APPENDIX I

BREACH RESPONSE PROTOCOLS

Breach Response Protocols
Fire Island Inlet to Montauk Point Reformulation Study
October 2015

1. Introduction

The Fire Island Inlet to Montauk Point Storm Risk Management Project will encompass a variety of measures to reduce storm-induced damages to mainland and barrier island communities within the project area.

As part of the Project, it may be necessary to close breaches along the Barrier Islands within the project area, to prevent additional flooding within the bays during major storm events and to reduce impacts to areas adjacent to the breach. It is cost-effective to close breaches quickly rather than wait to close breaches after they enlarge.

It is acknowledged that barrier island breaching can be beneficial to coastal processes and ecological services within the ocean, barrier and bay system along the south shore of Long Island (see Attachment A, developed by New York State Department of State).

There will be three types of Breach Response measures along project shorelines: Pro-Active Breach Response, Reactive Breach Response, Conditional Breach Response in Large, Publicly-owned Tracts of Land along Fire Island, and Conditional Breach Response in the Wilderness Area. The designation of which shoreline areas will be covered by each type of response is shown in Figure 1.

A breach is defined as the condition where a channel across the island permits the exchange of ocean and bay waters under normal tidal conditions. Two degrees of morphological response to breaching were considered in this study: A ***partial breach*** is a storm-induced barrier island cut that has a scoured depth between MHW and Mean Low Water (MLW) while a ***full breach*** is a storm-induced barrier island cut that has a scoured depth at or below Mean Low Water (MLW). A partial breach will allow for water to exchange between the ocean and bay during a portion of the normal tidal cycle while a full breach will allow water exchange during the complete tidal cycle. The breach may be temporary or permanent (i.e., a new inlet) depending on the size of the breach, adjacent bay water depths, potential tidal prism, littoral drift, and water level and wave conditions following the storm.

2. Proactive and Reactive Breach Response

Proactive Breach Response plan is triggered when protection is compromised. This trigger would be an evaluation of the level of protection against breaching, and serve as a trigger when the beach and dune are lowered below a particular design level, comparable to a 25-year level of protection.

Reactive breach closure is triggered when a breach has occurred. A breach is defined as the condition where a channel across the island permits the exchange of ocean and bay waters under normal tidal conditions.

3. Conditional Breach Response

Implementation of conditional breach response requires action be taken to develop processes for conditional breach response within the large, publicly owned tracts along Fire Island, considered the undeveloped areas within the purview of the Fire Island National Seashore. Within the national seashore boundary, the NPS needs to determine the likelihood of natural closure. All areas of the barrier island between Moriches Inlet and Shinnecock Inlet will either be a Pro-Active or Reactive Breach Response and therefore not addressed by the conditional breach management procedures.

Within the large, publicly owned tracts of land along Fire Island there is a desire to determine the likelihood of natural breach closure before specific design or construction activities are undertaken to close breaches. This would entail monitoring and standardized decision protocols to determine whether or not a breach appears to be naturally closing on its own. The conditional breach protocol authorization will be a part of the overall FIMP work. Breach Response Protocols are to be re-examined and updated every five to ten years. The PPA should be updated if there are adjustments to the response protocols to ensure readiness. Other agreement documents, including Certified Real Estate and Water Quality Certificates should be ready to avoid delays of processing from Senior Leaders of Agencies, State and Local communities.

Details on actions during post-authorization design, annual/continuous monitoring, and before, during and after a breach, within these specific areas, are described below. Tasks that will be completed post-authorization, pre-construction should be clearly detailed in the General Reevaluation Report and EIS.

4. Conditional Breach Response Decision Team

The Decision Makers Are: Superintendent, Fire Island National Seashore; Commissioner, New York State Department of Environmental Conservation; County Executive, Suffolk County; Colonel, U.S. Army Corps of Engineers, New York District; Regional Administrator, U.S. Fish and Wildlife Service.

