Fire Island Inlet to Montauk Point Reformulation Study

Project Purpose:

To reduce storm damage while maintaining or enhancing natural resources.

Cooperating Agencies

US Army Corps of Engineers®
New York District

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

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Fire Island Inlet to Montauk Point

Reformulation Study

Vision Statement

- No plan can reduce all risks.
- Collection and analysis of scientific data will improve understanding of the FIMP system.
- Site-specific measures will reduce mainland and barrier island flooding.

- Measures that reduce risks and protect human life and property will be given priority.
- Measures that protect and enhance natural processes will be given preference.
- Measures that minimize adverse environmental impacts and demands for public resources will be used.

- Dune and beach replenishment will be optimized to balance storm damage reduction and environmental considerations.
- Existing coastal modifications will be assessed and possibly altered or removed to restore important physical and biological processes.

www.nan.usace.army.mil/fimp/index.htm

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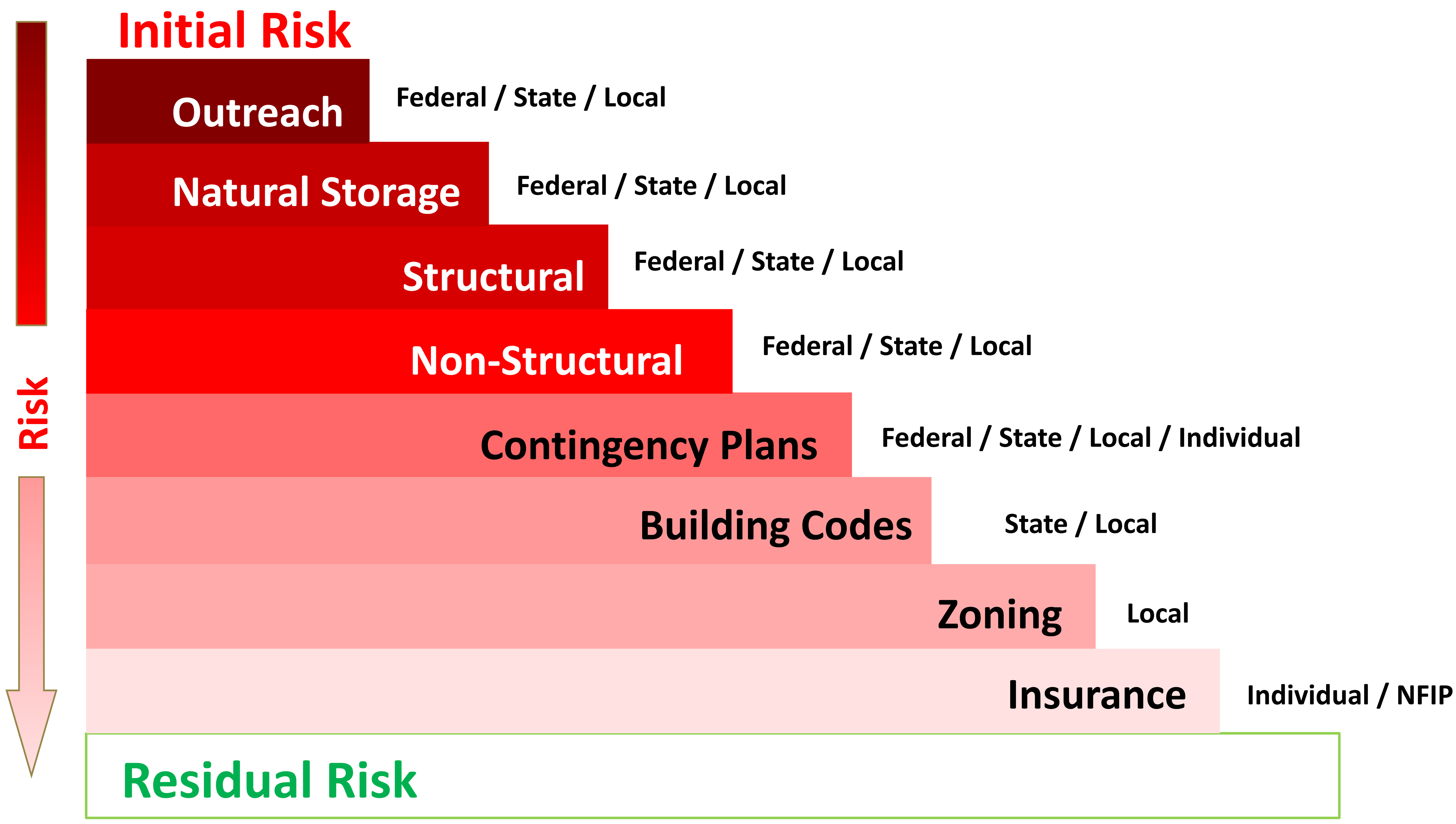
— Risk Reduction —



Effective storm damage risk reduction is achieved when property owners and all levels of government take preventive actions to reduce storm damages and consequences.

►Land management policies implemented through zoning and regulations such as Coastal Erosion Hazard Area Act discourage development in flood-prone or storm damage hazard areas.

►<u>Nonstructural storm damage measures</u>: Home relocation, home raising or buyouts reduce flood damages.

►<u>Structural storm damage measures</u>: Beach fill or breach contingency plans minimize flooding impacts.

►There will always be significant residual risk in a coastal area.

— No plan can reduce all risk —

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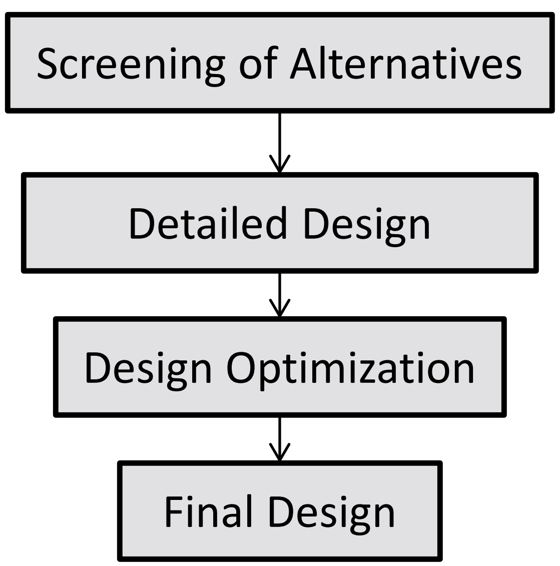
Planning Process

A comprehensive evaluation of alternatives to identify a recommended, long-term solution for reducing storm damages.

Recommended plan must be mutually acceptable to the Corps and the Department of the Interior.

This evaluation included a 3-phase planning process:

Phase 1	**Initial Screening**:	Considers the effectiveness of alternative measures
Phase 2	**Design & Evaluation**:	Evaluates the cost and economics of alternatives
Phase 3	**Plan Optimization**:	Evaluated the combinations of alternatives as plans



Measures supported for inclusion in plans:

- Inlet management
- Breach response
- Back-bay non-structural retrofits
- Beach fill
- Groin modification
- Sediment management features
- Land and development management
- Coastal process features

Dune Erosion **Shoreline Erosion**

Coastal Processes

- Shorelines erode and move seasonally and with storms.
- Storm surge through inlets is the primary cause of flooding hazard to the mainland and back bay areas.
- Overwash and breaches occur.
- Coastal barriers migrate landward.
- Sea level rise increases flooding and erosion.
- Natural protective features help reduce flood risk.

WHY IS OVERWASH IMPORTANT?

►Creation and maintenance of early successional habitat (sparsely vegetated, wide sandy beach).

► Creation and maintenance of points of access to preferred foraging habitats, such as bayside flats.

► Formation of prime foraging habitat; unvegetated intertidal flats, ephemeral pools.

► Increases the interior elevation of the islands.

PROBLEM IDENTIFICATION

►Intensive development in the floodplain puts buildings, infrastructure, and people at risk.

►Naturally protective features (beaches and dunes) have been altered or impaired – inlets, channels, groins, bulkheads, and hardened shorelines.

►Mainland and bayside barrier island shoreline damages — storm surge through inlets, breaching, over wash and bay set-up.

►Ocean shorefront damages - caused by both flooding and wave erosion, breaching and over wash.

