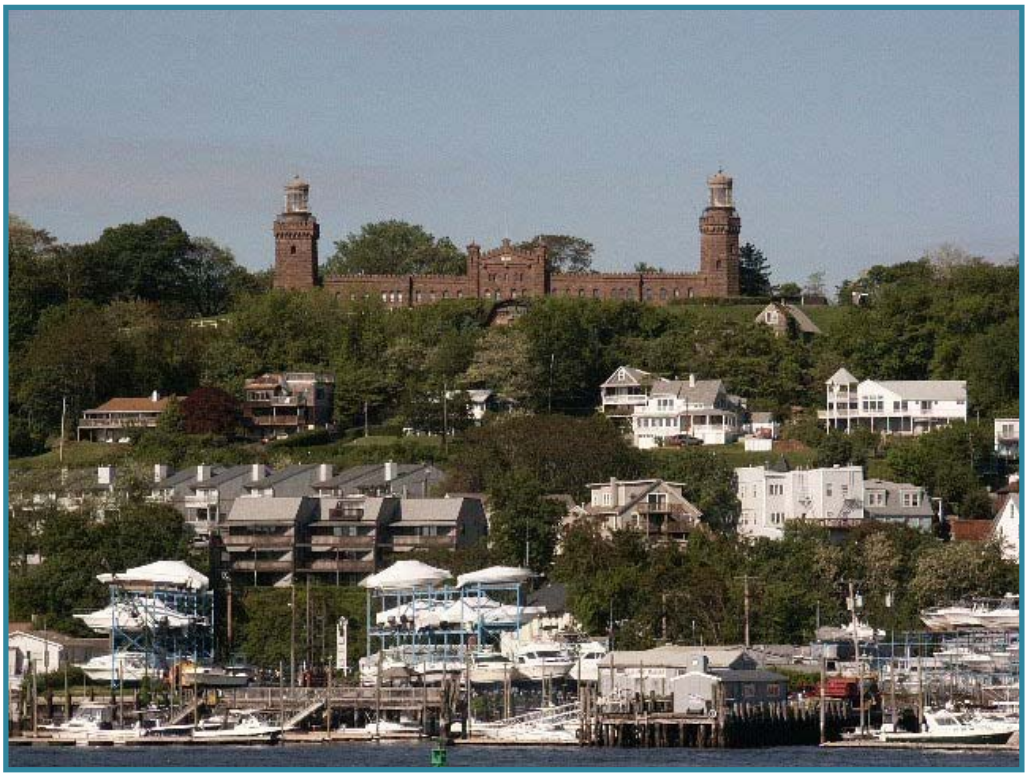
Raritan Bay and Sandy Hook Bay Highlands, New Jersey Coastal Storm Risk Management Feasibility Study



Draft Integrated Feasibility Report and Environmental Assessment

JULY 2015

New Jersey
Department of
Environmental Protection

U.S. Army Corps of Engineers
North Atlantic Division
New York District

Home damaged by Hurricane Sandy in Highlands, New Jersey (2012).

Raritan Bay and Sandy Hook Bay
Highlands, New Jersey
Coastal Storm Risk Management
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PERTINENT DATA

DESCRIPTION

The US Army Corps of Engineers (USACE) Coastal Storm Risk Management (CSRM) Tentatively Selected Plan (TSP) for the Raritan Bay and Sandy Hook Bay, Highlands, New Jersey (Highlands) feasibility study provides for an alignment of elevation +10 feet (ft) North Atlantic Vertical Datum of 1988 (NAVD88) to +12.4 ft NAVD88, consisting of raised bulkheads, raised ground surfaces, floodwalls, and reinforced dunes, that ties into high ground at each end of the project. The exact dimensions and level of performance of the project will be determined as part of the optimization process to follow the release of this draft Feasibility Report.

LOCATION

The Borough of Highlands is located in Monmouth County, NJ, along Sandy Hook Bay and the Shrewsbury River.

FEATURES

The project spans a geographic distance of approximately 8,000 linear feet along the coast of Highlands and ties into high ground (+10 ft NAVD 88 to +12.4 ft NAVD88) at each end. Because the project follows the actual perimeter of the shoreline, its total length is 10,636 linear ft. For each segment of the project, features were chosen to match the existing surroundings, *i.e.*, elevated bulkheads where the shoreline is already bulkheaded and reinforced dunes (seawalls covered with sand and a vegetation cap) on the existing beaches.

Project Feature	Length (lf)
Raised Bulkheads	7,289
Capped Existing Bulkheads	1,395
Floodwall	375
Reinforced Dune	1,194
Raised Ground Surfaces	328
Closure Gate (width)	55
Total Length	10,636

REAL ESTATE REQUIREMENTS

The project will require temporary and permanent easements, as well as fee simple purchase for environmental mitigation. The estimated cost for real estate is $6,627,000.

Permanent Easements	9.3 acres
Temporary Easements	18.4 acres
Fee Simple Purchase (for mitigation)	5 acres
Total	32.7 acres

PROJECT COSTS (October 2014 price levels)

Initial Project First Cost	$ 78,905,000
Real Estate Cost	$6,627,000

ECONOMICS (October 2014 price levels)

Annual Project Cost (Discounted at 3.375% over a 50-year period)	$3,489,000
Average Annual Benefits (Discounted at 3.375% over a 50-year period)	$9,376,000
Average Annual Net Benefits	$5,887,000
Benefit Cost Ratio	2.7

COST APPORTIONMENT (October 2014 price levels)

Fully Funded Initial Project First Cost	
Federal (65%)	$51,288,000
Non-Federal (35%)	$27,617,000
Total	$78,905,000

EXECUTIVE SUMMARY

This study has determined that periodic coastal storms, such as tropical storms, hurricanes, and nor'easters, pose a severe threat to life and property in the Borough of Highlands, Monmouth County, New Jersey (Highlands). There is an opportunity to manage coastal storm risks in Highlands. In response to these problems and opportunities, plan formulation activities considered a range of structural and nonstructural measures. Through an iterative plan formulation process, potential coastal storm risk management measures were identified, evaluated, and compared.

Alternative coastal storm risk management plans that survived the initial screening of alternatives included hard structural (floodwalls and bulkheads) and soft structural (beachfill and dune) plans, and a hybrid plan that minimized environmental impacts by matching the existing ground surface (*ie*., elevated bulkheads where the shoreline is already bulkheaded and reinforced dunes consisting of sand-covered seawalls on the existing beaches). The hybrid plan was found to be the most effective and efficient of the three alternatives, and was further developed into five variations to assess various components to maximize water access, such as buoyant swing gates and removable floodwalls. Of the five variations, the alternative that prioritized coastal storm risk management over water access, by including stationary components, was found to have the highest net benefits, making it the Tentatively Selected Plan (TSP).

The project spans a geographic distance of approximately 8,000 linear feet along the bayshore of Highlands and ties into high ground (+10 ft NAVD 88) at each end. Because the project follows the actual perimeter of the shoreline, its total length is 10,636 linear ft. Access to Sandy Hook Bay and the Shrewsbury River will be provided as a project feature on publicly owned land. Private property owners will be allowed continued access and will receive compensation if their existing access needs to be removed for construction. All of the alternatives were evaluated at the 2 percent flood (50 year) level of performance. The exact height of the project, which could be as high as +14 ft NAVD88, will be determined during the optimization phase of the study, which follows public comments and reviews of the draft report.

The estimated total first cost for project implementation is $78,905,000 (October 2014 Price Level), to be cost shared 65% Federal and 35% non-Federal. Annual net benefits are in the amount of $5,887,000 and the benefit-to-cost ratio is 2.7.

The non-Federal project partner, New Jersey Department of Environmental Protection (NJDEP), has indicated its support for the TSP and is willing to enter into a Project Partnership Agreement (PPA) with the Federal Government for the implementation of the Recommended Plan, which will be identified in the Final Feasibility Report.

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**Sections of text marked with an asterisk are applicable to the satisfaction of National Environmental Policy Act (NEPA) requirements*

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Chapter 1: Introduction

1.1 Study Purpose and Scope

The U.S. Army Corps of Engineers (USACE) North Atlantic Division (NAD), New York District prepared this draft Integrated Feasibility Report and Environmental Assessment for the Raritan Bay and Sandy Hook Bay, Highlands, New Jersey, Coastal Storm Risk Management Study (Highlands study). It includes input from the non-Federal study partner, local governments, natural resource agencies, and the public. This report presents potential solutions to manage coastal storm risk in the Borough of Highlands, Monmouth County, New Jersey (Highlands) (Figure 1). Sections of the report that are required to fulfill the requirements of National Environmental Policy Act (NEPA) of 1970 are marked with an asterisk (*) in the headings.

Figure 1: Highlands, Monmouth County, New Jersey.

The Federal objective of water and related land resources project planning is to contribute to national economic development (NED) consistent with managing and reducing risk to the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements (Principles and Guidelines (P&G), 1983). Water and

related land resources projects are formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. This feasibility report will: (1) summarize the current and potential water resource problems, needs, and opportunities for coastal storm risk management in Highlands; (2) present and discuss the results of the plan formulation for water resource management solutions; (3) identify specific details of the Tentatively Selected Plan (TSP), including inherent risks and (4) determine the extent of Federal interest and local support for the plan.

1.2 Purpose and Need for Action*

Highlands is located on the shoreline of Sandy Hook Bay and the Shrewsbury River approximately 20 miles south of Manhattan, New York. Its "working waterfront" is lined with marinas, docks, piers, and a ferry terminal that serves many businesses throughout the northeast and provides mass transportation for commuters to New York City. Access to the waterfront is critical to the Borough's economy. Large-scale flood risk management structures that could impede use of the waterfront have not been built. Because of this, the Borough is highly susceptible to flooding. Most homes and businesses in Highlands are located in the relatively low-lying downtown area extending from the shoreline to Shore Drive (Figure 2). The land is generally at an elevation lower than +10 feet (ft) North Atlantic Vertical Data of 1988 (NAVD88).

Figure 2: Topography of Highlands.

Highlands experiences moderate to severe flooding from coastal storms like tropical storms, hurricanes, and nor'easters. Flooding is caused by storm surge, which is created when winds push on the ocean's' surface, causing an abnormal rise of water over and above the predicted tide. Residences and businesses have experienced flooding from multiple storm events, most recently Hurricane Sandy in October 2012. Highlands was severely impacted by the storm, which was a 0.5 percent flood (190-year event) at the waterfront.[1] Of approximately 1,500 structures in Highlands, about 1,100 were damaged or destroyed by flood waters. Bay Shore Drive and Bay Avenue, the two main roads in the town, were impassable for days after the storm. The downtown business area was submerged for days; many businesses have not reopened. Borough Hall and the Highlands Police Station were flooded; the offices remain in temporary trailers almost three years after the storm. The SeaStreak Ferry, which provides commuter service to Manhattan, was unable to operate for months because the ferry terminal was destroyed by the storm. Residents were displaced for weeks, months, or even years, many living in temporary trailers or gutted homes as they rebuild. The Borough continues to work towards full recovery.

[1] This estimate was developed using historic stage-frequency curves, which is the typical method used by USACE-New York District.

1.3 Study Authority

The Highlands study was authorized by a resolution of the Committee on Public Works and Transportation of the U.S. House of Representatives adopted August 1, 1990:

> *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 requested to review the report of the Chief of Engineers on Raritan Bay and Sandy Hook Bay, New Jersey, published as House Document No. 464, Eighty-seventh Congress, Second Session, and other pertinent reports, to determine the advisability of modifications to the recommendations contained therein to provide erosion control and storm damage prevention for the Raritan Bay and Sandy Hook Bay.*

This study authority covered the Raritan Bay and Sandy Hook Bay area, from South Amboy at the western end to Highlands at the eastern end. In response to the study authority, the Raritan Bay and Sandy Hook Bay, New Jersey Combined Flood Control and Shore Protection Reconnaissance Study Report (1993) concluded that within the study area shoreline protection and flood control projects in Highlands and five other communities appeared to be economically viable and were recommended for further investigation.

The Reconnaissance Report recommended that Highlands and the other identified communities could proceed to interim feasibility studies after a "pre-feasibility" study was conducted. It was indicated that such a study was to further demonstrate the extent of Federal interest in a site-specific plan and to provide a better basis for estimating the feasibility phase cost. The pre-feasibility study for Highlands (2000) identified a potential plan that appeared economically and environmentally feasible. The Feasibility Cost Sharing Agreement (FCSA) with the New Jersey Department of Environmental Protection (NJDEP) for the Highlands Coastal Storm Risk Management (CSRM) Study was executed in 2001.

Prior to Hurricane Sandy, the Highlands CSRM Study was close to completion. The effects of Hurricane Sandy are described in Section 3.1 (Problem Statement) of this report. The Highlands CSRM Study was included in the Second Interim Report in response to Disaster Relief Appropriations Act, Public Law 113-2 (P.L. 113-2), as a project under study to receive $1,500,000 to complete the feasibility study. A FCSA amendment for $1,500,000 to complete the feasibility study at full Federal expense was executed with NJDEP on 23 August 2013.

1.4 The Planning Process

In compliance with the USACE planning process, this draft Feasibility Report is being released for concurrent public and agency technical review by USACE of the Tentatively Selected Plan (TSP).[2] For the TSP, the study team has evaluated an array of alternatives to arrive at a general description of the TSP (type of treatment - floodwalls vs. beachfill vs. nonstructural treatments such as house elevations, relocations, etc), with the exact details to be determined in a process called optimization. Optimization of the TSP happens after comments from public review and agency review are received and incorporated into the draft report package. Through optimization, the TSP becomes the Recommended Plan. Following final rounds of agency reviews, the study team will prepare a Final Feasibility Report to present the Recommended Plan.

[2] http://planning.usace.army.mil/toolbox/smart.cfm?Section=4&Part=0

1.5 National Environmental Policy Act Requirements

This draft Integrated Feasibility Report and Environmental Assessment (EA) was prepared pursuant to the National Environmental Policy Act (NEPA), the Council on Environmental Quality's (CEQ) Guidance Regarding NEPA Regulations, and the USACE's Procedures for Implementing NEPA (Engineering Regulation [ER]-200-2-2).

An EA is a concise public document prepared by the Federal agency to determine whether the proposed action has the potential to cause significant environmental effects (40 Code of Federal Regulations (CFR) 1508.9(a)). The purposes of an EA are to:

- provide evidence and analysis sufficient to determine whether an Environmental Impact Statement (EIS) is required;
- aid a Federal agency's compliance with NEPA when no EIS is necessary;
- facilitate preparation of an EIS when one is necessary; and
- serve as the basis to justify a finding of no significant impact (FONSI).

The EA must discuss:

- the need for the proposed action;
- the proposed action and alternatives;
- the probable environmental impacts of the proposed action and alternatives;
- and the agencies and persons consulted during preparation of the EA.

NEPA requires federal agencies to integrate the environmental review into their planning and decision-making process. This integrated report is consistent with NEPA statutory requirements. The report reflects an integrated planning process, which avoids, minimizes, and mitigates adverse project effects associated with coastal storm risk management actions. Sections of the report that are required to fulfill the requirements of National Environmental Policy Act (NEPA) of 1970 are marked with an asterisk (*) in the headings.

1.6 Prior Studies, Reports, and Existing Water Projects

Existing reports on the Highlands study area include the 1993 Reconnaissance Report for Raritan Bay and Sandy Hook Bay, and the pre-Feasibility Report conducted on Highlands in 2000, as described in Section 1.3 (Study Authority).

Existing Federal Projects

There are no existing USACE coastal storm risk management projects within the Highlands study area. The closest USACE project is the navigation channel on the Shrewsbury and Navesink Rivers (Figure 3). The navigation project in the Shrewsbury and Navesink Rivers was authorized by the Rivers and Harbors Act of 1919. It consists of a channel about 2.2 miles long, 12 feet deep Mean Low Water and 300 feet wide, following the westerly shore from deep water in Sandy Hook Bay to approximately the Route 36 bridge. This is connected to a channel (South Branch) about 6.8 miles long, 9 feet deep Mean Low Water and 150 feet wide, widened at bends, ending at Branchport Avenue in Branchport and to a tributary channel (North Branch) connected to the South Branch channel at Normandie, which extends up the Navesink River approximately 6.1 miles to Red Bank. This channel has a depth of 6 feet Mean Low Water and width of 150 feet. The project is used by the Sea Streak ferry that connects to New York City. P.L. 113-2 funds

were used to dredge 100,000 cy of sand from the Federal navigation channels in the Shrewsbury and Navesink Rivers in 2014.

Other navigation projects include the Federal navigation channels at Atlantic Highlands, Leonardo, and Belford Harbor. Authorized in 1937, the Atlantic Highlands project consists of a 4,000 ft long rubble-mount breakwater, with the area landward of the breakwater up to the pierline dredged to a depth of 8 ft. The Leonardo navigation channel in Sandy Hook Bay was authorized by the Rivers and Harbors Acts of 1945 and 1950, and provides for an entrance channel eight ft deep, 150 ft wide, and approximately 2,500 ft long, from the eight ft contour in Sandy Hook Bay to the entrance of the small boat harbor at Leonardo. In addition to provide access to small recreational vessels, the channel is also used to transport distillate fuel oil (approximately 379 tons for the five year average annual commercial tonnage). P.L. 113-2 funds were used to remove approximately 35,000 cubic yards (cy) of sand to restore function to the project in 2014. The navigation project at Belford is the Shoal Harbor and Compton Creek Federal Navigation Project, which was authorized by the Rivers and Harbors Act of 1935. The existing project, used for fishing operations, is two miles long from deep water in Sandy Hook Bay up through Compton Creek. It ranges from 8-12 ft deep at Mean Low Water (MLW), narrows from 150 ft wide in the bay to 75 ft wide in Compton Creek. P.L. 113-2 funds were used to dredge 160,000 cy of sand in 2014.

Nearby coastal storm risk management projects to the west of the study include Union Beach; Keansburg, North Middletown and Laurence Harbor (Keansburg); and Port Monmouth. Designs are underway for the Union Beach project, which includes levees and floodwalls, tide gates, pump stations, and a dune and beach-berm with terminal groins. The existing Keansburg coastal storm risk management project encompasses 2.7 miles of shoreline in the Borough of Keansburg and North Middletown (formerly East Keansburg, located in Middletown Township), Monmouth County, and 0.6 miles of shoreline in Laurence Harbor (located in Old Bridge Township), Middlesex County. In 1966, USACE constructed a beach berm and levees at Laurence Harbor. In 1968, USACE completed the construction of a beach berm, groins, levees, pump station, floodwall, and a storm closure gate in Keansburg and North Middletown. The project in Keansburg was damaged by Hurricane Sandy in 2012 and has been repaired and restored pursuant to P.L. 84-99, Flood Control and Coastal Emergencies (33 U.S.C. 701n) and P.L. 113-2. There is also a USACE coastal storm risk management project under construction at Port Monmouth between Leonardo and Keansburg. While the beachfill portion of Port Monmouth is complete, the structural components, including levees, floodwalls, a tide gate, pump stations, road closure gates, and environmental mitigation, are scheduled for contract award in 2016.

To the east of Highlands is the Sea Bright to Manasquan, NJ Coastal Storm Risk Management and Erosion Control Project. Originally authorized by the Rivers and Harbors Act of 1958, the project consists of 21 miles of Atlantic coast shoreline from the Township of Sea Bright to the Manasquan Inlet in Monmouth County, New Jersey. The beach erosion control project provides beach erosion control protection of the shoreline that protects the highly populated communities and infrastructure located along this area of the New Jersey shoreline. Storm damage reduction is provided by constructing a 100 foot wide beach berm at a total elevation of +12 ft mean low water (MLW), +9.3 ft North Atlantic Vertical Datum (NAVD). Construction on part of the project was initiated in 1994 and completed in 2001. The project includes periodic nourishment of the restored beaches on a 6-year cycle for a period of 50 years from the start of initial construction. Some of the constructed portions of the Sea Bright to Manasquan project

were damaged by Hurricane Sandy in 2012 and have been repaired and restored pursuant to P.L. 84-99, Flood Control and Coastal Emergencies (33 U.S.C. 701n) and P.L. 113-2 in 2014.

Proposed coastal storm risk management actions for Highlands would not affect or be affected, due to the lack of geographical contiguity, by the existing USACE projects at Union Beach, Keansburg, North Middletown, Laurence Harbor, Port Monmouth, Belford, Leonardo, Atlantic Highlands, the Shrewsbury and Navesink Rivers, or along the Atlantic coast of New Jersey from Sea Bright to Manasquan.

Existing Local Structures. There are a number of existing piers, bulkheads, and other revetments in Highlands, including a raised bulkhead constructed by the State of New Jersey between Snug Harbor Avenue and Sea Drift Avenue. They were built mainly for the purpose of shoreline erosion management and not to prevent flooding from coastal storms. The structures are low enough to allow both inundation and wave damage in landward regions (i.e., lower than elevation +10.7 ft NAVD88). Several of the private bulkheads were undergoing replacement at the time of the inventory, with evidence of several more imminent replacements (stockpiled bulkhead materials).

1.7 Study Area

The **study area** is the area within which significant project benefits and impacts may occur. The study area includes the downtown area of Highlands from Sandy Hook Bay to Shore Drive (Figure 4). Highlands is an established community located on the shoreline of Sandy Hook Bay and the Shrewsbury River in Monmouth County, New Jersey. Within Highlands, the study area is approximately 8000 ft along the bayshore, from Murray Beach at the western end to the Route 36 Bridge at the eastern end (see Figure 4). Shore Drive serves as the southern boundary.

1.7.1 Planning Reaches

The study area shoreline was divided into four reaches for plan formulation, based on shoreline characteristics and orientation (Figure 5). Reaches 1, 2, and 3 are the bay-fronting sections along Sandy Hook Bay, and Reach 4 is the river-fronting section along the Shrewsbury River. Reach 1 and 3 are similar, consisting primarily of beaches and piers, with some private bulkheads. Reach 2 is characterized by a public bulkhead built by the State of New Jersey, and a small, privately owned and operated marina. Reach 4 is primarily bulkheaded with piers.

1.7.2 Project Area

The **project area** is the area in which measures will likely be built. Because the TSP is a mostly structural plan, the project area encompasses only the portion of the study area that is on the bay and river shorelines (Figure 6).

Figure 3: Existing USACE Projects and Studies

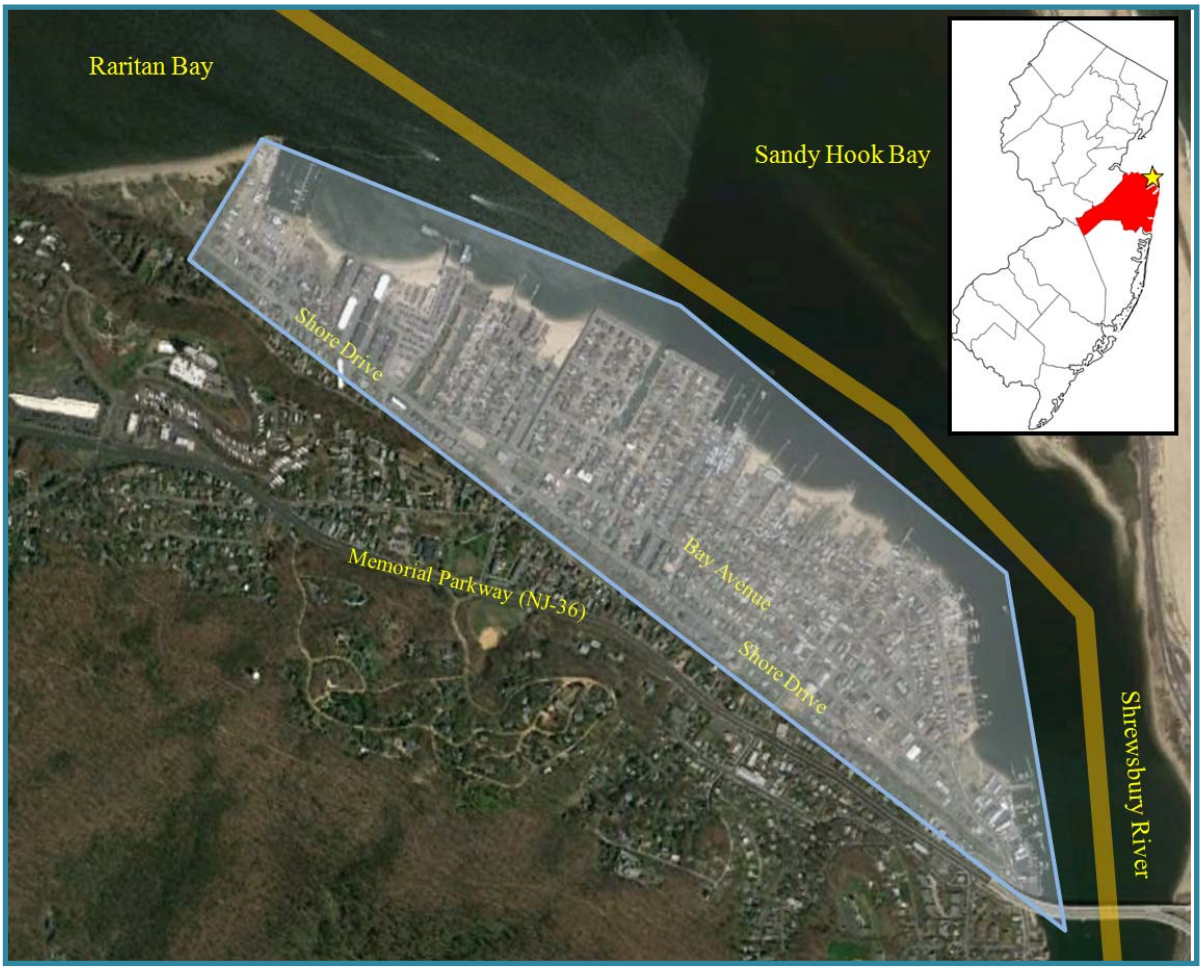

Figure 4: Highlands study area. The study area is shown shaded in blue. The Shrewsbury River Federal navigation channel is shown in orange.

Figure 5: Planning Reaches in Highlands

Figure 6: Highlands project area. The study area is shown shaded in blue. The project area is shown highlighted in green.

1.8 Non-Federal Partner

The non-Federal cost sharing partner is the New Jersey Department of Environmental Protection (NJDEP). In October 2001, the USACE and the NJDEP executed a Feasibility Cost-Share Agreement (FCSA) for the project. Though not the study partner, the Highlands governing body is an active participant in the study. Both the NJDEP and the Highlands governing body support the proposed TSP. The study will be completed with funds authorized by the Disaster Relief Appropriation Act of 2013 (P.L. 113-2) at full Federal expense.

Chapter 2: Existing Conditions*

Existing conditions, which serve as the basis for the characterization of problem identification and projection of future without project conditions, are described in this section. Existing conditions are described through the environmental setting, the built environment, and the human environment. Details from the Highlands Strategic Recovery Planning Report (NJ Future, 2014) informed the existing conditions of this report. For an explanation of how USACE describes storms and flood levels, see Section 2.4 (Describing Storms and Flood Levels).

2.1 Existing Conditions Affected Environment*

This description of the environment to be affected within existing conditions is in accordance with the requirements of National Environmental Policy Act (NEPA), and serves as the baseline for Chapter 5: Environmental Impacts and Chapter 6: Cumulative Impacts of this draft integrated report.

2.1.1 Topography, Geology, and Soils

The relatively low-lying downtown area extends from the shoreline to Shore Drive and is flanked by bluffs to the south (Figure 2). The land is generally at an elevation of less than 10 ft NAVD88. The flat topography of the waterfront and low existing bulkhead elevations allow tidal inundation during periods of major storm events. Modeling shows that a one percent flood (+11.2 ft NAVD88, including wave setup) would submerge Highlands under five feet of water from shoreline to the base of bluffs, approximately 1,500 feet inland. This largely occurred during Hurricane Sandy, which was a 0.5 percent flood at Highlands.