5. Science and Engineering Advisory Team

The Science and Engineering Advisory Team will include representatives from the National Park Service, U.S. Army Corps of Engineers, U.S. Geological Survey, the U.S. Fish and Wildlife Service, New York State Department of Environment Conservation and Department of State, and Suffolk County.

6. Locations Considered for Conditional Breach Response

The locations of the Large, Publically Owned Tracks of Land on Fire Island are listed below:

- East of Point of Woods to west of Cherry Grove
- East of Cherry Grove to Fire Island Pines (Carrington)
- East of FI Pines to west of Water Island (Talisman/Barrett Beach)
- East of Water Island to Davis Park

- East of Davis Park to Smith Point County Park (Wilderness Area – with requirements for EIS Development)
- Smith Point County Park to RV Campground.

7. Allowable Conditional Breach Closure Characteristics within the Large, Publically Owned Tracts

Breach closure will be accomplished, if the breach is not naturally closing (or is not predicted to close based on modeling results), within 45 to 60 days of the breach opening. Contracting procedures shall be started at the occurrence of the breach, but may need to be cancelled if the breach closes naturally. The cross-section of the breach closure would be at +9.5 ft NGVD height at a minimum, the breach cross-section would match the 0.0 ft NGVD shorelines on both the ocean and bay sides making smooth shorelines without indentations, and the cross-section slope would match adjacent bayside and ocean-side slopes. No cross-sectional sand maintenance of the breach closure template would be allowed after the breach closure.

If a breach closed naturally, no additional fill material would be allowed in that location to bring the section to the above cross-section characteristics. Only on the occurrence of a new breach, that did not close naturally in that location, would additional material be allowed to be placed to bring the cross-section to the +9.5 ft NGVD height and shoreline to shoreline width. There would be increasing likelihood of re-breaching and subsequent vulnerability in those locations that did not close naturally with the increased berm height.

Placement of additional sand material in the bay during the hydraulic construction closure of the breach could be included in the condition breach closure, to emulate flood shoal volumes of breaches allowed to remain open. Proposed volume and dimensions of any additional bay material placed during breach closure operations will need to be determined during the Pre-Construction Engineering and Design Phase.

8. Actions to be undertaken during the Engineering and Design Phase (post-authorization, pre-construction)

a) During Pre-Construction Engineering and Design, a Bayesian Model will be developed to aid in the determination of likelihood of natural closure of breaches in the large, publically owned tracts on Fire Island. Using a probabilistic, Bayesian approach, based on empirical physical, climatological and hydraulic data, time of year considerations, etc. a decision tool will be created for use by the Science and Engineering Advisory Team (see 5.c below) in their role in advising the decision makers regarding breach closure actions. Development and use of a Bayesian model will determine the likelihood of natural closure and confidence values for that likelihood. All available appropriate data will be used in the development of the Bayesian model, including data from USGS and its modeling efforts. Tabletop exercises will be conducted at the time of model development to run through multiple breaching and closing scenarios, to validate the modeling process for the Fire Island barrier island.

Data collection of conditions will be necessary to continually improve the validity of the Bayesian model as a tool for decision Advisory of closure actions. The majority of the data that would be used in the Bayesian model would be physical and meteorological data. Data collection requirements are described below.

The Bayesian model developed under this effort will be exercised prior to and/or in the event of a breach by the Science and Engineering Advisory Team, and the model outcomes will guide the closure activities.

b) Develop a detailed, specific siting plan for additional water level gages within Great South Bay, Moriches Bay and Shinnecock Bay. This plan will be developed by the Science and Engineering Advisory Team. The water level gage data will be used for the development and yearly updating of the Bayesian model, and for post-breach monitoring of bay water levels. Determine if additional nearshore ocean wave gages are needed, and if so develop a siting plan.

c) Formation of the Science and Engineering Advisory Team. The Science and Engineering Advisory Team will advise decision makers for conditional closure within the large publically owned tracts on Fire Island, based on the Bayesian Model and specific post-storm and time of year conditions.

