, a sample population of buildings was selected for on-site inspection to determine damage potential. The survey targeted three major groups of structures with specific analysis goals considered in the sample designs; major oceanfront structures, residential structures, and non-residential structures.

Major Oceanfront Structures. Along the Long Beach oceanfront are a series of large and/or high-rise structures which may not incur damage in the manner predicted by standard wave or storm recession damage functions. A total of thirty damage interviews were performed representing approximately 70% of structures in this category.

These major structures along the oceanfront of Long Beach Island have the lowest floor elevations ranging from 0.0 to 13.6. The buildings date from 1955 to 1986, with the majority built after Hurricane Donna, 1960 and the 1962 Ash Wednesday storm. Accordingly, no extensive record of structural failures was obtained during the damage interviews.

Flood damages for each structure were estimated for a range of water depths from zero damage to 12 feet above the main floor, providing the most accurate available measure of potential damage. In addition to providing specific data on the surveyed buildings, value for these surveys were also used to develop generalized estimates of damage as a percent of structure to residential apartments.

Residential Structures. The survey of residential damage utilized a stratified sampling procedure with specific targets established by structure usage and location. This procedure helped ensure that the sample would reflect local development variations. In order to improve the accuracy of damage predictions, the sample was initially designed to update and supplement surveys conducted for the Sea Bright to Ocean Township, New Jersey Project.

In general, the residential sample was designed to update damage functions for Colonial, Cape, Ranch, Bungalow and Custom style structures. Development of new damage functions was anticipated for Split Level, Bi-level, Raised Ranch, Two-family, Duplex and Multiple family style structures.

Damages obtained from each survey were compared to damages estimated using the Sea Bright damage functions. Review of the damage data indicated an extremely large difference in damages. This difference was apparently due to physical differences in the size and occupancy of buildings on Long Beach Island compared to Sea Bright. Accordingly, the Sea Bright residential damage functions were not considered valid for use in the Long Beach Project Area.

In order to develop new site specific damage functions using adequate sample sizes, the residential surveys were regrouped into three categories as follows:

- One Story: Applicable to Ranch and Bungalow style homes.
- Multi Story: Applicable to Colonial, Cape, Custom and Multiple family dwellings.
- Split Level: Applicable to structures in which the main living area (main floor) is not the lowest or first floor. This includes Split Level, Bi-level (Hi-ranch) and Raised-Ranch style homes.

At various depths relative to the main floor physical (including content) and emergency, damage as a percent of depreciated structure value were calculated for each building surveyed. Emergency costs include items such as evacuation, housing, and cleanup costs. Average percent damages were then calculated for the three groupings of residential structures. These generalized damage functions are presented in Figures D-3 through D-5.

Non-Residential Structures. Damage surveys were performed to calculate a non-residential flood damage adjustment factor for use in conjunction with the Sea Bright to Ocean Township generalized damage functions. Utilizing flood damage interviews, damages relative to flood depth were obtained. Reported mean damages for physical and emergency categories were compared to damages predicted by generalized damage functions. The following structure uses were sampled (Table D-5):

TABLE D-5

NON-RESIDENTIAL STRUCTURES USES FOR BUILDING INVENTORY

Code	Usage	Number Sampled
30	Diner	3
44	Office	5
47	Restaurant	5
48	Rooming House	2
49	Small Retail	5
55	Laundromat	2

The adjustment factor was calculated by averaging the ratio of reported to predicted damages from all the interviews at various depths of flooding. The initial averaged adjustment factors were calculated to be 2.86 for physical damage and 1.63 for emergency costs. These factors appeared unreasonable in light of other economic indicators such as location and price level adjustment factors.

Further analysis indicated that the adjustment factors for diners (usage 30) and laundromats (usage 55) were 3.41 and 7.86, respectively, skewing the analysis results.

The diner sample had an average damage adjustment factor of 3.41. According to the interviews the level of damages are not atypical for this category, however, an unusually small average size of the structures inflates the per square foot damages relative to the Sea Bright results. This category was deleted from the generalized damage adjustment due to the incompatible populations.

During the survey of damages for the Sea Bright project, laundromats were included in the usage grouping for household furnishings and appliances based on expectation of similar content values and damage. Comparison of laundromats to Sea Bright's home furnishing code (usage 37) shows and adjustment factor of 7.86. This comparison indicates the categories are not compatible and laundromats should be excluded from the update analysis.

Omitting the usages that are not compatible the adjustment factors are calculated to be 1.74 for physical damages and 1.30 for emergency damages. This factor compares reasonably well with economic indices for the price level adjustment. The full range of damages for the Sea Bright damages functions were adjusted to the location and condition of the project area.

Since Usage 30 and Usage 55 were excluded from the update calculation, the interviews of these usages were analyzed to develop generalized functions for use in analyzing these structural categories. Table D-5 depicts the sample size, number of interviews and proportion of the population sampled to develop new generalized damage functions.

TABLE D-6

NON-RESIDENTIAL USAGE 30 AND USAGE 55 GENERALIZED DAMAGE FUNCTION SUMMARY

	Diner Usage 30	Laundromats Usage 55
Usage Population	31	7
Number Interviewed	3	2
Percent of Population	9.68%	28.57%

Description of Damage Functions

Generalized damage functions were generated for physical damage, and emergency costs, damage. Non-residential damage functions reflect damages per square foot of structure size which were then applied to each structure to determine damages at 1-foot increments of flood stage. For the residential structures, functions were developed relating the physical damages and emergency costs to structure value. Table D-7 provides a summary of the damage functions used for this study.

TABLE D-7
EAST ROCKAWAY INLET TO
JONES INLET, LONG BEACH, NY

SUMMARY OF DAMAGE FUNCTIONS

	BASIS OF DAMAGE			SOURCE OF DATA		
USAGE/OCCUPANCY	STRUCTURE SPECIFIC	% OF STRUCTURE VALUE	$ PER SQ.FT.	DIRECT SURVEY	ADJUSTED SEA BRIGHT DATA	PROJECT SPECIFIC FUNCTION
RESIDENTIAL						
ONE STORY		X		X		X
SPLIT LEVEL		X		X		X
MULTI-STORY		X		X		X
APARTMENTS/TOWNHOUSES	X	X		X		X
HIGHRISES	X	X		X		X
COMMERCIAL						
ARCADE			X		X	
ART GALLERY			X		X	
AUTO SALES			X		X	
AUTO SERVICES			X		X	
BANK			X		X	
BAR			X		X	
BATHHOUSE			X		X	
CHURCH			X		X	
CLOTHING STORE			X		X	
DEPARTMENT STORE			X		X	
DINER			X	X		X
DRUG STORE			X		X	
DRY CLEANING			X		X	
FOOD STORE			X		X	
FUNERAL HOME			X		X	
HAIR SALON			X		X	
HARDWARE			X		X	
HOME FURNISHINGS			X		X	
HOSPITAL			X		X	
INDOOR SPORTS			X		X	
JEWELERS			X		X	
LIQUORS			X		X	
MARINA			X		X	
MEDICAL OFFICE			X	X	X	
OFFICE			X	X	X	
OFFICE WAREHOUSE			X		X	
OUTDOOR SPORTS			X		X	
RESTAURANT			X	X	X	
ROOMING HOUSE			X	X	X	
SMALL RETAIL			X	X	X	
THEATERS			X		X	
CABANA			X		X	
BEACH CLUB			X		X	
MOTEL			X		X	
LAUNDROMAT			X	X		X
OTHER						
INDUSTRIAL			X		X	
UTILITY			X		X	
MUNICIPAL			X		X	

Reach Selection

In order to adequately access the economic feasibility of proposed erosion control and coastal protection plans, the project area was subdivided into segments or reaches of more uniform characteristics. The criteria utilized in determining a composite reach selection are described below:

- Municipal Boundaries: Segmenting the project at municipal boundaries will allow an increments to be considered based on implementation constraints and provides a measure of the difference in development patterns by town.

- Coastal Protection Features: Since each reach in the analysis may include only one set of stage, runup, or storm recession frequency curves, features which would significantly impact the limits of erosion, wave attack or inundation damages must be taken into consideration. These features include the presence and height of dunes, the existing berm height/berm width and any other factors impacting the applicability of frequency curves.

- Critical Erosion Zones: Since the analysis includes the impacts of shoreline change in assessing future damages, the location of variations in without project erosion rates were considered in determining reach boundaries.

- Economic Development Criteria: Consideration of the impact of development density on damage potential will assist in determining the most cost-effective plan. This impact was also considered in determining reach designations.

A delineatin of economic reaches in the project area is illustrated in Figure D-6. Table D-8 provides a summary of the number, type and value of structures in each reach.

TABLE D-8
EAST ROCKAWAY INLET TO JONES INLET, LONG BEACH, NY

TABULATION OF DEVELOPMENT AND STRUCTURE VALUES

REACH	RESIDENTIAL		NONRESIDENTIAL		TOTAL
	# STRUCTURES	STRUCTURE VALUE	# STRUCTURES	STRUCTURE VALUE	
REACH 1	1515	$236,993,080	157	$49,254,570	$286,247,650
REACH 2	106	$35,202,910	98	$16,252,900	$51,455,810
REACH 3	4988	$1,162,547,860	516	$182,587,700	$1,345,135,560
REACH 4	2088	$215,630,200	125	$16,931,920	$232,562,120
REACH 5	629	$98,410,880	129	$15,647,370	$114,058,250
REACH 6	834	$141,732,130	288	$29,277,990	$171,010,120
TOTAL	10160	$1,690,517,060	1313	$309,952,450	$2,200,469,510

NOTE: Residential includes both single and multifamily dwellings. Non_residential includes industrial, commercial, municipal, and utility structures.

DAMAGE MECHANISMS

Oceanfront structures within the study area are exposed to storm damages from a number of possible mechanisms:

- Long-term Erosion;
- Storm Recession;
- Inundation; and
- Wave Action.

Long-Term Erosion Damage

General. Erosion damages refer to the long-term loss of dry land area due to deficits in littoral sediment transport, the impact of sea level rise and the long-term net impact of storms, including post-storm accretion. Long-term erosion may itself cause economic losses and will reduce the amount of protective beach area resulting in increased future storm damage. Damages were analyzed by advancing the shoreline landward for the without project conditions over the project life. For the with project condition, long-term erosion is not considered because costs are included in the project estimates to maintain the beach at its design level.

It is important to realize that actual undermining of structures due to long-term erosion has a minimal impact on project benefits. This is due to the high probability of storm damage in the years preceding failure caused by long-term erosion. Rebuilding of such structures becomes economically irrational and therefore there is only a small probability that any structure exists by the time long-term erosion reaches the seaward edge of the building due to the high probability of prior failure.

Methodology. The area subject to long-term erosion was determined for project years, P_0, P_{10}, P_{20}, P_{30}, P_{40}, and P_{50}. In determining damage due to long-term erosion, undermined structures were considered a total non-recurring loss. Each structure impacted by long-term erosion was removed from evaluation when considering storm-induced damages in subsequent years. The major impact of long-term erosion is the reduction in berm area protecting structures from the impact of storm damage due to shoreline recession, breaking wave impacts, wave runup and increased flooding caused by more frequent dune failure.

Each alternative considered in detail will halt long-term erosion as a result of implementing a nourishment program which has been included in the project costs. Residual with project damages were therefore calculated without consideration for long-term erosion.

Assumptions. Based on historic actions, it was determined that maintenance efforts would protect major structures such as high-rise buildings, bulkheads, major roadways and boardwalks required for access to commercial facilities. Long-term erosion would therefore be arrested at the leading edge of these structures through intervention by man, thus no long-term erosion was considered beyond such structures.

The future costs of protecting structures in the without project condition was estimated based on the cost of fill required to offset ongoing erosion. Fill volume requirements were estimated at 1 cy/lf per foot of annual erosion. The length of shoreline requiring stabilization was calculated at 10 year increments with interpolation used for intermediate years. Costs were estimated at $10/cy for trucked and placed fill. Table D-9 provides a sample calculation of annual costs to protect existing structures.

Storm Recession Damage

General. The project area is potentially subject to significant storm-induced shoreline recession which becomes increasingly more damaging as long-term erosion reduces the ability of the beach to provide a protective buffer. Unlike long-term erosion, which is assumed to halt at bulkheads and major access roads, storm recession occurs over a short period of time during the course of the storm, thereby not providing sufficient time for preventive intervention by man. Thus, storm recession is considered capable of impacting any building, including those fronted by protective structures.

Methodology. In order to more accurately define the area impacted by recession, an adjusted recession distance was found by applying a variability factor of 2.0 as described in Appendix A to the existing condition recession distance, as determined from modeling of typical beach profiles. This longshore variability is caused by variations in storm forces and beach characteristics such as onshore slope, offshore slope, berm height or width, grain size and vegetation. Since the with project beaches will exhibit far more regularity, a variability factor of 1.5 was utilized for the with project conditions.

TABLE D-8
EAST ROCKAWAY INLET TO
JONES INLET, LONG BEACH, NY

SAMPLE ANALYSIS OF ANNUAL DAMAGE
REACH 3, SHORELINE STABILIZATION

PROJ. LIFE= 50
DISCOUNT RAT 8.000%
COST/LF $40.00

YEAR	PROJECT YEAR	LENGTH OF STABILIZATION	COST IN YEAR	PRESENT WORTH FACTOR	PRESENT WORTH OF COST
2000	0	0	$0	0.9259	$0
2001	1	0	$0	0.8573	$0
2002	2	0	$0	0.7938	$0
2003	3	0	$0	0.7350	$0
2004	4	0	$0	0.6806	$0
2005	5	0	$0	0.6302	$0
2006	6	0	$0	0.5835	$0
2007	7	0	$0	0.5403	$0
2008	8	0	$0	0.5002	$0
2009	9	0	$0	0.4632	$0
2010	10	0	$0	0.4289	$0
2011	11	0	$0	0.3971	$0
2012	12	0	$0	0.3677	$0
2013	13	0	$0	0.3405	$0
2014	14	0	$0	0.3152	$0
2015	15	0	$0	0.2919	$0
2016	16	0	$0	0.2703	$0
2017	17	0	$0	0.2502	$0
2018	18	0	$0	0.2317	$0
2019	19	0	$0	0.2145	$0
2020	20	0	$0	0.1987	$0
2021	21	0	$0	0.1839	$0
2022	22	0	$0	0.1703	$0
2023	23	0	$0	0.1577	$0
2024	24	0	$0	0.1460	$0
2025	25	0	$0	0.1352	$0
2026	26	0	$0	0.1252	$0
2027	27	0	$0	0.1159	$0
2028	28	0	$0	0.1073	$0
2029	29	0	$0	0.0994	$0
2030	30	0	$0	0.0920	$0
2031	31	0	$0	0.0852	$0
2032	32	0	$0	0.0789	$0
2033	33	0	$0	0.0730	$0
2034	34	0	$0	0.0676	$0
2035	35	0	$0	0.0626	$0
2036	36	0	$0	0.0580	$0
2037	37	0	$0	0.0537	$0
2038	38	0	$0	0.0497	$0
2039	39	0	$0	0.0460	$0
2040	40	0	$0	0.0426	$0
2041	41	277	$11,092	0.0395	$440
2042	42	555	$22,184	0.0365	$810
2043	43	832	$33,276	0.0338	$1,125
2044	44	1109	$44,368	0.0313	$1,390
2045	45	1387	$55,460	0.0290	$1,610
2046	46	1664	$66,552	0.0269	$1,785
2047	47	1941	$77,644	0.0249	$1,930
2048	48	2218	$88,736	0.0230	$2,045
2049	49	2496	$99,828	0.0213	$2,130
2050	50	2773			
			SUM OF PRESENT WORTH		$13,265
			CAPITAL RECOVERY FACT		0.0817
			AVERAGE ANNUAL COST		$1,080

With the variability factor included, the damages occur at a lower frequency than without the consideration of variability, but the dollar value of the damage is one-half. The potential damage to any structure was determined based on the structure value as well as content value and emergency costs as determined from the on-site surveys. Damage begins when the recession distance exceeds the leading edge of the structure as defined by the setback distance, with total damage occurring when recession reaches the mid-point of the structure. Damage between these two points was determined using linear interpolation. For major structures, such as the high-rise apartment buildings in Long Beach, deep pile foundations will limit the loss potential due to the deep supporting system. For such structures, a lesser level of damage was considered.

The foundation and superstructure designs for these large buildings were reviewed in order to determine potential failure or damage modes. In general, the foundation designs include timber piles (load ranges of 20 to 30 tons) capped with reinforced concrete 2-1/2 to 3 feet thick. Floor slabs spanning the pile caps are typically 4 or 6 inches thick. Although detailed analysis of combined loadings was not performed, it appears unlikely that a complete structural failure would occur. Analysis of the foundation slab, however, indicated that loss of bearing material would result in damage to the foundation slab, with repair cost estimated at $9/ft^2$ of undermined foundation. No undermining was anticipated until the storm caused recession below the pile cap, assumed to be 3 feet below the lowest floor elevation of the structure. The extent of undermining was then estimated based on a 1:50 profile slope.

Recession damage was analyzed for existing conditions and for the Project Base Year (P_0), to 50 years after project construction (P_{50}) at 10-year increments. Analysis of future damage was based on shoreline positions adjusted for long-term erosion. Structures lost to long-term erosion were removed from the analysis in subsequent years due to the permanent loss of land.

Residual recession damage for each plan was evaluated using the same methodology, but excluding long-term erosion since project maintenance will stabilize the shoreline. Setback and mid-point distances were adjusted for the additional beach width to reflect the increased level of protection provided by the project.

The actual damage at any specific structure will vary in accordance with specific construction features. The determination that storm recession damage is most accurately estimated by utilizing straight line interpolation of damages between the leading edge and the mid-point of the structure represents a conservative approach to highly variable site-specific conditions.

Assumptions. The following assumptions were utilized in the evaluation of storm recession damages:

1. No storm damage was claimed for recession to the seaward edge of a building.

2. If the recession extends through 50% or more of a building's length (measured perpendicular to the shoreline), the entire building and its contents were considered a total loss.

3. A linear relationship was used to estimate damage for recession occurring between the seaward edge and mid-point of the building. For example, if 25% of the building foundation is undermined by recession, 50% of the value of the structure was considered as the loss.

4. For buildings less than four stories with a footprint size of 10,000 feet or greater, no total failure was assumed. Content damage was calculated based on the value of first floor contents only, utilizing a linear relationship between the setback and mid-point. Damage to the structure was also calculated using a linear relationship with a limitation on maximum damages to 25% of the value of one story for structures 10,000 square feet or greater.

5. Structures four stories or greater assumed slab damage only.

Summary. Sample stage vs. frequency relationships for the project base year are presented in Table D-10 and Figure D-7. A complete set of tables is provided in Sub-appendix D1.

Inundation Damages

General. The most widespread problem on Long Beach Island is frequent flooding, resulting in damage to homes, businesses and public facilities. This extensive flooding results from the convergence of tides surging through the inlets with waves running over the dunes and across the island. Stabilizing and strengthening the oceanfront dune system may significantly reduce the extent of flooding by protecting against wave overwash. Flooding from tidal surges backing up storm drains and overtopping the bulkheads along Broad Channel will not be significantly impacted by the oceanfront improvements.

Quantifying inundation damages required a predictive technique, sensitive to alterations in beach and dune configuration, and capable of representing both flatwater bay induced flooding and overwash flowing across the island. The analysis focused on differentiating between flood sources, and determining which physical process is most severe at any location. Critical elements quantified include:

- Overtopping discharge rate;
- Depth of flowing water; and
- Bay/channel stages.

Flatwater stages due to flooding in Broad Channel were taken from prior studies as described in Appendix A.

Methodology. Overtopping rates are theoretically related to ocean surge elevations, wave height and period, and the berm/dune configuration. Attempts to calibrate to historic flooding using theoretical analyses of wave overtopping indicated that the calculated discharge rates were insufficient to generate the reported severity of flooding. In order to produce agreement between predicted and historical flooding, a simplified analysis incorporating the wave runup and dune heights into a weir equation was used to estimate overtopping discharge rates. The dune height utilized for this analysis incorporates outputs of the S-Beach model to predict changes in dune crest elevations. Future runup heights were adjusted for the expected rate of sea level rise.

TABLE D-10
SAMPLE FREQUENCY VS DAMAGE SUMMARY
WITHOUT PROJECT RECESSION DAMAGE

REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	$4,200	$300	$100	$4,300
7.0	$4,200	$300	$100	$4,300
16.0	$143,500	$51,100	$1,500	$145,000
30.0	$267,900	$95,100	$2,500	$270,400
56.0	$294,200	$104,700	$2,800	$297,000
100.0	$294,200	$104,700	$2,800	$297,000
179.0	$294,200	$104,700	$2,800	$297,000
294.0	$294,200	$104,700	$2,800	$297,000
455.0	$294,200	$104,700	$2,800	$297,000

TYPE=RESIDENTIAL

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	.	.	.	.
7.0	.	.	.	.
16.0	$1,737,200	$438,600	$90,700	$1,827,900
30.0	$7,029,600	$1,759,200	$362,400	$7,392,000
56.0	$8,981,000	$2,245,800	$462,200	$9,443,200
100.0	$10,172,600	$2,543,500	$525,200	$10,697,800
179.0	$12,262,000	$3,085,000	$645,200	$12,907,200
294.0	$14,706,500	$3,675,500	$774,300	$15,480,800
455.0	$17,884,300	$4,509,100	$964,000	$18,848,300

Flow depths were calculated as normal depths using Manning's equation. Slopes were estimated for each location identifier cell based on typical existing topography, from landward of the dune to bayside bulkheads. Friction losses were calculated using a Manning's "n" of 0.04, considered to represent average conditions reasonably.

Overwash-induced flood elevations were calculated based on the bayside elevation, normal depth and profile slope. In localized ridges on the island, bayside elevations were adjusted to reflect impacts from adjacent areas. This adjustment compensates for the natural concentration of discharge to the lowest portions of the island. Flood depths were initially limited not to exceed stillwater ocean stages or fall below bay stages. The inundation analysis considers flood depths variously controlled by ocean stages, normal flow depths and bay stages.

The flood stage at each structure was evaluated for various storms and considered potential flooding from the following three sources:

- Ocean stages;
- Normal flow depths; and
- Bay stages.

This data was integrated with structure elevation, depth damage and structure values or size as appropriate to establish a damage vs. frequency relationship for each structure. A significant control on the level of inundation damage is the stability of the current dune line in relation to both storm and long term erosion. Table D-11 provides a summary of the dune stability analysis presented in Appendix A.

Summary. A sample inundation damage vs. frequency relationship for the project base year are presented in Table D-12 and Figure D-8. A complete set of tables is provided in Sub-appendix D2.

TABLE D-11

EAST ROCKAWAY INLET TO
JONES INLET, LONG BEACH, NY

FREQUENCY OF DUNE FAILURE (YEARS)
WITHOUT PROJECT CONDITIONS

REACH	EROSION RATE	ANALYSIS YEAR					
	FT/YR *	P0	P10	P20	P30	P40	P50
1A	0	92	92	92	92	92	92
	1.7	92	57	47	25	17	12
1B	2.7	500	500	500	500	500	500
2	1.7	500	500	500	500	500	500
3	4	92	35	17	5	1.5	1.5
4	4	92	35	17	5	1.5	1.5
5	4	92	35	17	5	1.5	1.5
6 *	2	92	57	47	25	17	12

* Rates reflect impact of future without project nourishment.

TABLE D-12
SAMPLE FREQUENCY VS DAMAGE SUMMARY
WITHOUT PROJECT INUNDATION DAMAGE

REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	.	.	.	.
7.0	.	.	.	.
16.0	.	.	$100	$100
30.0	.	.	$500	$500
56.0	$4,800	.	$19,300	$24,100
100.0	$7,278,500	.	$102,900	$7,381,400
179.0	$8,946,400	.	$108,900	$9,055,300
294.0	$9,737,400	.	$112,900	$9,850,300
455.0	$9,968,000	.	$114,600	$10,082,600

TYPE=RESIDENTIAL

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	$13,200	$3,700	$5,500	$18,700
3.0	$62,500	$17,500	$8,800	$71,300
7.0	$128,300	$36,000	$13,200	$141,500
16.0	$270,100	$76,700	$35,000	$305,100
30.0	$496,500	$142,100	$76,700	$573,200
56.0	$1,787,100	$507,700	$168,600	$1,955,700
100.0	$48,723,200	$13,207,000	$3,152,100	$51,875,300
179.0	$64,342,200	$17,700,300	$4,642,200	$68,984,400
294.0	$74,316,900	$20,634,100	$5,711,000	$80,027,900
455.0	$79,226,300	$22,112,900	$6,253,900	$85,480,200

Wave Attack Damage

General. Many structures along the oceanfront are potentially subject to significant forces due to the impacts of waves breaking against the structure or the runup associated with waves breaking seaward of the structure. The forces associated with such waves are capable of causing structural failure due to overturning or lateral displacement.

Methodology. For typical residential and commercial structures, damage was evaluated as failure of the entire building with complete loss of the structure and contents value, and emergency costs estimated from the upper limit of flood damages. Non-residential contents value was estimated utilizing the contents to structure value ratios.

The continued long-term erosion of the project area shoreline will result in an increase in the frequency and severity of wave attack damage. This evaluation takes into account the increased landward extent of wave runup attributable to a reduction in energy dissipation over the narrower protective beach.

Breaking Wave Damage - The limits of potential damage due to waves breaking at a structure were evaluated according to the methodology described in Section I of "Floodplain Management: Ways of Estimating Wave Heights in Coastal High Hazard Areas" (FEMA, 1981), which utilizes a standard ratio of wave height to still water depth and incudes transmission coefficients to evaluate the impacts of buildings or other obstructions. The determination of wave heights landward of a dune line incorporates the dune stability as previously described.

The evaluation of breaking wave limits utilized the depth of ocean surge over the protective dune or berm based on the typical profile for the reach. Wave heights were calculated based on a standard ration of 78% of the depth over the dune. Based on the structure density and ratio of open space between structures in each location identified, local wave transmission coefficients were determined. These coefficients presented in Table D-13 represent the percentage of the wave height which would be transmitted past rows of structures to impact on subsequent rows. In this manner, wave height which would be transmitted at each flood stage was calculated for each structure.

The force required for wave failure was based on analyses conducted during the Asbury Park to Manasquan Study. The wave height forces necessary to cause failure of average structures was calculated

TABLE D-13

SUMMARY OF LOCAL WAVE TRANSMISSION COEFFICIENTS
(PERCENT OF ARRIVING WAVE)

TOWN	PROFILE	LID	LONGSHORE DISTANCE	OPEN SPACE RATIO	TRANSMISSION COEFFICIENTS				
					COEF 1 ROW 1	COEF 2 ROW 2	COEF 3 ROW 3	COEF 4 ROW 4	COEF 5 ROW 5
HEMPSTEAD/ LIDO VIL.		48	1000	0.6	0.77	0.6	0.46	0.36	0.28
	140								
		47	1600	0.6	0.77	0.6	0.46	0.36	0.28
	150								
		46	1520	0.9	0.95	0.90	0.85	0.81	0.77
	160								
		45	2440	0.9	0.95	0.90	0.85	0.81	0.77
	170								
		44	1450	0.8	0.89	0.80	0.72	0.64	0.47
	172								
		43	1475	0.9	0.95	0.90	0.85	0.81	0.77
	174								
		42	960	0.7	0.84	0.70	0.59	0.49	0.41
		41	1020	0.5	0.71	0.50	0.35	0.25	0.18
	180								
		40	1720	0.8	0.89	0.80	0.72	0.64	0.47
	182								
		39	1470	0.7	0.84	0.70	0.59	0.49	0.41
	184								
		38	1190	0.7	0.84	0.70	0.59	0.49	0.41
		37	780	0.7	0.84	0.70	0.59	0.49	0.41
	190								
		36	1520	0.7	0.84	0.70	0.59	0.49	0.41
	192								
LONG BEACH CITY		35	970	0.25	0.5	0.25	0.15	0	0
	194								
		34	1300	0.25	0.5	0.25	0.15	0	0
	196								
		33	1200	0.25	0.5	0.25	0.15	0	0
	200								
		32	1170	0.25	0.5	0.25	0.15	0	0
	202								
		31	1320	0.6	0.77	0.60	0.46	0.36	0.28
	204								
		30	1410	0.6	0.77	0.60	0.46	0.36	0.28
	206								
		29	1250	0.6	0.77	0.60	0.46	0.36	0.28
	210								
		28	1250	0.6	0.77	0.60	0.46	0.36	0.28
	212								
		27	1250	0.3	0.55	0.30	0.16	0.1	0
	214								
		26	1310	0.3	0.55	0.30	0.16	0.1	0
	216								
		25	1200	0.5	0.71	0.50	0.35	0.25	0.18
	220								
		24	640	0.5	0.71	0.50	0.35	0.25	0.18
		23	470	0.7	0.84	0.70	0.59	0.49	0.41
	222								
		22	1400	0.4	0.63	0.40	0.25	0.16	0.1
	224								
		21	1500	0.4	0.63	0.40	0.25	0.16	0.1
	226								
		20	1010	0.7	0.84	0.70	0.59	0.49	0.41
	230								
ATLANTIC BEACH		19	1010	0.7	0.84	0.70	0.59	0.49	0.41
		18	1010	0.7	0.84	0.70	0.59	0.49	0.41
	234								
		217	980	0.7	0.84	0.70	0.59	0.49	0.41
		216	1000	0.6	0.77	0.6	0.46	0.36	0.28
	238								
		215	1000	0.7	0.84	0.70	0.59	0.49	0.41
		214	500	0.7	0.84	0.70	0.59	0.49	0.41
	250								
		213	1000	0.7	0.84	0.70	0.59	0.49	0.41
		17	1000	0.7	0.84	0.70	0.59	0.49	0.41
	270								
		16	900	0.7	0.84	0.70	0.59	0.49	0.41
		15	1000	0.7	0.84	0.70	0.59	0.49	0.41
	290								
		14	1100	0.6	0.77	0.60	0.46	0.36	0.28
		13	1100	0.6	0.77	0.60	0.46	0.36	0.28
	310								
		12	950	0.9	0.95	0.90	0.85	0.81	0.77
		11	950	0.9	0.95	0.90	0.85	0.81	0.77
	330								
		10	1100	0.9	0.95	0.90	0.85	0.81	0.77

NOTE: "COE" REFERS TO DATA PROVIDED BY THE N.Y. DISTRICT.
A MAXIMUM BEACH ELEVATION OF 10 ft. WAS ASSUMED WHERE NO BERM WAS IDENTIFIED.

utilizing procedures described in the "Shore Protection Manual" (USACE, 1984) and the FEMA Manual, "Elevating to the Wave Crest Level" (FEMA, 1980). The ability of the typical wood frame and masonry structures to resist lateral movement and overturning was determined by computing the structure's dead load and the resisting force and resisting moment produced by that dead load. These are as follows:

	Resisting Force	Resisting Moment
Wood Frame	0.9 kips/ft	38.0 ft-kips/ft
Masonry	1.2 kips/ft	62.3 ft-kips/ft

The total force and total moment of the breaking wave was then computed for various depths of water and plotted on a curve, see Figures D-8 and D-9. The breaking wave height was assumed equal to 78% of the still water depth. For the average structure from each "construction category" the resisting force and resisting moment was then located on the curves. This produces the following minimum stillwater depths required for failure:

Minimum Still Water Depth for Lateral Movement	Minimum Still Water Depth for Overturning
3.0 ft	.>7 ft
3.3 ft	>7 ft

Both structures will fail laterally before overturning.

This dual limitation on wave failure avoids the potential for overestimating damage in the following conditions:

1. When there is sufficient water depth to support a wave capable of causing failure, but obstacles seaward of the structure would limit the actual wave height.

2. When a potentially damaging wave may reach the structure, but the building construction type indicates that a larger wave for which there is insufficient water depth would be necessary to cause failure.

Sample wave attack damages calculated for various storms are summarized in sample Table D-14 and Figure D-11. A complete set of tables is provided in Sub-appendix D3.

Wave Runup Damage - In order to evaluate the true limit of damaging wave forces, runup or uprush associated with large waves breaking seaward of the structures must be considered. Many areas which are protected by sufficient ground elevation to prevent the impact or a breaking wave are so close to the shoreline that the uprush associated with larger waves is capable of causing structural failure. The initial step is evaluating the limit of destructive runup was to determine the force necessary for structural failure. Previous analysis for both the Sea Bright to Ocean Township and the Asbury Park to Manasquan

TABLE D-14
SAMPLE FREQUENCY VS DAMAGE SUMMARY
WITHOUT PROJECT WAVE ATTACK DAMAGE

REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	.	.	.	.
7.0	.	.	.	.
16.0	.	.	.	.
30.0	.	.	.	.
56.0	.	.	.	.
100.0	.	.	.	.
179.0	.	.	.	.
294.0	$499,700	$176,700	$4,000	$503,700
455.0	$579,900	$208,900	$5,500	$585,400

TYPE=RESIDENTIAL

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	.	.	.	.
7.0	.	.	.	.
16.0	.	.	.	.
30.0	.	.	.	.
56.0	.	.	.	.
100.0	.	.	.	.
179.0	.	.	.	.
294.0	$9,708,900	$2,457,600	$522,400	$10,231,300
455.0	$21,318,000	$5,344,400	$1,123,800	$22,441,800

studies indicate a typical structure may resist a force of 1800 lbs/sq ft. This value was adopted for use in the runup analysis.

The wave runup limits corresponding to the failure force of 1800 lbs/sq ft. were evaluated for typical profiles at storm recurrence intervals of 10 years, 25 years, 50 years, 100 years and 500 years. The results were then plotted to develop curves of runup distance vs. frequency. The calculation of runup distances incorporated the storm recession distance for each profile. This limit is shown as the X_t distance on Figure D-12, Wave Runup Schematic.

In addition, the maximum runup height corresponding to X_2 on Figure D-12 for each profile was utilized to develop curves of runup height vs. frequency. When the building setback, including the impacts of long-term erosion, is less than the X_1 runup distance and the ground elevation at the building is less than the maximum runup height, the structure was assumed to fail.

Assumptions. The following assumptions were utilized in the evaluation of wave attack damage.

1. Wave attack for exceptionally large buildings (over 10,000 square feet) or buildings four stories or taller is unlikely to result in total failure.

2. A wave capable of causing total failure to relatively small buildings, will result in structure damage to approximately 25% of the first story and damage to the full amount of first floor contents to structures constructed of similar materials with a footprint size greater than 10,000 square feet.

3. Structures four stories or more are assumed not to result in structure damage due to a wave capable of reaching the building.

Sample wave runup damages are summarized in sample Table D-15 and Figure D-13. A complete set of tables is provided in Sub-appendix D4 with calculations as previously described.

TABLE D-15
SAMPLE FREQUENCY VS DAMAGE SUMMARY
WITHOUT PROJECT WAVE RUNUP DAMAGE

REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	.	.	.	.
7.0	.	.	.	.
16.0	.	.	.	.
30.0	.	.	.	.
56.0	.	.	.	.
100.0	$588,400	$209,400	$5,600	$594,000
179.0	$588,400	$209,400	$5,600	$594,000
294.0	$588,400	$209,400	$5,600	$594,000
455.0	$588,400	$209,400	$5,600	$594,000

TYPE=RESIDENTIAL

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	.	.	.	.
7.0	.	.	.	.
16.0	.	.	.	.
30.0	.	.	.	.
56.0	.	.	.	.
100.0	$5,284,100	$1,332,200	$271,400	$5,555,500
179.0	$5,542,700	$1,396,100	$284,500	$5,827,200
294.0	$16,558,000	$4,143,900	$855,100	$17,413,100
455.0	$17,031,100	$4,238,600	$878,500	$17,909,600

Critical Damage

As previously described, the study area's oceanfront structures are exposed to storm damages resulting from long-term erosion, storm recession, inundation and wave action. In order to calculate Average Annual Damages, damages for each reach were summarized by frequency-damage over the 50-year project life. Each one-foot stage of inundation was related to a frequency and that frequency was utilized to evaluate the potential damage from each mechanism. To prevent double counting, only the maximum damage to any single structure is reported for a specific frequency. As depicted in Figure D-14, the "Critical Damage" can fluctuate from inundation to storm recession to wave attack for different frequency events. Since a structure may suffer damage due to more than one mechanism (which would be double counting), the sum of damages resulting from these individual damage mechanisms will often far exceed the critical damage (maximum damage). Maximum damage vs. frequency data is presented in Table D-16 and Figure D-15. Sub-appendix D5 provides a summary of damage frequencies.

Damage Verification

In order to verify the accuracy and reasonableness of the current calculation of storm damage, these results were compared to available reports of actual storm damage. This comparison utilized data compiled after the Ash Wednesday storm in March, 1962 and flood insurance claims data from the December, 1992 storm. Review of this data indicates that updated damages would total $12,200,000 for the March, 1962 storm and $35,000,000 for the December, 1992 storm. Based on the calculated damage vs. frequency relationships for current conditions, damages were calculated to be $8,900,000 for the 1962 storm and $35,000,000 for the 1992 storm. This relatively close correlation between reported and calculated damage indicates that the analysis procedures utilized for this project provide an accurate representation of expected future damages.

TABLE D-16
SAMPLE FREQUENCY VS DAMAGE SUMMARY
WITHOUT PROJECT MAXIMUM DAMAGE

REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	.	.	.	.
3.0	$4,200	$300	$100	$4,300
7.0	$4,200	$300	$100	$4,300
16.0	$143,500	$51,100	$1,700	$145,200
30.0	$267,900	$95,100	$3,000	$270,900
56.0	$299,000	$104,700	$22,100	$321,100
100.0	$7,691,100	$209,400	$104,600	$7,795,700
179.0	$9,299,900	$209,400	$110,300	$9,410,200
294.0	$10,084,100	$209,400	$114,200	$10,198,300
455.0	$10,314,700	$209,400	$115,800	$10,430,500

TYPE=RESIDENTIAL

STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1.0	.	.	.	.
1.5	$13,200	$3,700	$5,500	$18,700
3.0	$62,500	$17,500	$8,800	$71,300
7.0	$128,300	$36,000	$13,200	$141,500
16.0	$2,007,300	$515,300	$125,700	$2,133,000
30.0	$7,526,100	$1,901,300	$439,100	$7,965,200
56.0	$10,768,000	$2,753,500	$630,800	$11,398,800
100.0	$57,570,900	$15,324,100	$3,583,900	$61,154,800
179.0	$73,418,100	$19,865,500	$5,089,500	$78,507,600
294.0	$91,500,800	$24,739,300	$6,515,400	$98,016,200
455.0	$100,390,700	$27,197,500	$7,269,700	$107,660,400

ANNUAL DAMAGES

Average Annual Building Damages

Utilizing the critical damage-frequency relationships for oceanfront structures, including adjustments for probability of existence, probability weighted average annual damages were computed at 10-year increments for each structure. Sample equivalent annual damages over the project life were calculated as shown in Table D-17. A complete set of damages for the without project conditions are presented in Sub-appendix D6.

Damage to Roads and Infrastructure

Without project and with project damages to roads and utilities were calculated based on storm recession undermining the facility, necessitating replacement and emergency bypassing. For utilities and roads perpendicular to the oceanfront, damage was taken based on the linear feet of recession impacting the facility. When paralleling the ocean, damage was considered when recession reached the item. For roads parallel to the oceanfront, damage was evaluated starting at the ocean side of the roadway and linearly evaluated to 100% damage at the landward side of the roadway. Damages were adjusted in future years to reflect the without project loss of protective beach.

Without project and with project damages to wooden boardwalks on piles were evaluated using the repair and replacement costs reported for ongoing maintenance projects. Damages to beach access ramps were based on damage surveys from the December 1992 storm. Damage frequency curves were developed using the reported damages, with the upper portion of the curve based on the elevation at which the average wave crest is expected to impact the stringers supporting the boardwalk. Based on a stringer elevation of 15 ft. NGVD or a ground elevation of 8 ft. NGVD, it was estimated that a storm stage of approximately 12.5 ft. NGVD would result in failure of the boardwalk deck and stringers, as well as failure of access ramps and stairways.

In the with project conditions, the boardwalk will be protected by the stabilized dune. For storm events which would not result in dune failure only damage to access ramps and stairs was considered. Storms resulting in failure of the dune system were also considered to result in failure of the boardwalk.

TABLE D-17
SAMPLE CALCULATION OF EQUIVALENT ANNUAL DAMAGES

PROJ. LIFE= 50 (REACH 1)
DISCOUNT RATE= 8.000%

YEAR	PROJECT YEAR	RESIDENTIAL PHYS	RESIDENTIAL EMER	COMMERCIAL PHYS	COMMERCIAL EMER	OTHER PHYS	OTHER EMER	TOTAL PHYS	TOTAL EMER	PRESENT WORTH FACTOR	PRESENT WORTH RESIDENTIAL PHYSICAL	PRESENT WORTH RESIDENTIAL EMERGENCY	PRESENT WORTH COMMERCIAL PHYSICAL	PRESENT WORTH COMMERCIAL EMERGENCY	PRESENT WORTH OTHER PHYSICAL	PRESENT WORTH OTHER EMERGENCY
1992	-8	932339	53818	582481	12064	67209	1182	1582029	67064	1.7138						
1994	-6							0	0	1.4693						
2000	0	921817	53492	298946	5165	69223	1216	1289986	59873	0.9259	$853,255	$49,530	$274,028	$4,780	$64,095	$1,125
2001	1	918000	53374	287355	5075	69462	1220	1274817	59669.1	0.8573	$787,030	$45,760	$246,360	$4,350	$59,580	$1,045
2002	2	914482	53256	278764	4985	69701	1224	1262947	59465.2	0.7938	$725,946	$42,278	$221,290	$3,960	$55,330	$970
2003	3	910965	53138	270174	4896	69939	1227	1251078	59261.3	0.7350	$669,585	$39,060	$198,565	$3,600	$51,410	$900
2004	4	907447	53020	261583	4806	70178	1231	1239208	59057.4	0.6806	$617,595	$36,085	$178,030	$3,270	$47,760	$840
2005	5	903930	52902	252992	4717	70417	1235	1227339	58853.5	0.6302	$569,630	$33,335	$159,430	$2,970	$44,375	$780
2006	6	900413	52784	244401	4627	70656	1239	1215470	58649.6	0.5835	$525,380	$30,800	$142,606	$2,700	$41,225	$725
2007	7	896895	52666	235810	4537	70895	1243	1203600	58445.7	0.5403	$484,645	$28,455	$127,400	$2,450	$38,300	$670
2008	8	893378	52548	227220	4447	71133	1246	1191731	58241.8	0.5002	$446,910	$26,285	$113,655	$2,225	$35,585	$625
2009	9	889860	52430	218629	4358	71372	1250	1179861	58037.9	0.4632	$412,180	$24,285	$101,265	$2,020	$33,060	$580
2010	10	886343	52312	210038	4268	71611	1254	1167992	57834	0.4289	$380,135	$22,435	$90,080	$1,830	$30,715	$540
2011	11	884583	52274	206506	4238	71849	1257	1162938	57769	0.3971	$351,280	$20,760	$82,005	$1,685	$28,540	$500
2012	12	882823	52236	202974	4207	72126	1260	1157923	57704	0.3677	$324,610	$19,208	$74,635	$1,545	$26,520	$465
2013	13	881064	52199	199441	4177	72384	1264	1152889	57639	0.3405	$299,970	$17,770	$67,900	$1,420	$24,645	$430
2014	14	879304	52161	195909	4146	72641	1267	1147854	57574	0.3152	$277,195	$16,445	$61,760	$1,305	$22,900	$400
2015	15	877544	52123	192377	4116	72899	1270	1142820	57509	0.2919	$256,145	$15,215	$56,155	$1,200	$21,280	$370
2016	16	875784	52085	188845	4086	73157	1273	1137786	57444	0.2703	$236,695	$14,075	$51,040	$1,105	$19,770	$345
2017	17	874024	52047	185313	4055	73414	1276	1132751	57379	0.2502	$218,725	$13,025	$46,375	$1,015	$18,370	$320
2018	18	872265	52010	181780	4025	73672	1280	1127717	57314	0.2317	$202,110	$12,050	$42,120	$935	$17,070	$295
2019	19	870505	51972	178248	3994	73929	1283	1122682	57249	0.2145	$186,765	$11,150	$38,245	$855	$15,860	$275
2020	20	868745	51934	174716	3964	74187	1286	1117648	57184	0.1987	$172,580	$10,315	$34,710	$785	$14,740	$255
2021	21	868319	52039	173108	3966	74466	1290	1115893	57294.9	0.1839	$159,720	$9,570	$31,840	$730	$13,695	$238
2022	22	867893	52144	171500	3968	74745	1294	1114138	57405.8	0.1703	$147,815	$8,980	$29,210	$675	$12,730	$220
2023	23	867467	52249	169892	3970	75024	1298	1112384	57516.7	0.1577	$136,600	$8,240	$26,790	$625	$11,830	$205
2024	24	867041	52354	168284	3972	75303	1302	1110629	57627.6	0.1460	$126,605	$7,645	$24,575	$580	$10,995	$190
2025	25	866615	52459	166677	3974	75582	1306	1108874	57738.5	0.1352	$117,170	$7,095	$22,535	$535	$10,220	$175
2026	26	866190	52564	165069	3976	75861	1309	1107119	57849.4	0.1252	$108,435	$6,580	$20,665	$500	$9,495	$165
2027	27	865764	52669	163461	3978	76140	1313	1105364	57960.3	0.1159	$100,365	$6,105	$18,945	$460	$8,825	$150
2028	28	865338	52774	161853	3980	76419	1317	1103610	58071.2	0.1073	$92,875	$5,665	$17,370	$425	$8,200	$140
2029	29	864912	52879	160245	3982	76698	1321	1101855	58182.1	0.0994	$85,955	$5,265	$15,925	$395	$7,620	$130
2030	30	864486	52984	158637	3984	76977	1325	1100100	58293	0.0920	$79,545	$4,875	$14,595	$365	$7,085	$120
2031	31	865448	53172	158706	4061	77714	1353	1101868	58585.6	0.0852	$73,735	$4,530	$13,520	$345	$6,620	$115
2032	32	866410	53360	158775	4138	78450	1381	1103636	58878.2	0.0789	$68,350	$4,210	$12,525	$325	$6,190	$110
2033	33	867372	53548	158844	4215	79187	1408	1105403	59170.8	0.0730	$63,355	$3,910	$11,605	$310	$5,785	$105
2034	34	868334	53736	158913	4292	79923	1436	1107170	59463.4	0.0676	$58,730	$3,635	$10,750	$290	$5,405	$95
2035	35	869296	53924	158982	4369	80660	1464	1108938	59756	0.0626	$54,440	$3,375	$9,955	$275	$5,050	$90
2036	36	870257	54111	159051	4445	81397	1492	1110706	60048.6	0.0580	$50,465	$3,140	$9,225	$260	$4,720	$85
2037	37	871219	54299	159120	4522	82133	1520	1112473	60341.2	0.0537	$46,775	$2,915	$8,545	$245	$4,410	$80
2038	38	872181	54487	159189	4599	82870	1547	1114240	60633.8	0.0497	$43,360	$2,710	$7,915	$230	$4,120	$75
2039	39	873143	54675	159258	4676	83606	1575	1116008	60926.4	0.0460	$40,190	$2,515	$7,330	$215	$3,850	$75
2040	40	874105	54863	159327	4753	84343	1603	1117775	61219	0.0426	$37,255	$2,340	$6,790	$205	$3,595	$70
2041	41	875455	55067	158931	4775	84643	1608	1119028	61449.7	0.0395	$34,550	$2,175	$6,270	$190	$3,340	$65
2042	42	876806	55270	158534	4797	84942	1613	1120281	61680.4	0.0365	$32,040	$2,020	$5,785	$175	$3,105	$60
2043	43	878158	55474	158138	4820	85242	1617	1121538	61911.1	0.0338	$29,710	$1,875	$5,350	$165	$2,885	$55
2044	44	879505	55678	157741	4842	85541	1622	1122787	62141.8	0.0313	$27,555	$1,745	$4,940	$150	$2,680	$50
2045	45	880855	55882	157345	4864	85841	1627	1124041	62372.5	0.0290	$25,550	$1,620	$4,565	$140	$2,490	$48
2046	46	882205	56085	156948	4886	86141	1632	1125294	62603.2	0.0269	$23,695	$1,505	$4,215	$130	$2,315	$45
2047	47	883555	56289	156552	4908	86440	1637	1126547	62833.9	0.0249	$21,975	$1,400	$3,895	$120	$2,150	$40
2048	48	884905	56493	156155	4931	86740	1641	1127800	63064.6	0.0230	$20,375	$1,300	$3,595	$115	$1,995	$40
2049	49	886255	56696	155759	4953	87039	1646	1129053	63295.3	0.0213	$18,895	$1,210	$3,320	$105	$1,855	$35
2050	50	887605	56900	155362	4975	87339	1651	1130306	63526							
										SUM OF PRESENT WORTHS	$10,924,570	$446,355	$2,770,235	$58,285	$884,355	$18,520
										CAPITAL RECOVERY FACTOR	0.0817	0.0817	0.0817	0.0817	0.0817	0.0817
										EQUIV ANNUAL DAMAGE =	$893,010	$62,830	$226,450	$4,620	$72,290	$1,270

Public Emergency Costs

Historical reports of storm damage in the study area indicate two major sources of publicly-borne emergency costs — the post-storm cleanup of sand and materials deposited landward of the beach, and costs of providing emergency police protection, road closings, evaluation and related services.

The costs of additional public services during storm events were analyzed using damage survey reports for the 1992 storm. In order to estimate the emergency costs, it was assumed that costs would vary in relationship to damages to buildings. Damage frequency curves for each reach were based on a ratio of emergency costs to building damage of 0.11%. Since the plans considered would reduce both the extent and the severity of storm impacts, it was assumed that residual emergency protection costs would represent 0.11% of residual building damages.

Historically, substantial volumes of sand are carried inland during major storms, clogging sewers and roads and requiring substantial resources for collection and disposal. Damage survey reports cited a total cost of $180,000 for the City of Long Beach to collect such material after the December 1992 storm. Based on a collection and handling cost of $5/CY the volume of material is estimated at 36,000 CY, or 1.9 CY per linear foot of beach. This volume correlates reasonably well with S-beach erosion model results for survey profile 238, which was therefore considered representative of both with and without project sand overwash volumes.

Annual cost of cleanup for sand overwash was calculated using a cost of $5 per CY. Any overwash volumes less than 1 CY/lf was considered included in normal street cleaning and beach maintenance efforts and were not included in the storm damage analysis. For alternatives 1, 4 and 7, which do not substantially improve the dune/beach stability, no significant reduction in sand overwash is anticipated. A sample calculation of average annual costs of sand overwash cleanup is provided in Table D-18.

Future Protection Costs

Under without project conditions it is expected that various efforts will be made to protect various locations from long-term erosion. The most significant of these costs occurs in conjunction with dredging of Jones Inlet, during which the suitable dredge material is placed near Point Lookout on the most

TABLE D-18

SAMPLE CALCULATION
SAND/DEBRIS REMOVAL - SAND OVERWASH

EXISTING CONDITION
WITHOUT PROJECT

REACH 3 14270 LF

EXCEEDANCE INTERVAL	PROBABILITY	VOLUME CY	COST ($5/CY)	AVERAGE COST	ANNUAL COST
2	0.5	0	$0		
				$0	$0
5	0.2	0	0		
				0	0
10	0.1	0	0		
				0	0
20	0.05	0	0		
				132,000	4,000
50	0.02	52,799	264,000		
				314,000	3,100
100	0.01	72,777	363,900		
				378,200	1,900
200	0.005	78,485	392,400		
				392,400	1,200
500	0.002	78,485	392,400		
				392,400	800

TOTAL
ANNUAL COST $11,000

critically eroding portion of the beach, at an average cost of $400,000 per year. Since these efforts will not continue under with project conditions, there will be $400,000 in annual costs avoided over the life of the project.

Even with the continued placement of sand from Jones Inlet, some locations will require future intervention to prevent erosion of critical access or protection features. The costs of protecting these features was determined as was previously presented in Table D-8. Since each of the alternatives considered will prevent long-term erosion over the life of the project, these expenses will not be required under with project conditions.

With Project Analysis Procedure

Storm damage reduction benefits were calculated as the difference between without project average annual damages and the residual with project average annual damages. The calculation of residual damages utilized the same analysis methodology as described for the calculation of without project damages. With project storm damages were calculated for six reaches and nine alternatives. Storm damage reduction benefits from the proposed plans of improvement were subsequently calculated by evaluating storm damages future protection costs with and without the proposed project. The limits of damage for the with project condition were adjusted to reflect increased beach width and height, increased dune stability and/or dune heights, and continued nourishment to offset the impacts of long-term erosion. The additional beach width for each alternative was established at frequent intervals as indicated on Table D-19.

The added height and width of the beach/dune complex will serve to absorb much of the damaging and erosive energy of future storms. Accordingly, the dunes are more stable, providing a barrier against ocean flooding and wave action across the island. A summary of the dune failure data used in the analysis of storm damage is provided in Table D-20.

TABLE D-19
ADDITIONAL BEACH WIDTHS BY LID, REACH, AND ALTERNATIVE

TOWN	LID	LONGSHORE DISTANCE	REACH	ADDED BEACH WIDTH * ALTERNATIVE 2	3	5	6	8	9
HEMPSTEAD/ LIDO VIL.	48	1000	REACH 1a TP1	300	350	290	340	310	360
	47	1600	"	203	252.5	190	240	210	260
	46	1520	"	145	195	175	225	195	245
	45	2440	"	143	192.5	180	230	200	250
	44	1450	REACH 2 TP3	25	50	25	50	35	60
	43	1475	"	0	0	0	0	0	0
	42	960	"	0	0	0	0	0	0
	41	1020	"	0	0	0	0	0	0
	40	1720	"	68	92.5	63	87.5	72.5	97.5
	39	1470	REACH 1b TP1	163	212.5	158	207.5	177.5	227.5
	38	1190	"	184	233.8	183	232.5	202.5	252.5
	37	780	"	171	221.3	168	217.5	187.5	237.5
	36	1520	"	245	295	243	292.5	262.5	312.5
LONG BEACH CITY	35	970	REACH 3 TP2	320	370	303	352.5	322.5	372.5
	34	1300	"	280	330	240	290	260	310
	33	1200	"	258	307.5	235	285	255	305
	32	1170	"	280	330	285	335	305	355
	31	1320	"	253	302.5	258	307.5	277.5	327.5
	30	1410	"	218	267.5	218	267.5	237.5	287.5
	29	1250	"	190	240	190	240	210	260
	28	1250	"	183	232.5	180	230	200	250
	27	1250	"	223	272.5	218	267.5	237.5	287.5
	26	1310	"	228	277.5	225	275	245	295

TABLE D-19
ADDITIONAL BEACH WIDTHS BY LID, REACH, AND ALTERNATIVE

TOWN	LID	LONGSHORE DISTANCE	REACH	ADDED BEACH WIDTH * ALTERNATIVE 2	3	5	6	8	9
LONG BEACH CITY	25	1200	"	208	257.5	203	252.5	222.5	272.5
	24	640	"	196	246.3	189	238.8	208.8	258.8
	23	470	REACH 4 TP3	189	238.8	186	236.3	206.3	256.3
	22	1400	"	185	235	178	227.5	197.5	247.5
	21	1500	"	193	242.5	180	230	200	250
	20	1010	"	170	220	190	240	210	260
ATLANTIC BEACH	19	1010	REACH 5 TP3	158	207.5	215	265	235	285
	18	1010	"	193	242.5	265	315	285	335
	217	990	"	183	232.5	260	310	280	330
	216	1000	"	128	177.5	200	250	220	270
	215	1000	"	50	75	85	110	95	120
	214	500	"	0	0	0	0	0	0
	213	1000	REACH 6	0	0	0	0	0	0
	17	1000	TP2	0	0	0	0	0	0
	16	900	"	0	0	0	0	0	0
	15	1000	"	0	0	0	0	0	0
	14	1100	"	0	0	0	0	0	0
	13	1100	"	0	0	0	0	0	0
	12	950	"	0	0	0	0	0	0
	11	950	"	0	0	0	0	0	0
	10	1100	"	0	0	0	0	0	0

* Seaward change in shoreline position.
** Alternatives 1, 4, & 7 do not alter shoreline position.

TABLE D-20

LONG BEACH FEASIBILITY STUDY
COMPARISON OF WITH AND W/O PROJECT DAMAGE ANALYSIS INPUT DATA
DUNE FAILURE FREQUENCY
(Exceedance Interval in Years)

ALTERNATIVE	DESCRIPTION	REACH 1A/1B	REACH 2	REACH 3	REACH 4	REACH 5	REACH 6
Existing Base Yr		92/500	500	92	92	92	92
Alt. 1	Ex. Berm Ex. Dune	92/500	500.	92	92	92	92
Alt. 2	110 ft Berm* Ex.Dune	200/500	500	200	200	200	92
Alt. 3	160 ft Berm* Ex.Dune	200/500	500	200	200	200	92
Alt. 4	Ex.Berm 15 ft.Dune*	100/500	500	100	100	100	92
Alt.5	110 ft Berm* 15 ft Dune*	200/500	500	200	200	200	92
Alt. 6	160 ft Berm* 15 ft Dune*	200/500	500	200	200	200	92
Alt. 7	Ex. Berm 17 ft Dune*	100/500	500	100	100	100	92
Alt. 8	110 ft Berm* 17 ft Dune*	200/500	500	200	200	200	92
Alt. 9	160 ft Berm* 17 ft Dune*	200/500	500	200	200	200	92

NOTE: All alternatives incorporate nourishment to stabilize beach.
* Minimum Design Value

Loss of Land

Under the without project scenario, the project area is subject to a loss of land due to long-term erosion. The value of this land represents a potential project benefit as long-term erosion will be halted by the periodic nourishment program. The nourishment program will prevent future losses of property to long-term erosion resulting in a project benefit. To quantify land loss damages, the acreage landward of the recreational beach subject to erosion was identified. As described earlier in this appendix, long-term erosion was assumed to be halted at the leading edge of bulkheads and road systems paralleling the beach, based on anticipated intervention by man. For each town near shore land values were applied to the eroded land area to establish the value of land lost in any future year. The present worth of these values was then annualized to determine the equivalent annual value of land loss.

RECREATION BENEFITS

The procedure for estimating the use value of a recreation was to develop a Simulated Demand Curve. These demand curves are referred to as "simulated" since they are not based on actual market behavior, but on behavior in the hypothetical market. The concept of demand, in the instance of a beach visitor using a daily pass to enter the beach, describes the relationship between the number of annual visits (Quantity Demanded) people are willing to make each Willingness to Pay (WTP) bid (Price). For a visitor using a season pass to enter the beach, quantity demanded is measured by the number of people using a season pass rather than the number of annual visits. The use value is estimated as the area under the demand curve.

The information necessary to develop a simulated demand curve was obtained from a survey. The survey was conducted during *July and August* 1992. Respondents were asked about the WTP for the 'without' and 'with project' conditions, and about their visitation patterns. The methodology described above is referred to as the Contingent Valuation Method (CVM).

Three CVM questionnaires were used. The first, referred to as Form #1, obtained information form respondents using the City of Long Beach beaches. The second, referred to as Form #2 obtained information from respondents using the beaches at Point Lookout. The third questionnaire, referred to as Form #3, obtained information from respondents using Nassau County beaches. Information at the

Nassau beaches was gathered on the WTP to switch to the use of the beaches at Long Beach and Point Lookout once the nourishment project ('with project' condition) is implemented. Recent attendance at the survey beaches is presented in Tables D-21 and D-22. It should be noted that a substantial decline in beach attendance has taken place at Point Lookout in recent years. In 1984, for example, attendance stood at 523,065. This attendance decline coincided with a significant loss of beach at this location.

TABLE D-21

TOTAL ATTENDANCE, LONG BEACH (FORM #1): AVERAGE OF 1992-93

	1992		1993		Average	
Survey Beach	**Daily Pass**	**Season Pass**	**Daily Pass**	**Season Pass**	**Daily Pass**	**Season Pass**
Long Beach	112,281	669,390	166,540	813,376	139,411	741,383

TABLE D-22

TOTAL ATTENDANCE, POINT LOOKOUT (FORM #2), NASSAU & LIDO (FORM #3): AVERAGE OF 1992-93

Survey Beach	1992	1993	Average
Point Lookout (Form #2)	***151,940***	***115,852***	***133,896***
Nassau + Lido (Form #3)	***447,686***	***480,469***	***464,078***
Nassau	333,542	347,479	340,511
Lido	114,144	132,990	123,567

The benefit analysis considered the impact of the project on both attendance and WTP. Future use of the recreation beach was forecast to vary in proportion to the projected growth in population. Table D-23 provides a summary of recreation benefits for the various alternatives. Sub-appendix D7 provides a more detailed description of the recreation analysis procedures.

TABLE D-23 RECREATION BENEFITS SUMMARY OF FORECASTED USE VALUE				
	Percent Use Value			Annual Cash Flow 8% Discount Rate
Category	8% Discount Rate	7% Discount Rate	9% Discount Rate	
With "Prevent Erosion" Project				
Form #3 - Beaches at Nassau County	*$7,818,712*	*$8,755,851*	*$7,058,030*	*$639,124*
"With Project" Condition (Alternatives 2,5,& 8)				
Form #1 - Beaches at Long Beach, Day Pass Visitors	*$5,305,849*	*$5,940,855*	*$4,790,341*	*$433,715*
Form #1 - Beaches at Long Beach, Season Pass Visitors	*$2,286,917*	*$2,561,024*	*$2,064,423*	*$186,939*
Form #2 - Beaches at Point Lookout	*$3,871,989*	*$4,336,079*	*$3,495,283*	*$316,507*
Total "With Project" Condition	***$11,464,755***	***$12,837,958***	***$10,350,047***	***$937,161***
Incremental Benefits **With "Alternative" Project** (Alternatives 3,6,& 9)				
Form #1 - Beaches at Long Beach, Day Pass Visitors	*$284,976*	*$319,073*	*$257,295*	*$23,295*
Form #1 - Beaches at Long Beach, Season Pass Visitors	*$501,287*	*$561,371*	*$452,517*	*$40,977*
Form #2 - Beaches at Point Lookout	*$576,118*	*$645,170*	*$520,067*	*$47,094*
Form #3 - Beaches at Nassau and Lido (increase in visitation with increase taken at Long Beach and Point Lookout + "switchers" to Long Beach and Point Lookout	*$3,634,834*	*$4,070,500*	*$3,281,202*	*$297,122*
Total Incremental With "Alternative" Project	***$4,997,215***	***$5,596,144***	***$4,511,081***	***$408,488***

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SUMMARY OF DAMAGE AND BENEFITS

Damages

Average annual damages were calculated over the life of the project for the nine improvement alternatives as well as for the without project condition. A summary of the equivalent annual without project damages for each of the six reaches analyzed is provided in Table D-24. The largest cause of building damage, representing approximately 57% of the critical damage, is widespread flooding due to the combined impacts of high ocean surges, waves overtopping berms and dunes, and elevated stages in the channels and bays to the north of the island. Inundation drainage is expected to become progressively more widespread in response to continued loss of dune stability and an expected rise in sea level. The second most widespread cause of damage, representing approximately 35% of the critical damage, is undermining of structures due to shoreline recession during storms. The severe damages caused by such undermining is expected to worsen in future years as protective beaches are narrowed by erosion, exposing upland structures to more frequent damage. Damage from the wave impact is the least widespread though most severe cause of damage. Representing approximately 15% of the critical damage, wave impacts may be due to either waves breaking directly on the structure or the uprush on runup associated with broken waves. It is important to re-emphasize that the sum of damages from the various causes exceeds the 'critical' damage due to the potential for some structures to suffer damage from multiple causes, for example, a flooded structure suffering wave damage.

Under with project conditions the various alternatives will reduce the potential for storm damage. Each of the major project components; widening the beach, ensuring a stable dune line, and continued periodic nourishment, address the specific causes of storm damage, such as inadequate protective beach, or waves overtopping the beach and dune. The analysis of damages for each alternative included adjustments in physical damage parameters including:

- Long-term Erosion;
- Structure Setback;
- Storm Recession;
- Wave Runup;
- Dune Height;
- Dune Stability; and
- Wave Overtopping.

TABLE D-24
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH, NY
SUMMARY OF EQUIVALENT ANNUAL DAMAGES
MAXIMUM/CRITICAL DAMAGE
W/O PROJECT CONDITIONS

DAMAGE TO EXISTING STRUCTURES	REACH 1	2	3	4	5	6	TOTAL
RESIDENTIAL STRUCTURES							
PHYSICAL	$982,700	$25,630	$9,077,300	$2,514,730	$745,030	$1,425,310	$14,770,700
EMERGENCY	$57,480	$1,250	$538,690	$158,540	$36,120	$78,840	$869,120
COMMERCIAL STRUCTURES							
PHYSICAL	$236,780	$70,800	$2,840,520	$228,870	$149,740	$739,700	$4,266,410
EMERGENCY	$4,720	$1,170	$53,710	$3,450	$2,490	$10,160	$75,700
OTHER STRUCTURES							
PHYSICAL	$72,520	$4,290	$703,230	$6,490	$4,040	$19,820	$810,390
EMERGENCY	$1,270	$210	$11,020	$100	$1,860	$280	$14,740
SUBTOTAL	$1,355,470	$103,350	$13,222,870	$2,912,180	$939,280	$2,274,110	$20,807,060
DAMAGE TO INFRASTRUCTURE							
INFRASTRUCTURE DAMAGE	$0	$0	$69,500	$84,010	$0	$0	$153,510
BOARDWALK/ACCESS RAMPS	$0	$0	$17,400	$0	$0	$12,400	$29,800
SUBTOTAL	$0	$0	$86,900	$84,010	$0	$12,400	$183,310
PUBLIC EMERGENCY COSTS							
EMERGENCY PROTECTION	$1,491	$114	$14,545	$3,203	$1,033	$2,502	$22,888
SAND/DEBRIS REMOVAL	$8,800	$5,100	$11,000	$3,400	$3,000	$8,100	$39,400
SUBTOTAL	$10,291	$5,214	$25,545	$6,603	$4,033	$10,602	$62,288
FUTURE PROTECTION COSTS							
SECTION 933 COSTS	$400,000	$0	$0	$0	$0	$0	$400,000
EXIST. STRUC. PROTECTION	$590	$0	$270	$0	$110	$0	$970
SUBTOTAL	$400,590	$0	$270	$0	$110	$0	$400,970
LOSS OF LAND	$490	$0	$0	$0	$950	$0	$1,440
							TOTAL
TOTAL DAMAGE	$1,766,841	$108,564	$13,335,385	$3,002,793	$944,373	$2,297,112	$21,455,068

A summary of with project damage is shown in Table D-25. This table does not reflect any improvements in the Village of Atlantic Beach (Reach 6). Damages in this reach, however, reflect prevention of long-term shoreline erosion based on the impact of project nourishment in eliminating any material deficit in the littoral system. Although no designed protection is included for this reach, the project will prevent any ongoing loss of protective beach.

Benefits

Benefits for each alternative are simply the difference in storm damage and other economic outputs with and without the project. Table D-26 provides a summary of benefits for each alternative considered.

BENEFIT COST COMPARISON

Table D-27 is a matrix presenting annual costs and benefits for the nine different design alternatives. The plans consist of the placement of fill for two berm widths — 110 feet and 160 feet, and a no-berm condition; and the construction of a 15-foot NGVD or 17-foot NGVD dune or no-dune. To determine the optimum alternative, net excess benefits were calculated. The alternative that maximizes the net excess benefits is the optimum plan. Alternative 5, a 110-foot wide berm with a 15-foot NGVD dune provided the greatest net excess benefits. Since the purpose of this project is to provide damage reduction, annual costs have also been compared to storm benefits, which exclude benefits associated with recreation. Alternative 5 also provided the maximum storm damage reduction benefits.

Identification of the NED Plan

As seen in Table D-27, the plan providing the largest amount of storm damage reduction benefits in excess of costs has been identified as a berm width of 110 feet with a 15 feet NGVD dune. This plan, designated as the NED plan, is consistent with project planning objectives.

TABLE D-25

EAST ROCKAWAY INLET TO
JONES INLET, LONG BEACH, NY
SUMMARY OF DAMAGES BY ALTERNATIVE
INTEREST RATE= 8.00%

DAMAGE TO EXISTING STRUCTURES	ALTERNATIVE 1	2	3	4	5	6	7	8	9
RESIDENTIAL STRUCTURES									
PHYSICAL	$12,038,770	$9,099,020	$9,026,300	$5,824,390	$4,681,860	$4,638,280	$5,740,070	$4,503,370	$4,502,650
EMERGENCY	$678,300	$617,010	$611,690	$377,840	$310,830	$307,660	$373,610	$302,760	$302,700
COMMERCIAL STRUCTURES									
PHYSICAL	$3,283,020	$2,195,150	$2,184,740	$1,498,240	$905,380	$899,850	$1,434,020	$881,850	$882,090
EMERGENCY	$81,610	$50,820	$50,760	$28,920	$20,280	$20,220	$29,660	$18,750	$18,750
OTHER STRUCTURES									
PHYSICAL	$580,390	$230,790	$228,380	$118,150	$85,660	$85,250	$118,100	$84,400	$84,200
EMERGENCY	$12,020	$11,770	$11,850	$4,410	$3,390	$3,380	$4,410	$3,120	$3,120
SUBTOTAL	$16,674,670	$12,104,560	$12,011,720	$7,848,650	$6,007,400	$5,954,750	$7,697,890	$5,796,330	$5,794,410
DAMAGE TO INFRASTRUCTURE									
INFRASTRUCTURE DAMAGE	$26,822	$992	$978	$5,086	$782	$200	$4,910	$229	$203
BOARDWALK/ACCESS RAMPS	$29,800	$26,500	$26,500	$28,700	$25,400	$25,400	$28,700	$25,400	$25,400
SUBTOTAL	$56,322	$27,492	$27,478	$33,786	$26,182	$25,600	$33,610	$25,629	$25,603
PUBLIC EMERGENCY COSTS									
EMERGENCY PROTECTION	$18,342	$13,318	$13,213	$9,634	$6,606	$6,550	$9,468	$6,378	$6,374
SAND/DEBRIS REMOVAL	$39,400	$10,700	$10,600	$38,400	$11,200	$11,100	$38,400	$13,200	$13,200
SUBTOTAL	$57,742	$24,018	$23,813	$48,034	$17,806	$17,650	$47,868	$19,578	$19,574
FUTURE PROTECTION COSTS									
SECTION 933 COSTS	$0	$0	$0	$0	$0	$0	$0	$0	$0
EXIST. STRUC. PROTECTION	$0	$0	$0	$0	$0	$0	$0	$0	$0
SUBTOTAL	$0	$0	$0	$0	$0	$0	$0	$0	$0
TOTAL DAMAGES	$16,790,734	$12,156,067	$12,063,011	$7,930,470	$6,051,370	$5,998,000	$7,779,368	$5,840,534	$5,839,587

TABLE D-26

EAST ROCKAWAY INLET TO
JONES INLET, LONG BEACH, NY
SUMMARY OF BENEFITS BY ALTERNATIVE
INTEREST RATE= 8.00%

REDUCED DAMAGE TO EXISTING STRUCTURES	ALTERNATIVE 1	2	3	4	5	6	7	8	9
RESIDENTIAL STRUCTURES									
PHYSICAL	$2,711,030	$5,671,680	$5,744,400	$8,948,310	$10,088,840	$10,132,410	$9,030,630	$10,267,330	$10,288,150
EMERGENCY	$190,780	$352,110	$387,830	$491,580	$550,490	$581,460	$495,810	$588,340	$588,420
COMMERCIAL STRUCTURES									
PHYSICAL	$982,890	$2,071,200	$2,081,870	$2,770,170	$3,361,030	$3,366,460	$2,832,390	$3,384,580	$3,384,320
EMERGENCY	$14,080	$24,880	$24,840	$45,780	$55,420	$55,480	$44,020	$55,950	$55,950
OTHER STRUCTURES									
PHYSICAL	$230,000	$579,600	$584,010	$694,240	$724,530	$725,140	$694,280	$725,930	$726,180
EMERGENCY	$2,720	$2,970	$2,790	$10,330	$11,350	$11,360	$10,330	$11,620	$11,620
SUBTOTAL	$4,132,390	$8,702,500	$8,785,340	$12,958,410	$14,789,660	$14,852,310	$13,108,170	$15,011,730	$15,012,650
REDUCED DAMAGE TO INFRASTRUCTURE									
INFRASTRUCTURE DAMAGE	$124,990	$152,520	$152,530	$148,420	$182,750	$183,310	$148,600	$183,280	$183,310
BOARDWALK/ACCESS RAMPS	$0	$3,300	$3,300	$1,100	$4,400	$4,400	$1,100	$4,400	$4,400
SUBTOTAL	$124,990	$155,820	$155,830	$149,520	$187,150	$187,710	$149,700	$187,680	$187,710
PUBLIC EMERGENCY REDUCED COSTS									
EMERGENCY PROTECTION	$4,550	$9,570	$9,670	$14,250	$16,280	$16,340	$14,420	$16,510	$16,510
SAND/DEBRIS REMOVAL	$0	$28,700	$28,800	$0	$28,200	$28,300	$0	$26,200	$26,200
SUBTOTAL	$4,550	$38,270	$38,470	$14,250	$44,480	$44,640	$14,420	$42,710	$42,710
FUTURE PROTECTION COSTS FORGONE									
SECTION 933 COSTS	$400,000	$400,000	$400,000	$400,000	$400,000	$400,000	$400,000	$400,000	$400,000
EXIST. STRUC. PROTECTION	$970	$970	$970	$970	$970	$970	$970	$970	$970
SUBTOTAL	$400,970	$400,970	$400,970	$400,970	$400,970	$400,970	$400,970	$400,970	$400,970
RECREATION BENEFITS									
RECREATION ENHANCEMENT	$0	$937,160	$1,345,650	$0	$937,160	$1,345,650	$0	$937,160	$1,345,650
RECREATION MAINTENANCE	$639,120	$639,120	$639,120	$639,120	$639,120	$639,120	$639,120	$639,120	$639,120
SUBTOTAL	$639,120	$1,576,280	$1,984,770	$639,120	$1,576,280	$1,984,770	$639,120	$1,576,280	$1,984,770
LOSS OF LAND BENEFITS									
LOSS OF LAND	$1,440	$1,440	$1,440	$1,440	$1,440	$1,440	$1,440	$1,440	$1,440
TOTAL BENEFITS	$5,303,460	$10,875,280	$11,376,820	$14,163,710	$16,979,960	$17,441,640	$14,314,820	$17,190,810	$17,600,250

TABLE D-27 LONG BEACH FEASIBILITY STUDY BENEFIT/COST MATRIX				
		EXISTING BERM	110 FT BERM	160 FT BERM
		ALT.1	ALT.2	ALT.3
NO DUNE	TOTAL BENEFITS	$5,303,460	$10,875,000	$11,377,000
	STORM BENEFITS	$4,664,000	$9,299,000	$9,392,000
	ANNUAL COST	$8,817,100	$8,756,500	$8,444,300
	BCR	0.6	1.2	1.3
	NET BENEFITS	($3,513,640)	$2,118,500	$2,932,700
	NET STORM BENEF	($4,153,100)	$542,500	$947,700
		ALT.4	ALT.5	ALT.6
+15 FT NGVD DUNE HT.	TOTAL BENEFITS	$14,164,000	$16,980,000	$17,442,000
	STORM BENEFITS	$13,525,000	$15,404,000	$15,457,000
	ANNUAL COST	$9,524,800	$8,954,000	$9,428,300
	BCR	1.5	1.9	1.8
	NET BENEFITS	$4,639,200	$8,026,000	$8,013,700
	NET STORM BENEF	$4,000,200	$6,450,000	$6,028,700
		ALT.7	ALT.8	ALT.9
+17 FT NGVD DUNE HT.	TOTAL BENEFITS	$14,315,000	$17,191,000	$17,600,000
	STORM BENEFITS	$13,676,000	$15,615,000	$15,615,000
	ANNUAL COST	$9,946,600	$9,361,200	$10,012,100
	BCR	1.4	1.8	1.8
	NET BENEFITS	$4,368,400	$7,829,800	$7,587,900
	NET STORM BENEF	$3,729,400	$6,253,800	$5,602,900

NOTE: Annual costs from USACOE update of 2-23-95.

ECONOMICS OF THE NED PLAN

Plan Description

The NED plan for shore protection of Long Beach Island from Jones Inlet to East Rockaway Inlet calls for the placement of beach fill to provide a 110-foot berm width in conjunction with a 15-foot NGVD dune. Project costs are $8,954,000 annually for the 50-year life of the project.

Benefits

The NED plan will provide $16,980,000 in annual benefits over a project life of 50 years with annual net excess benefits of $8,026,000.

Of the total benefits, $15,400,000 are attributable to the project's damage prevention accomplishments and $1,580,000 are attributable to the maintenance and enhancement of recreation opportunities. The damage prevention benefits include $15,000,000 in reduced storm damage and emergency costs for physical structures such as buildings and roads, and $401,000 in reduced future protection costs.

The recreation benefits include $639,000 for maintaining the existing beaches and $937,000 for enhanced recreation opportunities.

Sensitivity Analysis

In evaluating the benefits and costs of any project there are often uncertainties which may affect project justification. In order to evaluate the impact of these uncertainties on the BCR, sensitivity analyses were performed to quantify a range of possible results. Two elements of significant uncertainty, overwash flood depths and interest rate, were selected for analysis.

While the convergence of multiple forces create many uncertainties in the dynamic coastal environment, inundation has been determined as the most widespread cause of damage on Long Beach Island, thus reducing the impact of uncertainties associated with wave attack and recession. In order to more accurately reflect documented flood marks, the economic analysis has assumed that in some cases near-shore flood depths can exceed still water ocean stages as a result of wave runup. While such extensive flooding is well documented in video and still photographs, these flood depths are potentially transient and may not fully saturate the building and contents. To evaluate the sensitivity of using the runup depth, the impact of more limited flood depths on the storm damage analysis was evaluated. This sensitivity analysis limited maximum flood stages to the still water ocean flood level, which is considered to be an extreme lower limit of potential flooding.

This alternative flooding analysis reduced the without project damage estimates $3,338,000 annually, while only reducing the with project damages $266,000 annually. As seen in Table D-28, this significant change in the analysis procedure still results in a strongly positive BCR.

TABLE D-28

EAST ROCKAWAY INLET TO JONES INLET, LONG BEACH, NEW YORK

FLOOD DEPTH SENSITIVITY OF SELECTED PLAN (ALTERNATIVE 5)

	Selected Flood Depth Analysis	Alternative Flood Depth Analysis
Benefits	$16,980,000	$13,908,220
Storm Benefits	$15,404,000	$12,331,940
Costs	**$8,954,000**	**$8,954,000**
BCR	1.9	1.6
Net Benefits	$8,026,000	$4,954,220
Net Storm Benefits	$6,450,000	$3,377,940

The sensitivity analysis also considered uncertainty with regard to future interest rates. In addition to the FY 94 annual discount rate of 8%, annual rates of 7% and 9% were considered. As seen in Table D-29, this analysis indicated that fluctuations in interest rates will not impact project justification.

TABLE D-29 EAST ROCKAWAY INLET TO JONES INLET, LONG BEACH, NEW YORK INTEREST RATE SENSITIVITY OF SELECTED PLAN (ALTERNATIVE 5)			
Interest Rate	**7.00%**	**8.00%**	**9.00%**
Benefits	$17,354,860	$16,980,000	$16,650,190
Storm Benefits	$15,790,180	$15,404,000	$15,062,110
Costs	$8,229,700	$8,954,000	$9,705,000
BCR	2.1	1.9	1.7
Net Benefits	$9,125,160	$8,026,000	$6,945,190
Net Storm Benefits	$7,560,480	$6,450,000	$5,357,110

Residual Damages

Residual storm damages for the 110-foot wide berm, 15-foot NGVD dune will average $6,051,000 million annually. Since the project would not mitigate residual flooding from Reynolds Channel, approximately 75% of residual damage is caused by inundation. Table D-30 presents the damage summary by reach for the NED Plan. Sub-appendix D8 presents the with project storm frequency vs damage for the selected plan.

One source of the high residual damage is the approximately $1.7 million in damage in the incorporated village of Atlantic Beach. This damage is not mitigated since protection for this area is not included in the selected plan.

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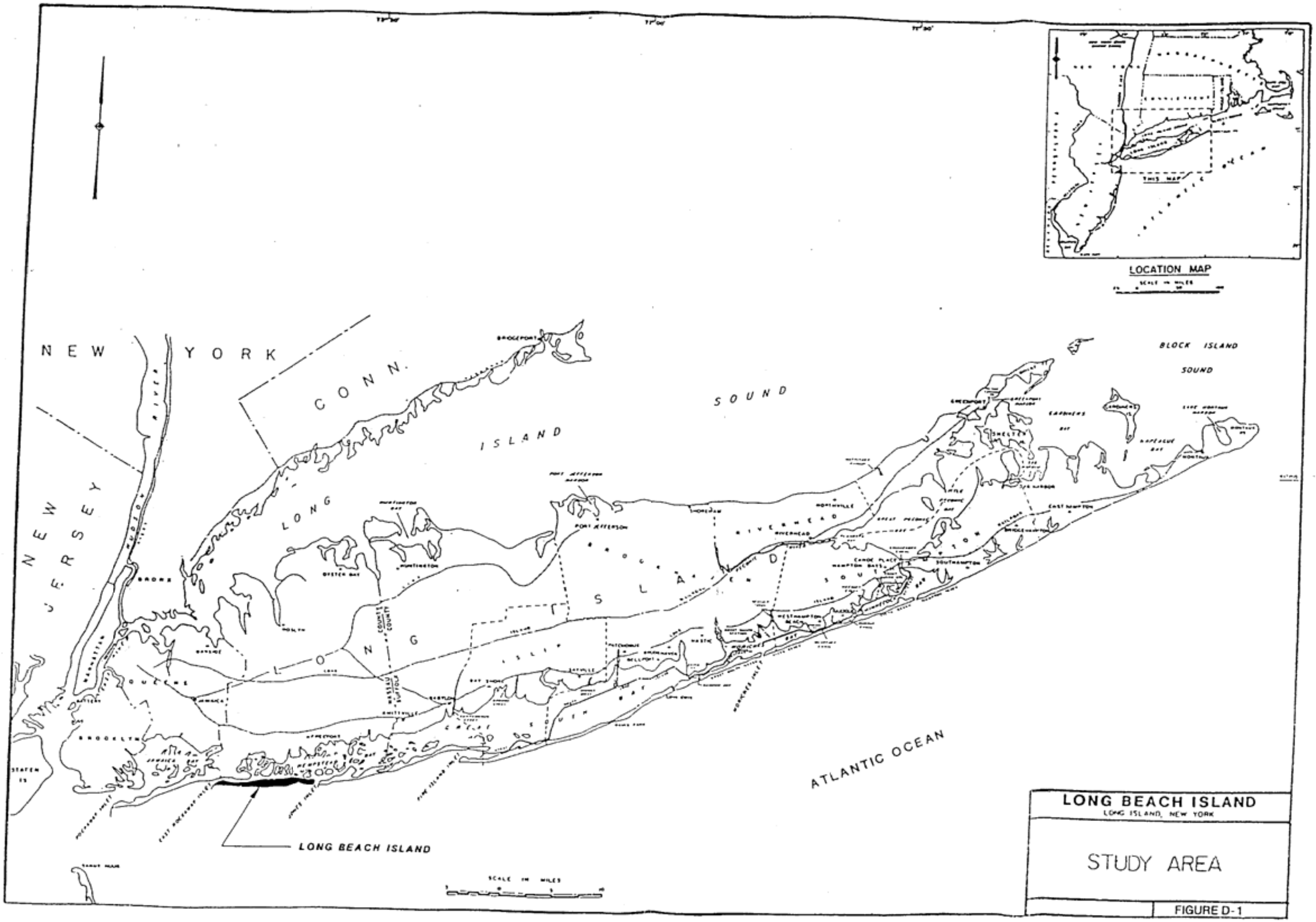
TABLE 3D

JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH, NY
SUMMARY OF EQUIVALENT ANNUAL DAMAGES
MAXIMUM/CRITICAL DAMAGE
NED PLAN (ALTERNATIVE 5) CONDITIONS

DAMAGE TO EXISTING STRUCTURES	REACH 1	2	3	4	5	6	TOTAL
RESIDENTIAL STRUCTURES							
PHYSICAL	$502,090	$25,810	$2,094,480	$641,890	$239,330	$1,178,480	$4,681,860
EMERGENCY	$32,020	$1,220	$148,610	$51,910	$12,550	$66,320	$310,830
COMMERCIAL STRUCTURES							
PHYSICAL	$65,150	$24,100	$317,370	$59,350	$38,850	$404,560	$909,380
EMERGENCY	$2,170	$670	$9,100	$1,310	$700	$6,330	$20,280
OTHER STRUCTURES							
PHYSICAL	$26,450	$4,290	$36,710	$2,580	$960	$14,870	$85,860
EMERGENCY	$310	$210	$2,210	$50	$390	$220	$3,390
SUBTOTAL	$628,190	$56,100	$2,608,480	$758,090	$289,780	$1,670,780	$6,007,400
DAMAGE TO INFRASTRUCTURE							
INFRASTRUCTURE DAMAGE	$0	$0	$25	$737	$0	$0	$762
BOARDWALK/ACCESS RAMPS	$0	$0	$13,000	$0	$0	$12,400	$25,400
SUBTOTAL	$0	$0	$13,025	$737	$0	$12,400	$26,162
PUBLIC EMERGENCY COSTS							
EMERGENCY PROTECTION	$691	$62	$2,067	$832	$310	$1,838	$9,606
SAND/DEBRIS REMOVAL	$900	$500	$1,100	$300	$300	$8,100	$11,200
SUBTOTAL	$1,591	$562	$3,167	$1,132	$610	$9,938	$17,806
FUTURE PROTECTION COSTS							
SECTION 933 COSTS	$0	$0	$0	$0	$0	$0	$0
EXIST. STRUC. PROTECTION	$0	$0	$0	$0	$0	$0	$0
SUBTOTAL	$0	$0	$0	$0	$0	$0	$0
TOTAL DAMAGE	$629,781	$56,662	$2,623,452	$757,959	$290,390	$1,693,118	$6,051,370

15-Jul-94



LONG BEACH ISLAND
LONG ISLAND, NEW YORK

STUDY AREA

FIGURE D-1

COMBINED DAMAGE CALCULATION FLOW NET

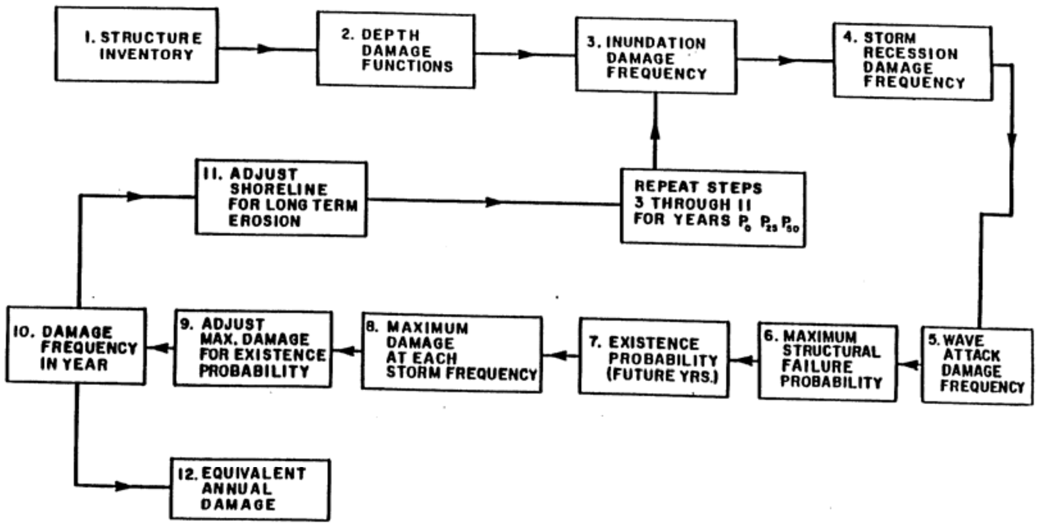
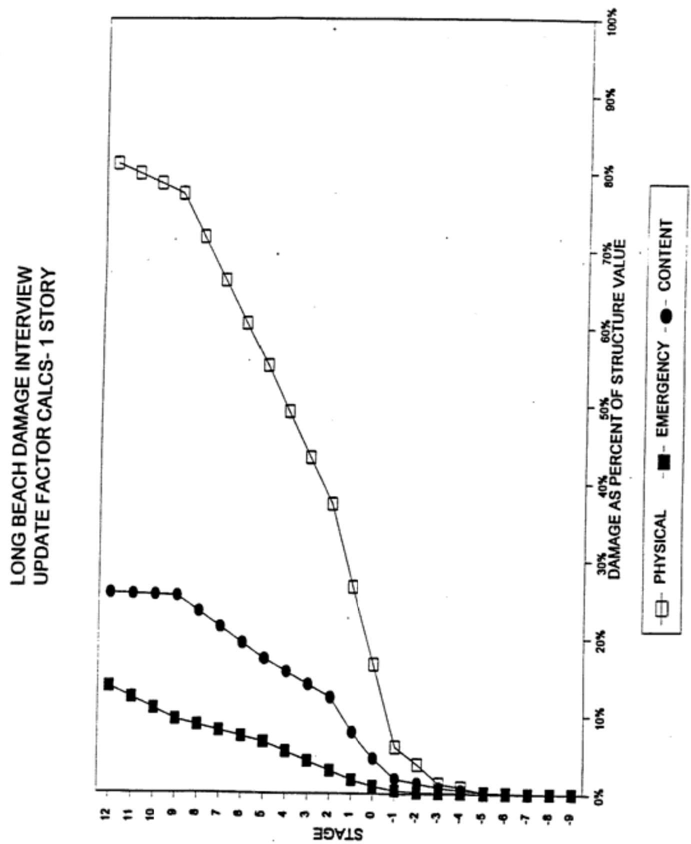


FIGURE D-2



LONG BEACH DAMAGE INTERVIEW
UPDATE FACTOR CALCS- 1 STORY
STAGE
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
DAMAGE AS PERCENT OF STRUCTURE VALUE
PHYSICAL
EMERGENCY
CONTENT

FIGURE D-3

LONG BEACH DAMAGE INTERVIEW
UPDATE FACTOR CALCS- SPLIT LEVEL

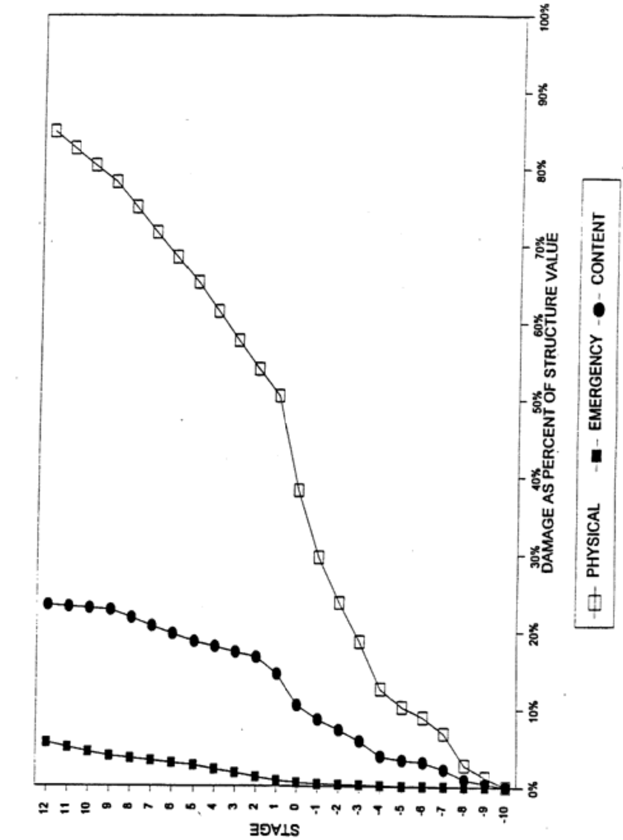


FIGURE D-4

LONG BEACH DAMAGE INTERVIEW
UPDATE FACTOR CALCS- MULTI-STORY

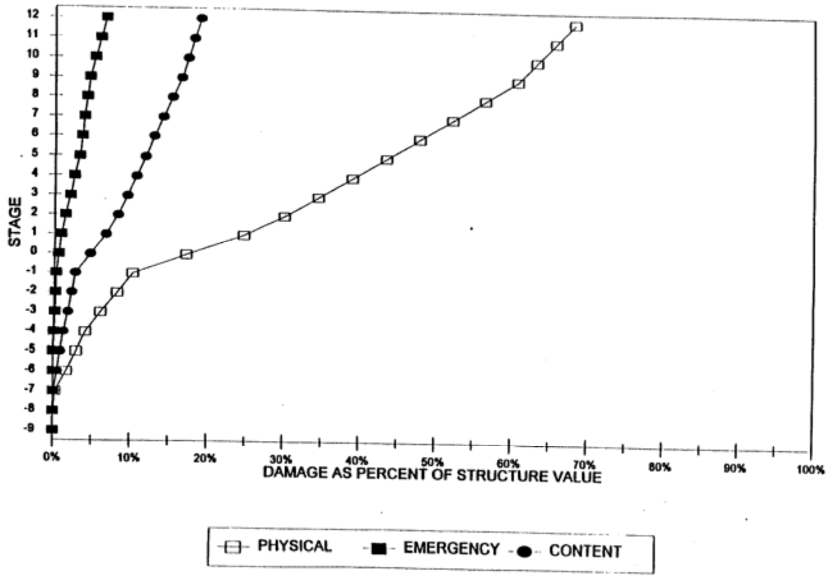
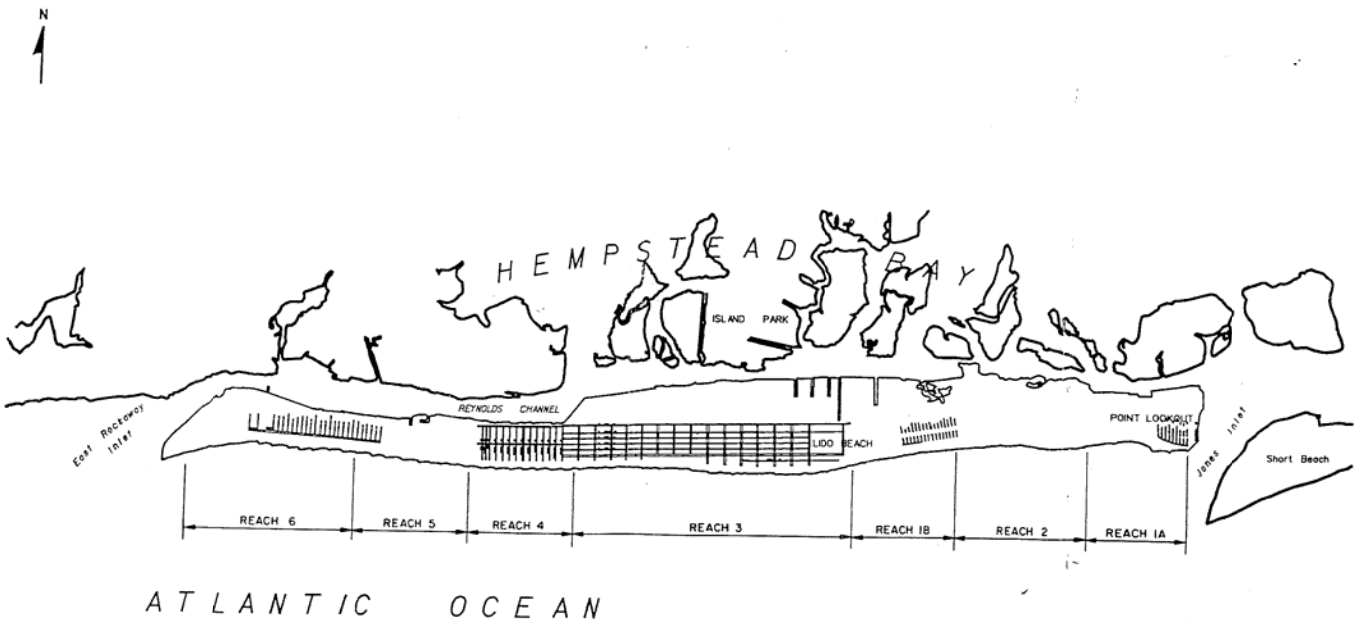


FIGURE D-5



LONG BEACH ISLAND
LONG ISLAND, NEW YORK

ECONOMIC REACHES

SCALE: NONE

FIGURE D-6

SAMPLE TOTAL RECESSION DAMAGE VS STORM FREQUENCY

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.

