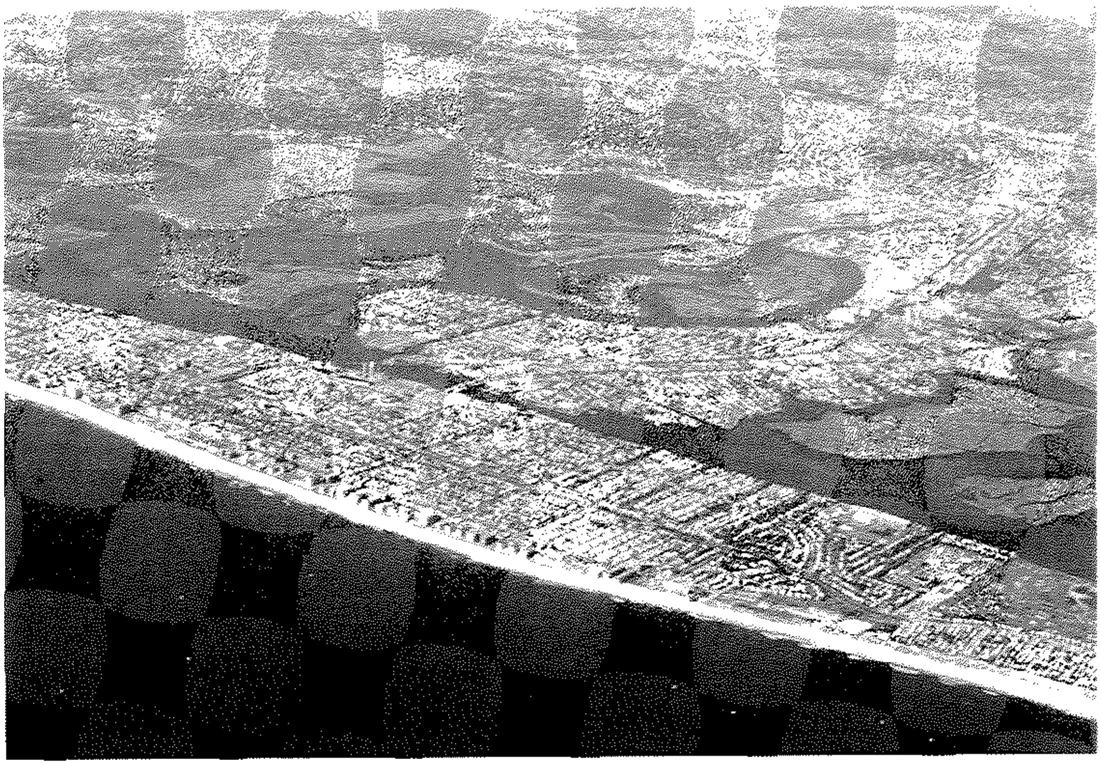
Atlantic Coast of Long Island
Jones Inlet to East Rockaway Inlet

Long Beach Island, New York
Hurricane And Storm Damage Reduction
Limited Reevaluation Report



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US Army Corps of Engineers
New York District
North Atlantic Division

New York State Department of Environmental Conservation

February 2006

Atlantic Coast of New York
Jones Inlet to East Rockaway Inlet

HURRICANE AND STORM DAMAGE REDUCTION
LONG BEACH ISLAND, NEW YORK

LIMITED REEVALUATION REPORT
WITH
DRAFT ENVIRONMENTAL ASSESSMENT

TOWN OF HEMPSTEAD
AND
NASSAU COUNTY
AND
CITY OF LONG BEACH

February 2006

PREPARED BY

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

SYLLABUS

This report, titled "Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York Limited Reevaluation Report," updates the recommended plan and incorporates recent changes to the 1995 Feasibility Report. It does not reanalyze project alternatives as the formulation of the authorized project is still considered appropriate for the Long Beach Island problem area. This report provides supporting technical documentation for the changes being recommended. This report also includes an update of the analysis of the associated costs, benefits, and environmental impacts for the recent changes. The benefits considered are derived from storm damage reduction to the barrier island including residential, commercial, and other structures; damage to infrastructure; public emergency costs; future protection costs; beach recreation benefits; and loss of land. The non-Federal sponsor is the New York State Department of Environmental Conservation (NYSDEC). Local sponsors include the Town of Hempstead, Nassau County, and the City of Long Beach.

The barrier island of Long Beach, New York is located on the Atlantic Coast of Long Island, New York, between Jones Inlet and East Rockaway Inlet. The area lies within Nassau County, New York. The Long Beach Island, New York Final Feasibility Report With Final Environmental Impact Statement for Storm Damage Reduction (Feasibility Report) was completed in February 1995, with a Record of Decision (ROD) issued in January 1999.

The Long Beach Project is a storm damage reduction project, which has been designed to provide protection against wave attack and inundation for homes and businesses along 6.4 miles (34,000 feet) of oceanfront, including the Town of Hempstead (Point Lookout and Lido Beach), Nassau County (Nickerson Beach), and the City of Long Beach for storms with a recurrence interval of 100 years. This area has been subject to major flooding during storms, causing damage to structures along the barrier island. Over the years, continued erosion particularly in the eastern areas, has resulted in a reduction in the height and width of the beachfront, which has increased the potential for storm damages.

The selected LRR storm damage reduction plan including changes from the authorized project, comprises 29,000 lf of beach fill and generally extends from the eastern end of the barrier island at Point Lookout to the western boundary of the City of Long Beach, including an incidental taper into East Atlantic Beach. No initial fill is being placed along 5,000 lf of shoreline in the Town of Hempstead, because at this time the protection afforded by the existing dunes and beach berm currently meets design criteria. This plan consists of:

- a dune with a top elevation of + 15 ft above NGVD, a top width of 25 ft, and landward and seaward slopes of 1V:5H along the entire project area except where the City of Long Beach boardwalk is located;
- sand barrier located directly beneath the City of Long Beach boardwalk with a 25 ft crest width at elevation +15.0' NGVD with a 1V:3H landward slope and 1V:5H seaward slope (except at boardwalk seaside ramp locations, where it has a 1V:2.5H landward and seaward slope). The toe of the sand barrier will extend approximately 15 ft seaward of the boardwalk;

- a beach berm extending 110 ft from the seaward toe of the recommended dune or sand barrier at an elevation of +10 ft NGVD, then gradually sloping approximately between 1V:20H (Point Lookout) and 1V:35H (Long Beach and Lido Beach) to match the existing bathymetry;
- total sandfill quantity of 6,600,000 cy for the initial fill placement, including tolerance, overfill and advanced nourishment;
- planting of 12 acres of dune grass and installation of 47,000 lf of sand fence;
- construction of 12 timber dune walkovers (including 8 ADA compliant and 1 extending from the boardwalk), 12 gravel surface dune walkovers, 8 extensions of existing dune walkovers, 8 gravel surface vehicle accessways, 2 swing gate vehicle access structures, 1 timber raised vehicle accessway, 1 reconstructed lifeguard headquarters, construction of timber retaining walls around: 4 existing comfort stations, 2 comfort stations with existing concession stands, and 1 lifeguard headquarters; replacement of 11,000 LF of boardwalk deck with composite wood;
- rehabilitation of 17 of the existing groins, plus the rehabilitation and 100-ft extension of the existing terminal groin at Point Lookout (18 structures total);
- 7 newly constructed groins at the eastern end of the island (3 of which are deferred construction to be built in the future if required);
- identification of 5,000 lf of bird nesting and foraging area for piping plovers and least terns (within the Town of Hempstead)
- advanced nourishment to ensure the integrity of the initial fill design;
- and periodic nourishment of approximately 1,726,000 cy of fill material at 5 year intervals for the 50 year life of the project.

The estimated initial cost of the recommended plan is $98,535,300 (October 2004 price levels, Discount Rate 5-3/8%). The Federal Government shall contribute 65% of the initial cost of the selected plan, which is currently estimated to be $63,592,900 and the non-Federal sponsor shall contribute 35% of the initial cost, which is currently estimated to be $34,942,400. The annual cost for this plan is estimated to be $9,016,600, with annual benefits of $24,008,700. The benefit to cost ratio (BCR) is calculated to be 2.7. Periodic nourishment of the selected plan shall be cost shared at 65% Federal and 35% non-Federal. Note that for the initial fill and renourishment fill within two segments of the project in Lido Beach, the non-Federal sponsor or the Town of Hempstead will fund 100% of the cost, because these lands are privately owned and privately used.

Beach fill for initial construction and periodic renourishment for the project life would be obtained from a designated borrow area approximately 1.5 miles south of Long Beach Island.

The proposed work will have no significant impact on the quality of the human environment in the Project Area. It has been determined that the impacts to environmental resources in the proposed Project Area are expected to be minor and less than those that would have resulted from the original Project recommended by the 1995 Feasibility Report. Special consideration was given to the effects of the selected plan on surfing, fishing, and cultural experiences. Most impacts associated with this project will be temporary, and none of the impacts are regarded as significant.

The non-Federal sponsor, NYSDEC, has indicated their support for the LRR selected plan and is willing to enter into a Project Cooperation Agreement with the Federal

Government for the implementation of the plan. Local municipalities along the barrier island intend to cost share the non-Federal share with the State. These municipalities, which include the Town of Hempstead, Nassau County, and the City of Long Beach, are supportive of the selected plan. The plan provides improvements to 6.4 miles of public shorefront. The unincorporated Village of East Atlantic Beach has asked not to be included in the project and is not affected by the proposed plan, with the exception of an incidental taper of beach fill material (1,500 ft).

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
HURRICANE AND STORM DAMAGE REDUCTION
LIMITED REEVALUATION REPORT

PERTINENT DATA

DESCRIPTION: The authorized project with changes developed for this LRR provides a protective beach with a dune system and groin system to reduce the potential for storm damage along 34,000 ft of shoreline along the barrier island of Long Beach, New York.

LOCATION: Town of Hempstead, Nassau County, and the City of Long Beach, NY

BEACH FILL

Volume of Initial Fill	6,600,000 cy
Volume of Renourishment Fill	1,726,000 cy
Interval of Renourishment *	every 5 years for 50 years

** Subject to the Corps monitoring program*

Length of Fill *	29,000 ft

** Reflects no fill along 5,000 ft of shoreline for bird nesting and foraging area*

Width of Beach Berm	110 ft
Width of Dune Crest and Sand Barrier	25 ft

ELEVATIONS

Dune Crest and Sand Barrier	+15 ft NGVD
Beach Berm	+10 ft NGVD

SLOPES

Dune (Landward and Seaward)	1V:5H
Sand Barrier (Seaward)	1V:5H
Sand Barrier (Landward) *	1V:3H
Beach Berm to existing bottom (Point Lookout)	1V:20H
Beach Berm to existing bottom (Lido Beach and Long Beach)	1V:35H

** Some limited locations have a 1V:2.5H landward and seaward side slopes at existing boardwalk ramp locations.*

GROINS

(1) Rehabilitation of 15 existing groins in the City of Long Beach
(2) Rehabilitation of 2 existing groins in the Town of Hempstead (Point Lookout)
(3) Rehabilitation and extension (100 ft) of the terminal groin in the Town of Hempstead (Point Lookout)
(4) Seven New Groins fronting the Town Park in the Town of Hempstead (construction of 3 of the 7 groins has been deferred based on monitoring and determination of future needs)

ATLANTIC COAST OF LONG ISLAND,
JONES INLET TO EAST ROCKAWAY INLET,
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FOR
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DUNE APPURTENANCES

Timber Dune Walkovers (including 8 ADA compl. and 1 extending the boardwalk)	12
Gravel Surface Dune Walkovers	12
Extensions of Existing Dune Walkovers	8
Gravel Surface Vehicle Accessways	8
Raised Timber Vehicle Accessway	1
Swing Gate Vehicle Access Structures	2
Dune Grass	12 ac
Sand Fence	47,000 lf

STRUCTURAL COMPONENTS

Construction of Timber Retaining Walls* around:

1) 5 existing comfort stations
2) 2 existing comfort/lifeguard stations
3) 1 existing lifeguard headquarters

**All within the City of Long Beach*

Construction of Lifeguard Headquarters (Town of Hempstead)	1
Replacement of Boardwalk Surface with Composite Wood	11,000 lf

ECONOMICS (October 2004 price levels)

Initial Project First Cost	$98,535,300
Annual Project Cost (Discounted at 5-3/8% over a 50-year period)	$9,016,600
Average Annual Benefits (Discounted at 5-3/8% over a 50-year period)	
Storm Damage Reduction	$21,902,300
Public Emergency Costs	$52,800
Future Protection Costs	$400,900
Recreation	$1,652,100
Loss of Land	$600
Total	$24,008,700
Net Excess Benefits	$14,992,100
Benefit to Cost Ratio	2.7

COST APPORTIONMENT (FIRST COST)

Federal (65%)	$63,592,900
Non-Federal (35%)	$34,942,400
Cash	$33,282,400
Beach fill in Lido Beach (private properties)	$700,000
Real Estate Lands and Damages	$57,500
Relocations (Lifeguard Headquarters in Town of Hempstead)	$902,500

ATLANTIC COAST OF LONG ISLAND
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LONG BEACH ISLAND, NEW YORK
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LONG BEACH ISLAND, NEW YORK
HURRICANE AND STORM DAMAGE REDUCTION
LIMITED RE-EVALUATION REPORT

I. Introduction

1. The barrier island of Long Beach, New York is located on the Atlantic Coast of Long Island, New York, between Jones Inlet and East Rockaway Inlet. The area lies within Nassau County, New York. The Long Beach Island, New York Final Feasibility Report With Final Environmental Impact Statement for Storm Damage Reduction (Feasibility Report) was completed in February 1995, with a Record of Decision (ROD) issued in January 1999. The Long Beach Project is a storm damage reduction project, which has been designed to provide protection against wave attack and inundation for homes and businesses along 6.4 miles of oceanfront, including the Town of Hempstead (Point Lookout and Lido Beach), Nassau County (Nickerson Beach), and the City of Long Beach for a 100 year storm event, or storms that have a 1 percent chance of being equaled or exceeded in any one year (see description of storm event frequency data in Section II - Stage Frequency). This area has been subject to major flooding during storms, causing damage to structures along the barrier island. Over the years, continued erosion, particularly in the eastern areas, has resulted in a reduction in the height and width of the beachfront, which has increased the potential for storm damages.

A. Purpose of the Limited Re-Evaluation Report

2. This Limited Reevaluation Report (LRR) serves as a decision document for budgeting for and construction of the Long Beach Island, New York Storm Damage Reduction Project. It addresses relevant changes in the existing condition that have occurred since the Feasibility Report was completed in February 1995. Moreover, because more than three years have passed since completion of the latest approved economic analysis (i.e. more than 3 years since the Feasibility Report), ER1165-2-100, requires that the economic analysis of the project be updated. The updated analysis demonstrates that the plan recommended in the Feasibility Report is economically justified and environmentally acceptable, in accordance with policy. Additionally, this LRR documents design refinements that improve project cost effectiveness and its acceptability to local interests. It also serves as the basis for a Project Cooperation Agreement (PCA) between the Federal Government and the non-Federal Sponsor, New York State Department of Environmental Conservation (NYSDEC). The PCA is the agreement which commits both the Federal Government and the non-Federal sponsor to implement a storm damage reduction project with a 50-year project life, to be accomplished via initial construction and periodic beach fill nourishment at 5-year intervals. Changes proposed to the Feasibility Recommended Plan from this report are incorporated into the revised Recommended Plan via this LRR.

The report is organized as follows:

- First, it presents the history of the project and the existing conditions;
- Second, it summarizes changes that have occurred since publication of the Feasibility Report and the effects of these changes on the Recommended Plan;
- Third, it confirms that the Recommended Plan remains economically justified and environmentally acceptable.

This LRR does not reanalyze the alternatives, but simply updates the recommended plan, and incorporates recent changes.

B. History of the Project

3. In 1965, the New York District prepared a draft survey report, addressing storm damage protection for Long Beach, New York. This survey report, entitled Beach Erosion Control and Interim Hurricane Study for the Atlantic Coast of Long Island. New York. Jones Inlet to East Rockaway Inlet, was prepared to determine the best method of restoring adequate protective beach fronts and recreational beaches, to provide continued stability of the beach, and to develop an adequate plan of protection against storm tidal inundation of the barrier island.

4. The 1965 report recommended a multiple purpose plan of improvement for shore and hurricane protection of the study area. This plan was designed to provide protection against tidal inundation caused by the occurrence of a hurricane surge level of 12.3 ft above sea level. The recommended plan of 1965 included hurricane barriers, closure levees, an oceanfront dune with protective beach berm, groin reconstruction, construction of a terminal groin at Jones Inlet and periodic beach nourishment. This plan was economically justified.

5. Local interests voiced objections to the 1965 recommended plan. The primary objection was that the proposed dune along the oceanfront was not compatible with the type of development on the barrier island of Long Beach. Even after various modifications, the plan was still not acceptable to local interests. The New York District sent a letter, dated July 21, 1971, to the New York State Department of Environmental Conservation (the local cooperating agency), indicating that the study was to be terminated and a negative report issued. The local interests concurred with the termination of the study.

6. Following Hurricane Gloria in 1985 and in response to the authorizing resolution of 1986, Federal funds were allocated in 1988 to conduct a reconnaissance study of the area entitled "Long Beach Island, New York." The reconnaissance report entitled Atlantic Coast of Long Island. Jones Inlet to East Rockaway Inlet, Long Beach Island, New York: Reconnaissance Report, dated March 1989, was approved by the Office of the Chief of Engineers (OCE) in July 1989. The reconnaissance report indicated that a 110-foot wide beach at an elevation of +10 ft NGVD, backed by a dune system to elevation +15 ft NGVD with suitable advance and continuing nourishment would be an implementable design. The plan included the rehabilitation of 30 groins and the reconstruction of the terminal groin at the eastern end of the island. This analysis indicated a first cost of $53.2 million (Oct 1988 price levels), with a resulting benefit to cost ratio of 1.7. These findings indicated that there is Federal interest in protecting the barrier island of Long Beach from storm damage, therefore, the reconnaissance report recommended that the necessary planning and engineering studies proceed to a cost shared feasibility study. State and local government officials concurred in the decision to proceed, and a Feasibility Cost Sharing Agreement was signed in September 1990. With the receipt of non-Federal and matching Federal funds in May 1991, the Feasibility Study was initiated.

7. Numerous reports and other documents have been prepared regarding the navigation oriented studies conducted in the Jones Inlet area. The most recent of these reports entitled Section 933 Evaluation Report, Jones Inlet, New York, dated March 1993, connected the dredging of material from Jones Inlet with the storm damage reduction potential for the barrier island, specifically the eastern end of the island at Point Lookout. This evaluation report determined that it is justified to place material dredged from Jones Inlet onto the adjacent beaches based on the benefits derived from storm damage protection. This report was approved by the Headquarters of the Army Corps of Engineers (HQUSACE) in August 1993. Based upon the findings of the evaluation report and the authorizing language in Section 933 of

the Water Resources Development Act of 1986, the incremental cost of placing the dredged material from Jones Inlet onto the adjacent beaches in the Town of Hempstead was cost-shared 50% Federal-50% non-Federal, in lieu of offshore (or less costly) disposal. In 1994 and 1996, Jones Inlet was dredged and the material was placed onto the adjacent beaches in accordance with the basic design presented in the Section 933 Evaluation Report.

8. In 1995, the feasibility report titled; Long Beach Island, New York Final Feasibility Report with Final Environmental Impact Statement for Storm Damage Reduction (Feasibility Report) was completed.

9. Following approval of the 1995 Feasibility Report, the 1996 Water Resources and Development Act (WRDA) authorized the project for construction. Due to a change in Federal policy regarding the budgeting of hurricane and storm damage projects that include a beach nourishment component, the Pre-Construction Engineering and Design Phases were not initiated immediately subsequent to the authorization of the project recommended by the 1995 Feasibility Report. It should also be noted that WRDA 1999 changed the cost sharing for beach nourishment projects; however, the cost-sharing of this project was not affected because it was previously authorized (as stated above).

10. Following authorization of the project recommended by the 1995 Feasibility Study, East Atlantic Beach chose not to participate in the project. Along with the Village of Atlantic Beach, which opted out of the project during the Feasibility phase, the East Atlantic Beach community (an unincorporated village in the Town of Hempstead) opted out of the project because they were unwilling to provide the level of public access required by the State of New York. The removal of East Atlantic Beach is a small change (based upon the small percentage of told project benefits and costs, approximately 10% of the 1995 Feasibility Recommended Plan) to the overall project as recommended by the 1995 Feasibility Study. The elimination of the dune and beach fill from East Atlantic Beach will not significantly affect the design protection for the rest of the project's protection area.

11. The Final Environmental Impact Statement (FEIS) was completed in March 1998. Following completion of the FEIS, the Record of Decision (ROD) was received in December 1998 and filed in the *Federal Register* in January 1999.

12. As part of the PED phase for the authorized project for Long Beach, in February 1999, a technical analysis entitled Terminal Groin Rehabilitation and Extension at Jones Inlet, Long Beach Island was completed and developed as a project modification to include the rehabilitation and extension of the terminal groin at Point Lookout to reduce the loss of sand from the beach and shoaling in the inlet.

13. The Recommended Plan from the Feasibility Study was completed by the New York District in 1995. It included the construction of six new rubble mound groins along a portion of the eastern shoreline of Long Beach Island, New York. The project area is shown in Figure 1. As part of the PED effort for Long Beach, in March 2000, a report entitled, Technical Reanalysis of the Shoreline Stabilization Measures for the Eastern Portion of the Long Beach Island, New York Project was completed. This report evaluated and developed a revised plan for groin construction along the Lido Beach and Point Lookout shoreline reaches. The proposed groin field was found to be necessary to reduce sand losses to the berm and dune system. Also changed from the Feasibility Recommended Plan is the project alignment so as to make it more suitable from the point of view of certain non-federal interests. This 85 ft landward alignment change includes removal of the proposed dune fronting the boardwalk and replacing it with a sand barrier of similar geometry under the boardwalk. Beside addressing non-federal concerns

regarding the potential for adverse change in the character of the beachfront, this alignment will be more cost effective than the one it has replaced.

14. Local residents and officials were concerned that the proposed groin field would, because of its ability to retain sand, reduce transport of sand downdrift of the groin field, thus inducing greater erosion (more erosion than in the without project condition) immediately west of the last groin. Concerns of local residents were based to some extent on the situation at nearby Westhampton, New York, where an uncompleted groin field was constructed over the eastern part of the barrier beach, and significant erosion occurred downdrift of the groin field along the ungroined shoreline over the years, while the groined portion of the barrier beach remained stable. The Long Beach Island Feasibility Report stated that, on Long Beach Island, the change in shoreline orientation west of the proposed groin field, specifically, formation of the ebb shoal attachment site, makes it unlike the Westhampton case and therefore it is unlikely that severe downdrift impacts will be experienced. The evidence presented in the feasibility report did not convince residents of Long Beach of this conclusion. Several other factors added to the reluctance of Long Beach residents to accept the conclusions of the Feasibility Report. First, the long-established residential communities in Lido Beach and Lido West would be west of the proposed groin field termination point and the residents felt they were potentially vulnerable to downdrift erosion. Second, that beach area has been observed to experience significant changes in beach width and elevation between seasons and during storms. Third, there would be about 7,000 ft of shoreline without groins, and therefore potentially vulnerable, between the groined beach of the City of Long Beach and the proposed new groin field.

15. The New York District, the U.S. Army Corps Coastal and Hydraulics Laboratory and New York State took these concerns seriously and set forth to reanalyze the project. This reanalysis addressed the issues of local concern and reexamined other portions of the Feasibility Recommended Plan using the latest computer models, utilizing the field measurements or surveys obtained since the Feasibility Study.

16. Since the Feasibility Study was performed in 1995, the New York District's Atlantic Coast of New York Monitoring Program (ACNYMP) has collected significant amounts of data to document beach conditions and processes. The enhanced understanding of the coastal processes over those available at the time of the Feasibility Study, together with changing field conditions and improved numerical modeling tools, have resulted in the reanalysis of shoreline stabilization measures for the eastern end (Point Lookout) of Long Beach Island. Significant accretion has taken place in the western portion of the eastern study area, especially at the ebb shoal attachment point (herein also called the ebb shoal "weldment"), as shown in Figure 13. However, to the east of the weldment, beach erosion has continued to occur with the attendant potential for flooding and other types of storm damage including endangering shorefront bath house and parking facilities. The discussion concerning these coastal processes can be found in the Physical Conditions section.

C. *Description of Authorized Project*

17. The Recommended Plan as presented in the 1995 Feasibility Report is a storm damage reduction plan which is characterized by a 110 ft wide beach berm at an elevation of +10 ft NGVD, and a dune system with a top elevation of +15 ft NGVD. The plan includes approximately 41,000 linear ft of beach fill which extends from the easternmost end of the barrier island at Point Lookout to Yates Avenue in East Atlantic Village, where the recommended plan tapers into the existing shoreline in Atlantic Village. The 1995 plan also includes groin construction and rehabilitation of existing groins to minimize the need for future beach renourishment. The 1995 Feasibility Report Recommended Plan is shown on Figure 2 to Figure 12. The Recommended Plan consists of the following components.

a) 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: A 15 to 25 ft maintenance area is included landward of the dune.

b) Berm: Extending 110 ft from the seaward toe of the dune at an elevation of +10 ft NGVD with a shore slope of 1 on 25 for the easternmost 5,500 lf of the project thence transitioning to a 1 on 35 slope for the remaining shoreline.

c) A total sand fill quantity of 8,642,000 cy including the following:

- +1.0 ft tolerance
- overfill factor of 2.5%
- advanced nourishment width of 50 ft

d) The dune construction includes planting 29 acres of dune grass and installation of 90,000 lf of sand fence for dune sand entrapment.

e) 16 dune walkovers and 13 timber ramps for boardwalk access, and 12 vehicle access ramps over the dune.

f) 6 new groins west of the existing groins at the eastern end of the island, spaced approximately 1,200 ft apart across 6,000 lf of beach frontage.

g) Rehabilitation of 16 of the existing groins, including rehabilitation of 640 ft of the existing revetment on the western side of Jones Inlet.

h) Renourishment of approximately 2,111,000 cy of sand fill from the offshore borrow area every 5 years for the 50 year project life. Beach fill for the proposed project is available from an offshore borrow area containing approximately 36 million cy of suitable beach fill material. The borrow area is located approximately 1.5 miles offshore of the barrier island of Long Beach.

i) To properly assess the functioning of the proposed plan, monitoring of the placed beach fill, borrow area, shoreline and wave and littoral environment is included in the plan. Environmental monitoring is being addressed through coordination with other interested agencies.

D. Authorization

18. The feasibility phase of studies for storm damage protection for the Long Beach barrier island was the second of a two-part study effort. The study was conducted in response to the authority of a resolution by the Committee on Public Works and Transportation of the U.S. House of Representatives adopted October 1, 1986, which reads:

> "Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, that the Board of Engineers for Rivers and Harbors is hereby requested to review the previous report on the Atlantic Coast of Long Island, New York, Jones Inlet to East Rockaway Inlet, authorized by resolution of the Committee on Public Works and Transportation, adopted March 20, 1963, and June 19, 1963, respectively, and also in response to Public Law 71, 84th Congress, First Session, approved June 15, 1955, with a view to determining the feasibility of providing storm damage protection works for Long Beach Island."

19. The construction of the Long Beach Island Storm Damage Reduction Project was authorized in Section 101 of the Water Resources Development Act of 1996, which reads in pertinent part:

> "(21) ATLANTIC COAST OF LONG ISLAND, NEW YORK. – The project for storm damage reduction, Atlantic Coast of Long Island from Jones Inlet to East Rockaway Inlet, Long Beach Island, New York: Report of the Chief of Engineers, dated April 5, 1996, at a total cost of $72,091,000, with an estimated Federal cost of $46,859,000 and an estimated non-Federal cost of $25,232,000."

E. Changes in Project Purpose

20. There is no change in project purpose. The project purpose remains the same as presented in the Feasibility Report, which is to provide for storm damage reduction along the barrier island of Long Beach. The study covers the Atlantic Coast of Long Island from Jones Inlet to East Rockaway Inlet and considers the restoration and protection of the shore of Long Beach Island from erosion and ocean storm damage. This report considers the results of the reconnaissance phase and feasibility phase of this study and includes the additional analyses conducted during the LRR phase to develop project refinements or modifications.

II. Existing Conditions

A. Physical Conditions

21. The physical conditions are the same as presented in the 1995 Feasibility Report, are considered to be adequate for this LRR, and are provided for continuity. A summary of the physical conditions in the study area is as follows:

22. Tides. Tides along the Atlantic shore portion of the study area are semi-diurnal. The mean tidal range along the outer coast of Long Beach is 4.5 ft and the spring tidal range reaches 5.4 ft. In Hempstead Bay, these ranges are 3.9 ft and 4.7 ft, respectively. The Mean High Water (MHW) level and Mean Low Water (MLW) level relative to NGVD are +2.5 ft and -2.0 ft, respectively for the Atlantic coast.

23. Currents. Tidal currents along the ocean shore of the study area are generally weak. Currents at Jones Inlet and East Rockaway Inlet have respective average maximum velocities of 3.1 and 2.3 knots at flood tide, and 2.6 and 2.2 knots at ebb tides.

24. 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 effect 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. Velocities during tropical storms exceed 60 mph, and may approach 100 mph during severe storms.

25. Waves. The direction of wave approach to the Long Beach Island shoreline is primarily from the south and southeast. A wave height-frequency curve was developed to obtain storm wave conditions (USACE New York District, 1995). Breaking wave heights were calculated for the 10, 25, 50, 100 and 500 year return periods using the data provided by the Coastal Hydraulics Laboratory. The results of storm wave conditions, including significant and breaking wave heights and the corresponding wave periods, are summarized in Appendix A of the 1995 Feasibility Report. The results of these calculations indicate that the deep-water wave height for a storm having a 100-year return period would be 21 ft.

26. 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) decreased atmospheric pressure; and 3) storm waves that 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. 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 based on the calculated water elevations for the 10, 25, 50, 100 and 500 year return periods. A storm having a return period of 100 years is calculated to have an associated water level elevation of 12.1 ft above NGVD. The following table illustrates the calculated ocean and bay elevations for various return period storms.

Table 1: 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

*Note: Return period or storm event frequency data can be presented as follows:
5 year storm event = 20% probability of a storm of this magnitude or greater occurring in a given year.
10 year storm event = 10%
20 year storm event = 5%
50 year storm event = 2%
100 year storm event = 1%
200 year storm event = .5%
500 year storm event = .2%

27. Sea Level Rise. The effects of possible changes in relative sea level were examined in accordance with EC 1105-2-186. 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, which correlates to 0.5 ft of increased water elevation over the 50-year project life. All project alternatives would require the same additional nourishment volumes and the same increase in berm and dune elevation. Therefore, the rate of sea level rise should have no impact on which alternative is the optimum. However, the impact of sea level rise on erosion rates throughout the project area would still need to be investigated.

28. Storms. The study area is subject to damages from hurricanes and from extratropical cyclones known as "nor'easters". Hurricanes strike the study area from June through November, and more frequently within this period from August through October. Nor'easters primarily strike the study area from October through March.

29. A summary of storms that struck, or occurred, near the project area from 1665 to 1962 is given in Appendix E of the 1965 Survey Report. More detail on historic storms can be found in that document. Appendix A of the Feasibility Study gives details on the major storms, which affected the project area in the more recent past.

30. 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 greater than or equal to 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.

31. 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 September 12, 1960.

32. Nor'easters. Named after the predominant wind direction, these are large-scale, low pressure disturbances that are less intense than hurricanes. Nor'easters have sustained wind speeds that rarely exceed 50 knots, although gusts can reach hurricane strength in a very intense nor'easter. Flood damage caused by a nor'easter 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 shoreline protection features.

33. Nor'easters 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 nor'easter of record that struck the project area occurred March 6- 8, 1962. It caused serious tidal flooding and widespread damage all along the Middle Atlantic Coast.

34. More recently, the Halloween Nor'easter of 1991 and the December 1992 Nor'easter caused significant inundation and erosion. Damages associated with these extratropical storms included property damage, damage to the boardwalk, groin damage and debris washing into the streets due to the severe coastal flooding.

35. 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 terminal 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.

36. The back-barrier lagoons and elongated-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.

37. Littoral Materials. Beach sediment grab samples were collected in 1988 along ten profile lines at +8, 0, -8, -18 and -30 ft NGVD. 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. 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. In light of the concerns of the local sponsor (primarily the City of Long Beach), about sand grain size and color, the analysis shows that the median grain size of the sand pumped onto the beaches in the Project area is very close to the existing native sand. With regard to the color of the sand, it is expected that exposure to sunlight will bleach the sand, over time, so that it looks more like the native sand on the beach. This bleaching is typical of what occurs following beach placement of dredged material.

38. Analyses were performed to compare offshore borrow material with the three native beach material models to determine the overfill and renourishment factors. Borrow areas were selected based on the compatibility of the material with the native beach sand. Detailed evaluation to determine beach and borrow area compatibility is presented in Appendix B of the Feasibility Report.

39. The following paragraphs discuss the findings from the Technical Analysis regarding the coastal processes, which serve as a basis for better understanding the design changes presented later in the LRR.

40. The influence of a tidal current is important and can be the dominant force, along coastal areas adjacent to an inlet. The majority of the sand bypassing Jones Inlet (from east to west) forms an ebb shoal to the southwest of Jones Inlet, which reattaches with the shoreline in the area known as the weldment. Within the region from Jones Inlet to the weldment area, the nearshore littoral drift (net transport) occurs toward the east. West of the weldment area (Lido Beach to Long Beach) in an area where the impact of the tidal current is minimal, there is a reversal of the littoral drift, to the west. A small fraction of the sand bypassing Jones Inlet remains in the system and becomes part of the net littoral drift westward through Lido Beach and Long Beach.

41. Three central coastal processes issues were identified. The first issue is the degree of stability of the shoreline position in Lido Beach. During recent years, significant accretion has taken place in the western portion of the eastern study area (Eastern Lido Beach and Nickerson Beach), especially in the area of the weldment. In addition, numerous beach fills have been placed in the Point Lookout and Hempstead Beach areas. Both Hempstead Beach and Lido Beach have benefited significantly from the beach fills. Since 1993, Lido Beach has experienced a noticeable degree of shoreline stability and has accreted as sand from the ebb shoal attachment, or weldment, point and the beach fills has been transported to the west. Only in the extreme western portion of Lido Beach has there been slight shoreline recession since 1990. The numerical modeling performed in the reanalysis effort was validated to reproduce those historical trends.

42. The second issue is the bypassing of sediment from Jones Beach into the ebb shoal and to the shoreline on Long Beach Island. Aerial photography and shoreline mapping data indicate a progressive advance of the shoreline and widening of the ebb shoal attachment point on Long Beach Island. Physical data, anecdotal (observational) evidence, and shoreline evolution modeling agree that the attachment point has progressed seaward and, has widened in both an easterly and westerly direction and should continue to do so. Widening toward the east may

become limited by strong tidal- and wave-driven currents, which could inhibit sediment from accreting. Coincident growth of the fillet (or pocket of sand) at the western end of Jones Island, a growth of the ebb shoal south of Jones Inlet and the formation of a flood shoal north of Jones Inlet are all typical features indicative of inlet sand bypassing processes. Calibrated numerical modeling of shoreline changes west of the ebb shoal attachment point (Lido Beach to Long Beach) requires a sediment influx that is consistent with the long term longshore sand transport rate and inlet bypassing rate determined using long term wave statistics. Therefore, the physical characteristics of the inlet features, the continued growth of the ebb shoal attachment point, and the requirement for a sediment supply at the attachment point for successful simulations of shoreline evolution indicate that bypassing of sediment from Jones Beach to Long Beach is occurring and is expected to continue.

43. The third issue is the process by which erosion occurs between the ebb shoal attachment point and the inlet. Numerical modeling performed in the reanalysis study indicates that during storm events from easterly directions the littoral drift near the shoreline is toward the west. However, further offshore, littoral drift is toward the east, with significant onshore-directed sediment transport from the shoal. It has been during storm conditions that erosion of the beach has been observed, when material is carried both toward the west and offshore, where the high currents then carry the sediment back toward the inlet where it is deposited. During mild wave conditions from the southwest, the littoral drift is generally east-directed both near the beach and in the offshore area. It is during the milder wave conditions that the onshore-directed sand transport from the shoal and the general east-directed transport creates an accreting condition offshore of the –6 ft contour, which appears to be responsible for the relatively flat bathymetry over this area. Further applications of numerical models indicate that a groin field can inhibit the erosional processes in this area.

44. Based on a better understanding of these central coastal processes through more advanced numerical modeling tools and expanded physical data from the area, a refined shoreline stabilization approach was developed that addresses beach erosion conditions existing in 1998 (the date when this study was initiated and when the most recent data were collected) while minimizing project cost and potential impacts on downdrift shoreline areas. The refined plan would consist of seven groins with the first groin constructed 800 ft west of existing Groin 55 in Point Lookout and the second through fourth groins constructed at intervals of 800 ft with lengths tapering to the weldment area (Figure 13).

45. Shoreline Changes. Shoreline changes between 1835 and 1990 are shown in Appendix B (Figure 2-3 and Figure 2-3a (Figure A-5) from the Feasibility Report). During this time period the barrier island/inlet system evolved to its present configuration. The magnitude of shoreline change, which has historically ranged from as erosive as -23 ft/yr at the eastern end of the barrier island to as accretive as +51.0 ft/yr in the west end (following the construction of the East Rockaway Inlet jetty), indicates the great potential for sediment movement that exists along the entire Long Beach shore. Stabilization efforts, namely construction of inlet jetties, groin fields, and seawalls, as well as periodic beach fill, 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.

46. Recent and Predicted Shoreline Changes. During recent years significant accretion has taken place in the eastern portion of the project area, especially in the area of the ebb shoal attachment point, the weldment. In addition, numerous beach fills have been placed in the Point Lookout and Hempstead Beach areas. Both Hempstead Beach and Lido Beach have benefited significantly from the beach fills. Since 1993, Lido Beach has experienced a noticeable degree of shoreline accretion as sand from the ebb shoal attachment point and the beach fills has been transported to the west. Only in the extreme western portion of Lido Beach has there been slight

shoreline recession since 1990. The numerical modeling performed in this limited reevaluation effort has been validated to reproduce those historical trends.

47. Bypassing Of Sediment From Jones Beach To The Shoreline On Long Beach Island. Calibrated numerical modeling of shoreline changes west of the ebb shoal attachment point (Lido Beach to Long Beach) requires a sediment influx that is consistent with the long term longshore sand transport rate and inlet bypassing rate determined using long term wave statistics. The physical characteristics of the inlet features, the continued growth of the ebb shoal attachment point, and the requirement for a sediment supply at the attachment point for successful simulations of shoreline evolution indicate that considerable bypassing of sediment from Jones Beach to Long Beach is occurring and will continue.

48. Erosion Between The Ebb Shoal Attachment Point And The Inlet. The present work indicates that this area exhibits coastal processes that are very different than those west of the ebb shoal attachment point. Numerical modeling performed in this study indicates that during storm events from the easterly directions the littoral drift near the shoreline is toward the west. However, further offshore, the littoral drift is toward the east, with significant onshore-directed sediment transport from the shoal. It has been during storm conditions that erosion of the beach has been observed, when material is carried both toward the west and offshore, where the high currents then carry the sediment back toward the inlet where it is deposited. During mild wave conditions from the southwest, the littoral drift is generally east-directed both very near the beach and in the offshore area. It is during the milder wave conditions that the onshore-directed sand transport from the shoal and the general east-directed transport creates an accreting condition offshore of the –6 ft contour, which appears to be responsible for the relatively flat bathymetry over this area. Further applications of numerical models indicate that a groin field can inhibit the erosional processes in this area.

49. 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 beach fills placed in that time period. This sediment budget was prepared during the Feasibility Study. The growth of the ebb shoal weldment constitutes a change of existing condition since completion of the Feasibility Study. This change was summarized and examined in *Section III, Without Project Conditions*, in the March 2000 Reanalysis. 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.

50. Sediment Budget-Projected 50-Year. A sediment budget was prepared for a 50-year projection, to reflect the without-project condition. This sediment budget was also prepared during the Feasibility Study. 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 estimated 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. 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.

51. Existing Beach Characteristics. At the time of the Feasibility Report preparation, dunes were present on 14 out of 33 profile surveys. The average maximum dune elevation measured on the beach profiles was +17.75 ft NGVD, with a range of maximum elevations from +13.5 to +20 ft NGVD. Average dune crest width was 17.12 ft, ranging from no flat crest to 160 ft of crest width. Dune side slopes ranged from 1V:4H to 1V:12.5H.

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

53. Offshore slopes were steeper on the eastern end of the island from Jones Inlet extending approximately 7,500 feet westward, averaging 1V:21.75H. The remaining offshore slopes averaged 1 V:34.52H.

54. Existing Coastal Structures. An update to the groin condition survey was conducted on September 29-30, 2003. This survey included on-site review of the structure dimensions and approximate elevations, 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 total of 40 groins were surveyed, 32 of which are located in the project area: 3 groins in Point Lookout, 4 groins in Lido Beach, 23 groins in the City of Long Beach, and 2 groins within the area of the taper of beach fill in East Atlantic Beach. The remaining 8 groins are located in the stretch of East Atlantic Beach, no longer included because the town opted out of the project. Each of these groins was evaluated as to structural condition, sand trapping effectiveness and planform holding effectiveness. The results of the survey are discussed in the "Design Change – Existing Groin Rehabilitation" section.

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

B. Economic Conditions

56. Population. Population in the City of Long Beach has increased from a 1980 total population of 34,073 to a 2000 total of 35,462. This trend is also evidenced in the overall population for Nassau County, and expected to continue in the future.

57. Income. Per capita income is an indicator of the economic strength of a community. The per capita income in the City of Long Beach has increased during the period of 1979 to 2000 from $12,479 to $31,069. This rate of increase is higher than that of the State of New York, yet slightly less than the overall rate for Nassau County.

58. Transportation. The study area is accessible to major population and commercial centers, through an extensive network of highways, roads and railways. Direct access from the major corridors to the barrier island is provided by three vehicular bridges from: Loop Parkway on the eastern end of the barrier island; Atlantic Beach bridge on the west; and the Long Beach causeway in the center. The communities are also served by the Long Island Railroad, which provides passenger rail service from eastern Long Island and New York City directly into the City of Long Beach. There is a public bus which runs east to west along the major artery of the barrier island from Point Lookout to Atlantic Beach.

59. Beach Usage. The south shore of Long Beach Island is a continuous strip of sand beach serving the year-round inhabitants as well as the great influx of summer visitors and vacationers. Most visitors to Long Beach are from Nassau, Kings, Queens, and New York Counties. From 1999 to 2002 an average of 500,000 people visited the beach in the City of Long Beach, and from 1994 to 2002 an average of almost 500,000 in the eastern beaches of Point Lookout, Nassau County and Lido Beach. It is noted that due to the erosion, which has most severely affected the usage of the Point Lookout area, beach attendance has substantially declined. For example, the attendance in this area in 1984 was 523,065 while the average attendance from 1993 to 2002 was approximately 130,000.

60. Shore Ownership and Use. The majority of the beaches within the study area are publicly owned and publicly accessible. Within the Town of Hempstead there are several privately owned properties and several special park districts, which are discussed further in the formulation section. There is public transportation to the majority of the beaches as well as sufficient parking area along most of the project shorefront. There is full lateral beach access along the entire study area shorefront, and a public bus, which provides drop-offs along the main artery of the barrier island. As prescribed by Corps policy and regulations, costs of improvements in those areas that are not open to the public would be 100% non-Federal, unless protection to such areas is incidental to the project. The State has submitted a Public Access Plan, which is intended to conform with Federal policy. To allow for full public access and yet offset the levies that residents are charged for beach maintenance, several of the beach areas have adopted differential fees, which include higher fees for non-residents than residents.

C. Environmental Resources

61. The project shoreline has been highly modified as a result of human development. Upland areas within the project area have been committed to residential, commercial, and recreational development.

62. Nourishing the project shoreline would serve the public interest by preserving beach and dune habitat from erosion and significantly increase protection to the shoreline from storm-induced waves and surges. In addition, it would preserve beach habitats for sand-dwelling invertebrates and a large population of shorebirds, as well as serve as a feeding and resting area for migrating birds along the Atlantic Flyway.

Significant Resources

63. **Regional Wildlife Resources**. Within the project area itself, the high degree of public recreational use of its beaches and development of adjacent lands limits their value to wildlife species. Gulls, terns, skimmers, and sandpipers typically use such areas for resting and feeding. Many species of waterfowl including geese, dabbling ducks, and diving ducks overwinter in the bays, inlets, and harbors along the south shore of Long Island. Many birds utilize the Jamaica Bay Wildlife Refuge and Gateway National Recreation Area located west of the project area and would, therefore, be expected to occur in the Long Beach Island vicinity on occasion. Terrestrial birds such as the rock dove *(Columba livia)*, mourning dove *(Zenaida macroura)*, tree swallow *(Iridoprocne bicolor)*, barn swallow *(Hirundo rustica)*, European starling *(Stumus vulgaris)*, American robin *(Turdus migratorius)*, common grackle *(Ouiscaluspuiscula)*, house sparrow *(Passer domesticus)*, and house finch *(Carpodacus mexicanus)* would be common in the developed area adjacent to the beaches. The Federally-listed threatened piping plover *(Charadarius melodus)* and State- listed endangered least tern *(Sterna antillarum)* currently nest at Nassau Beach, Lido Beach, and Atlantic Beach. Nesting occurred at Point Lookout until 1991, when coastal erosion due to storms eradicated the available nesting sites.

Mammalian species likely to be found in these areas include gray squirrel *(Sciurus carolinensis)*, house mouse *(Mus musculus)*, Norway rat *(Rattus norvegicus)*, eastern cottontail *(Svlvilagus floridanus)*, and feral cat *(Felis catus)*.

64. **Borrow Area Biological Resources**. The important biological resources of the proposed borrow area are the benthos (bottom fauna) and fin-fisheries. The diverse benthic fauna provides food for diverse fish species. The nearshore area provides a migratory pathway and spawning, feeding and nursery area for many species common to the mid-Atlantic region. The borrow area lies approximately 1.5 miles south of Long Beach Island between 25 ft mean low water (MLW) to about 60 ft MLW. Phytoplankton in this zone are an important food source for filter-feeding bivalves. A community dominated by sand dwelling organisms is found in the proposed borrow area. Very few individuals that occur in fine-grained materials were found in the borrow area. In June of 1993, the Corps conducted benthic invertebrate sampling within the proposed borrow area. Seventy-five taxa commonly found in sandy-bottom habitats were found during the course of the sampling, which indicated a clear positive correlation between number of taxa and percent silt/clay of sediments (WCH Industries, 1994). The presence of high proportions of juveniles and of species with short life cycles suggest that populations undergo large seasonal variations in this habitat (WCH Industries, 1994). Polychaete worms and blue mussels are the most numerous macrobenthic organisms. The most numerous species in the survey was the tube-dwelling polychaete *(Asabellides oculata)*.