9. Post-Authorization Actions including Data Collection to Advisory Decision Tools for Conditional Breach Response Protocols

Physical Ongoing/Pre-Storm Monitoring

- Ocean Water Levels
- Bay Water Levels –continuous recording measurements Great South Bay, Moriches Bay and Shinnecock Bay, as determined by 4.b above.
- Continue data collection at Buoy 44025 and additional nearshore wave gages as determined by 4.b. above.
- Back Bay Bathymetry – 1500 ft north of barrier island
- Yearly LiDAR of the entire barrier island system: develop pre-storm conditions along all barrier islands. More vulnerable areas may require more frequent, specifically for those locations, especially pre-storm
- May: Annual assessment of vulnerable locations, topography: island height, width, slopes (see 6. below)
- Tide range/Phase changes
- Barrier Island Cross sectional cores in areas determined to be of high probability of breaching.
- Development of a communication and information plan (primary and alternate given that availability of power and facilities within the storm impacted area may vary from storm to storm).
- Environmental Monitoring

10. Annual Actions to Catalogue Barrier Island Conditions

A brief “letter” report will be prepared in late May of each calendar year to describe the condition of the barrier islands of the Atlantic Coast of New York, from Fire Island Inlet to Southampton. The letter report will summarize, from information gathered up to 1 May of the calendar year, the highly vulnerable locations along the barrier island system with respect to barrier island breaching.

The annual survey will characterize the coastal barriers with physical parameters such as cross section width, height and volume. Locations that fall below a threshold percentile for each reach (for example: 50% on any two parameters: dune height, berm width, barrier width, cross sectional area/volume) should be identified. The threshold for reporting vulnerable locations will be determined and may not be uniform among different reaches. Reports should be clear that potential breaches are not limited to the identified locations and will identify the breach response type of the vulnerable areas.

The letter report will describe the breach closure protocols and reference all the required permits and coordination. The letter report will include multiple appendices (described below) to provide information needed to enact the breach closure protocols, if necessary, from 1 June of the present calendar year, to 1 June of the next calendar year. The letter report and appendices will be sent to all identified as part of Breach Protocol Team (as comprised of members from the Federal, State and Local Agencies who are partners in FIMP) in preparation for the summer hurricane season, and the fall-winter northeaster season.

2. The letter report will be prepared by the Corps, with Corps information and additional information provided by state and local agencies, and other Federal agencies. It will be shared with the entities listed for review prior to finalization.

3. Appendices:
A. Listing of Breaching Protocol Team
B. Listing of current breaching closure protocols
C. Federal Permits/State Permits
D. Updated Construction Documents – Plans and Specifications for Breach Closure
E. Fish and Wildlife Report – ESA mapping most recent available by May of the calendar year.
F. History of Beachfill/Risk Reduction Actions by Federal, State and Locals – from previous year 1 May to current Year 1 May.
G. Availability of Environmental Condition Data (ocean and bay water levels, waves, wind, etc.) as of 1 May of present year; listing of online sources.
H. Physical Monitoring Data collected 1 May past year to 1 May current year.
I. Aerial Photos – as recent as possible – spring of current year
J. September Condition Assessment of Federal Projects from prior calendar year from Corps Operations Division, including most recent condition surveys of navigation channels.
K. Written Topographic Assessment – May of present year
L. Confirmation of Permits/Contract Available for various breach closure alternatives – listing of available sources of breach closure material
M. Post-Storm Data Collection Resources: Confirmation of availability of equipment, resources
N. Annual Letter from the Corps to New York State – confirming protocols, Real Estate coordination
O. Informal Consultation with FWS: Provide Breach Response Protocols Updates to create an administrative record documenting that NAN coordinated with the FWS and that they concurred

that the Breach Response Protocols Update (has no change to the prior Section 7 decision) is not likely to adversely affect the species or habitat.