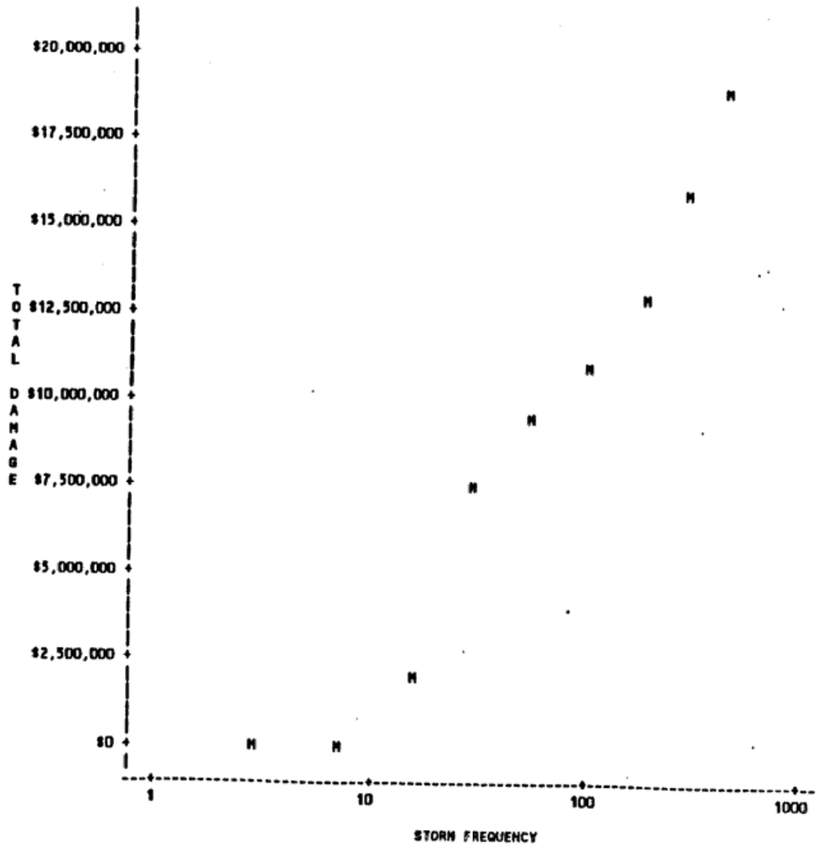


FIGURE D-7

SAMPLE TOTAL INUNDATION DAMAGE VS STORM FREQUENCY

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.

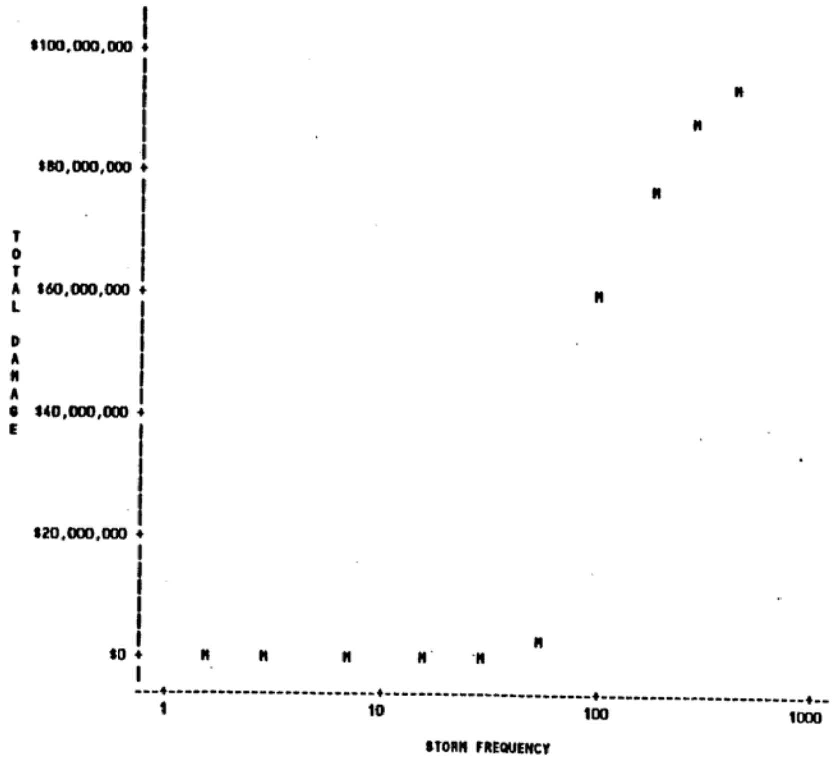


FIGURE D-8

FORCES ON A VERTICAL WALL

DUE TO A BREAKING WAVE

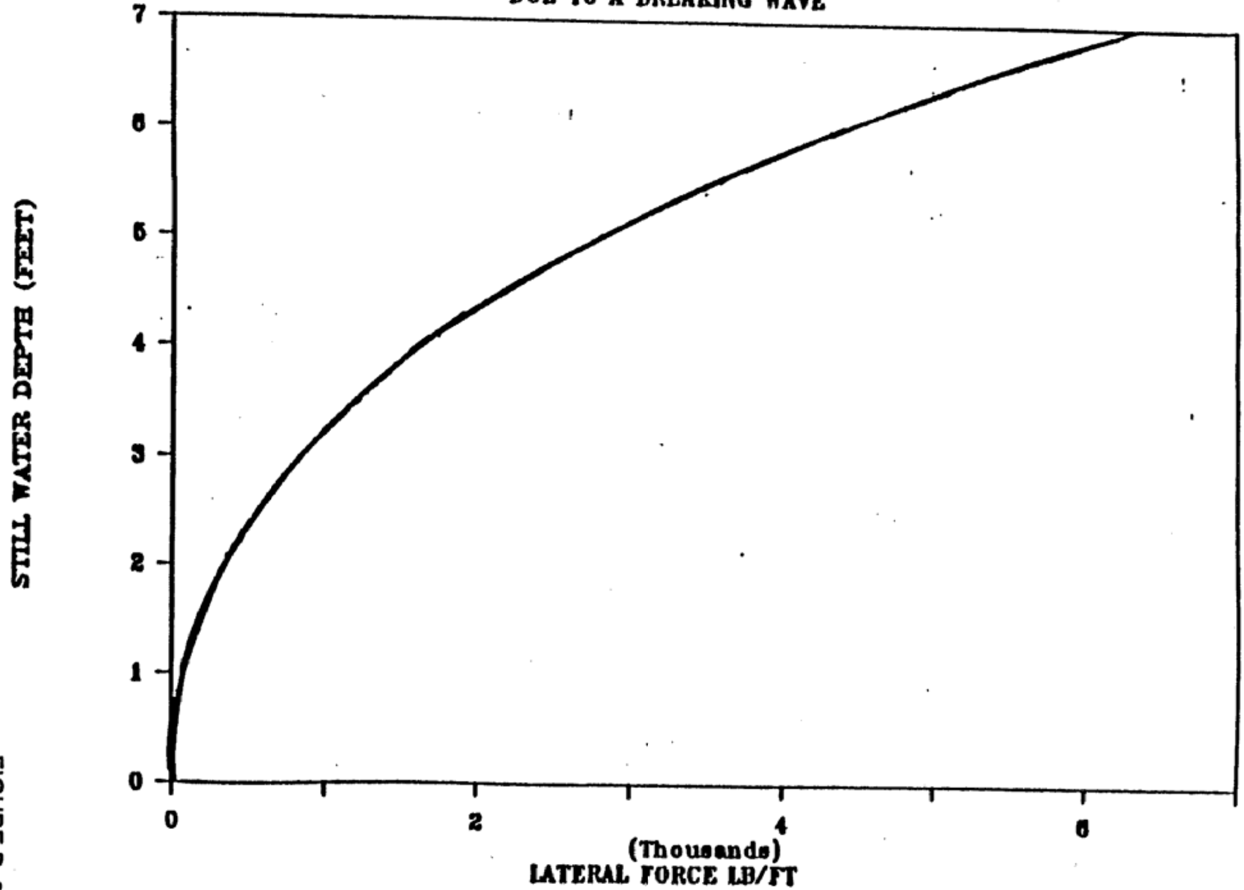
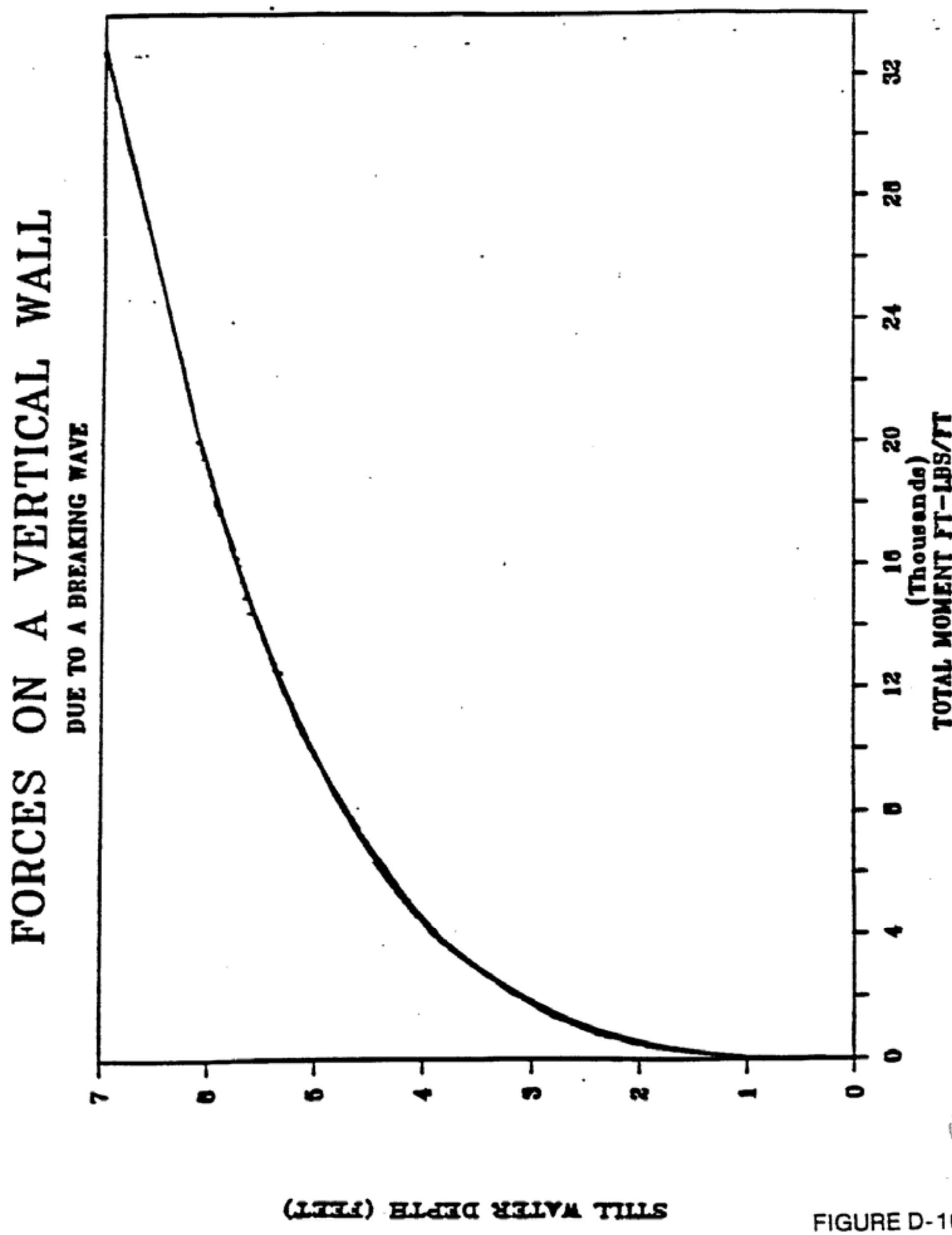


FIGURE D-9



FORCES ON A VERTICAL WALL
DUE TO A BREAKING WAVE
STILL WATER DEPTH (FEET)
0
1
2
3
4
5
6
7
(Thousands)
TOTAL MOMENT FT-LBS/FT
0
4
8
12
16
20
24
28
32

FIGURE D-10

SAMPLE TOTAL WAVE ATTACK DAMAGE VS STORM FREQUENCY

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.

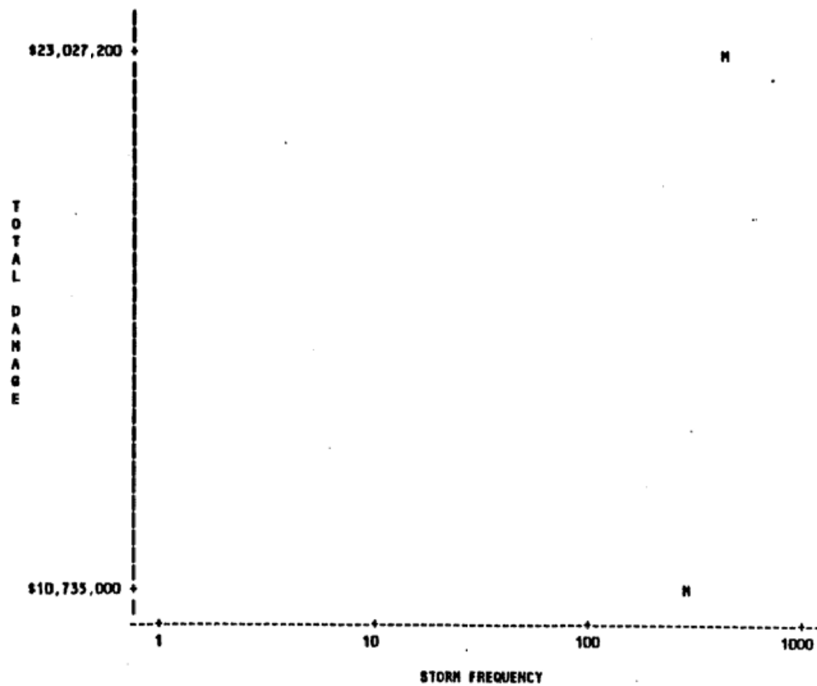


FIGURE D-11

SCHEMATIC OF WAVE RUNUP

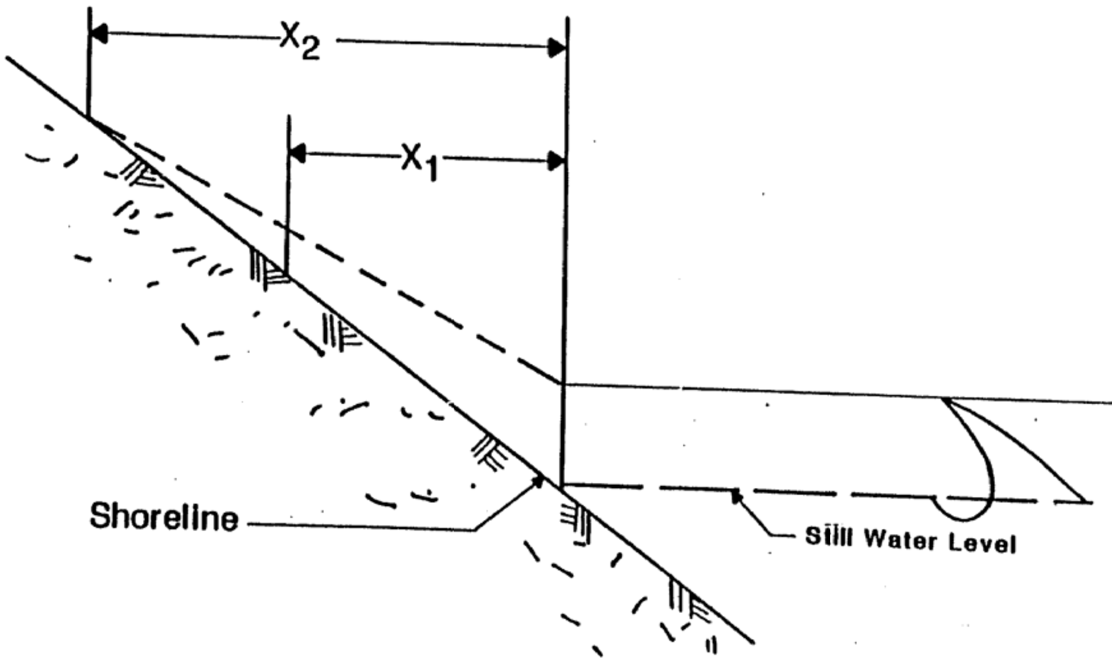


FIGURE D-12

SAMPLE TOTAL WAVE RUNUP DAMAGE VS STORM FREQUENCY

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.

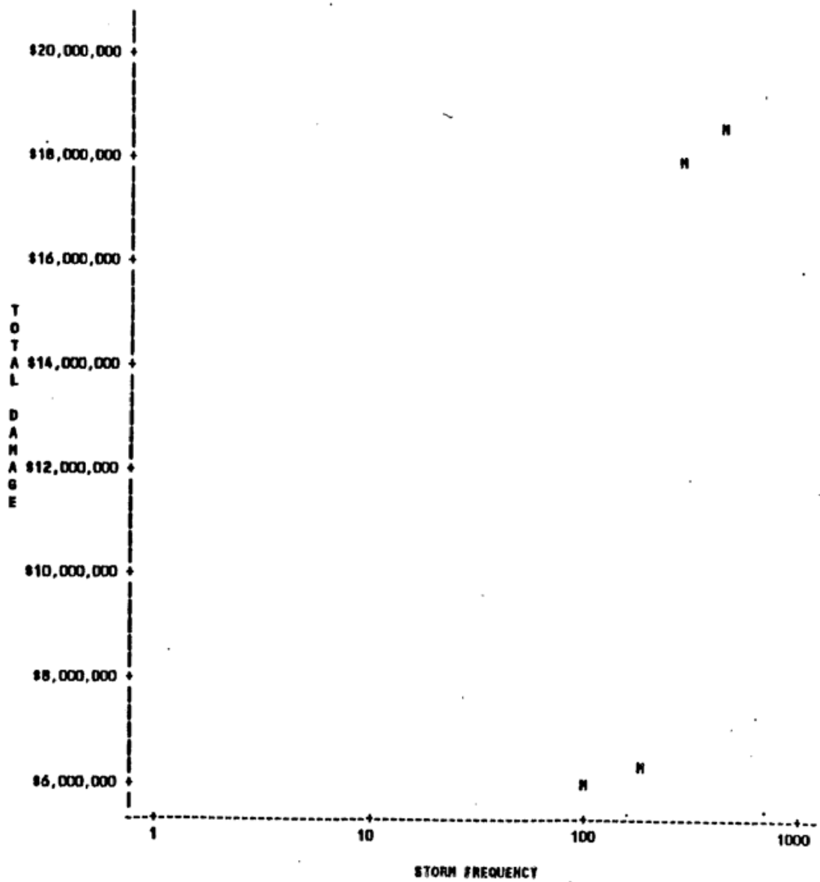
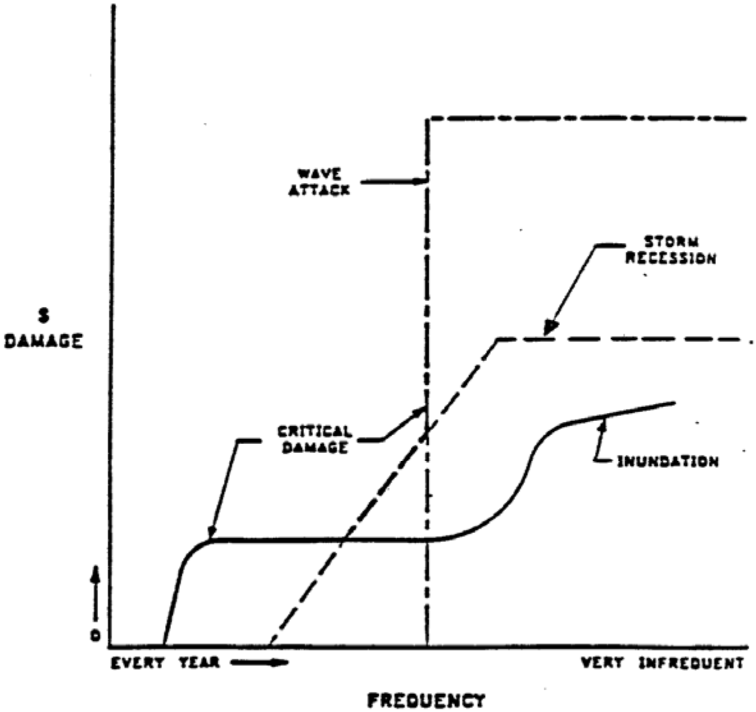


FIGURE D-13



SCHEMATIC OF CRITICAL DAMAGE ANALYSIS

FIGURE D-14

SAMPLE TOTAL WAVE ATTACK DAMAGE VS STORM FREQUENCY

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.

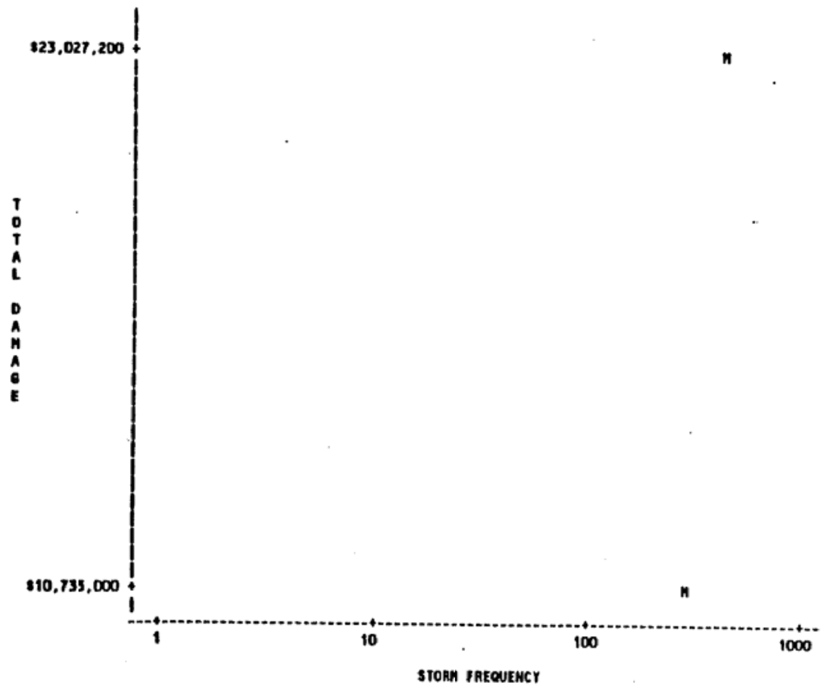


FIGURE D-11

SCHEMATIC OF WAVE RUNUP

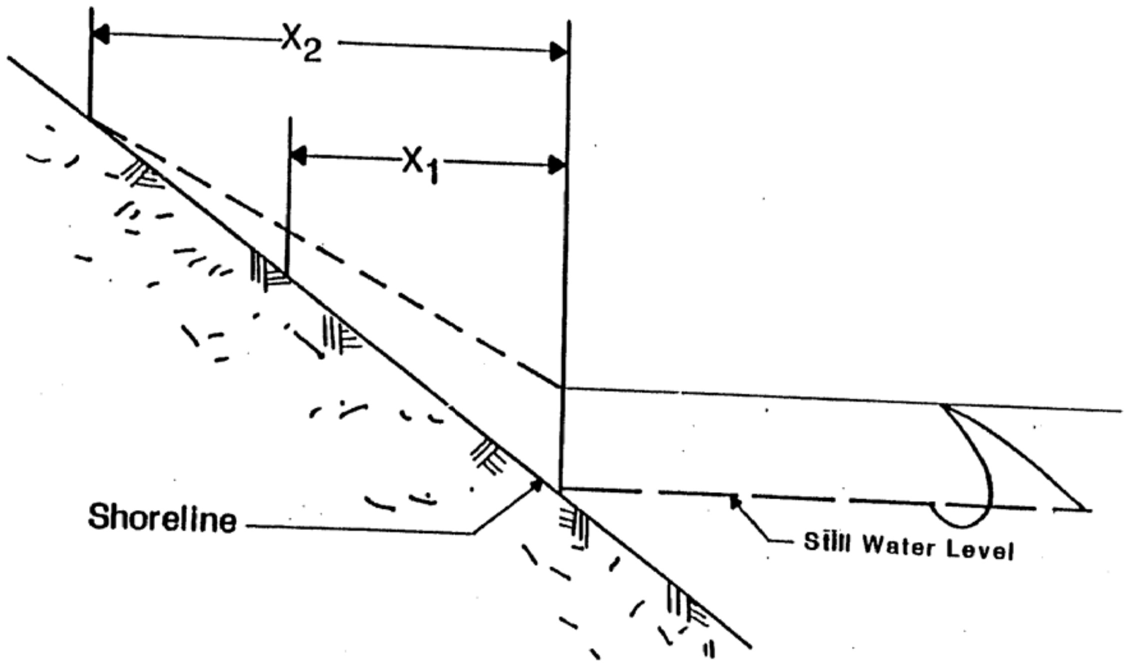


FIGURE D-12

SAMPLE TOTAL MAXIMUM DAMAGE VS STORM FREQUENCY

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.

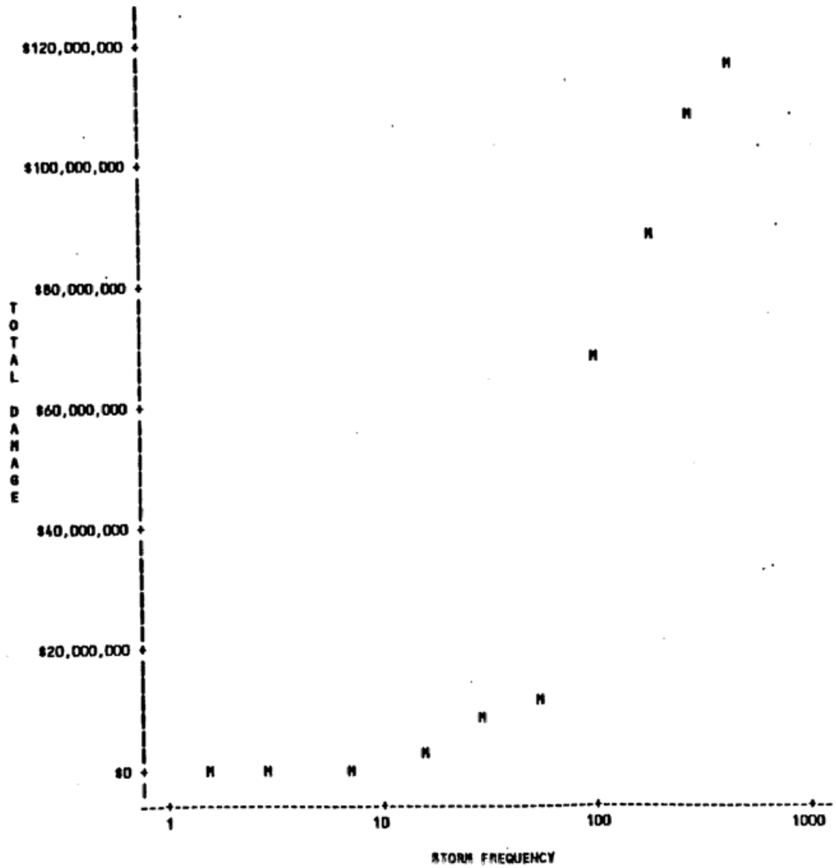


FIGURE D-15

SUB-APPENDIX D1

Without Project Storm Frequency vs Storm Recession Damage

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

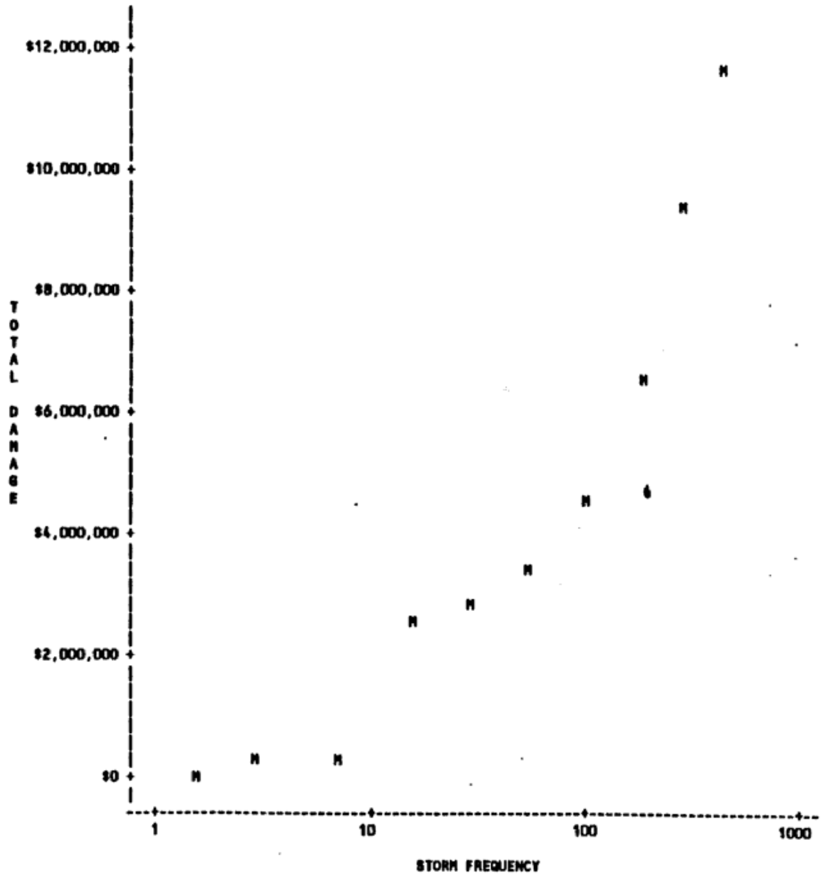
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	$84,900	$7,500	$1,000	$85,900
3	3.0	$154,500	$9,500	$1,700	$156,200
4	7.0	$296,300	$13,500	$3,300	$299,600
5	16.0	$448,100	$20,100	$5,200	$453,300
6	30.0	$599,400	$34,200	$7,500	$606,900
7	56.0	$712,900	$40,000	$9,200	$722,100
8	100.0	$889,100	$45,000	$11,100	$900,200
9	179.0	$1,127,500	$51,800	$13,800	$1,141,300
10	294.0	$1,257,500	$55,900	$15,400	$1,272,900
11	455.0	$1,341,600	$58,300	$16,400	$1,358,000

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	$1,984,100	$516,200	$99,400	$2,083,500
17	30.0	$2,231,400	$582,800	$110,400	$2,341,800
18	56.0	$2,640,300	$693,600	$134,000	$2,774,300
19	100.0	$3,554,900	$929,800	$184,000	$3,738,900
20	179.0	$5,221,100	$1,305,000	$273,200	$5,494,300
21	294.0	$7,847,300	$1,983,300	$418,900	$8,266,200
22	455.0	$9,930,100	$2,505,100	$526,600	$10,456,700

LONG BEACH, NY FEASIBILI. (UDY
REACH 1 - BASE YEAR CONDITIONS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILI). .TUDY
REACH 2 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	$38,600	$1,100	$400	$39,000
5	16.0	$134,600	$3,800	$1,400	$136,000
6	30.0	$248,900	$7,100	$2,700	$251,600
7	56.0	$383,600	$10,900	$4,100	$387,700
8	100.0	$505,200	$14,400	$5,400	$510,600
9	179.0	$609,900	$17,400	$6,600	$616,500
10	294.0	$713,300	$20,300	$7,700	$721,000
11	455.0	$794,600	$23,200	$8,600	$803,200

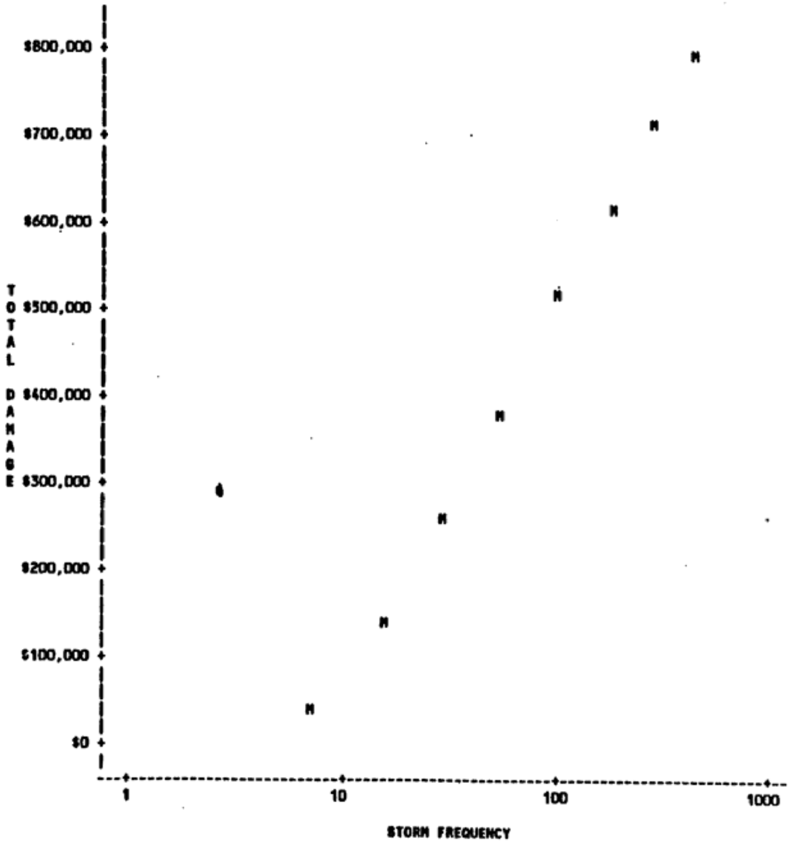
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILIT, STUDY
REACH 2 - BASE YEAR CONDITIONS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

15:37 Tuesday, July 5, 1994 3

Plot of TOTAL*STORM. Symbol used is 'N'.



NOTE: 3 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	$1,023,500	$105,500	$8,000	$1,031,500
3	3.0	$1,066,800	$183,600	$8,500	$1,075,300
4	7.0	$1,852,600	$396,200	$12,500	$1,865,100
5	16.0	$1,911,800	$587,800	$17,400	$1,929,200
6	30.0	$2,254,500	$909,600	$25,300	$2,279,800
7	56.0	$2,479,600	$1,147,000	$31,300	$2,510,900
8	100.0	$2,697,300	$1,304,000	$36,100	$2,733,400
9	179.0	$2,961,800	$1,441,500	$40,100	$3,001,900
10	294.0	$3,241,900	$1,506,300	$41,700	$3,283,600
11	455.0	$3,416,100	$1,529,800	$42,200	$3,458,300

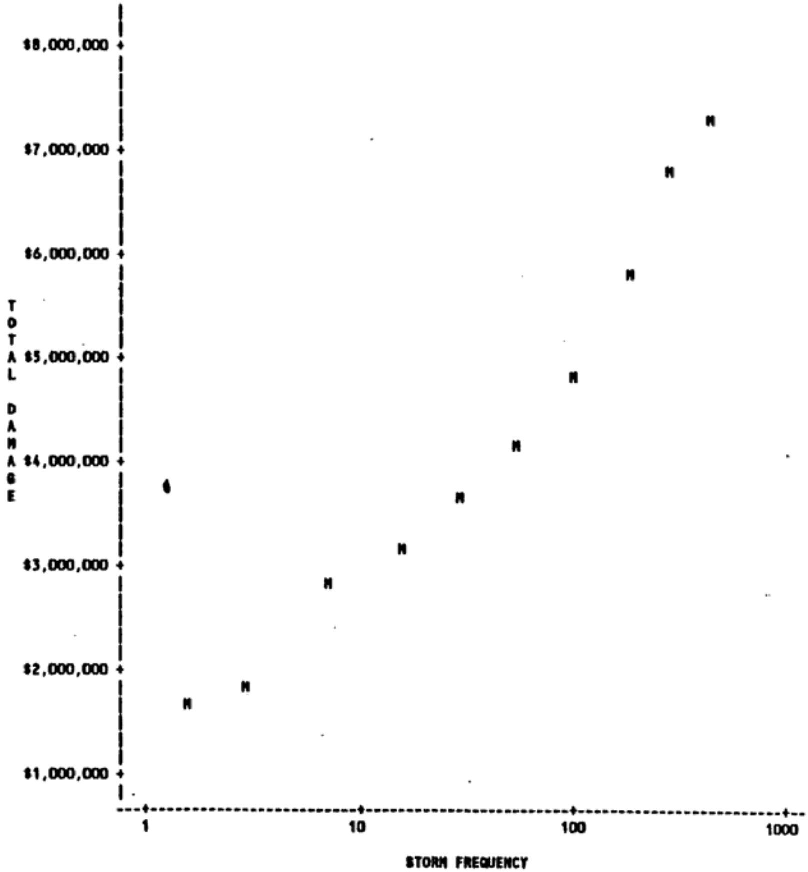
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$697,900	$45,200	$9,200	$707,100
14	3.0	$737,700	$113,000	$23,100	$760,800
15	7.0	$878,300	$231,700	$47,300	$925,600
16	16.0	$1,201,100	$389,100	$79,500	$1,280,600
17	30.0	$1,279,400	$751,300	$153,500	$1,432,900
18	56.0	$1,383,700	$938,800	$191,800	$1,575,500
19	100.0	$1,807,800	$1,029,800	$210,600	$2,018,400
20	179.0	$2,514,600	$1,201,500	$246,300	$2,760,900
21	294.0	$3,298,500	$1,345,300	$276,300	$3,574,800
22	455.0	$3,571,900	$1,353,700	$278,100	$3,850,000

LONG BEACH, NY FEASIBILI STUDY
REACH 3 - BASE YEAR CONDITIONS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

15:37 Tuesday, July 5, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	$4,200	$300	$100	$4,300
4	7.0	$4,200	$300	$100	$4,300
5	16.0	$143,500	$51,100	$1,500	$145,000
6	30.0	$267,900	$95,100	$2,500	$270,400
7	56.0	$294,200	$104,700	$2,800	$297,000
8	100.0	$294,200	$104,700	$2,800	$297,000
9	179.0	$294,200	$104,700	$2,800	$297,000
10	294.0	$294,200	$104,700	$2,800	$297,000
11	455.0	$294,200	$104,700	$2,800	$297,000

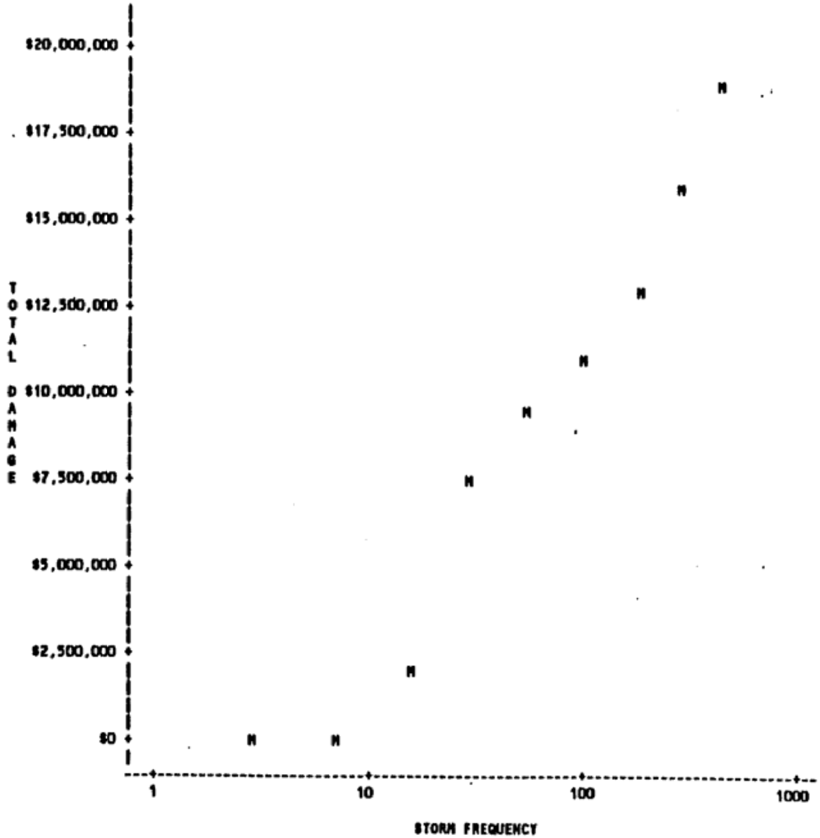
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	$1,737,200	$438,600	$90,700	$1,827,900
17	30.0	$7,029,600	$1,759,200	$362,400	$7,392,000
18	56.0	$8,981,000	$2,245,800	$462,200	$9,443,200
19	100.0	$10,172,600	$2,543,500	$525,200	$10,697,800
20	179.0	$12,262,000	$3,085,000	$645,200	$12,907,200
21	294.0	$14,706,500	$3,675,500	$774,300	$15,480,800
22	455.0	$17,884,300	$4,509,100	$964,000	$18,848,300

LONG BEACH, NY FEASIBILI1 .UDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

15:37 Tuesday, July 5, 1994 3

Plot of TOTAL*STORM. Symbol used is 'N'.



NOTE: 2 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

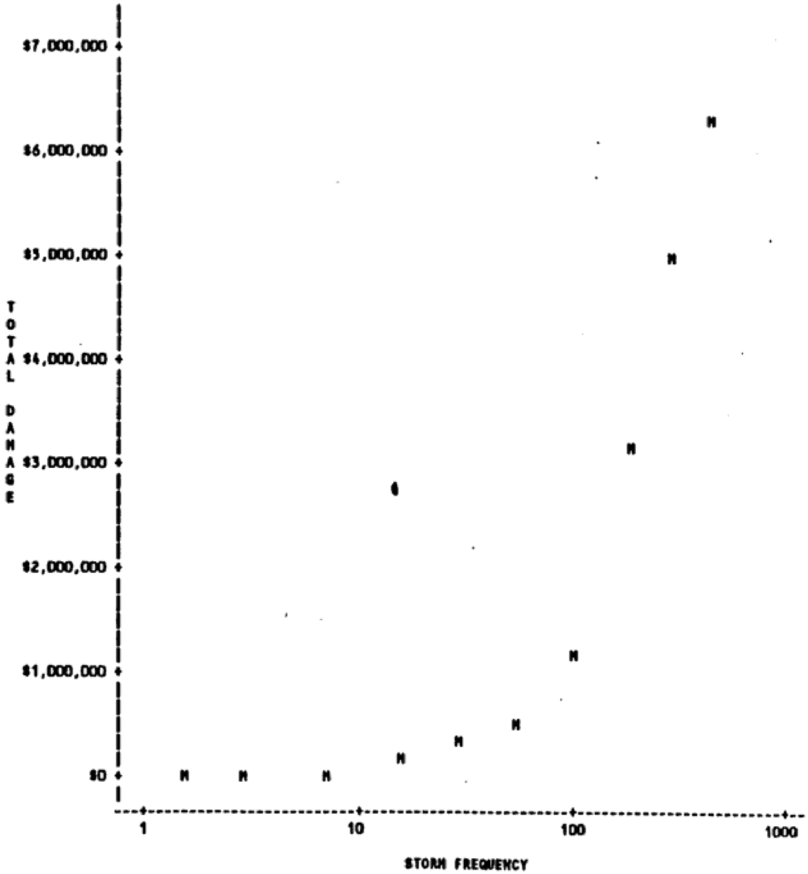
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	$13,900	$300	$100	$14,000
3	3.0	$23,000	$600	$200	$23,200
4	7.0	$24,400	$600	$200	$24,600
5	16.0	$109,700	$2,900	$1,100	$110,800
6	30.0	$278,300	$8,700	$2,900	$281,200
7	56.0	$464,500	$14,200	$4,900	$469,400
8	100.0	$660,400	$19,700	$6,900	$667,300
9	179.0	$762,300	$22,600	$7,900	$770,200
10	294.0	$917,600	$27,000	$9,500	$927,100
11	455.0	$1,481,000	$79,900	$13,200	$1,494,200

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	$2,900	.	.	$2,900
17	30.0	$8,500	.	.	$8,500
18	56.0	$68,500	$14,700	$3,000	$71,500
19	100.0	$536,300	$130,300	$26,600	$562,900
20	179.0	$2,221,700	$571,100	$105,700	$2,327,400
21	294.0	$3,814,700	$989,800	$184,600	$3,999,300
22	455.0	$4,626,000	$1,206,100	$228,800	$4,854,800

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

D1-10

LONG BEACH, NY FEASIBILITY STUDY
REACH 6 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

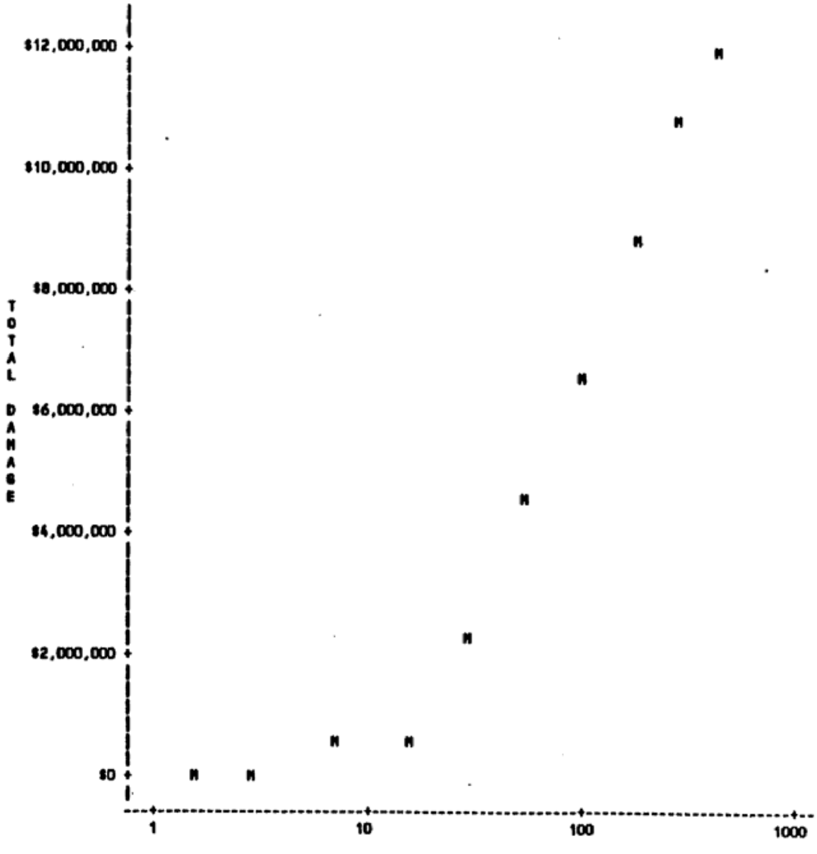
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	$17,500	$4,200	$200	$17,700
4	7.0	$431,900	$53,700	$5,100	$437,000
5	16.0	$600,200	$62,600	$8,300	$608,500
6	30.0	$1,342,500	$121,800	$12,600	$1,355,100
7	56.0	$2,390,600	$334,100	$24,800	$2,415,400
8	100.0	$3,086,200	$424,700	$33,300	$3,119,500
9	179.0	$3,718,300	$490,400	$41,700	$3,760,000
10	294.0	$4,288,400	$556,400	$49,500	$4,337,900
11	455.0	$4,626,500	$599,100	$53,900	$4,680,400

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$8,900	$2,000	$400	$9,300
14	3.0	$45,600	$10,200	$2,100	$47,700
15	7.0	$47,300	$10,200	$2,100	$49,400
16	16.0	$94,400	$21,900	$4,500	$98,900
17	30.0	$755,200	$185,200	$37,800	$793,000
18	56.0	$1,933,400	$476,500	$97,400	$2,030,800
19	100.0	$3,158,900	$779,400	$159,200	$3,318,100
20	179.0	$4,745,200	$1,171,600	$239,400	$4,984,600
21	294.0	$6,149,200	$1,518,600	$310,300	$6,459,500
22	455.0	$7,099,600	$1,753,600	$358,300	$7,457,900

LONG BEACH, NY FEASIBILI1. .UDY
REACH 6 - BASE YEAR CONDITIONS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

SUB-APPENDIX D2

Without Project Storm Frequency vs Inundation Damage

LONG BEACH, NY FEASIBILI. (UDY
REACH 1 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

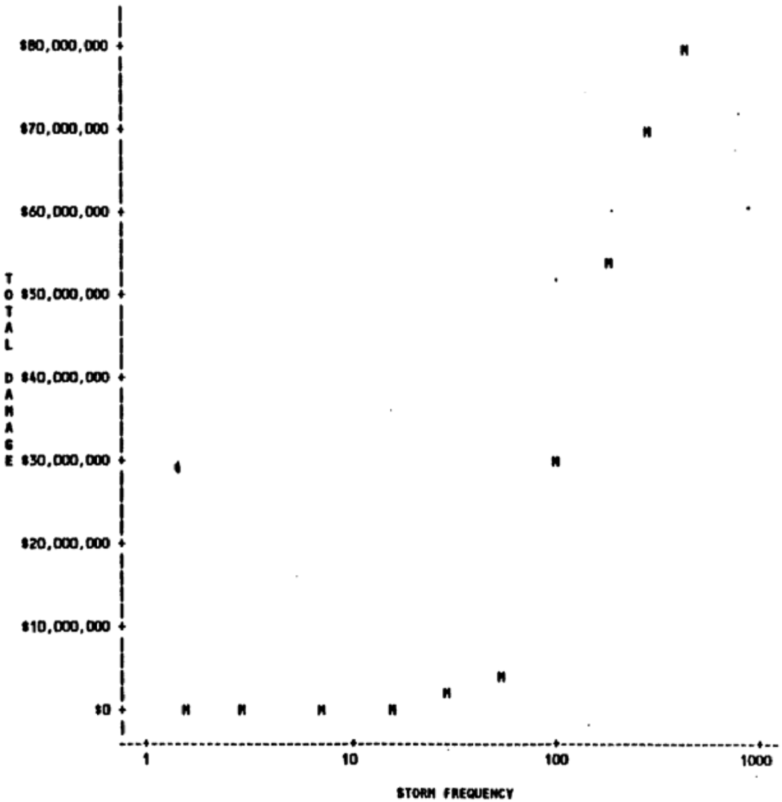
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	$0	$0
3	3.0	.	.	$0	$0
4	7.0	.	.	$0	$0
5	16.0	$52,800	.	$6,100	$58,900
6	30.0	$826,000	.	$50,300	$876,300
7	56.0	$1,636,700	.	$71,700	$1,708,400
8	100.0	$6,113,200	.	$128,500	$6,241,700
9	179.0	$9,539,600	.	$157,200	$9,696,800
10	294.0	$11,694,600	.	$171,300	$11,865,900
11	455.0	$13,077,100	.	$183,000	$13,260,100

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	$16,900	$16,900
17	30.0	$162,600	$49,500	$59,500	$222,100
18	56.0	$2,049,400	$581,400	$167,300	$2,216,700
19	100.0	$22,873,500	$6,528,700	$1,171,400	$24,044,900
20	179.0	$41,929,800	$12,076,900	$2,287,400	$44,217,200
21	294.0	$54,196,000	$15,449,900	$3,111,100	$57,307,100
22	455.0	$63,237,500	$17,959,500	$3,710,700	$66,948,200

LONG BEACH, NY FEASIBILI. .(UDY
REACH 1 - BASE YEAR CONDITIONS
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'N'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILI) .UDY
REACH 2 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

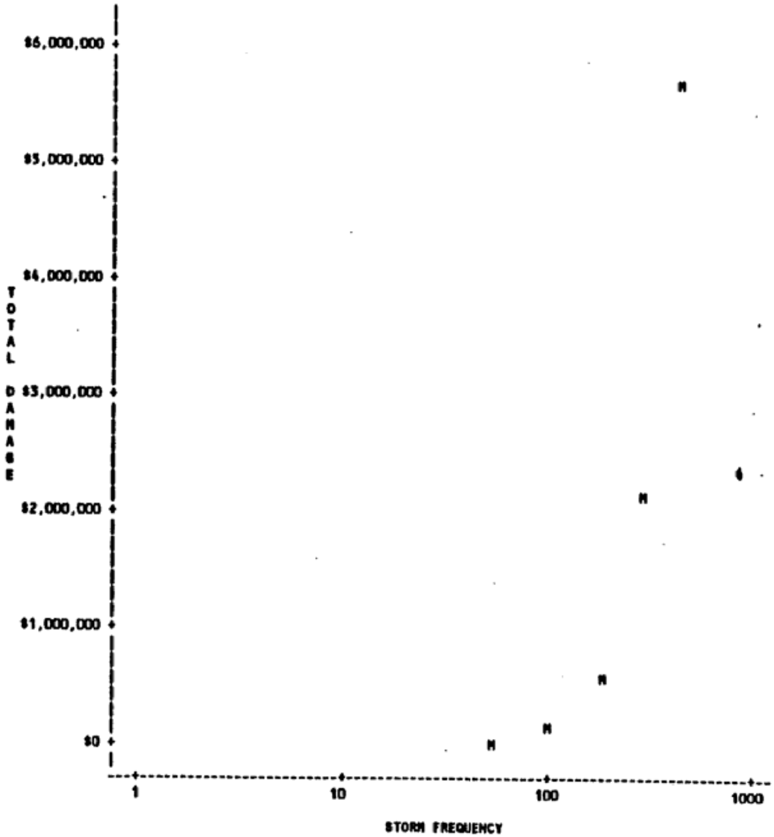
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	$300	$300
8	100.0	$9,100	.	$1,300	$10,400
9	179.0	$116,200	.	$10,300	$126,500
10	294.0	$716,700	.	$54,800	$771,500
11	455.0	$2,906,600	.	$171,600	$3,078,200

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	$2,300	$2,300
19	100.0	$120,800	$35,900	$7,700	$128,500
20	179.0	$469,300	$139,100	$19,200	$488,500
21	294.0	$1,264,200	$372,600	$45,300	$1,309,500
22	455.0	$2,525,000	$732,400	$75,900	$2,600,900

LONG BEACH, NY FEASIBILI. .UDY
REACH 2 - BASE YEAR CONDITIONS
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 6 obs had missing values.

LONG BEACH, NY FEASIBILI. .TUDY
REACH 3 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	$1,139,000	.	$71,200	$1,210,200
6	30.0	$13,749,300	.	$453,200	$14,202,500
7	56.0	$31,083,900	.	$826,500	$31,910,400
8	100.0	$46,420,300	.	$1,189,100	$47,609,400
9	179.0	$57,121,500	.	$1,302,500	$58,424,000
10	294.0	$62,492,000	.	$1,365,400	$63,857,400
11	455.0	$63,800,600	.	$1,379,700	$65,180,300

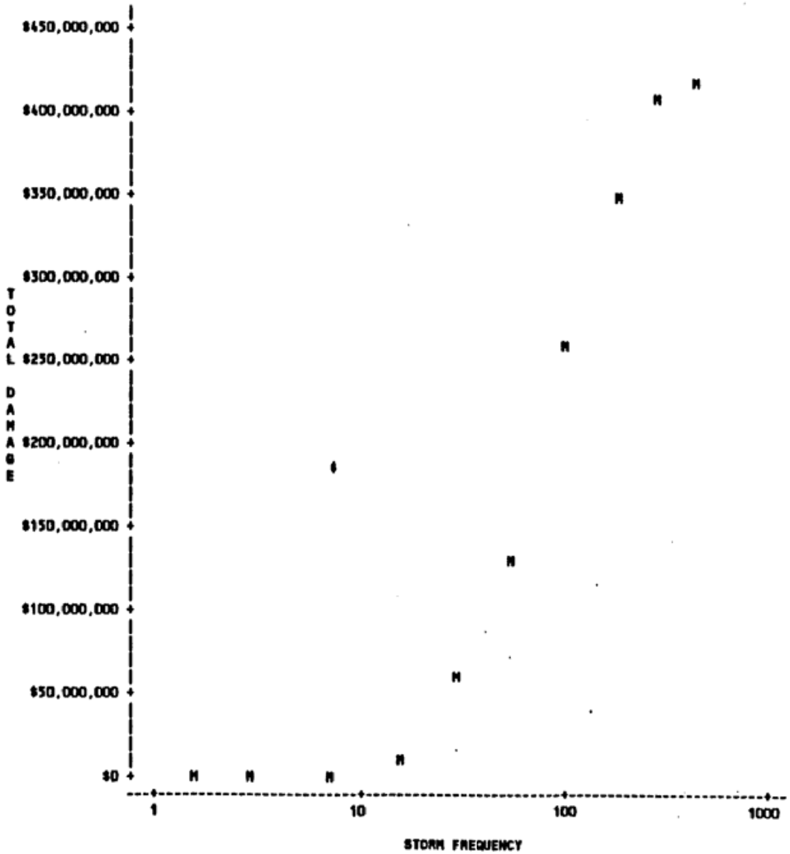
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$33,800	$9,600	$8,300	$42,100
14	3.0	$110,600	$31,000	$17,100	$127,700
15	7.0	$213,000	$59,500	$28,900	$241,900
16	16.0	$7,027,500	$1,505,400	$430,600	$7,458,100
17	30.0	$45,036,600	$10,143,600	$1,987,400	$47,024,000
18	56.0	$95,687,400	$23,529,200	$4,317,100	$100,004,500
19	100.0	$202,532,100	$50,909,200	$9,897,300	$212,429,400
20	179.0	$274,870,200	$70,187,200	$15,285,200	$290,155,400
21	294.0	$323,004,000	$83,225,800	$19,579,200	$342,583,200
22	455.0	$337,034,500	$87,274,000	$21,090,200	$358,124,700

D2-5

LONG BEACH, NY FEASIBILI. .TUDY
REACH 3 - BASE YEAR CONDITIONS
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

D2-6

LONG BEACH, NY FEASIBILI' .UDY
REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-INUNDATION DAMAGE FROM ALL CAUSES

------------------------------------ TYPE=NON-RESIDENT ------------------------------------

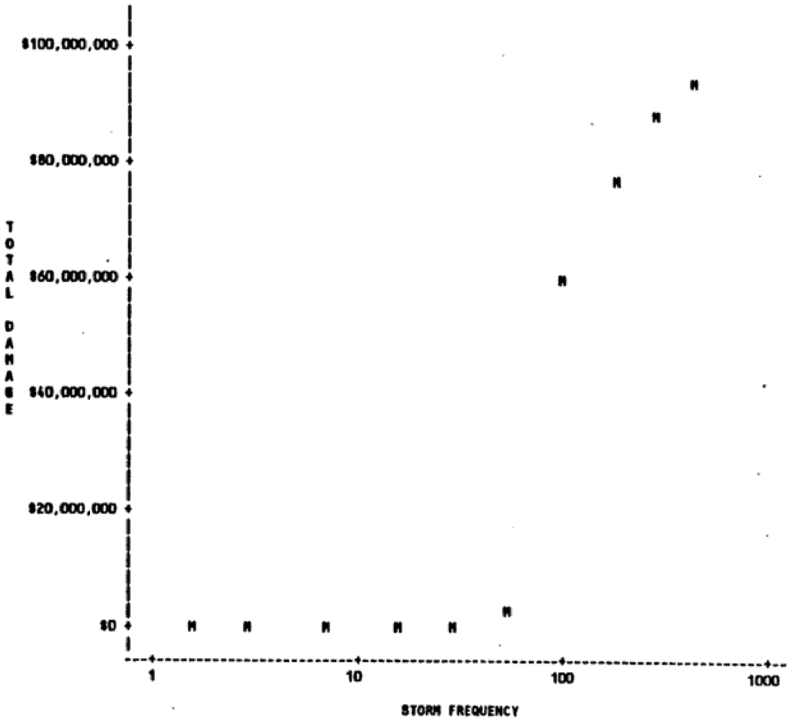
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	$100	$100
6	30.0	.	.	$500	$500
7	56.0	$4,800	.	$19,300	$24,100
8	100.0	$7,278,500	.	$102,900	$7,381,400
9	179.0	$8,946,400	.	$108,900	$9,055,300
10	294.0	$9,737,400	.	$112,900	$9,850,300
11	455.0	$9,968,000	.	$114,600	$10,082,600

------------------------------------ TYPE=RESIDENTIAL ------------------------------------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$13,200	$3,700	$5,500	$18,700
14	3.0	$62,500	$17,300	$8,800	$71,300
15	7.0	$128,300	$36,000	$13,200	$141,500
16	16.0	$270,100	$76,700	$35,000	$305,100
17	30.0	$496,500	$142,100	$76,700	$573,200
18	56.0	$1,787,100	$507,700	$168,600	$1,955,700
19	100.0	$48,723,200	$13,207,000	$3,152,100	$51,875,300
20	179.0	$64,342,200	$17,700,300	$4,642,200	$68,984,400
21	294.0	$74,316,900	$20,634,100	$5,711,000	$80,027,900
22	455.0	$79,226,300	$22,112,900	$6,253,900	$85,480,200

LONG BEACH, NY FEASIBILI .UDY 15:35 Tuesday, July 5, 1994 3
REACH 4 - BASE YEAR CONDITIONS
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

D2-B

LONG BEACH, NY FEASIBILIT, STUDY
REACH 5 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	$842,200	.	$72,700	$914,900
8	100.0	$2,346,300	.	$117,100	$2,463,400
9	179.0	$3,131,800	.	$137,400	$3,269,200
10	294.0	$3,205,900	.	$138,000	$3,343,900
11	455.0	$3,225,800	.	$138,100	$3,363,900

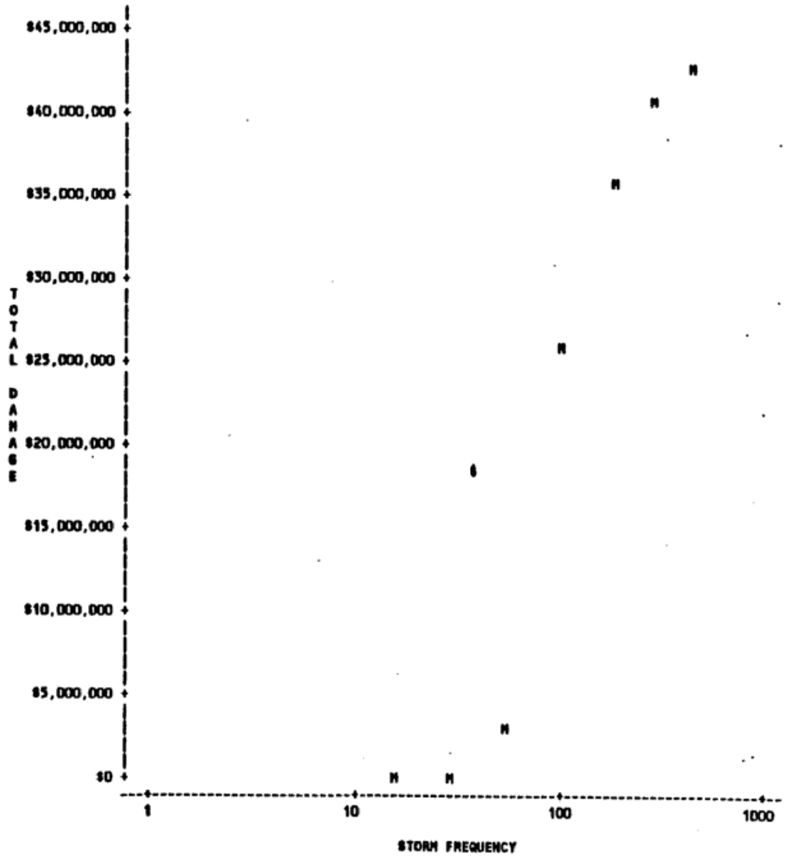
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	$200	$200
17	30.0	.	.	$600	$600
18	56.0	$2,199,000	$630,300	$66,200	$2,265,200
19	100.0	$22,552,300	$6,441,900	$1,037,600	$23,589,900
20	179.0	$30,697,800	$8,770,900	$1,576,900	$32,274,700
21	294.0	$35,490,500	$10,137,800	$1,914,700	$37,405,200
22	455.0	$37,214,200	$10,619,200	$2,047,700	$39,261,900

LONG BEACH, NY FEASIBILI.   TUDY
REACH 5 - BASE YEAR CONDITIONS
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

15:35 Tuesday, July 5, 1994   3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 4 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 6 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

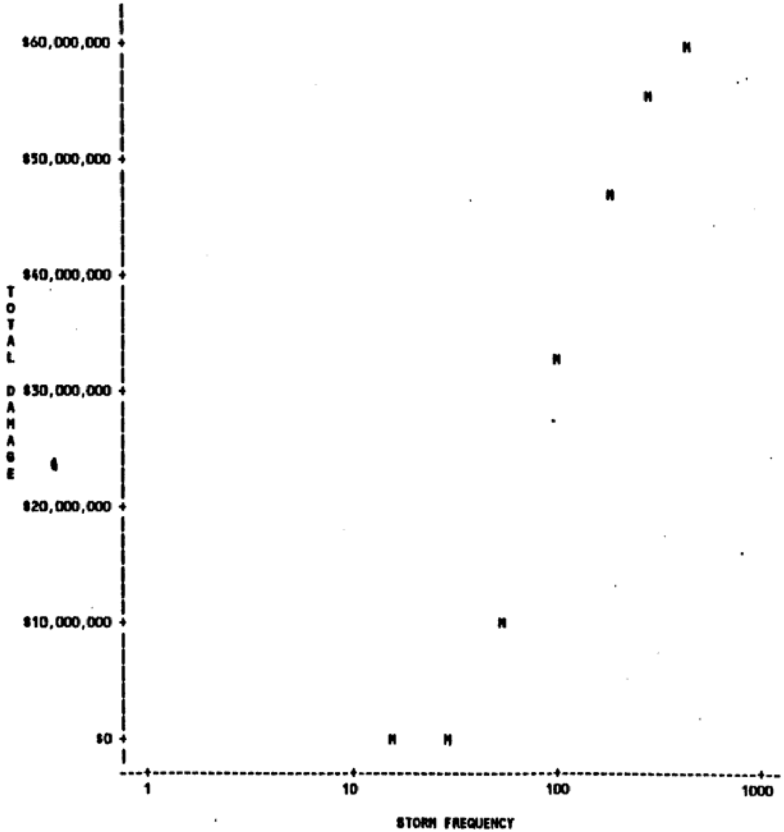
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	$6,100	.	$400	$6,500
6	30.0	$6,800	.	$500	$7,300
7	56.0	$2,113,200	.	$88,300	$2,201,500
8	100.0	$4,491,600	.	$156,600	$4,648,200
9	179.0	$6,276,400	.	$190,400	$6,466,800
10	294.0	$7,548,000	.	$210,000	$7,758,000
11	455.0	$7,743,800	.	$215,400	$7,959,200

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	$200	$200
17	30.0	.	.	$500	$500
18	56.0	$8,021,900	$2,282,200	$460,500	$8,482,400
19	100.0	$27,408,500	$7,847,700	$1,444,400	$28,852,900
20	179.0	$37,719,600	$10,793,300	$2,274,100	$39,993,700
21	294.0	$45,535,400	$13,007,900	$2,976,300	$48,511,700
22	455.0	$49,144,600	$14,058,400	$3,272,300	$52,416,900

LONG BEACH, NY FEASIBILI). .UDY
REACH 6 - BASE YEAR CONDITIONS
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'N'.



NOTE: 4 obs had missing values.

SUB-APPENDIX D3

Without Project Storm Frequency vs Wave Attack Damage

D3

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

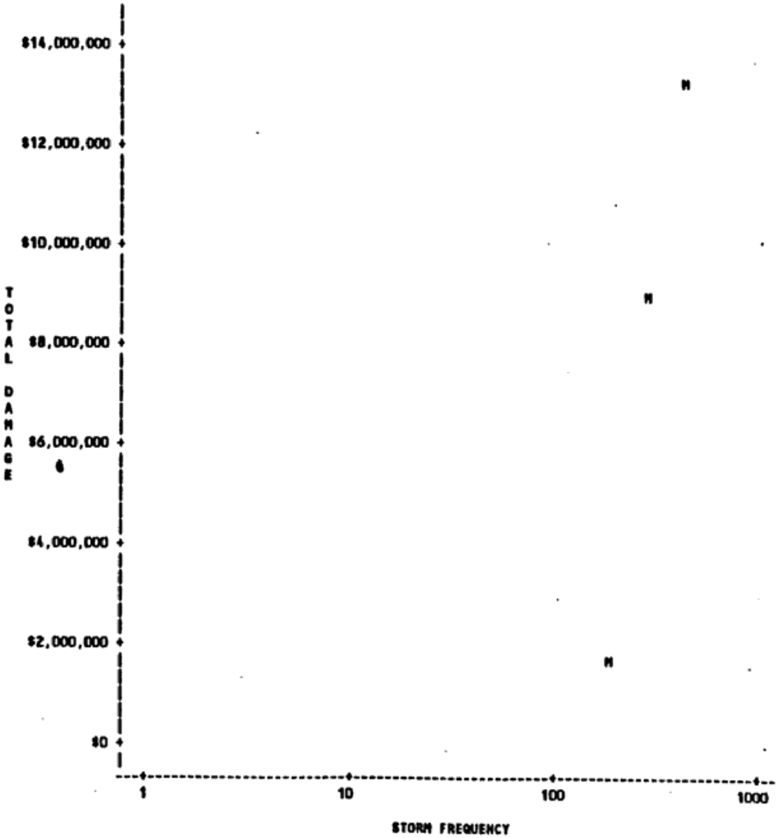
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	$1,517,900	$137,600	$19,900	$1,537,800
10	294.0	$6,391,900	$2,747,600	$73,300	$6,665,200
11	455.0	$6,391,900	$2,747,600	$73,300	$6,665,200

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	$2,296,800	$603,600	$141,400	$2,438,200
22	455.0	$6,263,900	$1,693,700	$362,800	$6,628,700

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 8 obs had missing values.

LONG BEACH, NY FEASIBILIT. .UDY
REACH 2 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_ATTACK DAMAGE FROM ALL CAUSES

------------------------------ TYPE=NON-RESIDENT ------------------------------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	.	.	.	.

------------------------------ TYPE=RESIDENTIAL ------------------------------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.		.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILI .UDY
REACH 3 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

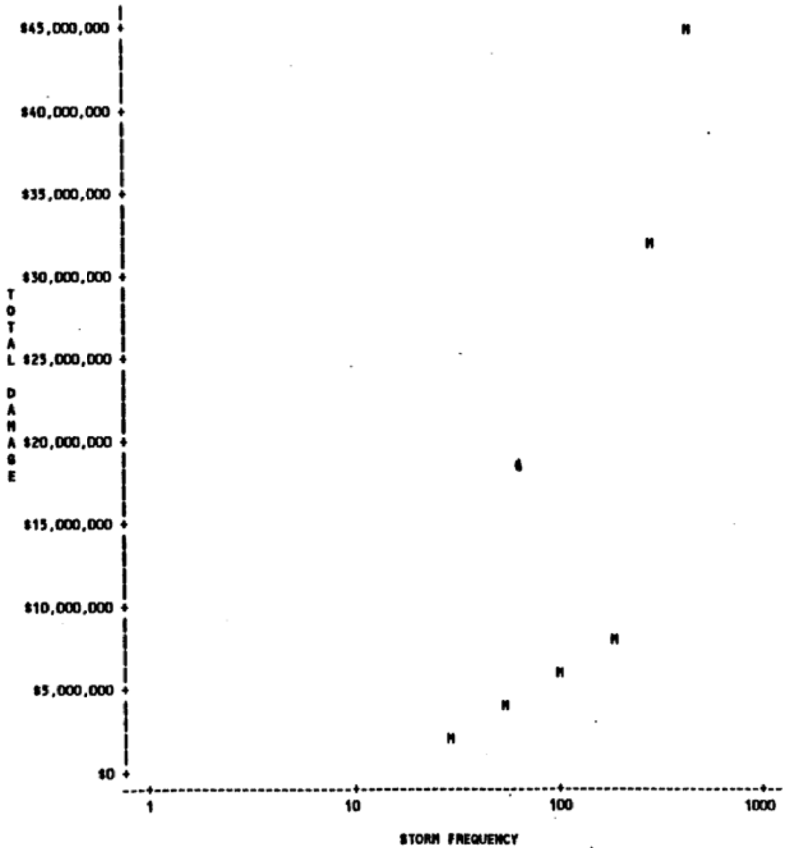
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	$741,900	$694,000	$6,300	$748,200
7	56.0	$1,428,500	$797,600	$12,200	$1,440,700
8	100.0	$2,722,100	$1,895,500	$70,200	$2,792,300
9	179.0	$2,741,500	$1,908,200	$70,300	$2,811,800
10	294.0	$7,939,500	$4,741,300	$170,400	$8,109,900
11	455.0	$9,755,500	$5,605,500	$195,000	$9,950,500

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	$1,019,000	$565,100	$230,900	$1,249,900
18	56.0	$1,721,000	$878,300	$422,900	$2,143,900
19	100.0	$2,867,200	$1,375,600	$626,100	$3,493,300
20	179.0	$4,503,000	$2,089,500	$889,600	$5,392,600
21	294.0	$22,364,700	$6,683,500	$1,791,600	$24,156,300
22	455.0	$33,004,200	$9,561,300	$2,453,900	$35,458,100

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 5 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

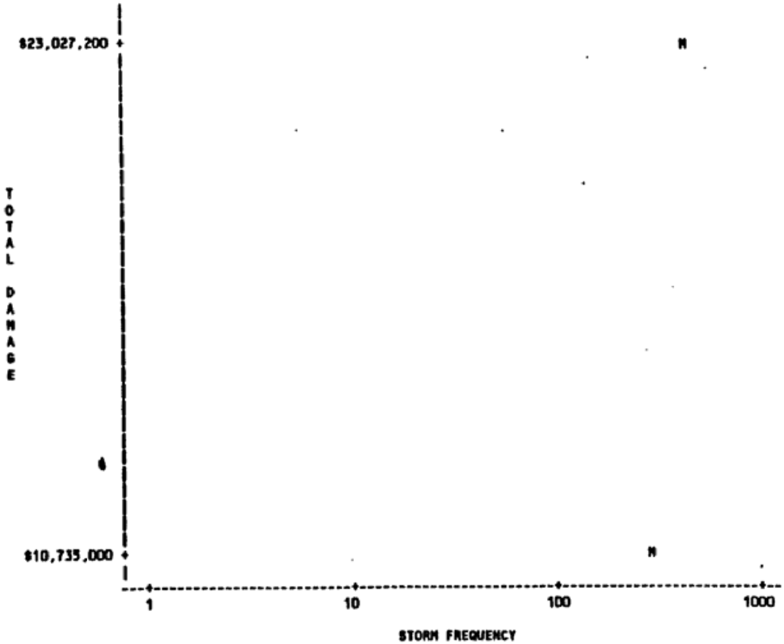
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	$499,700	$176,700	$4,000	$503,700
11	455.0	$579,900	$208,900	$5,500	$585,400

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	$9,708,900	$2,457,600	$522,400	$10,231,300
22	455.0	$21,318,000	$5,344,400	$1,123,800	$22,441,800

LONG BEACH, NY FEASIBILIT, ..UDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'N'.



NOTE: 9 obs had missing values.

LONG BEACH, NY FEASIBILIT. ..UDY
REACH 5 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

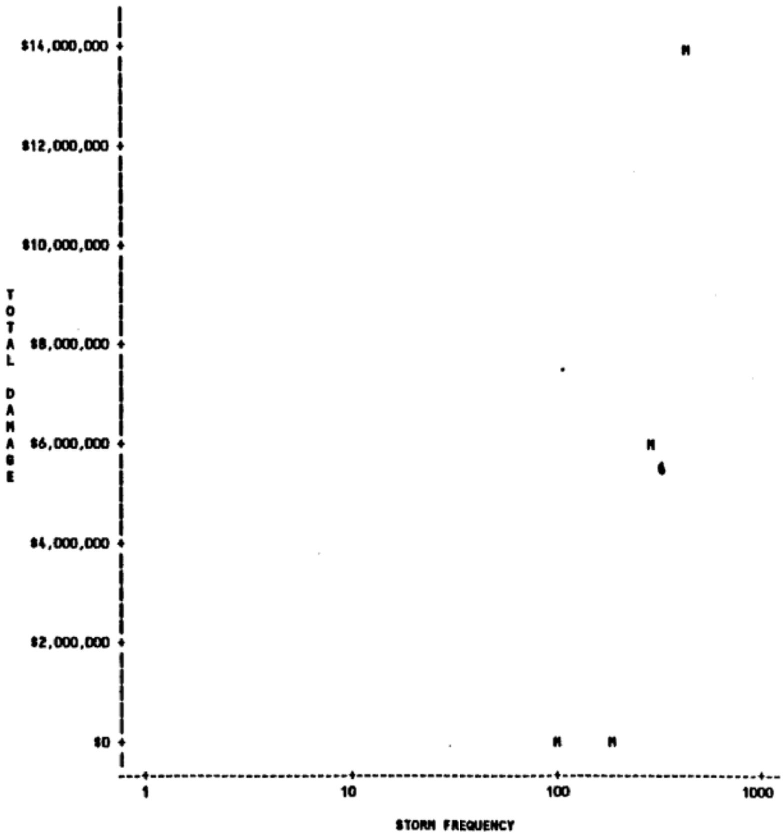
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	$3,400	.	.	$3,400
9	179.0	$3,400	.	.	$3,400
10	294.0	$2,394,000	$405,600	$35,000	$2,429,000
11	455.0	$5,961,700	$771,300	$78,500	$6,040,200

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	$3,346,600	$859,100	$175,800	$3,522,400
22	455.0	$7,511,300	$1,916,100	$389,100	$7,900,400

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 7 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 6 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

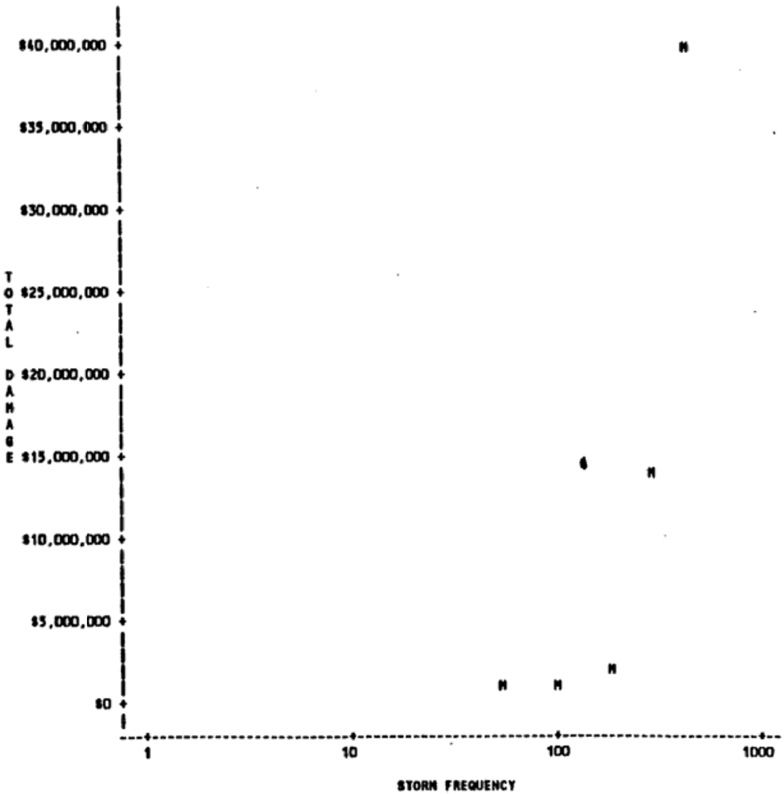
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	$945,400	$294,300	$28,900	$974,300
8	100.0	$1,210,200	$317,600	$37,500	$1,247,700
9	179.0	$1,544,900	$352,700	$50,500	$1,595,400
10	294.0	$8,893,400	$1,010,600	$132,100	$9,025,500
11	455.0	$16,709,100	$2,740,600	$227,400	$16,936,500

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	$14,400	.	.	$14,400
21	294.0	$4,848,700	$1,219,400	$245,800	$5,094,500
22	455.0	$22,206,300	$5,654,500	$1,220,400	$23,426,700

LONG BEACH, NY FEASIBILIT. .UDY
REACH 6 - BASE YEAR CONDITIONS
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 6 obs had missing values.

SUB-APPENDIX D4

Without Project Storm Frequency vs Wave Runup Damage

D4

LONG BEACH, NY FEASIBILI1. .ıUDY
REACH 1 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

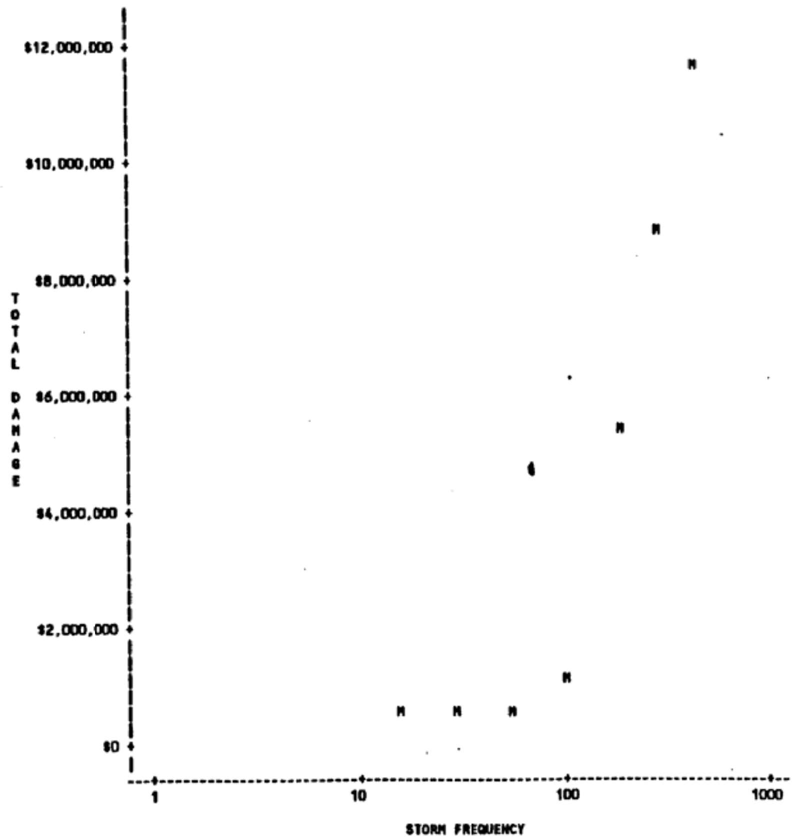
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	$456,900	$23,200	$5,100	$462,000
6	30.0	$456,900	$23,200	$5,100	$462,000
7	56.0	$456,900	$23,200	$5,100	$462,000
8	100.0	$997,200	$38,500	$11,100	$1,008,300
9	179.0	$1,170,100	$49,400	$13,600	$1,183,700
10	294.0	$1,724,300	$65,100	$20,000	$1,744,300
11	455.0	$2,099,800	$75,800	$24,100	$2,123,900

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	$3,963,600	$1,030,200	$198,800	$4,162,400
21	294.0	$6,840,400	$1,788,300	$350,100	$7,190,500
22	455.0	$9,064,800	$2,376,100	$492,100	$9,556,900

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 4 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

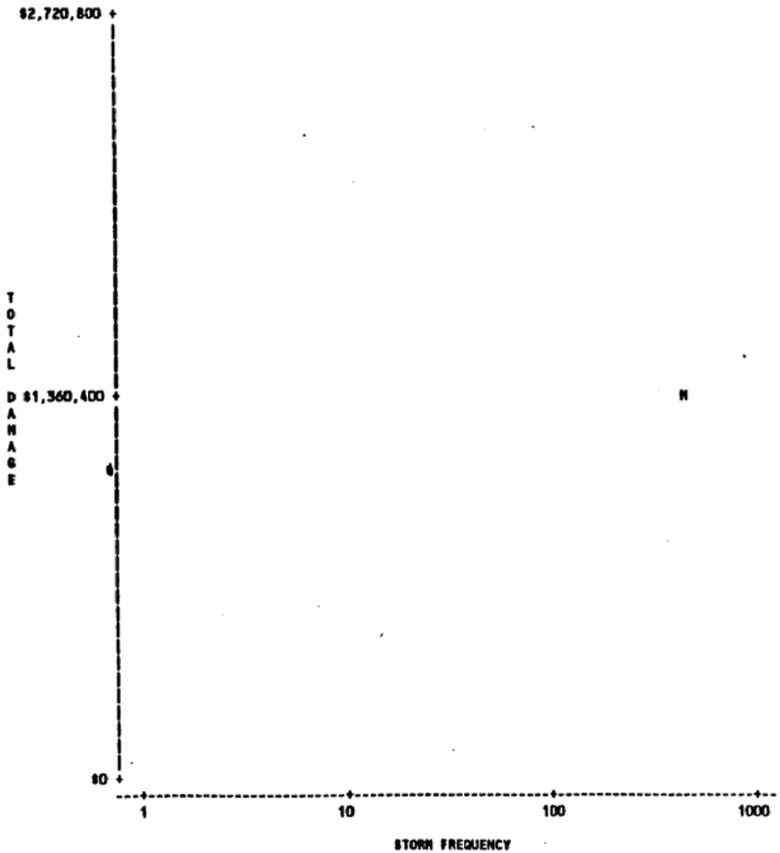
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	$1,345,900	$38,300	$14,500	$1,360,400

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILI1. .UDY 15:39 Tuesday, July 5, 1994 3
REACH 2 - BASE YEAR CONDITIONS
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 10 obs had missing values.