►Sea level rise impacts – potential for future increased damages to ocean and bay areas.

What may happen when a breach occurs?

Environmental Effects

- Habitat creation and exchange
- Spit and shoal creation in back bay
- Altered water quality
- Natural process

Storm Damage Effects

- Damage to property and infrastructure
- Potential breach growth
- Increased tidal range
- Channel shoaling due to changed hydraulics
- Down-drift erosion in vicinity of breach
- Increased risk of mainland flooding

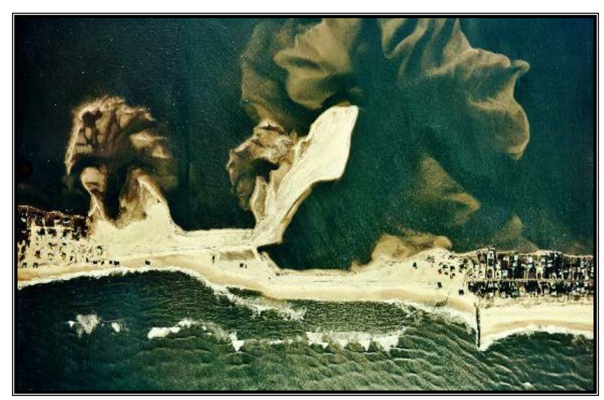
Westhampton Breach Evolution

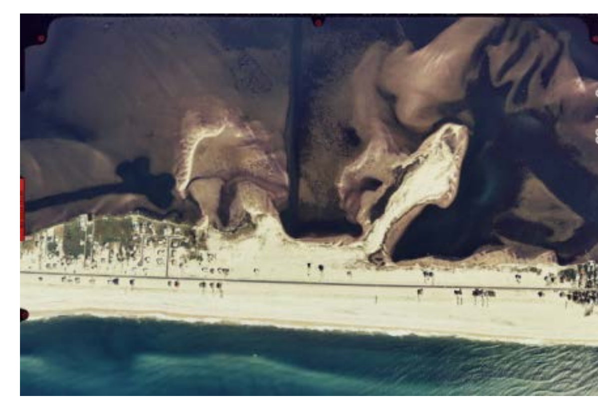

September 1992


December 1992


January 1993


March 1993


December 1993


August 1998

Hurricane Sandy Consequences

On October 29, 2012, Hurricane Sandy made landfall approximately five (5) miles south of Atlantic City, NJ.

- Coastal erosion, wave damages and flooding within the FIMP study area were severe and substantial.
- There were three breaches of the barrier island (below), multiple overwashes, and extensive back-bay flooding.
- The subaerial beach on Fire Island lost 55 percent of its pre-storm volume: nearly 4.5 million cubic yards of sand.
- A majority of the dunes were flattened or experienced severe erosion and scarping.
- There has been substantial natural recovery of the beach since Sandy

Stabilization Efforts

As a result of Hurricane Sandy, the Corps, in partnership with New York State, under authority of Public Law 113-2 has undertaken stabilization efforts on Fire Island and in Downtown Montauk to address the short-term risk in these vulnerable areas.

Fire Island to Moriches Inlet Stabilization Project

Construction is underway for the FIMI project, which is a one-time beach fill project that addresses the immediate need for Coastal Storm Risk Management pending completion of the Reformulation study.

The plan includes 7 Million CY of sand placement, of which 3 Million CY have been placed. Contract 1 & 2 have been completed. Contract 3A begins work in Fall 2016, and the next set of contracts are scheduled for Winter 2016 and Fall 2017.

Downtown Montauk Stabilization Project

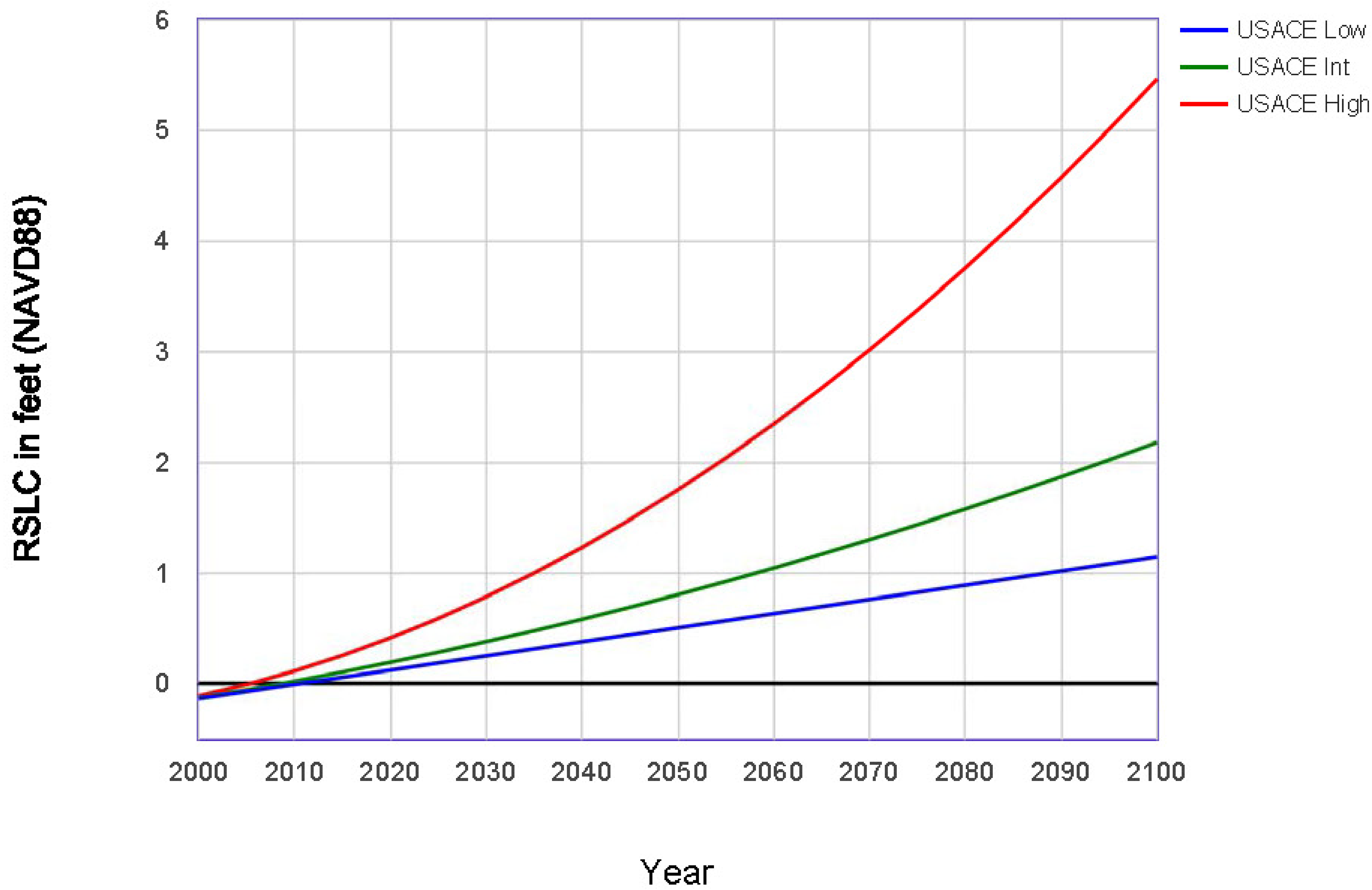
Construction was completed for the Downtown Montauk Project, which includes a geotextile bag revetment to address this vulnerable location, pending completion of the Reformulation study.