The geology in the study area consists of underlying crystalline bedrock composed of Cretaceous sediments. Quaternary deposits are found along the shoreline. The beach sand primarily consists of rounded quartz with lesser amounts of ironstone, sandstone, and argillite.

Sediments in the Sandy Hook Bay estuary are considered part of a Wisconsin glacial outwash plain that overlies an earlier continental drainage system. Silt and clay dominate the western section of the bay and spread from the Raritan River through the deeper part of the bay to Sandy Hook. The remaining bay consists of medium sand (diameter >250 microns) and fine sand (diameter >62 microns and <250 microns).

Soils in the study area primarily consist of the Hooksan Sand (HorBr), Udorthents-Urban Land Complex (UdauB), and, Phalanx (PhbE). The HwB soils occur on 0 to 5% slopes and are rarely flooded. The UdauB soils occur on 0 to 8% slopes and exhibit variable drainage capabilities. The PhbE are on 10 to 25% slopes and are well drained (USDA 2014).

The topography is stable and is not expected to change in the future.

2.1.2 Water Resources

2.1.2.1 Regional Hydrogeology and Groundwater Resources

The study area is located directly above the Northern Atlantic Coastal Plain (NACP) aquifer system, which is a Nationally-Designated Sole Source Aquifer (USEPA 1988). This aquifer system is a complex, multi-layered system underlain by semi-consolidated to unconsolidated sediments that consist of silt, clay, and sand, with some gravel and lignite (Trapp and Horn 1997).
The primary source of groundwater extraction in the study area is from the Potomac-Raritan-Magothy aquifer. The source of recharge for this aquifer is through precipitation and infiltration (Trapp and Horn 1997). Groundwater quality of the Potomac-Raritan-Magothy aquifer is

generally good, with a median chloride concentration of 11.6 milligram/liter (mg/L), soft groundwater (0-60 mg/L as calcium carbonate), iron concentrations routinely exceeding the national drinking-water standard of 300 micro-gram/liter (µg/L), and nitrate plus nitrite levels being consistently 0.11 mg/L or less (Moody *et al*. 1988). The predominant ions in most New Jersey groundwater are calcium, magnesium, and bicarbonate (Moody *et al*. 1988).

2.1.2.2 Surface Water

In general, the surface water quality throughout Sandy Hook Bay reflects the close proximity of a highly urbanized and developed population center. The environment of bay has been impacted by a variety of pollutants, including heavy metals, polynucleararomatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), excessive nutrient and organic carbon loading, and pathogenic bacteria and viruses (NJDEP 1983, Bretler 1985, NJDEPE 1993a, 1993b). Other problems documented in the bay include diseased fish, turbid and oily waters, noxious odors, beach and shellfish bed closings, and restricted shellfish harvesting (USDOI 1992).

Phytoplankton blooms have been the most visible, and appear to have had the most substantial impact, of all the water quality problems that have been experienced along the shoreline of the Raritan Bay and Sandy Hook Bay (USACE 2000a). Green, brown, or red tides are common in the Raritan Bay and Sandy Hook Bay during spring and summer seasons creating hypoxic conditions (depletion of dissolved oxygen [DO]) and causing the suffocation of marine fauna (USACE 2000a). The macrobenthic community of the Raritan Bay and Sandy Hook Bay has been described as impoverished because of low concentrations of DO (McGrath 1974).

2.1.2.3 Tidal Influences

Tides at the study area are semi-diurnal. In general, waters in Sandy Hook Bay typically circulate in a counter-clockwise direction. However, long shore currents in the study area transport sediments generally from east to west. Tidal currents along the shore of the area are generally weak except at the eastern end where the Navensink River discharges. The National Oceanic and Atmospheric Administration's (NOAA's) measurement of tidal currents show that maximum flood and ebb tide velocities are 0.6 and 0.4 knots, respectively, in bay (USACE 1996). The mean tide level, mean tidal range, and spring tidal range at the study area are 2.6 ft above mean low water (MLW), 4.9 ft MLW, and 5.9 ft MLW, respectively.

2.1.3 Coastal Processes

Three primary factors shape coastal zone morphology: 1) ocean factors; 2) beach characteristics; and, 3) other natural physical variables. Ocean factors include waves, tidal variations, storm surges, and sea level change. Beach characteristics include beach sediment volume, composition, and grain size. Other natural variables include rainfall runoff, groundwater flow, pore pressures, and existing vegetative cover (Komar 1998). All three factors interact in a dynamic process, which defines the coastal zone area.

Anthropogenic influences often supplement the natural forces, and play significant roles in shaping the coastal zone. As shorelines retreat due to long shore currents, wave and tidal action, and storm events, artificial structures are often constructed to slow down or minimize further erosion. These structures typically modify the coastal zone to increase sediment retention within heavily utilized or populated areas (USACE 2000b). The majority of the Highlands shoreline is bulkheaded and impacts the natural coastal process.

2.1.4 Vegetation

2.1.4.1 Upland

Upland vegetation within the study area is limited to maintained areas associated with residential and commercial buildings, narrow beach, and small, undisturbed pockets of trees. The most common vegetated upland areas are typically dominated by shrubs such as northern arrowwood (*Viburnum recognitum*), sweetgum (*Liquidambar styraciflua*), multiflora rose (*Rosa multiflora*), and staghorn sumac (*Rhus typhina*). The beach area is sparsely vegetated with American beachgrass (*Ammophila breviligulata*), sea lavender (*Limonium nashii*), and seaside goldenrod (*Solidago sempervirens*). The small pockets of upland forest scattered throughout the study area likely consist of sweetgum, black locust (*Robina pseudo-acacia*), oak (*Quercus* spp.), maple (*Acer* spp.), and ash (*Fraxinus* spp.).

2.1.4.2 Wetland

Because of the small area of Highlands and its almost fully developed condition, few wetlands are present. Wetlands mapped in the National Wetlands Inventory for Highlands consist only of intertidal and subtidal wetlands occurring along the western part of the project area (USFWS, 2015). Mapping using NJDEP Geo-Web (2012; Figure 7) indicates a 1.1 acre vegetated dune communities wetland, between Valley Street and Cedar Avenue. The mapped wetland contains minimal habitat. The exact delineation of the wetland will occur during PED phase. It is anticipated that this mapped wetland does not contain hydric soils as it appears to be filled.

Figure 7: NJDEP Mapped Wetland

2.1.5 Fish and Wildlife

2.1.5.1 Finfish

The Sandy Hook Bay is used as a spawning area, nursery area, and part-time residence by many recreational and commercial finfish species of the New York Bight (MacKenzie 1990). Historical data showed a great abundance of finfish in the bay. However, human intervention (*i.e.,* heavy

fishing sewage discharge, and dredging, reduction of suitable spawning habitat, and reduction in food supply have contributed to the decline of the diversity and abundance of finfish species in Raritan Bay and Sandy Hook Bay (MacKenzie 1990).

The description below is representative of the bay as a whole and suggests species likely to be encountered in the study area though there is no data to suggest that the waters of the study area offer any special or unique values or concentrations of species.

Bluefish (*Pomatomus saltatrix*), weakfish (*Cynoscion regalis*), winter and summer flounders (*Pseudopleuronectes americanus* and *Paralichthys dentatus*, respectively), striped bass (*Morone saxatilis*), and scup (*Stenotomus chrysops*) are some of the most sought-after fish by recreational anglers (Figley and McCloy 1988). The bay provides recreational opportunities throughout the year (USFWS 1992). During the spring season, winter flounder, windowpane (*Scophthalmus aquosus*) and anadramous species such as alewife (*Alosa pseudoharengus*), American and hickory shad (*A. sapidissima* and *mediocris*, respectively), and blueback herring (*A. aestivalis*) are abundant throughout the bay. During the summer and fall seasons, summer flounder and weakfish are abundant throughout the bay complex (USFWS 1992, Wilk *et. al.* 1998). Migratory species such as striped bass are found throughout the year (Woodhead 1991). Bay anchovy (*Anchoa mitchilli*), Atlantic silverside (*Menidia menidia*), and Atlantic menhaden (*Brevoortia tyrannus*) are found in the intertidal and nearshore waters.

2.1.5.2 Shellfish

Shellfish throughout the Sandy Hook Bay have been historically important and a major shellfishery existed in the bay (USFWS 1992). However, the increase in population around the New York metropolitan area precipitated an increase in the discharges of sewage effluent, dredging activities, and residential and commercial development thus affecting the shellfish resources of the bay (Figley and McCloy 1988). The NJDEP classifies the Highlands shoreline as "Special Restricted Area" requiring a special permit for commercial shell fishing.

McCloy (1988) found soft-shelled clam (*Mya arenaia*) beds and occurrence of hard-shell clam in the intertidal and nearshore waters. No known blue mussel (*Mytilus edulis*) or oyster (*Crassostrea virginica*) beds are found in vicinity of the study area, and surf clams (*Sapisula solidissima*) are confined to the deep waters of the bay (McCloy 1988). Beach seine surveys conducted by the NJDEP, Bureau of Marine Fisheries in 1982 and 1983, found that grass shrimp (*Palaemonetes pugio*), sand shrimp (*Crangon septemspinosa*), and lady crab (*Ovalipes ocellatus*) were the most abundant shellfish in the intertidal and nearshore waters of the study area (Byrne 1988).

2.1.5.3 Benthic Resources

Benthos is the complex community of plants and animals that live on or in bottom sediments of oceans, bays, streams, and wetlands. The benthic community in the Raritan Bay and Sandy Hook Bay area has historically been rich but unevenly distributed (McCormick et al. 1984), and is characterized as transitional due to changes in water quality and pollution (Steimle and Caracciolo-Ward 1989).

Most studies of Raritan Bay infauna have focused on open-bay waters (Dean, 1975; Dean and Haskin, 1960; Cerrato et al., 1989; Steimle and Caracciolo-Ward, 1989). Benthic invertebrate composition and abundance is highly dependent on sediment type and grain size distribution (Diaz and Boesch 1982, McGrath 1974). McGrath (1974) noted that powerful storms have the ability to shift sediments, thereby causing distributional changes in communities dependent on

a specific sediment type. Localized benthic communities can also exhibit large fluctuations between seasons.

As part of a pre-construction effort, intertidal and subtidal benthic samples were taken in 2002 and 2003 along the bay shoreline along Port Monmouth, Keansburg, North Middletown, and Union Beach, NJ (USACE 2004a, 2004b) just west of Highlands. A grand total of 155 taxa and over 42,000 animals were collected; dominant taxa included the gem clam, *Gemma gemma*, which made up 53% of all animals, and the spionid polychaetes *Streblospio benedicti* and *Polydora cornuta* which each accounted for approximately 6% of all animals (USACE 2004a, 2004b; Table 1). The oligochaete family Tubificidae and the tubificid species *Tubificoides heterochaetus* together made up an additional 10% of the total collection, while specimens identifiable only to the level of Oligochaeta constituted nearly 3%. Ribbon worms (Rhynchocoela) and the sabellariid polychaete *Sabellaria vulgaris* also supplied more than 2% of the total number of animals. Taxa making up approximately 1% of the collection included the snail *Ilynassa (Nassarius) obsoletus)*, the polychaetes *Mediomastus* lowest practical identification level (LPIL), *Heteromastus filiformis*, *Streptosyllis pettiboneae*, and *Protodriloides* LPIL.

Average total abundances within the study area ranged from a low of 2,681 animals/m^2 at Point Comfort to a high of 38,271 animals/m^2 at Port Monmouth. These values are similar to those from previous studies. Ettinger (1996), reported averages of 5,000-6,000 animals/m^2 for Port Monmouth and Keansburg. Ray (2004), computed averages of 15,000-21,000 animals/m^2 for Union and Cliffwood Beaches. Ettinger (1996) who found an average of 25.1 g /m2 at Port Monmouth and 192.0 g /m2 at Keansburg and was highest at subtidal depths has only previously reported biomass for this area. Annelids dominated biomass at MLW and subtidal depths of Port Monmouth, while gastropods (principally *I. obsoleta*) made up most of the biomass at mid-tide depths. At Keansburg, annelids and gastropods dominated upper- and mid-tide levels and bivalves comprised most of subtidal biomass. This same pattern is seen in the present study where annelids were the most important component of biomass at Port Monmouth and Keansburg MLW depths while bivalves constituted the majority of biomass elsewhere.

The sediments and infauna of the three study areas are similar to those previously reported for the Raritan Bay and Sandy Hook Bay shoreline. Species composition, abundance, and biomass differ slightly among the three areas, between depths, and over time but all values are within the degree of variability that is typical of intertidal benthic communities.

2.1.5.4 Reptiles and Amphibians

Site-specific studies or surveys describing the diversity and abundance of amphibians and reptiles within the study area are not available. With the exception of terrestrial woodland salamanders (*Plethodon* spp.) and various toads (*Bufo* spp.), amphibians would be limited to small, isolated freshwater habitats which do not exist in the project footprint. The southern leopard frog (*Rana utricularia*) and spring peeper (*Hyla crucifer*) are possible exceptions because they can tolerate slightly brackish waters (Conant and Collins 1991). No amphibians are expected to inhabit the shoreline project area because of the high salinity resulting from sea spray.

Table 1: Relative Total abundances of dominant taxa in the intertidal zone of the Raritan Bay and Sandy Hook Bay.

Taxon	***Total***	***PM***	***KB***	***PC***	***UB***	***MLW***	***MLW-1***
Gemma gemma	53.4	75.8	13.5	3.1	12.2	31.7	58.4
Streblospio benedicti	6.6	2.1	16.9	10.2	9.7	1.9	7.7
Polydora cornuta	6.3	3.6	14.1	4.6	4.7	8.1	5.8
Tubificidae (LPIL)	6.2	4.9	6.5	19.0	12.5	2.0	7.2
Tubificoides heterochaetus	4.1	2.2	5.4	1.1	13.5	1.4	4.7
Enchytraeidae (LPIL)	3.2	*	11.0	10.2	1.5	17.0	*
Oligochaeta (LPIL)	2.9	1.8	6.3	12.2	*	15.4	A
Sabellaria vulgaris	2.2	1.0	6.2	*	1.1	4.7	1.7
Ilyanassa obsoleta	1.4	*	*	3.5	8.9	*	1.6
Mediomastus (LPIL)	1.4	*	2.9	5.3	3.8	*	1.6
Heteromastus filiformis	1.2	*	*	1.4	7.0	*	1.3
Streptosyllis pettiboneae	1.0	*	*	*	7.3	*	1.2
Protodriloides (LPIL)	1.0	1.3	*	1.9	*	5.1	A
Paraonis fulgens	*	*	1.3	*	*	1.9	*
Microphthalmus (LPIL)	*	*	*	3.8	*	1.7	*
Polygordius (LPIL)	*	*	*	2.8	*	1.1	*
Lumbriculidae (LPIL)	*	*	2.1	1.9	*	*	*
Mulinia lateralis	*	*	1.6	3.9	*	*	*
Phyllodocidae (LPIL)	*	*	1.2	*	1.7	*	*
Hypereteone fauchaldi	*	*	1.0	1.1	1.5	*	*
Mediomastus ambiseta	*	*	*	2.4	1.7	*	*
Spionidae (LPIL)	*	*	*	1.1	*	*	*
Leitoscoloplos (LPIL)	*	*	*	1.3	*	*	*

PM: Port Monmouth; KB: Keansburg; UB: Union Beach; MLW: mean low water; MLW-1: I meter below mean low water; LPIL: lowest practical identification level; *: present but not in abundances <1% of total numbers of animals; A: Absent.

ReptilesBased on historical records, four species of reptiles are known to occur in similar habitat at the nearby Sandy Hook National Park, including diamondback terrapin (*Malaclemys terrapin*), eastern painted turtle (*Chrusemys picta*), northern brown snake (*Storeria dekayi*), and spotted turtle (*Chemmys guttata*) (USDI 1989). Fow*ler's* toad (*Bufo woodhousei*) is the only amphibian known to historically occur at Sandy Hook National Park where it is reported as extirpated (USDI 1989).

2.1.5.5 Birds

No site-specific bird surveys have been conducted in the study area, however a diversity of bird species is likely to be present due to the variety of habitats in the Raritan Bay and Sandy Hook Bay area. The most abundant species are likely to be habitat generalists that are tolerant of development. Table 2 (Padieck *et al.* 2015) provides a list of bird species observed breeding in the Keyport, NJ. a similar town, 20 miles west of Highlands.

Table 2: Common Bird Species Likely to Occur in the Study Area.

Common Name	Scientific Name	Common Name	Scientific Name
American Crow	*Corvus brachyrhynchos*	House Sparrow	*Passer domesticus*
American Goldfinch	*Carduelis tristis*	Mallard	*Anas platyrhynchos*
American Robin	*Turdus migratorius*	Mourning Dove	*Zenaida macroura*
Baltimore Oriole	*Icterus galbula*	Northern Cardinal	*Cardinalis cardinalis*
Barn Swallow	*Hirundo rustica*	Northern Mockingbird	*Mimus polyglottos*
Blue Jay	*Cyanocitta cristata*	Ovenbird	*Seiurus*
Brown Headed Cowbird	*Molothrus ater*	Red-bellied Woodpecker	*Melanerpes carolinus*
Canada Goose	*Branta canadensis*	Red-eyed Vireo	*Vireo olivaceus*
Carolina Wren	*Thryothorus ludovicianus*	Red-tailed Hawk	*Buteo jamaicensis*
Cedar Waxwing	*Bombycilla cedrorum*	Red-winged Blackbird	*Agelaius phoeniceus*
Chimmey Swift	*Chaetura pelagica*	Ring-necked Pheasant	*Phasianus colchicus*
Chipping Sparrow	*Spizella passerina*	Rock Pigeon	*Columba livia*
Common Grackle	*Quiscalus quiscula*	Scarlet Tanager	*Piranga olivacea*
Common Yellowthroat	*Geothlypis trichas*	Song Sparrow	*Melospiza melodia*
Downy Woodpecker	*Picoides pubescens*	Tufted Titmouse	*Parus bicolor*
Eastern Wood-Pewee	*Contopus virens*	Warbling Vireo	*Vireo gilvus*
European Starling	*Sturnus vulgaris*	White Breasted Nuthatch	*Sitta carolinensis*
Fish Crow	*Corvus ossifragus*	Wild Turkey	*Meleagris gallopavo*
Gray Catbird	*Dumetella carolinensis*	Willow Flycatcher	*Empidonax traillii*
Great Crested Flycatcher	*Myiarchus crinitus*	Yellow Warbler	*Setophaga petechia*
House Finch	*Haemorhous mexicanus*		

2.1.5.6 Mammals

Site specific studies describing the diversity and abundance of mammals within the study area are not available. The USFWS (1993) reported that several species of whales and dolphins, including the bottlenose dolphin (*Tursiops truncatus*), gray dolphin (*Globicephala macrorhynchus*), and Atlantic dolphin (*Delphinus delphis*) may occasionally spend time in Raritan Bay and Sandy Hook Bay. Juveniles of several species of whales may also enter the bay, but are generally limited to the deeper portions (USFWS 1993).

Mammals likely to inhabit the study area would be generalist tolerant of development such as muskrat (*Ondatra zibethicus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), gray squirrel (*Sciurus carolinensis*), and opossum (*Didelphis virginiana*; NJAS 1994).

2.1.6 Federal Threatened and Endangered Species

The USFWS lists the federally threatened Piping Plover (*Charadrius melodus*), Red Knot (*Calidris canutus rufa*), Seabeach amaranth (*Amaranthus pumilus*), and Northern long-eared Bat (*Myotis septentrionalis*) as potentially occurring in the project area. There is no designated critical habitat for any of the listed species in the project area. The USFWS has no records of any of the listed species occurring in the project area. Formal coordination with the USFWS and NMFS pursuant to Section 7 of the Endangered Species Act continues.

2.1.7 State Threatened and Endangered Species

The NJDEP Division of Fish and Wildlife, manages the state's listed animal species. A review of NJDEP's landscape data project maps threatened and endangered species habitat within the

state. The marine habitat region is the only Landscape Project layer that shows threatened and endangered habitat. The listed marine species are the Atlantic Green Turtle (*Chelonia mydas*), Atlantic Leatherback Turtle (*Dermochelys coriacea*), Atlantic Loggerhead Turtle (*Caretta caretta*), and Atlantic Kemp's Ridley Turtle (*Lepidochelys kempi*). The turtles may appear in the Raritan Bay and Sandy Hook Bay during various time of the year; however, they are not found in unusual population concentrations or would utilize the Highlands shoreline.

Transient Bald eagles (*Haliaeetus leucocephalus*) or Peregrine falcons (*Falco peregrinus*), both listed as threatened in New Jersey, may pass through the project area however none are expected to breed in the area.

The NJDEP Division of Parks and Forestry, maintains the state's listed plant species. The Landscape Project lists Seabeach Amaranth (*Amaranthus pumilus*) occurring in 2009, within a grid that includes the eastern most section of Highlands. The grid also includes part of Sandy Hook on the Atlantic coast.

Seabeach amaranth occurs on barrier island beaches, where its primary habitat consists of overwash flats at accreting ends of islands and lower foredunes and upper strands of non-eroding beaches. It occasionally establishes small temporary populations in other habitats, including sound-side beaches, blowouts in foredunes, and sand and shell material placed as beach replenishment or dredge spoil. The species appears to need extensive areas of barrier island beaches and inlets, functioning in a relatively natural and dynamic manner. These characteristics allow it to move around in the landscape as a fugitive species, occupying suitable habitat as it becomes available. Beaches in Highlands are very small, in the bay and lack a natural and dynamic process. Highlands beaches lack the habitat for Seabeach Amaranth.

2.1.8 Essential Fish Habitat

An Essential Fish Habitat (EFH) assessment was prepared and is included in the Environmental Appendix A1. Twenty-two EFH designated species are identified to potentially occur within the intertidal and nearshore subtidal zones along the Highlands shoreline, Table 3. Of the 22 EFH designated species, five species (Winter Flounder, Window Pane Flounder, Summer Flounder, Hake, and Scup) have been caught as a result of biological monitoring conducted by USACE (2004a, 2004b) in the Raritan Bay and Sandy Hook Bay.

2.1.9 Socioeconomics

A formal census update of post-Hurricane Sandy demographic information is not currently available. Because of the extensive damage Highlands sustained after the storm, population and income have likely decreased since 2010. See Section 3.1 (Problem Statement) of this report for a description of a study conducted by Rutgers University on the socioeconomic impact of Hurricane Sandy on Highlands.

2.1.9.1 Demographics

The population in Highlands increased from 2,959 to 5,187 between 1950 and 1980, and decreased to 5,005 in 2010 (U.S. Census, 2010). The 2010 median household income was $75,291, (U.S. Census, 2010). The Highlands SRPR (NJ Future, 2014:2) estimated that the median household income was closer to $53,000 in 2012, compared to the median income of $84,746 for Monmouth County overall in the 2010 census. In the 2010 census, about 93% of the Borough's 5,005 residents identified as Caucasian/white. In summary, the residents of Highlands are less affluent and more vulnerable to income disruptions from weather events compared to

Monmouth County overall. Beyond income level, other characteristics that mark socially vulnerable populations are concentrated within the Highlands study area, which correspond roughly to 2010 census block groups 1-4 in Highlands: 143 single parent households, 477 people over the age of 65, and 206 people under the age of 5.

Table 3: Essential Fish Habitat Species in the Study Area.

Common Name	Scientific Name	Life Stage Found at Location
Clearnose Skate	*Raja eglanteria*	Adult, Eggs
Witch Flounder	*Glyptocephalus cynoglossus*	Larvae
Window Pane Flounder	*Scopthalmus aquosus*	Eggs, Larvae, Juvenile, Adult
Winter Skate	*Leucoraja ocellata*	Juvenile
Yellowtail Flounder	*Pleuronectes ferruginea*	Larvae Eggs
Winter Flounder	*Pseudopleuronectes americanus*	Larvae, Eggs, Juvenile
Sandbar Shark	*Charcharinus plumbeus*	Juvenile, Adult
Red Hake	*Urophycis chuss*	Larvae, Juvenile, Eggs
Silver Hake	*Merluccius bilinearis*	Larvae, Juvenile, Eggs, Adult
Bluefin Tuna	*Thunnus thynnus*	Juvenile
Monkfish	*Lophius spp*	Eggs, Larvae
Smooth Dogfish	*Mustelus canis*	
Skipjack Tuna	*Katsuwonus pelamis*	Adult
Tiger Shark	*Galeocerdo cuvier*	Juvenile
Summer Flounder	*Paralichthys dentatus*	Adult, Juvenile, Larvae
Little Skate	*Leucoraja erinacea*	Juvenile
Scup	*Stemotomus chrysops*	Adult, Juvenile Larvae Eggs
Longfin Inshore Squid	*Doryteuthis pealeii*	Juvenile, Adult, Eggs
Bluefish	*Pomatomus saltatrix*	Adult, Juvenile
Atlantic Butterfish	*Peprilus triacanthus*	Larvae, Adult, Juvenile
Atlantic Cod	*Gadus morhua*	Adult
Atlantic Herring	*Clupea harengus*	Adult, Juvenile, Larvae

2.1.9.2 Economy and Employment

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

New development has been generally limited to public use projects such as the ferry terminal project, renovations to upgrade existing residential dwellings, and minor land development.

Of the 234 companies in Highlands, 146 were small businesses, defined as four or fewer employees in the Highlands Strategic Recovery Planning Report (NJ Future, 2014:22), and lack the resources that larger businesses have to survive disruptions. Many of these businesses were severely damaged by Hurricane Sandy. Some have not been able to operate since the storm.

2.1.10 Environmental Justice

In accordance with Executive Order 12898 (dated February 11, 1994), Federal agencies are required to identify and address the potential for disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low income populations.

The Highlands community is not a minority community based on race. According to the US Census (2015), 6.9% of the population considers themselves non-white. The Borough does not have disproportional environmental and health hazards. The Borough has equal access to the decision-making process to have a healthy environment in which to live, learn, and work. All Environmental Indexes for Highlands were in the 6-51 percentile (USEPA 2014). That means that more than 94-49 % have higher indexes than the Highlands.

2.1.11 Cultural Resources

As a Federal agency USACE has certain responsibilities for the identification, protection and preservation of cultural resources that may be located within the Area of Potential Effect (APE) associated with a proposed project. Present statutes and regulations governing the identification, protection and preservation of these resources include the National Historic Preservation Act of 1966 (NHPA), as amended; the National Environmental Policy Act of 1969; Executive Order 11593; and the regulations implementing Section 106 of the NHPA (36 CFR Part 800, Protection of Historic Properties, August 2004). Significant cultural resources include any material remains of human activity eligible for inclusion on the National Register of Historic Places (NRHP).

As established by 36 CFR Part 60, an historical property (generally a property over 50 years of age) is eligible for listing in the National Register if it possesses "integrity of location, design, setting, materials, workmanship, feeling, and association," and it meets at least one of four criteria:

A. It is associated with events that have made a significant contribution to the broad patterns of our history; or
B. It is associated with the lives of persons significant in our past; or
C. It embodies the distinctive characteristics of a type, period, or method of construction, or it represents the work of a master, or it possesses high artistic values, or it represents a significant and distinguishable entity whose components may lack distinction; or
D. It has yielded, or may be likely to yield information important in prehistory or history.

Cultural resource work is coordinated with the New Jersey Historic Preservation Office (NJHPO). The Advisory Council on Historic Preservation, Native American Tribes, other interested parties and the public are given opportunities to participate in the process.

The APE for this undertaking includes all areas directly impacted by activities required to construct project features as well as construction access and staging areas and, as required, environmental mitigation measures (See Chapter 4, TSP Figures 19 and 20 below). The APE also includes viewsheds and landscapes in the vicinity of the alignment.