P. Explanatory information on breaches and natural processes, similar to the content inserted here as “Attachment A” to reinforce local officials’ and residents’ understanding of coastal processes as a basis for decisions, and to provide a realistic framework for breaches and adaptive management.

11. Immediately Pre-Storm Actions

Upon the incipient occurrence of a breach, monitoring of critical areas with possibilities of breaching identified either in the annual assessment or additional pre-storm information will begin during the pre-storm preparations. Both the Decision Team and the Science and Engineering Advisory Team will be activated at the incipient occurrence of a storm that may have breaching potential (predicted water levels and wave heights higher than a 25 year return period event). A protocol for data collection, methods of vulnerability assessments, and a clear plan for how these data and analyses will be disseminated to the group will be developed during Pre-Construction Engineering and Design. Data will be stored in a portal-type digital interface.

- Assistance from NPS rangers regarding barrier island physical conditions, identification of potentially breach-vulnerable locations.
- Photography of potential vulnerable locations
- Examine wave and water level conditions, and wave and water level predictions
- Exercise Bayesian Model, if pre-storm barrier island vulnerability and predicted storm climate indicates post-breach conditions favorable to natural breach closure, with the Science and Engineering Advisory Team
- Based on vulnerability assessment and wave conditions, pre-storm beach measurements will be taken at specific locations. If conditions appear stable, no measurements taken. If conditions are vulnerable, take island cross-section measurements to obtain conditions prior to the possible breaching (one day of RTKS in the field).
- Environmental Monitoring as required

12. Post-Storm Actions, with significant changes to topography alongshore for a Full Breach or Partial Breach:

- The Science and Engineering Advisory Team will come together to exercise the probabilistic Bayesian of breach closure, to predict natural breach closure or growth within fourteen days of breach occurrence. The Science and Engineering Advisory Team will report the results of the probabilistic model (with confidence limits) within twenty-one days of the breach occurrence. The Bayesian model may have to exercise multiple times if the naturally remains open through a storm season (August through April). If a full breach does not form, no breach closure activities will be enacted.
- **Weekly:** Topography/Bathymetry through the throat of the breach area
- Aerial Photography: including flood tide delta
- Ground Level Photography
- Continuous Mainland Water Levels while breach is open, with assessment of tide gauge data and water level recurrence intervals in the time period the breach remains open.

- Mainland Flood Marks immediately post-breach and in the event of a subsequent storm while breach is open
- ADCP: **weekly** current flow in the channels (new breach, Moriches and Fire Island Inlets)
- Bathymetry at Fire Island and Moriches Inlets
- Ocean Waves just outside the breaches area
- Shallow cores within the breach area
- **Weekly:** Water Quality: Temp/Salinity/Clarity after breaching

13. Mechanical Closure Activities:

Mechanical Closure procedures and contracting to be initiated with within 45 days of breach opening within the large publically owned tracts on Fire Island, if there is not clear indication of imminent natural breach closure, such as decreasing cross-section width or breach depth from day 30 onward, and the Bayesian model predicts that breach will remain open. Closure procedures will have to be by hydraulic placement due to the locations of the large, publically owned tracts and the time period for closing. Flexibility should be integrated into the Breach Response Project Agreements as part of the FIMP PPA, so breach closure work can be done by State, County or Municipal entities if dredging equipment is already mobilized by those entities for other dredging projects. No maintenance fill for breach closure will be allowed in the large, publically owned tracts; stabilization actions taken only when subsequent breaching occurs.

14. Actions Upon Natural or Constructed Breach Closure:

- Continuation of Pre-Storm/Ongoing monitoring items in 5. above
- Documentation of Breach Closure Activities

15. Funding Requirements

All costs incurred for the conditional breach response protocols including development of the Bayesian Model, water level gauging, pre-storm monitoring, post-storm monitoring, meeting of the science response teams and their activities to develop a recommendation on breach closure, the updating of protocols over the life of the project will be cost-shared as part of the authorized project measures.