65. Important recreational species found in the proposed borrow area include Atlantic mackerel *(Scomber scomblrus)*, black sea bass *(Centropristes striatus)*, winter flounder *(Pseudopleuronectes americanus)*, summer flounder [fluke] *(Paralichthvs dentatus)*, and scup *(Stenotomus chrvsops)*.

66. Shipwrecks, obstructions and large rocks, in the borrow area and nearshore zone provide habitat for attaching organisms not found on sandy bottoms. Within the project area, shipwrecks may exist within one mile of the shore or within the borrow area. Shipwrecks and artificial reefs (such as the existing groins) provide shelter for fish and invertebrates. Hydroids, sponges, barnacles, mussels, polychaetes, crabs and lobsters are some of the organisms expected to use shipwrecks, artificial reef structures and irregular bottoms. Atlantic cod, pollock, hake and black sea bass are among the common species associated with high profiles and underwater structures and thus these areas are important to both recreational and commercial fisheries.

67. Shellfish also occur in the proposed borrow area. The most important bivalve species are the surf clam *(Spisula solidissima)*, the tellin *(Tellina agilis)*, and the razor clam *(Ensis directus)* (Steimle and Stone, 1973). In addition to the above there are gastropods, amphipods, isopods, sand dollars, starfish, and decapod crustaceans. This assemblage was also sampled by the June, 1993 Corps survey (WCH Industries, 1994).

68. **Surf Clam Survey**. Although it has been determined that there is no significant impact from dredging of the borrow site to the surf clams, the following analysis was performed to address any potential impacts to the surf clam industry. A surf clam stock assessment (survey) was conducted to characterize the existing relative abundances of surf clams in the proposed offshore borrow area. This survey was conducted on August 22, 2003 along the south shore of Long Beach Island, New York in coastal waters approximately 1 mile southwest of Jones Inlet. Details of this survey are presented in Environmental Appendix - Appendix I.

69. **Surf Clam Density**. The catch was standardized for each trawl for varying speed and distance. A standard trawl by NYSDEC is 3,418 square feet. Standardized data indicate that the offshore borrow area delineated by the New York District has very small, to no localized surf

clam populations. Twelve of the 32 stations sampled had less than one US bushel taken. The maximum number of US bushels taken in one tow was 15.5.

70. Stations that contained limited numbers of clams were located in the deepest water and the stations containing the most clams were those closest to shore in the shallowest water. The stations that yielded 0.5 bushel of clams or less were all in water with depths greater than 30 ft, whereas the stations containing greater than 10 bushels were at depths less than 30 ft. These data are consistent with the known vertical distribution of adult surf clam beds that have an average depth of 50 ft (Fay et al, 1983).

71. **Size Distribution Analysis.** There were many legal-sized clams measured from representative sub-samples. Of the 32 stations that were sampled, 28% contained clams that ranged from 120 to 170 mm. Only two (Stations 267 and 216) had clams with a mean length of less than 120 mm.

72. The density and size distribution of surf clams found in this study is consistent with other investigations. Surf clams can inhabit waters from the surf zone to a depth of 400 ft; however, Ropes (1978) reported that the highest populations off Long Island are found at depths of less than 60 ft. It has also been reported that clams offshore grow faster and attain a larger maximum size than clams inshore (Wagner, 1984; Ambrose et al, 1980). Cerrato and Keith (1992) report an inverse relationship between density and growth rate with high clam density negatively affecting growth rates. Thus, sparsely populated areas will tend to have larger clams.

73. **Commercial Implications.** Because a vessel's harvest of clams is limited by permit, decisions on where to clam are based on obtaining the maximum allowable harvest at the lowest cost per bushel. This decision considers the density and proximity of clam beds. Because the permit limits maintain a healthy stock of clams available for harvest, clammers generally meet the permit quotas. Decisions on how much to harvest are therefore controlled by the permit levels, not by the availability clams for harvest. The clam population in the proposed borrow area is small. The proposed borrow area is in deep water where populations densities are lower. It is unlikely the commercial clammers currently exploit the borrow area because of the combination of lower clam densities and greater distance from port. Thus, the loss of clams in the proposed borrow area would have a negligible effect on the surf clam industry.

74. **Regional Fishery Resources**. A variety of fish species with recreational and commercial importance can be found in the vicinity of the Long Beach Island beaches and East Rockaway and Jones Inlet areas. Many species of marine fish use the shallow nearshore waters as feeding areas. Important recreational species include Atlantic mackerel *(Scomber scomblrus)*, black sea bass *(Centropristes striatus)*, winter flounder *(Pseudopleuronectes americanus)*, summer flounder [fluke] *(Paralichthvs dentatus)*, and scup *(Stenotomus chrvsops)*. The principal species using this area include tautog *(Tautoga onitis)*, northern puffer *(Sphoeroides maculatus)*, black sea bass, striped bass *(Morone saxatilis)*, weakfish *(Cvnoscion regalis)*, and bluefish *(Pomatomus saltatrix)*. Species commonly found in the more protected inlet waters to the east include scup, windowpane *(Scophthalmus aquosus)*, summer flounder, winter flounder, and American eel *(Anguilla rostrata)*.

75. **Significant Coastal Habitat**. In the project area, Nickerson Beach is listed as significant coastal fish and wildlife habitat by the New York State Department of State (1987). Nickerson Beach is located approximately one mile west of Point Lookout. The beach is located within Nickerson Beach County Park, in the Town of Hempstead, Nassau County. The significant habitat consists of approximately 15 acres of sparsely vegetated dunes and the adjacent shell

and pebble area inland and north of the dunes. Although the beach receives heavy recreational use during the summer months, the habitat area is generally located behind the open beach, and receives little disturbance. The Town of Hempstead actively posts and protects the area.

76. This area serves as an important nesting area for the State-listed endangered least tern *(Sterna albifrons)* and Federal-listed threatened piping plover *(Charadrius melodus)*. In 1993, there were 6 piping plovers and zero least terns recorded in the area; a marked decrease from 8 piping plovers and 148 least terns in 1992 (NYSDEC, 1994). This drop appears to correlate with the severe erosion taking place at the project area.

Threatened or Endangered Species

77. The Federal-listed threatened piping plover, the State- listed threatened common tern *(Sterna hirundo)*, and the endangered least tern all use essentially the same habitat: sand or sand/cobble beaches along ocean shores, bays, and inlets between the high tide line and the area of dune formation. They usually nest at sites with little or no vegetation. However, it is not uncommon to find plover nests at the seaward base of dunes, or even behind the dunes, where blowouts provide access and where beachgrass *(Ammophila breviligulata)* can shelter the nest and eggs from the sun and weather (Andrle, 1988). Piping plovers have been cited within portions of the proposed project area, specifically in the "weldment area" (shown in Figure 13). Section 7 consultation under the Endangered Species Act, as amended (ESA), is ongoing to identify necessary measures to reduce the possibility of any actions significantly impacting shorebirds in the proposed project area.

78. No State and/or Federal-listed endangered or threatened marine species are known to breed within the study area. However, during the summer and early fall months, the threatened loggerhead *(Caretta caretta)*, endangered Kemp's ridley *(Lepiduchelvs kepmi)*, leatherback *(Dermochelvscoriacea)*, and green *(Chelonia mydas)* sea turtles occur in New York coastal waters (NMFS, 1993). Although sea turtles have been known to occur in this region, nesting has been documented only as far north as New Jersey (NRC, 1990). Consultation with the National Marine Fisheries Service under Section 7 of the Endangered Species Act of 1973, as amended, has resulted in the requirement that NMFS-approved observers will be utilized if hopper dredges are used.

D. Cultural Resources Baseline

79. To fulfill the Corps' responsibilities according to the National Historic Preservation Act of 1966, as amended (NHPA), the Abandoned Shipwreck Act of 1987, and the Advisory Council on Historic Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800), a cultural resources survey was prepared as part of this LRR. An extensive history and prehistory of the Long Beach Island area was compiled and a pedestrian survey of the shore portion of the study area was conducted (Pickman 1993). Within the waters of the Atlantic Ocean, preliminary near shore surveys were undertaken in 1996, 1998 and 2004 (Panamerican Consultants, Inc., 1996, 1998, 2004).

Onshore Portion of the Project Area

80. **Prehistoric Resources**. The cultural resources study found that there were no known prehistoric or contact period archaeological sites located on Long Beach Island (Pickman 1993:9). Native Americans living on the main portion of Long Island may have visited Long Beach Island for brief periods of time to collect fish and shellfish (Pickman 1993:11). The island, however, would not have been attractive to Native Americans for permanent or semi-permanent settlement because of its exposure to the wind and weather from the Atlantic Ocean. Long

Beach would have been especially uninviting to Native American occupation because there was no source of fresh water available on the island (Pickman 1993:11).

81. **Historic Resources**. The first European settlers arrived on Long Island during the first half of the seventeenth century. It was not until the middle of the nineteenth century, however, that Long Beach was occupied by Euro-Americans. According to local histories, no structures were located on Long Beach until after 1849. Residents of the mainland used the island primarily for pasturage. In 1849, a Life Saving Station was constructed on Long Beach to house surf boats, lifesaving apparatus and a crew of six to seven men.

82. Between 1849 and 1879, only a few buildings were constructed on Long Beach. In 1873, a transatlantic cable connecting New York to England, via Halifax, Nova Scotia, made its landfall at Long Beach Island, between the current Edwards and Riverside Boulevards. The development of the island began in 1880 with the construction of a railroad from Lynbrook to Long Beach and the construction of the first large resort hotel and bathing pavilion on the island. This was followed by the construction of a number of other hotels in the 1880s and 1890s and during the first two decades of the twentieth century. Summer homes and permanent residences were also built on the island during the twentieth century. The location of these structures was well north of the present boardwalk and beach zone (Pickman 1993:14-32; 51). No significant remains of the project area's history would be situated along the site of the present beach.

83. Two structures located in the vicinity of the project area, the Granada Towers and the United States Post Office, are listed on the NRHP. One private residence, located on Washington Boulevard and thought to be one of the first private homes on Long Beach, is listed on the historic structures inventory maintained by the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP). None of these structures will be affected by the proposed project.

Near Shore and Offshore Portions of the Project Area

84. **Shipwrecks**. Several dozen possible shipwrecks were identified in the initial near-shore survey of the project area (Panamerican Consultants 1996 and 1998) around Long Beach. Further testing on these sites will occur prior to construction. Two shipwrecks have been documented within the near shore sand placement zone near Lido Beach and Point Lookout (Pickman 1993, Panamerican Consultants 1996 and 1998). The 1837 wreck identified as the *Mexico* occurs near Lido Beach and a second unnamed wreck occurs near Point Lookout (Pickman 1993, Panamerican Consultants 1996 and 1998). Both wrecks are eligible for inclusion in the National Register of Historic Places and further work on each of these sites will be required prior to construction.

85. A Programmatic Agreement with the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP) will be completed by Spring 2006. This agreement will codify the requests made by the NYSOPRHP at the end of the EIS with regard to the future survey work in the Long Beach area, as well as outline the proposed testing strategy for the shipwrecks in the Lido Beach and Point Lookout areas. The agreement will also incorporate the steps to be taken if further buried resources are uncovered during the testing phases for the previously mentions areas.

86. **Submerged Prehistoric Sites**. During the last glacial period, the sea level was up to 400 feet lower than current levels. The shoreline at this time lay at the outer edge of the continental shelf approximately 100 miles from the present shoreline. According to area studies, the sea level rose at a steady pace between circa 7000 to 3000 before present era, with a slower rate of increase after circa 3000 before present era. Cores taken adjacent to the project

area indicate the presence of peat, silt, and clay deposits that are remains of the lagoons that formed behind the barrier islands that were created off the present Long Island shoreline at this time. The presence of these lagoonal deposits may mean that the inundation of the ground surface occurred in a low energy environment, which may have permitted any prehistoric sites located in the nearshore area to survive any disturbance. These deposits would consist of organic peat and/or organic silts and clays (Pickman 1993:46).

87. The proposed borrow area may also contain prehistoric land surfaces. The borrow site would have been available for human occupation until some time after 7000 before present era. Two of fifteen cores taken from within the borrow site to a depth of 20 ft below the ocean floor contained either a clay layer or layer of dark gray silt (Pickman 1993:47). Based on data taken from cores and borings for adjacent areas, it is possible that these two cores taken within the borrow site may represent land surfaces that would lie on top of prehistoric deposits (Pickman 1993:48).

III. Problem Identification

A. Description of the Problem

88. Long Beach Island is low-lying and generally flat. The terrain gently irregularly slopes downward from the Oceanside development toward the bayside of the island. The island is densely populated and has thousands of closely spaced residential, commercial, and public structures. When coastal storms occur there is little to stop the breaking waves, which ride atop the storm surge, from overtopping the existing low beach berms and intermittent dunes, damaging property and threatening lives as the storm waters cascade across the island toward the bay.

89. As stated previously, the terrain of the island is low-lying and flat with elevations generally less than 10 ft above NGVD. Although some areas have dunes, the ocean shoreline of Long Beach Island generally consists of a continuous strip of generally low-lying beach with a series of groins along the oceanfront.

90. Severe storms in recent years have caused a reduction in the overall beach height and width along the barrier island, and accelerated deterioration of the locally constructed stone groins, which makes the densely populated communities along the barrier island increasingly susceptible to storm damage. The continuing erosion combined with the low elevation of the protective beach berm exposes Long Beach Island to a high risk of catastrophic damage from ocean flooding and wave attack.

91. The rate of erosion is most severe at the eastern end of the barrier island, where recurring damages have been most evident. During the December 1992 Nor'easter, in the Town of Hempstead Town Park, the concrete sidewalk in front of the lifeguard stations collapsed and subsequently the lifeguard stations were undermined. The Town has consistently refilled the area with stone and concrete rubble as armament to protect these facilities from further storm damage.

92. The problems encountered in the Long Beach study area also include the deterioration of the existing protective coastal structures. Many of the groins fronting the barrier island, including the terminal groin (Groin #58), have been severely battered by storms and have not been repaired or maintained since the 1950's when most of these structures were constructed. The deterioration of these structures decreases the protective capability of the beach and increases the vulnerability of the communities along the barrier island to storm damage.

93. The barrier island is also subject to flooding, though at lower stages and less frequently, from the bay side of the island. However, this report, as did the 1995 Feasibility Report, concentrates on the protection of the barrier island from direct ocean storm damage, and is not intended to consider protection from tidal inundation from the bay side of the island. Based on the current 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.

94. Since completion of the 1995 Feasibility Report, no major coastal storms have struck the shoreline of Long Beach Island.

B. Storm History

95. Coastal storms have been a continuing source of damage and economic loss within the study area with significant events occurring in September 1938, September 1944, November 1950, November 1953, August 1954, September 1960, March 1962, March 1984, September 1985, October (Halloween) 1991, December 1992 and March 1993. The March 1962 storm, extending over five high tides, caused severe erosion, wave attack and inundation with the ocean meeting the bay in at least one location. This storm resulted in approximately $28.5 million in financial losses to the study area based on October 2004 price levels.

IV. Without Project Future Conditions

96. The reanalysis report provided further insight into the coastal processes affecting the without project future condition. These processes are discussed in the following paragraphs.

97. In the without project future condition, it is anticipated that the project area will be subject to the same erosive forces and other storm effects, which have necessitated the desire for protective measures to be implemented. Coastal storms of various frequencies will continue to occur and erosion will continue unabated resulting in further reduction in beach height and width. The average erosion rate across the barrier island shoreline of approximately 2 ft/yr to 4 ft/yr is anticipated to continue, based on surveys from 1835 to 1990 in Long Beach and 1835 to 1998 in the eastern end of the project.

98. Such erosion would further diminish the storm damage protection capability of the beach and existing dunes, therefore making the barrier island structures increasingly more vulnerable to storm damage from wave attack and inundation due to wave run-up. As the long-term erosion diminishes the width of the beach, the recreation portion of the beach will be similarly diminished.

99. In the without project future condition, it is anticipated that local municipalities would allow erosion to continue until the shoreline reached the seaward toe of the existing dunes or boardwalk before taking remedial action to restore the beach. The City of Long Beach, Town of Hempstead, Nassau County and NYSDEC have corroborated this assumption. For example, continually diminishes the easternmost beaches in the Town of Hempstead between dredging cycles of Jones Inlet. The Town and the State have attempted emergency measures aimed at preserving the cabanas, lifeguard stations, bathhouses and parking lot by placing concrete rubble, sta-pods and other similar structures on the Point Lookout section of the beach.

100. To reduce the effects of long-term erosion, which would occur without any storm damage protection project in place, it is anticipated the State and local government officials would request beach placement of the dredged material from the Federal navigation channel at Jones

Inlet, as they have in the past. Currently, the non-Federal Sponsor is responsible for providing fifty percent of the additional cost of dredging above the least costly alternative. Beach placement of sand dredged from Jones Inlet was most recently conducted in 1996. The past ten years (since 1995) have shown that the frequency at which maintenance dredging of Jones Inlet is required is variable and cannot be relied upon for beach fill in the Point Lookout area, but if available it would be used to compliment this project to ensure that the design profile is maintained.

101. During coastal storms, some of the damages incurred along the barrier island come from inundation of the bay structures on the north side of the barrier island. The alternative plans considered are solely intended to provide protection from erosion, wave attack and inundation due to the oceanic forces. With the implementation of a storm damage protection project for the barrier island of Long Beach, it is anticipated that the range of bay elevations will not change from the elevations observed in the without project condition. Therefore it is anticipated that in the with- and without project conditions, flooding will continue in the back bay areas. Note that the Town of Hempstead and other sub-county jurisdictions have taken measures to ameliorate bayside flooding, including road raising, modification of drainage, and modification of bulkheads.

V. Plan Formulation

A. Planning Needs, Objectives, and Constraints

Current Needs

102. Over the years erosion has seriously reduced the ability of the shoreline in the project area to provide adequate storm damage protection of the barrier island. Continuation of this historic trend will increase the potential for economic losses and the threat to human life and safety. The feasibility report evaluated and recommended an implementable plan which provides protection to the barrier island of Long Beach against ocean storm damage, by considering various alternative means of reducing storm damage within the project area. This LRR does not reanalyze all of the alternatives, but refines the recommended plan by incorporating changes in field conditions and several design modifications to make the project more compatible with traditional shore uses. The costs, benefits, and environmental effects of these changes are evaluated in this LRR.

Planning Objectives

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

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

- Reduce the threat of potential future damages due to the effects of storms, with an emphasis on inundation and recession.
- Mitigate the effect of or prevent the long term erosion that is now being experienced.
- In accordance with the limits of institutional participation, all plan components must maximize NED benefits.

- Utilize available material, such as the dredged material from Jones Inlet. In developing plans of improvements, use a systems approach, which considers the barrier island as a system whose source is primarily the littoral material coming from the east.

Planning Constraints

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

Technical Constraints

- Plans must represent sound, safe, acceptable engineering solutions.
- Plans must be in compliance with Corps engineering regulations.
- Plans must be realistic and reflect state-of-the-art measures and analysis techniques. They must not rely on future research and development of key components.
- Plans must provide storm damage protection.
- Plans which consider elimination of a segment of the project area must ensure that the elimination of such areas do not adversely affect the protected areas or the areas which have been eliminated.

Economic Constraints

- Plans must be efficient. They must represent optimal use of resources in an overall sense. Accomplishment of one economic purpose cannot unreasonably impact another economic system.
- The economic justification of the proposed project must be determined by comparing the average annual tangible economic benefits that would be realized over the economic life of the project with the average annual project costs. The average annual benefits must equal or exceed the annual costs.
- Federal participation in storm damage reduction projects requires that the project be economically justified primarily on benefits associated with storm damage reduction. Federal funds are not used to support storm damage reduction projects for which incidental recreation benefits are greater than 50 percent of the total benefits unless the project is economically justified on primary benefits alone.

Environmental Constraints

- Plans cannot unreasonably adversely affect environmental resources.
- Where a potential impact is established plans must consider mitigation or replacement and should adopt such measures, if justified.

Regional and Social

- All reasonable opportunities for development within the study scope must be weighed one against the other and state and local public interests' views must be solicited.
- The needs of other regions must be considered and one area cannot be favored to the unacceptable detriment of another.
- Public access plans must be obtained for those area where sand is proposed to be placed, unless such placement is purely incidental to project function or for cost savings to the Government.

Institutional

- Federal and State participation must be contracted for a period of up to 50 years.
- Plans must be consistent with existing federal, state, and local laws.
- Plans must be locally supported to the extent that local interests must, in a signed cooperation agreement, guarantee all items of local cooperation including cost sharing.
- Local interests must agree to provide public access to the beach in accordance with all requirements of Federal and state laws and regulations.
- The plan must be fair and find overall support in the region and state.
- A project will be designed that conforms with Federal and State regulations in that the State is unable to participate in plans not conforming to its CZM. NYS Coastal Zone Management Plan regulations state that beach erosion projects must have a reasonable probability of controlling erosion for at least 30 years.

106. During the early phases of feasibility studies, the plan formulation process involves identifying possible solutions, which would meet the objectives of providing storm damage protection along the nine miles of Long Beach Island. Possible solutions considered in the initial phases of that plan formulation are listed below:

No Action
Beach Restoration
Beach Restoration with Groins
Seawall
Seawall with Beach Restoration
Bulkhead with Beach Restoration
Breakwater with Beach Restoration
Perched Beach with Beach Restoration

107. All of the preliminary alternatives were evaluated based on designs, that provide similar storm damage protection with the exception of the No Action alternative. Similarity in the level of protection for the alternatives is based on the following design assumptions which were common to all alternative solutions:

- All alternatives used a 73-year storm event as the design storm (All final alternatives were tested for events within a range of frequency from 200 to 500 years);
- Design wave heights, wave periods, still water levels and wave set-up elevations were the same for all alternatives considered;
- Continuous coverage of the entire project shoreline was provided by each alternative;
- All beach restoration alternatives assumed the use of the same sand borrow source.

108. Based on the evaluations of preliminary alternatives for providing storm damage reduction, the most cost effective alternative considered was determined to be beach restoration. The

study then considered different beach restoration configurations or plans to economically optimize the project design level. Nine beach fill 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.

109. Plan 5 was identified as the NED plan (maximized net annual benefits) in the 1995 Feasibility Report; it was an implementable design and it was the selected plan for providing storm damage protection for the Long Beach barrier island. This plan met all of the planning objectives and was also the locally preferred plan. A description of the selected plan is provided in the following section.

110. The selected plan in the 1995 Feasibility Report incorporates a beach berm at an elevation of +10 ft above NGVD, a dune system with a top elevation of +15 ft NGVD and a transition of the beach berm in the western end for closure of the project into East Atlantic Beach (which opted out of the project following authorization of the plan recommended by the 1995 Feasibility Report). At the eastern end of the project, a similar closure was selected which would taper the beach fill to the terminal groin at Point Lookout. The taper at Point Lookout was expected to be sufficient to prevent the added fill from drifting into Jones Inlet: therefore, extension of the terminal groin was not considered necessary. However, rehabilitation of the terminal groin and the adjacent revetment was included in the plan. A series of six groins were proposed west of the easternmost three groins, which would provide stabilization of the shoreline fronting the Town of Hempstead and Lido Beach. This additional groin field would also significantly decrease the volume and cost of material required in the renourishment of these areas, and therefore was determined to be economically justified.

B. Design Changes

111. There have been no new significant changes with regard to storms, morphological processes, and new projects within the project area. Based on updated surveys, additional field measurements, the withdrawal of East Atlantic Beach from the project, local sponsors' preferences, the results of the reanalysis and efforts associated with this LRR, some design changes to various components of the Recommended Plan were developed. These changes are discussed in the following paragraphs.

1. Reduction in Project Length
2. Dune Alignment
3. Beach fill
4. Rehabilitation of Existing Groins
5. Proposed Groin Field
6. Point Lookout Terminal Groin Rehabilitation and Extension
7. Bird Nesting and Foraging Area
8. Dune Walkovers, Vehicle Access and Boardwalk Deck Replacement

1. Reduction in Project Length

112. Following completion of the 1995 Feasibility Study, the community of East Atlantic Beach withdrew from participation in the storm damage reduction project. The Recommended Plan length was shortened accordingly, with the dune line ending at the border of the City of Long Beach and East Atlantic Beach. The berm tapers to closure with the existing shoreline west of the end of the dune line (approximately 1,500 ft into East Atlantic Beach).

113. The dune is shortened by about 7,000 ft and the berm is shortened by 5,500 ft. Although not a separable constructible area, East Atlantic Beach was the most downdrift of the protected communities. This location made it possible to remove the protective beach berm and dune and not adversely affect the functioning of the rest of the project. Also the degree of protection for the nearest adjacent community, the City of Long Beach, is not significantly affected. The economic evaluation for the rest of the project, which is discussed later in this LRR shows that there is no effect on the project's economic feasibility.

2. Dune Alignment

114. The dune alignment of the 1995 Feasibility Report Recommended Plan and the LRR Recommended Plan is the same for the 18,000 ft of the eastern end of the project area, i.e. from Point Lookout west to a location 1,900 ft west of the Lido Beach/Long Beach boundary, and the 4,000 ft of the western end of the project area, west of the Long Beach boardwalk area. Only 12,000 ft of dune alignment at the Long Beach boardwalk section of the project area has been revised from the 1995 Recommended Plan. This change was made in order to develop a plan that is more acceptable to non-Federal interests in the City of Long Beach. The 1995 Feasibility Report Recommended Plan included a dune fronting the boardwalk at Long Beach. For the boardwalk segment of the project, the Plan had a 2004 price level annual cost of $3,237,000 (including initial construction, annualized renourishment and annualized operation and maintenance differing from existing, but excluding major rehabilitation, interest during construction and monitoring costs).

115. Although the 1995 Feasibility Plan was acceptable to the administration in the City of Long Beach at the time, a series of new concerns has been raised by local surfers, fisherman and environmental groups, the 1995 Feasibility Plan became unacceptable. Among these concerns is the feeling that the project as designed in 1995 would change the historical character and aesthetics of the boardwalk area and partially block ocean views from boardwalk users. In addition, local surfers and fishermen were concerned that the seaward extent of the footprint of the 1995 Plan would negatively impact conditions that have been conducive to fishing and surfing. In order to address these concerns, three possible modifications of the 1995 Feasibility Report Plan were investigated: (1) An update of the 1995 Recommended Plan with boardwalk extensions at Long Beach, (2) A Seawall Plan at the Long Beach boardwalk and (3) A Sand Barrier Plan at the Long Beach boardwalk.

116. **Updated 1995 Recommended Plan at Long Beach with Boardwalk Extensions (Modification 1).** For this modification, the dune alignment fronting the boardwalk was retained, but boardwalk extensions were proposed at various street ends, configured such that they would traverse the dune alignment. This plan would bring people over the dunes, closer to the ocean (to mitigate the visual impacts of the fronting dune) and closer to future beach activities and would allow the City to elevate its buildings (comfort and lifeguard stations) to boardwalk level, bringing them out of the innundation area.

117. The modified plan added a proposed boardwalk extension for fifteen street end locations each with a proposed length of approximately 100 ft, which would be sufficient to traverse the

proposed dune and 25 foot maintenance area. The width of each boardwalk extension; however, would vary depending upon location and projected use (i.e. relocation of comfort stations/lifguard stations).

118. Five comfort stations, two comfort/lifeguard stations and one lifeguard headquarters were proposed for relocation on these boardwalk extensions. In order to reduce utility hookup costs it was proposed to situate comfort stations and lifeguard stations closer to the boardwalk rather than far out on the extensions. The relocated lifeguard stations would allow continued proximity to and visibility of the nearshore ocean area. The existing beach structures would have been removed during the installation of the dunes.

119. The 2004 price level annual cost for the Long Beach boardwalk segment of the project for the Updated 1995 Recommended Plan is $3,779,000 (including initial construction, annualized renourishment and annualized operation and maintenance differing from existing, but excluding major rehabilitation, interest during construction and monitoring costs which are essentially the same for all plans compared in this Section). It is noted that the existing annual operation and maintenance cost including boardwalk repair/rehabilitation, maintenance of City beach vehicles, beach regrading and snow fence maintenance, beach cleaning, facility (comfort stations, etc) maintenance, security and lighting, incurred by the City of Long Beach for the beach/boardwalk at the boardwalk area is $1,350,000 (including continual deck replacement over a 10 year period), as submitted by the City. With the Updated 1995 Recommended Plan, the annual operation and maintenance cost is estimated (by the City) to be $2,050,000 or $700,000 more than existing annual maintenance expenses, due primarily to the increase in labor and equipment to maintain the 2.2 mile dune, added boardwalk extension and facilities maintenance, added security surveillance and cleanup under the boardwalk.

120. The City Council examined this plan and took the view that it would not meet their concerns regarding the additional cost and the alteration of the historic character and use of the beach and boardwalk nor would it address the concerns of the surfers and fishermen. In light of the City Council's views, the Boardwalk Extension Plan was not considered any further. The City Council requested that a seawall be considered as an alternative.

121. **Seawall Plan at Long Beach (Modification 2).** For this modified plan, a 11,200 ft long concrete seawall at the seaward face of the Long Beach boardwalk replaces the sand dune fronting the boardwalk as proposed in the 1995 and Updated 1995 Recommended Plans. This seawall would maintain the design level of protection, would preserve full ocean views from the boardwalk and would reduce the fronting improved beach fill footprint and seaward extent, alleviating the concerns from the surfers and fisherman. This seawall included a 2.2 ft width of reinforced concrete extending just in front of the seaward face of the timber boardwalk deck (approx. el. 17.0' NGVD). Refer to Figure 28 for a typical cross section.

122. The 2004 price level annual cost for the Long Beach boardwalk segment of the project for the Seawall Plan is $3,736,000 (including initial construction, annualized renourishment and annualized operation and maintenance differing from existing, but excluding major rehabilitation, interest during construction and monitoring costs which are essentially the same for all plans compared in this Section). Although the annualized cost of the seawall plan is similar to that of the updated 1995 Recommended Plan, this plan does not comply with New York State Department of State (NYSDOS) policy regarding hard shore parallel structures. Therefore, the Seawall Plan was eliminated from further consideration. Based on continuing coordination with the City officials, a plan for relocating the dune was considered. This plan, more appropriately called the sand barrier under the boardwalk plan, is discussed below.

123. **Sand Barrier Under the Boardwalk Plan at Long Beach (Modification 3).** For this modified plan, an 11,200 ft long sand barrier under the Long Beach boardwalk replaces the sand dune fronting the boardwalk, as proposed in the 1995 and Updated 1995 Recommended Plans. This barrier would maintain the design level of protection, would preserve full ocean views from the boardwalk and would reduce the improved beach fill footprint and seaward extent, alleviating the concerns from surfers and fisherman. This sand barrier, like the dune, includes a crest width of 25 ft. at elevation +15.0 NGVD, but adds a reinforcement of the seaward and landward slopes to preclude significant deformation from wind and storm wave action that would require subsequent work to restore the design level of protection. Refer to Figures 29 through 31 for typical plan and cross sections. Details of the sand barrier are included in the Beach fill Section, below. This modification met the planning objectives and is supported by the non-Federal sponsor.

124. **Sand Barrier Under the Boardwalk Plan - Formulation of Boardwalk Options.** Because the condition of the wooden boardwalk would be directly and adversely affected by the presence of the sand barrier under the boardwalk the replacement of the wooden part of the boardwalk would be more frequent with the Sand Barrier Under the Boardwalk Plan than it would be for any other Plan. There are 4 options for the boardwalk, as part of initial construction as well as long term maintenance, that need to be compared and the most cost effective option identified: (1) Option A - replacement of the boardwalk deck with the same yellow pine timber as is existing, (2) Option B – replacement of the boardwalk deck with composite wood, (3) Option C – replacement of the timber deck with hardwood, and (4) Option D – no boardwalk deck initial replacement.

125. **Background for Boardwalk Options.** With a sand barrier directly beneath the boardwalk, the barrier crest width and upper slope would extend under half the boardwalk and come within a foot of the underside of the timber deck. Accordingly, the barrier sand, saturated from storm/rain activity, will remain damp for extensive periods of time. In other words, the barrier sand will have little chance to dry due to the significantly reduced ventilation under the boardwalk with the sand barrier in place. This will significantly increase the existing condition moisture content in the air beneath the timber boardwalk. Increased and sustained moisture in contact with wood is a major contributor in the decay of wood. Both research and field experience indicate that new timber can suffer decay within 3 years where moisture levels are elevated, as compared with approximately 7 to 10 years with more moderate moisture levels. This increased moisture would impact maintenance of the existing boardwalk timber deck and therefore the boardwalk deck becomes a project cost consideration because the sand barrier under the boardwalk would directly increase the cost of existing local boardwalk maintenance.

126. **Boardwalk Options.** Boardwalk Options A, B and C, provide for the construction of the sand barrier by removing the boardwalk deck and placing sand between the 18" (on center) supporting stringers which are generally in good condition, but which would receive surface treatment and some rehabilitation so that they can be left in place to support a new deck. Sand placement for the barrier would be performed with a dragline from stockpiled beach fill sand (from the offshore borrow area). The only difference between Boardwalk Options A, B and C is the type of initial deck replacement utilized, i.e. Option A contemplates replacement with yellow pine, which is the type of wood used for the current decking (with the sand barrier in place minimum average 6 year life), Option B includes composite wood replacement (with an average life of approximately 20 to 25 years) and Option C includes hardwood replacement (with an average life of at least 15 to 20 years). It is noted that Boardwalk Options A – C include stringer rehabilitation for an estimated 30% of total stringer length, after boardwalk deck removal. It is cost effective to reinforce the damaged sections of stringers with liquid plastic wood and metal hardware vs. complete replacement (480 MBM, or thousand (feet) board measure), i.e. $130,000 vs. $960,000.

127. Boardwalk Option D provides for the construction of the sand barrier under the boardwalk with the existing boardwalk left in place. Because of the space restrictions with the boardwalk deck left in place, when placing the sand barrier under the boardwalk, even small grading equipment will not be able to place the upper sections of the sand barrier without sloughing. Therefore, sand placement requires pumping stockpiled beach fill sand to under the boardwalk. The required geometry can be achieved with the hydrated sand in two lifts (sections) and with a small assist from a small earthgrading piece of equipment. Water from the ocean can be drawn by a 4" diam. jet pump & hose which would mix with stockpiled sand placed in a large hopper and then pumped through a 6" diam. centrifugal pump and hose to fill the sand barrier. Sand bags placed at the landside toe of the sand barrier would prevent the sand slurry from moving further landward. To facilitate shaping the required geometry, the slurry would be applied in one lift section to obtain approximately half the shape, then allowed to drain prior to placing the second lift to complete the full shape. With this option, it is anticipated that the existing boardwalk would require replacement by 2011. This is due to the currently advanced age of most of the existing boardwalk and the accelerated moisture damage rate from the sand barrier under the boardwalk once it is in place, before project completion.

128. Because the boardwalk options each have a different performance life cycle, to compare the options for most cost effectiveness requires obtaining the total annual cost for each option, including first cost and replacement costs, over the 50-year project life. Interest during construction is not included as it is nearly the same for all options. The total annual costs (pertaining specifically to the boardwalk and sand barrier) for Option A, Option B, Option C and Option D are $982,000, $638,000, $727,000 and $689,000, respectively. Accordingly, Option B (boardwalk replacement with composite wood) is the most cost effective boardwalk option and is therefore, selected as the relocation cost of the boardwalk associated with the Sand Barrier Under the Boardwalk Plan. Refer to Appendix C for the detail cost comparisons.

129. The 2004 price level annual cost for the Long Beach boardwalk segment of the project for the Sand Barrier Under the Boardwalk Plan is $2,698,000, which includes initial construction (including boardwalk replacement), annualized renourishment and annualized operation and maintenance differing from or in excess of the existing cost, but excluding major rehabilitation, interest during construction and monitoring costs which are essentially the same for all plans compared in this Section. It is noted that the existing annual operation and maintenance cost including boardwalk repair/rehabilitation, maintenance of beach maintenance vehicles, beach regrading and snow fence maintenance, beach cleaning, facility (comfort stations, etc) maintenance, security and lighting, incurred by the City of Long Beach for the beach/boardwalk at the boardwalk area is $1,350,000 (including deck replacement over a 10 year period), as submitted by the City. With the Sand Barrier Under the Boardwalk Plan, annual operation and maintenance cost is estimated (by the City) to be $1,300,000 or $50,000 less than existing, due primarily to less boardwalk repair/rehabilitation (with a composite wood deck replacement) and less beach cleaning and sand removal required under the boardwalk. When the cost of deck replacement every 20 to 25 years, or a $150,000 annualized cost is added to the maintenance cost, the net annual operation and maintenance cost and replacement is $100,000 over existing maintenance.

130. **Selection of the LRR Recommended Plan for the Long Beach Segment of the Project.** The annual costs listed below only consider the components located within the region of the boardwalk. The 2004 price level annual cost for the four boardwalk options considered for establishment of the most cost effective plan modification is as follows:

	1995 Feasibility Report Recommended Plan	$3,237,000
(Modification 1)	Updated Feasibility Report Recommended Plan	$3,779,000
(Modification 2)	Seawall Plan	$3,736,000
(Modification 3)	Sand Barrier Under Boardwalk Plan	$2,698,000

Because the only difference in project benefits among the four plans is the storm damage protection of the boardwalk (representing significantly less than 1% of the total benefit pool) provided by the 1995 Feasibility Plan and Modifications 1 and 2 (but not 3) above, the benefits of the 1995 Feasibility Plan and the three modifications are essentially the same. The LRR Plan for the Long Beach segment, therefore, is the modification with the lowest total annual cost among the 1995 Feasibility Plan and three modifications indicated above, or Modification 3, the Sand Barrier Under the Boardwalk Plan. Refer to the Appendix C for the detailed cost comparisons.

131. Modification 3 addresses the concerns of the City of Long Beach in retaining the historical character, aesthetics and proximity to the beach activities from the boardwalk, as they currently exist. This plan also addresses the concerns of the fishermen by reducing the seaward extent of the beach fill and by reducing the proposed beach fill footprint from that recommended in the 1995 Feasibility Report. Constructing the sand barrier instead of a dune allows the foreshore slope of the beach fill to be pulled-back, thus reducing the length of groins covered by the beach fill preserving the existing fish habitat that is beneficial to the local fisherman. In addition, this plan addresses the concerns of the surfers because the plan's landward shift of the foreshore slope allows the toe of the proposed beach fill to fall landward of the authorized project's slope break, i.e. the point where the foreshore beach slope meets relatively flat ocean bottom, for approximately 90% of the boardwalk shoreline. This is significant because the slope break influences the breaking zone of that portion of the wave spectrum that is tripped by the slope break. Therefore, if the proposed limit of beach fill falls landward of the existing slope break, the Modification 3 design would have less impact on changing the zone of these breaking waves and thus be more favorable to the surfers. The reduction of the length of groins covered by beach fill also addresses concerns of the surfers because the structures help create more favorable conditions for surfing. In addition, there should be no concern with the rehabilitation of the groins in Long Beach because the groin rehabilitation does not change the overall length or configuration. The groins are being restored to their original condition.

132. **Other Segments of the LRR Recommended Plan.** The LRR Recommended Plan includes a change from the 1995 Feasibility Recommended Plan for the eastern 18,000 ft of project area from Point Lookout to the eastern vicinity of the boardwalk at Long Beach, based on the shoreline reanalysis to incorporate recent shoreline changes to update the design of the new groin field including the terminal groin at Point Lookout, as presented in the following sections. In accordance with the Corps' Environmental Operating Principles, the LRR Plan includes a Bird Nesting and Foraging Area in the eastern segment of the project. Removed is the revetment rehabilitation along approximately 700 ft of the western shore of Jones Inlet, adjacent to the terminal groin at Point Lookout because this revetment rehabilitation was recently accomplished by local interests. The LRR Recommended Plan west of the boardwalk deletes 7,000 ft of beach fill in East Atlantic Beach from the 1995 Recommended Plan because the Village of East Atlantic Beach withdrew from project participation and the NYSDEC agreed. All other features from the 1995 Recommended Plan remain in the LRR Recommended Plan.

3. Beach fill

133. The LRR Recommended Plan includes a beach fill component, which retains the 110 ft wide beach berm at an elevation of +10 ft above NGVD, and a dune and sand barrier system with a top elevation of +15 ft NGVD. The plan includes approximately 29,000 linear feet of

beach fill. Details of the LRR Recommended Plan are shown on Figures 14 through 25. The LRR Recommended Plan consists of the following components.

134. The LRR Recommended Plan includes the same beach fill cross-section for Plan 5 (the Recommended Plan) in the February 1995 Feasibility Report as modified by this LRR. The components of the beach fill include:

a) Berm fill from Point Lookout west to the western boundary of the City of Long Beach where the selected plan tapers into the existing shoreline in East Atlantic Beach (approximately 34,000 lf with 29,000 lf requiring new beach fill). It is noted that a 5,000 ft long area about a mile west of Point Lookout requires no beach fill improvement at this time due to the addition of ephemeral pool areas where the beach is left in its existing state for fish and wildlife enhancements. Design level of protection is maintained due to the existing dune and berm system in this reach.

b) Berm: Fronting the dune and sand barrier, a berm width of 110 ft at elevation +10 ft NGVD with a shore slope of 1V on 20H for the easternmost 4,000 lf of the project (Point Lookout), and a 1V on 35H shore slope for the remaining 25,000 lf (Lido Beach and Long Beach). It is noted that the 5,000 lf reach, between these two areas, where no beach fill is to be placed, has existing shore slopes of between 1V:20H at the eastern segment of this reach to 1V:35H at the western segment. This area is designated as the bird nesting and foraging area.

c) 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. The dune extends 14,000 lf from Point Lookout, to the eastern limit of the boardwalk at Long Beach, where it transitions to the sand barrier under the boardwalk. The dune continues from the western limit of the boardwalk (at the westerly end of the sand barrier), extending 4,000 lf to the western boundary of the City of Long Beach.

d) Sand Barrier: Crest elevation of +15 ft NGVD for a crest width of 25 ft with 1V on 5H seaward side slopes and 1V on 3H landward side slopes. Some limited locations have a 1V on 2.5H landward and seaward side slopes at existing boardwalk ramp locations. In addition, the 11,000 ft long sand barrier is reinforced with: (1) a buried 6" thick crushed stone (4" diam.) filled coated wire mattress on the seaward slope, (2) a 4"high cement filled geoweb surface, halfway up the landside slope, and (3) a pervious geotextile underlying the marine mattress and geoweb and continuing over the exposed to sand surfaces of the remainder of the sand barrier. Refer to Section 7 of Appendix B for more details.

e) A total sand fill quantity of 6,600,000 cy for the initial beach fill placement, including the following:

- +1.0 ft tolerance
- overfill factor of 2.5%
- advanced nourishment width of 50 ft

f) The dune construction includes planting of 12 acres of dune grass and installation of 47,000 lf of sand fence for dune sand entrapment as well as construction of 12 timber dune walkovers, 12 gravel surface dune walkovers, 8 extensions of existing dune walkovers, 8 gravel surface vehicle accessways, 1 timber raised vehicle accessway, 2 swing gate vehicle access structures, reconstruction (relocation) of 1 lifeguard headquarters, construction of timber retaining walls around 4 comfort stations, 2 comfort stations with concession stands, and 1 lifeguard headquarters, the replacement of 11,000 lf of boardwalk timber deck with composite wood is also included as the least cost boardwalk deck option.

g) Renourishment of approximately 1,726,000 cy of sand fill from the offshore borrow area every 5 years for the 50 year project life. Note that Jones Inlet may also be used as a sand source depending on the maintenance dredging schedule.

4. Rehabilitation of Existing Groins

135. A condition survey of the existing groins was conducted in September 2003. The purpose of this on-site inspection was to evaluate the current structural condition of the groins to evaluate the current functioning of the structures, specifically the sand trapping effectiveness. Details of this survey are presented in Appendix B. A summary of the survey results and recommendations are discussed in the following paragraphs.

136. This survey was conducted on September 29-30, 2003 and included on-site review of the structure dimensions and approximate elevations, 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.

137. The results of the existing condition survey and recommendations are as follows:

- **Long Beach**. There are 23 groins in this stretch of beach, between (and including) Groin No. 24 at the west end of Long Beach and Groin No. 48 at the east end of Long Beach (the numbering system used during the Feasibility Study included all coastal structures, including bulkheads along with groins). Each of these groins was evaluated as to structural condition, sand trapping effectiveness and planform holding effectiveness. Fifteen (15) of the groins inspected are recommended for rehabilitation. The proposed rehabilitation consists of repositioning existing armor stone and adding additional armor stone along the seaward 100 – 150 ft of each of 8 groins not fronting the sand barrier and along the seaward 200 – 330 ft of each of 7 groins fronting the sand barrier. The difference in rehabilitated length is due to the extent of which the existing groins will be buried by the design fill. Groins fronting the sand barrier will be exposed for most of their length due to the more landward position of the edge of the berm in that area. Groins east and west of the sand barrier will be partially buried, and so do not require rehab for their entire length. A minimum constructible crest width of approximately 13 ft was selected with side slopes of 1V on 2H. A primary armor weight of 5 tons was selected in order to approximately match the existing armor stone.

- **Lido Beach**. There are four groins on this length of shoreline, Groin Nos. 51-54. Each of these groins is in poor condition and considered to be deteriorated to such a point that they have ceased functioning and therefore are not candidates for rehabilitation.

- **Point Lookout**. There are three stone groins on this length of shoreline, Groin Nos. 55, 56 & 58. Groin Nos. 55 & 56 are generally in good condition except for a 100 ft length of each of the head sections which requires rehabilitation by repositioning and adding additional armor stone. Based on the analysis entitled "Terminal Groin Rehabilitation and Extension At Jones Inlet, Long Beach Island", it is recommended that Groin No. 58, the terminal groin, would be rehabilitated and extended 100 ft in accordance with the design proposed in the report.

5. Proposed Groin Field

138. For the reanalysis, design conditions along the eastern half of the project were updated using recently collected monitoring data from the Atlantic Coast of New York Monitoring Project (ACNYMP) and field measurements collected as part of the reanalysis. Numerical modeling of shoreline changes for both without-project conditions and numerous engineering alternatives were performed using both U.S. Army Corps of Engineers software and a system developed by the Danish Hydraulic Institute. The models agreed in the performance and projected impacts of the alternatives considered, yielding a revised stabilization plan that includes a field of seven groins that both reduces losses in the east and minimizes downdrift impacts in areas to the west.

139. Based on the results of circulation and sediment transport modeling, a modification to the new groin field proposed in the 1995 Feasibility Plan was required. The modification consists of 7 groins with the first groin constructed 800 ft west of existing Groin 55 in Point Lookout and the second through fourth groins constructed further west with tapered lengths at intervals of 800 ft. The remaining 3 groins would be constructed further west at 1,200 ft intervals with tapered lengths.