Environmental Effects of Overwashing and Breaching

- Creates early successional habitat important to state and federally-listed species
- Creates regionally important horseshoe crab spawning areas
- Provides increased recreational & commercial shellfishing & fishing opportunities
- Creates areas for new salt marsh development and submerged aquatic vegetation
- Creates sand flats which provide important habitat for migratory shorebirds and finfish

— Sea Level Rise —

Chart indicating varied sea level rise projections



Coastal storm risk management planning must consider sea level rise in developing alternatives:

► Study considers potential impacts of sea level rise

► Historic sea level rise has been 1.28 ft. in past 100 years

Corps guidance requires examining plan performance at three predicted rates of sea level rise:

- Continued historic rate……………… 0.7 ft. in 50 years
- Increased, 'intermediate' rate……..1.1 ft. in 50 years
- A higher and increased rate…………2.4 ft. in 50 years

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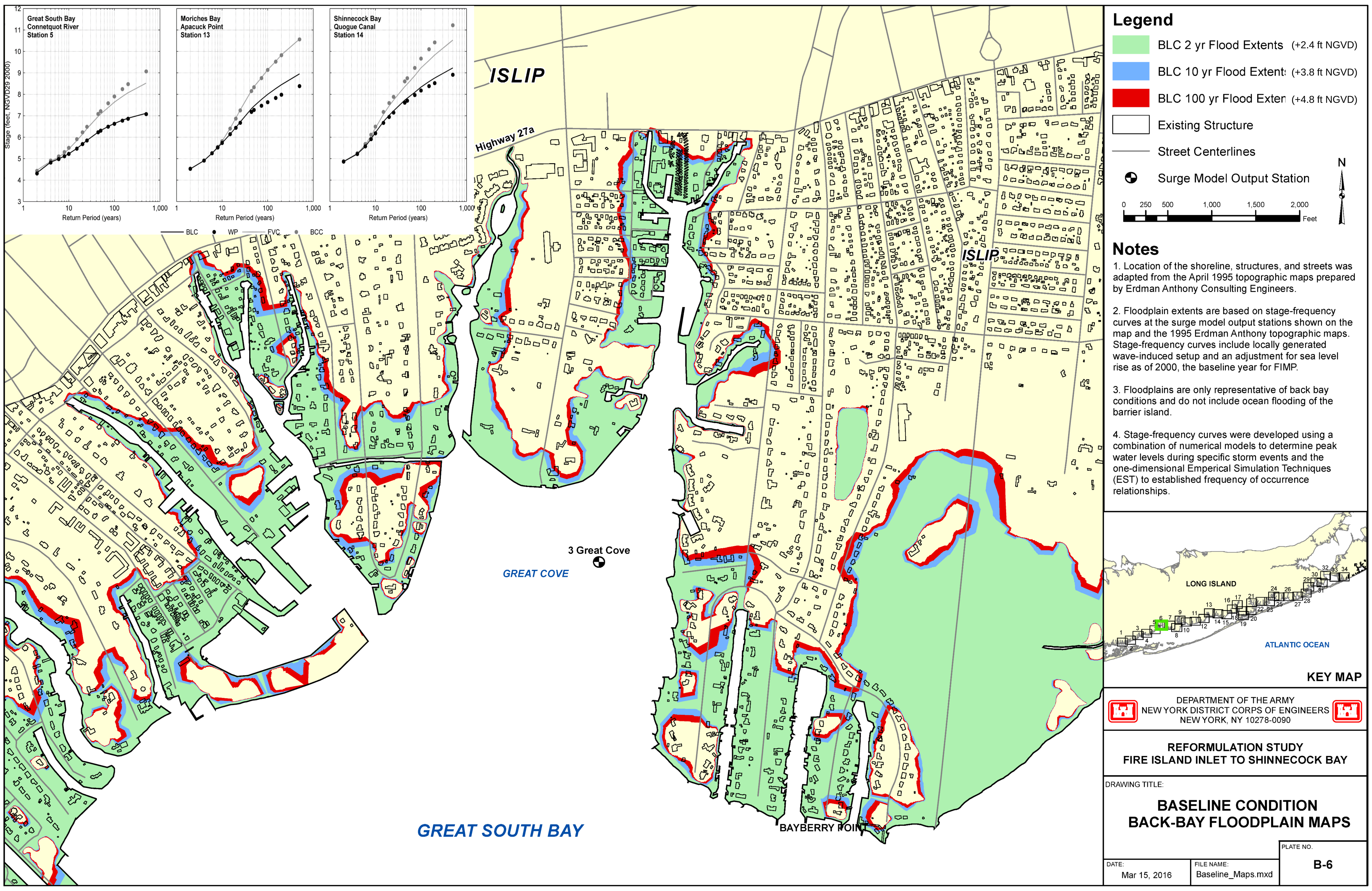
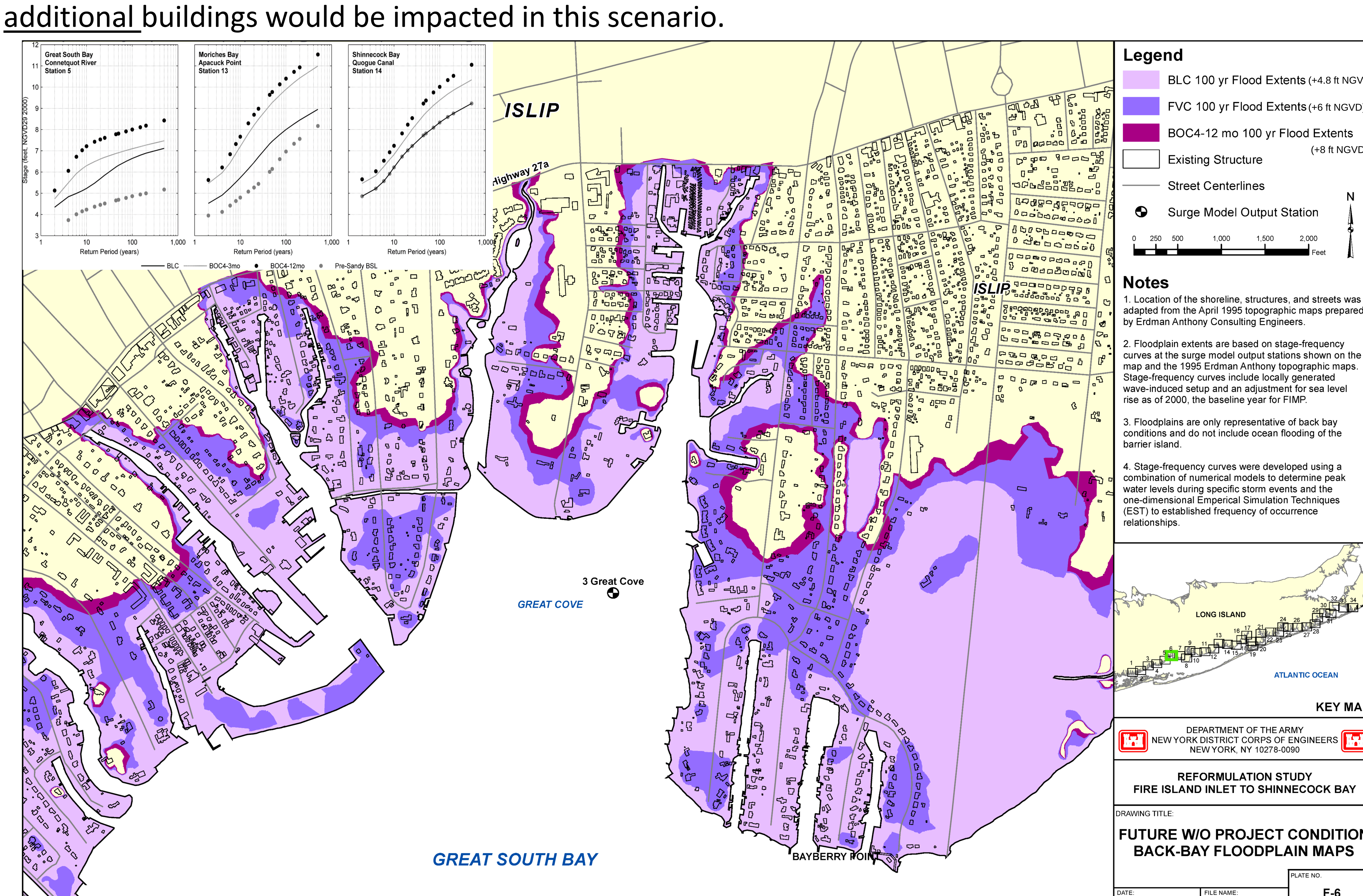
Back Bay flooding scenario under existing conditions

Potential impacts to communities in the 2, 10, and 100 year floodplain with barrier islands in their current configuration, and current Sea Level Rise conditions. This shows flooding due to water that enters through the inlets, and setup in the bays. Approximately 11,700 buildings are impacted in the 100-yr floodplain scenario.