D4-7

LONG BEACH, NY FEASIBILIT. .UDY
REACH 3 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

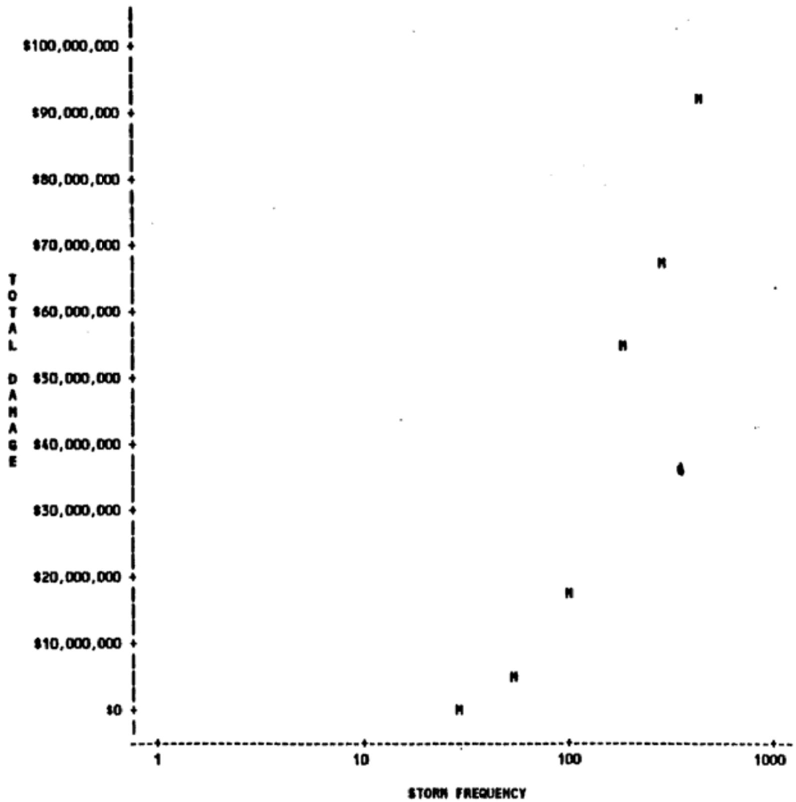
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	$21,200	$13,300	$200	$21,400
7	56.0	$1,522,200	$623,700	$17,300	$1,539,500
8	100.0	$1,568,900	$639,300	$17,700	$1,586,600
9	179.0	$3,831,500	$973,200	$23,600	$3,855,100
10	294.0	$4,506,400	$1,381,800	$40,800	$4,547,200
11	455.0	$5,979,100	$1,833,000	$62,500	$6,041,600

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	$12,600	.	.	$12,600
18	56.0	$3,928,200	$921,600	$191,300	$4,119,500
19	100.0	$15,401,300	$3,688,500	$754,300	$16,155,600
20	179.0	$49,301,500	$12,075,500	$2,466,400	$51,767,900
21	294.0	$61,080,900	$14,996,000	$3,080,200	$64,161,100
22	455.0	$81,117,600	$20,117,500	$4,195,900	$85,313,500

LONG BEACH, NY FEASIBILI1. .:UDY
REACH 3 - BASE YEAR CONDITIONS
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 5 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	$588,400	$209,400	$5,600	$594,000
9	179.0	$588,400	$209,400	$5,600	$594,000
10	294.0	$588,400	$209,400	$5,600	$594,000
11	455.0	$588,400	$209,400	$5,600	$594,000

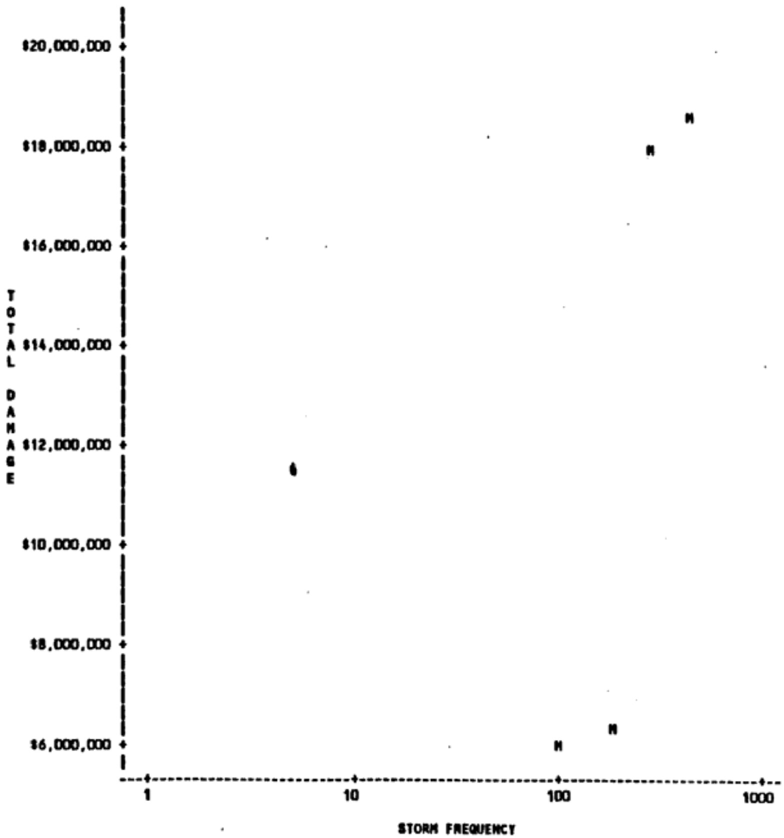
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	$5,284,100	$1,332,200	$271,400	$5,555,500
20	179.0	$5,542,700	$1,396,100	$284,500	$5,827,200
21	294.0	$16,558,000	$4,143,900	$855,100	$17,413,100
22	455.0	$17,031,100	$4,258,600	$878,500	$17,909,600

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

15:40 Tuesday, July 5, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 7 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

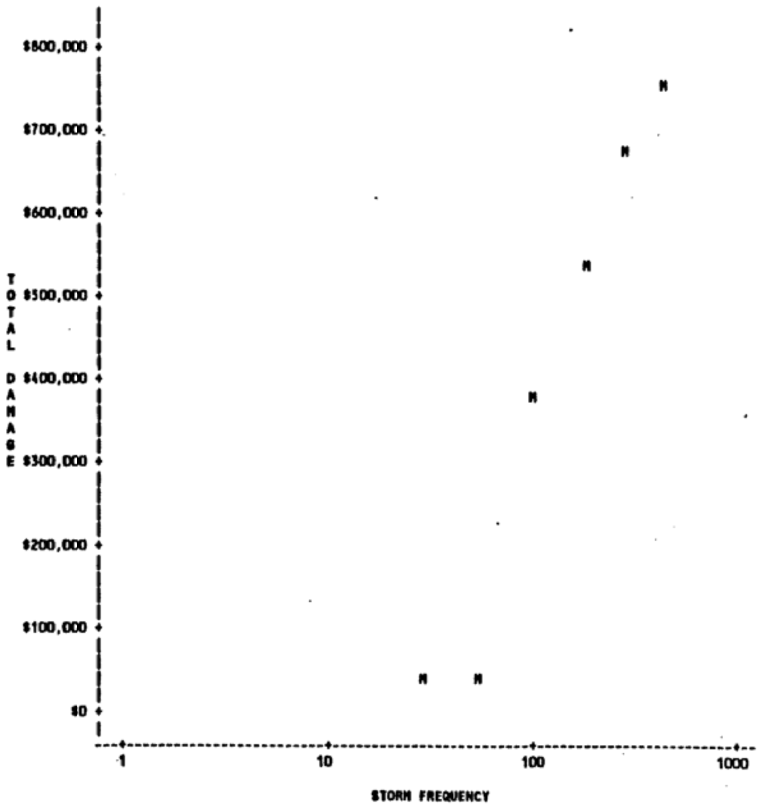
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	$40,300	$1,100	$400	$40,700
7	56.0	$40,300	$1,100	$400	$40,700
8	100.0	$378,700	$10,700	$4,000	$382,700
9	179.0	$537,300	$15,300	$5,600	$542,900
10	294.0	$654,500	$20,900	$7,000	$661,500
11	455.0	$727,500	$23,000	$7,800	$735,300

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	$5,800	.	.	$5,800
21	294.0	$18,100	.	.	$18,100
22	455.0	$18,100	.	.	$18,100

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 5 obs had missing values.

LONG BEACH, NY FEASIBILI). .TUDY
REACH 6 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

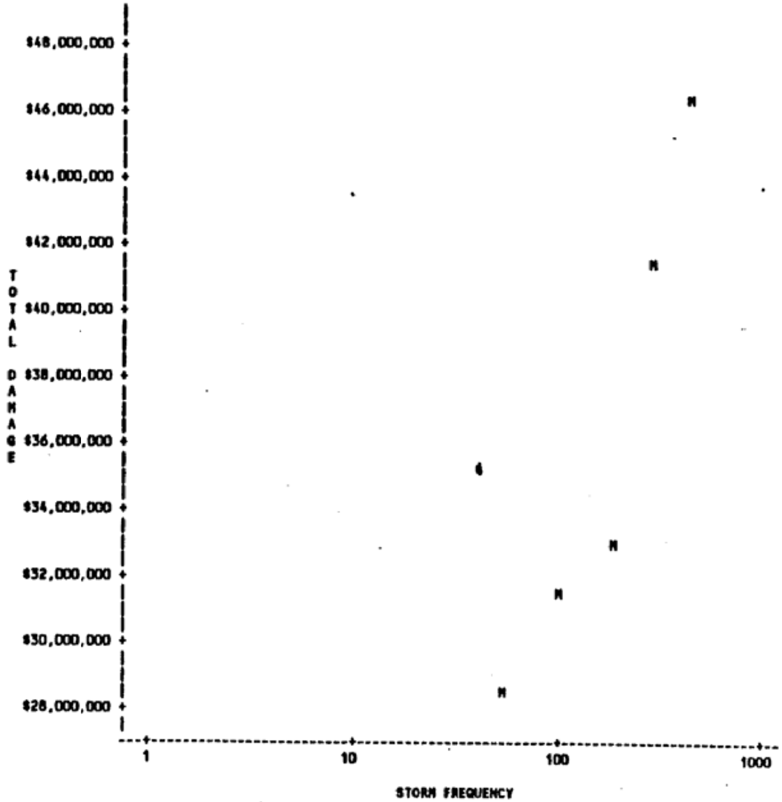
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	$9,048,600	$1,278,700	$113,100	$9,161,700
8	100.0	$11,085,800	$1,452,500	$129,700	$11,215,500
9	179.0	$12,016,000	$1,478,900	$140,300	$12,156,300
10	294.0	$12,725,200	$1,699,400	$145,600	$12,870,800
11	455.0	$12,841,400	$1,702,700	$147,000	$12,988,400

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	$18,374,400	$4,539,200	$927,400	$19,301,800
19	100.0	$19,426,900	$4,798,400	$980,400	$20,407,300
20	179.0	$19,675,000	$4,853,800	$998,300	$20,673,300
21	294.0	$27,083,400	$6,804,900	$1,426,500	$28,509,900
22	455.0	$31,637,200	$7,939,000	$1,669,700	$33,306,900

LONG BEACH, NY FEASIBILI1. .:UDY
REACH 6 - BASE YEAR CONDITIONS
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 6 obs had missing values.

SUB-APPENDIX D5

Without Project Storm Frequency vs Maximum Damage

LONG BEACH, NY FEASIBILI). .:UDY
REACH 1 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	$600	$0	$0	$600
2	1.5	$84,900	$7,500	$1,000	$85,900
3	3.0	$154,500	$9,500	$1,700	$156,200
4	7.0	$296,300	$13,500	$3,300	$299,600
5	16.0	$694,000	$31,700	$13,000	$707,000
6	30.0	$1,455,700	$45,700	$53,900	$1,509,600
7	56.0	$2,313,800	$51,600	$75,400	$2,389,200
8	100.0	$7,133,500	$64,300	$133,400	$7,266,900
9	179.0	$11,085,400	$186,500	$165,300	$11,250,700
10	294.0	$14,696,600	$2,761,900	$194,000	$14,890,600
11	455.0	$16,065,800	$2,761,900	$205,400	$16,271,200

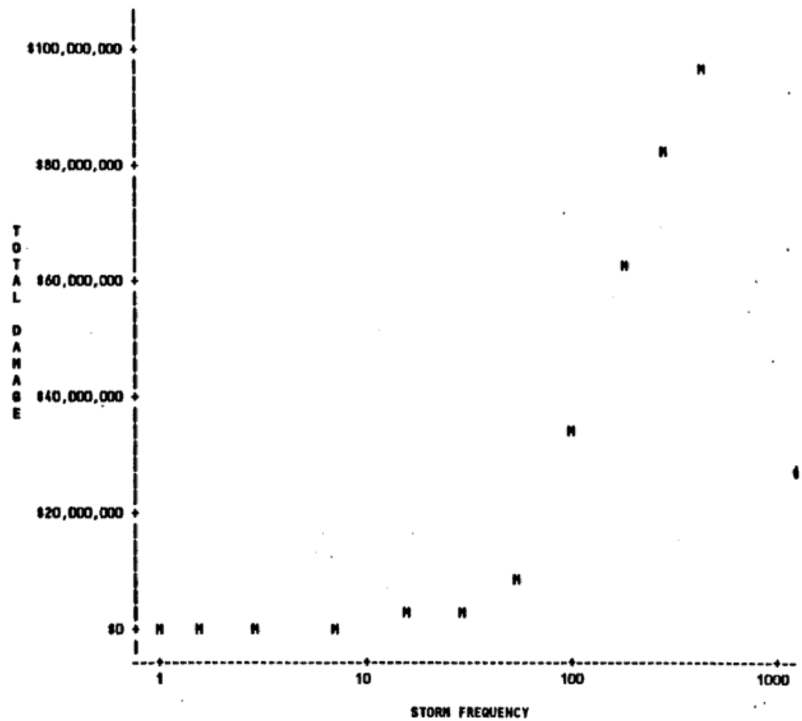
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	$1,984,100	$516,200	$116,300	$2,100,400
17	30.0	$2,394,000	$632,300	$169,900	$2,563,900
18	56.0	$4,689,700	$1,275,100	$301,400	$4,991,100
19	100.0	$25,804,400	$7,279,300	$1,330,400	$27,134,800
20	179.0	$47,602,000	$13,451,900	$2,581,200	$50,183,200
21	294.0	$64,248,000	$17,933,400	$3,636,800	$67,884,800
22	455.0	$75,977,400	$21,128,300	$4,394,800	$80,372,200

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

15:56 Wednesday, June 15, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



D5-2

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

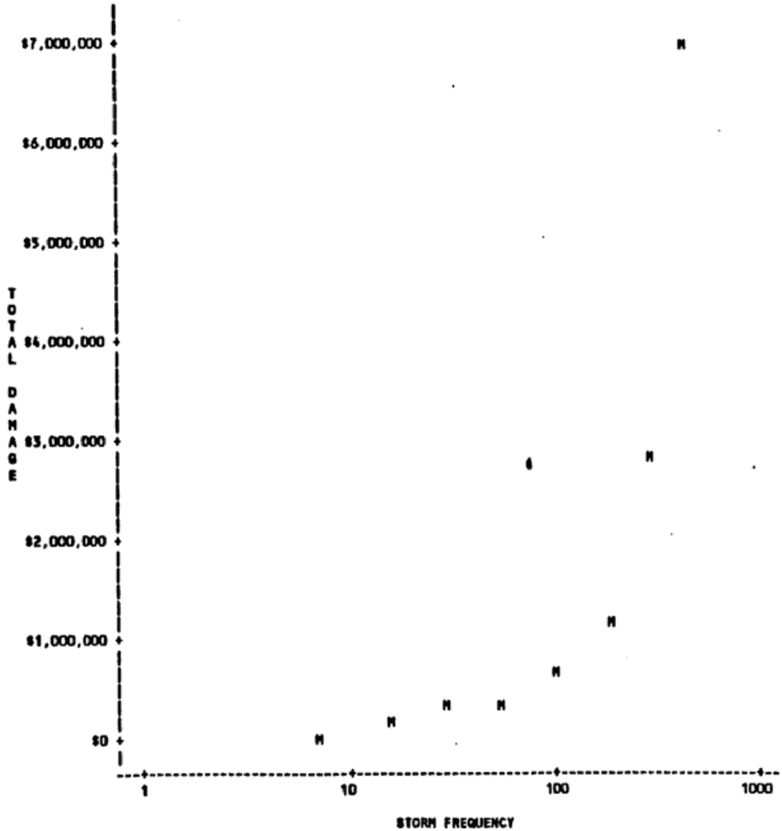
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	$38,600	$1,100	$400	$39,000
5	16.0	$134,600	$3,800	$1,500	$136,100
6	30.0	$248,900	$7,100	$2,700	$251,600
7	56.0	$383,600	$10,900	$4,400	$388,000
8	100.0	$514,300	$14,400	$6,800	$521,100
9	179.0	$726,100	$17,400	$16,900	$743,000
10	294.0	$1,412,300	$20,300	$61,400	$1,473,700
11	455.0	$4,143,600	$42,300	$177,900	$4,321,500

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	$2,300	$2,300
19	100.0	$120,800	$35,900	$7,700	$128,500
20	179.0	$469,300	$139,100	$19,200	$488,500
21	294.0	$1,264,200	$372,600	$45,300	$1,309,500
22	455.0	$2,525,000	$732,400	$75,900	$2,600,900

LONG BEACH, NY FEASIBILIT .UDY
REACH 2 - BASE YEAR CONDITIONS
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 3 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

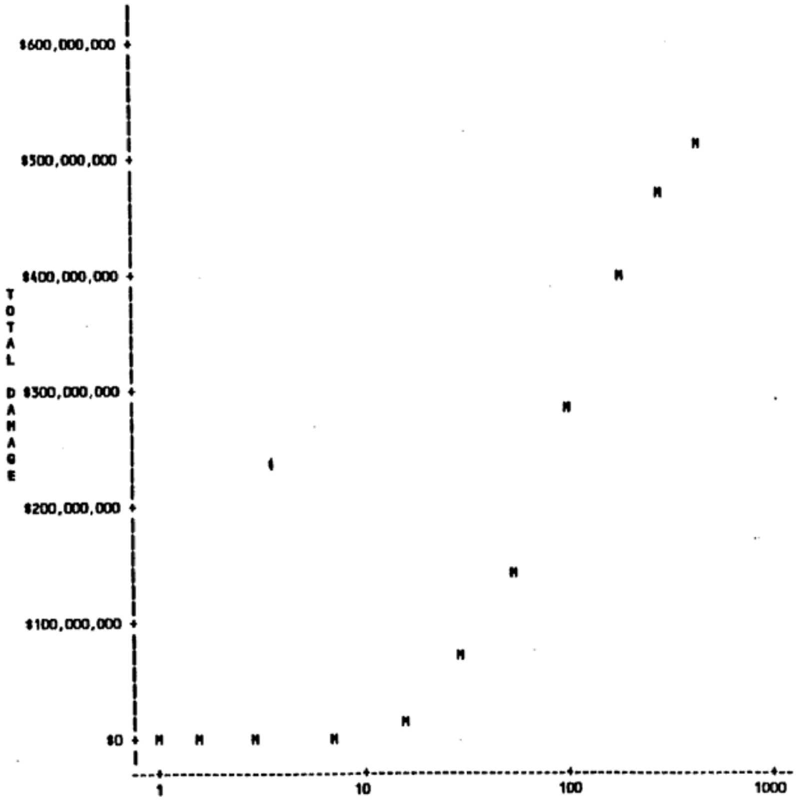
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	$531,500	$47,900	$7,600	$539,100
2	1.5	$1,023,500	$105,500	$8,000	$1,031,500
3	3.0	$1,066,800	$183,600	$8,500	$1,075,300
4	7.0	$1,852,600	$396,200	$12,500	$1,865,100
5	16.0	$3,038,800	$587,800	$86,500	$3,125,300
6	30.0	$16,332,200	$1,141,800	$478,300	$16,810,500
7	56.0	$34,837,800	$1,845,400	$861,200	$35,699,000
8	100.0	$48,976,500	$2,534,800	$1,226,000	$50,202,500
9	179.0	$61,454,600	$2,898,100	$1,341,200	$62,795,800
10	294.0	$67,990,900	$5,910,100	$1,439,000	$69,429,900
11	455.0	$70,871,500	$6,676,200	$1,467,600	$72,339,100

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	$2,000	.	.	$2,000
13	1.5	$731,600	$54,800	$17,500	$749,100
14	3.0	$848,300	$144,000	$40,200	$888,500
15	7.0	$1,091,400	$291,200	$76,300	$1,167,700
16	16.0	$8,228,700	$1,894,500	$510,100	$8,738,800
17	30.0	$46,282,700	$10,743,600	$2,243,600	$48,526,300
18	56.0	$99,916,000	$24,861,400	$4,812,000	$104,728,000
19	100.0	$217,508,200	$54,965,700	$11,065,400	$228,573,600
20	179.0	$317,326,500	$81,110,300	$17,962,400	$335,288,900
21	294.0	$384,929,000	$98,887,400	$23,205,700	$408,134,700
22	455.0	$417,452,500	$107,705,600	$25,829,000	$443,281,500

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



LONG BEACH, NY FEASIBILI1. ..UDY
REACH 4 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

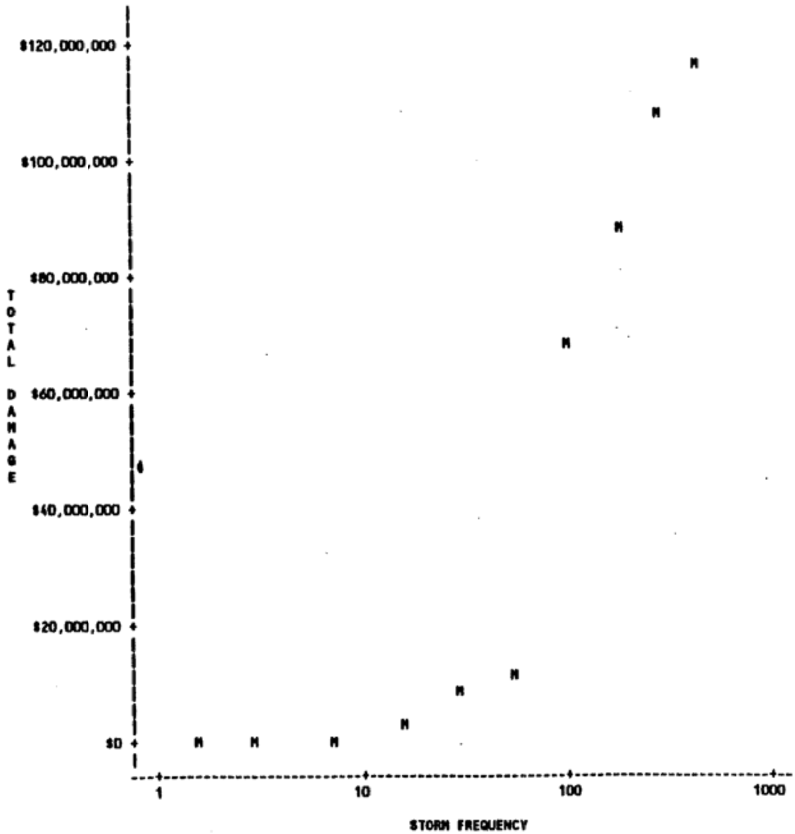
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	$4,200	$300	$100	$4,300
4	7.0	$4,200	$300	$100	$4,300
5	16.0	$143,300	$51,100	$1,700	$145,200
6	30.0	$267,900	$95,100	$3,000	$270,900
7	56.0	$299,000	$104,700	$22,100	$321,100
8	100.0	$7,691,100	$209,400	$104,600	$7,795,700
9	179.0	$9,299,900	$209,400	$110,300	$9,410,200
10	294.0	$10,084,100	$209,400	$114,200	$10,198,300
11	455.0	$10,314,700	$209,400	$115,800	$10,430,500

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$13,200	$3,700	$5,500	$18,700
14	3.0	$62,500	$17,500	$8,800	$71,300
15	7.0	$128,300	$36,000	$13,200	$141,500
16	16.0	$2,007,300	$515,300	$125,700	$2,133,000
17	30.0	$7,526,100	$1,901,300	$439,100	$7,965,200
18	56.0	$10,768,000	$2,753,500	$630,800	$11,398,800
19	100.0	$57,570,900	$15,324,100	$3,583,900	$61,154,800
20	179.0	$73,418,100	$19,865,500	$5,089,500	$78,507,600
21	294.0	$91,500,800	$24,739,300	$6,515,400	$98,016,200
22	455.0	$100,390,700	$27,197,500	$7,269,700	$107,660,400

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

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LONG BEACH, NY FEASIBILIT. ..UDY
REACH 5 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

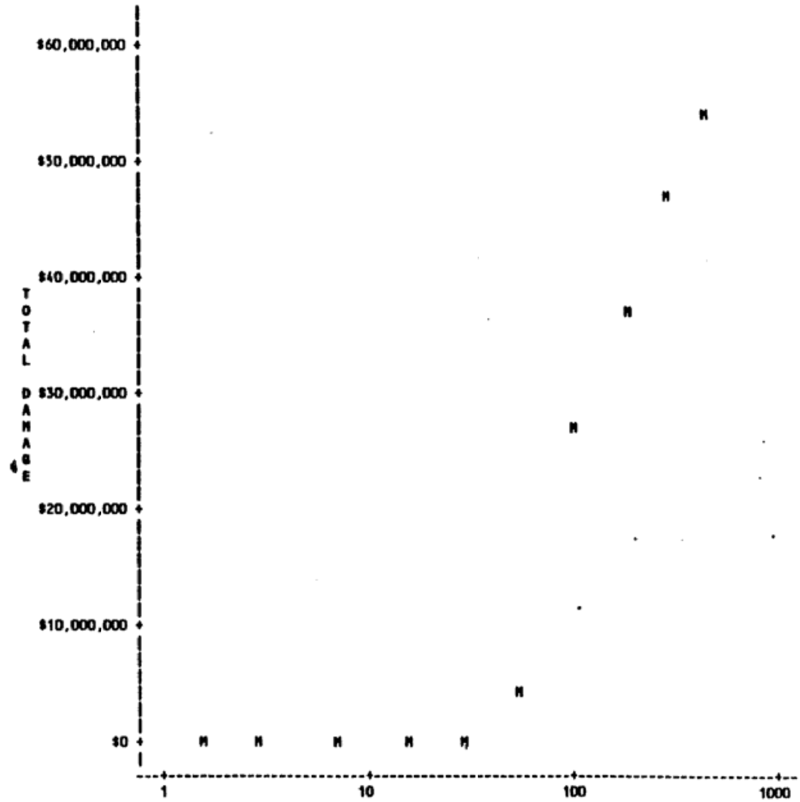
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	$13,900	$300	$100	$14,000
3	3.0	$23,000	$600	$200	$23,200
4	7.0	$24,400	$600	$200	$24,600
5	16.0	$109,700	$2,900	$1,100	$110,800
6	30.0	$298,500	$9,300	$3,100	$301,600
7	56.0	$1,272,700	$14,700	$75,600	$1,348,300
8	100.0	$3,006,200	$25,100	$118,600	$3,124,800
9	179.0	$3,915,300	$30,200	$139,200	$4,054,500
10	294.0	$5,494,800	$424,500	$153,300	$5,648,100
11	455.0	$8,089,600	$783,600	$171,900	$8,261,500

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	$2,900	.	$200	$3,100
17	30.0	$8,500	.	$600	$9,100
18	56.0	$2,267,500	$645,000	$69,300	$2,336,800
19	100.0	$22,812,200	$6,496,600	$1,049,500	$23,861,700
20	179.0	$31,883,100	$9,055,100	$1,639,300	$33,522,400
21	294.0	$39,554,300	$11,157,000	$2,123,000	$41,677,300
22	455.0	$43,864,200	$12,280,700	$2,385,200	$46,249,400

LONG BEACH, NY FEASIBILI1. .:UDY
REACH 5 - BASE YEAR CONDITIONS
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILIT. ..UDY
REACH 6 - BASE YEAR CONDITIONS
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITHOUT PROJECT-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

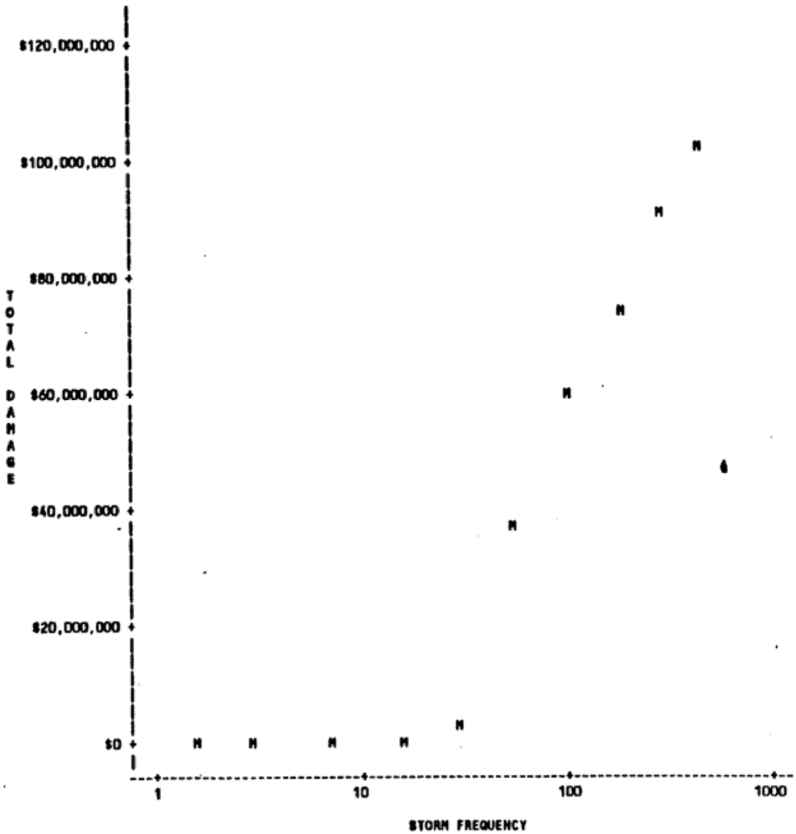
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	$17,500	$4,200	$200	$17,700
4	7.0	$431,900	$53,700	$5,100	$437,000
5	16.0	$606,200	$62,600	$8,600	$614,800
6	30.0	$1,349,300	$121,800	$12,900	$1,362,200
7	56.0	$11,238,100	$1,621,700	$178,500	$11,416,600
8	100.0	$15,137,700	$1,837,300	$245,500	$15,383,200
9	179.0	$17,736,700	$1,898,900	$289,300	$18,026,000
10	294.0	$20,528,100	$2,101,600	$305,000	$20,833,100
11	455.0	$23,117,000	$3,152,100	$332,300	$23,449,300

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$8,900	$2,100	$400	$9,300
14	3.0	$45,600	$10,300	$2,100	$47,700
15	7.0	$47,300	$10,300	$2,100	$49,400
16	16.0	$94,400	$21,900	$4,600	$99,000
17	30.0	$755,200	$185,200	$38,400	$793,600
18	56.0	$25,605,800	$6,605,700	$1,348,000	$26,953,800
19	100.0	$43,561,100	$11,756,300	$2,299,600	$45,860,700
20	179.0	$53,040,200	$14,449,500	$3,062,900	$56,103,100
21	294.0	$66,370,700	$18,027,500	$4,028,600	$70,399,300
22	455.0	$75,878,500	$20,515,800	$4,639,100	$80,517,600

LONG BEACH, NY FEASIBILIT. ..UDY
REACH 6 - BASE YEAR CONDITIONS
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

SUB-APPENDIX D6

Without Project Equivalent Annual Damages

D6

JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH, NY
SUMMARY OF EQUIVALENT ANNUAL DAMAGES
MAXIMUM DAMAGE
W/O PROJECT CONDITIONS

DAMAGE TO EXISTING STRUCTURES	REACH						TOTAL
RESIDENTIAL STRUCTURES							
PHYSICAL	$982,700	$26,630	$9,077,300	$2,514,730	$748,030	$1,428,310	$14,779,700
EMERGENCY	$57,480	$1,260	$638,890	$158,640	$38,120	$78,840	$969,120
COMMERCIAL STRUCTURES							
PHYSICAL	$236,780	$70,800	$2,840,820	$228,870	$149,740	$730,700	$4,266,410
EMERGENCY	$4,720	$1,170	$53,710	$3,460	$2,490	$10,160	$75,700
OTHER STRUCTURES							
PHYSICAL	$72,820	$4,290	$703,230	$8,490	$4,040	$19,820	$818,390
EMERGENCY	$1,270	$210	$11,020	$190	$1,560	$280	$14,740
SUBTOTAL	$1,355,470	$103,350	$13,222,870	$2,812,190	$938,280	$2,274,110	$20,807,060
DAMAGE TO INFRASTRUCTURE							
INFRASTRUCTURE DAMAGE	$0	$0	$69,500	$84,910	$0	$0	$153,610
BOARDWALK/ACCESS RAMPS	$0	$0	$17,400	$0	$0	$12,400	$29,800
SUBTOTAL	$0	$0	$86,900	$84,910	$0	$12,400	$183,310
PUBLIC EMERGENCY COSTS							
EMERGENCY PROTECTION	$163	$12	$17,881	$3,931	$0	$0	$21,987
SAND/DEBRIS REMOVAL	$9,800	$8,100	$11,800	$3,400	$3,000	$8,100	$39,400
SUBTOTAL	$9,963	$8,112	$28,681	$7,331	$3,000	$8,100	$61,387
FUTURE PROTECTION COSTS							
SECTION 933 COSTS	$400,000	$0	$0	$0	$0	$0	$400,000
EXIST. STRUC. PROTECTION	$590	$0	$270	$0	$110	$0	$970
SUBTOTAL	$400,590	$0	$270	$0	$110	$0	$400,970
DAMAGE TO RECREATION							
RECREATION ENHANCEMENT	$1,348,650	$0	$0	$0	$0	$0	$1,348,650
RECREATION MAINTENANCE	$639,120	$0	$0	$0	$0	$0	$639,120
SUBTOTAL	$1,987,770	$0	$0	$0	$0	$0	$1,987,770
LOSS OF LAND DAMAGE							
LOSS OF LAND	$490	$0	$0	$0	$950	$0	$1,440
							TOTAL
TOTAL DAMAGE	$3,750,253	$108,462	$13,338,691	$3,003,821	$943,340	$2,294,610	$23,438,907

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EAST ROCK/ 'LET
TO
JONES INLET
LONG BEACH, NY
ANALYSIS OF ANNUAL DAMAGE
REACH 1, TOTAL DAMAGES

PROJ. LIF 50
DISCOUN 8.000%

YEAR	PROJECT YEAR	RESIDENTIAL PHYS	RESIDENTIAL EMER	COMMERCIAL PHYS	COMMERCIAL EMER	OTHER PHYS	EMER	TOTAL PHYS	EMER	PRESENT WORTH FACTOR
1992	-8	932339	53516	882481	12064	87209	1182	1882929	68784	1.7138
1994	-6							0	0	1.4693
2000	0	921517	53492	295840	5165	69223	1216	1286480	59873	0.9259
2001	1	925170	53757	287100	5084	69462	1220	1281432	60060.7	0.8573
2002	2	928824	54023	279453	5002	69701	1224	1278178	60249.4	0.7938
2003	3	932477	54288	271507	4921	69939	1227	1273923	60436.1	0.7350
2004	4	936130	54554	263361	4839	70178	1231	1269669	60623.8	0.6806
2005	5	939784	54819	255215	4758	70417	1235	1265416	60811.5	0.6302
2006	6	943437	55084	247068	4676	70656	1239	1261161	60999.2	0.5835
2007	7	947090	55350	238922	4595	70895	1243	1256907	61186.9	0.5403
2008	8	950743	55615	230776	4513	71133	1246	1252652	61374.6	0.5002
2009	9	954397	55881	222629	4432	71372	1250	1248398	61562.3	0.4632
2010	10	958050	56146	214483	4350	71611	1254	1244144	61750	0.4289
2011	11	965889	56568	213023	4351	71924	1258	1250836	62176.6	0.3971
2012	12	973728	56990	211562	4351	72237	1262	1257527	62603.2	0.3677
2013	13	981568	57412	210102	4352	72551	1266	1264219	63029.8	0.3405
2014	14	989408	57834	208642	4352	72864	1270	1270911	63456.4	0.3152
2015	15	997244	58256	207182	4353	73177	1275	1277603	63883	0.2919
2016	16	1005083	58677	205721	4354	73490	1279	1284294	64309.6	0.2703
2017	17	1012922	59099	204261	4354	73803	1283	1290986	64736.2	0.2502
2018	18	1020760	59521	202801	4355	74117	1287	1297678	65162.8	0.2317
2019	19	1028599	59943	201340	4355	74430	1291	1304369	65589.4	0.2145
2020	20	1036438	60365	199880	4356	74743	1295	1311061	66016	0.1987
2021	21	1046783	61011	199333	4402	75074	1300	1320180	66713.1	0.1839
2022	22	1055127	61658	198787	4447	75404	1305	1329298	67410.2	0.1703
2023	23	1064472	62304	198240	4493	75735	1310	1338417	68107.3	0.1577
2024	24	1073816	62951	197694	4539	76066	1315	1347536	68804.4	0.1460
2025	25	1083161	63597	197147	4585	76397	1320	1356654	69501.5	0.1352
2026	26	1092505	64243	196600	4630	76727	1325	1365773	70198.6	0.1252
2027	27	1101850	64890	196054	4676	77058	1330	1374891	70895.7	0.1159
2028	28	1111194	65536	195507	4722	77389	1335	1384010	71592.8	0.1073
2029	29	1120539	66183	194961	4767	77719	1340	1393129	72289.9	0.0994
2030	30	1129883	66829	194414	4813	78050	1345	1402247	72987	0.0920
2031	31	1133481	67128	194204	4879	78790	1373	1406474	73380.1	0.0852
2032	32	1137078	67427	193993	4945	79530	1401	1410701	73773.2	0.0789
2033	33	1140676	67726	193783	5011	80269	1429	1414928	74166.3	0.0730
2034	34	1144274	68025	193572	5077	81009	1457	1419155	74559.4	0.0676
2035	35	1147872	68325	193362	5143	81749	1485	1423383	74952.5	0.0626
2036	36	1151469	68624	193152	5209	82489	1513	1427610	75345.6	0.0580
2037	37	1155067	68923	192941	5275	83229	1541	1431837	75738.7	0.0537
2038	38	1158665	69222	192731	5341	83968	1569	1436064	76131.8	0.0497
2039	39	1162262	69521	192520	5407	84708	1597	1440291	76524.9	0.0460
2040	40	1165860	69820	192310	5473	85448	1625	1444518	76918	0.0426
2041	41	1169656	70162	192970	5490	85754	1630	1448380	77282.1	0.0395
2042	42	1173452	70504	192730	5507	86060	1635	1452242	77646.2	0.0365
2043	43	1177248	70847	192490	5524	86366	1640	1456104	78010.3	0.0338
2044	44	1181044	71189	192250	5541	86672	1645	1459966	78374.4	0.0313
2045	45	1184841	71531	192011	5558	86978	1650	1463829	78738.5	0.0290
2046	46	1188637	71873	191771	5575	87283	1654	1467691	79102.6	0.0269
2047	47	1192433	72216	191531	5592	87589	1659	1471553	79466.7	0.0249
2048	48	1196229	72558	191291	5609	87896	1664	1475415	79830.8	0.0230
2049	49	1200025	72900	191051	5626	88201	1669	1479277	80194.9	0.0213
2050	50	1203821	73242	190811	5643	88507	1674	1483139	80559	

YEAR	PRESENT WORTH RESIDENTIAL PHYSICAL	PRESENT WORTH RESIDENTIAL EMERGENCY	PRESENT WORTH COMMERCIAL PHYSICAL	PRESENT WORTH COMMERCIAL EMERGENCY	PRESENT WORTH OTHER PHYSICAL	PRESENT WORTH OTHER EMERGENCY
1992						
1994						
2000	$853,285	$49,530	$274,025	$4,780	$64,095	$1,125
2001	$793,185	$46,090	$246,740	$4,360	$59,550	$1,045
2002	$737,330	$42,885	$222,000	$3,970	$55,330	$970
2003	$685,400	$39,905	$199,565	$3,615	$51,410	$905
2004	$637,115	$37,130	$179,240	$3,295	$47,760	$840
2005	$592,225	$34,545	$160,830	$3,000	$44,375	$780
2006	$550,485	$32,140	$144,160	$2,730	$41,225	$725
2007	$511,685	$29,905	$129,080	$2,480	$38,300	$670
2008	$475,610	$27,820	$115,445	$2,260	$35,580	$625
2009	$442,070	$25,885	$103,120	$2,055	$33,060	$580
2010	$410,890	$24,080	$91,990	$1,865	$30,715	$540
2011	$383,570	$22,455	$84,585	$1,730	$28,560	$500
2012	$358,040	$20,955	$77,790	$1,600	$26,560	$465
2013	$334,185	$19,545	$71,535	$1,480	$24,700	$430
2014	$311,900	$18,230	$65,775	$1,370	$22,970	$400
2015	$291,085	$17,005	$60,475	$1,270	$21,360	$370
2016	$271,645	$15,860	$55,600	$1,175	$19,860	$345
2017	$253,485	$14,790	$51,110	$1,090	$18,470	$320
2018	$236,520	$13,790	$46,990	$1,010	$17,175	$300
2019	$220,685	$12,860	$43,195	$935	$15,970	$275
2020	$205,895	$11,990	$39,705	$865	$14,850	$255
2021	$192,360	$11,220	$36,665	$810	$13,810	$240
2022	$179,765	$10,500	$33,855	$755	$12,840	$220
2023	$167,865	$9,825	$31,260	$710	$11,940	$205
2024	$156,795	$9,190	$28,860	$665	$11,105	$190
2025	$146,445	$8,600	$26,650	$620	$10,330	$180
2026	$136,765	$8,040	$24,605	$580	$9,605	$165
2027	$127,720	$7,520	$22,715	$540	$8,935	$155
2028	$119,260	$7,035	$20,975	$505	$8,305	$145
2029	$111,385	$6,575	$19,365	$470	$7,725	$135
2030	$103,965	$6,150	$17,880	$445	$7,180	$125
2031	$96,575	$5,720	$16,545	$415	$6,705	$115
2032	$89,705	$5,320	$15,310	$390	$6,275	$110
2033	$83,320	$4,945	$14,170	$365	$5,865	$105
2034	$77,390	$4,600	$13,110	$345	$5,480	$100
2035	$71,885	$4,280	$12,135	$320	$5,120	$95
2036	$66,770	$3,980	$11,230	$300	$4,785	$90
2037	$62,015	$3,700	$10,390	$285	$4,470	$85
2038	$57,600	$3,440	$9,615	$265	$4,175	$80
2039	$53,500	$3,200	$8,900	$250	$3,900	$75
2040	$49,690	$2,975	$8,235	$235	$3,640	$70
2041	$46,160	$2,770	$7,615	$215	$3,385	$65
2042	$42,880	$2,575	$7,045	$200	$3,145	$60
2043	$39,830	$2,395	$6,515	$185	$2,920	$55
2044	$37,000	$2,230	$6,025	$175	$2,715	$50
2045	$34,370	$2,075	$5,570	$160	$2,525	$50
2046	$31,925	$1,930	$5,150	$150	$2,345	$45
2047	$29,655	$1,795	$4,765	$140	$2,180	$40
2048	$27,545	$1,670	$4,405	$130	$2,025	$40
2049	$25,585	$1,555	$4,075	$120	$1,880	$35
2050						
SUM OF PRESENT WORT	$12,021,695	$703,215	$2,880,600	$87,685	$887,205	$15,585
CAPITAL RECOVERY FA	0.0817	0.0817	0.0817	0.0817	0.0817	0.0817
EQUIV ANNUAL DAMAGE	$982,700	$57,460	$235,780	$7,165	$72,485	$1,270

D6-2

EAST RC   \Y INLET

JONES INLET
LONG BEACH, NY
ANALYSIS OF ANNUAL DAMAGE
REACH 2, TOTAL DAMAGES

PROJ. LIFE= 50
DISCOUNT RA 8.000%

YEAR	PROJECT YEAR	RESIDENTIAL PHYS	RESIDENTIAL EMER	COMMERCIAL PHYS	COMMERCIAL EMER	OTHER PHYS	EMER	TOTAL PHYS	EMER	PRESENT WORTH FACTOR	PRESENT WORTH RESIDENTIAL PHYSICAL	PRESENT WORTH RESIDENTIAL EMERGENC	PRESENT WORTH COMMERCIAL PHYSICAL	PRESENT WORTH COMMERCIAL EMERGENC	PRESENT WORTH OTHER PHYSICAL	PRESENT WORTH OTHER EMERGENC
1992	-8	24029	1130	43628	838	4002	196	71868	2172	1.7138						
1994	-6							0	0	1.4693						
2000	0	24666	1178	52368	940	4123	204	81184	2322	0.9259	$22,840	$1,090	$48,488	$870	$3,820	$190
2001	1	24749	1185	53899	959	4137	205	82785.3	2349.9	0.8573	$21,229	$1,015	$46,210	$820	$3,546	$175
2002	2	24832	1193	55434	977	4151	206	84416.6	2376.8	0.7938	$19,716	$945	$44,005	$775	$3,295	$165
2003	3	24915	1200	56968	996	4164	207	86047.9	2402.7	0.7350	$18,315	$880	$41,875	$730	$3,060	$150
2004	4	24998	1207	58503	1015	4178	208	87679.2	2429.6	0.6806	$17,015	$820	$39,816	$690	$2,845	$140
2005	5	25082	1215	60037	1034	4192	209	89310.5	2456.5	0.6302	$15,805	$765	$37,835	$650	$2,640	$130
2006	6	25165	1222	61571	1052	4206	209	90941.8	2483.4	0.5835	$14,685	$715	$35,925	$615	$2,455	$120
2007	7	25248	1229	63106	1071	4220	210	92573.1	2510.3	0.5403	$13,640	$665	$34,095	$580	$2,280	$115
2008	8	25331	1236	64640	1090	4233	211	94204.4	2537.2	0.5002	$12,670	$620	$32,335	$545	$2,120	$105
2009	9	25414	1244	66175	1108	4247	212	95835.7	2564.1	0.4632	$11,770	$575	$30,650	$515	$1,965	$100
2010	10	25497	1251	67709	1127	4261	213	97467	2591	0.4289	$10,935	$535	$29,040	$485	$1,825	$90
2011	11	25579	1258	69310	1146	4275	214	99163.9	2617.6	0.3971	$10,158	$500	$27,525	$455	$1,700	$85
2012	12	25661	1266	70911	1165	4289	215	100860.8	2644.2	0.3677	$9,435	$465	$26,075	$430	$1,575	$80
2013	13	25742	1268	72512	1189	4303	217	102557.7	2670.8	0.3405	$8,765	$430	$24,690	$405	$1,465	$75
2014	14	25824	1269	74113	1210	4317	218	104254.6	2697.4	0.3152	$8,140	$400	$23,365	$380	$1,360	$70
2015	15	25906	1274	75715	1231	4331	219	105951.5	2724	0.2919	$7,560	$370	$22,100	$360	$1,265	$65
2016	16	25988	1279	77316	1252	4345	220	107648.4	2750.6	0.2703	$7,025	$345	$20,895	$340	$1,175	$60
2017	17	26070	1283	78917	1273	4359	221	109345.3	2777.2	0.2502	$6,525	$320	$19,750	$320	$1,090	$55
2018	18	26151	1288	80518	1293	4373	223	111042.2	2803.8	0.2317	$6,060	$300	$18,655	$300	$1,015	$50
2019	19	26233	1292	82119	1314	4387	224	112739.1	2830.4	0.2145	$5,630	$275	$17,620	$280	$940	$50
2020	20	26315	1297	83720	1335	4401	225	114436	2857	0.1987	$5,230	$260	$16,630	$265	$875	$45
2021	21	26400	1304	85822	1360	4415	226	116639.6	2890.1	0.1839	$4,855	$240	$15,785	$250	$815	$40
2022	22	26485	1311	87923	1386	4430	227	118843.0	2923.2	0.1703	$4,510	$225	$14,975	$235	$755	$40
2023	23	26570	1318	90025	1411	4453	227	121047.4	2956.3	0.1577	$4,190	$210	$14,195	$225	$700	$35
2024	24	26655	1325	92127	1437	4470	228	123251.2	2989.4	0.1460	$3,890	$195	$13,450	$210	$655	$35
2025	25	26740	1332	94229	1462	4487	229	125455	3022.5	0.1352	$3,615	$180	$12,740	$200	$605	$30
2026	26	26824	1339	96330	1487	4504	230	127658.8	3055.6	0.1252	$3,360	$170	-$12,060	$185	$565	$30
2027	27	26909	1346	98432	1513	4521	231	129862.6	3088.7	0.1159	$3,120	$155	$11,410	$175	$525	$25
2028	28	26994	1352	100534	1538	4539	231	132066.4	3121.8	0.1073	$2,895	$145	$10,790	$165	$485	$25
2029	29	27078	1359	102635	1564	4556	232	134270.2	3154.9	0.0994	$2,690	$135	$10,200	$155	$455	$25
2030	30	27164	1366	104737	1589	4573	233	136474	3188	0.0920	$2,500	$125	$9,635	$145	$420	$20
2031	31	27256	1371	106281	1607	4587	234	138133.2	3212	0.0852	$2,325	$115	$9,055	$135	$390	$20
2032	32	27347	1376	107824	1626	4601	235	139792.4	3236	0.0789	$2,160	$110	$8,505	$130	$365	$20
2033	33	27488	1380	109368	1644	4615	236	141451.6	3260	0.0730	$2,005	$100	$7,990	$120	$335	$15
2034	34	27570	1384	110911	1663	4629	237	143110.8	3284	0.0676	$1,865	$95	$7,500	$110	$315	$15
2035	35	27672	1389	112455	1681	4644	239	144770	3308	0.0626	$1,735	$85	$7,040	$105	$290	$15
2036	36	27773	1393	113998	1699	4658	240	146429.2	3332	0.0580	$1,610	$80	$6,610	$100	$270	$15
2037	37	27875	1398	115542	1718	4672	241	148088.4	3356	0.0537	$1,495	$75	$6,205	$90	$250	$15
2038	38	27976	1402	117085	1736	4686	242	149747.6	3380	0.0497	$1,390	$70	$5,820	$85	$235	$10
2039	39	28078	1407	118629	1755	4700	243	151406.8	3404	0.0460	$1,290	$65	$5,460	$80	$215	$10
2040	40	28179	1411	120173	1773	4714	244	153066	3428	0.0426	$1,200	$60	$5,120	$75	$200	$10
2041	41	28321	1427	121900	1794	4730	245	154950.4	3466	0.0395	$1,120	$55	$4,810	$70	$185	$10
2042	42	28462	1442	123627	1816	4746	246	156834.8	3504	0.0365	$1,040	$55	$4,515	$65	$175	$10
2043	43	28604	1458	125354	1837	4761	247	158719.2	3542	0.0338	$970	$50	$4,240	$60	$160	$10
2044	44	28745	1474	127081	1858	4777	248	160603.6	3580	0.0313	$900	$45	$3,980	$60	$150	$10
2045	45	28887	1490	128808	1880	4793	249	162488	3618	0.0290	$840	$45	$3,735	$55	$140	$5
2046	46	29029	1505	130535	1901	4809	250	164372.4	3656	0.0269	$780	$40	$3,505	$50	$130	$5
2047	47	29170	1521	132262	1922	4825	251	166256.8	3694	0.0249	$725	$40	$3,290	$50	$120	$5
2048	48	29312	1537	133989	1943	4840	252	168141.2	3732	0.0230	$675	$35	$3,085	$45	$110	$5
2049	49	29453	1552	135716	1966	4856	253	170025.6	3770	0.0213	$630	$35	$2,895	$40	$105	$5
2050	50	29595	1568	137443	1988	4872	254	171910	3808							
											$313,520	$15,325	$866,175	$14,280	$52,430	$2,530
											0.0817	0.0817	0.0817	0.0817	0.0817	0.0817
											$25,630	$1,250	$70,800	$1,170	$4,290	$210

D6-3

EAST ROCK INLET
TO
JONES INLET
LONG BEACH, NY
ANALYSIS OF ANNUAL DAMAGE
REACH 3, TOTAL DAMAGES

PROJ. LIF 50
DISCOUNT 8.000%

YEAR	PROJECT YEAR	RESIDENTIAL PHYS	RESIDENTIAL EMER	COMMERCIAL PHYS	COMMERCIAL EMER	OTHER PHYS	EMER	TOTAL PHYS	EMER	PRESENT WORTH FACTOR	PRESENT WORTH RESIDENTIAL PHYSICAL	PRESENT WORTH RESIDENTIAL EMERGENCY	PRESENT WORTH COMMERCIAL PHYSICAL	PRESENT WORTH COMMERCIAL EMERGENCY	PRESENT WORTH OTHER PHYSICAL	PRESENT WORTH OTHER EMERGENCY
1992	-8	6646676	361772	2020109	38790	283790	7838	8828479	398503	1.7138						
1994	-6							0	0	1.4693						
2000	0	7600520	409229	2267400	43600	480501	8414	10348420	461251	0.9259	$7,944,928	$378,018	$2,098,190	$40,380	$444,910	$7,790
2001	1	7742094	421168	2319045	44430	501156	8722	10562324	474320.2	0.8573	$6,637,600	$361,088	$1,988,205	$38,100	$429,685	$7,480
2002	2	7876648	433107	2380684	45268	521568	9030	10778222	487405.4	0.7938	$6,251,940	$343,815	$1,889,865	$35,938	$414,276	$7,170
2003	3	8009242	445047	2442324	46090	542553	9338	10994119	500482.6	0.7350	$5,887,030	$327,125	$1,795,180	$33,885	$398,798	$6,865
2004	4	8142818	456986	2503963	46928	563237	9646	11210017	513559.8	0.6806	$5,541,848	$311,018	$1,704,155	$31,940	$383,330	$6,565
2005	5	8276391	468925	2565603	47758	583922	9955	11425916	526637	0.6302	$5,215,830	$295,500	$1,616,765	$30,095	$367,970	$6,275
2006	6	8409966	480864	2627243	48587	604606	10263	11641813	539714.2	0.5835	$4,907,135	$280,580	$1,532,970	$28,350	$352,780	$5,990
2007	7	8543539	492803	2688882	49417	625290	10571	11857711	552791.4	0.5403	$4,615,810	$266,245	$1,452,720	$26,700	$337,825	$5,710
2008	8	8677113	504743	2750522	50247	645974	10879	12073608	565868.6	0.5002	$4,340,715	$252,495	$1,375,945	$25,135	$323,150	$5,440
2009	9	8810687	516682	2812161	51077	666659	11187	12289506	578945.8	0.4632	$4,081,055	$239,325	$1,302,575	$23,660	$308,790	$5,180
2010	10	8944261	528621	2873801	51907	687342	11495	12505404	592023	0.4289	$3,836,040	$226,715	$1,232,525	$22,260	$294,790	$4,930
2011	11	9060359	540782	2917734	52926	699800	11615	12673973	605302.1	0.3971	$3,598,405	$214,745	$1,160,670	$21,015	$277,930	$4,610
2012	12	9168458	552903	2961947	53943	712410	11734	12842842	618581.2	0.3677	$3,371,225	$203,300	$1,088,900	$19,835	$261,955	$4,315
2013	13	9280558	565046	3005600	54962	724955	11864	13011511	631860.3	0.3405	$3,159,870	$192,378	$1,023,290	$18,710	$246,820	$4,035
2014	14	9392055	577106	3049633	55980	737493	11974	13179600	645139.4	0.3152	$2,960,955	$181,865	$961,340	$17,645	$232,490	$3,778
2015	15	9504783	589327	3093466	56998	750031	12094	13348280	658418.6	0.2919	$2,774,345	$172,020	$902,965	$16,638	$218,926	$3,530
2016	16	9616881	601468	3137318	58016	762569	12213	13516819	671697.6	0.2703	$2,599,135	$162,560	$847,940	$15,680	$206,100	$3,300
2017	17	9728980	613609	3181331	59034	775107	12333	13686300	684976.7	0.2502	$2,434,660	$153,555	$796,125	$14,775	$193,970	$3,085
2018	18	9841048	625751	3225264	60053	787646	12453	13853957	698255.8	0.2317	$2,280,290	$144,995	$747,335	$13,915	$182,505	$2,885
2019	19	9953147	637892	3269197	61071	800182	12572	14022626	711534.9	0.2145	$2,135,430	$136,860	$701,400	$13,105	$171,690	$2,695
2020	20	10065245	650033	3313130	62089	812720	12692	14191095	724814	0.1987	$1,999,620	$129,135	$658,170	$12,335	$161,450	$2,520
2021	21	10198732	658695	3334096	63216	837833	12832	14370660	734742.1	0.1839	$1,875,900	$121,160	$613,275	$11,630	$154,110	$2,360
2022	22	10332220	667357	3355059	64341	862946	12972	14550225	744670.2	0.1703	$1,759,735	$113,660	$571,420	$10,960	$146,975	$2,210
2023	23	10465707	676019	3376024	65467	888060	13112	14729790	754598.3	0.1577	$1,650,435	$106,610	$532,385	$10,325	$140,045	$2,070
2024	24	10599195	684681	3396988	66593	913173	13252	14909355	764526.4	0.1460	$1,547,670	$99,975	$496,020	$9,725	$133,340	$1,935
2025	25	10732682	693344	3417953	67719	938286	13393	15088921	774454.5	0.1352	$1,451,000	$93,740	$462,115	$9,155	$126,860	$1,810
2026	26	10866169	702006	3438917	68844	963399	13533	15268486	784382.6	0.1252	$1,360,300	$87,890	$430,565	$8,620	$120,605	$1,695
2027	27	10999657	710668	3459882	69970	988512	13673	15448051	794310.7	0.1159	$1,275,010	$82,375	$401,050	$8,110	$114,585	$1,585
2028	28	11133144	719330	3480846	71096	1013626	13813	15627616	804238.8	0.1073	$1,194,995	$77,205	$373,590	$7,630	$108,790	$1,480
2029	29	11266632	727992	3501811	72222	1038739	13953	15807185	814166.9	0.0994	$1,119,650	$72,345	$348,000	$7,175	$103,225	$1,385
2030	30	11400119	736654	3522775	73348	1063852	14093	15986748	824095	0.0920	$1,048,995	$67,785	$324,150	$6,750	$97,890	$1,295
2031	31	11544085	739464	3552412	73678	1093864	14149	16190360	827490	0.0852	$983,665	$63,020	$302,665	$6,275	$93,195	$1,205
2032	32	11688050	742073	3582049	74008	1123876	14204	16393978	830885	0.0789	$922,060	$58,690	$282,605	$5,840	$88,660	$1,120
2033	33	11832016	744683	3611686	74338	1153888	14260	16597589	834280	0.0730	$864,275	$54,470	$263,615	$5,430	$84,285	$1,040
2034	34	11975981	748492	3641322	74668	1183900	14316	16801204	837675	0.0676	$809,990	$50,635	$246,260	$5,050	$80,075	$970
2035	35	12119947	751702	3670959	74998	1213913	14371	17004819	841070	0.0626	$759,005	$47,075	$229,890	$4,695	$76,020	$900
2036	36	12263912	754711	3700596	75327	1243925	14427	17208432	844465	0.0580	$711,130	$43,760	$214,560	$4,370	$72,130	$835
2037	37	12407878	757721	3730233	75657	1273937	14482	17412047	847860	0.0537	$666,185	$40,680	$200,280	$4,060	$68,400	$780
2038	38	12551843	760730	3759869	75987	1303949	14538	17615661	851255	0.0497	$623,995	$37,820	$186,915	$3,780	$64,820	$725
2039	39	12695809	763740	3789506	76317	1333961	14593	17819276	854650	0.0460	$584,400	$35,155	$174,435	$3,515	$61,405	$670
2040	40	12839774	766749	3819143	76647	1363973	14649	18022890	858045	0.0426	$547,245	$32,680	$162,775	$3,265	$58,135	$625
2041	41	13008306	769258	3859790	76827	1394190	14704	18262378	860788.7	0.0395	$513,365	$30,380	$152,325	$3,030	$55,020	$580
2042	42	13176998	771766	3900437	77007	1424426	14759	18501866	863532.4	0.0365	$481,600	$28,200	$142,525	$2,815	$52,080	$540
2043	43	13345609	774275	3941084	77187	1454661	14814	18741344	866276.1	0.0338	$451,835	$26,185	$133,345	$2,610	$49,215	$500
2044	44	13514221	776784	3981731	77367	1484877	14869	18980829	869019.8	0.0313	$423,370	$24,335	$124,740	$2,425	$46,620	$465
2045	45	13682833	779293	4022378	77547	1515103	14925	19220314	871763.5	0.0290	$396,900	$22,605	$116,660	$2,250	$43,950	$435
2046	46	13851446	781801	4063025	77726	1545329	14980	19459798	874507.2	0.0268	$372,030	$21,000	$109,125	$2,090	$41,605	$400
2047	47	14020057	784310	4103672	77906	1575555	15035	19699284	877250.9	0.0249	$348,665	$19,505	$102,055	$1,935	$39,185	$375
2048	48	14188669	786819	4144319	78086	1605781	15090	19938768	879994.6	0.0230	$326,720	$18,120	$95,430	$1,800	$36,975	$348
2049	49	14357280	789327	4184966	78266	1636007	15146	20178253	882738.3	0.0213	$306,115	$16,830	$89,230	$1,670	$34,880	$325
2050	50	14525892	791836	4225613	78446	1666233	15200	20417738	885482							
											----------------	$6,560,065	$34,749,815	$657,075	$8,602,975	$134,805
											0.0817	0.0817	0.0817	0.0817	0.0817	0.0817
											$9,077,300	$536,090	$2,840,620	$53,710	$703,230	$11,020

D6-4

EAST ROCK NLET
TO
JONES INLET
LONG BEACH, NY
ANALYSIS OF ANNUAL DAMAGE
REACH 4, TOTAL DAMAGES

PROJ. LIF 50
DISCOUNT 8.000%

	PROJECT	RESIDENTIAL		COMMERCIAL		OTHER		TOTAL		PRESENT WORTH	PRESENT WORTH RESIDENTIAL		PRESENT WORTH COMMERCIAL		PRESENT WORTH OTHER	
	YEAR	PHYS	EMER	PHYS	EMER	PHYS	EMER	PHYS	EMER	FACTOR	PHYSICAL	EMERGENCY	PHYSICAL	EMERGENC	PHYSICAL	EMERGENC
1992	-8	1103839	84844	128023	1769	4965	66	1313827	86689	1.7138						
1994	-4							0	0	1.4693						
2000	0	1610386	102824	138253	1900	5048	68	1803688	104492	0.9259	$1,388,605	$94,930	$128,010	$1,760	$4,675	$65
2001	1	1612216	108101	146295	1997	5231	71	1763741	110166.7	0.8573	$1,382,215	$92,680	$125,425	$1,710	$4,485	$60
2002	2	1714043	113678	154337	2094	5414	74	1873794	115845.4	0.7938	$1,360,645	$90,240	$122,520	$1,660	$4,300	$60
2003	3	1816072	119265	162379	2190	5696	76	1983640	121522.1	0.7350	$1,334,720	$87,655	$119,365	$1,610	$4,115	$55
2004	4	1917701	124832	170421	2287	5779	79	2093901	127198.8	0.6806	$1,305,165	$84,960	$115,985	$1,565	$3,935	$55
2005	5	2019530	130410	178464	2384	5961	82	2203954	132875.6	0.6302	$1,272,645	$82,190	$112,460	$1,500	$3,765	$50
2006	6	2121359	135987	186506	2481	6143	85	2314007	138552.2	0.5835	$1,237,790	$79,345	$108,825	$1,450	$3,585	$50
2007	7	2223187	141564	194548	2578	6326	88	2424060	144228.9	0.5403	$1,201,120	$76,490	$105,110	$1,395	$3,420	$45
2008	8	2325016	147141	202590	2674	6508	90	2534114	149905.6	0.5002	$1,163,065	$73,605	$101,345	$1,340	$3,255	$45
2009	9	2426844	152718	210632	2771	6691	93	2644167	155582.3	0.4632	$1,124,100	$70,740	$97,565	$1,285	$3,100	$45
2010	10	2528673	158295	218674	2868	6873	96	2754220	161259	0.4289	$1,084,500	$67,890	$93,785	$1,230	$2,950	$40
2011	11	2629108	163771	227891	3058	6936	99	2863626	166920	0.3971	$1,044,065	$65,035	$90,390	$1,210	$2,760	$40
2012	12	2729837	169247	236607	3231	6980	102	2973032	172581	0.3677	$1,003,845	$62,230	$86,965	$1,190	$2,570	$40
2013	13	2829969	174723	245424	3413	7045	106	3082438	178242	0.3405	$963,495	$59,485	$83,655	$1,160	$2,400	$35
2014	14	2930401	180199	254341	3594	7103	110	3191844	183903	0.3152	$923,785	$56,805	$80,160	$1,135	$2,240	$35
2015	15	3030833	185675	263258	3776	7160	113	3301250	189564	0.2919	$884,870	$54,195	$76,840	$1,100	$2,090	$35
2016	16	3131264	191152	272174	3957	7217	116	3410656	195225	0.2703	$846,285	$51,660	$73,560	$1,070	$1,950	$30
2017	17	3231696	196628	281091	4139	7275	120	3520062	200886	0.2502	$808,730	$49,205	$70,345	$1,035	$1,820	$30
2018	18	3332128	202104	290008	4320	7332	123	3629468	206547	0.2317	$772,095	$46,830	$67,200	$1,000	$1,700	$30
2019	19	3432560	207580	298924	4502	7390	127	3738874	212208	0.2145	$736,450	$44,535	$64,135	$965	$1,585	$25
2020	20	3532992	213056	307841	4683	7447	130	3848280	217869	0.1987	$701,855	$42,325	$61,165	$930	$1,480	$25
2021	21	3561867	215351	316716	4981	7483	132	3886165	220463.3	0.1839	$655,190	$39,610	$58,255	$915	$1,375	$25
2022	22	3590841	217645	325591	5279	7519	134	3924051	223057.6	0.1703	$611,890	$37,070	$55,455	$900	$1,290	$25
2023	23	3619815	219940	334465	5577	7555	135	3961938	225651.9	0.1577	$570,860	$34,685	$52,745	$880	$1,190	$20
2024	24	3648890	222234	343340	5876	7591	137	3999821	228246.2	0.1460	$532,805	$32,450	$50,135	$860	$1,110	$20
2025	25	3677865	224529	352215	6173	7627	139	4037707	230840.5	0.1352	$497,255	$30,355	$47,620	$835	$1,030	$20
2026	26	3706839	226823	361090	6471	7663	141	4075592	233434.8	0.1252	$464,045	$28,395	$45,205	$810	$940	$20
2027	27	3735814	229118	369965	6769	7699	143	4113477	236029.1	0.1159	$433,030	$26,560	$42,885	$785	$890	$15
2028	28	3764789	231412	378839	7067	7735	144	4151362	238623.4	0.1073	$404,065	$24,835	$40,650	$760	$830	$15
2029	29	3793763	233707	387714	7365	7771	146	4189246	241217.7	0.0994	$377,015	$23,225	$38,530	$730	$770	$15
2030	30	3822737	236001	396589	7663	7807	148	4227133	243812	0.0920	$351,765	$21,715	$36,495	$705	$720	$15
2031	31	3806582	235540	395726	7658	7830	149	4210537	243347.4	0.0852	$324,320	$20,070	$33,715	$650	$665	$15
2032	32	3790426	235079	394863	7654	7853	150	4193542	242882.8	0.0789	$299,025	$18,545	$31,160	$600	$620	$10
2033	33	3774271	234618	394000	7649	7876	151	4176546	242418.2	0.0730	$275,535	$17,140	$28,700	$560	$575	$10
2034	34	3758115	234157	393137	7644	7899	152	4159551	241953.6	0.0676	$254,100	$15,835	$26,590	$515	$535	$10
2035	35	3741960	233697	392274	7640	7922	153	4142555	241489	0.0626	$234,340	$14,635	$24,565	$480	$495	$10
2036	36	3725804	233236	391411	7635	7944	154	4125559	241024.4	0.0580	$216,045	$13,525	$22,695	$445	$460	$10
2037	37	3709649	232775	390548	7630	7967	155	4108564	240559.8	0.0537	$199,175	$12,500	$20,970	$410	$430	$10
2038	38	3693493	232314	389685	7626	7990	156	4091568	240095.2	0.0497	$183,615	$11,550	$19,375	$380	$395	$10
2039	39	3677338	231853	388822	7621	8013	157	4074573	239630.5	0.0460	$169,270	$10,670	$17,900	$350	$370	$5
2040	40	3661182	231392	387959	7616	8036	158	4057577	239166	0.0426	$156,045	$9,860	$16,535	$325	$345	$5
2041	41	3686458	232801	389289	7629	8071	159	4083818	240588.3	0.0395	$145,485	$9,185	$15,365	$300	$320	$5
2042	42	3711734	234209	390619	7641	8106	160	4110458	242010.6	0.0365	$135,630	$8,560	$14,275	$280	$295	$5
2043	43	3737010	235618	391948	7654	8140	161	4137099	243432.9	0.0338	$126,440	$7,970	$13,260	$260	$275	$5
2044	44	3762286	237026	393278	7666	8175	162	4163739	244855.2	0.0313	$117,865	$7,425	$12,320	$240	$255	$5
2045	45	3787562	238435	394608	7679	8210	164	4190380	246277.5	0.0290	$109,865	$6,915	$11,445	$225	$240	$5
2046	46	3812837	239844	395938	7692	8245	165	4217020	247699.8	0.0268	$102,410	$6,440	$10,635	$205	$220	$5
2047	47	3838113	241252	397268	7704	8280	166	4243661	249122.1	0.0249	$95,450	$6,000	$9,880	$190	$205	$5
2048	48	3863389	242661	398597	7717	8314	167	4270301	250544.4	0.0230	$88,960	$5,590	$9,180	$180	$190	$5
2049	49	3888665	244069	399927	7729	8349	168	4296942	251966.7	0.0213	$82,910	$5,205	$8,525	$165	$180	$5
2050	50	3913941	245478	401257	7742	8384	169	4323582	253389							
											$30,783,900	$1,939,830	$2,799,845	$42,235	$79,385	$1,225
											0.0817	0.0817	0.0817	0.0817	0.0817	0.0817
											$2,514,730	$158,840	$228,870	$3,450	$6,490	$100

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EAST ROC[illegible] INLET
T[illegible]
JONES INLE[illegible]
LONG BEACH, NY
ANALYSIS OF ANNUAL DAMAGE
REACH 6, TOTAL DAMAGES

PROJ. LIF 50
DISCOUNT 8.000%

YEAR	PROJECT YEAR	RESIDENTIAL PHYS	RESIDENTIAL EMER	COMMERCIAL PHYS	COMMERCIAL EMER	OTHER PHYS	EMER	TOTAL PHYS	EMER	PRESENT WORTH FACTOR	PRESENT WORTH RESIDENTIAL PHYSICAL	PRESENT WORTH RESIDENTIAL EMERGENCY	PRESENT WORTH COMMERCIAL PHYSICAL	PRESENT WORTH COMMERCIAL EMERGENCY	PRESENT WORTH OTHER PHYSICAL	PRESENT WORTH OTHER EMERGENCY
1992	-8	457784	22783	113041	1764	2898	1248	573492	25795	1.7138						
1994	-6							0	0	1.4693						
2000	0	472211	23554	104349	1806	2948	1257	579508	26616	0.9259	$437,230	$21,810	$96,620	$1,670	$2,730	$1,165
2001	1	490300	24430	106952	1840	2998	1260	600250	27530	0.8573	$420,355	$20,945	$91,695	$1,575	$2,570	$1,090
2002	2	508389	25305	109554	1874	3049	1264	620992	28443	0.7938	$403,575	$20,090	$86,970	$1,490	$2,420	$1,005
2003	3	526478	26181	112157	1909	3099	1267	641734	29357	0.7350	$386,975	$19,245	$82,440	$1,405	$2,280	$930
2004	4	544567	27056	114760	1943	3150	1270	662476	30270	0.6806	$370,625	$18,415	$78,100	$1,325	$2,145	$865
2005	5	562656	27932	117363	1978	3200	1274	683218	31184	0.6302	$354,670	$17,560	$73,960	$1,245	$2,015	$805
2006	6	580745	28808	119965	2013	3250	1277	703961	32097	0.5835	$338,840	$16,815	$70,000	$1,175	$1,895	$745
2007	7	598834	29683	122568	2047	3301	1280	724703	33011	0.5403	$323,530	$16,035	$66,220	$1,105	$1,785	$690
2008	8	616923	30559	125171	2082	3351	1283	745445	33924	0.5002	$308,615	$15,285	$62,615	$1,040	$1,675	$640
2009	9	635012	31434	127773	2116	3402	1287	766187	34838	0.4632	$294,135	$14,560	$59,185	$980	$1,575	$595
2010	10	653101	32310	130376	2151	3452	1290	786929	35751	0.4289	$280,105	$13,855	$55,915	$925	$1,490	$555
2011	11	686494	33767	136666	2254	3619	1396	826778	37417	0.3971	$272,615	$13,410	$54,270	$895	$1,435	$555
2012	12	719887	35224	142955	2356	3786	1502	866627	39082	0.3677	$264,700	$12,950	$52,565	$865	$1,390	$550
2013	13	753281	36680	149244	2459	3952	1609	906476	40748	0.3405	$256,485	$12,480	$50,810	$835	$1,345	$550
2014	14	786674	38137	155533	2561	4119	1715	946325	42413	0.3152	$247,990	$12,020	$49,030	$805	$1,300	$540
2015	15	820067	39594	161822	2664	4286	1821	986175	44079	0.2919	$239,370	$11,555	$47,235	$775	$1,260	$530
2016	16	853460	41051	168111	2766	4452	1927	1026024	45744	0.2703	$230,665	$11,095	$45,435	$760	$1,205	$520
2017	17	886853	42508	174400	2869	4619	2033	1065873	47410	0.2502	$221,835	$10,635	$43,645	$725	$1,155	$510
2018	18	920247	43964	180690	2971	4786	2140	1105722	49075	0.2317	$213,230	$10,185	$41,870	$690	$1,110	$495
2019	19	953640	45421	186979	3074	4952	2246	1145571	50741	0.2145	$204,600	$9,745	$40,115	$665	$1,065	$490
2020	20	987033	46878	193268	3176	5119	2352	1185420	52406	0.1987	$196,000	$9,310	$38,395	$630	$1,015	$485
2021	21	1018340	48254	198792	3266	5313	2563	1222444	54083	0.1839	$187,315	$8,875	$36,665	$600	$975	$470
2022	22	1049647	49630	204315	3355	5507	2773	1259469	55759	0.1703	$178,770	$8,455	$34,880	$570	$940	$470
2023	23	1080954	51007	209839	3445	5700	2984	1296493	57436	0.1577	$170,445	$8,045	$33,090	$545	$900	$470
2024	24	1112261	52383	215362	3535	5894	3195	1333518	59112	0.1460	$162,410	$7,650	$31,445	$515	$880	$465
2025	25	1143568	53760	220886	3625	6088	3406	1370542	60788	0.1352	$154,610	$7,270	$29,855	$490	$825	$460
2026	26	1174875	55136	226410	3714	6282	3616	1407566	62465	0.1252	$147,090	$6,900	$28,345	$465	$785	$455
2027	27	1206182	56511	231933	3804	6476	3827	1444591	64142	0.1159	$139,815	$6,550	$26,855	$440	$750	$445
2028	28	1237489	57888	237457	3894	6669	4038	1481615	65819	0.1073	$132,615	$6,215	$25,405	$425	$715	$435
2029	29	1268796	59264	242980	3983	6863	4248	1518640	67495	0.0994	$126,090	$5,890	$24,145	$395	$680	$420
2030	30	1300103	60640	248504	4073	7057	4459	1555664	69172	0.0920	$119,630	$5,580	$22,865	$375	$650	$410
2031	31	1332320	62227	252283	4141	7095	4464	1591689	70832	0.0852	$113,515	$5,300	$21,495	$355	$605	$390
2032	32	1364538	63814	256062	4209	7132	4470	1627732	72492	0.0789	$107,645	$5,035	$20,200	$330	$565	$380
2033	33	1396755	65401	259841	4276	7170	4475	1663756	74152	0.0730	$102,025	$4,775	$18,980	$310	$520	$325
2034	34	1428973	66988	263620	4343	7208	4481	1699800	75812	0.0676	$96,650	$4,530	$17,830	$295	$490	$305
2035	35	1461190	68576	267399	4411	7246	4486	1735838	77473	0.0626	$91,505	$4,295	$16,745	$275	$455	$290
2036	36	1493407	70163	271178	4479	7283	4491	1771869	79133	0.0580	$86,595	$4,070	$15,720	$260	$420	$260
2037	37	1525625	71750	274957	4546	7321	4497	1807903	80793	0.0537	$81,910	$3,860	$14,765	$245	$395	$240
2038	38	1557842	73337	278736	4614	7359	4502	1843937	82453	0.0497	$77,445	$3,645	$13,865	$230	$365	$225
2039	39	1590060	74924	282515	4681	7396	4508	1879971	84113	0.0460	$73,190	$3,450	$13,005	$215	$340	$205
2040	40	1622277	76511	286294	4749	7434	4513	1916005	85773	0.0426	$69,145	$3,260	$12,200	$200	$315	$190
2041	41	1620239	76339	294834	4823	7471	4518	1922544	85680	0.0395	$63,940	$3,015	$11,635	$190	$295	$180
2042	42	1618201	76167	303374	4896	7508	4524	1929082	85587	0.0365	$59,130	$2,785	$11,080	$180	$275	$165
2043	43	1616163	75996	311913	4970	7545	4529	1935621	85494	0.0338	$54,680	$2,570	$10,555	$170	$255	$155
2044	44	1614125	75824	320453	5043	7582	4535	1942160	85401	0.0313	$50,615	$2,375	$10,040	$160	$240	$140
2045	45	1612087	75652	328993	5117	7619	4540	1948699	85309	0.0290	$46,760	$2,195	$9,545	$150	$220	$130
2046	46	1610048	75480	337533	5190	7656	4545	1955237	85216	0.0269	$43,245	$2,025	$9,065	$140	$205	$120
2047	47	1608010	75308	346073	5264	7693	4551	1961776	85123	0.0249	$39,990	$1,875	$8,605	$130	$190	$115
2048	48	1605972	75137	354612	5337	7730	4556	1968315	85030	0.0230	$36,980	$1,730	$8,165	$125	$180	$105
2049	49	1603934	74965	363152	5411	7767	4562	1974853	84937	0.0213	$34,200	$1,600	$7,745	$115	$165	$95
2050	50	1601896	74793	371692	5484	7804	4567	1981392	84844							
											9114340	441180	1831825	30464	49416	22740
											0.0817	0.0817	0.0817	0.0817	0.0817	0.0817
											$745,030	$36,120	$149,740	$2,490	$4,040	$1,860

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EAST ROCKAWAY INLET
TO
JONES INLET
LONG BEACH, NY
ANALYSIS OF ANNUAL DAMAGE
REACH 6, TOTAL DAMAGES

PROJ. LIF 50
DISCOUNT 8.000%

YEAR	PROJECT YEAR	RESIDENTIAL PHYS	RESIDENTIAL EMER	COMMERCIAL PHYS	COMMERCIAL EMER	OTHER PHYS	EMER	TOTAL PHYS	EMER	PRESENT WORTH FACTOR	PRESENT WORTH RESIDENTIAL PHYSICAL	PRESENT WORTH RESIDENTIAL EMERGENCY	PRESENT WORTH COMMERCIAL PHYSICAL	PRESENT WORTH COMMERCIAL EMERGENCY	PRESENT WORTH OTHER PHYSICAL	PRESENT WORTH OTHER EMERGENCY
1992	-8	986130	55895	403994	6174	16036	218	1404163	62388	1.7138						
1994	-6							0	0	1.4693						
2000	0	1168278	65372	606059	7344	17802	248	1689136	72964	0.9259	$1,079,655	$60,530	$447,845	$6,800	$16,485	$230
2001	1	1175930	65892	618046	7496	18046	251	1712016	73639.6	0.8573	$1,008,170	$56,490	$444,135	$6,425	$15,470	$215
2002	2	1185868	66413	631021	7648	18290	254	1734897	74318.2	0.7938	$941,165	$52,720	$421,640	$6,070	$14,520	$200
2003	3	1195241	66933	644002	7801	18534	257	1757777	74990.8	0.7350	$878,540	$49,200	$398,560	$5,735	$13,620	$190
2004	4	1204696	67454	656983	7953	18778	260	1780657	75668.4	0.6806	$820,030	$45,910	$379,075	$5,415	$12,780	$175
2005	5	1214652	67974	669965	8105	19022	263	1803538	76342	0.6302	$765,375	$42,835	$359,175	$5,110	$11,985	$165
2006	6	1224207	68494	682946	8257	19266	266	1826418	77017.6	0.5835	$714,315	$39,965	$340,145	$4,820	$11,240	$155
2007	7	1233862	69015	695927	8409	19509	269	1849298	77693.2	0.5403	$666,615	$37,285	$321,860	$4,545	$10,540	$145
2008	8	1243517	69535	708908	8562	19753	272	1872178	78368.8	0.5002	$622,070	$34,785	$304,605	$4,285	$9,880	$135
2009	9	1253173	70056	721889	8714	19997	275	1895059	79044.4	0.4632	$580,460	$32,450	$288,085	$4,035	$9,265	$125
2010	10	1262828	70576	734870	8866	20241	278	1917939	79720	0.4289	$541,605	$30,270	$272,285	$3,800	$8,680	$120
2011	11	1290073	72376	664162	9292	20722	285	1982946	81961.8	0.3971	$515,485	$28,740	$263,745	$3,690	$8,230	$115
2012	12	1333310	74178	693434	9717	21202	292	2047953	84103.8	0.3677	$490,260	$27,275	$254,975	$3,575	$7,795	$105
2013	13	1368162	75974	722716	10143	21683	299	2112961	86418.4	0.3405	$465,940	$25,865	$244,085	$3,455	$7,380	$100
2014	14	1403307	77773	751997	10568	22163	306	2177968	88547.2	0.3152	$442,540	$24,515	$237,060	$3,330	$6,985	$95
2015	15	1439052	79573	781279	10994	22644	313	2242975	90879	0.2919	$420,045	$23,225	$228,050	$3,210	$6,610	$90
2016	16	1474297	81372	810561	11420	23125	319	2307982	93110.8	0.2703	$398,455	$21,990	$219,070	$3,085	$6,250	$85
2017	17	1509542	83171	839843	11846	23605	326	2372990	95342.6	0.2502	$377,750	$20,815	$210,170	$2,965	$5,905	$80
2018	18	1544786	84970	869124	12271	24086	333	2437997	97574.4	0.2317	$357,945	$19,690	$201,385	$2,845	$5,580	$75
2019	19	1580031	86770	898406	12696	24566	340	2503004	99806.2	0.2145	$338,995	$18,615	$192,750	$2,725	$5,270	$75
2020	20	1615276	88569	927688	13122	25047	347	2568011	102038	0.1987	$320,885	$17,595	$184,290	$2,605	$4,975	$70
2021	21	1675435	91687	970129	13429	24642	344	2670117	105450.8	0.1839	$308,180	$16,865	$178,445	$2,470	$4,520	$65
2022	22	1735595	94804	1012582	13716	24078	341	2772223	108863	0.1703	$295,600	$16,145	$172,465	$2,335	$4,100	$60
2023	23	1795754	97922	1054985	14016	23591	338	2874329	112275.6	0.1577	$283,190	$15,440	$166,370	$2,210	$3,720	$55
2024	24	1855913	101039	1097417	14314	23105	335	2976435	115688	0.1460	$270,995	$14,755	$160,245	$2,090	$3,375	$50
2025	25	1916073	104157	1139849	14612	22620	332	3078541	119100.6	0.1352	$259,055	$14,080	$154,110	$1,975	$3,060	$45
2026	26	1976232	107274	1182281	14910	22134	329	3180647	122513	0.1252	$247,400	$13,430	$148,005	$1,865	$2,770	$40
2027	27	2036391	110392	1224713	15208	21649	326	3282753	125925.6	0.1159	$236,045	$12,795	$141,960	$1,765	$2,510	$40
2028	28	2096550	113509	1267145	15506	21163	323	3384859	129338	0.1073	$225,020	$12,180	$136,000	$1,665	$2,270	$35
2029	29	2156710	116627	1309578	15804	20678	320	3486965	132750.6	0.0994	$214,330	$11,590	$130,140	$1,570	$2,055	$30
2030	30	2210869	119744	1352010	16102	20192	317	3589071	136163	0.0920	$203,390	$11,020	$124,405	$1,480	$1,860	$30
2031	31	2263342	121616	1368096	16433	19311	307	3640748	138356.7	0.0852	$191,985	$10,360	$116,660	$1,400	$1,645	$25
2032	32	2289614	123487	1384101	16765	18430	296	3692425	140648.4	0.0789	$180,640	$9,740	$109,195	$1,320	$1,455	$25
2033	33	2326207	125359	1400287	17096	17649	286	3744102	142741.1	0.0730	$169,925	$9,165	$102,285	$1,250	$1,280	$20
2034	34	2362780	127231	1416352	17428	16868	276	3795779	144933.8	0.0676	$159,805	$8,605	$95,795	$1,180	$1,125	$20
2035	35	2399232	129103	1432439	17759	15787	265	3847456	147126.5	0.0626	$150,250	$8,085	$89,705	$1,110	$990	$15
2036	36	2435704	130974	1448523	18090	14906	255	3899133	149319.2	0.0580	$141,235	$7,595	$83,995	$1,050	$865	$15
2037	37	2472177	132846	1464609	18422	14025	244	3950810	151511.9	0.0537	$132,730	$7,135	$78,635	$990	$755	$15
2038	38	2508649	134718	1480694	18753	13144	234	4002487	153704.6	0.0497	$124,715	$6,695	$73,610	$930	$655	$10
2039	39	2545122	136589	1496780	19085	12263	223	4054164	155897.3	0.0460	$117,155	$6,285	$68,900	$880	$565	$10
2040	40	2581594	138461	1512865	19416	11382	213	4105841	158090	0.0426	$110,030	$5,900	$64,450	$830	$485	$10
2041	41	2565120	137673	1525367	19576	11334	212	4101821	157460.7	0.0395	$101,230	$5,435	$60,195	$775	$445	$10
2042	42	2548646	136884	1537869	19736	11285	211	4097800	156831.4	0.0365	$93,130	$5,000	$56,195	$720	$410	$10
2043	43	2532172	136096	1550371	19896	11237	210	4093780	156202.1	0.0338	$85,675	$4,605	$52,455	$675	$380	$5
2044	44	2515698	135308	1562873	20056	11188	209	4089759	155572.8	0.0313	$78,810	$4,240	$48,960	$630	$350	$5
2045	45	2499225	134520	1575375	20216	11140	209	4085739	154943.5	0.0290	$72,495	$3,900	$45,695	$585	$325	$5
2046	46	2482751	133731	1587877	20375	11091	208	4081719	154314.2	0.0268	$66,685	$3,590	$42,650	$545	$300	$5
2047	47	2466277	132943	1600379	20535	11043	207	4077678	153684.9	0.0249	$61,335	$3,305	$39,800	$510	$275	$5
2048	48	2449803	132155	1612881	20695	10994	206	4073678	153055.6	0.0230	$56,410	$3,045	$37,140	$475	$255	$5
2049	49	2433329	131368	1625383	20855	10946	205	4069657	152426.3	0.0213	$51,880	$2,800	$34,655	$445	$235	$5
2050	50	2416855	130578	1637886	21015	10897	204	4065637	151797							
											$17,434,455	$964,645	$9,049,070	$124,265	$242,485	$3,415
											0.0817	0.0817	0.0817	0.0817	0.0817	0.0817
											$1,424,310	$78,840	$739,700	$10,150	$19,820	$280

D6-7

SUB-APPENDIX D7

Recreation Benefits

D7

NED RECREATION BENEFITS

ATLANTIC COAST OF LONG ISLAND, JONES INLET TO EAST ROCKAWAY LONG BEACH ISLAND

D 7-1

NED RECREATION BENEFITS

ATLANTIC COAST OF LONG ISLAND, JONES INLET TO EAST ROCKAWAY LONG BEACH ISLAND

TABLE OF CONTENTS

Baseline 1992
Summary of Annual Benefits

	Project 1 Incremental Benefits Above "Without Project" Condition	Project 2 (Larger than Project 1) Incremental Benefits Above "With Project 1" Condition
Type Of Benefit		
A. Beaches at Long Beach		
1) Daily Pass Visitors	$167,170	$20,416
2) Season Pass Visitors	$165,978	$36,382
3) Increase in Visitation	$219,222	N/A
B. Beaches at Point Lookout		
1) Current Visits	$169,842	$41,813
2) Increase in Visitation	$111,176	N/A
C. Nassau & Lido Beaches		
1) "Switchers"	N/A	$104,704
2) "Increase" in Visits	N/A	$159,102
Total	$833,388	$362,417

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I. PURPOSE AND OVERVIEW

1. Purpose of the analysis

The purpose of this study is to develop estimates of National Economic Development (NED) recreational benefits produced by a beach improvement project that covers the beaches from Long Beach to Jones Inlet.

Implementation of the project will widen the beaches within the study area. Increasing the width of existing beaches will create the potential for an enhanced recreation experience which may be reflected in an increase in willingness to pay (WTP) for the recreation experience, an increase in visitation, or both.

2. Statement of the 'without and 'with-project' condition

The "without project" condition is to maintain the beaches at present beach widths. The "with project" condition is to widen and maintain the beaches at Long Beach, Point Lookout and Lido West. All of the beaches in this area would be restored and maintained to a width of approximately 372 feet. An alternative 'with project' condition, a beach width of approximately 422 feet is compared with a beach width of 372 feet.

3. Description of the study area.

The impact of beach nourishment relates to the geographic recreation "market". The market is defined by the location of the potential user population. The potential user population is delineated as: people now using the Long Beach and Point Lookout beaches; and people now using the Nassau County and Lido East beaches who do not currently use the beaches at Long Beach and Point Lookout. People using the Nassau County beach (and Lido East) might transfer some of their beach visitations to Long Beach and Point Lookout from Nassau, or they might increase their total beach visitation with the increase taken at Long Beach and Point Lookout.

The people who visited the beaches at Long Beach during the summer of 1992-93 used either a day or season pass to enter the beach. The people who visited the beaches at Point Lookout and Nassau paid only for parking. We used an average of the 1992-93 beach visitation estimates in the analysis. The average was used because the number of passes sold in 1992 was significantly less than in 1993 due to bad weather conditions prevailing in 1992. An average of 1992-93 is used to provide a better estimate of annual visitation.

Three potential user populations are excluded from the study. Non-users of the beach are excluded. The study does not consider the potential demand for beach recreation of individuals whose maximum WTP for beach recreation currently falls below their travel costs or below the existing entry fee. Non-users of the beach might have a WTP for the improved Long Beach and Point Lookout beaches due to a perception that a wider beach provides an improved recreation experience. Potential "switchers" from other adjacent beaches (other than Nassau county and Lido beach users) might be willing to switch some or all of their visitations to the project beaches once the projects are implemented.

4. Introduction to Methodology

a) Simulated Demand Curve

The procedure for estimating the use value of a recreation site is to develop a Simulated Demand Curve. These demand curves are referred to as "simulated" since they are not based on actual market behavior, but on behavior in the hypothetical market. The concept of demand, in the instance of a beach visitor using a daily pass to enter the beach, describes the relationship between the number of annual visits (Quantity Demanded) people are willing to make at each WTP bid (Price). For a visitor using a season pass to enter the beach, quantity demanded is measured by the number of people using a season pass rather than the number of annual visits. The use value is estimated as the area under the demand curve.

b) Contingent Valuation Method

The information necessary to develop a simulated demand curve was obtained from a survey. The survey was conducted during the *July through August* months in 1992. Respondents were asked about their WTP for the 'without' and 'with-project' conditions, and about their visitation patterns. The methodology described above is referred to as the contingent valuation method (CVM). The CVM questionnaires are displayed in Appendix 'A'.

Three CVM questionnaires were used. The first, referred to as Form #1, obtained information from respondents using the Long Beach beaches. The second, referred to as Form #2 obtained information from respondents using the beaches at Point Lookout. Information was gathered on WTP for the 'without' and 'with-project' conditions as well as WTP for the alternative 'with-project' condition, summer 1992 visitation patterns to the New York beaches, and visitation to the New York beaches under the 'without' and 'with-project' conditions. The information gathered from Form #1 and Form #2 was used to estimate use value for people now using the Long Beach and Point Lookout beaches.

The third questionnaire, referred to as Form #3, obtained information from respondents using the Nassau County beaches. Information was gathered on WTP for the 'without' and 'with-project' conditions. Information was also gathered on the WTP to switch to the use of the beaches at Long Beach and Point Lookout once the nourishment project ("with project" condition) is implemented.

c) Incremental WTP

The WTP question for the 'without project' condition elicits a respondent's incremental or additional WTP, above what the cost was to use the beach during the summer of 1992. Only Long Beach charges a fee to use the beach. The fees charged for a beach pass at Long Beach is displayed in Table I-A.

Table I-A

Fees charged at Long Beach by type of Beach Pass

Type of Pass	Fees Charged
Daily	$5.00
Long Island Railroad	$4.50
Economy	$65.00
Non-Resident Family	$65.00
Non-Resident Individual	$50.00
Senior	$10.00
Resident Individual	$30.00
Resident Family	$50.00

The WTP question for the 'with-project' condition elicits a respondent's incremental or additional WTP, above what they bid for the 'without project' condition. The incremental WTP approach yields direct estimates of the use value for the 'without and with project' conditions. It is not necessary to subtract the 'without project' project condition from the 'with-project' condition to yield a net use value.

d) Sampling Distribution

The sampling distribution method was used to derive the simulated demand curves. This approach uses the distribution of WTP bids and corresponding quantity demanded at each bid from the CVM survey. The bids are arranged in ascending order. Visits or number of people willing to pay each bid are cumulated on a greater than basis. The sample proportion of respondents or visits willing to pay each bid or greater represents an estimate of the proportion of the population at each bid. The sample distribution of WTP bids and the population willing to pay each bid or greater is the price and quantity demanded in the simulated demand curve.

II. SAMPLE DESIGN AND EVALUATION

1. Form #1: Existing Visitors to the beaches in Long Beach

The sample design specifies the location and number of interviews, and how respondents are selected. Interviews were conducted at three beach locations in Long Beach. The locations are: Kentucky, Edwards and Neptune. A total of 216 interviews were conducted.

The analysis of NED recreation benefits will be disaggregated by beach pass. Separate simulated demand functions will be estimated for people using a season and a daily pass. The demand functions for the season pass visitors is based on the number of people using the season pass and the WTP for an unlimited number of visits. The demand functions for the daily pass visitors is based on the number of visits and the WTP for each visit.

The number of interviews completed and sampling weights by beach pass are displayed in Table II-A.

Table II-A.

Completion Rate: The Number of Interviews by Beach, Pass and Day
Form #1

Location	**Total Number of Interviews Completed**		**Pass**		**Sampling Weight**	
	Weekday	Weekend	Daily	Season	Daily	Season
Kentucky	35	31	20	46	0.09	0.21
Edwards	38	53	64	27	0.30	0.13
Neptune	40	19	12	47	0.06	0.22
Total	*113*	*103*	*96*	*120*	*0.44*	*0.56*

Respondents that entered the beach with a daily pass accounted for 44 percent of the sample. The largest number of daily pass visitors were interviewed at Edwards (64 or 30 percent of the sample). Kentucky and Neptune accounted for the largest number of respondents entering the beach with a season pass.

The number of interviews by beach pass can be evaluated to determine the limits of error between the sample mean willingness to pay (WTP) and the true population mean WTP. The error is a measure of precision when using the sample distribution method for estimating NED benefits.

The tolerated error (using the sampling distribution approach) is expressed as the deviation between the sample mean and the population mean as a percentage of the population mean.

The formula is :

$$r = \sqrt{t^2 v^2 / n}$$

Where
- r is the tolerated error
- t is the tolerated risk expressed as a t-statistic specifying the confidence level of using the sample mean to estimate the population mean.
- v is the coefficient of variation or the standard deviation divided by the mean, and
- n is the sample size.