Archaeological Resources

USACE prepared a Phase IA cultural resources report in 2005 in which archaeological testing of selected locations along the alignment was recommended however the NJHPO, upon reviewing the report, determined that a Phase IB archaeological testing of the alignment as then proposed was not required. As per that opinion USACE will undertake no archaeological testing where the project alignment remains unchanged. The western end of the alignment has been modified since the Phase I study to tie into a new development project. That development is being constructed by others so USACE will undertake no testing there. The eastern end of the alignment has been modified to tie into high ground along Bay Avenue. An archaeological assessment, followed as needed by testing, will be undertaken of that newly proposed section of alignment.

Historic Architectural Resources

The Phase IA report recommended a survey of historic architecture and streetscapes within the APE. In 2007 Panamerican Consultants, Inc, conducted a survey for USACE which identified a number of properties potentially eligible for the National Register of Historic Places (NRHP) (Panamerican Consultants, Inc, 2007) (Table 4).

The report identified the potential Shrewsbury Avenue Historic District comprising five houses on the east side of Shrewsbury Avenue (Numbers 26 - 34). These dwellings were noted as the last of their kind in this area of the New Jersey shore: large, mostly intact, turn-of-the-nineteenth-century residences still standing on sand beaches. Since Hurricane Sandy, the NJHPO has determined that these structures do not comprise an historic district and none of the structures are individually eligible (Michelle Hughes, personal communication, 2015).

The 2007 study identified two groups of bungalows as remnants of what was once a larger collection of bungalow/cottage communities within Highlands and the NJ shore in general. Honeysuckle Lodge (between Atlantic and Cedar Street) is a large intact group of bungalows while 58 Fifth Street consists of a small row of bungalows. The authors of the 2007 report noted that there is a lack of context for these middle-class bungalow and cottage communities on the New Jersey shore and they suggest that should a multiple property nomination be prepared these two properties should be included. Bungalow and cottage communities were an important part of summer life on the Jersey Shore, in the Highlands, and for thousands of vacationers, primarily from New Jersey and New York. These communities were an inexpensive answer to the questions of where and how to escape the heat, humidity, and monotony of summer in the big cities of New Jersey and New York. Many of these properties are long gone and those remaining are being lost to storms damage and development. These two properties have not yet received a determination of individual eligibility from NJHPO.

Table 4: Identified Properties within the APE and NRHP-eligibility Determinations

Name	Address	NRHP Eligibility
Honeysuckle Lodge	Between Atlantic and Cedar Street	Potentially eligible
58 Fifth Street Bungalows	58 Fifth Street	Potentially eligible
Shrewsbury Avenue District	26 – 34 Shrewsbury Avenue	Not eligible
Clam Shanty	Bay end of Miller Street	Not eligible
Bay Avenue Historic District		Potentially eligible
The following Bay Avenue properties may be found to be contributing elements to the potential Bay Avenue Historic District. Individual eligibility is given below for each structure.		
Creighton Hotel (FLoBar Apartments)	24 Bay Avenue	Potentially eligible
Sculthorpe's Auditorium (the "Purple Building")	78 Bay Avenue	Potentially eligible
Sasha's Boutique Outlet	1 Bay Avenue	Not eligible
Bahrs Real Estate	15 Bay Avenue	Not eligible
Mewes Bros. Dairy	19 Bay Avenue	Not eligible
Sears, Roebuck & Co. kit house	257 Bay Avenue	Not eligible
Dwelling	60 Bay Avenue	Potentially eligible
Bahr's Landing Restaurant and Marina	2 Bay Avenue	Eligible

The NJHPO conducted a "windshield survey" of above ground resources immediately following Hurricane Sandy. The survey was limited to the areas that experienced surge from the storm. This survey identified for the Federal Emergency Management Agency (FEMA) and others involved in disaster recovery areas of known historic resources, potential historic properties/districts and properties/districts that were not likely to be significant. This survey identified four locations along the Highlands shoreline that had the potential for significant resources. One of the parcels was Honeysuckle Lodge, discussed above. The three other parcels identified in the windshield survey were surveyed in 2007 and no significant structures were identified.

The NJHPO windshield survey highlighted three structures on Bay Avenue. It must be noted that the survey did not extend far onto Bay Avenue due to survey limits associated with the storm surge. While Bay Avenue was also outside the immediate USACEUSACE study area and APE at the time of the 2007 survey, the authors noted that this mixed-use main artery of

Highlands had the potential to be a historic district but it was not considered in any detail as it was outside of the APE.

One structure noted by both surveys was 78 Bay Avenue, (Sculthorpe's Auditorium), also known as the "Purple Building" due to its paint color. It was built in 1909 and was the first theater in Highlands dedicated exclusively to stage and motion picture entertainment. No NRHP-eligibility assessment was given for this structure by either survey. Also noted in the windshield survey was the 24 Bay Avenue. The structure was built c. 1907 as the Creighton Hotel and is now the FLoBar Apartments. It is one of few remaining middle-class, pre-WWII hotels on the New Jersey shore that retains any integrity and was determined potentially individually eligible. The other structure noted in the windshield survey is 60 Bay Avenue which is included in the 2007 report but was also not given an evaluation of eligibility. As indicated in the 2007 report, previous studies by others determined that Sasha's Boutique Outlet (1 Bay Avenue), Bahrs Real Estate (15 Bay Avenue), and Mewes Bros. Dairy (19 Bay Avenue) were not eligible for the NRHP but may be determined to contribute to the Bay Avenue Historic District. At 2 Bay Avenue is Bahr's Landing Restaurant and Marina which is an NRHP-eligible property located 500 feet east of the APE.

Two properties in the APE were identified by the Borough of Highlands in its Master Plan as historically interesting; a Sears, Roebuck & Co. kit house at 257 Bay Avenue and the former clam-processing plant (Clam Shanty) at the end of Miller Street. They were both determined by the 2007 survey as too altered and lacking integrity to be individually NRHP-eligible.

The Twin Lights (Navesink Lighthouse) National Historic Landmark (NHL) and the Water Witch Casino, an NRHP-listed property, are on high ground rising above the Borough of Highlands approximately one mile west of the APE. The NRHP-listed Fort Hancock and Sandy Hook Proving Grounds Historic District and the Sandy Hook Lighthouse NHL are located approximately three miles north, across Sandy Hook Bay, from the APE. While well outside the APE, sections of the alignment are within the viewsheds of these historic properties.

2.1.12 Coastal Zone Management

The State of New Jersey administers its federally approved coastal zone program through the NJDEP, Land Use Regulation Program (LURP). Pursuant to the Federal Coastal Zone Management Act (CZM), New Jersey has defined its coastal zone boundaries and developed policies to be utilized to evaluate projects within the designated coastal zone, as set forth in New Jersey's Rules on CZM (N.J.A.C. 7:7, 7:7E, dated July 18, 1994 and addendum to 7:7E-5 and 7:7E-8.7, dated August 19, 1996). The Waterfront Development Law (N.J.S.A. 12:5-3) and related requirements (N.J.A.C. 7:7-23) provide the authority for issuance of permits for, among other activities, the placement or construction of structures, pilings, or other obstructions in any tidal waterway.

As a Federally funded project within the coastal zone of New Jersey, the Highlands project must be reviewed by the NJDEP for consistency with the policies of the New Jersey State CZM Plan. These applicable policies, along with an impact analysis and consistency determination are discussed within the environmental consequences section of this report as well CZM consistency review (state and local) that is presented in the Appendix A2.

2.1.13 Floodplains

Highlands has been classified as a "Special Flood Hazard Area" inundated by the 100-year flood (Figure 9). The topography of Highlands is flat for approximately 1,500 ft inshore to the base of

a steep grade. Severe storm events have historically caused extensive flooding and significant damages to the housing, property, and community infrastructure in the Highlands community (USACE 1993).

As previously described, the bay shoreline is subject to frequent storm surges and tidal inundation. It presently provides coastal storm risk management to inland areas against moderate storm surges and serves as a community recreational area. However, these values are diminished by continual erosion of the beach and dune in the small areas where they exist.

2.1.14 Land Use and Zoning

The current land use in the Highlands consists primarily of small beaches, developed residential areas, and public and private access to the bay. Residential areas cover the majority of the study area, including the areas abutting the beach.

The majority of land in the immediate project area contains residential (~70% of Borough area) and commercial and marine development (~30% of Borough area) within the low-lying areas along the Sandy Hook Bayshore (NJ Future, 2014). The local marinas, restaurants and ferry slips along the shoreline represent an important regional commercial resource. Highlands is a well-developed and densely populated area. Of the 3,039 housing units within the Borough, 2,434 units are occupied year round (Census 2010). The 2010 population of 5,005 and the borough area of 0.77 square miles yield a population density of 6,500 persons per square mile.

2.1.15 Hazardous, Toxic, and Radioactive Waste

A search of Federal and state environmental databases was conducted for a corridor study along the shoreline. The researched area was approximately one mile west, east, north, and south of the proposed shoreline. Governmental agency records were reviewed for information that would be helpful in determining the environmental status, the presence, or potential of hazardous, toxic, or radioactive waste (HTRW) contamination. Because regulated facilities may impact other properties, it was also necessary to review governmental records for the surrounding area.

Skippers Landing at 52 Shrewsbury Avenue, Schupp's Landing at 12 Bay Avenue, a property at 16 Bay Avenue, and Bahr's Landing at 2 Bay Avenue contain underground storage tanks (UST) within 400 ft of the shoreline alignment. None of these sites has violations or is in the maintained database of leaking USTs (LUST). The Dry Dock Café, Inc. at 50-52 Shrewsbury Avenue, Gulf Service Station at 116 Bay Avenue, and Ocean View Apartments at 18 Navesink Avenue are listed in the LUST database. The Dry Dock Café appears to be located within 400 ft of the shoreline. It is listed on the state release and spills databases. The LUST incident occurred in October of 1993 and the removal of the 550-gallon LUST containing oil waste was completed.

On May 30, 2002, USACE personnel along with a driller from Fort Monmouth conducted a series of subsurface sampling along the shoreline of Highlands (Fort Monmouth 2002). Sample points were determined as most likely locations for storm risk reduction measures. The proposed depth of construction for these measures determined the depth of sample collection. Ten samples were collected from depths ranging from 7.5 to 11.5 ft below top of boring. The samples were analyzed for volatile organics (VOAs), pesticides, polychlorinated biphenyls (PCB), and Resource Recovery and Conservation Act (RCRA) metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver.

Analytical results for VOAs showed nothing of concern and any results were reported in the parts per-billion-scale (ppb). Two compounds, acetone and 2-butanone were detected in all samples but at very low levels. The only other compound detected was methyl tertiary butyl ether (MTBE). The location of the sample that contained this compound previously contained an underground gasoline storage tank. The tank was removed from the site several years before this sampling event took place. The level of MTBE was 0.380 ppb.

The compounds acetone and 2-butanone ranged in quantities of 1.3 and 4.7 ppb. Combining the values of the two compounds on a per sample basis and the total, VOA levels ranged from 6.8 and 2.5 ppb, well below the New Jersey soil clean-up level for VOAs is a combined VOA level of 1,000 ppm1000 ppb.

There were no detections of pesticides or PCBs in any of the samples.

There were no detections exceeding the 20 part per million (ppm) clean-up criteria set by the state of New Jersey, of the RCRA metals in any of the samples. Arsenic did come close at 19.7 ppm. There are geologic formations in this part of New Jersey that have naturally occurring high levels of arsenic that exceed the threshold and could be the cause of the high arsenic levels. The state policy of this issue is on a case-by-case basis.

2.1.16 Aesthetic and Scenic Resources

The shoreline of Highlands is composed primarily of bulkheads, which range in elevation from around +5 ft NAVD88 at low points to approximately +9 ft NAVD88 at the highest point, which provides relatively unobstructed views of Sandy Hook and Shrewsbury River. Small marinas, restaurants, and houses characterize the shoreline. Small beaches with public access are also located in the Borough, and provide for recreational opportunities for residents and visitors.

2.1.17 Recreation

The small beaches provide access to the water for recreation. Recreational fishing charters and sightseeing are available from the local marinas. Many individuals and business have private docks providing access to boating. The Henry Hudson Trail begins along the western section of the study area and links to the Township of Aberdeen.

2.1.18 Air Quality

In accordance with the Clean Air Act of 1977, as amended, the USEPA developed National Ambient Air Quality Standards (NAAQS) to establish the maximum allowable atmospheric concentrations of pollutants that may occur while ensuring protection of public health and welfare, and with a reasonable margin of safety.

The USEPA measures community-wide air quality based on daily measured concentrations of six criteria air pollutants; carbon monoxide, sulfur dioxide, respirable particulate matter, lead, nitrogen dioxide, and ozone. Based on these measurements of air quality, the USEPA designates attainment areas and non-attainment areas nationwide. Non-attainment areas are designated in areas where air pollution levels persistently exceed the national ambient air quality standards.

Based on the NAAQS, Monmouth County is located in the New York, Northern New Jersey, Long Island, Connecticut, nonattainment area, which is currently classified as "marginal" nonattainment for the 2008 8-hour ozone standard. The nonattainment area is part of the

Ozone Transport Region. Ozone is controlled through the regulation of its precursor emissions, which include oxides of nitrogen (NOx) and volatile organic compounds (VOCs).

2.1.19 Noise

Noise is defined as unwanted sound. The day-night noise level (Ldn) is widely used to describe noise levels in any given community (USEPA 1978). The unit of measurement for Ldn is the "A"-weighted decibel (dBA), which closely approximates the frequency responses of human hearing. The primary source of noise in the study area is vehicular traffic on local roadways and local construction projects that may be underway. The Seastreak Ferry service to Manhattan also contributes noise. Although noise level measurements have not been obtained in the study area, they can be approximated based on existing land uses. The typical Ldn in residential areas ranges from 39 to 59 dBA (USEPA 1978). It is assumed that the existing sound levels in the study area are roughly within this range.

2.2 The Built Environment

The built environment is the human-made surroundings that provide the setting for human activity such as roads, homes, and businesses. It is the human-made space in which people live, work, and recreate on a day-to-day basis. Humans have greatly influenced the heavily-developed Borough.

2.2.1 Shoreline Condition

Historically, the bayshore played the role as a market and distribution center for the agricultural goods produced on the fertile soils of the county's interior. The bayshore's local commercial resources were developed for these uses. The majority of the study area presently contains mixed-use residential, commercial, and marine development within low-lying areas along the bayshore. Shoreline businesses represent those associated with fishing (clams, finfish), recreational charters, and sightseeing, and include some "dock and dine" restaurants. Commercial fleets use marinas to store boats and equipment, and to access Sandy Hook Bay.

The shoreline of Highlands is composed primarily of bulkheads, which range in elevation from around +5 ft NAVD88 at low points to approximately +9 ft NAVD88 at the highest point, and small beaches with public access. Small marinas, restaurants, and houses characterize the shoreline. The existing beaches and bulkheads are relatively stable, although there is a small portion of deteriorated timber bulkheads which are in need of repair. Based on the Raritan Bay and Sandy Hook Bay Reconnaissance Report (USACE, 1993) and recent field visual site inspection, the existing shoreline and beaches are relatively unchanged from 1993 due to the hardened condition of the shoreline.

2.2.2 Structures

The extension of a rail line from Atlantic Highlands through Highlands and along Sandy Hook and Sea Bright to Long Branch in the mid-1800s resulted in the development of Highlands as a summer resort. Throughout the late nineteenth and twentieth century's, Highlands grew from summer tent colonies and summer bungalows into a year-round residential community with many commercial structures. A number of bungalow neighborhoods still exist in Highlands. Most homes and businesses are still located in the relatively low-lying downtown area. The majority of development within the Borough is more than 50 years old and was constructed prior to the implementation of the National Flood Insurance Program and adoption of the associated Flood Plain Management Regulations.

2.2.3 Access Routes

Access to Sandy Hook across the Shrewsbury River from Highlands was originally via ferry. The first Highlands Bridge was built across the river in 1872 to carry pedestrian and carriage traffic. The Central Railroad purchased the bridge and remodeled it to accommodate trains, vehicles and pedestrians in the late nineteenth century. Waterfront access remains critical to the Borough's economy and residents. Commercial and recreational boats use Sandy Hook Bay to access Raritan Bay, Lower Bay, the Atlantic Ocean, and the Shrewsbury and Navesink Rivers. Residents and visitors use the SeaStreak ferry to travel to and from Manhattan.

Highlands is connected to other areas in the New York metropolitan area through a network of Federal and state highways. The Garden State Parkway and NJ-9 run northward to New York State and southward to Cape May, New Jersey. NJ-287 extends westward beyond Middlesex County, and the New Jersey Turnpike provides additional north-south access. NJ-36 is the primary evacuation route. Shore Drive and Bay Avenue are the main downtown roads. They are severely flooded during storm events, as are the local roads that feed into the main roads and evacuation routes.

2.3 The Human Environment (Community Resources)

Community resources refer to the social make-up of a community. Beyond population, housing, demographics, employment, income, community resources also include public services.

2.3.1 Public Services

Public services include schools, local government, police departments, fire departments, and emergency and medical services. Within the study area, there were the Borough Hall with a police station, Emergency Medical Services buildings, the Fire Department, the Department of Public Works facilities, four pump stations, and the Highlands Elementary School and the Henry Hudson Regional High School.

2.3.2 Community Facilities

Community facilities include parks and recreational areas, hospitals, libraries, community centers, and churches. There are two parks within the study area: Veteran's Waterfront Park and Huddy Park. In addition, the Robert D. Wilson Community Center, which also served as the library, are located within the study area.

2.3.3 Community Cohesion

Community cohesion refers to the common vision and sense of belonging within a community that is created and sustained by the extensive development of individual relationships that are social, economic, cultural, and historical in nature. The resilience of a community is directly tied to its degree of community cohesion. Anecdotally, the majority of families in the study area can trace their residence in Highlands back at least three generations. It is a stable, working-class community with churches, schools, and businesses. The Robert D. Wilson Community Center and the Veteran's Waterfront Park serve as a primary community meeting locations. Both locations were heavily damaged by Hurricane Sandy. After the storm, residents of Highlands demonstrated their community cohesion by helping each other and actively participating in coordination of recovery efforts

2.4 Describing Storms and Flood Levels

Floods are often defined according to their likelihood of occurring in any given year at a specific location. The most commonly used definition is the "100-year flood." This refers to a

flood level or peak that has a 1 in 100, or 1 percent chance of being equaled or exceeded in any year (i.e., 1 percent "annual exceedance probability"). Therefore, the 100-year flood is also referred to as the "1 percent flood," or as having a "recurrence interval" or "return period" of 100 years.

A common misinterpretation is that a 100-year flood is likely to occur only once in a 100-year period. In fact, a second 100-year flood could occur a year or even a week after the first one. The term only means that that the average interval between floods greater than the 100-year flood over a very long period (say 1,000 years) will be 100 years. However, the actual interval between floods greater than this magnitude will vary considerably.

In addition, the probability of a certain flood occurring will increase for a longer period of time. For example, over the life of an average 30-year mortgage, a home located within the 100-year flood zone has a 26 percent chance of being flooded at least once. Even more significantly, a house in a 10- year flood zone is almost certain to be flooded at least once (96 percent chance) in the same 30-year mortgage cycle. The probability (P) that one or more of a certain-size flood occurring during any period will exceed a given flood threshold can be estimated as

$$P = 1 - \left[1 - \frac{1}{T}\right]^n$$

where *T* is the return period of a given flood (e.g., 100 years, 50 years, 25 years) and n is the number of years in the period. The probability of flooding by various return period floods in any given year and over the life of a 30-year mortgage is summarized in Table 5.

Table 5: Examples of Flooding by Various Return Periods

Return Period (years)	Chance of flooding in any given year	Percent chance of flooding during 30-year mortgage
10	10 in 100 (10%)	96%
50	2 in 100 (2%)	46%
100	1 in 100 (1%)	26%
500	0.2 in 100 (0.2%)	6%

Because of the potential confusion, recent USACE guidance documents and policy letters recommend use of the annual exceedance probability terminology instead of the recurrence interval or return period terminology. For example, one would discuss the "1-percent-annual-exceedance-probability flood" or "1-percent-chance-exceedance flood," which may be shortened to "1 percent flood" as opposed to the "100-year flood." This report uses the short form "1 percent flood."

2.4.1 Water Surface Elevation

Stage-frequency curves for existing conditions were acquired from FEMA for the study area. The FEMA curves were adjusted to present the stage data into the North Atlantic Vertical Datum of 1988 (NAVD88) datum, because the FEMA curves are referenced to Mean Sea Level (MSL), which

is a difference of 0.24 ft from NAVD88.[3] The Sandy Hook gauge is close to the Highlands study area. The FEMA stage and wave frequency curves for a range of return periods, from the 20 percent flood to the 0.1 percent flood, are presented in Table 6.

The estimate of a 0.5 percent flood (190 year storm) for Hurricane Sandy was based on pre-Hurricane Sandy USACE stage-frequency curves. As stated earlier in this section, adjusted FEMA curves, which incorporated the Hurricane Sandy event, were used in the current analysis. Project optimization will include the newly developed USACE stage frequency curves from the North Atlantic Coast Comprehensive Study (NACCS).

Table 6: FEMA Stage and Wave Frequency Data for Existing Conditions

Chance of flooding in a given year	FEMA 2014 Offshore Node 395391 Mean Still Water Elevation in +ft NAVD88	2014 Average Onshore Mean Still Water Elevation in +ft NAVD88 including wave effects	Significant Wave Height, Hs, in ft	Peak Wave Period, Tp, in seconds
20%	6.6	7.9	2.8	3.8
10%	7.9	8.3	3.1	3.9
6.7%	8.6	8.9	3.3	4.0
5%	9.1	9.3	3.4	4.0
4%	9.5	9.7	3.5	4.1
2%	10.6	10.8	3.7	4.2
1.3%	11.3	11.5	3.9	4.3
1%	11.9	12.0	4.0	4.3
0.4%	13.6	13.8	4.6	4.5
0.2%	15.0	15.3	4.8	4.7
0.1%	16.4	16.8	5.1	4.8

2.4.2 Sea Level Change

Sea level change (SLC) is a change in the mean level of the ocean. Relative or "local" sea level change (RSLC) is the locally observed change in sea level relative to a fixed point. It is the additive effect of global or "eustatic" sea level rise if 1.7 millimeters (mm) per year, and the subsidence or uplift rate at a fixed point. RSLC considers the effects of (1) the eustatic, or global, average of the annual increase in water surface elevation due to the global warming trend, and (2) the "regional" rate of vertical land movement (VLM) that can result from localized geological processes, including the shifting of tectonic plates, the rebounding of the Earth's crust in locations previously covered by glaciers, the compaction of sedimentary strata and the

[3] Mean Sea Level is a tidal datum and reflects the average of hourly heights observed over the National Tidal Datum Epoch (NTDE), each of which lasts 19 years, as defined by the National Ocean Service. The current NTDE is 1983 through 2001. The North Atlantic Vertical Datum (1988) is a geodetic datum, which is defined by the National Geodetic Survey (NGS) as "A set of constants (bench marks) used for calculating the coordinates of points on the Earth." Geodetic datum relationships to tidal datums are established at tide stations by connecting tidal bench mark networks to the National Spatial Reference System (NSRS) maintained by NGS. http://www.ngs.noaa.gov/datums/vertical/

withdrawal of subsurface fluids. USACE projects must consider sea level change when planning and designing projects, per Engineering Regulation (ER) 1100-2-8162.

The Department of the Army Engineer Regulation ER 1100-2-8162 (31 Dec 2013) requires that future sea level rise (SLR) projections must be incorporated into the planning, engineering design, construction and operation of all civil works projects. The study team should evaluate the proposed alternatives in consideration of the "low," "intermediate," and "high" potential rates of future SLR for both "with" and "without project" conditions. This range of potential rates of SLR is based on findings by the National Research Council (NRC, 1987) and the Intergovernmental Panel for Climate Change (IPCC, 2007). The historic rate of future sea-level rise is determined directly from gauge data gathered in the vicinity of the study area. Tide conditions at Sandy Hook (National Oceanic and Atmospheric Administration (NOAA) Station #8531680) best represent the conditions experienced in Highlands. A 75-year record (1932 to 2006) of tide data gathered at Sandy Hook, NJ indicates a mean sea level trend (eustatic SLR + the local rate of VLM) of +3.96 mm/year, or 0.014 ft/year (Figure 8).

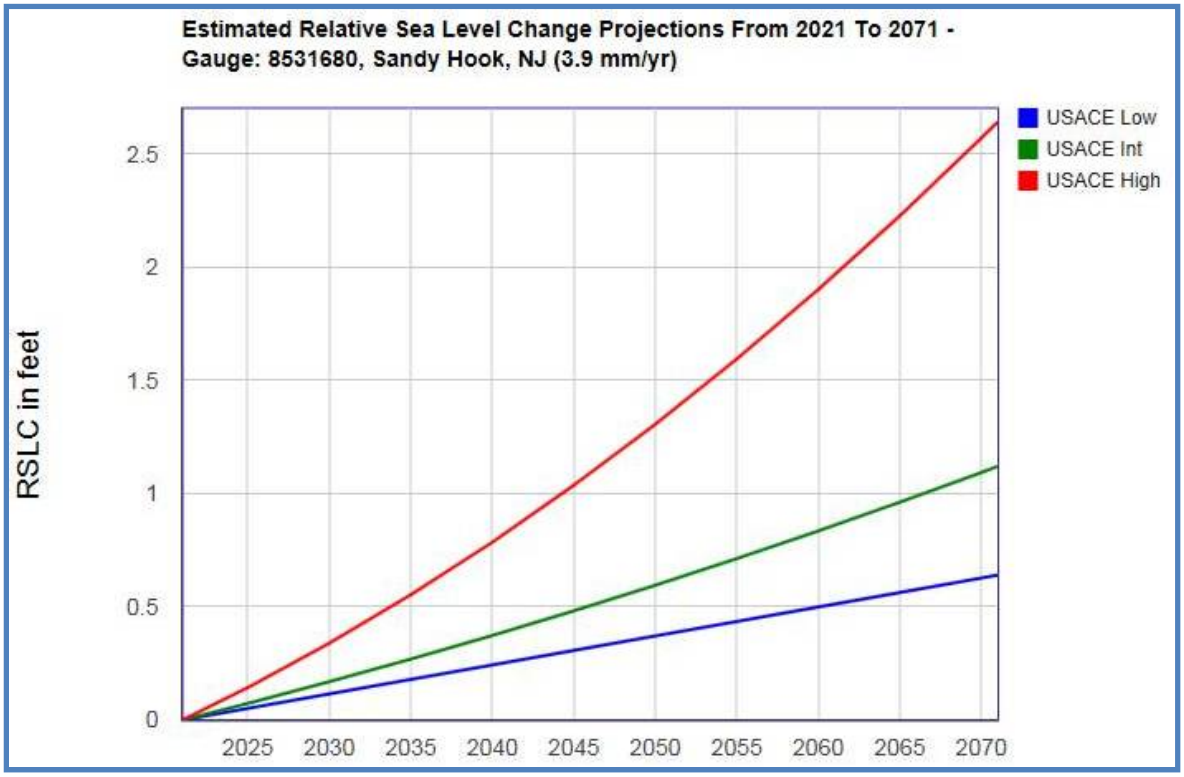

Figure 8: Relative sea level rise at NOAA Sandy Hook gage

Chapter 3: Plan Formulation

Planning plays a vital role in supporting the USACE Civil Works water resources development mission. Through planning activities, including feasibility studies, USACE study teams help decision-makers identify water resources problems, conceive solutions to them and compare the importance of the inevitable conflicting values inherent in any solution. The 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Implementation Studies (Principles and Guidelines) lay out an iterative 6-step planning process that is used for all USACE Civil Works studies, including the North Atlantic Coast Comprehensive Study (NACCS) CSRM framework (USACE 2015). The study team followed this planning process, as described in this chapter, to choose a Tentatively Selected Plan.

3.1 Problem Statement

Problem definition is the detailed description of a problem. It begins with a problem statement, a simple assertion of the basic problem.