Back Bay flooding scenario in the event of a barrier island breach

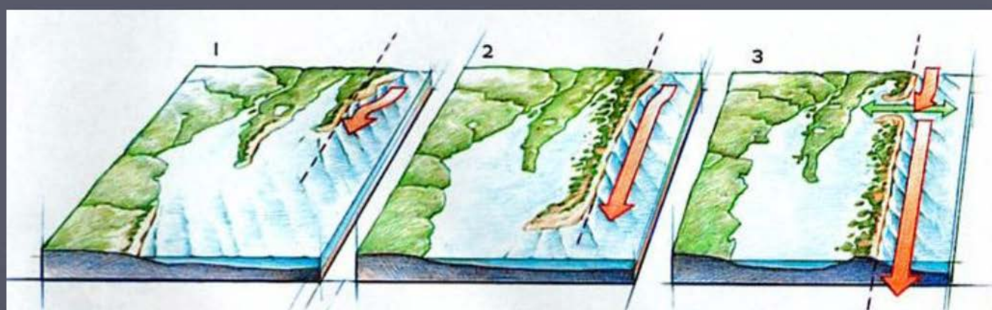
Potential impacts to communities in the 100 year ocean stormwater floodplain in the event of a breach. Approximately 10,600 additional buildings would be impacted in this scenario.



Note: The figure above shows flooding into the bay due to a breach in proximity to this location.
The amount of flooding that would occur depends upon the location and size of the breach.

Long-Term Barrier Island Processes

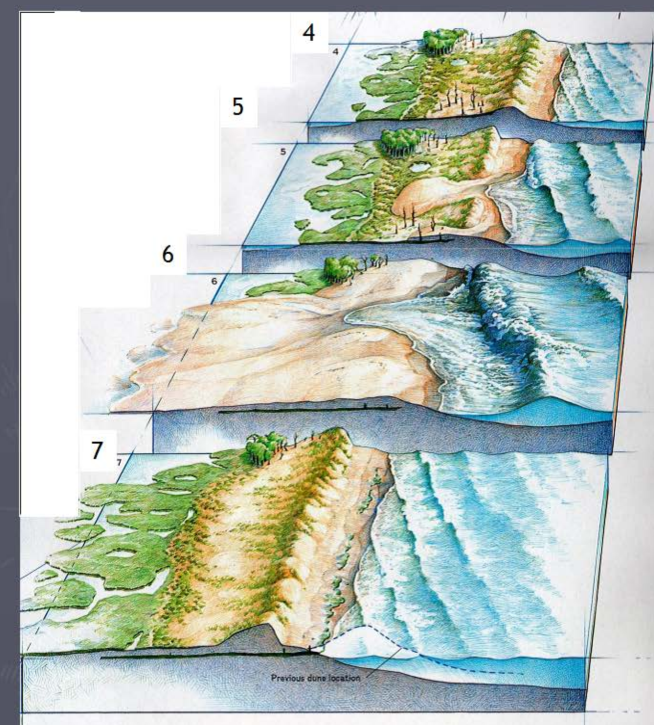
How our barriers and their beaches form:



National Geographic, 1997

1. Mainland spit expands
2. Spit is elongated by longshore transport of sand westward
3. Elongated spit is breached by storm waves, forming an island

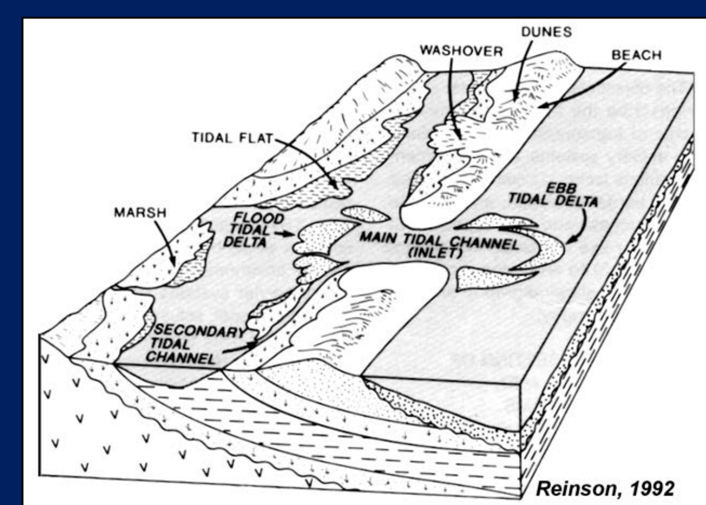
Barriers are Dynamic Systems



National Geographic, 1997

4. Sediment transported onshore builds up island beaches and dunes
5. Island overwashed by storm waves
6. Sediment transported through overwash buries vegetation
7. Island migrates landward

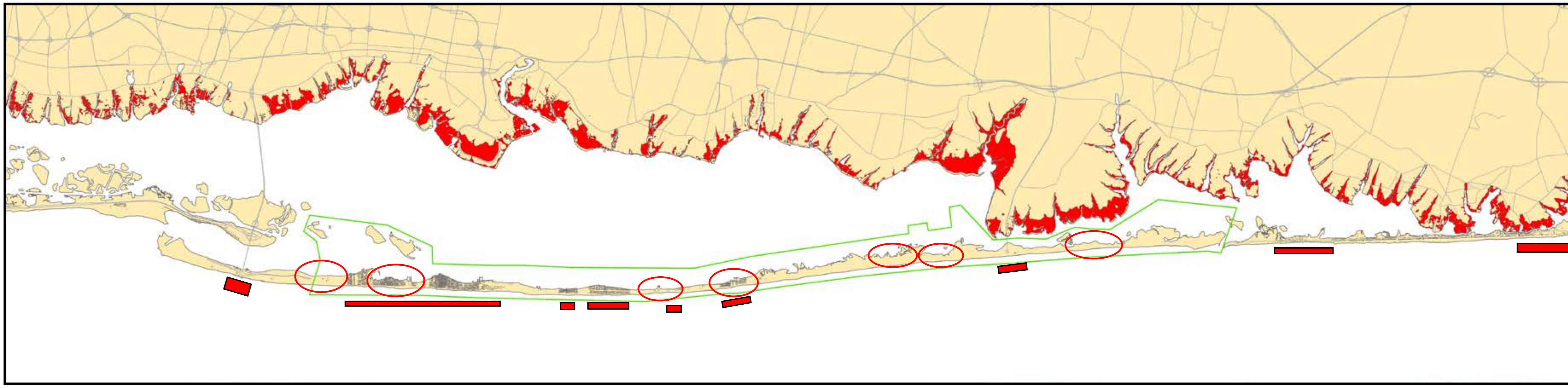
- Barrier islands migrate landward in response to sea level rise
- On the Long Island barrier-island system, inlet formation and overwash are important in terms of moving sand landward, forming salt marsh, and driving barrier island migration.
- Interruption of these processes will destabilize the barrier over time.