The above formula is solved using ten percent tolerated risk (t=1.282), substituting the actual sample size on the WTP bids, and the calculated coefficient of variation for the WTP bids. The results are displayed in Table II-B.

Table II-B

Tolerated Error for WTP bids
(Ten percent confidence level)
Form #1

WTP	Sample Size	Coefficient of Variation	Tolerated Error
WTP Without			
Daily Pass	93	1.62	21%
Season Pass	115	1.87	22%
WTP With Project 1			
Daily Pass	88	1.72	23%
Season Pass	104	1.85	23%
WTP With Project 2			
Daily Pass	81	6.5	93%
Season Pass	101	6.16	79%

One reason for the high coefficient of variation reported here is the structure of the WTP question. In this study respondents were asked about their incremental WTP for improvements to the beach using a payment card. The coefficient of variation in these kinds of surveys tends to be higher as compared to the total WTP approach where respondents are asked about their WTP for the beach under existing and improved conditions. The incremental WTP approach increases the number of zero bids. A large number of zero bids reduces the mean WTP relative to the standard deviation, thus increasing the coefficient of variation. For example, in the above sample there were approximately 63% valid zero bids for the "without project" case among daily pass visitors. Another reason for the high coefficient of variation is the relatively small sample size. A smaller sample size tends to increase the standard deviations thereby increasing the coefficient of variation.

2. **Form #2: Existing visitors to Point Lookout**

Interviews were conducted at Point Lookout East and Point Lookout West. A total of 167 interviews were conducted. The analysis of NED recreation benefits will be identical to those for Form #1 except that there will be no disaggregation by beach pass. The visitors only pay for parking. Entrance to the beach is free. All visitations are day visits.

The number of interviews completed at each location are displayed in Table II-C.
The coefficient of variation and tolerated error for WTP bids are displayed in Table II-D.

Table II-C.

Completion Rate: The Number of Interviews by Beach and Day
Form #2

Location	Total # of Interviews Completed	
	Weekday	Weekend
Point Lookout W	48	39
Point Lookout E	41	39
Total	*89*	*78*

Table II-D

Tolerated Error for WTP bids
(Ten percent confidence level)
Form #2

WTP	Sample Size	Coefficient of Variation	Tolerated Error
WTP Without	162	1.39	14%
WTP Project 1	154	1.15	12%
WTP Project 2	149	4.00	42%

The reasons for the high coefficient of variations would be the same as those for Form #1.

3. Form #3: Existing visitors to beaches at Nassau and Lido and potential 'switchers'

Form #3 is designed to estimate a) the use value of the beaches at Nassau and Lido East in their present condition (the "without project" condition), b) the use value of maintaining and preventing beach erosion at Nassau and Lido East (the "prevent erosion project" condition) and c) the use value of beach nourishment projects at Long Beach and Point Lookout to potential 'switchers' who currently do not use the beaches at either Long Beach or Point Lookout but might do so once the beach nourishment projects are implemented.

A total of 173 interviews were conducted at Nassau and Lido East. The number of interviews completed at each location are displayed in Table II-E. The coefficients of variation and tolerated error for WTP bids are displayed in Table II-F.

Table II-E.

Completion Rate: The Number of Interviews by Beach and Day
Form #3

Location	Total # of Interviews Completed	
	Weekday	Weekend
Lido East	27	35
Nassau	58	53
Total	***85***	***88***

Table II-F

Tolerated Error for WTP bids
(Ten percent confidence level)
Form #3

WTP	Sample Size	Coefficient of Variation	Tolerated Error
WTP Without	166	1.39	14%
WTP Prevent Erosion	163	1.04	10%
WTP Switch	43	0.85	17%

The reasons for the high coefficients of variation are the same as those for Forms #1 & 2.

4. Procedure to select respondents

The procedure for selecting respondents was:

Start at one end of the beach and position yourself at a diagonal to a line perpendicular to the beach. Proceed in this direction counting the number of individuals directly in your path until you come across the person who corresponds to the first random number (a random number card was utilized). If the questionnaire candidate is part of a group, interview the head of the household. If the person is less than 18 years old and no head of the household is present, go to the next randomly numbered person. If this person is not willing to cooperate with the survey make every effort to convince the person to participate. Should you be unsuccessful, go to the next randomly selected individual. Once you have completed the first interview, proceed along the same path until you reach the individual corresponding to the next random number. Repeat along successive diagonal paths until you reach the end of the beach and then repeat in the opposite direction.

5. Training session for interviewers

The focus of interviewer training was to highlight the technical details of the interviewing procedure and to furnish interviewers with experience on the interviewing and respondent selection process.

In addition to covering the project objectives, the training session provided an opportunity for personal interaction with the interviewers. The participation by the project director in the training session conveyed the feeling that the interviewers were important to the successful completion of the study. The session focused on recreation benefits, and mock interviews with all versions of the questionnaire. Source of bias and procedural problems that might be encountered were discussed. The interviewers were reminded not to provide supplementary information but to reread an item as many times as necessary. After the training session, interviewers completed questionnaires on the beach at all locations included in the sample design. Those questionnaires represented the pre-test. A comprehensive de-briefing session with the interviewers was held to evaluate any difficulty in the questionnaire or survey design.

III. DESCRIPTIVE STATISTICS

1. Trip Bias and Weighting Corrections

The sample distribution of visits does not correspond to the population distribution of visits, more so with the sample size being very small. Persons going to the beach more often are more likely to be selected as respondents. The information on visitation from the CV survey is subject to "trip bias".

The correction for the trip bias was to estimate the population average visitation from the sample data. The procedure is to divide the sample size by the sum of the inverse of visits for each case across all respondents in the sample.

The formula is:

$$Avg = [n / \sum (1/v_i)]$$

Where Avg is the average number of visits corrected for trip bias
n is the sample size
v_i is the number of visits for respondent i.

The correction for trip bias is presented in Table III-A. The adjustment for trip bias was performed based on a respondent's summer 1992 visitation to the survey beach. The sample mean visitation, as expected due to trip bias, is substantially larger than the mean visitation corrected for trip bias (the estimate of the population mean visits).

Table III-A

Mean Visitation to Survey Beaches (Summer of 1992)

Location	*Daily pass*		*Season Pass*	
	Actual From Survey	**Corrected For trip bias**	**Actual From Survey**	**Corrected For trip bias**
Long Beach	14.38	5.09	34.69	18.24
Point Lookout	19.2	9.14	N/A	N/A
Nassau County				
Nassau	15.07	6.71	N/A	N/A
Lido East	11.03	2.93	N/A	N/A

The existence of trip bias required that the survey information be adjusted for over representation of respondents that visit frequently. The correction was to weight the data items from each respondent by the inverse of visitation [$1/v_i$]: Where v_i is the summer 1992 visitation to the survey beach for each respondent. The weighting by the inverse of the summer 1992 visitation to the survey beach corrects the sample data for over representation of respondents that visit the beach frequently.

2. Descriptive Statistics from Form #1.

Descriptive statistics, sample means, standard deviations for the respondents entering the beaches in Long Beach with a daily or season pass are displayed in Table III-B. The information is stratified by the type of pass used to enter the beach as NED recreation benefits were estimated for each type of pass in case of Form #1.

The results of the mean difference test indicate that the characteristics of daily pass visitors tend to be statistically different than the characteristics of season pass visitors.

With respect to beach valuation, on average, daily pass visitors were willing to pay substantially less than season pass visitors for both maintaining the beach at existing conditions and for beach nourishment. This result is consistent with the fact that the daily pass bid was on a per visit basis and the season pass bid was on an annual basis.

Note the large number of "valid" zero bids. This is consistent with the incremental WTP approach. To identify outliers associated with protest responses on the beach valuation questions, respondents were asked to indicate the reason why they stated a maximum WTP of zero dollars. These questions were asked immediately after respondents had answered the "without" and "with" project valuation questions. A series of fixed response categories were presented along with an open ended category if a respondents reason did not fit one of the specified categories. A zero bid response was classified as "valid" if the respondent stated "that is (zero bid amount) what it ("without" and/or "with" project condition) is worth to me", or "worth more, but all can afford", or "beach fees already too high". Other responses ("not enough information", "did not want to place a dollar value", and "objected to way question was asked") were classified as protest bids.

Demographic characteristics were different for daily and season pass visitors. Respondents using a daily pass, on average, were younger, more likely to be employed full time and more likely to have a college education than season pass visitors. The percentage of female respondents was about the same for both daily and season pass visitors.

Beach visitation characteristics also tend to be different among daily and season pass visitors. Daily pass visitors were, on average, more likely to arrive by car.

Table III-B

Descriptive Statistics

(Means with Standard Deviations in Parenthesis)

Type of Question	Type of Respondent	
	Daily Pass	*Season Pass*
<u>Beach Valuation</u>		
Incremental WTP to Maintain Existing Condition (only positive bids) [percentage of valid 0 bids - Daily = 75.1%, Season = 74.7%]	$1.63 [.94]	$20.14 [32.37]
Incremental WTP with Project 1(only positive bids) [percentage of valid 0 bids - Daily = 49.1%, Season = 56.7%]	$1.44 [1.19]	$7.34 [9.58]
Incremental WTP with Project 2 (only positive bids) [percentage of valid 0 bids - Daily = 97%, Season = 97.3]	$0.01 [.10]	$0.42 [3.01]
% Certain of answers	65% [.49]	58% [.54]
% Stated Beach width Good/Excellent	82% [.40]	93% [.28]
<u>Demographic Characteristics</u>		
Age	33.71 [10.65]	41.58 [13.64]
% Age less than 30	41% [.51]	19% [.42]
% Employment Full Time	67% [.48]	65% [.52]
% Completed at least College Education	66% [.49]	55% [.54]
% Female	68% [.48]	69% [.50]
% Visiting with Children under 13	27% [.46]	32% [.50]
% Stated Beach Too crowded	18% [.39]	3% [.19]
% Arrived in Car	55% [.51]	41% [.53]
% Visit only on Weekends	55% [.51]	19% [.43]

% Day Visit	88% [.33]	41% [.53]

**Observations are weighted by the inverse of visitation to correct for trip bias.*

3. Descriptive Statistics from Form #2.

Descriptive statistics, sample means and standard deviations for respondents entering Point Lookout (Form #2) are displayed in Table III-C. All visitors entering these beaches pay only a parking fee. Thus all visitors to these beaches are considered to be day pass visitors.

Table III-C

Descriptive Statistics
(Means with Standard Deviations in Parenthesis)

Type of Question	Means
<u>**Beach Valuation**</u>	
Incremental WTP to Maintain Existing Condition (only positive bids) [percentage of valid 0 bids - 41.8%]	**$2.10 [1.74]**
Incremental WTP with Project 1 (only positive bids) [percentage of valid 0 bids - 26.5%]	**$1.57 [1.12]**
Incremental WTP with Project 2 (only positive bids) [percentage of Valid 0 bids - 90.2%]	**$2.73 [2.80]**
% Certain of answers	**55% [.51]**
% Stated Beach width Good/Excellent	**44% [.51]**
Parking Issue; % Stated Confusion/Concern	**97% [.19]**
Public Access Issue; % Not Aware	**80% [.41]**

Demographic Characteristics

Age	38.12 [12.51]
% Age less than 30	25% [.45]
% Employment Full Time	52% [.51]
% Completed at least College Education	46% [.51]
% Female	71% [.46]
% Visiting with Children under 13	36% [.50]
% Stated Beach Too crowded	25% [.44]
% Arrived in Car	99% [.08]
% Visit only on Weekends	28% [.46]
% Day Visit	90% [.31]

**Observations are weighted by the inverse of visitation to correct for trip bias.*

On Form #2 and #3 a question was asked to identify those respondents needing clarification about the parking fee at Point Lookout and Nassau beaches. These beaches charge no fee for beach use. Someone walking to the beach has access for no fee. Those arriving by car pay only for parking. Respondents, however, felt that the parking fee was actually a beach user fee. Interviewers were instructed to explain the distinction between a parking fee and a beach user fee, and then proceed with the questionnaire. Ninety seven percent of the respondents expressed confusion about the parking/beach user fee distinction.

3. Descriptive Statistics from Form #3.

Descriptive statistics, sample means and standard deviations for respondents entering Form #3 beaches are displayed in Table III-D(a) and III-D(b). All visitors entering these beaches pay only a parking fee. Thus all visitors to these beaches are considered to be day pass visitors.

Table III-D(a)

Descriptive statistics (Nassau Beach)
(Means with Standard Deviations in Parenthesis)

Type of Question	Means
<u>Beach Valuation</u>	
Incremental WTP to Maintain Existing Condition (only positive bids)	$2.65 [1.93]
Incremental WTP to Prevent Erosion (only positive bids)	$1.22 [.94]
Incremental WTP to Switch (only positive bids)	$3.84 [2.85]
% Certain of answers	65% [.49]
% Stated Beach width Good/Excellent	72% [.46]
Parking Issue; % Stated Confusion/Concern	90% [.31]
Public Access Issue; % Not Aware	89% [.32]
<u>Demographic Characteristics</u>	
Age	36.56 [12.36]
% Age less than 30	40% [.51]
% Employment Full Time	74% [.46]
% Completed at least College Education	65% [.49]
% Female	65% [.49]

% Visiting with Children under 13	25% [.45]
% Stated Beach Too crowded	3% [.18]
% Arrived in Car	98% [.15]
% Visit only on Weekends	52% [.52]
% Day Visit	82% [.40]

**Observations are weighted by the inverse of visitation to correct for trip bias.*

Table III-D(b)

Descriptive statistics (Lido Beach)
(Means with Standard Deviations in Parenthesis)

Type of Question	Means
Beach Valuation	
Incremental WTP to Maintain Existing Condition (only positive bids)	$1.89 [1.61]
Incremental WTP to Prevent Erosion (only positive bids)	$1.91 [2.64]
Incremental WTP to Switch (only positive bids)	$4.95 [4.43]
% Certain of answers	82% [.39]
% Stated Beach width Good/Excellent	92% [.27]
Parking Issue; % Stated Confusion/Concern	94% [.24]
Public Access Issue; % Not Aware	85% [.37]

Demographic Characteristics

Age	38.29 [11.25]
% Age less than 30	23% [.43]
% Employment Full Time	64% [.49]
% Completed at least College Education	39% [.50]
% Female	60% [.50]
% Visiting with Children under 13	50% [.51]
% Stated Beach Too crowded	2% [.13]
% Arrived in Car	99% [.10]
% Visit only on Weekends	53% [.51]
% Day Visit	78% [.42]

**Observations are weighted by the inverse of visitation to correct for trip bias.*

IV. BEACH ATTENDANCE

1. Estimated Beach Usage.

Beach attendance and the number of people using the beaches, the average of 1992-93, was estimated from the beach badge data furnished by individual beaches and from the visitation information from the CV survey. The beach badge data includes the number of daily and season passes sold in the case of Long Beach. In the case of Point Lookout, Nassau and Lido the data includes the number of car parking tickets sold.

The beach badge data has a tendency to understate the actual daily pass visitation. The towns charge for admission to the beach from Memorial Day through Labor Day. Beach visitation in May and September was not included in the data provided. Beach passes were not required when there is threatening weather or late in the afternoon. Children under 13 were not included in the attendance estimates. The understatement of benefits is likely to be in the 5 to 15 percent range. While expected WTP for these visits might be low the less than optimal weather, a significant visitation does accumulate in periods when visitation counts are not taken.

The number of people using the beaches at Long Beach (Form #1) during the summers of 1992-93 (average of 1992-93) is listed in Table IV-A. The information is separated by the type of pass sold. In the case of season passes, the number of passes sold is an estimate of the number of people using the beach. In the case of daily passes the number of people was estimated by dividing the number of daily passes sold by the average visitation rate, corrected for trip bias. For example the number of daily passes sold at Long Beach during the summer of 1992 was 112,281. This divided by the average visitation, corrected for trip bias, of 5.09 gives 22,059 for the number of visitors

The number of people using the beaches at Point Lookout (Form #2) during the summers of 1992-93 (average of 1992-93) is listed in Table IV-B. The beach data provided here was in the form of number of parking tickets sold. The number of people visiting the beach was estimated by multiplying the number of parking tickets sold by the average number of adult passengers in a car (1.97), calculated from the CV survey, and dividing this number by the average visitation rate corrected for trip bias.

The number of people using the beaches at Lido and Nassau (Form #3) during the summers of 1992-93 (average of 1992-93) is listed in Table IV-C. The total attendance for the summers of 1992-93 for Nassau beach was provided to us. The number of people visiting the beach was estimated by dividing the total attendance number by the average visitation rate to Nassau. The number of people visiting Lido was estimated by multiplying the number of parking tickets sold by the average number of adult passengers in a car (2.29), calculated from the CV survey, and dividing this number by the average visitation rate corrected for trip bias.

Table IV-A

Number of people using the beaches at Long Beach (Form #1): Average 1992-93

	1992		*1993*		*Average*	
Survey Beach	**Daily Pass**	**Season Pass**	**Daily Pass**	**Season Pass**	**Daily Pass**	**Season Pass**
Long Beach	22,059	36,699	32,719	44,593	27,389	40,646

Table IV-b

Number of people using the beaches at Point Lookout (Form #2) :Average 1992-93

Beach	**1992**	**1,993**	**Average**
Point Lookout	16,624	12,675	14,649

Table IV-C

Number of people using the beaches at Nassau and Lido (Form #3) :Average 1992-93

Beach	**1992**	**1,993**	**Average**
Nassau	49,708	51,785	50,747
Lido	38,957	45,389	42,173

Total attendance at Long Beach (Form #1) is presented in Table IV-D. Total attendance at Point Lookout (Form #2) and Nassau & Lido (Form #3) is presented in Table IV-E.

The attendance figures for season pass visitors at Long Beach was estimated by multiplying the number of people visiting a beach (with a season pass) by their average visitation rate per season, corrected for trip bias. The attendance figures for day pass visitors at Long Beach was estimated directly from the number of day passes sold. The attendance figures at Point Lookout and Lido was estimated by multiplying the number of parking tickets sold by the average number of adult passengers in a car, estimated from the CV survey. The attendance figures for Nassau Beach were provided directly.

Table IV-D

Total Attendance, Long Beach (Form #1): Average of 1992-93

Survey Beach	1992 Daily Pass	1992 Season Pass	1993 Daily Pass	1993 Season Pass	Average Daily	Average Season
Long Beach	112,281	669,390	166,540	813,376	139,411	741,383

Total attendance (average of 1992-94) at Long Beach was 880,794 (Daily Pass + Season Pass). Season pass visitors accounted for 84.2 percent of total attendance.

Table IV-D

Total Attendance, Point Lookout (Form #2), Nassau & Lido (Form #3): Average of 1992-93

Beach	1992	1993	Average
Point Lookout (Form #2)	*151,940*	*115,852*	*133,896*
Nassau + Lido (Form #3)	*447,686*	*480,469*	*464,078*
Nassau	333,542	347,479	340,511
Lido	114,144	132,990	123,567

Total attendance (average of 1993-94) at Form #2 beaches (Point Lookout) was 133,896 and at Form #3 beaches (Nassau and Lido) was 464,078. It should be noted that a substantial decline in beach attendance has taken place at Point Lookout in recent years. For example, in 1984 attendance stood at 523,065. A major part of the steady decline in Point Lookout attendance during the past ten years is due to beach erosion.

V. BENEFITS FROM EXISTING BEACH USERS

Simulated Demand Curves

1. Form #1 (Survey Beaches : beaches at Long Beach)

The procedure for estimating the use value of the improvements to the Form #1 beaches was to develop "simulated" demand curves. These demand curves are referred to as "simulated" since they are not based on actual market behavior, but on behavior in the hypothetical contingent valuation market. The concept of demand, in the instance of a visitor using a day pass to enter the beach, describes the relationship between the number of yearly visits (quantity demanded) people are willing to make at each WTP bid (price). For a visitor using a season pass to enter the beach, quantity demanded is measured by the number of people rather than annual visits. The approach used to obtain the WTP bids in the simulated demand curve was the sampling distribution. The sampling distribution uses the actual WTP bids from the CV survey.

A) Without Project Use Value

i) Description of the without project condition

The without project condition is to maintain the beaches at Long Beach, Point Lookout and Lido West at present beach widths.

Respondents were asked how often they use the beaches at the survey site (in this case, Long Beach). They were then asked how often they used any other beaches. Next the respondents were asked what is the maximum amount they would be willing to pay in addition to the fee they now paid to maintain the beaches in their existing state.

The WTP question was ..."Now I want to ask you a few questions about how much the use of this beach is worth to you. You just indicated that you visit (SURVEY SITE) approximately (X) days per summer. A (TYPE OF PASS RESPONDENT USED TO ENTER THE BEACH) pass for using this beach presently costs $___. Here is a card with amounts of money on it. Which of these amounts is the maximum you would be willing to pay in addition to the fee you now pay? (IF RESPONDS WITH DOLLAR AMOUNT, ADD TO EXISTING FEE AND ASK - That's a total of $___. Does that seem about right? - IF YES, GO TO THE NEXT QUESTION; IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY)..."

It is important to note that the WTP question elicits a respondent's incremental or additional WTP, above what the current cost is to use the beach, to maintain the beaches at Long Beach at their present condition.

ii) Without Project Recreation (Use) Value For Visitors Using A Day Pass, WTP Bids Based On The Sampling Distribution

The information necessary to calculate the simulated demand curve is: an estimate of the number of annual visits to the beaches at Long Beach under the "without project" condition, and the percentage of the visits by the respondents at each WTP bid or greater.

The number of annual visits to the beaches at Long Beach for the daily pass visitors under the without project condition is simply the total number of daily passes sold. The simulated "without project" demand curve for day pass visitors, using the sampling distribution, is shown in Table V-A.

Column '1' shows the actual (sample) WTP bids displayed in descending order. They range from a maximum of an additional $5.00 per visit to a minimum of $0.00. A zero bid means that the respondents were not willing to pay any additional amount over what they currently pay to maintain the beaches.

Column '2' is the average number of visits by respondents at each bid. This figure was adjusted for trip bias by weighting the number of visits by respondents at each bid by the inverse of the summer 1992 visitation to the survey beach. Column '3' is the number of respondents at each sample bid. This figure was also adjusted for trip bias by weighting the number of respondents at each bid by the inverse of the summer 1992 visitation to the survey beach. The multiplication of column '2' with column '3' yields the without project visits from the sample at each bid, which is shown in column '4'. There were, for example, 4 respondents in the sample willing to pay an additional $2.00 for a daily admission pass, to maintain the beaches at their existing condition. These respondents were willing to make an average of 11.53 visits at the additional $2.00 fee. The number of visits to the maintained beaches at Long Beach, from the respondents in the sample, at an additional $2.00, is 46.11.

The percentage of total visits to the maintained beaches at Long Beach at each bid, cumulated on a greater than basis, is presented in column '5'. For example at the $5.00 bid, sample visits account for 1 percent of total visits. As the sample bid (price) declines, visits increase. At the $2.00 bid, for example, 15 percent of the visitation will take place. Total population visits, displayed in column '6', at each sample bid were calculated by multiplying the cumulative percentages in column '5' times the estimation of total visitation from the population, 139,411.

The simulated demand curve is represented by column '1' (the sample distribution of WTP bids or "price") and column '6' (quantity demanded at each sample bid). The area under the simulated demand curve is displayed at the bottom of column '6'. This figure of $107,848, is an estimate of the annual without project use value from day pass visitors to the beaches at Long Beach. The use value is to maintain the beaches at their existing conditions.

Table V-A

Sampling Distribution (Form #1, Daily Pass Visitors, Without Project)
Use Value to Maintain Beaches at Long Beach in their present condition
—Number of annual visits estimated to be—
139,411

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$5.00	20.00	0.279	5.58	0.011759561	1,639
$3.50	17.01	0.279	4.75	0.021761067	3,034
$3.00	2.00	2.511	5.02	0.032344672	4,509
$2.50	6.87	1.488	10.22	0.053888188	7,513
$2.00	11.53	3.999	46.11	0.151059399	21,059
$1.50	6.79	4.464	30.31	0.214937334	29,965
$1.00	6.23	9.021	56.20	0.333377672	46,477
$0.75	25.00	0.186	4.65	0.343177306	47,843
$0.50	69.93	0.093	6.50	0.356883074	49,753
$0.25	6.00	0.837	5.02	0.367466679	51,229
$0.00	4.30	69.843	300.14	1	139,411
			Annual Use Value		**$107,848**

A 95 percent confidence interval was constructed for the area under the simulated demand curve. The procedure is to estimate the confidence interval for the proportion (percentage) of visits by respondents at bid or greater(column '5' in Table V-A).

The formula is:

Confidence Interval = $\sqrt{u \pm ts_p}$

where
- u = Estimated visits
- s_p = $p(1-p)/n(1-n/N)$ where s_p is the standard deviation of sample proportion
- p = sample proportion from column '5' Table V-A
- n = sample size
- t = t-statistic at 95 percent, 1.645

The confidence intervals for the simulated demand curve (Table V-A) is presented in Table V-B.

Table V-B

Sampling Distribution (Form #1, Daily Pass Visitors, without project)
Use Value to Maintain Beaches at Long Beach in their present condition
95% Confidence Intervals

				Visits at WTP bid or greater		
Sample WTP Bid	**Lower Limit**	**Sample**	**Upper Limit**	**Lower limit**	**Sample**	**Upper Limit**
$5.00	0.003633	0.01176	0.01988657	506.42	1639.41	2772.41
$3.50	0.010762	0.021761	0.03276041	1500.3	3033.73	4567.16
$3.00	0.019007	0.032345	0.0456819	2649.85	4509.2	6368.56
$2.50	0.036866	0.053888	0.07091064	5139.49	7512.61	9885.72
$2.00	0.124062	0.151059	0.17805646	17295.65	21059.34	24823.03
$1.50	0.183969	0.214937	0.24590526	25647.36	29964.63	34281.9
$1.00	0.297838	0.333378	0.36891724	41521.91	46476.51	51431.12
$0.75	0.307385	0.343177	0.37896942	42852.88	47842.69	52832.51
$0.50	0.320766	0.356883	0.3930001	44718.32	49753.43	54788.54
$0.25	0.331121	0.367467	0.40381252	46161.89	51228.9	56295.91
$0.00	1	1	1	139,411	139,411	139,411
				$93,677	**$107,848**	**$122,018**

iii) "Without Project" Recreation (Use) Value for Visitors Using a Season Pass

The information necessary to calculate the simulated demand curve for season pass visitors is: an estimate of the number of people using a season pass at the beaches in Long Beach and the percentage of respondents at each WTP bid or greater

The number of people visiting the beaches at Long Beach is simply the number of season passes sold. The simulated "without project" demand curve for season pass visitors, using the sampling distribution, is shown in Table V-C.

Column '1' displays the actual (sample) WTP bids arranged in descending order. They range from a maximum of an additional $60 to a minimum of $0. Column '2' is the number of respondents willing to pay each WTP bid. This figure was derived by weighting the number of respondents by the inverse of visitation to account for trip bias. The percentage of respondents at each bid or greater is presented in column '3'. At the $60 bid the number of respondents is 3 percent of the total. As the sample bid declines, the number of people willing to pay that bid or greater increases. At the $10 bid, for example, 16 percent of the respondents were willing to purchase a season pass. The total population of people willing to purchase a season pass at each sample bid was calculated by multiplying the cumulative percentages in column '3' with the estimate of the total number of people using a season pass, 40,646.

The simulated demand curve is represented by column '1' (the sample distribution of WTP bids or price) and column '4' (the number of people willing to pay each bid or greater). The area under the simulated demand curve is shown at the bottom of column curve. This figure, $243,551, is an estimate of the annual use value from season pass visitors to the beaches at Long Beach, to maintain these beaches at their present condition.

The confidence interval for the simulated demand curve in Table V-C is presented in Table V-D

Table V-C

Sampling Distribution (Form #1, Season Pass Visitors, Without Project)
Use Value to Maintain Beaches at Long Beach in their present condition
—Number of visitors estimated to be—
40,646

Sample WTP Bids	Number of respondents willing to pay bid	percentage of respondents at bid or greater	Number in population at WTP bid or greater
$60.00	3.795	0.033033033	1,343
$50.00	1.61	0.047047047	1,912
$40.00	0.69	0.053053053	2,156
$30.00	1.15	0.063063063	2,563
$25.00	1.84	0.079079079	3,214
$20.00	2.76	0.103103103	4,191
$15.00	0.805	0.11011011	4,476
$10.00	6.21	0.164164164	6,673
$5.00	5.29	0.21021021	8,544
$4.00	0.575	0.215215215	8,748
$2.00	3.22	0.243243243	9,887
$1.00	1.035	0.252252252	10,253
$0.00	85.905	1	40,646
		Annual Use Value	**$243,551**

Table V-D

Sampling Distribution (Form #1, Season Pass Visitors, Without Project)
Confidence Intervals
Use Value to Maintain Beaches at Long Beach in their present condition
95% Confidence Intervals

	Sample Proportion			Visits at WTP bids or Greater		
Sample WTP bid	**Lower Limit**	**Sample Mean**	**Upper Limit**	**Lower Limit**	**Sample Mean**	**Upper Limit**
$60.00	0.005643	0.033033	0.060424	229.3472	1342.661	2455.974
$50.00	0.014597	0.047047	0.079498	593.2909	1912.274	3231.258
$40.00	0.018702	0.053053	0.087404	760.1693	2156.394	3552.619
$30.00	0.02581	0.063063	0.100316	1049.072	2563.261	4077.45
$25.00	0.037721	0.079079	0.120437	1533.203	3214.248	4895.293
$20.00	0.056499	0.103103	0.149707	2296.447	4190.729	6085.01
$15.00	0.062137	0.11011	0.158084	2525.605	4475.536	6425.466
$10.00	0.107394	0.164164	0.220934	4365.141	6672.617	8980.092
$5.00	0.147765	0.21021	0.272656	6006.038	8544.204	11082.37
$4.00	0.152231	0.215215	0.278199	6187.583	8747.638	11307.69
$2.00	0.17749	0.243243	0.308997	7214.253	9886.865	12559.48
$1.00	0.185692	0.252252	0.318812	7547.639	10253.05	12958.45
$0.00	1	1	1	40,646	40,646	40,646
				$142,143	**$243,551**	**$344,958**

iv) Summary of "without project" use Value

The total "without project" recreation use value is presented below.

Type of Visitor	Use Value
Daily Pass	$107,848
Season Pass	$243,551
Total	$351,399

B) "With Project" Use Value

i) Description of the "With Project" Condition

The "with project" condition is to restore and maintain the beaches at Long Beach, Point Lookout and Lido West against further erosion to a width of approximately 372 feet; which is about one and one-half times wider than Long Beach is now. A protective sand dune with a width of about 50 feet would be built in the boardwalk area in Long Beach.

Respondents were asked about their visitation to the beaches at Long Beach, Point Lookout and Lido West with the improvements to these beaches. The WTP question was ..."You just indicated that you would use Long Beach (SURVEY SITE) about (X) times a year if the beaches at Long Beach, Point Lookout and Lido West were restored to a width of approximately 372 feet. The improvement and maintenance against erosion would only take place if you and others pay for it; and one way of collecting the needed funds is through user fees. You previously said you would be willing to pay (EXISTING FEE + WTP "WITHOUT PROJECT") $___ for a (TYPE OF PASS RESPONDENT USED TO ENTER THE BEACH) admission pass to use Long Beach in its present condition. Here is a card with amounts of money on it. Which of these amounts is the maximum <u>additional</u> amount you would be willing to pay for a (TYPE OF PASS RESPONDENT USED TO ENTER THE BEACH) admission pass for access to Long Beach in which the beach has been widened to 372 feet and has a protective sand dune? Any increase in fees would only be used to improve and maintain the beach. (IF RESPONDS WITH A DOLLAR AMOUNT, ADD TO THE ABOVE SUM AND ASK) That's a total amount of $___. Does that seem about right? (IF YES, GO TO THE NEXT QUESTION; IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY)..."

It is important to note that the WTP question elicits a respondent's <u>incremental</u> or <u>additional</u> WTP (above the sum of what the current cost is to enter the beach and their bid to maintain the beaches at Long Beach at their existing condition against erosion) for improvements to the beaches at Long Beach.

ii) "With Project" recreation (use) value for visitors with a Daily Pass

The recreation value for improvements to the beaches at Long Beach was derived from the responses to the <u>additional</u> WTP question and from beach visitation with the described improvements to the beaches at Long Beach. Since the visitation (quantity demanded) portion of the demand curve includes not only the increased WTP for visits taken under the "without project" conditions; but also absolute increases in beach use, some adjustments are required. We will analyze the "with project" recreation (use value) and the use value from 'increase in visitation' with the project separately.

The "with project" use value from the day pass users of the beaches at Long Beach includes: a) Increased WTP for expected visits also taken under the "without project" conditions and b) an increased WTP for an increase in total beach use.

a) Increased WTP for expected visits also taken under the "without project" conditions

This category of benefits is estimated as the area under the "with project" simulated demand curve. These visits are already occurring at the survey beach (Long Beach) under the "without project" conditions. We are only concerned with the additional amount users would WTP for these visits. The estimated annual number of visits, 139,411, is identical to the figure used in the "without project" simulated demand curve.

The simulated demand curve, for day pass visitors, using the sampling distribution, is displayed in Table V-E. Column '1' displays the actual (sample) WTP bids in descending order. They range from a maximum of $10.00 to a low of $0.00. These bids represent the additional WTP for improvements to the beaches at Long Beach. This is the additional amount over the respondent's WTP bid to maintain the beaches at Long Beach against erosion. The area under the demand curve is presented at the bottom of Column '6'. This amount, $167,170, is the estimate of the annual value to improve the beaches at Long Beach, for the visits taken to the beaches at Long Beach under the "without project" condition.

The confidence interval for the simulated demand curve (Table V-E) is displayed in Table V-F.

Table V-E

Sampling Distribution (Form #1, Daily Pass Visitors, With Project)
Use Value to improve the beaches at Long Beach (with project)
—Number of visitors estimated to be—
139,411

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$10.00	20.00	0.264	5.28	0.011549426	1,610
$9.00	69.93	0.088	6.15	0.025010296	3,487
$5.00	10.00	0.528	5.28	0.036559723	5,097
$3.00	5.23	2.992	15.66	0.070807106	9,871
$2.50	3.00	1.76	5.28	0.082357688	11,482
$2.00	7.07	11	77.79	0.252522504	35,204
$1.50	3.33	3.08	10.27	0.274979722	38,335
$1.00	4.46	12.76	56.86	0.3993608	55,675
$0.75	10.37	0.968	10.04	0.421325477	58,737
$0.50	2.52	10.296	25.95	0.478097298	66,652
$0.25	14.81	1.056	15.64	0.512317821	71,423
$0.00	5.16	43.208	222.95	1	139,411
		Annual Use Value for Improving the beaches at Long Beach			**$167,170**

Table V-F

Sampling Distribution (Form #1, Daily Pass Visitors, with project)
Use Value to Improve the Beaches at Long Beach (with project)
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater: Lower Limit	Sample	Upper Limit
$10.00	0.003343	0.011549	0.019756	466	1610.12	2754.23
$9.00	0.013016	0.02501	0.037005	1814.57	3486.71	5158.85
$5.00	0.022144	0.03656	0.050975	3087.15	5096.83	7106.51
$3.00	0.051105	0.070807	0.090509	7124.63	9871.29	12617.95
$2.50	0.061242	0.082358	0.103473	8537.81	11481.57	14425.32
$2.00	0.219152	0.252523	0.285893	30552.18	35204.41	39856.65
$1.50	0.240684	0.27498	0.309276	33553.98	38335.2	43116.41
$1.00	0.361742	0.399361	0.43698	50430.81	55675.29	60919.77
$0.75	0.383399	0.421325	0.459252	53450.04	58737.41	64024.77
$0.50	0.439729	0.478097	0.516465	61303.11	66652.02	72000.94
$0.25	0.473925	0.512318	0.550711	66070.31	71422.74	76775.17
$0.00	1	1	1	139,411	139,411	139,411
				$140,802	**$167,170**	**$193,537**

b) Increased WTP for an increase in total beach use

This category of benefits is estimated as the area under the "with project" simulated demand curve, due to an increase in the number of visits to the beaches at Long Beach after the improvements to the beaches. The information necessary to calculate this simulated demand curve are: The increase in the number of annual visits to the beaches at Long Beach by day pass visitors after the improvements to the beaches, and, the percentage of visits by respondents at each WTP bid or greater.

The increase in the number of annual visits to the beaches at Long Beach, by day pass visitors after the improvements to the beaches is estimated as follows:

Increase in number of visits = [% of sample increasing their visits to the beaches at Long Beach with improvement project implemented] x [Number of people using a day pass] x [Average increase in the number of visits to the beaches at Long Beach, by day pass visitors, after the improvement]

38,580 ≈ .1290322 x 27,389 x 10.916666

This number is estimated to be 38,580. The simulated demand curve, using the sample distribution, is displayed in Table V-G. Column '1' displays the actual (sample) WTP bids in descending order. They range from a maximum of $10.00 to a low of $0.00. These bids represent the total WTP (WTP "without project" + WTP "with project" + Existing fee to enter the beach) for increase in visits taken to the beaches at Long Beach after improvements to the beaches. This is the total WTP for the increased visitation due to improvements to the beaches at Long Beach. The area under the demand curve is presented at the bottom of Column '6'. This amount, $219,222, is the estimate of the annual value from the increase in visits due to improvements to the beaches at Long Beach.

The confidence interval for the simulated demand curve (Table V-G) is displayed in Table V-H.

Table V-G

Sampling Distribution (Form #1, Daily Pass Visitors, With Project)
Use Value from increase in visits to beaches at Long Beach with improvements
—Number of visitors estimated to be—
38,580

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$10.00	12.00480192	0.528	6.338535414	0.082481757	3,182
$8.50	2	3.192	6.384	0.165555132	6,387
$7.50	9.00090009	0.708	6.372637264	0.248480648	9,586
$7.00	14.49275362	0.888	12.86956522	0.415949042	16,047
$6.00	8	0.804	6.432	0.499647029	19,276
$5.00	16.47446458	0.78	12.85008237	0.666861898	25,728
$3.50	2	3.192	6.384	0.749935274	28,933
$2.00	6.99790063	0.912	6.382085374	0.832983735	32,137
$1.00	10	0.636	6.36	0.915744805	35,330
$0.00	17.98561151	0.36	6.474820144	1	38,580
		Annual Use Value from an increase in total beach use			**$219,222**

Table V-H

Sampling Distribution (Form #1, Daily Pass Visitors, with project)
Use Value from increase in visits to beaches at Long Beach with improvements
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater: Lower Limit	Sample	Upper Limit
$10.00	0.030911	0.082482	0.13405254	1,193	3,182	5,172
$8.50	0.095878	0.165555	0.23523183	3,699	6,387	9,075
$7.50	0.167472	0.248481	0.32948975	6,461	9,586	12,712
$7.00	0.323551	0.415949	0.5083471	12,483	16,047	19,612
$6.00	0.405915	0.499647	0.59337891	15,660	19,276	22,893
$5.00	0.578504	0.666862	0.75522023	22,319	25,728	29,137
$3.50	0.668754	0.749935	0.83111649	25,801	28,933	32,065
$2.00	0.763062	0.832984	0.90290593	29,439	32,137	34,834
$1.00	0.863673	0.915745	0.96781665	33,321	35,330	37,339
$0.00	1	1	1	38,580	38,580	38,580
				$191,395	**$219,222**	**$247,048**

c) Summary of "with project" use value for day pass visitors

The total recreational use value for day pass visitors under the "with project" condition is presented below.

Category	Use Value
1) Increased WTP for visits also taken under the "without project" condition	$167,170
2) Increased WTP for an increase in total beach use after improvements	$219,222
Total	$386,392

iii) "With Project" recreation (use) value for visitors with a Season Pass

The season pass sample is based on individuals already holding such a pass at the survey beach. The improvements to the beaches at Long Beach will not have any impact on the number of people currently using a season pass to enter the beach. Since the season pass provides unlimited visitation, the total WTP for additional visits after the improvements to the beaches at Long Beach is included in the area under the "with project" demand curve estimated from the survey data. Thus the project benefits from season pass users is the increase in WTP for current pass holders under the "with project" conditions.

a) Increased WTP for season pass visitors.

The simulated demand curve for the season pass holders under the "with project" condition, using the sampling distribution, is displayed in Table V-I.

Column '1' displays the actual (sample) WTP bids arranged in descending order. They range from a maximum of $30.00 to a minimum of $0.00. Note again that these bids are incremental or additional WTP over what they pay for the "without project" condition. Column '2' is the number of respondents willing to pay bid. This figure was derived by weighting the number of respondents by the inverse of visitation, to account for trip bias. The percentage of respondents at each bid or greater is presented in column '3' (also adjusted for trip bias). The total population willing to pay each bid or greater is shown in column '4'.

The area under the simulated demand curve is displayed at the bottom of column '4'. This figure, $165,978 , is an estimate of the annual use value for improvements to the beaches at Long Beach from season pass visitors to these beaches.

The confidence interval for the simulated demand curve (Table V-I) is displayed in Table V-J

Table V-I

Sampling Distribution (Form #1, Season Pass Visitors, With Project)
Use Value to improve beaches at Long Beach
—Number of visitors estimated to be—
40,646

Sample WTP Bids	Number of respondents willing to pay bid	Percentage of respondents at bid or greater	Number in Population at bid or greater
$30.00	1.768	0.017	691
$25.00	1.872	0.035	1,423
$20.00	0.936	0.044	1,788
$15.00	2.08	0.064	2,601
$10.00	11.648	0.176	7,154
$5.00	4.16	0.216	8,780
$4.00	0.416	0.22	8,942
$3.00	0.312	0.223	9,064
$2.00	20.696	0.422	17,153
$1.00	1.144	0.433	17,600
$0.00	58.968	1	40,646
		Annual Use Value	**$165,978**

Table V-J

Sampling Distribution (Form #1, Season Pass Visitors, With Project)
Confidence Intervals
Use Value to improve beaches at Long Beach
95% Confidence Intervals

				Visits at WTP bids or Greater		
Sample WTP bid	**Lower Limit**	**Sample Mean**	**Upper Limit**	**Lower Limit**	**Sample Mean**	**Upper Limit**
$30.00	0.00	0.02	0.04	0	691	1,537
$25.00	0.01	0.04	0.06	219	1,423	2,626
$20.00	0.01	0.04	0.08	445	1,788	3,131
$15.00	0.02	0.06	0.10	999	2,601	4,204
$10.00	0.11	0.18	0.24	4,660	7,154	9,647
$5.00	0.15	0.22	0.28	6,085	8,780	11,474
$4.00	0.15	0.22	0.29	6,230	8,942	11,655
$3.00	0.16	0.22	0.29	6,338	9,064	11,790
$2.00	0.34	0.42	0.50	13,919	17,153	20,387
$1.00	0.35	0.43	0.51	14,355	17,600	20,844
$0.00	1.00	1.00	1.00	40,646	40,646	40,646
				$111,037	**$165,978**	**$221,308**

iv) Summary of "with project" use value.

The "with project" incremental use value for people using the beaches at Long Beach is presented below. The total, $524,611 is the amount people were willing to pay for the improvement to the beaches at Long Beach over the amount they were WTP to maintain the beaches at their existing condition (the "without project" condition).

Type of Visitor	**Use Value**
Day Pass Visitor	*$386,392*
Season Pass Visitor	*$165,978*
Total	**$552,370**

C) "With (alternative) Project" Use Value

i) Description of the "With (alternative) Project" Condition

The "with (alternative) project" condition is to restore and maintain the beaches at Long Beach, Point Lookout and Lido West against further erosion to a width of approximately 422 feet (as opposed to "with project" condition where the beach width would be approximately 372 feet); which is about two times wider than Long Beach is now. A protective sand dune with a width of about 50 feet would be built in the boardwalk area in Long Beach.

Respondents were asked about their visitation to the beaches at Long Beach, Point Lookout and Lido West with the above mentioned improvements to these beaches. The WTP question was ..."You just indicated that you would use Long Beach (SURVEY SITE) about (X) times a year if the beaches at Long Beach, Point Lookout and Lido West were restored to a width of approximately 422 feet. The improvement and maintenance against erosion would only take place if you and others pay for it; and one way of collecting the needed funds is through user fees. You previously said you would be willing to pay (EXISTING FEE + WTP "WITHOUT PROJECT" + WTP "WITH PROJECT") $___ for a (TYPE OF PASS RESPONDENT USED TO ENTER THE BEACH) admission pass to use Long Beach if restored and maintained to a width of 372 feet. Here is a card with amounts of money on it. Which of these amounts is the maximum <u>additional</u> amount you would be willing to pay for a (TYPE OF PASS RESPONDENT USED TO ENTER THE BEACH) admission pass to use Long Beach with a 422-foot beach and a protective sand dune which is about two times the current beach width? Again, any increase in fees would only be used to improve and maintain the beach. (IF RESPONDS WITH A DOLLAR AMOUNT, ADD TO THE ABOVE SUM AND ASK) That's a total amount of $___. Does that seem about right? (IF YES, GO TO THE NEXT QUESTION; IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY)..."

It is important to note again that the WTP question elicits a respondent's <u>incremental</u> or <u>additional</u> WTP (above the sum of what the current cost is to enter the beach and their bid to maintain the beaches at Long Beach at their existing condition against erosion and their bid to improve the beaches at Long Beach to a width of approximately 372 feet) for improvements to the beaches at Long Beach to a width of 422 feet.

ii) "With (alternative) Project" recreation (use) value for visitors with a Daily Pass

The recreation value for the alternative improvements to the beaches at Long Beach was derived from the responses to the <u>additional</u> WTP question and from beach visitation with the described improvements to the beaches at Long Beach.

a) Increased WTP for expected visits also taken under the "with project" conditions

This category of benefits is estimated as the area under the "with (alternative) project" simulated demand curve. These visits are already occurring at the survey beach (Long Beach) under the "without and with project" conditions. We are only concerned with the additional amount users would WTP for these visits. The estimated annual number of visits, 139,411, is identical to the figure used in the "without and project" simulated demand curve.

The simulated demand curve, for day pass visitors, using the sampling distribution, is displayed in Table V-K. Column '1' displays the actual (sample) WTP bids in descending order. They range from a maximum of $1.00 to a low of $0.00. These bids represent the additional WTP for (alternative) improvements to the beaches at Long Beach. This is the additional amount over the respondent's WTP bid to improve the beaches at Long Beach to a width of approximately 372 feet. The area under the demand curve is presented at the bottom of Column '6'. This amount, $20,416, is the estimate of the annual value to improve the beaches at Long Beach to a width of approximately 422 feet, for the visits taken to the beaches at Long Beach under the "without project" and "with Project" conditions.

The confidence interval for the simulated demand curve (Table V-K) is displayed in Table V-L.

Table V-K

Sampling Distribution (Form #1, Daily Pass Visitors, With (alternative) Project)
Use Value to improve the beaches at Long Beach (with "alternative" project)
—Number of visitors estimated to be—
139,411

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$1.00	12.00	0.41	4.86	0.01	1,663
$0.50	3.00	1.70	5.10	0.02	3,408
$0.25	16.00	0.32	5.18	0.04	5,181
$0.00	5.00	78.57	392.46	1.00	139,411
		Annual Use Value with "alternative" project			$20,416

Table V-L

Sampling Distribution (Form #1, Daily Pass Visitors, with "alternative" project)
Use Value to Improve the Beaches at Long Beach (with "alternative" project)
95% Confidence Intervals

	Sample Proportion			Visits at WTP bid or greater		
Sample WTP Bid	Lower Limit	Sample	Upper Limit	Lower limit	Sample	Upper Limit
$1.00	0.003095	0.011928	0.020761	431.54	1662.9	2894.26
$0.50	0.011884	0.024449	0.037014	1656.72	3408.42	5160.11
$0.25	0.021776	0.037167	0.052558	3035.81	5181.46	7327.12
$0.00	1	1	1	139,411	139,411	139,411
				$18,914	$20,416	$21,917

iii) "With (alternative) Project" recreation (use) value for visitors with a Season Pass

The season pass sample is based on individuals already holding such a pass at the survey beach. The improvements (alternative) to the beaches at Long Beach will not have any impact on the number of people currently using a season pass to enter the beach. Since the season pass provides unlimited visitation, the total WTP for additional visits after the "alternative" improvements to the beaches at Long Beach, is included in the area under the "with (alternative) project" demand curve estimated from the survey data. Thus the "alternative" project benefits from season pass users is the increase in WTP for current pass holders under the "with (alternative) project" conditions.

a) Increased WTP for season pass visitors.

The simulated demand curve for the season pass holders under the "with (alternative) project" condition, using the sampling distribution, is displayed in Table V-M.

Column '1' displays the actual (sample) WTP bids arranged in descending order. They range from a maximum of $50.00 to a minimum of $0.00. Note again that these bids are incremental or additional WTP over what they pay for the "with project" condition. Column '2' is the number of respondents willing to pay bid. This figure was derived by weighting the number of respondents by the inverse of visitation, to account for trip bias. The percentage of respondents at each bid or greater is presented in column '3'. The total population willing to pay each bid or greater is shown in column '4'.

The area under the simulated demand curve is displayed at the bottom of column '4'. This figure, $36,382 , is an estimate of the annual use value for improvements to the beaches at Long Beach to a width of 422 feet (alternative project) from season pass visitors to these beaches.

The confidence interval for the simulated demand curve (Table V-M) is displayed in Table V-N

Table V-M

Sampling Distribution (Form #1, Season Pass Visitors, With (alternative) Project)
Use Value to improve the beaches at Long Beach (with "alternative" project)
—Number of visitors estimated to be—
40,646

Sample WTP Bids	Number of respondents willing to pay bid	Percentage of respondents at bid or greater	Number in Population at bid or greater
$50.00	0.202	0.001998002	81
$20.00	0.303	0.004995005	203
$15.00	0.505	0.00999001	406
$5.00	0.909	0.018981019	772
$1.00	0.909	0.027972028	1,137
$0.00	98.273	1	40,646
	Annual use value with "alternative" project (season pass visitors)		$36,382

Table V-N

Sampling Distribution (Form #1, Season Pass Visitors, With "alternative" Project)
Confidence Intervals
Use Value to improve beaches at Long Beach (alternative project)
95% Confidence Intervals

				Visits at WTP bids or Greater		
Sample WTP bid	Lower Limit	Sample Mean	Upper Limit	Lower Limit	Sample Mean	Upper Limit
$50.00	0	0.001998	0.009294	0	81.21079	377.7819
$20.00	0	0.004995	0.016514	0	203.027	671.2425
$15.00	0	0.00999	0.02624	0	406.0539	1066.547
$5.00	0	0.018981	0.041278	0	771.5025	1677.785
$1.00	0.001029	0.027972	0.054915	41.81884	1136.951	2232.083
$0.00	1	1	1	40,646	40,646	40,646
				$20,428	$36,382	$63,060

D) Summary of use Value for Form #1 (Beaches at Long Beach)

The summary of the use value for people using the beaches at Long Beach under the different project conditions is presented below.

Type of Visitor	Use Value "without project"	Use Value "with project"	Use Value "with (alternative) project"
Day Pass	$107,848	$386,392	$20,416
Season Pass	$243,551	$165,978	$36,382
Total	**$351,399**	**$552,370**	**$56,798**

2. **Form #2 (Survey Beaches : beaches at Point Lookout)**

The procedure for estimating the use value of the improvements to the Form #2 (the beaches at Point Lookout) beaches is identical to the ones used to estimate the use value to improvements to the form #1 (beaches at Long Beach)beaches. The only differences are: a) All visitors to the beaches at Point Lookout are day visitors. So there is no evaluation by season pass, and b) There is no fee to enter the beaches. Visitors are only charged a fee for parking. Hence the WTP question in the "without project" was not an incremental WTP question. The WTP (in the "without project" condition) question was ..."You just indicated that you visit (SURVEY SITE) approximately (X) days per summer. Here is a card with amounts of money on it. Which of these amounts is the maximum you would be willing to pay for a daily admission pass to use this beach? (IF RESPONDS WITH A DOLLAR AMOUNT, MULTIPLY TIMES VISITATION AND ASK) That's a total of $___ for the summer. Does that seem about right? (IF YES, GO TO THE NEXT QUESTION; IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY)...".

On Form #2 and #3 a question was asked to identify those respondents needing clarification about the parking fee at Point Lookout and Nassau beaches. These beaches charge no fee for beach use. Someone walking to the beach has access for no fee. Those arriving by car pay only for parking. Respondents, however, felt that the parking fee was actually a beach user fee. Interviewers were instructed to explain the distinction between a parking fee and a beach user fee, and then proceed with the questionnaire. Ninety seven percent of the respondents expressed confusion about the parking/beach user fee distinction.

All other WTP questions were identical to the ones on Form #1. The estimation procedure of the simulated demand curves under the different "project" conditions is identical to the procedure used in the case of day pass visitors in Form #1.

A) Without Project Recreation (Use) Value, WTP Bids Based On Sampling Distribution

The simulated "without project" demand curve, using the sampling distribution is displayed in Table V-O. The simulated demand curve is represented by column '1' (the sample distribution of WTP bids or "price") and column '6' (quantity demanded at each sample bid). The area under the simulated demand curve is displayed at the bottom of column '6'. This figure of $191,032, is an estimate of the annual "without project" use value from visitors to the beaches at Point Lookout.

The 95 percent confidence interval for the area under the simulated demand curve is presented in Table V-P

Table V-O

Sampling Distribution (Form #2, Without Project)
Use Value from visitors to Beaches at Point Lookout in their present condition
—Number of annual visits estimated to be—
133,896

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$8.00	5.99880024	1.458	8.74625075	0.005969953	799
$6.00	11.04972376	2.43	26.85082873	0.024297598	3,253
$5.00	9.671179884	10.206	98.7040619	0.091670306	12,274
$4.00	13.85041551	1.944	26.92520776	0.110048721	14,735
$3.00	15.89825119	4.05	64.38791733	0.153998162	20,620
$2.50	1.923076923	9.396	18.06923077	0.166331728	22,271
$2.00	12.04819277	12.798	154.1927711	0.271579519	36,363
$1.50	6.887052342	9.234	63.59504132	0.314987765	42,176
$1.00	7.892659826	29.808	235.2644041	0.475572848	63,677
$0.75	13.71742112	3.24	44.44444444	0.505909417	67,739
$0.50	1.935359009	9.396	18.18463325	0.518321754	69,401
$0.25	30.03003003	0.324	9.72972973	0.524963002	70,290
$0.00	10.27749229	67.716	695.950668	1	133,896
			Annual Use Value "without project"		$191,032

Table V-P

Sampling distribution (Form #2, without project)
Use Value from visitors to Beaches at Point Lookout in their present condition
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater: Lower limit	Sample	Upper Limit
$8.00	0.002677	0.00597	0.00926253	358	799	1,240
$6.00	0.017717	0.024298	0.0308786	2,372	3,253	4,135
$5.00	0.079337	0.09167	0.10400384	10,623	12,274	13,926
$4.00	0.096673	0.110049	0.12342474	12,944	14,735	16,526
$3.00	0.138571	0.153998	0.16942563	18,554	20,620	22,685
$2.50	0.150416	0.166332	0.18224779	20,140	22,271	24,402
$2.00	0.252569	0.27158	0.29058991	33,818	36,363	38,909
$1.50	0.295134	0.314988	0.33484173	39,517	42,176	44,834
$1.00	0.454228	0.475573	0.49691816	60,819	63,677	66,535
$0.75	0.48454	0.505909	0.52727875	64,878	67,739	70,601
$0.50	0.496965	0.518322	0.53967823	66,542	69,401	72,261
$0.25	0.503619	0.524963	0.54630718	67,433	70,290	73,148
$0.00	1	1	1	133,896	133,896	133,896
				$177,394	$191,032	$204,671

B) "With Project" Use Value

i) Description of the "With Project" Condition

The "with project" condition is to restore and maintain the beaches at Long Beach, Point Lookout and Lido West against further erosion to a width of approximately 372 feet; which is about one and one-half times wider than the usable beach at Point Lookout is now.

Respondents were asked about their visitation to the beaches at Long Beach, Point Lookout and Lido West with the improvements to these beaches. The WTP question was ..."You just indicated that you would use Point Lookout (SURVEY SITE) about (X) times a year if the beaches at Long Beach, Point Lookout and Lido West were restored to a width of approximately 372 feet. The improvement and maintenance against erosion would only take place if you and others pay for it; and one way of collecting the needed funds is through user fees. You previously said you would be willing to pay (WTP "WITHOUT PROJECT") $___ for an admission pass to use Point Lookout in its present condition. Here is a card with amounts of money on it. Which of these amounts is the maximum additional amount you would be willing to pay for a daily admission pass to restore and maintain Point Lookout with a 370 foot beach which is about one and one half times wider that the existing beach. (IF RESPONDS WITH A DOLLAR AMOUNT, ADD TO THE ABOVE SUM AND ASK) That's a total amount of $___. Does that seem about right? (IF YES, GO TO THE NEXT QUESTION; IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY)..."

It is important to note again, that the WTP question elicits a respondent's incremental or additional WTP (above the sum of what the current cost is to enter the beach and their bid to maintain the beaches at Point Lookout at their existing condition against erosion) for improvements to the beaches at Point Lookout.

ii) "With Project" recreation (use) value.

Again, like in the case of day pass visitors for Form #1, the "with project" use value from the visitors to Point Lookout includes: a) Increased WTP for expected visits also taken under the "without project" conditions and b) an increased WTP for an increase in total beach use.

a) The simulated demand curve for increased WTP for expected visits also taken under the "without project" conditions is displayed in Table V-Q. The area under the simulated demand curve is displayed at the bottom of column '6'. This figure of $169,842, is an estimate of the annual "with project" use value from visitors to the beaches at Point Lookout.

The 95 percent confidence interval for the area under the simulated demand curve is presented in Table V-R.

Table V-Q

Sampling Distribution (Form #2, With Project)
Use Value from visitors to Beaches at Point Lookout "with project"
—Number of annual visits estimated to be—
133,896

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$5.00	6.896551724	6.314	43.54482759	0.032276542	4,322
$4.50	20	0.462	9.24	0.039125466	5,239
$4.00	21.59827214	1.232	26.60907127	0.058848792	7,880
$3.50	14.99250375	0.616	9.235382309	0.065694294	8,796
$3.00	19.26782274	3.696	71.21387283	0.11847984	15,864
$2.50	7.05716302	2.464	17.38884968	0.131368901	17,590
$2.00	6.896551724	20.328	140.1931034	0.235283621	31,504
$1.50	3.571428571	12.32	44	0.267897548	35,870
$1.00	7.320644217	54.978	402.4743777	0.566221866	75,815
$0.75	18.38235294	0.924	16.98529412	0.578811801	77,501
$0.50	8.244023083	9.548	78.7139324	0.637156584	85,313
$0.25	25	0.308	7.7	0.642864021	86,077
$0.00	11.80637544	40.81	481.8181818	1	133,896
				Annual Use Value	**$169,842**

Table V-R

Sampling distribution (Form #2, with project)
Use Value from visitors to Beaches at Point Lookout "with project"
95% Confidence Intervals

				Visits at WTP bid or greater		
Sample WTP Bid	**Lower Limit**	**Sample**	**Upper Limit**	**Lower limit**	**Sample**	**Upper Limit**
$5.00	0.024401	0.032277	0.04015173	3267.24	4321.7	5376.16
$4.50	0.030486	0.039125	0.0477653	4081.9	5238.74	6395.58
$4.00	0.048362	0.058849	0.06933553	6475.49	7879.62	9283.75
$3.50	0.054655	0.065694	0.07673382	7318.05	8796.2	10274.35
$3.00	0.104079	0.11848	0.13288043	13935.79	15863.98	17792.16
$2.50	0.116316	0.131369	0.14642131	15574.31	17589.77	19605.23
$2.00	0.216382	0.235284	0.25418477	28972.75	31503.54	34034.32
$1.50	0.248164	0.267898	0.28763142	33228.12	35870.41	38512.7
$1.00	0.544138	0.566222	0.58830543	72857.94	75814.84	78771.74
$0.75	0.55681	0.578812	0.60081313	74554.7	77500.58	80446.47
$0.50	0.615731	0.637157	0.65858178	82443.97	85312.72	88181.47
$0.25	0.621513	0.642864	0.66421503	83218.11	86076.92	88935.74
$0.00	1	1	1	133,896	133,896	133,896
				$159,723	$169,842	$179,960

b) Increased WTP for an increase in total beach use

This category of benefits is estimated identical to Form #1, day pass visitors. The increase in the number of annual visits to the beaches at Point Lookout after the improvements to the beaches was estimated to be 42,456. The formula is:

Increase in number of visits = [% of sample increasing their visits to the beaches at Point Lookout with improvement project implemented] x [Number of people using the beach] x [Average increase in the number of visits to the beaches at Point Lookout, after the improvement]

$42{,}456 \approx .2455089 \times 14{,}649 \times 11.804878$

The simulated demand curve, using the sample distribution, is displayed in Table V-S. The area under the demand curve is presented at the bottom of Column '6'. The sample WTP bids here represent the total WTP (WTP "without Project + WTP "with project") for increase in visits taken to the beaches at Point Lookout after improvements to the beaches. This amount, $111,176, is the estimate of the annual value from the increase in visits due to improvements to the beaches at Point Lookout.

The confidence intervals for the simulated demand curve (Table V-S) is displayed in Table V-T.

Table V-S

Sampling Distribution (Form #2, With Project)
Use Value from increase in visits to beaches at Point Lookout with improvements
—Number of visitors estimated to be—
42,456

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$10.00	4.614674665	3.485	16.08214121	0.049521618	2,102
$6.00	10	0.82	8.2	0.074771817	3,175
$5.00	2	0.41	0.82	0.077296837	3,282
$4.00	12.12121212	1.353	16.4	0.127797235	5,426
$3.50	28.98550725	0.287	8.31884058	0.153413379	6,513
$3.00	8.756567426	8.282	72.52189142	0.3767295	15,994
$2.50	4	2.009	8.036	0.401474695	17,045
$2.00	9.372071228	6.027	56.48547329	0.575409993	24,430
$1.50	6.666666667	2.419	16.12666667	0.625068718	26,538
$1.00	6.644518272	10.947	72.73754153	0.849048888	36,047
$0.25	30.03003003	0.287	8.618618619	0.875588137	37,174
$0.00	8.568980291	4.715	40.40274207	1	42,456
				Annual Use Value	**$111,176**

Table V-T

Sampling Distribution (Form #2, with project)
Use Value from increase in visits to beaches at Point Lookout with improvements
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater Lower limit	Sample	Upper Limit
$10.00	0.029793	0.049522	0.06925005	1,265	2,102	2,940
$6.00	0.050854	0.074772	0.09868941	2,159	3,175	4,190
$5.00	0.053012	0.077297	0.10158171	2,251	3,282	4,313
$4.00	0.097438	0.127797	0.15815666	4,137	5,426	6,715
$3.50	0.120642	0.153413	0.1861845	5,122	6,513	7,905
$3.00	0.332666	0.376729	0.42079281	14,124	15,994	17,865
$2.50	0.356899	0.401475	0.44605	15,153	17,045	18,938
$2.00	0.530463	0.57541	0.62035667	22,521	24,430	26,338
$1.50	0.581047	0.625069	0.66909011	24,669	26,538	28,407
$1.00	0.816495	0.849049	0.8816032	34,665	36,047	37,429
$0.25	0.845575	0.875588	0.90560082	35,900	37,174	38,448
$0.00	1	1	1	42,456	42,456	42,456
				$98,998	$111,176	$123,354

iii) Summary of "with project" use Value

The total recreational (use) value for visitors to the beaches at Point Lookout under the "with project" condition is presented below.

Category	Use Value
1) Increased WTP for visits also taken under the "without project" condition	$169,842
2) Increased WTP for an increase in total beach use after improvements	$111,176
Total	**$281,018**

C) "With (alternative) Project" Use Value

i) Description of the "With (alternative) Project" Condition

The "with (alternative) project" condition is to restore and maintain the beaches at Long Beach, Point Lookout and Lido West against further erosion to a width of approximately 422 feet (as opposed to "with project" condition where the beach width would be approximately 372 feet); which is about two times wider than Long Beach is now or about the size of Nassau Beach.

Respondents were asked about their visitation to the beaches at Long Beach, Point Lookout and Lido West with the above mentioned improvements to these beaches. The WTP question was ..."You just indicated that you would use Long Beach (SURVEY SITE) about (X) times a year if the beaches at Long Beach, Point Lookout and Lido West were restored to a width of approximately 422 feet. The improvement and maintenance against erosion would only take place if you and others pay for it; and one way of collecting the needed funds is through user fees. You previously said you would be willing to pay (WTP "WITHOUT PROJECT" + WTP "WITH PROJECT") $___ for a (TYPE OF PASS RESPONDENT USED TO ENTER THE BEACH) daily admission pass to use Point Lookout with a 372 foot wide beach. Here is a card with amounts of money on it. Which of these amounts is the maximum additional amount you would be willing to pay for a daily admission pass to maintain Point Lookout with a 422-foot beach which is about twice the size of the existing beach? Again, any increase in fees would only be used to improve and maintain the beach. (IF RESPONDS WITH A DOLLAR AMOUNT, ADD TO THE ABOVE SUM AND ASK) That's a total amount of $___. Does that seem about right? (IF YES, GO TO THE NEXT QUESTION; IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY)..."

It is important to note again that the WTP question elicits a respondent's incremental or additional WTP (above the sum of their bid to maintain the beaches at Point Lookout at their existing condition against erosion and their bid to improve the beaches at Point Lookout to a width of approximately 372 feet) for improvements to the beaches at Point Lookout to a width of 422 feet.

ii) "With (alternative) Project" recreation (use) value for visitors to Point Lookout

This category of benefits is estimated in an identical fashion as those for Form #1 (daily pass visitors).

The simulated demand curve, using the sampling distribution, is displayed in Table V-U. This amount, $41,813, is the estimate of the annual value from the increase in visits due to improvements to the beaches at Point Lookout.

The confidence interval for the simulated demand curve (Table V-V) is displayed in Table V-L.

Table V-U

Sampling Distribution (Form #2, With "alternative" Project)
Use Value from visitors to Beaches at Point Lookout "with (alternative) project"
—Number of annual visits estimated to be—
133,896

Sample WTP Bids	Average Visits by X respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$5.00	2	4.47	8.94	0.006821248	913
$4.00	30.03003003	0.298	8.948948949	0.013649324	1,828
$3.00	5.091649695	3.427	17.4490835	0.026963029	3,610
$2.00	14.28571429	1.192	17.02857143	0.039955882	5,350
$1.50	25	0.298	7.45	0.045640255	6,111
$1.00	19.01140684	1.788	33.99239544	0.071576559	9,584
$0.50	6.666666667	2.682	17.88	0.085219055	11,410
$0.25	25	0.298	7.45	0.090903428	12,172
$0.00	8.865248227	134.398	1191.471631	1	133,896
				Annual Use Value	**$41,813**

Table V-V

Sampling distribution (Form #2, with "alternative" project)
Use Value from visitors to Beaches at Point Lookout "with "alternative" project"
95% Confidence Intervals

				Visits at WTP bid or greater		
Sample WTP Bid	**Lower Limit**	**Sample**	**Upper Limit**	**Lower limit**	**Sample**	**Upper Limit**
$5.00	0.0031	0.006821	0.01054293	415.02	913.34	1411.66
$4.00	0.008403	0.013649	0.01889576	1125.11	1827.59	2530.07
$3.00	0.019639	0.026963	0.03428692	2629.6	3610.24	4590.88
$2.00	0.0311	0.039956	0.04881171	4164.17	5349.93	6535.69
$1.50	0.036203	0.04564	0.05507702	4847.5	6111.05	7374.59
$1.00	0.059921	0.071577	0.08323261	8023.12	9583.81	11144.51
$0.50	0.072594	0.085219	0.09784372	9720.1	11410.49	13100.88
$0.25	0.077905	0.090903	0.10390178	10431.18	12171.61	13912.03
$0.00	1	1	1	133,896	133,896	133,896
				$36,511	**$41,813**	**$47,116**

D) Summary of use Value for Form #2 (Beaches at Point Lookout)

The summary of the use value for people using the beaches at Point Lookout under the different project conditions is presented below.

Type of Project	**Use Value**
Without Project	$191,032
With Project	$281,018
With "alternative" Project	$41,813

3. Form #3 (Survey Beaches: Nassau and Lido)

Form #3 is designed to estimate a) the use value of the beaches at Nassau and Lido in their present condition (the "without project" condition), b) the use value of maintaining and preventing beach erosion at Nassau and Lido (the "with project" condition) and c) the use value of beach nourishment projects at Long Beach and Point Lookout to potential 'switchers' who currently do not use the beaches at either Long Beach or Point Lookout but might do so once the beach nourishment projects are implemented.

A) Without Project recreational (use) value

i) Description of the without project condition.

In the "without project" condition respondents were asked about their visitation patterns to the beaches at Nassau and Lido. They were then asked how often they used any other beaches. Next the respondents were asked what is the maximum amount they would be willing to pay for a daily admission pass to the beaches at Nassau and Lido.

The WTP question was ..."Now I want to ask you a few questions about how much the use of this beach (SURVEY SITE) is worth to you. You just indicated that you visit (SURVEY SITE) approximately (X) days per summer. Here is a card with amounts of money on it. Which of these amounts is the maximum you would be willing to pay for a daily admission pass to use this beach? (IF RESPONDS WITH A DOLLAR AMOUNT, MULTIPLY TIMES VISITATION AND ASK) That's a total of $___ for the summer. Does that seem about right? (IF YES, GO TO THE NEXT QUESTION; IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY).

We will estimate the use value for Nassau and Lido beaches separately.

ii-a) Without project recreation (use) value (Nassau Beach), WTP bids based on sampling distribution.

The procedure used to estimate this type of benefit is identical to the method used earlier for the "without project" condition for Form #2 beaches.

The simulated demand curve for the "without project" condition, using the sampling distribution, is displayed in Table V-Wa. The area under the demand curve is displayed at the bottom of column '6'. This figure of $643,671 is an estimate of the annual "without project" use value from visitors to Nassau Beach.

The 95% confidence intervals for the simulated demand curve (Table V-Wa) is presented in Table V-Wb.

Table V-Wa

Sampling Distribution (Form #3, Without Project)
Use Value from visitors to Beaches at Nassau in their present condition
—Number of annual visits estimated to be—
340,511

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$11.00	20	0.324	6.48	0.009010332	3,068
$10.00	20	0.324	6.48	0.018020664	6,136
$6.00	17.15265866	0.756	12.96740995	0.036051632	12,276
$5.50	4	3.348	13.392	0.054672985	18,617
$5.00	7.593014427	4.32	32.80182232	0.100283374	34,148
$4.00	8.347245409	6.372	53.18864775	0.174241303	59,331
$3.50	22.22222222	0.648	14.4	0.194264264	66,149
$3.00	14.81481481	2.268	33.6	0.240984505	82,058
$2.50	7.147962831	2.808	20.07147963	0.268893563	91,561
$2.00	7.704160247	13.716	105.6702619	0.415826304	141,593
$1.50	90.09009009	0.108	9.72972973	0.429355332	146,200
$1.00	5.382131324	14.796	79.63401507	0.540085105	183,905
$0.50	16.36661211	1.188	19.44353519	0.567121017	193,111
$0.25	14.99250375	0.432	6.476761619	0.576126846	196,178
$0.00	5.376344086	56.7	304.8387097	1	340,511
				Annual Use Value	**$643,671**

Table V-Wb

Sampling distribution (Form #3, without project)
Use Value from visitors to Beaches at Nassau in their present condition
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater: Lower limit	Sample	Upper Limit
$11.00	0.00322	0.00901	0.01480055	1,096	3,068	5,040
$10.00	0.009869	0.018021	0.02617195	3,361	6,136	8,912
$6.00	0.024629	0.036052	0.0474746	8,386	12,276	16,166
$5.50	0.040742	0.054673	0.0686035	13,873	18,617	23,360
$5.00	0.081877	0.100283	0.11868927	27,880	34,148	40,415
$4.00	0.150998	0.174241	0.19748428	51,417	59,331	67,246
$3.50	0.170021	0.194264	0.21850705	57,894	66,149	74,404
$3.00	0.214778	0.240985	0.26719104	73,134	82,058	90,981
$2.50	0.241725	0.268894	0.29606235	82,310	91,561	100,812
$2.00	0.385626	0.415826	0.44602698	131,310	141,593	151,877
$1.50	0.399025	0.429355	0.45968593	135,872	146,200	156,528
$1.00	0.509546	0.540085	0.57062444	173,506	183,905	194,304
$0.50	0.53676	0.567121	0.59748165	182,773	193,111	203,449
$0.25	0.545846	0.576127	0.6064076	185,867	196,178	206,488
$0.00	1	1	1	340,511	340,511	340,511
				$578,812	$643,671	$708,531

ii-b) Without project recreation (use) value (Lido Beach), WTP bids based on sampling distribution.

Again, the procedure to estimate the simulated demand curve is the same as for the "without project" condition in Form #2. The simulated demand curve for the "without project" condition, using the sampling distribution, is displayed in Table V-Xa. The area under the demand curve is displayed at the bottom of column '6'. This figure of $140,055 is an estimate of the annual "without project" use value from visitors to Lido.

The 95% confidence intervals for the simulated demand curve (Table V-Xa) is presented in Table V-Xb.

Table V-Xa

Sampling Distribution (Form #3, Without Project)
Use Value from visitors to Lido in its present condition
—Number of annual visits estimated to be—
123,567

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$6.00	2	1.425	2.85	0.017451962	2,156
$4.00	28.57142857	0.228	6.514285714	0.05734216	7,086
$3.00	4.199916002	1.368	5.74548509	0.092524611	11,433
$2.50	5	0.57	2.85	0.109976573	13,589
$2.00	3.871467286	5.187	20.08130081	0.232944326	28,784
$1.50	23.98081535	0.228	5.467625899	0.266425307	32,921
$1.00	3.924646782	5.073	19.90973312	0.388342466	47,986
$0.50	1.935359009	2.964	5.736404103	0.42346931	52,327
$0.00	2.352941176	40.014	94.15058824	1	123,567
				Annual Use Value	**$140,055**

Table V-Xb

Sampling distribution (Form #3, without project)
Use Value from visitors to Beaches at Lido in its present condition
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Lower limit	Sample	Upper Limit
				Visits at WTP bid or greater		
$6.00	0.000607	0.017452	0.03429721	75	2,156	4,238
$4.00	0.027434	0.057342	0.08725051	3,390	7,086	10,781
$3.00	0.055249	0.092525	0.1298002	6,827	11,433	16,039
$2.50	0.06973	0.109977	0.15022318	8,616	13,589	18,563
$2.00	0.178567	0.232944	0.28732166	22,065	28,784	35,503
$1.50	0.209555	0.266425	0.32329598	25,894	32,921	39,949
$1.00	0.325646	0.388342	0.45103849	40,239	47,986	55,733
$0.50	0.359907	0.423469	0.48703176	44,473	52,327	60,181
$0.00	1	1	1	123,567	123,567	123,567
				$111,815	$140,055	$168,296

B) **With Project recreational (use) value**

i) Description of the "with project" condition.

The "with project" condition is to preserve and maintain the Nassau County beaches against erosion. The WTP question was ..." As you may know beaches are subject to erosion. Several projects for restoring beach areas on Long Beach Island and maintaining the beaches against erosion are being studied. The improvement and maintenance against erosion would only take place if you and others pay for it; and one way of collecting the needed funds is through user fees. You previously said you would be willing to pay (WTP "WITHOUT PROJECT") $___ for a admission pass to use Nassau County beaches in its present condition. Here is a card with amounts of money on it. Which of these amounts is the maximum additional amount you would be willing to pay for a *daily* admission pass to maintain the Nassau County beaches against erosion? Again, any increase in fees would only be used to improve and maintain the beach. (IF RESPONDS WITH A DOLLAR AMOUNT, ADD TO THE ABOVE SUM AND ASK) That's a total of $___. Does that seem about right? (IF NO, PROBE USER AND CORRECT ENTRY IF NECESSARY).

Again, the WTP question elicits a respondent's incremental or additional WTP (above their WTP bid to use the beaches in their present condition) to maintain the Nassau County beaches against erosion. The use value will be estimated separately for Nassau and Lido East.

ii-a) Use value "with project" (Nassau)

The simulated demand curve for the "with project" recreational (use) value (Nassau Beach) is displayed in Table V-Ya. The 95% confidence intervals for the simulated curve (Table V-Ya) is presented in Table V-Yb. The area under the demand curve is displayed at the bottom of column '6'. This figure of $376,210 is an estimate of the annual "with project" use value from visitors to Nassau.

Table V-Ya

Sampling Distribution (Form #3, With Project)

Use Value from visitors to Nassau Beach with "prevent erosion" project

—Number of annual visits estimated to be—

340,511

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$5.00	20	0.315	6.3	0.009135122	3,111
$4.00	9.00090009	2.205	19.8469847	0.037913633	12,910
$3.00	5.45553737	2.415	13.17512275	0.057017816	19,415
$2.00	8.936550492	9.555	85.38873995	0.18083314	61,576
$1.00	7.262164125	26.145	189.869281	0.456147269	155,323
$0.75	27.93296089	0.735	20.53072626	0.485917219	165,460
$0.50	3.841721091	15.33	58.89358433	0.571314055	194,539
$0.25	11.24859393	1.785	20.07874016	0.600428617	204,453
$0.00	5.924170616	46.515	275.5627962	1	340,511
				Annual Use Value	**$376,210**

Table V-Yb

Sampling distribution (Form #3, with project)
Use Value from visitors to Beaches at Nassau with "prevent erosion" project
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater: Lower limit	Sample	Upper Limit
$5.00	0.003182	0.009135	0.01508868	1,083	3,111	5,138
$4.00	0.025962	0.037914	0.04986499	8,840	12,910	16,980
$3.00	0.042508	0.057018	0.07152789	14,474	19,415	24,356
$2.00	0.156749	0.180833	0.20491765	53,375	61,576	69,777
$1.00	0.424979	0.456147	0.48731504	144,710	155,323	165,936
$0.75	0.454641	0.485917	0.51719315	154,810	165,460	176,110
$0.50	0.540346	0.571314	0.60228252	183,994	194,539	205,084
$0.25	0.569778	0.600429	0.63107932	194,016	204,453	214,889
$0.00	1	1	1	340,511	340,511	340,511
				$343,444	$376,210	$408,976

ii-b) Use value "with project" (Lido)

The simulated demand curve for the "with project" recreational (use) value (Lido) is displayed in Table V-Yc. The 95% confidence intervals for the simulated curve (Table V-Yc) is presented in Table V-Yd. The area under the demand curve is displayed at the bottom of column '6'. This figure of $191,250 is an estimate of the annual "with project" use value from visitors to Lido East.

Table V-Yc

Sampling Distribution (Form #3, With Project)
Use Value from visitors to Lido with "prevent erosion" project
—Number of annual visits estimated to be—
123,567

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$10.00	1	2.85	2.85	0.017437374	2,155
$4.00	22.52252252	0.399	8.986486486	0.072420083	8,949
$3.00	23.98081535	0.228	5.467625899	0.105873078	13,082
$2.00	3.703703704	4.617	17.1	0.210497319	26,011
$1.00	2.293052052	22.401	51.36665902	0.524777888	64,845
$0.75	20	0.171	3.42	0.545702737	67,431
$0.50	1	2.85	2.85	0.56314011	69,586
$0.00	3.033060358	23.541	71.40127389	1	123,567
				Annual Use Value	**$191,250**

Table V-Yb

Sampling distribution (Form #3, with project)
Use Value from visitors to Lido with "prevent erosion" project
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater: Lower limit	Sample	Upper Limit
$10.00	0.000606	0.017437	0.03426866	75	2,155	4,234
$4.00	0.039093	0.07242	0.10574751	4,831	8,949	13,067
$3.00	0.06631	0.105873	0.14543605	8,194	13,082	17,971
$2.00	0.158077	0.210497	0.26291728	19,533	26,011	32,488
$1.00	0.460563	0.524778	0.58899233	56,910	64,845	72,780
$0.75	0.481678	0.545703	0.60972702	59,520	67,431	75,342
$0.50	0.499361	0.56314	0.62691885	61,705	69,586	77,466
$0.00	1	1	1	123,567	123,567	123,567
				$149,338	$191,250	$233,161

C) Recreational (use) value from i) Increase in total visitation with the increase taken at Long Beach and Point Lookout and ii) potential 'switchers'.

These categories of benefits were designed to obtain estimates of the use value for improvements to the beaches at Long Beach and Point Lookout (the with "alternative" project in Form #1) from people using the Nassau and Lido beaches. It is designed to estimate i) the use value of beach nourishment projects at Long Beach and Point Lookout to potential 'switchers' who currently do not use the beaches at either Long Beach or Point Lookout but might do so once the beach nourishment projects are implemented, and ii) The use value from an increase in total visitation with the increase taken in Long Beach and Point Lookout. We are only interested in those people using the Nassau and Lido beaches who do not currently use the beaches at either Long Beach or Point Lookout. Separating out these respondents will avoid double counting with the benefits derived from Form #1.

People using the beaches at Nassau and Lido not currently using the beaches at either Long Beach or Point Lookout, can have 3 responses to the improvements to beaches at Long Beach and Point Lookout: a) No change in visitation; b) Switch some or all of their visitation to the beaches at Long Beach and Point Lookout; and c) Increase their total visitation with the increase taken at Long Beach and Point Lookout.

Respondents that did not use the beaches at Long Beach and Point Lookout were asked about their WTP and beach use given that the improvements to the beaches at Long Beach and Point Lookout were made. Respondents were asked about their beach visitation after completion of the improvements to the beaches at Long Beach and Point Lookout.

The WTP question was ..."You just indicated that you would use Long Beach and Point Lookout about (X) times per summer if it and other Long Beach Island beaches were restored to a width of approximately 422 feet. The improvements and maintenance against erosion would only take place if you and others pay for it; and one way of collecting the needed funds is through user fees. Here is a card with amounts of money on it. Which of these amounts is the maximum you would be willing to pay for a daily admission pass to use Long Beach and Point Lookout with a 422-foot beach with a protective sand dune? Again, any fees would only be used to improve and maintain the beach..."

The WTP question here is <u>not</u> an <u>incremental</u> WTP. It is the respondent's WTP to use the beaches at Long Beach and Point Lookout after the improvements have been made. The WTP bids used in the case of "switchers" is Net WTP = WTP to switch some or all of the visitation to Long Beach and Point Lookout - WTP "without project". This is the net WTP to switch. In the case of "increase" in total visitation, their actual WTP bids were used. We will separately estimate the use value from visitors to Nassau and Lido beaches for each category.

a) Recreational Use Value from "switchers"

a-1) Use value from visits switched to the beaches at Long Beach and Point Lookout from Nassau Beach

The number of visits switched to Long Beach and Point Lookout from Nassau Beach is calculated using the following formula.

Number of visits switched = [% of sample now using Nassau Beach willing to switch to the beaches at Long Beach and Point Lookout] x [Number of people using Nassau Beach] x [Average number of Nassau Beach visits switched to Long Beach and Point Lookout]

41,544 ≈ [.1171171] x [50,747] x [6.99]

The increased use value associated with the visits switched to the beaches at Long Beach and Point Lookout from Nassau Beach is given by the simulated demand curve in Table V-Za. This figure of $51,183, (bottom of Column '6') is an estimate of the annual use value from the visits switched to the beaches at Long Beach and Point Lookout from Nassau Beach. The 95% confidence interval for the simulated demand curve (Table V-Za) is presented in Table V-Zb.

Table V-Za

Sampling Distribution (Form #3, "Switchers")
Use Value from "switchers" to the beaches at Long Beach and Point Lookout (after the improvements have been made)from Nassau Beach
—Number of annual visits estimated to be—
41,544

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$3.00	17.98561151	0.39	7.014388489	0.074866063	3,110
$2.00	4.737091426	4.433	20.99952629	0.298998482	12,422
$1.00	7.501875469	1.859	13.9459865	0.447846968	18,605
$0.75	90.09009009	0.078	7.027027027	0.522847925	21,721
$0.50	5	1.944	9.72	0.626591556	26,031
$0.00	7.215007215	4.849	34.98556999	1	41,544
				Annual Use Value	**$51,183**

Table V-Zb

Sampling distribution (Form #3, switchers)
Use Value from "switchers" to the beaches at Long Beach and Point Lookout (after the improvements have been made)from Nassau Beach
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Lower limit	Visits at WTP bid or greater Sample	Upper Limit
$3.00	0.030191	0.074866	0.11954142	1,254	3,110	4,966
$2.00	0.221281	0.298998	0.37671569	9,193	12,422	15,650
$1.00	0.363432	0.447847	0.53226161	15,098	18,605	22,112
$0.75	0.438059	0.522848	0.60763689	18,199	21,721	25,244
$0.50	0.544479	0.626592	0.70870373	22,620	26,031	29,442
$0.00	1	1	1	41,544	41,544	41,544
				$42,675	**$51,183**	**$59,691**

a-2) Use value from visits switched to the beaches at Long Beach and Point Lookout from Lido Beach

The number of visits switched to Long Beach and Point Lookout from Lido Beach is calculated using the following formula.

Number of visits switched = [% of sample now using Lido Beach willing to switch to the beaches at Long Beach and Point Lookout] x [Number of people using Lido Beach] x [Average number of Lido Beach visits switched to Long Beach and Point Lookout]

8,639 ≈ [.0806451] x [42,173] x [2.54]

The increased use value associated with the visits switched to the beaches at Long Beach and Point Lookout from Lido Beach is given by the simulated demand curve in Table V-Zc. This figure of $53,521, (bottom of Column '6') is an estimate of the annual use value from the visits switched to the beaches at Long Beach and Point Lookout from Lido Beach. The 95% confidence interval for the simulated demand curve (Table V-Zc) is presented in Table V-Zd.

Table V-Zc

Sampling Distribution (Form #3, "Switchers")
Use Value from "switchers" to the beaches at Long Beach and Point Lookout (after the improvements have been made)from Lido Beach (East)
—Number of annual visits estimated to be—
8,639

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$12.00	1	2.54	2.54	0.199834671	1,726
$6.00	3.00030003	0.845	2.535253525	0.399295914	3,450
$5.00	5	0.51	2.55	0.599917336	5,183
$2.00	3.00030003	0.845	2.535253525	0.799378578	6,906
$0.00	10	0.255	2.55	1	8,639
				Annual Use Value	**$53,521**

Table V-Zd

Sampling distribution (Form #3, switchers)
Use Value from "switchers" to the beaches at Long Beach and Point Lookout (after the improvements have been made)from Lido Beach (East)
95% Confidence Intervals

				Visits at WTP bid or greater		
Sample WTP Bid	Lower Limit	Sample	Upper Limit	Lower limit	Sample	Upper Limit
$12.00	0.015465	0.199835	0.38420457	134	1,726	3,319
$6.00	0.173486	0.399296	0.62510555	1,499	3,450	5,400
$5.00	0.374033	0.599917	0.82580125	3,231	5,183	7,134
$2.00	0.614737	0.799379	0.98402022	5,311	6,906	8,501
$0.00	1	1	1	8,639	8,639	8,639
				$34,025	**$53,521**	**$73,018**

b) Recreational Use Value from "Increase" in total visits

b-1) Use value from an increase in total visits from visitors at Nassau Beach with the increase taken at Long Beach and Point Lookout

The increase in visits to the beaches at Long Beach and Point Lookout from people currently using Nassau Beach is estimated as follows

Increase in visits	=	[% of sample at Nassau Beach not now using beaches at Long Beach and Point Lookout willing to increase total visitation] x [Number of people using Nassau Beach] x [Average increase in visits to the beaches at Long Beach and Point Lookout]
26,379	≈	[.09009] x [50,747] x [5.77]

The use value associated with the increase in visits is given by the simulated demand curve in Table V-Ze. This figure of $100,176, (bottom of Column '6') is an estimate of the annual use value from the increase in visits (from Nassau Beach visitors) taken at Long Beach and Point Lookout. The 95% confidence interval for the simulated demand curve (Table V-Ze) is presented in Table V-Zf.

Table V-Ze

Sampling Distribution (Form #3, "increase in visitation")
Use Value from increased visits to the beaches at Long Beach and Point Lookout (from Nassau Beach)
—Number of annual visits estimated to be—
26,379

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$6.00	3.333333333	3.46	11.53333333	0.199387169	5,260
$5.00	5	2.31	11.55	0.39906247	10,527
$4.00	10	0.58	5.8	0.499332318	13,172
$3.00	10	0.58	5.8	0.599602166	15,817
$2.00	20	0.58	11.6	0.800141861	21,107
$1.00	3.00030003	1.92	5.760576058	0.899730152	23,734
$0.00	10	0.58	5.8	1	26,379
				Annual Use Value	**$100,176**

Table V-Zf

Sampling distribution (Form #3, "increase in visitation")
Use Value from increased visits to the beaches at Long Beach and Point Lookout (from Nassau Beach)
95% Confidence Intervals

Sample WTP Bid	Lower Limit	Sample	Upper Limit	Visits at WTP bid or greater Lower limit	Sample	Upper Limit
$6.00	0.113065	0.199387	0.28570893	2,983	5,260	7,537
$5.00	0.29326	0.399062	0.50486487	7,736	10,527	13,318
$4.00	0.391306	0.499332	0.60735875	10,322	13,172	16,022
$3.00	0.493741	0.599602	0.70546362	13,024	15,817	18,609
$2.00	0.713744	0.800142	0.88654009	18,828	21,107	23,386
$1.00	0.834837	0.89973	0.96462373	22,022	23,734	25,446
$0.00	1	1	1	26,379	26,379	26,379
				$86,613	$100,176	$113,738

b-1) Use value from an increase in total visits from visitors at Lido Beach with the increase taken at Long Beach and Point Lookout

The increase in visits to the beaches at Long Beach and Point Lookout from people currently using Lido Beach is estimated as follows

Increase in visits = [% of sample at Lido ,not now using beaches at Long Beach and Point Lookout, willing to increase total visitation] x [Number of people using Lido Beach] x [Average increase in visits to the beaches at Long Beach and Point Lookout]

17,380 ≈ [.1129032] x [42,173] x [3.65]

The use value associated with the increase in visits is given by the simulated demand curve in Table V-Zg. This figure of $58,926, (bottom of Column '6') is an estimate of the annual use value from the increase in visits (from Lido Beach visitors) taken at Long Beach and Point Lookout. The 95% confidence interval for the simulated demand curve (Table V-Zg) is presented in Table V-Zh.

Table V-Zg

Sampling Distribution (Form #3, "increase in visitation")
Use Value from increased visits to the beaches at Long Beach and Point Lookout (from Lido Beach)
—Number of annual visits estimated to be—
17,380

Sample WTP Bids	Average Visits by respondents	Number of respondents willing to pay bid	Number of visits by respondents at bid	Percentage of visits by respondents at bid or greater	Estimated number of visits at WTP bid or greater
$6.00	20	0.182	3.64	0.142491928	2,477
$5.50	10	0.364	3.64	0.284983855	4,953
$2.00	2.399808015	3.045	7.307415407	0.571040917	9,925
$1.00	3.214400514	3.409	10.95789135	1	17,380
				Annual Use Value	**$58,926**

Table V-Zh

Sampling distribution (Form #3, "increase in visitation")
Use Value from increased visits to the beaches at Long Beach and Point Lookout (from Lido Beach)
95% Confidence Intervals

				Visits at WTP bid or greater		
Sample WTP Bid	**Lower Limit**	**Sample**	**Upper Limit**	**Lower limit**	**Sample**	**Upper Limit**
$6.00	0.028806	0.142492	0.25617745	501	2,477	4,452
$5.50	0.138173	0.284984	0.43179499	2,401	4,953	7,505
$2.00	0.410076	0.571041	0.7320063	7,127	9,925	12,722
$1.00	1	1	1	17,380	17,380	17,380
				$47,034	**$58,926**	**$70,817**

VI. SUMMARY OF RECREATIONAL (USE) VALUE

a) The summary of the total recreational (use) value for the "without project" condition is given below.

Type of Form	Use Value
Form #1 (Daily + Season)	*$351,339*
Form #2	*$191,032*
Total	**$542,371**

b) The summary of the total recreational (use) value for the "with project" condition is given below.

Category of Benefits	Use Value
Form #1 (Beaches at Long Beach)	
1) Use Value (Daily Pass) "with project"	$167,170
2) Use Value (Season Pass) "with project"	$165,978
3) Use Value from increase in visitation "with project"	$219,222
Form #2 (Beaches at Point Lookout)	
1) Use Value "with project"	$169,842
2) Use Value from increase in visitation "with project"	$111,176
Total Use Value "with project"	**$833,388**

c) The summary of the total recreational (use) value for the with "alternative" project condition is given below.