Problem statement: *The community of Highlands experiences damages from flooding and shoreline erosion due to coastal storms including tropical storms, hurricanes, and nor'easters.*

The primary problem encountered in the study area is coastal flooding associated with elevated water levels. Although nuisance flooding can occur during periods of high astronomical tides or minor storms, severe flooding damage results from tropical storms, hurricanes, and nor'easters. Due to the geographic setting known as the New York Bight and the offshore topography in the NY and NJ region among other meteorological factors, the surge potential is very high in Highlands during extreme coastal storms.

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), virtually all of Highlands has been classified as a "Special Flood Hazard Area" inundated by the 1 percent flood (base flood) (Figure 9). The Base Flood Elevation (BFE) in the AE zone is +11 ft NAVD88, and the BFE in the VE zone ranges from +12 ft NAVD88 to +15 ft NAVD88. To regulate land development in the floodplain, Highlands enforces the Highlands Flood Damage Prevention Ordinance (0-99-11 Part 7, Article XXIV of the Zoning Ordinance, adopted August 18, 1999), which has a primary purpose to prevent construction and development from increasing flooding as well as to ensure public safety and reduce property damage. The ordinances and regulations call for elevating buildings one foot above the BFE for both new construction projects and substantial improvements to existing structures.[4]

Highlands has a history of devastating flood damages. In general, flooding due to storm surges occurs over a large area of the Borough paralleling the low-lying Sandy Hook Bay shoreline and where flood waters propagate up and restrict flow from tributary storm drainage systems. The low-lying flooded area extends along the entire Borough from the northwest to southeast boundaries and includes a combination of residential and marine-based commercial buildings. Of the 1,100 structures in the 1 percent floodplain, approximately 900 structures are at or below elevation +8 ft NAVD88, subjecting them to severe flood damages.

[4] http://www.highlandsnj.us/docs/Ordinance/2013/O-13-05%20ABFE%20Amended%20Ordinance%20-%20Adoption.pdf

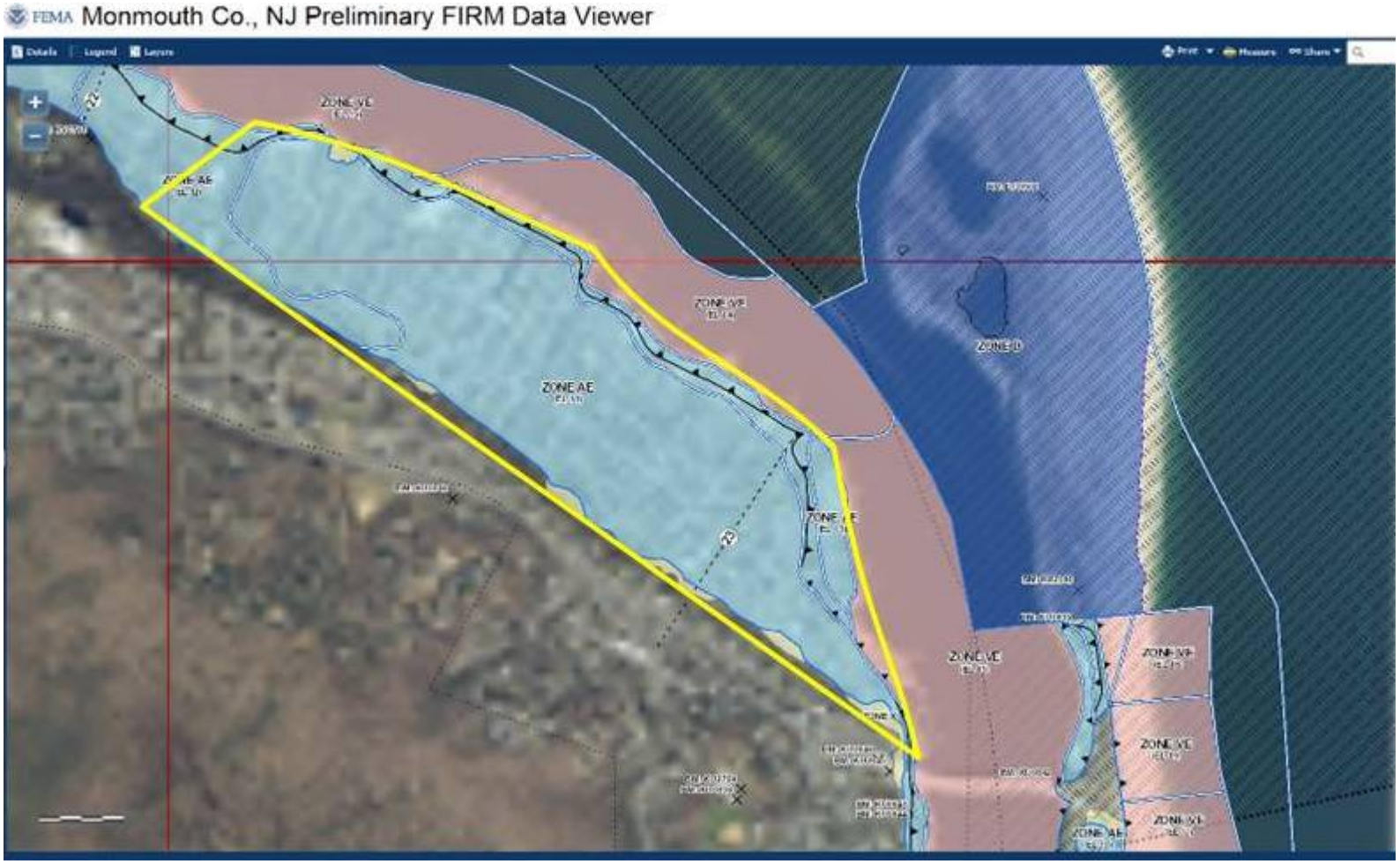

Figure 9: FEMA Preliminary Flood Insurance Rate Map (2015) for Highlands

Problems also exist with drainage of storm water through the inland areas of the Borough's storm water systems. Storm water drainage from 260 acres of upland and 240 acres of lower inland tributary areas concentrates by ponding in depressed inland areas. Four pump stations already exist to provide discharge of the storm water pipe systems from these areas into the Bay. Flooding resulting from elevated flood stages further exacerbates this problem. During Hurricane Sandy, four pump stations in Highlands – Waterwitch Avenue, Barberie, South Bay Avenue, and North Street were submerged in six to eight ft of floodwaters and heavy debris (NJ Future, 2014).

Many low-lying roadways are flooded during severe storm events cutting off access to this large portion of Highlands. Access through the Borough is limited to the upper arterial roadways including Bayside Drive, Linden Avenue, State Highway 36, and Portland Road, as local streets are flooded, cutting off access to evacuation routes. During Hurricane Sandy and other recent storms, access in and out of the low-lying areas of the Borough was impossible during flood events. Residents were unable to leave during the storms and businesses were closed for weeks. Closure of the roads made post-storm recovery very difficult and created a major safety hazard.

Public services in Highlands were curtailed because of the flood damages to the Borough Hall, the Fire Department, and Emergency Medical Services and Department of Public Work facilities. Borough Hall has been temporarily relocated to a less central location, which has affected its ability to provide services. The Robert D. Wilson Community Center, which also served as a library, was closed due to flood damages. There are no other community centers/libraries within the study area. The Veteran's Waterfront Park and Huddy Park also sustained severe damages from Hurricane Sandy.

There are significant concentrations of socially vulnerable populations within the study area. This description of Hurricane Sandy's impact on the residents of Highlands is from the Strategic Recovery Planning Report (SRPR) (2014:8):

> *A recently-completed analysis by Rutgers University revealed that Highlands Borough lost power for 12 days and that the amount of lost wages of residents totaled over $17,800,000.*[5] *Moreover, the analysis identified the impact of Sandy on the most vulnerable households (defined as "those working families that do earn enough to afford a basic household survival budget," or so-called ALICE (Assisted Limited Income Constrained, Employed) households). Highlands was among the top 30 municipalities in the state for Sandy's impact on these households. These households experienced total lost wages in excess of $1,500,000 from the storm. In addition, 70% of these households did not have property insurance, further exacerbating Sandy's impact. According to Rutgers data, these vulnerable households only received an average of $3,770 in FEMA Individual Assistance funds.*

As described in Section 2.1.9 (Socioeconomics) of this report, the Highlands economy had seen little growth prior to Hurricane Sandy, which rendered some of its residents even more financially vulnerable by displacing them from their homes or forcing businesses to close, whether temporarily or permanently.

[5] Halpin, Stephanie Hoopes; The Impact of Hurricane Sandy on New Jersey Towns and Households; Rutgers School of Public Affairs and Administration; n.d

3.2 Future Without Project Conditions

The future without project condition serves as the base conditions for all the alternative analyses. The future without project conditions at Highlands within the period of analysis (2021-2071) are identified as continued flooding and wave impacts from future storm episodes, and continued maintenance and reconstruction of coastal storm risk management facilities following storm events. Future Without Project Conditions are organized by the environmental setting, the built environment, and the human environment.

3.2.1 Future Without Project Conditions for the Environmental Setting

In the absence of Federal action, the condition of wetlands, air quality, flora & fauna, threatened and endangered species, cultural resources, and HTRW is expected to remain consistent with current conditions. Because Highlands is so built out, there are few developmental opportunities remaining.

The trend of sea level rise in the study area is expected to continue into the future. The predicted "low," "intermediate," and "high" rates of sea level change were calculated for Sandy Hook for 2021 through 2071, the period of analysis (ER 1100-2-8162). Figure 8, above, shows the low, intermediate, and high estimates for sea level rise based on the Sandy Hook gauge through the 50-yr period of analysis (2021-2071). Under the low scenario, sea level is projected to rise by 0.64 ft within the period of analysis. Under the intermediate scenario, sea level is projected to rise by 1.12 ft. Finally, under the high scenario, sea level is projected to rise 2.64 ft.

3.2.2 Future Without Project Conditions for the Built Environment

Because the downtown area is almost entirely developed, there is little opportunity for new expansion. Homeowners and businesses continue to rebuild structures flooded by Hurricane Sandy. Owners of substantially damaged properties (more than 50% damaged,[6] as defined by the local floodplain manager) are required to rebuild flooded structures one foot above the base flood elevation. Homes and businesses would continue to be at risk of flooding and damage from coastal storms. The Paradise Trailer Park at the western end of the study area was largely destroyed by Hurricane Sandy. It is currently under re-development, and the developer has been in coordination with the Borough administration and USACE. The resulting condominium development will have an elevated bulkhead that would tie into the USACE project.

Many users are dependent on present access routes. Because of this, street routes and ferry service will likely not change in the future. Shore Drive, Bay Avenue, and other local roads would continue to be at risk of flooding and damage from hurricanes and coastal storms, which may cause a life and safety hazard to the community.

3.2.3 Future Without Project Conditions for the Human Environment

Post-Hurricane Sandy recovery is expected to continue in the immediate future, as laid out in the Highlands SRPR. Local efforts will focus on stormwater drainage improvements and more rigorous enforcement of zoning and code requirements, building redundancy and resiliency into the Borough's administration and services, redevelopment studies, and examining the continued economic viability of clamming in the bay. It is unclear if the Borough has the resources to undertake all of the initiatives. The current USACE study is complementary to these efforts.

[6] When the value of the repairs exceeds 50% of the market value of the structure

3.2.4 Estimate of Future Without Project Damages

In the estimate of damages, the stage versus damage data was combined with stage versus frequency data using the HEC-FDA (Hydrologic Engineering Center – Flood Damage Analysis) program. The HEC-FDA program quantifies uncertainty in discharge-frequency, stage-discharge, and stage-damage functions and incorporates it into economic and performance analyses of alternatives. The process applies a procedure (Monte Carlo simulation) that computes the expected value of damage while accounting for uncertainty in the basic value. The HEC-FDA program presents results for expected annual damages and equivalent annual damages. Under current USACE guidance, risk and uncertainty must be incorporated into coastal storm risk management studies. The following areas of uncertainty were incorporated into the HEC-FDA program:

- stage frequency
- first floor elevation
- depreciated structure value
- content-to-structure value ratio
- other-to-structure value ratio

The economic analysis includes the existing risk management afforded by high shorefront elevations and bulkheads. Because damages are limited until the storm surge overtops the existing bulkhead or high ground, the analysis of existing conditions considers a levee as part of existing conditions along the shorefront. This levee allows the existing level of risk management to be taken into account when calculating project damages. The high ground elevation along the shorefront varies, but inundation will occur when water overtop the bulkheads at the lowest elevations, identified as +5 ft NAVD88. Under existing conditions, it is assumed that no damages result until water levels exceed the crest of this structure. Once water levels exceed the crest of the bulkheads, however, they are trapped within study area by these same bulkheads, prolonging the duration of the inundation and exacerbating flood damages.

The estimated annual equivalent damages from coastal storm inundation and wave damage are limited to structure, content, and other damages at specific buildings and vehicular damages. Expected annual equivalent damages for the future without project condition are $11,450,000. More details on the identification of future without project damages are in the Economics Appendix.

3.3 Key Uncertainties

Limitations to the quantity and quality of information result in uncertainties. The study team dealt with three major uncertainties.

1. RSLC projections: The historic rate of relative sea level change (RSLC) was assumed for the Highlands study. The historic rate of RSLC is 0.7-foot increase over the 50-year period of analysis (RSLC). In future years this will result in more frequent and higher stages of flooding. In the optimization of the TSP, formulation will account for how the project would perform under the intermediate and high rates of projected RSLC, consistent with the ER 1100-2-8162. Analysis of the intermediate and high rates of RSLC may affect the physical dimensions of the project, but would not affect the selection of the TSP.

2. Operations, Maintenance, Repair, Rehabilitation & Replacement (OMRR&R): Some coastal storm risk management measures that preserve waterfront access (removable flood wall,

buoyant swing gates) will require intensive operations and maintenance from the non-Federal Partner. It is unclear in this economic climate that the non-Federal partners will have the resources to provide the necessary OMRR&R for some of the measures to reliably meet the objectives of managing flood risk and associated damages. The study team focused its efforts on identifying the full costs of OMRR&R measures needed to avoid failure (personnel and equipment back-ups, pre-emptive project operation, etc), so that the true OMRR&R costs for these alternatives have informed the plan formulation.

3. Waterfront access: Waterfront access is important for the residents of Highlands. While the public is generally supportive of the features of the TSP, some have expressed concerns about how they will access the water. USACE and NJDEP hosted a series of meetings with the public to discuss public access options in spring 2014. Approximately seven meetings were held for the 107 property owners and businesses from whom easements would be required. To date, local feedback has not led to substantial design alterations.

3.4 Opportunities

Opportunities to solve problems in the study area have been identified by the study team. There are **opportunities** in Highlands to:

1. *Reduce coastal storm risk to residents, property, and infrastructure.*
2. *Reduce storm-induced shoreline erosion damages.*
3. *Reduce damages from wave action.*

The greatest need in the study area is for effective coastal storm risk management that provides acceptable levels of risk reduction from the impacts of storm inundation. Due to the low elevations of the land along the bayfront, as well as the dimensions of existing CSRM structures, effective coastal storm risk management against high surge from Sandy Hook Bay is a necessary component of a complete coastal storm risk management plan. Many roadways providing access within the study area are subject to frequent flooding, limiting transportation during flood events.

3.5 Federal Action

The Disaster Relief Appropriations Act of 2013, Public Law 113-2 (P.L. 113-2), directed the USACE to address damages caused by Hurricane Sandy and to reduce future flood risk in ways that will support the long-term sustainability of communities such as Highlands. This feasibility study was completed pursuant to this mission.

Per the 1983 Principles and Guidelines, the Federal objective of water and related land resources project planning is to "contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements." Water and related land resources project plans are formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. Contributions to National Economic Development (NED) are increases in the net value of the national output of goods and services.

3.6 Planning Goal

A study goal based on problems and opportunities was developed to help create and evaluate alternative plans. It is the overarching intent of the project.

Goal: Reduce the risk of flooding and associated damages caused by storm surge due to coastal storms that impact Highlands.

3.7 Planning Objectives

Plans are formulated to achieve planning objectives. Planning objectives and constraints are inexorably linked to problems and opportunities. A planning objective states the intended purposes of the planning process. It is a statement of what solutions should try to achieve. Objectives provide a clear statement of the study purpose.

In support of the goal, the planning objectives are to:

1. *Manage the risk of damages from flooding caused by storm surge due to coastal storms that impact Highlands through 2071.*
   Measurement: estimated annual damages, as calculated by the HEC-FDA model
2. *Reduce storm-induced shoreline erosion in Highlands through 2071.*
   Measurement: estimated annual erosion, as observed
3. *Develop a resilient and sustainable risk management solution for Highlands through 2071.*
   Measurement: qualitative analysis of engineering robustness and rapidity (the speed with which functionality can be restored to a system or project after a disruption)

Shoreline erosion was included as a benefit because the purpose was included in the study authority. No benefits from reducing shoreline erosion were included in the calculation of benefit-to-cost ratios.

3.8 Planning Constraints

Constraints are restrictions that limit the extent of the planning process. They can be divided into universal constraints and study-specific constraints. Universal planning constraints are the legal and policy constraints to be included in every planning study. Study-specific planning constraints are statements of things unique to a specific planning study that alternative plans should avoid. Constraints are designed to avoid undesirable changes between without- and with-plan conditions.

Universal planning constraints include:

General constraints:

1. The plan should meet the needs and concerns of the public within the study area;
2. The plan should be flexible to accommodate changing economic, social and environmental patterns and changing technologies.
3. The plan should integrate with and be complementary to other related programs in the study area.
4. The plan should be able to be implemented with respect to financial and institutional capabilities and public consensus.

Technical constraints:

1. Plans should be in compliance with USACE regulations.

2. Plans should be realistic and state-of-the-art while not relying on future research or development.

Environmental constraint:

1. Plans should avoid and minimize environmental impacts to the maximum degree practicable.
2. Plans should not adversely impact threatened or endangered species, and their habitat.
3. Plans should be compliant with all Federal environmental laws, Executive Orders, and guidance.

Regional and Social constraints:

1. All reasonable opportunities for development within the project scope should be weighed, with consideration of state and local interests.
2. The needs of other regions should be considered, and one area cannot be favored to the detriment of another.
3. Plans should maintain existing cultural resources to the maximum degree possible and produce the least possible disturbance to the community.

Institutional constraints:

1. Plans should be consistent with existing Federal, state, and local laws.
2. Plans should be locally supported and signed by local authorities in the form of a local cooperation agreement and guarantee for all items of local cooperation including possible cost sharing.
3. The plan should be fair and find overall support in the region and state.

Study-specific planning constraints include:

1. Waterfront Use: Plans should not restrict or significantly change current waterfront use. The bayshore is extensively developed, and is currently employed for many residential, commercial, and recreational uses, outlined in the *Monmouth County Growth Management Plan*. Commercial businesses depend on waterfront access and existing infrastructure. In addition, public access to beaches, marinas, boardwalks, parks, piers, and the Conner's Highlands Sea Streak ferry terminal, as described in the *Bayshore Waterfront Access Plan*, should be maintained. Homeowner's waterfront access will also remain, or be provided to the extent practicable.

2. Federal Navigation Project: Plans should minimize disruptions to the operations of the Shrewsbury River Federal navigation project. The project provides depths of 12 ft from Sandy Hook Bay to a point just north of the bridge at Highlands, then 9 ft in Shrewsbury River to the Branchport Avenue Bridge at Long Branch, about 7.4 miles.

3.9 Management Measures

Plans are composed of measures. A measure can be nonstructural (actions to reduce flood damages without significantly alternating the nature of extent of flooding) or structural (a physical modification designed to reduce the frequency of damaging levels of flood inundation).

They can be used individually or combined with other management measures to form alternative plans. Measures were developed to address problems and to capitalize upon opportunities. They were derived from a variety of sources including prior studies, the public scoping process, and the study team's experience.

The following nonstructural and structural measures were considered to provide coastal storm risk management and maximize project benefits. All measures were screened for their capability to meet objectives and avoid constraints, for engineering and economic feasibility. Measures that warranted consideration were assembled into alternative plans. Below are the nonstructural and structural measures that were considered.

Nonstructural Actions

1. **Buyouts (acquisition) of frequently flooded structures.** This technique includes permanent evacuation of existing areas subject to erosion and/or inundation and involves the acquisition of this land and its structures, either by purchase or by exercising the powers of eminent domain. Following this action, all development in these areas is either demolished or relocated.
2. **Elevation (raising) of frequently flooded structures.** This technique lifts an existing structure. Elevation can be performed on extended foundation walls, or on piers, post, piles, and columns.
3. **Ringwalls/structural peripheral wall.** This technique is applicable on a small-scale basis. As nonstructural measures, berms and floodwalls are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance requirements. Within Highlands, ringwalls are mostly likely to be built around individual structures.
4. **Floodproofing of frequently flooded structures.** Floodproofing is a body of techniques for preventing damages due to floods, and requires adjustments both to structures and to building contents. It involves keeping water out of structures, as well as reducing the effects of water entry. Wet floodproofing entails that all construction materials and finishing materials be water resistant, and all utilities must be elevated above the design flood elevation. Dry floodproofing consists of waterproofing structures.

Hard Structural Features

5. **Seawall/bulkhead with closure gates (raised epoxy coated steel sheet pile bulkhead).** This measure would entail raising or capping existing bulkheads. Raised bulkheads would provide risk reduction from coastal flooding to interior structures.
6. **Offshore closure structure.** During tidal flood events, closure gates placed across waterways can be closed, and high flows pumped across the closure. Such **closure gates and pump stations** could be included in a structural line of risk reduction to ensure access through.
7. **Navigation sector gates.** Gates could be used to allow navigation through a closure structure. They would be designed with consideration of U.S. Coast Guard standards.
8. **Removable fabricated floodwall (inland).** A removable floodwall is a temporary structure that is erected prior to a flood event. Post-flooding, the barrier walls are stored offsite.

9. **Setback floodwalls (I-type floodwall).** Floodwalls are intended to provide risk reduction from coastal flooding to interior structures. While these structures may provide a cost-effective means to prevent flooding of low-lying areas, runoff trapped behind the structure may affect the hydrology and drainage of interior areas. This may alter tidal wetlands and require additional drainage facilities.
10. **Raised road, ground surface, and asphalt areas.** Roads and surfaces would be raised to a level that would provide risk reduction to landward areas. Areas could be raised using fill material**.**

Soft Structural Features

11. **Reinforced dune.** Dune construction involves the placement of sand to build the relatively high feature. A buried sheetpile seawall would provide stability.
12. **Beachfill and dune with terminal groins (with buried sheetpile seawall).** Beach nourishment involves the placement of sand on an eroding shoreline to restore its form and to provide adequate risk management. A beach fill typically includes a berm backed by a dune; these elements combine to reduce erosion and inundation damages to leeward areas. A terminal groin would mitigate sand movement via longshore transport.

3.10 Initial Array of Alternatives

Measures that warranted continued consideration were assembled into **alternative plans**. An alternative plan (also known as, "**plan**" or "**alternative**") is a set of one or more management measures functioning together to address one or more planning objectives. Measures were grouped by theme into the following **design strategies**, which formed the basis of the alternatives. The design strategies were the basis for alternative development and refinement. In general, reinforced dunes and raised ground surfaces/parking areas were used where possible. Raised bulkheads were used to maximize the number of structures to be protected, except where impacts to water views and adjacent property shoreline access would be too extensive.

- **Hard structural strategy.** Based on the pre-feasibility study, a hard structural strategy would include hardening the bayshore to reduce the frequency of damaging levels of flood inundation.
- **Nonstructural strategy.** Instead of trying to reduce the frequency of damaging levels of flood inundation with physical modifications to the bayshore, a nonstructural strategy would consist of actions to reduce flood damages (elevations, buyouts, etc.) without affecting the frequency or intensity of the flooding.
- **Regional strategy - offshore closure.** An offshore closure structure with a navigation sector gate between Highlands and Sandy Hook would remove the need for local structural measures (floodwalls, dunes, etc.) to reduce the frequency of damaging levels of flood inundation and would reduce risk to the entire Shrewsbury and Navesink River Basins.[7]

[7] This concept is being investigated in more detail in the USACE Shrewsbury River and Tributaries, NJ, Coastal Storm Risk Management Feasibility Study, currently underway.

- **Soft structural strategy.** This strategy focuses on beach fill, dunes, and road raisings to reduce the frequency of damaging levels of flood inundation.
- **Hybrid Strategy.** This strategy tries to match the existing surroundings (hard structures where shoreline is already hardened, beach/dune where there is beach) in developing an alignment to reduce the frequency of damaging levels of flood inundation. It is a hybrid of the hard structural and soft structural strategies.

The design strategies were used to guide the development of alternative plans. Existing risk reduction systems, businesses, homes, and other structures were considered when combining features into strategies. Planning constraints, especially to maintain current waterfront uses, were considered as well. For example, raising existing bulkheads was preferable to building new structures.

Descriptions of Alternative Plans

All given quantities in this section are approximate. Storm risk management features are described from west to east. In general, reinforced dunes and raised ground surfaces/parking areas were used where possible as a line of risk reduction. Raised bulkheads were used to maximize the performance of the project, except where impacts to water views and adjacent property shoreline access would be too extensive. Specific details of the connection of the new raised epoxy-coated steel sheet pile bulkheads to existing bulkheads will be determined in future phases of this project.

For comparison purposes, the alternatives were developed for a still water level (SWL) for a 2% flood (50-year return period) storm surge of elevation +8.1 ft NAVD88, plus an anticipated sea level rise of +0.7 ft (over the 50-year period of analysis), for a design storm surge elevation of +8.8 ft NAVD88. A minimum inland crest elevation, where minimal surface wind wave action is anticipated, was set at elevation +10 ft NAVD88, which is the design storm surge elevation of +8.8 ft NAVD88, plus a value of +1.1 ft for the height of small surface, wind generated inland waves.

It should be noted that while the results of the Pre-Feasibility Report (May 2000) were used in the development of the study alternatives, the topographic mapping of the project site has been updated, additional geotechnical information and field observations have been collected, and the cost and wave analyses were updated to what was available in 2010. After verifying that post Hurricane Sandy conditions would affect the outcome of the plan formulation, the team will focus on updating the TSP to conditions in 2015. The full layouts of the alternatives can be found in the Engineering Appendix. Table 7 provides a summary of the alternative components.

- **No Action Alternative:** This plan includes additional Federal actions taken to provide for coastal storm risk management, namely, grants from FEMA to support disaster recovery for homeowners and businesses. This plan fails to meet the USACE study objectives or needs for the majority of the project area. It will, however, provide the base against which project benefits are measured.

- **Alternative 1: Hard Structural Plan (Pre-Feasibility Study Plan)**
  The pre-feasibility study identified a plan consisting of 13,200 ft of vinyl coated, steel sheet pile floodwall driven in front of the existing bulkhead, tie-ins, three closure gates, 10,032 ft of stone scour protection, 8,448ft of interior storm water diversion pipes, 33 gated interior

outlets, and three pump stations with a total capacity of 180 cubic ft per second (cfs) (Figure 10).
Measures: I-type floodwall, raised/capped bulkhead, closure gates, pump sations

- **Alternative 2: Nonstructural Plan**. Nonstructural measures are required to be evaluated in all feasibility studies. Under this alternative (Figure 11), measures include 17 "dry" flood proofings; 65 "wet" flood proofings (for which 50 require barriers to be constructed around the utilities in the basement and 15 require relocation of the utilities in a shed above ground); 861 structure elevations; 13 structures with surface floodwalls; and 35 structures with ringwall/berms. The average height of elevation for buildings is approximately 4.5 ft above existing grade. The total length of ringwall/berms and structure surface floodwalls required is approximately 12,820 ft. After Hurricane Sandy, 160 structures were removed from the calculations of potential damages because they were in the process of being demolished, elevated, or rebuilt to current code.