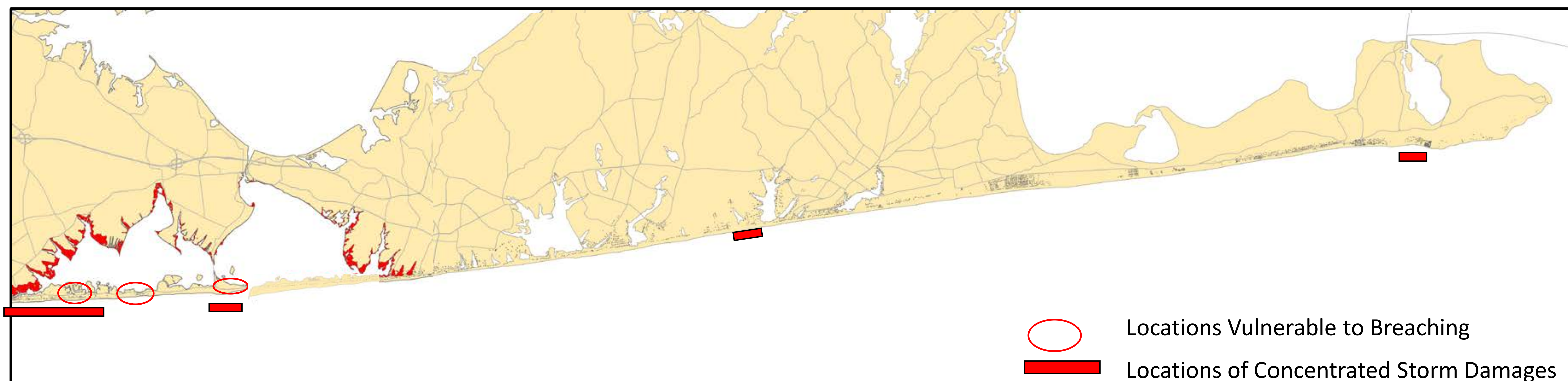


Reinson, 1992

Areas of Concentrated Risk for Storm Damages

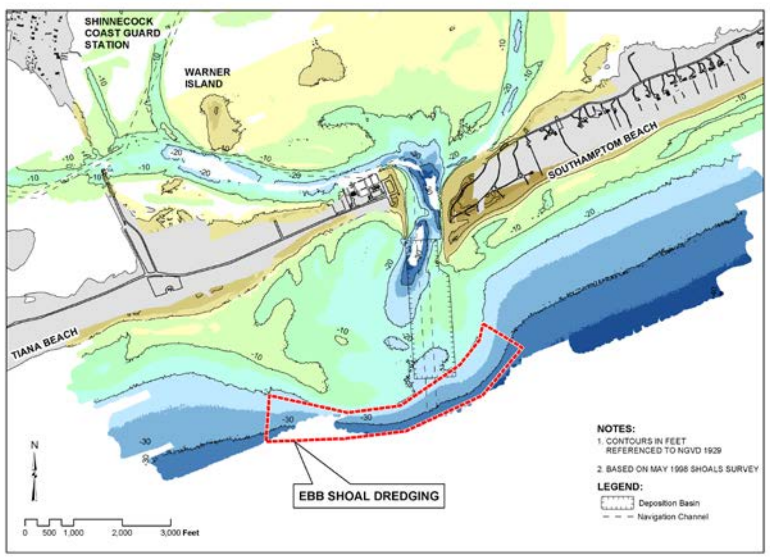
The images below indicate: **1)** Locations vulnerable to breaching
2) Locations vulnerable to bayside flooding
3) Areas of concentrated damages along the shorefront



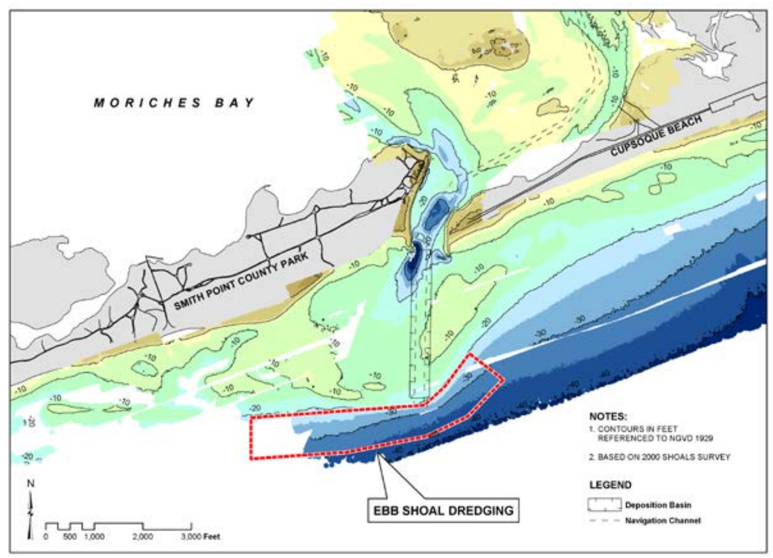


Managing Inlets

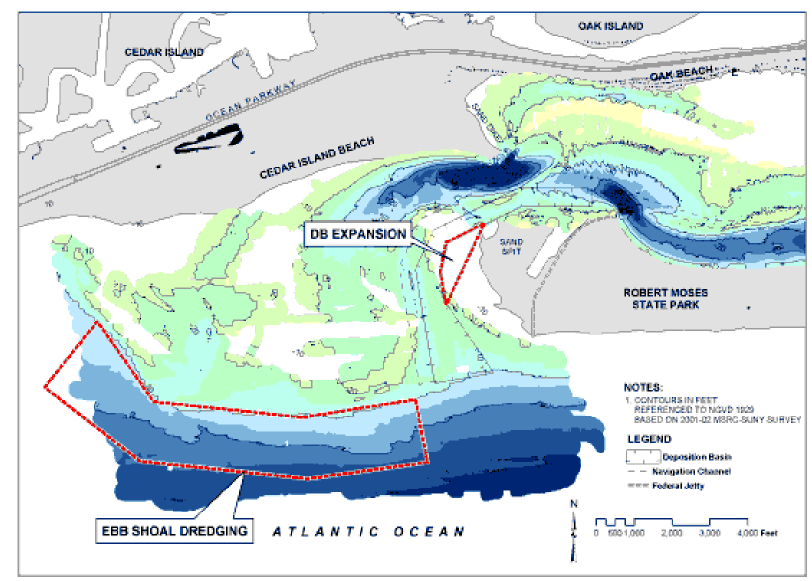
- Inlets provide for safe navigation.
- Inlets allow storm surge to enter the bay.
- Inlets interrupt natural, alongshore sediment movement when jetties extend into the path of the sand.
- Inlet management measures proposed include sand bypassing: to dredge sand from ebb shoal (accumulation of sand at seaward mouth of tidal inlet) and authorized navigation channels to place on down-drift shorelines to mimic or compensate for interrupted littoral drift.
- These practices are subject to change over time if monitoring suggests different approaches are warranted.



Shinnecock Inlet



Moriches Inlet



Fire Island Inlet

Non-Structural Features on Mainland Back Bay Areas

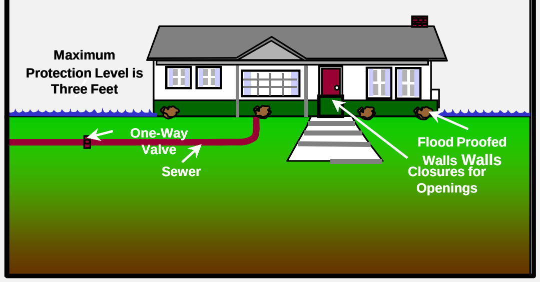
Non-structural solutions move what is being damaged, rather than altering the movement of water.

Building retrofits modify an existing building to make it less vulnerable to flooding.

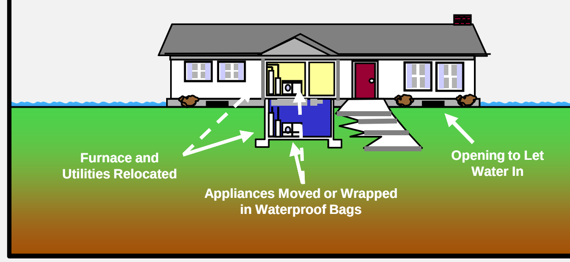
- Retrofit program would be offered to buildings in the 10-year floodplain.
- Approximately 4,400 structures within the existing 10-year floodplain.
- Retrofits provide a 100-year level of protection with 2 feet of freeboard
- Elevation and limited relocation or buyout based upon structure type and condition.
- Voluntary retrofit program.
- Structural Road-raising is included to protect homes in four areas.
- Retrofit specifics will be detailed in the next phase, Project Engineering and Design (PED), based upon specific building surveys.