140. The four easternmost groins provide the required erosion control and storm protection for the severely eroded shoreline area in Point Lookout. The remaining three groins would be mostly buried in the existing weldment area if constructed under current conditions; therefore, these structures are proposed for deferred construction if and when the stability of the weldment area changes. The deferred tapered groins are included in the overall plan to address the possibility that the weldment may migrate westward, possibly due to changes in the characteristics of Jones Inlet, creating erosional pressure to the east as the weldment moves. Deferring these three groins is recommended because the weldment area is currently stable and is not expected to change. The stability and position of the weldment will be monitored, as described in the following section.

141. The role of the proposed groin field is to address the problems that are occurring east of the weldment. Areas to the west of the weldment presently benefit from sediment entering from the weldment, which is supplied from the ebb tidal shoal. Based on the reanalysis, it is concluded that the flow of sand from the weldment toward areas to the west would not be changed by the modified groin field.

142. **Physical Criteria For Initiating Construction of Deferred Project Elements**. Construction of deferred plan elements, the three westernmost groins and beach fill in the 7-groin field at Lido Beach, may be triggered at a future date within the 50-year project life based upon physical monitoring data. The criteria for construction will include a change from the accretive or stable condition to an eroded condition in the area where the deferred structures are to be located. The criteria include field measurements and analysis. The "trigger" for implementing the construction of the deferred project components (including design fill, and renourishment) in this area is a berm width of 250 ft. or less (berm defined as the distance between the dune toe and the seawardmost +7 ft. NGVD contour) which persists for one year.

143. The three westerly groins that are proposed for deferred construction will be largely buried in the existing weldment area and are to be built only if there is instability of the weldment area sometime in the future.

144. Any major change in the weldment would likely take place over a long period of time (year or more) that should be adequate to accomplish the construction of the deferred groin structures. This assumes that appropriate monitoring (as outlined in the Monitoring Section)

and analysis are performed to first, recognize the effect and, second, to identify the cause(s). A reduction in sand supply to the weldment, and subsequent narrowing of the beach, will be noticeable over a one- to two-year period of monitoring, primarily through a constant trend in the reduction of the beach width. Because the weldment and ebb shoal are submerged and difficult to quantitatively measure, weldment dissipation or migration (along with any corresponding changes to the ebb shoal) would be noticeable over a 3-5 year period. The rate at which the beach is narrowing should determine the schedule for construction of the beach fill and/or deferred structures so that the protective nature of the project is not compromised. Details of this analysis are presented in Appendix B.

6. Point Lookout Terminal Groin Rehabilitation and Extension

145. **Introduction**. The 175-foot long terminal groin (groin #58) is situated within the unincorporated community of Point Lookout, located at the eastern end of Long Beach Island. The rubble-mound terminal groin and the adjacent 2,800-foot long rubble-mound revetment were constructed in 1953 by the State of New York as initial attempts to stabilize Jones Inlet and protect the Point Lookout shoreline from further erosion. The recent deterioration of the groin and its decreased effectiveness at retaining sand has prompted the development and implementation of a design for the rehabilitation and extension of the groin. Details of this design are presented in Appendix B. A summary of the design development is presented in the following paragraphs.

146. The terminal groin, as constructed, was 175-ft long, with the centerline oriented approximately 20 degrees west of south. Details of the design are scarce and design plans or construction specifications could not be located. The design template of the groin appears to have specified a single layer of armor cap stone and an inner section consisting of core/bedding material. Based on a visual survey conducted by the USACE (USACE, 1995), the existing groin crest height was estimated at elevation 5.5 ft NGVD; a crest width of 12 ft; and side slopes of 1V:1.5H. A topographic survey done in December 1996 by TVGA of the site shows the actual average crest height of the terminal groin to be elevation 4.9 ft NGVD (USACE, 1999).

147. **Structural Integrity - Terminal Groin**. The geometry of the groin structure has essentially been retained since its construction. The side slopes of the structure have retained their original placement except in the areas where undermining of the core stone has resulted in the sloughing of the cross section as evidenced along the eastern (inlet) side of the groin and at the groin head. Details of this analysis are presented in Appendix B.

148. **Armor Stone Estimate**. The size and weight of the armor stone is critical in assessing what design condition the existing structure is able to withstand without significant damage. Field measurements indicate that the estimated armor stone weight ranges between 4 and 12 tons, with the W_{50} (median weight) equal to approximately 10 tons. This stone size is significantly larger than the stone sizes previously estimated (USACE, 1995).

149. **Determination of Extension Length**. Presently, sediment is being transported from the southwest direction past the tip of the terminal groin into the inlet where the sediment is distributed between the northwest edge of the inlet and the flood shoal located at the northern extent of the navigation channel. The sediment is transported into the inlet by a combination of mechanisms, consisting mainly of wave- and tidal-induced currents. Wave-induced currents are generated from oblique incoming waves. The longshore component of motion produced by the obliquity of the waves generates a longshore current. This current, which generally occurs between the breaker zone and the shoreline, transports sediment toward the east. During prevailing conditions (non-storm conditions), the terminal groin is able to arrest the majority of

longshore transport from entering the inlet. This is evidenced by the small change in beach plan within the two groin compartments over the past 8 years.

150. Extending the terminal groin a set length may decrease the amount of sediment lost toward the inlet after the beach fill project and possibly retain additional alongshore sediment transport without causing large changes in inlet dynamics. Approximately 30,000 cubic yards per year (cy/yr) to 80,000 cy/yr of sediment annually bypasses the terminal groin and enters the inlet. If the groin extension can retain the beach fill (after its equilibrium state) and trap a portion of alongshore sediment quantity, it is anticipated that the shoreline in the eastern groin compartment will remain stable or increase slightly.

7. Bird Nesting and Foraging Area

Physical Description of Bird Nesting/Foraging Area and Representative Profile.

151. The LRR Recommended Plan has been modified to accommodate an area of the beach which, due to existing width and berm height, is a prime area for ephemeral pool formation and, as such, is a prime shorebird nesting and foraging area, as shown in Figures 15 – 17 and Figure 32. The ephemeral pool encompasses a 93.4 acre area and the plover and least tern nesting area encompasses a 42.3 acre area. This plan provides storm damage reduction using the existing profile and allows for the continued unimpeded use of this area as shorebird nesting and foraging areas. The area will be monitored to ensure that the existing profile is maintained; therefore, affording a consistent level of protection.

152. **Evaluation of Equivalent Storm Protection**. A representative beach profile was developed for the bird nesting/foraging area using available survey data collected from 1995 and 2002. Using this profile, the storm protection capability of the existing beach in the bird nesting/foraging area was evaluated for an equivalent level of protection using the Storm-Induced BEAch CHange Model (SBEACH). Details of this evaluation are presented in Appendix B.

153. Storm parameters required by SBEACH include time histories of total water level (astronomical tide plus storm surge), wave height, wave period and wave angle. Wind data can also be used; however, model sensitivity to wind effects was evaluated in the Feasibility Study and was determined to be insignificant for the profiles at Long Beach.

154. Using the representative beach profile and storm time histories, the SBEACH model simulation indicates that the seaward edge of the berm recedes 220 ft landward during a storm event coinciding with the provided level of protection. There is a slight leveling of the undulations on the berm, but the significant sand transport rate is limited to the seaward third of the berm. A second simulation with the same storm input and a berm narrowed to 250 ft, indicates slight scarping of the toe of the main dune and would be the condition under which design storm protection would be compromised. Therefore, the "trigger" for implementing the construction of the deferred project components (including design fill, and renourishment) in this area is a berm width of 250 ft. or less (berm defined as the distance between the dune toe and the seawardmost +7 ft. NGVD contour) which persists for one year. A one-year time period will ensure that the narrowed berm condition is representative of a long-term trend, and not seasonal or temporary. For construction of the deferred groins, a one-year persistent berm width of 250 ft. or less in the weldment area will be combined with assessment and verification of movement of the weldment area towards the west, based on aerial photography and survey data along with change in beach width.

155. Based on this analysis, the existing beach width is adequate and there is no beach fill required in this area to achieve design-level protection. Accordingly, the adjacent beach fill

areas will be tapered into the existing berm width and height, in areas where the present berm width exceeds 250 ft.

8. Dune Walkovers, Vehicle Access, and Boardwalk Deck Replacement

156. For the Project, dune crossing structures are proposed to both accommodate the volume of recreational use of the area and protect the dunes from foot and vehicular traffic. Details on the proposed dune walkovers and beach access structures are presented in Appendix B.

157. Five (5) ADA compliant timber dune walkovers (1 extending from the Boardwalk), twelve (12) gravel surface dune walkovers, one (1) gravel surface vehicle access ramp over the dune, two (2) swing gate vehicle access structures and one (1) boardwalk extension are proposed in the City of Long Beach.

158. In addition, 2,774 lf of timber retaining walls will be constructed around the four (4) comfort stations, two (2) comfort stations with concession stands, and one (1) lifeguard headquarters that exist within the City of Long Beach.

159. Placement of the sand barrier under the boardwalk will reduce the ventilation under the boardwalk. The effect of the loss of adequate ventilation would be an increase in the level of moisture to which the boardwalk is subjected. The effect of the increased moisture level would be to shorten the average life of the components of the existing wooden decking of the boardwalk. Because placing the sand barrier under the boardwalk would directly increase the cost of existing local boardwalk maintenance, an issue of project cost estimation is presented. Refer to Section 7 of Appendix B for more details. The most cost effective boardwalk action is the replacement of the timber deck with a composite wood deck, which would be a non-Federal Relocation cost item.

160. For the Town of Hempstead, the extension of eight (8) existing dune walkovers, construction of seven (7) new timber dune walkovers (including 3 ADA), seven (7) gravel surface vehicle access ramps, one (1) raised timber vehicular access and the relocation of one (1) lifeguard headquarters is included in the selected plan.

161. The proposed locations for each of these structures are shown as a component of the Recommended Plan in Figure 14 to Figure 25. Plan views and cross-section views of the beach access structures are shown on Figure 33 and Figure 34.

C. Real Estate

162. For the project, a section of the dune and beach nourishment will be located on three privately owned parcels under two different ownerships in the Lido Beach section of the Town of Hempstead. The privately owned parcels include Lido Towers (2 lots), and Lido Townhouses (1 lot), and comprise a total of approximately 1,200 lineal ft of project shoreline, where the ownership extends down to the MHW line (Figure 35 and Figure 36). The uses of these lands are multi-family residential, with a private beach recreational component. This Real Estate is required for project implementation, but concerns have been raised regarding the cost and ability of the local sponsor to acquire the necessary Real Estate. As such, several approaches were developed to identify the preferred means to acquire the necessary Real Estate for the project.

163. The standard approach for a shore protection project, (in accordance with federal requirements) is for the necessary Real Estate to be secured with a "Perpetual Beach Nourishment and Restrictive Dune Easement", which allows for limited right to use, access, and

modify these areas. New York State; however, requires a fee simple estate be acquired for the beach area, while still allowing for a "Restrictive Dune Easement" in the dune area. NYSDEC and the Town of Hempstead would be required to obtain the proposed beach fill area as fee simple and also acquire the "Restrictive Dune Easement", to participate in a cost-shared project in these areas.

164. A preliminary level appraisal was undertaken for the three privately owned parcels to identify the impact of acquiring these real estate interests, and the costs associated with this impact. The initial appraisal indicated that the value of the individual units on these lots is in part due to the fact that these units include access to a private beach. Acquiring the beach to provide for public access and use, could reduce the value of each unit, by some amount. Considering the number of units, and considering the composite impact, the costs associated with acquiring the beach for this project could potentially be in the range of ten's of millions of dollars. Furthermore, it is unlikely the property owners would be willing to provide the real estate, and a condemnation procedure would likely be required. Based upon this assessment, the sponsor indicated a concern over the ability to acquire the necessary land through use of fee acquisition and permanent easement.

165. An alternative to acquiring these properties, was to see if the project footprint could be altered to avoid placing sand in the area of the three parcels. This was not acceptable, as altering the project design would require eliminating beach fill along these stretches of shoreline, and would reduce the protection in these areas. Both the Federal and non-Federal sponsor agreed that it is necessary to provide continuity in the protection, for the project to perform as designed, and that this approach was not acceptable.

166. Another alternative means to obtain the necessary Real Estate, would be for the non-federal sponsor to obtain a "Right-of-Entry" for construction and maintenance activities, that does not open the beach for public access, or in any way alter the private use of the existing beach area. Consistent with the Federal and State policies, this approach would require the non-Federal, non-State Sponsor (i.e. the Town of Hempstead) to pay 100% of the project cost for work within the boundaries of the three privately owned parcels. Based upon the current plan layouts, and estimated beach fill quantities, the project cost at these parcels is approximately $700,000 (131,300 cy). Presently, Lido Townhouses is located in the area identified as the bird nesting and foraging area, where no sand placement is expected as part of initial construction. It is included in this assessment, because of the potential need for future renourishment in this area.

167. Based upon the projected costs for project construction within these areas, as compared to the cost and difficulty in obtaining the necessary Real Estate to make this a publicly accessible beach, the local sponsors agreed that the preferred approach would be for the Town of Hempstead to pay 100% of the costs associated with the project within these areas. This will be accounted for in the overall project cost-sharing.

D. Air Quality Compliance

168. All water resources projects including hurricane and storm damage reduction projects must consider, and must include, Clean Air Act compliance. Projects must consider the emissions associated with the construction activities, and ensure that the effects are acceptable, or brought to an acceptable range. The U.S. Army Corps of Engineers has examined, in detail, how various projects could be implemented in such a manner to comply with the Clean Air Act. The estimated cost to comply, are included, as part of the total project cost. In this instance, an analysis of emission outputs, in terms of nitrogen dioxide (NO_x), identified that the project would

exceed the National Ambient Air Quality Standards (NAAQS) allowable threshold of 25 tons/year. Additionally, this project has not been accounted for in the New York State Implementation Plan (SIP). As such, the alternatives to comply with the Clean Air Act include:

1. extend the construction period so as to prevent emissions in any one year reaching or exceeding the threshold level;
2. reduce project emissions by altering the set of equipment used or changing the way the equipment is operated, or both;
3. offset project emissions by causing emissions produced within the non-attainment area (any area that the Environmental Protection Agency currently designates as not meeting one or more of the NAAQS for criteria pollutants, or more specifically within the NJ/NY/CT tri-state non-attainment area) by others to be less than they otherwise would have been;
4. purchase, year by year, emission reduction credits (ERCs) generated by emission reductions accomplished by "stationary sources" within the non-attainment area
5. identify new offset possibilities; or
6. suspend construction during the peak ozone season (1 May to 30 September) each year, thus extending the period of construction but also avoiding emissions of pollutants like NO_x for the entire period during which they are harmful.

169. For this project these alternatives were compared and it was determined that the most cost effective means (the alternative that represents the NED plan) would be to suspend construction during the peak ozone season each year, thus extending the period of construction but also avoiding emissions of pollutants like NO_x for the period during which they are of concern. For a more detailed analysis of the Clean Air Act Compliance alternatives and the formulation of the selected alternative refer to Appendix G.

VI. With Project Conditions

A. Physical Conditions

170. **<u>Levels of Protection Unchanged from 1995 Feasibility Report</u>**. The existing condition within the project area provides a relatively low level of protection against storm events. The storm damage reduction beach fill design for the recommended plan 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. Because the design dimensions of the beach fill in the recommended plan presented in the LRR are identical to the dimensions for Plan 5, the Recommended Plan from the Feasibility Report, the same level of protection will be provided. A discussion of the level of protection is presented in the following paragraphs.

171. The beach fill design will provide increased protection against oceanfront inundation, however the improvements will not lessen the storm water inundation from the back bay side, which will continue to occur during storms. 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 from the Atlantic Ocean is approximately a storm event with a 10 percent chance of being equaled or exceeded in any one year. The improved condition designs, which include dunes, therefore are estimated to give a level of protection against inundation for ocean surges from storms that have a 1 percent chance of being equaled or exceeded in any one year.

172. The level of storm-induced recession protection afforded by the existing beach and by the design beach fill 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 (1995 Feasibility Report) 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 that have existing dunes. The improved condition level of protection against storm-induced recession for the Recommended Plan, Profile 200, would be over 500 years.

173. 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 beach fill and dune against wave attack was defined as the return period of the storm event that corresponds to the distance of the critical force of 1,800 lbs/ft to the seaward wall of the seaward line of buildings in the project area. The existing condition level of protection for Typical Profile 2 (1995 Feasibility Report) is approximately 200 years. The improved condition level of protection against wave attack for the Recommended Plan, Profile 200, would be over 500 years.

B. Environmental Conditions

174. Long-term impacts to water quality are not expected to occur as a result of project implementation. The effects on the environment of the operation of sand removal and beach fill placement are materially influenced by the conditions at the borrow site, by the nature of the materials removed, and both directly and indirectly by the types of equipment used. By their action, the equipment (i.e. cutter head dredge) may cause a variety of temporary environmental impacts to water quality and aquatic ecosystem. These include:

<u>Water Quality</u>

Increased levels of turbidity at the borrow site and placement area may result in:

a. the reduction of dissolved oxygen levels, primary productivity and photosynthesis.
b. the clogging of finfish gills.

<u>Aquatic Habitat</u>

1. Temporary disturbance of the aquatic habitat at the borrow site.
2. Mortality of benthic organisms.
3. Altered benthic diversity following recolonization.
4. Changes in circulation patterns.
5. Modified sediment deposition.
6. Creation of either hypoxic or anoxic zones.
7. Biological uptake of released pollutants.
8. Modified behavior of organisms due to increased stress levels possibly affecting reproduction.
9. Mortality of organisms being entrained within the equipment.

175. **<u>Water Quality</u>**. There will be short-term adverse water quality impacts during the construction period of this project (Naqvi and Pullen, 1982). Problems with anoxic sediments and nutrient release in the nearshore zone of a high-energy beach as a result of beach nourishment do not appear to be significant because: (1) Fine materials that are high in organics are generally moved offshore; (2) Sulfides are rapidly oxidized; and (3) Fine sediments are

rapidly diluted by the high-energy mixing process. Removing sand from the proposed borrow areas will generate turbidity and sedimentation impacts within the immediate vicinity of the operation and does not appear to significantly impact water quality (Naqvi and Pullen, 1982). Generally, the large grain-sized material will keep the area of impact small and will ensure that there are no impacts beyond the period of construction. The beach fill periods will last several months at a time and localized water quality impacts will be experienced in the proposed borrow area for the duration. Similar short-term water quality impacts will occur at the nourishment sites along the 6.4 miles of shoreline. Beach fill operations will deliver a slurry of sand to the receiving shore, increasing turbidity in the immediate area. This effect, however, will not be significant because turbidity levels in the high-energy surf area are naturally high.

176. Short-term turbidity may affect organisms in several ways. Settling of sediments may bury sedentary species. Suspended matter can clog gills and filter-feeding structures, which could directly cause mortality or reduce feeding efficiency and cause indirect effects such as reduction in reproduction or decreased ability to avoid predation (Sherk, 1971). In addition, turbidity may reduce light penetration through the water column, lowering photosynthetic activity and dissolved oxygen content. Turbidity and associated water quality parameters at the borrow areas and placement sites will rapidly return to preconstruction levels with no lingering adverse impacts expected (Naqvi and Pullen, 1982). Periodic renourishment will produce water quality impacts similar to those generated by initial construction, but for a shorter time period (Naqvi and Pullen, 1982). Renourishment impacts are also not expected to be significant.

177. **Borrow Area Biological Resources**. Potential adverse impacts within any borrow area include: (1) mortality of benthic organisms; (2) altered benthic diversity following recolonization; (3) changes in circulation patterns; (4) modified sediment deposition; and (5) creation of either hypoxic or anoxic zones. Loss of benthic and epibenthic organisms will be the most direct and most immediate impact in the borrow areas for the project. Mortality will occur as organisms pass through either the equipment or as a result of transport to an unsuitable environment. Benthic and epibenthic organisms will be buried by resuspended and redeposited sediments. Sessile or sedentary species will be eliminated by direct burial or capture while motile organisms can move away.

178. **Effects on Fishery Resources**. Motile bottom fishes should be able to avoid the equipment and will move away from the disturbance and therefore, should not be impacted. Most pelagic organisms should be capable of avoiding the area during construction activities. A short-term decrease in dissolved oxygen concentration is not expected to be a problem.

179. The primary impact to fisheries will be due to disturbances to benthos and epibenthos within the borrow area immediately following construction. The benthos and epibenthos population are expected to recover relatively rapidly following project completion. In addition, as indicated above, the rapid repopulation by the pioneering species would provide a more than ample base for benthic feeders (USACE, 1991). As borrow areas and channels appear to contain higher levels of fish than the adjacent shoals (Woodhead and McCafferty, 1986), it would appear reasonable to conclude that the resource does not demonstrate any adverse impacts from the creation of borrow areas once the immediate construction period is over. Therefore, this impact to fisheries is anticipated to be short-term.

180. **Effects of Beach Fill Placement on Benthic Resources**. Beach and surf zone organisms are well adapted to their dynamic environment and the natural erosion and accretion cycles associated with storms and seasonal changes.

181. The placement of material in the nearshore zone will mean a direct reduction in habitat for benthic and epibenthic marine invertebrates. This loss is negligible in view of the vast amount of

existing nearshore area available. The loss in biomass will be a short-term impact, because the new sandy bottom should begin to be recolonized by benthic organisms shortly after construction ceases. However, it was found that recovery was affected by failure of adult intertidal organisms to return from offshore overwintering areas, reductions in organism densities on adjacent unnourished beaches, and inhibition of pelagic larval recruitment (Reilly and Bellis, 1979). The recovery of benthic resources in terms of their abundance, diversity and biomass are expected to return to their pre-construction conditions within 2 to 6 months following the placement of sand (USACE 2001). Tidal zone organisms will have an area of habitat equivalent to that at present, and there are expected to be no major long-term impacts to these organisms.

182. **Effects of Groin Rehabilitation/Construction on Marine Biota**. Impacts associated with the placement of rock substrate into the intertidal zone to rehabilitate/construct groins could include the mortality of clams and other invertebrates associated with sandy habitat that would be eliminated during groin construction.

183. However, the groin structure itself, once constructed, has the potential beneficial impact of improving habitat for some tidal organisms. The crevices between the stones provide protection for the species young against larger predators. In addition, the rocks themselves provide attachment points for numerous species of invertebrates that must have solid substrate in order to survive as adults. The effects of sand burial of groins would result in a loss of artificial rocky intertidal habitat and a permanent impact to only the landward end of existing groins. Once covered, these landward groin ends will not be available for fisherman to use nor to provide habitat for invertebrates and shorebirds. Non-mobile organisms and intertidal dwellers would be affected by burial from the placement of sand. However, the beach fill placement over the groins will re-establish sandy bottomed intertidal habitat. As these creatures form the base of the detrital food-chain in this area, reduction of higher order consumers is also a short-term possibility.

184. **Endangered Fish and Wildlife Resources**. The nearshore waters of Long Beach Island may contain threatened and endangered sea turtles during summer and early fall months. Listed species that may be present include the threatened loggerhead *(Care-carerta)* and endangered Kemp's ridley *(Lepidochelvs kempi)*, leatherback *(Dermochelvs coriacea)*, and green *(Chelonia mydas)* sea turtles. Occurrences of these species in the project area would be limited to occasional transient individuals. However, NMFS indicated that the proposed project, as presently designed, would not likely adversely affect any of the cited species (N H S , 1993). However, NMFS stated that if hydraulic dredges are utilized between mid-June and mid-November, NMFS-approved turtle observers must be on board to monitor the dredging activity. The piping plover Federally listed as threatened, and the State endangered least tern have been known to nest along Long Beach Island. If beach fill placement coincides with the shorebirds' nesting season (April-August), suitable buffer zones with protective measures will be incorporated into the project plans. The presence of shorebird nests will be determined by surveys prepared by qualified Corps biologists. Section 7 consultation under the Endangered Species Act, as amended (ESA), is ongoing to identify necessary measures to reduce the possibility of any actions significantly impacting these populations in the proposed project area.

185. Noise and air impacts are restricted to site construction, (generally beginning two weeks prior to dredging) actual placement operations and borrow site operations. Noise is limited to land based vehicles like trucks, bulldozers, and front-end loaders (or similar equipment) used to manipulate the material during placement. Additional noise may be caused by the hydraulic dredge, tug boats, and the pumpout station. No delays in construction are anticipated due to noise-related impacts to fish, wildlife resources or local residents. Air quality impacts would similarly be limited to emissions from the heavy equipment and pumpout station. These impacts

would end when placement is completed. No long-term significant impacts to the local air quality are anticipated.

186. A Final Environmental Impact Statement, containing a detailed discussion of the impacts of the proposed project, along with the list of coordinating agencies, has been prepared and can be found at the end of the Main Report of the 1995 Feasibility Report. The environmental assessment conducted as a part of the LRR effort will supplement the Final Environmental Impact Statement. The construction schedule for the project has the flexibility to avoid sand placement at Lido Beach if environmental restrictions are placed on the construction of the project. The groin work at Lido Beach requires continuous construction due to the extent of work. The following list comprises the mitigative measures which will be included for the project:

a. groins will be filled to equilibrium state to encourage sand bypassing,
b. pre- and post- dredging surveys of surf clams will be conducted,
c. provision of a trained turtle observer on any hydraulic dredge that may be used between the months of May and November,
d. construction of the project in approximately 600-foot sections during the months of May through November to reduce impacts to the recreational season and to facilitate construction, and
e. pre-construction surveys for piping plovers, least terns, and sea beach amaranth

C. Cultural Resource Baseline

187. **Cultural Resources.** To date, the NHPA Section 106 process has not been completed for the Project. However, in 1997, NYSOPRHP granted the USACE final approval to allow the Project to move forward under the following specific conditions: 1) the USACE must continue the research necessary to complete the Section 106 requirements; 2) the USACE must inform NYSOPRHP of all findings; and, 3) work relating to Section 106 process must be completed prior to any construction activities (EA Appendix F).

188. **Historic Resources.** No structures will be affected by the proposed project. A transatlantic cable dating from 1873 may be located within the near shore portion of the Project Area (USACE 1999). However, deposition of sand during construction would help to protect the cable. No adverse impacts to the cable are expected from the Project (NYSOPRHP 1993).

189. **Shipwrecks.** Due to the possibility of several shipwrecks in the area near Long Beach, and the two identified wrecks in the areas of Lido Beach and Point Lookout, a Programmatic Agreement will be completed with the NYSOPRHP by Spring 2006. This agreement will outline the future undertakings with regard to the three areas in questions. This work will occur prior to any construction of the overall project. Coordination with the NYSOPRHP will occur throughout the testing phase to insure compliance with all stipulations in the agreement.

190. **Submerged Sites.** Based on cores taken at the proposed borrow area, potential lagoonal deposits occur at 20 feet depth. Submerged prehistoric sites would occur below this depth (Pickman 1993). Thus, dredging activities for the Project would have no impact on submerged prehistoric sites. Should dredging depth exceed 20 feet, additional studies would be required to determine whether prehistoric deposits exist within the borrow area.

191. The proposed components of the recommended plan will not change the overall project area, which has already been studied and approved in the original EIS. However, the project area has been reduced by 7,000 feet with East Atlantic Beach opting out of the project. The following components are a modification of the original designs based on changed existing conditions and additional investigations. These components include:

- Terminal Groin Extension (Groin #58)
- New Groin Construction
- Additional Existing Groin Rehabilitation (Groins #55 and #56 in Point Lookout)

D. Socio Economic Conditions

192. **Introduction**. The recommended plan would provide storm damage protection to the island's highly developed communities that are subject to wave attack and flooding during major storms and hurricanes. As a part of the LRR, an update of the project benefits was conducted to confirm the viability of the recommended project with the recommended modifications.

193. In this update, benefits were considered for the design alternative put forward by the 1995 Feasibility Study as the NED Plan, which was originally referred to in the Feasibility Study as Alternative 5. This plan generally provides a 110-foot wide berm backed by a dune system at an elevation of 15 ft above NGVD. Based on 1994 price levels, the NED Plan provided almost $17 million in annual benefits and annual net excess benefits of $8.03 million over the project life of 50 years, with an overall benefit/cost ratio of 1.9. The recommended plan in the LRR includes 29,000 lf of berm backed by 18,000 lf of dune and 11,000 lf of sand barrier vs. 41,000 lf of dune and berm for the 1995 Feasibility Plan and would provide the same level of protection as the NED plan from the 1995 Feasibility Study.

194. The principal community benefiting from the project is the City of Long Beach, Nassau County. Also benefiting are the non-incorporated communities of Point Lookout and Lido Beach, both within the Town of Hempstead, and also in Nassau County (Figure 37). The predominant land use in Long Beach is moderate to high-density residential development consisting primarily of single-family units, with areas of high-density residential development consisting of high-rise apartments and condominiums along the oceanfront. There are occasional areas of moderate to high density commercial and other non-residential development, particularly in the City of Long Beach. The eastern end of the island is less urbanized, with substantial recreational areas separating the Lido Beach and Point Lookout communities.

195. The populations of the various communities affected by the project are presented in Table 2. Contrary to the downward trend in the first half of the 1990s, there is now an overall upward trend in the County population figures.

Table 2: Community Populations

Census Listed Community	1990	2000
Nassau County	1,287,348	1,334,544
City of Long Beach	33,510	35,462
Town of Hempstead	49,453	58,026
Lido Beach Community	2,786	2,825

(Source: Census 1990 and 2000, US Census Bureau, US Department of Commerce)

196. **Original Project Benefits.** The estimates of all economic benefits were originally based on January 1994 price levels and reflected the economic condition of the floodplain as of 1992. A project life of 50 years and a discount rate of 8% were used. In the Feasibility Study, the benefits to be derived from the improvement were listed as:

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

197. The first five of these categories were considered storm damage reduction benefits, and the original distribution of annual benefits for the NED plan are summarized in Table 3:

Table 3: Original Benefits of NED Plan

Storm Damage Reduction Benefits	**Annual Benefit**	**% of Total**
Residential Structures		
Physical	$10,088,840	59.42
Emergency	$558,490	3.29
Commercial Structures		
Physical	$3,361,030	19.79
Emergency	$55,420	0.33
Other Structures		
Physical	$724,530	4.27
Emergency	$11,350	0.07
Reduced Damage to Infrastructure		
Infrastructure Damage	$152,750	0.90
Boardwalk/Access	$4,400	0.03
Reduced Public Emergency Costs		
Emergency Protection	$16,280	0.10
Sand/debris Removal	$28,200	0.17
Future Protection Costs Foregone		
Section 933 Costs	$400,000	2.36
Existing Structure Protection	$970	0.01
Other Benefits		
Recreation Benefits		
Recreation Enhancement	$937,160	5.52
Recreation Maintenance	$639,120	3.76
Loss of Land Benefits		
Loss of Land	$1,440	0.01
Total Benefits	$16,979,980	100

* (Cost Base January 1994, Discount Rate 8%)

198. A cost base of October 2004, a project base year of 2008, and a 5.375% Federal Discount Rate have been used in the updating of benefits for this report. Only those benefits considered to be of significant value to the overall viability of the project (i.e. the major benefits) have been updated in detail. Storm damage reduction to structures and recreational benefits are considered to be the "major" benefits, and the process of updating them is presented in detail in the following sections, whilst the other "minor" benefits have been updated by means of various

update factors as appropriate. The updated project benefits reflect the elimination of protection for East Atlantic Beach.

199. **Update of Residential Structure Benefits**. For the 1995 Feasibility Study, an inventory/database of all structures in the study area was compiled, and generalized damage functions were developed for the various structure types. For residential structures, these functions took the form of curves relating flood depth to damage as a percentage of the structure's depreciated structure value, whereas damage functions for non-residential structures were based on a dollar value per square foot of structure size. Damages were then calculated for residential and non-residential structures by identifying the type of damage causing the maximum impact at each structure for various storm frequencies.

200. Residential damages for with and without project conditions have been revised for this reevaluation report by applying an update factor based on observed changes to residential structures in the study area that could have an impact on the depreciated structure value. To determine significant changes in the residential structure database since the 1995 Feasibility Study, a resurvey was undertaken based on a randomly selected sample of approximately 100 structures, intended to represent 1% of the total number of residential structures.

201. Calculations documenting the derivation of the update factor can be found in Appendix D along with sample calculations of updated lifecycle structure damages. The resulting updated benefits are presented in the Summary of Updated Benefits section later in this report.

202. **Update of Non-Residential Structure Benefits.** In the Feasibility Study, replacement costs for non-residential structures (commercial, industrial, utility, and municipal) were based on the most typical construction practices within each usage, with reference to the Means Square Foot Cost Guide. These practices were determined to vary with the size of the structure and unit prices were varied accordingly. The original structure build quality was again used as an indicator of the physical depreciation.

203. Because less than 20% of the original benefits originated from damage to non-residential structures, a less detailed approach than for residential structures was used to update these benefits. Non-residential structure damages for with and without project conditions were updated by applying a cost index factor derived from Marshall & Swift valuation data, following a review of the original predicted sources of major non-residential damage.

204. Sample damage update calculations are presented in Appendix D, and the updated benefits for non-residential structures are presented in the Summary of Updated Benefits section later in this report.

205. **Update of Recreation Benefits**. For the estimation of recreational benefits in the Feasibility Study, simulated demand curves were developed to model the hypothetical behavior of people visiting the various beaches along the project area and their willingness to pay to use these beaches, given that the project creates the potential for an enhanced recreation experience. These curves were based on the results of a comprehensive questionnaire survey carried out in July and August of 1992, which asked beach visitors about their willingness to pay to use the beaches with and without the implementation of the project, and their visitation patterns. Beach use values were forecast using a use-estimating model that assumed the increase in beach use would follow the projected growth of the local populations. Annual beach use and attendance data was acquired from the local authorities in various forms: For Long Beach, the total numbers of daily and season passes sold were obtained, for beaches operated by the Town of Hempstead the attendance was derived from the number of parking tickets sold, and for Nassau Beach attendance figures were received directly from County sources.

206. Because the recreation benefits contribute less than 10% of the overall project benefits, it was not considered necessary to conduct additional beach use surveys. It was considered sufficient for this study to recreate the simulated demand curves with the Willingness To Pay prices updated using a October 2004 Consumer Price Index Factor of 1.306, and more recent beach attendance data from the relevant local authorities. Recent beach attendance data received from the Town of Hempstead had been allocated to a number of separate beaches, which were then assigned to the two originally designated main beaches (Lido Beach and Point Lookout Beach) as shown in Figure 34, to ensure that valid comparisons with the Feasibility Report analyses could be made.

207. Table 4 presents summarized average beach attendance figures from the original analysis and for the period since the Feasibility Report, derived from data provided by local authorities. The raw data received is presented in Appendix D.

Table 4: Comparison of Average Beach Attendance

Location	Average Attendance 1992 – 1993	Average Attendance
Long Beach		
Daily Pass	139,411	163,901 (1999-2002)
Season Pass	741,383	330,554 (1999-2002)
Lido Beach	123,567	137,493 (1994-2002)
Nassau Beach	340,511	201,961 (1994-2002)
Point Lookout Beach	133,896	127,973 (1994-2002)

208. Attendance at Nassau Beach was found to have declined noticeably in recent years. Local officials attributed this to a range of factors including the deterioration of facilities and the increasing width of the beach, which discourages many older and less mobile patrons from visiting.

209. Attendance at Point Lookout Beach was also found to be generally declining, but by no means as dramatically as at Nassau Beach, hence the forecast of use model for Point Lookout Beach incorporated an adjustment factor to bring the predicted attendance into alignment with recorded figures, and the original assumed population growth was still applied.

210. Only limited recent beach attendance data was received from Long Beach, and the figures suggested a steep decline in the use of season passes at some point between 1993 and 1996, for which no explanation has been suggested. Detailed data was only available for 1999, but overall the data received was sufficient to derive estimated average attendance figures for 1999 to 2003 for input to the demand curves and the forecast of use model.

211. **Update of Minor Benefits**. Reductions in damage to infrastructure, public emergency costs and loss of land benefits have been considered to be minor benefits, because together they contribute less than 4% of the total benefits originally provided by the project.

212. For the purposes of the LRR, benefits were revised simply by applying appropriate update factors to the originally calculated benefits, as presented in Table 5, which summarizes the method of updates for the full range of benefits.

213. **Summary of Updated Benefits**. All updated benefits are presented in Table 6. These benefits were calculated assuming a project base year of 2008, project appraisal period of 50 years, a cost base of October 2004, and a Federal Discount Rate of 5.375%.

Table 5: Summary of Factors Used to Update Benefits

Benefit Category	Update Factor Source	Date	Update Factor
Residential Structures Physical Emergency	Update factor calculated from limited sample resurvey	October 2004	1.289 1.289
Commercial Structures Physical Emergency	Marshall & Swift Valuation Service – Building Cost Index*	October 2004	1.387 1.387
Other Structures Physical Emergency	Marshall & Swift Valuation Service – Building Cost Index*	October 2004	1.390 1.390
Infrastructure Damage Infrastructure Boardwalk/Access	ENR Construction Cost Index	October 2004	1.371 1.371
Public Emergency Costs Emergency Protection Sand/Debris Removal	Consumer Price Index	October 2004	1.306 1.306
Future Protection Costs Section933 Costs Existing Structure Protection	Not Updated	-	-
Recreation Recreation Enhancement Recreation Maintenance	Consumer Price Index and recent beach attendance data	October 2004	1.306 1.306
Loss of Land	Consumer Price Index	October 2004	1.306

*Adjusted to reflect relative frequencies of structure types (i.e. timber/masonry)

Table 6: Summary of Updated Benefits

Benefit Category	Updated Annual Benefit
Residential Structures	
Physical	$14,677,900
Emergency	$853,900
Commercial Structures	
Physical	$4,742,900
Emergency	$83,000
Other Structures	
Physical	$1,319,100
Emergency	$16,100
Damage to Infrastructure	
Infrastructure Damage	$209,400
Boardwalk/Access	$0
Public Emergency Costs	
Emergency Protection	$19,500
Sand/debris Removal	$33,300
Future Protection Costs	
Section 933 Costs	$400,000
Existing Structure Protection	$900
Recreation Benefits	
Recreation Enhancement	$1,082,800
Recreation Maintenance	$569,300
Loss of Land	$600
Total Benefits	**$24,008,700**

(Cost Base October 2004, Discount Rate 5.375%)

214. **Assessment of Surfability**. The LRR addresses the concerns of the surfing community in the study area, through an evaluation of the existing surfing conditions and the potential impacts of the proposed project. Details of this evaluation are presented in Appendix F. A summary of this evaluation is presented in the following paragraphs.

215. The southern coast of Long Island, New York, directly borders the Atlantic Ocean. Because of its orientation slightly toward the southeast, the shoreline is exposed to waves arriving from directions ranging from east to west. The easterly quadrants can bring locally-generated wind waves and swell from distant ocean storms. Winds from the westerly directions bring small locally-generated wind waves. Surfers on Long Island ride both storm-generated waves (large wind waves and swell) and locally-generated (usually smaller daily) waves generated by wind.

216. Typical daily wave conditions along the south shore of Long Island include average waves with a height of about 3 ft and a period of 5 to 8 seconds. Most often, the waves arrive from the southeast to southwest directions. Large storms can generate waves near the coast in the range of 10-15 ft with wave periods between 10 and 14 seconds. Hurricane waves, including swell from distant storms, usually arrive from the south to southeast while nor'easters (winter storms) usually generate waves from the east to northeast.

217. Surfers take advantage of waves as they propagate into shallow water where they are transformed by the ocean bottom into breaking conditions and are suitable for riding by surfers.

The way in which the waves are affected by the seafloor makes each surfing site unique. Other factors that affect the characteristics of a surfing site are the wind and tide. The height and period of the breaking wave, the breaker type and the peel angle also contribute to surf site characteristics (Walker, 1974).

218. Ideally, offshore bathymetry (seafloor conditions) seaward of a surf site will cause a wave to peak gradually toward the wave breaking point. Once reaching shallower water, the part of the wave advancing in shallower water moves more slowly than the part still in deeper water, causing the wave crest line to refract or bend toward the alignment of the underwater depth contours.

219. Channels and structures can also create surfable waves. Channels will cause a wave to refract due to the shallow side walls and deep water in the center of the channel, creating a gradient in wave height that in turn causes the wave to break gradually along its crest (peel) creating surfable conditions. Shoals and structures adjacent to the channels can add to the complexity of the wave-breaking process, sometimes making the wave height, peel, and duration of the ride more surfable.

220. Jetties and groins can cause incident waves to diffract at the head of the structure, with the diffracted wave having a gradient in height along the crest (highest height immediately along the structure), again inducing a gradual peel and surfability. Then, as the diffracted wave travels into shallower water at the shoreline, it peaks up again (shoals) enhancing the surfability of the wave again in the form of "shore break."

221. Physical traits of popular surfing spots include ready access to the beach, parking, and adjacent landowners and beach users who are amenable to surfers. Surfers are willing to walk a reasonable distance down the beach to surf at a good break, but ready access and available parking definitely enhance the utility of a given location. The City of Long Beach allows surfing from dawn to dusk at both Lincoln Blvd. and Laurelton Blvd. during the summer beach season (per telephone information from Recreation Department, May 2004). These are the only designated surfing locations.

222. **Surfing Site Conditions on Long Beach Island**. Based on conversations with local area surfers, there are three general types of surfing spots on Long Beach Island, New York:

- Type 1: Surf that is primarily enhanced by the (diffractive) effect of groins and favorable bottom conditions (refraction and shoaling) in proximity to and inside the groin compartments. These spots are popular in nearly any type of wave condition – relatively small daily waves up to storm-generated swell.
- Type 2: Surf that is enhanced by favorable bottom conditions (refraction and shoaling) very close to shore. These spots are popular primarily during relatively small daily wave conditions. These bottom conditions are always changing based on the daily wave climate.
- Type 3: Surf that is enhanced by bathymetric features (shoals or offshore bars) that are shallow (in the range of 4-8 ft), in offshore waters that generally range in depth from 10 to 20 ft.

223. There are some other types of areas, such as the inlets, where surfing takes place, but the three types listed above appear to the most frequently mentioned.

224. **Lafayette, Laurelton and Lincoln Boulevards**: These locations have characteristics of Type 1 surfing spots, as described above, in that surfing conditions are primarily enhanced by the

(diffractive) effect of groins and favorable bottom conditions inside the groin compartments. These spots are popular in nearly any type of wave condition – relatively small daily waves up to storm-generated swell. The spots are located in Long Beach, have diffracting groins, and ready access to the beach. The Lincoln Blvd groin is project groin number 43. This groin has been rated as being in poor condition and is not slated for rehabilitation as part of the project. The Lafayette and Laurelton Blvd groins are project groin numbers 35 and 36, respectively. These groins are in poor condition but have some sand retention capability and are thus slated for rehabilitation as part of this project.

225. It is expected that there will be some temporary effects on the surfability in the City of Long Beach. A more accurate approximation of the temporary effects on the surfability of the waves can be closer to a four to six month period, but could be up to one or two years, depending on the frequency and strength of storms that occur following sand placement. Moving a sand barrier under the boardwalk allows for a less extensive berm fill and less covering of the existing groins (Figure 38 and Figure 39). It is likely that this would reduce some negative impacts on surfing as well.

226. **Lido West**: This location has characteristics of Type 3 surfing spots, as described above, in that surfing waves occur when incident waves are enhanced by bathymetric features (shoals or offshore bars) that are normally located in water depths of 10-20 ft. There are no structures in this area and the beach is wide and relatively low. This location, and another to the west called the Azores (at approximately at the east end of Long Beach) are popular primarily when storm or post-storm swell occurs.

227. The toe of beach fill that is planned for the area will roughly extend to the offshore boundary of the surf line. Here, the beach fill should not impact the nature of surf affected by the offshore shoals or bars, but it will alter the inshore breakers.

228. **Hempstead Town Park**: This location has characteristics of Type 2 surfing spots, as described above, in that surfing waves occur when incident waves are enhanced by favorable bottom conditions (refraction and shoaling) very close to shore ("shore break"). These spots are popular primarily during relatively small daily wave conditions. The feature that makes this spot popular is the convenient parking and beach access at the Town Park.

229. The planned beach fill will alter the nearshore surf zone; however, the new structures will extend into deeper water and have the potential to create new, surfable conditions. The existing three groins at Point Lookout are not reported to be popular surf spots, possibly because of the more limited access, the presence of the residential community and lower wave energy associated with sheltering by the offshore ebb shoal. This sheltering would also affect waves at the new structures in the Town Park.

230. **Monitoring**. A monitoring program is suggested that would provide data for verifying conditions when surfable waves occur at sites of interest, and later to verify that project components have not adversely affected surf conditions. The local surfing community has recommended that a minimum of two web cameras be supported on a real time basis and that photographs be archived at 10-minute intervals throughout the life of the project. At least two web cameras are currently operating on Long Beach Island for this purpose and these could be utilized as part of the monitoring program.

231. The local surfing community has also recommended that wave gauging be part of the project. This information will be used for monitoring the project and could be used to monitor surfing conditions to determine if the project created any beneficial or adverse impacts to the surfability. A wave gauge would be placed off of the exposed open coast of Long Beach and

would provide data relevant to the popular surf spots at Lincoln Blvd and Laurelton Blvd. A second gauge would be placed offshore of Hempstead Town Park and would provide similar data for the areas inside the ebb shoal where the new groins will be constructed. These data sources, along with offshore Buoy 44025 and the web cameras, will provide the necessary physical data to quantify wave, wind and tide conditions when waves are surfable and if the project is effective in preserving the excellent surf on Long Beach Island. Communication between the local surfing community and the U.S. Army Corps of Engineers should continue so that concerns about the project can be voiced and updates on the project (including lessons learned from monitoring efforts) can be provided.

232. Real-time surf cameras, as recommended by the local surf community, are not included in the project's coastal monitoring program; therefore, the cost to utilize the equipment is not included as part of the project cost. The local surfing community could utilize the images from the existing wave cameras to verify surfing conditions following construction of the project. The coastal monitoring program, as part of the LRR Recommended Plan, includes one gage positioned offshore of Long Beach Island at a location yet to be determined.

E. Cost Estimate

233. **First Costs.** This section presents a detailed cost estimate for initial construction, nourishment and maintenance resulting in total and annualized project costs for the recommended storm damage reduction plan. The recommended plan from Point Lookout to Long Beach includes: dune to elevation +15 ft NGVD, 110 ft fronting berm at elevation +10 ft NGVD, sand barrier beneath the boardwalk in Long Beach to elevation +15 ft NGVD, 7 new groins in the Town of Hempstead Beach with the westernmost 3 groins as deferred construction, 17 groin rehabilitations and rehabilitation/extension of the terminal groin, design and advanced nourishment beach fill including sand fence and dune grass as well as new dune walkovers, a boardwalk extension and vehicle accesses. The dune has a 25 ft wide berm crest with 1 on 5 side slopes. The sand barrier located directly beneath the City of Long Beach boardwalk has a 25 ft crest width at elevation +15.0' NGVD with a 1V:3H landward slope and 1V:5H seaward slope except at boardwalk seaside ramp locations, where it has a 1V:2.5H landward and seaward slope. The toe of the sand barrier will extend approximately 15 ft seaward of the boardwalk. Boardwalk deck replacement associated with the sand barrier under the boardwalk at Long Beach is included as a non-Federal Relocation Item. The plan provides for periodic nourishment at 5-year intervals, maintenance of the dune, 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.