Attachment A

Information on Coastal Barrier Breaches

Managing breaches of New York's coastal barriers has become increasingly important with the progress of development. Breaches occur periodically through a combination of sea level rise, erosion and storms. Before the 20th century most breaches closed naturally over time unless they were maintained by jetties and dredging. One study documented at least 31 breaches between 1500 and 1980 in the region from Fire Island Inlet to Shinnecock Inlet. Since 1900 most breaches have been closed by human actions. At Moriches (1931) and Shinnecock (1938) breaches were maintained as navigation inlets. From a geologic perspective breaches are episodic events that help form the coastal barriers by depositing sediment in shoals that widen the barrier and form a platform where aquatic plants help accumulate sand. Washovers, or sand driven up onto the barriers during storms, also help build sand volume. Management efforts that prevent breaches and washovers may destabilize the barriers by preventing retreat in response to sea level rise. The shore face will continue to erode and steepen, while the bayshore will shrink with encroaching sea level and lack of sediment input. This combination of factors could lead to thinning the barriers, loss of volume and possible catastrophic breaches in a major storm. It's important to understand coastal barrier processes and the role of breaches to formulate effective management plans. The need to reduce impacts while respecting essential natural processes underscores the importance of resilient land use planning.

The origin of the coastal barriers is uncertain but evidence indicates they have existed since the end of the last ice age. Processes that created the barriers include the deposition of outwash sediments from glaciers, erosion and transport of sand along the shore, and sediment reworking by storms and waves. Geologic records show that the barriers evolved as a result of shore face retreat in response to sea level rise. "The geophysical data from the inner shelf and shoreface suggest that Fire Island has migrated continuously, albeit intermittently, during the past 7,000 years from its previous position 2 km (1.2 mi.) offshore."ii There has been debate about the relative stability of parts of the coastal barrier. During the past 300 years eastern sections have been breaching more frequently and migrating landward faster than central Fire Island, where portions of the land form show ages of 750-1300 years before the present time.iii This is attributed to greater exposure to weather events toward the east end and increased sediment supply in the west.iv Western Fire Island has seen ocean side and bayside erosion, coupled with spit growth as sediment accumulates at Democrat Point. Current research indicates offshore sand formations may help stabilize central Fire Island by contributing substantial quantities of sand to the beach.v But the capacity of this source to continue the stability of central Fire Island may be drawing to a close, as the width of the island is thinning over time. "…the system will continue to migrate landward in response to a rising sea level…"vi

The current protocol for managing barrier breaches between Fire Island Inlet and Shinnecock Inlet is established in a Breach Contingency Plan (BCP) of the U.S. Army Corps of Engineers.vii Through the BCP a technical team will review breaches and initiate a process to fill them in if they are likely to remain open. The Army Corps and participating agencies recognize that the BCP and other management plans can reduce but not eliminate breaches, so some breaches are inevitable. More frequent breaches in the eastern region and accelerated shoreline retreat suggest this area is more likely to experience new breaches in the future. In addition, flooding from storm water flowing into the bays through the existing inlets, which causes more damage in the region over the course of time, is not addressed by breach management. Efforts are underway to prepare a regional plan to reduce storm impacts. The success of these measures will depend to a large extent on the level of participation of all partners, private, local, state and federal, in utilizing their capacities to reduce impacts. Given the fact that some breaches are inevitable, and that healthy coastal barriers depend on restoring sediment processes that allow the barriers to migrate in response to sea level rise, efforts must be made to adapt if we are to reduce impacts to development. Breach management must be coupled with development management to carry out this adaptation. Communities surrounding the bays, on the barriers and the mainland, should use their land use authority to avoid flood and erosion damages. Where these damages occur elevation, relocation or voluntary acquisition should be considered as options to avoid repeat damages. Adaptive measures should be coordinated with management efforts at all levels. Cooperative planning among neighboring communities is one option for creating programs to address these needs.