Category of Benefits	Use Value
Form #1 (Beaches at Long Beach)	
1) Use Value (Daily Pass) with "alternative" project	$20,416
2) Use Value (Season Pass) with "alternative" project	$36,382
Form #2 (Beaches at Point Lookout)	
1) Use Value with "alternative" project"	$41,813
Form #3 (Nassau and Lido Beaches)	
1) Use Value from "switchers" with "alternative" project (Nassau + Lido)	$104,704
2) Use Value from "increase" in total visitation with "alternative" project (Nassau + Lido)	$159,102
Total Use Value with "alternative" project	**$362,817**

VII. FORECAST OF USE VALUE

The analysis presented previously generates a 1992 or baseline estimate of the "without" and with project use values. It should be noted that the estimated use values are incremental above what people currently pay to use the beach. A forecast of use value is generated for all the "with project" categories. The forecast assumes that the improvements to the beaches at Long Beach, Point Lookout and Lido will be completed in the year 2000.

The forecast of use value is based on population projections for the New York counties[1]. The data provided was county projections of population changes to the year 2040[2]. The population projections were not annual but rather varied between 5-year and 20-year projections. The percent increase for each year was calculated using the following formula.

$$k = \sqrt[1/n]{(fv \div pv)} - 1$$

Where k *is the effective annual percent change in population*
fv *is the future projected population figure*
pv *is the present projected population figure*
n *is the lag (number of years) between projection estimates*

Example; The projected population figure for Nassau county for 1995 is 1,317,000 and for the year 2000 is 1,336,800. The yearly percent change in from 1995 to 2000 population is

$\sqrt[1/5]{(1,336,800 \div 1,317,000}$ $- 1$ which is 0.002988913.

The annual number of visits from each county were assumed to change in direct proportion to population projection changes in those counties (i.e. the 1996 estimate of visitation is (1+.002988913) × visitation in 1995). All visitors to Point Lookout, Nassau and Lido were from Nassau county. Only in the case of day pass visitors from Long Beach were there visitors from counties other than Nassau. The procedure for forecasting benefits is to multiply baseline benefits by the proportional increase in visitation. For example; Consider Table VII-A (Forecast of use value for day pass visitors "with project" - Long Beach). The visit estimate for 1999 is 179,963 and the benefits were $390,674. The visit estimate for 2000 is 180,422. The benefits for 2000 is calculated as follows.

Benefits in 2000 = (180,422/179,963) × $390,674 ≈ $391,669

[1]Data Source; U.S. Dept of Commerce, Economics and Statistics administration.
[2]For Data on Poulation Projections, see Table VII-I given at the end of the section

1. "With Project" Forecast

A) Form #1 - Beaches at Long Beach.

i) Day Pass visitors

The Forecast of the "with project" use value from day pass visitors in Long Beach is shown in Table VII-A. Visitors to the beaches at Long Beach originated mainly from three counties, namely, Nassau, Kings and New York. These counties accounted for 93.8% of total day visitors. The remaining 6.2% were dispersed among many different origins. Each of these origins had a relatively small percentage of visits. Visits from these origins were added as a constant to the visit forecast. The procedure to calculate the forecast was as follows.

1) For each county, the percent change in population projections were computed.

2) The number of visits coming from each county (this also includes the number of visits from increase in visitation with the project implemented) was multiplied by the percent change in population projections for each year to get the change in number of visits in each year.

3) For each year, the number of visits were added across the different counties to get an estimate of the total number of visits for a given year.

4) The forecast for the estimated use value is calculated by multiplying the baseline benefits by the percent change in visitation. Note that the baseline benefits here also includes the use value from increase in visitation with the project implemented

5) The present value of the forecasted use value for 50 years is calculated by multiplying the estimated use value in each year by an annual discount rate of 8%.

6) The Total Present Use value is simply the sum of the present use value for each year.

7) The annual cash flow is calculated using the following formula.

$$Annual\ CashFlow = Total\ present\ Value \times k \div (1-(1-k)^{-n})$$

Where *k is the discount rate.*
n is number of periods (in our case 50).

Table VII-A

Forecast of use value from visitors to Long Beach ("with project")
(Day Pass visitors)
(The 1992 Baseline use Value includes $167,170 from Table V-E and $219,222 from Table V-G)

Year	Visit Estimate	Estimated Use Value	Discount Factor 8%	Present Value
1992	177,991	$386,392	0	$0
1993	178,042	$386,502	0	$0
1994	178,093	$386,613	0	$0
1995	178,144	$386,724	0	$0
1996	178,597	$387,707	0	$0
1997	179,051	$388,693	0	$0
1998	179,507	$389,682	0	$0
1999	179,963	$390,674	0	$0
2000	180,422	$391,669	1	$391,669
2001	180,875	$392,652	0.925925926	$363,567
2002	181,329	$393,638	0.85733882	$337,481
2003	181,784	$394,627	0.793832241	$313,267
2004	182,241	$395,618	0.735029853	$290,791
2005	182,699	$396,612	0.680583197	$269,928
2006	183,185	$397,667	0.630169627	$250,598
2007	183,672	$398,725	0.583490395	$232,652
2008	184,161	$399,787	0.540268885	$215,992
2009	184,651	$400,851	0.500248967	$200,525
2010	185,143	$401,918	0.463193488	$186,166
2011	185,607	$402,926	0.428882859	$172,808
2012	186,072	$403,936	0.397113759	$160,408
2013	186,539	$404,948	0.367697925	$148,899
2014	187,007	$405,964	0.340461041	$138,215
2015	187,476	$406,982	0.315241705	$128,298
2016	187,946	$408,003	0.291890468	$119,092
2017	188,418	$409,027	0.270268951	$110,547
2018	188,891	$410,053	0.250249029	$102,615
2019	189,365	$411,082	0.231712064	$95,253
2020	189,840	$412,114	0.214548207	$88,418
2021	189,879	$412,200	0.198655748	$81,886
2022	189,919	$412,285	0.183940507	$75,836
2023	189,958	$412,371	0.170315284	$70,233
2024	189,997	$412,456	0.157699337	$65,044
2025	190,037	$412,542	0.146017905	$60,238
2026	190,076	$412,627	0.135201764	$55,788
2027	190,116	$412,713	0.125186818	$51,666
2028	190,155	$412,798	0.115913721	$47,849
2029	190,194	$412,884	0.107327519	$44,314
2030	190,234	$412,969	0.099377333	$41,040
2031	190,273	$413,055	0.092016049	$38,008
2032	190,313	$413,141	0.085200045	$35,200

2033	190,352	$413,226	0.078888931	$32,599
2034	190,392	$413,312	0.073045306	$30,190
2035	190,431	$413,398	0.067634543	$27,960
2036	190,471	$413,483	0.062624577	$25,894
2037	190,510	$413,569	0.057985719	$23,981
2038	190,550	$413,655	0.053690481	$22,209
2039	190,589	$413,741	0.049713408	$20,568
2040	190,629	$413,826	0.046030933	$19,049
2041	190,668	$413,912	0.042621235	$17,641
2042	190,708	$413,998	0.039464106	$16,338
2043	190,747	$414,084	0.036540839	$15,131
2044	190,787	$414,170	0.03383411	$14,013
2045	190,826	$414,256	0.03132788	$12,978
2046	190,866	$414,342	0.029007296	$12,019
2047	190,905	$414,427	0.026858607	$11,131
2048	190,945	$414,513	0.024869081	$10,309
2049	190,985	$414,599	0.023026927	$9,547
		Present Use Value at 8%		**$5,305,849**
		Annual Cash Flow at 8%		**$433,715**
		Present Use Value at 7%		***$5,940,855***
		Present Use Value at 9%		***$4,790,341***

ii) Season Pass Visitors

The procedure to calculate the forecast for season pass visitors is the same as in the case of day pass visitors except that the number of people using a season pass was used instead of the number of visits. All season pass visitors originated from Nassau County. So the percent increase in visits in each year is simply the percent increase in population projections in each year. The forecast for the use value from season pass visitors "with project" is shown in Table VII-B.

Table VII-B

Forecast of use value from visitors to Long Beach ("with project")
(Season Pass visitors)
(The 1992 Baseline use value of $165,978 is taken from Table V-I)

Year	Number of People	Estimated Use Value	Discount Factor 8%	Present Value
1992	40,646	$165,978	0	$0
1993	40,641	$165,958	0	$0
1994	40,636	$165,938	0	$0
1995	40,631	$165,919	0	$0
1996	40,753	$166,415	0	$0
1997	40,875	$166,912	0	$0
1998	40,997	$167,411	0	$0
1999	41,119	$167,911	0	$0
2000	41,242	$168,413	1	$168,413
2001	41,358	$168,887	0.925925926	$156,376
2002	41,475	$169,361	0.85733882	$145,200
2003	41,591	$169,838	0.793832241	$134,823
2004	41,708	$170,315	0.735029853	$125,187
2005	41,825	$170,794	0.680583197	$116,240
2006	41,945	$171,283	0.630169627	$107,937
2007	42,065	$171,773	0.583490395	$100,228
2008	42,185	$172,264	0.540268885	$93,069
2009	42,306	$172,757	0.500248967	$86,421
2010	42,427	$173,251	0.463193488	$80,249
2011	42,542	$173,719	0.428882859	$74,505
2012	42,657	$174,188	0.397113759	$69,172
2013	42,772	$174,658	0.367697925	$64,222
2014	42,887	$175,130	0.340461041	$59,625
2015	43,003	$175,603	0.315241705	$55,357
2016	43,119	$176,078	0.291890468	$51,395
2017	43,236	$176,553	0.270268951	$47,717
2018	43,353	$177,030	0.250249029	$44,302
2019	43,470	$177,508	0.231712064	$41,131
2020	43,587	$177,988	0.214548207	$38,187
2021	43,598	$178,032	0.198655748	$35,367

2022	43,609	$178,076	0.183940507	$32,755
2023	43,619	$178,120	0.170315284	$30,337
2024	43,630	$178,164	0.157699337	$28,096
2025	43,641	$178,208	0.146017905	$26,022
2026	43,652	$178,252	0.135201764	$24,100
2027	43,663	$178,296	0.125186818	$22,320
2028	43,673	$178,340	0.115913721	$20,672
2029	43,684	$178,384	0.107327519	$19,146
2030	43,695	$178,428	0.099377333	$17,732
2031	43,706	$178,472	0.092016049	$16,422
2032	43,716	$178,516	0.085200045	$15,210
2033	43,727	$178,560	0.078888931	$14,086
2034	43,738	$178,605	0.073045306	$13,046
2035	43,749	$178,649	0.067634543	$12,083
2036	43,760	$178,693	0.062624577	$11,191
2037	43,771	$178,737	0.057985719	$10,364
2038	43,781	$178,781	0.053690481	$9,599
2039	43,792	$178,825	0.049713408	$8,890
2040	43,803	$178,870	0.046030933	$8,234
2041	43,814	$178,914	0.042621235	$7,626
2042	43,825	$178,958	0.039464106	$7,062
2043	43,835	$179,002	0.036540839	$6,541
2044	43,846	$179,046	0.03383411	$6,058
2045	43,857	$179,091	0.03132788	$5,611
2046	43,868	$179,135	0.029007296	$5,196
2047	43,879	$179,179	0.026858607	$4,813
2048	43,890	$179,224	0.024869081	$4,457
2049	43,901	$179,268	0.023026927	$4,128
		Present Use Value at 8%		**$2,286,917**
		Annual Cash Flow at 8%		**$186,939**
		Present Use Value at 7%		***$2,561,024***
		Present Use Value at 9%		***$2,064,423***

B Form #2 - Beaches at Point Lookout

The forecast for the "with project" use value from visitors to the beaches at point lookout is shown in Table VII-C. The procedure is the same as above. All visitors originate from Nassau County. Note again that the baseline use value also includes the use value from increase in visitation with improvements to the beaches.

Table VII-C

Forecast of use value from visitors to Point Lookout ("with project") (The 1992 baseline use value includes $169,842 from Table V-Q and $111,176 from Table V-S)

Year	Visit Estimate	Estimated Use Value	Discount Factor 8%	Present Value
1992	176,352	$281,018	0	$0
1993	176,331	$280,984	0	$0
1994	176,310	$280,951	0	$0
1995	176,289	$280,917	0	$0
1996	176,816	$281,757	0	$0
1997	177,344	$282,599	0	$0
1998	177,874	$283,444	0	$0
1999	178,406	$284,291	0	$0
2000	178,939	$285,141	1	$285,141
2001	179,442	$285,943	0.925925926	$264,762
2002	179,947	$286,747	0.85733882	$245,839
2003	180,453	$287,553	0.793832241	$228,269
2004	180,960	$288,361	0.735029853	$211,954
2005	181,469	$289,172	0.680583197	$196,806
2006	181,988	$289,999	0.630169627	$182,749
2007	182,509	$290,829	0.583490395	$169,696
2008	183,031	$291,661	0.540268885	$157,575
2009	183,554	$292,495	0.500248967	$146,320
2010	184,079	$293,332	0.463193488	$135,869
2011	184,577	$294,124	0.428882859	$126,145
2012	185,075	$294,918	0.397113759	$117,116
2013	185,575	$295,715	0.367697925	$108,734
2014	186,076	$296,514	0.340461041	$100,951
2015	186,579	$297,315	0.315241705	$93,726
2016	187,083	$298,118	0.291890468	$87,018
2017	187,588	$298,923	0.270268951	$80,790
2018	188,095	$299,730	0.250249029	$75,007
2019	188,603	$300,540	0.231712064	$69,639
2020	189,112	$301,352	0.214548207	$64,654
2021	189,159	$301,426	0.198655748	$59,880
2022	189,206	$301,501	0.183940507	$55,458
2023	189,253	$301,575	0.170315284	$51,363
2024	189,299	$301,650	0.157699337	$47,570
2025	189,346	$301,724	0.146017905	$44,057
2026	189,393	$301,799	0.135201764	$40,804

2027	189,440	$301,873	0.125186818	$37,791
2028	189,487	$301,948	0.115913721	$35,000
2029	189,533	$302,023	0.107327519	$32,415
2030	189,580	$302,097	0.099377333	$30,022
2031	189,627	$302,172	0.092016049	$27,805
2032	189,674	$302,247	0.085200045	$25,751
2033	189,721	$302,321	0.078888931	$23,850
2034	189,768	$302,396	0.073045306	$22,089
2035	189,815	$302,471	0.067634543	$20,457
2036	189,862	$302,546	0.062624577	$18,947
2037	189,909	$302,620	0.057985719	$17,548
2038	189,955	$302,695	0.053690481	$16,252
2039	190,002	$302,770	0.049713408	$15,052
2040	190,049	$302,845	0.046030933	$13,940
2041	190,096	$302,920	0.042621235	$12,911
2042	190,143	$302,995	0.039464106	$11,957
2043	190,190	$303,069	0.036540839	$11,074
2044	190,237	$303,144	0.03383411	$10,257
2045	190,284	$303,219	0.03132788	$9,499
2046	190,331	$303,294	0.029007296	$8,798
2047	190,378	$303,369	0.026858607	$8,148
2048	190,425	$303,444	0.024869081	$7,546
2049	190,473	$303,519	0.023026927	$6,989
		Present Use Value at 8%		**$3,871,989**
		Annual Cash Flow at 8%		**$316,507**
		Present Use Value at 7%		***$4,336,079***
		Present Use Value at 9%		***$3,495,283***

2. With "alternative" Project Forecast

A) Form #1 - Beaches at Long Beach

i) Day Pass Visitors

The procedure to estimate forecast of the with "alternative" project use value from day pass visitors is identical to the "with project" method with the baseline use value being the with "alternative" project use value for 1992. The forecast is displayed in Table V-D.

Table V-D
Forecast of Use Value from Visitors to Long Beach (with "alternative" project)
(Day Pass Visitors)
(The baseline benefits consists of $20,416 from Table V-K)

Year	Visit Estimate	Estimated Use Value	Discount Factor 8%	Present Value
1992	139,411	$20,416	0	$0
1993	141,843	$20,772	0	$0
1994	141,883	$20,778	0	$0
1995	141,923	$20,784	0	$0
1996	142,277	$20,836	0	$0
1997	142,633	$20,888	0	$0
1998	142,990	$20,940	0	$0
1999	143,348	$20,993	0	$0
2000	143,707	$21,045	1	$21,045
2001	144,062	$21,097	0.925925926	$19,534
2002	144,417	$21,149	0.85733882	$18,132
2003	144,774	$21,201	0.793832241	$16,830
2004	145,132	$21,254	0.735029853	$15,622
2005	145,490	$21,306	0.680583197	$14,501
2006	145,871	$21,362	0.630169627	$13,462
2007	146,253	$21,418	0.583490395	$12,497
2008	146,636	$21,474	0.540268885	$11,602
2009	147,020	$21,530	0.500248967	$10,770
2010	147,405	$21,587	0.463193488	$9,999
2011	147,768	$21,640	0.428882859	$9,281
2012	148,133	$21,693	0.397113759	$8,615
2013	148,498	$21,747	0.367697925	$7,996
2014	148,865	$21,800	0.340461041	$7,422
2015	149,232	$21,854	0.315241705	$6,889
2016	149,600	$21,908	0.291890468	$6,395
2017	149,970	$21,962	0.270268951	$5,936
2018	150,340	$22,016	0.250249029	$5,510
2019	150,711	$22,071	0.231712064	$5,114
2020	151,084	$22,125	0.214548207	$4,747
2021	151,114	$22,130	0.198655748	$4,396

2022	151,145	$22,134	0.183940507	$4,071
2023	151,176	$22,139	0.170315284	$3,771
2024	151,207	$22,143	0.157699337	$3,492
2025	151,238	$22,148	0.146017905	$3,234
2026	151,269	$22,152	0.135201764	$2,995
2027	151,300	$22,157	0.125186818	$2,774
2028	151,330	$22,162	0.115913721	$2,569
2029	151,361	$22,166	0.107327519	$2,379
2030	151,392	$22,171	0.099377333	$2,203
2031	151,423	$22,175	0.092016049	$2,040
2032	151,454	$22,180	0.085200045	$1,890
2033	151,485	$22,184	0.078888931	$1,750
2034	151,516	$22,189	0.073045306	$1,621
2035	151,547	$22,193	0.067634543	$1,501
2036	151,578	$22,198	0.062624577	$1,390
2037	151,608	$22,202	0.057985719	$1,287
2038	151,639	$22,207	0.053690481	$1,192
2039	151,670	$22,211	0.049713408	$1,104
2040	151,701	$22,216	0.046030933	$1,023
2041	151,732	$22,220	0.042621235	$947
2042	151,763	$22,225	0.039464106	$877
2043	151,794	$22,229	0.036540839	$812
2044	151,825	$22,234	0.03383411	$752
2045	151,856	$22,239	0.03132788	$697
2046	151,887	$22,243	0.029007296	$645
2047	151,918	$22,248	0.026858607	$598
2048	151,949	$22,252	0.024869081	$553
2049	151,980	$22,257	0.023026927	$513
		Present Use Value at 8%		**$284,976**
		Annual Cash Flow at 8%		**$23,295**
		Present Use Value at 7%		***$319,073***
		Present Use Value at 9%		***$257,295***

ii) Season Pass Visitors

The procedure to estimate forecast of the with "alternative" project use value from season pass visitors is identical to the "with project" method with the baseline use value being the with "alternative" project use value for 1992. The forecast is displayed in Table V-E.

Table V-E

Forecast of Use Value from visitors to Long Beach (with "alternative" project)
(Season Pass Visitors)
(The baseline benefits consists of $36,382 from Table V-M)

Year	Number of People	Estimated Use Value	Discount Factor 8%	Present Value
1992	40,646	$36,382	0	$0
1993	40,641	$36,378	0	$0
1994	40,636	$36,373	0	$0
1995	40,631	$36,369	0	$0
1996	40,753	$36,478	0	$0
1997	40,875	$36,587	0	$0
1998	40,997	$36,696	0	$0
1999	41,119	$36,806	0	$0
2000	41,242	$36,916	1	$36,916
2001	41,358	$37,020	0.925925926	$34,277
2002	41,475	$37,124	0.85733882	$31,828
2003	41,591	$37,228	0.793832241	$29,553
2004	41,708	$37,333	0.735029853	$27,441
2005	41,825	$37,438	0.680583197	$25,479
2006	41,945	$37,545	0.630169627	$23,660
2007	42,065	$37,652	0.583490395	$21,970
2008	42,185	$37,760	0.540268885	$20,400
2009	42,306	$37,868	0.500248967	$18,943
2010	42,427	$37,976	0.463193488	$17,590
2011	42,542	$38,079	0.428882859	$16,331
2012	42,657	$38,182	0.397113759	$15,162
2013	42,772	$38,285	0.367697925	$14,077
2014	42,887	$38,388	0.340461041	$13,070
2015	43,003	$38,492	0.315241705	$12,134
2016	43,119	$38,596	0.291890468	$11,266
2017	43,236	$38,700	0.270268951	$10,459
2018	43,353	$38,805	0.250249029	$9,711
2019	43,470	$38,909	0.231712064	$9,016
2020	43,587	$39,015	0.214548207	$8,370
2021	43,598	$39,024	0.198655748	$7,752
2022	43,609	$39,034	0.183940507	$7,180
2023	43,619	$39,043	0.170315284	$6,650
2024	43,630	$39,053	0.157699337	$6,159
2025	43,641	$39,063	0.146017905	$5,704
2026	43,652	$39,072	0.135201764	$5,283

2027	43,663	$39,082	0.125186818	$4,893
2028	43,673	$39,092	0.115913721	$4,531
2029	43,684	$39,101	0.107327519	$4,197
2030	43,695	$39,111	0.099377333	$3,887
2031	43,706	$39,121	0.092016049	$3,600
2032	43,716	$39,130	0.085200045	$3,334
2033	43,727	$39,140	0.078888931	$3,088
2034	43,738	$39,150	0.073045306	$2,860
2035	43,749	$39,159	0.067634543	$2,649
2036	43,760	$39,169	0.062624577	$2,453
2037	43,771	$39,179	0.057985719	$2,272
2038	43,781	$39,188	0.053690481	$2,104
2039	43,792	$39,198	0.049713408	$1,949
2040	43,803	$39,208	0.046030933	$1,805
2041	43,814	$39,217	0.042621235	$1,671
2042	43,825	$39,227	0.039464106	$1,548
2043	43,835	$39,237	0.036540839	$1,434
2044	43,846	$39,247	0.03383411	$1,328
2045	43,857	$39,256	0.03132788	$1,230
2046	43,868	$39,266	0.029007296	$1,139
2047	43,879	$39,276	0.026858607	$1,055
2048	43,890	$39,285	0.024869081	$977
2049	43,901	$39,295	0.023026927	$905
		Present Use Value at 8%		**$501,287**
		Annual Cash Flow at 8%		**$40,977**
		Present Use Value at 7%		***$561,371***
		Present Use Value at 9%		***$452,517***

B Form #2 - Beaches at Point Lookout

The forecast for the with "alternative" project use value from visitors to the beaches at Point Lookout is shown in Table V-F. The procedure is the same as in the case of Form #1 with the baseline use value being the with "alternative" project use value from visitors to Point Lookout.

Table V-F

Forecast of Use Value from visitors to Point Lookout (with "alternative" project)
(The 1992 baseline use value consists of $41,813 from Table V-U)

Year	visit estimate	Estimated Use Value	Discount Factor 8%	Present Value
1992	133,896	$41,813	0	$0
1993	133,880	$41,808	0	$0
1994	133,864	$41,803	0	$0
1995	133,848	$41,798	0	$0
1996	134,248	$41,923	0	$0
1997	134,649	$42,048	0	$0
1998	135,052	$42,174	0	$0
1999	135,456	$42,300	0	$0
2000	135,860	$42,426	1	$42,426
2001	136,242	$42,546	0.925925926	$39,394
2002	136,625	$42,665	0.85733882	$36,579
2003	137,010	$42,785	0.793832241	$33,964
2004	137,395	$42,906	0.735029853	$31,537
2005	137,781	$43,026	0.680583197	$29,283
2006	138,175	$43,149	0.630169627	$27,191
2007	138,571	$43,273	0.583490395	$25,249
2008	138,967	$43,397	0.540268885	$23,446
2009	139,364	$43,521	0.500248967	$21,771
2010	139,763	$43,645	0.463193488	$20,216
2011	140,141	$43,763	0.428882859	$18,769
2012	140,519	$43,881	0.397113759	$17,426
2013	140,899	$44,000	0.367697925	$16,179
2014	141,279	$44,119	0.340461041	$15,021
2015	141,661	$44,238	0.315241705	$13,946
2016	142,043	$44,357	0.291890468	$12,947
2017	142,427	$44,477	0.270268951	$12,021
2018	142,812	$44,597	0.250249029	$11,160
2019	143,198	$44,718	0.231712064	$10,362
2020	143,584	$44,838	0.214548207	$9,620
2021	143,620	$44,850	0.198655748	$8,910
2022	143,655	$44,861	0.183940507	$8,252
2023	143,691	$44,872	0.170315284	$7,642

2024	143,726	$44,883	0.157699337	$7,078
2025	143,762	$44,894	0.146017905	$6,555
2026	143,797	$44,905	0.135201764	$6,071
2027	143,833	$44,916	0.125186818	$5,623
2028	143,868	$44,927	0.115913721	$5,208
2029	143,904	$44,938	0.107327519	$4,823
2030	143,940	$44,949	0.099377333	$4,467
2031	143,975	$44,961	0.092016049	$4,137
2032	144,011	$44,972	0.085200045	$3,832
2033	144,046	$44,983	0.078888931	$3,549
2034	144,082	$44,994	0.073045306	$3,287
2035	144,118	$45,005	0.067634543	$3,044
2036	144,153	$45,016	0.062624577	$2,819
2037	144,189	$45,027	0.057985719	$2,611
2038	144,224	$45,038	0.053690481	$2,418
2039	144,260	$45,050	0.049713408	$2,240
2040	144,296	$45,061	0.046030933	$2,074
2041	144,331	$45,072	0.042621235	$1,921
2042	144,367	$45,083	0.039464106	$1,779
2043	144,403	$45,094	0.036540839	$1,648
2044	144,438	$45,105	0.03383411	$1,526
2045	144,474	$45,116	0.03132788	$1,413
2046	144,510	$45,128	0.029007296	$1,309
2047	144,546	$45,139	0.026858607	$1,212
2048	144,581	$45,150	0.024869081	$1,123
2049	144,617	$45,161	0.023026927	$1,040

Present Use Value at 8% **$576,118**

Annual Cash Flow at 8% **$47,094**

Present Use Value at 7% ***$645,170***

Present Use Value at 9% ***$520,067***

C Form #3 - Beaches at Nassau and Lido

This is the forecast of the with "alternative project" use value from visitors who currently use the beaches at Nassau and Lido but might "switch" some of their visitation to the beaches at Long Beach and Point Lookout or "increase" their total visitation with the increase taken at Long Beach and Point Lookout, once the with "alternative" project improvements are implemented. The baseline use value here includes both the use value from "increase" in visitation and from "switchers". The forecast is shown in Table V-G.

Table V-G

Forecast of Use Value from "increase" in Visitation and Potential "switchers" from Current Visitors to Nassau and Lido after the "alternative" project is implemented (The 1992 baseline use value includes $51,183 from Table V-Za; $53,521 from Table V-Zc; $100,176 from Table V-Ze and $58,926 from Table V-Zg)

Year	visit estimate	Estimated Use Value	Discount Factor 8%	Present Value
1992	93,942	$263,806	0	$0
1993	93,931	$263,775	0	$0
1994	93,920	$263,743	0	$0
1995	93,908	$263,712	0	$0
1996	94,189	$264,500	0	$0
1997	94,471	$265,290	0	$0
1998	94,753	$266,083	0	$0
1999	95,036	$266,879	0	$0
2000	95,320	$267,676	1	$267,676
2001	95,588	$268,429	0.925925926	$248,545
2002	95,857	$269,184	0.85733882	$230,782
2003	96,127	$269,941	0.793832241	$214,288
2004	96,397	$270,700	0.735029853	$198,972
2005	96,668	$271,461	0.680583197	$184,752
2006	96,944	$272,237	0.630169627	$171,556
2007	97,222	$273,016	0.583490395	$159,302
2008	97,500	$273,797	0.540268885	$147,924
2009	97,779	$274,580	0.500248967	$137,358
2010	98,058	$275,365	0.463193488	$127,547
2011	98,323	$276,109	0.428882859	$118,418
2012	98,589	$276,855	0.397113759	$109,943
2013	98,855	$277,603	0.367697925	$102,074
2014	99,122	$278,353	0.340461041	$94,768
2015	99,390	$279,104	0.315241705	$87,985
2016	99,658	$279,858	0.291890468	$81,688
2017	99,927	$280,614	0.270268951	$75,841
2018	100,197	$281,372	0.250249029	$70,413
2019	100,468	$282,132	0.231712064	$65,373
2020	100,739	$282,894	0.214548207	$60,694
2021	100,764	$282,964	0.198655748	$56,212
2022	100,789	$283,034	0.183940507	$52,061

2023	100,814	$283,104	0.170315284	$48,217
2024	100,839	$283,174	0.157699337	$44,656
2025	100,864	$283,244	0.146017905	$41,359
2026	100,889	$283,314	0.135201764	$38,305
2027	100,914	$283,384	0.125186818	$35,476
2028	100,939	$283,454	0.115913721	$32,856
2029	100,964	$283,524	0.107327519	$30,430
2030	100,989	$283,594	0.099377333	$28,183
2031	101,014	$283,664	0.092016049	$26,102
2032	101,039	$283,734	0.085200045	$24,174
2033	101,064	$283,805	0.078888931	$22,389
2034	101,089	$283,875	0.073045306	$20,736
2035	101,114	$283,945	0.067634543	$19,204
2036	101,138	$284,015	0.062624577	$17,786
2037	101,163	$284,085	0.057985719	$16,473
2038	101,188	$284,155	0.053690481	$15,256
2039	101,214	$284,226	0.049713408	$14,130
2040	101,239	$284,296	0.046030933	$13,086
2041	101,264	$284,366	0.042621235	$12,120
2042	101,289	$284,436	0.039464106	$11,225
2043	101,314	$284,507	0.036540839	$10,396
2044	101,339	$284,577	0.03383411	$9,628
2045	101,364	$284,647	0.03132788	$8,917
2046	101,389	$284,718	0.029007296	$8,259
2047	101,414	$284,788	0.026858607	$7,649
2048	101,439	$284,859	0.024869081	$7,084
2049	101,464	$284,929	0.023026927	$6,561
		Present Use Value at 8%		**$3,634,834**
		Annual Cash Flow at 8%		**$297,122**
		Present Use Value at 7%		***$4,070,500***
		Present Use Value at 9%		***$3,281,202***

4. With "prevent erosion" Project Forecast for Nassau and Lido

This is the forecast of the use value from visitors to Nassau and Lido with "prevent erosion" project. The baseline use value includes the use value from the with "prevent erosion" project from visitors to both Nassau and Lido. The forecast is presented in Table V-H.

Table V-H

Forecast of Use Value from visitors to Nassau and Lido (with "prevent erosion" project) (The use value includes $376,210 from Table V-Ya and $191,250 from Table V-Yc)

Year	Visit Estimate	Estimated Use Value	Discount Factor 8%	Present Value
1992	464,078	$567,460	0	$0
1993	464,023	$567,392	0	$0
1994	463,967	$567,325	0	$0
1995	463,912	$567,257	0	$0
1996	465,299	$568,952	0	$0
1997	466,689	$570,653	0	$0
1998	468,084	$572,359	0	$0
1999	469,483	$574,069	0	$0
2000	470,887	$575,785	1	$575,785
2001	472,211	$577,404	0.925925926	$534,634
2002	473,538	$579,028	0.85733882	$496,423
2003	474,870	$580,656	0.793832241	$460,943
2004	476,205	$582,289	0.735029853	$427,999
2005	477,544	$583,926	0.680583197	$397,410
2006	478,910	$585,596	0.630169627	$369,025
2007	480,280	$587,271	0.583490395	$342,667
2008	481,654	$588,951	0.540268885	$318,192
2009	483,031	$590,635	0.500248967	$295,465
2010	484,413	$592,325	0.463193488	$274,361
2011	485,721	$593,925	0.428882859	$254,724
2012	487,033	$595,529	0.397113759	$236,493
2013	488,349	$597,138	0.367697925	$219,566
2014	489,668	$598,750	0.340461041	$203,851
2015	490,990	$600,368	0.315241705	$189,261
2016	492,317	$601,989	0.291890468	$175,715
2017	493,646	$603,615	0.270268951	$163,139
2018	494,980	$605,246	0.250249029	$151,462
2019	496,317	$606,881	0.231712064	$140,622
2020	497,657	$608,520	0.214548207	$130,557
2021	497,780	$608,670	0.198655748	$120,916
2022	497,903	$608,821	0.183940507	$111,987
2023	498,027	$608,971	0.170315284	$103,717
2024	498,150	$609,122	0.157699337	$96,058
2025	498,273	$609,272	0.146017905	$88,965

2026	498,396	$609,423	0.135201764	$82,395
2027	498,519	$609,573	0.125186818	$76,311
2028	498,642	$609,724	0.115913721	$70,675
2029	498,766	$609,875	0.107327519	$65,456
2030	498,889	$610,026	0.099377333	$60,623
2031	499,012	$610,176	0.092016049	$56,146
2032	499,135	$610,327	0.085200045	$52,000
2033	499,259	$610,478	0.078888931	$48,160
2034	499,382	$610,629	0.073045306	$44,604
2035	499,506	$610,780	0.067634543	$41,310
2036	499,629	$610,931	0.062624577	$38,259
2037	499,753	$611,082	0.057985719	$35,434
2038	499,876	$611,233	0.053690481	$32,817
2039	500,000	$611,384	0.049713408	$30,394
2040	500,123	$611,535	0.046030933	$28,150
2041	500,247	$611,686	0.042621235	$26,071
2042	500,370	$611,837	0.039464106	$24,146
2043	500,494	$611,988	0.036540839	$22,363
2044	500,618	$612,140	0.03383411	$20,711
2045	500,742	$612,291	0.03132788	$19,182
2046	500,865	$612,442	0.029007296	$17,765
2047	500,989	$612,594	0.026858607	$16,453
2048	501,113	$612,745	0.024869081	$15,238
2049	501,237	$612,897	0.023026927	$14,113

Present Use Value at 8%	**$7,818,712**
Annual Cash Flow at 8%	**$639,124**
Present Use Value at 7%	***$8,755,851***
Present Use Value at 9%	***$7,058,030***

Summary of Forecasted Use Value

Category	Present Use Value			Annual Cash Flow 8% discount rate
	8% discount rate	7% discount rate	9% discount rate	
"with project" Condition				
Form #1-Beaches at Long Beach, Day Pass Visitors	$5,305,849	$5,940,855	$4,790,341	$433,715
Form #1-Beaches at Long Beach, Season Pass Visitors	$2,286,917	$2,561,024	$2,064,423	$186,939
Form #2-Beaches at Point Lookout	$3,871,989	$4,336,079	$3,495,283	$316,507
Total "with project" Condition	***$11,464,755***	***$12,837,958***	***$10,350,047***	***$937,161***
With "alternative" Project				
Form #1-Beaches at Long Beach, Day Pass Visitors	$284,976	$319,073	$257,295	$23,295
Form #1-Beaches at Long Beach, Season Pass Visitors	$501,287	$561,371	$452,517	$40,977
Form #2-Beaches at Point Lookout	$576,118	$645,170	$520,067	$47,094
Form #3-Beaches at Nassau and Lido (increase in visitation with increase taken at Long Beach and Point Lookout + "switchers" to Long Beach and Point Lookout)	$3,634,834	$4,070,500	$3,281,202	$297,122
Total With "alternative" Project	***$4,997,215***	***$5,596,114***	***$4,511,081***	***$408,488***
With "prevent Erosion" Project Form #3-Beaches at Nassau County	$7,818,712	$8,755,851	$7,058,030	$639,124

Table VII-I

New York County Population Projections To 2040
(Figures in Thousands)

Year	County			Yearly % Increase		
	Kings	*New York* (All Figures in Thousands)	*Nassau*	*Kings*	*New York*	*Nassau*
1988	**2,314.30**	**1,509.90**	**1,318.10**			
1989	2,316.34	1,511.05	1,317.94			
1990	2,318.38	1,512.21	1,317.79		*Annual Growth Rate, 1988-95*	
1991	2,320.42	1,513.37	1,317.63	*0.000880382*	*0.000764614*	*-0.000119262*
1992	2,322.46	1,514.52	1,317.47			
1993	2,324.51	1,515.68	1,317.31			
1994	2,326.55	1,516.84	1,317.16			
1995	**2,328.60**	**1,518.00**	**1,317.00**			
1996	2,332.37	1,522.35	1,320.94			
1997	2,336.14	1,526.72	1,324.88		*Annual Growth Rate, 1995-2000*	
1998	2,339.92	1,531.10	1,328.84	*0.001618048*	*0.002868867*	*0.002988913*
1999	2,343.71	1,535.49	1,332.82			
2000	**2,347.50**	**1,539.90**	**1,336.80**			
2001	2,351.74	1,544.45	1,340.56			
2002	2,356.00	1,549.02	1,344.33		*Annual Growth Rate, 2000-2005*	
2003	2,360.26	1,553.60	1,348.11	*0.001808146*	*0.002956683*	*0.002811791*
2004	2,364.52	1,558.19	1,351.90			
2005	**2,368.80**	**1,562.80**	**1,355.70**			
2006	2,373.90	1,567.81	1,359.58			
2007	2,379.01	1,572.83	1,363.47		*Annual Growth Rate, 2005-2010*	
2008	2,384.13	1,577.87	1,367.37	*0.002152149*	*0.003204379*	*0.002860333*
2009	2,389.26	1,582.93	1,371.28			
2010	**2,394.40**	**1,588.00**	**1,375.20**			
2011	2,399.82	1,592.52	1,378.91			
2012	2,405.26	1,597.06	1,382.64			
2013	2,410.71	1,601.60	1,386.37			
2014	2,416.17	1,606.16	1,390.12		*Annual Growth Rate, 2010-2020*	
2015	2,421.64	1,610.74	1,393.87	*0.002265439*	*0.002847369*	*0.002701079*
2016	2,427.13	1,615.32	1,397.64			
2017	2,432.63	1,619.92	1,401.41			
2018	2,438.14	1,624.54	1,405.20			
2019	2,443.66	1,629.16	1,408.99			
2020	**2,449.20**	**1,633.80**	**1,412.80**			
2021	2,449.39	1,634.22	1,413.15			
2022	2,449.58	1,634.64	1,413.50			
2023	2,449.77	1,635.06	1,413.85			
2024	2,449.96	1,635.48	1,414.20			
2025	2,450.15	1,635.90	1,414.55			

2026	2,450.34	1,636.32	1,414.90
2027	2,450.53	1,636.74	1,415.25
2028	2,450.72	1,637.15	1,415.60
2029	2,450.91	1,637.57	1,415.95
2030	2,451.10	1,637.99	1,416.30
2031	2,451.29	1,638.41	1,416.65
2032	2,451.48	1,638.83	1,417.00
2033	2,451.67	1,639.26	1,417.35
2034	2,451.86	1,639.68	1,417.70
2035	2,452.05	1,640.10	1,418.05
2036	2,452.24	1,640.52	1,418.40
2037	2,452.43	1,640.94	1,418.75
2038	2,452.62	1,641.36	1,419.10
2039	2,452.81	1,641.78	1,419.45
2040	2,453.00	1,642.20	1,419.80
2041	2,453.19	1,642.62	1,420.15
2042	2,453.38	1,643.04	1,420.50
2043	2,453.57	1,643.46	1,420.85
2044	2,453.76	1,643.89	1,421.20
2045	2,453.95	1,644.31	1,421.56
2046	2,454.14	1,644.73	1,421.91
2047	2,454.33	1,645.15	1,422.26

Annual Growth Rate, 2020-2040

7.75192E-05	*0.000256444*	*0.000247154*

SUB-APPENDIX D8

With Project Storm Frequency vs Damage for Selected Plan

D8

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

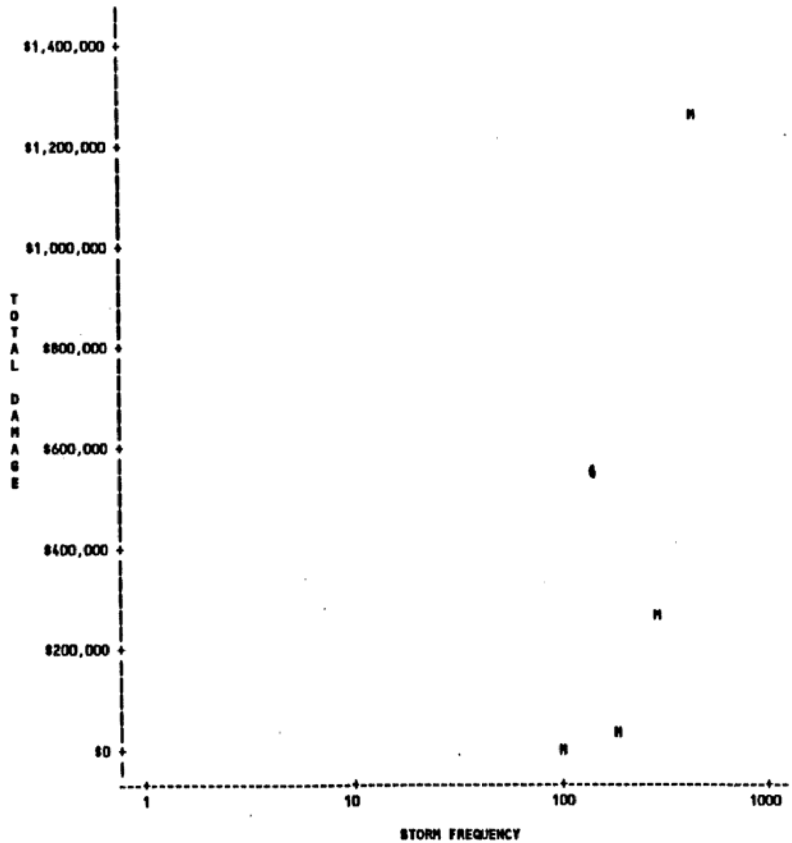
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	$600	$0	$0	$600
9	179.0	$31,600	$6,000	$300	$31,900
10	294.0	$279,000	$13,000	$3,100	$282,100
11	455.0	$561,100	$28,300	$6,800	$567,900

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	$675,300	$181,200	$35,200	$710,500

LONG BEACH, NY FEASIBILIT. STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 7 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	$156,100	$4,400	$1,700	$157,800
10	294.0	$568,900	$16,200	$6,100	$575,000
11	455.0	$775,400	$22,100	$8,400	$783,800

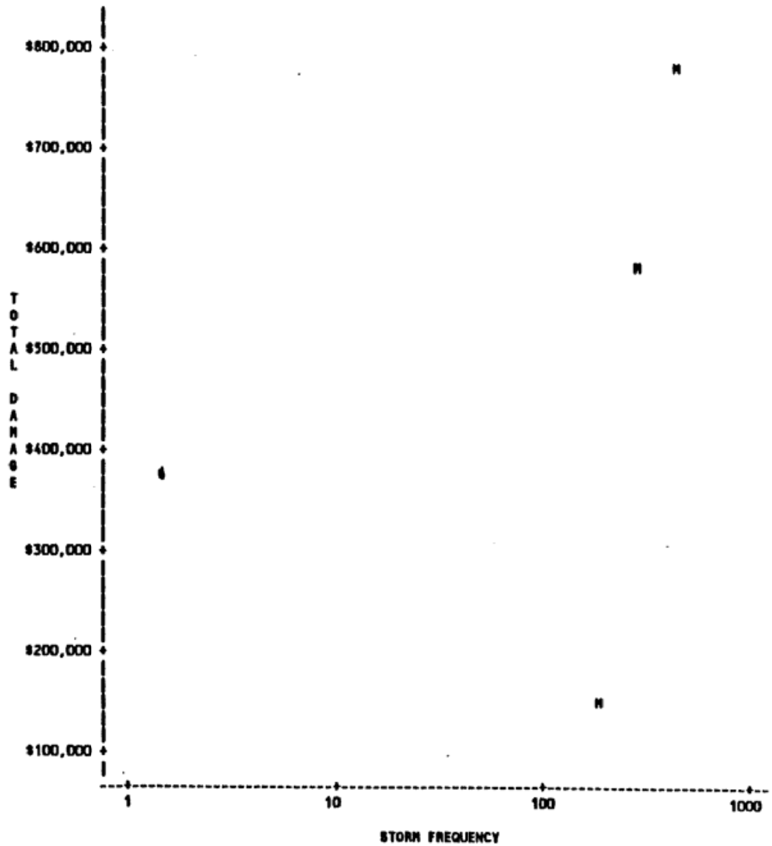
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	$5,100	.	.	$5,100

D8-3

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS - ALTS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 8 obs had missing values.

DB-4

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	.	.	.	.

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILI. (UDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

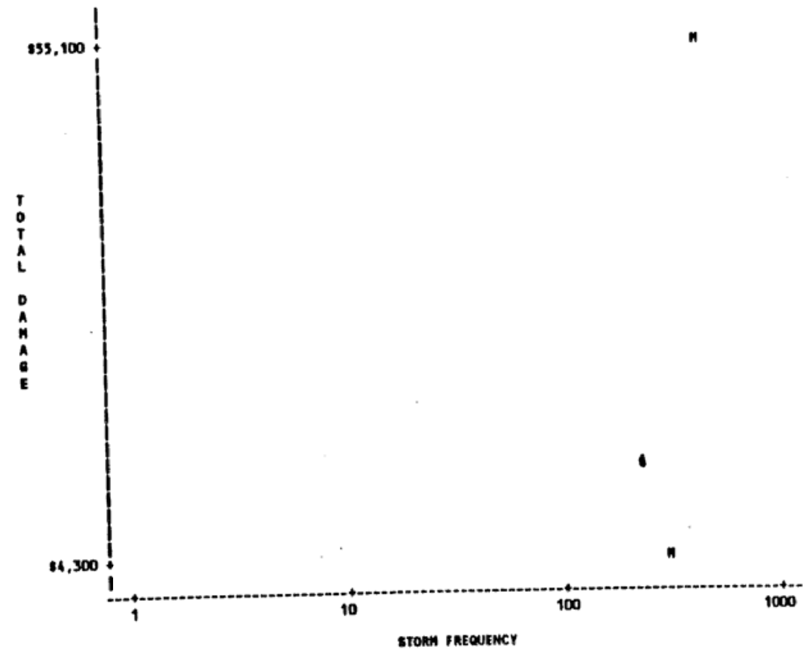
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	$4,200	$300	$100	$4,300
11	455.0	$4,200	$300	$100	$4,300

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	$48,400	$12,000	$2,400	$50,800

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS - ALTS
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 9 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-RECESSION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

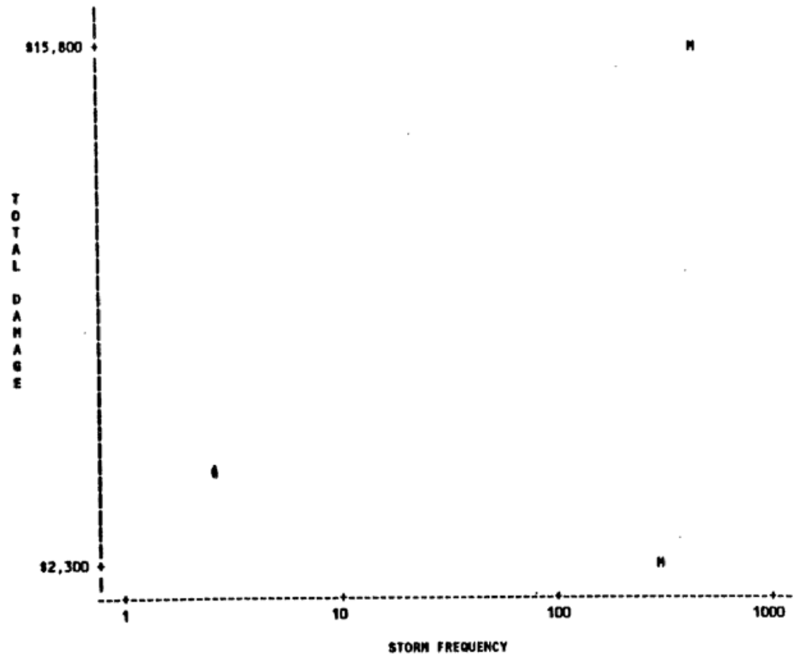
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	$2,300	.	.	$2,300
11	455.0	$15,700	$300	$100	$15,800

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
TOTAL RECESSION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 9 obs had missing values.

D8-9

LONG BEACH, NY FEASIBILIT. STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	$0	$0
3	3.0	.	.	$0	$0
4	7.0	.	.	$0	$0
5	16.0	$400	.	$2,700	$3,100
6	30.0	$1,300	.	$8,800	$10,100
7	56.0	$96,600	.	$23,400	$120,000
8	100.0	$651,500	.	$48,500	$700,000
9	179.0	$2,780,700	.	$117,600	$2,898,300
10	294.0	$11,289,800	.	$170,900	$11,460,700
11	455.0	$12,861,800	.	$182,800	$13,044,600

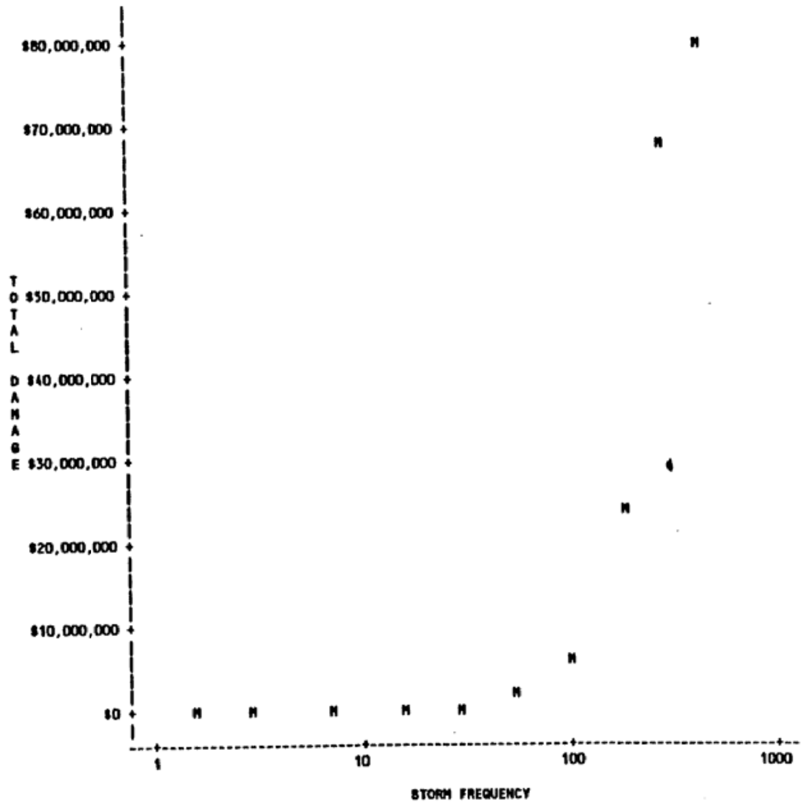
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	$16,900	$16,900
17	30.0	.	.	$53,000	$53,000
18	56.0	$1,760,800	$494,300	$156,000	$1,916,800
19	100.0	$5,914,600	$1,677,500	$322,100	$6,236,700
20	179.0	$21,008,700	$6,024,700	$982,800	$21,991,500
21	294.0	$53,824,100	$15,349,400	$3,080,100	$56,904,200
22	455.0	$63,424,200	$18,011,000	$3,725,900	$67,150,100

D8-10

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILI.. .TUDY
REACH 2 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	$300	$300
8	100.0	$9,100	.	$1,300	$10,400
9	179.0	$116,200	.	$10,300	$126,500
10	294.0	$716,700	.	$54,800	$771,500
11	455.0	$2,906,600	.	$171,600	$3,078,200

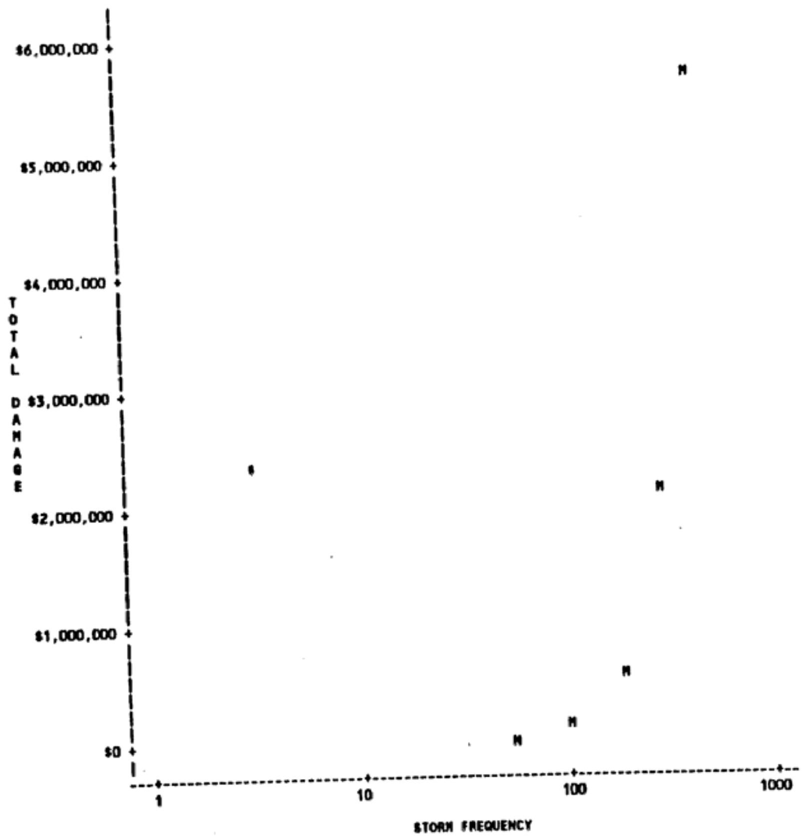
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	$2,300	$2,300
19	100.0	$120,800	$35,900	$7,700	$128,500
20	179.0	$469,300	$139,100	$19,200	$488,500
21	294.0	$1,264,200	$372,600	$45,300	$1,309,500
22	455.0	$2,525,000	$732,400	$75,900	$2,600,900

D8-12

LONG BEACH, NY ...
REACH 2 - BASE YEAR CONDITIO... ALTS
TOTAL INUNDATION DAMAGE VS. STOR... QUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 6 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

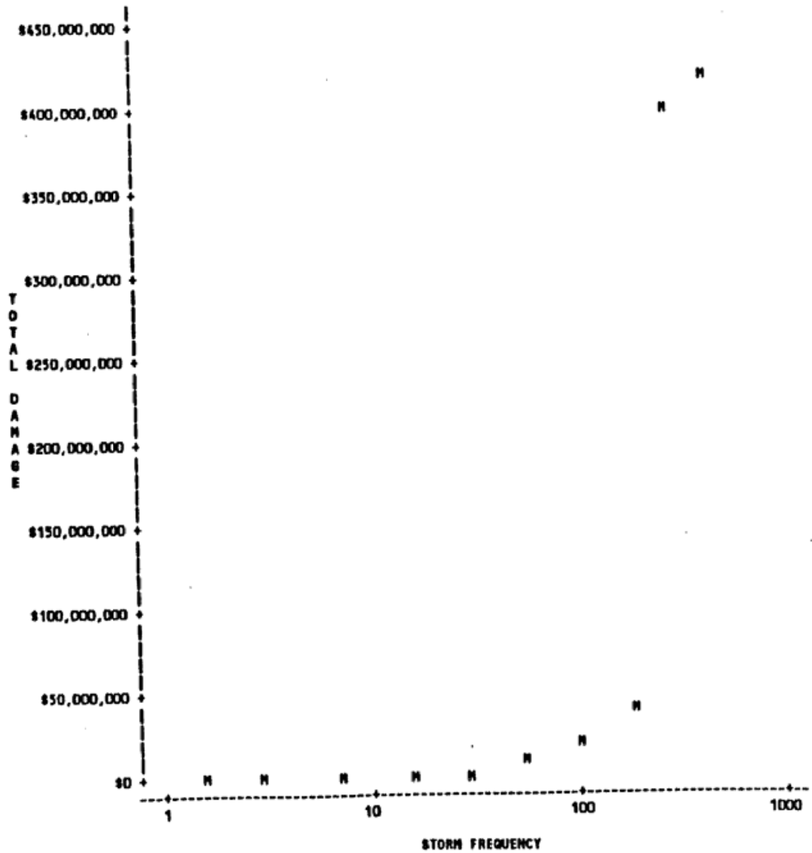
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	$1,100	$1,100
6	30.0	.	.	$3,500	$3,500
7	56.0	$286,600	.	$90,000	$376,600
8	100.0	$2,213,900	.	$227,000	$2,440,900
9	179.0	$6,553,400	.	$424,100	$6,977,500
10	294.0	$62,097,700	.	$1,362,100	$63,459,800
11	455.0	$63,633,900	.	$1,378,900	$65,012,800

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$33,800	$9,600	$8,300	$42,100
14	3.0	$110,600	$31,000	$17,100	$127,700
15	7.0	$213,000	$59,500	$28,900	$241,900
16	16.0	$684,200	$195,300	$86,800	$771,000
17	30.0	$1,573,000	$452,900	$197,000	$1,770,000
18	56.0	$4,884,100	$1,406,500	$500,900	$5,385,000
19	100.0	$13,660,000	$3,800,900	$1,060,200	$14,720,200
20	179.0	$29,723,200	$8,115,800	$1,918,400	$31,641,600
21	294.0	$317,656,800	$81,728,500	$18,978,500	$336,635,300
22	455.0	$335,332,800	$86,794,800	$20,913,900	$356,246,700

LONG BEACH, NY FEASIBILI). .IUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILI). JTUDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	$100	$100
7	56.0	$4,800	.	$500	$500
8	100.0	$548,100	.	$19,300	$24,100
9	179.0	$2,907,900	.	$41,600	$589,700
10	294.0	$9,696,000	.	$72,300	$2,980,200
11	455.0	$9,968,000	.	$112,700	$9,808,700
				$114,600	$10,082,600

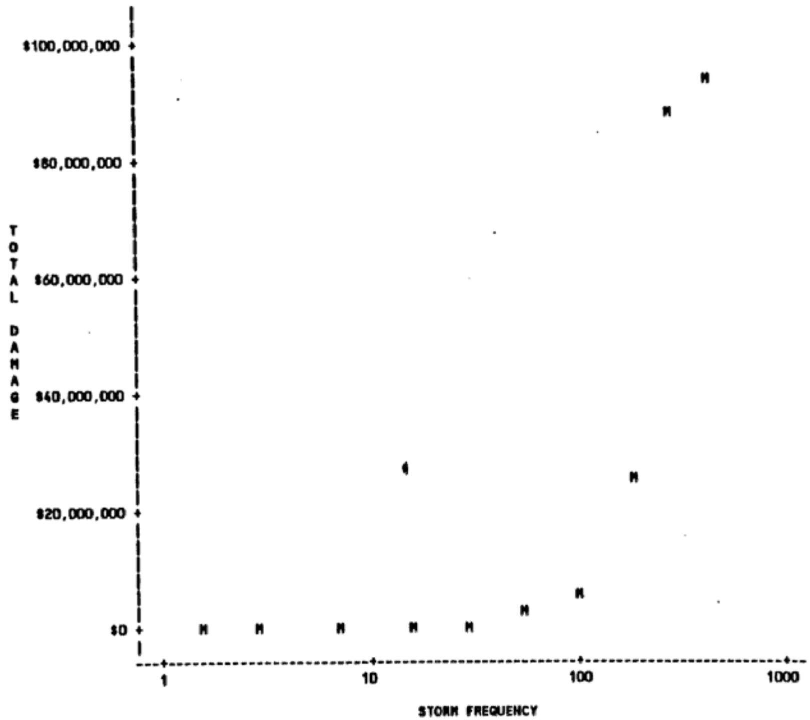
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$13,200	$3,700	$5,500	$18,700
14	3.0	$62,500	$17,500	$8,800	$71,300
15	7.0	$128,300	$36,000	$13,200	$141,500
16	16.0	$270,100	$76,700	$35,000	$305,100
17	30.0	$496,500	$142,100	$76,700	$573,200
18	56.0	$1,787,100	$507,700	$168,600	$1,955,700
19	100.0	$4,287,700	$1,223,700	$350,500	$4,638,200
20	179.0	$21,265,600	$5,200,400	$1,258,600	$22,524,200
21	294.0	$73,676,600	$20,443,200	$5,641,300	$79,317,900
22	455.0	$79,226,300	$22,112,900	$6,253,900	$85,480,200

LONG BEACH, NY FEASIBILIT, ,TUDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

07:38 Tuesday, July 12, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

DB-17

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-INUNDATION DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	$700	$700
8	100.0	$14,400	.	$2,400	$16,800
9	179.0	$1,274,600	.	$91,600	$1,366,200
10	294.0	$3,201,500	.	$138,000	$3,339,500
11	455.0	$3,225,800	.	$138,100	$3,363,900

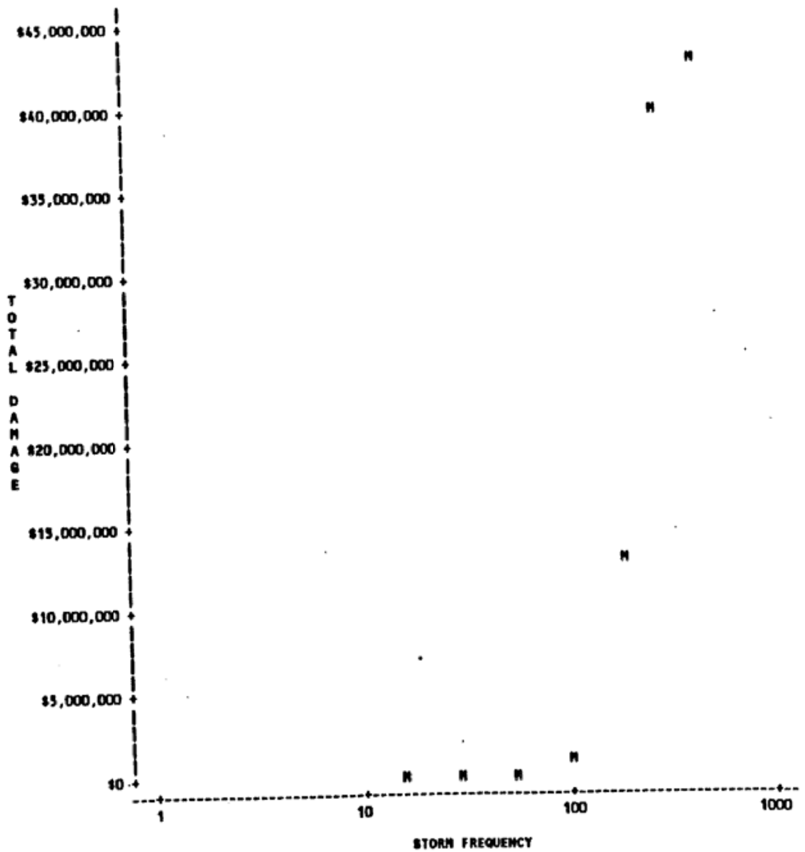
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	$200	$200
17	30.0	.	.	$600	$600
18	56.0	$28,400	$8,000	$16,200	$44,600
19	100.0	$565,200	$164,600	$52,800	$618,000
20	179.0	$11,339,800	$3,245,900	$367,600	$11,707,400
21	294.0	$35,235,900	$10,066,100	$1,895,400	$37,131,300
22	455.0	$37,214,200	$10,619,200	$2,047,700	$39,261,900

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
TOTAL INUNDATION DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

07:39 Tuesday, July 12, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 4 obs had missing values.

D8-19

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	$1,604,200	$143,100	$21,000	$1,625,200
11	455.0	$6,391,900	$2,747,600	$73,300	$6,665,200

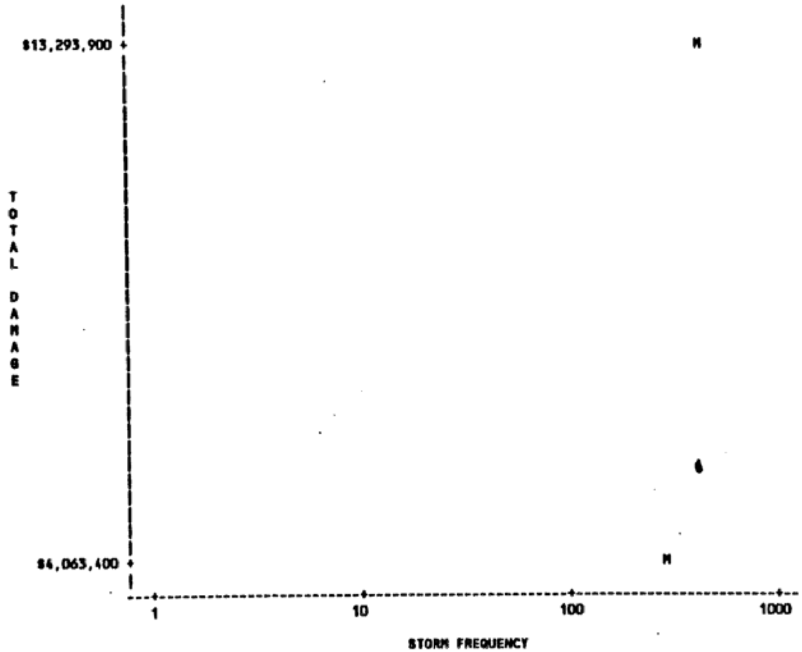
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	$2,296,800	$603,600	$141,400	$2,438,200
22	455.0	$6,265,900	$1,693,700	$362,800	$6,628,700

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

07:46 Tuesday, July 12, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 9 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS:- ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	.	.	.	.

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	$289,300	$93,600	$15,300	$304,600
10	294.0	$1,297,700	$863,600	$29,100	$1,326,800
11	455.0	$6,488,500	$3,083,100	$107,300	$6,595,800

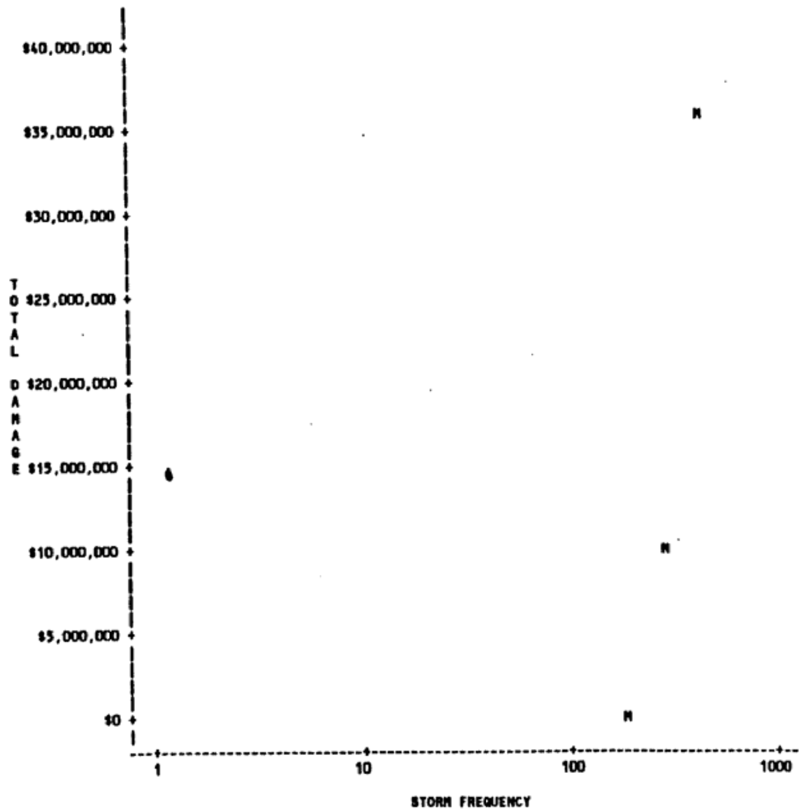
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	$8,529,600	$2,308,500	$605,100	$9,134,700
22	455.0	$27,487,000	$7,177,900	$1,559,900	$29,046,900

D8-23

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'N'.



NOTE: 8 obs had missing values.

D8-24

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

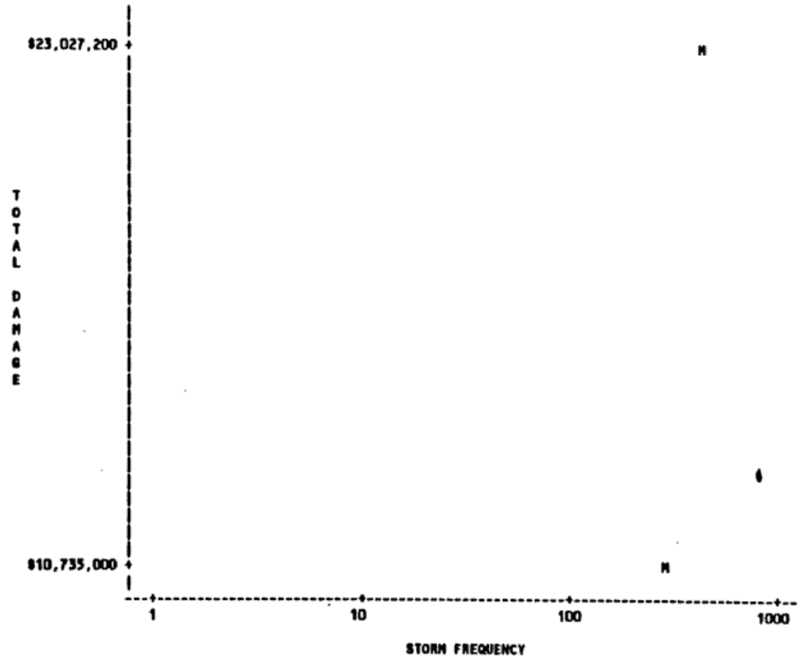
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	$499,700	$176,700	$4,000	$503,700
11	455.0	$579,900	$208,900	$5,500	$585,400

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	$9,708,900	$2,457,600	$522,400	$10,231,300
22	455.0	$21,318,000	$5,344,400	$1,123,800	$22,441,800

LONG BEACH, NY FEASIBILIT. .UDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 9 obs had missing values.

LONG BEACH, NY FEASIBILI. .UDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_ATTACK DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	$2,390,600	$405,600	$35,000	$2,425,600
11	455.0	$5,961,700	$771,300	$78,500	$6,040,200

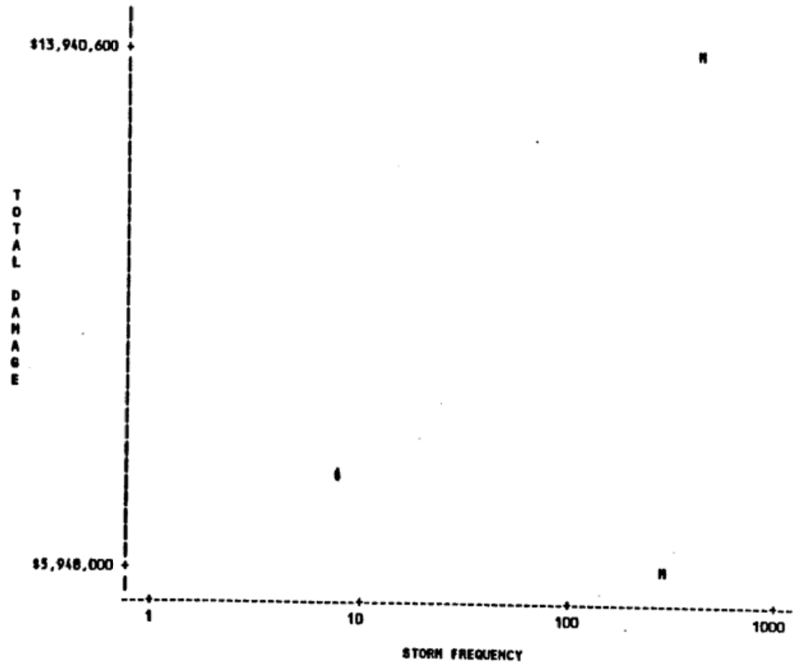
TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	$3,346,600	$859,100	$175,800	$3,522,400
22	455.0	$7,511,300	$1,916,100	$389,100	$7,900,400

LONG BEACH, NY FEASIBILI. .TUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
TOTAL WAVE_ATTACK DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

07:48 Tuesday, July 12, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 9 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

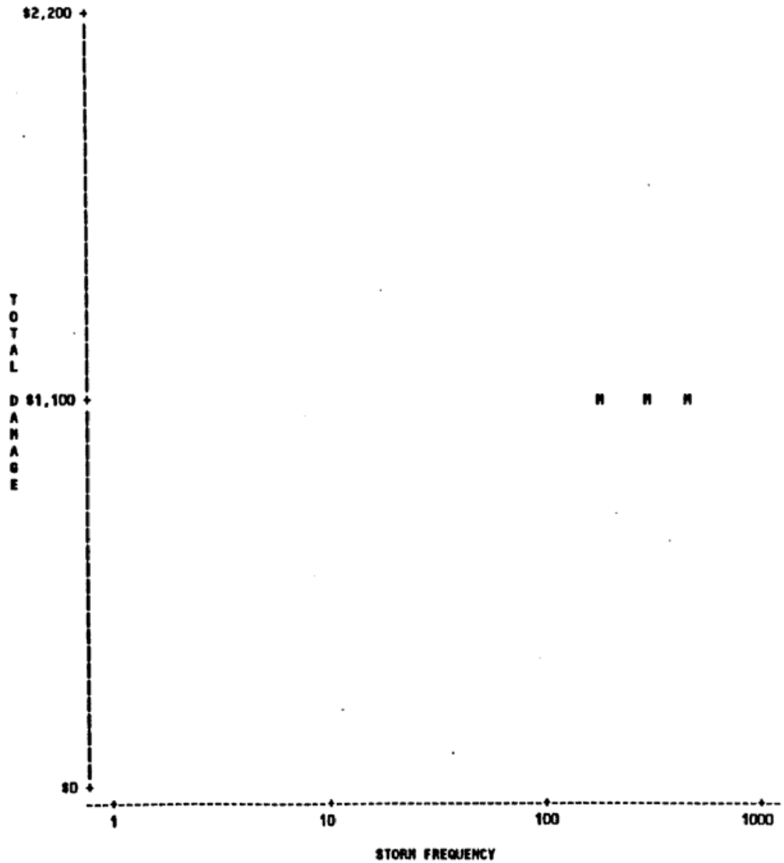
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	$1,100	$100	$0	$1,100
10	294.0	$1,100	$100	$0	$1,100
11	455.0	$1,100	$100	$0	$1,100

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILIT, STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOT obs had missing values.

D8-30

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

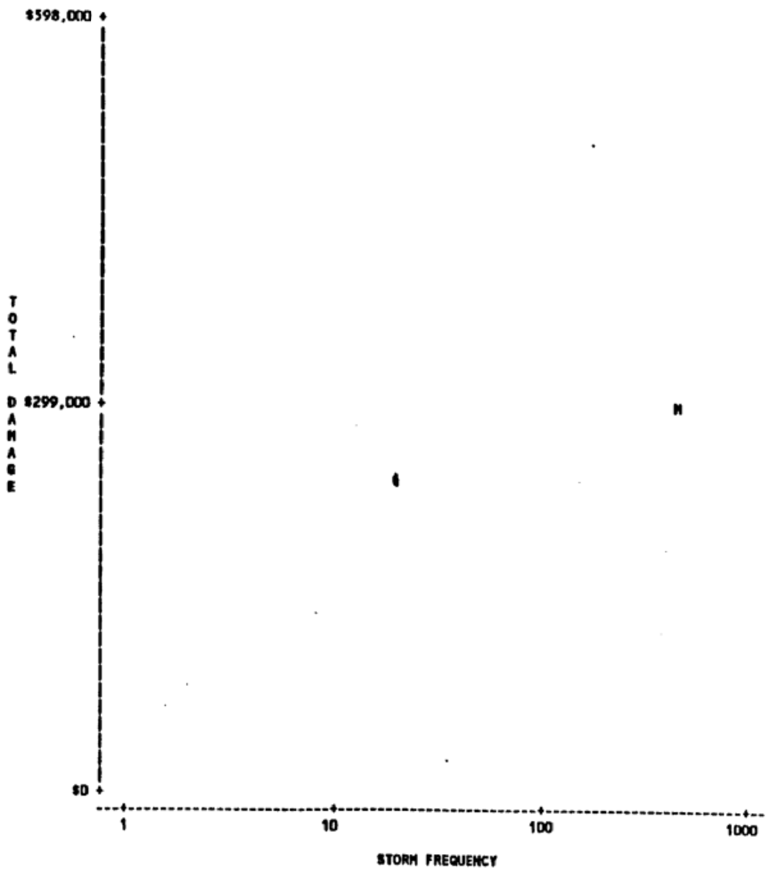
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	$295,800	$8,400	$3,200	$299,000

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS - ALT5
TOTAL WAVE_RUNUP DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 10 obs had missing values.

LONG BEACH, NY FEASIBILI1. .TUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	.	.	.	.

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILITY STUDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_RUNUP DAMAGE FROM ALL CAUSES

---------- TYPE=NON-RESIDENT ----------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	.	.	.	.

---------- TYPE=RESIDENTIAL ----------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-WAVE_RUNUP DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	.	.
8	100.0	.	.	.	.
9	179.0	.	.	.	.
10	294.0	.	.	.	.
11	455.0	.	.	.	.

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	.	.
19	100.0	.	.	.	.
20	179.0	.	.	.	.
21	294.0	.	.	.	.
22	455.0	.	.	.	.

LONG BEACH, NY FEASIBILITY STUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-MAXIMUM DAMAGE FROM ALL CAUSES

------------------------- TYPE=NON-RESIDENT -------------------------

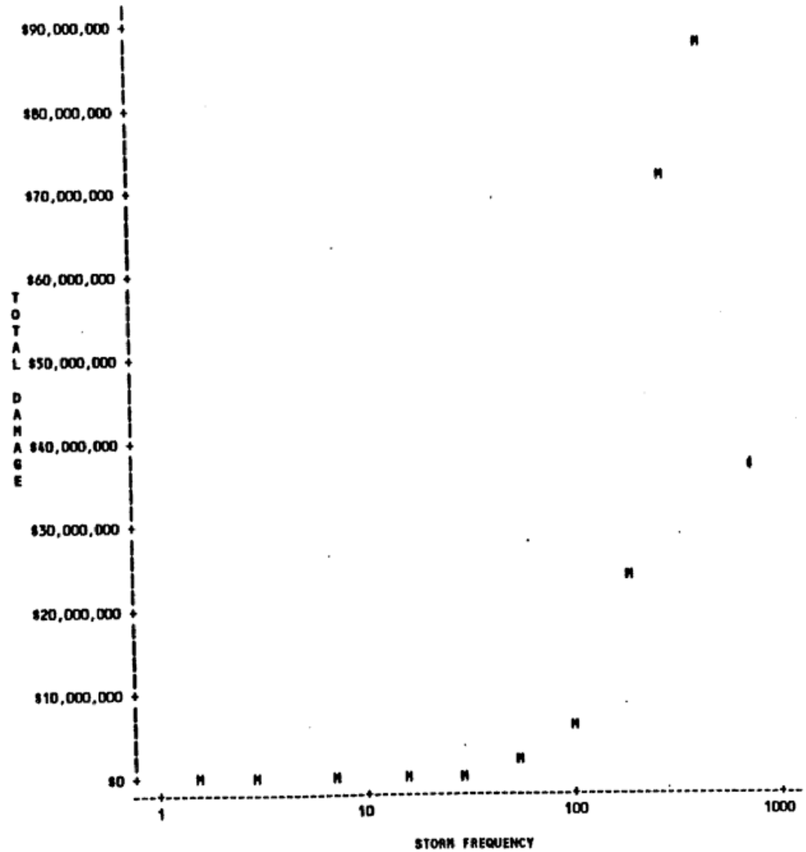
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	$0	$0
3	3.0	.	.	$0	$0
4	7.0	.	.	$0	$0
5	16.0	$400	.	$2,800	$3,200
6	30.0	$1,300	.	$8,800	$10,100
7	56.0	$96,600	.	$23,400	$120,000
8	100.0	$652,000	$0	$48,500	$700,500
9	179.0	$2,784,500	$6,000	$117,600	$2,902,100
10	294.0	$12,431,700	$148,700	$176,700	$12,608,400
11	455.0	$15,815,400	$2,753,300	$204,200	$16,019,600

------------------------- TYPE=RESIDENTIAL -------------------------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	$16,900	$16,900
17	30.0	.	.	$53,000	$53,000
18	56.0	$1,760,800	$494,300	$156,000	$1,916,800
19	100.0	$5,914,600	$1,677,500	$322,000	$6,236,600
20	179.0	$21,008,700	$6,024,700	$982,800	$21,991,500
21	294.0	$55,382,100	$15,738,700	$3,163,200	$58,545,300
22	455.0	$68,396,900	$19,319,700	$3,997,600	$72,394,500

LONG BEACH, NY FEASIBILI1. .IUDY
REACH 1 - BASE YEAR CONDITIONS - ALT5
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILIT, aTUDY
REACH 2 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

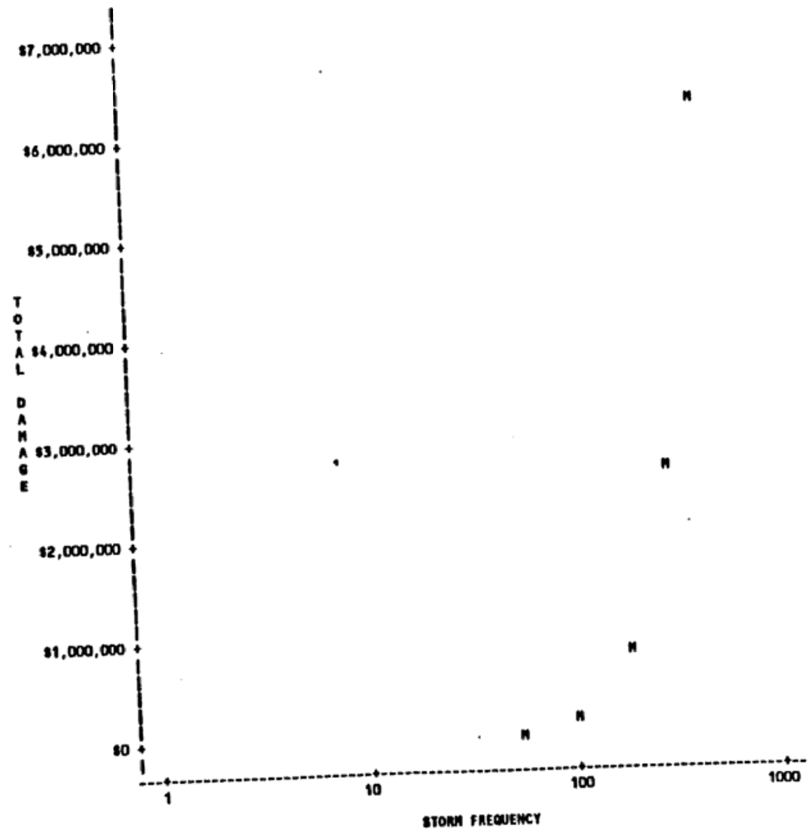
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	$300	$300
8	100.0	$9,100	.	$1,300	$10,400
9	179.0	$272,300	$4,400	$12,000	$284,300
10	294.0	$1,267,900	$16,200	$59,800	$1,327,700
11	455.0	$3,606,400	$26,300	$173,000	$3,779,400

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	.	.
17	30.0	.	.	.	.
18	56.0	.	.	$2,300	$2,300
19	100.0	$120,800	$35,900	$7,700	$128,500
20	179.0	$469,300	$139,100	$19,200	$488,500
21	294.0	$1,264,200	$372,600	$45,300	$1,309,500
22	455.0	$2,530,000	$732,400	$75,900	$2,605,900

LONG BEACH, NY FEASIBILITY STUDY
REACH 2 - BASE YEAR CONDITIONS - ALT5
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 6 obs had missing values.

LONG BEACH, NY FEASIBILI.. .TUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-MAXIMUM DAMAGE FROM ALL CAUSES

---------- TYPE=NON-RESIDENT ----------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	$1,100	$1,100
6	30.0	.	.	$3,500	$3,500
7	56.0	$286,600	.	$90,000	$376,600
8	100.0	$2,213,900	.	$227,000	$2,440,900
9	179.0	$6,842,600	$93,600	$437,700	$7,280,300
10	294.0	$62,185,300	$863,600	$1,369,300	$63,554,600
11	455.0	$67,465,200	$3,083,100	$1,422,400	$68,887,600

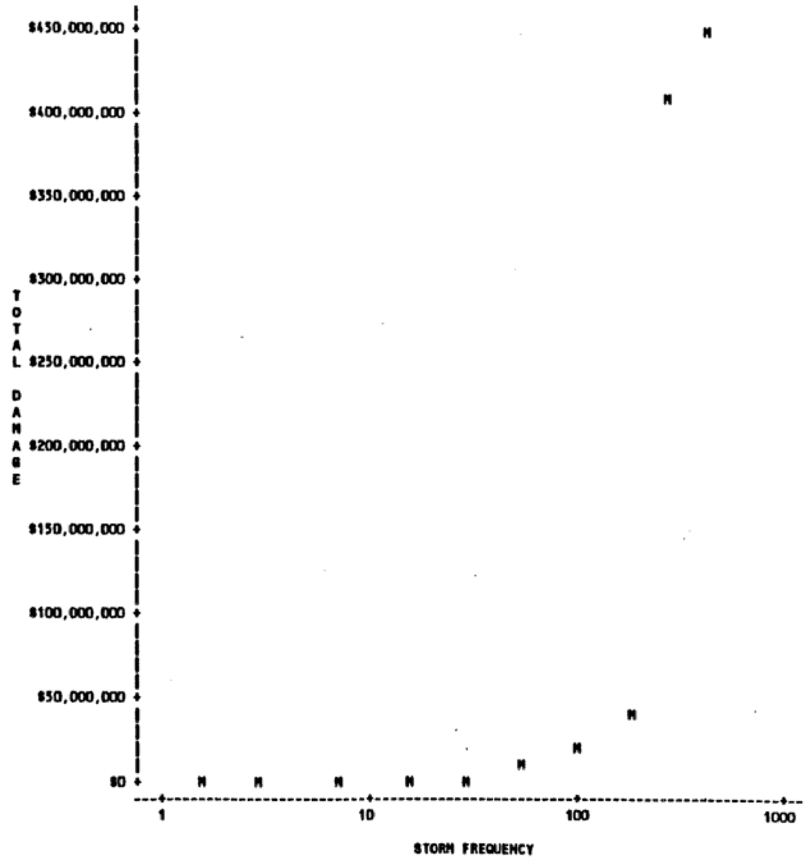
---------- TYPE=RESIDENTIAL ----------

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$33,800	$9,600	$8,300	$42,100
14	3.0	$110,600	$31,000	$17,100	$127,700
15	7.0	$213,000	$59,500	$28,900	$241,900
16	16.0	$684,200	$195,300	$86,800	$771,000
17	30.0	$1,573,000	$452,800	$197,000	$1,770,000
18	56.0	$4,884,100	$1,406,500	$500,800	$5,384,900
19	100.0	$13,660,000	$3,800,800	$1,060,200	$14,720,200
20	179.0	$29,723,200	$8,115,800	$1,918,300	$31,641,500
21	294.0	$324,239,000	$83,338,700	$19,407,300	$343,646,300
22	455.0	$356,034,400	$91,902,600	$22,044,100	$378,078,500

LONG BEACH, NY FEASIBILITY STUDY
REACH 3 - BASE YEAR CONDITIONS - ALT5
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

07:34 Tuesday, July 12, 1994 3

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

DB-41

LONG BEACH, NY FEASIBILI1 .UDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

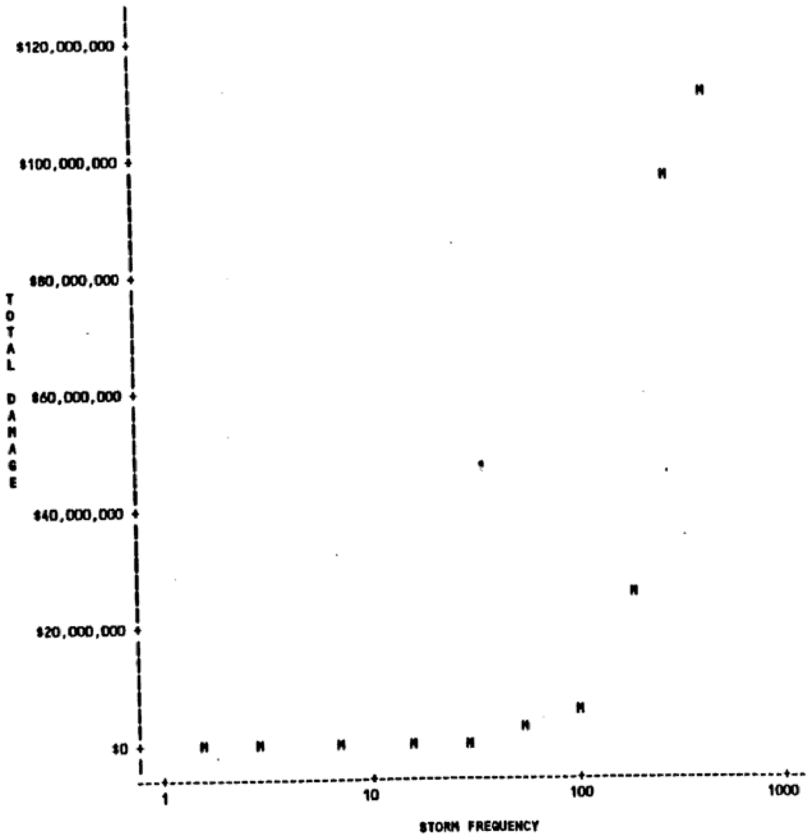
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	$200	$200
6	30.0	.	.	$500	$500
7	56.0	$4,800	.	$19,300	$24,100
8	100.0	$548,100	.	$41,600	$589,700
9	179.0	$2,907,900	.	$72,300	$2,980,200
10	294.0	$10,007,000	$177,000	$113,400	$10,120,400
11	455.0	$10,310,500	$209,200	$115,800	$10,426,300

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	$13,200	$3,700	$5,500	$18,700
14	3.0	$62,500	$17,500	$8,800	$71,300
15	7.0	$128,300	$36,000	$13,200	$141,500
16	16.0	$270,100	$76,700	$35,000	$305,100
17	30.0	$496,500	$142,100	$76,700	$573,200
18	56.0	$1,787,100	$507,700	$168,500	$1,955,600
19	100.0	$4,287,700	$1,223,700	$350,500	$4,638,200
20	179.0	$21,265,600	$5,200,400	$1,258,600	$22,524,200
21	294.0	$81,679,700	$22,423,300	$6,058,900	$87,738,600
22	455.0	$95,020,500	$25,932,300	$6,996,100	$102,016,600

LONG BEACH, NY FEASIBILI1. .IUDY
REACH 4 - BASE YEAR CONDITIONS - ALT5
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 1 obs had missing values.

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
FREQUENCY VS. DAMAGE SUMMARY
(1992 PRICE LEVEL)
WITH PROJECT-ALT5-MAXIMUM DAMAGE FROM ALL CAUSES

TYPE=NON-RESIDENT

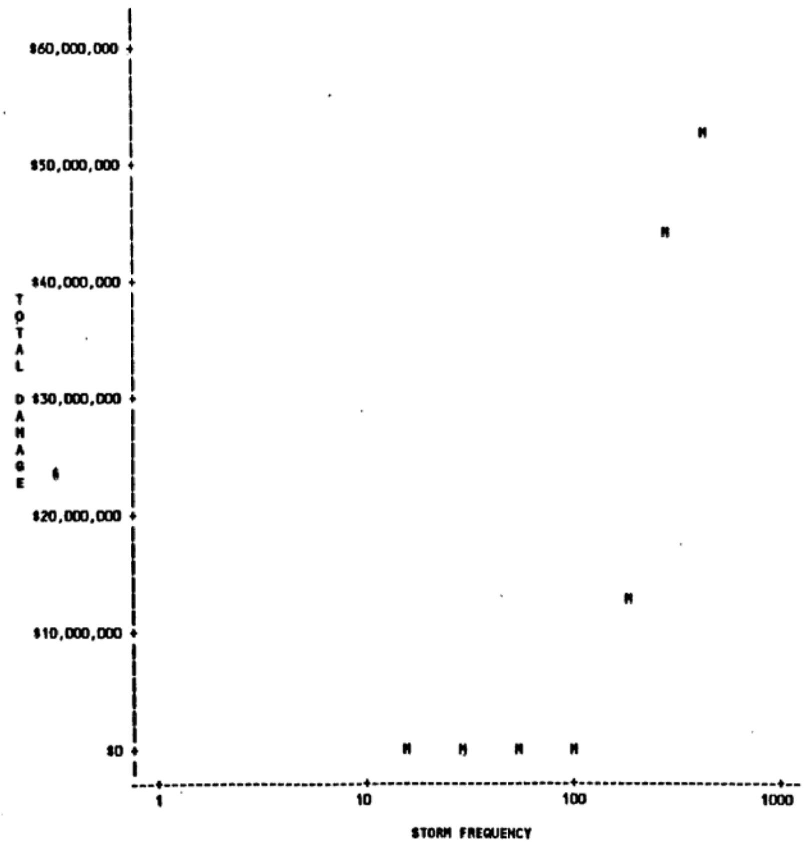
OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
1	1.0	.	.	.	.
2	1.5	.	.	.	.
3	3.0	.	.	.	.
4	7.0	.	.	.	.
5	16.0	.	.	.	.
6	30.0	.	.	.	.
7	56.0	.	.	$700	$700
8	100.0	$14,400	.	$2,400	$16,800
9	179.0	$1,274,600	.	$91,600	$1,366,200
10	294.0	$5,042,400	$405,600	$152,200	$5,194,600
11	455.0	$7,765,800	$771,300	$171,400	$7,937,200

TYPE=RESIDENTIAL

OBS	STORM FREQUENCY	PHYSICAL DAMAGE	CONTENT DAMAGE	EMERGENCY DAMAGE	TOTAL DAMAGES
12	1.0	.	.	.	.
13	1.5	.	.	.	.
14	3.0	.	.	.	.
15	7.0	.	.	.	.
16	16.0	.	.	$200	$200
17	30.0	.	.	$600	$600
18	56.0	$28,400	$8,000	$16,200	$44,600
19	100.0	$565,200	$164,600	$52,700	$617,900
20	179.0	$11,339,900	$3,245,900	$367,600	$11,707,500
21	294.0	$37,659,800	$10,671,300	$2,019,800	$39,679,600
22	455.0	$42,656,300	$11,964,400	$2,316,100	$44,972,400

LONG BEACH, NY FEASIBILITY STUDY
REACH 5 - BASE YEAR CONDITIONS - ALT5
TOTAL MAXIMUM DAMAGE VS. STORM FREQUENCY
1992 PRICE LEVEL

Plot of TOTAL*STORM. Symbol used is 'M'.