  This alternative does meet the overall project objective of reducing storm damage in the Borough of Highlands. However, as the measures provide risk management to only buildings and structures from flooding, considerable residual damage would remain after a storm (i.e. to the infrastructure, cars, landscaping, and basements of "wet" flood-proofed structures), and significant emergency personnel activity would be required. The nonstructural features will not obstruct any water views, nor will waterfront access need to be modified.
  Measures: dry and wet flood proofing, relocations, structure elevation, surface floodwalls, ringwalls/berms.

- **Alternative 3: Offshore Closure Plan**
  This alternative combines structural storm risk management features in Reach 1 with an offshore breakwater that extends 4,500 linear ft across the Sandy Hook Bay, providing risk management to Reaches 2, 3, and 4 (Figure 12). At the western end of Reach 1, existing ground will be raised using impervious fill to create a raised ground surface to elevation +10 ft NAVD88 that will tie into the existing contour near the end of Shore Drive, where approximately 195 ft of concrete I-type floodwall will be constructed at elevation +10 ft NAVD88. A combination of raised ground surface and constructed floodwalls will gradually transition upward to elevation +12.4 ft NAVD88 to meet a reinforced dune constructed along the existing shoreline. The reinforced dune will consist of a buried sheetpile seawall (1V:1.5H) covered with sand (1V:5H) and with an impervious earthen core installed along the backside of the seawall. The dunes will be planted with native dune grass to provide additional stabilization. The reinforced dune will continue at elevation +12.4 ft NAVD88 for 290 ft to meet a raised bulkhead.

  The raised bulkhead, at elevation +12.4 NAVD, will be located along the set-back high water mark, immediately in front of existing seawalls. The bulkhead will be fronted by a breakwater, constructed at the toe of the bulkhead, to reduce wave overtopping impacts. In addition, the breakwater will also provide risk management from the isolated historic erosion that is occurring at this location. From the bulkhead proceeding eastward, there will be a series of contiguous reinforced dune interspersed with raised ground surfaces for the rest of Planning Reach 1 up to the existing state bulkhead in Reach 2, which will be raised to +12 ft NAVD88.

At the eastern end of Reach 1, an offshore breakwater will be tied in to the end of the on-shore dune barrier and run parallel to the existing state bulkhead, continuing across the bay and connecting to high ground on Sandy Hook. The total breakwater alignment is approximately 4,500 ft, crossing a broad shoal area on the Sandy Hook side. At the location of the existing navigation channel approximately 500 ft from the state bulkhead, a 135-foot wide navigation sector gate will be installed to allow for a 100-foot clear opening for navigation transit when the gate is in the open position. Prior to potential major storm events, the sector gate will be closed during a period of lower tide, sealing the inner basin, providing additional runoff storage leeward of the barrier and providing risk management to Reaches 2, 3, and 4. No additional storm risk management features will be constructed in Reaches 2, 3, and 4.

Mean bay-bottom elevation along the breakwater alignment is roughly –4 ft NAVD88 or less, except across the navigation channel where it is an average of –19 to –21 ft NAVD88. The crest of the breakwater will be set at elevation +12.4 ft NAVD88. The crest elevation was selected to limit the effect of storm waves, reduce overtopping damage to the leeward side of the breakwater, and avoid water buildup from overtopping wave effects. There is insufficient storage leeward of the breakwater to store storm water runoff buildup to below elevation +5 ft NAVD88 with the sector gate closed, therefore a pump station will be required. Based on gross approximations, a 4,000 cfs pump station will be necessary to prevent residual damages from the closed gate.
Measures: raised road, ground surface, and asphalt areas; reinforced dune; raised bulkhead; I-type floodwall; navigation sector gate; offshore closure structure; breakwater

- **Alternative 4: Beachfill and Dune Plan**
  The structural storm risk management features in this alternative in Reach 1 are the same as those in Alternative 3—with the substitution of beachfill and dune in a portion of the reach (Figure 13). This is the only area where a beachfill and dune section can be accommodated due to the proximity of the existing navigation channel, piers, and shoreline frontage usage.

  In Reach 2, 1,280 linear ft of the existing state bulkhead will be capped to an elevation of +12 ft NAVD88, for an increase in the bulkhead's existing height of approximately 1 foot. At the center of Reach 2, a buoyant swing gate will be installed at the inlet opening to a marina, tying together the two portions of the capped state bulkhead. The entire gate structure will be 70-ft wide, with a 55-foot wide channel available for navigation transit when the gate is in the open position. Prior to potential major storm events, the swing gate will be closed during a period of lower tide, sealing the existing marina and providing risk management against flood waters. The capped bulkhead will connect to a raised bulkhead in Reach 3.

  In Reach 3, a 430-foot transition section of raised bulkhead will be constructed at a crest elevation of +12 ft NAVD88. The raised bulkhead will be located along the set back high water mark, immediately in front of existing seawalls. The associated breakwater will only be constructed for 75 ft from the capped state bulkhead, since the remainder of the raised bulkhead runs along the inside perimeter of an existing marina and a breakwater would interfere with marina operations. To the east, a raised bulkhead will transition to meet a raised asphalt parking area with a crest elevation of +11 ft NAVD88. From this point, reinforced dunes will alternate with raised bulkhead and associated breakwaters at elevation +11 ft NAVD88 for the remainder of Reach 3, up to a concrete I-type floodwall in Reach 4. The Windansea Restaurant and its seaside deck will be raised in place and the restaurant

entry will be modified to maintain existing water views and access with the alignment to elevation +11 ft NAVD88.

In Reach 4, 140 ft of concrete I-type floodwall will be constructed from the eastern end of the raised bulkhead in Reach 3 southwest along the Windansea Restaurant's property line towards Shrewsbury Street, transitioning from elevation +11 ft NAVD88 to elevation +10 ft NAVD88. The I-type floodwall will connect to the northwestern end of 1,075 ft of removable fabricated floodwall, installed at a crest elevation of +10 ft NAVD88 along the waterside curb of Shrewsbury Street. The removable fabricated floodwall will connect to the northwestern end of another raised ground surface. The crest will continue at elevation +10 ft NAVD88. At the southeastern end of this area, the crest elevation of the raised ground will continue at elevation +10 ft NAVD88 and meet a 415-linear foot raised portion of the existing Bay Avenue to tie into the +11 ft NAVD88 contour along Bay Avenue at the eastern closure of the project. The 415 ft of existing road will be raised to elevation +10 ft NAVD88; regrading will be necessary for access to driveways and walks. To match existing grades of the existing Bay Avenue to the northwest and close the alignment at the eastern end of the project site, a transition road approach will be constructed at a slope of 1V:10H from the northwestern end of the raised road.
Measures: raised road, ground surface, and asphalt areas; beachfill and dune; reinforced dune; raised/capped bulkhead; I-type floodwall; buoyant swing gate; removable floodwall, breakwater

- **Alternative 5: Hybrid Plan**
  Alternative 5 is geared toward matching the existing ground type (Figure 14). In Reach 1, it incorporates the measures from Alternative 3 and incorporates the alignment of Alternative 4 for Reaches 2, 3, and 4.

  At the western end of Reach 1, existing ground will be raised using impervious fill to create a raised ground surface to elevation +10 ft NAVD88 that will tie into the existing contour near the end of Shore Drive, where approximately 195 ft of concrete I-type floodwall will be constructed at elevation +10 ft NAVD88. A combination of raised ground surface and constructed floodwalls will gradually transition upward to elevation +12.4 ft NAVD88 to meet an reinforced dune constructed along the existing shoreline. The reinforced dune will consist of a buried sheetpile seawall (1V:1.5H) covered with sand (1V:5H) and with an impervious earthen core installed along the backside of the seawall. The dunes will be planted with native dune grass to provide additional stabilization. The reinforced dune will continue at elevation +12.4 ft NAVD88 for 290 ft to meet a raised bulkhead.

  The raised bulkhead, at elevation +12.4 NAVD, will be located along the set back high water mark, immediately in front of existing seawalls. The bulkhead will be fronted by a breakwater, constructed at the toe of the bulkhead, to reduce wave overtopping impacts. In addition, the breakwater will also provide risk management from the isolated historic erosion that is occurring at this location. From the bulkhead proceeding eastward, there will be a series of contiguous reinforced dune interspersed with raised ground surfaces for the rest of Planning Reach 1 up to the existing state bulkhead in Reach 2, which will be raised to +12 ft NAVD88.

  In Reach 2, 1,280 linear ft of the existing state bulkhead will be capped to an elevation of +12 ft NAVD88, for an increase in the bulkhead's existing height of approximately 1 foot. At

the center of Reach 2, a buoyant swing gate will be installed at the inlet opening to a marina, tying together the two portions of the capped state bulkhead. The entire gate structure will be 70-ft wide, with a 55-foot wide channel available for navigation transit when the gate is in the open position. Prior to potential major storm events, the swing gate will be closed during a period of lower tide, sealing the existing marina and providing risk management against flood waters. The capped bulkhead will connect to a raised bulkhead in Reach 3.

In Reach 3, a 430-foot transition section of raised bulkhead will be constructed at a crest elevation of +12 ft NAVD88. The raised bulkhead will be located along the set back high water mark, immediately in front of existing seawalls. The associated breakwater will only be constructed for 75 ft from the capped state bulkhead, since the remainder of the raised bulkhead runs along the inside perimeter of an existing marina and a breakwater would interfere with marina operations. To the east, a raised bulkhead will transition to meet a raised asphalt parking area with a crest elevation of +11 ft NAVD88. From this point, reinforced dunes will alternate with raised bulkhead and associated breakwaters at elevation +11 ft NAVD88 for the remainder of Reach 3, up to a concrete I-type floodwall in Reach 4. The Windansea Restaurant and its seaside deck will be raised in place and the restaurant entry will be modified to maintain existing water views and access with the alignment to elevation +11 ft NAVD88.

In Reach 4, 140 ft of concrete I-type floodwall will be constructed from the eastern end of the raised bulkhead in Reach 3 southwest along the Windansea Restaurant's property line towards Shrewsbury Street, transitioning from elevation +11 ft NAVD88 to elevation +10 ft NAVD88. The I-type floodwall will connect to the northwestern end of 1,075 ft of removable fabricated floodwall, installed at a crest elevation of +10 ft NAVD88 along the waterside curb of Shrewsbury Street. The removable fabricated floodwall will connect to the northwestern end of another raised ground surface. The crest will continue at elevation +10 ft NAVD88. At the southeastern end of this area, the crest elevation of the raised ground will continue at elevation +10 ft NAVD88 and meet a 415-linear foot raised portion of the existing Bay Avenue to tie into the +11 ft NAVD88 contour along Bay Avenue at the eastern closure of the project. The 415 ft of existing road will be raised to elevation +10 ft NAVD88; regrading will be necessary for access to driveways and walks. To match existing grades of the existing Bay Avenue to the northwest and close the alignment at the eastern end of the project site, a transition road approach will be constructed at a slope of 1V:10H from the northwestern end of the raised road.
Measures: raised road, ground surface, and asphalt areas; beachfill and dune; reinforced dune; raised/capped bulkhead; I-type floodwall; buoyant swing gate; removable floodwall, breakwater

Figures 10 to 15 show the layouts of Alternatives 1 to 5. The full layouts can be found in the Engineering Appendix.

Table 7: Summary of Measures for Highlands Alternatives

WEST *EAST*

Hard Structural Alternative[1]	I-Type Floodwall	Raised Bulkhead[5]						Raised Bulkhead[5]	Capped Existing State Bulkhead	Raised Bulkhead[5]				Raised Bulkhead[5]		Fabricated Floodwall	I-Type Floodwall	
Nonstructural Alternative	Nonstructural Measures																	
Regional Alternative - Offshore Closure [2]	Raised Ground Surface	Raised Roadway	Reinforced dune		Raised Bulkhead	I-Type Floodwall	Raised Asphalt Area	Navigation Sector Gate	Offshore Closure Structure									
Beachfill and dune Alternative[3]	Raised Ground Surface	Raised Roadway	Beachfill and dune	Reinforced dune	Raised Bulkhead	I-Type Floodwall	Raised Asphalt Area	Buoyant Swing Gate	Capped Existing State Bulkhead	Reinforced dune	Raised Bulkhead	Raised Asphalt Area	I-Type Floodwall	Fabricated Floodwall	Raised Ground Surface	Raised Roadway		
Hybrid Alternative[4]	Raised Ground Surface	Raised Roadway	Reinforced dune		Raised Bulkhead	I-Type Floodwall	Raised Asphalt Area	Buoyant Swing Gate	Capped Existing State Bulkhead	Reinforced dune	Raised Bulkhead	Raised Asphalt Area	I-Type Floodwall	Fabricated Floodwall	Raised Ground Surface	Raised Roadway		

Notes:

1. Includes 4 closure gates, the replacement of 10 existing outlets with 10 new tide gates, and 27 timber stair walkovers.
2. Includes 2 closure gates, the replacement of 1 existing outlet with 1 new tide gate, 5 earthen dune walkovers, and 1 timber stair walkover.
3. Includes 3 closure gates, the replacement of 4 existing outlets with 4 new tide gates, 8 earthen dune walkovers, 9 timber stair walkovers, and 1 modified timber stair walkover for the dune fill.
4. Includes 3 closure gates, the replacement of 3 existing outlets with 3 new tide gates, 10 earthen dune walkovers, and 10 timber stair walkovers.
5. The raised bulkhead feature includes a breakwater along the seaward side of the bulkhead, except in the inside perimeter of marina areas.

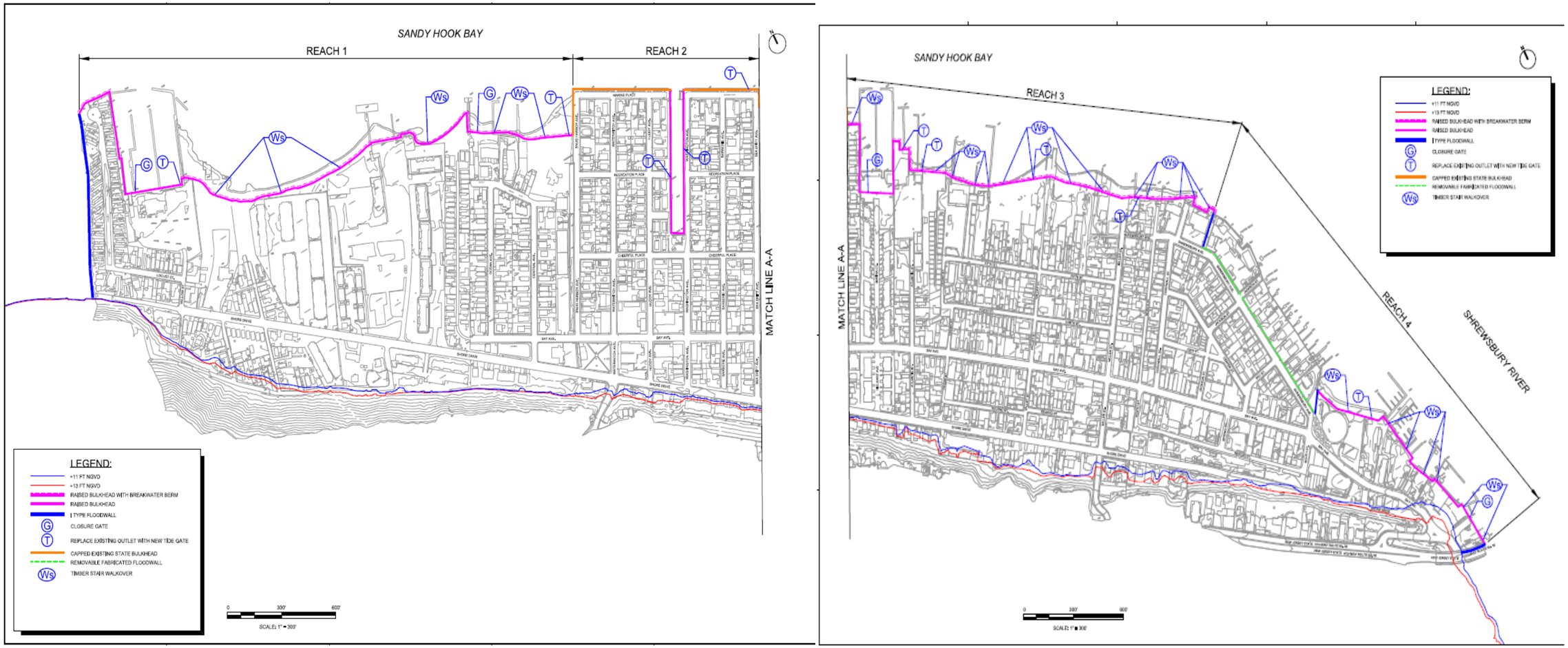

Figure 10: Alternative 1 – Hard Structural Plan*

*A higher resolution version of these images can be found in the Engineering Appendix of this report.

Figure 11: Alternative 2 – Nonstructural Plan*

*A higher resolution version of these images can be found in the Engineering Appendix of this report.

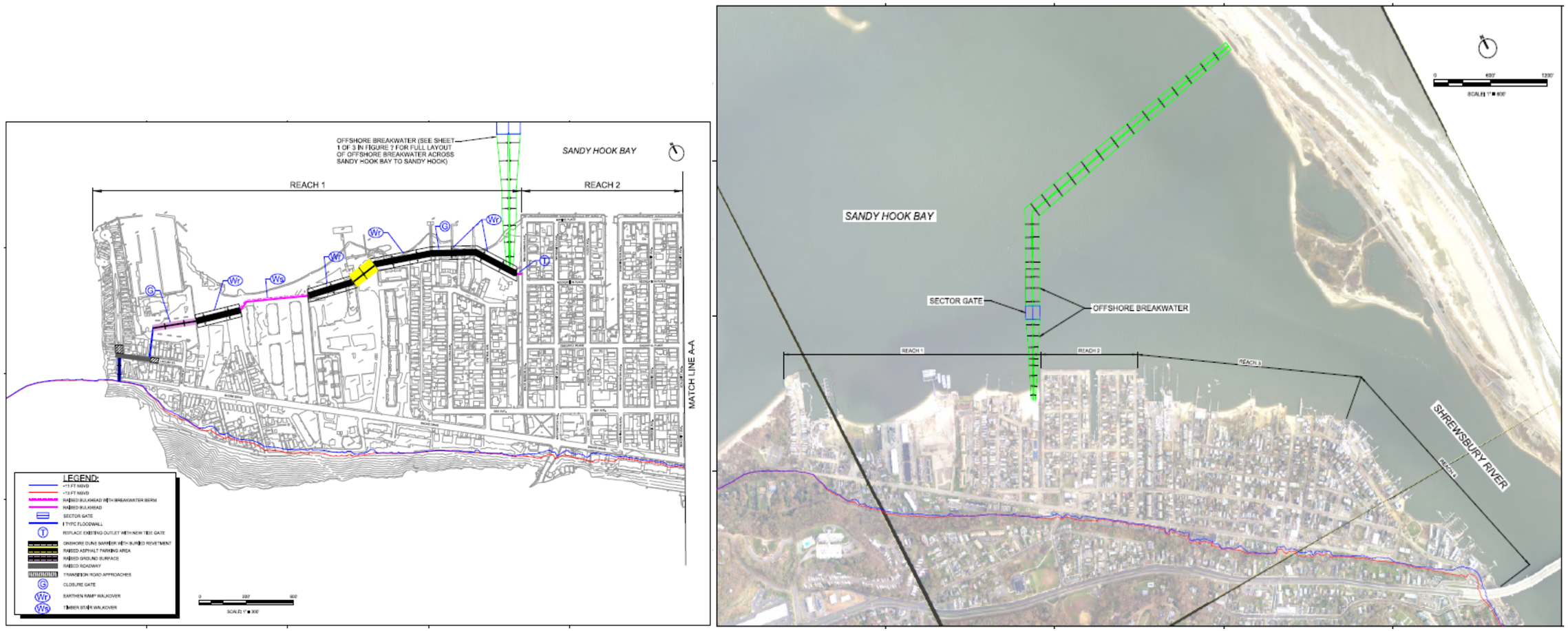

Figure 12: Alternative 3 – Offshore Closure Plan*

*A higher resolution version of these images can be found in the Engineering Appendix of this report.

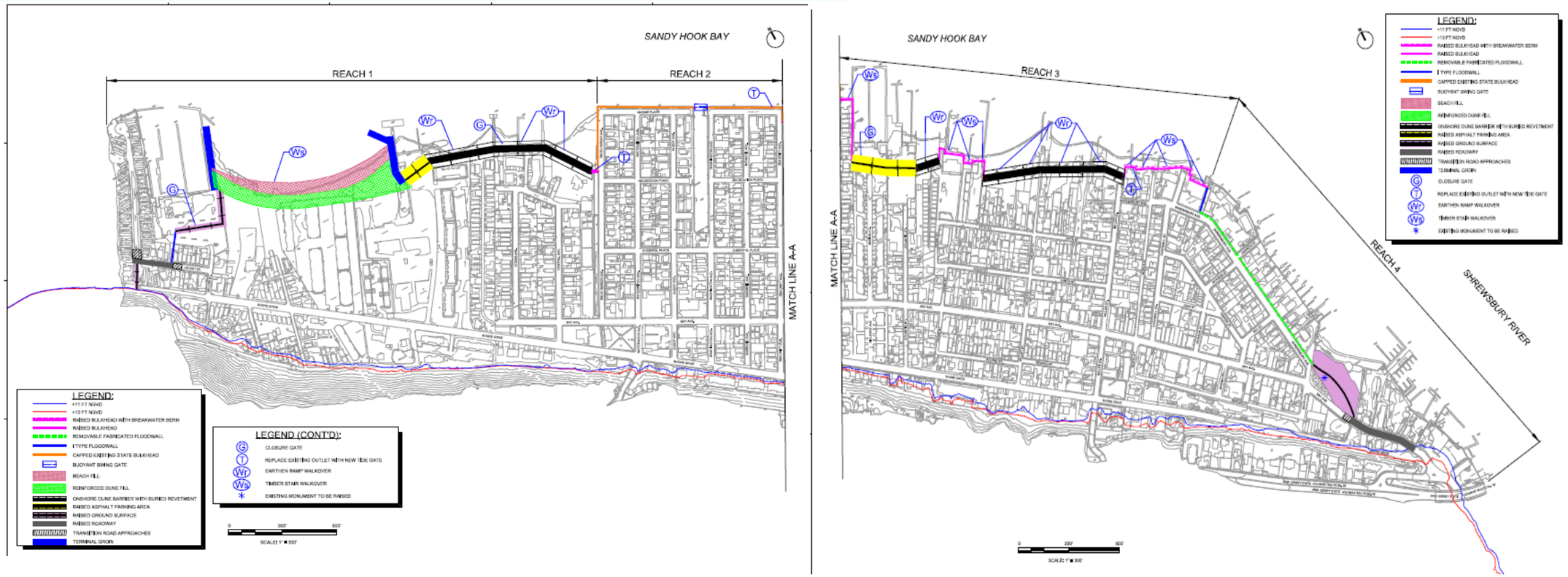

Figure 13: Alternative 4 – Beach and Dunefill Plan*

*A higher resolution version of these images can be found in the Engineering Appendix of this report.

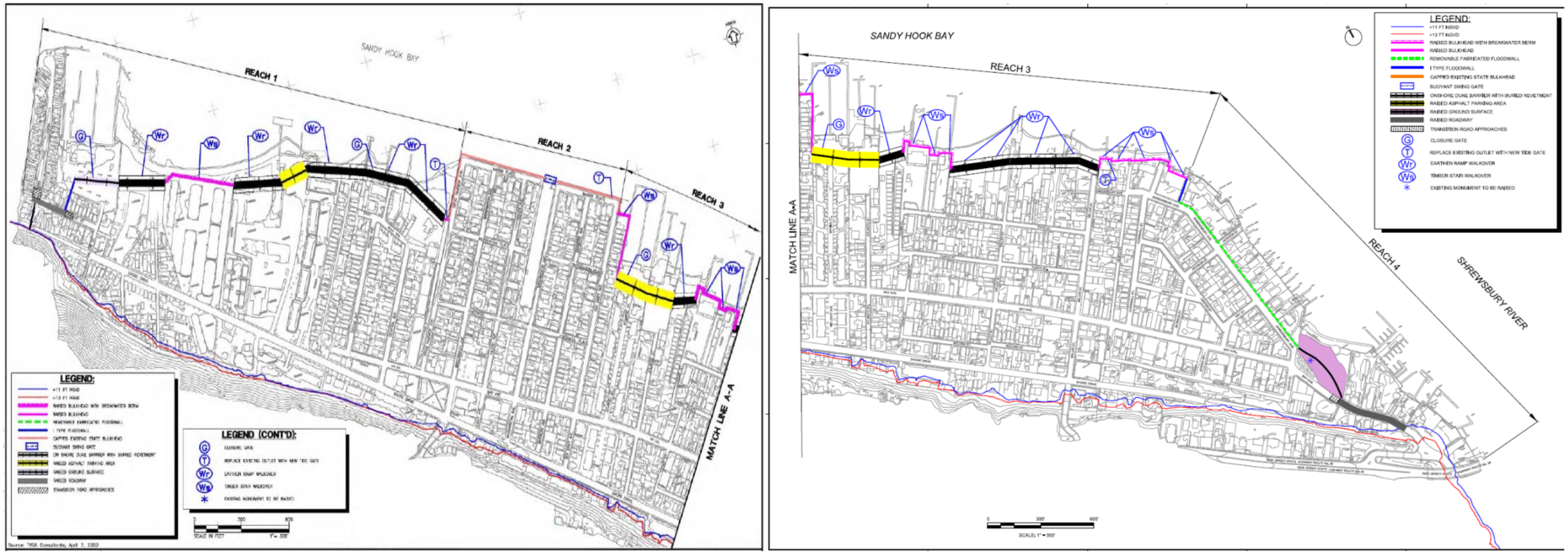

Figure 14: Alternative 5 - Hybrid Plan*

*A higher resolution version of these images can be found in the Engineering Appendix of this report.

3.11 Evaluation of Initial Array of Alternatives

The purpose of the evaluation step is to carefully examine each alternative and determine if it is worthy of additional consideration. Criteria used to evaluate a plan against to determine if it qualifies for further consideration include all significant resources, outputs, and plan effects. Significant plan effects must include contributions to planning objectives and constraints. They also include the Federal Objective, environmental compliance requirements, the 1983 Principles and Guidelines Criteria four evaluation criteria, and other impacts important to the study team and stakeholders.

3.11.1 The Federal Objective

Per the 1983 Principles and Guidelines, the Federal objective of water and related land resources project planning is to "contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements." Table 8 shows the estimated cost for construction of each alternative. Through a sensitivity analysis, it was determined that the update to existing conditions would not affect the results of the plan formulation, because increases in construction costs would be proportional across the alternatives. Consequently, costs and benefits are presented in October 2010 price level to reflect when these numbers were derived.

Table 8: First Cost and Annual Cost Summary For Highlands Alternatives

(October 2010 price level – Discount Rate of 4.125%)					
	Alternative #1	**Alternative #2**	**Alternative #3**	**Alternative #4**	**Alternative #5**
Total First Cost	**$50,077,046**	**$127,769,865**	**$139,757,234**	**$44,638,290**	**$38,787,591**
Interest During Construction	$2,030,424	$5,180,557	$5,666,597	$1,809,904	$1,572,682
Total Investment Cost	$52,107,470	$132,950,422	$145,423,831	$46,448,195	$40,360,273
Annualized Total Investment Cost *	$2,477,762	$6,321,924	$6,915,047	$2,208,658	$1,919,171
Annualized Periodic Nourishment Cost *	$0	$0	$0	$70,000	$0
Annualized OMRR&R Cost	$201,593	$153,611	$270,379	$162,897	$161,207
Total Annual Cost	**$2,679,355**	**$6,475,535**	**$7,185,426**	**$2,441,555**	**$2,080,378**

3.11.2 1983 Principles and Guidelines Criteria

The 1983 Principles and Guidelines require that plans are formulated in consideration of four criteria: **completeness**, **effectiveness**, **efficiency**, and **acceptability**.