If appropriate measures are taken, losses can be reduced to a manageable level. This would allow natural sediment processes to resume, including breaches, washovers and barrier migration, which are essential to maintain the barriers. Without these sediment processes the barriers will become increasingly unstable. "Processes such as wave run-up, overwash and barrier beaching, which occur during elevated storm surge are all necessary processes in enabling the efficient transfer of sediments, nutrients and marine water from the Atlantic Ocean across the barriers and into Great South Bay. A large body of scientific data and information published over the past 50 years shows that such transfers of sediment and water from the ocean to the bays are essential for the long-term maintenance of the barrier island and back-bay systems and their biologically diverse habitats and ecosystems." viii Preventing these natural processes could be harmful: "…interruption or prevention of these processes over a long period of time (lifetime of the Corps project [Fire Island Reformulation] is assumed to be 50 years) could have demonstrable, adverse effects."ix New York's coastal barriers will have to evolve over time if they are to be sustained. The present need is to adapt both development patterns and breach management to arrive at a point where communities can coexist successfully with their environment.

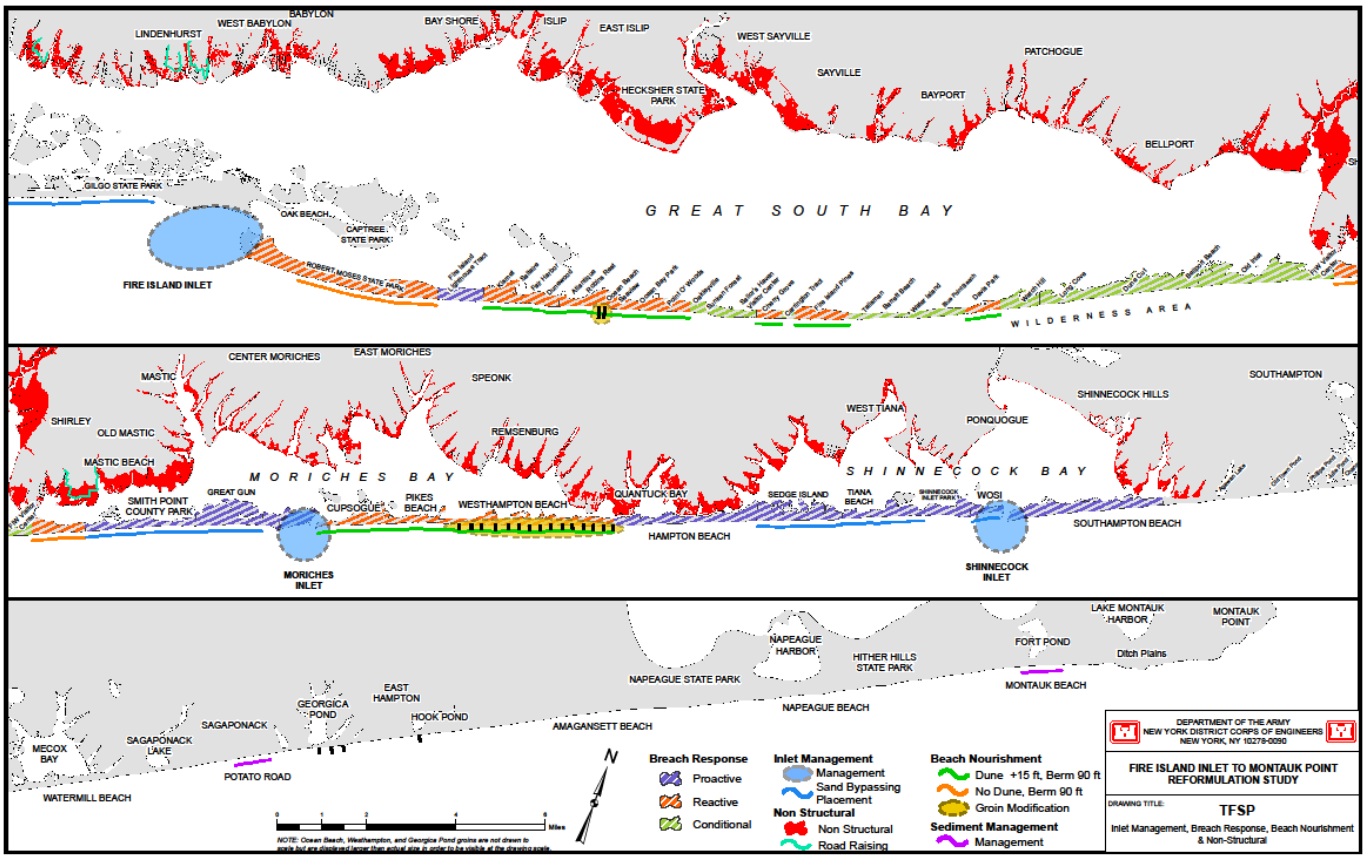
i Leatherman, Stephen P. and Joneja, Danielle, Final Report, Geomorphic Analysis of South Shore Barriers Long Island, New York: Phase I, National Park Service Cooperative Research Unit Report 47, 1980
ii Leatherman, Stephen P. and Allen, James R. editors, Geomorphologic Analysis of South Shore of Long Island Barriers, report to the U.S. Army Corps of Engineers, New York District, 1985. (page 269)
iii Leatherman and Allen, (pages 174-5)
iv Leatherman and Allen, (page 57)
v Hapke, Cheryl J., et al, A Review of Sediment Budget Imbalances along Fire Island, New York: Can Nearshore Geologic Framework and Patterns of Shoreline Change Explain the Deficit?, Journal of Coastal Research, May 2010, V. 26, no. 3, p. 510-522
vi Leatherman and Allen, page 62