NOTE: 4 obs had missing values.

D8-45

APPENDIX E

PERTINENT CORRESPONDENCE

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

January 12, 1995

Planning Division
Coastal Section

Mr. William Daley
New York State Department
of Environmental Conservation
50 Wolf Road
Albany, NY 12233

Dear Mr. Daley:

The feasibility study for storm damage protection of Long Beach Island, New York is near completion. As you are aware, the New York District met with our Division and HQUSACE counterparts at a Feasibility Review Conference on December 13, 1995. Mr. Roman Rakoczy of your staff attended the meeting.

Overall, everyone appears to be satisfied with the recommendations contained in the draft feasibility report. Comments that were raised at the meeting have been responded to and incorporated into a Project Guidance Memorandum (see Enclosure 1). The draft report has been circulated for public review. Revisions to the report will be included in the final report which is scheduled to be submitted in February 1995. The changes do not affect the recommendations of the report.

One issue which was raised at the FRC is the Public Access Plan. This plan needs to be finalized and clearly indicate the conditions that will be in effect for conformity with Federal and State requirements regarding public access. HQUSACE has determined that the western areas of the proposed project, which include tapering the project beach fill into Atlantic Beach, are incidental to the project and do not require public access for compliance with Federal regulations. However, the State may determine that these areas must remain open to the public with full lateral access. Furthermore, within the project boundaries (excluding the western tapered area), there must be full lateral access. Therefore, the sign in East Atlantic Beach indicating restrictions to persons with a resident identification must be removed. The Town has been informed of this, and is willing to take remedial measures to ensure conformity with public access. Please note that we have not received the public access plan for the Nassau County areas.

A response has been prepared and submitted regarding comments raised by the Town of Hempstead (see Enclosure 2). One modification has been made to address the Town's concerns, which includes the rehabilitation of the existing revetment in Point Lookout bordering Jones Inlet. The review of the remaining concerns appears to substantiate our initial findings.

If there are no further concerns on this proposed project, please submit your intent to cost share this project in accordance with the schedule presented in the feasibility report. The current schedule forecasts construction initiation in our fiscal year 1998, which allows for an October 1997 start. Your letter should include your capability to cost share the project, your willingness to provide the required items of local cooperation and the intent to execute a mutually agreeable Project Cooperation Agreement.

If you have any further questions or comments regarding this matter is still necessary please contact Mr. Clifford Jones at 212-264-9079.

Stuart Piken, P.E.
Chief, Planning Division

2 Enclosures

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

6 January 1995

Planning Division
Coastal Section

Mr. Thomas Doheny
Town of Hempstead
Department of Conservation & Waterways
Lido Boulevard
P.O. Box 180
Pt. Lookout, NY 11569-0810

Dear Mr. Doheny:

This is in reply to your letter dated September 23, 1994 which provided comments on the tentatively selected plan of protection for Long Beach Island. As discussed with you in recent conversations with District's staff we do not believe there is a need to change the project design. Specific responses to your comments are enclosed.

Representatives from our office met with the North Atlantic Division and Headquarters counterparts regarding the feasibility study of Long Beach Island, New York. Mr. Roman Rakoczy of the New York State Department of Conservation also attended the meeting. Overall, our higher authority was very receptive of the feasibility report. The comments discussed will be addressed in the final report, which is due to Division office in February 1995. The discussions and subsequent revisions will not effect the findings of the report.

If you have further comments or questions on any aspect of this project please call me or Mr. Clifford Jones at 212-264-9079.

Sincerely,

STUART PIKEN, P.E.
Chief, Planning Division

Enclosure

CC:NYSDEC

Long Beach Island, New York - Feasibility Report
New York District Responses to Town of Hempstead Comments

In response to your contention that a longer groin field (than proposed) is needed to alleviate erosion, a longer groin field would add cost to the project beyond what is necessary to minimize the beach nourishment losses in the severe erosion zone. Note that the severe erosion zone currently existing west of the last groin in Pt. Lookout is due to two factors. The primary factor is a sediment deficit caused by a loss of littoral drift material to Jones Inlet. The second factor is the absence of wave sheltering by the ebb shoal and, to some extent, by the Jones Inlet east jetty. The absence of wave sheltering establishes the location where severe erosion begins. The erosion itself is the result of insufficient material being carried by wave forces. More material is removed from that portion of the shoreline than is brought to it by littoral transport, resulting in a net loss. As the longshore current travels westward, the sediment deficit is gradually corrected by shoreline losses until equilibrium is reached.

Construction of a groin field will not translate the location of wave sheltering provided by the inlet or the resulting point at which severe erosive forces begin to impact the beach. Translation of the severe erosive zone to the downdrift side of the groin field would only occur if the sediment deficit is not overcome within the groin field. The recommended plan provides sufficient advanced nourishment to overcome the inlet-induced sediment deficit without impacting the design berm within the groin field or downdrift of the groin field.

As for the extension of the terminal groin (or a terminal jetty) at Jones Inlet, construction of an extended terminal jetty on the west side of Jones Inlet would have major impacts on the inlet system, and downdrift shoreline, while providing minor benefits. One of these impacts would be to move the inlet components further offshore. The ebb shoal would be forced south into deeper water, and would be enlarged in order to pass around the lengthened terminal jetty. Experience at other inlets indicate that these adjustments could take decades to occur, resulting in a sediment deficit on Long Beach Island, and could increase downdrift shoreline erosion. The location of severe erosion on Long Beach Island would be shifted westward as the ebb shoal enlarged. Other impacts include possible relocation of the navigation channel, alterations to tidal current channels, and changes to shoaling patterns.

The proposed plan, which includes a sand taper in Pt. Lookout, places less sand in that reach than the Reconnaissance Plan which called for a lengthened terminal groin. The amount of sand placed in Pt. Lookout in the Feasibility recommended plan is well below the large accumulation which occurred about 1972 when shoal welding and fill operations pushed this portion of the shoreline beyond the capacity of the existing groins. Any increased shoaling in Jones Inlet due to the recommended plan, therefore, will be less than that which occurred in the last 22 year period. Since no increase in shoaling will result from the project as compared to that which occurred in the past, a lengthened jetty to preclude such shoaling is not necessary.

The benefit of lengthening the terminal jetty would be in providing a larger design berm section in the easternmost groin compartment in Pt. Lookout. The length of shoreline which would benefit extends approximately 750 ft., whereas negative impacts could affect 8000 ft. of shoreline or more, as well as potentially impacting the navigation channel. The Recommended Plan for this compartment provides the design dune section, a fronting berm, and renourishment of the berm at the project's five-year renourishment cycle, which provides an increased level of protection. In addition, the easternmost groin will be refurbished, as well as the revetment along the western side of the inlet.

Recommendation of a terminal groin at the Reconnaissance Phase of study only indicates that this alternative is economically justified, using Reconnaissance level data and analysis. The Feasibility Study examined inlet effects, shoreline history, and impacts of each proposed plan on the overall shoreline, as well as providing a refined cost and benefit analysis. Additional study showed that the terminal groin option is a possible solution, but not the best solution for storm damage reduction and erosion control for Long Beach Island.

As discussed at the meeting, the point you made about the rehabilitation of the revetment at Pt. Lookout has been included in the recommended plan. The recent deterioration of this revetment has brought a changed condition to the project area than which was originally envisioned. I agree that the revetment left in its present state could lead to flanking of the easternmost groin, which would negatively impact the proposed project and properties in the Pt. Lookout area.

Town of Hempstead Department of Conservation & Waterways

LIDO BOULEVARD
P.O. BOX 180
POINT LOOKOUT, N.Y. 11569-0180
(516) 431-9200

September 23, 1994

Mr. Joseph Vetri
Assistant Chief of Planning
U.S.A.C.O.E.
26 Federal Plaza
New York, NY 10278-0090

Dear Mr. Vetri,

This correspondance is to advise you of the concerns expressed at the meeting held yesterday at the City of Long Beach relative to the proposed storm protection plan for the Long Beach Barrier Island.

1) - It is quite evident that there is a great disparity between the work effort produced for the City of Long Beach and that portion of the plan addressing crutial issues relating to the needs of the Town of Hempstead.

While artistic renditions of the final plan as it relates to the City of Long Beach are being exhibited areas of Point Lookout, which requires almost emergency attention are not even considered in the scope of the Corps Plan.

2) - The plan also calls for the installation of (6) Jetties between Pt.Lookout and Lido Beach and preliminary plans calling for the extension of the terminal Jetty at Point Lookout which we enthusiastically endorsed, was eliminated from this version.

Six years ago I requested the Corps representative to include the installation of short, low profile pourous jetties from those in Point Lookout to those existing in Lido Beach as a means of slowing down the Westerly movement of sand along the beach front. Until this report came out not one word was mentioned about jetties in this reach over the six years. Now as a result of Corps evaluation of shoreline changes over a twenty year period we have jetties installed along the only stable portion of the beach, based on the Corps belief that, that area is unstable, and no jetties along the remainder of the Lido area which is unstable and without adequate elevation.

Installation of the three jetties in the erosion area at Point Lookout Town Park is warranted and necessary. I am concerned that without a complete jetty system for the remainder of the beach front in Lido, the project may translate present erosion rates existing West of the last jetty in Pt.Lookout to the area in Lido West of the 6th jetty at Nassau Beach.

3) - Regarding the terminal jetty at Point Lookout; I think that based upon the explanations offered by Corps staff yesterday, it ought to be reconsidered, in light of the purposes for which this entire study was based and not incrumental benefits for just the immediate area surrounding the jetty.

We need the jetty extended to:
A) - Direct the inlet exchange further to the South which will push its scouring effect further offshore.

B) - It will entrap sand and prevent additional secondary shoaling of the inlet area from incoming tidal currents.

C) - It will provide a wider base width to the existing beach which presently and for many years has been eroding and thereby afford an increased level of protection to that segment.

D) - And it was originally proposed and justified by your staff as necessary to the plan.

Finally I would like to request that the existing rock revetment be surveyed and its restoration to a protective feature be included in the Barrier Beach Plan. I have made mention of this situation to Corps staff many times starting from the Reconnaissance Study in the late 1980's as well as the lengthing of the terminal jetty and instalation of additional jetties from Pt.Lookout to Lido.

If the purpose of this project is to provide a greater level of protection against storms then, not addressing the revetment is a serious ommission. For the record, any reconstruction a restoration of that revetment should be done at a level which will provide more than just sufficient protection well into the year 2040.

Very truly yours,

Thomas E. Doheny
Director of Conservation

TED:lb

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INCORPORATED
Village of Atlantic Beach
65 THE PLAZA
ATLANTIC BEACH, N.Y. 11509
(516) 371-4600
Fax (516) 371-4631

September 28, 1994

Mr. Stuart Piken, P.E.
Chief, Planning Division
Department of the Army
New York District Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

Re: Long Beach Island Storm Damage Reduction Plan

Dear Mr. Rakoczy:

At its September 12, 1994 meeting, the Village Board resolved that the Village will not participate in the above-referenced plan.

Very truly yours,

Barry G. Felder

BGF/lgs
cc: Mr. Roman Rakoczy
Mayor Earliene Shipper
01902736.LET

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

August 5, 1994

Planning Division
Navigation & Coastal Section

The Honorable Earlene Shipper
Mayor Village of Atlantic Beach
65 The Plaza
Atlantic Beach, NY 11509

Dear Mayor Shipper:

Please reference a recent meeting regarding the feasibility study and potential storm damage reduction plans for the barrier island of Long Beach, NY. A copy of the record of the meeting is attached. Also, enclosed are drawings of the potential plans for the Village of Atlantic Beach.

The tentatively selected plan for the barrier island includes a dune at an elevation of +15 ft. NGVD and protective beach berm 110 ft wide with a gradual slope to match the existing bathymetry. The plan also includes rehabilitation of 15 of the existing groins and a new series of 6 groins in the vicinity of Lido Beach. Based upon previous coordination between Mr. Clifford Jones of my staff, and your office, the proposed project extends from Point Lookout westward to about Yates Avenue where it would taper into the eastern portion of the Village of Atlantic Beach. This will avoid conflicts of public accessibility and potential obstruction of view to the beach, which have been the voiced concerns from your constituent. However, please note that if the project is implemented, the Village will not be provided the same degree of protection as the remaining areas along the barrier island. I need to know if this is acceptable.

During the plan formulation for the project, an alternative plan was considered for storm damage protection for the Village. This considered plan for Atlantic Beach would consist of a dune at elevation +15 ft. NGVD (consistent with the other project areas) with periodic nourishment of the existing beach as necessary to ensure the integrity of the design. This plan was chosen since it is essential to provide a barrier at a high enough elevation that will reduce the storm surge run-up. Currently the shore front area in the Village exhibits wide beaches which have higher elevations than most of the remaining barrier island beaches so additional beach berm design is unnecessary.

Please review the enclosed plan sheets which show the general alignment of the considered dune for Atlantic Beach and provide comments, if any. It is important that we get a firm grasp of your intentions before we submit our recommendations for higher authority review. Therefore, it is requested that you provide, in writing to me and Mr. Roman Rakoczy of the NYSDEC, a definitive position of the desires of the Village of Atlantic Beach prior to submission of the draft report, which is scheduled for the end of September 1994. My staff will continue coordination with your office. Your cooperation in this matter is greatly appreciated.

Stuart Piken
Stuart Piken, P.E.
Chief, Planning Division

cc:
NYSDEC/Rackoczy
Town of Hempstead/Aiello
Nassau County/Cosgrove

CENAN-PL-FN 25 July 1994

MEMORANDUM FOR THE RECORD

SUBJECT: Long Beach Island, New York

1. A meeting was held on 15 July 1994 between representatives from the ACOE, NYSDEC, City of Long Beach, Town of Hempstead, Nassau County and the Village of Atlantic Beach. An attendance list is attached (see attachment 1).

2. The study schedule to construction of the project was discussed. It was noted that the preparation of the draft feasibility report was delayed, but is anticipated to be submitted to NAD in September 1994. The remaining schedule to complete the feasibility phase has been accelerated so that the remaining schedule is not altered (ie. the final report will still be submitted in Feb 95). Subsequent to the feasibility phase, a Design Memorandum (DM) is to be prepared which would solidify the recommendations of the feasibility study. The DM would include cultural investigations of the borrow area and other pertinent details of the project design and fill material. The DM will be followed by Plans and Specifications and then construction. A tentative schedule was presented as a hand-out (see attachment 2). The NYSDEC representative stated that the schedule anticipates an April 1998 construction start, and further noted that this start date is not likely since the State is budgeting for a 1998 start (the State Fiscal year begins in April). It was agreed that the schedule would be modified to show a July 1998 construction start to allow time for the availability of non-Fed funds; however, it was also noted that the schedule shown could be accelerated based on the actual time to complete and review the DM and P&S.

3. The formulation of the plan(s) was briefly discussed, and as had been discussed at previous meetings, the emphasis of the analyses centered around 9 beachfill alternatives. The discussion on alternatives had been presented in the P-4A Technical Review submission dated August 1993 which was previously distributed to the members of the study team.

4. Based on the economics of the 9 alternatives considered, the tentatively selected plan is similar to the plan recommended in the recon report. The characteristics of this plan are noted below:

- 110 ft. beach berm at elevation +10 ft. NGVD.
- dune at +15 ft. with a top width of 25 ft. landward and seaward slopes of 1H:5V;
- 15 to 25 ft buffer zone landward of the landward toe of the dune for vehicle access and maintenance;
- dune grass planting and fencing to ensure the integrity of the dune;
- dune walkovers and vehicle access ramps;

- 6 additional groins west of the 3 easternmost groinfield approximately 1200 ft apart;
- rehabilitation of 15 existing groins.
- advanced nourishment to ensure the design integrity; average width of 50 feet;
- periodic nourishment of 2,111,000 cy every 5 years.

5. Based on coordination with the State and local governments, the plan for Long Beach Island does not include improvements in the Village of Atlantic Beach. However, in order to visualize a potential plan for this area, one plan was selected. This plan includes a protective dune system with a top elevation at +15 ft NGVD fronting the beach in this area which would tie into the selected dune for the remaining areas along the barrier island. Should the Village of Atlantic Beach request (or be requested) to participate in the plan, a separate analysis must be done to ensure that the plan is optimized and/or cost differential would be developed if local interests desire a different plan. Village representatives acknowledge that these beaches are wider and higher than most other areas on the island and that these beaches are the recipients of much of the sand that is transported along the barrier shoreline. The Corps representatives explained that although wide beaches are not needed, additional height as can be provided by a dune would be needed to provide protection from storms with surges and wave runup that exceed existing beach elevations. Mayor Shipper requested that the Corps of Engineers send a letter to the Village spelling out their options and to provide specific information on any plan of protection considered.

6. A designated offshore borrow source has been proposed for use for beachfill. There are two remaining issues regarding the borrow area:

(1) Environmental - NYSDEC has indicated that there is a clam population that exists in the proposed borrow area, which would be impacted by dredging. Environmental Branch is coordinating with NYSDEC and will provide documentation of the coordination in the EIS.

(2) Cultural - A literature search was conducted of the impacts of the proposed project. The investigation did not note any wrecks in the borrow area; however, it was recommended that a remote sensing survey be conducted. The remote sensing is scheduled to be done in the Design Memo, and if anomalies are found, there is sufficient material available that they can be avoided. Of the 34,000,000 cy available, 8,642,000 is needed for initial construction.

CENAN-PL-FN
SUBJECT: Long Beach Island, New York

7. The duration of construction is estimated to be 2 years, at an estimated cost of $67 million. Environmental Branch will coordinate with Federal and State agencies to obtain concurrence for an uninterrupted construction schedule. As discussed, if this is not possible, the project cost will increase.

8. Lastly, the issue of public access was discussed. The State was asked to reply to our request to coordinate with the local governments and submit a plan which details the existing and future (with project) access to the beaches in the project area. The plan must include available transportation and parking as well as the fee structure(s) of the various beaches along the barrier island. It is preferable to use color coding to denote:

- -private areas (no access)
- -open to the public with differential fees (i.e. $4 for residents; $12 for non-residents);
- -open to all at the same rate.

9. The state and local interests were asked to review the project plans and to provide any comments as soon as possible. It is estimated that a preliminary draft of the feasibility report would be available around mid-August. We agreed to meet again in late August or early September to discuss the comments or any concerns raised, so that revisions could be incorporated in the draft feasibility report to be sent for review to Corps higher authority by 30 September 1994.

CLIFFORD S. JONES
Project Manager

2 Encls
1. Attendance List
2. Schedule

Concurred by:
Thomas Pfeifer
Chief, Navigation & Coastal Section

ATTENDANCE - Long Beach Mtg - July 15, 1994

CLIFFORD JONES	Project Manager ACOE	212-264-9079
TOM HARNEDY	PROGRAMS/PROJ MGMT. ACOE	(212) 264-246
Roman Rakoczy	Project Manager NYSDEC	518-457-3158
Nancy Antonius	N.C. Dept of Rec+Pks	516-572-0[illegible]
Nat Etrog	Trustee, Village of Atlantic Beach	(516) 371-4[illegible]
[illegible]	Mayor, " " "	" " "
Joe Vietri	Asst. Chief Planning Div.	212-264-9219
Peter Weppler	Biologist - ACOE	212-264-466[illegible]
Diane Rahoy	hydraulic engineer - ACOE	212-264-9091
Thomas Pfeifer	Chief, Navigation & Coastal Section - ACOE	212-264-9077
Lynn M. Bocamazo	hydraulic engineer - ACOE	212 264 - 9083
[illegible]	CITY OF LONGBEACH - ENGINEER	516 431-1000 x264
Tom Doheny	TOWN OF HEMPSTEAD	516-897-4133
EDWIN L EATON	CITY OF LONG BEACH	516-431-1000

Schedule

Assuming that Federal funds are appropriated so that the District can immediately proceed to the PED phase after the Public Notice is issued, the forecast milestones subsequent to the feasibility phase are as follows:

Complete Feasibility Phase	*Mar 1995*
Initiate preparation of Design Memo	*Apr 1995*
Submit Design Memo to NAD (DM forwarded to HQUSACE for concurrent review)	*Apr 1996*
Design Memo Approved by HQUSACE	*Jul 1996*
Plans & Specs Submitted to NAD	*Jul 1997*
Plans & Specs Approved	*Sep 1997*
PCA Submitted to NAD	*Nov 1997*
PCA Executed	*Feb 1998*
Advertisement	*Feb 1998*
Bid Opening	*Mar 1998*
Contract Award	*Apr 1998*
Initiate Construction	*Apr 1998* *

* Based on meeting with NYSDEC, construction will be scheduled for July 1998 although it is noted that this schedule has the potential to be accelerated.
CJones

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York, 12233-

Langdon Marsh
Acting
Commissioner

April 13, 1994

The Honorable Earliene Shipper
Mayor
Incorporated Village of Atlantic Beach
65 The Plaza
Atlantic Beach, New York 11509

Dear Mayor Shipper:

The U.S. Army Corps of Engineers in cooperation with this Agency and various local governments is currently conducting a feasibility study to determine what shore protection efforts are justified for the Long Beach Barrier Island. The feasibility study is designed to evaluate conditions and develop a project which would provide erosion and storm damage protection. The study area stretches from Jones Inlet to East Rockaway Inlet. The effort is being sponsored and funded by the Town of Hempstead, City of Long Beach, Nassau County, the State of New York and the Federal Government. The State of New York is acting as the non-Federal sponsor on behalf of the local municipalities.

At this stage of the study we need to know whether the Village of Atlantic Beach has changed its position regarding participation in the study and any future projects. The State had previously extended the opportunity to participate in the study and any resultant shore protection projects. However, the Village declined the opportunity. This is essentially a "last chance" opportunity for the Village because the Corps is at the stage of selecting an alternative. Therefore, it is imperative that the Village notify us of any change in its intentions as soon as possible since the Village's inclusion would have a significant impact on which alternative is selected. If the Village continues to be disinterested a plan that terminates at the west end of the City of Long Beach will be selected.

If the Village desires to participate in a joint effort, please notify us as soon as possible of that decision. The Village would be required to pay a prorated share of the non-Federal costs of the study and project as well as provide any lands, easements and rights-of-way necessary for the project. The initial project cost is currently estimated at $60,000,000 of which $21,000,000 is the non-Federal share. The local municipalities would be responsible for $6,300,000 which represents 10.5 of total project cost and 30 percent of the non-Federal share. Annual operation and maintenance costs and periodic nourishment costs have not yet been estimated but the local municipalities would continue to be responsible for approximately 10.5% of such costs. Please be advised that the Village would also be required to make its beaches accessible to the general public.

If you have any questions please feel free to contact William W. Daley, Chief of the Coastal Erosion Management Section at 518-457-3158.

Sincerely,

Frank J. Dwyer
Director
Bureau of Flood Protection

RGR/tc

New York State Department of Environmental Conservation
Building 40—SUNY, Stony Brook, New York 11790-2356

(516) 444-0365
FAX (516) 444-0373

Thomas C. Jorling
Commissioner

March 2, 1994

Mr. Bruce A. Bergmann
Chief, Planning Division
Dept. of the Army
New York District, Corps of Engineers
Jacob K. Javits Federal Building
New York, NY 10278-0090

Re: Interim Storm Damage Protection Project,
Westhampton Beach
Pre-Application #1-4736-00811/00001-0

Dear Mr. Bergmann:

Robert Greene, Regional Permit Administrator, is in receipt of your 10.20.93 letter requesting comments on the noted project. As the project manager I am responding to that request. the project has been given a pre-application number as shown above, which will eventually become the application and ultimately the permit number. The proposal and supporting plans have been circulated among our regional technical program units and the following are our comments and recommendations.

Conceptually we do not have any objection to the proposal. However, before issuing a final decision we will need more specific detailed information. Some of our general concerns at this point are:

1. Have the borrow areas been investigated for marine resources? How much sand will be moved and how?

2. Creation of buildable lots. will previously unbuildable areas become subject to development pressure? Who will own these lots? what is the purpose of encouraging building areas on the barrier island?

3. Will existing dune areas and vegetation be disturbed? If so, is this necessary?

4. Is there a known sand budget comparison from the east of the groin field to the west? How much sand is expected to pass through the transition zone? And what is the expected change to the area west of the transition zone once the project is completed?

5. Endangered species concerns should be considered. The area is a possible Piping Plover/Least Tern nesting area and may have endangered plant species. Please evaluate possible impacts to the species and possible considerations that may have to be made on the job site.

6. Public access should be more clearly defined and specific proposals/recommendations made.

7. Plans and forms. We will need 4 copies of a full set of plans. These plans must include a plan view of the entire reach of affected area. The site plan must show Mean High water and proposed high water and existing and proposed top of dune. Cross sectional views must be submitted including bottom profiles of the borrow areas. Please include copies of the mentioned station maps (stat. 643 & 75-710). Groin details must be included in the submittal.

I am enclosing an application form and a full environmental assessment form for your staff to complete. Please consider our comments when preparing the resubmission and required forms. If you have any questions I can be reached at the above address or (516) 444-0362.

Very truly yours,

Roger Evans

Roger Evans
Environmental Analyst I

RXE:cg
Enclosure

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 13, 1994

Environmental Analysis Branch
Environmental Assessment Section

Mr. Robert Greene
Regulatory Affairs
New York State Department of
Environmental Conservation
SUNY Campus, Building 40
Loop Road
Stony Brook, New York 11790

Dear Mr. Greene:

The U.S. Army Corps of Engineers, New York District wishes to initiate the application process for Section 401 Water Quality Certification concerning the proposed storm damage reduction project for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York. This project is necessary due to the continual erosion that is decreasing the width of beach and the loss of beach material during severe storms.

Long Beach Island, New York, a barrier island, is located on the Atlantic Coast of Long Island, between Jones Inlet and East Rockaway Inlet. The project study area lies within Nassau County, New York and is encompassed by the communities of Point Lookout, Lido Beach, the City of Long Beach and the Village of Atlantic Beach. All unincorporated areas are under the jurisdiction of the Town of Hempstead. The study area is bounded on the east by Jones Inlet, on the south by the Atlantic Ocean, on the west by East Rockaway Inlet, and on the north by Reynolds Channel (Enclosure 1). A feasibility study is currently underway, which will result in an optimum plan to reduce storm damages in this area. It is likely that this plan will be a beachfill plan that would be periodically nourished. The beachfill plan would include a dune system at +15 feet NGVD. The purpose of the beachfill and nourishment would be to insure the integrity of the dune. Proposed sand sources would be from offshore borrow areas (Enclosure 2). In addition to beach fill, the plan includes rehabilitating some of the thirty (30) groins/jetties, and one of two closure alternatives near the Point Lookout end of the project, which we are currently evaluating: 1) sand fill taper and, 2) constructing six new groins. The plan also includes rehabilitating terminal groin at Point Lookout (Enclosure 3). The closure alternatives would be designed to ameliorate the erosive condition at the Point Lookout/Lido Beach areas.

Upon receipt of this request, please assign a file number and a permit coordinator to the subject project. We ask that the NYSDEC point of contact (POC) notify the District POC, Mr. Peter Weppler at 212-264-4663 once a file number is assigned.

If there are any questions concerning this matter, please contact Mr. Weppler of my office at the above telephone number.

Sincerely,

Stuart Piken P.E.
for Chief, Planning Division

Enclosures

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

December 17, 1992

REPLY TO
Environmental Assessment Section
Environmental Analysis Branch

Mr. Steve Hendrickson
New York Department of
Environmental Conservation
SUNY Campus
Loop Road Building 40
Stony Brook, New York 11790-2356

Dear Mr. Hendrickson:

The U.S. Army Corps, New York District, has been authorized by the Committee on Public Works and Transportation of the House of Representatives in October 1986 to participate in the storm damage reduction project for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York. This project is necessary due to continual erosion leading to a decrease in the width of beach and a loss of beach material during severe storms and hurricanes.

Long Beach Island, New York, a barrier island, is located on the Atlantic Coast of Long Island, between Jones Inlet and East Rockaway Inlet. The project study area lies within Nassau County, New York and is encompassed by the communities of Point Lookout, Lido Beach, the City of Long Beach and the Village of Atlantic Beach. All unincorporated areas are under the jurisdiction of the Town of Hempstead. The study area is bounded on the east by Jones Inlet, on the south by the Atlantic Ocean, on the west by East Rockaway Inlet, and on the north by Reynolds Channel (Figure 1). A reconnaissance study was completed in 1989, which identified the Federal interest of storm damage reduction on the barrier island of Long Beach. A feasibility study is currently underway, which will result in an optimum plan to reduce storm damages in this area. It is likely that this plan will be a beachfill plan which would be periodically nourished. Proposed sand sources would be from offshore borrow areas (Figure 2). In addition to beach fill, the plan includes rehabilitation of thirty (30) groins/jetties and the reconstruction of the terminal groin at Point Lookout.

The New York District requests information on the presence of any known commercial and/or recreational presence of any known commercial and/or recreational shellfishing areas in the project area.

Any questions concerning this matter should be addressed to Mr. Peter Weppler at (212) 264-4663.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Enclosures

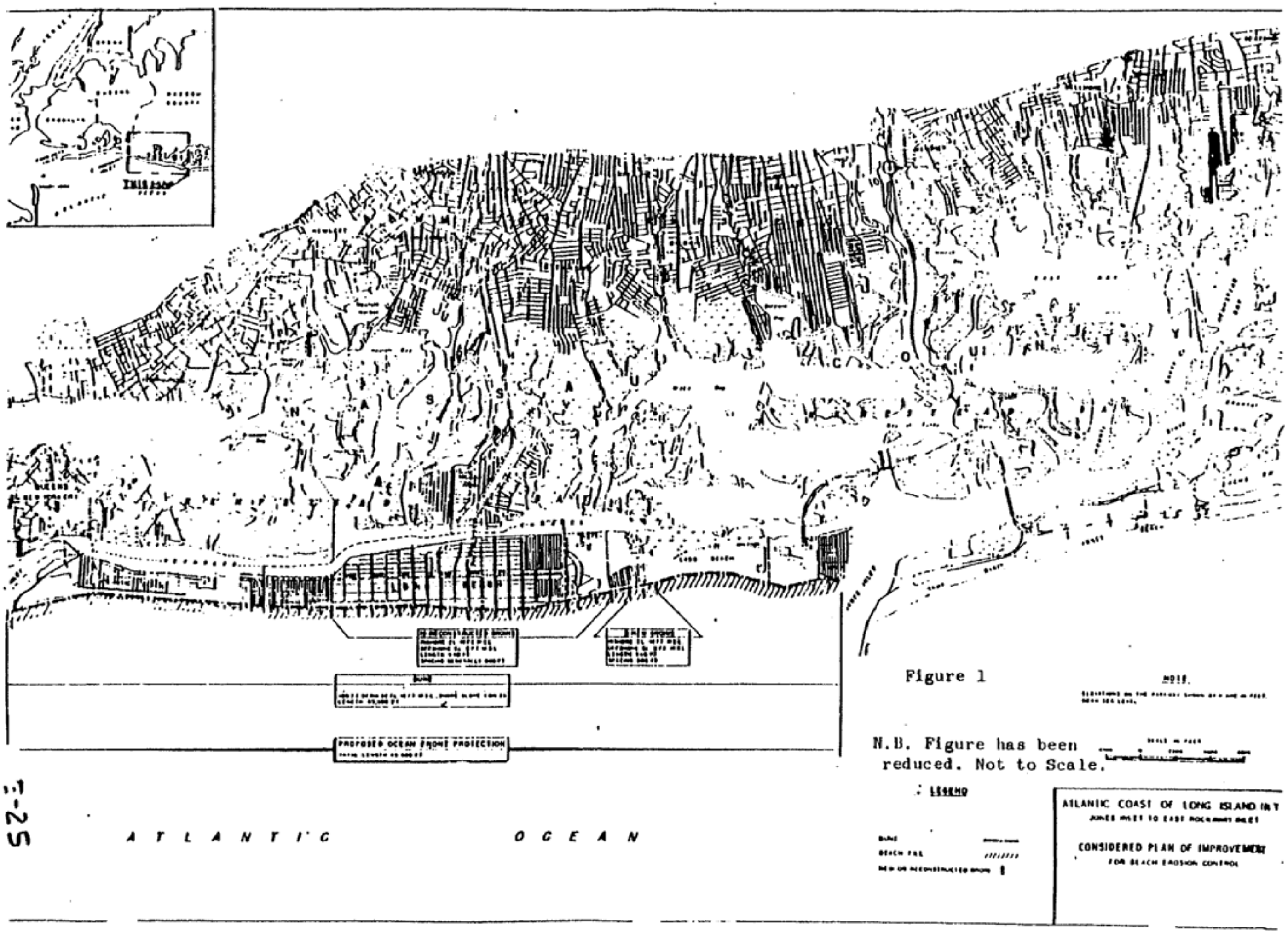


Figure 1

N.B. Figure has been reduced. Not to Scale.

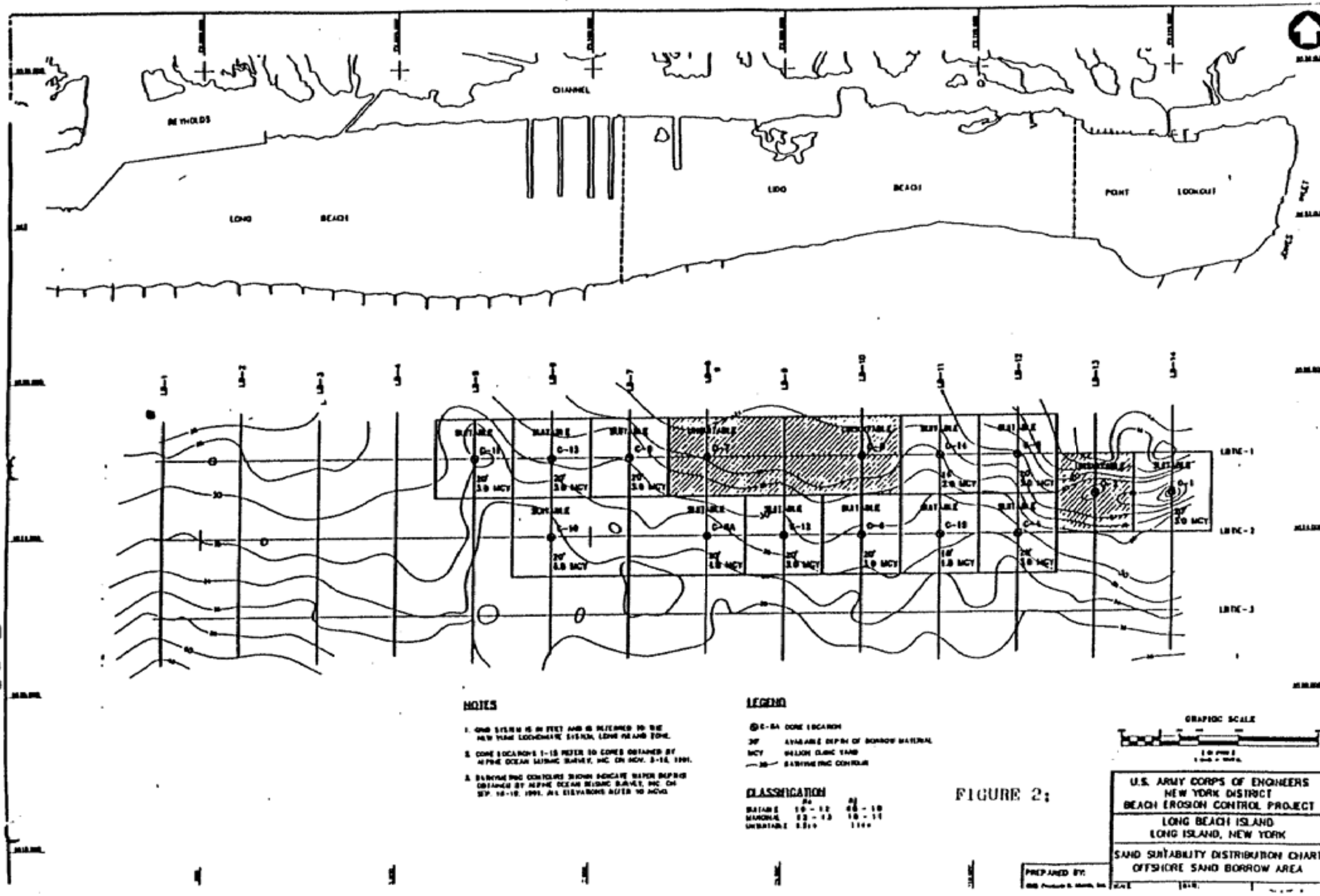


FIGURE 2;

N.B. Map has been reduced; not to sc

New York State Department of Environmental Conservation
Building 40—SUNY, Stony Brook, New York 11790-2356

Thomas C. Jorling
Commissioner

December 29, 1992

Mr. Bruce A. Bergman
Chief, Planning Division
New York District Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

Dear Mr. Bergman:

Stephen Hendrickson, Acting Chief of the Bureau of Shellfisheries, has asked that I respond to your inquiry about commercial and/or recreational shellfishing grounds in the near-shore Atlantic Ocean in the vicinity of Lido Beach. I understand that your interest is in connection with a feasibility study to develop an optimum plan to reduce storm damages to Long Beach Island. Your letter states that it is likely that the optimum plan will be a beachfill plan which would be periodically nourished. Figure 2, enclosed with your correspondence, presumably shows a "borrow area" which is under consideration as a source of beach nourishment material for this project.

The area indicated in Figure 2 has an extensive population of surf clams (Spisula solidissima), and lies within an area which is, and has historically been, heavily exploited by commercial harvesters. As the enclosed graph shows, New York's inshore landings have averaged over 144,000 bushels annually for the past twenty years, and have been significantly higher in recent years. Most of this production has been from New York's certified shellfishing waters located west of Jones Inlet within three miles of shore.

In addition, a surf clam population assessment conducted last July by this Department yielded populations as high as 42 adult surf clams per square meter of bottom within the area identified by Figure 2.

In light of the above, this Department believes that the borrowing of beach nourishment material from the identified area would cause extensive damage to a valuable commercial resource, and cause considerable disruption to a long-term and important commercial fishery centered in the vicinity.

Should you have questions or wish to discuss the matter further, please contact Mr. Hendrickson or me directly at (516) 751-6381.

Sincerely,

Richard E. Fox

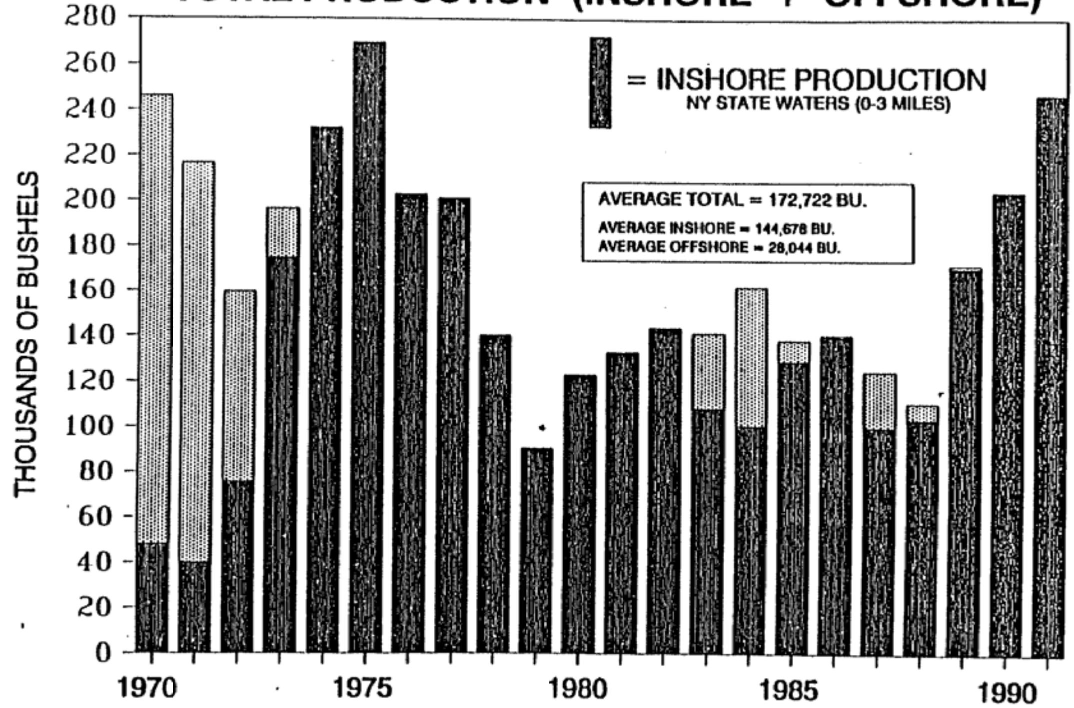
Richard E. Fox
Marine Resources Specialist

Enc:

cc: Stephen A. Hendrickson, Acting Chief
Bureau of Shellfisheries

~~E-19~~
SAY E-27

NYS ATLANTIC OCEAN SURF CLAM PRODUCTION
TOTAL PRODUCTION (INSHORE + OFFSHORE)



DATA SOURCE: NYSDEC/NMFS

Aqua Explorers, Inc

PO Box 116, East Rockaway, USA, NY 11518
2745 Cheshire Drive, Baldwin, USA, NY 11510
Phone/Fax (516) 868-2658

3-9-1994

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
Attn: Chief Bruce A. Bergmann
Jacob Javits Federal Building
New York, N.Y. 10278-0090

Dear Mr. Bergmann,

I am in receipt your recent letter concerning beach nourishment and its impact on local and historical shipwrecks. First let me say that I am glad the corp is concerned about these underwater time capsules. As you know shipwrecks are an invaluable tool for archoligest. Wrecks are also the key and main attraction to local fishing and sport scuba diving, not to mention the bread and butter for charter boats opperations.

Fortunately there are only a few wrecks within the areas you have marked, that will be effected. Although other sources may list additional shipwrecks the ones I will list are not buried and are all still visible above the sand. For the area marked in Long Beach you have two wrecks marked the eastern most site is of the vessel MEXICO and is an historical site. I do not have accurate Loran #s on the MEXICO but can obtain them if needed. A small tug boat sits in shallow water east of the MEXICO but this site has no significance and should not be a concern. The western wreck you have marked is an unknown site, I beleive she is now almost completely buried, so beach nourishment should not have a negative impact. Also of little concern is a barge located at the extreme west point of Atlantic Beach. You also make mention of an offshore borrow site. The deeper waters off Long Beach contain literally hundreds of shipwrecks so without knowing the exact borrow site I can not provide information as to any damage. I would recommend the books WRECK VALLEY Vol II which provides Loran #s for most area wrecks.

~~In regards to the Westhampton site I am not aware of any significant historical wrecks in this area.~~

As a side note I am aware that a similar project is planned for the New Jersey coast. Although I have not been contacted I would like to state that their are several wrecks within on 100 yards of the Jersey shore that should be considered prior to any beach nourishment project. I can provide the accurate location for each and every one of these wrecks. Please let me know if you have any input on the New Jersey project or if you would like to receive the location information.

Sincerely,

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

Environmental Analysis Branch
Environmental Assessment Section

Mr. David A. Stilwell
Acting Field Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
3817 Luker Road
Cortland, New York 13045

Dear Mr. Stilwell:

The U.S. Army Corps, New York District, has been authorized by the Committee on Public Works and Transportation of the House of Representatives in October 1986 to participate in the storm damage reduction project for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York. A Planning Aid Report was prepared for this project by your office in January 1989.

Pursuant to the Fish and Wildlife Coordination Act (48 Sta. 401, as amended; 16 U.S.C. 661 et seq.), the New York District requests a detailed report on the effects and/or environmental benefits of the proposed actions to be included in the Draft Environmental Impact Statement for the project as per the attached Scope of Work (SOW) [Enclosure 1] which was discussed with Mr. Robert Murray of your staff on February 1 and February 2, 1994.

Please find enclosed the SOW and a copy of the signed DA Form 2544 which was mailed to your Region 5 office in Massachusetts.

The New York District will continue coordination with your agency, to further assist in your preparation of the report.

Any questions concerning this matter should be addressed to Mr. Peter Weppler at (212) 264-4663.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Enclosures
cc: Nancy Schlotter, USFWS-LIFO

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, New York 13045

February 4, 1994

Mr. Bruce A. Bergmann
Chief, Planning Division
U.S. Army Corps of Engineers
26 Federal Plaza
New York, NY 10278

Attention: Mr. Peter Weppler

Dear Mr. Bergmann:

The U.S. Fish and Wildlife Service (Service) has received the January 10, 1994 Revised Scope of Work (SOW) for Service input to the proposed Long Beach Island, New York, Storm Damage Reduction Project.

Enclosed are the modifications to the SOW which were developed as requested by and discussed with Mr. Peter Weppler, of your staff, on February 1 and February 2, 1994. We have made some minor modifications including a revision of staff days and milestone due dates for submission of a Draft 2(b) Fish and Wildlife Coordination Report to allow the Service sufficient time to coordinate our efforts with the New York State Department of Environmental Conservation. The SOW requires the submission of a draft and final 2(b) Fish and Wildlife Coordination Act Report for the project. We are submitting a cost breakdown which provides for 24 days of Service effort at a total cost of $13,240.00 for the project.

If you are agreeable to the enclosed SOW, please prepare a DA Form 2544 and send it along with the scope-of-work to this office. Please send copies of these documents to the Long Island Field Office. We will then forward the package to our Regional Office for signature and processing.

Bob Murray, at the Service's Long Island Field Office, will be the point of contact should your staff have any questions and he can be reached at (516) 581-2941. We appreciate your cooperation and look forward to working with your staff in implementing the SOW.

Sincerely,

ACTING FOR David A. Stilwell
Acting Field Supervisor

INCORPORATED

Village of Atlantic Beach

65 THE PLAZA
ATLANTIC BEACH, N.Y. 11509
Telephone 371-4600

August 6, 1993

Mr. Clifford Jones
US Army Corps of Engineers
CENAM-PL-FN
26 Federal Plaza
New York, NY 10278

Dear Mr. Jones:

As you know there has been a great deal of publicity regarding the Long Beach Barrier Island shoreline. The Board of Trustees of the Village of Atlantic Beach strongly believes that our Community should be informed about the issues that will affect the future of the Atlantic Beach beachfront. Therefore, we would like to invite you or your representative, to speak at a Town Meeting entitled "Future of the Atlantic Beach Shoreline", on Monday, September 13, 1993 at 8:30 P.M., Village Hall, 65 The Plaza, Atlantic Beach, NY 11509.

Invited speakers are:

Assemblyman Harvey Weisenberg
New York State Department of Environmental Conservation
Town of Hempstead Conservation & Waterways
US Army Corps of Engineers
Village of Atlantic Beach Coastal Consortium
Pebble Cove
Breitstone Insurance Agency

Please respond as soon as possible to confirm your attendance so that the Mayor may contact you to discuss details of the meeting protocol and agenda.

We look forward to your positive response concerning this important meeting.

Sincerely,

Mayor and Board of Trustees

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

25 OCT 1993

REPLY TO
ATTENTION OF

District Engineer

Honorable Peter T. King
House of Representatives
Washington, DC 20515

Dear Mr. King:

This is in reply to your letter dated October 6, 1993 on behalf of Mr. Gary Shakerdge of Long Beach, New York concerning potential legislation affecting shorelines and measures to protect the barrier beach at Long Beach and inland areas.

I am not familiar with the potential legislation on Expedited Shoreline Resources Improvement Act (HR2051). I would appreciate any information about it that may may be available. I can provide information on New York District projects in and around your Congressional District.

The plans for closures across Jones Inlet and East Rockaway Inlet and dunes for Long Beach Island were recommended in a New York District Survey Report in 1965. The plan included hurricane barriers (inlet closure gates), levees, an oceanfront dune with protective beach berm, groin reconstruction, a terminal groin or jetty at the Point Lookout side of Jones Inlet and periodic beach nourishment.

Local interests objected because the proposed dune along the oceanfront was not compatible with the type of development on the Long Beach barrier island. Even after various modifications, the plan was still not acceptable to local interests. In a letter dated July 21, 1971, the New York District notified the project sponsor, the New York State Department of Environmental Conservation that the study to evaluate the plan was to be terminated and a negative report issued. Local interests concurred with the termination of the study.

Following Hurricane Gloria, which occurred in September 1985, a Resolution of the Committee on Public Works and Transportation of the U.S. House of Representatives was adopted in October 1986 authorizing a new study for storm damage protection for Long Beach Island. The New York District completed a Reconnaissance Report in March 1989, which recommended continuation of studies to evaluate protection measures for the oceanfront areas. Coordination with the New York State Department of Environmental Conservation and local municipalities determined that there is broad support for the oceanfront berm and dune measures, but no support for more comprehensive plans to protect against storm

SEP 28 1993

September 22, 1993

Dear Mr. King,

Thank you for writing to me concerning the protection of the south shore from storms and hurricanes. Living in Long Beach, I am very concerned about this matter.

I wonder if you would send me a copy of your bill, the Expedited Shoreline Resources Improvement Act (HR 2051). Please keep me informed as to its status in Congress. I would be happy to write more letters on this bill if you would tell me what congressmen to address.

I wonder if you know something about the Army Corps of Engineers' proposal to build tidal gates in East Rockaway Inlet and Jones Inlet (this proposal dates back to 1965!). These tidal gates would close IN EMERGENCIES ONLY to block off ocean waters from hurricanes and storms, thus protecting the barrier beach and inland communities from flooding via Reynolds Channel. I also understand that an 18-foot sand dune would extend along the ocean from Atlantic Beach to Point Lookout.

The December and March storms showed me how vulnerable we are. We could lose most of our beach if we don't do something to protect it. Of course lives and property are also in danger. What happened in the Mid-West this past summer with the floods could happen to us someday. So we must minimize the potential damage to our area.

Please continue your efforts to protect Long Island from the damage of very dangerous storms.

Thank you again.

Sincerely,

Gary Shakerdge

E-34

surges through the inlets and in the bay shore areas. Factors considered were the much higher cost and the environmental impacts of potentially reduced tidal exchange through the inlets.

The feasibility phase study for the oceanfront of Long Beach Island is underway and a draft feasibility report is scheduled for completion in the current FY 1994.

I trust this is sufficient for your present needs. If you would like any additional information, please contact me or Mr. Clifford Jones, Project Manager, at 212-264-9079.

Sincerely,

Thomas A. York
Colonel, Corps of Engineers
District Engineer

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

SEP 2 2 1993

Senator Alfonse M. D'Amato
Seven Penn Plaza
Suite 600
370 Seventh Avenue
New York, N.Y. 10001

Dear Senator D'Amato:

I am writing in reply to your letter dated September 10, 1993, on behalf of Mr. Morris H. Kramer, concerning the feasibility of tide gates across Jones Inlet and East Rockaway Inlet.

As Mr. Kramer states in his letter, the non-Federal interests did not support large scale storm damage reduction measures including tide gates that would protect the barrier island and the back bay areas. Our current feasibility study for Long Beach Island is specifically focused, therefore, on reducing damages from wave attack and beach erosion on the Atlantic shorefront. Inundation by storm tides or surges entering the inlet is not being addressed.

Mr. Kramer should contact officials of the Town of Hempstead, who in turn should contact Mr. William Daley of the New York State Department of Environmental Conservation at 518-457-3157. If there is renewed interest in plans to prevent storm surge inundation, we would be willing to meet with the local representatives to discuss their desires and the best means to address them.

I trust this is sufficient for your present needs. If you would like any additional information, please contact me or Mr. Thomas Pfeifer, P.E., Chief of the Ocean and Estuary Section, at 212-264-9077.

Sincerely,

Ronald Anderson
Major, Corps of Engineers
Acting District Engineer

Encl.

ALFONSE M. D'AMATO
NEW YORK

SUITE 600
SEVEN PENN PLAZA
370 SEVENTH AVENUE
NEW YORK, NY 10001
(212) 947-7390

United States Senate

WASHINGTON, DC 20510

September 10, 1993

TO: Army Corps of Engineers
26 Federal Plaza
New York, New York 10278

FROM: Alfonse M. D'Amato
United States Senator

Because of the desire of this office to be responsive to all inquiries and communications, your consideration of the attached is requested.

PLEASE TRY TO RESPOND WITHIN 4 WEEKS OF YOUR RECEIPT OF THIS REQUEST. YOUR FINDINGS AND VIEWS, IN DUPLICATE, ALONG WITH THE RETURN OF THIS MEMO, WILL BE APPRECIATED.

SEND ALL CORRESPONDENCE ON THIS MATTER DIRECTLY TO MY NEW YORK CITY OFFICE, SEVEN PENN PLAZA, SUITE 600, NEW YORK, NEW YORK, 10001.

Thank you.

ADA/MTM/mm

E-37

MORRIS H. KRAMER
ENVIRONMENTALIST
BOX 444
ATLANTIC BEACH, NY 11509
TEL / FAX (516) 889-6323

September 10, 1993

REVIVE CORPS. OF ENGINEERS PROPOSAL
TO
CONSTRUCT HURRICANE GATES
IN
EAST ROCKAWAY AND JONES INLETS

Hon. Alfonse D'Amato c/o **MIRIAM MADDEN**
370 Seventh Avenue
New York, NY 10001

Dear Senator D'Amato:

Without your taking a position on this issue, I respectfully request that you ask the U.S. Army Corps. of Engineers to re-examine and revise this long abandoned proposal to determine its feasibility for this decade and next century.

In my opinion, a project such as the above would help protect about 25 communities. A major hurricane would cause extensive flooding in nearly all of these communities. The damage would be in the $billions, vastly exceeding costs of construction, and the Hurricane Gates would still be available for future hurricanes and Nor'easters.

An insurance industry projected scenario exists for a Category 4 Hurricane striking Long Island and New Jersey. It would, if it happens result in $50 billion in insured losses, which should be doubled to $100 billion in peoples non-reimbursed losses. Hurricane Andrew and Hugo's victims recovered on average only 50% of their losses. Hurricane Andrew's insured losses total about $18 billion so far.

I hope to take this issue further, but wanted to give it to you first, since you have been so responsive on other matters that I have brought to your attention.

Please feel free to contact me if you have any questions. Thank you for your efforts in all of these issues.

Sincerely yours,

Morris H. Kramer

Enc.

E-38

Morris Kramer
Environmentalist

P.O. Box 444 • Atlantic Beach, NY 11509
Telephone/Fax: (516) 889-6323

FOR IMMEDIATE RELEASE: August 1993

ENVIRONMENTALIST WANTS CONTROVERSIAL 1965 U.S. ARMY CORPS OF ENGINEERS PROPOSAL TO PROTECT LONG BEACH BARRIER ISLAND, THE TOWN OF HEMPSTEAD AND NASSAU COUNTY REVIVED, REVISED AND INITIATED

"A bitterly opposed twenty-eight year old U.S. Army Corps of Engineers (COE) proposal to protect communities* from the Five Towns to Baldwin, Freeport, Merrick and Seaford, as well as Long Beach Barrier Island should be revived," states environmentalist Morris Kramer.

"The Disgarded 1965 proposal featured huge tidal gates** in East Rockaway Inlet and Jones Inlet that in *emergencies only* would close to block out ocean waters from Hurricanes and Nor'easters and thus protect the inland communities and the barrier beach from flooding via the Bay. An eighteen foot high sand dune would also extend along the ocean from Silver Point (Atlantic Beach) to Point Lookout," Mr. Kramer said.

"The COE proposal would protect most of the Town of Hempstead, the most populated Town in the United States. Also, few people realize that there is a tremendous amount of inland waterways in Hempstead Town," says Kramer.

"We have learned a lot since 1965. A major hurricane can push Ocean and Bay waters all the way up to Sunrise Highway. Last December's Nor'easter did not come close to the so called 100 year storm mentioned in the media. A warming climate can intensify potential Hurricane and Nor'easters."***

"Actually, a COE Long Beach Island Hurricane Protection Proposal is in the planning stages. It would include a dune from Silver Point to Point Lookout. It is scheduled for 1997 (*if we last that long*). *So, the Tidal Gates will be all that's needed.*"

"The insurance companies are betting against Long Island, as is the Federal Flood Insurance Program, we better wake up and try to protect ourselves from catastrophic storms before it is too late," Mr. Kramer added.

Kramer has begun contacting Members of Congress on this matter.

---

* The following communities would receive some form of protection from this proposal: Merrick, Freeport, Baldwin Harbor, Baldwin, Oceanside, Harbor Isle, Island Park, Barnum Island, Bay Park, East Rockaway, Hewlett, Hewlett Bay Park, Hewlett Harbor, Hewlett Neck, Inwood, Meadowmere Park, Bellmore, Wantagh, Seaford, Atlantic Beach, East Atlantic Beach, Long Beach, Lido Beach, and Point Lookout.

** A huge tidal gate at New Bedford, Mass. has been useful in mitigating hurricane damage. Also, one on the Thames River in England.

*** Environmentalist Morris Kramer was the first person in the Country to publicly and actively raise the question: Did Global Warming Strengthen 'Freakish' 1991 Halloween Storm? After 1992's Hurricane Andrew: "Many scientists say recent storms prove that Global Warming in changing the World's Climate." (Newsweek 9/7/92)

Nassau HERALD
All the News of the Five Towns
50 CENT
SEPTEMBER 9 - 15, 199

Seek dunes, gates to protect against flooding

By Roberta Bausmann

As forecasters closely monitored Hurricane Emily's journey through the East Coast last week, environmentalists and the Army Corps of Engineers have been experimenting on methods to minimize damage to southern Nassau County in the event of such a storm.

The Army Corps of Engineers is currently drafting a hurricane protection proposal "that suggests widening and heightening the beaches" as well as building a dune system, according to Cliff Jones, project manager.

Such a system may include the erection of 12 to 18 foot dunes extending from Atlantic Beach to Point Lookout, although the exact details will not be specified until 1994, when the report is scheduled to be finished, according to Mr. Jones. If implemented, the plan would be funded by both the Federal and local governments, he adds.

Although the heightening of beaches and the building of dunes would help protect the Long Beach Barrier Island from ocean flooding in a category four hurricane, these dunes would not halt bay waters from flooding the entire portion of Long Island south of Sunrise Highway, according to environmentalist Morris Kramer. Currently, American Red Cross evacuation sites are planned for areas north of Sunrise Highway, because flooding would be likely in areas south should a storm seize the area.

During a category four hurricane, which packs winds of between 131 and 155 miles per hour and surges or floods of between 13 and 18 feet, ocean waters would flood the bay through the East Rockaway and the Jones Beach Inlets, adding to the destruction of southern Nassau County, Mr. Kramer says.

As a solution to this potential disaster, Mr. Kramer suggests implementing "huge tidal gates [in the inlets] that in emergencies only would close to block out ocean waters...and thus protect the inland communities and the barrier beach from flooding via the bay."

Such tidal gates, Mr. Kramer explains, would be concrete and hinged on pivots, "so when a hurricane or nor'easter came, they would close and form a wall like a dam."

Tidal gates are currently employed in New Bedford, Massachusetts and in the Thames River in England, according to Mr. Kramer.

The gates were originally part of a "bitterly opposed 28 year old U.S. Army Corps proposal to protect" southern Nassau County, Mr. Kramer says.

Although Mr. Jones, project manager for the corps, could not say exactly why the 1965 plans were negatively received, he speculated that the reaction stemmed from a policy which "opposed hard structures" and favored "letting the beaches fill themselves naturally rather than producing new structures."

Environmentalist Morris Kramer advocates tidal gates to protect inland communities and the barrier beach from bay flooding.

Flood gates located in the East Rockaway and Jones Beach Inlets would block ocean waters from flooding the bay.

Strong hurricanes predicted for L.I.

According to experts, global warming and a strong hurricane cycle have increased the potential for powerful hurricanes to hit the East Coast, says Morris Kramer, environmentalist.

Global warming, resulting in increased ocean water temperatures, has formed a "hurricane alley" from Florida to Cape Cod, Mr Kramer says.

Since warmer waters intensify and keep hurricanes near the coast, many believe Long Island should prepare for a category four hurricane, like Hurricane Andrew, which devastated Homestead, Florida, last summer, he notes.

In addition, a study on the frequency of category three, four and five hurricanes, which was presented at the 14th Annual National Hurricane Conference, found that the Atlantic States may be concluding a weak hurricane cycle.

If the findings are correct, then the East Coast is now in the throes of a strong hurricane cycle, according to Mr. Kramer. Such a cycle may explain why, in past five years, the East Coast has been hit by three of this century's most powerful hurricanes, the Atlantic Beach environmentalist says.

E-40

Newsday
THE LONG ISLAND NEWSPAPER
MONDAY, AUG. 30, 1993 • NASSAU

HURRICANE WATCH

A Fair Day at Long Beach

By Andrew Smith
STAFF WRITER

Cathy Koneschusky planned only on a glorious day at the beach yesterday when she and her two children came to Long Beach from Brooklyn. She didn't expect a lesson in environmentalism, provided free by the City of Long Beach.

"I think it's great," she said. She found the fair by mistake and was impressed with its educational value. She showed her 4-year-old daughter, Suzanne, the U.S. Fish and Wildlife Service's display of the hides of endangered animals seized from smugglers. "I want my children to learn to protect other living creatures."

The city sponsored its fifth Envirofest yesterday, an open-air show on environmentalism on the boardwalk at Riverside Boulevard. About two dozen exhibitors explained various environmental issues to beach goers or displayed products made from recycled materials.

Among the exhibitors at the fair was Earth Fundamentals, a New Jersey company that helps organizations raise money in Earth-conscious ways. Instead of selling chocolate, for example, Earth Fundamentals helps groups sell things like pens made out of recycled tires or three-ring binders with old computer circuit boards for covers, said Howard Davis, one half of the

NEWSDAY, MONDAY, AUGUST 30,

A Fair Day at Long Beach

FAIR from Page 19

company's two-person work force. The other half is his brother, Matthew, the company president.

Giving companies like Earth Fundamentals a forum is one purpose of Envirofest, said city council vice president Michael Zapson, the fair's prime mover. Another is to remind people to recycle.

And this year, the city wanted to remind people to protect the area's aquifers and sand dunes, Zapson said.

The city encouraged residents to write to federal officials for help to rebuild the beach's stone jetties damaged in last winter's storms.

Local environmentalist Morris Kramer had another suggestion. He handed out brochures urging the Army Corps of Engineers to build enormous tidal gates in East Rockaway Inlet and Jones Inlet, at either end of Long Beach. The gates would protect communities along the South Shore from flooding during hurricanes, his brochure said. He also had a map plotting the progress of Hurricane Emily.

About 5,000 people attended the daylong event, Zapson said. People who wandered into the fair said they thought it was a good thing.

"I think it's very educational," said Al Puglia of Oceanside. He and his wife, Ann, recycle carefully and use fluorescent bulbs to save electricity, he said.

E-41

New York State Office of Parks, Recreation and Historic Preservation
Historic Preservation Field Services Bureau
Peebles Island, PO Box 189, Waterford, New York 12188-0189 518-237-8643

Orin Lehman
Commissioner

June 23, 1993

Mr. Bruce A. Bergmann
Chief, Planning Division
Department of the Army
Corps of Engineers
New York District Office
Jacob K. Javits Federal Building
New York, New York 10278-0090

Dear Mr. Bergmann:

Re: CORPS
Long Beach Erosion Control
Long Beach Island, Nassau County
92PR2416

Thank you for requesting the comments of the State Historic Preservation Office (SHPO). We have reviewed the Cultural Resources Reconnaissance Report in accordance with Section 106 of the National Historic Preservation Act of 1966 and the relevant implementing regulations.

Based upon this review, the SHPO concurs with the recommendations of the the report. It is the opinion of the SHPO that no further investigations are warranted for the on-shore area of the project. We look forward to receiving the results of the surveys of the off-shore borrow areas when that work is completed.

If you have any questions, please call James Warren of our Project Review Unit at (518) 237-8643 ext. 280.

Sincerely,

Julia S. Stokes
Deputy Commissioner for
Historic Preservation

JSS/RDK:gc

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

14 June 1993

Environmental Analysis Branch
Environmental Assessment Section

Ms. Julia S. Stokes
Deputy Commissioner for Historic Preservation
New York State Office of Parks, Recreation, and
Historic Preservation
Historic Preservation Field Services Bureau
Peebles Island
P.O. Box 189
Waterford, New York 12188-0189

Dear Ms. Stokes,

The New York District, Corps of Engineers (Corps), has been authorized to construct a beach nourishment project along the length of Long Beach Island, Nassau County, New York (Figure 1). This project is needed to replace portions of the beach that have undergone severe erosion and to protect existing development from further erosion. The current project area includes the shore and near-shore sand placement area as well as an offshore borrow area located approximately 2000 feet south of the eastern end of Long Beach Island (Figure 1 and 2). The proposed project will not impact the salt marshes situated on the northeast side of Long Beach Island.

Current project plans call for the placement of sand dredged from the offshore borrow site to be placed on Long Beach Island. This material will be placed above the mean high water mark to widen the beach berm to a width of 110 feet and to construct dunes in certain areas. Two portions of Long Beach Island, the westernmost portion of Atlantic Beach and a section of Lido Beach, are not being considered as part of the initial nourishment project, although they will be included as part of the subsequent maintenance cycle. As the project is currently scheduled, the beach maintenance program will last for 50 years, with beach nourishment occurring every five years.

Two structures, the Granada Towers and the U.S. Post Office, are listed on the National Register of Historic Places (NRHP). One private residence located on Washington Boulevard is listed on the historic structures inventory maintained by the New York State Office of Parks, Recreation, and Historic Preservation because it is considered to be one of the first private homes built in Long Beach. None of these structures will be affected by this project.

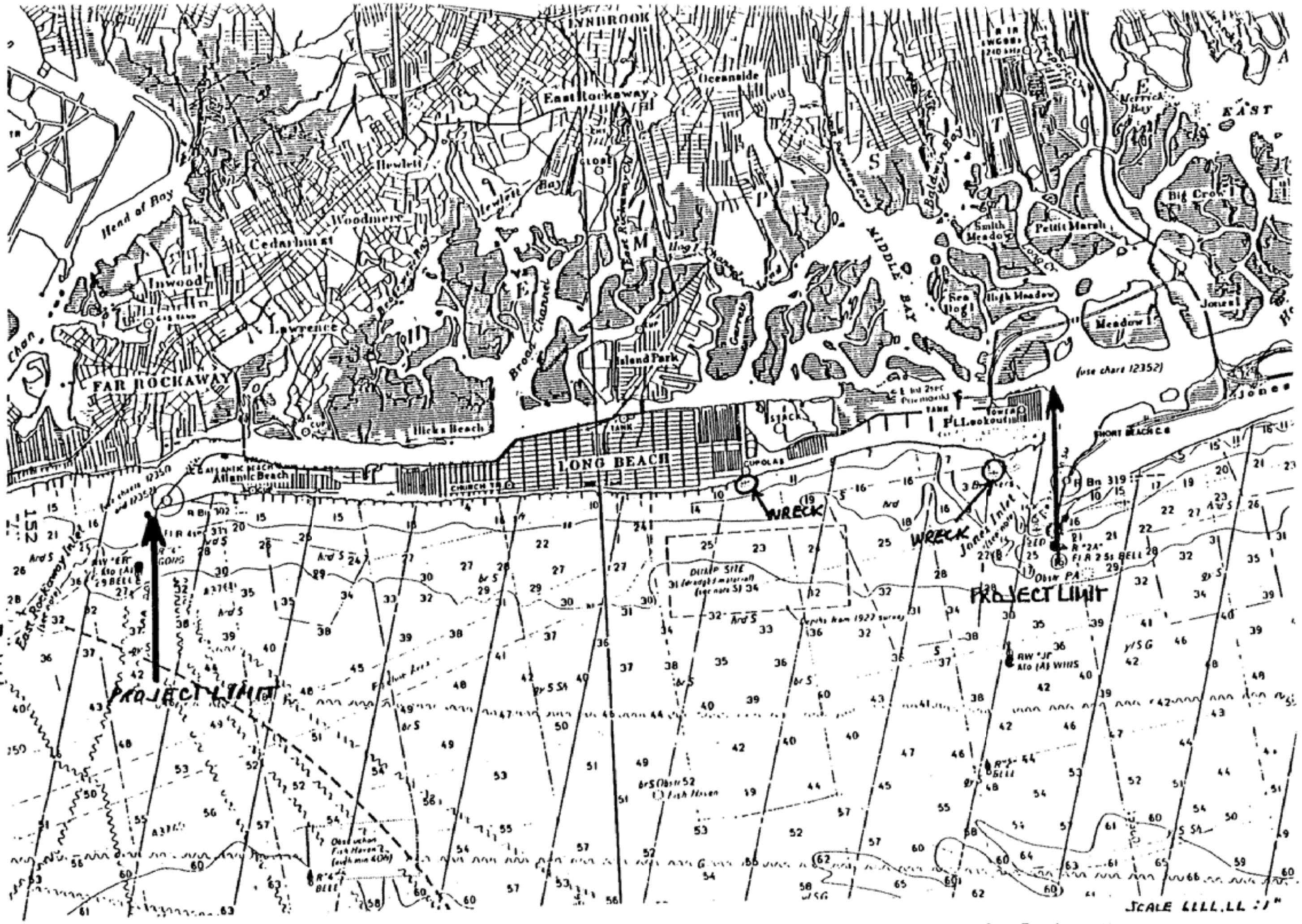


Figure 1: Project Map
Long Beach Island, Nassau unty,
New York.

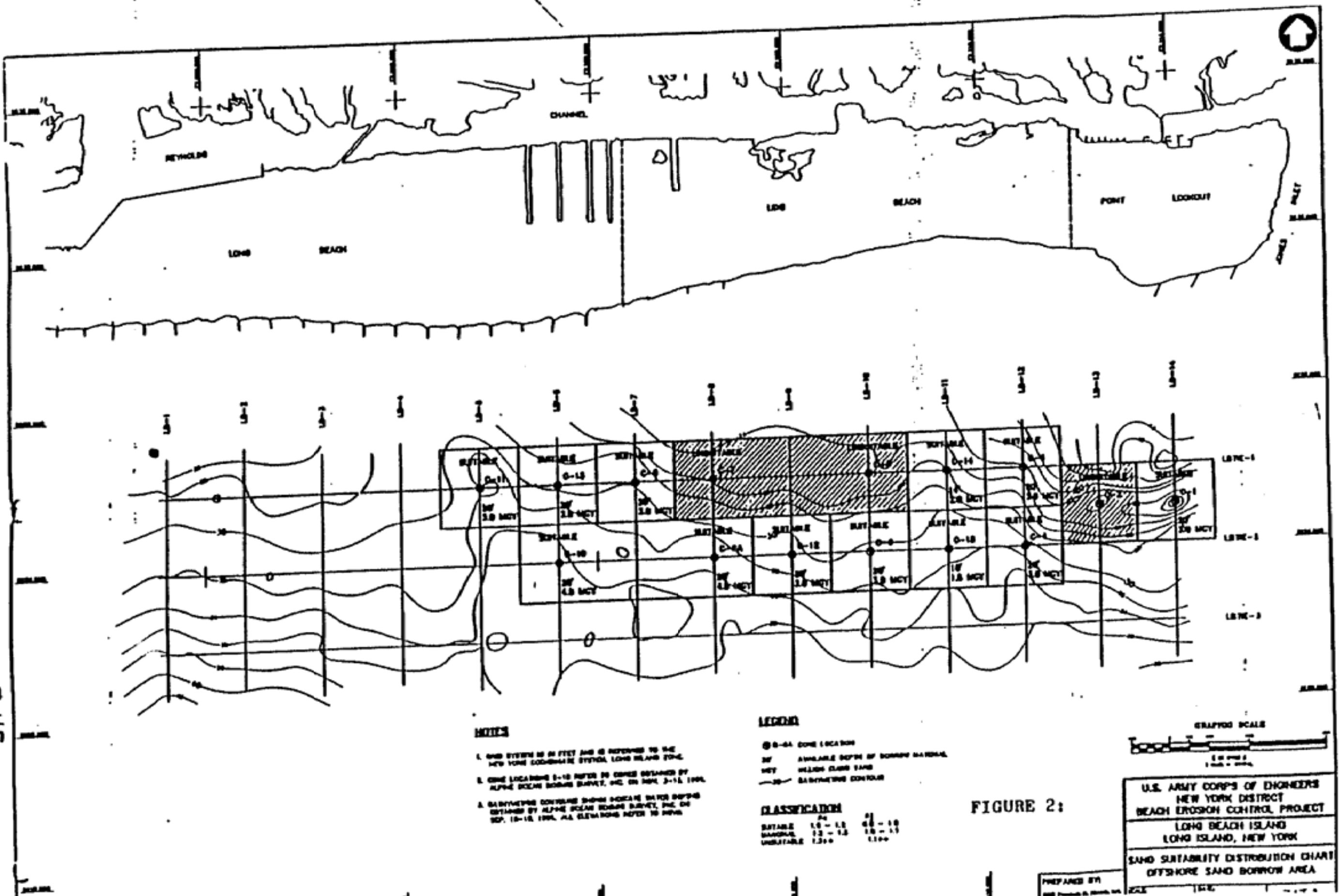


FIGURE 2:

N.B. Map has been reduced; not to scale.

To determine if there were any other potentially NRHP eligible properties located within the project area, the Corps had a cultural resources study prepared as part of this project (Attachment 1). An extensive history and prehistory of the Long Beach Island area was compiled and a pedestrian survey was also conducted for this report. This study found that there were no prehistoric/contact period occupations or archaeological sites on Long Beach. In addition, the location of the 19th and early 20th century structures would be located north of the present beach zone and that no significant remains of the project area's history would be located at the site of the present beach. Since the proposed project involves the deposition of sand, no sites will be disturbed.

The cultural resources study also examined the potential for shipwrecks to be located in the near-shore placement area and the offshore borrow area. Marine charts of the project area show two wrecks within the near-shore sand placement zone in the Lido Beach/Point Lookout areas. These wrecks, however, are not listed on the National Oceanic and Atmospheric Administration's (NOAA) Automated Wreck and Obstruction Information System (AWOIS) listing for the project area. Mark J. Friese, Hydrographic Surveys Branch, NOAA, stated that the AWOIS is often not updated to include information from their charts. There is the potential, then, for the two wrecks to be located in the eastern section of the project area. An underwater investigation of the near-shore area in the vicinity of the two wrecks will be conducted during the next phase of the project.

A number of marine accidents or wrecks have occurred within and near the borrow site. In the next phase of this project, the Corps is planning to conduct a remote sensing survey of the proposed borrow area to determine if any wrecks are present.

On the basis of current project plans and pending review by your office, the Corps is of the opinion that the "Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, Nassau County, New York Beach Nourishment Project" will have no effect on historic properties located onshore. Please provide us with Section 106 comments for the onshore portion of this project as pursuant to 36 CFR 800.5.

The remote sensing survey of the borrow site using a magnetometer and side scan sonar will be conducted as part of the next phase of the project. In addition, an underwater survey of the near-shore area in the location of the two wrecks will also be conducted. The results of these surveys will be coordinated with your office when this work is completed.

If your or your staff have any questions or require further information about this project, please contact Ms. Nancy J. Brighton, Project Archaeologist, (212)264-4663. Thank you for your assistance.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Attachments

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

May 3, 1993

REPLY TO
ATTENTION OF

Environmental Analysis Branch
Environmental Assessment Section

Mr. Leonard P. Corin
Field Supervisor
U.S. Department of the Interior
Fish and Wildlife Service
3817 Luker Road
Cortland, New York 13045

Dear Mr. Corin:

This letter is in reference to the September 22, 1988 correspondence (Enclosure 1) regarding the presence of threatened or endangered species within the study area for the storm damage reduction project for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York.

The New York District feels that a biological assessment for the Federal-listed threatened piping plover is not necessary for the proposed project. The District will take the necessary protective measures to prevent impacts to both the piping plover and State-listed threatened least tern which will be subject to review with your Long Island Field Office. Please see Enclosure 2 for a draft of the monitoring protocol.

Please advise in writing, as to the feasibility of the proposed subject as soon as possible.

Any questions concerning this matter should be addressed to Mr. Peter Weppler at (212) 264-4663.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Enclosures
cc: Nancy Schlotter, USFWS-LIFO

Enclosure 2

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)

September 22, 1988

Mr. Richard J. Maraldo, P.E.
Acting Chief, Planning Division
New York District, Corps of Engineers
26 Federal Plaza
New York, New York 10278-0090

Dear Mr. Maraldo:

This is in response to your August 23, 1988 request to the Fish and Wildlife Service (Service) for information on the presence of endangered or threatened species within the study area of the Beach Erosion Control Project on Long Beach Island (East Rockaway Inlet to Jones Inlet), Nassau County, New York. The project will consist of the placement of sand along the length of the Island from a point above mean high water into the offshore waters. Dune construction may occur above the intertidal zone and existing groins may be rebuilt in an effort to protect the Island from storm damage and beach erosion.

The piping plover (Charadrius melodus), a federally listed threatened species on the Atlantic Coast, is known to breed at four sites on Long Beach Island: Lido Beach, Nassau Beach, Ocean Beach Club and Silver Point. In 1987, six nests were documented on Long Beach Island by researchers of the Long Island Colonial Waterbird and Piping Plover Survey. Project activities within the area of the plover breeding locations have the potential to adversely affect the species. A biological assessment or further consultation pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531) is required to evaluate any potential adverse effects of project implementation to the plover or its habitat and to determine if formal consultation or a conference is necessary.

In the preparation of an assessment, the following information should be considered for inclusion:

1. the result of a survey of the Island to document most recent areas of plover use;

2. a discussion of any impacts to the plover or its habitat expected to result from project activities, including any changes in vegetation, slope or other habitat characteristics which may impair feeding or nesting activities;

3. an analysis of any cumulative effects expected to result to the plover or its habitat, including indirect effects such as any

anticipated increase in use of the beaches which could result in disturbance to nesting plovers;

4. an analysis of measures available to minimize or avoid impacts to the plover and its habitat such as a time restriction on project activities and establishment of a buffer area around the nesting and feeding araas; and,

5. any other relevant information on the project which may affect the plover or its habitat.

In addition to the federally threatened piping plover, State listed endangered or threatened species may occur within the project location. To determine the presence of these species, the Service recommends that you contact the following offices:

Ms. Kathryn Schnieder
New York Natural Heritage Program
Wildlife Resource Center
Delmar, New York 12054
(518/439-7488)

Mr. Steve Sandford
New York Department of Environmental Conservation
S.U.N.Y. at Stony Brook
Building 40
Stony Brook, New York ,11790
(516/751-7900)

If you have any questions, please contact Lynn Wilson of my staff.

Sincerely,

Clifford G. Day
Supervisor

Enclosure 2

DRAFT MONITORING PLAN PROTOCOL

1. The monitoring plan is designed with three goals:

   a. Identify all critical areas existing before construction.
   b. Identify critical areas that develop during construction.
   c. Ensure that protective measures are avoiding impacts.

A. From April 1 to June 30 (based on two biologist team)

   1. Before construction: Weekly surveys beginning two weeks before any construction related activities (including surveys, site preparation, etc.) begins, to include dusk and dawn periods and, if possible, high and low tides (one overnight stay/week)

   2. During construction: Twice weekly surveys under the conditions described above, as well as one survey each day (pre-dusk/post dawn) during work hours (two overnight stays/week). In addition, daily checks by a Corps inspector of all critical areas identified by a Corps survey team before or during construction.

B. From July 1 to August 15

   1. Before construction: As in A(1) above, except that no further surveys are necessary if critical areas were already identified in late June.

   2. During construction: Weekly checks during work hours only by a single biologist, as well as daily checks of critical areas by the inspector.

2. Assuming critical areas were identified, the following protective measures would have to be undertaken by the contractor to avoid work impacts:

   a. Fence all nesting sites with a 100 foot diameter around each nest with post and string fencing. No activity of any sort will be permitted within the fenced area, and noise generating equipment should not be stored or operated adjacent to that perimeter.

b. No obstacles (equipment, roadways, deep tire ruts, pipes, etc.) shall be placed between the nest site and the shoreline, and traffic in that area (vehicular and foot) shall be reduced to the minimum essential for the accomplishment of a specific task.

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

May 6, 1993

REPLY TO ATTENTION OF

Environmental Assessment Section
Environmental Analysis Branch

Mr. Thomas E. Bigford
National Marine Fisheries Service
Division Chief
Habitat and Protected Resources Division
One Blackburn Drive
Gloucester, MA 01939-2298

Dear Mr. Bigford:

This letter is in response to your March 9, 1993 letter regarding the possible presence of the threatened loggerhead (Caretta caretta) and endangered Kemp's ridley (Lepidochelys kempi), leatherback (Dermochelys coriacea), and green (Chelonia mydas) turtles (Sea Turtles) in the Jones and East Rockaway Inlets and the offshore borrow areas of Long Beach Island, New York project area (Enclosure 1).

The U.S. Army Corps of Engineers, New York District (Corps), agreed to prepare a Biological Assessment on Sea Turtles for Section 934 East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York project area in accordance to Section 7 of the Endangered Species Act (Enclosure 2), which is adjacent to the above referenced project.

The Corps proposes that due to the proximity of the Long Beach project area to the Section 934 project area, information gathered for the Section 934 Biological Assessment can be used to evaluate Section 7 requirements for the Long Beach Island project area. In addition, recent correspondence from your office concerning similar projects (April 12, 1993 re: Atlantic Coast of New Jersey from Sandy Hook to Barnegat Inlet, April 20, 1993 re: Emergency Closure of the Westhampton Breaches) states that one of the listed sea turtles (leatherback) will not be affected by dredging at the offshore borrow sites (Enclosure 3). Therefore, we also propose that a similar approach be used in our Section 7 consultation for the Long Beach Island project.

We request your office's response to these issues by May 28, 1993, so that the appropriate timetable can be scheduled.

Any questions concerning this subject should be addressed to Mr. Peter Weppler or Mr. Howard Ruben at (212) 264-4663.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Enclosure
cc: Beach, NMFS-NE Region
Rusanowsky, NMFS-Milford

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

Northeast Region
Habitat and Protected
Resources Division
One Blackburn Drive
Gloucester, MA 01939-2298

March 9, 1993

Bruce A. Bergmann
Chief, Planning Division
Environmental Assessment Section
Department of the Army
New York District, Corps of Engineers
Jacob K. Javits Federal Building
New York, NY 10278-0090

Dear Mr. Bergmann:

This is in response to your letter to Colleen Coogan, dated December 17, 1992, requesting information on the presence of endangered or threatened species in the Jones and East Rockaway Inlets and the offshore borrow areas of Long Beach Island, New York. Listed species that may be present include the threatened loggerhead (Caretta caretta) and endangered Kemp's ridley (Lepidochelys kempi), leatherback (Dermochelys coriacea), and green (Chelonia mydas) sea turtles. These species occur in New York coastal waters during the summer and early fall months. Steve Morreale, of the Okeanos Foundation, has been conducting research on sea turtles in New York waters and may be able to provide more precise information regarding their presence in the project area. He can be reached at (516) 728-4523.

While it is not clear at this time what the Corps of Engineers' ultimate plan will be to reduce storm damage on the barrier island of Long Beach, I assume that the plan will include dredging and disposal on the beaches, by hopper, hydraulic or pipeline dredges. Because hopper dredges are known to kill sea turtles and shortnose sturgeon, NMFS is concerned about projects using hopper dredges, especially during the summer and fall months in the northeast. In fact, if hopper dredges are to be employed for this project from mid-June through mid-November, we would consider it a 'may affect' situation requiring a formal consultation pursuant to Section 7(a)(2) of the Endangered Species Act of 1973, as amended.

I have enclosed a copy of the ESA regulations which describes the consultation process and the information that should be included in a biological assessment (50 CFR Part 402.12(f)). Please submit to us a preliminary assessment of the potential impacts of the proposed storm damage reduction project upon the threatened and endangered species mentioned above. You may contact Margot Bohan of my staff, at (508) 281-9136, if you have any questions regarding this information.

Sincerely,

Thomas E. Bigford

Thomas E. Bigford
Division Chief

Enclosure

cc: F/PR2 - Williams, Ziobro
F/NEO2 - Rusanowsky
ACOE - Weppler
Okeanos - Morreale

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

January 26, 1993

REPLY TO
Environmental Assessment Section
Environmental Analysis Branch

Mr. Thomas E. Bigford
National Marine Fisheries Service
Division Chief
Habitat and Protected Resources Division
One Blackburn Drive
Gloucester, MA 01939-2298

Dear Mr. Bigford:

This letter is in response to your October 7, 1992 letter regarding the possible presence of the threatened loggerhead (Caretta caretta) and endangered Kemp's ridley (Lepidochelys kempi), leatherback (Dermochelys coriacea), and green (Chelonia mydas) turtles (Sea Turtles) in the Section 934 East Rockaway Inlet to Rockaway Inlet and Jamaica Bay, New York project area. The Corps would like verification of the species list stated in the October 7, 1992 letter. A description of the project is enclosed (Enclosure 1).

The U.S. Army Corps of Engineers, New York District (Corps), agrees to initiate preparation of a Biological Assessment on Sea Turtles for the above referenced project in accordance to Section 7 of the Endangered Species Act. In order to initiate this process, we request a coordination meeting to discuss and schedule the contents of the Biological Assessment. At this time, we would like to know of your time frame for the preparation of a Biological Opinion upon receipt of a completed Biological Assessment.

We wish to have the initial coordination meeting as soon as possible, but no later than February 12, 1993.

Any questions concerning this matter should be addressed to Mr. Peter Weppler at (212) 264-4663.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Enclosures
cc: Rusanowsky NMFS-Milford

PROJECT DESCRIPTION

The project area, commonly known as Rockaway Beach is a Federally authorized beach erosion control and hurricane protection project along the Atlantic Coast of New York City between East Rockaway Inlet and Rockaway Inlet within the Borough of Queens, approximately 22 miles east of the Battery, southern tip of the Borough of Manhattan. The project was authorized by the Flood Control Act of October 27, 1965. The Beach Erosion Control phase was authorized in the Omnibus Bill of March 7, 1974 with the Corps participating in periodic nourishment activities for the first 10 years of the project's 50 year life.

The U.S. Army Corps, New York District (Corps), has been authorized under Section 934 of the Water Resources Development Act of 1986 by New York State (State) to analyze the Federal participation in the extension of the 1974 Beach Erosion Control project.

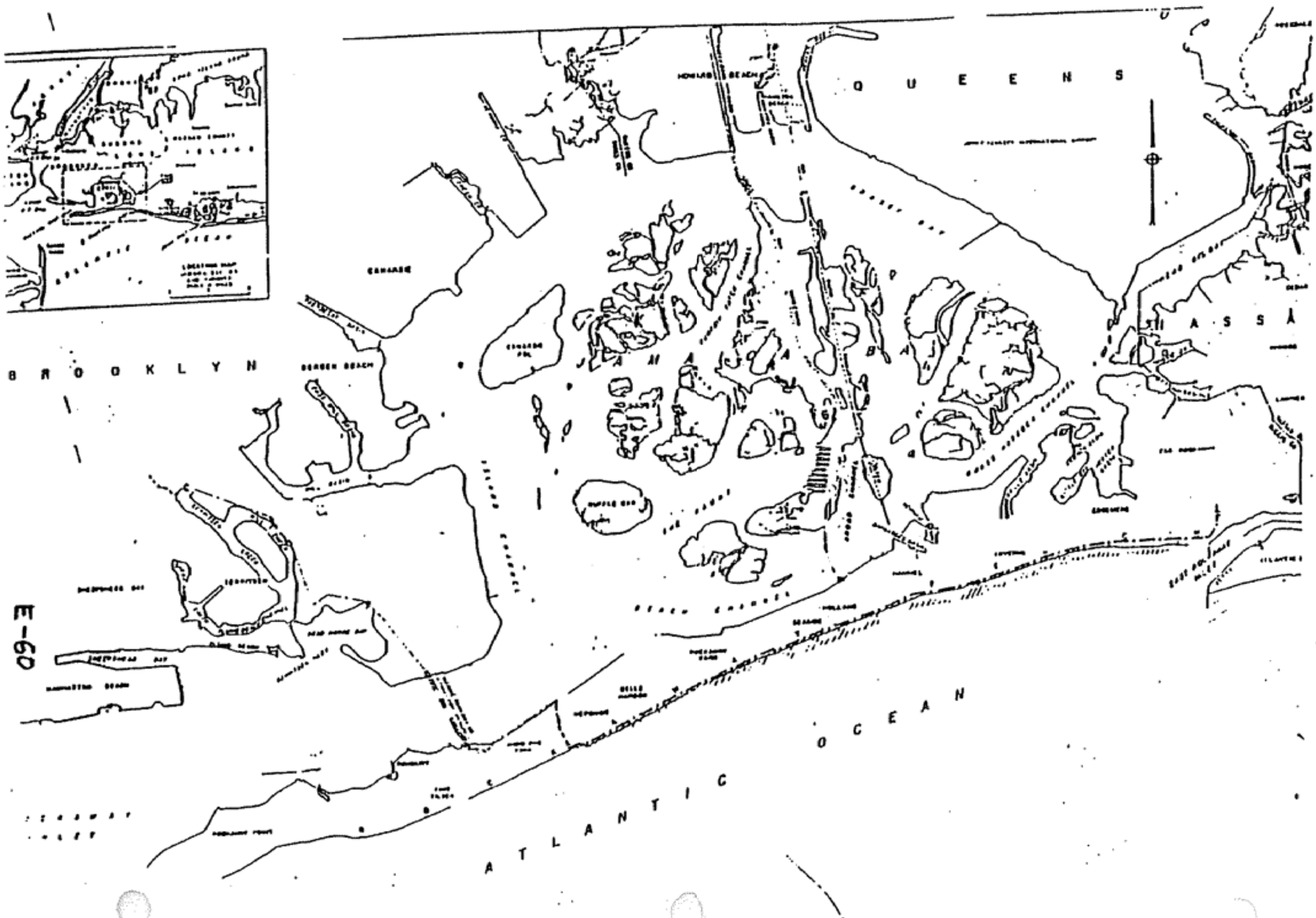
The basic intent of Section 934 of the Water Resources Development Act of 1986 is to participate in beach nourishment for coastal projects for up to 50 years. Any proposed Section 934 project must be economically and environmentally supported.