- **Completeness** is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other Federal and non-Federal entities. For the Highlands study, an alternative had to provide risk management along the entire length of the alignment (8,000 ft) to be considered complete. Any "holes in the fence" would threaten the success of the entire project.
- **Effectiveness** is the extent to which the alternative plans contribute to achieve the planning objectives. Effectiveness of the alternatives was measured by the reduced damages in the with-project condition against a 2 percent flood (50 year event). Alternatives that have a Benefit to Cost Ratio lower than one will be eliminated from consideration.
- **Efficiency** is the extent to which an alternative plan is the most cost effective means of achieving the objectives. Efficiency will be measured through a comparison of benefit to cost ratios (BCRs) and reduced damages. Plans that provide the same level of performance, but at higher cost, will be eliminated from consideration.
- **Acceptability** is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies. The alternatives were formulated to be in accord with applicable laws and regulations.

It is necessary to know the preliminary benefits and costs of the alternatives in order to assess their effectiveness and efficiency. Accordingly, the annual costs and benefits for Alternatives 1 to 5 are presented in Table 9:

Table 9: Highlands Alternatives Annual Costs and Annual Benefits

Net Benefit and Benefit to Cost Ratio (October 2010 P.L.)				
Alternative	**Cost**	**Benefit**	**Net Benefit**	**B/C ratio**
1	$2,679,355	$3,142,600	$463,200	1.2
2	$6,475,535	$4,791,770	-$1,683,765	0.7
3	$7,185,426	$3,123,530	-$4,061,426	0.4
4	$2,441,555	$3,121,230	$679,675	1.3
5	$2,080,378	$3,121,230	$1,040,492	1.5

With the BCRs in hand, Table 10 shows alternatives screening using the P&G criteria. Based on the Benefit to Cost Ratios below one, Alternative 2 (Nonstructural) and Alternative 3 (Off-Shore Barrier with Navigation Sector Gate) were removed from further consideration. This screening resulted in Alternatives 1 (the Pre-Feasibility Alternative), 4 (the Dune and Beachfill Alternative), and 5 (the Hybrid Alternative) remaining for consideration. Of the three alternatives, Alternative 5 had the highest net benefits and met the most of the P& G criteria. Accordingly, Alternative 5 was developed further with five (5) variants, 5A to 5E.

Table 10: Summary of Consideration of P&G Criteria.

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
No Action	N	N	N	N
Alternative 1	Y	Y	N	Y
Alternative 2	Y	N	N	Y
Alternative 3	Y	N	N	Y
Alternative 4	Y	Y	N	Y
Alternative 5	Y	Y	Y	Y

Shaded alternatives eliminated from consideration.

3.12 Final Array of Alternative Plans

Alternative 5 was further developed in the next round of planning into 5 variants, 5A to5E, which involved different elevations, and substitution of higher floodwall for buoyant swing gates, removable floodwalls, and concrete floodwalls & bulkheads (Figures 15-18). Table 11 shows that the elements for the five variants were the same in Reaches 1 and 3 – a combination of raised bulkheads and reinforced dunes to match the existing ground cover. [8] All five variants include the same assumption of three pump stations for three interior drainage areas of Highlands, to be refined during plan optimization.

Table 11: Summary of 5A to 5E Features

Alt	Reach 1	Reach 2	Reach 3	Reach 4	
5A	Combination of raised bulkheads and reinforced dunes	**Raised bulkhead**	Combination of raised bulkheads and reinforced dunes	**Removable floodwalls**	Combination of reinforced dunes and floodwall
5B		**Buoyant swing gate**		**Nonstructural and raised bulkhead +10.9ft NAVD88**	
5C				**Nonstructural and raised bulkhead +12.1ft NAVD88**	
5D				**Raised bulkhead +12.4ft NAVD88**	
5E		**Raised bulkhead**			

[8] The alignments for Alternatives 5A to 5E are shorter than Alternatives 1 to 5. After Hurricane Sandy, the trailer park at the eastern end of the proposed alignment is being turned into condominiums by a local developer. 5A to 5E begin at the eastern end of the condominium development.

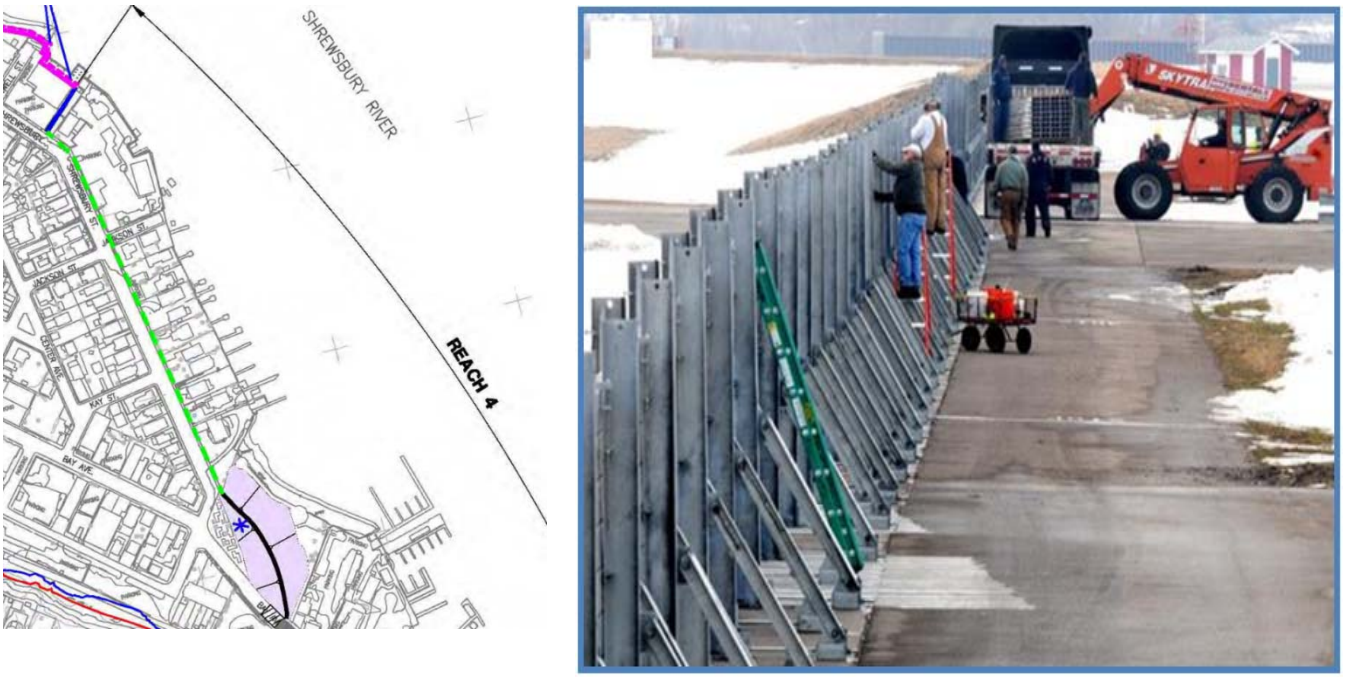

Figure 15: **Installation of removable floodwall**

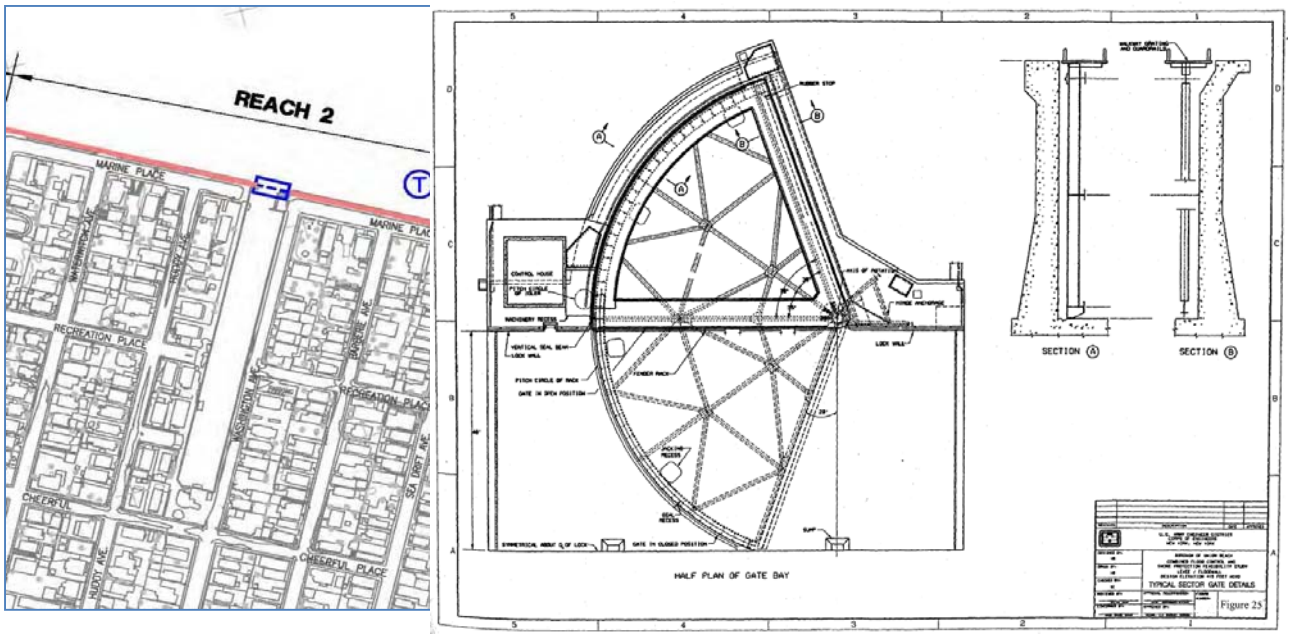

Figure 16: Schematic of buoyant swing gate

Figure 17: Example of floodwall

Figure 18: Example of bulkhead

The costs for Alternatives 5A to 5E are presented in Table 12 in October 2014 price levels. The level of detail provided on operations, maintenance, repair, rehabilitation and replacement (OMRR&R) costs is greater than typically provided for this level of alternative analysis. The OMRR&R costs were developed to this level of detail because is a specific issue of concern for NJDEP, particularly with regard to the operations of projects with movable components, such as removable floodwalls or buoyant swing gates. Typically it is assumed that the project would be operated when needed, based on USACE projections about future storm events. The Non-Federal partner advised, based on its experience with built USACE projects, that there is uncertainty in predicting whether a given storm would require project operation. As a precaution, the Non-Federal partner was operating the projects much more frequently than was assumed, and the projected OMRR&R costs were far exceeded by the reality for some projects.

Incorporating feedback from the Non-Federal partner, the study team used the frequency of warnings for coastal storm warnings issued by the National Oceanic and Atmospheric Administration from 2003 and 2013 as a proxy for how often the Highlands project would have to be operated.[9] Regardless of whether the warning would lead to flooding and damages, the project would have to be operated as a precaution. Between 2003 and 2013, there were 41 such warnings issued by NOAA, which is an average of four times per year. It was assumed that projects would be operated four times per year over the period of analysis for OMRR&R costs.

This adjustment had a greater effect upon the alternatives with removable floodwalls and buoyant swing gates than alternatives that were stationary (Alternative 5E). All of the alternatives carry the same level of annual maintenance and inspections - mowing, resealing, recoating, *etc*. The update to OMRR&R costs was important in the identification of the TSP because the first project cost for alternatives with removable floodwalls and buoyant swing gates were lower than the first costs for stationary alternatives, but require more intensive OMRR&R in the long run. The true cost of these alternatives is reflected in the annual equivalent costs with updated OMRR&R.

Table 12: **First Cost and Annual Cost Summary For Highlands Alternatives 5A to 5E**

(October 2014 price level)					
	Alternative 5A	**Alternative 5B**	**Alternative 5C**	**Alternative 5D**	**Alternative 5E**
Total First Cost	$78,628,000	$84,824,000	$81,978,000	$80,454,000	$78,904,000
Interest During Construction	$2,596,000	$2,801,000	$2,707,000	$2,657,000	$2,605,000
Total Investment Cost	$81,224,000	$87,625,000	$84,685,000	$83,111,000	$81,509,000
Annualized Total Investment Cost*	$3,385,000	$3,652,000	$3,529,000	$3,464,000	$3,397,000
Annualized OMRR&R Cost*	$319,000	$207,000	$211,000	$213,000	$92,000
Total Annual Cost	**$3,705,000**	**$3,859,000**	**$3,740,000**	**$3,677,000**	**$3,489,000**
*Discount rate 3.375% over a 50 year period of analysis.					

[9] http://www.ncdc.noaa.gov/stormevents/choosedates.jsp?statefips=34%2CNEW+JERSEY

3.13 Trade-Off Analysis

The annual costs of alternatives 5A to 5E have a relatively small range – from $3,489,000 for 5E to $3,859,000 for 5B. This observation prompts the question of whether it is worthwhile for the non-Federal partner to pursue one of the slightly more expensive alternatives as a Locally Preferred Plan.[10] The trade-off is that the additional cost would buy more convenient water access through the construction of removable floodwalls and buoyant swing gates, in addition to providing CSRM benefits.

A key factor in this consideration is that the removable floodwalls and buoyant swing gate would not be operated until needed, to preserve easy water access the rest of the time. Consequently, if just one of these elements is not operated in time or fails, the project alignment would be incomplete. Given the topography of Highlands, an incomplete alignment would lead to flooding of the entire study area, just as if there were not project at all - there is no intermediate level of flooding with part of the project in place.

The hazards inherent with the buoyant swing gate include the following, many of which were experienced during Hurricane Katrina in 2005:

1) No commercial power
2) Backup generator failure
3) Lack of fuel for generator
4) Mechanical failure of components
5) Operator unavailability
6) Operator error
7) Debris blocking gate seal
8) Shoaled sediment blocking gate seal

The hazards associated with the removable floodwall are:

1) Short storm warning time, preventing full erection of the wall
2) Inaccessibility of the storage facility
3) Structural failure of components
4) Debris blocking placement site
5) Operator unavailability
6) Operator error
7) Lack of fuel or mechanical failure of the vehicle transporting the components from the storage facility to the placement site.

The O&M costs provided for 5A to 5E assume that the buoyant swing gate and removable floodwalls will be properly deployed, whenever needed, and in time to reduce flood damages. As previously listed, there are many factors that could interfere with this proper, timely deployment, resulting in what would essentially be the without project condition. In light of the inherent risks and uncertainty associated with these features, NJDEP is not pursuing any of the alternatives within 5A to 5D as a Locally Preferred Plan.

[10] An alternative that does not have the highest net benefits (the NED plan) may be pursued as a Locally Preferred Plan (LPP), assuming 1) the alternative has a benefit to cost ratio above one; 2) the alternative meets USACE policy on residual risk and uncertainty; and 3) the Non-Federal partner is willing and able to pay for 100% of the difference between the NED plan and the LPP, should the LPP be more expensive than the NED plan.

3.14 Identification of the Tentatively Selected Plan

Alternative plans 5A to5E could provide risk management to a water surface elevation of +9.9 ft NAVD88, including the historic rate of sea level change, over the 50 year period of analysis. Average annual damages are shown in Table 13 for the without project condition and for Alternatives 5A to 5E. The benefits are calculated at October 2014 price levels and a discount rate of 3.375%. Post Hurricane Sandy, a structure inventory update was conducted using a 10% of the 1000+ structures in the study area. The analysis of the updated information is ongoing, including identification of properties that have received rebuilding permits and confirmation of rebuilding requirements. The annual equivalent damages for the future without project conditions for the Highland study are $11,450,000.

Table 13: Highlands Equivalent Annual Damages

Equivalent Annual Damages (Oct. 2014 P.L.)			
Alternatives	Without Project Damages	With Project Damages	Damages Reduced
No Action	$11,450,000	$11,450,000	$ -
Alternative 5A	$11,450,000	$2,074,000	$9,376,000
Alternative 5B	$11,450,000	$2,074,000	$9,376,000
Alternative 5C	$11,450,000	$2,074,000	$9,376,000
Alternative 5D	$11,450,000	$2,074,000	$9,376,000
Alternative 5E	$11,450,000	$2,074,000	$9,376,000

This table shows that Alternatives 5A to 5E each provides the same level of performance. Any differentiation would be achieved through examination of annual costs against the annual benefits (Table 14), with the lowest annual cost determining the Tentatively Selected Plan.

Table 14: Net Benefit and Benefit to Cost Ratio

Highlands Alternatives 5A to 5E				
(Oct. 2014 P.L.)				
Alternative	Cost	Benefit	Net Benefit	B/C ratio
5A	$3,705,000	$9,376,000	$5,671,000	2.5
5B	$3,859,000	$9,376,000	$5,517,000	2.4
5C	$3,740,000	$9,376,000	$5,636,000	2.5
5D	$3,677,000	$9,376,000	$5,699,000	2.5
5E	**$3,489,000**	**$9,376,000**	**$5,887,000**	**2.7**

Based on having the highest annual net benefits ($5,887,000), Alternative 5E is the Tentatively Selected Plan. This alternative consists of approximately 10,600 linear ft of raised bulkheads, raised ground surfaces, floodwalls, and reinforced dunes. Beyond being the most efficient and and effective plan, 5E also best meets the P&G criteria by being the most sustainable and resilient plan, as it requires minimal human intervention to be operational during storm events and has the fewest OMRR&R requirements.

Chapter 4: Tentatively Selected Plan*

This section of the report describes the Tentatively Selected Plan (TSP). The TSP will be optimized after agency and public reviews for the optimal project height, which may be up to 14 ft NAVD88 (height is limited by elevation of tie-offs).

4.1 Proposed Action/Plan Components

Based on having the highest annual net benefits ($5,887,000), Alternative 5E is the Tentatively Selected Plan. This alternative consists of approximately 10,636 linear ft of raised bulkheads, raised ground surfaces, floodwalls, and reinforced dunes (Table 15). The project spans a geographic distance of approximately 8,000 linear ft along the bay shoreline of Highlands and ties into high ground (+10 ft NAVD 88 to +12.4 ft NAVD88) at each end. Because the project follows the actual perimeter of the shore, its total length is 10,636 linear ft. For each segment of the project, features were chosen to match the existing surroundings, *ie.*, elevated bulkheads where the shoreline is already bulkheaded and reinforced dunes consisting of sand-covered seawalls on the existing beaches. The final length and heights will be determined during project optimization.

Table 15: Highlands TSP components

Project Feature	Length (lf)
Raised Bulkheads	7,289
Capped Existing Bulkheads	1,395
Floodwall	375
Reinforced dune	1,194
Raised Ground Surfaces	328
Closure Gate (width)	55
Total Length	10,636

The reach-by-reach description of the proposed Highlands projects begins with Reach 1 to the west and ends at Reach 4 on the Shrewsbury River to the east.

Reach 1

At the western end of Reach 1, a private developer has submitted preliminary plans to the Borough of Highlands that proposes a new multi-use development at the western end of the project area (approximately 600 linear ft). This area, referred to as the Bollerman development, will include a combination of raised ground surfaces and new bulkheads that will tie into the proposed USACE project. After final design heights have been determined for the USACE project, the Bollerman development will need to be reexamined to ensure that a continuous and complete alignment is provided at the western tie-in.

The design elevation in Reach 1 is +12.4 ft NAVD88 for the raised bulkheads that are proposed throughout Reach 1 and will include a stone breakwater and concrete splash pad along the entire length. The seaside rock berm will provide toe protection against erosion and will act as a breakwater to reduce wave action. The breakwater is 12 ft wide and 2 ft thick and will be placed on top of a 6 inch layer of bedding material on geotextile. The concrete splash pad will be placed on the landside to reduce risk against erosion from overtopping. The splash pad is 10 ft wide and 2 ft thick and will be placed on top of a 1 ft layer of bedding material on geotextile. At two locations in Reach 1, sand fill will be placed over the raised bulkhead to improve the

aesthetics because they are located along existing beach areas. The sand fill is 12 ft wide at the crown with 1V:5H side slopes to tie into the surrounding area. The dunes will be planted with native vegetation to help reduce risk against erosion.

Reach 2

In Reach 2, 1,395 lf of the existing state bulkhead will be capped to an elevation of +11.9 ft NAVD88, for an increase in the bulkhead's existing height of approximately one foot. A parapet of approximately 10 to 15 degrees will be applied to the cap to reduce wave overtopping impacts, allowing for a crest elevation +11.9 ft NAVD88. Because the increase in height will be relatively small, a fixed, rather than removable, extension is assumed, simplifying the needed structural connection. There will also be a setback floodwall along the perimeter of Captain's Cove Marine, consisting of 1,567 linear ft of epoxy coated steel sheetpile bulkhead at elevation +11.9 ft NAVD88. No breakwater is proposed for the setback wall as wave action is reduced within the marina and toe protection will be provided by the existing wall that is left in place. The landward side of the capped bulkhead (above grade) will need to be structurally reinforced to avoid the potential of exceeding the design loads of the existing bulkhead with the added loads intercepted by the capping. This reinforcement will include a 1.5-foot thick (average) monolithic section of reinforced concrete along the landside of the existing bulkhead, continuing with a 2-foot thick, 10-foot wide monolithic reinforced concrete slab at grade.

Reach 3

For features in Reach 3, the design elevation is set at +10.9 ft NAVD88. Raised bulkheads are proposed throughout Reach 3 and will include a stone breakwater and concrete splash pad along the entire length. At two locations in Reach 3, sand fill will be placed over the raised bulkhead to improve the aesthetics because they are located along existing beach areas. The dunes will be planted with native vegetation to reduce erosion. In addition, a boat launch facility that utilizes a 35 ton travel lift will need to be raised in place to the new design elevation and will require the construction of an approach ramp to tie into the existing parking lot. Also, the Inlet Café Restaurant and the seaside deck of the Windandsea restaurant will be raised in place to mitigate viewshed impacts to their dining areas.

Reach 4

In Reach 4, 140 ft of concrete I-type floodwall will be constructed from the eastern end of the raised bulkhead in Reach 3 southwest along the Windansea Restaurant's property line towards Shrewsbury Street, transitioning from elevation +10.9 ft NAVD88 to elevation +9.9 ft NAVD88. The I-type floodwall will connect to the northwestern end of 1,075 ft of bulkheads raised to a height of 12.8 ft NAVD88 along the existing shoreline, which will connect to the northwestern end of another raised ground surface. The crest will continue at elevation +9.9 ft NAVD88. The footprint of this raised ground covers 50,850 sq ft of an existing public park located to the north of Bay Avenue. The raised surface will duplicate the existing park features and surfacing, including the raising of a monument at the entrance to the park. The raised ground area will be capped with 6 inches of topsoil and planted with native vegetation. At the southeastern end of this area, the crest elevation of the raised ground will continue at elevation +9.9 ft NAVD88 and meet a 415 lf raised portion of the existing Bay Avenue to tie into the +10 ft NAVD88 contour along Bay Avenue at the eastern closure of the project.

The eastern tie-in will consist of an epoxy-coated sheet pile sea wall from the alignment along the center of Veteran's Memorial Park to high ground at the bluff. A steel and reinforced concrete closure structure and hydraulic gate or gates, 55 ft wide, will be required to allow

access along Bay Avenue while maintaining the alignment. This tie-in was selected as the most economical option and reduced the number of conflicts with landowners, including the Twin Lights and Gateway Marinas.

The layout for the TSP is shown in Figures 19 and 20.

4.2 Benefits of the Plan

Benefits were calculated as the difference in damages in without and with project conditions. Benefits were then amortized over a 50-year period to identify equivalent annual benefits using October 2014 price levels and an interest rate of 3.375%. The without project annual damages are $10,463,000. The proposed project would reduce $8,736,000 worth of annual damages, leaving $1,727,000 in annual damages. As the alternatives were developed to the 2 percent flood (50 yr) level of performance, the residual flood damages were from properties and infrastructure outside of the 2% floodplain. During optimization, the study team will find the optimal height of the project to maximize the net benefits, which may lead to decrease in the residual damages identified at this time.

4.3 Cost Estimate

A summary of the costs of the Highlands TSP is presented in Table 16.

Table 16: Total Firsts Costs for Highlands (October 2014 P.L.)

Account/Feature	Amount
01 – Lands and Damages	$6,627,000
10 – Breakwaters & Seawalls	$39,479,000
11 – Levees & Floodwalls	$17,245,000
14 – Recreation Facilities*	$720,000
30 – Planning, Engineering, & Design	$8,617,000
31 – Construction Management	$5,744,000
Total	**$78,905,000**

* This account is for the walkover access that the project will provide on publicly owned portions. No recreational benefits were included in the calculation of benefit to cost ratios in this study.

The initial project first cost is $78,905,000 (October 2014 P.L.) and the fully funded cost is $85,273,000, assuming price escalation through construction. These costs include construction, lands and damages, design, supervision and associated administration costs. The material costs were based on a combination of MII database, RSMeans, quotes, and some historical information. Equipment rates were obtained from region 1, and Davis Bacon Wage Rates for Monmouth County, NJ were utilized for labor costs. The contingencies were developed using Abbreviated Risk Analysis program (ARA). The summary of the results of this risk analysis, and more detail on the cost estimate, can be viewed in the Cost Appendix.