Non-Structural Alternatives: Building Retrofits

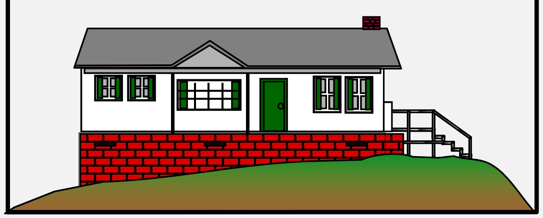
Dry Flood Proofing



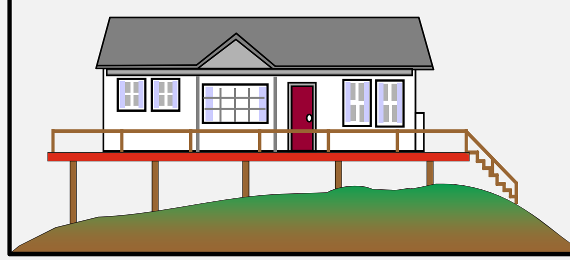
Wet Flood Proofing



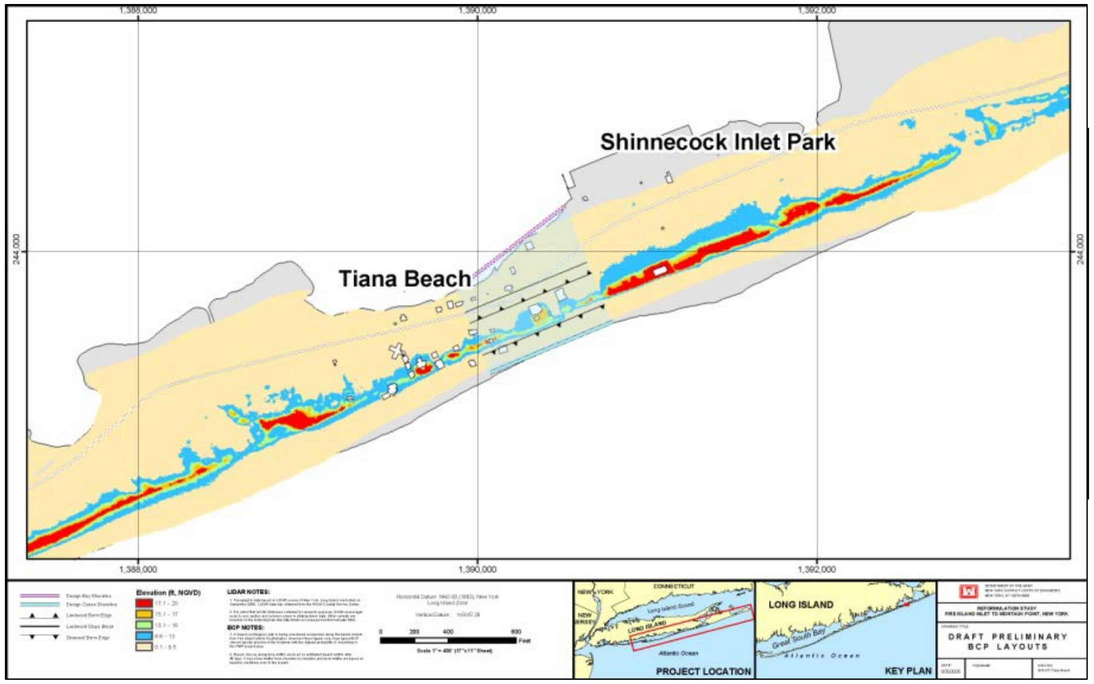
Elevating on Extended Foundation Walls



Elevating on Piers, Posts or Piles



Breach Response Measures



Breach response: placement of sediment to close or prevent a breach.

Proactive breach closure

- Acting before a breach occurs, when the barrier island falls below a pre-determined island cross section (height and width).

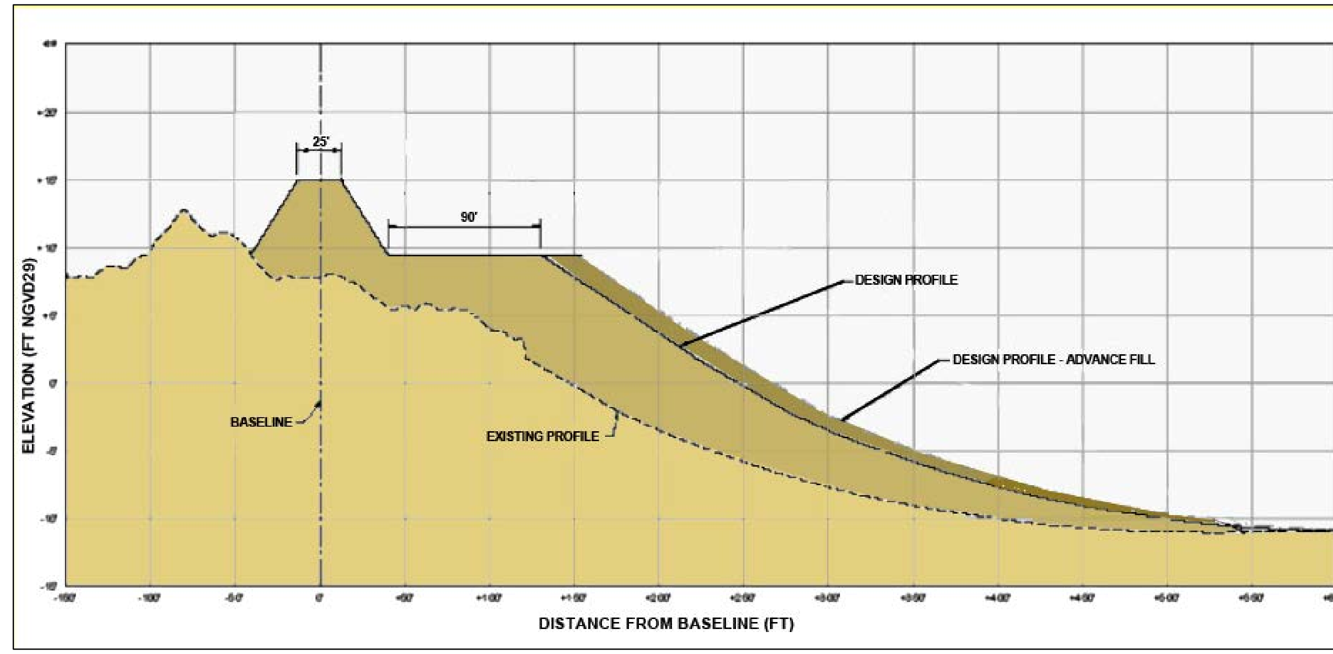
Reactive breach closure

- Acting immediately after a breach.

Conditional breach closure

- Acting after monitoring of breach suggests natural closure will not occur.

Beach Fill Measures



Beach fill Measures Template with 15' Dune

Beach fill placed along the barrier islands to increase the height and width of the beach profile dune and berm will reduce wave impacts and storm erosion, and reduce the likelihood of breaches.

- 15' dunes for developed areas.
- 13' dunes for undeveloped areas.
- Renourishment: This would call for 30 years of periodic renourishment, with renourishments approximately every 4 years.

Local Land and Development Management Measures

►Local land management regulations includes enforcement of federal and state zoning requirements as a necessary complementary feature for long-term risk reduction.

►These measures are a necessary component of any plan.

►Structural solutions alone cannot address all storm risks.

►Over the long-term, land management can reduce the need for continued intervention.