vii US Dept. of the Army, Barrier Islands and Atlantic Coastline Fire Island Inlet to Montauk Point, Babylon to Southampton, NY, NYS-DEC Permit Number 1-4799-00015/00005, NYS Coastal Consistency Number F-2010-0878

viii Williams, S.J. and M.K. Foley, Recommendations for a Barrier Island Breach Management Plan for Fire Island National Seashore, including the Otis Pike High Dune Wilderness Area, Long Island, New York. Technical Report NPS/NER/NRTR—2007/075 National Park Service. Boston, MA, February 2007.

ix Leatherman and Allen, page 270

Figure 1. FIMP Project Components



FIMP Shorefront Components (Great South Bay and Moriches Bay) include:

- Conditional Breach Response in undeveloped areas of Fire Island National Seashore:
  - Breach Closure at elevation +9.5 ft NGVD
  - East of Point O'Woods to west of Cherry Grove
  - East of Cherry Grove to Fire Island Pines (Carrington)
  - East of FI Pines to west of Water Island (Talisman/Barrett Beach)
  - East of Water Island to Davis Park
  - East of Davis Park to Smith Point County Park (Wilderness Area)
- Fire Island Inlet sand-bypassing (every two years, ~380,000 CY)

- Beach and dune fill along developed communities
  - +15 ft NGVD dune, berm with a width of 90 ft.
- Removal of Ocean Beach Groins
- Breach Response in Smith Point County Park
  - Reactive Response in Developed areas (west limit to RV Campground)
  - Proactive Response in undeveloped areas (east of RV Campground to Moriches Inlet)
- Beachfill in Developed Portions of Smith Point County Park
- Moriches Bypassing (every two years, ~75,000 CY)
- Reactive Breach Response in Cupsogue Beach County Park
- Beachfill (continued renourishment) in Completed Westhampton Project
  - +15 NGVD Dune, berm width of 90 ft
- Modification of Westhampton Groin Field (tapering groins 70-100 ft)