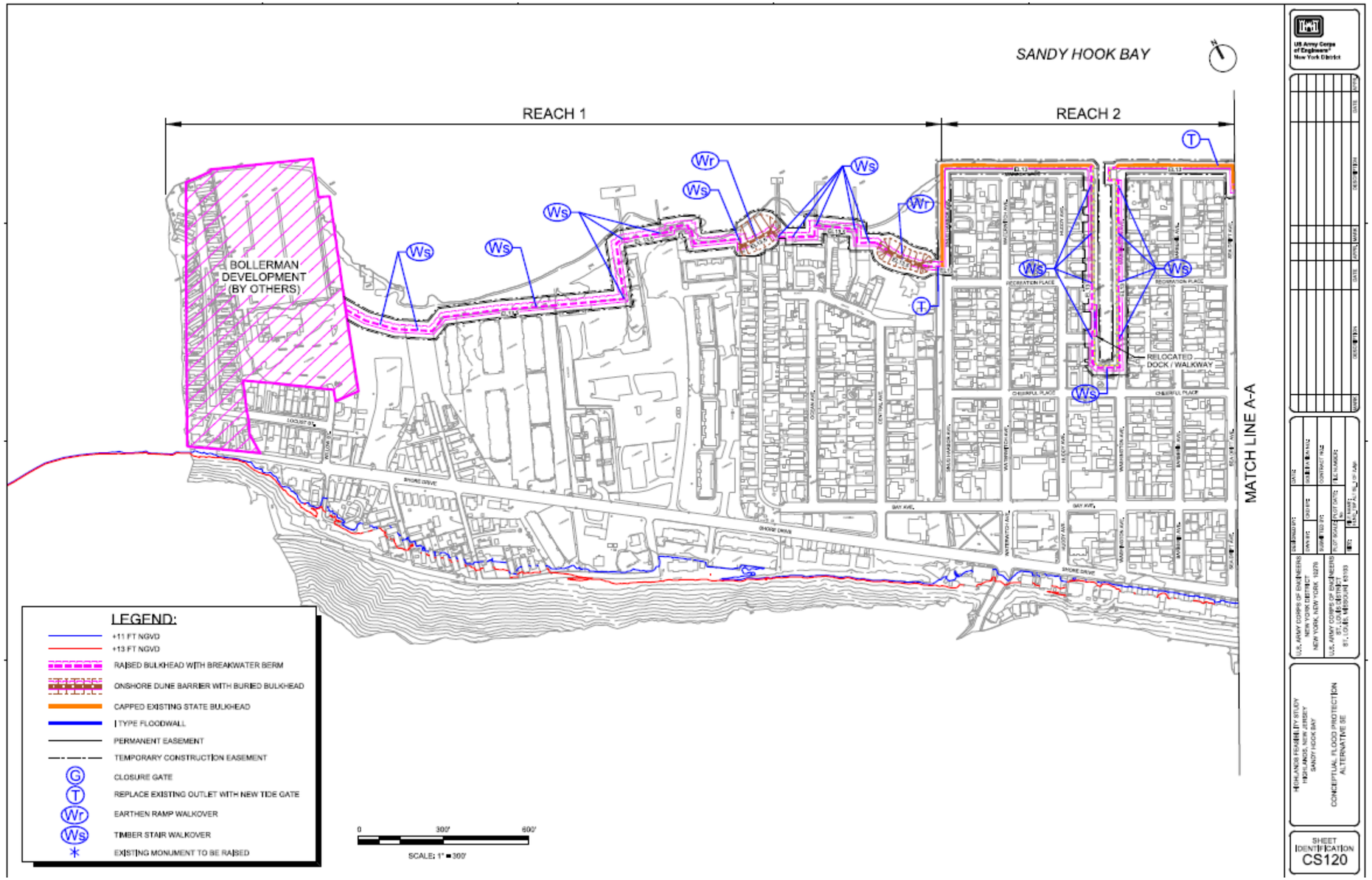

Figure 19: Highlands TSP Reaches 1 & 2

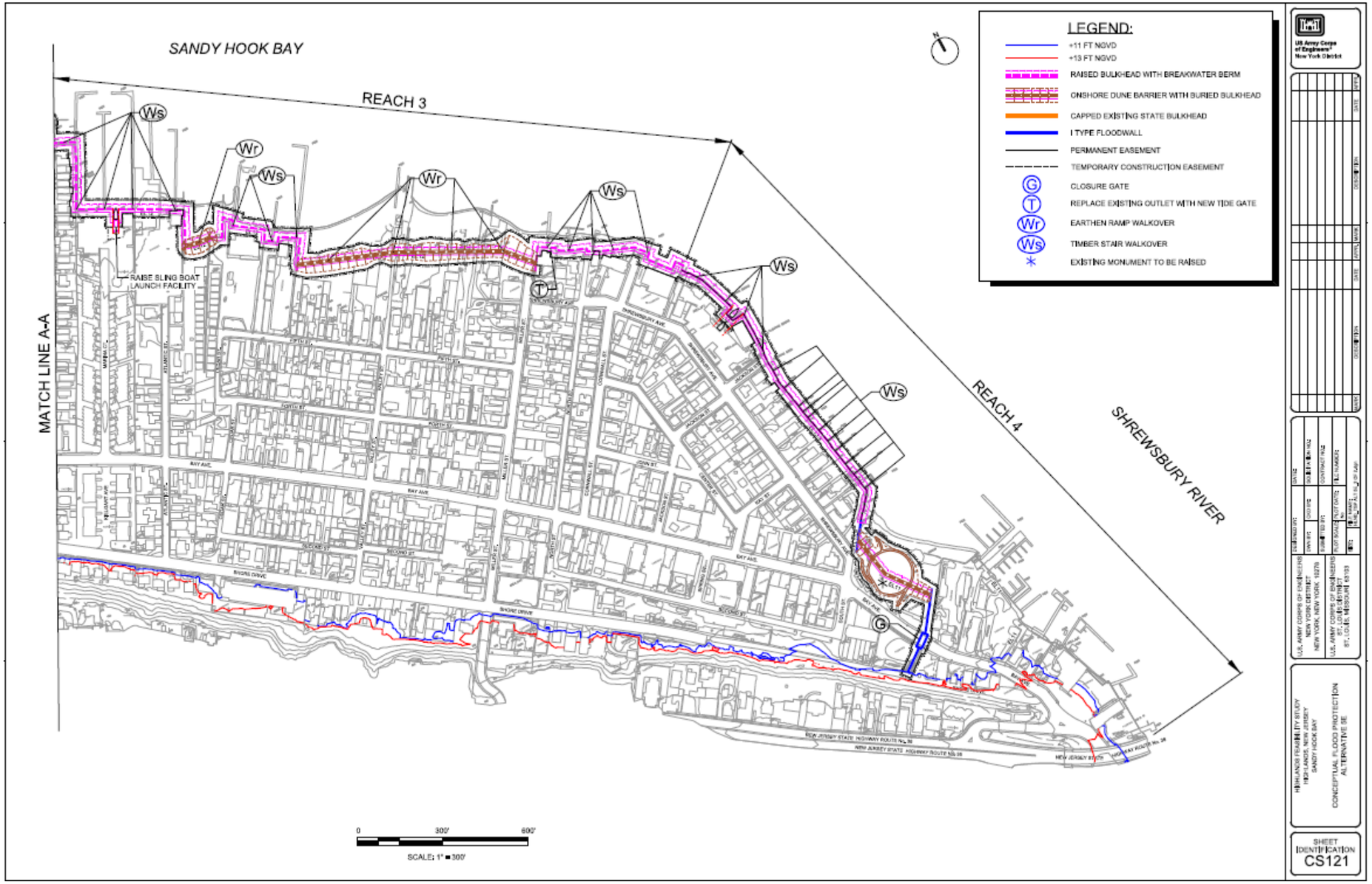

Figure 20: Highlands TSP Reaches 3 & 4

4.4 Operations, Maintenance, Repair, Replacement, & Rehabilitation Considerations

Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) actions will be minimal for the TSP because the project does not contain movable parts in the water. Aside from the major repair of a closure gate halfway through the period of analysis, most of the OMRR&R consists of minor repairs (recoating the bulkhead, resurfacing the raised roadway, *etc*.) and inspections, at an estimated annual cost of $92,000.

4.5 Interior Drainage and Minimum Facilities

Three pump stations, with a total capacity of 180 cfs, have been identified for the three interior drainage areas of Highlands. Interior drainage and minimum facilities will be refined during optimization. There have also been local plans for interior drainage work that might reduce the required capacity, but the status of this local project is still being coordinated (NJ Future, 2014).

4.6 Risk and Uncertainty Analysis

Per USACE guidance, risk and uncertainty must be incorporated into flood risk management studies. The following areas of uncertainty were incorporated into the HEC-FDA program:

- stage frequency
- first floor elevation
- depreciated structure value
- content-to-structure value ratio
- other-to-structure value ratio

The HEC-FDA program allows uncertainty in stage-frequency to be calculated using equivalent record length, for which USACE Engineering Manual, EM 1110-2-1619, Table 4-5, was consulted. For the Highlands HEC-FDA models, an equivalent record length of 70 years was assumed. A first floor standard deviation of 0.6 ft was selected based on recommendations in the USACE Engineering Manual, EM 1110-2-1619, Table 6-5, and the 2-foot contour intervals provided in the project topographic mapping.

The analysis recognizes that estimates of depreciated structure value based on windshield inventories contain inherent uncertainty. Structure values are assumed to have a coefficient of variation of 10%. Engineering Manual EM 1110-2-1619 suggests that in lieu of better site-specific information, content-structure value ratios based on large samples of Flood Insurance Administration (FIA) claims records can be used (Table 6-4 in Engineering Manual EM 1110-2-1619). A coefficient of variation of 25% was applied to the content-to-structure value ratio. Because the damage functions present other damage as a percent of structure value, the other-to-structure value ratio was estimated to have a coefficient of variation of 10%.

4.7 Economic, Environmental, and Other Social Effects

Four accounts have been established to facilitate evaluation of alternative plans:

1. National Economic Development (NED) – changes in the economic value of the national output of goods and services
2. Environmental Quality (EQ) – non-monetary effects on significant natural and cultural resources

3. Regional Economic Development (RED) – changes in the distribution of regional economic activity that result from each alternative plan
4. Other Social Effects (OSE) – effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

In reducing damages from future storm and flood events, the Highlands TSP contributes to National Economic Development. In addition to reducing property damage, implementation of the TSP would serve to keep critical facilities, such as police and emergency services, operational during storm events by reducing the intensity and frequency of flooding. It would also reduce flooding on evacuation routes, access routes for emergency vehicles, and the local roads that feed into these major roads. It neither contributes nor detracts from the RED account. As identified in the Environmental Assessment, there would be minimal environmental impacts because of the highly developed nature of the project area and the relatively tight footprint of the project.

As for the OSE account, this project will affect the community's water views or water access along some portions of the alignment. The height of the project above the existing ground surfaces ranges from two to eight feet. Waterfront access will be maintained in the form of timber walkovers, and the benefits of the CSRM project will outweigh the water access issues for the community overall.

4.8 Plan Costs and Benefits

The benefits of implementing coastal storm risk management measures represent flood damages avoided by the project. Benefits were calculated as the difference in damages before and after project implementation. Benefits were then amortized over a 50-year period to identify equivalent annual benefits using October 2014 price levels and an interest rate of 3.375%. Table 17 provides a summary of the annual costs and benefits of the plan.

Table 17: Performance of Highlands Tentatively Selected Plan (Oct. 2014 P.L.)

Annual Project Cost (Discounted at 3.375% over a 50-year period)	$3,489,000
Average Annual Benefits (Discounted at 3.375% over a 50-year period)	$9,376,000
Average Annual Net Benefits	$5,887,000
Benefit-Cost Ratio	2.7

4.9 Executive Order (EO) 11988

Executive Order 11988 requires that Federal agencies avoid, to the extent possible, adverse impacts associated with the occupancy and modification of flood plains and to avoid support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities."

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, as referenced in ER 1165-2-26, requires an eight-step process that agencies should carry

out as part of their decision-making on projects that have potential impacts to, or are within the floodplain. The eight steps and project-specific responses to them are summarized in Table 18.

Table 18: Highlands Study Compliance with E.O. 11988

EO 11988 Step	Project-Specific Response
Determine if a proposed action is in the base floodplain (that area which has a one percent or greater chance of flooding in any given year).	The proposed action is within the base floodplain. However, the project is designed to reduce damages to existing infrastructure located landward of the proposed project.
If the action is in the base flood plain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain.	Practicable measures and alternatives were formulated and evaluated against USACE of Engineers guidance, including nonstructural measures such as retreat, demolition and land acquisition.
If the action must be in the flood plain, advise the general public in the affected area and obtain their views and comments.	The draft Feasibility Report and Environmental Assessment was released to public review in July 2015, and public hearings have been held throughout the study.
Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain will affect the base flood plain, impacts resulting from these actions should also be identified.	The anticipated impacts associated with the Selected Plan are summarized in Chapters 4 and 5 of this report. The project would not alter or impact the natural or beneficial flood plain values.
If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists.	The project will not encourage development in the floodplain because the project area frontage is 100% developed. The project provides benefits solely for existing development.
As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values. This should include reevaluation of the "no action" alternative.	The project would not induce development in the flood plain and the project has minimal mitigation. Chapter 3 of this report summarizes the alternative identification, screening and selection process. The "no action" alternative was included in the plan formulation phase.
If the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the general public in the affected area of the findings.	The draft Feasibility Report and Environmental Assessment was released to public review in July 2015, and public hearings have been held throughout the study.
Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.	The Recommended Plan is the most responsive to all of the study objectives and the most consistent with the executive order.

Chapter 5: Environmental Impacts*

5.1 Topography, Geology, and Soils

No- Action Alternative: Under the No-Action alternative, topography may change due continued soil erosion and degradation. Geology will not change and soils will continue to erode and degrade as flooding continues. Soils will continue to erode during the flooding with no action.

Proposed Action: No significant impacts to topography, geology, and soils will result from the implementation of the proposed action. Topography along the Highlands shoreline would be permanently impacted by the installation of higher bulkheads. Bulkheads will be raised to +10 ft to+12.4 ft NAVD88. Along the beaches, sand fill will be placed over the raised bulkhead to improve the aesthetics. The sand fill is 12 ft wide at the crown with 1V:5H side slopes to tie into the surrounding area. The sand covered bulkheads will be planted with native vegetation to help reduce risk against erosion.

No impacts will occur to the geology of the Highlands with the implementation of the proposed action.

Soils behind the bulkheads will be stabilized with the proposed action, as floodwaters eroding the soils will be reduced. The dynamic coastal processes that presently influence the soils on the beach will continue, such that the beach elevations and width will continue to fluctuate as it has in the past.

5.2 Water Resources

5.2.1 Regional Hydrogeology and Groundwater Resources

No Action Alternative: The no action alternative will have no effect on hydrogeology and groundwater as natural processes will continue.

Proposed Action: The implementation of the proposed action will have neither short nor long-term impacts to regional hydrology and groundwater resources.

5.2.2 Surface Water

No Action Alternative: The no action alternative will allow natural flood processes to continue and will allow seawater to impact and flood the Borough.

Proposed Action: During construction of the proposed action, there will be minor short-term impacts to the surface water with an increase in suspended sediments in the water. This will be localized to the immediate area and will dissipate quickly. Additionally the implementation of best management practices (BMP) such as silt fencing during construction will minimize the impacts.

There will be no long-term impacts to surface water.

5.2.3 Tidal Influences

No Action Alternative: The no action alternative will have no impacts to tidal influences.

Proposed Action: Implementation of the proposed action will have neither short nor long-term impacts to tidal influences, as most of the shoreline is currently bulkheaded.

5.2.4 Coastal Processes

No Action Alternative: The no action alternative will have neither short nor long-term impacts to coastal processes.

Proposed Action: The construction of the bulkheads would not change the nature of, or the rate of, existing coastal processes. However, the proposed action will reduce the influence of the existing coastal processes on the land-based structures. In particular, the beach plan will provide long-term coastal storm risk management to residences, roads, and other structures and properties.

5.3 Vegetation

5.3.1 Upland

No Action Alternative: The no action alternative will have minor short term impacts to upland vegetation as flooding may destroy ornamental vegetation and lawns.

Proposed action: Implementation of the proposed action will have minor short-term impacts to upland vegetation as minimal amounts of vegetation will be removed. There will be positive long-term impacts as the buried bulkheads will be covered with sand and planted with native grasses, increasing the amount of vegetation along the beach areas. Long-term impacts will also be positive, as ornamental vegetation, lawns, and other upland vegetation will not flood as often.

5.3.2 Wetlands

No Action Alternative: Under the no action alternative wetlands may decrease with the rise in sea level permanently flooding some of the existing wetlands.

Proposed Action: Under the proposed action, the subtidal and intertidal wetlands will have minor short-term impacts to the benthos within the sand. The construction of the reinforced dune is expected to cover benthic organisms and cause some mortality. Benthic resources would begin to recolonize along the bulkheads immediately following the completion of each construction reach, and populations are expected to revert to pre-construction levels (Wilber and Clarke, 1998). There will be no long-term impacts to the subtidal and intertidal wetlands as the benthos are expected to return to pre construction levels (USACE, 2014). An NJDEP-identified wetland between Valley Street and Cedar Avenue, will have minor short term impacts during construction as vegetation is impacted. During optimization the reinforced dune will be placed as far inland to avoid the wetland. Impacts to the wetland will be minor as habitat and existing vegetation in the wetland are minimal. Wetland impact will be less than an acre and will be calculated during plan optimization and according to NJDEP regulations.

5.4 Fish and Wildlife

No Action Alternative: The no action alternative will have neither short nor long term impacts on fish and wildlife.

5.4.1 Finfish

The proposed action is expected to have an indirect, short-term impact on fish species in the immediate construction area. Motile species would likely avoid burial during the construction of the bulkheads by relocating outside of the area. However, the potential for some fish mortality

does exist. Demersal fishes that may reside just offshore of the construction footprint (*e.g.*, winter flounder, windowpane, summer flounder, etc.) would be temporarily displaced until appropriate invertebrate species return to the area. Resident fish are expected to feed in surrounding areas, and therefore be relatively unaffected by temporary, localized, reductions in available benthic food sources (USACE, 2000a).

There will be no long-term adverse impacts on fish.

5.4.2 Shellfish

The proposed action is expected to have a direct, short-term, impact on shellfish. Sessile shellfish that are present in the immediate construction area such as the razor clam and blue mussel are likely to be buried. However, no shellfish with significant commercial or recreational importance were identified. Motile shellfish would avoid the study area during construction and therefore would not be impacted. Upon construction completion, any shellfish that moved can return (Wilber and Clarke 1998).

There will be no long-term impacts on shellfish.

5.4.3 Benthic Resources

The implementation of the proposed action is expected to have a direct, short-term impact on benthic resources. The construction of the bulkheads is expected to cover benthic organisms and cause some mortality. Benthic resources would begin to recolonize along the bulkheads immediately following the completion of each construction reach, and populations are expected to revert to pre-construction levels (Wilber and Clarke, 1998).

There will be no long-term impacts on benthic resources as they are expected to return to preconstruction levels (USACE 2014).

5.4.4 Reptiles and Amphibians

No Action Alternative: The no action alternative will have neither short nor long term impacts on reptiles and amphibians.

Proposed Action: The implementation of the proposed action is expected to have neither short nor long-term impacts on reptiles and amphibians. As stated in section 2.5.4, the there are low numbers if any reptiles and amphibians in the construction area. Any reptiles in the bay would be able to move and avoid construction of the bulkheads.

5.4.5 Birds

No Action Alternative: The no action alternative will have neither short nor long-term impacts on birds.

Proposed Action: Birds that currently use the area may have indirect short-term impacts. Increased noise and heavy machine activity could cause their displacement or disruption in foraging within the immediate vicinity of the construction. Avian species are highly mobile and are expected to avoid the construction area and return after completion of the construction.

There will be no long-term impacts on bird species.

5.4.6 Mammals

No Action Alternative: The no action alternative will have neither short nor long-term impacts on mammals.

Proposed Action: Mammals in the construction area may have short-term impacts during construction activities. During construction, heavy machinery activity and increased noise levels may indirectly cause displacement of individuals near construction activities. Mammals are mobile species and will move and avoid the construction areas minimizing their impacts. Most mammals inhabiting the study area are accustomed to human activities and would likely return after completion of construction. It is anticipated that any muskrat, raccoon, striped skunk, gray squirrel, and opossum in the area would return to areas after construction.

There will be no long-term impacts on mammals.

5.5 Federal Threatened and Endangered Species

No Action Alternative: The no action alternative will have neither short nor long-term impacts on federal threatened and endangered species as there are no records of their occurrence in the study area.

Proposed Action: There will be no short-or long-term impacts on federal threatened and endangered species as the USFWS has no records of the federally threatened Piping Plover, Red Knot, Seabeach amaranth, and Northern long-eared Bat occurring in the project area. Coordination with USFWS will continue as project progresses to construction.

5.6 State Threatened and Endangered Species

No Action Alternative: The no action alternative will have neither short nor long-term impacts on state threatened and endangered species as there are no records of their occurrence in the study area.

Proposed Action: There will be no short-or long-term impacts on state threatened and endangered species as there are no records of any occurring in the study area.

5.7 Essential Fish Habitat

No Action Alternative: The no action alternative will have neither short nor long-term impacts on essential fish habitat.

Proposed Action: The proposed action is expected to have an indirect, short-term impact on food availability for benthic-feeding EFH designated species in the immediate placement area. The construction of the bulkheads may cause mortality of benthic infaunal organisms. However, resident fish are expected to feed in surrounding areas, and therefore be relatively unaffected by temporary, localized, reductions in available benthic food sources (USACE 2004a). A detailed EFH assessment is provided in environmental Appendix A1. The conclusion of this assessment indicates that implementation of the proposed action will have short-term, minimal effects to EFH species, their habitat, and no long-term impacts. This EA and the EFH worksheet will be submitted to NMFS in compliance with EFH

5.8 Socioeconomics

No Action Alternative: The no action alternative may have short- or long-term impacts on socioeconomics as continued flooding may deter businesses and industry from developing or rebuilding. With a lack of industry and businesses, the community may have a difficult time supporting themselves having to travel for work, goods, and services. Households may not rebuild and leave empty lots or unrepaired homes with continued flooding.

Proposed Action: The implementation of the proposed action should have positive short- and long-term socioeconomic impacts to existing business in the Highlands area because of the reduction of future storm damages and improved accessibility to businesses during storm events. There may also be a minor, indirect economic benefit on the local economy during initial construction. The introduction of construction workers should result in their purchasing of supplies and food during the initial construction phase and the additional phases. Construction work along the beaches will not occur during the months of June-August to avoid impact to the beaches. The implementation of the plan is expected have a direct positive impact on housing and structures due to a reduction in future storm damage to existing properties, and the subsequent reduction in associated costs to repair such damages. An indirect benefit to residential property values in Highlands is the expected increase due to the added coastal storm risk management of storm damages.

5.9 Environmental Justice

No Action Alternative: The no action alternative will have neither short nor long-term impacts to environmental justice communities.

Proposed Action: The implementation of the proposed action will have no short-or long-term impacts to environmental justice communities. As stated in section 2.1.10, Highlands is not considered an environmental justice community. In fact, the low-income and lower-than-average-income communities would benefit through the allocation of Federal/public funds to this coastal storm risk management project.

5.10 Cultural Resources

No Action Alternative: The no action alternative will have neither short nor long-term impacts to cultural resources.

Proposed Action: The NJHPO has previously indicated that no archaeological testing is required for the project as proposed in 2007. The alignment has remained largely as originally proposed but now ties into high ground along Bay Avenue on the eastern end. As per the NJHPO opinion USACE will not undertake archaeological testing along the shoreline where the project alignment remains unchanged. The western end of the alignment has been modified since 2007 to tie into a new development project. That development is being constructed by others and USACE will not undertake testing. The eastern end of the alignment has been modified to tie into high ground along Bay Avenue. An archaeological assessment, followed as needed by testing, will be undertaken of this newly proposed section of alignment and for any future project changes.

The project will have no effect on 2 Bay Avenue, Bahrs Restaurant and Marina, due to the distance of the property from the project alignment. The NRHP eligibility of Honeysuckle Lodge and 58 Fifth St., both identified previously as potentially eligible as part of a thematic bungalow/cottage communities of the New Jersey shore, will need to be re-assessed following impacts from Hurricane Sandy and recovery measures. As the alignment is now proposed to cross Bay Avenue the eligibility of Bay Avenue, previously noted as a potentially eligible historic district before Hurricane Sandy, will also need to be evaluated. The FloBar Apartments, determined to be a potential individually eligible property, is just three parcels from the now proposed closure gate. Sculthorpe's Auditorium and 60 Bay Street would be included in the overall Bay Street evaluation but will also be evaluated for individual eligibility. It is clear that no

above ground resources, if determined eligible, will be directly impacted by the proposed plan however indirect impacts to any properties determined significant will need to be evaluated.

Sections of the alignment are visible from the Sandy Hook Lighthouse NHL, the Twin Lights (Navesink Lighthouse) NHL, the Water Witch Casino and Fort Hancock Historic District. The project will have no adverse effect on the viewsheds from these properties as the views from them are focused out to sea. Also, the proposed project will match existing shoreline features so when viewed from these distant historic properties there will be little change from existing conditions.

The Borough of Highlands has a Master Plan which contains a Design Manual for the Central Business District. While the proposed closure structure across Bay Avenue is just outside the designated Central Business District as per the Borough's zoning map, the streetscape improvement suggestions therein should be considered for the design of the line of protection in the vicinity of Bay Avenue (Borough of Highlands 2004).

Section 106 Coordination. All previous USACE cultural resources studies for this study were coordinated with the NJHPO (see Appendix A4). USACE has drafted a Programmatic Agreement (PA) (Appendix A5) which stipulates the actions the USACE will take with regard to cultural resources as the project proceeds. The PA will be used to ensure that the USACE satisfies its responsibilities under Section 106 of the NHPA and other applicable laws and regulations. The Draft PA has been provided to the NJHPO, the Advisory Council on Historic Preservation (ACHP), the Delaware Nation, the Delaware Tribe of Indians, the Shawnee Tribe of Oklahoma and the Historical Society of Highlands.

The draft PA is available for public review in Appendix A of this Draft EA and will serve as the USACE Section 106 public coordination. The final PA will incorporate comments received on the draft document, as appropriate.

5.11 Coastal Zone Management

No Action Alternative: The no action alternative will have neither short nor long-term impacts to the Coastal Zone Management policies.

Proposed action: In conformance with the established policies of New Jersey's Coastal Zone Management Program, USACE has determined that the proposed action is consistent with New Jersey's Rules on Coastal Zone Management. For further discussion, see Appendix A22.

5.12 Floodplains

No Action Alternative: The no action alternative will have negative short and long term impacts to the floodplains Highlands. Flooding will continue eroding soils, damaging property, roads, and infrastructure.

Proposed Action: The construction of the proposed action will result in a direct, long-term benefit to the community of Highlands. The construction of the bulkhead and reinforced dune will result in both short-and long-term impacts to floodplain values. Temporary indirect effects, which are associated with construction activities, include the displacement of aquatic and terrestrial resources, loss of recreational opportunities, and an increase in suspended sediments should a severe storm event occur during construction. Public access to the beach would be temporarily impeded during the construction period because of safety concerns.

The construction of the proposed action will provide long-term enhancement of floodplain values including coastal storm risk management, recreational opportunities, and wildlife habitat. Increased coastal storm risk management will result from the bulkhead and reinforced dune.

5.13 Land Use and Zoning

No Action Alternative: The no action alternative may have short- and long-term impacts as flooding will continue and possibly necessitating changes in land use a zoning as property is destroyed and land lost.

Proposed Action: Implementation of the proposed action will have no negative short- or long-term impacts to land use and zoning. The resulting increase in coastal storm risk management is not expected to significantly induce future development in the adjacent residential areas, because most, if not all, of the developable areas are developed.

5.14 Hazardous, Toxic, and Radioactive Waste

No Action Alternative: The no action alternative will have neither short nor long-term impacts from HTRW.

Proposed Action: There will be neither short nor long-term impacts from HTRW. As stated in section 2.12.15, only MTBE was detected and that was from a deep sample from a former gasoline station. Environmental impacts from the MTBE would be minimal, at most because of the soil depth it was detected at and the limited quantity present at that location. There may be small potential for the MTBE to migrate via ground water flow. The potential for this occurring is low. First because the area the compound is located in is paved, preventing direct infiltration. Second it is located at a soil depth that is above the ground water table, further reducing the potential for migration. The remaining soil samples contained no detection of NJDEP listed compounds. The reminder of the proposed line of construction is viewed as clear of possible environmental impacts from sub-surface contaminants.

5.15 Aesthetic and Scenic Resources

No Action Alternative: The no action alternative may have negative short- and long-term impacts as flooding will continue, damaging houses, business, and personal property.

Proposed Action: Implementation of the proposed action will have negative and positive short-term impacts to aesthetics and scenic resources. Construction equipment and vehicles will be in the community during the implementation of the plan generally not considered visually appealing. Positively, the plan will provide flood management to segments completed reducing damage to property.

Long-term impacts of the proposed action will also have negative and positive impacts. The view shed toward the water will be altered, as the existing bulkheads will be raised up to 12.4 ft NAVD88. The covered bulkheads on the beaches will also raise the horizon of the view toward the bay. Positively, the plan will reduce damage to property resulting in less destruction, construction, and rebuilding of the community by managing flood risk.

5.16 Recreation

No Action Alternative: The no action alternative may have negative short-and long-term impacts as beaches, access to docks, and businesses will continue to flood and not be accessible.

Proposed Action: Implementation of the proposed action will have negative short-term impacts to recreation as beaches and docks will be temporarily inaccessible during construction. Long-term impacts will be positive as future risks of flooding of Veterans Park, and residents will be able to utilize the park after storms.

5.17 Air Quality

No Action Alternative: The no action alternative may have negative short-term impacts to air quality as construction may occur more often repairing property from continued floods. There will be no long-term impacts.

Proposed action: Based on a preliminary, qualitative assessment of the estimated construction schedule (42 months), it is anticipated that Highlands project will be within the *de minimis* levels in any one construction year. This assessment is based on a comparison with the nearby Union Beach CSRM project, which is a larger and more complex project and has the same construction duration. As Union Beach is presumed to conform to the General Conformity requirements, it is expected that the Highlands project will conform as well. The full air quality analysis will be conducted as part of TSP optimization, when the detailed cost estimate and equipment lists will be available. See Appendix A6 for the draft Record of Non-Applicability.

5.18 Noise

No Action Alternative: The no action alternative may have negative short-term impacts to noise as construction may occur more often than repairing property from continued floods. There will be no long-term impacts.