234. **Basis of Cost**. Cost estimates presented herein are based on October 2004 price levels. Initial beach fill quantities are based on beach surveys taken in 1998, 2001 and 2003. The beach fill cost is based on use of the offshore borrow area designated in the Feasibility Study. The groin rehabs are assumed to utilize land based equipment. The unit prices were developed on the basis that construction procedures will be as outlined herein. All first and annual costs presented are NED costs. Initial and periodic nourishment beach fill costs are based on the use of a 30-inch hydraulic cutterhead dredge for the entire project area.

235. For cost estimating purposes, stone costs for new groin construction are based on both trucking stone from a west central New Jersey quarry and barging from a quarry in the vicinity of Poughkeepsie, N.Y on the Hudson River. The barged stone will be delivered to a docking facility on the bay side, just east of Jones Inlet. This stone will be rehandled from the barges and trucked approximately 10 miles to the project. Stone quantities and costs are displayed in Table 7. Groin work is based on utilization of land-based equipment with construction

proceeding from the landward end of the groin crest out to the seaward crest. The inshore end of the groin will require open cut excavation in order to construct the design section. The groins are to be constructed prior to beach fill placement.

236. **Estimated First Cost.** The estimated project first cost for the Recommended Plan - (dune to elevation +15 ft NGVD, sand barrier beneath the boardwalk in Long Beach to elevation +15 ft NGVD, 110 ft fronting berm at elevation +10 ft NGVD) is $98,535,300 including placement of 6,600,000 cy of hydraulically placed design and advanced nourishment beach fill (including overfill and tolerance), the construction of 7 new groins (including 3 groins as deferred construction), 17 groin rehabs, 1 groin rehab/extension, construction of 12 timber dune walkovers (including 8 ADA), 12 gravel surface dune walkovers, 8 extensions of existing dune walkovers, 8 gravel surface vehicle accessways, 2 swing gate vehicle access structures, boardwalk composite wood deck replacement, 1 timber raised vehicle accessway. The project also includes reconstruction of 1 lifeguard headquarters, construction of timber retaining walls around 4 comfort stations, 2 comfort stations with concession stands, and 1 lifeguard headquarters, the placement of 12 acres of dune grass and 47,000 lf of sand fence, real estate administration costs and pertinent contingency, engineering and design and construction management costs. The estimated project first cost for the Recommended Plan, including the cost of the three groins as deferred construction, is $98,535,300. The cost of the project without the three deferred groins is $89,884,800. Details of the first cost estimate are shown on Table 7.

237. **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. Engineering and design costs (excluding coastal and environmental pre-construction monitoring) are based on 8% of the direct construction costs. Construction management costs are based on 8% 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 rehabs, terminal groin rehab/extension to account for design refinements dictated by changing beach profiles at the groin locations; 10% - 20% was applied to walkovers to account for design refinements, 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 and 12% was applied to hydraulic beach fill placement to account for changed field conditions at the time of construction.

238. **Annual Charges.** The estimates of annual charges for the economic evaluation of the Recommended Plan are based on an economic life of 50 years and a discount rate of 5 3/8%. The annual charges include the annualized first cost and interest during construction, the annualized periodic nourishment costs, the annualized major rehabilitation costs, post-construction monitoring costs and annual dune and new groin maintenance. Interest during construction was developed for the first cost of the project constructed over a 4.3 year period at a 5 3/8% discount rate. Total annual charges for the recommended plan are $9,016,600 as summarized in Table 8.

239. **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 1,726,000 cy, which includes overfill and tolerance at a total cost per operation of $12,508,700.

240. **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 is

based on the storm event that causes the erosion volume to exceed 15 cy per linear ft along the beach front. This is the average nourishment volume anticipated to be available at the midpoint of the renourishment cycle because the significant storm event has a 50% chance of occurring earlier or later than the cycle midpoint.

241. **Monitoring Costs**. Post-construction monitoring costs include coastal monitoring over the 50-year project life and environmental monitoring over the first 5 years of the project. Annualized monitoring costs are shown on Table 8.

F. Benefit-Cost

242. **Recommended Plan**. The first cost estimate (October 2004 price level) for the LRR Recommended Plan is presented in Table 7. As shown in Table 8, the annual cost for the Recommended Plan is $9,016,600, which results in a benefit cost ratio (BCR) of 2.7 with the current annual benefits of $24,008,700 (Table 6).

Table 7: First Cost

October 2004 Price Level

Long Beach Island, NY

Storm Damage Reduction Project (LRR Phase) 3 CONTRACT CONSTRUCTION SCHEDULE

Account Code	Description	QTY UOM	Unit Price	Amount	% Cont'g	Cont'g Amt	Total
01	LANDS AND DAMAGES						
	Administrative Costs	1 LS		$ 50,000	15%	$ 7,500	$ 57,500
01	**TOTAL LANDS AND DAMAGES**			**$ 50,000**		**$ 7,500**	**$ 57,500**
	CONTRACT # 1						
	PT. LOOKOUT						
10	BREAKWATERS & SEAWALLS						
	Mob/Demob	1 LS		$ 417,623	10%	$ 41,782	$ 459,605
	SITE WORK FOR NEW GROINS						
	Excavation	10,650 CY	$ 5.92	$ 63,033	10%	$ 6,303	$ 69,336
	Geotextile	12,600 SY	$ 10.81	$ 136,181	10%	$ 13,618	$ 149,799
	Bedding Stones	19,200 Ton	$ 75.97	$ 1,458,706	10%	$ 145,871	$ 1,604,577
	Underlayer Stone 2100 Lbs	11,300 Ton	$ 91.76	$ 1,036,932	10%	$ 103,693	$ 1,140,625
	10-12tons Capstone	24,950 Ton	$ 99.12	$ 2,473,068	10%	$ 247,307	$ 2,720,375
	Re-handling the Stones	27,725 Ton	$ 14.24	$ 394,768	10%	$ 39,477	$ 434,245
10	**TOTAL BREAKWATERS & SEAWALLS**			**$ 5,980,511**		**$ 598,051**	**$ 6,578,562**
30	PLANNING, ENGINEERING, & DESIGN	1 LS		$ 190,400	15%	$ 28,560	$ 218,960
31	CONSTRUCTION MANAGEMENT	1 LS		$ 485,000	15%	$ 72,750	$ 557,750
	TOTAL CONTRACT # 1			**$ 6,705,911**		**$ 706,861**	**$ 7,412,772**
	CONTRACT # 2						
	PT. LOOKOUT						
10	BREAKWATERS & SEAWALLS						
	Mob/Demob	5 ea		$ 871,508	15%	$ 130,726	$ 1,002,234
	SITE WORK TO RECONSTRUCT GROIN						
	Remove & Stockpile Groin Stones	1,059 Ton	$ 26.04	$ 27,573	15%	$ 4,136	$ 31,709
	Realign Existing Armor Stones	400 LF	$ 328.66	$ 131,462	15%	$ 19,719	$ 151,181
	Excavation	1,024 CY	$ 51.53	$ 52,769	15%	$ 7,915	$ 60,684
	5 Ton Capstone	3,224 Ton	$ 71.99	$ 232,081	15%	$ 34,812	$ 266,893
	Dispose Excess Stones (at site)	247 Ton	$ 67.63	$ 16,703	15%	$ 2,506	$ 19,209
	TERMINAL GROIN EXTENSION/REHAB						
	Remove Stockpile/Reuse Groin Stones	7,400 Ton	$ 26.07	$ 192,937	15%	$ 28,941	$ 221,878
	Excavation	2,500 CY	$ 5.92	$ 14,797	15%	$ 2,219	$ 17,016
	Geotextile	3,200 SY	$ 10.81	$ 34,586	15%	$ 5,188	$ 39,774
	Bedding Stones	3,900 Ton	$ 78.79	$ 307,265	15%	$ 46,090	$ 353,355
	Class A 10 Ton Armor Stone	3,300 Ton	$ 47.09	$ 155,403	15%	$ 23,310	$ 178,713
	Class B 10.75 Ton Armor Stone	9,400 Ton	$ 99.12	$ 931,737	15%	$ 139,761	$ 1,071,498
	Class C 12 Ton Toe Stone	1,100 Ton	$ 99.12	$ 109,033	15%	$ 16,355	$ 125,388
	Class D Secondary Armor Stone 2100 lbs	5,600 Ton	$ 99.12	$ 555,077	15%	$ 83,262	$ 638,339
	Install & Remove Temporary Sheet Pile	575 LF	$ 1,063.38	$ 611,445	15%	$ 91,717	$ 703,162
	SITE WORK FOR NEW GROINS						
	Excavation	10,650 CY	$ 5.92	$ 63,033	10%	$ 6,303	$ 69,336
	Geotextile	12,600 SY	$ 10.81	$ 136,181	10%	$ 13,618	$ 149,799
	Bedding Stones	19,200 Ton	$ 75.97	$ 1,458,706	10%	$ 145,871	$ 1,604,577
	Underlayer Stone 2100 Lbs	11,300 Ton	$ 91.76	$ 1,036,932	10%	$ 103,693	$ 1,140,625
	10-12tons Capstone	27,950 Ton	$ 88.48	$ 2,473,068	10%	$ 247,307	$ 2,720,375
	RE-HANDLING THE STONES	51,850 Ton	$ 14.24	$ 738,277	15%	$ 110,742	$ 849,019
	TOTAL PT. LOOKOUT			**$ 10,150,573**		**$ 1,264,191**	**$ 11,414,764**
	CITY OF LONG BEACH						
10	BREAKWATERS & SEAWALLS						
	Mob/Demob	2 ea		$ 573,156	15%	$ 85,973	$ 659,130
	SITE WORK TO RECONSTRUCT GROIN						
	Remove & Stockpile Groin Stones	10,541 Ton	$ 26.04	$ 274,464	15%	$ 41,170	$ 315,630
	Realign Existing Armor Stones	3,000 LF	$ 328.66	$ 985,960	15%	$ 147,895	$ 1,133,860
	Excavation	10,176 CY	$ 51.53	$ 524,416	15%	$ 78,662	$ 603,080
	5 Ton Capstone	31,976 Ton	$ 59.74	$ 1,910,232	15%	$ 286,535	$ 2,196,770
	Dispose Excess Stone (At Site)	2,453 Ton	$ 67.62	$ 165,880	15%	$ 24,882	$ 190,760
	Re-Handling of the Stones	15,988 Ton	$ 14.24	$ 227,652	15%	$ 34,148	$ 261,800
	TOTAL CITY OF LONG BEACH			**$ 4,661,768**		**$ 699,265**	**$ 5,361,030**
30	PLANNING, ENGINEERING, & DESIGN	1 LS		$ 467,600	15%	$ 70,140	$ 537,740
31	CONSTRUCTION MANAGEMENT	1 LS		$ 1,020,000	15%	$ 153,000	$ 1,173,000
	TOTAL CONTRACT # 2			**$ 16,299,941**		**$ 2,186,596**	**$ 18,486,534**

CONTRACT # 3

PT. LOOKOUT

02	RELOCATION						
	STRUCTURES						
	Timber Raised Vehicle Access 10' x 157'	1 Ea	$ 273,612.00	$ 273,612	10%	$ 27,361	$ 300,973
	Timber Pedestrian Non ADA Dune Walkover 6' x 137'	4 Ea	$ 49,222.75	$ 196,891	10%	$ 19,689	$ 216,580
	Timber Pedestrian ADA Dune Walkover 6' x 235'	3 Ea	$ 168,947.00	$ 506,841	10%	$ 50,684	$ 557,525
	Existing Timber Pedestrian Walkover to be Extended 6' x 137'	8 Ea	$ 49,222.75	$ 393,782	10%	$ 39,378	$ 433,160
	Vehicle Access Gravel Surface 10' x 220'	7 Ea	$ 49,828.14	$ 348,797	10%	$ 34,880	$ 383,677
	Lifeguard Headquarters	1,555 SF	$ 483.68	$ 752,120	20%	$ 150,424	$ 902,544
02	**TOTAL RELOCATIONS**			**$ 2,472,043**		**$ 322,416**	**$ 2,794,459**
17	BEACH REPLENISHMENT						
	Mob/Demob	1 LS		$ 2,863,987	12%	$ 343,678	$ 3,207,670
	Beach Fill	1,100,000 CY	$ 4.15	$ 4,566,119	12%	$ 547,934	$ 5,114,050
	ASSOCIATED GENERAL ITEMS						
	Dune Grass	130,680 SF	$ 1.03	$ 134,758	15%	$ 20,241	$ 155,000
	Sand Fence	10,000 LF	$ 7.73	$ 77,341	15%	$ 11,601	$ 88,940
17	**TOTAL BEACH REPLENISHMENT**			**$ 7,642,205**		**$ 923,454**	**$ 8,565,660**
	TOTAL PT. LOOKOUT			**$ 10,114,248**		**$ 1,245,870**	**$ 11,360,119**

CITY OF LONG BEACH

02	RELOCATION						
02.03.47	STRUCTURES						
	Timber Pedestrian ADA Dune Walkover (zig-zag) 6' x 250'	5 Ea	$ 173,164.20	$ 865,821	10%	$ 86,582	$ 952,400
	** The above 5 include 1 dune walkover extending from the boardwalk*						
	Gravel Surface Pedestrian Walkover 6' x 220'	12 Ea	$ 36,654.00	$ 439,848	10%	$ 43,985	$ 483,830
	Remove & Stockpile Boardwalk Railing, Benches, Lights etc.	1 LS	$ 240,000.00	$ 240,000	15%	$ 36,000	$ 276,000
	Remove Boardwalk Timber Decking	1 LS	$ 400,000.00	$ 400,000	15%	$ 60,000	$ 460,000
	Deck Timber Disposal at Landfill	1 LS	$ 150,000.00	$ 150,000	15%	$ 22,500	$ 172,500
	Reinforce 30% Timber Stingers	1 LS	$ 67,670.00	$ 67,670	15%	$ 10,151	$ 77,820
	Treat Stringer surface with moisture protection	673,000 SF	$ 0.80	$ 538,400	15%	$ 80,760	$ 619,160
	Composite (Plastic wood) Deck	1,200,000 LF	$ 2.50	$ 3,000,000	10%	$ 300,000	$ 3,300,000
	Decking & Reinforced Stringer hardware	1,301,000 LF	$ 0.50	$ 650,650	10%	$ 65,065	$ 715,720
	Decking Labor	1 LS	$ 720,000.00	$ 720,000	10%	$ 72,000	$ 792,000
	Reinstall Boardwalk Railing, Benches, Lights etc.	1 LS	$ 320,000.00	$ 320,000	15%	$ 48,000	$ 368,000
	Sand Barrier fill placement	94,000 CY	$ 3.50	$ 329,000	15%	$ 49,350	$ 378,350
	Geotextile for sand barrier	81,000 SY	$ 2.50	$ 202,500	10%	$ 20,250	$ 222,750
	Marine matters	4,150 CY	$ 200.00	$ 830,000	10%	$ 83,000	$ 913,000
	4" high cement filled Geoweb	10,000 SY	$ 30.00	$ 300,000	10%	$ 30,000	$ 330,000
	Swing Gate	2 EA	$ 280,000.00	$ 560,000	15%	$ 84,000	$ 644,000
	20' Timber pile	2,774 LF	$ 185.00	$ 513,130	15%	$ 76,979	$ 590,170
	Sand Fill	19,000 CY	$ 5.10	$ 96,900	12%	$ 11,628	$ 108,530
02	**TOTAL RELOCATIONS**			**$ 10,223,979**		**$ 1,180,250**	**$ 11,404,230**
17	BEACH REPLENISHMENT						
	Beach Fill	5,500,000 CY	$ 5.00	$ 27,525,599	12%	$ 3,303,072	$ 30,828,670
	ASSOCIATED GENERAL ITEMS						
	Dune Grass	392,040 SF	$ 1.03	$ 404,274	15%	$ 60,641	$ 464,920
	Sand Fence	37,000 LF	$ 7.73	$ 286,160	15%	$ 42,924	$ 329,080
17	**TOTAL BEACH REPLENISHMENT**			**$ 28,216,033**		**$ 3,406,637**	**$ 31,622,670**
	TOTAL CITY OF LONG BEACH			**$ 38,440,012**		**$ 4,586,887**	**$ 43,026,900**
30	PLANNING, ENGINEERING & DESIGN	1 LS		$ 1,940,000	15%	$ 291,000	$ 2,231,000
31	CONSTRUCTION MANAGEMENT	1 LS		$ 3,450,000	15%	$ 517,500	$ 3,967,500
	TOTAL CONTRACT # 3			**$ 53,944,260**		**$ 6,641,257**	**$ 60,585,519**
30	PLANNING, ENGINEERING & DESIGN (MONEY SPENT)	1 LS		$ 3,400,000			$ 3,400,000
	TOTAL FIRST COST			**$ 80,350,112**		**$ 9,534,714**	**$ 89,884,825**

DEFERRED GROINS (E-G)

10	BREAKWATERS & SEAWALLS						
10.05.01	Mob/Demob	1 LS		$ 202,060	10%	$ 20,206	$ 222,266
10.05.6	SITE WORK FOR NEW GROINS						
	Excavation	36,170 CY	$ 5.91	$ 213,864	10%	$ 21,386	$ 235,250
	Geotextile	18,000 SY	$ 10.80	$ 194,351	10%	$ 19,435	$ 213,790
	Bedding Stones	23,000 Ton	$ 75.90	$ 1,745,673	10%	$ 174,567	$ 1,920,240
	Underlayer Stone 2100 Lbs	14,500 Ton	$ 91.67	$ 1,329,255	10%	$ 132,925	$ 1,462,180
	10-12 tons Capstone	34,600 Ton	$ 99.02	$ 3,426,180	10%	$ 342,618	$ 3,768,800
10	**TOTAL BREAKWATERS & SEAWALLS**			**$ 7,111,383**		**$ 711,137**	**$ 7,822,526**
30	PLANNING, ENGINEERING & DESIGN	1 LS		$ 198,800	15%	$ 29,820	$ 228,620
31	CONSTRUCTION MANAGEMENT	1 LS		$ 521,143	15%	$ 78,171	$ 599,314
	TOTAL FIRST COST w/Deferred			**$ 87,461,495**		**$ 10,245,851**	**$ 98,535,285**

TABLE 8: ANNUAL COSTS

First Cost (a)	$	95,135,300
Investment Cost		
Interest During Construction (b)	$	9,798,800
Total Investment Cost	$	104,934,100
Annual Costs		
Annualized Investment Cost (c)	$	6,084,100
Annual Scheduled Renourishment (d)	$	2,193,900
Annualized Major Rehabilitation (Emergency Beach Fill) Cost (e)	$	146,400
Annual Dune and Groin Maintenance Cost (f)	$	308,000
Annual Coastal Monitoring Cost	$	187,800
Annual Environmental Monitoring Cost	$	96,400
Total Annual Cost *	**$**	**9,016,600**

* October 2004 Price Levels

(a) Total First Cost without sunk PED costs ($3,400,000)

(b) Based on 52 month construction period @ 5 3/8%, based upon Total First Cost without sunk PED costs ($98,535,300)

(c) I = 5 3/8% for 50 year period of analysis

(d) Based on 1,726,000 cy @ $5/cy

(e) Maximum erosion volume landward of a given profile position computed from SBEACH (50,100 and 200 year storms extraploated from northeasters); based on $20/cy for trucked sand

(f) Based 0.5% of initial new groin, groin extension and groin rehabilitation costs ($31,510,000)(0.005) = **$158,000**, Plus annualized Long Beach dune and beach maintenance cost estimated (by the City) to be $1,300,000 or $50,000 less than existing, due primarily to less boardwalk repair/rehab. (with a composite wood deck replacement) and less beach cleaning required under the boardwalk; when added to the deck replacement every 20 to 25 years, ($150,000 annualized cost), the net annual operation and maintenance cost for Long Beach is **$100,000** over existing, plus annualized dune maintenance for Pt. Lookout/Hempstead Park at 50 days/year at $1,000/day = **$50,000** over existing beach maintenance.

VII. Selected Plan

A. General

243. The selected storm damage reduction plan from the 1995 Feasibility Study included 41,000 linear feet of beach fill and generally extended from the eastern end of the barrier island at Point Lookout to Yates Avenue in East Atlantic Village where the plan tapered into the existing shoreline in Atlantic Beach. This plan consisted of:

- a dune with a top elevation of + 15 ft above NGVD, a top width of 25 ft, and landward and seaward slopes of 1V:5H;
- a beach berm extending 110 ft from the seaward toe of the recommended dune at an elevation of +10 ft NGVD, thus gradually sloping approximately between 1V:25H and 1V:35H to match the existing bathymetry;
- a total sand quantity of 8,642,000 cy for the initial beach fill placement, including tolerance, overfill and advanced nourishment;
- planting of 29 acres dune grass and installation of 90,000 linear ft of sand fence;
- 16 dune walkovers and 13 timber ramps for boardwalk access, and 12 vehicle access ramps over the dunes;
- 6 new groins at the eastern end of the island
- rehabilitation of 16 of the existing groins, including the rehabilitation of 640 ft of the existing revetment on the western side of Jones Inlet;
- advanced nourishment to ensure the integrity of the initial beach fill design; and
- periodic nourishment of approximately 2,111,000 cy of beach fill material at 5 year intervals for the 50 year life of the project.

Total First Cost = $90,593,500*
*updated to October 2004 Price Levels using CWICCS Index

244. The LRR selected storm damage reduction plan includes 29,000 linear feet of beach fill and generally extends from the eastern end of the barrier island at Point Lookout to the western boundary of the City of Long Beach. This plan consists of:

- a dune with a top elevation of + 15 ft above NGVD, a top width of 25 ft, and landward and seaward slopes of 1V:5H along the entire project area except where the City of Long Beach boardwalk is located;
- sand barrier located directly beneath the City of Long Beach boardwalk with a 25 ft crest width at elevation +15.0' NGVD with a 1V:3H landward slope and 1V:5H seaward slope except at boardwalk seaside ramp locations, where it has a 1V:2.5H landward and seaward slope. The toe of the sand barrier will extend approximately 15 ft seaward of the boardwalk;
- a beach berm extending 110 ft from the seaward toe of the recommended dune or sand barrier at an elevation of +10 ft NGVD, then gradually sloping approximately between 1V:20H (Point Lookout) and 1V:35H (Long Beach and Lido Beach) to match the existing bathymetry;
- a total sand fill quantity of 6,600,000 cy for the initial beach fill placement, including tolerance, overfill and advanced nourishment;
- planting of 12 acres of dune grass and installation of 47,000 lf of sand fence;
- construction of 12 timber dune walkovers (including 8 ADA compliant and 1 extending from the boardwalk), 12 gravel surface dune walkovers, 8 extensions of existing dune walkovers, 8 gravel surface vehicle accessways, 2 swing gate vehicle access structures, 1 timber raised vehicle accessway, reconstruction of 1 lifeguard headquarters,

construction of timber retaining walls around: 4 existing comfort stations, 2 comfort stations with concession stands, and 1 lifeguard headquarters; replacement of 11,000 LF of boardwalk deck with composite wood;

- rehabilitation of 17 of the existing groins, plus the rehabilitation and 100-ft extension of the existing terminal groin at Point Lookout (18 structures total);
- 7 newly constructed groins at the eastern end of the island (3 of which are deferred construction to be built in the future if required);
- creation of 5,000 lf of bird nesting and foraging area for piping plovers and least terns (within the Town of Hempstead)
- advanced nourishment to ensure the integrity of the initial beach fill design;
- and periodic nourishment of approximately 1,726,000 cy of beach fill material at 5 year intervals for the 50 year life of the project.

Total First Cost = $98,535,300

B. Monitoring

245. A monitoring program is proposed to collect and analyze physical data in a systematic manner to verify design parameters, check on the status of the project in providing erosion control, storm damage reduction and recreational benefits. The components of the monitoring plan are described in the following paragraphs and are in accordance with EC1105-2-409 (31 May 2005) for monitoring and adaptive management.

246. **Beach Fill Monitoring**. Beach profiles will be surveyed before and after initial beach fill placement and twice per year (spring and fall) throughout the first nourishment cycle (5 years). A total of twenty (20) profiles will be surveyed over the entire project area. In addition, from Lido Beach to Point Lookout, thirty (30) beach profiles should be surveyed at 500-ft spacing from E1085000 to E1100000 to document the evolution of the ebb shoal attachment location. Repetitive surveys of these profiles will track the movement of placed beach fill alongshore and offshore and will provide estimates of subsequent erosion and accretion. After the first nourishment cycle profiles will be surveyed immediately before beach fill placement, immediately after beach fill placement, and once per year over the life of the project. The survey will capture characteristics of the post-winter beach and will be surveyed in February-early March to avoid impact to nesting birds.

247. Beach sediment grab samples will be collected once each nourishment cycle to define the redistribution of sediment after placement. Aerial photography will be acquired at the time of prefill, postfill, annually for five years, and every other year thereafter for a five-year period.

248. A directional wave gauge will be deployed seaward of central Long Beach. The gauge will be located west of the ebb shoal attachment point in Long Beach at a location to be determined in coordination with the City of Long Beach. The gauge will assist in quantifying the driving forces behind changes to the native and constructed beach.

249. Data analysis of beach fill response information will include profile volume change and shape readjustment, area of loss or gain on profiles, volume of beach fill remaining in the project, assessment of alongshore and cross-shore beach fill movement from beach and nearshore placement area, seasonal and storm response and shoreline change.

Borrow Area Monitoring

250. The Long Beach borrow area will be monitored to determine borrow area infilling rates and borrow area reusability. Hydrographic surveys, vibracores and a subbottom survey will be taken at the end of the first nourishment cycle to determine type and quantity of sediment filling in the dredged areas. Hydrographic surveys of the borrow area will be taken before construction (prefill), after construction (postfill), and just prior to each renourishment (every 5 years). These will be compared to determine borrow area infilling rates and patterns.

251. Every five years or when a potential trigger condition is met for construction of deferred structures, hydrographic surveys that include the inlet and the exterior of the ebb and flood shoals should be performed. The surveys, which could indicate, for example, changes in the long-term supply of sediment to the shoreline, indicate a need for increased beach fill in the groin field.

C. Public Access

252. **Background**. 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 that receive beach fill 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.

253. The geographical scope of this public access plan includes the beachfront areas, which shall be provided beach fill in accordance with the recommended storm damage reduction plan for Long Beach Island, New York. The recommended plan extends from the easternmost boundary at Point Lookout to the westernmost boundary of the City of Long Beach. The taper section of beach fill between Long Beach and 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 the western boundary of the City of Long Beach to the terminal jetty at Point Lookout.

254. **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.

255. **Project Access**. The proposed project for storm damage reduction generally includes a 110 ft wide beach berm backed by a dune at elevation +15 ft NGVD. 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 plan sheets. 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. As mentioned in the Formulation section of this LRR, the two properties (Lido Towers and Lido Townhouses) will remain private contrary to State of New York coastal policy, which requires the beaches to be publicly owned. In view of this, the cost of the beach fill within these boundaries will be the responsibility of the Town of Hempstead.

256. The Point Lookout Civic area and the Lido Civic area (between Lido Towers and Lido Townhouses) are special park districts that lease land from the Town of Hempstead. The agreement, in its present form, between these special park districts and the Town of Hempstead, limits the public access to the beach. In order to meet Federal and New York State Public Access regulations, within these properties, additional access points are proposed. A dune crossover structure is proposed at Beach Street in Point Lookout, while the existing dune walkover at Biaritz Street (currently identified for extension) is proposed as a public access point to satisfy public access requirements in the Lido Civic area.

257. **Public Access Plans**. The City of Long Beach and the Town of Hempstead have submitted separate plans to illustrate the public access provisions in 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 were provided as attachments to the overall Public Access Plan for the 1995 Feasibility Report.

D. Real Estate Requirements

258. The proposed project located in Nassau County, New York, is a storm damage reduction project. The purpose of this project is to provide storm damage reduction for the barrier island.

259. The recommended plan for the project is for the construction of a 110-foot wide beach berm that will extend 29,000 ft in length along the beach frontage in the project. Additionally, the plan requires the construction of a dune system that will have a footprint width of 75 ft for 18,000 ft in length. A dune maintenance area 25 ft wide and extending northward from the landward toe of the proposed dune is also required. The remaining 11,000 ft of beach beach fill is backed by a sand barrier of 65 ft width essentially under the boardwalk at Long Beach. Included in the 34,000 foot total project length is an existing terminal groin at the eastern limit of the project (shown on Figure 14 as Groin No. 58) that is programmed for rehabilitation and a project limit at the western boundary of the City of Long Beach 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 seventeen (17) existing groin structures in addition to the rehab and extension of Groin No. 58
b. construction of seven (7) new groins; 4 initial construction, 3 deferred construction
c. construction of twenty-four (24) new dune walkovers (12 timber and 12 gravel surface)
d. extension of eight (8) existing dune walkovers
e. construction of nine (9) new vehicle access ramps (8 gravel surface and 1 timber) and 2 swing gate vehicle access structures
f. construction of timber retaining walls around four existing comfort stations, 2 comfort stations with concession stands, and one lifeguard headquarters in the City of Long Beach
g. relocation of 1 lifeguard headquarters in the Town of Hempstead
h. replacement of timber boardwalk with composite wood

260. Real estate required to build the project is described as follows.

261. **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 NYSDEC who is the primary non-Federal sponsor for the project. These publicly owned lands comprise a total of 34,000 lineal ft 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 "Easement" to enter upon the lands to specifically construct, operate and maintain the project. A non-standard estate for the Easement 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.

262. Dune and beach nourishment areas will also be located on three (3) privately owned parcels under two (2) different ownerships. These privately owned parcels comprise a total of approximately 1,200 lf of project shoreline, which includes dune and beach nourishment area. The three private parcels are located in the Lido Beach section of the project. The uses of these lands are recreational and residential. The standard approach for a shore protection project, (In accordance with federal requirements) is for the necessary Real Estate to be secured with a "Perpetual Beach Nourishment and Restrictive Dune Easement", which allows for limited right to use, access, and modify these areas. New York State; however, requires that for the beach area a fee simple estate be acquired, while still allowing for a "Restrictive Dune Easement" in the dune area. The NYSDEC and the Town of Hempstead would be required to obtain the proposed beach fill area as fee simple and also acquire the "Restrictive Dune Easement", to participate in a cost-shared project in these areas

263. **Selected Real Estate Alternative.** As discussed earlier, the non-Federal sponsor will obtain a "Right-of-Entry" for construction and maintenance activities, that does not subject the beach in the privately owned parcels to public access, or in any way alter the private use of the existing beach area. Consistent with the Federal and State policies, this approach requires the non-Federal , non-State Sponsor (the Town of Hempstead) to pay 100% of the project cost for work within the boundaries of the three privately owned parcels. Based upon the current plan layouts, and estimated beach fill quantities, the project cost at these parcels is approximately $700,000 (131,300 cy). Presently, Lido Townhouses is located in the area identified as the bird nesting and foraging area, where no sand placement is expected as part of initial construction. It is included in this assessment, because of the potential need for future renourishment in this area. This will be accounted for in the overall project cost-sharing.

264. **Work/Staging Areas**. There are neither 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 "Easement" 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.

265. **Walkovers and Vehicle Access Ramps**. There are neither 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 above.

The dune maintenance area landward from the landward toe of the dune is included in the dune area and "Restrictive Dune Easement".

266. **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 an "Easement" 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.

267. **Summary**. 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 "Easement" 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. Administrative cost associated with the private land acquisition is estimated at $57,500 and 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 interests in lands below the Mean High Water Line (MHWL) are to be acquired.

268. 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 extraction activities 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 or replacement of structures are dealt with elsewhere in the feasibility report and are estimated in the Micro Computer Aided Cost Estimating System (MCACES) 02 account. Costs for relocation of facilities in the project are estimated elsewhere in the report and in the "Relocation" account. A "Lands and Damages" account summary and breakdown of administrative cost estimate for lands and damages is attached in Appendix E. Total real estate cost and associated administrative cost, including contingency, are estimated at $57,500.

269. Local municipalities, including the Town of Hempstead and the City of Long Beach, and Nassau County and their constituencies are supportive of the project. In addition to the Village of Atlantic Beach (which opted out of the project during the Feasibility phase), East Atlantic Beach has given notice in writing that it 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 at the west boundary of the City of Long Beach.

VIII. Local Cooperation

A. General

270. In accordance with Section 105 (a)(1) of WRDA 1986, the feasibility study of Long Beach Island, New York was cost shared 50% - 50% between the Federal Government and the State of New York. Furthermore, the local sponsors of Nassau County, Town of Hempstead and the City of Long Beach cost shared the non-Federal share (70% State/30% local). The contributed funds of the non-Federal sponsor, the New York State Department of Environmental Conservation, and the local municipalities have shown the intent to support a project for Long Beach Island, New York.

271. A fully coordinated Project Cooperation Agreement (PCA) package (to include the sponsor's financing plan) will be prepared subsequent to the approval of the LRR phase, which will reflect the recommendations of the LRR. Before the selected plan can be constructed, the PCA will be negotiated with the State of New York. According to the current schedule, the Federal Government and the State of New York plan to enter into a PCA in January 2006. The non-Federal Sponsor, the New York State Department of Environmental Conservation, has indicated support of the recommendations presented in this LRR and the desire to execute a PCA for the recommended plan. Other non-Federal interests, such as the City of Long Beach, the Town of Hempstead and Nassau County have indicated their support of the project. The non-Federal sponsor shall be required to comply with all applicable Federal laws and policies and other requirements, as applicable to the beach fill nourishment feature selected herein, including but not limited to:

a. Provide non-Federal costs assigned to hurricane and storm damage reduction as further specified below:

    (1) Enter into an agreement which provides, prior to construction, 25 percent of pre-construction engineering and design (PED) costs;
    (2) Provide, during construction, any additional funds needed to cover the non-federal share of PED costs;
    (3) Provide all lands, easements, and rights-of-way, including suitable borrow areas, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project;
    (4) Provide, during construction, any additional amounts as are necessary to make its total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits.
    (5) Provide, during construction of each periodic nourishment 35 percent of periodic nourishment costs assigned to hurricane and storm damage reduction plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits.

b. For so long as the project remains authorized, operate, maintain and repair the completed project, or functional portion of the project, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the Non-Federal Sponsor with prior specific written direction, in which case the Non-Federal Sponsor shall perform such investigations in accordance with such written direction;

g. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree that the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army, and Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), requiring non-Federal preparation and implementation of flood plain management plans;

k. Provide 35 percent of that portion of total historic preservation mitigation and data recovery costs assigned to initial construction of hurricane and storm damage reduction, 35 percent of those costs assigned to periodic nourishment and 100 percent of those costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits that are in excess of 1 percent of the total amount authorized to be appropriated for the project;

l. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

m. Within 1 year after the date of signing a project cooperation agreement, prepare a floodplain management plan designed to reduce the impact of future flood events in the project area. The plan shall be prepared in accordance with guidelines developed by the Federal Government and must be implemented not later than 1 year after completion of construction of the project;

n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the project;

o. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

p. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

q. For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

r. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

s. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and advance nourishment section and provide the results of such surveillance to the Federal Government;

u. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute.

272. The City of Long Beach, Town of Hempstead, and Nassau County have expressed support for a potential project. The cooperation between the various governments indicates a strong willingness to proceed with a potential solution to the flood and storm damage problems facing the barrier island of Long Beach.

273. In an effort to keep the sponsor and interested local municipalities informed, coordination throughout the feasibility phase was maintained. Meetings were held periodically among representatives of the District, NYSDEC, City of Long Beach, Town of Hempstead and Nassau County.

274. Coordination efforts shall continue, including coordination of this report with other State and Federal agencies, such as National Marine Fisheries Service, United States Fish and Wildlife Service, United States Environmental Protection Agency, New York State Department of Environmental Conservation-Region 1, and New York State Department of State. It is currently anticipated that an informational public meeting will be held upon approval of this LRR.

B. Project Implementation

275. The implementation process will carry the Selected Plan through preconstruction engineering and design (PED), including development of Plans and Specifications (P&S), and construction. Funding by the Federal Government to support these activities would have to meet budget criteria. Non-Federal contributions would be received for cost-sharing purposes at the time of construction.

276. **General**. The Long Beach Island, New York storm damage reduction project is authorized to provide storm damage protection for the Long Beach Island area. The recommended change to the project, as prescribed in the selected plan, is consistent with the purpose of the project authorization and is within the authorized project funding limits. Therefore, in accordance with Department of the Army Engineering Regulations, ER 1105-2-100, and Section 902 of WRDA 1986, additional authorization is not required. The project is eligible for continuing construction funding. The project will be considered for inclusion in the Federal Budget on the basis of national priorities, magnitude of the Federal commitment, economic and environmental feasibility, level of local support, willingness of the non-Federal partner to fund its share of the project cost, and budgetary constraints that may exist at the time of funding.

C. Cost Apportionment

277. The proposed apportionment of first costs between the Federal Government and the non-Federal Sponsor for the selected plan is in accordance with Section 101 of WRDA 1986.

278. Because the Project was authorized prior to WRDA 1999, which outlined new cost sharing for future storm damage reduction projects involving beach nourishment, the project cost sharing remains 65% Federal / 35% non-Federal.

279. As indicated in Table 9, the Federal share of the NED project's first costs (65%) is $63,592,900. The Federal government will also provide a 65% share of renourishment costs. The non-Federal share of the NED project's first costs (35%) is $34,942,400.

280. The cost-shared amount represents 65%/35% of the first cost minus the cost of the project within the boundaries of the Lido Towers property ($700,000). The cost apportionment in Table 9 identifies the cost of the project in the Lido Towers property in Lido Beach ($700,000) where the Town of Hempstead will pay 100% of the project cost. The total non-Federal share of the project cost includes $700,000 in addition to the cost-shared amount.

Table 9: Cost Apportionment

Cost Sharing	Federal Share	Non-Federal Share	TOTAL
Cash Contribution	$ 63,592,900	$ 33,282,400	$ 96,875,300
Real Estate Lands & Damages	$ -	$ 57,500	$ 57,500
Relocations (a)	$ -	$ 902,500	$ 902,500
Subtotal First Cost	**$ 63,592,900**	**$ 34,242,400**	**$ 97,835,300**
Beachfill in Lido Beach (private properties) (b)		$ 700,000	$ 700,000
Total First Cost	**$ 63,592,900**	**$ 34,942,400**	**$ 98,535,300**
Continuing Construction			
Beach Nourishment (c)	$ 73,176,000	$ 39,402,500	$ 112,578,500
Major Rehab (Emergency Beach Fill) (d)	$ 4,757,600	$ 2,561,800	$ 7,319,400
Coastal Monitoring (e)	$ 4,273,750	$ 2,301,250	$ 6,575,000
Environmental Monitoring (f)	$ 2,356,250	$ 1,268,750	$ 3,625,000
Subtotal Cumulative Nourishment Cost (g)	**$ 84,563,600**	**$ 45,534,300**	**$ 130,097,900**
Cumulative Construction Cost (h)	**$ 148,156,500**	**$ 80,476,700**	**$ 228,633,200**
Annual Dune Maintenance	$ -	$ 158,000	$ 158,000
Annual Groin Maintenance	$ -	$ 150,000	$ 150,000
Subtotal Annual Non-Federal O&M Costs	$ -	**$ 308,000**	**$ 308,000**

* October 2004 Price Levels
* * Share based on 65% Federal and 35% non-Federal for construction and renourishment
(a) Relocation (reconstruction) of Lifeguard Headquarters in Town of Hempstead
(b) Town of Hempstead will pay 100% of the real estate acquisition cost in Lido Beach (Lido Towers property at border with the City of Long Beach)
(c) Beach Nourishment = $12,508,727/cyle for 9 cycles
(d) Major Rehab = $146,387/year for a 50 year project life
(e) Detailed breakout - Cost Appendix Table C-6
(f) Biological monitoring for 7 years (1 year pre, 1 year during, and five years post construction) - $125K/year and 50 years of endangered species monitoring - $55K/year for a 50 year project life - Cost Appendix Table C-7
(g) Cumulative Nourishment Cost included Beach Nourishment, Emergency Beach Fill, and Coastal Monitoring.
(h) Cumulative Construction Cost includes Total First Cost and Cumulative Nourishment Cost

D. *Section 902 CAP Analysis*

281. Section 902 of the 1996 Water Resources Development Act (33 U.S.C. § 2280) allows for increases in project cost due to modifications that do not materially alter the scope or function of a project. Such project modifications may encompass further engineering and design refinements to project features that are identified in project authorizing documents, as well as the construction of new project features that are not identified in authorizing documents. In cases where further engineering and design refinements are necessary to construct project features that are only generally described in authorizing documents, the maximum cost of the project can be increased by up to 20 percent, also known as the inflation adjusted authorized

cost, to pursue the changes. Calculations performed per the guidance regarding section 902 that appears in Appendix G1 of ER 1105-2-100 indicate that the current section 902 Cap for this LRR recommended project is $117,310,900 for the initial project and $173,971,200 for the cumulative nourishment costs. As shown in Table 9, the LRR recommended initial project and cumulative nourishment costs are well within the 902 Cap.

E. Construction and Funding Schedule

282. **General**. The Feasibility Report recommended placement of beach fill using a 30-inch hydraulic cutterhead dredge for the placement areas located within three (3) miles of the proposed borrow area. For placement areas further than three miles from the borrow area, a hopper dredge was proposed.

283. The beach fill placement area is reduced now that the East Atlantic Beach is not part of the project. Analysis of Figure B-11 in the Feasibility Report, which shows the limits of the proposed borrow area and the areas of suitable beach fill in the borrow area, indicates that the entire current beach fill placement area is located within three (3) miles of the western end of the borrow area. Accordingly, it is proposed that the 30-inch hydraulic cutterhead dredge be used for all beach fill placement. The production rate of the dredge is calculated to be 20,000 cy per day, 20 working days per month, or 400,000 cy per month.

284. **Constraints**. Four constraints exist which affect the construction schedule. These are:

(1). No beach fill or stone work during endangered/threatened bird nesting and foraging season. Endangered and threatened bird nesting and foraging occur in the Town of Hempstead, east of the City of Long Beach, from 1 March through 31 August. No beach fill placement or work on stone groins may be accomplished in that area during those months.

(2). No beach fill or stone work during the peak ozone season. The peak ozone season occurs from 1 May to 30 September. No beach fill placement or work on stone groins may be accomplished during those months.

(3). Construction of new groins should not occur at the same time (or immediately after) as sand placement operations in the new groin vicinity (in Point Lookout). This restriction will preclude difficulty in establishing excavated grades below ocean bottom for the groin foundation construction. Sand placement operations will cause a significant amount of hydraulically placed project beach fill sand to be washed offshore by tidal and littoral currents with sand remaining suspended in the water column, just offshore. As excavation is attempted for establishment of foundation grades, this suspended sand will quickly beach fill the excavated area, making it extremely difficult to place stone for the groin's foundation.

(4) Beach fill should be implemented in a separate contract from stone work to reduce cost and avoid extensive subcontractor overhead costs if the beach fill and stone work are combined in one contract.

In light of the above constraints, three contracts will be required to construct the LRR Recommended Plan. A total of 52 calendar months (4.33 years) will be required for the three contracts. The construction schedule is shown in Figure 41. The first two contracts will be executed simultaneously. Contract 3 will immediately follow Contract 1.

285. **Contract 1 – Two of Four New Groins at Point Lookout.**

(1) New Groin Construction. Seven (7) new groins are proposed for construction in the Point Lookout area under the LRR Recommended Plan, with construction of three (3) of

those groins being deferred until such time as physical condition of the beach warrants their construction. The easternmost four (4) new groins are required to provide erosion control and storm damage protection for the severely eroded shoreline east of the ebb shoal weldment. The four new groins are positioned east of the weldment and natural sand supply bypassing Jones Inlet to shoreline west of the weldment will continue uninterrupted during construction.

(2) Construction of two of the four new groins, for the first contract, will extend over 1.5 years to avoid impact to nesting birds. Construction will include groin C and groin D (the western most two groins of the four), so that new groin construction will proceed west to east, with the prevailing littoral drift direction, in order to trap littoral flowing sand and thus keep the subsequent construction area of groins A and B (Contract 2) as clear of shoaling sand, as possible. Groins C and D will be constructed simultaneously, from October through February for two consecutive years.

286. **Contract 2 – Groin Rehabilitation at Point Lookout and Long Beach, Groin Extension and Rehabilitation at Point Lookout, and the Remaining Two New Groins at Point Lookout.**

(1). Rehabilitation of Existing Groins. Fifteen (15) existing groins in Long Beach will be rehabilitated as part of the LRR Recommended Plan. The proposed rehabilitation consists of repositioning existing armor stone and adding additional armor stone of similar size to existing, along the seaward 100-330 feet of each of the groins. For the purpose of cost estimating, use of a quarry in upstate New York was assumed.

(2). Contract 2 will also include the terminal groin rehabilitation and 100-foot extension at Point Lookout, plus the rehabilitation of groins 55 and 56, also at Point Lookout. Total duration is assumed to be 10 months with work being accomplished between 1 October and 30 April in the first year and 1 October through 31 December of the second year of Contract 2. Stone required for the groin construction will be transported by truck and barged from the quarry. For the purpose of cost estimating, use of a quarry in upstate New York was assumed.

(3). Rehabilitation of Groins Nos. 55 and 56. The proposed rehabilitation consists of repositioning existing armor stone and adding additional armor stone as needed along the seaward 100-200 feet of each groin

(4). Rehabilitation and Extension of Groin No. 58, the easternmost terminal groin at Point Lookout, is included to reduce the transport of newly placed and existing sand into the inlet, and is to be accomplished prior to placement of beach fill in the vicinity of Point Lookout, to maximize sand retention and prevent increased shoaling in Jones Inlet.

(5) Construction of the Remaining Two New Groins, for the second contract, will extend over 1.3 years to avoid impact to nesting birds. Construction will include groin A and groin B (the eastern most two groins of the four). Groins A and B will be constructed simultaneously, from October through February and October through December for two consecutive years.