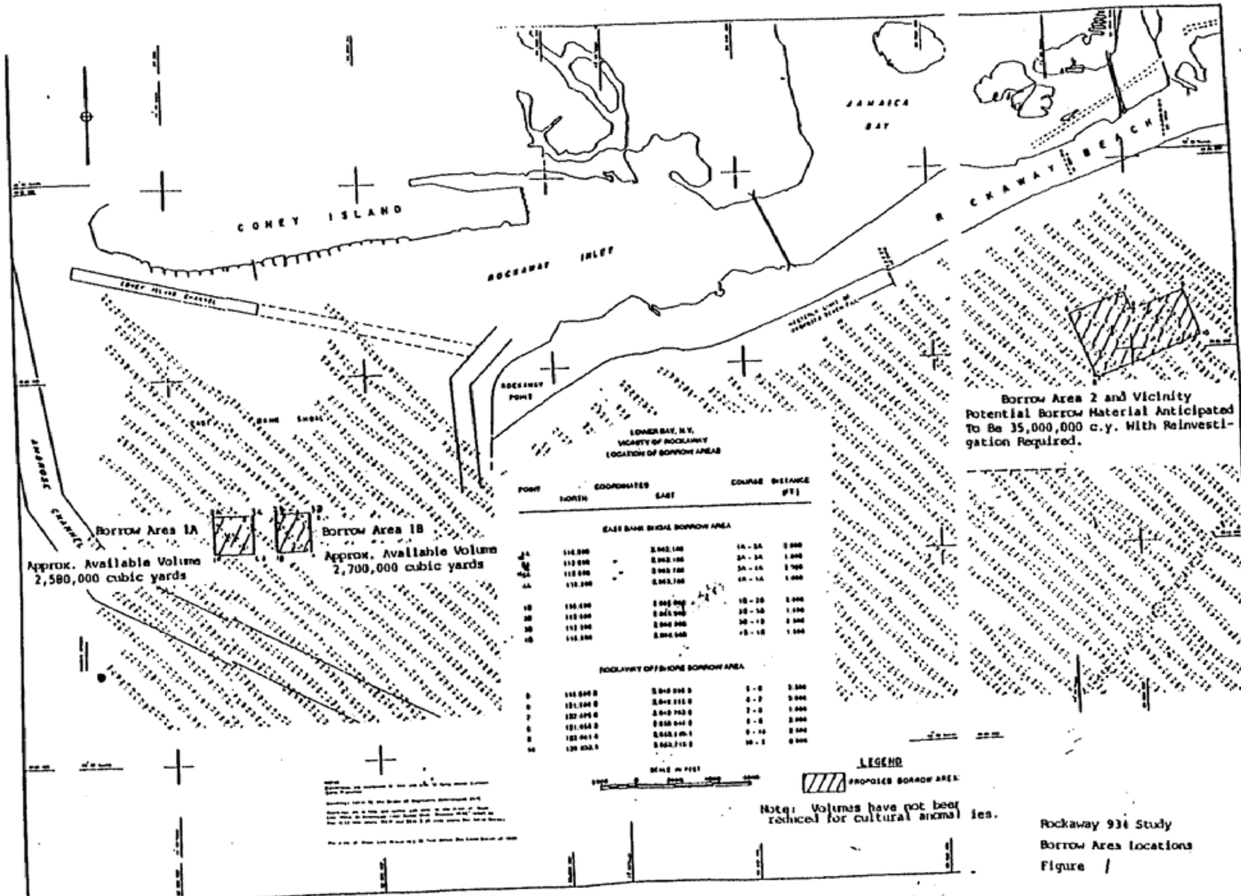
Sand fill taken from the shown borrow areas will be placed onto the area known as Rockaway Beach from Beach 19th Street to Beach 149th Street.

DESCRIPTION OF STUDY AREA

As shown in Figure 1, the study area is located along Atlantic Coast of New York City from East Rockaway Inlet westerly to Rockaway Inlet. Approximately 10 miles in length, it forms a peninsula located entirely within the Borough of Queens. This area is commonly known as the Rockaways. The communities which comprise the Rockaways include from the west to east; Rockaway Point, Roxbury, Neponsit, Belle Harbor, Rockaway Park, Seaside, Hammel, Arverne, Edgemere and Far Rockaway. Fort Tilden and the public Jacob Riis Park are located in the western half of the peninsula.

ENCLOSURE 1





Rockaway 934 Study
Borrow Area Locations
Figure 1

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Region
One Blackburn Drive
Gloucester, MA 01930

APR 12 1993

Bruce A. Bergmann
Chief, Planning Division
Environmental Assessment Section
Department of the Army
New York District, Corps of Engineers
Jacob K. Javits Federal Building
New York, NY 10278-0090

Dear Mr. Bergmann:

This letter is in response to your letter to Thomas Bigford dated March 25, 1993, requesting concurrence on your determination that the proposed beach erosion project along the coast of New Jersey from Sandy Hook to Barnegat Inlet is not likely to adversely affect any endangered or threatened species under the jurisdiction of the National Marine Fisheries Service (NMFS). Listed species that may be present include the threatened loggerhead (Caretta caretta) and endangered Kemp's ridley (Lepidochelys kempi), leatherback (Dermochelys coriacea), and green (Chelonia mydas) sea turtles, as well as the endangered fin (Balaenoptera physalus), humpback (Megaptera novaeangliae), and right (Eubalaena glacialis) whales.

The whales mentioned above feed on pelagic prey (small schooling fish or copepods) and will not be affected by dredge activity at the offshore borrow sites. The leatherback sea turtle also feeds on pelagic prey (jellyfish) that will not be affected by dredge activity at the offshore borrow sites.

The other sea turtle species occur in New Jersey coastal waters during the summer and early fall months and are known to feed on benthic organisms such as crabs. This could place the turtles in the path of fast moving dredge systems such as hopper dredges. Hopper dredges are known to lethally take sea turtles. The information contained in the DEIS did not identify the dredge type to be used.

We can concur with your determination that the beach nourishment project proposed to be conducted along the New Jersey coastline for an 18 month period will be not likely to adversely affect endangered species provided the following conditions are met. If hopper dredges will be employed in the offshore borrow sites between mid-June and mid-November, NMFS-approved observers must be aboard the vessels to monitor the material coming aboard. If evidence of sea turtle entrainment in the dredge-head is observed, further consultation may be required.

We also understand that a pre-dredge survey of the borrow site will be conducted. Should that survey demonstrate that the borrow sites are devoid of the types of benthic prey organisms known to be preferred by sea turtles, consultation should be reinitiated to readdress the need for the conditions mentioned above.

Steve Morreale, of the Okeanos Foundation, has been conducting research on sea turtles in New York waters and may be able to provide more precise information regarding their presence and food preference in the project area. He can be reached at (516) 728-4523. Please contact Margot Bohan of my staff, at (508) 281-9136, if you have any questions regarding this information.

Sincerely,

Richard B. Roe
Regional Director

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northeast Region
One Blackburn Drive
Gloucester, MA 01930

APR 20 1993

Bruce A. Bergmann
Chief, Planning Division
Environmental Assessment Section
Department of the Army
New York District, Corps of Engineers
Jacob K. Javits Federal Building
New York, NY 10278-0090

Dear Mr. Bergmann:

This letter is in response to your letter to Douglas Beach dated March 29, 1993, requesting additional consultation on the proposed emergency plan to close the breaches in the barrier island at Westhampton Beach, Suffolk County, New York. Your letter indicates that the project cannot be completed by May 30, 1993, as originally planned. Listed species that may be present near the borrow areas include the threatened loggerhead (Caretta caretta) and endangered Kemp's ridley (Lepidochelys kempi), leatherback (Dermochelys coriacea), and green (Chelonia mydas) sea turtles, as well as the endangered fin (Balaenoptera physalus), humpback (Megaptera novaeangliae), and right (Eubalaena glacialis) whales.

The whales mentioned above feed on pelagic prey (small schooling fish or copepods) and will not be affected by dredge activity at the offshore borrow sites. The leatherback sea turtle also feeds on pelagic prey (jellyfish) that will not be affected by dredge activity at the offshore borrow sites.

The other sea turtle species occur in New York coastal waters during the summer and early fall months and are known to feed on benthic organisms such as crabs. This could place the turtles in the path of fast moving dredge systems such as hopper dredges. Hopper dredges are known to lethally take sea turtles. The information contained in your original letter did not identify the dredge type to be used.

We can concur with your determination that the emergency breach closure project proposed to be conducted along the Long Island coastline will be not likely to adversely affect endangered species provided the following conditions are met. If hopper dredges will be employed in the offshore borrow sites between mid-June and mid-November, NMFS-approved observers must be aboard the vessels to monitor the material coming aboard. If evidence of sea turtle entrainment in the dredge-head is observed, further consultation may be required.

Should a pre-dredge survey of the borrow site demonstrate that the borrow sites are devoid of the types of benthic prey organisms known to be preferred by sea turtles, consultation should be reinitiated to readdress the need for the conditions mentioned above.

Steve Morreale, of the Center for the Environment, Cornell University, has been conducting research on sea turtles in New York waters and may be able to provide more precise information regarding their presence and food preference in the project area. He can be reached at (607) 255-1216. Please contact Margot Bohan of my staff, at (508) 281-9136, if you have any questions regarding this information.

Sincerely,

Richard B. Roe
Regional Director

cc: F/PR2 - Williams, Ziobro
F/NEO2 - Gorski
ACOE - NY - Mark Burlas
Peter Wepler
Okeanos - Morreale

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, New York 13045

March 17, 1993

Mr. Bruce A. Bergmann
Chief, Planning Division
U.S. Army Corps of Engineers
26 Federal Plaza
New York, NY 10278

Dear Mr. Bergmann:

This is in response to your letter of February 25, 1993, regarding your request for the U.S. Fish and Wildlife Service (Service) to prepare a Fish and Wildlife Coordination Act (FWCA) report for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York. This request has been made pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). In addition, your office has submitted a Scope of Work (SOW) in regard to this proposed project. You have specifically asked the Service to advise your office, in writing, of the feasibility of the proposed subject as soon as possible.

The New York District has requested the Service to prepare "a detailed report on the effects and/or environmental benefits of the proposed actions to be included in the Draft Environmental Impact Statement for the project". According to the SOW, the Corps submitted a detailed description of the recommended plan to the Service on February 24, 1993. At a February 10, 1993, informal meeting held between Bob Murray, of my staff, and Peter Weppler, of your staff, Mr. Murray received a working draft blueprint of the Worst Case Alternative and the "Detailed Investigation of Borrow Areas" report which identified and investigated borrow sources. These documents have only limited usefulness and are insufficient for the Service to initiate its evaluation of the project.

The Service requires workable maps and diagrams, such as 8.5" x 11" maps and figures similar to those that have been provided to the Service with previous requests for FWCA reports. Appropriate cross sectional diagrams indicating the beach nourishment and the dune system finished elevations, along with a precise location of the borrow area and the beach nourishment/groin rehabilitation areas on a plan view map are valuable. A narrative interpretation of such diagrams and a narrative description of the entire project is also required, including a discussion on the beach nourishment and dredging aspects of the project, the proposed dune system, the proposed rehabilitation of 30 groins, and the reconstruction of the terminal groin at the eastern end of the island. Also, the project history should be discussed.

If an Environmental Assessment: Section 933 Evaluation Report has been prepared for the project (as was done by the Corps and submitted with their request for a Draft FWCA Report for the Atlantic Coast of New York City East Rockaway Inlet to Rockaway Inlet project), the Service requests a copy. If such a document has not been prepared, the Service requests that a narrative and working diagrammatic project description be submitted. In addition, the Service requests a copy of the "Long Beach Island, New York, Reconnaissance Report" that was prepared in July 1989.

In the Planning Aid Report (PAR) for Long Beach Island, which was prepared by the Service in January, 1989, the Service identified specific information that "would be necessary for detailed impact assessment and completion of the Fish and Wildlife Coordination Act Report." The Service has not received this detailed information nor any indication from the Corps that such information data gaps are being addressed. Preliminary mitigation measures as discussed in the PAR, including preliminary mitigation measures for the Piping Plover (*Charadrius melodus*), Federally listed as a threatened species, have also not been addressed. The Corps status regarding all of the Preliminary Mitigation Measures at this point in time is unknown.

A SOW starting date can only be initiated upon the receipt of sufficient and detailed information describing the recommended plan. As of February 24, 1993, the Service has not received such detailed information and therefore does not consider this date as the starting point. The Service is anticipating the receipt of a sufficiently detailed narrative and diagrammatic project description. Subsequently, in order to keep the process moving forward, the Service has enclosed a Revised Scope of Work for your review and consideration. Should you have any questions concerning this matter, please contact Bob Murray, of my Long Island Field Office at (516) 581-2941.

Sincerely,

Nancy J. Schlotter

Acting for Leonard P. Corin
Field Supervisor

Enclosure

REVISED SCOPE OF WORK
FISCAL YEAR 1993

U.S. FISH AND WILDLIFE SERVICE/U.S. ARMY CORPS OF ENGINEERS
ATLANTIC COAST OF LONG ISLAND, JONES INLET TO EAST ROCKAWAY INLET, LONG BEACH ISLAND, NEW YORK,

SUBJECT: Revised Scope of Work for the U.S. Fish and Wildlife Service (Service) and the New York District Corps of Engineers (Corps) for the Fiscal Year 1993.

PROJECT NAME: Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York, Storm Damage Reduction Project.

CORPS DISTRICT AND CONTACT: New York District - 26 Federal Plaza New York, New York 10278-0900.

Project Manager:	Clifford Jones	(212) 264-9077
Project Biologist:	Peter Weppler	(212) 264-4663

SERVICE OFFICE AND CONTACT: Long Island Field Office - P.O. Box 608, Islip, New York 11751.

Field Supervisor:	Nancy Schlotter	(516) 581-2941
Project Biologist:	Robert Murray	(516) 581-2941

DESCRIPTION OF STUDY: To analyze Federal participation of proposed measures for storm damage reduction.

STATUS OF STUDY:

SCHEDULE OF MILESTONES OF STUDY ACTIVITIES:

(M1)	Corps provides detailed description of recommended plan	April 5, 1993
(M2)	Service submits Draft FWCA Report to Corps, NYSDEC-F&W, NMFS and EPA	June 23, 1993 **(contingent upon receipt of detailed project information by April 5)**
(M3)	Corps forwards comments on Draft FWCA Report to Service	July 8, 1993
(M4)	Service submits final FWCA Report	July 23, 1993 **(or 15 days from receipt of all Agency's comments and NYSDEC concurrence)**

* All dates contingent upon timely receipt for earlier milestones.

DATA AND INFORMATION NEEDED:

(1) Description of fish and wildlife resources and uses (within the placement area and borrow area) with and without implementation of the recommended plan.
(2) Recommendations for mitigation (i.e. impact avoidance/ minimization/compensation).
(3) Identification of enhancement opportunities.
(4) Cost estimates for proposed mitigation and enhancement measures.

SPECIFIC SERVICE WORK COMPLETED: Input to Reconnaissance Report and Planning Aid Report (PAR) for the Atlantic Coast of Long Island, East Rockaway Inlet to Jones Inlet (Long Beach Island) Study, January 20, 1989.

FUNDS EXPENDED TO DATE: Approximately $7-10K

SPECIFIC SERVICE WORK TO BE ACCOMPLISHED:

(1) Evaluate impacts of proposed recommended plan to fish and wildlife resources in the project area.
(2) Identify mitigation needs, opportunities for enhancement and any additional study needs. Provide estimated costs for any proposals.
(3) Provide names and qualifications of report preparers.
(4) Request concurrence on the FWCA Report from the New York State Department of Environmental Conservation's Division of Fish and Wildlife (NYSDEC-F&W).

DETAIL AND EFFORT REQUIRED:

(1) Evaluate fish and wildlife resources and uses (within placement and borrow areas) with and without project, based on currently available information.
(2) Provide recommendations for mitigation and enhancement.
(3) Provide draft FWCA Report.
(4) Request concurrence on draft report from NYSDEC-F&W.
(5) Review Corps and NYSDEC-F&W comments to draft report and provide FWCA Report.

CORPS INPUT TO SERVICE:

(1) Detailed description of recommended plan	April 5, 1993
(2) Comments to draft FWCA	July 8, 1993

SERVICE DOCUMENTS EXPECTED:

(1) Draft FWCA Report	June 23, 1993 (contingent upon receipt of detailed project information by April 5)

(2) Final FWCA Report	July 23, 1993 **(or 15 days from receipt of all Agency's comments and NYSDEC concurrence)**

* All dates contingent upon timely receipt for earlier milestones.

REPORT FORMAT: As previously developed

SERVICE EFFORT AND COSTS:		Staff Days
Coordination meeting		2
Preparation of draft FWCA Report		12
Preparation of final FWCA Report		7
	Total	21

Cost: 21 staff days at $400/day		$ 8,400.00
38% overhead		3,192.00
	Total	$11,592.00

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

January 6, 1993

Environmental Analysis Branch
Environmental Assessment Section

Mr. Mark Friese
Hydrographic Survey
National Ocean Survey
6001 Executive Boulevard
Rockville, Maryland 20852

Dear Mr. Friese,

The Corps of Engineers, New York District is currently studying the feasibility of a beach nourishment and protection plan for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York. In order to complete our responsibilities under Section 106 of the National Historic Preservation Act, we are compiling an inventory of shipwrecks and other cultural properties within the proposed sand borrow area. We would greatly appreciate a copy of the Automated Wreck and Obstruction Information System (AWOIS) for the area defined by the Long Island Lambert system coordinates provided below. We will provide your office with any new information concerning wrecks and obstructions resulting from our research. The study area coordinates are as follows:

NW corner	N128,000	E2,095,000	NE corner	N128,000	E2,115,000
SW corner	N122,000	E2,095,000	SE corner	N122,000	E2,115,000

If you or your staff have any questions or require additional information, please contact Nancy Brighton (212)264-4663. Thank you for your assistance.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

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

December 17, 1992

REPLY TO ATTENTION OF

Environmental Assessment Section
Environmental Analysis Branch

Ms. Colleen Coogan
National Marine Fisheries Service
Northeast Region
Habitat and Protected Resources Division
One Blackburn Drive
Gloucester, MA 01939-2298

Dear Ms. Coogan:

The U.S. Army Corps, New York District, has been authorized by the Committee on Public Works and Transportation of the House of Representatives in October 1986 to participate in the storm damage reduction project for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York. This project is necessary due to continual erosion leading to a decrease in the width of beach and a loss of beach material during severe storms and hurricanes.

Long Beach Island, New York, a barrier island, is located on the Atlantic Coast of Long Island, between Jones Inlet and East Rockaway Inlet. The project study area lies within Nassau County, New York and is encompassed by the communities of Point Lookout, Lido Beach, the City of Long Beach and the Village of Atlantic Beach. All unincorporated areas are under the jurisdiction of the Town of Hempstead. The study area is bounded on the east by Jones Inlet, on the south by the Atlantic Ocean, on the west by East Rockaway Inlet, and on the north by Reynolds Channel (Figure 1). A reconnaissance study was completed in 1989, which identified the Federal interest of storm damage reduction on the barrier island of Long Beach. A feasibility study is currently underway, which will result in an optimum plan to reduce storm damages in this area. It is likely that this plan will be a beachfill plan which would be periodically nourished. Proposed sand sources would be from offshore borrow areas (Figure 2). In addition to beach fill, the plan includes rehabilitation of thirty (30) groins/jetties and the reconstruction of the terminal groin at Point Lookout.

Pursuant to Section 7 of the Endangered Species Act of

1973, as amended, the New York District requests information on the presence of endangered or threatened species in Jones and East Rockaway Inlets as well as the marked borrow areas.

Any questions concerning this matter should be addressed to Mr. Peter Weppler at (212) 264-4663.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Enclosures
cc: Diane Rusanowsky, NMFS-Milford

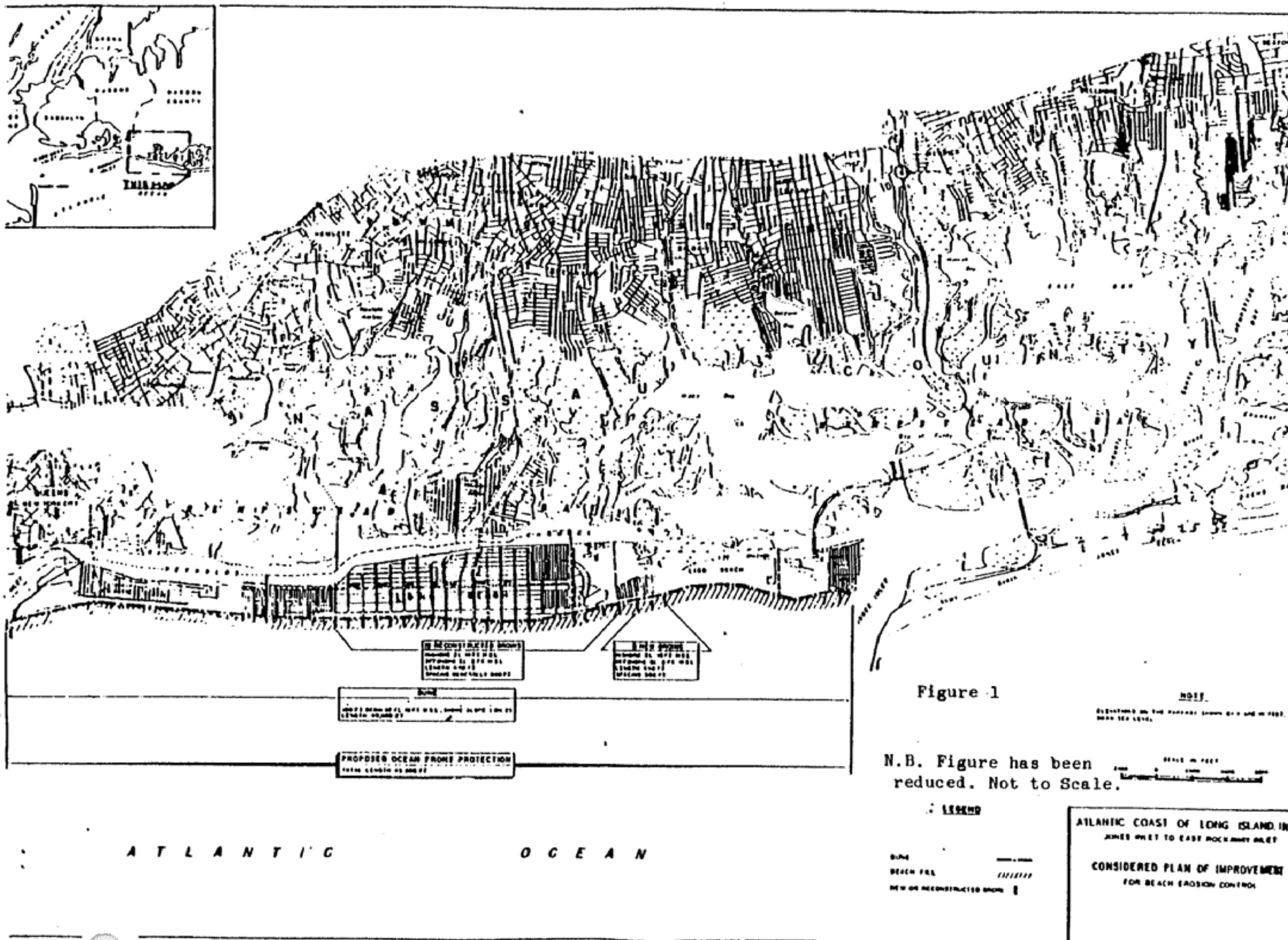


Figure 1

N.B. Figure has been reduced. Not to Scale.

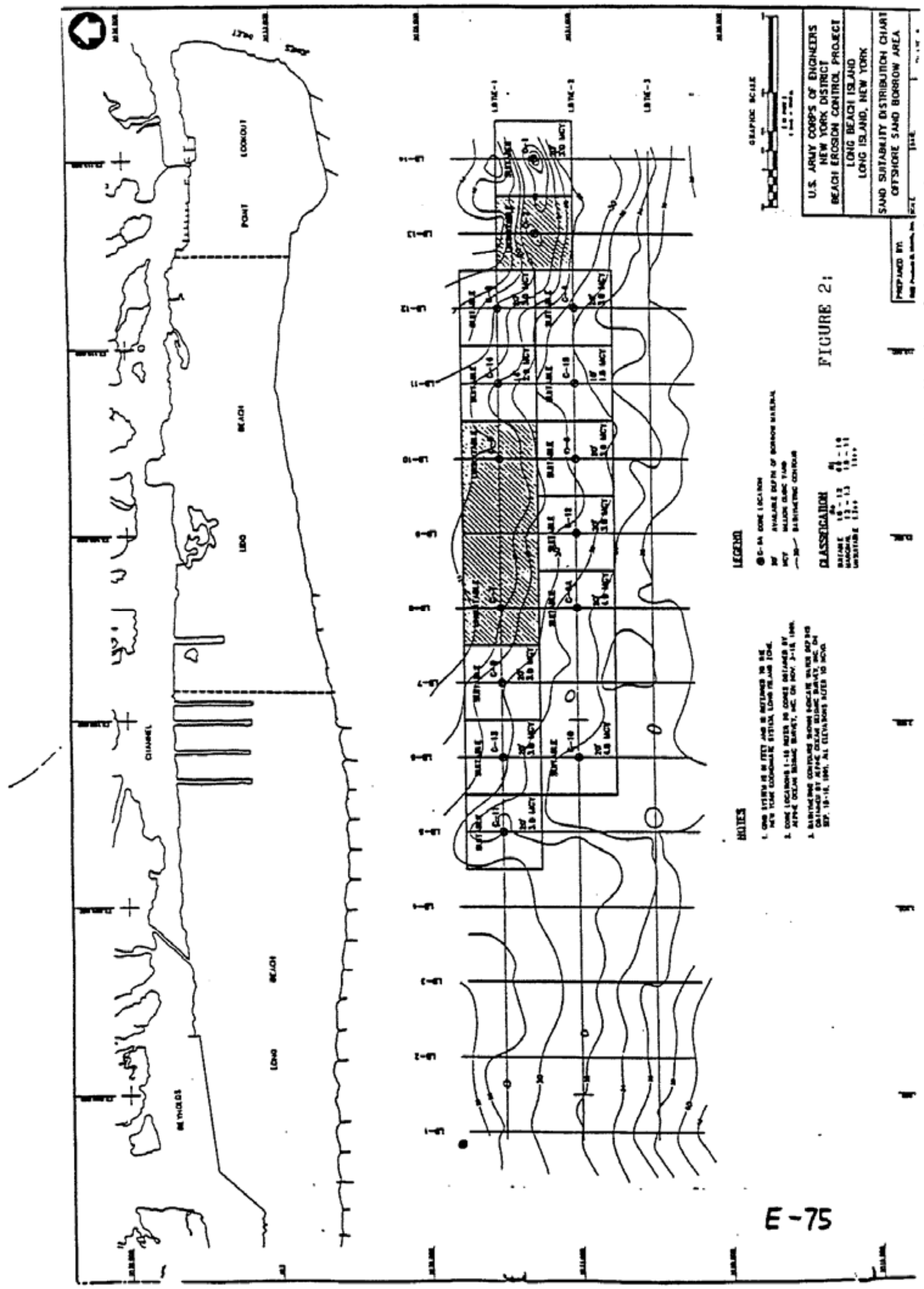


FIGURE 2:

N.B. Map has been reduced; not to scale.

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

December 17, 1992

REPLY TO
Environmental Assessment Section
Environmental Analysis Branch

Mr. Steve Hendrickson
New York Department of
Environmental Conservation
SUNY Campus
Loop Road Building 40
Stony Brook, New York 11790-2356

Dear Mr. Hendrickson:

The U.S. Army Corps, New York District, has been authorized by the Committee on Public Works and Transportation of the House of Representatives in October 1986 to participate in the storm damage reduction project for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York. This project is necessary due to continual erosion leading to a decrease in the width of beach and a loss of beach material during severe storms and hurricanes.

Long Beach Island, New York, a barrier island, is located on the Atlantic Coast of Long Island, between Jones Inlet and East Rockaway Inlet. The project study area lies within Nassau County, New York and is encompassed by the communities of Point Lookout, Lido Beach, the City of Long Beach and the Village of Atlantic Beach. All unincorporated areas are under the jurisdiction of the Town of Hempstead. The study area is bounded on the east by Jones Inlet, on the south by the Atlantic Ocean, on the west by East Rockaway Inlet, and on the north by Reynolds Channel (Figure 1). A reconnaissance study was completed in 1989, which identified the Federal interest of storm damage reduction on the barrier island of Long Beach. A feasibility study is currently underway, which will result in an optimum plan to reduce storm damages in this area. It is likely that this plan will be a beachfill plan which would be periodically nourished. Proposed sand sources would be from offshore borrow areas (Figure 2). In addition to beach fill, the plan includes rehabilitation of thirty (30) groins/jetties and the reconstruction of the terminal groin at Point Lookout.

The New York District requests information on the presence of any known commercial and/or recreational presence of any known commercial and/or recreational shellfishing areas in the project area.

Any questions concerning this matter should be addressed to Mr. Peter Weppler at (212) 264-4663.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

Enclosures

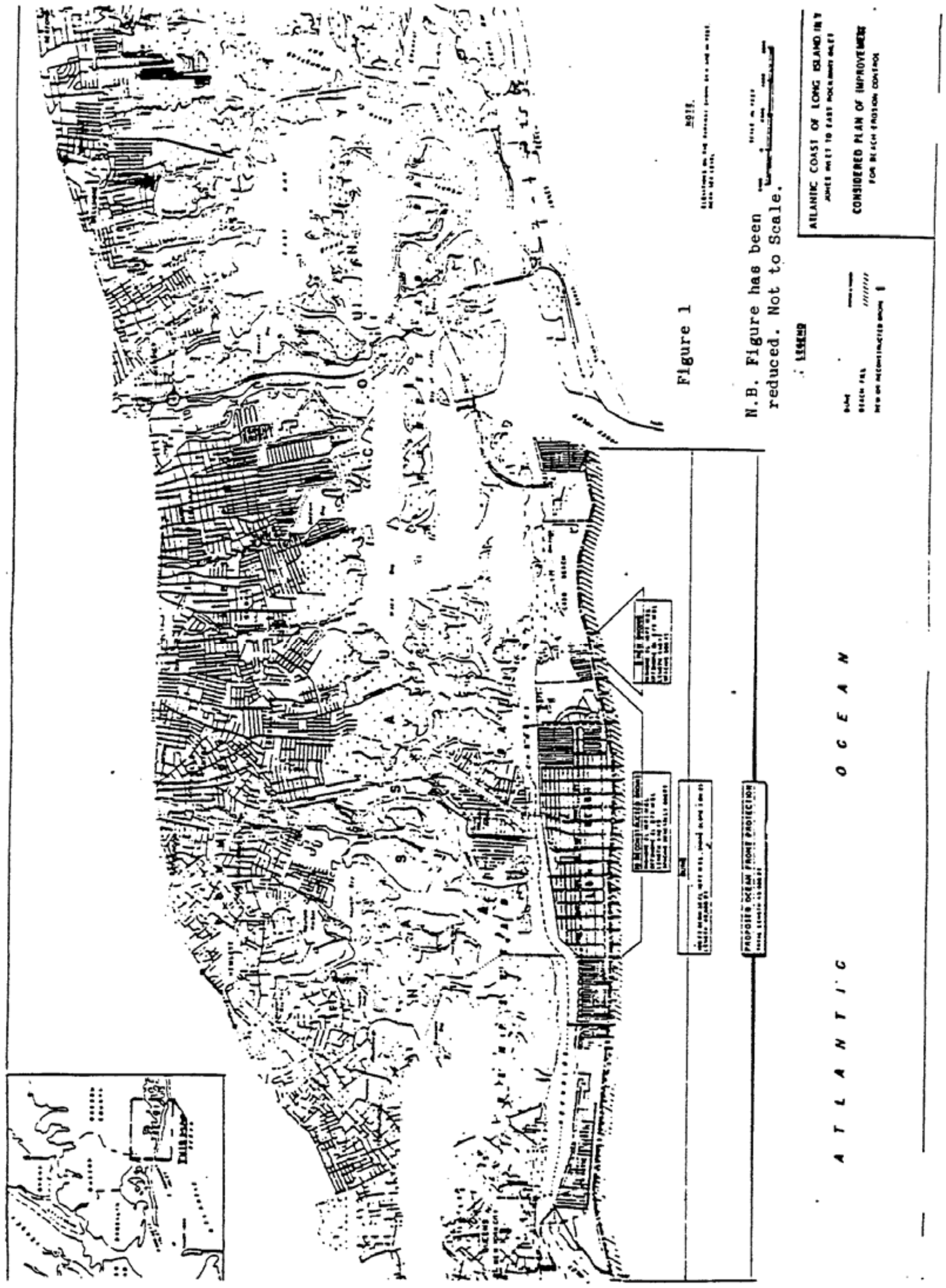
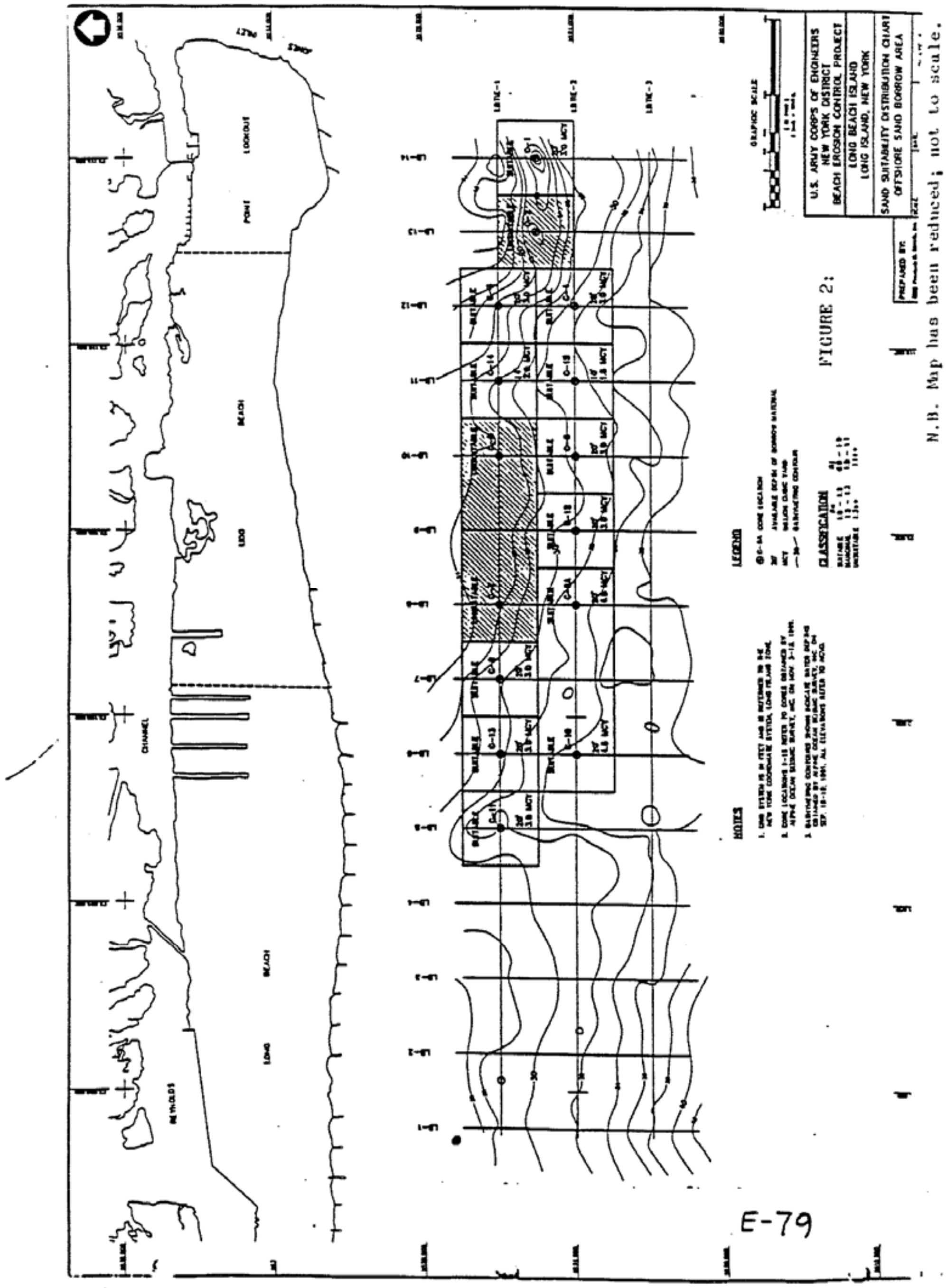


Figure 1
N.B. Figure has been reduced. Not to Scale.
LEGEND
ATLANTIC COAST OF LONG ISLAND N.Y.
CONSIDERED PLAN OF IMPROVEMENT
FOR BEACH EROSION CONTROL
PROPOSED OCEAN FRONT PROTECTION
ATLANTIC OCEAN

E-78


U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT
BEACH EROSION CONTROL PROJECT
LONG BEACH ISLAND
LONG ISLAND, NEW YORK
SAND SUITABILITY DISTRIBUTION CHART
OFFSHORE SAND BORROW AREA
FIGURE 2:
N.B. Map has been reduced; not to scale.
E-79

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

December 17, 1992

REPLY TO
ATTENTION OF

Environmental Assessment Section
Environmental Analysis Branch

Mr. John Blevins
National Marines Fisheries Service
Data Management Unit
NFSC, Woods Hole Laboratory
166 Water Street
Woods Hole, MA 02543

Dear Mr. Blevins:

The U.S. Army Corps, New York District, is in the planning stage for the proposed storm damage reduction project for the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York.

The New York District requests the following information on the concerning shellfish and finfish:

1. The project area is the Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York (NE Statistical Area 612).

2. By species, the pounds and dollar values of shellfish and finfish caught and landed from 1990 to present for the above referenced area.

Any questions concerning this matter should be addressed to Mr. Peter Weppler at (212) 264-4663. Thank you for your assistance and cooperation.

Sincerely,

Bruce A. Bergmann
Chief, Planning Division

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Thomas C. Jorling
Commissioner

September 24, 1992

Mr. Bruce Bergmann
Chief, Planning Division
U.S. Department of the Army
New York District Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

Dear Mr. Bergmann:

We are responding to your July 31, 1992 letter concerning the Long Beach Island feasibility study. We have reviewed the options that you presented regarding the possibility of combining the feasibility study and preparation of the general design memorandum. While the proposal certainly has some appeal the added cost and the timing of this effort in our annual budget cycle make it impractical at this time. We would have to seek legislative authorization for this proposal and the earliest we could get that authorization would be April 1, 1994. The information presented in your letter reveals that the combined process could save as much as 17 months. However, the State's inability to get immediate authorization would reduce the time savings, perhaps to a little as a few months.

Thank you for bringing this possibility to our attention.

Sincerely,

James Kelley

James F. Kelley
Director
Bureau of Flood Protection

RGR:tc

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

July 31, 1992

Planning Division
Ocean and Estuary Section

Mr. James F. Kelley
Director, Flood Protection Bureau
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, NY 12233

Dear Mr. Kelley:

The cost-shared feasibility study of Long Beach Island, NY is currently underway as scheduled. My staff has been looking at different ways to reduce the time it may take to get this study to construction. In doing so, we have looked at combining the ongoing Feasibility Study with the subsequent phase (preparation of a General Design Memorandum). A GDM for this size of study has typically taken approximately three years to complete with an associated cost of $3,500,000. However, the effort required for the GDM process is contingent upon the findings of the feasibility study. The estimates of time and cost for the GDM are based solely on our previous experience with similar studies, and are subject to change.

I have attached a table which lays out the estimated costs for a combined Feasibility/Design study. Please note that any additional costs for a combined study must be cost-shared similar to the feasibility study, as opposed to the cost sharing of a traditional GDM which would be cost-shared at the same time and apportionment as initial project construction.

Also attached is a timeline of each of the study scenarios. These timelines show the approximate savings of a combined study. As you can see on these attachments, the estimated cost increase for the combined study over the ongoing Feasibility study is $1,630,000 for a savings of approximately 17 months. Justifications for increases of study activities are provided on the attachment.

Similarly, estimates for a modified Feasibility study were considered (also provided on the attachments). This modified study would enable us to conduct only the major or time consuming activities required for the GDM, so that only a "limited GDM" effort would be required upon completion of the Feasibility study. The increase in this scenario would be $880,000 for a savings of approximately 15 months.

I realize that it is difficult for the State to increase funds for a study that cannot guarantee a project; however, I am certain that you understand the value of reducing the amount of time to get the study to construction. Having said that, I will let you peruse the package and decide for yourself the appropriate action to take.

Please note that the feasibility study for Long Beach Island, NY is proceeding as scheduled. In August 1992, the study team here at the District is scheduled to meet with our Division counterparts to discuss the work completed to date. Upon completion of this meeting, I would like to sit down with you and/or our representative staffs and discuss the same. The project manager, Clifford Jones, will be in contact with your office to arrange a date. As a reminder, I'll mention that on or before October 1, 1992, we shall expect non-Federal funds in the amount of $220,000 in order to continue with this study as scheduled.

If you have any questions or comments regarding this matter, please call me or Mr. Clifford Jones at 212-264-9077. In the meantime, I will await your decision.

Sincerely,

Joseph Vietri

Bruce A. Bergmann
Chief, Planning Division

Attachments

LONG BEACH ISLAND, NEW YORK

'91	'92	'93	'94	'95	'96	'97	'98	'99	'00

CURRENT SCHEDULE (FEASIBILITY STUDY)

•5/91	•5/95	•5/98	•10/99
•FEASIBILITY STUDY	•DESIGN MEMORANDUM	•P & S (1)	•CONSTRUCTION
•$1,470,000	•$3,500,000 (2)		•

ALTERNATIVE COMBINED FEASIBILITY/DESIGN STUDY (3)

•5/91	•5/96	•5/98
•FEASIBILITY STUDY	•P & S	•CONSTRUCTION
•$3,100,000	•400,000	•

ALTERNATIVE MODIFIED FEASIBILITY STUDY (3)

•5/91	•9/95	•2/97	•7/98
•FEASIBILITY STUDY	•DESIGN MEMO	•P&S	•CONSTRUCTION
•$2,350,000	•$2,000,000		•

NOTES

(1) PLANS & SPECIFICATIONS: INCLUDES TIME FOR BIDABILITY, CONSTRUCTABILITY, OPERABILITY (BCO); ALSO ADVERTISEMENT, BID & AWARD (GENERALLY 6 MONTHS).

(2) COST SHOWN IS PRECONSTRUCTION, ENGINEERING & DESIGN (PED) EFFORT AS PRESENTLY ESTIMATED; INCLUDES DESIGN MEMO AND P&S

(3) ALL TIME AND COST ESTIMATES SHOWN OTHER THAN THE ONGOING FEASIBILITY STUDY ARE APPROXIMATE. AND ASSUME CONTINUOUS FUNDING THOUGHOUT THE STUDY SCHEDULES; THESE WILL BE REFINED UPON COMPLETION OF THE FEASIBILITY STUDY.

CULTURAL				
Cultural Input	27.0	60.0	60.0	*Includes Cultural Resources contract, reviews, coordination, revisions and input to report; slightly higher for modified studies.
Remote Sensing	0.0	100.0	100.0	*Remote Sensing to ID potential wrecks required for both studies.
Underwater Invest.	0.0	100.0	0.0	*Underwater Investigation can be delayed until DM. *Estimates based on recent experience (i.e. Sea Bright)
TOTAL CULTURAL	27.0	260.0	160.0	
REAL ESTATE				
LCA	15.0	25.0	20.0	*New activities added per recent guidance requirements from regarding all design studies.
Real Estate Supplement	0.0	25.0	25.0	
Gross Value Appraisal	0.0	30.0	30.0	
TOTAL REAL ESTATE	15.0	50.0	45.0	
ECONOMICS				
Economics	361.0	361.0	361.0	*No change
STUDY MANAGEMENT				
FY91–FY95	400.0	500.0	500.0	*Management effort increased for one added year of study.
ESCALATION/CONTINGENCY				
FY92–FY95	54.0	355.0	265.0	
TOTAL	1470.0	3100.0	2350.0	

LONG BEACH ISLAND, NEW YORK

Below is a listing of the major activities that are added or affected by changing the scope of the feasibility study to include a Design Memorandum (DM) or modify the feasibility study to only require a limited DM. The affect on the schedule of each of these scenarios is provided as a separate enclosure.

ACTIVITY	CURRENT FEASIBILITY	COMBINED FEAS/DM	MODIFIED FEAS/ LIMITED DM	COMMENTS
COASTAL ENGINEERING				
Topographic Mapping	104.0	215.0	128.5	*1:100 scale mapping required for DM but not for Feasibility; $128.5 reflects actual cost of mapping (complete).
Beach Surveys	0.0	212.0	0.0	*no new surveys scheduled for Feasibility; will use available data; surveys will be required for DM.
Borrow Area Invest.	123.0	230.0	155.0	*$15 based on actual cost (complete); DM will require additional coring to detail and confirm area data.
Beach Erosion Modelling	50.0	235.0	120.0	*Primary advantage of modifying study is to incorporate both S-BEACH and GENESIS modelling into study to save time. Estimates are based on recently negotiated costs with CERC.
Coastal Analysis	136.0	195.0	195.5	*The remaining coastal effort is basically the same; additional funds necessary for Engineering involvement, milestone reports and monitoring program have been added.
Quantities & Costs	70.0	83.0	83.0	
TOTAL COASTAL	483.0	1170.0	682.0	
ENVIRONMENTAL				
DEIS	21.0	72.0	56.0	*Estimates are based on recent similar studies.
Planning Aid Letter	12.0	18.0	12.0	*DM must include a comprehensive evaluation of all environmental concerns; feasibility study was based on the premise of conducting subsequent GDM to include a thorough environmental reevaluation.
Benthic Studies	35.0	82.0	82.0	*Since this is the only document that will receive public comment, preparation, coordination and review have been increased.
Field collection/survey	2.0	62.0	62.0	
Finalize EIS	25.0	60.0	60.0	
Other Env. Tasks	35.0	80.0	35.0	
TOTA[illegible] [illegible]VIRONMENTAL	130.0	374.0	307.0	

City of Long Beach
KENNEDY PLAZA
LONG BEACH, NEW YORK 11561
(516) 431-1000
FAX: (516) 431-1389

EDWIN L. EATON
CITY MANAGER

September 23, 1992

Mr. Clifford S. Jones
New York District Corps of Engineers
New York District Plaza
New York, New York 10278-0090

Re: Envirofest

Dear Mr. Jones:

We would like to take this opportunity to thank you for your attendance at our Envirofest celebration that took place on Sunday, September 13, 1992.

In our approach to this event, we knew that the success or failure of the festival would depend upon the dedication, credibility, and knowledge of the exhibitors that attended. Thanks to your contributions our Envirofest celebration was indeed a success.

Since Envirofest was received so enthusiastically by the public, the City is hoping to make this an annual end of the summer occurrence.

We look forward to seeing you next year.

Sincerely yours,

Edwin L. Eaton
City Manager

City of Long Beach
KENNEDY PLAZA
LONG BEACH, NEW YORK 11561
(516) 431-1000
FAX: (516) 431-1389

EDWIN L. EATON
CITY MANAGER

July 15, 1992

Mr. Clifford Jones
Project Manager
U.S. Army Core of Engineers
New York District Plaza
New York, New York 10278-0090

Re: Envirofest 1992

Dear Mr. Jones:

We would be honored to have a representative of your agency participate in our Envirofest 1992 celebration scheduled for Sunday, September 13 1992. We would greatly appreciate if you and/or your consultants could set up an exhibit apprising the public of the current beach erosion study your organization is performing.

The purpose of the Envirofest celebration is to educate the public on various environmental issues i.e, recycling, beach erosion, sludge, quality of drinking water, quality of ocean water, energy conservation etc.

We realize that the event is less than two months away and apologize for the short notification. However, we feel that your input would add greatly to the overall success of the event. Therefore, given the time constraints involved, we would appreciate a response as soon as possible.

If you plan to attend, please contact Joseph Febrizio Jr. at 431-1000 Ext. 215.

We look forward to hearing from you.

Sincerely yours,

Edwin L. Eaton
City Manager

jf/ELE

COUNTY OF NASSAU

Inter-Departmental Memo

To: Dave Vieser

From: Francis A. Cosgrove
Senior Deputy Commissioner

Date: October 7, 1991

Subject: PRESS CONFERENCE
BEACH EROSION PROJECT

Attached is the most current list of elected officials, agency officials, and interested citizens, who should be invited to attend the Press Conference scheduled for:

Date: Tuesday, October 15, 1991
Time: 11:00 a.m.
Place: Nassau Beach, East Terrace Ballroom
Lido, New York
516 889-5661

The names have been provided by the contact persons indicated; however, there is likely to be changes which I will advise you on as soon as I know.

The program format is being developed primarily by the Corps of Engineers who will provide the briefing on the scope and importance of this project.

Relative to the media invitations and the proper protocol for our attendees, you will have to guide us on how best to incorporate their participation in the program

I expect to have the Corps' draft by Monday, October 7, and will advise you as soon as I receive it.

Bud Cosgrove

Francis A. Cosgrove
Senior Deputy Commissioner

cc:
John B. Kiernan
Frank Ryan
Ed Hillman
Tony Panzarella
Ruth Balkin
Ed Eaton
Ramon Rakoczy
Cliff Jones

NASSAU COUNTY STATE OF NEW YORK

FAC/jld

E-89

NC 5040, Rev. 1/8

1. Colonel Ralph Danielson
District Engineer, N.Y. District
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

2. Mr. Bruce Bergmann
Chief, Planning Division
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

3. Mr. Joseph Vietri
Assistant Chief, Planning Division
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

4. Mr. Thomas Cramer
Department District Engineer
Project Management
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

5. Mr. Thomas Pfeifer
Chief, Ocean and Estuary Section
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

6. Mr. Cliff Jones
Project Manager
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

7. Mr. Peter Shugert
Public Affairs Office
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

8. Ms. Roselle Henn
Environmentalist
U. S. Army Corps of Engineers
Jacob K. Javits Federal Building
New York, New York 10278-0090

City of Long Beach

1. Mr. Kevin Braddish, President
c/o City Hall
Long Beach, New York

2. Mr. Michael G. Zapson, Councilman
c/o City Hall
Long Beach, New York

3. Ms. Pearl Weill, Councilwoman
c/o City Hall
Long Beach, New York

4. Mr. Edmund Buscemi, Councilman
c/o City Hall
Long Beach, New York

5. Mr. Edwin Eaton, City Manager
c/o City Hall
Long Beach, New York

Note:
Mr. Ed Eaton is the contact person for the City of Long Beach.
(516 431-1000, ext. 201)

New York State Department of Environmental Conservation

1. Mr. Thomas Jorling, Commissioner
N.Y.S. DEC
51 Wolf Road
Albany, New York 12233-3507

2. Mr. Langdon Marsh
Deputy Commissioner
N.Y.S. DEC
51 Wolf Road
Albany, New York 12233-3507

3. Mr. James F. Kelley
Bureau Director
Flood Protection
N.Y.S. DEC
51 Wolf Road
Albany, New York 12233-3507

4. Mr. William W. Daley
Chief, Coastal Erosion
Management Section
N.Y.S. DEC
51 Wolf Road
Albany, New York 12233-3507

5. Mr. Ramon Rakoczy
Senior Coastal Engineer
N.Y.S. DEC
51 Wolf Road
Albany, New York 12233-3507

6. Mr. Raymond Cowen
Long Island Regional Director
N.Y.S. DEC
SUNY, Stonybrook
Bldg. 40
Loop Road
Stonybrook, New York 11790-2356

Note:
The N.Y.S. DEC contact person is Ramon Rakoczy (518 457-3158)

Elected Federal/State Officials

Senators D'Amato and Moynihan
Congressmen, McGrath and Lent
State Senators, Marino and Skelos
State Assemblyman, Weisenberg

Nassau County Executive, Thomas Gulotta
Presiding Supervisor, Joseph Mondello
Board of Supervisors

Department Officials

1. Nassau County

County Attorney, Robert Schmidt
DPW Commissioner, Lou Hasl
Recreation and Parks Commissioner, John B. Kiernan
Planning Commissioner, Jack Polis
Comptroller, Peter King

2. Town of Hempstead
Defer to Town

3. City of Long Beach
Defer to City

The following individuals have been very supportive of Beach Protection Programs, and should be invited:

1. Mr. Morris Kramer, Environmentalist
88 Florida Avenue
Long Beach, New York 11560

2. Ms. Rosemary Dowling, Environmentalist
129 Baldwin Avenue
Point Lookout, New York 11569

3. Ms. Addie Quinn
1 Ocean Blvd.
Lido Beach, New York 11560

4. Dr. Anita Freudenthal
c/o Cedar Creek Park
Nassau County Dept. of Recreation and Parks

LONG ISLAND

Army Launches Study Of South Shore Erosion

By Suzanne Bilello
STAFF WRITER

After weathering state budget problems and a local storm over public access to beaches, a study to find ways to slow erosion along South Shore barrier beaches and bolster storm protection for Long Beach island is under way, officials announced yesterday.

The U.S. Army Corps of Engineers project, planned for several years, was delayed by state budget problems as well as the initial refusal of the town and county to open their beaches to non-residents this year.

The federal government requires all municipalities receiving federal aid — such as the study — to accept non-residents in public areas. After balking at first, the town and county later agreed to accept non-residents if they were charged higher permit fees, a proposal accepted by federal officials.

The study, preliminary aspects of which began in May, is expected to cost $1.5 million, with the cost split between the federal government and the state. The share to be paid by the state totals $735,000 — including $220,500 that was to have been paid with local funds but that state officials agreed to cover. It is expected the study will be completed by 1995 and that work to solve erosion problems could be under way by 1999 or earlier, officials said.

The area to be studied totals eight miles of shoreline, much of it in the City of Long Beach and some in beach areas under the jurisdiction of either the Town of Hempstead or Nassau County.

The engineers are expected to consider several options to stem beach erosion, including the construction of coastal levees and breakwaters,as well as restoration of dunes, according to Clifford S. Jones, project manager for the Army Corps. Jones and other Corps officials, as well as Hempstead Presiding Supervisor Joseph Mondello and County Executive Thomas S. Gulotta, announced the study yesterday during a news conference at Nassau Beach.

"Mother Nature has been very helpful for our area. She has blessed us with natural resources," Gulotta said, adding: "We have seen erosion, little by little, take that away."

There is a sense of urgency to resolve the erosion problem, since the barrier beach islands protect the mainland of Long Island from storm-caused waves.

"It's really life or death for us in Long Beach," said Supervisor Bruce Nyman. "We are totally dependent upon the beach for our future. We are physically dependent on the beach because it is our only protection from the tide. We are economically dependent on the beach for our property values and sources of revenues."

While erosion is a gradual process, there is some concern that a serious storm would accelerate the deterioration prior to the study's completion.

NEWS

Nassau County Executive
THOMAS S. GULOTTA

PRESS OFFICE
1 West Street
Mineola, N.Y. 11501
(516) 535-4227

October 15, 1991

CONTACT: Dave Vieser
535-4227 (office)
623-7219 (home)

OFFICIALS ANNOUNCE STUDY TO PREVENT BEACH EROSION

In what the officials described as a "prime example of intergovernmental cooperation" Nassau County Executive Thomas S. Gulotta, Hempstead Presiding Supervisor Joseph N. Mondello and Long Beach City Council President Kevin Braddish joined today with State and Federal officials to announce the start of a comprehensive study designed to remediate beach erosion on the Point Lookout/Long Beach barrier beaches. In a press briefing at Nassau Beach, the officials declared that the study, to be performed by the U.S. Army Corps of Engineers, would assist municipalities in preserving one of Long Island's most important assets.

"We share the concern of all our residents about the encroachment of erosion on our South Shore beaches," Gulotta said. "Our beaches are a gift of nature which represent one of our Island's most precious natural resources. This study is essential for the preservation of our south shore beaches."

Mondello explained that, "In order to determine a long-term solution to the problems associated with beach erosion, the Army Corps of Engineers will conduct a feasibility study of the entire Barrier Island. The local share of the costs of the long-term feasibility study is $225,000, which will be funded through a special grant procured by State Senator Ralph Marino and the Long Island Senate delegation. We are extremely grateful for their assistance in making this study possible. By providing these funds, the State is making a wise investment in our region's future."

"This is an historic moment for our Nassau County municipalities, as it demonstrates the positive result of cooperation

-more-among our City, Town and County officials for the benefit of all residents and visitors in the area," noted Braddish.

Senator Marino said, "While the State continues to face serious fiscal challenges, we cannot abandon the needs of our local communities. Preservation of our environment and the south shore barrier beaches is an important need which we will not ignore. I also wish to commend the members of the Nassau County Senatorial Delegation, particularly State Senator Dean Skelos, who supported this vital funding request."

Together, the three municipalities operate over 8 miles of barrier beach. The Town of Hempstead has jurisdiction over Point Lookout and Lido beaches, encompassing some 2.2 miles of beachfront; serving over 750,000 vistors annually. Nassau County operates a one mile ocean beach called Nassau Beach serving 400,000 visitors yearly, and the City of Long Beach operates 5 miles of ocean beacnfront.

-30-

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

August 16, 1991

Planning Division
Ocean and Estuary Section

Mr. James F. Kelley
New York State
Dept. of Environmental Conservation
50 Wolf Road
Albany, NY 12233

Dear Mr. Kelley:

This letter is to inform you of two concerns that the New York District has regarding the feasibility study of Long Beach Island, NY.

First, recent guidance from our higher authority in Washington requires us to document all schedule and cost changes on all project. These are documented a "Schedule and Cost Change Request" (SACCR). I have enclosed one of these forms to document the two year delay in initiating the Feasibility Study for Long Beach. I would greatly appreciate it if you would sign this form and return it to me on or before August 28, 1991. Please include any additional comments that you may have in the space provided on the form.

Secondly, I want to remind you that October 1 is approaching, and we are expecting to continue with the Feasibility Study as scheduled. Keep in mind that the earlier we receive funds from your office, the greater the possibility for us to expedite the work effort. We are confident that we can receive funds immediately upon receipt of sponsor funds, so that we can proceed with the study as scheduled.

Due to slippages, savings and other adjustments, we have received a revised breakout of funds from our higher authorities. This breakout is provided below:

Year	Amount	Status
FY91 (October 1, 1990):	$150,000	Received May 1991
FY92 (October 1, 1991):	$245,000	
FY93 (October 1, 1992):	$220,000	
FY94 (October 1, 1993):	$120,000	
Total	$735,000	

We look forward to your response on both of these issues very soon. If you have any further questions, please call me or Cliff Jones at 212-264-9077.

BRUCE A. BERGMANN
Chief, Planning Division

SCHEDULE AND COST CHANGE REQUEST (SACCR)	PROJECT: *(Authorizing Document Title)* Long Beach Island, NY (13063) (Feasibility Study)		SACCR NO: 13063-91-01 DATE: 31 July 1991	Page 1 RCS: CECW-LM
FROM: CENAN-PL-FN	THRU: CENAN-DP	TO: CENAD-PP	PROJECT MGR *(Name/Telephone)* Clifford, Jones 212-264-9077 Signature ______ Date ______	

SECTION I - REQUEST *(Attach additional sheet if necessary)*

DESCRIPTION OF CHANGE REQUEST: Initiation of the study did not occur until 2 years after the approved initiation date in the IPMP; consequently the study must be completed 2 years later. No change in study schedule, only shifted.

JUSTIFICATION FOR CHANGE: *(Include attempted resourcing through use of Contingencies and Schedule Float)*

Delay in obtaining funds; hence delay in study initiation.

SECTION II - IMPACT ASSESSMENT *(Attach additional sheet if necessary)*

ORGANIZATION	BRIEF DESCRIPTION OF IMPACT OF CHANGE
CENAN-PL	Funds must be budgeted for FY94 and FY95 to account for a May 1995 completion date: FY91 - $150 FY94 - $75 FY92 - $285 FY95 - $25 FY93 - $200

SECTION III - PROJECT MANAGER'S EVALUATION

CATEGORY	IMPACT	RESOURCES REQUIRED
COSTS ($000)		
SCHEDULE (MO)	DELAY in initiation of construction.	In an effort to maintain study schedule, no additonal resources are required. Potential for developing combined Feasibility/GDM;
MANPOWER (MM)		will require additional resources.

SUBMIT SACCR TO CECW-LM WITH PROJECT EXECUTIVE SUMMARY.

PROJECT: Long Beach Island, NY (13063) (Feasibility Study) | SACCR NO. 13063-91-01 | Page 2

SECTION IV - COORDINATION WITH SPONSOR

SPONSOR'S POSITION:

SPONSOR ACKNOWLEDGEMENT OF CHANGE REQUEST: Signature______________________ Date__________
(Name/Title)

SECTION V - PRB ACTION

A. DDE(PM) RECOMMENDATION: Signature______________________ Date__________

B. DISTRICT PRB RECOMMENDATION:
(Specify reason)
___ APPROVAL
___ APPROVAL WITH MODIFICATIONS
___ DISAPPROVAL
___ RETURNED TO PM WITHOUT ACTION
___ REFERRED TO DIVISION

C. DIVISION PRB ASSESSMENT:
(Specify reason)
___ APPROVAL
___ APPROVAL WITH MODIFICATIONS
___ DISAPPROVAL
___ RETURNED WITHOUT ACTION
___ REFERRED TO HQUSACE

D. HQUSACE PRB ASSESSMENT:
(Specify reason)
___ APPROVAL
___ APPROVAL WITH MODIFICATIONS
___ DISAPPROVAL
___ RETURNED WITHOUT ACTION

SECTION VI - RESOLUTION OF REQUEST *(District/Division/HQUSACE action, as appropriate)*

BASIS OF ACTION:

DISTRICT APPROVING/RECOMMENDING OFFICIAL______________________ Date__________
DIVISION APPROVING/RECOMMENDING OFFICIAL______________________ Date__________
HQUSACE APPROVING OFFICIAL______________________ Date__________
(Name/Title/Signature)

SUBMIT SACCR TO CECW-LM WITH PROJECT EXECUTIVE SUMMARY

APPENDIX F

REAL ESTATE SUPPLEMENT

F

REAL ESTATE PLAN (REP)

1. The project name is Long Beach Island located in Nassau County, New York, which is a coastal erosion control project. The purpose of this project is to provide storm damage reduction for the barrier island.

2. The recommended plan for the project is for the construction of a 110 foot wide beach berm that will extend 41,000 feet in length along the beach frontage in the project. Additionally, the plan requires the construction of a dune system that will have a width of 75 feet also 41,000 feet in length. A dune maintenance area 25 feet wide and extending northward from the landward toe of the proposed dune is also required. Included in the 41,000 foot length is an existing terminal groin at the eastern limit of the project (on project mapping as Groin No. 58) that is programmed for rehabilitation and a western project limit to Yates Avenue where dune and beach nourishment areas taper into the community of East Atlantic Beach. Other facets of the project include the following.

a. rehabilitation of fifteen (15) existing groin structures in addition to No. 58 above
b. construction of six (6) new groins
c. construction of sixteen (16) new dune walkovers
d. construction of thirteen (13) new ramps for boardwalk access including demolition and removal of existing ramps
e. construction of twelve (12) new vehicle access ramps
f. construction of timber retaining walls against the landward side of the dune slope for access around a boardwalk platform structure and for access around a comfort station
g. move lifeguard station seaward

3. Real estate required to build the project is described as follows.

a. **Dune and Beach Berm (nourishment area)** - Supporting lands for these features are mainly municipally owned beach recreation areas. These lands are owned in fee simple by the City of Long Beach, the Town of Hempstead and Nassau County and have existing public access. Moreover, the above named municipalities will enter into written sub-agreements with the New York State Department of Environmental Conservation who is primary sponsor for the project. These publicly owned lands comprise a total of 36,700 lineal feet of project shoreline which includes the dune and beach nourishment areas. These lands will be committed to the project by the municipalities. The sponsor's interest in these municipally owned lands will be a long term "Right of Entry" to enter upon the lands to specifically construct, operate and maintain the project. A non-standard estate for the Right of Entry will be recommended and one will be sent to HQUSACE for approval. The above interest will provide the sponsor with sufficient control of the real estate so as to rehabilitate, construct, operate and maintain the dune and beach nourishment areas. There is zero cost to acquire the above interest in the municipal lands. Also, as the project will end up generating a betterment to the lands, value of the lands is offset by the benefit from the project and zero value and no credit are given for the real estate.

Dune and beach nourishment areas will also be located on seven (7) privately owned parcels under six (6) different ownerships. A listing of the private owners is attached (Exhibit A). These privately owned parcels comprise a total of approximately 4,300 lineal feet of project shoreline which includes dune and beach nourishment area. Four of the private parcels are located in the taper area section of the project and in the community of East Atlantic Beach. The three other private parcels are located in the Lido Beach section of the project. The uses of these lands are recreational and residential. In accordance with federal requirements interests in these lands can be accomplished with a Perpetual Beach Nourishment Easement and a Perpetual Restrictive Dune Easement. The sponsor's unconsolidated state laws of New York however, require that a fee simple estate be acquired in the beach nourishment area and a "Restrictive Dune Easement" in the dune area to include a twenty-five (25) feet wide maintenance area landward of the landward toe of the dune. Total private land area to be acquired in fee simple for beach nourishment area is estimated at 10.85 acres. Total private land area to be acquired in "Restrictive Dune Easement" is estimated at 9.87 acres. An exhibit of the "Restrictive Dune Easement" estate is attached (Exhibit B). The above interests are to be acquired in the private properties by the Town of Hempstead who will be one of the parties to the sub-agreements with the sponsor for the project. The New York State Department of Environmental Conservation (NYSDEC) as primary sponsor will obtain a long term "Right of Entry" from The Town of Hempstead after the fee simple and "Restrictive Dune Easement" interests in the real estate have been acquired. The project will create a betterment on these lands that would otherwise not exist in the absence of the project. As a result, the existing "as is" value of the private beach lands to be acquired will be offset by the benefits provided from the project. Hence there is estimated to be zero value for the lands and no credit is given to the sponsor or co-sponsors for providing these private lands.

b. **Work/Staging Areas -** There are no lands nor interests in lands to be acquired specifically for storage areas associated with the construction of the project. Storage areas as delineated in the engineering and design for the project will be located on the beach along side of the construction as it progresses through the project. The storage areas will be located within dune and nourishment area land which will have been previously acquired, as described in Paragraph 3a above. Conveyed as part of the "Right of Entry" will also be the broad right of use and circulation on and over municipally owned uplands which abut the project landward of the dune. This will provide the sponsor with sufficient ingress and egress for accessing the project for construction, nourishment, rehabilitation and operation and maintenance of all project features.

c. **Walkovers and Vehicle Access Ramps** - There are no lands nor interests in lands to be acquired specifically for these features of the project. The walkovers and vehicle access ramps will be constructed in the dune area which will have been previously acquired as described in Paragraphs 3a above. The dune maintenance area landward from the landward toe of the dune is included in the dune area and "Restrictive Dune Easement".

d. **Groins/Terminal Groin (new and rehabilitation of existing)** - There are no lands to be acquired for these features of the project. All lands supporting existing groins as well as lands for proposed groins are owned in fee simple by the municipalities including the City of Long Beach, the Town of Hempstead and Nassau County. The municipalities also own lands adjacent to and abutting the immediate supporting lands of the groins. The sponsor will be granted a "Right of Entry" interest in these lands which is sufficient to access the groins and conduct the proposed construction and rehabilitation and operation and maintenance. There

is zero cost to acquire the above interest in the municipal lands. Also, as the project and these features specifically will contribute to bettering immediate groin lands and adjoining lands owned by the municipalities, value of the lands is offset by the benefit from the project and zero value and no credit are given for the real estate.

e. **Summation -** Based on the preceding, a value of zero is estimated as the real estate cost for the project. Also, no damages are estimated. The LERRD requirements over private properties in the project are to be acquired by the Town of Hempstead with the sponsor (NYSDEC) providing its eminent domain authority, if necessary, to acquire the real estate. The municipal entities owning lands in the project will provide representations and warranties stating that they own the lands for use in the project and are legally capable to grant "Right of Entry" to the sponsor. By way of the above processes, the sponsor has the resources to accomplish the acquisition of interests in the real estate necessary for the construction, rehabilitation and operation and maintenance of the project. The sponsor and municipal land owners will not seek credit for administrative and legal work associated with issuing the "Right of Entry". Administrative cost associated with the private land acquisition is estimated at $28,735 and no credit is given for this cost. There are no federally owned lands within the project. The sponsor (NYSDEC) owns no lands nor do they have an interest in any real property in the project. No lands nor interests in lands below the Mean High Water Line (MHWL) are to be acquired.

4. A beach transition section 2,000 feet in length located off the west end of the project and beyond the limits of the public beach will provide mitigation for downdrift effests. This area has no design, storm damage reduction function nor requirements for these functions. Private parcels in this area will be unacquired.

5. The project maps demonstrating the alignment of the dune system and beach berm (nourishment area) and placement of other project features are attached. A total of nine (9) maps are exhibited. It is noted that the dune line at two points in the project will be modified during a final plans and specs phase of engineering to show the dune moved seaward from its present location at those points. This is done so as to avoid possible encroachment into the dune maintenance area by existing tennis court and pool/cabana improvements from private property. These points on the proposed dune are shown on Map No.s 1 and 7.

6. There are no utilities to be relocated nor are there any known or potential hazardous or toxic waste problems associated with this project. Present or anticipated mineral activity in the project area and vicinity is nonexistent. Based on the Attorney's Report of Compensable Interests, there are compensable interests in some facilities of the project. As outlined in the attorney's report, these facilities consist of and are limited to physical structures and do not require supporting land replacement outside of the project. There are no administrative or lands costs associated with the relocations. Also, costs associated with the relocation replacement structures are dealt with elsewhere in the feasibility report and are estimated in the MCACES 02 account.

7. The project area is habitat to two critical species of shore birds listed as endangered and threatened species by State and Federal agencies. Also the near shore waters of Long Beach Island may contain threatened and endangered sea turtles during summer and early fall months. The National Marine Fisheries Service has indicated that the project as designed would not likely adversely affect the sea turtles. NMFS has stated that if hopper dredges are utilized between mid-June and mid-November, NMFS approved turtle observers must be on board to monitor the

dredging activity. Also, if fill placement coincides with the shorebirds' nesting season (April-August), suitable buffer zones with protective measures will be incorporated into the project plans. With these preventive actions, there will be no major impact to the above species as a result of the project.

8. Local municipalities including the Town of Hempstead, City of Long Beach and Nassau County and their constituencies are supportive of the project. The incorporated Village of Atlantic Beach has given notice in writing that the Village will not participate in the project. For this reason, the project area has been modified to exclude the Village of Atlantic Beach and as modified has a western limit just to the west of the City of Long Beach.

9. A real estate cost estimate has been prepared by the Baltimore District and the real estate for the project is valued at zero. Project administrative cost is estimated at $28,735. Cost for relocation of facilities in the project are estimated elsewhere in the report and in the MCACES 02 account. A MCACES 01 account summary and breakdown of administrative cost estimate for lands and damages is attached. Total real estate cost and associated administrative cost, including contingency, are estimated at $33,049.

10. The real estate milestones for this project are presented below. PCA execution and construction milestones are also included to show the overall execution plan.

MAJOR MILESTONE	SCHEDULE
Initial R.E. assessment w/ sponsor	10/96
PCA Executed	1/97
Initiate R.E. acquisition	2/97
Appraisal, survey & title search contract awarded	3/97
ETA for appraisal, survey & title search	6/97
Right of Entry for terminal groin obtained	7/97
Review appl., survey & title work completed	9/97
Construction award & start - terminal groin	10/97
R.E. acquisition completed	6/98
Construction award & start - beach fill	8/98

REAL ESTATE PLAN SUPPLEMENT for
Long Beach Island, New York
Coastal Erosion Control Project

Private Ownership Listing

Owner Name & Address	Nassau County Land & Tax Map Reference
Taper Area	
Lawrence Beach Club, Inc. Atlantic Beach, N.Y. 11509 (516) 239-4491	Sec. 58, Blk 144-1, Lot 62
Walter G. & Yvonne G. Scheer 140 East 56th Street New York, N.Y. 10022 Taxpayers: William K. & Cheryl P. Scheer Beech Street Atlantic Beach, N.Y. 11509	Sec. 58, Blk 144-1, Lot 105
Jem Caterers of Nassau, Inc. 1395 Beech Boulevard Atlantic Beach, N.Y. 11509 (516) 371-4000	Sec. 58, Blk 144-1, Lot 439
Water Club Assoc. 170 Tulip Ave. Floral Park, N.Y. 11001	Sec. 58, Blk 157, Lot 60
Lido Beach Area	
Residential Condominium Project 2 Richmond Road Lido Beach, N.Y. (Multiple owners in common areas)	Sec. 59, Blk 66, Lots 15A & 15B
Residential Condominium Project 750 Lido Boulevard Lido Beach, N.Y. (Multiple owners in common area)	Sec. 60, Blk 91, Lot 4

EXHIBIT A

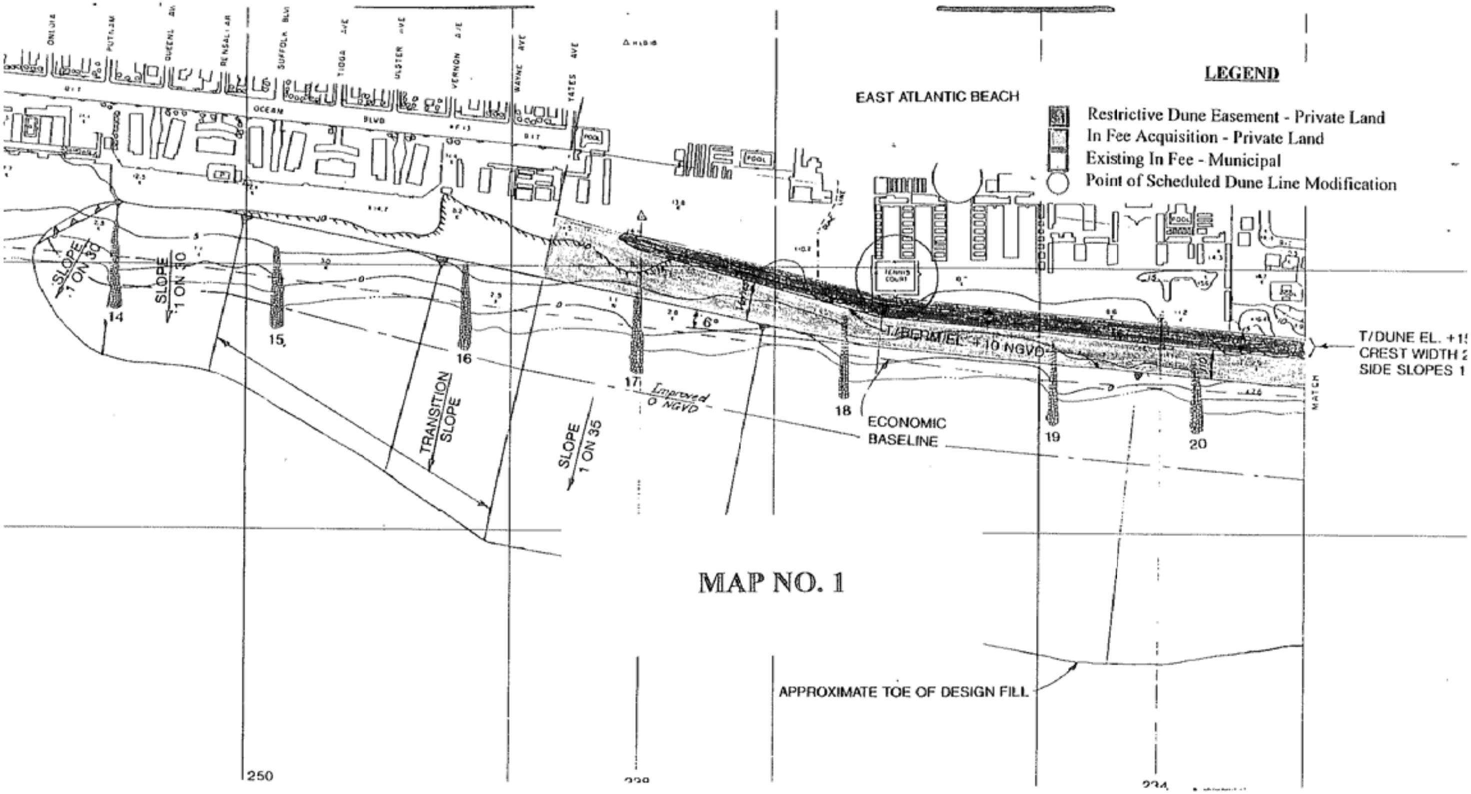
PERPETUAL RESTRICTIVE DUNE EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tract No. ___) to construct, operate, maintain, patrol, repair, rehabilitate, and replace a dune system and appurtenances thereto, together with the right to post signs, plant vegetation and prohibit the grantor(s), (his) (her) (its) (their) (heirs) successors, assigns and all others from entering upon or crossing over said dune easement; reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs) successors and assigns, the right to construct dune walkover structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape or dimension and prior approval of the plans and specifications for such structures shall have been obtained from the District Engineer, U.S. Army Engineer District, ____________________, and all other rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

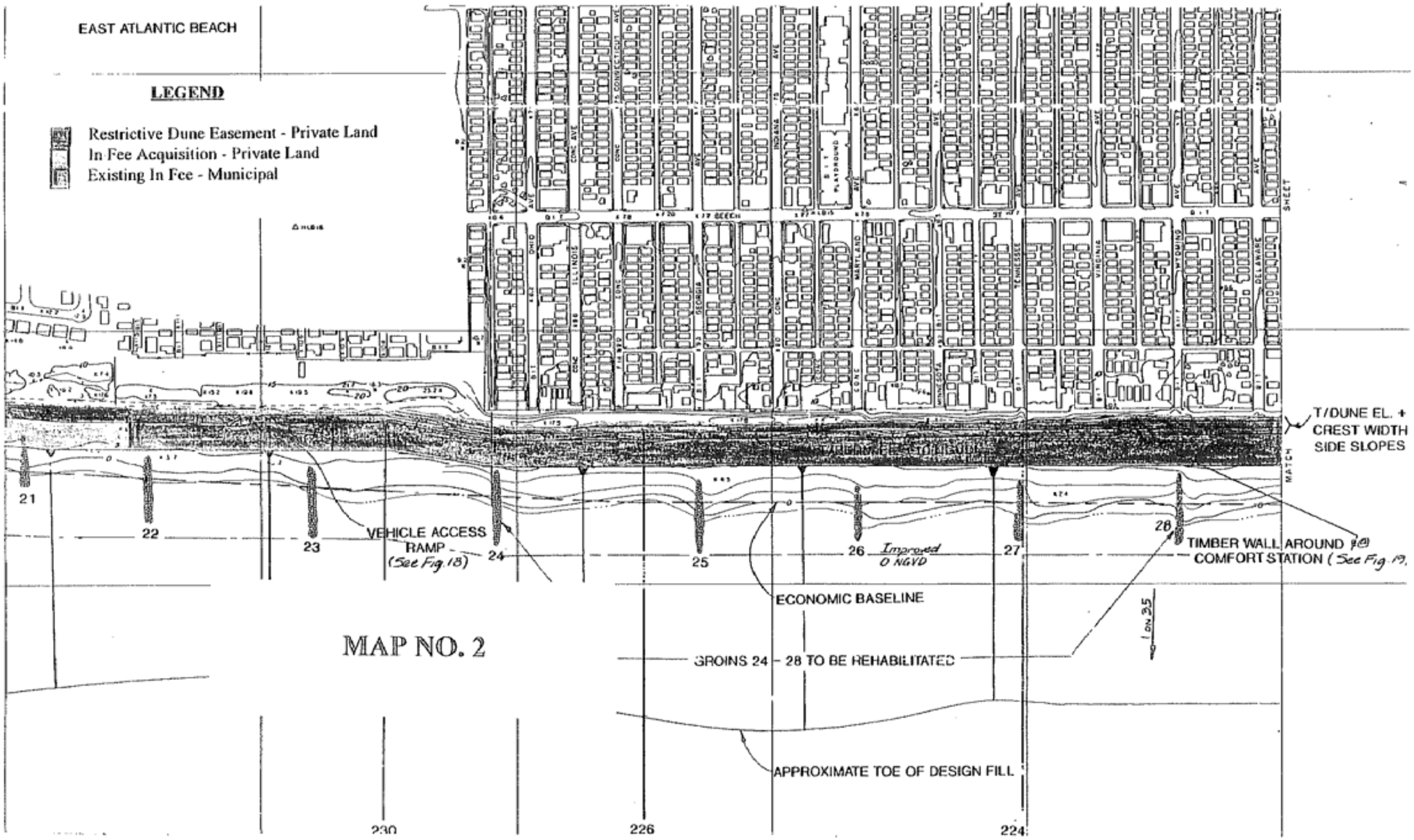
EXHIBIT B

EXHIBIT C

ACCT CODE	DESCRIPTION	QTY UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONT. AMOUNT	CONT. %
01	LANDS AND DAMAGES					
01.02	ACQUISITIONS	1 JOB		7,575	1,137	15%
01.05	APPRAISALS	1 JOB		2,780	418	15%
	TOTAL LANDS AND DAMAGES			10,305	1,555	11,920
02	RELOCATION					
02.03.47	STRUCTURES					
02.03.47.02.01	TIMBER DUNE WALKOVER	16 EA	10,000	160,000	32,000	20%
02.03.47.02.02	TIMBER RAMP W/STAIRS & RAILINGS	13 EA	20,000	260,000	52,000	20%
02.03.47.02.03	RELOCATE LIFE GUARD STATION	1 EA	31,305	31,305	6,261	20%
02.03.47.02.04	EARTH ACCESS RAMP	12 EA	15,479	185,748	37,150	20%
02.03.47.02.05	RAISE TIMBER DECK	1 EA	9,090	9,090	1,819	20%
	TOTAL RELOCATION			646,148	129,230	775,378
10	BREAKWATERS AND SEAWALLS					
10.03	MOBILIZATION, DEMOBILIZATION, AND PREPARATORY WORK	1 LS	294,204	294,204	44,143	15%
10.03.46	BREAKWATERS					
10.03.46.02	SITEWORK FOR NEW GROINS					
10.03.46.02.01	PLACEMENT OF ACCESS STONES	6,200 TONS	38.27	243,472	36,521	15%
10.03.46.02.03	EXCAVATION	40,080 CY	10.71	429,341	64,251	15%
10.03.46.02.04	FILTER CLOTH	38,600 SY	9.77	379,257	56,880	15%
10.03.46.02.05	BEDDING STONES	28,430 TON	47.33	1,384,527	204,780	15%
10.03.46.02.06	UNDERLAYER STONES 1200-1600 LBS	11,800 TON	50.74	658,172	98,726	15%
10.03.46.02.07	8-9 TON CAPSTONE	60,000 TON	68.04	4,128,325	918,049	15%
10.03.46.03	SITEWORK TO RECONSTRUCT GROINS					
10.03.46.03.02	REMOVE STOCKPILE GROIN STONES	26,290 TON	34.56	874,580	146,190	15%
10.03.46.03.03	EXCAVATION	61,800 CY	10.71	661,768	99,286	15%
10.03.46.03.04	FILTER CLOTH	16,700 SY	9.77	163,237	24,486	15%
10.03.46.03.05	BEDDING STONES	14,400 TON	47.33	681,554	102,235	15%
10.03.46.03.06	UNDERLAYER STONES	6,800 TON	56.74	374,477	56,172	15%
10.03.46.03.07	6 TON CAPSTONE	40,800 TON	50.40	2,028,470	304,271	15%
10.03.46.03.11	DISPOSE EXCESS STONES (AT SITE)	5,300 TON	13.82	73,264	10,990	15%
10.03.47	SEAWALL					
10.03.47.02	SITEWORKS FOR REVETMENT REHABILITATION					
10.03.47.02.01	4-TON ARMOR STONES	13,440 TON	83.20	1,118,424	167,914	15%
10.03.47.02.02	BACKFILL (SAND)	73 CY	3.19	233	35	15%
10.03.47.02.03	EXCAVATION	18,987 CY	7.78	147,750	22,163	15%
10.03.47.02.04	FILTER CLOTH	6,514 SY	9.77	63,672	9,551	15%
10.03.47.02.05	BEDDING STONES	2,083 TON	47.33	98,500	14,780	15%
10.03.47.02.06	UNDERLAYER STONES 800 LBS	5,960 TON	56.74	338,299	50,685	15%
10.03.47.02.07	1.4 TON ARMOR STONES	1,486 TON	68.04	116,054	17,400	15%
10.03.47.03	SITEWORKS FOR RECONSTRUCT REVETMENT					
10.03.47.03.02	REMOVE, STOCKPILE & REUSED ARMOR	1,154 TON	49.92	57,008	8,641	15%
10.03.47.03.05	REMOVE, STOCKPILE & REUSED BEDDING	175 TON	49.92	8,734	1,310	15%
10.03.47.03.05	REMOVE, STOCKPILE & REUSED UNDERLAYER	489 TON	49.92	24,411	3,662	15%
	TOTAL BREAKWATER AND SEAWALL			17,054,559	2,558,189	19,612,748
17.00.01	MOBILIZATION, DEMOBILIZATION, AND PREPARATORY WORK	1 LS	1,236,443	1,236,443	185,466	15%
17.00.14	PIPELINE DREDGING					
17.00.16.02	SITE WORK					
17.00.16.02.01	SAND FILL PLACEMENT	8,641,900 CY	4.01	34,648,406	5,197,261	15%
17.00.50	ASSOCIATED GENERAL ITEMS					
17.00.50.02.01	DUNE GRASS	29 ACR	7,518	218,012	32,702	15%
17.00.50.02.02	SAND FENCE	90,000 LF	6.46	583,085	87,463	15%
17.00.50.02.03	TIMBER WALL, 4' HIGH	570 LF	97.24	55,428	11,086	20%
	TOTAL BEACH REPLENISHMENT			36,741,374	5,513,978	42,255,352
30	ENGINEERING AND DESIGN	1 LS		2,228,000	222,800	10%
31	CONSTRUCTION MANAGEMENT	1 LS		3,830,000	957,500	25%
	TOTAL PROJECT FIRST COST (JUNE 1994 PRICE LEVEL)			60,510,447	9,383,252	69,893,699

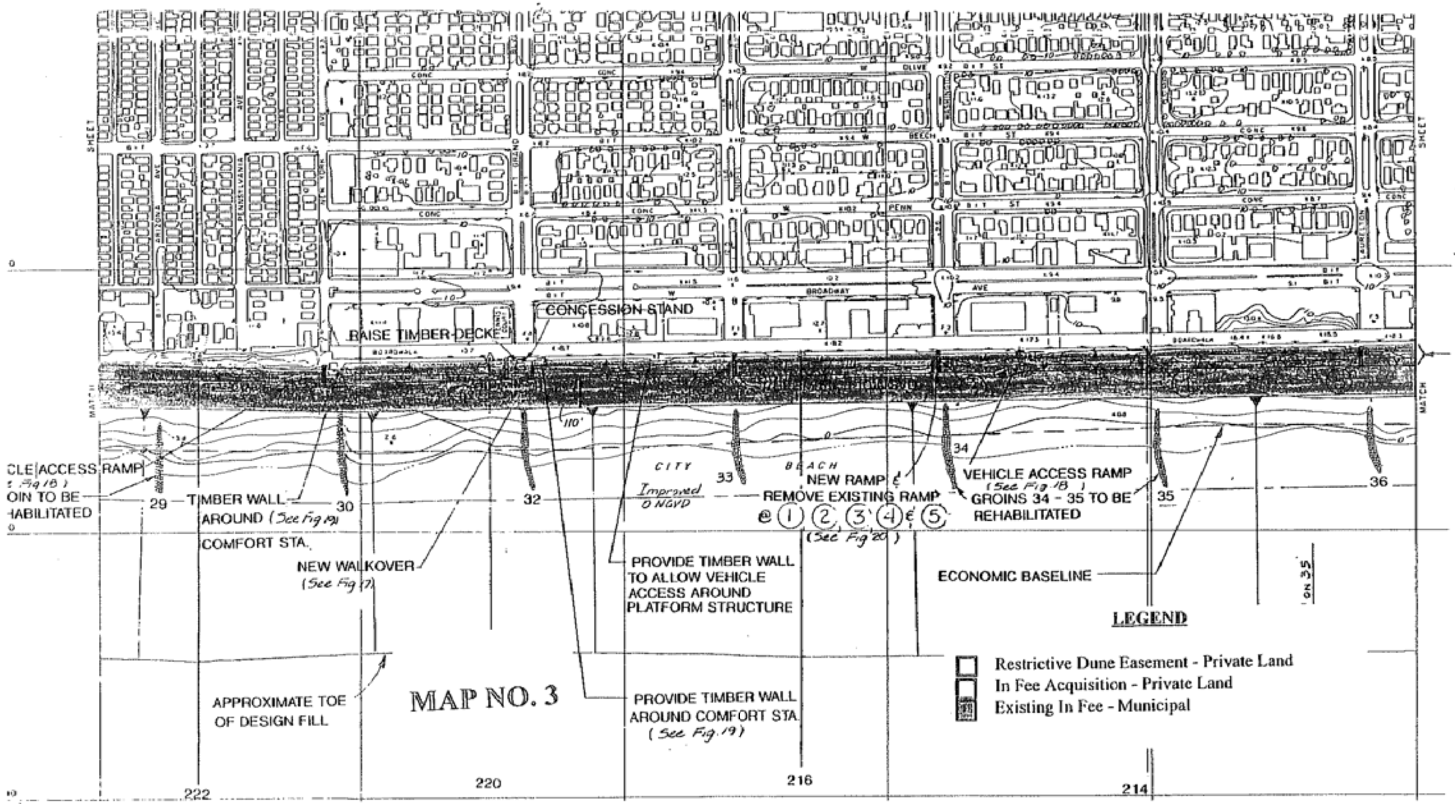

LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
Point of Scheduled Dune Line Modification
EAST ATLANTIC BEACH
OCEAN BLVD
SLOPE 1 ON 30
SLOPE 1 ON 30
TRANSITION SLOPE
SLOPE 1 ON 35
T/BERM EL. +10 NGVD
Improved 0 NGVD
ECONOMIC BASELINE
T/DUNE EL. +1
CREST WIDTH
SIDE SLOPES 1
MATCH
APPROXIMATE TOE OF DESIGN FILL
14
15
16
17
18
19
20
250

MAP NO. 1



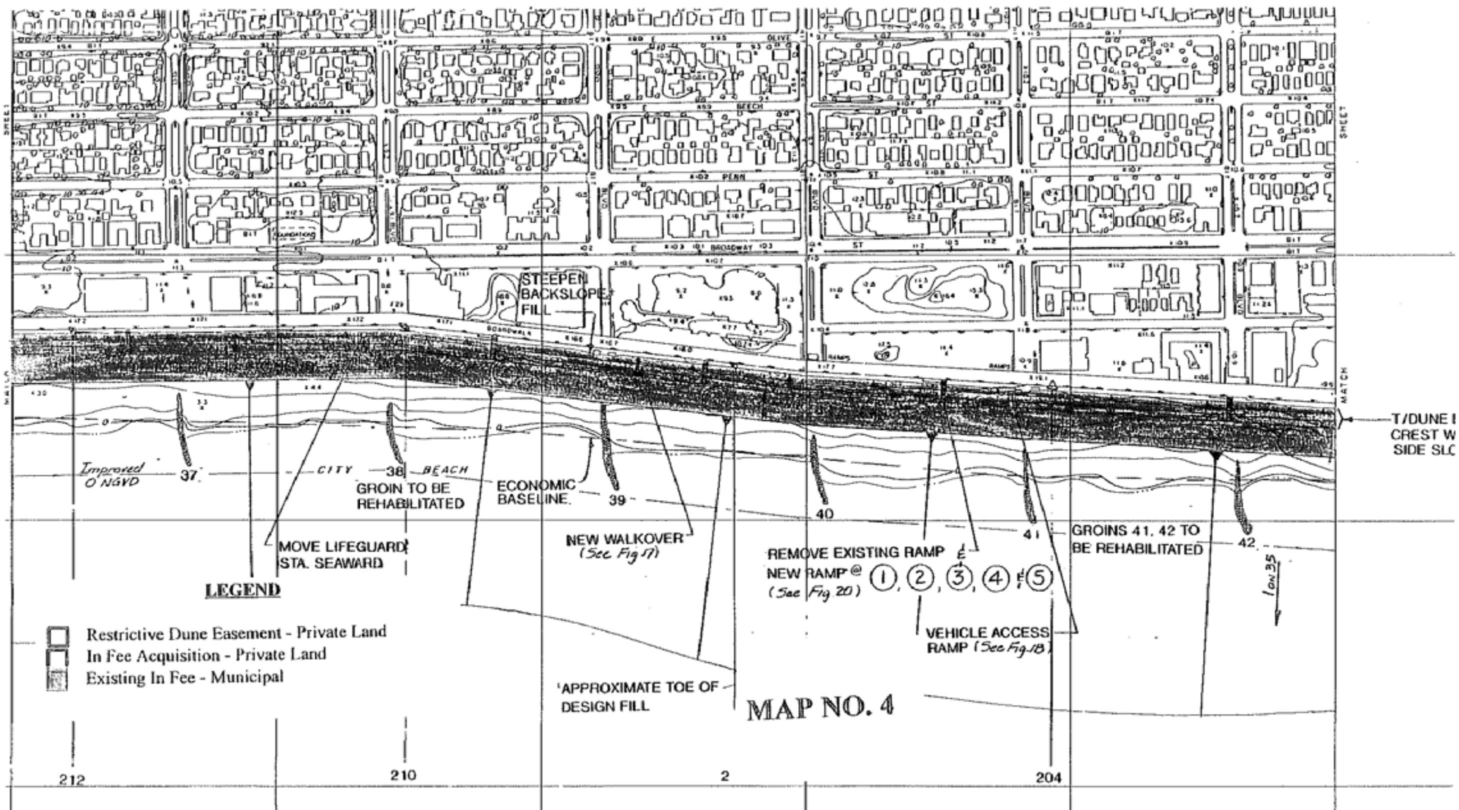
EAST ATLANTIC BEACH
LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
T/DUNE EL. +
CREST WIDTH
SIDE SLOPES
VEHICLE ACCESS RAMP (See Fig. 18)
TIMBER WALL AROUND
COMFORT STATION (See Fig. 19,
Improved
0 NGVD
ECONOMIC BASELINE
GROINS 24 - 28 TO BE REHABILITATED
APPROXIMATE TOE OF DESIGN FILL
21
22
23
24
25
26
27
28
230
226
224
MATCH
SHEET