Proposed action: Implementation of the proposed action will have minor negative short-term impacts to noise as construction vehicles and actions will increase the noise levels temporarily. up to 100 dBa Long-term impacts may be positive as continued construction and repair noise from repeated flooding will be reduced.

Chapter 6: Cumulative Impacts*

Cumulative impacts refer to one or more individual impacts which, when considered together, are considerable or which compound or increase the other's impacts. The cumulative impact from several projects is the change in the environment that results from the incremental impact of the proposed action when added to other closely related past, present, or reasonably foreseeable future projects. USACE currently has two other projects in study; Leonardo, a nonstructural CSRM project in Middletown Township, and Shrewsbury River, a CSRM study in Sea Bright; and two authorized projects along the Raritan Bay and Sandy Hook Bay shoreline, Union Beach and Port Monmouth. Union Beach is a structural project in design phase, consisting of structural floodwalls, levees, and beach nourishment. Port Monmouth is in construction and consists of structural floodwalls, levees, and beach nourishment. Implementation of the Highlands project is not anticipated with overlap with other projects in construction within Raritan Bay and Sandy Hook Bay.

There will be positive cumulative impacts to upland vegetation as all projects will replace removed vegetation with native vegetation. There will be a cumulative loss to wetlands; however all wetlands impacts will be mitigated according to NJDEP regulations resulting in the creation or restoration of the impacted wetlands.

There are potential cumulative impacts to the benthic communities resulting from the combined USACE projects. Intertidal and subtidal benthic communities are expected to recolonize within a few months after construction. Following this type of disturbance, the species composition of the reestablished community might be slightly different than the pre-construction composition. This effect, along with this project is a potential cumulative effect. However based on projected schedules, funding, and the distances between each project this is not a likely occurrence.

There are no anticipated cumulative impacts to fish and wildlife and Federal and state threatened and endangered species. All of the projects anticipate no long-term or major impacts to fish and wildlife and Federal and state threatened and endangered species.

Several low-income and lower-than-average-income communities would benefit through the allocation of Federal/public funds to USACE proposed coastal storm risk management projects along the Raritan Bay and -Sandy Hook Bay coast. Specifically, construction will have a positive benefit to the lowest income population of the area by reducing costs resulting from storm and water damage as well as costs incurred from temporary relocation during and after storm events.

The implementation of numerous beach erosion projects along the Raritan Bay and Sandy Hook Bay will involve the conversion of subtidal habitat to sandy beach, resulting in an overall loss of subtidal habitat and an extension of the intertidal zone. However, the loss of this habitat is minute when compared to the expanses of subtidal habitat along the Raritan Bay and Sandy Hook Bay shoreline.

The implementation of the USACE project would result in increased levees, floodwalls, and bulkheads altering the parts of the view shed in and along the Raritan Bay and Sandy Hook Bay. However, the local communities support all the projects and they understand and accept the impacts in exchange for flood control.

Chapter 7: Coordination & Compliance with Environmental Requirements*

Table 19. Summary of Primary Federal Laws and Regulations Applicable to the Proposed Project

Legislative Title U.S. Code/Other		Compliance
Clean Air Act	42 U.S.C. §§ 7401 7671g	On-going, Appendix A5
Clean Water Act	33 U.S.C. §§ 1251 et seq.	USACE produced an evaluation complying with the Clean Water Act in Appendix A3.
Coastal Zone Management Act	16 U.S.C. §§ 1451-1464 N.J.A.C. 7:7 and N.J.A.C. 7:7E	A CZM Determination was prepared and is located in Appendix A2.
Endangered Species Act of 1973	16 U.S.C. §§ 1531 et seq.	USACE has completed Section 7 Coordination the Service regarding endangered species and is located in Appendix A.
Environmental Justice in Minority and Low Income Populations	Executive Order 12898	USACE performed an analysis and has determined that a disproportionate negative impact on minority or low-income groups in the community is not anticipated; a full evaluation of Environmental Justice issues is not required.
Fish and Wildlife Coordination Act	16 U.S.C. § 661 et seq.	On-going
Magnuson-Stevens Act Fishery Conservation and Management Act	Section 305(b)(2) 1996 Amendments	EFH Assessment was prepared and submitted to NOAA-Fisheries as part of the Draft HSLRR/EA review. The EFH Assessments are located in Appendix A.
National Environmental Policy Act of 1969	42 U.S.C. §§ 4321-4347	The circulation of the Draft EA fulfills requirements of this act.
National Historic Preservation Act of 1966	16 U.S.C. §§ 470 et seq.	On-going. Correspondence and draft PA included in Appendix A4.
Executive Order 11990, Protection of Wetlands	May 24, 1977	Circulation of this report for public and agency review fulfills the requirements of this order.
Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks	April 21, 1997	Implementation of this project will reduce environmental health risks. Circulation of this report for public and agency review fulfills the requirements of this order.

Table 20. List of Report Preparers

Individual	Responsibility
Matthew Voisine	Biologist; NEPA
Lynn Rakos	Archeologist: NEPA, SEC. 106
Richard Dabal	Physical Scientist: HTRW, NEPA
Jenine Gallo	Biologist: Clean Air Act, NEPA
Olivia Cackler	Lead Planner
Danielle Tommaso	Planner

Chapter 8: Plan Implementation

As non-Federal partner, the NJDEP must sign a Project Partnership Agreement (PPA) that will carry the project through the Preconstruction Engineering and Design (PED) phase to project construction. This process is described in more detail in Section 8.4. A Project Management Plan (PMP) will be prepared to identify tasks, responsibilities, and financial requirements of the Federal Government and the non-Federal partner during PED and construction. A project schedule has been estimated to serve as the basis of the cost estimate based on reasonable assumptions for the detailed design and construction schedules. It will be refined as more data are available in subsequent phases of the project.

8.1 Institutional Requirements

NJDEP has indicated its intent to implement this project through a strong record of involvement and coordination in the feasibility study, and a letter of support (Pertinent Correspondence Appendix).

A fully coordinated PPA package, which will include the non-Federal partner's financing plan, will be prepared subsequent to the approval of the feasibility phase to initiate design and construction. It will be based on the recommendations of the feasibility study.. NJDEP has agreed to comply with all applicable Federal laws and policies and other requirements that include, but are not limited to:

a. Provide all lands, easements, rights-of-way, and relocations and disposal/borrow areas (LERRD) uncontaminated with hazardous and toxic wastes.

b. Provide an additional cash contribution if the value of LERRD contributions toward total project costs is less than 35 percent, so that the total share equals 35 percent.

c. Provide all improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the construction, operation, and maintenance of the project. Such improvements may include, but are not necessarily limited to, retaining dikes, waste-weirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.

d. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project, or functional portion of the project, including mitigation features, at no cost to the Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and any specific directions prescribed by the Government in the OMRR&R manual and any subsequent amendments thereto.

e. Provide of the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal project partner, now or hereafter, owns or controls for access to the Project for the purpose of inspection, and, if necessary after failure to perform by the non-Federal project partner, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the non-Federal project partner of responsibility to meet the non-Federal project partner's obligations, or to preclude the Federal

Government from pursuing any other remedy at law or equity to ensure faithful performance.

f. Hold and save the United States free from all damages arising from the construction, 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.

g. 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 Codes of Federal regulations (CFR) Section 33.20.

h. Perform, or cause to be performed, any investigations for hazardous substances as 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 (P.L.) 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 construction, operation, and maintenance of the Project. However, for lands that the Federal Government determines to be subject to the navigational servitude, only the Federal Government shall perform such investigations unless the Federal Government; provides the non-Federal project partner with prior specific written direction, in which case the non-Federal project partner shall perform such investigations in accordance with such written direction.

i. Assume complete financial responsibility, as between the Federal Government and the non-Federal project partner 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 construction, operation, or maintenance of the Project.

j. As between the Federal Government and the non-Federal project partner, the non-Federal project partner shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace and rehabilitate the Project in a manner that will not cause liability to arise under CERCLA.

k. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1790, Public Law 91-646, as amended by Title IV of the Surface Transportation and Unifom1 Relocation Assistance Act of 1987 (Public Law 100-17),and the Unifom1 Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the construction, 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.

l. 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."

m. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement.

n. Participate in and comply with applicable Federal flood plain management and flood insurance programs and comply with the requirements in Section 402 of the Water Resources Development Act of 1986, as amended.

o. Not less than once each year inform affected interests of the extent of risk management 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 flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with the coastal storm risk management provided by the project.

q. Provide, during construction, any additional funds needed to cover the non-Federal share of PED costs.

r. Grant the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the non-Federal project partner owns or controls for access to the project for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing or rehabilitating the project.

s. Comply with 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 project partner has entered into a written agreement to furnish its required cooperation for the project or separable element.

t. Prevent obstructions of or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the ecosystem restoration, hinder its operation and maintenance, or interfere with its proper function, such as any new development on project lands or the addition of facilities which would degrade the benefits of the project.

u. 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), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction, operation, and maintenance of the project; except that the non-Federal partner shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

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

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

In an effort to keep the non-Federal project partner involved and the local government informed, meetings were held throughout the feasibility phase. Coordination efforts will continue, including coordination of this study with other State and Federal agencies. It is currently anticipated that a public meeting will be held upon release of the draft feasibility report for public review and approval of this feasibility study.

8.2 Financial Analysis

For purposes of executing the PPA, NJDEP has a dedicated source of funding for coastal storm risk management projects and has indicated its intent to enter into a PPA at the conclusion of the study. The Letter of Support from NJDEP is included in the Pertinent Correspondence Appendix.

8.3 Real Estate Requirements

The total lands and easements required in support of the project is approximately 32.7 acres; 9.3 acres required in permanent easements, 18.4 acres required in temporary easements, and 5 acres of fee simple purchase for environmental mitigation purposes. The project impacts approximately 107 parcels, affecting approximately 92 private owners and 2 public owners (15 parcels). In some instances, more than one estate is required to be obtained over the lands of an owner.

Access to Sandy Hook Bay will be provided as a project feature on publicly owned land either in the form of an earthen ramp or timber stair walkover (Figures 21 & 22). Private property owners will be allowed continued access and will receive compensation if their existing access needs to be removed for construction. The compensation estimate is the amount that the Federal government has estimated to build either a timber stair walkover or an earthen ramp, similar to the type identified for the public property, as part of the real estate easements.

The appraisal cost estimate was completed by the New York District Corps of Engineers in March 2015. The total estimated cost for the required lands and easements is $6,627,000. Publicly owned lands within the project impact area are not valued, or acquisition costs are nominal, and not considered in the cost estimate.[11] It is to be noted that the real estate cost estimate may need to be adjusted to account for the riparian rights in the project. This will be done during optimization of the plan.

[11] In accordance with Section 5.a. of USACE North Atlantic Division memorandum dated 16 October 2013, subject: Regional Real Estate Policy Guidance – Hurricane Sandy Coastal Restoration Program Easement Valuation.

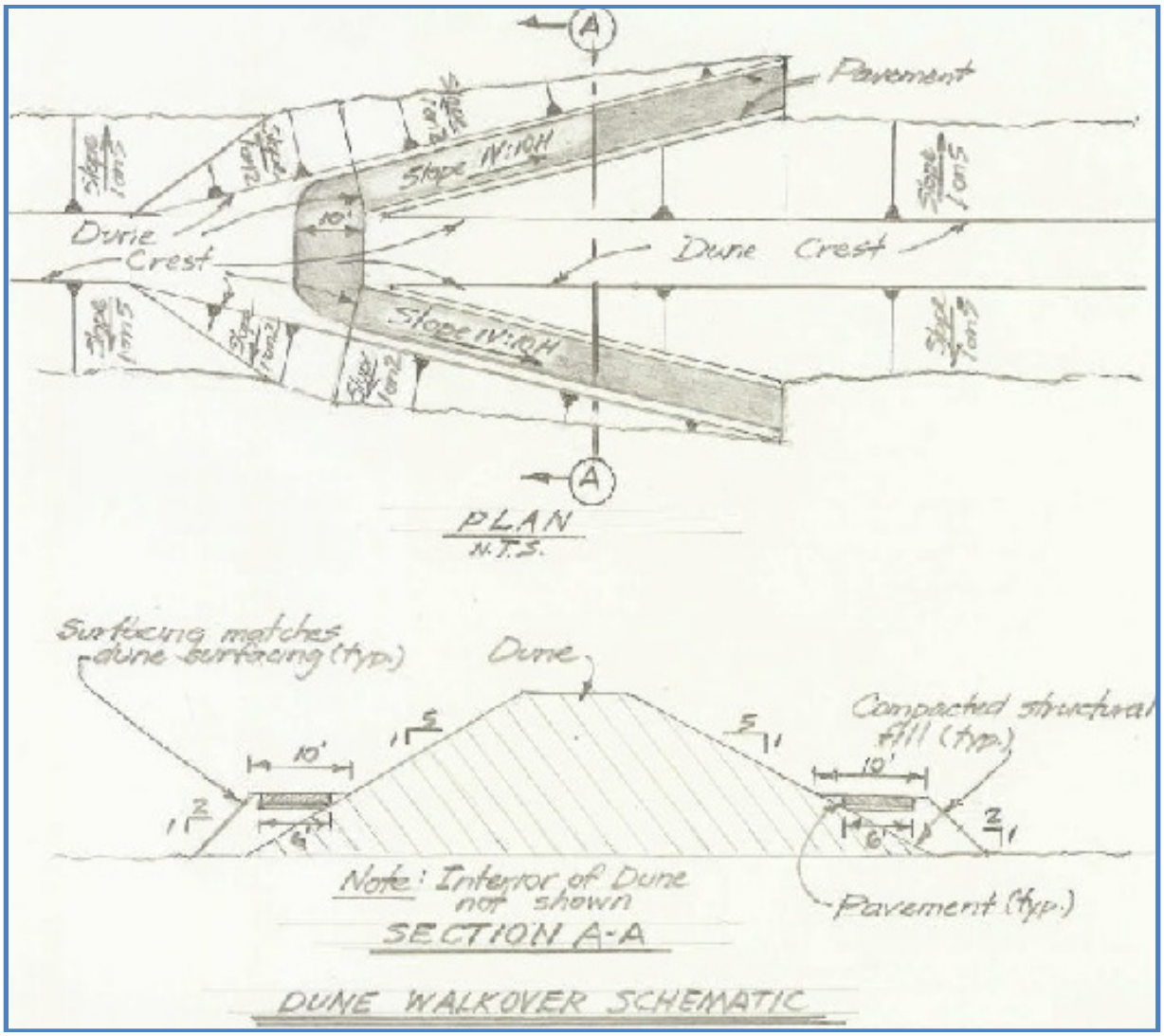

Figure 21: Schematic of earthen ramp for dune walkover

Figure 22: Example of timber stair walkover

8.4 Preconstruction Engineering and Design

Because Highlands has been included as a project under study as part of the P.L. 113-2 response to Hurricane Sandy, Preconstruction Engineering and Design (PED) could be cost shared under a Project Partnership Agreement (PPA) (which typically only covers construction), if there are sufficient P.L. 113-2 funds to complete initial construction of the project.[12,13] Initial construction does not include subsequent periodic nourishment of beach elements, if applicable, to the project. A separate Design Agreement (DA) for PED is not required unless P.L. 113-2 funds are insufficient to complete initial construction of a project. It is anticipated that completion of the Highlands feasibility study will be followed by PPA execution, once the Assistant Secretary to the Army (Civil Works) (ASA (CW)) provides notification to the Committee on Appropriations of the U.S. House of Representatives and the Senate.

For the Highlands project, PED costs are estimated at $8,617,000 (Oct. 2014 P.L.), to be cost-shared 65% Federal and 35% non-Federal. The approximate duration for PED is 18 months, from 2016 to 2017, for tasks including detailed field surveys and geotechnical data collection, and construction contract award.

[12] 09 December 2013 CECW-ZA guidance, "Disaster Relief Appropriations Act of 2013, Policy Guidance Memorandum Construction Account."

[13] 07 July 2013 CECW-ZA guidance, "Disaster Relief Appropriations Act of 2013, Policy Guidance Memorandum Expenses and Investigations Accounts."

8.5 Construction Schedule

The project assumes a construction period of 42 months, from 2017 to 2021 (Figure 23). This duration estimate is based on the nearby authorized project at Union Beach, for which the duration of construction is 42 months. The construction duration specific to Highlands will be determined during plan optimization. As Union Beach is a larger and more complex project, it is anticipated that the construction duration for Highlands will be shorter than the 42 months currently assumed. The work will be issued in two contracts. The first contract will be for publicly owned parcels of bulkhead and beach, because real estate issues will be minimal for publicly owned property. Work on the publicly owned portions can proceed while the real estate is negotiated for the private parcels in the project.

8.6 Cost Sharing and Non-Federal Partner Responsibilities

The details behind the initial total project first cost of implementing the TSP are shown in Table 21. The Federal share is 65 percent of the total project first cost. The Federal Government will design the project, prepare detailed plans/specifications and construct the project, exclusive of those items specifically required of non-Federal interests. The non-Federal share of the estimated total first cost of the proposed project is 35 percent of the total. The non-Federal share includes real estate costs in the estimated amount of $6,627,000, which are credited against the Non-Federal share, reducing the non-Federal cash contribution to$20,990,000.

Table 21: Cost Apportionment (Oct. 2014 Price level)

Fully Funded Initial Project First Cost for PPA	
Federal (65%)	$ 51,288,000
Non-Federal (35%)	$ 27,617,000
Total	**$78,905,000**

8.7 Views of the Non-Federal Partner and Other Agencies

The proposed action has received strong support from the non-Federal project partner, NJDEP and the affected local government in Highlands. This support is expressed through the Letter of Support (Pertinent Correspondence Appendix). Through project planning and National Environmental Policy Act (NEPA) scoping in 2003, a variety of other Federal agencies have been involved in this investigation and support the project goals.

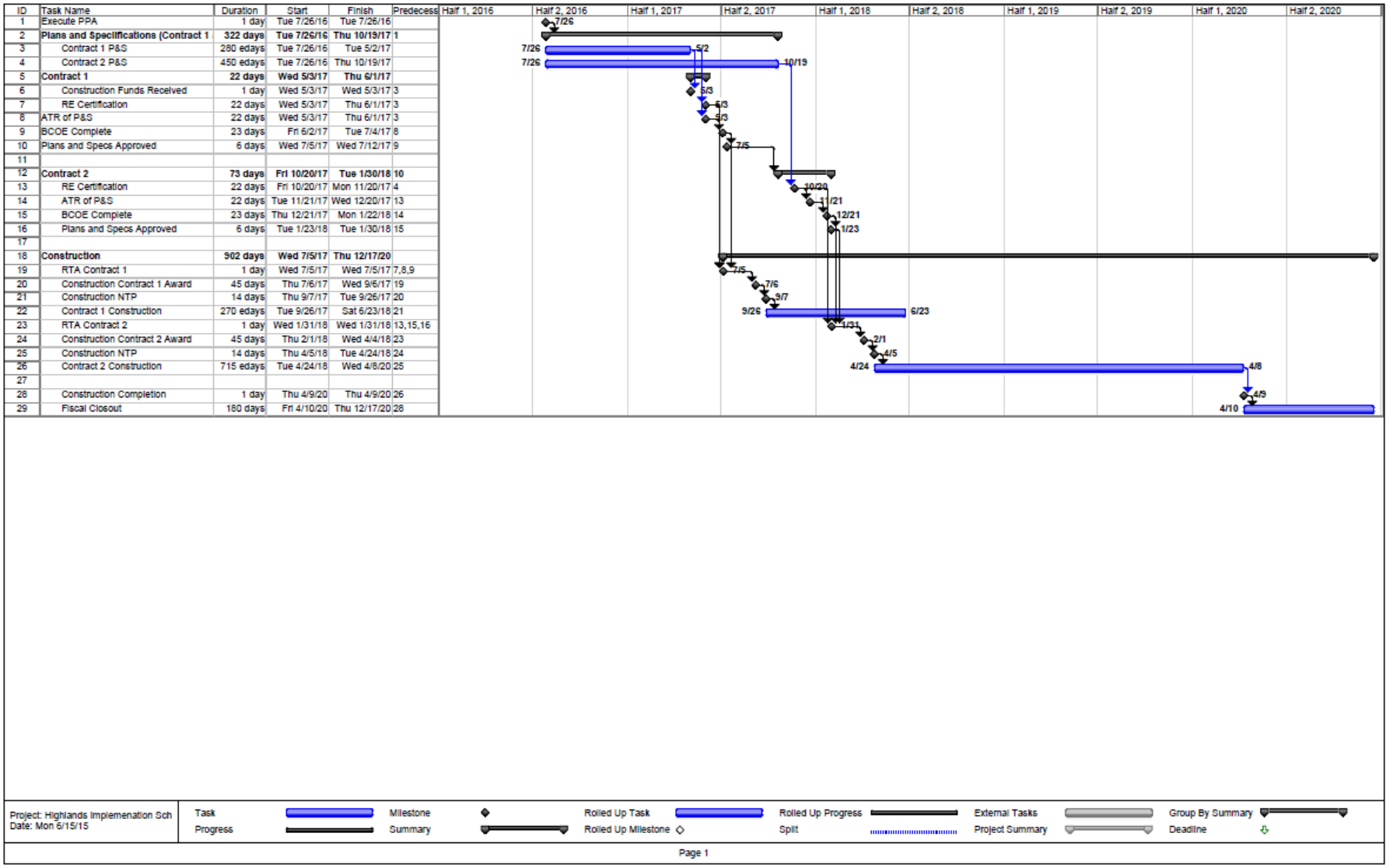

Figure 23: Implementation Schedule for Highlands TSP

8.8 Consistency with Public Law 113-2

This draft feasibility report has been prepared in accordance with the Disaster Relief Appropriations Act of 2013, Public Law 113-2.. Specifically, this section of the report addresses:

1. The specific requirements necessary to demonstrate that the project is economically justified, technically feasible, and environmentally acceptable, and
2. The specific requirements necessary to demonstrate resiliency, sustainability, and consistency with the North Atlantic Coast Comprehensive Study (NACCS).)

8.8.1 Economics Justification, Technical Feasibility and Environmental Compliance

The prior sections of this report demonstrate how the TSP manages coastal storm risk. It also identifies the TSP to be economically justified for the authorized period of Federal participation. The draft Environmental Assessment has been prepared to meet the requirements of NEPA and demonstrate that the TSP is compliant with environmental laws, regulations, and policies and has effectively addressed any environmental concerns of resource and regulatory agencies.

8.8.2 Resiliency, Sustainability, and Consistency with the NACCS

This section describes how the Highlands feasibility study is consistent with the findings and recommendations of the North Atlantic Coast Comprehensive Study (NACCS). Resiliency is defined as the ability to adapt to changing conditions and withstand, and rapidly recover from disruption due to emergencies.[14] Sustainability is defined as the ability to continue (in existence or a certain state, or in force or intensity), without interruption or diminution.

The North Atlantic Coast Comprehensive Study (NACCS) was released in January 2015 and provides a risk management framework designed to help local communities better understand changing flood risks associated with climate change, and to provide tools to help those communities better prepare for future flood risks. In particular, it encourages planning for resilient coastal communities that incorporates wherever possible sustainable coastal landscape systems that takes into account, future sea level and climate change scenarios (USACE, 2015).

The process used to identify the TSP used the NACCS Risk Management framework that included evaluating alternative solutions and also considering future sea level change and climate change. A local OMRR&R plan will be put in place with periodic USACE inspections to sustain a continuous level of risk management for the period of analysis.

The Highlands TSP is a resilient, sustainable, and a robust solution. It consists of raised and capped bulkheads, floodwalls, and reinforced dunes. Compared to beach and dunefill systems, this plan has the advantage of not needing renourishment to maintain its authorized dimensions (renourishment requires future, additional congressional authorization). The exact dimensions of the Highlands TSP will be identified during optimization. Optimization will take into account project performance under intermediate and high rates of sea level change, in accord with ETL 1100-2-1 (dated 30 Jun 2014). The ability of the structures to adapt to higher rates of sea level change by increasing the height of the project without increasing the project footprint (which would increase the environmental mitigation required), will be evaluated during optimization.

[14] in the February 2013 USACE-NOAA Infrastructures Systems Rebuilding Principles white paper

8.9 Major Conclusions and Findings

This study has determined that periodic coastal storms, including tropical storms, hurricanes, and nor'easters pose a severe threat to life and property in Highlands, Monmouth County, New Jersey. There is potential to manage coastal storm risks in Highlands. In response to these problems and opportunities, plan formulation activities considered a range of structural and nonstructural measures. Through an iterative plan formulation process, potential coastal storm risk management measures were identified, evaluated, and compared.

Alternative coastal storm risk management plans that survived the initial screening of alternatives included hard structural (floodwalls and bulkheads) and soft structural (beachfill and dune) plans, and a hybrid plan that minimized environmental impacts by matching the existing ground surface (*ie*., elevated bulkheads where the shoreline is already bulkheaded and sand-covered seawalls on the existing beaches). The hybrid plan was found to be the most effective and efficient of the three alternatives, and was further developed into five variations to assess the varying project heights and components to maximize water access, such as buoyant swing gates and removable floodwalls. Of the five variations, the alternative that prioritized coastal storm risk management over water access, by including only stationary components, was found to have the highest net benefits, making it the Tentatively Selected Plan (TSP).

The project spans a geographic distance of approximately 8,000 linear ft along the bayshore of Highlands and ties into high ground (+10 ft NAVD 88 to +12.4 ft NAVD88) at each end. Because the project follows the actual perimeter of the shore, its total length is 10,636 linear ft. Access to Sandy Hook Bay will be provided as a project feature on publicly owned land. Private property owners will be allowed continued access and will receive compensation if their existing access needs to be removed for construction. All of the alternatives were evaluated at the 2% flood (50 year) level of performance. The exact height of the project will be determined during the optimization phase of the study, which follows public comments and reviews of the draft feasibility report.

Chapter 9: Recommendations

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 Jersey and other non-Federal interests.

I recommend that the selected plan for coastal storm risk management at Raritan Bay and Sandy Hook Bay, Highlands, New Jersey, as fully detailed in this draft Feasibility Report and Environmental Assessment, be authorized for construction as a Federal project, subject to such modifications as may be prescribed by the Chief of Engineers.

I recommend authorization of the coastal storm risk management project for Highlands, NJ, with such modifications thereof as in the discretion of the Commander, HQUSACE, as may be advisable. These recommendations are made with the provisions that local interests will:

a. Provide to the United States all necessary lands, easements, rights-of-way, relocations, and suitable borrow and/or disposal areas deemed necessary by the United States for initial construction and subsequent maintenance of the project.

b. Hold and save the United States free from claims for damages that may result from construction and subsequent maintenance, operation, and public use of the project, except damages due to the fault or negligence of the United States or its contractors.

c. Contribute the local share of non-Federal costs for initial construction and operation and maintenance over the 50 year period of analysis of the project, as required to serve the intended purposes. **This plan consists of 10,600 lf of raised bulkheads, floodwalls, raised ground surfaces, and reinforced dunes at a total first cost of $78,905,000 (October 2014 price levels) and a fully funded cost of $85,273,000. Under current guidelines, the project will be cost shared on a 65% Federal and 35% non-Federal basis.**

d. Upon completion of each project feature, acquire, rehabilitate, repair, replace, operate and maintain easements for public access to areas created or enhanced by the project. The cost of the operation and maintenance of these easements will be the responsibility of the non-Federal partner.

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 (by the Chief of Engineers) before they are transmitted to the Congress as proposals for authorization and implementing funding. However, prior to transmittal to Congress, the partner, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

David A. Caldwell
Colonel, U.S. Army
District Engineer

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Raritan Bay and Sandy Hook Bay
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Coastal Storm Risk Management
Feasibility Study

Appendix A

Environmental Documentation

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Appendix B

Engineering

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Appendix C

Economics

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Appendix D

Cost Engineering

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Appendix E

Real Estate Plan

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Appendix F

Pertinent Correspondence

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