287. **Contract 3 – Point Lookout/Town of Hempstead and Long Beach Beach Fill and Beach Access and Boardwalk Deck Replacement.**

(1). Dredging/beach fill placement. A total of 6,600,000 cubic yards of beach fill will be dredged and placed using a hydraulic cutterhead dredge (1,100,000 cy at Point

Lookout/Hempstead Park and 5,500,000 cy at Long Beach. Based on the production rate (400,000 cy/month) of this dredge, duration of this activity is 17 months. However, in order avoid impacts to nesting birds and interference with new groin construction at Point Lookout, the beach fill placement is divided into three phases over the last 2.3 years of the project construction. All of the beach fill at Point Lookout/Hempstead Park and approximately 1,200,000 cy at Long Beach will be placed between October and April. Following the air quality constraint, the second phase of the beach fill (2,800,000 cy) will be placed, again in the October to April timeframe of the following year. The final phase of beach fill placement (1,500,000 cy) will commence, again, after the air quality window, in October and be completed in January. The design sand quantity is to be placed between Jones Inlet and the weldment proceeding from east to west, against the prevailing direction of littoral drift.

(2). Life Guard Station Relocation in Point Lookout. One (1) lifeguard station will be relocated. This relocation will occur prior to the placement of sand at Point Lookout/Hempstead Park.

(3). Pedestrian and Vehicular Dune Crossovers. Twenty-four (24) pedestrian dune walkovers will be constructed, eight (8) existing walkovers will be extended, and eleven (11) vehicular accesses (8 gravel surface, one raised timber accessway and 2 swing gate structures) will be constructed in Point Lookout/Town of Hempstead and Long Beach. Construction will be phased to follow the placement of the beach fill/dune.

(4). Dune Grass Planting. Twelve (12) acres of dune grass will be planted, in late fall/early spring, as is appropriate for this type of vegetation. Planting will be phased to follow the placement and grading of the beach fill.

(5). Sand Fence Installation. 47,000 linear feet of sand fence will be installed. Placement will be phased to follow placement and grading of beach fill and dune and will generally occur during the timeframe of dune grass planting.

(6). Boardwalk Deck Replacement, Retaining Walls and Sand Barrier. Short retaining walls will be constructed surrounding 4 comfort stations, 2 comfort stations with concession stands, and 1 lifeguard headquarters to prevent impact from placed beach fill. The boardwalk deck will be removed to facilitate placement of the sand barrier, which is also included in Contract 3. The removed decking will be replaced with new composite wood decking, including treatment of stringers to preclude moisture damage due to the presence of the sand barrier. Attached equipment including railings, benches, access stairways from deck to beach berm, etc. will be removed and repositioned.

IX. Conclusions

288. This report, titled "Atlantic Coast of Long Island, Jones Inlet to East Rockaway Inlet, Long Beach Island, New York Limited Reevaluation Report," updates the recommended plan and incorporates recent changes to the 1995 Feasibility Report. This report provides supporting technical documentation for the changes being recommended. This report also includes an update of the analysis of the associated costs, benefits, and environmental impacts for the recent changes. The benefits considered are derived from storm damage reduction to the barrier island and mainland including residential, commercial, and other structures; damage to infrastructure; public emergency costs; future protection costs; beach recreation benefits; and loss of land.

289. The barrier island of Long Beach, New York is located on the Atlantic Coast of Long Island, New York, between Jones Inlet and East Rockaway Inlet. The area lies within Nassau County, New York. The Long Beach Island, New York Final Feasibility Report With Final Environmental Impact Statement for Storm Damage Reduction (Feasibility Report) was completed in February 1995, with a Record of Decision (ROD) issued in January 1999. The Long Beach Project is a storm damage reduction project, which has been designed to provide 100-year level protection against wave attack and inundation for homes and businesses along 6.4 miles (34,000 feet) of oceanfront, including the Town of Hempstead (Point Lookout and Lido Beach), Nassau County (Nickerson Beach), and the City of Long Beach. This area has been subject to major flooding during storms, causing damage to structures along the barrier island. Over the years, continued erosion particularly in the eastern areas, has resulted in a reduction in the height and width of the beachfront, which has increased the potential for storm damages.

290. The LRR selected storm damage reduction plan includes 29,000 linear feet of beach fill and generally extends from the eastern end of the barrier island at Point Lookout to the western boundary of the City of Long Beach (including an incidental taper into East Atlantic Beach). This plan consists of:

- a dune with a top elevation of + 15 ft above NGVD, a top width of 25 ft, and landward and seaward slopes of 1V:5H along the entire project area except where the City of Long Beach boardwalk is located;
- sand barrier located directly beneath the City of Long Beach boardwalk with a 25 ft crest width at elevation +15.0' NGVD with a 1V:3H landward slope and 1V:5H seaward slope except at boardwalk seaside ramp locations, where it has a 1V:2.5H landward and seaward slope. The toe of the sand barrier will extend approximately 15 ft seaward of the boardwalk;
- a beach berm extending 110 ft from the seaward toe of the recommended dune or sand barrier at an elevation of +10 ft NGVD, then gradually sloping approximately between 1V:20H (Point Lookout) and 1V:35H (Long Beach and Lido Beach) to match the existing bathymetry;
- a total sand fill quantity of 6,600,000 cy for the initial beach fill placement, including tolerance, overfill and advanced nourishment;
- planting of 12 acres of dune grass and installation of 47,000 lf of sand fence;
- construction of 12 timber dune walkovers (including 8 ADA compliant and 1 extending from the boardwalk), 12 gravel surface dune walkovers, 8 extensions of existing dune walkovers, 8 gravel surface vehicle accessways, 2 swing gate vehicle access structures, 1 timber raised vehicle accessway, reconstruction of 1 lifeguard headquarters, construction of timber retaining walls around: 4 comfort stations, 2 comfort stations with concession stands, and 1 lifeguard headquarters; replacement of 11,000 LF of boardwalk deck with composite wood;
- rehabilitation of 17 of the existing groins, plus the rehabilitation and 100-ft extension of the existing terminal groin at Point Lookout (18 structures total);
- 7 newly constructed groins at the eastern end of the island (3 of which are deferred construction to be built in the future if required);
- creation of 5,000 lf of bird nesting and foraging area for piping plovers and least terns (within the Town of Hempstead)
- advanced nourishment to ensure the integrity of the initial beach fill design;
- and periodic nourishment of approximately 1,726,000 cy of beach fill material at 5 year intervals for the 50 year life of the project.

291. The estimated initial cost of the recommended plan is $98,535,300 (October 2004 price levels). The Federal Government shall contribute 65% of the initial cost of the selected plan,

which is currently estimated to be $63,592,900 and the non-Federal shall contribute 35% of the initial cost, which is $34,942,400. The annual cost for this plan is estimated to be $9,016,600, with annual benefits of $24,008,700. The benefit to cost ratio (BCR) was calculated to be 2.7. Periodic nourishment of the selected plan shall be similarly cost shared. Note that for the initial beach fill and renourishment beach fill within two segments of the project in Lido Beach, the non-Federal sponsor or the Town of Hempstead will fund 100% of the cost, because these lands are privately owned and privately used. Locally required maintenance is estimated at $308,000 and included in the estimated annual cost above.

292. Beach fill for initial construction and periodic renourishment for the project life would be obtained from a designated borrow area approximately 1.5 miles south of Long Beach Island.

293. The proposed work will have no significant impact on the quality of the environment in the Project Area. It has been determined that the impacts to environmental resources in the proposed Project Area are expected to be minor and less than those that would have resulted from the original Project recommended by the 1995 Feasibility Report. Special consideration was given to the effects of the selected plan on surfing, fishing, and cultural experiences. Most impacts associated with this project will be temporary, and none of the impacts are regarded as significant.

X. Recommendations

Prefatory Statement. In making the following recommendations, I have given consideration to all significant aspects in the overall public interest, including environmental social and economic effects, engineering feasibility and compatibility of the project with the policies, desires and capabilities of the State of New York and other non-Federal interests.

Recommendation. I recommend that the authorized project with modifications described herein for storm damage reduction to the barrier island of Long Beach, New York be designed and constructed and that implementation funds be provided. A public notice shall be issued to inform all interested parties of the Federal intent to implement the project described herein. Federal funding should be utilized to complete all necessary engineering and design and associated management leading to execution of a Project Cooperation Agreement for the project described herein. The costs for these activities leading to construction shall be reimbursed by the non-Federal Sponsor as a project cost shared item.

The recommended changes to the authorized storm damage reduction project (1995 Feasibility Report) include a reduction of: 12,000 lf of beach fill (2,042,000 cy), 17 ac of planted dune grass, 43,000 lf of installed sand fence, 5 dune walkovers, 1 vehicle access ramp, 2 proposed groins, and 385,000 cy of beach fill required for each renourishment cycle, and an increase of: 8 dune walkover extensions, replacement of 11,000 lf of boardwalk surface, rehabilitation of 2 existing groins, and 100 ft extension of the terminal groin. The recommended changes include the identification of 5,000 lf of bird nesting and foraging area for piping plovers and least terns (within the Town of Hempstead). Since approval of the 1995 Feasibility Report, the unincorporated Village of East Atlantic Beach opted out of the project, accounting for approximately 7,000 ft of the reduced beach fill. The recommended changes also account for the reduction of approximately 1,000,000 cy of beach fill due to the landward shift of the dune in the City of Long Beach.

The plan is being recommended with such modification thereof as in the discretion of the Chief of Engineers may be advisable, at a first cost to the Federal Government estimated at $63,592,900, provided that non-Federal interests comply with requirements substantially in accordance with a Project Cooperation Agreement to be prepared upon approval of this report.

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

Richard J. Polo, Jr.
Colonel, U.S. Army
District Engineer

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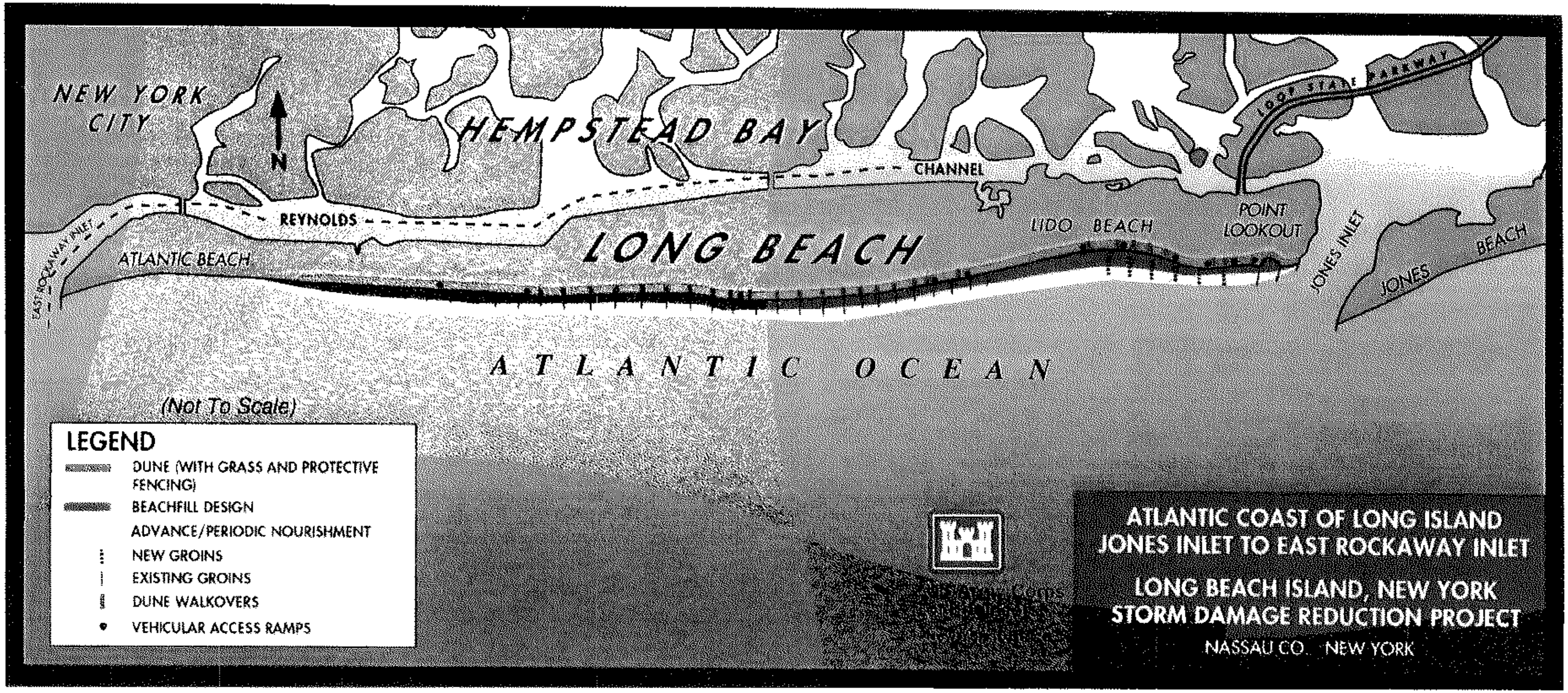
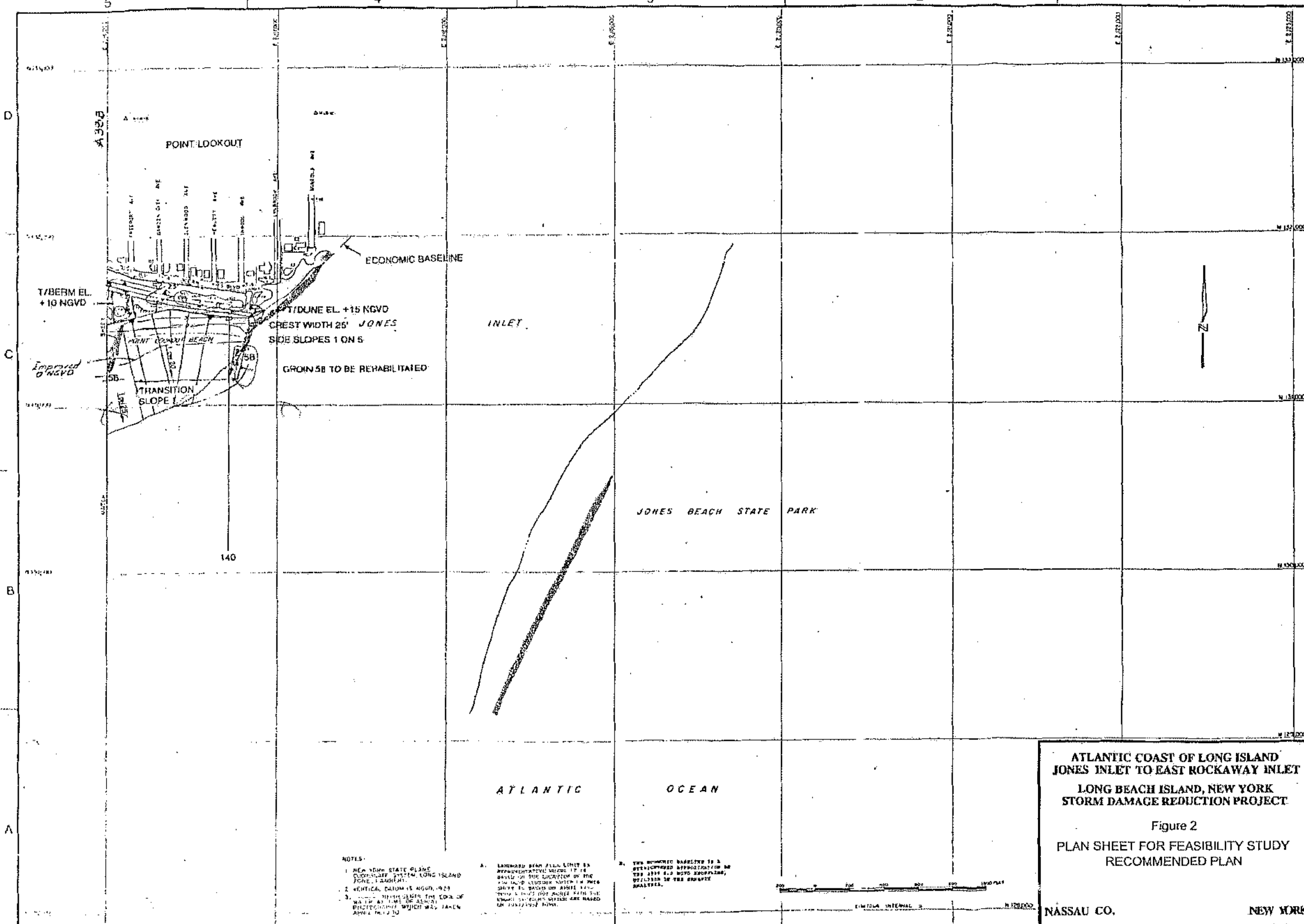
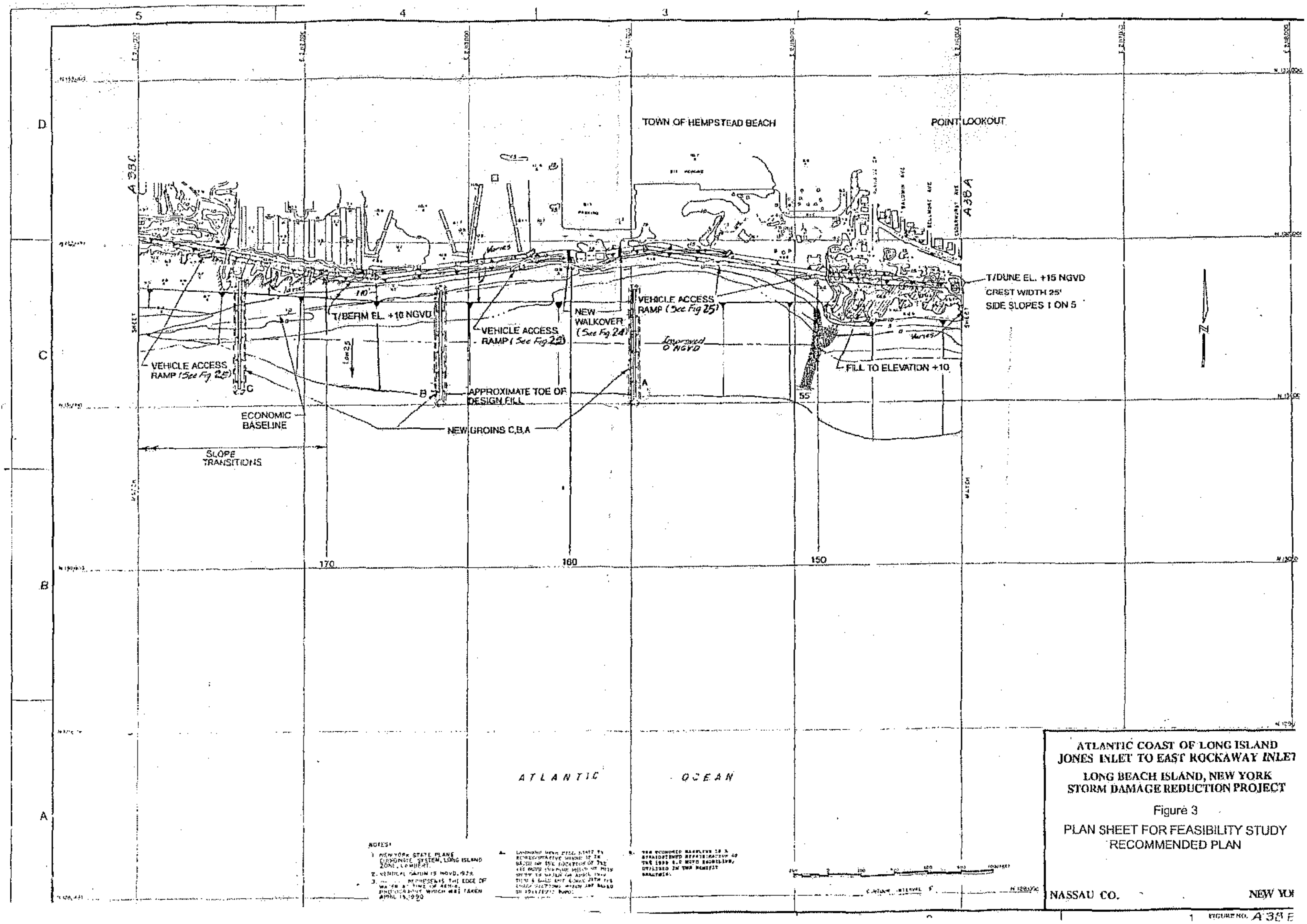


FIGURE 1 – 1995 FEASIBILITY STUDY AREA

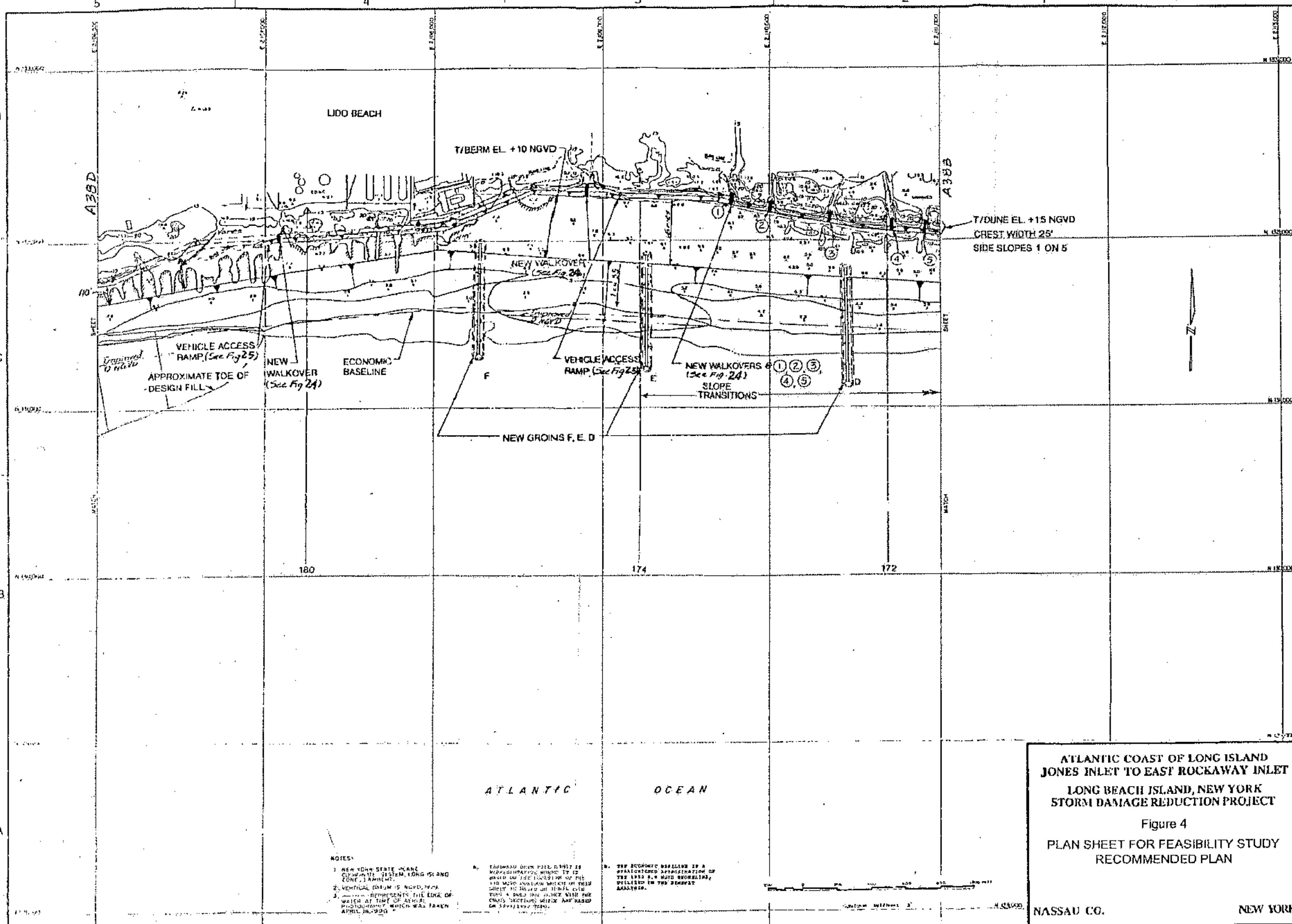


POINT LOOKOUT
ECONOMIC BASELINE
T/BERM EL. +10 NGVD
T/DUNE EL. +15 NGVD
CREST WIDTH 25'
SIDE SLOPES 1 ON 5
JONES INLET
GROIN 58 TO BE REHABILITATED
TRANSITION SLOPE
140
JONES BEACH STATE PARK
ATLANTIC OCEAN
N
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
Figure 2
PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN
NASSAU CO.
NEW YORK



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)
NEW WALKOVER (See Fig 24)
T/BERM EL. +10 NGVD
FILL TO ELEVATION +10
APPROXIMATE TOE OF DESIGN FILL
NEW GROINS C,B,A
ECONOMIC BASELINE
SLOPE TRANSITIONS
Improved 0 NGVD
Varies
55'
150
160
170
ATLANTIC
OCEAN

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
Figure 3
PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN
NASSAU CO.
NEW YORK
FIGURE NO. A 38 B



ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

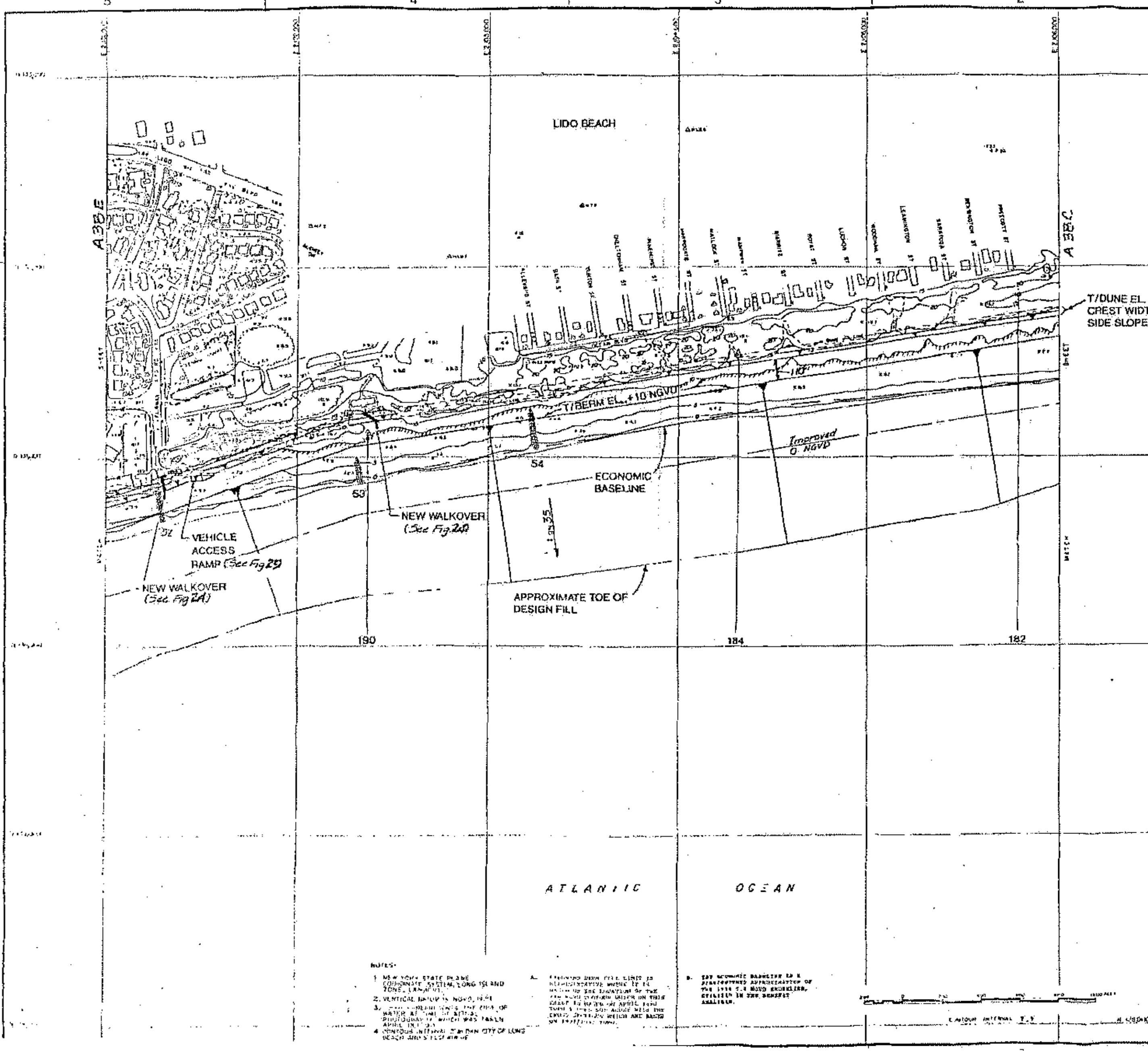
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Figure 4

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN

NASSAU CO. NEW YORK

A38C



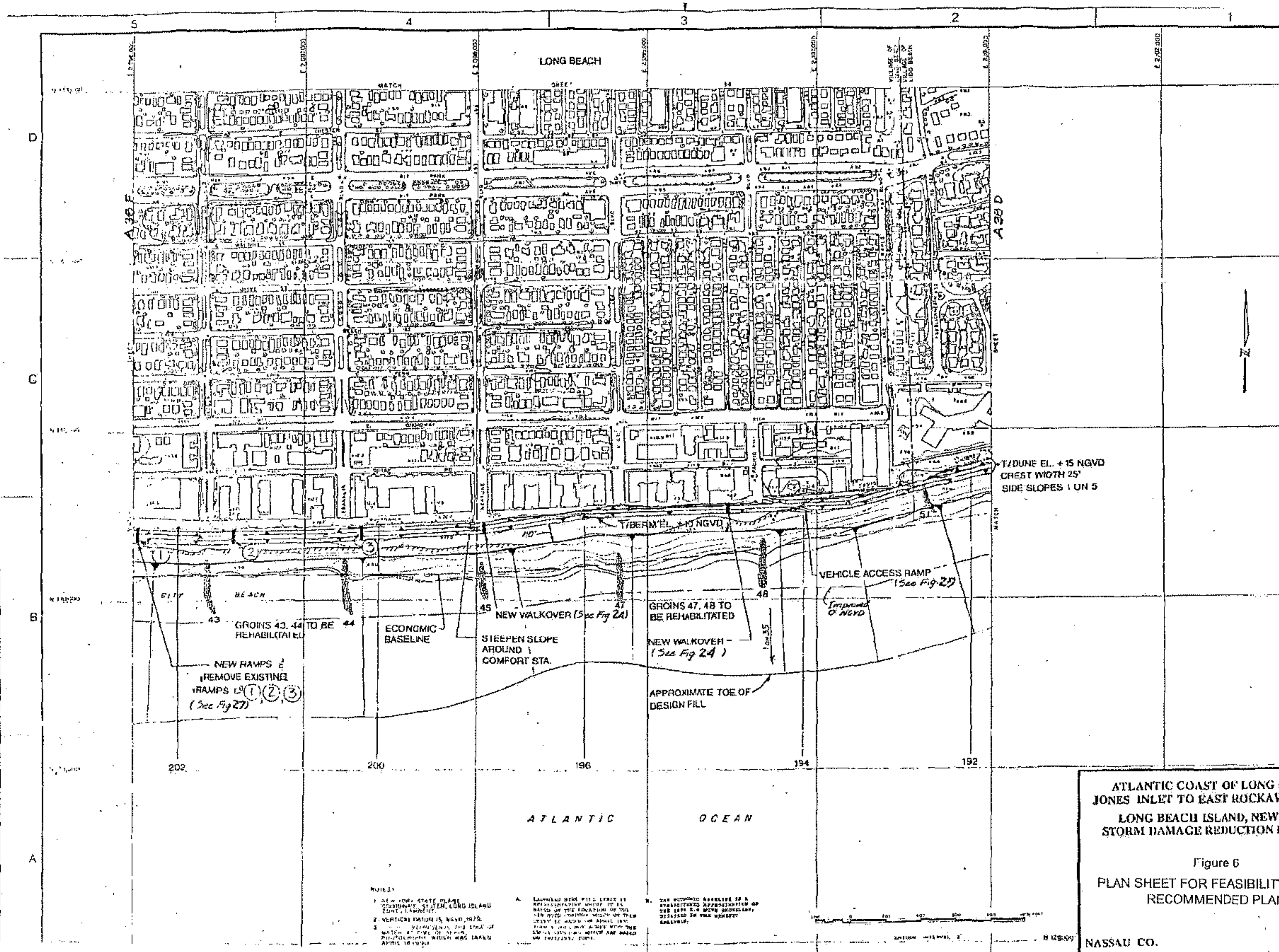
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Figure 5

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN

NASSAU CO. NEW YORK



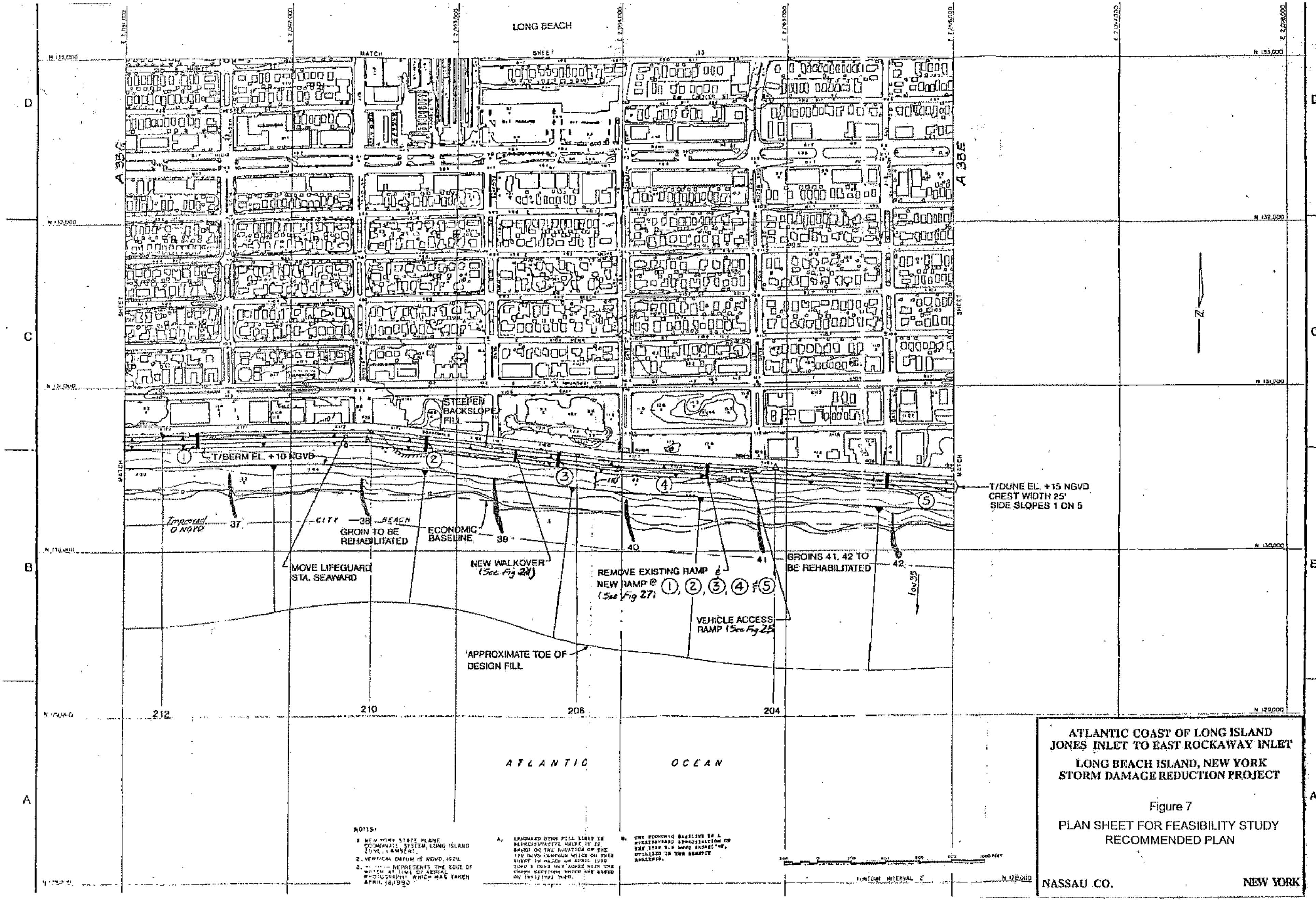
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Figure 6

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN

NASSAU CO. NEW YORK



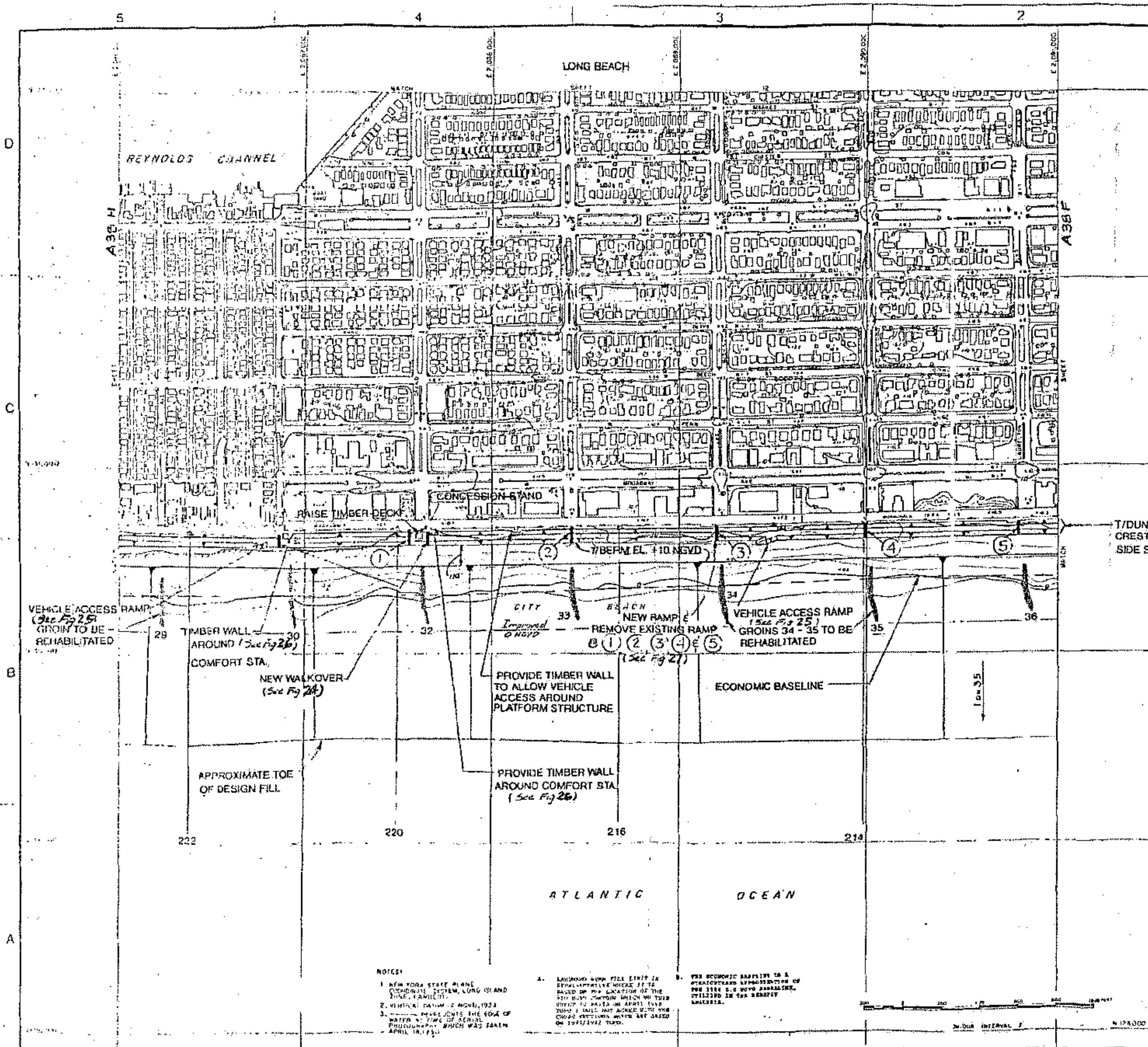
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Figure 7

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN

NASSAU CO. NEW YORK



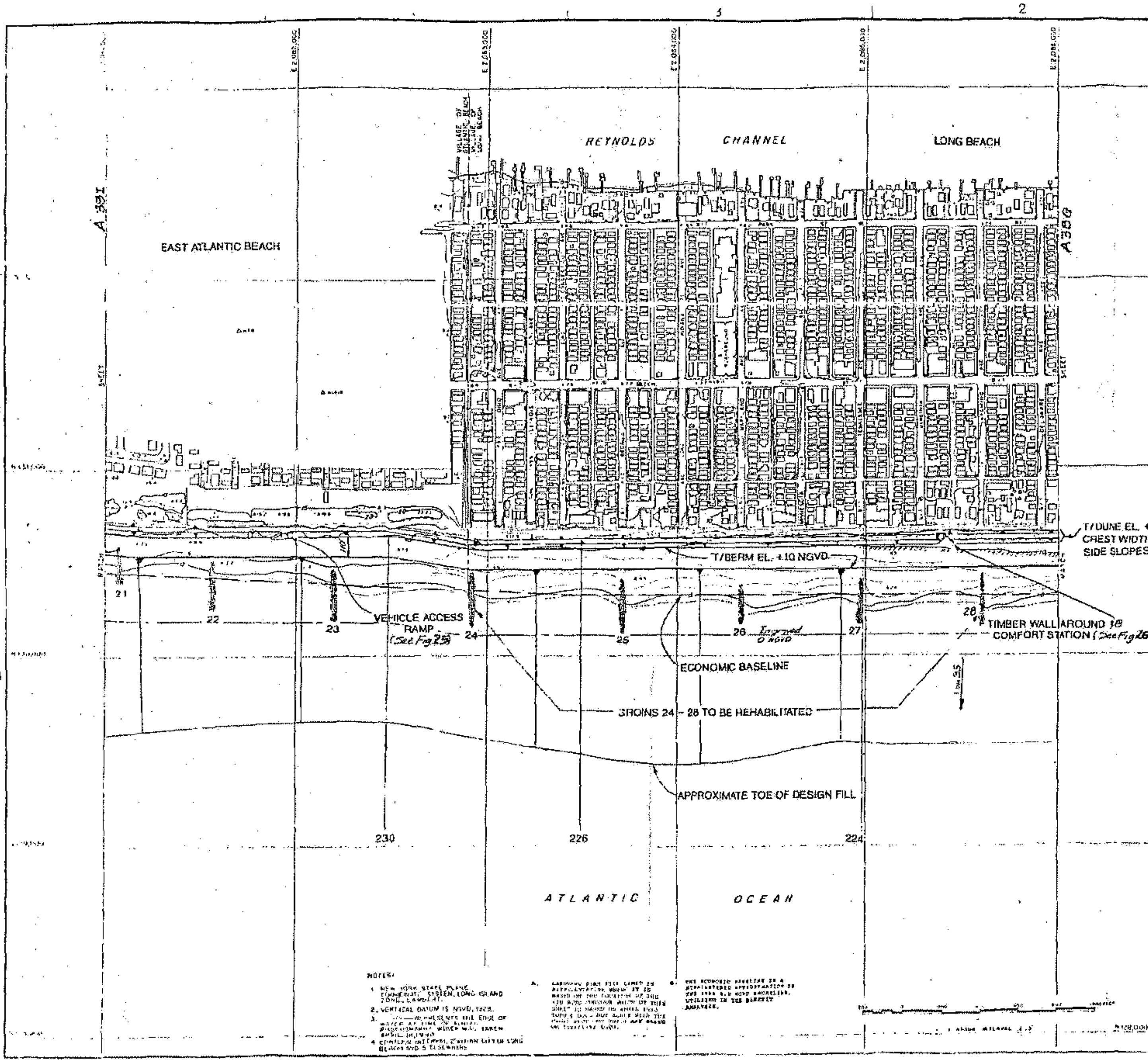
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Figure 8

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN

NASSAU CO. NEW YORK



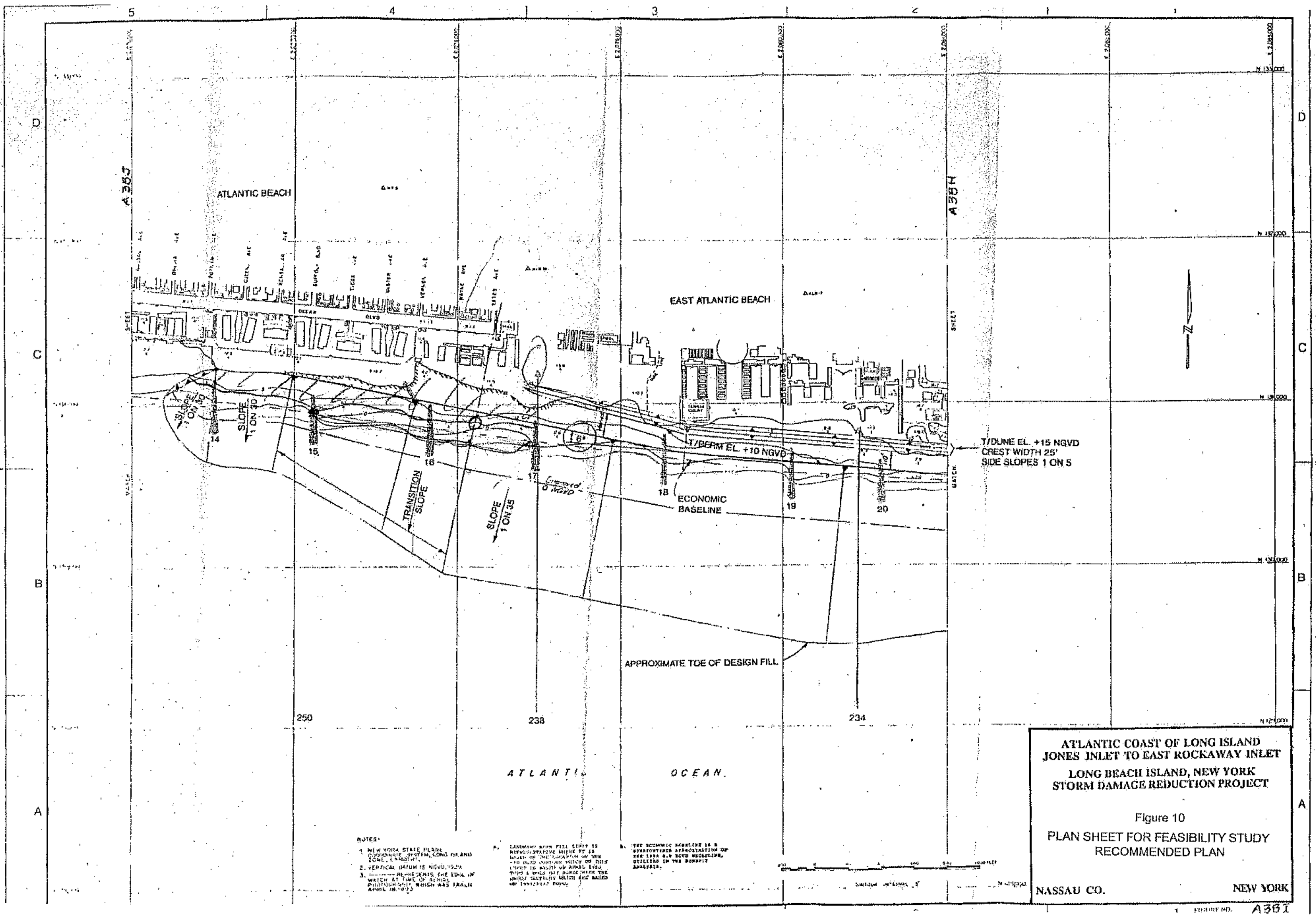
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Figure 9