Need something here

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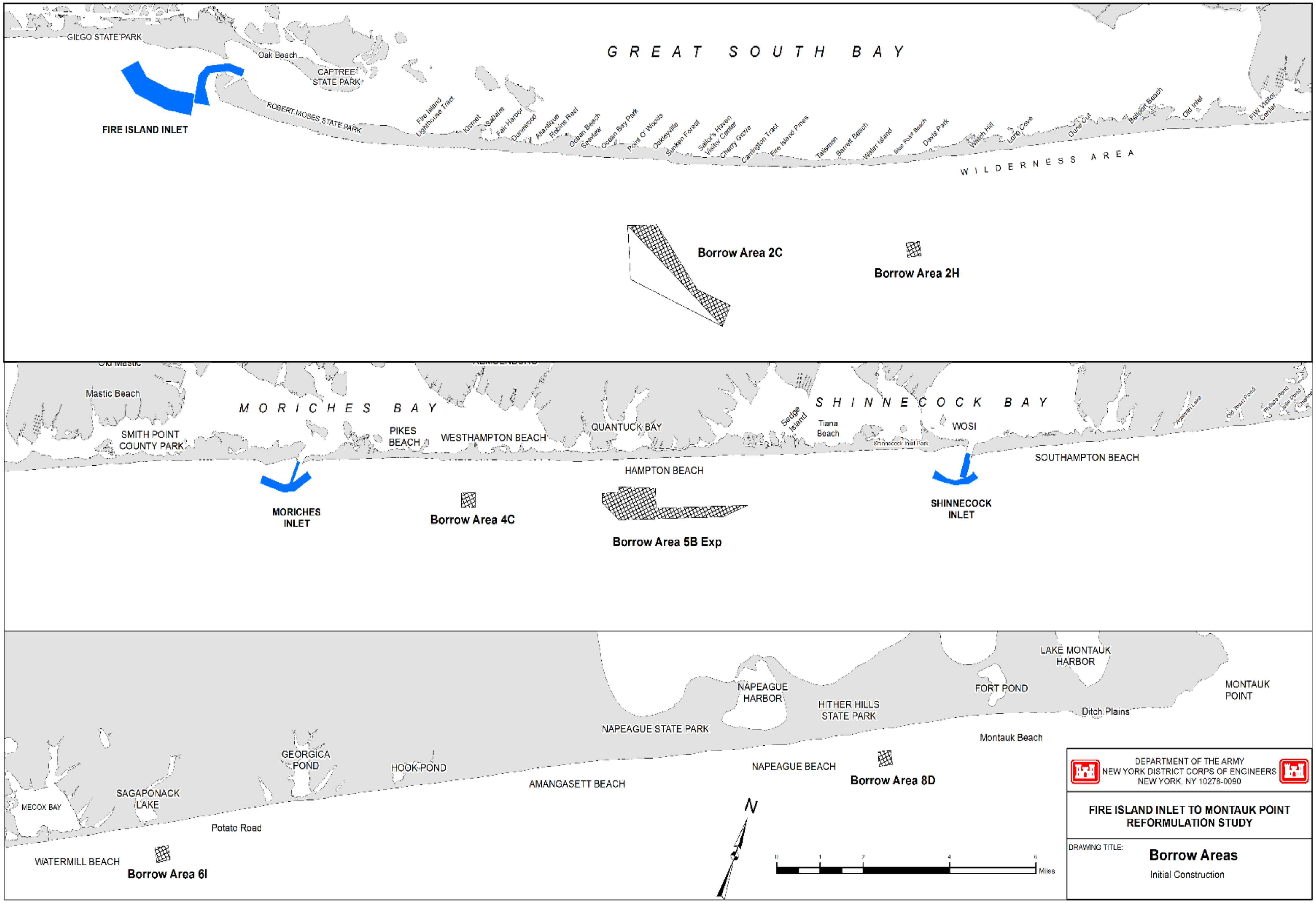

GREAT SOUTH BAY
GILGO STATE PARK
Oak Beach
CAPTREE STATE PARK
FIRE ISLAND INLET
ROBERT MOSES STATE PARK
WILDERNESS AREA
Borrow Area 2C
Borrow Area 2H
Mastic Beach
MORICHES BAY
SMITH POINT COUNTY PARK
PIKES BEACH
WESTHAMPTON BEACH
QUANTUCK BAY
SHINNECOCK BAY
Tiana Beach
WOSI
SOUTHAMPTON BEACH
HAMPTON BEACH
MORICHES INLET
Borrow Area 4C
Borrow Area 5B Exp
SHINNECOCK INLET
LAKE MONTAUK HARBOR
MONTAUK POINT
NAPEAGUE HARBOR
HITHER HILLS STATE PARK
FORT POND
Ditch Plains
NAPEAGUE STATE PARK
Montauk Beach
GEORGICA POND
HOOK POND
NAPEAGUE BEACH
Borrow Area 8D
AMANGASETT BEACH
SAGAPONACK LAKE
MECOX BAY
Potato Road
WATERMILL BEACH
Borrow Area 6I
N
Miles
DEPARTMENT OF THE ARMY
NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NY 10278-0090
FIRE ISLAND INLET TO MONTAUK POINT REFORMULATION STUDY
DRAWING TITLE:
Borrow Areas
Initial Construction

COASTAL PROCESS FEATURES

THE INTERAGENCY STUDY TEAM EVALUATED POTENTIAL WAYS TO REESTABLISH THE FIVE COASTAL PROCESSES IDENTIFIED AS BEING CRITICAL TO REDUCING COASTAL STORM DAMAGES AND PROVIDING A SUSTAINABLE, RESILIENT PLAN:

Longshore Sediment Transport.

- Longshore transport is the movement of sand along the shoreline.
- Reestablishment of the longshore process can help to maintain a more natural shoreline condition, and a more natural beach profile.
- Reestablishing these processes can reduce the need for future activities to address erosion in these areas.

Cross-Island Transport

- Cross-Island transport is the movement of sand over, or across the barrier island in response to storm activity, such as breaches and overwash.
- These process contribute sediment to the backbay, and contribute to raising the height of the island.

Dune Development and Evolution

- In much of the study area, the long-term trend is erosional.
- Under a natural condition, the dunes would migrate over time, but this does not occur if a beach and dune are maintained.
- Significant amounts of dune habitat have been degraded due to building near or on the dunes.

Bayside Shoreline Processes

- The natural evolution of the bayside shoreline has been altered by construction of bulkheads, marinas, and the dredging of channels.
- These actions have altered the natural evolution of the bayside shoreline.

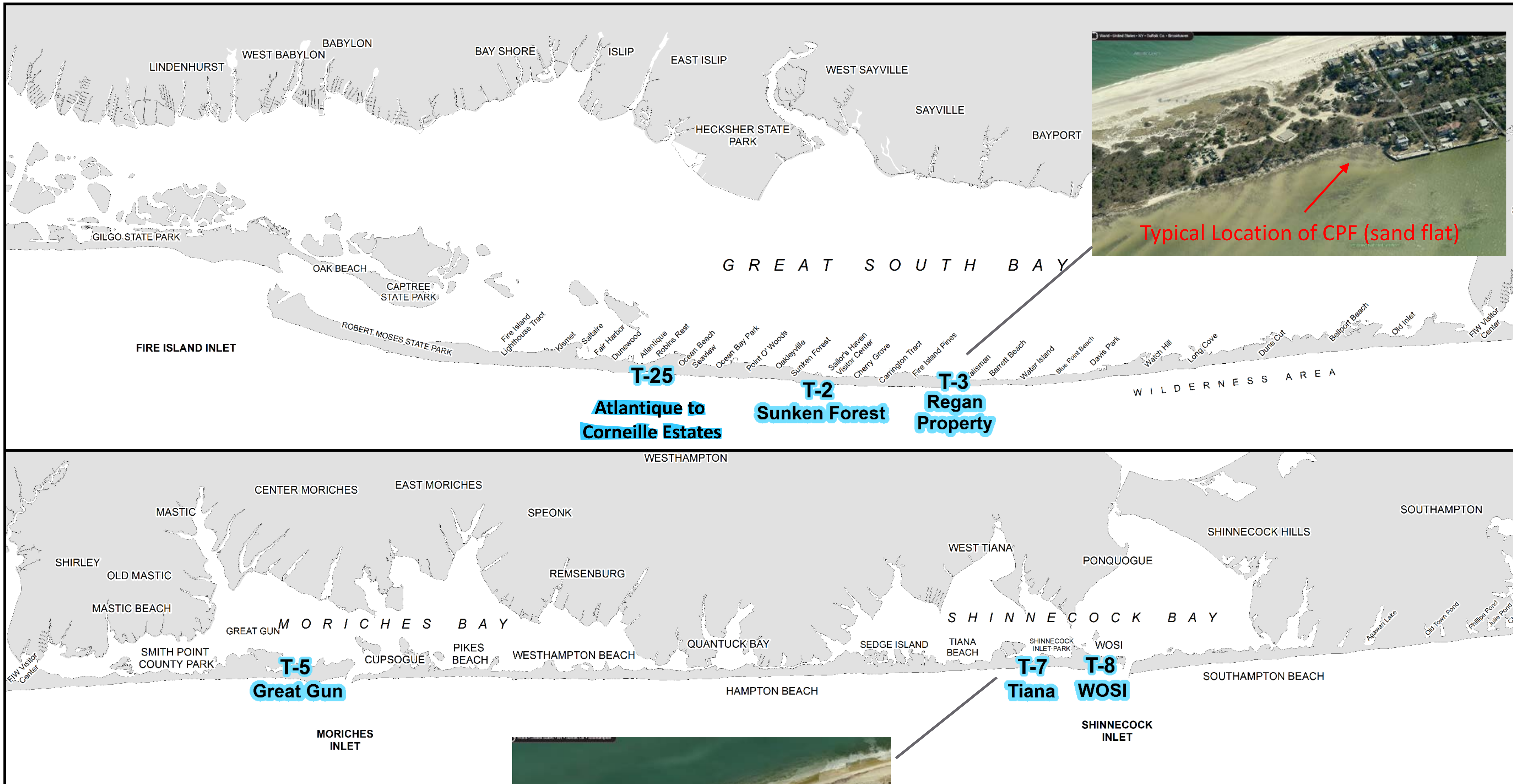
Estuarine Circulation

- Estuarine circulation is the exchange of water in the bay.
- The magnitude of human changes within the estuary and the complexity of the interaction between the physical processes and the environment limit the opportunities for reestablishing estuarine circulation processes.