MAP NO. 2

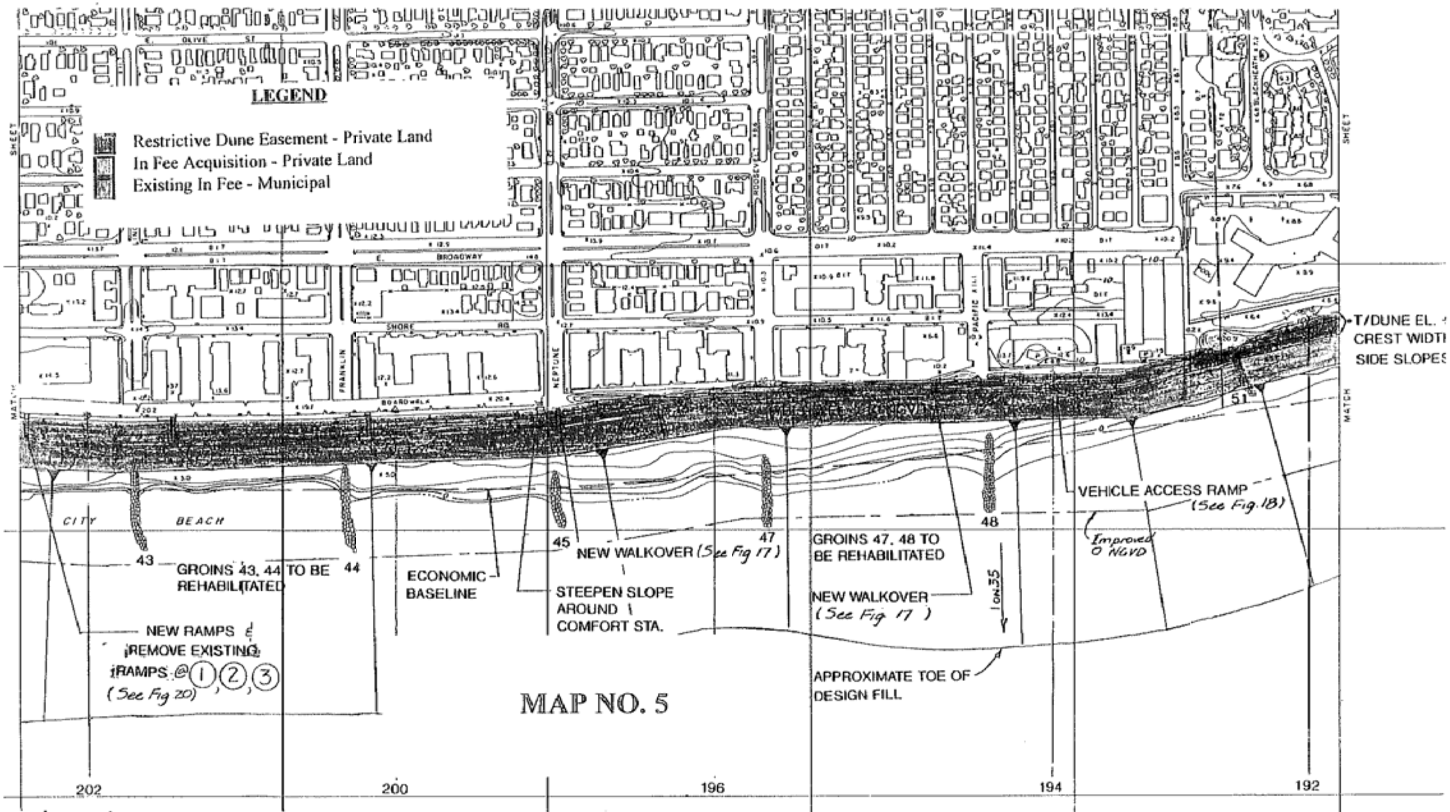


CONCESSION STAND
RAISE TIMBER DECK
BROADWAY
AVE
CITY
BEACH
Improved
0 NGVD
VEHICLE ACCESS RAMP
(See Fig 18)
GROINS 34 - 35 TO BE
REHABILITATED
NEW RAMP &
REMOVE EXISTING RAMP
@ 1 2 3 4 & 5
(See Fig 20)
TIMBER WALL
AROUND (See Fig 19)
COMFORT STA.
NEW WALKOVER
(See Fig 17)
PROVIDE TIMBER WALL
TO ALLOW VEHICLE
ACCESS AROUND
PLATFORM STRUCTURE
ECONOMIC BASELINE
APPROXIMATE TOE
OF DESIGN FILL
PROVIDE TIMBER WALL
AROUND COMFORT STA.
(See Fig. 19)
29
30
32
33
34
35
36
222
220
216
214
LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal

MAP NO. 3

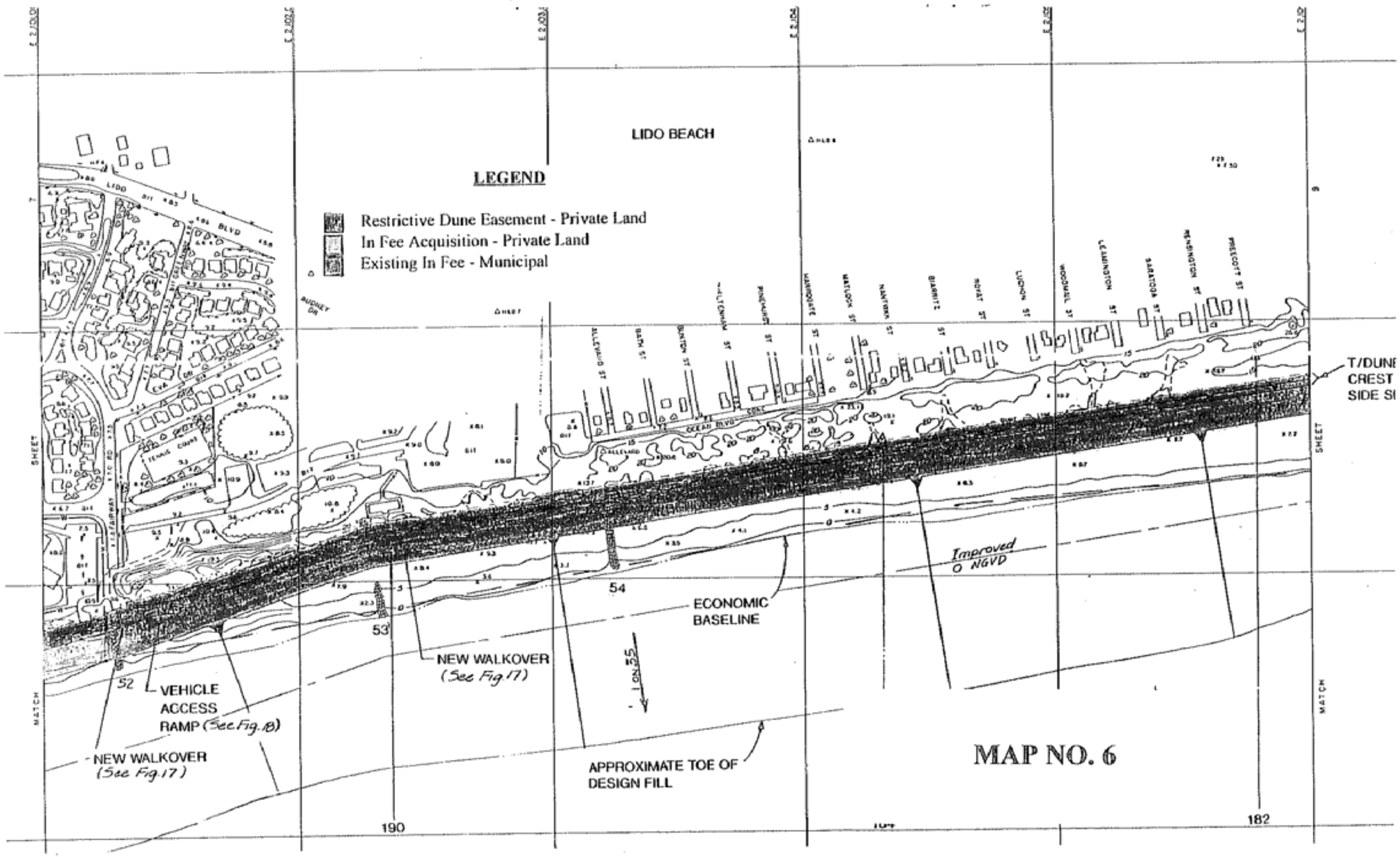

T/DUNE
CREST W
SIDE SLC
MATCH
SHEET
STEEPEN BACKSLOPE FILL
Improved
0 NGVD
37
CITY
38
BEACH
GROIN TO BE REHABILITATED
ECONOMIC BASELINE
39
40
41
42
MOVE LIFEGUARD STA. SEAWARD
NEW WALKOVER (See Fig 17)
REMOVE EXISTING RAMP &
NEW RAMP @ 1, 2, 3, 4 & 5
(See Fig 20)
GROINS 41, 42 TO BE REHABILITATED
VEHICLE ACCESS RAMP (See Fig 18)
APPROXIMATE TOE OF DESIGN FILL
1 on 35
OLIVE
BEACH
PENN
BROADWAY
BOARDWALK
LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
212
210
2
204

MAP NO. 4

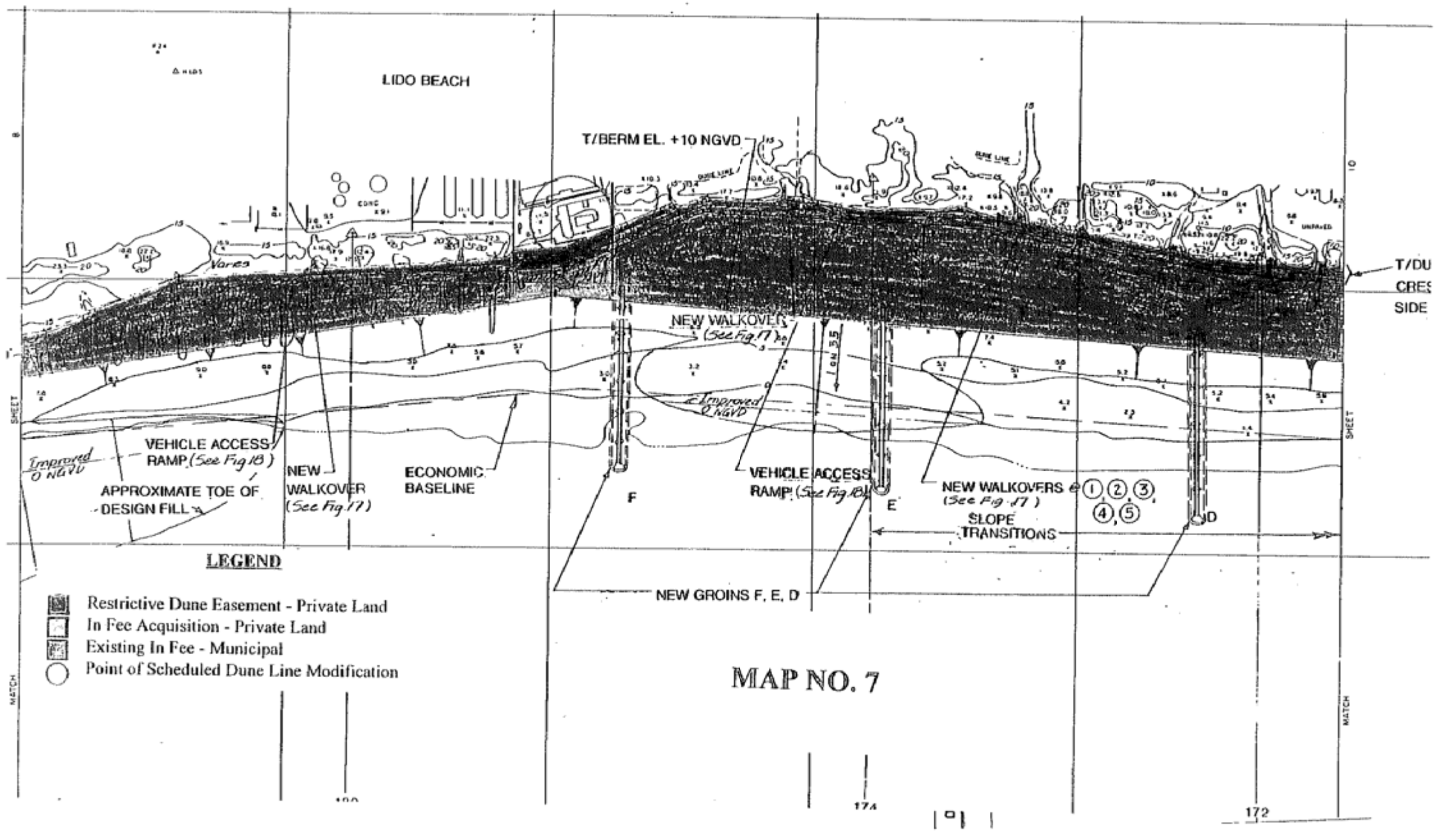


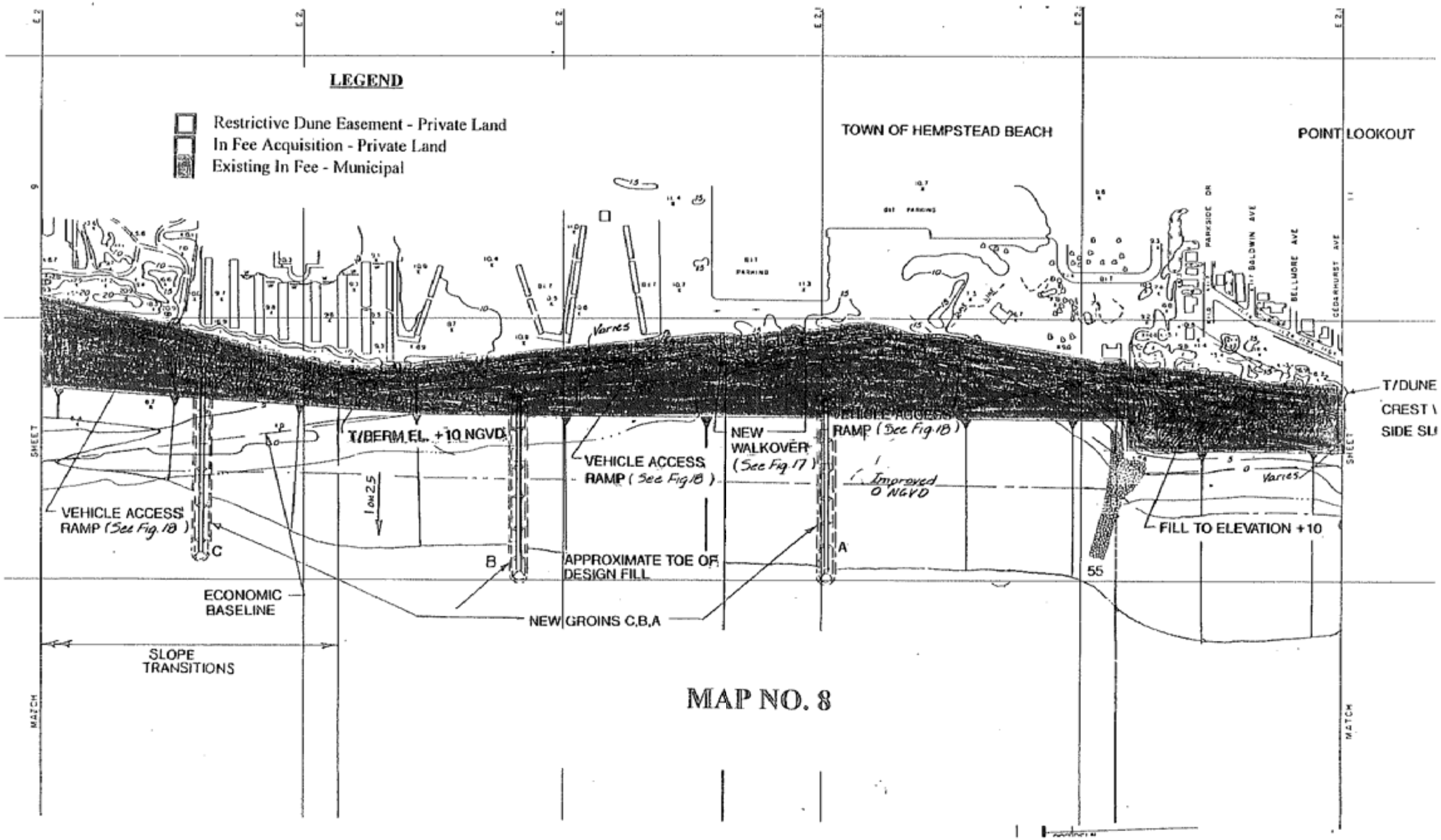
LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
OLIVE ST
BROADWAY
SHORE RD
BOARDWALK
FRANKLIN
NEPTUNE
PACIFIC
CITY BEACH
T/DUNE EL.
CREST WIDTH
SIDE SLOPES
VEHICLE ACCESS RAMP (See Fig.18)
Improved 0 NGVD
GROINS 47, 48 TO BE REHABILITATED
NEW WALKOVER (See Fig 17)
APPROXIMATE TOE OF DESIGN FILL
NEW WALKOVER (See Fig 17)
STEEPEN SLOPE AROUND COMFORT STA.
ECONOMIC BASELINE
GROINS 43, 44 TO BE REHABILITATED
NEW RAMPS & REMOVE EXISTING RAMPS @ 1, 2, 3 (See Fig 20)
43
44
45
47
48
51
202
200
196
194
192
MATCH
SHEET

MAP NO. 5

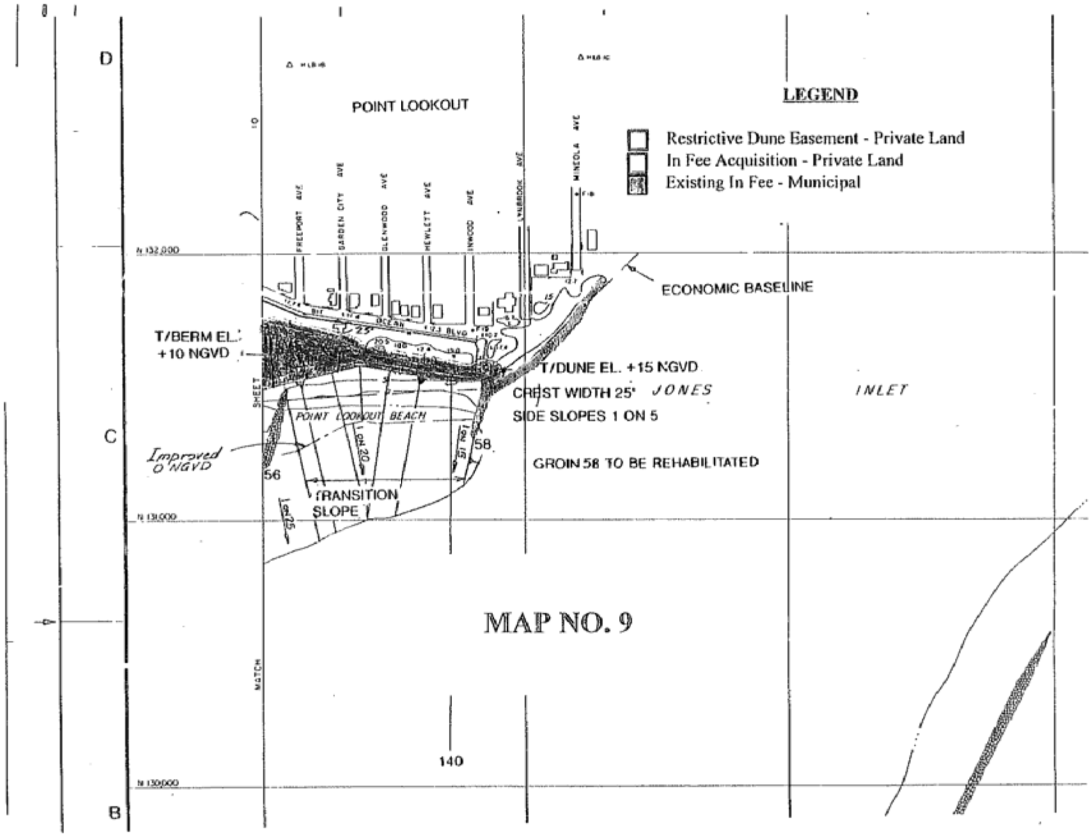


LIDO BEACH
LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
PRESCOTT ST
KENSINGTON ST
SARATOGA ST
LEAMINGTON ST
WOODMILL ST
LUCHON ST
ROYAT ST
BIARRITZ ST
NANTWKK ST
MATLOCK ST
HARROGATE ST
PINEHURST ST
CHELTENHAM ST
BUXTON ST
BATH ST
ALLEVARD ST
OCEAN BLVD
LIDO BLVD
TENNIS COURT
FAIRWAY
AUDNEY DR
T/DUNE
CREST
SIDE SL
SHEET
MATCH
Improved
0 NGVD
ECONOMIC BASELINE
APPROXIMATE TOE OF DESIGN FILL
NEW WALKOVER (See Fig.17)
VEHICLE ACCESS RAMP (See Fig.18)
NEW WALKOVER (See Fig.17)
52
53
54
190
182
MAP NO. 6


LIDO BEACH
T/BERM EL. +10 NGVD
T/DU
CRES
SIDE
NEW WALKOVER (See Fig. 17)
VEHICLE ACCESS RAMP (See Fig 18)
Improved 0 NGVD
APPROXIMATE TOE OF DESIGN FILL
NEW WALKOVER (See Fig. 17)
ECONOMIC BASELINE
F
VEHICLE ACCESS RAMP (See Fig 18)
E
NEW WALKOVERS @ ①②③, ④,⑤ (See Fig. 17)
D
SLOPE TRANSITIONS
NEW GROINS F, E, D
LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
Point of Scheduled Dune Line Modification
MAP NO. 7
MATCH
SHEET
174
172


LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
TOWN OF HEMPSTEAD BEACH
POINT LOOKOUT
PARKSIDE DR
BALDWIN AVE
BELLMORE AVE
CEDARHURST AVE
T/DUNE
CREST
SIDE SL
VEHICLE ACCESS RAMP (See Fig. 18)
NEW WALKOVER (See Fig. 17)
Improved 0 NGVD
VEHICLE ACCESS RAMP (See Fig 18)
T/BERM EL. +10 NGVD
1 on 25
VEHICLE ACCESS RAMP (See Fig. 18)
FILL TO ELEVATION +10
Varies
APPROXIMATE TOE OF DESIGN FILL
NEW GROINS C,B,A
ECONOMIC BASELINE
SLOPE TRANSITIONS
C
B
A
55
SHEET
MATCH

MAP NO. 8



D
C
B
POINT LOOKOUT
LEGEND
Restrictive Dune Easement - Private Land
In Fee Acquisition - Private Land
Existing In Fee - Municipal
FREEPORT AVE
GARDEN CITY AVE
GLENWOOD AVE
HEWLETT AVE
INWOOD AVE
LYNBROOK AVE
MINEOLA AVE
ECONOMIC BASELINE
T/BERM EL.
+10 NGVD
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
JONES
INLET
POINT LOOKOUT BEACH
1 ON 20
1 ON 15
1 ON 25
58
56
GROIN 58 TO BE REHABILITATED
Improved
0 NGVD
TRANSITION
SLOPE
SHEET
MATCH
N 132,000
N 131,000
N 130,000
MAP NO. 9

140

ATLANTIC COAST OF LONG ISLAND
EAST ROCKAWAY INLET TO JONES INLET
STORM DAMAGE REDUCTION PROJECT

LONG BEACH ISLAND, NEW YORK

PUBLIC ACCESS PLAN

1. Background

a. Purpose

The purpose of the public access plan is to describe public accessibility to the proposed dune and beach area that will be created as a result of the proposed Long Beach Island, New York Storm Damage Reduction Project. In order for the project to conform with Federal and State regulations, public access is required. The requirement for public access shall be limited to such areas which receive beachfill for the purpose of providing storm damage protection. Public access requirements shall not be required for areas where protection and restoration is incidental to the protection of publicly owned shores or if such protection would result in public benefits.

b. Scope

The geographical scope of this public access plan includes the beachfront areas which shall be provided beachfill in accordance with the recommended storm damage protection plan for Long Beach Island, New York. The recommended plan extends from the easternmost boundary at Point Lookout to the westernmost boundary which lies approximately at Oneida Avenue in Atlantic Beach. The taper section of beachfill between Yates Avenue and Oneida Avenue in Atlantic Beach is considered to be incidental to the storm damage protection provided to East Atlantic Beach, and is therefore not required to provide a plan for public access. The scope of the public access plan is limited to the areas east of Yates Avenue to the terminal jetty at Point Lookout.

2. Shoreline Ownership Category and Project Benefits

In accordance with ER 1165-2-130, all of the shores within the geographical scope of this project are considered to be under the general category of "Publicly Owned and/or Privately Owned with Public Benefits" for the purpose of Storm Damage Reduction. Land loss and recreation benefits are considered to be incidental for the storm damage reduction purpose of this project.

3. Definitions

Accessways - Public pathways or corridors which provide access from a public road to the beach. For this project, these accessways include dune walkover structures, vehicle access ramps

and boardwalk access ramps.

Conservation Areas - Locations where human uses are generally excluded because of resource sensitivity. These areas include the areas subject to a dune conservation easement, which will be appropriately fenced and vegetated to ensure the integrity of the protective dune.

Beach - The zone of unconsolidated material that extends landward from the low water lie to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation.

Public Benefits - Benefits resulting from public recreational use and the prevention of damage to publicly-owned facilities.

Public Use - Available for use by any and all of the general public on equal terms.

Storm Damage Reduction Benefits - Benefits from prevention of damages to Federal and public property and facilities (i.e., lands and/or structures, except non-Federal public lands dedicated to park and conservation uses) and developed private property and facilities due to shore erosion and/or tidal inundation.

4. The Proposed Project

The proposed project for storm damage reduction generally includes a 110 ft wide beach berm backed by a dune at elevation +15 ft NGVD. The details of the plan are described in the maintext of the Long Beach Island, New York Feasibility Report dated February 1995. In order to protect the integrity and erosion protection values of the proposed dune, access through the dune conservation areas will be limited to public or private dune accessways. The locations of the proposed accessways are described and delineated in the Real Estate Appendix of the project Feasibility Report. Property owners shall have the right to construct private dune walkover structures provided that such structures do not violate the integrity of the dune in shape or dimension. Such structures shall be in accordance with Article 34 of Environmental Conservation Law and require approval from the U.S. Army Corps of Engineers.

5. Public Access Plans

The City of Long Beach and the Town of Hempstead have submitted separate plans to illustrate the public access requirements of their municipalities. These plans have been determined by the New York District to be in compliance with public access and are expected to remain in effect for the life of the project. These plans are provided as attachments to the overall Public Access Plan for the proposed project.

APPENDIX G

PUBLIC ACCESS PLAN

G

ATLANTIC COAST OF LONG ISLAND
EAST ROCKAWAY INLET TO JONES INLET
STORM DAMAGE REDUCTION PROJECT

LONG BEACH ISLAND, NEW YORK

PUBLIC ACCESS PLAN

1. Background

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The City of Long Beach and the Town of Hempstead have submitted separate plans to illustrate the public access requirements of their municipalities. These plans have been determined by the New York District to be in compliance with public access and are expected to remain in effect for the life of the project. These plans are provided as attachments to the overall Public Access Plan for the proposed project.

City of Long Beach
KENNEDY PLAZA
LONG BEACH, NEW YORK 11561
(516) 431-1000
FAX: (516) 431-1389

EDWIN L. EATON
CITY MANAGER

APR 1994
Received
Flood Protection
Bur. NYS DEC

April 20, 1994

Mr. Roman Rakoczy
N.Y.S. Department of Environmental Conservation
50 Wolf Road - Room 330
Albany, New York 12233-3507

RE: City of Long Beach Public Access Plan

Dear Roman:

Please find enclosed a copy of the City of Long Beach Public Access Plan.

As per the advice of Cliff Jones, this plan has been prepared to address that requisite section of Federal Law which Mandates that beaches receiving Federal funding possess a plan which accommodates the general public.

If you should have any questions regarding the enclosed, please do not hesitate to contact us.

Very truly yours,

Edwin L. Eaton
City Manager

ELE:jk

CC: Comm. Robert L. Raab
Public Works

CITY OF LONG BEACH PUBLIC ACCESS PLAN

1. Background

a. Purpose

The purpose of the public access plan is to describe public accessibility to the proposed dune and beach area that will be created as a result of the U.S. Army Corps of Engineer's Long Beach Renourishment and Stabilization Project. In order for the project to be consistent with New York State Coastal Management Program policies, public access is required.

b. Scope

The geographical scope of this public access plan extends for the 3.5 miles of municipally-owned Ocean Beach Park, which lies between the western-most boundary of the City at Nevada Avenue, extending to the eastern boundary line at Maple Boulevard.

2. Property Ownership

The property known as the Ocean Beach Park, the recipient of the U.S. Army Corps of Engineers project, is owned in its entirety by the City of Long Beach.

3. Public Use

As a result of an agreement executed in 1936 between the City of Long Beach and the Federal Government, the Ocean Beach Park is available, in perpetuity, for use by the general public. That is, no residency restrictions are operative.

4. Accessways and Dune Walkover Structures

a. Location of Accessways

As noted above, this plan affirms the right of access to the restored beach by all members of the public at all public accessways. All accessways are located at existing street-ends. (Please see attached.) All accessways are located on public property.

b. Number of Accessways

Accessways total 31 in number. (Please see attached.)

c. Ownership and Use of Accessways

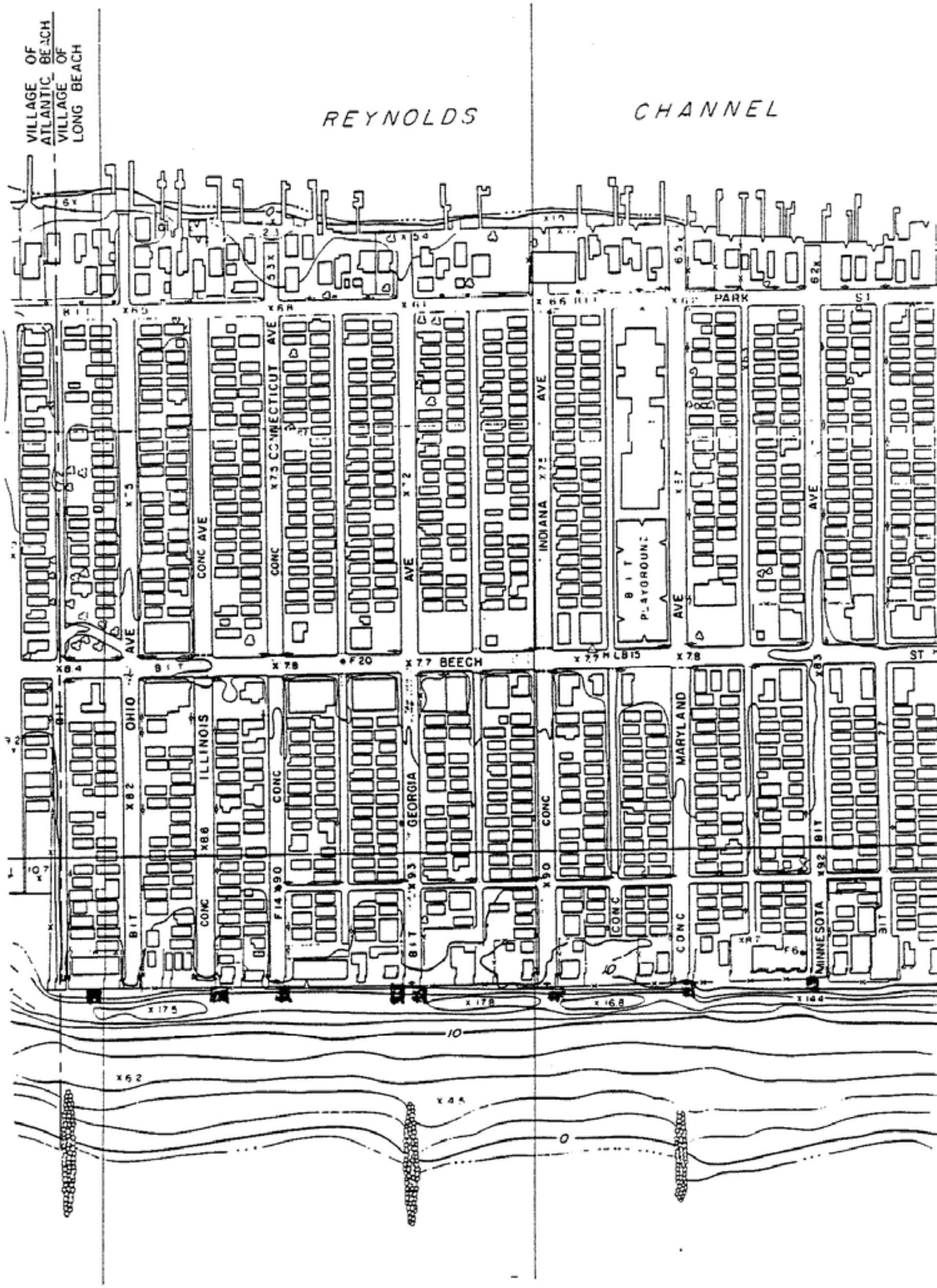
Ownership of all accessways will rest with the City of Long Beach. The use of the accessways shall be in accordance with the City of Long Beach Code of Ordinances.

d. Dune Walkover Structures

Dune walkover structures will be placed at public accessways and oriented over the dune to protect and maintain the integrity and stability of the dune. The design of the respective walkover structures will reflect the anticipated pedestrian traffic of the area in which it is located. Further, the design of the structure will encourage use of the accessway and may include overlooks and other desirable improvements.

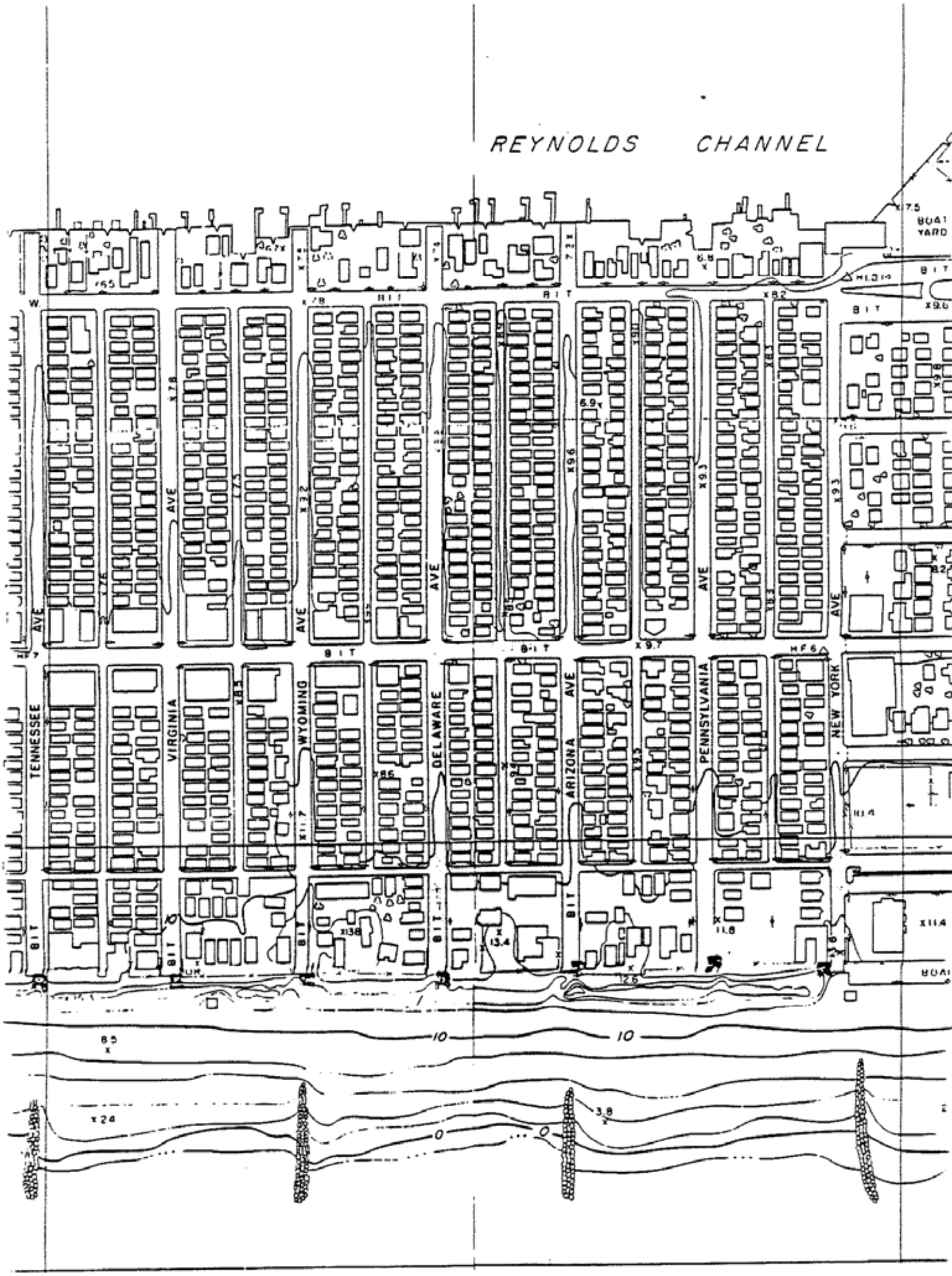
5. Parking Accommodations

Vehicle parking is available on all municipal thoroughfares. No residency restrictions or parking fees exist.

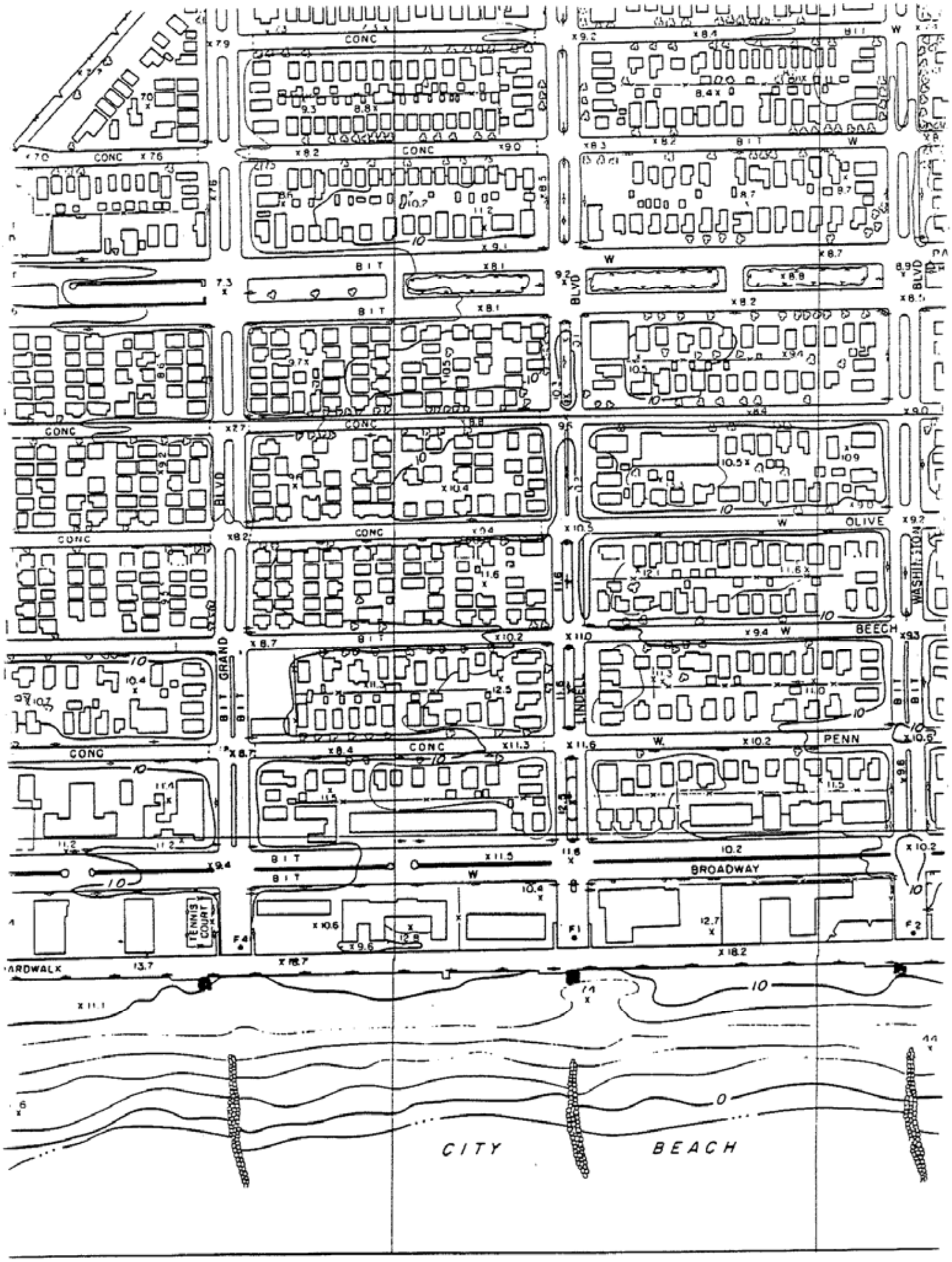


VILLAGE OF ATLANTIC BEACH
VILLAGE OF LONG BEACH
REYNOLDS
CHANNEL
PARK
ST
CONNECTICUT AVE
CONC AVE
CONC
AVE
INDIANA AVE
BIT PLAYGROUND
BEECH
ST
OHIO
ILLINOIS
GEORGIA
CONC
MARYLAND
MINNESOTA
BIT

G-a

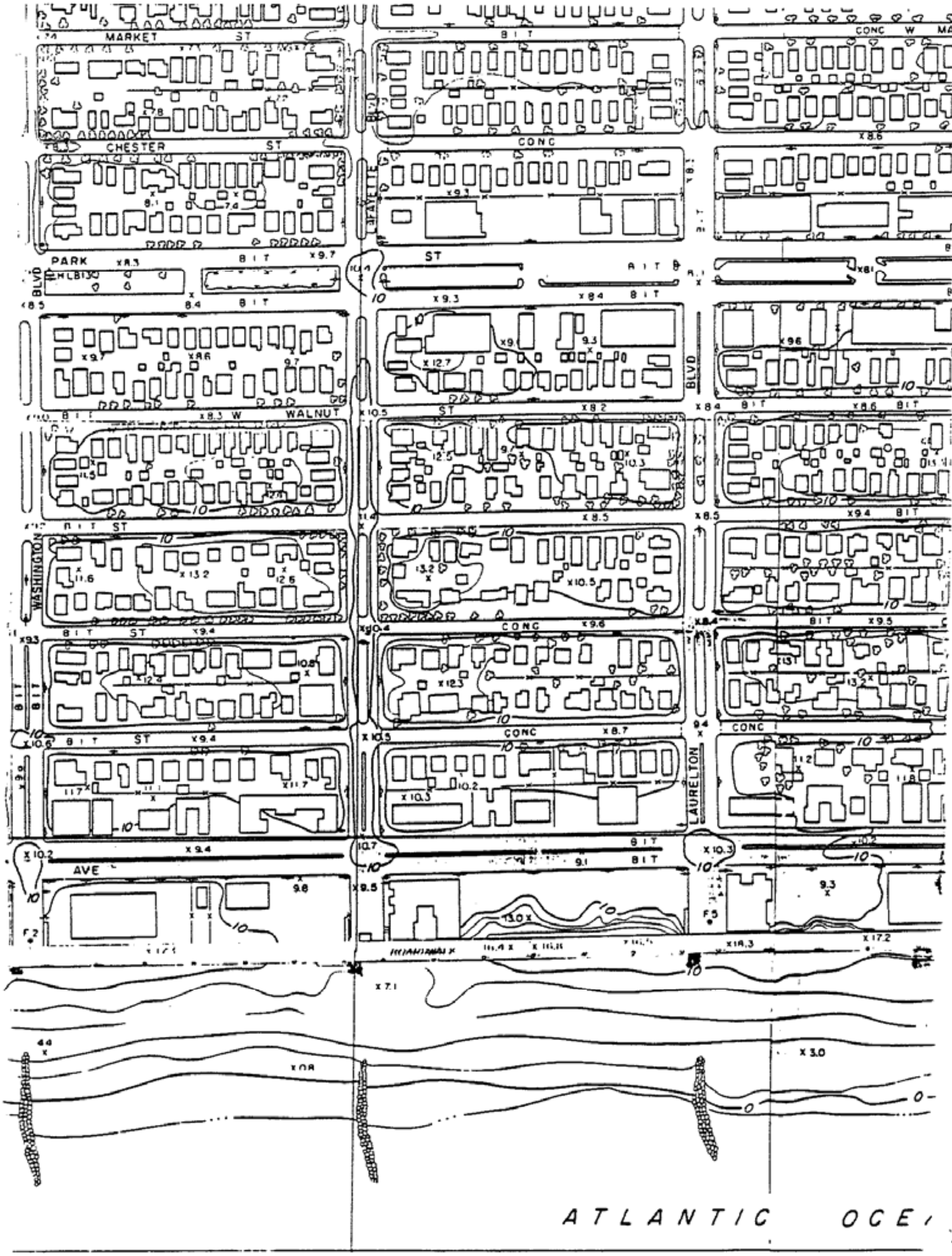

REYNOLDS CHANNEL
BOAT YARD
W.
AVE
TENNESSEE
VIRGINIA
WYOMING
DELAWARE
ARIZONA
PENNSYLVANIA
NEW YORK
BIT
10
0

G-b



CONC
BIT
W
BLVD
GRAND BLVD
LINDELL BLVD
OLIVE
WASHINGTON BLVD
BEECH
PENN
BROADWAY
TENNIS COURT
CITY BEACH

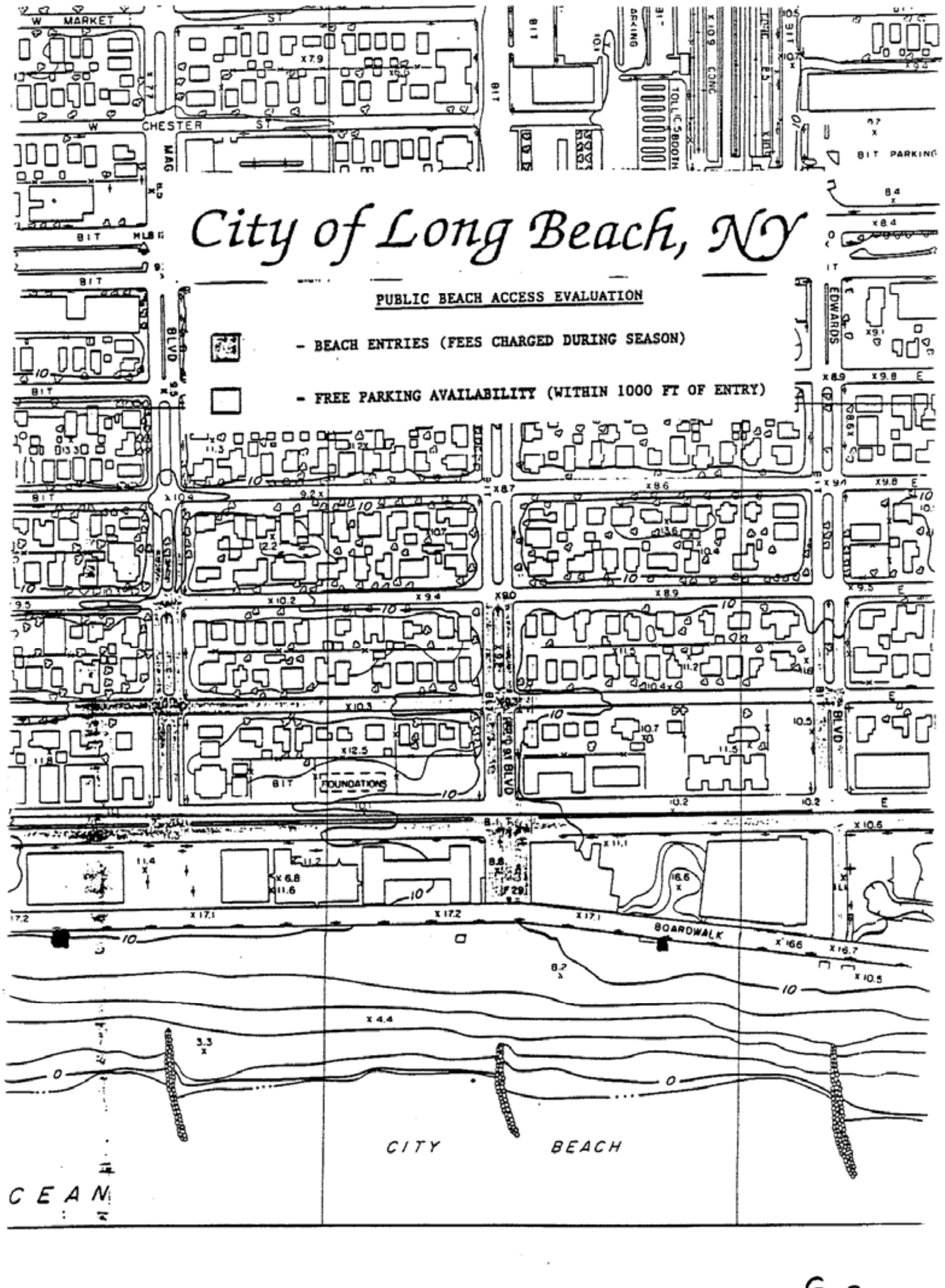
G-c

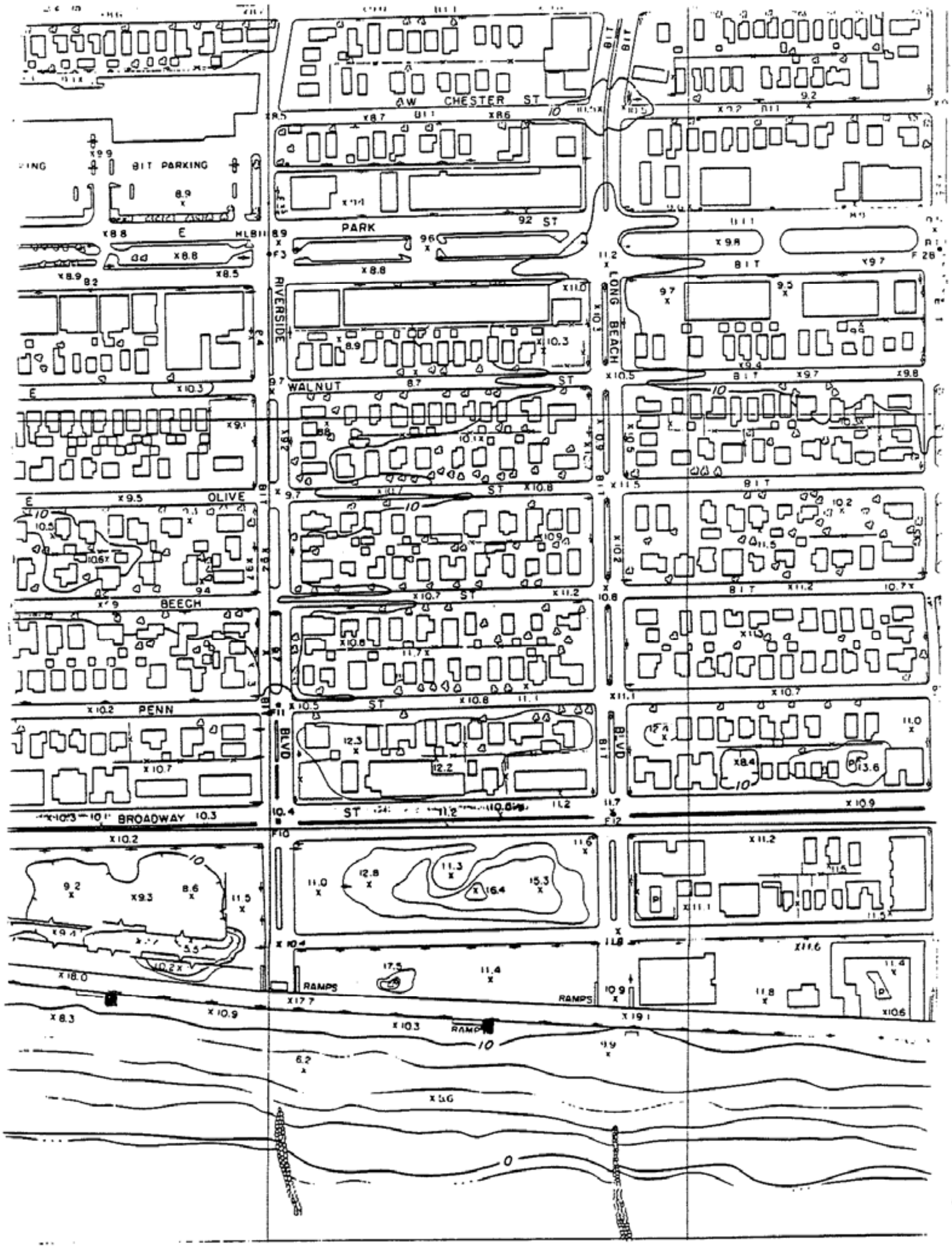

MARKET ST
CHESTER ST
CONC
PARK
BLVD
ST
WALNUT
WASHINGTON
LAURELTON
AVE
BIT
ATLANTIC

City of Long Beach, NY

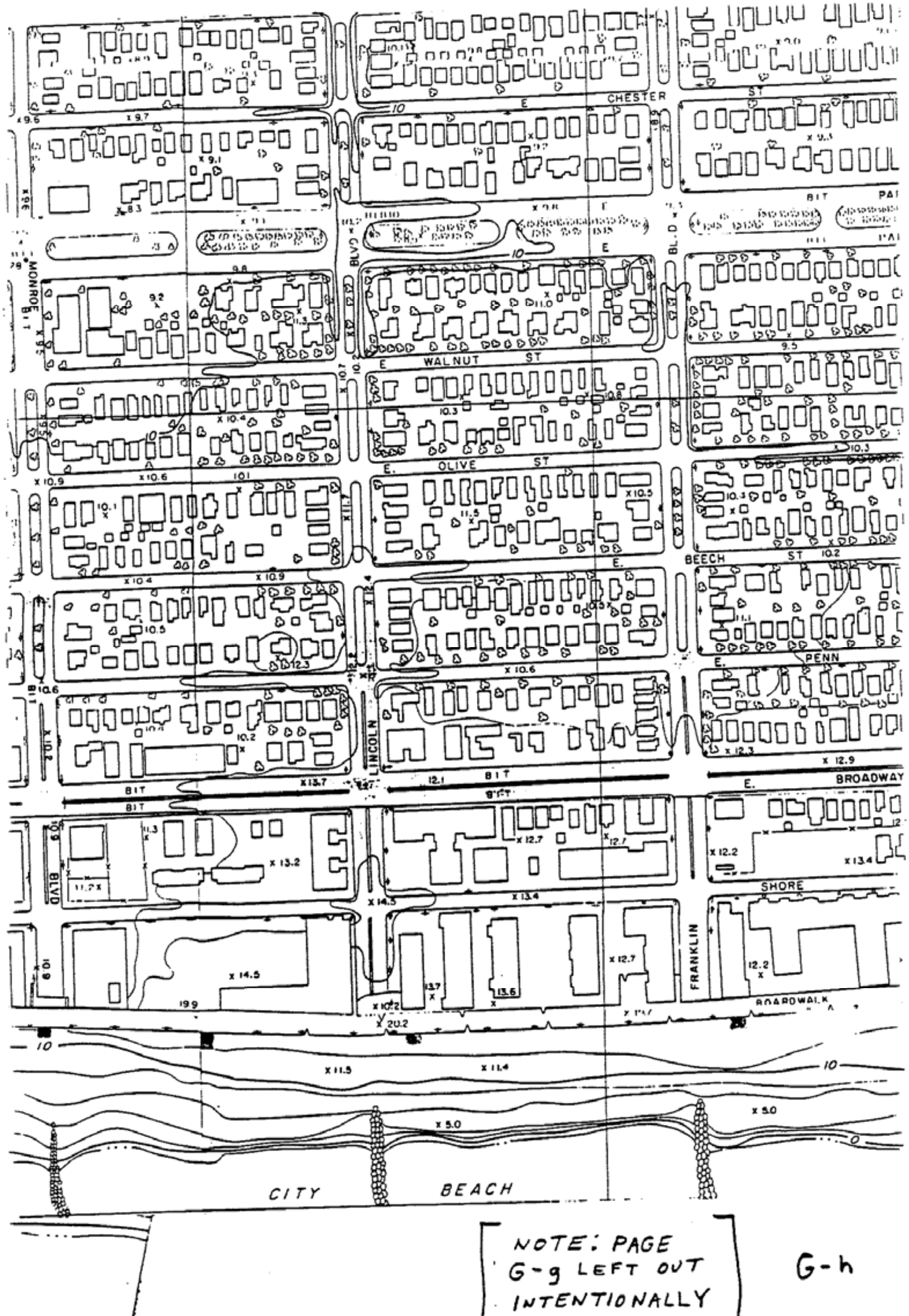
PUBLIC BEACH ACCESS EVALUATION

- BEACH ENTRIES (FEES CHARGED DURING SEASON)
- FREE PARKING AVAILABILITY (WITHIN 1000 FT OF ENTRY)



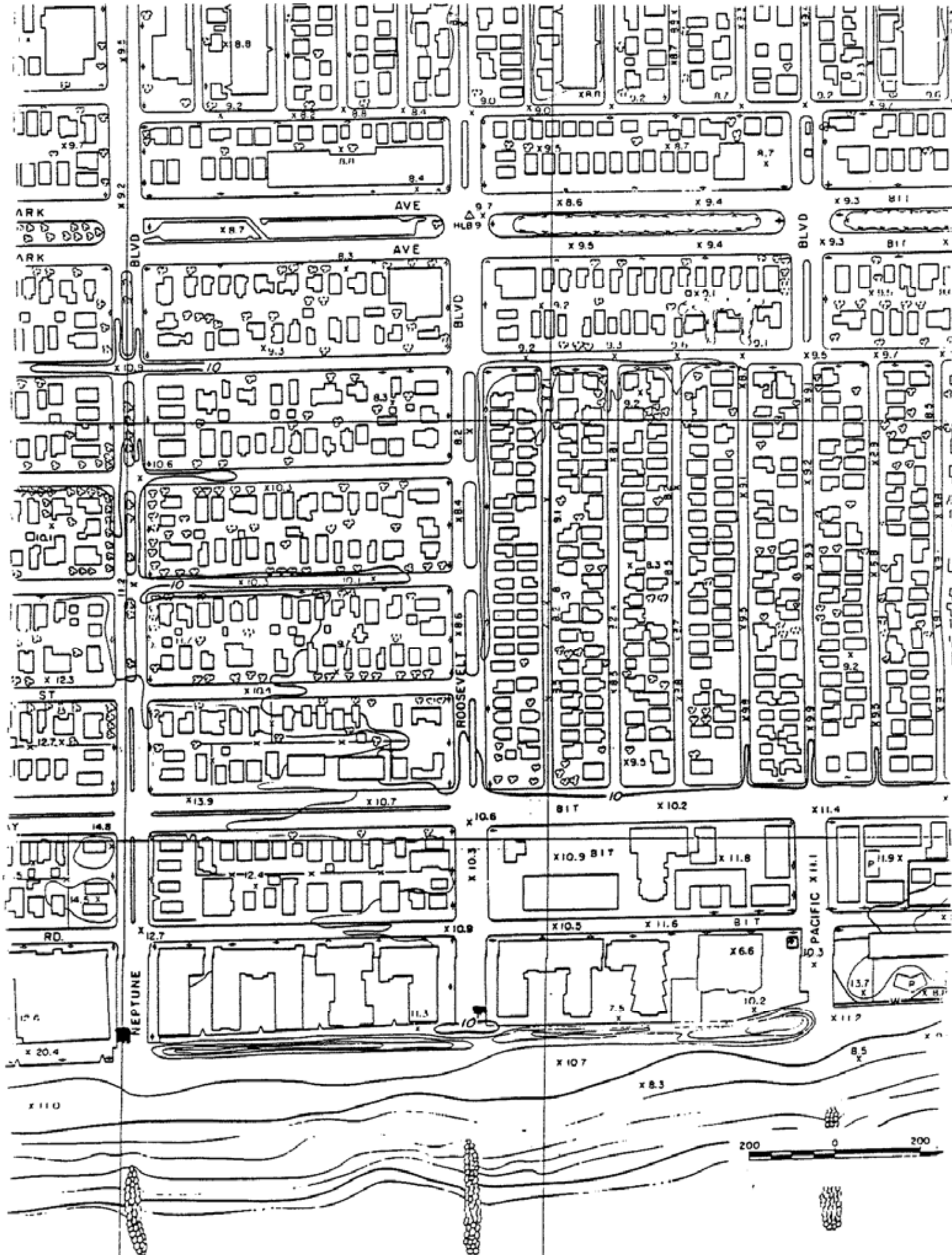

W CHESTER ST
BIT PARKING
PARK
ST
RIVERSIDE
LONG BEACH
WALNUT
ST
OLIVE
ST
BEECH
ST
PENN
ST
BLVD
BROADWAY
ST
RAMPS
RAMPS
RAMP

G-F

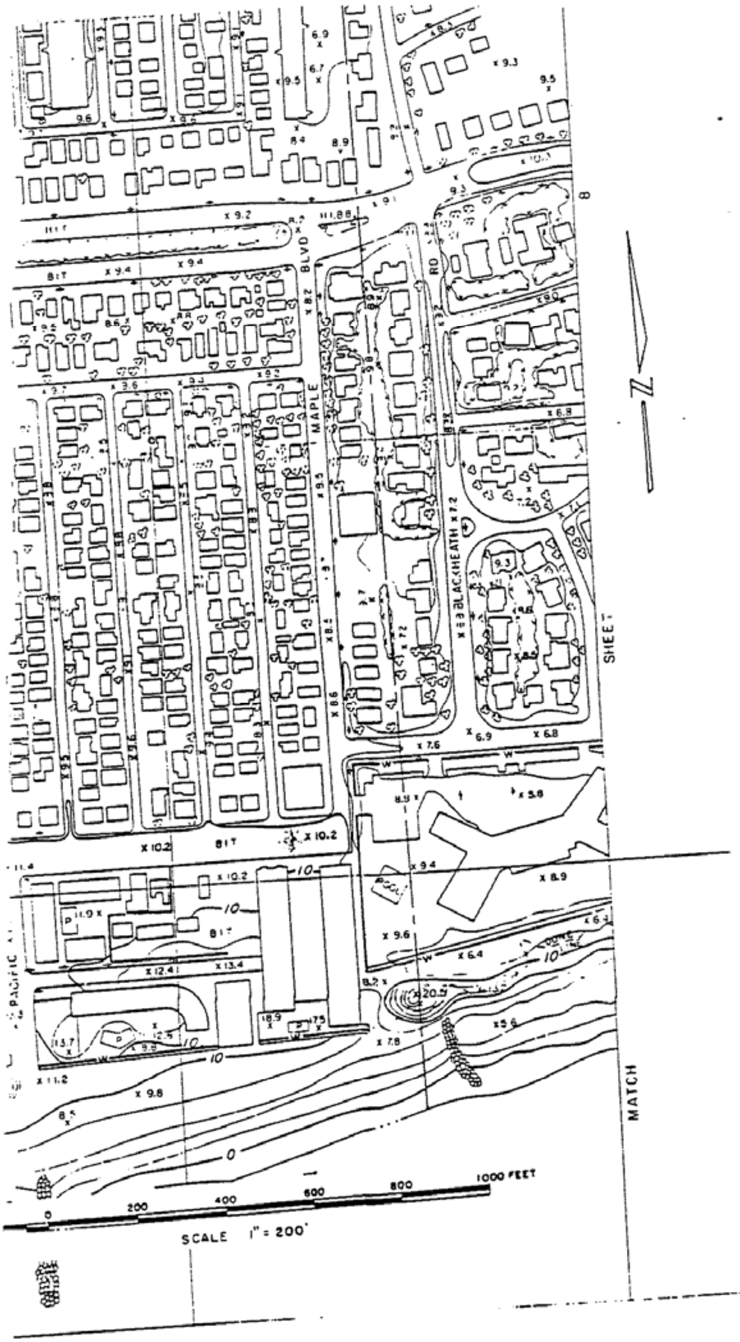


NOTE: PAGE G-g LEFT OUT INTENTIONALLY

G-h



AVE
AVE
BLVD
BLVD
BLVD
ROOSEVELT
NEPTUNE
PACIFIC
ST
RD.
BIT
200
0
200



MAPLE BLVD
BLACKHEATH RD
PACIFIC
BIT
POOL
MATCH SHEET
0 200 400 600 800 1000 FEET
SCALE 1" = 200'

G-j

Town of Hempstead
Public Access for Beach Parks

The beaches associated with designated Town Parks established at Point Lookout, Lido Beach, and West Lido Beach are open to all on an equal basis and have no admission fee attached to their use.

Admission to Town Park facilities without fee is routinely accomplished by walking, bicycling, bus or car transportation to park entrances. A train-bus link allows beachgoers from as far away as New York City to access the beach park facilities on a daily basis. There is no admission charge for parking prior to Memorial Day and after Labor Day.

The Town Parks have a passenger car parking fee associated with admission to the park facility. The parking is available to all, on an equal basis first come first served, as other limited parking facilities in New York State. The parking fee covers the vehicle only, since the Town does not have per person admission fee to use park facilities or its beaches.

Parking fees for passenger cars of non resident public reflect the differential in fixed operational costs, borne by Town residents, to provide the continued existance of the facility for all on an equal basis.

Once the parking areas are filled to capacity cars are prohibited from entering the facility, on the same equal basis, as they are admitted. The same policy is followed at state operated beach parking facilities such as Jones Beach.

List of Town Park-Beach Facilities
with Public Access (Figure 1)

1) - Town Park at Point Lookout
2) - Town Park at Lido Beach
3) - Town Park at Lido Beach-West

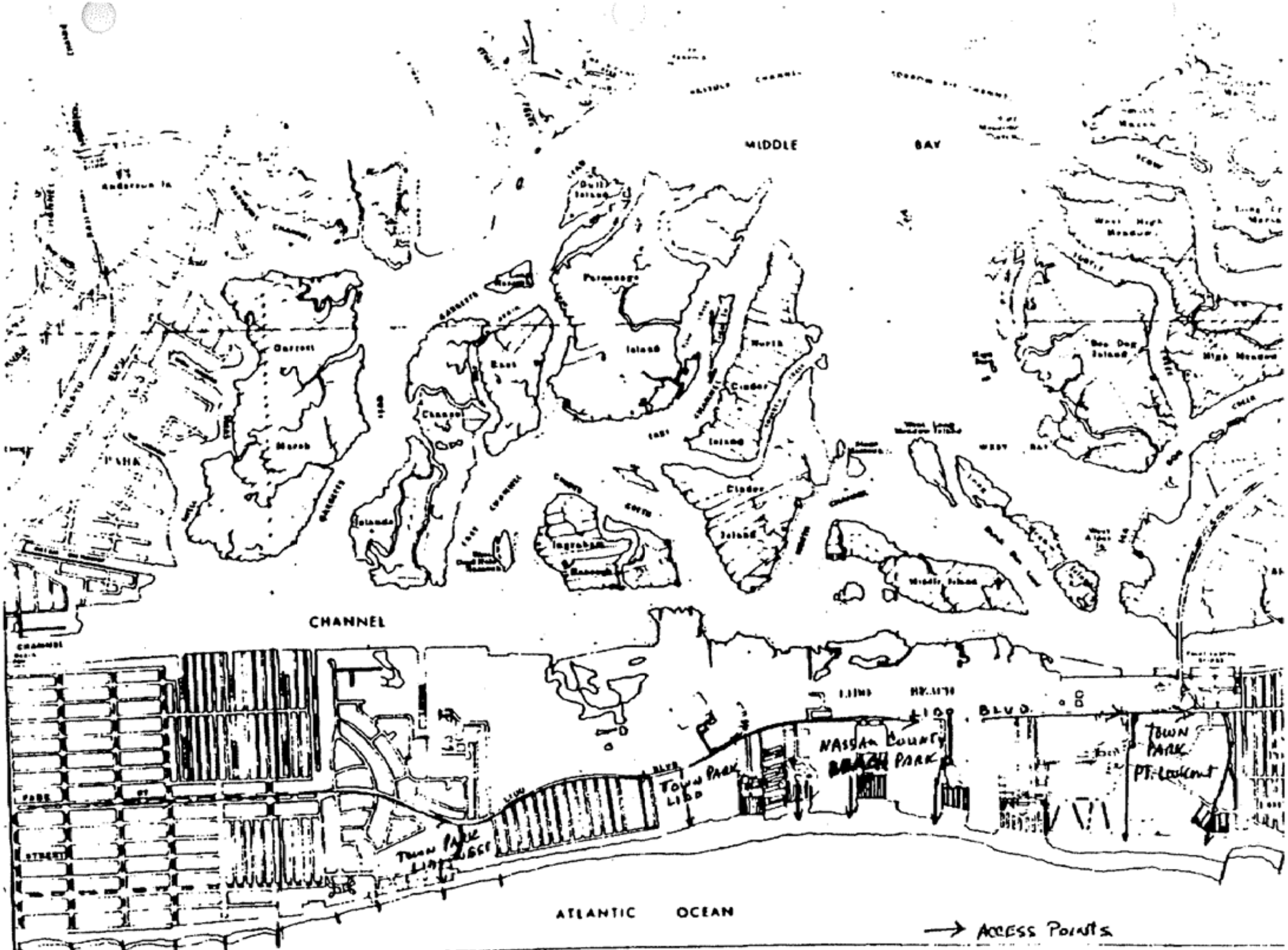
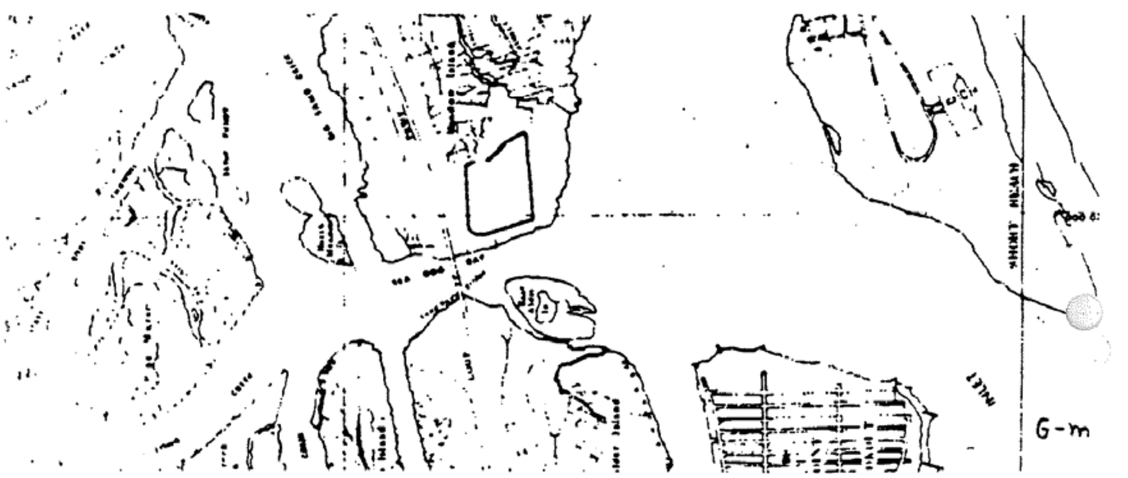

MIDDLE
BAY
CHANNEL
LIDO BLVD.
TOWN PARK
PT. Lookout
NASSAU COUNTY
BEACH PARK
TOWN PARK
LIDO
ATLANTIC OCEAN
→ ACCESS POINTS
JONES

FIGURE 1

G-2


G-m

APPENDIX H

MONITORING PLAN

H

APPENDIX H
PROPOSED MONITORING PROGRAM

Table of Contents

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Appendix H
Proposed Monitoring Program

H1. Introduction

Little documentation exists on the role of waves, tides and coastal currents in the behavior of beach nourishment projects. In order to improve Corps of Engineers ability to design projects and have them provide the desired erosion control, storm damage reduction and recreational benefits, data needs to be collected and analyzed in a systematic manner. Coastal processes data need to be compared to project behavior data and the results applied to improved design templates. With increasing costs and stringent regulations on project impact, monitoring must become a required part of any project, with an ultimate goal of improved design and increased project longevity.

H2. The following description details the requirements of the coastal processes monitoring for Long Beach, New York. There are four tasks; fill monitoring, borrow area monitoring, shoreline change monitoring and wave/littoral environment monitoring.

Fill Monitoring

H3. Beach Profiles. Beach profiles will be collected before and after initial fill placement and twice a year throughout the first nourishment cycle (5 years). A total of 13 profiles will be sampled within the project area. Repetitive survey of these monitoring profiles will track the movement of placed fill alongshore and offshore and will provide estimates of subsequent erosion and/or accretion. Monitoring profiles are shown in Figure H1.

H4. Profiles will be taken from known benchmarks that are documented and recoverable. Each monitoring survey will cover the same profile locations. Beach profile locations have been established on lines surveyed in 1988 and 1991 and will be used for monitoring where applicable. Profiles will extend from a stable point on the beach (e.g. behind the dune crest, behind a seawall, on the boardwalk) on a repeatable line normal to the shoreline out to closure depth (about 30 ft. contour line) or a minimum of 2500 feet seaward.

H5. Profiles will be surveyed immediately before fill placement (prefill), immediately after fill placement (postfill), and twice per year over the time period of one nourishment cycle (5 years). One survey will capture characteristics of the winter beach and will be taken in March or April. The second set will capture the characteristics of the summer beach and will be taken in September or October. Special profile surveys should be conducted subsequent to all major storm events. For estimating purposes, an additional two sets of post-storm beach profile surveys per year for years 1 through 5 (the first nourishment cycle) have been included. Profiles will be surveyed once per year after the first nourishment cycle.

H6. Beach Sediment Samples. In addition to profiles, sediment redistribution across the entire profile will be monitored during the time of beach profile surveying. This will be accomplished by taking sediment grab samples along the 13 profile lines. These samples will be taken at a minimum of three subaerial sample locations (mean high water, mid-tide level and mean low water) per profile line in the intertidal zone, and 4-6 locations offshore. If an offshore bar formation is evident, offshore samples will be taken at the bar trough, offshore bar crest, offshore bar seaward slope, and at seaward closure depth in the offshore zone. This sampling characterizes the hydrodynamic zonation of the sediment grain size distribution as the fill material readjusts to the coastal processes rather than the more common practice of sampling at fixed points seaward of a shore reference point regardless of profile shape and swash zone position. If, however, no offshore bar is evident, offshore samples will be taken at -4, -8, -12, -18, -24 and -30 ft. NGVD where appropriate. At each sampling site the x, y and z coordinates will be recorded. Sediment grab sampling will be done during profile collection to optimize manpower and field work.

H7. Storm Events. Monitoring fill after major storm events is highly desirable to assess fill behavior and storm protection ability. This monitoring should include a survey of all 13 profile lines as well as sediment sampling, an aerial survey, analysis and reporting. Two sets of post-storm profile surveys have been included per year for years 1 through 5 of the project life. Aerial photos following storm events (2 per year) for years 6 through 50 of the project life have also been included.

H8. Fill Response Data Analysis. Data analysis will include: profile volume change and shape readjustment, area of loss or gain on profile, volume of fill remaining in the project, assessment of alongshore and cross-shore fill movement from beach and nearshore fill placement area, and seasonal and storm response. Sediment analysis will include grain size statistics of native and fill material, with readjustment over the monitoring period, seasonal and storm grain size response, and assessment of fill and renourishment factors for future fill requirements.

Borrow Area Monitoring

H9. The Long Beach borrow area is shown in Figure H2. Borrow area monitoring for coastal processes is used to determine borrow site infilling rates, and to assess potential borrow reusability.

Vibracores and a subbottom survey will be taken at the end of the first nourishment cycle (year 5) to determine type and quantity of sediment filling in the dredged areas.

H10. Hydrographic and Subbottom Surveys. Hydrographic surveys of the borrow area will be taken before dredging and immediately after dredging, for initial construction and each renourishment operation (every 5 years). These will be compared to determine the borrow area infilling rate. Some area outside the dredged area should be surveyed as a control, for comparison of infilling rates in areas that were not dredged with those that were dredged. Subbottom surveys using a bottom penetrating acoustic device will be taken after initial dredging and in year 5 of monitoring. These will be used to determine type and quantity of sediments at greater depth.

H11. Cores. Cores will be taken after the first nourishment cycle (in year 5 of monitoring) in those areas which were dredged to determine the composition of the infilling material and to help quantify volumes of infilling. At this time 15 cores 20 feet in length are proposed. Actual number, length and location of cores will be decided based on bathymetric and seismic surveys performed in year 5 of monitoring.

H12. Borrow Area Data Analysis. Representative samples for each identified sediment layer will be taken per core to assess the reusability of the entire borrow area. The exact number and location of samples within each core is a function of complexity of sediment types and layering, but a representative number of samples should be analyzed to characterize the entire core. At this time it is estimated that six samples will be taken per core. All lab analysis and operations on cores will be standardized as to description of sediment type and grain size distribution.

H13. Hydrographic surveys, seismic records and core data will be used to map spatial changes in the borrow area surface, and to determine sediment layer geometry. Infilling volumes and rates will be determined and compared to areas outside the borrow area. Suitability of material taken from the cores as beachfill material will be determined. Borrow areas dredged for initial construction will be examined for possible reuse in future renourishment cycles, based on suitability of material (Ra and Rj factors) and quantities available.

Shoreline Change Monitoring

H14. Aerial Photography. Aerial survey overflights of the project area including control areas east and west of the project will be done throughout the 50-year project life. Flights will be performed pre-fill, immediately post-fill, and at the time of biannual beach profile measurement during years 1 through 5. During years 6 through 50, aerial photography will continue to be performed twice a year. Additionally, aerial photos will be taken subsequent to major storm events (estimated at two per year) for the 50-year project life. Aerial photographs should be taken at low tide. These photographs will be used for construction of a base map and to document change over the entire project area. Coordination of aerials and beach profile surveys is necessary to facilitate analysis of shoreline change and to accurately determine volume changes in the beach fill.

H15. Each overflight mission will be a single flightline with 60% overlap stereo coverage including the entire project area shoreline. Black and white or color film with a 9 x 9 inch film format is recommended. The scale of the photographs should be sufficient to identify shoreline features, such as 1 inch = 800 feet.

H16. Shoreline Change Data Analysis. Data analysis will result in maps of successive shorelines, and, in conjunction with beach profile analysis, will result in estimates of volume changes in beach fill within the project reaches and downdrift areas. Cross-shore and alongshore sediment movement will be compared. Shoreline data will be digitized, and compiled into a database of shorelines.

Wave/Littoral Environment Monitoring

H17. Field Wave Data Collection. Wave, longshore current, and meterological data should be collected to understand the coastal processes that occur in the project area. Collection of wave data is an integral part of evaluation of any coastal engineering erosion control project, since wave driven coastal processes are a controlling factor in the response of the native and nourished beach. Significant profile and sediment changes can be expected during the fill placement and monitoring period as the fill material readjusts to the local wave climate. Establishing a cause and effect relationship between the waves and project response is essential to predict future fill behavior.

H18. Wave Gage. Wave data will be collected by deployment of a directional wave gage, and by observations from shore. Deploying a directional wave gage will provide the data used to compute longshore currents and assess the movement of the fill. Directional wave data will be collected with the deployment of one PUV meter which will provide continuous, real time data reporting for the project area. Exact location of the wave gage will be determined at the time monitoring is implemented.

H19. LEO Program. Since difficulties with operating a gage in the marine environment could occur, particularly during severe storms, the Littoral Environment Observations (LEO) program is recommended to supplement directional wave gage operation and to document alongshore variability and the inshore wave conditions. A systematic LEO program will supply important backup information to analyze project performance. Visual observations from LEO data include: 1) wave conditions such as direction, period, breaker height and breaker type, 2) beach data such as littoral current speed and direction, beach foreslope, rip current data, and beach cusp spacings; and 3) wind data, such as speed and direction. LEO information collection should begin before project construction and continue throughout the monitoring program.

H20. Wave/Littoral Environment Data Analysis. Wave data will be analyzed and reports prepared bi-monthly during wave gage operation. Standard analysis techniques will be used to provide information on the wave height and period, energy spectra, peak direction, mean current, and tidal elevation. Coastal processes data will be compared to project behavior data. Results will be applied to improve project design templates. Wave data from LEO observations will be compiled and analyzed on a yearly basis.

Analysis and Reporting

H21. Yearly reports will be compiled from monitoring data during the first nourishment cycle, as well as a final report at the end of the fifth year summarizing conclusions drawn over the first 5-year nourishment period. In general, reports should provide description of observed changes in the beach fill area and concurrent observed coastal processes and sediment data. Cause and effect relations between coastal and geomorphic processes and observed fill behavior will be sought and presented. Suggestions for improved beachfill design based on analysis of observations over the 5-year period will be made. Report requirements, if any, for the rest of the project life (years 6 through 50) will be reevaluated after the first renourishment cycle.

H22. Specific products from each task are described below:

H23. Task I: Fill Monitoring. All beach profiles survey data in graphic and digital form, and data from sediment analysis will be included in yearly and final reports. A comparison of repetitive beach profiles and estimates of behavior of placed fill including erosion/accretion volumes and changes in slopes will be made. Grain size distribution curves will be prepared. Sediment grain size variability with time will be presented in tabular and graphic form, and an estimate made of percentage of fine grain material lost from placed fill.

H24. Task II: Borrow Area Monitoring. Hydrographic surveys taken pre-and post-dredging for initial construction, and before and after dredging for the first nourishment cycle will be presented and used to analyze changes in bathymetry over time. Vibracore data and subbottom profile data will be presented, with estimates of sediment type and quantity to the depth of the vibracores. Sediment samples from the cores will be presented, and compared to core samples taken before dredging. Infilling rates will be computed, and recommendations on reusability of the borrow areas for future beach nourishment will be made, considering suitability of material, quantity of material available, and possible impacts to project shoreline.

H25. Task III: Shoreline Change Analysis. Digitized shorelines will be produced from aerial photographs, and will be presented in the form of shoreline change maps. A database will be created from repetitive shoreline information. Yearly and final reports will summarize the observed changes in the project shoreline and will describe the effects of coastal and geomorphic processes on the beach fill placement.

H26. Task IV: Wave/Littoral Environment Monitoring. Results from the PUV wave gage will include continuous record of wave height, direction and period. Littoral Environment Observation program records will be presented, and used to document alongshore variability and inshore wave conditions. Standard analysis techniques will be used to provide information on the wave height and period, energy spectra, peak direction mean current, and tidal elevation. Coastal processes will be compared to project behavior data.

Schedule and Budget

H27. A schedule of monitoring activities for the 50 years of coastal processes monitoring is shown Table H1. Total annual cost for coastal processes monitoring is $207,000. Estimated costs are subject to change due to conditions at the time of implementation of the monitoring program.

Table H1
Schedule of Monitoring Activities

	Prefill	Postfill	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6-50 per year
Fill Monitoring								
Beach Profiles	x	x	x x	x x	x x	x x	x x	
Sediment Samples	x	x	x x	x x	x x	x x	x x	
Borrow Area Monitoring								
Hydrographic Survey	x	x						x x (a)
Seismic Survey								
Long Cores (20')								
Shoreline Change Monitoring								
Aerial Survey	x	x	x x	x x	x x	x x	x x	x x
Wave/Littoral Environment Monitoring								
Wave Gage			x ---	------	------	------	-----x	
LEO Observations			x ---	------	------	------	-----x	
Reports			x	x	x	x	x	(b)
Storm Monitoring (estimated twice yearly)			x x	x x	x x	x x	x x	x x (c)

Notes: (a) Hydrographic surveys of the borrow area will be taken before and after each nourishment operation, i.e. in years 5, 10, 15, 20, 25, 30, 35, 40 and 45 of the project life.
(b) Report needs for years 6 through 50 will be determined after year 5.
(c) Storm monitoring for years 1 through 5 will consist of beach profiles, sediment samples, and aerial photography. For years 6-50 storm monitoring will be limited to aerial photography.

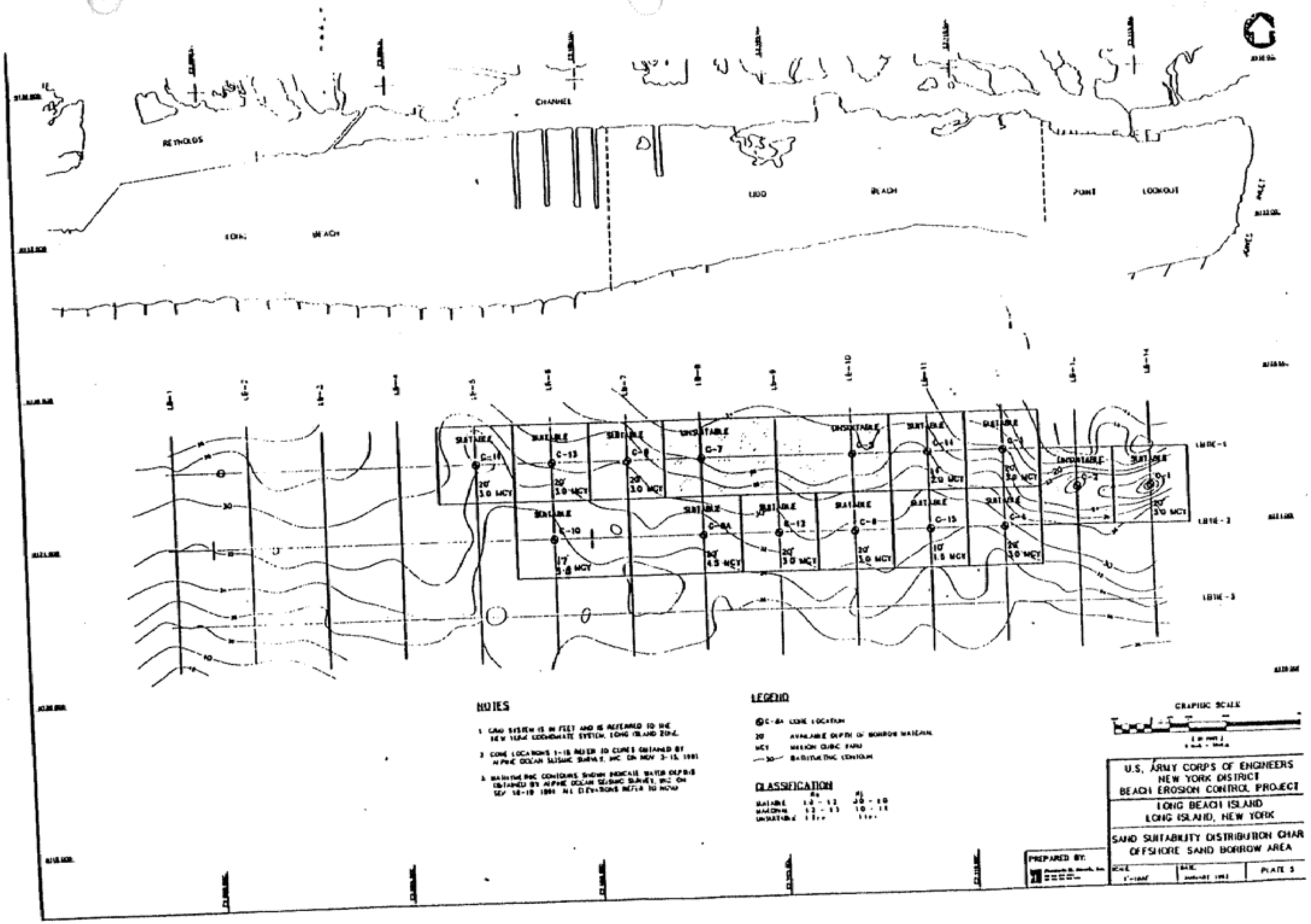
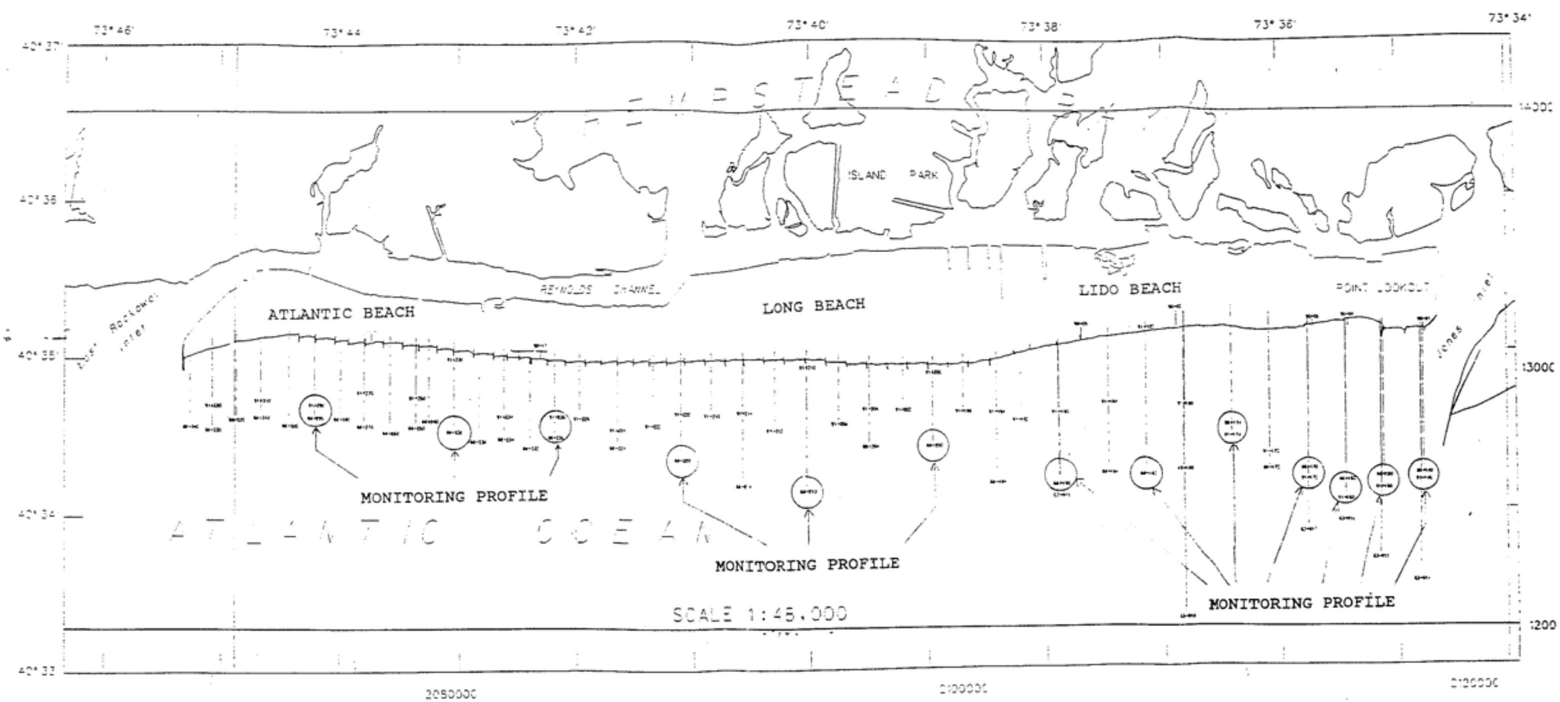

CHANNEL
REYNOLDS
LONG BEACH
LIDO BEACH
POINT LOOKOUT
SUITABLE
UNSUITABLE
NOTES
LEGEND
CLASSIFICATION
GRAPHIC SCALE
U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT
BEACH EROSION CONTROL PROJECT
LONG BEACH ISLAND
LONG ISLAND, NEW YORK
SAND SUITABILITY DISTRIBUTION CHAR
OFFSHORE SAND BORROW AREA
PREPARED BY:
PLATE 5

FIGURE H2



MONITORING PROFILE NUMBERS AND LOCATIONS

FIGURE H1