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN

NASSAU CO. NEW YORK



ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

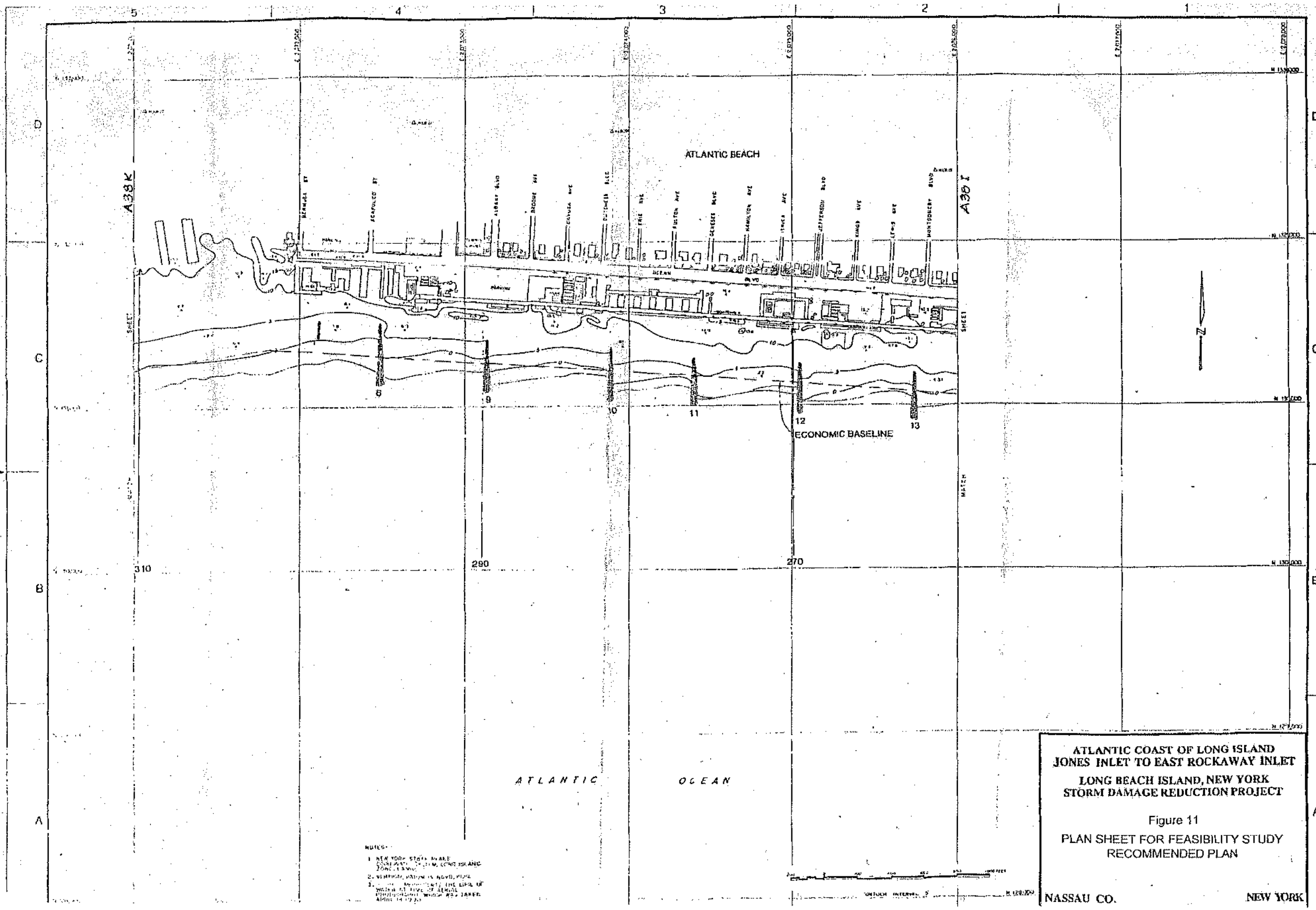
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

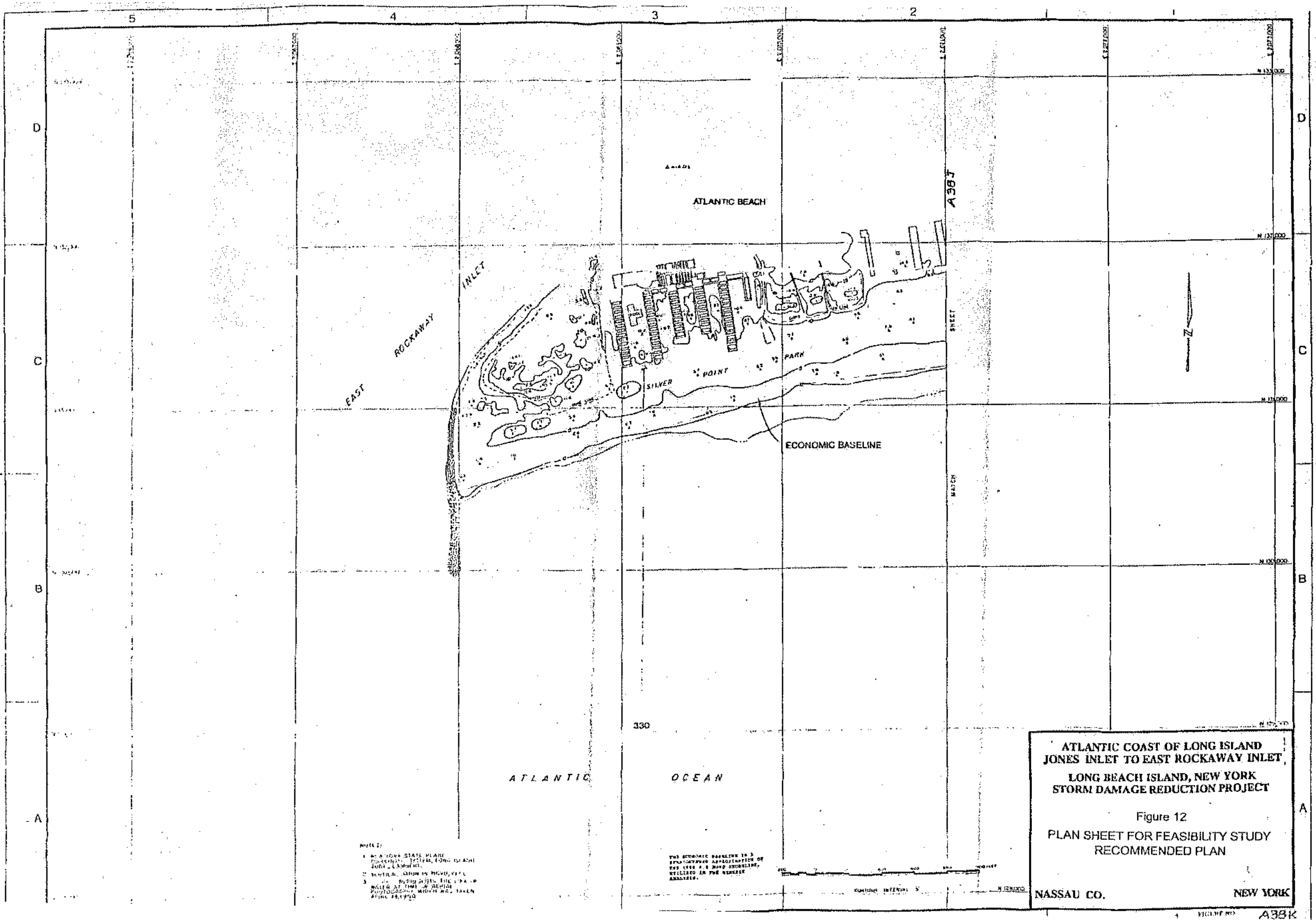
Figure 10

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN

NASSAU CO. NEW YORK

A38I


ATLANTIC BEACH
A38 K
A38 I
BERMUDA ST
ACAPULCO ST
ALBANY BLVD
BROOME AVE
CAYUGA AVE
DUTCHESS BLVD
ERIE AVE
FULTON AVE
GENESEE BLVD
HAMILTON AVE
ITHACA AVE
JEFFERSON BLVD
KINGS AVE
LEWIS AVE
MONTGOMERY BLVD
OCEAN BLVD
SHEET
MATCH
8
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
Figure 11
PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN
NASSAU CO.
NEW YORK

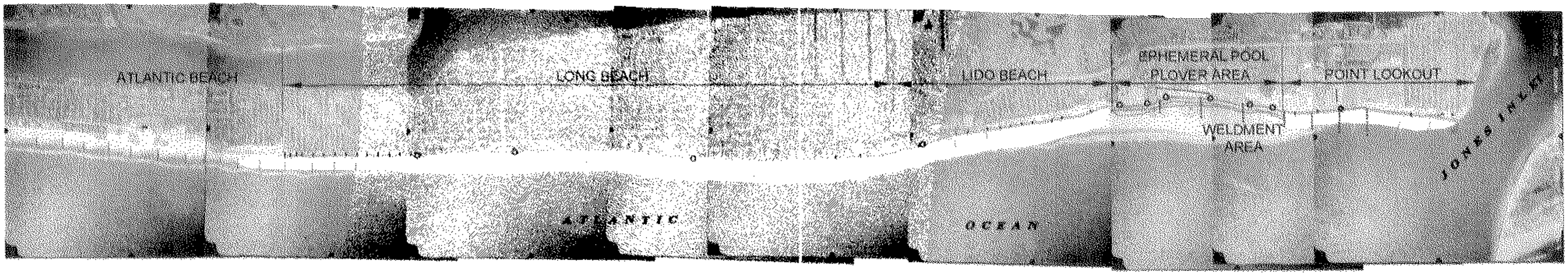


ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

Figure 12

PLAN SHEET FOR FEASIBILITY STUDY
RECOMMENDED PLAN



NOTE: WELDMENT AREA IS A PART OF A SAND SHOAL THAT WILL CHANGE IN POSITION FROM YEAR TO YEAR

* GROIN COVERAGE IS NOT REPRESENTATIVE OF THE PROPOSED CONDITION (SEE FIGURES 14 TO 25 FOR AN ACCURATE DEPICTION OF THE GROIN COVERAGE).

LEGEND

- DUNE (WITH GRASS AND PROTECTIVE FENCING)
- SAND BARRIER
- BEACH FILL*
- NEW GROINS
- EXISTING GROINS
- DUNE WALKOVERS
- VEHICULAR ACCESS RAMPS
- TERMINAL GROIN EXTENSION

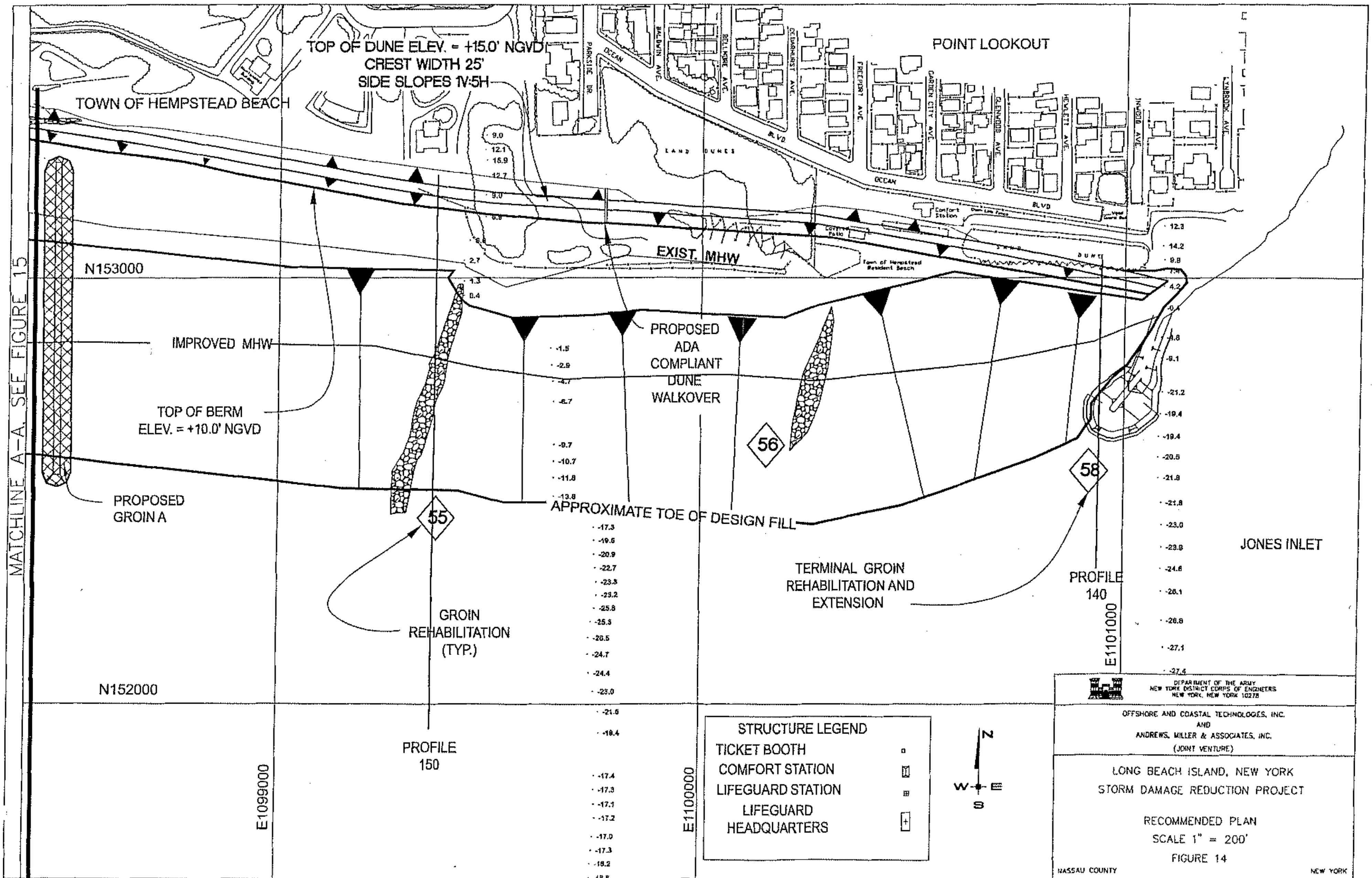
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)

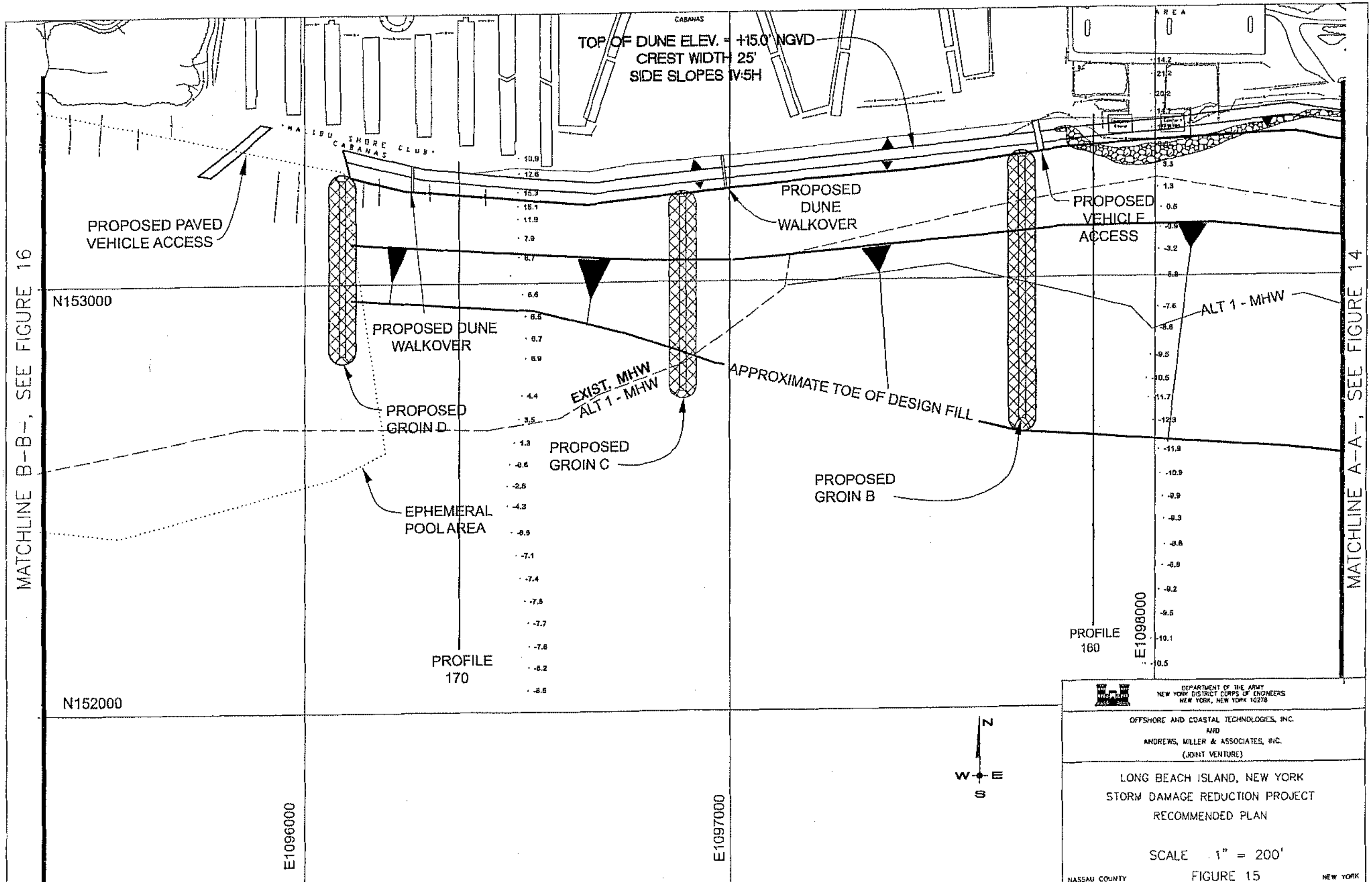
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
LRR RECOMMENDED PLAN
STUDY AREA

SCALE 1" = 3000'

NASSAU COUNTY Figure No 13 NEW YORK



...\June 05\RECOM-MOD DUNE.dgn 9/29/2005 9:01:04 AM



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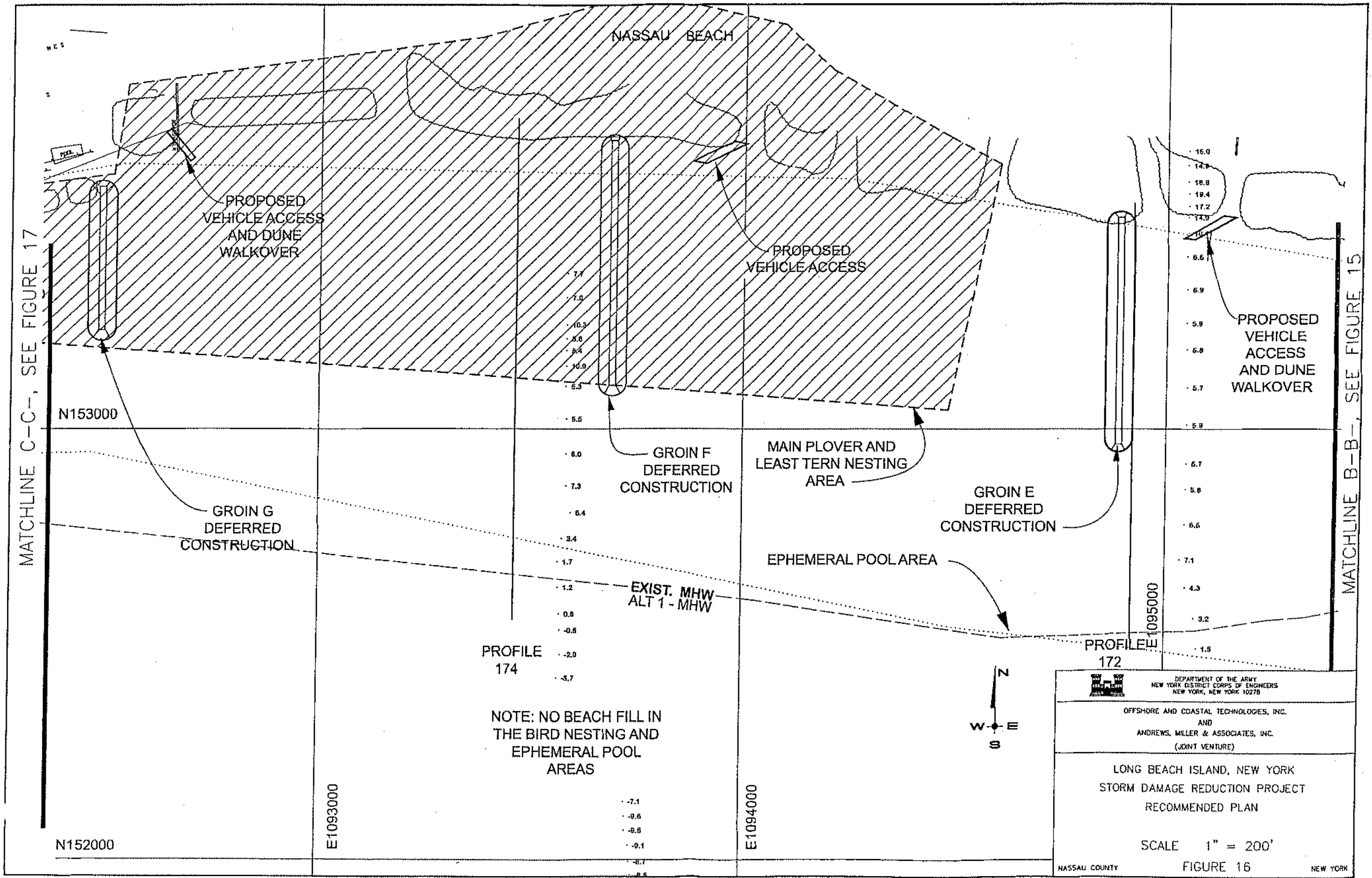
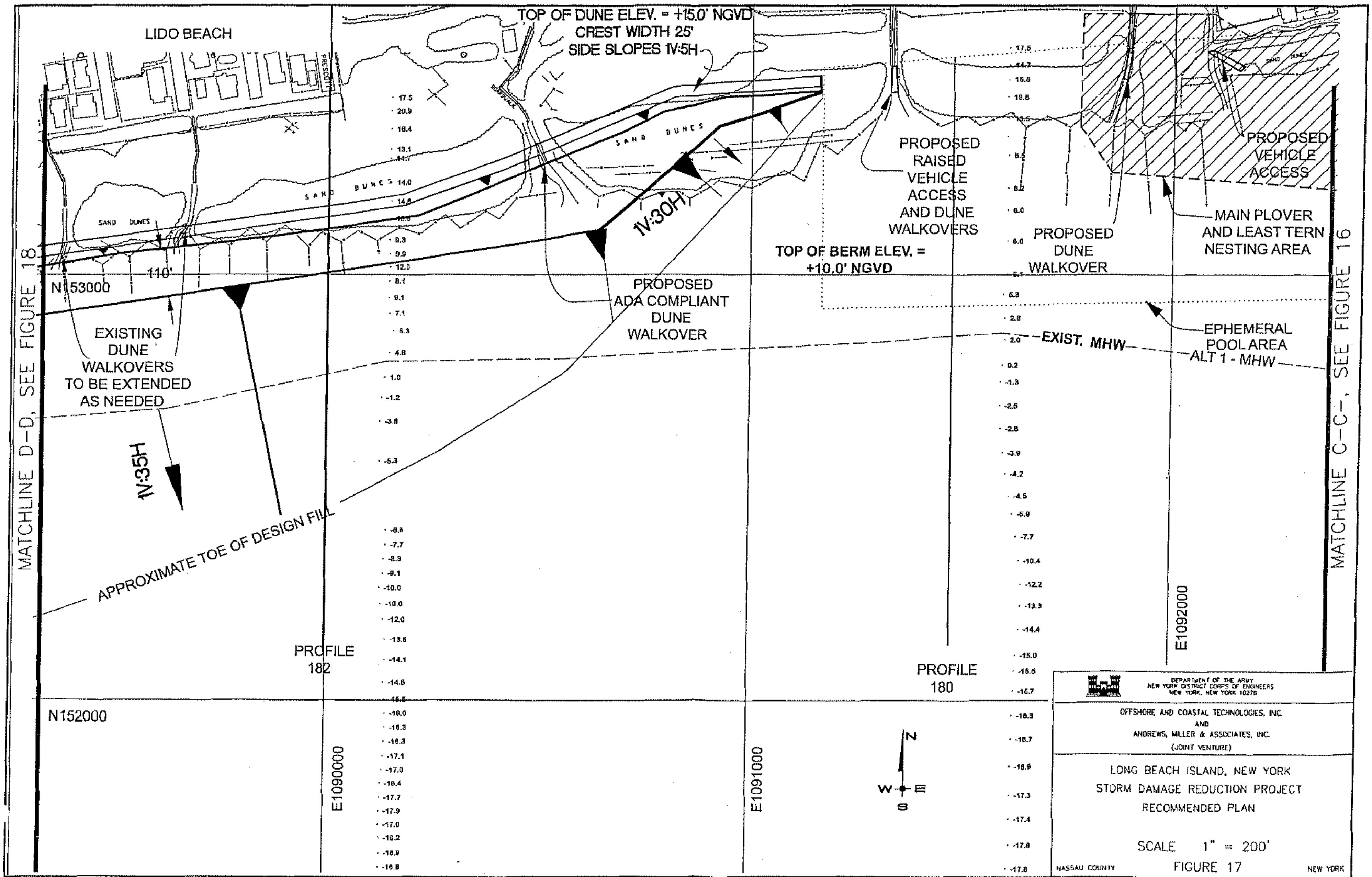
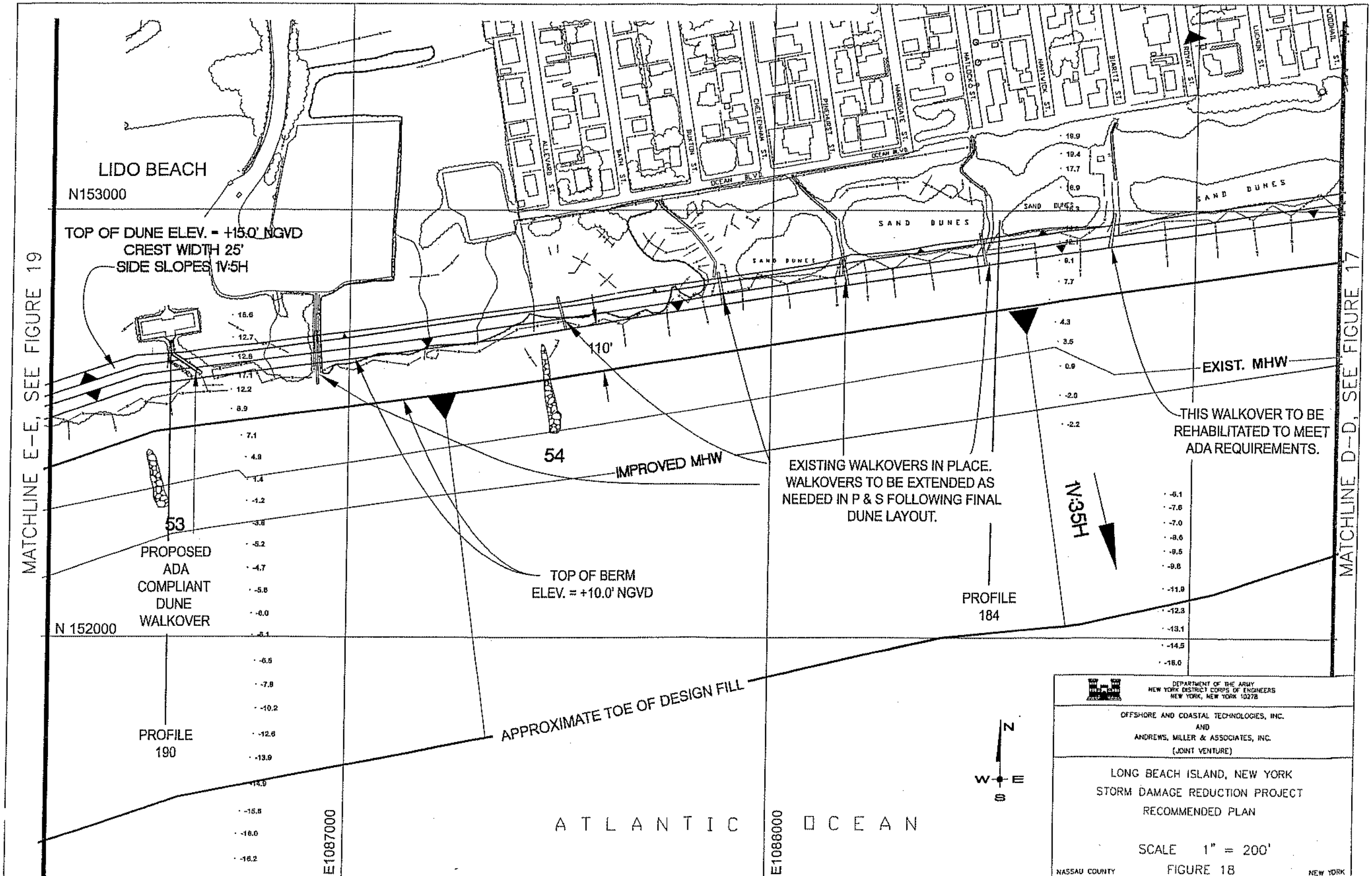

NASSAU BEACH
PROPOSED VEHICLE ACCESS AND DUNE WALKOVER
PROPOSED VEHICLE ACCESS
PROPOSED VEHICLE ACCESS AND DUNE WALKOVER
MATCHLINE C–C–, SEE FIGURE 17
MATCHLINE B–B–, SEE FIGURE 15
N153000
N152000
E1093000
E1094000
E1095000
GROIN G DEFERRED CONSTRUCTION
GROIN F DEFERRED CONSTRUCTION
MAIN PLOVER AND LEAST TERN NESTING AREA
GROIN E DEFERRED CONSTRUCTION
EPHEMERAL POOL AREA
EXIST. MHW
ALT 1 - MHW
PROFILE 174
PROFILE 172
NOTE: NO BEACH FILL IN THE BIRD NESTING AND EPHEMERAL POOL AREAS
N
W
E
S
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN
SCALE 1" = 200'
NASSAU COUNTY
FIGURE 16
NEW YORK


LIDO BEACH
TOP OF DUNE ELEV. = +15.0' NGVD
CREST WIDTH 25'
SIDE SLOPES 1V:5H
SAND DUNES
1V:30H
PROPOSED RAISED VEHICLE ACCESS AND DUNE WALKOVERS
PROPOSED VEHICLE ACCESS
MAIN PLOVER AND LEAST TERN NESTING AREA
PROPOSED DUNE WALKOVER
TOP OF BERM ELEV. = +10.0' NGVD
PROPOSED ADA COMPLIANT DUNE WALKOVER
110'
N153000
EXISTING DUNE WALKOVERS TO BE EXTENDED AS NEEDED
EPHEMERAL POOL AREA
EXIST. MHW
ALT 1 - MHW
MATCHLINE D-D, SEE FIGURE 18
MATCHLINE C-C-, SEE FIGURE 16
1V:35H
APPROXIMATE TOE OF DESIGN FILL
PROFILE 182
PROFILE 180
N152000
E1090000
E1091000
E1092000
N
W E
S
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN
SCALE 1" = 200'
NASSAU COUNTY
FIGURE 17
NEW YORK



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NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

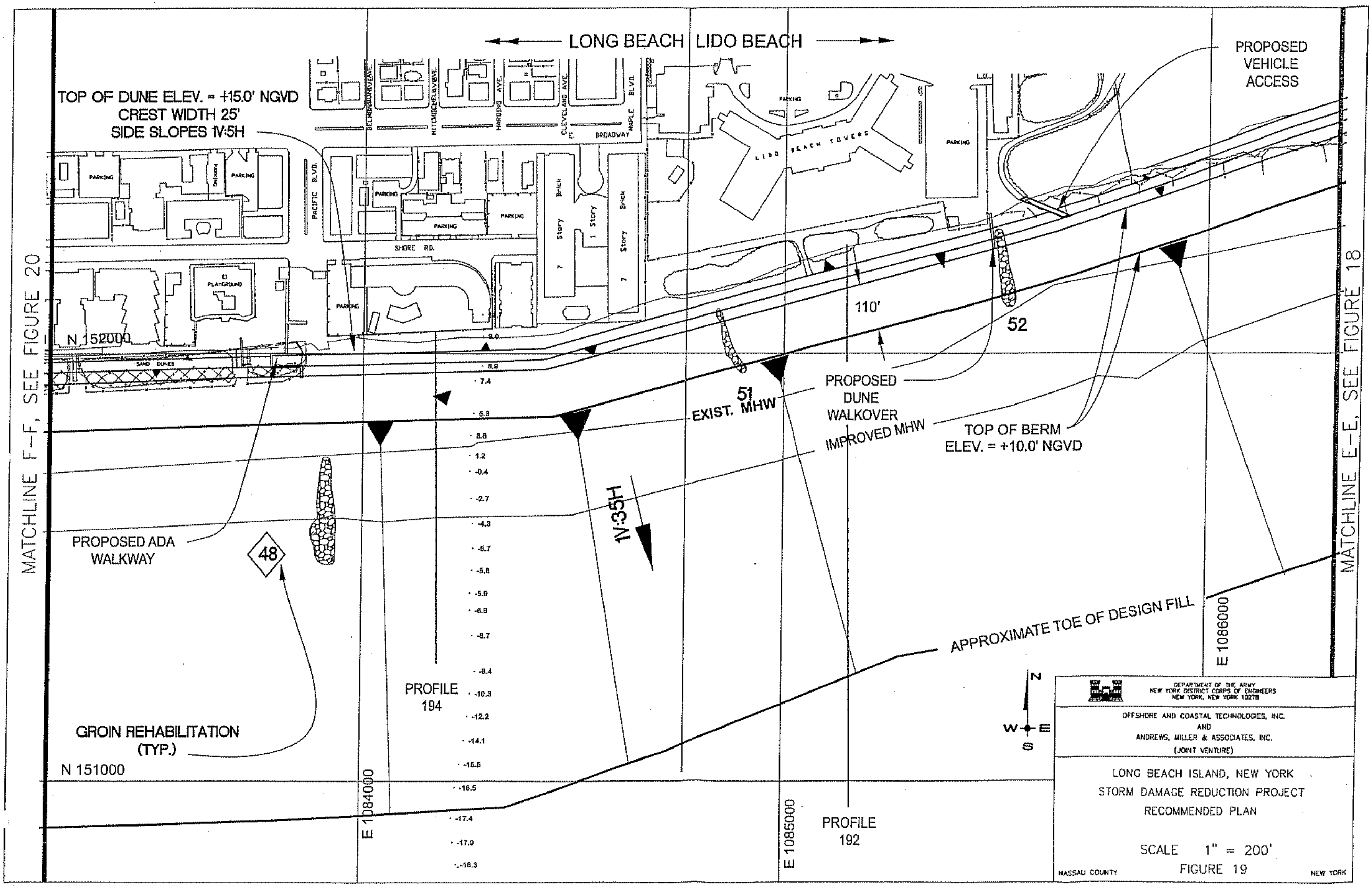
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN

SCALE 1" = 200'

NASSAU COUNTY FIGURE 18 NEW YORK

...\June 05\RECOM-MOD DUNE.dgn 9/29/2005 9:00:26 AM



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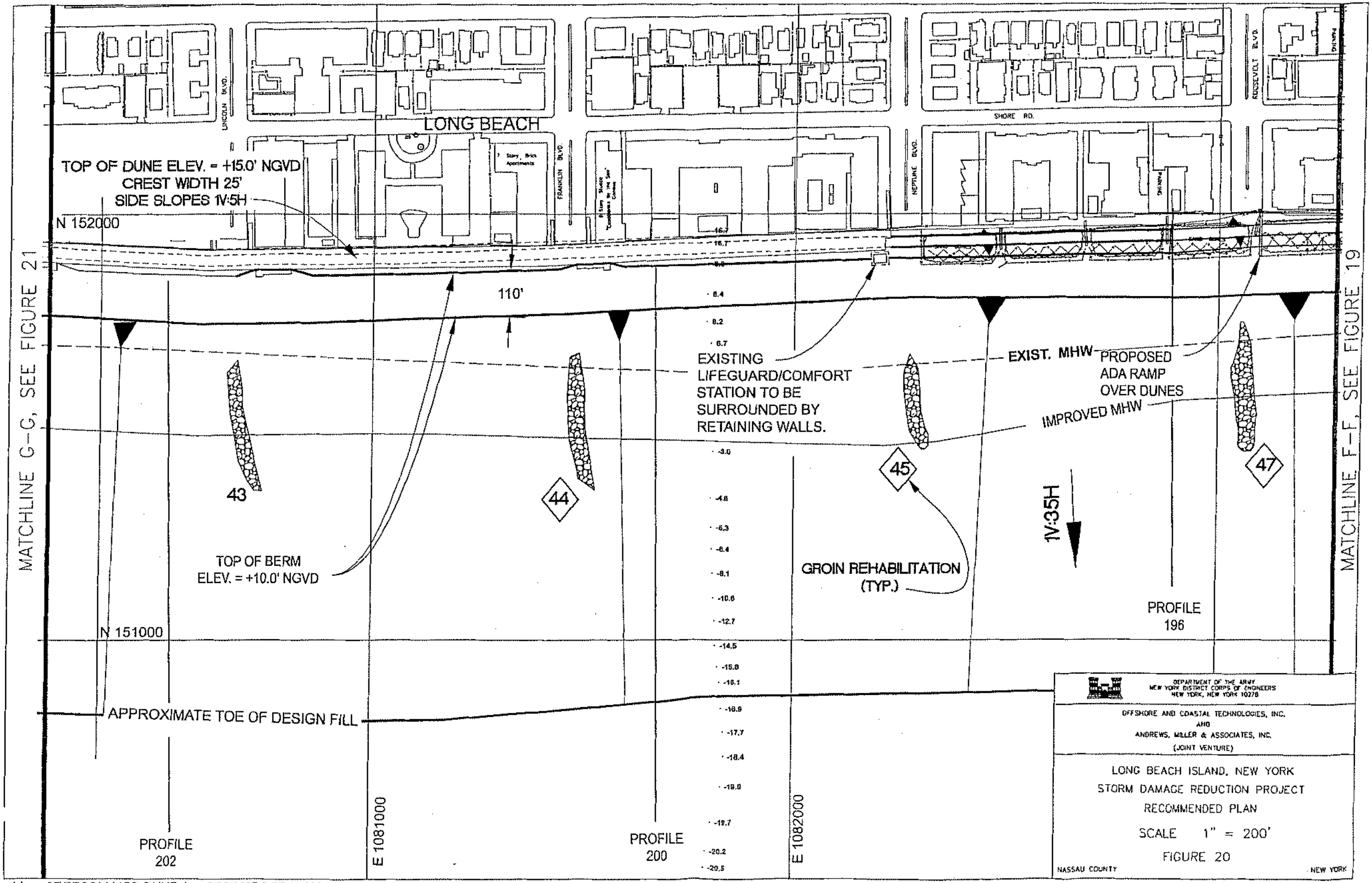
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)

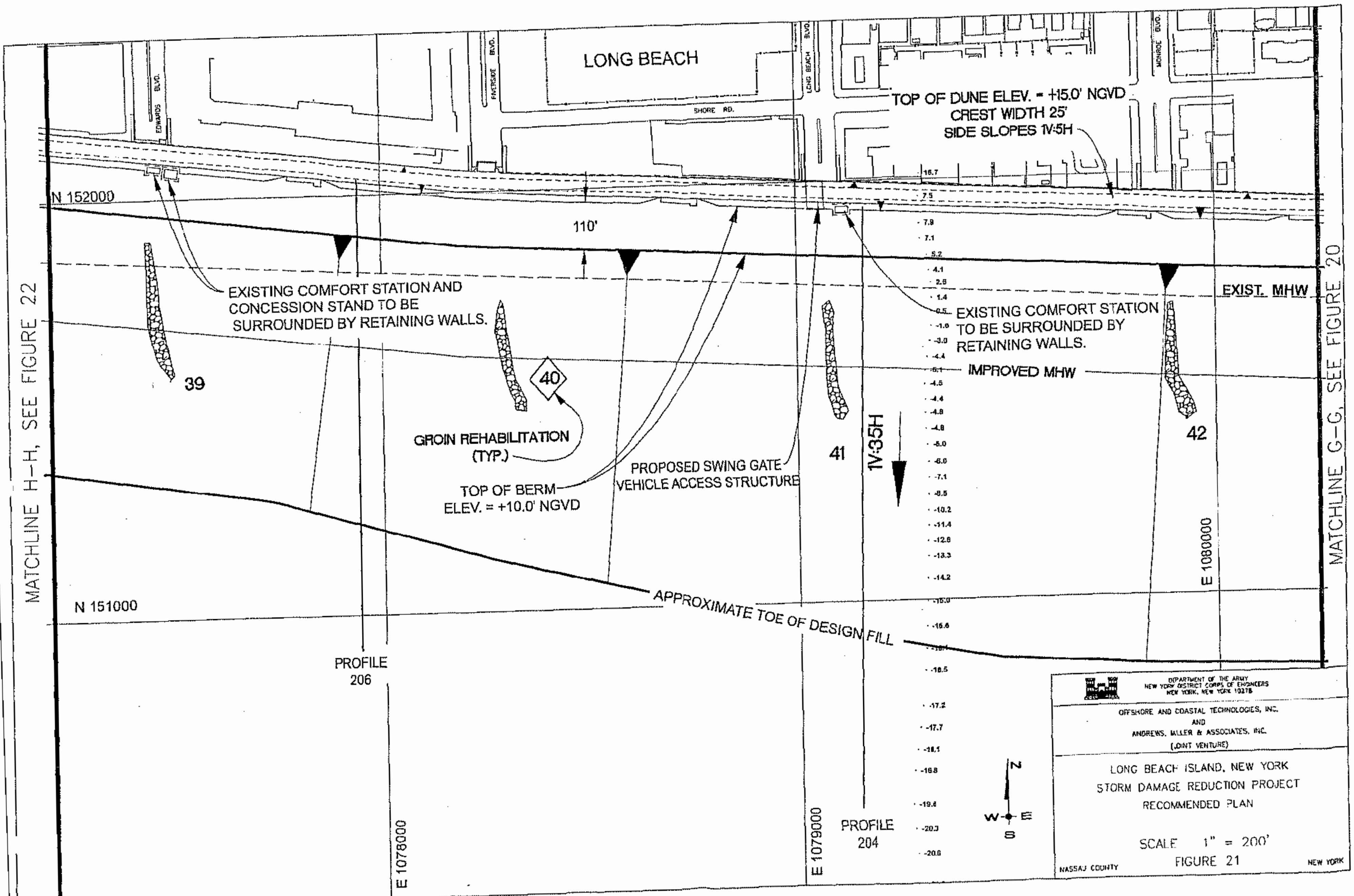
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN

SCALE 1" = 200'