Reestablishing Coastal Processes

- One option is removal of the man made features that is disrupting the process (for example, removal of a groin that disrupts longshore transport).
- If removal of the barrier is not possible, modification of the barrier could be considered (for example, shortening a groin)
- If neither of these options are viable, it may be possible to replicate the natural processes (for example, placing sand to compensate for the groin).

COASTAL PROCESS FEATURES



Coastal Process Features

T-2 Barrier Island Features

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NEW YORK DISTRICT CORPS OF ENGINEERS
NEW YORK, NY 10278-0090

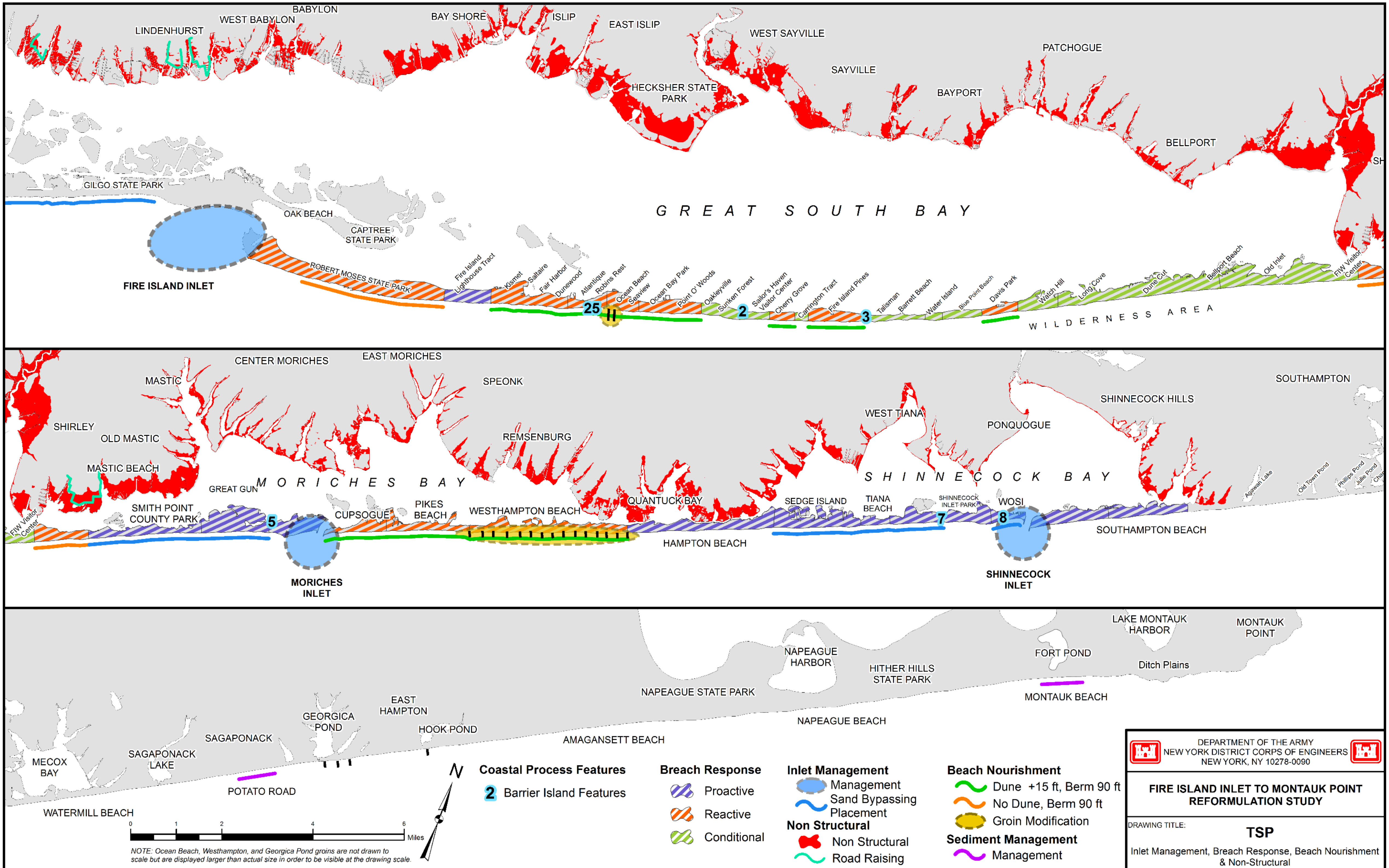
FIRE ISLAND INLET TO MONTAUK POINT REFORMULATION STUDY

DRAWING TITLE:

TSP

Coastal Process Features

TENTATIVELY SELECTED PLAN (TSP)



Economic Analysis

- Cost Benefit Analysis compares costs to benefits to determine if a project is economically justified.
- Computer simulations of random storms estimate damages to property and contents over a 50 year analysis period.
- Benefits compare without project damages to with project damages to estimate 'damages avoided.'
- Project features are combined to maximize net benefits.
- **<u>No project eliminates all damages from all storms</u>**. Coastal areas remain highly vulnerable to major storms – residual risk always remains.
- Nearly 1/2 of the without project damages are shown to be reduced with the project in place.

Summary of Without and With Project Damages

Damage Category	Without Project Damage	With Project Damage TSP
Total Project		
Tidal Inundation occurring due to inlet conditions, wave setup, storm-related breaching and overwash in backbay		
Total Mainland Inundation	$98,382,500	$36,407,000
Total Barrier Inundation	$17,016,300	$15,909,000
Total Inundation	$115,398,800	$52,316,000,
***Damages (Inundation* and Structure Failure) due to a breach remaining open**		
Inundation (Open Wilderness Area Breach)	$4,733,300	$4,733,000
Inundation (Future Breaches)	$3,578,400	$116,000
Total Breach Open Damages	$8,311,000	$4,848,000
Shorefront Damages	$12,848,300	$6,681,000
Emergency Costs/Breach Closure (Including Proactive Breach Costs)	$1,816,000	$761,000
Total Damage	$138,374,100	$64,607,000
Discount Rate 3.125%, Period of Analysis 50 years, October 2015 price levels		

Economic Analysis of the TSP	**TSP (Low SLC)**	**TSP (Med SLC)**	**TSP (High SLC)**
Initial Project First Cost	$1,107,099,500	$1,107,099,500	$1,107,099,500
Interest During Construction (IDC)	$111,733,000	$111,733,000	$111,733,000
Investment Cost	$1,218,832,500	$1,218,832,500	$1,218,832,500
Annualized Cost	$67,168,700	$67,978,700	$83,004,700
Total Storm Damage Reduction Benefits	$72,713,000	$95,230,000	$314,270,000
Costs Avoided – Breach Closure	$1,816,000	$2,530,000	$6,876,000
Recreation Benefits	$22,695,000	$22,695,000	$22,695,000
Total Benefits	$97,224,000	$120,455,000	$343,841,000
Net Benefits	$30,055,300	$52,476,300	$260,836,300
BCR	1.4	1.7	4.0

* Oct 2015 PL, Annualized over the 50 year period of analysis using the Federal Discount rate of 3.125%