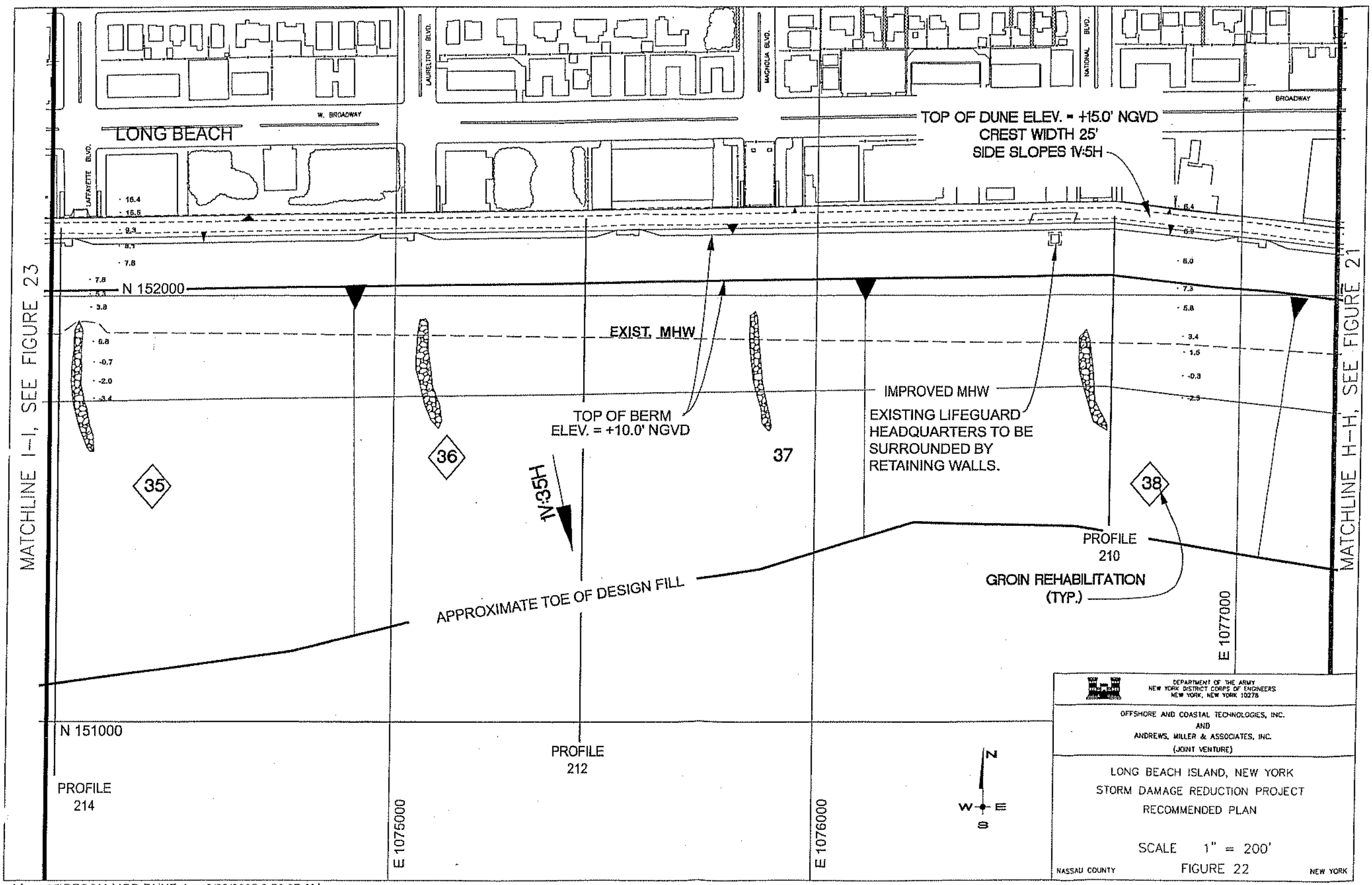
FIGURE 19

NASSAU COUNTY NEW YORK

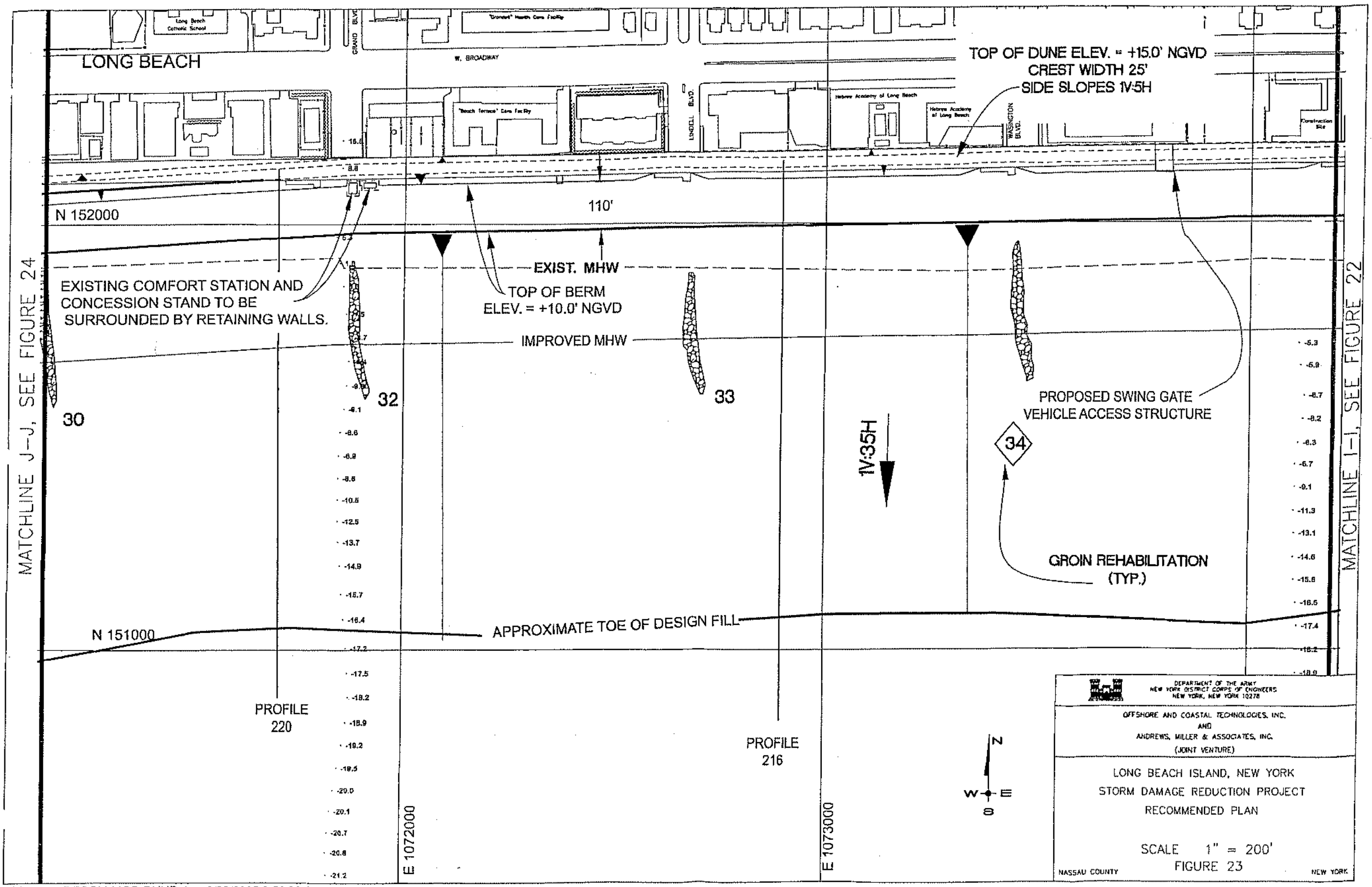

LONG BEACH
LINCOLN BLVD.
FRANKLIN BLVD.
NEPTUNE BLVD.
ROOSEVELT BLVD.
SHORE RD.
TOP OF DUNE ELEV. = +15.0' NGVD
CREST WIDTH 25'
SIDE SLOPES 1V:5H
N 152000
110'
EXISTING
LIFEGUARD/COMFORT
STATION TO BE
SURROUNDED BY
RETAINING WALLS.
EXIST. MHW
PROPOSED
ADA RAMP
OVER DUNES
IMPROVED MHW
43
44
45
47
1V:35H
TOP OF BERM
ELEV. = +10.0' NGVD
GROIN REHABILITATION
(TYP.)
PROFILE
196
N 151000
APPROXIMATE TOE OF DESIGN FILL
PROFILE
202
E 1081000
PROFILE
200
E 1082000
MATCHLINE G-G, SEE FIGURE 21
MATCHLINE F-F, SEE FIGURE 19
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN
SCALE 1" = 200'
FIGURE 20
NASSAU COUNTY
NEW YORK

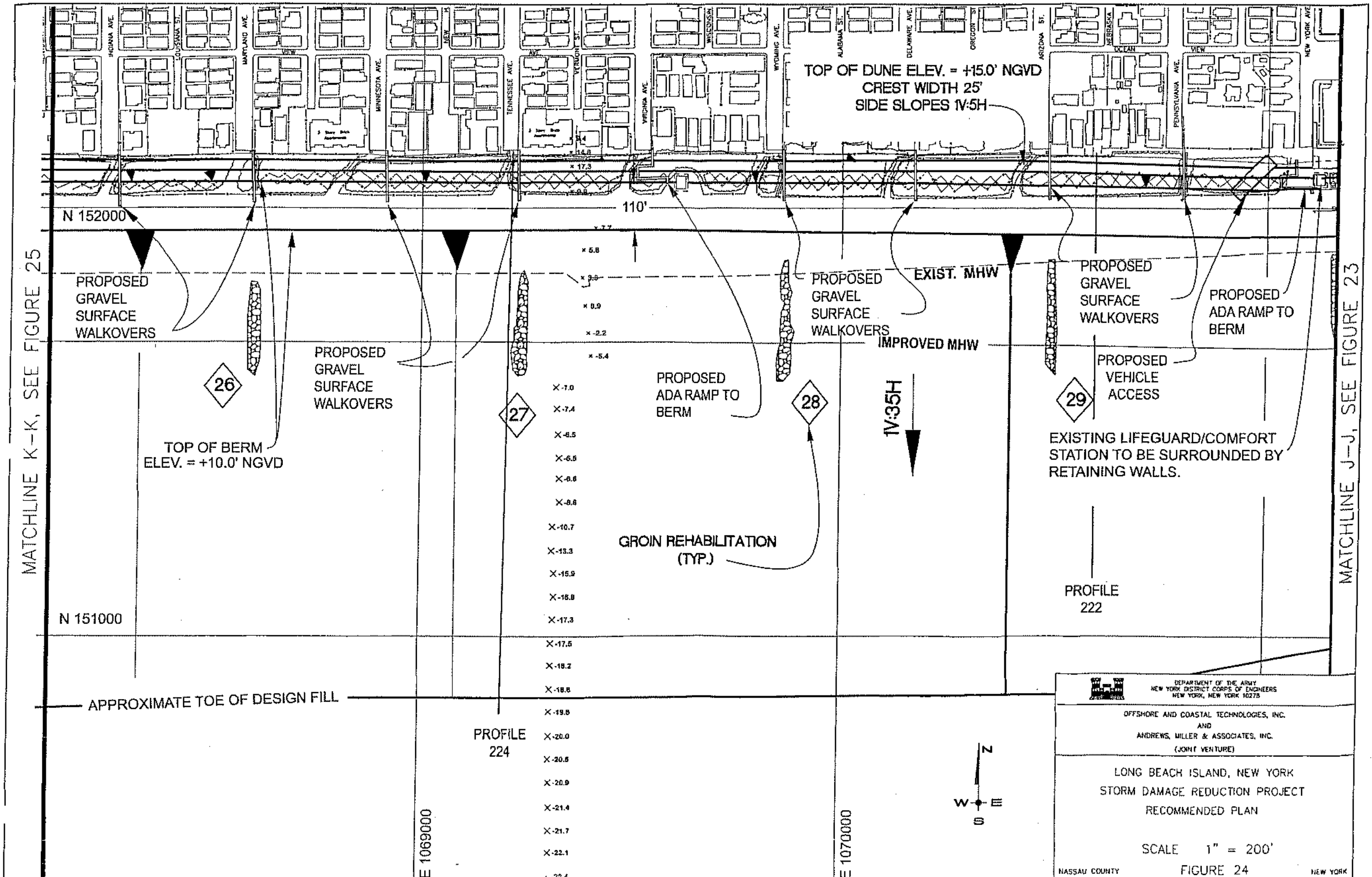


June 05\RECOM-MOD DUNE.dgn 9/29/2005 8:57:12 AM

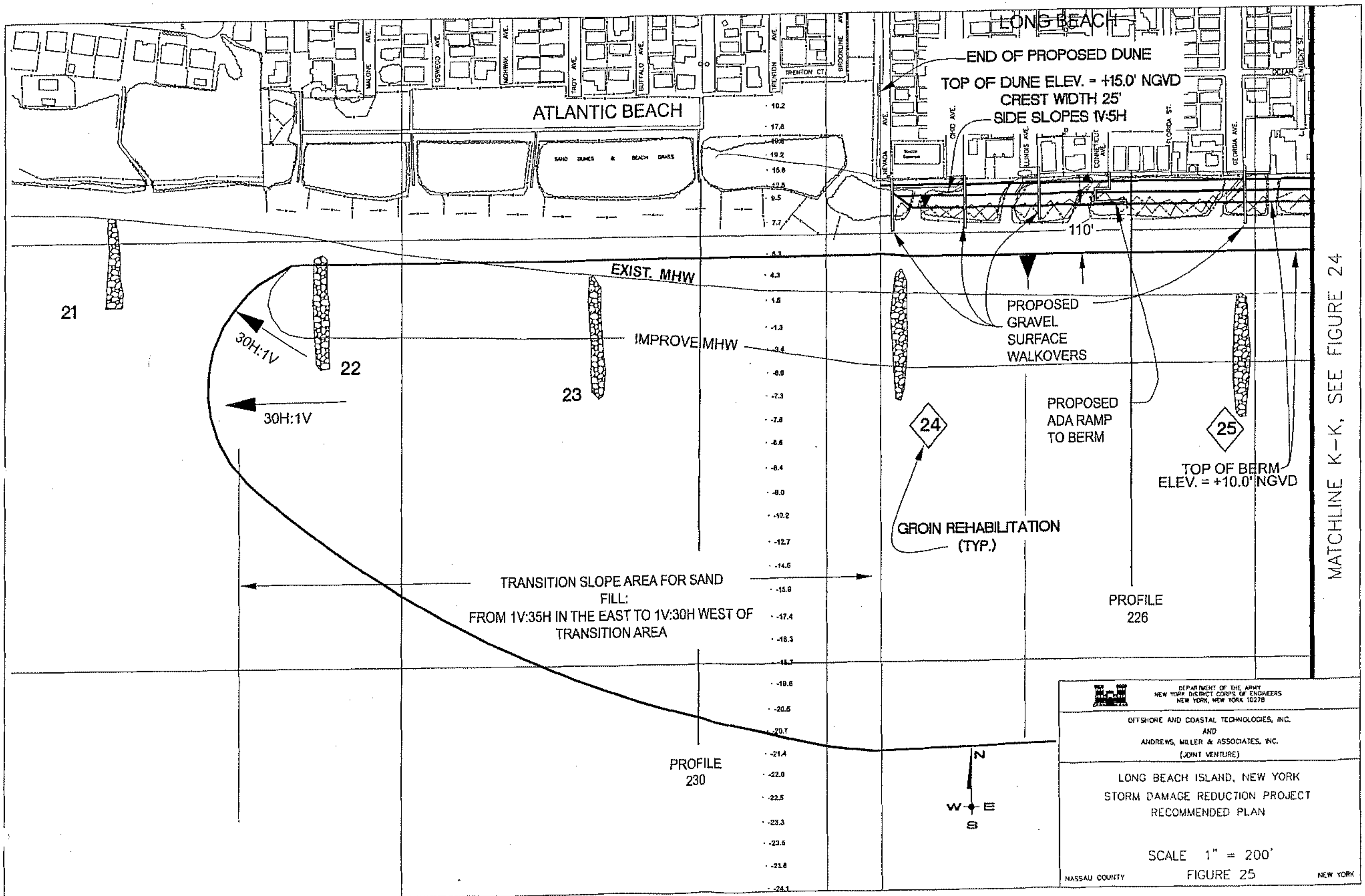


MATCHLINE I–I, SEE FIGURE 23
MATCHLINE H–H, SEE FIGURE 21
LONG BEACH
W. BROADWAY
LAFAYETTE BLVD.
LAURELTON BLVD.
MAGNOLIA BLVD.
NATIONAL BLVD.
BROADWAY
TOP OF DUNE ELEV. = +15.0' NGVD
CREST WIDTH 25'
SIDE SLOPES 1V:5H
N 152000
N 151000
EXIST. MHW
IMPROVED MHW
TOP OF BERM
ELEV. = +10.0' NGVD
EXISTING LIFEGUARD
HEADQUARTERS TO BE
SURROUNDED BY
RETAINING WALLS.
1V:35H
35
36
37
38
PROFILE
210
PROFILE
212
PROFILE
214
GROIN REHABILITATION
(TYP.)
APPROXIMATE TOE OF DESIGN FILL
E 1075000
E 1076000
E 1077000
N
W
E
S
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN
SCALE 1" = 200'
NASSAU COUNTY
FIGURE 22
NEW YORK


LONG BEACH
W. BROADWAY
GRAND BLVD.
LINDELL BLVD.
WASINGTON BLVD.
TOP OF DUNE ELEV. = +15.0' NGVD
CREST WIDTH 25'
SIDE SLOPES 1V:5H
N 152000
110'
EXIST. MHW
EXISTING COMFORT STATION AND
CONCESSION STAND TO BE
SURROUNDED BY RETAINING WALLS.
TOP OF BERM
ELEV. = +10.0' NGVD
IMPROVED MHW
30
32
33
34
PROPOSED SWING GATE
VEHICLE ACCESS STRUCTURE
1V:35H
GROIN REHABILITATION
(TYP.)
N 151000
APPROXIMATE TOE OF DESIGN FILL
PROFILE
220
PROFILE
216
E 1072000
E 1073000
MATCHLINE J–J, SEE FIGURE 24
MATCHLINE I–I, SEE FIGURE 22
N
W
E
S
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN
SCALE 1" = 200'
FIGURE 23
NASSAU COUNTY
NEW YORK

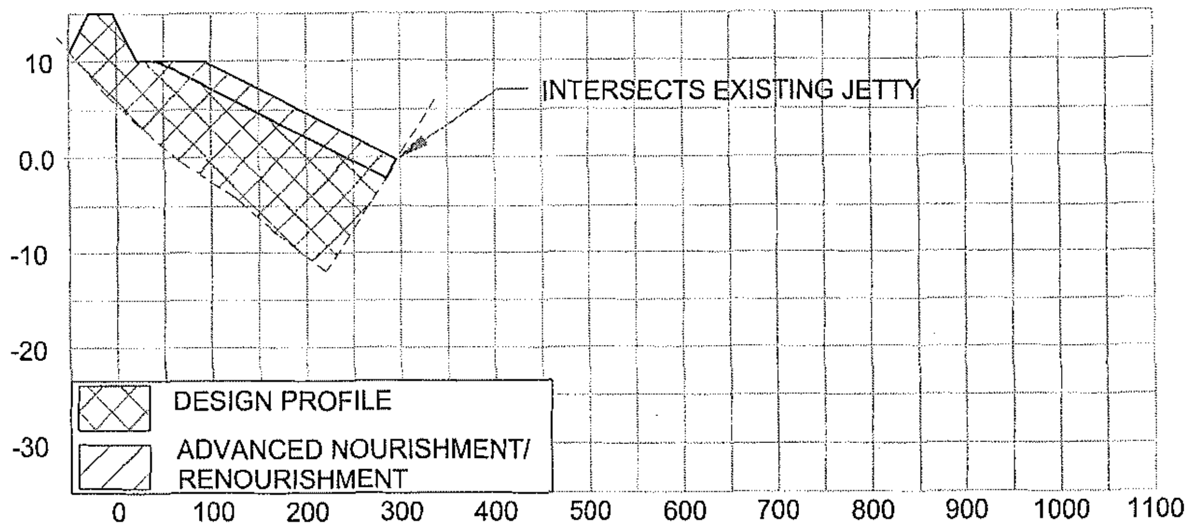


TOP OF DUNE ELEV. = +15.0' NGVD
CREST WIDTH 25'
SIDE SLOPES 1V:5H
N 152000
110'
N 151000
MATCHLINE K–K, SEE FIGURE 25
MATCHLINE J–J, SEE FIGURE 23
PROPOSED GRAVEL SURFACE WALKOVERS
PROPOSED GRAVEL SURFACE WALKOVERS
PROPOSED GRAVEL SURFACE WALKOVERS
PROPOSED GRAVEL SURFACE WALKOVERS
EXIST. MHW
IMPROVED MHW
PROPOSED ADA RAMP TO BERM
PROPOSED ADA RAMP TO BERM
PROPOSED VEHICLE ACCESS
TOP OF BERM ELEV. = +10.0' NGVD
1V:35H
EXISTING LIFEGUARD/COMFORT STATION TO BE SURROUNDED BY RETAINING WALLS.
GROIN REHABILITATION (TYP.)
26
27
28
29
PROFILE 224
PROFILE 222
APPROXIMATE TOE OF DESIGN FILL
E 1069000
E 1070000
N
W
E
S
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN
SCALE 1" = 200'
NASSAU COUNTY
FIGURE 24
NEW YORK


LONG BEACH
ATLANTIC BEACH
MALONE AVE.
OSWEGO AVE.
MOHAWK AVE.
TROY AVE.
BUFFALO AVE.
TRENTON AVE.
TRENTON CT.
BROOKLINE AVE.
NEVADA AVE.
OHIO AVE.
ILLINOIS AVE.
CONNECTICUT AVE.
FLORIDA ST.
GEORGIA AVE.
KENTUCKY ST.
OCEAN
SAND DUNES & BEACH GRASS
END OF PROPOSED DUNE
TOP OF DUNE ELEV. = +15.0' NGVD
CREST WIDTH 25'
SIDE SLOPES 1V:5H
110'
EXIST. MHW
IMPROVE MHW
30H:1V
30H:1V
21
22
23
24
25
PROPOSED
GRAVEL
SURFACE
WALKOVERS
PROPOSED
ADA RAMP
TO BERM
TOP OF BERM
ELEV. = +10.0' NGVD
GROIN REHABILITATION
(TYP.)
TRANSITION SLOPE AREA FOR SAND
FILL:
FROM 1V:35H IN THE EAST TO 1V:30H WEST OF
TRANSITION AREA
PROFILE
230
PROFILE
226
MATCHLINE K-K, SEE FIGURE 24
N
W
E
S
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.
(JOINT VENTURE)
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
RECOMMENDED PLAN
SCALE 1" = 200'
NASSAU COUNTY
FIGURE 25
NEW YORK

PROFILE No. 140

15' NGVD DUNE
110' BERM @ 10' NGVD



EXISTING DESIGN AND NOURISHMENT PROFILES FOR RECOMMENDED PLAN

SCALE: HORZ. 1" = 200'
VERT. 1" = 20'

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

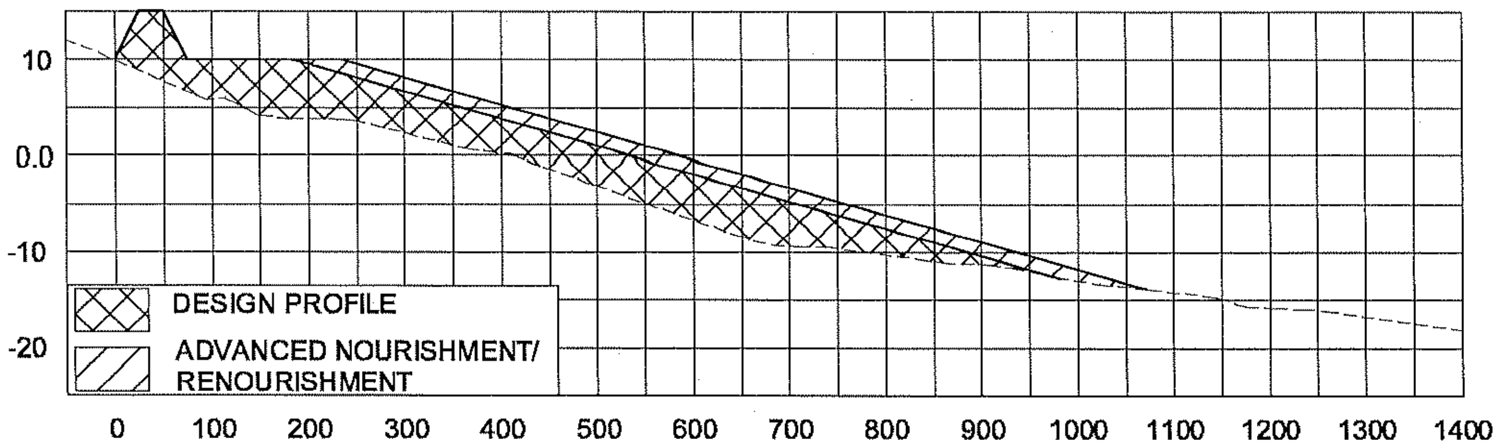
LRR RECOMMENDED PLAN
CROSS SECTION

NASSAU CO. NEW YORK

FIGURE No. 26

PROFILE No. 192

15' NGVD DUNE
110' BERM @ 10' NGVD



EXISTING DESIGN AND NOURISHMENT PROFILES FOR RECOMMENDED PLAN

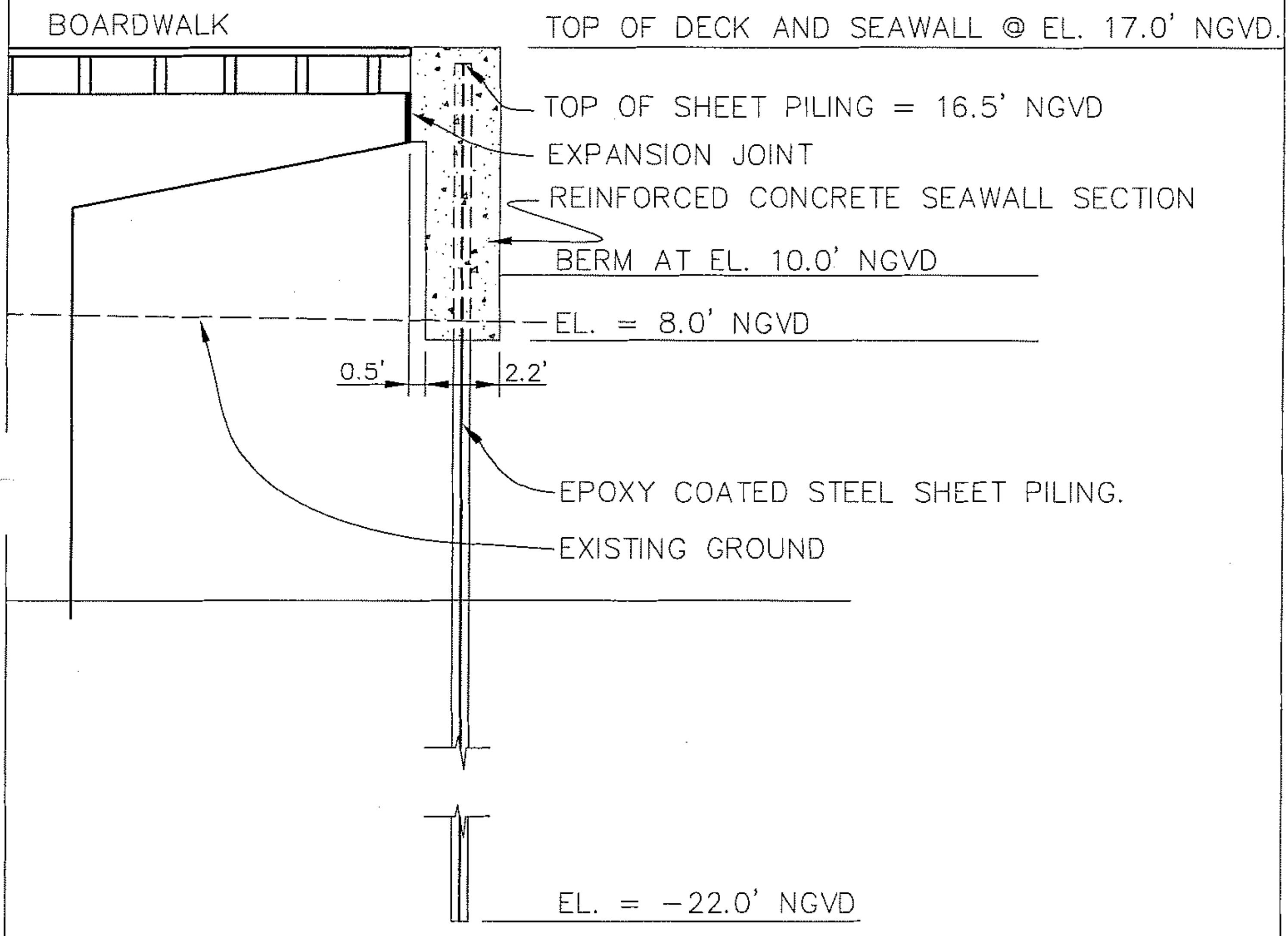
SCALE: HORZ. 1" = 200'
VERT. 1" = 20'

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT

LRR RECOMMENDED PLAN CROSS SECTION

NASSAU CO. NEW YORK

FIGURE No. 27



TYPICAL CROSS-SECTION
SCALE: 1" = 5'

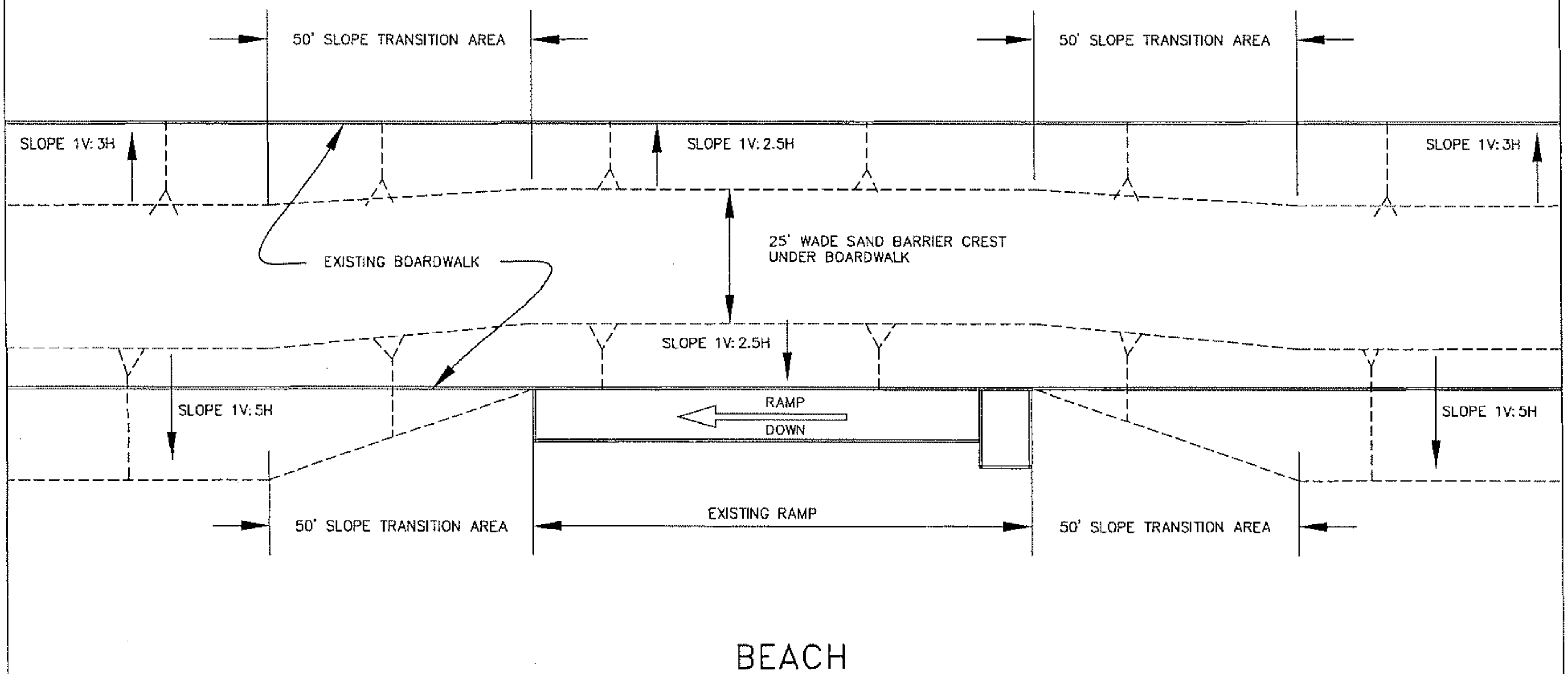
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
TYPICAL SEAWALL CROSS SECTION AT
CITY OF LONG BEACH

SCALE : ONE INCH = 5 FEET

NASSAU COUNTY | Figure 28 | NEW YORK



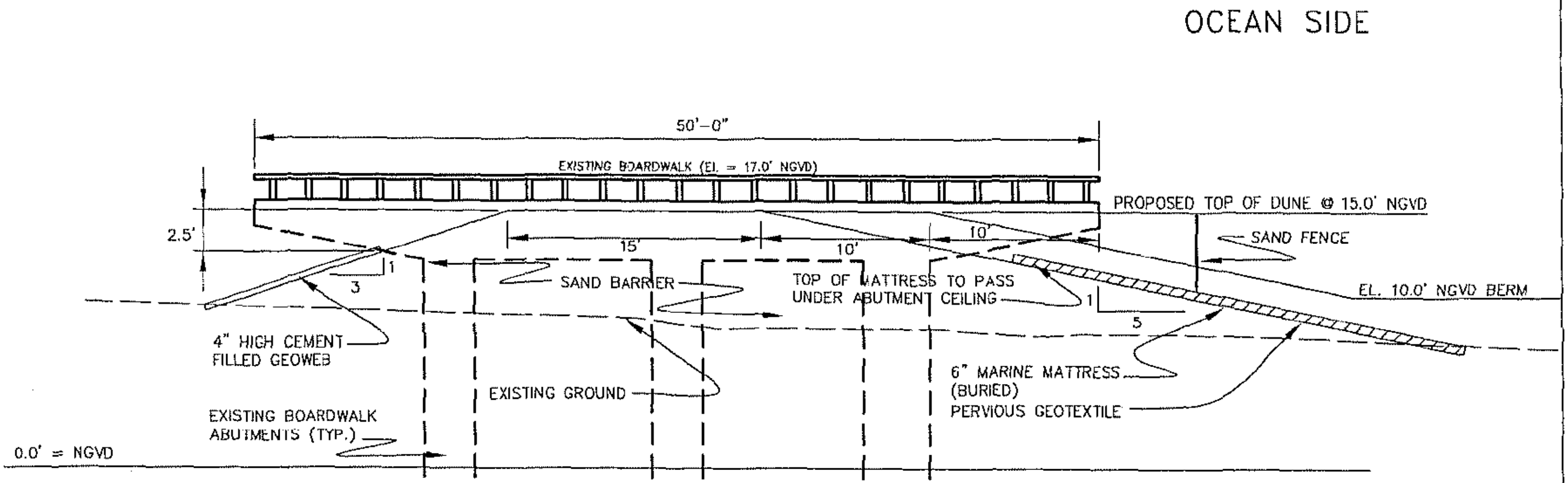
TYPICAL PLAN VIEW
1" = 30'

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
TYPICAL PLAN VIEW OF SAND BARRIER
AT CITY OF LONG BEACH
AT RAMP AREA
SCALE : AS SHOWN

NASSAU COUNTY | Figure 29 | NEW YORK



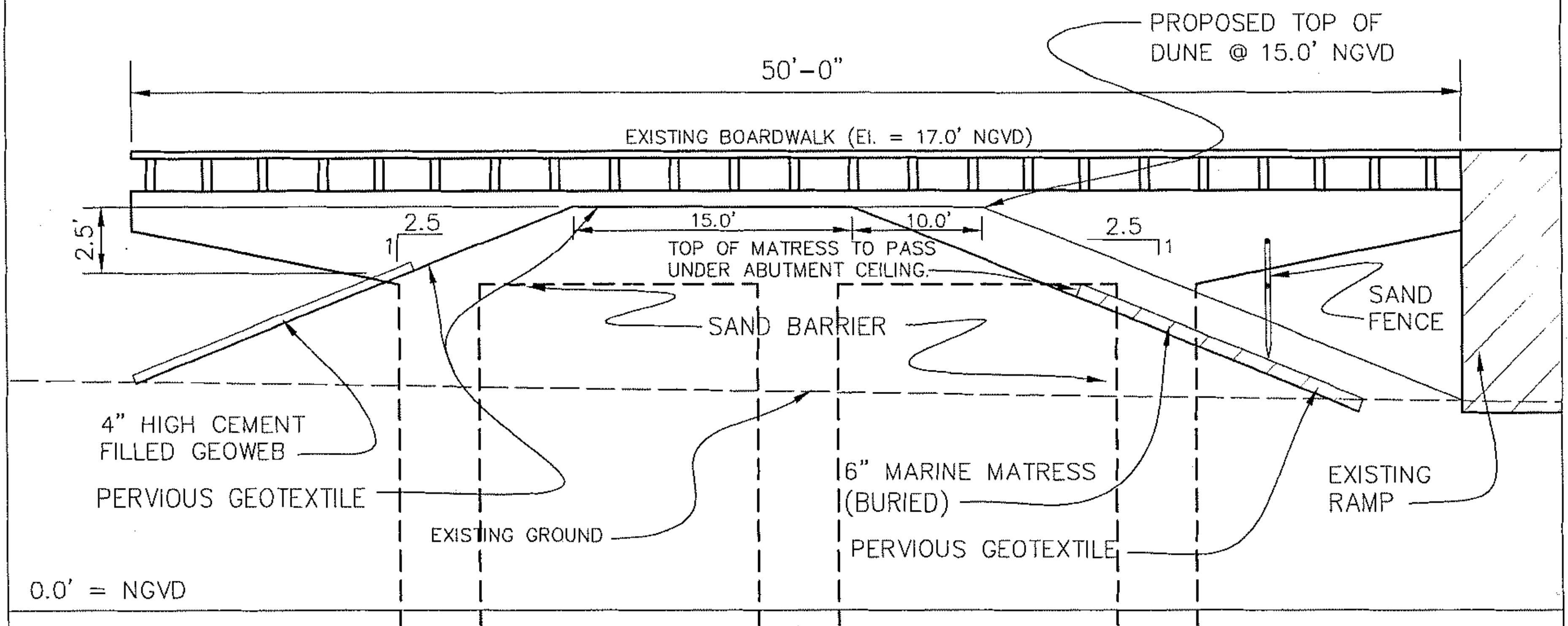
SCALE 1" = 10'

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
TYPICAL SAND BARRIER CROSS SECTION
AT CITY OF LONG BEACH
EXCEPT AT RAMP AREA
SCALE : ONE INCH = 10 FEET

NASSAU COUNTY | Figure 30 | NEW YORK



SCALE: 1" = 6'

NOTE: ℄ of Sand Barrier Crest set @ ℄ of boardwalk @ ramp locations.

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NEW YORK, NEW YORK 10278

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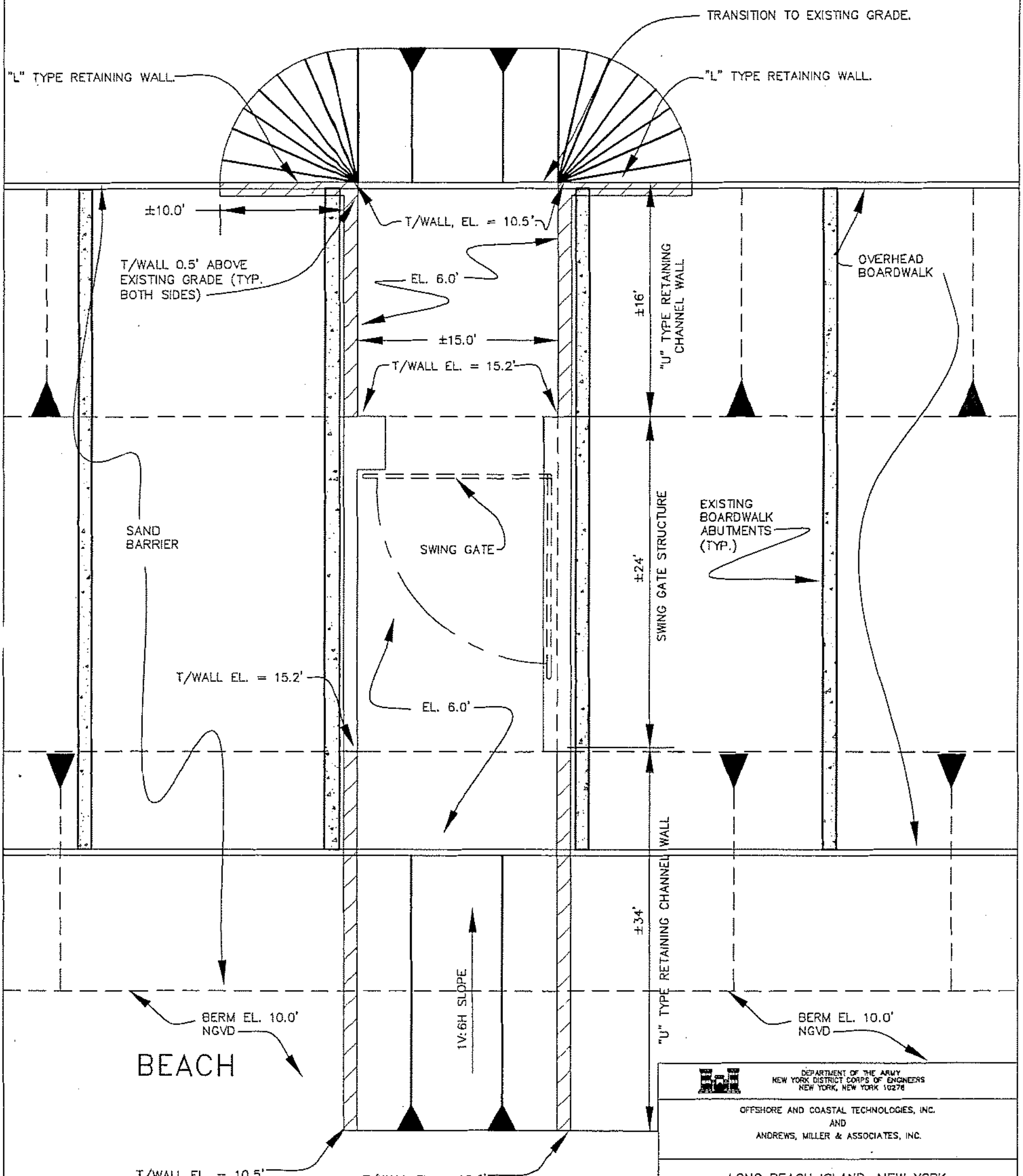
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
TYPICAL SAND BARRIER CROSS SECTION
AT CITY OF LONG BEACH
AT RAMP AREA
SCALE : ONE INCH = 6 FEET

NASSAU COUNTY | Figure 31 | NEW YORK



TYPICAL PLAN VIEW
N.T.S.

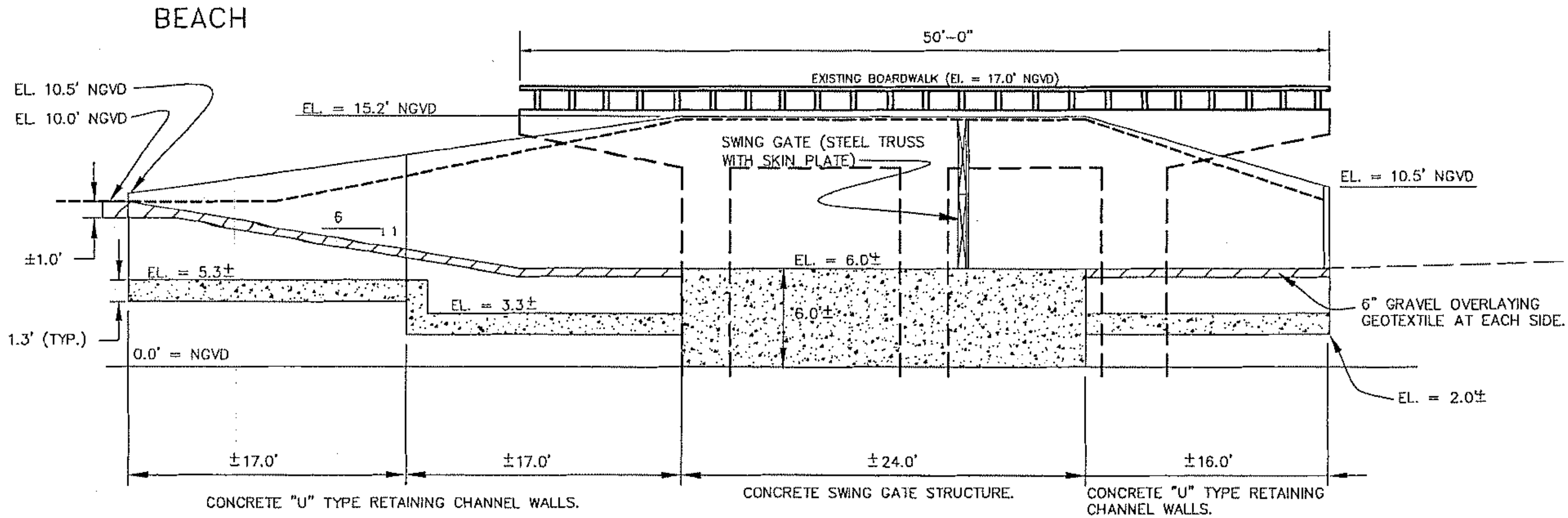
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
SWING GATE VEHICULAR ACCESS
UNDER BOARDWALK

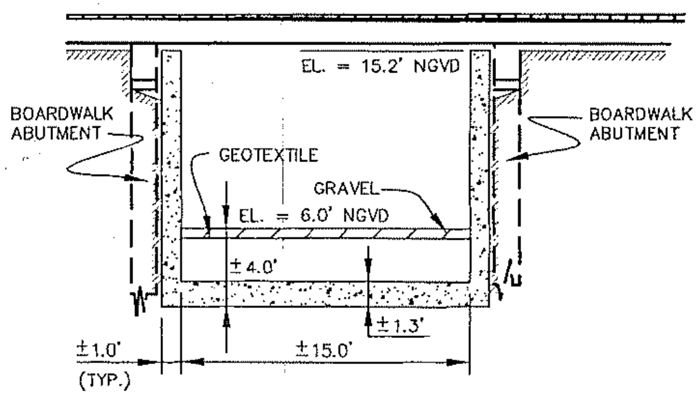
SCALE AS SHOWN

NASSAU COUNTY | Figure 32 | NEW YORK

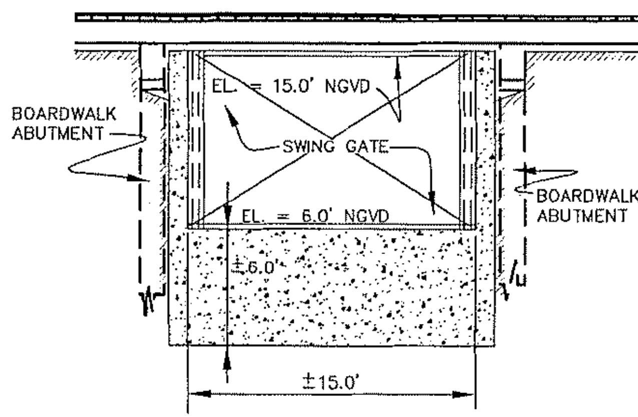


TYPICAL CROSS–SECTION
N.T.S.

NOTE: PILE SUPPORT OF RETAINING WALLS AND SWING GATE STRUCTURE IS NOT ANTICIPATED.



SECTION THRU RETAINING WALLS ("U" TYPE CHANNEL)
N.T.S.



SECTION THRU SWING GATE STRUCTURE
N.T.S.

DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

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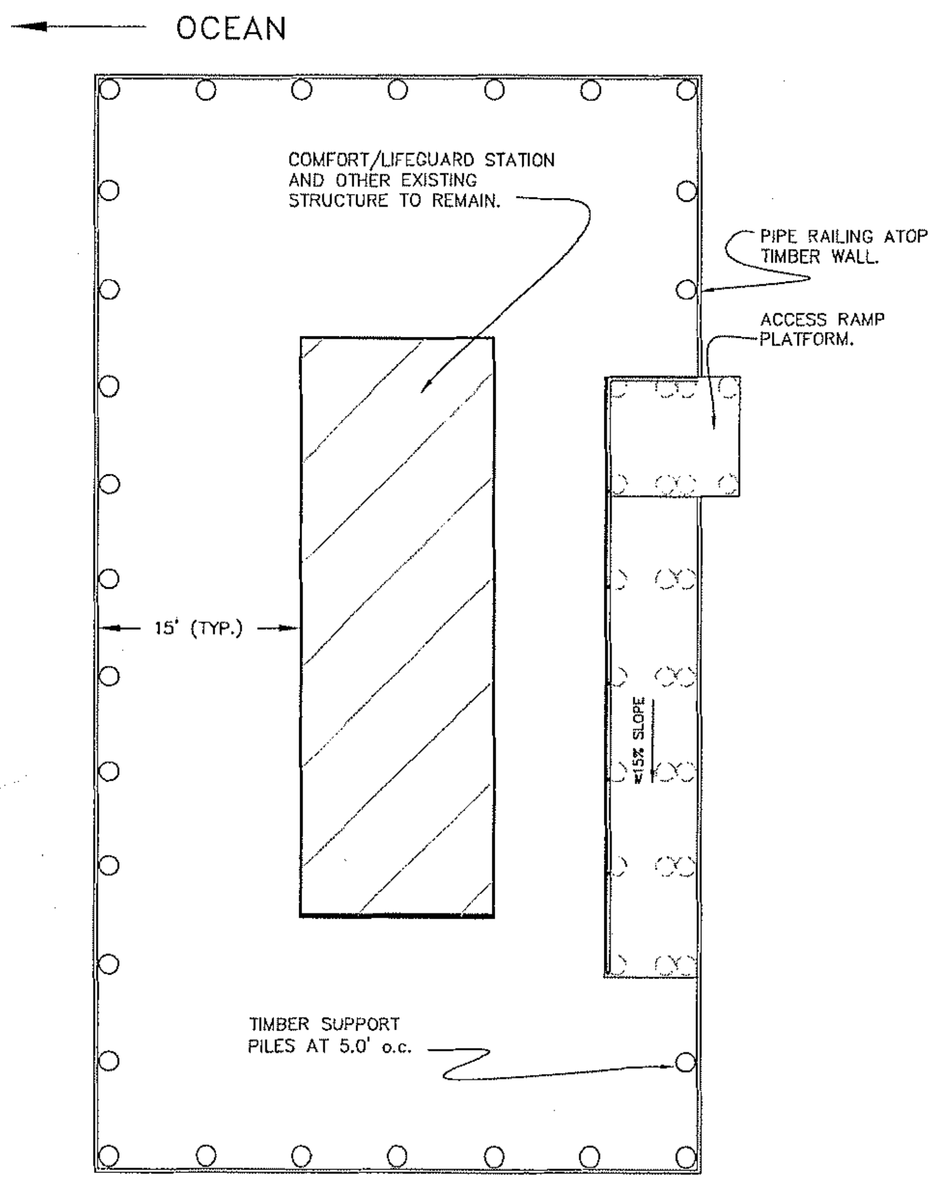
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
SWING GATE VEHICULAR ACCESS
CROSS SECTIONS

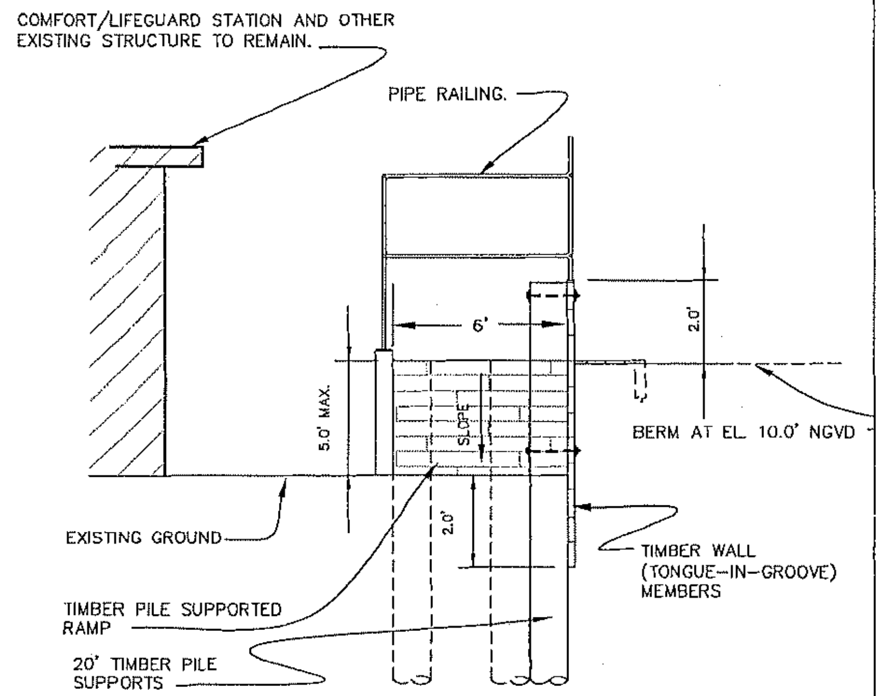
SCALE AS SHOWN

NASSAU COUNTY Figure 33 NEW YORK



PLAN VIEW

N.T.S.



CROSS SECTION

N.T.S.

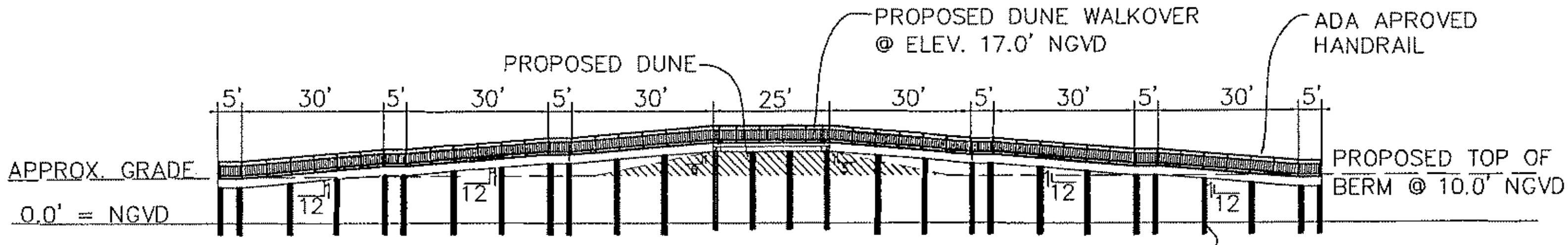
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.

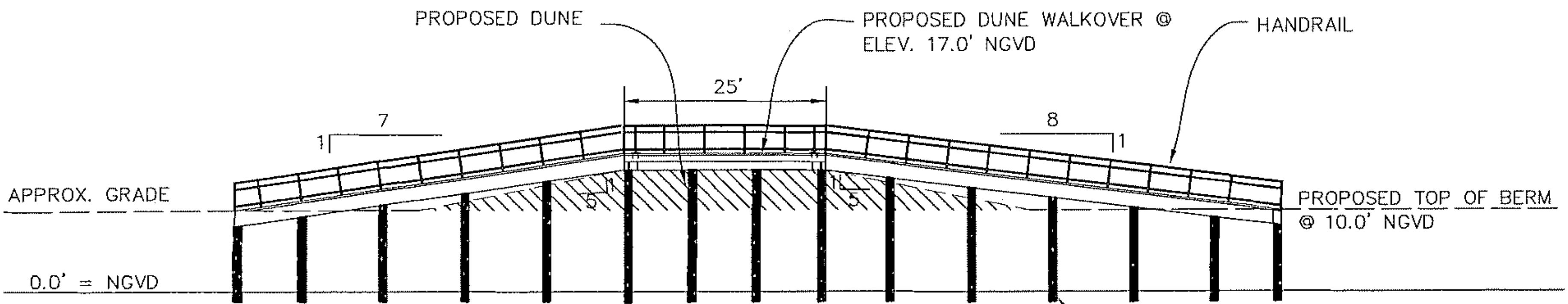
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
TIMBER WALL DETAIL
AT AND SURROUNDING BEACH STRUCTURES

SCALE : ONE INCH = 6 FEET

NASSAU COUNTY | Figure 34 | NEW YORK



TYPICAL ELEVATION VIEW
(ADA COMPLIANT – 6' WIDE)
SCALE: 1" = 40'



TYPICAL ELEVATION VIEW
(NON-ADA COMPLIANT – 6' WIDE)
SCALE: 1" = 20'

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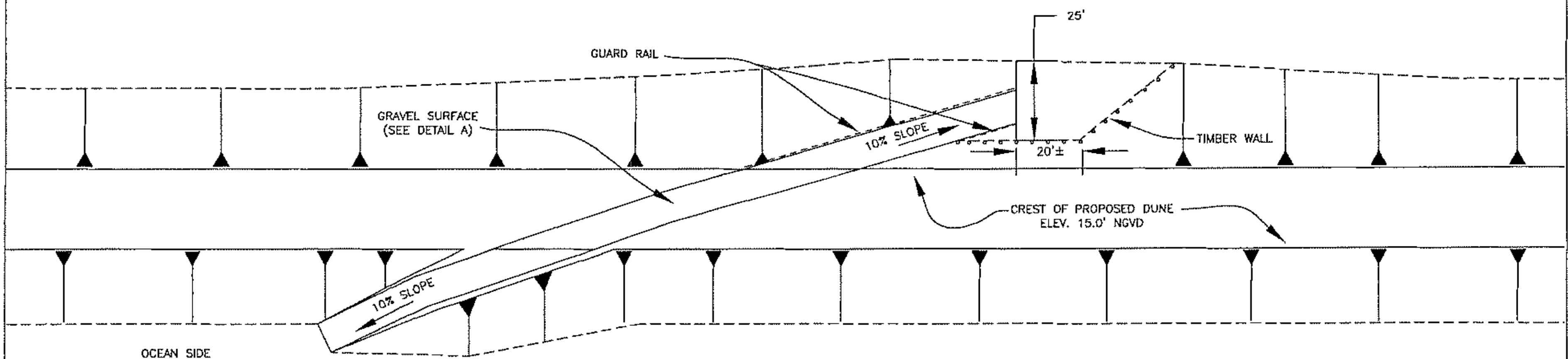
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

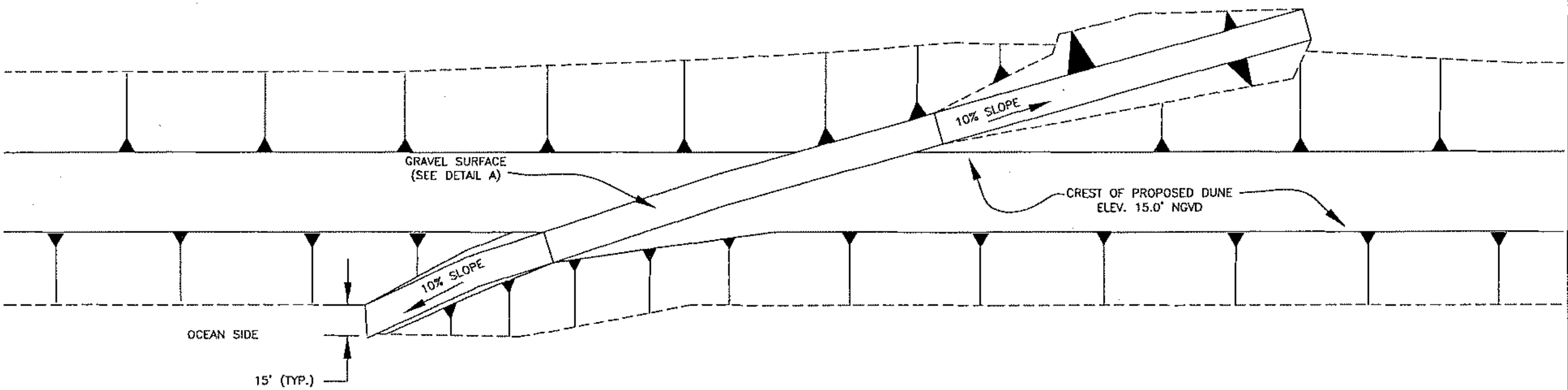
OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
TYPICAL DUNE WALKOVER

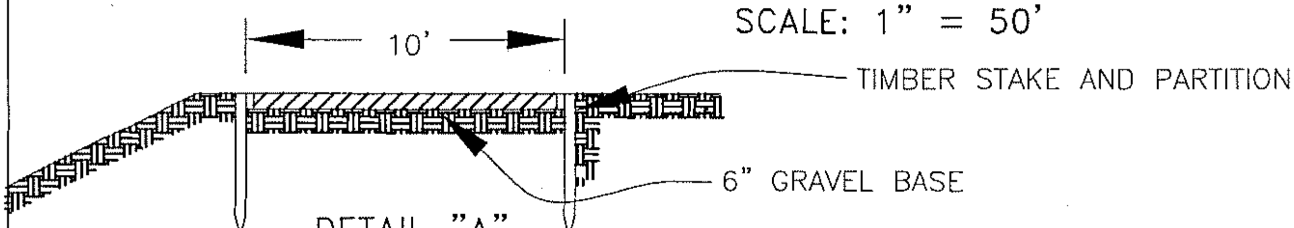
NASSAU COUNTY — Figure 35 — NEW YORK



TYPICAL PLAN VIEW @ LONG BEACH RAMPS
SCALE: 1" = 50'



TYPICAL PLAN VIEW @ LIDO BEACH RAMPS
SCALE: 1" = 50'



DETAIL "A"
SCALE: 1" = 6'

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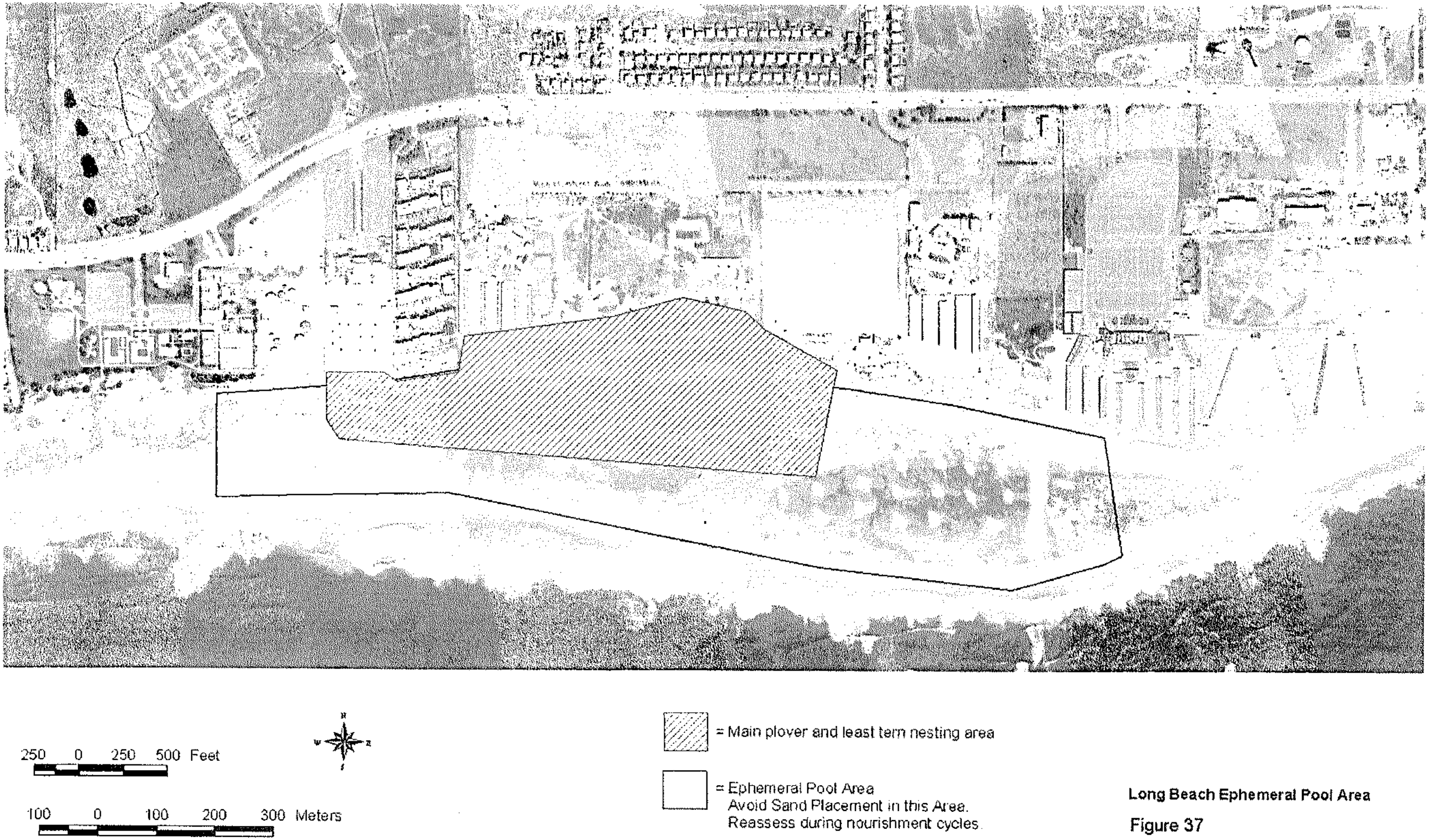
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NEW YORK 10278

OFFSHORE AND COASTAL TECHNOLOGIES, INC.
AND
ANDREWS, MILLER & ASSOCIATES, INC.

LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
VEHICULAR ACCESS RAMP

NASSAU COUNTY | Figure 36 | NEW YORK



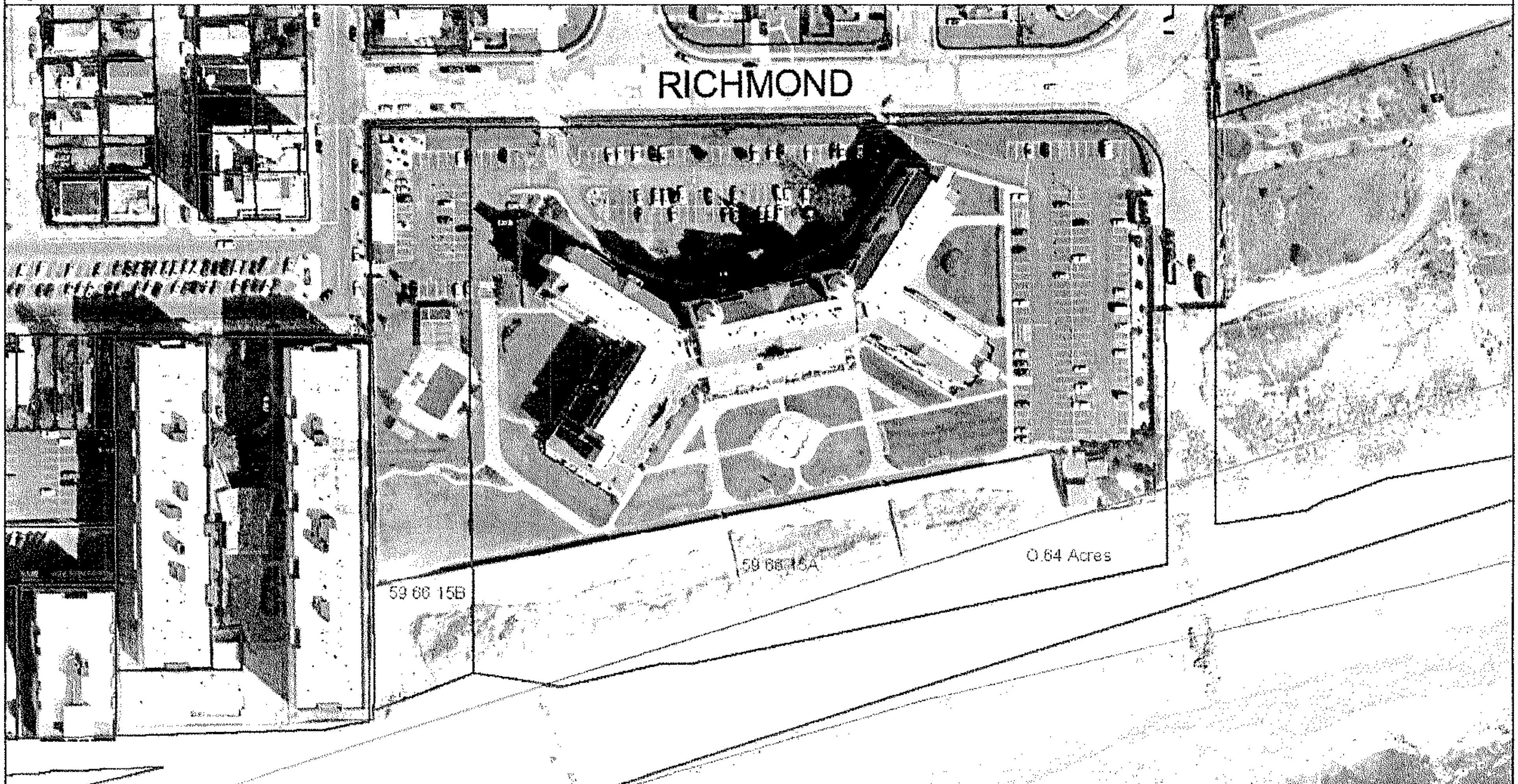
Long Beach Ephemeral Pool Area

Figure 37

US Army Corps of Engineers
New York District

Fig. 38

LONG BEACH ISLAND
STORM REDUCTION PROJECT
REAL ESTATE REQUIREMENTS

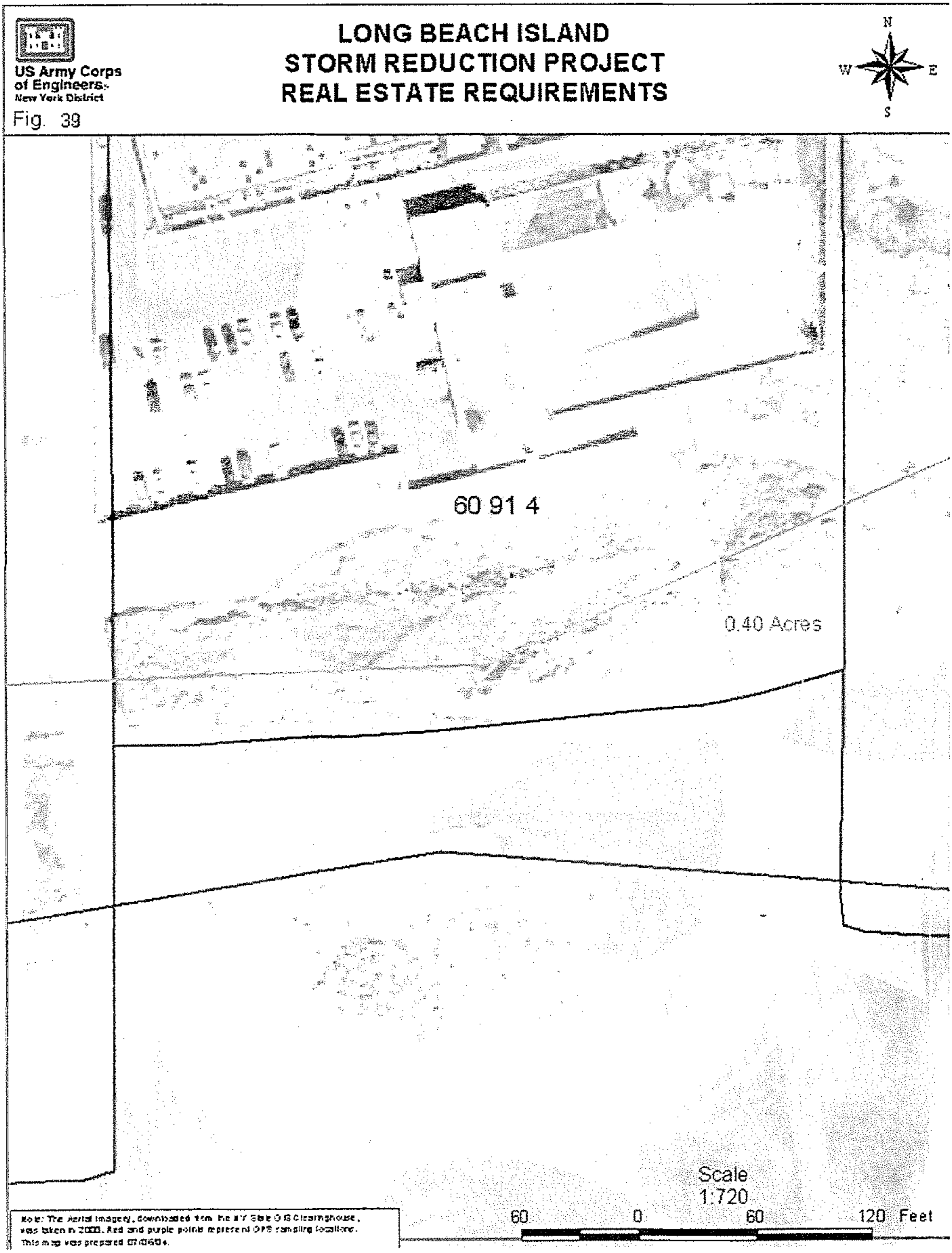


Note: The Aerial Imagery, downloaded from the NY State GIS Clearinghouse, was taken in 2000. Red and purple points represent GPS sampling locations. This map was prepared 07/06/04.

US Army Corps of Engineers
New York District

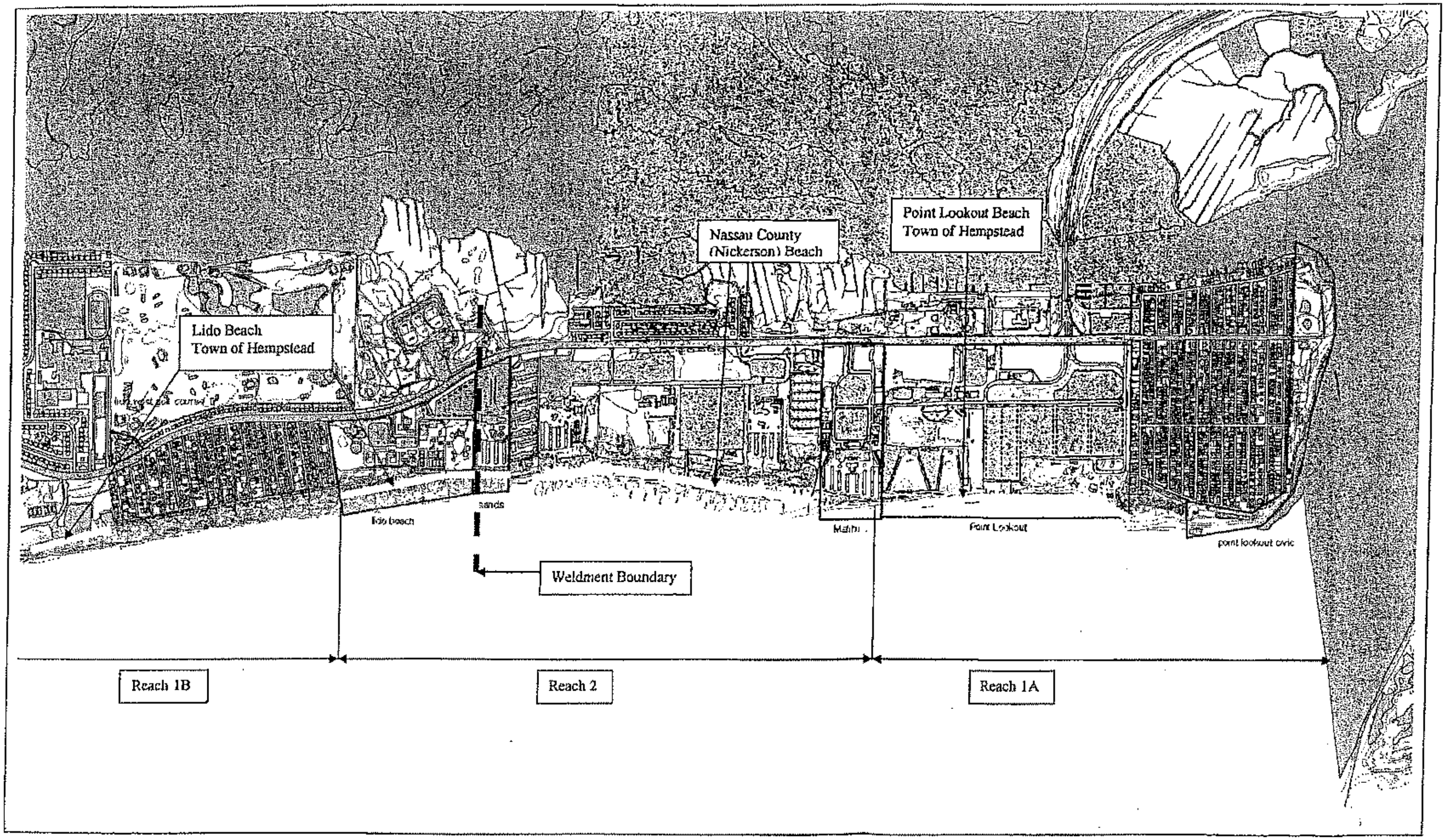
LONG BEACH ISLAND
STORM REDUCTION PROJECT
REAL ESTATE REQUIREMENTS

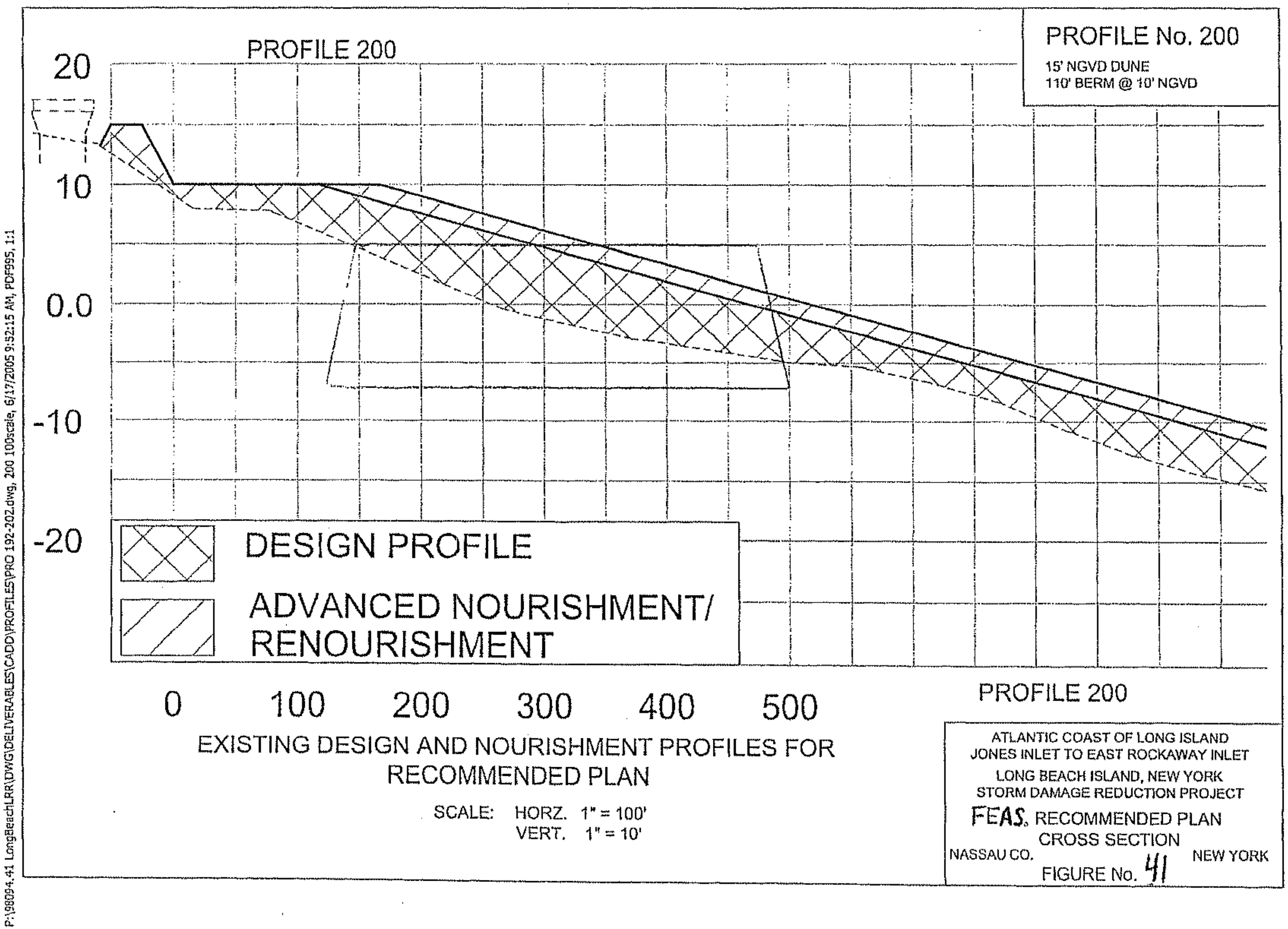
Fig. 39



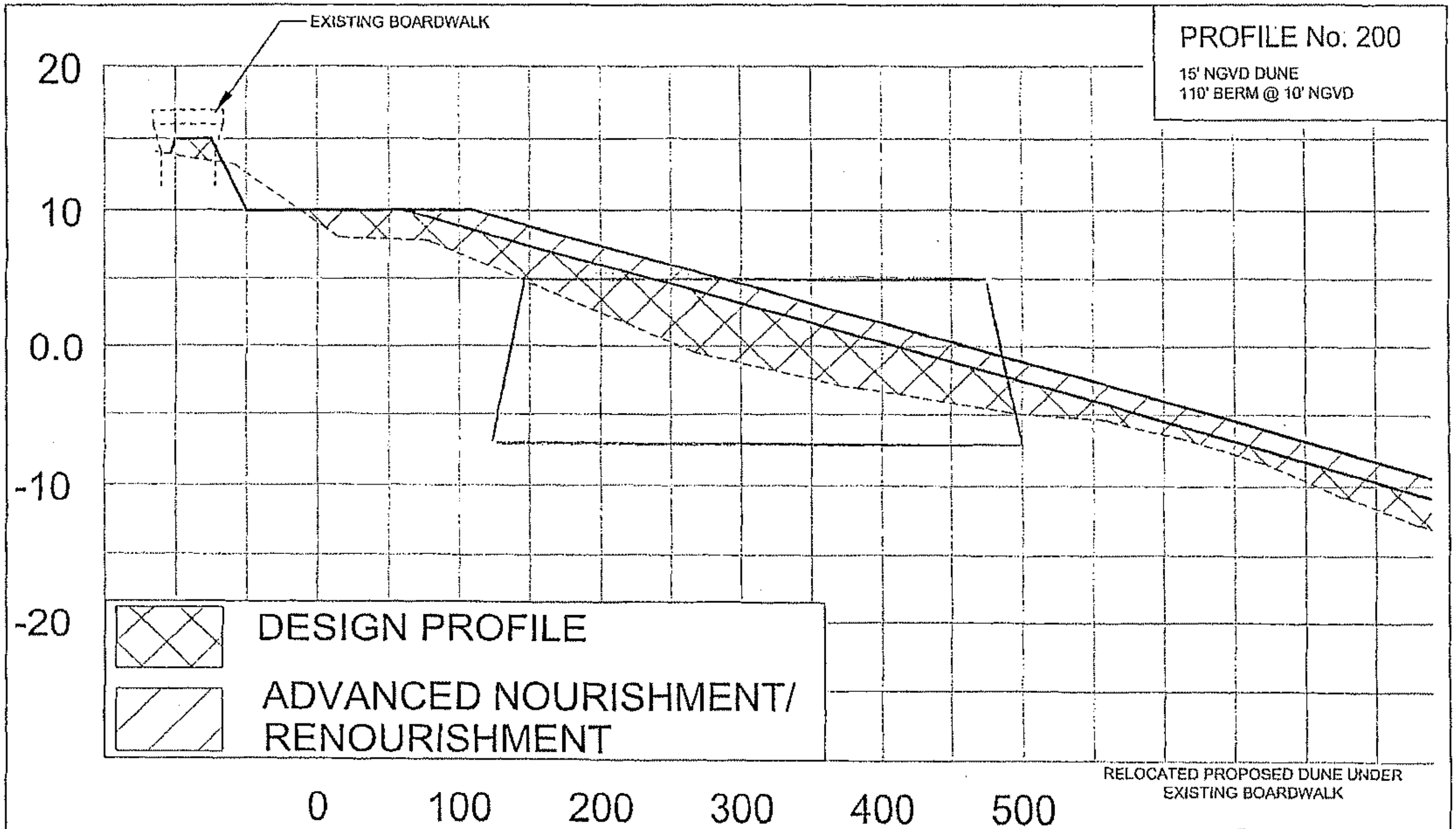
Note: The Aerial Imagery, downloaded from the NY State GIS Clearinghouse, was taken in [illegible]. Red and purple points represent GPS sampling locations. This map was prepared [illegible].

Figure 40 Long Beach Island East – Nassau County & Town of Hempstead Beach Areas
Original map image provided by USACE NAN





PROFILE No. 200
15' NGVD DUNE
110' BERM @ 10' NGVD
PROFILE 200
20
10
0.0
-10
-20
DESIGN PROFILE
ADVANCED NOURISHMENT/
RENOURISHMENT
0
100
200
300
400
500
EXISTING DESIGN AND NOURISHMENT PROFILES FOR
RECOMMENDED PLAN
SCALE: HORZ. 1" = 100'
VERT. 1" = 10'
PROFILE 200
ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
FEAS, RECOMMENDED PLAN
CROSS SECTION
NASSAU CO.
NEW YORK
FIGURE No. 41
P:\98094.41 LongBeachLRR\DWG\DELIVERABLES\CADD\PROFILES\PRO 192-202.dwg, 200 100scale, 6/17/2005 9:52:15 AM, PDF995, 1:1



EXISTING DESIGN AND NOURISHMENT PROFILES FOR RECOMMENDED PLAN

SCALE: HORZ. 1" = 100'
VERT. 1" = 10'

ATLANTIC COAST OF LONG ISLAND
JONES INLET TO EAST ROCKAWAY INLET
LONG BEACH ISLAND, NEW YORK
STORM DAMAGE REDUCTION PROJECT
LRR RECOMMENDED PLAN
CROSS SECTION

NASSAU CO. NEW YORK

FIGURE No. 42

P:\98094.41 LongBeachLRR\DWG\DELIVERABLES\BOARDWALK DUNE 61405\PROFILES\ADJ 200-202.dwg, 200-100 scale, 6/17/2005 8:18:35 AM, PDF995, 1:1

Long Beach Storm Erosion Reduction Project

Prepared by
Department of Conservation and Waterways
Town of Hempstead

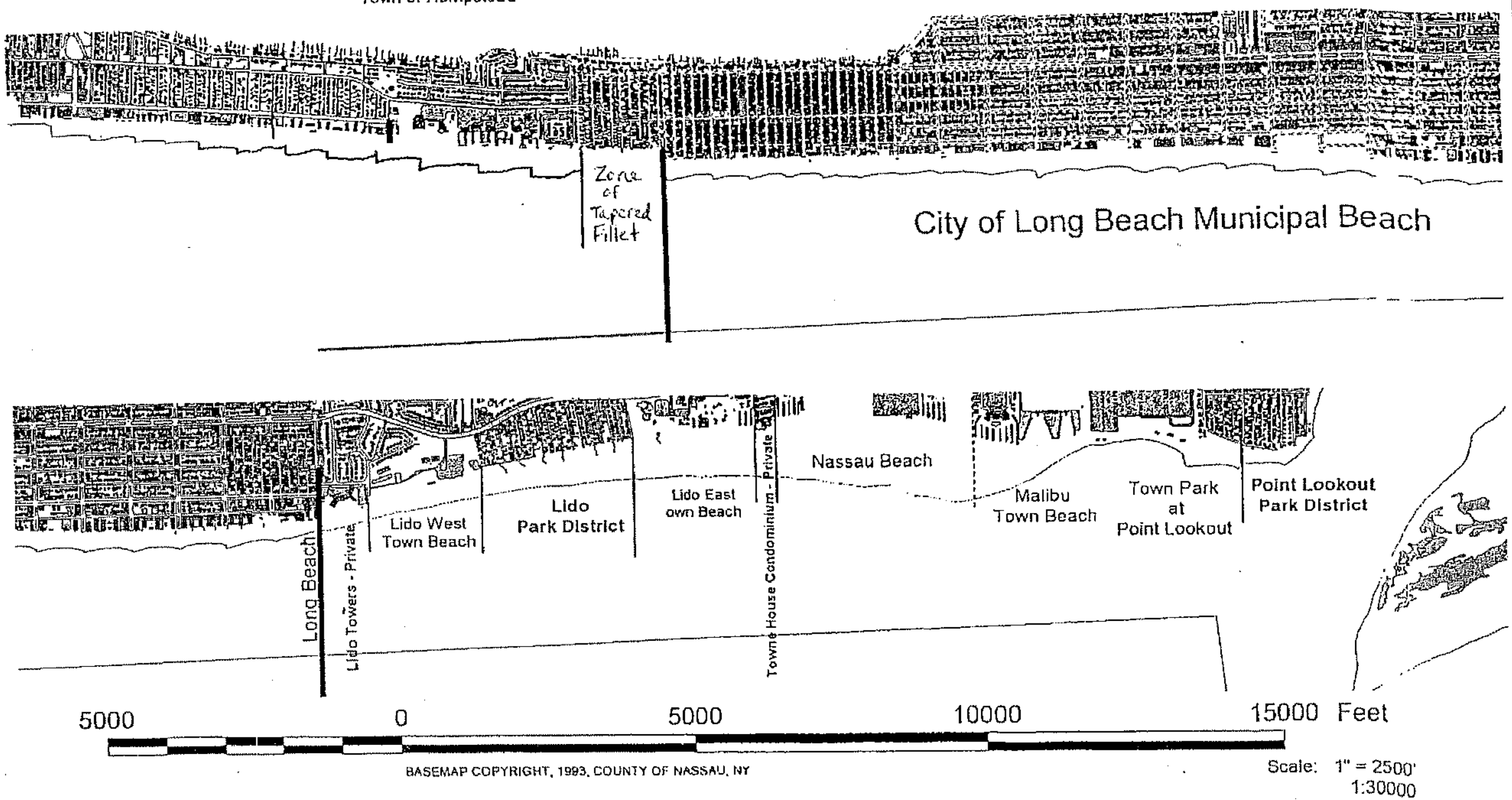


Figure 43

Long Beach LRR
52 Month Construction Schedule, three contracts

FIGURE 44

Duration mnth	Month	Season	Quarter	Calendar Year
1	Oct	fall	4th Q	Year 1 (partial)
2	Nov			
3	Dec			
4	Jan	winter	1st Q	Year 2
5	Feb			
6	Mar			
7	Apr	spring	2nd Q	
8	May			
9	Jun			
10	Jul	summer	3rd Q	
11	Aug			
12	Sep			
13	Oct	fall	4th Q	
14	Nov			
15	Dec			
16	Jan	winter	1st Q	Year 3
17	Feb			
18	Mar			
19	Apr	spring	2nd Q	
20	May			
21	Jun			
22	Jul	summer	3rd Q	
23	Aug			
24	Sep			
25	Oct	fall	4th Q	
26	Nov			
27	Dec			
28	Jan	winter	1st Q	Year 4
29	Feb			
30	Mar			
31	Apr	spring	2nd Q	
32	May			
33	Jun			
34	Jul	summer	3rd Q	
35	Aug			
36	Sep			
37	Oct	fall	4th Q	
38	Nov			
39	Dec			
40	Jan	winter	1st Q	Year 5
41	Feb			
42	Mar			
43	Apr	spring	2nd Q	
44	May			
45	Jun			
46	Jul	summer	3rd Q	
47	Aug			
48	Sep			
49	Oct	fall	4th Q	
50	Nov			
51	Dec			
52	Jan	wint	1stQ	Yr6

Task	Work Days
CONTRACT 1	
New Groins	
Mob stone, equipment	60 days
New groins (2 of 4)	178 days
CONTRACT 2	
New Groins, Stone Rehabs and Groin Extension	
Mob stone, equip	160 days
Groin rehab - 2 at Point Lookout	61 days
New groin (2 of 4)	178 days
Terminal groin extension & rehab	181 days
Groin rehab - 15 at Long Beach	418 days
CONTRACT 3	
Sand, Accessways, Relocations	
Mob for sand	60 days
Sand Fill, Point Lookout (1,100,000 c.y.)	55 days
Lido Beach and Long Beach (5,500,000 c.y.)	275 days
Dune grass	120 days
Sand Fence	120 days
Walkovers, accessways & relocations	352 days
Relocate lifeguard station	50 days

AIR QUALITY

nesting birds 1 Mar-31 Aug no stone, sand placement in Pt. Lookout

AIR QUALITY SHUTDOWN 1 MAY - 30 SEP

Assumptions:
1. Bird nesting restrictions in Pt. Lookout 1 Mar-31 Aug on stone and sand placement
2. Total construction time not to exceed 4.33 years
3. Assumes sand barrier plan in Long Beach
4. Air emissions restrictions handled by total shut down 1 May-30 Sept.
5. Land-based construction asumed on all new, extended and rehabed groins
6. Dune grass to be planted in late winter
7. Sand pumping rate assumed 400,000 cy/month
8. Groin rehabs assumes 2 crews working simultaneously in Long Beach for the 3rd construction season, one crew at Pt. Lookout for the 2nd season & one crew for the 1st & 2nd constr. seasons at Long Beach, all at 22 days/month
9. Groin rehab/extension in Pt. Lookout assumes one crew @22 days/month in the 2nd season
10. New groin work assumes 2 crews simultaneously working on 2 groins, 22 working days/month
11. Includes walkovers, boardwalk work, vehicle accessways, relocated structures, timber retaining walls

Photo 1: Point Lookout, Town of Hempstead

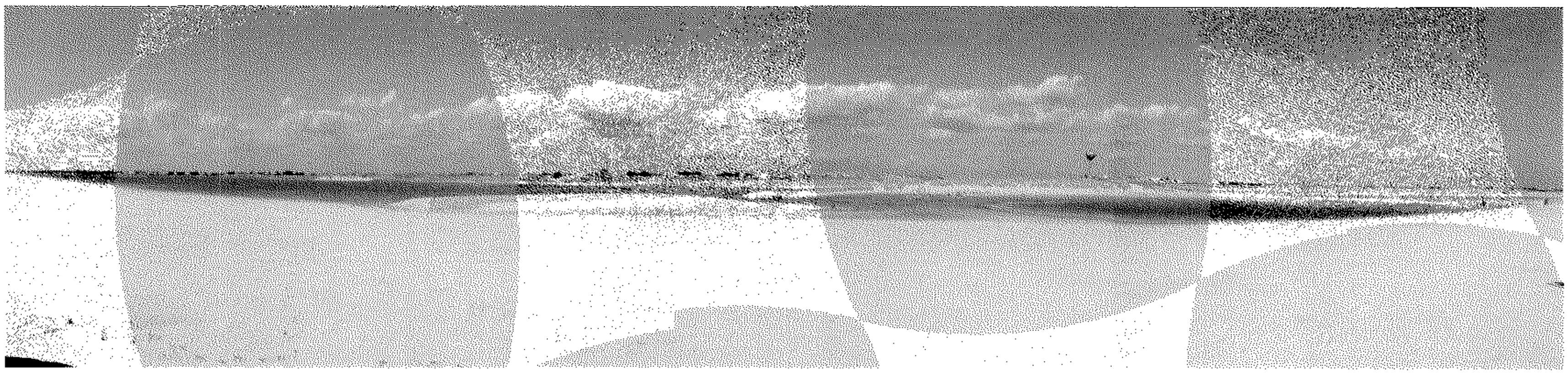


Photo 2: Bird Nesting and Foraging Area, Town of Hempstead

Photo 3: Lido Towers, Lido Beach, Town of Hempstead

Photo 4: Laurelton Boulevard, City of Long Beach